THE IMPACTS OF CLIMATE CHANGE ON DESIGNING SUSTAINABLE URBAN LANDSCAPES

BY:

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Abstract

There is much evidence to indicate that the climate is changing. The aims of this study were to develop meadow-like communities of Continental, Mediterranean and Temperate grassland species as a new approach to designing sustainable urban landscapes under different climate change scenarios. To achieve this aim, a community of thirty-six species from Marine, Mediterranean and Continental temperate climates were chosen to represent a gradient from well-fitted to poorly-fitted to the current British climate. The species were chosen to share similar morphological characteristics, in terms of canopy size, texture and structure. They were also chosen to be attractive in terms of colourful flowers, from spring to autumn, which provides a strong design impact. Three series of the experiment were conducted to investigate the effects of different climate scenarios on the fitness and growth performance of native and non-native species in meadow-like communities. The plant species seedlings were grown *in situ* at Sheffield Botanical Gardens with three watering regime rates (50% increase in precipitation, 50% decrease in precipitation and ambient), two different temperature treatments (Ambient and Ambient plus 3^0C), two levels of CO_2 concentration (Ambient and Ambient +450PPM) in the presence or absence of molluscs. The results indicate that water availability; CO_2 concentration and temperature are three important factors to choose plant species for greenspace according to the future climate change scenarios. Although each of the environmental factors has specific effects on species fitness and adjustment, their interaction is more important. At the Ambient level of CO_2, the intermediate-fitted group (Mediterranean climate species) shows the highest biomass production in future climate scenarios. The poorly-fitted species cannot tolerate high levels of moisture, when the moisture level reaches Ambient over 50% of the plants in this group will show negligible growth, but increasing temperature can decrease this effect excess water in different species at different levels. Increasing CO_2 from the ambient level to 900PPM enhanced the biomass productivity in all groups. The continental temperate grassland species (poorly fitted species) at CO_2:900PPM, Temperature: Ambient, Moisture: Ambient and the Ambient +50% condition, showed similar biomass productivity to Mediterranean climate species. Overall, a designed plant community of species from Marine and Mediterranean climates will present the best-fitted species to design naturalistic urban landscapes according the 2050 UK climate change scenarios. Mollusc grazing was affected by different climate scenarios (from dry and warm to wet and hot). Slugs showed different behaviours in dry, wet, warm and ambient temperature in terms of plant selection for feeding. There was no significant difference in biodiversity support between native and non-native species regarding mollusc grazing.

DECLARATION

I, Behdad Alizadeh declare that this thesis (THE IMPACTS OF CLIMATE CHANGE ON DESIGNING SUSTAINABLE URBAN LANDSCAPES) and the work presented in it are my own and has be generated by me as the result of my own original research. I confirm that any part of this thesis has not previously been submitted for a degree or any other qualification at this University or any other institution, this has been clearly stated.

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Chapter 1: Introduction

1.1 Background

Densely populated areas are changing and more complicated landscapes in which green or open spaces are considered to be of incalculable value for the welfare of people and wildlife (Pickett *et al*., 2004) are developing. Urban landscapes show an important role in supporting urban “ecological and social” systems (Barbosa *et al., 2*007). In urban areas, city parks, private gardens and street green space supply essential ecosystem services (Gill *et al*. 1998). The presence of natural ecosystems such as urban parks and forests, green belts and their parts (i.e. trees, water) enhance the standards of life in many ways. The availability of green spaces affects the environmental quality such as “air and water purification”, “wind and noise filtering”, or microclimate stabilization. Urban green space such as parks and gardens play a key role in supporting “biodiversity” and other important “ecosystem services” (Barbosa *et al., 2*007). These landscapes increasingly support the movement of fauna to the cities and hence to maintaining or improving urban biodiversity (Angold *et al*., 2006). As a result, they can provide a bridge between “natural environment” and “biodiversity” and the residents of urban areas (Jorgensen *et al*., 2002). Besides important environmental services, urban green spaces provide “social and psychological services”, which are very important for the livability of modern cities and the well-being of urban residents (Chiesura, 2004). At the “neighbourhood level”, green spaces help provide restoration from stress, improving “mental health” (Hartig *et al*., 1991; Conway, 2000) for adults and also provide a space for children’s “physical and mental” development (Jacobs, 1961). Green space also potentially enhances feelings of social protection and safety (Groenewegen *et al*., 2006; Maas *et al*., 2009; Troy & Grove, 2008), increases social communication and the attractiveness of the city and promotes it as a landmark for tourists, increasing property values and therefore tax revenues (Jim & Chen, 2009). The people who are living in a “greener” environment report lower levels of fear, fewer bad manners, less hostile and violent behaviour and feelings of insecurity associated with vandalism, and lower fear of crime in abandoned places (Chiesura, 2004).

It is clear that the health, happiness, comfort, safety and security of urban residents are potentially affected by the area of "green space" in a city, the method of designing "urban landscape" and access to urban green space. As a result, any factors that make an impression on the urban landscape (such as climate change) will have an effect on people's lives directly or indirectly. Today, it is widely accepted that our climate is warming. Climate change is one of the greatest environmental issues of our time. Most of the environmental challenges in our world such as water shortages, flooding, rising sea levels, changes in biodiversity, decreasing air quality, increased size and number of forest fires and changes to the extent and location of landscape scale vegetation, are increasingly associated with climate change (Bigler *et al.*, 2006). From the beginning of the twenty-first century the mean world temperature has risen about 0.6^{o}C and from the 1970s increased by 0.4^{o}C (Hulme *et al.,* 2002). The 2007 Assessment Report by the IPCC indicates that GHG (greenhouse gas) emissions increased by 70% between 1970 and 2004 (IPCC, 2007). The climate of Western Europe (Bakkenes *et al.,* 2002) and Britain in particular (Broadmeadow *et al., 2*005; Wilby and Perry, 2006) will in common with other parts of the world also change.

1.2 Creative opportunities associated with climate change

Climate change challenges urban planners, urban designers, architects and landscape architecture professionals to pursue sustainability. However, climate change also helps to free up conventional thinking, by making people come to terms with the idea that the future will not be the same as the past. In the mid-1990s, Dunnet and Hitchmough focused their research on selecting native and non-native species to cultivate sown, naturalistic, urban planting. Cost-effective management and creating new visual forms can be achieved through planting based on ecological concepts using the plant species well-fitted to the local environment.

Planting based on ecological concepts using species well-fitted to the local environment to create semi-natural vegetation can not only reduce management costs but also create new visual forms in urban landscapes. In particular, it can change our traditional planting design from being dominated by mono-coloured mass planting of evergreen shrubs to richer, more diverse, and long-flowering herbaceous planting. However, these changes are not without loss as meadow landscapes involve trade-offs between drama and attractive winter effects. Achieving the desired aesthetic impression over a long season can only be attained if a combination of native and exotic species is used, in particular, when a country has a very limited native flora. When the combination of species is designed/planned, this combination needs to be functional and also to address the aesthetic needs of a landscape. Typical features that need to be considered are the colour of the flowers, the leaf textures and inflorescence. Low maintenance requirements, while producing dramatic flowering displays, are only feasible if the initial plant density is controlled and their growth requirements, adaptability and phenology are properly evaluated.

1.3 Where might climate change adaptation landscape species come from?

1.3.1 Britain

Britain is a collection of islands surrounded by sea, with a very pronounced “marine or oceanic” climate. These climates are typical of the “west coasts” at the “middle latitudes”. In the marine climate regions the summers are mild to warm and the winters are mild to cool with few extremes at either end of the climatic spectrum. The approximately temperature in summer is 15ºC and in winter 5ºC. As a result, the annual average temperature in the UK is about 10ºC (Buchdahl, 2015). Annual precipitation varies from place to place, between 400 to 1500mm p.a. In comparison to other areas of Britain, the eastern UK is generally drier, all year round, and colder in winter, as it is closer to continental Europe, and hence caught up in high-pressure systems in winter.

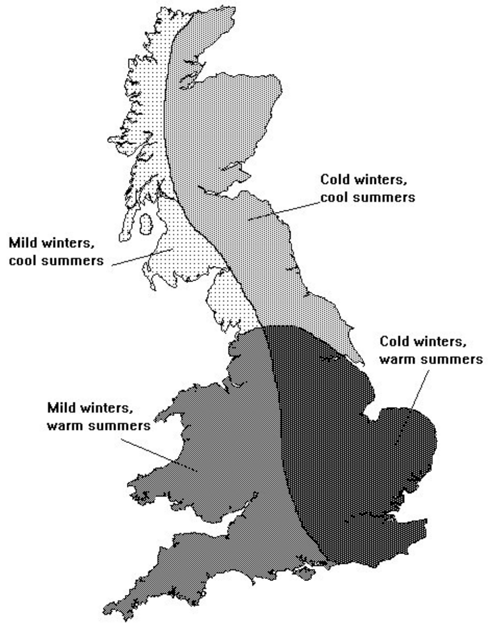

Figure 1.1 ***The climate of Britain*** **(Buchdahl 2015)**

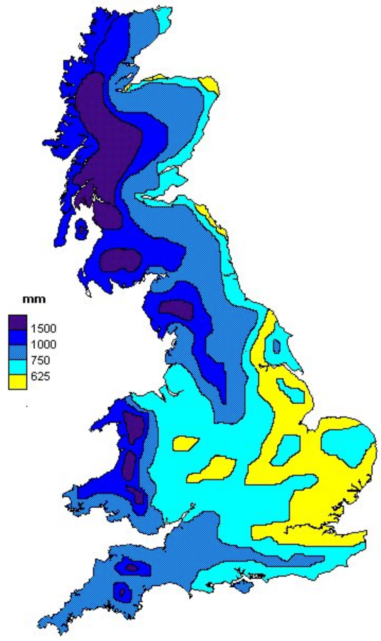

Figure 1.2 ***Yearly precipitation in Britain*** **(Buchdahl, 2015)**

Since the 1970s, the average annual temperature of the UK has risen by $1^{o}C$. According to the levels of “greenhouse gases” in the atmosphere, the UK is expected to be warmer over the next three decades. The “climate change” simulation models indicate, because of increasing temperature (warming), exceedingly wet winters might be happen five times more frequently during the next 100 years. More river flooding and flash floods will occur as will a rise in sea-level. Conversely, the models suggest that the UK could experience warmer, drier summers in the future (Clark, 2013). Even if action to reduce greenhouse gases and decrease the levels of global warming and climate change is taken now, we will still have to deal with these changes in the future.

1.3.2 The European Mediterranean region

Given its close geographical proximity to Britain, this region potentially represents the next step in climate change scenarios. Climatic models suggest that London will experience a similar climate in 2050 to Bordeaux, i.e. near Mediterranean. The Mediterranean region proper experiences cool winters and hot dry summers. With climate change some currently Mediterranean areas will begin to approach desert conditions. The Mediterranean extends from Italy to Morocco (north to south) and Portugal to Lebanon (east to west). Greece, Malta, Cyprus, Spain, Italy, France and Portugal are the countries, which are Mediterranean or have areas that are Mediterranean.

Figure 1.3 Map of Europe with Mediterranean climate areas (*Worldatlas.com*. N.p., 2015. Web. 28 Sept. 2015).

The Mediterranean supports a very diverse flora, with some of the most characteristic plant communities being steppe-like, open, dry grasslands mixed with shrubby species and small trees. Depending on height, these communities are often described as *garrigue* and *maquis*. Almost half of "Habitats Directive" species are associated with the Mediterranean Region (Sundset, 2009). Mediterranean species from Southern Europe are currently widely cultivated in the UK; however, their use in ecologically-based designed communities has not yet been extensively investigated.

1.3.3 Temperate Continental Regions

These climates occur within large continental landmasses and share some of the characteristics of the Mediterranean climate but with much much colder winters with most precipitation as snow. Summers are hot. The predominant vegetation type is steppe, and mixes of grasses and forbs and sometimes dwarfs shrubs. As such, these climates might be thought of as a further step in climate change gradients from Britain at the present moment. Examples of these steppe environments include, the rennosterveld of South Africa, the Puszta of Hungary, the Pampas of Argentina, the steppes of the former Soviet Union and the Prairies in central North America (Ucmp.berkeley.edu, 2015).

Woodward *et al*. (2004) state that "Grasslands often occur in areas with annual precipitation between 600 and 1,500mm and average mean annual temperatures ranges from −5 to 20°C" (Woodward *et al., 2*004). In reality this means vegetation types that experience temperature ranges from -40^{o}C to +40^{o}C.

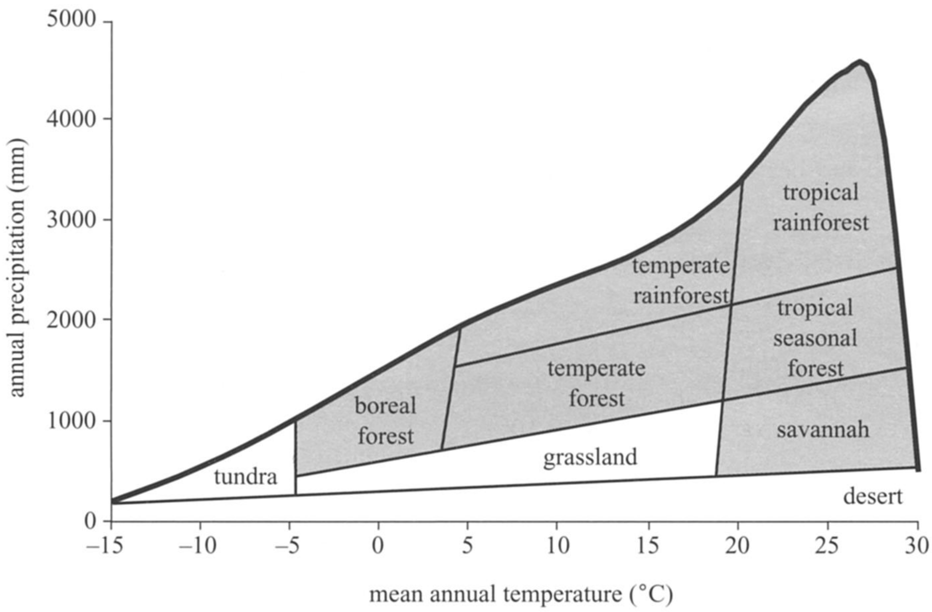

Figure 1.4 annual precipitations and temperature of Grassland compared with other "defined biomass" (Woodward & Lomas, 2004).

1.4 Overall aim of the research

The overall aims of this research are to assess the adaptability and fitness of designed plant communities and individual species under different climate change projection scenarios. It aims to look not only at individual factors e.g. temperature, precipitation and CO_2 but also on the impacts of combinations and feedback between these factors. It aims to start the process of understanding how plant communities could be designed for use in public landscapes as part of the process of climate change adaption. In addition to considering physical factors such as temperature and CO_2 , it also look at how biological factors such as mollusc herbivory interact with these physical factors.

1.5 The research

A series of experiments were undertaken to simulate and investigate the effects of the climate change phenomena on designed, meadow-like, plant communities. This study assesses the impacts of different levels of CO_2 concentration, precipitation and temperature on Grassland and Steppe Vegetation from Mediterranean climate (Southern Europe) and Continental climate (South West of North America), which were combined with some native plant species of Western Europe (Maritime climate). Reproductive performance, phenology and the growth rate of species were studied. The first study looked at the effect of six different climate change scenarios for the UK on key species (Chapter 3). Secondly climate change and biodiversity in urban green space were investigated by focusing on molluscan herbivory in six UK climate change scenarios (Chapter 4). This was followed by studying the effect of different levels of CO_2, temperature and water regime on productivity and plant fitness in a designed plant community (12 climate change scenarios) in Chapter 5. Studies on the impact of different levels of environmental factors on species have been conducted in chapters 3, 4 and 5.

The key research questions associated with this research are as follows:

- Will it be possible within current climate change scenarios to continue to use the plant species which are utilized in green spaces at the present, in the future as well? (Chapters 3 and 5)
- Do the species of grassland in Maritime climate zones respond to UK climate change scenarios in a common way? (Chapters 3 and 5)
- Is it possible to use the meadow vegetation of European Mediterranean climate zones and the species of Continental grasslands in a designed plant community in the UK's current climate situation? (Chapter 3)
- Does competitive capacity of these intermediate and poorly fitted species increase under climate change scenarios? (Chapter 3)

- Does the competitive capacity of currently well-fitted native and near native species decline under climate change scenarios? (Chapter 3)
- Will grassland species of Mediterranean (hypothesised to currently be intermediate in fitness) and Continental grasslands (hypothesised to be poorly-fitted) become more fitted in the future UK climate and in a designed plant community? (Chapter 3)
- Does molluscan herbivory interact with climate change to affect the stability of both individual species and the plant community? (Chapter 4)
- What are the impacts of molluscan herbivory on the composition of designed meadow communities under different climate scenarios? (Chapter 4)
- Does increasing CO_2 concentration in interaction with changing climate variables (temperature and moisture) lead to predictable changes in PGR ? (Chapter 5)
- Is it possible to design a plant community of Mediterranean meadow vegetation or Continental grasslands species in an urban landscape under future UK climate scenarios? (Chapters 3,5 and 6)

CHAPTER 2: A SHORT REVIEW OF PAST RESEARCH

2.1 The Changing Nature of Climate

There is a common consensus that the temperature has increased in most part of the world over the past century. Since the beginning of the 21st Century, there has been a rise in the world's temperature by an estimated 0.6°C, with an increase of 0.4°C recognised from the 1970s (Hulme *et al*., 2002). Importantly, the IPCC's 2007 Assessment Report makes the suggestion that, during the period 1970–2004, there has been a 70% increase in Greenhouse Gas emissions (IPCC, 2007). Climate change will have a major effect on physical and biological phenomena and processes across the range of spatial and temporal scales. Negative impacts will be felt in terms of biodiversity changes, decreasing air quality, the distribution and resilience of wild-occurring vegetation, water shortages, flooding, rising sea levels, and the increased number and scale of forest fires (Bigler *et al.,* 2006).

Climate change is already having a marked effect on Western Europe's climate (Bakkenes *et al*., 2002), as well as that of Britain specifically (Broadmeadow *et al*., 2005; Wilby & Perry, 2006). By 2050, models suggest that London will experience a near Mediterranean climate, similar to that currently experienced by Bordeaux in south-west France (Broadmeadow *et al*., 2005; Hitchmough, 2011). In addition to background climate change, the urban heat island effect is expected to intensify as a direct result of ever-increasing temperatures, especially during summer periods, resulting in threats to human health and well-being in the built environment, particularly in southern England (Hulme *et al*., 2002).

2.2 Climate Change in the UK

Central England Temperature (CET) has been monitored continuously since 1772, providing one of the longest records of climate and its change in the world. Whilst there are still many unknowns in the climate science, the consensus research view (IPCC, 2014) is that the warming rates experienced cannot be explained by variations in the natural climate, but are believed to be due to the huge increases in greenhouse gas emissions and the use of aerosols post-industrialisation. Central England temperatures have shown a much faster rise than the mean land temperatures on a global scale. This may be due to the influence of higher sea-surface temperatures in the North Atlantic, stemming from natural variations in the North Atlantic circulation (UKCP02). The climate of the UK changed in different aspects. The annual mean precipitation of England and also Wales were systematically recorded from 1766. From that time, the mean precipitation in the UK has not significantly changed. According to the data**,** it is clear that there is a significant difference between mean precipitation in summer and winter and it has decreased in summer and increased in winter. But, although during the last 50 years it has changed a little, during the last 45 years the pattern of rainfall has changed as well. All parts of the UK have experienced wetter winters with heavy precipitation. However, at the same time all regions, with the exception of Northern Scotland and North-east England, have experienced drier summers (UKCP09).

Climate change has been identified by the UK Climate Projections (UKCP09) as potentially the most significant threat facing humanity, and this organisation has been charged with providing data and information up to the end of the 21st Century to support efforts to reduce greenhouse gas emissions to allow adaptation to climate change effects that cannot be circumvented. Three different scenarios are detailed in these projections: high, medium and low greenhouse gas emissions. These predictions are based on 30-year projections; 2010–2039, referred to as ‘the 2020s’; 2040–2069, referred to as ‘the 2050s’; and 2070–2099, referred to as ‘the 2080s’, with the inclusion of three probability levels: 10%, 50% and 90%. The strength of evidence to support the projected changes is given by probability level maps (UKCP09).

The UKCP emphasizes "it is not necessarily the most likely projection. Because the changes presented are relative to a 1961-1990 baseline" (UKCP09). The level of greenhouse gas emissions have largely been determined by the greenhouse gases which have already been emitted, so there is little difference between the high and the low climate change scenarios in 2020 (UKCP09).

2.3 Specific predictions for the UK in 2050 and 2080:

There has been a significant increase in atmospheric CO_2 at a rate of an estimated 1–2µmol/mol on an annual basis, predominantly owing to the burning of fossil fuels (Keeling *et al*., 1995), with levels predicted to reach in excess of 700µmol/mol by 2100 (Houghton *et al*., 1995). Such an increase is recognised as having the propensity to change the energy balance of the planet, inducing critical changes in naturally occurring vegetation, agriculture, urban greenspace and horticulture (Adams *et al*., 1990). Key changes linked with CO_2 increases will be potentially higher temperatures and decreases in the moisture levels in soil (Mitchell *et al*., 1990) where there is no increase in precipitation (Rind *et al*., 1990). In the specific context of the climate of the UK, climate change scenarios imply the potential for annual temperature increases of an average of between 1°C and 5°C by 2080, with winter temperature increases obviously lower than summer temperatures. Moreover, the seasonality of precipitation also will be affected, with winters expected to be as much as 30% wetter by 2080 and summers as much as 50% drier. Such estimations, however, are dependent on two key factors, namely, emission scenarios and the region itself (Hulme *et al*., 2002). Mean temperature changes in the summer are recognised as being most profound in southern England and much lower in North-west Scotland. The most significant precipitation changes are expected in winter, with increases of as much as +33%, specifically across the western UK (UKCP09). In the summer, the most notable change will be in precipitation, with this decreasing by 40% in the far south of England. Changes that are close to zero are expected in northern Scotland, with changes in the wettest days of the winter ranging from around zero as opposed to +25% in other areas of Britain.

2.4 Climate Change Effects on Urban Landscape

Research publications concerned with the effects of climate change on urban greenspace are relatively few (Wilby & Perry, 2006; Gill, 2006). Nonetheless, some of the effects of climate change on urban greenspace have been considered (Gill, 2006).

In spite of all maintenance and management in the urban landscape, including urban parks and gardens, the climate remains the most important factor, which controls the range of species and their "behaviour", "Physiology" and "phenology" in the urban landscape (Bisgrove & Hadley, 2002).

Extremes of soil and water, storms and temperatures, will have significant effects on fungal diseases and insect pests, and hence the growth of trees (Broadmeadow, 2002). Moreover, climate change has the capacity to increase the utilisation of urban greenspace by citizens seeking to take advantage of the cooler microclimate in urban greenspace during times of high temperatures (McEvoy *et al*., 2006). These increases in use will place additional pressures on the growth of vegetation and particularly in historically important elements such as mown turf in such areas (London Climate Change Partnership, 2002).

Longer frost-free winter periods and other changes in temperature are beginning to affect the growing season in the UK (Bisgrove & Hadley, 2002), with every degree of annual warming meaning the growing season is extended by as many as three weeks in the south and 1.5 weeks in more northern regions.

Accordingly, the expectation is that, by the 2050s, threshold spring temperatures could be witnessed 1–3 weeks earlier than at the present time, with a corresponding delay of winter temperatures by 1–3 weeks (Hulme *et al*., 2002). A growing season that is longer would have an effect on the phenology of plants, as highlighted by various scholars (e.g. Sparks & Gill, 2002; Sparks, 1999), which, in turn, would encourage a number of subsequent phenomena, including earlier flowering, leaf appearance and plant maturity, in addition to delayed leaf fall, prolonged flowering into winter time, 'unseasonal' spring bulb flowering and the near continuous growth of lawns, thereby increasing maintenance costs for grass cutting

(Bisgrove & Hadley, 2002). Of course these differences already occur across the UK, with South-west England and Wales experiencing almost frost-free wet winters in stark contrast to winter conditions in central and Northern England. In this sense we are already familiar with the nature of future climate change, the gradients will, however, be stretched further. These differentials will be maximal within urban areas where plant phenology is already hugely affected by the urban heat island (White *et al*., 2002; Roetzer *et al*., 2000). Moreover, higher carbon dioxide levels in combination with higher temperatures enhance the speed of plant species growth, development and their growth rate. As a result, the herbaceous plant will die or go into the dormant situation before they use the full growing season (Bisgrove & Hadley, 2002).

These changing climatic gradients will impact on the types of plant that can be grown, with those plants better able at adapting being most favoured. In South-east England, beech trees are being seen to decline due to more regular summer moisture stress (Bisgrove & Hadley, 2002), with the London region, in contrast, more able to adapt to climate change owing to its greenspace being dominated by hybrid and oriental planes that naturally grow in hotter climates, such as in the Mediterranean (White, 1994). In addition, it is well known that dry and hot climates facilitate the growth of sweet chestnuts, and further support a larger number of species (London Climate Change Partnership, 2002). Whilst most of the climate change discourse is on the negatives of climate change, within urban areas, species that grow less well will be counterbalanced by species that grow better in a climate change world; there will be opportunities as well as threats. Throughout the Twentieth century there have been a large number of new trees introduced (Grimshaw et *al*., 2009) in response to the changing climatic conditions.

Much of the discourse on urban greenspace has focused on the balance between pests, their hosts and their enemies, and how this balance is likely to be affected by climate change, making it difficult to be conclusive on likely patterns of damage (Broadmeadow, 2002). Insect distributions and their life cycles are significantly weather-dependent (Burt, 2002), with population sizes generally increasing with temperature increases (Broadmeadow, 2002). The range of some native insects will progress northwards in direct response to warmer temperatures and longer growing seasons (Bisgrove & Hadley, 2002; Parmesan *et* *al*., 1999). Some species will expand their range others will show contraction. Pest insects currently common in continental Europe are highly likely to expand their territories to the UK (Bisgrove & Hadley, 2002). However, there will also be a likely increase in the diversity of flying insects, for example in butterfly diversity and abundance (Gill, 2006).

Beyond the fears of new pest and disease epidemics, the main threat to existing tree populations in greenspace is likely to be drought (Bisgrove & Hadley, 2002; Broadmeadow, 2002; Gill *et al*., 2004; Gill, 2006).

Trees experiencing drought-related stress are identified as being particularly susceptible to various pathogens. Capacity to withstand summer droughts could also be weakened as a direct result of winter rainfall, causing anoxia in the root and thus impacting on rooting depth (Broadmeadow, 2002). In turn, this further increases trees' vulnerability to wind throw (Bisgrove & Hadley, 2002; Broadmeadow, 2002).

2.5 Climate Change and Grasslands

The effects of these droughts will initially be most obvious on mown grass growth as a result of the shallow depth of roots of this vegetation. When water supply is without restriction, almost 99% of all water taken from the plant's roots is lost as a direct result of through-air transpiration (Raven *et al*., 1998). Furthermore, the potential for grass fires to occur, as witnessed in the July 2006 heatwave experienced in Greater Manchester, is far more likely (Greater Manchester Fire and Rescue Service, 2006; Gill, 2006). Accordingly, it is essential for the spatial occurrence of drought conditions to be well-examined and considered in direct relation to grass within climate change and baseline settings.

When seeking greater understanding of global change responses for natural ecosystems (Zaveleta *et al.*, 2003), there is a wealth of data derived through laboratory experiments on plants' reactions to CO_2, moisture and temperature (Larcher, 1983). Temperature changes, and the response to such, all depend on the characteristics of the species of plant, and thus may be negative or positive, depending on the overall health of the environment.

Importantly, the effects of some factors could be counterbalanced by others: as an example, biomass production will be increased through higher CO_2, whilst biomass production will be lessened as a result of lower precipitation (Gifford *et al*., 1984; Cannell, 1985). Should there be no change in precipitation or temperature, the root/shoot ratio could be increased through an increase in CO_2 as the plant adapts and responds to decreasing C limitation in line with the limitation of nutrients (Troughton, 1977). Should there be an increase of precipitation along with CO_2, there could be water stress reductions that are ultimately counterbalanced by the decreased C limitation, where the net effect on the root/shoot ratio would not be simple to estimate. Plant response effects following climate change cannot be established through photosynthesis only, and the effect of climate change on ecosystems will not be established only as a result of plant responses. Decomposition response, as a result of moisture- and temperature-related changes, probably will be as notable as those experienced during photosynthesis. However, decomposition should not have a direct impact stemming from CO_2 (Lamborg *et al*., 1983).

When aiming greater insight into the long-term effects associated with global climate changes on the operation of the ecosystem, one of the key approaches is to model a micro ecosystem that is subject to factorial manipulations and that has the capacity to produce a quick response (Shaw, 2002). Annual grasslands containing a diversity of small, short-lived plants are regarded as an appealing model system for global change experiments (Shaw *et al.*, 2002). When aiming at establishing a viable global change manipulation of an entire ecosystem, complete with animal, microbial, plant and soil processes, an area of approximately 1m^2 is adequate (Shaw *et al.*, 2002). Importantly, the yearly lifecycle of the dominant plant enables somewhat brief experiments to be carried out across a number of complete generations (Reich *et al*., 2001).

The majority of experimental studies under natural field conditions, specifically those geared towards the responses of the ecosystem to global change have addressed only single global changes. Few studies have examined two or more interacting treatments and system responses. Experimental manipulations such as changes in CO_2 concentration, precipitation and temperature, for example, are not common in relation to ecosystem studies (Grime, 1973; Mittelbach *et al*., 2001), despite the fact that elevated CO_2 is regarded as being a key driving force behind the phenomenon of climate change (Vitousek *et al*., 1997). A number of modelling investigations have been centred on addressing ecosystem responses to multifactorial global changes (Tilman, 1988; Goldberg & Miller, 1990). However, the theoretical foundation underpinning the estimation of ecosystem responses to multiple factors is incomplete. Accordingly, in an effort to establish and identify the impacts concerning climate change on the ecosystem, a number of different experimental manipulation works need to be carried out in the context of terrestrial ecosystems, on a global scale, ensuring the inclusion of increased temperature, elevated CO_2 levels and changes in precipitation volumes and trends (e.g. Wright, 1998; Knapp *et al*., 2002; Beier *et al*., 2004).

It is challenging to bring together experimental manipulations that involve CO_2 increases alongside changes in precipitation and temperature in ways that do not confound the results (Beier *et al*., 2004, 1998). Thus far, no experimental research has been undertaken on the effects of climate change in the specific area of designed plant communities in urban settings.

2.6 The Effects of Mollusc and Invertebrate Grazing in Urban Greenspace

Invertebrate herbivory in combination with plant competition have potentially dramatic effects on the overall dynamics of plant assemblages, however, these interactions have not been afforded as much attention as is desirable (Rodríguez & Brown, 1998). Throughout the past ten years, experimental work (such as those by Bruelheide & Scheidel, 1999 and Wilby & Brown, 2001) have demonstrated the importance of biotic interactions and, more specifically, mollusc-herbivory, with climate, and how these have marked impacts on the development of grassland vegetation and plant survival. In temperate regions with seasonally moist climates, the development and overall composition of both semi-natural (e.g. Bruelheide & Scheidel, 1999; Wilby & Brown, 2001) and designed (Hitchmough & de la Fleur, 2006) herbaceous vegetation (Hitchmough & Wagner, 2011) is strongly affected by these herbivores. The species of plants signify the developmental phases (seedling or adult), where seedling size and plant establishment methods have direct effects on molluscs grazing in the greenspace (Fenner *et al*., 1999; Hanley *et al*., 1995; Hulme, 1994; Baskin & Baskin, 1998; Hanf, 1973; Hitchmough & Wagner, 2011).

Some of the herbivores recognised as most important in low herbaceous vegetation, specifically in regions of low temperature, are slugs (Rees & Brown, 1992; Hulme, 1996; Rodriguez & Brown, 1998), which can have a notable impact not only on the species composition of plant communities but also on the composition of the biomass (Oliveira Silva, 1992; Hanley *et al*., 1995; Hulme, 1996; Bruelheide & Scheidel, 1999). Furthermore, in those settings where the climate is seasonally moist, slugs' herbivory has equivalent affects in the development and composition of both semi-natural (e.g. Bruelheide & Scheidel, 1999; Wilby & Brown, 2001) and designed (Hitchmough & de la Fleur, 2006) herbaceous vegetation. They exert a fundamental selection pressure (Harper, 1977), which, as a result, can eventually lead to the evolution of resistance to herbivory (Harper, 1977). Studies that have analysed individual slug species' grazing effects have emphasised that grassland ecosystems are notably impacted by mollusc herbivory (e.g. Pallant, 1972; Hanley *et al*., 1995; Grimm, 2001; Scheidel & Bruelheide, 2001). Nonetheless, thus far, only a few studies have focused on a herbivore's role in the diversity of vegetation (Huntly, 1991; Silva, 1992). Mostly, the focus has been on plant communities that are most resistant to mollusc herbivory (Grime, 2001; Scheidel & Bruelheide, 2005).

Amongst plant species in Europe, the grazing of slugs has been the focus of much study (e.g. Briner & Frank, 1998; Fenner *et al*., 1999; Frank, 2003; Hulme, 1994; Keller *et al*., 1999; Scheidel & Bruelheide, 1999). In the specific context of Central Europe, a region where continentality has made slug grazing a minor ecological factor, the spread of the invasive slug *Arion lusitanicus* has increasingly impacted on semi-natural meadows, affecting competitive processes and species coexistence (Grimm, 2001; Buchsmann *et al*., 2005).

There is a strong association between the intensity of slug activity in Europe and anthropogenic urban habitats, namely parks and gardens, not only in relation to their native distribution range (Pfleger & Chatfield, 1988), but also in terms of their introduced range (e.g. Holland *et al*., 2007). In contrast, there is very little understanding of the various influences on slug herbivory on prairie species in remnant habitats in North America, despite the fact that European slugs are recognised as a risk factor to those prairie species that are endangered in their native ecosystems (Maze, 2009).

Given that in public spaces slug-control measures in urban naturalistic vegetation designed to provide for ecosystem services and human cultural systems, is more or less politically impossible, grazing by slugs can have profound effects (Hitchmough & Wagner, 2011). This is particularly so in the preliminary establishment stage, when plant seedlings are very small and especially palatable to slugs (Hanley *et al*., 1995; Frank, 1998; Hanley, 1998). Slugs are known to be a key factor in influencing vegetation composition throughout the earliest phases of secondary succession. In contrast to adult plants, it is common for them to contain lower concentrations of secondary metabolites (Fenner *et al*., 1999; Hanley *et al*., 1995), with fewer hairs and other morphological structures that act, in much the same way, to decrease palatability (Scheidel & Bruelheide, 1999). Slug grazing is not as likely to have such a profound effect on established plants, although there may be a notable reduction in their fitness and vigour (Ehrlén, 1995). Slug grazing in spring when species are producing their new leaves from buds and adult shoots is particularly damaging too many species. Importantly, amongst European grassland species, there is much variation in palatability to slugs (Fenner *et al*., 1999), and it has been implied that species-specific variations in the size and overall chemistry of seedlings could be responsible for such differences (Hulme, 1994): those that have larger seedlings seem to be far better positioned to survive slug grazing; However, they are also more able to withstand grazing and to recover (Hitchmough & Wagner, 2011).

Through feeding on vegetation, invertebrate herbivores not only decrease vegetation productivity and associated biomass, but also change the overall species composition (Buchsmann *et al., 2005*). Although slug species are generally considered polyphagous (Buchsmann *et al., 2005*), it is common for them to prefer specific plant species whilst choosing not to feed on others (South, 1992; Briner & Frank, 1998; Frank & Friedli, 1999). The impact of these processes are complicated, encompassing a number of variables (Rees & Brown, 1992; Crawley, 1989, 1997) for example, should the slugs choose to graze on only a select few species, the abundance of these would decline and, potentially, could even result in their complete eradication from the vegetation. This does not necessarily result in plant species' diversity loss: if these species are competitive the diversity of the community could increase through enabling other, less vigorous, species to thrive (Brown & Gange, 1989; Bach, 1994; Olff & Ritchie, 1998).

The overall productivity of a site in terms of above ground biomass has an effect on the number of plant species likely to be present (Hector *et al*., 1999; Tilman *et al*., 2002) with biodiversity generally increasing as productivity decreases. These patterns arise because of the increased interspecific competition for light with increasing productivity. Predation by slugs mediates these relationships through preferential feeding on given species (Fraser & Grime, 1999). The idea that herbivory can increase plant diversity implies that most species in those communities are relatively unpalatable to grazing slugs.

Lanta (2007) found that generalist herbivores such as slugs tend to preferentially feed on subordinate palatable species, in his study (*Hypochaeris, Lychnis* and *Alopecurou*s), as opposed to fast-growing dominant competitors. The fast-growing community dominants in this study were unpalatable, resulting in increases in the overall productivity of the mixtures.

The general palatability of various species across different developmental phases to molluscs requires more understanding and knowledge in an effort to ensure the design of such sustainable naturalistic plant communities will be well-informed (Hitchmough & Wagner, 2011).

2.7 Climate Change and Invertebrates

At the present time, ecosystem services are being affected and influenced by climate change in terms of primary production (e.g. Melillo *et al*., 1993) and water flux and quality (Vorosmarty & Sahagian, 2000). Ecosystem services are recognised as the supply of advantages from ecosystems to society, which are fundamental in supporting human life (Chan *et al*., 2006). Research investigating relationships between climate-change-related responses by invertebrates to ecosystem services consequences are rather limited. The majority of ecosystem services are, however, affected by invertebrates in some ways (Prather *et al.,* 2013).

The studies that do exist focus on insect-mediated changes to ecosystem services in response to climate change (Volney & Fleming, 2000; Ladanyi & Horvath, 2010; Rojas, Locatelli & Billings, 2010; Moraal & Jagers op Akkerhuis, 2011; Rafferty & Ives, 2011). These tend to be centred on only the direct services (and disservices) provided by invertebrates, with no mention of the indirect effects through food web interactions (Traill *et al*., 2010). Owing to the fact that they are recognised as being highly sensitive to climate change, the climate change effects on these organisms at the ecosystem level need to be assessed (Prather *et al.,* 2013).

However, it is possible to make some general conclusions on the effects of climate change on slug herbivory on the basis of past studies (e.g. Briner & Frank, 1998; Fenner *et al*., 1999; Frank, 2003; Hulme, 1994; Keller *et al*., 1999; Scheidel & Bruelheide, 1999; Hitchmough & Wagner, 2011). As soft bodied animals, slugs are highly sensitive to desiccation and are most active in terms of feeding under moist conditions. Nystrand and Granstroom, 1997 found that damage from slugs was directly correlated to the duration of the soil surface staying moist. Climate change scenarios that involved longer drier summers suggest that slug grazing will be reduced during these times of year, whereas it is likely to be extended in warmer wetter winters. What is completely unknown is what the net effect of these changes will be for both naturally occurring and designed urban plant communities.

2.8 Naturalistic Design of a Plant Community

Throughout the past twenty years, there has been much attention directed towards the design of structurally diverse and species-rich naturalistic vegetation for utilisation in urban areas (Kingsbury, 2004). This attention has centred on semi-natural stereotypes, including North American prairie and Eurasian meadow, as a substitution for species-poor monocultural plantings (Kingsbury, 2004). Such developments, to some degree, have encouraged the view that such vegetation, especially when involving native species established by sowing (e.g. Luscombe & Scott, 2004), necessitates a lower degree of resource input in establishment and longer-term management when compared with more conventional plantings (Oudolf & Kingsbury, 2005). These perceptions have run in parallel with the view that such vegetation might also be considered more attractive, not only to those people living in urban settings (Dunnett & Hitchmough, 2004), but also to native invertebrate species (Hitchmough & Wagner, 2012.). Moreover, even when species that are non-native to the area are used, naturalistic vegetation that is complex in terms of species diversity, species phenology (Crisp *et al*., 1998; Asteraki *et al*., 2004), and spatial form (Smith *et al*., 2006a), is likely to be a more valuable habitat for fauna that are native to the setting than monocultural plantings (Hitchmough & Wagner, 2011).

There particular advantages to be garnered from interacting with nature in urban places. Much of the research in this area has dealt with nature in a very vague, generalised sense. More specific work, for example Özgüner & Kendle (2006), has shown that flower-rich, nature-like vegetation is particularly attractive to urban people. These aesthetic preferences run in parallel with the attention given during the past two decades to the design of species-rich and structurally-diverse, naturalistic vegetation for use in urban green spaces to benefit biodiversity. In actuality, during recent years, there has been a wealth of landscape development in urban areas involving the application of ecological or naturalistic styles; in other words, designs centred on semi-natural stereotypes, including prairie and meadow, as mentioned previously, providing a substitute for species' poor monoculture plantings (Hitchmough, 2011; Kingsbury, 2004). In response to the separation of people from nature during the industrial revolution, new perspectives have been adopted in many rich western countries towards the creation of more natural landscapes as a means of ensuring that contact with more natural settings is preserved (Kendle & Forbes, 1997). The naturalistic landscape style in the UK, for example, has a long history, and was a significant factor in the 18th Century when the English Landscape Garden first appeared. In the nineteenth century, landscape naturalism coexisted with far more architectural styles, sometimes on a smaller urban scale, notably by William Robinson in the 'Wild Garden' (Robinson & Darke, 2009). Naturalistic landscapes reappeared as a major force in the UK in the 1970s as 'nature in cities' or 'ecological design' (Ruff, 1979; Ruff and Tregay, 1982), and these ideas were adopted in various park systems and New Towns, to varying degrees. McHarg (1969), and Hough (1995) were influential thinkers in the application of various principles and theories surrounding the design of ecological landscapes in urban areas, but their ideas were mostly associated with planning, rather than design scales.

At the design scale, natural planting design is the concept of taking species and combining them in ways that reflect the character they display in the wild (Oudolf & Kingsbury, 2005). This approach embraces ecology as a dynamic concept, with change within the planting over time a key part of the design process. Thoughtful plant selection is the preliminary stage. The selection of a species that is appropriate for the new environment and which can compete and persist is not a simple task; rather, there is a fundamental need to examine the natural setting and to investigate how such species can grow naturally in their environment and subsequently achieve stable species combinations. Accordingly, when implementing the design of a naturalistic vegetation that is species-diverse in nature and thereby potentially well-positioned to support a wide variety of fauna, it is essential to utilise species that are capable of living for long periods of time as adults whilst also achieving recruitment from self-sown seed (Hitchmough & de la Fleur, 2006; Hitchmough & Wagner, 2013). Naturalistic planting involves a diversity of approaches which are necessary to deal with a variety of contexts, for example, aesthetics, community involvement, costs, environmental education, safety, sustainability, and wildlife conservation (Hitchmough, 1994; Kendle & Forbes, 1997; Dunnet & Hitchmough, 2004).

As design ideas based on naturalistic planting have developed, there has been an equivalent increase in asking questions about what people think about the appearance of these designed plant communities. Studies conducted within environmental psychology typically find that, overall, people tend to consider natural environments more attractive from an aesthetic perspective because of their continuity, intricacy, their symbolic and cultural significance and their overall sensory stimulation (Kaplan & Kaplan, 1989). The objectives of studies about "landscape preference", are research about the conservation of aesthetically valuable landscape (Godlovitch, 1998) which attempts to find a way to describe and evaluate the "public's preference" in terms of the aesthetic values of urban landscapes. Research studies in the field of landscape preferences and perceptions surrounding urban natural areas are growing, (Chiesura, 2004; Jorgensen, 2004; Özgüner & Kendle, 2006,) most recently driven by the increasing importance of biodiversity policy in urban areas. The difficulties in this literature are that it often deals with notions of the natural that are so vague as to be meaningless. Just because someone implies that they have a preference for environments they consider to be more natural, does not mean they favour environments which are, at the human scale, relatively disordered. Hence, there is a need for vegetation to be designed with attention to aesthetic principles if it is to achieve the aim of being well understood and appreciated by the public as a whole (Dunnett & Hitchmough, 2004).

All planting styles have a number of different sustainability-related outcomes in relation to dynamism and diversity. Naturalistic and ecologically inspired designs are typically viewed as being more sustainable than traditional styles (Dunnett & Hitchmough, 1996). In the majority of situations, naturalistic planting is further recognised as encouraging the natural regeneration of spontaneous vegetation on site, and further enables distinctive urban vegetation to be developed (Dunnett & Hitchmough, 1996). Community involvement in the design process not only reduces labour requirements but often increases final-use flexibility and the adoption of local materials when designing a natural setting (Dunnett & Clayden, 2000).

Amongst professionals in the field, one common idea is that naturalistic landscapes are seen to be far less expensive to manage when compared with more formal landscapes. A number of ecologists have made the suggestion that costs could be decreased through adopting a vegetation pattern that is more natural and that will require a lesser degree of intervention in order for it to be maintained (Bradshaw & Handley, 1982; Brooker & Corder, 1986). This is probably true in some situations, such as woodlands, but in many situations these ideas are not realistic: Kendle & Forbes (1997) argue that the costs associated with naturalistic landscape management might prove to be greater when compared with some ornamental and formal plantings, especially when management operations are unfamiliar and there is much intricacy in the patterning.

When vegetation is viewed as an educational resource, traditional formal open space is less able to provide for environmental education compared to more naturalistic landscapes comprising basic ecosystem elements, such as grassland, woodland, water and scrub. Historically, it has been argued that various different types of habitat act as a better stimulant to the imagination and can provide a valuable means of drawing contrasts between different types of habitat (Cole, 1983). Ensuring the presence of the most valuable habitats for wildlife is a fundamental consideration when adopting an urban landscape design. Potentially, one of the most valuable assumptions in relation to the naturalistic management and design of urban landscapes centres on the view that they are better at encouraging wildlife than urban landscapes based on conventional ornamental designs. Thus they are better able to meet wildlife conservation objectives. Increasing the overall diversity of plant species and habitats for birds, insects and small mammals can be achieved through various methods, such as creating softer edges when lining ponds and changing the mowing regimes so as to allow for longer grass growth. The major change that has taken place over the past ten years is that these approaches seem to be successful whether pursued with native or non-native species (Owen, 2013; Salisbury *et al.,* 2015). This recent evolution of ecological understanding is very important in urban places as it enables a diverse fauna to be supported whilst providing a wide range of physical structures or seasonal colour effects that are not always possible with native species alone in small countries with a small native flora (Hitchmough & Dunnett, 2004). These aesthetically-based strategies are critical to ensuring public support for naturalistic vegetation in cities (Hands & Brown, 2002; Todorova *et al*., 2004; Özgüner *et al*., 2007).

There are many factors that affect feeling secure in the urban landscape, and the form of design is one of them (Özgüner & Kendle, 2006). In spite of all the advantages of the naturalistic design of an urban landscape, there are some issues, such as increasing the cover available for potential attackers (Özgüner *et al.,* 2007), that give rise to real concerns. Schroeder and Anderson (1984) showed that the perceived security of parks and urban landscapes were significantly enhanced by high visibility. Involving local people in the management of urban landscape, increases their "sense of responsibility” and, as a result, enhances the feeling of security whilst decreasing vandalism (Hollick, 1982; Johnston, 1990).

2.8.1 Landscape Design and Climate Change

The climate change literature makes the suggestion that, in times to come, a number of the species incorporated into public planting programmes will no longer be sustainable. In the specific context of North America, for example, there has been the wide implementation of naturalistic design with the use of predominantly native species, whereas in the context of Europe, both non-native and native species have been used, depending on various cultural and ecological factors (Hitchmough & Dunnett, 2004). Importantly, a number of species utilised in the planting design initiatives of the UK, at the present time, are not well-aligned to their current locations from a climatic point of view. In order to ensure that sustainable urban landscapes can be achieved, it is likely to be essential to incorporate a larger range of native and non-native species that are increasingly well-fitted to the changing climate. In Europe, there is a diversity of views surrounding the incorporation of non-native plant species in urban designed landscapes, although the debate is generally less skewed to a natives-only policy than is the case in the USA (Hitchmough, 2011). These arguments are based on concerns about potential invasiveness and the advantages of using native rather than non-native species, to support animal biodiversity to the greatest possible degree. Nativeness is a concept first outlined by John Henslow in 1783. Henslow was a botanist who had considered the concept in line with the terms ‘native’ and ‘alien’, as applied from common law in the late-1840s, in an effort to define plants that were “British” rather than artefacts from elsewhere. His interests were mainly practical rather than philosophical. In the 100 years that followed, a number of different professionals, including zoologists and botanists, have detailed and examined the various species introduced with and without awareness. “The Ecology of Invasions by Animals and Plants” was written by British ecologist Charles Elton in 1958, at a time when there was a general lack of agreement in relation to the overall appropriateness of intervening upon the introduction of alien species. It was some time later- notably in the 1990s - that the concept of ‘invasion biology’ became recognised as its own distinctive discipline and non-native species began to be seen as causing harm. In more recent years, there are signs of more thoughtful positions on non-native species beginning to emerge in the ecological research literature (although generally not in the USA) as the evidence begins to accrue for non-native species also playing valuable roles in terms of delivering ecosystem services. In many countries, non-native species and their introduction has notably increased the number of species in a region, both those that are now established parts of the biota and the much larger range or species that are transients that gradually become extinct. This is not to say that there are not some harmful aliens, but rather that the balance sheet is more complex than originally thought.

In this vein, it is clear that utilising a combination of both non-native and native species in urban public environments enables a greater impact in terms of colour (Hitchmough & Woudstra, 1999). Native species tend to be accepted as the most suitable plants for use when aiming at achieving the most sustainable planting as they are often highly pre-adapted to local climates with the assumption that they have been sourced from comparable biomass as in urban settings. They are particularly useful because of their high capacity in many cases for self-reproduction, without this being regarded (as it is with non-native species), as a biological invasion. Nonetheless, exotic plants have also been recognised as part of many civilisations and designed landscapes for long periods of time, particularly in Europe and Asia, thus meaning it is essential to consider the views of people in terms of what they perceive to be suitable (Kendle & Rose, 2000). Accordingly, there are a number of valuable opportunities centred on improving the aesthetic character of urban landscapes through ensuring the careful selection of non-native plant communities. It is common for plant fitness, in an urban setting, can be significantly impacted by the habitat in which the species has evolved, where the species will be seen to be a better fit when the habitat is well aligned with the environmental conditions apparent at the location of cultivation. Such plants will generally be the most sustainable (Hitchmough, 2011). With this in mind, the view might be taken that local native species typically will be more fitted to many planting sites than species from further afield (Schmitz & Simberloff, 1997; Gilbert & Anderson, 1998; Parker *et al*., 1999). Although the view seems to be relatively true when taking into account climatic factors (Davis, 1989; Hitchmough, 2011), some species prove to be well-fitted even when those environments are comparatively different to their present habitats. Sometimes, this is due to their past biogeographical distribution and history. In other cases, species that are really well-fitted are those that occur in habitats a long way away, that due to local factors such as altitude and soil moisture etc., closely resemble the conditions at the planting site. Importantly, although fitness is acknowledged to be an important factor, it remains that there has been little attention directed towards herbaceous species.

2.8.2 The effect of enhanced CO_2 and Plant Interaction in Designed Communities

It is expected that, by the end of the 21st Century, atmospheric CO_2 levels will have doubled, with an increase in mean global temperature of between 1.6°C and 6.4°C (IPCC, 2007). These changes will have significant impacts on physiological processes and the development of plants (Jordan, 2002; Fiscus *et al.*, 2005). The hypothesis has been made that increased levels of CO_2 in the future will mean carbon assimilation will be enhanced, along with improvements in species' productivity and water use efficiency (Osmond *et al*., 1980), with general growth responses modified, as seen in phenology and morphology (Bazzaz, 1990). When taken in combination, such altered processes might affect the overall productivity, structure and composition of species in naturally occurring vegetation (Overdieck & Reining, 1986; Patterson & Flint, 1990), with such projections centred on assessments of experimental results from short-term CO_2 enrichment tests, which sometimes, but not always, provide clear indications that species demonstrate various differences in their growth responses and photosynthetic reactions to CO_2. The assumption in the hypotheses suggests that, in line with the increase in CO_2 levels, species seen to have a preference for elevated levels of CO_2 will be far more competitive and will outcompete species that respond less to enrichment. Kramer (1981) makes the counter hypothesis that increases in photosynthesis in direct relation to increased levels of CO_2 are commonly recognised as short-term as opposed to permanent, with no significant impact on productivity and ecosystem functionality. The inability to react to increased CO_2 levels has been referred to as 'CO_2 acclimation' and is widely considered to be a key unknown factor in the CO_2 equation for future environments (Bazzaz, 1990,). The significant loss of sensitivity to higher levels in this regard can be rationalised by directing attention to other fundamental growth resources, such as light, nutrients and water, which may be seen to be more restrictive than

CO_2 in regulating overall carbon gain, as well as in terms of the growth process overall. With this noted, the conclusion is drawn by Kramer (1981) that, 'In nature the rate of photosynthesis and biomass production probably is limited more often by water and nitrogen deficiency than by the low CO_2 concentration of the air.'

Assessment of the expected outcomes in vegetation stemming from changes in CO_2 levels on a plant community, might be focused on communities comprising C3 and C4 plants, which respond differently due to anatomical and biochemical differences in the uptake pathway of CO_2. Importantly, as a whole, the C4 group is recognised as having a general photosynthetic rate an estimated 50 times greater than that of the C3 group (Osmond *et al*., 1982). In specific regard to carbon uptake in photosynthesis and growth, C4 plants are seen to be far more efficient when compared to non-efficient C3 plants (Black *et al*., 1969), although not of course when temperatures are suboptimal for the C4 species. However, C3 species' photosynthetic rates do show the most pronounced sensitivity in response to CO_2 levels (Pearcy & Bjorkma, 1983), with growth and photosynthesis differences between C3 and C4 species at increased CO_2 levels known from a number of experiments (Patterson & Flint, 1980; Carlson & Bazzaz, 1980; Carter & Peterson, 1983; Zangerl & Bazzaz, 1984; Wray & Strain, 1986, 1987; Curtis *et al*., 1989, 1990). When reviewing the working hypothesis, the statement is made that CO_2 levels direct preference to the C3 group through redirecting their competitive balance. Results garnered through the completion of experiments provide support for this hypothesis (Patterson & Flint, 1990; Long & Hutchin, 1991).

In the past two decade, Large-scale, experiments to test this hypothesis were carried out but have been plagued by significant changes in CO_2 levels (Barnola *et al.,* 1987). All changes in settings for CO_2 must be represented in the structure and composition of the vegetation. Information relating to issues such as CO_2 effects on plant processes must be in the physiology of the different species and reflected in the species composition of plant communities (Barnola *et al.,* 1987)

A number of different plant exposure methods and systems have been used, such as branch bags (Barton *et al*., 1993; Kellomäki & Wang, 1997; Saugier *et al.*, 1997; Robertnz, 1999), free air CO_2 enrichment (FACE) systems (Hendrey *et al.*, 1999; Herrick & Thomas, 2001), glass domes with adjustable windows (Urban *et al.*, 2001), open-top chambers (Leadley & Drake, 1993; Norris *et al.*, 1996) and whole-plant closed top chambers (Kellomäki *et al.*, 2000; Medhurst *et al.*, 2006). All of these methods have provided notable contributions to the general knowledge surrounding plants' complex responses to elevated CO_2. Nonetheless, all of these systems have a number of different drawbacks as well as benefits.

When combining CO_2 with other environmental factors, however, there is the issue of cost. It is difficult for the CO_2 levels to be manipulated without creating highly-artificial greenhouse-type surroundings, which can provide somewhat dubious results. In the recent past, experiments have suggested that growth cabinet chamber systems seem to be appropriate (Zhou *et al*., 2012) as they provide a number of different climatic conditions for air temperature (T_a), relative humidity (RH) and CO_2 concentration (C_a).I

2.9 Plant Communities and Competition

2.9.1 Plant Growth Rate and Relative Growth Rate

Any increase in plants' dry weight is referred to as the plant growth rate, which is taken across a specific duration. Dry weight increases are commonly linked with an increase in the size of the plant (Fitter & Hay, 2001). From a historical perspective, people have normally shown a greater degree of interest in choosing species in designed plantings with a quicker rate of growth as opposed to those that grow at a slower rate when incorporated in a mixed community.

Those plants that grow at a quicker rate demonstrate higher carbon-exchange-producing leaves and roots at a faster pace. Although it is accurate to state that high-growth species can be valuable in overcoming weed issues in the community, there is also a tendency for such plants to eliminate those plants that are slower growing, thus resulting in a decline in diversity and a lower degree of visual interest. In-community competition therefore needs to be considered in order to ensure that a functional and secure community can be produced.

Importantly, high plant growth rates are seen to be fundamental when dealing with those soils that are highly productive. A lack of stability will be evident amongst low-productivity species as a result of high levels of water and nutrients promoting high-productivity weed-like species (Dunnet & Hitchmough, 2004).

When categorising different species, especially seedlings, in terms of resource competition, a relative growth rate method has been applied (Grime & Hunt, 1975; Grime *et al*., 2007). Small seeded species are usually seen to have greater rates of growth (Turnbull *et al*., 2008) and also have a tendency to be more ephemeral species associated with more open habitats. In the work completed by Gross (1984), the effects of seed size and growth were identified amongst monocarpic perennial plants, with the conclusion drawn that the relative growth rates of seedlings was seen to have an inverse link with seed size, with faster relative growth rate being seen amongst small-seeded species when compared with larger-seeded ones. Comparable patterns have been recognised by Turnbull (2008). Essentially, the view is that successful establishment depends on the interplay between plant traits and characteristics, including emergence time, seedling growth form and relative growth rate, with seed size also sometimes affecting such factors (Gross, 1984; Rey, 2004).

2.9.2 Competition in Designed Plant Communities

In naturalistic planting in designed landscapes, higher levels of competition between individual herbaceous plants is experienced owing to the fact that there is a much closer sowing space than in conventional planning. Particularly where plants demonstrate differences in their growth forms and their rates of growth, this results in what is referred to as *competitive asymmetry*, where some plants are more competitive in fighting for light and other resources than other plants (Schwinning & Weiner, 1998). Grime (1979) makes the statement that plant competition in the adult and earlier stages are associated with neighbouring plants' tendency to adopt the same nutrients, volume of space, quantum of light and water. Understanding these processes in plant communities has been a focus of much research across the past thirty years. There are two key factors that restrict the survival and growth of possibly dominant aggressive species: stress and disturbance. In aerial plant parts, the developmental stages and the timing of growth etc., have a notable effect on survival value in competitive situations amongst species (Harris, 1977). Most of this research has been undertaken on semi-natural plant communities (for example Tilman 1990 & 1988). Importantly, however, further study is needed in this area in order to establish how varying growth rates may be accommodated that allow relative stability within designed naturalistic plant communities. The work of Hitchmough *et al.* has explored this territory, looking at growth rate differences, as well as differences in the biomass productivity, prior to combining the species in designed plant communities (Sayuti & Hitchmough, 2013). The general pattern to emerge from this work is that fast-growing species eliminate slow-growing species (where these species are shade intolerant) in the short-term in competition for resources in communities. This process of elimination can only be reduced when the abundance of the former per unit area is reduced. Competition can also be used as a positive strategy; by increasing the sowing density, sown species compete more effectively against weedy species (Hitchmough & de la Fleur, 2006; Schwinning & Weiner, 1998). However, this also has a negative effect on slower growing sown species, which tend to be eliminated through competition with the fastest growing ones. When developing planted or sown multi-species communities, there is a need for the species to be understood and evaluated in terms of their different growth rates and growth patterns, as these differ between species. This is in addition to understanding their flowering period, growth rates and size at maturity in order to ensure a community is developed that can function effectively and be attractive over long periods of time (Hitchmough, 2004).

2.9.2.1 Competition for water

Wilson and Tilman (1993) propose that in those environments where there is an abundance of light but a restriction of soil resources, water availability is a key factor in competition. Weiner (1988) poses the view that light competition is fundamental owing to the fact that plants can grow bigger in fertile soil; when there is a lack of nutrients and water, however, the opposite is most likely to be true (Casper & Jackson, 1997). Such a view is keenly supported by a number of past works, which emphasise that below-ground competition intensity increases as productivity levels decrease (Putz & Canham, 1992; Wilson, 1993; Wilson & Tilman, 1993)

Competition for water begins when seedlings first emerge, becoming fiercer as seedlings increase in size. As proposed by Schwinning & Weiner (1998), the hypothesis surrounding water-based competition is centred on the key idea that each unit of biomass is seen to be equal in its contribution to water-uptake.

It is anticipated that competition for water is “size asymmetric” and corresponds to a “plant’s water potential”. Thereby, the larger plants with lower ‘tissue water potentials’ open their stomata longer to increase transpiration (Schwinning and Weiner, 1998).

Casper and Jackson showed (1997) that water uptake is driven by “plant transpiration” and is a function of “water movement” to the root, maximum rate of “transpiration” [SOMETHING MISSING HERE] (Schulze, 1994). In “root interactions mechanics”, specifically in relation to below-ground competition, as a result of increasing “effective water diffusion”, the degree of competition increases (Baldwin, 1976). The competition is dependent on the soil moisture available and also on the root system capacity (Friedman and Orshan, 1974).

Vila & Sardan (1999) and Silvertown *et al.* (2012) have studied the effects of making changes to the moisture regime under which herbaceous plants were growing and they found that this impacted on dominance patterns and vegetation changes. In a dry area grassland biome, for example, the turnover and change of tufted perennials depends on the rainfall regime, with drought-related mortality leading to significant compositional change (O'Connor & Bredenkamp, 1997). Araya (2011) found that fynbos niche segregation in the Western Cape of South Africa can be witnessed in the field. Research carried out in an English meadow by Silvertown (1999), further highlighted that plant communities are segregated across hydrological gradients generated by shade from trees. Air temperature and near-ground solar radiation are reduced through shading, with plant and soil evaporation rates being observed to decline (Breshears *et al*., 1998)

Some studies on seedling growth in herbaceous communities indicated that, increasing the water moisture availability in a plant community shows a positive effect on their growth. This can happen because decreasing soil evaporation enhances the "counter-balancing water" loss through the canopy (Vila and Sardan, 1999). In plant communities, the root system, the depth of roots, and water absorbing efficiency are three factors which control the degree of water competition (Archibold, 1995).

2.9.2.2 Competition for light

In a community, each species has a somewhat different leaf morphology, shoot and growth habit when compared to the others. Despite the fact that similar patterns may be seen amongst various species, the capacity to compete for light between species in a community ultimately rests on their own ability to utilise newly produced and stored photosynthates to fuel shoot elongation. The work of Grime (1979) illustrates how, in closed herbaceous vegetation, stature-related variations could have a notable effect on survival, with height-related differences also related to significant changes in the capacity of the plant to successfully compete for light. Competition for light has been found to be a key mechanism in the loss of diversity amongst plant communities (Hautier *et al*., 2009). Owing to the fact that nutrient and water availability can have a key effect on the way in which growth is produced; such factors have a notable effect on light-related competition. The spatial arrangement of leaves can have a fundamental effect in the competitive ability for light (Grime, 1979; Spitters & Aerts, 1983; Mitchley, 1988; Barnes *et al*., 1990; Aerts *et al*., 1990). In designed vegetation there is potential for herbaceous vegetation to be created as "multiple layers" of species, all stacked on top of each other. This typically involves plants that are low-growing, shade-tolerant and spring-flowering, with mid-canopy species which flower in late spring through to summer. The tallest species typically flower during early autumn (Ahmad & Hitchmough, 2007). Complicated structures pertaining to layers can be established to fully exploit the utilisation of resources within the vegetation, whilst simultaneously limiting invasive weedy species from the outside and maximizing flowering periods to exploit wildlife opportunities and the biodiversity of invertebrates (Hitchmough, 2008). It is imperative to provide a suitable and attractive image in a designed natural urban landscape. In this method of design, it is necessary to pay attention to the aesthetics of the physical characteristics of the plant species. In the particular context of mixed communities, with the combination of low and high canopy species, variations in growth rate and size asymmetry allow some species to receive more light. Larger plant species are able to decrease light levels amongst smaller species (Parker & Muller, 1982). Importantly, there is the thinning of small species under adult plant's shading, with shading smaller in comparison to those seedlings that are exposed (Vila & Sardan, 1999). In ecologically-based planting factors that have an influence on competitive interactions, such as light, this would have an influence on the way in which practitioners decide on the outcomes of competition amongst the plants to be utilised (Hitchmough, 2010).

2.9.2.3 Competition for Soil Nutrients

There are two well-known contrast perspectives in the competition for nutrients. Tilman & Grace, 1990) suggest that competition for nutrients between species increases when there is a lower availability of nutrients in the soil. Grime (1979, 2002) poses the view that such responses work in a diametrically opposite manner, with competition increasing in line with the increase of nutrients. Grime makes this interpretation owing to the fact that, when plant biomass is high, competitive asymmetry is evident (Weiner & Thomas, 1986), with slower growing species eliminated on a larger scale. In the case of highly infertile soils, however, biomass is rarely sufficient for marked competitive asymmetry to be a powerful factor.

Soil fertility in urban regions is known to demonstrate considerable variation; overall, this is owing to both unintentional and intentional eutrophication. The majority of plants are seen to create more biomass at a quicker rate when fertile soil is used compared to that present in landscapes not subject to eutrophication (Bullock & Gregory, 2009). Soil nutrients are commonly distributed heterogeneously and supplied episodically (Cadwell *et al*., 1996). Nutrient uptake will increase per unit root length when plants grow on nutrient-rich soil

(Fransen *et al*., 2001). As a result, competition will increase in the case of more fertile soils. In communities of species as opposed to agricultural and horticultural monocultures, increasing the levels of fertility limits the capacity for maintaining species diversity. Competition intensity is increased in line with the extent of nutrient availability in the soil (Buckland & Grime, 2000). Heterogeneous patterns of nutrient renewal in soil can affect competition.

Furthermore, the way in which the roots react to dealing with a soil resource with a heterogeneous distribution means that competitive asymmetry changes (Casper & Cahill, 1996). For example, the study by Aerts (1999) demonstrates that those habitats that are high in nutrients are dominated by fast-growing perennials with a tall stature, although these demonstrate high turnover rates of leaves and roots. Those species that are fast-growing and that achieve a significant rate of growth tend to eliminate slow growth and small seedlings, with the lower species facing a shading effect. In such settings, individual species will commonly be seen to respond to additional nutrients by eliminating other species and thus becoming more dominant themselves (Tilman & Grace, 1990). In the view of Grime (1979), the highly competitive species will suppress other species at higher nutrients levels. A drop in the overall richness of the species will be witnessed in this situation. A number of researchers concerned with the richness of species in regard to nutrient availability (Pausus & Austin, 2001) suggest that the richness of species drops along the resource gradient with the decline in nutrient concentration (Grime, 1973; Austin & Smith, 1989; Pausus & Carreras, 1995; Vetaas, 1997).

CHAPTER 3: THE EFFECTS OF DIFFERENT LEVELS OF WATER REGIME, AND TEMPERATURE ON BIOMASS PRODUCTIVITY AND PLANT SPECIES FITNESS IN DESIGNED PLANT COMMUNITIES

3.1 Introduction

Today, much attention is paid to biodiversity, and the potential impact of climate change on biodiversity. In most parts of the world plant distribution will be affected by climate change. According to the IPCC (2001) climate change is estimated to exacerbate the loss of species most, where those species have restricted climate and habitat requirements, and limited migration capabilities. Thomas et al., (2004) have estimated that climate change may lead to between 3–21% of all endemic plant species of Europe becoming extinct by 2050. Species composition will change in every part of Europe in a different way. Bakkenes et al. (2006) suggests that “The most dramatic changes will occur in Northern Europe, where more than 35% of the species composition in 2100 will be invasive, and in Southern Europe, where up to 25% of the species now present will have disappeared under the climatic circumstances forecasted for 2100” (Bakkenes et al. 2006).

On the European and other continental land masses climate change will lead to movement of species, as some existing species become less fit and current unfit species become more fit. In the designed, culturally founded landscapes of cities reducing the climate change will need to involve parallel, but strongly human mediated processes. New plant species, from other parts of the world, which are more similar to future climate change scenarios and hence more tolerant, will become essential in designed sustainable urban landscapes. Although, currently in most parts of the world, alien plant species are considered as unsustainable design elements in urban landscapes (Hitchmough 2011), in the future, these attitudes will have to change.

These incoming or alien plant species have ecological functions in urban landscape, as do current native species. They support native invertebrates and also are attractive for people, and facilitate a range of ecosystem service functions which are generic and not based on plant origin.

Greenhouse gases, moisture availability and temperature are three important factors that should be considered in climate change research. Impacts of water stress on plant growing in urban landscape were investigated by the researcher in different aspects. This study is the first to look at the effects of changing precipitation and temperature on a designed community plant of native and alien meadow plant species in urban landscapes.

3.1.1 Objectives

The specific objectives of this study were:

- To investigate the effects of different climate change scenarios on a designed plant community in an urban landscape
- To investigate the effects of different climate change scenarios on plant species fitness and adaptation.
- To investigate the possibility of using the intermediate fitted species from southern Europe (Mediterranean climate), and poorly fitted species from the Southern Rocky Mountain Region (Continental climate) in current and future urban landscape according to the 2050 UK climate change scenarios
- To evaluate the growth performance and vegetative phenology of the well fitted species from Western Europe (Maritime climate) in UK urban landscape according to the 2050 UK climate change scenarios.

3.1.2 Design process:

Multiple canopy layered plant communities are a new approach to naturalistic planting design, which has been developed by James Hitchmough in UK (Dunnett and Hitchmough 2007).

Multiple layered plant communities are a community of long flowering period with shade tolerant species in the lower layers and shade sensitive species in the upper layers. These kinds of planting arrangements are increasingly used by designers and landscape architects around the world. The Olympic Garden in London is one of the best examples of this method of planting design (designed by James Hitchmough and Nigel Dunnett). There are different strategies for designing a multi layer community of plant species such as plant habitat focus system, plant survival strategy (Grime's C-S-R strategy) and plant strategy type model (Rainer and West 2015).

Rainer and West believe that "Many different approaches exist, ranging from purely empirical to science-based plant classification. Even though none of these has been able to create a perfect method for planting design, simplifying and combining the best aspects of each can help tremendously" (Rainer and West 2015). German researchers such as Richard Hansen and Friedrich Stahl suggested a plant habitat focus system. Richard Hansen and Friedrich Stahl in their book "Perennials and their garden habitat" explained that if the species were planted in conditions similar to their wild habitat, they would live longer, be more resilient and be easier to manage (Hansen and Stahl 1993). They split species into the five categories and introduced a scale of sociability for the plant species with the solitary specimens at beginning of the spectrum, category 1, and clonal-spreading ground covers at the other end of the spectrum (category 5): "The plant species at the lower end of sociability (1 and 2) are generally tall, visually dominant and should be arranged individually. The plant with higher level of sociability are suitable for groundcover and should be used in a group" (Rainer and West 2015). This approach is essentially based on the idea that the patterns and spatial arrangement found in nature are essentially optimal. All of the plant lists in the book were based on species available in the Europe at the time. Translating his list into regionally appropriate examples for the other part of the world takes a high degree of plant knowledge. Also this strategy cannot explain how species from different habitats can still form effective designed community. These days many designer and researcher such as James Hitchmough and Piet Oudolf have created successful plant communities with plants from different habitats (Rainer and West 2015, Oudolf and Kingsbury 2013).

Messer (2008) believed that plant species have to be selected for multi layer communities and arranged by taking into account the following traits:

- Choice of suitable site/habitat conforming (Hansen& Stahl 1993)
- Thematic focus of the planting (i.e. blue-yellow contrast)
- Growth rhythm (short-term dynamics, annual aspects, height in various seasons, long-term dynamics)
- Life expectancy of the plants
- Plant sociability (Hansen& Stahl 1993)
- Reproduction and rate of propagation
- Population biological strategies (Grime, Hodgson & Hunt 1986)
- Aesthetic criteria (layering, colour combinations, texture)

Ahmad and Hitchmough suggested that "to achieve successful multi-layer communities requires avoiding high densities of large, fast growing species with dense basal foliage are avoided, especially during the first year"(Ahmad and Hitchmough, 2007). The visual impact of the slow-growing species is critical to designing multiple canopy layers of meadow- like communities. They need more time to develop, and this in turn, reduces the aesthetic value of a developing community in the first year. Lower layer species cover the soil early spring (such as Primula vulgaris and *Primula veris*). They help to increase the foliage cover values at ground level played an important role in not only the aesthetic but also in community management. They made it much harder for weeds to invade and become established. In multiple canopy layered plant communities design the survival of the species with the lowest leaf canopies will be inversely proportional to the percentage of species with taller foliage. Typically medium and tall foliage canopies species, growth and development during the late spring, early to late of and also early Autumn.

In this study, to answer the fundamental issues, the same method which was used by Ahmad and Hitchmough 2007, Sayuti and Hitchmough 2013 was used to design Multiple canopies layered plant communities. One of the primary hypothesis of this research is that the aesthetic of a designed plant community will be affected by climate change in mixed communities, because the establishment, development and the growth rate of species can be affected by climate change.

3.1.3 Species selection

Temperature-change scenarios in Europe vary regionally but show a clear trend toward warming. The average projected temperature increase in Europe ranged from 2.1-C to 4.4-C. Britain will experience wetter and hotter summers in the future and in some parts (particularly Southern England) drier summers and wetter winters. As a result of these effects and change in the pattern of precipitation, the species composition and life form diversity of the plant communities have changed markedly, which includes the abandoned groves and in the periodically clear-cut coppice stands (Gondard *et.al* 2001).

In order to provide a naturalistic design of multi-layer plant community and according to the UK climate change scenarios, the plant species of three different habitats (Western Europe with Maritime climate, Sothern Europe with Mediterranean climate and Rocky Mountain Region with Temperate Continental climate) were investigated.

The climate of Mediterranean region of Europe is characterised by hot dry summers and humid, cool winters. It is also very capricious with sudden heavy rain or bouts of high winds. It includes high mountains and rocky shores, thick scrub and semi-arid steppes, coastal wetlands and sandy beaches (Sundseth, 2009). This region is one of the world's top biodiversity hotspots. The Mediterranean has not only a very rich biodiversity but also a large number of species that do not exist anywhere else. While most central and northern European forests are now dominated by only a dozen or so tree species, the Mediterranean forests are much more diverse, harbouring up to 100 different tree species (Sundseth, 2009). Other areas of the Mediterranean are covered in grasslands. These semi-arid stepped areas may seem barren and lifeless but, on closer inspection, reveal an equally rich wildlife.

Temperate grasslands are located north of the Tropic of Cancer (23.5 degrees North) and south of the Tropic of Capricorn (23.5 degrees South). Summer temperatures can be well over 38C^{o} degrees, while winter temperatures can be as low as -40 C^{o} (Miller 1992). They typically have between 255mm and 900mm of precipitation a year, much of it occurring in the late spring and early summer. Snow often serves as a reservoir of moisture for the beginning of the growing season. It is increased with an increase in altitude (Nelson and Williams 1992).

Parts of the Rocky Mountains in North America are considered as temperate grassland. The Rocky Mountain climate is characterized by summer dryness, abundant sunlight, and rapid temperature change. Most precipitation falls as snow in winter. The distribution of vegetation in the Rocky Mountains correlates directly to elevation changes, which influence the temperature and availability of moisture. Different plant communities characterize each zone (such as foothill, montane, subalpine, and alpine) from the base of a mountain to the top, and each zone may contain several types of plant communities. More than 5,000 plant species occur in the Rocky Mountains (Nelson and Williams 1992).

The flora of the Mediterranean region and North America temperate grassland, provide a unique opportunity to selecting and introducing new plant species to the UK urban landscape according to the future climate change scenarios.

Thirty six species, 12 native to Western Europe, 12 from the Southern Europe, and 12 from, the Southern Rocky Mountain Region (Continental climate) species were chosen to represent a gradient from well fitted to poorly fitted to the current British climate. The characteristics of these species are shown in Table 3.1, 3.2 and 3.3. These 36 species were utilized to create a biological meadow assay to investigate climate change in the form of a multi layer designed meadow community.

This study was undertaken on the criteria for plants selection are as follows:

- Seed availability
- Typical fitness to UK conditions
- Canopy size, and form morphological similarity

- Flowering period, Plant height and Aesthetic function of the species
- Diverse yet complementary ecological strategies
- Appropriate in relation to UK 2050-2080 climate change scenarios.

The heights of species were important to designing a multi-layer meadow community and they were selected and characterised into 4 groups in terms of their height:

1: <20 cm   2: 20-40 cm   3: 40-80 cm   4: > 80 cm

Figure 3.1 multi layer plant community (Rainer and West, 2015)

Seeds for the study were purchased from Jellito Seeds, Schwarmsted, Germany, and Alplains, Colorado, USA. Species were selected on the basis of their performance in gardens and designed landscapes, as recorded in the horticultural literature, their natural distribution, and the experience of "plant experts", in particular Professor James Hitchmough.

Table 3.1 The Maritime climate (mostly Western Europe) plant species

Species	Habit	Typical fitness	Flowering period	Plant height(cm)	Aesthetic function
Arnica montana	Mat with ascending stem	Well	May - August	20–60	Orange – yellow flower
Bupthalmum salicifolium	Hummock	Well	All the Summer	50 -100	an abundance of yellow daisies
Centaurea montana	Hummock	Well	May - July	Up to 50	blue flower
Galium verum	Mat with ascending stem	Well	May - September	up to 50	Acid yellow flower panicles
Geranium sylvaticum	Hummock	Well	June – July	up to 70	Violet blue flower valuable in early to midsummer
Knautia arvensis	Hummock with ascending stem	Well	May – August	50 to 100	violet-blue flower, High attractive to the bees and butterflies
Origanum vulgare	Hummock	Well	July - October	35	Aromatic pink flower, High attractive to the bees and butterflies
Phyteuma spicatum (var. coeruleum)	Hummock with ascending stem	Well	May – June	60-80	Blue flower
Primula veris	Mat with ascending stem	Well	March – May	20	Yelow flower in spring.
Prunella vulgaris	Mat with ascending stem	Well	June – September	20 cm	a groundcover species with long period of violet flower
Salvia pratensis	Hummock with ascending stem	Well	June – August	Up to 60	Violet flowers and attractive to bees
Scabiosa caucasica	Hummock with ascending stem	Well	June – September	up to 50	Lavender flowers

Table 3.2 The Mediterranean climate (Southern Europe) plant species

Species	Habitat	Typical fitness	Flowering Period	Plant height(cm)	Aesthetic function
Asphodelius lutea	Hummock with ascending stem	Intermediate	May- June	80	Bold spikes of fragrant, star-shaped yellow flowers and blue-tinted grass-like foliage
centaurea triumfettii	Hummock with ascending stem	Intermediate	May – July	Up to 40	BLue flower , attractive to bees
Centuarea orientalis	Hummock with ascending stem	Intermediate	late summer to early autumn	Up to 100	Clear yellow knapweed flowers from beautiful intricate shiny buds
Dianthus carthusianorum	Mat with ascending stem	Intermediate	June - September	Up to 100	Pink larg flower
Euphorbia nicaeensis	Hummock	Intermediate	April – June	Up to 50	Yellow flower
Hedysarum hedysaroides	Hummock	Intermediate	July – August	40	Bright scarlet flower racemes, attractive to bees
Linum flavum 'compactum'	Hummock	Intermediate	June – August	20	Yellow flower ,attractive for bees
Linum narbonense	Hummock with ascending stem	Intermediate	June - July	40	Sky blue flower
Lychnis coronaria	Hummock with ascending stem	Intermediate	July - August	75	red-purple to carmine-red flowers. Decorative white and silvery foliage
Lychnis flos jovis	Mat with ascending stem	Intermediate	May – July	25	Silver foliage plant and bright rosy-red flowers
Paradisea liliastrum	Hummock with ascending stem	Intermediate	May – June	50	White flower
Salvia nemorosa	Hummock with ascending stem	Intermediate	May – September	60	Violet flower

Table 3.3 The Continental climate (mostly Southern Rocky Mountain Region) Plant species

Species	Habit	Typical fitness	Flowering period	Plant height(cm)	Aesthetic function
Amsonia jonesii	Hummock	Poor	April-May	30	star-like sky-blue flowers in spring
Asclepias tuberosa (Colorado form)	Hummock	Poor	June - August	70	Orange flower
Balsamorhiza sagittifolius	Hummock with ascending stem	Poor	May - June	40	Showy yellow sunflower-like flowers
Centaurea pulcherrima[1]	Hummock	Poor	June – October	40	Pink flower
Delphinium barbeyi	Hummock with ascending stem	Poor	July – August	100	Large blue flower
Dracocephalum grandiflorum[2]	Mat with ascending stem	Poor	July – August	20	Intense blue hooded flowers on a compact plant
Geum triflorum	Mat with ascending stem	Poor	May – July	25	3-flowered, entire plant covered with silky hairs, ornamental seed-spikes
Hymenoxys grandiflora	Mat with ascending stem	Poor	May – June	30	Yellow flower
Penstemon strictus	Mat with ascending stem	Poor	July – August	45	Dark blue flower, Bee atractive
Salvia pachyphylla	Hummock	Poor	July - September	60	Blue-violet with purple bracts,
Sphaeralcea coccinea	Hummock	Poor	June – July	30	long blooming season
Zinnia grandiflorus	Hummock	Poor	July - October	15	Yellow flower, Long flowering

1. The origin of this species is turkey but it is poorly- fitted species in UK   2- The origin of this species is Centeral Asia

3.2 Material and methods

The research started in spring 2012 with site and soil preparation and the construction of growth cabins at Sheffield Botanical Garden. In order to simulate climate change scenarios, two different climate change chamber were designed and built (see fig.3.2). In total, 48 climate control chambers were built.

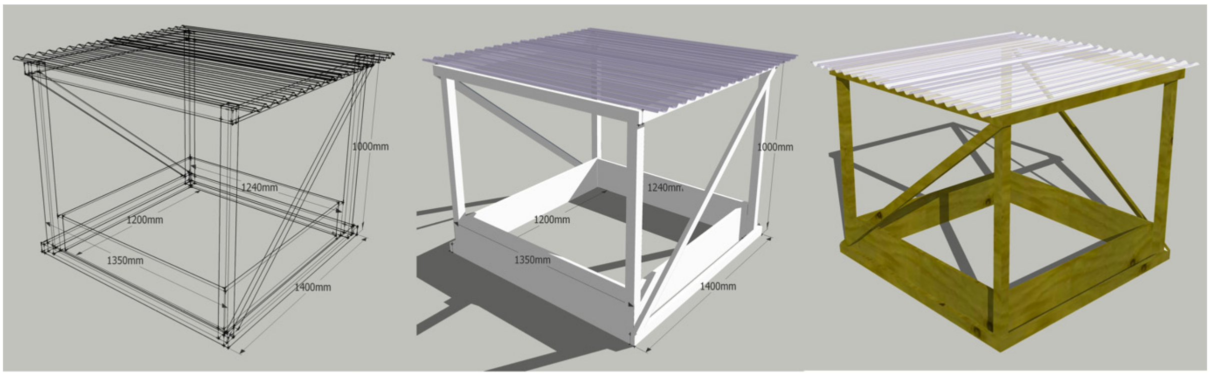

Figure 3.2 The dimensions of plots and climate control chambers

Figure 3.3 The Climate control chambers, spring 2012

Figure 3. 4 Climate control chamber were covered by greenhouse UV plastic

3.2.1 Climate scenarios

This experiment was conducted under field experiment conditions for a period of 3 years. The climate in the UK is typically maritime. During the research period (2011-2014) the mean annual rainfall in Sheffield was 877mm and the mean annual temperature 10^{o}C. According to the 2050 – 2080 UK climate change scenarios on base of changing in precipitation and temperature the effect of this natural phenomena on designed plant community in urban landscape, were investigated.

3.2.1.1 Precipitation scenarios

The average precipitation of Sheffield during the March to September growth season during the last 50 years (Appendix 1) was used as the ambient base line of rainfall during the experiments to allow three precipitation scenarios to be designed around this ambient value:

- Ambient – 50%,
- Ambient,
- Ambient+50%

Table 3. 4 Calculation of precipitation amounts per month for the rainfall scenarios based on the average of Rainfall in Sheffield from 1955- 2012

Months	Average (Ambient)	Ambient+50%	Ambient-50%	Days of rainfall>=1
March	62.9	94.35	31.45	12.3
April	60.0	90	30	10.3
May	60.69	91.03	30.34	9.6
June	67.1	100.65	33.55	9.1
July	60.6	90.9	30.3	9.2
August	67.8	101.5	33.9	9.9
September	64.3	96.45	32.15	8.9

In all treatments (ambient, ambient ±50) all plots were covered with a rain shelter lid, hence the only water that was added was delivered as irrigation. Natural rainfall was excluded from the plots to allow the ambient scenarios shown in Table 3.4 to be achieved. As an example of this process, the average precipitation during March in last 50 years in Sheffield was 62.3mm and the average of the number of rainfall days during the same time were 12, equating to a rainfall event approximately 3 times per week. So Ambient percipitation treatment plots were irrigated 3 times a week and each time they recivied 5.19 mm of water per squre metre during March. For the plots with other precipitation treatments, -50% or +50%, this amount of water was increased or decreased in relation to the value of 5.19mm at each irrigation event as shown in Table 3.4.

3.2.1.2 Temperature scenarios

The maximum temperature of Sheffield during March to September growth season during the last 50 years (Appendix 2) was used as base line of temperature upon which two temperature scenarios were designed:

Temperature: Ambient and Ambient+3^{o}C

In order to achieve the desired 3^{o}C elevation of air temperature within the growth cabins, a series of different sized vents were cut in the polyethylene wall of growth cabins. These vents represented 10%, 15%, 20%, 30%, 60% of the area of one side of the wall of the climate control cabinet) with 2 replication for each of them (they were used just to test the temperature).The temperature in cabins with a vent including those with none, was recorded every 30 minutes by using Tinytag recorders over a one year period. When considered in terms of both day and night temperature, a permanently open vent of 10% the areas of the wall of climate chamber was found to provide on average 2.6 to 3^{o}C difference from the ambient during the growth season. For instance the average of ambient temperature outside of the cabins during August 2012 was 18.52 ^{o}C and the average temperature of climate chamber with 10% vent was 21.5 ^{o}C (Figure 3.5).

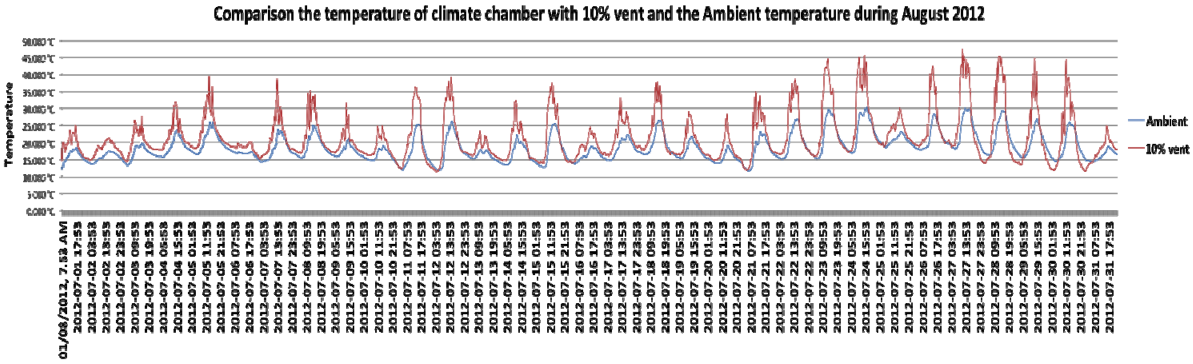

Figure 3. 5 10% vent on the wall of climate chamber provided 2.9 c difference with the Ambient temperature during August 2012

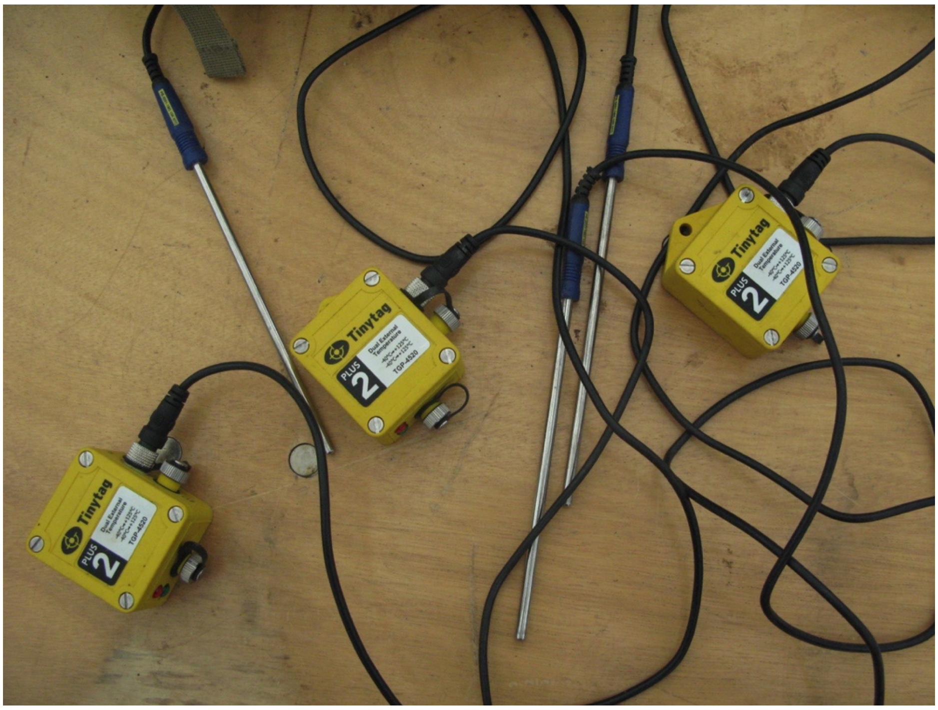

Figure 3. 6 Tanytags and probes to recording the internal temperature

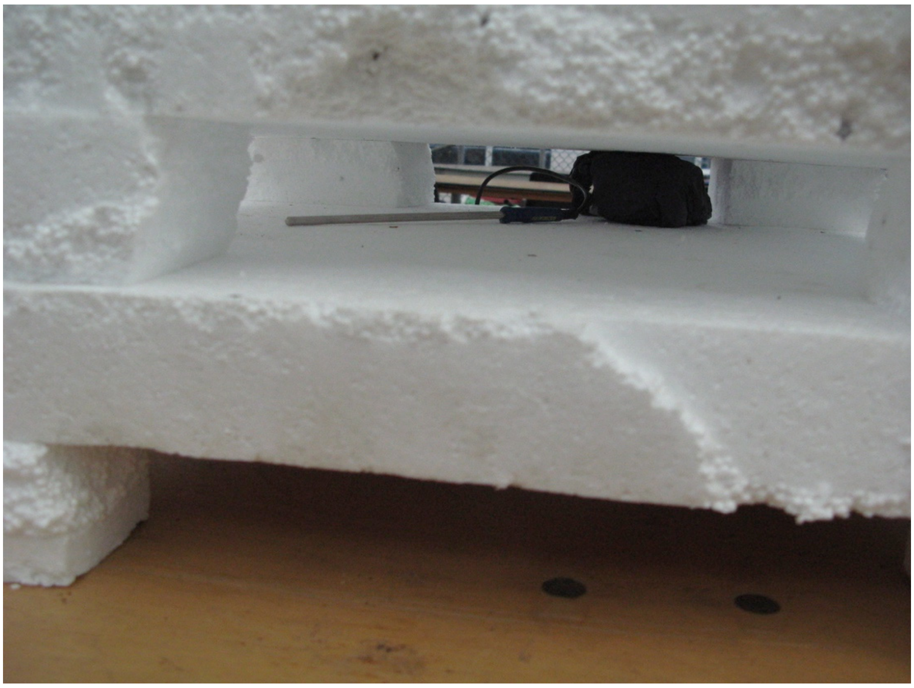

Figure 3. 7 During the temperature calibration tests, the tanytags and probes were kept in a Polystyrene structure screened from direct solar insolation and from contact with warmed surfaces

Figure 3. 8 The temperature inside of climate chambers with different percentage of vent (Ambient, 10%, 15%, 30% and60%) on their wall recorded over the one year

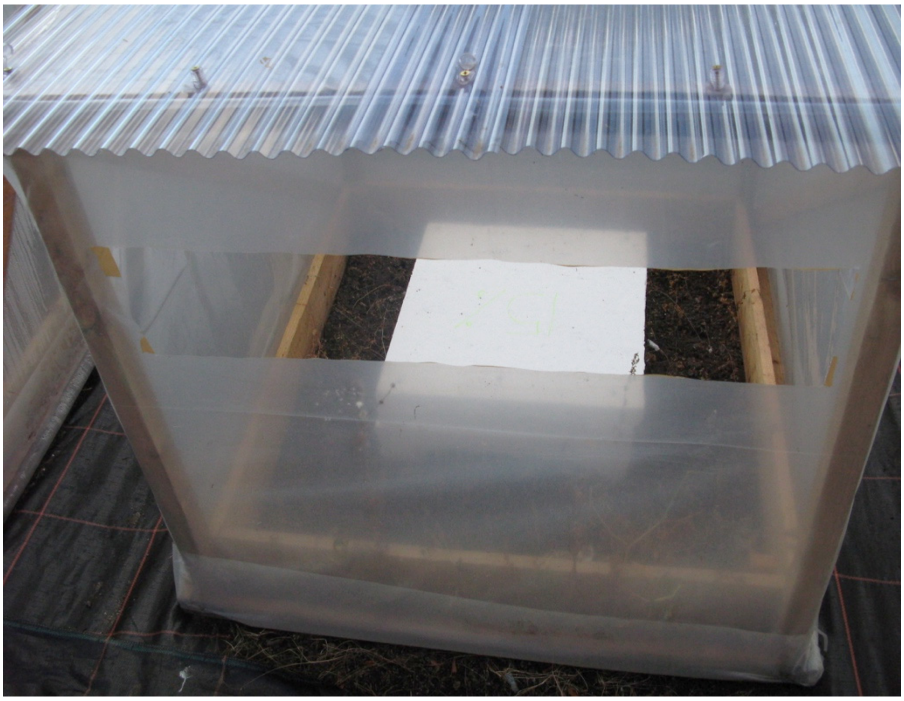

Figure 3.9 10% vent on the wall of climate chamber as chosen to represent the average of 2.5 to 3C difference from the Ambient

Combination of three precipitation and two temperature scenarios leads to a research with six following climate change scenarios:

a. 50% increase in precipitation (Ambient+50%) ; no change in temperature(Ambient)
b. 50% increase in precipitation (Ambient+50%) ;3^{o}C increasing in temperature (Ambient+3^{o}C)
c. Ambient precipitation and ambient temperature
d. Ambient precipitation ; 3^{o}C increasing in temperature (Ambient+3^{o}C)
e. 50% decrease in precipitation (Ambient-50%); no change in temperature (Ambient)
f. 50% decrease in precipitation (Ambient-50%); 3^{o}C increasing in temperature (Ambient+3^{o}C)

Increasing Precipitaion →

Temperature ↓			
	W: Ambient-50% **T: Ambient**	**W:Ambient** **T: Ambient**	**W:Ambient+50%** **T: Ambient**
	W: Ambient-50% **T: Ambient +3°C**	**W:Ambient** **T: Ambient+3°C**	**W:Ambient+50%** **T: Ambient+3°C**

Table 3.5 Different Climate senariose of the experiments

As a result a designed meadow like community of 36 species, were investigated under 6 climate change scenarios , 2 different for harvesting time and 4 replications. It is involved a factorial design with 3 key factors:

i) Water regime
ii) Temperature
iii) Harvest time (year 1 and year 2)

The map of 2 blocks is coming in figure 3.10.

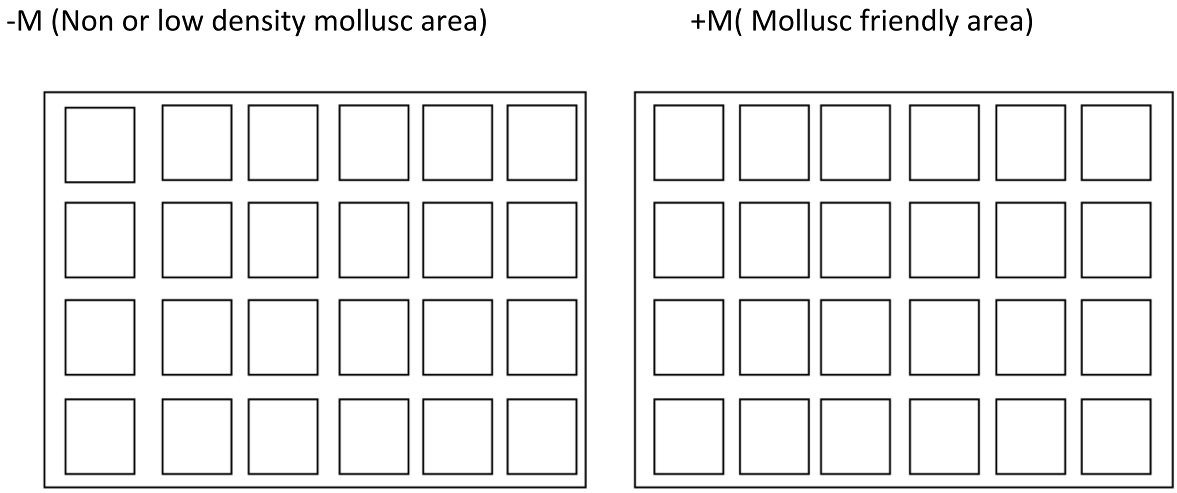

Figure 3. 10 The plan of the plots in the experiment, with the + and - mollusc treatments

Table 3.6 The maps of plots and the ditales of treatments

Precipitation 50% ↑ Temperature ↑ (3 C) Replication 2	Precipitation Ambient Temperature Ambient Replication 1	Precipitation 50% ↓ Temperature ↑ (3C) Replication 2	Precipitation 50% ↑ Temperature ↑ (3C) Replication 4
Precipitation Ambient Temperature Ambient Replication 4	Precipitation 50% ↑ Temperature ↑ (3 C) Replication 3	Precipitation Ambient Temperature ↑ (3C) Replication 3	Precipitation 50% ↓ Temperature Ambient Replication 3
Precipitation 50% ↓ Temperature ↑ (3 C) Replication 3	Precipitation 50% ↓ Temperature Ambient Replication 2	Precipitation 50% ↑ Temperature Ambient Replication 1	Precipitation Ambient Temperature Ambient Replication 3
Precipitation 50% ↑ Temperature Ambient Replication 4	Precipitation Ambient Temperature ↑ (3C) Replication 4	Precipitation Ambient Temperature Ambient Replication2	Precipitation 50% ↓ Temperature ↑ (3C) Replication 2
Precipitation Ambient Temperature ↑ (3C) Replication 2	Precipitation 50% ↑ Temperature Ambient Replication 3	Precipitation 50% ↓ Temperature Ambient Replication 1	Precipitation 50% ↑ Temperature Ambient Replication 4
Precipitation 50% ↓ Temperature Ambient	Precipitation 50% ↓ Temperature ↑ (3C) Replication 1	Precipitation 50% ↑ Temperature ↑ (3C) Replication 4	Precipitation Ambient Temperature ↑ (3C)

Replication 4			Replication 1

3.2.2 Production of plants for the study

The seeds were sown in seedling trays or pots on April 2012 at Sheffield Botanical Garden greenhouse and also in a growth cabinet in the Landscape Department laboratory. Before sowing the seeds, seeds of species which need a period of chilling to germinate, were pre-chilled in small pots of moist compost in a fridge at 2°C for varying durations (6-8 weeks depend on plant species) to ensure that their chilling requirements were sufficiently satisfied to achieve uniform germination in the experiment. The species with hard seed coats used were scarified to allow germination.

Figure 3. 11 Emerged and emerging seedlings prior to transplanting to the growth cabinets

Figure 3. 12   May 2012

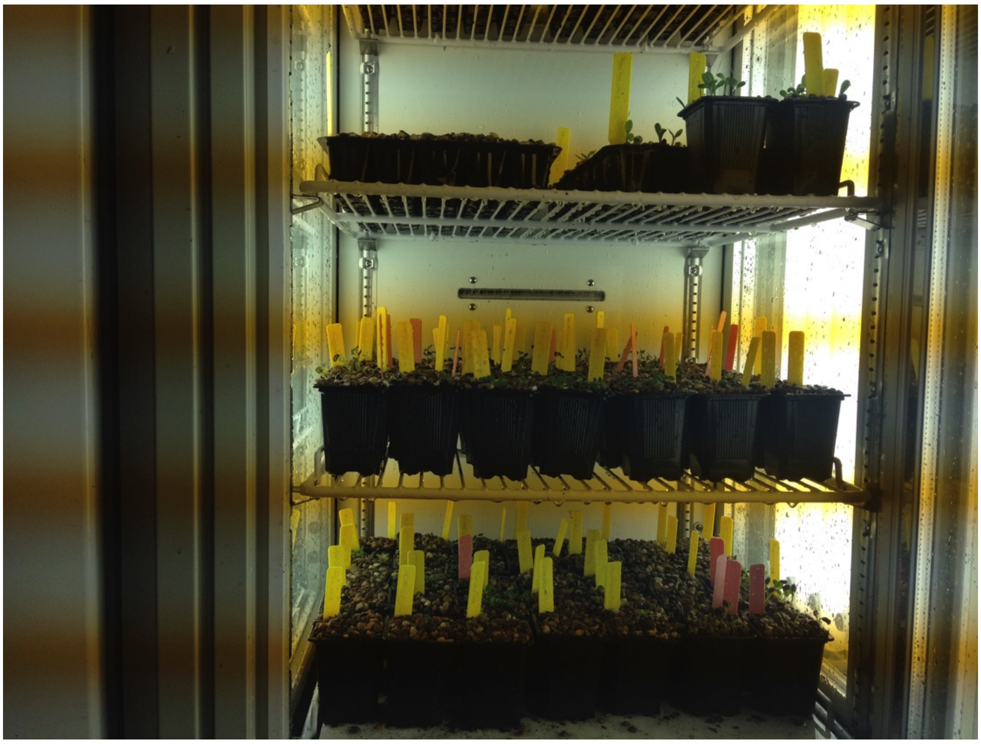

Figure 3. 13   A growth chamber was used to germinate seeds of the most poorly fitted species

Figure 3. 14 Seedling at the end of spring 2012 prior to moving outside

After seeds had emerged and were well established the seedling trays and pots were transferred outside of greenhouse to harden them off.

Figure 3. 15 the seedlings hardening process

Seedlings were transferred to the experimental blocks and in to the plots which were covered with sand layer in surface from June 2012 . At first 8 plant from species were added to the plots after plant establishment, In order to provide uniform conditions for all species and reduce the competition in all treatments, only 4 seedlings from each species.The extra plants of each species were reduced randomly in term of size and growth stage.

Figure 3. 16 Seedlings transferred to the site from June 2012 on

Figure 3. 17 the seedlings in September 2012 at the end of the first growing season

During summer 2012 the seedlings established in the treatment block and at the end of summer all plant species in all plots were cut above the ground level to have uniform and similar species in term of size and growth stage for the next year.

Figure 3. 18 winter 2012

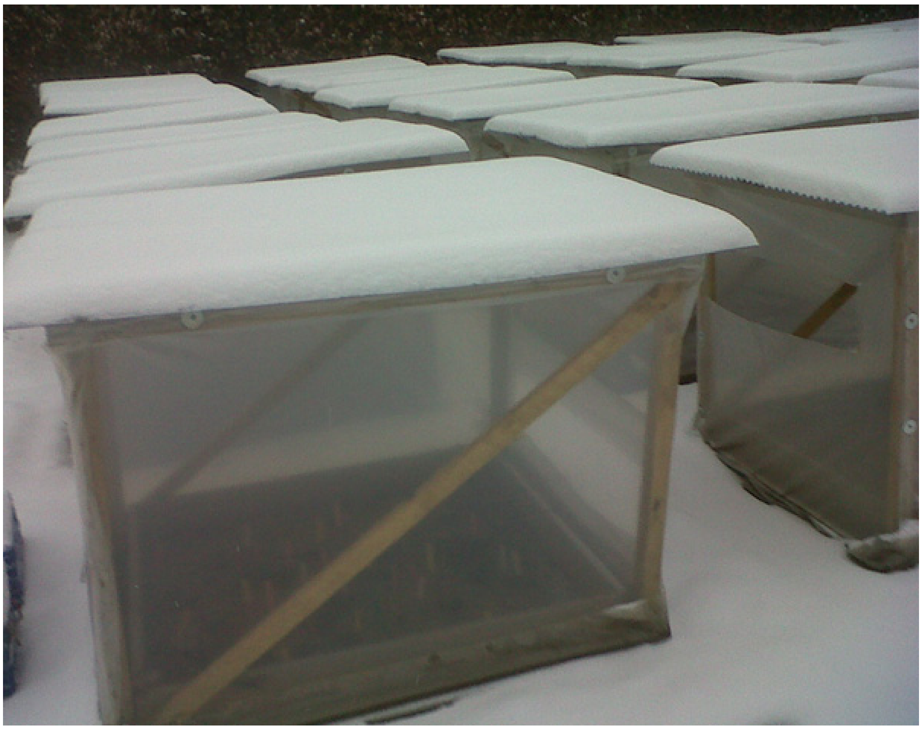

Figure 3. 19 During the winter the species were kept inside the climate cabins without any heating system

From spring 2013 the various water and temperature regimes in the experiment was formally commenced and continued through until November 2014. (See fig. 3, 18-22) and table 3-2.

The experiments was split into two sets blocks(with 24 plots in)each, to look at the effect of mollusc herbivory interacting with the temperature and irrigation treatments(chapter 4).

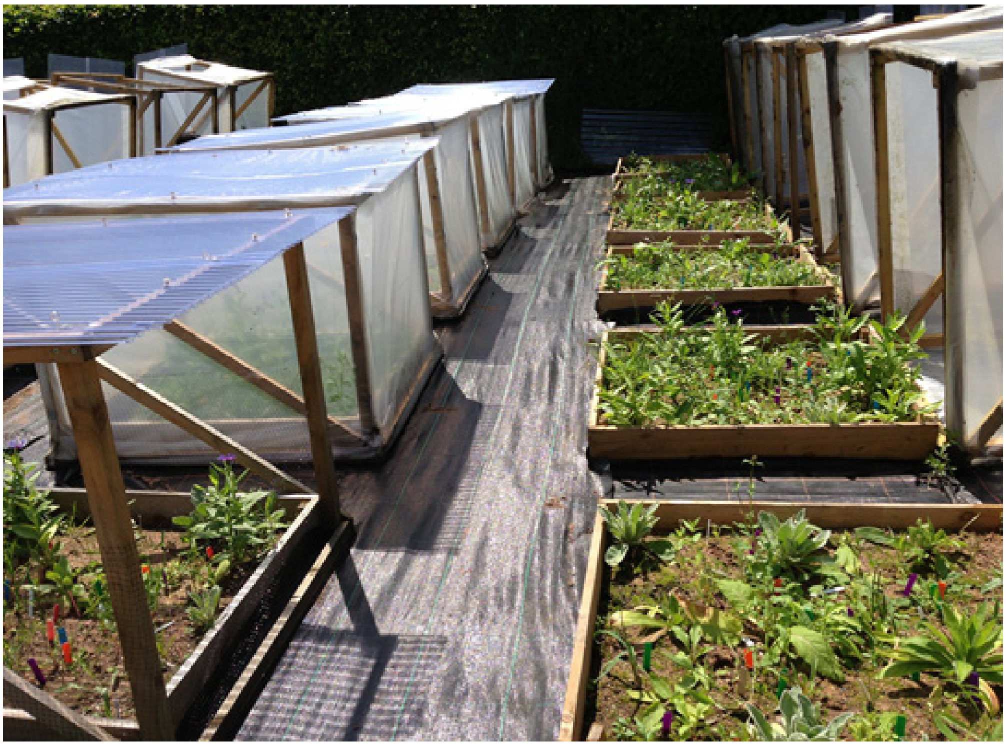

Figure 3. 20 Serious competition between the plants starts in spring 2013

Figure 3. 21 Summer 2013

Figure 3. 22   summer 2014, in an ambient temperature plot

Figure 3. 23 October 2014

3.2.3 Data collection

The productivity of plant species within each plot was recorded from spring 2013 to Autumn 2014. The number of plants of each species in each plot was counted every two-weeks to get the percentage of individual species that disappeared during the observation period.

The plants were harvested in October 2013 after the first growing season. A harvesting procedure was developed to cope with highly variable biomass and species of very different sizes within an individual plot and plant groups, and also to ensure that all plant samples were available for harvest at the end of the summer . Each of the sampled plant species from all species were cut off at a ground level and the cut biomass of each individual plant placed into individual coded envelopes. Samples were dried at ambient temperatures (15-25°C) within a botanical garden greenhouse before being transferred to the oven at 60 C for five days. A similar protocol was utilized in November 2014 after second growth season.

Figure 3. 24 Samples were dried at ambient temperatures in greenhouse for 5 days

Mean dry weights of all species in the experiment for the time period 2013-2014 were used to compare the effect of the climate scenarios on the growth of the sown species both as “fitness” groups (well fitted, intermediate fitted and poorly fitted) and biomass productivity of individual species during the establishment.

3.2.4 Statistical analysis

Statistical analysis was undertaken using SPSS Version21., and advice was provided by Dr Jean Russell from the Students Statistical Support Centre at Sheffield University. Data was initially explored through a variety of statistical approaches, both parametric and non-parametric. This included log e transformation of harvest weight data, and arcsine square root for percentage data to improve the properties of the data sets for parametric analysis, namely distributional characteristics and homogeneity of variance (Zar, 1999). The SPSS data file outputs are provided in the appendices.

3.3 Results

When SE bars overlap in the figures this indicates that, the difference between the two means is not statistically significant ($P>0.05$). In all the graphs which are not involved the factor of “Year” (Year 1 and Year 2) the data used is the mean of biomass productivity over the two years of the study. ,

3.3.1 Response of Species as Plant Fitness Groups

3.3.1.1 Effects of water availability on biomass production within fitness groups

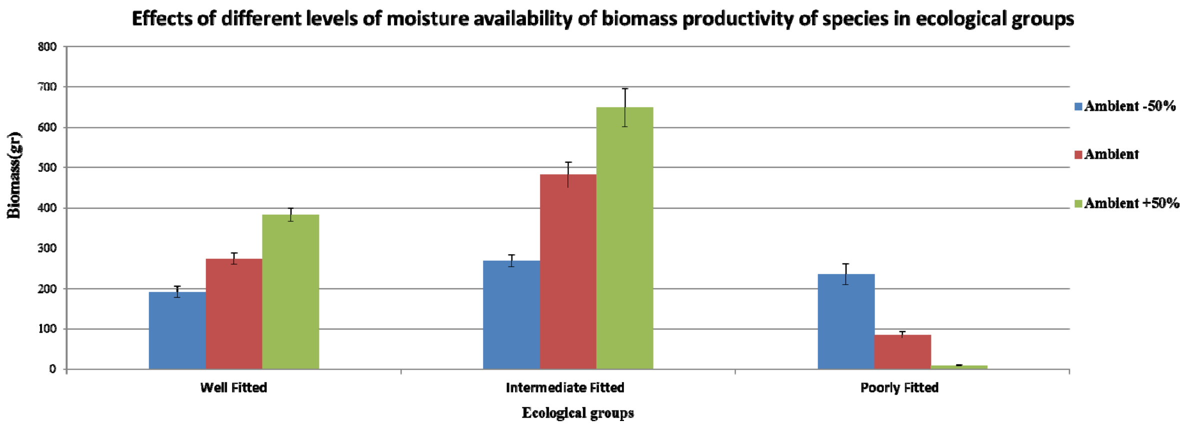

Figure 3. 25 Effect of water regime on biomass of well fitted, Intermediate fitted and poorly fitted ecological groups. Data represents mean of year 1 and year 2.

Among the three groups of plant species the intermediate fitted group, mostly southern to central European near natives showed the highest biomass productivity for all three levels of the moisture availability. This mainly reflects the idiosyncracy inherent in selecting species for these types of experiments, despites attempts to pick species with broadly similar standing biomass characteristics. The UK native plants or well-fitted group whilst having less total biomass show the same biomass production patterns with respect to water moisture availability, as water increases so does biomass. The poorly fitted group, involving species that are typically associated with much warmer more xeric environments show the opposite behavior.

3.3.1.2 Effects of different levels of temperature on biomass production of the ecological groups

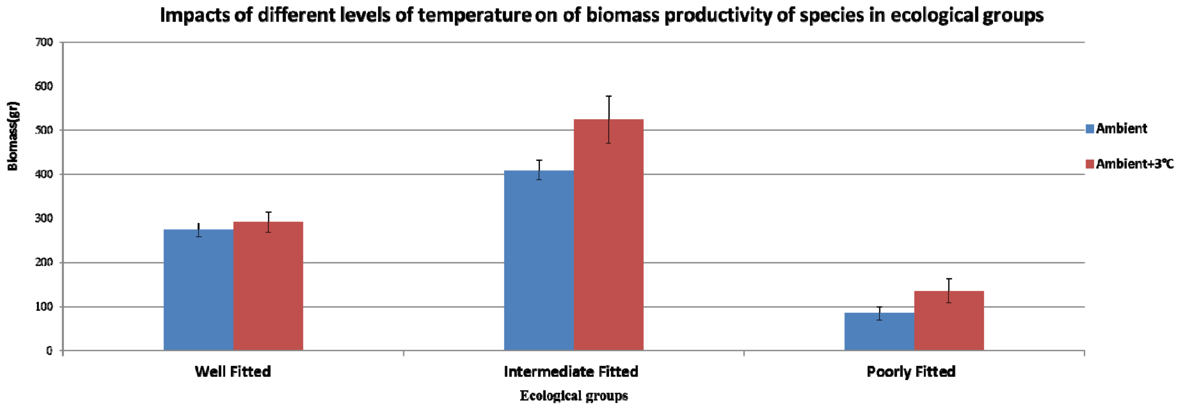

Figure 3.26 Effects of different levels of temperature among well fitted, intermediate fitted and poorly fitted ecological groups. Data represents mean of year 1 and year 2.

Figure 3.26 shows how the intermediate fitted group again has the largest biomass of the three groups, followed by the well fitted group. It is clear that temperature has significant effect on biomass productivity of intermediates and poorly fitted species. Increasing temperature from ambient to ambient +3c enhanced the growth rate of species in all groups. Although it was not significant for well fitted species.

3.3.1.3 comparison biomass productivity of species among the ecological groups over the 2 years

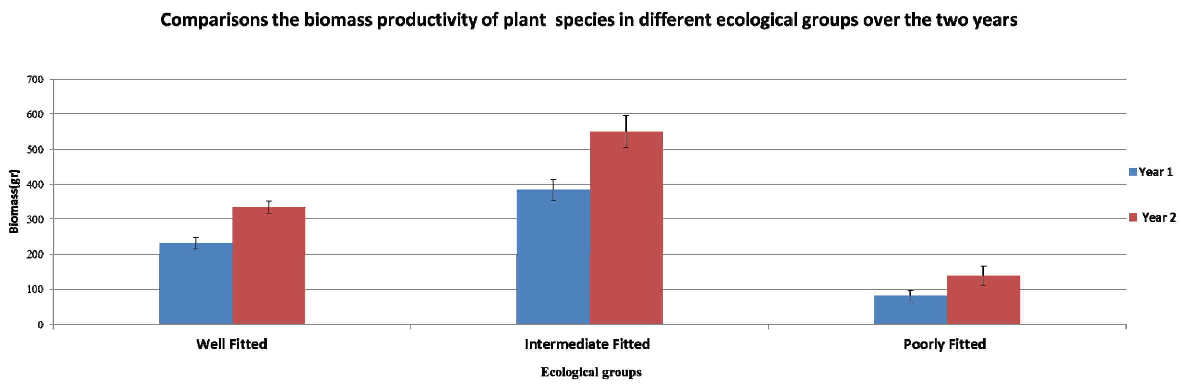

Figure 3. 27 Biomass prodictivity of species among the ecological groups in year 1 and year 2

All the species in all group showed better adaptation after 2 years. They showed significant difference in terms biomass productivity between year 1 and year 2. Intermediate fitted group showed the highest amount of biomass productivity after two years and poorly fitted species provide the lowest biomass after 2 years. Even at the end of year one intermediate fitted species showed better adaptation. They produced more biomass than well fitted and poorly fitted after 1 years (figure 3.26).

3.3.1.4 The effect of moisture availability in combination with different levels of temperature on plant species fitness in terms of biomass productivity among the ecological groups

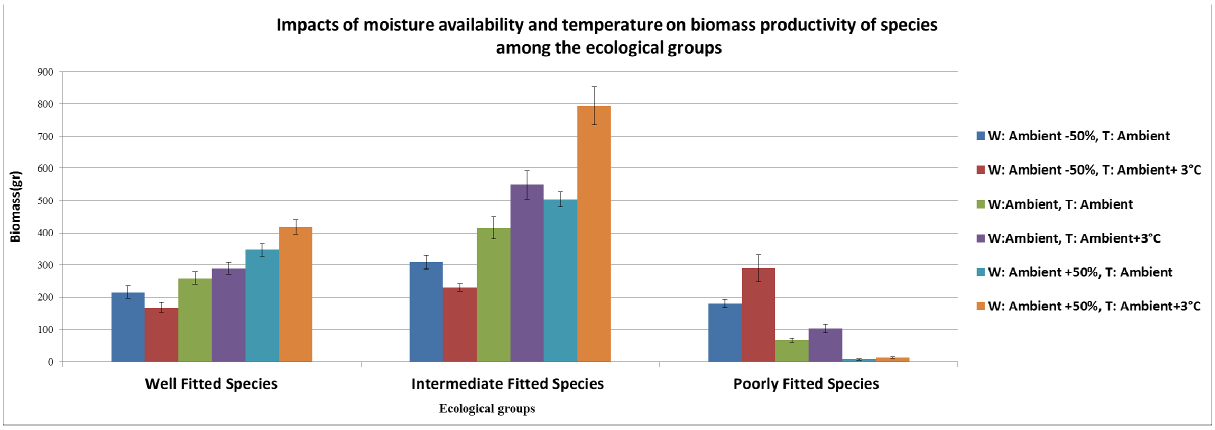

Figure 3. 28 Effects of different levels of moisture and temperature on biomass productivity amongst well fitted, intermediate Fitted and Poorly Fitted groups. Data represents mean of year 1 and year 2.

The well and intermediate fitted group show similar behavior with respect to variation of water and temperature levels. Both of these two groups produce the least biomass when the temperature increases and less moisture is available (W: Ambient -50% & T: Ambient Ambient+3C). However, if the water moisture is ambient, increasing the temperature improves biomass production. The same behavior is seen when both the temperature and available moisture is increased. Overall the highest biomass productivity belongs to the intermediate fitted species when the ambient water and temperature are increased (W: Ambient +50% & T: Ambient Ambient+3°C). The poorly fitted species show the opposite pattern to the other groups. Reducing the available moisture while increasing the temperature leads to higher biomass while increasing the temperature and moisture availability (W: Ambient +50% & T: Ambient Ambient+3°C) severely inhibits biomass production. The observed pattern suggests that the plant species in the poorly fitted group are sensitive to moisture availability and cannot tolerate higher moisture levels. Comparing W: Ambient -50% & T: Ambient and W: Ambient +50% & T: Ambient clearly indicates that how this plant group is affected by high moisture availability. Comparing W: Ambient -50% &

T: Ambient with Ambient -50% & T: Ambient+3°C shows notable increase of the biomass production for the latter.

3.3.1.4.1 Effects of moisture availability and different levels of temperature on well-fitted species in terms of biomass productivity

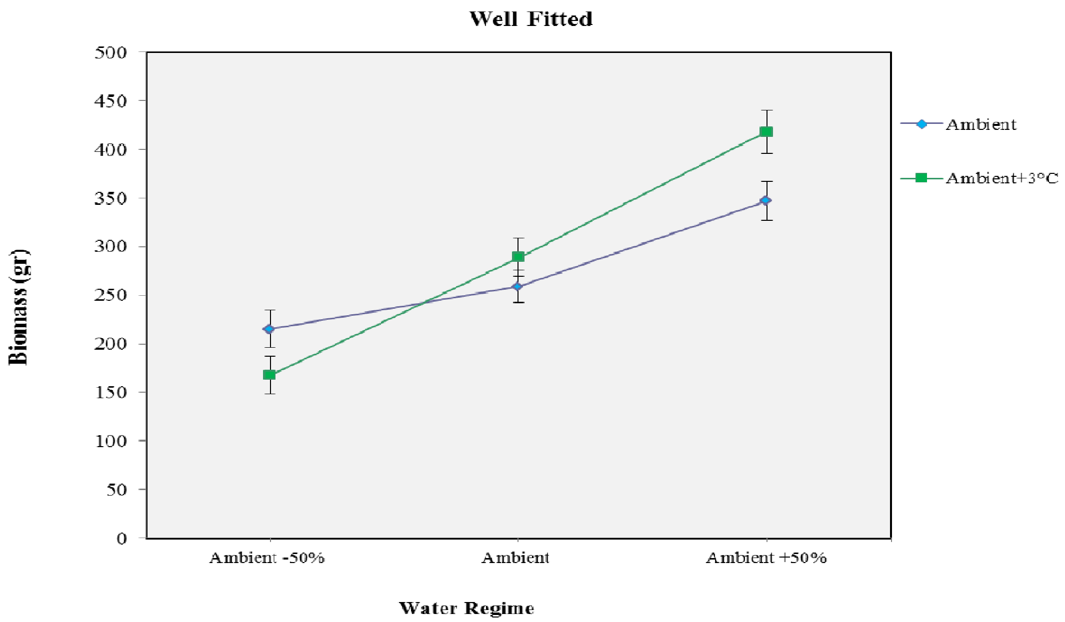

Figure 3. 29 Effects of different levels of moisture and temperature on biomass productivity of well fitted species. Data represents mean of year 1 and year 2.

Increasing temperature improves the biomass production of species in the well fitted group if enough moisture is available. Reducing water available with increase in temperature of Ambient +3°C reduces the biomass production. Increasing water available wth increased temperature has the opposite effect of boosting biomass.

3.3.1.4.2 Effects of moisture availability and different levels of temperature on intermediate fitted species in terms of biomass productivity

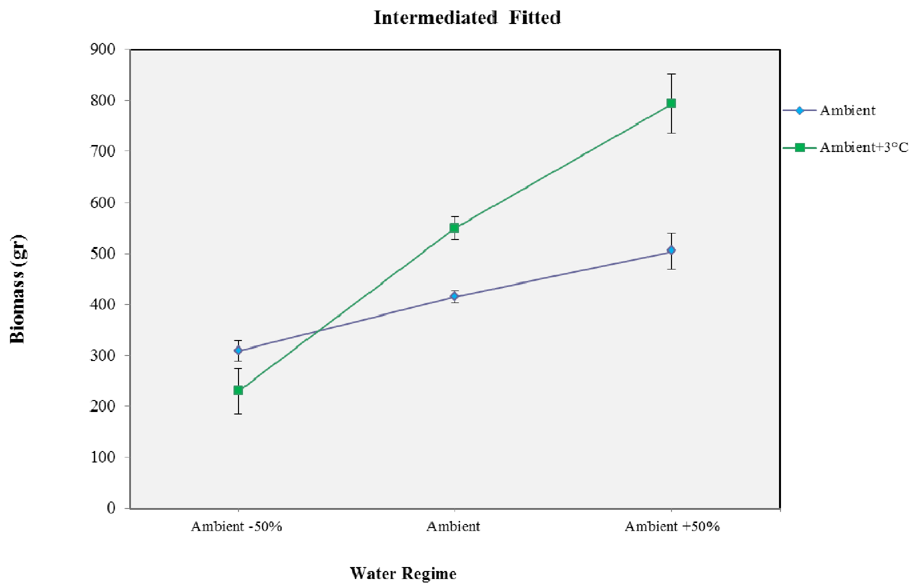

Figure 3. 30 Effects of different levels of mositure and temperature on biomass productivity of Intermediate fitted species. Data represents mean of year 1 and year 2.

The plant species in the intermediate fitted group show similar behavior to the well-fitted group. However, the slope of increase in the biomass production levels under Ambient +3°C is much higher compared to the well fitted group, suggesting these species of warmer habitats are more able to respond to elevated temperatures, and become more potentially dominant in communities under these conditions.

3.3.1.4.3 Effects of moisture availability and different levels of temperature on poorly fitted species in terms of biomass productivity

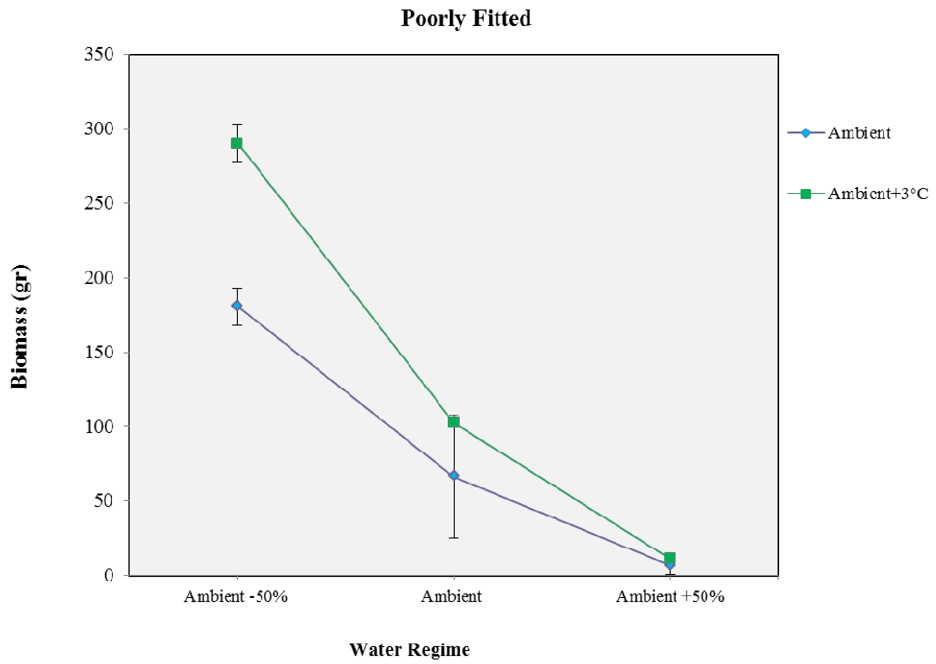

Figure 3. 31 Effects of different levels of moisture and temperature on biomass productivity of poorly fitted species. Data represents mean of year 1 and year 2.

The species in this group show the complete opposite trend compared to the plant species in the well and intermediate fitted groups with biomass in increasing in response to temperature at the ambient and ambient -50% available moisture treatments. This is presumably because these species are adapted to soils with low or transient levels of abundant moisture and are either highly sensitive to reduce oxygen in soils or are being affected by root pathogens at these elevated moisture conditions.

3.3.1.5 Comparison the effects of water regime on biomass productivity of species among the ecological groups in the first and second year of the study.

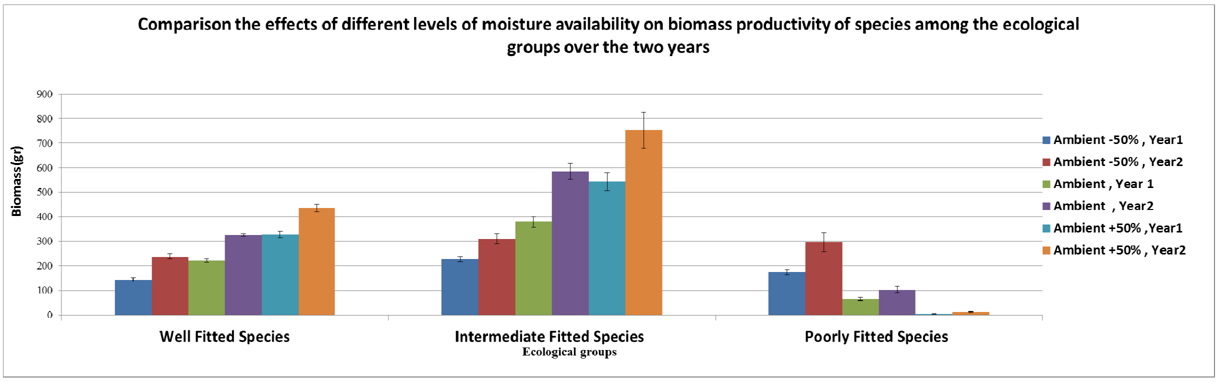

Figure 3. 32 Effects of water regime on biomass productivity of species among the ecological groups. Data represents mean of all temperature treatments.

This graph demonstrates, as would be expected, that all three different plant groups have higher biomass production in the year 2 compared to the year one. The exception is the poorly fitted group that can not tolerate increasing level of available moisture beyond Ambient -50% and hence biomass production is greatly reduced by increasing available moisture. This data is however useful as it gives a longer term view of these responses

3.3.1.6 Comparison of the effects of different levels of temperature on biomass productivity of species among the ecological groups in year 1 and 2 of the study. Data represents mean of all water treatments.

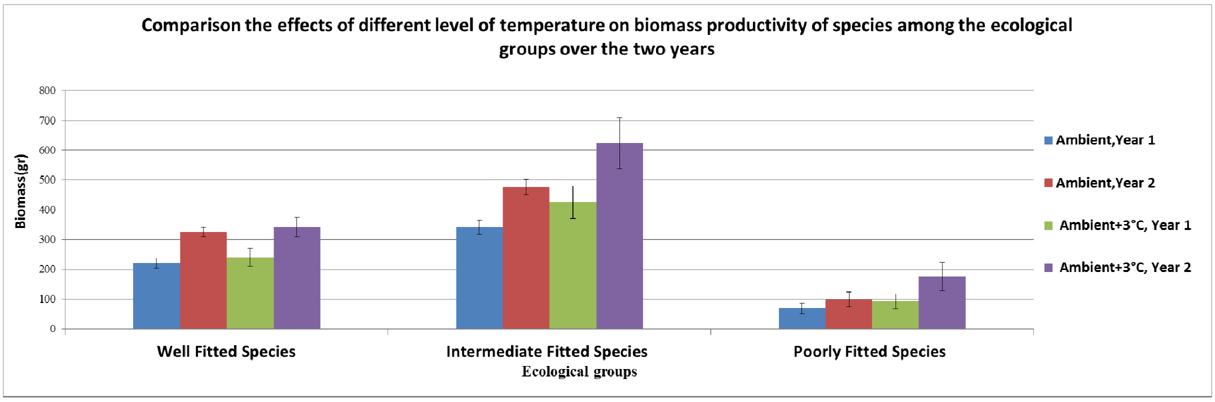

Figure 3. 33 Effects of different levels of temperature on biomass productivity of species among the ecological groups in year 1 and 2 .The Intermediate Fitted Species show the highest biomass production.

This figure shows positive effect of increasing temperature, ambient +3C, on the plants growth. All three groups of well, intermediate and poorly fitted have higher biomass production when they are exposed to the warmer environment. They also show that biomass productivity is higher for year 2 compared to the year 1, although not statistically so in all comparitors.

3.3.1.7 impacts of interaction between moisture availability and different levels on temperature on biomass productivity of species among the ecological groups in year 1 and 2.

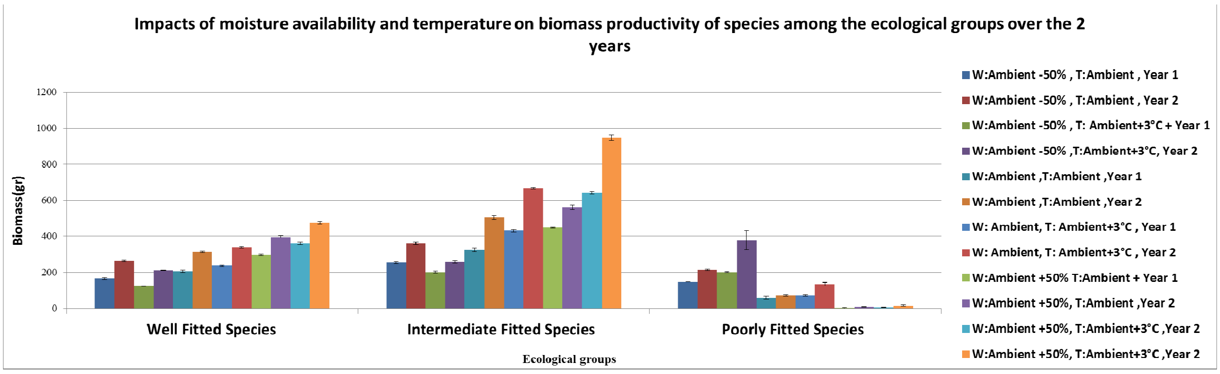

Figure 3. 34 Effects of moisture availability and different levels of temperature on biomass productivity of species among the ecological groups over the 2 years

The graph compares how combination of the water and temperature treatments affects the biomass production among the three plant groups. In particular it highlights the extreme responses, what resulted in the lowest and highest levels of biomass. The overall pattern is similar to what was observed in the previous graphs, with the very lowest levels of biomass associated with the increased water and ambient temperature regime in the least fitted species.

3.3.2 Response of species to the inviromental factors as individual

3.3.2.1 Response of species to the to water regime in term of biomass

3.3.2.1.1 Well Fitted Species

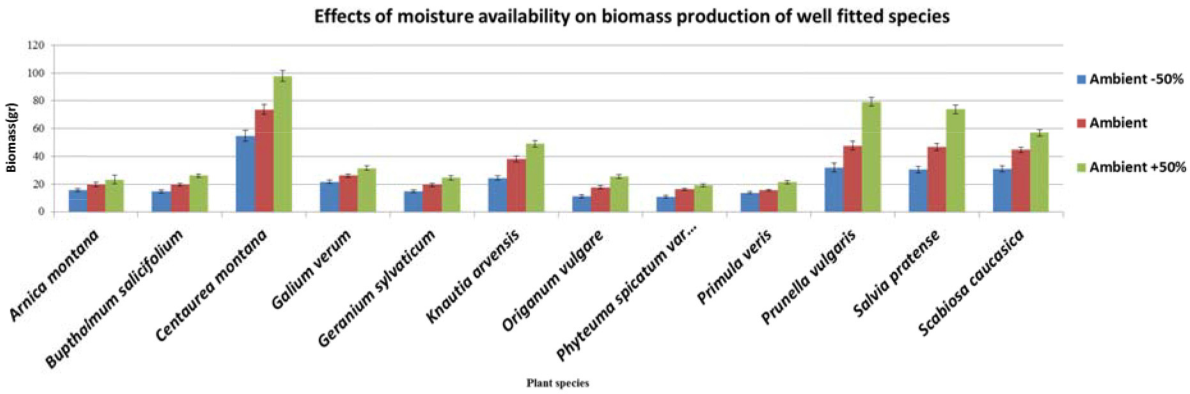

Figure 3.35 Effect of moisture availability on the biomass (gr) productivity among the plant species in the well fitted . Data represents mean of temperature treatments and the mean of year 1 and year 2.

This figure shows how different plant species in the well-fitted group have reacted to the water treatments in this research. As shown six plant species stand out from others, producing more biomass under all of the three water treatments; *Centaurea montana, Galium verum, Knautia arvensis, Prunella vulgaris, Salvia pratense,* and *Scabiosa caucasica.* For all of these species Ambient +50% leads to higher biomass production. Among all of plants in this group the highest biomass production belongs to *Centaurea montana.*

3.3.2.1.2 Intermediate Fitted Species

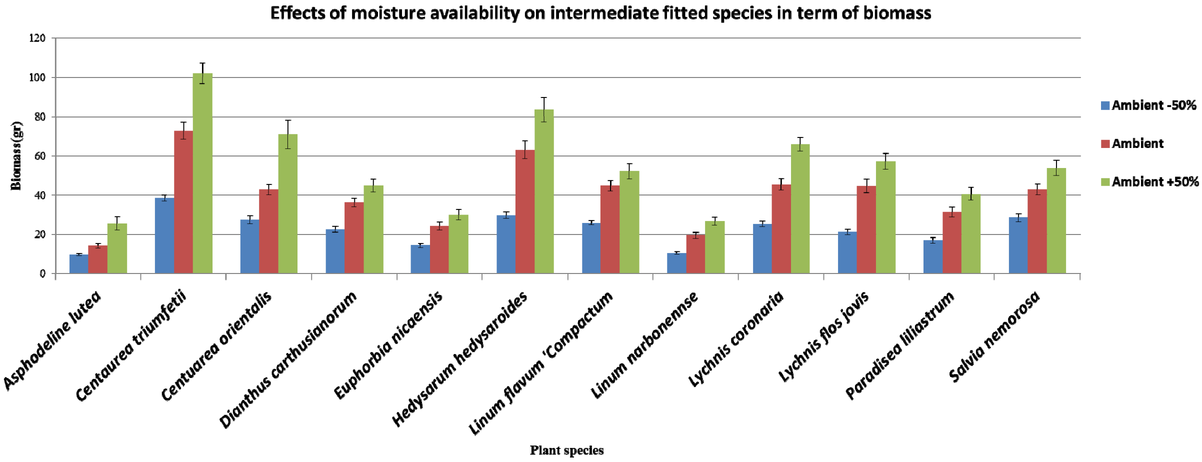

Figure 3. 36 Effect of moisture availability on the biomass productivity among the plant species in the intermediate fitted group Data represents mean of temperature treatments and the mean of year 1 and year 2.

Eight species produce notably greater amount of biomass under all of three moisture treatments including; *Centaurea triumfetii*, Centaurea orientalis, *Dianthus carthusinorum*, *Hedysarum hedysaroides*, Linum flavum Compactum, Lychnis cornonoria, Lychnis flos jovis and *Salvia nemorosa*. The highest biomass yield in this group belongs to *Centaurea triumfetii*. This trend is similar and within the same range of its peer species in the well fitted group; *Centaurea montana*.

3.3.2.1.3 Intermediate Poorly Species

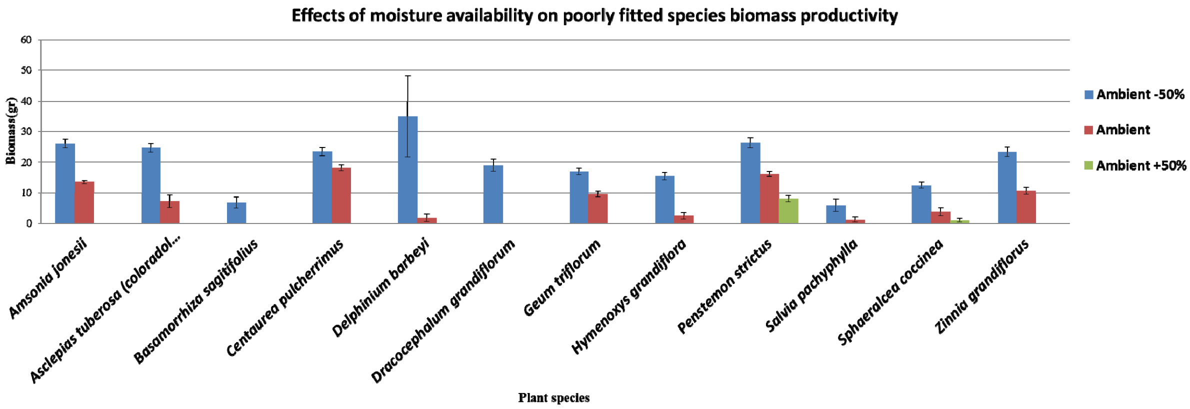

Figure 3. 37 Effect of moisture availability on the biomass productivity among the plant species in the poorly fitted group Data represents mean of temperature treatments and the mean of year 1 and year 2

Almost all species disappeared when the water availability levels reach Ambient +50% within this poorly fitted group. There is some capacity to produce biomass if the moisture level remains on the Ambient level. The highest amount of growth belongs to Ambient -50%. In this group six of the twelve plant species show notable growth under Ambient -50% treatments. They include; *Amsonia jonesii, Asclepias tuberosa (Coloradol form), Centaurea pulcherrimus, Delphinium barbeyi, Penstemon strictus* and *Zinnia grandiflora*. Clearly on average the overall biomass production for this group of plants is notably lower compared to the well-fitted and intermediate ones. These species are as predicted clearly less adapted compared the 2 other groups to uk climate.

3.3.2.2 Response of plant species to different levels of temperature in terms of biomass productivity:

3.3.2.2.1 Well Fitted Species

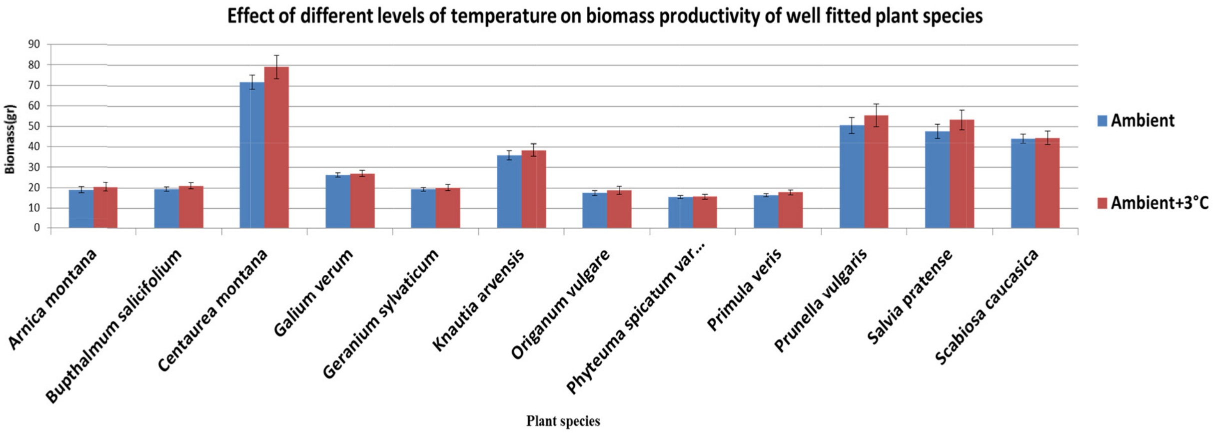

Figure 3. 38 Effect of temperature on the biomass (gr) productivity of plant species in the well fitted group Data represents mean of temperature treatments and the mean of year 1 and year 2

This graph demonstrates how the well-fitted group plants have responded to increasing much less to temperature than they do to water availability . Although an increase in biomass production levels is observed for some species in this group, few dramatic increase, and few statistically significant differences can be seen for any of the species in this group due to changing the temperature level to Ambient +3C.

3.3.2.2.2 Intermediate Fitted Species

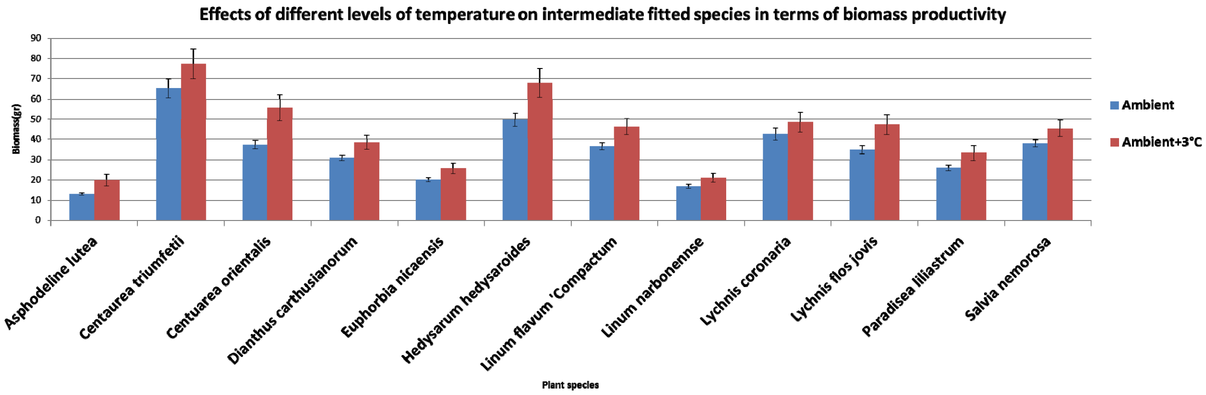

Figure 3. 39 Effect of temperature on the biomass productivity of plant species in the intermediate fitted group Data represents mean of temperature treatments and the mean of year1 and year 2

The response of species in the intermediate fitted group with respect to increasing the temperature to Ambient +3°C is shown in this graph., is much greater with clear statistical differences between the two temperature regimes in every species.

3.3.2.2.3 Poorly Fitted

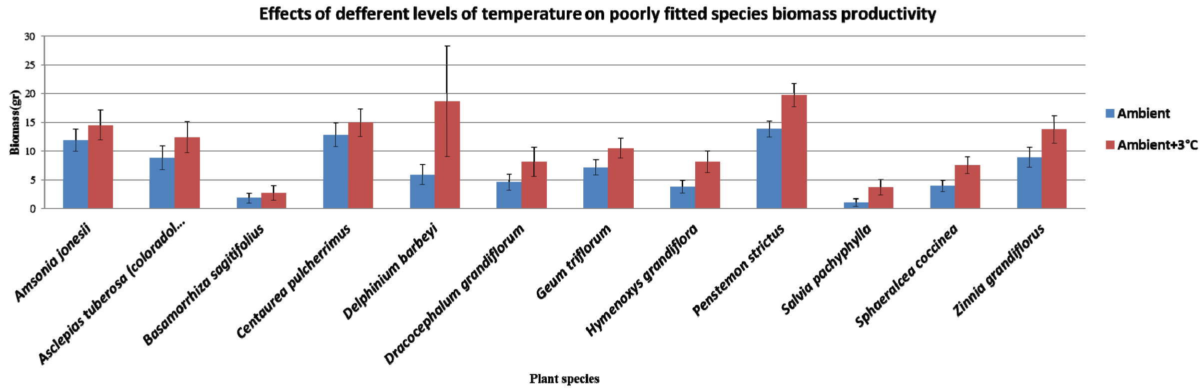

Figure 3.40 Effect of temperature on the biomass productivity of plant species in the intermediate fitted group Data represents mean of temperature treatments, and the mean of year on and year 2

When the level of moisture availability is ambient increasing the temperature did not made a drastic increase in the amount of biomass production in the poorly fitted group. Among these species *Delphinium barbeyi* shows a sharp increase, however high standard deviation make it difficult to attribute this increase solely to Ambient +3°C. Overall the poorly fitted group has a higher level of biomass productivity with increasing the temperature under the experimental conditions (figure 3.40), with some significant differences shown.

3.3.2.3 Differences in productivity of species over the 2 years

3.3.2.3.1 Well fitted species

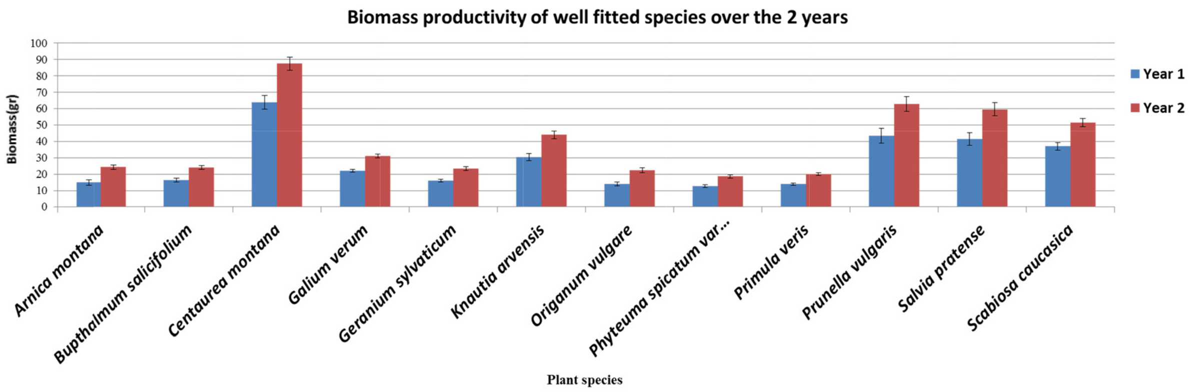

Figure 3. 41 Productivity of Well fitted species over the 2 years as mean of all treatments.

The biomass production levels in during the year 1 and 2 of the experiments are shown in above figure. Slight increase in the biomass productivity is seen for all of the well-fitted group species, nevertheless there is no sharp increase for any of these plant species. Highest amount of the biomass productivity in both years belong to *Centaurea montana* while *Phyteuma spicatum var caeruluem* has the least biomass productions. *Prunella vulgaris* and *Salvia pratense* are plant species in 2nd and 3rd place of biomass production among the twelve plants that were evaluated in this group.

3.3.2.3.2 Intermediate fitted species

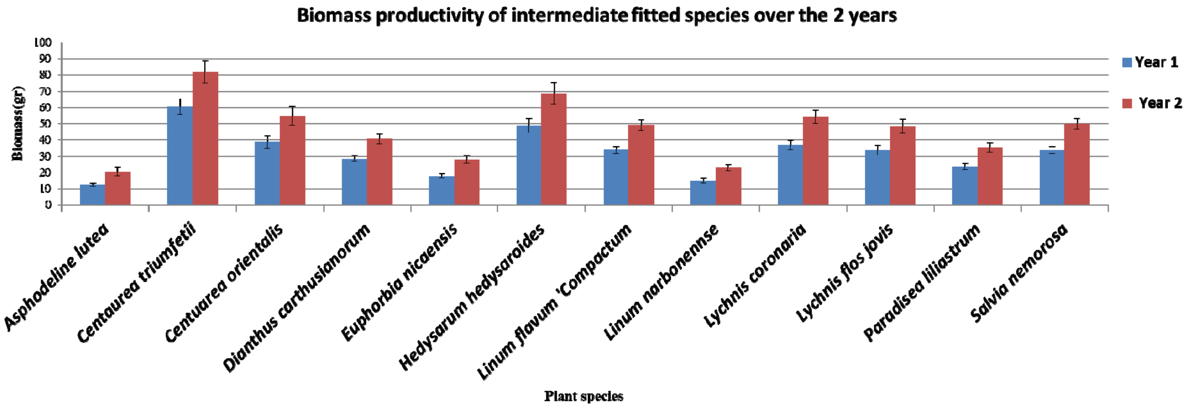

Figure 3. 42 Productivity of Intermediate fitted species over the 2 years as mean of all treatments.

The plant species in the intermediate fitted group are no exception and show compatible biomass productivity behavior to the well fitted group with respect to time, Year 1 and 2. All of these species show a notable but not drastic increase in the amount of the biomass production.

3.3.2.3.3 Poorly Fitted Species

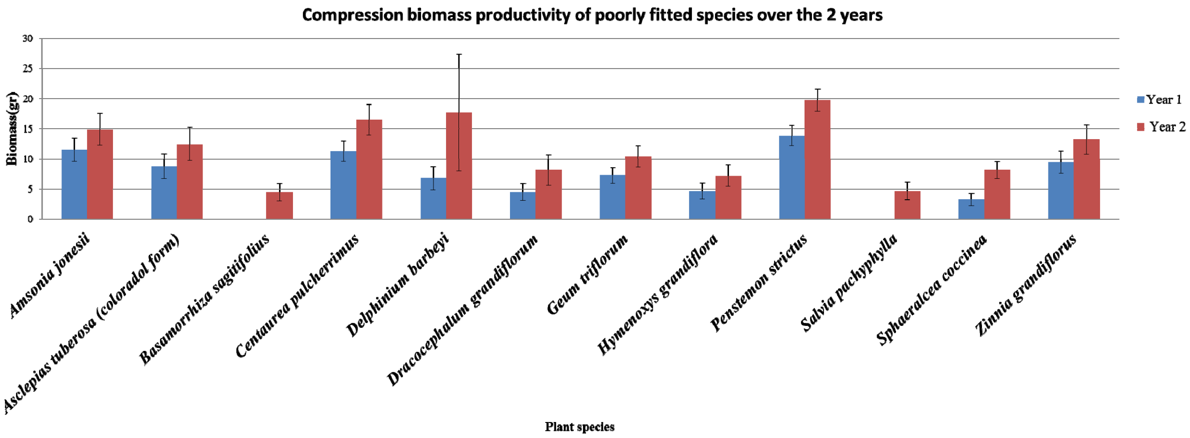

Figure 3. 43 Biomass productivity of Poorly fitted species over the 2 years. This figure displays how the plants in the poorly fitted group have grown in year 1 and 2 of the experiments.

The plant species in the poorly fitted group show the same pattern as the other two groups, however the amount of biomass produced is much reduced, typically only one third of that in the other two groups. Biomass yield in year 2 was higher than year 1. Species that did no survival in first year were re- sown in the spring of the second year (*Balsamorrhiza sagitifolius* and *Salvia pachyphylla*).

3.3.2.4 Response of plant species to moisture availability × temperature in terms of biomass

3.3.2.4.1 well-fitted species

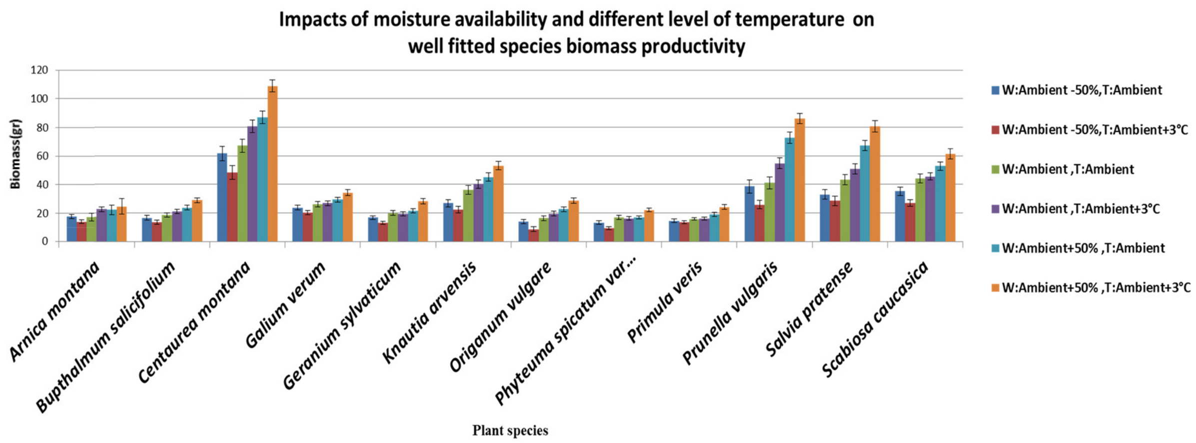

Figure 3. 44 Effects of water regimes and different levels of temperature on biomass (gr) productivity of Well fitted species. Data represents mean of year 1 and year 2.

The highest biomass yield belongs to combined effects of W: Ambient +50% and T: Ambient +3°C. This suggest that native and near native plants will grow better and produce more biomass when temperature increases and more water becomes available (to compensate the increased evaporation rate). The lowest amount of the biomass productivity belongs to when the available moisture is reduced, W: Ambient -50%, but the temperature increases, Ambient +3°C. This also suggests that these plant species are water sensitive and reducing available moisture combined with increasing the temperature will hamper plant growth. *Centaurea montana* is the plant species that provides the highest biomass under all of the treatment conditions

3.3.2.4.1.1 Well fitted species by species

The following figures show how temperature and water treatments affect the plant species in the well fitted group. As seen *Arnica montana*, *Bupthalmum salicifolium, Centaurea montana, Galium verum, Knautia arvensis, Origanum vulgare* and *Prunella vulgaris* Ambient temperature produces more biomass at the Ambient-50% moisture. With increasing the moisture availability more biomass is produced when these species are exposed to Ambient +3°C. For *Geranium sylvaticum*, *Phyteuma spicatum* var. *caeruluem, Primula veris* and *Scabiosa caucasica* though these species produce the same range of biomass for both of the temperature treatments when they are exposed to Ambient moisture, however, the growth slope for these species, like the latter ones is considerably steeper when they are exposed to Ambient +3°C.

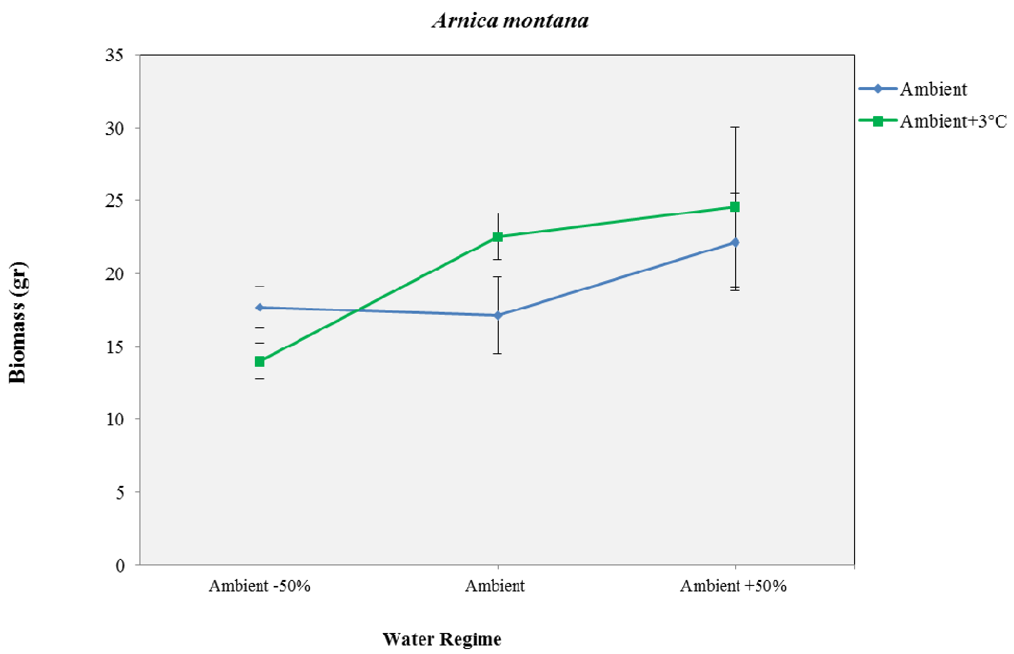

Figure 3. 45 Effect of water regime and different levels of temperature on biomass productivity of *Arnica montana* . Data represents mean of year 1 and year 2.

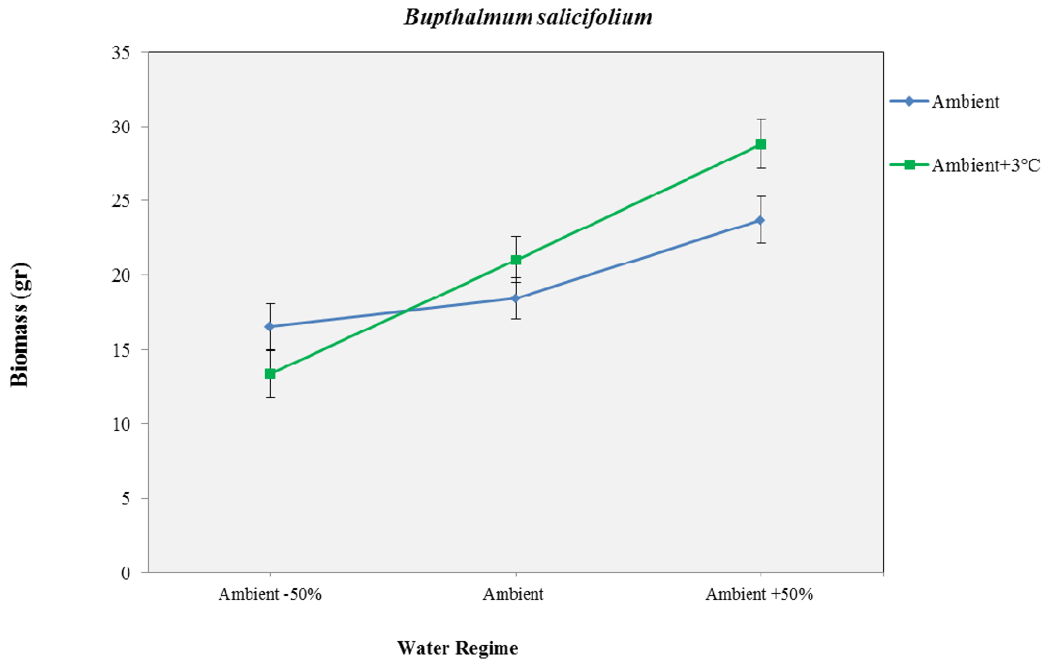

Figure 3. 46 Effects of water regimes and different levels of temperature on biomass productivity of *Bupthalmum salicifolium* . Data represents mean of year 1 and year 2.

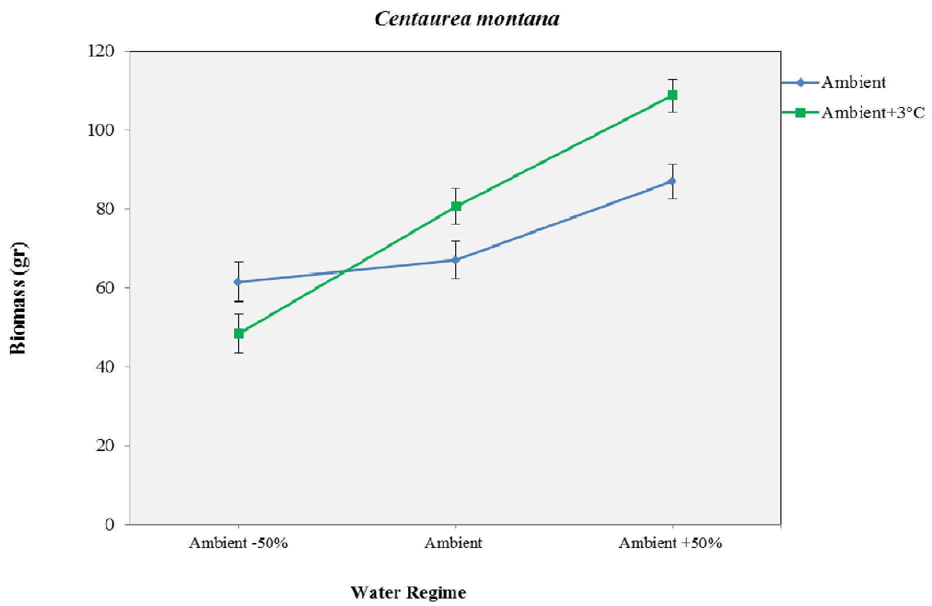

Figure 3.47 Effects of water regimes and different levels of temperature on biomass productivity of *Centaurea montana.* Data represents mean of year 1 and year 2.

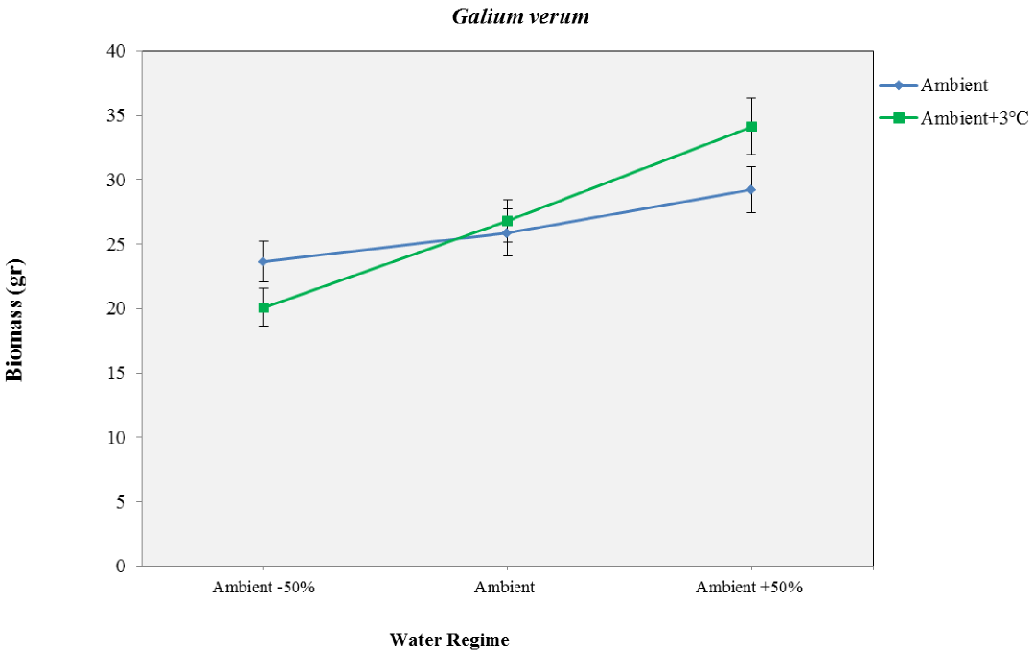

Figure 3. 48 Effect of water regime and different levels of temperature on biomass productivity of *Galium verum* Data represents mean of year 1 and year 2.

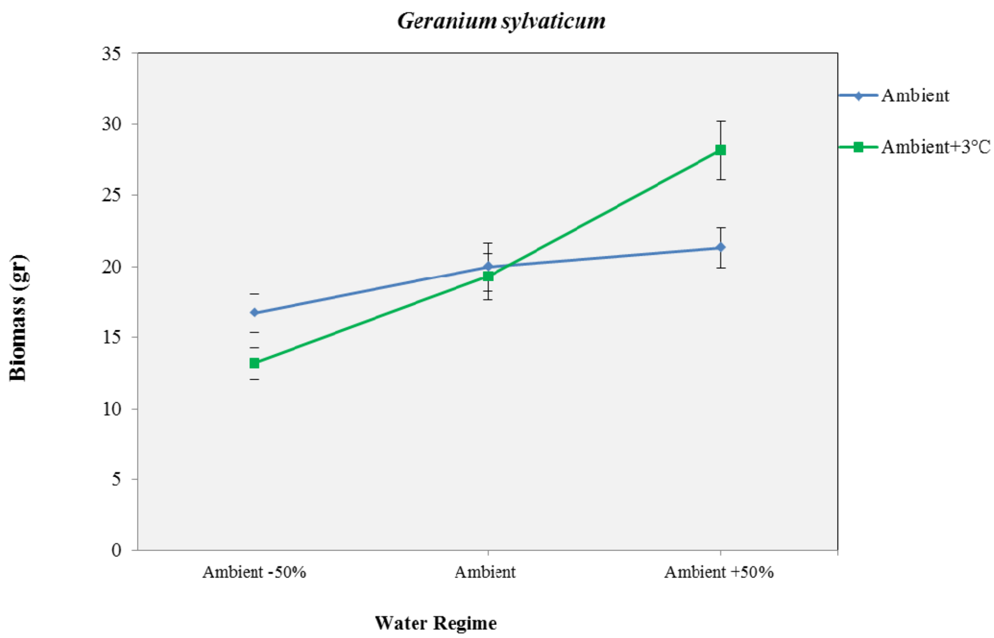

Figure 3. 49 Effect of water regime and different levels of temperature on biomass productivity of *Geranium sylvaticum* Data represents mean of year 1 and year 2.

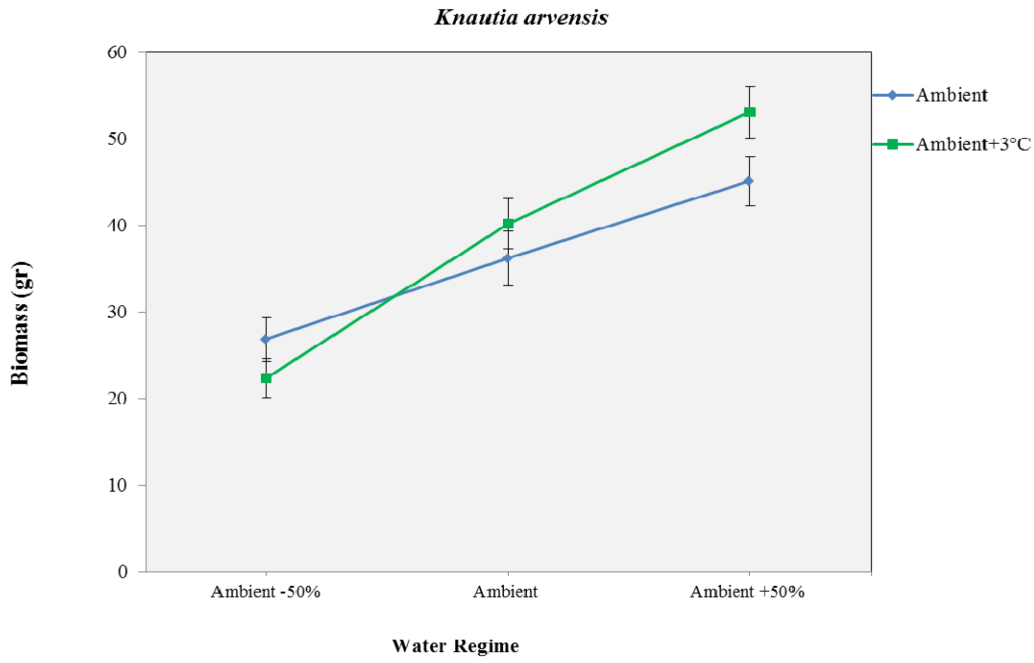

Figure 3. 50 Effects of water regime and different levels of temperature on biomass productivity of *Knautia arvensis* Data represents mean of year 1 and year 2.

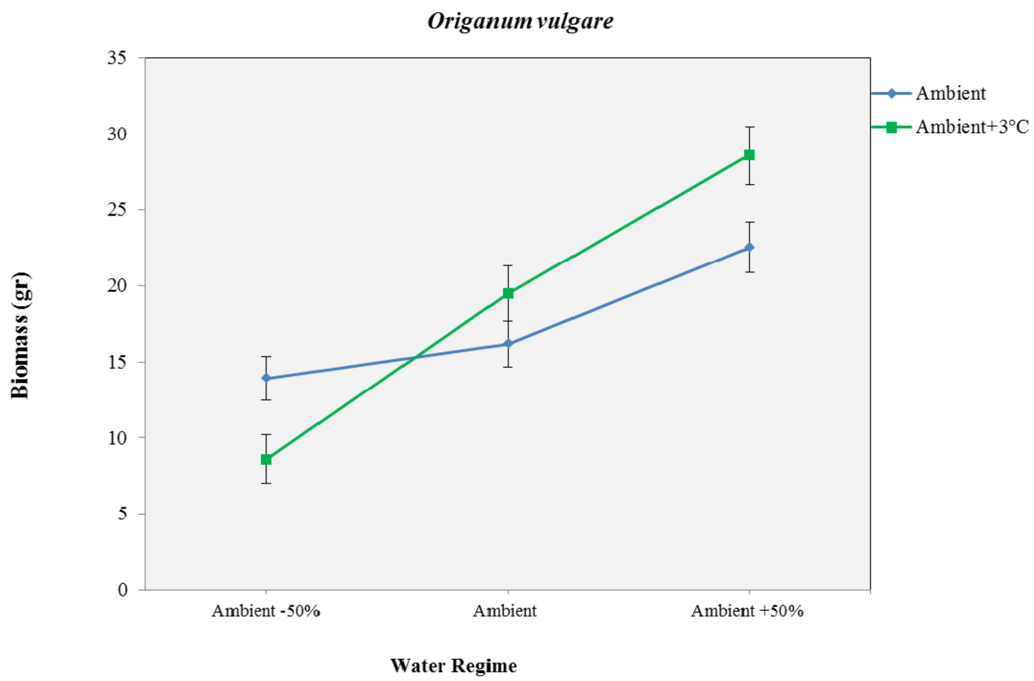

Figure 3. 51 Effects of water regime and different levels of temperature on biomass productivity of *Origanum vulgare* Data represents mean of year 1 and year 2.

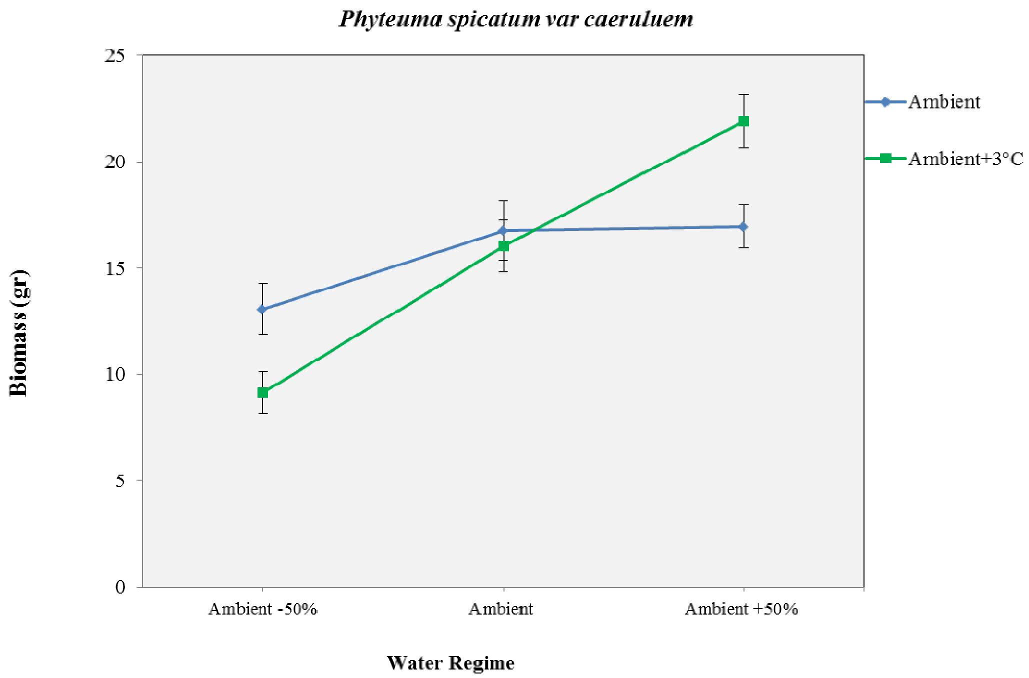

Figure 3. 52 Effect of water regime and different levels of temperature on biomass productivity of *Phyteuma spicatum* Data represents mean of year 1 and year 2.

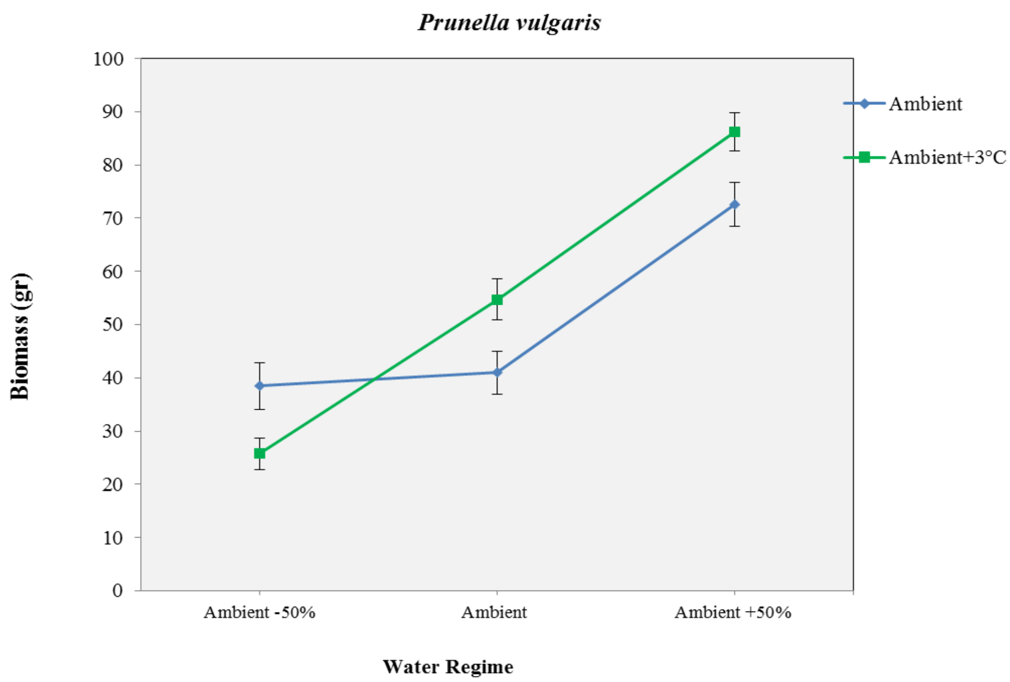

Figure 3. 53 Effect of water regime and different levels of temperature on biomass productivity of *Primula veris*. Data represents mean of year 1 and year 2.

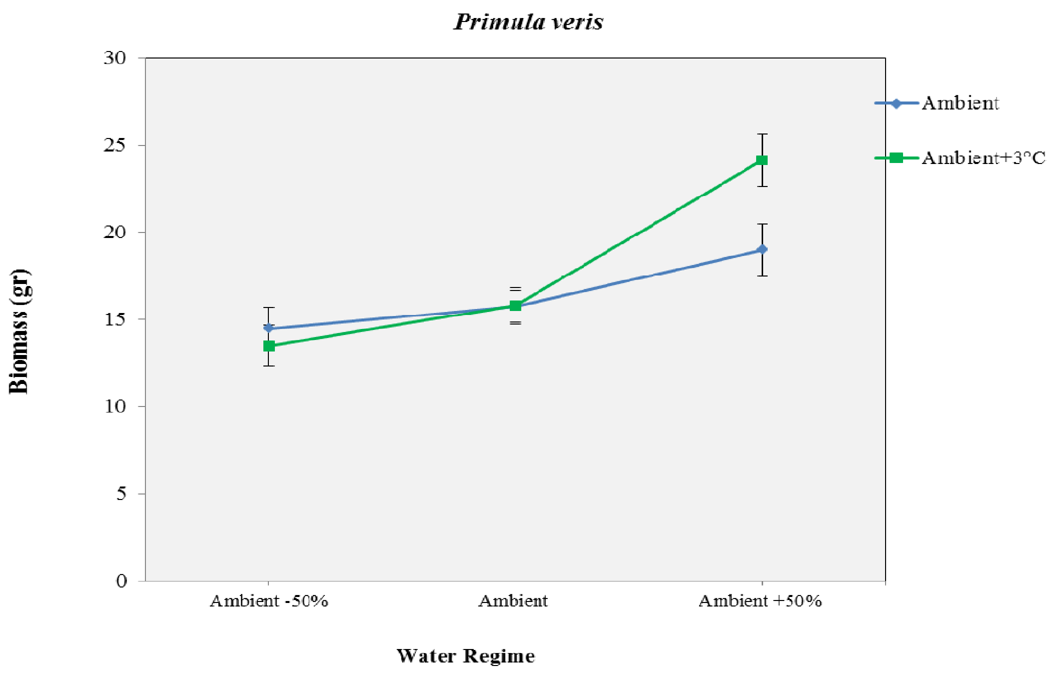

Figure 3. 54 Effect of water regime and different levels of temperature on biomass productivity of *Prunella vulgaris*. Data represents mean of year 1 and year 2.

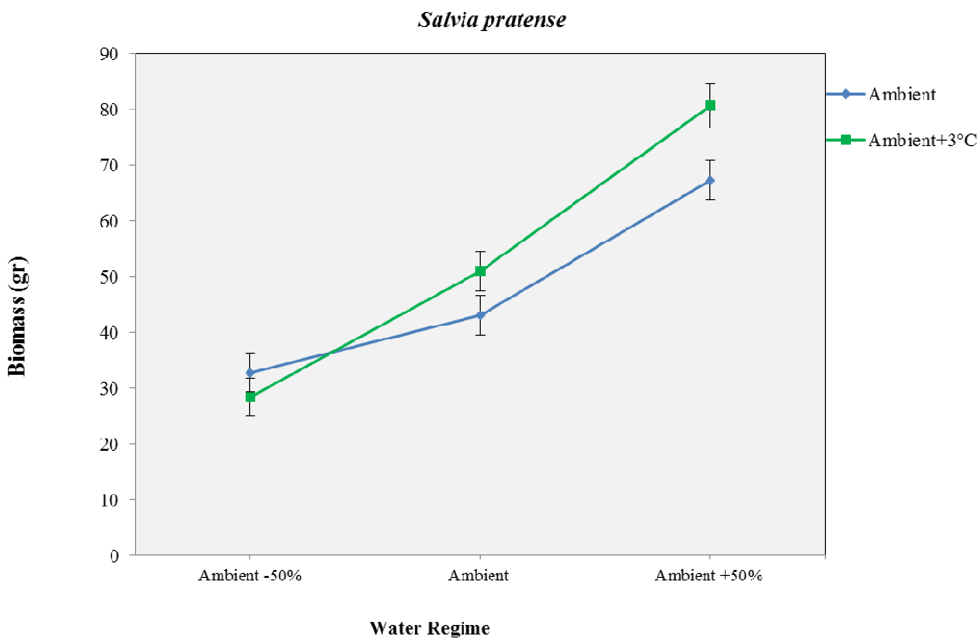

Figure 3. 55 Effect of water regime and different levels of temperature on biomass productivity of *Salvia pratense.* Data represents mean of year 1 and year 2.

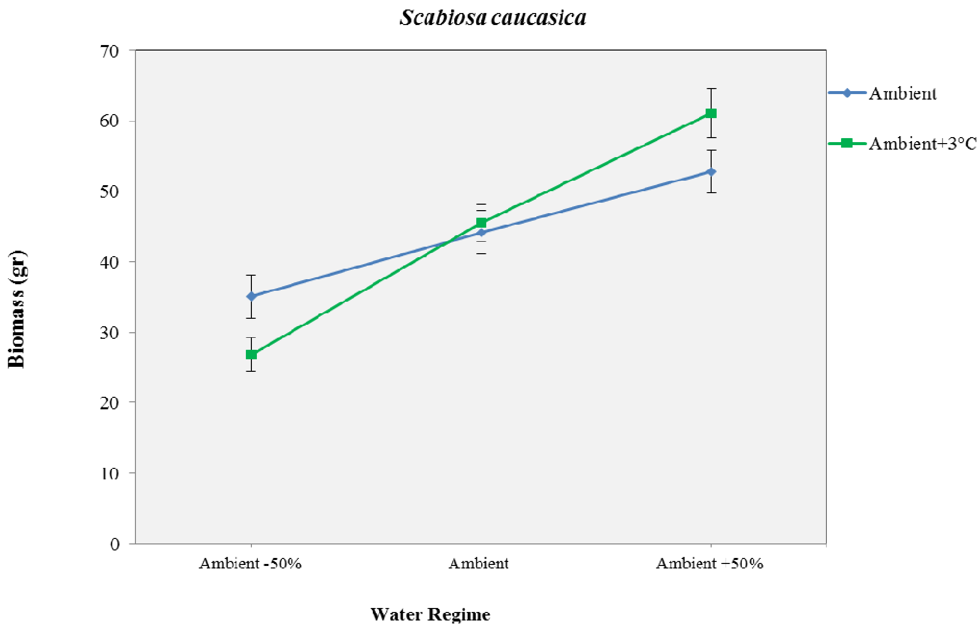

Figure 3. 56 Effect of water regime and different levels of temperature treatments on *Scabiosa caucasica.* Data represents mean of year 1 and year 2.

3.3.2.4.2 Comparison of species among the intermediate fitted ecological group

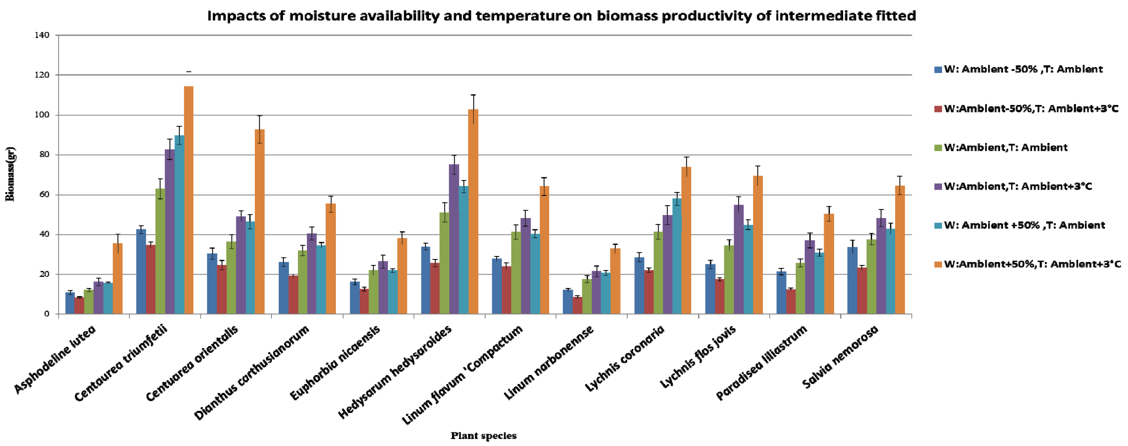

Figure 3. 57 Effect of water regime and different levels of temperature on biomass productivity of Intermediate fitted species. Data represents mean of year 1 and year 2.

The individual species in the intermediate fitted group respond to the water and temperature treatment in a similar fashion to the well-fitted group. All of them produce their least amount of biomass if the water treatment is at Ambient -50% and the temperature is Ambient +3°C. The highest biomass production belongs to Ambient +50% and Ambient +3°C. Overall the plant species in this group are more homogenous with respect of the biomass production under the different experimental conditions.

3.3.2.4.2.1 Intermediate fitted species by species

Biomass production is higher for the ambient temperature compared to Ambient +3°C at Ambient -50% moisture. With no exception all of the species in this group, show drastic increase in biomass productivity when more moisture become available, Ambient and Ambient +50%, while they are under higher temperature treatment Ambient +3°C. However, under the Ambient temperature conditions, some of the plants in this group show no or negligible additional growth when more moisture becomes available; (see Figures), which respectively belong to *Asphodeline lutea, Centaurea orientalis, Dianthus carthusinorum, Euphorbia nicaensis, Linum flavum 'Compactum'* and *Salvia nemorosa*.

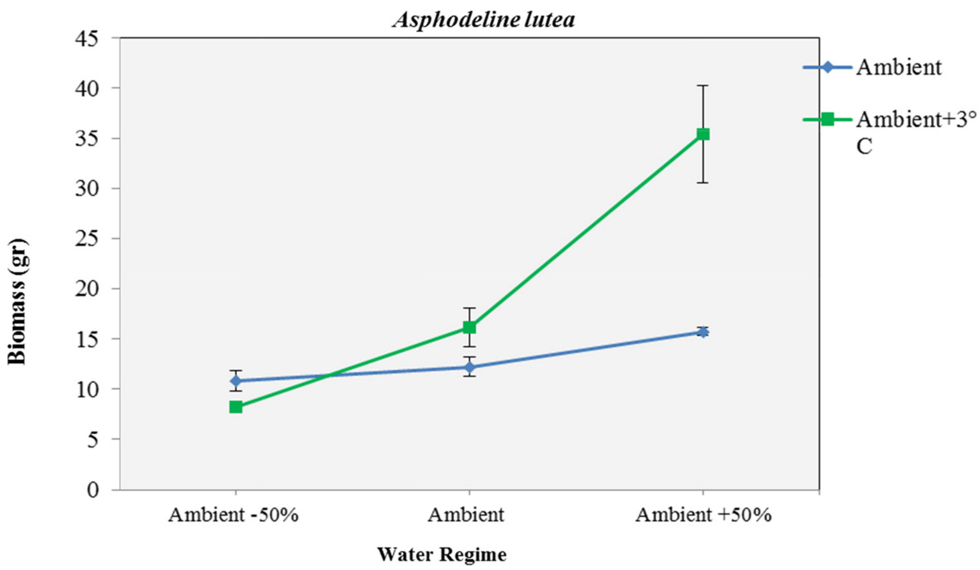

Figure 3. 58 Effect of water regime and different levels of temperature on biomass productivity of *Asphodeline lutea* Data represents mean of year 1 and year 2.

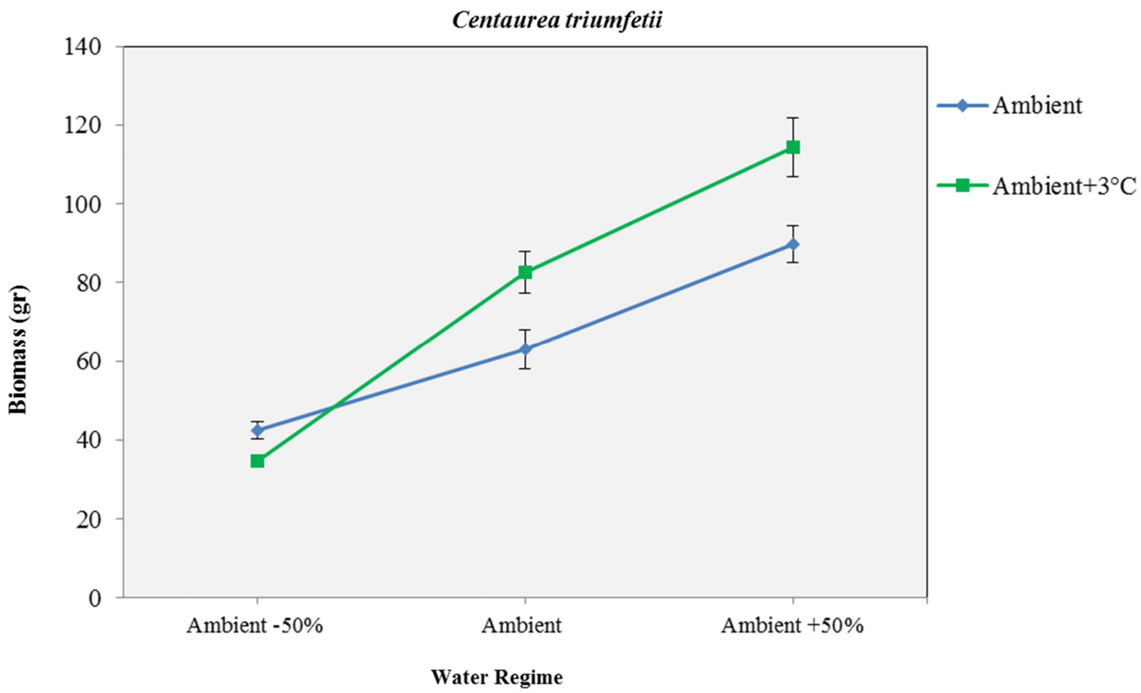

Figure 3.59 Effect of water regime and different levels of temperature on biomass productivity of *Centaurea triumfetii.* Data represents mean of year 1 and year 2.

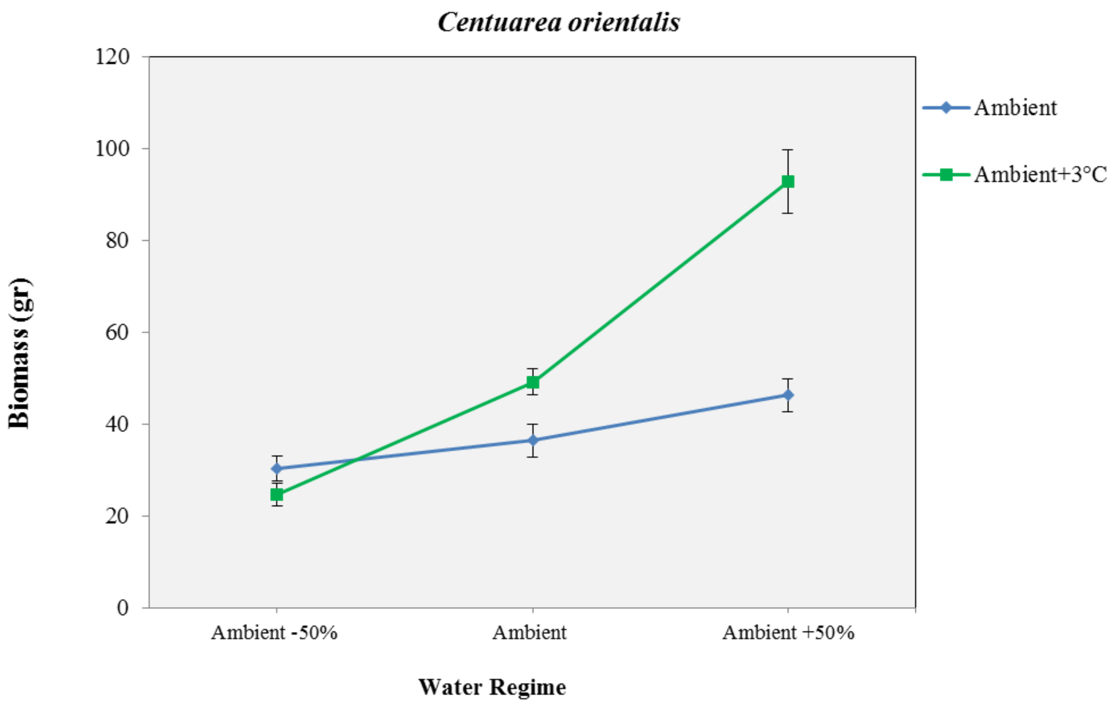

Figure 3. 60 Effect of water regime and different levels of temperature on biomass productivity of *Centaurea orientalis.* Data represents mean of year 1 and year 2.

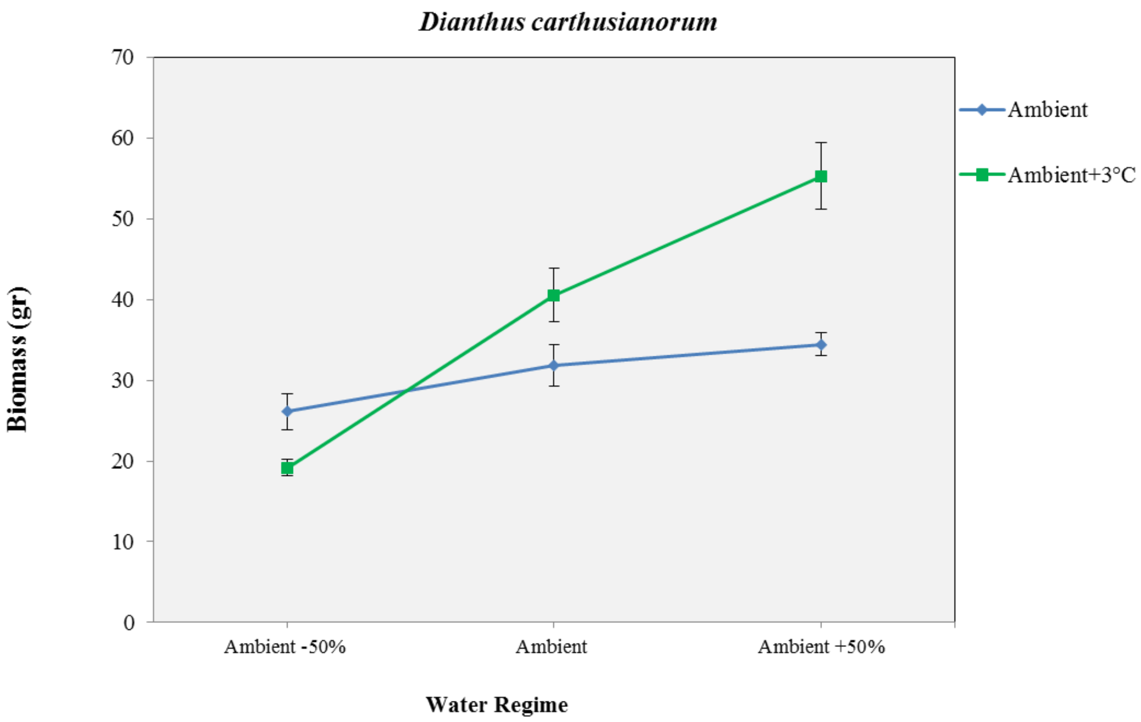

Figure 3. 61 Effect of water regime and different levels of temperature on biomass productivity of *Dianthus carthusianorum* Data represents mean of year 1 and year 2.

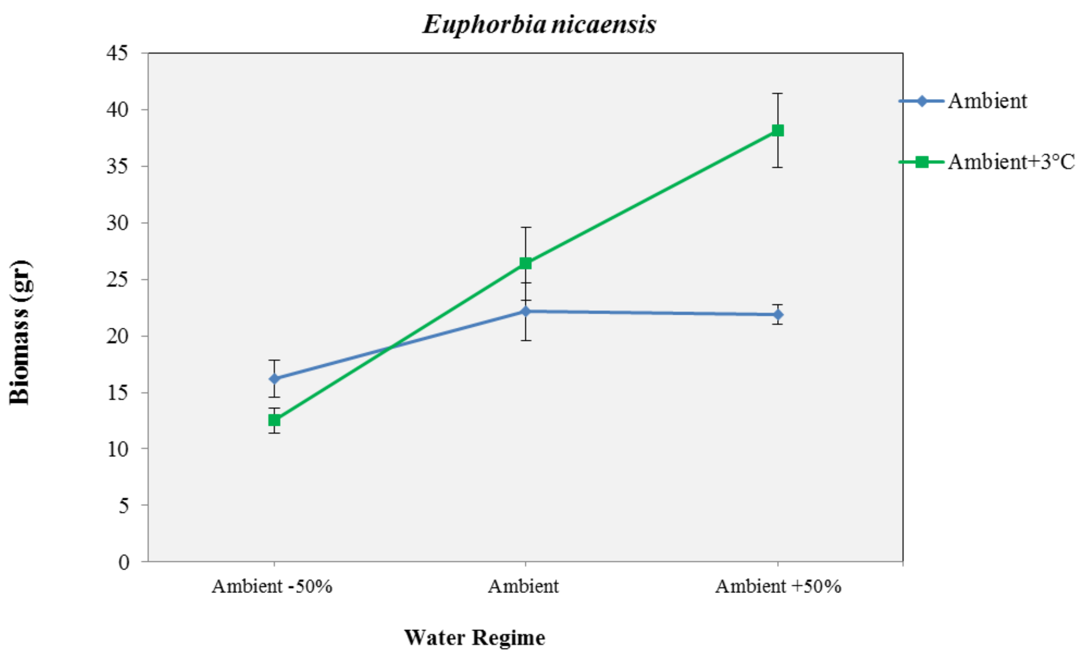

Figure 3. 62 Effect of water regime and different levels of temperature on biomass productivity of *Euphorbia nicaensis*. Data represents mean of year 1 and year 2.

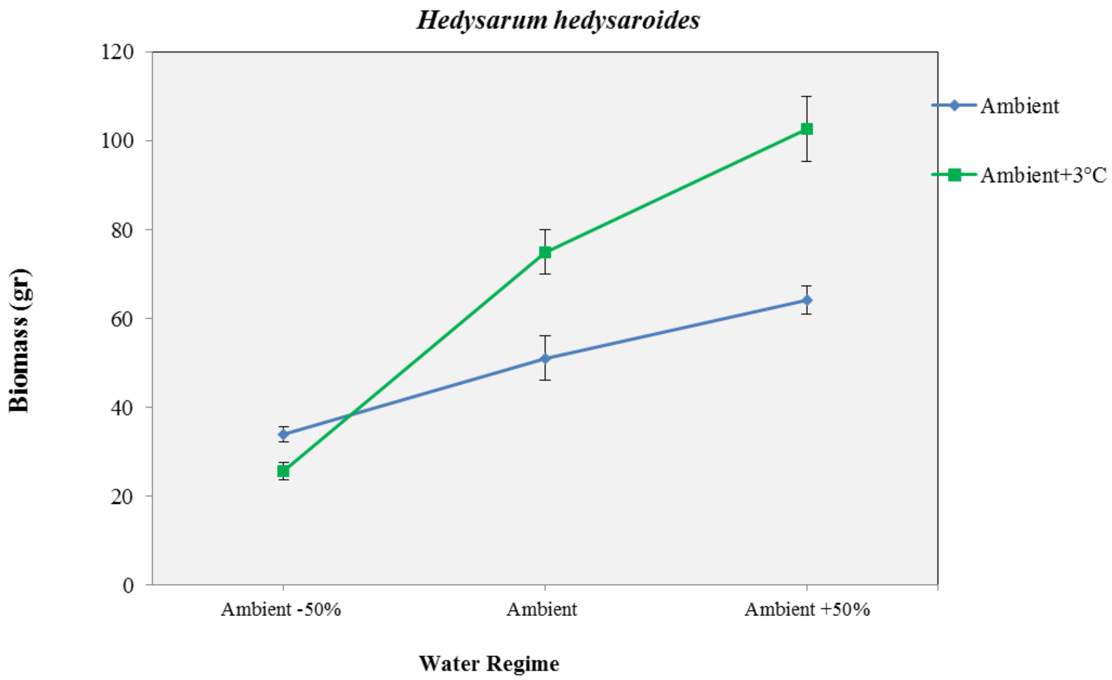

Figure 3. 63 Effect of water regime and different levels of temperature on biomass productivity of *Hedysarum hedysaroides* Data represents mean of year 1 and year 2.

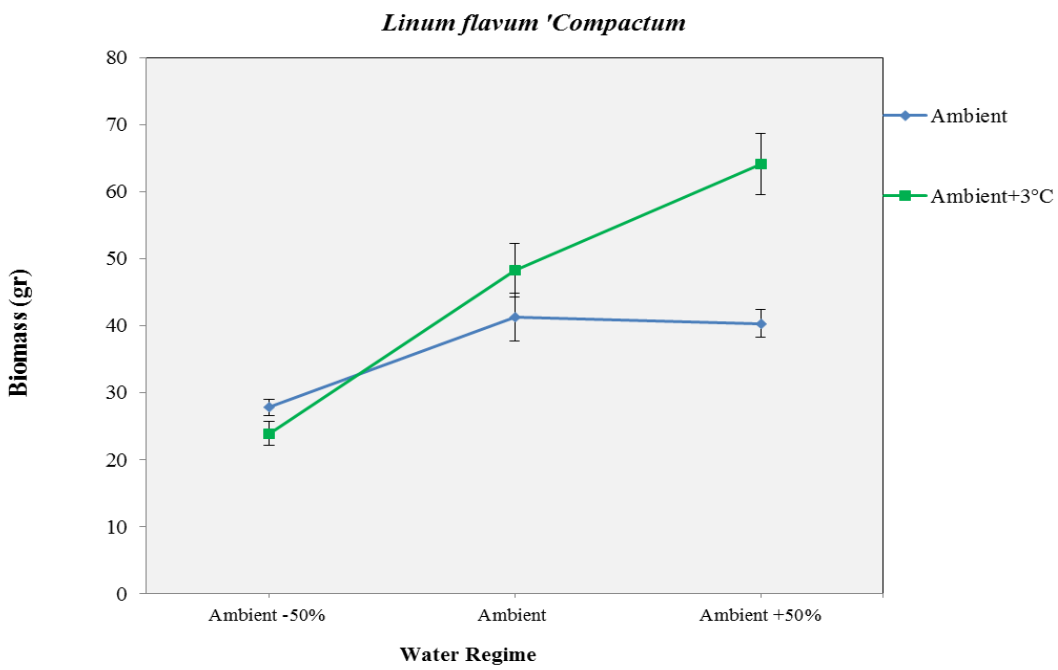

Figure 3. 64 Effect of water regime and different levels of temperature on biomass productivity of *Linum flavum 'Compactum* Data represents mean of year 1 and year 2.

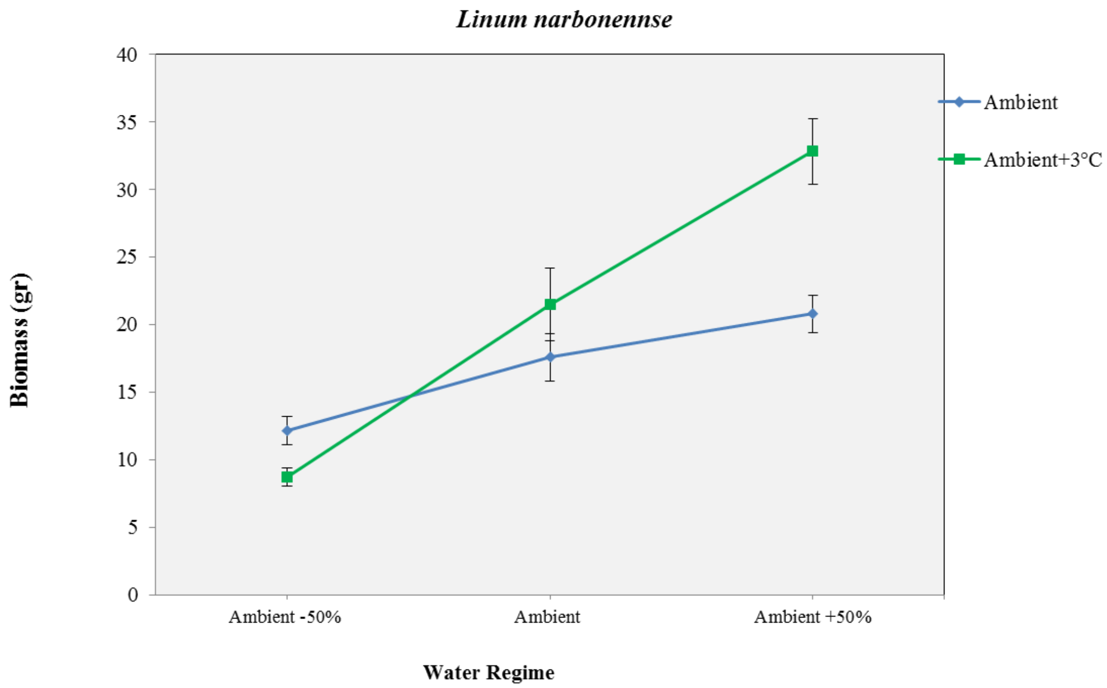

Figure 3. 65 Effect of water regime and different levels of temperature on biomass productivity of *Linum narbonnense* Data represents mean of year 1 and year 2.

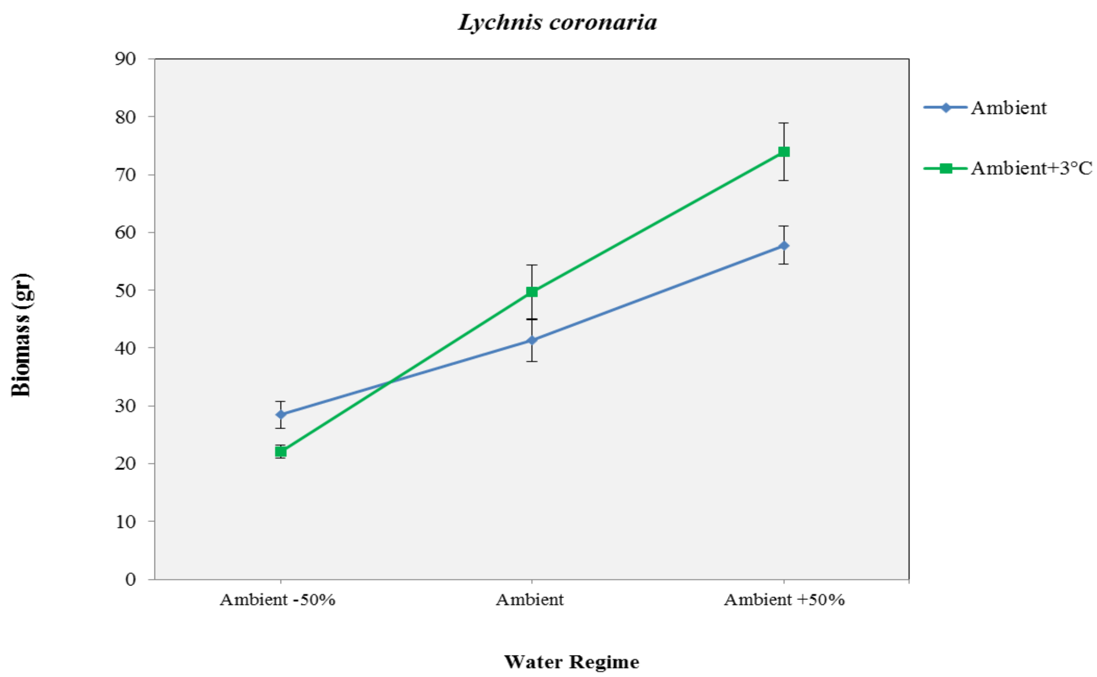

Figure 3. 66 Effect of water regime and different levels of temperature on biomass productivity of *Lychnis coronaria.* Data represents mean of year 1 and year 2.

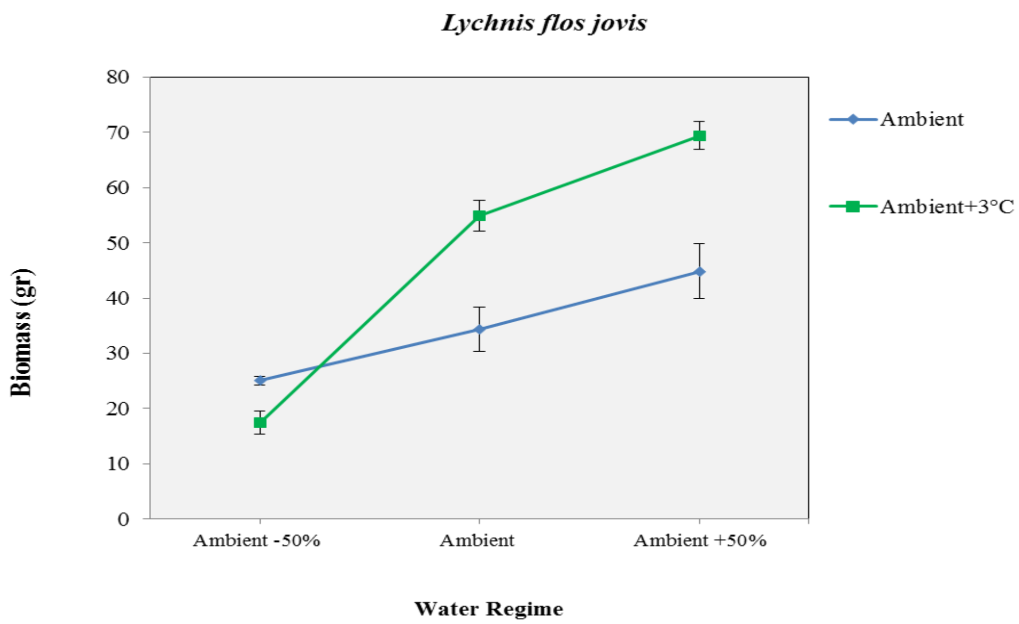

Figure 3. 67 Effect of water regime and different levels of temperature on biomass productivity of *Lychnis flos jovis.* Data represents mean of year 1 and year 2.

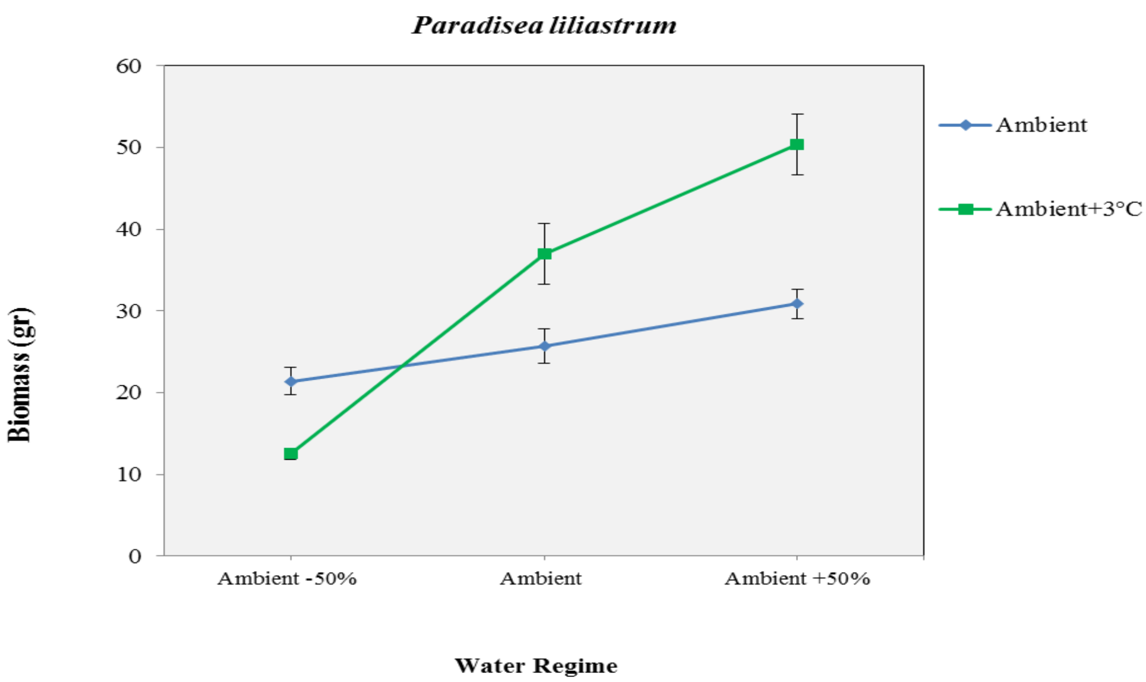

Figure 3. 68 Effect of water regime and different levels of temperature on biomass productivity of *Paradisea liliastrum.* Data represents mean of year 1 and year 2.

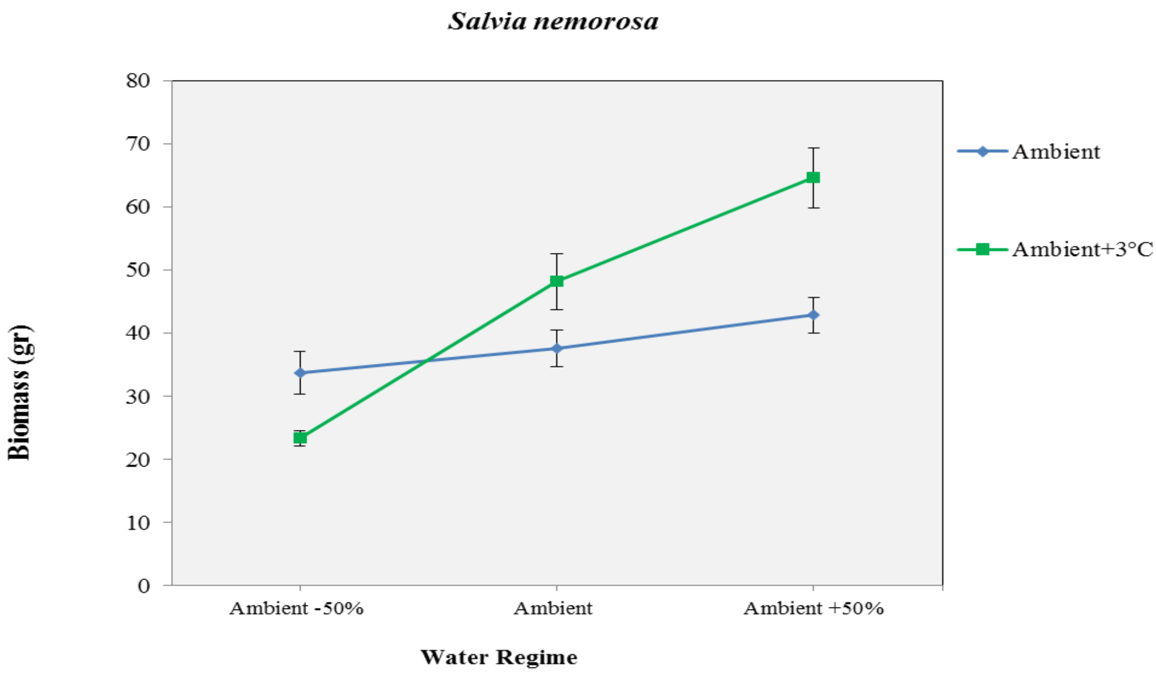

Figure 3. 69 Effect of water regime and different levels of temperature on biomass productivity of *Salvia nemorosa* Data represents mean of year 1 and year 2.

3.3.2.4.3 Poorly fitted species

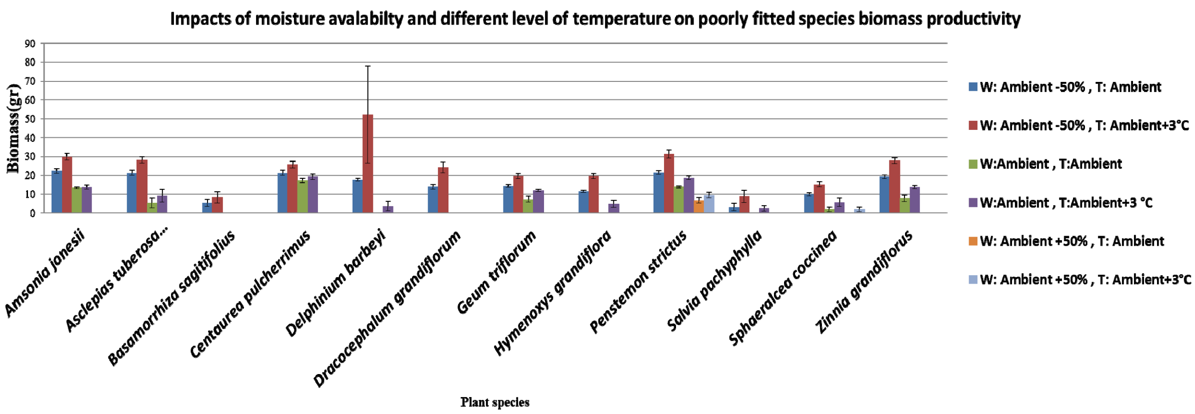

Figure 3. 70 Effect of water regime and different levels of temperature on biomass productivity of poorly fitted species

The poorly fitted plants, did indeed behave as such, and appear to require higher temperatures and less water. Negligible growth was observed when the species were under Ambient + 50% water treatment.

3.3.2.4.3.1 Response of Poorly fitted species individually

This group of plants, which are mainly species native to Western North America, cannot, generally speaking, tolerate high moisture levels. They clearly produce more biomass, when they are exposed to Ambient +3°C temperature, and when the moisture levels is the lowest (Ambient -50%). This pattern is completely different to the intermediate group, mainly drawn from Southern Europe. When the water treatment is at the highest, Ambient +50%, non of these plants can really thrive. *Amsonia jonesii* (Fig .3.71)*, Asclepias tuberosa* (Fig .3.72)*, Centaurea pulcherrimus* (Fig .3.74)*, Geum triflorum* (Fig .3.77)*, Hymenoxys grandiflora* (Ambient +3°C only) (Fig .3.78), *Penstemon Strictus* (Fig .3. 79)*,* Salvia pachyphylla (Ambient +3°C only) (Fig .3.80), Sphaeralacea coccinea (Fig .3.81), Zinnia grandifloras (Fig .3.82) generally showed the best performance.

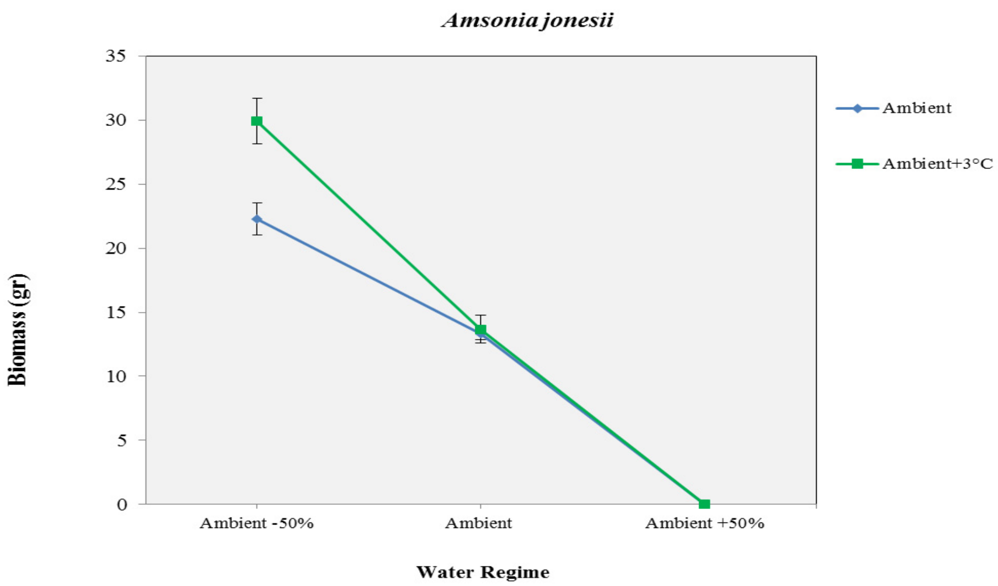

Figure 3. 71 Effect of water regime and different levels of temperature on biomass productivity of *Amsonia jonesii* Data represents mean of year 1 and year 2.

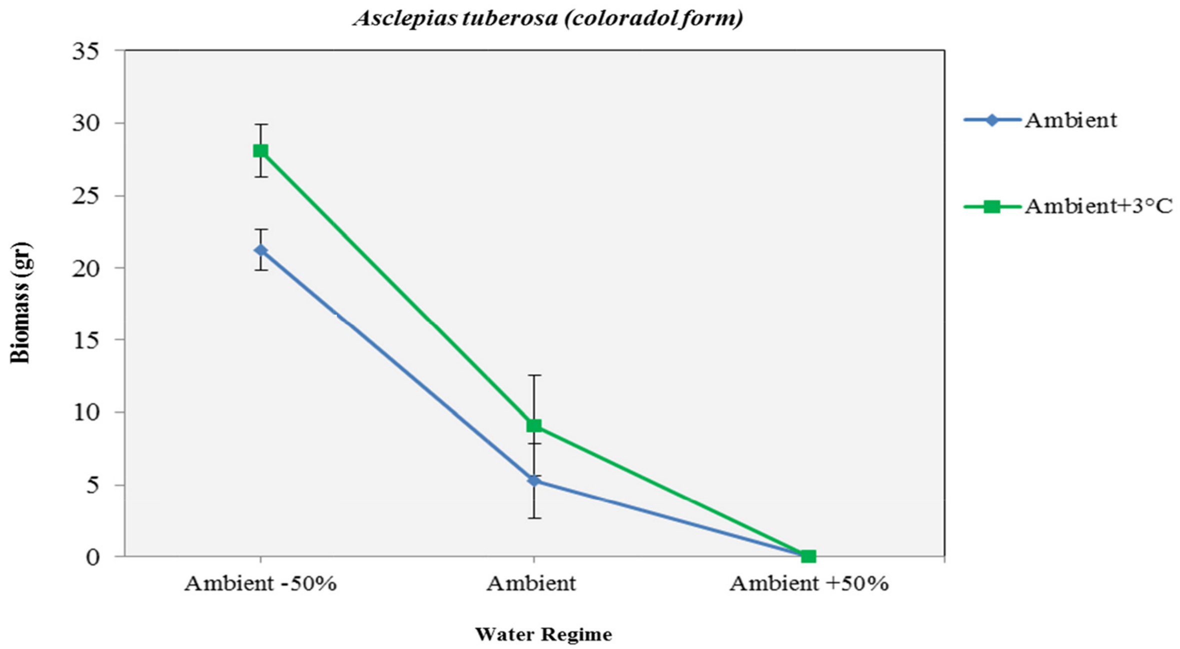

Figure 3. 72 Effect of water regime and different levels of temperature on biomass productivity of *Asclepias tuberosa*. Data represents mean of year 1 and year 2.

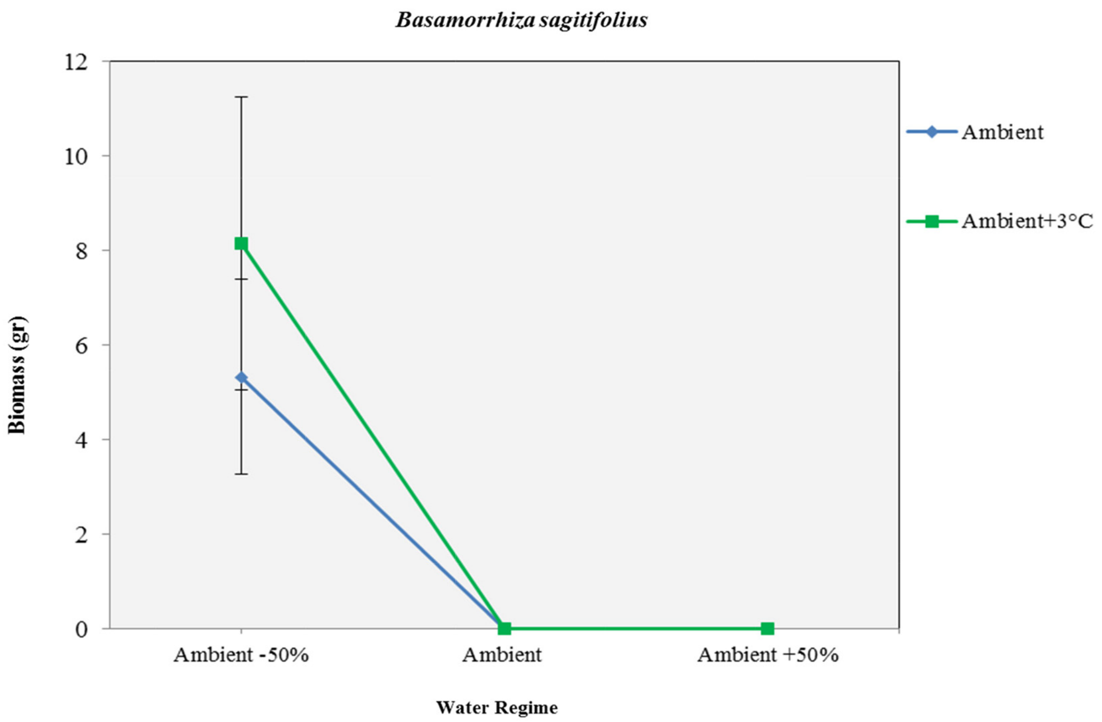

Figure 3. 73 Effect of water regime and different levels of temperature on biomass productivity of *Balsamorrhiza sagitifolius* Data represents mean of year 1 and year 2.

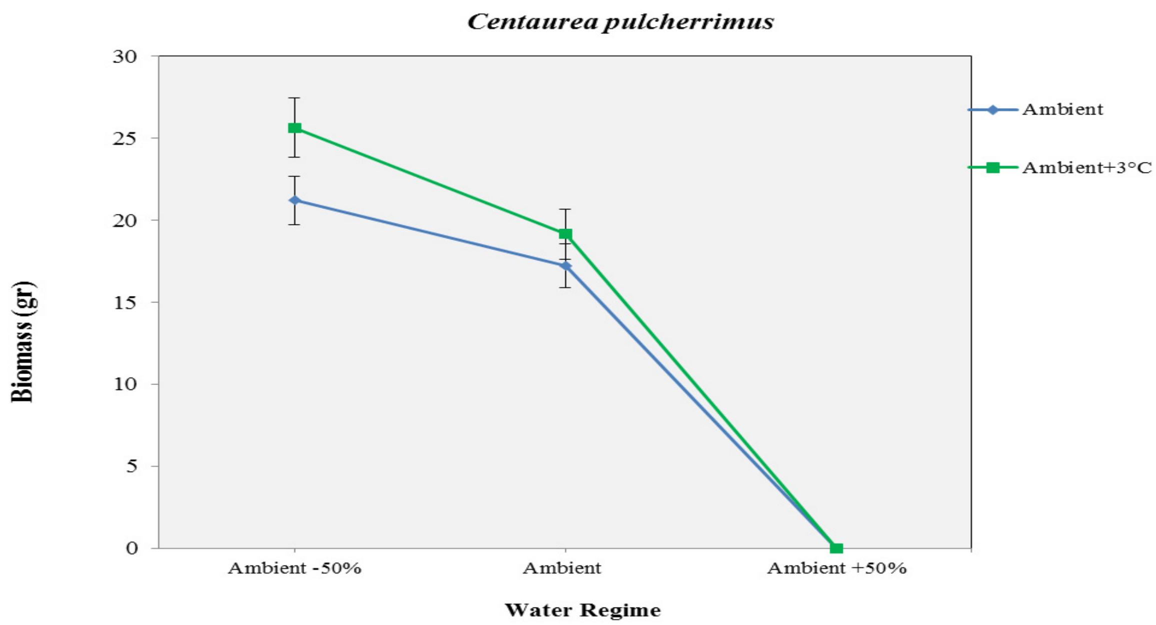

Figure 3. 74 Effect of water regime and different levels of temperature on biomass productivity of *Centaurea pulcherrimus* Data represents mean of year 1 and year 2.

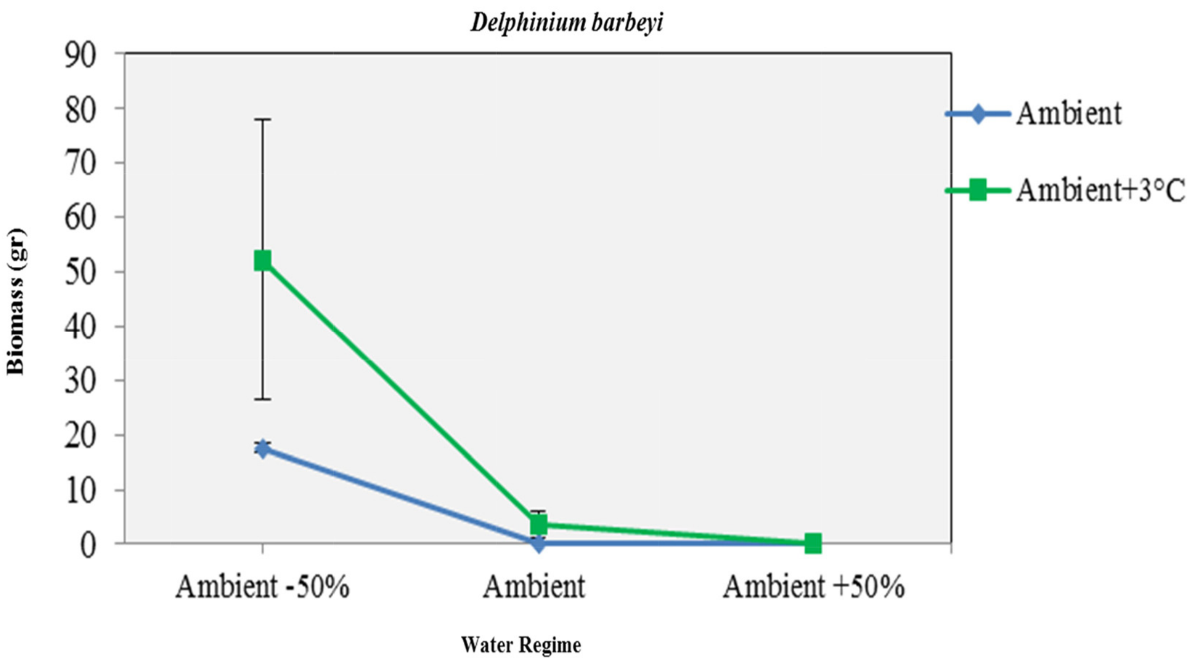

Figure 3. 75 Effect of water regime and different levels of temperature on biomass productivity of *Delphinium barbeyi* Data represents mean of year 1 and year 2.

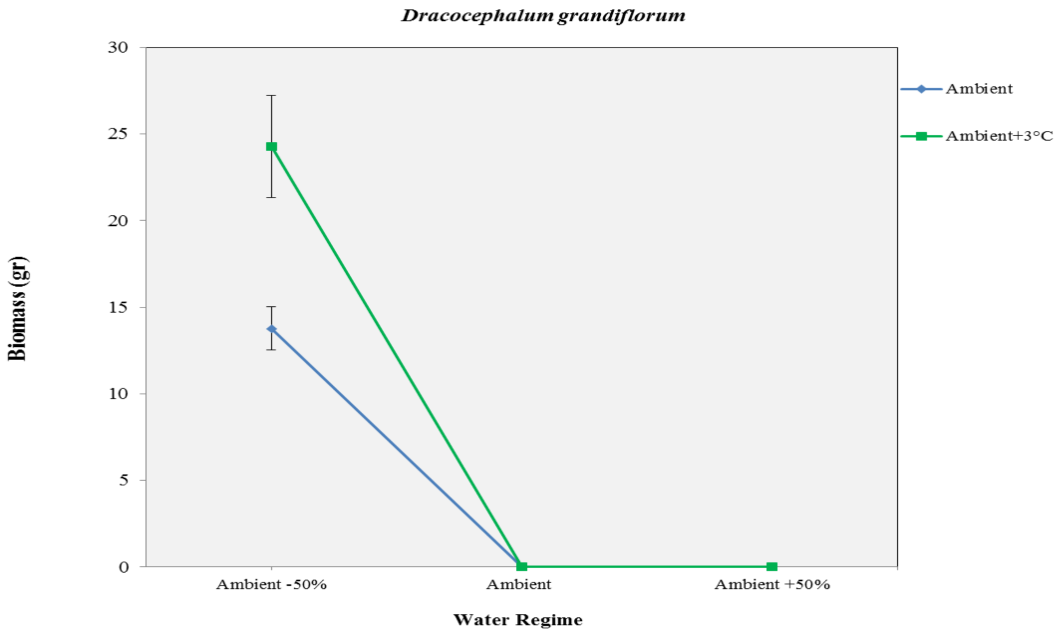

Figure 3. 76 Effect of water regime and different levels of temperature on biomass productivity of *Dracocephalum grandiflorum,* Data represents mean of year 1 and year 2.

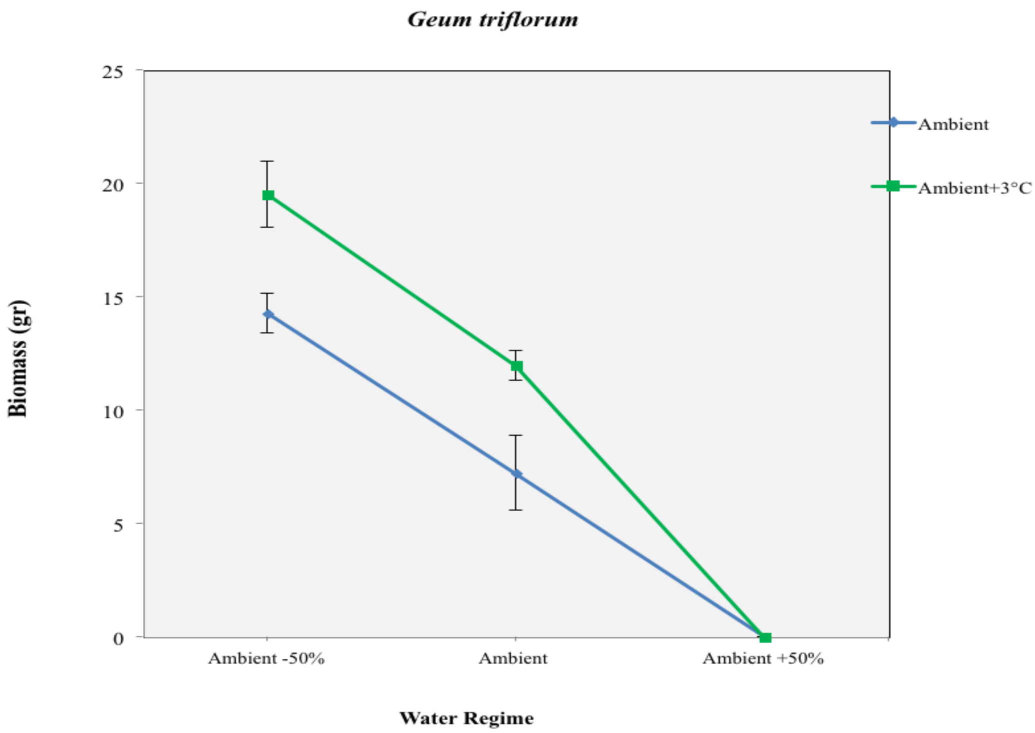

Figure 3. 77 Effect of water regime and different levels of temperature on biomass productivity of *Geum triflorum* Data represents mean of year 1 and year 2.

Figure 3. 78 Effect of water regime and different level of temperature on biomass productivity of *Hymenoxys grandiflora* Data represents mean of year 1 and year 2.

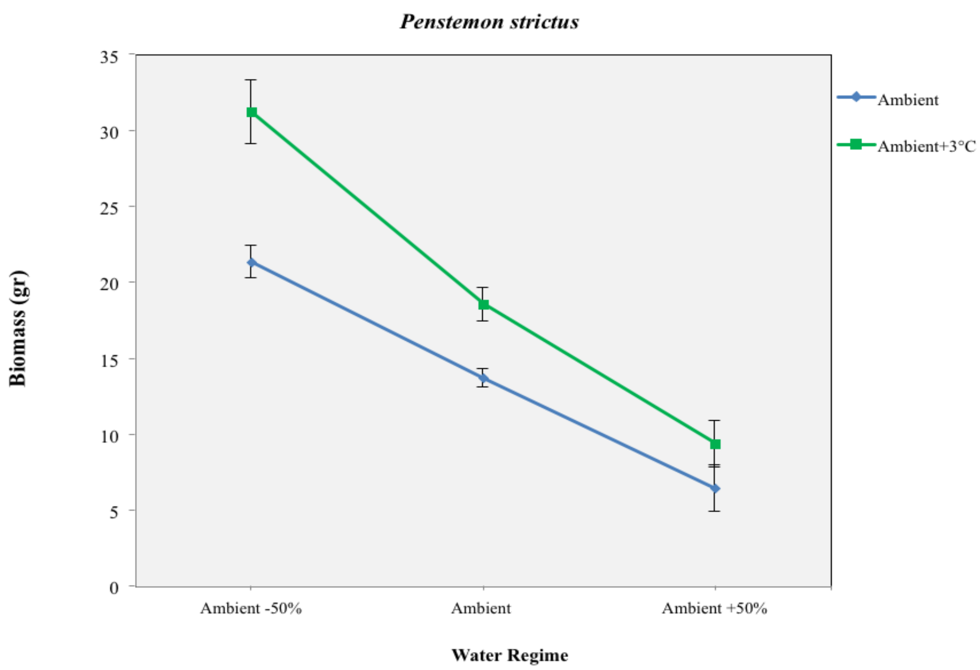

Figure 3. 79 Effect of water regime and different levels of temperature on biomass productivity of *Penstemon strictus* Data represents mean of year 1 and year 2.

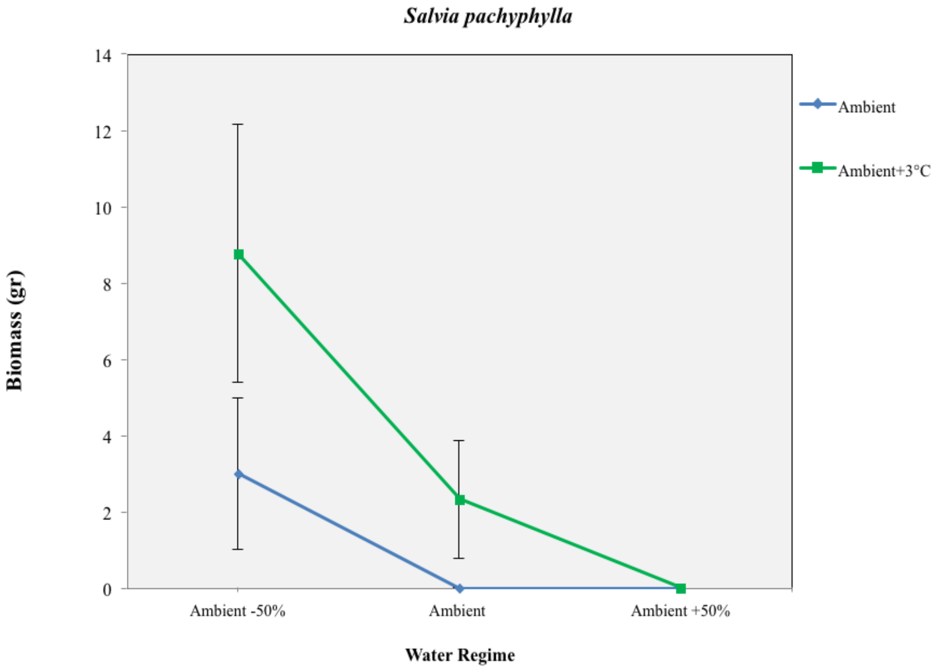

Figure 3. 80 Effect of water regime and different levels of temperature on biomass productivity of *Salvia pachyphylla* Data represents mean of year 1 and year 2.

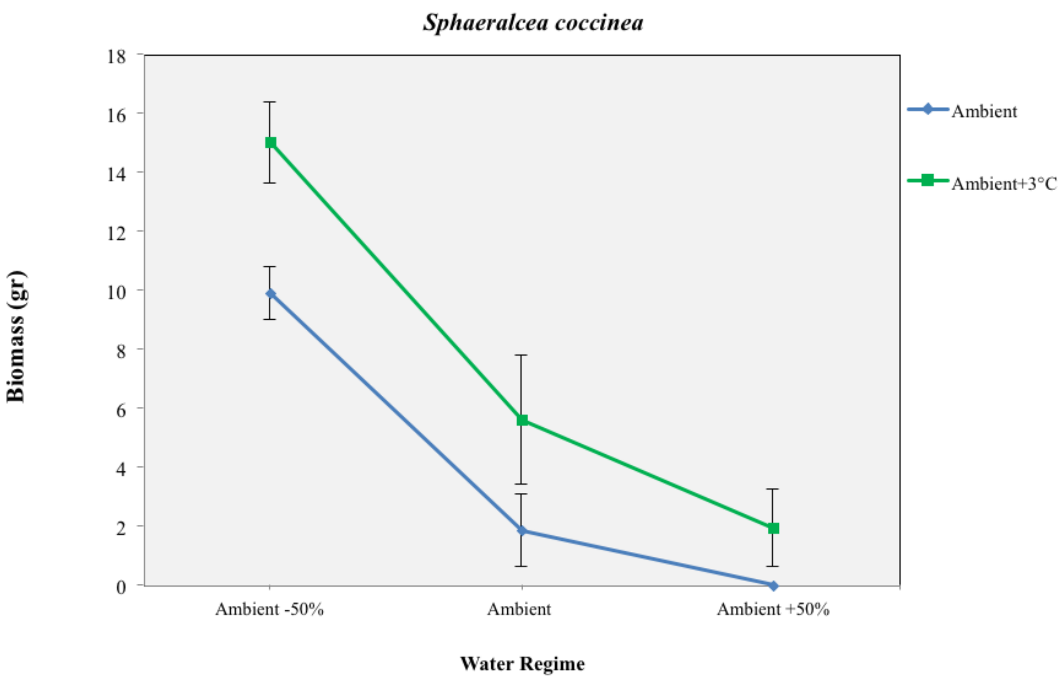

Figure 3. 81 Effect of water regime and different levels of temperature on biomass productivity of *Sphaeralcea coccinea* Data represents mean of year 1 and year 2.

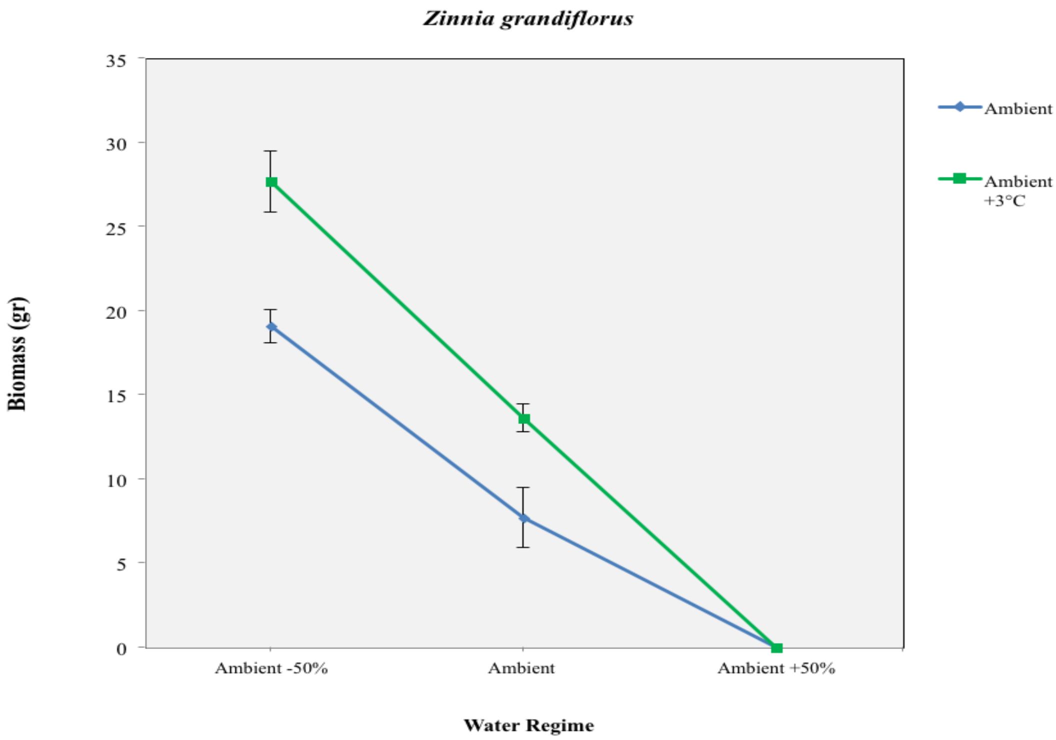

Figure 3. 82 Effect of water regime and different levels of temperature on biomass productivity of *Zinnia grandiflorus* Data represents mean of year 1 and year 2.

3.3.2.5 Comparison the biomass productivity of species over the 2 years under different water availability

3.3.2.5.1 Well-fitted species

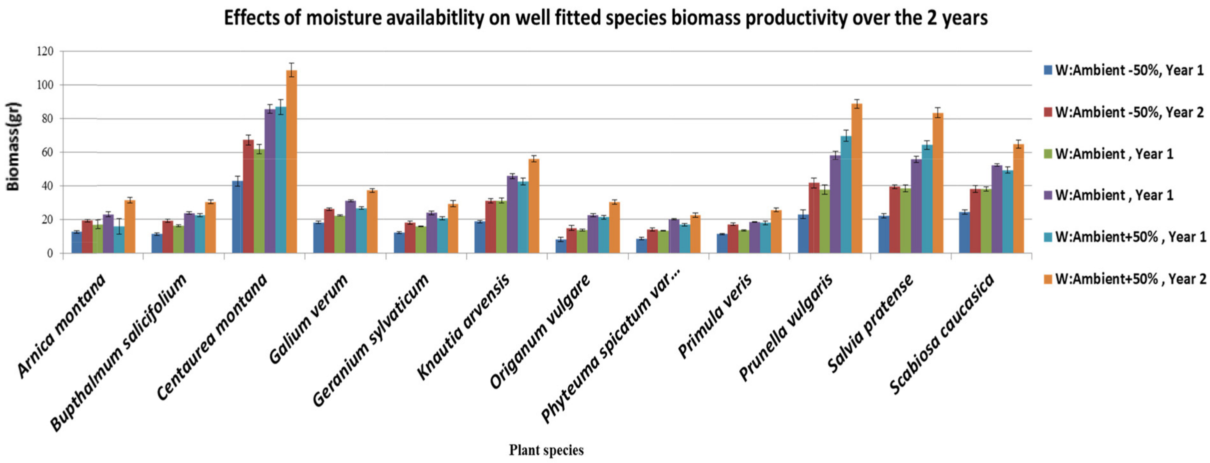

Figure 3. 83 Effects of different levels of moisture availability on biomass productivity of Well fitted species over the 2 years

The plant species in the well-fitted group show better biomass production during year 1 and 2. As anticipated all of the species produce more biomass during the second year regardless of the moisture availability, even though competition for resources is obviously greater in the second year. *Centaurea montana* produces the highest yield across all species in this group in all treatments.

3.3.2.5.1.1 Response of well fitted species individually

Sharp increases in biomass productivity is seen for all of these species when more water becomes available. The only exception is *Arnica montana* (Fig. 3.84) that though during Year 2 has consistent increase in growth with moisture increase, during Year 1 shows maximum growth at Ambient moisture level, its biomass productivity decreased when water availability is at Ambient +50%, though it still grows “better” than Ambient -50%.

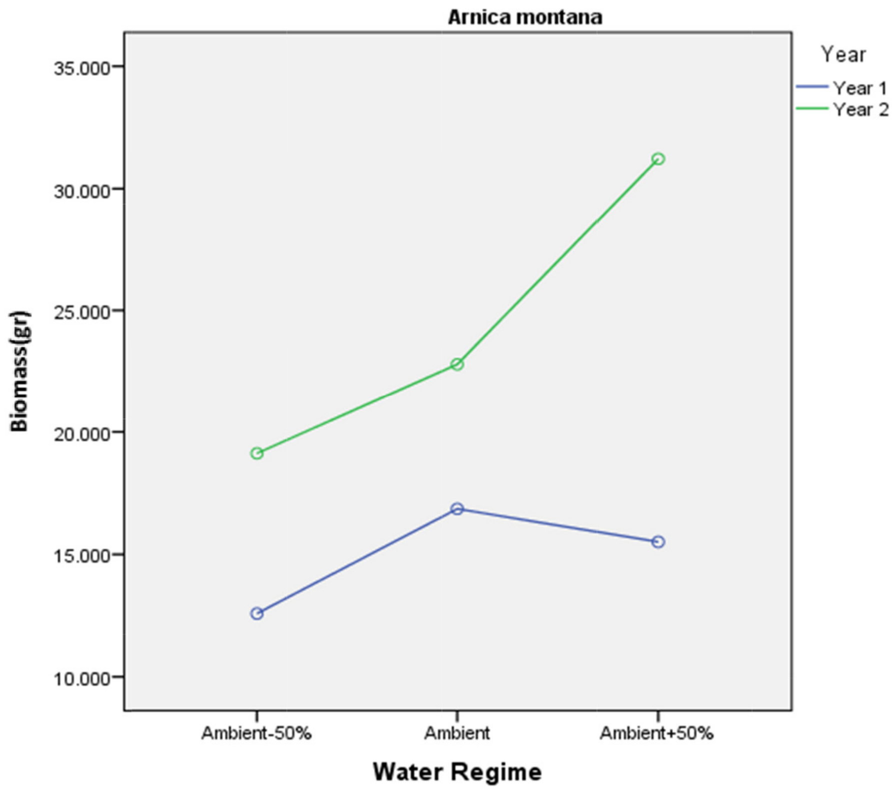

Figure 3. 84 Effects of different levels of moisture availability on biomass (gr) productivity of *Arnica montana* over the 2 years

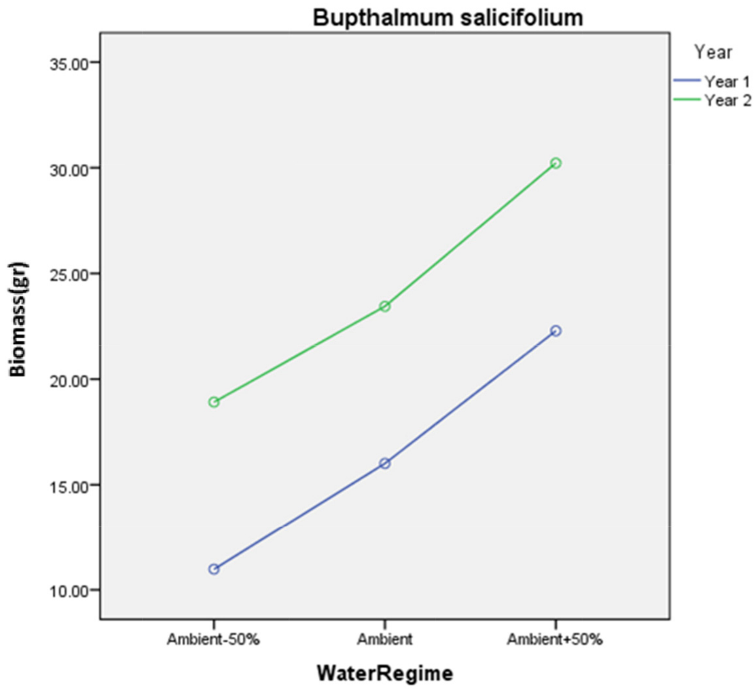

Figure 3. 85 Effects of different levels of moisture availability on biomass (gr) productivity of *Bupthalmum salicifolium* over the 2 years

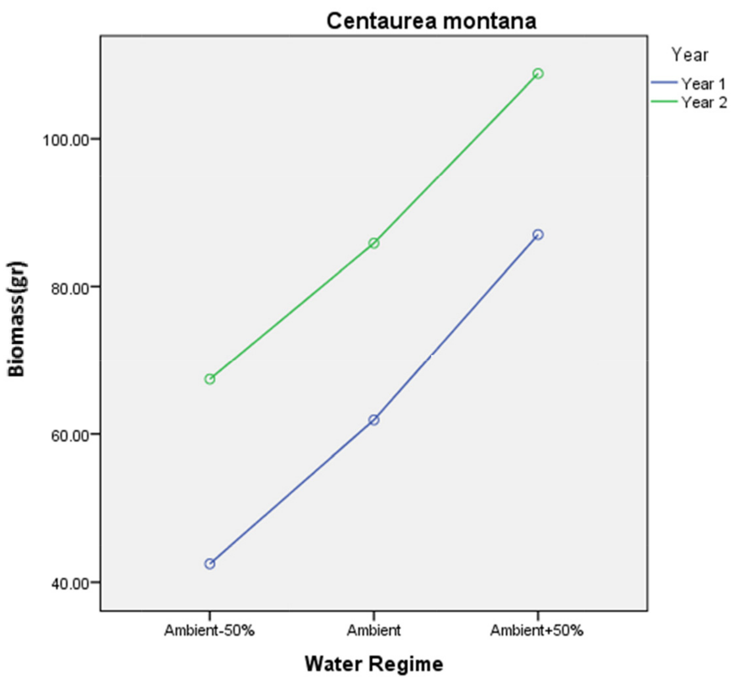

Figure 3. 86 Effects of different levels of moisture availability on biomass (gr) productivity in *Centaurea montana* over the 2 years

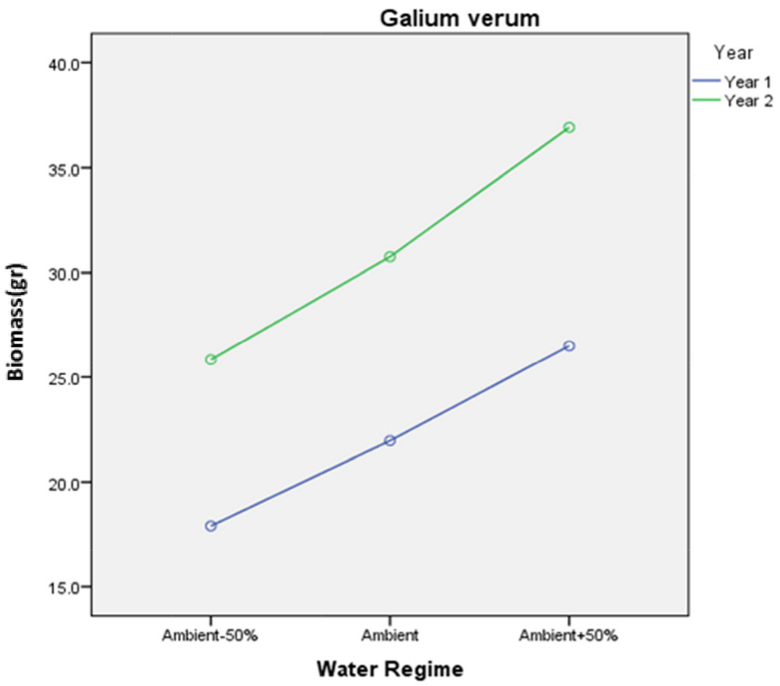

Figure 3. 87 Effects of different levels of moisture availability on biomass (gr) productivity of *Galium verum* over the 2 years

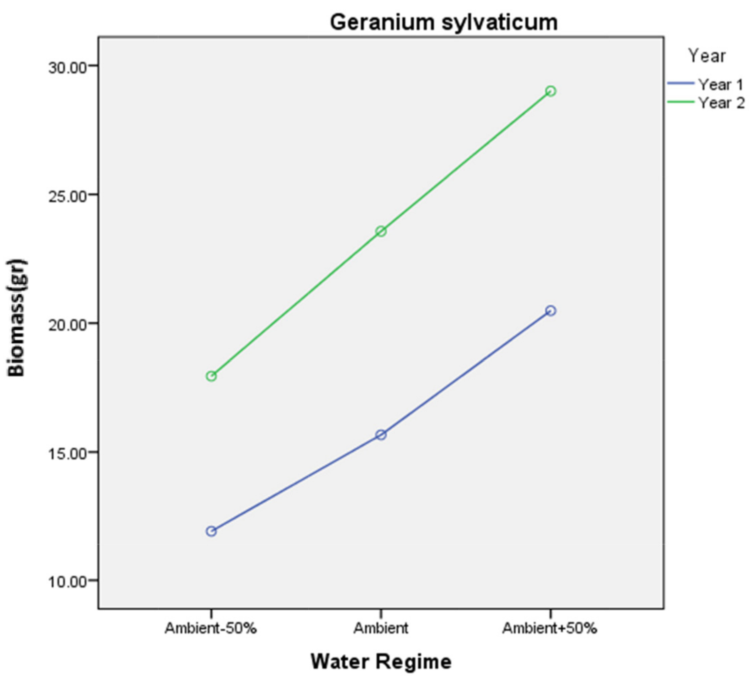

Figure 3. 88 Effects of different levels of moisture availability on biomass (gr) productivity of *Geranium sylvaticum* over the 2 years

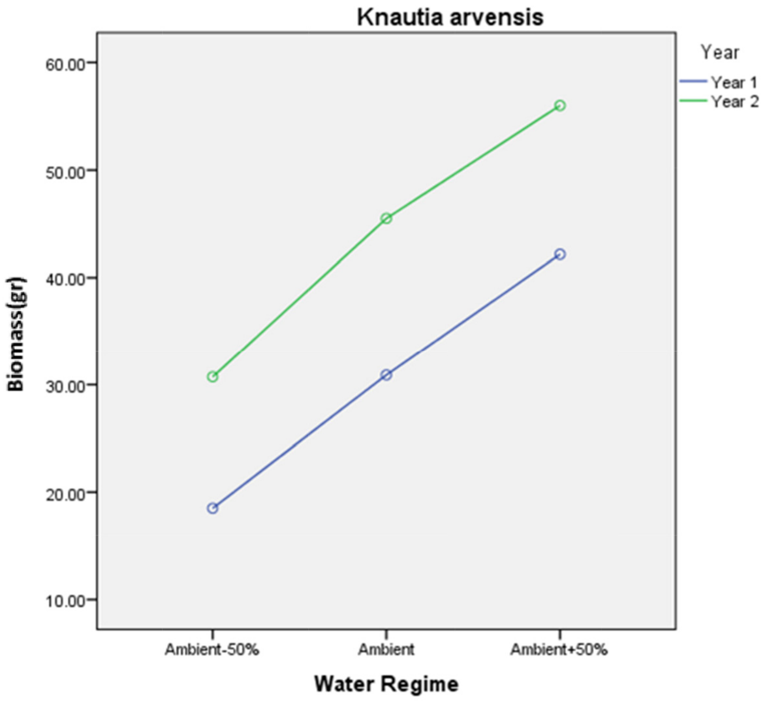

Figure 3. 89 Effects of different levels of moisture availability on biomass(gr) productivity of *Knautia arvensis* over the 2 years

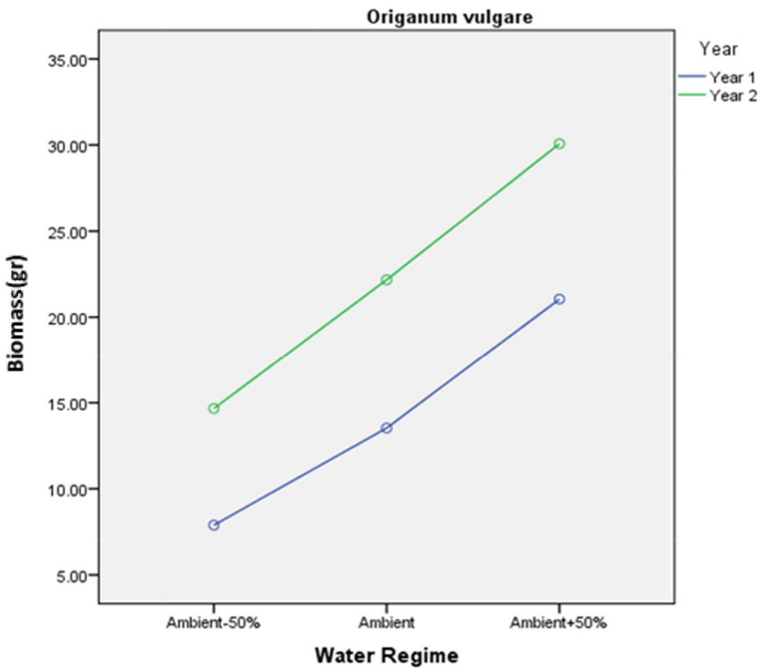

Figure 3. 90 Effects of different levels of moisture availability on biomass (gr) productivity of *Origanum vulgare* over the 2 years

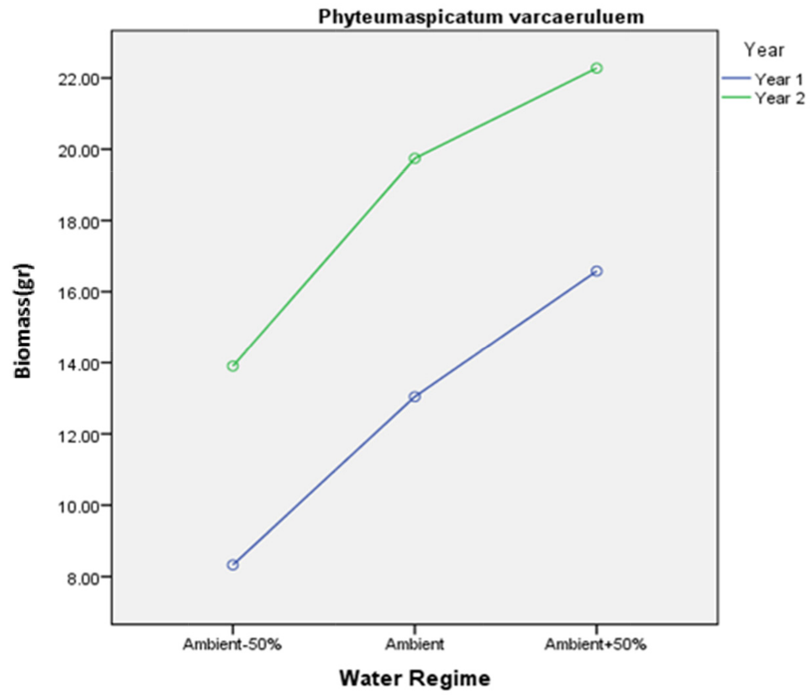

Figure 3. 91 Effects of different levels of moisture availability on biomass (gr) productivity of *Phyteuma spicatum* over the 2 years

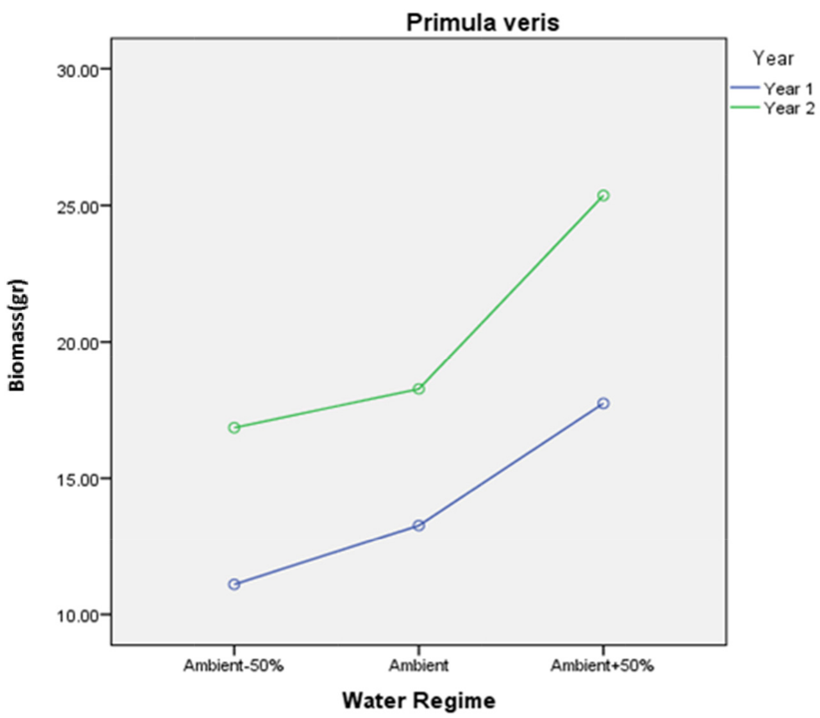

Figure 3. 92 Effects of different levels of moisture availability on biomass (gr) productivity of *Primula veris* over the 2 years

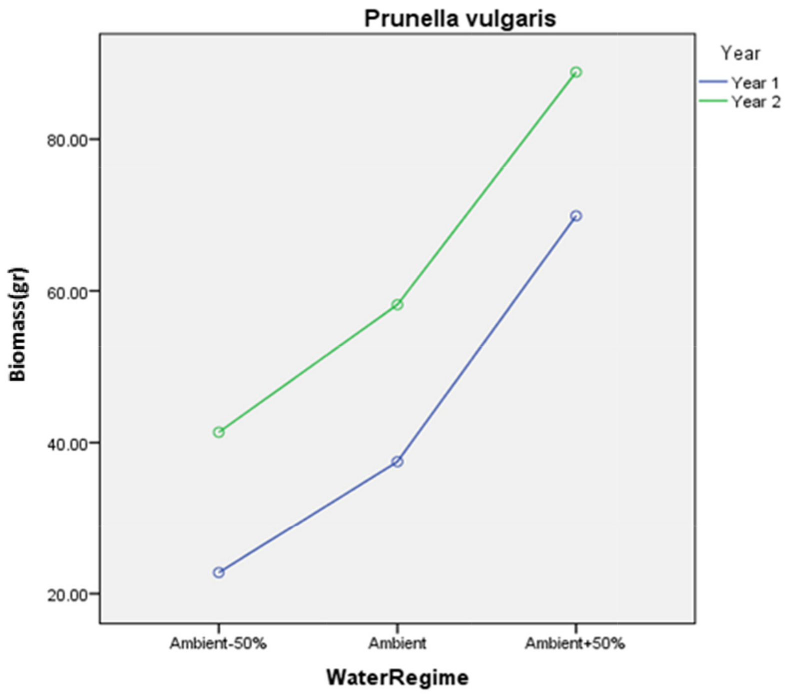

Figure 3. 93 Effects of different levels of moisture availability on biomass (gr) productivity of *Prunella vulgaris* over the 2 years

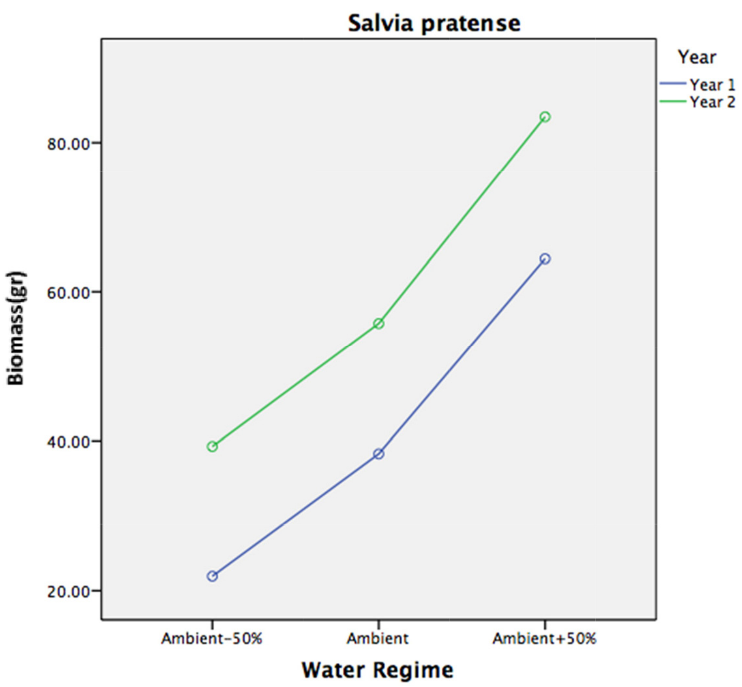

Figure 3. 94 Effects of different levels of moisture availability on biomass (gr) productivity of *Salvia pratense* over the 2 years

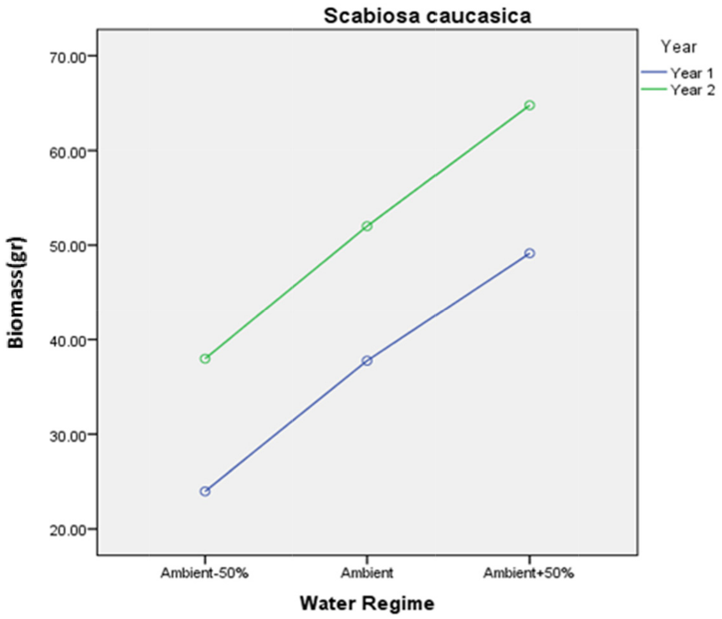

Figure 3. 95 Effects of different levels of temperature on biomass (gr) productivity of *Scabiosa caucasica* over the 2 years

3.3.2.5.2 Intermediate fitted species

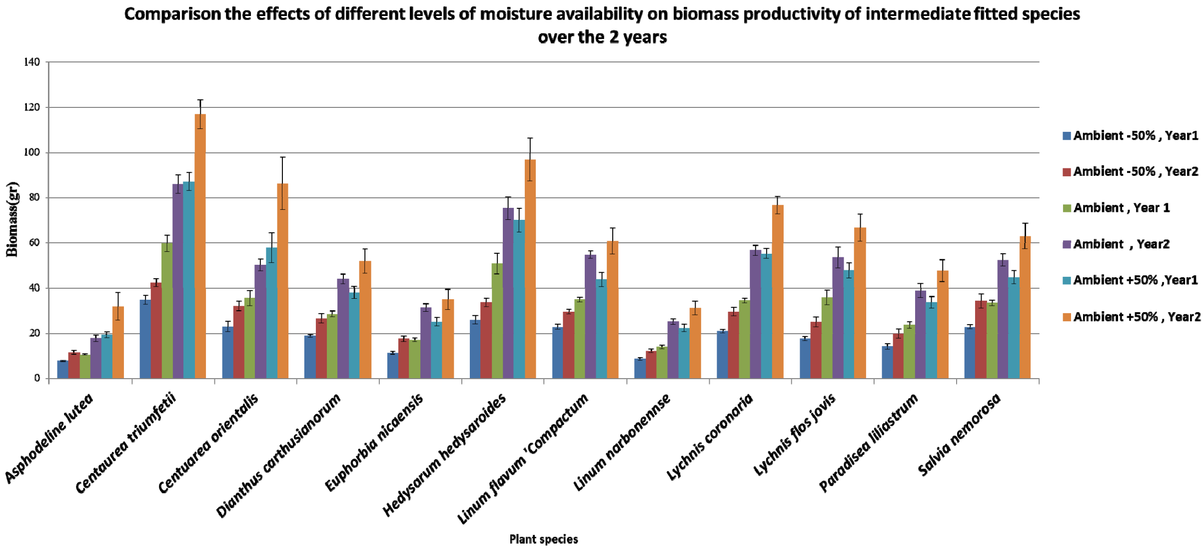

Figure 3.96 Effects of different levels of moisture availability on biomass (gr) productivity of intermediate fitted species over the 2 years

The plants studied in the intermediate fitted group respond similar to the well-fitted species. They all have higher amount of biomass productivity in the year 2. The highest biomass production level belongs to Ambient+ 50% water. The plant species in this category have, overall, higher biomass production compared to the well fitted plants.

3.3.2.5.2.1 Response of Intermediate fitted species individually

The Mediterranean species used in this study shows the best growth and biomass productivity compared to the other groups. Similar to the plants in the fitted group Year 2 shows considerably better growth for all of these species compared to Year 1. For all of these species when the available moisture increases they produce more biomass in both years. Fig. 3.98, which belongs to *Centaurea triumfetii* shows the highest amount of growth among other species in this group. These figures clearly suggest that moisture availability has positive impact and reinforces growth of the plants in the intermediate fitted group.

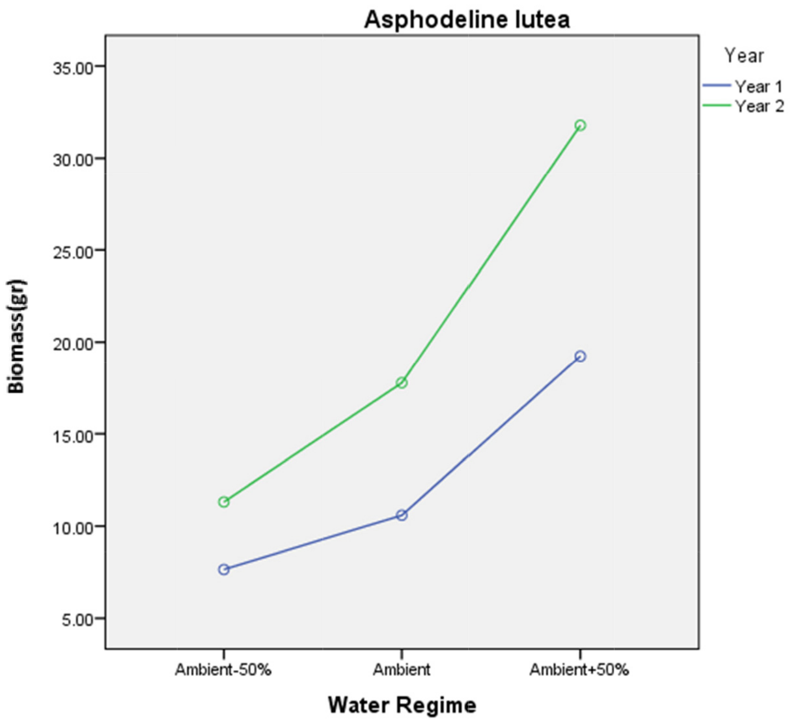

Figure 3. 97 Effects of different levels of moisture availability on biomass(gr) productivity of *Asphodeline lutea* over the 2 years

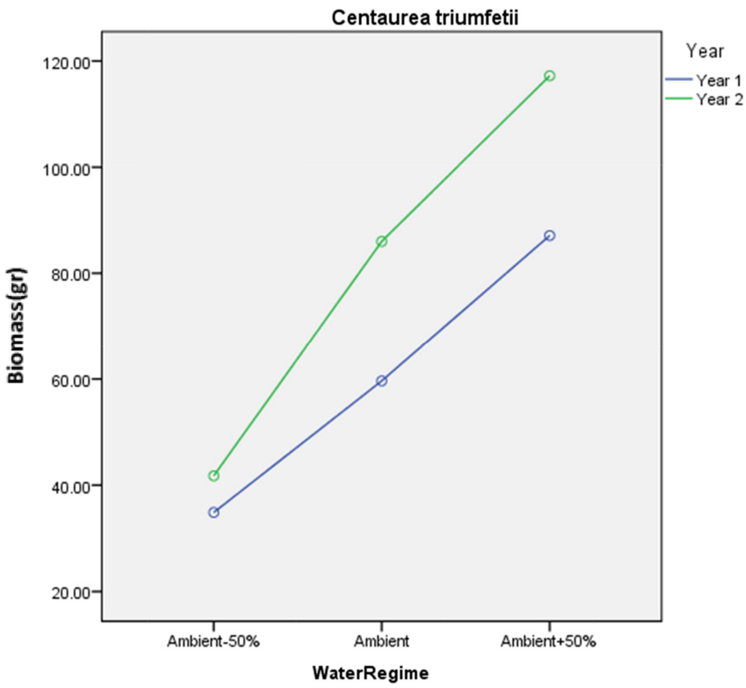

Figure 3. 98 Effects of different levels of moisture availability on biomass (gr)productivity of *Centaurea triumfetii* over the 2 years

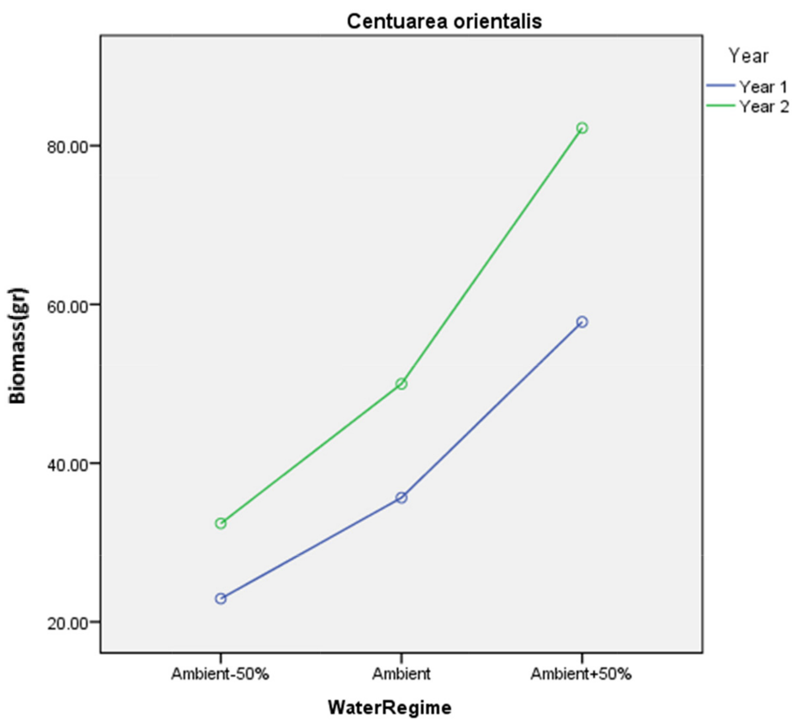

Figure 3. 99 Effects of different levels of moisture availability on biomass (gr)productivity of *Centaurea orientalis* over the 2 years

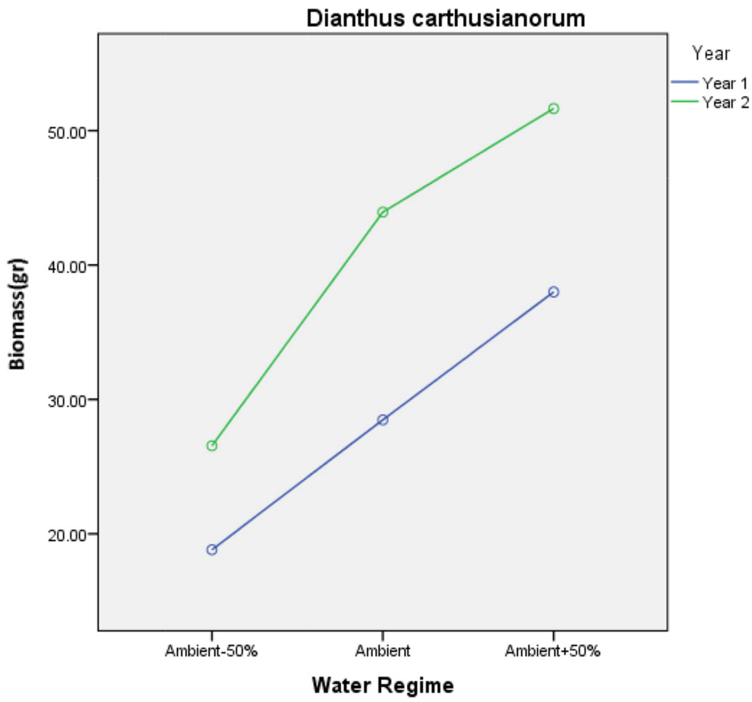

Figure 3. 100 Effects of different levels of moisture availability on biomass productivity of *Dianthus carthusianorum* over the 2 years

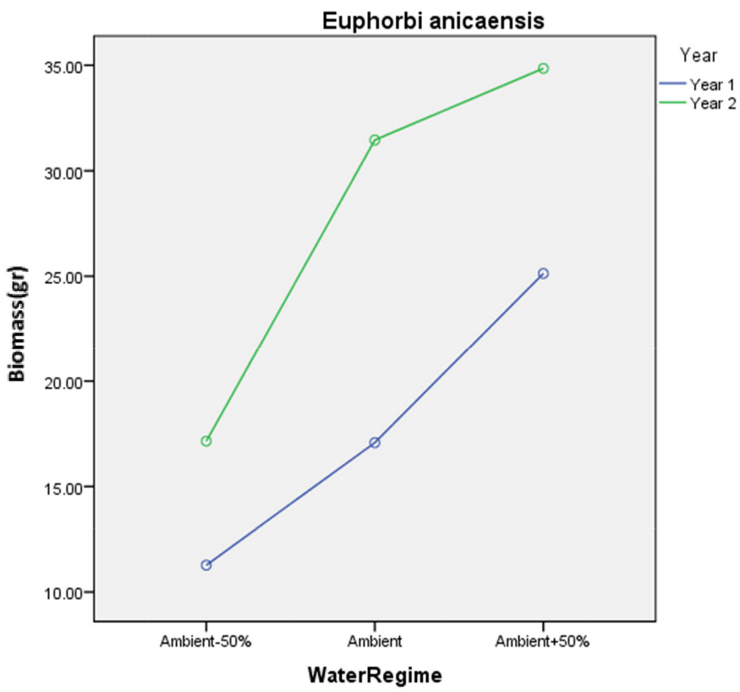

Figure 3. 101 Effects of different levels of moisture availability on biomass (gr) productivity of *Euphorbia nicaensis* over the 2 years

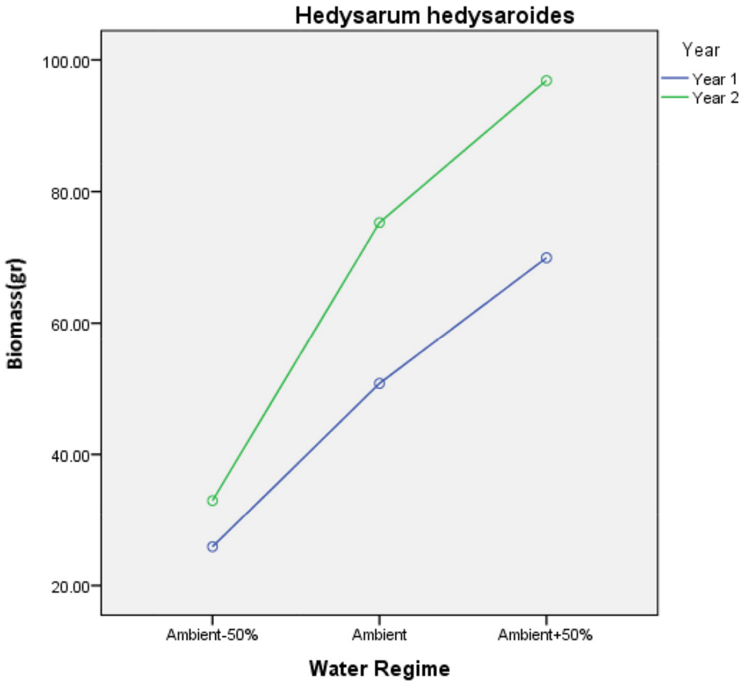

Figure 3. 102 Effects of different levels of moisture availability on biomass(gr) productivity of *Hedysarum hedysaroides* over the 2 years

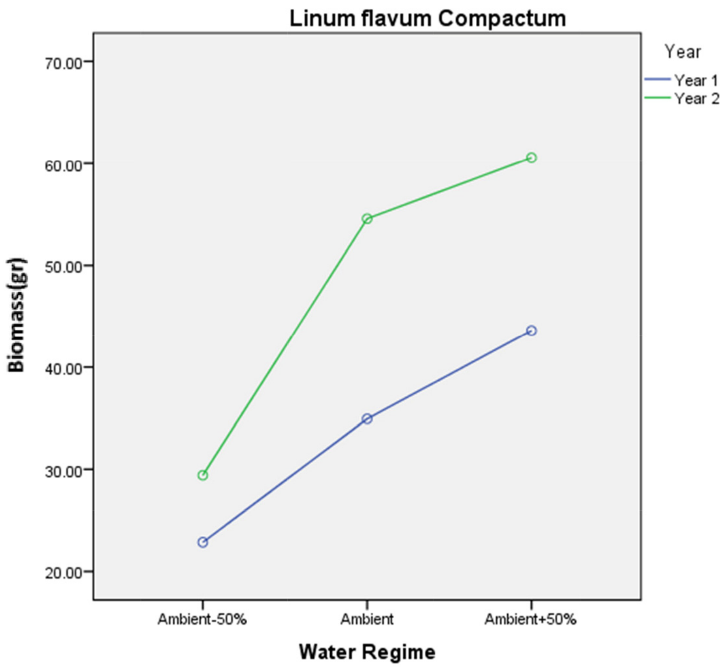

Figure 3. 103 Effects of different levels of moisture availability on biomass(gr) productivity of *Linum flavum 'Compactum'* over the 2 years

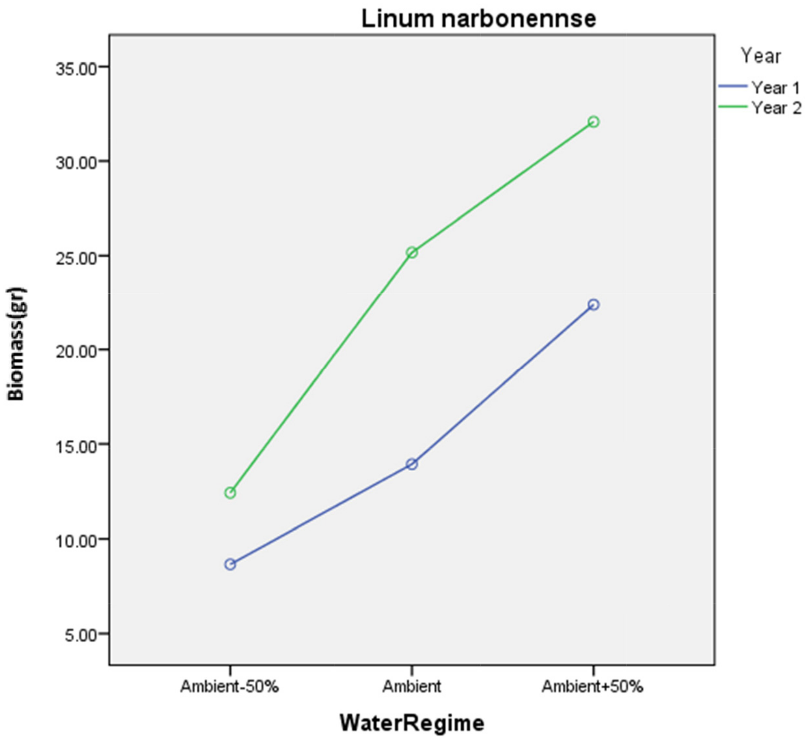

Figure 3. 104 Effects of different levels of moisture availability on biomass(gr) productivity of *Linum narbonennse* over the 2 years

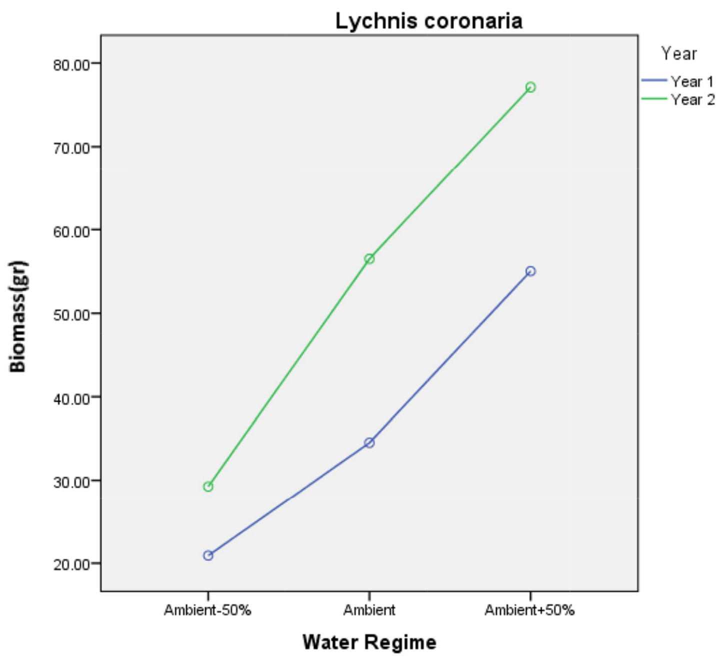

Figure 3. 105 Effects of different levels of moisture availability on biomass productivity of *Lychnis coronaria* over the 2 years

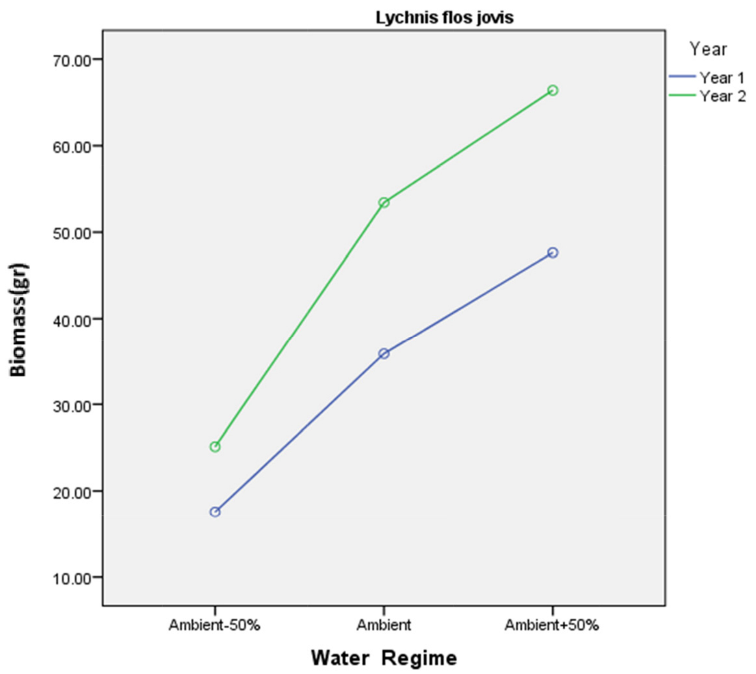

Figure 3. 106 Effects of different levels of moisture availability on biomass (gr)productivity of *Lychnis flos jovis* over the 2 years

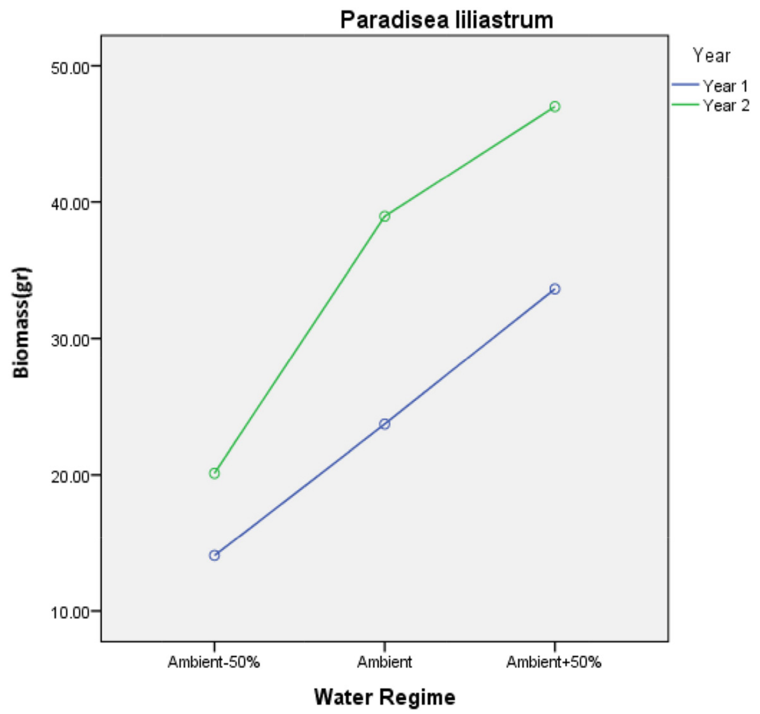

Figure 3. 107 Effects of different levels of moisture availability on biomass(gr) productivity of *Paradisea liliastrum* over the 2 years

Figure 3. 108 Effects of different levels of moisture availability on biomass(gr) productivity of *Salvia nemorosa* over the 2 years

3.3.2.5.3 Poorly fitted species

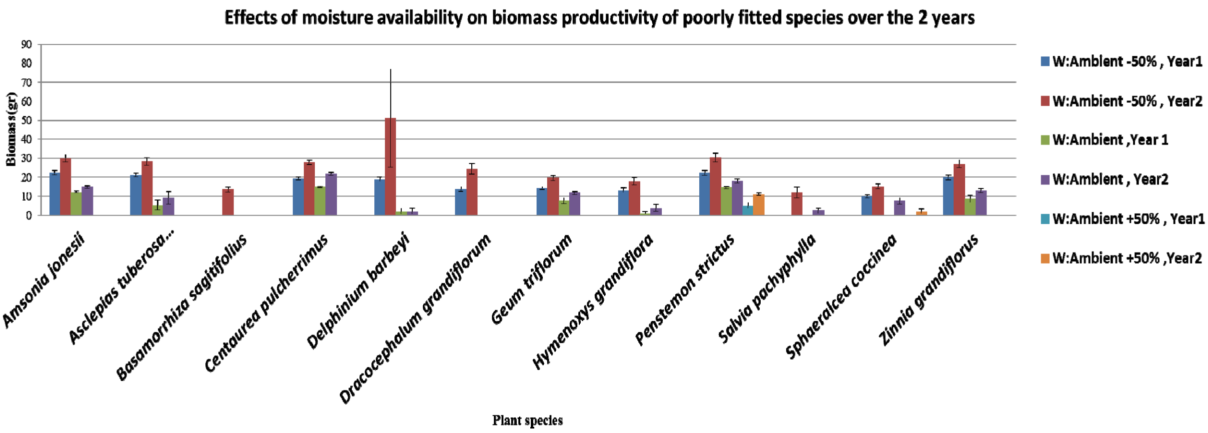

Figure 3. 109 Effects of different levels moisture availability on biomass productivity of poorly fitted species over the 2 years

As mentioned previously, the plant species in the poorly fitted group respond negatively to increasing moisture availability. Only *Penstemon strictus* was able to produce growth when the water treatment was at Ambient+50%. Ambient -50%, produces the most biomass during the second year.

3.3.2.5.3.1 Response of individual poorly fitted species

Fig. 3.112 & 3.119 reveal interesting responses in Balsmorrhiza sagitifolius, *Salvia pachyphylla* in Year 1 and 2 of the experiment. In Year 1 the response to increasing moisture is a flat line, in other words no growth even at Ambient -50% moisture levels, in contrast to other species in this group. However, in Year 2 these two species can still survive at Ambient -50% moisture levels, though show much less growth compared to other plant species in this group, but die at Ambient and Ambient +50% moisture levels.

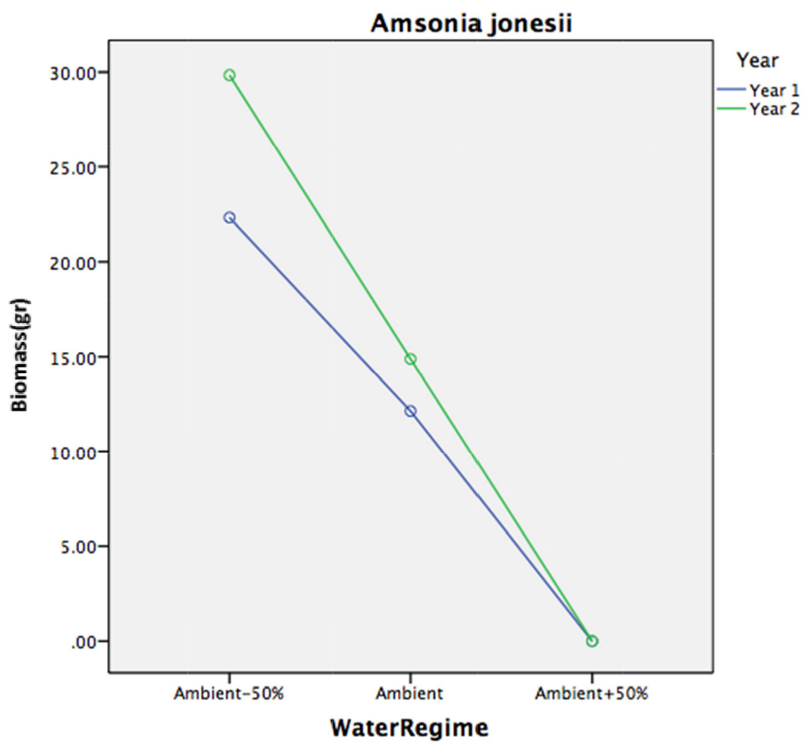

Figure 3. 110 Effects of different levels of moisture availability on biomass(gr) productivity of *Amsonia jonesii* over 2 years

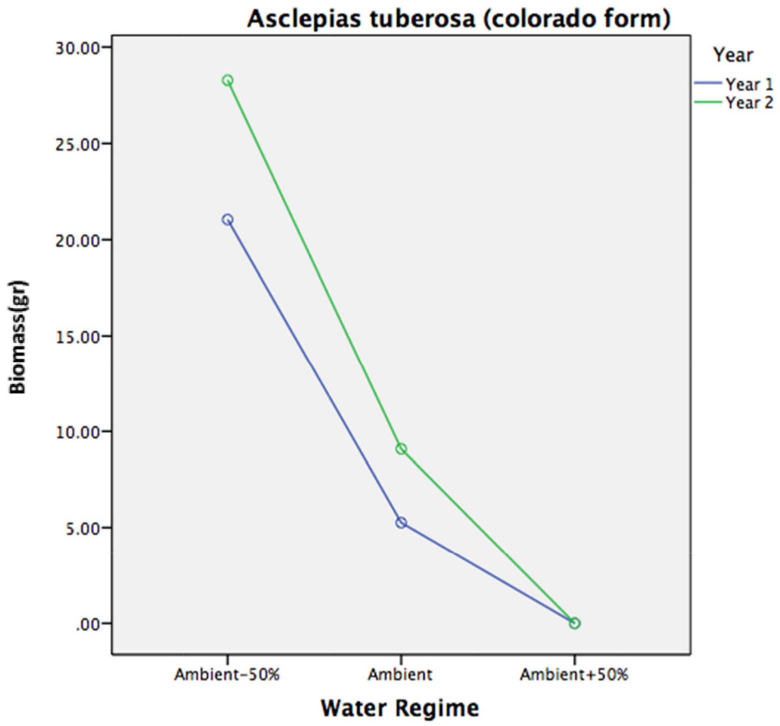

Figure 3. 111 Effects of different levels moisture availability on biomass(gr) productivity of *Asclepias tuberosa* over 2 years

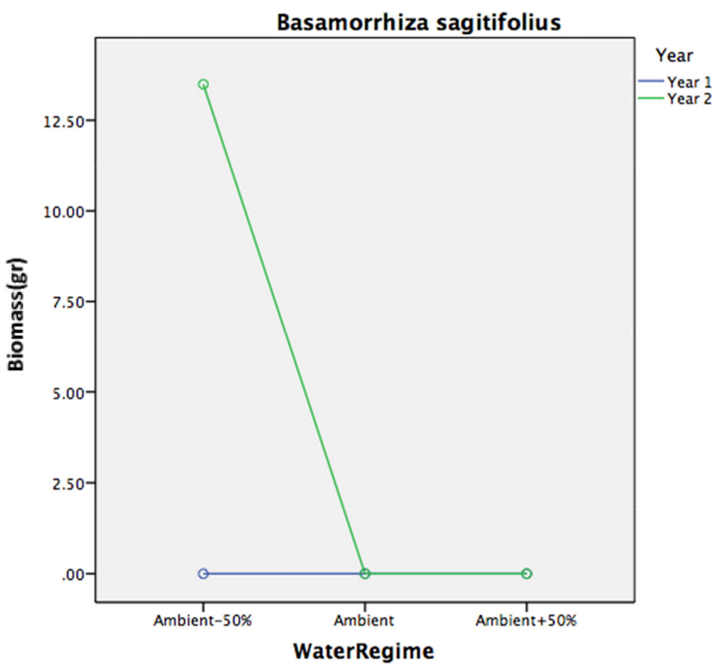

Figure 3. 112 Effects of different levels moisture availability on biomass(gr) productivity of Balsamorrhiza sagitifolius over the 2 years

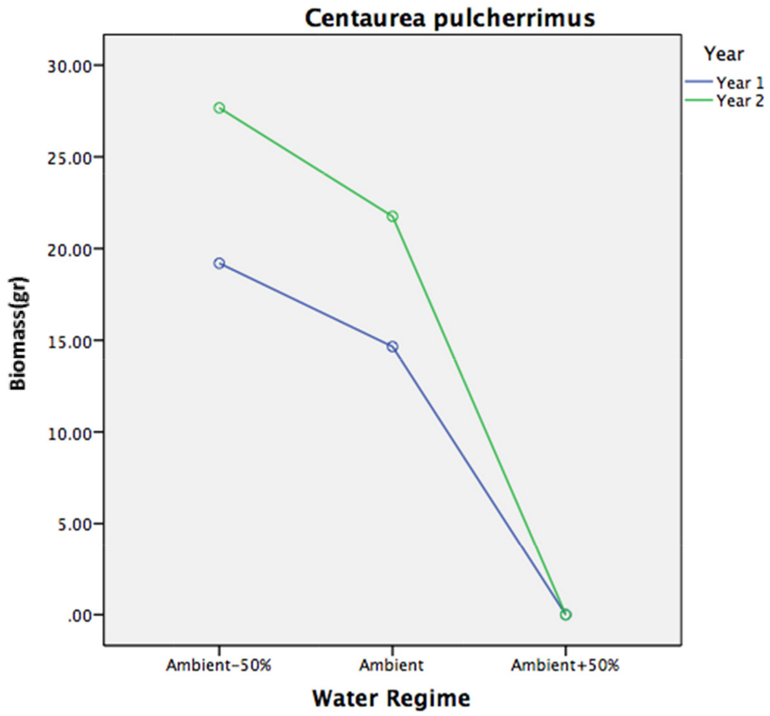

Figure 3. 113 Effects of different levels moisture availability on biomass (gr)productivity of *Centaurea pulcherrimus* over 2 years

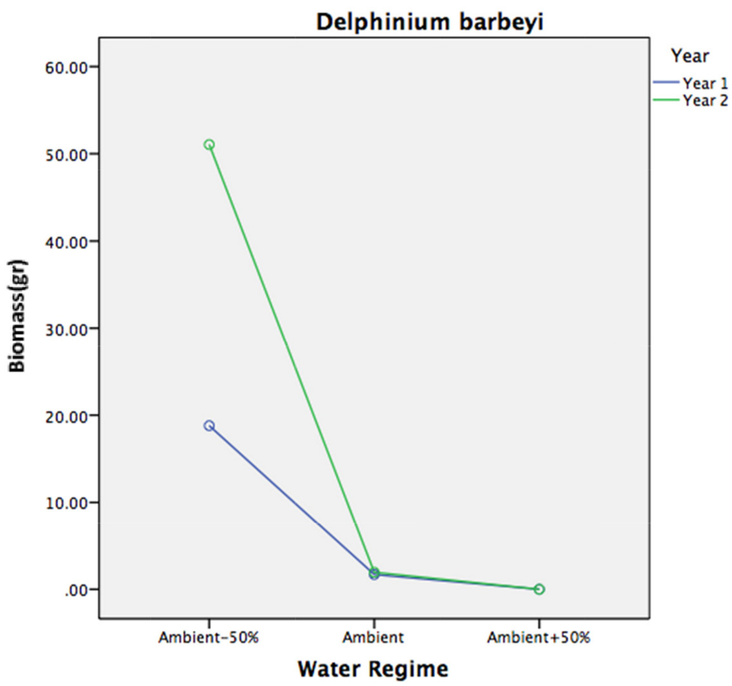

Figure 3. 114 Effects of different levels moisture availability on biomass (gr)productivity of *Delphinium barbeyi* over 2 years

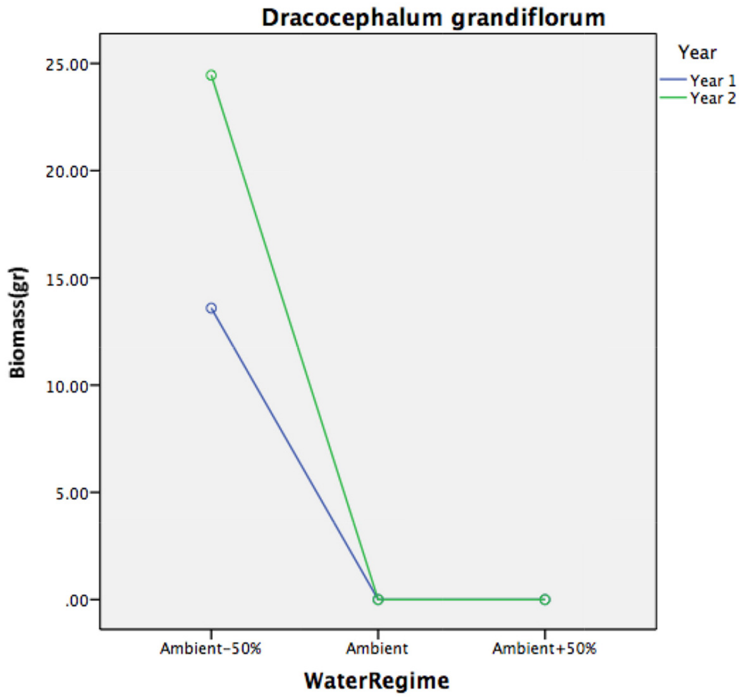

Figure 3. 115 Effects of different levels moisture availability on biomass (gr)productivity of *Dracocephalum grandiflorum* over 2 years

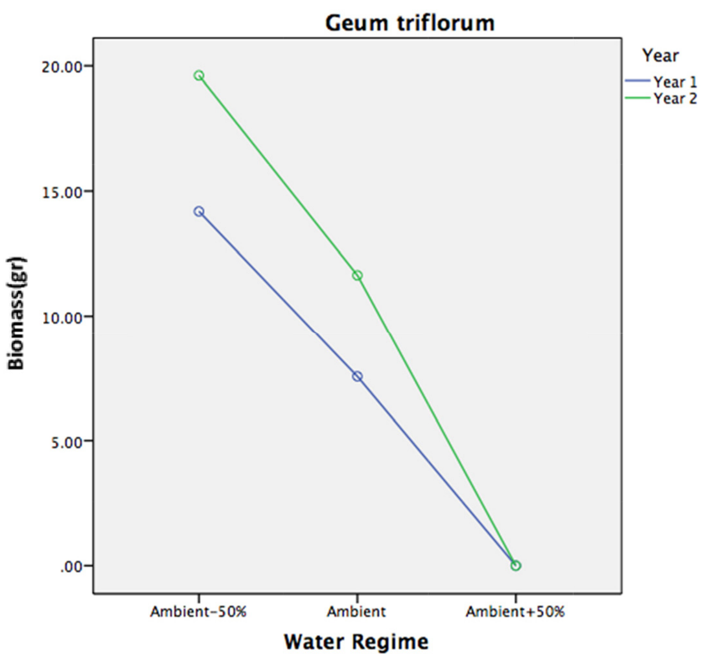

Figure 3. 116 Effects of different levels moisture availability on biomass (gr)productivity of *Geum triflorum* over 2 years

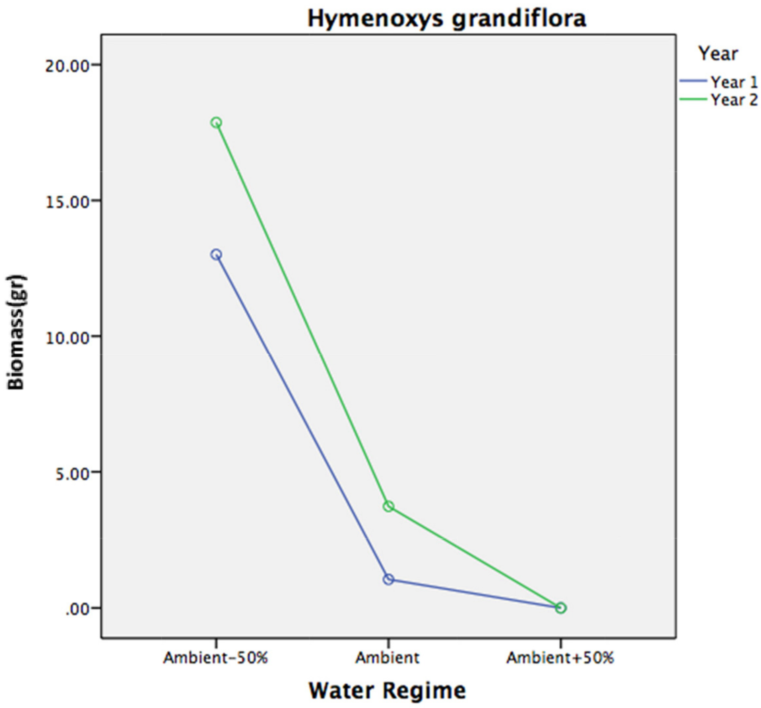

Figure 3. 117 Effects of different levels moisture availability on biomass (gr)productivity of *Hymenoxys grandiflora* over 2 years

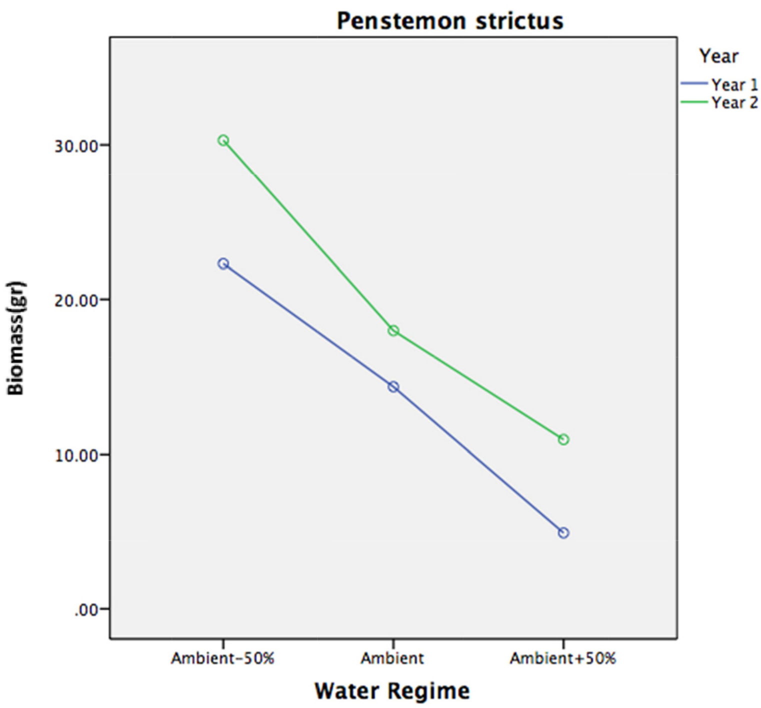

Figure 3. 118 Effects of different levels of moisture availability on biomass (gr)productivity of *Penstemon strictus* over 2 years

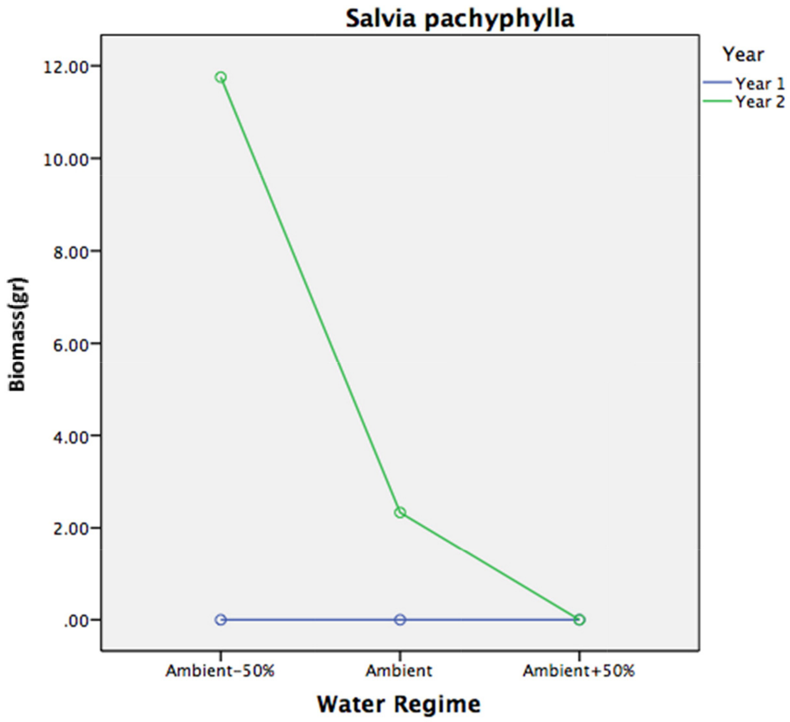

Figure 3. 119 Effects of different levels moisture availability on biomass (gr)productivity of *Salvia pachyphylla* over 2 years

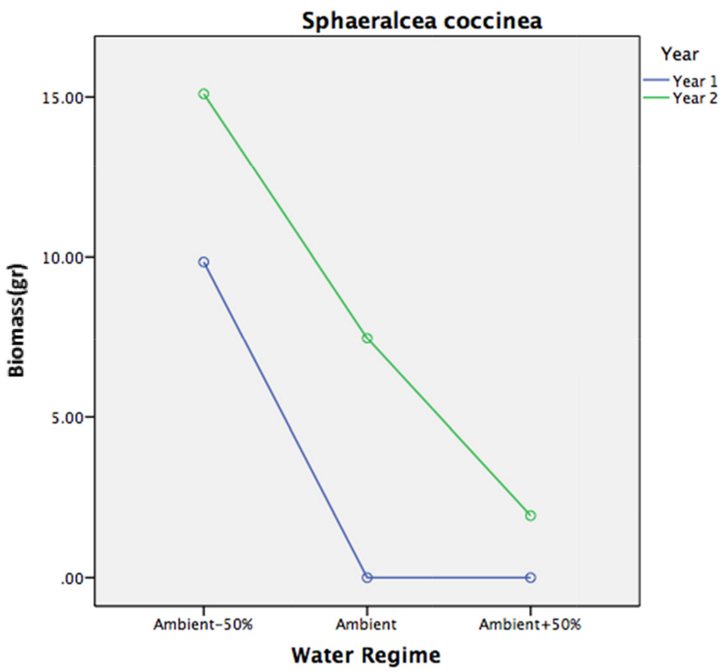

Figure 3. 120 Effects of different levels moisture availability on biomass productivity of *Sphaeralcea coccinea* over 2 years

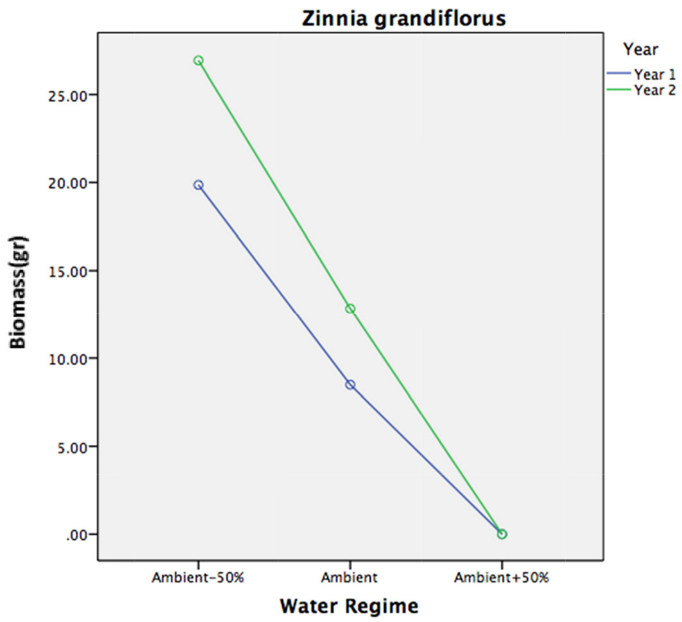

Figure 3. 121 Effects of different levels moisture availability on biomass (gr)productivity of *Zinnia grandiflorus* over 2 years

3.3.2.6 The effects different levels of temperature on biomass productivity of over the 2 years experiments

3.3.2.6.1 Well fitted species

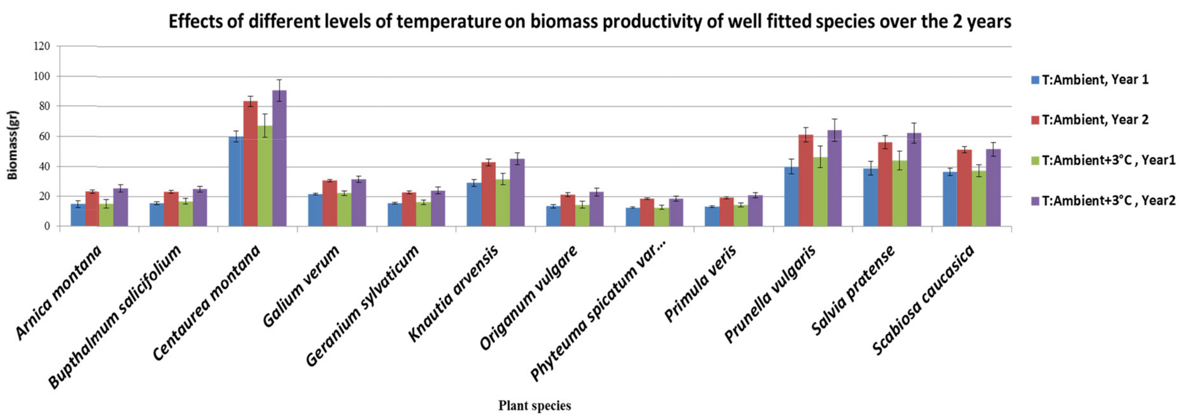

Figure 3.122 Effects of different levels of temperature on biomass(gr) productivity of well fitted species over the 2 years

All of the species show better growth and higher biomass production during the year 2 as well as when they are exposed to Ambient +3°C, although in many cases these differences are not statistically significant

3.3.2.6.1.1 Response of individual well fitted species

All of the plant species in the well-fitted group show notably higher biomass productions in Year 2 compared to Year 1. Increasing the temperature level to ambient +3°C, further increases plant growth with the exception of *Phyteuma spicatum* var*. caerulea and Scabiosa caucasica.*

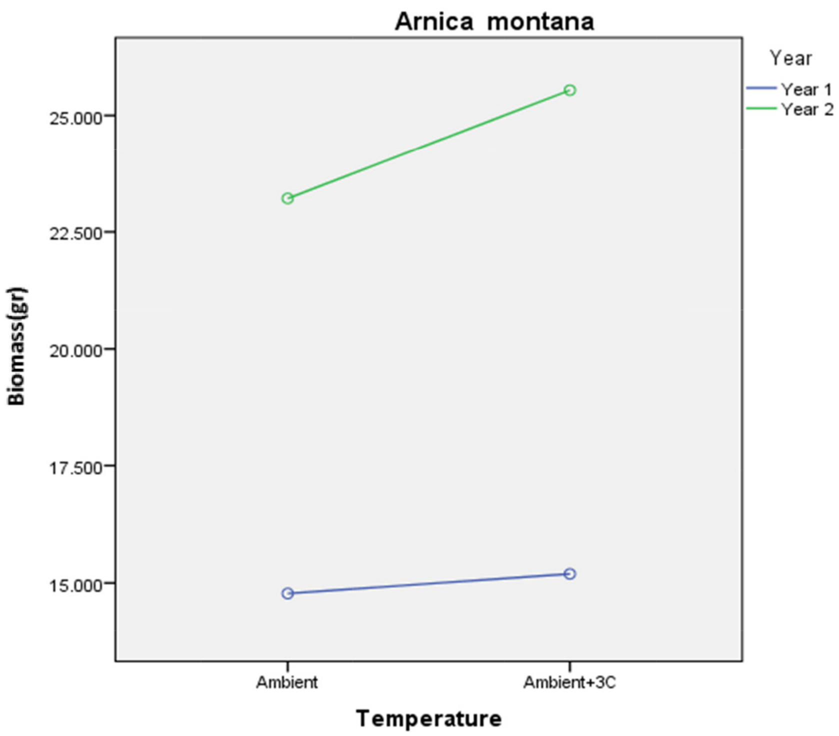

Figure 3. 123 Effects of different levels of temperature on biomass(gr) productivity of *Arnica montana* over 2 years

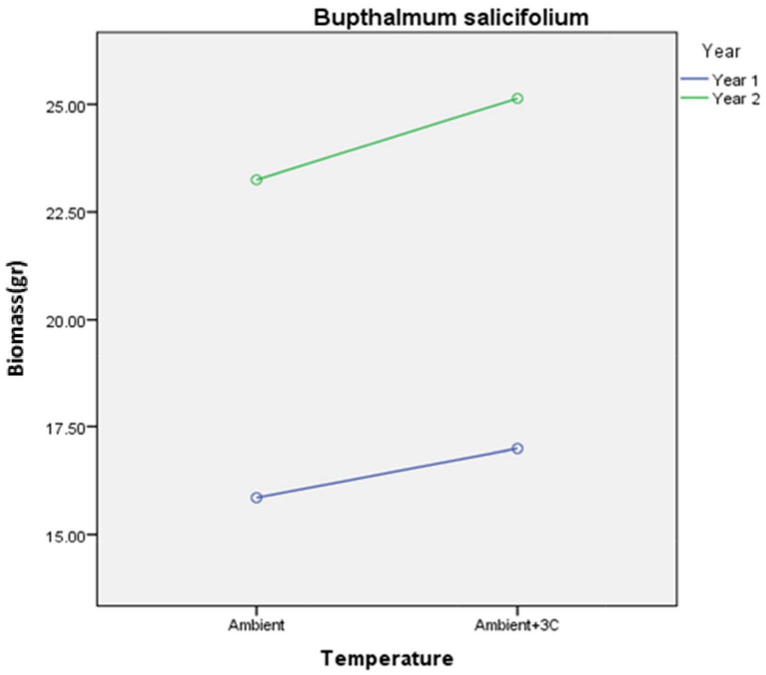

Figure 3. 124 Effects of different levels of temperature on biomass (gr)productivity of *Bupthalmum salicifolium* over 2 years

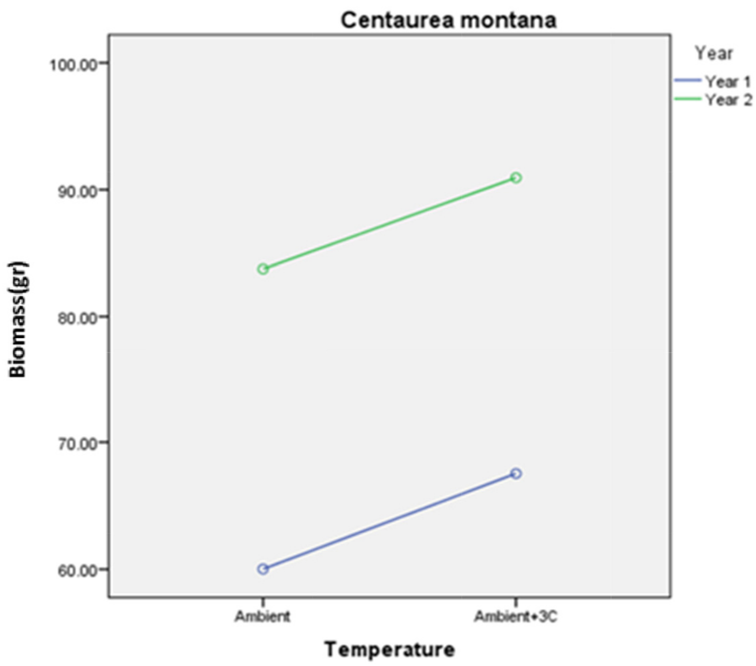

Figure 3. 125 Effects of different levels of temperature on biomass(gr) productivity of *Centaurea montana* over 2 years

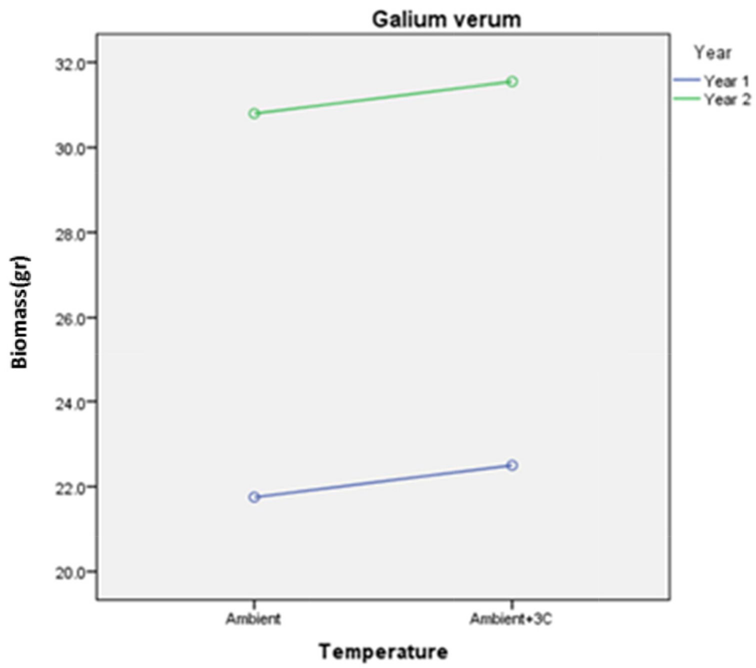

Figure 3. 126 Effects of different levels of temperature on biomass(gr) productivity of *Galium verum* over 2 years

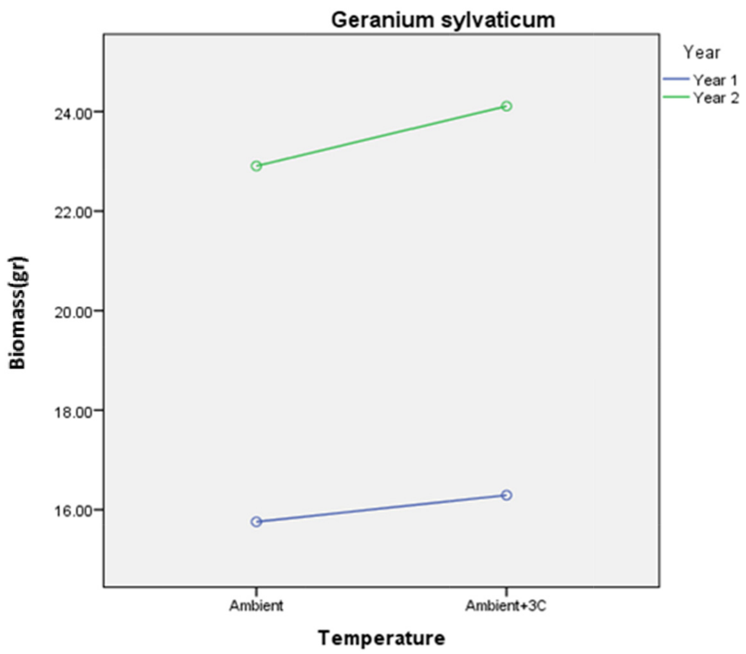

Figure 3. 127 Effects of different levels of temperature on biomass(gr) productivity of *Geranium sylvaticum* over 2 years

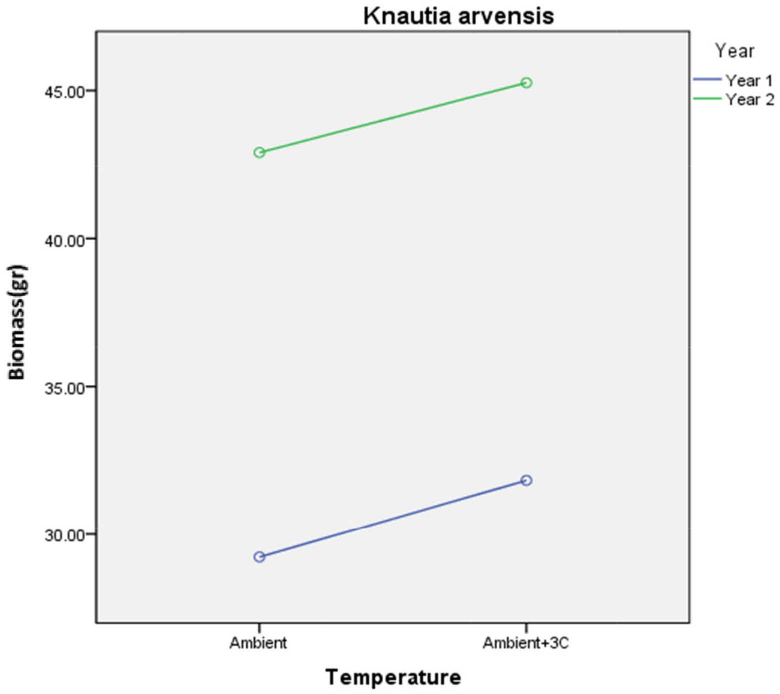

Figure 3.128 Effects of different levels of temperature on biomass(gr) productivity of *Knautia arvensis* over

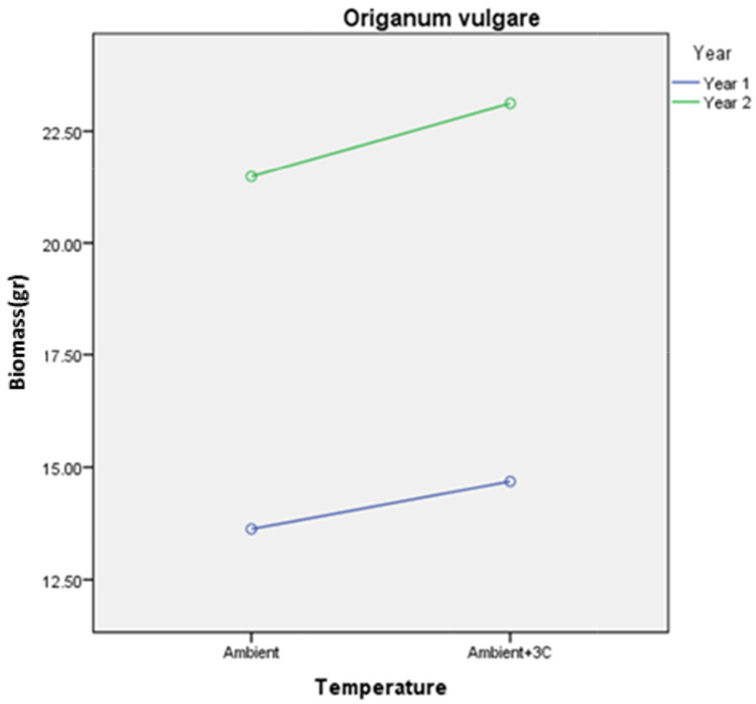

Figure 3.129 Effects of different levels of temperature on biomass(gr) productivity of *Origanum vulgare* over 2 years

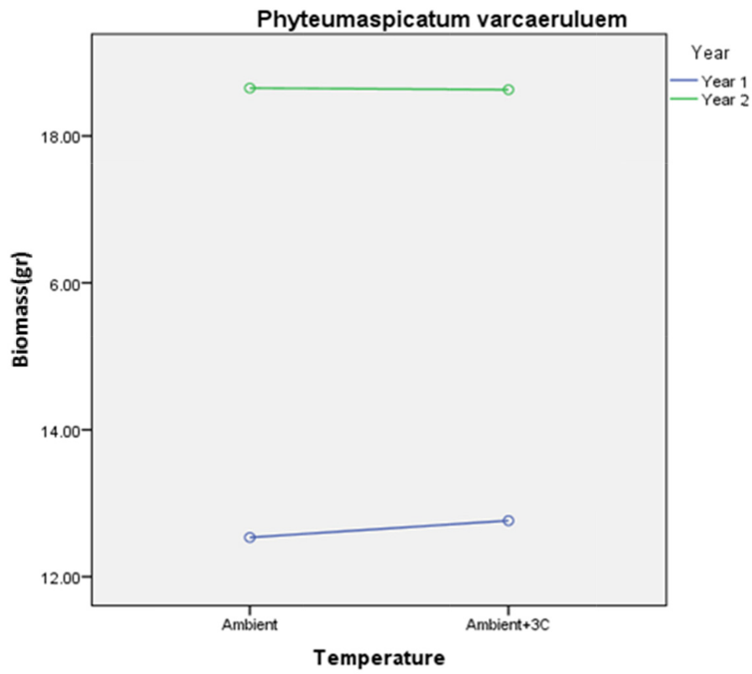

Figure 3. 130 Effects of different levels of temperature on biomass (gr)productivity of *Phyteuma spicatum* over 2 years

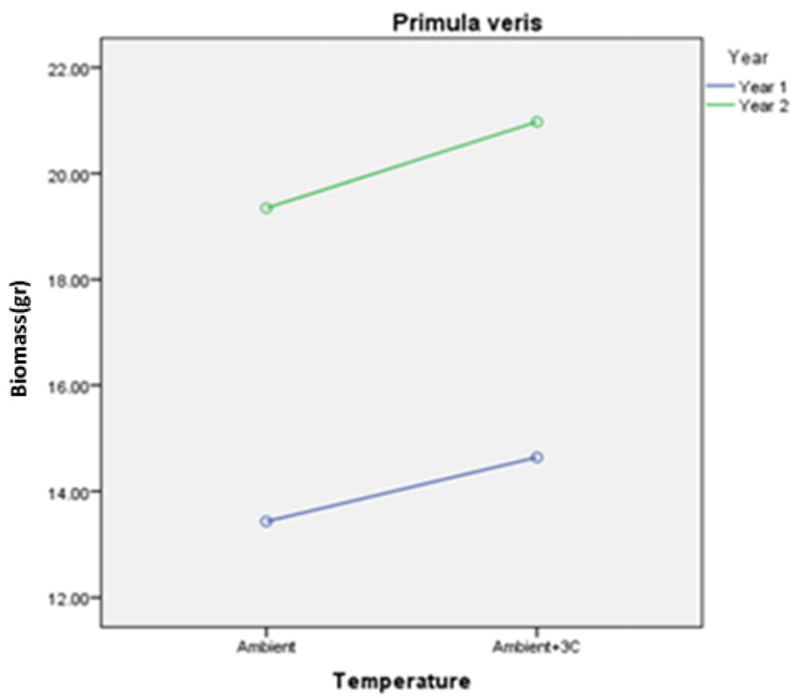

Figure 3.131 Effects of different levels of temperature on biomass(gr) productivity of *Primula veris* over 2 years

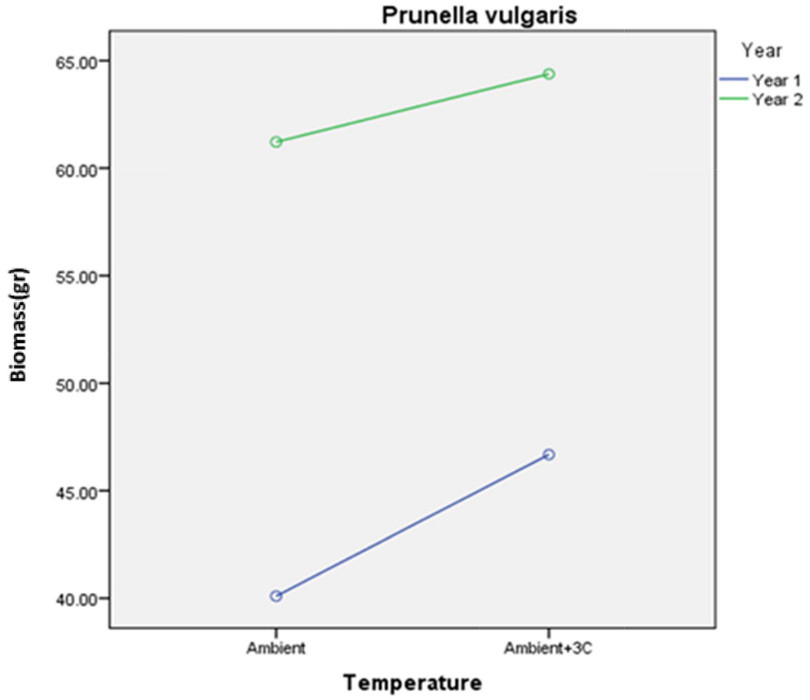

Figure 3. 132 Effects of different levels of temperature on biomass (gr)productivity of *Prunella vulgaris* over 2 years

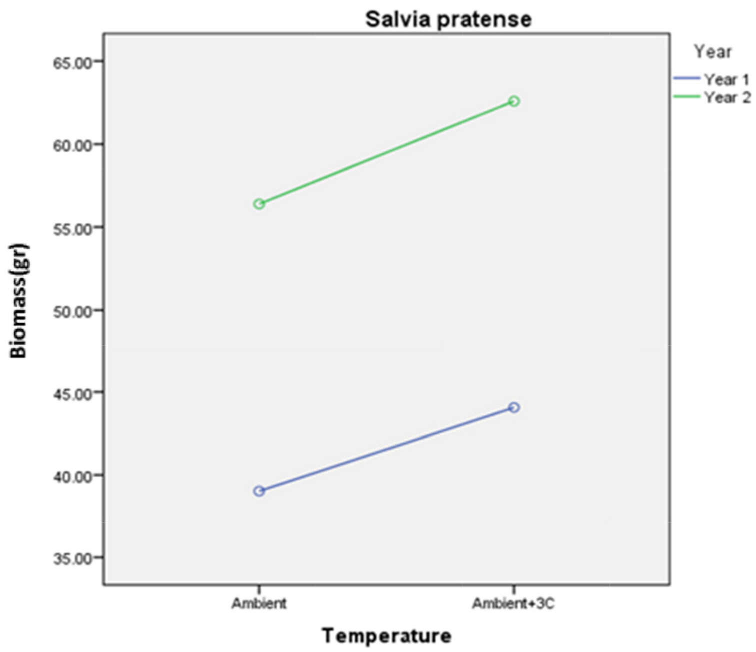

Figure 3.133 Effects of different levels of temperature on biomass(gr) productivity of *Salvia pratense* over 2 years

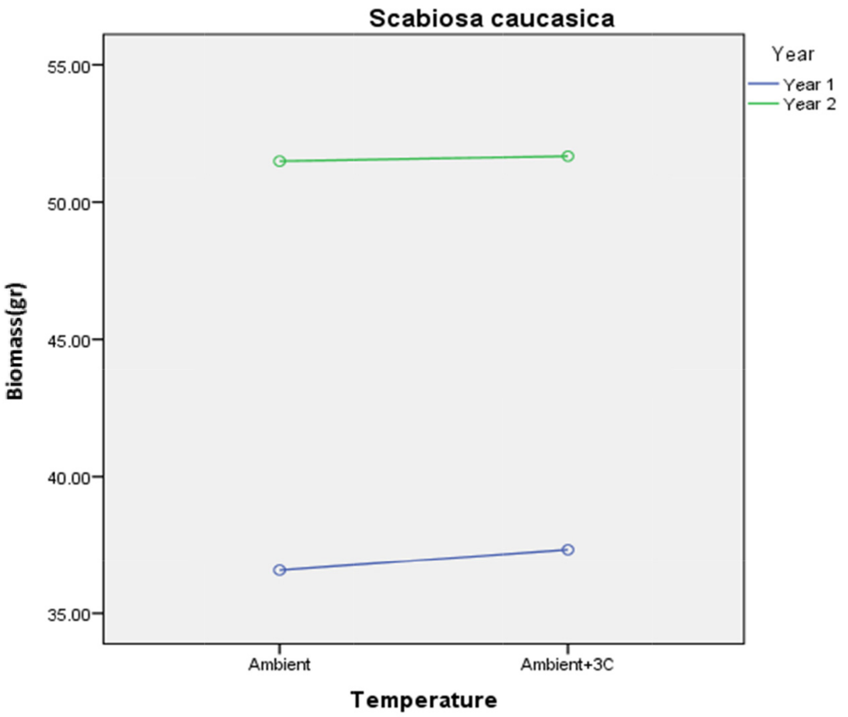

Figure 3. 134 Effects of different levels of temperature on biomass(gr) productivity of *Scabiosa caucasica* over the 2 years

3.3.2.6.2 Intermediate fitted species

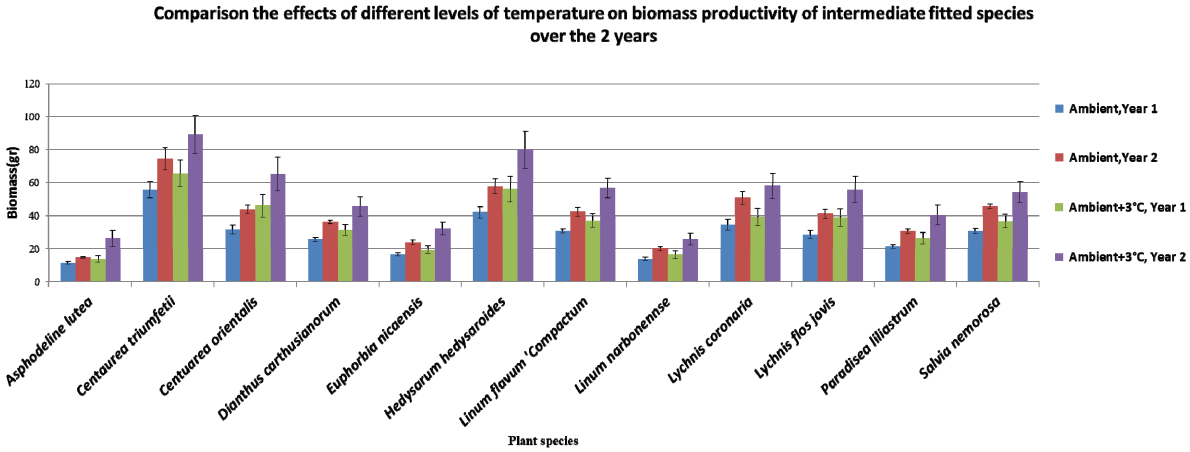

Figure 3.135 Effects of different levels of temperature on biomass productivity of Intermediate fitted over the 2 years

These show similar behavior to the well fitted group, but with more biomass during the second year of growth. They also react positively when they are exposed to Ambient +3°C and produce higher amount of biomass, though this increase is not drastic.

3.3.2.6.2.1 Response of Intermediate fitted species individualy

The slope of increasing biomass productivity in Year 2 compared to Year 1 is approximately similar for these species (except for *Asphodeline lutea*, Fig 3.136); however, the biomass production is considerably higher for all of these species in this group in Year 2 in comparison to Year 1. This suggests that these southern European species take longer to adapt and establish in 1 year.

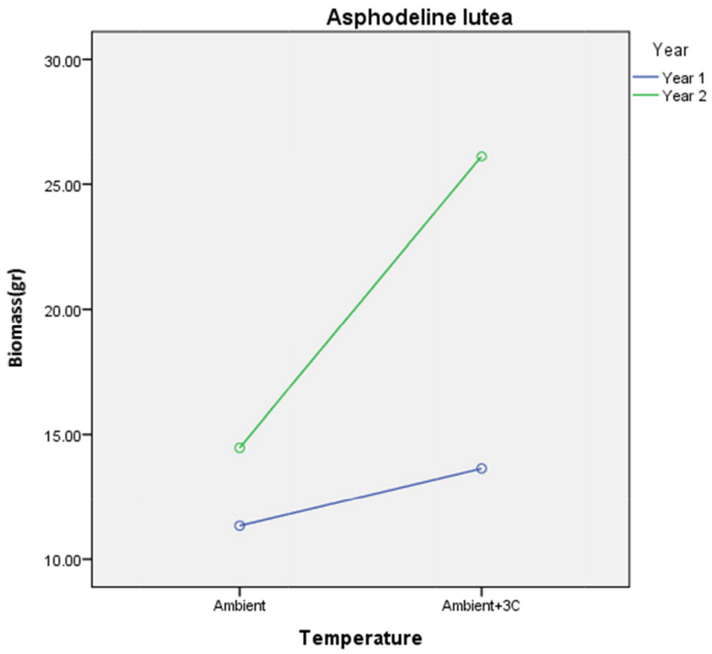

Figure 3.136 Effects of different levels of temperature on biomass(gr) productivity of *Asphodeline lutea* over 2 years

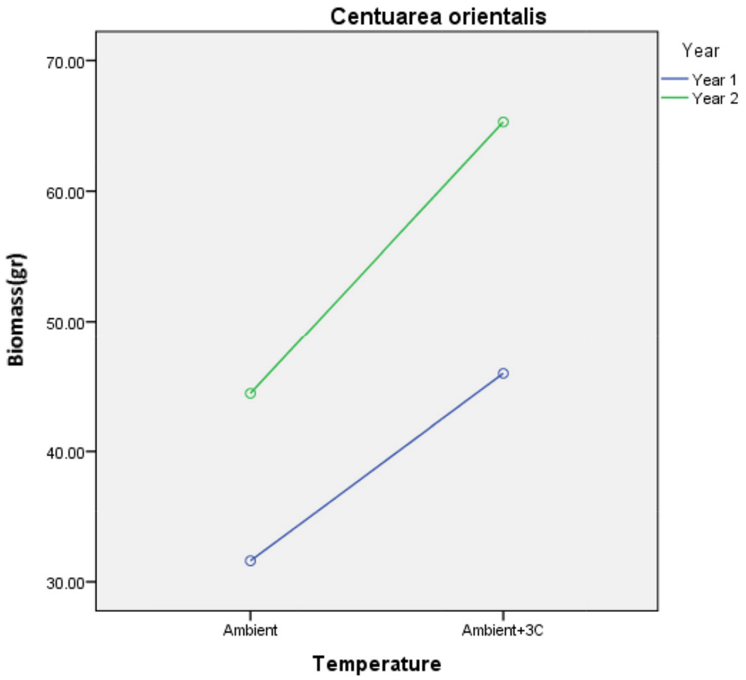

Figure 3.137 Effects of different levels of temperature on biomass(gr) productivity of *Centuarea orientalis* over 2 years

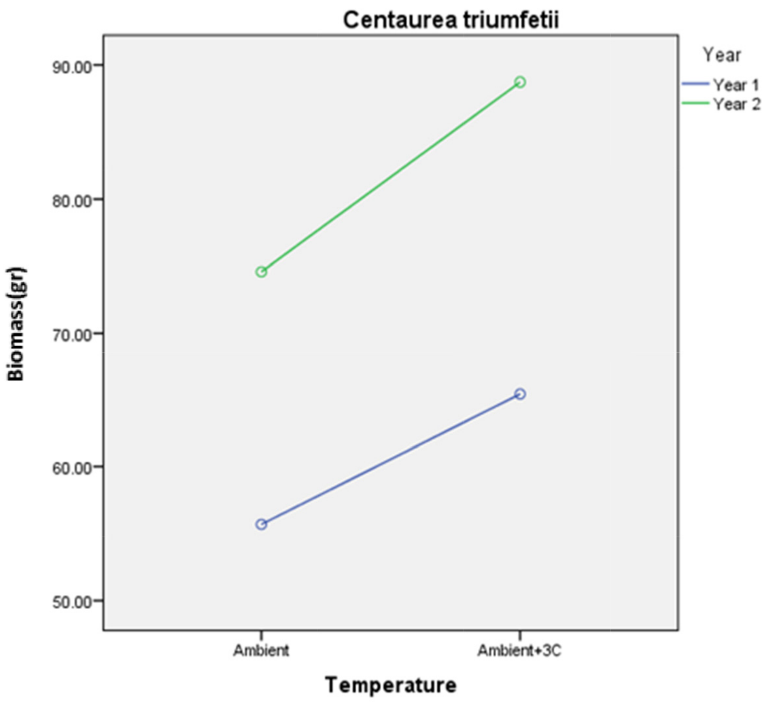

Figure 3. 138 Effects of different levels of temperature on biomass(gr) productivity of *Centaurea triumfetii* over the 2 years

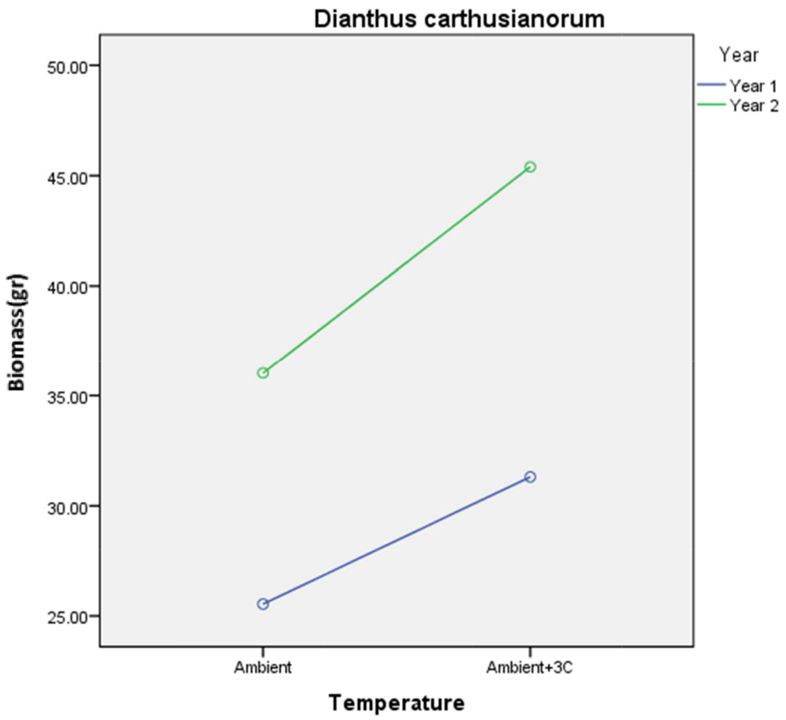

Figure 3. 139 Effects of different levels of temperature on biomass(gr) productivity of *Dianthus carthusianorum* over 2 years

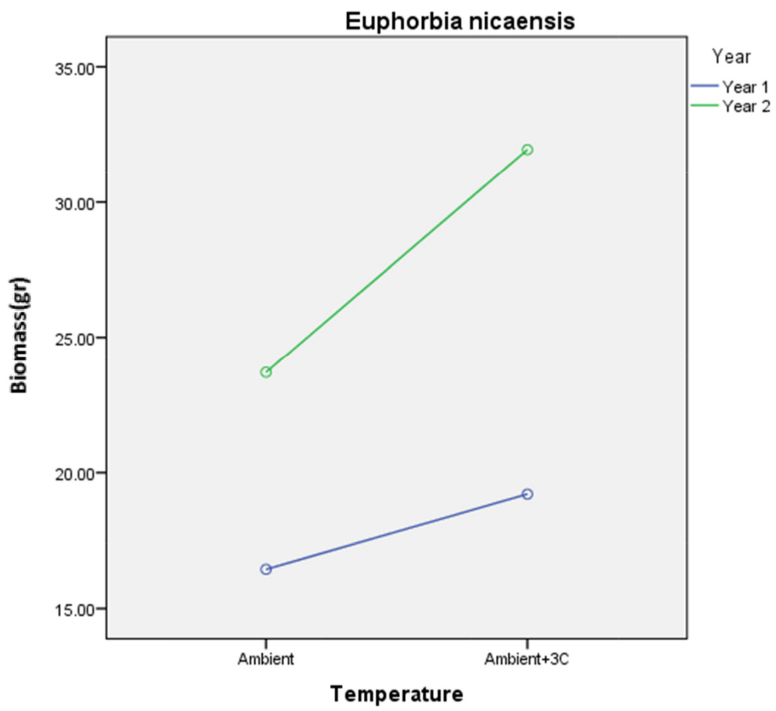

Figure 3. 140 Effects of different levels of temperature on biomass (gr)productivity of *Euphorbia nicaensis* over 2 years

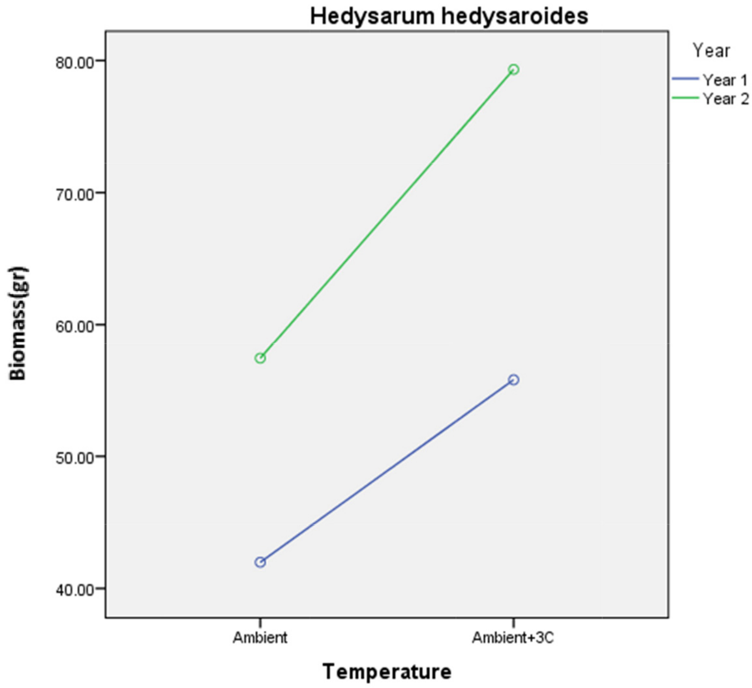

Figure 3. 141 Effects of different levels of temperature on biomass (gr)productivity of *Hedysarum hedysaroides* over 2 years

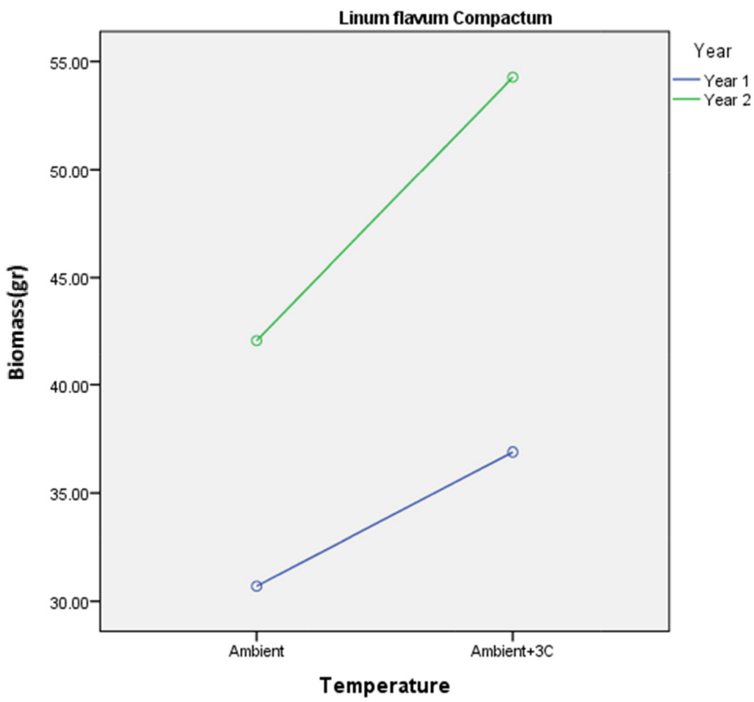

Figure 3. 142 Effects of different levels of temperature on biomass(gr) productivity of *Linum flavum 'Compactum'* over 2 years

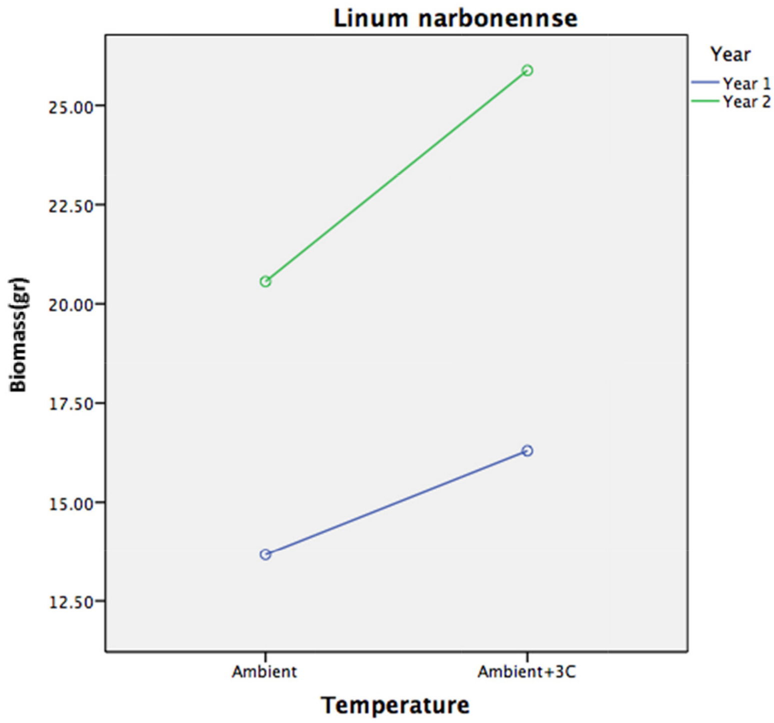

Figure 3. 143 Effects of different levels of temperature on biomass(gr) productivity of *Linum narbonennse* over 2 years

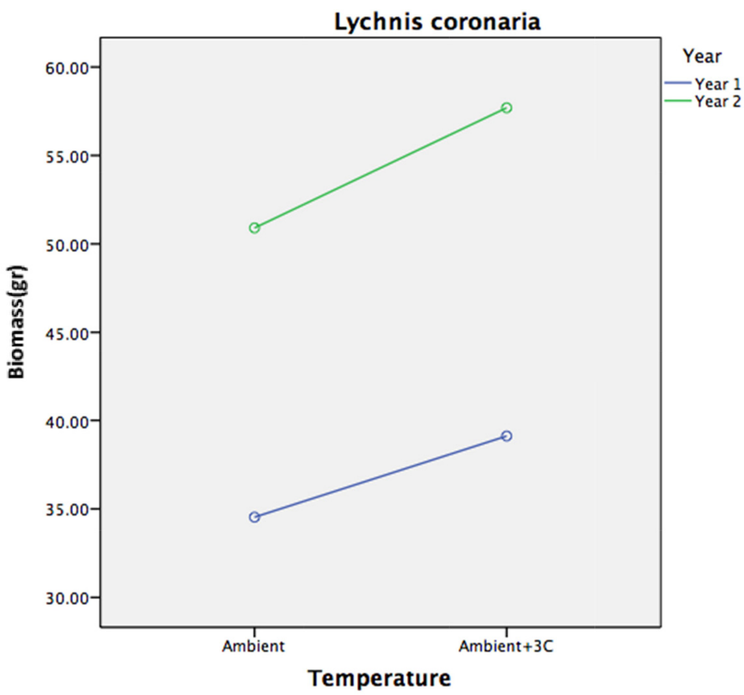

Figure 3. 144 Effects of different levels of temperature on biomass(gr) productivity of *Lychnis coronaria* over 2 years

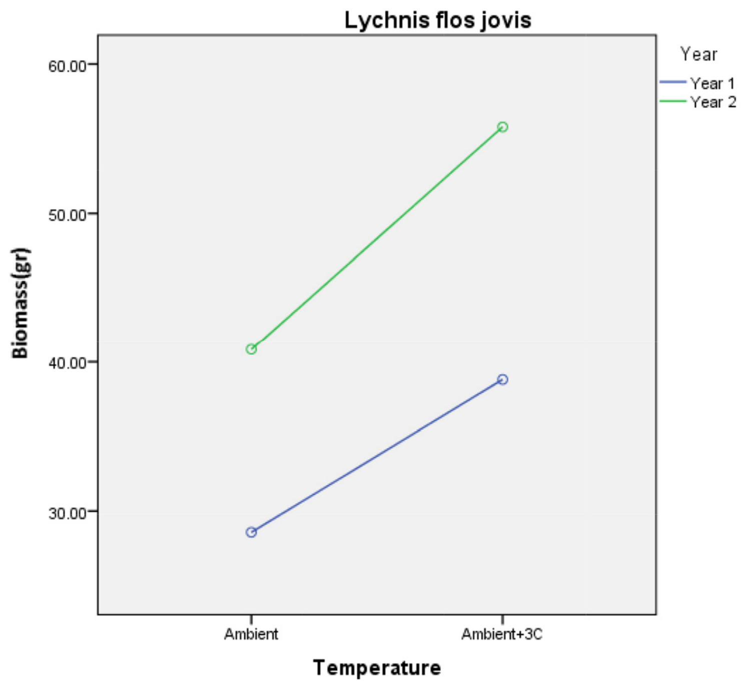

Figure 3. 145 Effects of different levels of temperature on biomass (gr)productivity of *Lychnis flos-jovis* over 2 years

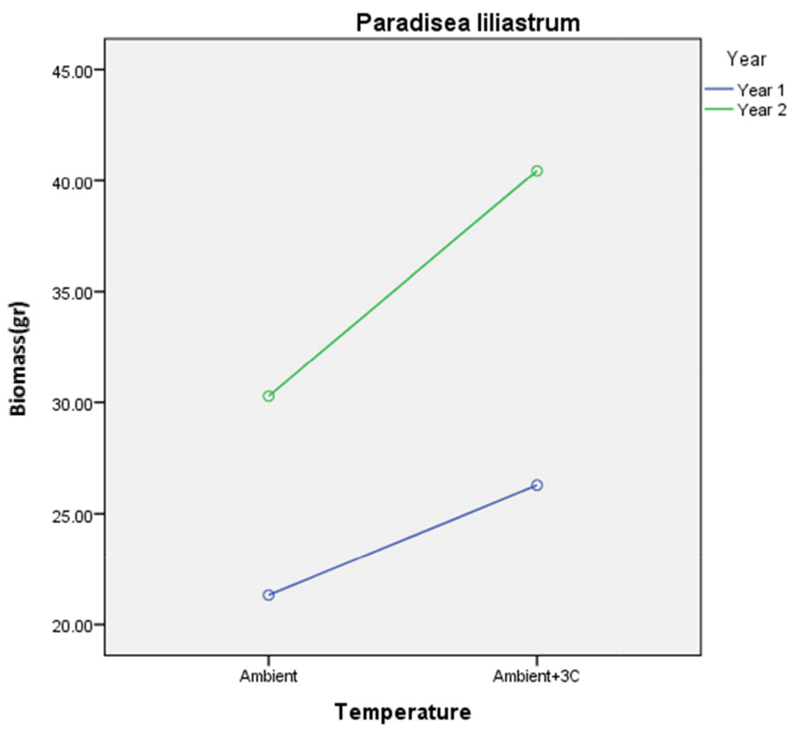

Figure 3. 146 Effects of different levels of temperature on biomass(gr) productivity of *Paradisea liliastrum* over 2 years

Figure 3.147 Effects of different levels of temperature on biomass (gr)productivity of *Salvia nemorosa* over 2 years

3.3.2.6.3 Poorly fitted species

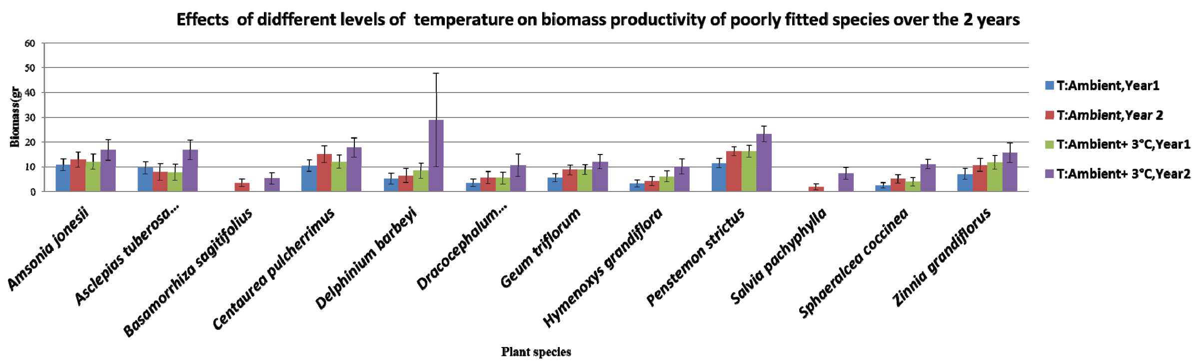

Figure 3. 148 Effects of different levels of temperature on biomass (gr)productivity of poorly fitted species over 2 years

The plants in this group show increase in biomass production in Year 2 when they are exposed to Ambient +3°C. As mentioned before this group of mainly north Americn native plants are sensitive to high levels of moisture. Increasing the temperature accelerate evaporation rate and better meets their temperature requirements for optimal photosynthesis leading to better growth for these species.

3.3.2.6.3.1 Response of poorly fitted species individually

The plant species in this group produce the lowest amount of biomass compared to the other species in this study. The negligible amount of the biomass produced shows steady increase in Year 2 for all of the studied plants in this group when the temperature is increased. Nevertheless, changes in biomass production in Year 1 as a result of changing the temperature is not consistent and shows a spectrum of behavior from failing to survive to steady growth. Although the data show some biomass productivity, compared to the species in intermediate group, these plants overall are still poorly fitted to the experimental conditions. *Asclepias tuberosa* (Fig 3.150) surprisingly moves towards failing to survive when the temperature increases. As Fig 3.151 shows, during the first year of experiments the *Balsmorrhiza sagitifolius* died. Fig 3.158 *Salvia pachyphylla* shows similar behavior.

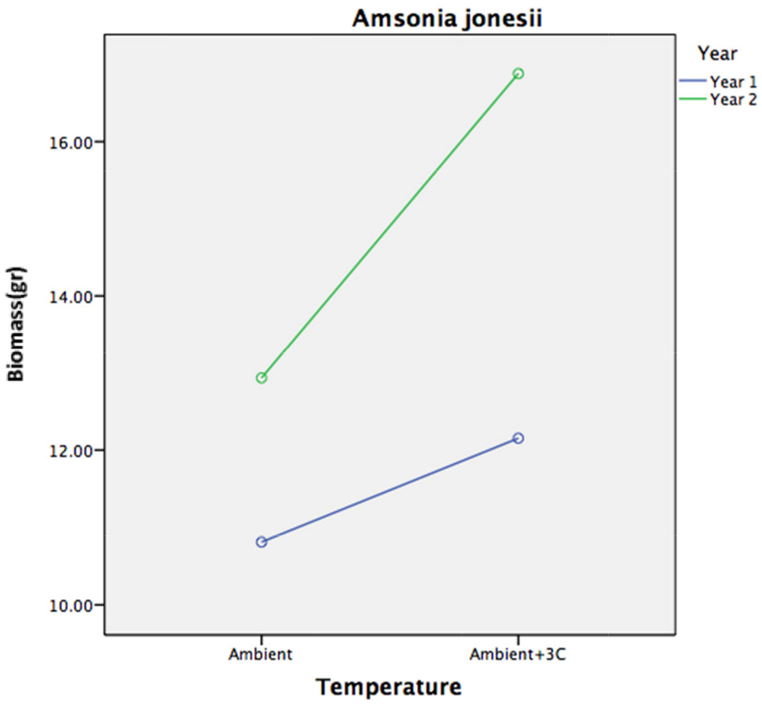

Figure 3.149 Effects of different levels of temperature on biomass(gr) productivity of *Amsonia jonesii* over the 2 years

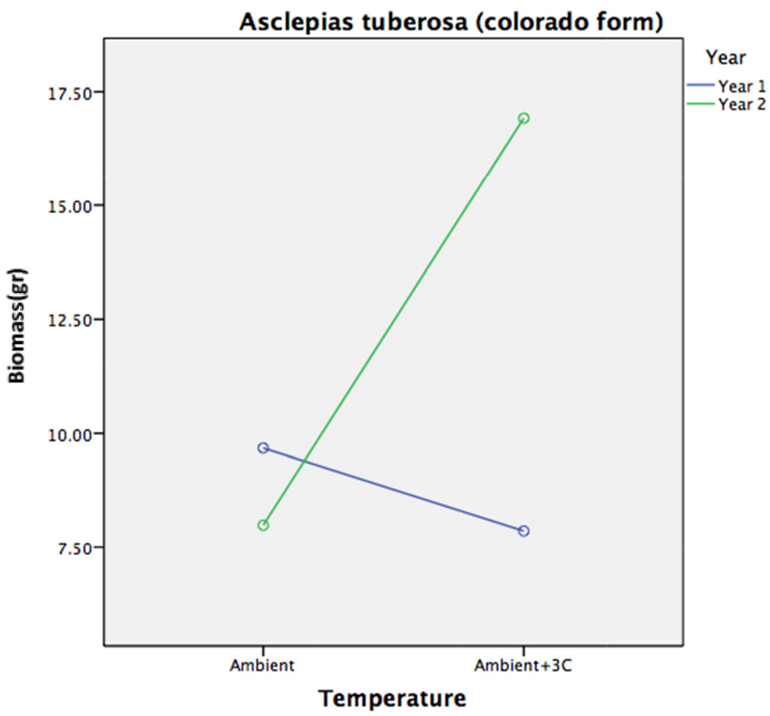

Figure 3.150 Effects of different levels of temperature on biomass(gr) productivity of *Asclepias tuberosa* over the 2 years

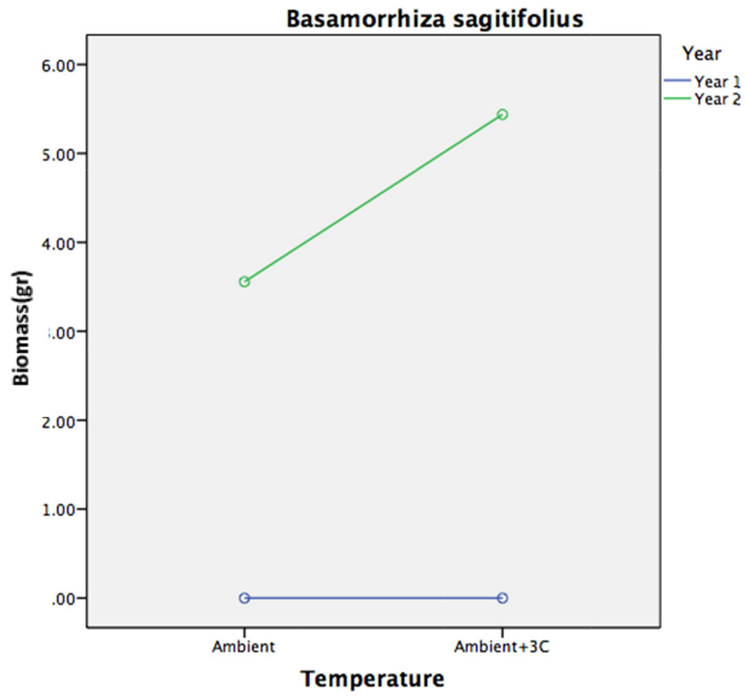

Figure 3.151 Effects of different levels of temperature on biomass (gr)productivity of *Balsamorrhiza sagitifolius* over the 2 years

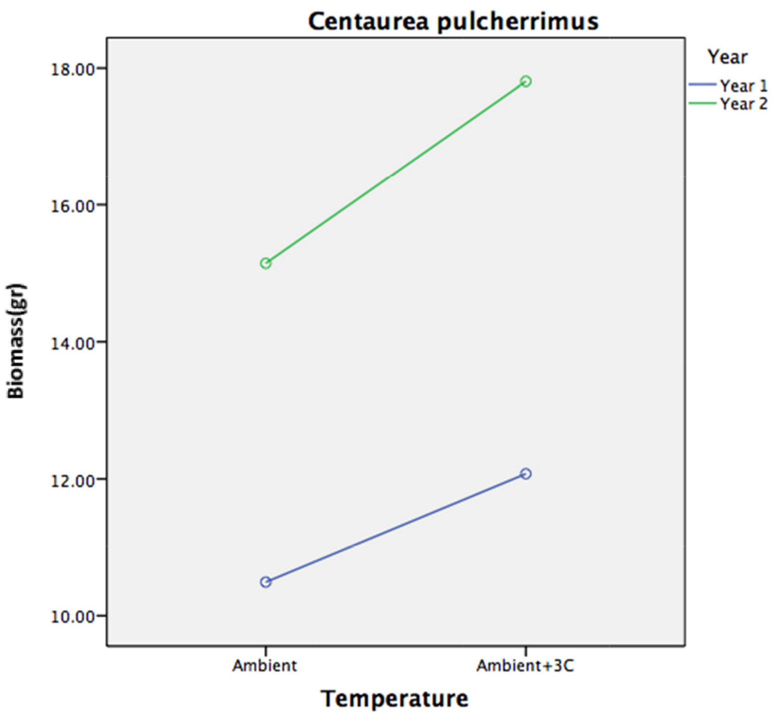

Figure 3.152 Effects of different levels of temperature on biomass (gr)productivity of *Centaurea pulcherrimus* over the 2 years

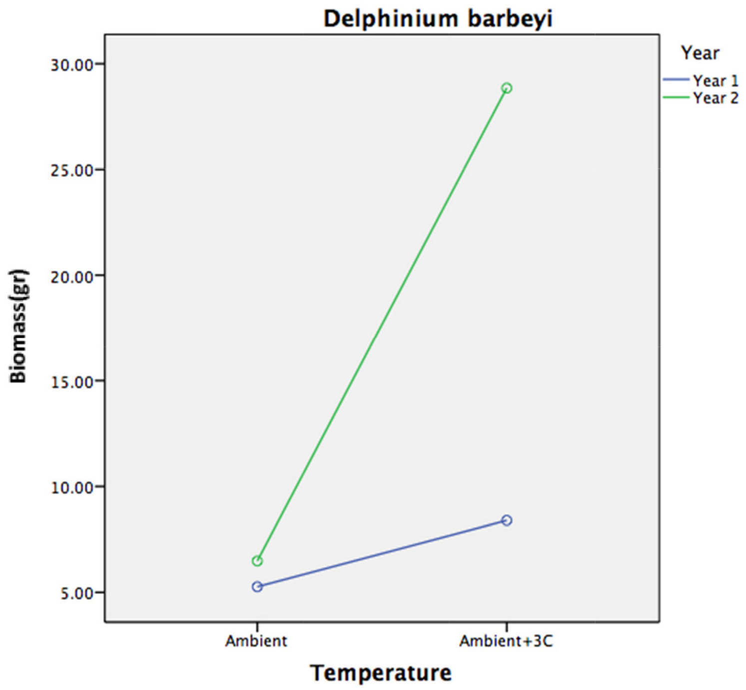

Figure 3.153 Effects of different levels of temperature on biomass (gr)productivity of *Delphinium barbeyi* over the 2 years

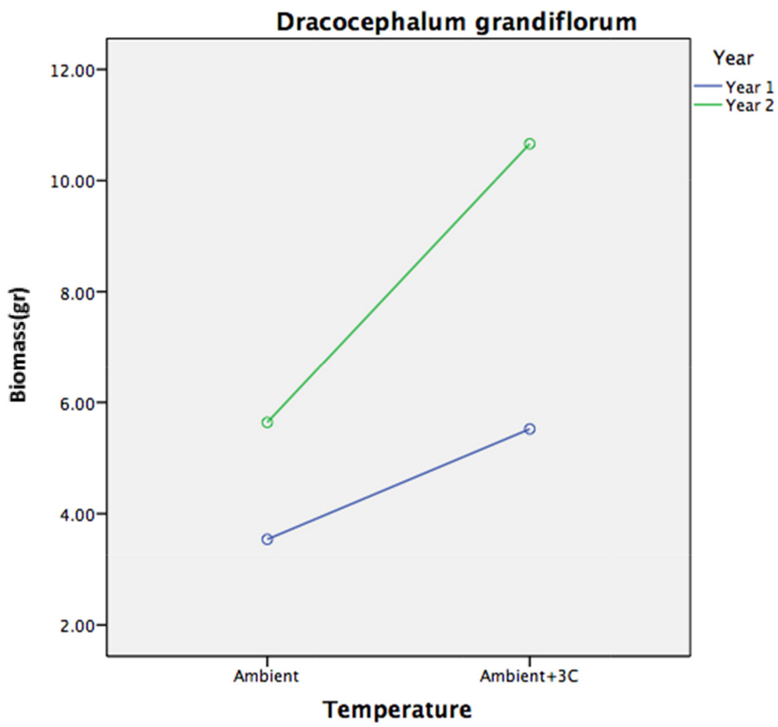

Figure 3.154 Effects of different levels of temperature on biomass(gr)productivity of *Dracocephalum grandiflorum* over the 2 years

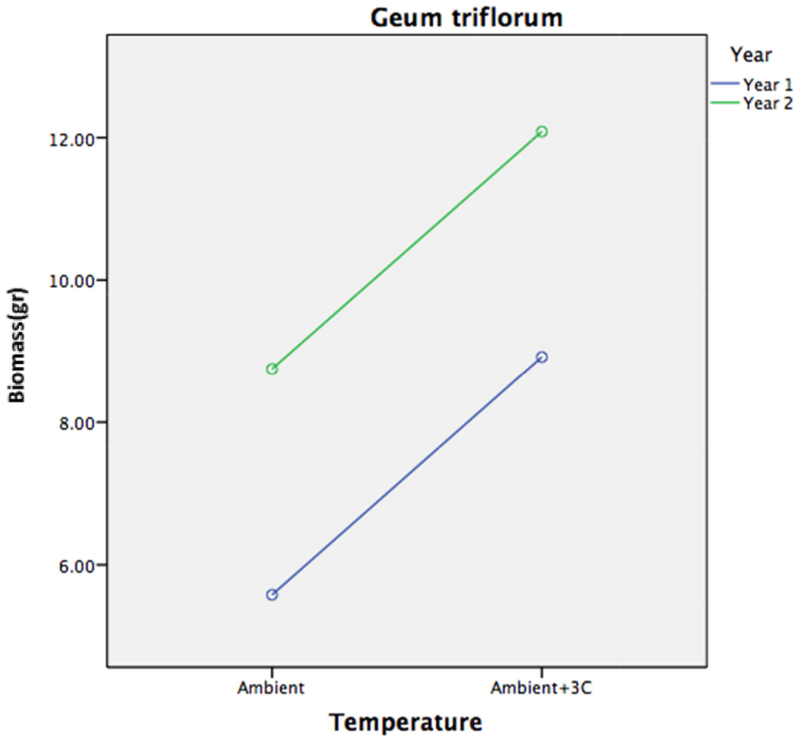

Figure 3. 155 Effects of different levels of temperature on biomass (gr)productivity of *Geum triflorum* over the 2 years

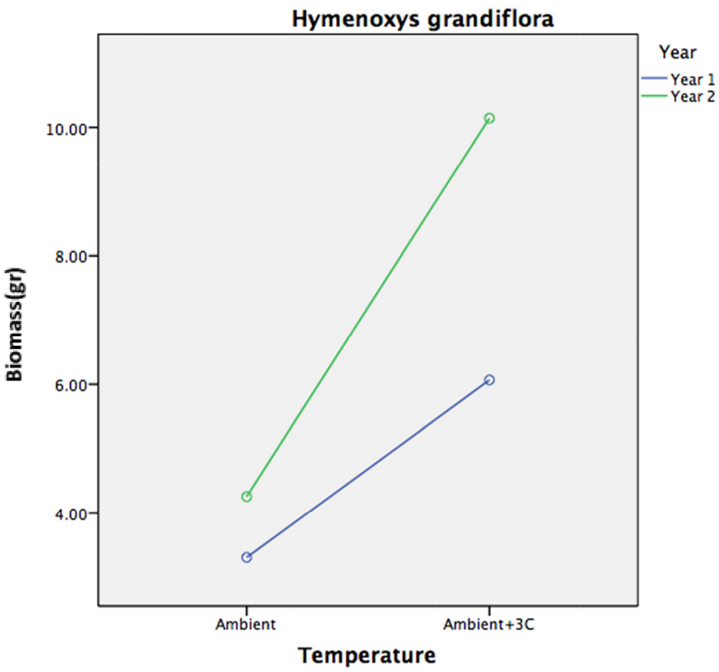

Figure 3. 156 Effects of different levels of temperature on biomass (gr)productivity of *Hymenoxys grandiflora* over the 2 years

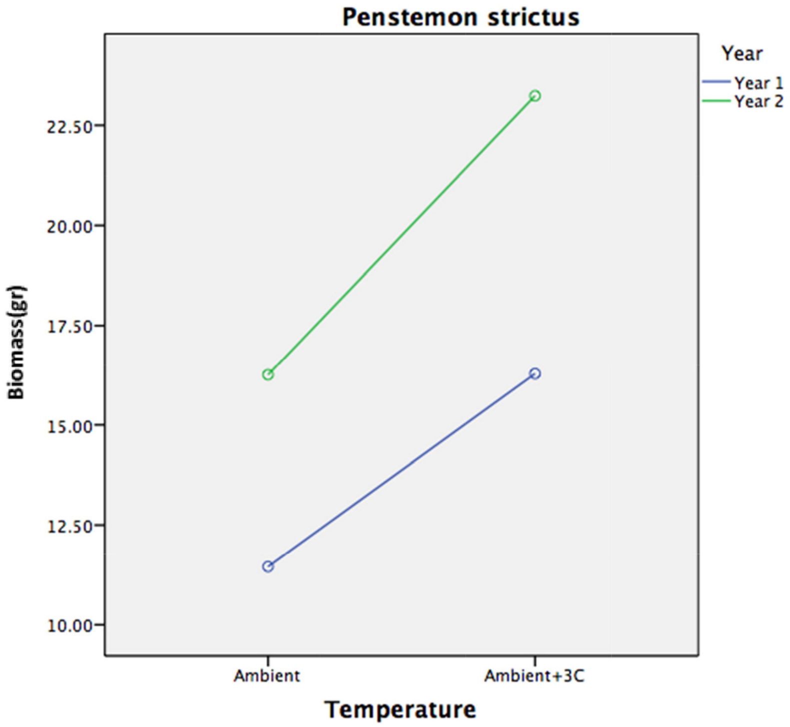

Figure 3.157 Effects of different levels of temperature on biomass (gr)productivity of *Penstemon strictus* over the 2 years

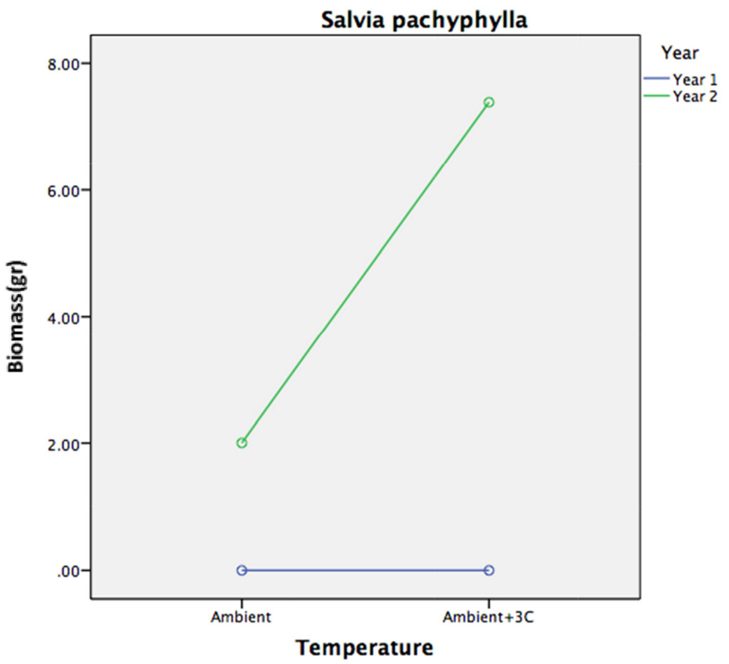

Figure 3. 158 Effects of different levels of temperature on biomass(gr) productivity of *Salvia pachyphylla* over the 2 years

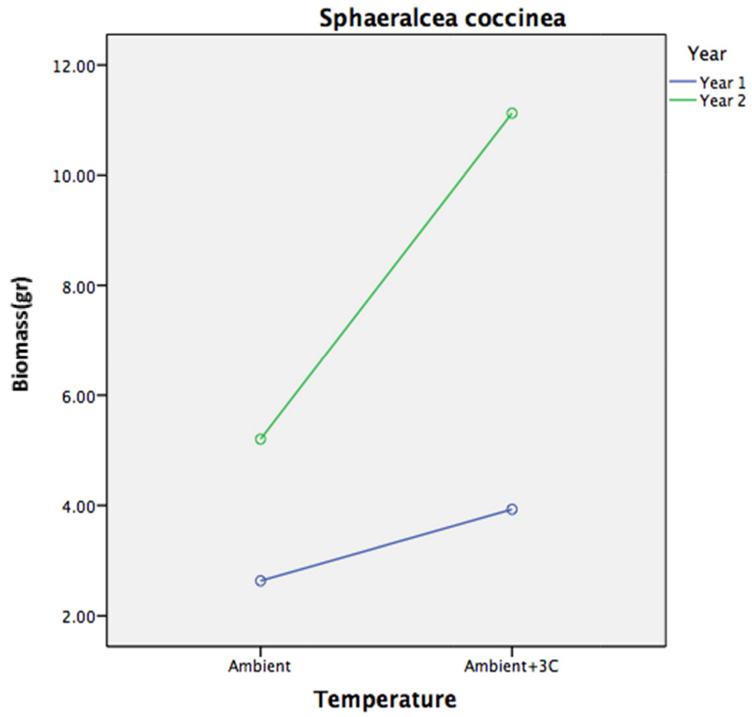

Figure 3. 159 Effects of different levels of temperature on biomass(gr) productivity of Sphaeralcea coccinea over the 2 years

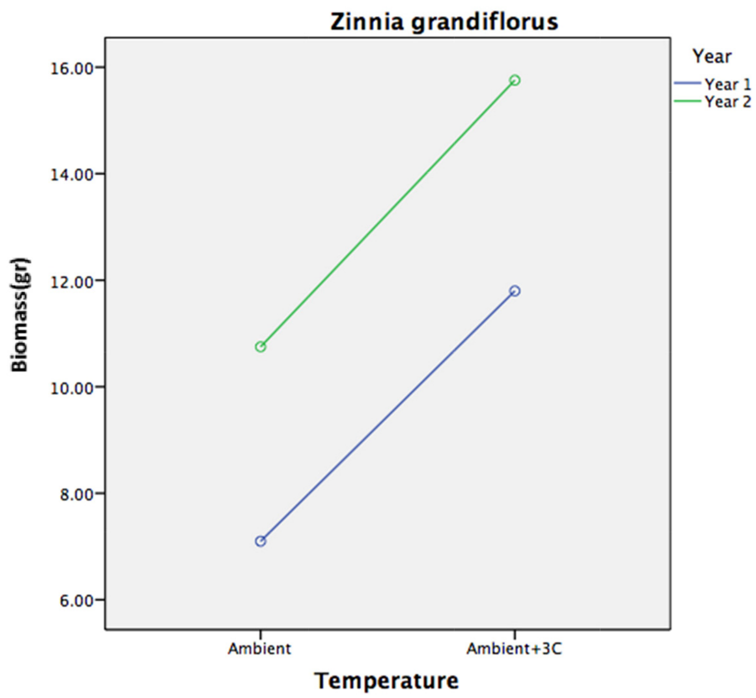

Figure 3. 160 Effects of different levels of temperature on biomass (gr)productivity of *Zinnia grandiflora* over the 2 years

3.3.2.7 Effects of different levels moisture availability and temperature on biomass productivity of species in year 1 and 2.

3.3.2.7.1 Well fitted species

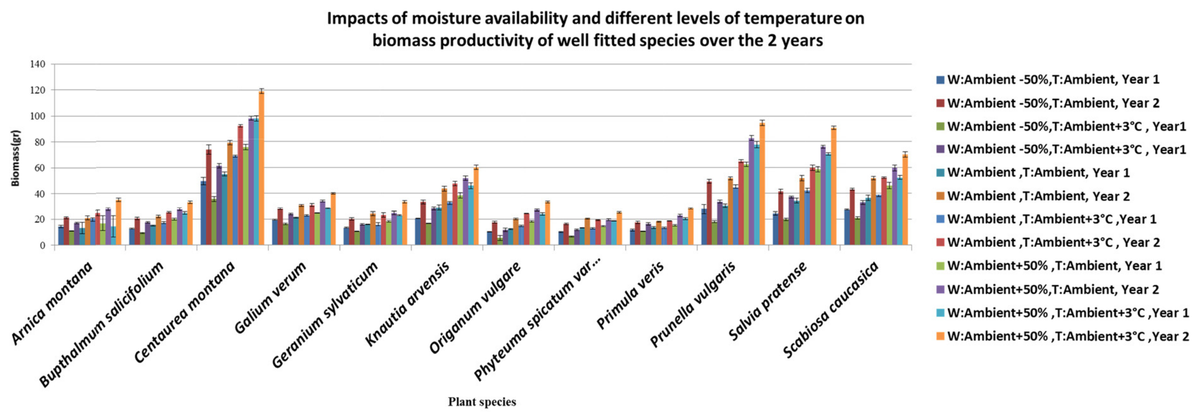

Figure 3. 161 Effects of the interaction of water regime and different level of temperature on biomass productivity of well-fitted species over the 2 years

Maritime-montane climate species (well fitted group) show higher amount of the biomass production in the second year compared to the year one. They all have the highest amount of growth when they are exposed to W: Ambient + 50% and T: Ambient +3°C (Year 2). Lowest level of biomass growth belongs to W: Ambient -50% and T: Ambient +3°C in this group. From this observation it can be inferred that the plant species in the well-fitted group are very sensitive to the water availability but less sensitive to temperature.

3.3.2.7.2 Intermediate fitted species

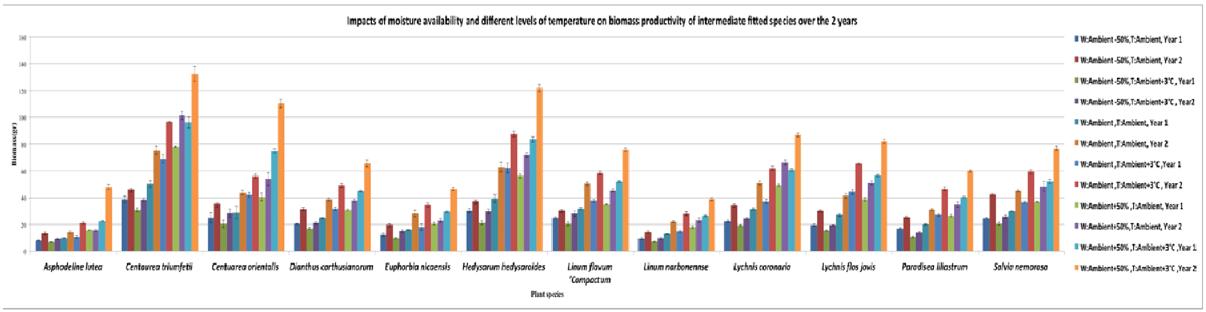

Figure 3.162 Effects of interaction between the water regime and different level of temperature on biomass productivity of Intermediate fitted species over the 2 years

Mediterranean climate species (intermediate fitted group), similar to the well-fitted plant species, have the highest growth rate in year 2 and when they are exposed to W Ambient+50% and ambient +3°C. Overall biomass production for all of these species in this group is higher than those in the well-fitted group. Lowest level of growth belongs to Year 1 when these species experience Ambient-50% moisture level and Ambient Temperature. This indicates that increasing temperature and moisture availability reinforces biomass productivity.

3.3.2.7.3 Poorly fitted species

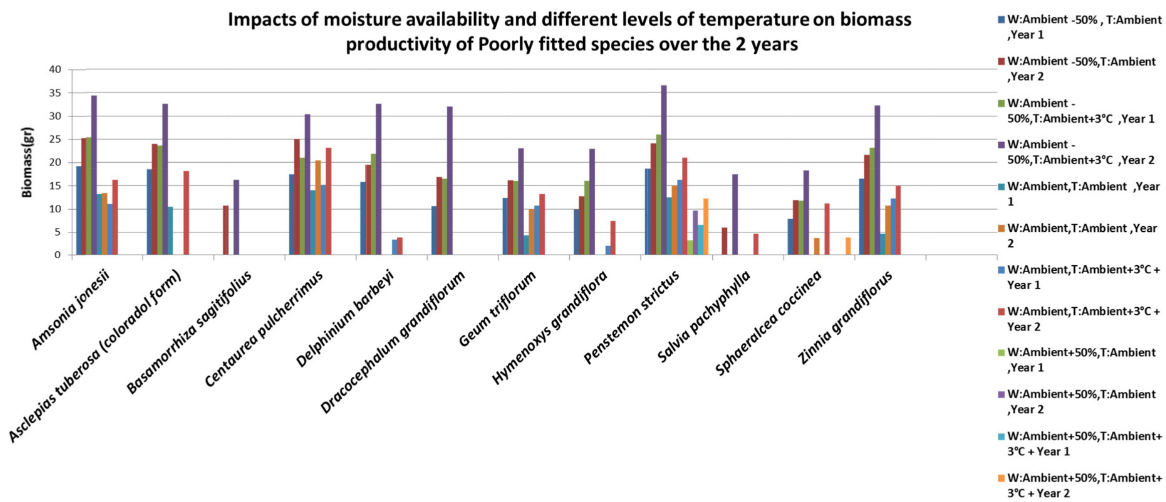

Figure 3. 163 Effects of interaction water regime and different level of temperature on biomass productivity of well fitted species over the 2 years

The biomass production of this group is inversely related to moisture availability but positively related to temperature. This figure suggests that the species in this group have the highest biomass productivity during the Year 2 when the available moisture has been at Ambient-50% and temperature at Ambient+3°C. Overall the biomass production in Year 2 is notably higher than Year 1. This figure also suggests that how increasing the moisture level, through the water treatment, hampers biomass productions of these species, suggesting that these Continental temperate grassland species (poorly fitted species) can be used in the UK when they are exposed to limited amount of water (below the threshold of their tolerance) or increasing temperature with high degree of maintenance.

3.4 Discussion

In this study, there are three main questions to deal with:

1. How did the species respond to the treatments in terms of biomass?
2. What were the effects of moisture availability under different levels of temperature on plant species growth, development, and fitness?
3. Did the different climate change scenarios provide opportunities for poorly fitted and intermediate fitted species to adapt themselves to the future UK climate?

In a multifactorial study such as this there is inevitably always conflicting response in some species; however the main patterns to emerge from this study were as follows:

I. At the ecological group level the pattern of biomass production of species generally agreed with our initial assumptions on how fit these species were, and how they were likely to respond to wetness and dryness.
II. At the ecological group level the response of species generally agreed with our hypothesis on how these species respond to the different levels of temperature
III. Competitive asymmetry has profound impact on the observed pattern between the three ecological groups in this study. Well and intermediate fitted groups are fast growing species, while the USA native plants and others in the poorly fitted group grow slowly. Different growth rates correspond to dissimilar access to essential growth resources namely light and water, which determine the produced biomass. The lower the growth rate the weaker the plant species position to compete with others.

These are discussed under three topics, water regime, temperature, and combination of moisture availability and temperature.

3.4.1 Water Regime:

Although all of the species in all groups require adequate moisture levels, this study has shown how excess water has a very detrimental effect on the least fitted species most of which are USA natives. Although in a horticultural sense we might see the southern European group of species as similar to the mainly North American group, it is clear that there are very great differences. The Southern European species, in common with the well fitted maritime-montane species are about to increase their biomass in response to Increasing the moisture level from Ambient-50% to Ambient and Ambient+%50%. This has positive impacts on the biomass production of the species in the well and intermediate fitted groups. Better growth and notable increase in biomass production is seen when the UK and Mediterranean plants in this study are exposed to the higher amount of moisture availability. In particular, the species in the intermediate group. In other words, if the Mediterranean plants in this study are provided with Ambient+50% moisture levels they will yield the highest amount of biomass productivity compared to others.

The US native plants in this study, the poorly fitted group, show a negative correlation with increasing water availability. These plants fail to survive when they are exposed to Ambient and Ambient+50% moisture levels. Regardless of the water availability the USA they are exposed to they produce considerably less biomass compared to the other two group. They can survive when the moisture level is at Ambient-50% and even these negligible growth is severely hampered when the moisture level reaches Ambient level. These plants die when they are under Ambient+50% water treatment. These behaviors suggest that these poorly fitted species are adapted to far more divergent and extreme soil moisture and temperature conditions than are the Southern Europe species. If the latter represent one step different from the well fitted the USA species are 2-3 steps different.

Comparing rainfall and temperature of the native US species with other studied groups reveals more about the differences between the original habitats of these plants. The poorly fitted plants belong to a climate with relatively low, compared to others, annual precipitation. The plants that have evolved in the climatic condition of Rocky Mountains can tolerate very high temperature as the average temperature for June, July and August does not go below 20 C, with average high of approximately 30 C during these months. These plants need to substantial amount of light as 250 sunny days, specially during spring and summer, is one of characteristics of their original habitats. When the conditions imposes slower growth, compared to the fitted and intermediate fitted groups, these plants due to multilayer nature of the plant community, receive less light and produce even less biomass. Moisture availability is another important factor, which hints why these plants fail to survive when the water treatment reaches Ambient +50%.

Average annual precipitation that these species have been exposed to is approximately 300-400mm. Highest precipitation on average occurs in May, and from April till end of August this region receives highest amounts of precipitations on average. It is not surprising that these ecological group shows its best performance when the moisture is at Ambient-50% and temperature is at Ambient+3C. Under these circumstances these plant have completive edge compared to the other two groups and can succeed in the asymmetric competition. Another important aspect that needs more attention when the plant species in the intermediate fitted group is compared to the poorly fitted species is temporal distribution of the precipitation that can lead to different precipitation regimes, even when the total annual precipitation is approximately similar. When we compare temporal distribution precipitation in a region with Mediterranean climate e.g. Bordeaux in France an interesting pattern emerges. This region receives highest amount of the annual precipitation in November, December and January, while these months show the lowest annual precipitation for Denver. Also the average annual precipitation for Bordeaux (Mediterranean climate) is 1000mm that is 250% higher than Denver. Such differences in total amount of annual precipitation and temporal distribution clearly indicates to differences in the preferred climate condition of the poorly and intermediate fitted groups for the optimum growth and biomass production.

3.4.2 Temperature

As described before the temperature treatment has positive impact on all of the three groups of plants studied in this research. Ambient+3°C treatment leads to the highest biomass production for UK and Mediterranean native plants, when enough moisture is available. US native plants or poorly fitted can survive, though do not show a tangible growth levels, when they are exposed to Ambient+3°C temperature and the moisture is on its lowest level. Unlike the well and intermediate fitted groups that Ambient+3°C stimulates growth, the impacts of high temperature on the US native plants can be attributed to its effect on better meeting their optimal temperatures for photosynthesis and also accelerating evaporation and reducing the moisture levels that these plants are exposed to.

Biomass productivity is a direct result of the plant's photosynthesis. Beside light availability this physiological process, photosynthesis, is greatly influence by the ambient temperature. Carbon dioxide assimilation is a prerequisite and essential part of plant photosynthesis. Different plants species have different preferred temperature range to assimilate CO_2. As suggested by Larcher (2003) temperature's impact on enzymatic reactions is substantial and most plants preferred/optimal photosynthesis temperature is close to their normal growth temperature in the habitat.

In light of the direct impact of temperature on photosynthesis and optimal photosynthesis temperature we could better understand the biomass productivity for the tree ecological groups studied in this research. The well, intermediate and poorly fitted groups have different growth seasons, which corresponds to different temperature in their native habitats. They show optimal biomass growth if they are exposed to a similar temperature. In Sheffield mean temperature in July is approximately 16 C while in Denver it is 6 C more about 22C. The poorly fitted group plant species grow in spring and summer when temperature is higher while intermediate fitted groups show their most growth in other seasons; autumn, winter and spring. Increasing the temperature in these experiments has increased the ambient temperatures to levels, which are closer to growth season original habitat temperature of these species, leading to more efficient photosynthesis process.

3.4.3 Water regime and temperature

For the well and intermediate fitted plants combination of high temperature and moisture levels, Ambient+50% and Ambient+3°C reinforces biomass productivity as both of UK and Mediterranean native plants show their highest biomass production under this combination. With respect to achieving the highest level of growth and biomass productivity, *Asphodelus lutea , Centaurea triumfetii, Centuarea orientalis, Dianthus carthusianorum, Euphorbia nicaensis, Hedysarum hedysaroides, Linum flavum 'Compactum', Linum narbonennse, Lychnis coronaria, Lychnis flos jovis, Paradisea liliastrum, Salvia nemorosa* or the Mediterranean native species provide the most promising growth when they are exposed to higher temperature and moisture conditions.

Poorly fitted species, which were selected from temperate grassland in the Rocky Mountain area in Colorado USA. Evaluating plants growth and biomass production clearly indicates that high moisture levels are detrimental for the poorly fitted group. though they can only survive when the moisture is at Ambient-50% and the temperature is at Ambient+3°C. They showed best growth in ambient -50% and Ambient+3°C. But, increasing the temperature reduces the moisture availability so at ambient level of moisture and ambient +3C, they can survive some of them even at ambient +50% level of moisture and ambient temperature survived (figure3.148-151)

Water availability is a fundamental factor for plant growth and is one of the major resources that the plants compete for. The faster the growth rate the better competitive edge a plant species has. As said earlier when the moisture level increases the poorly fitted group can not survive. These could be attributed to three factors; 1-the plants in poorly fitted group lag behind in growth, and they receive less light compared to others, 2- Competition between the species in different ecological groups does not only occur above the ground, there is also underground completion for nutrients, slower growth means less chance to win the competition for the nutrients by the USA native plants, 3- the species in the poorly fitted group, due to their native growth conditions in Rocky Mountains are not able to tolerate high level of moisture and fail to survive.

An interesting growth behavior, which indicates importance of (asymmetric) competition among these species is the high biomass productivity of the poorly fitted group when they are exposed to low moisture and high temperature. These species due to their preferred growth conditions have competitive advantage over the well and intermediate group under similar environment. Then they grow faster, have access to better access to light and growth better compare to the other two groups.

The behavior and growth of species in this multilayer plant community is direct impact of their photosynthesis, which only occurs in proper rate if they have access to adequate amount of light. This again highlights importance of plants growth rates, size and morphology

Figure 3.164 ***Salvia pachyphylla*** **under ambient moisture availability - 50% and 3C more than Ambient temperature treatment**

Figure 3.165 *Salvia pachyphylla* under Ambient moisture availability -50% and Ambient temperature treatment

Figure 3. 166 *Salvia pachyphylla* under Ambient moisture availability Ambient temperature treatment

Figure 3. 167 *Salvia pachyphylla* under of Ambient moisture availability plus 50% and Ambient temperature treatment

3.5 Conclusion

This research shows that climate change has a significant effect on growth, development and establishment, adaptation and fitness of plant species in urban green space. On the other hand, it provide new opportunities to use naturalistic design form in urban landscape and new plant species to develop green space under climate change situation.

The main findings of this research are as follow:

- With respect to impacts of water and temperature treatments, the species in the intermediate fitted group (Mediterranean climate species) show overall the highest biomass production in future climate scenarios.
- When W: Ambient +50% and T: Ambient +3°C the plant species in both well fitted (Marine climate species) and intermediate fitted groups show the highest biomass

production. In other words both Marine climate species Mediterranean native species have better growth if the temperature increases +3°C and they are provided more moisture in parallel.

- The poorly fitted species can not tolerate high levels of moisture, when the moisture level reaches Ambient +50% the plants in this group will show negligible growth.
- All of the plant species in the three test groups show better growth, adaptation and fitted after two years 2.
- Considering the research variables and experimental conditions the plant species in intermediate fitted group seems to be a better fit in a climate when higher moisture levels and temperature levels are expected.
- Overall combination of Marine climate species and Mediterranean climate species shows good fitness to the UK climate change scenarios, however Continental temperate grassland species (poorly fitted species) at Temperature: Ambient+3C, moisture: Ambient and Ambient - 50% condition, showed the similar respond.
- A designed plant community of species from Marine climate and Mediterranean climate will be presented the best fitted species to design naturalistic urban landscape according the 2050 UK climate change scenarios.

3.6 Research limits:

Doing an experimental research in a public open space such as Sheffield Botanical Garden is not easy. Always something happens which I was not ready for them. In these unplanned situations I had to decide immediately to reduce their side effects on the results. Wind and storm, Cat, fox, squirrel, mollusc and also vandalism made some problems during my 3 years research.

In addition, I had to face other limitations in order to be able to perform these experiments under controlled conditions. For instance, light is a master variable that affects plants species. Performing these experiments in the glasshouse essentially meant receiving less light by the species in this study. Approximately the light input was reduced by 25% due to growing the species in the glasshouse, which was affecting the species competition for light. The plants also were not exposed to wind. So the growth condition was deviated from what we expect in a natural environment. Though this research also aimed to evaluate impacts of water and temperature on the biomass productivity of the studied species, nevertheless attributing the observed growth behavior to either or combination of them needs to be considered in light of different growth rates. The plant species in the studied categories did not have similar growth rates, with fast growing plant species in the well and intermediate fitted groups and slow growing plants in the US native groups the competition for light, water and nutrients was different. Similarity of the growth rates among the studied species needs to be considered in future studies to obtain more accurate and consistent results. There were fungal diseases such as mildew that you probably would not have got outside, and so on.

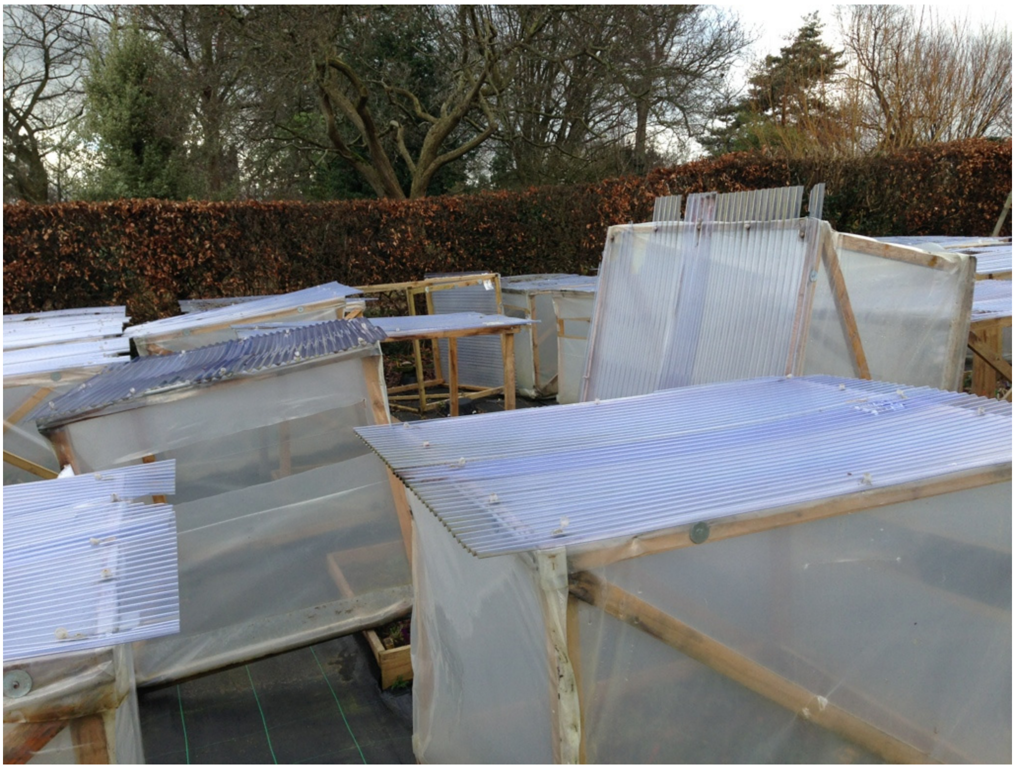

Figure 3. 168 February 2013

Figure 3. 169   storm 2013

Figure 3. 170   vandalism 2012

Figure 3. 171 vandalism

Figure 3. 172 Fox effcts

Figure 3. 173 plants diseases

CHAPTER 4: THE EFFECT OF SLUG GRAZING ON DESIGNED PLANT COMMUNITIES UNDER DIFFERENT CLIMATE CHANGE SCENARIOS.

4.1 Introduction

Improving the “quality of life”, “human well-being” and “biodiversity are currently key policy drivers in metropolitan areas through urban greenspace. Greenspaces are one of the most important wildlife habitats in the urban area. Urban greenspace play a major role in providing habitats for wildlife, and an important vegetation type in doing this is “species-rich herbaceous” vegetation which provides both pollen and nectar plus physical habitat for native fauna (Dunnett and Hitchmough 2004). These habitats also support large populations of slugs and snails, and these herbivores have a reciprocal impact on the vegetation itself (Hitchmough & Wagner 2011). There is much evidence that in moist temperate climates slugs and snails significantly affect the “development and composition” of herbaceous vegetation (Bruelheide and Scheidel 1999; Hitchmough & Wagner 2011; Wilby and Brown 2001; Holland et al. 2007). Mollusc herbivory is an important element for limiting plant species distribution as has been shown for instance, with *Arnica montana*. Herbivory is important because when combined with competition between plant species it acts to exaggerate competition, slow growing, shade intolerant species that are palatable are likely to be eliminated much more quickly from vegetation than species of similar competitiveness but that are unpalatable.

In the last chapter, the effects of different climate change scenarios on designed plant community in the urban area were investigated. In this chapter, the effects of simulated climate change on slug grazing effects on three communities of varying palatability is studied. Food selection by snail and slug in plant communities has been investigated by Grime et al. 1968, 1970, 1996, Gain 1891; Pallant 1972; Dirzo 1980; Wardle et al. 1998; Lawrey 1983; Rathke 1985; Briner & Frank 1998; Speiser & Rowell-Rahier 1993, Jennings &

Barkham 1975). This appears to be the first study on food selection by slug and snail under different climate change scenarios.

4.1.1 Objectives

The specific objectives of this study were:

- To evaluate the growth performance and vegetative phenology of species in the presence of different mollusc densities
- To investigate the effects of different climate change scenarios on slug grazing in designed plant community in urban landscape
- To compare the impact of molluscs on the composition of the plant species composition of designed meadow communities
- To study the palatability of species to molluscs under different climate scenarios.

4.2 Material and methods

This research started in summer 2011 at the Sheffield Botanical garden using the same methods previously discussed in Chapter 3. Only experimental details specific to molluscs are discussed in this chapter, for background see Chapter 3.

4.2.1 experimental blocks

The aim of the experiment was to create two areas with different densities of molluscs, low and higher. In order to achieve this aim and evaluate the above objectives, it was necessary to provide two experimental blocks. The mollusc was involved to one of the blocks and the other block was kept as free or low-density mollusc area (figure 4.1).

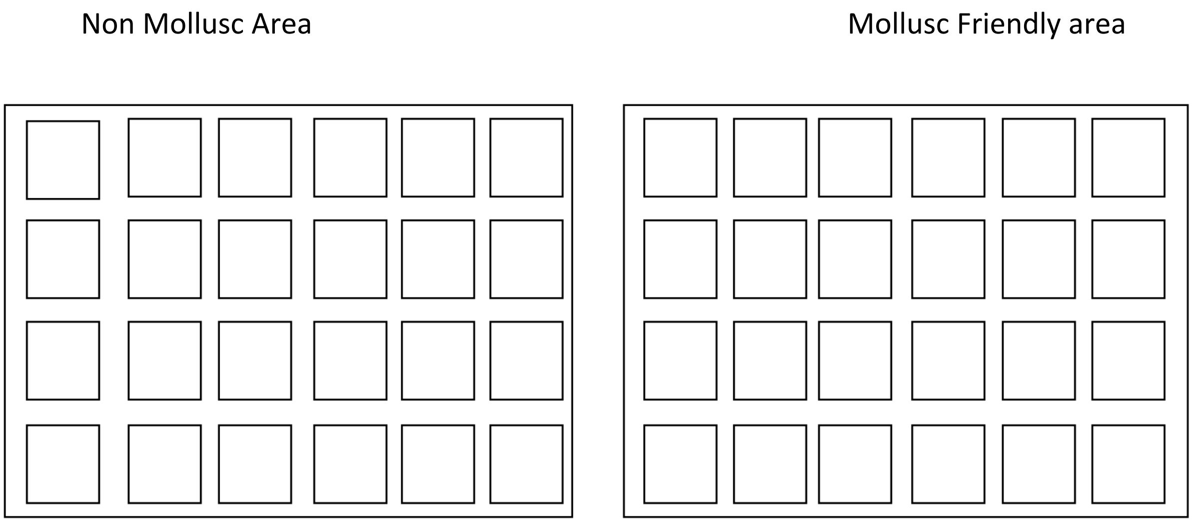

Figure 4. 1 The layout plan of the research area and the mollusc friendly and non mollusc blocks

In mollusc friendly area and to provide a desirable place for mollusc grazing, a combination of cat food in a plastic saucer was offered to the slugs on saucers that also contained garden soil and was covered with a black film. These saucers were then used to inoculate the most intense mollusc feeding in mollusc friendly block (half of the experiment). Although the author recognised that the split block experimental arrangement represents pseudoreplication, given the limited space available for the research, this seemed a less damaging problem than that of loss of independence of the plots, which would have been the case had an entirely random distribution of plots been used. After this initial inoculation with slugs during the experiments, the slugs were provided with shaded refuges that wee placed within the experiments (see Figure 4.11). The aim was to try to maintain a relatively uniform level of slug density across both mollusc regimes.

Figure 4. 2 Iniitally slugs were kept in saucers containing wet garden soil

Figure 4. 3 Adding cat foods to the slug's shelter

Figure 4. 4 Cat foods is very palatable to slugs

Figure 4. 5 During the night, the slugs feeding from the species of plots and in the morning they come bake to the shelter

Figure 4. 6   The slug shelter covered with black film and were added to the mollusc friendly area. At first next to the plots and later inside them

Figure 4. 7   Slug availability was checked evry days during early spring and late sumer

Figure 4. 8 Arion ater (orange morph) was common in the research area

Figure 4. 9 snail species *(Helix)* in research area

Figure 4. 10 ***Arion rufus*** **or black slug**

Figure 4. 11 the slugs stay in dormant during the day under the soil

In order to prevent the slug and snail grazing in non-mollusc block, slog bite were used in all plots, pathways and around the site .The small size mesh were used around the plots to prevent the sluge grazing as well.

4.2.2 plant species

As explained in chapter 3, a designed meadow-like plant communities of thirty six species, 12 native to Western Europe (Maritime climate), 12 from the Southern Europe (Mediterranean climate), and 12 from, the Southern Rocky Mountain Region (Southern Continental climate) species (Table 4.1) were offered to different slug and snail species that naturally occurred on the site (*Arion ater,* , *A. subfuscus, A. rufus, A. vulgaris* both Arionidae, and *Deroceras reticulatum)* occur in UK meadows in parks and gardens. (Table 4.1)

Table 4. 1 Plant Species used in this study. Categorisation is based on a combination of the research literature and practical experience on field experiments and in practice.

Species	Typical fitness in UK conditions	Slug Palatability
Arnica montana	well	Palatable
Bupthalmum salicifolium	well	Palatable
Centaurea montana	well	Palatable
Galium verum	well	Unpalatable
Geranium sylvaticum	well	unpalatable
Knautia arvensis	well	unpalatable
Origanum vulgare	well	unpalatable
Phyteuma spicatum var caeruluem	well	Palatable
Primula veris	well	unpalatable
Prunella vulgaris	well	unpalatable

Species	Typical fitness in UK conditions	Slug Palatability
Salvia pratensis	well	Palatable
Scabiosa caucasica	Well	Palatable
Asphodelius lutea	Intermediate	Palatable
Centaurea triumfetii	Intermediate	Palatable
Centuarea orientalis	Intermediate	Palatable
Dianthus carthusianorum	Intermediate	Unpalatable
Euphorbia nicaeensis	Intermediate	Unpalatable
Hedysarum hedysaroides	Intermediate	Palatable
Linum flavum 'Compactum	Intermediate	Unpalatable
Linum narbonennse	Intermediate	Unpalatable
Lychnis coronaria	Intermediate	Unpalatable
Lychnis flos-jovis	Intermediate	Unpalatable
Paradisea liliastrum	Intermediate	Palatable
Salvia nemorosa	Intermediate	Palatable
Amsonia jonesii	poor	Unpalatable
Asclepias tuberosa (Colorado form)	poor	Palatable
Basamorrhiza sagitifolius	poor	Palatable
Centaurea pulcherrimus	poor	Palatable
Delphinium barbeyi	poor	Palatable
Dracocephalum grandiflorum	poor	Palatable
Geum triflorum	poor	Unpalatable
Hymenoxys grandiflora	poor	Palatable
Penstemon strictus	poor	Unpalatable
Salvia pachyphylla	poor	Unpalatable
Sphaeralcea coccinea	poor	Unpalatable
Zinnia grandiflorus	poor	Unpalatable

4.2.3 Climate scenarios

As previously discussed this study utilized six climatic scenarios:

g. 50% increase in precipitation (Ambient+50%) ; no change in temperature(Ambient)
h. 50% increase in precipitation (Ambient+50%) ;3c increasing in temperature (Ambient+3C)
i. Ambient precipitation and ambient temperature
j. Ambient precipitation ; 3c increasing in temperature (Ambient+3C)
k. 50% decrease in precipitation (Ambient+50%); no change in temperature (Ambient)
l. 50% decrease in precipitation (Ambient+50%); 3c increasing in temperature (Ambient+3C)

Water regime and temperature calibration was explained in the last chapter. The experiment involved 36 species, 6 treatment combinations (3 levels of water regime and 2 levels for temperature), 2 different for harvesting time and 4 replications. So It is involved a factorial design experiment with 3 key factors:

iv) Water regime
v) Temperature
vi) Harvest time (after one year and after two year)

Figure 4. 12 Snail grazing, Some species were palatable and some of the were not.

Figure 4. 13 *Salvia nemorosa* is palatable to slugs and snails

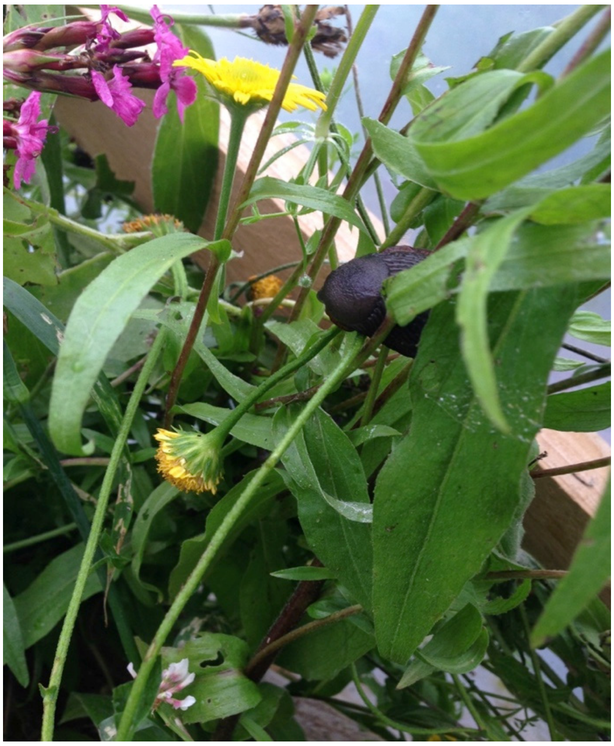

Figure 4. 14 Slug grazing on *Bupthalmum salicifolium*

Figure 4. 15 *Prunella vulgaris* is a unpalatable species

Figure 4. 16 Effects of mollusc grasing on *Salvia nemorosa*

4.2.4 Data collection

The harvesting protocols used in this experiment have already been discussed in Chapter 3.

4.2.5 Statistical analysis

On the basis of statistical advice (provided by Dr Jean Russell from the Students Statistical Support Centre at Sheffield University) the mollusc part of the experiment was analysed separately from the main factorial experimental. Each of the lower and higher mollusc density blocks were subdivided into 24 subplots (48 subplots in total). The subplots represented the six treatments with four replications inside of the each blocks. The non completely random, directed blocking approached used in this experiment was based on statistical advice to reduce shade effects from the tree and hedges near the plots. Statistical analysis was undertaken using SPSS and also Minitab for Mac. Data was initially explored through a variety of statistical approaches, both parametric and non-parametric. This included transformation log e for weight data, and arcsine square root for percentage data to improve the properties of the data sets for parametric analysis, namely distributional characteristics and homogeneity of variance (Zar, 1999). Data analysis outputs are provided as an appendix (Appendix5).

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Figure 4. 17   An infographic to explain mollusc friendly area

4.3 The Results

The effects of different climate scenarios on a community of three ecological groups of species in the absence of molluscs were investigated in chapter 3. In this chapter, the effects of mollusc grazing on plant communities, under different climate scenarios has been studied.

In all the figures when SE bars overlap in the figures this indicates that, the difference between the two means is not statistically significant (P>0.05). In all graphs the data used is mean of biomass for the two years of the study.

4.3.1 Comparison of mollusc grazed and non-mollusc grazed

4.3.1.1 Fitness groups

4.3.1.1.1 Effects of molluscs on the total biomass of the communities

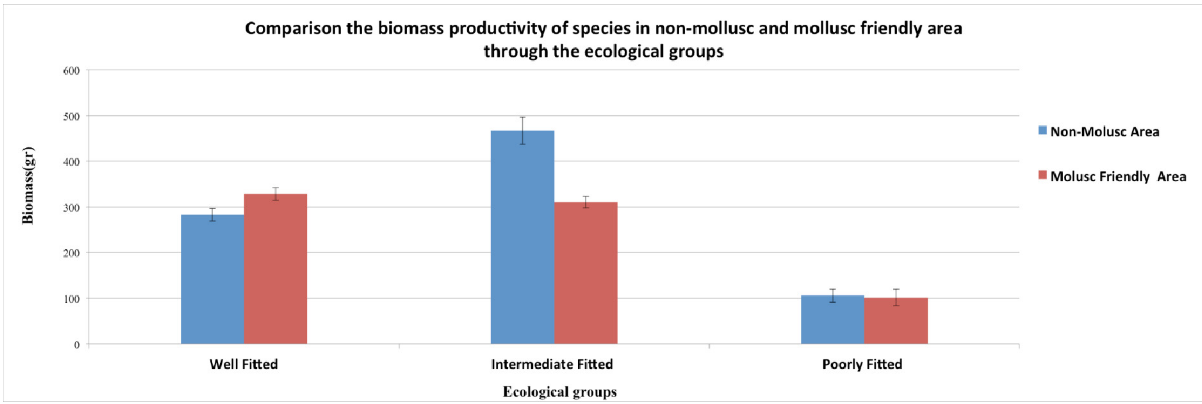

Figure 4. 18 The effects of mollusc grazing on overall biomass production of different fitness groups

This graph suggests that the overall biomass of a community of well fitted species is not greatly influenced by mollusc grazing, where as the intermediate fitted species are much more affected, ie as a group are much more palatable. There is no different for poorly fitted species.

4.3.1.1.2 Effects of molluscs on the total biomass of the communities at different moisture regimes

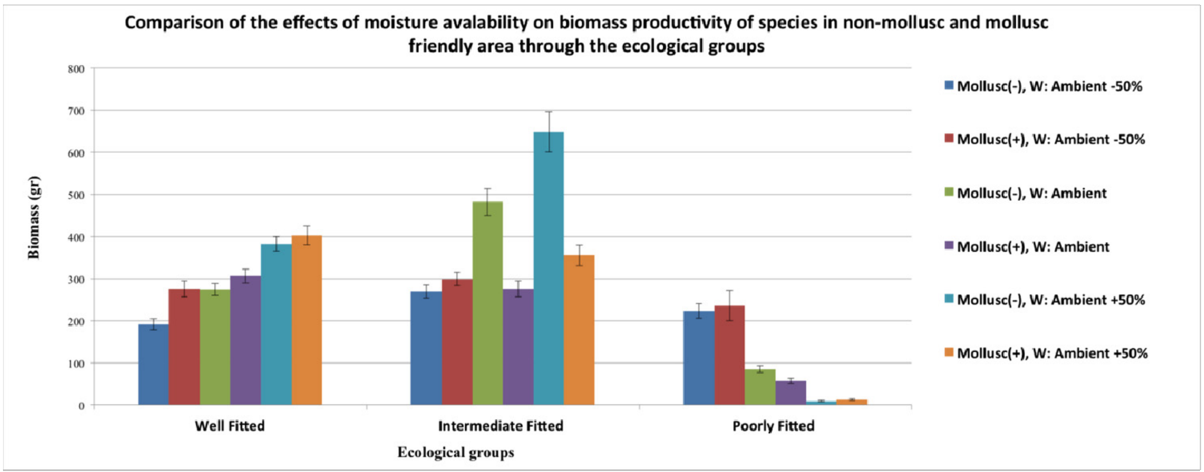

Figure 4. 19 Comparsion in mollusc grazed area and non mollusc area -the effects of mollusc grazing and moisture avalability on biomass production of the studied species within the different group

The difference between -mollusc and +mollusc treatments are not very notable for the well and poorly fitted groups. For the poorly fitted group the main factor is clearly inability to tolerant elevated moisture, rather than slug grazing. Within the well fitted group there is a step wise progression in biomass as one moves from -50% to +50%. Its clear that the molluscs are not causing the biomass to decline below that of the no mollusc treatment as soil moisture increases. This suggests that positive benefits of more water on biomass production are greater than the negative effects of molluscs on consuming that biomass.

This is perhaps different to what might be expected: wetter conditions allow longer mollusc grazing and hypothetically greater consumption of plant biomass.

The intermediate fitted group clearly shows the effects of mollusc grazing most strongly with biomass productivity of these species much higher when molluscs are excluded, and much less when present.

4.3.1.1.3 Effects of molluscs on the total biomass of the communities at different temperature regimes

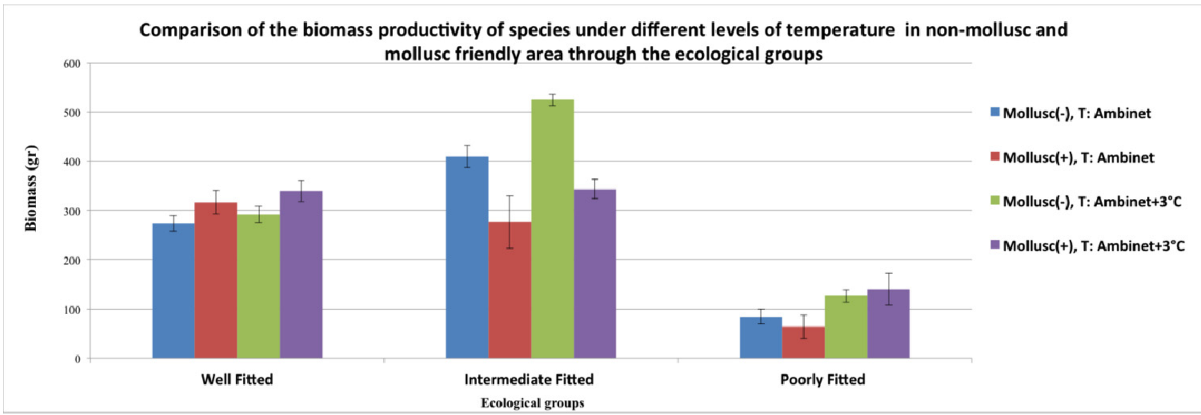

Figure 4. 20 This figure shows how biomass production of the studied species has been affected in non-molusc and mollusc friendly area as a result of variation in the temperature treatments.

Increasing the temperature levels improves the biomass productivity of all the species in all ecological groups whether molluscs are present or not. In the most responsive group (the intermediate group) biomasss the molluscs do however appear to apply a break to biomass production as temperature rises, perhaps because molluscs are more active at these elevated temperatures.

In well-fitted species the biomass productivity in the mollusc area at both temperatures were more than non-mollusc areas. The actual differences are vey small, reinforcing that fact that molluscs did not have a a great deal of impact on these well fitted species.

4.3.1.1.4 Effects of molluscs on the total biomass of the communities at different temperature and moisture regimes

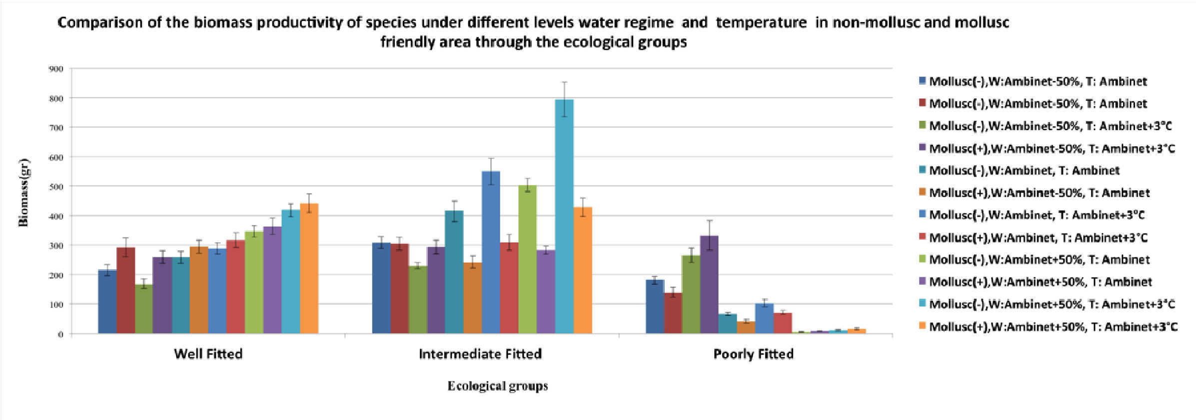

Figure 4. 21 The effects of mollusc grazing on biomass of species under different levels of moisture and temperature

Above graph compares how mollusc grazing can be affected by combination of the water and temperature treatments. The overall pattern is similar to what was observed in the previous graphs. The main effects are seen in the intermediate fitted group where the presence of molluscs has a significant reduction in total biomass, compared to when absent, and this pattern is generally repeated across all climatic comparisons. The effect of the molluscs on the fitted species is rarely significant, suggesting that the species chosen are either fundamentally less paltable to molluscs, or that the least palatable species in the mix were able to utilize the increased resources made available by damage to the more palatable species. This process does not seem to be able to operate in the intermediate species. Normally slogs and snail do not show activity at drier and warmer conditions (w: ambient-50%). So the mass productivity of species at these climate conditions is not belongs to the mollusc activities and it have been investigated in chapter 3. Also the results of chapter 3 indicated that the poorly fitted species cannot tolerate and survive under wetter condition (w: Ambient+50%). in this situation biomass productivity of species in both blocks (mollusc grazed and non-mollusc area) didn't show significant difference.

As explained before, for the well fitted group mollusc presence reducing the competition between species. Overall the graph indicate that increasing the moisture levels improve mollusc activities and also the plant growth and, on the other hand the higher temperature reduces the mollusc activity.

4.3.1.2 The effect of mollusc grazing on individual plant species with the well fitted species

The effects of mollusc grazing on well fitted species and intermediate fitted species is evaluated in this section. As it was not clear that palatable species in poorly fitted species disappeared as a result of mollusc grazing or the climate condition, the poorly fitted species are not compared.

4.3.1.2.1 Effects of molluscs on the total biomass of the well fitted species

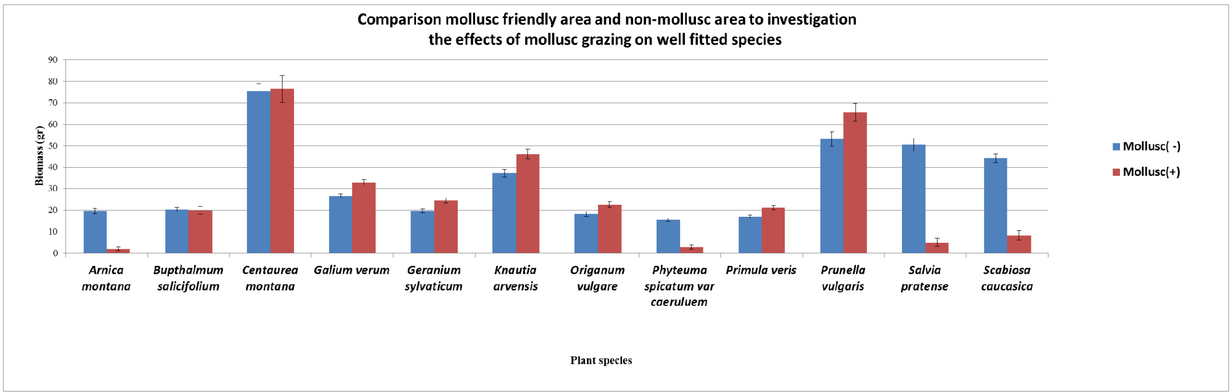

Figure 4.22 The effects of mollusc grazing on total biomass of well fitted species

The biomass productivity of the well-fitted species under mollusc grazing condition is compared with the mass productivity of non mollusc area and shown in the above graph. As seen clearly The most palatable species in these group, *Arnica montana, Phyteuma* *spicatum, Salvia pratense and Scabiosa caucasica* show much lower biomass when they are exposed to mollusc grazing. The unpalatable species; *Galium verum,Geranium sylvaticum, Knautia arvensis, Origanum vulgare and Prunella vulgaris* on the other hand show even higher biomass production. This is presumed to be because grazing is either acting as a stimulus to produce more biomass, rather like a form of light pruning, or more likely, because damage to the more palatable species is freeing up resources which they can use to increase their own biomass. Although *Bupthalmum salicifolium* and *Centaurea montana* were included as palatable species on the basis of experience in previous studies, at present of the other palatable species they behaved as non-, in this study. , the mollusc prefers to feeding on them.

4.3.1.2.2 Effects of molluscs on the total biomass of the well fitted at different moisture regimes

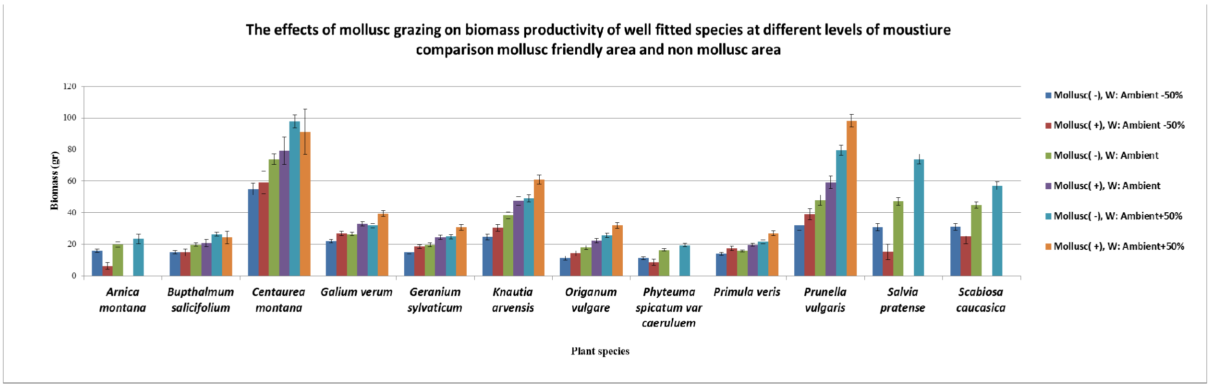

Figure 4.23 Comparison of mollusc grazed area and non-mollusc area- the effects of mollusc grazing on biomass productivity of well fitted species under different levels of moisture availability

The effects of mollusc grazing on the biomass productivity of the well species when exposed to the moisture treatments and condition is shown in the above graph. The general pattern here mirrors that shown in previous graphs of total biomass. In general biomass increases as water and increases; the greater opportunities for slugs to be active does not prevent this occurring except in the most palatable species. In the case of *Arnica*, *Phyteuma*, *Salvia* and *Scabiosa*, these species disappear at ambient and ambient plus 50% water treatments.

It is clear than mollusc don't have activity when we have Ambient-50% moisture level and showed their maximum at Ambient+50%. Palatable species in these group (*Arnica montana*, phyteuma spicatum, salvia partense and scabiosa caucasia) show much lower biomass presence when they are exposed to mollusc grazing. In these species we see some degree of biomass presence when we have Ambient-50% moisture level. This is due to lower activities of mollusc in drier environments. The unpalatable species; (*Bupthalmum salicifolium* , *Centaurea montana Galium verum,Geranium sylvaticum, Knautia arvensis, Origanum vulgare and Prunella)* however show more biomass with increasing the moisture levels. Reduced competition for access to more favorable environment as a result of the palatable species by mollusc grazing also has a role in more biomass production of unpalatable species.

4.3.1.2.3 Effects of molluscs on the total biomass of the well fitted at different temperature regimes

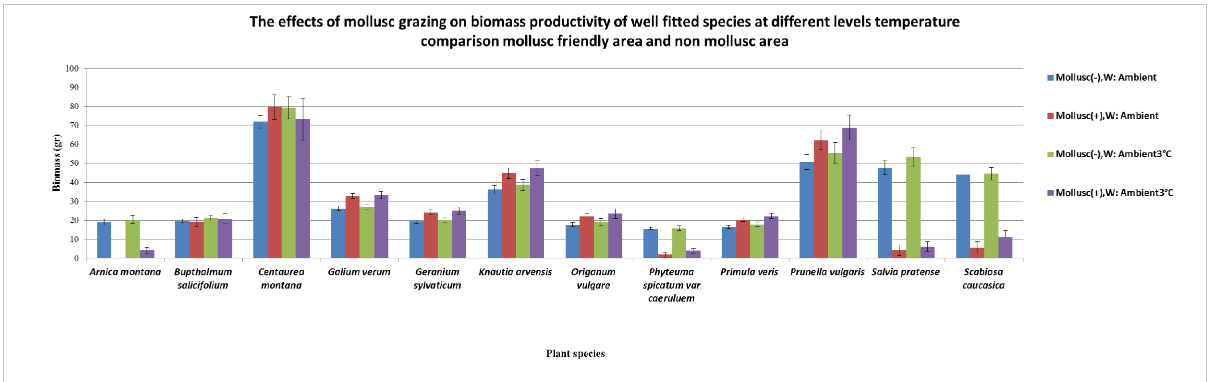

Figure 4.24 the effects of mollusc grazing on biomass productivity of well fitted species under different levels of temperature

As the graph shows clearly, increasing the temperature (3C) does not make a significant effect on growth and developed of well fitted species. The same patterns of reductions in the biomass of the palatable species are shown as in previous graphs, irrespective of temperature.The graph indicates that increasing the temperature has negative effects on mollusc activity and the biomass productivity of palatable species at ambient level of temperature is less than ambient+3C (because of more mollusc activity).

4.3.1.2.4 Effects of molluscs on the total biomass of the well fitted at different temperature and moisture regimes

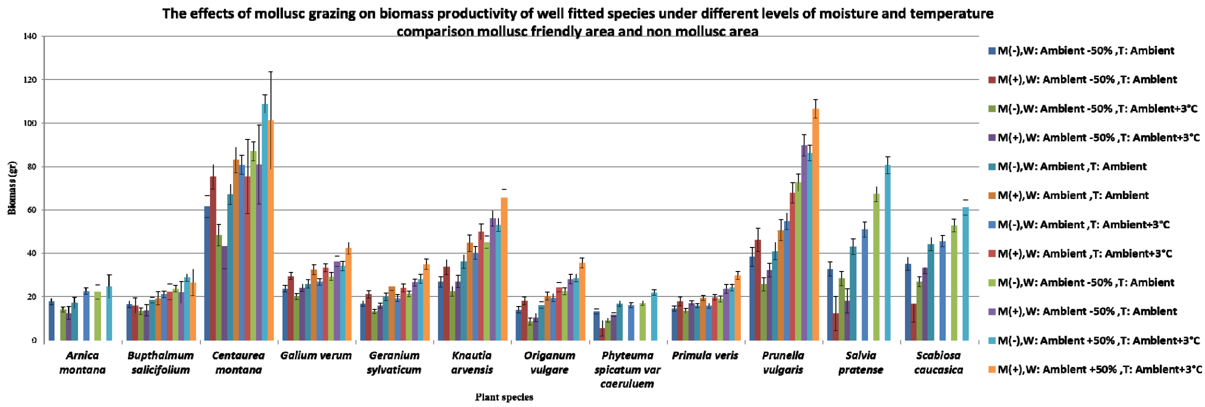

Figure 4.25 the effects of mollusc grazing on biomass productivity of well fitted species under different levels of moisture and temperature

The graph shows that combined effects of higher moisture and temperature, provided more desireble inviromnt   for mollusc activity and all the palatable species disapeared in this climate (Ambient+50% and Ambient+3C), but mirrors the trends previously shown in response to temperature and moisture as individual factors. This knid of climate leads the non palatable species to produce more biomass not only becoese the climate condition , but also because the mollusc activity. some species such as Arnica monta are very palatable for mollusc. they disapead event at ambient-50% of water regime and ambinet level of temperature. Non palatable species produced more dry mass in mollusc friendly area than mollusc non mollusc area because of low competion. The graph indicates that slogs and snail select their food from palatable speceis .

4.3.1.3 The effect of mollusc grazing on individual plant species with Intermediate fitted species

4.3.1.3.1 Effects of molluscs on the total biomass of the intermediate fitted species

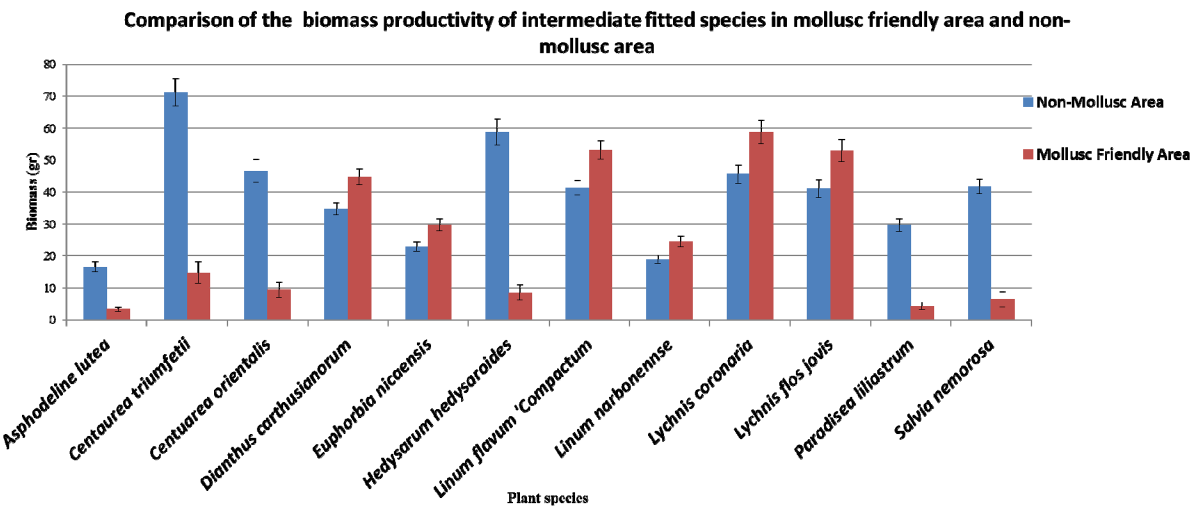

Figure 4. 26 The effects of mollusc grazing on total biomass productivity of intermediate fitted species

The biomass productivity of the intermediate fitted species under mollusc grazing condition is shown in the above graph. The unpalatable species; *Dianthus carthusianorum, Euphorbia nicaensis, Linum flavum 'Compactum', Linum narbonennse, Lychnis cornonoria* and *Lychnis flos-jovis* show increased biomass production, for the same reasons as previously proposed for fitted species. This can be attributed to the role of mollusc grazing. Unpalatable species show higher growth and mass productivity in mollusc friendly one reason can be more space for growth and reducing the competition for light, water and nutrition.The palatable species in these group *Asphodeline lutea, Centaurea triumfetii, Centaurea orientalis, Hedysarum hedysaroides, Paradisea liliastrum* and *Salvia nemorosa* show much lower biomass presence when they are exposed to mollusc grazing. Hedysarum appears on the basis of grazed biomass as a percentage of non-grazed biomass to be the most palatable species. These data suggest that these latter species are unlikely to become capable of playing a more significant role in future UK plantings under climate change unless this is accompanied by gross reductions in mollusc activity.

4.3.1.3.2 Effects of molluscs on the total biomass of the intermediate fitted at different moisture regimes

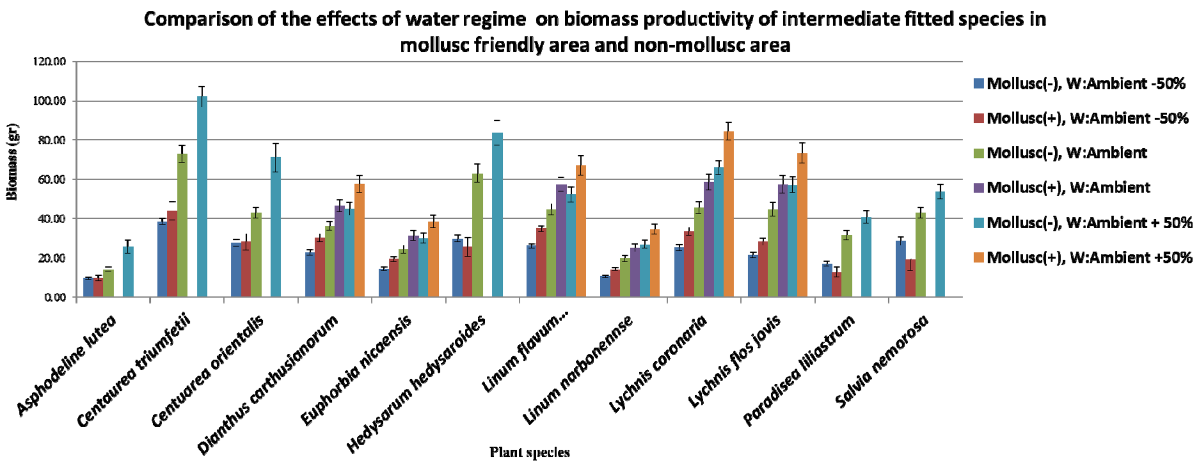

Figure 4. 27 The effects of mollusc grazing on biomass productivity of intermediate fitted species under different levels of moisture

.The biomass productivity of the intermediate fitted species when exposed to the moisture treatments and under mollusc grazing condition is shown in the above graph. Biomass increases step wise in intermediated fitted species as water increases except in the case of palatable species which are severely damaged or eliminated at these higher moisture levels. The palatable species in these group (*Asphodeline lutea, Centaurea triumfetii, Centaurea orientali, Hedysarum hedysaroides, Paradisea liliastrum , Salvia nemorosa)* show much lower biomass presence when they are exposed to mollusc grazing.. So due to lower activities of mollusc in drier environments the differences between mass productivity of species between non mollusc area and mollusc grazed area may refer to the other factors.The unpalatable species; (*Dianthus carthusinorum, Euphorbia nicaensis,Linum flavum Compactum, Linum narbonennse,Lychnis cornonoria, Lychnis flos jovis.* however show more biomass with increasing the moisture levels. Reduced competition for access to more favorable environment as a result of the palatable species by mollusc grazing also has a role in more biomass production of unpalatable species.

4.3.1.3.3 Effects of molluscs on the total biomass of the intermediate fitted s at different temperature regimes

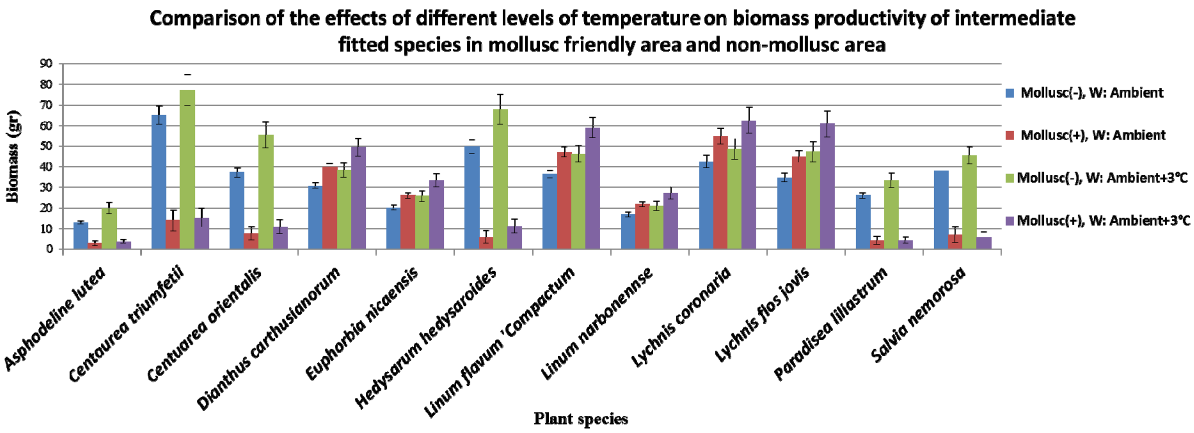

Figure 4. 28 The effects of mollusc grazing on biomass productivity of intermediate fitted species under different levels of temperature

The general pattern is for biomass to increase with an increase in temperature. Higher temperature and drier environments potentially hamper mollusc activity, however in the case of the palatable species in this graph there is no compelling evidence that higher temperature has this effect. . All of the palatable species in the intermediate fitted group (*Asphodeline lutea, Centaurea triumfetii, Centaurea orientali, Hedysarum hedysaroides, Paradisea liliastrum , Salvia nemorosa)* have produced sharply less biomass under mollluse friendly area condition. The higher temperature treatment leads to more biomass productivity for these species under non-mollusc grazing condition. Not a notable difference is observed between the produced biomass in mollusc friendly environment between the two temperature treatments, that though the mollusc grazing is less but overall they are active enough to consume the produced biomass under the higher temperature treatment. The unpalatable species ;(*Dianthus carthusinorum, Euphorbia nicaensis,Linum flavum Compactum, Linum narbonennse,Lychnis cornonoria* and *Lychnis flos jovis*) however show slightly more biomass with increasing the temperature levels.

4.3.1.3.4 Effects of molluscs on the total biomass of the intermediate fitted at different temperature and moisture regimes

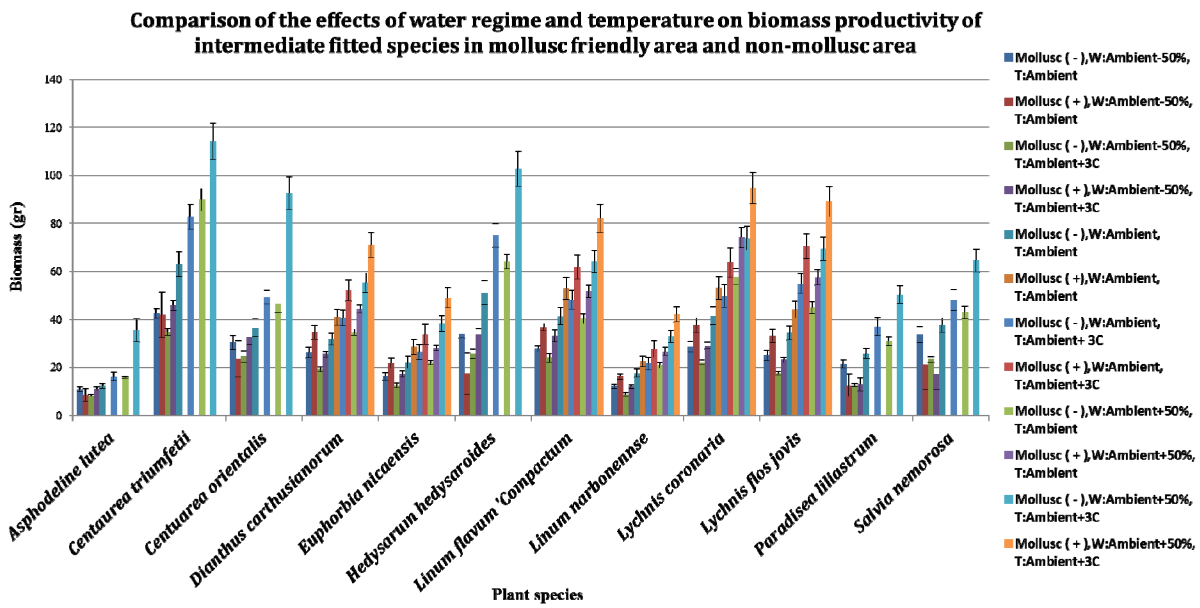

Figure 4. 29 The effects of mollusc grazing on biomass productivity of intermediate fitted species under different levels of moisture and temperature

The data for the different treatment combinations of water, temperature and with and without mollusc grazing, follow the same patterns as the previously shown graphs, i.e. there is a net increase in biomass as temperature and water increase but this is reversed in the presence of molluscs in the case of palatable species. Increasing the temperature do not show significant effect in mollusc grazing in intermediate fitted species. Because palatable species disapeared in both levels of temepratur in ambient and ambient+50% of moistur abalability. Comparsiron non mollusc area and moullsc grazed area show in peresent of mollusc grazing , un palatable species growing more and produced more mass .For example *Lychnis coronaria* at in mollusc grazed area and at ambient+50% of moisture and ambient +3c of temperature produced 26% more bimass than the same treatment in non mollusc area. The present biomass in palatable and non-palatable species under mollusc friendly and non-mollusc area clearly highlights role of mollusc grazing in consuming the palatable plant species.

4.3.2 Mollusc grazed area

In chapter 3 the effects of different climate change scenarios on a designed plant community of 36 species in a relatively mollusc free area was investigated. In this part of this chapter, the effects of different levels of moisture and temperature on grazing of slugs and snails in mollusc friendly experimental blocks will be presented. Graphs are only presented when the response of a species is markedly different in the presence of slugs to what it was in their absence (as shown in Chapter 3). In appendix 4 other graphs related to this part were presented.

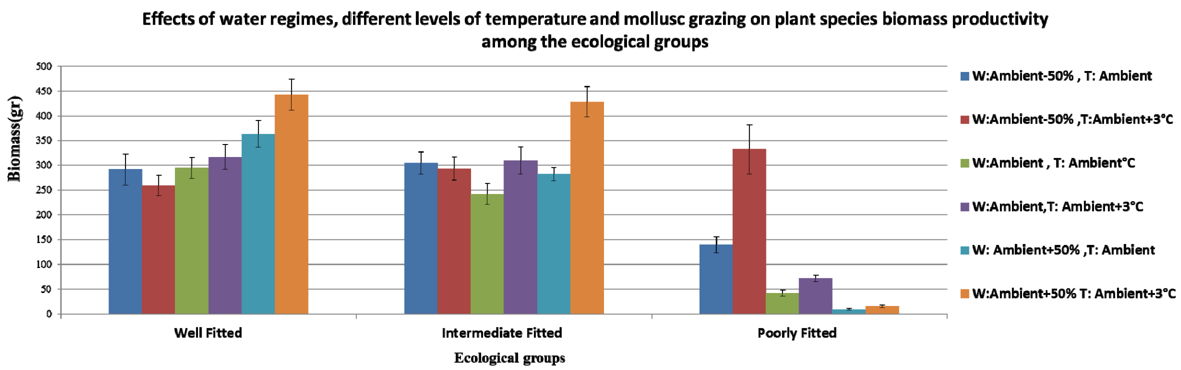

Figure 4. 30 Effect of mollusc grazing on biomass production in different fitness groups for all six water x temperature treatments

The graph indicates that, the highest biomass productivity belongs to the intermediate fitted species when the ambient water and temperature are increased (W: Ambient +50% & T: Ambient & Ambient+3C). Although within this climate situation slugs and snails showed more activity and all palatable species of plant community disappeared, because of the reduced competition for water, light and soil nutrition, unpalatable spices grew more. As a result, mass production increased in this situation. Decreasing water availability at ambient and also at the ambient +3c level of temperature decreased mollusc activity. So biomass productivity increased at this climate scenario.

The poorly fitted species show opposite pattern to the other groups. Increasing moisture availability, which also enhances the slugs activity, led to reduced biomass. Species in this group show the highest mass production at ambient-50% of water regime and ambient +3c of temperature and this climate also hampers slug activity. Comparing W: Ambient -50% & T: Ambient and W: Ambient +50% & T: Ambient clearly indicates that how this plant group is affected by high moisture availability and also mollusc activity.

4.3.2.1 Responses of well fitted species

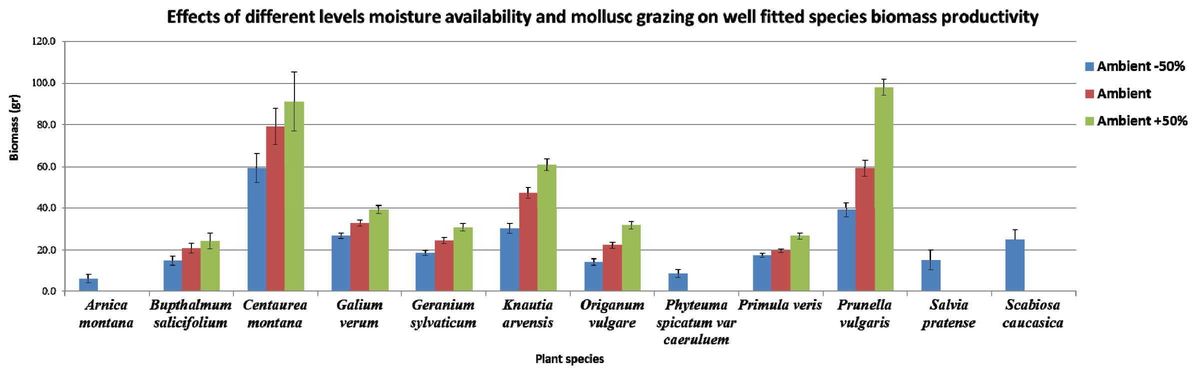

Figure 4. 31 Effects of mollusc grazing and water regime treatments on biomass productivity of the well fitted group.

This figure shows how different plant species in the well-fitted group were affected by mollusc grazing under different level of water treatments in this research. *Bupthalmum* *salicifolium*, *Centaurea Montana, Galium verum, Geranium sylvaticum, Knautia arvensis, Origanum vulgare and Prunella* are not palatable for slugs or snails. Normally *Bupthalmum salicifolium* and *Centaurea montana* are considered as palatable species, but this results indicates that in the presence of the other palatable species, slugs did not select *Bupthalmum salicifolium and Centaurea montana*. At ambient -50% of moisture availability the palatable species did not disappear. This situation is suboptimal for mollusc activity. Unpalatable species at ambient +50% show their highest biomass productivity. At this level of moisture, not only the situation for growth and development of well fitted species is suitable but also the reducing the palatable species by mollusc grazing provided better situation for produce more mass.

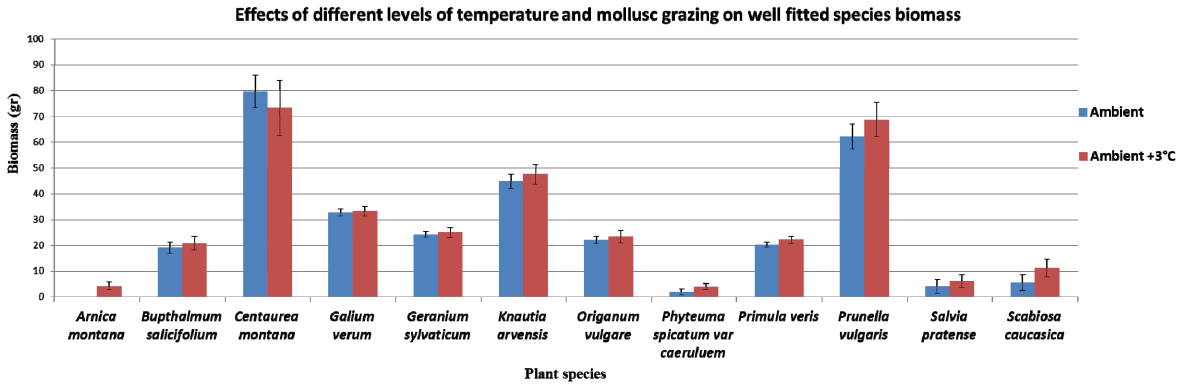

Figure 4. 32 Effects of mollusc grazing and temperature treatments of biomass peroductivity of well fitted species biomass productivity

This graph demonstrates how mollusc grazing responded to increasing the temperature in the well fitted group. Increasing the temperature, enhanced the biomass productivity by decreasing mollusc activity and also increasing the rate of photosynthesis. *Arnica montana* is a very palatable species at ambient temperatures; all of the plants disappeared at this; but increasing the temperature reduced the mollusc activity, but ultimately did not prevent extinction. Despite this *Centaurea montana , Galium verum* (unpalatable), *Knautia arvensis* (unpalatable), *Prunella vulgaris* (unpalatable), are the only species that have more tangible biomass production.

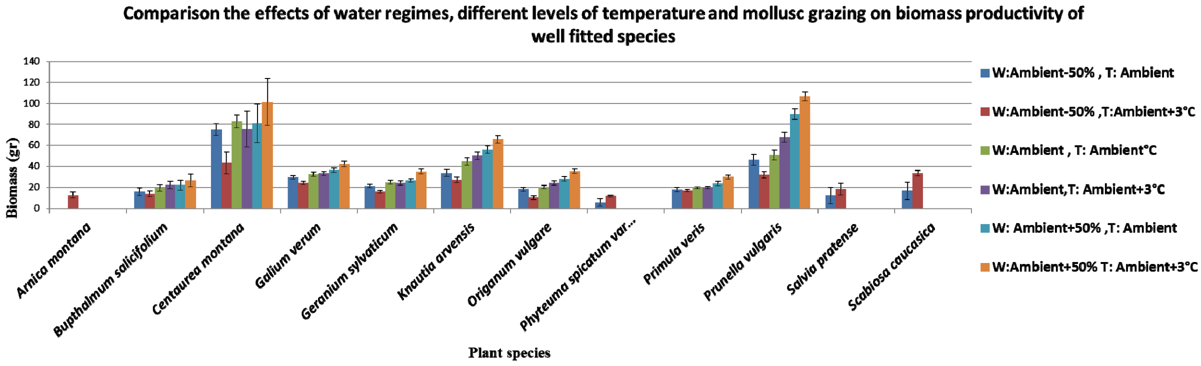

Figure 4. 33 Combined effects mollusc grazing , water regime and temperature treatments on mass productivity of well fitted species.

The effects mollusc grazing on the individual species of the well-fitted group under the combination of water and temperature treatments is shown in figure 4.33. Molluscs don't like dry and warm climates but *Arnica montana* is so palatable as to disappear even at ambient -50% of water and ambient temperature. The other palatable species (such as *Salvia, Scabiosa* and *Phyteuma*) survived in this climate. Increasing moisture availability (to Ambient and Ambient+50%) enhanced mollusc activity at both level of temperature.

Unpalatable species showed the highest biomass yield at W: Ambient +50% and T: Ambient +3°C because of reduced competition with the palatable species, but because the maritime climate species grew better and produce more biomass when temperature increased and more water become available. Lowest amount of the biomass productivity belongs to when the available moisture is reduced, W: Ambient -50%, but the temperature increases, Ambient +3°C. This suggests that these plant species are water sensitive and reducing available moisture combined with increasing the temperature will hamper the plant growth.

4.3.2.2 Responses of Intermediate Fitted Species

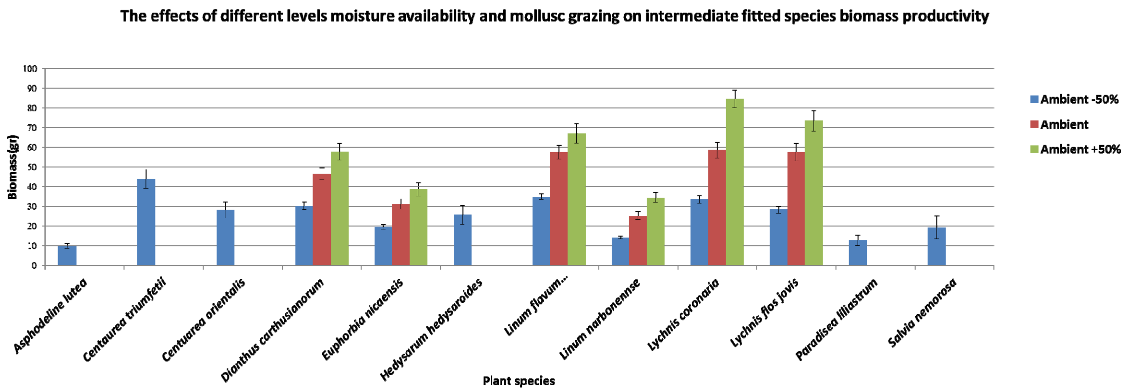

Figure 4. 34 Effects of mollusc grazing and water regimes on biomass productivity of Intermediate fitted species

The effects of the mollusc grazing and on individual species of intermediate fitted group and their respond to the water shown in above figure. The show a similar fashion to the well fitted groupe. Because of mollusc activity Palatable species (*Asphodeline lutea, Centaurea triumfetii, Centaurea orientalis, Hedysarum hedysaroides, Paradisea liliastrum*, *Salvia nemorosa) disappeared* at both ambient and ambiet +50% of moisture levels. At ambient –50% of water regime mollusc don't show activity so palatable species didn't disappear. Non palatable species showed the max biomass productivity at ambient+50% level of moisture.

It is happened because the intermediate fitted species at this condition growth more than the other situation. Also mollusc activity reduced the palatable species and unpalatable species growing with low competition. This situation has been seen at ambient level of moisture but not as sharp as ambient+50%. This suggests that increasing the moisture level has increased mollusc grazing activities, which has led to consuming all of the palatable plant species in this group.

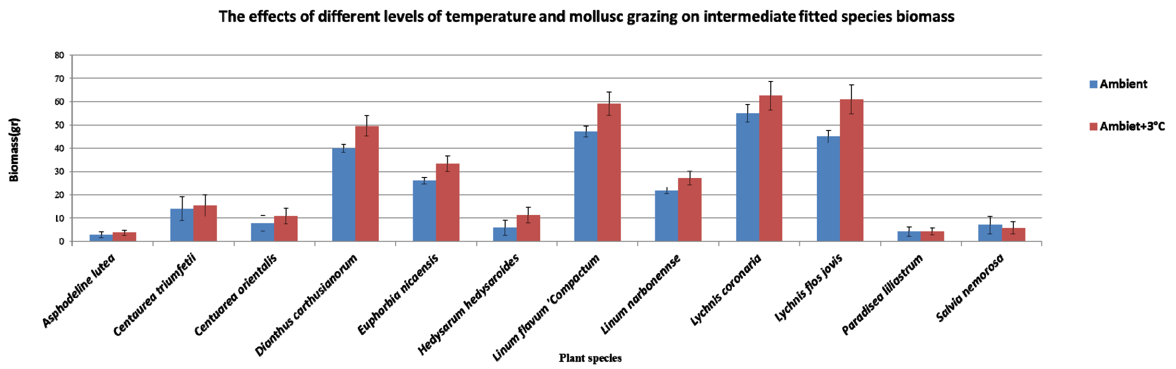

Figure 4.35 Effects of mollusc grazing and temperature treatment on biomass productivity of species in the intermediate fitted group.

Respond of the intermediate fitted group with respect to mollusc grazing and increasing the temperature to Ambient +3°C is shown in this graph. unlike the moisture treatment, increasing the temperature level leads to more biomass for the palatable species. This can be attributed to the reduced mollusc grazing under the higher temperature conditions, which causes more remained biomass for *Asphodeline lutea, Centaurea triumfetii, Centaurea orientalis, Hedysarum hedysaroides, Paradisea liliastrum* and *Salvia nemorosa* species Similar to the well fitted group, though an increase in the amount of biomass production is observed by increasing the temperature, non of these changes are drastic and the species in this group retain similar biomass production pattern to the Ambient temperature conditions.

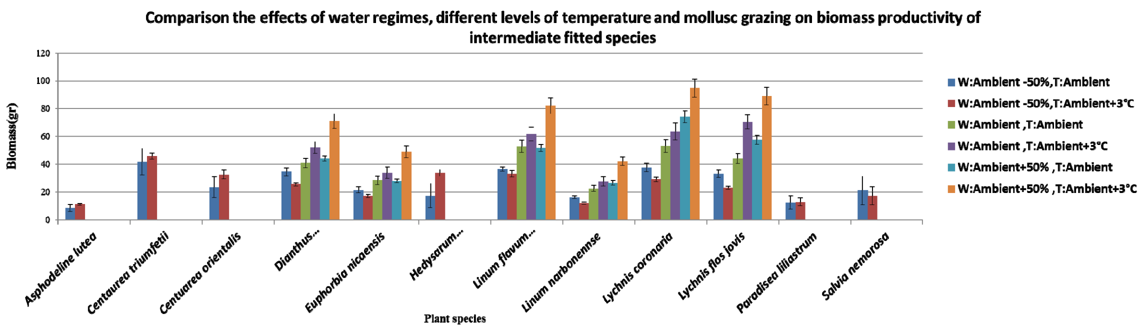

Figure 4.36 Combined effects of mollusc grazing on biomass productivity of of Intermediate fitted species in response to water x temperature treatments.

The individual species in the intermediate fitted group respond to mollusc grazing, moisture availability and temperature treatments in a similar fashion to the well-fitted group. At Ambient -50% and the temperature Ambient +3°C the species produce their least amount of biomass, however mollusc activity is minimal under these conditions so this compensated for reduced growth rates. In addition because all palatable and non-palatable species were present in the community the level of competition between species was increased. The highest biomass production occurred at ambient +50% and ambient +3°C. In this climate all palatable species disappeared and unpalatable species produce more biomass. Overall the plant species in this group are more homogenous with respect of the biomass production under each experimental conditions. More available moisture increases mollusc activities, while higher temperature hampers it. Again, not surprisingly the palatable species in this group; *Asphodeline lutea, Centaurea triumfetii, Centaurea orientalis, Hedysarum hedysaroides, Paradisea liliastrum* and *Salvia nemorosa* are eliminated by grazing when the moisture levels reaches Ambient and Ambient+50%, which suggests even when the temperature increases, Ambient +3°C, if enough moisture is available these species are entirely consumed by mollusc grazing.

4.4 Disscusion

This study aimed to investigate how mollusc grazing and environmental conditions, the water and temperature treatments, affect the biomass productivity among different plant species. In these experiments the plants in the well, intermediate and poorly fitted groups included both palatable and unpalateble species. We are aware that the majority of ecosystem services are affected by invertebrates in some ways (Prather et al. 2013), though studies that investigate the relationships between climate change-related responses by invertebrate to ecosystem services consequences are rather limited.

Mollusc behaviour and impacts on ecosystems under climate change scenarios are not thoroughly studied, nevertheless previous studies provide a general understanding about climate change impacts on slug herbivory (e.g., Briner & Frank, 1998; Fenner *et al*., 1999;

Frank, 2003; Hulme, 1994; Keller *et al*., 1999; Scheidel & Bruelheide, 1999; Hitchmough & Wagner, 2011). For instance, the role of moisture on mollusc grazing activities is well established, Nystrand and Granstroom (1997) suggest the activities of soft body animals are highly related to available moisture levels. When the soil moisture is reduced and bodies of these animals face desiccation their feeding activity is significantly hampered.

For each of the three ecological groups studied in this research six palatable and six unpalatable plant species were exposed to mollusc activity. As mentioned earlier, when the growth conditions were favourable and adequate moisture for mollusc grazing was provided, mollusc grazing significantly reduced level of biomass for palatable species. Interestingly, unpalatable plant species due to lack of competition,showing more biomass productivity in mollusc friendly environments. This scenario may lead to dominance by the most unpalatable, and productive species. Moisture and temperature are not the only factors that affect plant consumption by molluscs. As Hithmough and Wagner (2011) study suggests, the effect of mollusc grazing on palatable species also depends on the physical size and growth rate of the seeldings. For instance, palatable species with slow growth or small seedlings are typically more likely to be eliminated due to mollusc grazing. They also conclude that mollusc grazing can affect population and community dynamics of plant species. Scheidel & Bruelheide (1999) research reveals mollusc feeding behaviour even depends on morphological factors. For instance epidermal cell tickness and hairiness of plant's leafs affect if they are prefered by mollusc.

4.4.1 Compasion of mollusc and non-mollusc experimental areas

The well and poorly fitted species show overall similar (but not equal) patterns of biomass productivity when exposed to the mollusc grazing. In the well-fitted group even the mollusc friendly environment produced slightly less biomass, which can be attributed to the contribution to the biomass of *Bupthalmum salicifolium* and *Centaurea montana*. The intermediate fitted group show a clear decrease in the biomass production as a result of mollusc grazing. This pattern suggests that when molluc species selectively choose palatable plants, the other less favorable or unpalatable plants have more favorable environment to grow and face less competition in their ambient environment. This can lead to their overall better growth that compensate for the biomass lost to molluscs. Unlike the well fitted species, the unpalatable plant species can not produce enough biomass in the intermediate fitted group. When the studied ecological groups were exposed to combined effects of the moisture and treatment variations in mollusc friendly and non-mollusc environments they showed that increasing moisture will increase their activity and therefore the grazing levels. Though the plant species grow better when they are exposed to more moisture but presence of molluscs prevents these species from reaching their full biomass productivity potential in the new growth environment. It also can be deduced that when palatable species are selectively chosen by the mollusc species for grazing the unpalatable plants face less competition and can compensate removed biomass of palatable plants. Increased temperature when more moisture is also available does not have tangible effect on the mollusc grazing providing adequate moisture is available. The intermediate fitted group clearly shows when the unpalatable species cannot compensate the palatable species biomass removal in mollusc friendly areas, how dramatic is the impact of mollusc grazing on the biomass productivity. For instance for this group the biomass productivity has reduced by half in the Ambient+50% moisture and Ambient +3C Temperature, when these species are exposed to mollusc grazing.

4.4.2 Well fitted species

The palatable species in this group *Arnica montana*, *Bupthalmum salicifolium*, *Centaurea montana*, Phyteuma spicatum var. caeruluem, Salvia pratense, and *Scabiosa caucasica* to some extent reacted differently to molluscs when exposed to different moisture levels. Although *Bupthalmum salicifolium*, *Centaurea montana* were at the outset of the experiment considered as palatable species (on the basis of previous experimental work) but these two species proved to be unpalatable in this study. Not surprisingly all of unpalatable species *Galium verum*, *Geranium sylvaticum*, *Knautia arvensis*, *Knautia arvensis*, Origanum vulgare, *Prunella vulgaris* and *Primula veris* showed better growth and more biomass productivity with increasing the moisture availability. This can be because of two reasons, the first one is the positive impact of moisture on these species growth and the other one is less competition for light and better growth conditions. When the palatable species are reduced and consumed due to mollusc grazing these species have a better environment in which to grow. Exposure to the higher temperature, Ambient + 3C, supports this finding. The plant species in this group show slight increase in biomass productivity, however, interestingly the palatable species fail to survive in the higher moisture levels. Higher temperature leads to less moisture due to evaporation. Mollusc grazing is reduced when soil is less moist, and therefore we see better growth even for the palatable species. During Year 2 more biomass productivity is observed for the species in the well-fitted group. This is compatible with Hithmough and Wagner (2011) findings that suggests some of the plant species that were heavily consumed by mollusc grazing in the first year when smaller and more juvenile could show considrable growth during the Year 2.

The combined effects of the moisture and temperature treatments are in line with the above findings. Apart from *Bupthalmum salicifolium* and *Centaurea montana* that produces biomass under the different combined treatment, other palatable species; *Arnica montana, Phyteuma spicatum* var. *caeruluem, Salvia pratense,* and *Scabiosa caucasica* retain their biomass only when the moisture levels is at Ambient-50%. This indicates that grazing activities with increasing the moisture levels are enough to eliminate these plants. Even for these species under the Ambient-50% moisture level, Ambient+3C temperature leads to better growth, which is due to reduced activity of mollusc species. It is assumed that increased biomass productivity of *Bupthalmum salicifolium, Centaurea montana* when grazing conditions are suitable, is due to the presence of alkaloids and other toxic molecules in the leaves of adult plants.

4.4.3 Intermediate fitted species

Among the three ecological groups in this research the intermediate fitted group species clearly show the greatest impact of grazing on their biomass productivity. *Asphodeline lutea, Centaurea triumfetii, Centaurea orientalis, Hedysarum hedysaroides* and *Paradisea liliastrum* are palatable to highly palatable species that disappear with increasing moisture levels. This leads with increasing the moisture levels leads to better biomass productivity for the unproductive plant species; *Dianthus carthusinorum, Euphorbia nicaensis, Linum flavum* 'Compactum'*, Linum narbonennse, Lychnis coronaria, Lychnis flos jovis.* The same growth pattern was expected for the palatable species because of the high moisture levels but they disappeared when the temperature reaches Ambient and Ambient+50% moisture levels. Again this can clearly be attributed to higher mollusc grazing due to more available moisture. Similar to the well-fitted group these plant species show slight increase with increasing temperature to Ambient +3°C. Interestingly all of palatable species are present when the temperature increases. Higher temperature, more evaporation and less available moisture to molluscs, hampers their grazing, which causes more biomass productivity at the higher temperature treatment. For the combined water and temperature treatment, the plants in the intermediate fitted group produce their least amount of biomass if the water treatment is at Ambient -50% and the temperature is Ambient +3°C. Although many of these species naturally grow in landscapes that experience significant drought in summer, many of these species grow earlier in the year thus avoiding the most severe moisture stress. While the highest biomass production belongs to Ambient +50% and Ambient +3°C. Increasing mollusc activities due to the more available moisture was neutralized by higher temperature levels. The palatable species in this group; *Asphodeline lutea, Centaurea triumfetii, Centaurea orientalis, Hedysarum hedysaroides, Paradisea liliastrum* and *Salvia nemorosa* are all naturally distributed in parts of Europe and Eurasia with prolonged dry conditions in summer. The exception to this is *Paradisia,* which occurs at moderate altitudes in the Alps at which slug populations are small or absent. These species are likely to become better fitted to Southern Britain in the future where drier spring to autumn conditions are currently predicted by climate change models.

4.4.4 Poorly fitted species

The plant species disappear when the moisture availability levels reaches Ambient +50%. Some of the species show biomass productivity when the moisture is at the Ambient level. These plant groups are mostly native of the continental temperate steppe grassland and can not tolerate higher moisture levels. At lower levels of moisture in these habitats molluscs are mostly absent and hence these species are potentially palatable *Balsmorrhiza sagitifolius, Centaurea pulcherrimus, Delphinium barbeyi, Dracocephalum grandiflorum* and *Hymenoxys grandiflora* are the palatable species in this group. When the moisture levels reach Ambient and Ambient + 50% even if some of the palatable specie can survive the moisture level and consequently the increased grazing of mollusc grazing make them disappear. Similar to the well and intermediate fitted group, but to a much greater degree, the plants in this category show better biomass productivity when the temperature is increased. At Ambient+3C not only all of these species show better growth but also the palatable species are present, which is because of hampered mollusc grazing due to the environmental dryness. These native US and central Asian plant species show their best biomass production when they are exposed to less water and higher temperatures. Not surprisingly the highest biomass production in these species, when exposed to the combined temperature and moisture treatments, belongs to Ambient-50% moisture and Ambient +3C temperature.

4.5 Conclusions

In this study the effects of slug grazing on “designed plant communities” under different climate scenarios that closely reflected those predicted for 2050 were investigated. The species to develop a meadow- like community were selected from three different habitat types/ecological regions. Mollusc grazing was affected by different climate scenarios (from dry and warm to wet and hot). Molluscs showed different behaviors in dry, wet, warm and ambient temperature and this led to significant differences in the biomass and structure of these communities.

CHAPTER 5: EFFECT OF DIFFERENT LEVELS OF CO_2, TEMPERATURE AND WATER ON THE PRODUCTIVITY OF INDIVIDUAL SPECIES

5.1 Introduction

Cities play a significant role in carbon dioxide production worldwide. The carbon dioxide (CO_2) of the atmosphere has increased to 348 ppm over the past 250 years. First and foremost this is because of burning fossil fuels such as coal, oil, and gas and second, because of the conversion of land from natural or semi-natural ecosystems in which carbon is sequestered to the built environment. The excessive CO_2 in the atmosphere is one the reasons behind climate warming. The temperature of the land surface in urban area increases due to the combination of background increases in greenhouse gases and the more localised urban heat island effect. This may disturb species configuration (Niemelä, 1999) by increasing the growing season and decreasing air quality (Feizizadeh and Blaschke, 2013; Lai and Cheng, 2009; Sarrat *et al.*, 2006 and Weng and Yang, 2006). Climate change is also responsible for global changes in the dissemination of species and massive movement of future ecosystems in all part of the world (Costion *et al.*, 2015). The are many plant species distribution models (SDMs) used to assess species' potential range shifts or disappearance risk under climate change in ecological research (Crimmins *et al.*, 2013), but no one has applied them to designed plant communities in urban landscapes.

Herbaceous vegetation is an increasingly important element of the urban landscape. Today, naturalistic planting design, semi-natural grassland and meadow in the urban landscape, are increasingly accepted by the public and professional urban designers. Both native and exotic species have an important role in naturalistic planting design. Increased CO_2 and air temperature in conjunction with the changing rainfall conditions, as the three important factors of climate change, potentially alter almost all world ecosystems.

Climate change provides new opportunities, and in some cases an obligate need, to use non-native plant species in conjunction with native plant species, not only to reduce the side effects of climate change but also to increase the species diversity and aesthetic value in meadow-like naturalistic planting design. Previous chapters have described how the impacts of simulated climate change on designed plant communities in urban green space in the UK were studied. One the most reliable tools for studying how plant species respond to climate change is the experimental manipulation of the local climate. In this study we investigated the effect of manipulating CO_2 concentration, precipitation (irrigation) and temperature regime on individual plants of species drawn from across a climatic-fitness gradient. This involved species from the Southern Rocky Mountains (Continental climate), Southern Europe (Mediterranean climate) Grassland and Steppe Vegetation, in comparison with better-fitted species from Western Europe (Marine climate).

5.1.1 Objectives

The specific objectives of this study were:

1) To determine the effects of changing CO_2 concentration in combination with temperature and precipitation on the standing, above-ground biomass and the relative growth rate of the species used in this study in monoculture.
2) To use this quantification of growth rate as a means of establishing a fitness index for the species used within the field experiment.
3) To assist in the interpretation of the data from the field study.
4) To investigate the response to CO_2 under different levels of other resources such as temperature and precipitation.

5.1.2 Species selection

This study was undertaken on 18 species split into three groups on the basis of differential predicted fitness: 1) well-fitted; 2) intermediate-fitted; 3) poorly-fitted to the UK climate (As explained in Chapters 3 and 4).

The species were selected from Western Europe (Temperate maritime climate), South Europe (Mediterranean climate) and the Southern Rocky Mountain region (Continental climate). The criteria for plants selection are as follows:

- The results of our previous experiments,
- Seed availability,
- Ease and reliability of establishment from seed,
- Providing a range of ecological trait-strategies.

All seeds were purchased from Jelitto Seeds, Schwarmstad, Germany and Alplains, Colorado, USA. (Table 5.1).

Table 5.1 Plant Species used in this study

Species	Typical fitness in UK conditions
Centaurea montana	Well
Centaurea triumfetii	Well
Galium verum	Well
Prunella vulgaris	Well
Salvia pratensis	Well
Scabiosa caucasica	Well
Asphodeline lutea	Intermediate

Bupthalmum salicifolium	Intermediate
Dianthus carthusianorum	Intermediate
Linum flavum 'Compactum'	Intermediate
Lychnis coronaria	Intermediate
Salvia nemorosa	Intermediate
Asclepias tuberosa	Poor
Hymenoxys grandiflora	Poor
Centaurea pulcherrimus	Poor
Penstemon strictus	Poor
Salvia pachyphylla	Poor
Zinnia grandiflorus	Poor

5.2 Material and methods

This experiment was conducted at Sheffield Botanic Gardens for a period of 6 months. Twelve climate change scenarios involving variations in CO_2, moisture stress and elevated temperature were designed. As it was explained in chapter 3 the average precipitation of Sheffield in growth season during the last 50 years (Appendix 1) was used as the base line of rainfall (Ambient) during the experiments (See page 49-55). Again according to the ambient rainfall of Sheffield new precipitation scenarios were designed:

Precipitation: Ambient – 50%, Ambient, Ambient+50%

The average of temperature during the last 50 years (Appendix 2) was used as the base line of temperature (Ambient) during the experiment to provide 2 temperature scenarios as well:

Temperature: Ambient, Ambient+3-5^{o}C

As result twelve climate change scenarios involving variations in CO2 (450 & 900 PPM), moisture stress and elevated temperature were designed.

a. CO_2 concentration 900 PPM, 50% increase in precipitation, temperature ambient.
b. CO_2 concentration 900 PPM, 50% increase in precipitation and temperature increase 3- 5°C.
c. CO_2 concentration 900 PPM, Ambient precipitation and temperature.
d. CO_2 concentration 900 PPM, 50% decrease in precipitation and temperature increase 3- 5°C.
e. CO_2 concentration 900 PPM, 50% decrease in precipitation and temperature ambient.
f. CO_2 concentration 900 PPM, precipitation doesn't change and temperature increase 3- 5°C.
g. CO_2 concentration 350PPM Ambient precipitation and temperature.
h. CO_2 concentration 450 PPM, 50% decrease in precipitation and temperature increase 3- 5° C.
i. CO_2 concentration 450PPM, 50% increase in precipitation and temperature increase 3- 5° C.
j. CO_2 concentration 450PPM, 50% decrease in precipitation and temperature ambient.
k. CO_2 concentration 450PPM, 50% increase in precipitation and temperature ambient.
l. CO_2 concentration 450 PPM, precipitation ambient, temperature increase 3- 5°C.

The experiment involved a factorial design with four key factors:

i) CO2 concentration,
ii) Water regime,
iii) Temperature,
iv) Growth duration.

Designing the precipitation scenarios was explained before (chapter3 , 3.2.1.1). At this part of research again the average of Sheffield precipitation during June to September (Appendix1) was used as the baseline for "ambient" rainfall during the experiments and three precipitation scenarios were designed.

precipitation scenarios: Ambient – 50%, Ambient, Ambient+50%

Also the mean maximum temperature of Sheffield (June to September) in the last 50 years (Appendix2) was used as a temperature base line allowing two temperature scenarios to be designed:

Temperature: Ambient, Ambient+4^{o}C [3^{o} – 5^{O} C]

In order to achieve the desired 3.0-5^{o}C elevation of temperature within the growth cabins a series of vents was provided by opening the top door of the growth cabins at different angles and then calibrating the effect of this by testing prior to the experiment commencing.

Table 5.2 The Growth Season Rainfall in Sheffield during 1955 - 2014

Months	Highest Rainfall	Lowest Rainfall	Average
March	149.0	11.2	62.9
April	196.6	1.8	60.0
May	186.4	11.2	60.69
June	254.9	8.1	67.1
July	087.0	12.4	60.6
August	195.9	8.4	67.8
September	17.4	1.0	64.3

For example, the average of rainfall during the July in last 50 years was 61mm (Appendix 1) and the average of temperature was 16^oC (Appendix 2). The Figure 5. 1 show the 12 climate change scenarios which were designed for July 2014 (Figure 5. 1).

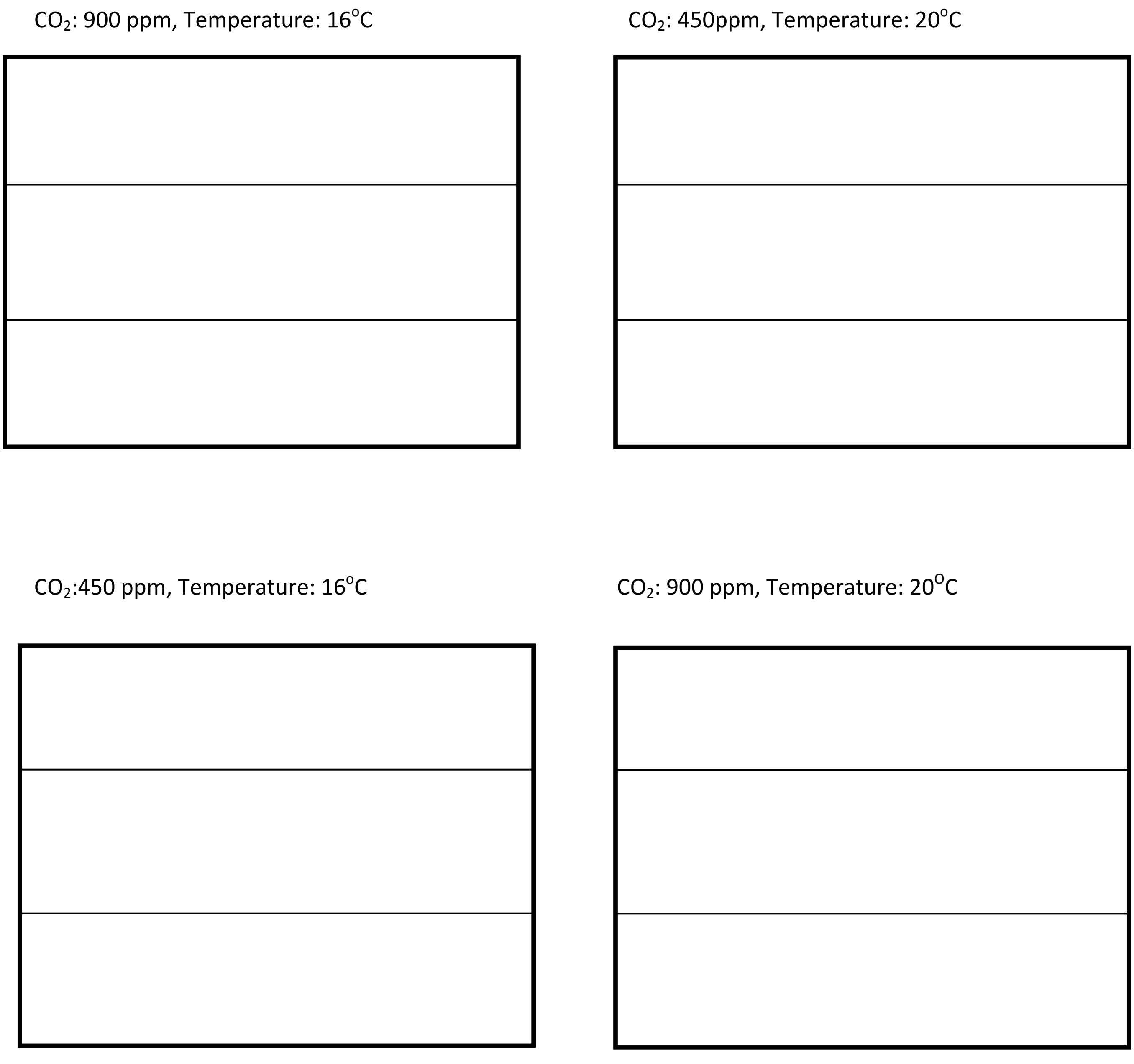

Figure 5. 1 The 12 different climate change scenarios which were designed for July

The 18 plant species from 3 different habitat , were treated by 12 combinations climate scenarios , 2 different harvesting times and 4 replications. The seeds were sown in seedling trays on 20th May 2014 in a greenhouse at Sheffield Botanical Gardens (**Figure 5.** 2).

Figure 5. 2 Seeds sown in a greenhouse at Sheffield Botanic Gardens

After germination and seedling establishment (about one month later) the seedling trays were transferred to the growth cabins (**Figure 5.**3). Four growth cabins were used to control temperature and CO_2 levels.

Figure 5.3 Controlled Atmosphere Growth Cabins

LBS thermostatically controlled heat mats (**Figure 5.** 4) were used to elevate the temperature of the growth cabins.

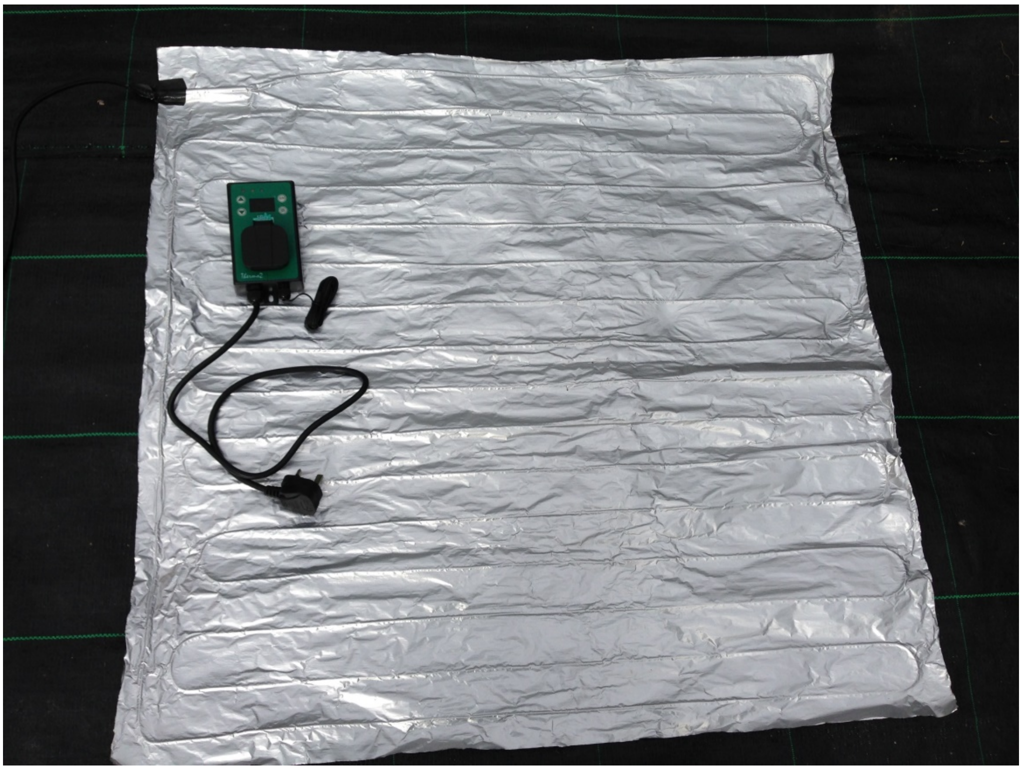

Figure 5. 4 Garden Heat Mat with Thermostat

A water flow meter was used to assist in delivering different irrigation volumes when irrigating to create the gradient of moisture stress treatments.

Figure 5.5 Gardena Water Flow Meter

To increase the CO_2 concentration inside the growth cabins a CO_2 boost bucket (**Figure 5.**6) system was use.

Figure 5.6 CO_2 Boost Bucket

The concentration of CO_2 was measured and recorded every 2 minutes using an Extech CO_2/Humidity/ Temperature Datalogger (**Figure 5.**7).

Figure 5.7 Extech CO_2/ Humidity/ Temperature Datalogger

5.2.1 Data collection

The productivity of plant species both in a fitness group and individually grown within each small plot was recorded from June to September 2014. The number of plant species in each mini-plot was counted at two-week intervals to estimate the percentage mortality of individual species during the observation period.

The plants were first harvested at 45 days after transferring to growth cabins with a second and final harvest 45 days after the first harvest. Harvesting of seedlings sown in June commenced in August 2014, with the second harvest in September 2014.

A harvesting procedure was developed to cope with the highly variable biomass within an individual plot plant group, and also to ensure that all plant samples were available for harvesting at the end of the summer. The procedure for harvesting at 45 and 90 days was as follows:

- In order to provide the same situation for all species and reduce the competition in all treatments, only 4 seedlings from each species were kept.
- The extra species were reduced randomly in terms of size and growth stage.

Each of the sampled plants from all species was cut off at a ground level and the cut biomass of each individual plant placed into individual coded envelopes. Samples were dried at ambient temperatures (15-25°C) within a laboratory before being transferred to the oven at 60**°C** for five days. Mean dry weights for the time period in question were then used to compare the effect of climate scenarios on the growth rate of the sown species in fitness groups and on the biomass of individual plants. The harvesting data were then used to generate the growth rate data for the fitness groups (well-fitted, intermediate-fitted and poorly-fitted) and the productivity of individual species during the experiment.

Relative growth rate was calculated using the formula of Hunt (2003):

Relative growth rate = $\ln (W_2) - \ln (W_1) / t_2 - t_1$

W_1 = above ground weight 60 days after emergence W_2 = above ground weight 150 days after emergence

t_1 = number of days at first harvest t_2 = number of days at second harvest

5.2.2 Statistical analysis

Statistical analysis was undertaken using SPSS for Mac. Data was initially explored through a variety of statistical approaches, both parametric and non-parametric. This included transformation $\log_e$ for weight data, and arcsine square root for percentage data to improve the properties of the data sets for parametric analysis, namely distributional characteristics and homogeneity of variance (Zar, 1999). Even after transformation, the data was significantly non-normally distributed, and variance was far from homogenous ($P<0.05$). Thus, following discussions with a statistician, a decision was made to use a non-parametric means of analysis. Data analysis outputs are provided at Appendix 6.

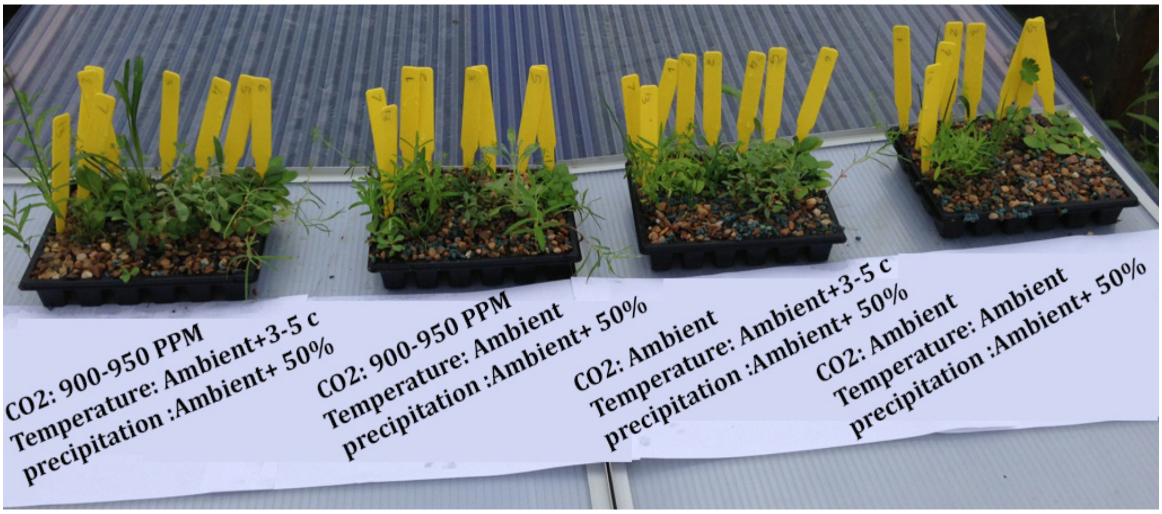

Figure 5.8 Effect of CO_2 concentration and temperature at ambient +50% level of precipitation on plant species

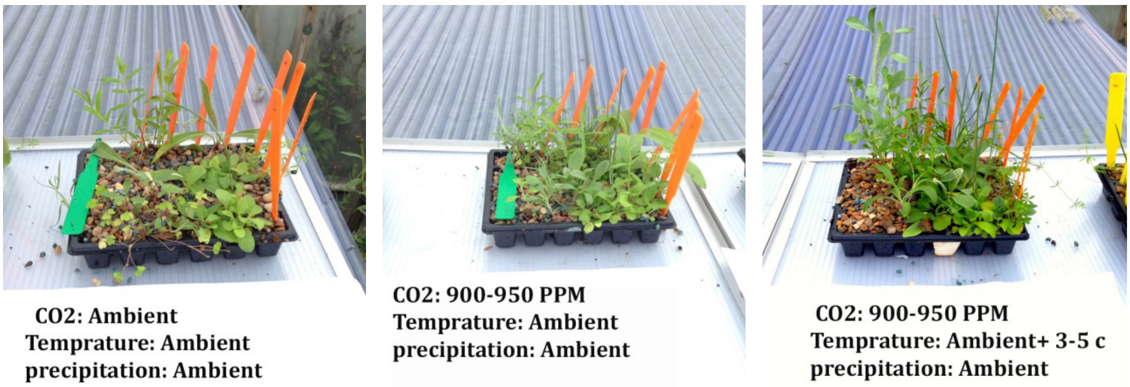

Figure 5.9 Effect of CO_2 concentration and Temperature at ambient level of precipitation on plant species

5.3 Results

5.3.1 Response of species as plant fitness group

5.3.1.1 Effect of water availability on biomass production

The responses of plant species as fitness groups to the water regime are shown in Figures 5-9. It is interesting to note that, generally speaking, well- and intermediate-fitted species showed a similar response whilst poorly-fitted species showed a different growth response to the water. This suggests that the species that were chosen to represent the different fitness groups were an accurate reflection of our initial assumptions when making up the groups.

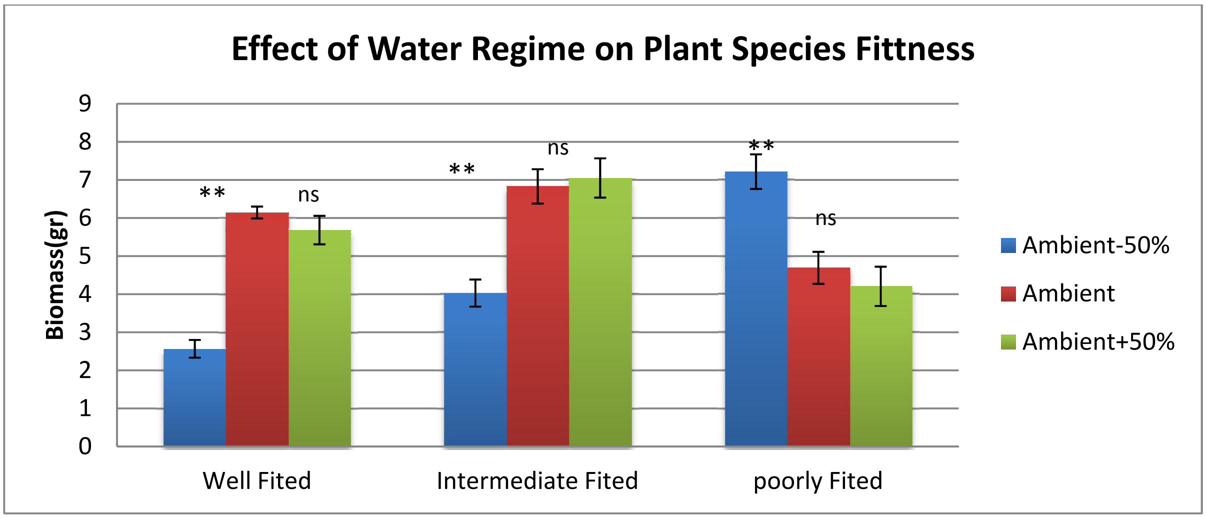

Figure 5. 10 Effect of water regime on biomass of species in fitness groups. Significant differences (Mann-Whitney U-test) within each fitness group are indicated by; * P=0.05; ** P=0.01; ns, not significant. Error bars represent 1 S.E.M.

5.3.1.2 Effect of CO_2 concentration on biomass production

The results showed large differences in biomass of plant species within each group, under different levels of CO_2 concentration (450-900 PPM). It can be seen from Figure 5.11 that the highest difference was in poorly-fitted species and the lowest was in the well-fitted group. Again, the response seemed to support our initial assumptions when including species in these groups.

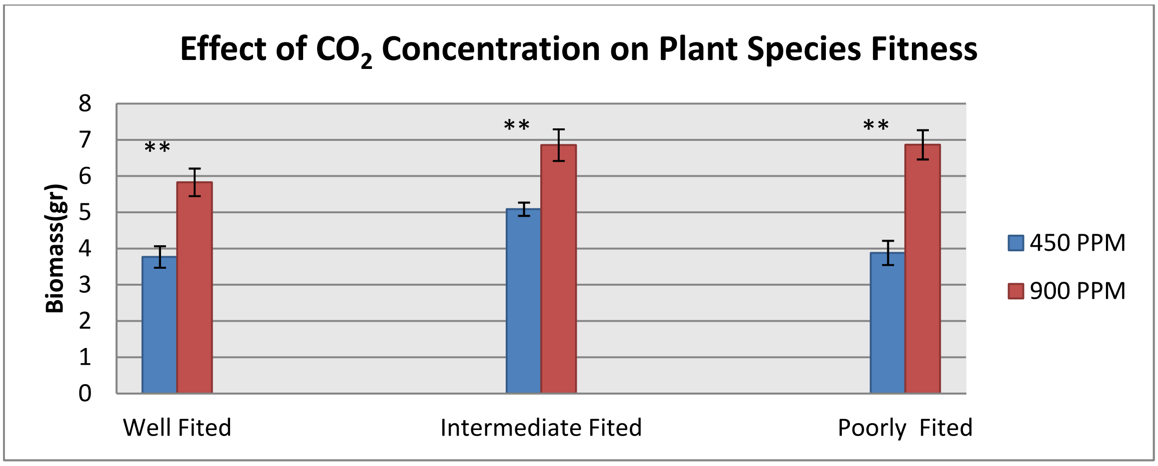

Figure 5. 11 Effect of CO_2 concentration on different fitness groups. Significant differences (Mann-Whitney U-test) between biomass production of plant species group in 450 PPM and 900 PPM are indicated by; * P=0.05; ** P=0.01; ns, not significant. Error bars represent 1 S.E.M.

5.3.1.3 Effect of temperature on biomass production

Temperature was one of the most important factors in plant species growth and development. The results indicated that increasing temperature had a significant positive effect on plant biomass production in poorly-fitted species and their fitness in general. On the other hand, the result showed that increasing temperature up to 4^{o}**C** did not have a significant effect on well-fitted and intermediate-fitted species.

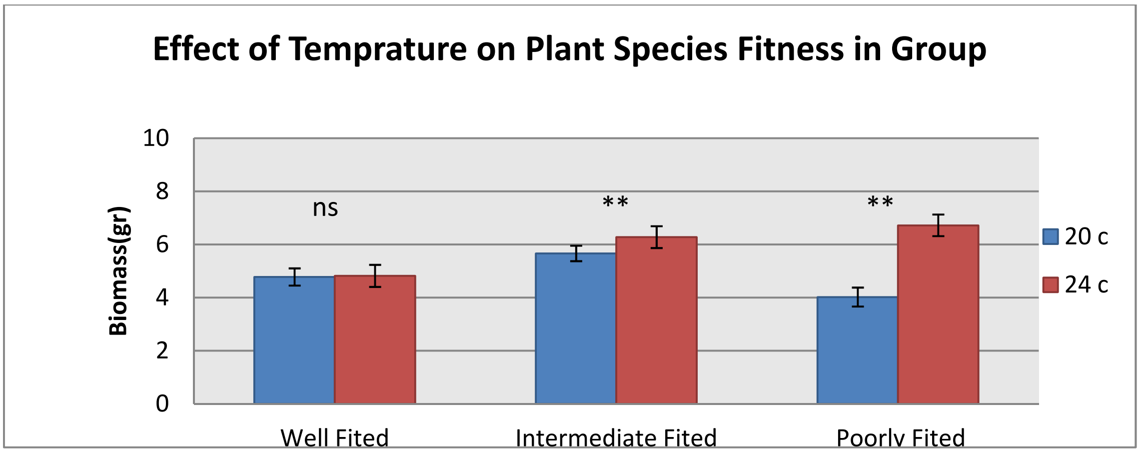

Figure 5. 12 Effect of temperature on plant species fitness groups (as biomass) by September 2014. Significant differences (Mann-Whitney U-test) at 20c and 24 c are indicated by; * P=0.05; ** P=0.01; ns, not significant. Error bars represent 1 S.E.M.

5.3.1.4 Effect of growth duration on biomass production

All plant groups showed a similar response to the growth duration, with biomass production after 3 months in all treatments more than the biomass production after 1.5 months.

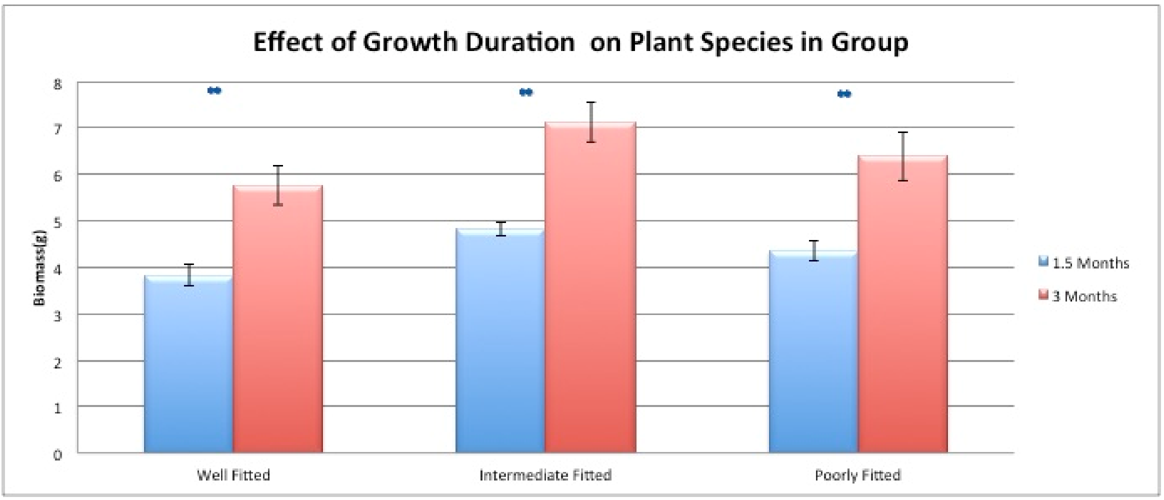

Figure 5.13 Effect of time scale on biomass production of plant species in well-, intermediate- and poorly-fitted groups by September 2014. Significant differences (Mann-Whitney U-test) are indicated by; * P=0.05; ** P=0.01; ns, not significant. Error bars represent 1 S.E.M

5.3.1.5 Effect of CO_2 ×Water regime on plant species fitness.

5.3.1.5.1 Well-fitted species

At both $C0_2$ levels a parallel response to changing moisture availability was observed. At -50% irrigation the biomass declined sharply from the ambient moisture, and a much smaller decline was observed at the +50% suggesting that the growth of well-fitted species was most disadvantaged at the highest irrigation level. Although there was a significant difference between biomass production at -50% irrigation and ambient, -50% and +50% at both $C0_2$ levels, but there was no significant difference between ambient and +50% at both $C0_2$ levels.

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5.3.1.5.2 Intermediate-fitted species

Moisture availability in combination with CO_2 concentration showed significant effects on biomass productivity in this plant group. The highest biomass was achieved at ambient irrigation at both levels of CO_2 and the lowest at 50% irrigation. In the +50% irrigation, similar to well-fitted species, a much smaller decline in growth than in the poorly-fitted group was observed.

5.3.1.5.3 Poorly-fitted species

The mean biomass of poorly-fitted species showed a very different pattern to that of fitted species, in that it decreased from the driest treatment to the wettest treatment. At -50% irrigation biomass increased sharply from that at the ambient moisture, and a much smaller increase was observed at the +50% at both levels of CO_2 concentration, increased moisture availability had a negative effect on biomass production and these responses broadly parallel one another.

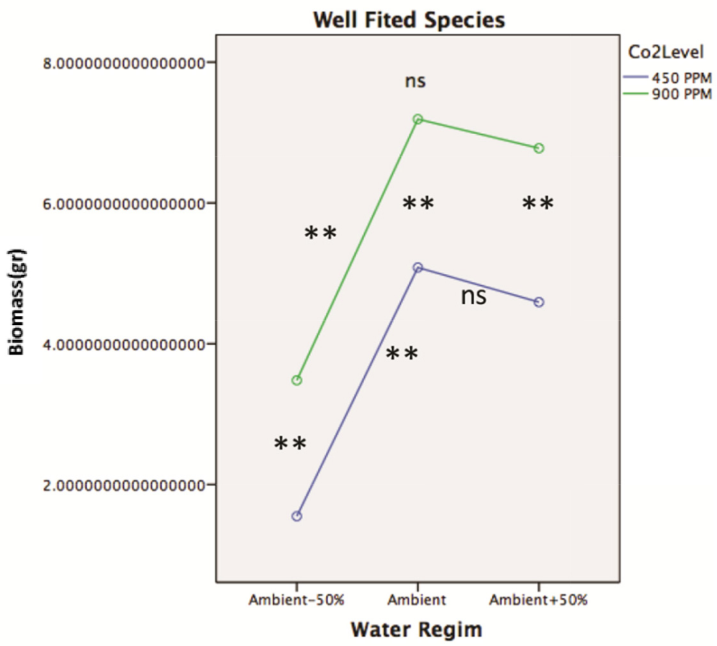


Figure 5.14 The effect of $C0_2$ and water regime on final biomass (gr) (September 2014) of well-fitted species. In the Figure, Significant differences among the points on and between the lines are indicated by; * P=0.05; ** P=0.01; ns, not significant

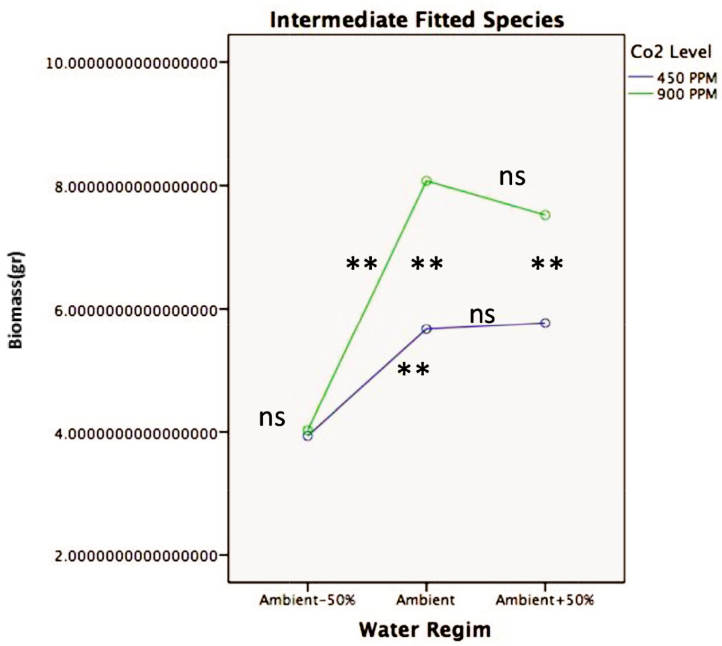


Figure 5.15 The effect of CO_2 and water regime on final biomass (gr) (September 2014) for intermediate-fitted species. In the Figure, significant differences among the points on and between the lines are indicated by; * P=0.05; ** P=0.01; ns, not significant

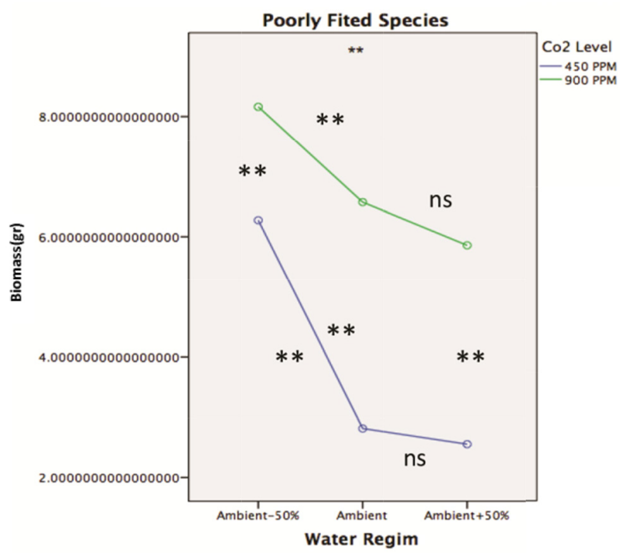


Figure 5.16 The effect of CO_2 and water regime on final biomass (gr) (September 2014) poorly-fitted species. In the Figure, significant differences among the points on and between the lines are indicated by; * P=0.05; ** P=0.01; ns, not significant

5.3.1.6 Effect of temperature ×water regime on plant species fitness.

5.3.1.6.1 Well-fitted species

At both temperatures (20°C and 24°C) significant responses to water availability was observed. At 20°C, changing moisture from -50% to ambient showed an increase in biomass. A biomass decline was observed at +50%. At 24°C, increasing level of irrigation from -50% to +50% caused the biomass productivity to increase. In contrast to the situation at 20°C the highest level of irrigation (+50%) did not have any negative effect on biomass.

5.3.1.6.2 Intermediate-fitted species

Moisture availability in combination with different levels of temperature (20°**C** and 24°**C**) had significant effects on biomass productivity in intermediate-fitted species. Similar patterns to the most-fitted species were observed. The highest dry weight (biomass) was achieved in +50% and the lowest in -50% irrigation at 24°**C**. At 20°**C**, in +50% irrigation, a decline in biomass was observed.

5.3.1.6.3 Poorly-fitted species

Poorly-fitted species showed a positive response to increasing temperature (20°**C** to 24°**C**) and also decreasing moisture (from +50% to -50%). They showed a very different pattern to that of well-fitted and intermediate species, in that it decreased from the driest treatment to the wettest treatment. At -50% less irrigation, biomass increased sharply from the ambient moisture, at both levels of temperature, and a much smaller increase was observed at the ambient from +50%. Increasing temperature in all moisture treatments had a significant effect on biomass productivity.

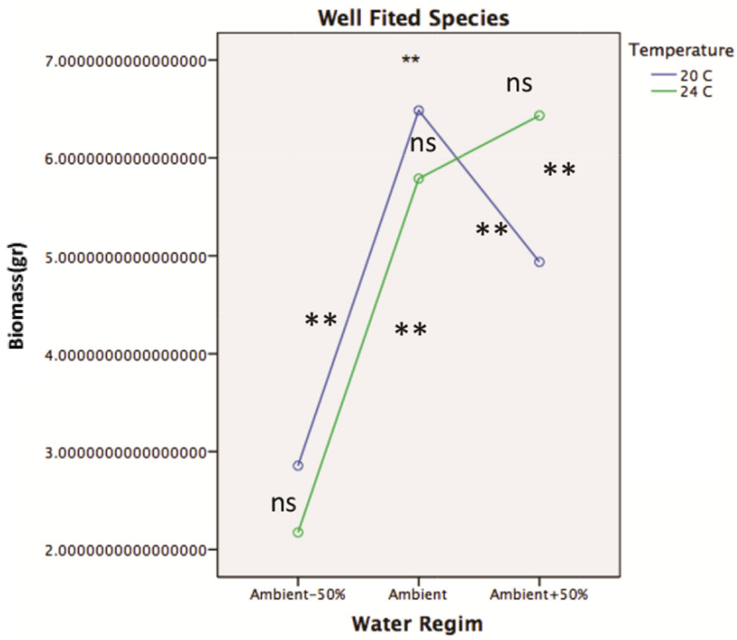


Figure 5. 17 The effect of Temperature and water regime on the final biomass (gr) of well-fitted species (September 2014). In the Figure, significant differences among the points on and between the lines are indicated by; * P=0.05; ** P=0.01; ns, not significant

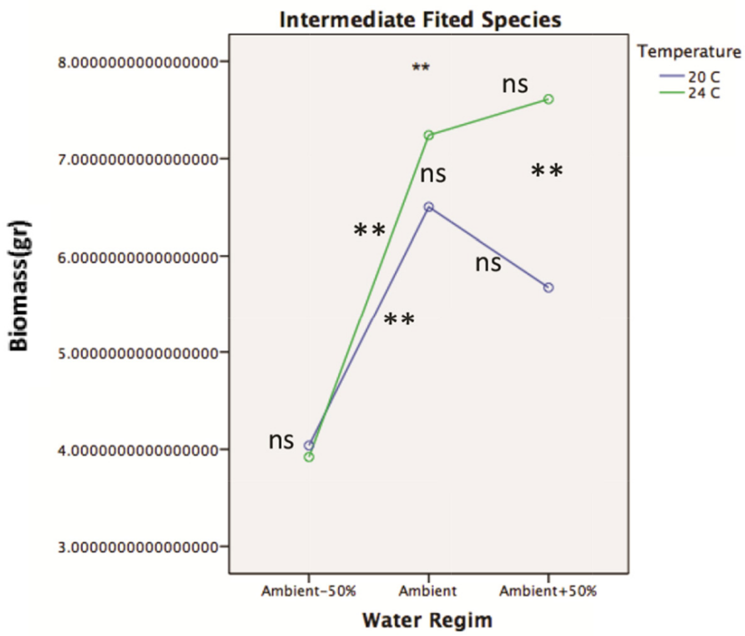


Figure 5.18 The effect of Temperature and water regime on the final biomass (gr) of intermediate-fitted species (September 2014). In the Figure, Significant differences among the points on and between the lines are indicated by; * P=0.05; ** P=0.01; ns, not significant

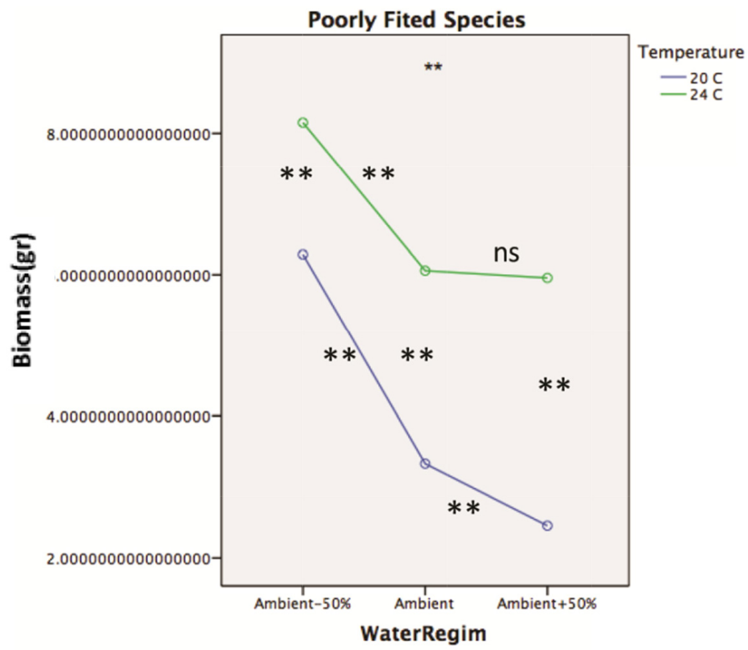


Figure 5.19 The effect of Temperature and water regime on the final biomass (gr) of poorly-fitted species (September 2014). Significant differences among the points on and between the lines are indicated by; * P=0.05; ** P=0.01; ns, not significant

5.3.1.7 Effect of Growth duration ×Water regime on plant species fitness.

5.3.1.7.1 Well-fitted species

After three months, the effects of water regimes on biomass productivity of well-fitted species were very obvious. All levels of moisture treatment represent a clear difference between one and a half months and the three-month growth duration in terms of biomass. The ambient water regime showed the best biomass productivity and -50% showed the least. Excess irrigation (+ 50%) had a negative effect at both growth durations (one and half months and three-month).

5.3.1.7.2 Intermediate-fitted species

On both growth durations (one and a half months and three months) the reaction of intermediate-fitted plant species to the water regime was similar to the well-fitted species. After three months, they fitted better. The biomass increased sharply from -50% to ambient moisture, and excess water (+50%) did not have a negative effect on biomass productivity.

5.3.1.7.3 Poorly-fitted species

Mean biomass of poorly-fitted species showed a very different pattern to that of fitted and intermediate-fitted species because of their sensitivity to moisture. After three months, they had enough time to respond to the treatments (moisture). Biomass productivity decreased from the driest treatment to the wettest treatment. At -50% irrigation, biomass increased sharply from that at ambient moisture, and a much smaller decrease was observed at +50% at both growth durations. Increasing moisture availability had a negative effect on biomass production and these responses broadly parallel one another at the two temperature regimes.

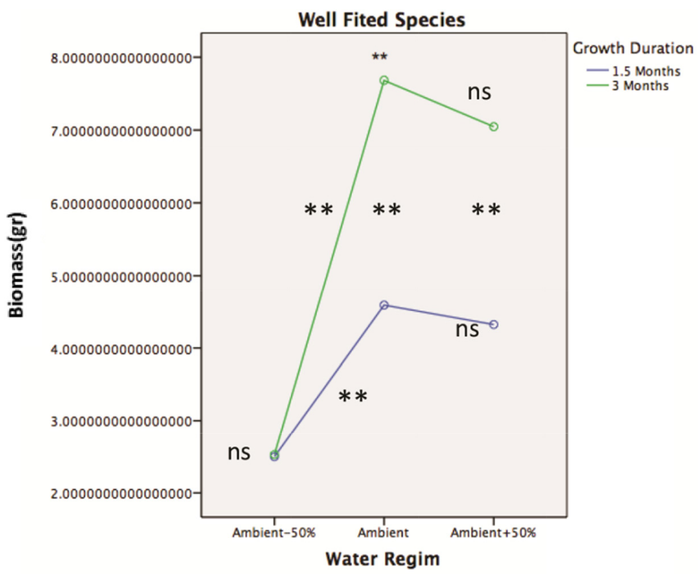


Figure 5.20 The effect of temperature and water regime on the final biomass (gr) of well-fitted species *(*September 2014). Significant differences are indicated by; * P=0.05; ** P=0.01; ns, not significant.

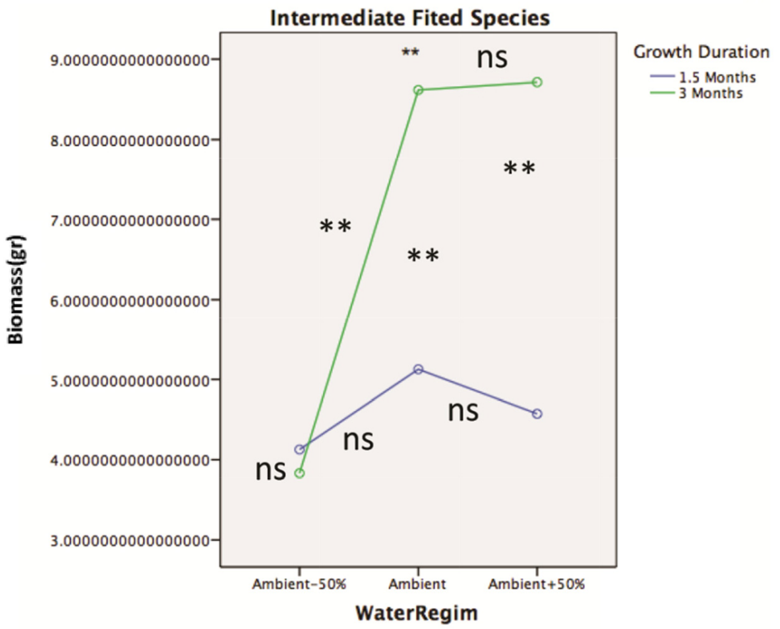


Figure 5. 21 The effect of growth duration and water regime on the final biomass (gr) of intermediate-fitted species (September 2014). Significant differences are indicated by; * P=0.05; ** P=0.01; ns, not significant.

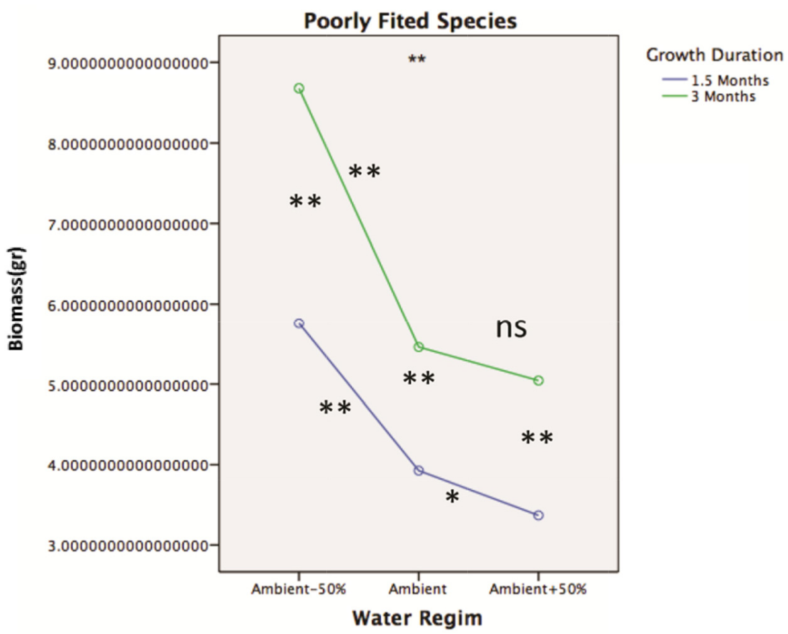


Figure 5.22 The effect of growth duration and water regime on the final biomass (gr) of poorly-fitted species (September 2014). In the Figure, significant differences among the points on and between the lines are indicated by; * P=0.05; ** P=0.01; ns, not significant

5.3.1.8 Effect of CO_2 × temperature on plant species' productivity across the fitness ecological groups.

5.3.1.8.1 Well-fitted species

The results show that at both 20^{o}C and 24^{o}C, increasing the CO_2 concentration enhances biomass productivity. At the ambient level of CO_2 (450 PPM), the biomass declines from 20^{o}C to 24^{o}C. Different responses to CO_2 concentration were observed at 900 PPM concentration. This level of CO_2, combined with increasing temperature from 20^{o}C to 24^{o}C enhances biomass production.

5.3.1.8.2 Intermediate-fitted species

Temperature in combination with CO_2 concentration had a significant effect on biomass productivity in this group. At both levels of CO_2 (450 and 900 PPM), enhancing temperature increased the dry biomass. The highest biomass was achieved at 24^{o}C at 900 PPM CO_2 and the lowest at 20^{o}C and ambient CO_2 (450 PPM). At 450 PPM level of CO_2, increasing temperature (+4^{o}C) did not have a significant effect in terms of biomass.

5.3.1.8.3 Poorly-fitted species

Poorly-fitted species showed a positive response to the combination of CO_2 and temperature. These species need high temperature and low precipitation to grow well. At both levels of CO_2 (450 PPM and 900 PPM), enhancing the temperature (from 20^{o}C to 24^{o}C) increased the biomass. Again these responses broadly parallel one another.

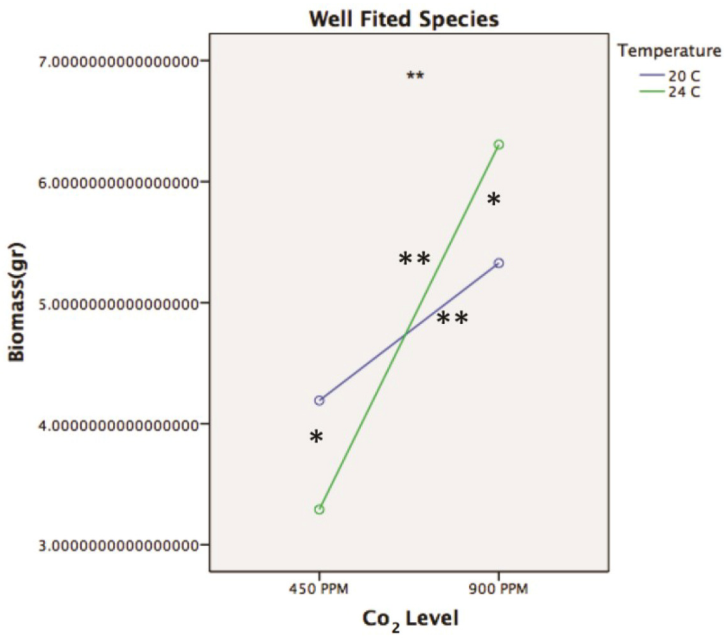


Figure 5.23 The effect of CO_2 and temperature on the final biomass (gr) of well-fitted species (September 2014). Significant differences among the points on and between the lines are indicated by; * P=0.05; ** P=0.01; ns, not significant

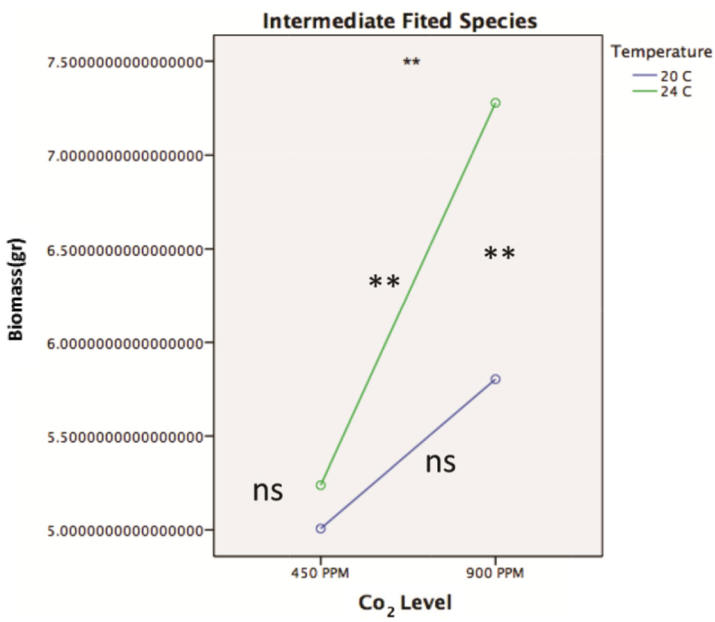


Figure 5. 24 The effect of $C0_2$ and temperature on the final biomass (gr) of intermediate-fitted species (September 2014). Significant differences among the points on and between the lines are indicated by; * P=0.05; ** P=0.01; ns, not significant

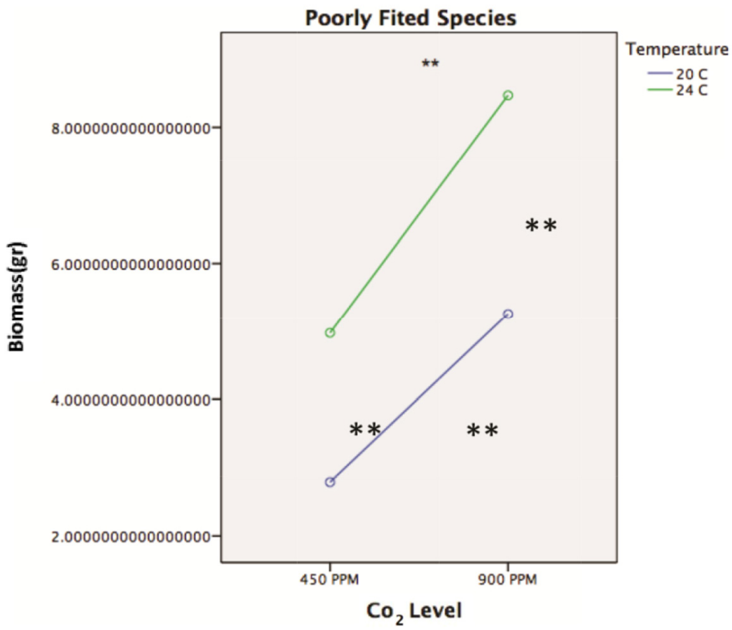


Figure 5.25 The effect of $C0_2$ and temperature on the final biomass (gr) of poorly-fitted species (September 2014). Significant differences among the points on and between the lines are indicated by; * P=0.05; ** P=0.01; ns, not significant

5.3.1.9 Effect of $CO_2 \times$ growth duration on plant species' biomass.

5.3.1.9.1 Well-fitted species

At both CO_2 levels (450 PPM and 900 PPM), as might be expected, growth duration had a positive effect on biomass. The length of the experiment was long enough for well-fitted species to produce significantly more biomass by the second harvest (90 days). Also at both growth durations (1.5 and 3 months), increasing CO_2 levels enhanced the biomass productivity. Three months growth in combination with 900 PPM CO_2 concentration showed the best biomass productivity and one and a half months' growth duration at 450 PPM, CO_2 concentration **made a lesser amount of** biomass.

5.3.1.9.2 Intermediate-fitted species

At both CO_2 levels, intermediate-fitted species showed a significant response to the duration of the experiment. They produced most biomass at 900 PPM of CO_2 concentration after three months growth. Increasing the length of the growth season from 1.5 to 3 months showed a positive effect on biomass productivity at 900 PPM, CO2. There was no significant effect at 450 PPM CO_2.

5.3.1.9.3 Poorly-fitted species

Increasing the CO_2 level from 450 to 900 PPM enhanced biomass at both the first and second harvest. Three months' growth in combination with 900 PPM CO_2 concentration showed the highest biomass and one and half months' growth at 450 PPM of CO_2 the least. At 450 PPM CO_2, growth duration was not significantly different in terms of biomass.

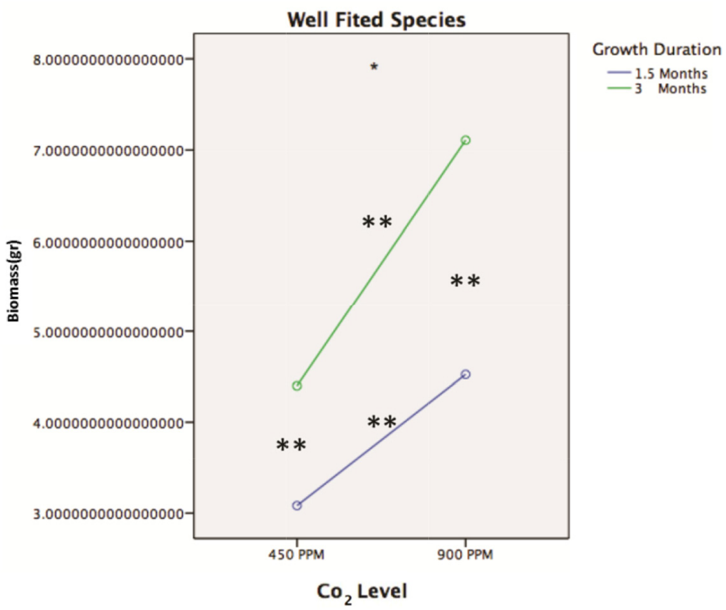


Figure 5.26 The effect of growth duration and CO_2 on the final biomass (gr) of well-fitted species (September 2014). Significant differences among the points on and between the lines are indicated by; * P=0.05; ** P=0.01; ns, not significant

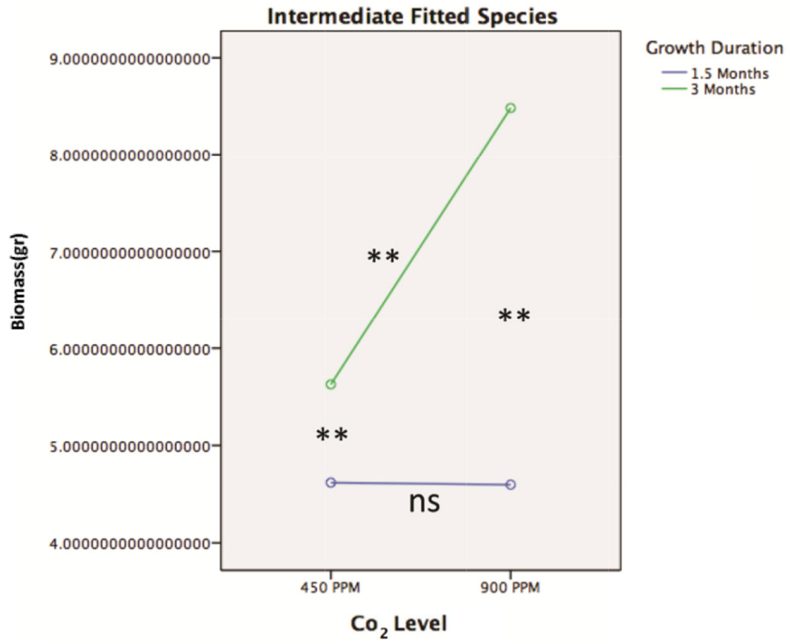


Figure 5.27 The effect of growth duration and CO_2 on the final biomass (gr) of intermediate-fitted species (September 2014). Significant differences among the points on and between the lines are indicated by; * P=0.05; ** P=0.01; ns, not significant

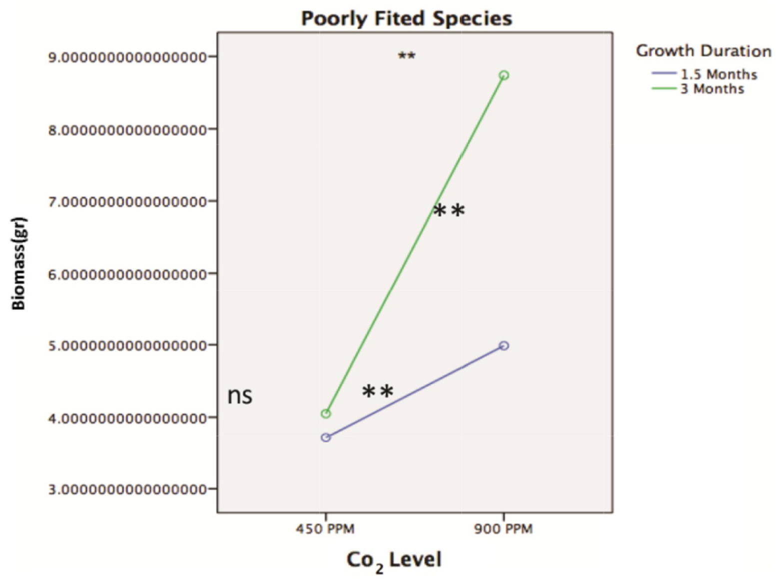


Figure 5.28 The effect of growth duration and CO_2 on the final biomass (gr) of poorly-fitted species (September 2014). Significant differences among the points on and between the lines are indicated by; * P=0.05; ** P=0.01; ns, not significant

5.3.1.10 Effect of temperature × growth duration on biomass.

5.3.1.10.1 Well-fitted species

Growth duration increased productivity at both temperature levels (20^{o}C and 24^{o}C). However, increasing temperature from 20^{o}C to 24^{o}C did not significantly increase biomass productivity at either 1.5 or three months.

5.3.1.10.2 Intermediate-fitted species

These species showed a greater response to increased temperature at both harvest points. After 3 months, increasing temperature (20^{o}C to 24^{o}C) did not show any significant difference in terms of biomass.

5.3.1.10.3 Poorly-fitted species

At both level of temperature (20^{o}C and 24^{o}C), dry material production (Biomass) was significantly increased by the length of the growth season. Increasing the growth season enhanced the biomass at both growth durations (1.5 and three months) as did increasing the temperature from 20^{o}C to 24^{o}C.

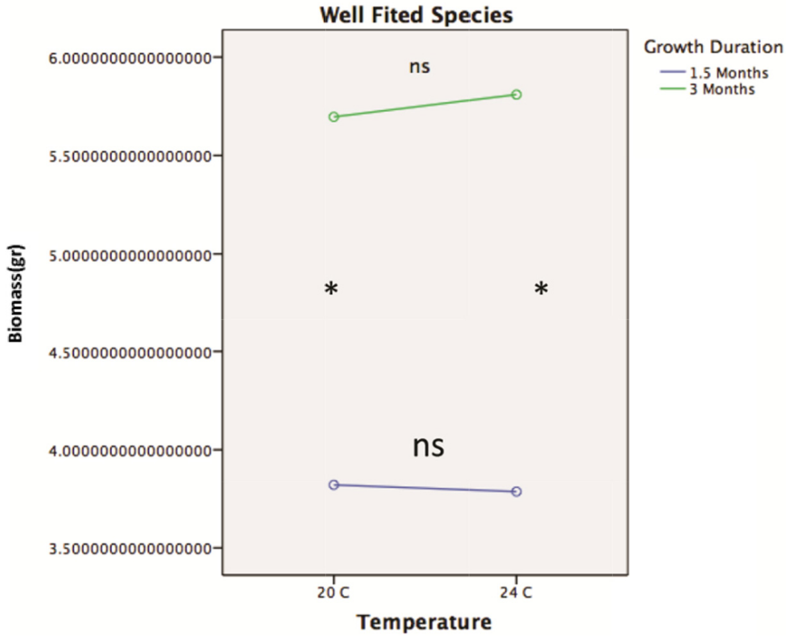


Figure 5.29 The effect of growth duration and temperature on the final biomass (gr) of well-fitted species (September 2014). Significant differences among the points on and between the lines are indicated by; * P=0.05; ** P=0.01; ns, not significant

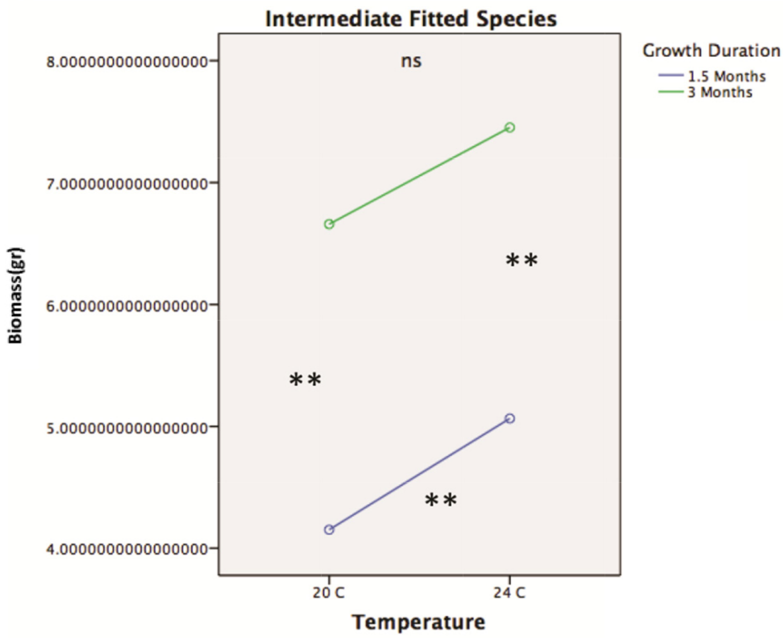


Figure 5.30 The effect of growth duration and temperature on the final biomass (gr) of intermediate-fitted species (September 2014). Significant differences among the points on and between the lines are indicated by; * P=0.05; ** P=0.01; ns, not significant

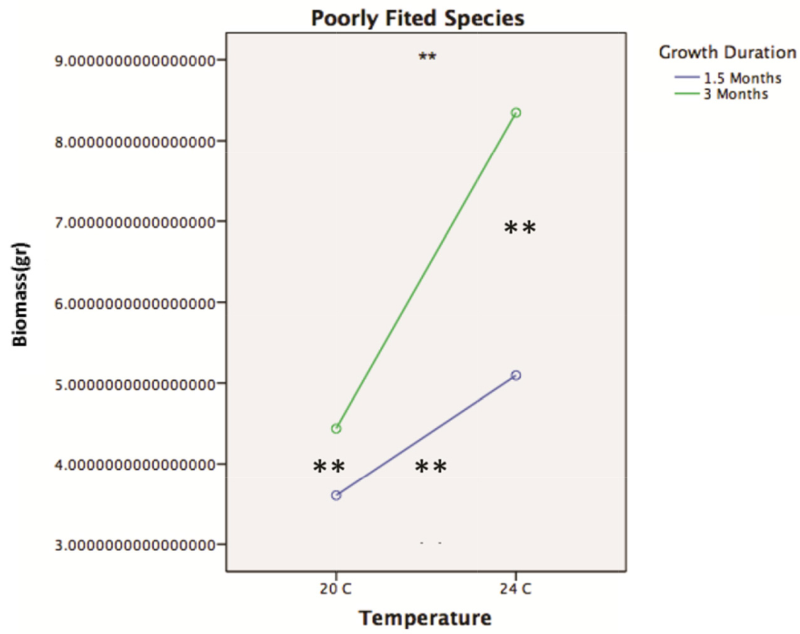


Figure 5.31 The effect of growth duration and temperature on the final biomass (gr) of poorly-fitted species (September 2014). Significant differences among the points on and between the lines are indicated by; * P=0.05; ** P=0.01; ns, not significant

5.3.2 Response of individual species

5.3.2.1 Response of plant species to water regimes in terms of biomass

Depending on the zone and the area in which species have developed originally, they showed different responses to the moisture availability. Well-fitted species (*Centaurea montana*, *Centaurea triumfetii, Galium verum, Prunella vulgaris, Salvia pratensis* and *Scabiosa caucasica*) showed high sensitivity to the low moisture (Ambient-50%) but poorly-fitted species (*Asclepias tuberosa, Hymenoxys grandiflora, Centaurea pulcherrimus, Penstemon strictus, Salvia pachyphylla* and *Zinnia grandiflorus*) showed their best growth at this level of water. Increased watering decreased the biomass in *Centaurea triumfetii, Galium verum, Prunella vulgaris, Salvia pratensis, Scabiosa caucasica*, *Asclepias tuberosa, Hymenoxys grandiflora, Centaurea pulcherrimus, Penstemon strictus, Salvia pachyphylla,* and

Zinnia grandiflorus. But increasing moisture availability to ambient +50% increased the biomass in intermediate-fitted species (*Asphodeline lutea*, *Bupthalmum salicifolium, Dianthus carthusianorum, Linum flavum 'Compactum', Lychnis coronaria* and *Salvia nemorosa*). However, significant differences between this level of water regime and ambient were only observed in *Penstemon strictus* and *Zinnia grandiflorus*.

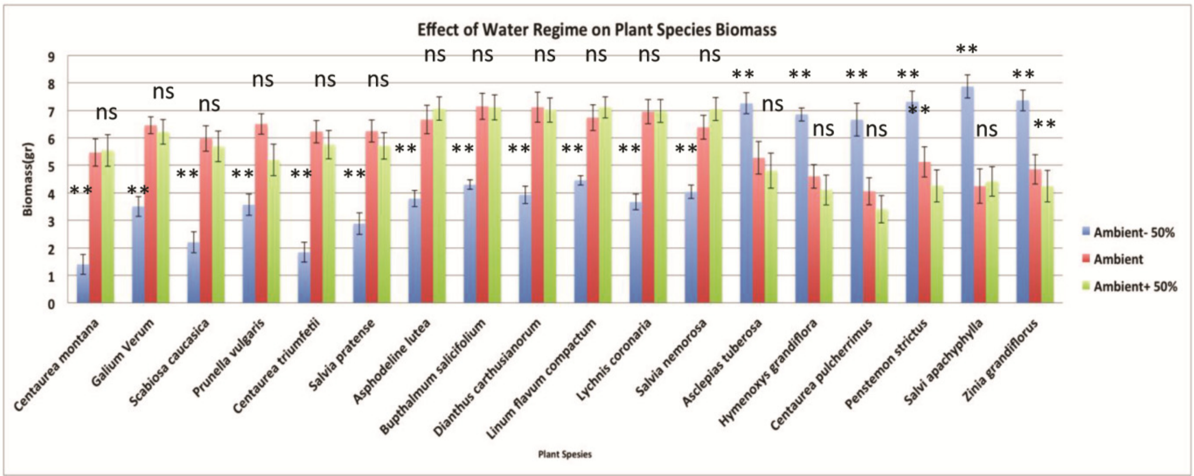


Figure 5.32 The effect of moisture availability on the final biomass (gr) of plant species (September

2014). Significant differences are indicated by; * P=0.05; ** P=0.01; ns, not significant.

5.3.2.2 Response of plant species to CO_2 level in terms of biomass

CO_2 enhanced growth and biomass productivity in all species. Differences between dry matter at the two levels of CO_2 were significant in all species. However, the responses of species to enhanced CO_2 were different.

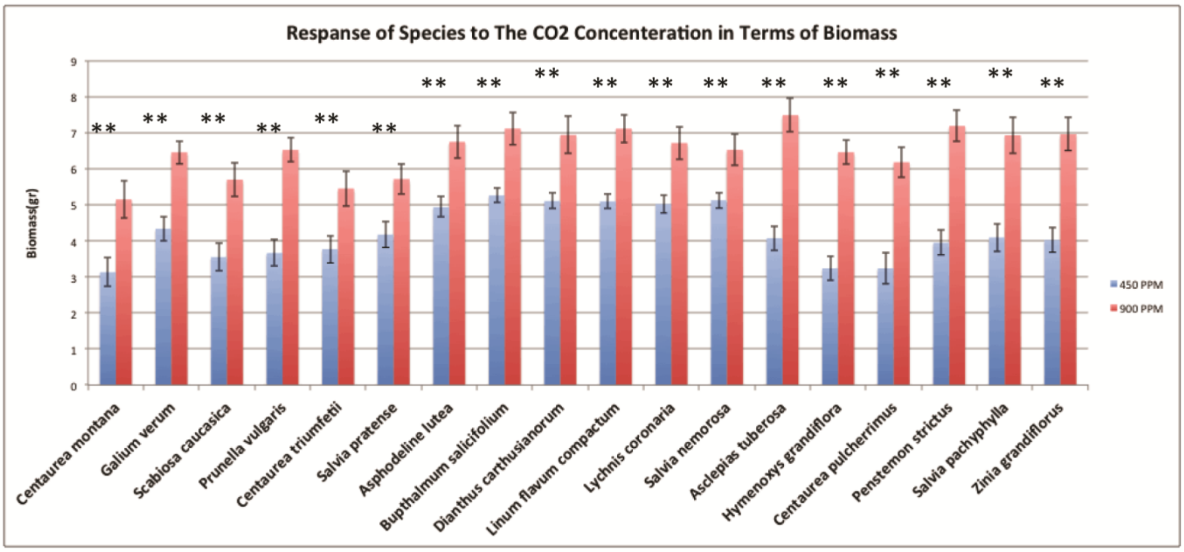


Figure 5.33 The effect of CO_2 concentration on the final biomass (gr) of plant species (September 2014). Significant differences are indicated by; * P=0.05; ** P=0.01; ns, not significant

5.3.2.3 Response of plant species to increasing temperature in terms of biomass

Increasing temperature from 20°C to 24°C showed no significant difference in well-fitted species (*Centaurea montana*, *Centaurea triumfetii, Galium verum, Prunella vulgaris* and *Salvia pratensis*) except in *Scabiosa caucasica*. Almost all intermediate-fitted species (*Bupthalmum salicifolium, Dianthus carthusianorum, Linum flavum 'Compactum', Lychnis coronaria* and *Salvia nemorosa)* showed a positive response to increasing temperature. The greatest increase in biomass productivity at 24°C temperature was observed in poorly-fitted species (*Asclepias tuberosa, Hymenoxys grandiflora, Centaurea pulcherrimus, Penstemon strictus, Salvia pachyphylla* and *Zinnia grandiflorus)*.

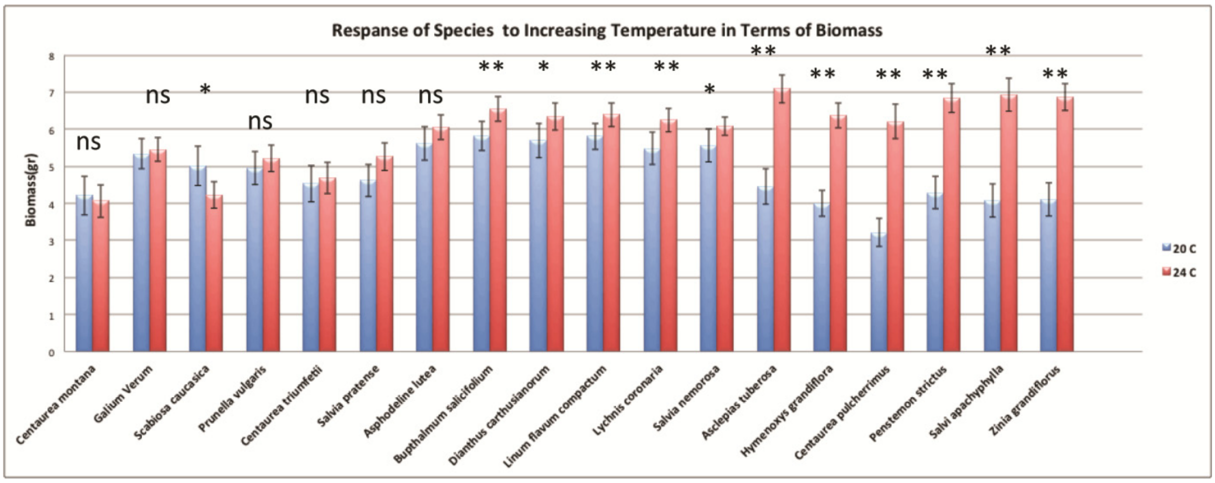


Figure 5.34 The effect of temperature on the final biomass (gr) of plant species (September 2014). Significant differences are indicated by; * P=0.05; ** P=0.01; ns, not significant

5.3.2.4 Response of plant species to growth duration in terms of biomass

Biomass productivity was significantly more at the second harvest in all species (Figure 5. 33).

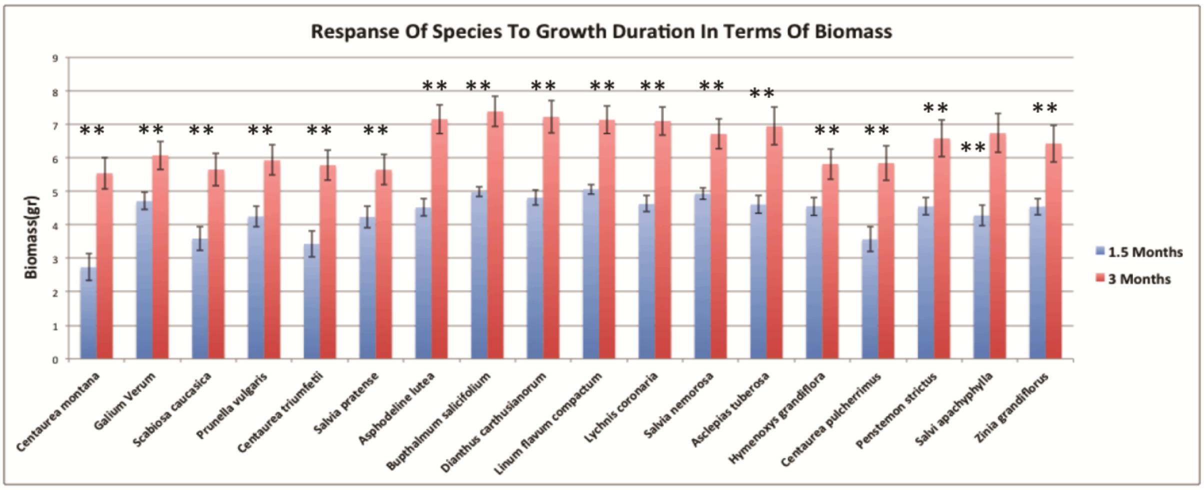


Figure 5.35 The effect of growth duration on the final biomass (gr) of plant species (September 2014). Significant differences are indicated by; * P=0.05; ** P=0.01; ns, not significant

5.3.2.5 Effect of CO_2 ×water regime on the productivity of individual species.

5.3.2.5.1 Well-fitted Species

At both 450 and 900 PPM, increasing irrigation significantly enhanced the biomass. However, excess water (Ambient+50%) did not enhance or reduce the biomass at either 450 or 900 ppm significantly in comparison with the ambient level of irrigation. At 900 ppm of CO_2, the productivity was higher at all moisture levels. The highest biomass productivity was achieved when CO_2 concentration increased to 900 PPM at ambient level of water regime. Biomass declined at ambient -50% level of water regime at both levels of CO_2 (especially at

450 PPM CO_2). At both levels of CO_2 (450 and 900 ppm) the biomass productivity at Ambient +50% was more than at Ambient-50%.

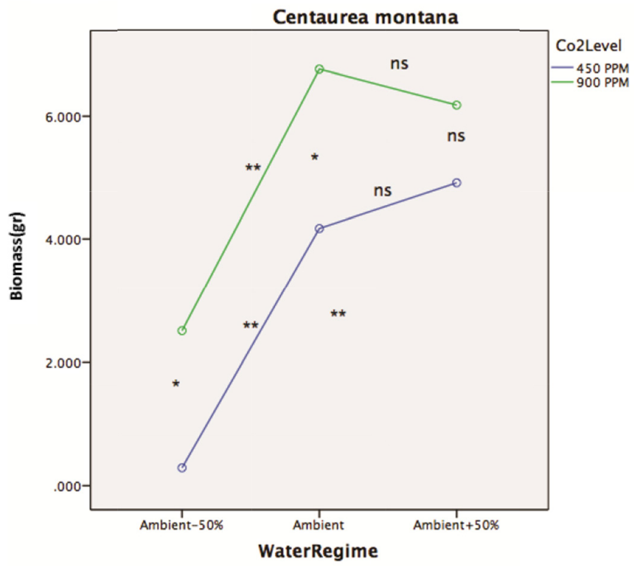


Figure 5.36 The effect of $C0_2$ and water regime on final the biomass (gr) of *Centaurea montana* (September 2014). In the Figure, significant differences among the points on and between the lines are indicated by; * P=0.05; ** P=0.01; ns, not significant.

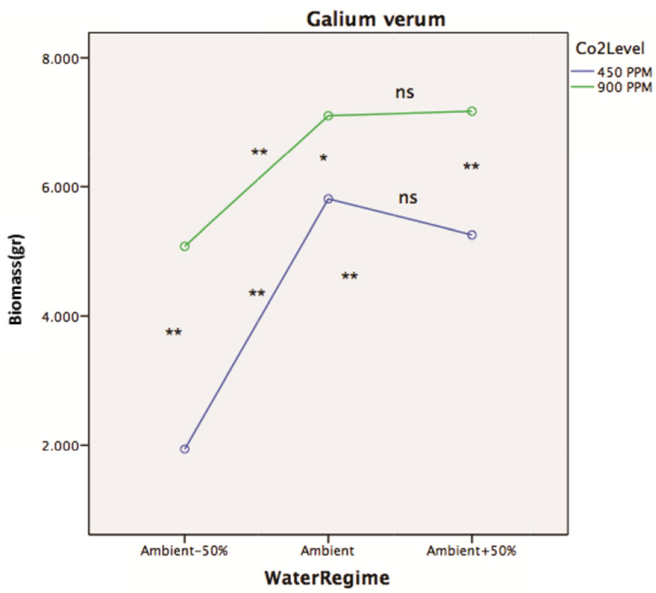


Figure 5.37 The effect of $C0_2$ and water regime on the final biomass (gr) of Galium *verum* (September 2014). In the Figure, significant differences among the points on and between the lines are indicated by; * P=0.05; ** P=0.01; ns, not significant.

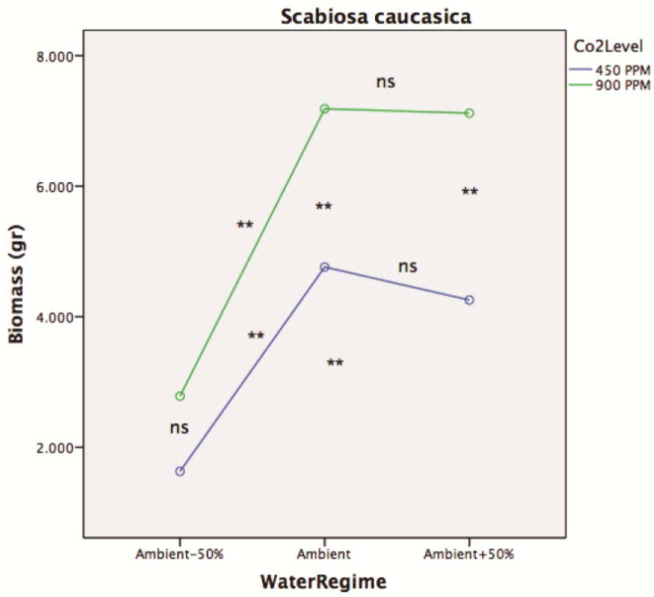


Figure 5.38 The effect of CO_2 and water regime on the final biomass (gr) of *Scabiosa caucasica* (September 2014). In the Figure, significant differences among the points on and between the lines are indicated by; * P=0.05; ** P=0.01; ns, not significant

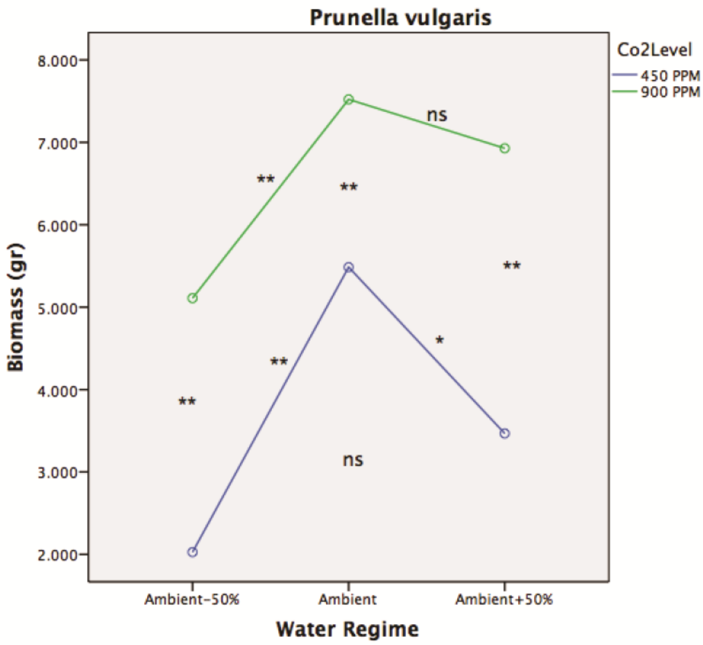


Figure 5.39 The effect of CO_2 and water regime on the final biomass (gr) of *Prunella vulgaris* (September 2014). In the Figure, significant differences among the points on and between the lines are indicated by; * P=0.05; ** P=0.01; ns, not significant

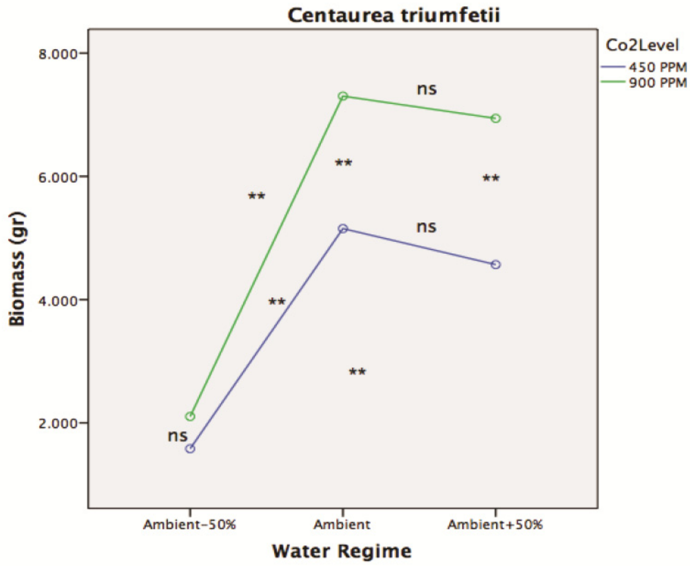


Figure 5. 40 The effect of CO_2 and water regime on the final biomass (gr) of *Centaurea triumfetii.* (September 2014). In the Figure, significant differences among the points on and between the lines are indicated by; * P=0.05; ** P=0.01; ns, not significant

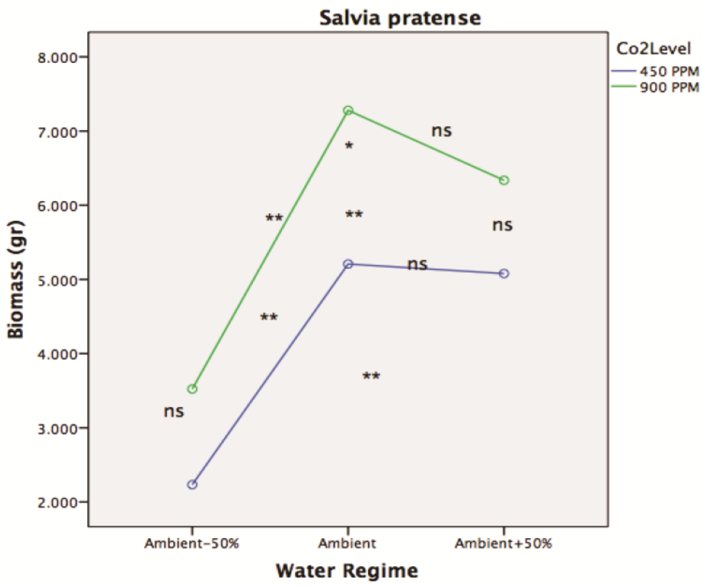


Figure 5.41 The effect of CO_2 and water regime on the final biomass (gr) of *Salvia pratensis.* (September 2014). In the Figure, significant differences among the points on and between the lines are indicated by; * P=0.05; ** P=0.01; ns, not significant.

5.3.2.5.2 Intermediate-fitted

The species showed a positive response to CO_2 concentration and water regime. Increasing CO_2 concentration and moisture availability enhanced the biomass productivity. Almost all of them at 900 PPM of the CO_2 level and ambient+50% of moisture availability produced the maximum biomass. The minimum biomass was produced at 450 PPM CO_2 level and ambient -50% of moisture availability (except *Dianthus carthusianorum* and *Salvia nemorosa*). At both levels of CO_2, the species showed a similar response to the water regime and the biomass productivity increased from ambient-50% water regime to ambient. Increasing the water availability from ambient to ambient +50% enhanced the biomass of most of the species in this group but not significantly so. For both ppm levels, the biomass at Ambient -50% was also significantly different from Ambient +50%. The similar reactions of species to the treatments proved that they had been categorized correctly.

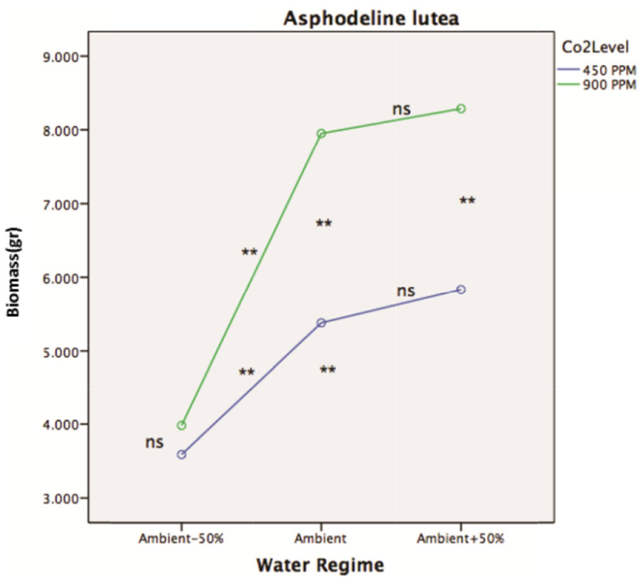


Figure 5.42 The effect of $C0_2$ and water regime on the final biomass (gr) of *Asphodeline lutea* (September 2014). In the Figure, significant differences among the points on and between the lines are indicated by; * P=0.05; ** P=0.01; ns, not significant

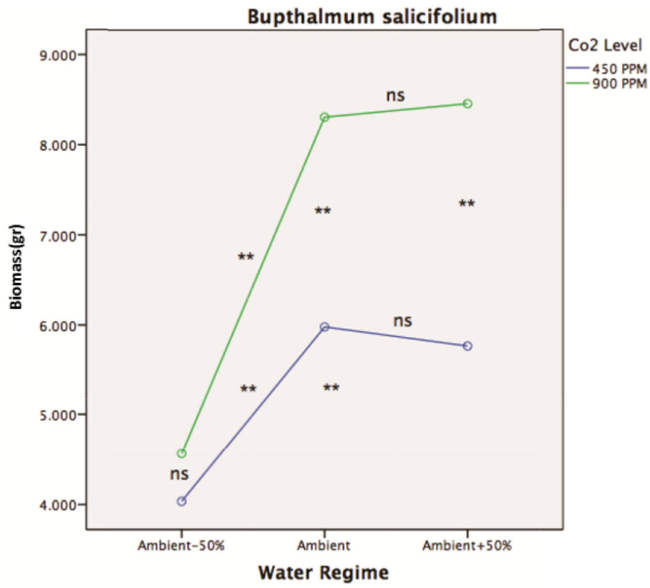


Figure 5.43 The effect of CO_2 and water regime on the final biomass (gr) of *Bupthalmum salicifolium* (September 2014). In the Figure, significant differences among the points on and between the lines are indicated by; * P=0.05; ** P=0.01; ns, not significant

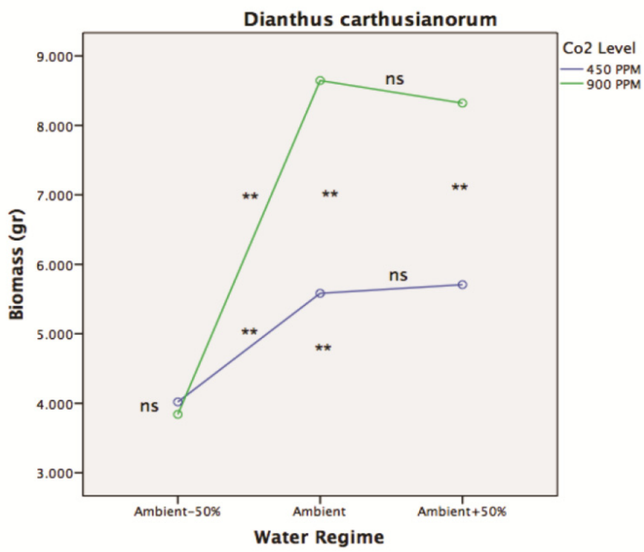


Figure 5.44 The effect of CO_2 and water regime on the final biomass (gr) of *Dianthus carthusianorum* (September 2014). In the Figure, significant differences among the points on and between the lines are indicated by; * P=0.05; ** P=0.01; ns, not significant

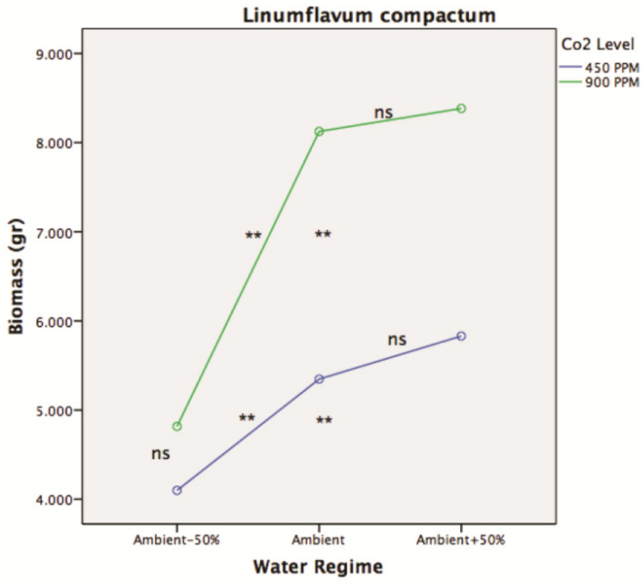


Figure 5.45 **The effect of CO_2 and water regime on the final biomass (gr) of *Linum flavum 'Compactum'* (September 2014). In the Figure, significant differences among the points on and between the lines are indicated by; * P=0.05; ** P=0.01; ns, not significant**

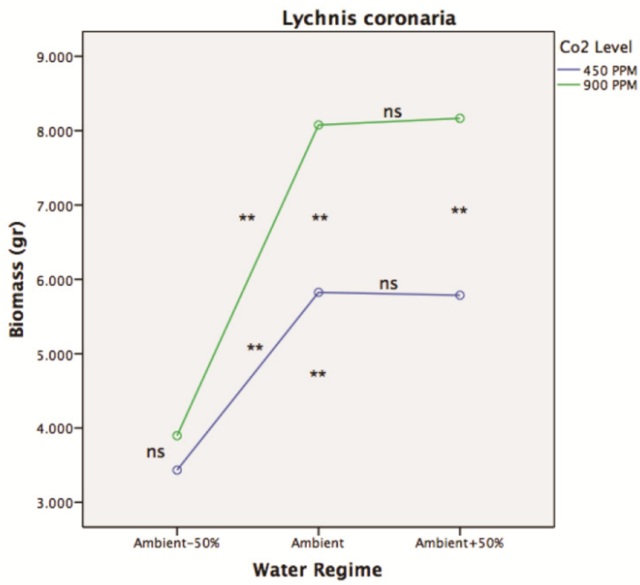


Figure 5.46 **The effect of CO_2 and water regime on the final biomass (gr) of *Lychnis coronaria* (September 2014). In the Figure, significant differences among the points on and between the lines are indicated by; * P=0.05; ** P=0.01; ns, not significant**

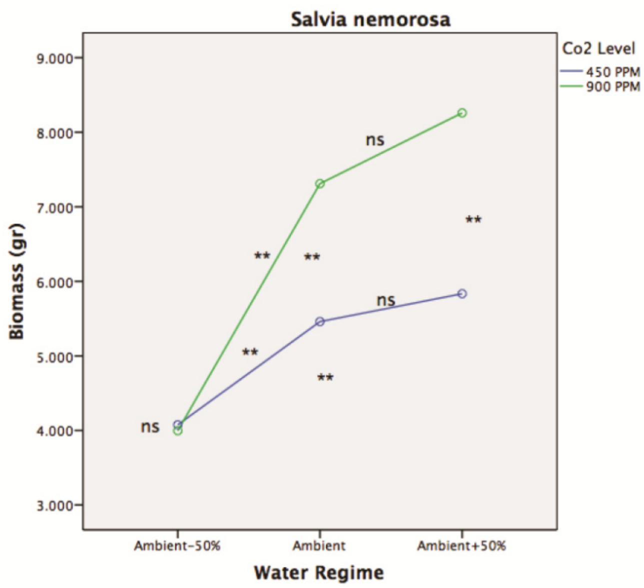


Figure 5.47 The effect of $C0_2$ and water regime on the final biomass (gr) of *Salvia nemorosa* (September 2014). In the Figure, significant differences among the points on and between the lines are indicated by; * P=0.05; ** P=0.01; ns, not significant

5.3.2.5.3 Poorly-fitted species:

Poorly-fitted species (*Asclepias tuberosa, Hymenoxys grandiflora, Centaurea pulcherrimus, Penstemon strictus, Salvia pachyphylla* and *Zinnia grandiflorus*) are more sensitive to extra water. At both levels of CO_2 concentration (450 PPM and 900 PPM) biomass declined as moisture availability increased. Also significant effects on biomass were observed when the CO_2 concentration increased from 450 PPM to 900 PPM at all levels of water availability. For both ppm levels, the biomass at Ambient -50% was also significantly higher than at Ambient +50%. The species showed a similar reaction to the CO_2 X Water regime.

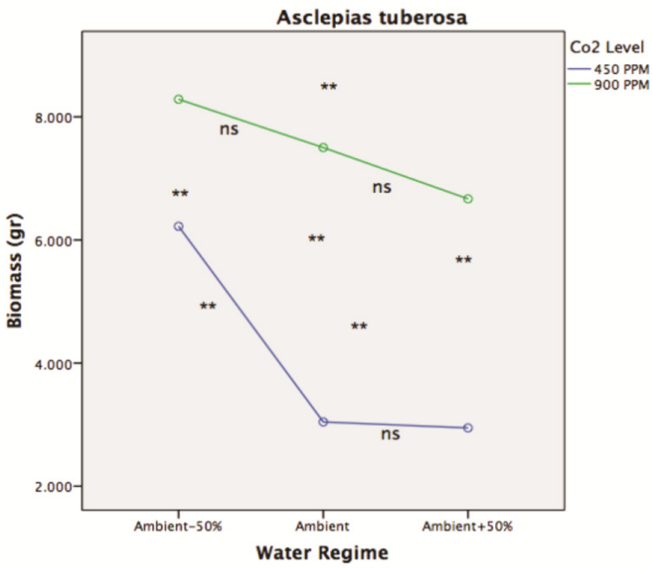


Figure 5.48 The effect of CO_2 and water regime on the final biomass (gr) of *Asclepias tuberosa* (September 2014). In the Figure, significant differences among the points on and between the lines are indicated by; * P=0.05; ** P=0.01; ns, not significant

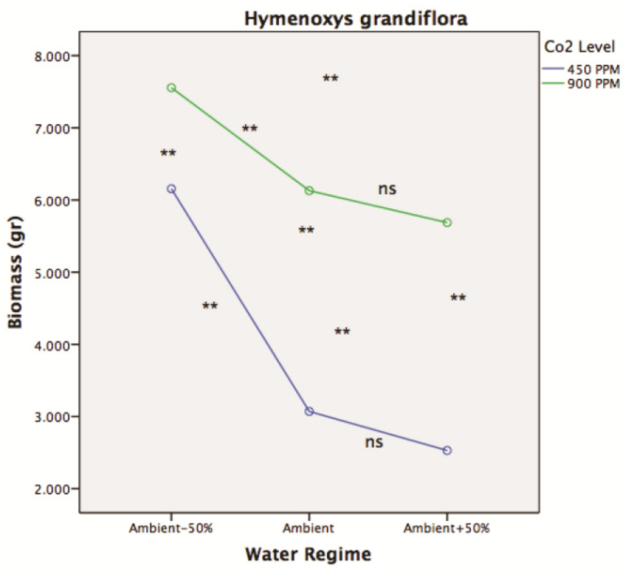


Figure 5.49 The effect of CO_2 and water regime on the final biomass (gr) of *Hymenoxys grandiflora* (September 2014). In the Figure, significant differences among the points on and between the lines are indicated by; * P=0.05; ** P=0.01; ns, not significant

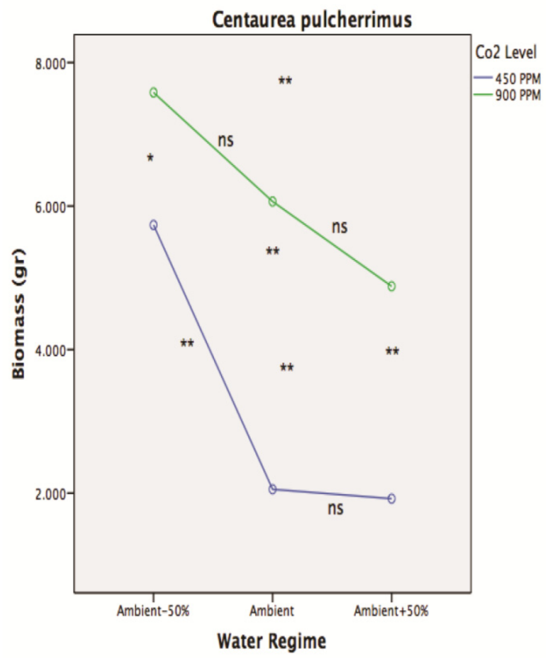


Figure 5.50 The effect of $C0_2$ and water regime on the final biomass (gr) of *Centaurea pulcherrimus* (September 2014). In the Figure, significant differences among the points on and between the lines are indicated by; * P=0.05; ** P=0.01; ns, not significant

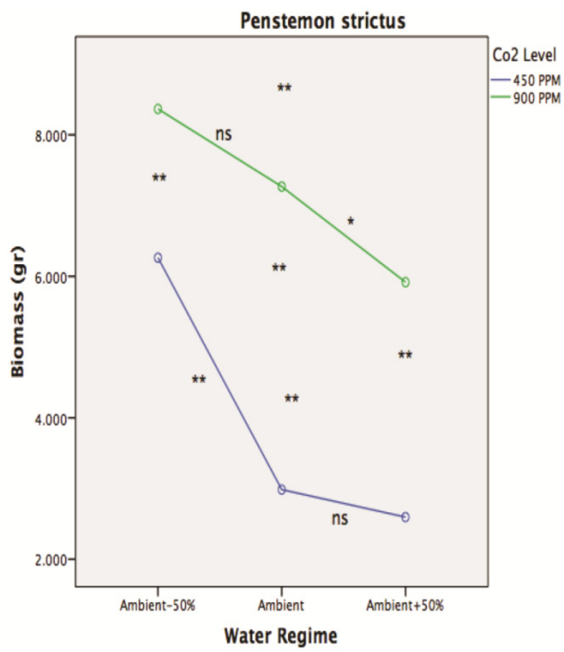


Figure 5.51 The effect of $C0_2$ and water regime on the final biomass (gr) of *Penstemon strictus* (September 2014). In the Figure, significant differences among the points on and between the lines are indicated by; * P=0.05; ** P=0.01; ns, not significant

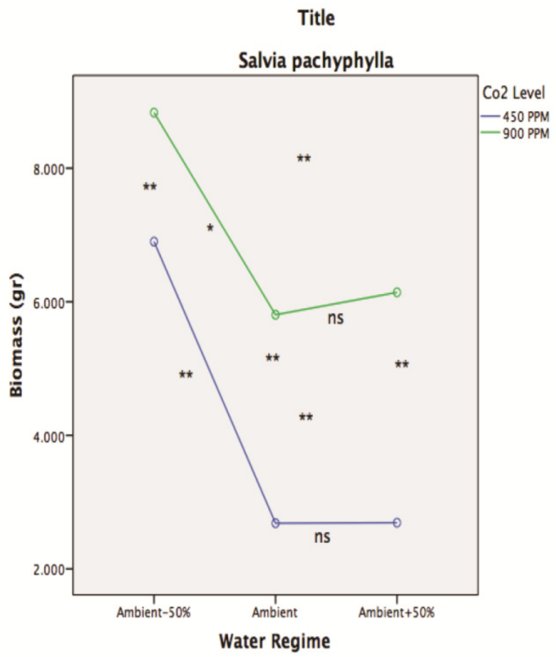


Figure 5.52 The effect of CO_2 and water regime on the final biomass (gr) of *Salvia pachyphylla* (September 2014). In the Figure, significant differences among the points on and between the lines are indicated by; * P=0.05; ** P=0.01; ns, not significant

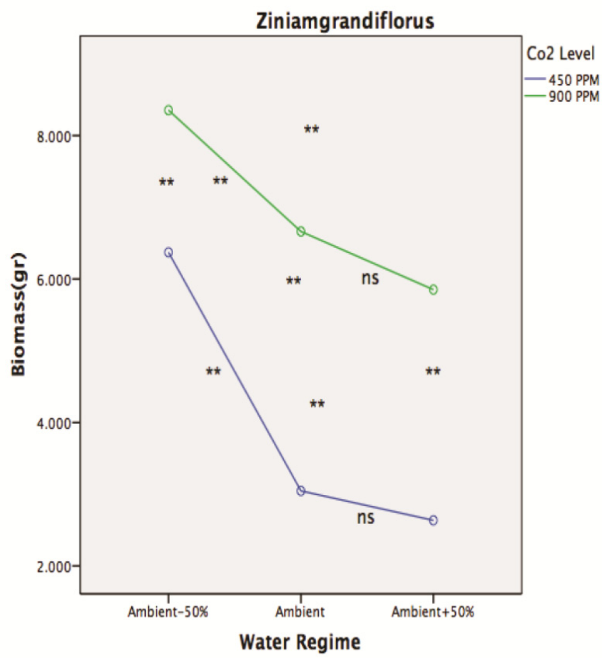


Figure 5.53 The effect of CO_2 and water regime on the final biomass (gr) of *Zinnia grandiflorus* (September 2014). In the Figure, significant differences among the points on and between the lines are indicated by; * P=0.05; ** P=0.01; ns, not significant

5.3.2.6 Effect of temperature ×water regime on plant biomass.

5.3.2.6.1 Well-fitted

Well-fitted species showed different reactions to the temperature at all levels of moisture availability. At 20°C, the biomass productivity, from Ambient -50% to Ambient was enhanced and from Ambient to Ambient +50% declined. At this level of temperature, the lowest dry matter was seen at Ambient -50% of moisture availability. At 24°C, increasing the moisture (from Ambient -50% to Ambient+50%) enhanced the biomass. The biomass productivity at 20°C, Ambient -50% and Ambient levels of moisture was more than the biomass at 24°C and conversely at ambient+50%, biomass was higher at 24°C .

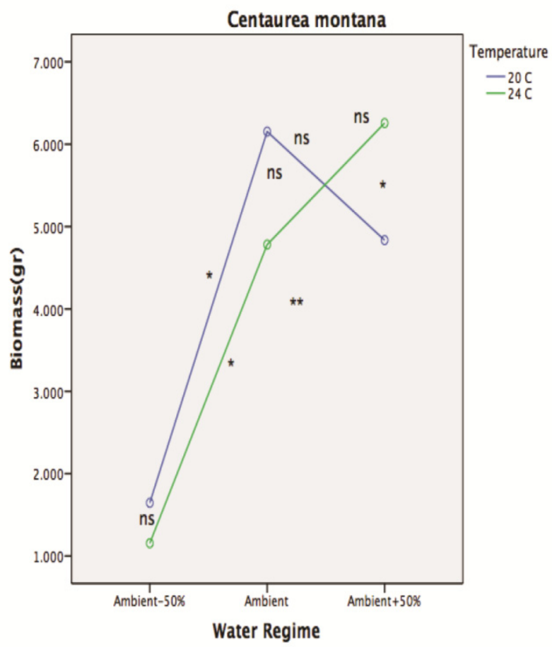


Figure 5.54 The effect of temperature and water regime on the final biomass (gr) of *Centaurea montana* (September 2014). Significant differences among the points on and between the lines are indicated by; * P=0.05; ** P=0.01; ns, not significant

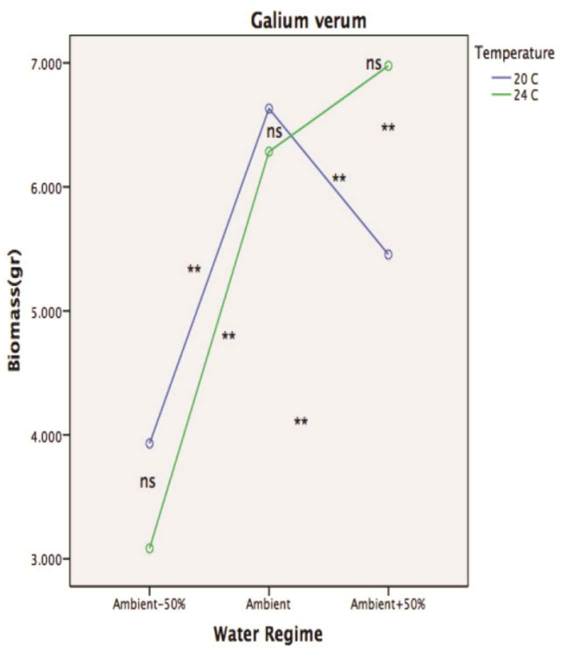


Figure 5.55 The effect of temperature and water regime on the final biomass (gr) of *Galium verum* (September 2014, Significant differences among the points on and between the lines are indicated by; * P=0.05; ** P=0.01; ns, not significant

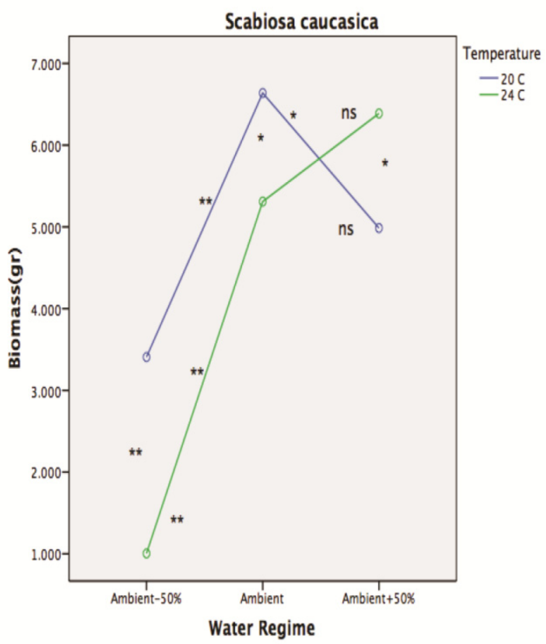


Figure 5.56 The effect of temperature and water regime on the final biomass (gr) of *Scabiosa caucasic* (September 2014). Significant differences among the points on and between the lines are indicated by; * P=0.05; ** P=0.01; ns, not significant

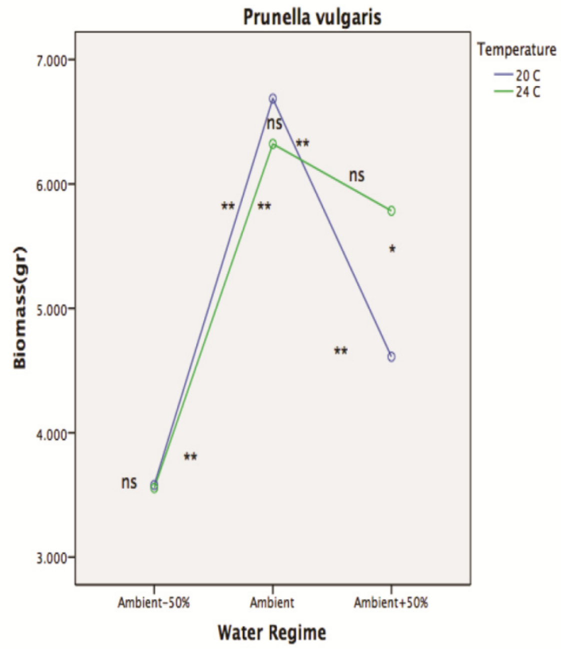


Figure 5.57 The effect of temperature and water regime on the final biomass (gr) of *Prunella vulgaris* (September 2014). Significant differences among the points on and between the lines are indicated by; * P=0.05; ** P=0.01; ns, not significant

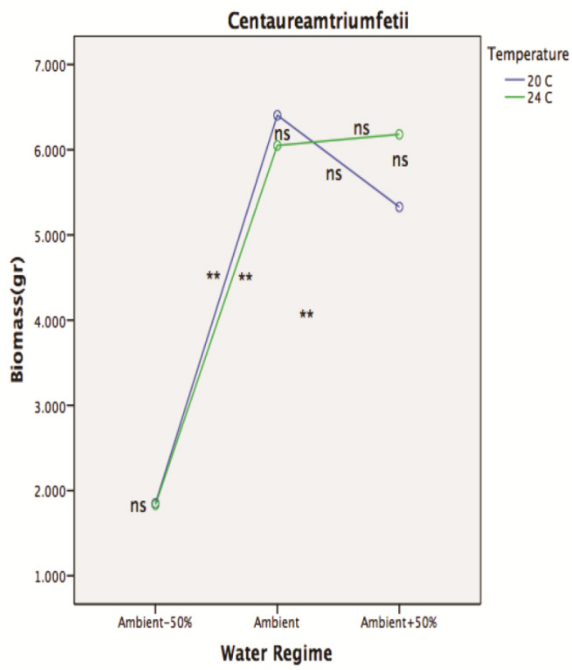


Figure 5.58 The effect of temperature and water regime on the final biomass (gr) of *Centaurea triumfetii* (September 2014). Significant differences among the points on and between the lines are indicated by; * P=0.05; ** P=0.01; ns, not significant

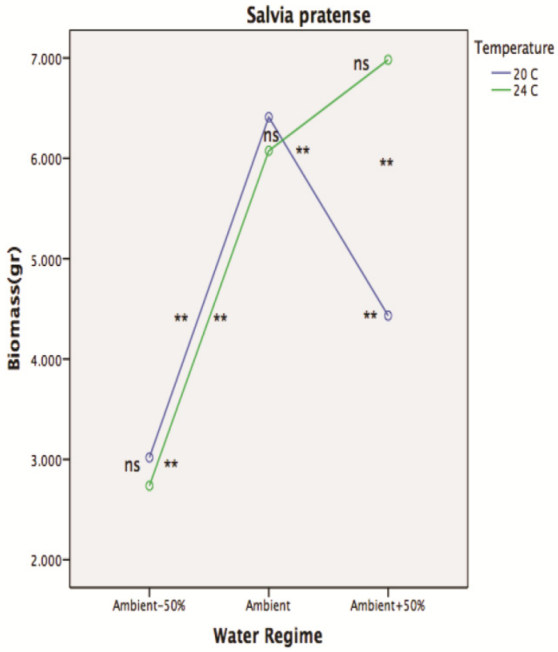


Figure 5.59 The effect of temperature and water regime on the final biomass (gr) of *Salvia pratensis* (September 2014). Significant differences among the points on and between the lines are indicated by; * P=0.05; ** P=0.01; ns, not significant

5.3.2.6.2 Intermediate-fitted

Temperature in combination with water regime produced significant differences within this group from well-fitted and poorly-fitted species. *Asphodeline lutea, Bupthalmum salicifolium, Dianthus carthusianorum, Linum flavum 'Compactum', Lychnis coronaria* and *Salvia nemorosa* are more adapted to a warmer and wetter climate. In this group, increasing temperature and moisture enhanced the biomass. Maximum biomass was produced at 24^{o}C and Ambient+50% of moisture availability. The minimum biomass was seen at Ambient -50% of water regime (except *Saliva nemorosa*). At this level of moisture availability, increasing temperature did not result in a significant difference.

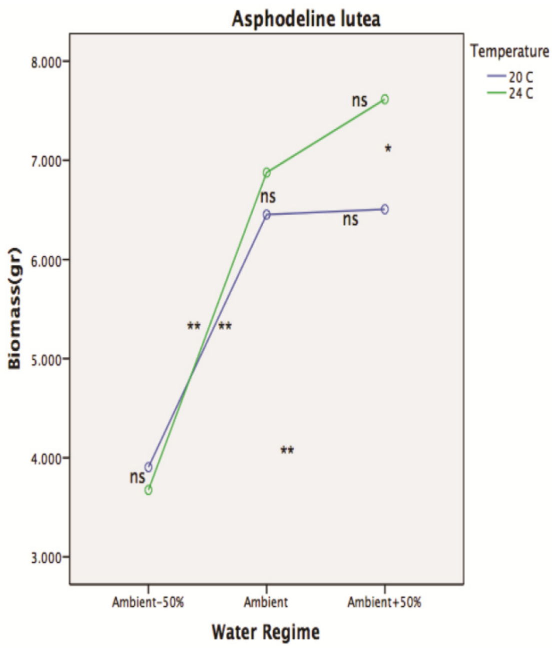


Figure 5.60 The effect of temperature and water regime on the final biomass (gr) of *Asphodeline lutea* (September 2014). Significant differences among the points on and between the lines are indicated by; * P=0.05; ** P=0.01; ns, not significant

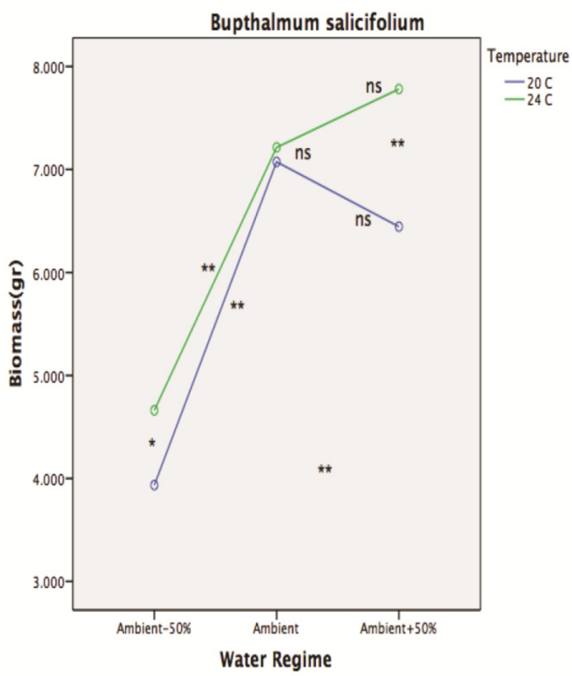


Figure 5.61 The effect of temperature and water regime on the final biomass (gr) of *Bupthalmum salicifolium* (September 2014). Significant differences among the points on and between the lines are indicated by; * P=0.05; ** P=0.01; ns, not significant

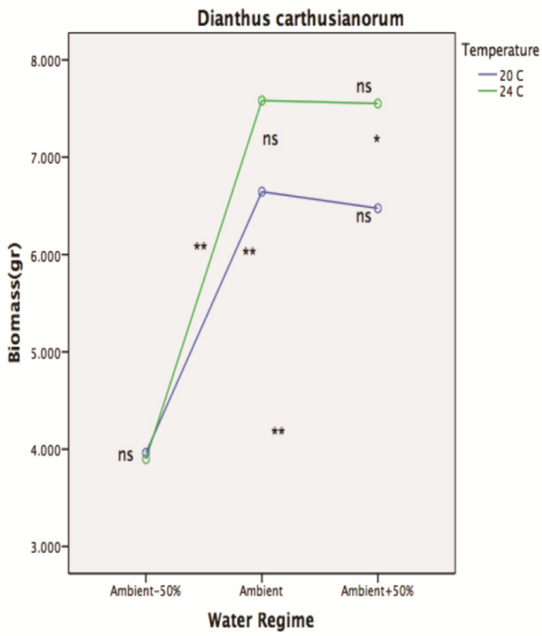


Figure 5.62 The effect of CO_2 and water regime on the final biomass (gr) of *Dianthus carthusianorum* (September 2014). Significant differences among the points on and between the lines are indicated by; * P=0.05; ** P=0.01; ns, not significant

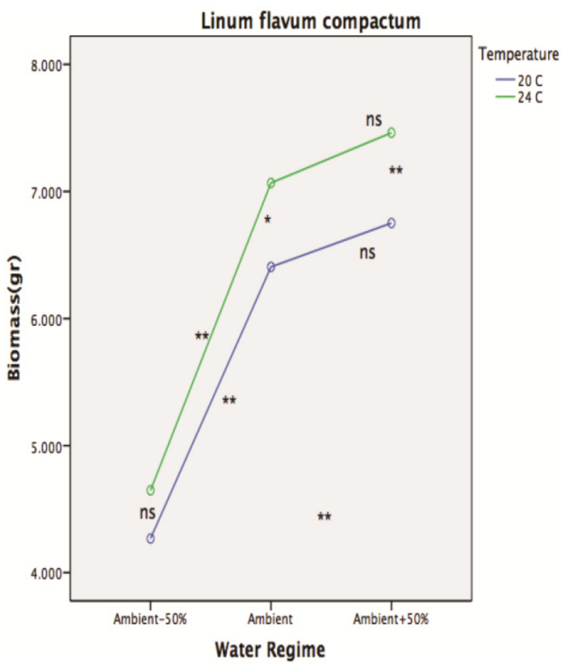


Figure 5.63 The effect of CO_2 and water regime on the final biomass (gr) of *Linum flavum 'Compactum'* (September 2014). Significant differences among the points on and between the lines are indicated by; * P=0.05; ** P=0.01; ns, not significant

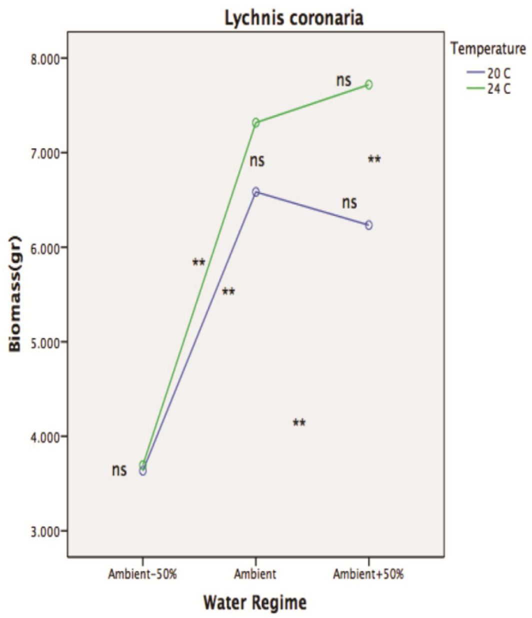


Figure 5.64 **The effect of temperature and water regime on the final biomass (gr) of *Lychnis coronaria* (September 2014). Significant differences among the points on and between the lines are indicated by; * P=0.05; ** P=0.01; ns, not significant.**

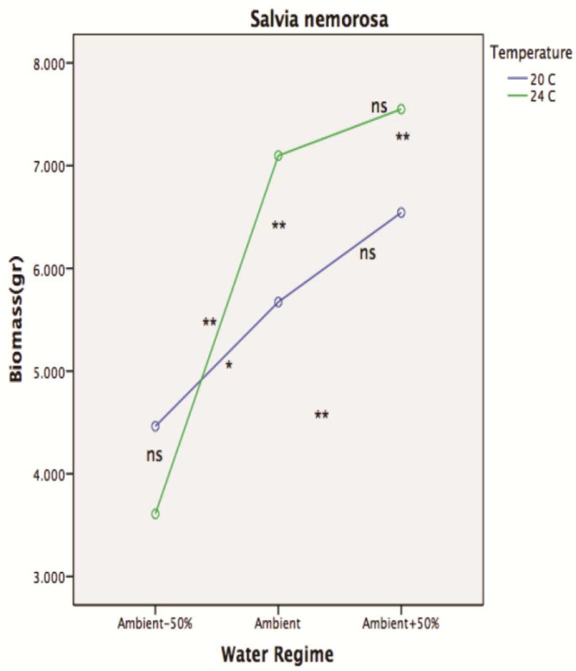


Figure 5.65 **The effect of temperature and water regime on the final biomass (gr) of *Salvia nemorosa* (September 2014). Significant differences among the points on and between the lines are indicated by; * P=0.05; ** P=0.01; ns, not significant**

5.3.2.6.3 Poorly Fitted

Decreasing moisture availability and increasing temperature enhanced the dry matter productivity. There was a significant difference between biomass productivity at 24°C and 20°C at all level of moisture availability. Also, both the temperature levels (20°C and 24°C) enhanced the biomass. Almost all species (*Asclepias tuberosa, Hymenoxys grandiflora, Centaurea pulcherrimus, Penstemon strictus, Salvia pachyphylla* and *Zinnia grandiflorus*) showed similar reactions.

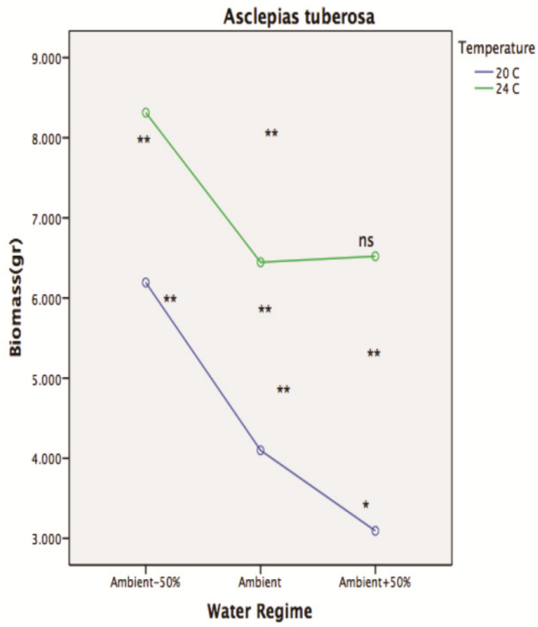


Figure 5.66 The effect of temperature and water regime on the final biomass (gr) of *Asclepias tuberosa* (September 2014). Significant differences among the points on and between the lines are indicated by; * P=0.05; ** P=0.01; ns, not significant

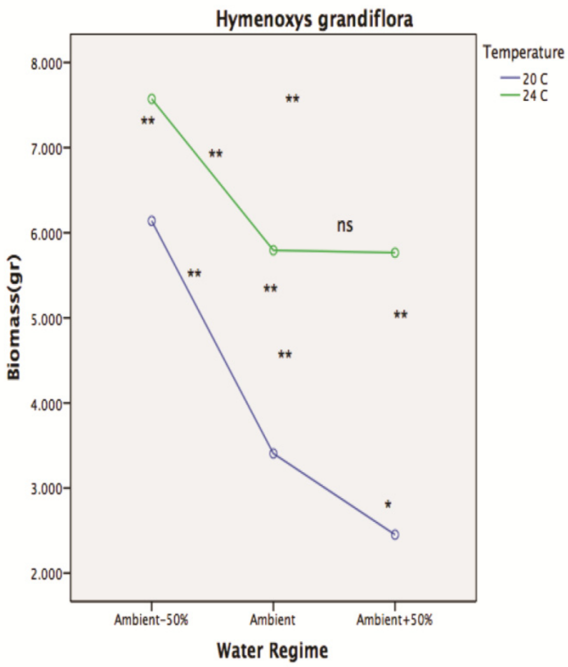


Figure 5.67 The effect of temperature and water regime on the final biomass (gr) of *Hymenoxys grandiflora* (September 2014). Significant differences among the points on and between the lines are indicated by; * P=0.05; ** P=0.01; ns, not significant

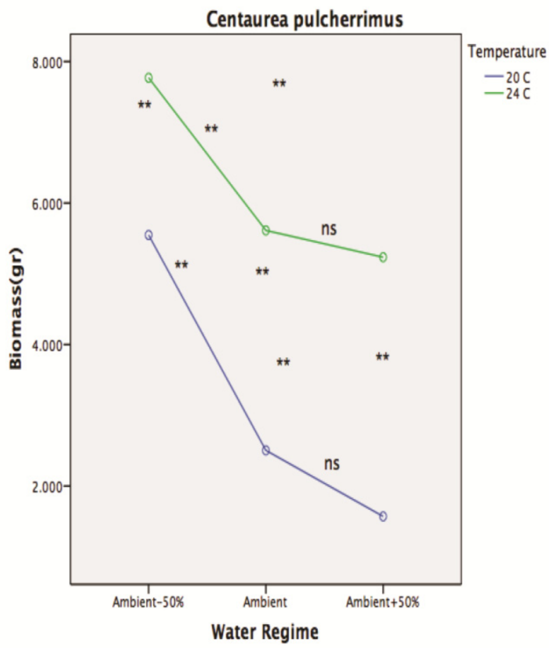


Figure 5.68 The effect of temperature and water regime on the final biomass (gr) of *Centaurea pulcherrimus* (September 2014). Significant differences among the points on and between the lines are indicated by; * P=0.05; ** P=0.01; ns, not significant

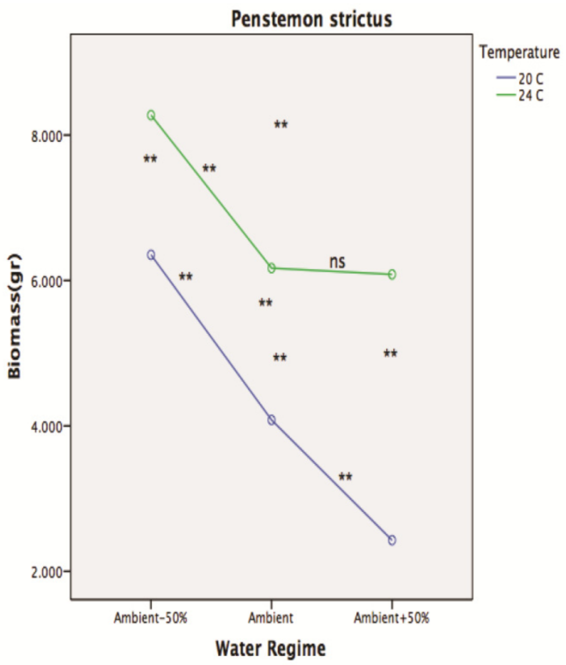


Figure 5.69 The effect of temperature and water regime on the final biomass (gr) of *Penstemon strictus* (September 2014). Significant differences among the points on and between the lines are indicated by; * P=0.05; ** P=0.01; ns, not significant

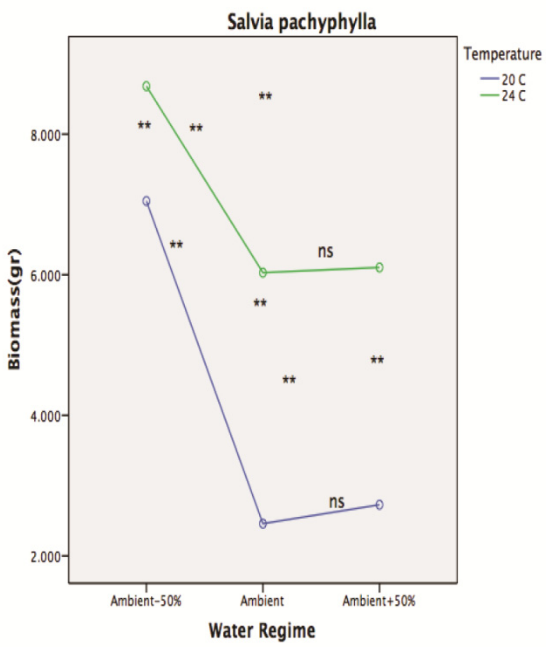


Figure 5.70 The effect of temperature and water regime on the final biomass (gr) of *Salvia pachyphylla* (September 2014). Significant differences among the points on and between the lines are indicated by; * P=0.05; ** P=0.01; ns, not significant

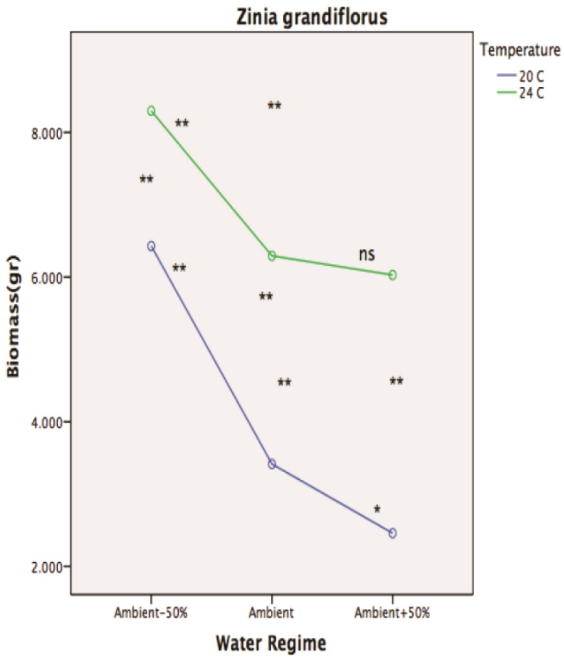


Figure 5.71 The effect of temperature and water regime on the final biomass (gr) of *Zinnia grandiflorus* (September 2014). Significant differences among the points on and between the lines are indicated by; * P=0.05; ** P=0.01; ns, not significant

5.3.2.7 Effect of CO_2 ×temperature on plant species fitness.

5.3.2.7.1 Well-fitted

Increasing CO_2 concentration from 450PPM to 900PPM at both levels of temperature (20°Cand 24°C) enhanced the biomass. At the ambient level of CO_2 (450 PPM), increasing the temperature from 20°C to 24°C showed a negative effect on biomass productivity. The lowest biomass was produced at 24°C and 450PPM CO_2. At 900 PPM of CO_2 concentration and 24°C level of temperature, the maximum biomass was produced. All species (*Centaurea montana*, *Centaurea triumfetii, Galium verum, Prunella vulgaris, Salvia pratensis* and *Scabiosa caucasica*) showed similar reactions.

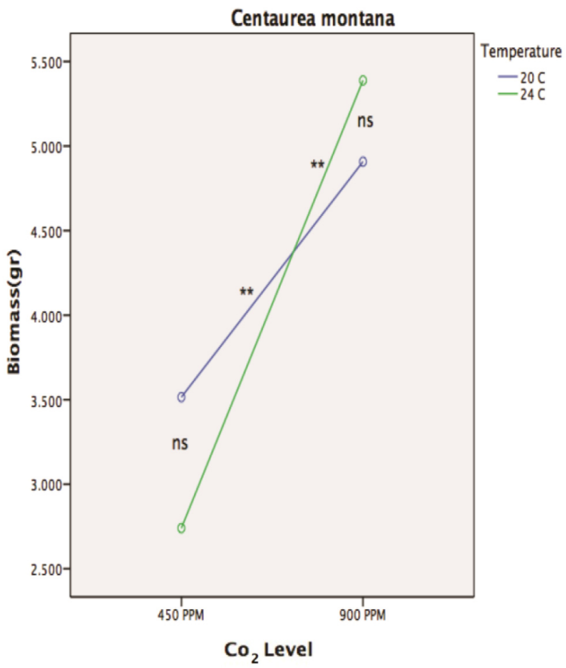


Figure 5.72 The effect of CO_2 and temperature on the final biomass (gr) of *Centaurea montana* (September 2014). Significant differences among the points on and between the lines are indicated by; * P=0.05; ** P=0.01; ns, not significant

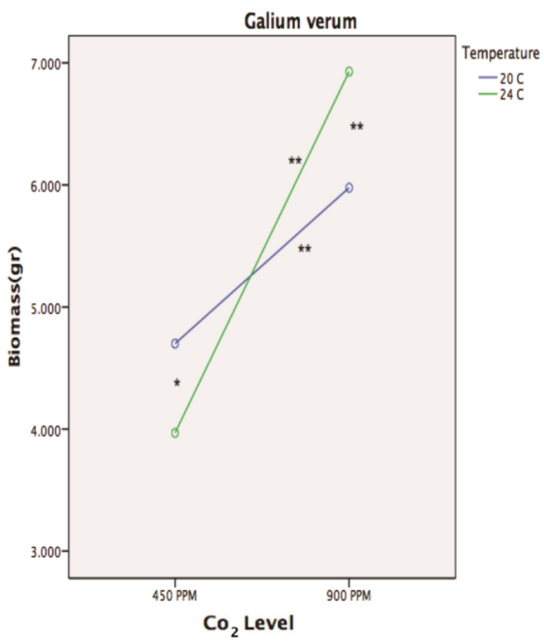


Figure 5.73 The effect of CO_2 and temperature on the final biomass (gr) of *Galium verum (*September 2014). Significant differences among the points on and between the lines are indicated by; * P=0.05; ** P=0.01; ns, not significant

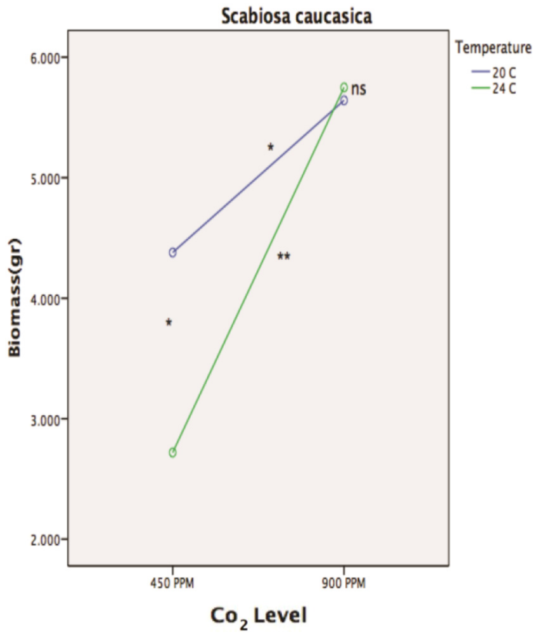


Figure 5.74 The effect of CO_2 and temperature on the final biomass (gr) of *Scabiosa caucasica* (September 2014). Significant differences among the points on and between the lines are indicated by; * P=0.05; ** P=0.01; ns, not significant

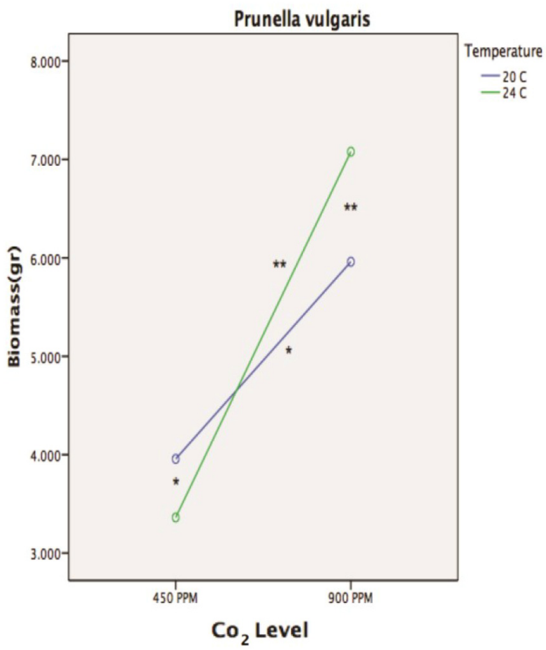


Figure 5.75 The effect of CO_2 and temperature on the final biomass of *Prunella vulgaris (*September 2014). Significant differences among the points on and between the lines are indicated by; * P=0.05; ** P=0.01; ns, not significant

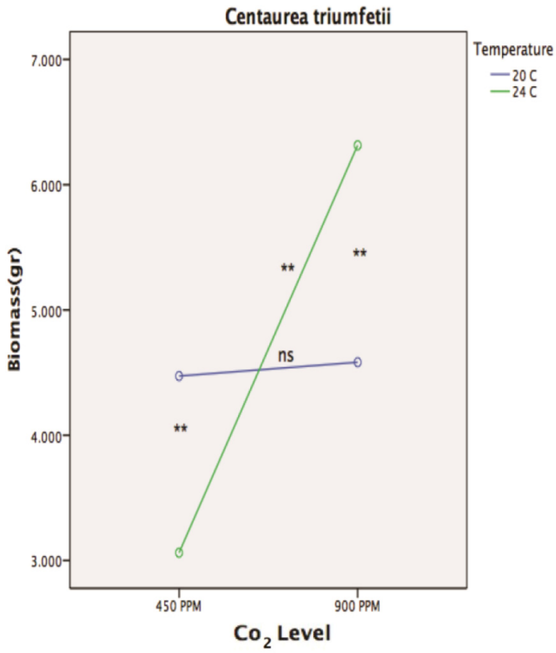


Figure 5.76 The effect of CO_2 and temperature on the final biomass (gr) of *Centaurea triumfetii* (September 2014). Significant differences among the points on and between the lines are indicated by; * P=0.05; ** P=0.01; ns, not significant

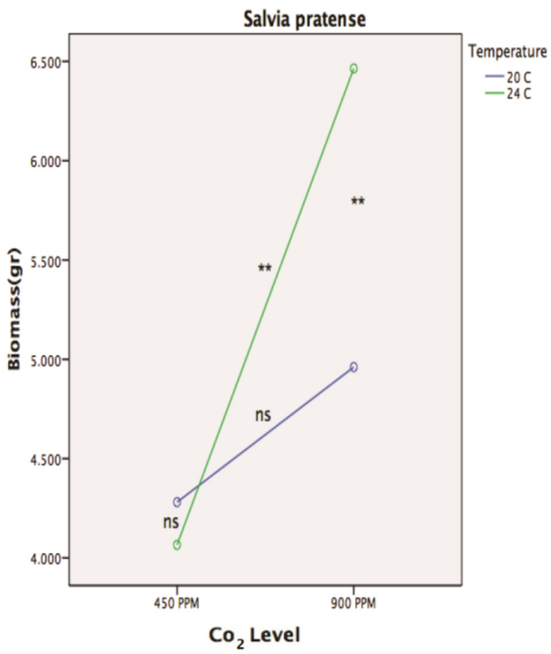


Figure 5.77 The effect of CO_2 and temperature on the final biomass (gr) of *Salvia pratensis* (September 2014). Significant differences among the points on and between the lines are indicated by; * P=0.05; ** P=0.01; ns, not significant

5.3.2.7.2 Intermediate-fitted

These plants showed positive growth responses to CO_2 elevation. At both 20^{o}C and 24^{o}C, increasing CO_2 from 450 PPM to 900 PPM, enhanced the biomass. Also, enhancing temperature at both levels of CO_2 increased the biomass. However, at the ambient level of CO_2, this was not significant. The maximum biomass was achieved at 24^{o}C and 900 PPM of CO_2.

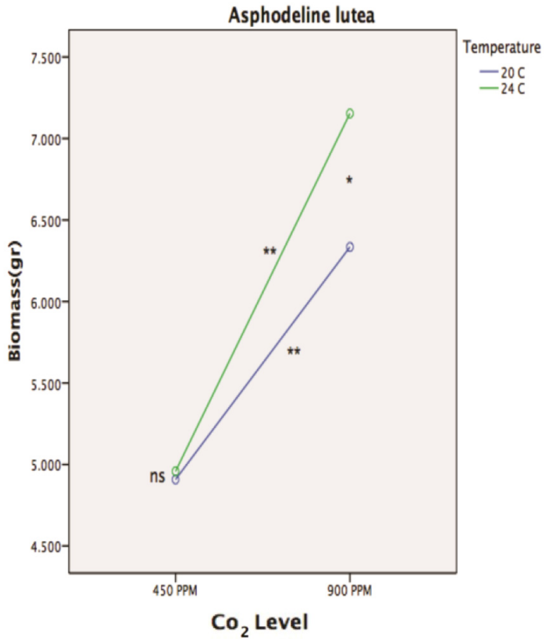


Figure 5.78 The effect of C0$_2$ and temperature on the final biomass (gr) of *Asphodeline lutea* (September 2014). Significant differences among the points on and between the lines are indicated by; * P=0.05; ** P=0.01; ns, not significant

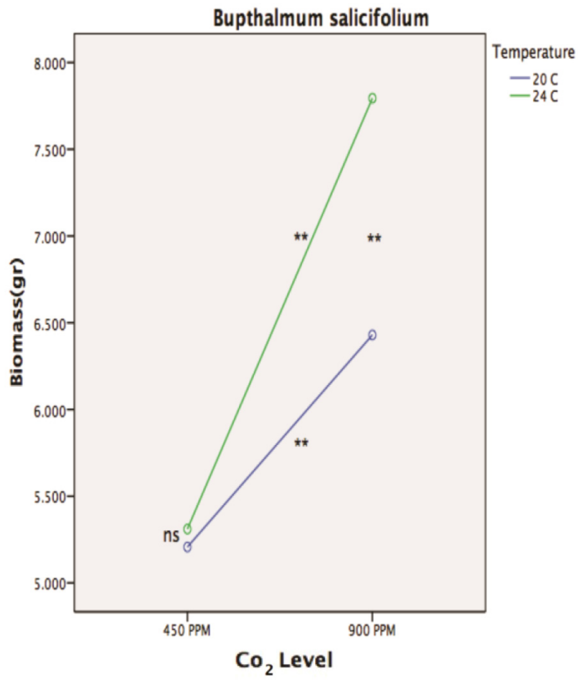


Figure 5.79 The effect of CO_2 and temperature on the final biomass (gr) of *Bupthalmum salicifolium* (September 2014). Significant differences among the points on and between the lines are indicated by; * P=0.05; ** P=0.01; ns, not significant

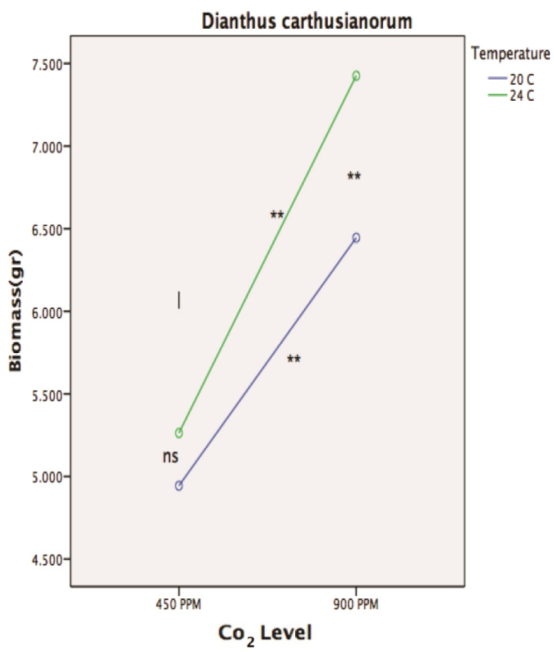


Figure 5.80 The effect of CO_2 and temperature on the final biomass (gr) of *Dianthus carthusianorum* (September 2014). Significant differences among the points on and between the lines are indicated by; * P=0.05; ** P=0.01; ns, not significant

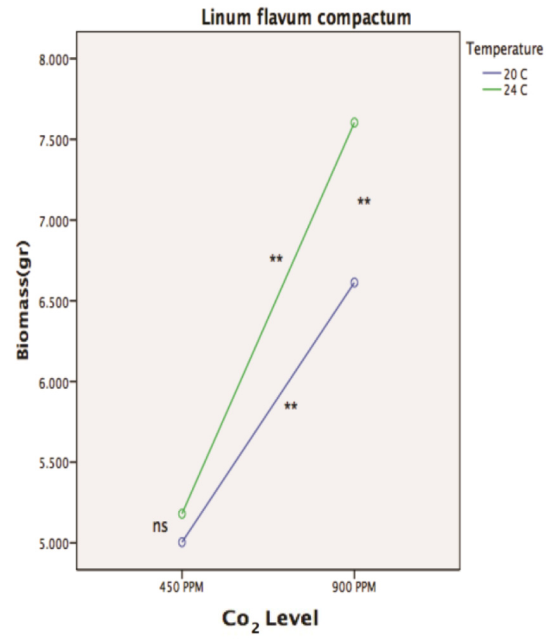


Figure 5.81 The effect of C0$_2$ and temperature on the final biomass (gr) of *Linum flavum* 'Compactum' *(*September 2014). Significant differences among the points on and between the lines are indicated by; * P=0.05; ** P=0.01; ns, not significant.

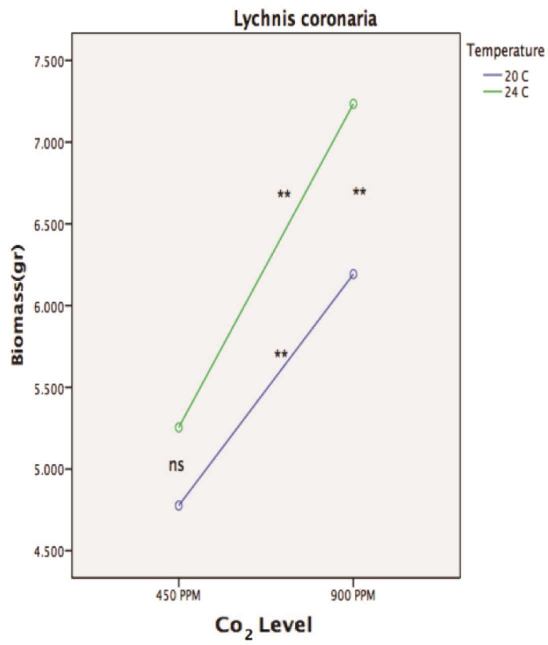


Figure 5.82 The effect of C0$_2$ and temperature on the final biomass (gr) of *Lychnis coronaria* (September 2014). Significant differences among the points on and between the lines are indicated by; * P=0.05; ** P=0.01; ns, not significant

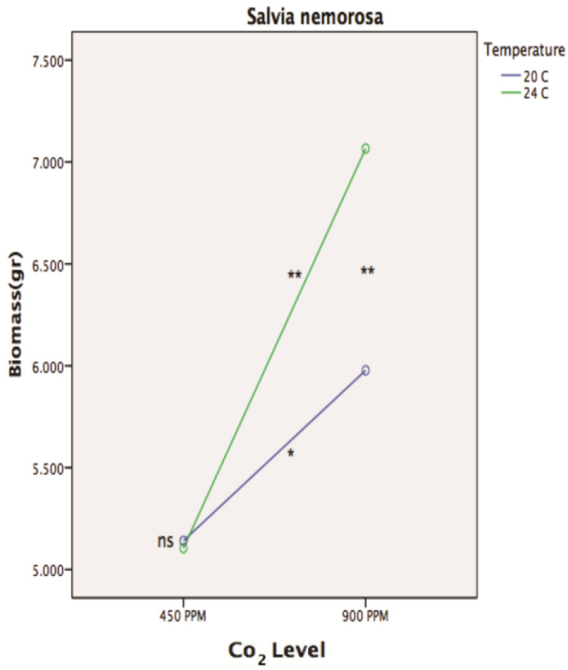


Figure 5.83 The effect of $C0_2$ and temperature on the final biomass (gr) of *Salvia nemorosa* (September 2014). Significant differences among the points on and between the lines are indicated by; * P=0.05; ** P=0.01; ns, not significant

5.3.2.7.3 Poorly-fitted species

This group of species showed more adaptation to the higher temperature. At both levels of CO_2 concentration, increasing temperature (from 20°C to 24°C) enhanced the biomass as did increasing the concentration of CO_2 from 450 PPM to 900 PPM. The maximum biomass productivity was achieved at 900PPM of CO_2 and 24°C, and the minimum was seen at 450PPM of CO_2 and 20°C temperature.

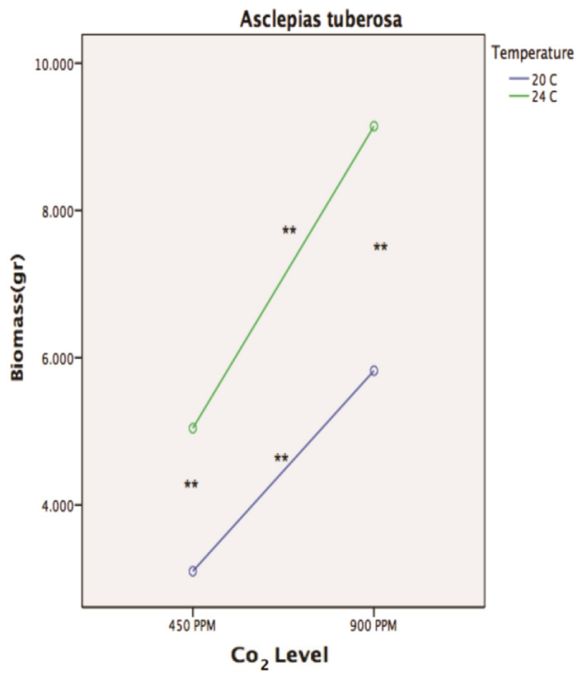


Figure 5.84 The effect of $C0_2$ and temperature on the final biomass (gr) of *Asclepias tuberosa* (September 2014). Significant differences among the points on and between the lines are indicated by; * P=0.05; ** P=0.01; ns, not significant

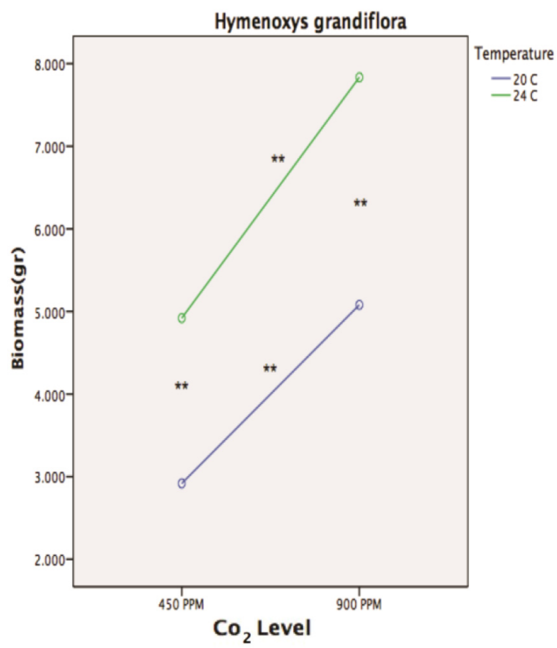


Figure 5.85 The effect of $C0_2$ and temperature on the final biomass (gr) of *Hymenoxys grandiflora* (September 2014). Significant differences among the points on and between the lines are indicated by; * P=0.05; ** P=0.01; ns, not significant

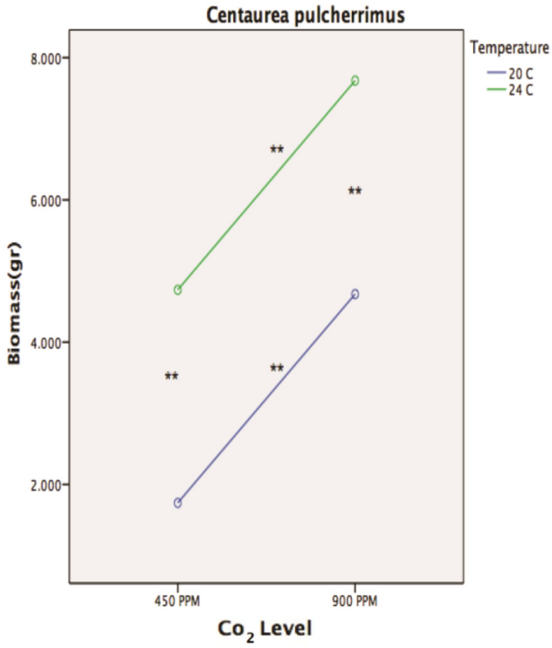


Figure 5.86 The effect of CO_2 and temperature on the final biomass (gr) of *Centaurea pulcherrimus* (September 2014). Significant differences among the points on and between the lines are indicated by; * P=0.05; ** P=0.01; ns, not significant

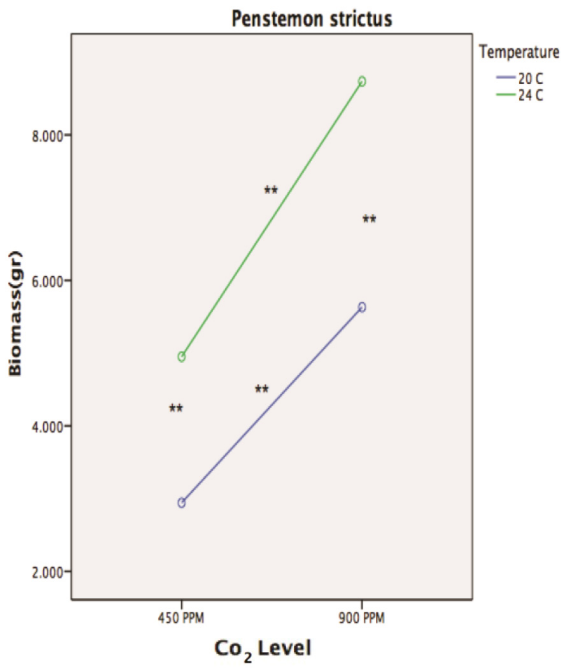


Figure 5.87 The effect of CO_2 and temperature on the final biomass (gr) of *Penstemon strictus* (September 2014). Significant differences among the points on and between the lines are indicated by; * P=0.05; ** P=0.01; ns, not significant.

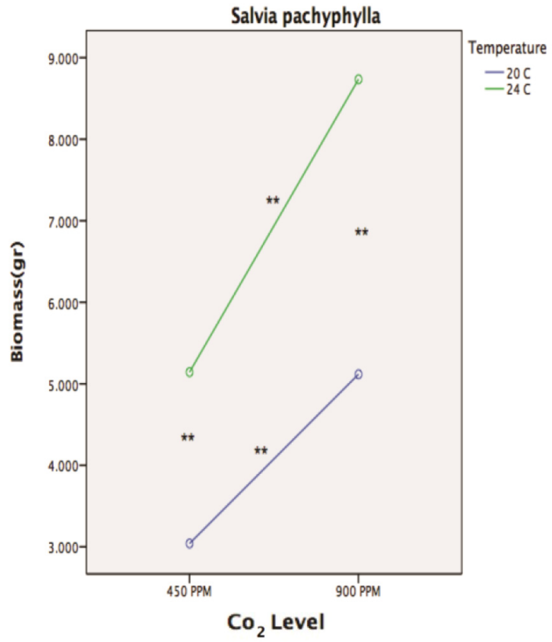


Figure 5.88 The effect of CO_2 and temperature on the final biomass (gr) of *Salvia pachyphylla* (September 2014). Significant differences among the points on and between the lines are indicated by; * P=0.05; ** P=0.01; ns, not significant

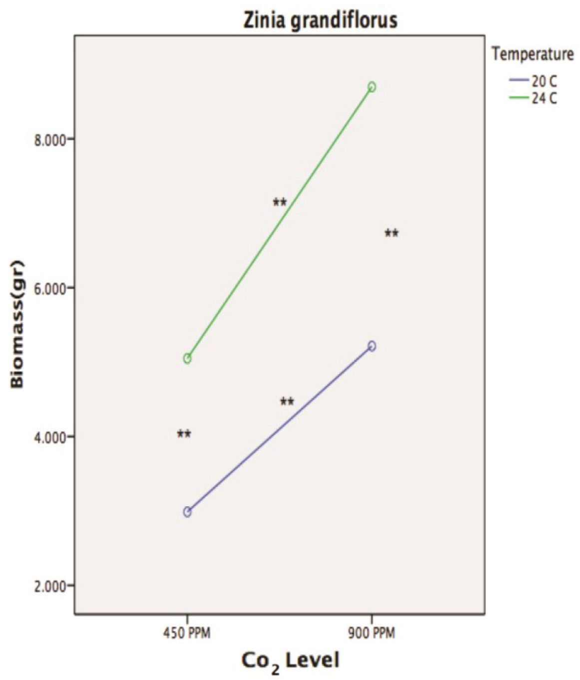


Figure 5.89 The effect of CO_2 and temperature on the final biomass (gr) of *Zinnia grandiflorus* (September 2014). Significant differences among the points on and between the lines are indicated by; * P=0.05; ** P=0.01; ns, not significant

5.3.3 Relative growth rate (RGR)

5.3.3.1 Well-fitted species:

These species showed the highest RGR at Ambient CO_2 concentration (450 PPM), 24^oC and Ambient+50% moisture availability (C1T2W3). The lowest RGR for this group of plant species was seen at Ambient CO_2 concentration (450 PPM), 24^oC (temperature) and Ambient-50% moisture availability (C1T2W1) (Figure 5.89).

5.3.3.2 Intermediate-fitted species

At 900 PPM of CO_2 concentration, 24^oC and Ambient+50% moisture availability (C2T2W3), the highest RGR was produced. The lowest RGR was seen at C1T2W1 (450 PPM CO_2, 24^oC and Ambient - 50% moisture availability) (Figure 5.89).

5.3.3.3 Poorly-fitted Species

Increasing temperature and CO_2 concentration and reducing moisture availability enhanced the RGR of poorly-fitted species. In this group, the minimum RGR was seen at ambient CO_2 concentration, ambient temperature and ambient moisture availability (C1T1W1).

Almost, all ecological plants group (well-, intermediate- and poorly-fitted) at C2T1W2&W3 (CO_2; 900 PPM, Temperature: Ambient, moisture: Ambient and Ambient +50%) showed a similar response in terms of growth rate (Figure 5.90).

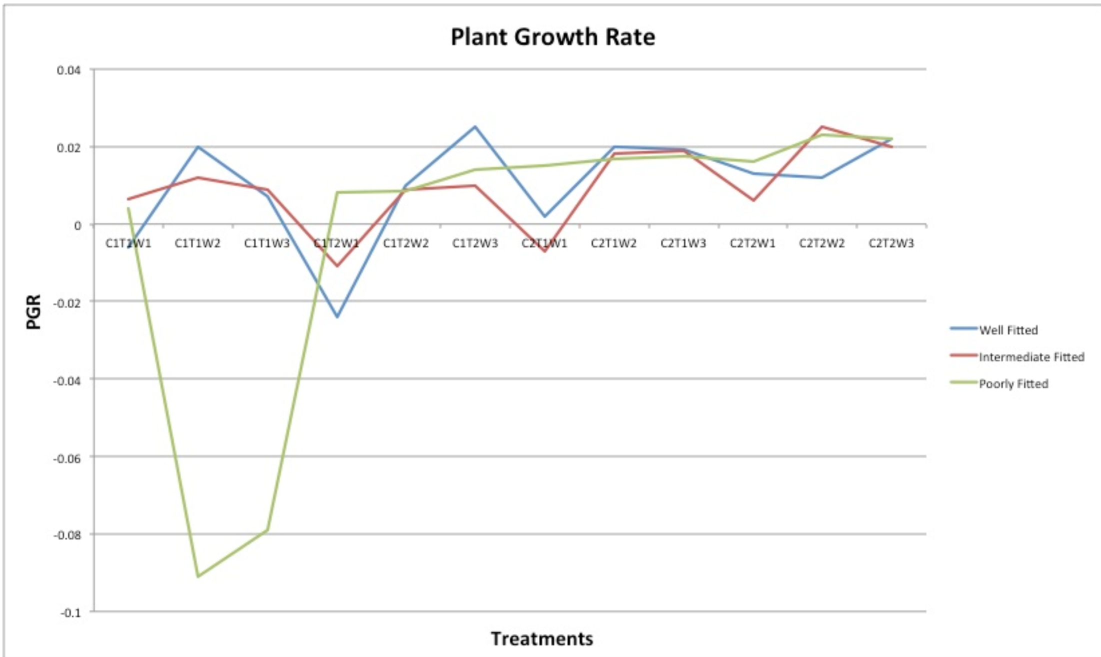


Figure 5.90 Plant growth rate of three ecological group species (September 2014). C1: 450 PPM of CO_2, C2: 900 PPM, T1: 20°C, T2: 24°C, W1: Ambient-50%, W2:Ambient, W3:Ambient+50%

5.4 Discussion

In this part of the study, there are three main questions to deal with:

1. What is the effect of CO_2 concentration under different levels of other resources, such as temperature and soil moisture, on plant species' growth, development and adaptation?
2. Did the different climate change scenarios provide opportunities for poorly-fitted and intermediate-fitted species to better fit themselves to the future UK climate?
3. How did the species respond to the treatments in terms of biomass production and RGR?

In a multifactorial study such as this, there are inevitably always conflicting responses in some species; however, the main patterns to emerge from this study are as follows:

I. In nearly all species, biomass increased with elevated CO_2, mostly irrespective of water stress levels.

II. At the ecological group level, the pattern of biomass production generally closely agreed with our initial assumptions on how these species were likely to respond to wetness and dryness.

These are discussed under four topics, water regime, CO_2 concentration, temperature and plant growth rate.

5.4.1 Water Regime:

Abiotic stress has a range of morphological and physiological effects on plant growth and, as a result, biomass production (Wang *et al.*, 2001). All plant species are affected by water supply. Increasing or decreasing moisture availability generally leads to changing leaf water potential, stomata diffusion resistance, photosynthesis and, finally, the growth. However, these growth effects differ between plant species (Frank *et.al*. 1973). Korner believed that "All species with a particular "growth form" or "growth habit" share similar leaf areas, stomatal indices (total number and size of stomata), hydraulic architectures (i.e. size and dimensions of conductive tissue elements and subsequent resistance in the pathway), root morphologies, photosynthetic pathways, and/or physio-types" (Korner *et al.*, 1979 p.45).

In this study, changing moisture availability, increased or decreased the biomass productivity depending on the species' habitat. Our research indicated that essentially maritime climate species (well-fitted), Mediterranean climate species (intermediate) and Continental climate species (poorly-fitted) show different responses to the three different levels of water supply (Ambient -50%, Ambient and Ambient +50%). Continental climate species from more southerly latitudes (poorly-fitted) and Maritime climate species (well-fitted) showed negative responses to the excess water (Ambient +50%) especially at the Ambient level of temperature. Mediterranean-southern European climate species (intermediate-fitted species) will be more adapted to the increasing precipitation situation. In drought situations (Ambient-50%) poorly-fitted species (Southern continental climate species) showed the maximum biomass productivity. According to the UK climate change scenarios, Britain is, in general, going to be both wetter and hotter, although most of the increase in precipitation will be associated with the winter months. UK climate predictions also suggest a strong north-south gradient with southern England becoming much drier in summer than the north. Under this scenario, our poorly-fitted species may prove to be better fitted in the future on freely drained soils.

5.4.2 CO_2 concentration

CO_2 fertilization has been used to increase greenhouse crop yields, but there has been little research about the effects of CO_2 concentration on semi-natural ecosystems. This is the first research about the effect of CO_2 concentration on designed plant communities for use in urban landscapes. In almost all plant species, high CO_2 concentrations increase the plant growth. Poorter (1993) investigated the effect of a doubling CO_2 concentration on the growth of 156 plant species. In this study, plant growth increased 35 % to 58% depending on the species (trees, crops, wild species and C3 or C4 species).

Pearcy and Bjorkman (1983) suggest that enhanced CO_2 concentration causes photosynthesis to be increased because of increasing substrate (CO_2) supply and decreasing photorespiration. Transpiration is also reduced because of lower stomatal conductance (Pearcy & Bjorkman, 1983). Environmental factors have a very important role in CO_2 increasing. The reaction of plant species to CO_2 concentration differs over a period of time. Some species become acclimated and some cannot make these adjustments or only to a limited degree (Bazzaz, 1990). There is some research about the effects of interaction between temperature and CO_2 on plant species. According Acock and Allen (1985), using the model for the response of photosynthesis in comparison with the ambient, at high levels of CO_2, the optimal temperature for photosynthesis will generally increase. Coleman and Bazzaz showed significant interactive effects on CO_2 × Temperature on C3 and C4 plant species, but the strength and direction of the response (i.e. whether photosynthesis decreased or increased differed between species (Acock, 1980; Acock and Allen, 1985; Bazzaz, 1990).

Our research shows similar results to those of other researchers). First, doubling CO_2 concentration increased plant growth in all species and the degree to which plant growth increased varied greatly between species and fitness groups species (well-fitted, intermediate-fitted and poorly-fitted). Evaluating the CO_2 and increasing the moisture availability increased the biomass in well-fitted and intermediate-fitted species. In poorly-fitted species, increasing moisture reduced the biomass, but increasing CO_2 at all levels of moisture (Ambient-50%, Ambient and Ambient +50%) enhanced the biomass. At the high level of CO_2, increasing the temperature enhanced photosynthesis and, as a result, biomass productivity. Data collection was done at two stages to study the effect of growth duration. Our results indicated that at high levels of CO_2 the species show adjustment after three months. However, at the ambient level of CO_2, intermediate-fitted species failed to show significant differences in terms of biomass productivity. Interaction between $C0_2$ and environmental factors (water and temperature) in all three groups of plants (well-fitted, intermediate-fitted and poorly-fitted) showed significant effects on (RGR).

5.4.3 Temperature

Optimal temperature for photosynthesis is an important aspect that needs to be considered when the biomass productivity/plant growth of the studied species is evaluated. Plants growth is a function of their photosynthesis. Photosynthesis is a complex biological activity which involves a number of proteins/enzymes that perform within certain temperature limits. The main input for photosynthesis is carbon dioxide, for which its proper assimilation is essential. Temperature impacts on enzymatic activities. Depending on how each species has evolved, including their growth season, temperature, and condition, they have different preferential/optimum growth temperatures.

Often, when the temperature impacts on photosynthesis are discussed, scientists refer to the Cardinal Temperature. As suggested by the American Meteorological Society, the Cardinal Temperature indicates an optimal temperature within a maximum and minimum range at which plant growth occurs with greatest rapidity. Optimal temperature for photosynthesis is often similar to the normal growth temperature for the plant species.

Cardinal temperatures or optimum growth temperatures are the result of evolving a species in their original habitat. However, it is unlikely that these plants, even in their native growth environment, experience the same favourable conditions in future. As has been discussed in different literatures (Sanchez *et al.,* 2014) global warming, increasing earth surface temperature and more frequent extreme conditions are highly expected. Such significant changes affect different growth stages of plant species. Such imposed risks are inevitable considering observed patterns of climate change (Lou 2011)

While, we talk about the challenges of adapting to new environments, e.g. higher temperatures, there are studies that suggest plants are becoming temperature acclimatised (Yamori *et al.*, 2014). In other words, some species have shown a notable capacity to change their photosynthetic behaviour to match the growth conditions in their new environment. This leads to more efficient photosynthesis and, over all, better biomass production. It is worth mentioning that different plants, due to the nature of their physiological and biochemical characteristics, have dissimilar abilities to adapt themselves to new growth conditions and shift their optimal growth temperature over time.

5.4.4 Relative growth rate

Relative growth rate can be used to determine the ability of species to adapt their fitness individually, in an ecological group and in multi-species plant communities to the different climate and climate change scenarios. It also provides a measure of the capacity of species to compete with one another in mixed communities. Assuming equivalent levels of shade tolerance, species with higher RGRs tend to competitively eliminate species with lower RGRs. Although for a given genotype, the RGR is a genetically-determined characteristic, moisture availability, temperature and CO_2 concentration individually and in combination affect the expression of RGR potential. The more poorly-fitted species are, the more their RGR is reduced.

The really interesting observation is that the RGR of the poorly-fitted species is similar to that of the other two fitness groups, under some of the treatments in the experiment, but collapses dramatically when these species are exposed to the combination of ambient temperatures (very much lower than the assumed T.opt temperatures for these species) and increased water supply.

5.5 Conclusion

This research shows that elements in climate change potentially have a significant effect on the growth, development and establishment, adaptation and fitness of plant species in urban greenspace. According to the different climate change scenarios, different combinations of precipitation, CO_2 concentration and temperature (as three important factors of climate change) potentially have a major impact on choosing plant species and designing urban landscape species for use in urban greenspace.

The main findings of this research are as follows:

- Although each environmental factor has specific effects on species fitness and adjustment, the interaction between these factors is probably more important.
- Overall, both maritime climate species and southern European, Mediterranean climate species show good fitness to the UK climate change scenarios. Southern Continental temperate grassland species (poorly-fitted species) only showed some signs of fitness at CO_2: 900 PPM, Temperature + $4^{o}C$ moisture: Ambient -50%. These species are unlikely to achieve the fitness of currently fit species even after predicated climate changes occur.

CHAPTER 6: CONCLUSION

Understanding the process of climate change adaptation is necessary to designing plant communities for use in public landscapes. This research has investigated and evaluated the adaptability and fitness of designed plant communities and individual species under different climate change projection scenarios. This research not only paid attention at individual environmental factors e.g. temperature, precipitation and CO_2 but also on the impacts of combinations and feedback between these factors.

This chapter is structured based on the research questions and objectives specified in Chapter 1 and the design aspects of the plant communities. At the end of this chapter, the potential areas for future research are suggested. At first it is important to recognize that this research was carried out in Sheffield, a northern city with cooler, moister summers than for example, more southerly cities such as London.

The colour of the flowers, size and architectural structure of many Mediterranean species and also continental meadow species potentially produce an interesting visual impact even in the first two years. On the other hand, recent data sets and reports indicating changes in phenological stages in plants, (Peñuelas & Filella, 2001) provide evidence that ecosystems are responding to climate change. These characterizations provide the potential to develop a new platform of designed urban plant communities in the UK making positive use of future climate change scenarios.

6.1 Maritime climate plant species (well-fitted), UK public landscape and UK climate change scenarios

The species that were used in this research as a new naturalistic design form were attractive to the public, and they could provide strong visual impact through flowering period from spring to autumn. This does not means all of the species of this did not be affected by climate change, but rather that there appears to be sufficient fitness amplitude to cope with the proposed climatic changes. Changes in the pattern and amount of precipitation, the temperature and also the CO_2 concentration caused morphological and physiological changes to this group of species. A key finding from the preliminary research was the well-fitted species, were much more sensitive to moisture stress. The results indicate that moisture availability has significant effects on biomass productivity of the species studied, whilst a 3^{o}C increase in temperature does not show significant impacts on mass of vegetative productivity. Most of the well fitted species showed a similar respond to the different level of water temperature and CO_2 concentration. This is not surprising as these species are adapted to environments in which severe moisture stress is occasional or rare. This research confirms the studies, which were done by other researcher. Some studies on seedling growth in herbaceous communities indicated that, increasing the water moisture availability in a plant community shows a positive effect on their growth. Vila & Sardan 1999 and Silvertown et al. (2012) reported the similar result about the effect of water stress on plant species. They founded that this impacted on dominance patterns and vegetation changes. Although increasing or decreasing the precipitation, temperature and CO_2 concentration provided significant effects on the growth rate and biomass productivity of the species; it is necessary to consider that these species were studied as a part of a multi-layer plant community. Some species were intrinsically faster growing and others slower. These differences lead to competition asymmetry with some species of all plant communities receiving more water, light and nutrition. In a multi- layer plant community, light is very important. In a community, each species has a somewhat different leaf morphology, shoot and growth habit when compared to the others. This kind of light effect have reported by some other researchers such as Grime, 1979; Spitters & Aerts, 1983;

Mitchley, 1988; Barnes et al., 1990; Aerts et al., 1990.The photosynthesis and biomass productivity of species are related to the amount of light, it is clear that some of the side effects of climate change on plant communities are influenced by competition as well and vice-versa.

6.2 Mediterranean grassland species (intermediate-fitted), UK public landscape and UK climate change scenarios

The results of this research are in accordance with those of Kramer et al. (2000) which indicates that the phenology of Mediterranean species significantly affects the growth response to a given climate change scenario. This study showed that Mediterranean-southern European plant species have good capacity to be fit in the UK climate, not only in the future but also at the moment. The result indicated that the biomass production of Mediterranean species, which were selected for use in this study, was equivalent to, or higher than, well-fitted species group. Increasing moisture availability and temperature do not have a negative effect on biomass productivity in these species. Decreasing the water availability and increasing of temperature did however cause the biomass of this group to, decrease. The flowering phenology of species in the community was affected by temperature, and moisture. However, the interaction of these environmental factors was more important. The results indicate that the temperature is imperative for flowering initiation and development. Meanwhile, the water regime is more important for the duration of the flowering period. The results of chapters 3 and 5 indicate that Mediterranean species show their highest productivity at high level of CO_2 (900PPM), Temperature (24^oC) and moisture availability (Ambient+50%) moisture availability. This group of species also showed the highest rate of plant growth (PGR). The lowest Plant Growth Rate (PGR) was seen at 450PPM of CO_2 concentration, 24^oC level of temperature and Ambient - 50% moisture availability (Figure 5.88). The competitive capacity of the intermediate fitted species increased in almost all different climate scenarios. Considering the research variables and experimental conditions the fitness of the plant species in the intermediate group seems to improve in a climate when higher moisture levels and temperature levels are expected.

6.3 Temperate continental grassland species (Poorly-fitted species), UK public landscape and UK climate change scenarios

Poorly-fitted species were largely selected from the continental climate of the Western North American steppe. The possibility of using and North American native meadow species in UK green space has been investigated by researchers in the past (e.g. Hitchmough and De La Fleur. 2006; Hitchmough *et al*., 2005; Hitchmough et al., 2004). But this is the first research on the effects of the UK climate change scenarios on Western North American steppe communities, species which come from much lower rainfall climates and which are historically regarded as highly unsuitable for cultivation in the maritime climate of the UK.

The results of this research indicated that poorly-fitted species could not tolerate the wetter conditions, or, even, the ambient level of moisture availability when subjected to competition with better fitted species. Increasing the CO_2 concentration (450 to 900 ppm) and the temperature (Ambient to Ambient+3^{o}C) increased their fitness, but this increase in temperature was insufficient to prevent the loss of some of the species. The competitive capacity of poorly fitted species decreased at high levels of moisture availability but in dryer and hotter situations increased. Appropriate management and maintenance system will enhance their adaptation, for example, using highly drained soils can significantly improve their fitness to the UK climate. Although the seed germination of Mediterranean and North American species was satisfactory, many of these species showed slower growth than species in the other two groups.

6.4 Compare the difference between the responses Maritime climate species, Mediterranean grassland species and Temperate continental grassland species to climate change?

In this research the Well-fitted species were chosen from the maritime climate of Britain and Western Europe, the intermediate-fitted species selected from the Mediterranean region of southern Europe and poorly- fitted species were selected from the continental climate in the US Rocky Mountains. This research showed that there is a difference between the response of well-fitted and poorly-fitted species to the changes in the environmental factors (such as the levels of moisture, temperature and also the concentration of CO_2). The results indicated that decreasing the level of moisture whilst increasing the temperature showed significant adverse effects on growth and biomass productivity of well-fitted species, while this condition improved growth and development for poorly-fitted species and *vice versa*. Well-fitted and intermediate-fitted species showed a similar response to increasing the level of moisture from ambient to ambient +50%. This situation enhanced the growth, development and biomass productivity of both groups of species, especially when the temperature increased as well. So the different climate change scenarios with various emissions scenarios show different effects on plant species. The responses of species to climate change are based on the region for which they have been evaluated and their habitat. Although the results indicated that they can show almost the same reaction in some specific climate scenarios. For example, in this research all ecological plants group (well-fitted, intermediate-fitted and poorly-fitted) at CO_2: 900PPM, Temperature: Ambient, moisture: Ambient and Ambient +50% showed similar plant growth rates. On the other hands the results indicate that it is possible to design a plant community of three different habitat species. This result contradicts the plant habitat focus system to designing plant community of perennial species, which was provided by Hansen and Stahl (1993).

These results can provide a new opportunity to develop a framework for designing a sustainable plant community for using in public landscapes according to the climate change of different regions. There are lots of non-native species with high aesthetic value, which can tolerate dry or wet situations. The results of this research showed that we could use them in naturalistically designed plant communities of native and non-native species in our urban landscape according to the different change scenarios.

6.4 Molluscan herbivory, designed plant community, individual species and climate change

Green space is part of urban ecosystems and biodiversity has a very important role in a dynamic ecosystem. It is a fact that climate change can affect all parts of an ecosystem. In the UK, molluscs have significant effects on their environment within these ecosystems. So, in this study the response of molluscs (slugs and snails) to the different climate change scenarios and also to the different plant species in a designed plant community were investigated (Chapter 4). The results indicated that molluscan herbivory interact with climate change affected the stability of both individual species and the plant community and confirm the results of pervious researchers such as Melillo et al., 1993 and Vorosmarty & Sahagian, 2000. Slugs, in particular because they are entirely soft bodied, are very sensitive to reductions in rainfall, and the need to avoid desiccation restricts feeding to times when humidity is high and temperatures low. Plant species in different stages of their life have different shapes and structures. The chemical compounds within plant species also differ from one stage of their life to another. All of them (shape, structure and chemical compounds) are very important for mollusc palatability. They are affected by climate change as well. During this study the maximum activity of slugs was recorded in early spring and late summer. At this time the weather was cooler and wetter. The results showed that increasing the temperature reduced mollusc activity. On the other hand, increasing precipitation enhanced the slugs' activity. This study showed that all environmental factors have important effects on mollusc behaviour, but the interaction of them is more important. At Ambient-50% of moisture availability and Ambient+3^{o}C of temperature, the slugs hardly had any activity. While at Ambient+50% level of water and ambient temperature and also ambient+3^{o}C, they showed their maximum activity. Increasing temperature and decreasing the humidity are two reasons for growing the small and tiny hair (in terms of size and number) on leaves of plant species. This is one of the plant species reactions to drought situations which can usually, but not always, make the species unpalatable to molluscs. Because snails have a shell through which they can better manage water loss, they are generally able to feed under drier conditions that can slugs.

What was apparent from observing the experiment was that mollusc feeding tended to vary greatly depending on the abundance of plant species, and, in particular, the abundance of palatable species. On the other hand, in a community of palatable species providing a good situation for mollusc activity in terms of humidity and temperature, this helps them to select their food. This knowledge of mollusc behaviour lets us keep our valuable species within a plant community by adding some species which are more palatable to molluscs. Mollusc grazing affected the flowering development and flowering period of the species by reducing the competition between species in the plant community. They reduce some species so allowing the other species to receive more space to grow and develop as well as more light and nutrition.

Figure 6. 1 Snail grazing a necrotic area on a hairy leaf

6.5 Plant growth (PGR), species fitness and changing climate variables

The results of this research showed almost all plant species in all three ecological groups were affected by simulated climate change in terms plant growth rate. As explained before (chapter 2) People have normally shown a greater degree of interest in choosing species in designed plantings with a quicker rate of growth as opposed to those that grow at a slower rate when incorporated in a mixed community.

Fitter & Hay showed that dry weight increases (growth rate) are commonly linked with an increase in the size of the plant (Fitter & Hay, 2001) and this research showed that there is a link between the plant growth rate and changing the environmental factors. So climate change can affect the processes of designing a plant community in public landscape, because it can affect the plant growth rate and the size of species as well. This research indicated that increasing CO_2 level in all plant groups (well-fitted, intermediate-fitted and poorly-fitted species) enhanced the biomass productivity and, as a result, plant growth rate. But increasing the level of CO_2 in combination with decreasing water availability from ambient to ambient -50% and also increasing temperature from ambient to ambient +4^{o}C showed a negative effect on plant growth rate of well-fitted and also intermediate-fitted plant groups. This did not occur with poorly-fitted species. The most exciting part of these results showed that almost all ecological plant groups (well-fitted, intermediate-fitted and poorly fitted) at CO_2: 900PPM, Temperature: Ambient, moisture: Ambient and Ambient +50%) showed similar responses in terms of growth rate (Figure 5.88). This is important because it shows that poorly-fitted species were equivalent to the better-fitted species when temperature and other factors that are conducive to growth are elevated. In these climate scenarios poorly-fitted species showed the same biomass productivity of well-fitted and intermediate-fitted species.

6.6 Final Thoughts

A designed plant community of Mediterranean meadow vegetation and maritime climate species in public landscape under future UK climate scenarios is recommended. With using a management and maintenance system we can use the temperate continental grassland species in current and future UK climate scenarios as well.

6.7 Recommendation for future research

This study has provided an understanding of how to establish a designed meadow–like community as a new naturalistic planting design in the urban landscape under different climate change scenarios (Figure 6.2 to 6.17). Many forbs, from three different ecological regions, have been investigated to evaluate their growth performance, hardiness and biomass production under different climate change scenarios.

Climate change has been investigated from variety aspects. Most of these studies have focused on climate change models (simulations). When considering climate change, using computer models is necessary and important; however, these approaches cannot answer all the questions. This is the first research on the effect of climate change on designed plant communities in urban landscapes and more work is needed on the simulation of climate change in a real environment, especially on designed urban planting. This study focused on new plant species from three different ecological and climate zones, and the possibility of their fitness to both the current and the 2050 UK climate were investigated. More inquiries on other plant species from other geographical zones would be beneficial, for example, South African species.

To evaluate plant species' fitness in a specific geographic and climate region, a three-year experiment is not long enough. Plant species fitness and adaptation are long processes and further investigation is required to explore the species productivity for survival under different climate scenarios.

During this research the response of slugs under different climate scenarios on a meadow-like community of native and non-native species regarding biomass productivity was evaluated. It is suggested that an investigation into other aspects such as the percentages of species that were eaten by molluscs. Also a deep and specific study is recommended about what are the effects of the molluscs at the level of each community, which species increase, when molluscs are present and which decrease?

This research focused on three main elements of climate change: greenhouse gases (CO_2), changes in precipitation and temperature but it is also important to pay much more attention to light and wind, factors not considered in this study. Also, in this research just two concentrations for CO_2 were considered. It is suggested that the effects of other concentrations of CO_2 in combination with moisture availability and temperature are evaluated.

Figure 6. 2 May 2013, water regime: Ambient, Temperature: Ambient+3C

Figure 6. 3 June 2013

Figure 6. 4 July 2013

Figure 6. 5 July 2013 water: Ambient- 50%, Temperature: Ambient

Figure 6. 6   July 2013 water: Ambient+50%, Temperature: Ambient

Figure 6. 7   July 2013 water: Ambient+50%, Temperature: Ambient+3C

Figure 6. 8 August 2013, water: Ambient+50%, Temperature: Ambient

Figure 6. 9 March 2014

Figure 6. 10   April 2014 water: Ambient, Temperature: Ambiet+3C

Figure 6. 11   May 2014 water: Ambient, Temperature: Ambient

Figure 6. 12 June 2014 W: Ambient+ 50%, Temperature: Ambient

Figure 6. 13 water: Ambient, Temperature: Ambient+3C

Figure 6. 14 Water Ambient, Temperature: Ambient

Figure 6. 15 July 2014

Figure 6. 16 August 2014

Figure 6. 17 some plant species of the plant community: *Linum flavum 'Compactum'*, *Scabiosa caucasica*, *Centaurea orientalis*, *Salvia nemorosa*, *Knautia arvensis*, *Salvia pratense*, *Bupthalmum salicifolium*, *Lychnis coronaria*, Lychnis flos-jovis, *Centaurea montana*, *Euphorbia niceaensis*

REFERENCES

Aaron, M. E., Denslow, J. S., Loiselle, B. A. and M, D. B. (1993). Seed and Seedling Ecology of Neotropical Melastomataceae. Ecology, 74, 1733-1749.

Acock, B. 1980. Analysing and predicting the response of the glasshouse crop to environmental manipulation. In Opportunities for Increasing Crop Yields, ed. R. G. Hurd. P. V. Biscoe, and C. Dennis, pp. 131-48. London: Pitman

Acock, B., Allen, L. H. J. 1985. Crop responses to elevated carbon dioxide concentrations. In Direct Effects of Increasing Carbon Dioxide on Vegetation, ed. B. R. Strain, J. D. Cure. pp. 53-98. US Dep Energy, Washington, DC

Adams, R.M., Rosenzweig, C., Peart, R.M., Ritchie, J.T., McCarl, B.A., Glyer, J.D., Curry, R.B., Jones, J.W., Boote, K.J., Allen, L.H., Jr., 1990. Global climate change and US agriculture. Nature 345, 219–224.

Aerts, R. (1999). Interspecific competition in natural plant communities: mechanisms, tradeoffs and plant-soil feedbacks. Journal of Experimental Botany, 50, 29-37.

Ahmad, H., Hitchmough, J.D., 2007. Germination and emergence of understorey and tallcanopy forbs used in naturalistic sowing mixes. A comparison of performance in vitro vs the field. Seed Science and Technology 35, 624-637.

Angold, P.G. et al., 2006. Biodiversity in urban habitat patches. *Science of the Total Environment*, 360(1-3), pp.196–204.

Araya, Y. N., Silvertown, J., Gowing, D. J., Mcconway, K. J., Peter Linder, H. and Midgley, G. (2011). A fundamental, eco-hydrological basis for niche segregation in plant communities. New Phytologist, 189, 253-258.

Archibold, O.W. (1995). Ecology of world vegetation. Chapmanand Hall, London, UK.

Asteraki, E.J., Hart, B.J., Ings, T.C. and Manley, W.J., 2004. Factors influencing the plant and invertebrate diversity of arable field margins. Agriculture, ecosystems & environment, 102(2), pp.219-231.

Austin, M.P. and Smith, T.M. (1989). A new model for the continuum concept. Vegetatio 83, 35-47.

Authority, G.L., Councils, L. and Homes, S., 2005. London Climate Change Partnership. *Adapting to Climate Change: A Checklist for Development: Guidance on Designing Developments in a Changing Climate. See http://pss. london. gov. uk/PSS/PViewDocument.*

Available at: http://www.sciencedirect.com/science/article/pii/S1146609X98800064 [Accessed December 29, 2015].

Bakkenes, M., Alkemade, J.R.M., Ihle, F., Leemans, R., Latour, J. B., (2002) Assessing effects of forecasted climate change on the diversity and distribution of European higher plants for 2050, Global Change Biology, Vol.8, Issue 4, PP. 390–407

Baldwin, J. (1976). Competition for plant nutrients in soil; a theoretical approach. Journal ofAgricultural Science, 87, 341-356

Barber, S. (1984). Soil nutrient bioavailability: a mechanistic approach. John Wiley & Sons, New York, NY.

Barbosa, O. et al., 2007. Who benefits from access to green space? A case study from Sheffield, UK. Landscape and Urban Planning, 83(2-3), pp.187–195.

Barnes, P., Beyschlag, W., Ryel, R., Flint, S. and Caldwell, M. (1990). Plant competition for light analyzed with a multispecies canopy model. Oecologia, 82, 560-566.

Barton, C.V.M., Lee, H.S.J., Jarvis, P.G.(1993) A branch bag and CO2 control system for long-term CO2 enrichment of mature Sitka spruce (Picea sitchensis (Bong.) Carr.). – Plant Cell Environ. 16: 1139-1148.

Baskin CC, Baskin JM (1998) Seeds, ecology, biogeography, and evolution of dormancy and germination. Academic, San Diego

Bazzaz, F. a. (1990). The Response of Natural Ecosystems to the Rising Global CO2 Levels. *Annual Review of Ecology and Systematics*, *21*(1), 167–196. doi:10.1146/annurev.es.21.110190.001123

Beier, C. (2004) Interactions of elevated CO2 and temperature on terrestrial ecosystem structure and functioning – the role of whole-ecosystem manipulation experiments. New Phytologist, 162, 243–245.

Beier, C., Emmett, B., Gundersen, P., Tietema, A., Penuelas, J., Estiarte, M., Gordon, C., Gorissen, A., Llorens, L., Roda, F. & Williams, D. (2004) Novel approaches to study climate change effects on terrestrial ecosystems in the field – drought and passive night time warming. Ecosystems, 7, 583–597.

Beier, C., Gundersen, P. & Rasmussen, L. (1998) European experience of manipulation of forest ecosystems by roof cover: possibilities and limitations. Experimental Reversal of Acid Rain Effects: The Gårdsjön Roof Project (eds H. Hultberg & R. Skeffington), pp. 397–410. John Wiley & Sons, Chinchester, England.

Bigler, C., Bräker, O.U., Bugmann, H., Dobbertin, M., Rigling, A. (2006) Drought as an inciting mortality factor in scots pine stands of the Valais, Switzerland, Ecosystems 9 (3) , pp. 330-343

Bisgrove, R. and Hadley, P., 2002. Gardening in the Global Greenhouse: the Impacts of Climate Change on Gardens in the UK. *The UK Climate Impacts Programme*.

Bradshaw, A.D. and Handley, J., 1982. An ecological approach to landscape design: principles and problems. Landscape Design, 138, pp.30-34.

Breshears, D. D., Rich, P. M., Barnes, F. J. and Campbell, K. (1997). Overstory-imposed heterogeneity in solar radiation and soil moisture in a semiarid woodland. Ecological Applications, 7, 1201-1215.

Briner T, Frank T (1998) The palatability of 78 wildflower strip plants to the slug Arion lusitanicus. Ann Appl Biol 133:123–133

Briner, T. & Frank, T. (1998) The palatability of 78 wildflower strip plants to the slug *Arion lusitanicus*. *Annals of Applied Biology* 133, 123–133.

Broadmeadow, M. ed., 2002. *Climate change: Impacts on UK forests* (pp. 119-140). Forestry Commission.

Broadmeadow, M., Ray, D., Sing, L. and Poulsom, L., 2002. Climate change and British woodland: what does the future hold. *Forest Research Annual Report and Accounts*, *2003*, pp.70-83.

Broadmeadow, M.S.J., Ray, D. and Samuel, C.J.A., (2005) Climate change and the future for broadleaved tree species in Britain, Source:Forestry Vol:78, Issue:2, PP.145 -161.

Brown, V.K. and Gange, A.C., 1989. Herbivory by soil-dwelling insects depresses plant species richness. *Functional Ecology*, pp.667-671.

Bruelheide H, Scheidel U (1999) Slug herbivory as a limiting factor for the geographical range of *Arnica montana*. J Ecol 87:839–848

Bruelheide H, Scheidel U (1999) Slug herbivory as a limiting factor for the geographical range of *Arnica montana*. J Ecol 87:839–848

Buchdahl, J. (2015). *Atmosphere, Climate & Environment Information Programme*. [online] Lordgrey.org.uk. Available at: http://www.lordgrey.org.uk/~f014/usefulresources/aric/Resources/Teaching_Packs/Key_Stage_4/Weather_Climate/11.html [Accessed 28 Sep. 2015].

Buckland, S. and Grime, J. (2000). The effects of trophic structure and soil fertility on the assembly of plant communities: a microcosm experiment. Oikos, 91, 336-352.

Bullock, P. and Gregory, P. J. (2009). Soils in the urban environment, Wiley-Blackwell.UK.

Burt, P.J.A., 2002. Weather and pests. *Weather*, *57*(5), pp.180-184.

Buschmann, H., Keller, M., Porret, N., Dietz, H. and Edwards, P.J., 2005. The effect of slug grazing on vegetation development and plant species diversity in an experimental grassland. *Functional Ecology*, *19*(2), pp.291-298.

Caldwell M.M., Manwaring J.H., and Durham S.L. (1996) Species inter-actions at the level of roots in the field influence of soil nutrient heterogeneity and plant size. Oecologia, 106: 440-447.

Caldwell, M. M. and Richards, J. H. (1989). Hydraulic lift: water efflux from upper roots improves effectiveness of water uptake by deep roots. Oecologia, 79, 1-5.

Cannell, M.G.R., 1985. Dry matter partitioning in tree crops. In: M.G.R. Cannell and J.E.Jackson (Editors), Attributes of Trees as Crop Plants. Abbots Ripton, Huntingdon, Great Britain, pp. 160-193.

Carlson, R.W. and Bazzaz, F.A. 1980. The effects of elevated CO 2 concentrations on growth, photosynthesis, transpiration, and water use efficiency of plants. In: J. Singh- jag and A. Deepek (Editors), Environmental and Climatic Impact of Coal Utilization. Academic Press, New York, NY, pp. 609--623.

Carter DR, Peterson KM (1983) Effects of a C02-enriched atmosphere on the growth and competitive interactions of a C3 and a C4 grass. Oecologia (Berlin) 58:188-193

Casper B.B, and Cahill J.F, Jr. (1996). Limited effects of soil nutrient heterogeneity on populations of Abutilon theophrasti (Malvaceae). American Journal. Botany. 83, 333–41.

Casper, B. B. and Jackson, R. B. (1997). Plant Competition Underground. Annual Review of Ecology and Systematics, 28, 545-570.

Chan, K., Shaw, M., Cameron, D., Underwood, E. C. & Daily, G. C. (2006). Conservation planning for ecosystem services. *PLoS Biology* 4, e379.

Change in the UK, M. G. R. Cannell, J. P. Palutitkof and T. H. Sparks (Eds.). Department

Change on London. Greater London Authority, London

Chiesura, A., 2004. The role of urban parks for the sustainable city. Landscape and Urban Planning, 68(1), pp.129–138.

Clark, D. (2013). What are the potential impacts of climate change for the UK?. [online] the Guardian. Available at: http://www.theguardian.com/environment/2013/oct/08/potential-impacts-climate-change-uk [Accessed 29 Sep. 2015].

Clark, D. (2013). *What are the potential impacts of climate change for the UK?*. [online] the Guardian. Available at: http://www.theguardian.com/environment/2013/oct/08/potential-impacts-climate-change-uk [Accessed 29 Sep. 2015].

Cole, D.N., 1983. Monitoring the condition of wilderness campsites (No. 300). US Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station.

Costion, C.M. et al., 2015. Will tropical mountaintop plant species survive climate change? Identifying key knowledge gaps using species distribution modelling in Australia. *Biological Conservation*, 191, pp.322–330. Available at: http://linkinghub.elsevier.com/retrieve/pii/S000632071530029X.

Crawley, M.J. (1989) The relative importance of vertebrate and invertebrate herbivores in plant population dynamics. Insect–Plant Interactions (ed. E.A.Bernays), pp. 45–71. CRC Press, Boca Raton, FL, USA.

Crawley, M.J. (1997) Plant–herbivore dynamics. Plant Ecology (ed. M.J.Crawley), pp. 401–474. Blackwell Scientific Publications, Oxford, UK.

Crimmins, S.M., Dobrowski, S.Z. & Mynsberge, A.R., 2013. Evaluating ensemble forecasts of plant species distributions under climate change. *Ecological Modelling*, 266(1), pp.126–130. Available at: http://dx.doi.org/10.1016/j.ecolmodel.2013.07.006.

Crimmins, S.M., Dobrowski, S.Z. & Mynsberge, A.R., 2013. Evaluating ensemble forecasts of plant species distributions under climate change. *Ecological Modelling*, 266(1), pp.126–130. Available at: http://dx.doi.org/10.1016/j.ecolmodel.2013.07.006.

Crisp, T.M., Clegg, E.D., Cooper, R.L., Wood, W.P., Anderson, D.G., Baetcke, K.P., Hoffmann, J.L., Morrow, M.S., Rodier, D.J., Schaeffer, J.E. and Touart, L.W., 1998. Environmental endocrine disruption: an effects assessment and analysis. Environmental health perspectives, 106(Suppl 1), p.11.

Curtis PS, Drake BG, Leadley PW, Arp W, Whigham D (1989) Growth and senescence of plant communities exposed to elevated CO2 concentrations on an estuarine marsh. Oecologia 78:20–26

Dallman, P. R., (1998) Plant life in the world's mediterranean climates: California, Chile, South Africa, Australia, and the Mediterranean Basin. University of California Press. during early old-field succession under set-aside. Oecologia 127:259–265

Davis, M.B., (1989) Lags in vegetation response to greenhouse warming. Climatic Change, Vol. 15, PP.75-82.

Davis, M.B., 1989. Address of the Past President: Toronto, Canada, August 1989: Insights from Paleoecology on Global Change. Bulletin of the Ecological Society of America, 70(4), pp.222-228.

Dirzo, R. (1980) Experimental studies on slug–plant interactions. I. The acceptability of 30 plant species to the slug Agriolimax caruanae. Journal of Ecology, 68, 981 998.

Dunnett, N. and Clayden, A., 2000. Resources: The raw materials of landscape. Landscape and Sustainability.

Dunnett, N. and Hitchmough, J., 1996. Excitement and energy. Landscape Design, 6, pp.43-46.

Dunnett, N. and Hitchmough,J.D (2004). “The dynamic landscape; Design, ecology and management of naturalistic urban planting. London.: Spon Press.

Dunnett, N., Kircher, W., and Kingsbury, N. (2004). Communicating ecological plantings. In: Dunnett, N. and Hitchmough, J. (Eds.), The Dynamic Landscape. London/New York, Spon Press.

Ehrlén, J. (1995) Demography of the perennial herb *Lathyrus vernus*. I. Herbivory and individual performance. *Journal of Ecology* 83, 287–295.

elevated CO2 and temperature under boreal conditions. Photosynthetica 38: 69-81

Environmental economy. E. & FN Spon, 1986.

Fenner M, Hanley ME, Lawrence R (1999) Comparison of seedling and adult palatability in annual and perennial plants. Funct Ecol 13:546–551

Fiscus, E.L., Booker, F.L., Burkey, K.O. (2005) Crop responses to ozone: uptake, modes of action, carbon assimilation and

Fitter, A. H. and Hay, R. K. M. (2001). Environmental physiology of plants, Academic press.

Frank T (2003) Influence of slug herbivory on the vegetation development in an experimental wildflower

Frank, A. B., Power, J. F., & Willis, W. O. (1973). Effect of temperature and plant water stress on photosynthesis, diffusion resistance, and leaf water potential in spring wheat. *Agronomy journal*, *65*(5), 777-780.

Frank, T. (2003) Influence of slug herbivory on the vegetation development in an experimental wildflower strip. *Basic and Applied Ecology* 4, 139–147.

Frank, T. & Friedli, J. (1999) Laboratory food choice trials to explore the potential of common weeds to reduce slug feeding on oilseed rape. *Biological Agriculture and Horticulture* 17, 19–29.

Fransen, B., De Kroon, H. and Berendse, F. (2001). Soil nutrient heterogeneity alters competition between two perennial grass species. Ecology, 82, 2534-2546.

Fraser, L.H. and Grime, J.P., 1999. Interacting effects of herbivory and fertility on a synthesized plant community. *Journal of Ecology*, *87*(3), pp.514-525.

Friedman, J. and Orshan, G. (1974). Allopatric distribution of two varieties of Medicago laciniata (L.) Mill. in the Negev desert. The Journal of Ecology, 107-114.

Gain, W.A. (1891) Notes on the food of some British molluscs. Journal of Conchology, 6, 349 360.

Gifford, R.M., Thorne, J.H., Hitz, W.D. and Giaquinta, R.T., 1984. Crop productivity and hotoassimilate partitioning. Science, 225: 801-808.

Gilbert, O.L., Anderson, P., (1998) Habitat Creation and Repair. Oxford University Press, Oxford

Gill, S., 2006. *Climate change and urban greenspace* (Doctoral dissertation, The University of Manchester).

Gill, S.E. et al., 1998. Adapting Cities for Climate Change : The Role of the Green Infrastructure. Built Environment, 33(1), pp.115–133.

Gill, S.E., 2006. Climate Change and Urban Greenspace. , pp.1–435. Available at: http://www.greeninfrastructurenw.co.uk/resources/Susannah_PhD_Thesis_full_final.pdf.

Greater Manchester Fire and Rescue Service (2006). Firefighters feel heat during warm

Grime, J. P. (1977). Evidence for the Existence of Three Primary Strategies in Plants and Its Relevance to Ecological and Evolutionary Theory. The American Naturalist, 111,1169-1194.

Grime, J. P., Mason, G., Cutis, A. V., Rodman, J. and Band, S. R. (1981). A Comparative Study of Germination Characteristics in a Local Flora. Journal of Ecology, 69, 1017-1059. Grootjans, A.P. a

Grime, J.P. (1973). Competitive exclusion in herbaceous vegetation. Nature 242, 344-347

Grime, J.P., Hodgson, J.G., and Hunt, R., (2007). Comparative Plant Ecology: A Functional approach to Common British Species. Unwin Hyman Ltd., London, UK.

Grime, J.P. (2001) Plant Strategies, Vegetation Processes, and Ecosystem Properties, 2nd edn. Wiley, Chichester, UK.

Grime, J.P., Cornelissen, J.H.C., Thompson, K., Hodgson, J.G. (1996) Evidence of a causal connection between anti-herbivore defence and the decomposition rate of leaves. Oikos, 77, 489 494

Grime, J. P., Hodgson, J. G. & Hunt, R. (1986), *Comparative Plant Ecology.* London,

Unwin Hyman.

Grime, J.P., and Hunt, R., (1975). Relative growth-rate: Its range and adaptive significance ina local Flora. Journal of Ecology 63, 393-422.

Grime, J.P., Blythe, G.M., Thornton, J.D. (1970) Food selection by the snail Cepaea nemoralis L. Animal Populations in Relation to Their Food Resources (ed. A.Watson). British Ecological Society Symposium 10. Blackwell Scientific Publications, Oxford, UK.

Grime, J.P., MacPherson-Stewart, S.F. & Dearman, R.S. (1968) An investigation of leaf palatability using the snail *Cepaea nemoralis* L. *Journal of Ecology* 57, 45–66.

Grime, J.P., MacPherson-Stewart, S.F., Dearman, R.S. (1968) An investigation of leaf palatability using the snail Cepaea nemoralis L. Journal of Ecology, 56, 405 420.

Grimshaw, J. and Bayton, R., 2009. *New trees*. Royal Botanic Gardens, Kew.

Gundersen, P., Boxman A.W., Lamersdorf, N., Moldan, F. & Andersen, B.R. (1998) Experimental manipulation of forest ecosystems – lessons from large roof experiments. For Ecology Management, 101, 339–352.

Gundersen, P., Emmett, B.A., Kjønaas, O.J., Koopmans, C.J. and Tietema, A., 1998. Impact of nitrogen deposition on nitrogen cycling in forests: a synthesis of NITREX data. *Forest Ecology and management*, *101*(1), pp.37-55.

Hansen, R. & Stahl, F. (1993), *Perennials and Their Garden Habitats*. Cambridge University Press.

Hands, D.E. and Brown, R.D., 2002. Enhancing visual preference of ecological rehabilitation sites. Landscape and Urban Planning, 58(1), pp.57-70.

Hanf M (1973) Weeds and their seedlings. BASF, Ipswich

Hanley ME, Fenner M, Edwards PJ (1995) The effect of seedling age on the likelihood of herbivory by the slug Deroceras reticulatum. Funct Ecol 9:754–759

Hanley, M.E., 1998. Seedling herbivory, community composition and plant life history traits. *Perspectives in Plant Ecology, Evolution and Systematics*, *1*(2), pp.191-205.

Harper, J.L., 1977. Population biology of plants. *Population biology of plants.*

Harris, D., Hamdi, Q. A. and Terry, A. C. (1987). Germination and emergence of Sorghum bicolor. genotypic and environmentally induced variation in the response to temperature and depth of sowing. Plant, Cell & Environment, 10, 501-508.

Hartig, T., Mang, M., Evans, G., 1991. Restorative effects of natural environments experiences. Environ. Behav. 23, 3–26. Jamieson, D., 1998. Sustainability and beyond. Ecol. Econ. 2–3 (24), 183–192.

Hautier, Y., Niklaus, P. A. and Hector, A. (2009). Competition for light causes plant

Hautier, Y., Niklaus,biodiversity loss after eutrophication. Science, 324, 636-638.

Hector, A., Schmid, B., Beierkuhnlein, C., Caldeira, M.C., Diemer, M., Dimitrakopoulos, P.G., Finn, J.A., Freitas, H., Giller, P.S., Good, J. and Harris, R., 1999. Plant diversity and productivity experiments in European grasslands. *science*, *286*(5442), pp.1123-1127.

Hendrey, G.R., Ellsworth, D.S., Lewin, K.F., Nagy, J.(1999) A freeair enrichment system for exposing tall forest vegetation to elevated atmospheric CO2. Global Change Biol. 5: 293-309,.

Herrick, J.D., Thomas, R.B.(2001) No photosynthetic downregulation in sweetgum trees (Liquidambar styraciflua L.) after three years of CO2 enrichment at the Duke Forest FACE experiment. Plant Cell Environ. 24: 53-64

Hitchmough JD, de la Fleur M (2006) Establishing North American prairie vegetation in urban parks in northern England: effect of management and soil type on long-term community development. Landsc Urban Plan 78:386– 397

Hitchmough JD, Wagner.M (2011) Slug grazing effects on seedling and adult life stages of North American Prairie plant used in designed urban landscapes, Urban Ecosystem 14:279–302

Hitchmough, J. (2004), Naturalistic herbaceous vegetation for urban landscapes. In: Dunnett, N. & Hitchmough, J. (Eds.), the Dynamic Landscape. London/New York,Spon Press.

Hitchmough, J. (2009). Applying an Ecological Approach; the Future of Urban Horticulture?II International Conference on Landscape and Urban Horticulture 881, 193-200.

Hitchmough, J. (2011). Exotic plants and plantings in the sustainable, designed urban landscape. Landscape and Urban Planning, 100, 380-382.

Hitchmough, J. and Dunnet, N., 2004. Naturalistic herbaceous vegetation for urban landscapes. The Dynamic Landscape: Design, Ecology and Management of Naturalistic Urban Planting, p.172.

Hitchmough, J. and Wagner, M., 2011. Slug grazing effects on seedling and adult life stages of North American Prairie plants used in designed urban landscapes. *Urban Ecosystems*, *14*(2), pp.279-302.

Hitchmough, J. and Wagner, M., 2013. The dynamics of designed plant communities of rosette forming forbs for use in supra-urban drainage swales. *Landscape and Urban Planning*, *117*, pp.122-134.

Hitchmough, J. and Woudstra, J., 1999. The ecology of exotic herbaceous perennials grown in managed, native grassy vegetation in urban landscapes. Landscape and urban planning, 45(2), pp.107-121.

Hitchmough, J. D. (2008). New approaches to ecologically based, designed urban plant communities in Britain: do these have any relevance in the United States? Cities and the Environment (CATE), 1, 10.

Hitchmough, J., (2011). Exotic plants and plantings in the sustainable, designed urban landscape. Landscape and Urban Planning. Vol. 100, PP. 380-382.

Hitchmough, J., 2011. Exotic plants and plantings in the sustainable, designed urban landscape. Landscape and Urban Planning, 100(4), pp.380-382.

Hitchmough, J., and Dunnet, N. (2004). Naturalistic herbaceous vegetation for urban landscapes. Dynamic Landscape: Design, Ecology and Management of Naturalistic Urban Planting, 172.

Hitchmough, J., and Fleur, M. D. L. (2006). Establishing North American prairie vegetation in urban parks in northern England: Effect of management and soil type on long-term community development. Landscape and Urban Planning, 78, 386-397.

Hitchmough, J., and Woudstra, J. (1999). The ecology of exotic herbaceous perennials grown in managed, native grassy vegetation in urban landscapes. Landscape and urban planning 45(2), 107-121.

Hitchmough, J., De La Fleur, M., and Findlay, C. (2004). Establishing North American prairie vegetation in urban parks in northern England: Part 1. Effect of sowing season, sowing rate and soil type. Landscape and Urban Planning 66, 75-90.

Hitchmough, J.D. and Dunnett, N.D., (2004) Introduction to naturalistic planting in urban landscapes. In: Dunnett, N., Hitchmough, J.D., (eds) The dynamic landscape, design, management and ecology of naturalistic urban planting. Spon Press, London, PP. 1–22.

Hitchmough, J.D., (2004) Naturalistic herbaceous vegetation for urban landscapes. In: Dunnett, N., Hitchmough, J.D., (eds) The dynamic landscape, design, management and ecology of naturalistic urban planting. Spon Press, London, PP. 130–183.

Hitchmough, J.D., 1994. Urban landscape management. Inkata Press Pty Ltd.

Hitchmough, J.D., and Wagner, M. (2013) The dynamics of designed plant communities of rosette forming forbs for use in supra-urban drainage swales Landscape and Urban Planning, 117, 122-134.

Hitchmough, J.D., De La Fleur, M., and Findlay, C. (2004) Establishing North American Prairie vegetation in urban parks in northern England: 1. Effect of sowing season, sowing rate and soil type. Landscape and Urban Planning, 66, 2, 75-90

Hitchmough, J.D., De La Fleur, M.,and Findlay, C. (2004). Establishing North American prairie vegetation in urban parks in northern England: Part 1. Effect of sowing season,sowing rate and soil type. Landscape and Urban Planning 66, 75-90.

Hitchmough, J.D., Kendle, A.D., and Paraskevopoulou, A. (2003). Seedling emergence, survival and initial growth in low productivity urban “waste” soils; a comparison of North American prairie forbs with meadow forbs and grasses native to Britain. Journal of Horticultural Science and Biotechnology 78, 89-99.

Hitchmough, J.D., Reid, E., and Dourado, A. (2005) Establishment andnpersistence of field sown North American prairie grasses in southern England in response to mulching and extensive weed management. Journal of Environnmental Horticulture, 23, 2, 101-108

Holland KD, McDonnell MJ, Williams NSG (2007) Abundance, species richness and feeding preferences of introduced molluscs in native grasslands of Victoria, Australia. Austral Ecol 32:626–634

Hough, M., 1995. Anxiety about crime: findings from the 1994 British Crime Survey. London: Home Office.

Houghton JT, Meiro-Filho LG, Callander BA, Harris N,Kattenburg A, Maskell K. (1995).Climate change :the science of climate change. Second Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge, UK: Cambridge University Press

Hulme PE (1994) Seedling herbivory in grassland: relative impact of vertebrate and invertebrate herbivores. J Ecol 82:873–880

Hulme, M., Jenkins, G., Lu, X. et. al, (2002) Climate Change Scenarios for the United Kingdom: the UKCIP02 Scientific Report . Tyndall Centre, Universityof East Anglia, Norwich.

Hulme, P.E. (1994) Seedling herbivory in grassland: relative impact of vertebrate and invertebrate herbivores. *Journal of Ecology* 13, 873–880.

Huntly, N., 1991. Herbivores and the dynamics of communities and ecosystems. *Annual Review of Ecology and Systematics*, pp.477-503.

Impact: towarda framework for understanding the ecological effects of invaders, Biological Invasions, Vol.1, PP.3-19.

IPCC (Intergovernmental Panel on Climate Change). Climate change. – In: Solomon, S., Qin, D., Manning, M., Chen, Z., Marquis, M., Averyt, K.B., Tignor, M., Miller, H.L. (ed.): Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge Univ. Press, Cambridge – New York 2007.

IPCC, 2001b. Climate Change 2001: Mitigation. Contribution of Working Group III to the Third Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, UK, New York, NY, USA.

IPCC, 2014: Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Field, C.B., V.R. Barros, D.J. Dokken, K.J. Mach, M.D. Mastrandrea, T.E. Bilir, M. Chatterjee, K.L. Ebi, Y.O. Estrada, R.C. Genova, B. Girma, E.S. Kissel, A.N. Levy, S. MacCracken, P.R. Mastrandrea, and L.L. White (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 1132 pp

Jennings, T.J. *&* Barkham, J.P. *(*1975*)* Food of slugs in mixed deciduous woodland. Oikos*,* 26*,* 211 221*.*

Jiang, J. et al., 2015. Identifying the spectral responses of several plant species under CO2 leakage and waterlogging stresses. *International Journal of Greenhouse Gas Control*, 37,pp.1–11.Availableat:
http://linkinghub.elsevier.com/retrieve/pii/S1750583615000328.

Jordan, B.R. (2002) Molecular response of plant cells to UV-B stress. Functional Plant Biol. 29: 909-916.

Jorgensen, A., 2004. The social and cultural context of ecological plantings. The Dynamic Landscape: Design, Ecology and Management of Naturalistic Urban Planting, p.416.

Jorgensen, A., Hitchmough, J., Calvert, T., 2002.Woodland spaces and edges: their impact on

Kaplan, R. and Kaplan, S., 1989. The experience of nature: A psychological perspective. CUP Archive.

Keeling, C.D., Whorf, T.P., Wahlen, M., Van Der Plicht, J. (1995) Interannual extremes in the rate of rise of atmospheric carbon dioxide since 1980, Nature 375 (6533) , pp. 666-670

Keller M, Kollmann J, Edwards PJ (1999) Palatability of weeds from different European origins to the slugs Deroceras reticulatum Müller and Arion lusitanicus Mabille. Acta Oecol 20:109–118

Kellomäki, S., Wang, K.Y., Lemettinen, M. (2000) Controlled environment chambers for investigating tree response to elevated CO2 and temperature under boreal conditions. Photosynthetica 38: 69-81.

Kendle, A.D. and Rose, J.E., 2000. The aliens have landed! What are the justifications for 'native only'policies in landscape plantings?. Landscape and urban planning, 47(1), pp.19-31.

Kendle, T. and Forbes, S., 1997. Urban nature conservation. E & FN Spon, London, 264.

Kingsbury, N., (2004) Contemporary overview of naturalistic planting design, cited In: The Dynamic Landscape. PP. 58-96. Spon Press, London.

Knapp, A.K., Fay, P.A., Blair, J.M., Collins, S.L., Smith, M.D., Carlisle, J.D., Harper, C.W., Danner, B.T., Lett, M.S. & McCarron, J.K. (2002) Rainfall variability, carbon cycling, and plant species diversity in a mesic grassland. Science, 298, 2202–2205.

Korner, C.H., Scheel, J.A., Bauer, H., 1979. Maximum leaf diffusive conductance in vascular plants. Photosynthetica 13 (1), 45–82.

Ladányi, M. and Horváth, L., 2010. A REVIEW OF THE POTENTIAL CLIMATE CHANGE IMPACT ON INSECT POPULATIONS- GENERAL AND AGRICULTURAL ASPECTS. *Applied ecology and environmental research*, *8*(2), pp.143-152.

Lai, L.-W., Cheng, W.-L., 2009. Air quality influenced by urban heat island coupled with synoptic weather patterns. Sci. Total Environ. 407, 2724–2733.

Lamborg, M.R., Hardy, R.W.F. and Paul, E.A., 1983. Microbial effects. In: E.R. Lemon (Editor), CO2 and Plants. AAAS Sel. Symp., 84. Westview, Boulder, CO, pp. 131-175.

Lanta, V., 2007. Effect of slug grazing on biomass production of a plant community during a short-term biodiversity experiment. *Acta Oecologica*, 32(2), pp.145–151. Available at: http://www.sciencedirect.com/science/article/pii/S1146609X07000446 [Accessed December 28, 2015].

Larcher, W., 2003. *Physiological plant ecology: ecophysiology and stress physiology of functional groups*. Springer Science & Business Media.

Leadley, P.W., Drake, B.G.(1993) Open top chambers for exposing plant canopies to elevated CO2 concentration and for measuring net gas exchange. Vegetatio. 104/105:3-15.

Lloret, F. et al., 2009. Plant community changes induced by experimental climate change: Seedling and adult species composition. *Perspectives in Plant Ecology, Evolution and Systematics*, 11(1), pp.53–63.

Lloret, F. et al., 2009. Plant community changes induced by experimental climate change: Seedling and adult species composition. *Perspectives in Plant Ecology, Evolution and Systematics*, 11(1), pp.53–63.

London Climate Change Partnership (2002). London's Warming: The Impacts of Climate

Long, S.P. and Hutchin, P.R., 1991. Primary production in grasslands and coniferous forests with climate change: an overview. *Ecological Applications*, pp.139-156.

Luo, Q., 2011. Temperature thresholds and crop production: a review.*Climatic Change*, *109*(3-4), pp.583-598.

Luscombe, G. and Scott, R., 1994. Wildflowers Work: A Technical Guide to Creating and Maintaining Wildflower Landscapes. Landlife.

Maas, J., Spreeuwenberg, P., Van Winsum-Westra, M., Verheij, R. A., de Vries, S., & Groenewegen, P. P. (2009). Is green space in the living environment associated with people’s feelings of social safety? Environment and Planning A, 41(7), 1763–1777.

Maimaitiyiming, M. et al., 2014. Effects of green space spatial pattern on land surface temperature: Implications for sustainable urban planning and climate change adaptation. *ISPRS Journal of Photogrammetry and Remote* Sensing, 89, pp.59–66. Available at: http://dx.doi.org/10.1016/j.isprsjprs.2013.12.010.

Maze, D.M., 2009. Effect of terrestrial mollusc herbivory on Holocarpha macradenia (Asteraceae) seedlings in California coastal prairie under different clipping regimes. *Madrono*, *56*(1), pp.1-7.

McEvoy, D and Northwest, S., 2005. *Climate Change and the Visitor Economy: Challenges and Opportunities for England's Northwest*. Sustainability Northwest.

McHarg, I.L. and Mumford, L., 1969. Design with nature (pp. 7-17). New York: American Museum of Natural History.

Medhurst, J., Parsby, J., Linder, S., Wallin, G.., Ceschia, E., Slaney, M (2006) A whole-tree chamber system for examining treelevel physiological responses of field-grown trees to environmental variation and climate change. – Plant Cel Environ. 29: 1853-1869

Melillo, J.M., McGuire, A.D., Kicklighter, D.W., Moore, B., Vorosmarty, C.J. and Schloss, A.L., 1993. Global climate change and terrestrial net primary production. *Nature*, *363*(6426), pp.234-240.

Messer, U. (2008), *Studies on the development and assessment of perennial planting mixtures.* Research Thesis for PhD, University of Sheffield, Department of Landscape, Sheffield, United Kingdom.

Miller, G.T., 1992. Living in the environment: an introduction to environment science. Wadsworth Publishing Company.

Mitchell. J.F.B, Manabe. S, Meleshko .V, Tokioka. T. (1990). Equilibrium climate change and its implications for the future. In: Houghton JT, Jenkins GJ, Ephraums JJ, eds. Climate change: the IPCC scienti®c assessment. Cambridge, UK: Cambridge University Press, 135-174.

Mitchley, J. (1988). Control of relative abundance of perennials in chalk grassland in southern England. II. Vertical canopy structure. Journal of Ecology 76, 341–350.

Mittelbach, G.G., Steiner, C.F., Scheiner, S.M., Gross, K.L., Reynolds, H.L., Waide, R.B., Willig, M.R., Dodson, S.I. and Gough, L., 2001. What is the observed relationship between species richness and productivity?. *Ecology*, *82*(9), pp.2381-2396.

Moraal, L. G. & Jagers op Akkerhuis, G. A. J. M. (2011). Changing patterns in insect pests on trees in The Netherlands since 1946 in relation to human induced habitat changes and climate factors-An analysis of historical data. *Forest Ecology and Management* 261, 50–61.

Nelson, R.A. and Williams, R.L., 1992. Handbook of Rocky Mountain Plants (Vol. 911797963). Niwot, Colo.: Roberts Rinehart Publishers xviii, 444p.-illus.. ISBN.

Niemelä, J. (1999). Ecology and urban planning Biodivers. Conserv., 8 (1999), pp

Norris, T., Wilkinson, D., Lockwood, A., Belay, A., Colls, J.J., Bailey, B.J. (1996) Performance of a controlled-ventilation open-top chamber for climate change research. – Agr. Forest Meteorol. 78: 239-257.

Nystrand, O. and Granström, A., 1997. Forest floor moisture controls predator activity on juvenile seedlings of Pinus sylvestris. *Canadian Journal of Forest Research*, *27*(11), pp.1746-1752.

O'Connor,T.G., Bredenkamp, G.J., (1997). Grassland. In: Cowling, R.M., Richardson, D.M., Pierce, S.M.(Eds.), Vegetation of Southern Africa. Cambridge University Press, Cambridge, UK. pp. 215-244.

Olff, H. & Ritchie, E. (1998) Effects of herbivores on grassland plant diversity. *Trends in Ecology and Evolution* 13, 261–265.

Oudolf, P. and Kingsbury, N., 2013. *Planting: A new perspective*. Timber Press

Oudolf, P. and Kingsbury, N., 2005. Planting design: gardens in time and space. Timber Press (OR).

Overdieck, D. and Reining, E., 1986. Effect of atmospheric CO2 enrichment on perennial ryegrass (Lolium perenne L.) and white clover (Trifolium repens L.) competing in managed model-ecosystems. II: Nutrient uptake. *Acta oecologica. Oecologia plantarum*, *7*(4), pp.367-378.

Özgüner, H. and Kendle, A.D., 2006. Public attitudes towards naturalistic versus designed landscapes in the city of Sheffield (UK). Landscape and Urban Planning, 74(2), pp.139-157.

Özgüner, H., Kendle, A.D. and Bisgrove, R.J., 2007. Attitudes of landscape professionals towards naturalistic versus formal urban landscapes in the UK. Landscape and Urban Planning, 81(1), pp.34-45.

Pallant, D. *(*1972*)* The food of the grey field slug, *Agriolimax reticulatus* (Müller), on grassland. Journal of Animal Ecology*,* 41*,* 761 769*.*

Parker, I.M., Simberloff, D., Lonsdale, W.M., Goodell, K., Wonham, M., Kareiva, P.M.,Williamson,M.H., Van Holle, B., Moyle, P.B., Byers, J.E. and Goldwasser, L., (1999)

Parker, V. and Muller, C. (1982). Vegetational and environmental changes beneath isolated live oak trees (Quercus agrifolia) in a California annual grassland. American Midland Naturalist, 69- 81.

Patterson, D. T., and Flint, E. P. (1980). Potential effects of global atmospheric C02 enrichment on the growth and competitiveness of C3 and C4 weed and crop plants. Weed Sci. 28, 71-5.

Pausas, J. G. and Austin, M. P. (2001). Patterns of plant species richness in relation to different environments: an appraisal. Journal of Vegetation Science, 12, 153-166.

Pausas, J.G. and Carreras, J. (1995). The effect of bedrock type,temperature and moisture on species richness of PyreneanScots pine (Pinus sylvestris L.) forests. Vegetatio 116,85-92

Pearcy, R. W. & BjOrkman, O. 1983. Physiological effects. In: Lemon, E. R. (ed), CO 2 and plants, the response of plants to rising levels of atmospheric carbon dioxide, pp. 65-105. Westview Press, Colorado.

Pendry, J.B., Schurig, D. and Smith, D.R., 2006. Controlling electromagnetic fields. science, 312(5781), pp.1780-1782.

perception of safety and preference. Landscape Urban Plan. 60, 135–150

Pfleger, V. and Chatfield, J., 1988. *A guide to snails of Britain and Europe*. London: Hamlyn.

Pickett STA, Cadenasso ML, Grove JM. Resilient cities: meaning, models, and metaphor for integrating the ecological, socio economic, and planning realms. Landscape Urban Plan2004; 69:369–84.

Pickett STA, Cadenasso ML, Grove JM. Resilient cities: meaning, models, and metaphor for integrating the ecological, socio economic, and planning realms. Landscape Urban Plan 2004; 69:369–84.

Poorter, H. (1993). Interspecific variation in the growth response of plants to an elevated ambient CO2 concentration. *Vegetatio*, *104-105*(1), 77–97. doi:10.1007/BF00048146

Prather, C.M. et al., 2013. Invertebrates, ecosystem services and climate change. *Biological Reviews*, 88(2), pp.327–348. Available at: http://doi.wiley.com/10.1111/brv.12002.

Prather, C.M., Pelini, S.L., Laws, A., Rivest, E., Woltz, M., Bloch, C.P., Del Toro, I., Ho, C.K., Kominoski, J., Newbold, T.A. and Parsons, S., 2013. Invertebrates, ecosystem services and climate change. *Biological Reviews*, *88*(2), pp.327-348.

Putz, F. and Canham, C. (1992). Mechanisms of arrested succession in shrublands: root and shoot competition between shrubs and tree seedlings. Forest Ecology and Management, 49, 267-275.

Rainer, T. and West, C., 2015. *Planting in a Post-Wild World: Designing Plant Communities for Resilient Landscapes*. Timber Press.

Rathke, B. (1985) Slugs as generalist herbivores: tests of three hypotheses on plant choices. Ecology, 66, 828 836.

Raven, P.H., Evert, R.F. and Eichhorn, S.E., 2005. *Biology of plants*. Macmillan.

Rees, M. & Brown, V.K. (1992) Interactions between invertebrate herbivores and plant competition. *Journal of Ecology* 80, 353–360.

Reich, P.B., Tilman, D., Craine, J., Ellsworth, D., Tjoelker, M.G., Knops, J., Wedin, D., Lee, T.D.2001, Do species and functional groups differ in acquisition and use of C, N and water under varying atmospheric CO 2 and N availability regimes? A field test with 16 grassland species, New Phytologist 150 (2), pp. 435-448

Rey, P.J., Alcantara, J.M., Valera, F., Sanchez-Lafuente, A.M. Garrido J.L., Ramirez, J.M. andMandzaneda, A.J. (2004). Seedling establishment in Olea europaea: seed size and microhabitat affect growth and survival. Ecoscience, 11, 310-320.

Rind D, Goldberg R, Hansen J, Rosenzweig C, Ruedy R. (1990). Potential evapotranspiration and the likelihood of future drought. Journal of Geophysical Research 95: 9983-10004.

Robertnz, P. (1999) Effects of long-term CO2 enrichment and nutrient availability in Norway spruce. I. Phenology and morphology of branches. – Trees 13: 188-198.

Robinson, W. and Darke, R. (2009). The Wild Garden. Expanded Edition. Published in 2009 by Timber Press, Inc

Robinson, W., 2009. The Wild Garden: Expanded Edition. Timber Press.

Rodríguez, M.A. & Brown, V.K., 1998. Plant competition and slug herbivory: Effects on the yield and biomass allocation pattern of Poa annua L. *Acta Oecologica*, 19(1), pp.37–46.

Roetzer, T., Wittenzeller, M., Haeckel, H. and Nekovar, J., 2000. Phenology in central Europe–differences and trends of spring phenophases in urban and rural areas. *International Journal of Biometeorology*, *44*(2), pp.60-66.

Rojas, M. R., Locatelli, B. & Billings, R. (2010). Climate change and outbreaks of Southern pine beetle Dendroctonus frontalis in Honduras. *Forest Systems* 19, 70–76.on plant-pollinator interactions. *Ecology Letters* 14, 69–74.

Ruff, A.R., 1979. Holland & the Ecological Landscape. Department of Town and Country Planning, the University of Manchester.

Sánchez, B., Rasmussen, A. and Porter, J. R. (2014), Temperatures and the growth and development of maize and rice: a review. Glob Change Biol, 20: 408–417. doi:10.1111/gcb.12389

Sarrat, C., Lemonsu, A., Masson, V., Guedalia, D., 2006. Impact of urban heat island on regional atmospheric pollution. Atmos. Environ. 40, 1743–1758.

Saugier, B., Granier, A., Pontailler, J.Y., Dufrêne, E., aldocchi, D.D.(1997) Transpiration of a boreal pine forest measured by branch bag, sap flow and micrometeorological methods. – Tree Physiol. 17: 511-519.

Sayuti, Z., and Hitchmough, J. (2013). Effect of sowing time on field emergence and growth of South African grassland specie. South African Journal of Botany,

Scheidel, U. & Bruelheide, H. (1999) Selective slug grazing on montane meadow plants. *Journal of Ecology* 87, 828–838. Scheidel, U. & Bruelheide, H. (1999) Selective slug grazing on montane meadow plants. *Journal of Ecology* 87, 828–838.

Scheidel, U. and Bruelheide, H., 2001. Altitudinal differences in herbivory on montane Compositae species. *Oecologia*, *129*(1), pp.75-86.

Scheidel, U. and Bruelheide, H., 2005. Effects of slug herbivory on the seedling establishment of two montane Asteraceae species. *Flora-Morphology, Distribution, Functional Ecology of Plants*, *200*(4), pp.309-320.

Scheidel, U., & Bruelheide, H.. (1999). Selective Slug Grazing on Montane Meadow Plants. Journal of Ecology, 87(5), 828–838. Retrieved from http://www.jstor.org/stable/2648639

Schmitz, D. C. and Simberloff, D. (1997) Biological Invasions: A Growing Threat, Science and Technology, Vol. 13, Issue 4, PP. 33–41.

Schulze, R.E. (1997). Climate. In Cowling, R.M et al.,(Ed). Vegetation of Southern Africa.Cambridge University Press.

Schwinning, S. and Weiner, J. (1998). Mechanisms determining the degree of size asymmetry in competition among plants. Oecologia, 113, 447-455.

Shaw, M.R., Zavaleta, E.S., Chiariello, N.R., Cleland, E.E., Mooney, H.A. & Field, C.B. (2002) Grassland responses to global environmental changes suppressed by elevated CO2. Science, 298, 1987–1990.

Silva, O. and Teresa, M., 1992. Effects of mollusc grazing on the development of grassland species. *Journal of Vegetation Science*, *3*(2), pp.267-270.

Silvertown, J., Araya, Y. N., Linder, H. P. and Gowing, D. J. (2012). Experimental investigation of the origin of fynbos plant community structure after fire. Annals of Botany, 110,1377-1383.

Silvertown, J., Dodd, M.E., Gowing, D. and Mountford, O. (1999). Hydrologically defined niches reveal a basis for species-richness in plant communities. Nature 400: 61-63.

Gondard, H., Romane, F., Grandjanny, M., Li, J. and Aronson, J., 2001. Plant species diversity changes in abandoned chestnut (Castanea sativa) groves in southern France. Biodiversity & Conservation, 10(2), pp.189-207.

South, A. (1992) Terrestrial Slugs – Biology, Ecology and Control. Chapman & Hall, London.

Sparks, T. H. (1999). Date of leaf emergence on trees in spring. In Indicators of Climate

Sparks, T., Gill, R. and Broadmeadow, M.S.J., 2002. Climate change and the seasonality of woodland flora and fauna. *Forestry Commission Bulletin*, *125*, pp.p69-82.

Speiser, B. *&* Rowell-Rahier, M. *(*1993*)* Does the land snail *Arianta arbustorum* prefer sequentially mixed over pure diets? Functional Ecology*,* 7*,* 403 410*.*

Spitters, C.J.T.,and Aerts, R. (1983). Simulation of competition for light and water in cropweed associations. Aspects of Applied Biology 4, 467–483.

Sundseth.K. (2009). The Mediterranean regions. [online] the Guardian. Available at: http://ec.europa.eu/environment/nature/info/pubs/docs/biogeos/Mediterranean.pdf [Accessed 29 Sep. 2015].

Takano, T., Nakamura, K.,Watanabe, M., 2002. Urban residential environments and senior citizens' longevity in megacity areas: the importance of walk able green spaces. J. Epidemiol. Commun. H 56, 913–918.

Thomas, C.D., Cameron, A., Green, R.E., Bakkenes, M., Beaumont, L.J., Collingham, Y.C., Erasmus, B.F.N., Siqueira, M.F.D., Graigner, A., Hannah, L., Hughes, L., Huntley, B., Jaarsveld, A.S.v., Midgley, G.F., Miles, L., Ortega-Huerta, M.A., Peterson, A.T., Philips, O.L., Williams, S.E., 2004. Extinction risk from climate change. Nature 427, 145–148.

Tilman, D. 1988. Plant strategies and the dynamics and structure of plant communities. Princeton University Press, Princeton, NJ.

Tilman, D. and Grace, J. (1990). Mechanisms of plant competition for nutrients: the elements of a predictive theory of competition. Perspectives on plant competition, 117-141

Todorova, A., Asakawa, S. and Aikoh, T. (2004). Preferences for and attitudes towards street flowers and trees in Sapporo, Japan. Landscape and Urban Planning, 69, 403-416.

Todorova, M., 2004. What is or is there a Balkan culture, and do or should the Balkans have a regional identity?. Southeast European and Black Sea Studies, 4(1), pp.175-185.

Traill, L. W., Lim, M. L. M., Sodhi, N. S. & Bradshaw, C. J. A. (2010). Mechanisms driving change: altered species interactions and ecosystem function through global warming. *Journal of Animal Ecology* 79, 937–947.

Tregay, R., 1982. Nature and an ecological approach to landscape design. An Ecological Approach to Urban Landscape Design, p.23.

Troughton, A., (1977). Relationship between the root and shoot systems of grasses. In: J.K. Marshall (Editor), The Belowground Ecosystem: A Synthesis of Primary Production

Associated Processes. Science Series, No. 26. Range Science Department, Colorado State University, Fort Collins, CO, pp. 39-51.

Troy, A., & Grove, J. M. (2008). Property values, parks, and crime: A hedonic analysis in Baltimore, MD. Landscape and Urban Planning, 87, 233–245.

Turnbull, L. A., Paul-Victor, C., Schmid, B. and Purves, D. W. (2008). Growth rates, seed size, and physiology: Do small-seeded species really grow faster. Ecology, 89, 1352-1363.

Ucmp.berkeley.edu, (2015). The Grassland Biome. [online] Available at: http://www.ucmp.berkeley.edu/glossary/gloss5/biome/grassland.html [Accessed 30 Sep. 2015].

UKCP02: Hulme.M, Turnpenny.J, (2002) UK Climate Projections: Briefing report ,Tyndall Centre for Climate Change Research, School of Environmental Sciences, University of East Anglia, Norwich, UK

UKCP09: Jenkins, G. J., Murphy, J. M., Sexton, D. M. H., Lowe, J. A., Jones, P. and Kilsby, C. G. (2009). UK Climate Projections: Briefing report. Met Office Hadley Centre, Exeter, UK

Ulrich, R.S., Simonst, R.F., Lositot, B.D., Fioritot, E., Milest, M.A., Zelsont, M., 1991. Stress recovery during exposure to natural and urban environments. J. Environ. Psych. 11, 201–230.

Ulrich, R.S., Simonst, R.F., Lositot, B.D., Fioritot, E., Milest, M.A., Zelsont, M., 1991. Stress recovery during exposure to natural and urban environments. J. Environ. Psych. 11, 201–230.

Van Der Werf, H., Wijlhuizen, M. and De Schitter, J. (1995). Plant density and self-thinning affect yield and quality of fibre hemp (Cannabis sativa L.). Field Crops Research, 40, 153-164.

Vetaas, O.R. 1997. The effect of canopy disturbance on species richness in a central Himalayan oak forest. Plant Ecolology. 132, 29-38.

Vila, M. and Sardans, J. (1999). Plant Competition in Mediterranean-Type Vegetation.Journal of Vegetation Science, 10, 281-294.

Vitousek, P.M., D'antonio, C.M., Loope, L.L., Rejmanek, M. and Westbrooks, R., 1997. Introduced species: a significant component of human-caused global change. *New Zealand Journal of Ecology*, pp.1-16.

Volney, W. J. A. & Fleming, R. A. (2000). Climate change and impacts of boreal forest insects. *Agriculture, Ecosystems and Environment* 82, 283–294.

Vörösmarty, C.J. and Sahagian, D., 2000. Anthropogenic disturbance of the terrestrial water cycle. *BioScience*, *50*(9), pp.753-765.

Wagner, M. and Hitchmough, J.D., 2011. Effects of slug grazing on seedlings and established plants of North American Prairie species used in designed urban vegetation.

Wardle, D.A., Barker, G.M., Bonner, K.I., Nicholson, K.S. (1998) Can comparative approaches based on plant ecophysiological traits predict the nature of biotic interactions and individual plant species effects in ecosystems? Journal of Ecology, 86, 405 420.

Weiner, J. (1988). The influence of competition on plant reproduction. Plant reproductive ecology: patterns and strategies, Oxford University Press, pp 228-245.

Weiner, J. and Thomas, S. C.(1986). Size variability and competition in plant monocultures. Oikos, 211-222.

Weng, Q., Yang, S., 2006. Urban air pollution patterns, land use, and thermal landscape: an examination of the linkage using GIS. Environ. Monit. Assess. 117, 463–489.

White, J. E. J. (1994). New tree species in a changing world. Arboricultural Journal, 18, 99-112.

White, M.A., Nemani, R.R., Thornton, P.E. and Running, S.W., 2002. Satellite evidence of phenological differences between urbanized and rural areas of the eastern United States deciduous broadleaf forest. *Ecosystems*, *5*(3), pp.260-273.

Wilby A, Brown VK (2001) Herbivory, litter and soil disturbance as determinants of vegetation dynamics during early old-field succession under set-aside. Oecologia 127:259–265

Wilby, R.L., and Perry, G.L.W., (2006) Climate change, biodiversity and the urban environment: Acritical review based on London, UK, Progress in physical geography, Vol.30, Issue 1, PP.73 -98

Wilson, J. B. (1988). The effect of initial advantage on the course of plant competition. Oikos, 19-24.

Wilson, S. D. (1993). Belowground competition in forest and prairie. Oikos, 146-150.

Wilson, S. D. and Gerry, A. K. (1995). Strategies for Mixed-Grass Prairie Restoration: Herbicide, Tilling, and Nitrogen Manipulation. Restoration Ecology, 3, 290-298.

Woodward, F. I. & Lomas, M. R. 2004 Vegetation dynamics: simulating responses to climate change. Biol. Rev. Camb. Phil. Soc. 79, 643-670.

Woodward, F. I., Lomas, M. R., & Kelly, C. K. (2004). Global climate and the distribution of plant biomes. *Philosophical Transactions of the Royal Society of London. Series B, Biological Sciences*, *359*(1450), 1465–1476. doi:10.1098/rstb.2004.1525

Wray, S.M. and Strain, B.R., 1986. Response of two old field perennials to interactions of CO2 enrichment and drought stress. *American Journal of Botany*, pp.1486-1491.

Wright, R.F. (1998) Effect of increased carbon dioxide and temperature on runoff chemistry at a forested catchment in southern Norway (CLIMEX project). Ecosystems, 1, 216–225.

Yamori, W., Hikosaka, K. and Way, D.A., 2014. Temperature response of photosynthesis in C3, C4, and CAM plants: temperature acclimation and temperature adaptation. *Photosynthesis research*, *119*(1-2), pp.101-117.

Zangerl, A.R. and Bazzaz, F.A., 1984. The response of plants to elevated CO2. *Oecologia*, *62*(3), pp.412-417.

Zavaleta, E.S., Shaw, M.R., Chiariello, N.R., Mooney, H.A. and Field, C.B., 2003. Additive effects of simulated climate changes, elevated CO_2, and nitrogen deposition on grassland diversity. *Proceedings of the National academy of Sciences*, *100*(13), pp.7650-7654.

Zavaleta, E.S., Shaw, M.R., Chiariello, N.R., Thomas, B.D., Cleland, E.E., Field, C.B., Mooney, H.A. (2003) Grassland responses to three years of levatedtemperature,CO_2, precipitation, and N deposition, Ecological Monographs 73 (4) , pp. 585-604

Zhou.x, Ge.Z.M., Kellomaki.S.,Wang..K.Y.(2012) Multi-objective environment chamber system for studying plant responses to climate change. PHOTOSYNTHETICA 50 (1): 24-34, 2012

APPENDIX

Appendix 1

MEAN MONTHLY RAINFALL OF SHEFFIELD 1955-2012 [1]

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1955	59.7	69.1	87.9	18.8	85.6	85.9	30.7	19.3	18.3	60.2	67.1	96.3
1956	154.2	30.2	26.2	63.2	11.2	82.0	141.7	137.4	79.2	34.5	19.1	99.8
1957	42.2	73.2	52.6	1.8	23.6	35.3	84.8	113.3	96.8	43.2	58.7	82.0
1958	83.1	129.3	50.0	18.5	64.5	137.9	129.5	92.7	82.6	55.1	17.5	114.8
1959	80.8	2.3	44.2	85.6	25.7	23.6	34.3	22.4	1.0	59.4	102.1	119.9
1960	132.6	75.2	52.1	37.1	48.8	25.9	74.4	88.9	108.0	172.5	126.7	87.9
1961	104.1	61.0	15.2	90.9	34.3	38.9	64.3	62.0	47.8	87.9	42.7	77.5
1962	85.9	52.1	36.6	81.0	66.0	15.5	34.8	90.4	80.3	29.7	43.2	53.3
1963	52.3	30.7	72.1	66.8	29.5	102.6	59.2	70.1	80.5	43.2	134.6	18.0
1964	23.9	30.2	130.3	53.1	50.3	67.6	46.7	56.9	24.6	38.1	36.1	88.6
1965	84.1	21.8	80.5	44.7	68.8	79.8	60.5	46.7	167.1	29.7	128.8	189.2
1966	49.0	147.8	53.6	144.3	73.2	76.2	48.5	93.0	57.2	103.4	77.2	74.9
1967	49.0	72.1	57.9	31.8	186.4	18.8	42.9	87.4	69.1	120.7	69.3	42.2
1968	59.9	43.7	55.6	61.7	81.5	48.3	127.0	45.5	146.1	58.4	86.6	52.8
1969	85.1	95.8	119.9	71.4	105.2	65.3	54.9	54.4	37.6	22.4	162.6	76.5
1970	98.8	91.9	57.2	97.8	14.5	22.6	38.9	82.3	46.7	41.9	154.2	35.6
1971	71.3	25.2	54.8	93.5	60.0	72.0	74.2	117.7	23.0	93.3	73.1	35.0
1972	103.3	73.0	122.2	60.0	57.6	80.4	48.4	57.9	53.9	18.9	86.7	79.3
1973	45.6	53.8	11.8	73.9	70.0	44.0	187.0	57.8	55.6	73.3	30.6	55.3
1974	84.5	81.0	39.5	13.8	44.2	47.1	73.0	87.8	94.3	52.4	122.4	67.4
1975	78.8	15.0	65.4	44.0	56.7	11.1	64.6	40.5	35.3	29.8	28.6	51.4
1976	99.1	35.5	47.1	14.5	82.8	17.1	19.6	8.4	137.0	137.3	33.6	83.5
1977	120.9	202.5	62.5	39.0	47.9	74.5	12.4	67.3	44.4	47.7	108.7	80.0
1978	109.5	66.6	69.6	49.5	39.9	99.9	60.8	52.1	53.0	11.8	44.8	214.5
1979	76.0	71.5	129.8	91.0	126.1	33.7	12.8	79.8	23.1	68.0	91.6	129.9
1980	81.4	122.1	106.9	10.6	21.8	128.9	57.7	83.8	35.5	110.4	79.6	49.1
1981	57.5	90.0	149.0	120.6	78.3	33.3	19.5	59.5	117.4	93.1	70.0	90.9
1982	42.9	19.7	99.7	16.3	26.3	228.6	14.6	86.5	56.5	59.8	118.1	69.0
1983	99.5	42.8	60.4	126.1	141.5	8.5	40.7	44.6	108.6	63.0	43.6	127.4
1984	144.7	84.2	60.1	9.0	22.7	35.2	15.0	80.0	122.4	81.7	103.3	48.5
1985	67.7	7.0	48.9	68.5	51.6	82.5	48.9	89.5	19.0	39.4	72.3	81.0
1986	177.4	35.1	66.4	109.2	100.0	48.3	27.7	103.8	6.4	88.3	92.4	149.1
1987	67.0	35.0	95.3	81.6	34.0	120.3	58.5	48.4	66.1	120.8	49.7	36.6
1988	153.2	74.3	95.6	44.4	52.7	63.4	111.5	81.0	40.7	83.1	45.3	39.1
1989	17.3	75.6	78.4	134.1	19.5	62.5	37.8	28.3	21.8	65.4	36.3	168.0
1990	124.4	102.0	19.9	20.5	14.9	51.9	21.7	38.2	24.0	135.5	45.6	122.6
1991	74.9	65.1	62.8	63.6	13.9	58.8	51.0	9.5	42.9	60.4	67.3	74.4
1992	39.0	22.3	73.8	36.9	59.4	63.3	72.3	115.3	72.2	70.0	120.5	67.2
1993	76.1	10.0	15.0	91.8	70.7	108.3	85.3	29.7	121.4	66.0	55.5	162.8
1994	112.0	73.7	71.0	53.4	68.8	13.8	28.7	49.3	140.9	62.7	108.1	113.8
1995	157.5	97.5	60.4	24.2	58.7	12.6	21.4	9.5	81.6	23.6	59.5	69.4
1996	59.0	75.8	50.8	42.9	37.4	27.4	29.4	91.3	28.1	69.6	131.9	101.5

1997	6.1	94.5	22.2	28.4	80.5	141.1	56.4	109.0	21.2	59.9	97.1	78.3
1998	91.0	12.3	97.6	111.6	32.6	149.9	45.4	49.8	55.7	198.1	53.4	53.8
1999	94.8	44.9	84.5	86.6	60.7	68.6	33.8	86.2	112.7	54.3	56.2	126.8
2000	40.7	72.7	43.8	144.7	56.8	47.5	55.0	48.5	131.5	134.0	171.4	119.2
2001	44.5	85.9	54.1	80.5	61.3	35.7	62.8	89.5	77.5	119.7	27.1	32.7
2002	59.1	157.8	39.1	42.5	70.6	31.8	117.8	78.8	42.2	139.4	121.2	136.6
2003	66.6	30.5	37.5	47.6	48.3	105.9	43.7	16.5	28.1	38.1	56.7	85.6
2004	101.0	48.7	44.1	36.3	113.1	65.6	39.5	195.9	40.0	88.4	46.0	47.8
2005	45.0	60.4	30.1	75.5	17.8	44.0	77.5	48.1	89.6	119.0	57.1	57.6
2006	18.9	50.9	99.7	55.2	93.1	8.1	56.4	90.1	66.7	106.6	67.4	114.6
2007	134.8	84.1	46.6	7.8	87.9	254.9	110.0	25.8	24.6	23.3	62.1	70.1
2008	142.4	44.1	93.1	68.3	47.0	50.8	110.0	85.6	106.8	100.5	73.1	61.3
2009	50.8	42.7	46.4	38.7	92.8	122.7	138.3	45.7	30.5	50.7	150.9	67.9
2010	63.7	64.4	65.0	28.7	18.1	45.9	80.6	49.4	63.7	69.3	122.4	31.9
2011	53.5	93.1	11.2	12.4	42.4	53.0	23.5	41.3	29.1	59.7	40.2	110.1
2012	82.0	26.8	30.5	196.6	47.1	182.3	118.8	96.0	102.0	64.3	116.2	155.1
2013	62.6											
Average	80.4	63.7	63.0	61.4	58.6	68.3	61.0	67.9	65.3	73.3	78.7	86.6
Highest Rainfall	177.4	202.5	149.0	196.6	186.4	254.9	187.0	195.9	167.1	198.1	171.4	214.5
Lowest Rainfall	6.1	2.3	11.2	1.8	11.2	8.1	12.4	8.4	1.0	11.8	17.5	18.0

1. Available at : http://www.sheffieldweather.co.uk/Averages/MONTHLYRAINAVERAGE.htm

Appendix 2

MEAN MONTHLY TEMPERATURE OF SHEFFIELD 1955-2014 [1]

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1955	3.0	2.0	4.2	8.7	9.8	13.4	17.2	18.4	14.7	9.5	6.8	4.6
1956	3.6	3.0	5.7	6.6	12.7	13.4	15.6	13.3	13.3	9.4	5.9	5.2
1957	4.9	4.1	8.6	8.4	10.3	17.2	16.3	15.2	12.4	10.7	6.7	4.6
1958	3.7	4.5	3.2	7.4	11.1	13.2	15.7	15.6	14.8	10.5	6.5	4.4
1959	1.9	4.7	6.9	9.1	12.7	15.3	17.4	17.4	15.1	12.3	6.6	5.5
1960	3.9	3.4	5.3	9.2	12.8	16.4	14.9	14.9	12.8	9.7	6.8	4.1
1961	3.0	6.6	8.8	9.3	10.6	14.5	14.7	15.2	14.6	10.6	6.0	2.1
1962	4.4	4.2	2.6	7.2	9.8	13.7	14.2	14.1	12.6	10.4	5.2	2.4
1963	-1.2	-1.1	5.4	7.9	10.2	14.5	15.0	13.7	12.8	10.5	7.6	2.8
1964	3.3	4.0	3.2	8.6	13.1	13.2	15.6	15.2	13.7	8.8	7.1	3.4
1965	3.3	3.2	4.7	7.9	11.3	14.4	13.7	14.8	12.2	11.1	4.0	4.1
1966	2.2	4.7	6.3	5.8	11.2	15.1	14.5	14.5	13.7	9.7	5.3	4.9
1967	3.9	5.1	6.7	7.4	9.4	14.5	16.8	15.6	13.1	10.1	4.9	4.3
1968	4.1	1.8	6.2	8.2	9.5	14.7	14.5	15.1	13.4	12.1	5.9	2.6
1969	5.2	0.0	2.1	7.0	10.6	13.6	16.8	16.0	13.6	12.4	4.7	3.2
1970	3.2	2.4	3.4	6.4	12.6	16.2	15.0	15.9	14.0	10.5	7.0	4.2
1971	4.1	4.7	4.9	7.3	11.2	11.7	16.9	15.0	14.2	11.2	6.0	6.7
1972	3.2	3.5	5.9	8.1	10.3	11.7	15.3	14.8	11.3	9.8	6.4	4.9
1973	4.4	4.3	6.8	6.8	11.0	15.0	15.7	15.8	13.8	8.8	5.8	4.7
1974	5.2	5.4	5.1	7.3	10.8	13.4	14.7	15.0	11.5	7.4	5.9	7.4
1975	5.8	3.8	4.2	8.2	9.4	14.5	17.1	19.2	12.9	9.6	5.9	5.7
1976	5.2	4.0	4.0	7.7	11.4	16.8	18.3	17.4	12.8	9.8	5.8	1.8
1977	2.1	3.6	5.4	6.6	10.0	12.2	15.6	15.3	12.8	10.7	5.7	5.3
1978	2.9	1.8	6.3	5.9	11.4	13.3	14.2	14.7	13.5	11.6	8.2	2.6
1979	-0.2	0.5	3.8	7.4	9.5	14.2	15.8	14.8	12.9	10.4	6.3	5.2
1980	1.9	4.7	4.2	8.8	10.9	13.5	14.1	15.2	14.2	8.3	5.9	5.4
1981	4.5	2.7	6.9	7.2	11.1	13.3	15.7	16.2	14.2	7.8	7.3	0.2
1982	2.5	4.4	5.8	8.8	11.6	14.8	16.5	15.3	13.9	9.8	7.3	4.0
1983	6.2	1.1	6.0	6.4	9.8	13.7	19.3	17.4	12.6	10.1	7.3	5.5
1984	2.8	2.8	4.3	8.1	10.3	14.4	16.9	17.4	13.1	10.5	7.4	4.8
1985	1.1	2.3	4.5	7.7	12.4	12.2	16.0	14.3	14.3	11.2	3.6	5.8
1986	2.6	-1.5	4.7	5.5	11.2	14.6	15.7	11.4	9.7	9.0	5.9	4.5
1987	-0.1	2.5	4.1	10.3	10.5	12.0	14.6	15.5	13.1	9.4	6.6	5.7
1988	4.9	4.6	5.5	8.1	11.5	14.8	14.7	15.8	12.4	9.8	5.7	7.5
1989	6.3	5.7	7.0	6.1	13.3	15.0	17.8	16.3	14.5	11.5	6.4	4.5
1990	6.3	6.8	8.4	8.4	12.9	13.7	16.7	18.3	13.0	11.3	6.6	4.4
1991	2.4	1.9	7.8	8.0	11.2	12.1	17.5	17.2	14.6	10.0	6.4	5.2
1992	3.8	5.8	7.0	8.4	13.8	16.5	16.2	15.1	13.0	7.5	7.0	3.7
1993	5.4	5.1	6.6	9.4	11.5	15.0	15.4	14.6	13.0	8.0	4.2	4.5
1994	4.7	2.4	7.1	8.2	10.0	14.9	18.3	15.7	12.4	9.7	9.3	6.1
1995	4.1	6.0	5.3	9.2	12.1	14.5	19.2	19.3	14.0	12.9	7.7	2.1
1996	3.6	2.7	4.0	8.4	9.4	14.7	16.9	17.0	13.5	11.3	5.7	2.8
1997	2.6	6.5	8.7	9.2	11.7	13.8	17.1	18.8	13.9	10.0	8.3	6.1

1998	5.1	8.3	8.1	7.8	13.0	14.0	15.7	16.1	14.6	10.1	6.2	5.5
1999	5.4	5.4	7.5	9.8	13.5	13.8	18.3	16.1	15.9	10.9	7.9	4.6
2000	6.0	6.5	7.7	7.9	12.1	15.1	15.6	17.2	14.6	10.1	6.7	5.5
2001	3.0	4.8	4.8	6.7	13.1	14.6	17.6	16.9	13.0	13.0	7.9	3.7
2002	5.4	6.9	7.8	9.4	12.2	14.7	16.0	17.0	14.1	9.3	7.7	4.9
2003	4.7	3.3	7.6	9.8	12.2	15.9	17.3	17.9	14.5	9.2	7.7	4.8
2004	5.1	5.7	6.6	9.8	12.7	15.4	15.9	17.6	14.8	10.3	7.6	6.2
2005	6.1	4.5	7.0	8.7	11.5	15.7	16.8	16.4	15.0	12.5	6.8	4.8
2006	4.5	4.0	4.6	8.5	12.1	16.6	20.0	16.1	16.3	12.1	7.8	6.1
2007	6.4	5.9	6.6	11.2	11.5	14.4	14.7	15.2	13.5	10.5	7.2	4.5
2008	5.9	4.9	5.3	7.4	12.6	13.9	15.9	15.8	13.0	9.2	6.4	3.6
2009	3.0	4.0	6.7	9.6	11.6	14.6	15.9	16.3	14.0	10.8	7.8	2.7
2010	1.2	1.9	5.9	9.1	10.9	15.2	16.2	14.9	13.4	9.5	4.9	0.4
2011	3.9	6.0	6.6	12.0	12.0	14.2	15.8	15.8	14.9	12.2	8.9	5.4
2012	5.1	4.5	8.6	6.7	11.6	13.4	15.5	16.2	12.7	8.8	6.1	4.2
2013	3.4	2.7	1.7	7.4	10.6	14.1	18.4	16.8	13.3	11.7	6.2	6.3
2014	5.0	5.6	7.4	10.1	12.2	15.3	17.9	14.9	14.4	11.4	7.8	5.2
Average	3.9	3.9	5.8	8.2	11.4	14.3	16.2	15.9	13.5	10.3	6.6	4.5
Highest Ave	6.4	8.3	8.8	12.0	13.8	17.2	20.0	19.3	16.3	13.0	9.3	8.6
Lowest Ave	-1.2	-1.5	1.7	5.5	9.4	11.7	13.7	11.4	9.7	7.4	3.6	0.2
High Average	2007	1998	1961	2011	1992	1957	2006	1995	2006	2001	1994	1974
Low Average	1963	1986	2013	1986	1967	1971	1965	1986	1986	1974	1985	1981

1. **Avaliable at : http://www.sheffieldweather.co.uk/Averages/MONTHLYAIRAVERAGE.htm**

APPENDIX 3

The data analyzing of chapter 3

1 Ecological groups

Multivariate Tests[a]

Effect		Value	F	Hypothesis df	Error df	Sig.
Intercept	Pillai's Trace	1.000	26875.022[b]	3.000	34.000	.000
	Wilks' Lambda	.000	26875.022[b]	3.000	34.000	.000
	Hotelling's Trace	2371.325	26875.022[b]	3.000	34.000	.000
	Roy's Largest Root	2371.325	26875.022[b]	3.000	34.000	.000
WaterRegime	Pillai's Trace	1.797	103.002	6.000	70.000	.000
	Wilks' Lambda	.001	368.337[b]	6.000	68.000	.000
	Hotelling's Trace	226.364	1245.003	6.000	66.000	.000
	Roy's Largest Root	222.339	2593.957[c]	3.000	35.000	.000
Temperature	Pillai's Trace	.965	309.460[b]	3.000	34.000	.000
	Wilks' Lambda	.035	309.460[b]	3.000	34.000	.000
	Hotelling's Trace	27.305	309.460[b]	3.000	34.000	.000
	Roy's Largest Root	27.305	309.460[b]	3.000	34.000	.000
Year	Pillai's Trace	.988	932.953[b]	3.000	34.000	.000
	Wilks' Lambda	.012	932.953[b]	3.000	34.000	.000
	Hotelling's Trace	82.319	932.953[b]	3.000	34.000	.000
	Roy's Largest Root	82.319	932.953[b]	3.000	34.000	.000
WaterRegime * Temperature	Pillai's Trace	1.028	12.339	6.000	70.000	.000
	Wilks' Lambda	.030	54.079[b]	6.000	68.000	.000
	Hotelling's Trace	30.379	167.084	6.000	66.000	.000
	Roy's Largest Root	30.315	353.677[c]	3.000	35.000	.000
Temperature * Year	Pillai's Trace	.757	35.352[b]	3.000	34.000	.000
	Wilks' Lambda	.243	35.352[b]	3.000	34.000	.000
	Hotelling's Trace	3.119	35.352[b]	3.000	34.000	.000
	Roy's Largest Root	3.119	35.352[b]	3.000	34.000	.000
WaterRegime * Year	Pillai's Trace	1.120	14.847	6.000	70.000	.000
	Wilks' Lambda	.088	26.905[b]	6.000	68.000	.000
	Hotelling's Trace	8.018	44.101	6.000	66.000	.000
	Roy's Largest Root	7.712	89.969[c]	3.000	35.000	.000
WaterRegime * Temperature * Year	Pillai's Trace	.786	7.559	6.000	70.000	.000
	Wilks' Lambda	.236	11.974[b]	6.000	68.000	.000
	Hotelling's Trace	3.133	17.232	6.000	66.000	.000
	Roy's Largest Root	3.102	36.191[c]	3.000	35.000	.000

Levene's Test of Equality of Error Variances[a]

	F	df1	df2	Sig.
WellFitted	1.161	11	36	.347
IntermediateFitted	1.561	11	36	.153
PoorlyFitted	5.223	11	36	.000

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

a. Design: Intercept + WaterRegime + Temperature + Year + WaterRegime * Temperature + Temperature * Year + WaterRegime * Year + WaterRegime * Temperature * Year

Tests of Between-Subjects Effects

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	WellFitted	452665.30[a]	11	41151.391	486.735	.000
	IntermediateFitted	2006526.1[b]	11	182411.464	646.362	.000
	PoorlyFitted	460333.73[c]	11	41848.521	455.199	.000
Intercept	WellFitted	3832700.36	1	3832700.36	45332.794	.000
	IntermediateFitted	10454315.2	1	10454315.2	37044.108	.000
	PoorlyFitted	532885.595	1	532885.595	5796.360	.000
WaterRegime	WellFitted	293378.478	2	146689.239	1735.026	.000
	IntermediateFitted	1158427.15	2	579213.577	2052.401	.000
	PoorlyFitted	376335.418	2	188167.709	2046.758	.000
Temperature	WellFitted	3859.612	1	3859.612	45.651	.000
	IntermediateFitted	159505.099	1	159505.099	565.195	.000
	PoorlyFitted	21074.025	1	21074.025	229.229	.000
Year	WellFitted	125683.754	1	125683.754	1486.575	.000
	IntermediateFitted	330706.529	1	330706.529	1171.835	.000
	PoorlyFitted	27485.041	1	27485.041	298.963	.000
WaterRegime * Temperature	WellFitted	28852.101	2	14426.050	170.630	.000
	IntermediateFitted	273401.026	2	136700.513	484.388	.000
	PoorlyFitted	12911.591	2	6455.796	70.222	.000
Temperature * Year	WellFitted	8.417	1	8.417	.100	.754
	IntermediateFitted	12354.265	1	12354.265	43.776	.000
	PoorlyFitted	4224.752	1	4224.752	45.954	.000
WaterRegime * Year	WellFitted	444.475	2	222.238	2.629	.086
	IntermediateFitted	42541.903	2	21270.951	75.372	.000
	PoorlyFitted	16456.917	2	8228.458	89.503	.000
WaterRegime * Temperature * Year	WellFitted	438.459	2	219.229	2.593	.089
	IntermediateFitted	29590.129	2	14795.065	52.425	.000
	PoorlyFitted	1845.984	2	922.992	10.040	.000
Error	WellFitted	3043.651	36	84.546		
	IntermediateFitted	10159.655	36	282.213		
	PoorlyFitted	3309.643	36	91.935		
Total	WellFitted	4288409.31	48			
	IntermediateFitted	12471001.0	48			
	PoorlyFitted	996528.965	48			
Corrected Total	WellFitted	455708.947	47			
	IntermediateFitted	2016685.76	47			
	PoorlyFitted	463643.370	47			

Parameter Estimates

Dependent Variable	Parameter	B	Std. Error	t	Sig.	95% ...
						Lower Bound
WellFitted	Intercept	475.863	4.597	103.506	.000	466.538
	[WaterRegime=1.0]	-264.688	6.502	-40.710	.000	-277.874
	[WaterRegime=2.0]	-136.023	6.502	-20.921	.000	-149.209
	[WaterRegime=3.0]	0[a]	.	.	.	.
	[Temperature=1.0]	-78.215	6.502	-12.030	.000	-91.401
	[Temperature=2.0]	0[a]	.	.	.	.
	[Year=1.0]	-115.920	6.502	-17.829	.000	-129.106
	[Year=2.0]	0[a]	.	.	.	.
	[WaterRegime=1.0] * [Temperature=1.0]	132.938	9.195	14.458	.000	114.289
	[WaterRegime=1.0] * [Temperature=2.0]	0[a]	.	.	.	.
	[WaterRegime=2.0] * [Temperature=1.0]	50.418	9.195	5.483	.000	31.769
	[WaterRegime=2.0] * [Temperature=2.0]	0[a]	.	.	.	.
	[WaterRegime=3.0] * [Temperature=1.0]	0[a]	.	.	.	.
	[WaterRegime=3.0] * [Temperature=2.0]	0[a]	.	.	.	.
	[Temperature=1.0] * [Year=1.0]	14.250	9.195	1.550	.130	-4.398
	[Temperature=1.0] * [Year=2.0]	0[a]	.	.	.	.
	[Temperature=2.0] * [Year=1.0]	0[a]	.	.	.	.
	[Temperature=2.0] * [Year=2.0]	0[a]	.	.	.	.
	[WaterRegime=1.0] * [Year=1.0]	29.250	9.195	3.181	.003	10.602
	[WaterRegime=1.0] * [Year=2.0]	0[a]	.	.	.	.
	[WaterRegime=2.0] * [Year=1.0]	14.000	9.195	1.523	.137	-4.648
	[WaterRegime=2.0] * [Year=2.0]	0[a]	.	.	.	.
	[WaterRegime=3.0] * [Year=1.0]	0[a]	.	.	.	.
	[WaterRegime=3.0] * [Year=2.0]	0[a]	.	.	.	.
	[WaterRegime=1.0] * [Temperature=1.0] * [Year=1.0]	-29.275	13.004	-2.251	.031	-55.647
	[WaterRegime=1.0] * [Temperature=1.0] * [Year=2.0]	0[a]	.	.	.	.
	[WaterRegime=1.0] * [Temperature=2.0] * [Year=1.0]	0[a]	.	.	.	.
	[WaterRegime=1.0] * [Temperature=2.0] * [Year=2.0]	0[a]	.	.	.	.
	[WaterRegime=2.0] * [Temperature=1.0] * [Year=1.0]	-18.500	13.004	-1.423	.163	-44.872

Pairwise Comparisons

Dependent Variable	(I) WaterRegime	(J) WaterRegime	Mean Difference (I-J)	Std. Error	Sig.[b]	95% Confidence ...[b] Lower Bound	95% Confidence ...[b] Upper Bound
WellFitted	Ambient-50%	Ambient	-82.474*	3.251	.000	-89.067	-75.881
		Ambient+50%	-190.913*	3.251	.000	-197.506	-184.319
	Ambient	Ambient-50%	82.474*	3.251	.000	75.881	89.067
		Ambient+50%	-108.439*	3.251	.000	-115.032	-101.846
	Ambient+50%	Ambient-50%	190.913*	3.251	.000	184.319	197.506
		Ambient	108.439*	3.251	.000	101.846	115.032
IntermediateFitted	Ambient-50%	Ambient	-212.781*	5.939	.000	-224.826	-200.735
		Ambient+50%	-379.604*	5.939	.000	-391.650	-367.559
	Ambient	Ambient-50%	212.781*	5.939	.000	200.735	224.826
		Ambient+50%	-166.824*	5.939	.000	-178.869	-154.778
	Ambient+50%	Ambient-50%	379.604*	5.939	.000	367.559	391.650
		Ambient	166.824*	5.939	.000	154.778	178.869
PoorlyFitted	Ambient-50%	Ambient	138.329*	3.390	.000	131.454	145.204
		Ambient+50%	213.838*	3.390	.000	206.962	220.713
	Ambient	Ambient-50%	-138.329*	3.390	.000	-145.204	-131.454
		Ambient+50%	75.509*	3.390	.000	68.634	82.384
	Ambient+50%	Ambient-50%	-213.838*	3.390	.000	-220.713	-206.962
		Ambient	-75.509*	3.390	.000	-82.384	-68.634

Based on estimated marginal means

*. The mean difference is significant at the

b. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

Estimates

Dependent Variable	Temperature	Mean	Std. Error	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
WellFitted	Ambient	273.607	1.877	269.800	277.413
	Ambient+3C	291.541	1.877	287.734	295.347
IntermediateFitted	Ambient	409.043	3.429	402.088	415.997
	Ambient+3C	524.334	3.429	517.380	531.289
PoorlyFitted	Ambient	84.412	1.957	80.442	88.381
	Ambient+3C	126.318	1.957	122.349	130.288

Pairwise Comparisons

Dependent Variable	(I) Temperature	(J) Temperature	Mean Difference (I-J)	Std. Error	Sig.[b]	95% Confidence ...[b] Lower Bound
WellFitted	Ambient	Ambient+3C	-17.934*	2.654	.000	-23.317
	Ambient+3C	Ambient	17.934*	2.654	.000	12.551
IntermediateFitted	Ambient	Ambient+3C	-115.291*	4.850	.000	-125.127
	Ambient+3C	Ambient	115.291*	4.850	.000	105.456
PoorlyFitted	Ambient	Ambient+3C	-41.907*	2.768	.000	-47.520
	Ambient+3C	Ambient	41.907*	2.768	.000	36.293

Pairwise Comparisons

Dependent Variable	(I) Temperature	(J) Temperature	95% Confidence ...[b] Upper Bound
WellFitted	Ambient	Ambient+3C	-12.551
	Ambient+3C	Ambient	23.317
IntermediateFitted	Ambient	Ambient+3C	-105.456
	Ambient+3C	Ambient	125.127
PoorlyFitted	Ambient	Ambient+3C	-36.293
	Ambient+3C	Ambient	47.520

Based on estimated marginal means

*. The mean difference is significant at the

b. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

Estimates

Dependent Variable	Year	Mean	Std. Error	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
WellFitted	Year 1	231.403	1.877	227.597	235.210
	Year 2	333.744	1.877	329.938	337.551
IntermediateFitted	Year 1	383.684	3.429	376.730	390.639
	Year 2	549.693	3.429	542.738	556.647
PoorlyFitted	Year 1	81.436	1.957	77.466	85.405
	Year 2	129.294	1.957	125.325	133.264

Pairwise Comparisons

Dependent Variable	(I) Year	(J) Year	Mean Difference (I-J)	Std. Error	Sig.[b]	95% Confidence Interval for Difference[b] Lower Bound	95% Confidence Interval for Difference[b] Upper Bound
WellFitted	Year 1	Year 2	-102.341*	2.654	.000	-107.724	-96.958
	Year 2	Year 1	102.341*	2.654	.000	96.958	107.724
IntermediateFitted	Year 1	Year 2	-166.009*	4.850	.000	-175.844	-156.173
	Year 2	Year 1	166.009*	4.850	.000	156.173	175.844
PoorlyFitted	Year 1	Year 2	-47.858*	2.768	.000	-53.472	-42.245
	Year 2	Year 1	47.858*	2.768	.000	42.245	53.472

Based on estimated marginal means

*. The mean difference is significant at the

b. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

Estimates

Dependent Variable	Temperature	WaterRegime	Mean	Std. Error	95% Confidence Interval Lower Bound	Upper Bound
WellFitted	Ambient	Ambient-50%	215.050	3.251	208.457	221.643
		Ambient	258.958	3.251	252.364	265.551
		Ambient+50%	346.813	3.251	340.219	353.406
	Ambient+3C	Ambient-50%	167.840	3.251	161.247	174.433
		Ambient	288.880	3.251	282.287	295.473
		Ambient+50%	417.903	3.251	411.309	424.496
IntermediateFitted	Ambient	Ambient-50%	308.474	5.939	296.428	320.519
		Ambient	414.680	5.939	402.634	426.726
		Ambient+50%	503.975	5.939	491.929	516.021
	Ambient+3C	Ambient-50%	229.980	5.939	217.935	242.026
		Ambient	549.335	5.939	537.289	561.381
		Ambient+50%	793.687	5.939	781.642	805.733
PoorlyFitted	Ambient	Ambient-50%	180.444	3.390	173.569	187.319
		Ambient	66.314	3.390	59.439	73.189
		Ambient+50%	6.478	3.390	-.398	13.353
	Ambient+3C	Ambient-50%	265.064	3.390	258.189	271.939
		Ambient	102.536	3.390	95.661	109.411
		Ambient+50%	11.355	3.390	4.480	18.230

Estimates

Dependent Variable	Temperature	Year	Mean	Std. Error	95% Confidence Interval Lower Bound	Upper Bound
WellFitted	Ambient	Year 1	222.018	2.654	216.634	227.401
		Year 2	325.196	2.654	319.813	330.579
	Ambient+3C	Year 1	240.789	2.654	235.406	246.172
		Year 2	342.293	2.654	336.909	347.676
IntermediateFitted	Ambient	Year 1	342.082	4.850	332.246	351.917
		Year 2	476.004	4.850	466.169	485.839
	Ambient+3C	Year 1	425.287	4.850	415.452	435.122
		Year 2	623.382	4.850	613.546	633.217
PoorlyFitted	Ambient	Year 1	69.864	2.768	64.251	75.478
		Year 2	98.959	2.768	93.346	104.573
	Ambient+3C	Year 1	93.008	2.768	87.394	98.621
		Year 2	159.629	2.768	154.016	165.243

Estimates

Dependent Variable	WaterRegime	Year	Mean	Std. Error	95% Confidence Interval Lower Bound	Upper Bound
WellFitted	Ambient-50%	Year 1	144.354	3.251	137.761	150.947
		Year 2	238.536	3.251	231.943	245.129
	Ambient	Year 1	221.896	3.251	215.303	228.489
		Year 2	325.941	3.251	319.348	332.534
	Ambient+50%	Year 1	327.960	3.251	321.367	334.553
		Year 2	436.755	3.251	430.162	443.348
IntermediateFitted	Ambient-50%	Year 1	228.319	5.939	216.273	240.365
		Year 2	310.135	5.939	298.089	322.181
	Ambient	Year 1	378.554	5.939	366.508	390.599
		Year 2	585.461	5.939	573.416	597.507
	Ambient+50%	Year 1	544.180	5.939	532.134	556.226
		Year 2	753.482	5.939	741.437	765.528
PoorlyFitted	Ambient-50%	Year 1	174.165	3.390	167.290	181.040
		Year 2	271.343	3.390	264.467	278.218
	Ambient	Year 1	65.196	3.390	58.321	72.071
		Year 2	103.654	3.390	96.779	110.529
	Ambient+50%	Year 1	4.946	3.390	-1.929	11.821
		Year 2	12.886	3.390	6.011	19.761

Pairwise Comparisons

Dependent Variable	(I) Temperature	(J) Temperature	Mean Difference (I-J)	Std. Error	Sig.[b]	95% Confidence ...[b] Lower Bound
WellFitted	Ambient	Ambient+3C	-17.934*	2.654	.000	-23.317
	Ambient+3C	Ambient	17.934*	2.654	.000	12.551
IntermediateFitted	Ambient	Ambient+3C	-115.291*	4.850	.000	-125.127
	Ambient+3C	Ambient	115.291*	4.850	.000	105.456
PoorlyFitted	Ambient	Ambient+3C	-41.907*	2.768	.000	-47.520
	Ambient+3C	Ambient	41.907*	2.768	.000	36.293

Pairwise Comparisons

Dependent Variable	(I) Temperature	(J) Temperature	95% Confidence ...[b] Upper Bound
WellFitted	Ambient	Ambient+3C	-12.551
	Ambient+3C	Ambient	23.317
IntermediateFitted	Ambient	Ambient+3C	-105.456
	Ambient+3C	Ambient	125.127
PoorlyFitted	Ambient	Ambient+3C	-36.293
	Ambient+3C	Ambient	47.520

Based on estimated marginal means

*. The mean difference is significant at the

b. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

Estimates

Dependent Variable	Temperature	WaterRegime	Year	Mean	Std. Error	95% Confidence Interval Lower Bound	Upper Bound
WellFitted	Ambient	Ambient-50%	Year 1	164.203	4.597	154.878	173.527
			Year 2	265.898	4.597	256.573	275.222
		Ambient	Year 1	205.873	4.597	196.548	215.197
			Year 2	312.043	4.597	302.718	321.367
		Ambient+50%	Year 1	295.977	4.597	286.653	305.302
			Year 2	397.648	4.597	388.323	406.972
	Ambient+3C	Ambient-50%	Year 1	124.505	4.597	115.181	133.829
			Year 2	211.175	4.597	201.851	220.499
		Ambient	Year 1	237.920	4.597	228.596	247.244
			Year 2	339.840	4.597	330.516	349.164
		Ambient+50%	Year 1	359.943	4.597	350.618	369.267
			Year 2	475.863	4.597	466.538	485.187
IntermediateFitted	Ambient	Ambient-50%	Year 1	254.962	8.400	237.927	271.998
			Year 2	361.985	8.400	344.950	379.020
		Ambient	Year 1	324.008	8.400	306.972	341.043
			Year 2	505.353	8.400	488.317	522.388
		Ambient+50%	Year 1	447.275	8.400	430.240	464.310
			Year 2	560.675	8.400	543.640	577.710
	Ambient+3C	Ambient-50%	Year 1	201.676	8.400	184.640	218.711
			Year 2	258.285	8.400	241.250	275.320
		Ambient	Year 1	433.100	8.400	416.065	450.135
			Year 2	665.570	8.400	648.535	682.605
		Ambient+50%	Year 1	641.085	8.400	624.050	658.120
			Year 2	946.290	8.400	929.255	963.325
PoorlyFitted	Ambient	Ambient-50%	Year 1	146.980	4.794	137.257	156.703
			Year 2	213.908	4.794	204.185	223.630
		Ambient	Year 1	59.335	4.794	49.612	69.058
			Year 2	73.293	4.794	63.570	83.015
		Ambient+50%	Year 1	3.278	4.794	-6.445	13.000
			Year 2	9.678	4.794	-.045	19.400
	Ambient+3C	Ambient-50%	Year 1	201.350	4.794	191.627	211.073
			Year 2	328.778	4.794	319.055	338.500
		Ambient	Year 1	71.058	4.794	61.335	80.780
			Year 2	134.015	4.794	124.292	143.738
		Ambient+50%	Year 1	6.615	4.794	-3.108	16.338
			Year 2	16.095	4.794	6.372	25.818

Descriptive Statistics

	WaterRegime	Temperature	Year	Mean	Std. Deviation	N
WellFitted	Ambient-50%	Ambient	Year 1	164.203	9.4205	4
			Year 2	265.898	7.2975	4
			Total	215.050	54.9152	8
		Ambient+3C	Year 1	124.505	.9981	4
			Year 2	211.175	2.6312	4
			Total	167.840	46.3637	8
		Total	Year 1	144.354	22.1069	8
			Year 2	238.536	29.6880	8
			Total	191.445	54.8161	16
	Ambient	Ambient	Year 1	205.873	12.3702	4
			Year 2	312.043	10.2306	4
			Total	258.958	57.7151	8
		Ambient+3C	Year 1	237.920	6.5951	4
			Year 2	339.840	7.8379	4
			Total	288.880	54.8897	8
		Total	Year 1	221.896	19.4335	8
			Year 2	325.941	17.0867	8
			Total	273.919	56.5619	16
	Ambient+50%	Ambient	Year 1	295.978	8.3212	4
			Year 2	397.648	10.3313	4
			Total	346.813	55.0344	8
		Ambient+3C	Year 1	359.943	13.7227	4
			Year 2	475.863	11.7357	4
			Total	417.903	63.0793	8
		Total	Year 1	327.960	35.7685	8
			Year 2	436.755	43.0424	8
			Total	382.358	67.9557	16
	Total	Ambient	Year 1	222.018	58.1740	12
			Year 2	325.196	57.6416	12
			Total	273.607	77.3611	24
		Ambient+3C	Year 1	240.789	100.7289	12
			Year 2	342.293	113.1264	12
			Total	291.541	116.8798	24
		Total	Year 1	231.403	81.0126	24
			Year 2	333.744	88.2376	24
			Total	282.574	98.4679	48
IntermediateFitted	Ambient-50%	Ambient	Year 1	254.963	15.8802	4
			Year 2	361.985	12.8273	4
			Total	308.474	58.7462	8
		Ambient+3C	Year 1	201.676	9.0121	4
			Year 2	258.285	15.7305	4
			Total	229.980	32.5033	8
		Total	Year 1	228.319	30.8897	8
			Year 2	310.135	57.0004	8
			Total	269.227	61.2089	16
	Ambient	Ambient	Year 1	324.008	20.3733	4
			Year 2	505.353	21.8794	4
			Total	414.680	98.8891	8

2 Well fitted species

Multivariate Tests[a]

Effect		Value	F	Hypothesis df	Error df	Sig.
Intercept	Pillai's Trace	1.000	8268.896[b]	12.000	25.000	.000
	Wilks' Lambda	.000	8268.896[b]	12.000	25.000	.000
	Hotelling's Trace	3969.070	8268.896[b]	12.000	25.000	.000
	Roy's Largest Root	3969.070	8268.896[b]	12.000	25.000	.000
WaterRegime	Pillai's Trace	1.784	17.885	24.000	52.000	.000
	Wilks' Lambda	.001	76.225[b]	24.000	50.000	.000
	Hotelling's Trace	303.327	303.327	24.000	48.000	.000
	Roy's Largest Root	299.627	649.192[c]	12.000	26.000	.000
Temperature	Pillai's Trace	.894	17.482[b]	12.000	25.000	.000
	Wilks' Lambda	.106	17.482[b]	12.000	25.000	.000
	Hotelling's Trace	8.391	17.482[b]	12.000	25.000	.000
	Roy's Largest Root	8.391	17.482[b]	12.000	25.000	.000
Year	Pillai's Trace	.992	260.272[b]	12.000	25.000	.000
	Wilks' Lambda	.008	260.272[b]	12.000	25.000	.000
	Hotelling's Trace	124.931	260.272[b]	12.000	25.000	.000
	Roy's Largest Root	124.931	260.272[b]	12.000	25.000	.000
WaterRegime * Temperature	Pillai's Trace	1.716	13.112	24.000	52.000	.000
	Wilks' Lambda	.007	23.534[b]	24.000	50.000	.000
	Hotelling's Trace	40.883	40.883	24.000	48.000	.000
	Roy's Largest Root	38.007	82.349[c]	12.000	26.000	.000
WaterRegime * Year	Pillai's Trace	.730	1.246	24.000	52.000	.249
	Wilks' Lambda	.393	1.239[b]	24.000	50.000	.256
	Hotelling's Trace	1.229	1.229	24.000	48.000	.266
	Roy's Largest Root	.867	1.879[c]	12.000	26.000	.087
Temperature * Year	Pillai's Trace	.196	.507[b]	12.000	25.000	.890
	Wilks' Lambda	.804	.507[b]	12.000	25.000	.890
	Hotelling's Trace	.244	.507[b]	12.000	25.000	.890
	Roy's Largest Root	.244	.507[b]	12.000	25.000	.890
WaterRegime * Temperature * Year	Pillai's Trace	.570	.863	24.000	52.000	.645
	Wilks' Lambda	.479	.926[b]	24.000	50.000	.570
	Hotelling's Trace	.984	.984	24.000	48.000	.502
	Roy's Largest Root	.865	1.875[c]	12.000	26.000	.087

Parameter Estimates

Dependent Variable	Parameter	B	Std. Error	t	Sig.	95% ... Lower Bound
Arnicamontana	Intercept	34.909	3.376	10.339	.000	28.062
	[WaterRegime=1.0]	-17.812	4.775	-3.730	.001	-27.496
	[WaterRegime=2.0]	-10.292	4.775	-2.155	.038	-19.976
	[WaterRegime=3.0]	0[a]	.	.	.	.
	[Temperature=1.0]	-7.403	4.775	-1.550	.130	-17.086
	[Temperature=2.0]	0[a]	.	.	.	.
	[Year=1.0]	-20.682	4.775	-4.331	.000	-30.366
	[Year=2.0]	0[a]	.	.	.	.
	[WaterRegime=1.0] * [Temperature=1.0]	11.475	6.753	1.699	.098	-2.220
	[WaterRegime=1.0] * [Temperature=2.0]	0[a]	.	.	.	.
	[WaterRegime=2.0] * [Temperature=1.0]	3.758	6.753	.556	.581	-9.938
	[WaterRegime=2.0] * [Temperature=2.0]	0[a]	.	.	.	.
	[WaterRegime=3.0] * [Temperature=1.0]	0[a]	.	.	.	.
	[WaterRegime=3.0] * [Temperature=2.0]	0[a]	.	.	.	.
	[WaterRegime=1.0] * [Year=1.0]	14.502	6.753	2.148	.039	.807
	[WaterRegime=1.0] * [Year=2.0]	0[a]	.	.	.	.
	[WaterRegime=2.0] * [Year=1.0]	16.502	6.753	2.444	.020	2.807
	[WaterRegime=2.0] * [Year=2.0]	0[a]	.	.	.	.
	[WaterRegime=3.0] * [Year=1.0]	0[a]	.	.	.	.
	[WaterRegime=3.0] * [Year=2.0]	0[a]	.	.	.	.
	[Temperature=1.0] * [Year=1.0]	9.970	6.753	1.476	.149	-3.725
	[Temperature=1.0] * [Year=2.0]	0[a]	.	.	.	.
	[Temperature=2.0] * [Year=1.0]	0[a]	.	.	.	.
	[Temperature=2.0] * [Year=2.0]	0[a]	.	.	.	.
	[WaterRegime=1.0] * [Temperature=1.0] * [Year=1.0]	-10.720	9.550	-1.123	.269	-30.088
	[WaterRegime=1.0] * [Temperature=1.0] * [Year=2.0]	0[a]	.	.	.	.
	[WaterRegime=1.0] * [Temperature=2.0] * [Year=1.0]	0[a]	.	.	.	.
	[WaterRegime=1.0] * [Temperature=2.0] * [Year=2.0]	0[a]	.	.	.	.
	[WaterRegime=2.0] * [Temperature=1.0] * [Year=1.0]	-13.470	9.550	-1.411	.167	-32.838

Estimates

Dependent Variable	WaterRegime	Mean	Std. Error	95% Confidence Interval Lower Bound	Upper Bound
Arnicamontana	Ambient-50%	15.856	1.688	12.432	19.280
	Ambient	19.830	1.688	16.406	23.254
	Ambient+50%	23.360	1.688	19.936	26.783
Bupthalmumsalicifolium	Ambient-50%	14.945	.373	14.189	15.701
	Ambient	19.728	.373	18.971	20.484
	Ambient+50%	26.254	.373	25.497	27.010
Centaureamontana	Ambient-50%	54.951	1.024	52.875	57.028
	Ambient	73.855	1.024	71.778	75.932
	Ambient+50%	97.889	1.024	95.812	99.965
Galiumverum	Ambient-50%	21.875	.309	21.249	22.501
	Ambient	26.363	.309	25.736	26.989
	Ambient+50%	31.713	.309	31.086	32.339
Geraniumsylvaticum	Ambient-50%	14.935	.462	13.999	15.871
	Ambient	19.618	.462	18.681	20.554
	Ambient+50%	24.745	.462	23.809	25.681
Knautiaarvensis	Ambient-50%	24.615	.830	22.932	26.298
	Ambient	38.200	.830	36.517	39.883
	Ambient+50%	49.098	.830	47.414	50.781
Origanumvulgare	Ambient-50%	11.275	.449	10.363	12.187
	Ambient	17.851	.449	16.940	18.763
	Ambient+50%	25.559	.449	24.647	26.470
Phyteumaspicatumvarcaeruluem	Ambient-50%	11.116	.228	10.655	11.578
	Ambient	16.393	.228	15.931	16.854
	Ambient+50%	19.428	.228	18.966	19.889
Primulaveris	Ambient-50%	13.975	.333	13.300	14.650
	Ambient	15.770	.333	15.095	16.445
	Ambient+50%	21.553	.333	20.877	22.228
Prunellavulgaris	Ambient-50%	32.079	.918	30.217	33.941
	Ambient	47.835	.918	45.973	49.697
	Ambient+50%	79.369	.918	77.507	81.231
Salviapratense	Ambient-50%	30.604	.783	29.016	32.192
	Ambient	47.011	.783	45.423	48.599
	Ambient+50%	73.941	.783	72.353	75.529
Scabiosacaucasica	Ambient-50%	30.971	.799	29.351	32.591
	Ambient	44.879	.799	43.259	46.499
	Ambient+50%	56.954	.799	55.334	58.574

Pairwise Comparisons

Dependent Variable	(I) WaterRegime	(J) WaterRegime	Mean Difference (I-J)	Std. Error	Sig.[b]	95% Confidence ...[b] Lower Bound
Arnicamontana	Ambient-50%	Ambient	-3.974	2.387	.105	-8.816
		Ambient+50%	-7.503*	2.387	.003	-12.345
	Ambient	Ambient-50%	3.974	2.387	.105	-.868
		Ambient+50%	-3.530	2.387	.148	-8.372
	Ambient+50%	Ambient-50%	7.503*	2.387	.003	2.661
		Ambient	3.530	2.387	.148	-1.312
Bupthalmumsalicifolium	Ambient-50%	Ambient	-4.783*	.527	.000	-5.852
		Ambient+50%	-11.309*	.527	.000	-12.378
	Ambient	Ambient-50%	4.783*	.527	.000	3.713
		Ambient+50%	-6.526*	.527	.000	-7.596
	Ambient+50%	Ambient-50%	11.309*	.527	.000	10.239
		Ambient	6.526*	.527	.000	5.457
Centaureamontana	Ambient-50%	Ambient	-18.904*	1.448	.000	-21.841
		Ambient+50%	-42.938*	1.448	.000	-45.874
	Ambient	Ambient-50%	18.904*	1.448	.000	15.967
		Ambient+50%	-24.034*	1.448	.000	-26.971
	Ambient+50%	Ambient-50%	42.938*	1.448	.000	40.001
		Ambient	24.034*	1.448	.000	21.097
Galiumverum	Ambient-50%	Ambient	-4.488*	.437	.000	-5.373
		Ambient+50%	-9.838*	.437	.000	-10.723
	Ambient	Ambient-50%	4.488*	.437	.000	3.602
		Ambient+50%	-5.350*	.437	.000	-6.236
	Ambient+50%	Ambient-50%	9.838*	.437	.000	8.952
		Ambient	5.350*	.437	.000	4.464
Geraniumsylvaticum	Ambient-50%	Ambient	-4.683*	.653	.000	-6.006
		Ambient+50%	-9.810*	.653	.000	-11.134
	Ambient	Ambient-50%	4.683*	.653	.000	3.359
		Ambient+50%	-5.128*	.653	.000	-6.451
	Ambient+50%	Ambient-50%	9.810*	.653	.000	8.486
		Ambient	5.128*	.653	.000	3.804
Knautiaarvensis	Ambient-50%	Ambient	-13.585*	1.174	.000	-15.966
		Ambient+50%	-24.483*	1.174	.000	-26.863
	Ambient	Ambient-50%	13.585*	1.174	.000	11.204
		Ambient+50%	-10.898*	1.174	.000	-13.278
	Ambient+50%	Ambient-50%	24.483*	1.174	.000	22.102
		Ambient	10.898*	1.174	.000	8.517
Origanumvulgare	Ambient-50%	Ambient	-6.576*	.636	.000	-7.865
		Ambient+50%	-14.284*	.636	.000	-15.573
	Ambient	Ambient-50%	6.576*	.636	.000	5.287
		Ambient+50%	-7.708*	.636	.000	-8.997
	Ambient+50%	Ambient-50%	14.284*	.636	.000	12.995
		Ambient	7.708*	.636	.000	6.418
Phyteumaspicatumvarcaeruluem	Ambient-50%	Ambient	-5.276*	.322	.000	-5.929
		Ambient+50%	-8.311*	.322	.000	-8.964
	Ambient	Ambient-50%	5.276*	.322	.000	4.624
		Ambient+50%	-3.035*	.322	.000	-3.688
	Ambient+50%	Ambient-50%	8.311*	.322	.000	7.659
		Ambient	3.035*	.322	.000	2.382

Pairwise Comparisons

Dependent Variable	(I) Temperature	(J) Temperature	Mean Difference (I-J)	Std. Error	Sig.[b]	95% Confidence ...[b] Lower Bound
Arnicamontana	Ambient	Ambient+3C	-1.372	1.949	.486	-5.325
	Ambient+3C	Ambient	1.372	1.949	.486	-2.582
Bupthalmumsalicifolium	Ambient	Ambient+3C	-1.514*	.431	.001	-2.387
	Ambient+3C	Ambient	1.514*	.431	.001	.641
Centaureamontana	Ambient	Ambient+3C	-7.360*	1.182	.000	-9.758
	Ambient+3C	Ambient	7.360*	1.182	.000	4.962
Galiumverum	Ambient	Ambient+3C	-.750*	.357	.042	-1.473
	Ambient+3C	Ambient	.750*	.357	.042	.027
Geraniumsylvaticum	Ambient	Ambient+3C	-.868	.533	.112	-1.949
	Ambient+3C	Ambient	.868	.533	.112	-.213
Knautiaarvensis	Ambient	Ambient+3C	-2.483*	.958	.014	-4.427
	Ambient+3C	Ambient	2.483*	.958	.014	.540
Origanumvulgare	Ambient	Ambient+3C	-1.347*	.519	.014	-2.399
	Ambient+3C	Ambient	1.347*	.519	.014	.294
Phyteumaspicatumvarca eruluem	Ambient	Ambient+3C	-.104	.263	.694	-.637
	Ambient+3C	Ambient	.104	.263	.694	-.429
Primulaveris	Ambient	Ambient+3C	-1.417*	.384	.001	-2.196
	Ambient+3C	Ambient	1.417*	.384	.001	.637
Prunellavulgaris	Ambient	Ambient+3C	-4.873*	1.060	.000	-7.024
	Ambient+3C	Ambient	4.873*	1.060	.000	2.723
Salviapratense	Ambient	Ambient+3C	-5.619*	.904	.000	-7.453
	Ambient+3C	Ambient	5.619*	.904	.000	3.786
Scabiosacaucasica	Ambient	Ambient+3C	-.473	.922	.612	-2.343
	Ambient+3C	Ambient	.473	.922	.612	-1.398

Estimates

Dependent Variable	Year	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
Arnicamontana	Year 1	14.985	1.378	12.189	17.781
	Year 2	24.379	1.378	21.583	27.174
Bupthalmumsalicifolium	Year 1	16.425	.304	15.807	17.042
	Year 2	24.193	.304	23.575	24.810
Centaureamontana	Year 1	63.785	.836	62.089	65.481
	Year 2	87.345	.836	85.649	89.041
Galiumverum	Year 1	22.125	.252	21.614	22.636
	Year 2	31.175	.252	30.664	31.686
Geraniumsylvaticum	Year 1	16.024	.377	15.260	16.789
	Year 2	23.508	.377	22.743	24.272
Knautiaarvensis	Year 1	30.525	.678	29.151	31.899
	Year 2	44.083	.678	42.709	45.458
Origanumvulgare	Year 1	14.154	.367	13.409	14.898
	Year 2	22.303	.367	21.559	23.047
Phyteumaspicatumvarca eruluem	Year 1	12.650	.186	12.273	13.026
	Year 2	18.641	.186	18.264	19.018
Primulaveris	Year 1	14.037	.272	13.485	14.588
	Year 2	20.162	.272	19.610	20.713
Prunellavulgaris	Year 1	43.390	.750	41.870	44.910
	Year 2	62.798	.750	61.278	64.319
Salviapratense	Year 1	41.544	.639	40.247	42.840
	Year 2	59.494	.639	58.197	60.790
Scabiosacaucasica	Year 1	36.955	.652	35.633	38.278
	Year 2	51.580	.652	50.258	52.903

Pairwise Comparisons

Dependent Variable	(I) Year	(J) Year	Mean Difference (I-J)	Std. Error	Sig.[b]	95% Confidence Interval for Difference[b]	
						Lower Bound	Upper Bound
Arnicamontana	Year 1	Year 2	-9.394*	1.949	.000	-13.347	-5.440
	Year 2	Year 1	9.394*	1.949	.000	5.440	13.347
Bupthalmumsalicifolium	Year 1	Year 2	-7.768*	.431	.000	-8.642	-6.895
	Year 2	Year 1	7.768*	.431	.000	6.895	8.642
Centaureamontana	Year 1	Year 2	-23.560*	1.182	.000	-25.958	-21.162
	Year 2	Year 1	23.560*	1.182	.000	21.162	25.958
Galiumverum	Year 1	Year 2	-9.050*	.357	.000	-9.773	-8.327
	Year 2	Year 1	9.050*	.357	.000	8.327	9.773
Geraniumsylvaticum	Year 1	Year 2	-7.483*	.533	.000	-8.564	-6.402
	Year 2	Year 1	7.483*	.533	.000	6.402	8.564
Knautiaarvensis	Year 1	Year 2	-13.558*	.958	.000	-15.502	-11.615
	Year 2	Year 1	13.558*	.958	.000	11.615	15.502
Origanumvulgare	Year 1	Year 2	-8.149*	.519	.000	-9.202	-7.097
	Year 2	Year 1	8.149*	.519	.000	7.097	9.202
Phyteumaspicatumvarcaeruluem	Year 1	Year 2	-5.992*	.263	.000	-6.525	-5.459
	Year 2	Year 1	5.992*	.263	.000	5.459	6.525
Primulaveris	Year 1	Year 2	-6.125*	.384	.000	-6.905	-5.345
	Year 2	Year 1	6.125*	.384	.000	5.345	6.905
Prunellavulgaris	Year 1	Year 2	-19.408*	1.060	.000	-21.559	-17.258
	Year 2	Year 1	19.408*	1.060	.000	17.258	21.559
Salviapratense	Year 1	Year 2	-17.950*	.904	.000	-19.783	-16.117
	Year 2	Year 1	17.950*	.904	.000	16.117	19.783
Scabiosacaucasica	Year 1	Year 2	-14.625*	.922	.000	-16.496	-12.754
	Year 2	Year 1	14.625*	.922	.000	12.754	16.496

Based on estimated marginal means

*. The mean difference is significant at the

b. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

Estimates

Dependent Variable	Temperature	WaterRegime	Mean	Std. Error	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
Arnicamontana	Ambient	Ambient-50%	17.705	2.387	12.863	22.547
		Ambient	17.133	2.387	12.291	21.974
		Ambient+50%	22.151	2.387	17.309	26.993
	Ambient+3C	Ambient-50%	14.008	2.387	9.166	18.849
		Ambient	22.528	2.387	17.686	27.369
		Ambient+50%	24.568	2.387	19.726	29.410
Bupthalmumsalicifolium	Ambient	Ambient-50%	16.535	.527	15.465	17.605
		Ambient	18.430	.527	17.360	19.500
		Ambient+50%	23.690	.527	22.620	24.760
	Ambient+3C	Ambient-50%	13.355	.527	12.285	14.425
		Ambient	21.025	.527	19.955	22.095
		Ambient+50%	28.818	.527	27.748	29.887
Centaureamontana	Ambient	Ambient-50%	61.583	1.448	58.646	64.519
		Ambient	67.053	1.448	64.116	69.989
		Ambient+50%	87.020	1.448	84.083	89.957
	Ambient+3C	Ambient-50%	48.320	1.448	45.383	51.257
		Ambient	80.658	1.448	77.721	83.594
		Ambient+50%	108.757	1.448	105.821	111.694
Galiumverum	Ambient	Ambient-50%	23.650	.437	22.764	24.536
		Ambient	25.900	.437	25.014	26.786
		Ambient+50%	29.275	.437	28.389	30.161
	Ambient+3C	Ambient-50%	20.100	.437	19.214	20.986
		Ambient	26.825	.437	25.939	27.711
		Ambient+50%	34.150	.437	33.264	35.036
Geraniumsylvaticum	Ambient	Ambient-50%	16.708	.653	15.384	18.031
		Ambient	19.953	.653	18.629	21.276
		Ambient+50%	21.335	.653	20.011	22.659
	Ambient+3C	Ambient-50%	13.163	.653	11.839	14.486
		Ambient	19.283	.653	17.959	20.606
		Ambient+50%	28.155	.653	26.831	29.479
Knautiaarvensis	Ambient	Ambient-50%	26.870	1.174	24.489	29.251
		Ambient	36.195	1.174	33.814	38.576
		Ambient+50%	45.123	1.174	42.742	47.503
	Ambient+3C	Ambient-50%	22.360	1.174	19.979	24.741
		Ambient	40.205	1.174	37.824	42.586
		Ambient+50%	53.073	1.174	50.692	55.453
Origanumvulgare	Ambient	Ambient-50%	13.943	.636	12.653	15.232
		Ambient	16.183	.636	14.893	17.472
		Ambient+50%	22.540	.636	21.251	23.829
	Ambient+3C	Ambient-50%	8.608	.636	7.318	9.897
		Ambient	19.520	.636	18.231	20.809
		Ambient+50%	28.578	.636	27.288	29.867
Phyteumaspicatumvarcaeruluem	Ambient	Ambient-50%	13.090	.322	12.437	13.743
		Ambient	16.748	.322	16.095	17.400
		Ambient+50%	16.943	.322	16.290	17.595
	Ambient+3C	Ambient-50%	9.143	.322	8.490	9.795
		Ambient	16.038	.322	15.385	16.690
		Ambient+50%	21.913	.322	21.260	22.565

Estimates

Dependent Variable	Temperature	Year	Mean	Std. Error	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
Arnicamontana	Ambient	Year 1	14.776	1.949	10.822	18.729
		Year 2	23.216	1.949	19.263	27.170
	Ambient+3C	Year 1	15.194	1.949	11.241	19.148
		Year 2	25.541	1.949	21.588	29.495
Bupthalmumsalicifolium	Ambient	Year 1	15.855	.431	14.982	16.728
		Year 2	23.248	.431	22.375	24.122
	Ambient+3C	Year 1	16.994	.431	16.121	17.867
		Year 2	25.138	.431	24.264	26.011
Centaureamontana	Ambient	Year 1	60.022	1.182	57.624	62.420
		Year 2	83.748	1.182	81.350	86.146
	Ambient+3C	Year 1	67.548	1.182	65.150	69.946
		Year 2	90.942	1.182	88.544	93.340
Galiumverum	Ambient	Year 1	21.750	.357	21.027	22.473
		Year 2	30.800	.357	30.077	31.523
	Ambient+3C	Year 1	22.500	.357	21.777	23.223
		Year 2	31.550	.357	30.827	32.273
Geraniumsylvaticum	Ambient	Year 1	15.757	.533	14.676	16.838
		Year 2	22.907	.533	21.826	23.988
	Ambient+3C	Year 1	16.292	.533	15.211	17.373
		Year 2	24.108	.533	23.027	25.189
Knautiaarvensis	Ambient	Year 1	29.221	.958	27.277	31.165
		Year 2	42.904	.958	40.960	44.848
	Ambient+3C	Year 1	31.829	.958	29.885	33.773
		Year 2	45.263	.958	43.319	47.206
Origanumvulgare	Ambient	Year 1	13.624	.519	12.572	14.677
		Year 2	21.486	.519	20.433	22.538
	Ambient+3C	Year 1	14.683	.519	13.631	15.736
		Year 2	23.120	.519	22.067	24.173
Phyteumaspicatumvarca eruluem	Ambient	Year 1	12.535	.263	12.002	13.068
		Year 2	18.652	.263	18.119	19.185
	Ambient+3C	Year 1	12.764	.263	12.231	13.297
		Year 2	18.631	.263	18.098	19.164
Primulaveris	Ambient	Year 1	13.433	.384	12.653	14.212
		Year 2	19.349	.384	18.569	20.129
	Ambient+3C	Year 1	14.641	.384	13.861	15.421
		Year 2	20.974	.384	20.194	21.754
Prunellavulgaris	Ambient	Year 1	40.099	1.060	37.949	42.249
		Year 2	61.216	1.060	59.066	63.366
	Ambient+3C	Year 1	46.681	1.060	44.531	48.831
		Year 2	64.381	1.060	62.231	66.531
Salviapratense	Ambient	Year 1	39.026	.904	37.192	40.859
		Year 2	56.393	.904	54.559	58.226
	Ambient+3C	Year 1	44.062	.904	42.228	45.895
		Year 2	62.595	.904	60.762	64.428
Scabiosacaucasica	Ambient	Year 1	36.573	.922	34.703	38.444
		Year 2	51.490	.922	49.619	53.361
	Ambient+3C	Year 1	37.338	.922	35.467	39.208
		Year 2	51.671	.922	49.800	53.542

Estimates

Dependent Variable	Temperature	WaterRegime	Year	Mean	Std. Error	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
Arnicamontana	Ambient	Ambient-50%	Year 1	14.240	3.376	7.392	21.088
			Year 2	21.170	3.376	14.322	28.018
		Ambient	Year 1	13.293	3.376	6.445	20.140
			Year 2	20.973	3.376	14.125	27.820
		Ambient+50%	Year 1	16.795	3.376	9.947	23.643
			Year 2	27.507	3.376	20.659	34.354
	Ambient+3C	Ambient-50%	Year 1	10.918	3.376	4.070	17.765
			Year 2	17.098	3.376	10.250	23.945
		Ambient	Year 1	20.438	3.376	13.590	27.285
			Year 2	24.618	3.376	17.770	31.465
		Ambient+50%	Year 1	14.228	3.376	7.380	21.075
			Year 2	34.909	3.376	28.062	41.757
Bupthalmumsalicifolium	Ambient	Ambient-50%	Year 1	12.630	.746	11.117	14.143
			Year 2	20.440	.746	18.927	21.953
		Ambient	Year 1	15.025	.746	13.512	16.538
			Year 2	21.835	.746	20.322	23.348
		Ambient+50%	Year 1	19.910	.746	18.397	21.423
			Year 2	27.470	.746	25.957	28.983
	Ambient+3C	Ambient-50%	Year 1	9.325	.746	7.812	10.838
			Year 2	17.385	.746	15.872	18.898
		Ambient	Year 1	16.995	.746	15.482	18.508
			Year 2	25.055	.746	23.542	26.568
		Ambient+50%	Year 1	24.663	.746	23.150	26.175
			Year 2	32.973	.746	31.460	34.485
Centaureamontana	Ambient	Ambient-50%	Year 1	49.428	2.048	45.274	53.581
			Year 2	73.738	2.048	69.584	77.891
		Ambient	Year 1	54.898	2.048	50.744	59.051
			Year 2	79.208	2.048	75.054	83.361
		Ambient+50%	Year 1	75.740	2.048	71.587	79.893
			Year 2	98.300	2.048	94.147	102.453
	Ambient+3C	Ambient-50%	Year 1	35.540	2.048	31.387	39.693
			Year 2	61.100	2.048	56.947	65.253
		Ambient	Year 1	68.878	2.048	64.724	73.031
			Year 2	92.438	2.048	88.284	96.591
		Ambient+50%	Year 1	98.228	2.048	94.074	102.381
			Year 2	119.287	2.048	115.134	123.441
Galiumverum	Ambient	Ambient-50%	Year 1	19.500	.618	18.247	20.753
			Year 2	27.800	.618	26.547	29.053
		Ambient	Year 1	21.125	.618	19.872	22.378
			Year 2	30.675	.618	29.422	31.928
		Ambient+50%	Year 1	24.625	.618	23.372	25.878
			Year 2	33.925	.618	32.672	35.178
	Ambient+3C	Ambient-50%	Year 1	16.325	.618	15.072	17.578
			Year 2	23.875	.618	22.622	25.128
		Ambient	Year 1	22.800	.618	21.547	24.053
			Year 2	30.850	.618	29.597	32.103
		Ambient+50%	Year 1	28.375	.618	27.122	29.628
			Year 2	39.925	.618	38.672	41.178
Geraniumsylvaticum	Ambient	Ambient-50%	Year 1	13.383	.923	11.510	15.255
			Year 2	20.033	.923	18.160	21.905

Pairwise Comparisons

Dependent Variable	(I) WaterRegime	(J) WaterRegime	Mean Difference (I-J)	Std. Error	Sig.[b]	95% Confidence ...[b] Lower Bound
Arnicamontana	Ambient-50%	Ambient	-3.974	2.387	.282	-9.952
		Ambient+50%	-7.503*	2.387	.010	-13.481
	Ambient	Ambient-50%	3.974	2.387	.282	-2.004
		Ambient+50%	-3.530	2.387	.382	-9.508
	Ambient+50%	Ambient-50%	7.503*	2.387	.010	1.525
		Ambient	3.530	2.387	.382	-2.448
Bupthalmumsalicifolium	Ambient-50%	Ambient	-4.783*	.527	.000	-6.103
		Ambient+50%	-11.309*	.527	.000	-12.629
	Ambient	Ambient-50%	4.783*	.527	.000	3.462
		Ambient+50%	-6.526*	.527	.000	-7.847
	Ambient+50%	Ambient-50%	11.309*	.527	.000	9.988
		Ambient	6.526*	.527	.000	5.206
Centaureamontana	Ambient-50%	Ambient	-18.904*	1.448	.000	-22.530
		Ambient+50%	-42.938*	1.448	.000	-46.563
	Ambient	Ambient-50%	18.904*	1.448	.000	15.278
		Ambient+50%	-24.034*	1.448	.000	-27.660
	Ambient+50%	Ambient-50%	42.938*	1.448	.000	39.312
		Ambient	24.034*	1.448	.000	20.408
Galiumverum	Ambient-50%	Ambient	-4.488*	.437	.000	-5.581
		Ambient+50%	-9.838*	.437	.000	-10.931
	Ambient	Ambient-50%	4.488*	.437	.000	3.394
		Ambient+50%	-5.350*	.437	.000	-6.444
	Ambient+50%	Ambient-50%	9.838*	.437	.000	8.744
		Ambient	5.350*	.437	.000	4.256
Geraniumsylvaticum	Ambient-50%	Ambient	-4.683*	.653	.000	-6.317
		Ambient+50%	-9.810*	.653	.000	-11.445
	Ambient	Ambient-50%	4.683*	.653	.000	3.048
		Ambient+50%	-5.128*	.653	.000	-6.762
	Ambient+50%	Ambient-50%	9.810*	.653	.000	8.175
		Ambient	5.128*	.653	.000	3.493
Knautiaarvensis	Ambient-50%	Ambient	-13.585*	1.174	.000	-16.524
		Ambient+50%	-24.483*	1.174	.000	-27.422
	Ambient	Ambient-50%	13.585*	1.174	.000	10.646
		Ambient+50%	-10.898*	1.174	.000	-13.837
	Ambient+50%	Ambient-50%	24.483*	1.174	.000	21.543
		Ambient	10.898*	1.174	.000	7.958
Origanumvulgare	Ambient-50%	Ambient	-6.576*	.636	.000	-8.168
		Ambient+50%	-14.284*	.636	.000	-15.875
	Ambient	Ambient-50%	6.576*	.636	.000	4.985
		Ambient+50%	-7.708*	.636	.000	-9.299
	Ambient+50%	Ambient-50%	14.284*	.636	.000	12.692
		Ambient	7.708*	.636	.000	6.116
Phyteumaspicatumvarcaeruluem	Ambient-50%	Ambient	-5.276*	.322	.000	-6.082
		Ambient+50%	-8.311*	.322	.000	-9.117
	Ambient	Ambient-50%	5.276*	.322	.000	4.470
		Ambient+50%	-3.035*	.322	.000	-3.841
	Ambient+50%	Ambient-50%	8.311*	.322	.000	7.505
		Ambient	3.035*	.322	.000	2.229

Pairwise Comparisons

Dependent Variable	Temperature	WaterRegime	(I) Year	(J) Year	Mean Difference (I-J)	Std. Error	Sig.[b]
Arnicamontana	Ambient	Ambient-50%	Year 1	Year 2	-6.930	4.775	.155
			Year 2	Year 1	6.930	4.775	.155
		Ambient	Year 1	Year 2	-7.680	4.775	.116
			Year 2	Year 1	7.680	4.775	.116
		Ambient+50%	Year 1	Year 2	-10.712*	4.775	.031
			Year 2	Year 1	10.712*	4.775	.031
	Ambient+3C	Ambient-50%	Year 1	Year 2	-6.180	4.775	.204
			Year 2	Year 1	6.180	4.775	.204
		Ambient	Year 1	Year 2	-4.180	4.775	.387
			Year 2	Year 1	4.180	4.775	.387
		Ambient+50%	Year 1	Year 2	-20.682*	4.775	.000
			Year 2	Year 1	20.682*	4.775	.000
Bupthalmumsalicifolium	Ambient	Ambient-50%	Year 1	Year 2	-7.810*	1.055	.000
			Year 2	Year 1	7.810*	1.055	.000
		Ambient	Year 1	Year 2	-6.810*	1.055	.000
			Year 2	Year 1	6.810*	1.055	.000
		Ambient+50%	Year 1	Year 2	-7.560*	1.055	.000
			Year 2	Year 1	7.560*	1.055	.000
	Ambient+3C	Ambient-50%	Year 1	Year 2	-8.060*	1.055	.000
			Year 2	Year 1	8.060*	1.055	.000
		Ambient	Year 1	Year 2	-8.060*	1.055	.000
			Year 2	Year 1	8.060*	1.055	.000
		Ambient+50%	Year 1	Year 2	-8.310*	1.055	.000
			Year 2	Year 1	8.310*	1.055	.000
Centaureamontana	Ambient	Ambient-50%	Year 1	Year 2	-24.310*	2.896	.000
			Year 2	Year 1	24.310*	2.896	.000
		Ambient	Year 1	Year 2	-24.310*	2.896	.000
			Year 2	Year 1	24.310*	2.896	.000
		Ambient+50%	Year 1	Year 2	-22.560*	2.896	.000
			Year 2	Year 1	22.560*	2.896	.000
	Ambient+3C	Ambient-50%	Year 1	Year 2	-25.560*	2.896	.000
			Year 2	Year 1	25.560*	2.896	.000
		Ambient	Year 1	Year 2	-23.560*	2.896	.000
			Year 2	Year 1	23.560*	2.896	.000
		Ambient+50%	Year 1	Year 2	-21.060*	2.896	.000
			Year 2	Year 1	21.060*	2.896	.000
Galiumverum	Ambient	Ambient-50%	Year 1	Year 2	-8.300*	.873	.000
			Year 2	Year 1	8.300*	.873	.000
		Ambient	Year 1	Year 2	-9.550*	.873	.000
			Year 2	Year 1	9.550*	.873	.000
		Ambient+50%	Year 1	Year 2	-9.300*	.873	.000
			Year 2	Year 1	9.300*	.873	.000
	Ambient+3C	Ambient-50%	Year 1	Year 2	-7.550*	.873	.000
			Year 2	Year 1	7.550*	.873	.000
		Ambient	Year 1	Year 2	-8.050*	.873	.000
			Year 2	Year 1	8.050*	.873	.000
		Ambient+50%	Year 1	Year 2	-11.550*	.873	.000
			Year 2	Year 1	11.550*	.873	.000
Geraniumsylvaticum	Ambient	Ambient-50%	Year 1	Year 2	-6.650*	1.306	.000

Pairwise Comparisons

Dependent Variable	(I) Temperature	(J) Temperature	Mean Difference (I-J)	Std. Error	Sig.[b]	95% Confidence ...[b] Lower Bound
Arnicamontana	Ambient	Ambient+3C	-1.372	1.949	.486	-5.325
	Ambient+3C	Ambient	1.372	1.949	.486	-2.582
Bupthalmumsalicifolium	Ambient	Ambient+3C	-1.514*	.431	.001	-2.387
	Ambient+3C	Ambient	1.514*	.431	.001	.641
Centaureamontana	Ambient	Ambient+3C	-7.360*	1.182	.000	-9.758
	Ambient+3C	Ambient	7.360*	1.182	.000	4.962
Galiumverum	Ambient	Ambient+3C	-.750*	.357	.042	-1.473
	Ambient+3C	Ambient	.750*	.357	.042	.027
Geraniumsylvaticum	Ambient	Ambient+3C	-.868	.533	.112	-1.949
	Ambient+3C	Ambient	.868	.533	.112	-.213
Knautiaarvensis	Ambient	Ambient+3C	-2.483*	.958	.014	-4.427
	Ambient+3C	Ambient	2.483*	.958	.014	.540
Origanumvulgare	Ambient	Ambient+3C	-1.347*	.519	.014	-2.399
	Ambient+3C	Ambient	1.347*	.519	.014	.294
Phyteumaspicatumvarcaeruluem	Ambient	Ambient+3C	-.104	.263	.694	-.637
	Ambient+3C	Ambient	.104	.263	.694	-.429
Primulaveris	Ambient	Ambient+3C	-1.417*	.384	.001	-2.196
	Ambient+3C	Ambient	1.417*	.384	.001	.637
Prunellavulgaris	Ambient	Ambient+3C	-4.873*	1.060	.000	-7.024
	Ambient+3C	Ambient	4.873*	1.060	.000	2.723
Salviapratense	Ambient	Ambient+3C	-5.619*	.904	.000	-7.453
	Ambient+3C	Ambient	5.619*	.904	.000	3.786
Scabiosacaucasica	Ambient	Ambient+3C	-.473	.922	.612	-2.343
	Ambient+3C	Ambient	.473	.922	.612	-1.398

3 termediate fitted species

Multivariate Tests[a]

Effect		Value	F	Hypothesis df	Error df	Sig.
Intercept	Pillai's Trace	1.000	6184.160[b]	12.000	23.000	.000
	Wilks' Lambda	.000	6184.160[b]	12.000	23.000	.000
	Hotelling's Trace	3226.518	6184.160[b]	12.000	23.000	.000
	Roy's Largest Root	3226.518	6184.160[b]	12.000	23.000	.000
WaterRegime	Pillai's Trace	1.894	35.711	24.000	48.000	.000
	Wilks' Lambda	.000	97.767[b]	24.000	46.000	.000
	Hotelling's Trace	284.906	261.164	24.000	44.000	.000
	Roy's Largest Root	276.146	552.292[c]	12.000	24.000	.000
Temperature	Pillai's Trace	.975	73.614[b]	12.000	23.000	.000
	Wilks' Lambda	.025	73.614[b]	12.000	23.000	.000
	Hotelling's Trace	38.407	73.614[b]	12.000	23.000	.000
	Roy's Largest Root	38.407	73.614[b]	12.000	23.000	.000
Year	Pillai's Trace	.991	216.864[b]	12.000	23.000	.000
	Wilks' Lambda	.009	216.864[b]	12.000	23.000	.000
	Hotelling's Trace	113.147	216.864[b]	12.000	23.000	.000
	Roy's Largest Root	113.147	216.864[b]	12.000	23.000	.000
WaterRegime * Temperature	Pillai's Trace	1.865	27.530	24.000	48.000	.000
	Wilks' Lambda	.002	47.042[b]	24.000	46.000	.000
	Hotelling's Trace	86.380	79.182	24.000	44.000	.000
	Roy's Largest Root	79.250	158.499[c]	12.000	24.000	.000
Temperature * Year	Pillai's Trace	.858	11.600[b]	12.000	23.000	.000
	Wilks' Lambda	.142	11.600[b]	12.000	23.000	.000
	Hotelling's Trace	6.052	11.600[b]	12.000	23.000	.000
	Roy's Largest Root	6.052	11.600[b]	12.000	23.000	.000
WaterRegime * Year	Pillai's Trace	1.602	8.045	24.000	48.000	.000
	Wilks' Lambda	.027	9.759[b]	24.000	46.000	.000
	Hotelling's Trace	12.777	11.712	24.000	44.000	.000
	Roy's Largest Root	10.570	21.139[c]	12.000	24.000	.000
WaterRegime * Temperature * Year	Pillai's Trace	1.601	8.020	24.000	48.000	.000
	Wilks' Lambda	.022	11.005[b]	24.000	46.000	.000
	Hotelling's Trace	16.144	14.799	24.000	44.000	.000
	Roy's Largest Root	14.142	28.285[c]	12.000	24.000	.000

Estimates

Dependent Variable	WaterRegime	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
Asphodelinelutea	Ambient-50%	9.482	.403	8.664	10.300
	Ambient	14.180	.387	13.394	14.966
	Ambient+50%	25.515	.403	24.697	26.333
Centaureatriumfetii	Ambient-50%	38.308	1.417	35.429	41.187
	Ambient	72.823	1.361	70.056	75.589
	Ambient+50%	102.165	1.417	99.285	105.044
Centuareaorientalis	Ambient-50%	27.660	1.529	24.553	30.766
	Ambient	42.813	1.469	39.828	45.797
	Ambient+50%	70.013	1.529	66.906	73.119
Dianthuscarthusianorum	Ambient-50%	22.682	.616	21.431	23.933
	Ambient	36.209	.592	35.007	37.411
	Ambient+50%	44.820	.616	43.568	46.071
Euphorbianicaensis	Ambient-50%	14.214	.647	12.899	15.530
	Ambient	24.266	.622	23.002	25.530
	Ambient+50%	29.990	.647	28.675	31.306
Hedysarumhedysaroide s	Ambient-50%	29.439	1.156	27.088	31.789
	Ambient	63.044	1.111	60.786	65.302
	Ambient+50%	83.410	1.156	81.059	85.760
LinumflavumCompactum	Ambient-50%	26.136	.577	24.964	27.308
	Ambient	44.741	.554	43.616	45.867
	Ambient+50%	52.082	.577	50.910	53.254
Linumnarbonennse	Ambient-50%	10.535	.479	9.563	11.508
	Ambient	19.550	.460	18.615	20.485
	Ambient+50%	27.226	.479	26.253	28.199
Lychniscoronaria	Ambient-50%	25.085	.605	23.855	26.315
	Ambient	45.513	.581	44.331	46.694
	Ambient+50%	66.085	.605	64.855	67.315
Lychnisflosjovis	Ambient-50%	21.338	.618	20.082	22.594
	Ambient	44.646	.594	43.440	45.853
	Ambient+50%	57.036	.618	55.780	58.292
Paradisealiliastrum	Ambient-50%	17.095	.470	16.140	18.051
	Ambient	31.329	.452	30.411	32.247
	Ambient+50%	40.335	.470	39.380	41.291
Salvianemorosa	Ambient-50%	28.471	.529	27.395	29.547
	Ambient	42.895	.509	41.861	43.929
	Ambient+50%	52.796	.529	51.720	53.872

Pairwise Comparisons

Dependent Variable	(I) WaterRegime	(J) WaterRegime	Mean Difference (I-J)	Std. Error	Sig.[b]	95% Confidence ...[b] Lower Bound
Asphodelinelutea	Ambient-50%	Ambient	-4.698*	.558	.000	-5.833
		Ambient+50%	-16.033*	.569	.000	-17.190
	Ambient	Ambient-50%	4.698*	.558	.000	3.563
		Ambient+50%	-11.335*	.558	.000	-12.470
	Ambient+50%	Ambient-50%	16.033*	.569	.000	14.876
		Ambient	11.335*	.558	.000	10.200
Centaureatriumfetii	Ambient-50%	Ambient	-34.515*	1.965	.000	-38.508
		Ambient+50%	-63.857*	2.004	.000	-67.929
	Ambient	Ambient-50%	34.515*	1.965	.000	30.522
		Ambient+50%	-29.342*	1.965	.000	-33.335
	Ambient+50%	Ambient-50%	63.857*	2.004	.000	59.785
		Ambient	29.342*	1.965	.000	25.349
Centuareaorientalis	Ambient-50%	Ambient	-15.153*	2.120	.000	-19.461
		Ambient+50%	-42.353*	2.162	.000	-46.746
	Ambient	Ambient-50%	15.153*	2.120	.000	10.845
		Ambient+50%	-27.200*	2.120	.000	-31.508
	Ambient+50%	Ambient-50%	42.353*	2.162	.000	37.959
		Ambient	27.200*	2.120	.000	22.892
Dianthuscarthusianorum	Ambient-50%	Ambient	-13.527*	.854	.000	-15.262
		Ambient+50%	-22.138*	.871	.000	-23.907
	Ambient	Ambient-50%	13.527*	.854	.000	11.792
		Ambient+50%	-8.611*	.854	.000	-10.346
	Ambient+50%	Ambient-50%	22.138*	.871	.000	20.368
		Ambient	8.611*	.854	.000	6.876
Euphorbianicaensis	Ambient-50%	Ambient	-10.052*	.898	.000	-11.876
		Ambient+50%	-15.776*	.915	.000	-17.636
	Ambient	Ambient-50%	10.052*	.898	.000	8.228
		Ambient+50%	-5.724*	.898	.000	-7.548
	Ambient+50%	Ambient-50%	15.776*	.915	.000	13.916
		Ambient	5.724*	.898	.000	3.900
Hedysarumhedysaroides	Ambient-50%	Ambient	-33.605*	1.604	.000	-36.864
		Ambient+50%	-53.971*	1.635	.000	-57.295
	Ambient	Ambient-50%	33.605*	1.604	.000	30.346
		Ambient+50%	-20.366*	1.604	.000	-23.625
	Ambient+50%	Ambient-50%	53.971*	1.635	.000	50.647
		Ambient	20.366*	1.604	.000	17.107
LinumflavumCompactum	Ambient-50%	Ambient	-18.605*	.800	.000	-20.230
		Ambient+50%	-25.946*	.815	.000	-27.603
	Ambient	Ambient-50%	18.605*	.800	.000	16.980
		Ambient+50%	-7.341*	.800	.000	-8.965
	Ambient+50%	Ambient-50%	25.946*	.815	.000	24.289
		Ambient	7.341*	.800	.000	5.716
Linumnarbonennse	Ambient-50%	Ambient	-9.015*	.664	.000	-10.364
		Ambient+50%	-16.691*	.677	.000	-18.066
	Ambient	Ambient-50%	9.015*	.664	.000	7.666
		Ambient+50%	-7.676*	.664	.000	-9.025
	Ambient+50%	Ambient-50%	16.691*	.677	.000	15.315
		Ambient	7.676*	.664	.000	6.327

Estimates

Dependent Variable	Temperature	Mean	Std. Error	95% Confidence Interval Lower Bound	Upper Bound
Asphodelinelutea	Ambient	12.903	.324	12.244	13.563
	Ambient+3C	19.881	.324	19.222	20.541
Centaureatriumfetii	Ambient	65.139	1.142	62.818	67.460
	Ambient+3C	77.058	1.142	74.737	79.378
Centuareaorientalis	Ambient	38.021	1.232	35.517	40.525
	Ambient+3C	55.636	1.232	53.132	58.139
Dianthuscarthusianorum	Ambient	30.782	.496	29.774	31.791
	Ambient+3C	38.358	.496	37.350	39.366
Euphorbianicaensis	Ambient	20.069	.522	19.008	21.129
	Ambient+3C	25.579	.522	24.519	26.639
Hedysarumhedysaroides	Ambient	49.705	.932	47.811	51.599
	Ambient+3C	67.557	.932	65.662	69.451
LinumflavumCompactum	Ambient	36.390	.465	35.445	37.334
	Ambient+3C	45.583	.465	44.639	46.528
Linumnarbonennse	Ambient	17.117	.386	16.333	17.901
	Ambient+3C	21.090	.386	20.306	21.874
Lychniscoronaria	Ambient	42.717	.488	41.726	43.709
	Ambient+3C	48.404	.488	47.413	49.395
Lychnisflosjovis	Ambient	34.710	.498	33.698	35.722
	Ambient+3C	47.304	.498	46.292	48.316
Paradisealiliastrum	Ambient	25.804	.379	25.034	26.574
	Ambient+3C	33.369	.379	32.599	34.139
Salvianemorosa	Ambient	37.447	.427	36.580	38.314
	Ambient+3C	45.328	.427	44.460	46.195

Estimates

Dependent Variable	Year	Mean	Std. Error	95% Confidence Interval Lower Bound	Upper Bound
Asphodelinelutea	Year 1	12.491	.316	11.849	13.133
	Year 2	20.294	.333	19.617	20.970
Centaureatriumfetii	Year 1	60.535	1.111	58.276	62.794
	Year 2	81.662	1.172	79.281	84.043
Centuareaorientalis	Year 1	38.785	1.199	36.348	41.222
	Year 2	54.871	1.264	52.302	57.440
Dianthuscarthusianorum	Year 1	28.428	.483	27.446	29.409
	Year 2	40.712	.509	39.678	41.747
Euphorbianicaensis	Year 1	17.828	.508	16.796	18.859
	Year 2	27.820	.535	26.732	28.908
Hedysarumhedysaroides	Year 1	48.885	.907	47.041	50.729
	Year 2	68.376	.956	66.433	70.320
LinumflavumCompactum	Year 1	33.795	.452	32.876	34.714
	Year 2	48.178	.477	47.209	49.147
Linumnarbonennse	Year 1	14.985	.375	14.222	15.748
	Year 2	23.222	.396	22.418	24.026
Lychniscoronaria	Year 1	36.824	.475	35.859	37.788
	Year 2	54.298	.500	53.281	55.315
Lychnisflosjovis	Year 1	33.692	.485	32.707	34.677
	Year 2	48.322	.511	47.283	49.360
Paradisealiliastrum	Year 1	23.808	.369	23.059	24.558
	Year 2	35.365	.389	34.574	36.155
Salvianemorosa	Year 1	33.628	.415	32.784	34.472
	Year 2	49.146	.438	48.257	50.036

Pairwise Comparisons

Dependent Variable	(I) Temperature	(J) Temperature	Mean Difference (I-J)	Std. Error	Sig.[b]	95% Confidence ...[b] Lower Bound
Asphodelinelutea	Ambient	Ambient+3C	-6.978*	.459	.000	-7.911
	Ambient+3C	Ambient	6.978*	.459	.000	6.045
Centaureatriumfetii	Ambient	Ambient+3C	-11.919*	1.615	.000	-15.201
	Ambient+3C	Ambient	11.919*	1.615	.000	8.637
Centuareaorientalis	Ambient	Ambient+3C	-17.615*	1.742	.000	-21.156
	Ambient+3C	Ambient	17.615*	1.742	.000	14.074
Dianthuscarthusianorum	Ambient	Ambient+3C	-7.576*	.702	.000	-9.002
	Ambient+3C	Ambient	7.576*	.702	.000	6.150
Euphorbianicaensis	Ambient	Ambient+3C	-5.510*	.738	.000	-7.009
	Ambient+3C	Ambient	5.510*	.738	.000	4.011
Hedysarumhedysaroides	Ambient	Ambient+3C	-17.852*	1.318	.000	-20.530
	Ambient+3C	Ambient	17.852*	1.318	.000	15.173
LinumflavumCompactum	Ambient	Ambient+3C	-9.194*	.657	.000	-10.529
	Ambient+3C	Ambient	9.194*	.657	.000	7.858
Linumnarbonennse	Ambient	Ambient+3C	-3.973*	.546	.000	-5.081
	Ambient+3C	Ambient	3.973*	.546	.000	2.864
Lychniscoronaria	Ambient	Ambient+3C	-5.687*	.690	.000	-7.089
	Ambient+3C	Ambient	5.687*	.690	.000	4.285
Lychnisflosjovis	Ambient	Ambient+3C	-12.594*	.704	.000	-14.025
	Ambient+3C	Ambient	12.594*	.704	.000	11.162
Paradisealiliastrum	Ambient	Ambient+3C	-7.566*	.536	.000	-8.655
	Ambient+3C	Ambient	7.566*	.536	.000	6.477
Salvianemorosa	Ambient	Ambient+3C	-7.881*	.603	.000	-9.107
	Ambient+3C	Ambient	7.881*	.603	.000	6.654

Pairwise Comparisons

Dependent Variable	(I) Year	(J) Year	Mean Difference (I-J)	Std. Error	Sig.[b]	95% Confidence Interval for Difference[b]	
						Lower Bound	Upper Bound
Asphodelinelutea	Year 1	Year 2	-7.803*	.459	.000	-8.736	-6.870
	Year 2	Year 1	7.803*	.459	.000	6.870	8.736
Centaureatriumfetii	Year 1	Year 2	-21.127*	1.615	.000	-24.409	-17.845
	Year 2	Year 1	21.127*	1.615	.000	17.845	24.409
Centuareaorientalis	Year 1	Year 2	-16.086*	1.742	.000	-19.626	-12.545
	Year 2	Year 1	16.086*	1.742	.000	12.545	19.626
Dianthuscarthusianorum	Year 1	Year 2	-12.284*	.702	.000	-13.710	-10.858
	Year 2	Year 1	12.284*	.702	.000	10.858	13.710
Euphorbianicaensis	Year 1	Year 2	-9.992*	.738	.000	-11.492	-8.493
	Year 2	Year 1	9.992*	.738	.000	8.493	11.492
Hedysarumhedysaroides	Year 1	Year 2	-19.491*	1.318	.000	-22.170	-16.813
	Year 2	Year 1	19.491*	1.318	.000	16.813	22.170
LinumflavumCompactum	Year 1	Year 2	-14.383*	.657	.000	-15.718	-13.047
	Year 2	Year 1	14.383*	.657	.000	13.047	15.718
Linumnarbonennse	Year 1	Year 2	-8.237*	.546	.000	-9.345	-7.128
	Year 2	Year 1	8.237*	.546	.000	7.128	9.345
Lychniscoronaria	Year 1	Year 2	-17.474*	.690	.000	-18.876	-16.072
	Year 2	Year 1	17.474*	.690	.000	16.072	18.876
Lychnisflosjovis	Year 1	Year 2	-14.629*	.704	.000	-16.061	-13.198
	Year 2	Year 1	14.629*	.704	.000	13.198	16.061
Paradisealiliastrum	Year 1	Year 2	-11.556*	.536	.000	-12.645	-10.467
	Year 2	Year 1	11.556*	.536	.000	10.467	12.645
Salvianemorosa	Year 1	Year 2	-15.518*	.603	.000	-16.745	-14.292
	Year 2	Year 1	15.518*	.603	.000	14.292	16.745

Based on estimated marginal means

*. The mean difference is significant at the

b. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

Estimates

Dependent Variable	Temperature	WaterRegime	Mean	Std. Error	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
Asphodelinelutea	Ambient	Ambient-50%	10.830	.547	9.718	11.942
		Ambient	12.225	.547	11.113	13.337
		Ambient+50%	15.655	.591	14.454	16.856
	Ambient+3C	Ambient-50%	8.134	.591	6.933	9.335
		Ambient	16.135	.547	15.023	17.247
		Ambient+50%	35.375	.547	34.263	36.487
Centaureatriumfetii	Ambient	Ambient-50%	42.428	1.925	38.515	46.340
		Ambient	62.958	1.925	59.045	66.870
		Ambient+50%	90.032	2.079	85.806	94.257
	Ambient+3C	Ambient-50%	34.188	2.079	29.963	38.414
		Ambient	82.688	1.925	78.775	86.600
		Ambient+50%	114.298	1.925	110.385	118.210
Centuareaorientalis	Ambient	Ambient-50%	30.330	2.077	26.109	34.551
		Ambient	36.418	2.077	32.197	40.638
		Ambient+50%	47.315	2.243	42.756	51.874
	Ambient+3C	Ambient-50%	24.990	2.243	20.431	29.549
		Ambient	49.208	2.077	44.987	53.428
		Ambient+50%	92.710	2.077	88.489	96.931
Dianthuscarthusianorum	Ambient	Ambient-50%	26.145	.837	24.445	27.845
		Ambient	31.855	.837	30.155	33.555
		Ambient+50%	34.347	.904	32.510	36.183
	Ambient+3C	Ambient-50%	19.219	.904	17.383	21.055
		Ambient	40.563	.837	38.862	42.263
		Ambient+50%	55.293	.837	53.592	56.993
Euphorbianicaensis	Ambient	Ambient-50%	16.233	.879	14.445	18.020
		Ambient	22.160	.879	20.373	23.947
		Ambient+50%	21.813	.950	19.883	23.744
	Ambient+3C	Ambient-50%	12.196	.950	10.266	14.127
		Ambient	26.373	.879	24.585	28.160
		Ambient+50%	38.168	.879	36.380	39.955
Hedysarumhedysaroide s	Ambient	Ambient-50%	33.943	1.571	30.749	37.136
		Ambient	51.098	1.571	47.904	54.291
		Ambient+50%	64.074	1.697	60.625	67.523
	Ambient+3C	Ambient-50%	24.935	1.697	21.486	28.384
		Ambient	74.990	1.571	71.797	78.183
		Ambient+50%	102.745	1.571	99.552	105.938
LinumflavumCompactum	Ambient	Ambient-50%	27.798	.783	26.205	29.390
		Ambient	41.280	.783	39.688	42.872
		Ambient+50%	40.091	.846	38.372	41.811
	Ambient+3C	Ambient-50%	24.475	.846	22.755	26.194
		Ambient	48.203	.783	46.610	49.795
		Ambient+50%	64.073	.783	62.480	65.665
Linumnarbonennse	Ambient	Ambient-50%	12.140	.650	10.818	13.462
		Ambient	17.580	.650	16.258	18.902
		Ambient+50%	21.632	.702	20.205	23.060
	Ambient+3C	Ambient-50%	8.930	.702	7.503	10.358
		Ambient	21.520	.650	20.198	22.842
		Ambient+50%	32.820	.650	31.498	34.142

Estimates

Dependent Variable	Temperature	Year	Mean	Std. Error	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
Asphodelinelutea	Ambient	Year 1	11.338	.447	10.431	12.246
		Year 2	14.468	.471	13.512	15.425
	Ambient+3C	Year 1	13.643	.447	12.736	14.551
		Year 2	26.119	.471	25.163	27.076
Centaureatriumfetii	Ambient	Year 1	55.688	1.572	52.494	58.883
		Year 2	74.589	1.657	71.222	77.957
	Ambient+3C	Year 1	65.382	1.572	62.187	68.576
		Year 2	88.734	1.657	85.367	92.101
Centuareaorientalis	Ambient	Year 1	31.611	1.696	28.164	35.057
		Year 2	44.431	1.788	40.798	48.064
	Ambient+3C	Year 1	45.960	1.696	42.514	49.406
		Year 2	65.311	1.788	61.679	68.944
Dianthuscarthusianorum	Ambient	Year 1	25.540	.683	24.152	26.928
		Year 2	36.024	.720	34.561	37.488
	Ambient+3C	Year 1	31.316	.683	29.928	32.704
		Year 2	45.400	.720	43.937	46.863
Euphorbianicaensis	Ambient	Year 1	16.445	.718	14.986	17.904
		Year 2	23.692	.757	22.154	25.230
	Ambient+3C	Year 1	19.210	.718	17.751	20.669
		Year 2	31.948	.757	30.409	33.486
Hedysarumhedysaroide s	Ambient	Year 1	41.980	1.283	39.373	44.587
		Year 2	57.429	1.352	54.681	60.178
	Ambient+3C	Year 1	55.790	1.283	53.183	58.397
		Year 2	79.323	1.352	76.575	82.071
LinumflavumCompactum	Ambient	Year 1	30.696	.640	29.396	31.996
		Year 2	42.083	.674	40.713	43.454
	Ambient+3C	Year 1	36.894	.640	35.594	38.194
		Year 2	54.272	.674	52.902	55.642
Linumnarbonennse	Ambient	Year 1	13.673	.531	12.593	14.752
		Year 2	20.562	.560	19.425	21.700
	Ambient+3C	Year 1	16.298	.531	15.219	17.377
		Year 2	25.882	.560	24.744	27.019
Lychniscoronaria	Ambient	Year 1	34.533	.671	33.169	35.898
		Year 2	50.901	.708	49.463	52.340
	Ambient+3C	Year 1	39.114	.671	37.750	40.479
		Year 2	57.694	.708	56.256	59.132
Lychnisflosjovis	Ambient	Year 1	28.580	.686	27.187	29.973
		Year 2	40.840	.723	39.371	42.308
	Ambient+3C	Year 1	38.804	.686	37.411	40.197
		Year 2	55.803	.723	54.335	57.272
Paradisealiliastrum	Ambient	Year 1	21.327	.522	20.267	22.387
		Year 2	30.281	.550	29.163	31.398
	Ambient+3C	Year 1	26.290	.522	25.230	27.350
		Year 2	40.449	.550	39.331	41.566
Salvianemorosa	Ambient	Year 1	30.671	.587	29.477	31.865
		Year 2	44.223	.619	42.965	45.481
	Ambient+3C	Year 1	36.585	.587	35.391	37.779
		Year 2	54.070	.619	52.812	55.328

Estimates

Dependent Variable	WaterRegime	Year	Mean	Std. Error	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
Asphodelinelutea	Ambient-50%	Year 1	7.650	.547	6.538	8.762
		Year 2	11.314	.591	10.113	12.515
	Ambient	Year 1	10.588	.547	9.476	11.699
		Year 2	17.773	.547	16.661	18.884
	Ambient+50%	Year 1	19.235	.547	18.123	20.347
		Year 2	31.795	.591	30.594	32.996
Centaureatriumfetii	Ambient-50%	Year 1	34.859	1.925	30.946	38.771
		Year 2	41.757	2.079	37.531	45.983
	Ambient	Year 1	59.638	1.925	55.725	63.550
		Year 2	86.008	1.925	82.095	89.920
	Ambient+50%	Year 1	87.109	1.925	83.196	91.021
		Year 2	117.220	2.079	112.995	121.446
Centuareaorientalis	Ambient-50%	Year 1	22.919	2.077	18.698	27.140
		Year 2	32.401	2.243	27.842	36.960
	Ambient	Year 1	35.643	2.077	31.422	39.863
		Year 2	49.983	2.077	45.762	54.203
	Ambient+50%	Year 1	57.795	2.077	53.574	62.016
		Year 2	82.230	2.243	77.671	86.789
Dianthuscarthusianorum	Ambient-50%	Year 1	18.814	.837	17.114	20.514
		Year 2	26.550	.904	24.714	28.386
	Ambient	Year 1	28.476	.837	26.776	30.176
		Year 2	43.941	.837	42.241	45.641
	Ambient+50%	Year 1	37.994	.837	36.294	39.694
		Year 2	51.645	.904	49.809	53.482
Euphorbianicaensis	Ambient-50%	Year 1	11.275	.879	9.488	13.062
		Year 2	17.154	.950	15.223	19.084
	Ambient	Year 1	17.079	.879	15.291	18.866
		Year 2	31.454	.879	29.666	33.241
	Ambient+50%	Year 1	25.129	.879	23.341	26.916
		Year 2	34.852	.950	32.922	36.783
Hedysarumhedysaroides	Ambient-50%	Year 1	25.903	1.571	22.709	29.096
		Year 2	32.975	1.697	29.526	36.424
	Ambient	Year 1	50.798	1.571	47.604	53.991
		Year 2	75.290	1.571	72.097	78.483
	Ambient+50%	Year 1	69.955	1.571	66.762	73.148
		Year 2	96.864	1.697	93.415	100.313
LinumflavumCompactum	Ambient-50%	Year 1	22.860	.783	21.268	24.452
		Year 2	29.412	.846	27.692	31.132
	Ambient	Year 1	34.928	.783	33.335	36.520
		Year 2	54.555	.783	52.963	56.147
	Ambient+50%	Year 1	43.598	.783	42.005	45.190
		Year 2	60.566	.846	58.847	62.286
Linumnarbonennse	Ambient-50%	Year 1	8.654	.650	7.332	9.975
		Year 2	12.417	.702	10.989	13.844
	Ambient	Year 1	13.929	.650	12.607	15.250
		Year 2	25.171	.650	23.850	26.493
	Ambient+50%	Year 1	22.374	.650	21.052	23.695
		Year 2	32.078	.702	30.651	33.506
Lychniscoronaria	Ambient-50%	Year 1	20.919	.822	19.248	22.590
		Year 2	29.251	.888	27.446	31.056

Estimates

Dependent Variable	Temperature	WaterRegime	Year	Mean	Std. Error	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
Asphodelinelutea	Ambient	Ambient-50%	Year 1	8.205	.774	6.633	9.777
			Year 2	13.455	.774	11.883	15.027
		Ambient	Year 1	10.070	.774	8.498	11.642
			Year 2	14.380	.774	12.808	15.952
		Ambient+50%	Year 1	15.740	.774	14.168	17.312
			Year 2	15.570	.893	13.755	17.385
	Ambient+3C	Ambient-50%	Year 1	7.095	.774	5.523	8.667
			Year 2	9.173	.893	7.358	10.989
		Ambient	Year 1	11.105	.774	9.533	12.677
			Year 2	21.165	.774	19.593	22.737
		Ambient+50%	Year 1	22.730	.774	21.158	24.302
			Year 2	48.020	.774	46.448	49.592
Centaureatriumfetii	Ambient	Ambient-50%	Year 1	38.678	2.722	33.145	44.210
			Year 2	46.178	2.722	40.645	51.710
		Ambient	Year 1	50.398	2.722	44.865	55.930
			Year 2	75.518	2.722	69.985	81.050
		Ambient+50%	Year 1	77.990	2.722	72.457	83.523
			Year 2	102.073	3.144	95.685	108.462
	Ambient+3C	Ambient-50%	Year 1	31.040	2.722	25.507	36.573
			Year 2	37.337	3.144	30.948	43.725
		Ambient	Year 1	68.878	2.722	63.345	74.410
			Year 2	96.498	2.722	90.965	102.030
		Ambient+50%	Year 1	96.228	2.722	90.695	101.760
			Year 2	132.368	2.722	126.835	137.900
Centuareaorientalis	Ambient	Ambient-50%	Year 1	25.205	2.937	19.236	31.174
			Year 2	35.455	2.937	29.486	41.424
		Ambient	Year 1	28.998	2.937	23.028	34.967
			Year 2	43.838	2.937	37.868	49.807
		Ambient+50%	Year 1	40.630	2.937	34.661	46.599
			Year 2	54.000	3.392	47.107	60.893
	Ambient+3C	Ambient-50%	Year 1	20.633	2.937	14.663	26.602
			Year 2	29.347	3.392	22.454	36.239
		Ambient	Year 1	42.288	2.937	36.318	48.257
			Year 2	56.128	2.937	50.158	62.097
		Ambient+50%	Year 1	74.960	2.937	68.991	80.929
			Year 2	110.460	2.937	104.491	116.429
Dianthuscarthusianorum	Ambient	Ambient-50%	Year 1	20.520	1.183	18.116	22.924
			Year 2	31.770	1.183	29.366	34.174
		Ambient	Year 1	25.060	1.183	22.656	27.464
			Year 2	38.650	1.183	36.246	41.054
		Ambient+50%	Year 1	31.040	1.183	28.636	33.444
			Year 2	37.653	1.366	34.877	40.429
	Ambient+3C	Ambient-50%	Year 1	17.108	1.183	14.703	19.512
			Year 2	21.330	1.366	18.554	24.106
		Ambient	Year 1	31.893	1.183	29.488	34.297
			Year 2	49.233	1.183	46.828	51.637
		Ambient+50%	Year 1	44.948	1.183	42.543	47.352
			Year 2	65.638	1.183	63.233	68.042
Euphorbianicaensis	Ambient	Ambient-50%	Year 1	12.608	1.244	10.080	15.135
			Year 2	19.858	1.244	17.330	22.385

Pairwise Comparisons

Dependent Variable	Temperature	WaterRegime	(I) Year	(J) Year	Mean Difference (I-J)	Std. Error	Sig.[b]
Asphodelinelutea	Ambient	Ambient-50%	Year 1	Year 2	-5.250*	1.094	.000
			Year 2	Year 1	5.250*	1.094	.000
		Ambient	Year 1	Year 2	-4.310*	1.094	.000
			Year 2	Year 1	4.310*	1.094	.000
		Ambient+50%	Year 1	Year 2	.170	1.182	.886
			Year 2	Year 1	-.170	1.182	.886
	Ambient+3C	Ambient-50%	Year 1	Year 2	-2.078	1.182	.088
			Year 2	Year 1	2.078	1.182	.088
		Ambient	Year 1	Year 2	-10.060*	1.094	.000
			Year 2	Year 1	10.060*	1.094	.000
		Ambient+50%	Year 1	Year 2	-25.290*	1.094	.000
			Year 2	Year 1	25.290*	1.094	.000
Centaureatriumfetii	Ambient	Ambient-50%	Year 1	Year 2	-7.500	3.850	.060
			Year 2	Year 1	7.500	3.850	.060
		Ambient	Year 1	Year 2	-25.120*	3.850	.000
			Year 2	Year 1	25.120*	3.850	.000
		Ambient+50%	Year 1	Year 2	-24.083*	4.159	.000
			Year 2	Year 1	24.083*	4.159	.000
	Ambient+3C	Ambient-50%	Year 1	Year 2	-6.297	4.159	.139
			Year 2	Year 1	6.297	4.159	.139
		Ambient	Year 1	Year 2	-27.620*	3.850	.000
			Year 2	Year 1	27.620*	3.850	.000
		Ambient+50%	Year 1	Year 2	-36.140*	3.850	.000
			Year 2	Year 1	36.140*	3.850	.000
Centuareaorientalis	Ambient	Ambient-50%	Year 1	Year 2	-10.250*	4.154	.019
			Year 2	Year 1	10.250*	4.154	.019
		Ambient	Year 1	Year 2	-14.840*	4.154	.001
			Year 2	Year 1	14.840*	4.154	.001
		Ambient+50%	Year 1	Year 2	-13.370*	4.487	.005
			Year 2	Year 1	13.370*	4.487	.005
	Ambient+3C	Ambient-50%	Year 1	Year 2	-8.714	4.487	.060
			Year 2	Year 1	8.714	4.487	.060
		Ambient	Year 1	Year 2	-13.840*	4.154	.002
			Year 2	Year 1	13.840*	4.154	.002
		Ambient+50%	Year 1	Year 2	-35.500*	4.154	.000
			Year 2	Year 1	35.500*	4.154	.000
Dianthuscarthusianorum	Ambient	Ambient-50%	Year 1	Year 2	-11.250*	1.673	.000
			Year 2	Year 1	11.250*	1.673	.000
		Ambient	Year 1	Year 2	-13.590*	1.673	.000
			Year 2	Year 1	13.590*	1.673	.000
		Ambient+50%	Year 1	Year 2	-6.613*	1.807	.001
			Year 2	Year 1	6.613*	1.807	.001
	Ambient+3C	Ambient-50%	Year 1	Year 2	-4.223*	1.807	.025
			Year 2	Year 1	4.223*	1.807	.025
		Ambient	Year 1	Year 2	-17.340*	1.673	.000
			Year 2	Year 1	17.340*	1.673	.000
		Ambient+50%	Year 1	Year 2	-20.690*	1.673	.000
			Year 2	Year 1	20.690*	1.673	.000
Euphorbianicaensis	Ambient	Ambient-50%	Year 1	Year 2	-7.250*	1.759	.000

Pairwise Comparisons

Dependent Variable	Temperature	Year	(I) WaterRegime	(J) WaterRegime	Mean Difference (I-J)	Std. Error
Asphodelinelutea	Ambient	Year 1	Ambient-50%	Ambient	-1.865	1.094
				Ambient+50%	-7.535*	1.094
			Ambient	Ambient-50%	1.865	1.094
				Ambient+50%	-5.670*	1.094
			Ambient+50%	Ambient-50%	7.535*	1.094
				Ambient	5.670*	1.094
		Year 2	Ambient-50%	Ambient	-.925	1.094
				Ambient+50%	-2.115	1.182
			Ambient	Ambient-50%	.925	1.094
				Ambient+50%	-1.190	1.182
			Ambient+50%	Ambient-50%	2.115	1.182
				Ambient	1.190	1.182
	Ambient+3C	Year 1	Ambient-50%	Ambient	-4.010*	1.094
				Ambient+50%	-15.635*	1.094
			Ambient	Ambient-50%	4.010*	1.094
				Ambient+50%	-11.625*	1.094
			Ambient+50%	Ambient-50%	15.635*	1.094
				Ambient	11.625*	1.094
		Year 2	Ambient-50%	Ambient	-11.992*	1.182
				Ambient+50%	-38.847*	1.182
			Ambient	Ambient-50%	11.992*	1.182
				Ambient+50%	-26.855*	1.094
			Ambient+50%	Ambient-50%	38.847*	1.182
				Ambient	26.855*	1.094
Centaureatriumfetii	Ambient	Year 1	Ambient-50%	Ambient	-11.720*	3.850
				Ambient+50%	-39.313*	3.850
			Ambient	Ambient-50%	11.720*	3.850
				Ambient+50%	-27.593*	3.850
			Ambient+50%	Ambient-50%	39.313*	3.850
				Ambient	27.593*	3.850
		Year 2	Ambient-50%	Ambient	-29.340*	3.850
				Ambient+50%	-55.896*	4.159
			Ambient	Ambient-50%	29.340*	3.850
				Ambient+50%	-26.556*	4.159
			Ambient+50%	Ambient-50%	55.896*	4.159
				Ambient	26.556*	4.159
	Ambient+3C	Year 1	Ambient-50%	Ambient	-37.838*	3.850
				Ambient+50%	-65.188*	3.850
			Ambient	Ambient-50%	37.838*	3.850
				Ambient+50%	-27.350*	3.850
			Ambient+50%	Ambient-50%	65.188*	3.850
				Ambient	27.350*	3.850
		Year 2	Ambient-50%	Ambient	-59.161*	4.159
				Ambient+50%	-95.031*	4.159
			Ambient	Ambient-50%	59.161*	4.159
				Ambient+50%	-35.870*	3.850
			Ambient+50%	Ambient-50%	95.031*	4.159
				Ambient	35.870*	3.850

4- Poorly fitted species

Estimates

Dependent Variable	WaterRegime	Mean	Std. Error	95% Confidence Interval Lower Bound	Upper Bound
Amsoniajonesii	Ambient-50%	26.081	.309	25.454	26.708
	Ambient	13.504	.309	12.877	14.131
	Ambient+50%	1.099E-013	.309	-.627	.627
Asclepiastuberosacolora dolform	Ambient-50%	24.664	.660	23.325	26.003
	Ambient	7.173	.660	5.834	8.512
	Ambient+50%	1.022E-013	.660	-1.339	1.339
Basamorrhizasagitifolius	Ambient-50%	6.746	.157	6.428	7.064
	Ambient	.000	.157	-.318	.318
	Ambient+50%	.000	.157	-.318	.318
Centaureapulcherrimus	Ambient-50%	23.435	.279	22.869	24.001
	Ambient	18.203	.279	17.637	18.768
	Ambient+50%	1.074E-013	.279	-.566	.566
Delphiniumbarbeyi	Ambient-50%	22.425	.788	20.827	24.023
	Ambient	1.824	.788	.226	3.422
	Ambient+50%	.000	.788	-1.598	1.598
Dracocephalumgrandifl orum	Ambient-50%	19.021	.184	18.649	19.394
	Ambient	1.002E-013	.184	-.372	.372
	Ambient+50%	1.038E-013	.184	-.372	.372
Geumtriflorum	Ambient-50%	16.901	.476	15.936	17.866
	Ambient	9.598	.476	8.633	10.563
	Ambient+50%	.000	.476	-.965	.965
Hymenoxysgrandiflora	Ambient-50%	15.440	.504	14.418	16.462
	Ambient	2.391	.504	1.368	3.413
	Ambient+50%	1.021E-013	.504	-1.022	1.022
Penstemonstrictus	Ambient-50%	26.300	.528	25.230	27.370
	Ambient	16.174	.528	15.104	17.244
	Ambient+50%	7.950	.528	6.880	9.020
Salviapachyphylla	Ambient-50%	5.878	.671	4.516	7.239
	Ambient	1.166	.671	-.195	2.528
	Ambient+50%	.000	.671	-1.361	1.361
Sphaeralceacoccinea	Ambient-50%	12.473	.537	11.384	13.561
	Ambient	3.731	.537	2.642	4.820
	Ambient+50%	.966	.537	-.123	2.055
Zinniagrandiflorus	Ambient-50%	23.390	.496	22.383	24.397
	Ambient	10.662	.496	9.655	11.669
	Ambient+50%	.000	.496	-1.007	1.007

Multivariate Tests[a]

Effect		Value	F	Hypothesis df	Error df	Sig.
Intercept	Pillai's Trace	.999	1902.316[b]	12.000	25.000	.000
	Wilks' Lambda	.001	1902.316[b]	12.000	25.000	.000
	Hotelling's Trace	913.112	1902.316[b]	12.000	25.000	.000
	Roy's Largest Root	913.112	1902.316[b]	12.000	25.000	.000
WaterRegime	Pillai's Trace	1.991	456.550	24.000	52.000	.000
	Wilks' Lambda	.000	649.872[b]	24.000	50.000	.000
	Hotelling's Trace	923.115	923.115	24.000	48.000	.000
	Roy's Largest Root	802.188	1738.074[c]	12.000	26.000	.000
Temperature	Pillai's Trace	.967	60.236[b]	12.000	25.000	.000
	Wilks' Lambda	.033	60.236[b]	12.000	25.000	.000
	Hotelling's Trace	28.913	60.236[b]	12.000	25.000	.000
	Roy's Largest Root	28.913	60.236[b]	12.000	25.000	.000
Year	Pillai's Trace	.988	171.649[b]	12.000	25.000	.000
	Wilks' Lambda	.012	171.649[b]	12.000	25.000	.000
	Hotelling's Trace	82.392	171.649[b]	12.000	25.000	.000
	Roy's Largest Root	82.392	171.649[b]	12.000	25.000	.000
WaterRegime * Temperature	Pillai's Trace	1.542	7.295	24.000	52.000	.000
	Wilks' Lambda	.009	19.577[b]	24.000	50.000	.000
	Hotelling's Trace	47.503	47.503	24.000	48.000	.000
	Roy's Largest Root	46.214	100.130[c]	12.000	26.000	.000
WaterRegime * Year	Pillai's Trace	1.842	25.307	24.000	52.000	.000
	Wilks' Lambda	.001	61.702[b]	24.000	50.000	.000
	Hotelling's Trace	145.854	145.854	24.000	48.000	.000
	Roy's Largest Root	140.216	303.802[c]	12.000	26.000	.000
Temperature * Year	Pillai's Trace	.920	24.110[b]	12.000	25.000	.000
	Wilks' Lambda	.080	24.110[b]	12.000	25.000	.000
	Hotelling's Trace	11.573	24.110[b]	12.000	25.000	.000
	Roy's Largest Root	11.573	24.110[b]	12.000	25.000	.000
WaterRegime * Temperature * Year	Pillai's Trace	1.772	16.827	24.000	52.000	.000
	Wilks' Lambda	.010	18.380[b]	24.000	50.000	.000
	Hotelling's Trace	20.011	20.011	24.000	48.000	.000
	Roy's Largest Root	14.970	32.434[c]	12.000	26.000	.000

Pairwise Comparisons

Dependent Variable	(I) WaterRegime	(J) WaterRegime	Mean Difference (I-J)	Std. Error	Sig.[b]	95% Confidence[b] Lower Bound
Amsoniajonesii	Ambient-50%	Ambient	12.578*	.437	.000	11.691
		Ambient+50%	26.081*	.437	.000	25.194
	Ambient	Ambient-50%	-12.578*	.437	.000	-13.464
		Ambient+50%	13.504*	.437	.000	12.617
	Ambient+50%	Ambient-50%	-26.081*	.437	.000	-26.968
		Ambient	-13.504*	.437	.000	-14.391
Asclepiastuberosacolora dolform	Ambient-50%	Ambient	17.491*	.934	.000	15.597
		Ambient+50%	24.664*	.934	.000	22.770
	Ambient	Ambient-50%	-17.491*	.934	.000	-19.384
		Ambient+50%	7.173*	.934	.000	5.279
	Ambient+50%	Ambient-50%	-24.664*	.934	.000	-26.558
		Ambient	-7.173*	.934	.000	-9.067
Basamorrhizasagitifolius	Ambient-50%	Ambient	6.746*	.222	.000	6.297
		Ambient+50%	6.746*	.222	.000	6.297
	Ambient	Ambient-50%	-6.746*	.222	.000	-7.196
		Ambient+50%	.000	.222	1.000	-.450
	Ambient+50%	Ambient-50%	-6.746*	.222	.000	-7.196
		Ambient	.000	.222	1.000	-.450
Centaureapulcherrimus	Ambient-50%	Ambient	5.233*	.394	.000	4.433
		Ambient+50%	23.435*	.394	.000	22.635
	Ambient	Ambient-50%	-5.233*	.394	.000	-6.032
		Ambient+50%	18.203*	.394	.000	17.403
	Ambient+50%	Ambient-50%	-23.435*	.394	.000	-24.235
		Ambient	-18.203*	.394	.000	-19.002
Delphiniumbarbeyi	Ambient-50%	Ambient	20.601*	1.114	.000	18.341
		Ambient+50%	22.425*	1.114	.000	20.165
	Ambient	Ambient-50%	-20.601*	1.114	.000	-22.861
		Ambient+50%	1.824	1.114	.110	-.436
	Ambient+50%	Ambient-50%	-22.425*	1.114	.000	-24.685
		Ambient	-1.824	1.114	.110	-4.084
Dracocephalumgrandifl orum	Ambient-50%	Ambient	19.021*	.260	.000	18.495
		Ambient+50%	19.021*	.260	.000	18.495
	Ambient	Ambient-50%	-19.021*	.260	.000	-19.548
		Ambient+50%	.000	.260	1.000	-.527
	Ambient+50%	Ambient-50%	-19.021*	.260	.000	-19.548
		Ambient	1.036E-013	.260	1.000	-.527
Geumtriflorum	Ambient-50%	Ambient	7.303*	.673	.000	5.938
		Ambient+50%	16.901*	.673	.000	15.536
	Ambient	Ambient-50%	-7.303*	.673	.000	-8.668
		Ambient+50%	9.598*	.673	.000	8.233
	Ambient+50%	Ambient-50%	-16.901*	.673	.000	-18.266
		Ambient	-9.598*	.673	.000	-10.963
Hymenoxysgrandiflora	Ambient-50%	Ambient	13.049*	.713	.000	11.604
		Ambient+50%	15.440*	.713	.000	13.994
	Ambient	Ambient-50%	-13.049*	.713	.000	-14.495
		Ambient+50%	2.391*	.713	.002	.945
	Ambient+50%	Ambient-50%	-15.440*	.713	.000	-16.886
		Ambient	-2.391*	.713	.002	-3.836

Pairwise Comparisons

Dependent Variable	(I) Temperature	(J) Temperature	Mean Difference (I-J)	Std. Error	Sig.[b]	95% Confidence ...[b]
						Lower Bound
Amsoniajonesii	Ambient	Ambient+3C	-2.646*	.357	.000	-3.370
	Ambient+3C	Ambient	2.646*	.357	.000	1.922
Asclepiastuberosacolora dolform	Ambient	Ambient+3C	-3.558*	.762	.000	-5.104
	Ambient+3C	Ambient	3.558*	.762	.000	2.012
Basamorrhizasagitifolius	Ambient	Ambient+3C	-.941*	.181	.000	-1.308
	Ambient+3C	Ambient	.941*	.181	.000	.574
Centaureapulcherrimus	Ambient	Ambient+3C	-2.125*	.322	.000	-2.778
	Ambient+3C	Ambient	2.125*	.322	.000	1.472
Delphiniumbarbeyi	Ambient	Ambient+3C	-4.414*	.910	.000	-6.259
	Ambient+3C	Ambient	4.414*	.910	.000	2.569
Dracocephalumgrandifl orum	Ambient	Ambient+3C	-3.503*	.212	.000	-3.932
	Ambient+3C	Ambient	3.503*	.212	.000	3.073
Geumtriflorum	Ambient	Ambient+3C	-3.337*	.549	.000	-4.452
	Ambient+3C	Ambient	3.337*	.549	.000	2.223
Hymenoxysgrandiflora	Ambient	Ambient+3C	-4.324*	.582	.000	-5.504
	Ambient+3C	Ambient	4.324*	.582	.000	3.143
Penstemonstrictus	Ambient	Ambient+3C	-5.904*	.609	.000	-7.140
	Ambient+3C	Ambient	5.904*	.609	.000	4.669
Salviapachyphylla	Ambient	Ambient+3C	-2.693*	.775	.001	-4.265
	Ambient+3C	Ambient	2.693*	.775	.001	1.121
Sphaeralceacoccinea	Ambient	Ambient+3C	-3.608*	.620	.000	-4.866
	Ambient+3C	Ambient	3.608*	.620	.000	2.351
Zinniagrandiflorus	Ambient	Ambient+3C	-4.854*	.573	.000	-6.016
	Ambient+3C	Ambient	4.854*	.573	.000	3.691

Estimates

Dependent Variable	Temperature	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
Amsoniajonesii	Ambient	11.872	.252	11.360	12.384
	Ambient+3C	14.518	.252	14.006	15.030
Asclepiastuberosacolora dolform	Ambient	8.833	.539	7.740	9.927
	Ambient+3C	12.391	.539	11.298	13.485
Basamorrhizasagitifolius	Ambient	1.778	.128	1.519	2.038
	Ambient+3C	2.719	.128	2.460	2.979
Centaureapulcherrimus	Ambient	12.817	.228	12.355	13.279
	Ambient+3C	14.942	.228	14.480	15.404
Delphiniumbarbeyi	Ambient	5.876	.643	4.571	7.181
	Ambient+3C	10.290	.643	8.985	11.595
Dracocephalumgrandifl orum	Ambient	4.589	.150	4.285	4.893
	Ambient+3C	8.092	.150	7.788	8.396
Geumtriflorum	Ambient	7.165	.389	6.377	7.953
	Ambient+3C	10.502	.389	9.714	11.290
Hymenoxysgrandiflora	Ambient	3.782	.412	2.947	4.616
	Ambient+3C	8.105	.412	7.271	8.940
Penstemonstrictus	Ambient	13.856	.431	12.982	14.729
	Ambient+3C	19.760	.431	18.886	20.634
Salviapachyphylla	Ambient	1.001	.548	-.110	2.113
	Ambient+3C	3.695	.548	2.583	4.806
Sphaeralceacoccinea	Ambient	3.919	.438	3.030	4.808
	Ambient+3C	7.528	.438	6.638	8.417
Zinniagrandiflorus	Ambient	8.924	.405	8.102	9.746
	Ambient+3C	13.778	.405	12.956	14.599

Estimates

Dependent Variable	Year	Mean	Std. Error	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
Amsoniajonesii	Year 1	11.483	.252	10.970	11.995
	Year 2	14.908	.252	14.395	15.420
Asclepiastuberosacolora dolform	Year 1	8.770	.539	7.677	9.864
	Year 2	12.454	.539	11.361	13.548
Basamorrhizasagitifolius	Year 1	.000	.128	-.260	.260
	Year 2	4.498	.128	4.238	4.757
Centaureapulcherrimus	Year 1	11.283	.228	10.821	11.745
	Year 2	16.475	.228	16.013	16.937
Delphiniumbarbeyi	Year 1	6.833	.643	5.528	8.138
	Year 2	9.333	.643	8.028	10.638
Dracocephalumgrandifl orum	Year 1	4.530	.150	4.226	4.834
	Year 2	8.150	.150	7.846	8.454
Geumtriflorum	Year 1	7.249	.389	6.461	8.037
	Year 2	10.418	.389	9.629	11.206
Hymenoxysgrandiflora	Year 1	4.687	.412	3.852	5.522
	Year 2	7.200	.412	6.365	8.035
Penstemonstrictus	Year 1	13.869	.431	12.996	14.743
	Year 2	19.747	.431	18.873	20.620
Salviapachyphylla	Year 1	.000	.548	-1.112	1.112
	Year 2	4.696	.548	3.584	5.807
Sphaeralceacoccinea	Year 1	3.283	.438	2.393	4.172
	Year 2	8.164	.438	7.275	9.053
Zinniagrandiflorus	Year 1	9.449	.405	8.627	10.271
	Year 2	13.253	.405	12.431	14.074

Estimates

Dependent Variable	Temperature	WaterRegime	Mean	Std. Error	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
Amsoniajonesii	Ambient	Ambient-50%	22.288	.437	21.401	23.174
		Ambient	13.329	.437	12.442	14.216
		Ambient+50%	1.099E-013	.437	-.887	.887
	Ambient+3C	Ambient-50%	29.875	.437	28.988	30.762
		Ambient	13.679	.437	12.792	14.566
		Ambient+50%	1.099E-013	.437	-.887	.887
Asclepiastuberosacolora dolform	Ambient	Ambient-50%	21.240	.934	19.346	23.134
		Ambient	5.260	.934	3.366	7.154
		Ambient+50%	1.022E-013	.934	-1.894	1.894
	Ambient+3C	Ambient-50%	28.088	.934	26.194	29.981
		Ambient	9.086	.934	7.192	10.980
		Ambient+50%	1.022E-013	.934	-1.894	1.894
Basamorrhizasagitifolius	Ambient	Ambient-50%	5.335	.222	4.885	5.785
		Ambient	.000	.222	-.450	.450
		Ambient+50%	1.002E-013	.222	-.450	.450
	Ambient+3C	Ambient-50%	8.158	.222	7.708	8.607
		Ambient	.000	.222	-.450	.450
		Ambient+50%	.000	.222	-.450	.450
Centaureapulcherrimus	Ambient	Ambient-50%	21.223	.394	20.423	22.022
		Ambient	17.228	.394	16.428	18.027
		Ambient+50%	1.076E-013	.394	-.800	.800
	Ambient+3C	Ambient-50%	25.648	.394	24.848	26.447
		Ambient	19.178	.394	18.378	19.977
		Ambient+50%	1.071E-013	.394	-.800	.800
Delphiniumbarbeyi	Ambient	Ambient-50%	17.628	1.114	15.368	19.887
		Ambient	.000	1.114	-2.260	2.260
		Ambient+50%	1.020E-013	1.114	-2.260	2.260
	Ambient+3C	Ambient-50%	27.223	1.114	24.963	29.482
		Ambient	3.648	1.114	1.388	5.907
		Ambient+50%	.000	1.114	-2.260	2.260
Dracocephalumgrandifl orum	Ambient	Ambient-50%	13.768	.260	13.241	14.294
		Ambient	1.002E-013	.260	-.527	.527
		Ambient+50%	1.033E-013	.260	-.527	.527
	Ambient+3C	Ambient-50%	24.275	.260	23.748	24.802
		Ambient	1.002E-013	.260	-.527	.527
		Ambient+50%	1.042E-013	.260	-.527	.527
Geumtriflorum	Ambient	Ambient-50%	14.273	.673	12.908	15.637
		Ambient	7.221	.673	5.856	8.586
		Ambient+50%	1.008E-013	.673	-1.365	1.365
	Ambient+3C	Ambient-50%	19.530	.673	18.165	20.895
		Ambient	11.975	.673	10.610	13.340
		Ambient+50%	.000	.673	-1.365	1.365
Hymenoxysgrandiflora	Ambient	Ambient-50%	11.345	.713	9.899	12.791
		Ambient	.000	.713	-1.446	1.446
		Ambient+50%	.000	.713	-1.446	1.446
	Ambient+3C	Ambient-50%	19.535	.713	18.089	20.981
		Ambient	4.781	.713	3.336	6.227
		Ambient+50%	1.043E-013	.713	-1.446	1.446

Estimates

Dependent Variable	WaterRegime	Year	Mean	Std. Error	95% Confidence Interval	
					Lower Bound	Upper Bound
Amsoniajonesii	Ambient-50%	Year 1	22.319	.437	21.432	23.206
		Year 2	29.844	.437	28.957	30.731
	Ambient	Year 1	12.129	.437	11.242	13.016
		Year 2	14.879	.437	13.992	15.766
	Ambient+50%	Year 1	1.094E-013	.437	-.887	.887
		Year 2	1.103E-013	.437	-.887	.887
Asclepiastuberosacolora dolform	Ambient-50%	Year 1	21.051	.934	19.157	22.945
		Year 2	28.276	.934	26.382	30.170
	Ambient	Year 1	5.260	.934	3.366	7.154
		Year 2	9.086	.934	7.192	10.980
	Ambient+50%	Year 1	1.058E-013	.934	-1.894	1.894
		Year 2	.000	.934	-1.894	1.894
Basamorrhizasagitifolius	Ambient-50%	Year 1	.000	.222	-.450	.450
		Year 2	13.493	.222	13.043	13.942
	Ambient	Year 1	.000	.222	-.450	.450
		Year 2	.000	.222	-.450	.450
	Ambient+50%	Year 1	.000	.222	-.450	.450
		Year 2	.000	.222	-.450	.450
Centaureapulcherrimus	Ambient-50%	Year 1	19.198	.394	18.398	19.997
		Year 2	27.673	.394	26.873	28.472
	Ambient	Year 1	14.653	.394	13.853	15.452
		Year 2	21.753	.394	20.953	22.552
	Ambient+50%	Year 1	1.051E-013	.394	-.800	.800
		Year 2	1.096E-013	.394	-.800	.800
Delphiniumbarbeyi	Ambient-50%	Year 1	18.800	1.114	16.540	21.060
		Year 2	26.050	1.114	23.790	28.310
	Ambient	Year 1	1.699	1.114	-.561	3.959
		Year 2	1.949	1.114	-.311	4.209
	Ambient+50%	Year 1	1.020E-013	1.114	-2.260	2.260
		Year 2	.000	1.114	-2.260	2.260
Dracocephalumgrandifl orum	Ambient-50%	Year 1	13.591	.260	13.065	14.118
		Year 2	24.451	.260	23.925	24.978
	Ambient	Year 1	1.002E-013	.260	-.527	.527
		Year 2	1.002E-013	.260	-.527	.527
	Ambient+50%	Year 1	1.033E-013	.260	-.527	.527
		Year 2	1.042E-013	.260	-.527	.527
Geumtriflorum	Ambient-50%	Year 1	14.189	.673	12.824	15.554
		Year 2	19.614	.673	18.249	20.979
	Ambient	Year 1	7.558	.673	6.193	8.922
		Year 2	11.639	.673	10.274	13.004
	Ambient+50%	Year 1	.000	.673	-1.365	1.365
		Year 2	.000	.673	-1.365	1.365
Hymenoxysgrandiflora	Ambient-50%	Year 1	13.010	.713	11.564	14.456
		Year 2	17.870	.713	16.424	19.316
	Ambient	Year 1	1.051	.713	-.394	2.497
		Year 2	3.730	.713	2.284	5.176
	Ambient+50%	Year 1	1.006E-013	.713	-1.446	1.446
		Year 2	1.037E-013	.713	-1.446	1.446
Penstemonstrictus	Ambient-50%	Year 1	22.300	.746	20.787	23.813
		Year 2	30.300	.746	28.787	31.813

Estimates

Dependent Variable	Temperature	WaterRegime	Year	Mean	Std. Error	95% ... Lower Bound
Amsoniajonesii	Ambient	Ambient-50%	Year 1	19.263	.618	18.008
			Year 2	25.313	.618	24.058
		Ambient	Year 1	13.173	.618	11.918
			Year 2	13.485	.618	12.231
		Ambient+50%	Year 1	1.061E-013	.618	-1.254
			Year 2	1.137E-013	.618	-1.254
	Ambient+3C	Ambient-50%	Year 1	25.375	.618	24.121
			Year 2	34.375	.618	33.121
		Ambient	Year 1	11.085	.618	9.831
			Year 2	16.273	.618	15.018
		Ambient+50%	Year 1	1.128E-013	.618	-1.254
			Year 2	1.070E-013	.618	-1.254
Asclepiastuberosacolora dolform	Ambient	Ambient-50%	Year 1	18.515	1.321	15.837
			Year 2	23.965	1.321	21.287
		Ambient	Year 1	10.520	1.321	7.842
			Year 2	.000	1.321	-2.678
		Ambient+50%	Year 1	1.093E-013	1.321	-2.678
			Year 2	.000	1.321	-2.678
	Ambient+3C	Ambient-50%	Year 1	23.588	1.321	20.909
			Year 2	32.588	1.321	29.909
		Ambient	Year 1	.000	1.321	-2.678
			Year 2	18.173	1.321	15.494
		Ambient+50%	Year 1	1.022E-013	1.321	-2.678
			Year 2	1.022E-013	1.321	-2.678
Basamorrhizasagitifolius	Ambient	Ambient-50%	Year 1	.000	.313	-.636
			Year 2	10.670	.313	10.034
		Ambient	Year 1	.000	.313	-.636
			Year 2	1.003E-013	.313	-.636
		Ambient+50%	Year 1	.000	.313	-.636
			Year 2	1.012E-013	.313	-.636
	Ambient+3C	Ambient-50%	Year 1	.000	.313	-.636
			Year 2	16.315	.313	15.679
		Ambient	Year 1	1.003E-013	.313	-.636
			Year 2	.000	.313	-.636
		Ambient+50%	Year 1	1.006E-013	.313	-.636
			Year 2	.000	.313	-.636
Centaureapulcherrimus	Ambient	Ambient-50%	Year 1	17.423	.558	16.291
			Year 2	25.023	.558	23.891
		Ambient	Year 1	14.053	.558	12.921
			Year 2	20.403	.558	19.271
		Ambient+50%	Year 1	1.054E-013	.558	-1.131
			Year 2	1.098E-013	.558	-1.131
	Ambient+3C	Ambient-50%	Year 1	20.973	.558	19.841
			Year 2	30.323	.558	29.191
		Ambient	Year 1	15.253	.558	14.121
			Year 2	23.103	.558	21.971
		Ambient+50%	Year 1	1.049E-013	.558	-1.131
			Year 2	1.094E-013	.558	-1.131
Delphiniumbarbeyi	Ambient	Ambient-50%	Year 1	15.803	1.576	12.607
			Year 2	19.453	1.576	16.257

Pairwise Comparisons

Dependent Variable	(I) Year	(J) Year	Mean Difference (I-J)	Std. Error	Sig.[b]	95% Confidence Interval for Difference[b]	
						Lower Bound	Upper Bound
Amsoniajonesii	Year 1	Year 2	-3.425*	.357	.000	-4.149	-2.701
	Year 2	Year 1	3.425*	.357	.000	2.701	4.149
Asclepiastuberosacolora dolform	Year 1	Year 2	-3.684*	.762	.000	-5.230	-2.137
	Year 2	Year 1	3.684*	.762	.000	2.137	5.230
Basamorrhizasagitifolius	Year 1	Year 2	-4.498*	.181	.000	-4.865	-4.130
	Year 2	Year 1	4.498*	.181	.000	4.130	4.865
Centaureapulcherrimus	Year 1	Year 2	-5.192*	.322	.000	-5.845	-4.539
	Year 2	Year 1	5.192*	.322	.000	4.539	5.845
Delphiniumbarbeyi	Year 1	Year 2	-2.500*	.910	.009	-4.345	-.655
	Year 2	Year 1	2.500*	.910	.009	.655	4.345
Dracocephalumgrandifl orum	Year 1	Year 2	-3.620*	.212	.000	-4.050	-3.190
	Year 2	Year 1	3.620*	.212	.000	3.190	4.050
Geumtriflorum	Year 1	Year 2	-3.169*	.549	.000	-4.283	-2.054
	Year 2	Year 1	3.169*	.549	.000	2.054	4.283
Hymenoxysgrandiflora	Year 1	Year 2	-2.513*	.582	.000	-3.693	-1.333
	Year 2	Year 1	2.513*	.582	.000	1.333	3.693
Penstemonstrictus	Year 1	Year 2	-5.878*	.609	.000	-7.113	-4.642
	Year 2	Year 1	5.878*	.609	.000	4.642	7.113
Salviapachyphylla	Year 1	Year 2	-4.696*	.775	.000	-6.268	-3.124
	Year 2	Year 1	4.696*	.775	.000	3.124	6.268
Sphaeralceacoccinea	Year 1	Year 2	-4.882*	.620	.000	-6.139	-3.624
	Year 2	Year 1	4.882*	.620	.000	3.624	6.139
Zinniagrandiflorus	Year 1	Year 2	-3.804*	.573	.000	-4.966	-2.641
	Year 2	Year 1	3.804*	.573	.000	2.641	4.966

Based on estimated marginal means

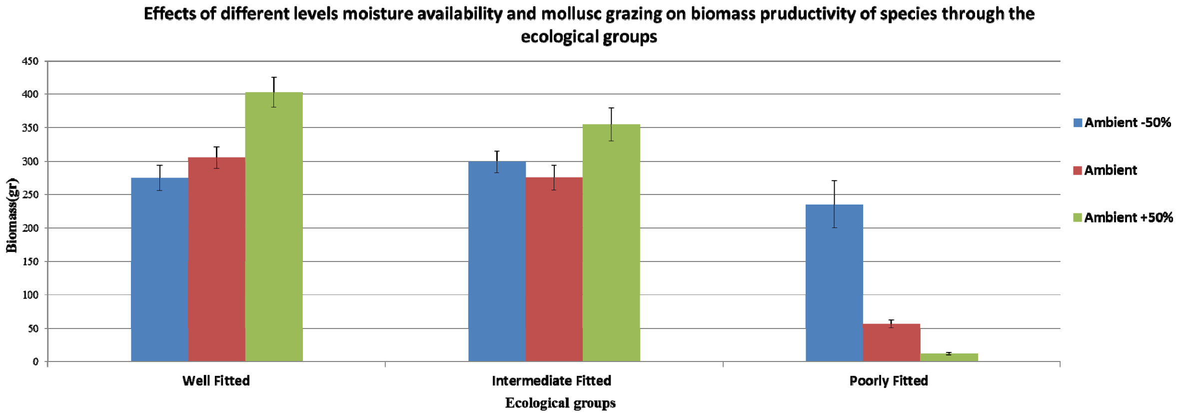
*. The mean difference is significant at the

b. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

Appendix 4

The Effects of mollusc grazing under different environmental source on the fitness of species in mollusc grazed area

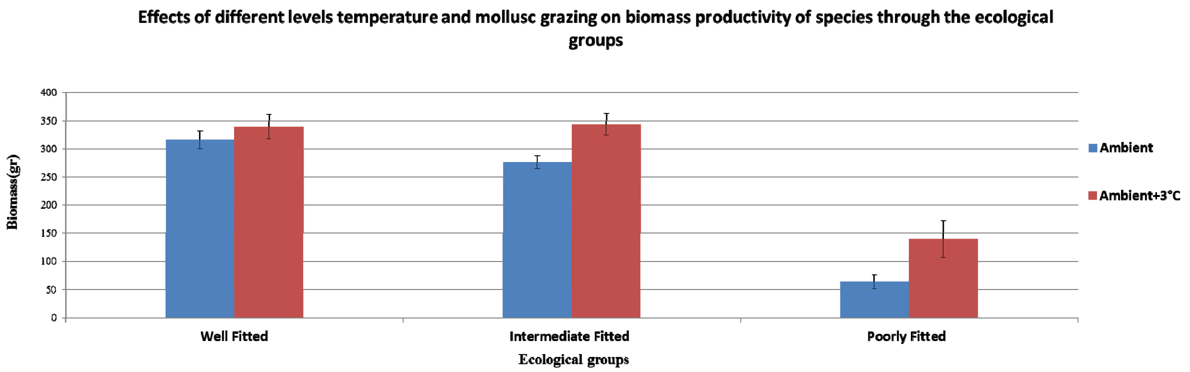
The effect of mollusc grazing on biomass production of the fitness groups (Well fitted, Intermediate fitted and Poorly fitted) at different moisture levels



Effect of molluscs grazing on biomass of fitness groups at different level of moisture avalability

Above figure indicats that mollusc grazing show significant effects on biomass productivity of the three groups of plant species.The well fitted species, at ambient+50% of moisture availability, shows the highest biomass productivity. Intermediate fitted group also shows notable biomass production at this level of moisture availability. The moisture in first two groups enhanced the mollusc activity and as result unplatable species growing more. But the poorly fitted group shows a sharp decrease in this respect and when the water treatment level is Ambient +50% the plant species of this group cannot survive. Decreasing mass production with increasing the moisture in this group can happen for two reasons: First, most of the poorly fitted species, can't tolerate wet and high moisture conditions and die and second increasing moisture availability enhances the mollusc activity and reduces biomass production. Decreasing mass productivity at ambient level of moisture availability among the intermediate fitted species is for the same reason.

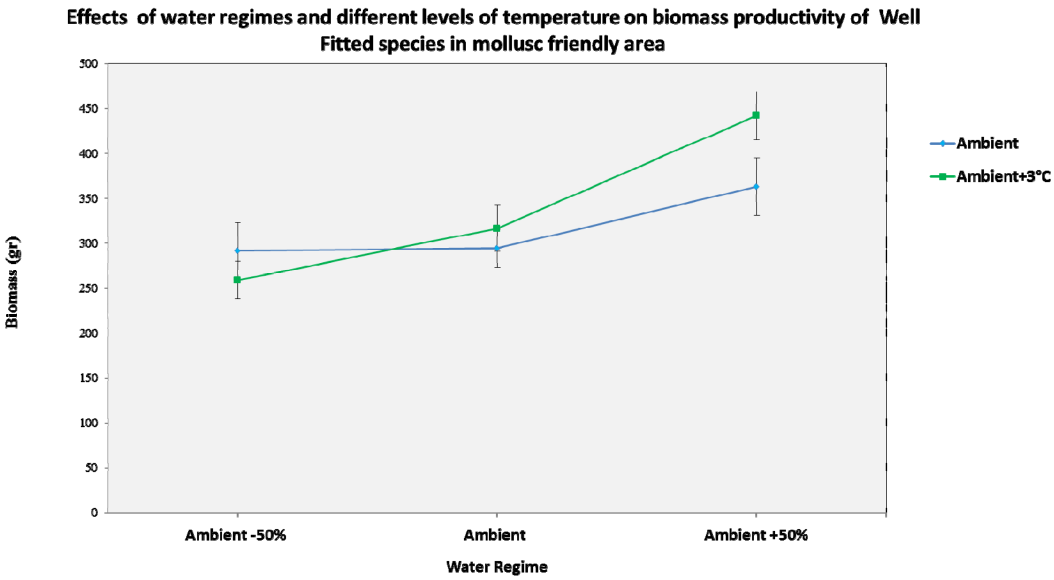
The effects of mollusc grazing on biomass production of the fitness groups (Well fitted, Intermediate fitted and Poorly fitted) at different temperature levels



Effect of molluscs grazing on biomass of fitness groups at different levels of temperatures

Effects of the temperature treatment on the plant groups are shown in above graph. It is clear that increasing temperature decreases the mollusc Increasing temperature up to 3°C not only improves the rate of plant photosynthesis, but also decreases the mollusc activities. Both of these factors have increased the biomass production among the ecological groups. Although in well fitted group it is not significant.

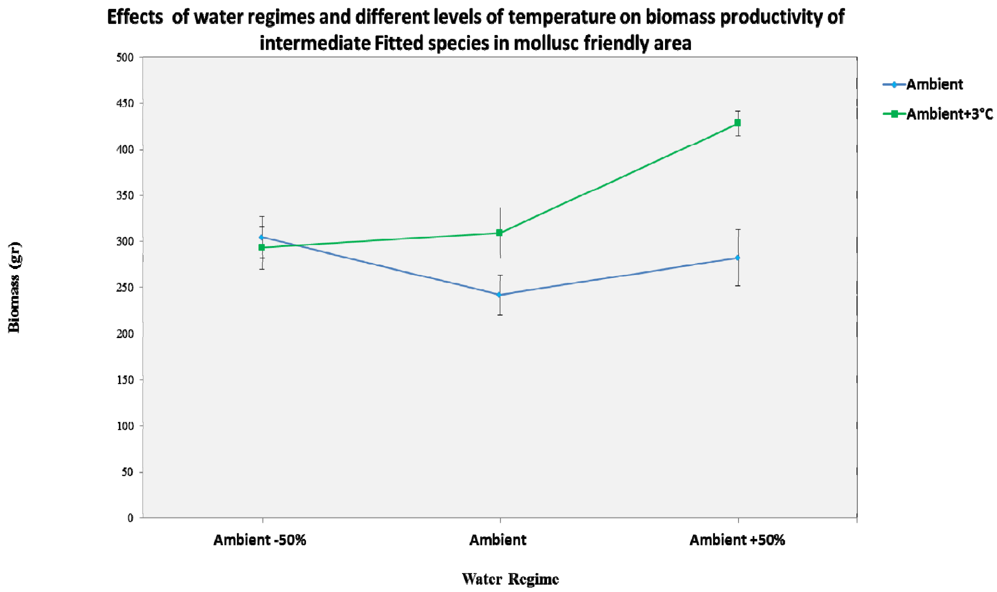
The effects of mollusc grazing well, intermediate and poorly fitted species under moisture×temperature



Effects of molluscs grazing on biomass production of well fitted species at different levels of moisture and temperature.

As it was indicated before, mollusc doesn't have activity in dry and warm situation. Increasing the level of moisture fom ambient – 50% to ambient+50% inhaled the mollusc activity. As the graph clearly show, at ambient level of temperature, enhance the moisture level from ambient-50% to ambient don't made significant difference in biomass productivity. Because,at ambient level of moisture the mollusc activity increased and at ambient-50% of the biomass productivity decreased. So overall they don't show significant difference in term of biomass productivity.

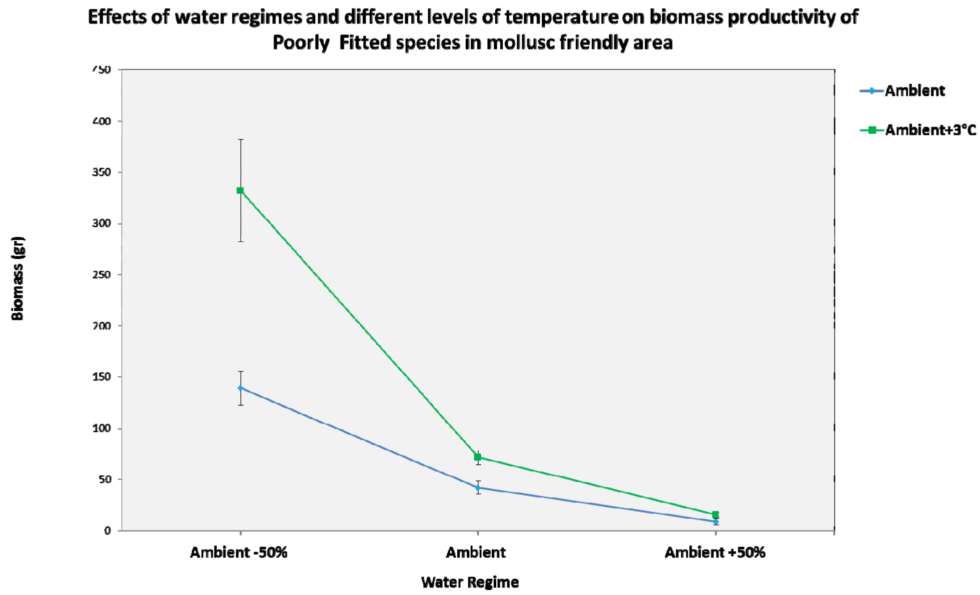
The graph show that, the best station for their activity is at ambient+50% of moisture and ambient level of temperature enhance temperature reduce mollusc activity. The graph also show increasing temperature increased the biomass productivity (except at ambient-50% of moisture level) it means mollusc had less activity in this situation .



Effects of molluscs grazing on biomass production of intermediate fitted species at different levels of moisture and temperature.

The plant species in the intermediate fitted group show similar behavior to the well-fitted group. They are more adapted to the dry and warm condition. The graph indicates that mollusc is not active at ambient-50% of moisture level and it enhance with increasing moisture level. So at ambient -50% we saw more biomass productivity than ambient level of moisture. Mollusc grazing reduces the competition between unpalatable species to receiving more light, water and space for their growth. So at ambient level of temperature, in spied of more mollusc activity at ambient+50% of water level, the biomass productivity of species at ambient level of moisture, were decreased.

The graph shows that mollusc activity decreased with increasing temperature, as well. So at ambient+3C biomass productivity is more than ambient level (except at ambient-50% of moisture).



Effects of molluscs grazing on biomass production of poorly fitted species at different levels of moisture and temperature.

Dryer and warmer climate provide the best situation for poorly fitted species growth and development. But this situation is not suitable for mollusc activity and grazing. Increasing the biomass in Ambient -50% and Ambient temperature to the higher temperature shows the mollusc did not have activity in this situation. The best climate for mollusc activity is wet and cold to warm which is not suitable for poorly fitted species. By providing more moisture, Ambient, this amounts are clearly reduced till the moisture availability is at Ambient +50% and the plants fail to survive. So Cleary when the species fail to survive presence of mollusc does not affect the results.

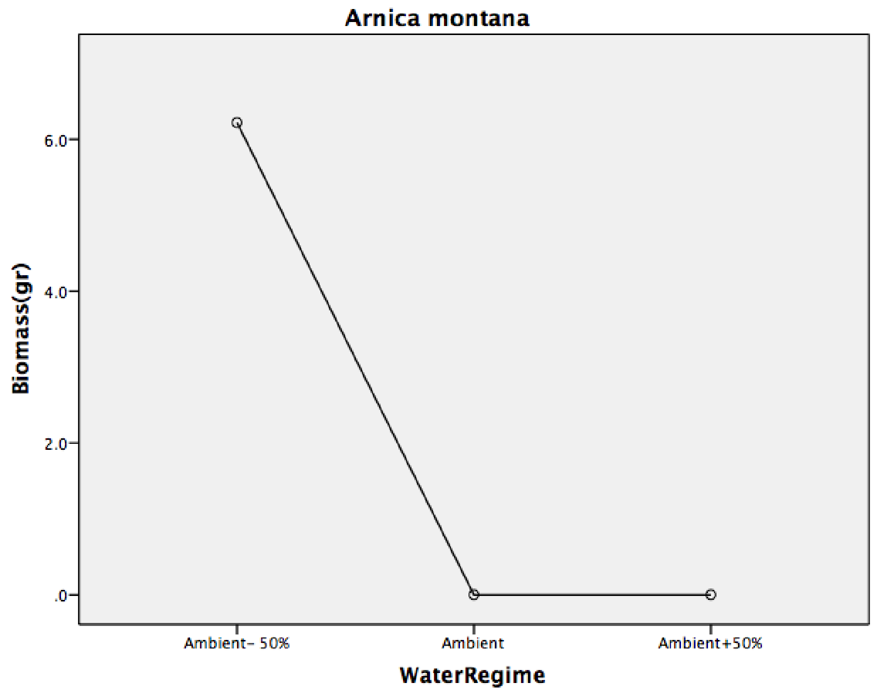
In an opposite trend compared to the plant species in the well and intermediate fitted groups increasing available moisture regardless of the temperature levels hampers the biomass production.

Response of species as individual

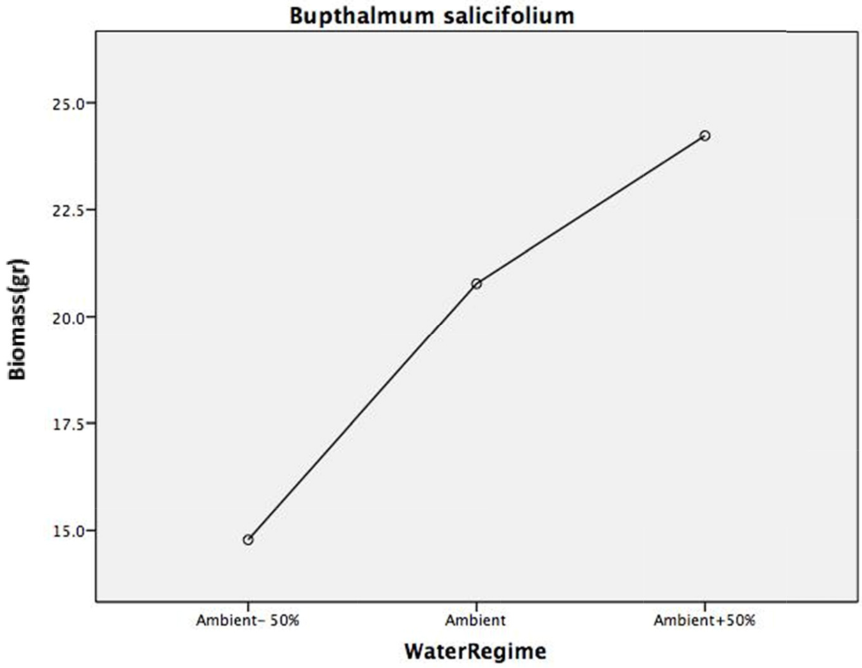
Well fitted species

The Effects of mollusc grazing and different levels of moisture species to the water on biomass productivity of well-fitted species

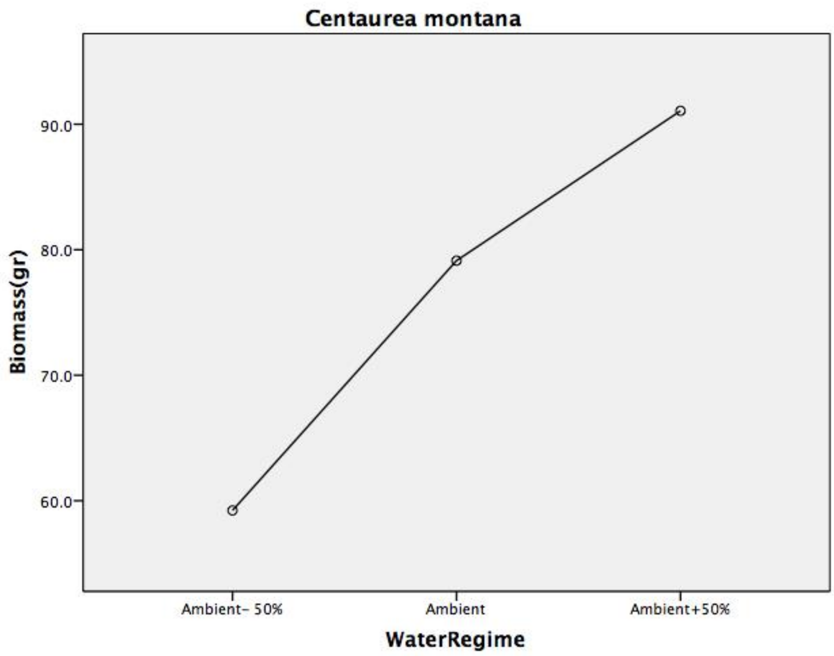
The following graph shows the effects of mollusc grazing and different level of moisture on the individual species in the well fitted group to the moisture treatments. As seen mixed behaviors is observed among these species to the increased moisture availability. *Arnica Montana (palatable), Phyteuma spicatum var caeruluem(palatable), Salvia pretense(palatable),* and *Scabiosa caucasica (palatable)* are the species that fail to produce biomass with increasing the moisture levels, while the produced biomass increases among the other plants in this group.



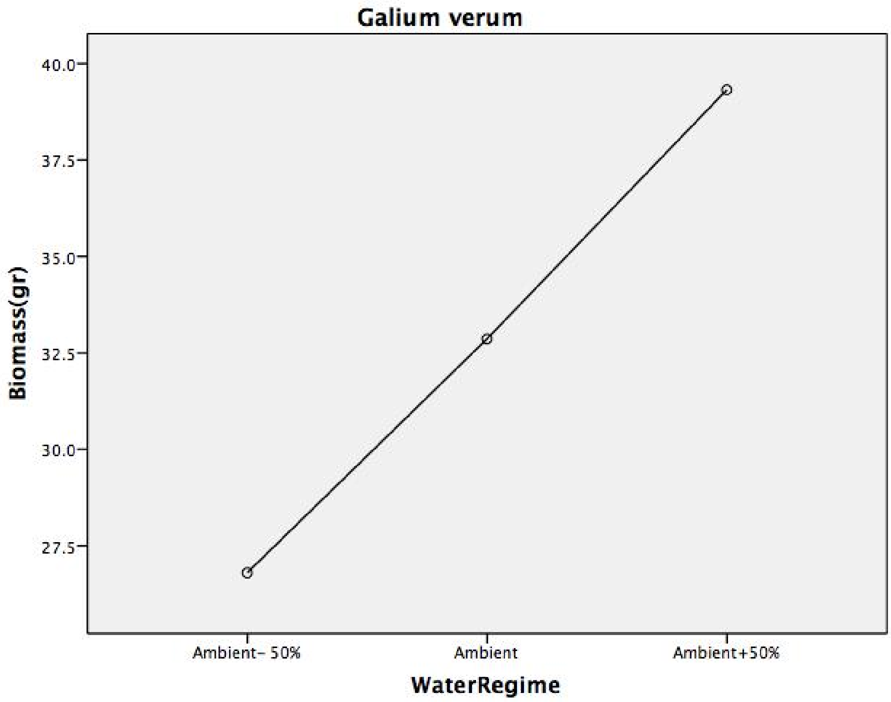
Effects of mollusc grazing and water regime treatments on biomass peroductivity of *Arnica montan (Palatable).*



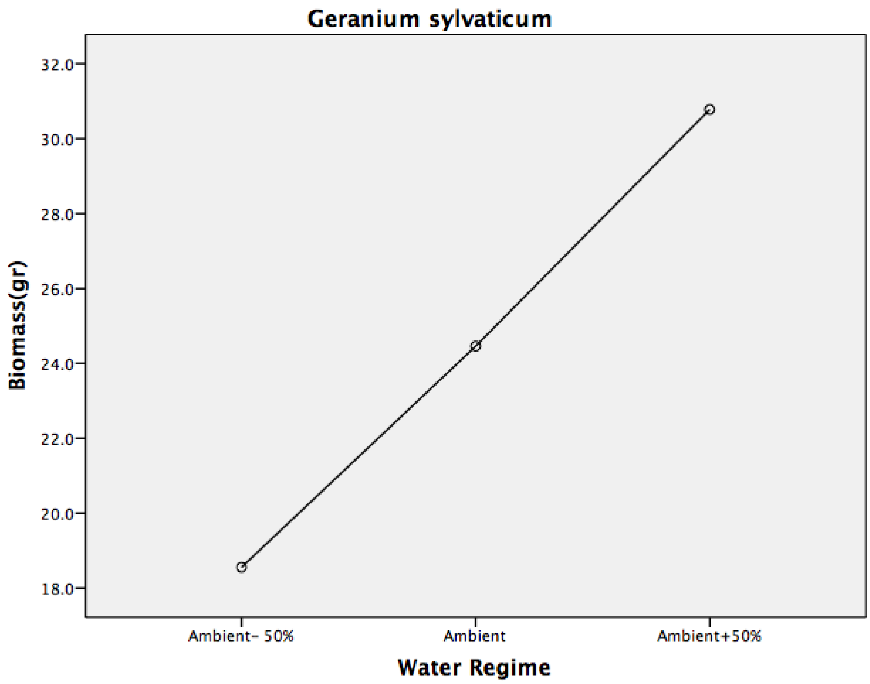
Effects of mollusc grazing and water regime treatments on biomass peroductivity of *Bupthalmum salicifolium (Palatable).*



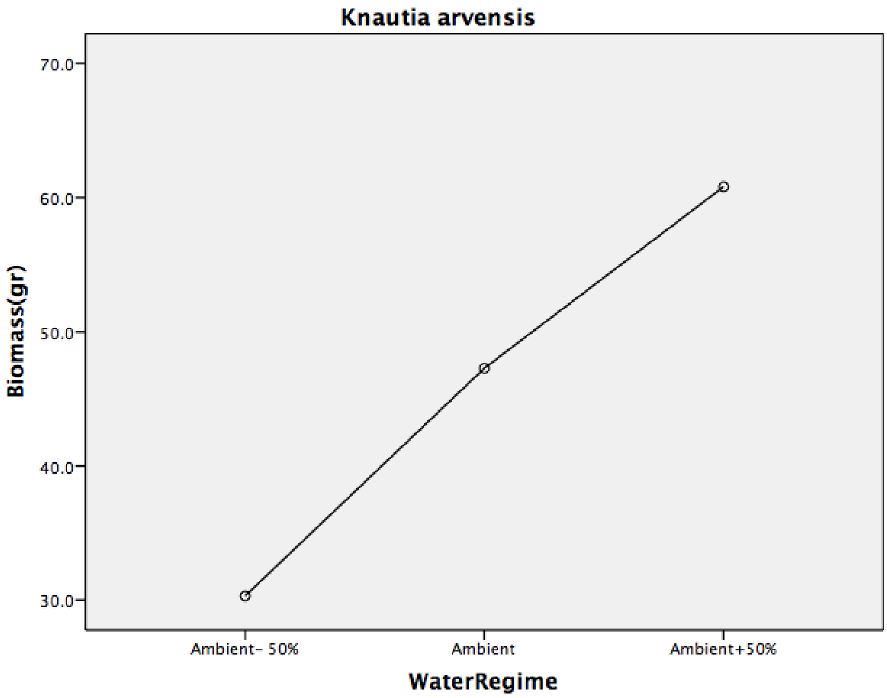
Effects of mollusc grazing and water regime treatments on biomass peroductivity of *Centaurea montana (Palatable).*



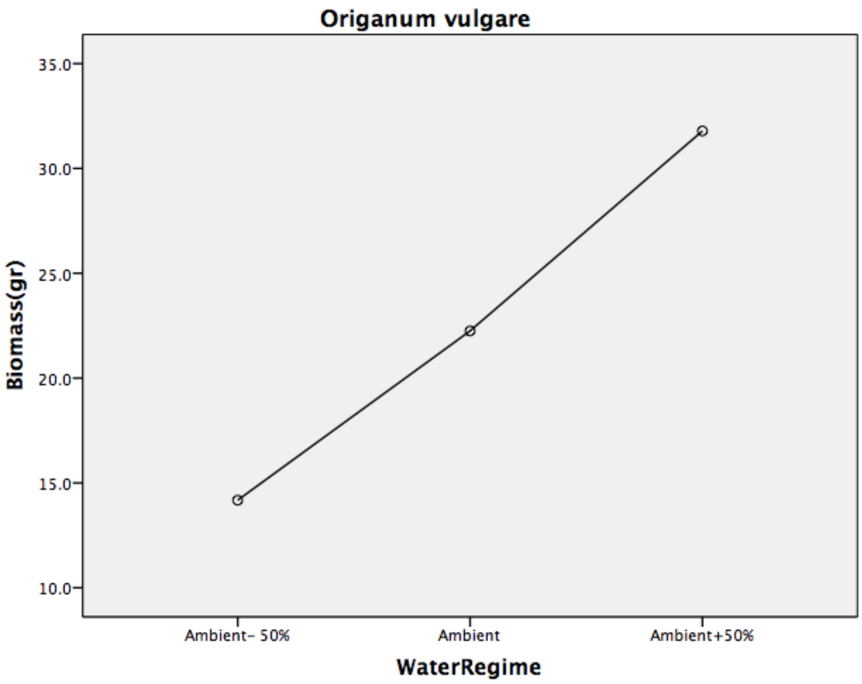
Effects of mollusc grazing and water regime treatments on biomass peroductivity of *Galium verum (Unpalatable).*



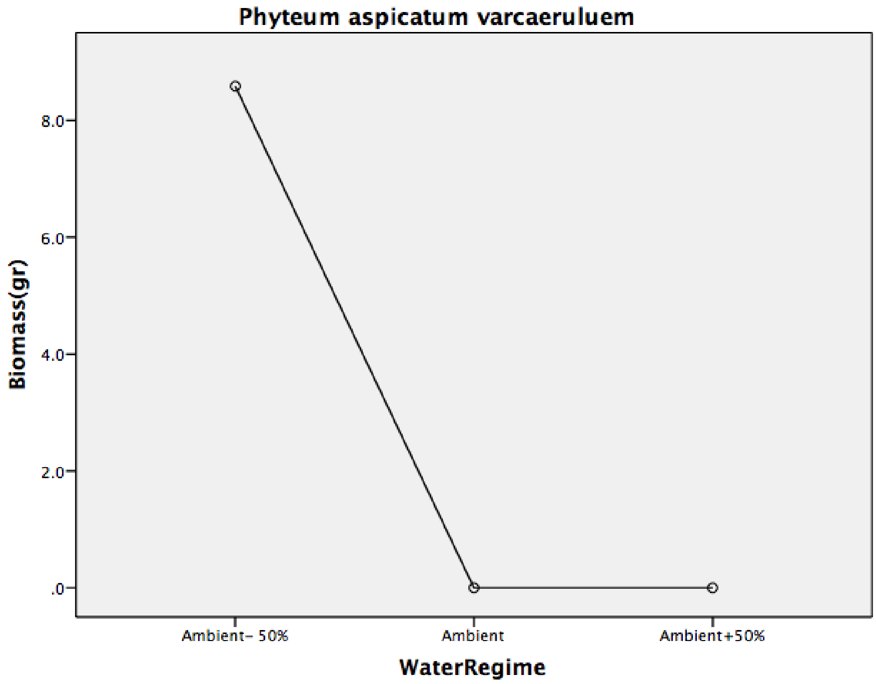
Effects of mollusc grazing and water regime treatments on biomass peroductivity of *Geranium sylvaticum (Unpalatable).*



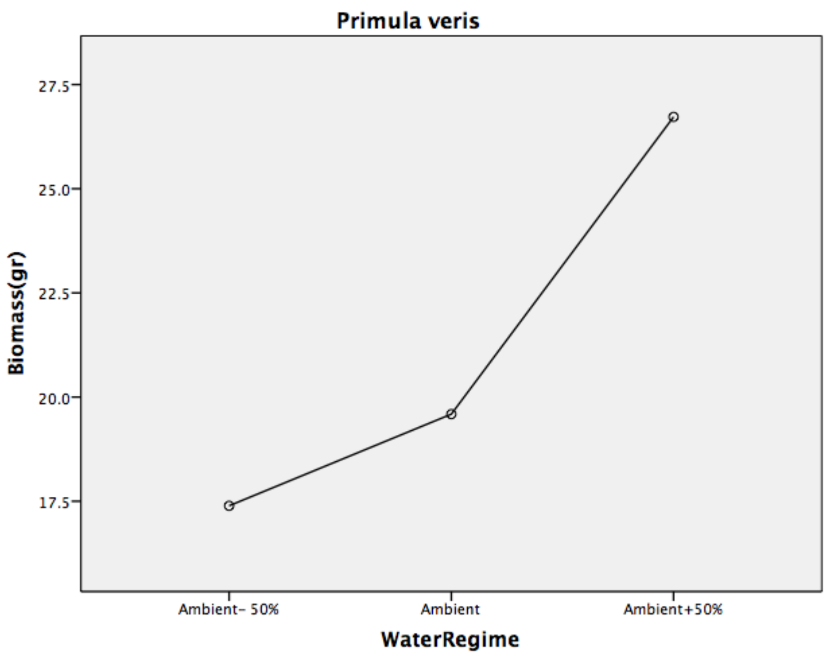
Effects of mollusc grazing and water regime treatments on biomass peroductivity of *Knautia arvensis (Unpalatable).*



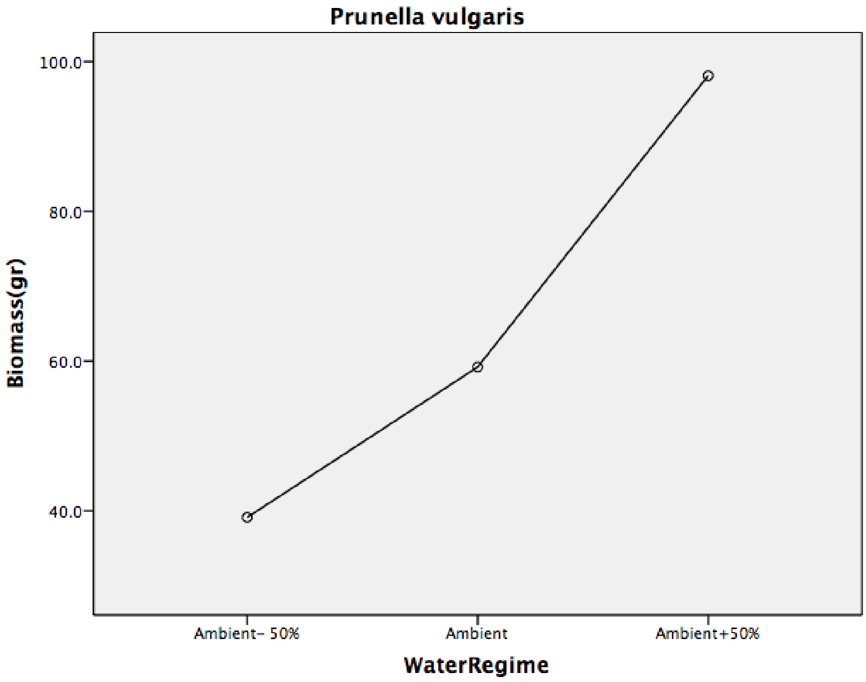
Effects of mollusc grazing and water regime treatments on biomass peroductivity of *Origanum vulgare (Unpalatable).*



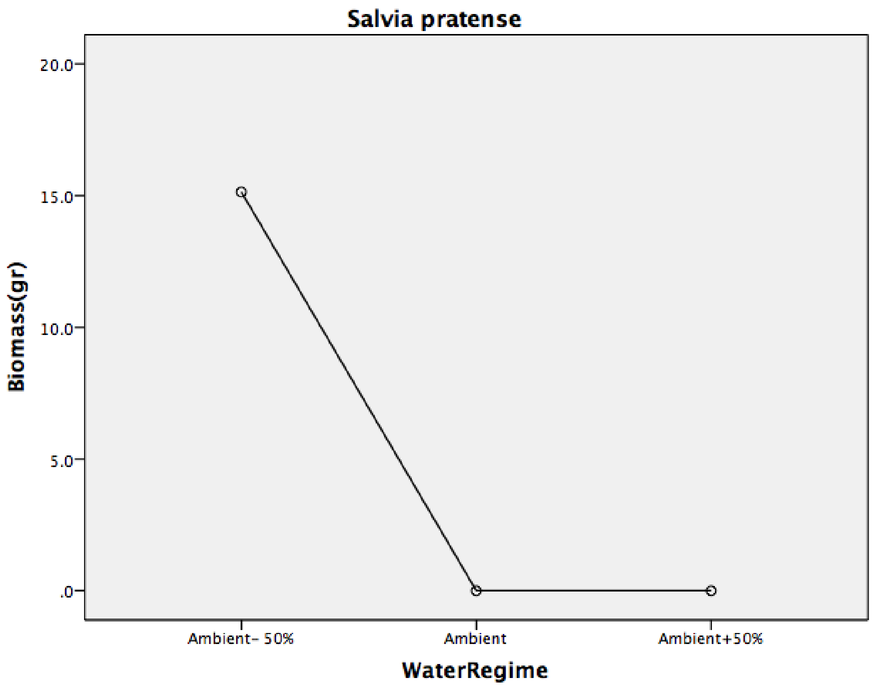
Effects of mollusc grazing and water regime treatments on biomass peroductivity of *Phyteuma spicatum var caeruluem (Palatable).*



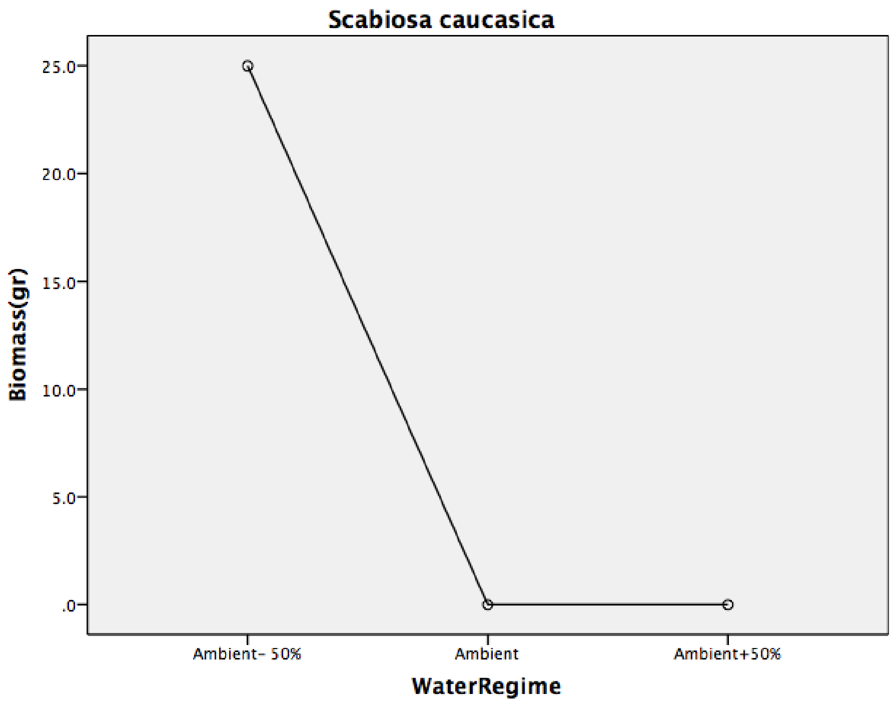
Effects of mollusc grazing and water regime treatments on biomass peroductivity of *Primula veris (Unpalatable).*



Effects of mollusc grazing and water regime treatments on biomass peroductivity of *Prunella vulgaris(Unpalatable).*



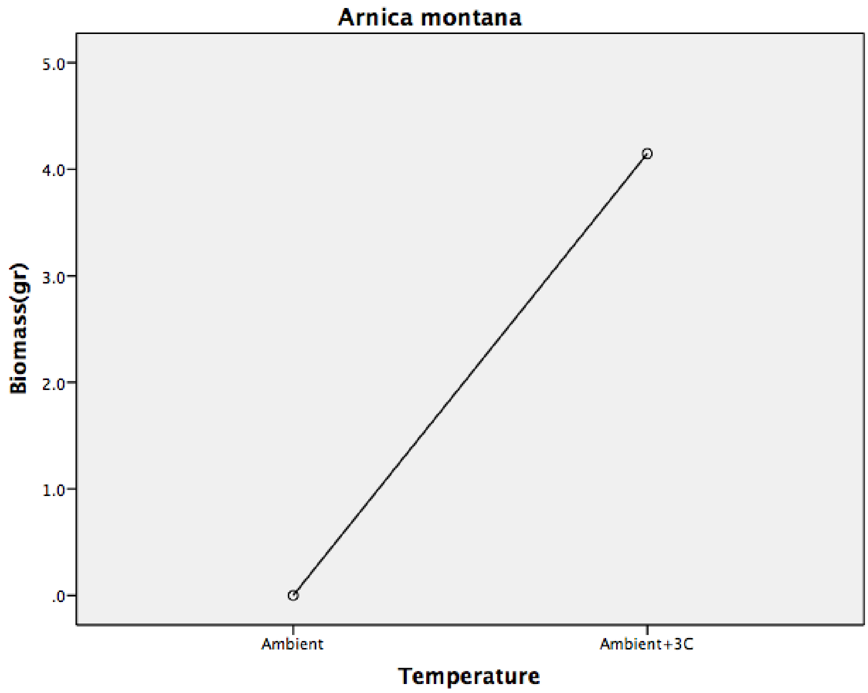
Effects of mollusc grazing and water regime treatments on biomass peroductivity of *Salvia pretense (Palatable).*



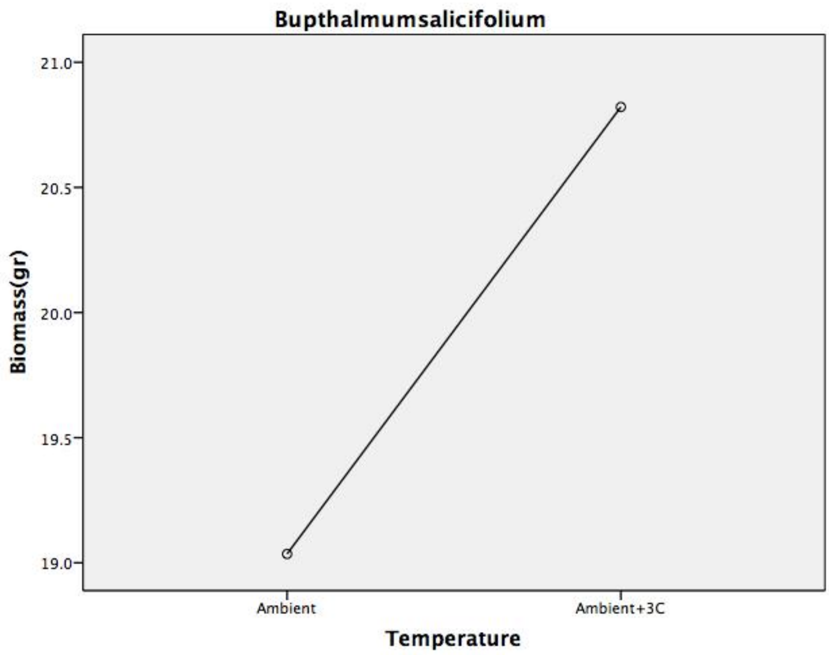
Effects of mollusc grazing and water regime treatments on biomass peroductivity of *Scabiosa caucasica (Palatable).*

The effects of mollusc grazing and different levels of temperature on biomass productivity of well fitted species.

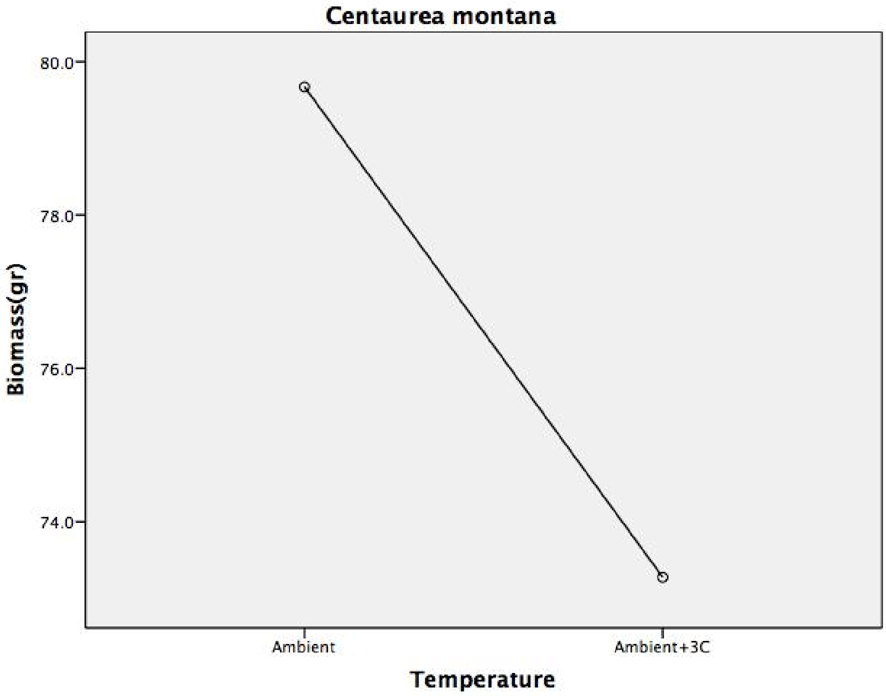
The following graphs shows how mollusc grazing in the individual species of well fitted group have reacted to the higher temperature level. As seen there is only one exception among the twelve plant species in this group and the rest show better growth with increasing the temperature level. *Centaurea montana* is the only species in this group that its biomass production is decreased by increasing the temperature level. Temperature did not show significant effects on biomass productivity of well fitted species



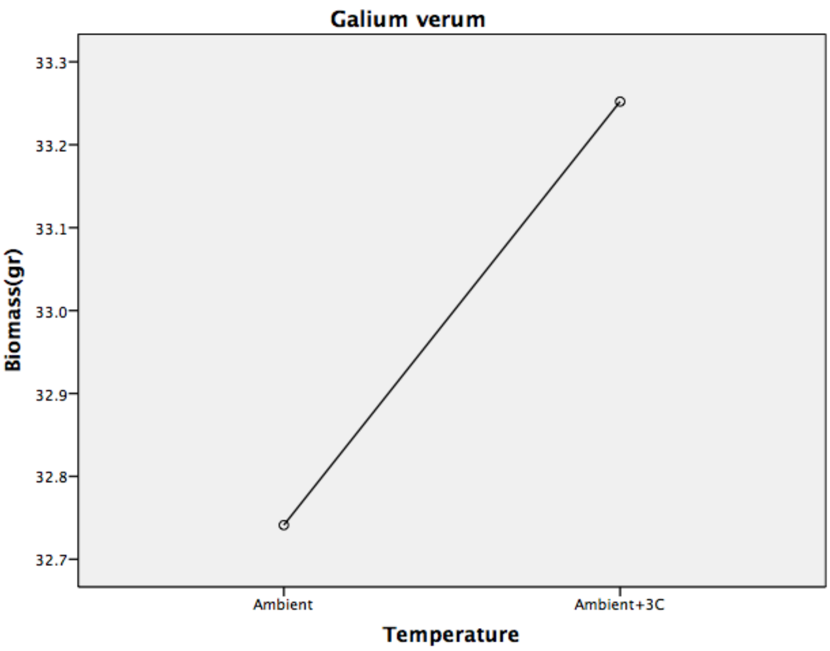
Effects of mollusc grazing and temperature treatments of biomass peroductivity of *Arnica montan (Palatable).*



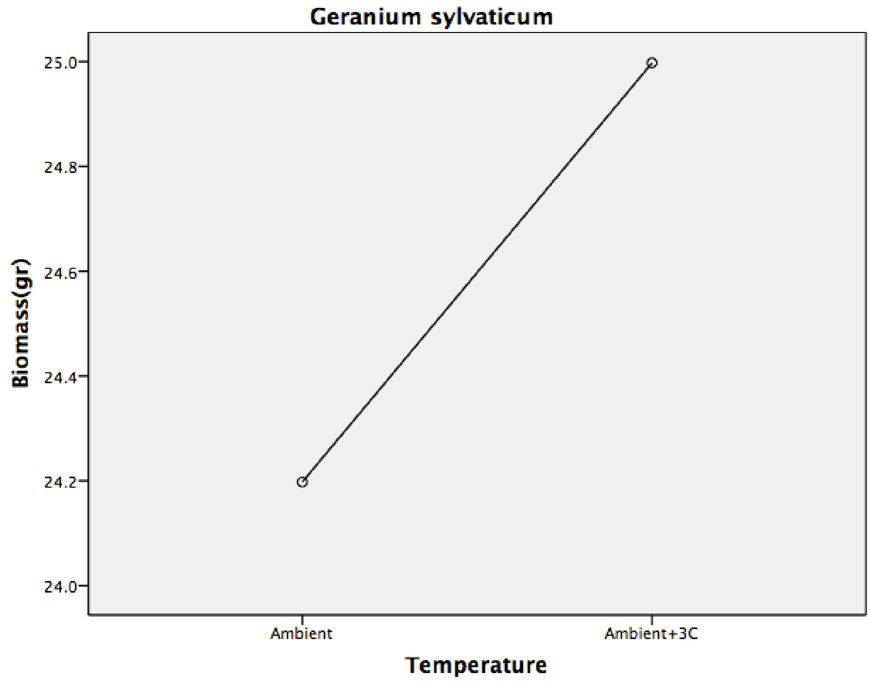
Effects of mollusc grazing and temperature treatments of biomass peroductivity of *Bupthalmum salicifolium (Palatable).*



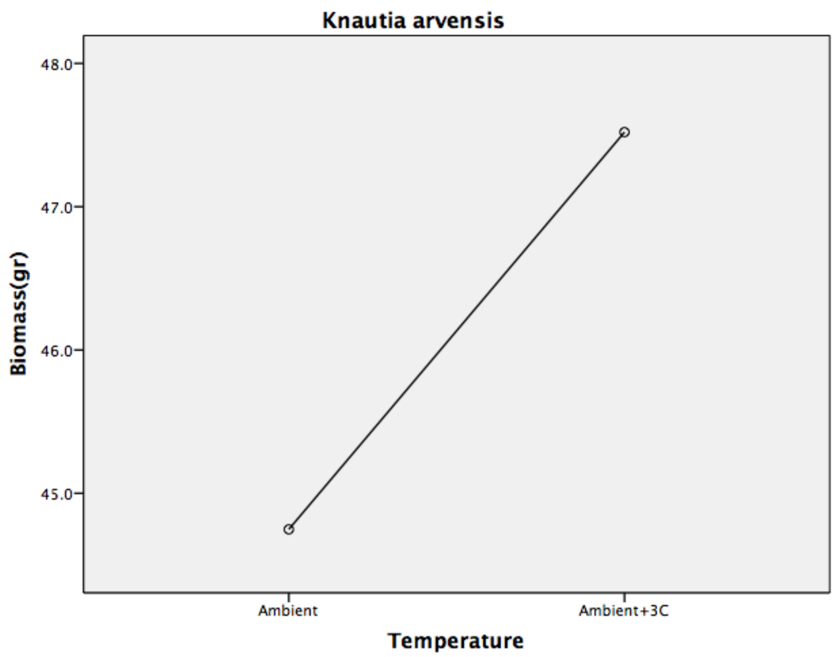
Effects of mollusc grazing and temperature treatments of biomass peroductivity of *Centaurea montana (Palatable).*



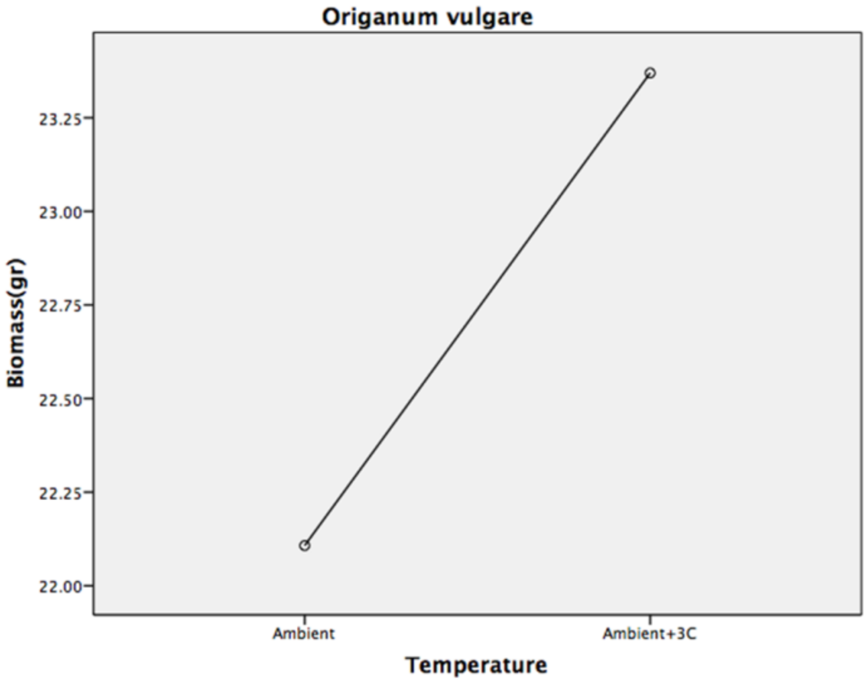
Effects of mollusc grazing and temperature treatments of biomass peroductivity of *Galium verum (Unpalatable).*



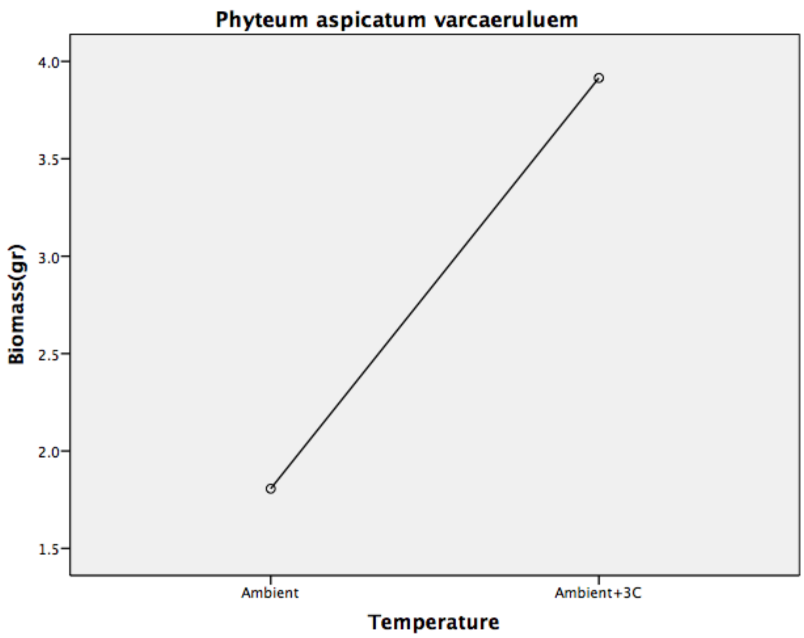
Effects of mollusc grazing and temperature treatments of biomass peroductivity of *Geranium sylvaticum (Unpalatable).*



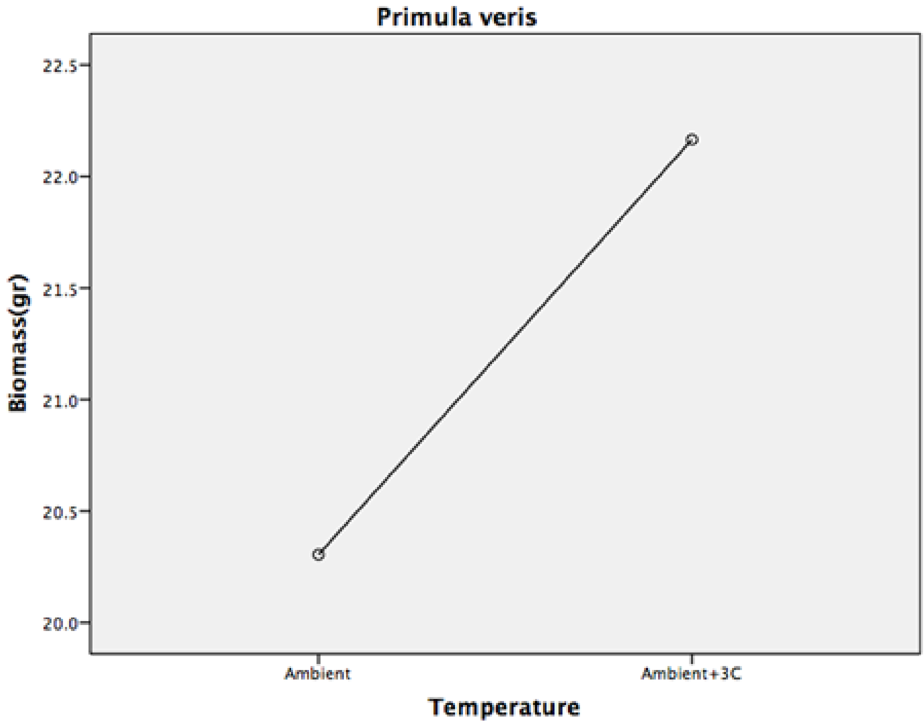
Effects of mollusc grazing and temperature treatments of biomass peroductivity of *Knautia arvensis (Unpalatable).*



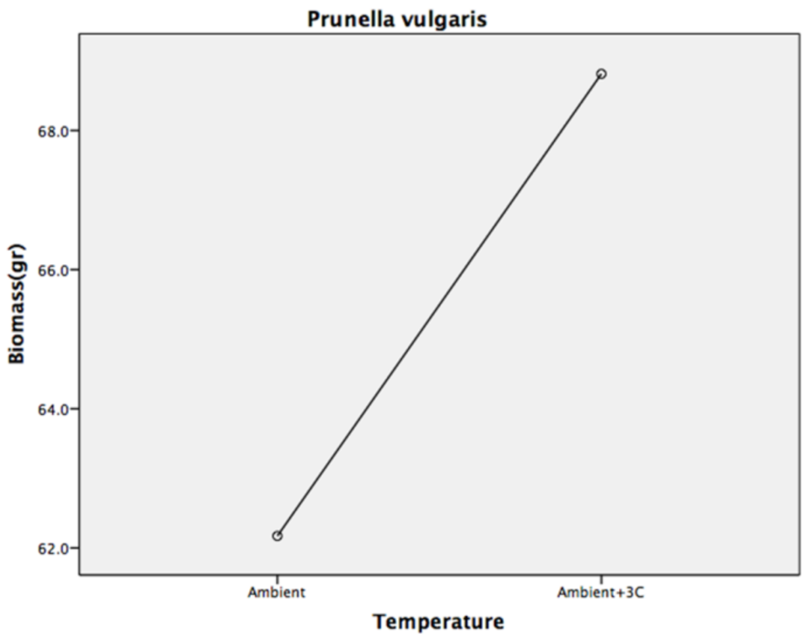
Effects of mollusc grazing and temperature treatments of biomass peroductivity of *Origanum vulgare (Unpalatable).*



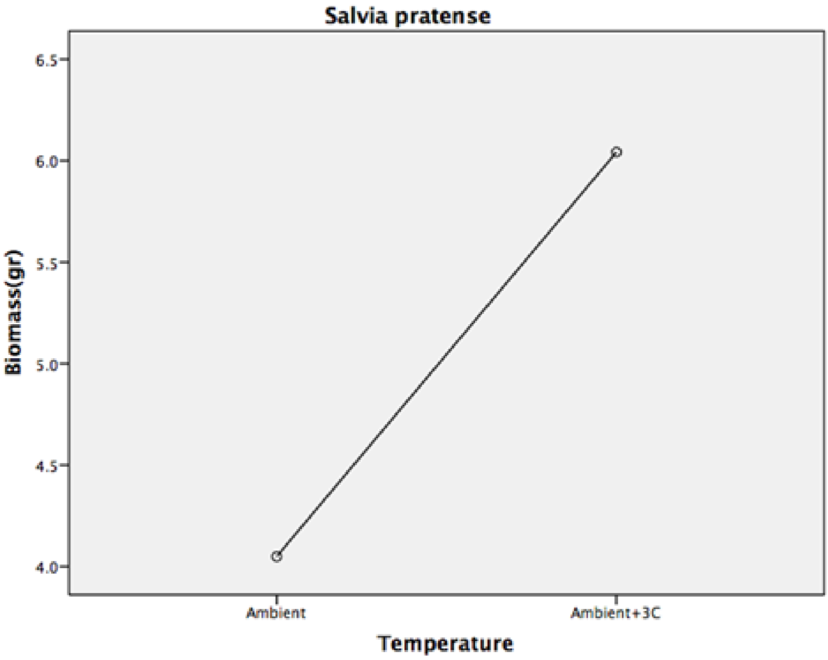
Effects of mollusc grazing and temperature treatments of biomass peroductivity of *Phyteuma spicatum var caeruluem (Palatable).*



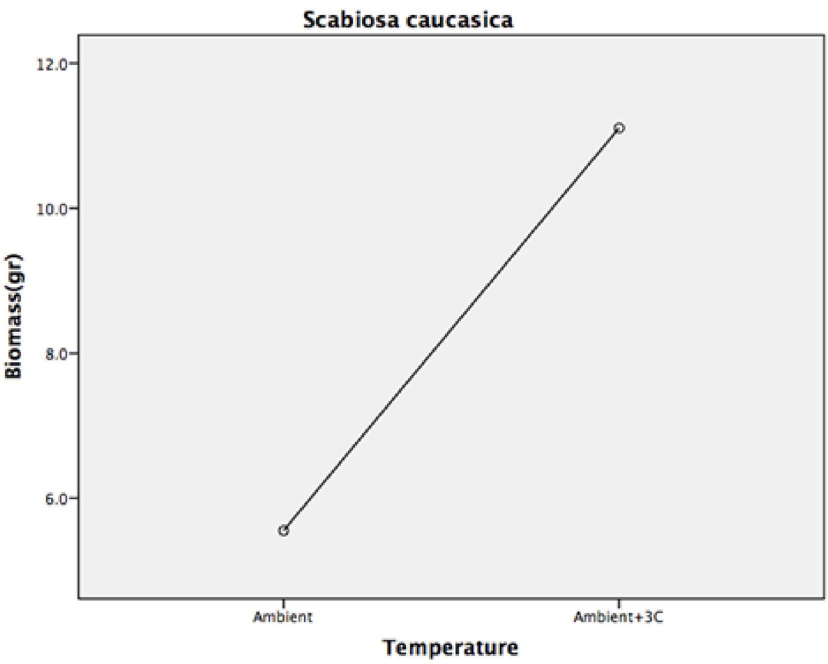
Effects of mollusc grazing and temperature treatments of biomass peroductivity of *Primula veris* *(Unpalatable).*



Effects of mollusc grazing and temperature treatments of biomass peroductivity of *Prunella vulgaris (Unpalatable).*



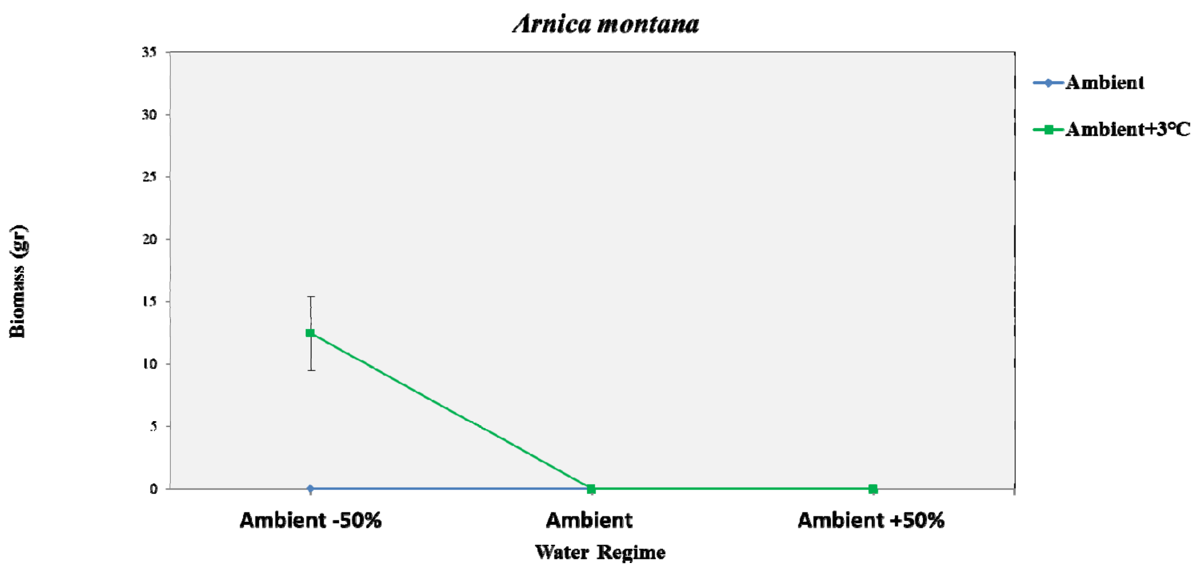
Effects of mollusc grazing and temperature treatments of biomass peroductivity of *Salvia pretense (Palatable).*



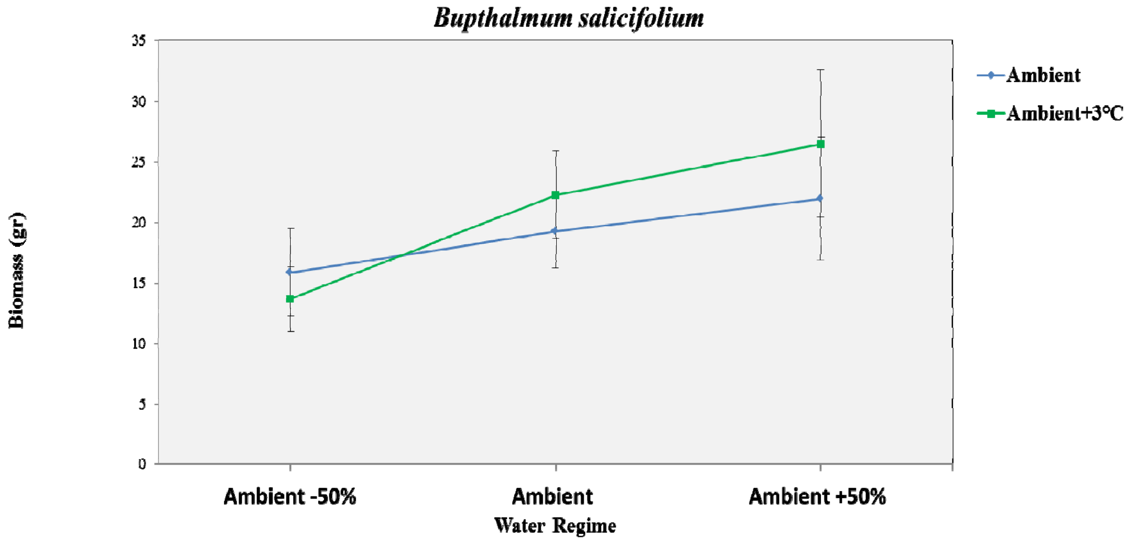
Effects of mollusc grazing and temperature treatments of biomass peroductivity of *Scabiosa caucasica (Palatable).*

The effects mollusc grazing and the water regime× temperature on well fitted species of biomass productivity.

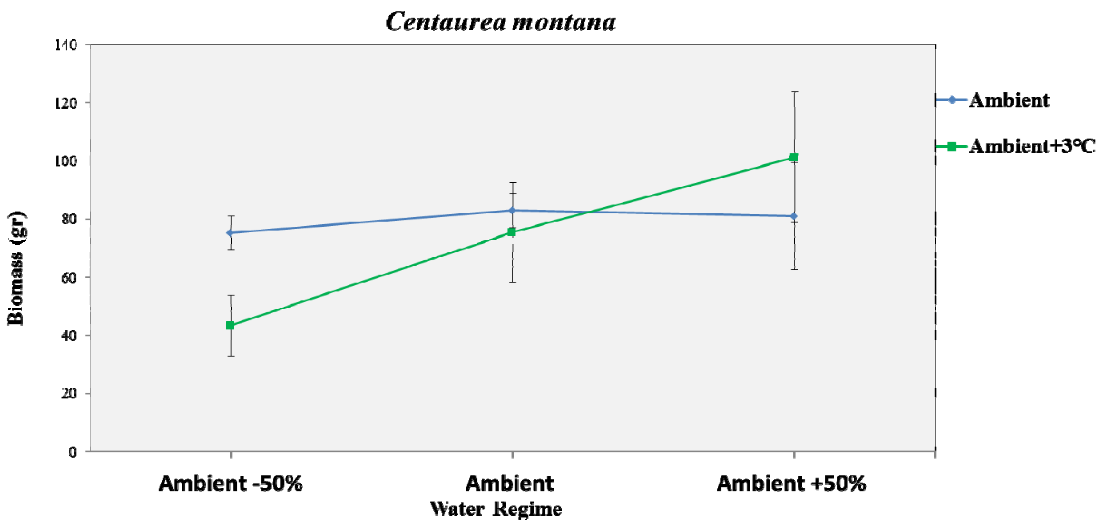
The following figures show in present of molllusc grazing how the temperature and water treatments affect the plant species in the well-fitted group. Because of mollusc grazing platabable species (*Arnica montana, Phyteuma spicatum var caeruluem, Salvia pretense and Scabiosa caucasica)* were disapearded when the moisture levels reaches Ambient at both of the temperature levels. As seen for unpalatable species (*Bupthalmum salicifolium, Centaurea montana, Galium verum, Geranium sylvaticu, Knautia arvensis, Origanum vulgare, Primula veris* and *Prunella vulgaris)* Ambient temperature produces more biomass at the Ambient-50% moisture. With increasing the moisture availability more biomass is produced when the these species are exposed to Ambient +3°C.



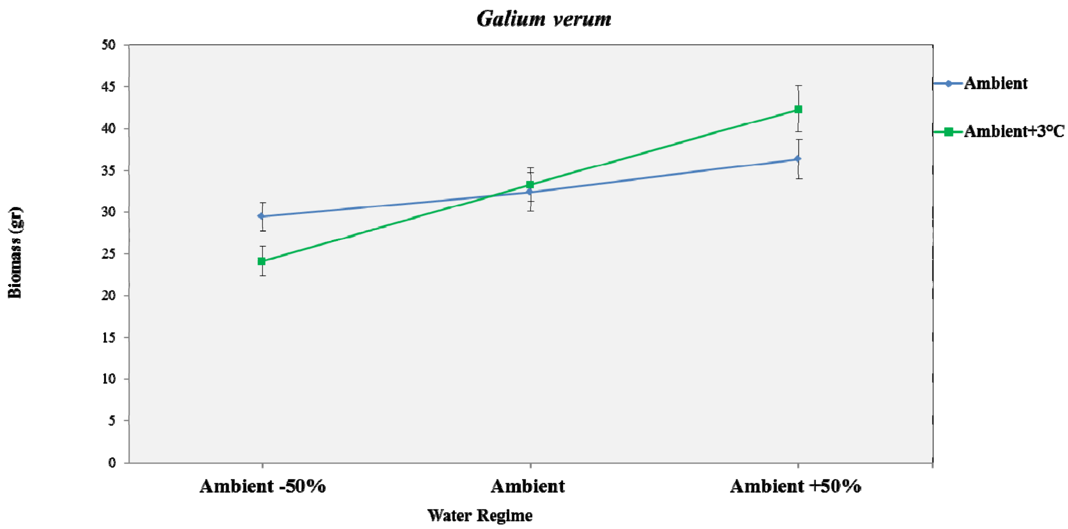
Combined effects mollusc grazing , water regime and temperature treatments on mass productivity of *Arnica montan (Palatable).*



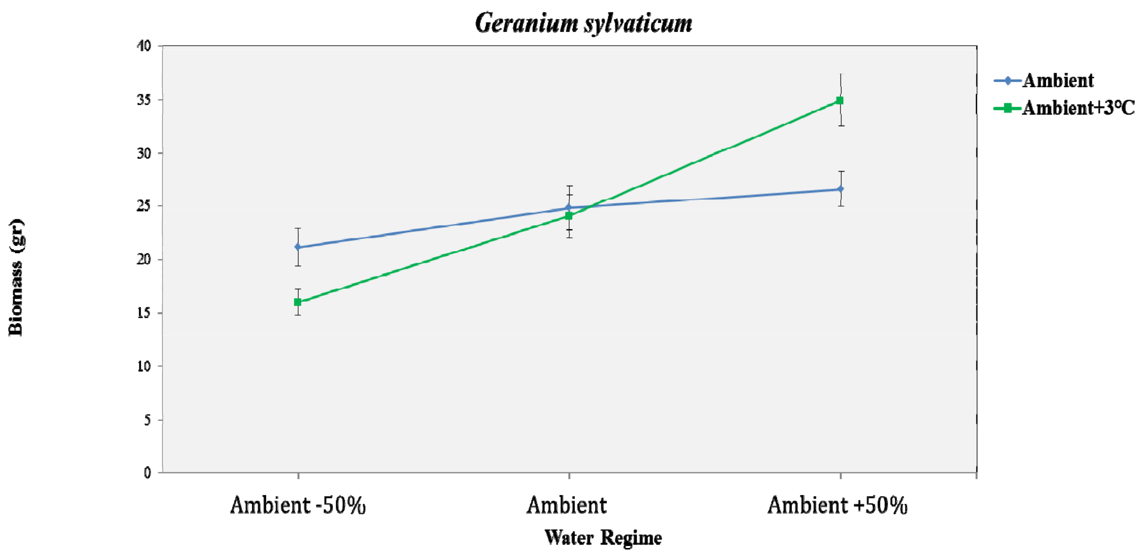
Combined effects mollusc grazing , water regime and temperature treatments on mass productivity of *Bupthalmum salicifolium (Palatable).*



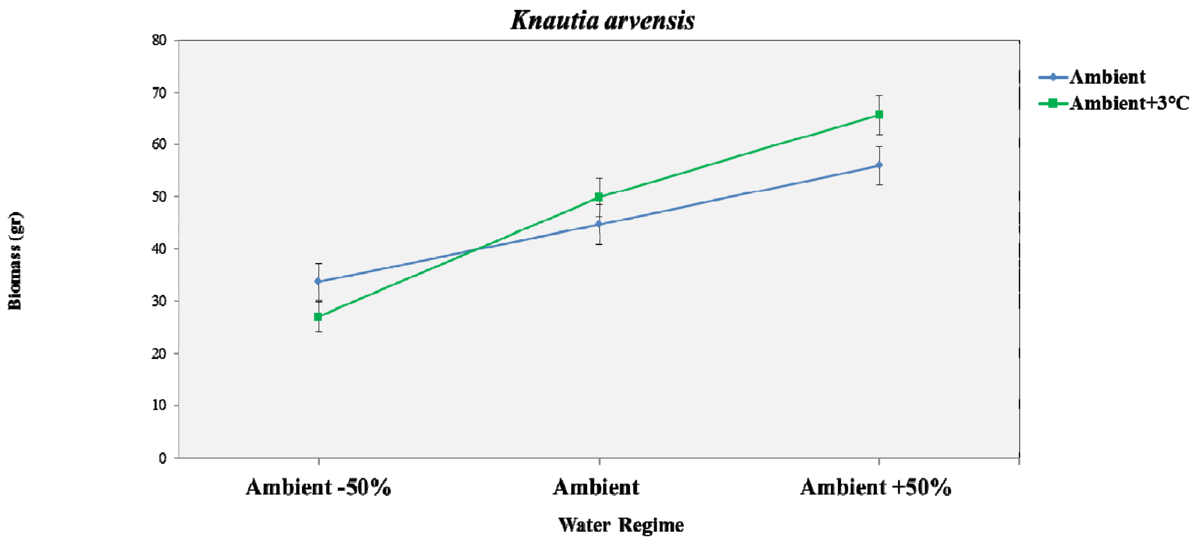
Combined effects mollusc grazing , water regime and temperature treatments on mass productivity of *Centaurea montana (Palatable).*



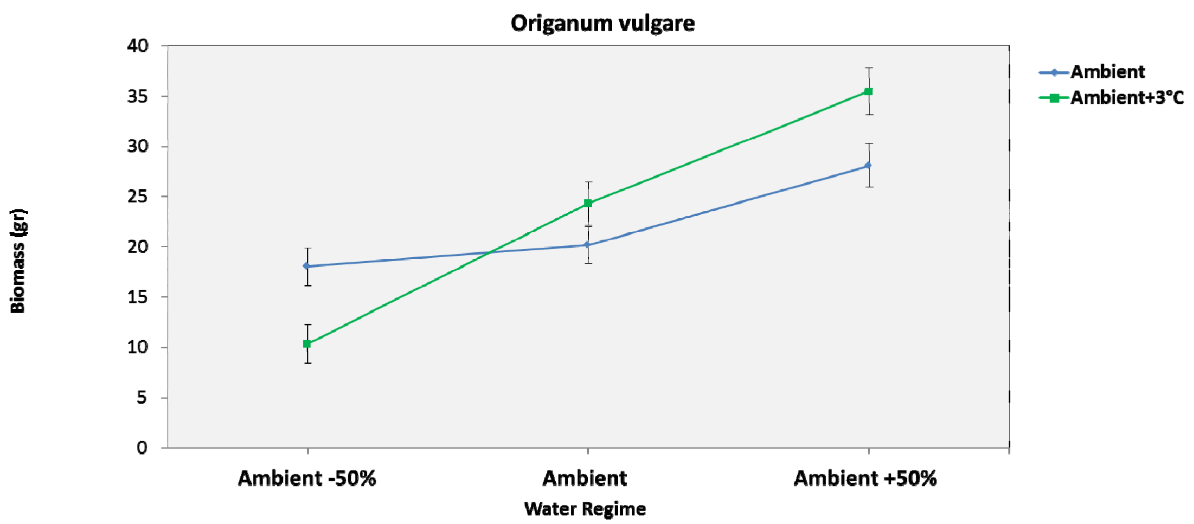
Combined effects mollusc grazing , water regime and temperature treatments on mass productivity of *Galium verum* (*Unpalatable).*



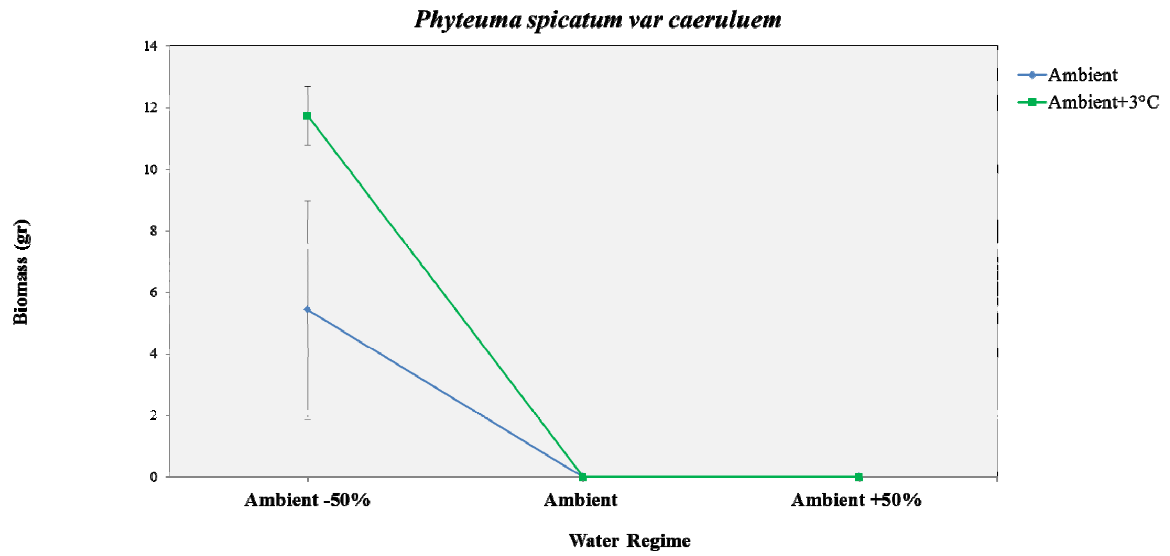
Combined effects mollusc grazing , water regime and temperature treatments on mass productivity of *Geranium sylvaticu (Unpalatable).*



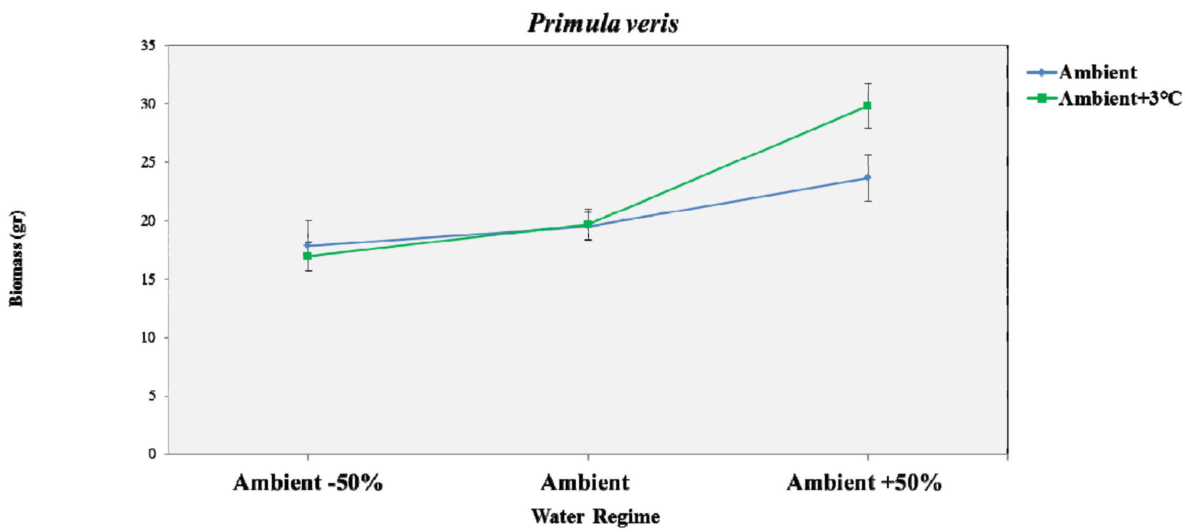
Combined effects mollusc grazing , water regime and temperature treatments on mass productivity of *Knautia arvensis (Unalatable).*



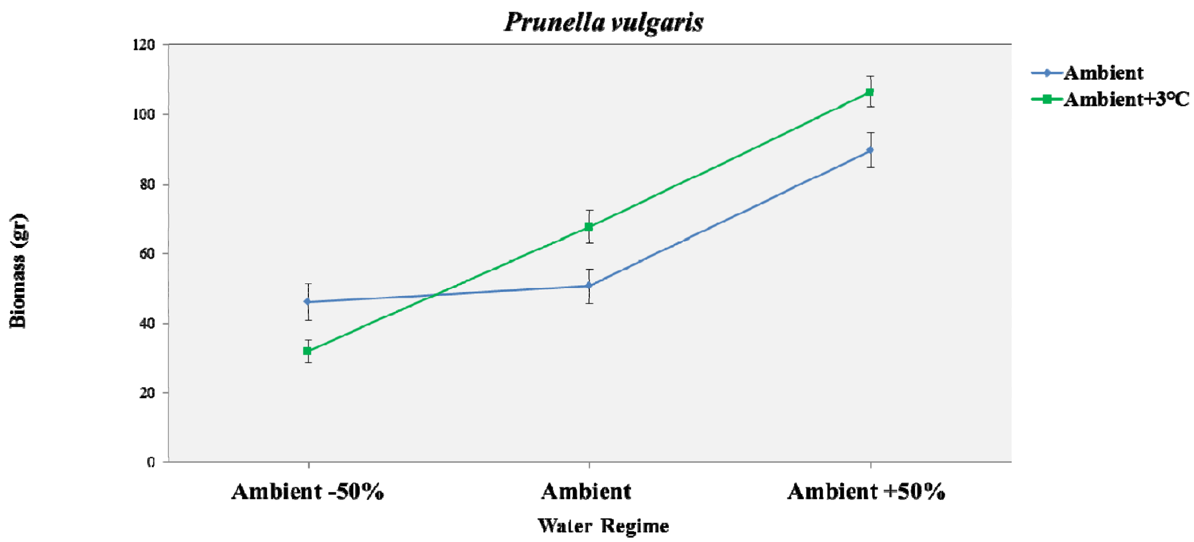
Combined effects mollusc grazing , water regime and temperature treatments on mass productivity of mollusc grazing *Origanum vulgare* (Palatable).



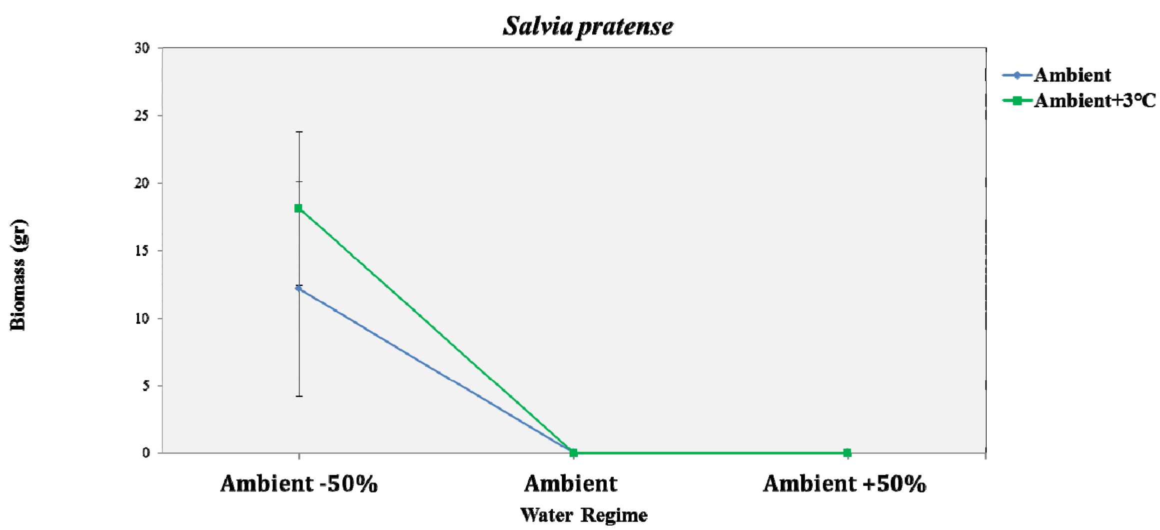
Combined effects mollusc grazing , water regime and temperature treatments on mass productivity of *Phyteuma spicatum var caeruluem (Palatable).*



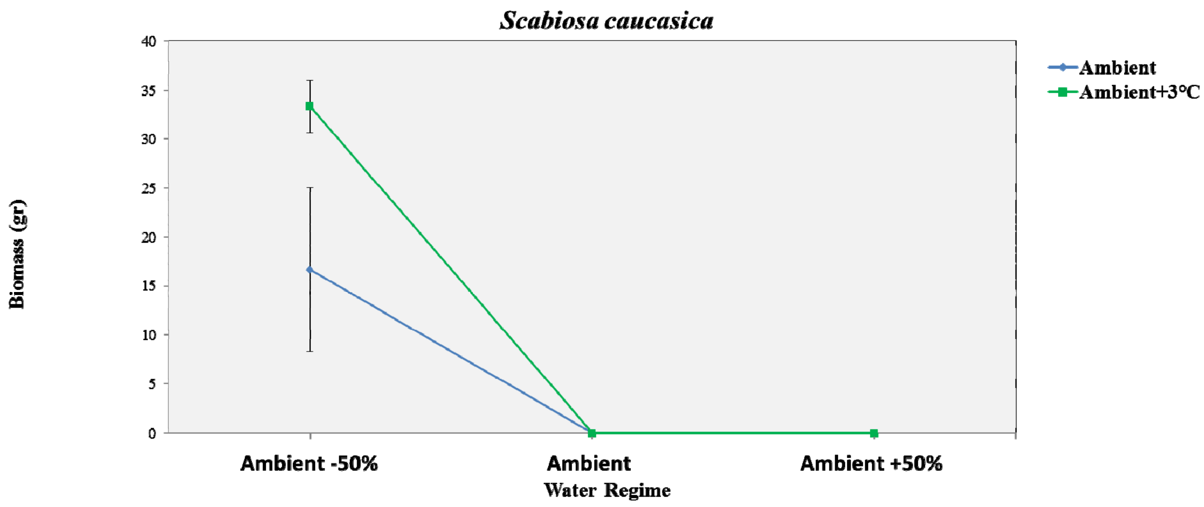
Combined effects mollusc grazing , water regime and temperature treatments on mass productivity of *Primula veris (Unpalatable).*



Combined effects mollusc grazing , water regime and temperature treatments on mass productivity of *Prunella vulgaris (Unpalatable).*



Combined effects mollusc grazing , water regime and temperature treatments on mass productivity of *Salvia pretense (Palatable).*

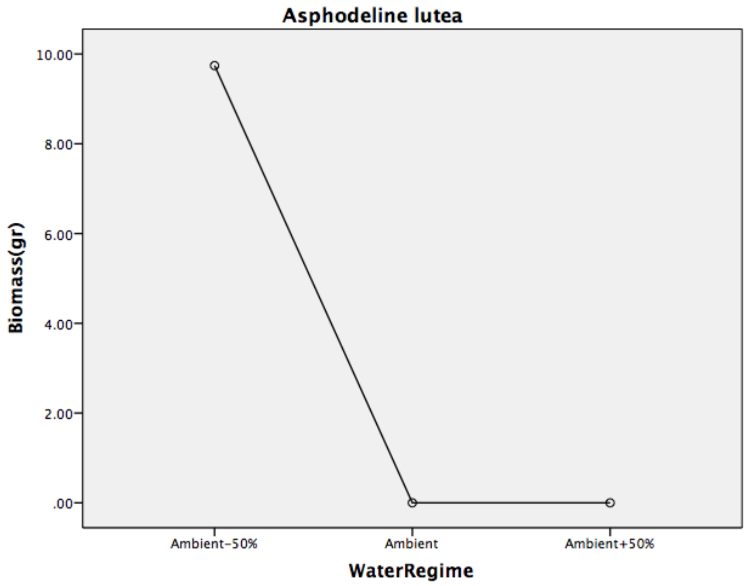


Combined effects mollusc grazing , water regime and temperature treatments on mass productivity of *Scabiosa caucasica (Palatable).*

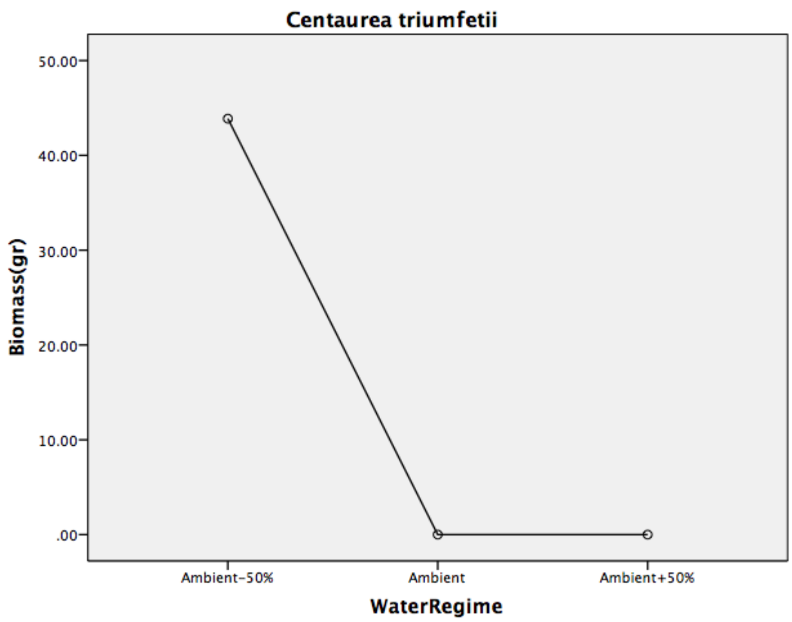
Intermediate Fitted Species

The effects of mollusc garing and the water regime on intermediate fitted species in terms of biomass productivity

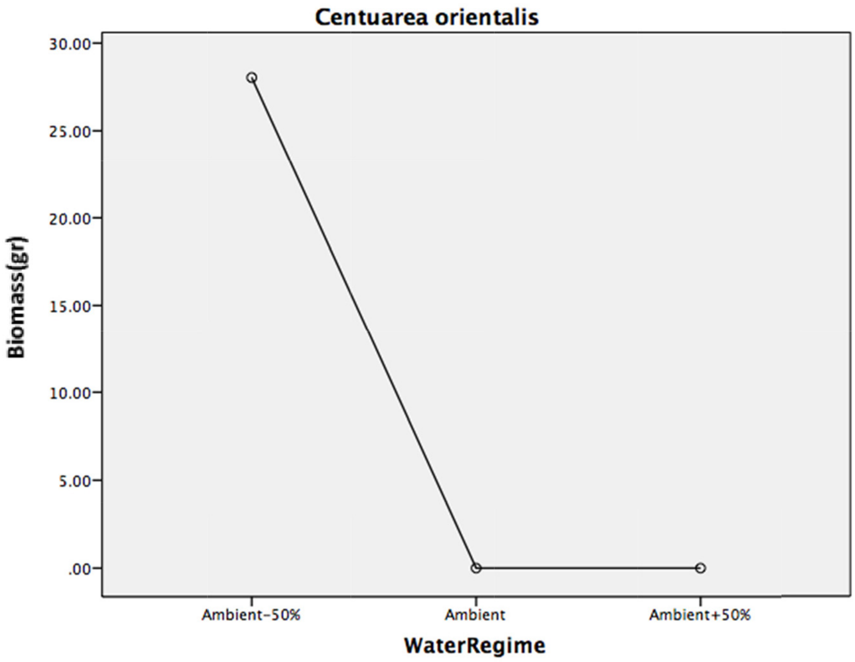
The following figures shows how the plant species in the intermediate fitted group have been affected by mollusc grazing and changing the moisture availability. Asphodeline lutea, *Centaurea triumfetii*, Centaurea orientali, *Hedysarum hedysaroides*, Paradisea liliastrum and *Salvia nemorosa* are all palatable species that disappear with increasing the moisture levels. Due to increased activities of the mollusc by increasing the moisture levels at Amibient and Ambient+50% moisture levels these palatable plants fail to survive. On the other hand *Dianthus carthusinorum*, Euphorbia nicaensis,Linum flavum Compactum, Linum narbonennse,Lychnis cornonoria and Lychnis flos jovis, which all are unpalatable plants in this group show a sharp increase in biomass production with increasing the moisture availability. As mollusc selevetiely choose palatable plants, the growth condition is more favorable with increasing the moisture levels for unpalatable species in the intermediate fitted group.



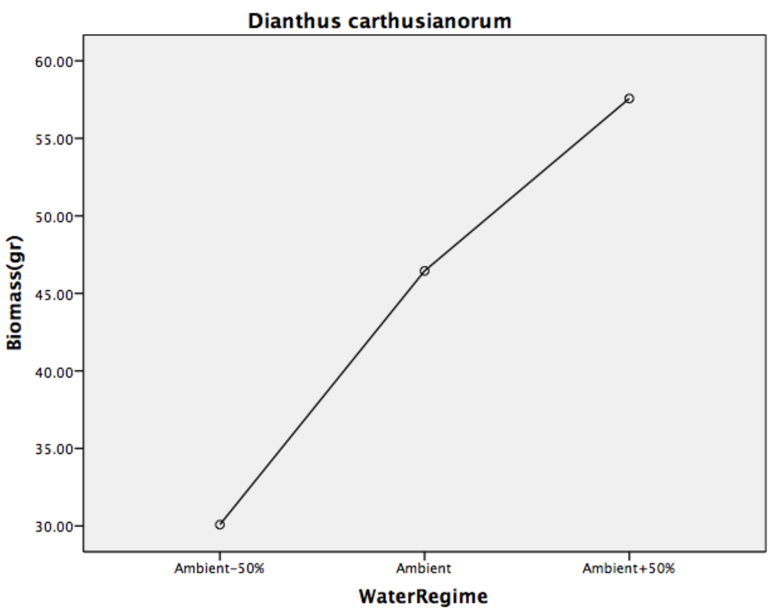
Effects of mollusc grazing and water regimes on biomass productivity of Asphodeline lutea (Palatable).



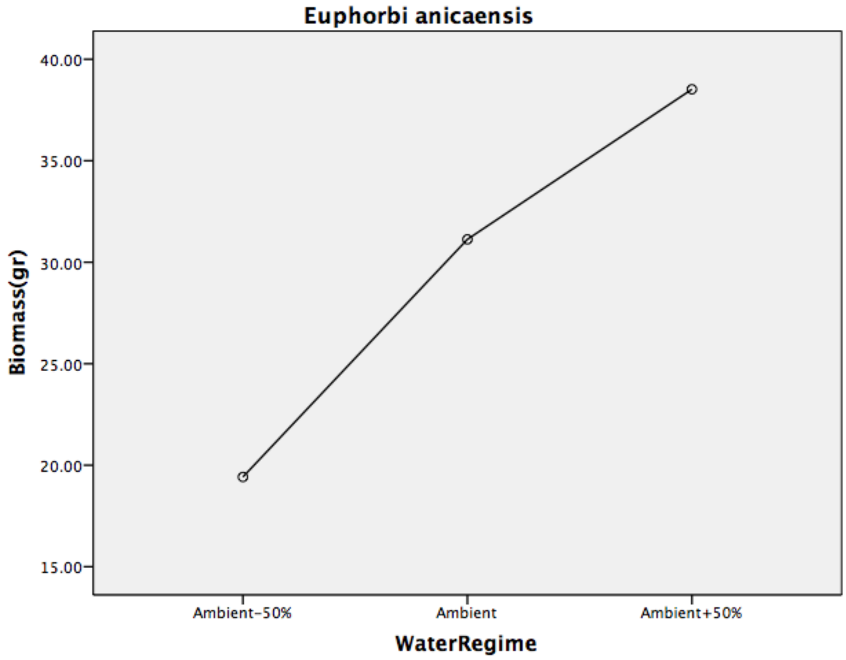
Effects of mollusc grazing and water regimes on biomass productivity of *Centaurea triumfetii* (Palatable).



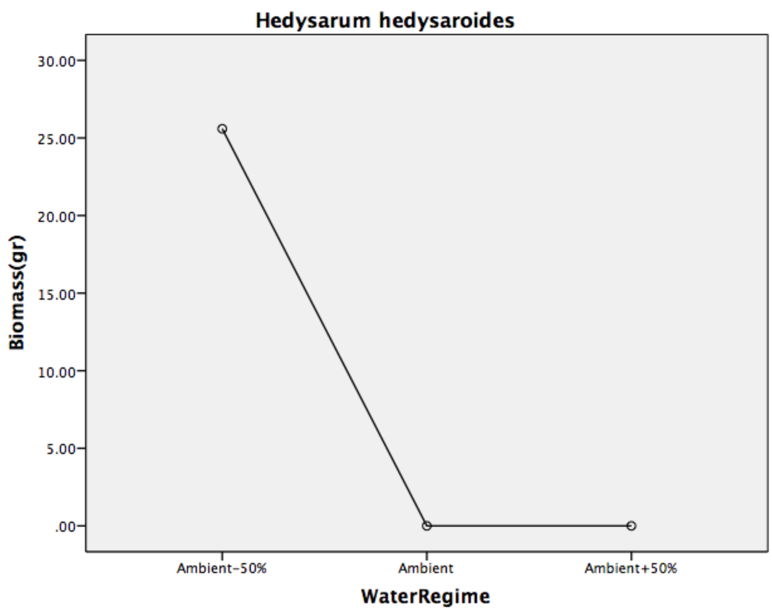
Effects of mollusc grazing and water regimes on biomass productivity of Centaurea orientalis (Palatable).



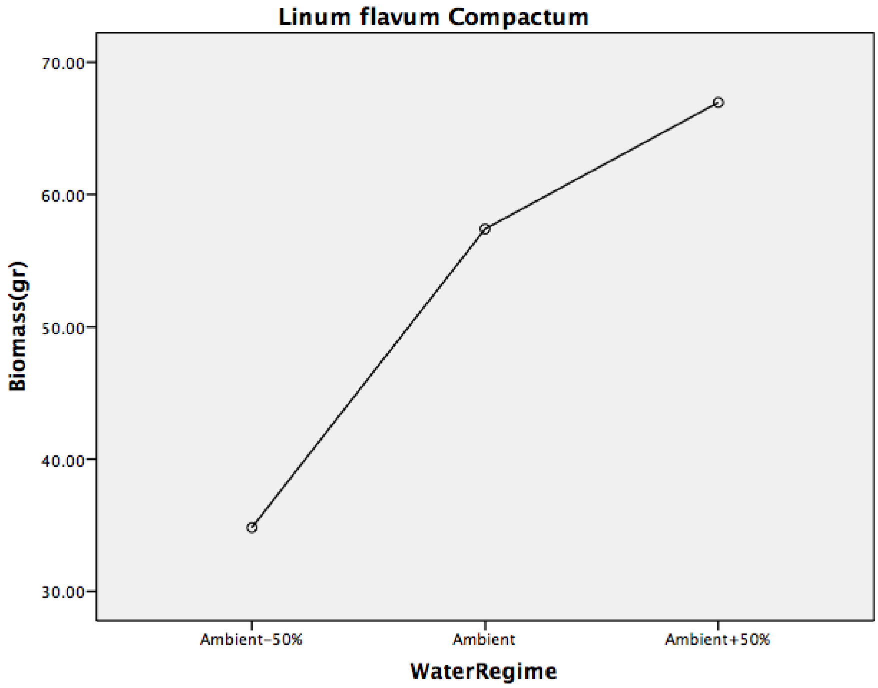
Effects of mollusc grazing and water regimes on biomass productivity of *Dianthus carthusinorum* (Unpalatable).



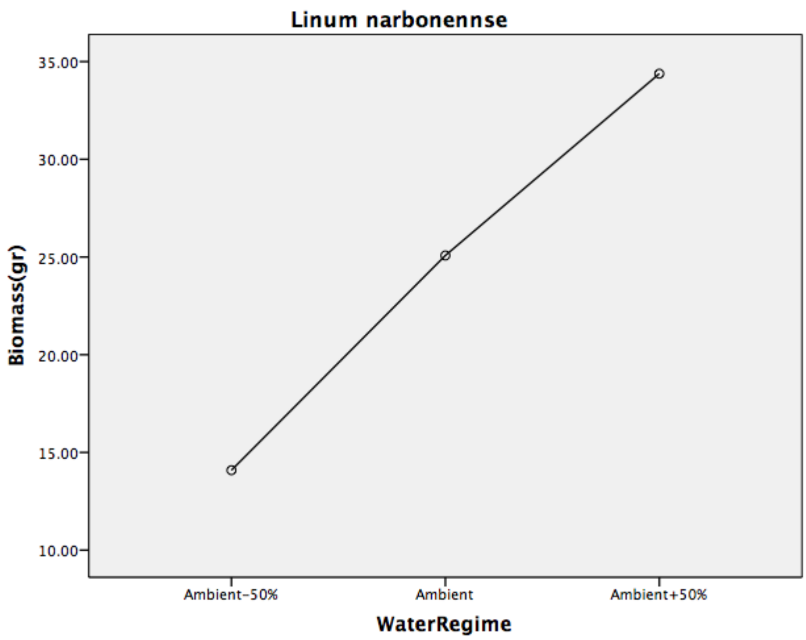
Effects of mollusc grazing and water regimes on biomass productivity of nicaensis (Unpalatable).



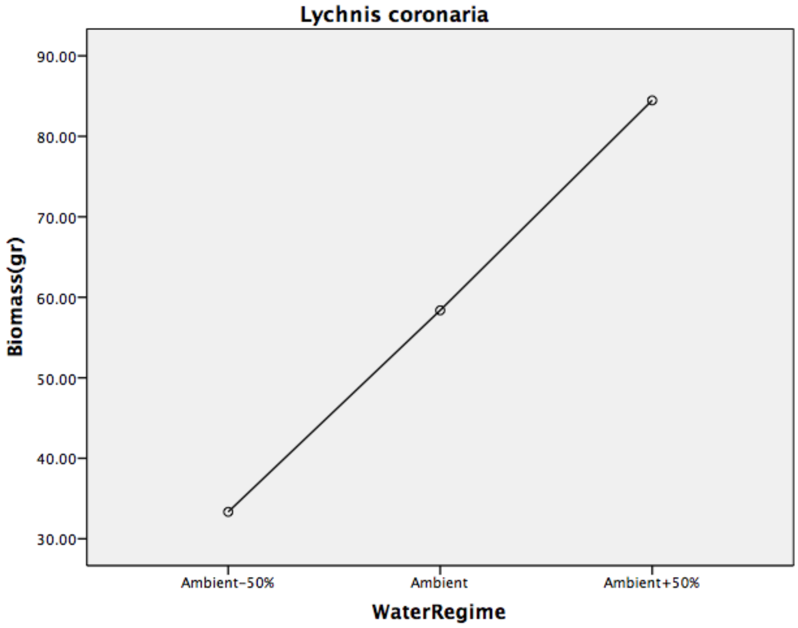
Effects of mollusc grazing and water regimes on biomass productivity of *Hedysarum hedysaroides* (Palatable).



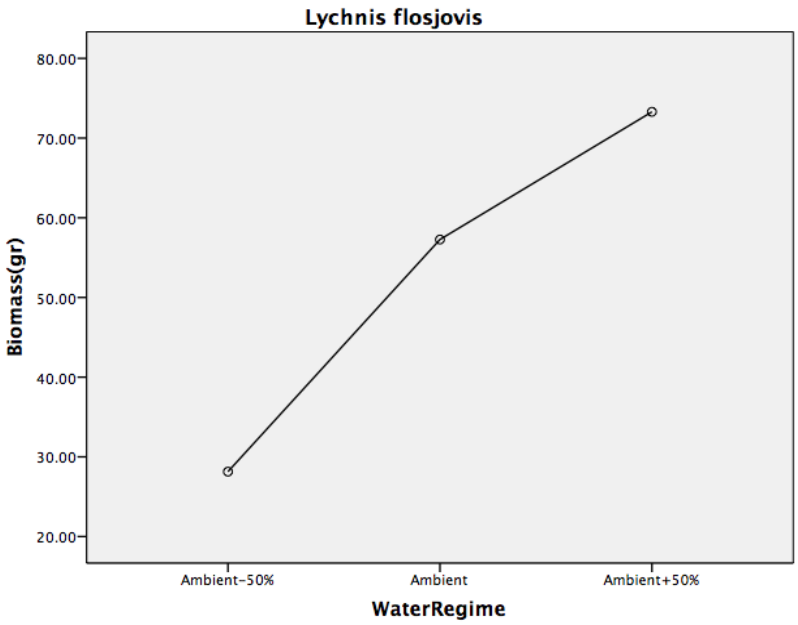
Effects of mollusc grazing and water regimes on biomass productivity of Linum flavum Compactum (Unpalatable).



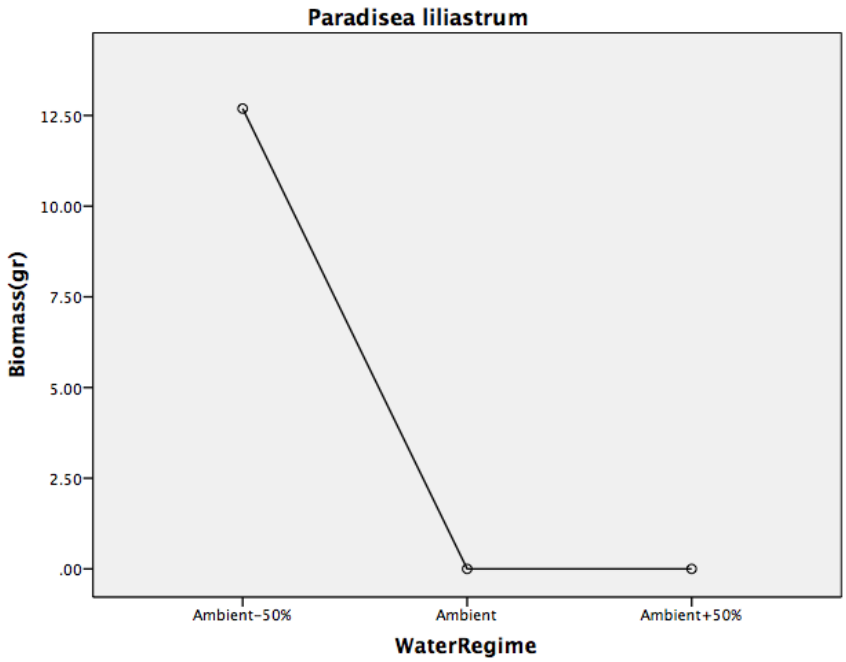
Effects of mollusc grazing and water regimes on biomass productivity of Linum narbonennse (unalatable).



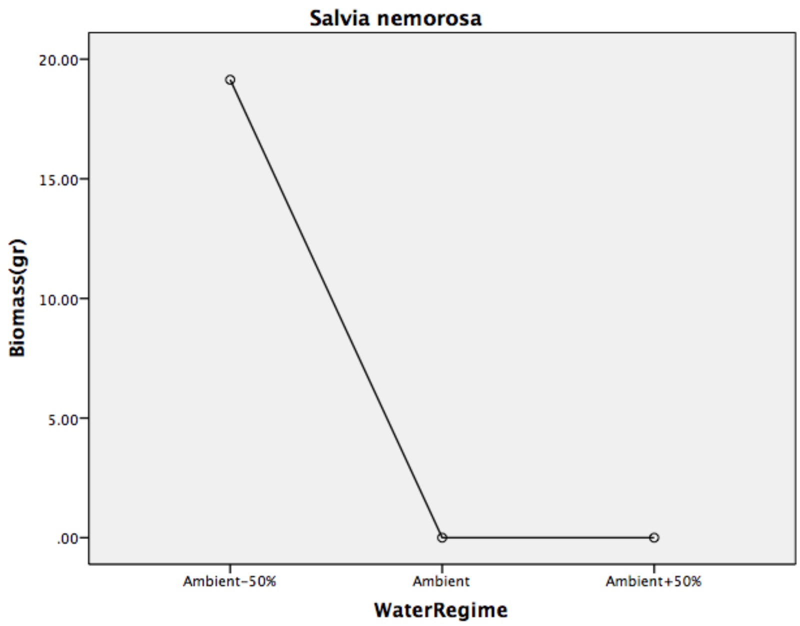
Effects of mollusc grazing and water regimes on biomass productivity of Lychnis cornonoria (Unpalatable).



Effects of mollusc grazing and water regimes on biomass productivity of Lychnis flos jovis (Unpalatable).



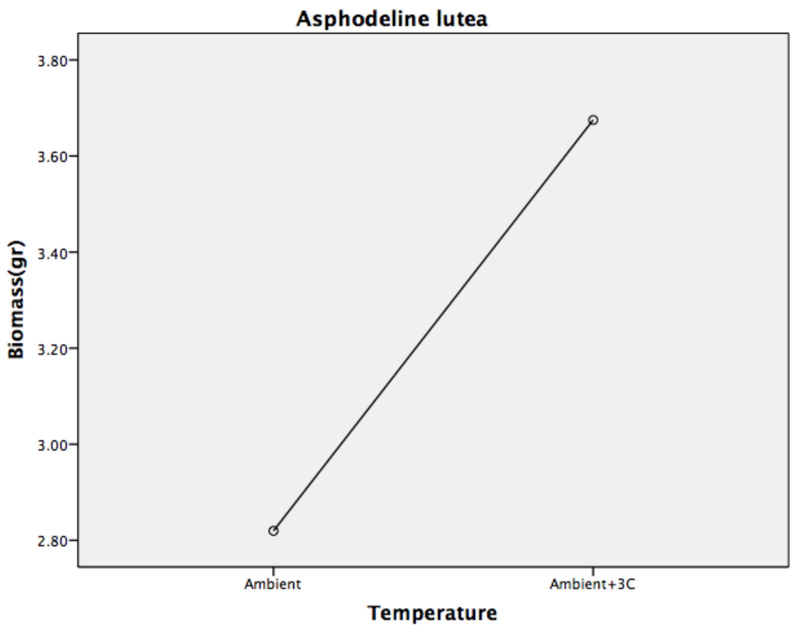
Effects of mollusc grazing and water regimes on biomass productivity of Paradisea liliastrum (Palatable).



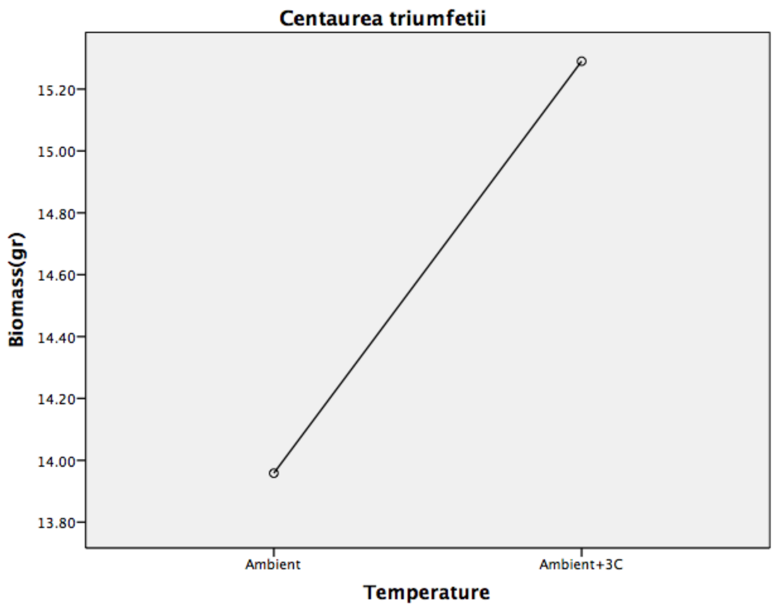
Effects of mollusc grazing and water regimes on biomass productivityof *Salvia nemorosa* (Palatable).

The effects of mollusc grazing and different level of temperature on biomass productivity of intermediated fitted species

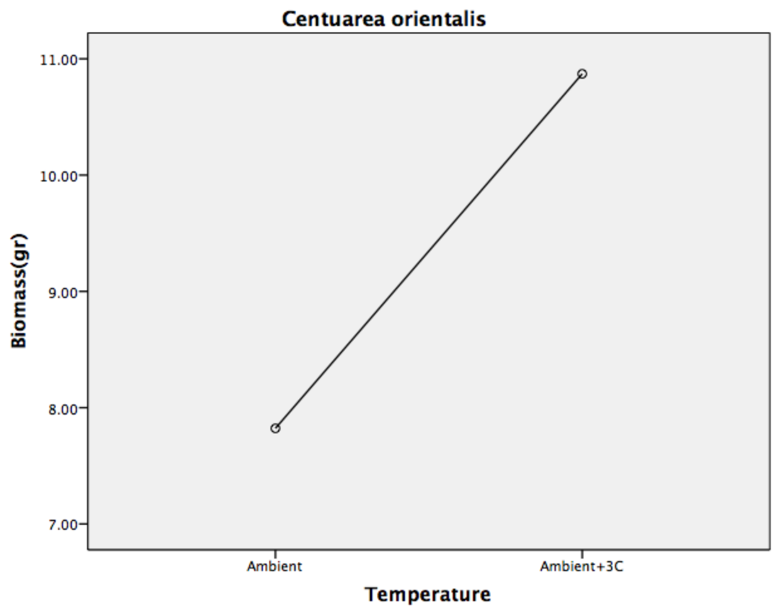
The following figures shows how the plant species in the intermediate fitted group have been affected by mollusc grazing and changing the temperature levels. It is clear that increasing the temperature levels improves biomass production for all the species, which could be attributed to both positive impacts of the temperature on the plant growth and reduced mollusc activities as a result of higher temperature. The only exception to this group is *Salvia nemorosa (Palatable)*, which shows decreasing trend with increasing the temperature.



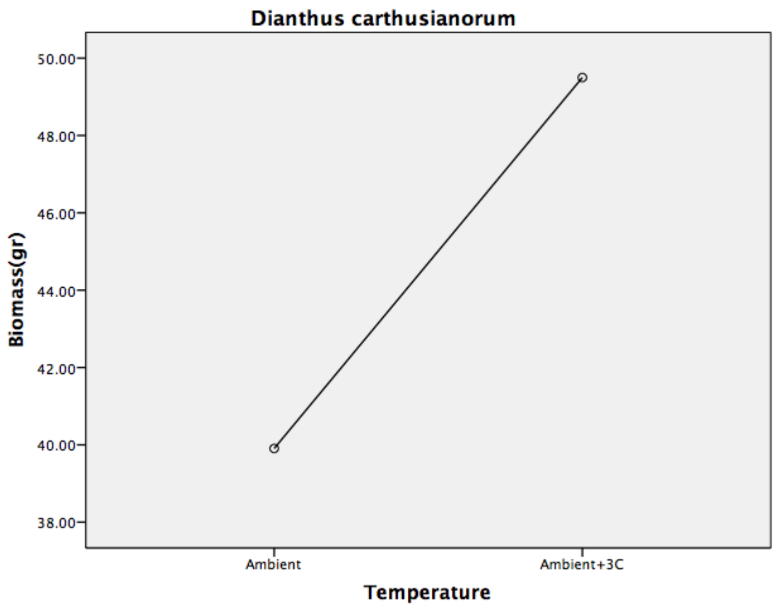
Effects of mollusc grazing and temperature treatment on biomass productivity of Asphodeline lutea (Palatable).



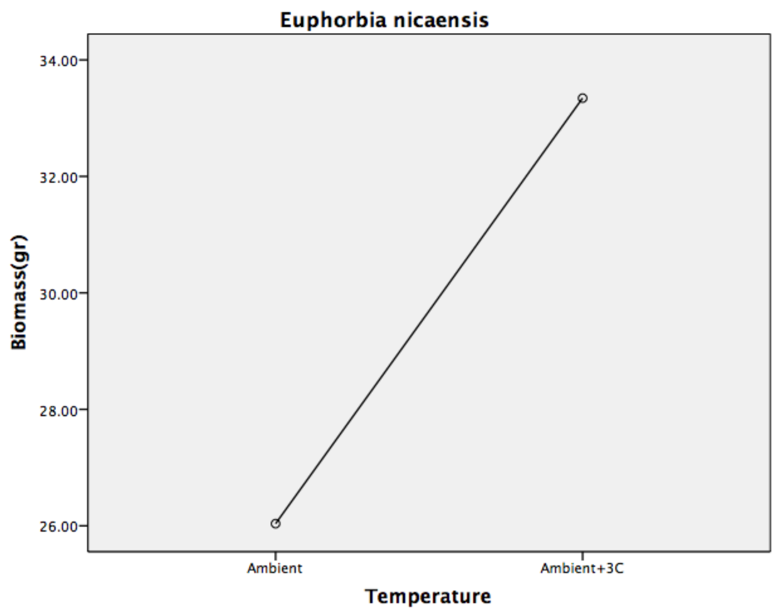
Effects of mollusc grazing and temperature treatment on biomass productivity of *Centaurea triumfetii* (Palatable).



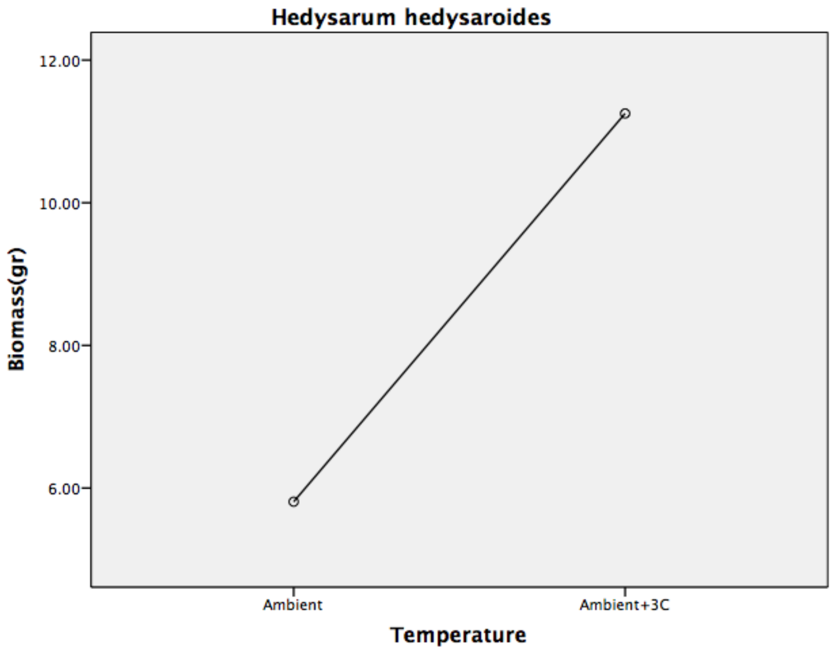
Effects of mollusc grazing and temperature treatment on biomass productivity of Centaurea orientalis (Palatable).



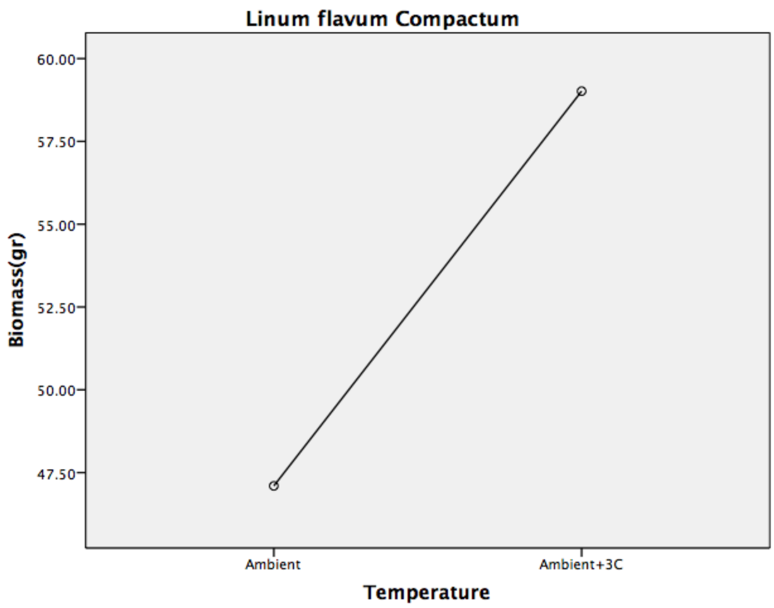
Effects of mollusc grazing and temperature treatment on biomass productivity of *Dianthus carthusinorum* (Unpalatable).



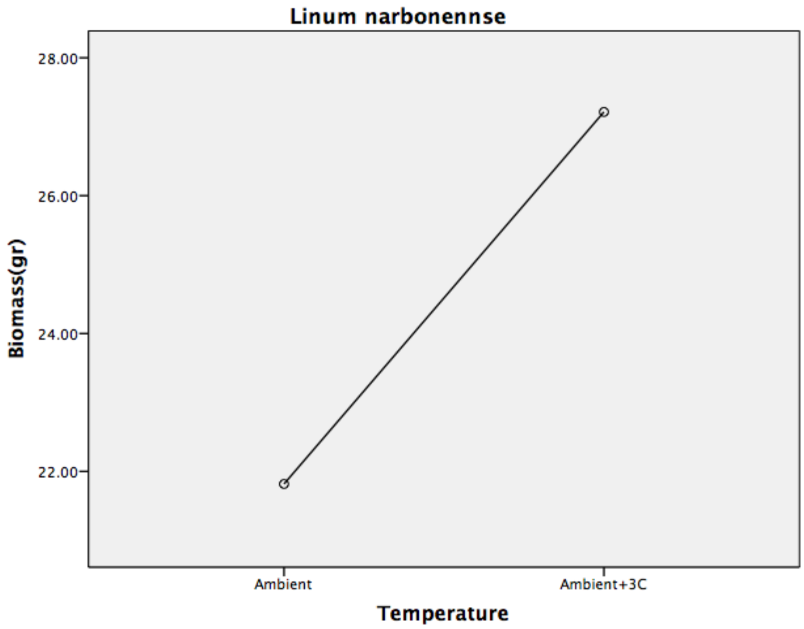
Effects of mollusc grazing and temperature treatment on biomass productivity of Euphorbia nicaensis (Unpalatable).



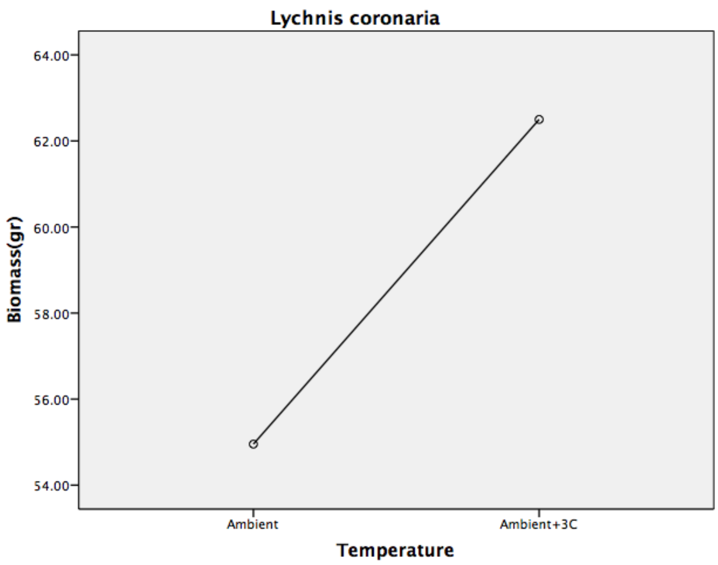
Effects of mollusc grazing and temperature treatment on biomass productivity of *Hedysarum hedysaroides* (Palatable).



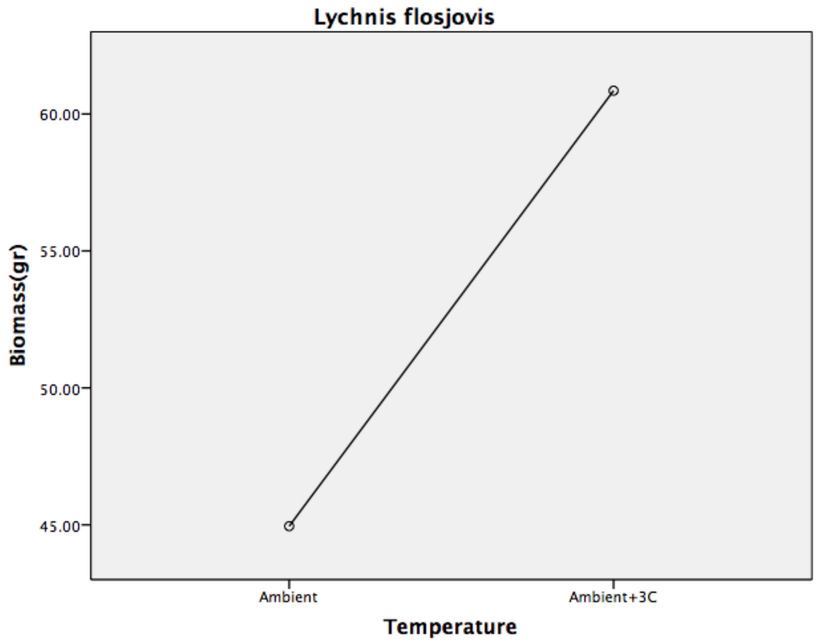
Effects of mollusc grazing and temperature treatment on biomass productivity of Linum flavum Compactum (Unpalatable).



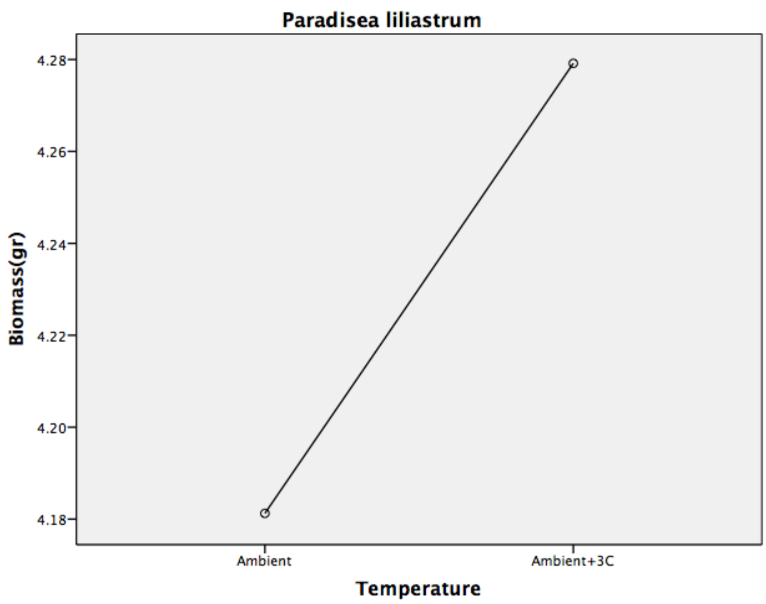
Effects of mollusc grazing and temperature treatment on biomass productivity of Linum narbonennse (unalatable).



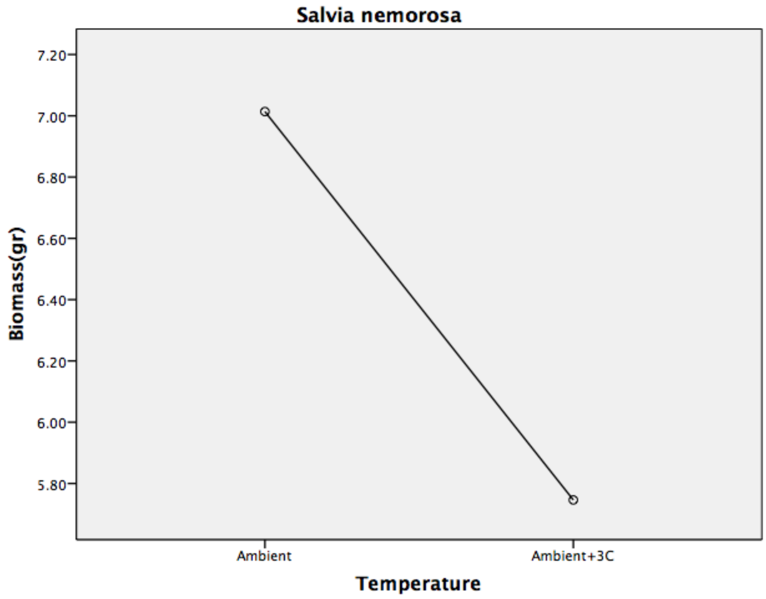
Effects of mollusc grazing and temperature treatment on biomass productivity of Lychnis cornonoria (Unpalatable).



Effects of mollusc grazing and temperature treatment on biomass productivity of Lychnis flos jovis (Unpalatable).



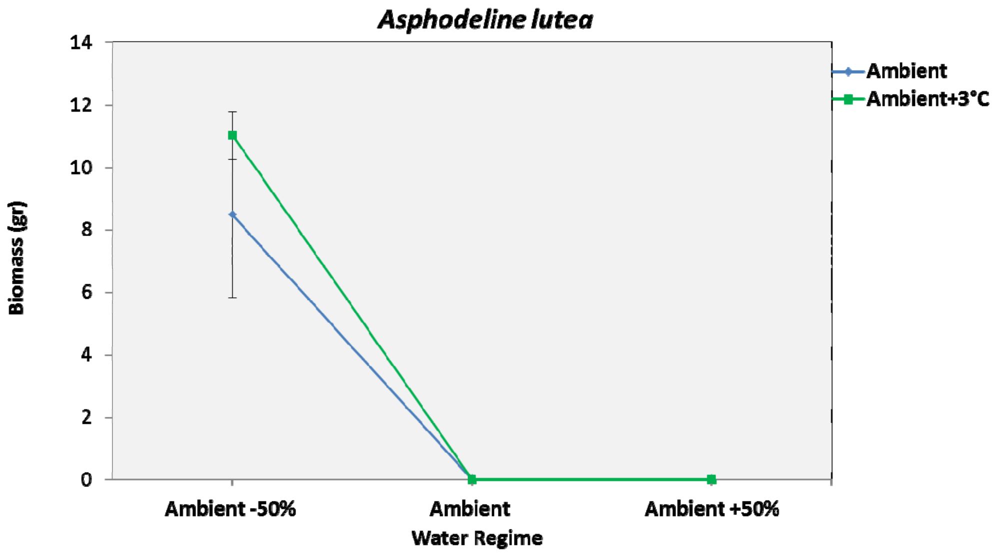
Effects of mollusc grazing and temperature treatment on biomass productivity of Paradisea liliastrum (Palatable).



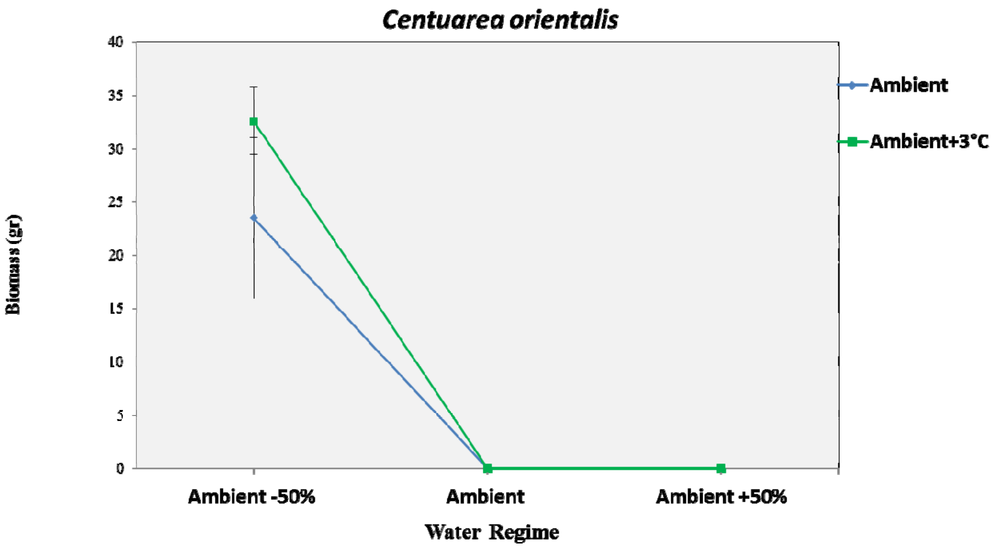
Effects of mollusc grazing and temperature treatment on biomass productivity of *Salvia nemorosa* (Palatable).

The effects mollusc grazing and the water regime× temperature on intermediate fitted species of biomass productivity.

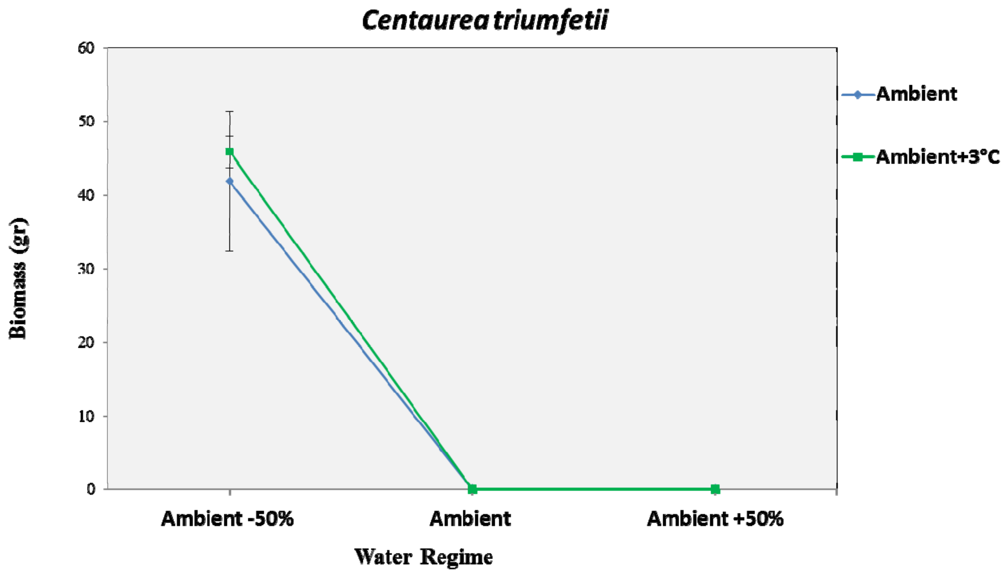
Combined effects of mollusc grazing , water regime and temperature on species shown in the following figures. A distinguishable pattern is observed between palatable and unpalatable species. The palatable species *Asphodeline lutea, Centaurea triumfetii, Centaurea orientalis, Hedysarum hedysaroides, Paradisea liliastrum* and *Salvia nemorosa* showed the max of their biomass productivity at Ambient-50% moisture for both of the temperature treatments. Because at this climate condition mollusc show thire min activity. With increasing the moisture levels there is sharp decrease in the biomass production and the palatable species fail to survive under both of the temperature conditions. This trend can suggest that increased activity of mollusc due to higher moisture levels is the reason that these species can not survive. The unpalatable plants biomass production shows an opposite trend and by increasing the moisture and temperature levels more biomass is produced, which again highlight role of mollusc grazing in plants survival .



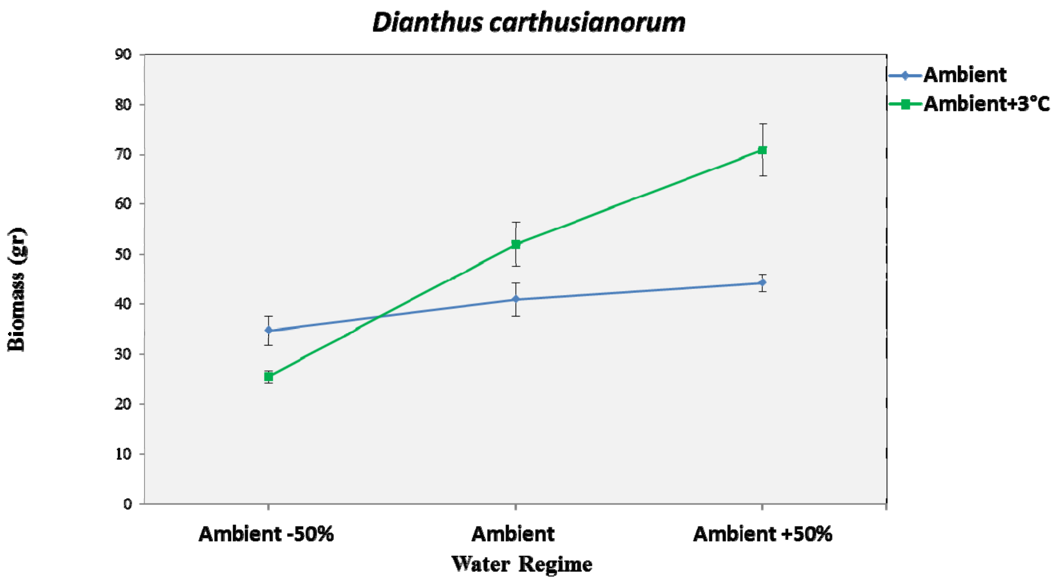
Combined effects of mollusc grazing for the water and temperature treatments biomass productivity of Asphodeline lute (Palatable).



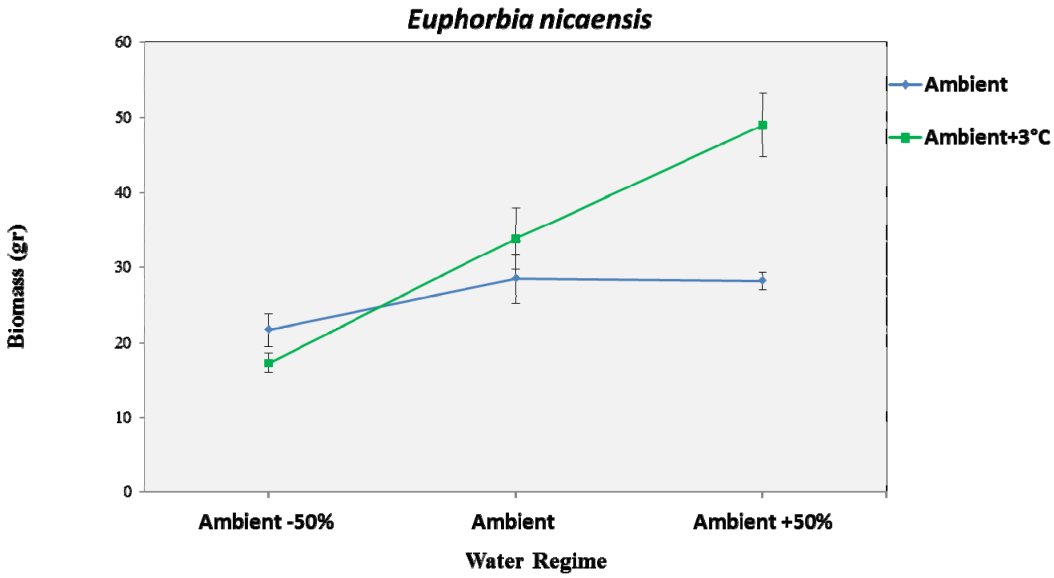
Combined effects of mollusc grazing for the water and temperature treatments biomass productivity of Centaurea orientalisn (Palatable).



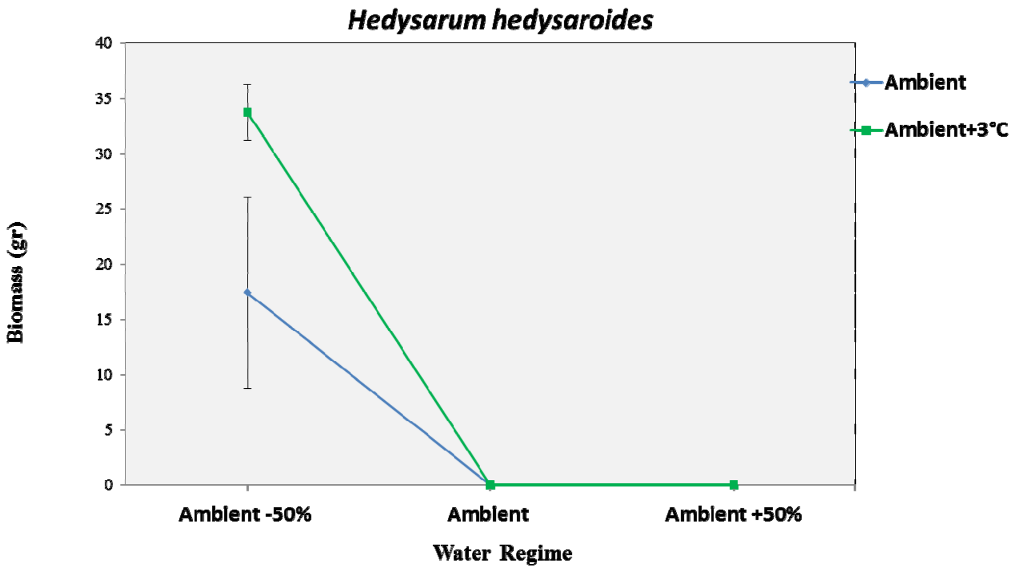
Combined effects of mollusc grazing for the water and temperature treatments biomass productivity of *Centaurea triumfetii* (Palatable).



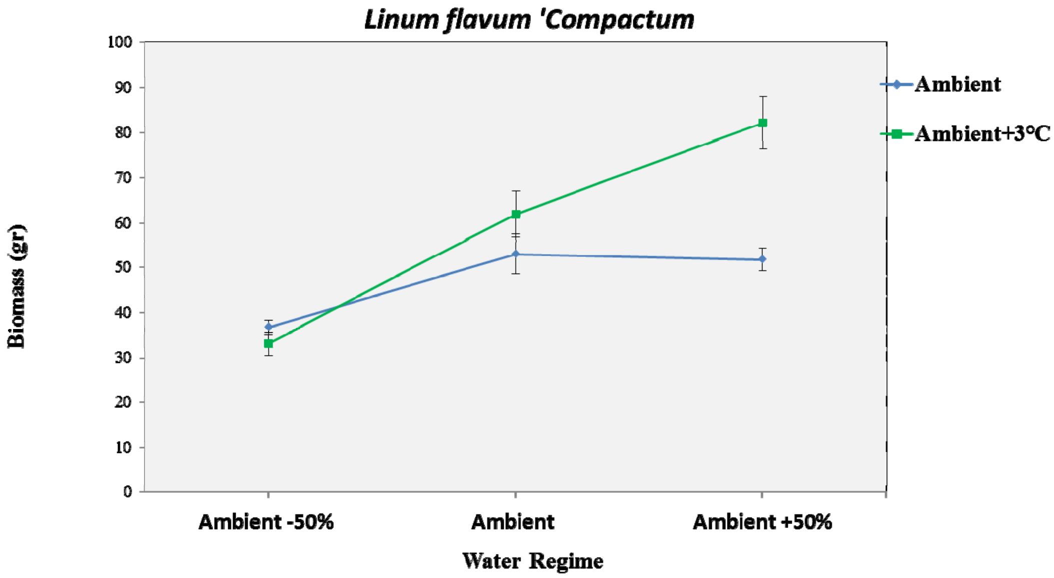
Combined effects of mollusc grazing for the water and temperature treatments biomass productivity of *Dianthus carthusinorum* (Unpalatable).



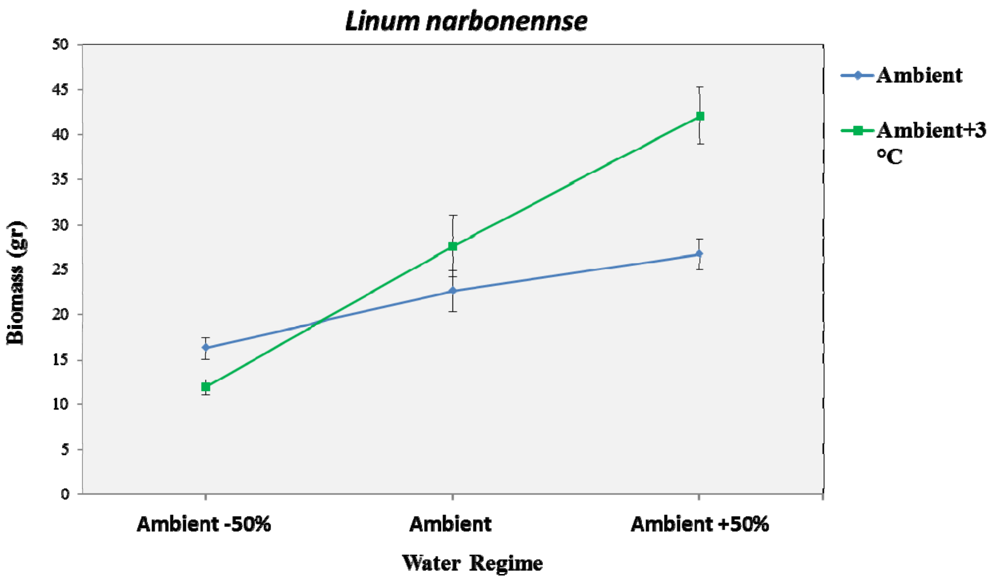
Combined effects of mollusc grazing for the water and temperature treatments biomass productivity of Euphorbia nicaensis (Unpalatable).



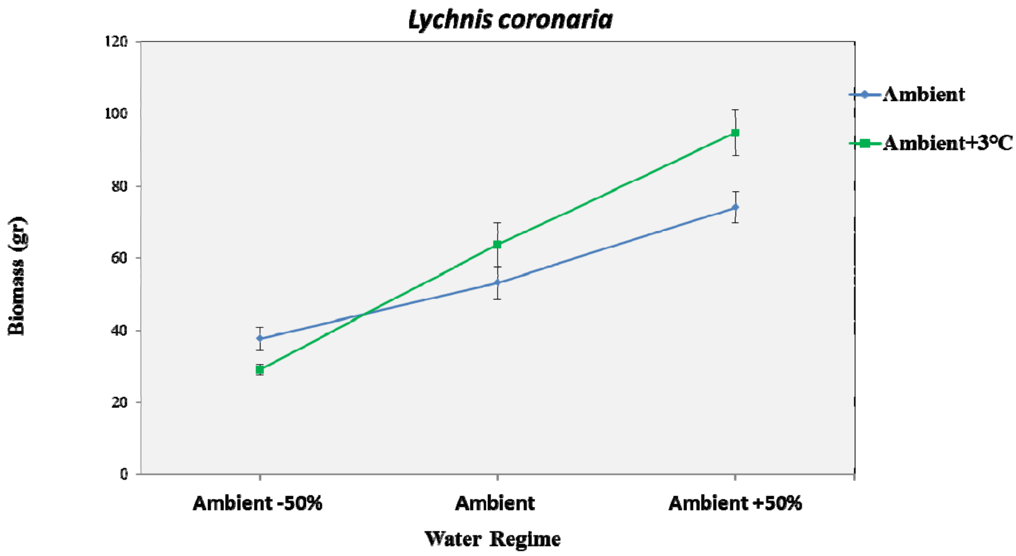
Combined effects omollusc grazing for the water and temperature treatments biomass productivity of *Hedysarum hedysaroides* (Palatable).



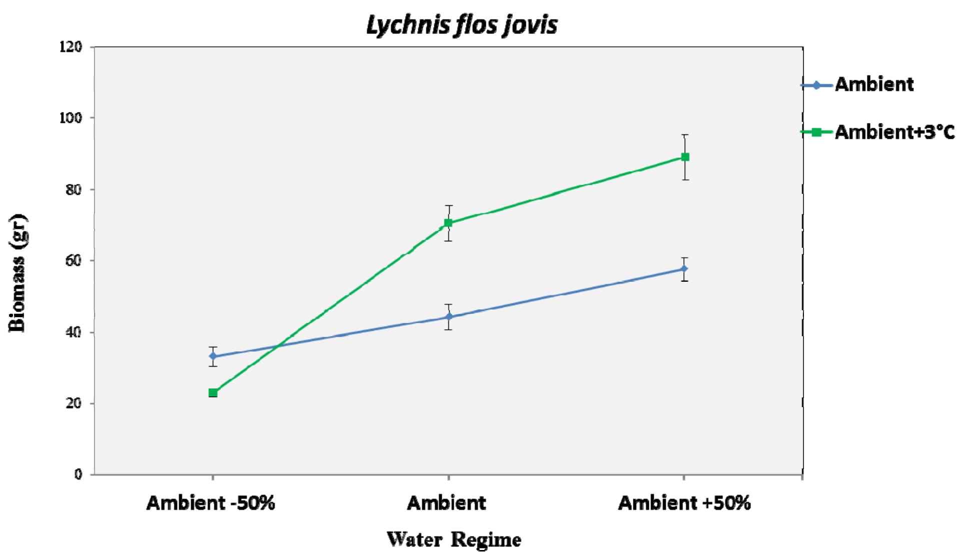
Combined effects of mollusc grazing for the water and temperature treatments biomass productivity of Linum flavum Compactum (Unpalatable).



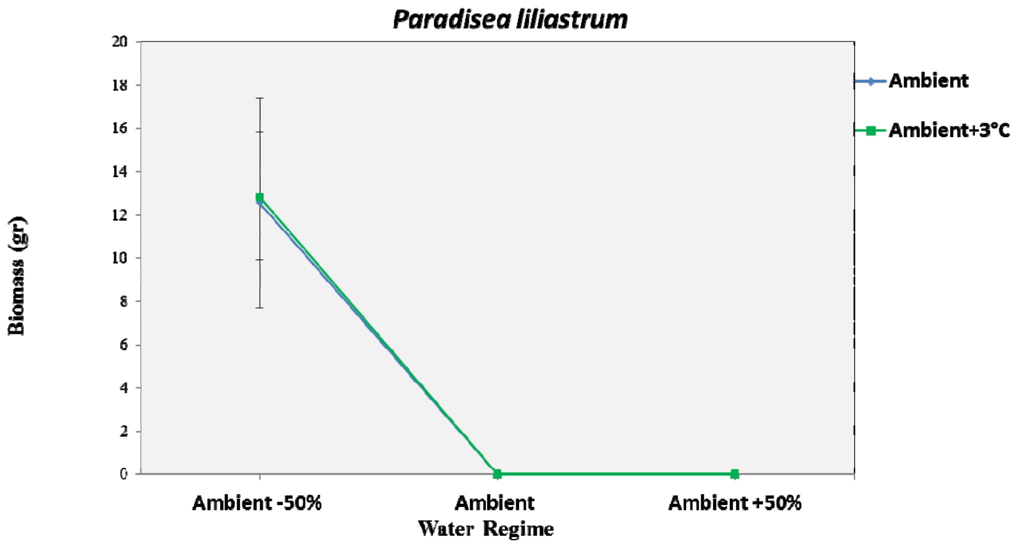
Combined effects of mollusc grazing for the water and temperature treatments biomass productivity of Linum narbonennse (Unpalatable).



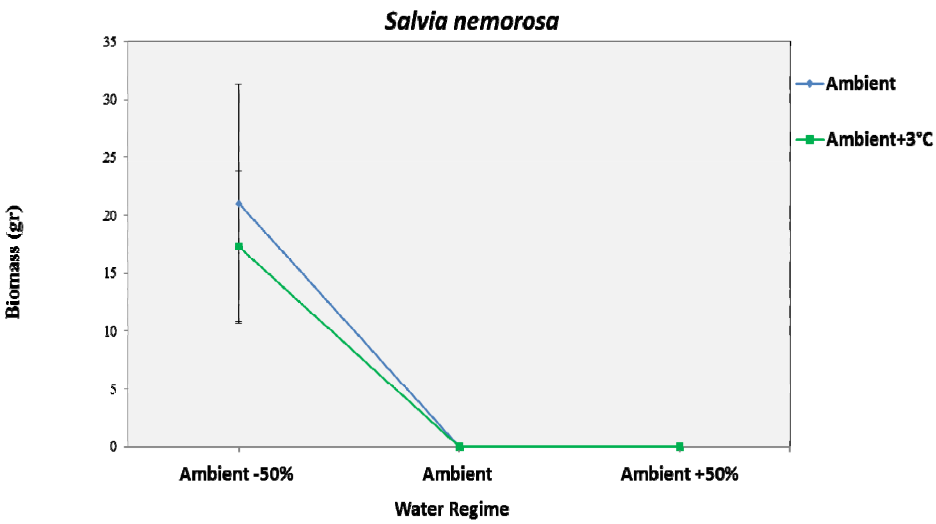
Combined effects of mollusc grazing for the water and temperature treatments biomass productivity of Lychnis cornonoria (Unpalatable).



Combined effects of mollusc grazing for the water and temperature treatments biomass productivity of Lychnis flos jovis (Unpalatable).



Combined effects of mollusc grazing for the water and temperature treatments biomass productivity of Paradisea liliastrum (Palatable).



Combined effects of mollusc grazing for the water and temperature treatments biomass productivity of *Salvia nemorosa* (Palatable).

Appendix 5

Data analyzing of chapter 4

Factor	Type	Levels	Values	
hazazon	fixed	2	1; 2	Hazazon:mollusc / 1: No mollusk, 2: mollusc
Water Regime	fixed	3	1; 2; 3	1:Ambient-50%,2: Ambient, 3: Ambient+50%
Temperature	fixed	2	1; 2	1: Ambient, 2: Ambient+3C
Year	fixed	2	1; 2	

5.1 Well fitted species

Note: Means that do not share a letter are significantly different.

Grouping Information Using Bonferroni Method and 95.0% Confidence

Analysis of Variance for Arnica montana, using Adjusted SS for Tests

Source	DF	Seq SS	Adj SS	Adj MS	F	P
hazazon	1	7441.00	7441.00	7441.00	212.66	0.000
Water Regime	2	51.08	51.08	25.54	0.73	0.485
hazazon*Water Regime	2	812.78	812.78	406.39	11.61	0.000
Temperature	1	182.79	182.79	182.79	5.22	0.025
hazazon*Temperature	1	46.25	46.25	46.25	1.32	0.254
Water Regime*Temperature	2	40.10	40.10	20.05	0.57	0.566
Year	1	629.06	629.06	629.06	17.98	0.000
hazazon*Year	1	438.46	438.46	438.46	12.53	0.001
Water Regime*Year	2	99.34	99.34	49.67	1.42	0.248
Temperature*Year	1	19.41	19.41	19.41	0.55	0.459
hazazon*Water Regime*Year	2	156.95	156.95	78.47	2.24	0.113
Water Regime*Temperature*Year	2	45.75	45.75	22.88	0.65	0.523
Error	77	2694.26	2694.26	34.99		
Total	95	12657.24				

S = 5.91527   R-Sq = 78.71%   R-Sq(adj) = 73.74%

Obs	Arnica montana	Fit	SE Fit	Residual	St Resid	
17	0.0000	15.7728	2.6316	-15.7728	-2.98	R
33	0.0000	16.8472	2.6316	-16.8472	-3.18	R
41	0.0000	14.1753	2.6316	-14.1753	-2.68	R
42	29.7800	14.1753	2.6316	15.6047	2.95	R
43	27.1300	14.1753	2.6316	12.9547	2.45	R
44	0.0000	14.1753	2.6316	-14.1753	-2.68	R
63	0.0000	10.9109	2.6316	-10.9109	-2.06	R

R denotes an observation with a large standardized residual.

Analysis of Variance for Bupthalmum salicifolium, using Adjusted SS for Tests

Source	DF	Seq SS	Adj SS	Adj MS	F	P
hazazon	1	3.47	3.47	3.47	0.05	0.829
Water Regime	2	1724.33	1724.33	862.17	11.69	0.000
hazazon*Water Regime	2	38.26	38.26	19.13	0.26	0.772
Temperature	1	65.34	65.34	65.34	0.89	0.350
hazazon*Temperature	1	0.44	0.44	0.44	0.01	0.938
Water Regime*Temperature	2	240.58	240.58	120.29	1.63	0.202
Year	1	887.44	887.44	887.44	12.03	0.001
hazazon*Year	1	68.34	68.34	68.34	0.93	0.339
Water Regime*Year	2	44.85	44.85	22.42	0.30	0.739
Temperature*Year	1	4.66	4.66	4.66	0.06	0.802
hazazon*Water Regime*Year	2	32.27	32.27	16.14	0.22	0.804
Water Regime*Temperature*Year	2	0.86	0.86	0.43	0.01	0.994
Error	77	5680.03	5680.03	73.77		
Total	95	8790.87				

S = 8.58875   R-Sq = 35.39%   R-Sq(adj) = 20.28%

Obs	Bupthalmum salicifolium	Fit	SE Fit	Residual	St Resid
56	0.0000	18.2027	3.8209	-18.2027	-2.37 R
62	0.0000	15.8598	3.8209	-15.8598	-2.06 R
71	0.0000	19.6077	3.8209	-19.6077	-2.55 R
77	0.0000	23.1898	3.8209	-23.1898	-3.01 R
81	0.0000	18.2727	3.8209	-18.2727	-2.38 R
86	0.0000	25.2252	3.8209	-25.2252	-3.28 R
89	0.0000	22.7573	3.8209	-22.7573	-2.96 R
94	0.0000	30.6648	3.8209	-30.6648	-3.99 R

R denotes an observation with a large standardized residual.

Analysis of Variance for Centaurea montana, using Adjusted SS for Tests

Source	DF	Seq SS	Adj SS	Adj MS	F	P
hazazon	1	19.8	19.8	19.8	0.02	0.881
Water Regime	2	22378.5	22378.5	11189.3	12.67	0.000
hazazon*Water Regime	2	721.0	721.0	360.5	0.41	0.666
Temperature	1	5.5	5.5	5.5	0.01	0.937
hazazon*Temperature	1	1135.8	1135.8	1135.8	1.29	0.260
Water Regime*Temperature	2	7670.4	7670.4	3835.2	4.34	0.016
Year	1	13332.8	13332.8	13332.8	15.10	0.000
hazazon*Year	1	0.0	0.0	0.0	0.00	0.999
Water Regime*Year	2	62.1	62.1	31.0	0.04	0.965
Temperature*Year	1	40.9	40.9	40.9	0.05	0.830
hazazon*Water Regime*Year	2	13.5	13.5	6.8	0.01	0.992
Water Regime*Temperature*Year	2	15.6	15.6	7.8	0.01	0.991
Error	77	67975.8	67975.8	882.8		
Total	95	113371.8				

S = 29.7120   R-Sq = 40.04%   R-Sq(adj) = 26.03%

Unusual Observations for Centaurea montana

Obs	Centaurea montana	Fit	SE Fit	Residual	St Resid

64	0.530	55.869	13.218	-55.339	-2.08 R
74	0.000	65.351	13.218	-65.351	-2.46 R
78	0.000	89.045	13.218	-89.045	-3.35 R
82	0.000	73.367	13.218	-73.367	-2.76 R
87	0.000	94.652	13.218	-94.652	-3.56 R
89	0.000	87.930	13.218	-87.930	-3.30 R
93	0.000	108.323	13.218	-108.323	-4.07 R

R denotes an observation with a large standardized residual.

Analysis of Variance for Galium verum, using Adjusted SS for Tests

Source	DF	Seq SS	Adj SS	Adj MS	F	P
hazazon	1	966.72	966.72	966.72	476.98	0.000
Water Regime	2	2002.55	2002.55	1001.28	494.03	0.000
hazazon*Water Regime	2	29.19	29.19	14.60	7.20	0.001
Temperature	1	9.54	9.54	9.54	4.71	0.033
hazazon*Temperature	1	0.34	0.34	0.34	0.17	0.682
Water Regime*Temperature	2	392.24	392.24	196.12	96.77	0.000
Year	1	2402.40	2402.40	2402.40	1185.34	0.000
hazazon*Year	1	21.89	21.89	21.89	10.80	0.002
Water Regime*Year	2	45.88	45.88	22.94	11.32	0.000
Temperature*Year	1	0.06	0.06	0.06	0.03	0.860
hazazon*Water Regime*Year	2	2.97	2.97	1.49	0.73	0.484
Water Regime*Temperature*Year	2	17.69	17.69	8.85	4.36	0.016
Error	77	156.06	156.06	2.03		
Total	95	6047.55				

S = 1.42364   R-Sq = 97.42%   R-Sq(adj) = 96.82%

Unusual Observations for Galium verum

Obs	Galium verum	Fit	SE Fit	Residual	St Resid
69	35.3800	38.2835	0.6333	-2.9035	-2.28 R
78	35.5400	38.1815	0.6333	-2.6415	-2.07 R
79	41.0500	38.1815	0.6333	2.8685	2.25 R
85	38.9000	42.6673	0.6333	-3.7673	-2.95 R

R denotes an observation with a large standardized residual.

Analysis of Variance for Geranium sylvaticum, using Adjusted SS for Tests

Source	DF	Seq SS	Adj SS	Adj MS	F	P
hazazon	1	560.33	560.33	560.33	121.29	0.000
Water Regime	2	1942.50	1942.50	971.25	210.23	0.000
hazazon*Water Regime	2	23.26	23.26	11.63	2.52	0.087
Temperature	1	16.69	16.69	16.69	3.61	0.061
hazazon*Temperature	1	0.03	0.03	0.03	0.01	0.938
Water Regime*Temperature	2	598.62	598.62	299.31	64.79	0.000
Year	1	1602.38	1602.38	1602.38	346.84	0.000
hazazon*Year	1	11.35	11.35	11.35	2.46	0.121
Water Regime*Year	2	32.03	32.03	16.02	3.47	0.036
Temperature*Year	1	2.62	2.62	2.62	0.57	0.453
hazazon*Water Regime*Year	2	0.21	0.21	0.10	0.02	0.978
Water Regime*Temperature*Year	2	49.08	49.08	24.54	5.31	0.007
Error	77	355.73	355.73	4.62		
Total	95	5194.84				

S = 2.14940   R-Sq = 93.15%   R-Sq(adj) = 91.55%

Unusual Observations for Geranium sylvaticum

Obs	Geranium sylvaticum	Fit	SE Fit	Residual	St Resid	
24	28.1300	24.1703	0.9562	3.9597	2.06	R
53	29.5400	24.7434	0.9562	4.7966	2.49	R
70	25.4900	29.7572	0.9562	-4.2672	-2.22	R
72	34.6800	29.7572	0.9562	4.9228	2.56	R
77	23.9400	28.4828	0.9562	-4.5428	-2.36	R
78	33.0000	28.4828	0.9562	4.5172	2.35	R
85	26.4900	30.8853	0.9562	-4.3953	-2.28	R

R denotes an observation with a large standardized residual.

Analysis of Variance for Knautia arvensis, using Adjusted SS for Tests

Source	DF	Seq SS	Adj SS	Adj MS	F	P
hazazon	1	1871.3	1871.3	1871.3	143.06	0.000
Water Regime	2	12140.8	12140.8	6070.4	464.06	0.000
hazazon*Water Regime	2	145.4	145.4	72.7	5.56	0.006
Temperature	1	165.7	165.7	165.7	12.67	0.001
hazazon*Temperature	1	0.5	0.5	0.5	0.04	0.845
Water Regime*Temperature	2	876.6	876.6	438.3	33.51	0.000
Year	1	5721.6	5721.6	5721.6	437.40	0.000
hazazon*Year	1	85.0	85.0	85.0	6.50	0.013
Water Regime*Year	2	20.0	20.0	10.0	0.76	0.470
Temperature*Year	1	2.2	2.2	2.2	0.17	0.680
hazazon*Water Regime*Year	2	0.2	0.2	0.1	0.01	0.994
Water Regime*Temperature*Year	2	14.2	14.2	7.1	0.54	0.584
Error	77	1007.2	1007.2	13.1		
Total	95	22050.8				

S = 3.61676   R-Sq = 95.43%   R-Sq(adj) = 94.36%

Unusual Observations for Knautia arvensis

Obs	Knautia arvensis	Fit	SE Fit	Residual	St Resid	
19	35.3100	28.5603	1.6090	6.7497	2.08	R
67	43.5300	35.6772	1.6090	7.8528	2.42	R
84	54.6400	47.8609	1.6090	6.7791	2.09	R
90	49.4600	56.2566	1.6090	-6.7966	-2.10	R
92	62.8300	56.2566	1.6090	6.5734	2.03	R

R denotes an observation with a large standardized residual.

Analysis of Variance for Origanum vulgare, using Adjusted SS for Tests

Source	DF	Seq SS	Adj SS	Adj MS	F	P
hazazon	1	488.21	488.21	488.21	100.33	0.000
Water Regime	2	4077.82	4077.82	2038.91	418.99	0.000
hazazon*Water Regime	2	44.40	44.40	22.20	4.56	0.013
Temperature	1	40.83	40.83	40.83	8.39	0.005
hazazon*Temperature	1	0.04	0.04	0.04	0.01	0.925
Water Regime*Temperature	2	770.22	770.22	385.11	79.14	0.000

Year	1	1931.69	1931.69	1931.69	396.96	0.000
hazazon*Year	1	16.23	16.23	16.23	3.33	0.072
Water Regime*Year	2	33.67	33.67	16.84	3.46	0.036
Temperature*Year	1	2.09	2.09	2.09	0.43	0.515
hazazon*Water Regime*Year	2	1.12	1.12	0.56	0.12	0.891
Water Regime*Temperature*Year	2	7.45	7.45	3.72	0.77	0.469
Error	77	374.70	374.70	4.87		
Total	95	7788.48				

S = 2.20596   R-Sq = 95.19%   R-Sq(adj) = 94.06%

Unusual Observations for Origanum vulgare

Obs	Origanum vulgare	Fit	SE Fit	Residual	St Resid	
10	0.0000	4.8643	0.9814	-4.8643	-2.46	R
13	15.1600	11.2080	0.9814	3.9520	2.00	R
55	17.6700	21.6230	0.9814	-3.9530	-2.00	R
56	27.7400	21.6230	0.9814	6.1170	3.10	R
58	0.0000	7.1707	0.9814	-7.1707	-3.63	R
62	9.9200	14.6220	0.9814	-4.7020	-2.38	R
92	33.8600	29.3201	0.9814	4.5399	2.30	R

R denotes an observation with a large standardized residual.

Analysis of Variance for Phyteuma spicatum var caeruluem, using Adjusted SS for Tests

Source	DF	Seq SS	Adj SS	Adj MS	F	P
hazazon	1	3922.69	3922.69	3922.69	394.11	0.000
Water Regime	2	53.91	53.91	26.95	2.71	0.073
hazazon*Water Regime	2	1297.80	1297.80	648.90	65.19	0.000
Temperature	1	29.37	29.37	29.37	2.95	0.090
hazazon*Temperature	1	24.10	24.10	24.10	2.42	0.124
Water Regime*Temperature	2	32.34	32.34	16.17	1.62	0.204
Year	1	436.48	436.48	436.48	43.85	0.000
hazazon*Year	1	71.59	71.59	71.59	7.19	0.009
Water Regime*Year	2	66.10	66.10	33.05	3.32	0.041
Temperature*Year	1	8.65	8.65	8.65	0.87	0.354
hazazon*Water Regime*Year	2	91.48	91.48	45.74	4.60	0.013
Water Regime*Temperature*Year	2	22.66	22.66	11.33	1.14	0.326
Error	77	766.41	766.41	9.95		
Total	95	6823.58				

S = 3.15489   R-Sq = 88.77%   R-Sq(adj) = 86.14%

Unusual Observations for Phyteuma spicatum var caeruluem

Obs	Phyteuma spicatum var caeruluem	Fit	SE Fit	Residual	St Resid	
53	0.0000	12.2565	1.4035	-12.2565	-4.34	R
54	0.0000	12.2565	1.4035	-12.2565	-4.34	R
55	21.4100	12.2565	1.4035	9.1535	3.24	R
56	21.9500	12.2565	1.4035	9.6935	3.43	R

R denotes an observation with a large standardized residual.

Analysis of Variance for Primula veris, using Adjusted SS for Tests

Source	DF	Seq SS	Adj SS	Adj MS	F	P
hazazon	1	410.56	410.56	410.56	168.07	0.000
Water Regime	2	1249.91	1249.91	624.96	255.83	0.000
hazazon*Water Regime	2	13.51	13.51	6.76	2.77	0.069
Temperature	1	64.40	64.40	64.40	26.36	0.000
hazazon*Temperature	1	1.18	1.18	1.18	0.48	0.490
Water Regime*Temperature	2	202.61	202.61	101.30	41.47	0.000
Year	1	1195.75	1195.75	1195.75	489.48	0.000
hazazon*Year	1	20.92	20.92	20.92	8.56	0.005
Water Regime*Year	2	38.87	38.87	19.44	7.96	0.001
Temperature*Year	1	2.06	2.06	2.06	0.84	0.362
hazazon*Water Regime*Year	2	1.82	1.82	0.91	0.37	0.691
Water Regime*Temperature*Year	2	15.43	15.43	7.71	3.16	0.048
Error	77	188.10	188.10	2.44		
Total	95	3405.11				

S = 1.56297   R-Sq = 94.48%   R-Sq(adj) = 93.18%

Unusual Observations for Primula veris

Obs	Primula veris	Fit	SE Fit	Residual	St Resid	
7	14.7300	18.1226	0.6953	-3.3926	-2.42	R
16	19.2000	15.5774	0.6953	3.6226	2.59	R
54	25.3900	22.5199	0.6953	2.8701	2.05	R
86	24.8000	28.5924	0.6953	-3.7924	-2.71	R

R denotes an observation with a large standardized residual.

Analysis of Variance for Prunella vulgaris, using Adjusted SS for Tests

Source	DF	Seq SS	Adj SS	Adj MS	F	P
hazazon	1	3689.2	3689.2	3689.2	227.59	0.000
Water Regime	2	46788.1	46788.1	23394.1	1443.18	0.000
hazazon*Water Regime	2	561.0	561.0	280.5	17.30	0.000
Temperature	1	795.6	795.6	795.6	49.08	0.000
hazazon*Temperature	1	18.8	18.8	18.8	1.16	0.285
Water Regime*Temperature	2	4382.0	4382.0	2191.0	135.16	0.000
Year	1	10812.9	10812.9	10812.9	667.05	0.000
hazazon*Year	1	79.3	79.3	79.3	4.89	0.030
Water Regime*Year	2	40.5	40.5	20.2	1.25	0.293
Temperature*Year	1	105.3	105.3	105.3	6.50	0.013
hazazon*Water Regime*Year	2	4.5	4.5	2.3	0.14	0.870
Water Regime*Temperature*Year	2	42.3	42.3	21.2	1.31	0.277
Error	77	1248.2	1248.2	16.2		
Total	95	68567.7				

S = 4.02618   R-Sq = 98.18%   R-Sq(adj) = 97.75%

Unusual Observations for Prunella vulgaris

Obs	Prunella vulgaris	Fit	SE Fit	Residual	St Resid	
4	16.800	28.008	1.791	-11.208	-3.11	R

50	40.420	32.957	1.791	7.463	2.07 R
52	20.160	32.957	1.791	-12.797	-3.55 R
89	103.300	95.653	1.791	7.647	2.12 R

R denotes an observation with a large standardized residual.

Analysis of Variance for Salvia pratense, using Adjusted SS for Tests

Source	DF	Seq SS	Adj SS	Adj MS	F	P
hazazon	1	49625.5	49625.5	49625.5	695.15	0.000
Water Regime	2	4058.6	4058.6	2029.3	28.43	0.000
hazazon*Water Regime	2	13706.6	13706.6	6853.3	96.00	0.000
Temperature	1	347.6	347.6	347.6	4.87	0.030
hazazon*Temperature	1	78.9	78.9	78.9	1.11	0.296
Water Regime*Temperature	2	139.7	139.7	69.8	0.98	0.381
Year	1	2267.8	2267.8	2267.8	31.77	0.000
hazazon*Year	1	1625.3	1625.3	1625.3	22.77	0.000
Water Regime*Year	2	19.3	19.3	9.7	0.14	0.874
Temperature*Year	1	217.9	217.9	217.9	3.05	0.085
hazazon*Water Regime*Year	2	41.7	41.7	20.8	0.29	0.748
Water Regime*Temperature*Year	2	563.9	563.9	281.9	3.95	0.023
Error	77	5496.9	5496.9	71.4		
Total	95	78189.7				

S = 8.44918   R-Sq = 92.97%   R-Sq(adj) = 91.33%

Unusual Observations for Salvia pratense

Obs	Salvia pratense	Fit	SE Fit	Residual	St Resid
53	46.3800	22.8168	3.7589	23.5632	3.11 R
54	0.0000	22.8168	3.7589	-22.8168	-3.02 R
55	0.0000	22.8168	3.7589	-22.8168	-3.02 R
56	50.8300	22.8168	3.7589	28.0132	3.70 R
61	41.8000	11.9357	3.7589	29.8643	3.95 R

R denotes an observation with a large standardized residual.

Analysis of Variance for Scabiosa caucasica, using Adjusted SS for Tests

Source	DF	Seq SS	Adj SS	Adj MS	F	P
hazazon	1	30997.5	30997.5	30997.5	479.09	0.000
Water Regime	2	718.9	718.9	359.4	5.56	0.006
hazazon*Water Regime	2	11351.4	11351.4	5675.7	87.72	0.000
Temperature	1	217.8	217.8	217.8	3.37	0.070
hazazon*Temperature	1	154.8	154.8	154.8	2.39	0.126
Water Regime*Temperature	2	66.1	66.1	33.0	0.51	0.602
Year	1	2319.3	2319.3	2319.3	35.85	0.000
hazazon*Year	1	551.7	551.7	551.7	8.53	0.005
Water Regime*Year	2	269.6	269.6	134.8	2.08	0.131
Temperature*Year	1	4.9	4.9	4.9	0.08	0.785
hazazon*Water Regime*Year	2	345.1	345.1	172.6	2.67	0.076
Water Regime*Temperature*Year	2	35.5	35.5	17.7	0.27	0.761
Error	77	4982.0	4982.0	64.7		
Total	95	52014.7				

S = 8.04371   R-Sq = 90.42%   R-Sq(adj) = 88.18%

Unusual Observations for Scabiosa caucasica

Obs	Scabiosa caucasica	Fit	SE Fit	Residual	St Resid	
52	32.7700	13.0994	3.5785	19.6706	2.73	R
53	0.0000	30.1206	3.5785	-30.1206	-4.18	R
54	49.7400	30.1206	3.5785	19.6194	2.72	R
55	0.0000	30.1206	3.5785	-30.1206	-4.18	R
56	50.7700	30.1206	3.5785	20.6494	2.87	R

R denotes an observation with a large standardized residual.

Arnica montana

hazazon	N	Mean	Grouping
1	48	19.682	A
2	48	2.074	B

Water Regime	N	Mean	Grouping
3	32	11.680	A
1	32	11.039	A
2	32	9.915	A

Temperature	N	Mean	Grouping
2	48	12.258	A
1	48	9.498	B

Year	N	Mean	Grouping
2	48	13.438	A
1	48	8.318	B

hazazon	Water Regime	N	Mean	Grouping
1	3	16	23.360	A
1	2	16	19.830	A B
1	1	16	15.856	B
2	1	16	6.222	C
2	2	16	0.000	C
2	3	16	0.000	C

hazazon	Temperature	N	Mean	Grouping
1	2	24	20.368	A
1	1	24	18.996	A
2	2	24	4.148	B
2	1	24	0.000	B

hazazon	Year	N	Mean	Grouping
1	2	24	24.379	A
1	1	24	14.985	B
2	2	24	2.497	C
2	1	24	1.651	C

Water Regime	Temperature	N	Mean	Grouping

1	2	16	13.226	A
3	2	16	12.284	A
2	2	16	11.264	A
3	1	16	11.075	A
1	1	16	8.853	A
2	1	16	8.566	A

Water Regime	Year	N	Mean	Grouping
3	2	16	15.604	A
1	2	16	13.312	A B
2	2	16	11.398	A B
1	1	16	8.766	B
2	1	16	8.433	B
3	1	16	7.756	B

Means that do not share a letter are significantly different.

Grouping Information Using Bonferroni Method and 95.0% Confidence for Bupthalmum salicifolium

hazazon	N	Mean	Grouping
1	48	20.309	A
2	48	19.928	A

Bupthalmum salicifolium

Water Regime	N	Mean	Grouping
3	32	25.242	A
2	32	20.251	A
1	32	14.863	B

Temperature	N	Mean	Grouping
2	48	20.944	A
1	48	19.294	A

Year	N	Mean	Grouping
2	48	23.159	A
1	48	17.078	B

hazazon	Water Regime	N	Mean	Grouping
1	3	16	26.254	A
2	3	16	24.230	A
2	2	16	20.774	A B
1	2	16	19.727	A B
1	1	16	14.945	B
2	1	16	14.781	B

hazazon	Temperature	N	Mean	Grouping
1	2	24	21.066	A
2	2	24	20.821	A
1	1	24	19.552	A
2	1	24	19.035	A

hazazon	Year	N	Mean	Grouping
1	2	24	24.193	A

2	2	24	22.125	A B
2	1	24	17.732	A B
1	1	24	16.425	B

Water Regime	Temperature	N	Mean	Grouping
3	2	16	27.655	A
3	1	16	22.829	A B
2	2	16	21.648	A B C
2	1	16	18.853	A B C
1	1	16	16.199	B C
1	2	16	13.527	C

Water Regime	Year	N	Mean	Grouping
3	2	16	29.083	A
2	2	16	22.422	A B
3	1	16	21.401	A B
2	1	16	18.079	B C
1	2	16	17.972	B C
1	1	16	11.754	C

hazazon	N	Mean	Grouping
2	48	76.474	A
1	48	75.565	A

Water Regime	N	Mean	Grouping
3	32	94.478	A
2	32	76.492	A
1	32	57.089	B

Temperature	N	Mean	Grouping
2	48	76.260	A
1	48	75.779	A

Year	N	Mean	Grouping
2	48	87.805	A
1	48	64.235	B

hazazon	Water Regime	N	Mean	Grouping
1	3	16	97.889	A
2	3	16	91.068	A
2	2	16	79.129	A B
1	2	16	73.855	A B
2	1	16	59.226	B
1	1	16	54.951	B

hazazon	Temperature	N	Mean	Grouping
2	1	24	79.674	A
1	2	24	79.245	A
2	2	24	73.275	A
1	1	24	71.885	A

hazazon	Year	N	Mean	Grouping
2	2	24	88.264	A
1	2	24	87.345	A B
2	1	24	64.685	B C
1	1	24	63.785	C

Water Regime	Temperature	N	Mean	Grouping
3	2	16	104.977	A
3	1	16	83.980	A B
2	2	16	78.001	A B
2	1	16	74.983	A B C
1	1	16	68.375	B C
1	2	16	45.802	C

Means that do not share a letter are significantly different.

Centaurea montana

Water Regime	Year	N	Mean	Grouping
3	2	16	105.141	A
2	2	16	88.994	A B
3	1	16	83.816	A B
1	2	16	69.279	B C
2	1	16	63.989	B C
1	1	16	44.899	C

Galium verum

hazazon	N	Mean	Grouping
2	48	32.997	A
1	48	26.650	B

Water Regime	N	Mean	Grouping
3	32	35.519	A
2	32	29.613	B
1	32	24.337	C

Temperature	N	Mean	Grouping
2	48	30.139	A
1	48	29.508	B

Year	N	Mean	Grouping
2	48	34.826	A
1	48	24.821	B

hazazon	Water Regime	N	Mean	Grouping
2	3	16	39.326	A
2	2	16	32.864	B
1	3	16	31.712	B
2	1	16	26.800	C
1	2	16	26.362	C
1	1	16	21.875	D

hazazon	Temperature	N	Mean	Grouping
2	2	24	33.252	A
2	1	24	32.741	A
1	2	24	27.025	B
1	1	24	26.275	B

hazazon	Year	N	Mean	Grouping
2	2	24	38.477	A
1	2	24	31.175	B
2	1	24	27.517	C
1	1	24	22.125	D

Water Regime	Temperature	N	Mean	Grouping
3	2	16	38.237	A
3	1	16	32.801	B
2	2	16	30.069	C
2	1	16	29.158	C
1	1	16	26.565	D
1	2	16	22.110	E

Water Regime	Year	N	Mean	Grouping
3	2	16	41.421	A
2	2	16	34.497	B
3	1	16	29.617	C
1	2	16	28.559	C
2	1	16	24.729	D
1	1	16	20.116	E

Geranium sylvaticum

hazazon	N	Mean	Grouping
2	48	24.598	A
1	48	19.766	B

Water Regime	N	Mean	Grouping
3	32	27.762	A
2	32	22.038	B
1	32	16.746	C

Temperature	N	Mean	Grouping
2	48	22.599	A
1	48	21.765	A

Year	N	Mean	Grouping
2	48	26.267	A
1	48	18.096	B

hazazon	Water Regime	N	Mean	Grouping
2	3	16	30.778	A
1	3	16	24.745	B
2	2	16	24.458	B
1	2	16	19.617	C

2	1	16	18.557	C
1	1	16	14.935	D

hazazon	Temperature	N	Mean	Grouping
2	2	24	24.998	A
2	1	24	24.198	A
1	2	24	20.200	B
1	1	24	19.332	B

hazazon	Year	N	Mean	Grouping
2	2	24	29.027	A
1	2	24	23.508	B
2	1	24	20.168	C
1	1	24	16.024	D

Water Regime	Temperature	N	Mean	Grouping
3	2	16	31.549	A
3	1	16	23.974	B
2	1	16	22.394	B
2	2	16	21.681	B
1	1	16	18.926	C
1	2	16	14.566	D

Water Regime	Year	N	Mean	Grouping
3	2	16	32.418	A
2	2	16	26.344	B
3	1	16	23.105	C
1	2	16	20.040	D
2	1	16	17.732	E
1	1	16	13.452	F

Knautia arvensis

hazazon	N	Mean	Grouping
2	48	46.134	A
1	48	37.304	B

Water Regime	N	Mean	Grouping
3	32	54.953	A
2	32	42.742	B
1	32	27.463	C

Temperature	N	Mean	Grouping
2	48	43.033	A
1	48	40.405	B

Year	N	Mean	Grouping
2	48	49.439	A
1	48	33.999	B

hazazon	Water Regime	N	Mean	Grouping
2	3	16	60.808	A
1	3	16	49.098	B

2	2	16	47.283	B
1	2	16	38.200	C
2	1	16	30.312	D
1	1	16	24.615	E

hazazon	Temperature	N	Mean	Grouping
2	2	24	47.520	A
2	1	24	44.748	A
1	2	24	38.546	B
1	1	24	36.062	B

hazazon	Year	N	Mean	Grouping
2	2	24	54.795	A
1	2	24	44.083	B
2	1	24	37.473	C
1	1	24	30.525	D

Water Regime	Temperature	N	Mean	Grouping
3	2	16	59.374	A
3	1	16	50.531	B
2	2	16	45.042	C
2	1	16	40.441	D
1	1	16	30.244	E
1	2	16	24.683	F

Knautia arvensis

Water Regime	Year	N	Mean	Grouping
3	2	16	62.790	A
2	2	16	50.952	B
3	1	16	47.116	B
1	2	16	34.576	C
2	1	16	34.531	C
1	1	16	20.351	D

Origanum vulgare

hazazon	N	Mean	Grouping
2	48	22.739	A
1	48	18.228	B

Water Regime	N	Mean	Grouping
3	32	28.673	A
2	32	20.051	B
1	32	12.726	C

Temperature	N	Mean	Grouping
2	48	21.136	A
1	48	19.831	B

Year	N	Mean	Grouping
2	48	24.969	A
1	48	15.998	B

hazazon	Water Regime	N	Mean	Grouping
2	3	16	31.788	A
1	3	16	25.559	B
2	2	16	22.251	C
1	2	16	17.851	D
2	1	16	14.177	E
1	1	16	11.275	F

hazazon	Temperature	N	Mean	Grouping
2	2	24	23.370	A
2	1	24	22.107	A
1	2	24	18.902	B
1	1	24	17.555	B

hazazon	Year	N	Mean	Grouping
2	2	24	27.635	A
1	2	24	22.303	B
2	1	24	17.842	C
1	1	24	14.154	D

Water Regime	Temperature	N	Mean	Grouping
3	2	16	32.027	A
3	1	16	25.319	B
2	2	16	21.914	C
2	1	16	18.188	D
1	1	16	15.986	D
1	2	16	9.466	E

Water Regime	Year	N	Mean	Grouping
3	2	16	33.725	A
2	2	16	24.788	B
3	1	16	23.621	B
1	2	16	16.394	C
2	1	16	15.314	C
1	1	16	9.058	D

Phyteuma spicatum var caeruluem

hazazon	N	Mean	Grouping
1	48	15.645	A
2	48	2.861	B

Water Regime	N	Mean	Grouping
1	32	9.849	A
3	32	9.714	A
2	32	8.196	A

Temperature	N	Mean	Grouping
2	48	9.806	A
1	48	8.700	A

Year	N	Mean	Grouping
2	48	11.385	A

1	48	7.121	B

hazazon	Water Regime	N	Mean	Grouping
1	3	16	19.428	A
1	2	16	16.393	A
1	1	16	11.116	B
2	1	16	8.582	B
2	2	16	0.000	C
2	3	16	-0.000	C

hazazon	Temperature	N	Mean	Grouping
1	2	24	15.698	A
1	1	24	15.593	A
2	2	24	3.915	B
2	1	24	1.807	B

hazazon	Year	N	Mean	Grouping
1	2	24	18.641	A
1	1	24	12.650	B
2	2	24	4.130	C
2	1	24	1.592	D

Water Regime	Temperature	N	Mean	Grouping
3	2	16	10.956	A
1	2	16	10.444	A
1	1	16	9.255	A
3	1	16	8.471	A
2	1	16	8.374	A
2	2	16	8.019	A

Water Regime	Year	N	Mean	Grouping
1	2	16	13.146	A
3	2	16	11.139	A B
2	2	16	9.871	A B C
3	1	16	8.289	B C
1	1	16	6.552	C
2	1	16	6.521	C

Primula veris

hazazon	N	Mean	Grouping
2	48	21.235	A
1	48	17.099	B

Primula veris

Water Regime	N	Mean	Grouping
3	32	24.138	A
2	32	17.680	B
1	32	15.683	C

Primula veris

Temperature	N	Mean	Grouping
2	48	19.986	A
1	48	18.348	B

Year	N	Mean	Grouping
2	48	22.696	A
1	48	15.638	B

hazazon	Water Regime	N	Mean	Grouping
2	3	16	26.724	A
1	3	16	21.552	B
2	2	16	19.591	C
2	1	16	17.391	D
1	2	16	15.770	D
1	1	16	13.975	E

hazazon	Temperature	N	Mean	Grouping
2	2	24	22.165	A
2	1	24	20.305	B
1	2	24	17.807	C
1	1	24	16.391	D

Means that do not share a letter are significantly different.

Grouping Information Using Bonferroni Method and 95.0% Confidence for Primula veris

hazazon	Year	N	Mean	Grouping
2	2	24	25.231	A
1	2	24	20.162	B
2	1	24	17.239	C
1	1	24	14.037	D

Means that do not share a letter are significantly different.

Grouping Information Using Bonferroni Method and 95.0% Confidence for Primula veris

Water Regime	Temperature	N	Mean	Grouping
3	2	16	26.989	A
3	1	16	21.287	B
2	2	16	17.749	C
2	1	16	17.612	C
1	1	16	16.145	C D
1	2	16	15.221	D

Water Regime	Year	N	Mean	Grouping
3	2	16	28.472	A
2	2	16	20.458	B
3	1	16	19.804	B
1	2	16	19.159	B
2	1	16	14.902	C
1	1	16	12.207	D

Prunella vulgaris

hazazon	N	Mean	Grouping
2	48	65.492	A
1	48	53.094	B

Water Regime	N	Mean	Grouping
3	32	88.750	A
2	32	53.526	B
1	32	35.604	C

Prunella vulgaris

Temperature	N	Mean	Grouping
2	48	62.172	A
1	48	56.415	B

Means that do not share a letter are significantly different.

Year	N	Mean	Grouping
2	48	69.906	A
1	48	48.680	B

hazazon	Water Regime	N	Mean	Grouping
2	3	16	98.131	A
1	3	16	79.369	B
2	2	16	59.216	C
1	2	16	47.835	D
2	1	16	39.130	E
1	1	16	32.079	F

hazazon	Temperature	N	Mean	Grouping
2	2	24	68.813	A
2	1	24	62.172	B
1	2	24	55.531	C
1	1	24	50.657	D

hazazon	Year	N	Mean	Grouping
2	2	24	77.014	A
1	2	24	62.798	B
2	1	24	53.971	C
1	1	24	43.390	D

Water Regime	Temperature	N	Mean	Grouping
3	2	16	96.339	A
3	1	16	81.161	B
2	2	16	61.248	C
2	1	16	45.803	D
1	1	16	42.280	D
1	2	16	28.929	E

Water Regime	Year	N	Mean	Grouping

3	2	16	99.223	A
3	1	16	78.277	B
2	2	16	64.994	C
1	2	16	45.501	D
2	1	16	42.057	D
1	1	16	25.707	E

Salvia pratense

hazazon	N	Mean	Grouping
1	48	50.519	A
2	48	5.046	B

Water Regime	N	Mean	Grouping
3	32	36.971	A
2	32	23.506	B
1	32	22.872	B

Temperature	N	Mean	Grouping
2	48	29.685	A
1	48	25.880	B

Year	N	Mean	Grouping
2	48	32.643	A
1	48	22.922	B

hazazon	Water Regime	N	Mean	Grouping
1	3	16	73.941	A
1	2	16	47.011	B
1	1	16	30.604	C
2	1	16	15.139	D
2	2	16	0.000	E
2	3	16	-0.000	E

hazazon	Temperature	N	Mean	Grouping
1	2	24	53.328	A
1	1	24	47.709	A
2	2	24	6.042	B
2	1	24	4.050	B

hazazon	Year	N	Mean	Grouping
1	2	24	59.494	A
1	1	24	41.544	B
2	2	24	5.792	C
2	1	24	4.301	C

Water Regime	Temperature	N	Mean	Grouping
3	2	16	40.315	A
3	1	16	33.626	A B
2	2	16	25.477	B C
1	2	16	23.264	C
1	1	16	22.479	C
2	1	16	21.534	C

Water Regime	Year	N	Mean	Grouping
3	2	16	41.739	A
3	1	16	32.202	B

1	2	16	28.321	B
2	2	16	27.868	B C
2	1	16	19.143	C D
1	1	16	17.422	D

Scabiosa caucasica

hazazon	N	Mean	Grouping
1	48	44.268	A
2	48	8.330	B

Water Regime	N	Mean	Grouping
3	32	28.477	A
1	32	27.980	A
2	32	22.439	B

Temperature	N	Mean	Grouping
2	48	27.805	A
1	48	24.793	A

Year	N	Mean	Grouping
2	48	31.214	A
1	48	21.384	B

hazazon	Water Regime	N	Mean	Grouping
1	3	16	56.954	A
1	2	16	44.879	B
1	1	16	30.971	C
2	1	16	24.989	C
2	2	16	0.000	D
2	3	16	-0.000	D

hazazon	Temperature	N	Mean	Grouping
1	2	24	44.504	A
1	1	24	44.032	A
2	2	24	11.106	B
2	1	24	5.553	B

hazazon	Year	N	Mean	Grouping
1	2	24	51.580	A
1	1	24	36.955	B
2	2	24	10.847	C
2	1	24	5.812	C

Water Regime	Temperature	N	Mean	Grouping
3	2	16	30.554	A
1	2	16	30.089	A
3	1	16	26.400	A
1	1	16	25.871	A
2	2	16	22.773	A
2	1	16	22.106	A

Water

Regime	Year	N	Mean	Grouping
1	2	16	35.257	A
3	2	16	32.383	A B
2	2	16	26.002	B C
3	1	16	24.571	B C
1	1	16	20.703	C
2	1	16	18.877	C

Arnica montana

Temperature	Year	N	Mean	Grouping
2	2	24	15.267	A
1	2	24	11.608	A B
2	1	24	9.248	B
1	1	24	7.388	B

Bupthalmum salicifolium

Temperature	Year	N	Mean	Grouping
2	2	24	24.204	A
1	2	24	22.114	A B
2	1	24	17.683	A B
1	1	24	16.473	B

Centaurea montana

Temperature	Year	N	Mean	Grouping
1	2	24	88.217	A
2	2	24	87.392	A
2	1	24	65.127	A B
1	1	24	63.342	B

Galium verum

Temperature	Year	N	Mean	Grouping
2	2	24	35.167	A
1	2	24	34.485	A
2	1	24	25.110	B
1	1	24	24.531	B

Geranium sylvaticum

Temperature	Year	N	Mean	Grouping
2	2	24	26.850	A
1	2	24	25.685	A
2	1	24	18.348	B
1	1	24	17.845	B

Knautia arvensis

Temperature	Year	N	Mean	Grouping
2	2	24	50.600	A
1	2	24	48.278	A
2	1	24	35.466	B
1	1	24	32.532	C

Origanum vulgare

Temperature	Year	N	Mean	Grouping
2	2	24	25.769	A
1	2	24	24.170	A
2	1	24	16.502	B

1	1	24	15.493	B

Phyteuma spicatum var caeruluem

Temperature	Year	N	Mean	Grouping
2	2	24	11.638	A
1	2	24	11.133	A
2	1	24	7.974	B
1	1	24	6.268	B

Primula veris

Temperature	Year	N	Mean	Grouping
2	2	24	23.369	A
1	2	24	22.024	B
2	1	24	16.603	C
1	1	24	14.672	D

Means that do not share a letter are significantly different.

Prunella vulgaris

Temperature	Year	N	Mean	Grouping
2	2	24	71.737	A
1	2	24	68.075	B
2	1	24	52.607	C
1	1	24	44.754	D

Salvia pratense

Temperature	Year	N	Mean	Grouping
2	2	24	33.039	A
1	2	24	32.247	A B
2	1	24	26.332	B
1	1	24	19.513	C

Scabiosa caucasica

Temperature	Year	N	Mean	Grouping
2	2	24	32.495	A
1	2	24	29.933	A
2	1	24	23.115	B
1	1	24	19.652	B

Arnica montana

Water Regime	Temperature	Year	N	Mean	Grouping
3	2	2	8	17.455	A
1	2	2	8	16.039	A B
3	1	2	8	13.753	A B
2	2	2	8	12.309	A B
1	1	2	8	10.585	A B
2	1	2	8	10.486	A B
1	2	1	8	10.413	A B
2	2	1	8	10.219	A B
3	1	1	8	8.398	A B
1	1	1	8	7.120	A B
3	2	1	8	7.114	A B
2	1	1	8	6.646	B

Means that do not share a letter are significantly different.

Bupthalmum salicifolium

Water Regime	Temperature	Year	N	Mean	Grouping
3	2	2	8	31.735	A
3	1	2	8	26.431	A B
2	2	2	8	24.145	A B C
3	2	1	8	23.575	A B C
2	1	2	8	20.699	A B C
3	1	1	8	19.226	A B C
1	1	2	8	19.211	A B C
2	2	1	8	19.151	A B C
2	1	1	8	17.007	A B C
1	2	2	8	16.732	A B C
1	1	1	8	13.186	B C
1	2	1	8	10.322	C

Means that do not share a letter are significantly different.

Centaurea montana

Water Regime	Temperature	Year	N	Mean	Grouping
3	2	2	8	115.416	A
3	1	2	8	94.865	A B
3	2	1	8	94.537	A B
2	2	2	8	89.313	A B
2	1	2	8	88.676	A B
1	1	2	8	81.109	A B C
3	1	1	8	73.095	A B C
2	2	1	8	66.689	A B C
2	1	1	8	61.290	B C
1	2	2	8	57.449	B C
1	1	1	8	55.641	B C
1	2	1	8	34.156	C

Galium verum

Water Regime	Temperature	Year	N	Mean	Grouping
3	2	2	8	44.731	A
3	1	2	8	38.111	B
2	2	2	8	34.506	C
2	1	2	8	34.489	C
3	2	1	8	31.743	D
1	1	2	8	30.855	D
3	1	1	8	27.491	E
1	2	2	8	26.262	E F
2	2	1	8	25.631	E F
2	1	1	8	23.827	F G
1	1	1	8	22.275	G
1	2	1	8	17.957	H

Geranium sylvaticum

Water Regime	Temperature	Year	N	Mean	Grouping
3	2	2	8	37.379	A
3	1	2	8	27.457	B
2	1	2	8	26.964	B
2	2	2	8	25.724	B C
3	2	1	8	25.720	B C
1	1	2	8	22.634	C D

3	1	1	8	20.490	D E
2	1	1	8	17.825	E F
2	2	1	8	17.639	E F
1	2	2	8	17.446	E F
1	1	1	8	15.219	F G
1	2	1	8	11.685	G

Knautia arvensis

Water Regime	Temperature	Year	N	Mean	Grouping
3	2	2	8	67.508	A
3	1	2	8	58.073	B
2	2	2	8	53.141	B C
3	2	1	8	51.241	C
2	1	2	8	48.764	C D
3	1	1	8	42.990	D E
1	1	2	8	37.999	E F
2	2	1	8	36.942	E F G
2	1	1	8	32.119	F G
1	2	2	8	31.152	G
1	1	1	8	22.489	H
1	2	1	8	18.214	H

Origanum vulgare

Water Regime	Temperature	Year	N	Mean	Grouping
3	2	2	8	37.285	A
3	1	2	8	30.165	B
2	2	2	8	27.106	B
3	2	1	8	26.769	B
2	1	2	8	22.470	C
3	1	1	8	20.474	C D
1	1	2	8	19.874	C D
2	2	1	8	16.721	D E
2	1	1	8	13.906	E F
1	2	2	8	12.915	E F
1	1	1	8	12.099	F
1	2	1	8	6.017	G

Phyteuma spicatum var caeruluem

Water Regime	Temperature	Year	N	Mean	Grouping
1	1	2	8	13.515	A
1	2	2	8	12.778	A
3	2	2	8	12.569	A B
2	1	2	8	10.174	A B C
3	1	2	8	9.709	A B C
2	2	2	8	9.569	A B C
3	2	1	8	9.344	A B C
1	2	1	8	8.110	A B C
3	1	1	8	7.234	B C
2	1	1	8	6.574	C
2	2	1	8	6.469	C
1	1	1	8	4.995	C

Primula veris

Water Regime	Temperature	Year	N	Mean	Grouping
3	2	2	8	31.347	A

3	1	2	8	25.596	B
3	2	1	8	22.630	C
2	2	2	8	20.763	C
1	1	2	8	20.321	C D
2	1	2	8	20.154	C D
1	2	2	8	17.997	D E
3	1	1	8	16.979	E F
2	1	1	8	15.070	F G
2	2	1	8	14.735	F G
1	2	1	8	12.445	G H
1	1	1	8	11.969	H

Prunella vulgaris

Water Regime	Temperature	Year	N	Mean	Grouping
3	2	2	8	105.851	A
3	1	2	8	92.595	B
3	2	1	8	86.828	B
2	2	2	8	72.436	C
3	1	1	8	69.726	C
2	1	2	8	57.552	D
1	1	2	8	54.077	D E
2	2	1	8	50.060	E
1	2	2	8	36.925	F
2	1	1	8	34.054	F
1	1	1	8	30.483	F
1	2	1	8	20.932	G

Salvia pratense

Water Regime	Temperature	Year	N	Mean	Grouping
3	2	2	8	45.490	A
3	1	2	8	37.989	A B
3	2	1	8	35.140	A B C
1	1	2	8	32.855	A B C
2	2	2	8	29.840	B C D
3	1	1	8	29.264	B C D
2	1	2	8	25.896	B C D E
1	2	2	8	23.787	B C D E
1	2	1	8	22.740	C D E
2	2	1	8	21.115	C D E
2	1	1	8	17.171	D E
1	1	1	8	12.104	E

Scabiosa caucasica

Water Regime	Temperature	Year	N	Mean	Grouping
1	2	2	8	36.409	A
3	2	2	8	34.991	A
1	1	2	8	34.105	A
3	1	2	8	29.775	A B
3	2	1	8	26.116	A B
2	2	2	8	26.085	A B
2	1	2	8	25.919	A B
1	2	1	8	23.769	A B
3	1	1	8	23.025	A B
2	2	1	8	19.460	B
2	1	1	8	18.294	B
1	1	1	8	17.638	B

5.2 Intermediate fitted species

Note: Means that do not share a letter are significantly different.

Grouping Information Using Bonferroni Method and 95.0% Confidence

Analysis of Variance for Asphodeline lutea, using Adjusted SS for Tests

Source	DF	Seq SS	Adj SS	Adj MS	F	P
halazon	1	4167.47	4105.70	4105.70	324.81	0.000
Water Regime	2	528.46	518.11	259.05	20.49	0.000
halazon*Water Regime	2	2709.16	2564.51	1282.26	101.44	0.000
Temperature	1	336.50	360.41	360.41	28.51	0.000
halazon*Temperature	1	211.02	220.42	220.42	17.44	0.000
Water Regime*Temperature	2	397.20	401.25	200.63	15.87	0.000
Year	1	456.94	431.71	431.71	34.15	0.000
halazon*Year	1	361.45	323.09	323.09	25.56	0.000
Water Regime*Year	2	66.82	54.55	27.28	2.16	0.123
Temperature*Year	1	158.77	162.21	162.21	12.83	0.001
halazon*Water Regime*Temperature	2	564.45	585.12	292.56	23.14	0.000
Water Regime*Temperature*Year	2	154.37	154.37	77.19	6.11	0.003
Error	75	948.03	948.03	12.64		
Total	93	11060.65				

S = 3.55533   R-Sq = 91.43%   R-Sq(adj) = 89.37%

Unusual Observations for Asphodeline lutea

Obs	Asphodeline lutea	Fit	SE Fit	Residual	St Resid
45	50.5300	43.5560	1.5828	6.9740	2.19 R
48	50.1400	43.5560	1.5828	6.5840	2.07 R
50	0.0000	9.0029	1.5828	-9.0029	-2.83 R
53	0.0000	7.9146	1.5828	-7.9146	-2.49 R
54	18.6100	7.9146	1.5828	10.6954	3.36 R
55	15.2400	7.9146	1.5828	7.3254	2.30 R
56	0.0000	7.9146	1.5828	-7.9146	-2.49 R

R denotes an observation with a large standardized residual.

Analysis of Variance for Centaurea triumfetii, using Adjusted SS for Tests

Source	DF	Seq SS	Adj SS	Adj MS	F	P
halazon	1	75076.2	75009.8	75009.8	897.47	0.000
Water Regime	2	3086.7	3479.0	1739.5	20.81	0.000
halazon*Water Regime	2	48038.7	47369.5	23684.8	283.38	0.000
Temperature	1	1083.8	1082.4	1082.4	12.95	0.001
halazon*Temperature	1	733.2	700.0	700.0	8.38	0.005
Water Regime*Temperature	2	937.6	840.8	420.4	5.03	0.009
Year	1	2284.8	2313.2	2313.2	27.68	0.000
halazon*Year	1	3211.3	3095.3	3095.3	37.03	0.000
Water Regime*Year	2	829.8	817.8	408.9	4.89	0.010

Temperature*Year	1	319.0	315.9	315.9	3.78	0.056
halazon*Water Regime*Temperature	2	1471.7	1443.2	721.6	8.63	0.000
Water Regime*Temperature*Year	2	182.2	182.2	91.1	1.09	0.341
Error	75	6268.5	6268.5	83.6		
Total	93	143523.4				

S = 9.14219   R-Sq = 95.63%   R-Sq(adj) = 94.58%

Unusual Observations for Centaurea triumfetii

Obs	Centaurea triumfetii	Fit	SE Fit	Residual	St Resid	
45	146.760	129.085	4.070	17.675	2.16	R
53	0.000	33.250	4.070	-33.250	-4.06	R
54	0.000	33.250	4.070	-33.250	-4.06	R
55	62.260	33.250	4.070	29.010	3.54	R
56	67.260	33.250	4.070	34.010	4.15	R

R denotes an observation with a large standardized residual.

Analysis of Variance for Centuarea orientalis, using Adjusted SS for Tests

Source	DF	Seq SS	Adj SS	Adj MS	F	P
halazon	1	33395.7	33128.4	33128.4	522.71	0.000
Water Regime	2	2913.0	2922.2	1461.1	23.05	0.000
halazon*Water Regime	2	20127.4	19246.3	9623.2	151.84	0.000
Temperature	1	2424.4	2544.8	2544.8	40.15	0.000
halazon*Temperature	1	1243.4	1274.4	1274.4	20.11	0.000
Water Regime*Temperature	2	1816.7	1782.2	891.1	14.06	0.000
Year	1	1307.4	1267.4	1267.4	20.00	0.000
halazon*Year	1	2054.4	1910.0	1910.0	30.14	0.000
Water Regime*Year	2	406.1	362.8	181.4	2.86	0.063
Temperature*Year	1	419.7	433.3	433.3	6.84	0.011
halazon*Water Regime*Temperature	2	3376.7	3353.5	1676.8	26.46	0.000
Water Regime*Temperature*Year	2	265.5	265.5	132.8	2.09	0.130
Error	75	4753.3	4753.3	63.4		
Total	93	74503.8				

S = 7.96102   R-Sq = 93.62%   R-Sq(adj) = 92.09%

Unusual Observations for Centuarea orientalis

Obs	Centuarea orientalis	Fit	SE Fit	Residual	St Resid	
1	14.020	28.366	3.544	-14.346	-2.01	R
14	21.200	35.432	3.956	-14.232	-2.06	R
53	0.000	16.393	3.544	-16.393	-2.30	R
54	0.000	16.393	3.544	-16.393	-2.30	R
55	0.000	16.393	3.544	-16.393	-2.30	R
56	52.930	16.393	3.544	36.537	5.13	R
58	17.600	31.969	3.573	-14.369	-2.02	R

R denotes an observation with a large standardized residual.

Analysis of Variance for Dianthus carthusianorum, using Adjusted SS for Tests

Source	DF	Seq SS	Adj SS	Adj MS	F	P

halazon	1	2307.5	2412.5	2412.5	354.37	0.000
Water Regime	2	9875.2	9629.7	4814.8	707.25	0.000
halazon*Water Regime	2	96.3	109.5	54.7	8.04	0.001
Temperature	1	1754.7	1721.9	1721.9	252.93	0.000
halazon*Temperature	1	22.0	24.1	24.1	3.54	0.064
Water Regime*Temperature	2	4073.1	3946.6	1973.3	289.86	0.000
Year	1	4748.1	4615.1	4615.1	677.90	0.000
halazon*Year	1	65.5	76.9	76.9	11.30	0.001
Water Regime*Year	2	329.9	330.0	165.0	24.24	0.000
Temperature*Year	1	93.6	93.7	93.7	13.76	0.000
halazon*Water Regime*Temperature	2	74.3	59.5	29.8	4.37	0.016
Water Regime*Temperature*Year	2	565.4	565.4	282.7	41.53	0.000
Error	75	510.6	510.6	6.8		
Total	93	24516.3				

S = 2.60918   R-Sq = 97.92%   R-Sq(adj) = 97.42%

Unusual Observations for Dianthus carthusianorum

Obs	Dianthus carthusianorum	Fit	SE Fit	Residual	St Resid	
45	70.9400	66.1944	1.1616	4.7456	2.03	R
48	59.2400	66.1944	1.1616	-6.9544	-2.98	R
56	36.4800	42.0500	1.1616	-5.5700	-2.38	R
93	91.0100	83.6506	1.1616	7.3594	3.15	R
96	76.0000	83.6506	1.1616	-7.6506	-3.27	R

R denotes an observation with a large standardized residual.

Analysis of Variance for Euphorbia nicaensis, using Adjusted SS for Tests

Source	DF	Seq SS	Adj SS	Adj MS	F	P
halazon	1	1050.40	1110.54	1110.54	147.71	0.000
Water Regime	2	4958.68	4781.45	2390.73	317.99	0.000
halazon*Water Regime	2	31.42	42.86	21.43	2.85	0.064
Temperature	1	957.71	962.16	962.16	127.98	0.000
halazon*Temperature	1	20.69	18.70	18.70	2.49	0.119
Water Regime*Temperature	2	2099.75	2047.74	1023.87	136.19	0.000
Year	1	3196.96	3086.76	3086.76	410.57	0.000
halazon*Year	1	45.39	55.91	55.91	7.44	0.008
Water Regime*Year	2	350.26	353.26	176.63	23.49	0.000
Temperature*Year	1	219.38	219.80	219.80	29.24	0.000
halazon*Water Regime*Temperature	2	30.18	22.43	11.21	1.49	0.232
Water Regime*Temperature*Year	2	410.45	410.45	205.22	27.30	0.000
Error	75	563.87	563.87	7.52		
Total	93	13935.13				

S = 2.74193   R-Sq = 95.95%   R-Sq(adj) = 94.98%

Unusual Observations for Euphorbia nicaensis

Obs	Euphorbia nicaensis	Fit	SE Fit	Residual	St Resid	
24	21.8500	28.3650	1.2207	-6.5150	-2.65	R
53	21.7600	26.7388	1.2207	-4.9788	-2.03	R
72	28.0300	36.1775	1.2207	-8.1475	-3.32	R
73	18.6100	23.6243	1.2207	-5.0143	-2.04	R
88	24.3100	30.1508	1.2306	-5.8408	-2.38	R

R denotes an observation with a large standardized residual.

Analysis of Variance for Hedysarum hedysaroides, using Adjusted SS for Tests

Source	DF	Seq SS	Adj SS	Adj MS	F	P
halazon	1	59825.4	58978.9	58978.9	726.72	0.000
Water Regime	2	2964.5	3234.7	1617.4	19.93	0.000
halazon*Water Regime	2	26845.0	26104.2	13052.1	160.82	0.000
Temperature	1	3196.7	3242.1	3242.1	39.95	0.000
halazon*Temperature	1	952.6	936.9	936.9	11.54	0.001
Water Regime*Temperature	2	912.0	902.7	451.3	5.56	0.006
Year	1	3546.3	3384.0	3384.0	41.70	0.000
halazon*Year	1	1561.7	1387.5	1387.5	17.10	0.000
Water Regime*Year	2	36.2	36.6	18.3	0.23	0.799
Temperature*Year	1	78.1	73.6	73.6	0.91	0.344
halazon*Water Regime*Temperature	2	4176.3	4227.0	2113.5	26.04	0.000
Water Regime*Temperature*Year	2	178.6	178.6	89.3	1.10	0.338
Error	75	6086.8	6086.8	81.2		
Total	93	110360.3				

S = 9.00876   R-Sq = 94.48%   R-Sq(adj) = 93.16%

Unusual Observations for Hedysarum hedysaroides

Obs	Hedysarum hedysaroides	Fit	SE Fit	Residual	St Resid	
49	39.300	15.727	4.011	23.573	2.92	R
53	0.000	19.125	4.011	-19.125	-2.37	R
54	0.000	19.125	4.011	-19.125	-2.37	R
55	44.850	19.125	4.011	25.725	3.19	R
56	55.260	19.125	4.011	36.135	4.48	R

R denotes an observation with a large standardized residual.

Analysis of Variance for Linum flavum Compactum, using Adjusted SS for Tests

Source	DF	Seq SS	Adj SS	Adj MS	F	P
halazon	1	3317.8	3413.7	3413.7	519.11	0.000
Water Regime	2	14188.9	13773.8	6886.9	1047.25	0.000
halazon*Water Regime	2	126.6	151.7	75.9	11.54	0.000
Temperature	1	2631.7	2607.8	2607.8	396.55	0.000
halazon*Temperature	1	43.4	43.4	43.4	6.61	0.012
Water Regime*Temperature	2	3900.7	3714.8	1857.4	282.44	0.000
Year	1	6539.2	6402.3	6402.3	973.56	0.000
halazon*Year	1	101.7	111.8	111.8	17.01	0.000
Water Regime*Year	2	964.8	938.3	469.1	71.34	0.000
Temperature*Year	1	282.7	286.4	286.4	43.56	0.000
halazon*Water Regime*Temperature	2	51.3	44.8	22.4	3.41	0.038
Water Regime*Temperature*Year	2	207.0	207.0	103.5	15.74	0.000
Error	75	493.2	493.2	6.6		
Total	93	32849.1				

S = 2.56440   R-Sq = 98.50%   R-Sq(adj) = 98.14%

Unusual Observations for Linum flavum Compactum

Obs	Linum flavum Compactum	Fit	SE Fit	Residual	St Resid
55	36.000	40.793	1.142	-4.793	-2.09 R
59	32.250	27.270	1.151	4.980	2.17 R
61	32.430	38.770	1.151	-6.340	-2.77 R
77	79.730	74.740	1.142	4.990	2.17 R

R denotes an observation with a large standardized residual.

Analysis of Variance for Linum narbonennse, using Adjusted SS for Tests

Source	DF	Seq SS	Adj SS	Adj MS	F	P
halazon	1	673.58	691.08	691.08	138.81	0.000
Water Regime	2	5381.90	5279.97	2639.98	530.27	0.000
halazon*Water Regime	2	46.89	50.20	25.10	5.04	0.009
Temperature	1	528.42	513.82	513.82	103.21	0.000
halazon*Temperature	1	10.40	11.80	11.80	2.37	0.128
Water Regime*Temperature	2	1186.45	1131.71	565.85	113.66	0.000
Year	1	1972.15	1928.87	1928.87	387.44	0.000
halazon*Year	1	15.90	18.66	18.66	3.75	0.057
Water Regime*Year	2	336.70	333.57	166.78	33.50	0.000
Temperature*Year	1	68.39	67.54	67.54	13.57	0.000
halazon*Water Regime*Temperature	2	30.04	26.39	13.19	2.65	0.077
Water Regime*Temperature*Year	2	87.19	87.19	43.59	8.76	0.000
Error	75	373.39	373.39	4.98		
Total	93	10711.39				

S = 2.23127   R-Sq = 96.51%   R-Sq(adj) = 95.68%

Unusual Observations for Linum narbonennse

Obs	Linum narbonennse	Fit	SE Fit	Residual	St Resid
73	13.6200	19.5653	0.9933	-5.9453	-2.98 R
78	40.8500	35.6472	0.9933	5.2028	2.60 R
85	23.5400	30.5165	1.0014	-6.9765	-3.50 R
93	54.0500	49.6379	0.9933	4.4121	2.21 R

R denotes an observation with a large standardized residual.

Analysis of Variance for Lychnis coronaria, using Adjusted SS for Tests

Source	DF	Seq SS	Adj SS	Adj MS	F	P
halazon	1	4076.8	4069.9	4069.9	563.16	0.000
Water Regime	2	33019.2	32713.5	16356.8	2263.36	0.000
halazon*Water Regime	2	408.9	393.0	196.5	27.19	0.000
Temperature	1	1090.2	1020.8	1020.8	141.25	0.000
halazon*Temperature	1	13.1	20.7	20.7	2.87	0.094
Water Regime*Temperature	2	2833.7	2662.8	1331.4	184.23	0.000
Year	1	9459.9	9261.8	9261.8	1281.59	0.000
halazon*Year	1	129.4	143.7	143.7	19.89	0.000
Water Regime*Year	2	1204.5	1205.5	602.8	83.41	0.000
Temperature*Year	1	45.1	43.9	43.9	6.08	0.016
halazon*Water Regime*Temperature	2	52.6	43.4	21.7	3.00	0.056
Water Regime*Temperature*Year	2	335.2	335.2	167.6	23.19	0.000
Error	75	542.0	542.0	7.2		
Total	93	53210.8				

S = 2.68827   R-Sq = 98.98%   R-Sq(adj) = 98.74%

Unusual Observations for Lychnis coronaria

Obs	Lychnis coronaria	Fit	SE Fit	Residual	St Resid	
71	70.300	65.359	1.197	4.941	2.05	R
88	91.410	85.351	1.206	6.059	2.52	R

R denotes an observation with a large standardized residual.

Analysis of Variance for Lychnis flos jovis, using Adjusted SS for Tests

Source	DF	Seq SS	Adj SS	Adj MS	F	P
halazon	1	3184.0	3320.6	3320.6	463.91	0.000
Water Regime	2	26447.9	25970.6	12985.3	1814.14	0.000
halazon*Water Regime	2	332.3	346.7	173.4	24.22	0.000
Temperature	1	4907.3	4739.6	4739.6	662.17	0.000
halazon*Temperature	1	50.9	65.2	65.2	9.11	0.003
Water Regime*Temperature	2	6420.8	6225.7	3112.8	434.89	0.000
Year	1	6728.6	6575.5	6575.5	918.64	0.000
halazon*Year	1	99.5	111.5	111.5	15.58	0.000
Water Regime*Year	2	775.8	762.1	381.0	53.23	0.000
Temperature*Year	1	162.3	162.0	162.0	22.64	0.000
halazon*Water Regime*Temperature	2	116.4	99.6	49.8	6.96	0.002
Water Regime*Temperature*Year	2	528.1	528.1	264.0	36.89	0.000
Error	75	536.8	536.8	7.2		
Total	93	50290.8				

S = 2.67541   R-Sq = 98.93%   R-Sq(adj) = 98.68%

Unusual Observations for Lychnis flos jovis

Obs	Lychnis flos jovis	Fit	SE Fit	Residual	St Resid	
24	46.180	41.366	1.191	4.814	2.01	R
70	48.150	53.276	1.191	-5.126	-2.14	R
72	59.240	53.276	1.191	5.964	2.49	R
76	52.230	57.336	1.191	-5.106	-2.13	R
87	70.370	65.570	1.201	4.800	2.01	R
93	109.630	104.730	1.191	4.900	2.05	R

R denotes an observation with a large standardized residual.

Analysis of Variance for Paradisea liliastrum, using Adjusted SS for Tests

Source	DF	Seq SS	Adj SS	Adj MS	F	P
halazon	1	15378.6	15216.2	15216.2	568.10	0.000
Water Regime	2	449.7	487.4	243.7	9.10	0.000
halazon*Water Regime	2	5465.1	5292.0	2646.0	98.79	0.000
Temperature	1	344.5	361.6	361.6	13.50	0.000
halazon*Temperature	1	342.3	343.8	343.8	12.84	0.001
Water Regime*Temperature	2	799.0	758.3	379.1	14.16	0.000
Year	1	894.1	882.8	882.8	32.96	0.000
halazon*Year	1	812.0	764.3	764.3	28.54	0.000
Water Regime*Year	2	53.9	54.5	27.2	1.02	0.367
Temperature*Year	1	233.7	232.2	232.2	8.67	0.004
halazon*Water Regime*Temperature	2	801.2	793.7	396.9	14.82	0.000

Source	DF	Seq SS	Adj SS	Adj MS	F	P
Water Regime*Temperature*Year	2	21.5	21.5	10.7	0.40	0.671
Error	75	2008.8	2008.8	26.8		
Total	93	27604.4				

S = 5.17536   R-Sq = 92.72%   R-Sq(adj) = 90.98%

Unusual Observations for Paradisea liliastrum

Obs	Paradisea liliastrum	Fit	SE Fit	Residual	St Resid	
50	0.0000	15.5816	2.3040	-15.5816	-3.36	R
53	0.0000	9.5059	2.3040	-9.5059	-2.05	R
54	31.7400	9.5059	2.3040	22.2341	4.80	R
55	0.0000	9.5059	2.3040	-9.5059	-2.05	R
56	0.0000	9.5059	2.3040	-9.5059	-2.05	R
57	0.0000	11.4759	2.3227	-11.4759	-2.48	R
58	0.0000	11.4759	2.3227	-11.4759	-2.48	R

R denotes an observation with a large standardized residual.

Analysis of Variance for Salvia nemorosa, using Adjusted SS for Tests

Source	DF	Seq SS	Adj SS	Adj MS	F	P
halazon	1	29220.5	28950.4	28950.4	409.17	0.000
Water Regime	2	385.6	379.0	189.5	2.68	0.075
halazon*Water Regime	2	8124.2	7742.7	3871.4	54.72	0.000
Temperature	1	250.1	294.2	294.2	4.16	0.045
halazon*Temperature	1	504.4	542.1	542.1	7.66	0.007
Water Regime*Temperature	2	1419.7	1338.9	669.5	9.46	0.000
Year	1	4928.8	4793.6	4793.6	67.75	0.000
halazon*Year	1	74.3	56.7	56.7	0.80	0.373
Water Regime*Year	2	1473.9	1435.4	717.7	10.14	0.000
Temperature*Year	1	8.7	8.1	8.1	0.11	0.736
halazon*Water Regime*Temperature	2	787.8	823.5	411.8	5.82	0.004
Water Regime*Temperature*Year	2	310.3	310.3	155.2	2.19	0.119
Error	75	5306.5	5306.5	70.8		
Total	93	52794.7				

S = 8.41150   R-Sq = 89.95%   R-Sq(adj) = 87.54%

Unusual Observations for Salvia nemorosa

Obs	Salvia nemorosa	Fit	SE Fit	Residual	St Resid	
53	56.4000	35.1638	3.7447	21.2362	2.82	R
54	54.2300	35.1638	3.7447	19.0662	2.53	R
55	0.0000	35.1638	3.7447	-35.1638	-4.67	R
56	57.7000	35.1638	3.7447	22.5362	2.99	R

R denotes an observation with a large standardized residual.

Asphodeline lutea

halazon	N	Mean	Grouping
1	46	16.498	A
2	48	3.247	B

Water Regime	N	Mean	Grouping
3	31	12.831	A
1	31	9.697	B
2	32	7.090	C

Asphodeline lutea

Temperature	N	Mean	Grouping
2	47	11.835	A
1	47	7.910	B

Asphodeline lutea

Year	N	Mean	Grouping
2	46	12.021	A
1	48	7.724	B

Asphodeline lutea

halazon	Water Regime	N	Mean	Grouping
1	3	15	25.661	A
1	2	16	14.180	B
2	1	16	9.742	C
1	1	15	9.652	C
2	2	16	0.000	D
2	3	16	-0.000	D

halazon	Temperature	N	Mean	Grouping
1	2	23	19.995	A
1	1	23	13.001	B
2	2	24	3.675	C
2	1	24	2.820	C

halazon	Year	N	Mean	Grouping
1	2	22	20.505	A
1	1	24	12.491	B
2	2	24	3.537	C
2	1	24	2.958	C

Water Regime	Temperature	N	Mean	Grouping
3	2	16	17.688	A
1	2	15	9.749	B
1	1	16	9.644	B
2	2	16	8.068	B
3	1	15	7.974	B
2	1	16	6.112	B

Water Regime	Year	N	Mean	Grouping
3	2	15	16.044	A
1	2	15	11.132	B
3	1	16	9.618	B
2	2	16	8.886	B C
1	1	16	8.261	B C
2	1	16	5.294	C

Centaurea triumfetii

halazon	N	Mean	Grouping
1	46	71.260	A
2	48	14.624	B

Centaurea triumfetii

Water Regime	N	Mean	Grouping
3	31	51.072	A
1	31	41.344	B
2	32	36.411	B

Centaurea triumfetii

Temperature	N	Mean	Grouping
2	47	46.343	A
1	47	39.542	B

Year	N	Mean	Grouping
2	46	47.915	A
1	48	37.969	B

halazon	Water Regime	N	Mean	Grouping
1	3	15	102.144	A
1	2	16	72.823	B
2	1	16	43.873	C
1	1	15	38.815	C
2	2	16	-0.000	D
2	3	16	-0.000	D

halazon	Temperature	N	Mean	Grouping
1	2	23	77.396	A
1	1	23	65.125	B
2	2	24	15.290	C
2	1	24	13.958	C

halazon	Year	N	Mean	Grouping
1	2	22	81.986	A
1	1	24	60.535	B
2	1	24	15.404	C
2	2	24	13.845	C

Water Regime	Temperature	N	Mean	Grouping
3	2	16	57.149	A
3	1	15	44.995	B
1	1	16	42.151	B
2	2	16	41.344	B
1	2	15	40.536	B C
2	1	16	31.479	C

Water Regime	Year	N	Mean	Grouping
3	2	15	58.590	A
3	1	16	43.554	B
2	2	16	43.004	B
1	2	15	42.152	B
1	1	16	40.535	B
2	1	16	29.819	C

Centuarea orientalis

halazon	N	Mean	Grouping
1	46	46.985	A
2	48	9.346	B

Centuarea orientalis

Water Regime	N	Mean	Grouping
3	31	35.051	A
1	31	28.040	B
2	32	21.406	C

Centuarea orientalis

Temperature	N	Mean	Grouping
2	47	33.380	A
1	47	22.952	B

Year	N	Mean	Grouping
2	46	31.847	A
1	48	24.485	B

halazon	Water Regime	N	Mean	Grouping
1	3	15	70.103	A
1	2	16	42.813	B
1	1	15	28.040	C
2	1	16	28.039	C
2	2	16	-0.000	D
2	3	16	-0.000	D

halazon	Temperature	N	Mean	Grouping
1	2	23	55.889	A
1	1	23	38.081	B
2	2	24	10.871	C
2	1	24	7.822	C

halazon	Year	N	Mean	Grouping
1	2	22	55.185	A
1	1	24	38.785	B
2	1	24	10.184	C
2	2	24	8.509	C

Water Regime	Temperature	N	Mean	Grouping
3	2	16	46.355	A
1	2	15	29.181	B
1	1	16	26.898	B
2	2	16	24.604	B C

3	1	15	23.748	B C
2	1	16	18.209	C

Water Regime	Year	N	Mean	Grouping
3	2	15	41.205	A
1	2	15	29.344	B
3	1	16	28.898	B
1	1	16	26.736	B
2	2	16	24.991	B C
2	1	16	17.821	C

Dianthus carthusianorum

halazon	N	Mean	Grouping
2	48	44.702	A
1	46	34.545	B

Water Regime	N	Mean	Grouping
3	31	51.181	A
2	32	41.330	B
1	31	26.361	C

Temperature	N	Mean	Grouping
2	47	43.913	A
1	47	35.335	B

Year	N	Mean	Grouping
2	46	46.648	A
1	48	32.600	B

halazon	Water Regime	N	Mean	Grouping
2	3	16	57.571	A
2	2	16	46.451	B
1	3	15	44.791	B
1	2	16	36.209	C
2	1	16	30.086	D
1	1	15	22.635	E

halazon	Temperature	N	Mean	Grouping
2	2	24	49.499	A
2	1	24	39.906	B
1	2	23	38.327	B
1	1	23	30.763	C

halazon	Year	N	Mean	Grouping
2	2	24	52.633	A
1	2	22	40.662	B
2	1	24	36.771	C
1	1	24	28.428	D

Water Regime	Temperature	N	Mean	Grouping
3	2	16	63.114	A
2	2	16	46.299	B
3	1	15	39.248	C
2	1	16	36.360	D
1	1	16	30.396	E

1	2	15	22.325	F

Water Regime	Year	N	Mean	Grouping
3	2	15	58.994	A
2	2	16	50.156	B
3	1	16	43.368	C
2	1	16	32.503	D
1	2	15	30.793	D
1	1	16	21.928	E

Euphorbia nicaensis

halazon	N	Mean	Grouping
2	48	29.690	A
1	46	22.799	B

Water Regime	N	Mean	Grouping
3	31	34.234	A
2	32	27.697	B
1	31	16.803	C

Temperature	N	Mean	Grouping
2	47	29.451	A
1	47	23.038	B

Year	N	Mean	Grouping
2	46	31.989	A
1	48	20.500	B

halazon	Water Regime	N	Mean	Grouping
2	3	16	38.521	A
2	2	16	31.128	B
1	3	15	29.947	B
1	2	16	24.266	C
2	1	16	19.422	D
1	1	15	14.183	E

halazon	Temperature	N	Mean	Grouping
2	2	24	33.343	A
2	1	24	26.037	B
1	2	23	25.558	B
1	1	23	20.040	C

halazon	Year	N	Mean	Grouping
2	2	24	36.208	A
1	2	22	27.770	B
2	1	24	23.172	C
1	1	24	17.827	D

Water Regime	Temperature	N	Mean	Grouping
3	2	16	43.565	A
2	2	16	30.101	B
2	1	16	25.293	C
3	1	15	24.903	C
1	1	16	18.919	D
1	2	15	14.686	E

Euphorbia nicaensis

Water Regime	Year	N	Mean	Grouping
3	2	15	39.786	A
2	2	16	35.902	B
3	1	16	28.682	C
1	2	15	20.279	D
2	1	16	19.492	D
1	1	16	13.326	E

Hedysarum hedysaroides

halazon	N	Mean	Grouping
1	46	58.751	A
2	48	8.530	B

Water Regime	N	Mean	Grouping
3	31	41.703	A
2	32	31.522	B
1	31	27.698	B

Temperature	N	Mean	Grouping
2	47	39.526	A
1	47	27.755	B

Year	N	Mean	Grouping
2	46	39.656	A
1	48	27.626	B

halazon	Water Regime	N	Mean	Grouping
1	3	15	83.405	A
1	2	16	63.044	B
1	1	15	29.804	C
2	1	16	25.591	C
2	2	16	0.000	D
2	3	16	0.000	D

halazon	Temperature	N	Mean	Grouping
1	2	23	67.800	A
1	1	23	49.702	B
2	2	24	11.252	C
2	1	24	5.809	C

Means that do not share a letter are significantly different.

halazon	Year	N	Mean	Grouping
1	2	22	68.617	A
1	1	24	48.885	B
2	2	24	10.694	C
2	1	24	6.367	C

Water Regime	Temperature	N	Mean	Grouping
3	2	16	51.373	A
2	2	16	37.495	B
3	1	15	32.033	B C
1	2	15	29.711	B C
1	1	16	25.684	C
2	1	16	25.549	C

Water Regime	Year	N	Mean	Grouping
3	2	15	48.428	A
2	2	16	37.645	B
3	1	16	34.978	B C
1	2	15	32.894	B C
2	1	16	25.399	C D
1	1	16	22.502	D

halazon	N	Mean	Grouping
2	48	53.057	A
1	46	40.975	B

Linum flavum Compactum

Water Regime	N	Mean	Grouping
3	31	59.510	A
2	32	51.070	B
1	31	30.468	C

Temperature	N	Mean	Grouping
2	47	52.294	A
1	47	41.738	B

Year	N	Mean	Grouping
2	46	55.289	A
1	48	38.743	B

halazon	Water Regime	N	Mean	Grouping
2	3	16	66.956	A
2	2	16	57.398	B
1	3	15	52.064	C
1	2	16	44.741	D
2	1	16	34.817	E
1	1	15	26.119	F

halazon	Temperature	N	Mean	Grouping
2	2	24	59.017	A
2	1	24	47.097	B
1	2	23	45.572	B
1	1	23	36.378	C

halazon	Year	N	Mean	Grouping
2	2	24	62.424	A
1	2	22	48.154	B
2	1	24	43.690	C
1	1	24	33.795	D

Water Regime	Temperature	N	Mean	Grouping
3	2	16	73.132	A
2	2	16	55.021	B
2	1	16	47.119	C
3	1	15	45.888	C
1	1	16	32.206	D
1	2	15	28.730	E

Water Regime	Year	N	Mean	Grouping
3	2	15	69.257	A
2	2	16	62.271	B
3	1	16	49.763	C
2	1	16	39.868	D
1	2	15	34.339	E
1	1	16	26.597	F

Linum narbonennse

halazon	N	Mean	Grouping
2	48	24.516	A
1	46	19.080	B

Water Regime	N	Mean	Grouping
3	31	30.785	A
2	32	22.314	B
1	31	12.295	C

Temperature	N	Mean	Grouping
2	47	24.141	A
1	47	19.455	B

Year	N	Mean	Grouping
2	46	26.339	A
1	48	17.257	B

halazon	Water Regime	N	Mean	Grouping
2	3	16	34.382	A
1	3	15	27.188	B
2	2	16	25.078	B
1	2	16	19.550	C
2	1	16	14.089	D
1	1	15	10.502	E

halazon	Temperature	N	Mean	Grouping
2	2	24	27.214	A
2	1	24	21.818	B
1	2	23	21.068	B
1	1	23	17.092	C

halazon	Year	N	Mean	Grouping

2	2	24	29.504	A
1	2	22	23.174	B
2	1	24	19.528	C
1	1	24	14.985	D

Water Regime	Temperature	N	Mean	Grouping
3	2	16	37.461	A
2	2	16	24.563	B
3	1	15	24.109	B
2	1	16	20.064	C
1	1	16	14.192	D
1	2	15	10.398	E

Water Regime	Year	N	Mean	Grouping
3	2	15	36.034	A
2	2	16	28.731	B
3	1	16	25.536	C
2	1	16	15.897	D
1	2	15	14.253	D
1	1	16	10.337	E

Lychnis coronaria

halazon	N	Mean	Grouping
2	48	58.727	A
1	46	45.535	B

Water Regime	N	Mean	Grouping
3	31	75.263	A
2	32	51.945	B
1	31	29.185	C

Temperature	N	Mean	Grouping
2	47	55.434	A
1	47	48.829	B

Year	N	Mean	Grouping
2	46	62.082	A
1	48	42.180	B

halazon	Water Regime	N	Mean	Grouping
2	3	16	84.462	A
1	3	15	66.063	B
2	2	16	58.378	C
1	2	16	45.513	D
2	1	16	33.342	E
1	1	15	25.029	F

halazon	Temperature	N	Mean	Grouping
2	2	24	62.500	A
2	1	24	54.954	B
1	2	23	48.367	C
1	1	23	42.703	D

halazon	Year	N	Mean	Grouping

2	2	24	69.918	A
1	2	22	54.246	B
2	1	24	47.537	C
1	1	24	36.824	D

Lychnis coronaria

Water Regime	Temperature	N	Mean	Grouping
3	2	16	84.330	A
3	1	15	66.195	B
2	2	16	56.641	C
2	1	16	47.249	D
1	1	16	33.041	E
1	2	15	25.329	F

Water Regime	Year	N	Mean	Grouping
3	2	15	87.695	A
2	2	16	64.504	B
3	1	16	62.831	B
2	1	16	39.386	C
1	2	15	34.046	D
1	1	16	24.324	E

Lychnis flos jovis

halazon	N	Mean	Grouping
2	48	52.901	A
1	46	40.985	B

Water Regime	N	Mean	Grouping
3	31	65.159	A
2	32	50.958	B
1	31	24.711	C

Temperature	N	Mean	Grouping
2	47	54.059	A
1	47	39.827	B

Year	N	Mean	Grouping
2	46	55.327	A
1	48	38.559	B

halazon	Water Regime	N	Mean	Grouping
2	3	16	73.292	A
2	2	16	57.270	B
1	3	15	57.026	B
1	2	16	44.646	C
2	1	16	28.141	D
1	1	15	21.282	E

halazon	Temperature	N	Mean	Grouping
2	2	24	60.852	A
1	2	23	47.266	B
2	1	24	44.950	C
1	1	23	34.703	D

halazon	Year	N	Mean	Grouping
2	2	24	62.377	A
1	2	22	48.277	B
2	1	24	43.425	C
1	1	24	33.692	D

Water Regime	Temperature	N	Mean	Grouping
3	2	16	79.195	A
2	2	16	62.663	B
3	1	15	51.123	C
2	1	16	39.253	D
1	1	16	29.104	E
1	2	15	20.318	F

Water Regime	Year	N	Mean	Grouping
3	2	15	75.926	A
2	2	16	60.990	B
3	1	16	54.393	C
2	1	16	40.926	D
1	2	15	29.066	E
1	1	16	20.357	F

Paradisea liliastrum

halazon	N	Mean	Grouping
1	46	29.739	A
2	48	4.230	B

Water Regime	N	Mean	Grouping
3	31	20.208	A
2	32	15.664	B
1	31	15.082	B

Temperature	N	Mean	Grouping
2	47	18.950	A
1	47	15.019	B

Year	N	Mean	Grouping
2	46	20.057	A
1	48	13.913	B

halazon	Water Regime	N	Mean	Grouping
1	3	15	40.415	A
1	2	16	31.329	B
1	1	15	17.473	C
2	1	16	12.691	C
2	2	16	0.000	D
2	3	16	0.000	D

halazon	Temperature	N	Mean	Grouping
1	2	23	33.621	A

1	1	23	25.857	B
2	2	24	4.279	C
2	1	24	4.181	C

halazon	Year	N	Mean	Grouping
1	2	22	35.669	A
1	1	24	23.808	B
2	2	24	4.444	C
2	1	24	4.017	C

Water Regime	Temperature	N	Mean	Grouping
3	2	16	25.171	A
2	2	16	18.489	B
1	1	16	16.973	B C
3	1	15	15.244	B C
1	2	15	13.190	B C
2	1	16	12.840	C

Water Regime	Year	N	Mean	Grouping
3	2	15	23.595	A
2	2	16	19.473	A B
1	2	15	17.102	B C
3	1	16	16.821	B C
1	1	16	13.061	C
2	1	16	11.856	C

Salvia nemorosa

halazon	N	Mean	Grouping
1	46	41.565	A
2	48	6.380	B

Salvia nemorosa

Water Regime	N	Mean	Grouping
3	31	26.352	A
1	31	24.118	A
2	32	21.448	A

Temperature	N	Mean	Grouping
2	47	25.746	A
1	47	22.200	B

Year	N	Mean	Grouping
2	46	31.131	A
1	48	16.814	B

halazon	Water Regime	N	Mean	Grouping
1	3	15	52.704	A
1	2	16	42.895	B
1	1	15	29.097	C
2	1	16	19.140	D
2	2	16	0.000	E
2	3	16	-0.000	E

halazon	Temperature	N	Mean	Grouping
1	2	23	45.745	A
1	1	23	37.386	B
2	1	24	7.014	C
2	2	24	5.746	C

halazon	Year	N	Mean	Grouping
1	2	22	49.503	A
1	1	24	33.628	B
2	2	24	12.760	C
2	1	24	0.000	D

Water Regime	Temperature	N	Mean	Grouping
3	2	16	32.301	A
1	1	16	27.375	A B
2	2	16	24.074	A B
1	2	15	20.862	B
3	1	15	20.403	B
2	1	16	18.821	B

Water Regime	Year	N	Mean	Grouping
1	2	15	36.821	A
3	2	15	30.378	A B
2	2	16	26.195	B
3	1	16	22.326	B C
2	1	16	16.700	C D
1	1	16	11.416	D

Asphodeline lutea

Temperature	Year	N	Mean	Grouping
2	2	23	15.300	A
1	2	23	8.742	B
2	1	24	8.370	B
1	1	24	7.078	B

halazon	Water Regime	Temperature	N	Mean	Grouping
1	3	2	8	35.375	A
1	2	2	8	16.135	B
1	3	1	7	15.947	B
1	2	1	8	12.225	B C
2	1	2	8	11.025	B C
1	1	1	8	10.830	B C
1	1	2	7	8.474	C
2	1	1	8	8.459	C
2	2	1	8	0.000	D
2	2	2	8	0.000	D
2	3	1	8	-0.000	D
2	3	2	8	-0.000	D

Centaurea triumfetii

Temperature	Year	N	Mean	Grouping
2	2	23	53.153	A
1	2	23	42.678	B

2	1	24	39.533	B
1	1	24	36.406	B

halazon	Water Regime	Temperature	N	Mean	Grouping
1	3	2	8	114.298	A
1	3	1	7	89.990	B
1	2	2	8	82.688	B
1	2	1	8	62.958	C
2	1	2	8	45.870	D
1	1	1	8	42.427	D
2	1	1	8	41.875	D
1	1	2	7	35.202	D
2	3	2	8	0.000	E
2	2	1	8	0.000	E
2	2	2	8	-0.000	E
2	3	1	8	-0.000	E

Centuarea orientalis

Temperature	Year	N	Mean	Grouping
2	2	23	39.213	A
2	1	24	27.548	B
1	2	23	24.481	B
1	1	24	21.422	B

halazon	Water Regime	Temperature	N	Mean	Grouping
1	3	2	8	92.710	A
1	2	2	8	49.208	B
1	3	1	7	47.496	B
1	2	1	8	36.418	B C
2	1	2	8	32.613	C
1	1	1	8	30.330	C
1	1	2	7	25.750	C
2	1	1	8	23.466	C
2	2	1	8	-0.000	D
2	2	2	8	-0.000	D
2	3	2	8	-0.000	D
2	3	1	8	-0.000	D

Dianthus carthusianorum

Temperature	Year	N	Mean	Grouping
2	2	23	51.937	A
1	2	23	41.358	B
2	1	24	35.888	C
1	1	24	29.311	D

Dianthus carthusianorum

halazon	Water Regime	Temperature	N	Mean	Grouping
2	3	2	8	70.935	A
1	3	2	8	55.292	B
2	2	2	8	52.036	B
2	3	1	8	44.206	C
2	2	1	8	40.865	C
1	2	2	8	40.562	C
2	1	1	8	34.646	D

1	3	1	7	34.290	D
1	2	1	8	31.855	D
1	1	1	8	26.145	E
2	1	2	8	25.525	E
1	1	2	7	19.126	F

Euphorbia nicaensis

Temperature	Year	N	Mean	Grouping
2	2	23	36.728	A
1	2	23	27.251	B
2	1	24	22.174	C
1	1	24	18.826	D

Euphorbia nicaensis

halazon	Water Regime	Temperature	N	Mean	Grouping
2	3	2	8	48.963	A
1	3	2	8	38.167	B
2	2	2	8	33.830	B
2	2	1	8	28.426	C
2	3	1	8	28.079	C
1	2	2	8	26.372	C D
1	2	1	8	22.160	D
1	3	1	7	21.727	D E
2	1	1	8	21.606	D E
2	1	2	8	17.238	E F
1	1	1	8	16.232	F G
1	1	2	7	12.134	G

Hedysarum hedysaroides

Temperature	Year	N	Mean	Grouping
2	2	23	46.428	A
1	2	23	32.883	B
2	1	24	32.625	B
1	1	24	22.628	C

halazon	Water Regime	Temperature	N	Mean	Grouping
1	3	2	8	102.745	A
1	2	2	8	74.990	B
1	3	1	7	64.066	B C
1	2	1	8	51.097	C
1	1	1	8	33.942	D
2	1	2	8	33.756	D
1	1	2	7	25.666	D E
2	1	1	8	17.426	E
2	2	1	8	0.000	F
2	2	2	8	0.000	F
2	3	2	8	0.000	F
2	3	1	8	0.000	F

Means that do not share a letter are significantly different.

Grouping Information Using Bonferroni Method and 95.0% Confidence for Linum flavum Compactum

Temperature	Year	N	Mean	Grouping
2	2	23	62.317	A
1	2	23	48.261	B
2	1	24	42.272	C

1	1	24	35.214	D

Linum flavum Compactum

halazon	Water Regime	Temperature	N	Mean	Grouping
2	3	2	8	82.191	A
1	3	2	8	64.072	B
2	2	2	8	61.839	B
2	2	1	8	52.957	C
2	3	1	8	51.721	C D
1	2	2	8	48.202	D
1	2	1	8	41.280	E
1	3	1	7	40.055	E F
2	1	1	8	36.614	F G
2	1	2	8	33.020	G
1	1	1	8	27.797	H
1	1	2	7	24.441	H

Linum narbonennse

Temperature	Year	N	Mean	Grouping
2	2	23	29.531	A
1	2	23	23.147	B
2	1	24	18.750	C
1	1	24	15.763	D

Means that do not share a letter are significantly different.

Grouping Information Using Bonferroni Method and 95.0% Confidence for Linum narbonennse

halazon	Water Regime	Temperature	N	Mean	Grouping
2	3	2	8	42.103	A
1	3	2	8	32.820	B
2	2	2	8	27.606	C
2	3	1	8	26.661	C
2	2	1	8	22.549	D
1	3	1	7	21.556	D E
1	2	2	8	21.520	D
1	2	1	8	17.580	E F
2	1	1	8	16.244	F
1	1	1	8	12.140	G
2	1	2	8	11.934	G
1	1	2	7	8.863	G

Lychnis coronaria

Temperature	Year	N	Mean	Grouping
2	2	23	66.069	A
1	2	23	58.094	B
2	1	24	44.798	C
1	1	24	39.563	D

halazon	Water Regime	Temperature	N	Mean	Grouping
2	3	2	8	94.780	A
2	3	1	8	74.144	B
1	3	2	8	73.880	B
2	2	2	8	63.652	C

1	3	1	7	58.247	D
2	2	1	8	53.104	E
1	2	2	8	49.630	E
1	2	1	8	41.395	F
2	1	1	8	37.615	F
2	1	2	8	29.069	G
1	1	1	8	28.467	G
1	1	2	7	21.590	H

Lychnis flos jovis

Temperature	Year	N	Mean	Grouping
2	2	23	63.759	A
1	2	23	46.895	B
2	1	24	44.359	C
1	1	24	32.758	D

halazon	Water Regime	Temperature	N	Mean	Grouping
2	3	2	8	89.008	A
2	2	2	8	70.424	B
1	3	2	8	69.382	B
2	3	1	8	57.576	C
1	2	2	8	54.902	C
1	3	1	7	44.670	D
2	2	1	8	44.116	D
1	2	1	8	34.390	E
2	1	1	8	33.159	E
1	1	1	8	25.050	F
2	1	2	8	23.124	F
1	1	2	7	17.513	G

Paradisea liliastrum

Temperature	Year	N	Mean	Grouping
2	2	23	23.597	A
1	2	23	16.516	B
2	1	24	14.303	B
1	1	24	13.522	B

halazon	Water Regime	Temperature	N	Mean	Grouping
1	3	2	8	50.343	A
1	2	2	8	36.977	B
1	3	1	7	30.488	B C
1	2	1	8	25.680	C
1	1	1	8	21.402	C D
1	1	2	7	13.543	D
2	1	2	8	12.838	D
2	1	1	8	12.544	D
2	2	1	8	0.000	E
2	3	2	8	0.000	E
2	3	1	8	0.000	E
2	2	2	8	-0.000	E

Salvia nemorosa

Temperature	Year	N	Mean	Grouping
2	2	23	33.199	A
1	2	23	29.064	A
2	1	24	18.292	B
1	1	24	15.335	B

halazon	Water Regime	Temperature	N	Mean	Grouping
1	3	2	8	64.603	A
1	2	2	8	48.148	B
1	3	1	7	40.806	B
1	2	1	8	37.642	B C
1	1	1	8	33.709	B C D
1	1	2	7	24.485	C D E
2	1	1	8	21.041	D E
2	1	2	8	17.239	E
2	2	1	8	0.000	F
2	2	2	8	0.000	F
2	3	1	8	0.000	F
2	3	2	8	-0.000	F

Asphodeline lutea

Water Regime	Temperature	Year	N	Mean	Grouping
3	2	2	8	24.010	A
3	2	1	8	11.365	B
1	2	2	7	11.306	B C
1	1	2	8	10.959	B C
2	2	2	8	10.583	B C
1	1	1	8	8.330	B C
1	2	1	8	8.192	B C
3	1	2	7	8.077	B C
3	1	1	8	7.870	B C
2	1	2	8	7.190	B C
2	2	1	8	5.553	B C
2	1	1	8	5.035	C

Centaurea triumfetii

Water Regime	Temperature	Year	N	Mean	Grouping
3	2	2	8	66.184	A
3	1	2	7	50.995	A B
2	2	2	8	48.249	B
3	2	1	8	48.114	B
1	2	2	7	45.025	B
1	1	1	8	45.024	B
1	1	2	8	39.279	B C
3	1	1	8	38.995	B C
2	1	2	8	37.759	B C
1	2	1	8	36.046	B C
2	2	1	8	34.439	B C
2	1	1	8	25.199	C

Centuarea orientalis

Water Regime	Temperature	Year	N	Mean	Grouping
3	2	2	8	55.230	A
3	2	1	8	37.480	B
1	2	2	7	34.344	B C
1	1	1	8	29.453	B C
2	2	2	8	28.064	B C D
3	1	2	7	27.181	B C D
1	1	2	8	24.344	B C D
1	2	1	8	24.019	B C D

2	1	2	8	21.919	C D
2	2	1	8	21.144	C D
3	1	1	8	20.315	C D
2	1	1	8	14.499	D

Dianthus carthusianorum

Water Regime	Temperature	Year	N	Mean	Grouping
3	2	2	8	74.922	A
2	2	2	8	56.196	B
3	2	1	8	51.305	C
2	1	2	8	44.116	D
3	1	2	7	43.066	D
1	1	2	8	36.892	E
2	2	1	8	36.402	E
3	1	1	8	35.430	E
2	1	1	8	28.604	F
1	2	2	7	24.693	F G
1	1	1	8	23.899	G
1	2	1	8	19.957	G

Euphorbia nicaensis

Water Regime	Temperature	Year	N	Mean	Grouping
3	2	2	8	53.370	A
2	2	2	8	39.534	B
3	2	1	8	33.760	C
2	1	2	8	32.271	C
3	1	2	7	26.202	D
3	1	1	8	23.604	D E
1	1	2	8	23.279	D E
2	2	1	8	20.669	E F
2	1	1	8	18.315	F G
1	2	2	7	17.279	F G
1	1	1	8	14.560	G H
1	2	1	8	12.092	H

Hedysarum hedysaroides

Water Regime	Temperature	Year	N	Mean	Grouping
3	2	2	8	60.923	A
2	2	2	8	43.809	B
3	2	1	8	41.822	B
3	1	2	7	35.933	B C
1	2	2	7	34.552	B C
2	1	2	8	31.481	B C
1	1	2	8	31.235	B C
2	2	1	8	31.181	B C
3	1	1	8	28.133	B C
1	2	1	8	24.870	C
1	1	1	8	20.134	C
2	1	1	8	19.616	C

Linum flavum Compactum

Water Regime	Temperature	Year	N	Mean	Grouping
3	2	2	8	86.735	A
2	2	2	8	66.829	B
3	2	1	8	59.529	C
2	1	2	8	57.714	C

3	1	2	7	51.779	D
2	2	1	8	43.212	E
3	1	1	8	39.998	E F
2	1	1	8	36.524	F G
1	1	2	8	35.291	G
1	2	2	7	33.387	G H
1	1	1	8	29.120	H
1	2	1	8	24.074	I

Linum narbonennse

Water Regime	Temperature	Year	N	Mean	Grouping
3	2	2	8	44.550	A
2	2	2	8	32.157	B
3	2	1	8	30.372	B C
3	1	2	7	27.517	C D
2	1	2	8	25.304	D
3	1	1	8	20.700	E
2	2	1	8	16.969	E F
1	1	2	8	16.619	F
2	1	1	8	14.825	F G
1	2	2	7	11.887	G H
1	1	1	8	11.765	G H
1	2	1	8	8.910	H

Lychnis coronaria

Water Regime	Temperature	Year	N	Mean	Grouping
3	2	2	8	99.226	A
3	1	2	7	76.163	B
2	2	2	8	70.744	C
3	2	1	8	69.434	C
2	1	2	8	58.265	D
3	1	1	8	56.228	D
2	2	1	8	42.539	E
1	1	2	8	39.855	E F
2	1	1	8	36.234	F
1	2	2	7	28.237	G
1	1	1	8	26.227	G H
1	2	1	8	22.421	H

Lychnis flos jovis

Water Regime	Temperature	Year	N	Mean	Grouping
3	2	2	8	93.826	A
2	2	2	8	74.659	B
3	2	1	8	64.564	C
3	1	2	7	58.025	D
2	2	1	8	50.667	E
2	1	2	8	47.321	E F
3	1	1	8	44.221	F
1	1	2	8	35.340	G
2	1	1	8	31.185	G
1	1	1	8	22.869	H
1	2	2	7	22.792	H
1	2	1	8	17.845	I

Paradisea liliastrum

Water

Regime	Temperature	Year	N	Mean	Grouping
3	2	2	8	30.046	A
2	2	2	8	23.335	A B
3	2	1	8	20.296	B C
1	2	2	7	17.410	B C D
1	1	1	8	17.153	B C D
3	1	2	7	17.143	B C D
1	1	2	8	16.794	B C D
2	1	2	8	15.611	B C D
2	2	1	8	13.643	C D
3	1	1	8	13.345	C D
2	1	1	8	10.069	D
1	2	1	8	8.970	D

Salvia nemorosa

Water Regime	Temperature	Year	N	Mean	Grouping
1	1	2	8	42.276	A
3	2	2	8	38.478	A B
1	2	2	7	31.366	A B C
2	2	2	8	29.753	A B C D
3	2	1	8	26.125	B C D E
2	1	2	8	22.638	C D E F
3	1	2	7	22.279	C D E F
3	1	1	8	18.528	C D E F
2	2	1	8	18.395	C D E F
2	1	1	8	15.005	D E F
1	1	1	8	12.474	E F
1	2	1	8	10.358	F

5.3 poorly fitted species

Note: Means that do not share a letter are significantly different.

Grouping Information Using Bonferroni Method and 95.0% Confidence

Analysis of Variance for Amsonia jonesii, using Adjusted SS for Tests

Source	DF	Seq SS	Adj SS	Adj MS	F
halazon	1	402.47	402.47	402.47	194.56
Water Regime	2	14133.93	14133.93	7066.96	3416.26
halazon*Water Regime	2	219.69	219.69	109.85	53.10
Temperature	1	203.95	203.95	203.95	98.59
halazon*Temperature	1	1.74	1.74	1.74	0.84
Water Regime*Temperature	2	350.70	350.70	175.35	84.77
Year	1	363.58	363.58	363.58	175.76
halazon*Year	1	5.24	5.24	5.24	2.53
Water Regime*Year	2	288.37	288.37	144.18	69.70
Temperature*Year	1	53.14	53.14	53.14	25.69
halazon*Water Regime*Temperature	2	2.55	2.55	1.28	0.62
halazon*Water Regime*Year	2	3.22	3.22	1.61	0.78
Water Regime*Temperature*Year	2	33.31	33.31	16.66	8.05
Error	75	155.15	155.15	2.07	
Total	95	16217.03			

Source	P
halazon	0.000
Water Regime	0.000
halazon*Water Regime	0.000
Temperature	0.000
halazon*Temperature	0.362
Water Regime*Temperature	0.000
Year	0.000
halazon*Year	0.116
Water Regime*Year	0.000
Temperature*Year	0.000
halazon*Water Regime*Temperature	0.543
halazon*Water Regime*Year	0.463
Water Regime*Temperature*Year	0.001
Error	
Total	

S = 1.43827   R-Sq = 99.04%   R-Sq(adj) = 98.79%

Obs	Amsonia jonesii	Fit	SE Fit	Residual	St Resid	
13	31.6000	34.4290	0.6727	-2.8290	-2.23	R
50	27.4600	24.9110	0.6727	2.5490	2.01	R
61	39.8600	43.2678	0.6727	-3.4078	-2.68	R
67	20.4400	17.8757	0.6727	2.5643	2.02	R
68	15.1000	17.8757	0.6727	-2.7757	-2.18	R
77	25.3200	22.1500	0.6727	3.1700	2.49	R

R denotes an observation with a large standardized residual.

Analysis of Variance for Asclepias tuberosa (coloradol f, using Adjusted SS for Tests

Source	DF	Seq SS	Adj SS	Adj MS	F
halazon	1	226.75	226.75	226.75	9.49
Water Regime	2	10387.48	10387.48	5193.74	217.38
halazon*Water Regime	2	218.44	218.44	109.22	4.57
Temperature	1	907.49	907.49	907.49	37.98
halazon*Temperature	1	161.15	161.15	161.15	6.74
Water Regime*Temperature	2	1308.87	1308.87	654.44	27.39
Year	1	282.63	282.63	282.63	11.83
halazon*Year	1	1.53	1.53	1.53	0.06
Water Regime*Year	2	308.69	308.69	154.35	6.46
Temperature*Year	1	214.68	214.68	214.68	8.99
halazon*Water Regime*Temperature	2	618.81	618.81	309.41	12.95
halazon*Water Regime*Year	2	38.46	38.46	19.23	0.80
Water Regime*Temperature*Year	2	222.85	222.85	111.42	4.66
Error	75	1791.92	1791.92	23.89	
Total	95	16689.76			

Source	P
halazon	0.003
Water Regime	0.000
halazon*Water Regime	0.013
Temperature	0.000
halazon*Temperature	0.011
Water Regime*Temperature	0.000
Year	0.001
halazon*Year	0.801
Water Regime*Year	0.003
Temperature*Year	0.004
halazon*Water Regime*Temperature	0.000
halazon*Water Regime*Year	0.451
Water Regime*Temperature*Year	0.012
Error	
Total	

S = 4.88797   R-Sq = 89.26%   R-Sq(adj) = 86.40%

Obs	Asclepias tuberosa (coloradol f	Fit	SE Fit	Residual	St Resid	
17	16.2100	6.9334	2.2861	9.2766	2.15	R
49	22.5900	5.6353	2.2861	16.9547	3.92	R
53	0.0000	13.3747	2.2861	-13.3747	-3.10	R
54	0.0000	13.3747	2.2861	-13.3747	-3.10	R
55	27.4900	13.3747	2.2861	14.1153	3.27	R
56	25.9600	13.3747	2.2861	12.5853	2.91	R

R denotes an observation with a large standardized residual.

Analysis of Variance for Basamorrhiza sagitifolius, using Adjusted SS for Tests

Source	DF	Seq SS	Adj SS	Adj MS	F	P
halazon	1	8.18	8.18	8.18	16.27	0.000
Water Regime	2	1239.32	1239.32	619.66	1233.09	0.000

halazon*Water Regime	2	16.36	16.36	8.18	16.27	0.000
Temperature	1	27.14	27.14	27.14	54.00	0.000
halazon*Temperature	1	0.36	0.36	0.36	0.72	0.400
Water Regime*Temperature	2	54.27	54.27	27.14	54.00	0.000
Year	1	619.66	619.66	619.66	1233.09	0.000
halazon*Year	1	8.18	8.18	8.18	16.27	0.000
Water Regime*Year	2	1239.32	1239.32	619.66	1233.09	0.000
Temperature*Year	1	27.14	27.14	27.14	54.00	0.000
halazon*Water Regime*Temperature	2	0.72	0.72	0.36	0.72	0.492
halazon*Water Regime*Year	2	16.36	16.36	8.18	16.27	0.000
Water Regime*Temperature*Year	2	54.27	54.27	27.14	54.00	0.000
Error	75	37.69	37.69	0.50		
Total	95	3348.95				

S = 0.708889   R-Sq = 98.87%   R-Sq(adj) = 98.57%

Obs	Basamorrhiza sagitifolius	Fit	SE Fit	Residual	St Resid	
5	12.1100	10.4862	0.3316	1.6238	2.59	R
6	9.2100	10.4862	0.3316	-1.2762	-2.04	R
7	8.9500	10.4862	0.3316	-1.5362	-2.45	R
8	12.4100	10.4862	0.3316	1.9238	3.07	R
15	17.8900	16.4987	0.3316	1.3913	2.22	R
53	15.2500	13.6212	0.3316	1.6288	2.60	R
54	11.6000	13.6212	0.3316	-2.0212	-3.23	R
55	11.2700	13.6212	0.3316	-2.3512	-3.75	R
56	15.6300	13.6212	0.3316	2.0088	3.21	R
63	22.5400	20.3687	0.3316	2.1713	3.47	R

R denotes an observation with a large standardized residual.

Analysis of Variance for Centaurea pulcherrimus, using Adjusted SS for Tests

Source	DF	Seq SS	Adj SS	Adj MS	F	P
halazon	1	919.52	919.52	919.52	46.06	0.000
Water Regime	2	8786.13	8786.13	4393.06	220.03	0.000
halazon*Water Regime	2	1732.20	1732.20	866.10	43.38	0.000
Temperature	1	459.77	459.77	459.77	23.03	0.000
halazon*Temperature	1	121.70	121.70	121.70	6.10	0.016
Water Regime*Temperature	2	729.91	729.91	364.95	18.28	0.000
Year	1	176.34	176.34	176.34	8.83	0.004
halazon*Year	1	147.73	147.73	147.73	7.40	0.008
Water Regime*Year	2	92.43	92.43	46.21	2.31	0.106
Temperature*Year	1	107.76	107.76	107.76	5.40	0.023
halazon*Water Regime*Temperature	2	364.00	364.00	182.00	9.12	0.000
halazon*Water Regime*Year	2	74.34	74.34	37.17	1.86	0.163
Water Regime*Temperature*Year	2	179.63	179.63	89.81	4.50	0.014
Error	75	1497.42	1497.42	19.97		
Total	95	15388.88				

S = 4.46829   R-Sq = 90.27%   R-Sq(adj) = 87.67%

Obs	Centaurea pulcherrimus	Fit	SE Fit	Residual	St Resid	
49	28.2600	15.7716	2.0899	12.4884	3.16	R
50	0.0000	15.7716	2.0899	-15.7716	-3.99	R

53	0.0000	10.4784	2.0899	-10.4784	-2.65 R
54	0.0000	10.4784	2.0899	-10.4784	-2.65 R
55	0.0000	10.4784	2.0899	-10.4784	-2.65 R
56	31.7000	10.4784	2.0899	21.2216	5.37 R

R denotes an observation with a large standardized residual.

Analysis of Variance for Delphinium barbeyi, using Adjusted SS for Tests

Source	DF	Seq SS	Adj SS	Adj MS	F	P
halazon	1	1	1	1	0.00	0.977
Water Regime	2	26291	26291	13145	12.61	0.000
halazon*Water Regime	2	38	38	19	0.02	0.982
Temperature	1	6426	6426	6426	6.16	0.015
halazon*Temperature	1	314	314	314	0.30	0.585
Water Regime*Temperature	2	11473	11473	5736	5.50	0.006
Year	1	3957	3957	3957	3.80	0.055
halazon*Year	1	97	97	97	0.09	0.761
Water Regime*Year	2	7838	7838	3919	3.76	0.028
Temperature*Year	1	2479	2479	2479	2.38	0.127
halazon*Water Regime*Temperature	2	997	997	499	0.48	0.622
halazon*Water Regime*Year	2	206	206	103	0.10	0.906
Water Regime*Temperature*Year	2	4896	4896	2448	2.35	0.103
Error	75	78186	78186	1042		
Total	95	143198				

S = 32.2874   R-Sq = 45.40%   R-Sq(adj) = 30.84%

Obs	Delphinium barbeyi	Fit	SE Fit	Residual	St Resid
15	232.330	83.528	15.101	148.802	5.21 R
61	38.240	103.602	15.101	-65.362	-2.29 R
62	44.010	103.602	15.101	-59.592	-2.09 R
63	292.730	103.602	15.101	189.128	6.63 R
64	42.950	103.602	15.101	-60.652	-2.13 R

R denotes an observation with a large standardized residual.

Analysis of Variance for Dracocephalum grandiflorum, using Adjusted SS for Tests

Source	DF	Seq SS	Adj SS	Adj MS	F	P
halazon	1	6.30	6.30	6.30	0.80	0.375
Water Regime	2	8355.07	8355.07	4177.54	527.98	0.000
halazon*Water Regime	2	12.61	12.61	6.30	0.80	0.455
Temperature	1	667.81	667.81	667.81	84.40	0.000
halazon*Temperature	1	75.40	75.40	75.40	9.53	0.003
Water Regime*Temperature	2	1335.63	1335.63	667.82	84.40	0.000
Year	1	455.01	455.01	455.01	57.51	0.000
halazon*Year	1	12.94	12.94	12.94	1.63	0.205
Water Regime*Year	2	910.02	910.02	455.01	57.51	0.000
Temperature*Year	1	46.15	46.15	46.15	5.83	0.018
halazon*Water Regime*Temperature	2	150.80	150.80	75.40	9.53	0.000
halazon*Water Regime*Year	2	25.87	25.87	12.94	1.63	0.202
Water Regime*Temperature*Year	2	92.30	92.30	46.15	5.83	0.004
Error	75	593.43	593.43	7.91		
Total	95	12739.35				

S = 2.81289   R-Sq = 95.34%   R-Sq(adj) = 94.10%

Obs	Dracocephalum grandiflorum	Fit	SE Fit	Residual	St Resid	
52	16.9400	4.4350	1.3156	12.5050	5.03	R
54	22.0200	15.5400	1.3156	6.4800	2.61	R
55	0.0000	15.5400	1.3156	-15.5400	-6.25	R
56	20.9600	15.5400	1.3156	5.4200	2.18	R

R denotes an observation with a large standardized residual.

Analysis of Variance for Geum triflorum, using Adjusted SS for Tests

Source	DF	Seq SS	Adj SS	Adj MS	F	P
halazon	1	186.32	186.32	186.32	36.86	0.000
Water Regime	2	6015.06	6015.06	3007.53	594.92	0.000
halazon*Water Regime	2	98.62	98.62	49.31	9.75	0.000
Temperature	1	367.07	367.07	367.07	72.61	0.000
halazon*Temperature	1	7.90	7.90	7.90	1.56	0.215
Water Regime*Temperature	2	184.33	184.33	92.16	18.23	0.000
Year	1	330.12	330.12	330.12	65.30	0.000
halazon*Year	1	7.00	7.00	7.00	1.38	0.243
Water Regime*Year	2	173.31	173.31	86.65	17.14	0.000
Temperature*Year	1	0.01	0.01	0.01	0.00	0.957
halazon*Water Regime*Temperature	2	3.96	3.96	1.98	0.39	0.677
halazon*Water Regime*Year	2	3.53	3.53	1.77	0.35	0.706
Water Regime*Temperature*Year	2	54.21	54.21	27.11	5.36	0.007
Error	75	379.15	379.15	5.06		
Total	95	7810.60				

S = 2.24841   R-Sq = 95.15%   R-Sq(adj) = 93.85%

Obs	Geum triflorum	Fit	SE Fit	Residual	St Resid	
17	8.4100	4.2419	1.0516	4.1681	2.10	R
18	9.1500	4.2419	1.0516	4.9081	2.47	R
19	0.0000	4.2419	1.0516	-4.2419	-2.13	R
20	0.0000	4.2419	1.0516	-4.2419	-2.13	R
62	25.2800	29.5956	1.0516	-4.3156	-2.17	R
65	11.5600	6.1831	1.0516	5.3769	2.71	R
66	12.5800	6.1831	1.0516	6.3969	3.22	R
67	0.0000	6.1831	1.0516	-6.1831	-3.11	R
68	0.0000	6.1831	1.0516	-6.1831	-3.11	R
70	17.6600	13.6694	1.0516	3.9906	2.01	R

R denotes an observation with a large standardized residual.

Analysis of Variance for Hymenoxys grandiflora, using Adjusted SS for Tests

Source	DF	Seq SS	Adj SS	Adj MS	F	P
halazon	1	6.99	6.99	6.99	0.86	0.358
Water Regime	2	4970.07	4970.07	2485.04	304.66	0.000
halazon*Water Regime	2	43.50	43.50	21.75	2.67	0.076
Temperature	1	633.04	633.04	633.04	77.61	0.000
halazon*Temperature	1	15.83	15.83	15.83	1.94	0.168

Water Regime*Temperature	2	768.19	768.19	384.10	47.09	0.000
Year	1	111.93	111.93	111.93	13.72	0.000
halazon*Year	1	3.00	3.00	3.00	0.37	0.546
Water Regime*Year	2	113.73	113.73	56.86	6.97	0.002
Temperature*Year	1	45.68	45.68	45.68	5.60	0.021
halazon*Water Regime*Temperature	2	216.28	216.28	108.14	13.26	0.000
halazon*Water Regime*Year	2	11.98	11.98	5.99	0.73	0.483
Water Regime*Temperature*Year	2	31.37	31.37	15.68	1.92	0.153
Error	75	611.75	611.75	8.16		
Total	95	7583.33				

S = 2.85599   R-Sq = 91.93%   R-Sq(adj) = 89.78%

Obs	Hymenoxys grandiflora	Fit	SE Fit	Residual	St Resid	
25	8.4100	2.7722	1.3358	5.6378	2.23	R
29	12.4100	6.7903	1.3358	5.6197	2.23	R
32	0.0000	6.7903	1.3358	-6.7903	-2.69	R
49	0.0000	5.9803	1.3358	-5.9803	-2.37	R
50	11.6000	5.9803	1.3358	5.6197	2.23	R
51	13.9000	5.9803	1.3358	7.9197	3.14	R
52	0.0000	5.9803	1.3358	-5.9803	-2.37	R
53	0.0000	8.5997	1.3358	-8.5997	-3.41	R
54	0.0000	8.5997	1.3358	-8.5997	-3.41	R
55	16.1200	8.5997	1.3358	7.5203	2.98	R
56	16.7000	8.5997	1.3358	8.1003	3.21	R

R denotes an observation with a large standardized residual.

Analysis of Variance for Penstemon strictus, using Adjusted SS for Tests

Source	DF	Seq SS	Adj SS	Adj MS	F	P
halazon	1	688.63	688.63	688.63	109.80	0.000
Water Regime	2	6646.16	6646.16	3323.08	529.88	0.000
halazon*Water Regime	2	71.58	71.58	35.79	5.71	0.005
Temperature	1	1133.72	1133.72	1133.72	180.78	0.000
halazon*Temperature	1	22.53	22.53	22.53	3.59	0.062
Water Regime*Temperature	2	257.99	257.99	129.00	20.57	0.000
Year	1	1135.23	1135.23	1135.23	181.02	0.000
halazon*Year	1	24.01	24.01	24.01	3.83	0.054
Water Regime*Year	2	96.51	96.51	48.25	7.69	0.001
Temperature*Year	1	33.39	33.39	33.39	5.32	0.024
halazon*Water Regime*Temperature	2	3.18	3.18	1.59	0.25	0.777
halazon*Water Regime*Year	2	1.26	1.26	0.63	0.10	0.905
Water Regime*Temperature*Year	2	39.61	39.61	19.81	3.16	0.048
Error	75	470.35	470.35	6.27		
Total	95	10624.15				

S = 2.50427   R-Sq = 95.57%   R-Sq(adj) = 94.39%

Obs	Penstemon strictus	Fit	SE Fit	Residual	St Resid	
44	0.0000	6.6517	1.1713	-6.6517	-3.01	R
82	9.7350	4.5430	1.1713	5.1920	2.35	R
83	0.0000	4.5430	1.1713	-4.5430	-2.05	R

84	0.0000	4.5430	1.1713	-4.5430	-2.05	R
92	0.0000	9.0558	1.1713	-9.0558	-4.09	R

R denotes an observation with a large standardized residual.

Analysis of Variance for Salvia pachyphylla, using Adjusted SS for Tests

Source	DF	Seq SS	Adj SS	Adj MS	F	P
halazon	1	10.28	10.28	10.28	1.09	0.299
Water Regime	2	785.60	785.60	392.80	41.85	0.000
halazon*Water Regime	2	9.90	9.90	4.95	0.53	0.592
Temperature	1	228.81	228.81	228.81	24.38	0.000
halazon*Temperature	1	3.73	3.73	3.73	0.40	0.530
Water Regime*Temperature	2	169.93	169.93	84.96	9.05	0.000
Year	1	686.99	686.99	686.99	73.19	0.000
halazon*Year	1	10.28	10.28	10.28	1.09	0.299
Water Regime*Year	2	785.60	785.60	392.80	41.85	0.000
Temperature*Year	1	228.81	228.81	228.81	24.38	0.000
halazon*Water Regime*Temperature	2	2.25	2.25	1.13	0.12	0.887
halazon*Water Regime*Year	2	9.90	9.90	4.95	0.53	0.592
Water Regime*Temperature*Year	2	169.93	169.93	84.96	9.05	0.000
Error	75	703.98	703.98	9.39		
Total	95	3805.99				

S = 3.06373   R-Sq = 81.50%   R-Sq(adj) = 76.57%

Obs	Salvia pachyphylla	Fit	SE Fit	Residual	St Resid	
5	11.4300	5.6341	1.4329	5.7959	2.14	R
6	12.6000	5.6341	1.4329	6.9659	2.57	R
7	0.0000	5.6341	1.4329	-5.6341	-2.08	R
8	0.0000	5.6341	1.4329	-5.6341	-2.08	R
53	14.4000	7.9409	1.4329	6.4591	2.39	R
54	15.8700	7.9409	1.4329	7.9291	2.93	R
55	0.0000	7.9409	1.4329	-7.9409	-2.93	R
56	0.0000	7.9409	1.4329	-7.9409	-2.93	R
77	14.0300	6.1919	1.4329	7.8381	2.89	R
78	11.6100	6.1919	1.4329	5.4181	2.00	R
79	0.0000	6.1919	1.4329	-6.1919	-2.29	R
80	0.0000	6.1919	1.4329	-6.1919	-2.29	R

R denotes an observation with a large standardized residual.

Analysis of Variance for Sphaeralcea coccinea, using Adjusted SS for Tests

Source	DF	Seq SS	Adj SS	Adj MS	F	P
halazon	1	77.27	77.27	77.27	12.37	0.001
Water Regime	2	2992.15	2992.15	1496.08	239.46	0.000
halazon*Water Regime	2	44.50	44.50	22.25	3.56	0.033
Temperature	1	418.04	418.04	418.04	66.91	0.000
halazon*Temperature	1	7.67	7.67	7.67	1.23	0.272
Water Regime*Temperature	2	49.09	49.09	24.55	3.93	0.024
Year	1	775.04	775.04	775.04	124.05	0.000
halazon*Year	1	15.40	15.40	15.40	2.46	0.121
Water Regime*Year	2	172.97	172.97	86.49	13.84	0.000
Temperature*Year	1	179.77	179.77	179.77	28.77	0.000
halazon*Water Regime*Temperature	2	0.52	0.52	0.26	0.04	0.959
halazon*Water Regime*Year	2	4.58	4.58	2.29	0.37	0.694
Water Regime*Temperature*Year	2	38.76	38.76	19.38	3.10	0.051

Error	75	468.59	468.59	6.25
Total	95	5244.36		

S = 2.49956   R-Sq = 91.06%   R-Sq(adj) = 88.68%

Obs	Sphaeralcea coccinea	Fit	SE Fit	Residual	St Resid	
22	8.5000	3.3478	1.1691	5.1522	2.33	R
45	9.2500	4.0456	1.1691	5.2044	2.36	R
69	0.0000	5.4372	1.1691	-5.4372	-2.46	R
70	11.6800	5.4372	1.1691	6.2428	2.83	R
71	0.0000	5.4372	1.1691	-5.4372	-2.46	R
80	19.5300	15.0753	1.1691	4.4547	2.02	R
93	12.7100	5.1294	1.1691	7.5806	3.43	R
94	0.0000	5.1294	1.1691	-5.1294	-2.32	R
96	0.0000	5.1294	1.1691	-5.1294	-2.32	R

R denotes an observation with a large standardized residual.

Analysis of Variance for Zinnia grandiflorus, using Adjusted SS for Tests

Source	DF	Seq SS	Adj SS	Adj MS	F
halazon	1	301.54	301.54	301.54	54.53
Water Regime	2	11424.28	11424.28	5712.14	1033.06
halazon*Water Regime	2	178.70	178.70	89.35	16.16
Temperature	1	764.56	764.56	764.56	138.27
halazon*Temperature	1	14.99	14.99	14.99	2.71
Water Regime*Temperature	2	414.97	414.97	207.48	37.52
Year	1	470.47	470.47	470.47	85.09
halazon*Year	1	9.34	9.34	9.34	1.69
Water Regime*Year	2	270.01	270.01	135.01	24.42
Temperature*Year	1	1.09	1.09	1.09	0.20
halazon*Water Regime*Temperature	2	7.59	7.59	3.79	0.69
halazon*Water Regime*Year	2	4.90	4.90	2.45	0.44
Water Regime*Temperature*Year	2	79.44	79.44	39.72	7.18
Error	75	414.70	414.70	5.53	
Total	95	14356.58			

Source	P
halazon	0.000
Water Regime	0.000
halazon*Water Regime	0.000
Temperature	0.000
halazon*Temperature	0.104
Water Regime*Temperature	0.000
Year	0.000
halazon*Year	0.198
Water Regime*Year	0.000
Temperature*Year	0.658
halazon*Water Regime*Temperature	0.507
halazon*Water Regime*Year	0.644
Water Regime*Temperature*Year	0.001
Error	
Total	

S = 2.35145   R-Sq = 97.11%   R-Sq(adj) = 96.34%

Obs	Zinnia grandiflorus	Fit	SE Fit	Residual	St Resid	
18	10.6200	4.5728	1.0998	6.0472	2.91	R
19	0.0000	4.5728	1.0998	-4.5728	-2.20	R
20	0.0000	4.5728	1.0998	-4.5728	-2.20	R
65	11.3700	6.6422	1.0998	4.7278	2.27	R
66	14.6000	6.6422	1.0998	7.9578	3.83	R
67	0.0000	6.6422	1.0998	-6.6422	-3.20	R
68	0.0000	6.6422	1.0998	-6.6422	-3.20	R

R denotes an observation with a large standardized residual.

Amsonia jonesii

halazon	N	Mean	Grouping
2	48	17.2901	A
1	48	13.1950	B

Water Regime	N	Mean	Grouping
1	32	29.6896	A
2	32	16.0380	B
3	32	-0.0000	C

Temperature	N	Mean	Grouping
2	48	16.7001	A
1	48	13.7850	B

Year	N	Mean	Grouping
2	48	17.1886	A
1	48	13.2965	B

halazon	Water Regime	N	Mean	Grouping
2	1	16	33.2979	A
1	1	16	26.0812	B
2	2	16	18.5723	C
1	2	16	13.5037	D
1	3	16	0.0000	E
2	3	16	-0.0000	E

halazon	Temperature	N	Mean	Grouping
2	2	24	18.8822	A
2	1	24	15.6979	B
1	2	24	14.5179	C
1	1	24	11.8721	D

halazon	Year	N	Mean	Grouping
2	2	24	19.4698	A
2	1	24	15.1104	B
1	2	24	14.9075	B
1	1	24	11.4825	C

Water Regime	Temperature	N	Mean	Grouping
1	2	16	33.8473	A
1	1	16	25.5319	B
2	2	16	16.2529	C
2	1	16	15.8231	C
3	2	16	-0.0000	D
3	1	16	-0.0000	D

Water Regime	Year	N	Mean	Grouping
1	2	16	33.8992	A
1	1	16	25.4800	B
2	2	16	17.6667	C
2	1	16	14.4094	D
3	1	16	-0.0000	E
3	2	16	-0.0000	E

Asclepias tuberosa

halazon	N	Mean	Grouping
1	48	10.6123	A
2	48	7.5385	B

Water Regime	N	Mean	Grouping
1	32	23.6397	A
2	32	3.5866	B
3	32	-0.0000	C

Temperature	N	Mean	Grouping
2	48	12.1500	A
1	48	6.0008	B

Year	N	Mean	Grouping
2	48	10.7913	A
1	48	7.3596	B

halazon	Water Regime	N	Mean	Grouping
1	1	16	24.6638	A
2	1	16	22.6156	A
1	2	16	7.1731	B
2	2	16	0.0000	C
1	3	16	0.0000	C
2	3	16	-0.0000	C

halazon	Temperature	N	Mean	Grouping
1	2	24	12.3913	A
2	2	24	11.9087	A
1	1	24	8.8333	A
2	1	24	3.1683	B

halazon	Year	N	Mean	Grouping
1	2	24	12.4542	A
2	2	24	9.1283	A B
1	1	24	8.7704	A B
2	1	24	5.9487	B

Water Regime	Temperature	N	Mean	Grouping
1	2	16	31.9069	A
1	1	16	15.3725	B
2	2	16	4.5431	C
2	1	16	2.6300	C
3	1	16	0.0000	C
3	2	16	-0.0000	C

Water Regime	Year	N	Mean	Grouping
1	2	16	27.8306	A
1	1	16	19.4488	B
2	2	16	4.5431	C
2	1	16	2.6300	C
3	2	16	-0.0000	C
3	1	16	-0.0000	C

Basamorrhiza sagitifolius

halazon	N	Mean	Grouping
2	48	2.8325	A
1	48	2.2487	B

Water Regime	N	Mean	Grouping
1	32	7.6219	A
2	32	0.0000	B
3	32	-0.0000	B

Temperature	N	Mean	Grouping
2	48	3.0723	A
1	48	2.0090	B

Year	N	Mean	Grouping
2	48	5.0812	A
1	48	0.0000	B

halazon	Water Regime	N	Mean	Grouping
2	1	16	8.4975	A
1	1	16	6.7462	B
2	2	16	0.0000	C
1	2	16	-0.0000	C
2	3	16	-0.0000	C
1	3	16	-0.0000	C

halazon	Temperature	N	Mean	Grouping
2	2	24	3.4254	A
1	2	24	2.7192	B
2	1	24	2.2396	B C
1	1	24	1.7783	C

halazon	Year	N	Mean	Grouping
2	2	24	5.6650	A
1	2	24	4.4975	B

1	1	24	0.0000	C
2	1	24	0.0000	C

Water Regime	Temperature	N	Mean	Grouping
1	2	16	9.2169	A
1	1	16	6.0269	B
2	1	16	0.0000	C
2	2	16	0.0000	C
3	1	16	-0.0000	C
3	2	16	-0.0000	C

Water Regime	Year	N	Mean	Grouping
1	2	16	15.2437	A
1	1	16	0.0000	B
2	2	16	0.0000	B
2	1	16	0.0000	B
3	1	16	0.0000	B
3	2	16	-0.0000	B

Centaurea pulcherrimus

halazon	N	Mean	Grouping
1	48	13.8792	A
2	48	7.6894	B

Water Regime	N	Mean	Grouping
1	32	23.2516	A
2	32	9.1013	B
3	32	-0.0000	C

Temperature	N	Mean	Grouping
2	48	12.9727	A
1	48	8.5958	B

Year	N	Mean	Grouping
2	48	12.1396	A
1	48	9.4290	B

halazon	Water Regime	N	Mean	Grouping
1	1	16	23.4350	A
2	1	16	23.0681	A
1	2	16	18.2025	B
2	2	16	0.0000	C
1	3	16	0.0000	C
2	3	16	-0.0000	C

halazon	Temperature	N	Mean	Grouping
1	2	24	14.9417	A
1	1	24	12.8167	A B
2	2	24	11.0037	B
2	1	24	4.3750	C

halazon	Year	N	Mean	Grouping
1	2	24	16.4750	A
1	1	24	11.2833	B
2	2	24	7.8042	B C
2	1	24	7.5746	C

Water Regime	Temperature	N	Mean	Grouping
1	2	16	29.3294	A
1	1	16	17.1737	B
2	2	16	9.5888	C
2	1	16	8.6138	C
3	1	16	0.0000	D
3	2	16	-0.0000	D

Water Regime	Year	N	Mean	Grouping
1	2	16	25.5425	A
1	1	16	20.9606	A
2	2	16	10.8763	B
2	1	16	7.3263	B
3	2	16	0.0000	C
3	1	16	-0.0000	C

Delphinium barbeyi

halazon	N	Mean	Grouping
1	48	12.2496	A
2	48	12.0598	A

Delphinium barbeyi

Water Regime	N	Mean	Grouping
1	32	35.5522	A
2	32	0.9119	B
3	32	0.0000	B

Delphinium barbeyi

Temperature	N	Mean	Grouping
2	48	20.3362	A
1	48	3.9731	B

Delphinium barbeyi

Year	N	Mean	Grouping
2	48	18.5752	A
1	48	5.7342	A

Delphinium barbeyi

halazon	Water Regime	N	Mean	Grouping
2	1	16	36.1794	A
1	1	16	34.9250	A
1	2	16	1.8238	A B
2	2	16	0.0000	B
1	3	16	0.0000	B
2	3	16	-0.0000	B

Delphinium barbeyi

halazon	Temperature	N	Mean	Grouping
2	2	24	22.0492	A
1	2	24	18.6233	A
1	1	24	5.8758	A
2	1	24	2.0704	A

halazon	Year	N	Mean	Grouping
2	2	24	19.4842	A
1	2	24	17.6663	A
1	1	24	6.8329	A
2	1	24	4.6354	A

Water Regime	Temperature	N	Mean	Grouping
1	2	16	59.1850	A
1	1	16	11.9194	B
2	2	16	1.8238	B
3	1	16	0.0000	B
2	1	16	0.0000	B
3	2	16	-0.0000	B

Water Regime	Year	N	Mean	Grouping
1	2	16	54.7512	A
1	1	16	16.3531	B
2	2	16	0.9744	B
2	1	16	0.8494	B
3	2	16	0.0000	B
3	1	16	-0.0000	B

Dracocephalum grandiflorum

halazon	N	Mean	Grouping
2	48	6.8529	A
1	48	6.3404	A

Water Regime	N	Mean	Grouping
1	32	19.7900	A
2	32	0.0000	B
3	32	-0.0000	B

Temperature	N	Mean	Grouping
2	48	9.2342	A
1	48	3.9592	B

Year	N	Mean	Grouping
2	48	8.7737	A
1	48	4.4196	B

halazon	Water Regime	N	Mean	Grouping
2	1	16	20.5587	A
1	1	16	19.0212	A
2	2	16	0.0000	B
1	2	16	0.0000	B

1	3	16	-0.0000	B
2	3	16	-0.0000	B

halazon	Temperature	N	Mean	Grouping
2	2	24	10.3767	A
1	2	24	8.0917	B
1	1	24	4.5892	C
2	1	24	3.3292	C

halazon	Year	N	Mean	Grouping
2	2	24	9.3971	A
1	2	24	8.1504	A
1	1	24	4.5304	B
2	1	24	4.3087	B

Water Regime	Temperature	N	Mean	Grouping
1	2	16	27.7025	A
1	1	16	11.8775	B
2	1	16	0.0000	C
2	2	16	0.0000	C
3	1	16	0.0000	C
3	2	16	-0.0000	C

Water Regime	Year	N	Mean	Grouping
1	2	16	26.3212	A
1	1	16	13.2587	B
2	2	16	0.0000	C
2	1	16	0.0000	C
3	1	16	-0.0000	C
3	2	16	-0.0000	C

Geum triflorum

halazon	N	Mean	Grouping
2	48	11.6194	A
1	48	8.8331	B

Water Regime	N	Mean	Grouping
1	32	19.2831	A
2	32	11.3956	B
3	32	-0.0000	C

Temperature	N	Mean	Grouping
2	48	12.1817	A
1	48	8.2708	B

Year	N	Mean	Grouping
2	48	12.0806	A
1	48	8.3719	B

halazon	Water Regime	N	Mean	Grouping
2	1	16	21.6650	A
1	1	16	16.9012	B
2	2	16	13.1931	C
1	2	16	9.5981	D
1	3	16	0.0000	E
2	3	16	-0.0000	E

halazon	Temperature	N	Mean	Grouping
2	2	24	13.8617	A
1	2	24	10.5017	B
2	1	24	9.3771	B
1	1	24	7.1646	C

halazon	Year	N	Mean	Grouping
2	2	24	13.7437	A
1	2	24	10.4175	B
2	1	24	9.4950	B
1	1	24	7.2487	C

Water Regime	Temperature	N	Mean	Grouping
1	2	16	22.3275	A
1	1	16	16.2387	B
2	2	16	14.2175	B
2	1	16	8.5738	C
3	2	16	0.0000	D
3	1	16	-0.0000	D

Water Regime	Year	N	Mean	Grouping
1	2	16	22.4237	A
1	1	16	16.1425	B
2	2	16	13.8181	B
2	1	16	8.9731	C
3	1	16	-0.0000	D
3	2	16	-0.0000	D

Hymenoxys grandiflora

halazon	N	Mean	Grouping
1	48	5.9435	A
2	48	5.4040	A

Water Regime	N	Mean	Grouping
1	32	15.8259	A
2	32	1.1953	B
3	32	-0.0000	B

Temperature	N	Mean	Grouping
2	48	8.2417	A
1	48	3.1058	B

Year	N	Mean	Grouping
2	48	6.7535	A
1	48	4.5940	B

halazon	Water Regime	N	Mean	Grouping
2	1	16	16.2119	A
1	1	16	15.4400	A
1	2	16	2.3906	B
2	2	16	0.0000	B

1	3	16	0.0000	B
2	3	16	-0.0000	B

halazon	Temperature	N	Mean	Grouping
2	2	24	8.3779	A
1	2	24	8.1054	A
1	1	24	3.7817	B
2	1	24	2.4300	B

halazon	Year	N	Mean	Grouping
1	2	24	7.2000	A
2	2	24	6.3071	A B
1	1	24	4.6871	B
2	1	24	4.5008	B

Water Regime	Temperature	N	Mean	Grouping
1	2	16	22.3344	A
1	1	16	9.3175	B
2	2	16	2.3906	C
2	1	16	0.0000	C
3	1	16	0.0000	C
3	2	16	-0.0000	C

Water Regime	Year	N	Mean	Grouping
1	2	16	18.3956	A
1	1	16	13.2562	B
2	2	16	1.8650	C
2	1	16	0.5256	C
3	2	16	-0.0000	C
3	1	16	-0.0000	C

Penstemon strictus

halazon	N	Mean	Grouping
2	48	22.1645	A
1	48	16.8079	B

Water Regime	N	Mean	Grouping
1	32	29.8147	A
2	32	19.2044	B
3	32	9.4395	C

Temperature	N	Mean	Grouping
2	48	22.9227	A
1	48	16.0497	B

Year	N	Mean	Grouping
2	48	22.9250	A
1	48	16.0474	B

halazon	Water Regime	N	Mean	Grouping
2	1	16	33.3294	A
1	1	16	26.3000	B

2	2	16	22.2350	C
1	2	16	16.1737	D
2	3	16	10.9291	E
1	3	16	7.9500	F

halazon	Temperature	N	Mean	Grouping
2	2	24	26.0854	A
1	2	24	19.7600	B
2	1	24	18.2435	B
1	1	24	13.8558	C

halazon	Year	N	Mean	Grouping
2	2	24	26.1033	A
1	2	24	19.7467	B
2	1	24	18.2256	B
1	1	24	13.8692	C

Water Regime	Temperature	N	Mean	Grouping
1	2	16	35.4712	A
1	1	16	24.1581	B
2	2	16	22.1094	B
2	1	16	16.2994	C
3	2	16	11.1875	D
3	1	16	7.6916	E

Water Regime	Year	N	Mean	Grouping
1	2	16	34.4125	A
1	1	16	25.2169	B
2	2	16	21.3563	C
2	1	16	17.0525	D
3	2	16	13.0063	E
3	1	16	5.8728	F

Salvia pachyphylla

halazon	N	Mean	Grouping
2	48	3.0023	A
1	48	2.3479	A

Water Regime	N	Mean	Grouping
1	32	6.6409	A
2	32	1.3844	B
3	32	-0.0000	B

Temperature	N	Mean	Grouping
2	48	4.2190	A
1	48	1.1312	B

Year	N	Mean	Grouping
2	48	5.3502	A
1	48	-0.0000	B

halazon	Water Regime	N	Mean	Grouping
2	1	16	7.4044	A
1	1	16	5.8775	A

2	2	16	1.6025	B
1	2	16	1.1662	B
2	3	16	-0.0000	B
1	3	16	-0.0000	B

halazon	Temperature	N	Mean	Grouping
2	2	24	4.7433	A
1	2	24	3.6946	A
2	1	24	1.2612	B
1	1	24	1.0012	B

halazon	Year	N	Mean	Grouping
2	2	24	6.0046	A
1	2	24	4.6958	A
2	1	24	0.0000	B
1	1	24	-0.0000	B

Water Regime	Temperature	N	Mean	Grouping
1	2	16	9.8881	A
1	1	16	3.3937	B
2	2	16	2.7687	B C
2	1	16	0.0000	C
3	1	16	-0.0000	C
3	2	16	-0.0000	C

Water Regime	Year	N	Mean	Grouping
1	2	16	13.2819	A
2	2	16	2.7688	B
3	1	16	-0.0000	B
1	1	16	-0.0000	B
2	1	16	-0.0000	B
3	2	16	-0.0000	B

Sphaeralcea coccinea

halazon	N	Mean	Grouping
2	48	7.5177	A
1	48	5.7233	B

Water Regime	N	Mean	Grouping
1	32	14.2850	A
2	32	4.4297	B
3	32	1.1469	C

Temperature	N	Mean	Grouping
2	48	8.7073	A
1	48	4.5337	B

Year	N	Mean	Grouping
2	48	9.4619	A
1	48	3.7792	B

halazon	Water Regime	N	Mean	Grouping
2	1	16	16.0975	A
1	1	16	12.4725	B
2	2	16	5.1281	C

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1        2       16   3.7313      C D
2        3       16   1.3275        D E
1        3       16   0.9662          E

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halazon  Temperature   N    Mean  Grouping
2        2            24  9.8871  A
1        2            24  7.5275    B
2        1            24  5.1483      C
1        1            24  3.9192      C


halazon  Year   N     Mean  Grouping
2        2     24  10.7596  A
1        2     24   8.1642    B
2        1     24   4.2758      C
1        1     24   3.2825      C


Water
Regime  Temperature   N     Mean  Grouping
1       2            16  17.1650  A
1       1            16  11.4050    B
2       2            16   6.6631      C
3       2            16   2.2937        D
2       1            16   2.1963        D
3       1            16  -0.0000        D

Water
Regime  Year   N     Mean  Grouping
1       2     16  17.2325  A
1       1     16  11.3375    B
2       2     16   8.8594    B
3       2     16   2.2937      C
2       1     16   0.0000      C
3       1     16  -0.0000      C

Zinnia  grandiflorus

halazon   N     Mean  Grouping
2        48  14.8952  A
1        48  11.3506    B

Water
Regime   N     Mean  Grouping
1       32  26.7091  A
2       32  12.6597    B
3       32  -0.0000      C


Temperature   N     Mean  Grouping
2            48  15.9450  A
1            48  10.3008    B

Year   N     Mean  Grouping
2     48  15.3367  A
1     48  10.9092    B

         Water
halazon  Regime   N     Mean  Grouping
2        1       16  30.0281  A
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1	1	16	23.3900	B
2	2	16	14.6575	C
1	2	16	10.6619	D
1	3	16	-0.0000	E
2	3	16	-0.0000	E

halazon	Temperature	N	Mean	Grouping
2	2	24	18.1125	A
1	2	24	13.7775	B
2	1	24	11.6779	C
1	1	24	8.9238	D

halazon	Year	N	Mean	Grouping
2	2	24	17.4208	A
1	2	24	13.2525	B
2	1	24	12.3696	B
1	1	24	9.4488	C

Water Regime	Temperature	N	Mean	Grouping
1	2	16	31.6569	A
1	1	16	21.7613	B
2	2	16	16.1781	C
2	1	16	9.1413	D
3	2	16	-0.0000	E
3	1	16	-0.0000	E

Water Regime	Year	N	Mean	Grouping
1	2	16	30.7669	A
1	1	16	22.6512	B
2	2	16	15.2431	C
2	1	16	10.0763	D
3	2	16	-0.0000	E
3	1	16	-0.0000	E

Amsonia jonesii

Temperature	Year	N	Mean	Grouping
2	2	24	19.3902	A
1	2	24	14.9871	B
2	1	24	14.0100	B
1	1	24	12.5829	C

halazon	Water Regime	Temperature	N	Mean	Grouping
2	1	2	8	37.8196	A
1	1	2	8	29.8750	B
2	1	1	8	28.7762	B
1	1	1	8	22.2875	C
2	2	2	8	18.8271	D
2	2	1	8	18.3175	D
1	2	2	8	13.6787	E
1	2	1	8	13.3287	E
1	3	1	8	0.0000	F
1	3	2	8	-0.0000	F
2	3	2	8	-0.0000	F
2	3	1	8	-0.0000	F

Water Regime	Temperature	Year	N	Mean	Grouping
1	2	2	8	38.8484	A
1	1	2	8	28.9500	B
1	2	1	8	28.8463	B
1	1	1	8	22.1137	C
2	2	2	8	19.3221	D
2	1	2	8	16.0113	E
2	1	1	8	15.6350	E F
2	2	1	8	13.1838	F
3	1	1	8	-0.0000	G
3	2	1	8	-0.0000	G
3	2	2	8	-0.0000	G
3	1	2	8	-0.0000	G

Asclepias tuberosa

Temperature	Year	N	Mean	Grouping
2	2	24	15.3613	A
2	1	24	8.9388	B
1	2	24	6.2213	B
1	1	24	5.7804	B

halazon	Water Regime	Temperature	N	Mean	Grouping
2	1	2	8	35.7263	A
1	1	2	8	28.0875	A B
1	1	1	8	21.2400	B
2	1	1	8	9.5050	C
1	2	2	8	9.0863	C
1	2	1	8	5.2600	C D
1	3	1	8	0.0000	D
2	2	1	8	0.0000	D
2	2	2	8	-0.0000	D
2	3	1	8	-0.0000	D
1	3	2	8	-0.0000	D
2	3	2	8	-0.0000	D

Water Regime	Temperature	Year	N	Mean	Grouping
1	2	2	8	36.9975	A
1	2	1	8	26.8163	B
1	1	2	8	18.6637	B C
1	1	1	8	12.0812	C D
2	2	2	8	9.0863	D
2	1	1	8	5.2600	D E
2	1	2	8	0.0000	E
3	1	2	8	0.0000	E
2	2	1	8	0.0000	E
3	1	1	8	-0.0000	E
3	2	2	8	-0.0000	E
3	2	1	8	-0.0000	E

Basamorrhiza sagitifolius

Temperature	Year	N	Mean	Grouping
2	2	24	6.1446	A
1	2	24	4.0179	B
1	1	24	0.0000	C
2	1	24	0.0000	C

halazon	Water Regime	Temperature	N	Mean	Grouping
2	1	2	8	10.2762	A
1	1	2	8	8.1575	B
2	1	1	8	6.7187	C
1	1	1	8	5.3350	D
2	2	1	8	0.0000	E
2	2	2	8	0.0000	E
1	2	1	8	0.0000	E
1	2	2	8	-0.0000	E
1	3	1	8	-0.0000	E
2	3	2	8	-0.0000	E
2	3	1	8	-0.0000	E
1	3	2	8	-0.0000	E

Basamorrhiza sagitifolius

Water Regime	Temperature	Year	N	Mean	Grouping
1	2	2	8	18.4337	A
1	1	2	8	12.0537	B
1	1	1	8	0.0000	C
2	1	2	8	0.0000	C
1	2	1	8	0.0000	C
2	2	1	8	0.0000	C
3	1	1	8	0.0000	C
2	2	2	8	-0.0000	C
2	1	1	8	-0.0000	C
3	2	1	8	-0.0000	C
3	2	2	8	-0.0000	C
3	1	2	8	-0.0000	C

Centaurea pulcherrimus

Temperature	Year	N	Mean	Grouping
2	2	24	15.3875	A
2	1	24	10.5579	B
1	2	24	8.8917	B
1	1	24	8.3000	B

Means that do not share a letter are significantly different.

Grouping Information Using Bonferroni Method and 95.0% Confidence for Centaurea pulcherrimus

halazon	Water Regime	Temperature	N	Mean	Grouping
2	1	2	8	33.0112	A
1	1	2	8	25.6475	A B
1	1	1	8	21.2225	B C
1	2	2	8	19.1775	B C D
1	2	1	8	17.2275	C D
2	1	1	8	13.1250	D
2	2	1	8	0.0000	E
1	3	1	8	0.0000	E
2	2	2	8	0.0000	E
1	3	2	8	-0.0000	E
2	3	2	8	-0.0000	E
2	3	1	8	-0.0000	E

Water Regime	Temperature	Year	N	Mean	Grouping

1	2	2	8	34.6112	A
1	2	1	8	24.0475	B
1	1	1	8	17.8737	B C
1	1	2	8	16.4737	B C
2	2	2	8	11.5512	C D
2	1	2	8	10.2013	C D
2	2	1	8	7.6263	D E
2	1	1	8	7.0263	D E
3	1	2	8	0.0000	E
3	1	1	8	0.0000	E
3	2	2	8	-0.0000	E
3	2	1	8	-0.0000	E

Delphinium barbeyi

Temperature	Year	N	Mean	Grouping
2	2	24	31.8379	A
2	1	24	8.8346	A B
1	2	24	5.3125	B
1	1	24	2.6337	B

halazon	Water Regime	Temperature	N	Mean	Grouping
2	1	2	8	66.1475	A
1	1	2	8	52.2225	A B
1	1	1	8	17.6275	A B
2	1	1	8	6.2112	B
1	2	2	8	3.6475	B
1	3	1	8	0.0000	B
2	2	1	8	0.0000	B
2	2	2	8	0.0000	B
1	2	1	8	0.0000	B
2	3	1	8	-0.0000	B
2	3	2	8	-0.0000	B
1	3	2	8	-0.0000	B

Water Regime	Temperature	Year	N	Mean	Grouping
1	2	2	8	93.5650	A
1	2	1	8	24.8050	B
1	1	2	8	15.9375	B
1	1	1	8	7.9012	B
2	2	2	8	1.9488	B
2	2	1	8	1.6988	B
2	1	2	8	0.0000	B
3	1	2	8	0.0000	B
3	2	2	8	-0.0000	B
3	1	1	8	-0.0000	B
2	1	1	8	-0.0000	B
3	2	1	8	-0.0000	B

Dracocephalum grandiflorum

Temperature	Year	N	Mean	Grouping
2	2	24	12.1046	A
2	1	24	6.3637	B
1	2	24	5.4429	B
1	1	24	2.4754	C

Water

halazon	Regime	Temperature	N	Mean	Grouping
2	1	2	8	31.1300	A
1	1	2	8	24.2750	B
1	1	1	8	13.7675	C
2	1	1	8	9.9875	C
2	2	1	8	0.0000	D
2	2	2	8	0.0000	D
1	3	1	8	0.0000	D
1	2	2	8	0.0000	D
1	2	1	8	0.0000	D
2	3	2	8	-0.0000	D
2	3	1	8	-0.0000	D
1	3	2	8	-0.0000	D

Water Regime	Temperature	Year	N	Mean	Grouping
1	2	2	8	36.3137	A
1	2	1	8	19.0912	B
1	1	2	8	16.3287	B
1	1	1	8	7.4262	C
2	1	2	8	0.0000	D
2	2	1	8	0.0000	D
2	2	2	8	0.0000	D
3	1	1	8	0.0000	D
2	1	1	8	0.0000	D
3	1	2	8	-0.0000	D
3	2	1	8	-0.0000	D
3	2	2	8	-0.0000	D

Geum triflorum

Temperature	Year	N	Mean	Grouping
2	2	24	14.0238	A
2	1	24	10.3396	B
1	2	24	10.1375	B
1	1	24	6.4042	C

halazon	Water Regime	Temperature	N	Mean	Grouping
2	1	2	8	25.1250	A
1	1	2	8	19.5300	B
2	1	1	8	18.2050	B C
2	2	2	8	16.4600	B C
1	1	1	8	14.2725	C D
1	2	2	8	11.9750	D E
2	2	1	8	9.9263	E F
1	2	1	8	7.2212	F
1	3	2	8	0.0000	G
1	3	1	8	-0.0000	G
2	3	2	8	-0.0000	G
2	3	1	8	-0.0000	G

Water Regime	Temperature	Year	N	Mean	Grouping
1	2	2	8	26.3700	A
1	1	2	8	18.4775	B
1	2	1	8	18.2850	B
2	2	2	8	15.7012	B C
1	1	1	8	14.0000	C
2	2	1	8	12.7338	C
2	1	2	8	11.9350	C
2	1	1	8	5.2125	D

3	2	1	8	0.0000	E
3	2	2	8	0.0000	E
3	1	1	8	-0.0000	E
3	1	2	8	-0.0000	E

Hymenoxys grandiflora

Temperature	Year	N	Mean	Grouping
2	2	24	10.0112	A
2	1	24	6.4721	B
1	2	24	3.4958	C
1	1	24	2.7158	C

halazon	Water Regime	Temperature	N	Mean	Grouping
2	1	2	8	25.1337	A
1	1	2	8	19.5350	B
1	1	1	8	11.3450	C
2	1	1	8	7.2900	C D
1	2	2	8	4.7812	D E
2	2	1	8	0.0000	E
1	3	1	8	0.0000	E
1	2	1	8	0.0000	E
2	2	2	8	0.0000	E
2	3	1	8	-0.0000	E
1	3	2	8	-0.0000	E
2	3	2	8	-0.0000	E

Water Regime	Temperature	Year	N	Mean	Grouping
1	2	2	8	26.3037	A
1	2	1	8	18.3650	B
1	1	2	8	10.4875	C
1	1	1	8	8.1475	C D
2	2	2	8	3.7300	D E
2	2	1	8	1.0512	E
2	1	2	8	0.0000	E
2	1	1	8	0.0000	E
3	1	2	8	0.0000	E
3	1	1	8	0.0000	E
3	2	2	8	-0.0000	E
3	2	1	8	-0.0000	E

Penstemon strictus

Temperature	Year	N	Mean	Grouping
2	2	24	26.9512	A
1	2	24	18.8987	B
2	1	24	18.8942	B
1	1	24	13.2006	C

Penstemon strictus

halazon	Water Regime	Temperature	N	Mean	Grouping
2	1	2	8	39.7050	A
1	1	2	8	31.2375	B
2	1	1	8	26.9537	B C
2	2	2	8	25.5988	C D
1	1	1	8	21.3625	D E
2	2	1	8	18.8713	E

1	2	2	8	18.6200	E
1	2	1	8	13.7275	F
2	3	2	8	12.9525	F G
1	3	2	8	9.4225	F G H
2	3	1	8	8.9056	G H
1	3	1	8	6.4775	H

Water Regime	Temperature	Year	N	Mean	Grouping
1	2	2	8	41.4037	A
1	2	1	8	29.5388	B
1	1	2	8	27.4212	B C
2	2	2	8	24.9288	C D
1	1	1	8	20.8950	D E
2	2	1	8	19.2900	E
2	1	2	8	17.7838	E F
2	1	1	8	14.8150	F G
3	2	2	8	14.5213	F G
3	1	2	8	11.4912	G H
3	2	1	8	7.8538	H I
3	1	1	8	3.8919	I

Salvia pachyphylla

Temperature	Year	N	Mean	Grouping
2	2	24	8.4379	A
1	2	24	2.2625	B
1	1	24	-0.0000	B
2	1	24	-0.0000	B

halazon	Water Regime	Temperature	N	Mean	Grouping
2	1	2	8	11.0250	A
1	1	2	8	8.7512	A B
2	1	1	8	3.7837	B C
2	2	2	8	3.2050	C
1	1	1	8	3.0037	C
1	2	2	8	2.3325	C
2	2	1	8	0.0000	C
2	3	2	8	-0.0000	C
1	2	1	8	-0.0000	C
2	3	1	8	-0.0000	C
1	3	1	8	-0.0000	C
1	3	2	8	-0.0000	C

Water Regime	Temperature	Year	N	Mean	Grouping
1	2	2	8	19.7762	A
1	1	2	8	6.7875	B
2	2	2	8	5.5375	B
2	1	2	8	0.0000	C
1	1	1	8	0.0000	C
3	2	1	8	-0.0000	C
3	1	1	8	-0.0000	C
2	2	1	8	-0.0000	C
2	1	1	8	-0.0000	C
3	1	2	8	-0.0000	C
1	2	1	8	-0.0000	C
3	2	2	8	-0.0000	C

Sphaeralcea coccinea

Temperature	Year	N	Mean	Grouping
2	2	24	12.9171	A
1	2	24	6.0067	B
2	1	24	4.4975	B C
1	1	24	3.0608	C

halazon	Water Regime	Temperature	N	Mean	Grouping
2	1	2	8	19.2925	A
1	1	2	8	15.0375	A B
2	1	1	8	12.9025	B C
1	1	1	8	9.9075	C D
2	2	2	8	7.7138	D
1	2	2	8	5.6125	D E
2	3	2	8	2.6550	E F
2	2	1	8	2.5425	E F
1	3	2	8	1.9325	E F
1	2	1	8	1.8500	E F
1	3	1	8	-0.0000	F
2	3	1	8	-0.0000	F

Water Regime	Temperature	Year	N	Mean	Grouping
1	2	2	8	20.8375	A
1	1	2	8	13.6275	B
1	2	1	8	13.4925	B C
2	2	2	8	13.3263	B C
1	1	1	8	9.1825	C
3	2	2	8	4.5875	D
2	1	2	8	4.3925	D
2	2	1	8	0.0000	E
2	1	1	8	0.0000	E
3	2	1	8	-0.0000	E
3	1	2	8	-0.0000	E
3	1	1	8	-0.0000	E

Zinnia grandiflorus

Temperature	Year	N	Mean	Grouping
2	2	24	18.2654	A
2	1	24	13.6246	B
1	2	24	12.4079	B
1	1	24	8.1937	C

halazon	Water Regime	Temperature	N	Mean	Grouping
2	1	2	8	35.6062	A
1	1	2	8	27.7075	B
2	1	1	8	24.4500	B
1	1	1	8	19.0725	C
2	2	2	8	18.7313	C
1	2	2	8	13.6250	D
2	2	1	8	10.5838	D E
1	2	1	8	7.6988	E
1	3	1	8	0.0000	F
1	3	2	8	-0.0000	F
2	3	2	8	-0.0000	F
2	3	1	8	-0.0000	F

Water Regime	Temperature	Year	N	Mean	Grouping

1	2	2	8	36.9850	A
1	2	1	8	26.3287	B
1	1	2	8	24.5488	B
1	1	1	8	18.9737	C
2	2	2	8	17.8112	C D
2	2	1	8	14.5450	D E
2	1	2	8	12.6750	E
2	1	1	8	5.6075	F
3	2	2	8	-0.0000	G
3	1	1	8	-0.0000	G
3	2	1	8	-0.0000	G
3	1	2	8	-0.0000	G

Obs	Zinnia grandiflorus	Fit	SE Fit	Residual	St Resid	
18	10.6200	4.5728	1.0998	6.0472	2.91	R
19	0.0000	4.5728	1.0998	-4.5728	-2.20	R
20	0.0000	4.5728	1.0998	-4.5728	-2.20	R
65	11.3700	6.6422	1.0998	4.7278	2.27	R
66	14.6000	6.6422	1.0998	7.9578	3.83	R
67	0.0000	6.6422	1.0998	-6.6422	-3.20	R
68	0.0000	6.6422	1.0998	-6.6422	-3.20	R

Amsonia jonesii

halazon	Water Regime	Year	N	Mean	Grouping
2	1	2	8	37.9546	A
1	1	2	8	29.8437	B
2	1	1	8	28.6412	B
1	1	1	8	22.3188	C
2	2	2	8	20.4546	C
2	2	1	8	16.6900	D
1	2	2	8	14.8788	D
1	2	1	8	12.1287	E
1	3	1	8	0.0000	F
1	3	2	8	-0.0000	F
2	3	2	8	-0.0000	F
2	3	1	8	-0.0000	F

Asclepias tuberosa (coloradol f

halazon	Water Regime	Year	N	Mean	Grouping
1	1	2	8	28.2763	A
2	1	2	8	27.3850	A
1	1	1	8	21.0513	A B
2	1	1	8	17.8462	B
1	2	2	8	9.0863	C
1	2	1	8	5.2600	C D
2	2	2	8	0.0000	D
1	3	1	8	0.0000	D
1	3	2	8	0.0000	D
2	2	1	8	-0.0000	D
2	3	2	8	-0.0000	D
2	3	1	8	-0.0000	D

Basamorrhiza sagitifolius

halazon	Water Regime	Year	N	Mean	Grouping
2	1	2	8	16.9950	A

1	1	2	8	13.4925	B
2	2	2	8	0.0000	C
1	1	1	8	0.0000	C
2	1	1	8	0.0000	C
1	2	1	8	0.0000	C
1	3	1	8	0.0000	C
2	2	1	8	0.0000	C
2	3	1	8	-0.0000	C
1	2	2	8	-0.0000	C
2	3	2	8	-0.0000	C
1	3	2	8	-0.0000	C

Centaurea pulcherrimus

halazon	Water Regime	Year	N	Mean	Grouping
1	1	2	8	27.6725	A
2	1	2	8	23.4125	A B
2	1	1	8	22.7237	A B
1	2	2	8	21.7525	A B C
1	1	1	8	19.1975	B C
1	2	1	8	14.6525	C
2	2	2	8	0.0000	D
2	2	1	8	0.0000	D
1	3	2	8	0.0000	D
1	3	1	8	0.0000	D
2	3	2	8	-0.0000	D
2	3	1	8	-0.0000	D

Delphinium barbeyi

halazon	Water Regime	Year	N	Mean	Grouping
2	1	2	8	58.4525	A
1	1	2	8	51.0500	A B
1	1	1	8	18.8000	A B
2	1	1	8	13.9062	A B
1	2	2	8	1.9488	A B
1	2	1	8	1.6987	B
2	2	2	8	0.0000	B
1	3	2	8	0.0000	B
2	2	1	8	0.0000	B
2	3	1	8	-0.0000	B
2	3	2	8	-0.0000	B
1	3	1	8	-0.0000	B

Dracocephalum grandiflorum

halazon	Water Regime	Year	N	Mean	Grouping
2	1	2	8	28.1912	A
1	1	2	8	24.4512	A
1	1	1	8	13.5912	B
2	1	1	8	12.9262	B
2	2	2	8	0.0000	C
2	2	1	8	0.0000	C
1	2	2	8	0.0000	C
1	2	1	8	0.0000	C
1	3	1	8	0.0000	C
2	3	1	8	-0.0000	C
1	3	2	8	-0.0000	C
2	3	2	8	-0.0000	C

Geum triflorum

halazon	Water Regime	Year	N	Mean	Grouping
2	1	2	8	25.2337	A
1	1	2	8	19.6137	B
2	1	1	8	18.0963	B C
2	2	2	8	15.9975	B C
1	1	1	8	14.1887	C D
1	2	2	8	11.6387	D
2	2	1	8	10.3888	D E
1	2	1	8	7.5575	E
1	3	1	8	0.0000	F
1	3	2	8	0.0000	F
2	3	1	8	-0.0000	F
2	3	2	8	-0.0000	F

Hymenoxys grandiflora

halazon	Water Regime	Year	N	Mean	Grouping
2	1	2	8	18.9212	A
1	1	2	8	17.8700	A B
2	1	1	8	13.5025	B
1	1	1	8	13.0100	B
1	2	2	8	3.7300	C
1	2	1	8	1.0513	C
2	2	2	8	0.0000	C
2	2	1	8	0.0000	C
1	3	1	8	0.0000	C
1	3	2	8	0.0000	C
2	3	2	8	-0.0000	C
2	3	1	8	-0.0000	C

Penstemon strictus

halazon	Water Regime	Year	N	Mean	Grouping
2	1	2	8	38.5250	A
1	1	2	8	30.3000	B
2	1	1	8	28.1338	B C
2	2	2	8	24.7263	C D
1	1	1	8	22.3000	D E
2	2	1	8	19.7438	E
1	2	2	8	17.9863	E F
2	3	2	8	15.0588	F G
1	2	1	8	14.3612	F G
1	3	2	8	10.9537	G H
2	3	1	8	6.7994	H I
1	3	1	8	4.9463	I

Salvia pachyphylla

halazon	Water Regime	Year	N	Mean	Grouping
2	1	2	8	14.8087	A
1	1	2	8	11.7550	A
2	2	2	8	3.2050	B
1	2	2	8	2.3325	B
2	1	1	8	0.0000	B
2	3	1	8	0.0000	B
2	2	1	8	0.0000	B
1	3	1	8	-0.0000	B

2	3	2	8	-0.0000	B
1	1	1	8	-0.0000	B
1	2	1	8	-0.0000	B
1	3	2	8	-0.0000	B

Sphaeralcea coccinea

halazon	Water Regime	Year	N	Mean	Grouping
2	1	2	8	19.3675	A
1	1	2	8	15.0975	A B
2	1	1	8	12.8275	B C
2	2	2	8	10.2563	C D
1	1	1	8	9.8475	C D
1	2	2	8	7.4625	D
2	3	2	8	2.6550	E
1	3	2	8	1.9325	E
2	2	1	8	0.0000	E
1	2	1	8	0.0000	E
1	3	1	8	-0.0000	E
2	3	1	8	-0.0000	E

Zinnia grandiflorus

halazon	Water Regime	Year	N	Mean	Grouping
2	1	2	8	34.6137	A
1	1	2	8	26.9200	B
2	1	1	8	25.4425	B
1	1	1	8	19.8600	C
2	2	2	8	17.6488	C
1	2	2	8	12.8375	D
2	2	1	8	11.6663	D E
1	2	1	8	8.4863	E
1	3	1	8	-0.0000	F
1	3	2	8	-0.0000	F
2	3	2	8	-0.0000	F
2	3	1	8	-0.0000	F

5.4 Ecological groups

Note: Means that do not share a letter are significantly different.

Grouping Information Using Bonferroni Method and 95.0% Confidence

Analysis of Variance for Well Fitted, using Adjusted SS for Tests

Source	DF	Seq SS	Adj SS	Adj MS	F	P
hazazon	1	49326	49326	49326	47.37	0.000
Water Regime	2	417191	417191	208596	200.33	0.000
hazazon*Water Regime	2	18310	18310	9155	8.79	0.000
Temperature	1	10070	10070	10070	9.67	0.003
hazazon*Temperature	1	156	156	156	0.15	0.700
Water Regime*Temperature	2	53221	53221	26610	25.56	0.000
Year	1	285651	285651	285651	274.33	0.000
hazazon*Year	1	1095	1095	1095	1.05	0.308
Water Regime*Year	2	144	144	72	0.07	0.933
Temperature*Year	1	1054	1054	1054	1.01	0.318
hazazon*Water Regime*Temperature	2	537	537	268	0.26	0.774
Water Regime*Temperature*Year	2	2978	2978	1489	1.43	0.246
Error	77	80178	80178	1041		
Total	95	919910				

S = 32.2687   R-Sq = 91.28%   R-Sq(adj) = 89.25%

Unusual Observations for Well Fitted

Obs	Well Fitted	Fit	SE Fit	Residual	St Resid	
64	249.180	307.125	14.356	-57.945	-2.01	R
74	201.790	262.197	14.356	-60.407	-2.09	R
78	285.750	371.158	14.356	-85.408	-2.96	R
82	239.010	307.003	14.356	-67.993	-2.35	R
87	344.450	419.472	14.356	-75.022	-2.60	R
89	276.940	381.102	14.356	-104.162	-3.60	R
93	404.810	503.833	14.356	-99.023	-3.43	R

R denotes an observation with a large standardized residual.

Analysis of Variance for Intermediate Fitted, using Adjusted SS for Tests

Source	DF	Seq SS	Adj SS	Adj MS	F	P
hazazon	1	589588	589588	589588	835.47	0.000
Water Regime	2	764041	764041	382021	541.34	0.000
hazazon*Water Regime	2	447817	447817	223908	317.29	0.000
Temperature	1	199756	199756	199756	283.06	0.000
hazazon*Temperature	1	13893	13893	13893	19.69	0.000
Water Regime*Temperature	2	277029	277029	138514	196.28	0.000
Year	1	469749	469749	469749	665.65	0.000
hazazon*Year	1	16356	16356	16356	23.18	0.000
Water Regime*Year	2	30674	30674	15337	21.73	0.000
Temperature*Year	1	21812	21812	21812	30.91	0.000

hazazon*Water Regime*Temperature	2	45694	45694	22847	32.38	0.000
Water Regime*Temperature*Year	2	22003	22003	11001	15.59	0.000
Error	77	54339	54339	706		
Total	95	2952751				

S = 26.5649   R-Sq = 98.16%   R-Sq(adj) = 97.73%

Unusual Observations for Intermediate Fitted

Obs	Intermediate Fitted	Fit	SE Fit	Residual	St Resid	
45	988.260	923.407	11.818	64.853	2.73	R
53	264.230	337.220	11.818	-72.990	-3.07	R
56	441.950	337.220	11.818	104.730	4.40	R
63	372.330	324.055	11.818	48.275	2.03	R

R denotes an observation with a large standardized residual.

Analysis of Variance for Poorly Fitted, using Adjusted SS for Tests

Source	DF	Seq SS	Adj SS	Adj MS	F	P
hazazon	1	345	345	345	0.39	0.534
Water Regime	2	816501	816501	408250	461.61	0.000
hazazon*Water Regime	2	7174	7174	3587	4.06	0.021
Temperature	1	84137	84137	84137	95.13	0.000
hazazon*Temperature	1	7185	7185	7185	8.12	0.006
Water Regime*Temperature	2	79043	79043	39521	44.69	0.000
Year	1	70428	70428	70428	79.63	0.000
hazazon*Year	1	956	956	956	1.08	0.302
Water Regime*Year	2	52648	52648	26324	29.76	0.000
Temperature*Year	1	12454	12454	12454	14.08	0.000
hazazon*Water Regime*Temperature	2	16417	16417	8209	9.28	0.000
Water Regime*Temperature*Year	2	10586	10586	5293	5.99	0.004
Error	77	68100	68100	884		
Total	95	1225974				

S = 29.7391   R-Sq = 94.45%   R-Sq(adj) = 93.15%

Unusual Observations for Poorly Fitted

Obs	Poorly Fitted	Fit	SE Fit	Residual	St Resid	
56	231.360	175.964	13.230	55.396	2.08	R
62	364.160	420.499	13.230	-56.339	-2.12	R
63	630.830	420.499	13.230	210.331	7.90	R

Well Fitted

hazazon	N	Mean	Grouping
2	48	327.909	A
1	48	282.574	B

Water Regime	N	Mean	Grouping
3	32	392.605	A
2	32	289.742	B
1	32	233.376	C

Well Fitted

Temperature	N	Mean	Grouping
2	48	315.483	A
1	48	294.999	B

Year	N	Mean	Grouping
2	48	359.790	A
1	48	250.693	B

hazazon	Water Regime	N	Mean	Grouping
2	3	16	402.853	A
1	3	16	382.357	A
2	2	16	305.566	B
2	1	16	275.307	B
1	2	16	273.919	B
1	1	16	191.445	C

hazazon	Temperature	N	Mean	Grouping
2	2	24	339.425	A
2	1	24	316.392	A B
1	2	24	291.541	B C
1	1	24	273.607	C

hazazon	Year	N	Mean	Grouping
2	2	24	385.835	A
1	2	24	333.744	B
2	1	24	269.982	C
1	1	24	231.403	D

Water Regime	Temperature	N	Mean	Grouping
3	2	16	430.185	A
3	1	16	355.025	B
2	2	16	302.779	C
2	1	16	276.706	C D
1	1	16	253.267	D
1	2	16	213.486	E

Water Regime	Year	N	Mean	Grouping
3	2	16	448.027	A
2	2	16	342.558	B
3	1	16	337.183	B
1	2	16	288.784	C
2	1	16	236.926	D
1	1	16	177.969	E

Intermediate Fitted

hazazon	N	Mean	Grouping
1	48	466.689	A
2	48	309.953	B

Intermediate Fitted

Water Regime	N	Mean	Grouping
3	32	502.007	A
2	32	378.855	B
1	32	284.099	C

Intermediate Fitted

Temperature	N	Mean	Grouping
2	48	433.936	A
1	48	342.705	B

Intermediate Fitted

Year	N	Mean	Grouping
2	48	458.272	A
1	48	318.369	B

Intermediate Fitted

hazazon	Water Regime	N	Mean	Grouping
1	3	16	648.831	A
1	2	16	482.008	B
2	3	16	355.183	C
2	1	16	298.972	D
2	2	16	275.703	D E
1	1	16	269.227	E

Intermediate Fitted

hazazon	Temperature	N	Mean	Grouping
1	2	24	524.334	A
1	1	24	409.043	B
2	2	24	343.538	C
2	1	24	276.367	D

Intermediate Fitted

hazazon	Year	N	Mean	Grouping
1	2	24	549.693	A
1	1	24	383.684	B
2	2	24	366.851	B
2	1	24	253.054	C

Intermediate Fitted

Water Regime	Temperature	N	Mean	Grouping
3	2	16	610.833	A
2	2	16	429.361	B
3	1	16	393.181	C
2	1	16	328.349	D
1	1	16	306.584	D
1	2	16	261.614	E

Intermediate Fitted

Water Regime	Year	N	Mean	Grouping
3	2	16	583.249	A
2	2	16	462.749	B
3	1	16	420.766	C
1	2	16	328.818	D
2	1	16	294.961	E
1	1	16	239.381	F

Poorly Fitted

hazazon	N	Mean	Grouping
1	48	105.365	A
2	48	101.576	A

Poorly Fitted

Water Regime	N	Mean	Grouping
1	32	229.205	A
2	32	70.621	B
3	32	10.586	C

Temperature	N	Mean	Grouping
2	48	133.075	A
1	48	73.866	B

Year	N	Mean	Grouping
2	48	130.556	A
1	48	76.385	B

hazazon	Water Regime	N	Mean	Grouping
2	1	16	235.656	A
1	1	16	222.754	A
1	2	16	84.425	B
2	2	16	56.816	B
2	3	16	12.257	C
1	3	16	8.916	C

hazazon	Temperature	N	Mean	Grouping
2	2	24	139.832	A
1	2	24	126.318	A
1	1	24	84.412	B
2	1	24	63.321	B

hazazon	Year	N	Mean	Grouping
2	2	24	131.818	A
1	2	24	129.294	A
1	1	24	81.436	B
2	1	24	71.334	B

Water Regime	Temperature	N	Mean	Grouping
1	2	16	298.621	A
1	1	16	159.788	B
2	2	16	87.123	C
2	1	16	54.119	D

3	2	16	13.481	E
3	1	16	7.692	E

Water Regime	Year	N	Mean	Grouping
1	2	16	288.624	A
1	1	16	169.785	B
2	2	16	87.744	C
2	1	16	53.498	D
3	2	16	15.300	E
3	1	16	5.873	E

Well Fitted

Temperature	Year	N	Mean	Grouping
2	2	24	366.718	A
1	2	24	352.861	A
2	1	24	264.248	B
1	1	24	237.137	C

hazazon	Water Regime	Temperature	N	Mean	Grouping
2	3	2	8	442.468	A
1	3	2	8	417.902	A B
2	3	1	8	363.238	B C
1	3	1	8	346.812	C D
2	2	2	8	316.678	C D E
2	2	1	8	294.454	D E F
2	1	1	8	291.484	D E F
1	2	2	8	288.880	E F
2	1	2	8	259.131	F G
1	2	1	8	258.957	F G
1	1	1	8	215.050	G H
1	1	2	8	167.840	H

Intermediate Fitted

Temperature	Year	N	Mean	Grouping
2	2	24	518.961	A
1	2	24	397.583	B
2	1	24	348.911	C
1	1	24	287.827	D

hazazon	Water Regime	Temperature	N	Mean	Grouping
1	3	2	8	793.688	A
1	2	2	8	549.335	B
1	3	1	8	503.975	B
2	3	2	8	427.979	C
1	2	1	8	414.680	C
2	2	2	8	309.387	D
1	1	1	8	308.474	D
2	1	1	8	304.695	D
2	1	2	8	293.249	D
2	3	1	8	282.387	D E
2	2	1	8	242.018	E F
1	1	2	8	229.980	F

Poorly Fitted

Temperature	Year	N	Mean	Grouping
2	2	24	171.550	A
2	1	24	94.600	B
1	2	24	89.562	B
1	1	24	58.171	C

Poorly Fitted

hazazon	Water Regime	Temperature	N	Mean	Grouping
2	1	2	8	332.179	A
1	1	2	8	265.064	B
1	1	1	8	180.444	C
2	1	1	8	139.132	C D
1	2	2	8	102.536	D E
2	2	2	8	71.709	E F
1	2	1	8	66.314	E F G
2	2	1	8	41.924	F G H
2	3	2	8	15.607	G H
1	3	2	8	11.355	H
2	3	1	8	8.906	H
1	3	1	8	6.478	H

Well Fitted

Water Regime	Temperature	Year	N	Mean	Grouping
3	2	2	8	488.173	A
3	1	2	8	407.881	B
3	2	1	8	372.198	B C
2	2	2	8	353.881	B C D
2	1	2	8	331.235	C D
1	1	2	8	319.466	C D
3	1	1	8	302.169	D E
1	2	2	8	258.101	E F
2	2	1	8	251.676	E F
2	1	1	8	222.176	F G
1	1	1	8	187.067	G
1	2	1	8	168.870	G

Intermediate Fitted

Water Regime	Temperature	Year	N	Mean	Grouping
3	2	2	8	727.500	A
2	2	2	8	523.910	B
3	2	1	8	494.166	B
3	1	2	8	438.998	C
2	1	2	8	401.589	C
1	1	2	8	352.163	D
3	1	1	8	347.365	D E
2	2	1	8	334.812	D E
1	2	2	8	305.474	E F
1	1	1	8	261.006	F G
2	1	1	8	255.109	G
1	2	1	8	217.755	G

Poorly Fitted

Water Regime	Temperature	Year	N	Mean	Grouping
1	2	2	8	383.785	A

1	2	1	8	213.458	B					
1	1	2	8	193.464	B					
1	1	1	8	126.112		C				
2	2	2	8	111.758		C	D			
2	1	2	8	63.730			D	E		
2	2	1	8	62.488			D	E	F	
2	1	1	8	44.507				E	F	G
3	2	2	8	19.109				E	F	G
3	1	2	8	11.491					F	G
3	2	1	8	7.854						G
3	1	1	8	3.892						G

APPENDIX 6

Data analyzing of chapter 5

1 Ecological groups data analyzing

Multivariate Tests[a]

Effect		Value	F	Hypothesis df	Error df	Sig.
Intercept	Pillai's Trace	.992	3465.323[b]	3.000	79.000	.000
	Wilks' Lambda	.008	3465.323[b]	3.000	79.000	.000
	Hotelling's Trace	131.595	3465.323[b]	3.000	79.000	.000
	Roy's Largest Root	131.595	3465.323[b]	3.000	79.000	.000
Co2Level	Pillai's Trace	.895	224.565[b]	3.000	79.000	.000
	Wilks' Lambda	.105	224.565[b]	3.000	79.000	.000
	Hotelling's Trace	8.528	224.565[b]	3.000	79.000	.000
	Roy's Largest Root	8.528	224.565[b]	3.000	79.000	.000
Temperature	Pillai's Trace	.855	155.333[b]	3.000	79.000	.000
	Wilks' Lambda	.145	155.333[b]	3.000	79.000	.000
	Hotelling's Trace	5.899	155.333[b]	3.000	79.000	.000
	Roy's Largest Root	5.899	155.333[b]	3.000	79.000	.000
WaterRegim	Pillai's Trace	1.062	30.186	6.000	160.000	.000
	Wilks' Lambda	.058	82.975[b]	6.000	158.000	.000
	Hotelling's Trace	14.164	184.129	6.000	156.000	.000
	Roy's Largest Root	14.016	373.769[c]	3.000	80.000	.000
Harvesttime	Pillai's Trace	.836	134.277[b]	3.000	79.000	.000
	Wilks' Lambda	.164	134.277[b]	3.000	79.000	.000
	Hotelling's Trace	5.099	134.277[b]	3.000	79.000	.000
	Roy's Largest Root	5.099	134.277[b]	3.000	79.000	.000
Co2Level * Harvesttime	Pillai's Trace	.716	66.380[b]	3.000	79.000	.000
	Wilks' Lambda	.284	66.380[b]	3.000	79.000	.000
	Hotelling's Trace	2.521	66.380[b]	3.000	79.000	.000
	Roy's Largest Root	2.521	66.380[b]	3.000	79.000	.000
Co2Level * Temperature	Pillai's Trace	.338	13.457[b]	3.000	79.000	.000
	Wilks' Lambda	.662	13.457[b]	3.000	79.000	.000
	Hotelling's Trace	.511	13.457[b]	3.000	79.000	.000
	Roy's Largest Root	.511	13.457[b]	3.000	79.000	.000
Co2Level * WaterRegim	Pillai's Trace	.373	6.109	6.000	160.000	.000
	Wilks' Lambda	.628	6.904[b]	6.000	158.000	.000
	Hotelling's Trace	.592	7.699	6.000	156.000	.000
	Roy's Largest Root	.591	15.758[c]	3.000	80.000	.000
Temperature * Harvesttime	Pillai's Trace	.579	36.159[b]	3.000	79.000	.000
	Wilks' Lambda	.421	36.159[b]	3.000	79.000	.000
	Hotelling's Trace	1.373	36.159[b]	3.000	79.000	.000
	Roy's Largest Root	1.373	36.159[b]	3.000	79.000	.000
WaterRegim * Harvesttime	Pillai's Trace	.752	16.070	6.000	160.000	.000
	Wilks' Lambda	.263	24.983[b]	6.000	158.000	.000
	Hotelling's Trace	2.739	35.608	6.000	156.000	.000
	Roy's Largest Root	2.718	72.469[c]	3.000	80.000	.000
Temperature * WaterRegim	Pillai's Trace	.454	7.837	6.000	160.000	.000
	Wilks' Lambda	.563	8.760[b]	6.000	158.000	.000
	Hotelling's Trace	.745	9.687	6.000	156.000	.000
	Roy's Largest Root	.701	18.701[c]	3.000	80.000	.000

Estimates

Dependent Variable	Co2Level	Mean	Std. Error	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
Wellfitted	450 PPM	3.741	.154	3.435	4.047
	900 PPM	5.817	.154	5.511	6.122
Intermediate	450 PPM	5.123	.141	4.842	5.405
	900 PPM	6.541	.141	6.260	6.822
Nonfitted	450 PPM	3.881	.089	3.703	4.059
	900 PPM	6.864	.089	6.687	7.042

Pairwise Comparisons

Dependent Variable	(I) Co2Level	(J) Co2Level	Mean Difference (I-J)	Std. Error	Sig.[b]	95% Confidence Interval for Difference[b] Lower Bound	95% Confidence Interval for Difference[b] Upper Bound
Wellfitted	450 PPM	900 PPM	-2.075*	.217	.000	-2.508	-1.643
	900 PPM	450 PPM	2.075*	.217	.000	1.643	2.508
Intermediate	450 PPM	900 PPM	-1.418*	.200	.000	-1.815	-1.020
	900 PPM	450 PPM	1.418*	.200	.000	1.020	1.815
Nonfitted	450 PPM	900 PPM	-2.983*	.126	.000	-3.234	-2.732
	900 PPM	450 PPM	2.983*	.126	.000	2.732	3.234

Based on estimated marginal means

*. The mean difference is significant at the

b. Adjustment for multiple comparisons: Sidak.

Tests of Between-Subjects Effects

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	Wellfitted	545.313[a]	14	38.951	34.338	.000
	Intermediate	565.690[b]	14	40.406	42.122	.000
	Nonfitted	802.906[c]	14	57.350	149.990	.000
Intercept	Wellfitted	2192.462	1	2192.462	1932.831	.000
	Intermediate	3265.198	1	3265.198	3403.850	.000
	Nonfitted	2771.057	1	2771.057	7247.201	.000
Co2Level	Wellfitted	103.356	1	103.356	91.116	.000
	Intermediate	48.226	1	48.226	50.273	.000
	Nonfitted	213.580	1	213.580	558.580	.000
Temperature	Wellfitted	.038	1	.038	.033	.856
	Intermediate	17.461	1	17.461	18.202	.000
	Nonfitted	174.850	1	174.850	457.289	.000
WaterRegim	Wellfitted	249.223	2	124.612	109.855	.000
	Intermediate	165.491	2	82.745	86.259	.000
	Nonfitted	167.423	2	83.712	218.933	.000
Harvesttime	Wellfitted	91.242	1	91.242	80.437	.000
	Intermediate	143.679	1	143.679	149.780	.000
	Nonfitted	100.176	1	100.176	261.994	.000
Co2Level * Harvesttime	Wellfitted	9.662	1	9.662	8.518	.005
	Intermediate	49.661	1	49.661	51.770	.000
	Nonfitted	70.078	1	70.078	183.275	.000
Co2Level * Temperature	Wellfitted	21.184	1	21.184	18.675	.000
	Intermediate	9.275	1	9.275	9.669	.003
	Nonfitted	6.345	1	6.345	16.593	.000
Co2Level * WaterRegim	Wellfitted	.273	2	.136	.120	.887
	Intermediate	22.801	2	11.400	11.884	.000
	Nonfitted	15.223	2	7.611	19.906	.000
Temperature * Harvesttime	Wellfitted	.131	1	.131	.116	.735
	Intermediate	.086	1	.086	.089	.766
	Nonfitted	35.182	1	35.182	92.012	.000
WaterRegim * Harvesttime	Wellfitted	44.773	2	22.387	19.736	.000
	Intermediate	91.927	2	45.964	47.915	.000
	Nonfitted	9.359	2	4.679	12.238	.000
Temperature * WaterRegim	Wellfitted	25.431	2	12.715	11.210	.000
	Intermediate	17.085	2	8.543	8.905	.000
	Nonfitted	10.690	2	5.345	13.980	.000
Error	Wellfitted	91.880	81	1.134		
	Intermediate	77.701	81	.959		
	Nonfitted	30.971	81	.382		
Total	Wellfitted	2829.655	96			
	Intermediate	3908.589	96			
	Nonfitted	3604.934	96			
Corrected Total	Wellfitted	637.193	95			
	Intermediate	643.390	95			
	Nonfitted	833.877	95			

Estimates

Dependent Variable	Temperature	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
Wellfitted	20 C	4.759	.154	4.453	5.065
	24 C	4.799	.154	4.493	5.105
Intermediate	20 C	5.406	.141	5.124	5.687
	24 C	6.258	.141	5.977	6.540
Nonfitted	20 C	4.023	.089	3.845	4.201
	24 C	6.722	.089	6.545	6.900

Pairwise Comparisons

Dependent Variable	(I) Temperature	(J) Temperature	Mean Difference (I-J)	Std. Error	Sig.[b]	95% Confidence ...[b]
						Lower Bound
Wellfitted	20 C	24 C	-.040	.217	.856	-.472
	24 C	20 C	.040	.217	.856	-.393
Intermediate	20 C	24 C	-.853*	.200	.000	-1.251
	24 C	20 C	.853*	.200	.000	.455
Nonfitted	20 C	24 C	-2.699*	.126	.000	-2.950
	24 C	20 C	2.699*	.126	.000	2.448

Pairwise Comparisons

Dependent Variable	(I) Temperature	(J) Temperature	95% Confidence ...[b]
			Upper Bound
Wellfitted	20 C	24 C	.393
	24 C	20 C	.472
Intermediate	20 C	24 C	-.455
	24 C	20 C	1.251
Nonfitted	20 C	24 C	-2.448
	24 C	20 C	2.950

Based on estimated marginal means

*. The mean difference is significant at the

b. Adjustment for multiple comparisons: Sidak.

Univariate Tests

Dependent Variable		Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Wellfitted	Contrast	.038	1	.038	.033	.856	.000
	Error	91.880	81	1.134			
Intermediate	Contrast	17.461	1	17.461	18.202	.000	.183
	Error	77.701	81	.959			
Nonfitted	Contrast	174.850	1	174.850	457.289	.000	.850
	Error	30.971	81	.382			

The F tests the effect of Temperature. This test is based on the linearly independent pairwise comparisons among the estimated marginal means.

Estimates

Dependent Variable	WaterRegim	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
Wellfitted	Ambient-50%	2.515	.188	2.141	2.890
	Ambient	6.137	.188	5.762	6.512
	Ambient+50%	5.685	.188	5.310	6.059
Intermediate	Ambient-50%	3.980	.173	3.635	4.324
	Ambient	6.872	.173	6.528	7.217
	Ambient+50%	6.644	.173	6.299	6.988
Nonfitted	Ambient-50%	7.219	.109	7.001	7.436
	Ambient	4.693	.109	4.475	4.910
	Ambient+50%	4.206	.109	3.988	4.423

Pairwise Comparisons

Dependent Variable	(I) WaterRegim	(J) WaterRegim	Mean Difference (I-J)	Std. Error	Sig.[b]	95% Confidence ...[b] Lower Bound
Wellfitted	Ambient-50%	Ambient	-3.622*	.266	.000	-4.271
		Ambient+50%	-3.169*	.266	.000	-3.818
	Ambient	Ambient-50%	3.622*	.266	.000	2.972
		Ambient+50%	.452	.266	.254	-.197
	Ambient+50%	Ambient-50%	3.169*	.266	.000	2.520
		Ambient	-.452	.266	.254	-1.102
Intermediate	Ambient-50%	Ambient	-2.892*	.245	.000	-3.489
		Ambient+50%	-2.664*	.245	.000	-3.261
	Ambient	Ambient-50%	2.892*	.245	.000	2.295
		Ambient+50%	.228	.245	.730	-.369
	Ambient+50%	Ambient-50%	2.664*	.245	.000	2.067
		Ambient	-.228	.245	.730	-.825
Nonfitted	Ambient-50%	Ambient	2.526*	.155	.000	2.149
		Ambient+50%	3.013*	.155	.000	2.636
	Ambient	Ambient-50%	-2.526*	.155	.000	-2.903
		Ambient+50%	.487*	.155	.007	.110
	Ambient+50%	Ambient-50%	-3.013*	.155	.000	-3.390
		Ambient	-.487*	.155	.007	-.864

Pairwise Comparisons

Dependent Variable	(I) WaterRegim	(J) WaterRegim	95% Confidence ...[b] Upper Bound
Wellfitted	Ambient-50%	Ambient	-2.972
		Ambient+50%	-2.520
	Ambient	Ambient-50%	4.271
		Ambient+50%	1.102
	Ambient+50%	Ambient-50%	3.818
		Ambient	.197
Intermediate	Ambient-50%	Ambient	-2.295
		Ambient+50%	-2.067
	Ambient	Ambient-50%	3.489
		Ambient+50%	.825
	Ambient+50%	Ambient-50%	3.261
		Ambient	.369
Nonfitted	Ambient-50%	Ambient	2.903
		Ambient+50%	3.390
	Ambient	Ambient-50%	-2.149
		Ambient+50%	.864
	Ambient+50%	Ambient-50%	-2.636
		Ambient	-.110

Based on estimated marginal means

*. The mean difference is significant at the

b. Adjustment for multiple comparisons: Sidak.

Univariate Tests

Dependent Variable		Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Wellfitted	Contrast	249.223	2	124.612	109.855	.000	.731
	Error	91.880	81	1.134			
Intermediate	Contrast	165.491	2	82.745	86.259	.000	.680
	Error	77.701	81	.959			
Nonfitted	Contrast	167.423	2	83.712	218.933	.000	.844
	Error	30.971	81	.382			

The F tests the effect of WaterRegim. This test is based on the linearly independent pairwise comparisons among the estimated marginal means.

Estimates

Dependent Variable	Harvesttime	Mean	Std. Error	95% Confidence Interval Lower Bound	Upper Bound
Wellfitted	15 Agust	3.804	.154	3.498	4.110
	15 September	5.754	.154	5.448	6.060
Intermediate	15 Agust	4.609	.141	4.327	4.890
	15 September	7.055	.141	6.774	7.337
Nonfitted	15 Agust	4.351	.089	4.174	4.529
	15 September	6.394	.089	6.217	6.572

Pairwise Comparisons

Dependent Variable	(I) Harvesttime	(J) Harvesttime	Mean Difference (I-J)	Std. Error	Sig.[b]	95% Confidence ...[b] Lower Bound
Wellfitted	15 Agust	15 September	-1.950*	.217	.000	-2.382
	15 September	15 Agust	1.950*	.217	.000	1.517
Intermediate	15 Agust	15 September	-2.447*	.200	.000	-2.845
	15 September	15 Agust	2.447*	.200	.000	2.049
Nonfitted	15 Agust	15 September	-2.043*	.126	.000	-2.294
	15 September	15 Agust	2.043*	.126	.000	1.792

Pairwise Comparisons

Dependent Variable	(I) Harvesttime	(J) Harvesttime	95% Confidence ...[b] Upper Bound
Wellfitted	15 Agust	15 September	-1.517
	15 September	15 Agust	2.382
Intermediate	15 Agust	15 September	-2.049
	15 September	15 Agust	2.845
Nonfitted	15 Agust	15 September	-1.792
	15 September	15 Agust	2.294

Based on estimated marginal means

*. The mean difference is significant at the

b. Adjustment for multiple comparisons: Sidak.

Estimates

Dependent Variable	Co2Level	Harvesttime	Mean	Std. Error	95% Confidence Interval Lower Bound	Upper Bound
Wellfitted	450 PPM	15 Agust	3.084	.217	2.651	3.516
		15 September	4.399	.217	3.966	4.832
	900 PPM	15 Agust	4.524	.217	4.092	4.957
		15 September	7.109	.217	6.676	7.541
Intermediate	450 PPM	15 Agust	4.619	.200	4.221	5.017
		15 September	5.627	.200	5.230	6.025
	900 PPM	15 Agust	4.598	.200	4.200	4.996
		15 September	8.483	.200	8.086	8.881
Nonfitted	450 PPM	15 Agust	3.714	.126	3.463	3.965
		15 September	4.048	.126	3.797	4.299
	900 PPM	15 Agust	4.988	.126	4.737	5.239
		15 September	8.740	.126	8.489	8.991

Pairwise Comparisons

Dependent Variable	Harvesttime	(I) Co2Level	(J) Co2Level	Mean Difference (I-J)	Std. Error	Sig.[b]	95% Confidence ...[b] Lower Bound
Wellfitted	15 Agust	450 PPM	900 PPM	-1.441*	.307	.000	-2.052
		900 PPM	450 PPM	1.441*	.307	.000	.829
	15 September	450 PPM	900 PPM	-2.710*	.307	.000	-3.321
		900 PPM	450 PPM	2.710*	.307	.000	2.098
Intermediate	15 Agust	450 PPM	900 PPM	.021	.283	.941	-.542
		900 PPM	450 PPM	-.021	.283	.941	-.583
	15 September	450 PPM	900 PPM	-2.856*	.283	.000	-3.419
		900 PPM	450 PPM	2.856*	.283	.000	2.293
Nonfitted	15 Agust	450 PPM	900 PPM	-1.274*	.179	.000	-1.630
		900 PPM	450 PPM	1.274*	.179	.000	.919
	15 September	450 PPM	900 PPM	-4.692*	.179	.000	-5.047
		900 PPM	450 PPM	4.692*	.179	.000	4.337

Pairwise Comparisons

Dependent Variable	Harvesttime	(I) Co2Level	(J) Co2Level	95% Confidence ...[b] Upper Bound
Wellfitted	15 Agust	450 PPM	900 PPM	-.829
		900 PPM	450 PPM	2.052
	15 September	450 PPM	900 PPM	-2.098
		900 PPM	450 PPM	3.321
Intermediate	15 Agust	450 PPM	900 PPM	.583
		900 PPM	450 PPM	.542
	15 September	450 PPM	900 PPM	-2.293
		900 PPM	450 PPM	3.419
Nonfitted	15 Agust	450 PPM	900 PPM	-.919
		900 PPM	450 PPM	1.630
	15 September	450 PPM	900 PPM	-4.337
		900 PPM	450 PPM	5.047

Based on estimated marginal means

*. The mean difference is significant at the

b. Adjustment for multiple comparisons: Sidak.

Pairwise Comparisons

Dependent Variable	Co2Level	(I) Harvesttime	(J) Harvesttime	Mean Difference (I-J)	Std. Error	Sig.[b]	95% Confidence ...[b] Lower Bound
Wellfitted	450 PPM	15 Agust	15 September	-1.315*	.307	.000	-1.927
		15 September	15 Agust	1.315*	.307	.000	.704
	900 PPM	15 Agust	15 September	-2.584*	.307	.000	-3.196
		15 September	15 Agust	2.584*	.307	.000	1.973
Intermediate	450 PPM	15 Agust	15 September	-1.008*	.283	.001	-1.571
		15 September	15 Agust	1.008*	.283	.001	.446
	900 PPM	15 Agust	15 September	-3.885*	.283	.000	-4.448
		15 September	15 Agust	3.885*	.283	.000	3.323
Nonfitted	450 PPM	15 Agust	15 September	-.334	.179	.065	-.689
		15 September	15 Agust	.334	.179	.065	-.021
	900 PPM	15 Agust	15 September	-3.752*	.179	.000	-4.107
		15 September	15 Agust	3.752*	.179	.000	3.397

Pairwise Comparisons

Dependent Variable	Co2Level	(I) Harvesttime	(J) Harvesttime	95% Confidence ...[b] Upper Bound
Wellfitted	450 PPM	15 Agust	15 September	-.704
		15 September	15 Agust	1.927
	900 PPM	15 Agust	15 September	-1.973
		15 September	15 Agust	3.196
Intermediate	450 PPM	15 Agust	15 September	-.446
		15 September	15 Agust	1.571
	900 PPM	15 Agust	15 September	-3.323
		15 September	15 Agust	4.448
Nonfitted	450 PPM	15 Agust	15 September	.021
		15 September	15 Agust	.689
	900 PPM	15 Agust	15 September	-3.397
		15 September	15 Agust	4.107

Based on estimated marginal means

*. The mean difference is significant at the

b. Adjustment for multiple comparisons: Sidak.

Estimates

Dependent Variable	Co2Level	Temperature	Mean	Std. Error	95% Confidence Interval Lower Bound	Upper Bound
Wellfitted	450 PPM	20 C	4.191	.217	3.759	4.624
		24 C	3.291	.217	2.859	3.724
	900 PPM	20 C	5.327	.217	4.894	5.760
		24 C	6.306	.217	5.874	6.739
Intermediate	450 PPM	20 C	5.008	.200	4.610	5.405
		24 C	5.239	.200	4.841	5.637
	900 PPM	20 C	5.803	.200	5.406	6.201
		24 C	7.278	.200	6.880	7.676
Nonfitted	450 PPM	20 C	2.789	.126	2.537	3.040
		24 C	4.974	.126	4.722	5.225
	900 PPM	20 C	5.258	.126	5.006	5.509
		24 C	8.471	.126	8.220	8.722

Pairwise Comparisons

Dependent Variable	Co2Level	(I) Temperature	(J) Temperature	Mean Difference (I-J)	Std. Error	Sig.[b]
Wellfitted	450 PPM	20 C	24 C	.900*	.307	.004
		24 C	20 C	-.900*	.307	.004
	900 PPM	20 C	24 C	-.979*	.307	.002
		24 C	20 C	.979*	.307	.002
Intermediate	450 PPM	20 C	24 C	-.231	.283	.416
		24 C	20 C	.231	.283	.416
	900 PPM	20 C	24 C	-1.475*	.283	.000
		24 C	20 C	1.475*	.283	.000
Nonfitted	450 PPM	20 C	24 C	-2.185*	.179	.000
		24 C	20 C	2.185*	.179	.000
	900 PPM	20 C	24 C	-3.213*	.179	.000
		24 C	20 C	3.213*	.179	.000

Pairwise Comparisons

				95% Confidence Interval for Difference[b]	
Dependent Variable	Co2Level	(I) Temperature	(J) Temperature	Lower Bound	Upper Bound
Wellfitted	450 PPM	20 C	24 C	.288	1.512
		24 C	20 C	-1.512	-.288
	900 PPM	20 C	24 C	-1.591	-.367
		24 C	20 C	.367	1.591
Intermediate	450 PPM	20 C	24 C	-.794	.331
		24 C	20 C	-.331	.794
	900 PPM	20 C	24 C	-2.037	-.912
		24 C	20 C	.912	2.037
Nonfitted	450 PPM	20 C	24 C	-2.540	-1.830
		24 C	20 C	1.830	2.540
	900 PPM	20 C	24 C	-3.568	-2.858
		24 C	20 C	2.858	3.568

Based on estimated marginal means

*. The mean difference is significant at the

b. Adjustment for multiple comparisons: Sidak.

Estimates

					95% Confidence Interval	
Dependent Variable	Co2Level	WaterRegim	Mean	Std. Error	Lower Bound	Upper Bound
Wellfitted	450 PPM	Ambient-50%	1.550	.266	1.020	2.079
		Ambient	5.083	.266	4.553	5.613
		Ambient+50%	4.591	.266	4.061	5.121
	900 PPM	Ambient-50%	3.481	.266	2.951	4.011
		Ambient	7.191	.266	6.661	7.720
		Ambient+50%	6.778	.266	6.248	7.308
Intermediate	450 PPM	Ambient-50%	3.934	.245	3.447	4.421
		Ambient	5.669	.245	5.181	6.156
		Ambient+50%	5.767	.245	5.280	6.254
	900 PPM	Ambient-50%	4.026	.245	3.539	4.513
		Ambient	8.076	.245	7.589	8.563
		Ambient+50%	7.521	.245	7.033	8.008
Nonfitted	450 PPM	Ambient-50%	6.275	.155	5.968	6.583
		Ambient	2.814	.155	2.507	3.122
		Ambient+50%	2.554	.155	2.246	2.862
	900 PPM	Ambient-50%	8.163	.155	7.855	8.470
		Ambient	6.572	.155	6.264	6.879
		Ambient+50%	5.858	.155	5.550	6.166

Pairwise Comparisons

Dependent Variable	Co2Level	(I) WaterRegim	(J) WaterRegim	Mean Difference (I-J)	Std. Error	Sig.[b]	95% Confidence ...[b] Lower Bound
Wellfitted	450 PPM	Ambient-50%	Ambient	-3.534*	.377	.000	-4.452
			Ambient+50%	-3.042*	.377	.000	-3.960
		Ambient	Ambient-50%	3.534*	.377	.000	2.616
			Ambient+50%	.492	.377	.478	-.426
		Ambient+50%	Ambient-50%	3.042*	.377	.000	2.124
			Ambient	-.492	.377	.478	-1.410
	900 PPM	Ambient-50%	Ambient	-3.709*	.377	.000	-4.628
			Ambient+50%	-3.297*	.377	.000	-4.215
		Ambient	Ambient-50%	3.709*	.377	.000	2.791
			Ambient+50%	.413	.377	.621	-.505
		Ambient+50%	Ambient-50%	3.297*	.377	.000	2.379
			Ambient	-.413	.377	.621	-1.331
Intermediate	450 PPM	Ambient-50%	Ambient	-1.735*	.346	.000	-2.579
			Ambient+50%	-1.833*	.346	.000	-2.678
		Ambient	Ambient-50%	1.735*	.346	.000	.890
			Ambient+50%	-.099	.346	.989	-.943
		Ambient+50%	Ambient-50%	1.833*	.346	.000	.989
			Ambient	.099	.346	.989	-.745
	900 PPM	Ambient-50%	Ambient	-4.050*	.346	.000	-4.894
			Ambient+50%	-3.495*	.346	.000	-4.339
		Ambient	Ambient-50%	4.050*	.346	.000	3.206
			Ambient+50%	.556	.346	.301	-.289
		Ambient+50%	Ambient-50%	3.495*	.346	.000	2.650
			Ambient	-.556	.346	.301	-1.400
Nonfitted	450 PPM	Ambient-50%	Ambient	3.461*	.219	.000	2.928
			Ambient+50%	3.721*	.219	.000	3.188
		Ambient	Ambient-50%	-3.461*	.219	.000	-3.994
			Ambient+50%	.260	.219	.557	-.273
		Ambient+50%	Ambient-50%	-3.721*	.219	.000	-4.254
			Ambient	-.260	.219	.557	-.793
	900 PPM	Ambient-50%	Ambient	1.591*	.219	.000	1.058
			Ambient+50%	2.305*	.219	.000	1.772
		Ambient	Ambient-50%	-1.591*	.219	.000	-2.124
			Ambient+50%	.714*	.219	.005	.181
		Ambient+50%	Ambient-50%	-2.305*	.219	.000	-2.838
			Ambient	-.714*	.219	.005	-1.247

Estimates

Dependent Variable	Harvesttime	Temperature	Mean	Std. Error	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
Wellfitted	15 Agust	20 C	3.821	.217	3.389	4.254
		24 C	3.787	.217	3.354	4.219
	15 September	20 C	5.697	.217	5.264	6.130
		24 C	5.811	.217	5.378	6.243
Intermediate	15 Agust	20 C	4.152	.200	3.755	4.550
		24 C	5.065	.200	4.667	5.463
	15 September	20 C	6.659	.200	6.261	7.057
		24 C	7.452	.200	7.054	7.850
Nonfitted	15 Agust	20 C	3.607	.126	3.356	3.858
		24 C	5.095	.126	4.844	5.346
	15 September	20 C	4.439	.126	4.188	4.690
		24 C	8.349	.126	8.098	8.600

Pairwise Comparisons

Dependent Variable	Temperature	(I) Harvesttime	(J) Harvesttime	Mean Difference (I-J)	Std. Error	Sig.[b]
Wellfitted	20 C	15 Agust	15 September	-1.876*	.307	.000
		15 September	15 Agust	1.876*	.307	.000
	24 C	15 Agust	15 September	-2.024*	.307	.000
		15 September	15 Agust	2.024*	.307	.000
Intermediate	20 C	15 Agust	15 September	-2.506*	.283	.000
		15 September	15 Agust	2.506*	.283	.000
	24 C	15 Agust	15 September	-2.387*	.283	.000
		15 September	15 Agust	2.387*	.283	.000
Nonfitted	20 C	15 Agust	15 September	-.832*	.179	.000
		15 September	15 Agust	.832*	.179	.000
	24 C	15 Agust	15 September	-3.254*	.179	.000
		15 September	15 Agust	3.254*	.179	.000

Pairwise Comparisons

Dependent Variable	Temperature	(I) Harvesttime	(J) Harvesttime	95% Confidence Interval for Difference[b]	
				Lower Bound	Upper Bound
Wellfitted	20 C	15 Agust	15 September	-2.488	-1.264
		15 September	15 Agust	1.264	2.488
	24 C	15 Agust	15 September	-2.635	-1.412
		15 September	15 Agust	1.412	2.635
Intermediate	20 C	15 Agust	15 September	-3.069	-1.944
		15 September	15 Agust	1.944	3.069
	24 C	15 Agust	15 September	-2.950	-1.824
		15 September	15 Agust	1.824	2.950
Nonfitted	20 C	15 Agust	15 September	-1.187	-.477
		15 September	15 Agust	.477	1.187
	24 C	15 Agust	15 September	-3.609	-2.899
		15 September	15 Agust	2.899	3.609

Based on estimated marginal means

*. The mean difference is significant at the

b. Adjustment for multiple comparisons: Sidak.

Estimates

Dependent Variable	Harvesttime	WaterRegim	Mean	Std. Error	95% Confidence Interval	
					Lower Bound	Upper Bound
Wellfitted	15 Agust	Ambient-50%	2.500	.266	1.971	3.030
		Ambient	4.590	.266	4.060	5.120
		Ambient+50%	4.322	.266	3.792	4.852
	15 September	Ambient-50%	2.530	.266	2.001	3.060
		Ambient	7.684	.266	7.154	8.214
		Ambient+50%	7.047	.266	6.517	7.577
Intermediate	15 Agust	Ambient-50%	4.128	.245	3.640	4.615
		Ambient	5.126	.245	4.638	5.613
		Ambient+50%	4.573	.245	4.086	5.060
	15 September	Ambient-50%	3.832	.245	3.345	4.319
		Ambient	8.619	.245	8.132	9.106
		Ambient+50%	8.715	.245	8.228	9.202
Nonfitted	15 Agust	Ambient-50%	5.758	.155	5.450	6.065
		Ambient	3.926	.155	3.619	4.234
		Ambient+50%	3.370	.155	3.062	3.677
	15 September	Ambient-50%	8.680	.155	8.373	8.988
		Ambient	5.460	.155	5.152	5.767
		Ambient+50%	5.042	.155	4.735	5.350

Pairwise Comparisons

Dependent Variable	WaterRegim	(I) Harvesttime	(J) Harvesttime	Mean Difference (I-J)	Std. Error	Sig.[b]
Wellfitted	Ambient-50%	15 Agust	15 September	-.030	.377	.937
		15 September	15 Agust	.030	.377	.937
	Ambient	15 Agust	15 September	-3.094*	.377	.000
		15 September	15 Agust	3.094*	.377	.000
	Ambient+50%	15 Agust	15 September	-2.725*	.377	.000
		15 September	15 Agust	2.725*	.377	.000
Intermediate	Ambient-50%	15 Agust	15 September	.296	.346	.396
		15 September	15 Agust	-.296	.346	.396
	Ambient	15 Agust	15 September	-3.493*	.346	.000
		15 September	15 Agust	3.493*	.346	.000
	Ambient+50%	15 Agust	15 September	-4.142*	.346	.000
		15 September	15 Agust	4.142*	.346	.000
Nonfitted	Ambient-50%	15 Agust	15 September	-2.923*	.219	.000
		15 September	15 Agust	2.923*	.219	.000
	Ambient	15 Agust	15 September	-1.534*	.219	.000
		15 September	15 Agust	1.534*	.219	.000
	Ambient+50%	15 Agust	15 September	-1.673*	.219	.000
		15 September	15 Agust	1.673*	.219	.000

Pairwise Comparisons

Dependent Variable	WaterRegim	(I) Harvesttime	(J) Harvesttime	95% Confidence Interval for Difference[b]	
				Lower Bound	Upper Bound
Wellfitted	Ambient-50%	15 Agust	15 September	-.779	.719
		15 September	15 Agust	-.719	.779
	Ambient	15 Agust	15 September	-3.843	-2.345
		15 September	15 Agust	2.345	3.843
	Ambient+50%	15 Agust	15 September	-3.475	-1.976
		15 September	15 Agust	1.976	3.475
Intermediate	Ambient-50%	15 Agust	15 September	-.393	.985
		15 September	15 Agust	-.985	.393
	Ambient	15 Agust	15 September	-4.182	-2.804
		15 September	15 Agust	2.804	4.182
	Ambient+50%	15 Agust	15 September	-4.831	-3.453
		15 September	15 Agust	3.453	4.831
Nonfitted	Ambient-50%	15 Agust	15 September	-3.357	-2.488
		15 September	15 Agust	2.488	3.357
	Ambient	15 Agust	15 September	-1.969	-1.099
		15 September	15 Agust	1.099	1.969
	Ambient+50%	15 Agust	15 September	-2.108	-1.238
		15 September	15 Agust	1.238	2.108

Based on estimated marginal means

*. The mean difference is significant at the

b. Adjustment for multiple comparisons: Sidak.

Estimates

Dependent Variable	Temperature	WaterRegim	Mean	Std. Error	95% Confidence Interval	
					Lower Bound	Upper Bound
Wellfitted	20 C	Ambient-50%	2.856	.266	2.326	3.386
		Ambient	6.484	.266	5.955	7.014
		Ambient+50%	4.937	.266	4.407	5.467
	24 C	Ambient-50%	2.175	.266	1.645	2.704
		Ambient	5.789	.266	5.260	6.319
		Ambient+50%	6.432	.266	5.902	6.962
Intermediate	20 C	Ambient-50%	4.039	.245	3.552	4.526
		Ambient	6.503	.245	6.016	6.990
		Ambient+50%	5.675	.245	5.187	6.162
	24 C	Ambient-50%	3.921	.245	3.433	4.408
		Ambient	7.242	.245	6.754	7.729
		Ambient+50%	7.613	.245	7.126	8.100
Nonfitted	20 C	Ambient-50%	6.286	.155	5.978	6.593
		Ambient	3.328	.155	3.020	3.636
		Ambient+50%	2.456	.155	2.148	2.763
	24 C	Ambient-50%	8.152	.155	7.845	8.460
		Ambient	6.058	.155	5.750	6.366
		Ambient+50%	5.956	.155	5.649	6.264

Pairwise Comparisons

Dependent Variable	WaterRegim	(I) Temperature	(J) Temperature	Mean Difference (I-J)	Std. Error	Sig.[b]
Wellfitted	Ambient-50%	20 C	24 C	.681	.377	.074
		24 C	20 C	-.681	.377	.074
	Ambient	20 C	24 C	.695	.377	.069
		24 C	20 C	-.695	.377	.069
	Ambient+50%	20 C	24 C	-1.495*	.377	.000
		24 C	20 C	1.495*	.377	.000
Intermediate	Ambient-50%	20 C	24 C	.119	.346	.733
		24 C	20 C	-.119	.346	.733
	Ambient	20 C	24 C	-.739*	.346	.036
		24 C	20 C	.739*	.346	.036
	Ambient+50%	20 C	24 C	-1.939*	.346	.000
		24 C	20 C	1.939*	.346	.000
Nonfitted	Ambient-50%	20 C	24 C	-1.867*	.219	.000
		24 C	20 C	1.867*	.219	.000
	Ambient	20 C	24 C	-2.730*	.219	.000
		24 C	20 C	2.730*	.219	.000
	Ambient+50%	20 C	24 C	-3.501*	.219	.000
		24 C	20 C	3.501*	.219	.000

Pairwise Comparisons

Dependent Variable	WaterRegim	(I) Temperature	(J) Temperature	95% Confidence Interval for Difference[b]	
				Lower Bound	Upper Bound
Wellfitted	Ambient-50%	20 C	24 C	-.068	1.430
		24 C	20 C	-1.430	.068
	Ambient	20 C	24 C	-.054	1.444
		24 C	20 C	-1.444	.054
	Ambient+50%	20 C	24 C	-2.245	-.746
		24 C	20 C	.746	2.245
Intermediate	Ambient-50%	20 C	24 C	-.570	.807
		24 C	20 C	-.807	.570
	Ambient	20 C	24 C	-1.428	-.050
		24 C	20 C	.050	1.428
	Ambient+50%	20 C	24 C	-2.628	-1.250
		24 C	20 C	1.250	2.628
Nonfitted	Ambient-50%	20 C	24 C	-2.302	-1.432
		24 C	20 C	1.432	2.302
	Ambient	20 C	24 C	-3.165	-2.295
		24 C	20 C	2.295	3.165
	Ambient+50%	20 C	24 C	-3.936	-3.066
		24 C	20 C	3.066	3.936

Based on estimated marginal means

*. The mean difference is significant at the

b. Adjustment for multiple comparisons: Sidak.

Univariate Tests

Dependent Variable		Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Wellfitted	Contrast	103.356	1	103.356	91.116	.000	.529
	Error	91.880	81	1.134			
Intermediate	Contrast	48.226	1	48.226	50.273	.000	.383
	Error	77.701	81	.959			
Nonfitted	Contrast	213.580	1	213.580	558.580	.000	.873
	Error	30.971	81	.382			

The F tests the effect of Co2Level. This test is based on the linearly independent pairwise comparisons among the estimated marginal means.

2- Species by species

Multivariate Tests[a]

Effect		Value	F	Hypothesis df	Error df	Sig.
Intercept	Pillai's Trace	.995	687.863[b]	18.000	64.000	.000
	Wilks' Lambda	.005	687.863[b]	18.000	64.000	.000
	Hotelling's Trace	193.461	687.863[b]	18.000	64.000	.000
	Roy's Largest Root	193.461	687.863[b]	18.000	64.000	.000
Co2Level	Pillai's Trace	.912	36.659[b]	18.000	64.000	.000
	Wilks' Lambda	.088	36.659[b]	18.000	64.000	.000
	Hotelling's Trace	10.310	36.659[b]	18.000	64.000	.000
	Roy's Largest Root	10.310	36.659[b]	18.000	64.000	.000
Temperature	Pillai's Trace	.899	31.557[b]	18.000	64.000	.000
	Wilks' Lambda	.101	31.557[b]	18.000	64.000	.000
	Hotelling's Trace	8.875	31.557[b]	18.000	64.000	.000
	Roy's Largest Root	8.875	31.557[b]	18.000	64.000	.000
WaterRegim	Pillai's Trace	1.302	6.731	36.000	130.000	.000
	Wilks' Lambda	.017	23.360[b]	36.000	128.000	.000
	Hotelling's Trace	38.018	66.531	36.000	126.000	.000
	Roy's Largest Root	37.531	135.527[c]	18.000	65.000	.000
Harvesttime	Pillai's Trace	.874	24.606[b]	18.000	64.000	.000
	Wilks' Lambda	.126	24.606[b]	18.000	64.000	.000
	Hotelling's Trace	6.921	24.606[b]	18.000	64.000	.000
	Roy's Largest Root	6.921	24.606[b]	18.000	64.000	.000
Co2Level * Harvesttime	Pillai's Trace	.824	16.625[b]	18.000	64.000	.000
	Wilks' Lambda	.176	16.625[b]	18.000	64.000	.000
	Hotelling's Trace	4.676	16.625[b]	18.000	64.000	.000
	Roy's Largest Root	4.676	16.625[b]	18.000	64.000	.000
Co2Level * Temperature	Pillai's Trace	.526	3.948[b]	18.000	64.000	.000
	Wilks' Lambda	.474	3.948[b]	18.000	64.000	.000
	Hotelling's Trace	1.110	3.948[b]	18.000	64.000	.000
	Roy's Largest Root	1.110	3.948[b]	18.000	64.000	.000
WaterRegim * Co2Level	Pillai's Trace	.895	2.925	36.000	130.000	.000
	Wilks' Lambda	.288	3.070[b]	36.000	128.000	.000
	Hotelling's Trace	1.837	3.215	36.000	126.000	.000
	Roy's Largest Root	1.375	4.964[c]	18.000	65.000	.000
Temperature * Harvesttime	Pillai's Trace	.761	11.334[b]	18.000	64.000	.000
	Wilks' Lambda	.239	11.334[b]	18.000	64.000	.000
	Hotelling's Trace	3.188	11.334[b]	18.000	64.000	.000
	Roy's Largest Root	3.188	11.334[b]	18.000	64.000	.000
WaterRegim * Harvesttime	Pillai's Trace	1.261	6.165	36.000	130.000	.000
	Wilks' Lambda	.070	9.854[b]	36.000	128.000	.000
	Hotelling's Trace	8.507	14.888	36.000	126.000	.000
	Roy's Largest Root	7.911	28.568[c]	18.000	65.000	.000
WaterRegim * Temperature	Pillai's Trace	.935	3.172	36.000	130.000	.000
	Wilks' Lambda	.275	3.230[b]	36.000	128.000	.000
	Hotelling's Trace	1.878	3.287	36.000	126.000	.000
	Roy's Largest Root	1.282	4.630[c]	18.000	65.000	.000

Tests of Between-Subjects Effects

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	Centaureamontana	752.067[a]	14	53.719	13.862	.000
	GaliumVerum	459.910[b]	14	32.851	20.184	.000
	Scabiosacaucasica	650.413[c]	14	46.458	12.942	.000
	Prunellavulgaris	529.430[d]	14	37.816	13.950	.000
	Centaureatriumfetii	686.824[e]	14	49.059	15.982	.000
	Salviapratense	459.432[f]	14	32.817	8.889	.000
	Asphodelinelutea	583.763[g]	14	41.697	22.598	.000
	Bupthalmumsalicifolium	564.271[h]	14	40.305	50.498	.000
	Dianthuscarthusianorum	635.871[i]	14	45.419	22.666	.000
	Linumflavumcompactum	474.981[j]	14	33.927	50.081	.000
	Lychniscoronaria	562.687[k]	14	40.192	27.574	.000
	Salvianemorosa	459.783[l]	14	32.842	21.666	.000
	Asclepiastuberosa	921.460[m]	14	65.819	55.306	.000
	Hymenoxysgrandiflora	585.302[n]	14	41.807	35.367	.000
	Centaureapulcherrimus	852.734[o]	14	60.910	27.790	.000
	Penstemonstrictus	865.277[p]	14	61.805	64.936	.000
	Salviapachyphylla	1007.635[q]	14	71.974	57.732	.000
	Ziniagrandiflorus	847.683[r]	14	60.549	61.930	.000
Intercept	Centaureamontana	1643.721	1	1643.721	424.159	.000
	GaliumVerum	2792.808	1	2792.808	1715.938	.000
	Scabiosacaucasica	2051.234	1	2051.234	571.442	.000
	Prunellavulgaris	2486.893	1	2486.893	917.407	.000
	Centaureatriumfetii	2038.432	1	2038.432	664.081	.000
	Salviapratense	2345.622	1	2345.622	635.381	.000
	Asphodelinelutea	3272.491	1	3272.491	1773.507	.000
	Bupthalmumsalicifolium	3672.839	1	3672.839	4601.651	.000
	Dianthuscarthusianorum	3478.416	1	3478.416	1735.853	.000
	Linumflavumcompactum	3572.599	1	3572.599	5273.659	.000
	Lychniscoronaria	3301.350	1	3301.350	2264.930	.000
	Salvianemorosa	3254.603	1	3254.603	2147.047	.000
	Asclepiastuberosa	3204.664	1	3204.664	2692.813	.000
	Hymenoxysgrandiflora	2583.935	1	2583.935	2185.903	.000
	Centaureapulcherrimus	2127.460	1	2127.460	970.667	.000
	Penstemonstrictus	2973.892	1	2973.892	3124.537	.000
	Salviapachyphylla	2913.435	1	2913.435	2336.923	.000
	Ziniagrandiflorus	2891.078	1	2891.078	2957.005	.000
Co2Level	Centaureamontana	97.964	1	97.964	25.279	.000
	GaliumVerum	107.741	1	107.741	66.197	.000
	Scabiosacaucasica	110.586	1	110.586	30.807	.000
	Prunellavulgaris	196.276	1	196.276	72.406	.000
	Centaureatriumfetii	67.852	1	67.852	22.105	.000
	Salviapratense	56.883	1	56.883	15.408	.000
	Asphodelinelutea	78.737	1	78.737	42.671	.000
	Bupthalmumsalicifolium	82.420	1	82.420	103.262	.000
	Dianthuscarthusianorum	80.551	1	80.551	40.198	.000
	Linumflavumcompactum	97.574	1	97.574	144.034	.000
	Lychniscoronaria	69.212	1	69.212	47.484	.000
	Salvianemorosa	46.966	1	46.966	30.983	.000
	Asclepiastuberosa	279.607	1	279.607	234.948	.000
	Hymenoxysgrandiflora	154.681	1	154.681	130.854	.000

Estimates

Dependent Variable	Co2Level	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
Centaureamontana	450 PPM	3.128	.284	2.562	3.693
	900 PPM	5.148	.284	4.583	5.713
GaliumVerum	450 PPM	4.334	.184	3.968	4.701
	900 PPM	6.453	.184	6.087	6.819
Scabiosacaucasica	450 PPM	3.549	.273	3.005	4.093
	900 PPM	5.696	.273	5.152	6.240
Prunellavulgaris	450 PPM	3.660	.238	3.187	4.133
	900 PPM	6.520	.238	6.047	6.992
Centaureatriumfetii	450 PPM	3.767	.253	3.264	4.270
	900 PPM	5.449	.253	4.946	5.952
Salviapratense	450 PPM	4.173	.277	3.621	4.725
	900 PPM	5.713	.277	5.161	6.265
Asphodelinelutea	450 PPM	4.933	.196	4.543	5.323
	900 PPM	6.744	.196	6.354	7.134
Bupthalmumsalicifolium	450 PPM	5.259	.129	5.002	5.515
	900 PPM	7.112	.129	6.855	7.369
Dianthuscarthusianorum	450 PPM	5.103	.204	4.697	5.510
	900 PPM	6.935	.204	6.529	7.342
Linumflavumcompactum	450 PPM	5.092	.119	4.856	5.329
	900 PPM	7.109	.119	6.872	7.345
Lychniscoronaria	450 PPM	5.015	.174	4.668	5.362
	900 PPM	6.713	.174	6.367	7.060
Salvianemorosa	450 PPM	5.123	.178	4.770	5.477
	900 PPM	6.522	.178	6.168	6.876
Asclepiastuberosa	450 PPM	4.071	.157	3.758	4.384
	900 PPM	7.484	.157	7.171	7.798
Hymenoxysgrandiflora	450 PPM	3.919	.157	3.606	4.231
	900 PPM	6.457	.157	6.145	6.770
Centaureapulcherrimus	450 PPM	3.238	.214	2.813	3.664
	900 PPM	6.177	.214	5.752	6.602
Penstemonstrictus	450 PPM	3.948	.141	3.667	4.228
	900 PPM	7.184	.141	6.904	7.464
Salviapachyphylla	450 PPM	4.092	.161	3.771	4.413
	900 PPM	6.926	.161	6.605	7.247
Ziniagrandiflorus	450 PPM	4.019	.143	3.735	4.303
	900 PPM	6.957	.143	6.673	7.241

Pairwise Comparisons

Dependent Variable	(I) Co2Level	(J) Co2Level	Mean Difference (I-J)	Std. Error	Sig.[b]	95% Confidence ..[b] Lower Bound
Centaureamontana	450 PPM	900 PPM	-2.020*	.402	.000	-2.820
	900 PPM	450 PPM	2.020*	.402	.000	1.221
GaliumVerum	450 PPM	900 PPM	-2.119*	.260	.000	-2.637
	900 PPM	450 PPM	2.119*	.260	.000	1.601
Scabiosacaucasica	450 PPM	900 PPM	-2.147*	.387	.000	-2.916
	900 PPM	450 PPM	2.147*	.387	.000	1.377
Prunellavulgaris	450 PPM	900 PPM	-2.860*	.336	.000	-3.528
	900 PPM	450 PPM	2.860*	.336	.000	2.191
Centaureatriumfetii	450 PPM	900 PPM	-1.681*	.358	.000	-2.393
	900 PPM	450 PPM	1.681*	.358	.000	.970
Salviapratense	450 PPM	900 PPM	-1.540*	.392	.000	-2.320
	900 PPM	450 PPM	1.540*	.392	.000	.759
Asphodelinelutea	450 PPM	900 PPM	-1.811*	.277	.000	-2.363
	900 PPM	450 PPM	1.811*	.277	.000	1.260
Bupthalmumsalicifolium	450 PPM	900 PPM	-1.853*	.182	.000	-2.216
	900 PPM	450 PPM	1.853*	.182	.000	1.490
Dianthuscarthusianorum	450 PPM	900 PPM	-1.832*	.289	.000	-2.407
	900 PPM	450 PPM	1.832*	.289	.000	1.257
Linumflavumcompactum	450 PPM	900 PPM	-2.016*	.168	.000	-2.351
	900 PPM	450 PPM	2.016*	.168	.000	1.682
Lychniscoronaria	450 PPM	900 PPM	-1.698*	.246	.000	-2.189
	900 PPM	450 PPM	1.698*	.246	.000	1.208
Salvianemorosa	450 PPM	900 PPM	-1.399*	.251	.000	-1.899
	900 PPM	450 PPM	1.399*	.251	.000	.899
Asclepiastuberosa	450 PPM	900 PPM	-3.413*	.223	.000	-3.856
	900 PPM	450 PPM	3.413*	.223	.000	2.970
Hymenoxysgrandiflora	450 PPM	900 PPM	-2.539*	.222	.000	-2.980
	900 PPM	450 PPM	2.539*	.222	.000	2.097
Centaureapulcherrimus	450 PPM	900 PPM	-2.938*	.302	.000	-3.540
	900 PPM	450 PPM	2.938*	.302	.000	2.337
Penstemonstrictus	450 PPM	900 PPM	-3.236*	.199	.000	-3.633
	900 PPM	450 PPM	3.236*	.199	.000	2.840
Salviapachyphylla	450 PPM	900 PPM	-2.834*	.228	.000	-3.288
	900 PPM	450 PPM	2.834*	.228	.000	2.381
Ziniagrandiflorus	450 PPM	900 PPM	-2.938*	.202	.000	-3.340
	900 PPM	450 PPM	2.938*	.202	.000	2.537

Estimates

Dependent Variable	Temperature	Mean	Std. Error	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
Centaureamontana	20 C	4.211	.284	3.646	4.777
	24 C	4.064	.284	3.499	4.630
GaliumVerum	20 C	5.339	.184	4.972	5.705
	24 C	5.449	.184	5.082	5.815
Scabiosacaucasica	20 C	5.011	.273	4.467	5.555
	24 C	4.234	.273	3.690	4.778
Prunellavulgaris	20 C	4.959	.238	4.486	5.432
	24 C	5.220	.238	4.748	5.693
Centaureatriumfetii	20 C	4.528	.253	4.025	5.031
	24 C	4.688	.253	4.185	5.191
Salviapratense	20 C	4.621	.277	4.069	5.173
	24 C	5.265	.277	4.713	5.817
Asphodelinelutea	20 C	5.621	.196	5.231	6.011
	24 C	6.056	.196	5.666	6.446
Bupthalmumsalicifolium	20 C	5.818	.129	5.562	6.075
	24 C	6.552	.129	6.296	6.809
Dianthuscarthusianorum	20 C	5.695	.204	5.288	6.101
	24 C	6.344	.204	5.938	6.751
Linumflavumcompactum	20 C	5.809	.119	5.572	6.045
	24 C	6.392	.119	6.156	6.629
Lychniscoronaria	20 C	5.484	.174	5.138	5.831
	24 C	6.244	.174	5.897	6.591
Salvianemorosa	20 C	5.559	.178	5.206	5.913
	24 C	6.086	.178	5.732	6.439
Asclepiastuberosa	20 C	4.462	.157	4.149	4.775
	24 C	7.094	.157	6.780	7.407
Hymenoxysgrandiflora	20 C	3.999	.157	3.687	4.311
	24 C	6.377	.157	6.065	6.689
Centaureapulcherrimus	20 C	3.209	.214	2.783	3.634
	24 C	6.207	.214	5.781	6.632
Penstemonstrictus	20 C	4.288	.141	4.008	4.568
	24 C	6.843	.141	6.563	7.124
Salviapachyphylla	20 C	4.079	.161	3.758	4.400
	24 C	6.939	.161	6.618	7.260
Ziniagrandiflorus	20 C	4.102	.143	3.818	4.386
	24 C	6.874	.143	6.590	7.158

Pairwise Comparisons

Dependent Variable	(I) Temperature	(J) Temperature	Mean Difference (I-J)	Std. Error	Sig.[b]	95% Confidence ..[b] Lower Bound
Centaureamontana	20 C	24 C	.147	.402	.715	-.652
	24 C	20 C	-.147	.402	.715	-.947
GaliumVerum	20 C	24 C	-.110	.260	.674	-.628
	24 C	20 C	.110	.260	.674	-.408
Scabiosacaucasica	20 C	24 C	.776*	.387	.048	.007
	24 C	20 C	-.776*	.387	.048	-1.546
Prunellavulgaris	20 C	24 C	-.262	.336	.439	-.930
	24 C	20 C	.262	.336	.439	-.407
Centaureatriumfetii	20 C	24 C	-.161	.358	.655	-.872
	24 C	20 C	.161	.358	.655	-.551
Salviapratense	20 C	24 C	-.644	.392	.104	-1.425
	24 C	20 C	.644	.392	.104	-.136
Asphodelinelutea	20 C	24 C	-.435	.277	.121	-.986
	24 C	20 C	.435	.277	.121	-.117
Bupthalmumsalicifolium	20 C	24 C	-.734*	.182	.000	-1.097
	24 C	20 C	.734*	.182	.000	.371
Dianthuscarthusianorum	20 C	24 C	-.650*	.289	.027	-1.225
	24 C	20 C	.650*	.289	.027	.075
Linumflavumcompactum	20 C	24 C	-.584*	.168	.001	-.918
	24 C	20 C	.584*	.168	.001	.249
Lychniscoronaria	20 C	24 C	-.760*	.246	.003	-1.250
	24 C	20 C	.760*	.246	.003	.270
Salvianemorosa	20 C	24 C	-.526*	.251	.039	-1.026
	24 C	20 C	.526*	.251	.039	.026
Asclepiastuberosa	20 C	24 C	-2.632*	.223	.000	-3.075
	24 C	20 C	2.632*	.223	.000	2.189
Hymenoxysgrandiflora	20 C	24 C	-2.378*	.222	.000	-2.820
	24 C	20 C	2.378*	.222	.000	1.937
Centaureapulcherrimus	20 C	24 C	-2.998*	.302	.000	-3.599
	24 C	20 C	2.998*	.302	.000	2.397
Penstemonstrictus	20 C	24 C	-2.555*	.199	.000	-2.951
	24 C	20 C	2.555*	.199	.000	2.159
Salviapachyphylla	20 C	24 C	-2.860*	.228	.000	-3.314
	24 C	20 C	2.860*	.228	.000	2.407
Ziniagrandiflorus	20 C	24 C	-2.772*	.202	.000	-3.173
	24 C	20 C	2.772*	.202	.000	2.370

Estimates

Dependent Variable	WaterRegim	Mean	Std. Error	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
Centaureamontana	Ambient-50%	1.401	.348	.708	2.093
	Ambient	5.467	.348	4.775	6.160
	Ambient+50%	5.546	.348	4.853	6.238
GaliumVerum	Ambient-50%	3.508	.226	3.059	3.956
	Ambient	6.458	.226	6.009	6.907
	Ambient+50%	6.216	.226	5.767	6.664
Scabiosacaucasica	Ambient-50%	2.206	.335	1.540	2.872
	Ambient	5.974	.335	5.308	6.641
	Ambient+50%	5.687	.335	5.021	6.354
Prunellavulgaris	Ambient-50%	3.568	.291	2.989	4.147
	Ambient	6.504	.291	5.925	7.083
	Ambient+50%	5.198	.291	4.618	5.777
Centaureatriumfetii	Ambient-50%	1.842	.310	1.226	2.458
	Ambient	6.228	.310	5.612	6.844
	Ambient+50%	5.754	.310	5.138	6.371
Salviapratense	Ambient-50%	2.878	.340	2.202	3.554
	Ambient	6.243	.340	5.568	6.919
	Ambient+50%	5.708	.340	5.032	6.383
Asphodelinelutea	Ambient-50%	3.790	.240	3.312	4.268
	Ambient	6.665	.240	6.187	7.142
	Ambient+50%	7.061	.240	6.583	7.539
Bupthalmumsalicifolium	Ambient-50%	4.299	.158	3.985	4.613
	Ambient	7.144	.158	6.830	7.458
	Ambient+50%	7.113	.158	6.799	7.427
Dianthuscarthusianorum	Ambient-50%	3.930	.250	3.432	4.428
	Ambient	7.114	.250	6.616	7.612
	Ambient+50%	7.014	.250	6.516	7.512
Linumflavumcompactum	Ambient-50%	4.458	.145	4.169	4.748
	Ambient	6.736	.145	6.447	7.026
	Ambient+50%	7.107	.145	6.817	7.396
Lychniscoronaria	Ambient-50%	3.666	.213	3.241	4.090
	Ambient	6.951	.213	6.526	7.375
	Ambient+50%	6.976	.213	6.552	7.401
Salvianemorosa	Ambient-50%	4.036	.218	3.603	4.469
	Ambient	6.385	.218	5.952	6.818
	Ambient+50%	7.047	.218	6.614	7.480
Asclepiastuberosa	Ambient-50%	7.254	.193	6.870	7.637
	Ambient	5.272	.193	4.888	5.656
	Ambient+50%	4.807	.193	4.424	5.191
Hymenoxysgrandiflora	Ambient-50%	6.856	.192	6.473	7.238
	Ambient	4.600	.192	4.218	4.982
	Ambient+50%	4.108	.192	3.726	4.491
Centaureapulcherrimus	Ambient-50%	6.660	.262	6.139	7.181
	Ambient	4.059	.262	3.539	4.580
	Ambient+50%	3.403	.262	2.883	3.924
Penstemonstrictus	Ambient-50%	7.314	.172	6.971	7.658
	Ambient	5.127	.172	4.784	5.470
	Ambient+50%	4.256	.172	3.913	4.599

Pairwise Comparisons

Dependent Variable	(I) WaterRegim	(J) WaterRegim	Mean Difference (I-J)	Std. Error	Sig.[b]	95% Confidence [b] Lower Bound
Centaureamontana	Ambient-50%	Ambient	-4.066*	.492	.000	-5.266
		Ambient+50%	-4.145*	.492	.000	-5.345
	Ambient	Ambient-50%	4.066*	.492	.000	2.866
		Ambient+50%	-.078	.492	.998	-1.278
	Ambient+50%	Ambient-50%	4.145*	.492	.000	2.945
		Ambient	.078	.492	.998	-1.121
GaliumVerum	Ambient-50%	Ambient	-2.950*	.319	.000	-3.728
		Ambient+50%	-2.708*	.319	.000	-3.486
	Ambient	Ambient-50%	2.950*	.319	.000	2.173
		Ambient+50%	.242	.319	.833	-.535
	Ambient+50%	Ambient-50%	2.708*	.319	.000	1.930
		Ambient	-.242	.319	.833	-1.020
Scabiosacaucasica	Ambient-50%	Ambient	-3.768*	.474	.000	-4.923
		Ambient+50%	-3.481*	.474	.000	-4.636
	Ambient	Ambient-50%	3.768*	.474	.000	2.613
		Ambient+50%	.287	.474	.907	-.868
	Ambient+50%	Ambient-50%	3.481*	.474	.000	2.326
		Ambient	-.287	.474	.907	-1.442
Prunellavulgaris	Ambient-50%	Ambient	-2.936*	.412	.000	-3.939
		Ambient+50%	-1.630*	.412	.000	-2.633
	Ambient	Ambient-50%	2.936*	.412	.000	1.932
		Ambient+50%	1.306*	.412	.006	.303
	Ambient+50%	Ambient-50%	1.630*	.412	.000	.626
		Ambient	-1.306*	.412	.006	-2.310
Centaureatriumfetii	Ambient-50%	Ambient	-4.386*	.438	.000	-5.454
		Ambient+50%	-3.913*	.438	.000	-4.980
	Ambient	Ambient-50%	4.386*	.438	.000	3.318
		Ambient+50%	.473	.438	.631	-.595
	Ambient+50%	Ambient-50%	3.913*	.438	.000	2.845
		Ambient	-.473	.438	.631	-1.541
Salviapratense	Ambient-50%	Ambient	-3.365*	.480	.000	-4.536
		Ambient+50%	-2.829*	.480	.000	-4.000
	Ambient	Ambient-50%	3.365*	.480	.000	2.194
		Ambient+50%	.536	.480	.608	-.635
	Ambient+50%	Ambient-50%	2.829*	.480	.000	1.658
		Ambient	-.536	.480	.608	-1.707
Asphodelinelutea	Ambient-50%	Ambient	-2.875*	.340	.000	-3.703
		Ambient+50%	-3.272*	.340	.000	-4.099
	Ambient	Ambient-50%	2.875*	.340	.000	2.047
		Ambient+50%	-.397	.340	.572	-1.225
	Ambient+50%	Ambient-50%	3.272*	.340	.000	2.444
		Ambient	.397	.340	.572	-.431
Bupthalmumsalicifolium	Ambient-50%	Ambient	-2.845*	.223	.000	-3.390
		Ambient+50%	-2.814*	.223	.000	-3.359
	Ambient	Ambient-50%	2.845*	.223	.000	2.301
		Ambient+50%	.031	.223	.999	-.514
	Ambient+50%	Ambient-50%	2.814*	.223	.000	2.270
		Ambient	-.031	.223	.999	-.576

Estimates

Dependent Variable	Harvesttime	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
Centaureamontana	15 Agust	2.736	.284	2.171	3.301
	15 September	5.540	.284	4.974	6.105
GaliumVerum	15 Agust	4.710	.184	4.343	5.076
	15 September	6.078	.184	5.711	6.444
Scabiosacaucasica	15 Agust	3.592	.273	3.047	4.136
	15 September	5.653	.273	5.109	6.197
Prunellavulgaris	15 Agust	4.251	.238	3.778	4.724
	15 September	5.928	.238	5.455	6.401
Centaureatriumfetii	15 Agust	3.432	.253	2.929	3.935
	15 September	5.784	.253	5.281	6.287
Salviapratense	15 Agust	4.239	.277	3.687	4.791
	15 September	5.647	.277	5.096	6.199
Asphodelinelutea	15 Agust	4.520	.196	4.130	4.910
	15 September	7.157	.196	6.767	7.547
Bupthalmumsalicifolium	15 Agust	4.984	.129	4.728	5.241
	15 September	7.387	.129	7.130	7.643
Dianthuscarthusianorum	15 Agust	4.812	.204	4.405	5.218
	15 September	7.227	.204	6.821	7.634
Linumflavumcompactum	15 Agust	5.062	.119	4.826	5.298
	15 September	7.139	.119	6.902	7.375
Lychniscoronaria	15 Agust	4.625	.174	4.278	4.971
	15 September	7.104	.174	6.757	7.450
Salvianemorosa	15 Agust	4.928	.178	4.574	5.281
	15 September	6.717	.178	6.364	7.071
Asclepiastuberosa	15 Agust	4.608	.157	4.295	4.921
	15 September	6.947	.157	6.634	7.261
Hymenoxysgrandiflora	15 Agust	4.555	.157	4.243	4.867
	15 September	5.821	.157	5.509	6.134
Centaureapulcherrimus	15 Agust	3.569	.214	3.143	3.994
	15 September	5.846	.214	5.421	6.272
Penstemonstrictus	15 Agust	4.549	.141	4.269	4.829
	15 September	6.583	.141	6.303	6.863
Salviapachyphylla	15 Agust	4.281	.161	3.960	4.601
	15 September	6.737	.161	6.417	7.058
Ziniagrandiflorus	15 Agust	4.546	.143	4.262	4.830
	15 September	6.430	.143	6.146	6.714

Pairwise Comparisons

Dependent Variable	(I) Harvesttime	(J) Harvesttime	Mean Difference (I-J)	Std. Error	Sig.[b]	95% Confidence ...[b] Lower Bound
Centaureamontana	15 Agust	15 September	-2.804*	.402	.000	-3.603
	15 September	15 Agust	2.804*	.402	.000	2.004
GaliumVerum	15 Agust	15 September	-1.368*	.260	.000	-1.886
	15 September	15 Agust	1.368*	.260	.000	.850
Scabiosacaucasica	15 Agust	15 September	-2.062*	.387	.000	-2.831
	15 September	15 Agust	2.062*	.387	.000	1.292
Prunellavulgaris	15 Agust	15 September	-1.677*	.336	.000	-2.345
	15 September	15 Agust	1.677*	.336	.000	1.008
Centaureatriumfetii	15 Agust	15 September	-2.352*	.358	.000	-3.063
	15 September	15 Agust	2.352*	.358	.000	1.640
Salviapratense	15 Agust	15 September	-1.409*	.392	.001	-2.189
	15 September	15 Agust	1.409*	.392	.001	.628
Asphodelinelutea	15 Agust	15 September	-2.637*	.277	.000	-3.189
	15 September	15 Agust	2.637*	.277	.000	2.085
Bupthalmumsalicifolium	15 Agust	15 September	-2.402*	.182	.000	-2.765
	15 September	15 Agust	2.402*	.182	.000	2.040
Dianthuscarthusianorum	15 Agust	15 September	-2.415*	.289	.000	-2.990
	15 September	15 Agust	2.415*	.289	.000	1.841
Linumflavumcompactum	15 Agust	15 September	-2.077*	.168	.000	-2.411
	15 September	15 Agust	2.077*	.168	.000	1.742
Lychniscoronaria	15 Agust	15 September	-2.479*	.246	.000	-2.969
	15 September	15 Agust	2.479*	.246	.000	1.989
Salvianemorosa	15 Agust	15 September	-1.789*	.251	.000	-2.290
	15 September	15 Agust	1.789*	.251	.000	1.289
Asclepiastuberosa	15 Agust	15 September	-2.339*	.223	.000	-2.782
	15 September	15 Agust	2.339*	.223	.000	1.896
Hymenoxysgrandiflora	15 Agust	15 September	-1.266*	.222	.000	-1.708
	15 September	15 Agust	1.266*	.222	.000	.825
Centaureapulcherrimus	15 Agust	15 September	-2.278*	.302	.000	-2.879
	15 September	15 Agust	2.278*	.302	.000	1.677
Penstemonstrictus	15 Agust	15 September	-2.034*	.199	.000	-2.430
	15 September	15 Agust	2.034*	.199	.000	1.638
Salviapachyphylla	15 Agust	15 September	-2.457*	.228	.000	-2.910
	15 September	15 Agust	2.457*	.228	.000	2.003
Ziniagrandiflorus	15 Agust	15 September	-1.884*	.202	.000	-2.286
	15 September	15 Agust	1.884*	.202	.000	1.482

Estimates

Dependent Variable	Co2Level	Harvesttime	Mean	Std. Error	95% Confidence Interval Lower Bound	Upper Bound
Centaureamontana	450 PPM	15 Agust	2.220	.402	1.420	3.019
		15 September	4.036	.402	3.236	4.835
	900 PPM	15 Agust	3.252	.402	2.453	4.052
		15 September	7.044	.402	6.244	7.843
GaliumVerum	450 PPM	15 Agust	4.011	.260	3.493	4.529
		15 September	4.658	.260	4.140	5.176
	900 PPM	15 Agust	5.409	.260	4.890	5.927
		15 September	7.498	.260	6.979	8.016
Scabiosacaucasica	450 PPM	15 Agust	2.840	.387	2.071	3.610
		15 September	4.258	.387	3.488	5.027
	900 PPM	15 Agust	4.343	.387	3.573	5.112
		15 September	7.049	.387	6.279	7.818
Prunellavulgaris	450 PPM	15 Agust	3.056	.336	2.387	3.725
		15 September	4.264	.336	3.595	4.932
	900 PPM	15 Agust	5.447	.336	4.778	6.115
		15 September	7.592	.336	6.924	8.261
Centaureatriumfetii	450 PPM	15 Agust	2.888	.358	2.176	3.599
		15 September	4.647	.358	3.935	5.358
	900 PPM	15 Agust	3.976	.358	3.265	4.688
		15 September	6.921	.358	6.210	7.633
Salviapratense	450 PPM	15 Agust	3.624	.392	2.843	4.404
		15 September	4.723	.392	3.943	5.503
	900 PPM	15 Agust	4.854	.392	4.073	5.634
		15 September	6.572	.392	5.791	7.352
Asphodelinelutea	450 PPM	15 Agust	4.170	.277	3.618	4.722
		15 September	5.696	.277	5.144	6.248
	900 PPM	15 Agust	4.870	.277	4.318	5.422
		15 September	8.618	.277	8.066	9.170
Bupthalmumsalicifolium	450 PPM	15 Agust	4.691	.182	4.328	5.054
		15 September	5.826	.182	5.463	6.189
	900 PPM	15 Agust	5.277	.182	4.914	5.640
		15 September	8.947	.182	8.584	9.310
Dianthuscarthusianorum	450 PPM	15 Agust	4.592	.289	4.017	5.167
		15 September	5.615	.289	5.040	6.190
	900 PPM	15 Agust	5.032	.289	4.457	5.607
		15 September	8.839	.289	8.264	9.414
Linumflavumcompactum	450 PPM	15 Agust	4.626	.168	4.291	4.960
		15 September	5.559	.168	5.224	5.893
	900 PPM	15 Agust	5.498	.168	5.164	5.833
		15 September	8.719	.168	8.384	9.053
Lychniscoronaria	450 PPM	15 Agust	4.310	.246	3.819	4.800
		15 September	5.720	.246	5.230	6.211
	900 PPM	15 Agust	4.940	.246	4.449	5.430
		15 September	8.487	.246	7.997	8.977
Salvianemorosa	450 PPM	15 Agust	4.890	.251	4.389	5.390
		15 September	5.357	.251	4.857	5.857
	900 PPM	15 Agust	4.966	.251	4.466	5.466
		15 September	8.078	.251	7.578	8.578
Asclepiastuberosa	450 PPM	15 Agust	4.031	.223	3.587	4.474
		15 September	4.112	.223	3.669	4.555

Pairwise Comparisons

Dependent Variable	Harvesttime	(I) Co2Level	(J) Co2Level	Mean Difference (I-J)	Std. Error	Sig.[b]
Centaureamontana	15 Agust	450 PPM	900 PPM	-1.033	.568	.073
		900 PPM	450 PPM	1.033	.568	.073
	15 September	450 PPM	900 PPM	-3.008*	.568	.000
		900 PPM	450 PPM	3.008*	.568	.000
GaliumVerum	15 Agust	450 PPM	900 PPM	-1.398*	.368	.000
		900 PPM	450 PPM	1.398*	.368	.000
	15 September	450 PPM	900 PPM	-2.840*	.368	.000
		900 PPM	450 PPM	2.840*	.368	.000
Scabiosacaucasica	15 Agust	450 PPM	900 PPM	-1.502*	.547	.007
		900 PPM	450 PPM	1.502*	.547	.007
	15 September	450 PPM	900 PPM	-2.791*	.547	.000
		900 PPM	450 PPM	2.791*	.547	.000
Prunellavulgaris	15 Agust	450 PPM	900 PPM	-2.391*	.475	.000
		900 PPM	450 PPM	2.391*	.475	.000
	15 September	450 PPM	900 PPM	-3.329*	.475	.000
		900 PPM	450 PPM	3.329*	.475	.000
Centaureatriumfetii	15 Agust	450 PPM	900 PPM	-1.088*	.506	.034
		900 PPM	450 PPM	1.088*	.506	.034
	15 September	450 PPM	900 PPM	-2.275*	.506	.000
		900 PPM	450 PPM	2.275*	.506	.000
Salviapratense	15 Agust	450 PPM	900 PPM	-1.230*	.555	.029
		900 PPM	450 PPM	1.230*	.555	.029
	15 September	450 PPM	900 PPM	-1.849*	.555	.001
		900 PPM	450 PPM	1.849*	.555	.001
Asphodelinelutea	15 Agust	450 PPM	900 PPM	-.700	.392	.078
		900 PPM	450 PPM	.700	.392	.078
	15 September	450 PPM	900 PPM	-2.922*	.392	.000
		900 PPM	450 PPM	2.922*	.392	.000
Bupthalmumsalicifolium	15 Agust	450 PPM	900 PPM	-.586*	.258	.026
		900 PPM	450 PPM	.586*	.258	.026
	15 September	450 PPM	900 PPM	-3.121*	.258	.000
		900 PPM	450 PPM	3.121*	.258	.000
Dianthuscarthusianorum	15 Agust	450 PPM	900 PPM	-.440	.409	.285
		900 PPM	450 PPM	.440	.409	.285
	15 September	450 PPM	900 PPM	-3.224*	.409	.000
		900 PPM	450 PPM	3.224*	.409	.000
Linumflavumcompactum	15 Agust	450 PPM	900 PPM	-.873*	.238	.000
		900 PPM	450 PPM	.873*	.238	.000
	15 September	450 PPM	900 PPM	-3.160*	.238	.000
		900 PPM	450 PPM	3.160*	.238	.000
Lychniscoronaria	15 Agust	450 PPM	900 PPM	-.630	.349	.074
		900 PPM	450 PPM	.630	.349	.074
	15 September	450 PPM	900 PPM	-2.767*	.349	.000
		900 PPM	450 PPM	2.767*	.349	.000
Salvianemorosa	15 Agust	450 PPM	900 PPM	-.077	.355	.830
		900 PPM	450 PPM	.077	.355	.830
	15 September	450 PPM	900 PPM	-2.721*	.355	.000
		900 PPM	450 PPM	2.721*	.355	.000
Asclepiastuberosa	15 Agust	450 PPM	900 PPM	-1.155*	.315	.000

Estimates

Dependent Variable	Co2Level	Harvesttime	Mean	Std. Error	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
Centaureamontana	450 PPM	15 Agust	2.220	.402	1.420	3.019
		15 September	4.036	.402	3.236	4.835
	900 PPM	15 Agust	3.252	.402	2.453	4.052
		15 September	7.044	.402	6.244	7.843
GaliumVerum	450 PPM	15 Agust	4.011	.260	3.493	4.529
		15 September	4.658	.260	4.140	5.176
	900 PPM	15 Agust	5.409	.260	4.890	5.927
		15 September	7.498	.260	6.979	8.016
Scabiosacaucasica	450 PPM	15 Agust	2.840	.387	2.071	3.610
		15 September	4.258	.387	3.488	5.027
	900 PPM	15 Agust	4.343	.387	3.573	5.112
		15 September	7.049	.387	6.279	7.818
Prunellavulgaris	450 PPM	15 Agust	3.056	.336	2.387	3.725
		15 September	4.264	.336	3.595	4.932
	900 PPM	15 Agust	5.447	.336	4.778	6.115
		15 September	7.592	.336	6.924	8.261
Centaureatriumfetii	450 PPM	15 Agust	2.888	.358	2.176	3.599
		15 September	4.647	.358	3.935	5.358
	900 PPM	15 Agust	3.976	.358	3.265	4.688
		15 September	6.921	.358	6.210	7.633
Salviapratense	450 PPM	15 Agust	3.624	.392	2.843	4.404
		15 September	4.723	.392	3.943	5.503
	900 PPM	15 Agust	4.854	.392	4.073	5.634
		15 September	6.572	.392	5.791	7.352
Asphodelinelutea	450 PPM	15 Agust	4.170	.277	3.618	4.722
		15 September	5.696	.277	5.144	6.248
	900 PPM	15 Agust	4.870	.277	4.318	5.422
		15 September	8.618	.277	8.066	9.170
Bupthalmumsalicifolium	450 PPM	15 Agust	4.691	.182	4.328	5.054
		15 September	5.826	.182	5.463	6.189
	900 PPM	15 Agust	5.277	.182	4.914	5.640
		15 September	8.947	.182	8.584	9.310
Dianthuscarthusianorum	450 PPM	15 Agust	4.592	.289	4.017	5.167
		15 September	5.615	.289	5.040	6.190
	900 PPM	15 Agust	5.032	.289	4.457	5.607
		15 September	8.839	.289	8.264	9.414
Linumflavumcompactum	450 PPM	15 Agust	4.626	.168	4.291	4.960
		15 September	5.559	.168	5.224	5.893
	900 PPM	15 Agust	5.498	.168	5.164	5.833
		15 September	8.719	.168	8.384	9.053
Lychniscoronaria	450 PPM	15 Agust	4.310	.246	3.819	4.800
		15 September	5.720	.246	5.230	6.211
	900 PPM	15 Agust	4.940	.246	4.449	5.430
		15 September	8.487	.246	7.997	8.977
Salvianemorosa	450 PPM	15 Agust	4.890	.251	4.389	5.390
		15 September	5.357	.251	4.857	5.857
	900 PPM	15 Agust	4.966	.251	4.466	5.466
		15 September	8.078	.251	7.578	8.578
Asclepiastuberosa	450 PPM	15 Agust	4.031	.223	3.587	4.474
		15 September	4.112	.223	3.669	4.555

Pairwise Comparisons

Dependent Variable	Co2Level	(I) Harvesttime	(J) Harvesttime	Mean Difference (I-J)	Std. Error	Sig.[b]
Centaureamontana	450 PPM	15 Agust	15 September	-1.816*	.568	.002
		15 September	15 Agust	1.816*	.568	.002
	900 PPM	15 Agust	15 September	-3.791*	.568	.000
		15 September	15 Agust	3.791*	.568	.000
GaliumVerum	450 PPM	15 Agust	15 September	-.647	.368	.083
		15 September	15 Agust	.647	.368	.083
	900 PPM	15 Agust	15 September	-2.089*	.368	.000
		15 September	15 Agust	2.089*	.368	.000
Scabiosacaucasica	450 PPM	15 Agust	15 September	-1.418*	.547	.011
		15 September	15 Agust	1.418*	.547	.011
	900 PPM	15 Agust	15 September	-2.706*	.547	.000
		15 September	15 Agust	2.706*	.547	.000
Prunellavulgaris	450 PPM	15 Agust	15 September	-1.208*	.475	.013
		15 September	15 Agust	1.208*	.475	.013
	900 PPM	15 Agust	15 September	-2.146*	.475	.000
		15 September	15 Agust	2.146*	.475	.000
Centaureatriumfetii	450 PPM	15 Agust	15 September	-1.759*	.506	.001
		15 September	15 Agust	1.759*	.506	.001
	900 PPM	15 Agust	15 September	-2.945*	.506	.000
		15 September	15 Agust	2.945*	.506	.000
Salviapratense	450 PPM	15 Agust	15 September	-1.099	.555	.051
		15 September	15 Agust	1.099	.555	.051
	900 PPM	15 Agust	15 September	-1.718*	.555	.003
		15 September	15 Agust	1.718*	.555	.003
Asphodelinelutea	450 PPM	15 Agust	15 September	-1.526*	.392	.000
		15 September	15 Agust	1.526*	.392	.000
	900 PPM	15 Agust	15 September	-3.748*	.392	.000
		15 September	15 Agust	3.748*	.392	.000
Bupthalmumsalicifolium	450 PPM	15 Agust	15 September	-1.135*	.258	.000
		15 September	15 Agust	1.135*	.258	.000
	900 PPM	15 Agust	15 September	-3.670*	.258	.000
		15 September	15 Agust	3.670*	.258	.000
Dianthuscarthusianorum	450 PPM	15 Agust	15 September	-1.024*	.409	.014
		15 September	15 Agust	1.024*	.409	.014
	900 PPM	15 Agust	15 September	-3.807*	.409	.000
		15 September	15 Agust	3.807*	.409	.000
Linumflavumcompactum	450 PPM	15 Agust	15 September	-.933*	.238	.000
		15 September	15 Agust	.933*	.238	.000
	900 PPM	15 Agust	15 September	-3.220*	.238	.000
		15 September	15 Agust	3.220*	.238	.000
Lychniscoronaria	450 PPM	15 Agust	15 September	-1.411*	.349	.000
		15 September	15 Agust	1.411*	.349	.000
	900 PPM	15 Agust	15 September	-3.548*	.349	.000
		15 September	15 Agust	3.548*	.349	.000
Salvianemorosa	450 PPM	15 Agust	15 September	-.467	.355	.192
		15 September	15 Agust	.467	.355	.192
	900 PPM	15 Agust	15 September	-3.112*	.355	.000
		15 September	15 Agust	3.112*	.355	.000
Asclepiastuberosa	450 PPM	15 Agust	15 September	-.081	.315	.797

Estimates

Dependent Variable	Co2Level	Temperature	Mean	Std. Error	95% Confidence Interval	
					Lower Bound	Upper Bound
Centaureamontana	450 PPM	20 C	3.515	.402	2.715	4.315
		24 C	2.740	.402	1.941	3.540
	900 PPM	20 C	4.908	.402	4.108	5.707
		24 C	5.388	.402	4.589	6.188
GaliumVerum	450 PPM	20 C	4.700	.260	4.182	5.218
		24 C	3.969	.260	3.450	4.487
	900 PPM	20 C	5.977	.260	5.459	6.496
		24 C	6.929	.260	6.411	7.447
Scabiosacaucasica	450 PPM	20 C	4.379	.387	3.610	5.149
		24 C	2.719	.387	1.950	3.489
	900 PPM	20 C	5.642	.387	4.873	6.412
		24 C	5.749	.387	4.980	6.519
Prunellavulgaris	450 PPM	20 C	3.958	.336	3.289	4.626
		24 C	3.362	.336	2.693	4.031
	900 PPM	20 C	5.960	.336	5.292	6.629
		24 C	7.079	.336	6.410	7.747
Centaureatriumfetii	450 PPM	20 C	4.473	.358	3.761	5.184
		24 C	3.062	.358	2.351	3.774
	900 PPM	20 C	4.583	.358	3.871	5.294
		24 C	6.315	.358	5.603	7.026
Salviapratense	450 PPM	20 C	4.281	.392	3.500	5.061
		24 C	4.066	.392	3.285	4.846
	900 PPM	20 C	4.961	.392	4.181	5.741
		24 C	6.465	.392	5.684	7.245
Asphodelinelutea	450 PPM	20 C	4.908	.277	4.356	5.460
		24 C	4.958	.277	4.406	5.510
	900 PPM	20 C	6.335	.277	5.783	6.886
		24 C	7.154	.277	6.602	7.705
Bupthalmumsalicifolium	450 PPM	20 C	5.207	.182	4.844	5.570
		24 C	5.311	.182	4.948	5.673
	900 PPM	20 C	6.430	.182	6.067	6.792
		24 C	7.794	.182	7.431	8.157
Dianthuscarthusianorum	450 PPM	20 C	4.944	.289	4.369	5.519
		24 C	5.263	.289	4.688	5.838
	900 PPM	20 C	6.445	.289	5.870	7.020
		24 C	7.426	.289	6.851	8.001
Linumflavumcompactum	450 PPM	20 C	5.004	.168	4.670	5.338
		24 C	5.180	.168	4.846	5.515
	900 PPM	20 C	6.613	.168	6.279	6.947
		24 C	7.604	.168	7.270	7.938
Lychniscoronaria	450 PPM	20 C	4.776	.246	4.286	5.266
		24 C	5.254	.246	4.764	5.744
	900 PPM	20 C	6.192	.246	5.702	6.683
		24 C	7.234	.246	6.744	7.725
Salvianemorosa	450 PPM	20 C	5.141	.251	4.641	5.641
		24 C	5.105	.251	4.605	5.605
	900 PPM	20 C	5.978	.251	5.478	6.478
		24 C	7.066	.251	6.566	7.566
Asclepiastuberosa	450 PPM	20 C	3.100	.223	2.657	3.543
		24 C	5.042	.223	4.599	5.485

Pairwise Comparisons

Dependent Variable	Temperature	(I) Co2Level	(J) Co2Level	Mean Difference (I-J)	Std. Error	Sig.[b]
Centaureamontana	20 C	450 PPM	900 PPM	-1.393*	.568	.016
		900 PPM	450 PPM	1.393*	.568	.016
	24 C	450 PPM	900 PPM	-2.648*	.568	.000
		900 PPM	450 PPM	2.648*	.568	.000
GaliumVerum	20 C	450 PPM	900 PPM	-1.277*	.368	.001
		900 PPM	450 PPM	1.277*	.368	.001
	24 C	450 PPM	900 PPM	-2.960*	.368	.000
		900 PPM	450 PPM	2.960*	.368	.000
Scabiosacaucasica	20 C	450 PPM	900 PPM	-1.263*	.547	.023
		900 PPM	450 PPM	1.263*	.547	.023
	24 C	450 PPM	900 PPM	-3.030*	.547	.000
		900 PPM	450 PPM	3.030*	.547	.000
Prunellavulgaris	20 C	450 PPM	900 PPM	-2.003*	.475	.000
		900 PPM	450 PPM	2.003*	.475	.000
	24 C	450 PPM	900 PPM	-3.717*	.475	.000
		900 PPM	450 PPM	3.717*	.475	.000
Centaureatriumfetii	20 C	450 PPM	900 PPM	-.110	.506	.828
		900 PPM	450 PPM	.110	.506	.828
	24 C	450 PPM	900 PPM	-3.252*	.506	.000
		900 PPM	450 PPM	3.252*	.506	.000
Salviapratense	20 C	450 PPM	900 PPM	-.680	.555	.224
		900 PPM	450 PPM	.680	.555	.224
	24 C	450 PPM	900 PPM	-2.399*	.555	.000
		900 PPM	450 PPM	2.399*	.555	.000
Asphodelinelutea	20 C	450 PPM	900 PPM	-1.427*	.392	.000
		900 PPM	450 PPM	1.427*	.392	.000
	24 C	450 PPM	900 PPM	-2.196*	.392	.000
		900 PPM	450 PPM	2.196*	.392	.000
Bupthalmumsalicifolium	20 C	450 PPM	900 PPM	-1.223*	.258	.000
		900 PPM	450 PPM	1.223*	.258	.000
	24 C	450 PPM	900 PPM	-2.484*	.258	.000
		900 PPM	450 PPM	2.484*	.258	.000
Dianthuscarthusianorum	20 C	450 PPM	900 PPM	-1.501*	.409	.000
		900 PPM	450 PPM	1.501*	.409	.000
	24 C	450 PPM	900 PPM	-2.163*	.409	.000
		900 PPM	450 PPM	2.163*	.409	.000
Linumflavumcompactum	20 C	450 PPM	900 PPM	-1.609*	.238	.000
		900 PPM	450 PPM	1.609*	.238	.000
	24 C	450 PPM	900 PPM	-2.424*	.238	.000
		900 PPM	450 PPM	2.424*	.238	.000
Lychniscoronaria	20 C	450 PPM	900 PPM	-1.416*	.349	.000
		900 PPM	450 PPM	1.416*	.349	.000
	24 C	450 PPM	900 PPM	-1.980*	.349	.000
		900 PPM	450 PPM	1.980*	.349	.000
Salvianemorosa	20 C	450 PPM	900 PPM	-.837*	.355	.021
		900 PPM	450 PPM	.837*	.355	.021
	24 C	450 PPM	900 PPM	-1.961*	.355	.000
		900 PPM	450 PPM	1.961*	.355	.000
Asclepiastuberosa	20 C	450 PPM	900 PPM	-2.724*	.315	.000

Pairwise Comparisons

Dependent Variable	Co2Level	(I) Temperature	(J) Temperature	Mean Difference (I-J)	Std. Error	Sig.[b]
Centaureamontana	450 PPM	20 C	24 C	.775	.568	.177
		24 C	20 C	-.775	.568	.177
	900 PPM	20 C	24 C	-.481	.568	.400
		24 C	20 C	.481	.568	.400
GaliumVerum	450 PPM	20 C	24 C	.731	.368	.050
		24 C	20 C	-.731	.368	.050
	900 PPM	20 C	24 C	-.951*	.368	.012
		24 C	20 C	.951*	.368	.012
Scabiosacaucasica	450 PPM	20 C	24 C	1.660*	.547	.003
		24 C	20 C	-1.660*	.547	.003
	900 PPM	20 C	24 C	-.107	.547	.845
		24 C	20 C	.107	.547	.845
Prunellavulgaris	450 PPM	20 C	24 C	.595	.475	.214
		24 C	20 C	-.595	.475	.214
	900 PPM	20 C	24 C	-1.118*	.475	.021
		24 C	20 C	1.118*	.475	.021
Centaureatriumfetii	450 PPM	20 C	24 C	1.410*	.506	.007
		24 C	20 C	-1.410*	.506	.007
	900 PPM	20 C	24 C	-1.732*	.506	.001
		24 C	20 C	1.732*	.506	.001
Salviapratense	450 PPM	20 C	24 C	.215	.555	.699
		24 C	20 C	-.215	.555	.699
	900 PPM	20 C	24 C	-1.504*	.555	.008
		24 C	20 C	1.504*	.555	.008
Asphodelinelutea	450 PPM	20 C	24 C	-.050	.392	.899
		24 C	20 C	.050	.392	.899
	900 PPM	20 C	24 C	-.819*	.392	.040
		24 C	20 C	.819*	.392	.040
Bupthalmumsalicifolium	450 PPM	20 C	24 C	-.103	.258	.689
		24 C	20 C	.103	.258	.689
	900 PPM	20 C	24 C	-1.365*	.258	.000
		24 C	20 C	1.365*	.258	.000
Dianthuscarthusianorum	450 PPM	20 C	24 C	-.319	.409	.437
		24 C	20 C	.319	.409	.437
	900 PPM	20 C	24 C	-.980*	.409	.019
		24 C	20 C	.980*	.409	.019
Linumflavumcompactum	450 PPM	20 C	24 C	-.176	.238	.461
		24 C	20 C	.176	.238	.461
	900 PPM	20 C	24 C	-.991*	.238	.000
		24 C	20 C	.991*	.238	.000
Lychniscoronaria	450 PPM	20 C	24 C	-.478	.349	.174
		24 C	20 C	.478	.349	.174
	900 PPM	20 C	24 C	-1.042*	.349	.004
		24 C	20 C	1.042*	.349	.004
Salvianemorosa	450 PPM	20 C	24 C	.036	.355	.920
		24 C	20 C	-.036	.355	.920
	900 PPM	20 C	24 C	-1.089*	.355	.003
		24 C	20 C	1.089*	.355	.003
Asclepiastuberosa	450 PPM	20 C	24 C	-1.942*	.315	.000

Estimates

Dependent Variable	Co2Level	WaterRegim	Mean	Std. Error	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
Centaureamontana	450 PPM	Ambient-50%	.291	.492	-.689	1.270
		Ambient	4.178	.492	3.198	5.157
		Ambient+50%	4.915	.492	3.936	5.894
	900 PPM	Ambient-50%	2.511	.492	1.532	3.490
		Ambient	6.757	.492	5.778	7.736
		Ambient+50%	6.176	.492	5.197	7.155
GaliumVerum	450 PPM	Ambient-50%	1.938	.319	1.303	2.572
		Ambient	5.810	.319	5.175	6.445
		Ambient+50%	5.255	.319	4.620	5.890
	900 PPM	Ambient-50%	5.077	.319	4.443	5.712
		Ambient	7.106	.319	6.471	7.740
		Ambient+50%	7.176	.319	6.542	7.811
Scabiosacaucasica	450 PPM	Ambient-50%	1.630	.474	.688	2.572
		Ambient	4.762	.474	3.819	5.704
		Ambient+50%	4.256	.474	3.313	5.198
	900 PPM	Ambient-50%	2.782	.474	1.840	3.724
		Ambient	7.186	.474	6.244	8.129
		Ambient+50%	7.119	.474	6.176	8.061
Prunellavulgaris	450 PPM	Ambient-50%	2.027	.412	1.208	2.846
		Ambient	5.486	.412	4.667	6.305
		Ambient+50%	3.467	.412	2.648	4.286
	900 PPM	Ambient-50%	5.109	.412	4.290	5.928
		Ambient	7.522	.412	6.703	8.341
		Ambient+50%	6.928	.412	6.109	7.747
Centaureatriumfetii	450 PPM	Ambient-50%	1.581	.438	.709	2.452
		Ambient	5.153	.438	4.282	6.025
		Ambient+50%	4.568	.438	3.697	5.440
	900 PPM	Ambient-50%	2.103	.438	1.232	2.975
		Ambient	7.302	.438	6.431	8.174
		Ambient+50%	6.941	.438	6.069	7.812
Salviapratense	450 PPM	Ambient-50%	2.234	.480	1.278	3.189
		Ambient	5.208	.480	4.252	6.163
		Ambient+50%	5.079	.480	4.123	6.034
	900 PPM	Ambient-50%	3.523	.480	2.567	4.478
		Ambient	7.279	.480	6.324	8.235
		Ambient+50%	6.336	.480	5.381	7.292
Asphodelinelutea	450 PPM	Ambient-50%	3.593	.340	2.917	4.269
		Ambient	5.375	.340	4.699	6.051
		Ambient+50%	5.831	.340	5.155	6.506
	900 PPM	Ambient-50%	3.986	.340	3.311	4.662
		Ambient	7.954	.340	7.278	8.630
		Ambient+50%	8.292	.340	7.616	8.968
Bupthalmumsalicifolium	450 PPM	Ambient-50%	4.032	.223	3.588	4.476
		Ambient	5.978	.223	5.534	6.423
		Ambient+50%	5.766	.223	5.322	6.211
	900 PPM	Ambient-50%	4.566	.223	4.121	5.010
		Ambient	8.310	.223	7.866	8.755
		Ambient+50%	8.460	.223	8.016	8.905

Pairwise Comparisons

Dependent Variable	WaterRegim	(I) Co2Level	(J) Co2Level	Mean Difference (I-J)	Std. Error	Sig.[b]
Centaureamontana	Ambient-50%	450 PPM	900 PPM	-2.220*	.696	.002
		900 PPM	450 PPM	2.220*	.696	.002
	Ambient	450 PPM	900 PPM	-2.579*	.696	.000
		900 PPM	450 PPM	2.579*	.696	.000
	Ambient+50%	450 PPM	900 PPM	-1.261	.696	.074
		900 PPM	450 PPM	1.261	.696	.074
GaliumVerum	Ambient-50%	450 PPM	900 PPM	-3.139*	.451	.000
		900 PPM	450 PPM	3.139*	.451	.000
	Ambient	450 PPM	900 PPM	-1.296*	.451	.005
		900 PPM	450 PPM	1.296*	.451	.005
	Ambient+50%	450 PPM	900 PPM	-1.921*	.451	.000
		900 PPM	450 PPM	1.921*	.451	.000
Scabiosacaucasica	Ambient-50%	450 PPM	900 PPM	-1.152	.670	.089
		900 PPM	450 PPM	1.152	.670	.089
	Ambient	450 PPM	900 PPM	-2.425*	.670	.001
		900 PPM	450 PPM	2.425*	.670	.001
	Ambient+50%	450 PPM	900 PPM	-2.863*	.670	.000
		900 PPM	450 PPM	2.863*	.670	.000
Prunellavulgaris	Ambient-50%	450 PPM	900 PPM	-3.082*	.582	.000
		900 PPM	450 PPM	3.082*	.582	.000
	Ambient	450 PPM	900 PPM	-2.036*	.582	.001
		900 PPM	450 PPM	2.036*	.582	.001
	Ambient+50%	450 PPM	900 PPM	-3.461*	.582	.000
		900 PPM	450 PPM	3.461*	.582	.000
Centaureatriumfetii	Ambient-50%	450 PPM	900 PPM	-.523	.619	.401
		900 PPM	450 PPM	.523	.619	.401
	Ambient	450 PPM	900 PPM	-2.149*	.619	.001
		900 PPM	450 PPM	2.149*	.619	.001
	Ambient+50%	450 PPM	900 PPM	-2.373*	.619	.000
		900 PPM	450 PPM	2.373*	.619	.000
Salviapratense	Ambient-50%	450 PPM	900 PPM	-1.289	.679	.061
		900 PPM	450 PPM	1.289	.679	.061
	Ambient	450 PPM	900 PPM	-2.072*	.679	.003
		900 PPM	450 PPM	2.072*	.679	.003
	Ambient+50%	450 PPM	900 PPM	-1.258	.679	.068
		900 PPM	450 PPM	1.258	.679	.068
Asphodelinelutea	Ambient-50%	450 PPM	900 PPM	-.393	.480	.415
		900 PPM	450 PPM	.393	.480	.415
	Ambient	450 PPM	900 PPM	-2.579*	.480	.000
		900 PPM	450 PPM	2.579*	.480	.000
	Ambient+50%	450 PPM	900 PPM	-2.461*	.480	.000
		900 PPM	450 PPM	2.461*	.480	.000
Bupthalmumsalicifolium	Ambient-50%	450 PPM	900 PPM	-.534	.316	.095
		900 PPM	450 PPM	.534	.316	.095
	Ambient	450 PPM	900 PPM	-2.332*	.316	.000
		900 PPM	450 PPM	2.332*	.316	.000
	Ambient+50%	450 PPM	900 PPM	-2.694*	.316	.000
		900 PPM	450 PPM	2.694*	.316	.000
Dianthuscarthusianorum	Ambient-50%	450 PPM	900 PPM	.179	.500	.722

Estimates

Dependent Variable	Co2Level	WaterRegim	Mean	Std. Error	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
Centaureamontana	450 PPM	Ambient-50%	.291	.492	-.689	1.270
		Ambient	4.178	.492	3.198	5.157
		Ambient+50%	4.915	.492	3.936	5.894
	900 PPM	Ambient-50%	2.511	.492	1.532	3.490
		Ambient	6.757	.492	5.778	7.736
		Ambient+50%	6.176	.492	5.197	7.155
GaliumVerum	450 PPM	Ambient-50%	1.938	.319	1.303	2.572
		Ambient	5.810	.319	5.175	6.445
		Ambient+50%	5.255	.319	4.620	5.890
	900 PPM	Ambient-50%	5.077	.319	4.443	5.712
		Ambient	7.106	.319	6.471	7.740
		Ambient+50%	7.176	.319	6.542	7.811
Scabiosacaucasica	450 PPM	Ambient-50%	1.630	.474	.688	2.572
		Ambient	4.762	.474	3.819	5.704
		Ambient+50%	4.256	.474	3.313	5.198
	900 PPM	Ambient-50%	2.782	.474	1.840	3.724
		Ambient	7.186	.474	6.244	8.129
		Ambient+50%	7.119	.474	6.176	8.061
Prunellavulgaris	450 PPM	Ambient-50%	2.027	.412	1.208	2.846
		Ambient	5.486	.412	4.667	6.305
		Ambient+50%	3.467	.412	2.648	4.286
	900 PPM	Ambient-50%	5.109	.412	4.290	5.928
		Ambient	7.522	.412	6.703	8.341
		Ambient+50%	6.928	.412	6.109	7.747
Centaureatriumfetii	450 PPM	Ambient-50%	1.581	.438	.709	2.452
		Ambient	5.153	.438	4.282	6.025
		Ambient+50%	4.568	.438	3.697	5.440
	900 PPM	Ambient-50%	2.103	.438	1.232	2.975
		Ambient	7.302	.438	6.431	8.174
		Ambient+50%	6.941	.438	6.069	7.812
Salviapratense	450 PPM	Ambient-50%	2.234	.480	1.278	3.189
		Ambient	5.208	.480	4.252	6.163
		Ambient+50%	5.079	.480	4.123	6.034
	900 PPM	Ambient-50%	3.523	.480	2.567	4.478
		Ambient	7.279	.480	6.324	8.235
		Ambient+50%	6.336	.480	5.381	7.292
Asphodelinelutea	450 PPM	Ambient-50%	3.593	.340	2.917	4.269
		Ambient	5.375	.340	4.699	6.051
		Ambient+50%	5.831	.340	5.155	6.506
	900 PPM	Ambient-50%	3.986	.340	3.311	4.662
		Ambient	7.954	.340	7.278	8.630
		Ambient+50%	8.292	.340	7.616	8.968
Bupthalmumsalicifolium	450 PPM	Ambient-50%	4.032	.223	3.588	4.476
		Ambient	5.978	.223	5.534	6.423
		Ambient+50%	5.766	.223	5.322	6.211
	900 PPM	Ambient-50%	4.566	.223	4.121	5.010
		Ambient	8.310	.223	7.866	8.755
		Ambient+50%	8.460	.223	8.016	8.905

Pairwise Comparisons

Dependent Variable	Co2Level	(I) WaterRegim	(J) WaterRegim	Mean Difference (I-J)	Std. Error	Sig.[b]
Centaureamontana	450 PPM	Ambient-50%	Ambient	-3.887*	.696	.000
			Ambient+50%	-4.624*	.696	.000
		Ambient	Ambient-50%	3.887*	.696	.000
			Ambient+50%	-.738	.696	.646
		Ambient+50%	Ambient-50%	4.624*	.696	.000
			Ambient	.738	.696	.646
	900 PPM	Ambient-50%	Ambient	-4.246*	.696	.000
			Ambient+50%	-3.665*	.696	.000
		Ambient	Ambient-50%	4.246*	.696	.000
			Ambient+50%	.581	.696	.791
		Ambient+50%	Ambient-50%	3.665*	.696	.000
			Ambient	-.581	.696	.791
GaliumVerum	450 PPM	Ambient-50%	Ambient	-3.872*	.451	.000
			Ambient+50%	-3.317*	.451	.000
		Ambient	Ambient-50%	3.872*	.451	.000
			Ambient+50%	.555	.451	.529
		Ambient+50%	Ambient-50%	3.317*	.451	.000
			Ambient	-.555	.451	.529
	900 PPM	Ambient-50%	Ambient	-2.028*	.451	.000
			Ambient+50%	-2.099*	.451	.000
		Ambient	Ambient-50%	2.028*	.451	.000
			Ambient+50%	-.071	.451	.998
		Ambient+50%	Ambient-50%	2.099*	.451	.000
			Ambient	.071	.451	.998
Scabiosacaucasica	450 PPM	Ambient-50%	Ambient	-3.132*	.670	.000
			Ambient+50%	-2.626*	.670	.001
		Ambient	Ambient-50%	3.132*	.670	.000
			Ambient+50%	.506	.670	.835
		Ambient+50%	Ambient-50%	2.626*	.670	.001
			Ambient	-.506	.670	.835
	900 PPM	Ambient-50%	Ambient	-4.404*	.670	.000
			Ambient+50%	-4.337*	.670	.000
		Ambient	Ambient-50%	4.404*	.670	.000
			Ambient+50%	.068	.670	.999
		Ambient+50%	Ambient-50%	4.337*	.670	.000
			Ambient	-.068	.670	.999
Prunellavulgaris	450 PPM	Ambient-50%	Ambient	-3.459*	.582	.000
			Ambient+50%	-1.440*	.582	.046
		Ambient	Ambient-50%	3.459*	.582	.000
			Ambient+50%	2.019*	.582	.003
		Ambient+50%	Ambient-50%	1.440*	.582	.046
			Ambient	-2.019*	.582	.003
	900 PPM	Ambient-50%	Ambient	-2.413*	.582	.000
			Ambient+50%	-1.819*	.582	.007
		Ambient	Ambient-50%	2.413*	.582	.000
			Ambient+50%	.594	.582	.673
		Ambient+50%	Ambient-50%	1.819*	.582	.007
			Ambient	-.594	.582	.673

Estimates

Dependent Variable	Harvesttime	Temperature	Mean	Std. Error	95% Confidence Interval	
					Lower Bound	Upper Bound
Centaureamontana	15 Agust	20 C	2.688	.402	1.888	3.487
		24 C	2.784	.402	1.985	3.584
	15 September	20 C	5.735	.402	4.935	6.535
		24 C	5.345	.402	4.545	6.144
GaliumVerum	15 Agust	20 C	4.692	.260	4.174	5.210
		24 C	4.727	.260	4.209	5.245
	15 September	20 C	5.985	.260	5.467	6.504
		24 C	6.170	.260	5.652	6.688
Scabiosacaucasica	15 Agust	20 C	4.222	.387	3.453	4.992
		24 C	2.961	.387	2.191	3.730
	15 September	20 C	5.799	.387	5.030	6.569
		24 C	5.508	.387	4.738	6.277
Prunellavulgaris	15 Agust	20 C	4.141	.336	3.472	4.810
		24 C	4.362	.336	3.693	5.031
	15 September	20 C	5.777	.336	5.108	6.446
		24 C	6.079	.336	5.410	6.748
Centaureatriumfetii	15 Agust	20 C	3.549	.358	2.838	4.261
		24 C	3.315	.358	2.603	4.026
	15 September	20 C	5.506	.358	4.795	6.218
		24 C	6.062	.358	5.350	6.773
Salviapratense	15 Agust	20 C	3.769	.392	2.989	4.550
		24 C	4.708	.392	3.928	5.489
	15 September	20 C	5.473	.392	4.692	6.253
		24 C	5.822	.392	5.042	6.602
Asphodelinelutea	15 Agust	20 C	4.548	.277	3.996	5.099
		24 C	4.492	.277	3.941	5.044
	15 September	20 C	6.695	.277	6.143	7.247
		24 C	7.619	.277	7.067	8.171
Bupthalmumsalicifolium	15 Agust	20 C	4.581	.182	4.218	4.944
		24 C	5.387	.182	5.024	5.750
	15 September	20 C	7.056	.182	6.693	7.418
		24 C	7.718	.182	7.355	8.080
Dianthuscarthusianorum	15 Agust	20 C	4.673	.289	4.098	5.248
		24 C	4.950	.289	4.375	5.525
	15 September	20 C	6.716	.289	6.141	7.291
		24 C	7.738	.289	7.163	8.313
Linumflavumcompactum	15 Agust	20 C	4.723	.168	4.389	5.057
		24 C	5.401	.168	5.067	5.735
	15 September	20 C	6.894	.168	6.560	7.228
		24 C	7.383	.168	7.049	7.718
Lychniscoronaria	15 Agust	20 C	4.473	.246	3.982	4.963
		24 C	4.777	.246	4.286	5.267
	15 September	20 C	6.496	.246	6.006	6.986
		24 C	7.712	.246	7.221	8.202
Salvianemorosa	15 Agust	20 C	5.010	.251	4.510	5.510
		24 C	4.846	.251	4.345	5.346
	15 September	20 C	6.109	.251	5.609	6.609
		24 C	7.326	.251	6.826	7.826
Asclepiastuberosa	15 Agust	20 C	4.129	.223	3.686	4.572
		24 C	5.087	.223	4.644	5.530

Pairwise Comparisons

Dependent Variable	Temperature	(I) Harvesttime	(J) Harvesttime	Mean Difference (I-J)	Std. Error	Sig.[b]
Centaureamontana	20 C	15 Agust	15 September	-3.047*	.568	.000
		15 September	15 Agust	3.047*	.568	.000
	24 C	15 Agust	15 September	-2.560*	.568	.000
		15 September	15 Agust	2.560*	.568	.000
GaliumVerum	20 C	15 Agust	15 September	-1.294*	.368	.001
		15 September	15 Agust	1.294*	.368	.001
	24 C	15 Agust	15 September	-1.443*	.368	.000
		15 September	15 Agust	1.443*	.368	.000
Scabiosacaucasica	20 C	15 Agust	15 September	-1.577*	.547	.005
		15 September	15 Agust	1.577*	.547	.005
	24 C	15 Agust	15 September	-2.547*	.547	.000
		15 September	15 Agust	2.547*	.547	.000
Prunellavulgaris	20 C	15 Agust	15 September	-1.636*	.475	.001
		15 September	15 Agust	1.636*	.475	.001
	24 C	15 Agust	15 September	-1.717*	.475	.001
		15 September	15 Agust	1.717*	.475	.001
Centaureatriumfetii	20 C	15 Agust	15 September	-1.957*	.506	.000
		15 September	15 Agust	1.957*	.506	.000
	24 C	15 Agust	15 September	-2.747*	.506	.000
		15 September	15 Agust	2.747*	.506	.000
Salviapratense	20 C	15 Agust	15 September	-1.703*	.555	.003
		15 September	15 Agust	1.703*	.555	.003
	24 C	15 Agust	15 September	-1.114*	.555	.048
		15 September	15 Agust	1.114*	.555	.048
Asphodelinelutea	20 C	15 Agust	15 September	-2.147*	.392	.000
		15 September	15 Agust	2.147*	.392	.000
	24 C	15 Agust	15 September	-3.127*	.392	.000
		15 September	15 Agust	3.127*	.392	.000
Bupthalmumsalicifolium	20 C	15 Agust	15 September	-2.474*	.258	.000
		15 September	15 Agust	2.474*	.258	.000
	24 C	15 Agust	15 September	-2.330*	.258	.000
		15 September	15 Agust	2.330*	.258	.000
Dianthuscarthusianorum	20 C	15 Agust	15 September	-2.043*	.409	.000
		15 September	15 Agust	2.043*	.409	.000
	24 C	15 Agust	15 September	-2.788*	.409	.000
		15 September	15 Agust	2.788*	.409	.000
Linumflavumcompactum	20 C	15 Agust	15 September	-2.171*	.238	.000
		15 September	15 Agust	2.171*	.238	.000
	24 C	15 Agust	15 September	-1.982*	.238	.000
		15 September	15 Agust	1.982*	.238	.000
Lychniscoronaria	20 C	15 Agust	15 September	-2.023*	.349	.000
		15 September	15 Agust	2.023*	.349	.000
	24 C	15 Agust	15 September	-2.935*	.349	.000
		15 September	15 Agust	2.935*	.349	.000
Salvianemorosa	20 C	15 Agust	15 September	-1.099*	.355	.003
		15 September	15 Agust	1.099*	.355	.003
	24 C	15 Agust	15 September	-2.480*	.355	.000
		15 September	15 Agust	2.480*	.355	.000
Asclepiastuberosa	20 C	15 Agust	15 September	-.666*	.315	.038

Pairwise Comparisons

Dependent Variable	WaterRegim	(I) Harvesttime	(J) Harvesttime	Mean Difference (I-J)	Std. Error	Sig.[b]
Centaureamontana	Ambient-50%	15 Agust	15 September	-1.273	.696	.071
		15 September	15 Agust	1.273	.696	.071
	Ambient	15 Agust	15 September	-3.152*	.696	.000
		15 September	15 Agust	3.152*	.696	.000
	Ambient+50%	15 Agust	15 September	-3.986*	.696	.000
		15 September	15 Agust	3.986*	.696	.000
GaliumVerum	Ambient-50%	15 Agust	15 September	.980*	.451	.033
		15 September	15 Agust	-.980*	.451	.033
	Ambient	15 Agust	15 September	-2.718*	.451	.000
		15 September	15 Agust	2.718*	.451	.000
	Ambient+50%	15 Agust	15 September	-2.366*	.451	.000
		15 September	15 Agust	2.366*	.451	.000
Scabiosacaucasica	Ambient-50%	15 Agust	15 September	-.422	.670	.531
		15 September	15 Agust	.422	.670	.531
	Ambient	15 Agust	15 September	-3.122*	.670	.000
		15 September	15 Agust	3.122*	.670	.000
	Ambient+50%	15 Agust	15 September	-2.642*	.670	.000
		15 September	15 Agust	2.642*	.670	.000
Prunellavulgaris	Ambient-50%	15 Agust	15 September	.961	.582	.102
		15 September	15 Agust	-.961	.582	.102
	Ambient	15 Agust	15 September	-2.999*	.582	.000
		15 September	15 Agust	2.999*	.582	.000
	Ambient+50%	15 Agust	15 September	-2.993*	.582	.000
		15 September	15 Agust	2.993*	.582	.000
Centaureatriumfetii	Ambient-50%	15 Agust	15 September	-1.083	.619	.084
		15 September	15 Agust	1.083	.619	.084
	Ambient	15 Agust	15 September	-3.290*	.619	.000
		15 September	15 Agust	3.290*	.619	.000
	Ambient+50%	15 Agust	15 September	-2.684*	.619	.000
		15 September	15 Agust	2.684*	.619	.000
Salviapratense	Ambient-50%	15 Agust	15 September	.805	.679	.240
		15 September	15 Agust	-.805	.679	.240
	Ambient	15 Agust	15 September	-3.214*	.679	.000
		15 September	15 Agust	3.214*	.679	.000
	Ambient+50%	15 Agust	15 September	-1.816*	.679	.009
		15 September	15 Agust	1.816*	.679	.009
Asphodelinelutea	Ambient-50%	15 Agust	15 September	-.490	.480	.311
		15 September	15 Agust	.490	.480	.311
	Ambient	15 Agust	15 September	-4.211*	.480	.000
		15 September	15 Agust	4.211*	.480	.000
	Ambient+50%	15 Agust	15 September	-3.210*	.480	.000
		15 September	15 Agust	3.210*	.480	.000
Bupthalmumsalicifolium	Ambient-50%	15 Agust	15 September	.234	.316	.460
		15 September	15 Agust	-.234	.316	.460
	Ambient	15 Agust	15 September	-3.939*	.316	.000
		15 September	15 Agust	3.939*	.316	.000
	Ambient+50%	15 Agust	15 September	-3.502*	.316	.000
		15 September	15 Agust	3.502*	.316	.000
Dianthuscarthusianorum	Ambient-50%	15 Agust	15 September	.258	.500	.608

Estimates

Dependent Variable	Harvesttime	WaterRegim	Mean	Std. Error	95% Confidence Interval	
					Lower Bound	Upper Bound
Centaureamontana	15 Agust	Ambient-50%	.764	.492	-.215	1.743
		Ambient	3.891	.492	2.912	4.870
		Ambient+50%	3.553	.492	2.573	4.532
	15 September	Ambient-50%	2.038	.492	1.058	3.017
		Ambient	7.043	.492	6.064	8.022
		Ambient+50%	7.539	.492	6.560	8.518
GaliumVerum	15 Agust	Ambient-50%	3.998	.319	3.363	4.632
		Ambient	5.099	.319	4.464	5.733
		Ambient+50%	5.033	.319	4.398	5.667
	15 September	Ambient-50%	3.018	.319	2.383	3.652
		Ambient	7.817	.319	7.182	8.452
		Ambient+50%	7.399	.319	6.764	8.033
Scabiosacaucasica	15 Agust	Ambient-50%	1.995	.474	1.053	2.938
		Ambient	4.413	.474	3.471	5.356
		Ambient+50%	4.366	.474	3.424	5.309
	15 September	Ambient-50%	2.417	.474	1.474	3.359
		Ambient	7.535	.474	6.593	8.477
		Ambient+50%	7.008	.474	6.066	7.951
Prunellavulgaris	15 Agust	Ambient-50%	4.049	.412	3.230	4.868
		Ambient	5.004	.412	4.185	5.823
		Ambient+50%	3.701	.412	2.882	4.520
	15 September	Ambient-50%	3.087	.412	2.268	3.906
		Ambient	8.003	.412	7.184	8.822
		Ambient+50%	6.694	.412	5.875	7.513
Centaureatriumfetii	15 Agust	Ambient-50%	1.301	.438	.429	2.172
		Ambient	4.583	.438	3.712	5.454
		Ambient+50%	4.413	.438	3.541	5.284
	15 September	Ambient-50%	2.383	.438	1.512	3.255
		Ambient	7.873	.438	7.001	8.744
		Ambient+50%	7.096	.438	6.225	7.968
Salviapratense	15 Agust	Ambient-50%	3.281	.480	2.325	4.236
		Ambient	4.636	.480	3.681	5.592
		Ambient+50%	4.799	.480	3.844	5.755
	15 September	Ambient-50%	2.476	.480	1.520	3.431
		Ambient	7.851	.480	6.895	8.806
		Ambient+50%	6.616	.480	5.660	7.571
Asphodelinelutea	15 Agust	Ambient-50%	3.545	.340	2.869	4.220
		Ambient	4.559	.340	3.883	5.235
		Ambient+50%	5.456	.340	4.781	6.132
	15 September	Ambient-50%	4.035	.340	3.359	4.710
		Ambient	8.770	.340	8.094	9.446
		Ambient+50%	8.666	.340	7.991	9.342
Bupthalmumsalicifolium	15 Agust	Ambient-50%	4.416	.223	3.971	4.860
		Ambient	5.175	.223	4.730	5.619
		Ambient+50%	5.362	.223	4.918	5.807
	15 September	Ambient-50%	4.182	.223	3.737	4.626
		Ambient	9.114	.223	8.669	9.558
		Ambient+50%	8.864	.223	8.420	9.309

Estimates

Dependent Variable	Temperature	WaterRegim	Mean	Std. Error	95% Confidence Interval	
					Lower Bound	Upper Bound
Centaureamontana	20 C	Ambient-50%	1.646	.492	.667	2.625
		Ambient	6.153	.492	5.174	7.132
		Ambient+50%	4.835	.492	3.856	5.814
	24 C	Ambient-50%	1.156	.492	.176	2.135
		Ambient	4.781	.492	3.802	5.760
		Ambient+50%	6.256	.492	5.277	7.235
GaliumVerum	20 C	Ambient-50%	3.930	.319	3.296	4.565
		Ambient	6.631	.319	5.997	7.266
		Ambient+50%	5.454	.319	4.820	6.089
	24 C	Ambient-50%	3.085	.319	2.450	3.719
		Ambient	6.284	.319	5.650	6.919
		Ambient+50%	6.977	.319	6.342	7.611
Scabiosacaucasica	20 C	Ambient-50%	3.408	.474	2.465	4.350
		Ambient	6.638	.474	5.696	7.581
		Ambient+50%	4.986	.474	4.044	5.929
	24 C	Ambient-50%	1.004	.474	.062	1.947
		Ambient	5.310	.474	4.368	6.253
		Ambient+50%	6.388	.474	5.446	7.331
Prunellavulgaris	20 C	Ambient-50%	3.580	.412	2.761	4.399
		Ambient	6.686	.412	5.867	7.505
		Ambient+50%	4.611	.412	3.792	5.430
	24 C	Ambient-50%	3.556	.412	2.737	4.375
		Ambient	6.322	.412	5.503	7.141
		Ambient+50%	5.784	.412	4.965	6.603
Centaureatriumfetii	20 C	Ambient-50%	1.850	.438	.979	2.721
		Ambient	6.405	.438	5.534	7.276
		Ambient+50%	5.328	.438	4.457	6.200
	24 C	Ambient-50%	1.834	.438	.962	2.705
		Ambient	6.051	.438	5.179	6.922
		Ambient+50%	6.181	.438	5.309	7.052
Salviapratense	20 C	Ambient-50%	3.019	.480	2.063	3.975
		Ambient	6.411	.480	5.456	7.367
		Ambient+50%	4.433	.480	3.477	5.388
	24 C	Ambient-50%	2.737	.480	1.782	3.693
		Ambient	6.076	.480	5.120	7.031
		Ambient+50%	6.983	.480	6.027	7.938
Asphodelinelutea	20 C	Ambient-50%	3.905	.340	3.229	4.580
		Ambient	6.453	.340	5.777	7.129
		Ambient+50%	6.506	.340	5.831	7.182
	24 C	Ambient-50%	3.675	.340	2.999	4.351
		Ambient	6.876	.340	6.201	7.552
		Ambient+50%	7.616	.340	6.941	8.292
Bupthalmumsalicifolium	20 C	Ambient-50%	3.936	.223	3.492	4.380
		Ambient	7.074	.223	6.630	7.518
		Ambient+50%	6.445	.223	6.001	6.890
	24 C	Ambient-50%	4.662	.223	4.217	5.106
		Ambient	7.214	.223	6.770	7.659
		Ambient+50%	7.781	.223	7.337	8.226

Pairwise Comparisons

Dependent Variable	WaterRegim	(I) Temperature	(J) Temperature	Mean Difference (I-J)	Std. Error	Sig.[b]
Centaureamontana	Ambient-50%	20 C	24 C	.490	.696	.483
		24 C	20 C	-.490	.696	.483
	Ambient	20 C	24 C	1.372	.696	.052
		24 C	20 C	-1.372	.696	.052
	Ambient+50%	20 C	24 C	-1.421*	.696	.044
		24 C	20 C	1.421*	.696	.044
GaliumVerum	Ambient-50%	20 C	24 C	.846	.451	.064
		24 C	20 C	-.846	.451	.064
	Ambient	20 C	24 C	.347	.451	.444
		24 C	20 C	-.347	.451	.444
	Ambient+50%	20 C	24 C	-1.523*	.451	.001
		24 C	20 C	1.523*	.451	.001
Scabiosacaucasica	Ambient-50%	20 C	24 C	2.403*	.670	.001
		24 C	20 C	-2.403*	.670	.001
	Ambient	20 C	24 C	1.328	.670	.051
		24 C	20 C	-1.328	.670	.051
	Ambient+50%	20 C	24 C	-1.402*	.670	.039
		24 C	20 C	1.402*	.670	.039
Prunellavulgaris	Ambient-50%	20 C	24 C	.024	.582	.967
		24 C	20 C	-.024	.582	.967
	Ambient	20 C	24 C	.364	.582	.534
		24 C	20 C	-.364	.582	.534
	Ambient+50%	20 C	24 C	-1.173*	.582	.047
		24 C	20 C	1.173*	.582	.047
Centaureatriumfetii	Ambient-50%	20 C	24 C	.016	.619	.979
		24 C	20 C	-.016	.619	.979
	Ambient	20 C	24 C	.355	.619	.569
		24 C	20 C	-.355	.619	.569
	Ambient+50%	20 C	24 C	-.853	.619	.173
		24 C	20 C	.853	.619	.173
Salviapratense	Ambient-50%	20 C	24 C	.282	.679	.679
		24 C	20 C	-.282	.679	.679
	Ambient	20 C	24 C	.336	.679	.623
		24 C	20 C	-.336	.679	.623
	Ambient+50%	20 C	24 C	-2.550*	.679	.000
		24 C	20 C	2.550*	.679	.000
Asphodelinelutea	Ambient-50%	20 C	24 C	.230	.480	.634
		24 C	20 C	-.230	.480	.634
	Ambient	20 C	24 C	-.423	.480	.381
		24 C	20 C	.423	.480	.381
	Ambient+50%	20 C	24 C	-1.110*	.480	.023
		24 C	20 C	1.110*	.480	.023
Bupthalmumsalicifolium	Ambient-50%	20 C	24 C	-.726*	.316	.024
		24 C	20 C	.726*	.316	.024
	Ambient	20 C	24 C	-.140	.316	.658
		24 C	20 C	.140	.316	.658
	Ambient+50%	20 C	24 C	-1.336*	.316	.000
		24 C	20 C	1.336*	.316	.000
Dianthuscarthusianorum	Ambient-50%	20 C	24 C	.064	.500	.899