CNOC COIG: THE SPATIAL ANALYSIS OF A LATE MESOLITHIC SHELL MIDDEN IN WESTERN SCOTLAND

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by

Richard William Nolan

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Department of Prehistory and Archaeology

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APPENDIX A

A REVIEW OF FUNCTIONAL INTERPRETATIONS OF LIMPET SCOOPS

One of the most abundant and diagnostic classes of artifacts found in Obanian shell middens are the small, elongated, bevelled-ended tools which are made of either antler, bone or stone and which are commonly referred to as "limpet scoops". The functional connotations of this term have not, however, been universally accepted. Indeed, as mentioned in Chapter 4, opinions have varied considerably with regards to the function of this class of Obanian tools, and considerable confusion has developed, partly because of the presence of larger but somewhat similar artifacts which are generally referred to as "limpet hammers", and partly because of the input of ideas from other parts of the British Isles where artifacts similar to Obanian limpet scoops and limpet hammers have been found. In order to dispel some of this confusion, a review of the functional interpretations which have been proposed for these objects is presented here in an effort to determine which of the many interpretations is the most plausible.

Obanian Limpet Scoops

In the earliest published reports on Obanian sites (Anderson 1895; 1898; Grieve 1882; 1885), no formal name was given to limpet scoops. Anderson simply referred to them as "round-nosed, chisel- or punch-like implements". He (1895: 220, 222-223) did suggest, however, that the bevelling on the ends was a result of extensive wear, such as from rubbing, and he put forward the interpretation that these tools were used in the dressing of skins. Bishop (1914: 95) did not regard this as a reasonable explanation, and he suggested instead that these implements were used to extract limpets from their shells; in support of this notion, he reports that a piece of cement which he used for this purpose acquired a form identical to the S.L.S. from

Cnoc Sligeach (see 1914: Fig. 36, bottom right corner). Like Anderson, Bishop felt that the bevelling was due to use-wear, but he held that beach pebbles were initially flaked to give a rough, sharp edge for extracting limpet meat out of the shell and that they then wore down into the "classic" rounded and bevelled form of limpet scoops -- more will be said about this interpretation later.

Breuil (1922: 267-271) took exception to Bishop's limpet scoop hypothesis and argued instead that these Obanian tools served two functions, both relating to the working of flint. He regarded that the bevelling or abrasion resulted from being used as a tool for pressure flaking, while fracturing on the ends of limpet scoops was due to being used as a punch for flint flaking; specimens with evidence of fracturing and then bevelling, he regarded as having been used first as a punch and then as a pressure-flaker. Although Breuil's flaking-tool interpretation was accepted by some (e.g. Garrod 1926: 182-183), it was generally regarded with scepticism by most authors who addressed this problem of the function of limpet scoops (see Clark 1932: 15; 1956: 92; Gordon-Williams 1926: 108; Lacaille 1954: 216; Movius 1942: 183). The arguments against this notion are obvious enough -- considering the expedient nature of the bipolar technique of flint working and the almost total absence of any retouched flakes in Obanian flint assemblages, it is scarcely possible even to consider Breuil's interpretation as a serious one. In a similar vein, for some Welsh specimens from Pembrokeshire about which more will be said later, Gordon-Williams (1926: 108-109) proposed that bevelled pebbles were used as tongs to hold small flakes onto an anvilstone when trimming the flake! Regardless of the value of this interpretation for the Welsh specimens, in the Obanian context, it can be immediately dismissed on the same basis as Breuil's flaking-tool hypothesis.

Aside from flint working tools, limpet scoops have been similarly interpreted as implements for working antler, bone and wood. Grieve (1923: 54) mentions hearing the suggestion that they were used to rub and smooth the surface of antler and bone harpoons! He does not credit the source of this suggestion, but in any case, it is an idea that no one has seriously entertained. Aside from the fact that it is difficult to see how antler and bone could be coarse enough and hard enough to act as abrasives for working harpoons made of the same materials, there is an obvious discrepancy between the huge number of limpet scoops in Obanian assemblages and the relative paucity of harpoon fragments (even if we do regard the former as non-curated and the latter as curated tools). Movius (1942: 183-185) suggested that some limpet scoops at least were used as "heavy chisels or adzes" for working wood but, as Clark has quite correctly observed, this is "...a function for which their working edges would hardly seem to be adapted" (Clark 1956: 92). Yet, Clark had previously, albeit cautiously, opinioned that: "It is possible that they fulfilled a function not unlike that of the picks and axes of the shell-mounds of the Baltic..." (Clark 1932: 15). However, as Clark recognized at the time, Breuil (1922: 267) had wisely cautioned against such an erroneous interpretation based simply on illustrated specimens. Despite this caution however, many years later, Lacaille (1954: 216) still entertained the notion that an axe- or chisel-like function was possible at least for some S.L.S.

Thus, it can be seen that there has been no lack of imaginative speculation regarding the possible functions of limpet scoops -- these various ideas and opinions about them are summarized in Table 45. Since most of the proposed ideas can be readily dismissed as being highly unlikely, we are left with only two interpretations which are, ironically, the two earliest suggestions: namely, Anderson's skin working and Bishop's limpet scooping interpretations. Before examining these in more detail, reference should be made to Grieve's notion of stone limpet hammers. As can be seen from Table 45, despite proffering other interpretations to explain either antler and bone limpet scoops or smaller S.L.S., both Movius (1942: 183, 185; 1953: 102) and Lacaille (1951: 125-126; 1954: 216, 218)

Table 45. Summary of the Functional Interpretations Which Have Been Assigned to Limpet Scoops and Limpet Hammers for Obanian and Various Other Mesolithic Assemblages.
Note: P = proposes; A = accepts; R = rejects; M = mentions without explicitly accepting or rejecting.

Author and Source	Limpet Scoop	Limpet Hammer	Skin Working	Flaking Tool	Flaking Tongs	Wood Working	Axe- or Chisel-like Function	Antler/ Bone Working
Grieve (1882; 1885)		P						
" (1923)	R	P	M					M
Anderson (1895)			P					
Bishop (1914)	P		R					
Cantrill (1915)	R?	A?	M					
Breuil (1922)	R	R		P			R	
Gordon-Williams (1926)	R	R	R	R	P			
Clark (1932)				R			P?	
" (1956)				R		R		
Movius (1942)		A	A	R		P		
" (1953)		A						
Lacaille (1951)	M	A	M					
" (1954)	A?	A	A	R			A?	
Liversage (1968)	M	A	M	M		M		
Coles (1971)			A					
Jacobi (1979)	A							
" (1980)	R		A					

have accepted that some stone specimens may best be regarded as limpet hammers, while others have rejected this concept completely, either because it was felt that such a function would not require enough force to cause the observed abrasion and fracturing on the pebbles (Breuil 1922: 270), or because it was held that pebbles would not be used in such a fashion to cause this wear pattern (Gordon-Williams 1926: 100, 105). However, experiments conducted by the author (see Appendix B) and by Liversage (1968: 147) have shown that Breuil's objection is not a valid one. Gordon-Williams' objection is based on the argument that, to produce the observed abrasion, these pebbles would have had to be used "cue-wise" (i.e. pushed), whereas one would "naturally" swing them club-wise. Once again, experiments by the author (see also Liversage 1968: 147) show that the opposite is true -- a club-like stroke lacks the control, both in terms of strength and in terms of the point of impact, that a short and sharp (whether a push or a pull) stroke does, so that it results in an unacceptable amount of breakage of the limpet shells. Thus, present evidence strongly indicates that, in the Obanian context at least, it is advisable to recognize Grieve's limpet hammers as a distinct category of elongated pebble tools, regardless of what other function(s) one ascribes to limpet scoops.

Non-Obanian Limpet Scoops

Reference has already been made to supposed limpet scoops in non-Obanian contexts, and these should now be discussed since there has been considerable exchange of ideas regarding functional interpretations among the various regions of the British Isles where abraded, elongated beach pebbles have been found.

Sites in Ireland

On the east coast of Ireland, a small number of elongated beach pebble tools have been recovered from shell midden sites. At Rockmarshall III, there were found

"...several elongated beach pebbles whose ends had been altered by rubbing and pounding" (Mitchell 1949: 171-173). Despite their large size, Mitchell (1949: 173) regards them as equivalent to Obanian S.L.S. from Oronsay, although Movius (1953: 103) claims that they are identical with Obanian S.L.H.! From the one sketchily illustrated specimen (Mitchell 1949: Fig. 1G), it is unfortunately not possible to determine whether these artifacts are analogous to Obanian S.L.S. or to S.L.H. Similarly, at the shell midden site of Sutton, 20 relatively large elongated pebble tools were recovered, which Mitchell (1956: 14-17) calls "limpet-hammers", although elsewhere (1956: 21) he less certainly refers to them as "limpet-hammers (limpet-scoops)". This confusion on the part of Mitchell is well indicated by the three illustrated specimens from this site: one of them (1956: Fig. 13b) is clearly neither a S.L.S. nor a S.L.H., and indeed, it would appear to be best classified as a hammer/anvilstone; another specimen (1956: Fig. 13a) <u>might</u> be a limpet hammer on the basis of the damage on one end, but similar use-wear in the middle of one edge of the pebble would seem to indicate that this item also should be regarded as a hammerstone and not as a limpet hammer; and only the third illustrated specimen (1956: Fig. 12b) would appear to conform to the pattern of use-wear characteristic of a limpet hammer (or perhaps even a limpet scoop), but, due to the sketchiness of the illustration, it is not possible to identify this item with certainty. Given Mitchell's apparent confusion, and on the basis of the rather poor illustrations and also Movius' statements, it would seem that the elongated beach pebble assemblages from the Rockmarshall III and Sutton shell middens do contain some S.L.H. but probably not any S.L.S.

Less problematical are 11 bevel-ended pebbles found in the Southern Basal Midden of Site II at Dalkey Island (Liversage 1968: 119). These specimens reveal a combination of rough bevelling and chipping (Liversage 1968: 147, Fig. 29, Plate XI) which indicates to Liversage that these objects are best interpreted as limpet hammers and not scoops. As was discussed in Chapter 4, and as is further elaborated on in Appendix B, this is indeed the typical use-wear pattern of limpet hammers as revealed by experimental evidence. But in addition, their size alone, particularly the width of the utilized ends, would strongly suggest that these artifacts from Dalkey Island cannot be limpet scoops.

Thus, the published information on these three Irish shell middens would seem to indicate that at least a few of the elongated pebble tools found in them are limpet hammers, and that probably none represent large S.L.S. In any case, it is certainly clear that: "The smaller type of 'limpet scoop' found in the Scottish 'Obanian' sites does not, however, occur in Ireland" (Woodman 1978: 357). It is also clear that these elongated pebble tools have a distribution which is solely confined to coastal shell midden sites.[1] Moreover, these Irish coastal sites would appear to be roughly contemporaneous with the Oronsay middens, on the basis of one date from each site (Jacobi 1979: Fig. 21; Woodman 1978: Table 1, Fig. 1), although they belong to the period of transition between the Mesolithic and Neolithic in Ireland which is indicated in part by the fact that domesticated mammals appear to be represented in the faunal material from both Rockmarshall and Dalkey Island (Woodman 1978: 356, Table 2).

Sites in Southwest Britain

Even more problematical than these Irish specimens are bevel-ended pebbles from coastal sites in southwestern Britain, primarily in Devon, Cornwall and Pembrokeshire. Jacobi (1979: 77, Fig. 19) records the occurrence of bevelled pebbles from 14 sites distributed along the coasts of Devon and Cornwall, and he (1979: 78) provides counts for the seven sites clustered around Gwithian. The number of bevel-ended pebbles from these sites ranges from one

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[1] Elongated pebbles found inland at Newferry Site 3 are certainly nothing like the coastal limpet hammers on the basis of their use-wear pattern (see Woodman 1977: 167, 174, 177, 180, 190, Plate 13).

to 51, with an average of about 12. By Obanian standards, this number is very low, although it should be noted that the artifactual content overall from the Gwithian sites is equally low. In any case, from the illustrations of seven Cornish specimens (Jacobi 1979: Figs. 6, 7 & 13), four of which are double-ended, it is clear that these bevelled pebbles are not limpet hammers, since they are well bevelled bifacially and they have little or no flaking (except for one specimen). In other words, they have the classic form of Obanian S.L.S., and it would be tempting to regard them as such were it not for the fact that they are larger than Obanian specimens -- they range in length from about 97 to 137 mm, with an average around 110 mm, and in width at the bevelled end from about 12 to 36 mm, with an average around 26 mm. Nevertheless, Jacobi (1979: 77) seems content to regard them as limpet scoops and as indicating the existence of shellfish processing sites.

Yet elsewhere, Jacobi (1980: 188-189) rejects this functional interpretation and accepts instead their use as seal skin processing tools! In this publication, he has broadened his study to include one site in Dorset and 23 sites along the Welsh coast (see 1980: Fig. 4.30), and he provides (1980: Figs. 4.18 & 4.24) illustrations of four Welsh specimens, one from Nab Head and three from the sites at Frainslake. These specimens and 12 other illustrated Pembrokeshire pebbles (Cantrill 1915: Figs. 11, 12 & 14) are classically bevelled like the Cornish examples, though with some flaking in a few cases; but in only one instance (Cantrill 1915: Fig. 12) does the flaking and bevelling appear to conform to a limpet hammer. In short, they look very much like Obanian S.L.S., except they are all much larger like the Cornish examples.

Another site much further north along the Welsh coast, at Aberystwyth, yielded about 30 "...elongated pebbles having the appearance of so-called limpet scoops" (Thomas & Dudlyke 1925: 73). Although in passing Thomas and Dudlyke compare these pebbles to Pembrokeshire and Obanian S.L.S., from their description and illustrations

(1925: 85-86, Figs. 4-6), it is clear that very few of these pebbles, and probably only one, should be regarded as possible S.L.S. -- indeed, they record that the elongated pebble shown in Figure 5 is "...the only specimen which shows definite signs of abrasion at the end" (Thomas & Dudlyke 1925: 85). Thus, Jacobi (1980: Fig. 4.30) quite properly regards this site at Aberystwyth as an unconfirmed find spot of bevelled pebbles. In any case, like the Cornish and Pembrokeshire specimens, all of these elongated pebbles (including the one possible S.L.S.) are larger than Obanian S.L.S., especially in terms of the width of the bevelled end.

Thus, from the published descriptions and illustrations, the bevelled pebbles from coastal Wales and southwest England seem to constitute a uniform class of artifacts, which are very much like Obanian S.L.S. except that they are significantly larger. Jacobi (1980: 188), like Cantrill (1915: 198, 200) and Gordon-Williams (1926: 105) before him, suggests that, at least for the majority of these pebbles, the width of the bevelled end would seem to preclude their use as limpet scoops. This is entirely reasonable, although it should be noted that Henderson Bishop examined several of the Pembrokeshire specimens and was satisfied that at least some of them could be regarded as limpet scoops, analogous to Obanian B.L.S. and S.L.S. (Cantrill 1915: 198-199).

Cantrill (1915: 196-203) was non-committal about the functional interpretation of these pebbles, and he felt it was better to consider the matter an open one. However, Jacobi (1980: 188-189) maintains that the bevelled pebbles from southwest England and Wales should be interpreted as tools used for cleaning seal skins. First of all, Jacobi notes their absence from three shell midden sites in the area, and that their total distribution in England and Wales is more limited than that of shellfish beds, although he does recognize that this may simply be due to differential destruction of shellfish processing sites. In any case, he argues that their distribution seems to correlate closely with large breeding colonies of grey seals and, by analogy to "sponge-finger stones" found in Beaker period graves which have been interpreted as being associated with leather working (Smith & Simpson 1966: 134-135), he suggests a seal skin cleaning function for these bevelled pebbles. Yet, this analogy is a rather dubious one. Without going into details, it is sufficient to note here that Smith and Simpson's (1966: 134-141) interpretation of sponge-finger stones, and the seemingly cognate bone and antler "spatulae", is far from being unequivocal. They arrived at their leather working hypothesis for these early Bronze Age tools by <u>assuming</u> that all the tools found in the Primary Grave at West Overton 6b barrow were functionally related and by drawing an analogy with Russian Upper Palaeolithic implements <u>interpreted</u> by Semenov (1964: 175-179) to be leather processing tools. Regardless of the validity of Smith and Simpson's functional interpretation of early Bronze Age sponge-finger stones and antler/bone spatulae, it is sheer folly to extend their argument to include Mesolithic bevelled pebbles. Moreover, an examination of the illustrations of sponge-finger stones and antler/bone spatulae (Smith & Simpson 1966: Figs. 3, 5 & 6) convincingly shows that the resemblance between these objects and Mesolithic limpet scoops is at best highly superficial.

In summary, Jacobi's (1980: 188-189) seal skin working interpretation for the bevel-ended pebbles from southwest England and south Wales is not very convincing, although it must be admitted that the width of the bevelled ends on these tools also casts doubt on interpreting them as limpet scoops. Moreover, in contrast to Obanian sites where limpet scoops are always associated with limpet remains, there is almost no association between the distribution of bevelled pebbles in southwest England and south Wales and the occurrence of shellfish accumulations, even though this might be due to the destruction of shellfish processing sites in these areas (Jacobi 1980: 185). In spite of this latter possibility, it might be noted that bevelled pebbles have been found at 39 sites in southwest

England and south Wales, whereas there are only five Mesolithic shell middens in these areas (Jacobi 1979: cf. Figs. 19 & 20; 1980: cf. Figs. 4.30 & 4.28), and there is some doubt about the Mesolithic age of two of these shellfish accumulations (Jacobi 1980: 184). Of these five sites, bevelled pebbles were found only at Portland, with one possible specimen from Culverwell (Jacobi 1980: 189, Fig. 4.30); and even though the principal mollusc in one of these shell middens (Westward Ho!) is the oyster, so that this lack of association is not too surprising here, the other four middens do appear to contain at least some limpets. In conclusion, the functional interpretation of this group of bevel-ended pebbles from southwestern Britain must remain problematical until further research, particularly experimental work, is conducted. In any event, it is argued here that the same need not be said for Obanian limpet scoops.

Morton, Fifeshire

Returning to Scotland but before returning to the Obanian, mention should be made of another site where B.L.S. were found. Coles (1971: 314) reports finding 38 "spatula-like" bone tools from Site B at Morton Tayport in Fifeshire. These artifacts are made from the metapodials of red deer (and possibly also *Bos primigenius*), have one end rounded and abraded, and range in length from 35 to 105 mm. This description certainly suggests that these tools are akin to Obanian B.L.S., and although the outline drawings of 15 specimens (Coles 1971: Fig. 15) are too sketchy to permit any reliable assessment, they can apparently be classified as B.L.S. (P. Mellars, personal communication). At any rate, it is interesting to note that Coles (1971: 314) interprets these artifacts to be skin working tools; and once again, this is based on an analogy with the Russian Upper Palaeolithic tools interpreted by Semenov (1964: 175-179) to be leather working implements.

Skin Working Tools or Limpet Scoops?

As we have seen and as Table 45 illustrates, the skin working interpretation of limpet scoops from both Obanian and other Mesolithic assemblages has been the most commonly accepted idea regarding the function of these artifacts. Although Bishop's (1914) term "limpet scoop" has been widely used to refer to this class of objects, no one has accepted the functional connotation of the term, except Lacaille (1954: 200) who is only willing to accept that some of these tools might possibly have been used in the preparation of food and bait, and Jacobi (1979: 77-78) who implicitly accepts this interpretation but later (1980: 188-189) explicitly rejects it!

Nevertheless, it is held here that Bishop's interpretation is the best idea suggested to date, at least as far as the Obanian is concerned. The skin working hypothesis presents a number of problems. Firstly, it is based on no experimental evidence, except for the dubious analogy with Semenov's (1964: 175-179) Upper Palaeolithic tools from Russia which, regardless of the validity of Semenov's interpretation, do <u>not</u> resemble Obanian or any other limpet scoops except in the most superficial way. Furthermore, translating Jacobi's (1980) seal skin working notion to the Obanian, there is not the close correlation with seal remains which one would expect. It is true that at Cnoc Coig seal bones are the most abundantly represented in the assemblage, but this is not apparently repeated at other sites. Seal bones were certainly found at C.N.G. I (Grieve 1882: 485; 1885: 54), Cnoc Sligeach (Bishop 1914: 105) and Risga (Lacaille 1951: 116; 1954: Table V). However, even though these early sources do not quantify the bone remains from these sites, recent sampling of all the Oronsay middens has shown that the high frequency of seal bones found at Cnoc Coig is not repeated at the other four sites (P. Mellars, personal communication). Yet, all of these sites contain large quantities of limpet scoops. More importantly, no seal bones at all were found at MacArthur Cave or Druimvargie (Anderson 1895: 227; 1898:

299) and yet, once again, limpet scoops are quite numerous in these sites. These data clearly demonstrate that limpet scoops do not highly correlate with the exploitation of seals as Jacobi suggests.

Of course, it could be argued that they were also used for dressing red deer and wild boar hides, since these two species are present in all Obanian sites (see Lacaille 1954: Table V). However, there are problems with this argument as well. If limpet scoops did serve as hide working tools for deer and wild boar, why have none been found at Mesolithic sites inland? The response to this question would obviously be that antler and bone were used for making these tools at inland sites where conditions have generally not favoured their preservation. However, such negative evidence is hardly strong support for this idea. More importantly, conditions favourable to the preservation of antler and bone did exist at Star Carr, and Pitts (1979) has even argued that the site was a specialized antler working and hide processing locality; but regardless of the validity of Pitts' reinterpretation of Star Carr (cf. Andresen *et al*. 1981), the fact remains that no antler or bone limpet scoops were found at this site. Furthermore, at Cnoc Coig which is the most thoroughly excavated and best documented Obanian site, the number of limpet scoops found seems totally out of proportion to the number of hides which would be indicated by the number of mammals in the site. For seal, otter, red deer and pig at Cnoc Coig, there would be about 30 to 35 limpet scoops per animal, which certainly seems to be a rather large number; and this is assuming that the deer and pig bones represent whole animals (and therefore complete hides) and not just portions of animals brought to the island, which in fact would seem to be the case so that the number of scoops per hide would be even greater.

All these considerations would seem to cast considerable doubt on the skin working interpretation of limpet scoops. In addition, there is positive evidence in favour of the limpet scoop hypothesis. Firstly and most simply, the sheer number of limpet scoops accords well with the large amounts of limpet shells which are contained in these sites, as does their ubiquitous distribution throughout the midden observed at Cnoc Coig. This is certainly suggestive, though far from conclusive, evidence. However, additionally, experimental data adds considerable weight to the limpet scooping interpretation. Bishop was first to suggest this idea and he outlines the processes through which a stone specimen would pass before being discarded:

> A stone of suitable size was chosen from the beach, and the ends chipped by a sharp blow to give the rough surface which was desirable for the easy accomplishment of the end in view. Repeated gougings produced the convex facets, and these gradually became smoother, ultimately losing their gripping power, and so the implements were discarded and thrown into the refuse heap. In some cases, if the stone was still otherwise serviceable, it might be re-chipped (Bishop 1914: 95).

Bishop also reports that: "As an experiment a piece of cement...was used for this purpose, and the result was a tool identical in form with the stones from the site" (1914: 95). Unfortunately, Bishop used a piece of cement rather than a beach pebble or a fragment of antler or bone, and he does not say how many limpets had to be scooped to achieve this limpet scoop shape. Nevertheless, experiments conducted by the author (see Appendix B) also provide some confirmation of Bishop's interpretation. On balance then, the evidence seems to point strongly in favour of Bishop's limpet scooping interpretation rather than Anderson's skin working hypothesis.

Summary and Conclusions

It has been seen that a wide range of functional interpretations has been proposed for the class of Obanian tools commonly referred to as "limpet scoops". Despite this proliferation of interpretations and the fact that considerable confusion has arisen regarding these artifacts, most of these interpretations can be readily dismissed as being highly implausible. Perhaps ironically, it is the earliest two suggestions -- namely, Anderson's (1895: 220, 222-223) skin working and Bishop's (1914: 95) limpet scooping hypotheses -- which deserve serious consideration. Though seldom crediting Anderson with the idea, most researchers have favoured the hide working hypothesis, but no one has based this belief on a thorough review of all the evidence. Having done so here on the basis of the published information, it is maintained that Bishop's notion of limpet scoops is the most plausible interpretation of the function of these elongated, bevel-ended artifacts found in Obanian shell middens. The only proviso to this conclusion is that a few of the large, elongated stone specimens are not limpet scoops; rather, they conform to Grieve's (1882: 486-487; 1885: 57; 1923: 59-61) notion of stone limpet hammers.

Similar artifacts, mostly made of stone, have been recovered from non-Obanian sites in other coastal areas of the British Isles, and an exchange of ideas amongst these various areas has added to the confusion concerning the function of these various artifacts. On the basis of the published evidence, which is admittedly often sketchy, it seems clear that the few elongated bevelled pebbles from shell midden sites located along the east coast of Ireland belong to the category of limpet hammer and are not limpet scoops. The bevelled pebbles from southwest England and south Wales are much more problematical, and it is not at present possible to ascertain with confidence their functional status, although it is clear that formally they constitute a uniform class of artifacts which are significantly larger than, but otherwise identical to, Obanian S.L.S. Finally, the bone implements from the site of Morton in Fifeshire can be classified as B.L.S., identical in form and presumably function to limpet scoops from Obanian shell midden sites in southwestern Scotland.

APPENDIX B

EXPERIMENTAL DATA ON BEACH PEBBLE ARTIFACTS

As part of the research programme dealing with the shellfish remains from the Oronsay middens (Jones 1984), a number of trips to Oronsay and Colonsay were made to carry out field work on the modern shellfish populations on the islands. During two of the visits in which I participated, in July 1981 and March 1982, I conducted a number of relatively straightforward, small-scale experiments in order to gain further understanding of the nature of Obanian beach pebble technology. Although, due to limitations of time imposed by the demands of the shellfish field work, these experiments were neither comprehensive enough nor sufficiently large in scale to answer all of the issues and questions that such experiments might address, they were of sufficient scope to help clarify at least some aspects pertaining to the procurement, manufacture and use of Obanian beach pebble artifacts. The results are certainly informative enough to vindicate many recent claims that such experimental work holds much promise for increasing our ability to interpret the archaeological record more accurately, and to indicate that more detailed experimental work on these matters should be a profitable area for further research. The results of these experiments are described here in detail.

The Availability of Beach Pebbles

The first observation that should be made concerns the ease with which an abundant supply of beach pebbles can be procured from the storm beaches found on Oronsay and Colonsay. There are many raised storm beaches on these islands which are more or less contemporaneous with the Mesolithic shell middens (see Jardine 1977; 1978), and modern storm beaches are also common. However, such storm beaches are by no means ubiquitously distributed around the coast, and thus, not every possible settlement location would necessarily have equal access to such storm beaches. Nevertheless, given the relatively small size of Oronsay, both today and especially at the time of the maximum Holocene marine transgression (see Fig. 2), no location would be so far away from a storm beach that the demand for this raw material would be difficult to satisfy.

Another feature of these beaches which is of interest is that they are not all uniform in terms of the size and shape of the pebbles which comprise them. Some contain virtually none of the small, elongated pebbles which were used as S.L.S. -- for example, two of the raised storm beaches on the western side of Colonsay, one near Dun Challain on the north shore of Port Lobh and the other at Port Sgibinis west-southwest of Balnahard farm. In contrast, other beaches, such as one located near the Priory Midden at Port na Luinge, contain an abundance of such pebbles. Another and very extensive storm beach on the west coast of Colonsay, which is located north of Rubha Aird Alanais and the golf course at Tobar Fuar but south of Port Mor, includes a wide variety of pebbles which are sorted by size and shape into a number of bands of varying width which roughly parallel the coast. To procure pebbles of a certain size and shape (such as ones suitable for S.L.S.), one simply needs to walk across the beach towards the sea until the suitable band is found and then to walk along the beach following the "seam" containing the desired pebbles. In a few minutes, one person can obtain dozens of suitable specimens, and indeed, a collection equalling the size of the entire assemblage of P.S.L.S. and S.L.S. from Cnoc Coig could be acquired by a handful of people walking several times along such seams!

Consequently, even though storm beaches are not ubiquitous around the coast and not all beaches necessarily contain pebbles of suitable sizes and shapes, the fact remains that an abundant supply of beach pebbles is readily available on the islands. Given an embedded procurement strategy (Binford 1979b: 259-261) in which these pebbles could be collected as required during the normal course of travelling to and from shellfish collecting and other localities, the amount of labour invested in their procurement would indeed be negligible. Certainly, there is no reason to think that beach pebbles would have been procured by task-specific trips to storm beaches.

Pitted Pebbles and Dog Whelk Processing

Were Dog Whelks Broken Open on Pitted Pebbles?

Pitted pebbles are relatively large, flat, round to oblong beach pebbles with marked pitting in one or more places on the pebble, and they are a type of stone artifact which has been found at virtually all Obanian sites. Nearly all specimens from Cnoc Coig are anvilstones (with pitting on the flat face of the pebble), about 40% of which are also hammerstones (with pitting on the edges of the pebble). The pitting on anvilstones is generally confined to small, roughly circular patches either in the centre of the pebble or slightly off-centre towards one end. Bishop (1914: 91) attributes this pitting on these pebbles to their having been used for breaking open the shells of dog whelks to extract the meat.

In order to test this idea, 63 dog whelks were cracked open on a flat anvilstone collected from the storm beach at Port na Luinge on Oronsay, using the edge of an elongated pebble for a hammer (Plate 3). The result of this experiment does indeed indicate that breaking open dog whelks causes some pitting on the anvilstone and also some marking on the edge of the hammerstone (Plate 4). However, the scarring of the surface of the anvilstone is quite superficial and does <u>not</u> compare with the much more marked pitting found on the archaeological specimens. Therefore, this experiment would seem to demonstrate that the pitting observed on archaeological specimens cannot be attributed solely to the breaking open of dog whelks as Bishop suggests.

Of course, it must be admitted that this experiment was limited to only one anvilstone on which only around five dozen dog whelks were broken. It therefore remains possible that breaking open, say, several hundred dog whelks might result in more marked pitting. Nevertheless, my impression is that the breaking open of dog whelks would never produce the degree of pitting observed archaeologically on the Cnoc Coig pitted pebbles. It seems more likely that a more robust activity, such as the fracturing of flint cobbles, is responsible for the deeper pitting found on these pebbles. Despite this however, it is reasonable to suggest that anvilstones were multi-purpose surfaces used for the crushing, breaking or cutting of a variety of different kinds of objects and materials, including the breaking open of dog whelks, even if this task alone is not responsible for the pitting observed on these pebbles.

Breakage Patterns of Dog Whelk Shells

This experiment served one other purpose. In the course of his shellfish research, Jones (1984: 93) had to break open dog whelks to extract the meat from the shell in order to determine shell weight/meat weight ratios. Using a variety of modern metal implements to open whelks by percussion or pressure, he noticed that none replicated the characteristic breakage pattern of the archaeological specimens (D. Jones, personal communication). The experiment described above to test Bishop's hypothesis also served to demonstrate that this breakage pattern was easily replicated using stone tools.

Using these implements, several techniques were initially tried out which involved holding the dog whelk in various ways and striking it at different points on the shell, but only one turned out to be at all efficacious. This involved holding the dog whelk firmly on the anvilstone using the thumb and index finger, with about a third of the apex end of the shell protruding from the hand; the aperture could be either held against the thumb so that a rounded side of the body whorl rested on the anvil, or better still it could be held face down on the anvilstone. A quick, firm stroke directed close to where the shell protrudes from the hand cracks open the shell towards the apex end, thereby typically leaving the aperture intact with much of the body whorl and usually also the lower part of the columella attached to the aperture fragment (see Plate 3).

It should be noted, however, that not all dog whelks broke in this "typical" fashion. With the aperture held against the thumb (Method II), a third of the shells (5 of 16) ended up having intact apertures, with the remaining two-thirds having broken apertures in which the siphonal canal fragments contained only portions of the aperture (i.e. to varying degrees, portions of the outer lip or peristome, perhaps some of the body whorl, the columella region of the inner lip, and perhaps some of the parietal region of the inner lip but not enough to form a complete closure of the aperture). With the aperture held face down on the anvilstone (Method III), the ratio was reversed, with two-thirds (10 of 15) having intact apertures and one-third more broken apertures. Given the small sample sizes, it is doubtful, however, if these differing frequencies of intact apertures should be taken as being significant.

Thus, combining the results from these two variants of the basic method, approximately only half of the specimens actually replicated the "classic" breakage pattern observed archaeologically. It remained, however, to determine precisely the frequency of the classic breakage pattern in archaeological samples. Using seven of the archaeological samples of dog whelk fragments sorted and analysed by Jones (1984: Table 30), the relative frequencies of siphonal canal fragments with intact versus broken apertures could be easily determined and compared with the experimental results. These are shown in Table 46. What is striking about these data is that, except for two quite small samples, the ratio of intact to broken apertures is

Table 46. Comparison of the Frequencies of Siphonal Canal Fragments with Intact Apertures and Those with Broken Apertures for Seven Archaeological Samples of Dog Whelk Shells and for the Experimentally Broken Open Dog Whelks.

Site and Level	Intact Apertures: No.	%	Broken Apertures: No.	%	Total
C.N.G. II - E	22	52.4	20	47.6	42
" - F	13	52.0	12	48.0	25
" - G	2	28.6	5	71.4	7
Cnoc Sligeach - B28	61	50.4	60	49.6	121
" - B29	79	50.3	78	49.7	157
" - B31	42	54.5	35	45.5	77
" - B32	20	69.0	9	31.0	29
C.N.G. II - Total	37	50.0	37	50.0	74
Cnoc Sligeach - Total	202	52.6	182	47.4	384
Total of 7 Samples	239	52.2	219	47.8	458
Experimental -					
Method II	5	31.2	11	68.8	16
Method III	10	66.7	5	33.3	15
Total	15	48.4	16	51.6	31

consistently about 50:50, regardless of the site or level from which the samples are taken. Moreover, it is surprising to note that this mirrors exactly the results obtained experimentally!

However, it might be suggested that the frequency of intact apertures in the archaeological samples might have been lowered somewhat from what had been originally deposited due to post-depositional trampling of the shells in the middens. If so, then a ratio more in favour of intact apertures might have been more characteristic of the Obanian processing of dog whelks (such as that observed from Cnoc Sligeach B32), and hence, our experimental results would not be so consistent with the pattern observed archaeologically. In this situation however, we might suggest that the observed differences between experimental Methods II and III are indeed truly reflective of different degrees of efficiency in the breaking of dog whelks so that the aperture remains intact -- of course, further and more extensive experimental work could easily determine this. If borne out with larger sample sizes and so a ratio of two intact to one broken aperture fragments were maintained for Method III, then it would seem that holding the whelk with the aperture face down on the anvil-stone would be the more effective variant of the basic method, and importantly, the results would be entirely consistent with our expectations based on the archaeological observations and the consideration of the factor of post-depositional trampling. In either case, it is clear that the Obanian method of breaking open dog whelks did not produce the classic breakage pattern in all, or even in nearly all, instances; and in this sense, our experimental results are more than just broadly consistent with the archaeological data.

At this point, the reader may wonder what is so important about whether or not the aperture remains intact when the shell is broken open. The answer is quite simple: intact apertures mean less processing time and less chance of small shell fragments being included with the meat. When the whelk shell is broken, the meat ends up in the siphonal canal/aperture fragment, which is the portion of the shell held in the hand, and not in the apex end which is the one that fragments. When the aperture remains intact, the meat can be readily plucked from this large fragment with virtually no chance of any small pieces of shell adhering to it (see Plate 3). On the other hand, if the siphonal canal/aperture end also fragments, the meat is often riddled with small bits of shell and removing these is tedious and time-consuming. Thus, a method which minimizes the frequency of breaking the aperture end minimizes the time and effort spent in processing dog whelks.

It is true that dog whelks form a relatively small proportion of the shellfish assemblage from the Oronsay middens, especially in comparison to limpets (see Jones 1984: 224-232), and hence that they constituted a very minor component of the shellfish diet so that large numbers of them would probably never have been processed at any one time. Nevertheless, a timed whelk smashing experiment was carried out, and this indicates that this task is so time-consuming that adopting a method which maximizes efficiency is indeed sensible, even for processing small quantities of these shellfish. In this simple experiment, performing the task as quickly as possible but not so frantically that all control of the pattern of shell breakage was lost, 20 dog whelks were broken open and the meat was separated from the shell and placed in a container; this took 10:45 minutes to complete, a full 32.25 seconds per whelk, which works out to only 111.6 whelks/person/hour. This rate is exceedingly slow compared to limpets (see below), and the amount of meat yielded from one whelk is on average less than from one limpet.[1] In addition, despite considerable variation as a result of local habitat conditions, on average limpets outnumber dog whelks by a factor of more than two on the modern coast of Oronsay (Jones 1984: 153-157).[2] Given all this, one might question why the Mesolithic inhabitants of

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[1] Jones (1984: 234-239, and especially Figs. 177 & 179 and Tables 54-59 & 61) has calculated the mean dry meat weights for dog whelks and for five size categories of limpets (defined on the basis of shell weights) for each of his six two-month sampling intervals spanning a yearly cycle. From these data, it is clear that the average dry meat weight of a dog whelk is only greater than that of the smallest size group of limpets, is roughly comparable to the second smallest size group, and is less than the three larger groups. Even though the smaller size groups are by far the most numerous in the midden limpet samples, it remains true that on average a dog whelk yields less meat than one limpet.

[2] In contrast, in the 29 samples analysed by Jones (1984: 224-232, and especially Table 53), which are taken from all five shell midden sites on Oronsay, limpets nearly always comprise over 90% of the total number of shellfish (i.e. limpets, periwinkles and dog whelks), and never less than 87.81% and as high as 99.79%; on the other hand, dog whelks have a maximum frequency of only 9.94% in these samples. In short, in the Oronsay middens, limpets out-number dog whelks by a factor of at least nine or ten.

Oronsay bothered exploiting dog whelks at all. Yet, as carnivores, the meat of dog whelks has a very strong, pungent smell (and so presumably taste) -- and this is more than apparent when one engages in a little whelk smashing! It is not unreasonable to suggest (see also Jones 1984: 230, 238) that small quantities of whelks might have been used to "spice up" limpets for example, which are extremely bland in flavour. If so, or indeed even if not, the presence of considerable quantities of dog whelks in the Oronsay middens might be seen to be an example where some form of cost-benefit analysis is unable to account for all observed aspects of hunter-gatherer subsistence strategies and diet. In any case, it is worth noting in this context that Meehan (1982: 69, 105, 107) records that among the Anbara gastropods are collected in very small quantities compared to bivalve molluscs to add variety to the diet; the relative frequencies of these two groups of molluscs (2% compared to 98%) is more or less identical to the relative proportions of limpets compared to dog whelks and periwinkles as observed in the Oronsay middens.

Stone Limpet Hammers and Limpet Collecting

Identifying Stone Limpet Hammers

As was discussed above in Chapter 4, during the history of research into the Obanian, there has developed considerable confusion over the concept of stone limpet hammers -- that is, relatively large, elongated beach pebbles which are interpreted to have been used to detach limpets from rocks. This confusion centres on what attributes of the utilized end are diagnostic of such a function. Specifically, does detaching limpets off rocks produce bevelling on the S.L.H. as Lacaille (1954: 216-218) suggests, or flaking as Grieve (1882: 486; 1885: 57; 1923: 59-60) argues, or some combination of the two as Liversage (1968: 147) maintains?

In order to answer this question, seven elongated beach pebbles were used for collecting limpets. The method of use was not unlike that described by Liversage (1968: 147) for his experiments. The pebble was held obliquely and a quick, sharp, jabbing blow was delivered to the limpet at its base where it was attached to the rock, thereby dislodging it (Plate 5). But in order to reduce the likelihood of fracturing the limpet shell, the limpet itself is not actually hit directly; rather, the end of the pebble initially strikes the rock face at a point very close to the limpet and is then slid into the base of the limpet, thus loosening its grip on the rock. Although the pebble hits the rock for only an instant, it is the rock and not the limpet which takes the initial impact of the blow and which therefore produces any wear on the end of the pebble. By this technique, limpets are quickly removed causing a minimum amount of damage to the shells. If the limpet is struck directly, the number of fractured shells is considerable, with the result that either these limpets must be discarded, which is a rather wasteful use of the resource, or that a considerable amount of processing time is required for picking out fragments of shell from the meat, which is an inefficient use of time.

In any case, the amount of use, both in terms of time and the number of limpets collected, was recorded for each of the seven experimental S.L.H. The results are shown in Table 47. The first thing to note from this is that these S.L.H. were used for quite short periods of time, only 15 minutes in five cases and 45 minutes for the other two. Yet despite this, the amount of wear and damage to these pebbles was considerable. Plates 6 and 7 show the seven pebbles and the resulting damage to them. One pebble (No. 39), after only 15 minutes of use, had a very large fragment (running over half the length of the pebble) flake off one side; in addition, the utilized end has much flaking <u>and</u> bevelling on it. Two relatively soft and flaky pebbles (Nos. 33 and 34), again after only 15 minutes of use, were so extensively chipped that the utilized ends had become bifacially flaked so that a straight edge transverse to the long axis of the pebble was produced; and because the stone flaked comparatively easily and frequently,

Table 47. Amount of Limpet Collecting Use for Each of the Experimental S.L.H.

S.L.H. No.	Amount of Time Used	No. of Limpets Collected
33	15 min.	125
34	15 "	153
35	45 "	339
36	45 "	335
37	15 "	123
38	15 "	118
39	15 "	157

virtually no bevelling developed. The other pebbles, which were harder and much less flaky, acquired less flaking than these other two and consequently some bevelling; and in two cases (Nos. 35 and 36), there was extensive bevelling with virtually no flaking. One of these harder specimens (No. 36) actually snapped transversely in two during its third 15 minute session of use, making it almost useless for any further collecting.

The results of this experiment therefore indicate that collecting limpets causes much damage to S.L.H. -- the softer, flakier stones acquire much flaking and no bevelling, while the harder specimens are characterized by less extreme flaking and some bevelling, with the hardest specimens acquiring extensive bevelling with little or no flaking. However, not even with the hardest stones does the resulting bevelling suggest the classic limpet scoop form; the bevelling is altogether rougher and less extensive than that found on S.L.S. Consequently, S.L.H. can be distinguished from S.L.S. by having a variable combination of rough, uneven bevelling and flaking, which does not in any combination resemble the classic limpet scoop form.

Another conclusion which comes out of this experiment concerns the amount of reuse one might expect for S.L.H. Since periods of only 15 and 45 minutes of collecting limpets caused so much damage to the seven experimental S.L.H., it would seem that very few S.L.H. would survive, say, a two or three hour collecting session; indeed, it appears that many S.L.H. would not last throughout such a period of time so that a limpet collector might need two or three S.L.H. for each collecting session. Given this and the fact that S.L.H. would generally be discarded at limpet collecting localities, then the small numbers of S.L.H. found in Obanian sites is perfectly understandable and consistent with the fact that few S.L.H. are ever likely to have been reused for collecting sessions over and over again. The few S.L.H. that are found in the middens would thus represent ones which had "survived" a collecting session and which had been brought to camp with the intention of being used again but were either lost or abandoned as de facto refuse.

Limpet Collecting Rates

This experiment also served another purpose, namely, to get some estimate, however rough, of limpet collecting rates. The limpet collecting experiment was conducted at rock skerries on the east coast of Oronsay over three 15 minute sessions, each involving three or four persons, totalling eleven 15 minute collecting episodes. The results of this experiment are shown in Table 48.[1] It should be noted that, although the sessions were relatively brief, the participants in the experiment were instructed not to collect at the fastest possible speed, but rather, at a rate which was physiologically comfortable and which could be sustained for longer periods of time, say, for one or two hours. In other words, these rates do not represent collecting at breakneck speeds which could only be sustained for short periods of time.

Looking at the rates in terms of the number of limpets per hour, it can be seen that collecting rates did vary over a considerable range, from 312 to 652 limpets per

[1] The results of this experiment are also reported in Jones (1984: 271-273).

Table 48. Experimental Results of Limpet Collecting Rates, Based on Eleven 15 Minute Collecting Episodes during Three Collecting Sessions (Sessions 1 & 2 in July 1981, and Session 3 in March 1982).

Session	Person	No. of Limpets	Seconds Per Limpet	No. of Limpets/ Minute	Hour
1	1	153	5.9	10.2	612
	2	125	7.2	8.3	500
	3	81	11.1	5.4	324
	4	78	11.5	5.2	312
2	1	123	7.3	8.2	492
	2	118	7.6	7.9	472
	3	95	9.5	6.3	380
	4	126	7.1	8.4	504
3	1	163	5.5	10.9	652
	2	157	5.7	10.5	628
	3	131	6.9	8.7	524
Average based on 2 3/4 man-hours:		1350	7.3	8.2	491

hour. This is due to a number of factors. One is the fact that not all participants had equal amounts of experience in collecting limpets (although no one had any experience in using S.L.H. prior to the first session). In terms of prior experience (albeit using modern implements such as knives and the archaeologist's all-purpose trowel), participant 1 had the most and participant 2 rather less, while participants 3 and 4 had almost none. Interestingly, this ranking is reflected exactly if the personal rates based on all three sessions are calculated -- 585.3 limpets per hour for participant 1, 533.3 for participant 2, and 409.3 and 408.0 for participants 3 and 4 respectively. But perhaps too much should not be made of this factor of experience since another personal factor -- namely, the rate of work which each person finds physiologically comfortable -- is also involved. Indeed, it could be argued that, beyond a certain minimal amount of experience, differences in personal rates reflect more this latter factor than the amount of limpet collecting experience that one has. In any case, another very important factor is the location of limpet collecting. Not all parts of the coast and not all rock skerries of similar size are equal in terms of the abundance of limpets (see Jones 1984: 28-36, Tables 19 & 25). Of course, the relative richness of a particular collecting locality will directly affect limpet collecting rates. For example, after having chosen the locality for the third session and having carried out the timed collection, all participants had the immediate impression that this area was much richer than the two localities used previously; and indeed, when the limpets were counted, the results confirmed this impression, since this session produced the highest personal rates for all participants.

Regardless of these possible reasons for the variability in the observed collecting rates, we may simply note that rates range from just over 300 limpets per hour to approximately twice this figure, with an overall average of just below 500 limpets per hour. Of course, these figures must be taken as a crude estimate of what might have been the collecting rates for the Mesolithic inhabitants of Oronsay. On the one hand, their greater experience at collecting limpets using S.L.H., in combination with their greater knowledge of the local environment in terms of the location of good collecting localities, might well mean that our experimental rates are rather low by comparison. On the other hand however, offsetting this would presumably be the fact that we were collecting from unexploited (by humans) and thus relatively abundant populations of limpets, whereas they would have been collecting from exploited, and perhaps even heavily exploited, populations.[1] In any case, the point of the experiment was not to attempt to replicate precisely the limpet collecting rates of the Mesolithic occupants of

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[1] This question of whether or not the limpet remains in the Oronsay middens reflect a heavily exploited population is discussed at some length by Jones (1984: 195-205).

Oronsay -- indeed, such an objective would be futile if not absurd, since one could never determine if one's collecting rates matched those of prehistoric peoples! The aim of the experiment was simply to obtain a "ballpark" estimate of collecting rates, however crude it might be; and in this sense, the results of the experiment are sufficiently informative.

Thus, if we take the figure of 500 limpets/person/hour as a rough but not unreasonable estimate, then, for example, three or four people collecting over a period of two to three hours at extreme low tide could gather somewhere between 3,000 and 6,000 limpets each collecting day. How many people this could feed would of course depend on the relative dietary contribution of limpets and therefore on the average number of limpets eaten per person per day. However, one general observation does seem warranted from these experimentally derived collection estimates -- namely, it would appear that each person could easily collect considerably more limpets than they themselves would consume in one day, and probably a sufficient supply for two or three (or perhaps even more) average person-days of consumption. In other words, these collection estimates suggest that task-specific subgroups could readily collect a day's supply of limpets for all of the occupants at a settlement. This statement is of course not exactly startling, in light of ethnographic and ethnoarchaeological observations regarding shellfish collecting (e.g. Meehan 1982: 143-145). Nevertheless, on the basis of these experimentally derived collection rates alone -- that is, until similar estimates are obtained for other variables such as the relative dietary contribution of limpets and the size of the groups who occupied the Oronsay middens -- nothing more specific can be said regarding limpet collecting at this time.

Stone Limpet Scoops and Limpet Processing

Were Limpet Scoops Used to Scoop Limpets?

Aside from the time spent collecting limpets, time must also be spent each day processing whatever has been collected since, like dog whelks and other shellfish, the limpet meat must be separated from the shell before it can be consumed. The most obvious way of achieving this with limpets is by boiling, but, given a boiling technology involving skin containers and boiling stones, this method would in fact be a comparatively difficult and time-consuming way of processing large quantities of limpets. With such a boiling technology therefore, the use of a special tool for removing limpet meat from the shell makes perfect sense.

Despite this apparent need however, as is detailed in Appendix A, the functional connotation of Bishop's (1914: 95) term "limpet scoop" has not been accepted by most other workers, and a number of other functional interpretations have been proposed for this class of Obanian artifacts. This is in spite of the fact that Bishop is the only researcher to have carried out some experimental work to obtain evidence in support of his interpretation. Nevertheless, it must be admitted that Bishop's experiments were very limited in scope. In order to clarify some of the issues regarding limpet scoops, I conducted some further experiments. Unfortunately, I carried out this work at a time when I too was sceptical of Bishop's experimental results. Indeed, it was only when I began to muse over my own experimental results and to investigate systematically all of the arguments that I came to appreciate more fully the soundness of Bishop's arguments. Thus, my own experimental work was not an attempt to replicate Bishop's results or to test directly his model of the life history of a limpet scoop. Notwithstanding these limitations, the results that I obtained do have some bearing on the matter and do indeed offer some support for Bishop's interpretation.

If we assume for the moment that limpet scoops were used for removing limpet meat from the shell, then the characteristic rounded and bevelled ends of these implements could arise in one of three alternative ways:[1]

(A) unmodified elongated beach pebbles (i.e. P.S.L.S.) were used for scooping out limpets for a sufficient length of time to acquire the characteristic bevelled end and were then discarded;

(B) P.S.L.S. were purposefully ground in order to produce a sharp bevelled end and then used in this form as limpet scoops, with the use resulting in the dulling and rounding of the utilized end;

(C) the ends of P.S.L.S. were first of all flaked, producing a sharp end-flaked pebble (or U.S.L.S.), which were then used to scoop limpets until they wore down into the classic rounded and bevelled form, at which point they were discarded.

Alternative C is of course Bishop's model. My experiments were concerned with alternatives A and B, since it seemed to me at the time that removing limpets from the shell could not produce the amount of wear on the pebble that Bishop's model suggests.

Concerning alternative A, five unmodified P.S.L.S. were used to scoop 50 limpets each. The first observation to make from this exercise is that even scooping this small number of limpets did in fact produce noticeable, albeit rather slight, signs of wear on the pebble. One of these P.S.L.S. was then used to scoop another 150 limpets and, not surprisingly, this resulted in even more noticeable wear. The end of the pebble did not, however, begin to acquire the rounded and bevelled form of S.L.S., and therefore, it seems that this experiment would cast some doubt on the validity of alternative A. Of course, it must be conceded that a much greater amount of use (say, scooping several thousand limpets) might be required before the

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[1] Since my experiments solely concerned S.L.S., this discussion will specifically refer to objects of this material, but the general thrust of the arguments would apply equally to antler and bone.

classic S.L.S. form was attained, and until such an experiment is conducted, preferably on several P.S.L.S., this caution must be kept in mind.

At any rate, the second observation to make is that unmodified P.S.L.S. can indeed be used to remove limpet meat from the shell. However, their effectiveness for this purpose varied depending on the thickness of the utilized end of the pebble -- a relatively fine, thin end was much better than a stout one. The implication of this is that modifying the end of the pebble so as to thin (in effect, to sharpen) it would produce a more effective tool. This observation is a more serious objection to alternative A and indicates that alternatives B or C would seem to be more likely models of the life history of a limpet scoop. And another objection to alternative A is that, if true, one would expect to find in the middens forms which represent an intergrading series in terms of the amount of wear on the end of the pebble, from P.S.L.S. with no signs of use on the one extreme to classic S.L.S. on the other. Clearly though, this is not the case -- items are either unmodified P.S.L.S. or classic S.L.S., and no forms which would represent intervening degrees of use are found.

Given that the preceding experiment suggests that thinning the utilized end of a pebble is preferable, one way by which this could be achieved is by grinding the end to produce a thinner, sharper end. Using relatively coarse grinding stones collected from the storm beach at Port na Luinge on Oronsay, 20 elongated beach pebbles[1] were bifacially ground (Plate 8); all of these were mudstones, except for three which were harder metamorphic rocks with quartzite inclusions, and they cover a variety of sizes in terms of overall length but especially in terms of the

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[1] Although 20 pebbles were used in the S.L.S. manufacturing experiment, one pebble (No. 21) was bifacially ground on both ends, so that the number of pebbles used is effectively 21. However, one pebble (No. 1) was a trial effort and so was not subject to the same experimental controls as were the others. Hence, this pebble is not included in the more specific results reported here, so the sample for these results is actually 20.

width and thickness of the ends. The result of this grinding is that the end becomes bifacially bevelled (see Plate 9), but unlike the classic limpet scoop form, it is not rounded in profile but rather it has a relatively thin, sharp edge. Even though pebbles with a relatively wide or thick end remain rather difficult to use in comparison with thinner ones, all pebbles do benefit from this process and the result is an improved limpet scooping tool (Plate 10). Thus, this experiment confirmed the impression obtained from the P.S.L.S. experiment that modifying the end of a pebble so as to thin it makes a more effective tool.

Can then alternative B be considered a satisfying and valid model of the life history of a limpet scoop? Despite the success of this experiment in at least one sense, the answer must be: probably not. First of all, grinding the pebbles into shape took between approximately 6 and 15 minutes per pebble, with an average manufacturing time of just under 10 minutes (Table 49). This involves enough time and effort that one begins to doubt whether the improved effectiveness of the tool is worth it. After all, unmodified P.S.L.S. do work as limpet scoops and by selecting only the better specimens (i.e. those with a relatively narrow and thin end), one wonders whether improvements in effectiveness gained by bifacially grinding pebbles is sufficient to warrant the time and effort expended in manufacturing. Related to this is the fact that, although improved somewhat by being ground, pebbles with a thick end remained rather difficult to use. Yet similar specimens are found in the Oronsay middens, and one wonders why someone would expend effort grinding a pebble into shape when the end result is such a slight improvement. Once again, why not select only the narrower, thinner P.S.L.S. and grind these ones into S.L.S.? Thirdly, the pattern of use-wear on these objects was not so much blunting by rounding of the end into the classic S.L.S. form as a truncation of the sharp end of the pebble. As with the P.S.L.S. however, we must caution that a much greater amount of use of these pebbles would be required before being certain about this

Table 49. Experimental Results of Stone Limpet Scoop Manufacturing, Showing the Manufacturing Time Required to Produce a Sharp Bevelled End and the Amount of Reduction in Pebble Length for Twenty Experimental Specimens.

S.L.S. No.	Maximum Length (mm): Before	After	Reduction in Length (mm)	Manuf. Time
7	104.6	104.5	0.1	8:12
8	82.7	82.6	0.1	13:43
9	73.0	72.8	0.2	7:31
10	74.0	73.9	0.1	14:30
11	70.4	69.9	0.5	8:32
12	64.4	64.2	0.2	7:23
13	58.6	58.5	0.1	7:07
14	57.5	57.4	0.1	9:59
15	46.3	46.2	0.1	10:45
16	76.9	76.2	0.7	10:14
17	60.9	60.8	0.1	8:14
18	54.5	53.7	0.8	10:26
19	49.5	49.1	0.4	8:16
20	45.7	45.6	0.1	7:33
21A	71.9	71.0	0.9	7:25
21B	71.0	70.5	0.5	5:35
22	50.5	50.0	0.5	8:09
23	79.7	79.3	0.4	12:12
24	63.5	63.0	0.5	13:12
25	54.9	54.1	0.8	12:31
	Mean reduction in length:		0.36	
	Mean manufacturing time:			9:35

conclusion -- 150 limpets represent the maximum amount of use of these experimental S.L.S. (in two instances). Finally, if we ignore the last objection and suggest instead that truncation of the sharp end is simply an initial stage leading to rounding when subjected to further use, then we might expect to find at least a few S.L.S. which are still relatively sharp and represent specimens intermediate between unmanufactured S.L.S. (i.e. P.S.L.S.) and fully used S.L.S. Yet, no such intermediate forms -- that is, manufactured but only minimally used S.L.S. -- are found in Cnoc Coig. Of course, further experimental work could readily determine if additional use would result in a rounding of the truncated sharp ends of the pebbles. My impression is that it would not, but in any case, the balance of the evidence would appear to indicate that alternative B is an unlikely model of the sequence of manufacture and use of S.L.S.

What then can be said in favour of Bishop's model, even if the experimental work reported here does not directly test it? Bishop proposed that the end of a pebble was initially bifacially flaked to produce a sharp cutting edge, and this idea is appealing for a number of reasons. First of all, in contrast to the manufacturing time involved in grinding a pebble to produce a thin edge (see Table 49), the time required to remove a few flakes off the end of the pebble would be much less, presumably more in terms of a minute or two on average rather than 10 minutes. Secondly, the removal of several flakes off the end of the pebble would reduce its overall length by a considerable amount which, as noted above in Chapter 4 (p. 157), would account for the fact that the P.S.L.S. in Cnoc Coig are significantly longer than S.L.S. The grinding of P.S.L.S. into S.L.S. reduced the length of the 20 experimental pebbles by less than 1.0 mm in all cases, with an average of only 0.36 mm (see Table 49), and this indicated amount of reduction in pebble length would not even come close to accounting for the observed differences in length between P.S.L.S. and S.L.S. from Cnoc Coig (see Fig. 14). With the grinding model then, this observation would be an anomaly in need of explanation, whereas it makes perfect sense with Bishop's model. Thirdly, the resulting end-flaked pebble would have a much sharper cutting edge than ground ones, and such a sharp, jagged edge would indeed be very effective for cutting the adductor muscle to remove limpets from their shells. And importantly, this would almost certainly apply even to the pebbles with relatively broad or stout ends; in contrast, the grinding of such pebbles did not improve their efficacy by a significant amount. Finally and perhaps most importantly of all, there have been found in Cnoc Coig a few pebbles which do represent the intermediate forms between P.S.L.S. and fully used S.L.S. that one would expect from Bishop's model. Most notable are the nine end-flaked pebbles (U.S.L.S.) which conform precisely to Bishop's suggested initial form for S.L.S. In addition, there are a number of limpet scoops (both S.L.S. and B.L.S.) which are more or less classically rounded and bevelled, but on which one can clearly see that some flaking had occurred prior to the bevelling -- and in fact, even Breuil (1922: 267-271), who disagrees with Bishop's interpretation, draws attention to the presence of these flaked and then bevelled specimens in Obanian assemblages. In other words, these specimens represent limpet scoops which had not been used sufficiently to obliterate entirely traces of the initial flaking of these tools.

All of these considerations add support both to Bishop's limpet scoop interpretation in general and to his specific model of limpet scoop manufacture and use. Yet, although I am reasonably convinced that Bishop got it right, it must be admitted that further experimental work must be carried out in order to test directly Bishop's ideas. Of course, so far we have assumed that limpet scoops did indeed function as such and were not used for some other purpose. In order to put the final nail on the coffin and lay to rest once and for all this problem of the functional interpretation of these objects, which has haunted Obanian researchers for nearly a century, it would be desirable if a series of other experiments were designed and conducted in order to test the skin working hypothesis, which was originally put forward by Anderson (1895: 220, 222-223) and has been accepted by several researchers, and which offers the only serious alternative to Bishop's ideas. Until such work is done, the matter must unfortunately be left open. Nevertheless, the balance of the evidence must surely now be seen to be tipping in favour of the conclusion that limpet scoops were indeed used for scooping limpets!

Limpet Processing Rates

Finally, these limpet scooping experiments also served the purpose of obtaining a rough estimate of limpet processing rates. Much of the scooping of limpets was carried out in a series of timed experiments, spanning seven sessions involving between one and four participants, totalling 19 scooping episodes. The results are summarized in Table 50. As with collecting rates, we may note that limpet scooping rates vary considerably, from 227.8 to 463.5 limpets per hour.

In contrast to collecting, personal experience cannot be seen as a major factor affecting these rates because the P.S.L.S. scooping experiment referred to above was the only experience that any participant had prior to the first session, and this previous experience was rather minimal and equal for all participants. Once again, the participants were instructed to proceed at a pace which was physiologically comfortable, and this factor undoubtedly does contribute somewhat to the observed variability of the scooping rates. Nevertheless, this factor is presumably of rather minimal importance -- for example, if we look at the rates for participant 2, it can be seen that these more or less cover the full range observed for all the participants. And the average rates for the three major participants based on all episodes are quite similar: 349.8 limpets per hour for participant 1, 315.3 for participant 2, and 370.9 for participant 3. In any case,

Table 50. Experimental Results of Limpet Processing Rates, Based on Nineteen Scooping Episodes during Seven Scooping Sessions (Sessions 1 to 3 in July 1981, and Sessions 4 to 7 in March 1982).

Session	Person	No. of Limpets	Time	Secs./ Limpet	No. of Minute	Limpets/ Hour
1	1	30	6:12	12.4	4.8	290.3
	4	30	6:45	13.5	4.4	266.7
2	1	30	4:46	9.5	6.3	377.6
	2	30	4:57	9.9	6.1	363.6
	3	30	5:17	10.6	5.7	340.7
3	2	31	6:46	13.0	4.6	274.9
	3	32	5:16	9.9	6.1	364.6
4	1	30	4:25	8.8	6.8	407.5
	2	30	5:00	10.0	6.0	360.0
	3	30	3:53	7.7	7.7	463.5
5	1	30	5:12	10.4	5.8	346.2
	2	30	6:23	12.8	4.7	282.0
	3	30	5:18	10.6	5.7	339.6
6	2	59	8:49	9.0	6.7	401.5
	2	58	8:13	8.5	7.1	423.5
7	2	30	7:54	15.8	3.8	227.8
	2	30	5:29	11.0	5.5	328.3
	2	30	7:44	15.5	3.9	232.8
	2	30	6:52	13.7	4.4	262.1
Average based on totals:		630	115:11	11.0	5.5	328.2

the major factor which is undoubtedly responsible for most of the variability in the observed rates is the varying efficacy of the different S.L.S. It was quite obvious at the time of the experiments that some pebbles, most particularly those with a relatively thin and sharp end, were better than others; and this is reflected in their respective scooping rates. For example, S.L.S. No. 13 and No. 9 were two of the best pebbles and the rates obtained with them over four episodes each bear this out (average rates of 381.4 and 373.8 limpets per hour respectively).

Thus, the results obtained using the most effective S.L.S. indicate, as a rough average, a scooping rate of between 350 and 400 limpets per hour, while the overall average is somewhat less than this. Comparing these with collecting rates (Table 48), it can be seen that processing limpets is more time-consuming than actually collecting them -- not that this indicates all that much, since scooping limpets is a much less strenuous activity than clambering over rock skerries collecting them, and it can be carried out in comparatively comfortable and congenial surroundings. However, these data do suggest that, with limpets as indeed with many other food resources, processing time may well be as important as the actual collection time, even if it is a more leisurely task. In any case, these limpet collecting rates must be taken as being the crudest of estimates, since they are based on using ground S.L.S. which, as discussed previously, would seem to be less efficacious for the purpose than Bishop's suggested flaked S.L.S. It would be interesting to see how much more effective such flaked S.L.S. would be in terms of scooping rates, if the appropriate experiments were conducted. This final comment underscores the observation repeatedly made throughout this discussion that the experiments reported here indicate the potential value of following them up with further, more comprehensive experimental research into the problems posed by Obanian beach pebble artifacts.

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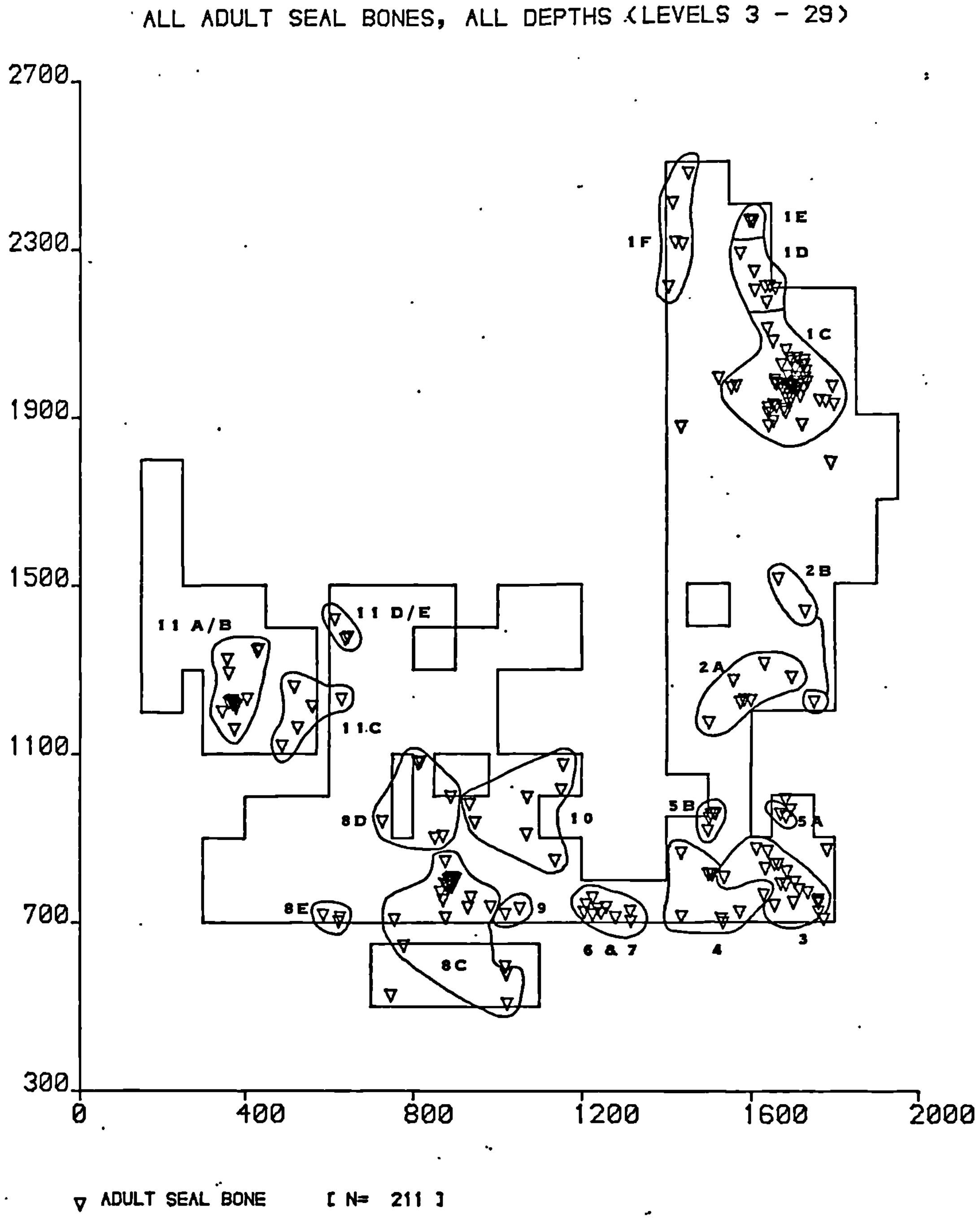

Figure 41. Horizontal Plot Showing the Distribution of All Adult Seal Bones in All Levels.

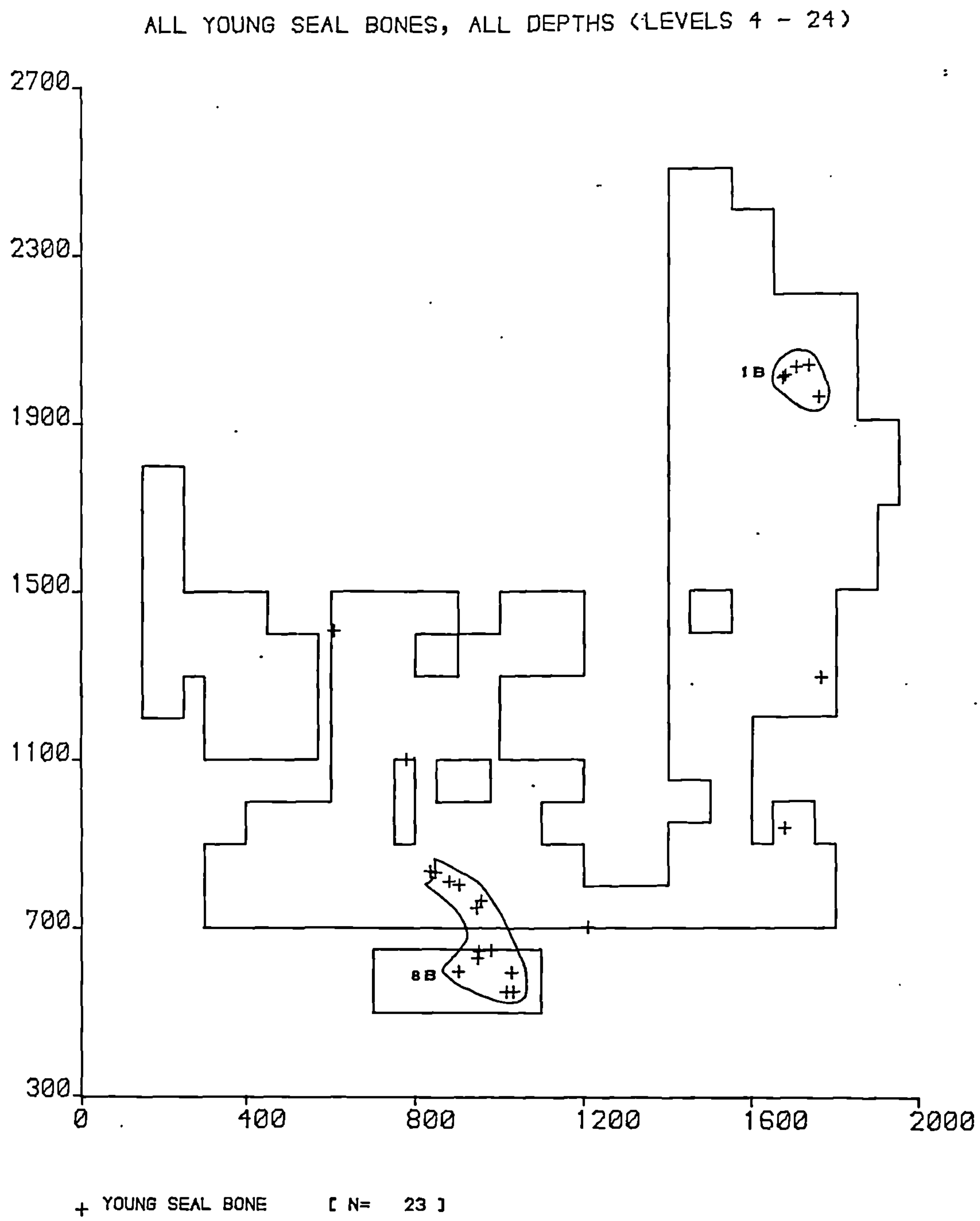

Figure 42. Horizontal Plot Showing the Distribution of All Young Seal Bones in All Levels.

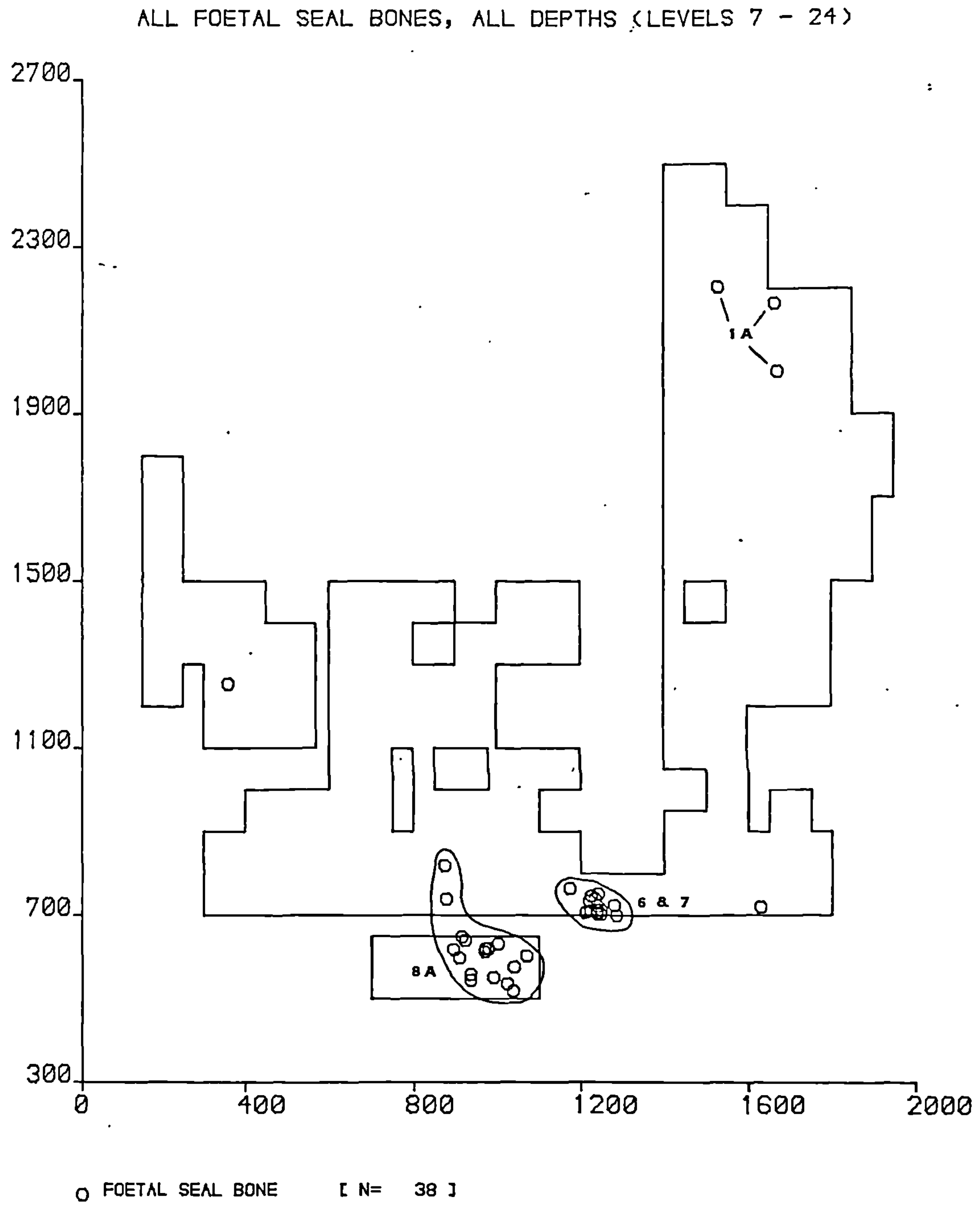

Figure 43. Horizontal Plot Showing the Distribution of All Foetal Seal Bones in All Levels.

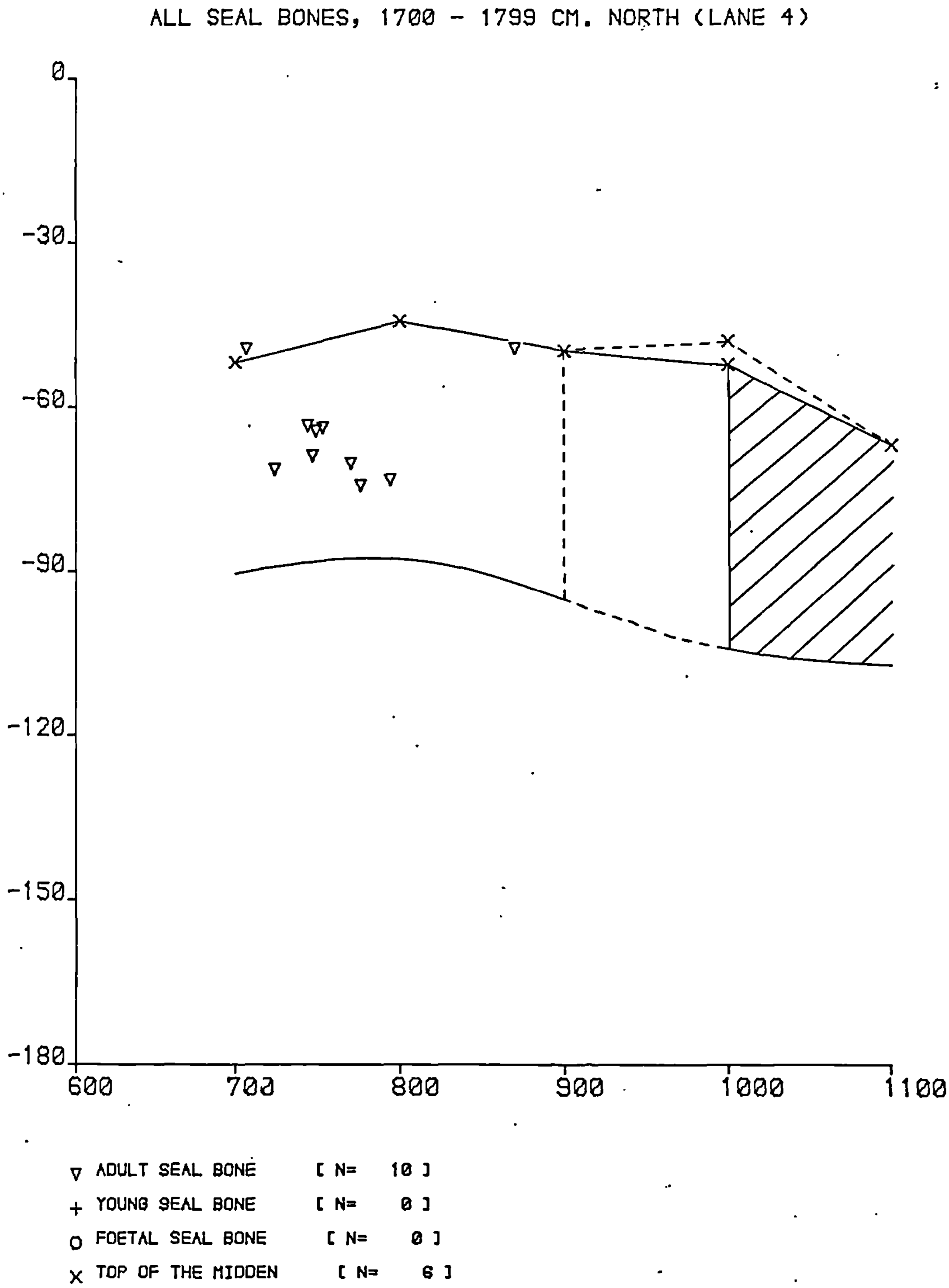

Figure 44. Sectional Plot Showing the Distribution of Seal Bones in Lane 4 (Eastern One-Third).

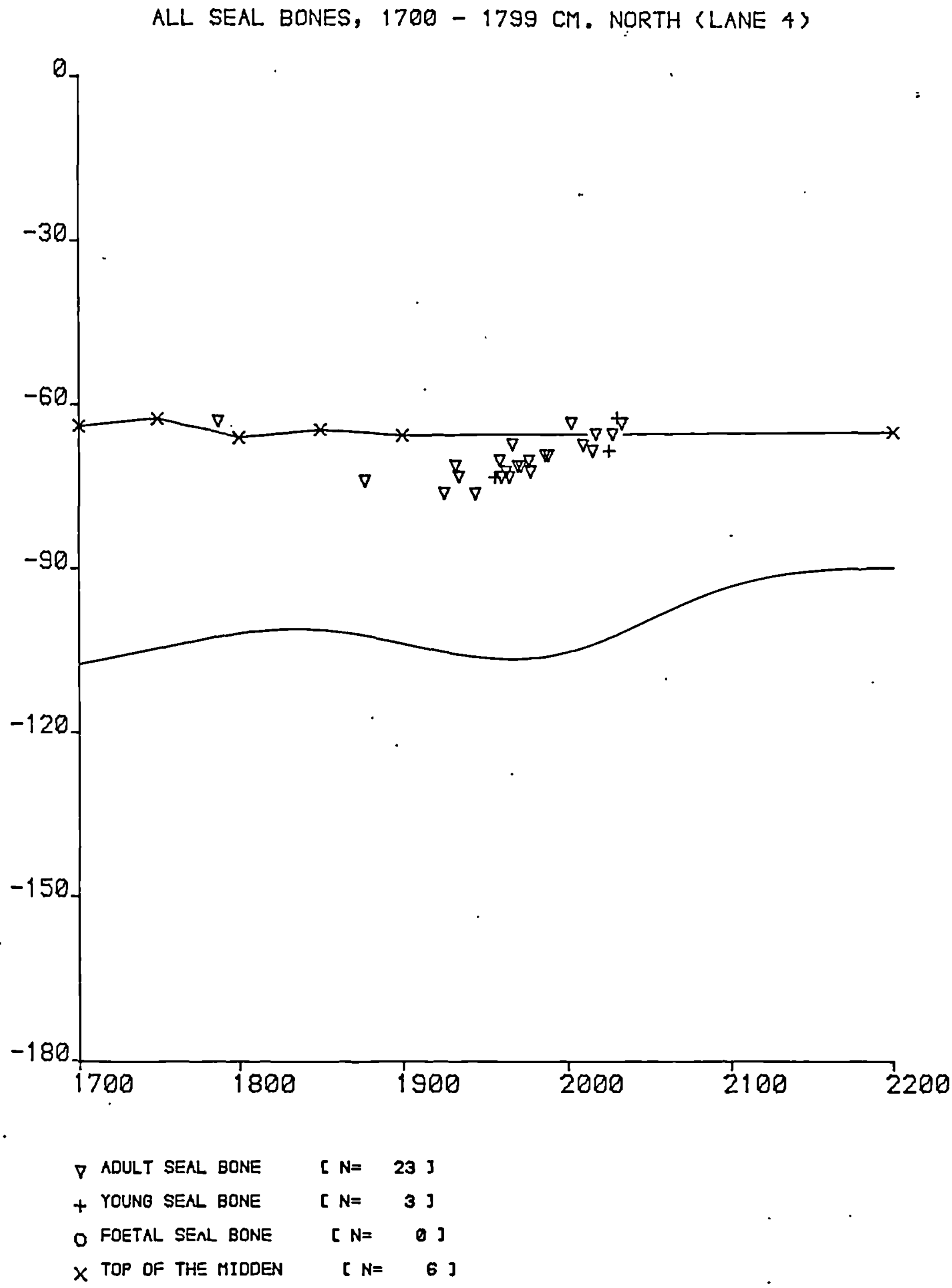

Figure 45. Sectional Plot Showing the Distribution of Seal Bones in Lane 4 (Western One-Third).

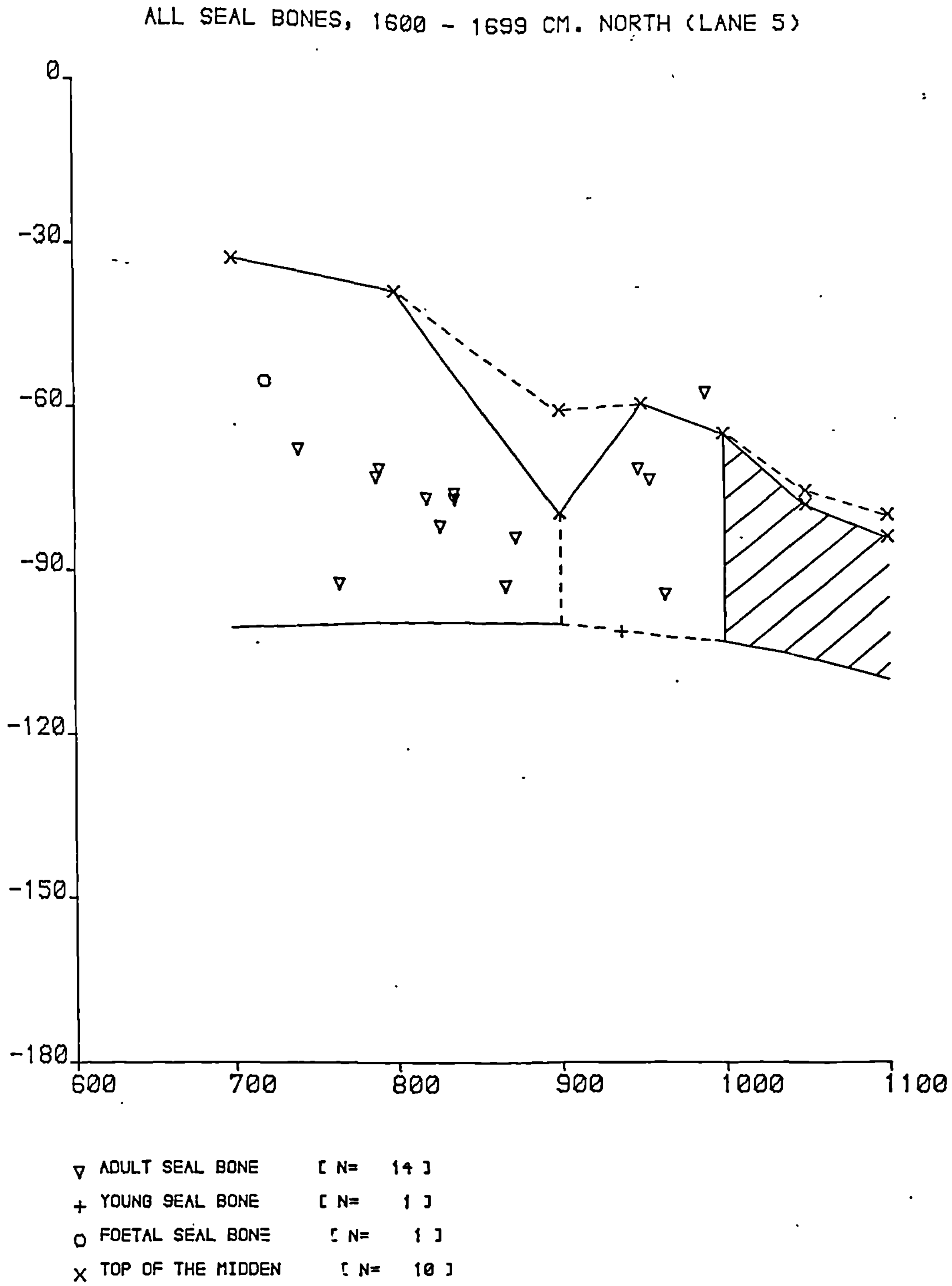

Figure 46. Sectional Plot Showing the Distribution of Seal Bones in Lane 5 (Eastern One-Third).

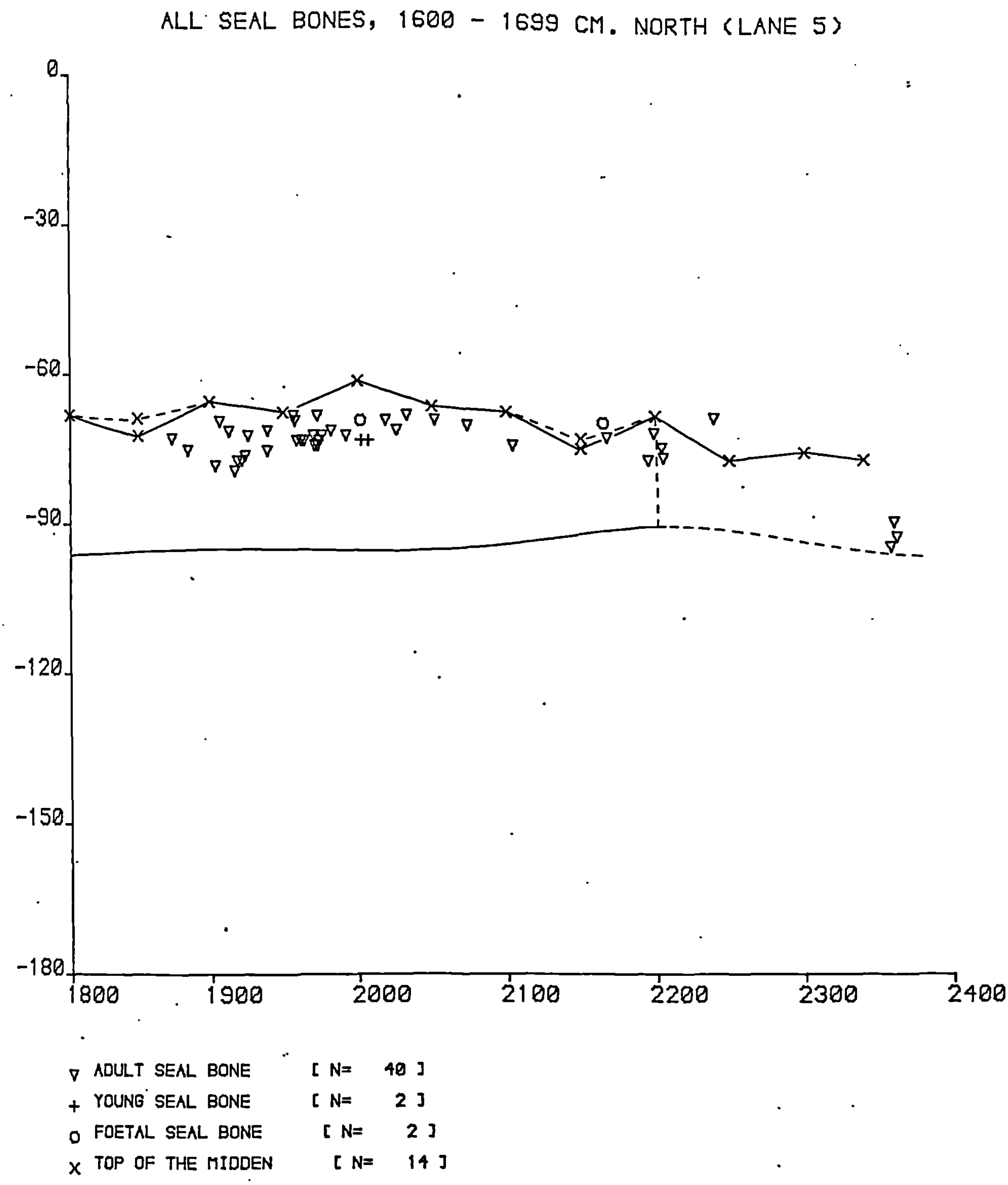

Figure 47. Sectional Plot Showing the Distribution of Seal Bones in Lane 5 (Western One-Third).

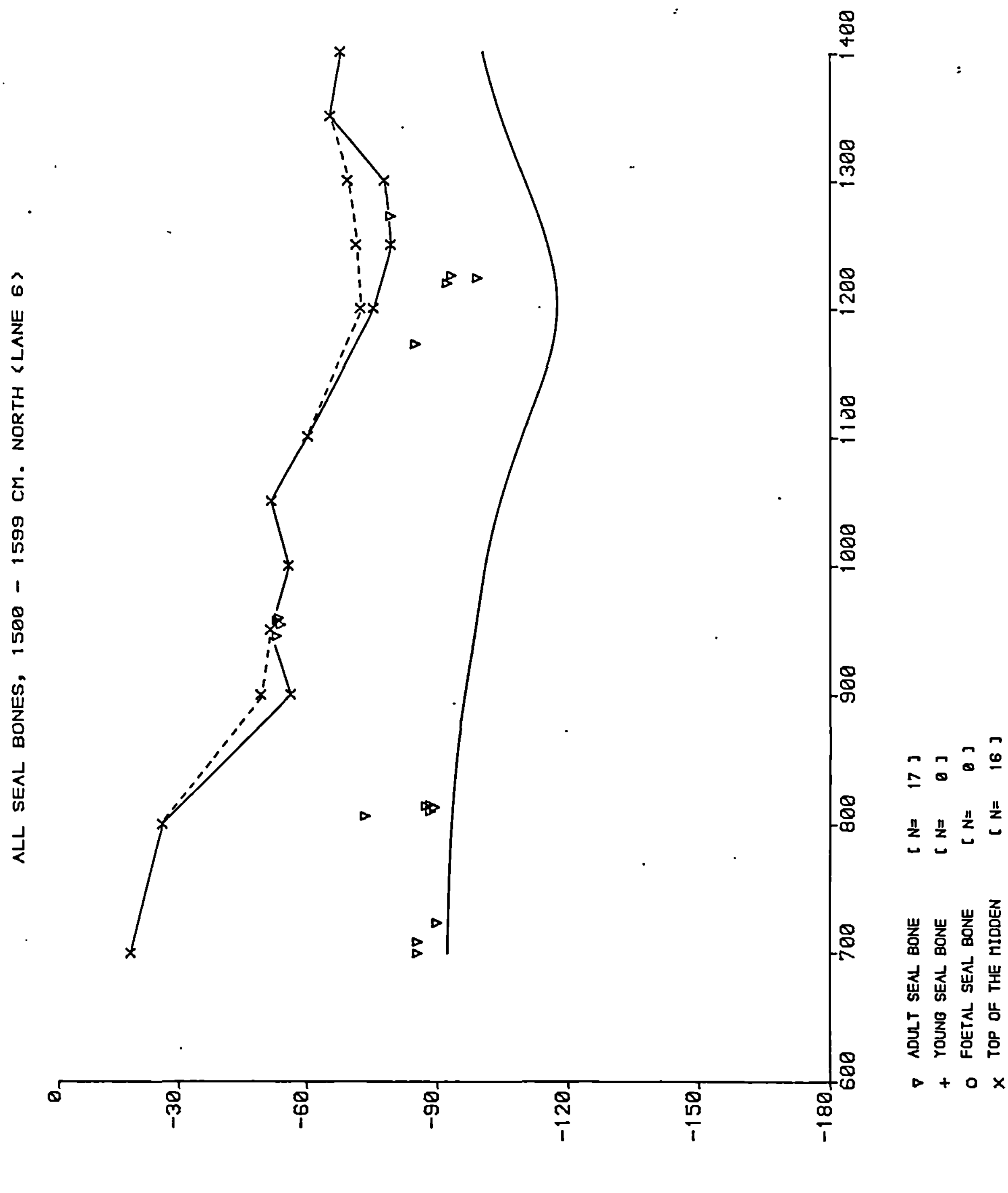

Figure 48. Sectional Plot Showing the Distribution of Seal Bones in Lane 6 (Eastern Half).

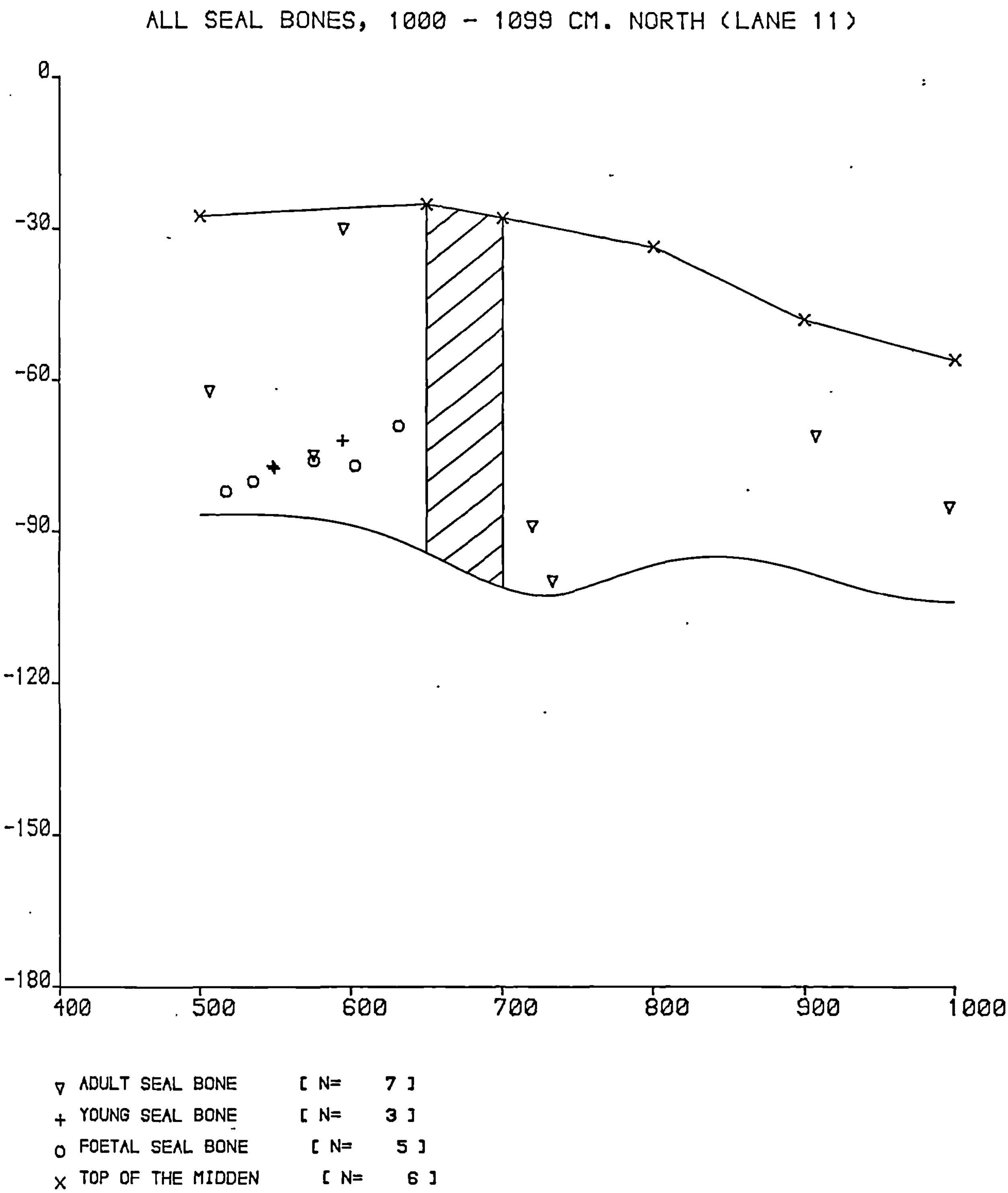

Figure 49. Sectional Plot Showing the Distribution of Seal Bones in Lane 11 (Eastern Half).

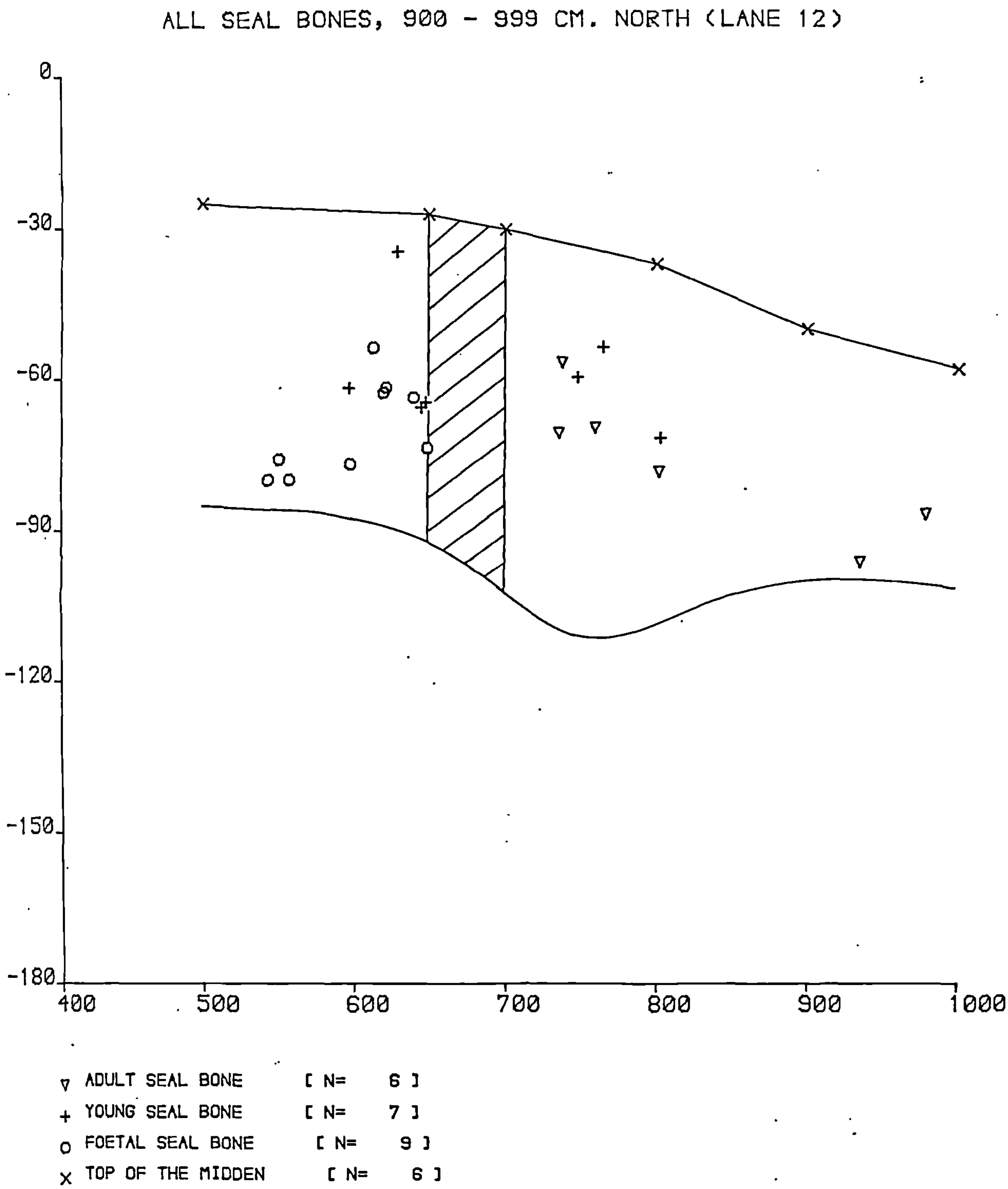

Figure 50. Sectional Plot Showing the Distribution of Seal Bones in Lane 12 (Eastern Half).

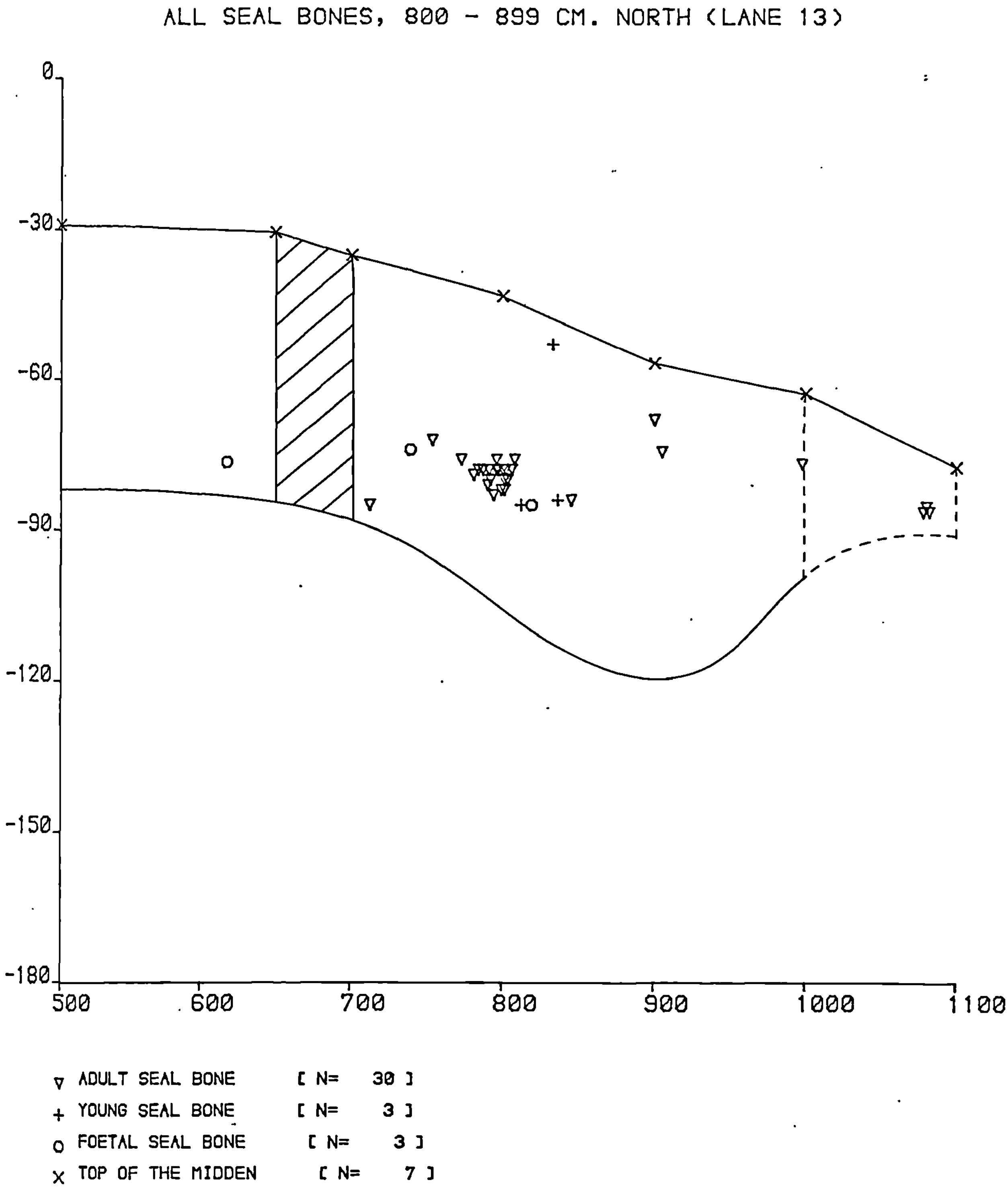

Figure 51. Sectional Plot Showing the Distribution of Seal Bones in Lane 13 (Eastern Half).

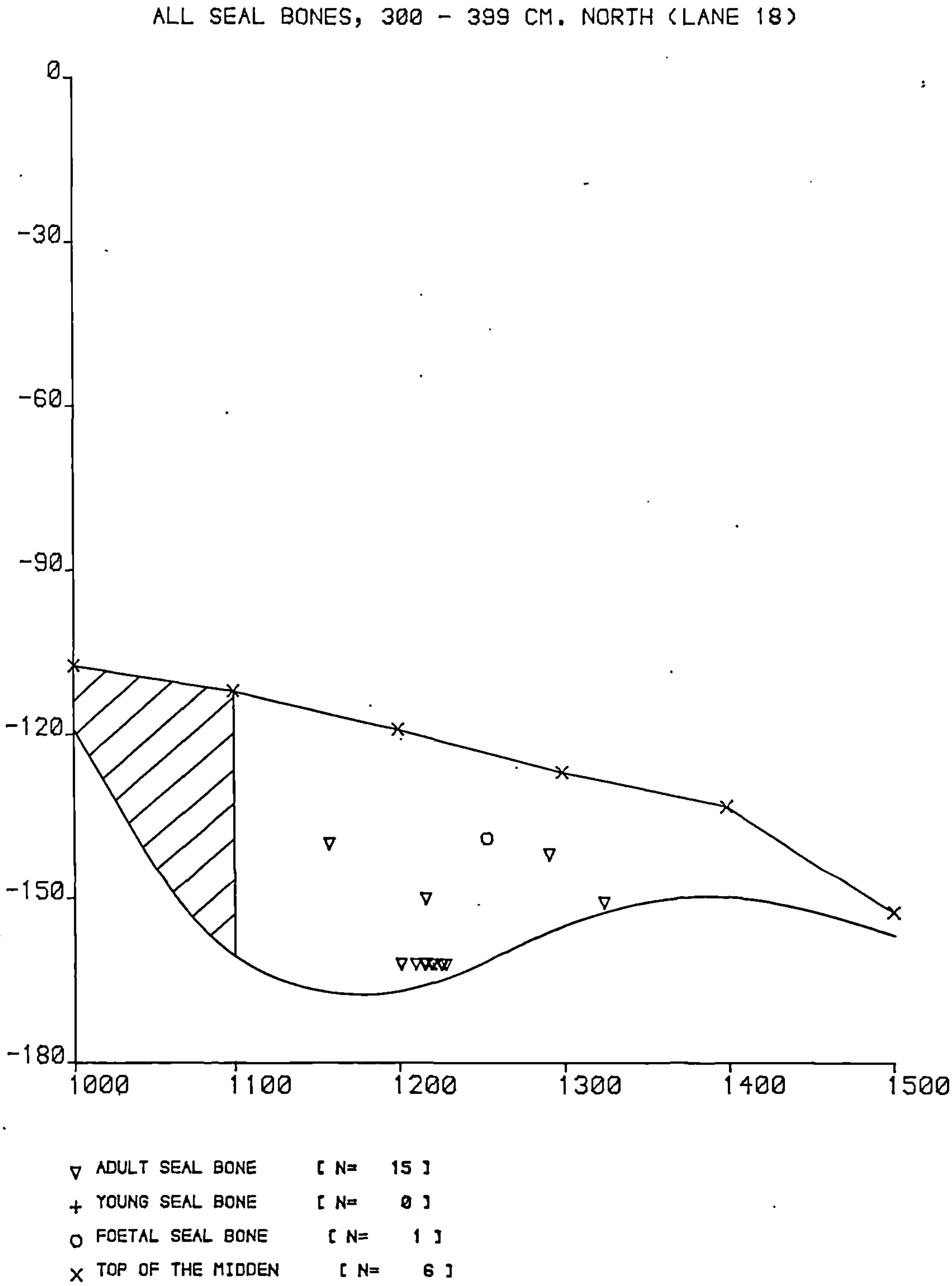

Figure 52. Sectional Plot Showing the Distribution of Seal Bones in Lane 18 (Western Half).

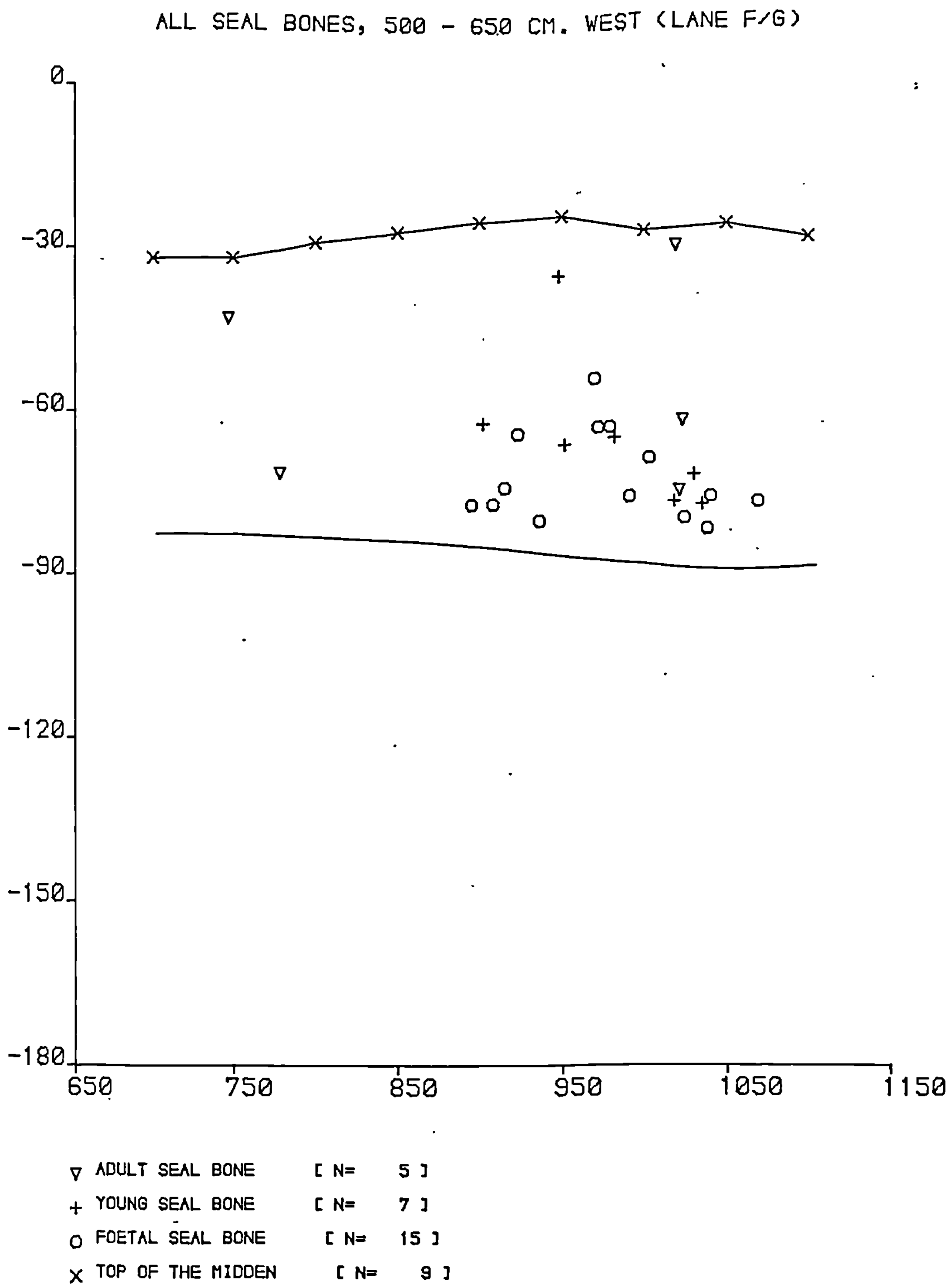

Figure 53. Sectional Plot Showing the Distribution of Seal Bones in Lane F/G.

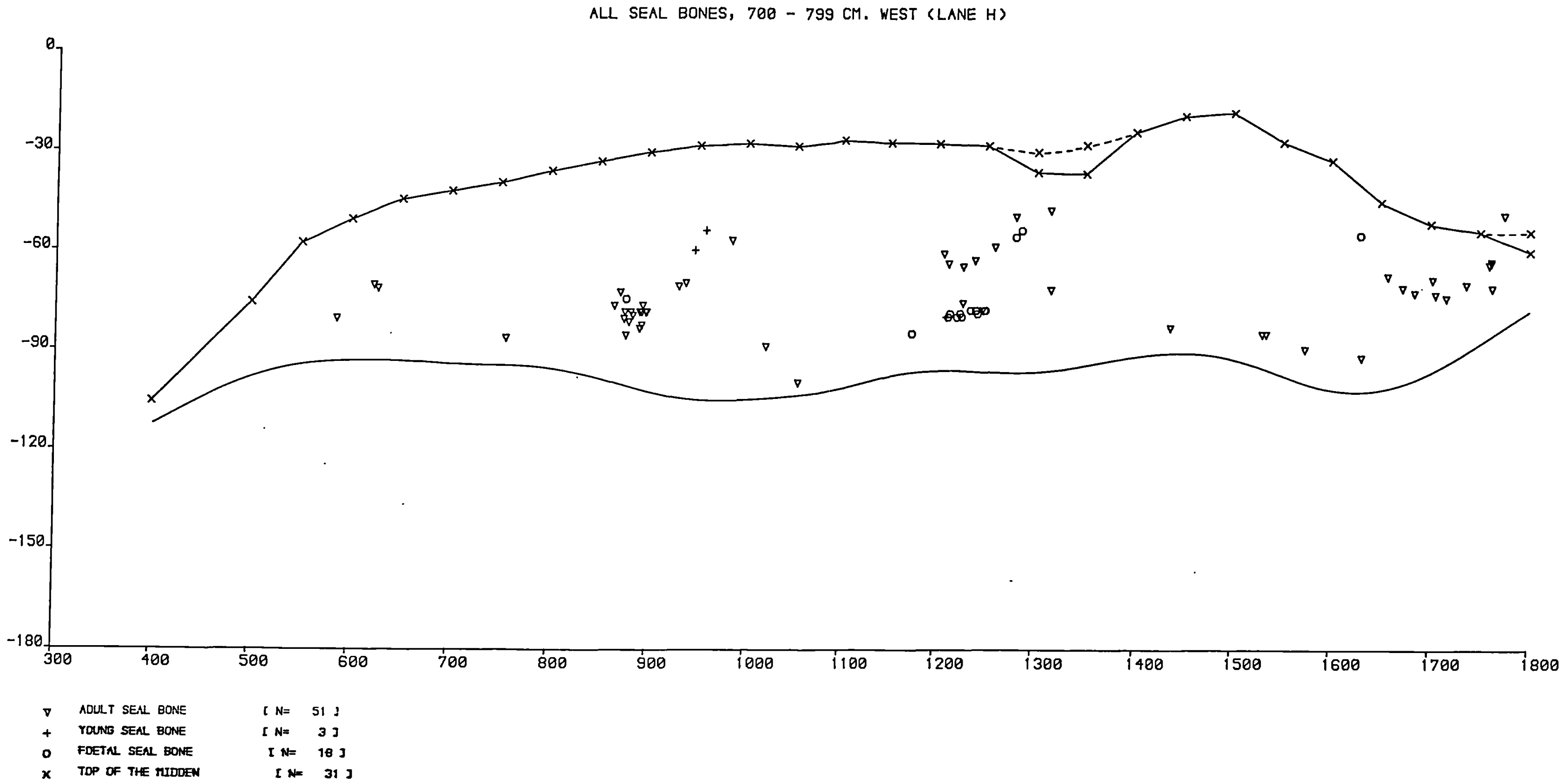

Figure 54. Sectional Plot Showing the Distribution of Seal Bones in Lane H.

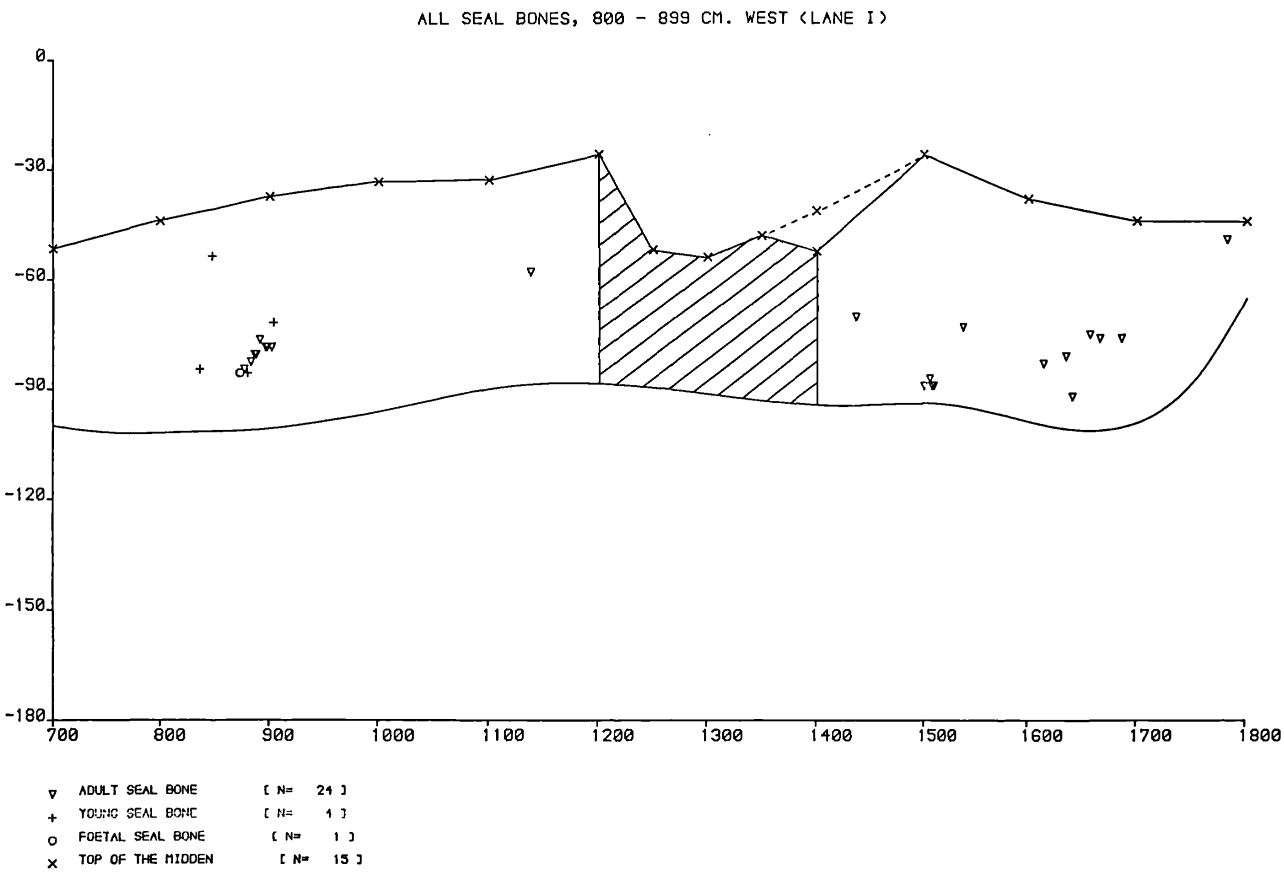

Figure 55. Sectional Plot Showing the Distribution of Seal Bones in Lane I (Northern Three-Quarters).

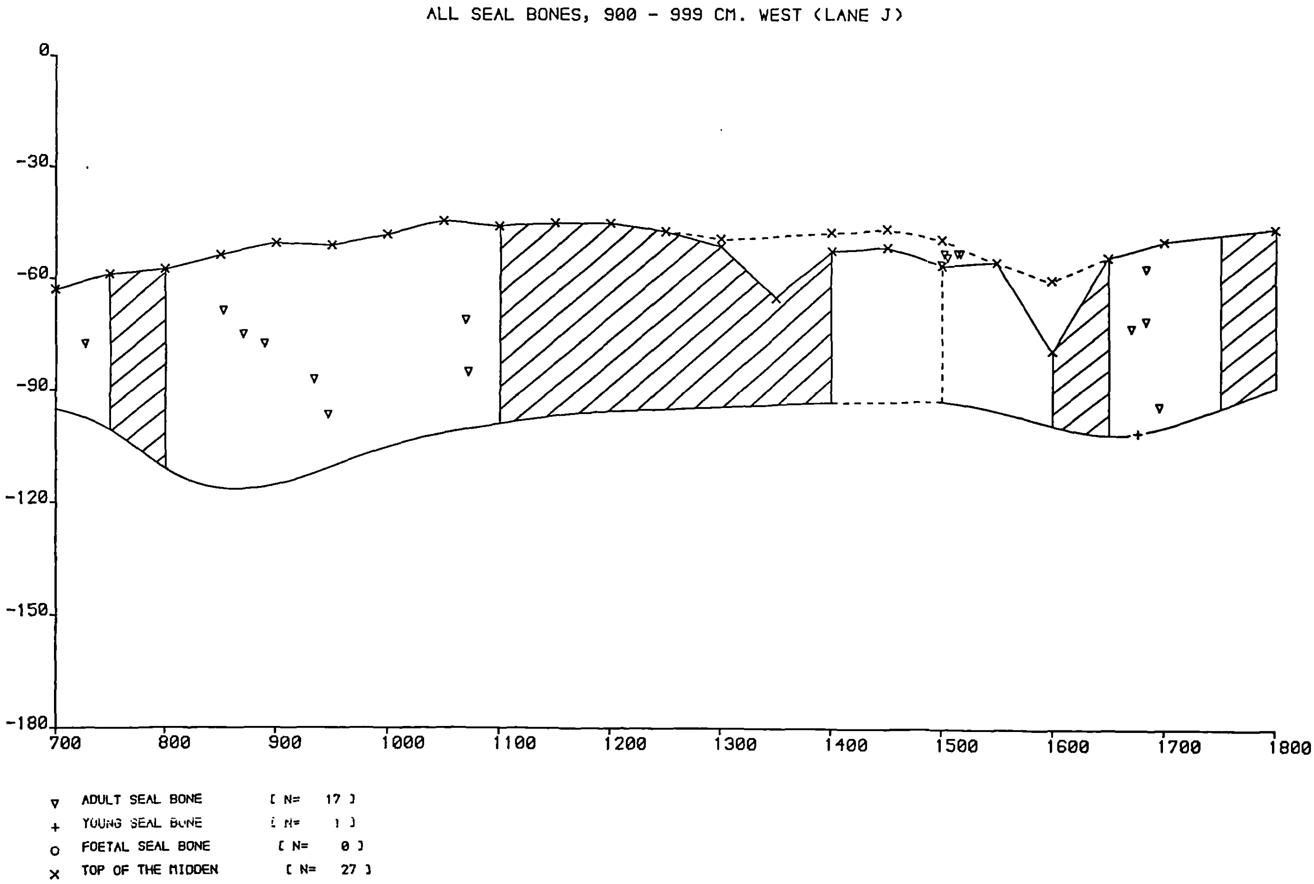

Figure 56. Sectional Plot Showing the Distribution of Seal Bones in Lane J (Northern Three-Quarters).

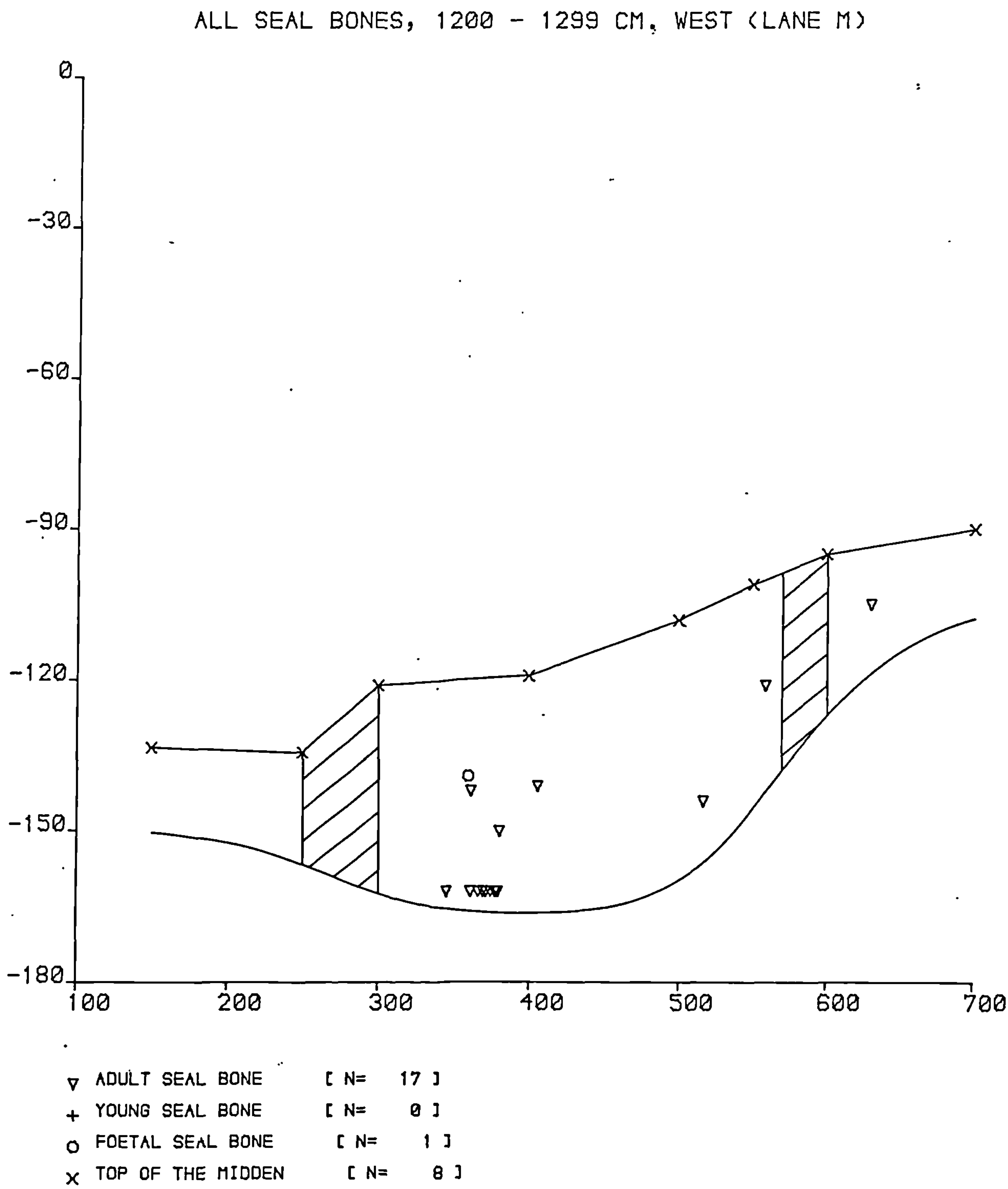

Figure 57. Sectional Plot Showing the Distribution of Seal Bones in Lane M (Southern One-Third).

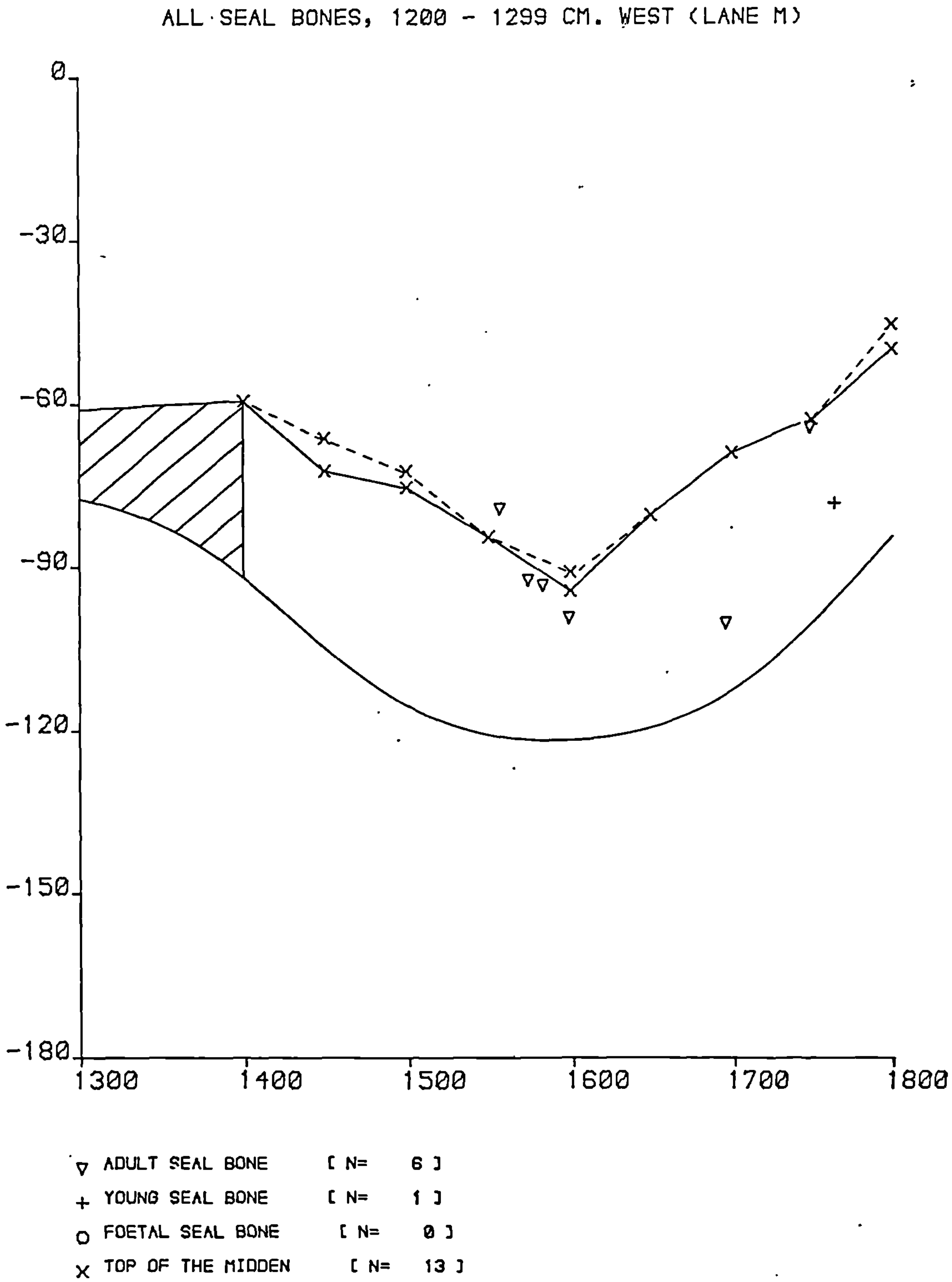

Figure 58. Sectional Plot Showing the Distribution of Seal Bones in Lane M (Northern One-Third).

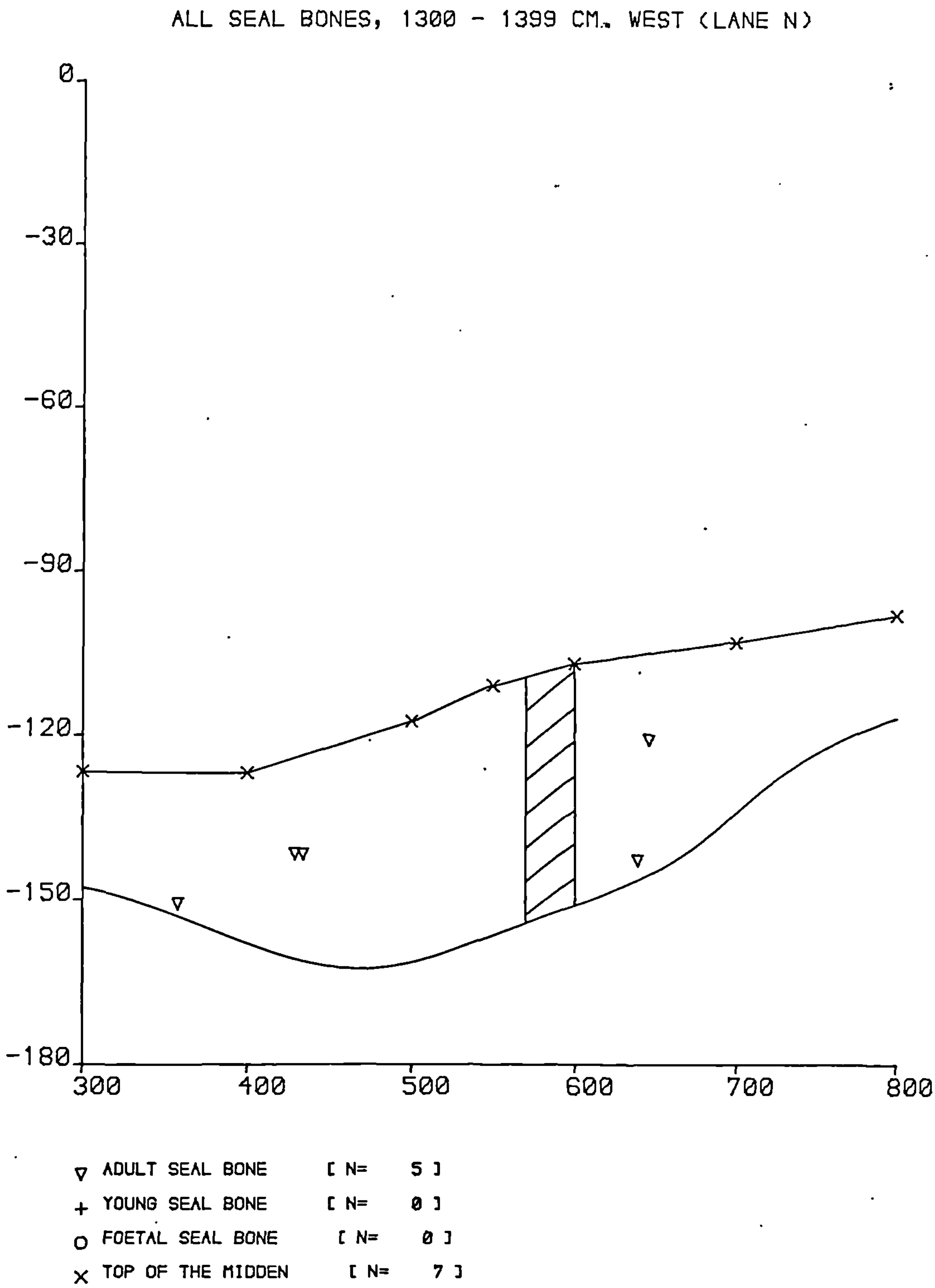

Figure 59. Sectional Plot Showing the Distribution of Seal Bones in Lane N (Southern One-Third).

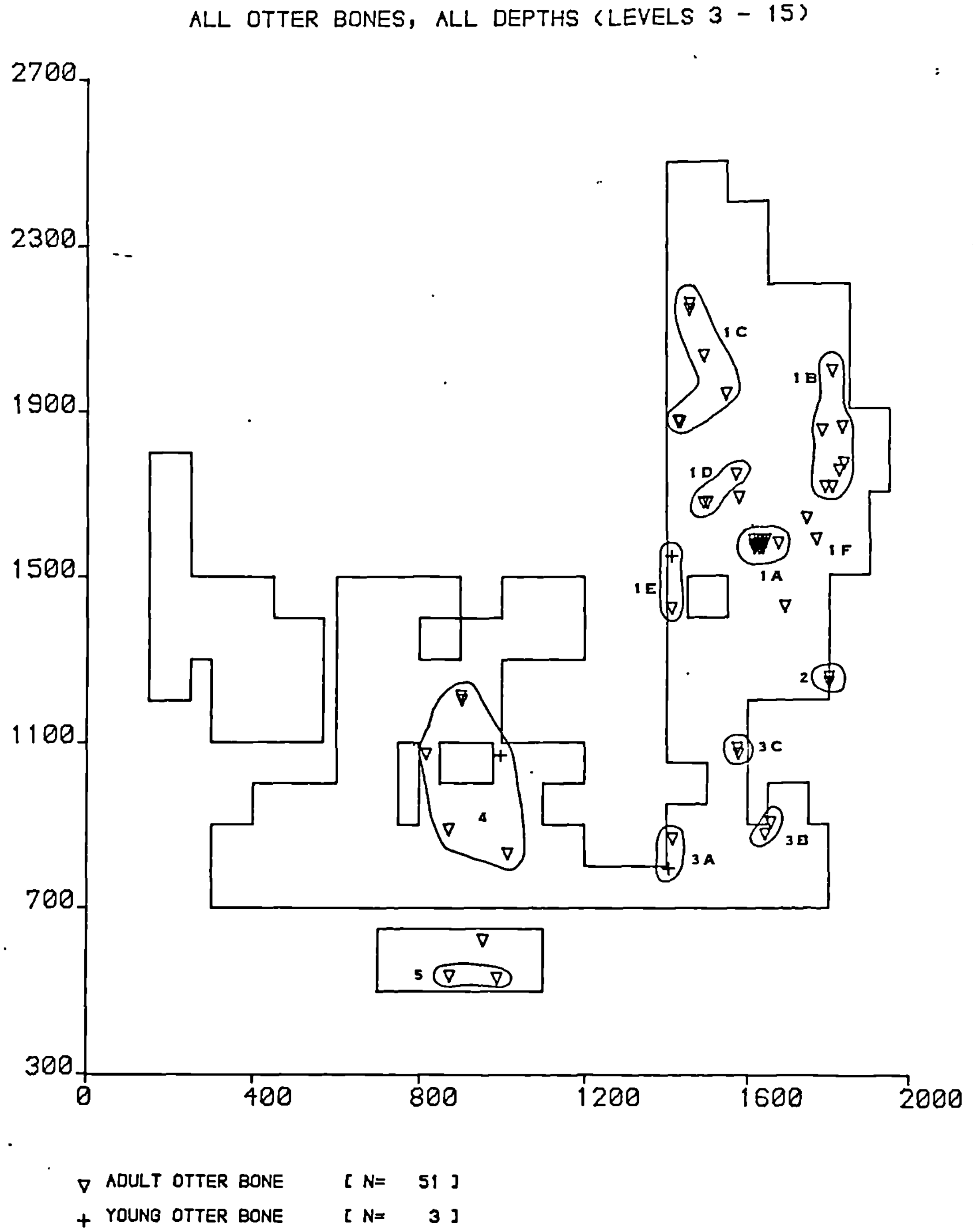

Figure 60. Horizontal Plot Showing the Distribution of All Otter Bones in All Levels.

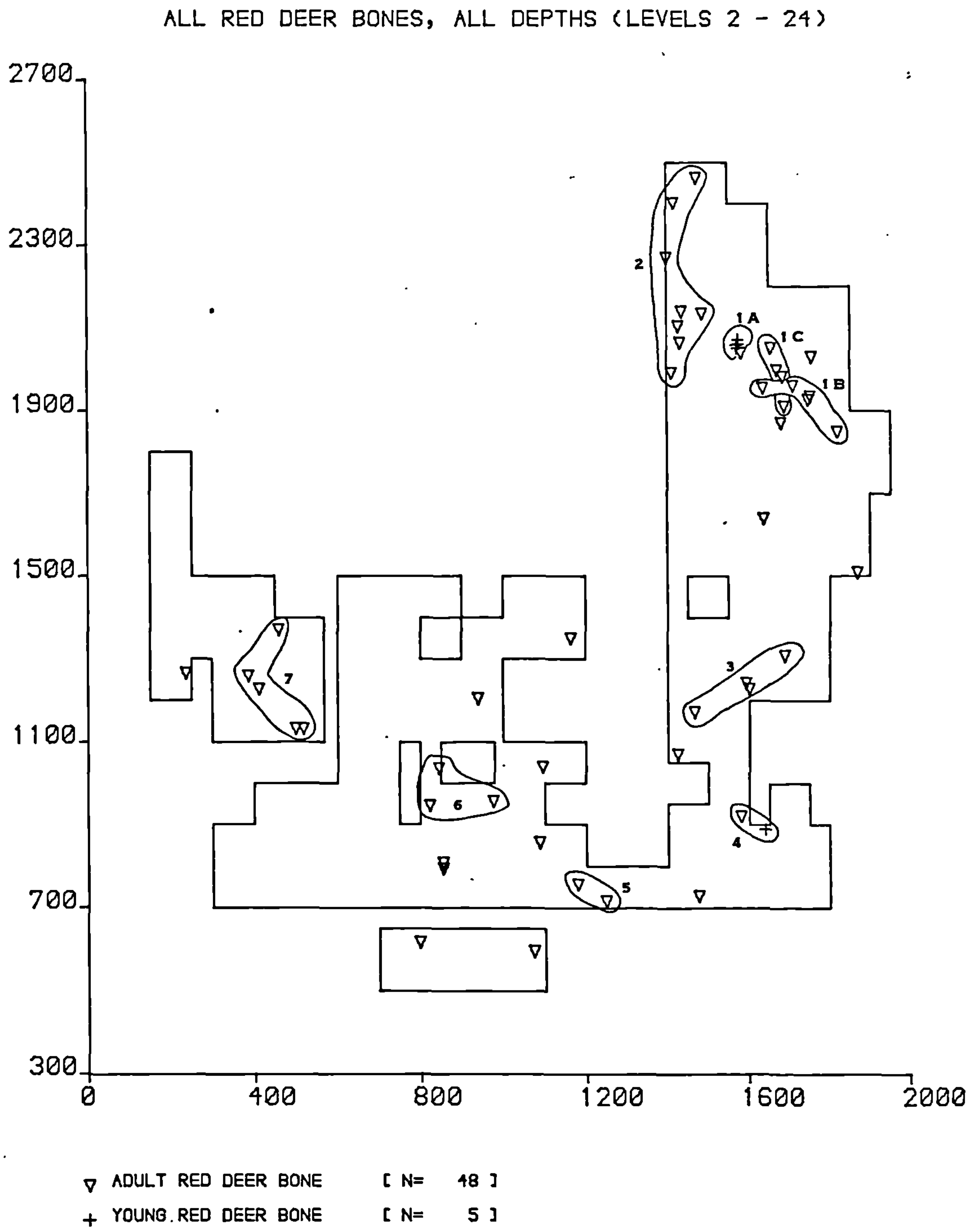

Figure 61. Horizontal Plot Showing the Distribution of All Red Deer Bones in All Levels.

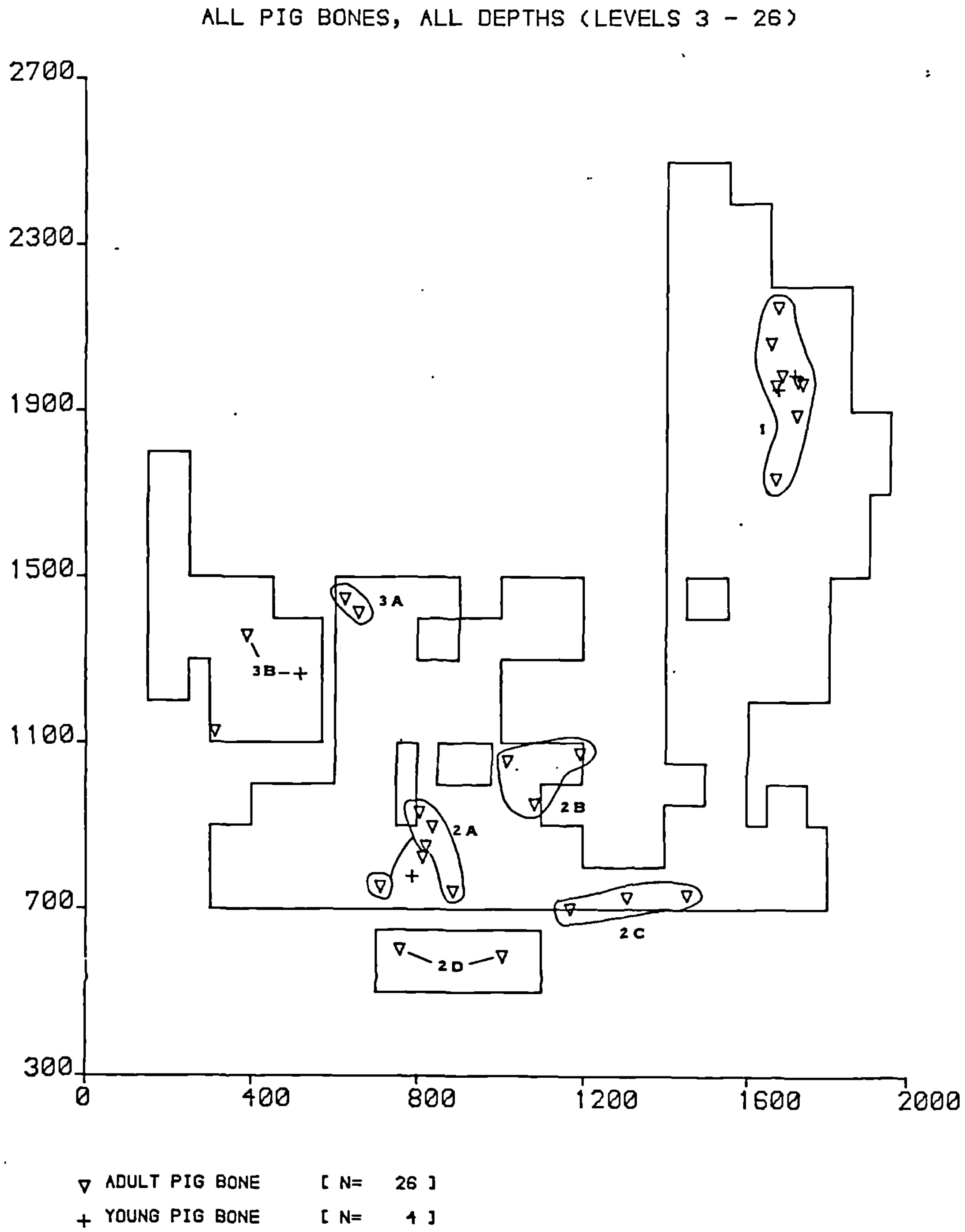

Figure 62. Horizontal Plot Showing the Distribution of All Pig Bones in All Levels.

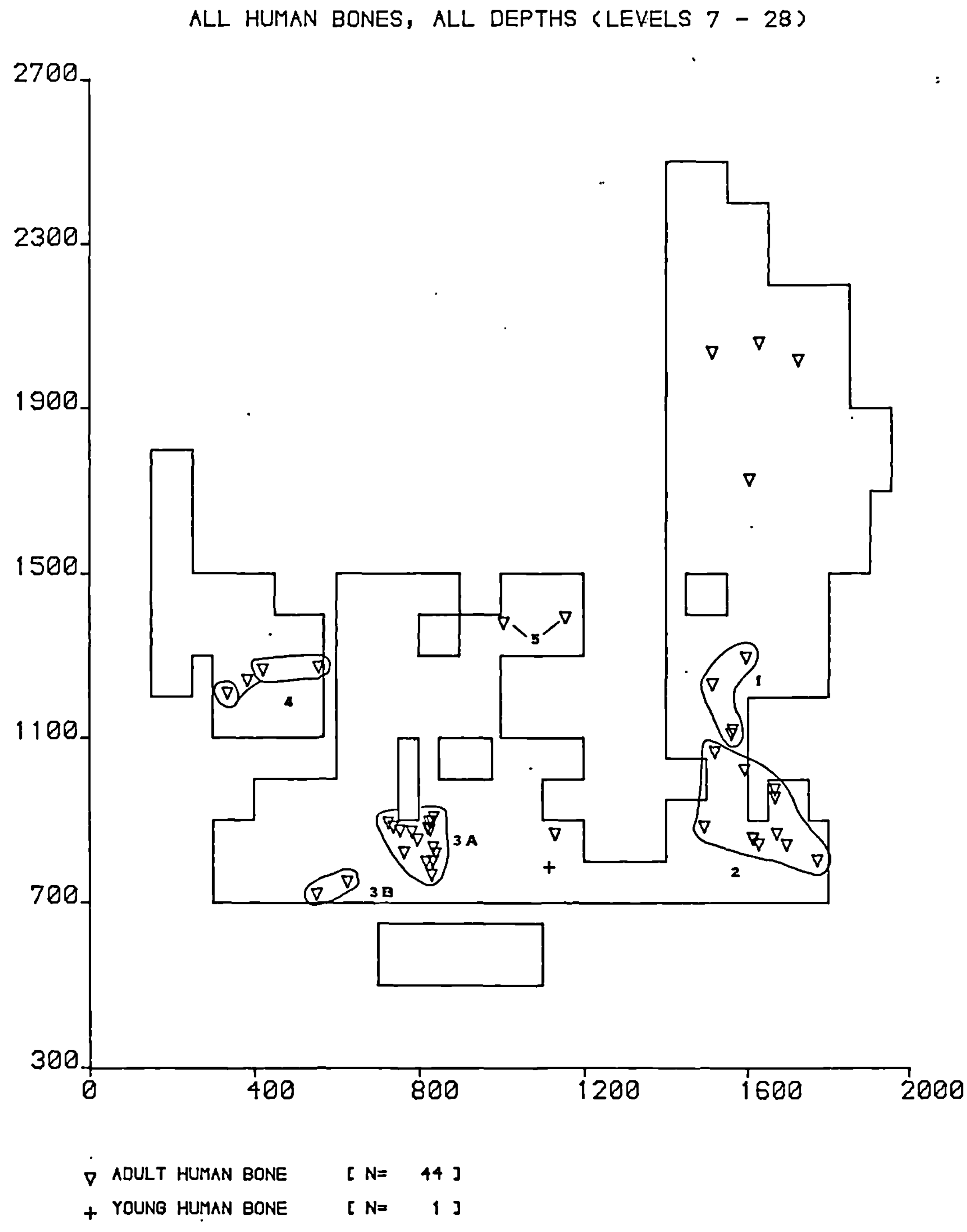

Figure 63. Horizontal Plot Showing the Distribution of All Human Bones in All Levels.

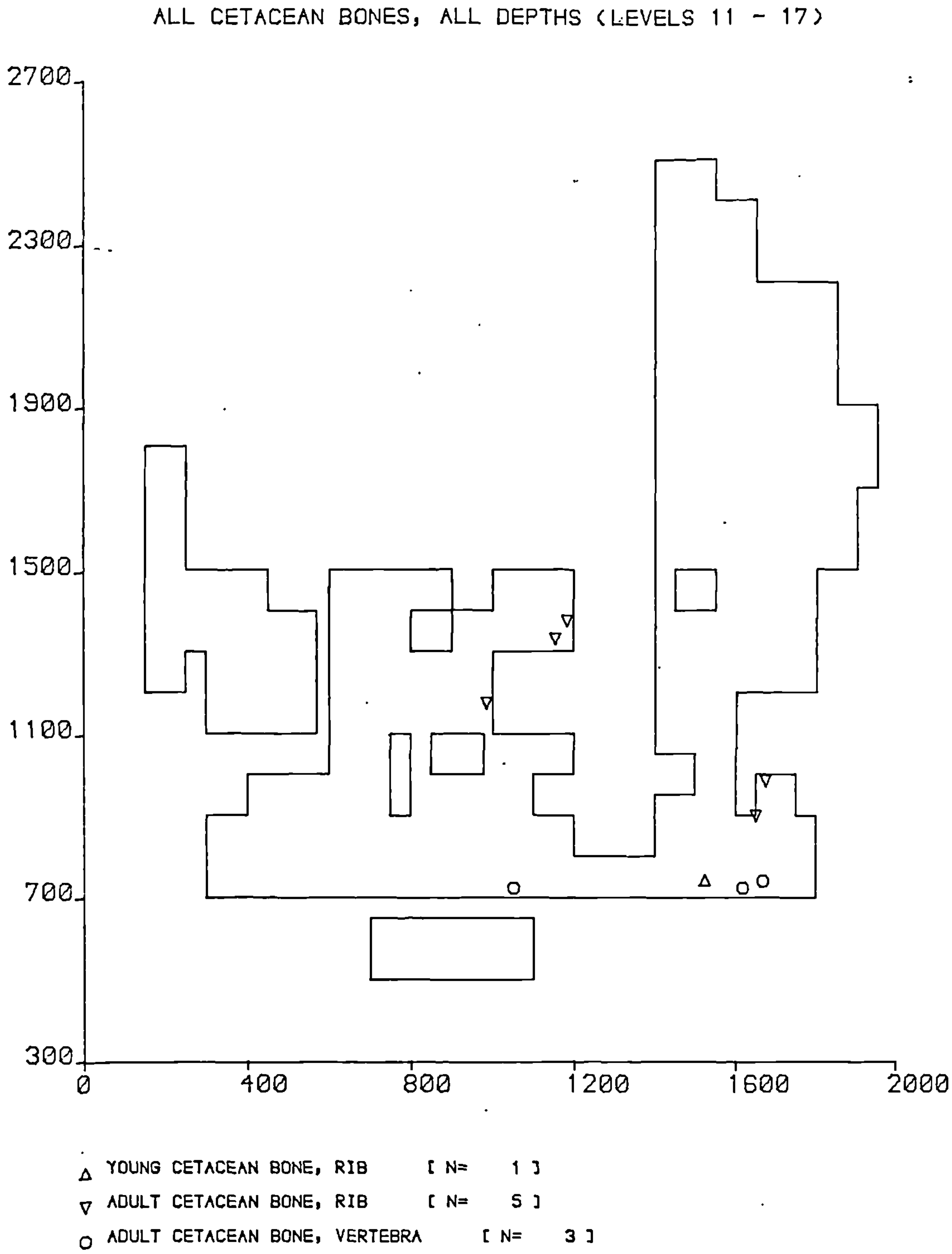

Figure 64. Horizontal Plot Showing the Distribution of All Cetacean Bones in All Levels.

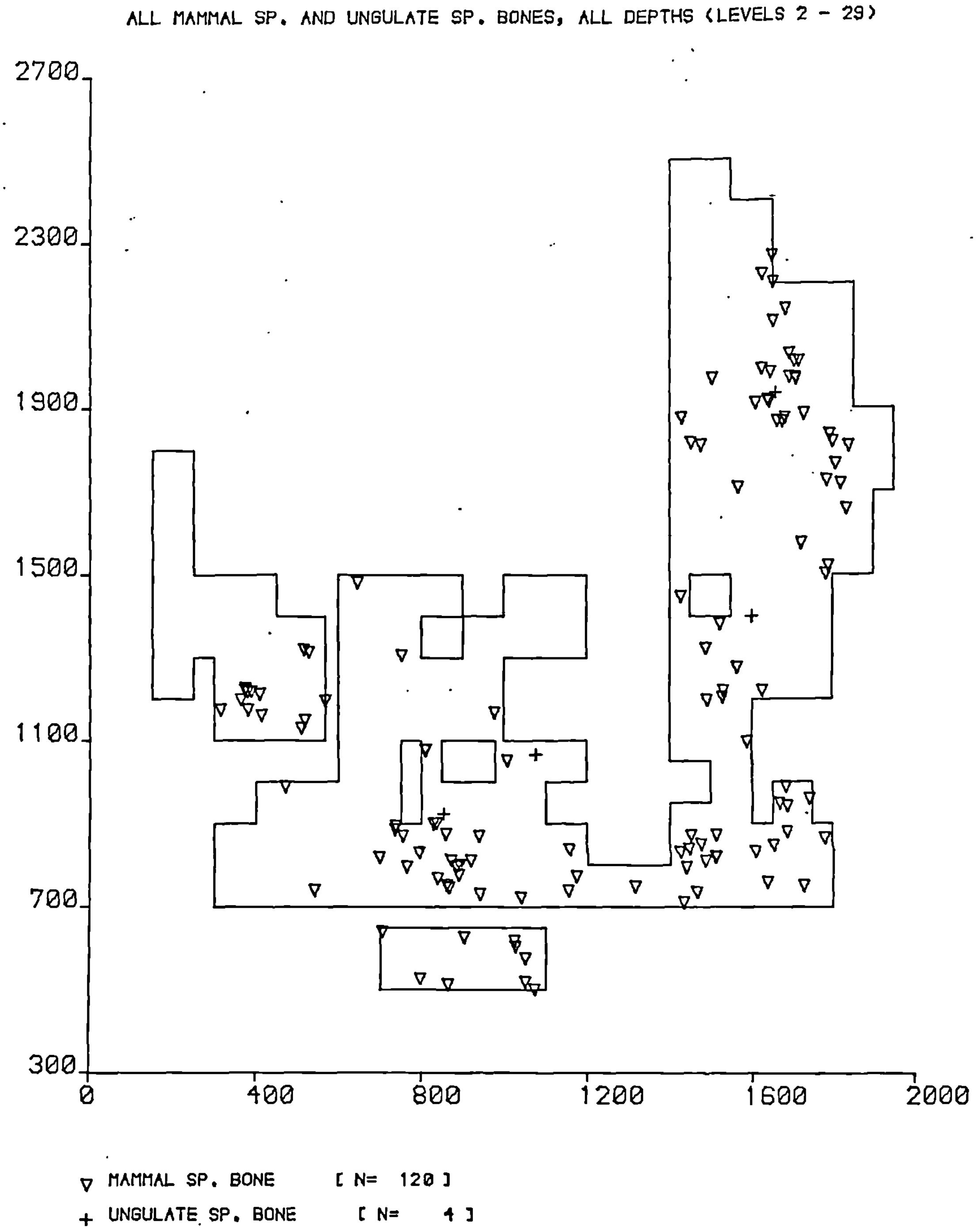

Figure 65. Horizontal Plot Showing the Distribution of All Ungulate and Mammal Bones of Indeterminate Species in All Levels.

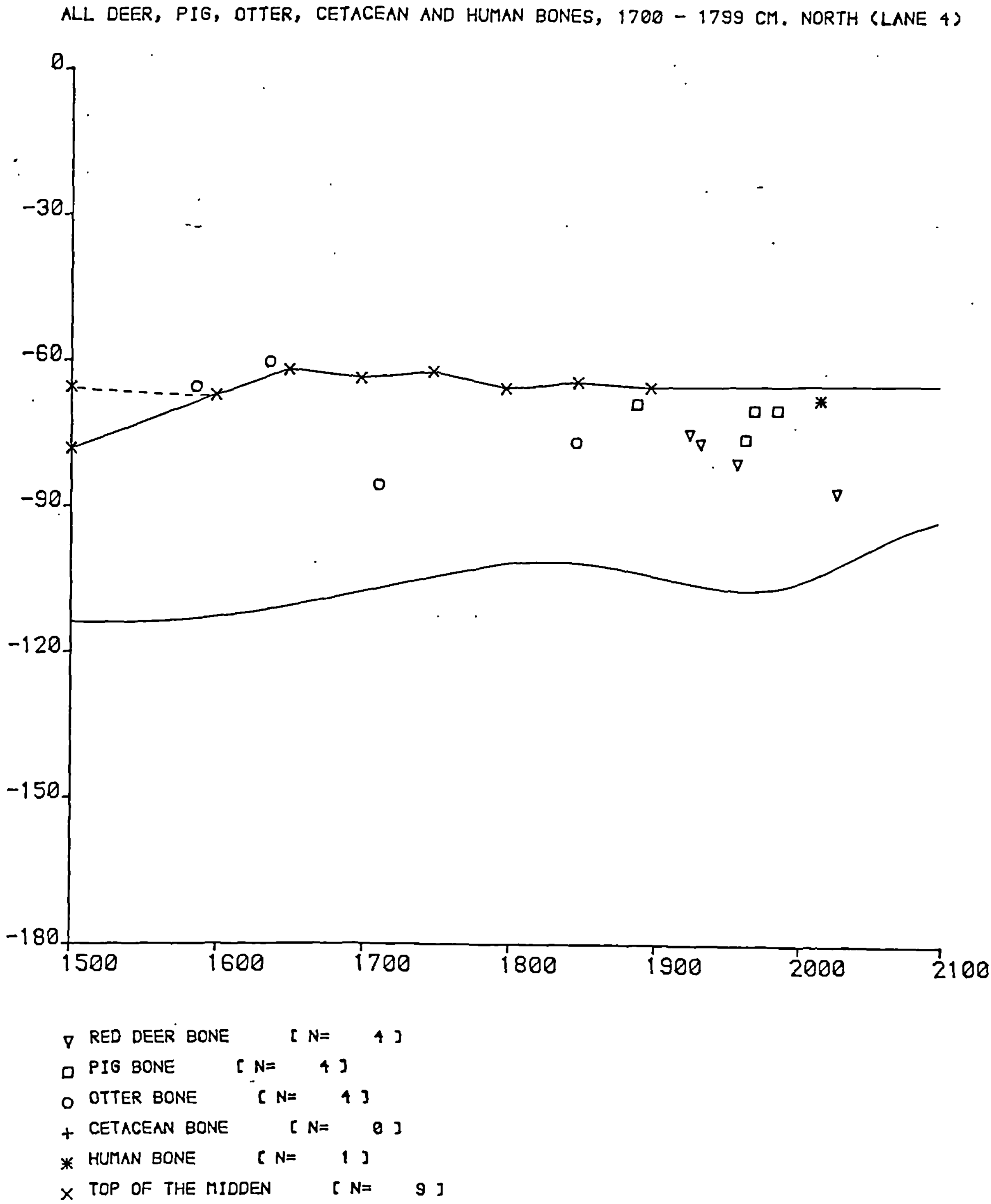

Figure 66. Sectional Plot Showing the Distribution of Red Deer, Pig, Otter, Cetacean and Human Bones in Lane 4 (Western Half).

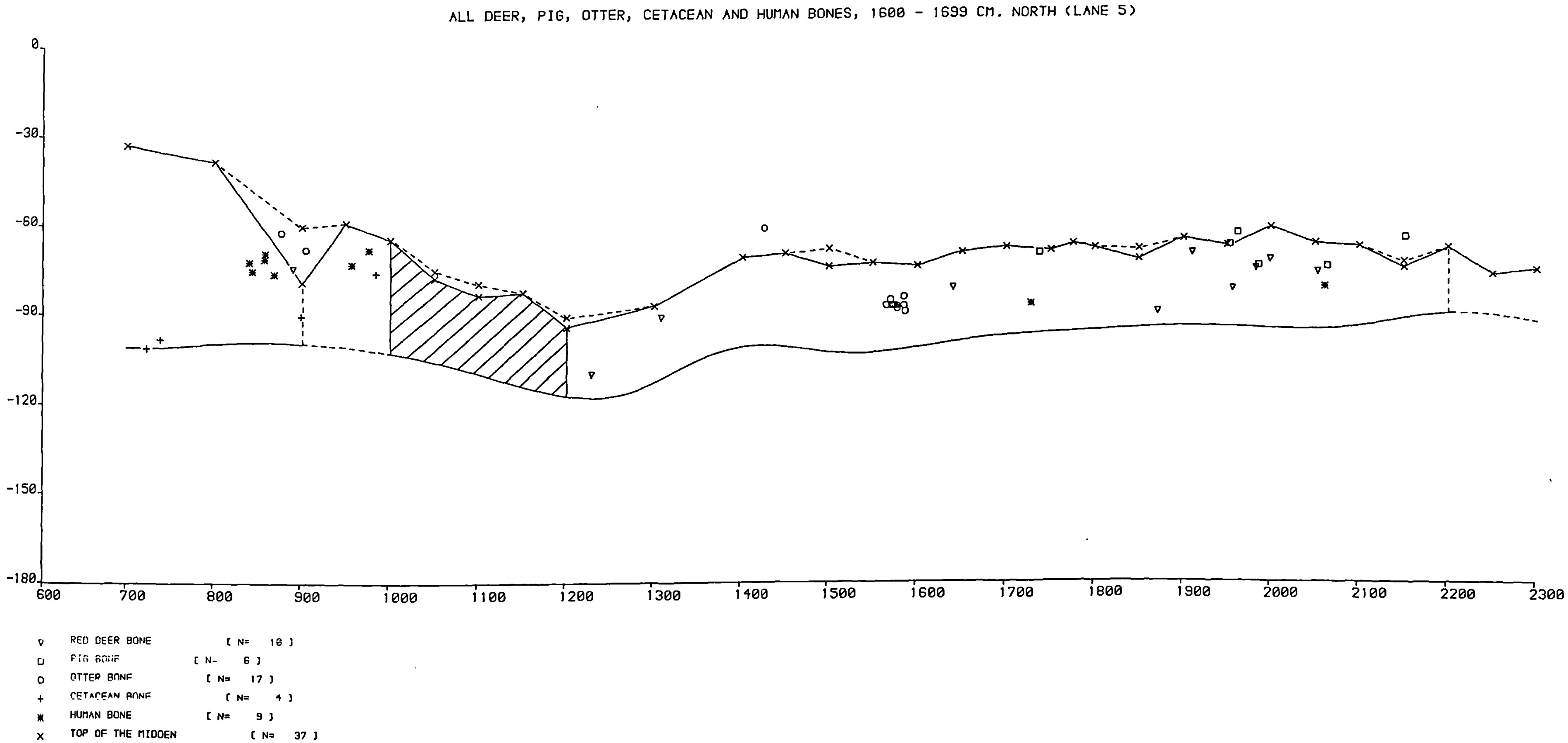

Figure 67. Sectional Plot Showing the Distribution of Red Deer, Pig, Otter, Cetacean and Human Bones in Lane 5.

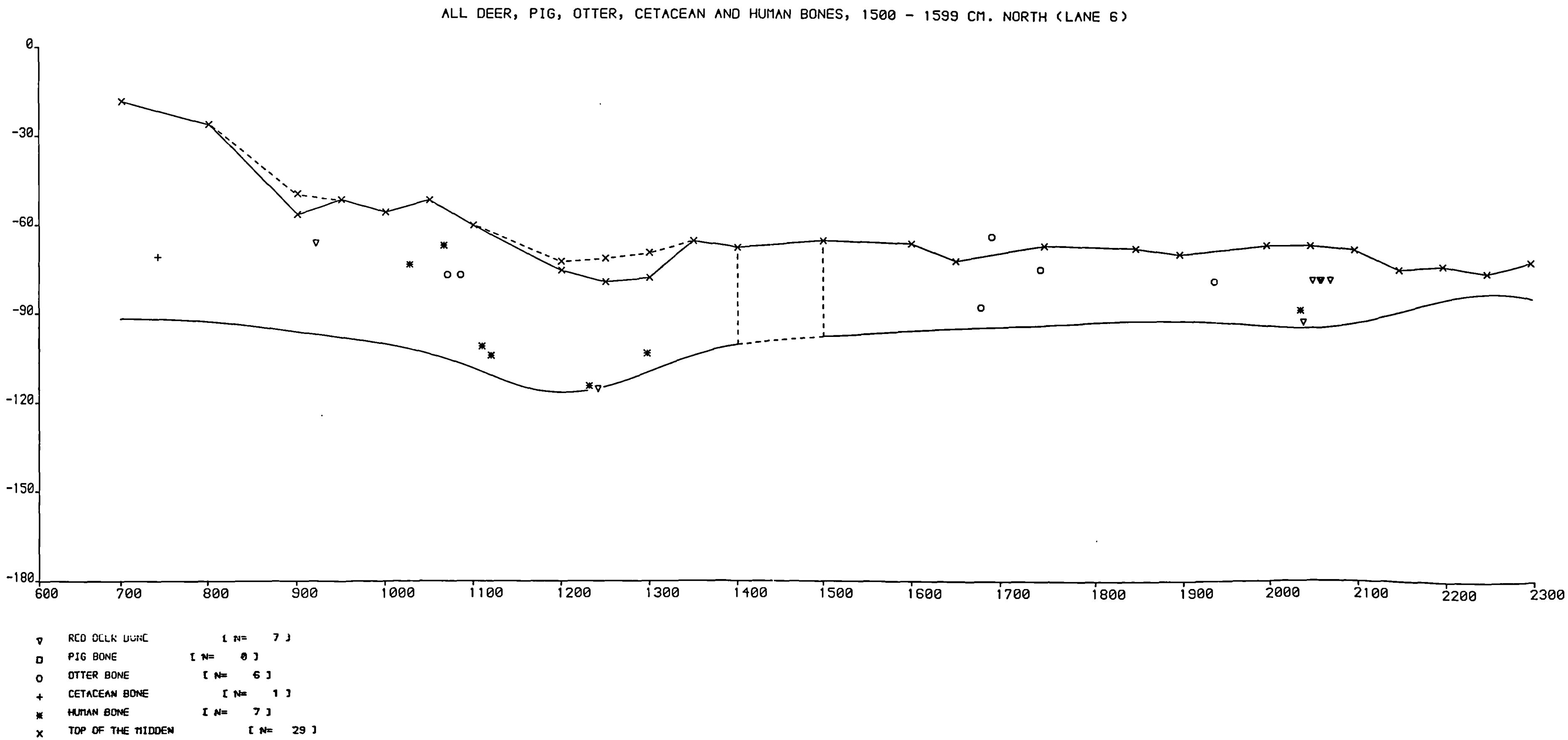

Figure 68. Sectional Plot Showing the Distribution of Red Deer, Pig, Otter, Cetacean and Human Bones in Lane 6.

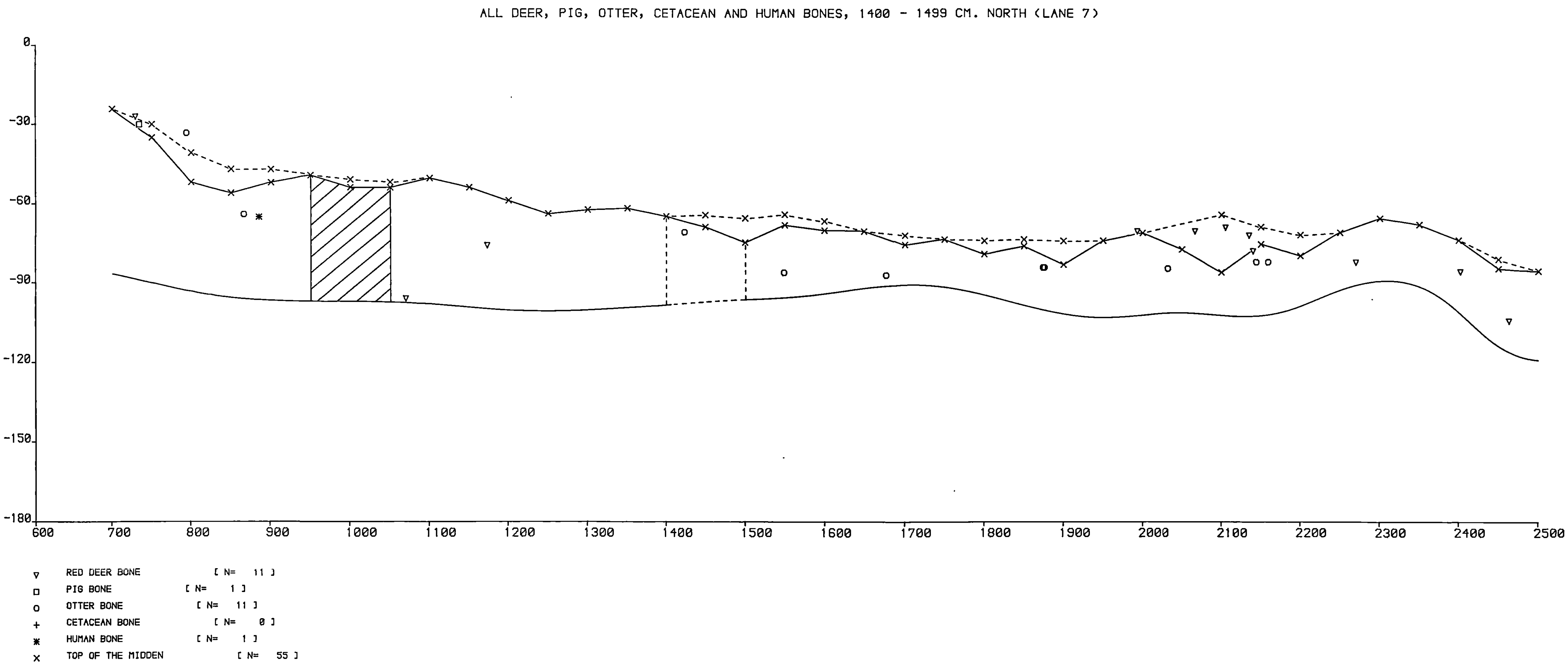

Figure 69. Sectional Plot Showing the Distribution of Red Deer, Pig, Otter, Cetacean and Human Bones in Lane 7.

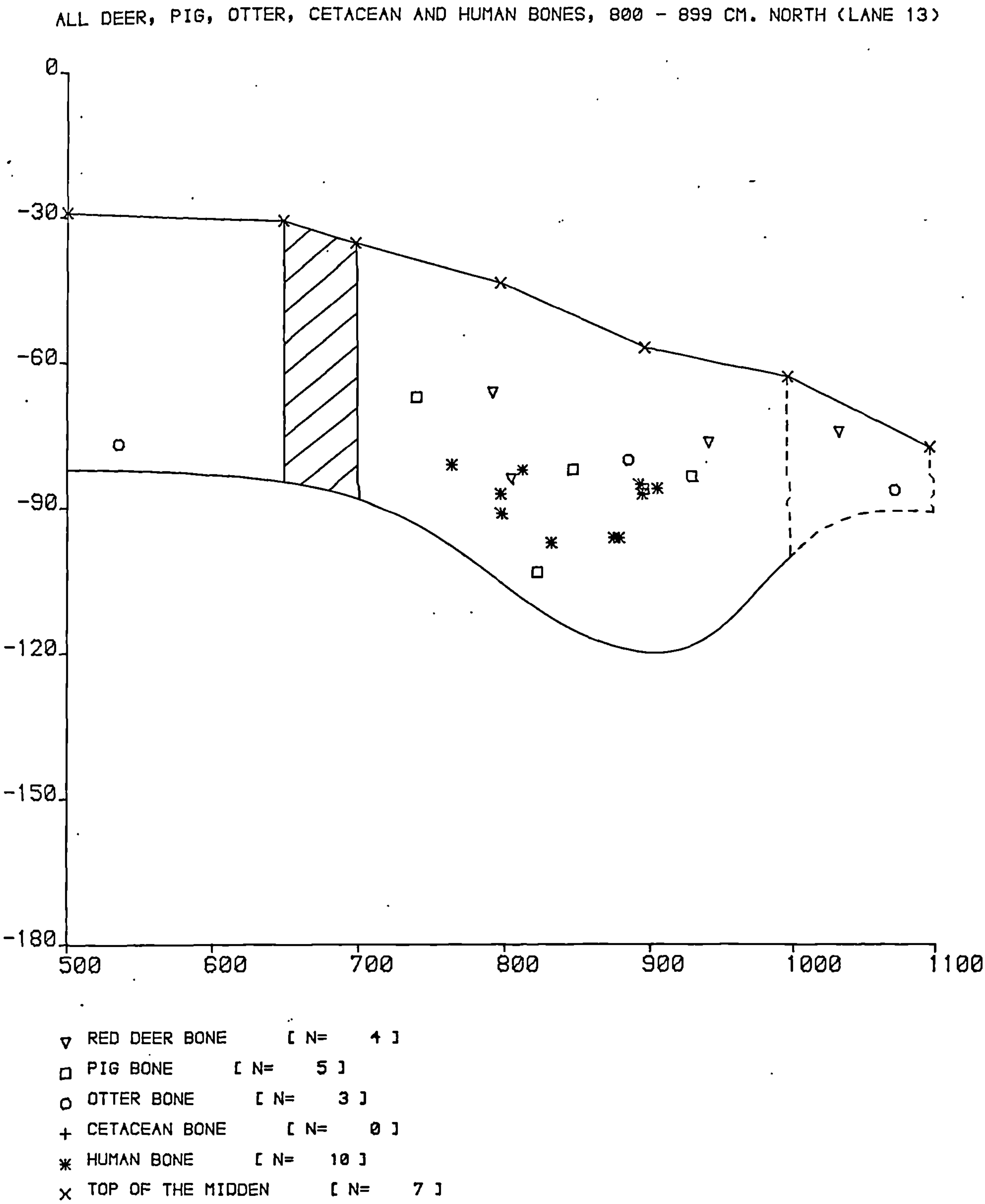

Figure 70. Sectional Plot Showing the Distribution of Red Deer, Pig, Otter, Cetacean and Human Bones in Lane 13 (Eastern Half).

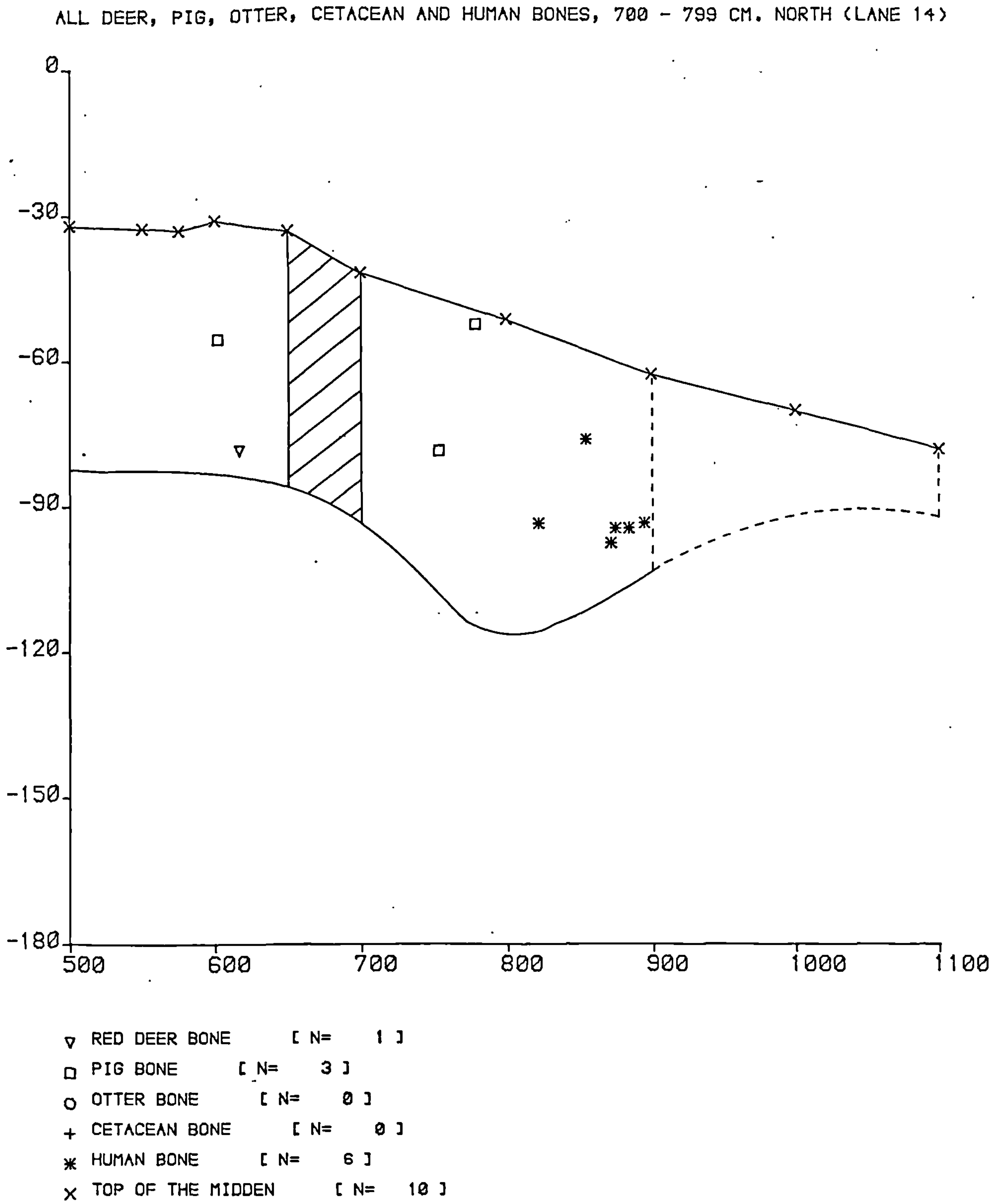

Figure 71. Sectional Plot Showing the Distribution of Red Deer, Pig, Otter, Cetacean and Human Bones in Lane 14 (Eastern Half).

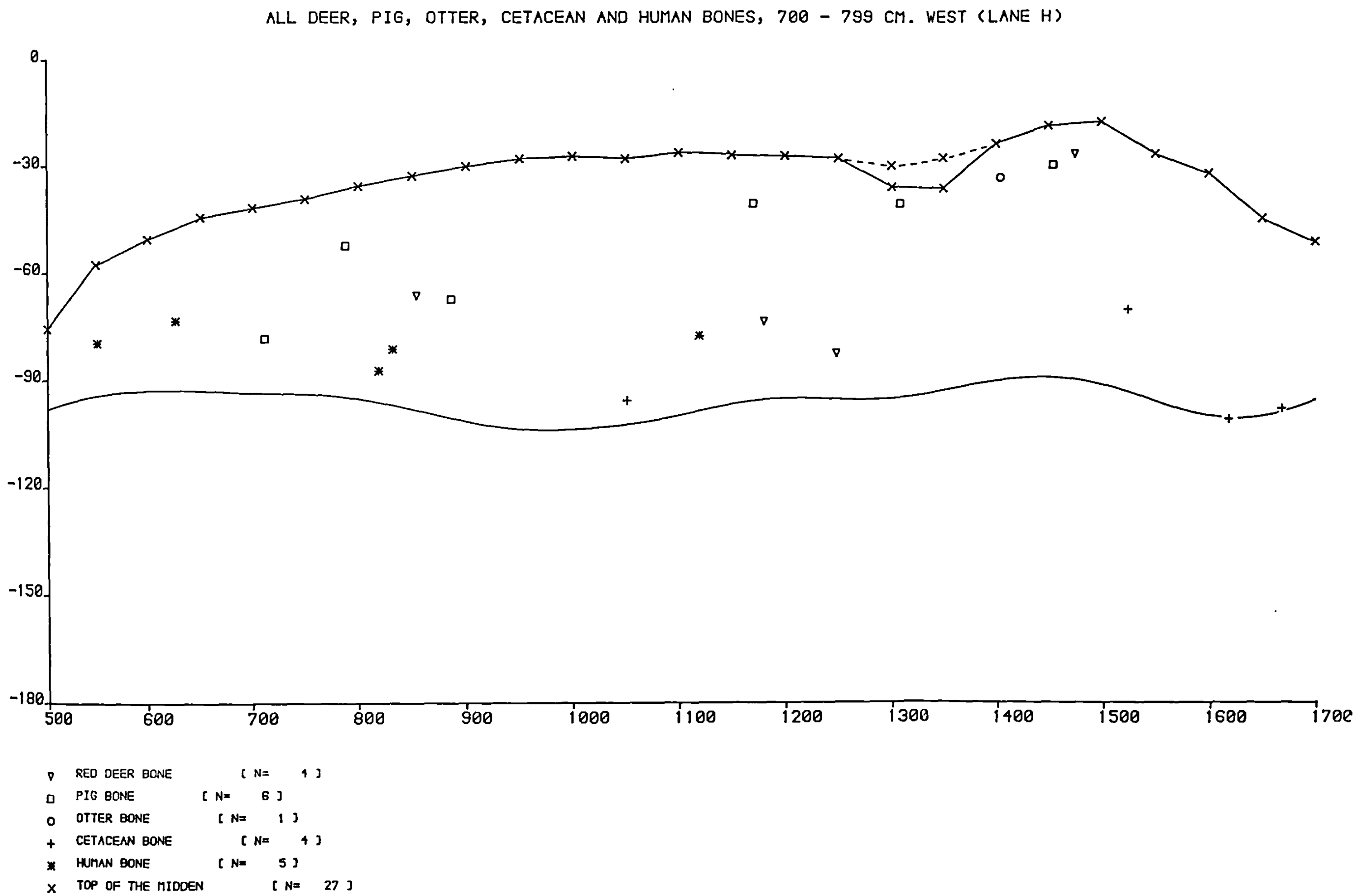

Figure 72. Sectional Plot Showing the Distribution of Red Deer, Pig, Otter, Cetacean and Human Bones in Lane H.

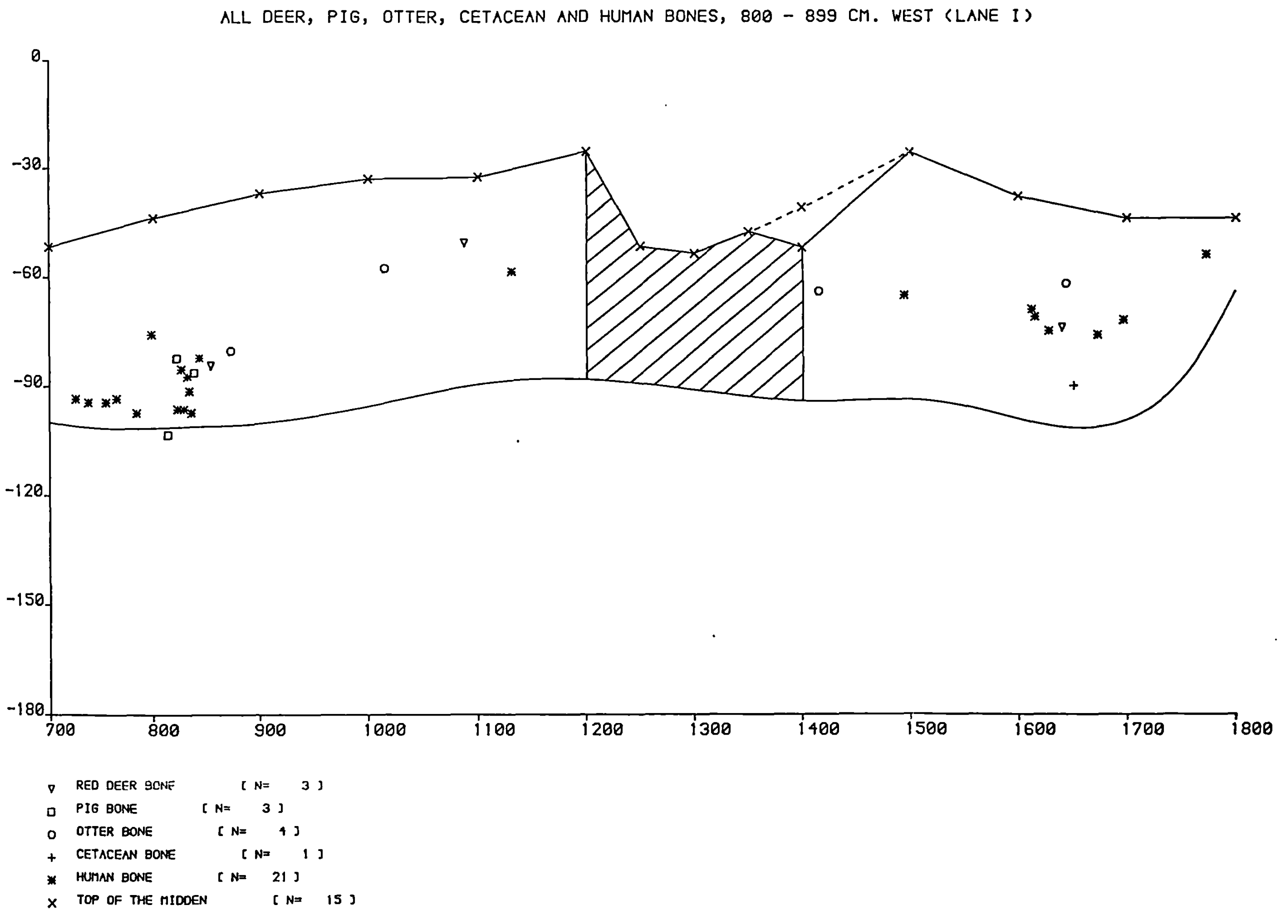

Figure 73. Sectional Plot Showing the Distribution of Red Deer, Pig, Otter, Cetacean and Human Bones in Lane I (Northern Three-Quarters).

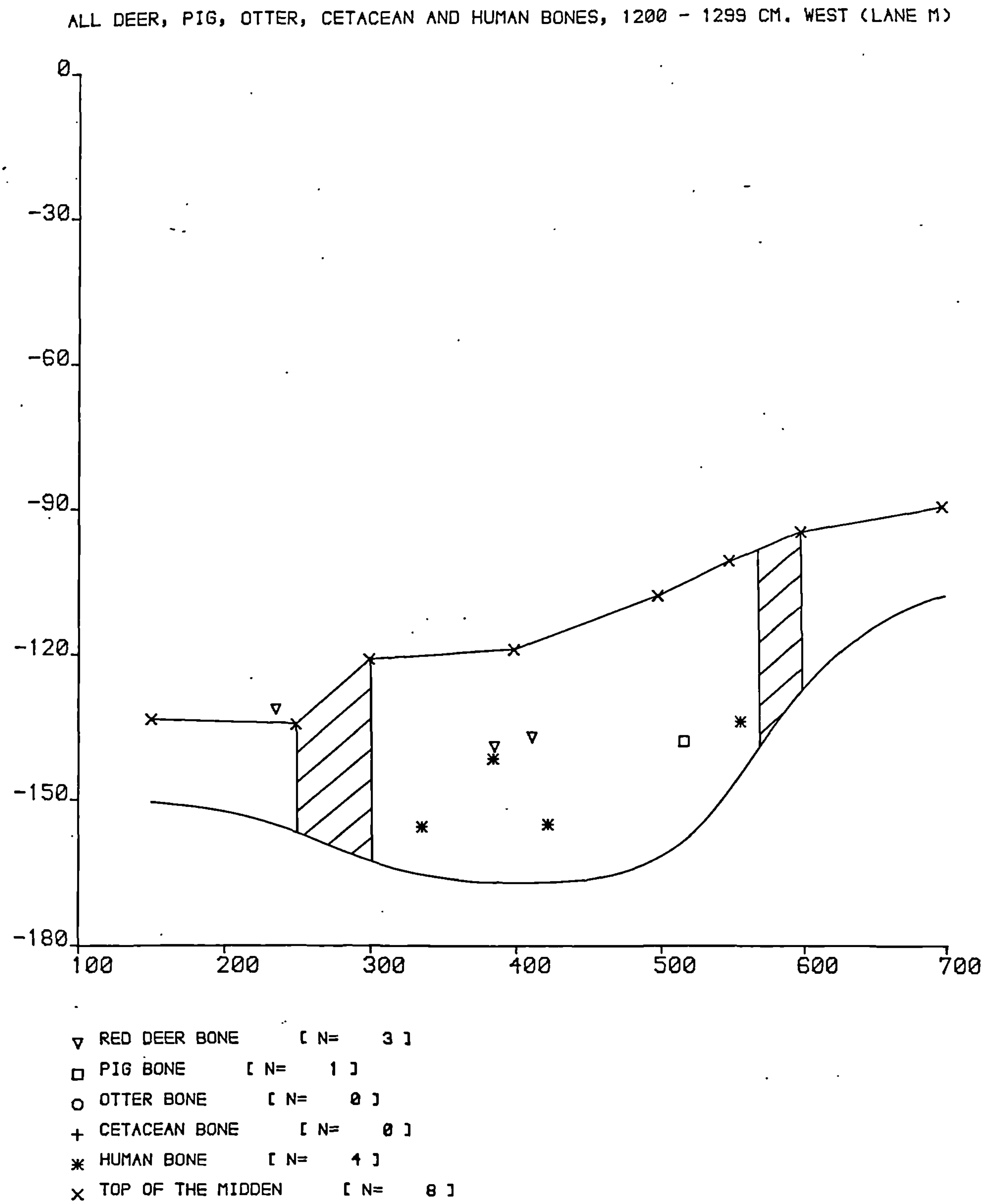

Figure 74. Sectional Plot Showing the Distribution of Red Deer, Pig, Otter, Cetacean and Human Bones in Lane M (Southern One-Third).

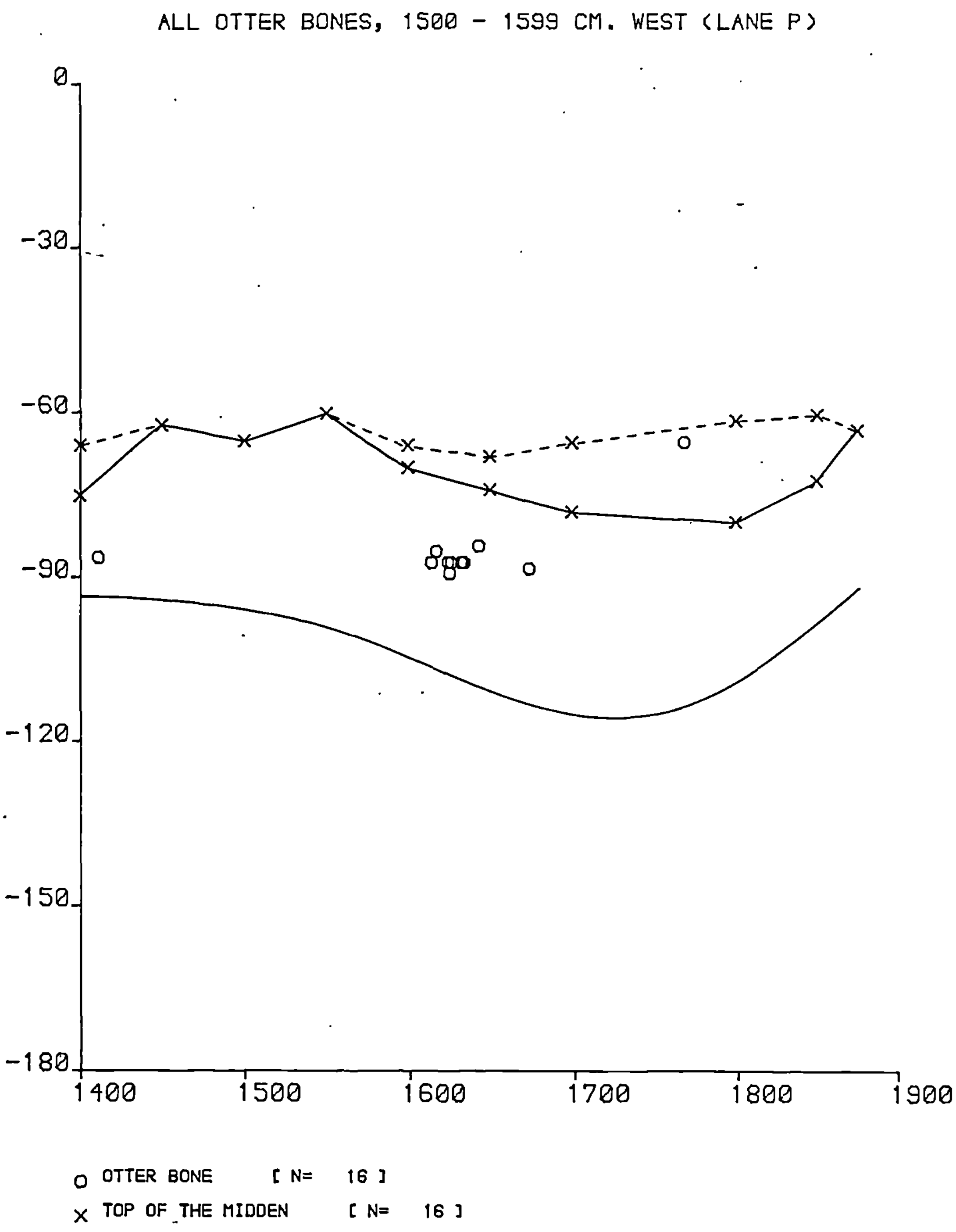

Figure 75. Sectional Plot Showing the Distribution of Otter Bones in Lane P.

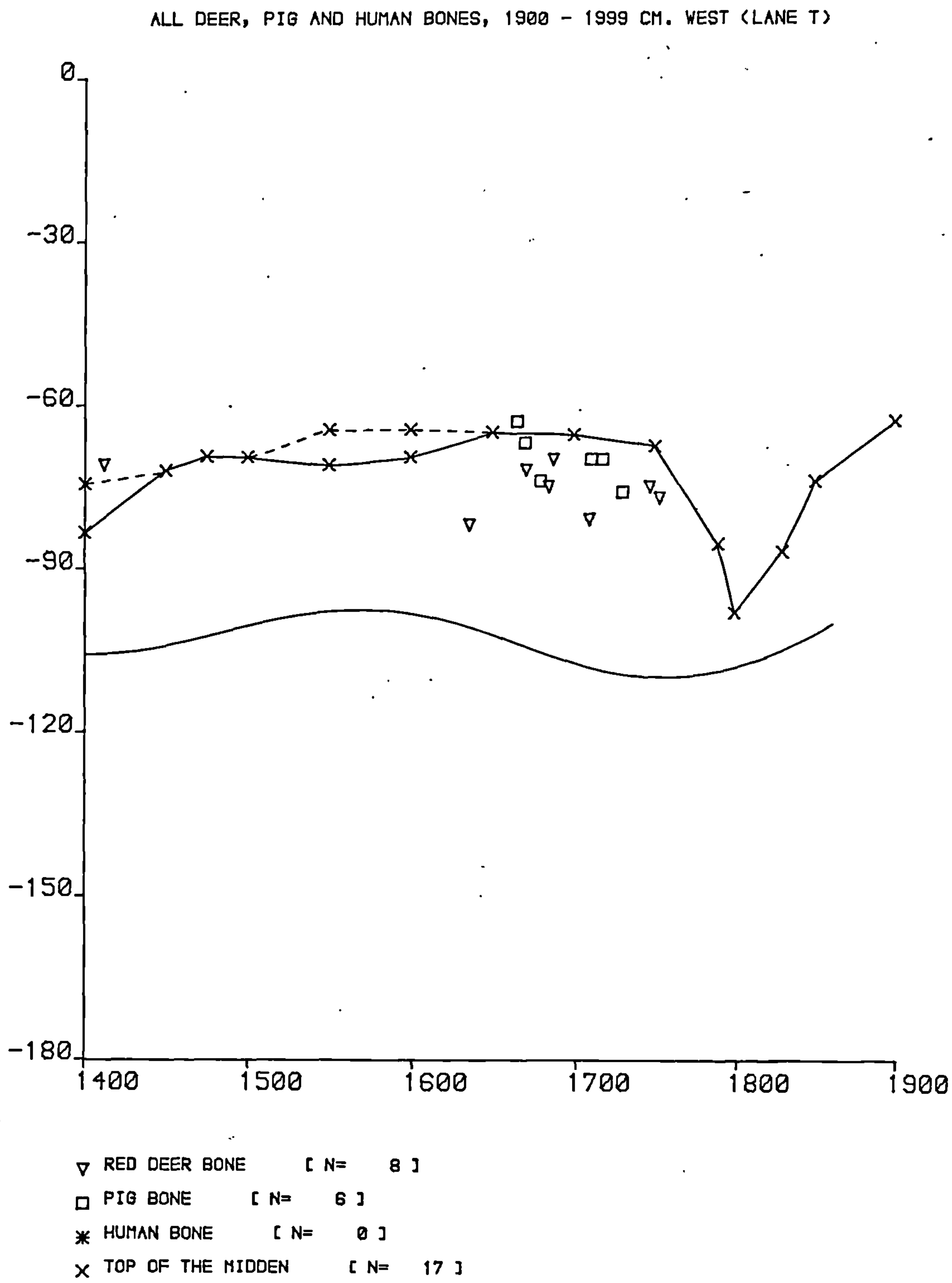

Figure 76. Sectional Plot Showing the Distribution of Red Deer, Pig and Human Bones in Lane T.

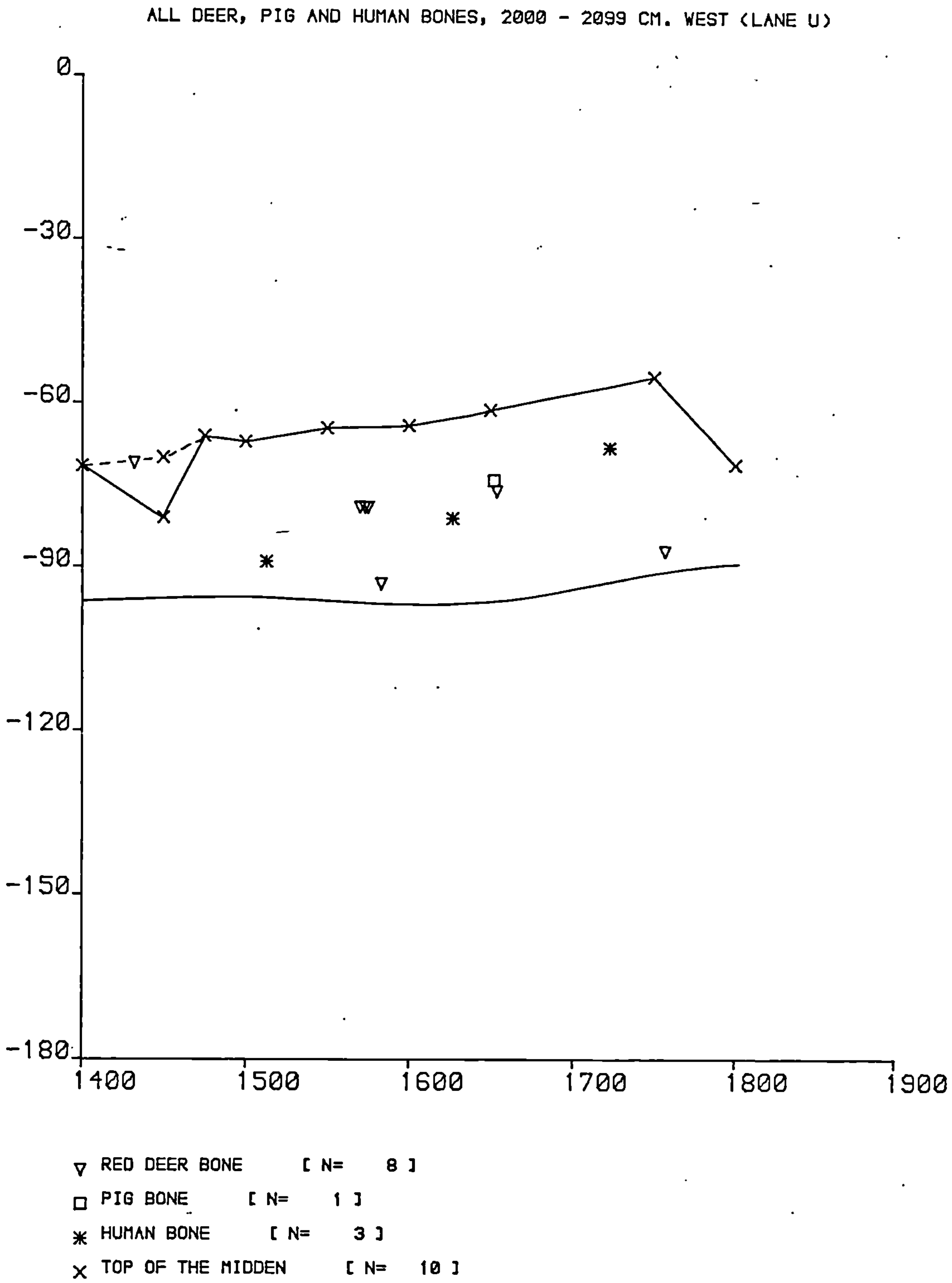

Figure 77. Sectional Plot Showing the Distribution of Red Deer, Pig and Human Bones in Lane U.

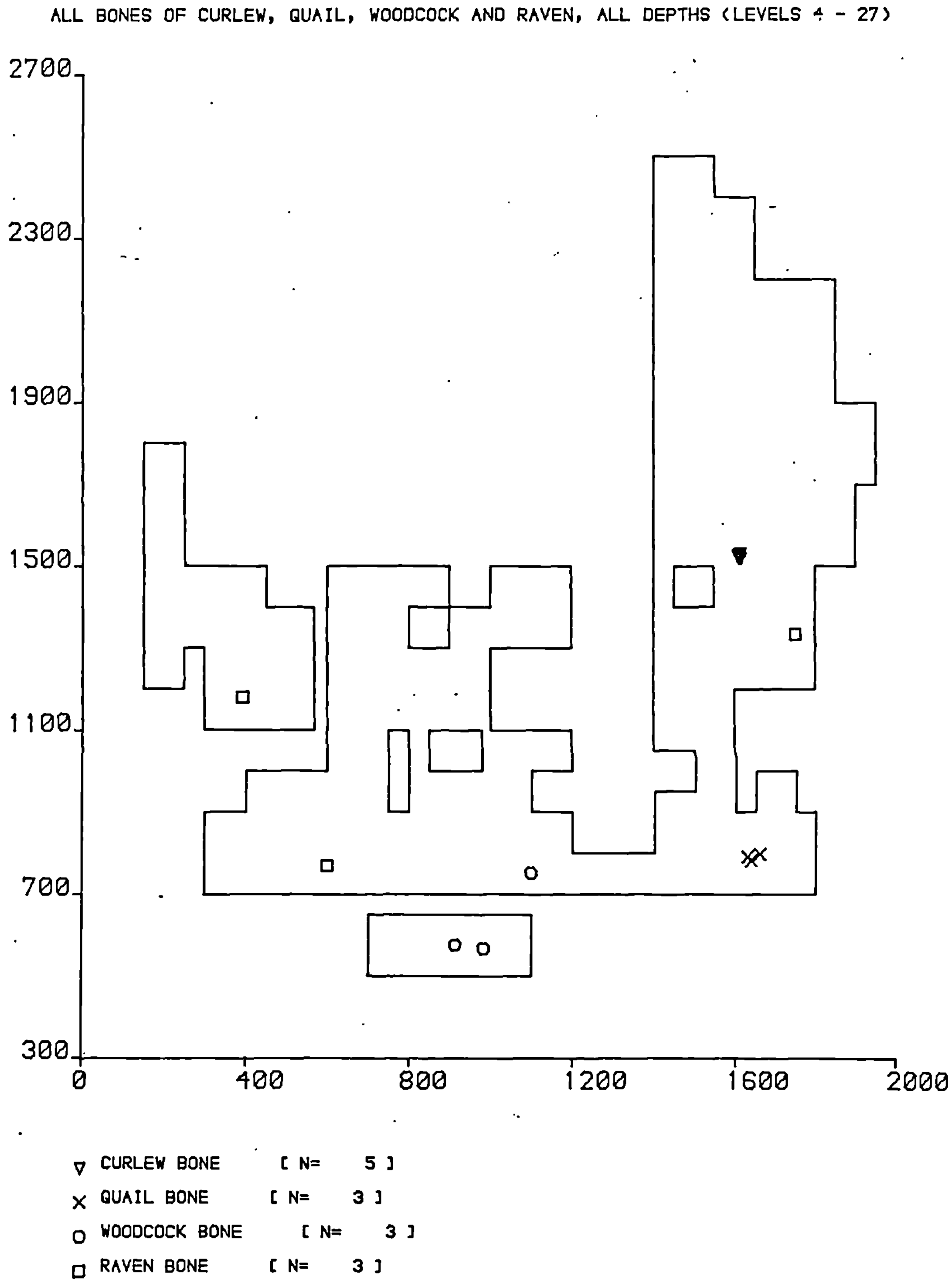

Figure 78. Horizontal Plot Showing the Distribution of All Curlew, Quail, Woodcock and Raven Bones in All Levels.

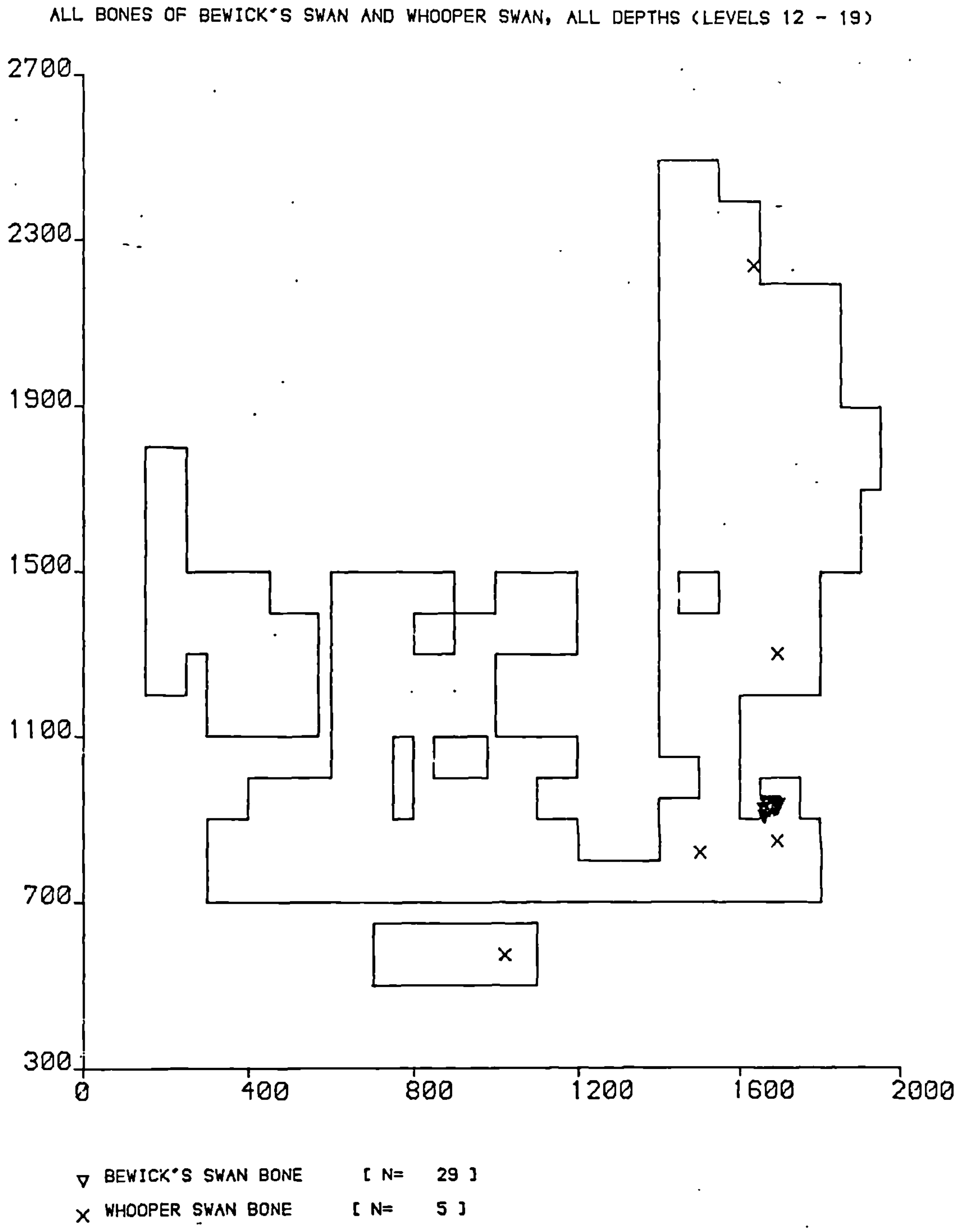

Figure 79. Horizontal Plot Showing the Distribution of All Bewick's Swan and Whooper Swan Bones in All Levels.

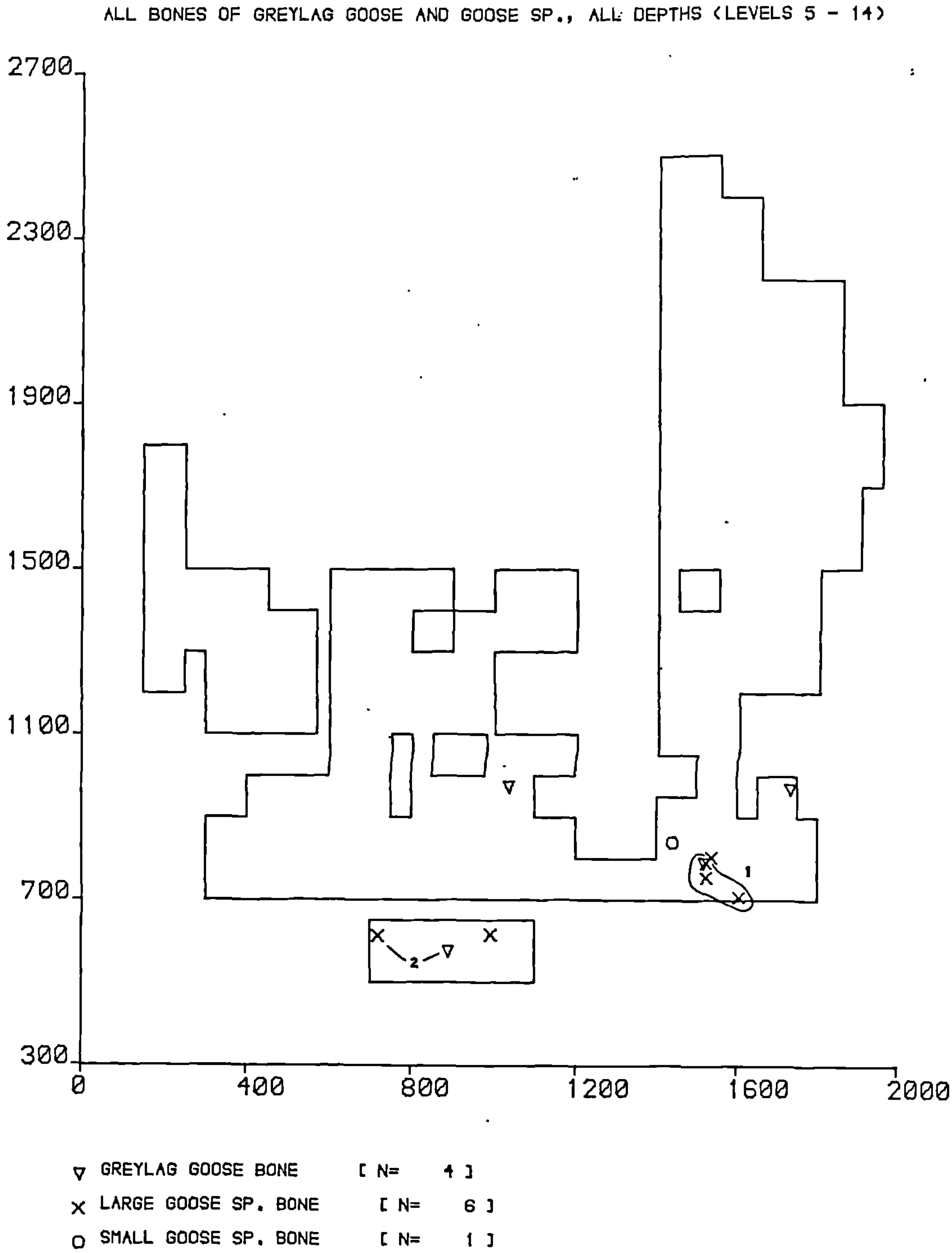

Figure 80. Horizontal Plot Showing the Distribution of All Greylag Goose and Goose spp. Bones in All Levels.

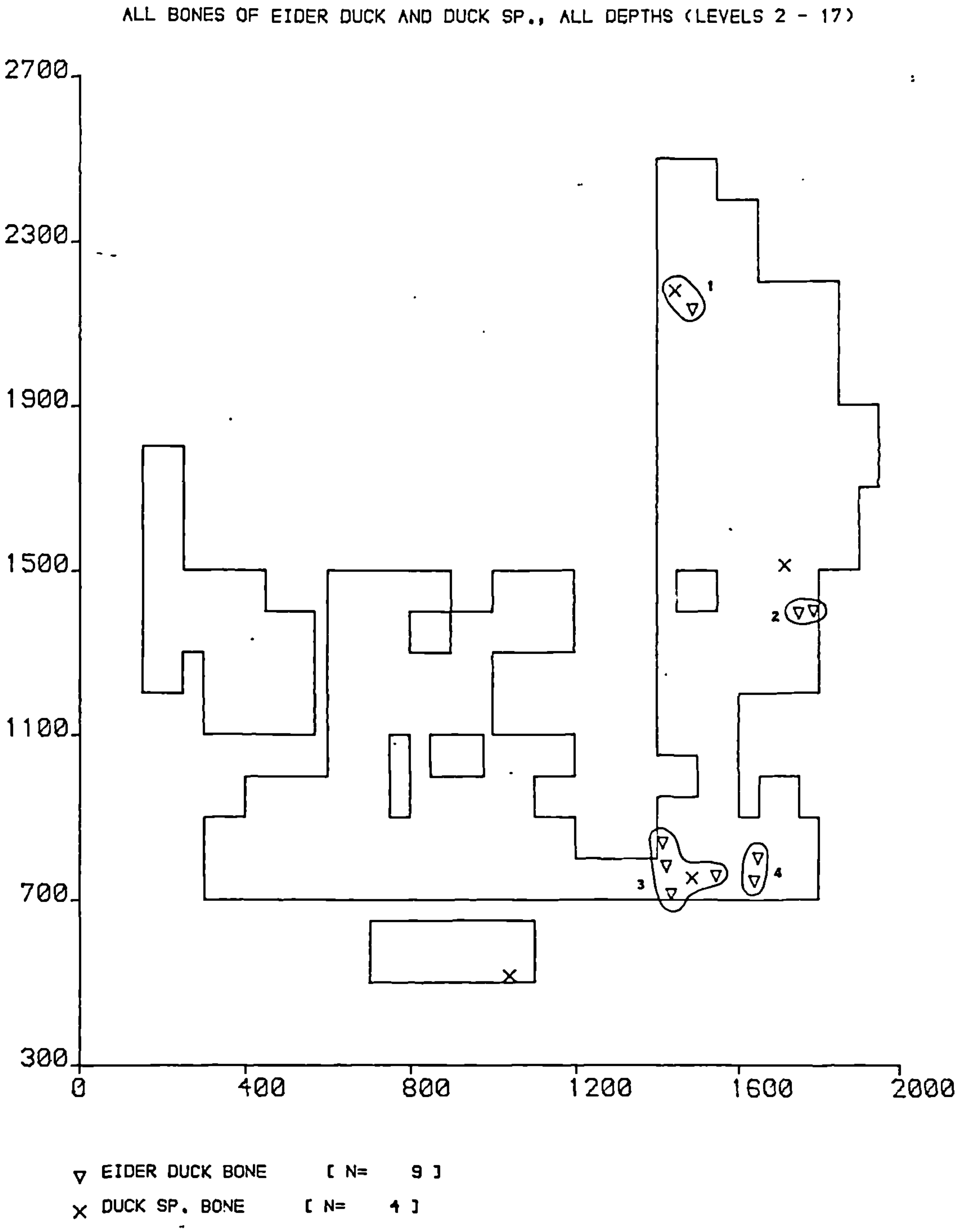

Figure 81. Horizontal Plot Showing the Distribution of All Eider Duck and Duck spp. Bones in All Levels.

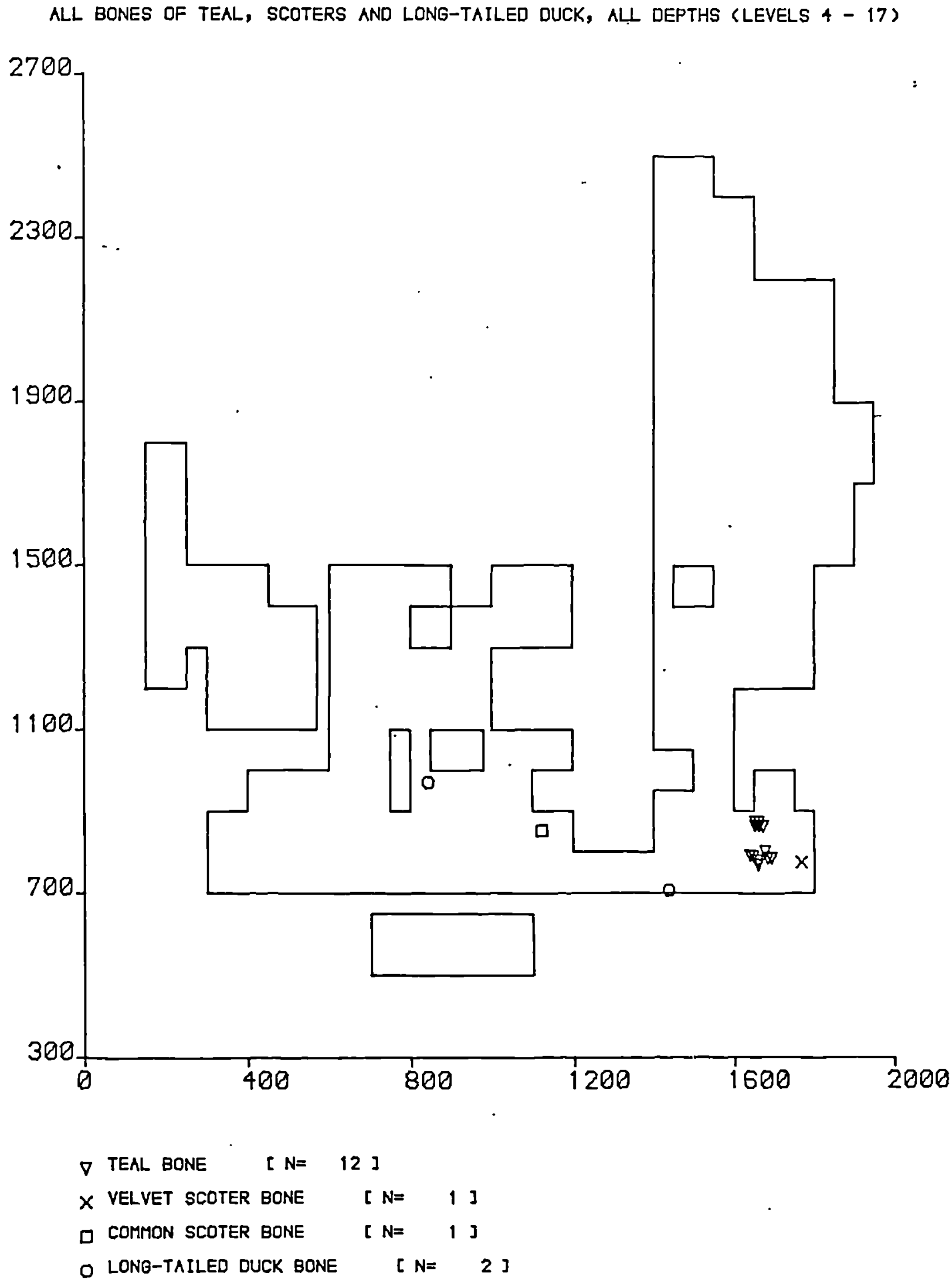

Figure 82. Horizontal Plot Showing the Distribution of All Teal, Velvet Scoter, Common Scoter and Long-tailed Duck Bones in All Levels.

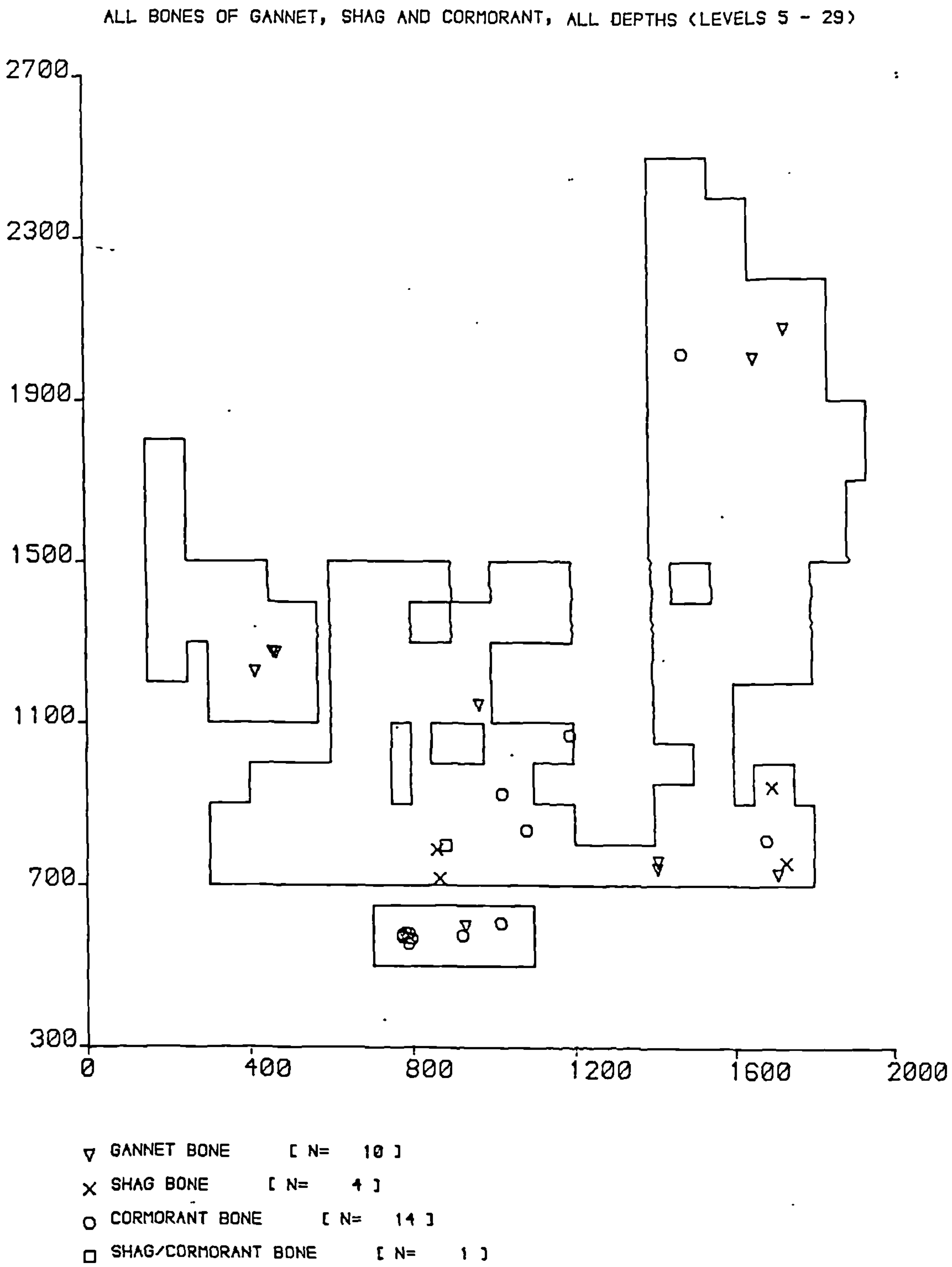

Figure 83. Horizontal Plot Showing the Distribution of All Gannet, Shag and Cormorant Bones in All Levels.

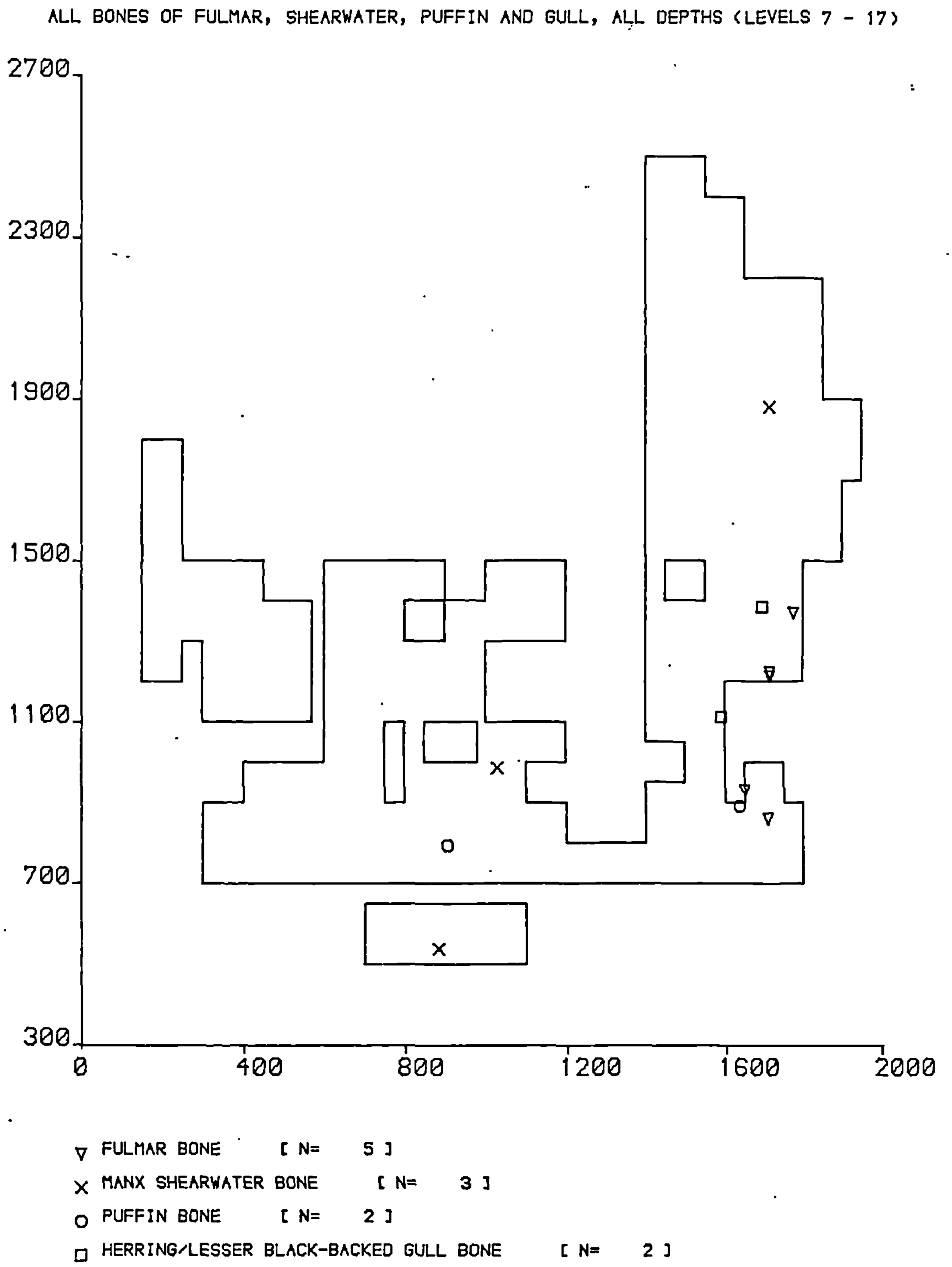

Figure 84. Horizontal Plot Showing the Distribution of All Fulmar, Manx Shearwater, Puffin and Herring/ Lesser Black-backed Gull Bones in All Levels.

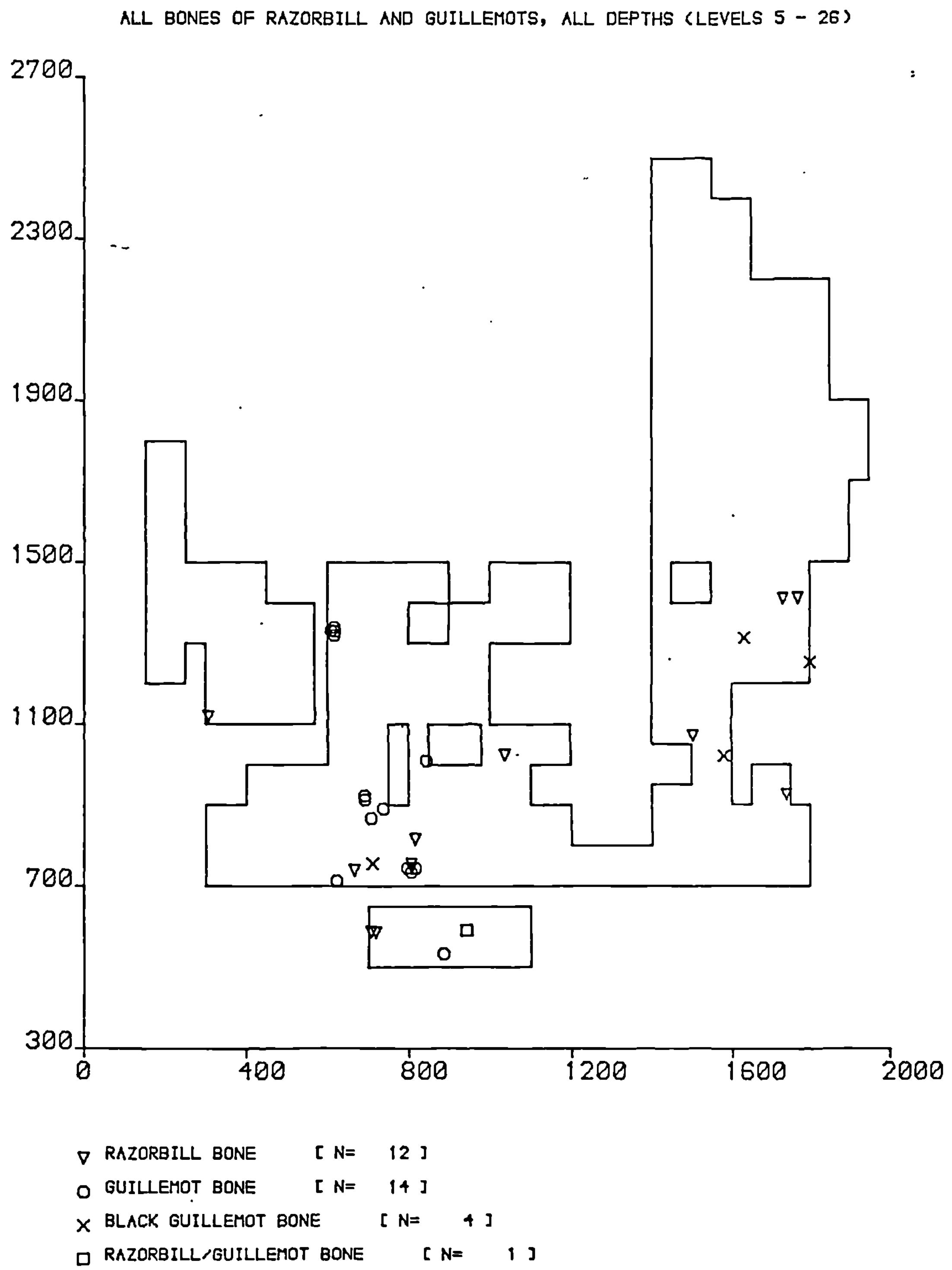

Figure 85. Horizontal Plot Showing the Distribution of All Razorbill, Guillemot and Black Guillemot Bones in All Levels.

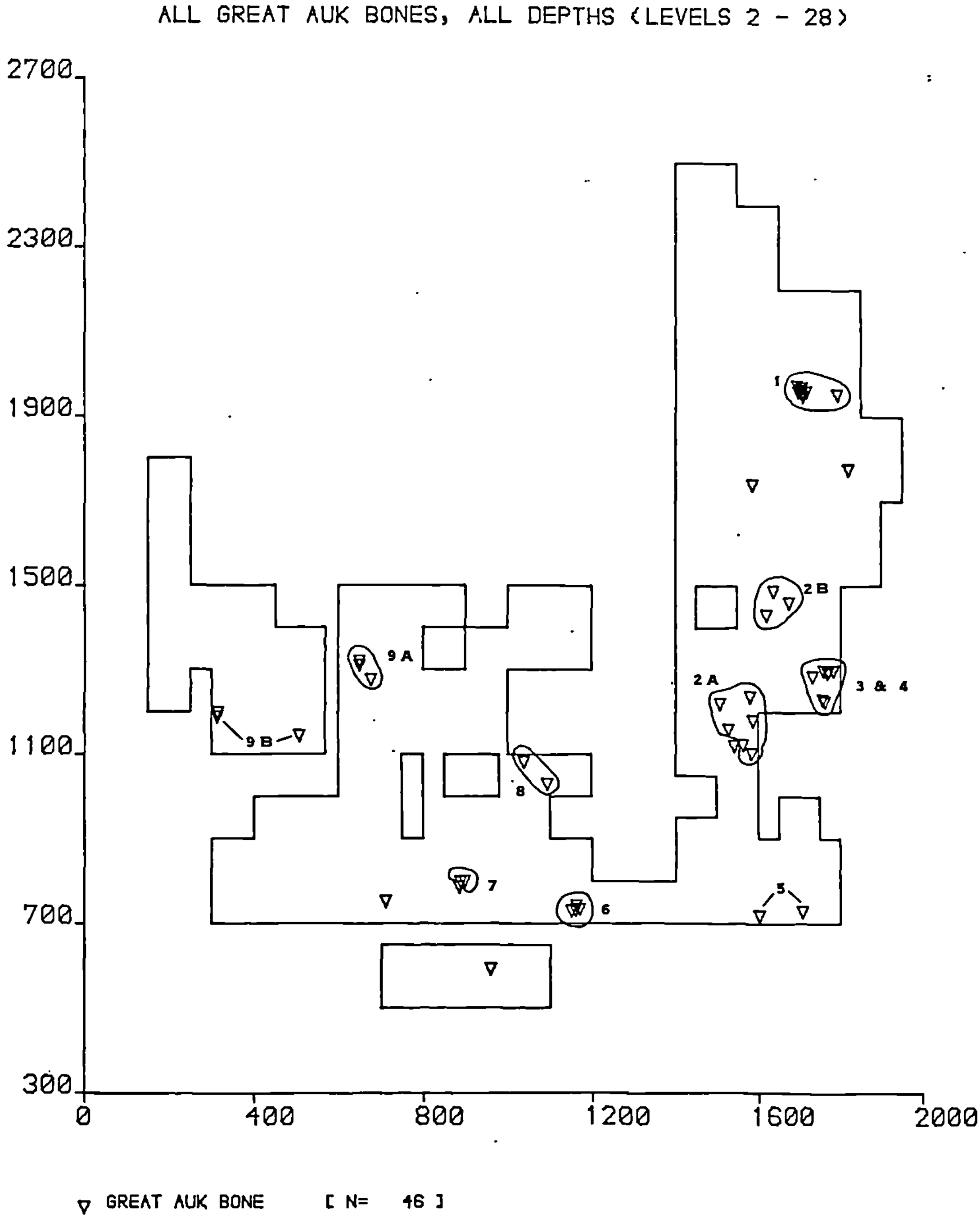

Figure 86. Horizontal Plot Showing the Distribution of All Great Auk Bones in All Levels.

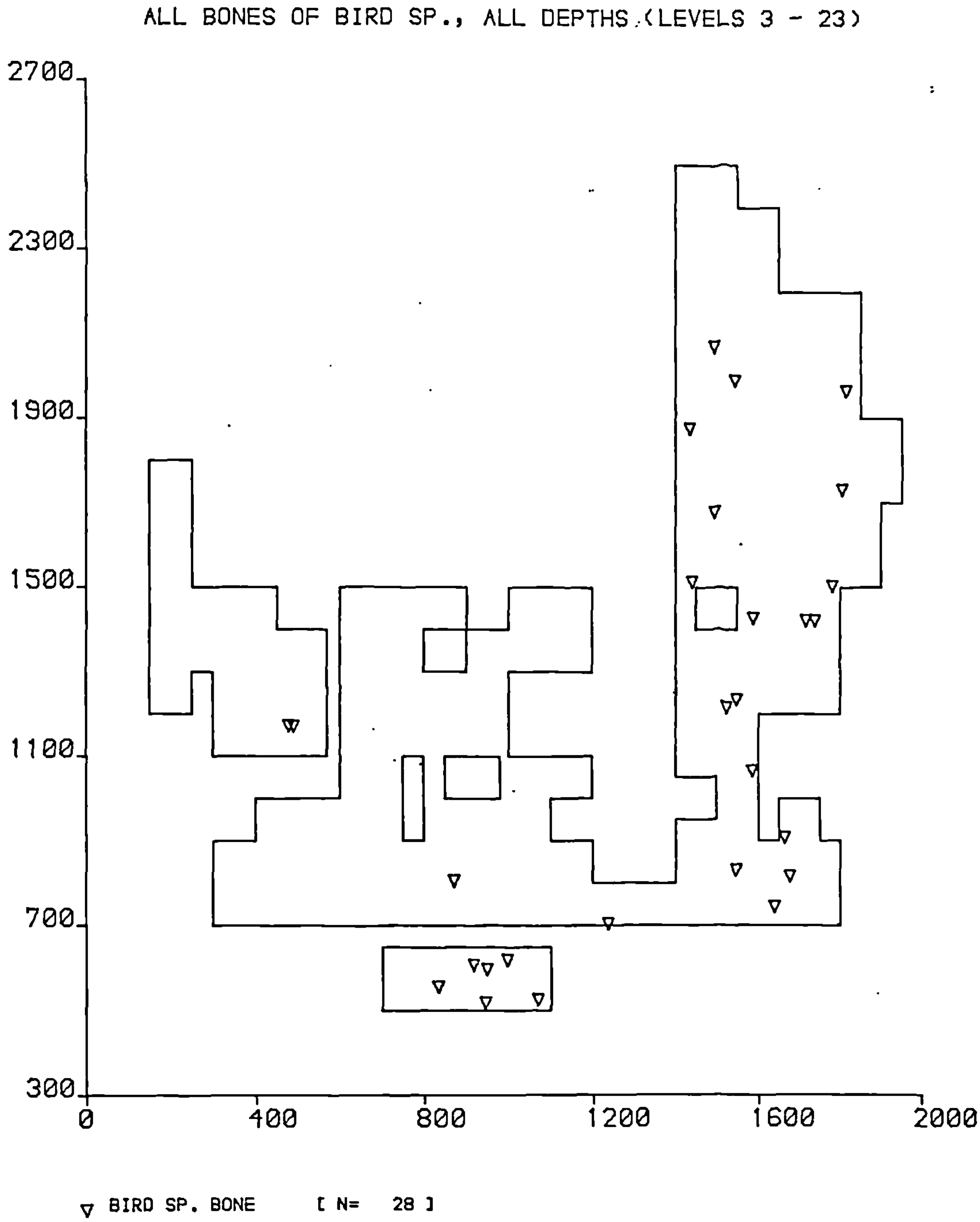

Figure 87. Horizontal Plot Showing the Distribution of All Bird Bones of Indeterminate Species in All Levels.

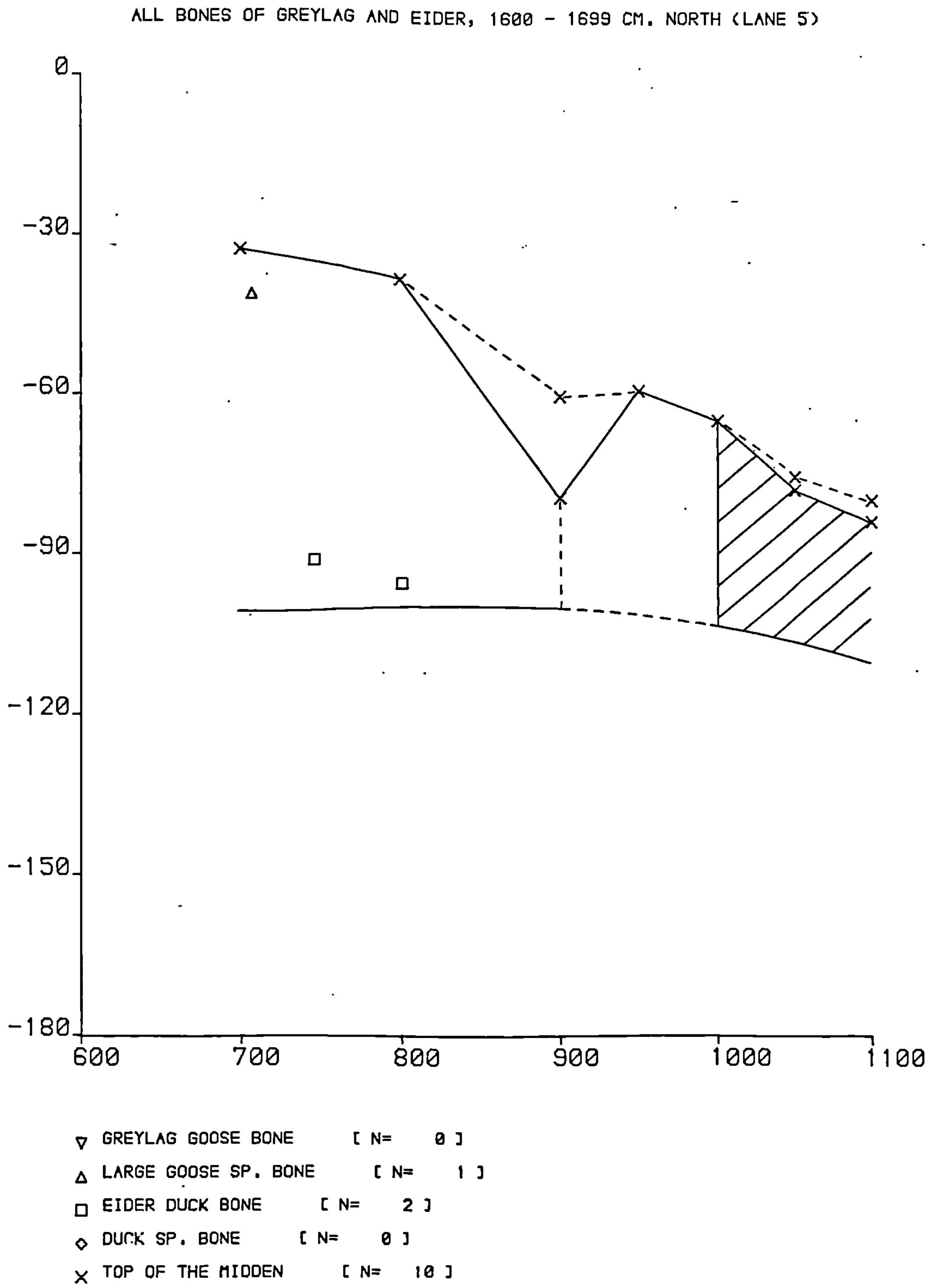

Figure 88. Sectional Plot Showing the Distribution of Greylag Goose, Large Goose spp., Eider Duck and Duck spp. Bones in Lane 5 (Eastern One-Third).

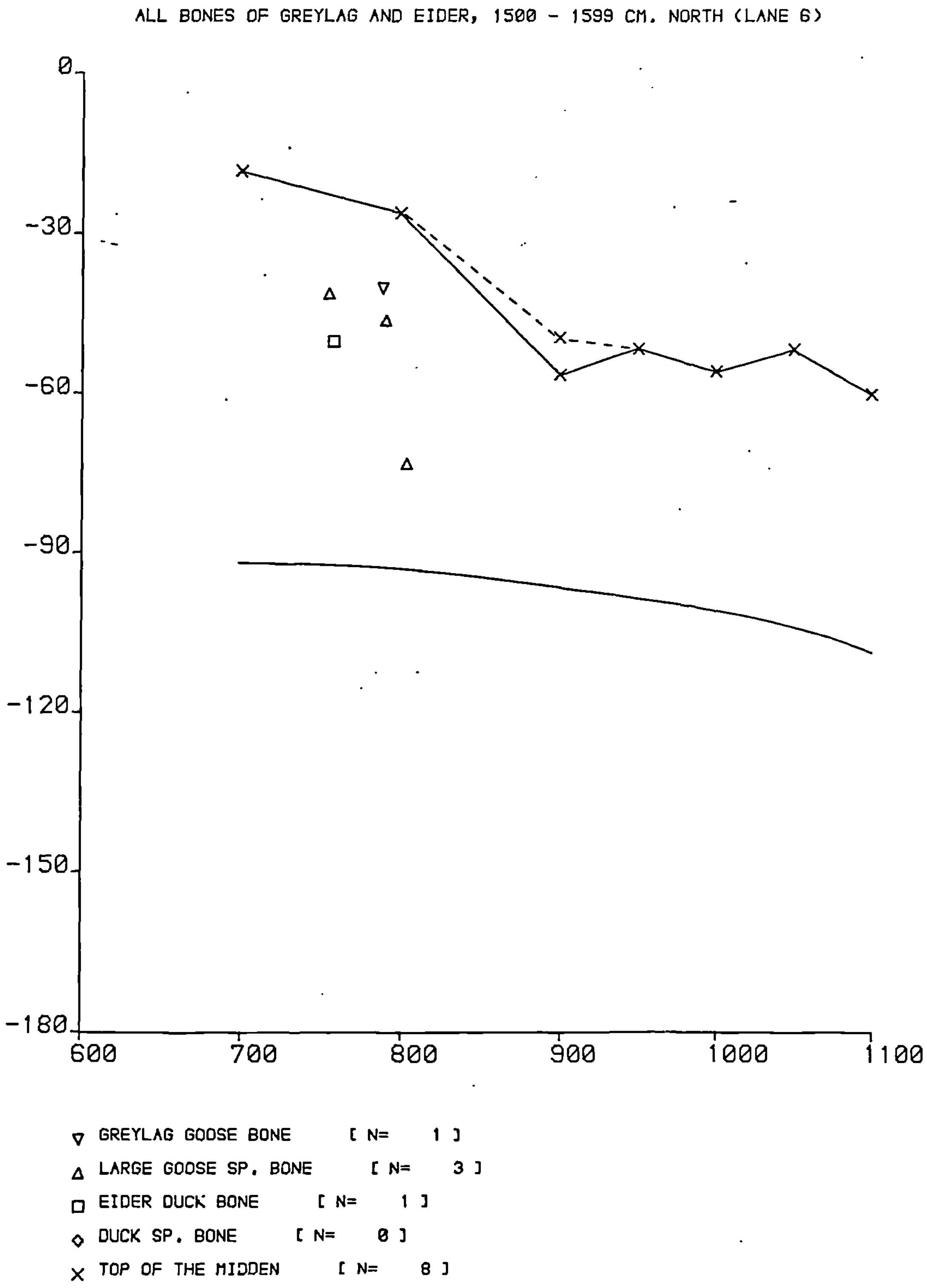

Figure 89. Sectional Plot Showing the Distribution of Greylag Goose, Large Goose spp., Eider Duck and Duck spp. Bones in Lane 6 (Eastern One-Third).

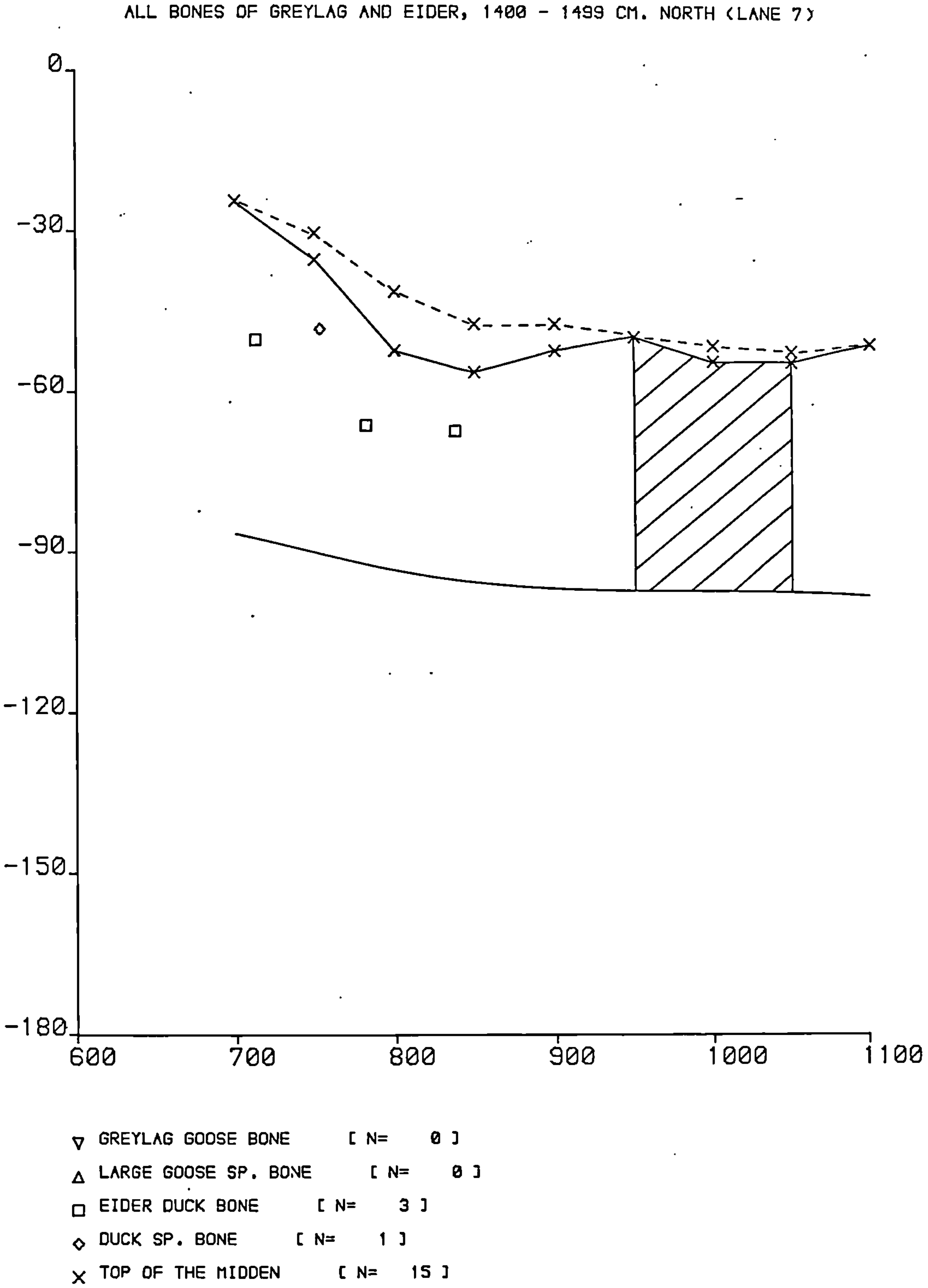

Figure 90. Sectional Plot Showing the Distribution of Greylag Goose, Large Goose spp., Eider Duck and Duck spp. Bones in Lane 7 (Eastern One-Third).

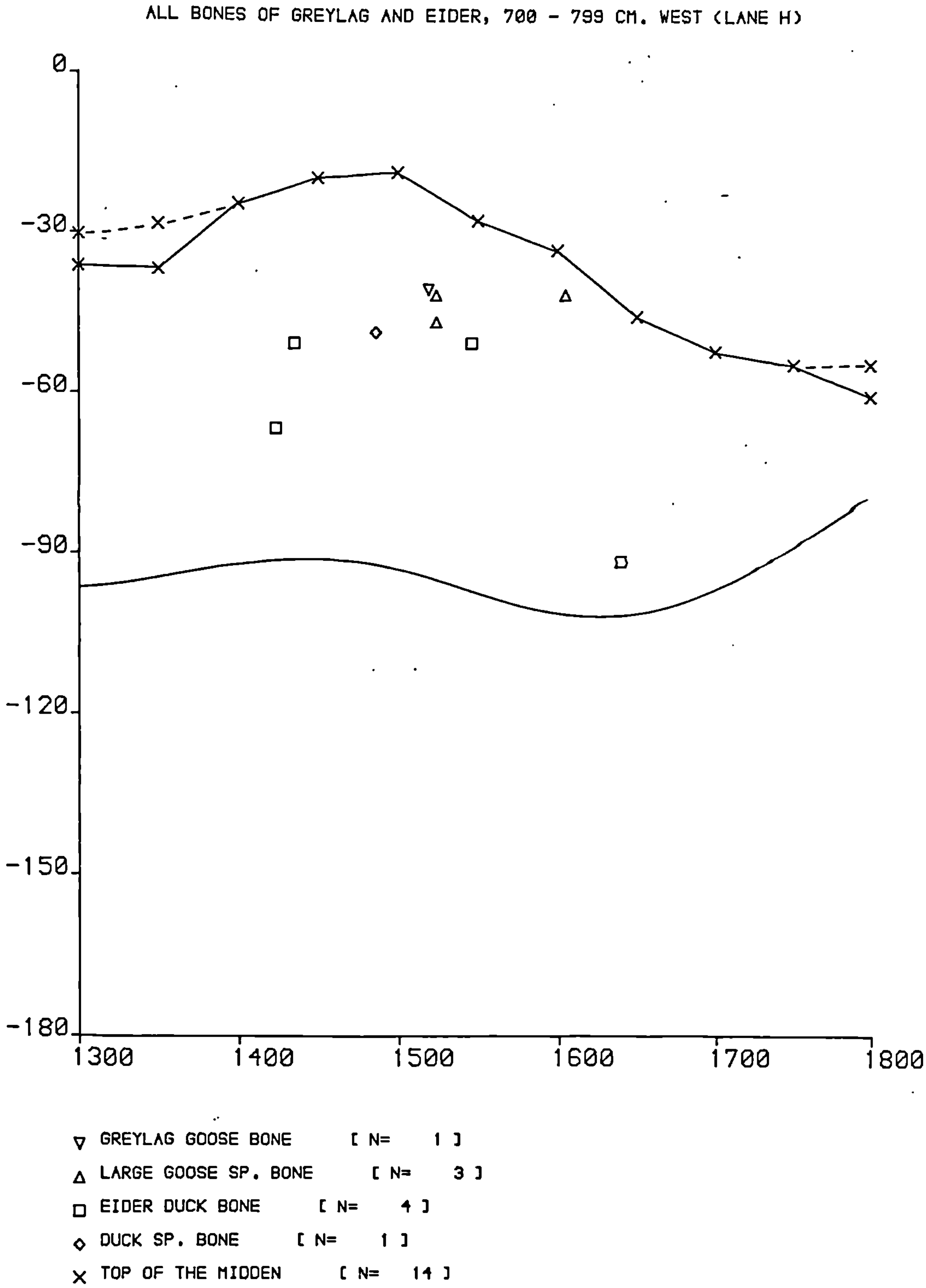

Figure 91. Sectional Plot Showing the Distribution of Greylag Goose, Large Goose spp., Eider Duck and Duck spp. Bones in Lane H (Northern One-Third).

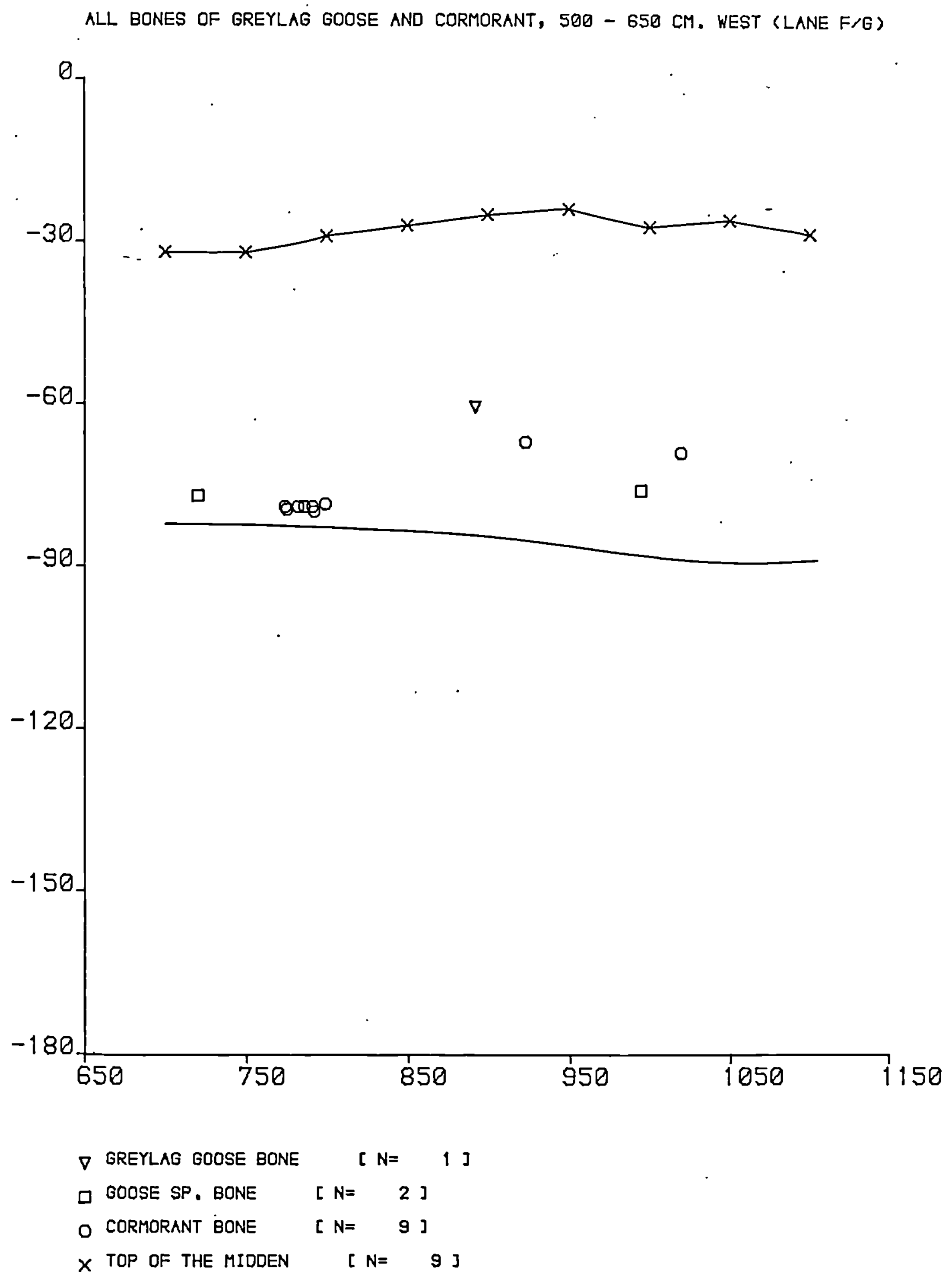

Figure 92. Sectional Plot Showing the Distribution of Greylag Goose, Goose spp. and Cormorant Bones in Lane F/G.

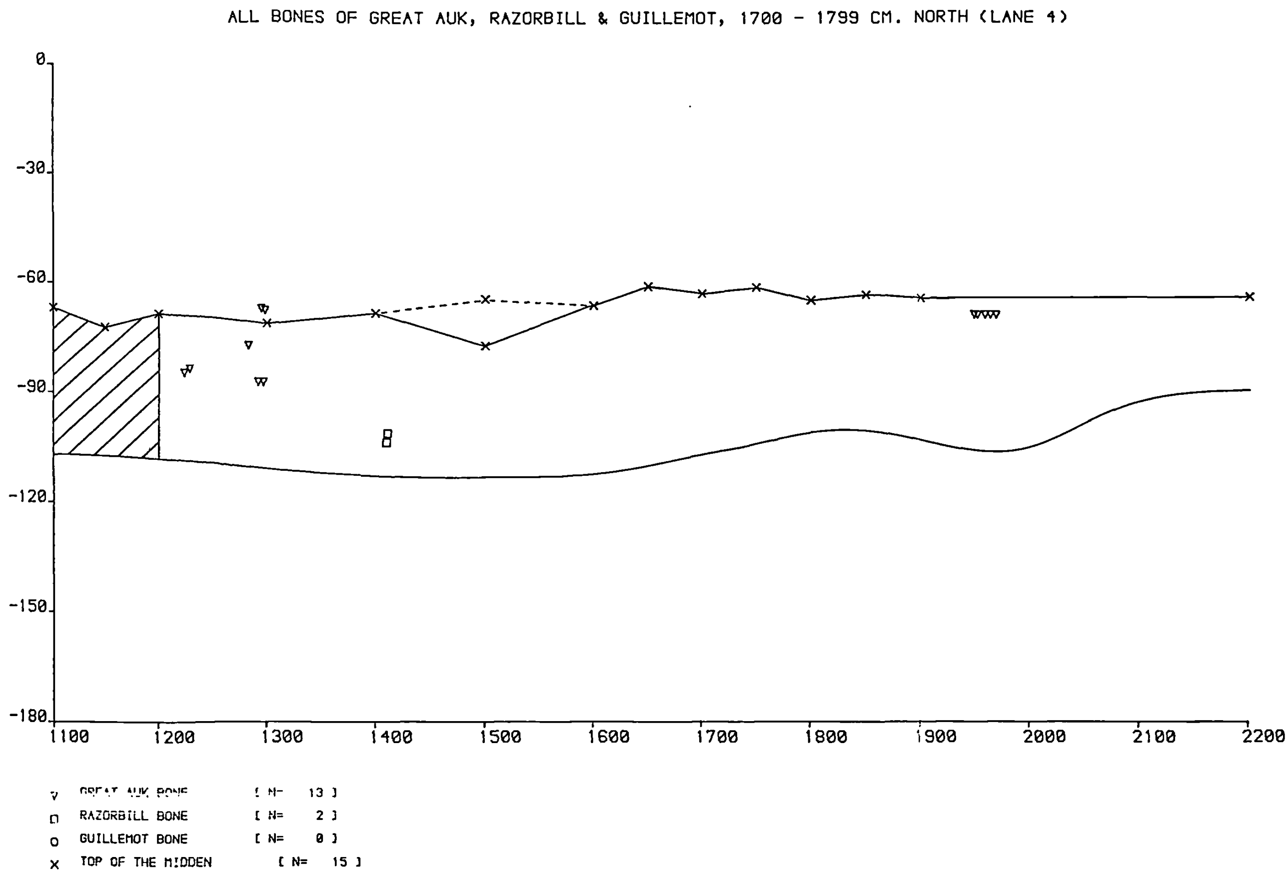

Figure 93. Sectional Plot Showing the Distribution of Great Auk, Razorbill and Guillemot Bones in Lane 4 (Western Three-Quarters).

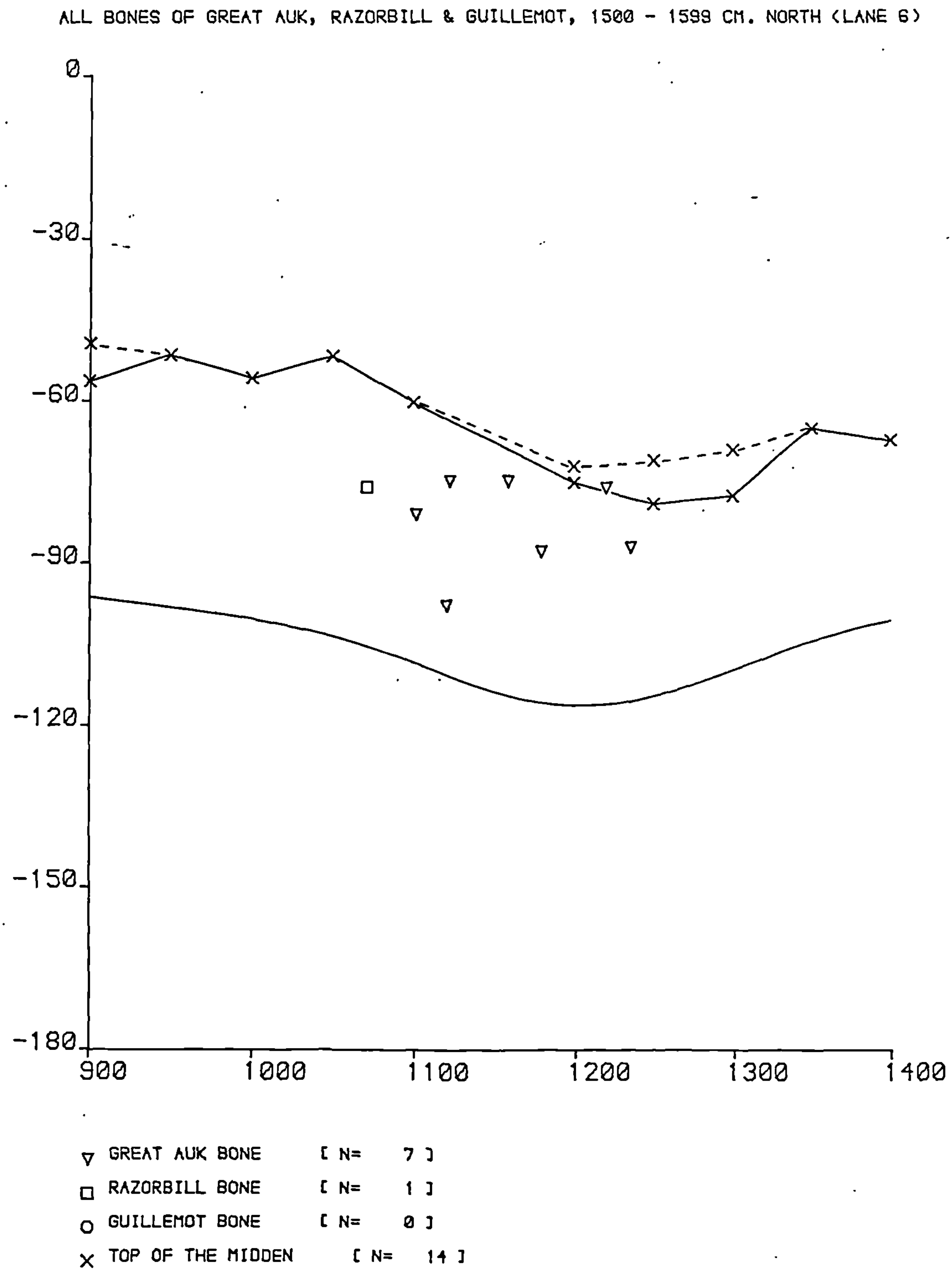

Figure 94. Sectional Plot Showing the Distribution of Great Auk, Razorbill and Guillemot Bones in Lane 6 (East-Central Portion).

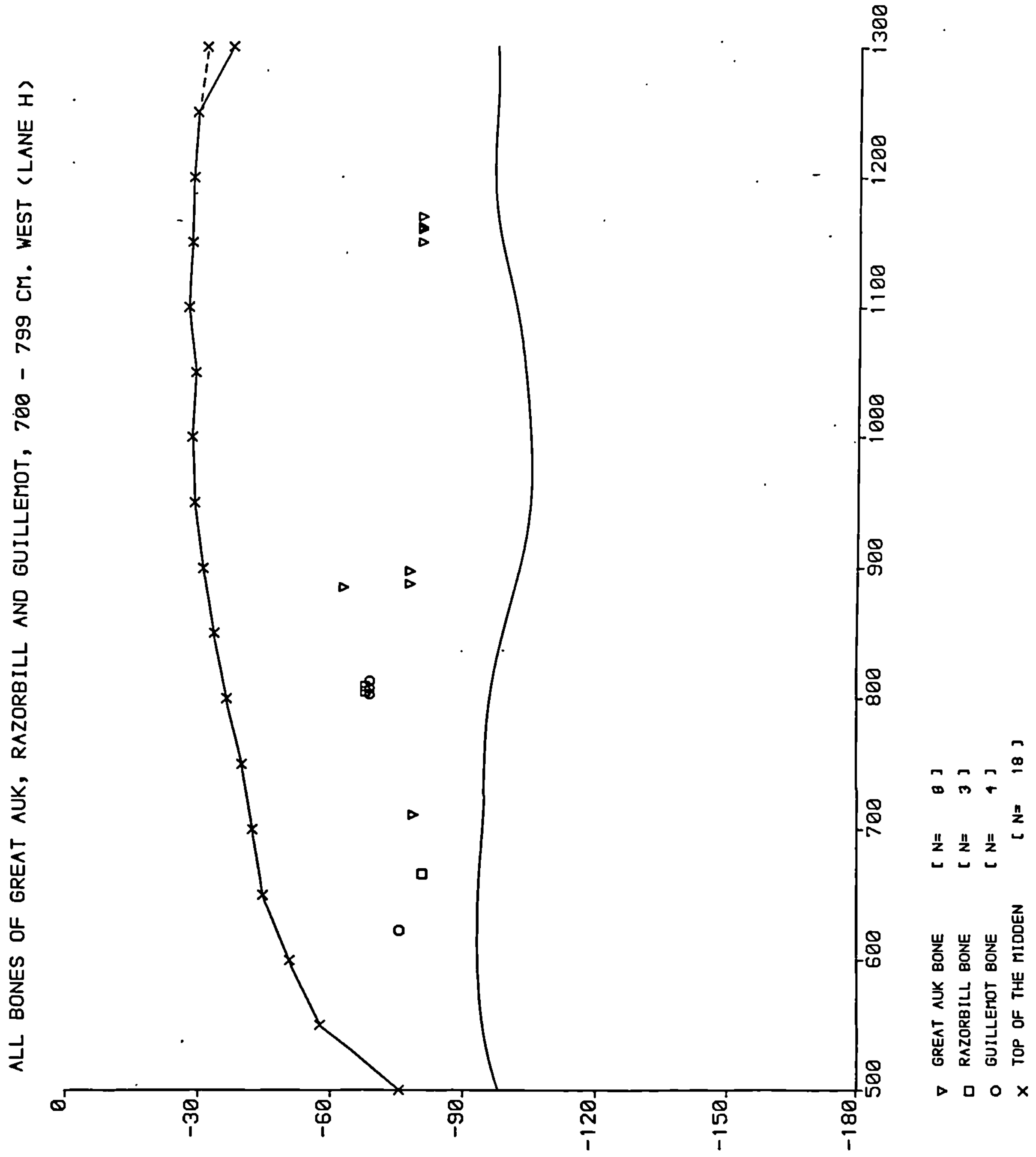

Figure 95. Sectional Plot Showing the Distribution of Great Auk, Razorbill and Guillemot Bones in Lane H (Southern Two-Thirds).

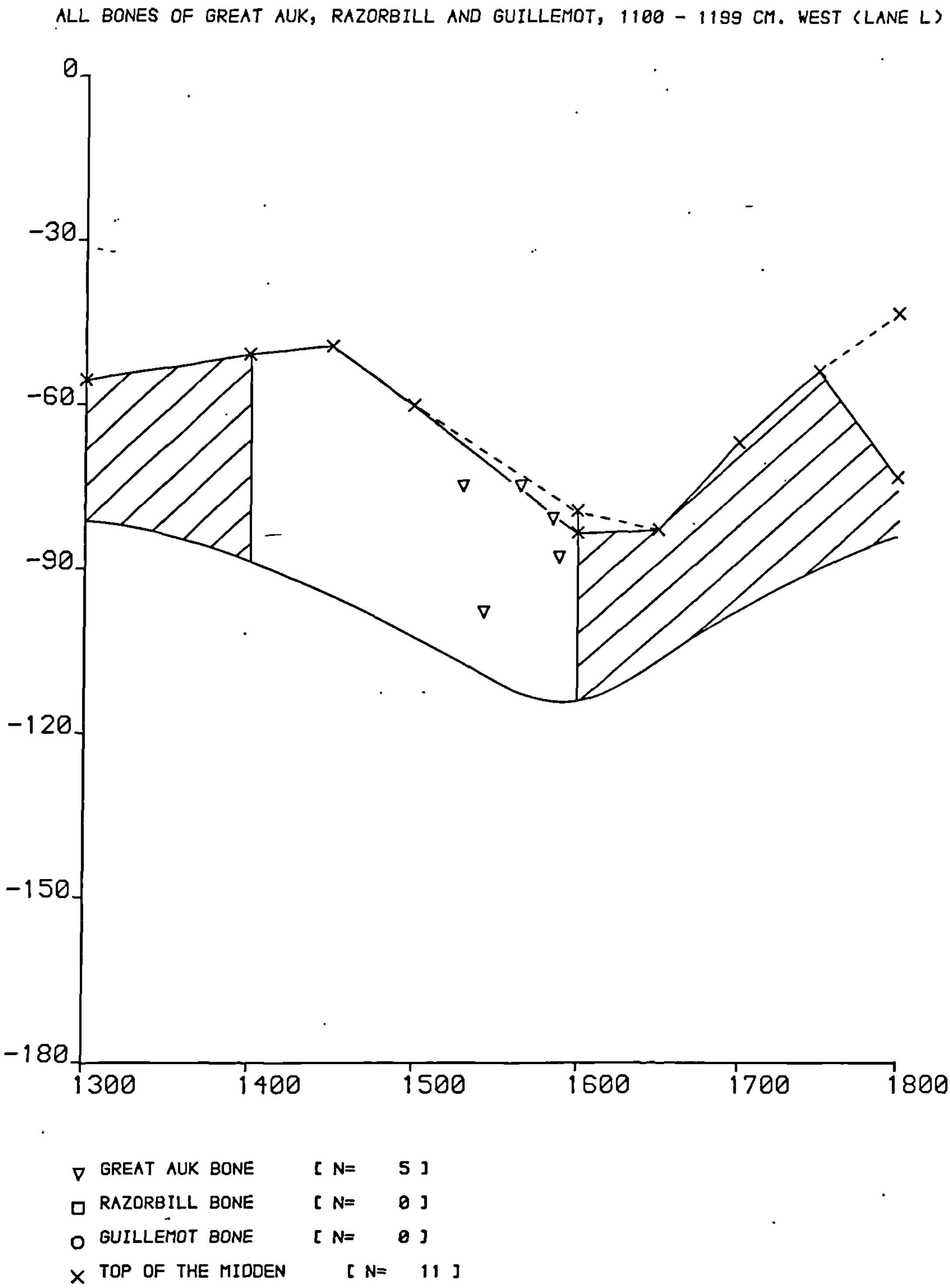

Figure 96. Sectional Plot Showing the Distribution of Great Auk, Razorbill and Guillemot Bones in Lane L (Northern One-Third).

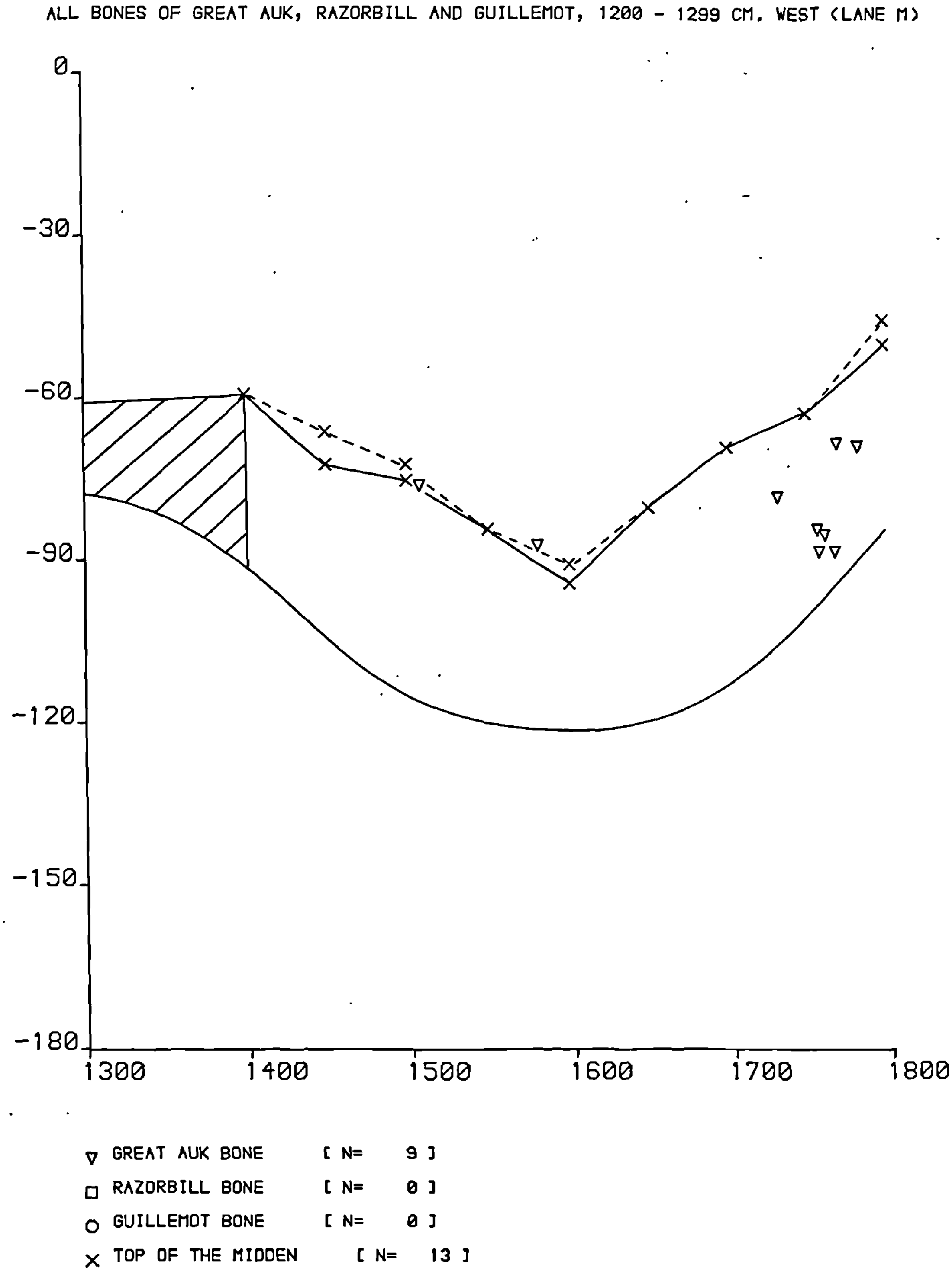

Figure 97. Sectional Plot Showing the Distribution of Great Auk, Razorbill and Guillemot Bones in Lane M (Northern One-Third).

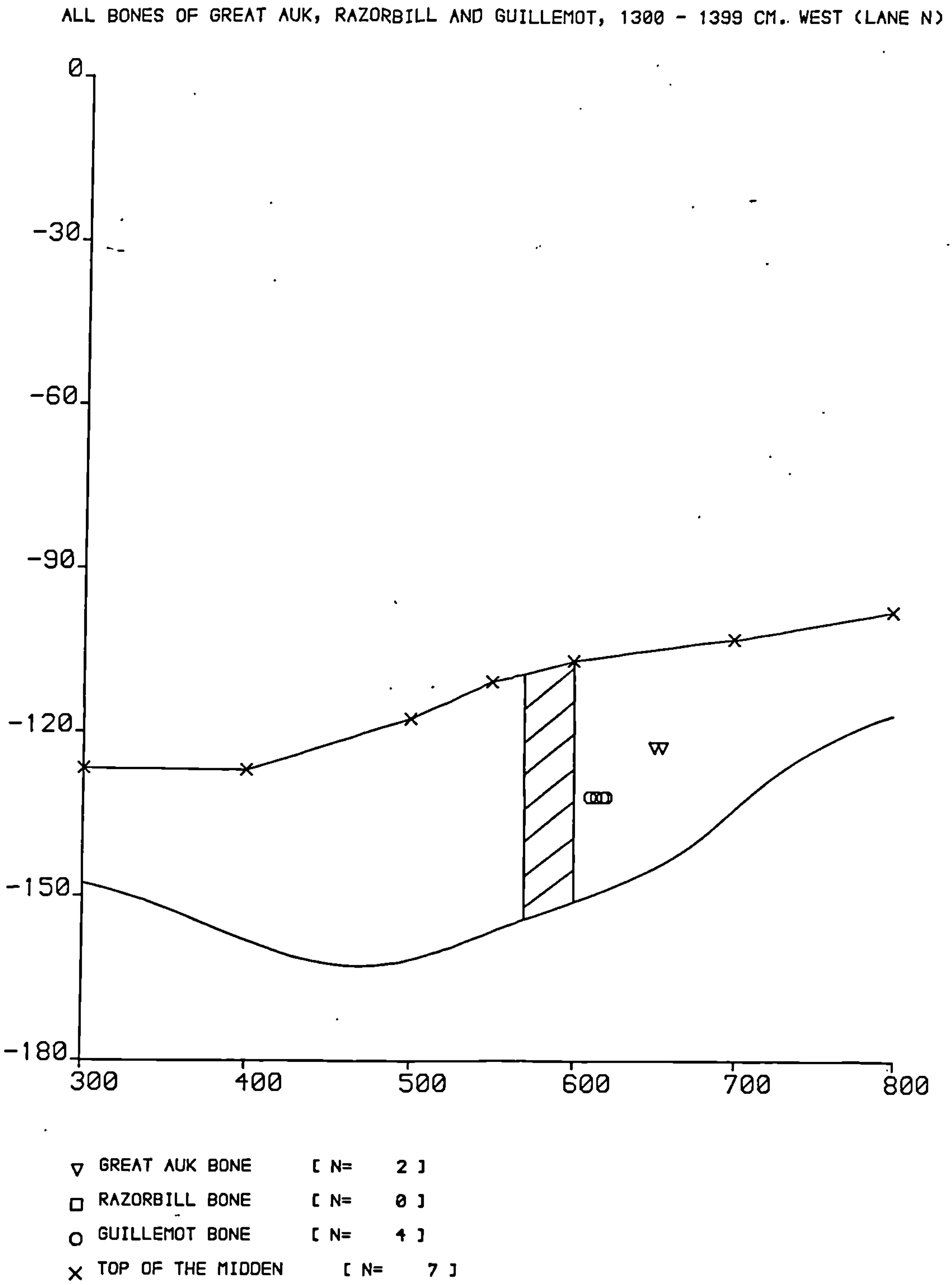

Figure 98. Sectional Plot Showing the Distribution of Great Auk, Razorbill and Guillemot Bones in Lane N (Southern One-Third).

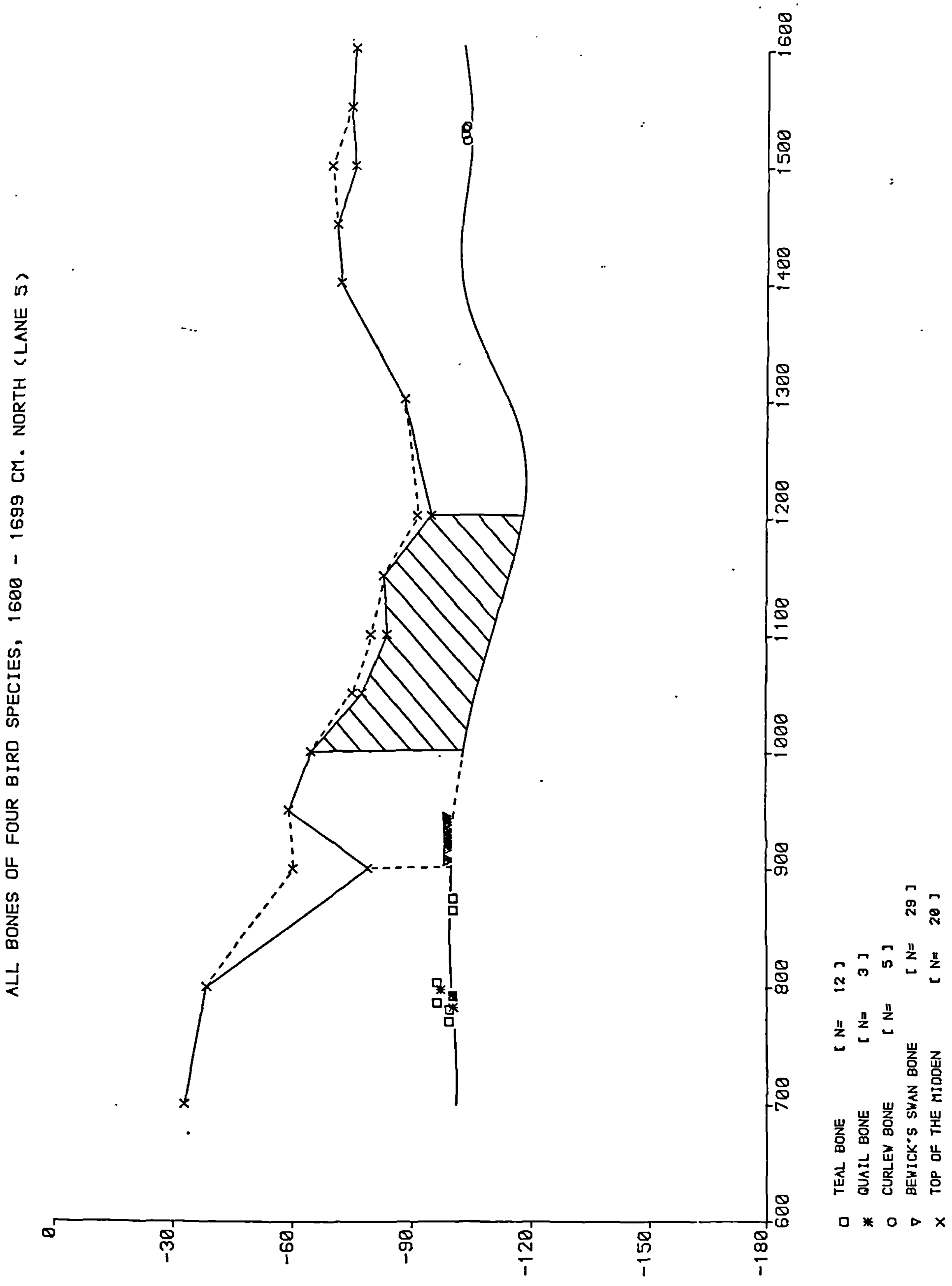

Figure 99. Sectional Plot Showing the Distribution of Teal, Quail, Curlew and Bewick's Swan Bones in Lane 5 (Eastern Half).

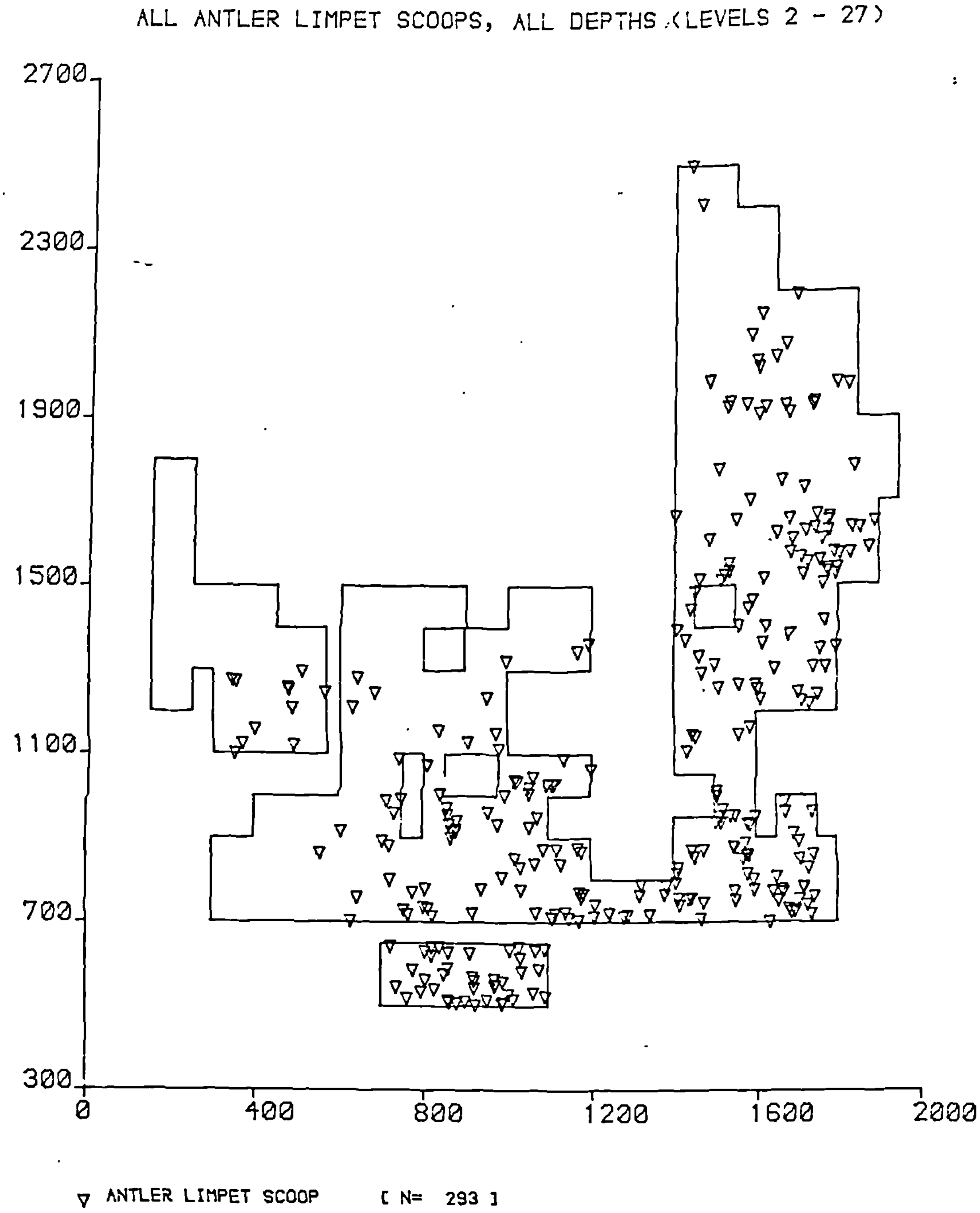

Figure 100. Horizontal Plot Showing the Distribution of All Antler Limpet Scoops in All Levels.

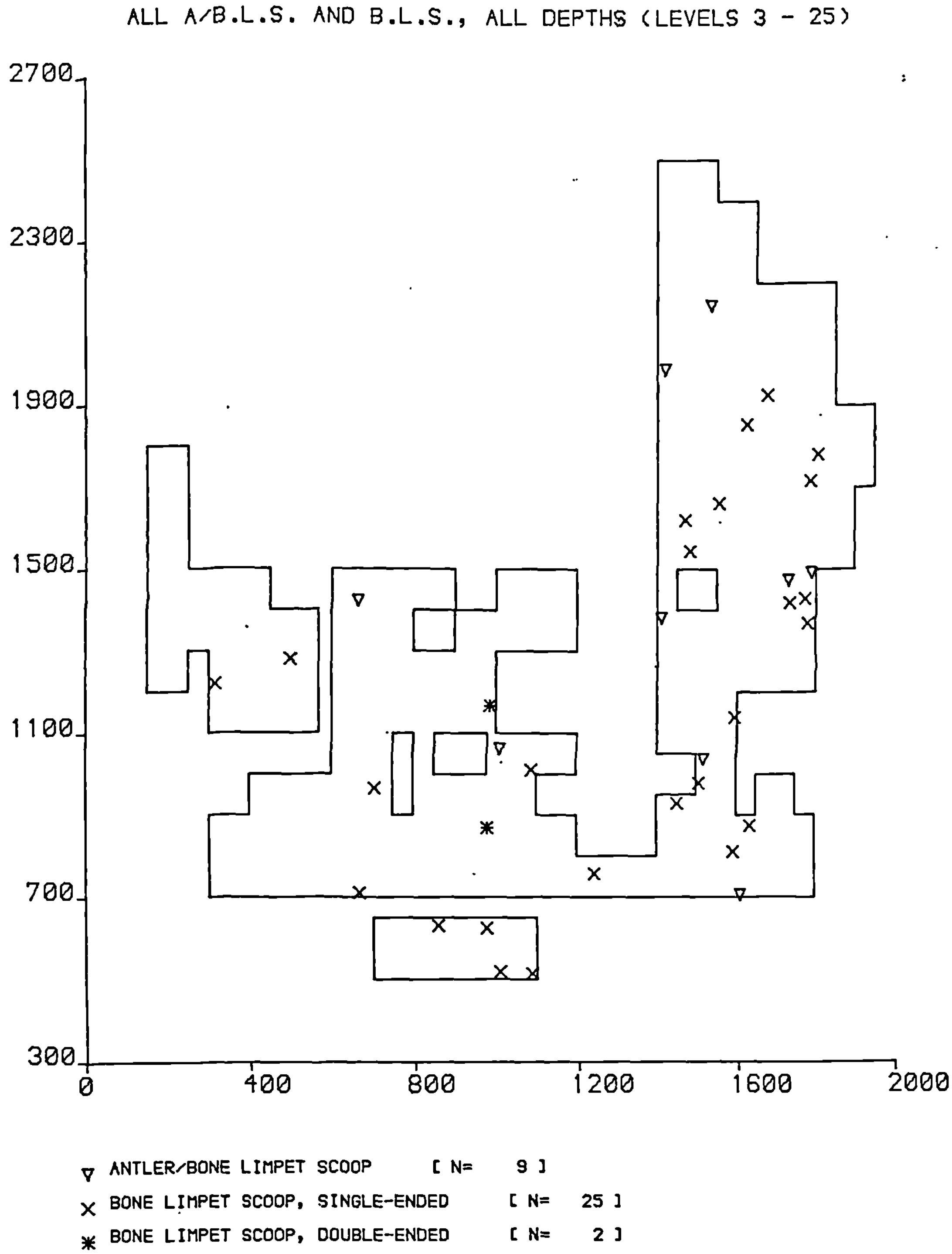

Figure 101. Horizontal Plot Showing the Distribution of All Antler/Bone and Bone Limpet Scoops in All Levels.

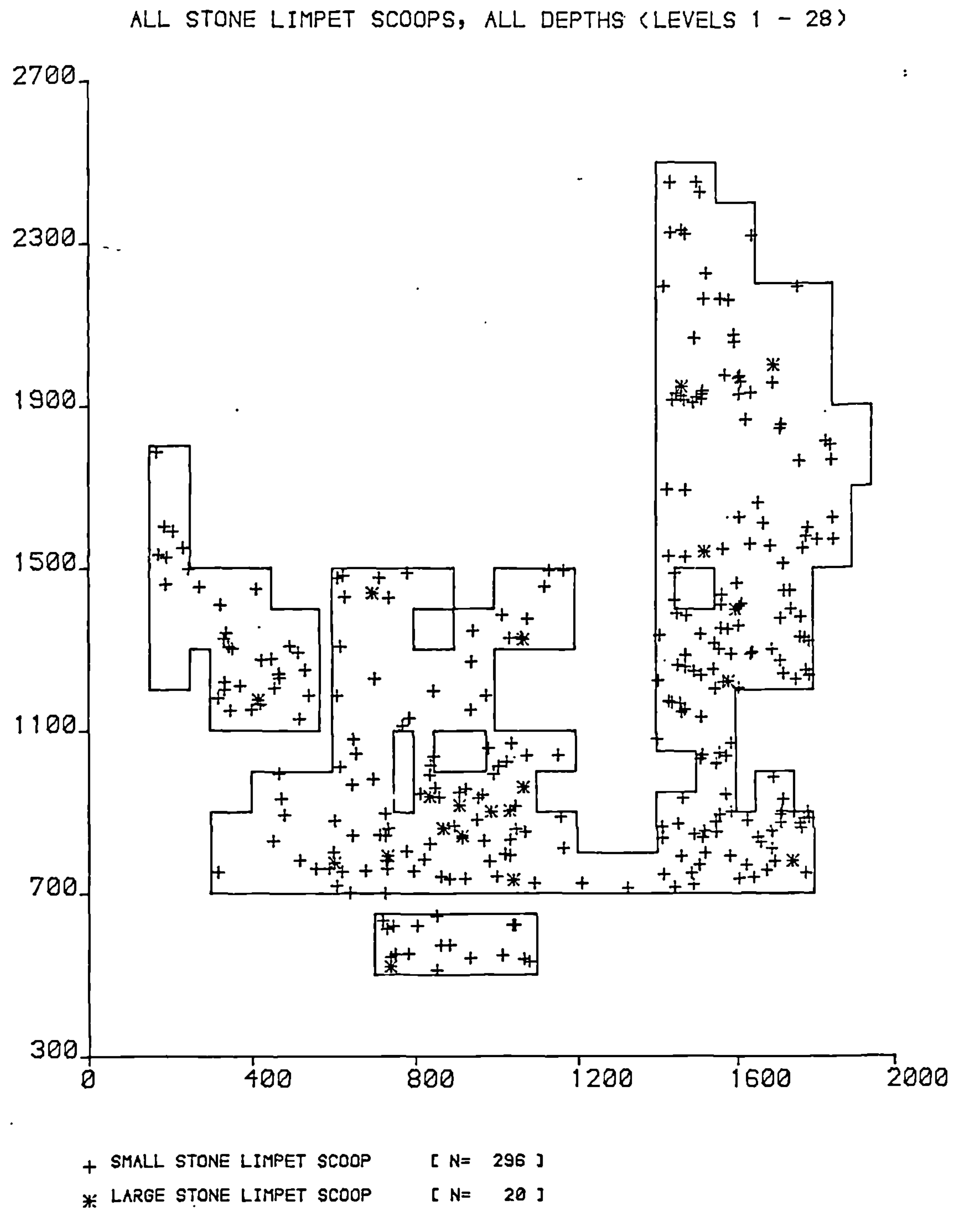

Figure 102. Horizontal Plot Showing the Distribution of All Stone Limpet Scoops in All Levels.

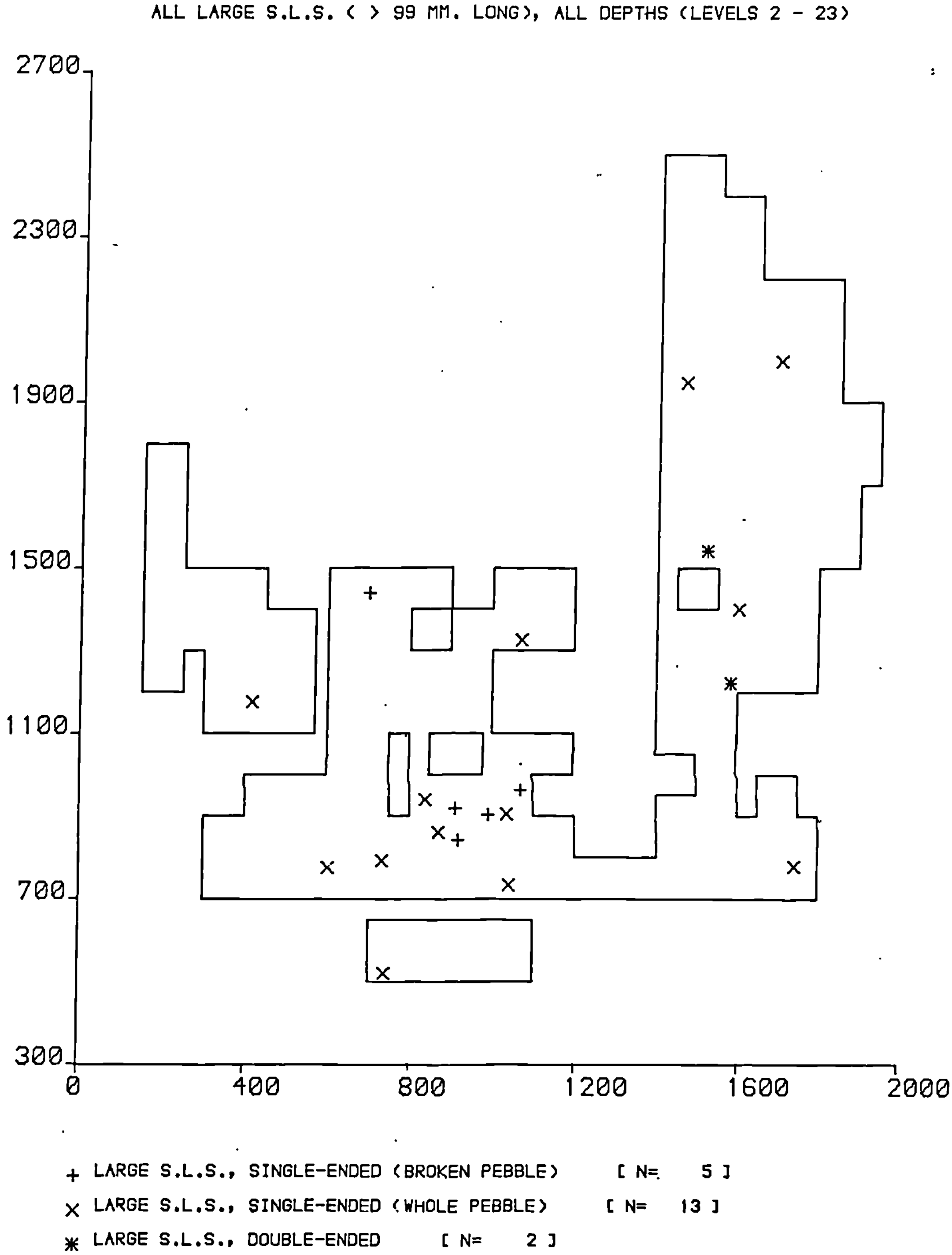

Figure 103. Horizontal Plot Showing the Distribution of All Large Stone Limpet Scoops (greater than 99 mm in length) in All Levels.

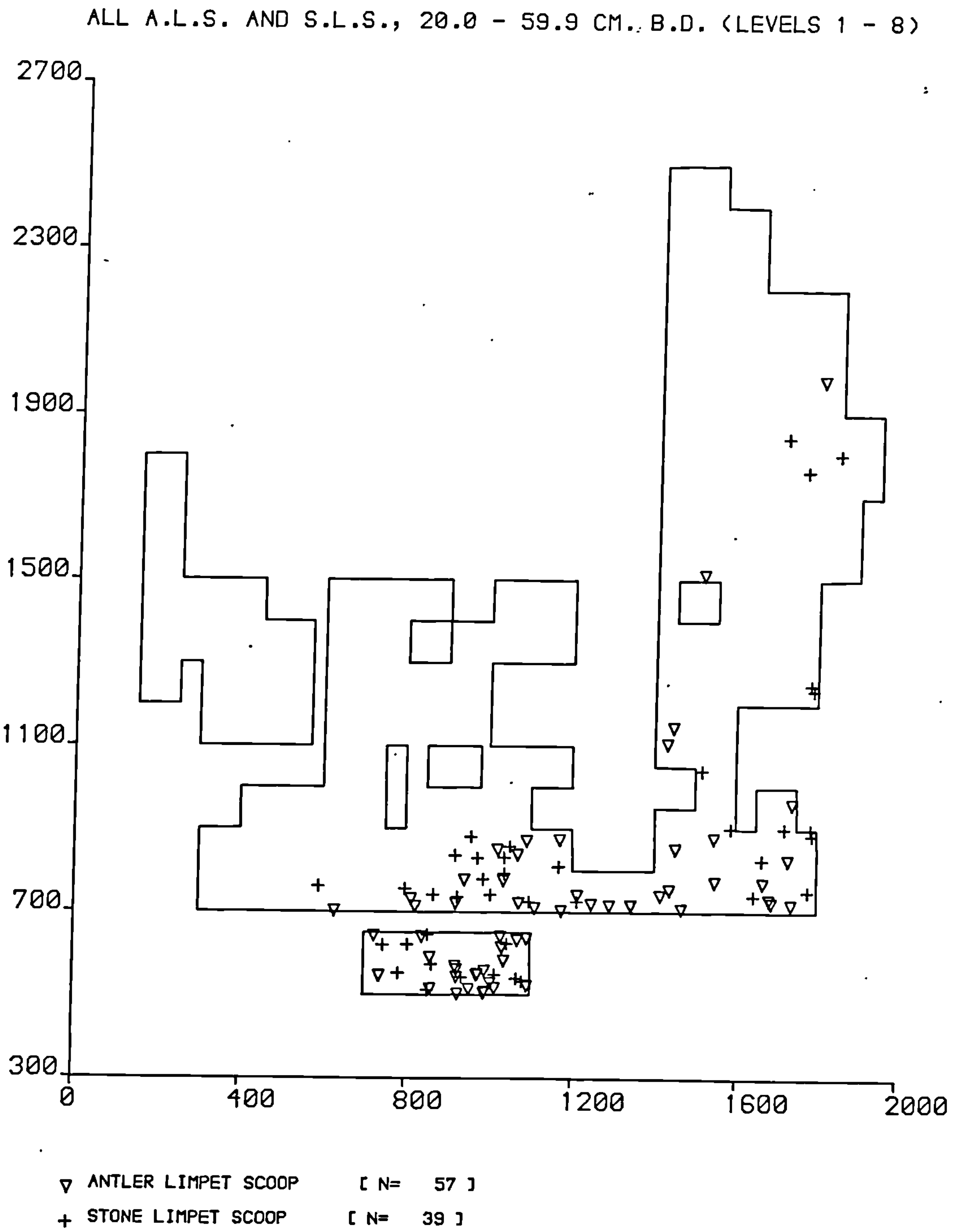

Figure 104. Horizontal Plot Showing the Distribution of Antler Limpet Scoops and Stone Limpet Scoops (under 100 mm long) in Levels 1 to 8.

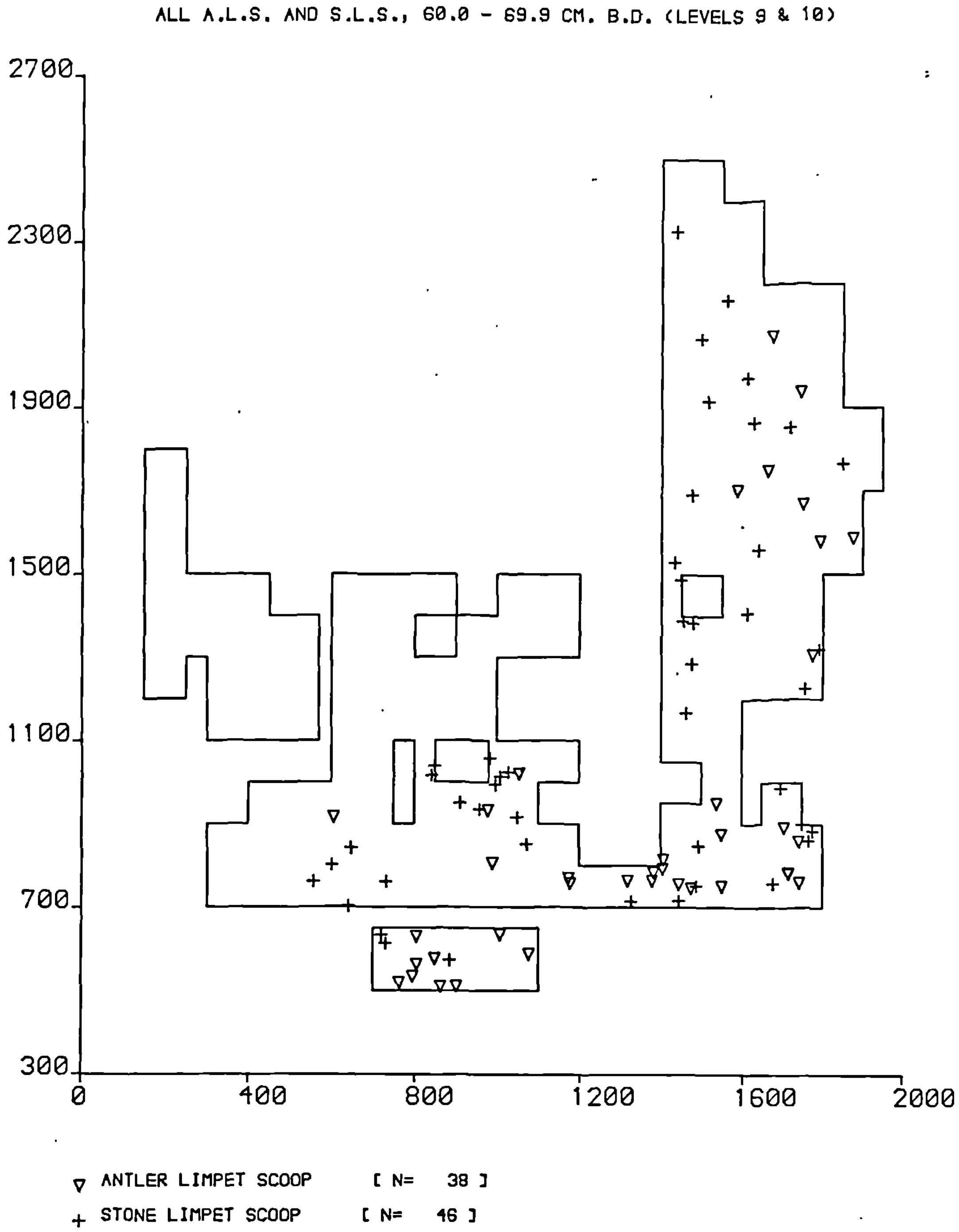

Figure 105. Horizontal Plot Showing the Distribution of Antler Limpet Scoops and Stone Limpet Scoops (under 100 mm long) in Levels 9 and 10.

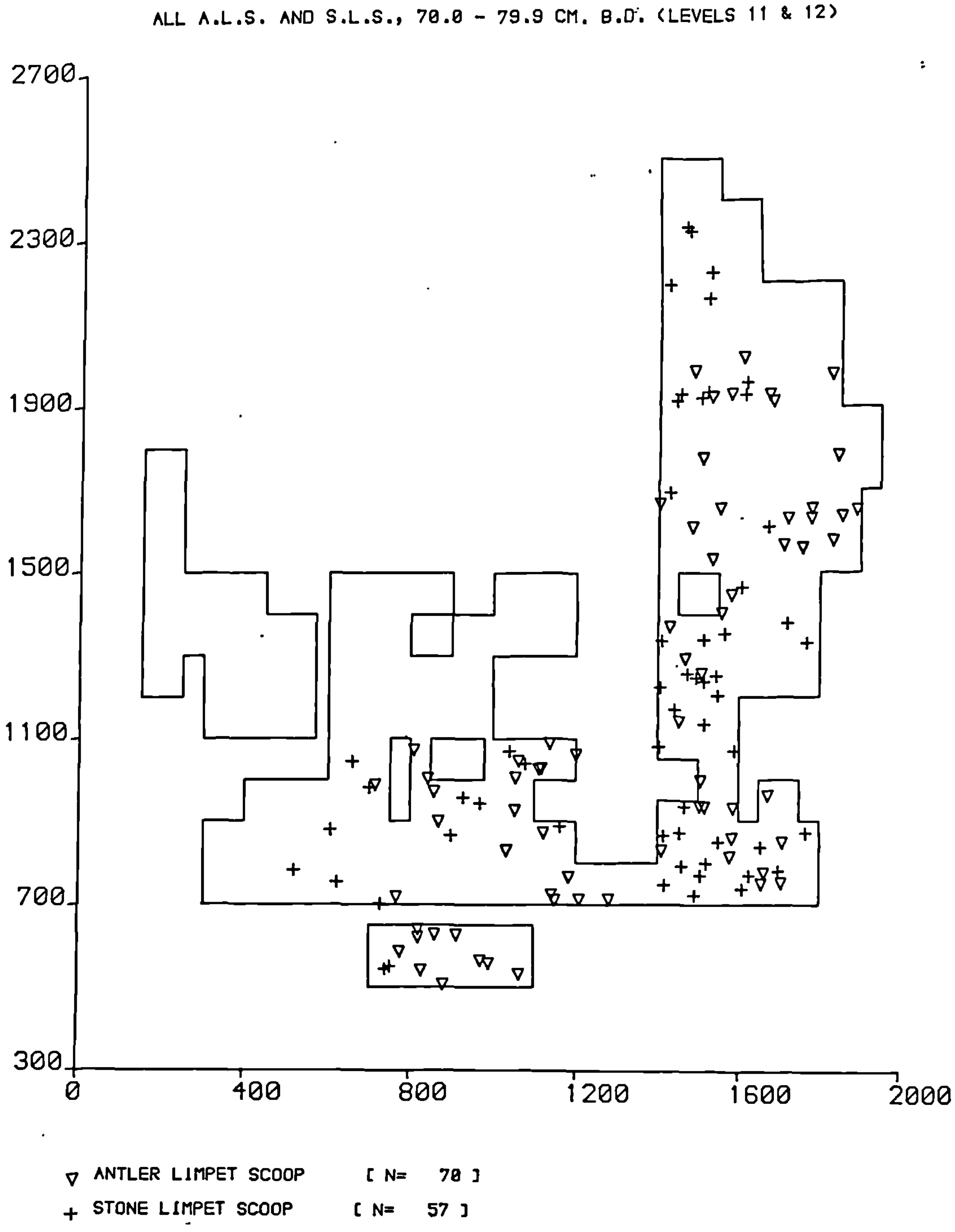

Figure 106. Horizontal Plot Showing the Distribution of Antler Limpet Scoops and Stone Limpet Scoops (under 100 mm long) in Levels 11 and 12.

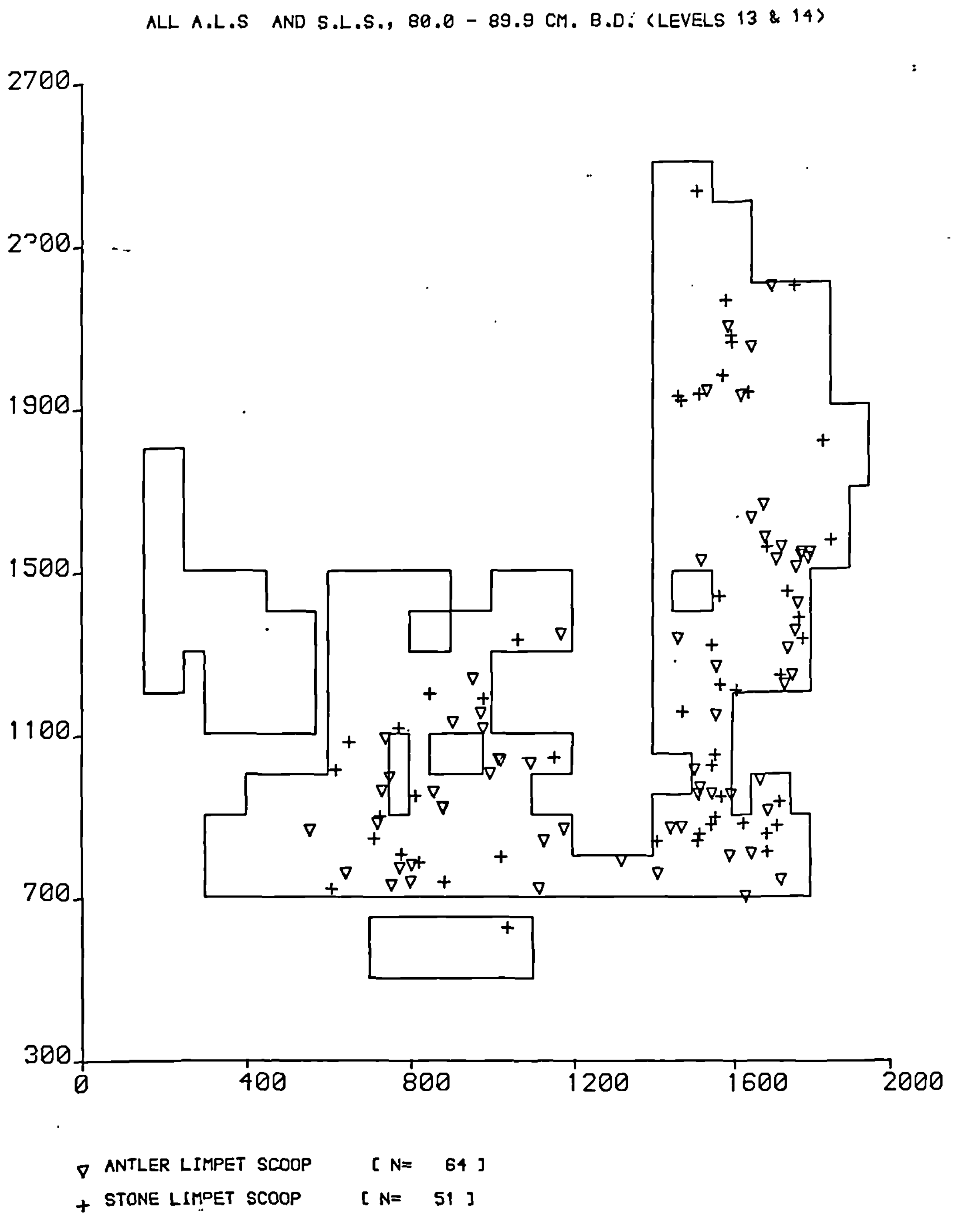

Figure 107. Horizontal Plot Showing the Distribution of Antler Limpet Scoops and Stone Limpet Scoops (under 100 mm long) in Levels 13 and 14.

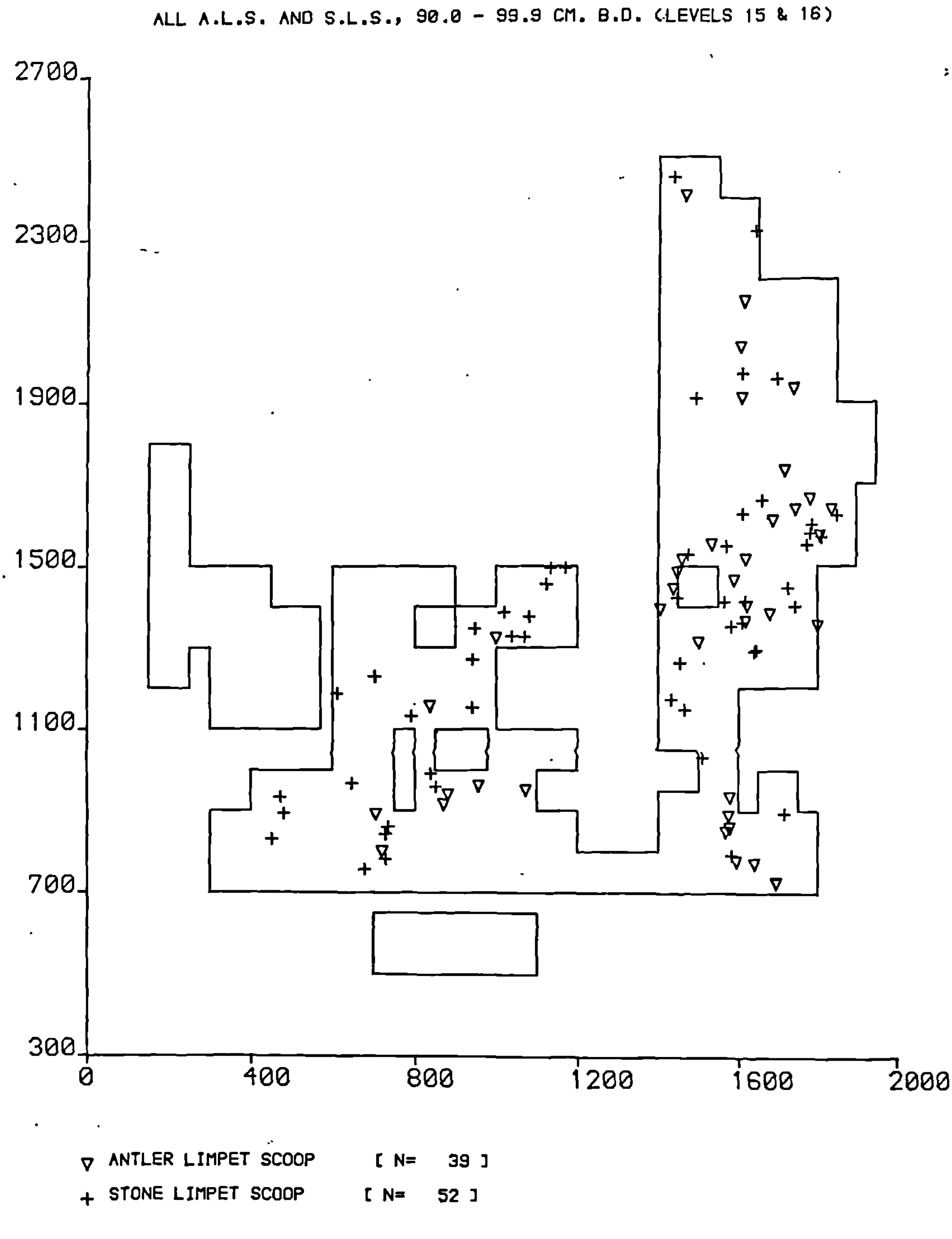

Figure 108. Horizontal Plot Showing the Distribution of Antler Limpet Scoops and Stone Limpet Scoops (under 100 mm long) in Levels 15 and 16.

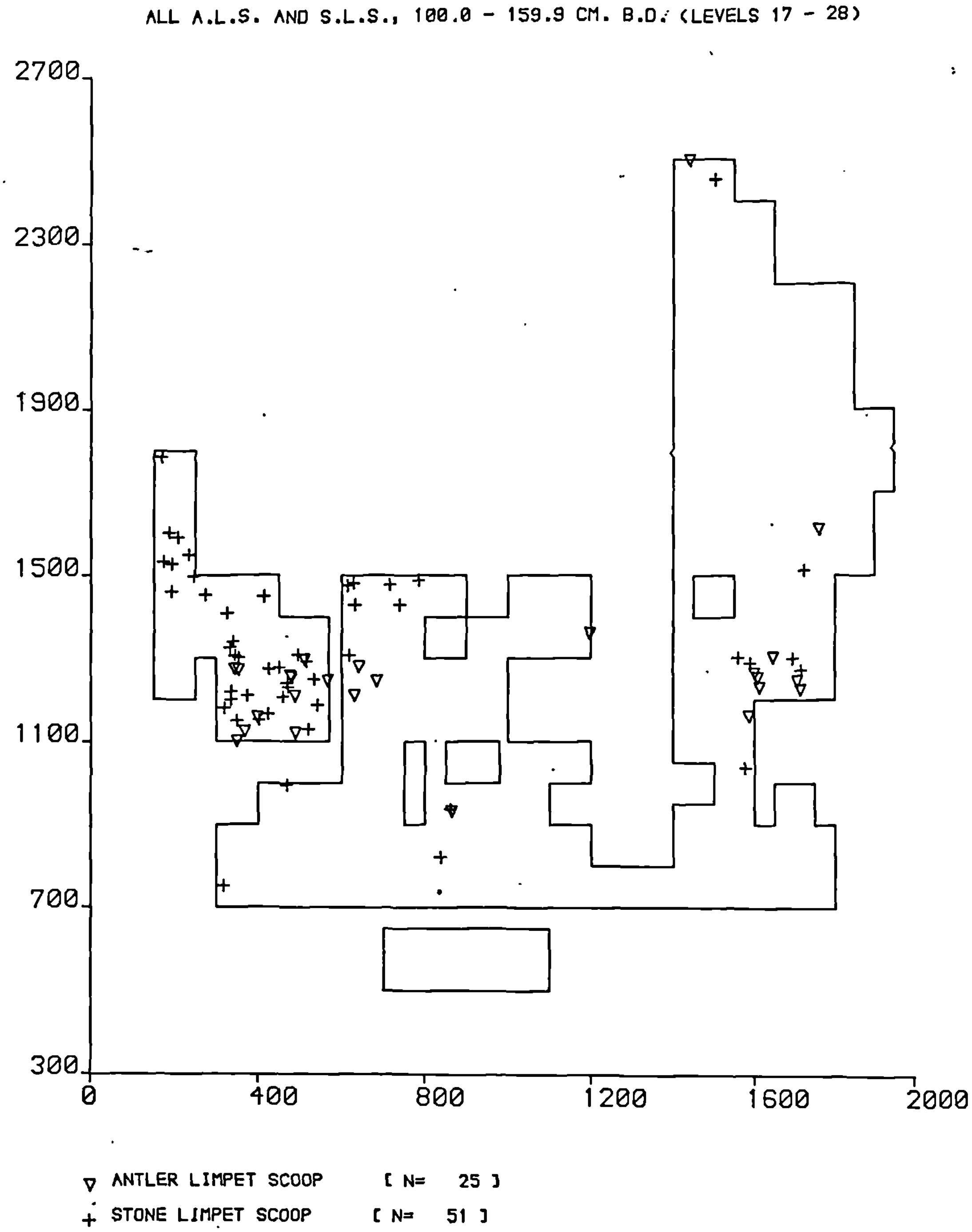

Figure 109. Horizontal Plot Showing the Distribution of Antler Limpet Scoops and Stone Limpet Scoops (under 100 mm long) in Levels 17 to 28.

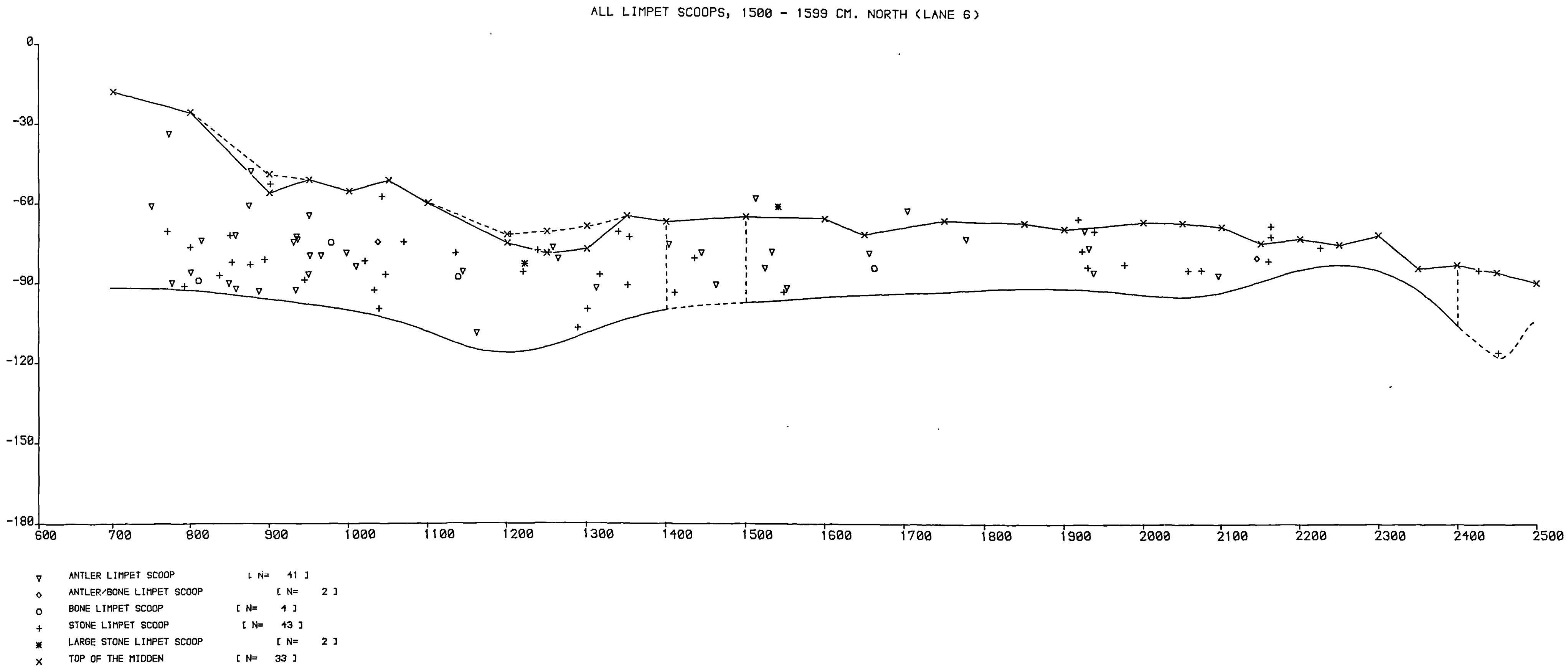

Figure 110. Sectional Plot Showing the Distribution of All Limpet Scoops in Lane 6.

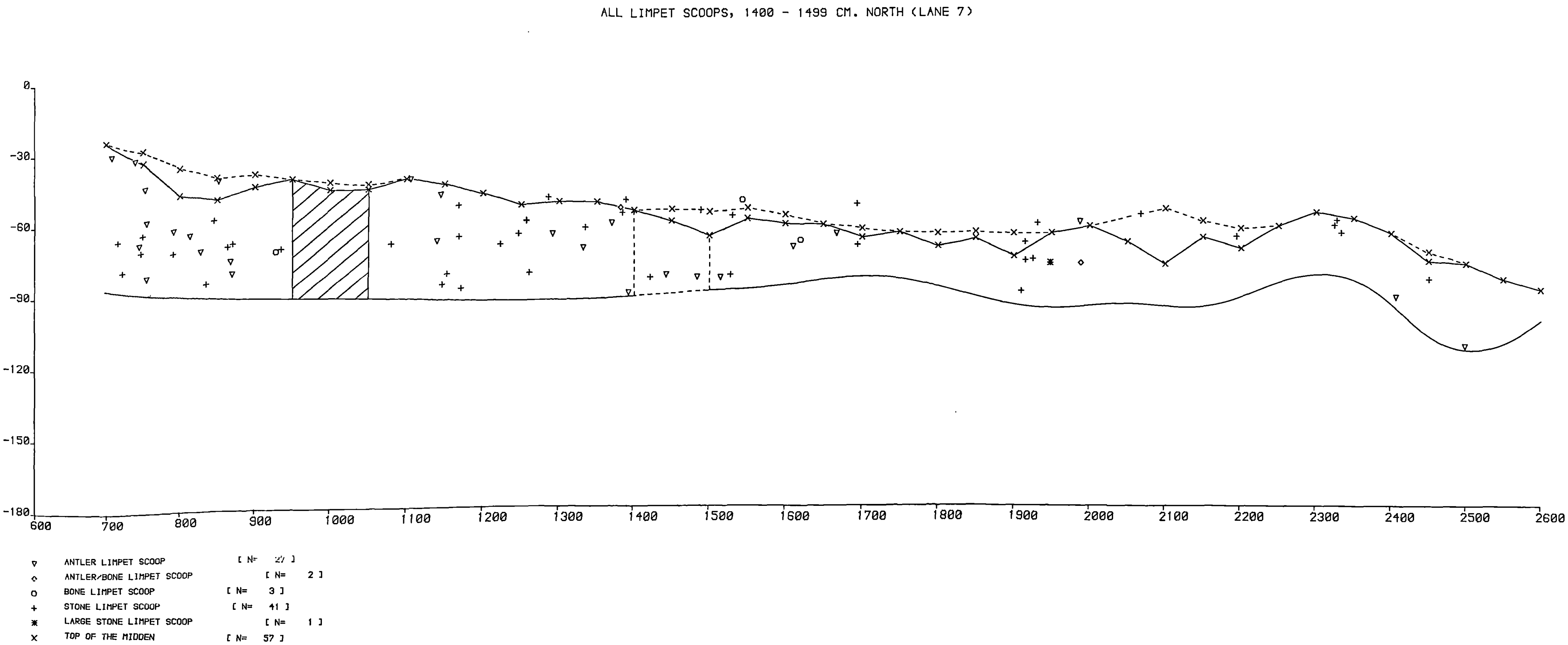

Figure 111. Sectional Plot Showing the Distribution of All Limpet Scoops in Lane 7.

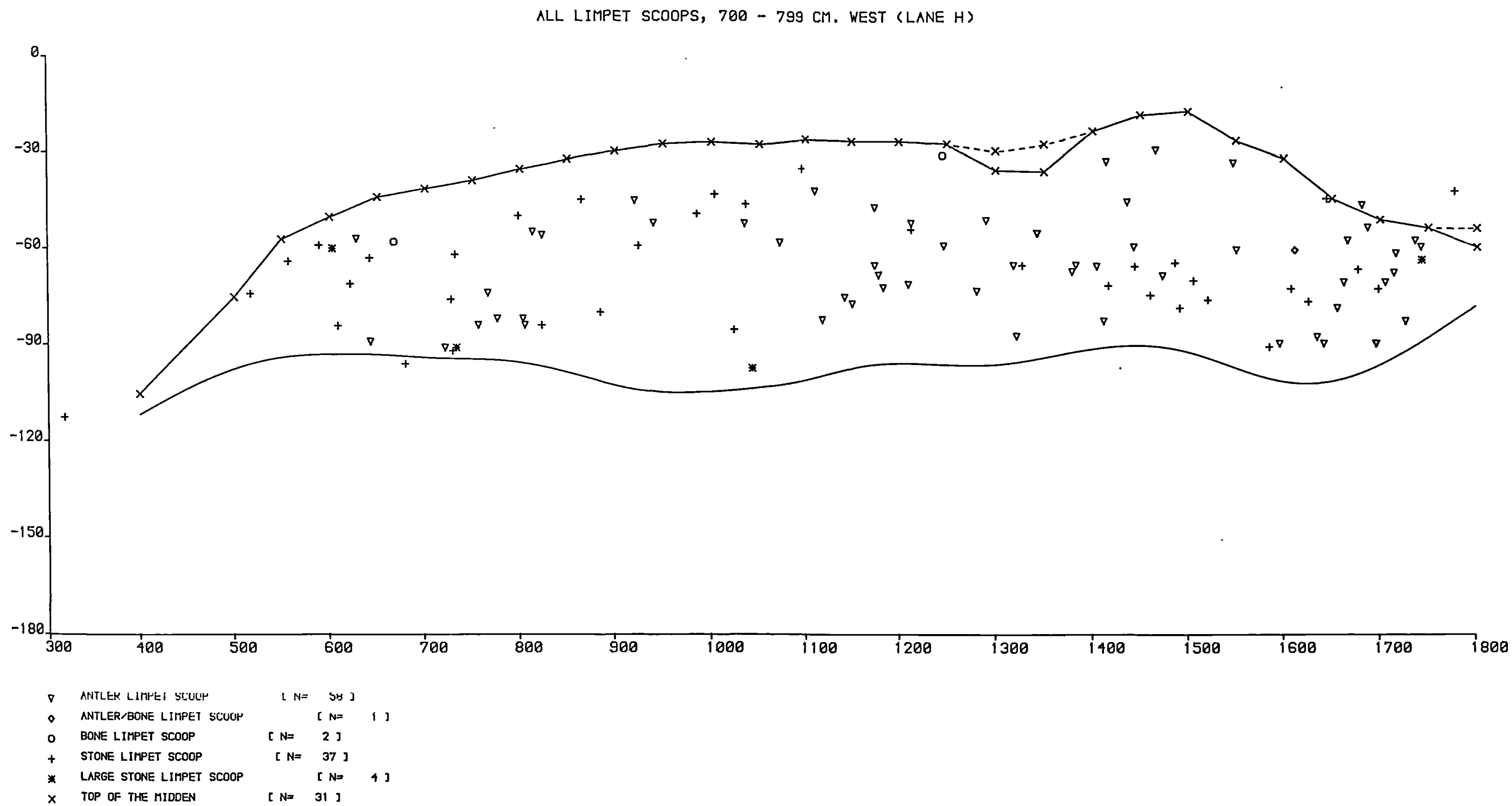

Figure 112. Sectional Plot Showing the Distribution of All Limpet Scoops in Lane H.

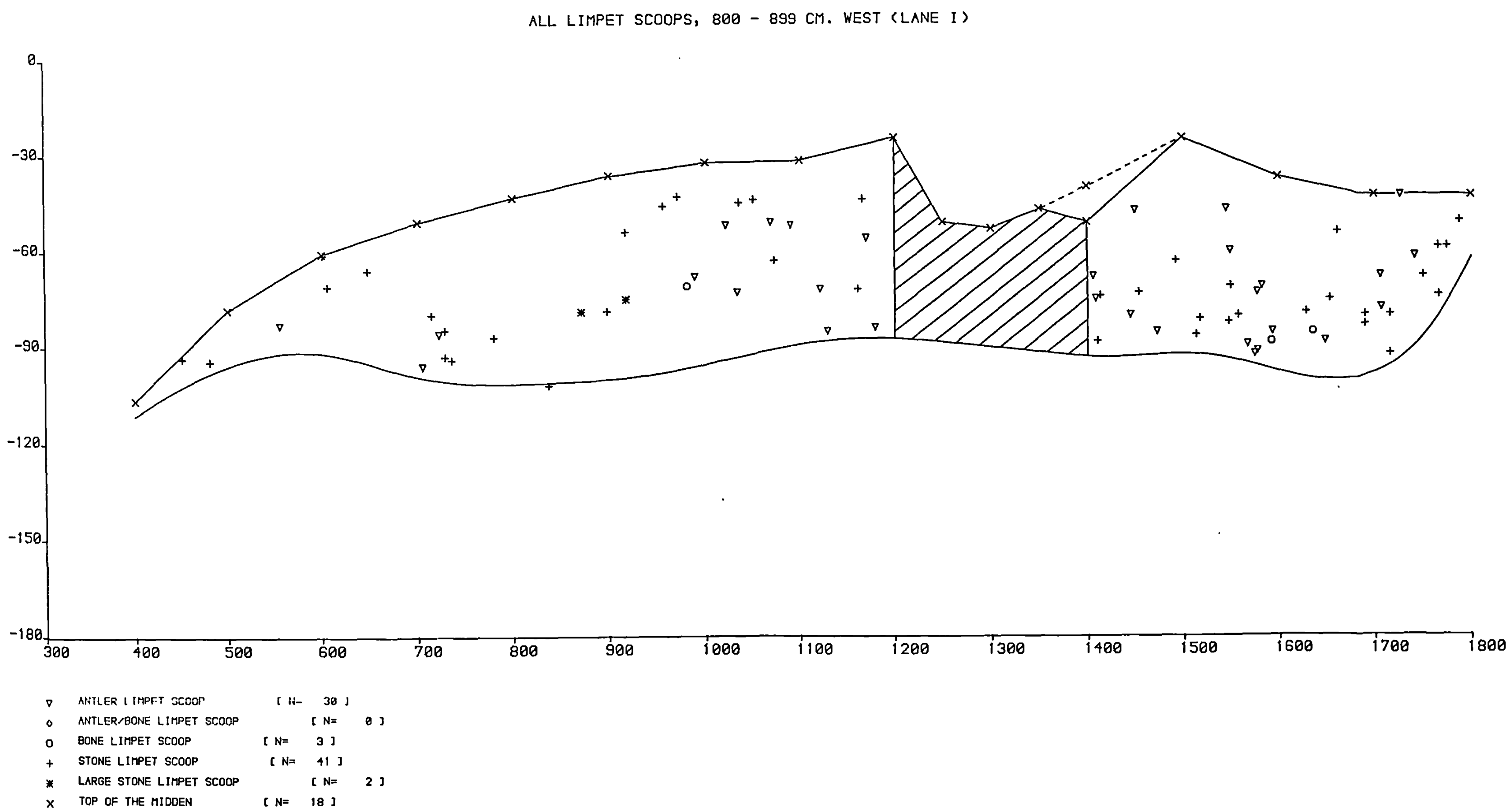

Figure 113. Sectional Plot Showing the Distribution of All Limpet Scoops in Lane I.

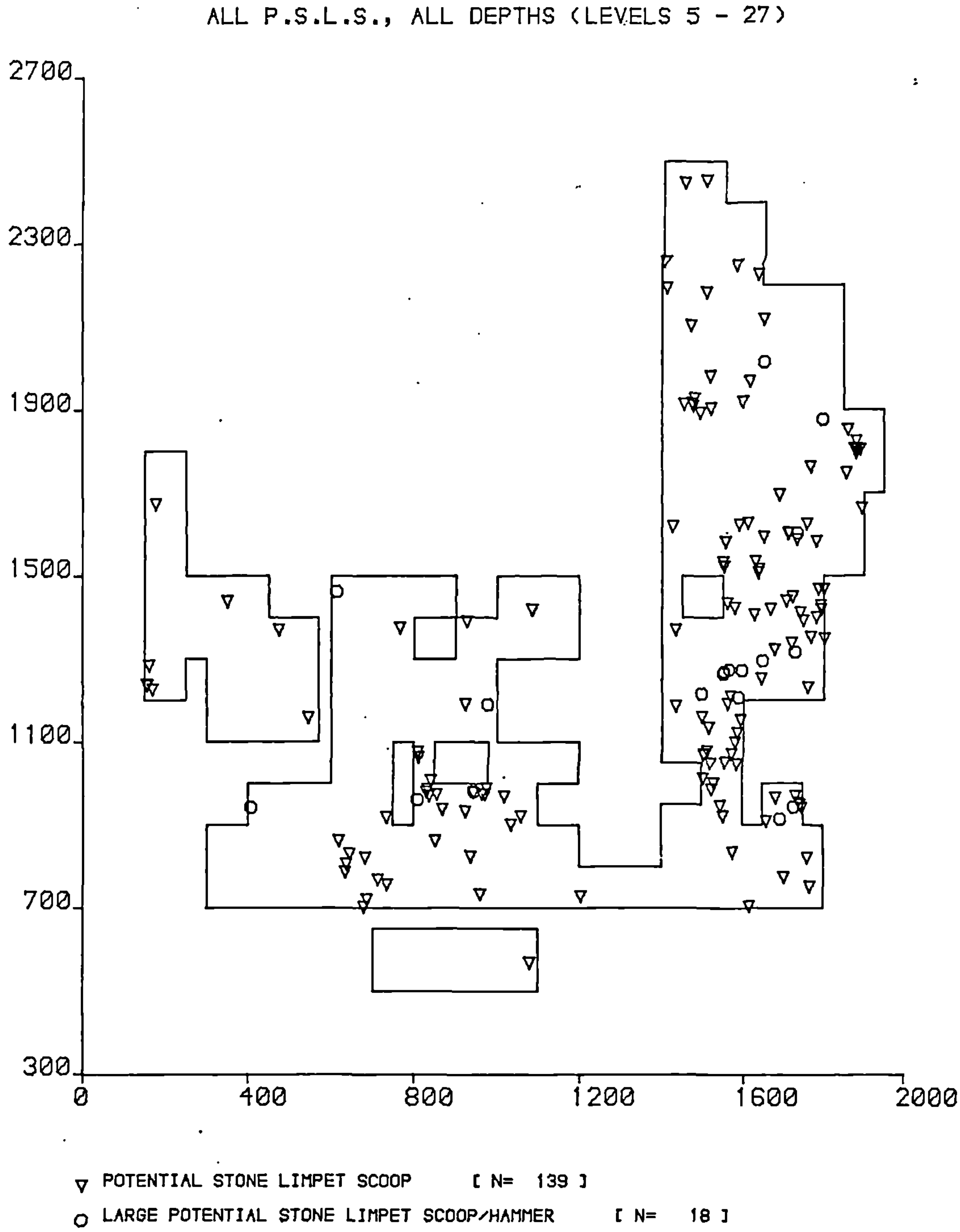

Figure 114. Horizontal Plot Showing the Distribution of All Potential Stone Limpet Scoops and Potential Stone Limpet Scoops/Hammers in All Levels.

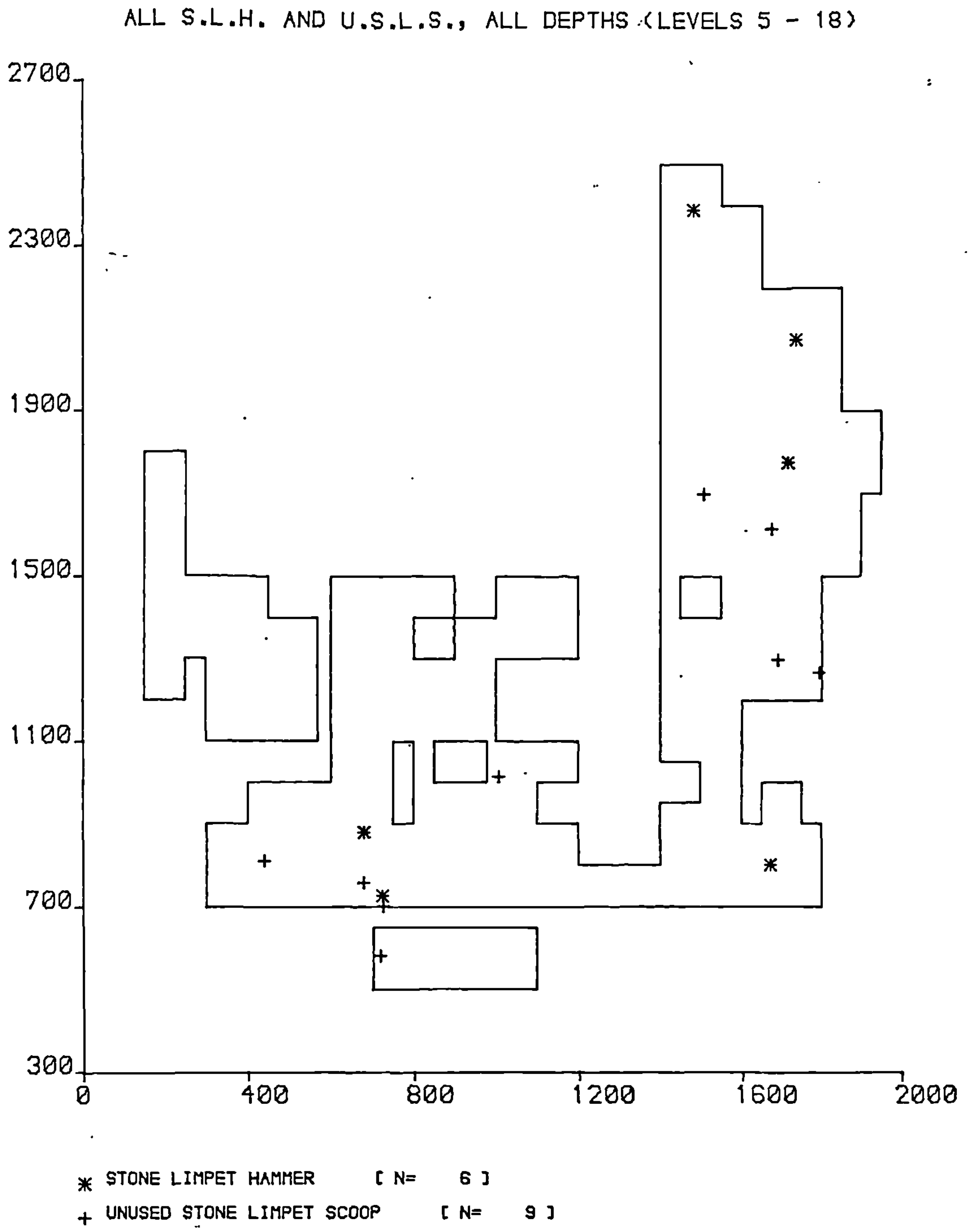

Figure 115. Horizontal Plot Showing the Distribution of All Stone Limpet Hammers and Unused Stone Limpet Scoops in All Levels.

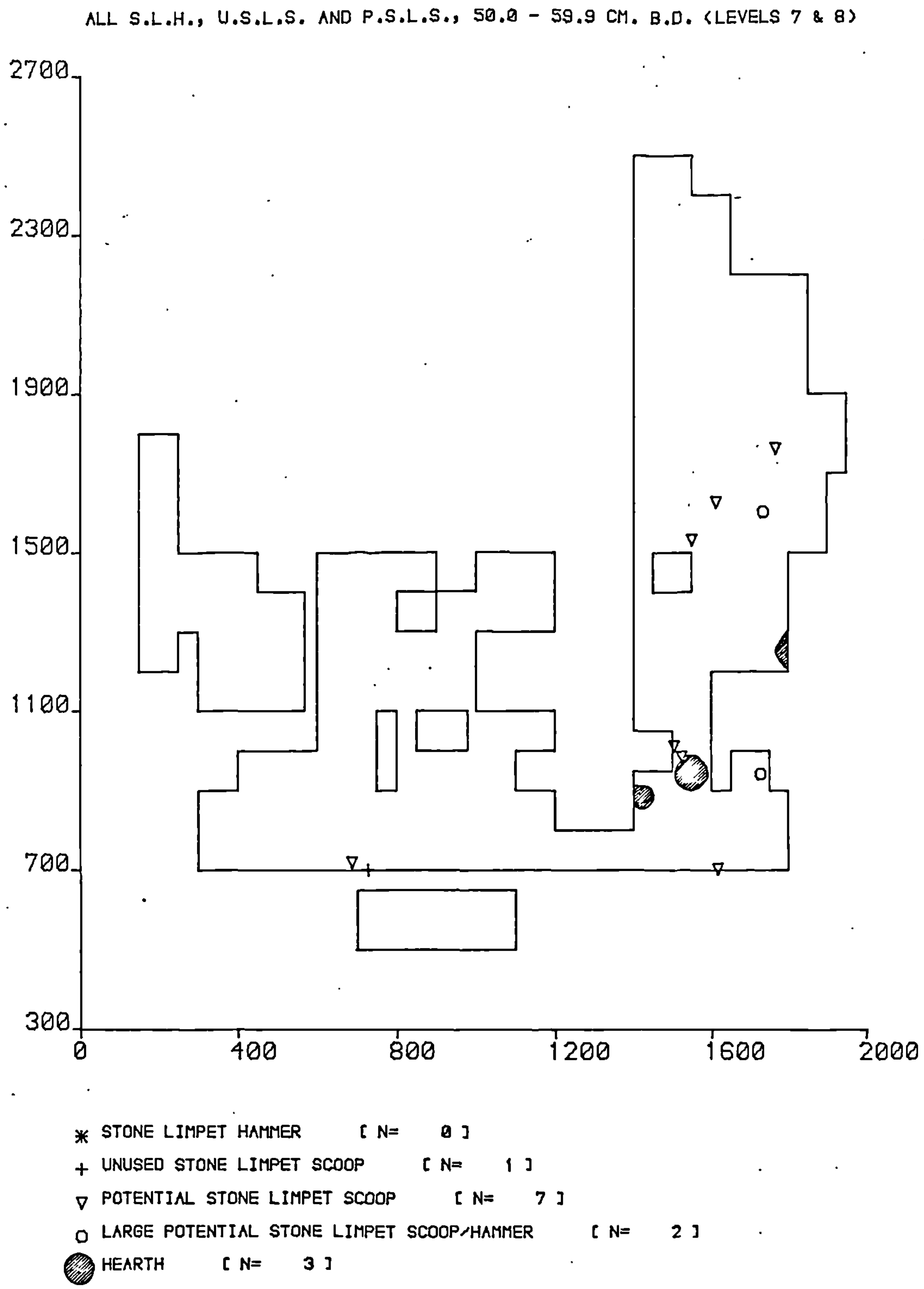

Figure 116. Horizontal Plot Showing the Distribution of Stone Limpet Hammers, Unused Stone Limpet Scoops, Potential Stone Limpet Scoops and Potential Stone Limpet Scoops/Hammers in Levels 7 and 8.

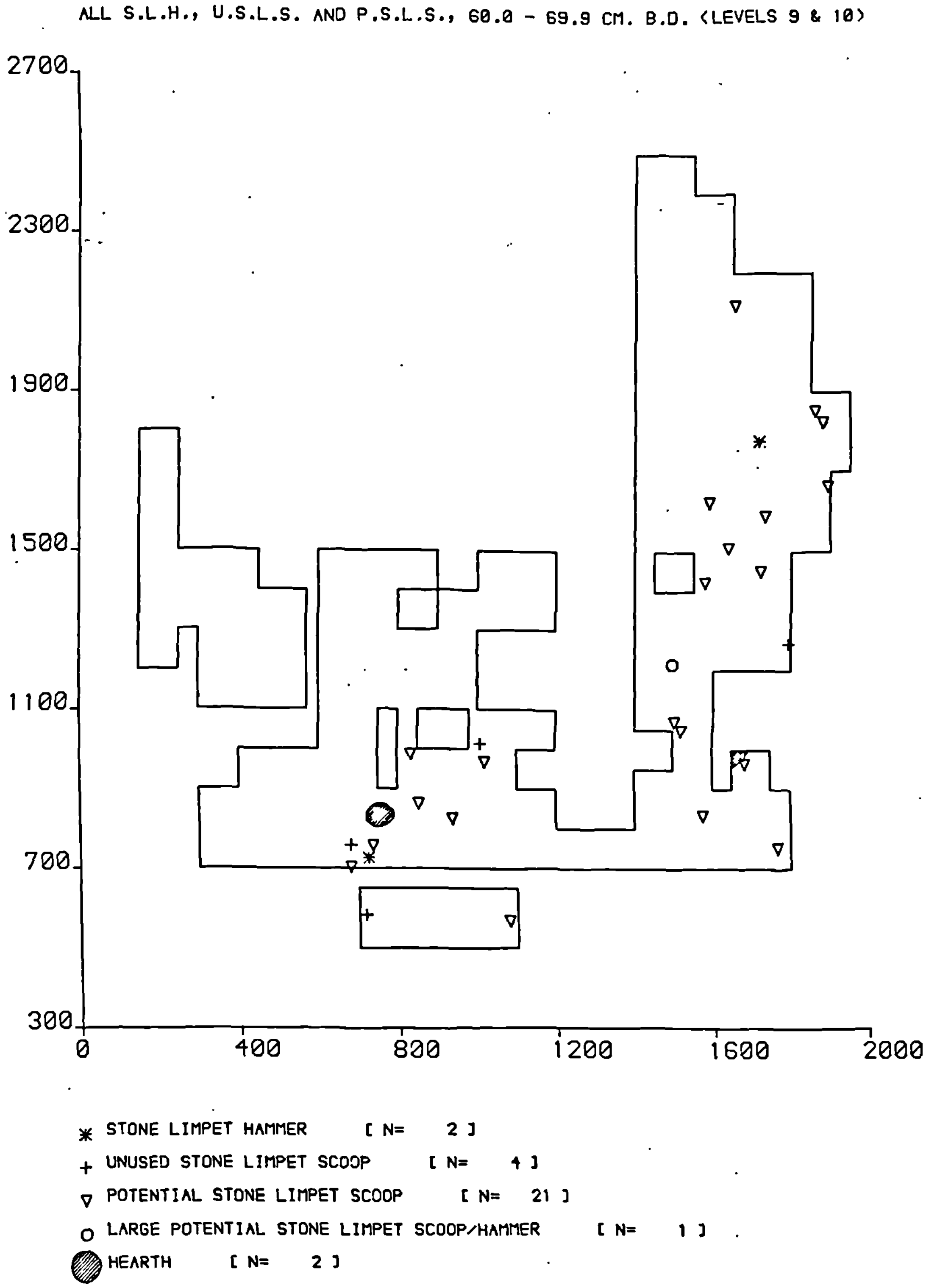

Figure 117. Horizontal Plot Showing the Distribution of Stone Limpet Hammers, Unused Stone Limpet Scoops, Potential Stone Limpet Scoops and Potential Stone Limpet Scoops/Hammers in Levels 9 and 10.

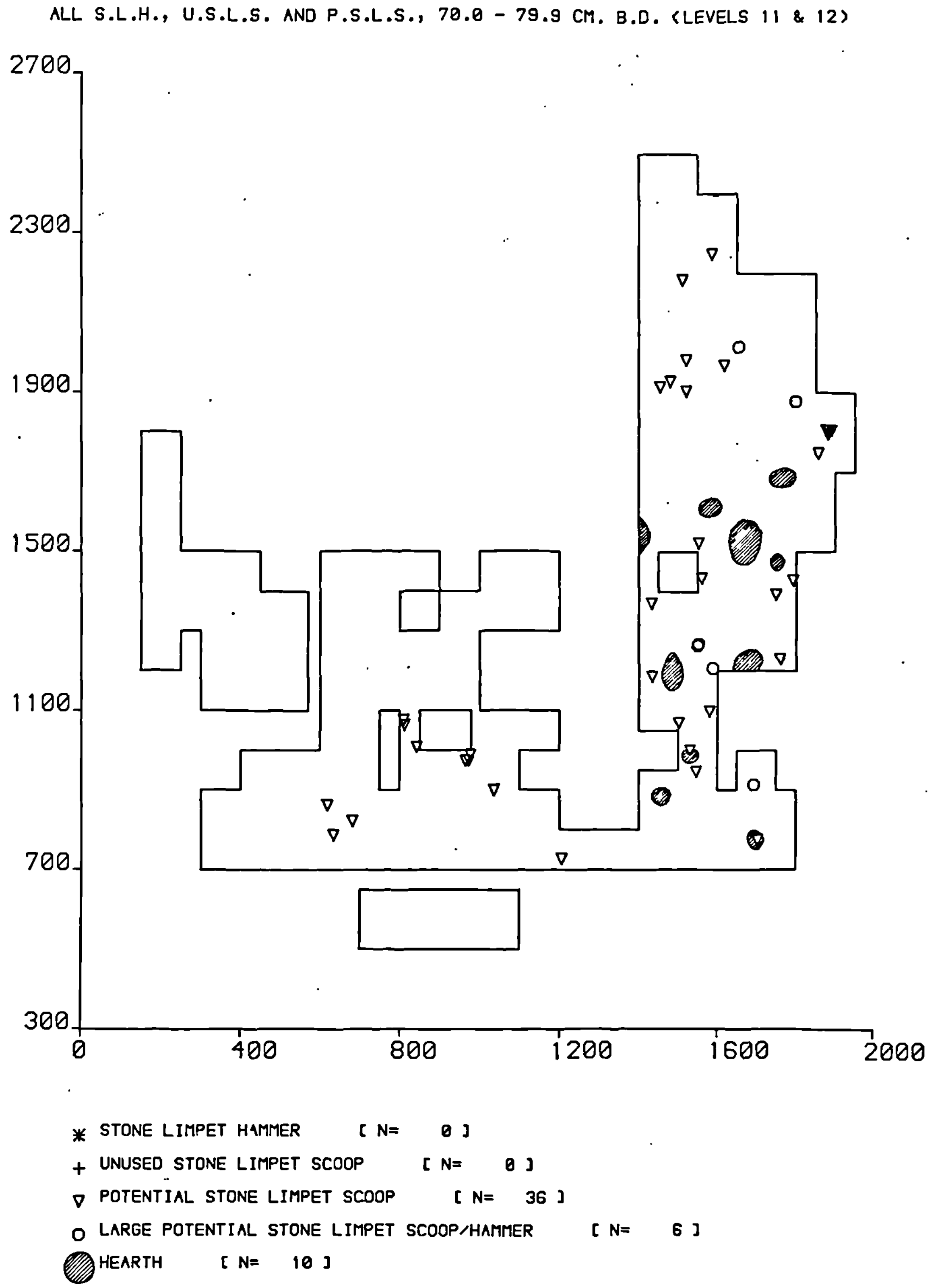

Figure 118. Horizontal Plot Showing the Distribution of Stone Limpet Hammers, Unused Stone Limpet Scoops, Potential Stone Limpet Scoops and Potential Stone Limpet Scoops/Hammers in Levels 11 and 12.

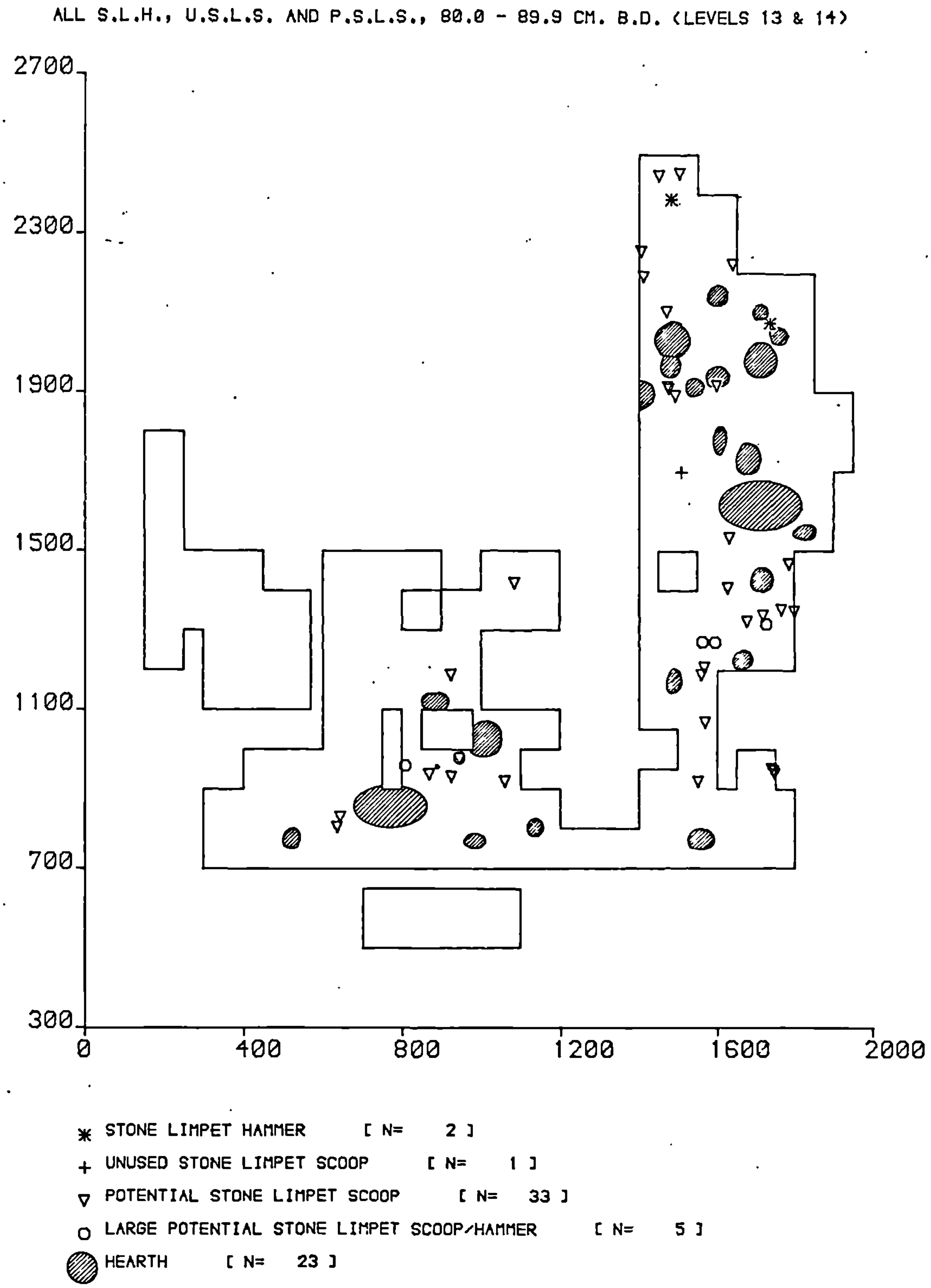

Figure 119. Horizontal Plot Showing the Distribution of Stone Limpet Hammers, Unused Stone Limpet Scoops, Potential Stone Limpet Scoops and Potential Stone Limpet Scoops/Hammers in Levels 13 and 14.

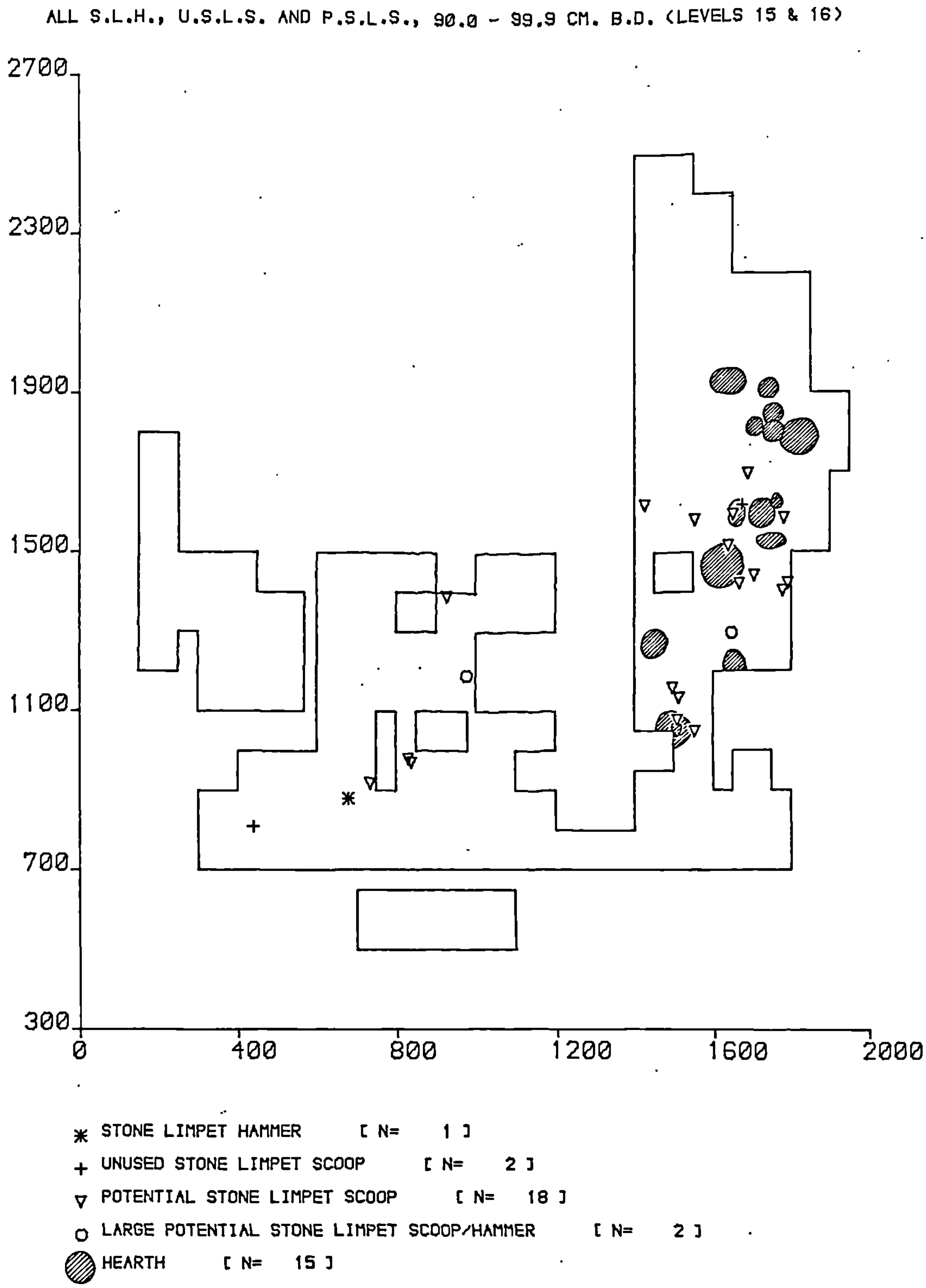

Figure 120. Horizontal Plot Showing the Distribution of Stone Limpet Hammers, Unused Stone Limpet Scoops, Potential Stone Limpet Scoops and Potential Stone Limpet Scoops/Hammers in Levels 15 and 16.

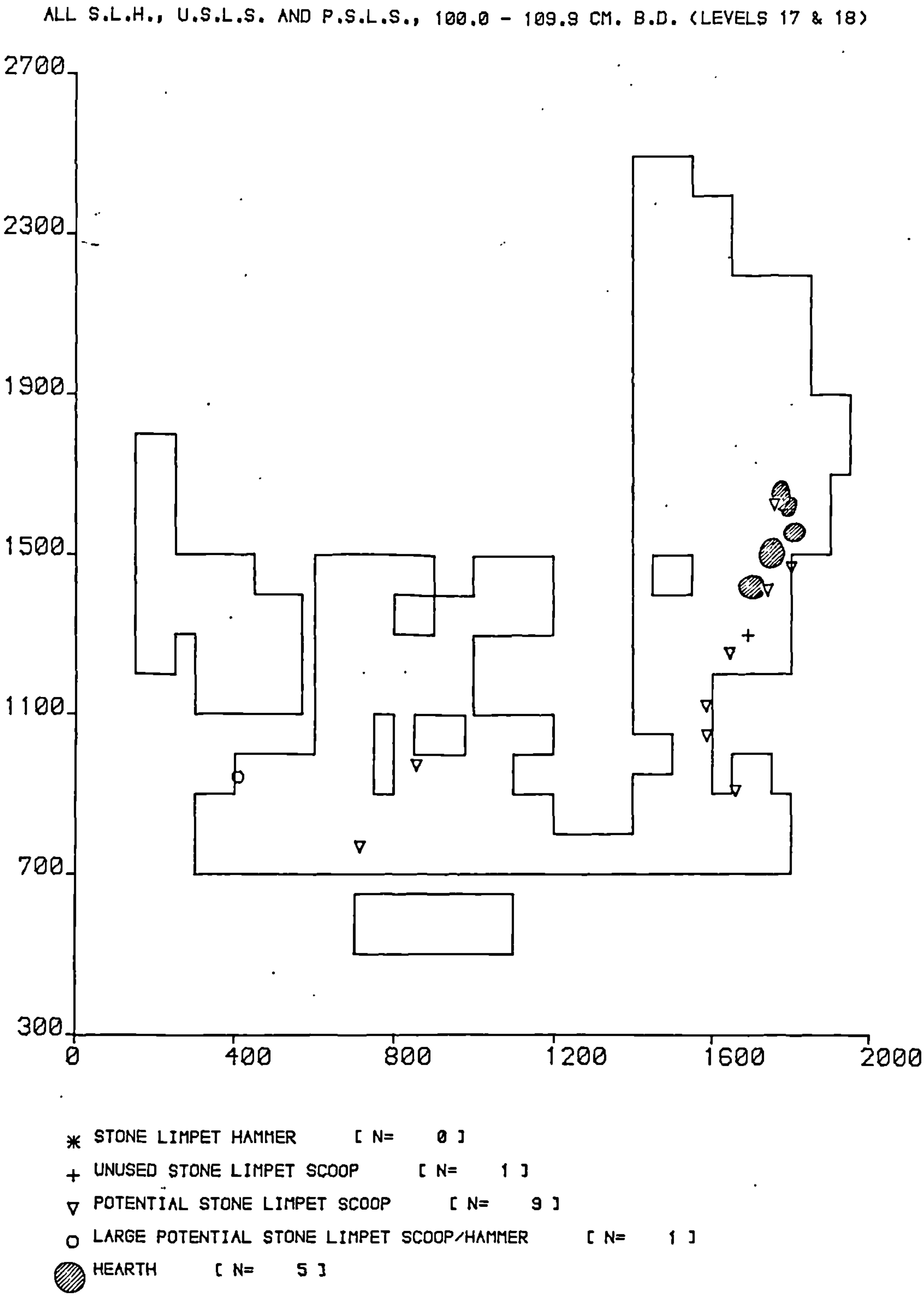

Figure 121. Horizontal Plot Showing the Distribution of Stone Limpet Hammers, Unused Stone Limpet Scoops, Potential Stone Limpet Scoops and Potential Stone Limpet Scoops/Hammers in Levels 17 and 18.

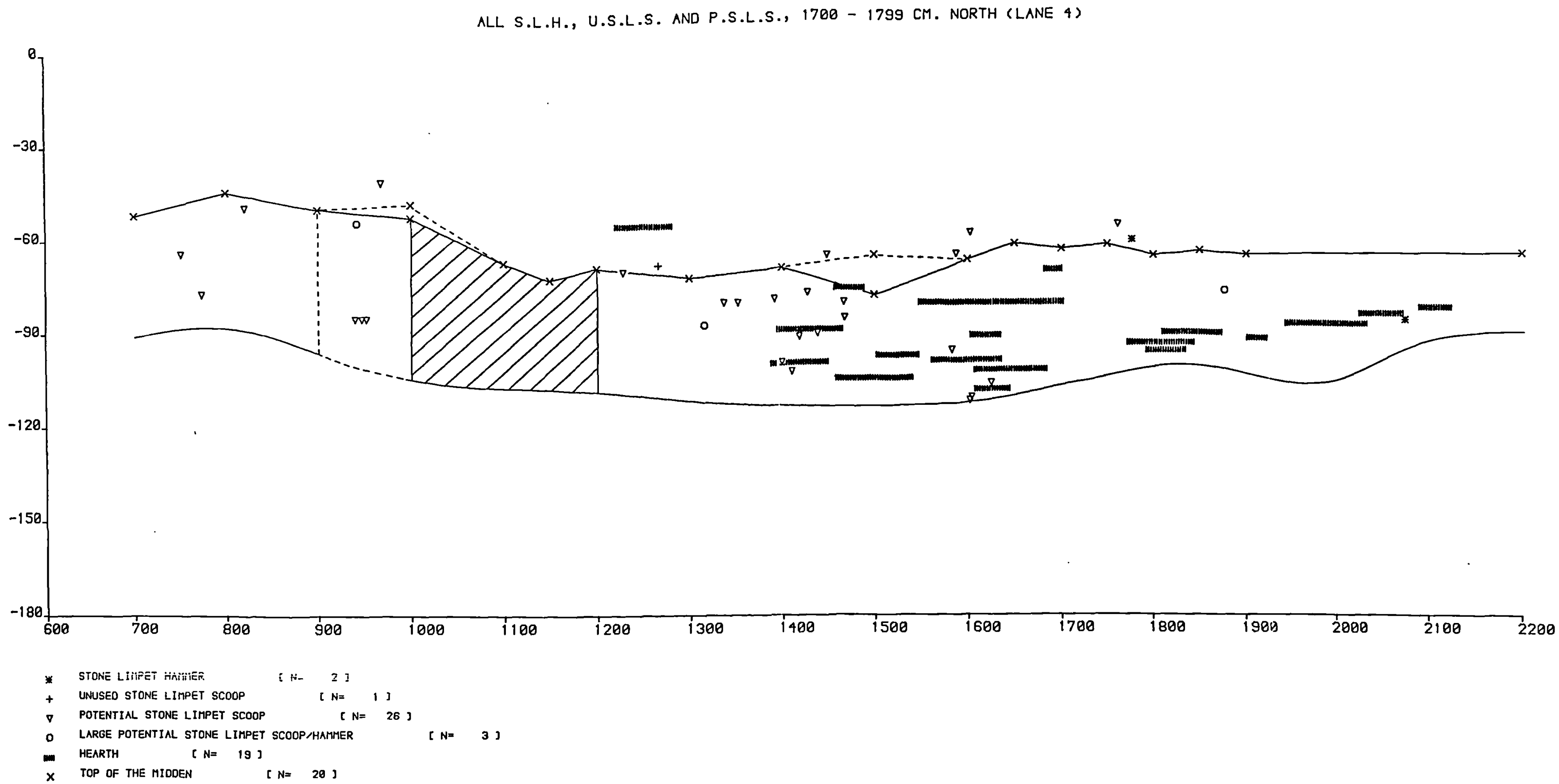

Figure 122. Sectional Plot Showing the Distribution of Stone Limpet Hammers, Unused Stone Limpet Scoops, Potential Stone Limpet Scoops and Potential Stone Limpet Scoops/Hammers in Lane 4.

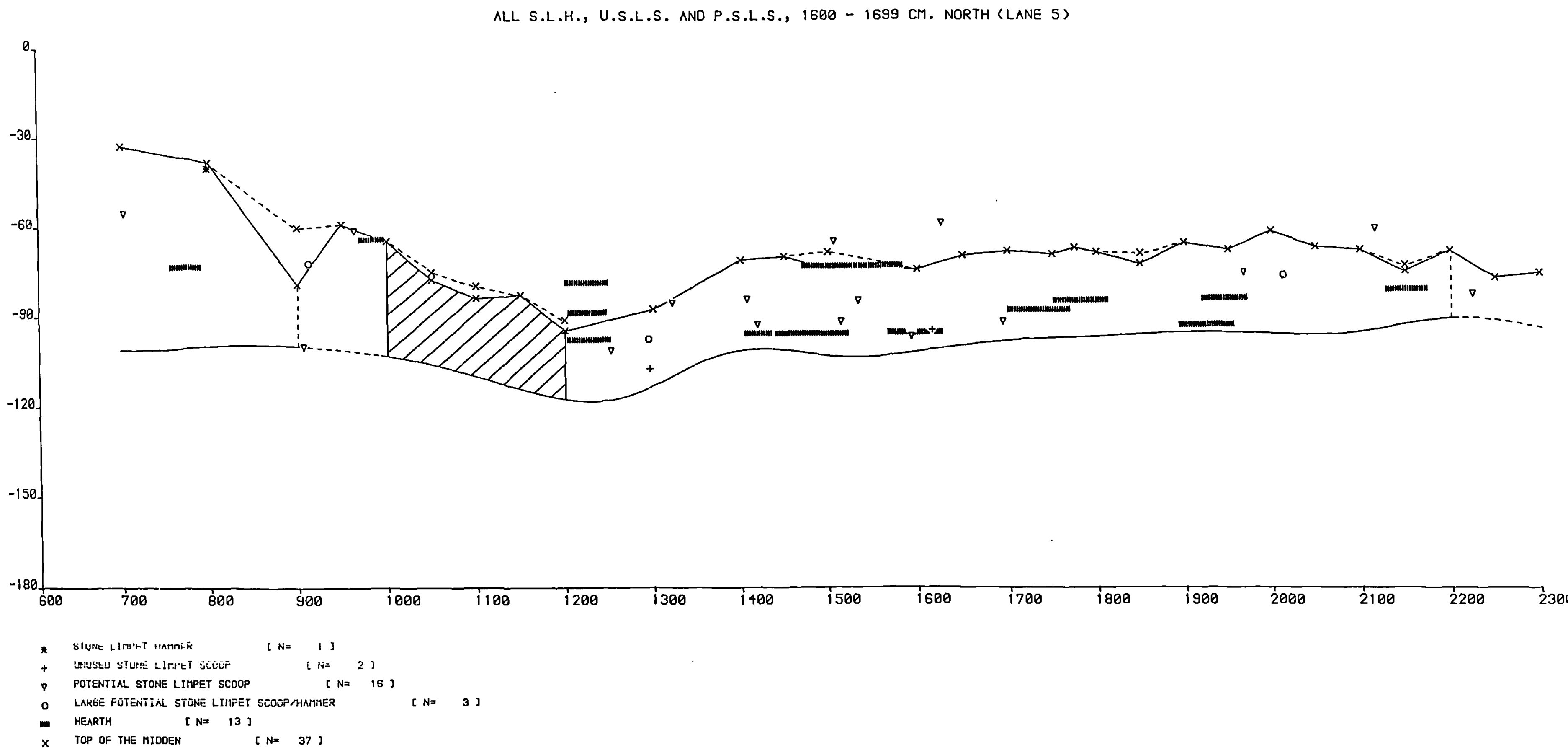

Figure 123. Sectional Plot Showing the Distribution of Stone Limpet Hammers, Unused Stone Limpet Scoops, Potential Stone Limpet Scoops and Potential Stone Limpet Scoops/Hammers in Lane 5.

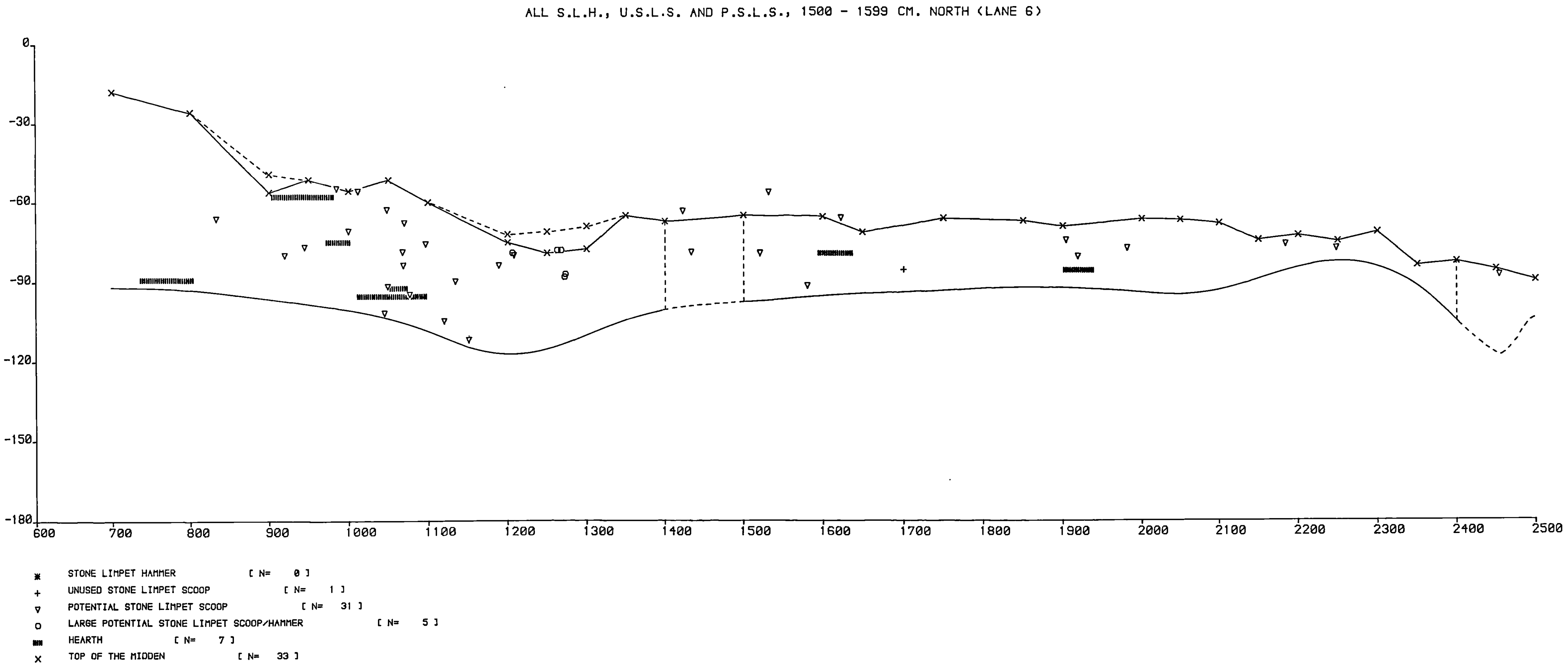

Figure 124. Sectional Plot Showing the Distribution of Stone Limpet Hammers, Unused Stone Limpet Scoops, Potential Stone Limpet Scoops and Potential Stone Limpet Scoops/Hammers in Lane 6.

ALL S.L.H., U.S.L.S. AND P.S.L.S., 1400 - 1499 CM. NORTH (LANE 7)

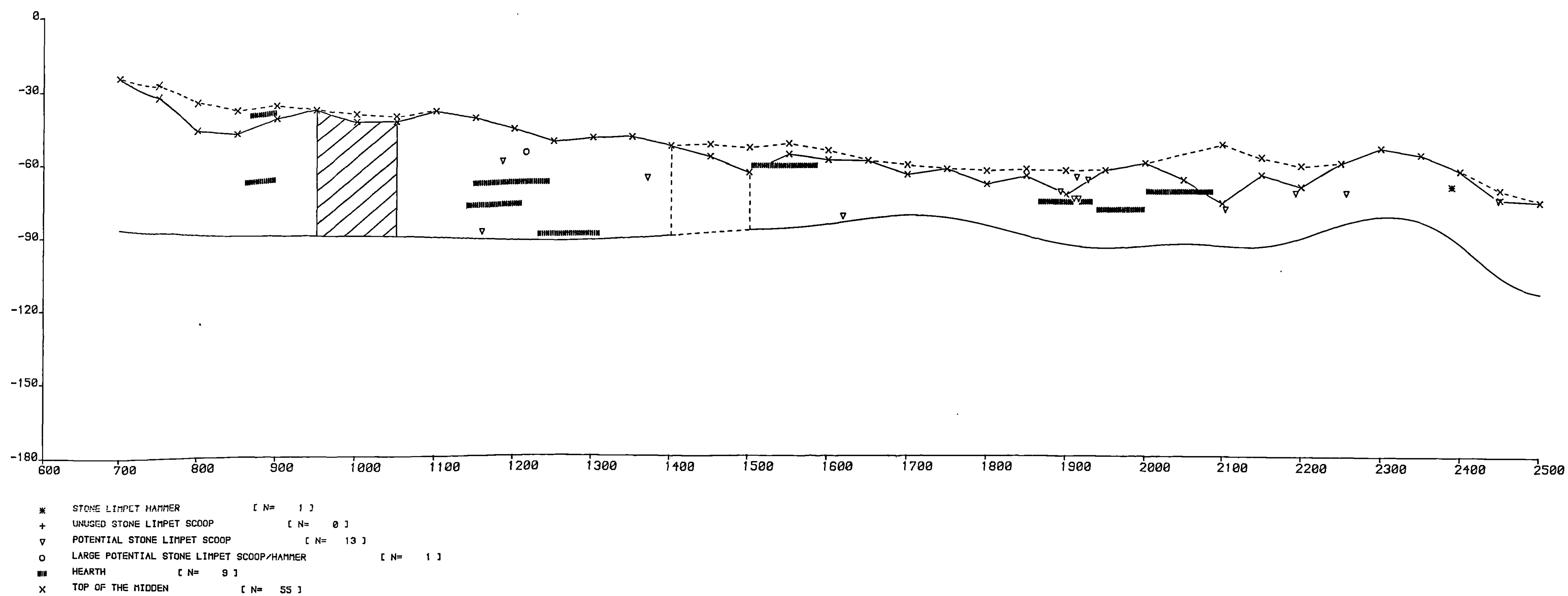

Figure 125. Sectional Plot Showing the Distribution of Stone Limpet Hammers, Unused Stone Limpet Scoops, Potential Stone Limpet Scoops and Potential Stone Limpet Scoops/Hammers in Lane 7.

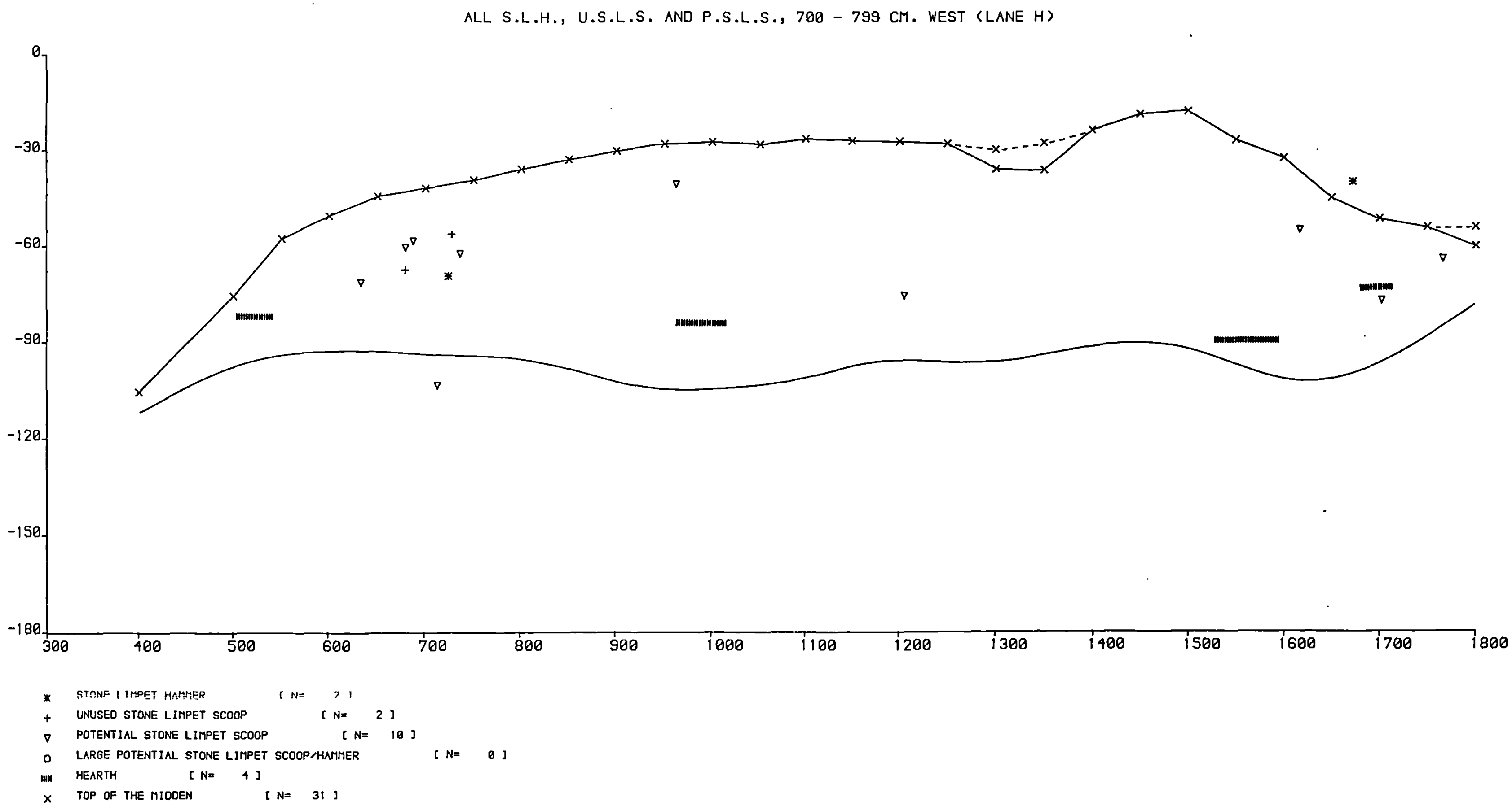

Figure 126. Sectional Plot Showing the Distribution of Stone Limpet Hammers, Unused Stone Limpet Scoops, Potential Stone Limpet Scoops and Potential Stone Limpet Scoops/Hammers in Lane H.

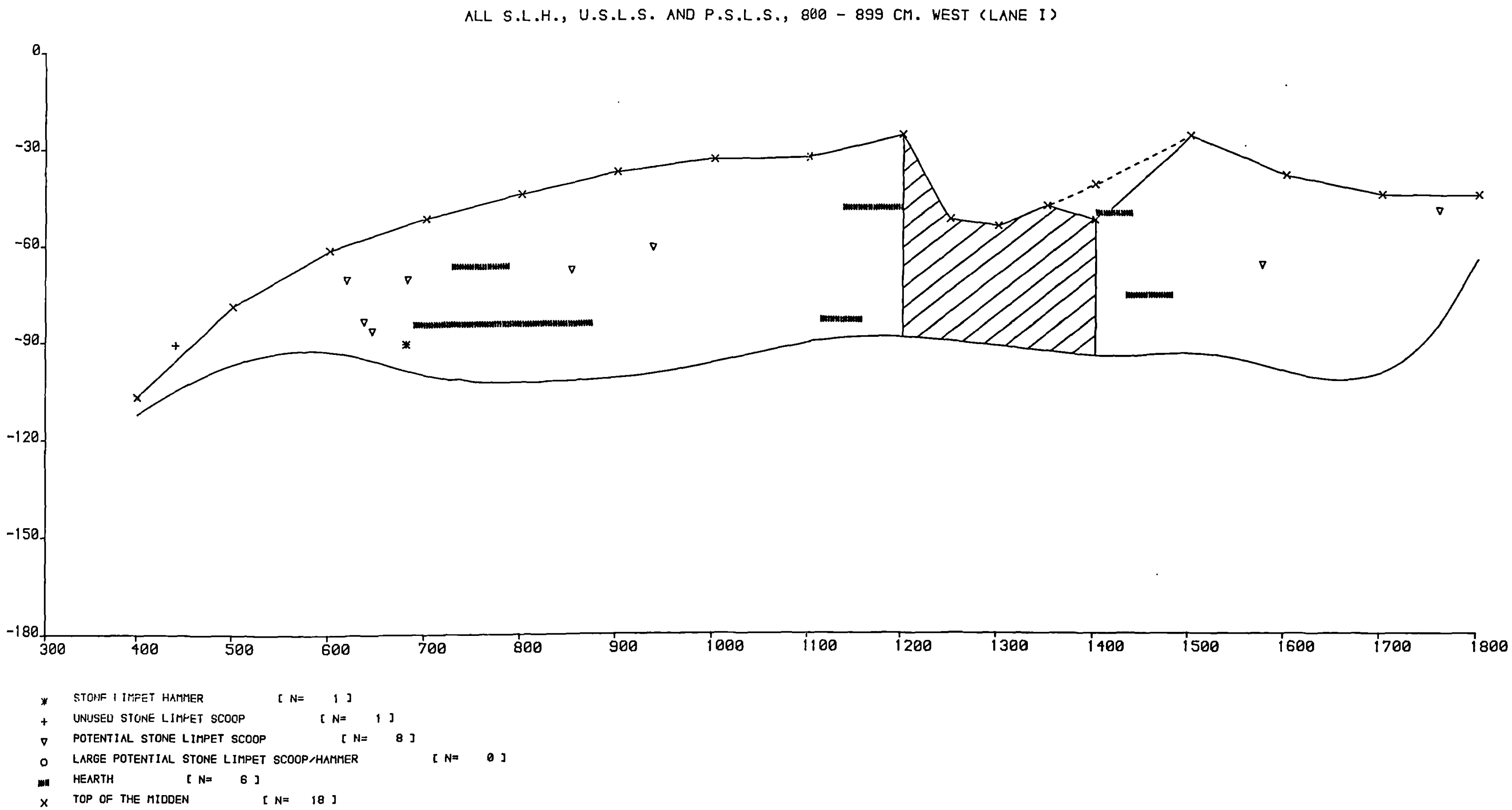

Figure 127. Sectional Plot Showing the Distribution of Stone Limpet Hammers, Unused Stone Limpet Scoops, Potential Stone Limpet Scoops and Potential Stone Limpet Scoops/Hammers in Lane I.

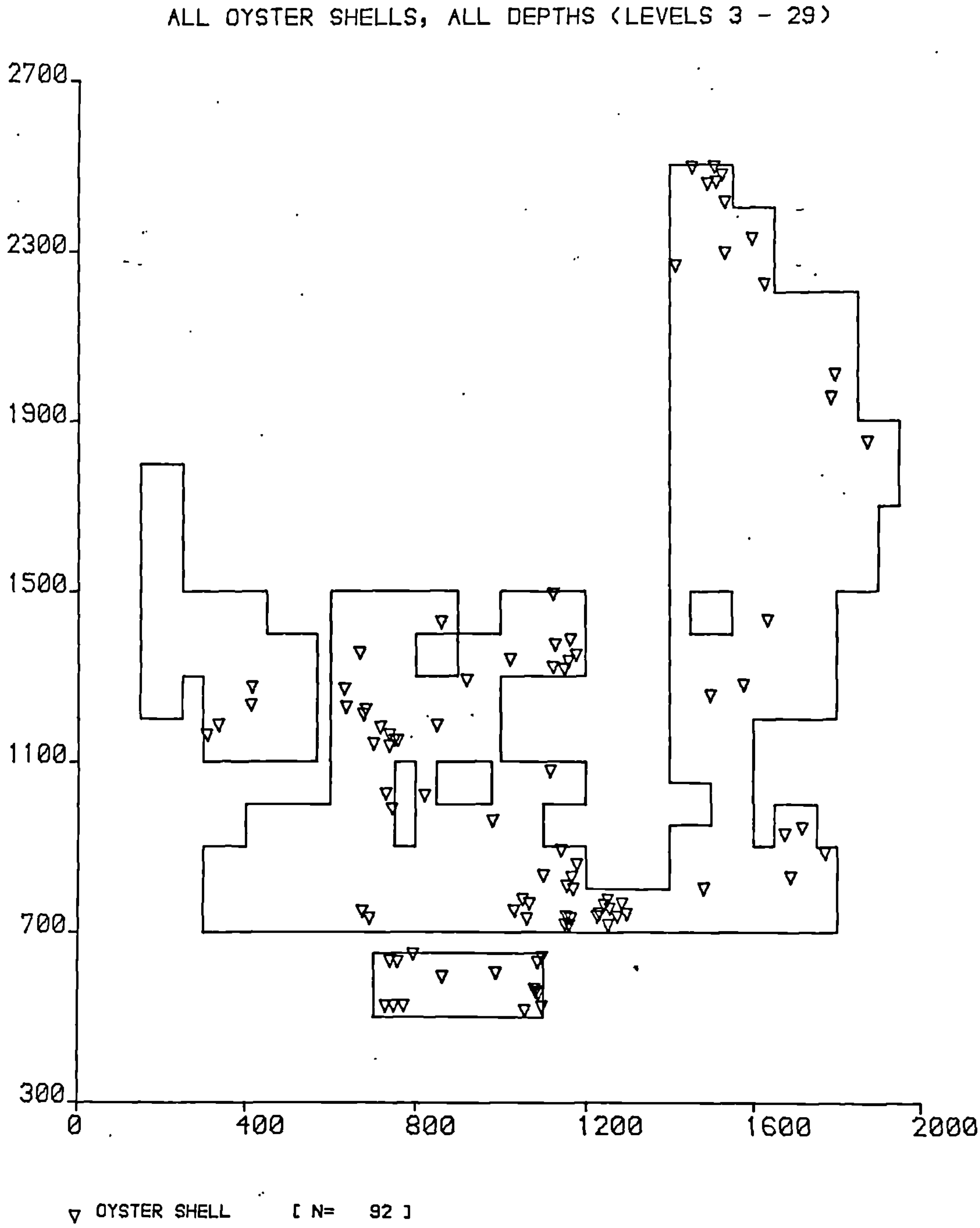

Figure 128. Horizontal Plot Showing the Distribution of All Oyster Shells in All Levels.

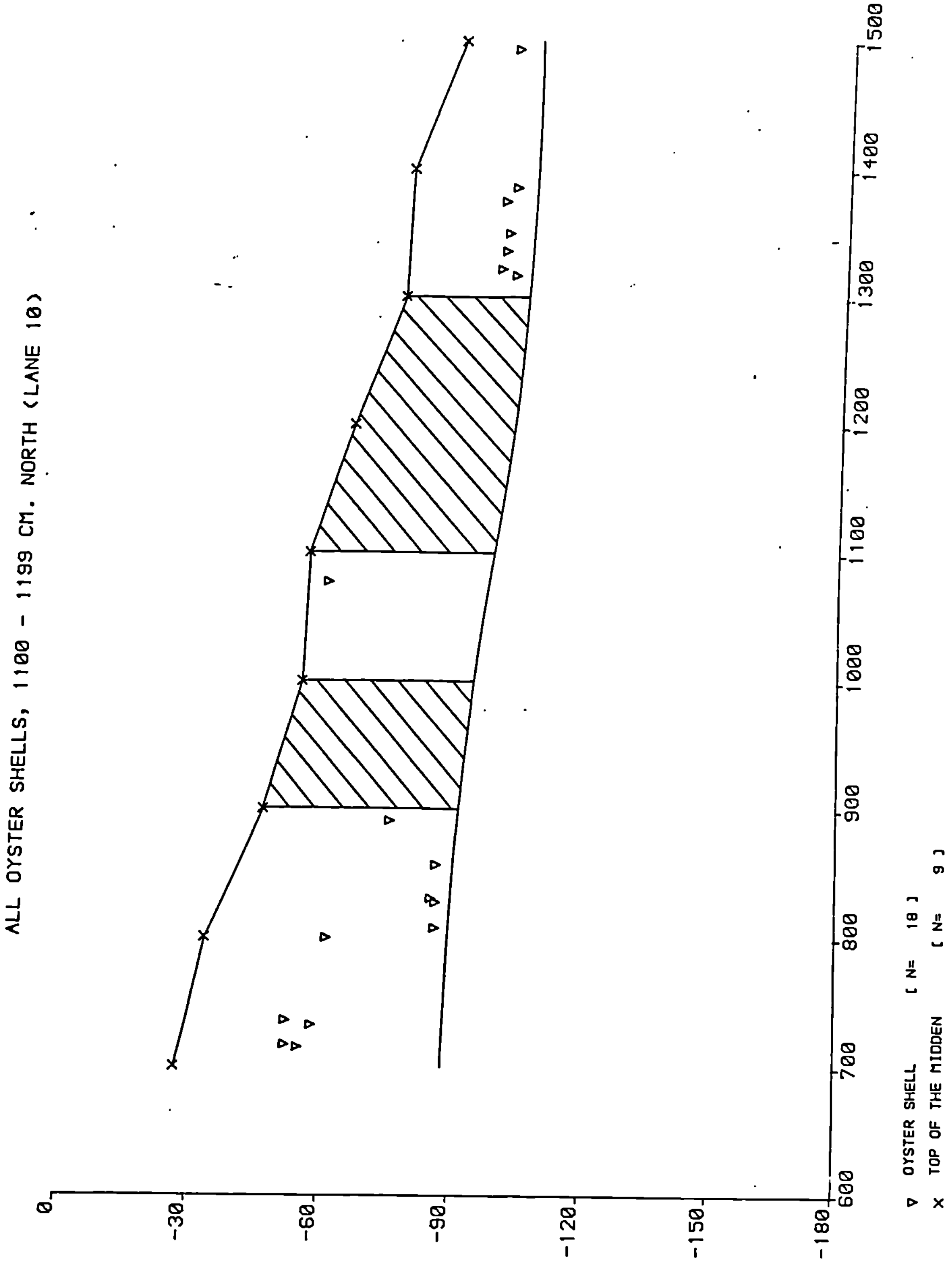

Figure 129. Sectional Plot Showing the Distribution of Oyster Shells in Lane 10.

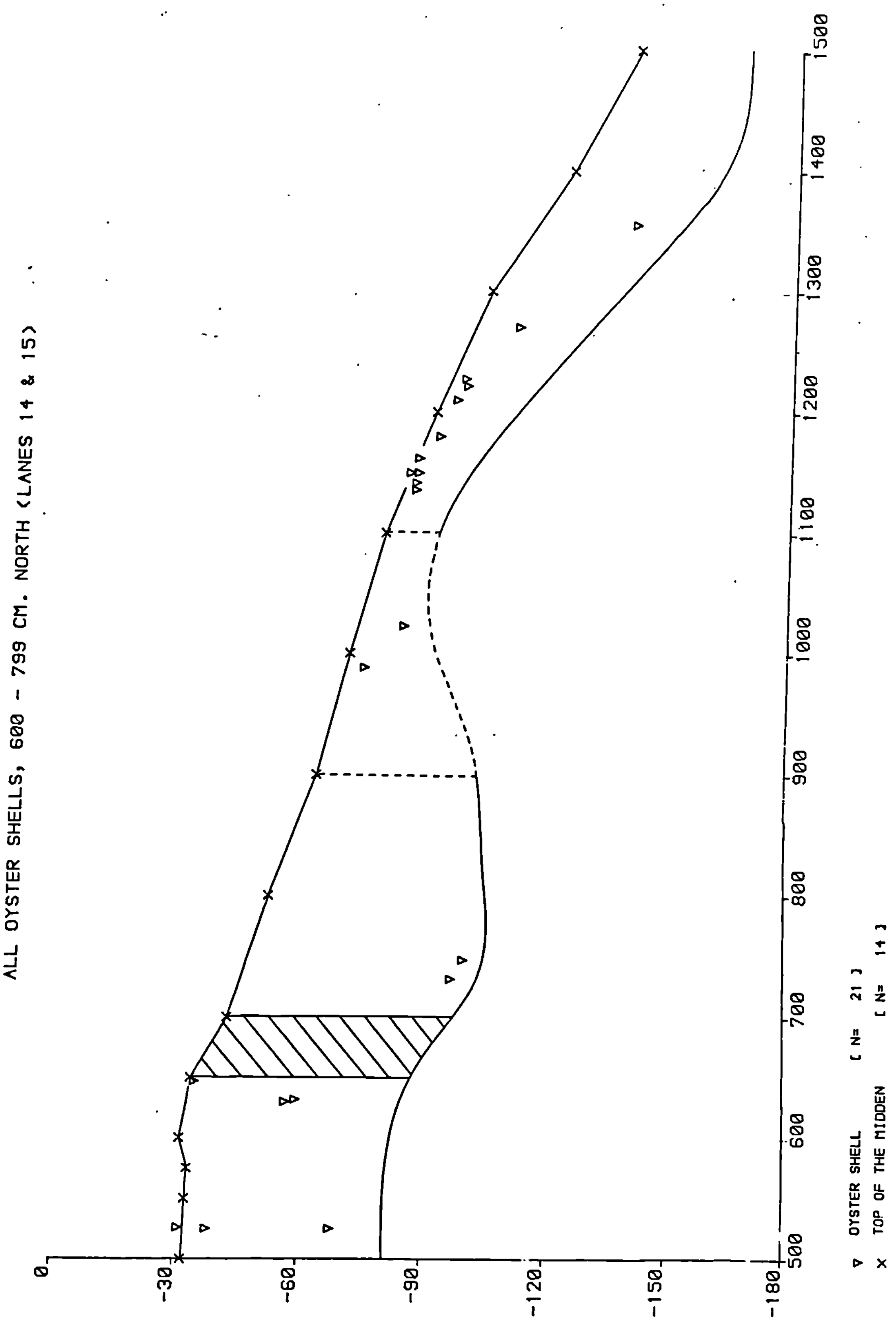

Figure 130. Sectional Plot Showing the Distribution of Oyster Shells in Lanes 14 and 15.

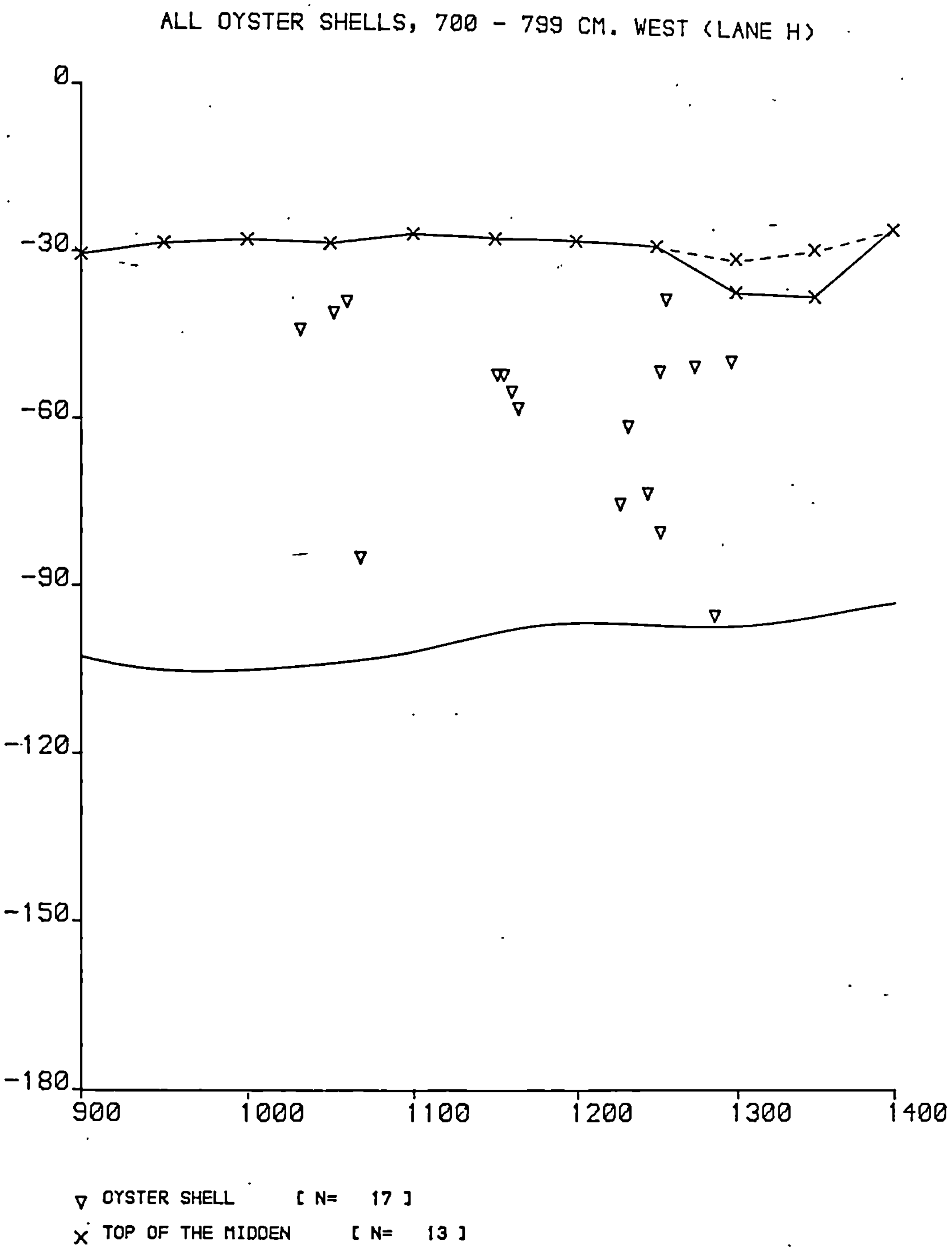

Figure 131. Sectional Plot Showing the Distribution of Oyster Shells in Lane H (Central Portion).

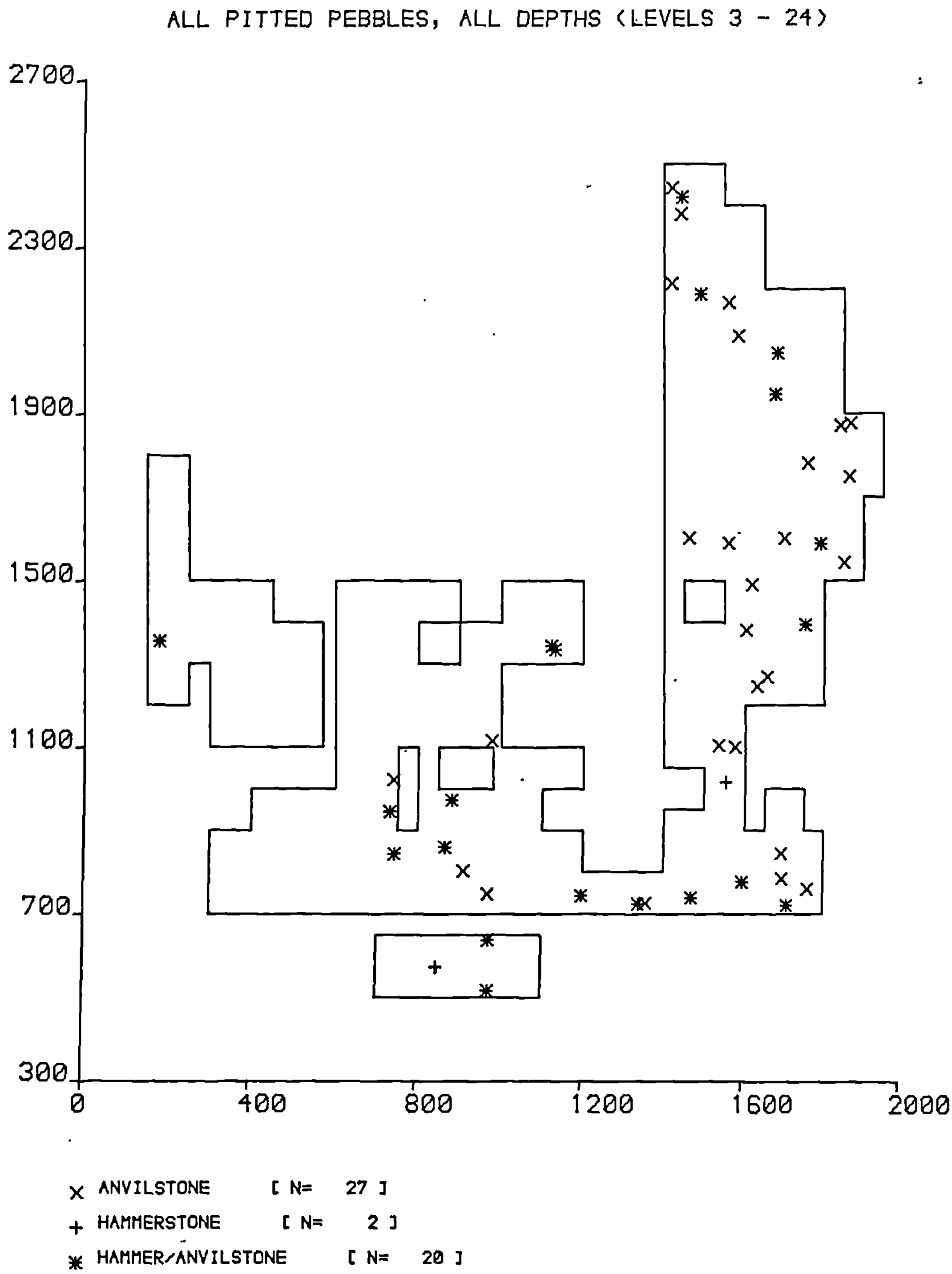

Figure 132. Horizontal Plot Showing the Distribution of All Pitted Pebbles in All Levels.

PITTED PEBBLES, CYPRINAS & PRICKLY COCKLES, 45.0 - 59.9 CM. B.D. (LEVELS 6-8)

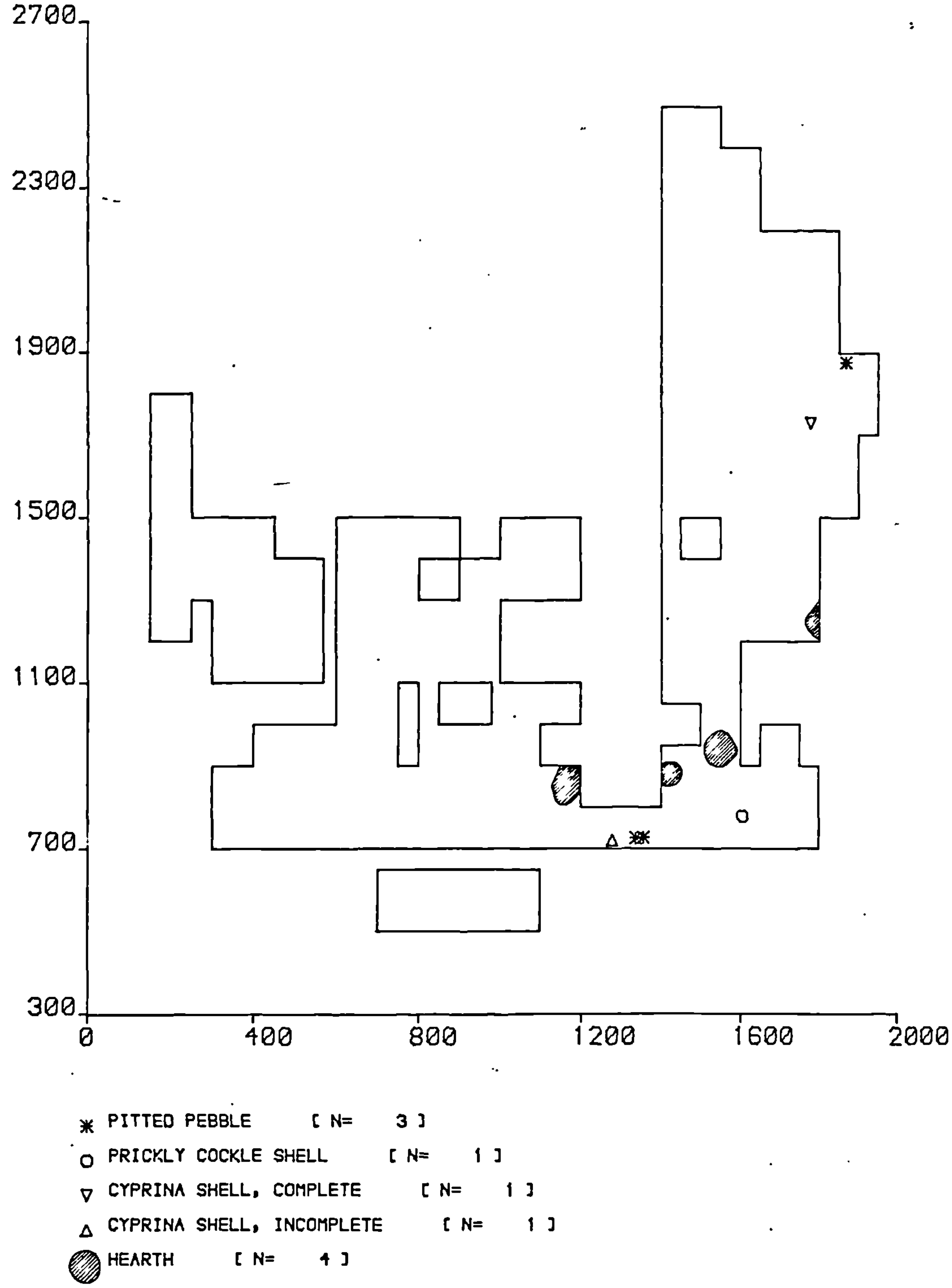

Figure 133. Horizontal Plot Showing the Distribution of Pitted Pebbles, Prickly Cockle Shells and Cyprina Shells in Levels 6 to 8.

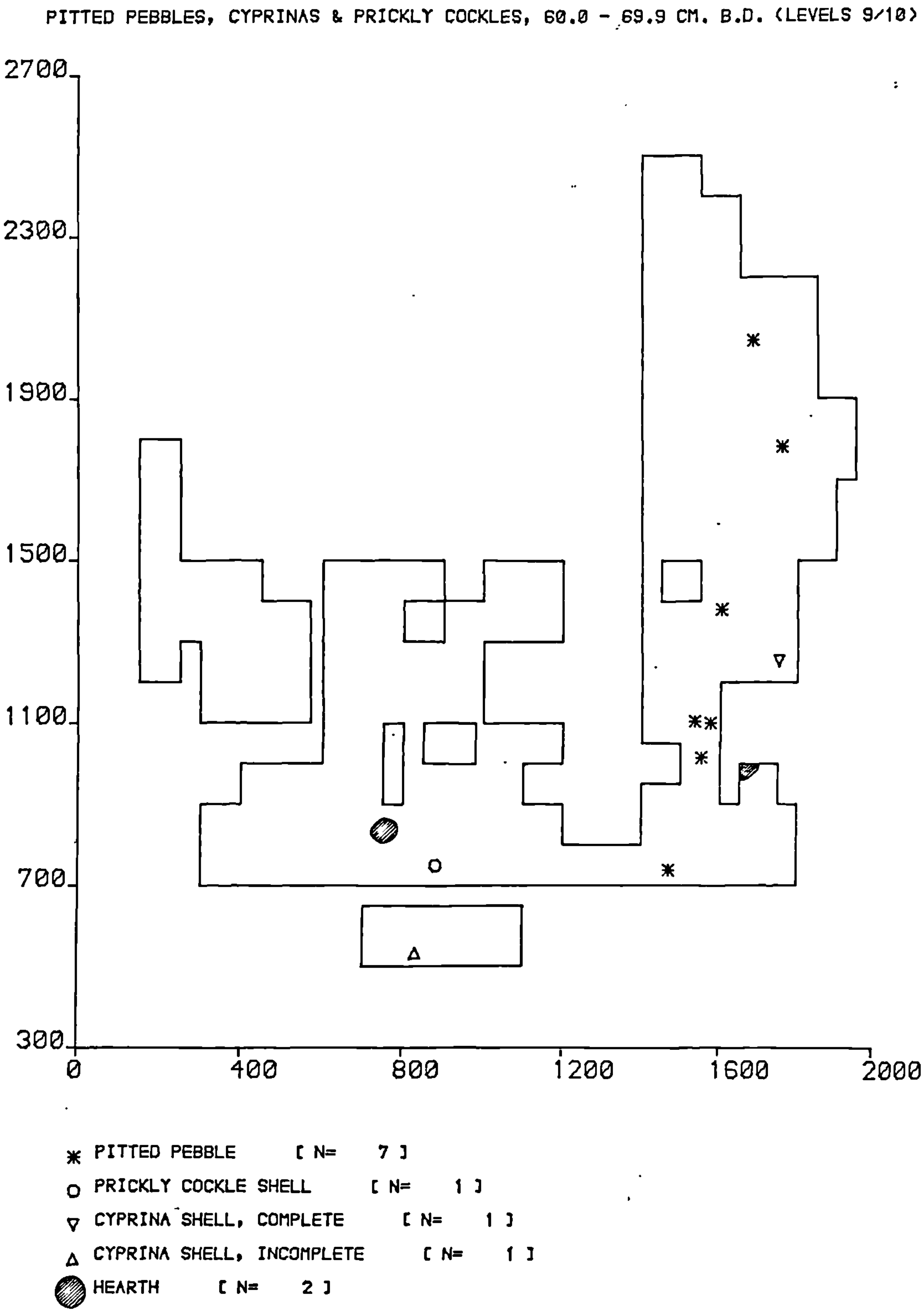

Figure 134. Horizontal Plot Showing the Distribution of Pitted Pebbles, Prickly Cockle Shells and Cyprina Shells in Levels 9 and 10.

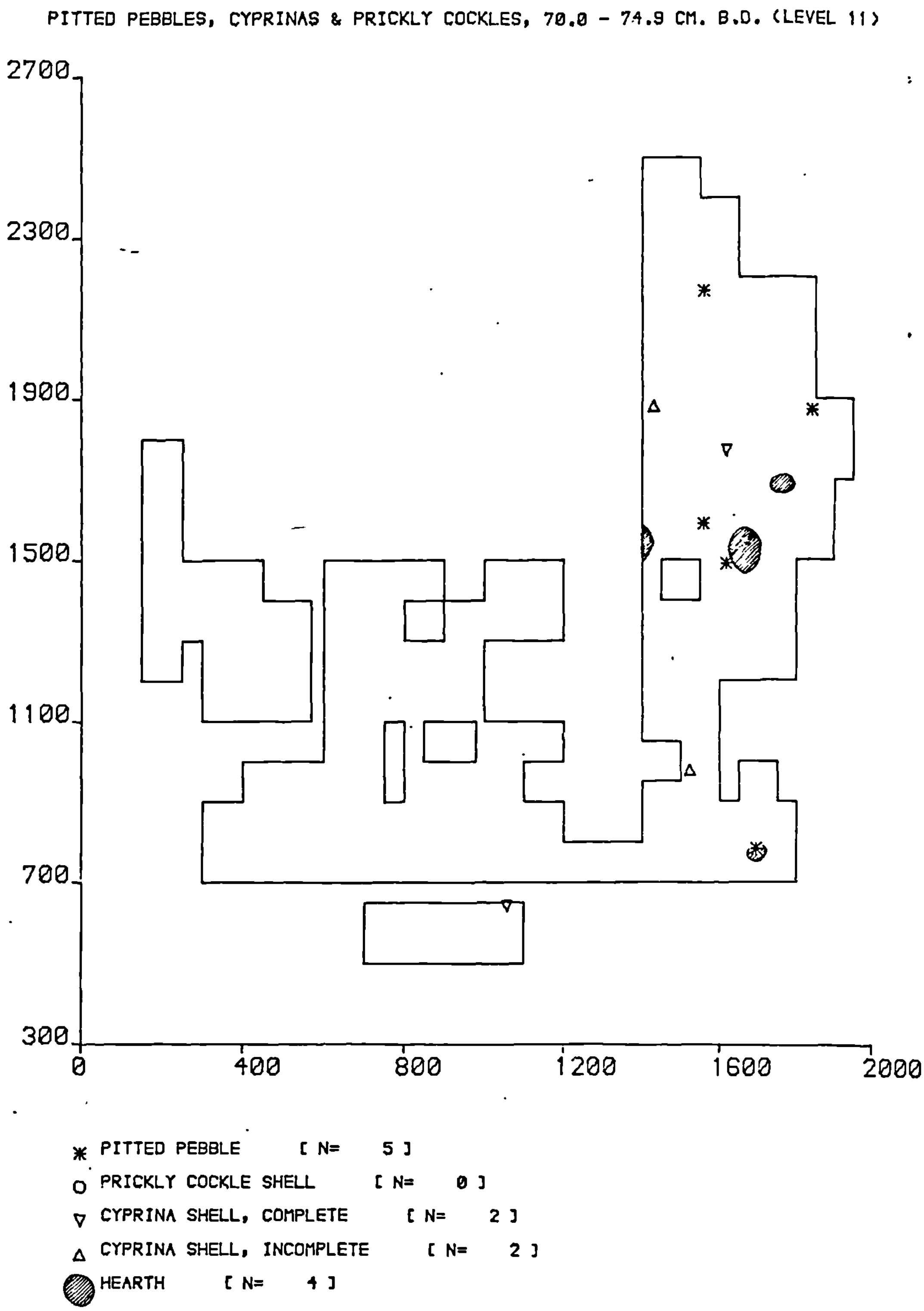

Figure 135. Horizontal Plot Showing the Distribution of Pitted Pebbles, Prickly Cockle Shells and Cyprina Shells in Level 11.

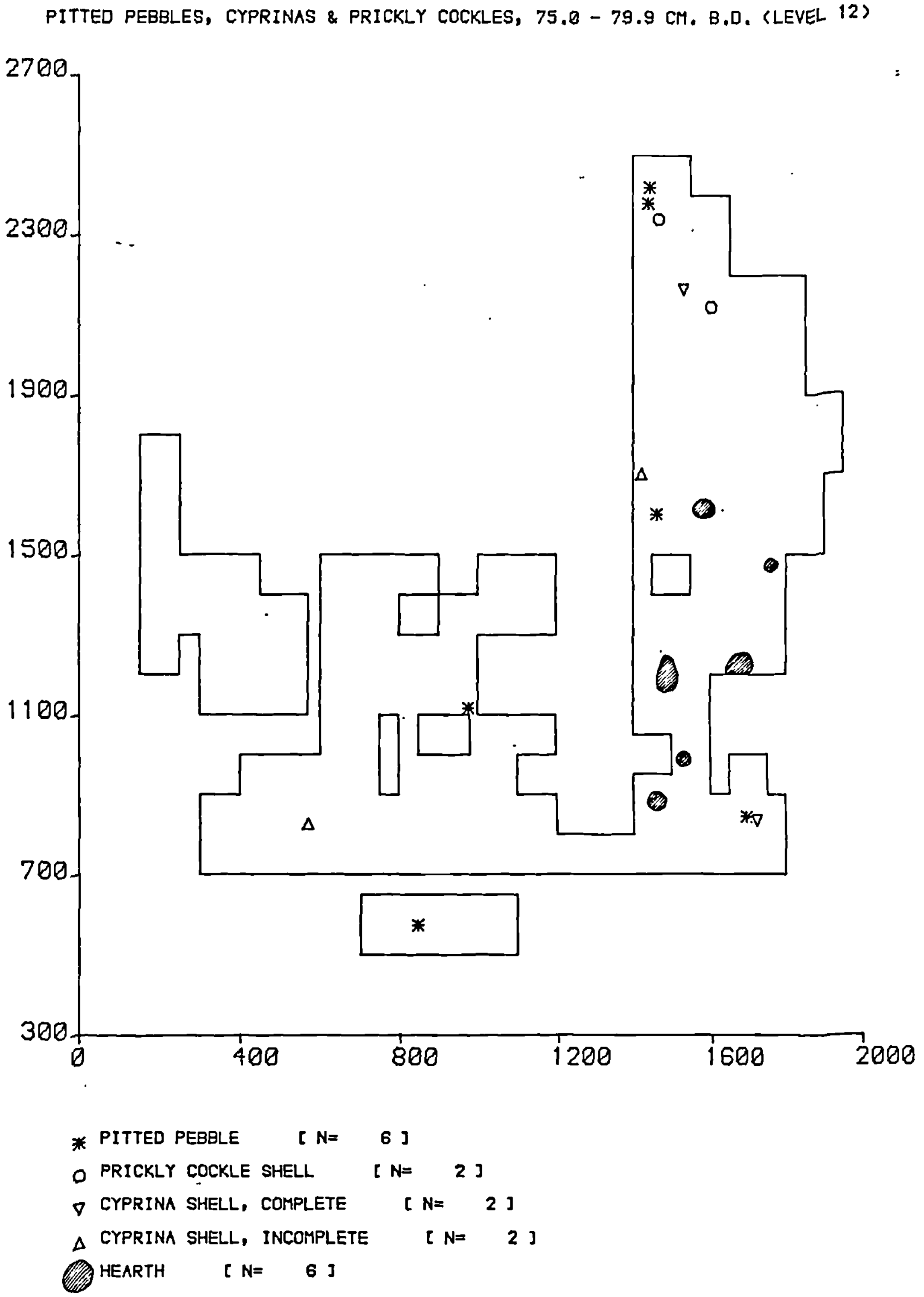

Figure 136. Horizontal Plot Showing the Distribution of Pitted Pebbles, Prickly Cockle Shells and Cyprina Shells in Level 12.

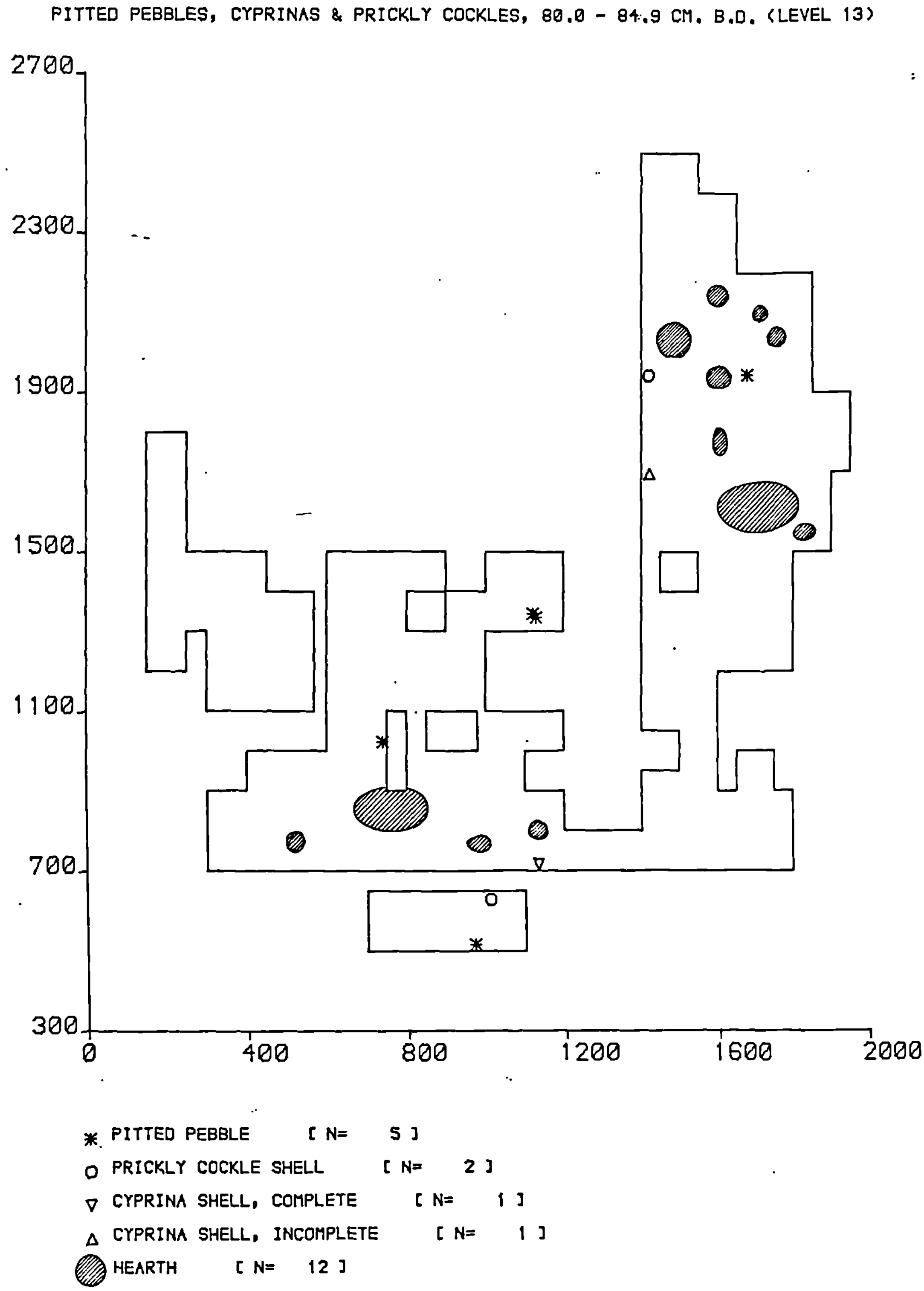

Figure 137. Horizontal Plot Showing the Distribution of Pitted Pebbles, Prickly Cockle Shells and Cyprina Shells in Level 13.

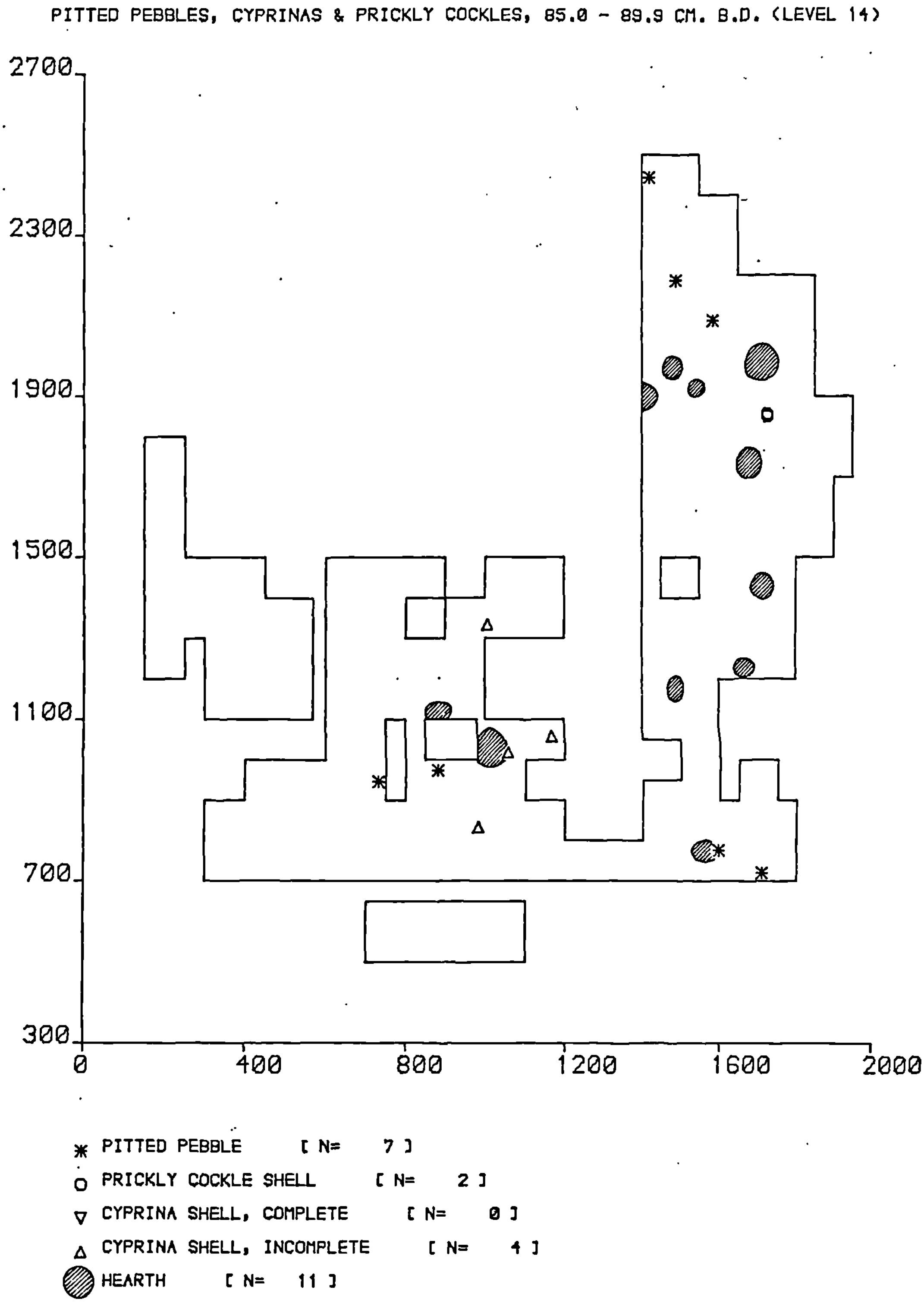

Figure 138. Horizontal Plot Showing the Distribution of Pitted Pebbles, Prickly Cockle Shells and Cyprina Shells in Level 14.

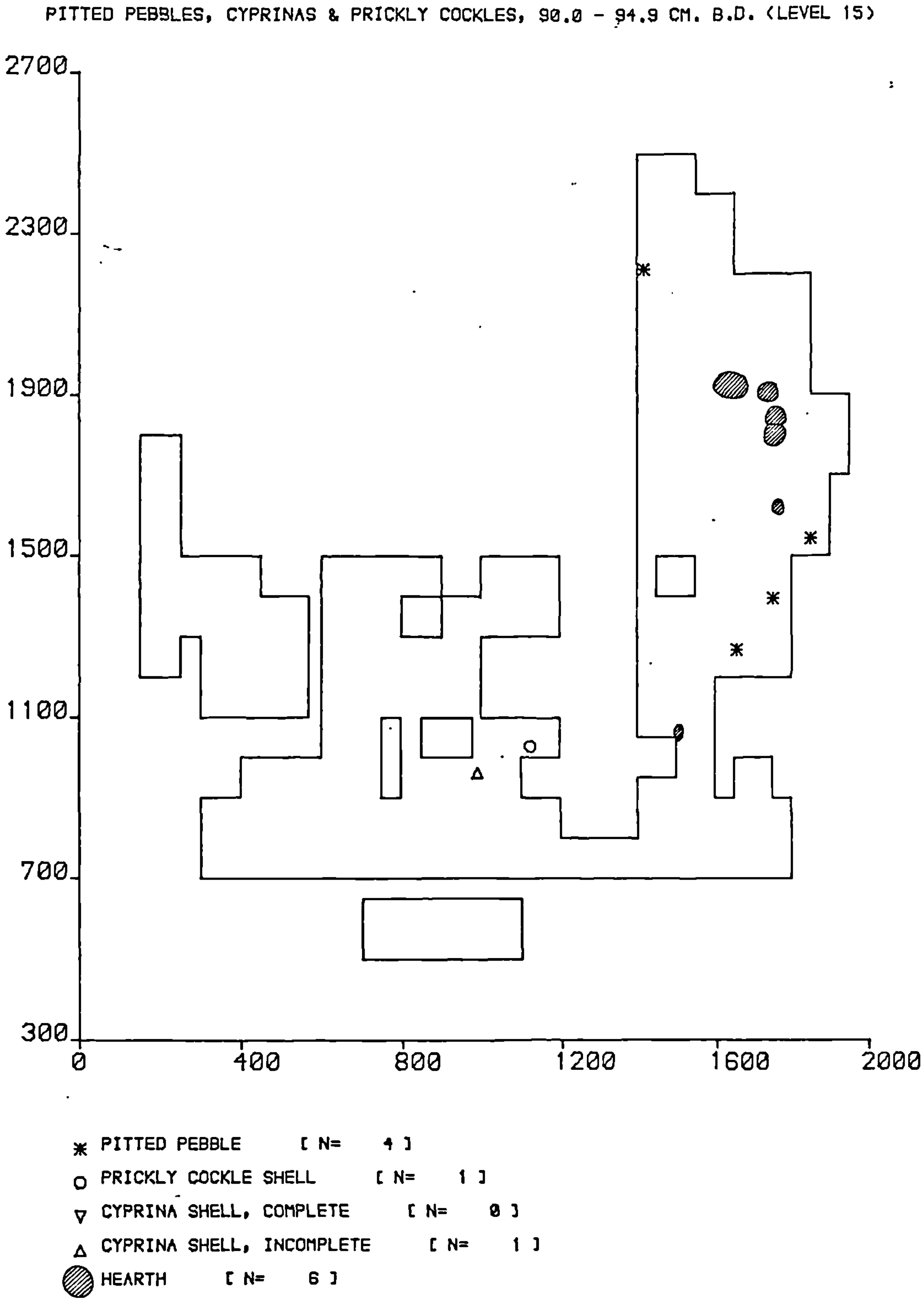

Figure 139. Horizontal Plot Showing the Distribution of Pitted Pebbles, Prickly Cockle Shells and Cyprina Shells in Level 15.

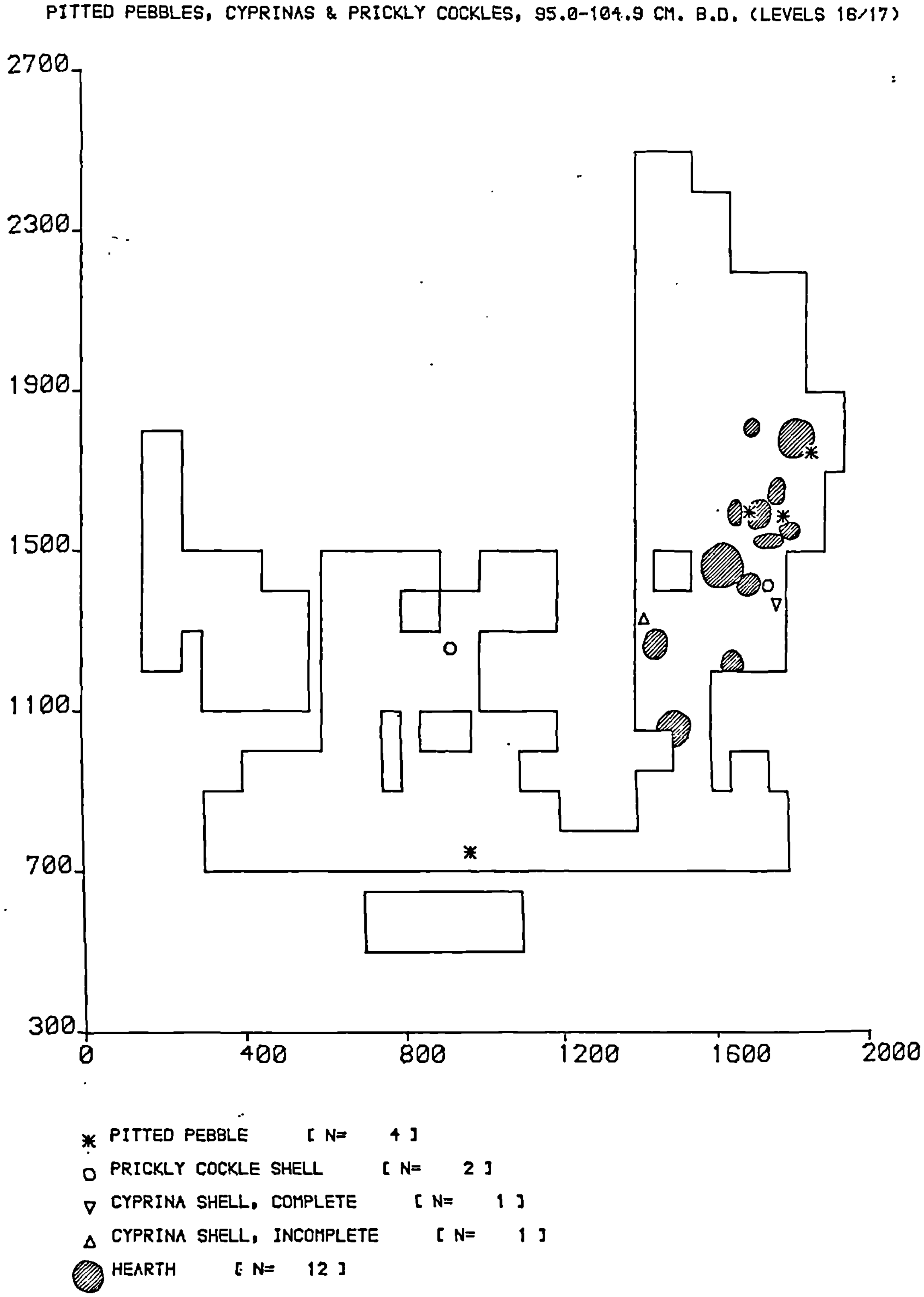

Figure 140. Horizontal Plot Showing the Distribution of Pitted Pebbles, Prickly Cockle Shells and Cyprina Shells in Levels 16 and 17.

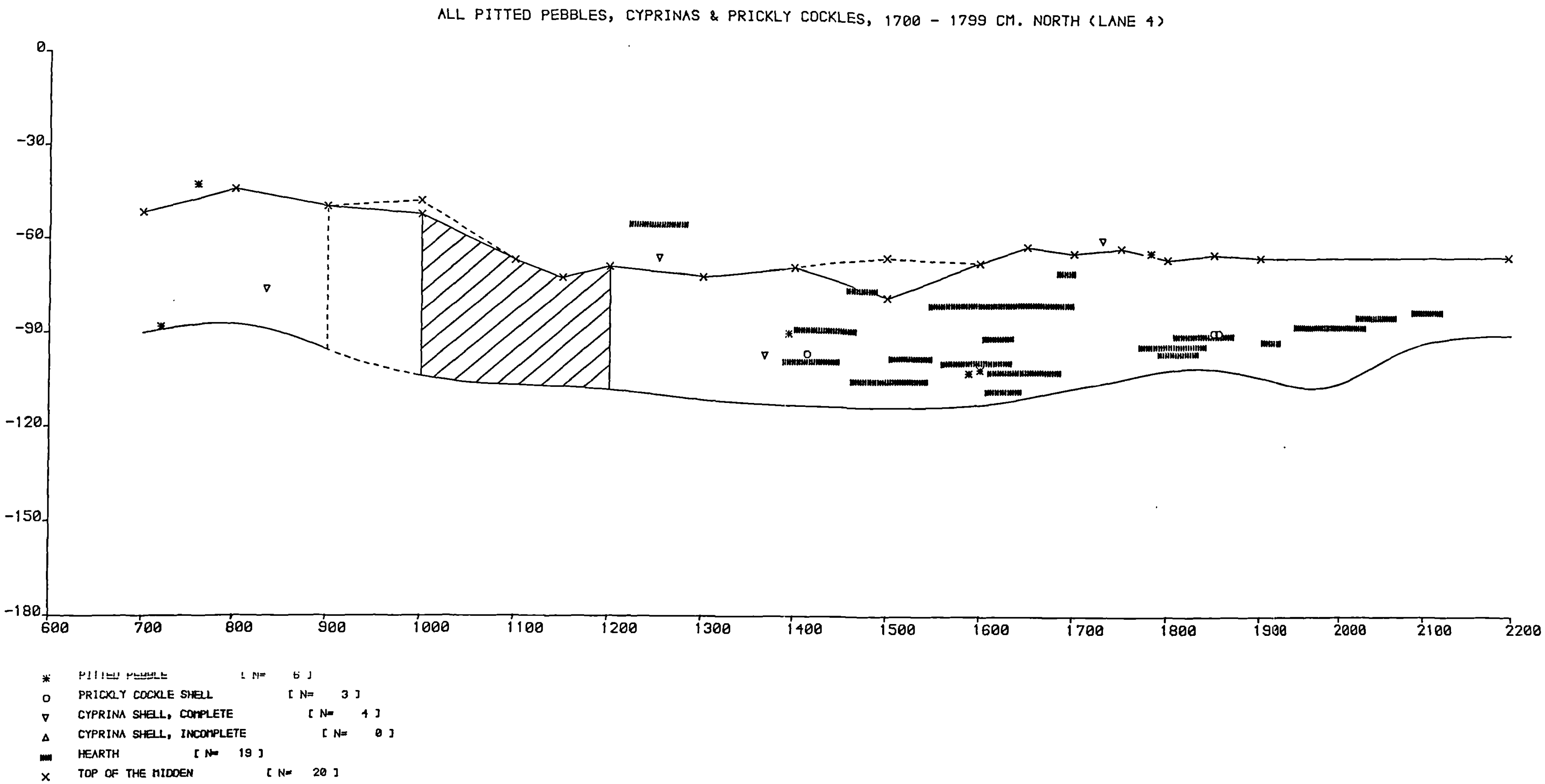

Figure 141. Sectional Plot Showing the Distribution of Pitted Pebbles, Prickly Cockle Shells and Cyprina Shells in Lane 4.

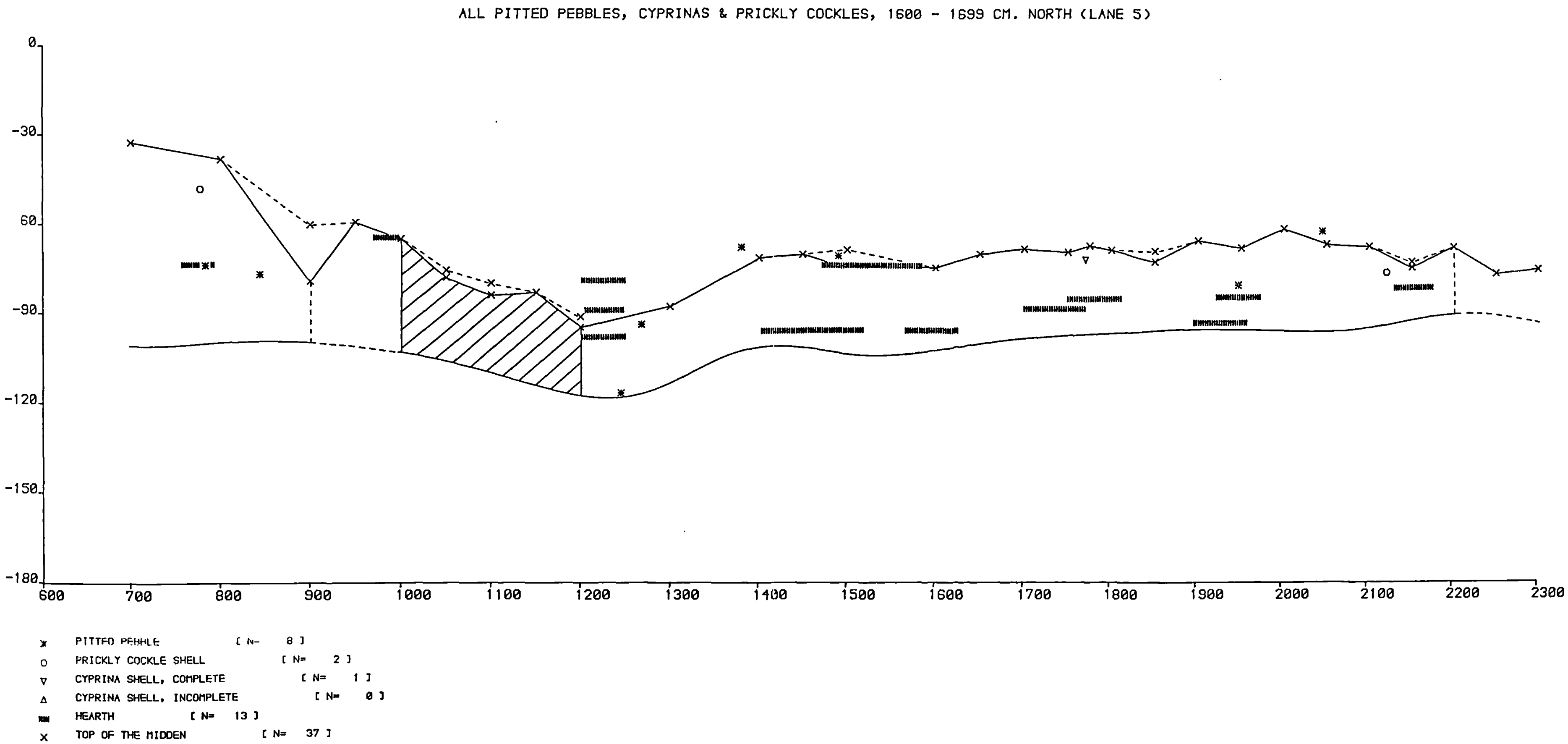

Figure 142. Sectional Plot Showing the Distribution of Pitted Pebbles, Prickly Cockle Shells and Cyprina Shells in Lane 5.

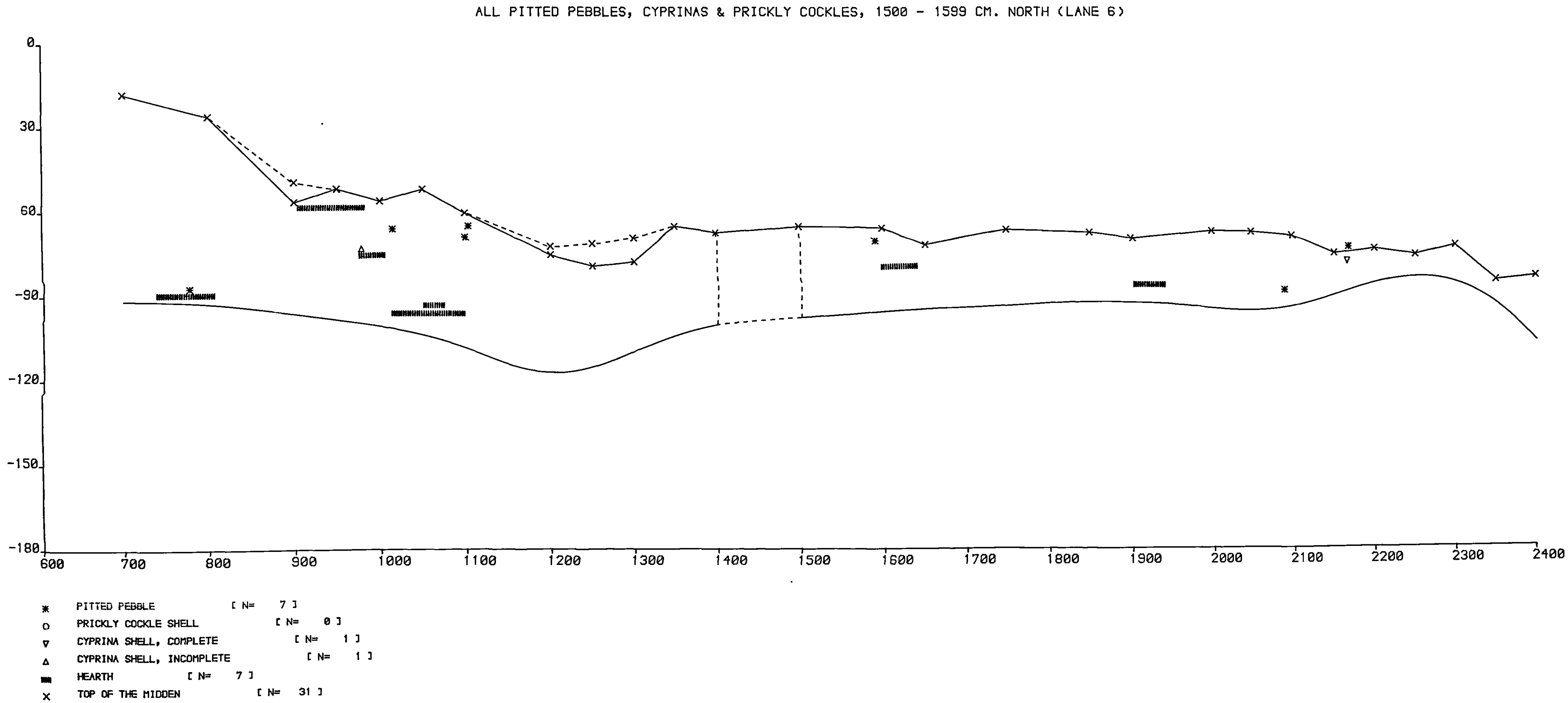

Figure 143. Sectional Plot Showing the Distribution of Pitted Pebbles, Prickly Cockle Shells and Cyprina Shells in Lane 6.

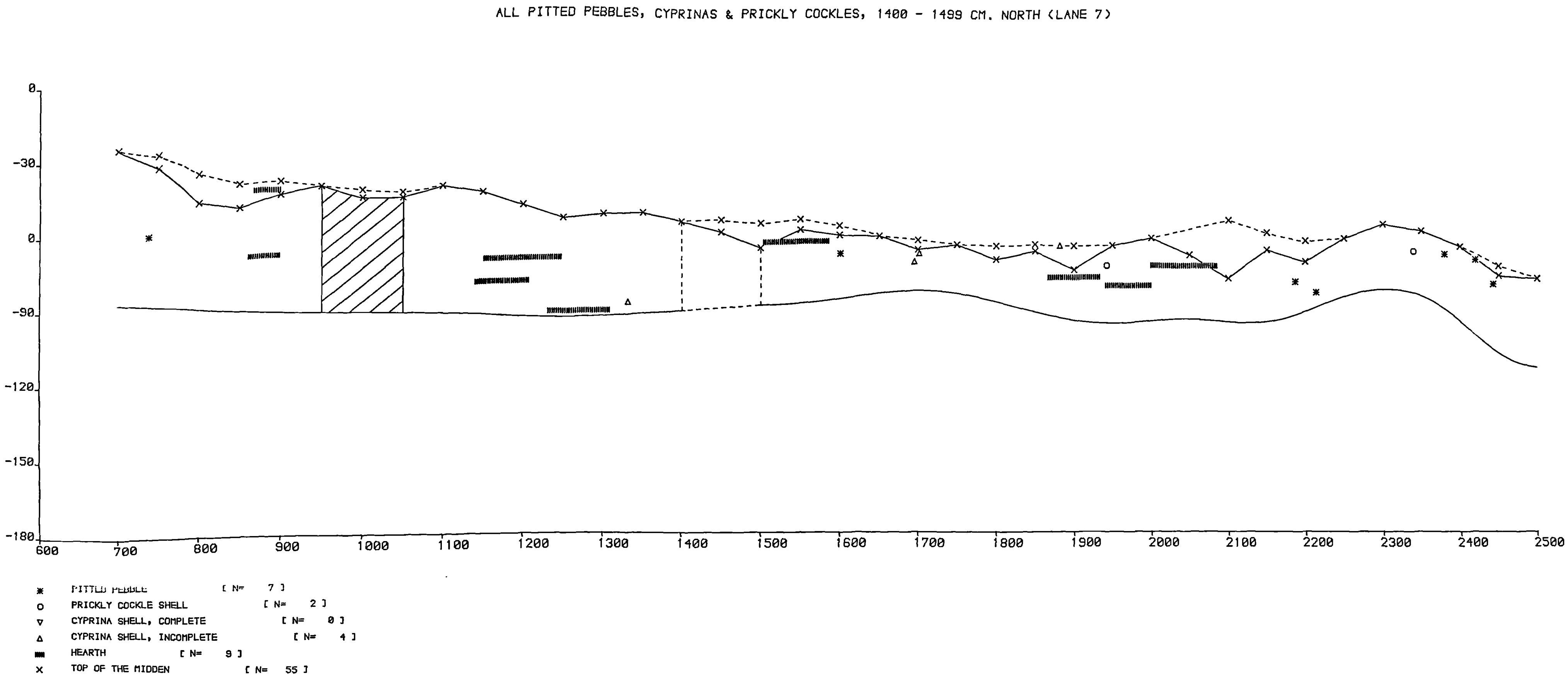

Figure 144. Sectional Plot Showing the Distribution of Pitted Pebbles, Prickly Cockle Shells and Cyprina Shells in Lane 7.

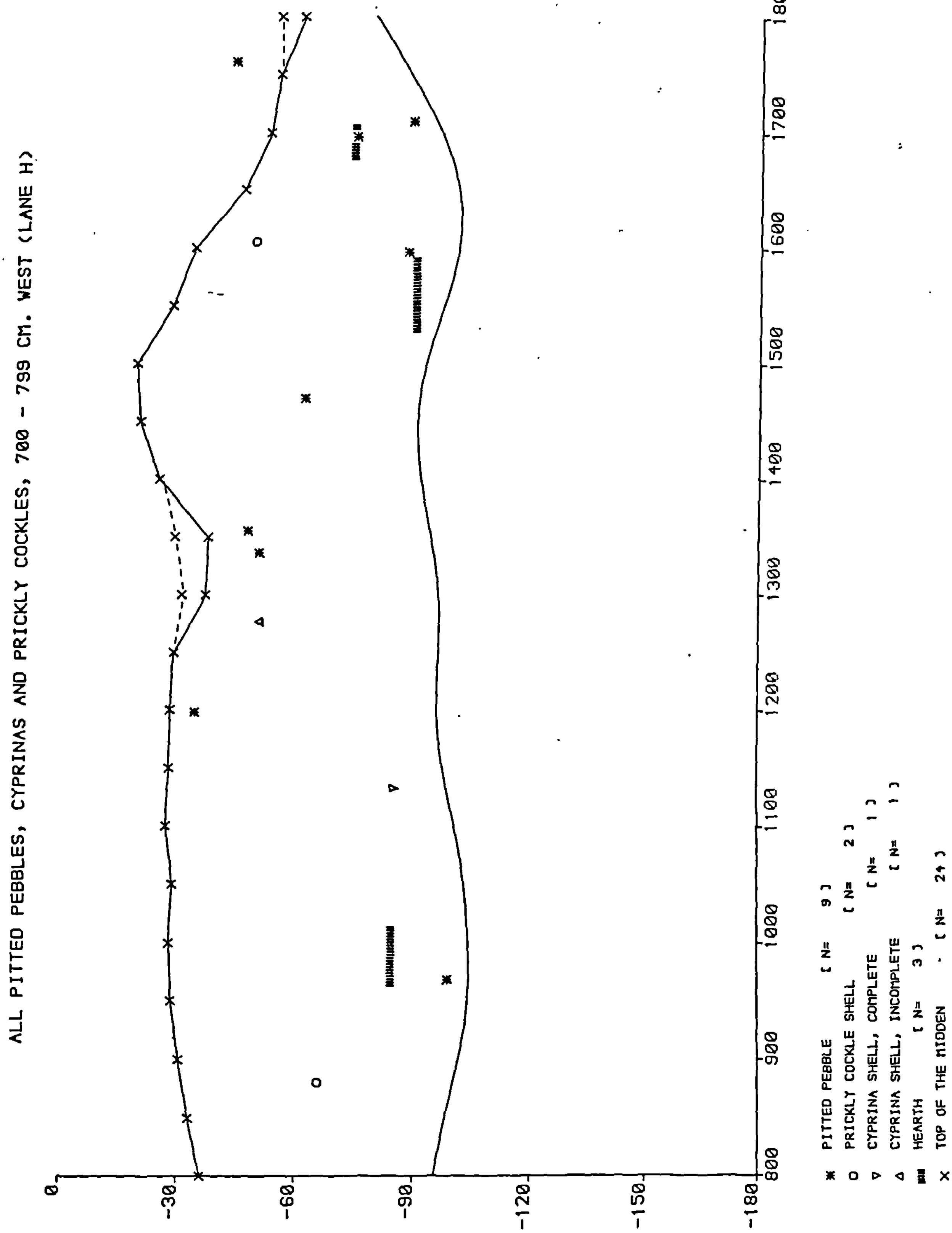

Figure 145. Sectional Plot Showing the Distribution of Pitted Pebbles, Prickly Cockle Shells and Cyprina Shells in Lane H (Northern Two-Thirds).

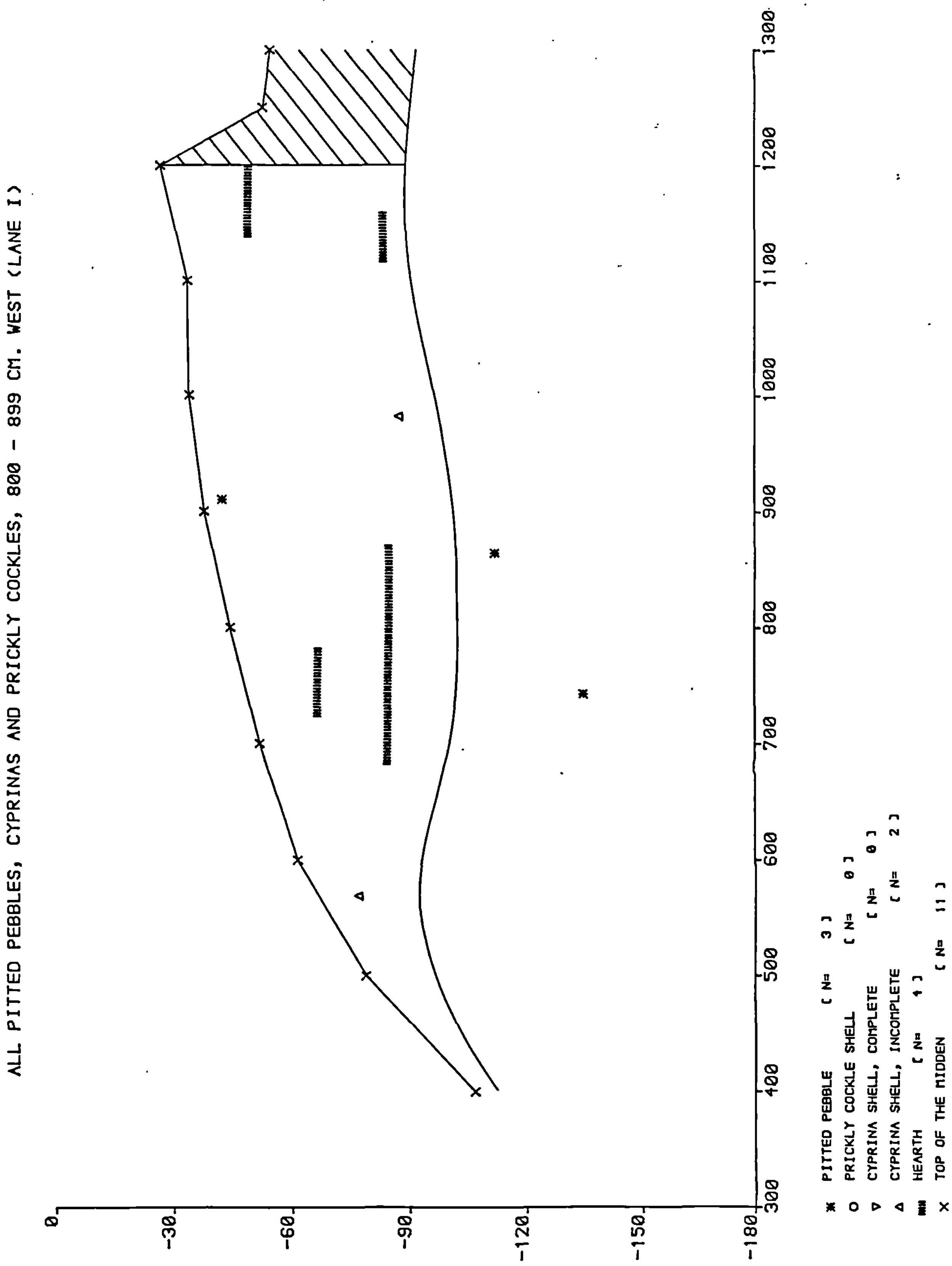

Figure 146. Sectional Plot Showing the Distribution of Pitted Pebbles, Prickly Cockle Shells and Cyprina Shells in Lane I (Southern Two-Thirds).

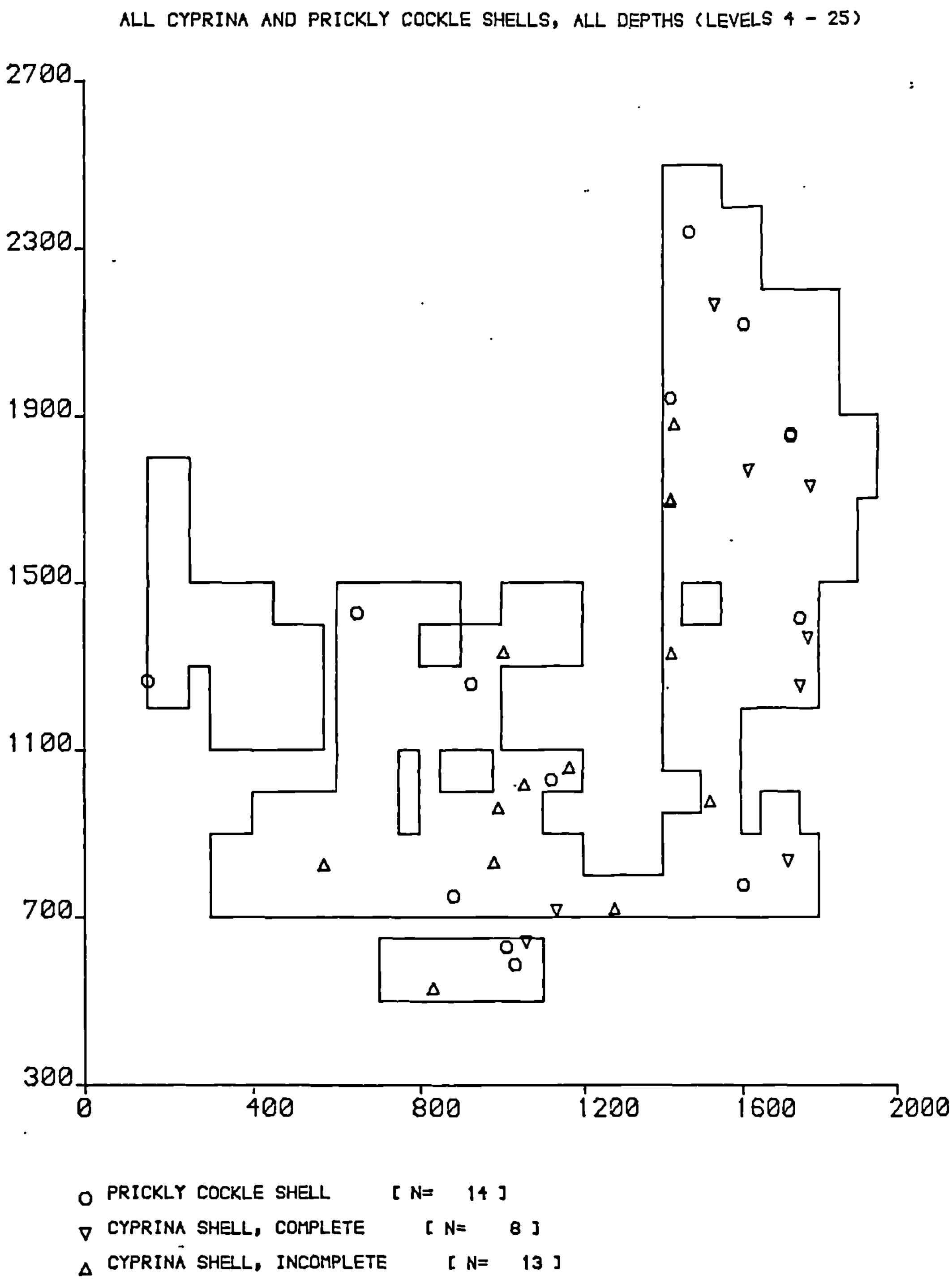

Figure 147. Horizontal Plot Showing the Distribution of All Prickly Cockle Shells and Cyprina Shells in All Levels.

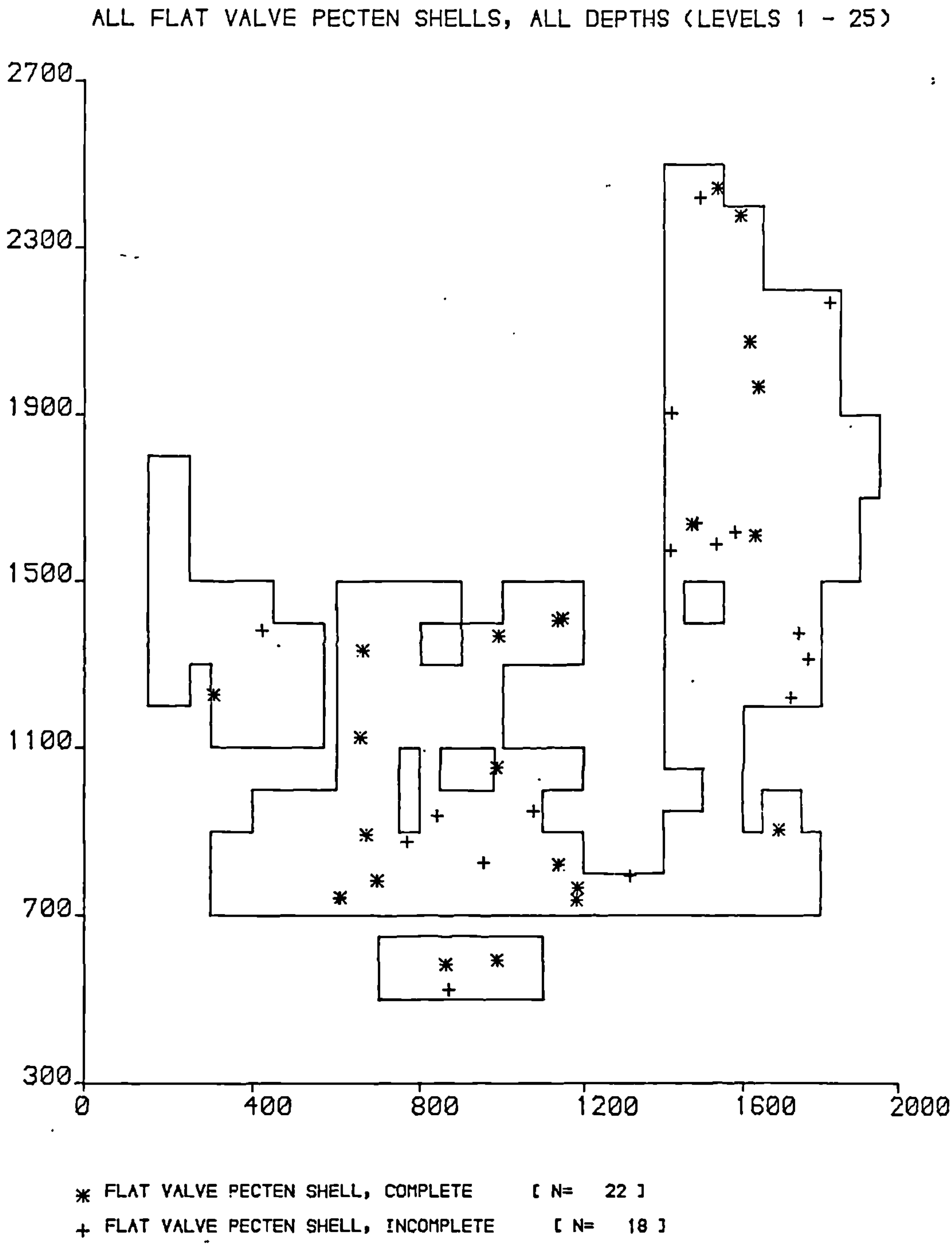

Figure 148. Horizontal Plot Showing the Distribution of All Flat Valve Pecten Shells in All Levels.

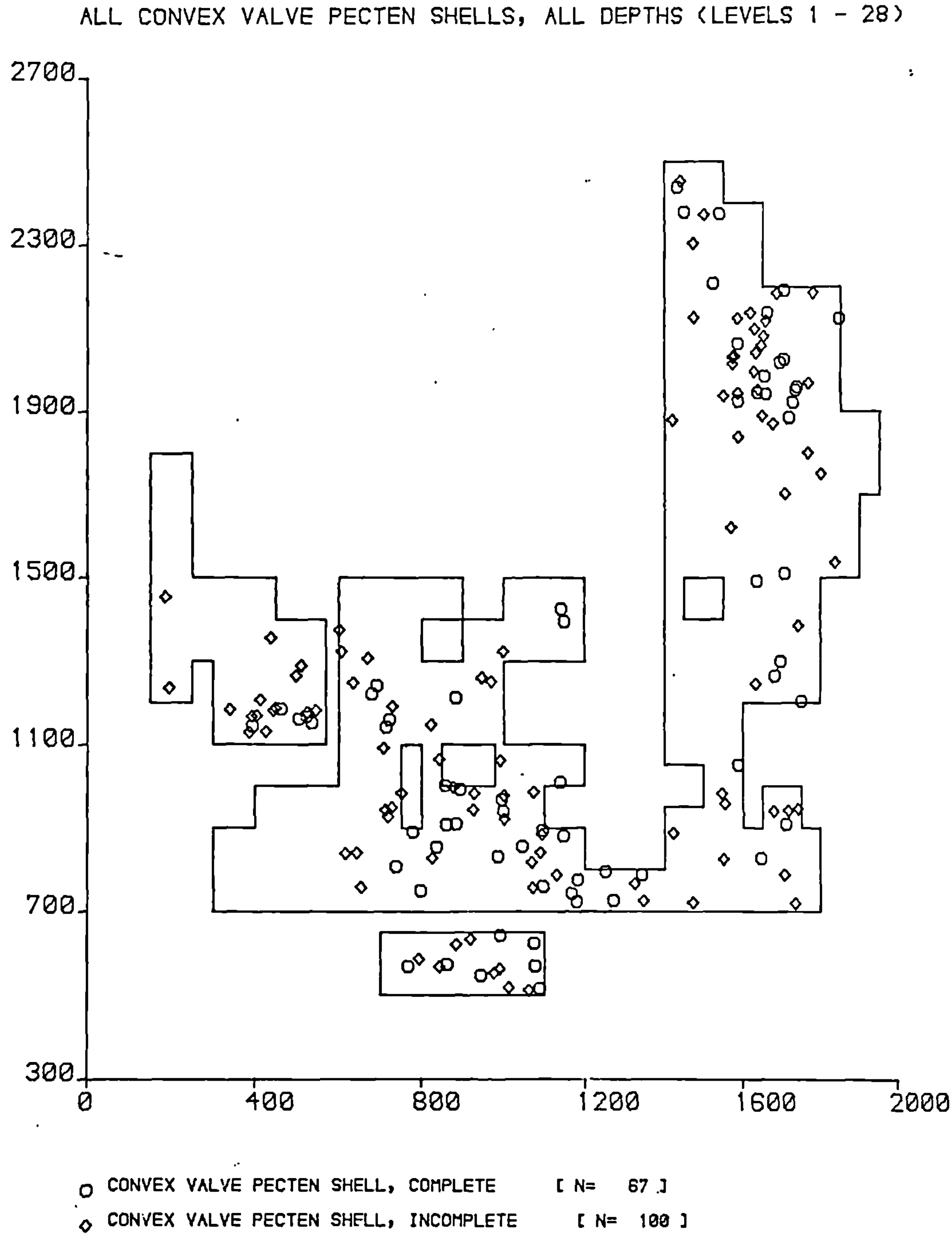

Figure 149. Horizontal Plot Showing the Distribution of All Convex Valve Pecten Shells in All Levels.

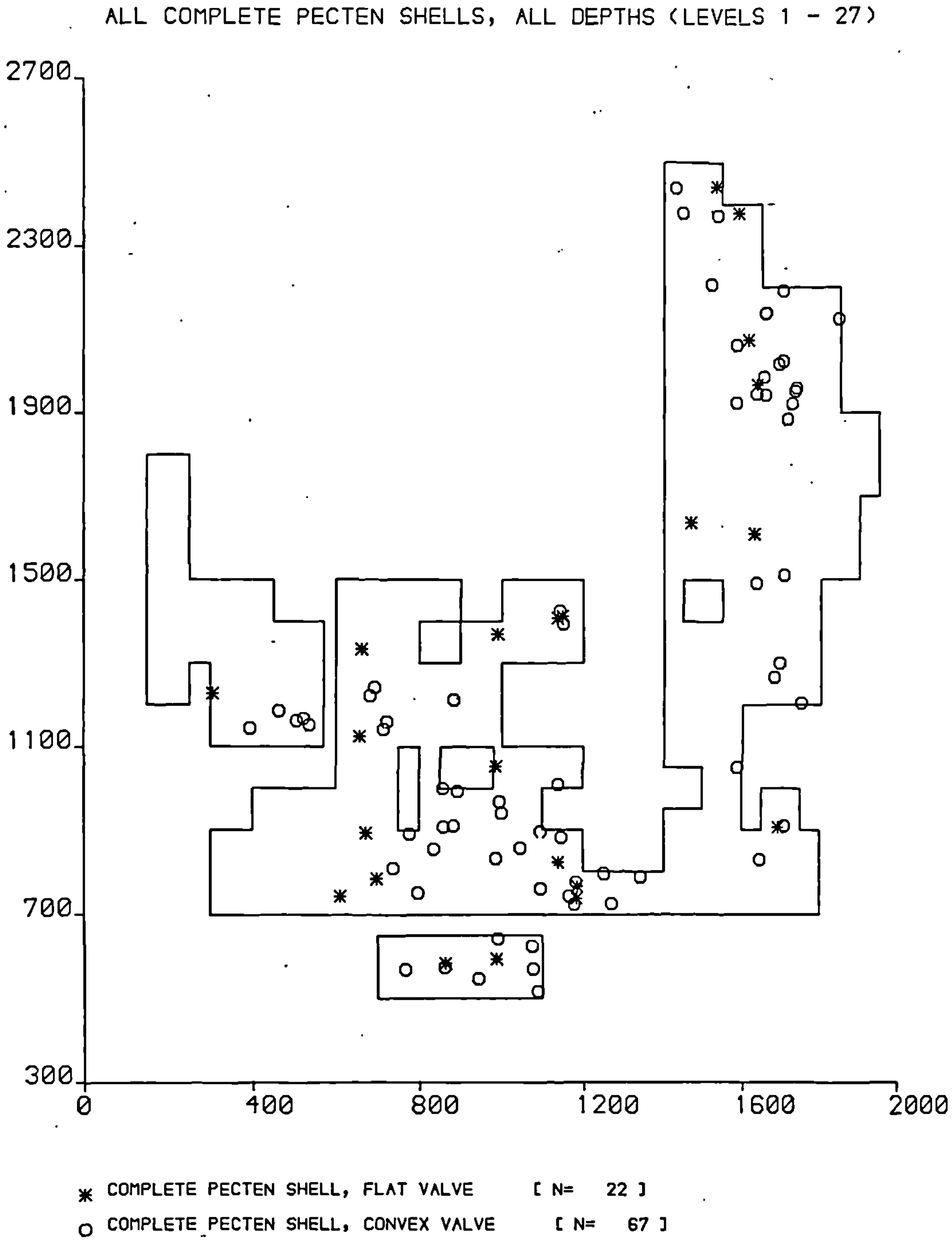

Figure 15Q. Horizontal Plot Showing the Distribution of All Complete Pecten Shells in All Levels.

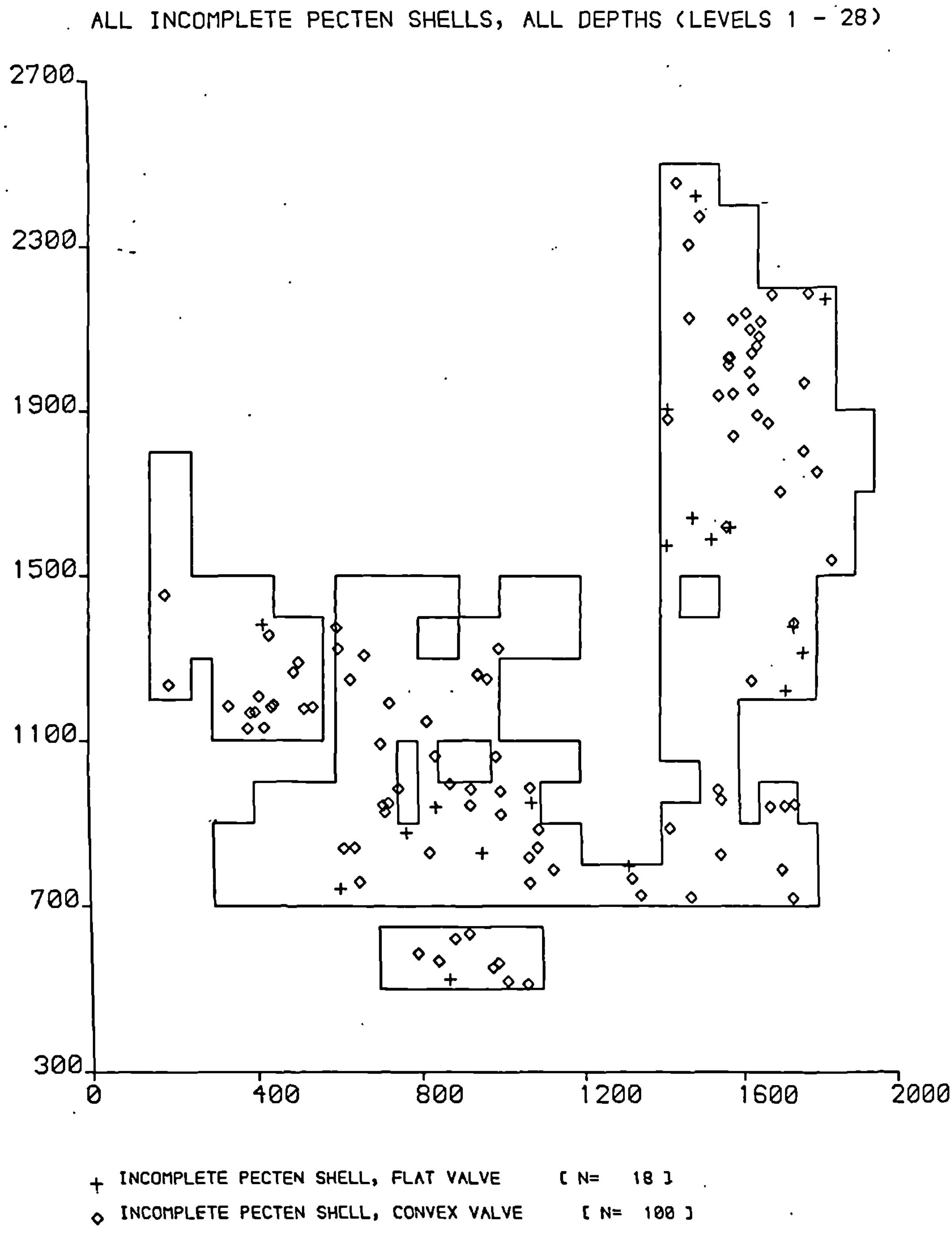

Figure 151. Horizontal Plot Showing the Distribution of All Incomplete Pecten Shells in All Levels.

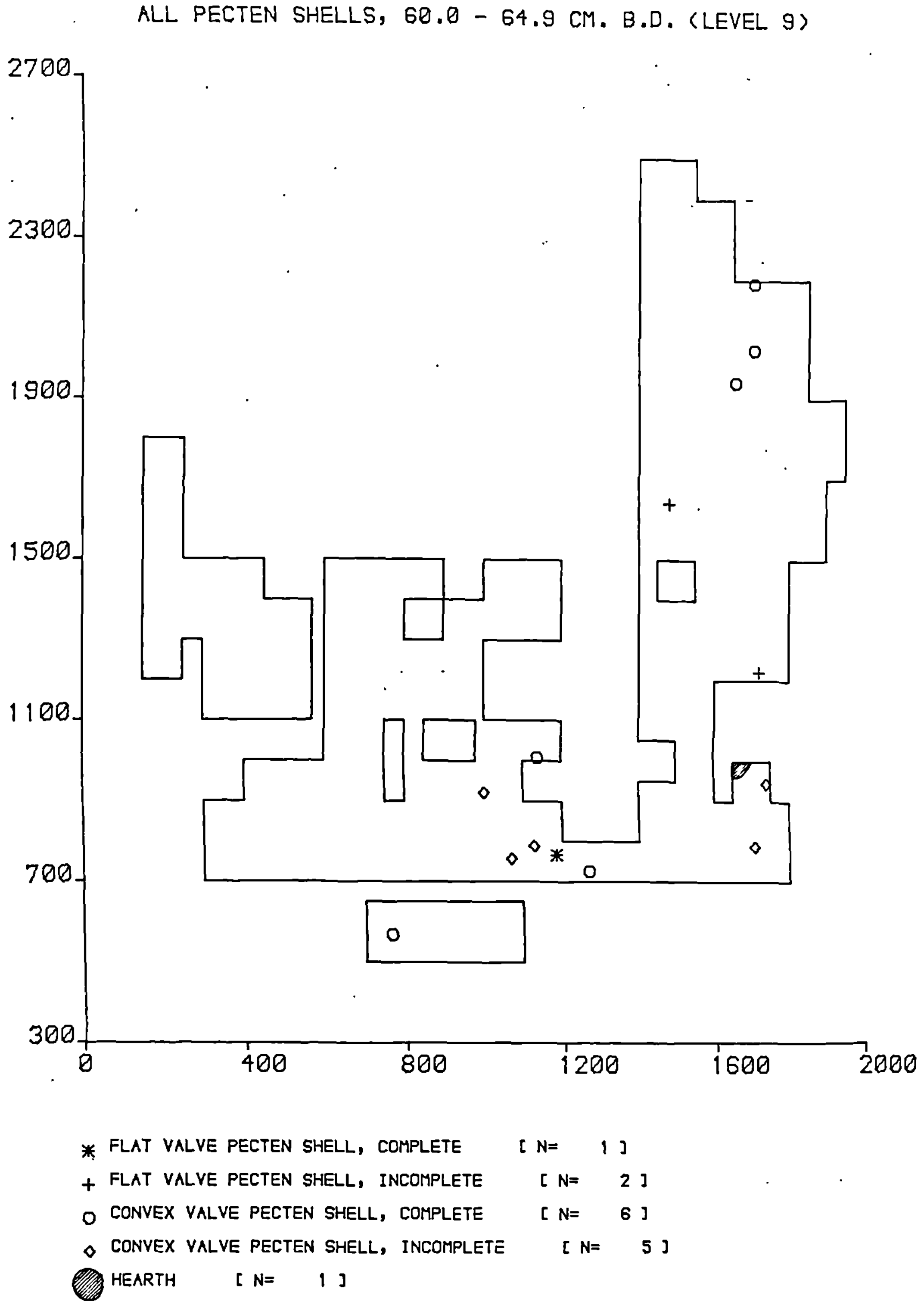

Figure 152. Horizontal Plot Showing the Distribution of All Pecten Shells in Level 9.

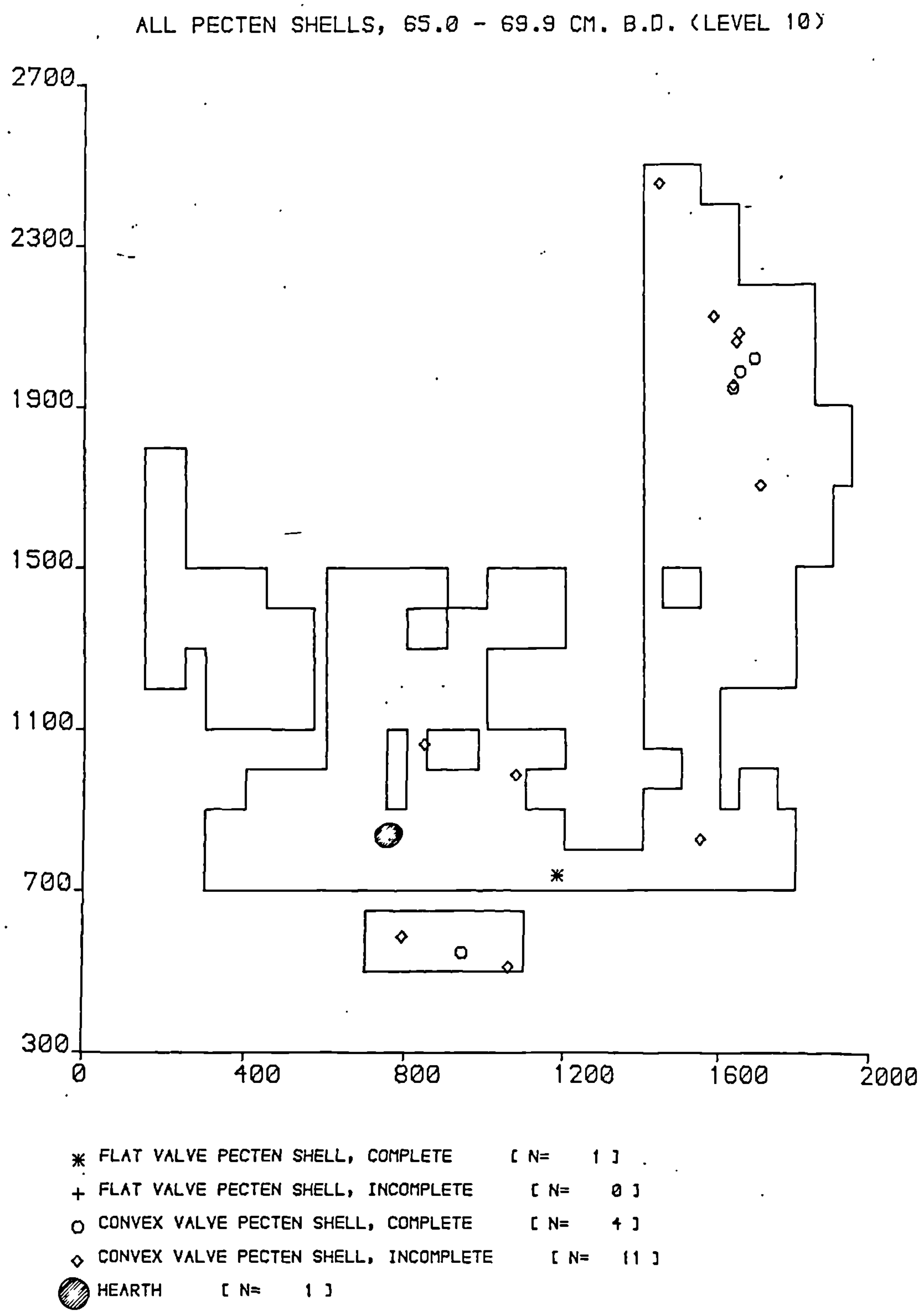

Figure 153. Horizontal Plot Showing the Distribution of All Pecten Shells in Level 10.

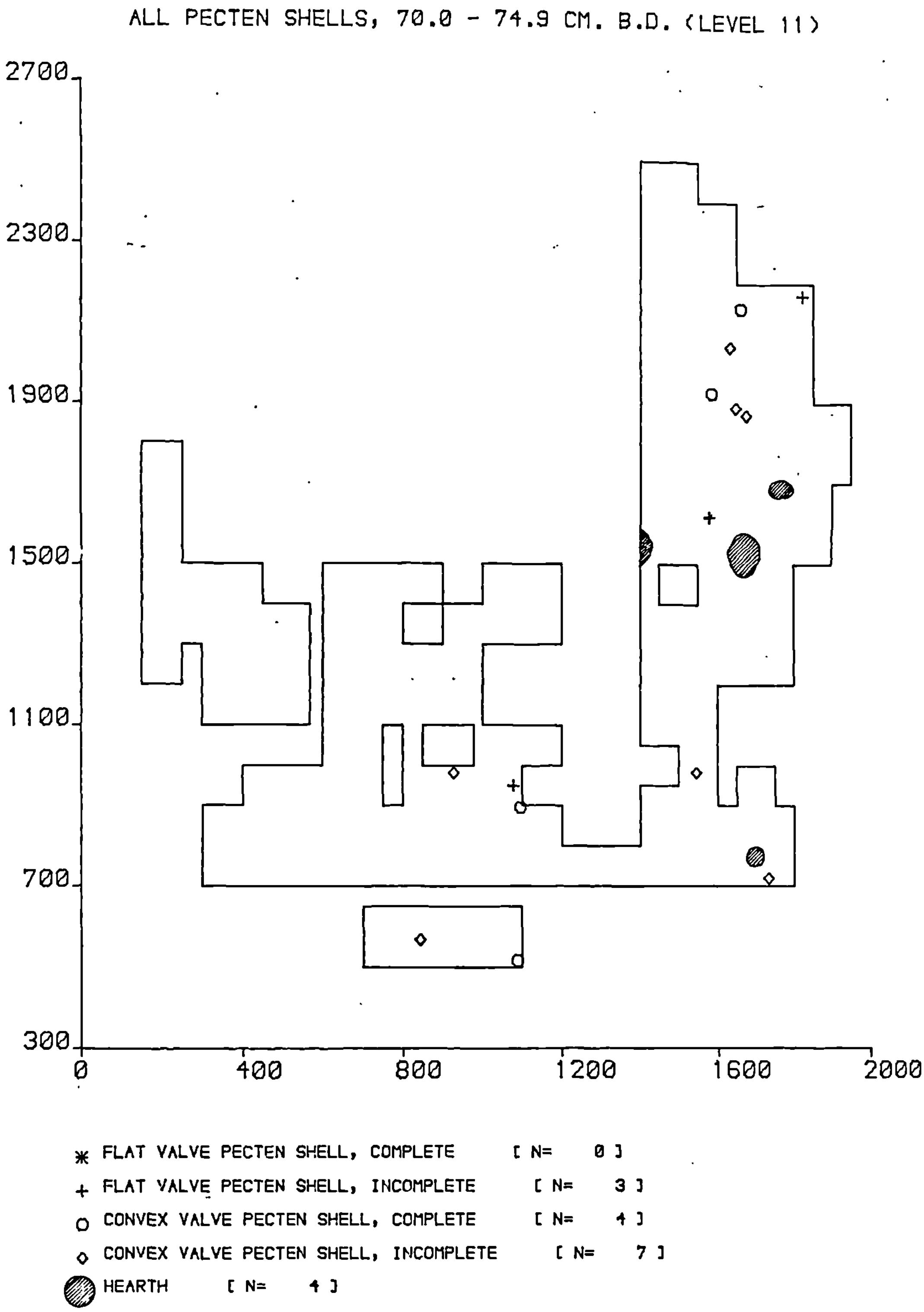

Figure 154. Horizontal Plot Showing the Distribution of All Pecten Shells in Level 11.

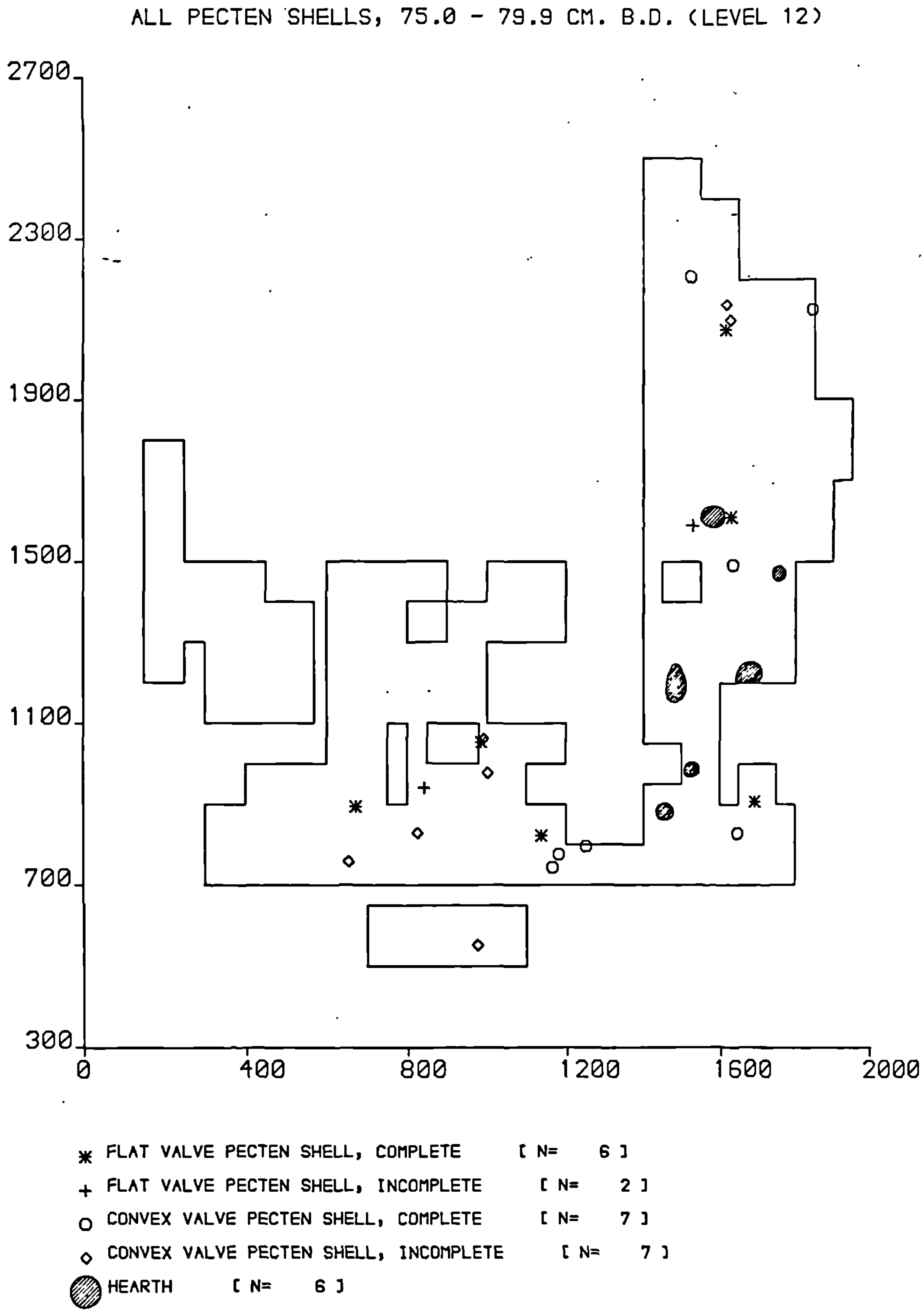

Figure 155. Horizontal Plot Showing the Distribution of All Pecten Shells in Level 12.

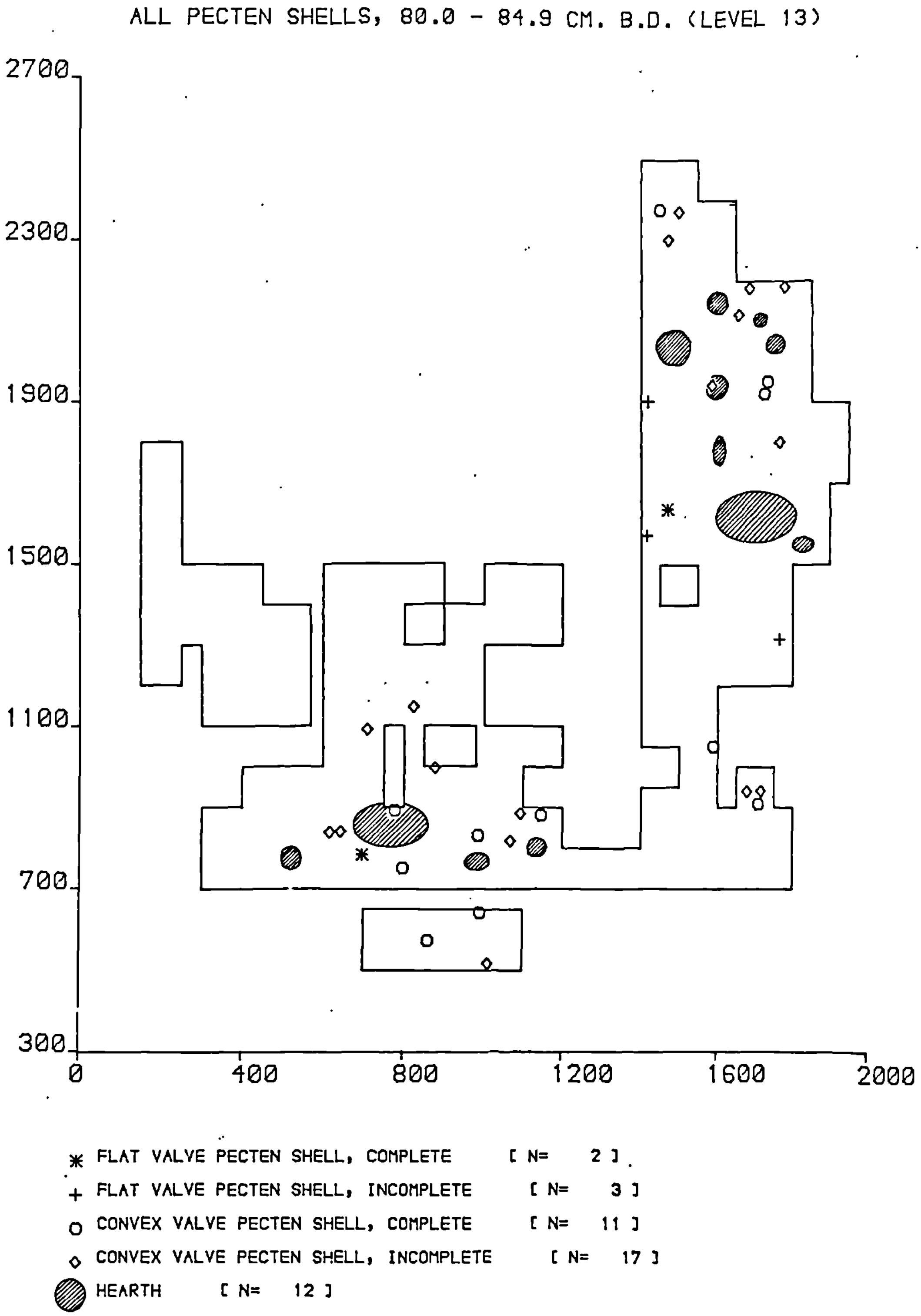

Figure 156. Horizontal Plot Showing the Distribution of All Pecten Shells in Level 13.

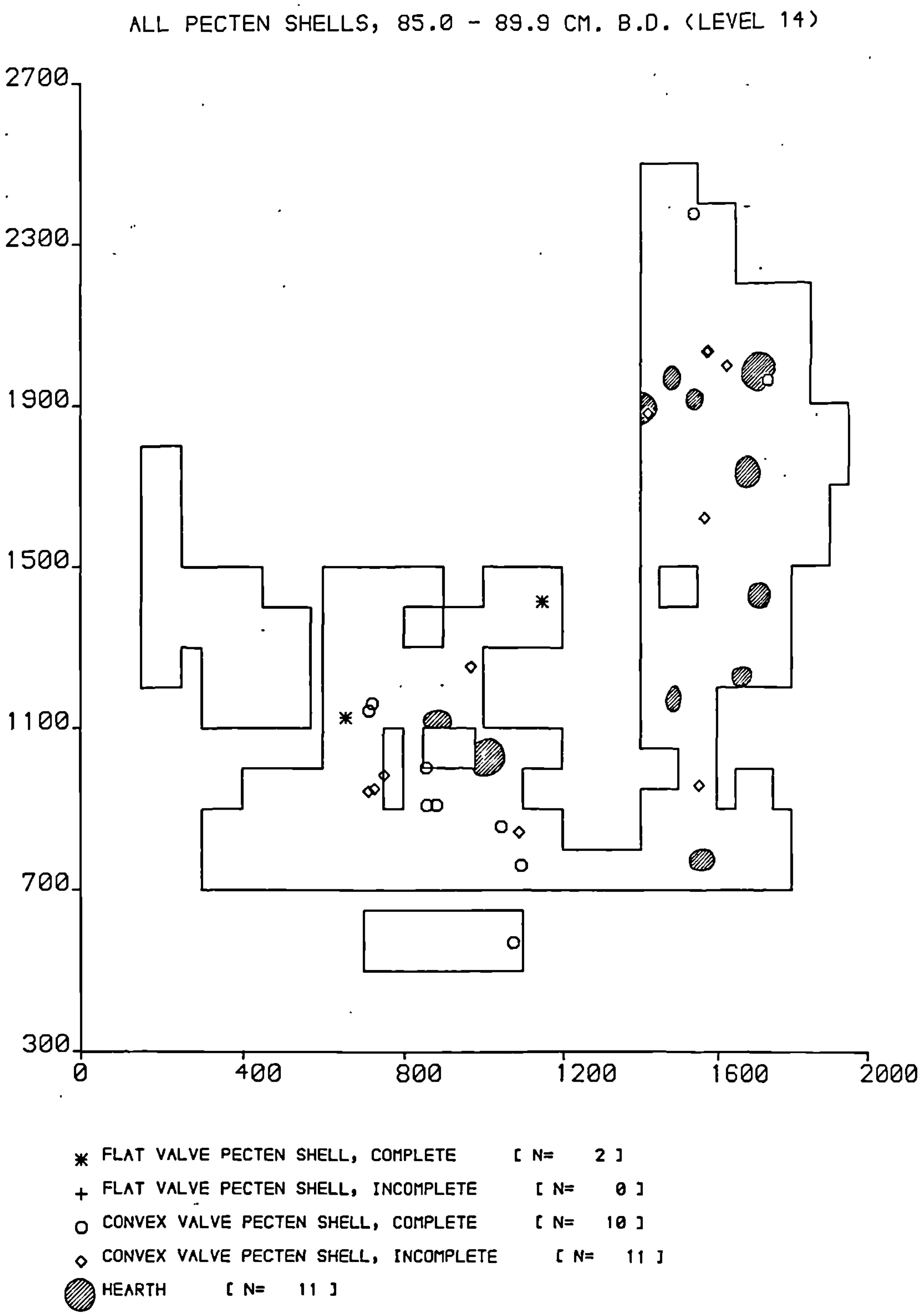

Figure 157. Horizontal Plot Showing the Distribution of All Pecten Shells in Level 14.

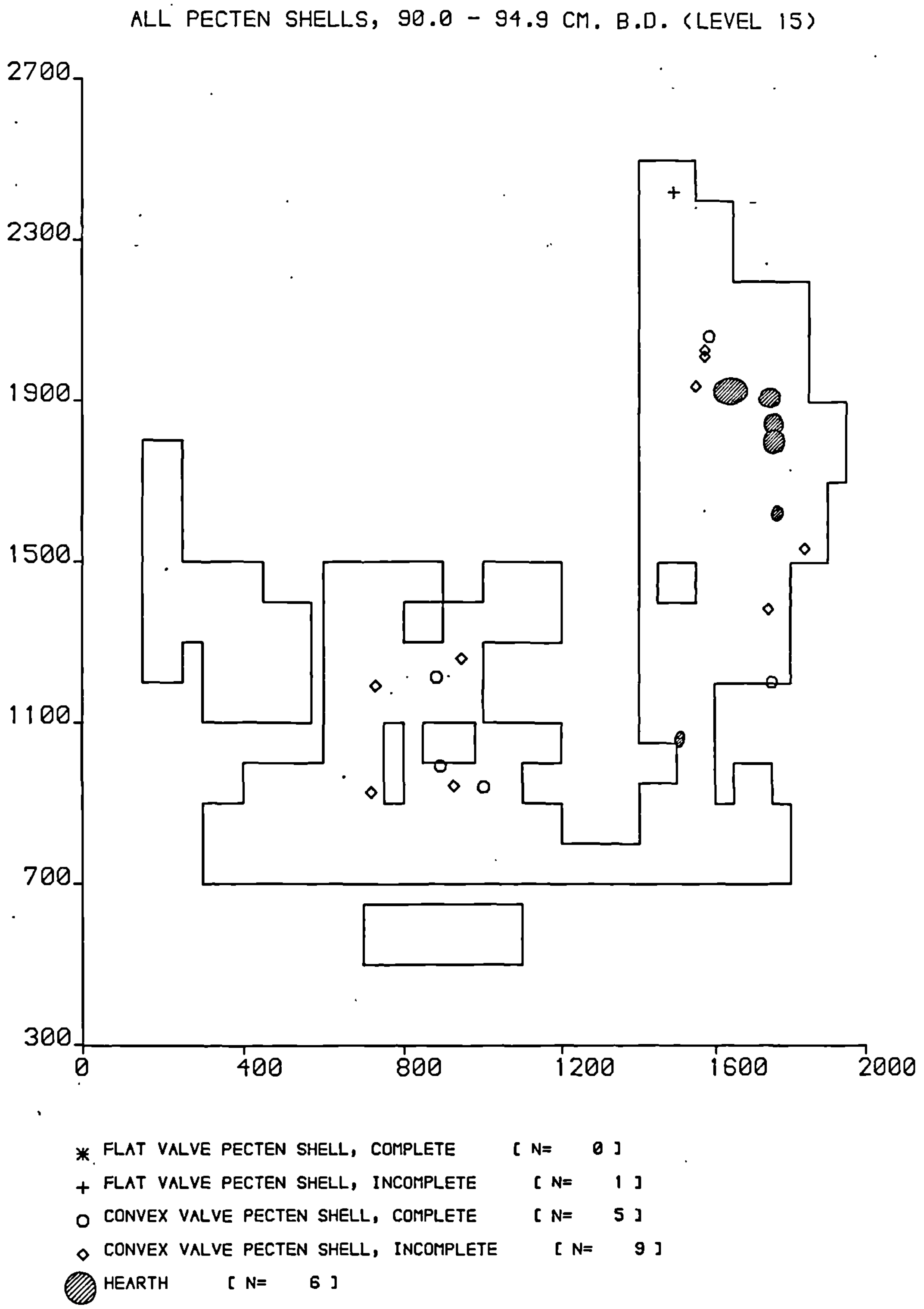

Figure 158. Horizontal Plot Showing the Distribution of All Pecten Shells in Level 15.

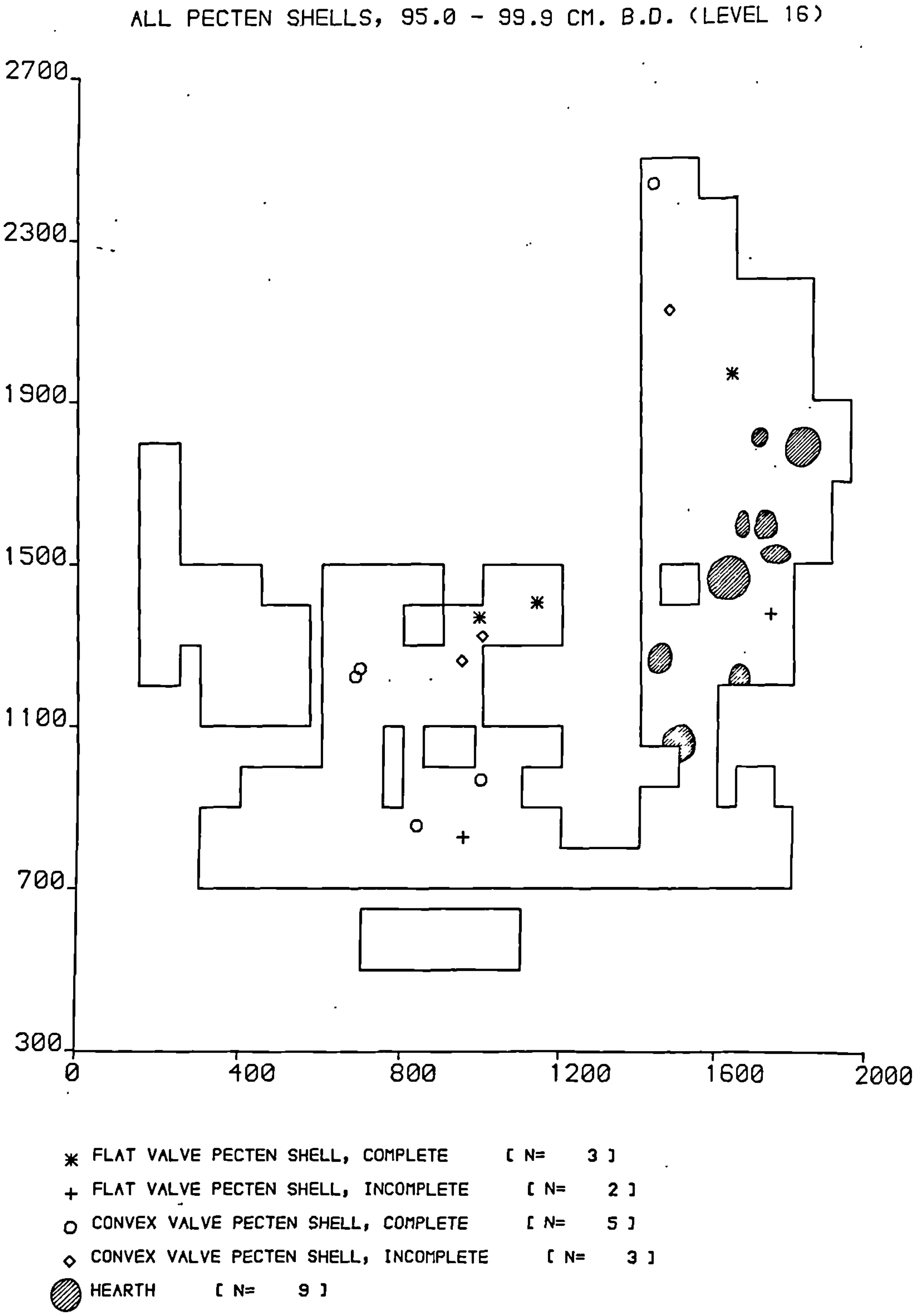

Figure 159. Horizontal Plot Showing the Distribution of All Pecten Shells in Level 16.

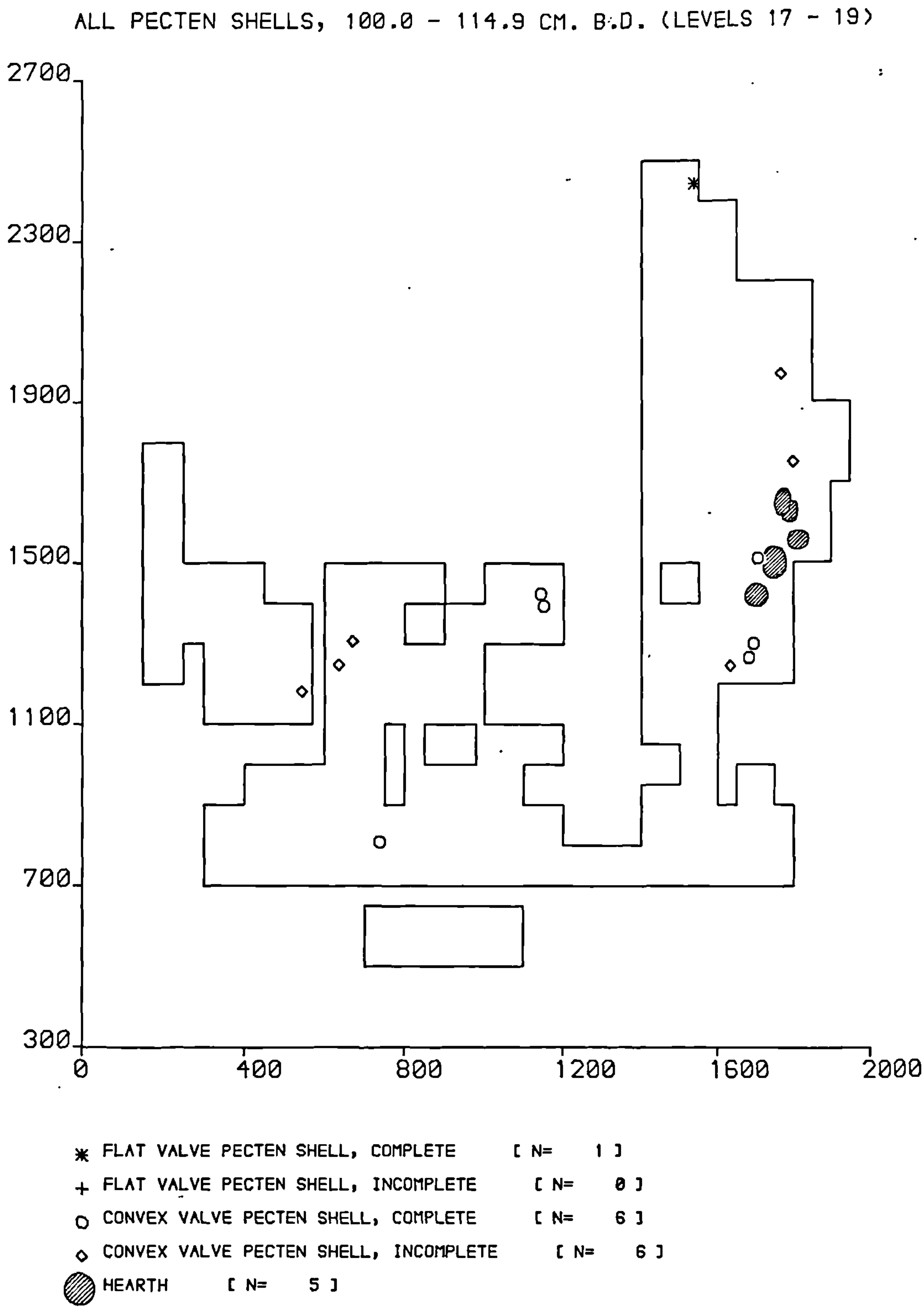

Figure 160. Horizontal Plot Showing the Distribution of All Pecten Shells in Levels 17 to 19.

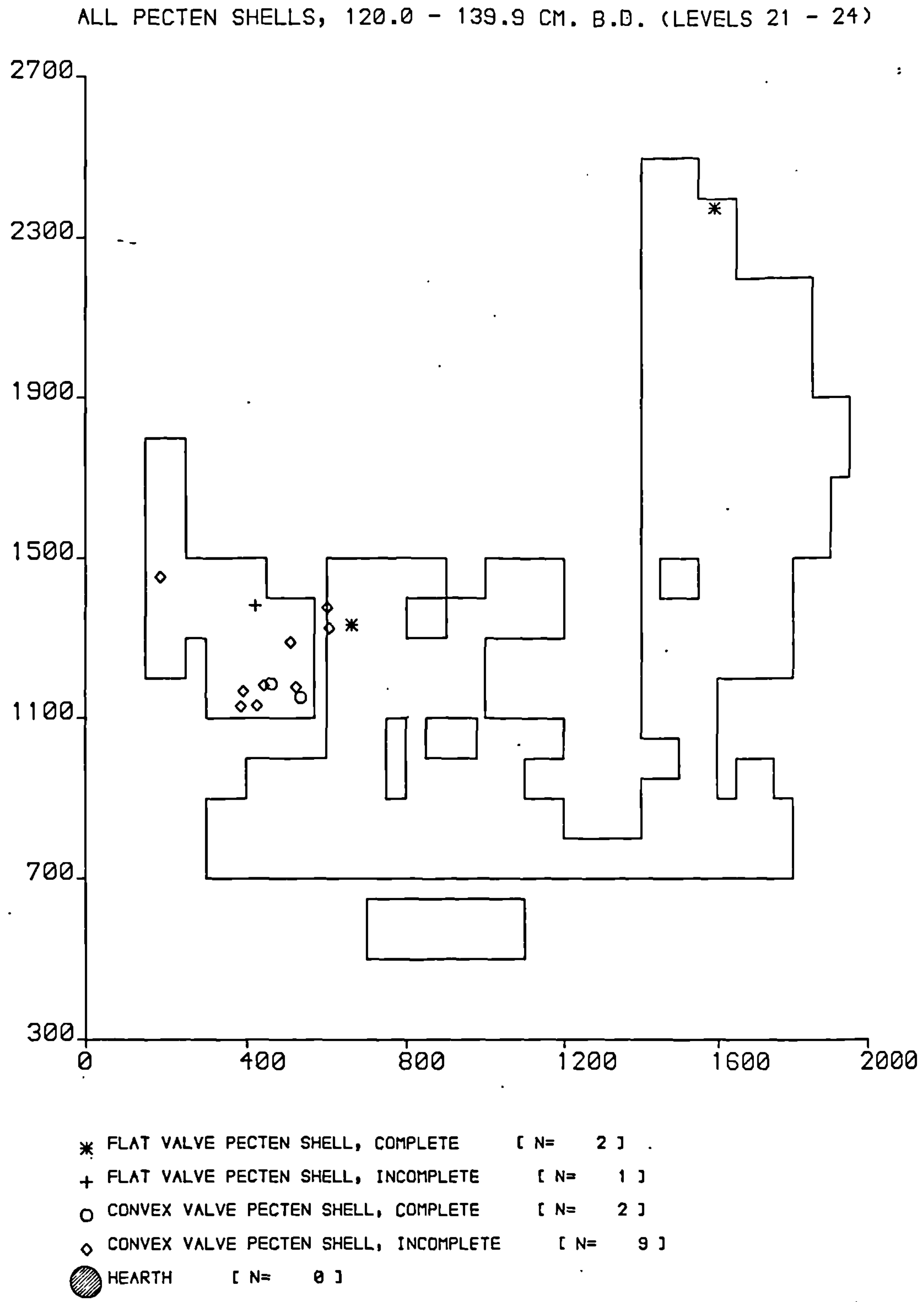

Figure 161. Horizontal Plot Showing the Distribution of All Pecten Shells in Levels 21 to 24.

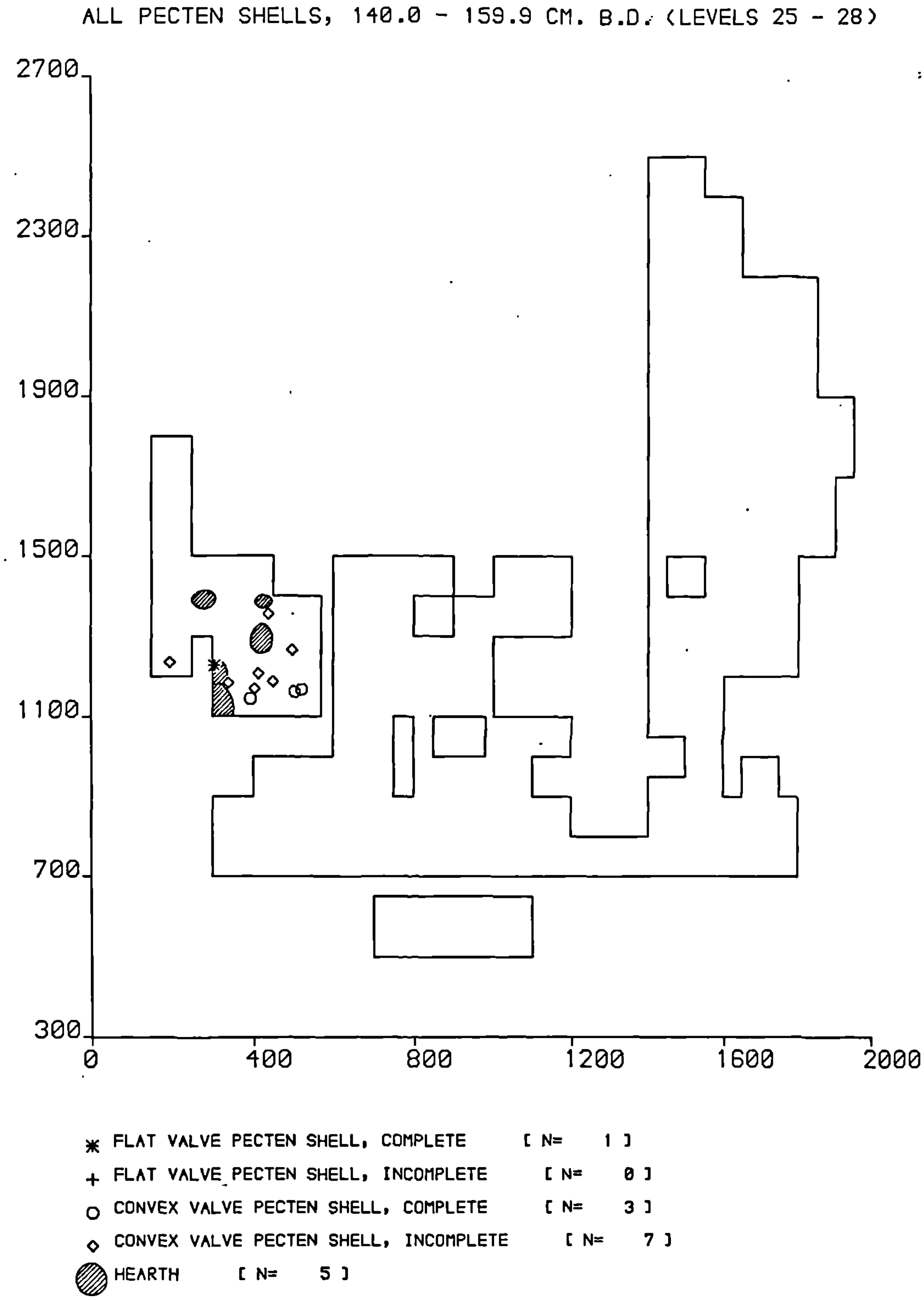

Figure 162. Horizontal Plot Showing the Distribution of All Pecten Shells in Levels 25 to 28.

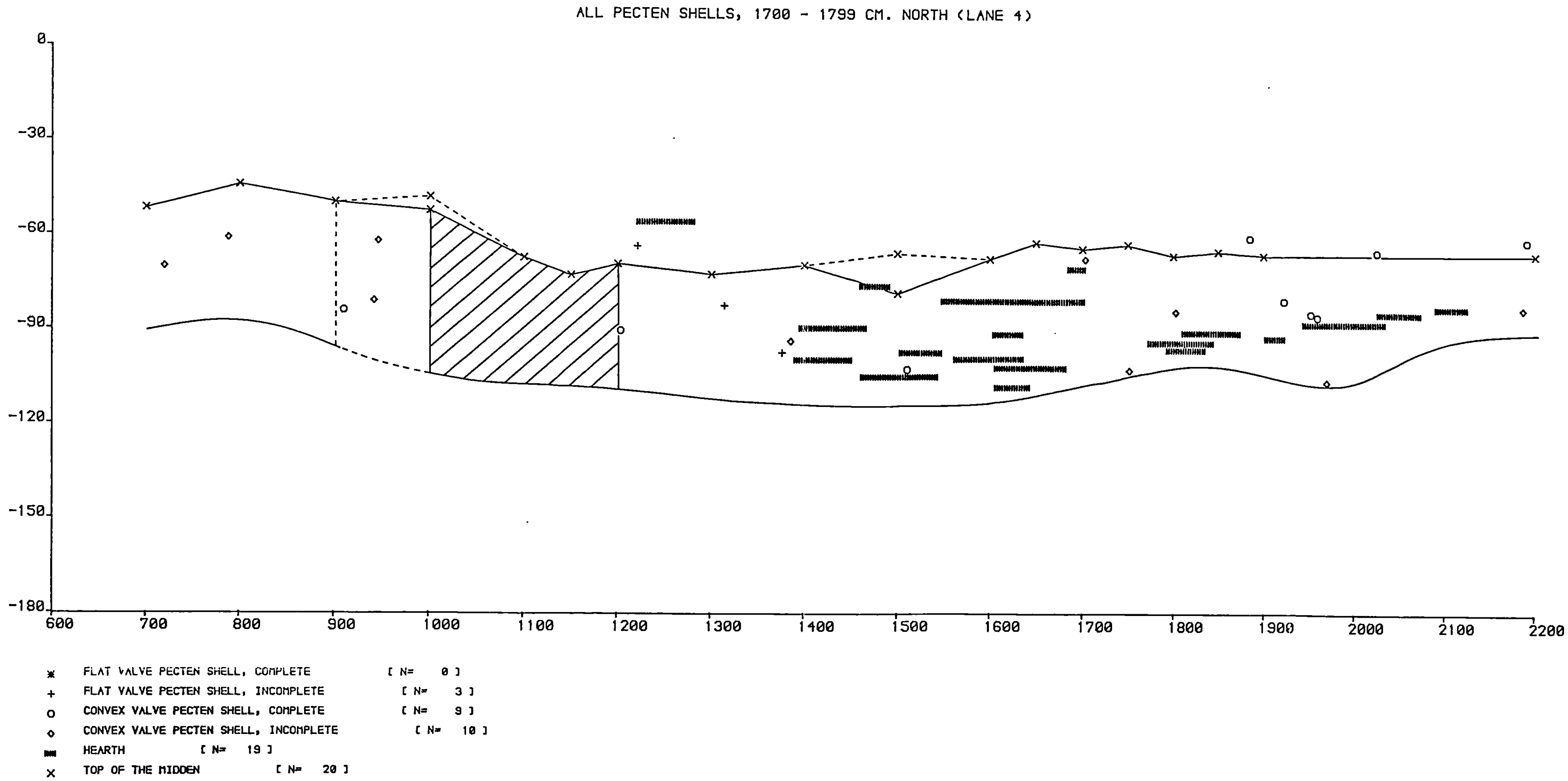

Figure 163. Sectional Plot Showing the Distribution of All Pecten Shells in Lane 4.

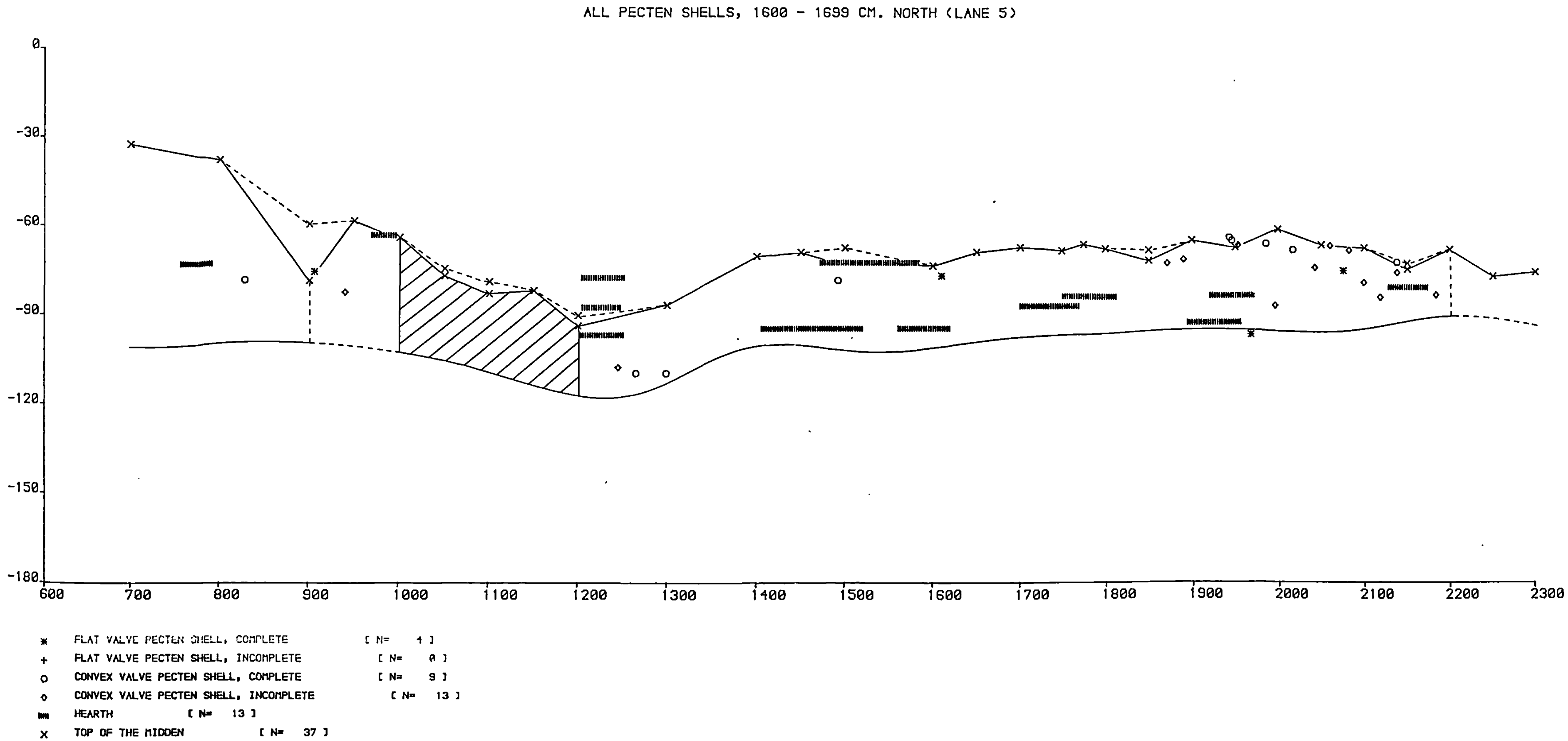

Figure 164. Sectional Plot Showing the Distribution of All Pecten Shells in Lane 5.

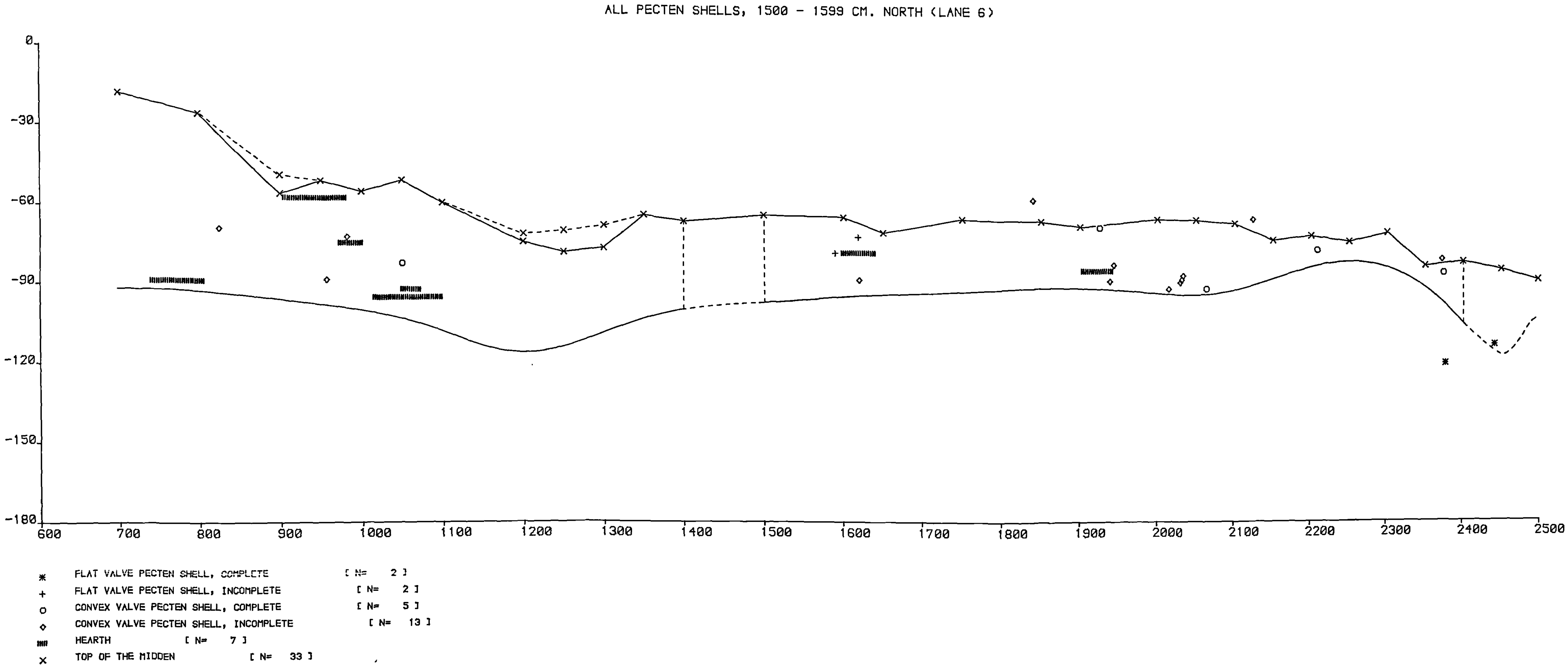

Figure 165. Sectional Plot Showing the Distribution of All Pecten Shells in Lane 6.

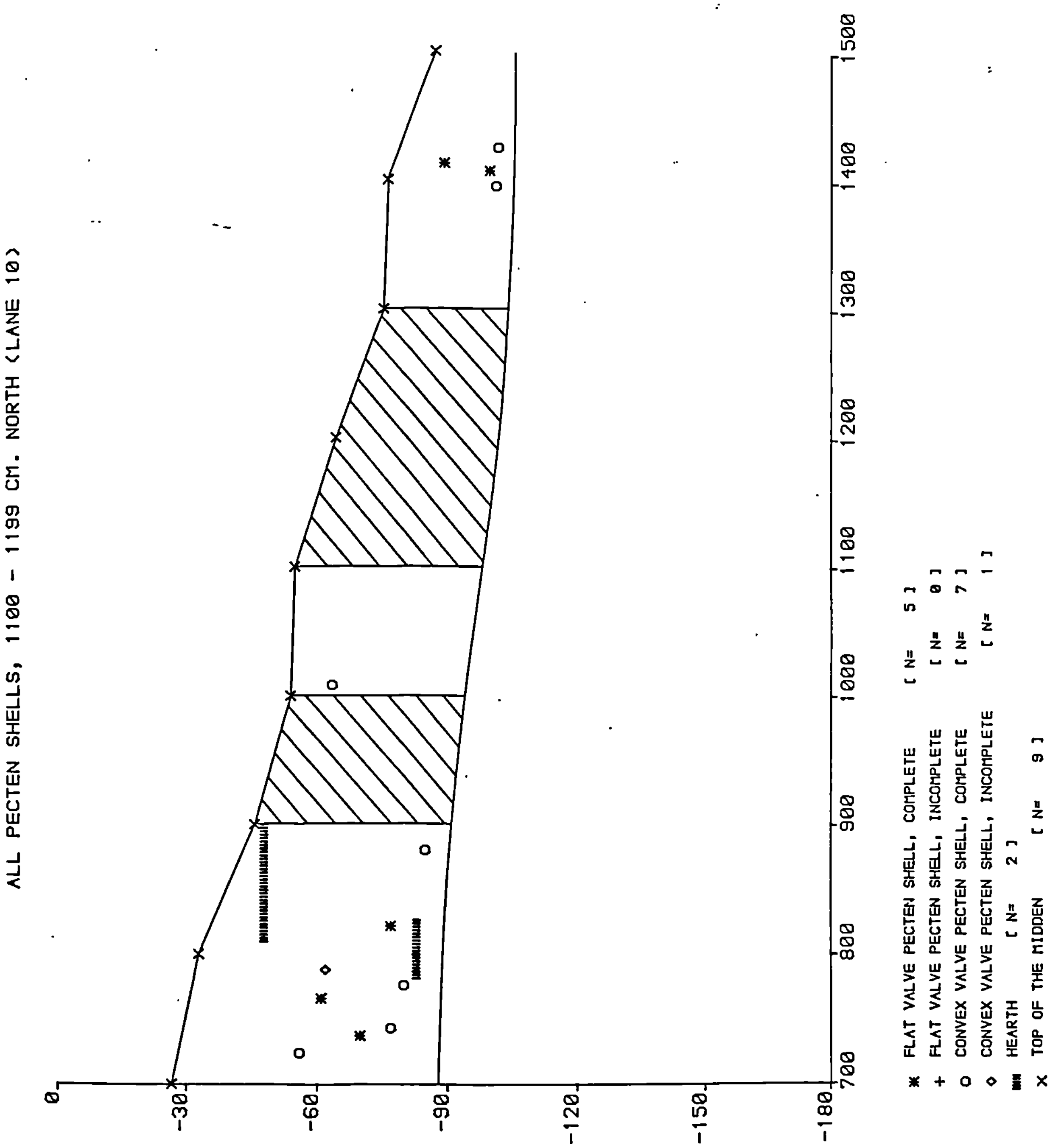

Figure 166. Sectional Plot Showing the Distribution of All Pecten Shells in Lane 10.

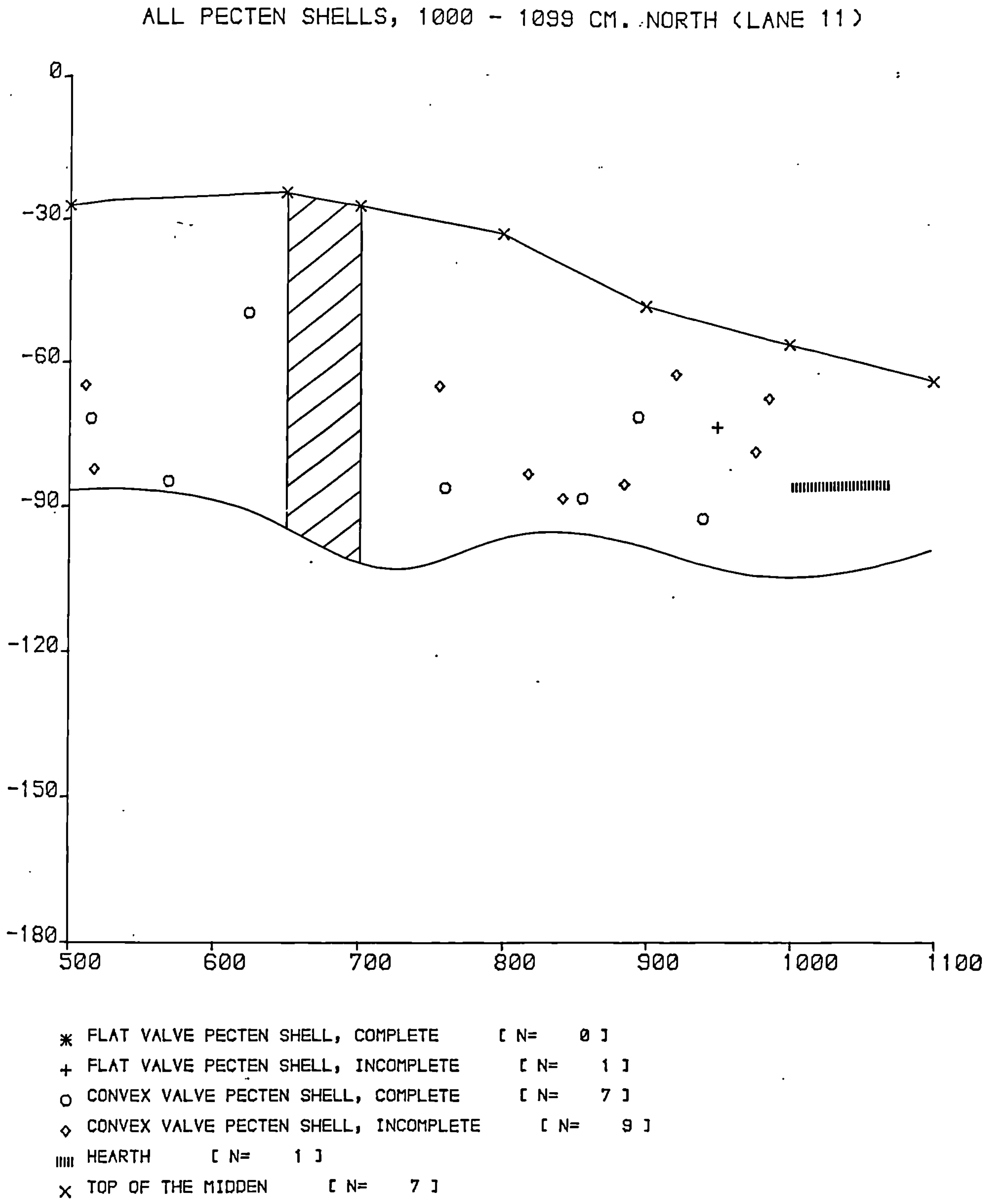

Figure 167. Sectional Plot Showing the Distribution of All Pecten Shells in Lane 11 (Eastern Half).

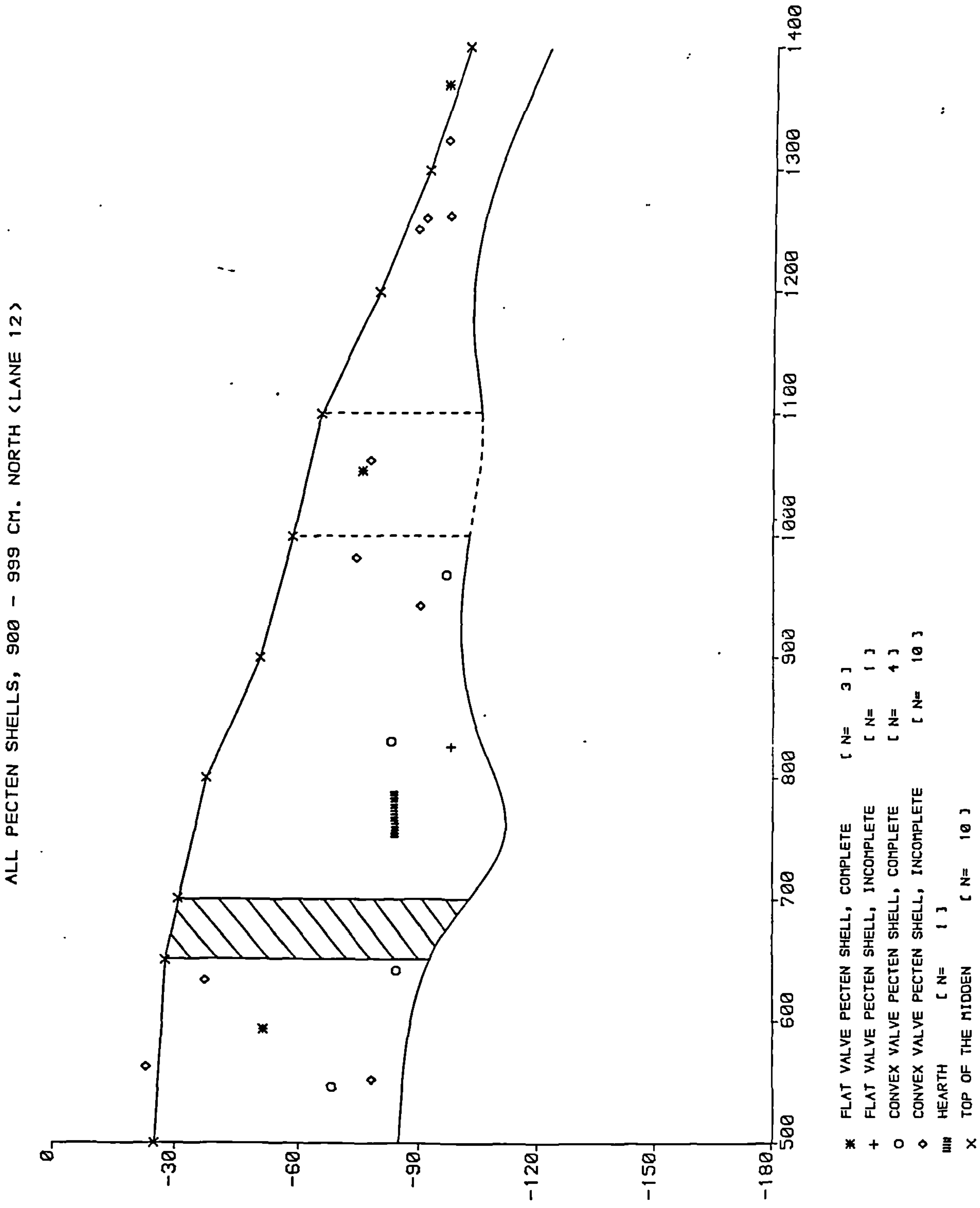

Figure 168. Sectional Plot Showing the Distribution of All Pecten Shells in Lane 12.

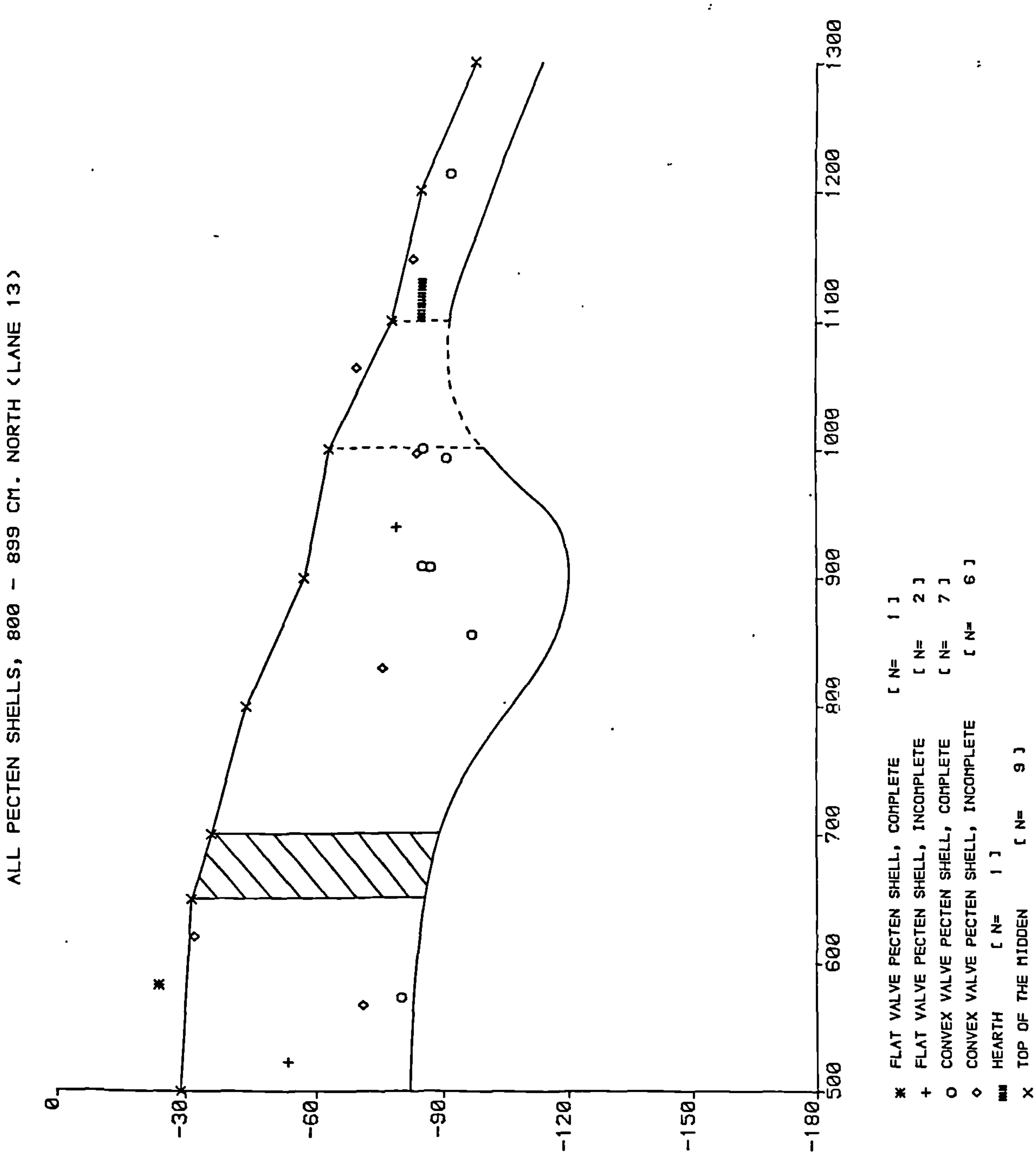

Figure 169. Sectional Plot Showing the Distribution of All Pecten Shells in Lane 13.

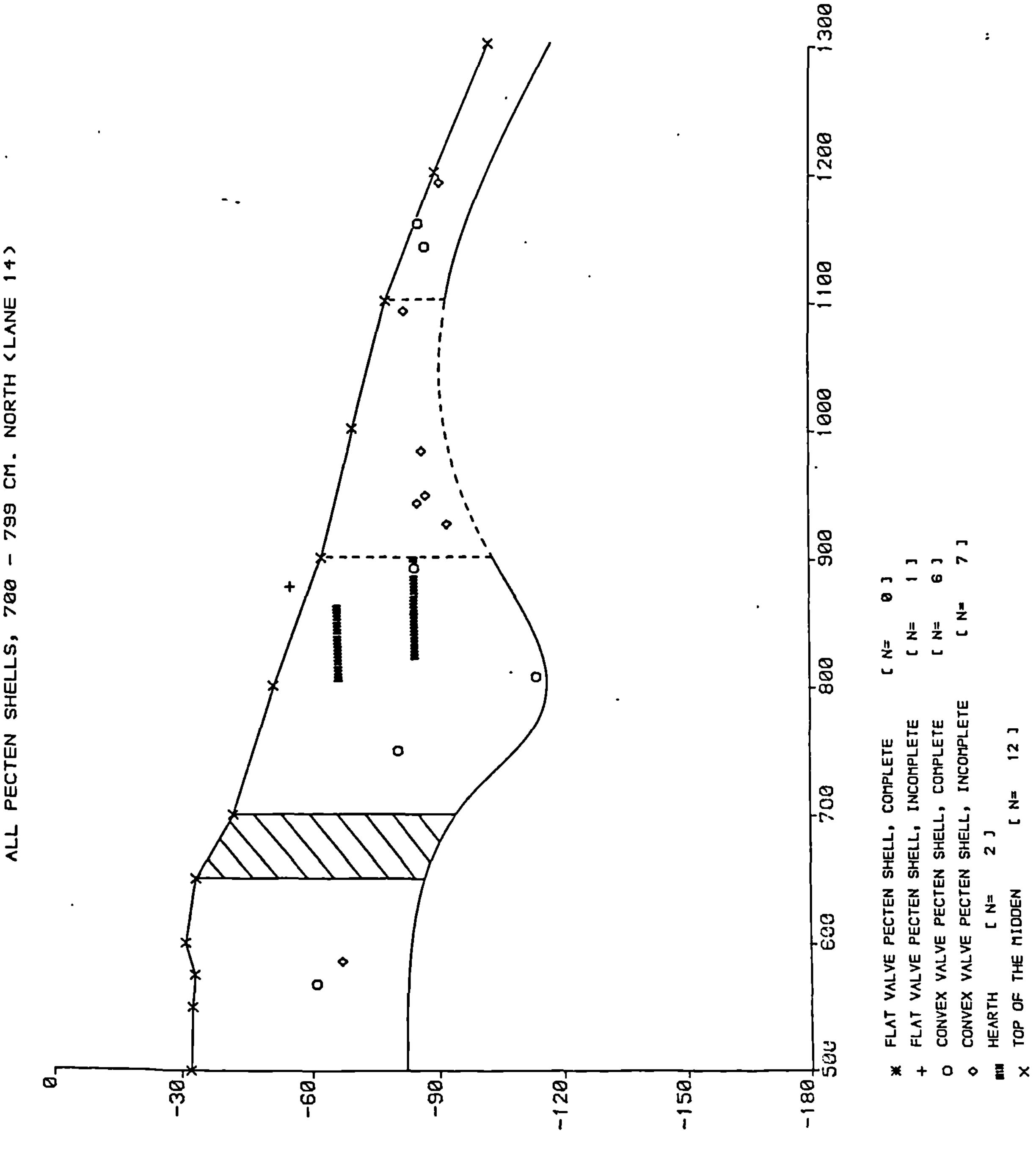

Figure 170. Sectional Plot Showing the Distribution of All Pecten Shells in Lane 14.

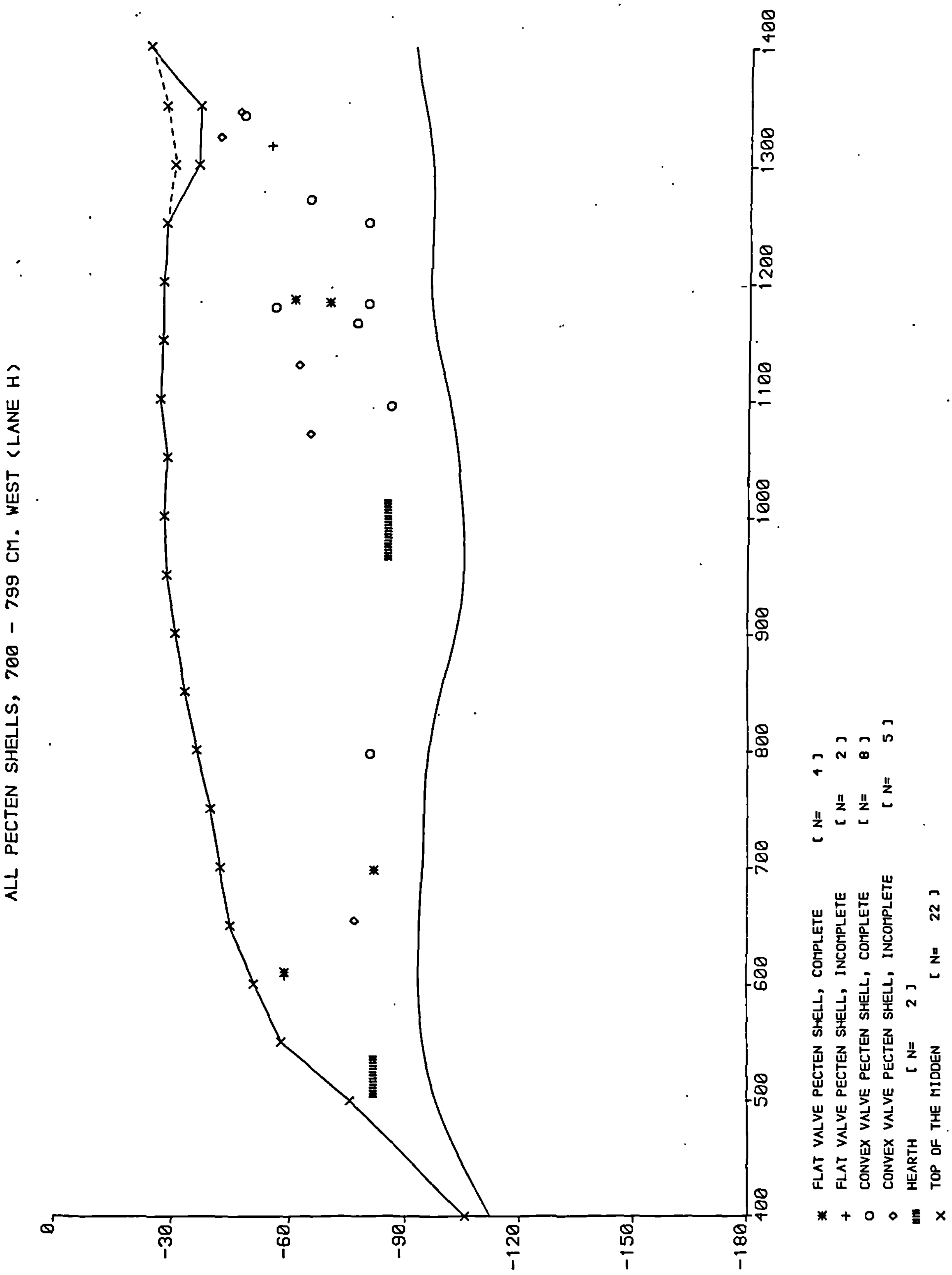

Figure 171. Sectional Plot Showing the Distribution of All Pecten Shells in Lane H (Southern Two-Thirds).

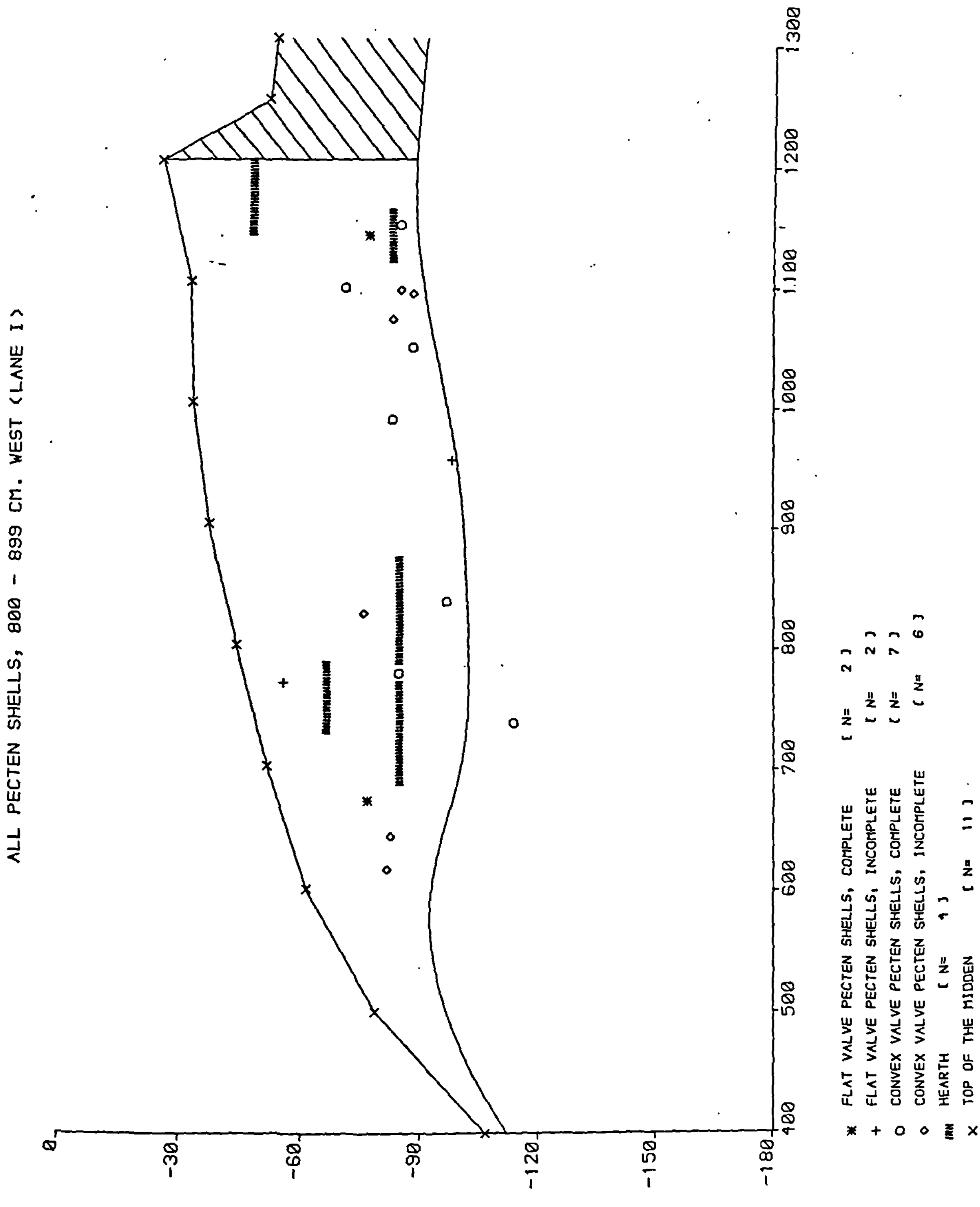

Figure 172. Sectional Plot Showing the Distribution of All Pecten Shells in Lane I (Southern Two-Thirds).

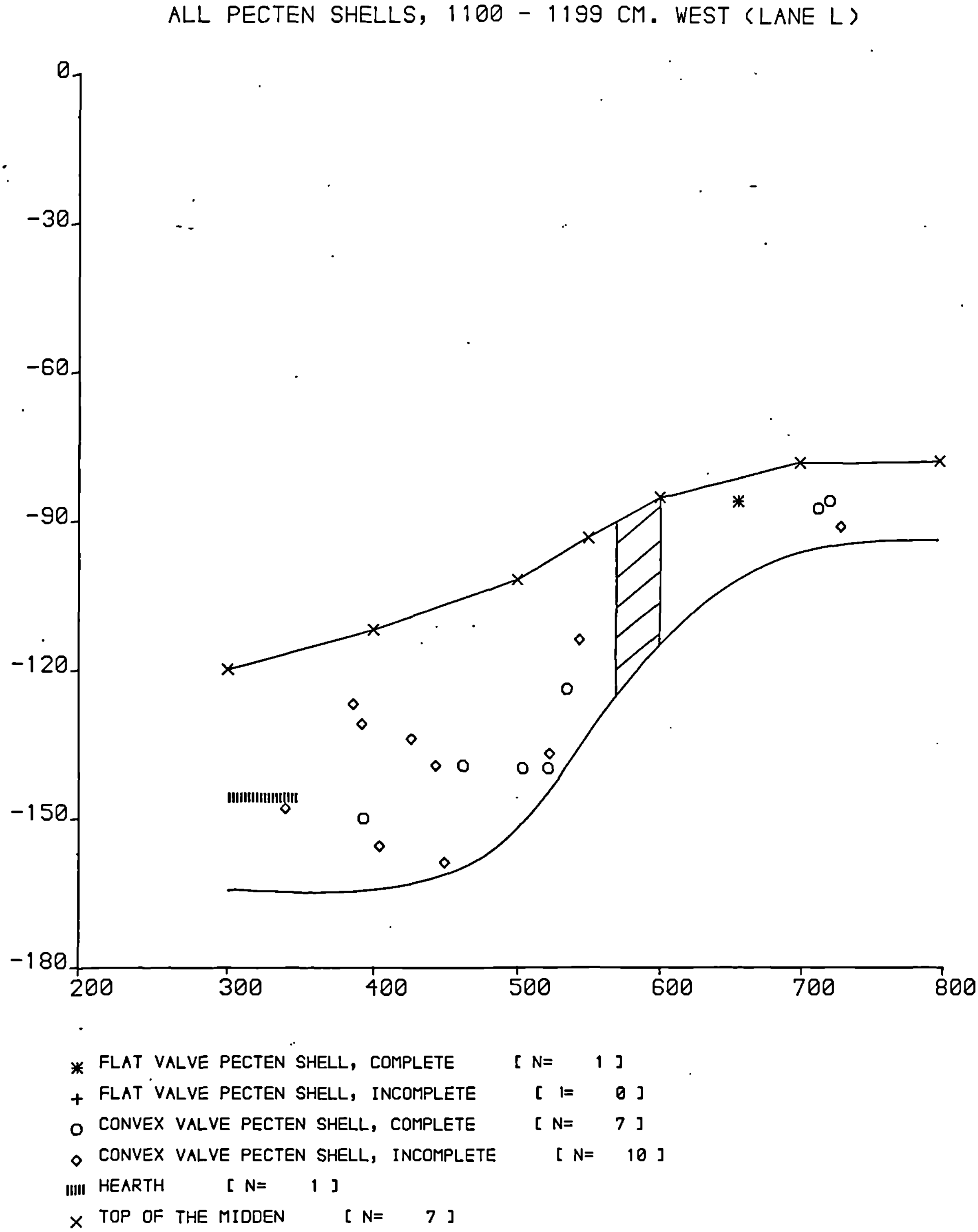

Figure 173. Sectional Plot Showing the Distribution of All Pecten Shells in Lane L (Southern One-Third).

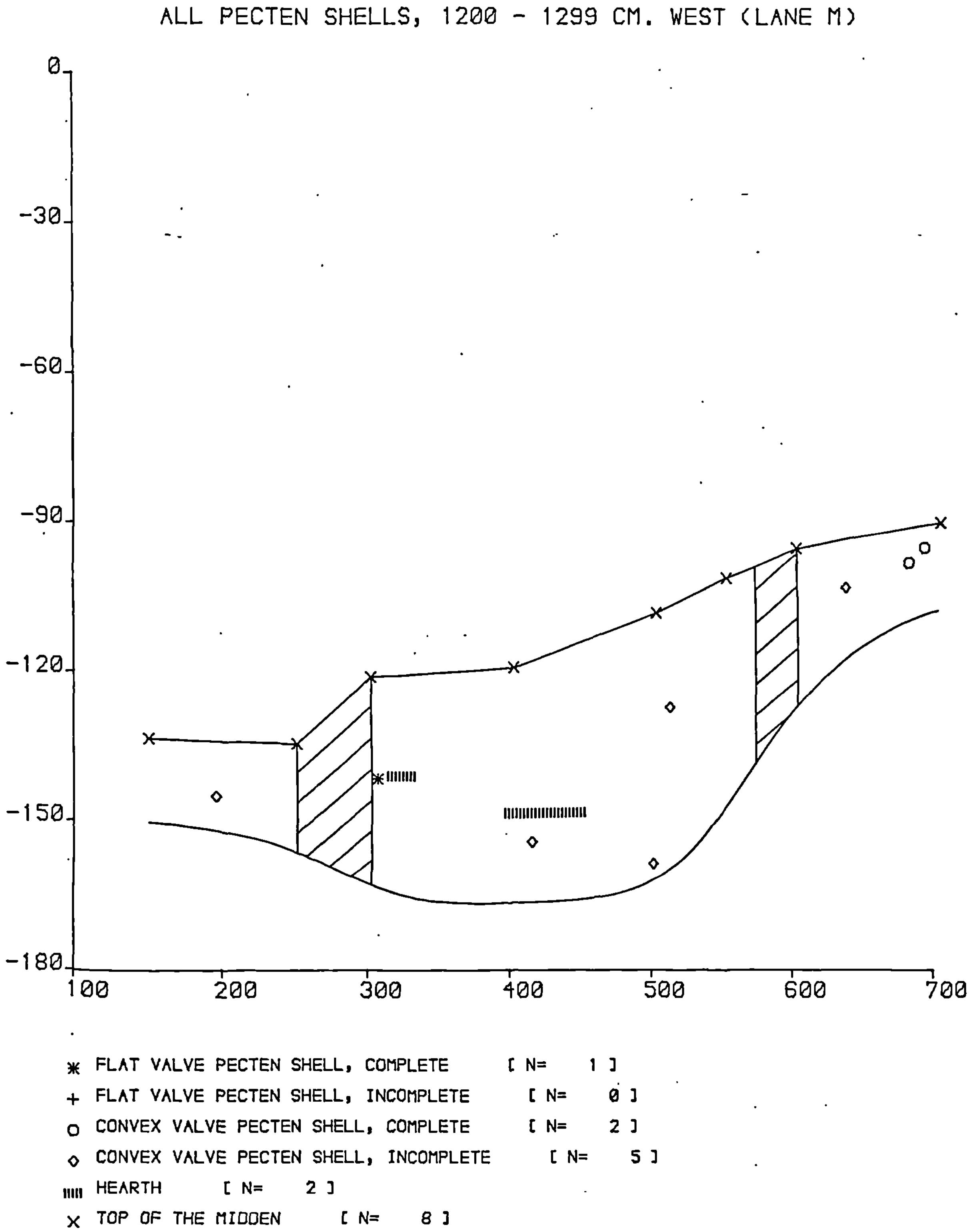

Figure 174. Sectional Plot Showing the Distribution of All Pecten Shells in Lane M (Southern One-Third).

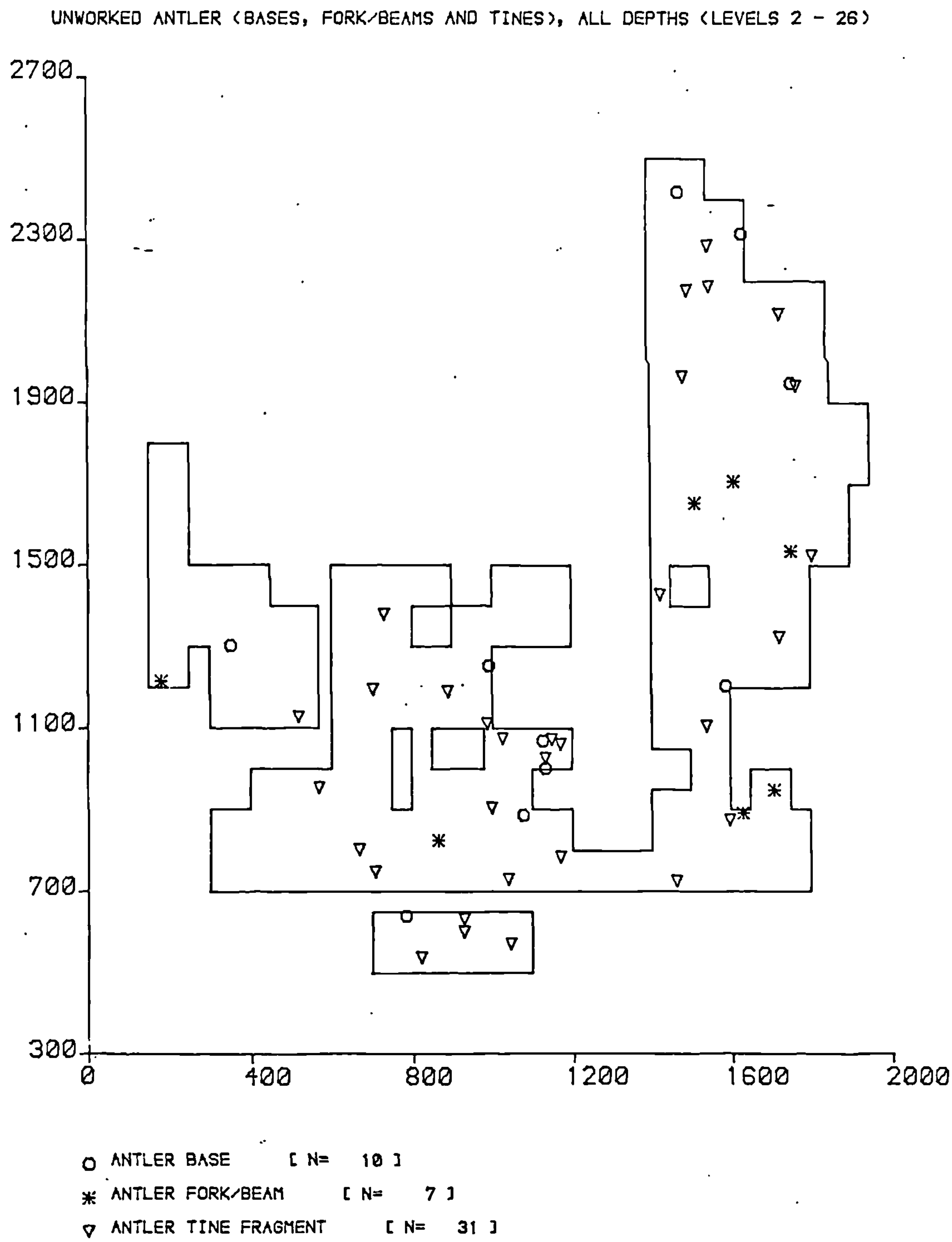

Figure 175. Horizontal Plot Showing the Distribution of All Antler Bases, Antler Fork/Beams and Antler Tine Fragments in All Levels.

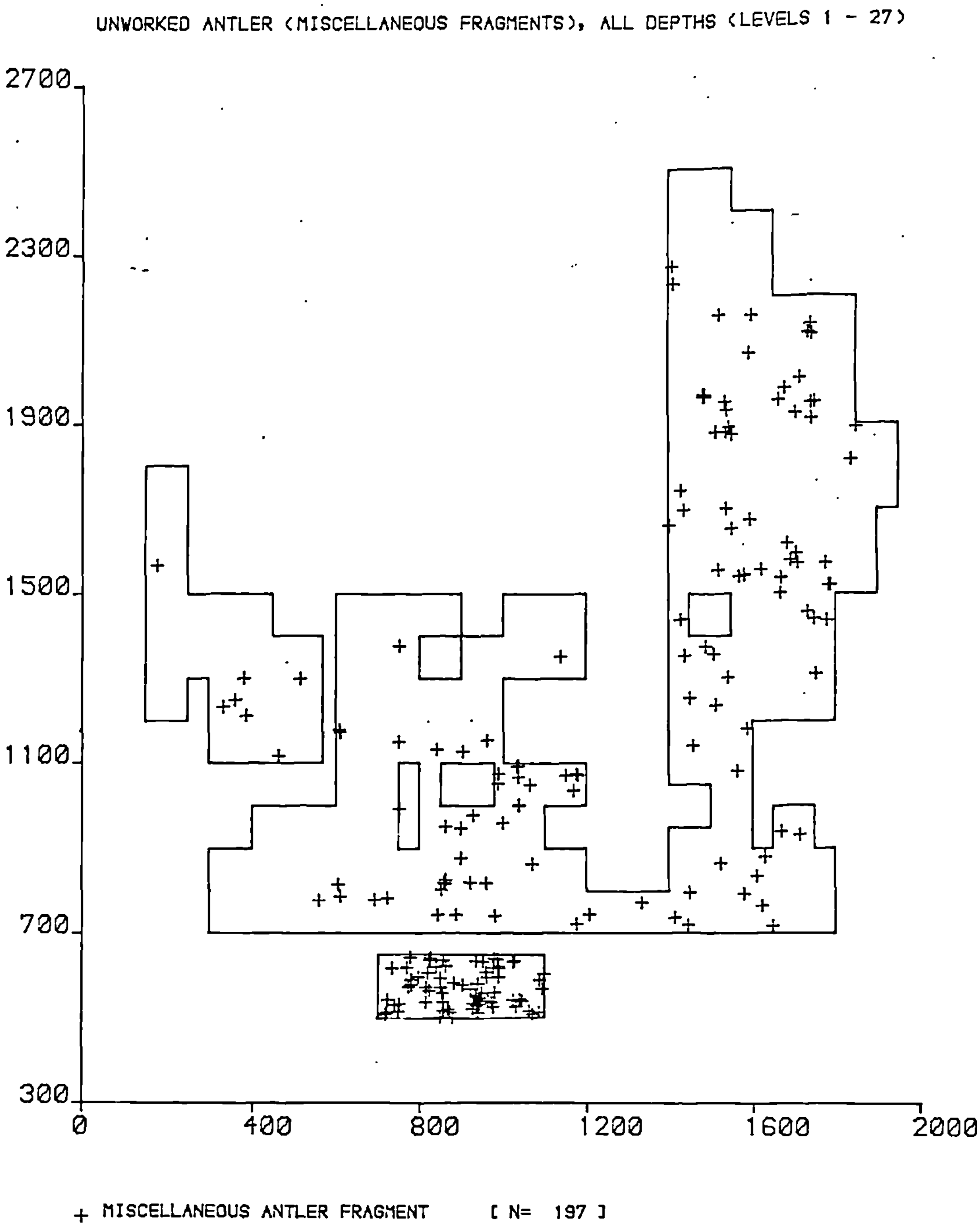

Figure 176. Horizontal Plot Showing the Distribution of All Miscellaneous Fragments of Unworked Antler in All Levels.

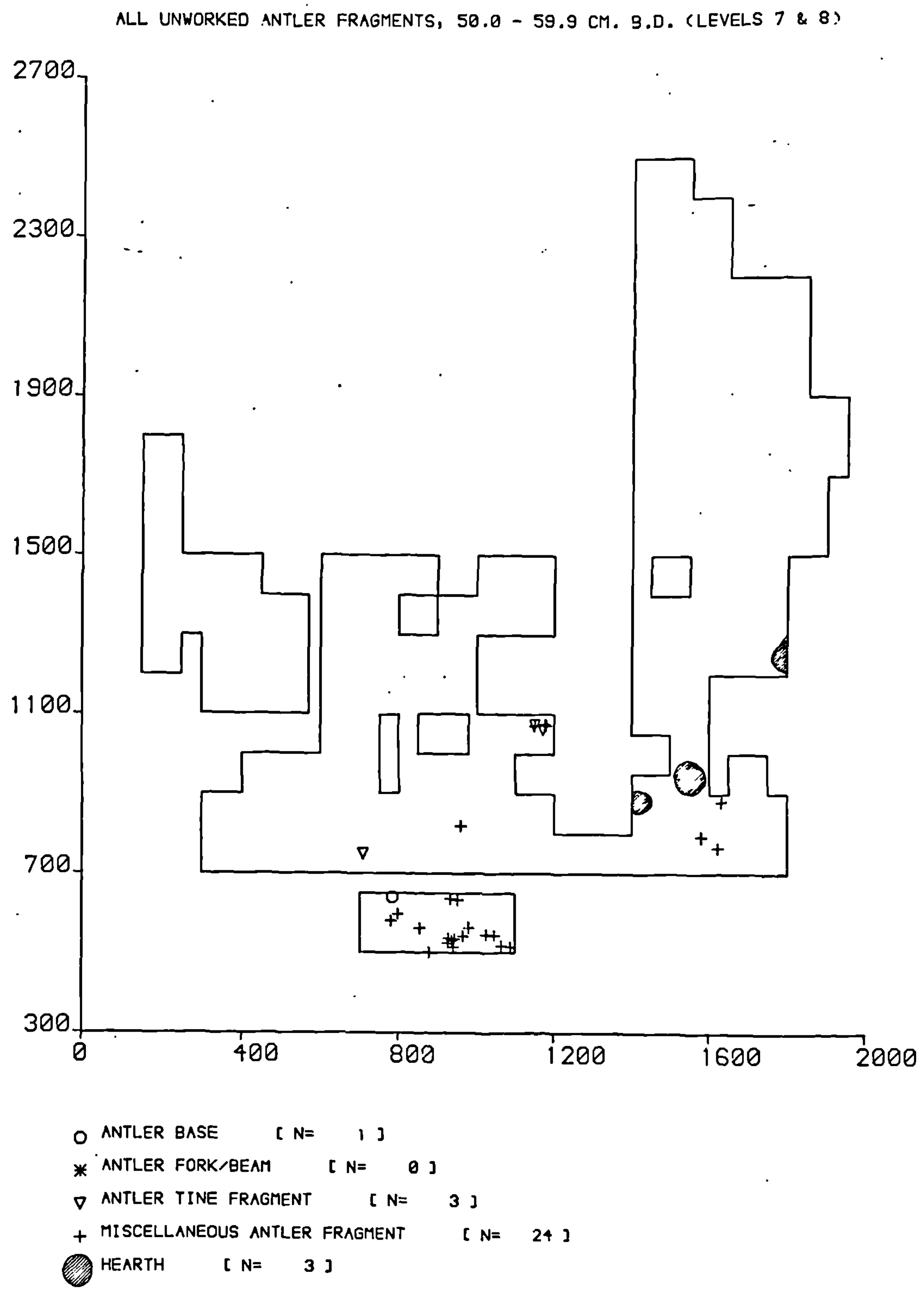

Figure 177. Horizontal Plot Showing the Distribution of All Unworked Antler Fragments in Levels 7 and 8.

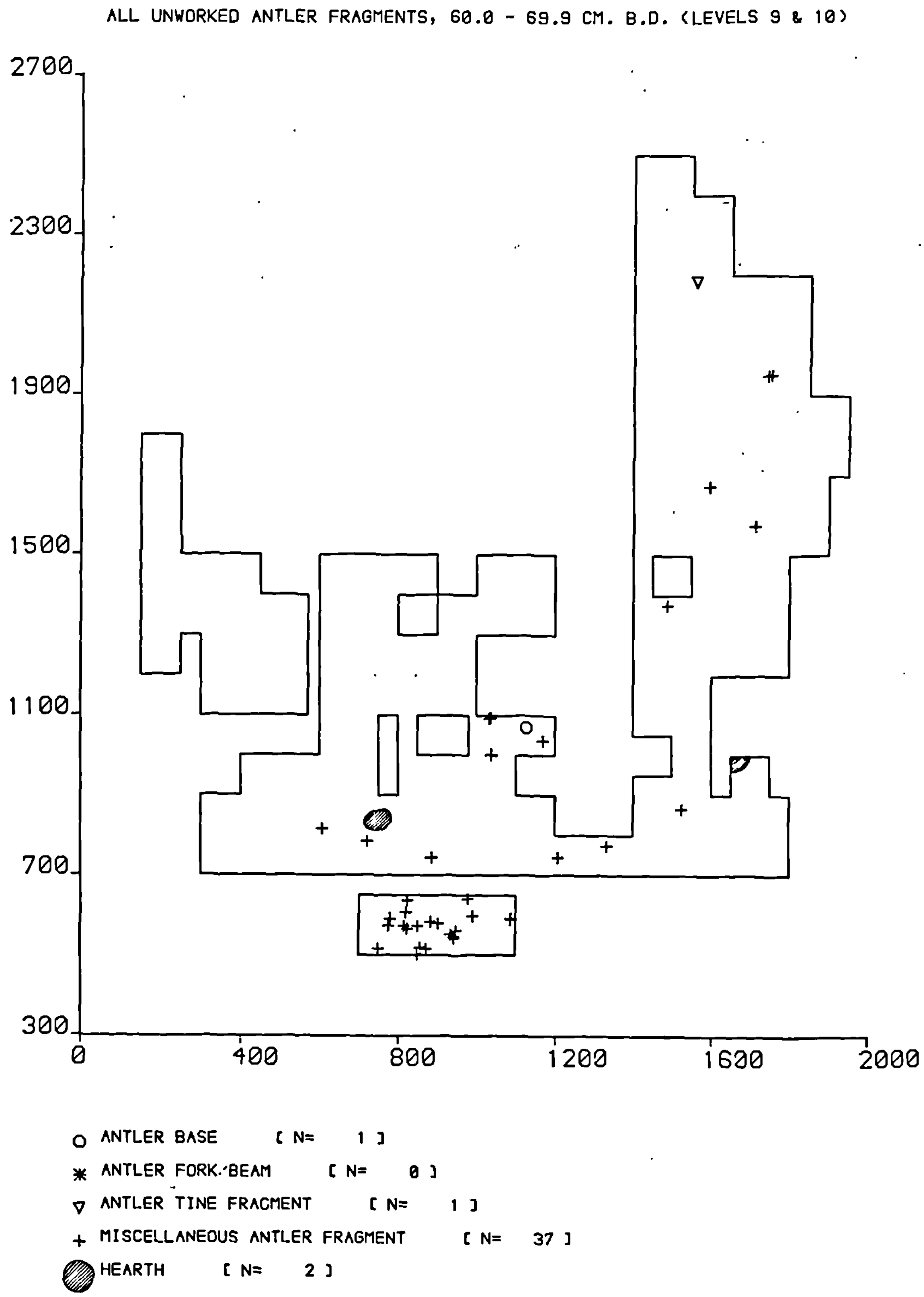

Figure 178. Horizontal Plot Showing the Distribution of All Unworked Antler Fragments in Levels 9 and 10.

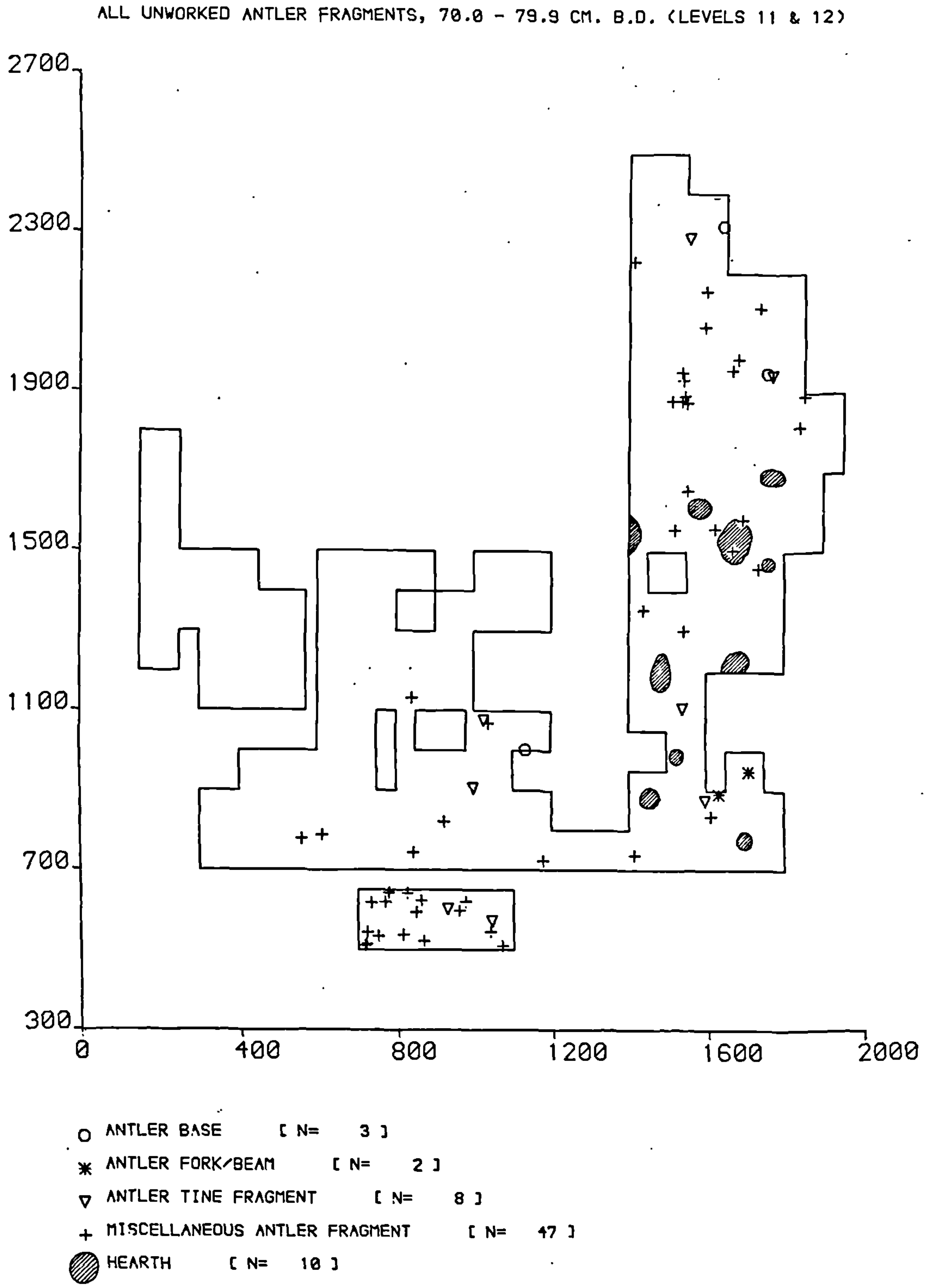

Figure 179. Horizontal Plot Showing the Distribution of All Unworked Antler Fragments in Levels 11 and 12.

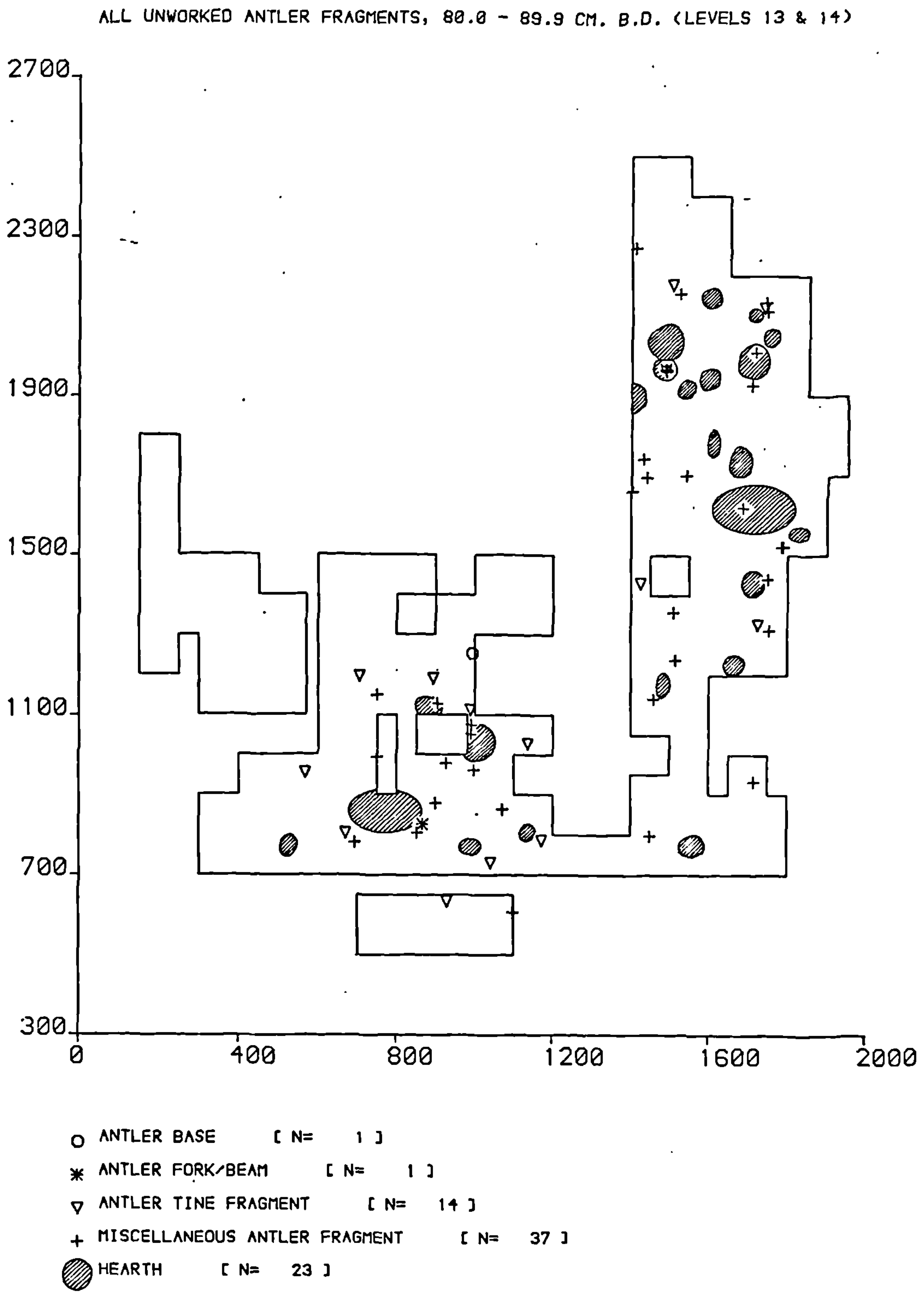

Figure 180. Horizontal Plot Showing the Distribution of All Unworked Antler Fragments in Levels 13 and 14.

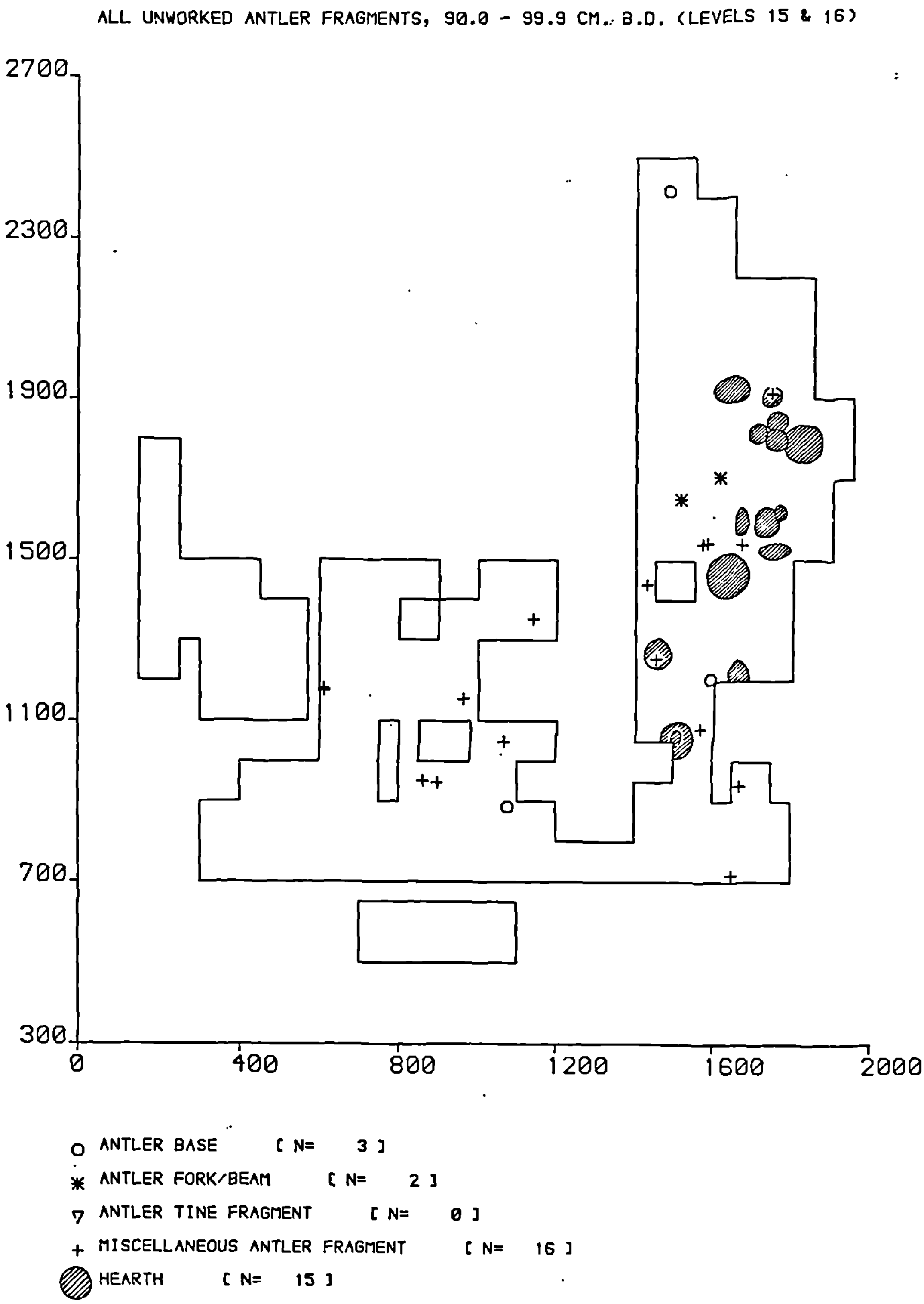

Figure 181. Horizontal Plot Showing the Distribution of All Unworked Antler Fragments in Levels 15 and 16.

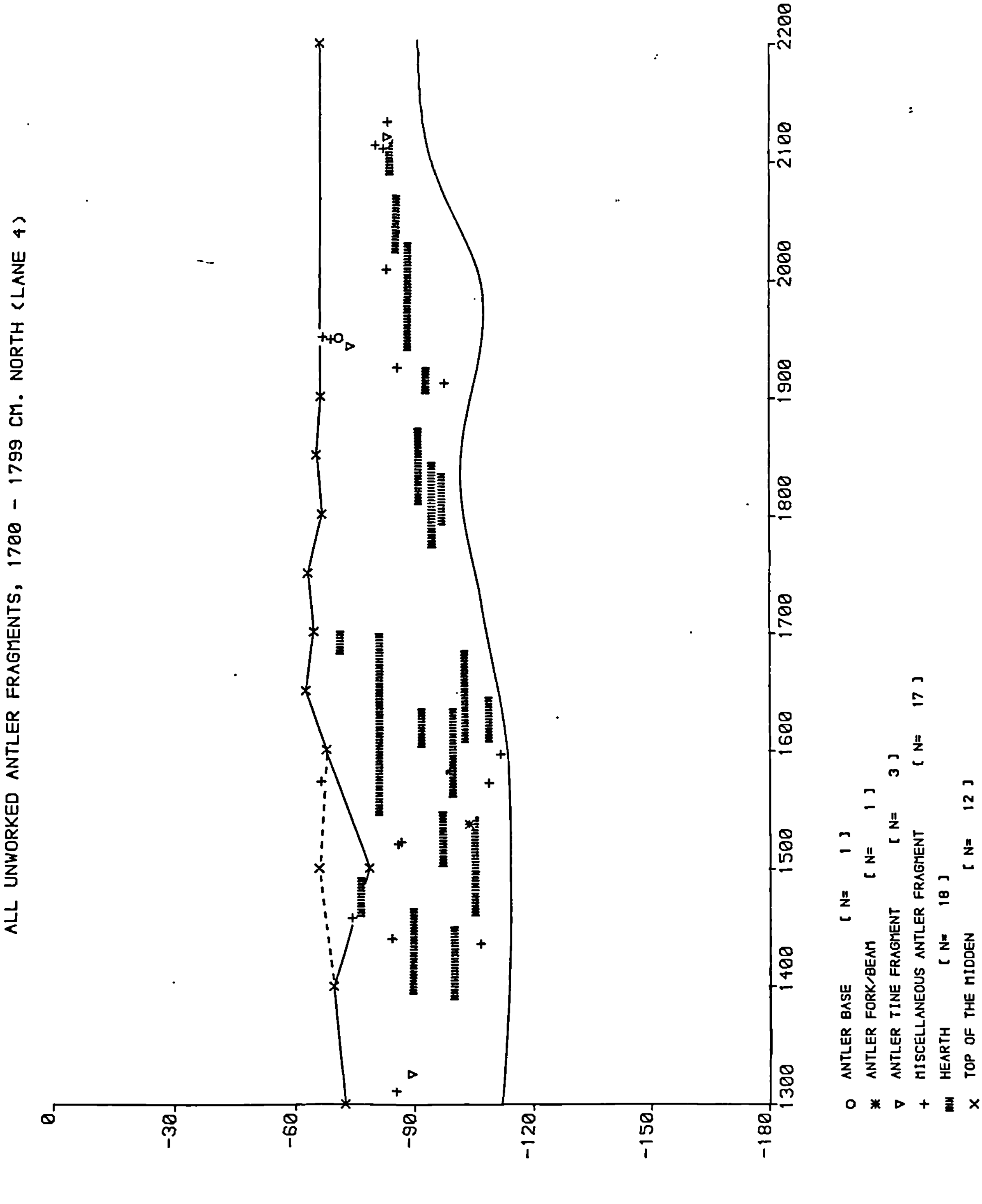

Figure 182. Sectional Plot Showing the Distribution of All Unworked Antler Fragments in Lane 4 (Western Half).

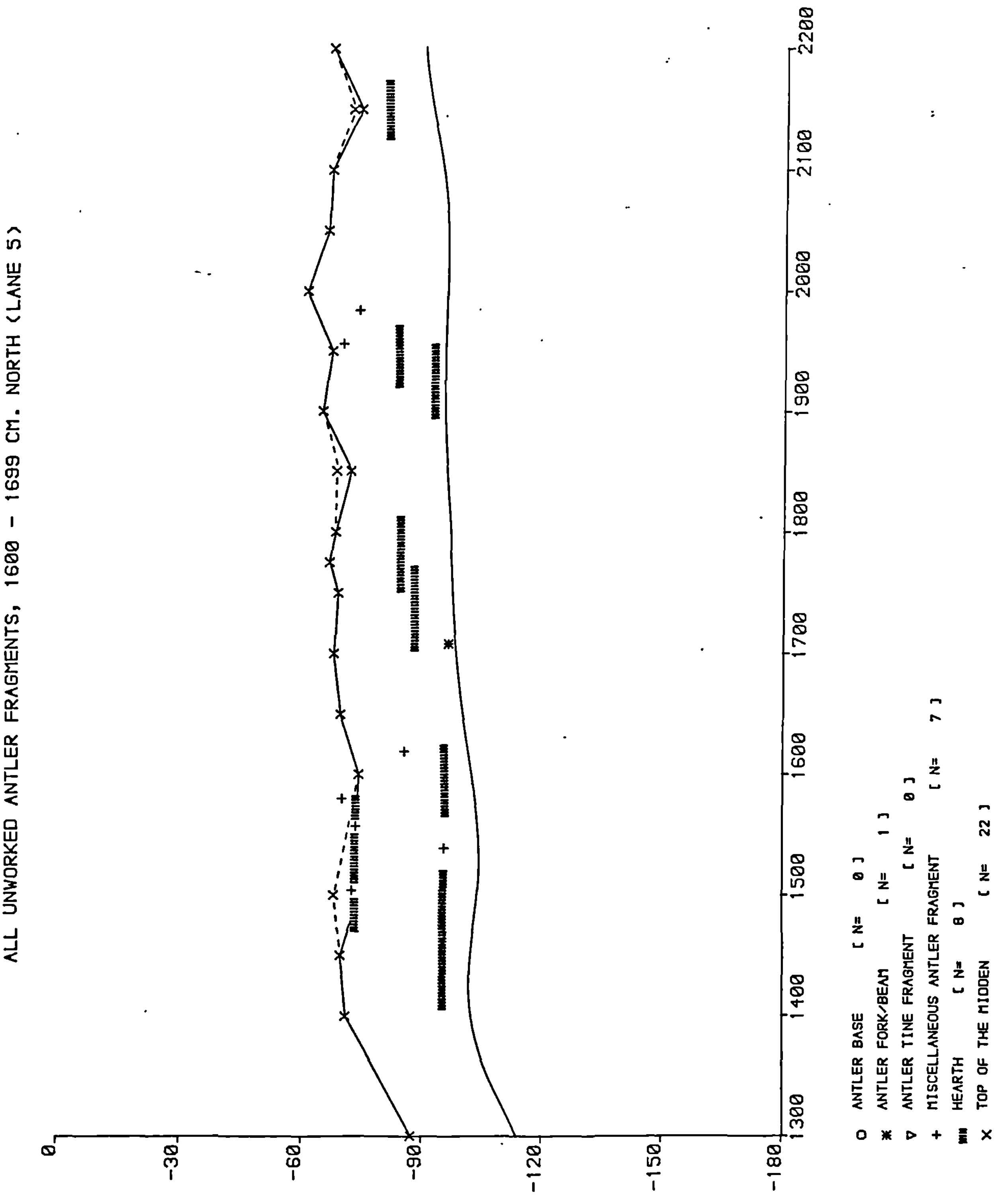

Figure 183. Sectional Plot Showing the Distribution of All Unworked Antler Fragments in Lane 5 (Western Half).

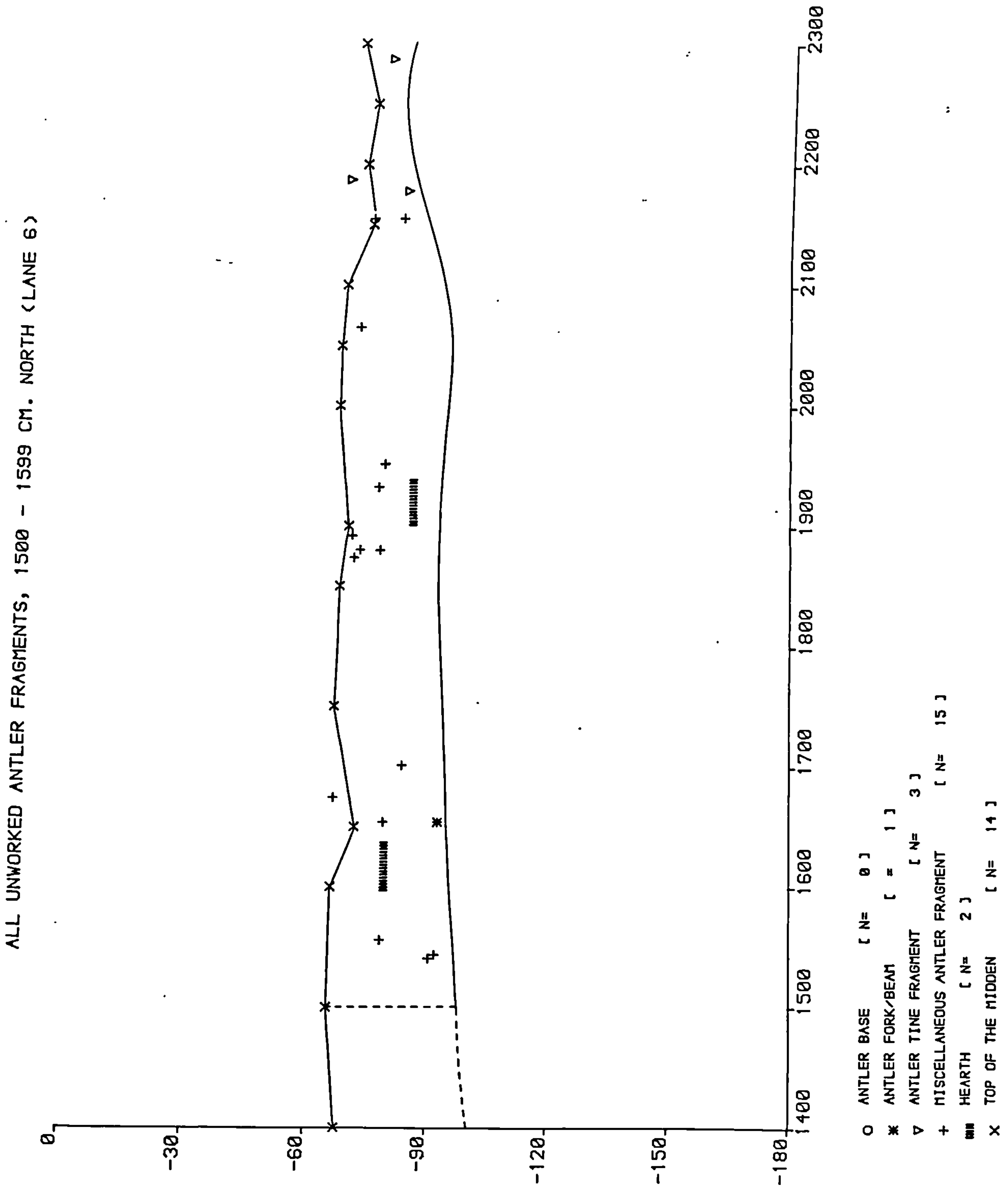

Figure 184. Sectional Plot Showing the Distribution of All Unworked Antler Fragments in Lane 6 (Western Half).

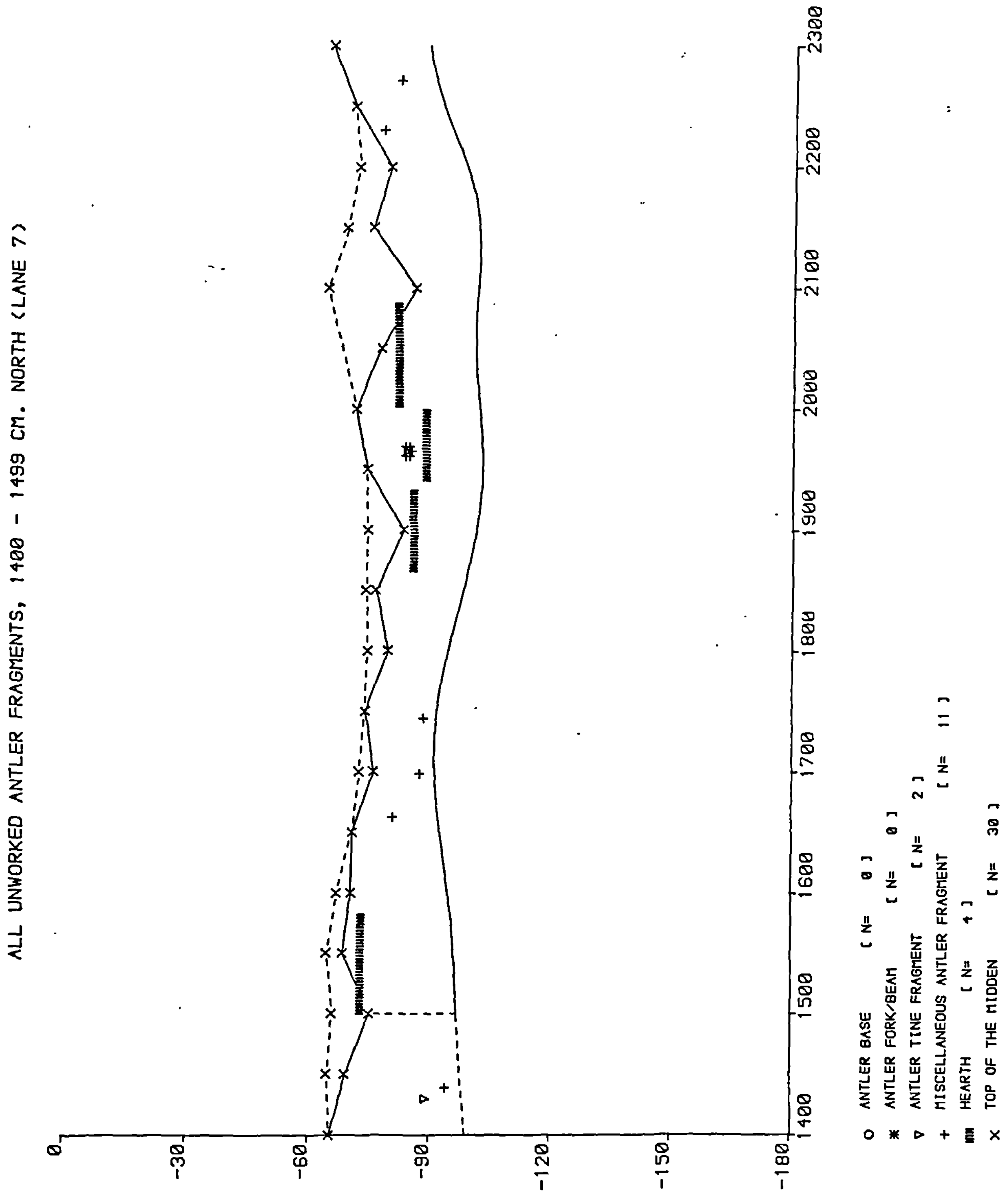

Figure 185. Sectional Plot Showing the Distribution of All Unworked Antler Fragments in Lane 7 (Western Half).

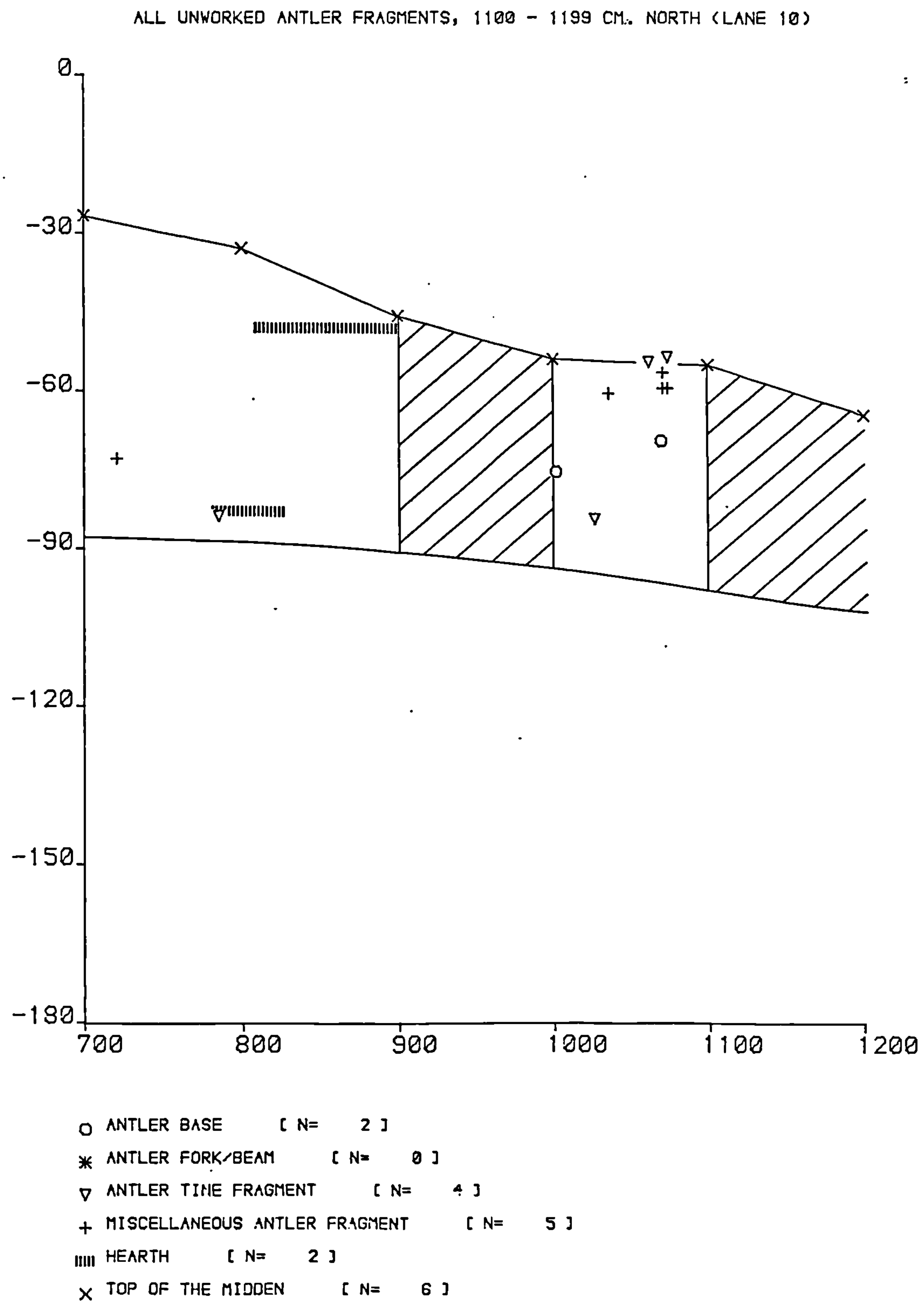

Figure 186. Sectional Plot Showing the Distribution of All Unworked Antler Fragments in Lane 10 (Eastern Half).

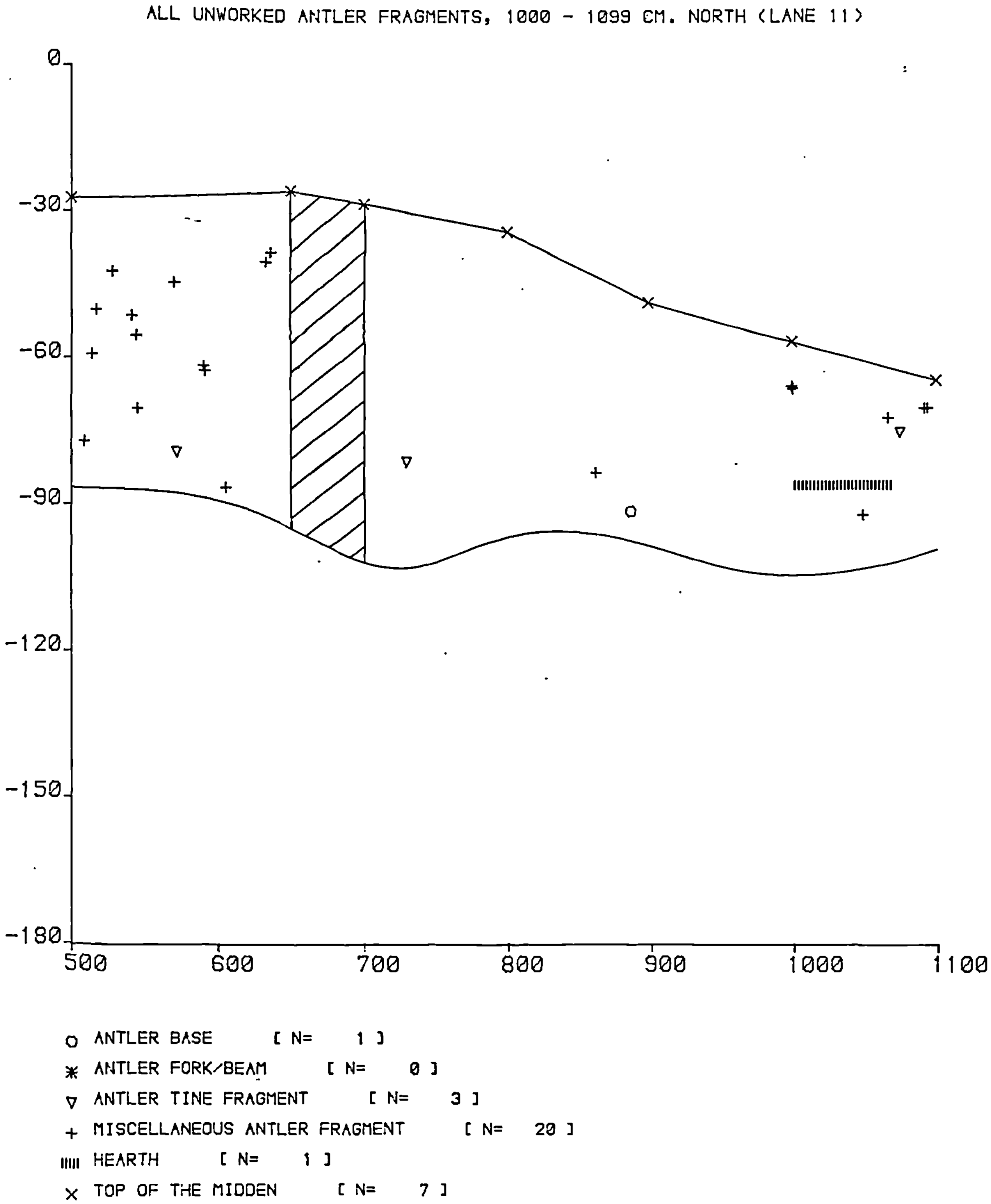

Figure 187. Sectional Plot Showing the Distribution of All Unworked Antler Fragments in Lane 11 (Eastern Half).

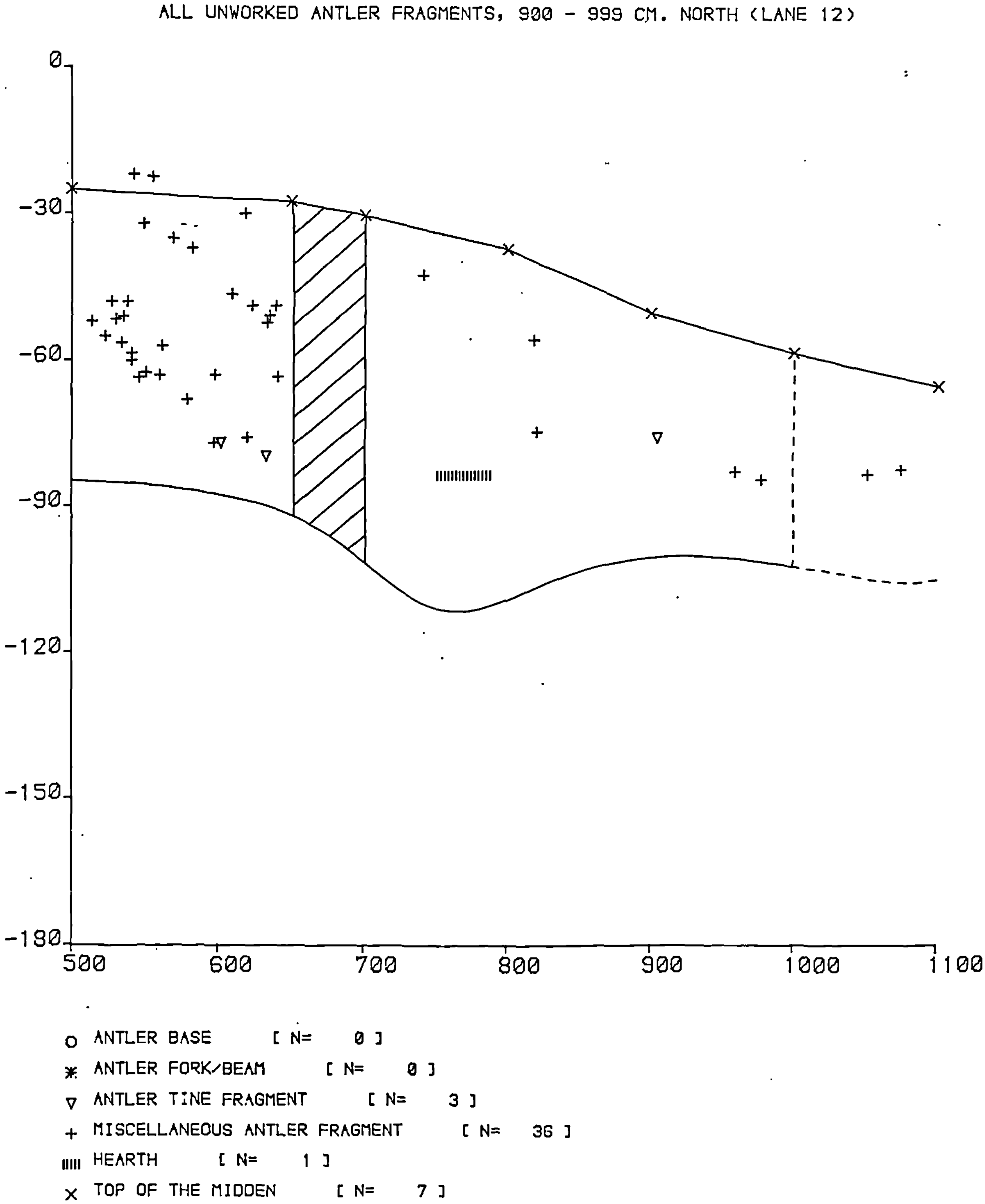

Figure 188. Sectional Plot Showing the Distribution of All Unworked Antler Fragments in Lane 12 (Eastern Half).

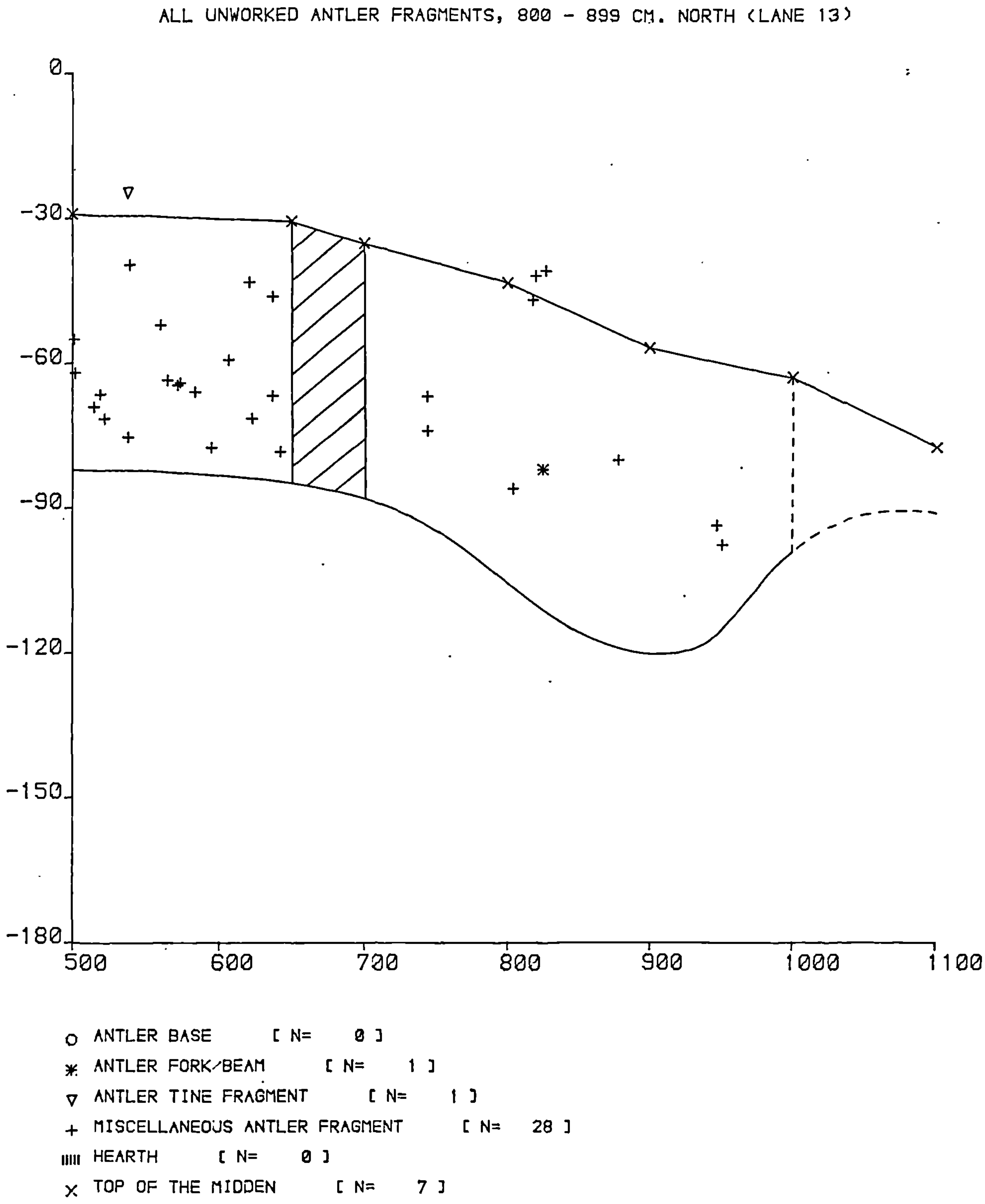

Figure 189. Sectional Plot Showing the Distribution of All Unworked Antler Fragments in Lane 13 (Eastern Half).

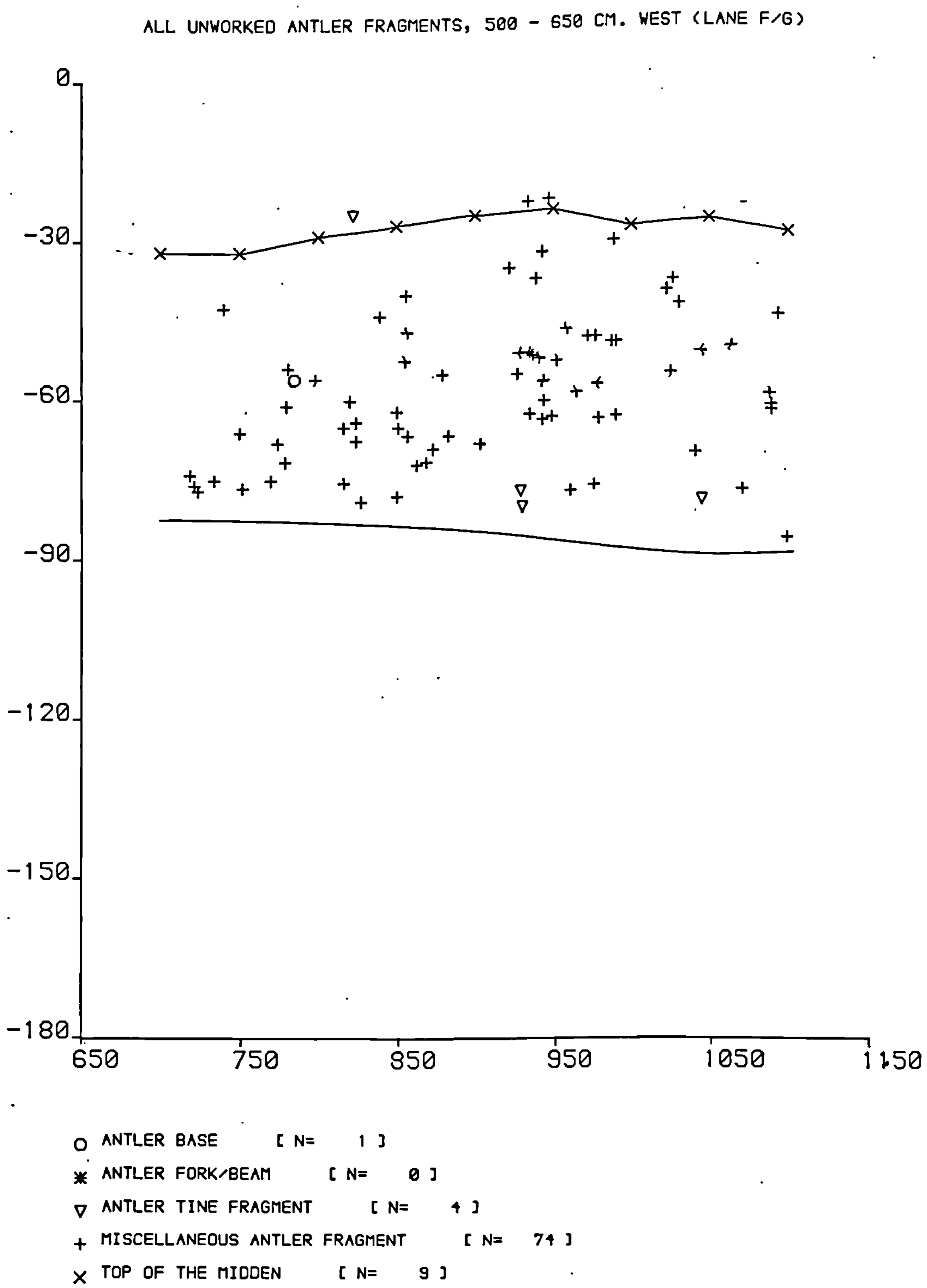

Figure 190. Sectional Plot Showing the Distribution of All Unworked Antler Fragments in Lane F/G.

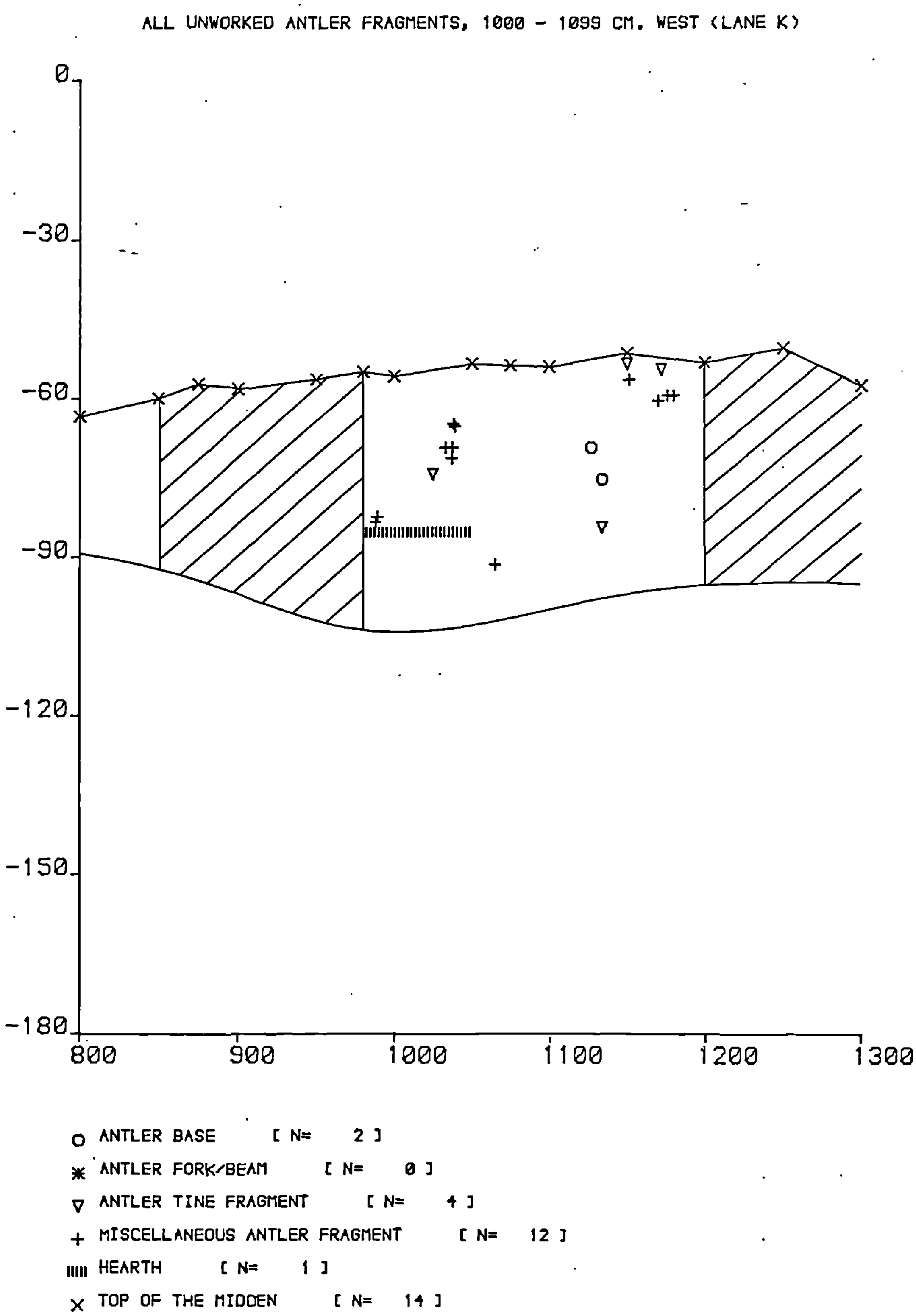

Figure 191. Sectional Plot Showing the Distribution of All Unworked Antler Fragments in Lane K (Central One-Third).

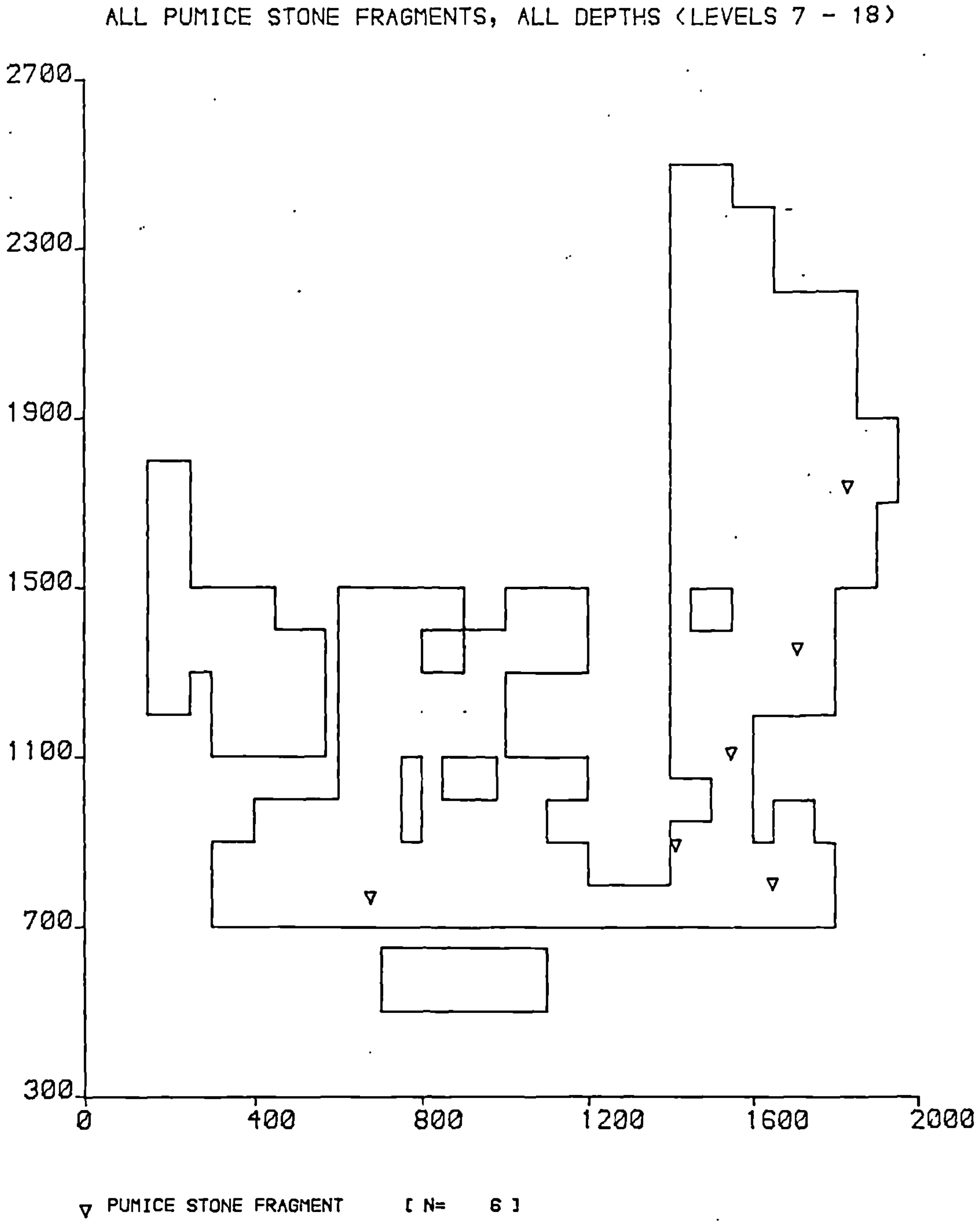

Figure 192. Horizontal Plot Showing the Distribution of All Pumice Stone Fragments in All Levels.

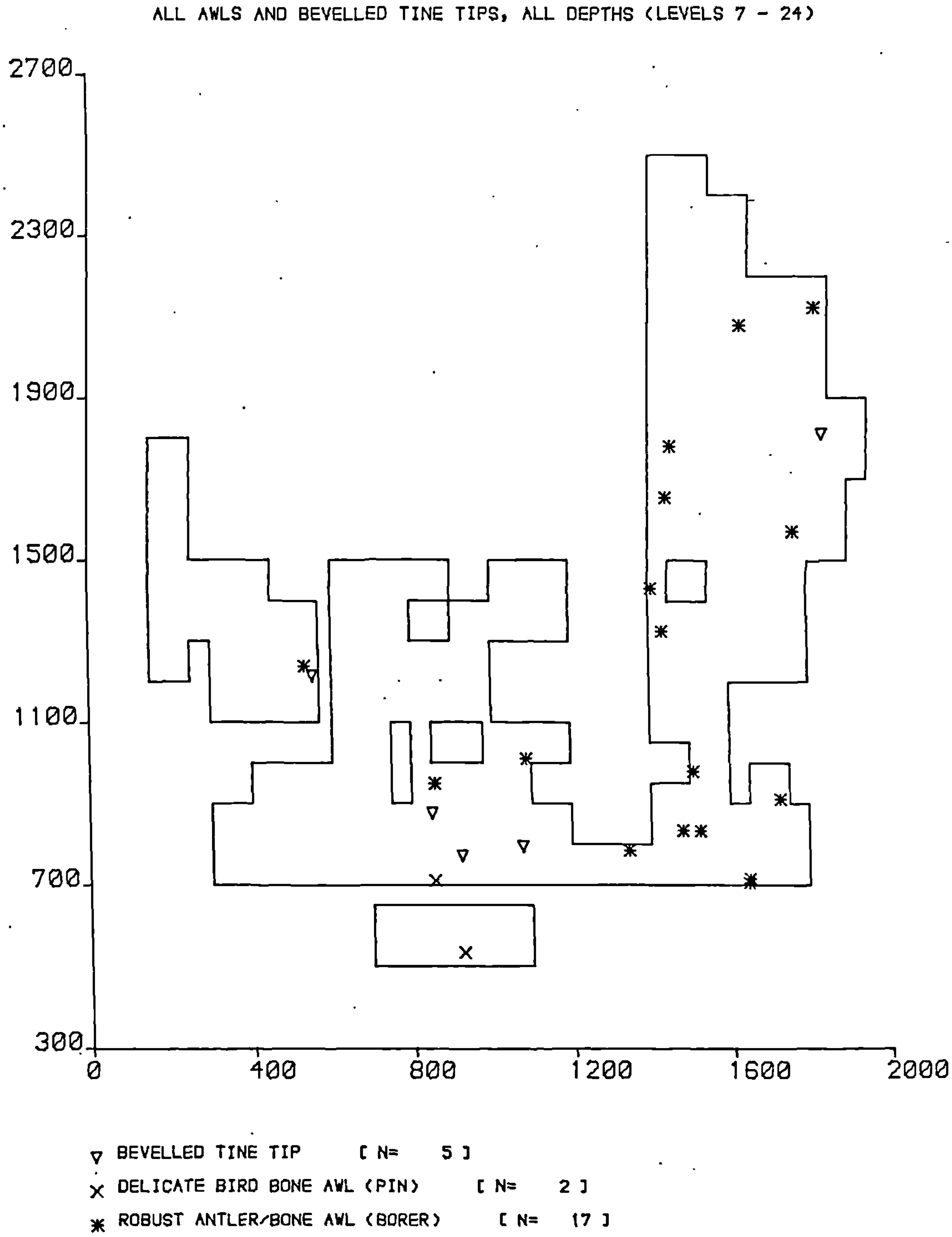

Figure 193. Horizontal Plot Showing the Distribution of All Bevelled Tine Tips and Awls in All Levels.

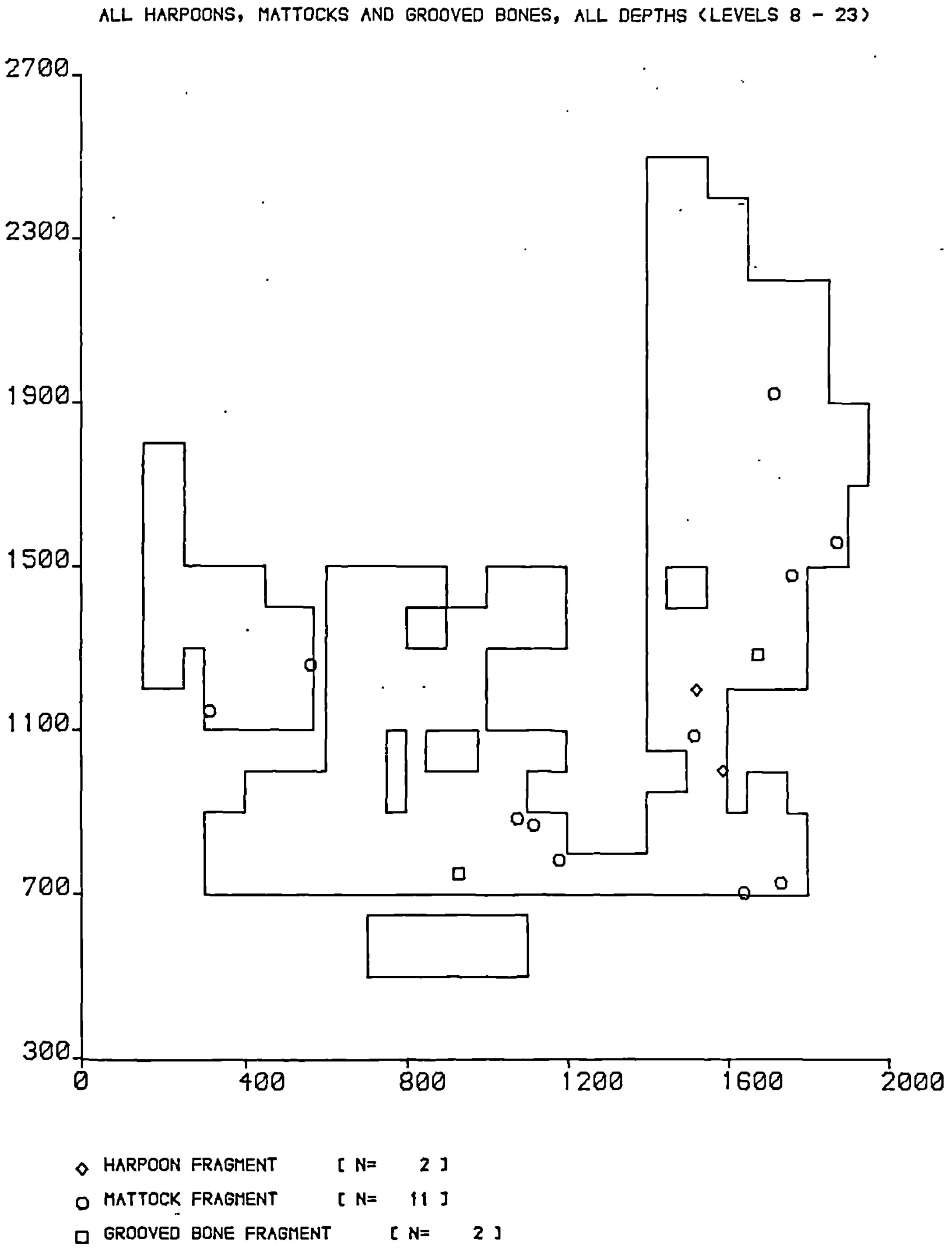

Figure 194. Horizontal Plot Showing the Distribution of All Harpoon, Mattock and Grooved Bone Fragments in All Levels.

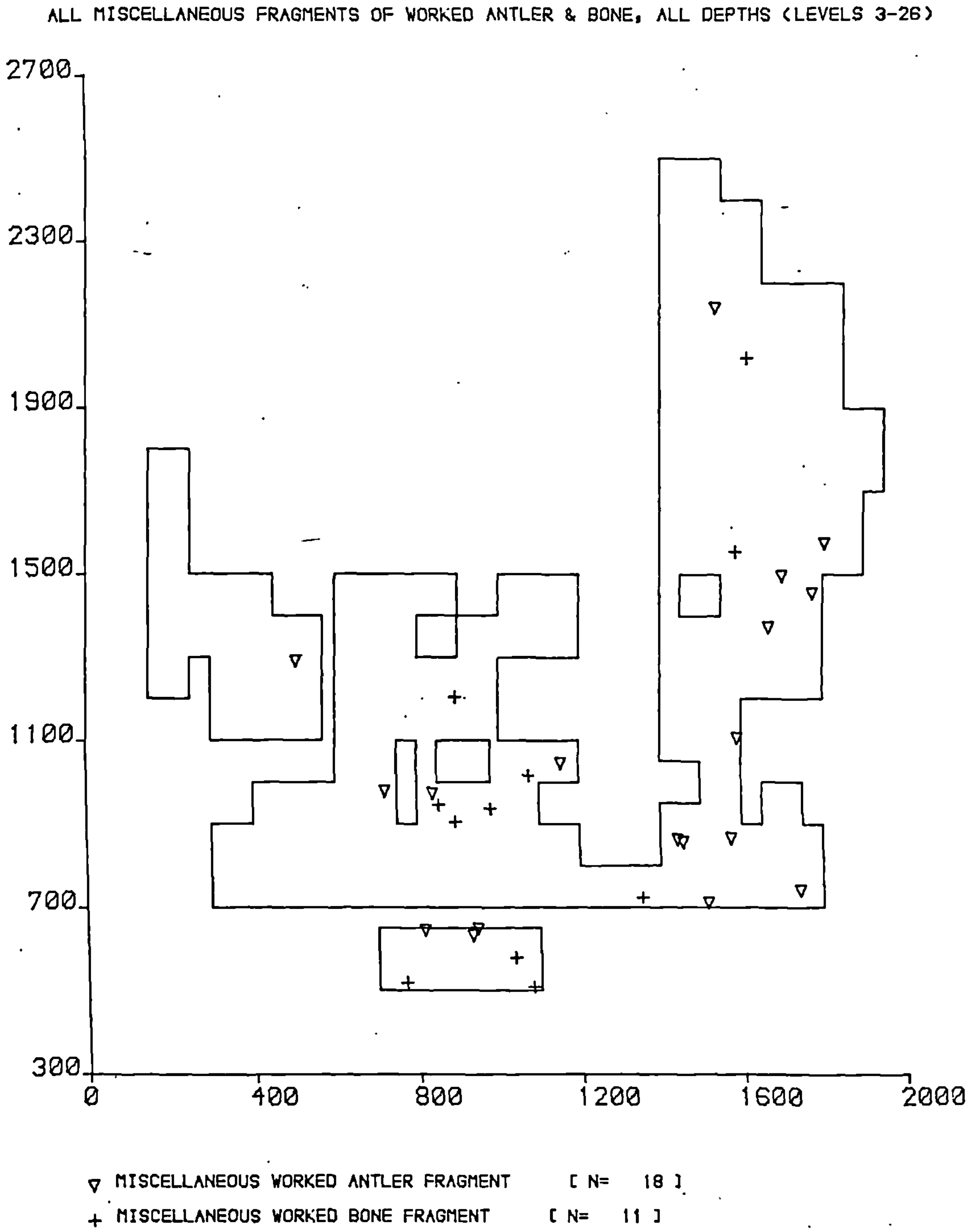

Figure 195. Horizontal Plot Showing the Distribution of All Miscellaneous Fragments of Worked Antler and Bone in All Levels.

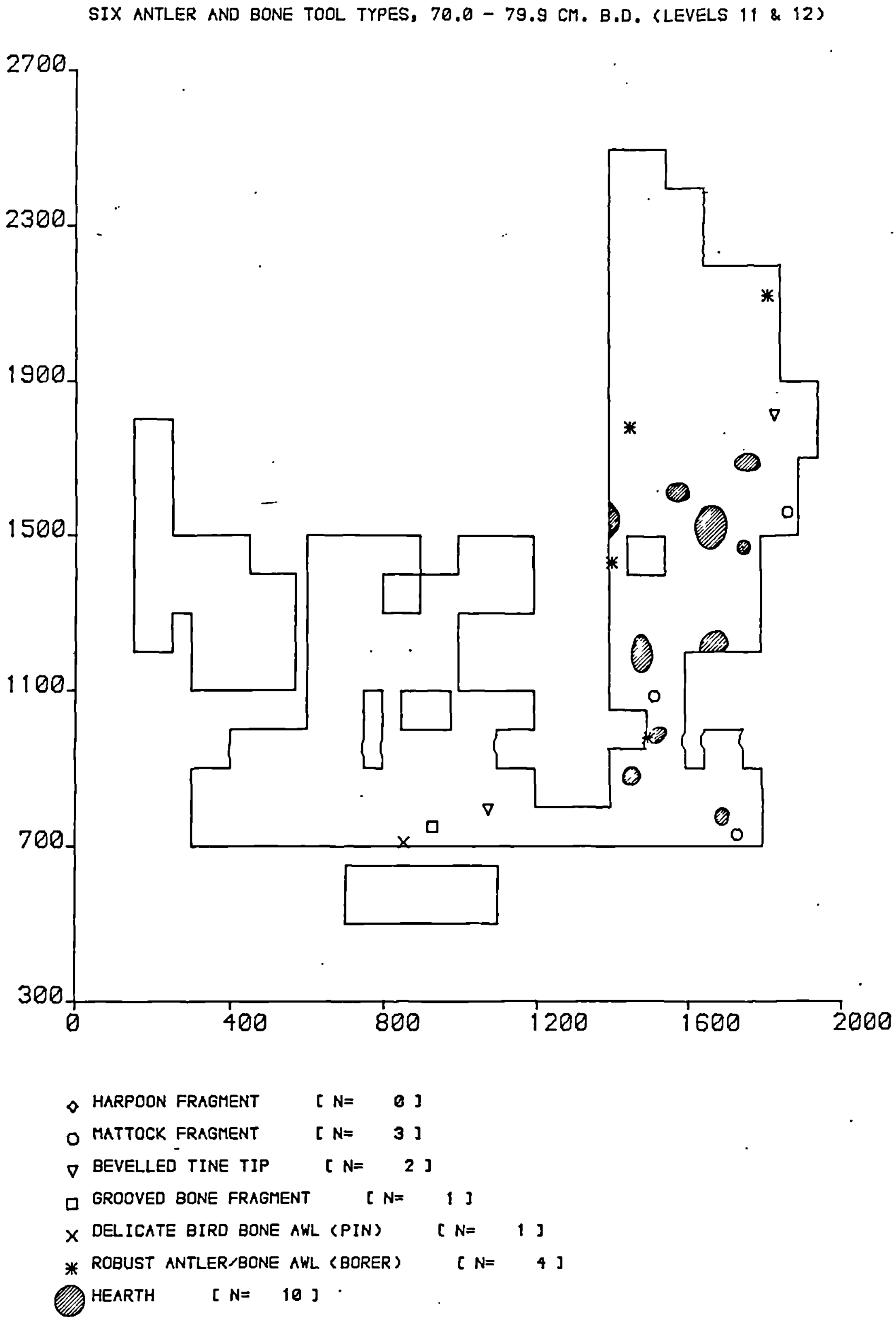

Figure 196. Horizontal Plot Showing the Distribution of All Finds of Six Antler and Bone Tool Types in Levels 11 and 12.

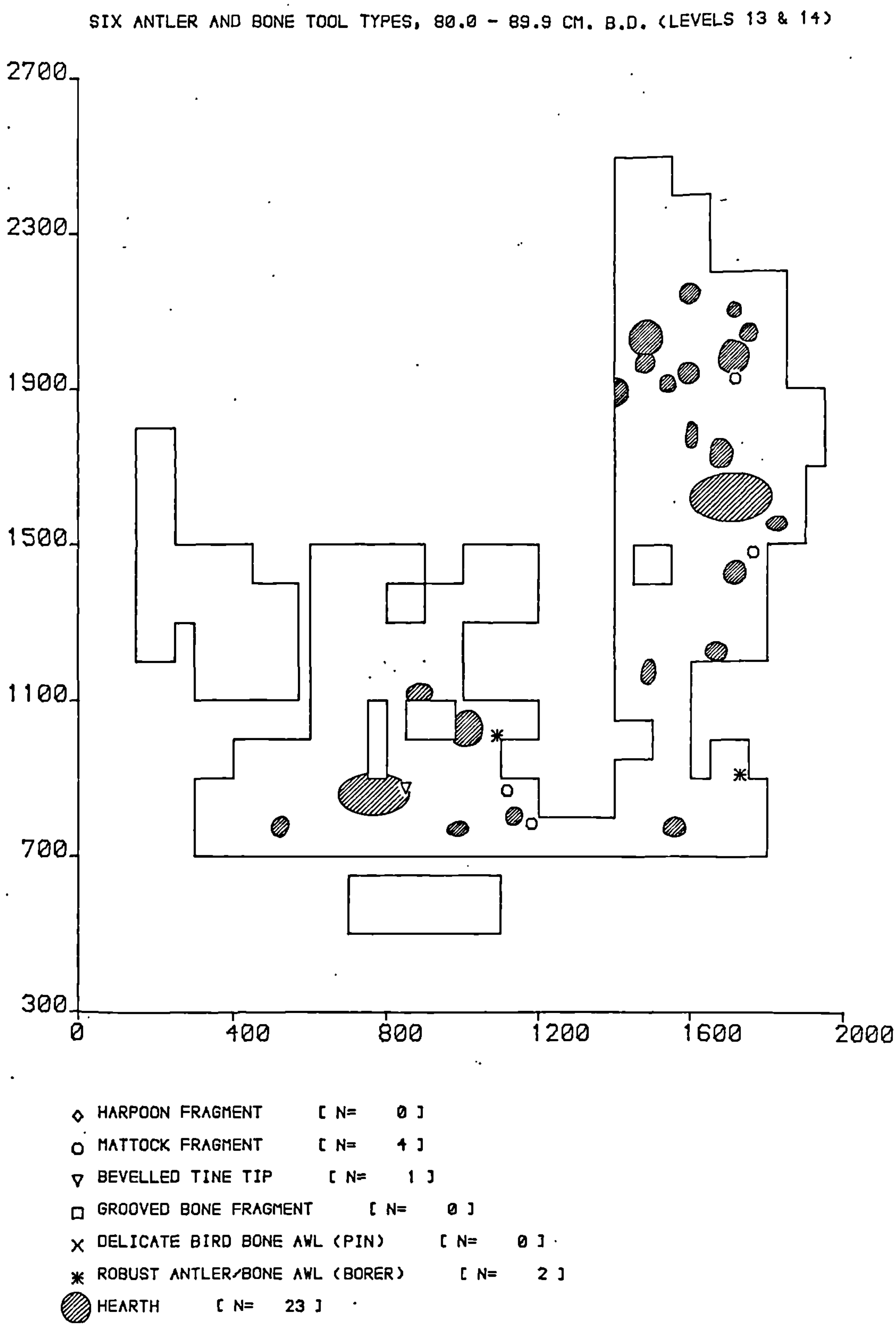

Figure 197. Horizontal Plot Showing the Distribution of All Finds of Six Antler and Bone Tool Types in Levels 13 and 14.

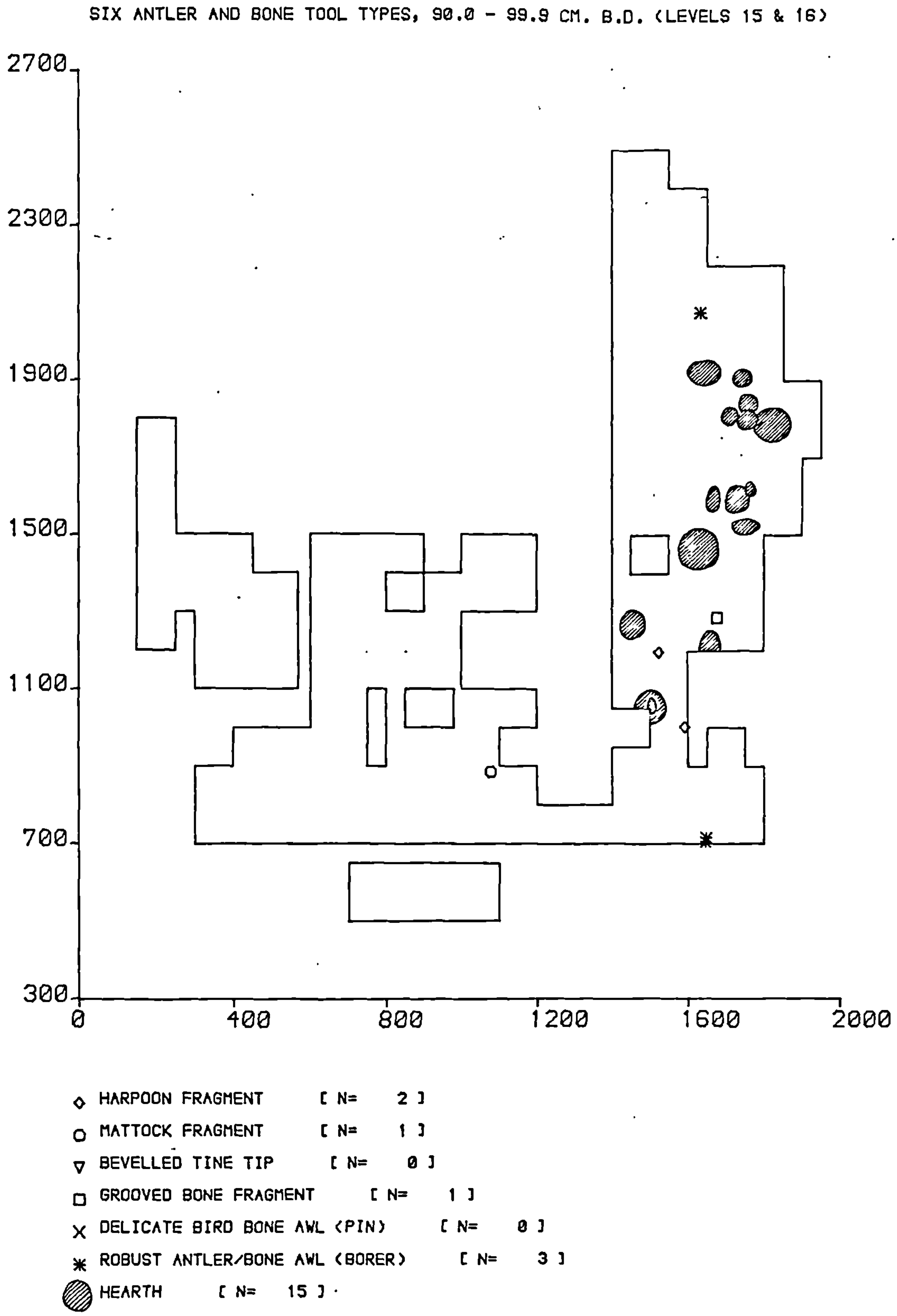

Figure 198. Horizontal Plot Showing the Distribution of All Finds of Six Antler and Bone Tool Types in Levels 15 and 16.

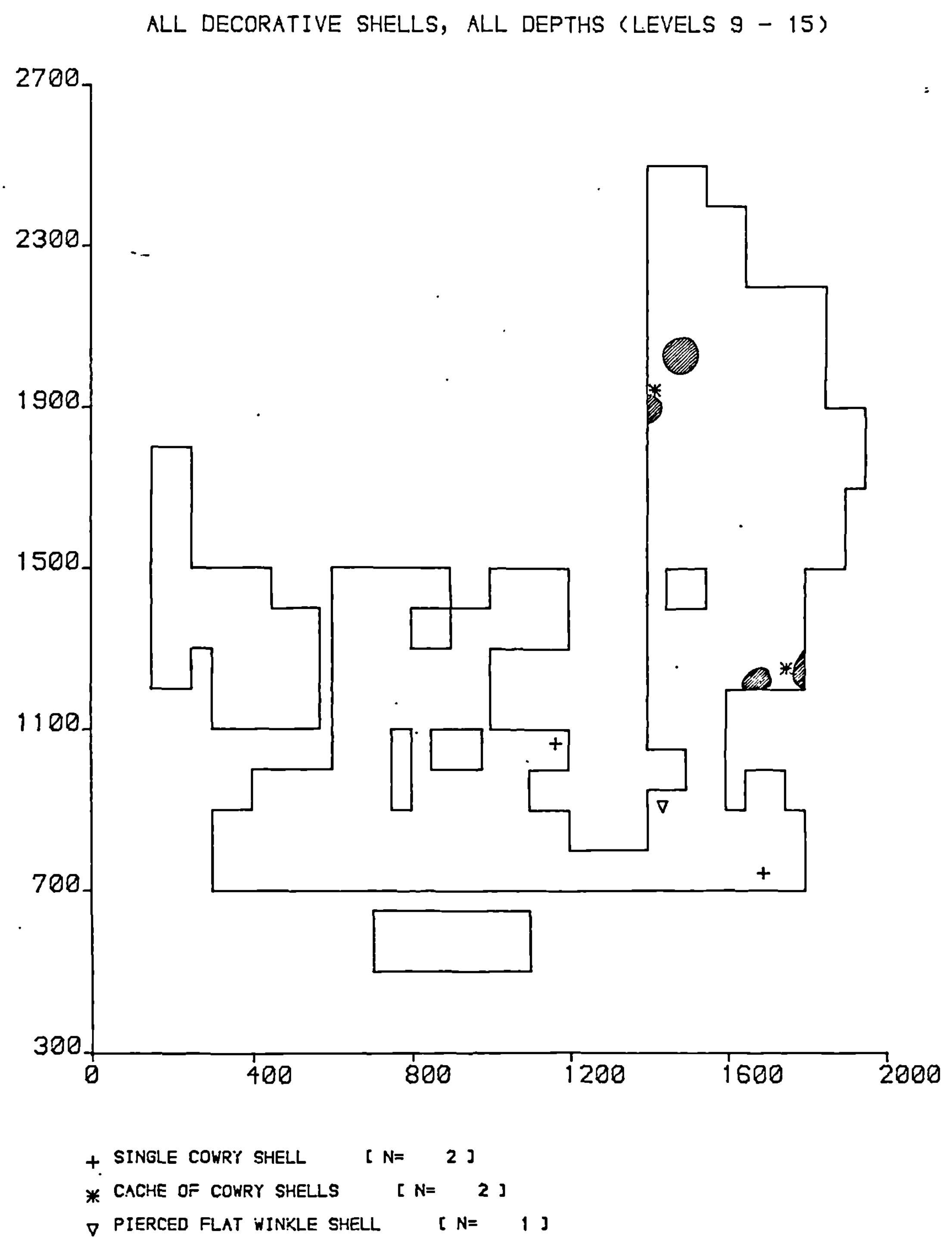

Figure 199. Horizontal Plot Showing the Distribution of All Decorative Shells in All Levels.

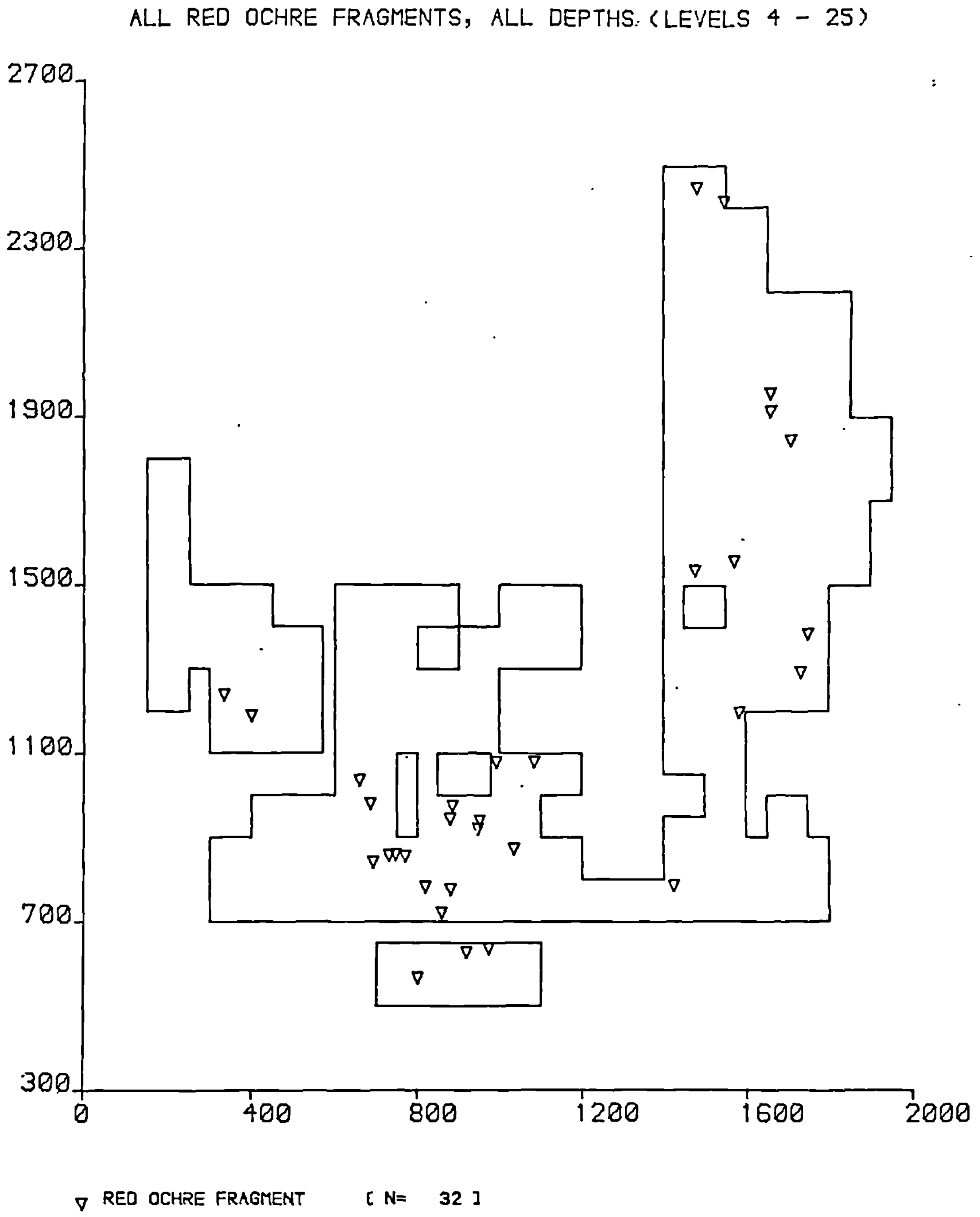

Figure 200. Horizontal Plot Showing the Distribution of All Red Ochre Fragments in All Levels.

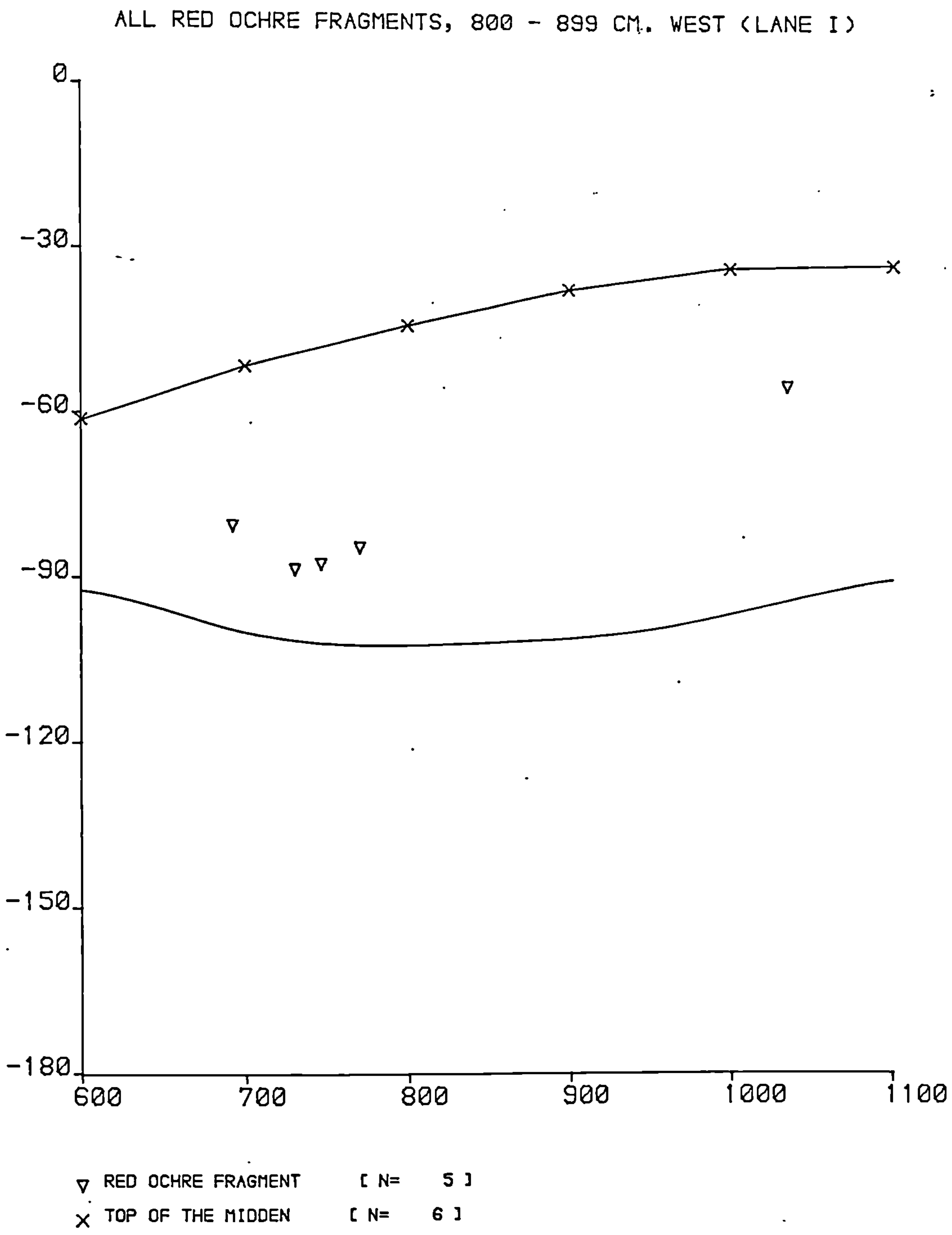

Figure 201. Sectional Plot Showing the Distribution of Red Ochre Fragments in Lane I (South-Central One-Third).

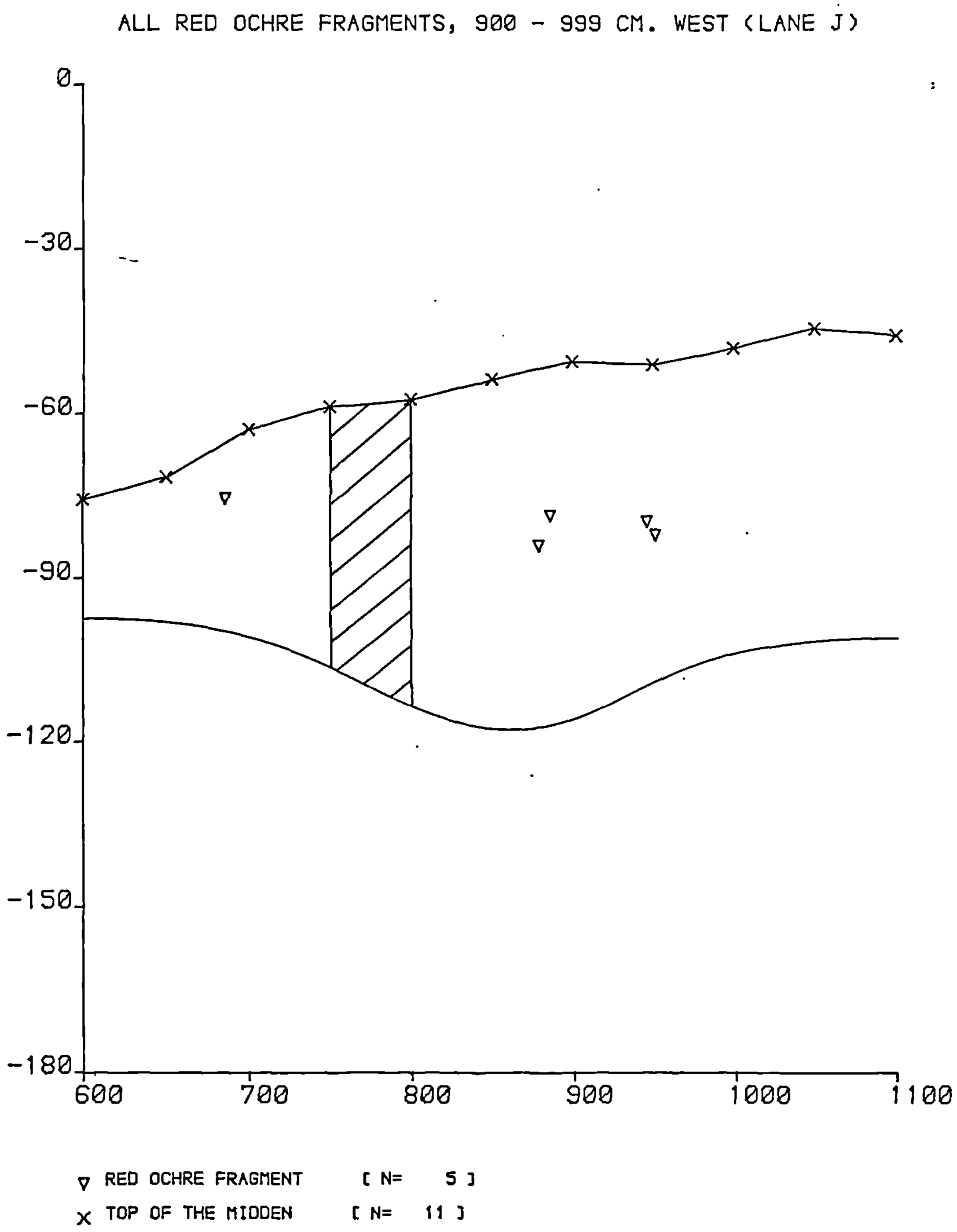

Figure 202. Sectional Plot Showing the Distribution of Red Ochre Fragments in Lane J (South-Central One-Third).

Plate 1. Two Stone Limpet Hammers from Cnoc Coig.
Photograph courtesy of P. A. Mellars.

Plate 2. Two Pitted Pebbles from Cnoc Coig. Photograph courtesy of P. A. Mellars.

Plate 3. Breaking Open a Dog Whelk Using a Hammerstone and an Anvilstone (Nos. 32 & 31).

Plate 4. Experimental Anvilstone and Hammerstone Used to Break Open Dog Whelks (Nos. 31 & 32).

Plate 5. Detaching a Limpet from a Rock Using a Stone Limpet Hammer (No. 35).

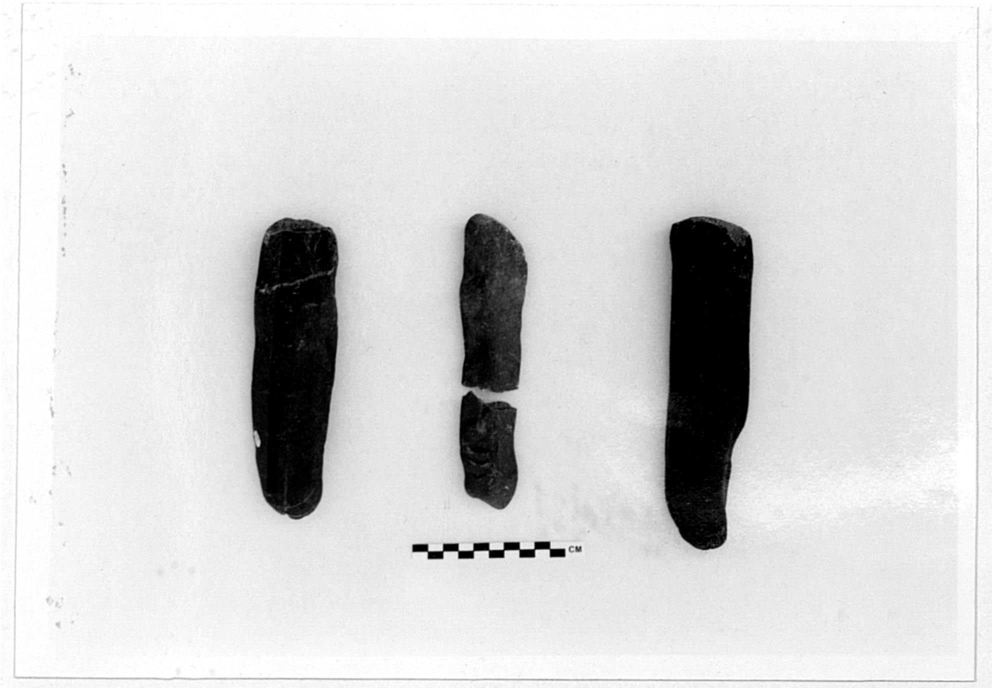

Plate 6. Three of the Experimental Stone Limpet Hammers After Use Showing the Resulting Damage to the Utilized Ends (left to right: Nos. 35, 36 & 39).

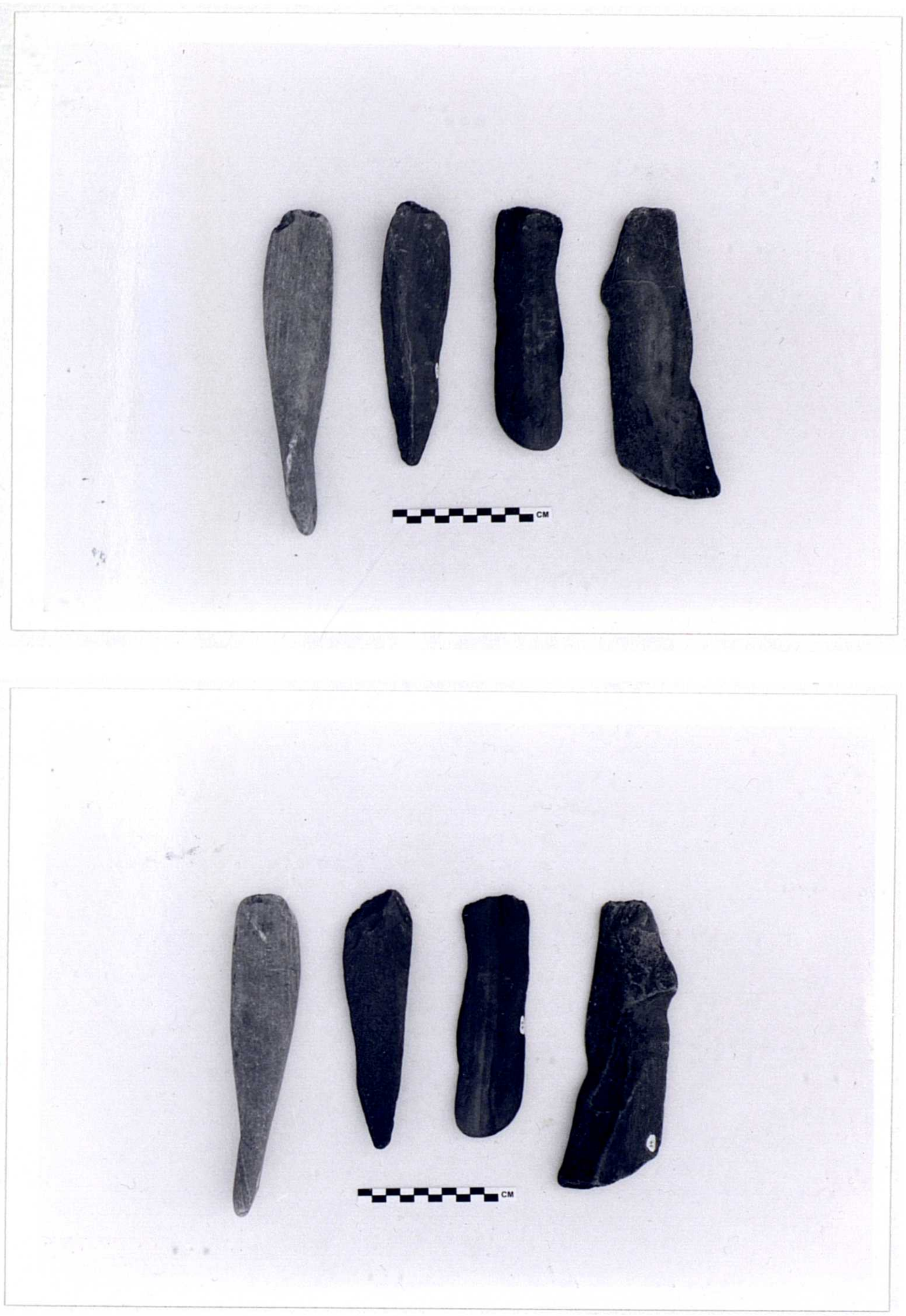

Plate 7. Four of the Experimental Stone Limpet Hammers After Use Showing the Resulting Damage to the Utilized Ends (left to right: Nos. 37, 38, 33 & 34).

Plate 8. Grinding Elongated Beach Pebbles into Stone Limpet Scoops (top: No. 14; bottom: No. 9).

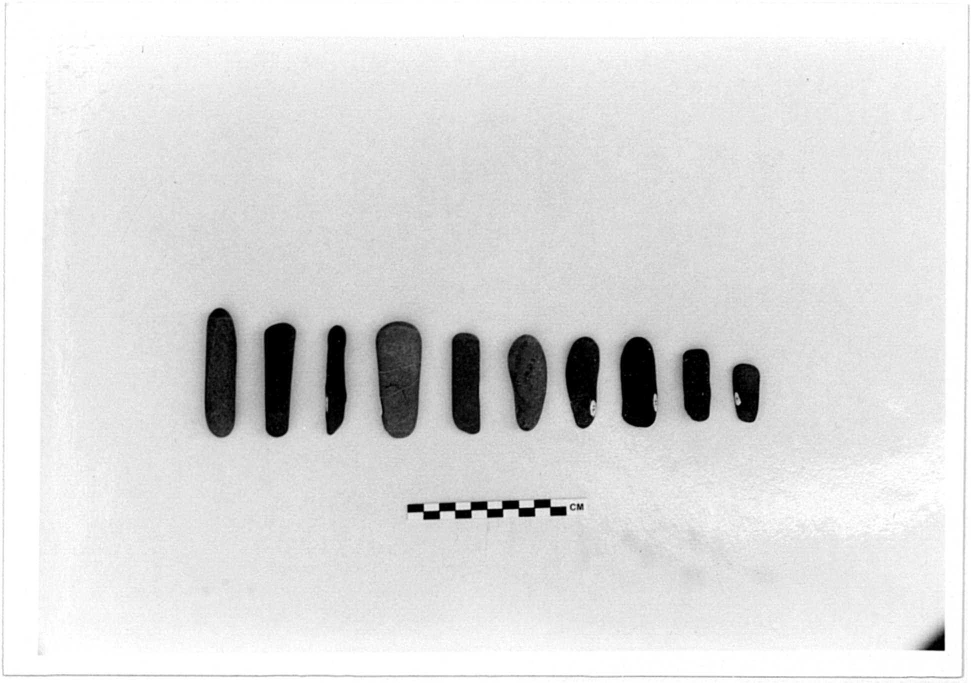

Plate 9. Ten of the Experimentally Ground Stone Limpet Scoops and Three of the Grindstones Used in Their Manufacture (top, left to right: Nos. 8, 9, 11, 10, 12, 17, 13, 14, 15 & 1; bottom, left to right: Nos. 30, 27 & 26).

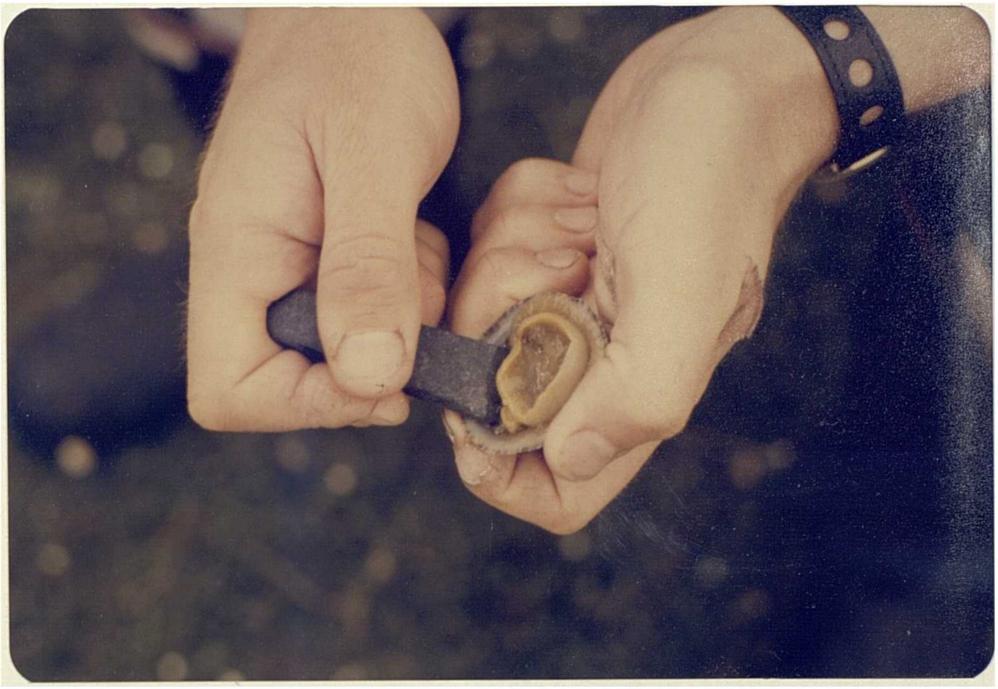

Plate 10. Removing a Limpet from its Shell Using a Stone Limpet Scoop (No. 9).