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ZONATION AND EXPOSURE ON BURRY HOLMS

Zonation and Exposure on the Rocky Shores around Burry Holms.

Contents

Errata

Throughout the text substitute the words Armeria maritima for Spergularia maritima.

List of Illustrations

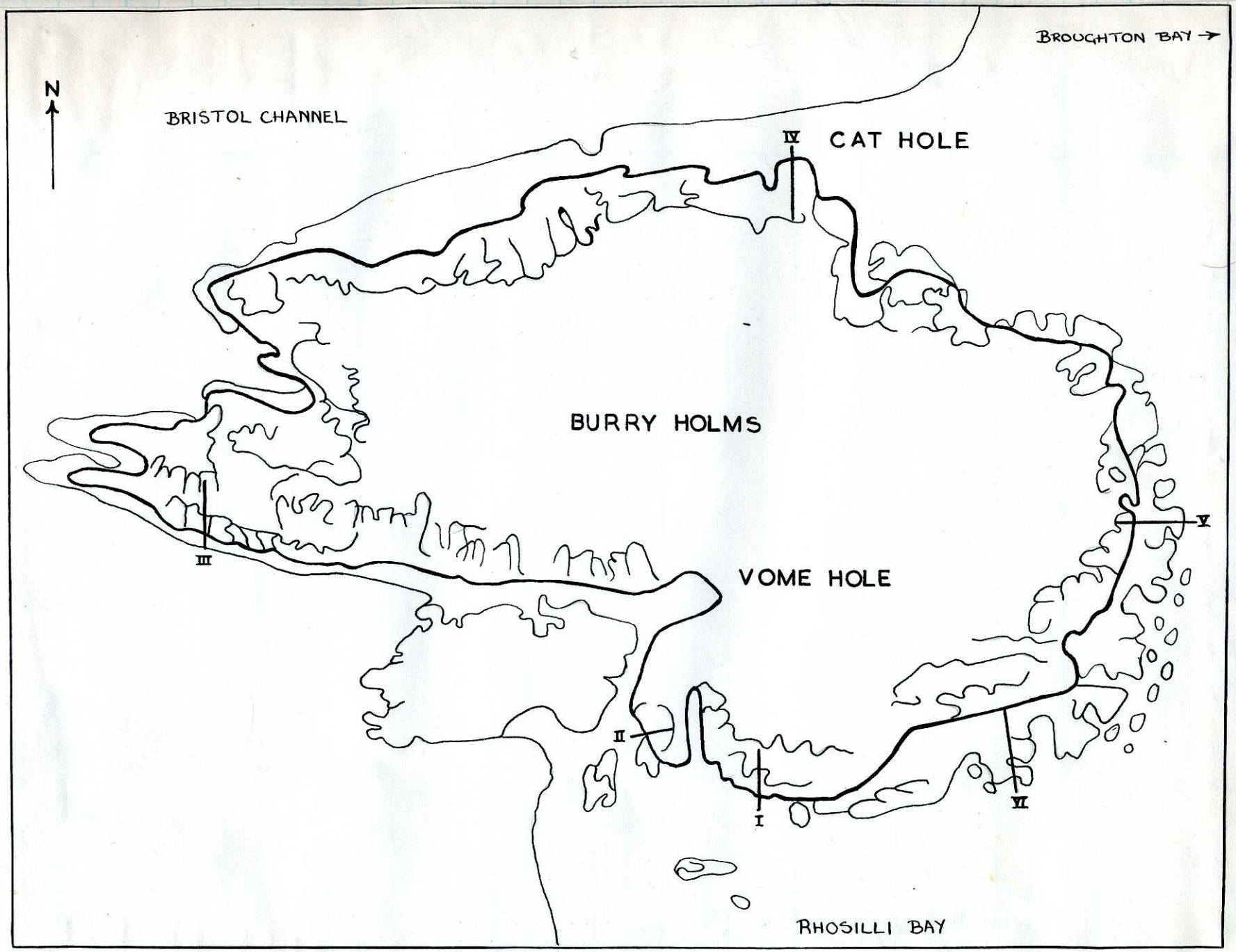


FIGURE 1 The Island Burry Holms

Zonation and Exposure around Burry Holms

Introduction and Topography of the Island.

Burry Holms is an island projecting into the Bristol Channel from the tip of the Gower Peninsula in Glamorgan, South Wales. It is situated at the northernmost end of Rhossili Bay and marks the boundary between the latter and Broughton Bay. The island is composed of oolitic limestone and is separated from the mainland by a small, boulder-covered causeway. The geology of the island has a direct influence on the nature of the coastline and this in turn effects the fauna. Fissures in the rock (caused by faulting as shown by calcite crystals / where heat generated during movements has metamorphosed the rock) have been eroded back into small bays. In other places, vertical joints which are characteristic of limestone have been worn away with the same result. Bedding planes form steep, flat surfaces of the cliffs on the north and west of the island and transect II was made on such a bedding plane. There resulting coastline is, therefore, one of many inlets.

The island reaches an approximate height of 120 feet to the west, but height decreases in the east to about 40 feet. The cliffs of the west are steep and often almost vertical while on the east side, by the causeway, there is only a gentle incline. On the west and south west parts of the island coast "solution hollows" are common. These are deep bowls in the solid rock which have been eroded by the weak carbonic acid solution in rain and sea water. The erosion may be aided by the abrading process of pebbles and stones tossed

around by turbulence when the tide covers the hollows. These water-filled hollows are often inhabited by their own typical fauna which prefers this more sheltered environment.

At low water of spring tides (LWST) the south west part of the island is uncovered down to the point at which the sand meets the rocks for a few minutes, but on the west and northwest during the period of the survey the tide never wholly uncovered the base of the cliff. At high tide the island is cut off from the mainland but at low tide the causeway is uncovered to allow free access to Barry Holms.

To the south west is an area of rocks which was rarely accessible because high winds caused waves to break over them on most days during the survey. However, it was possible on the last and calmest day to climb down to these rocks on which fauna proved to be more abundant than on any other part of the island. It must be borne in mind, though, that this area is atypical of the shores of the island because it is separated from the island, is rarely uncovered by the tide, is a relatively sheltered inlet south of a promontary and the crevices and hollows are so deeply eroded by wave action that Laminarians grow in the pools providing cover for fairly large fish.

The aim of the studies on Barry Holms was to determine what species live on an exposed type of coastline. The most common sessile plants and animals on the rocky and stony shores were recorded on transects which were chosen because they were considered to be representative of the variations in shore type and fauna around the island.

The choice of points on the coastline for the siting of the transects was, however, affected by their accessibility. For example, the first 6 feet of transect III was inaccessible because rough sea and high winds prevailed on the days Burry Holms was surveyed during mid-October. Also some of the rock faces were too steep to work on. The first three transects (I, II, III) were the steepest, as one would expect on the west of the island; and V & VI were the gentlest transects. IV was of an intermediate gradient.

Gradients of the six transects

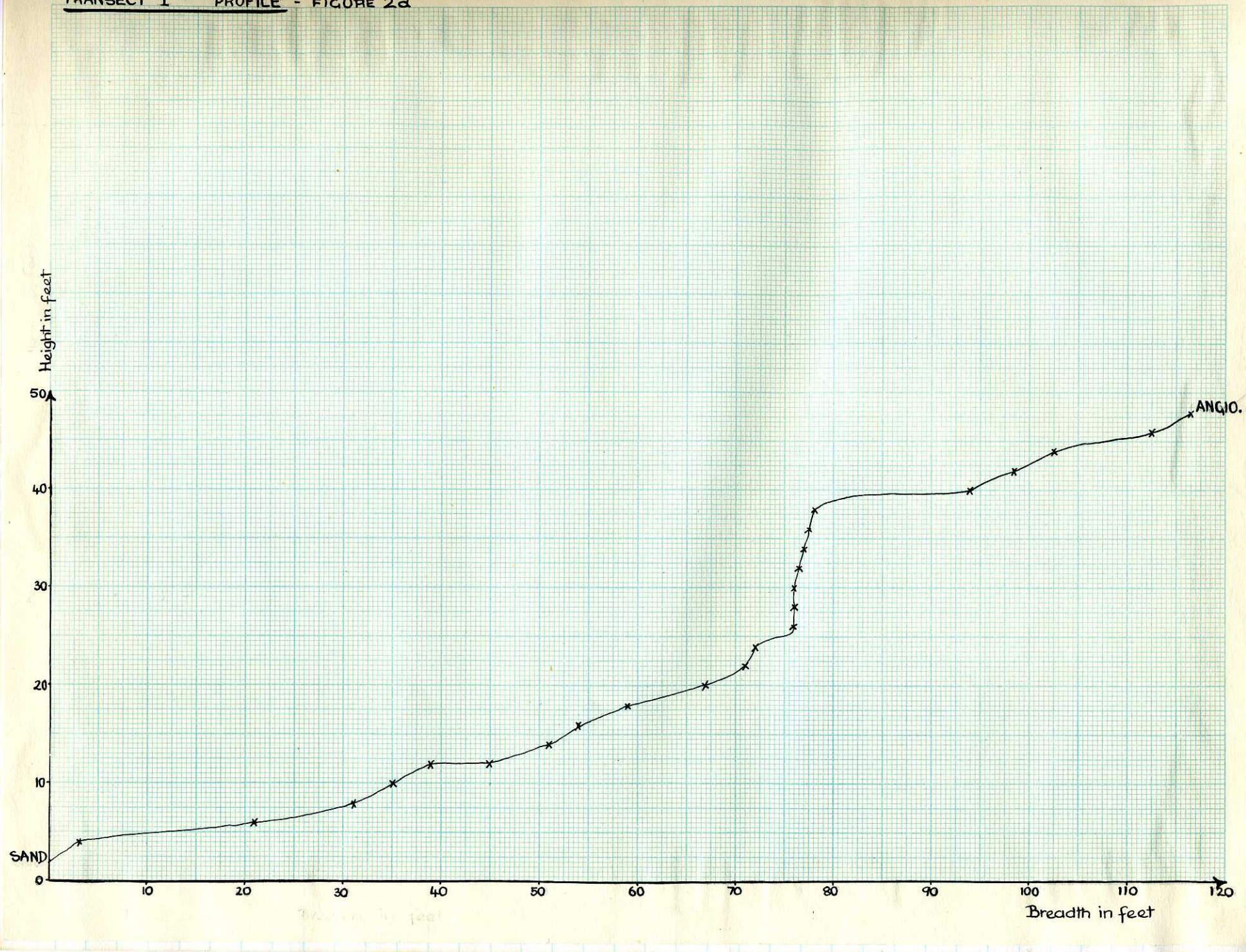
I 1 in 2·57 feet (correct to 2 dec. pl.)
II 3 in 1
III 1 in 2·05
IV 1 in 2·36
V 1 in 5·89
VI 1 in 3·74

Refer to the map on Figure 1 for the position of the transects and to Figures 2a - 2f for the profiles.

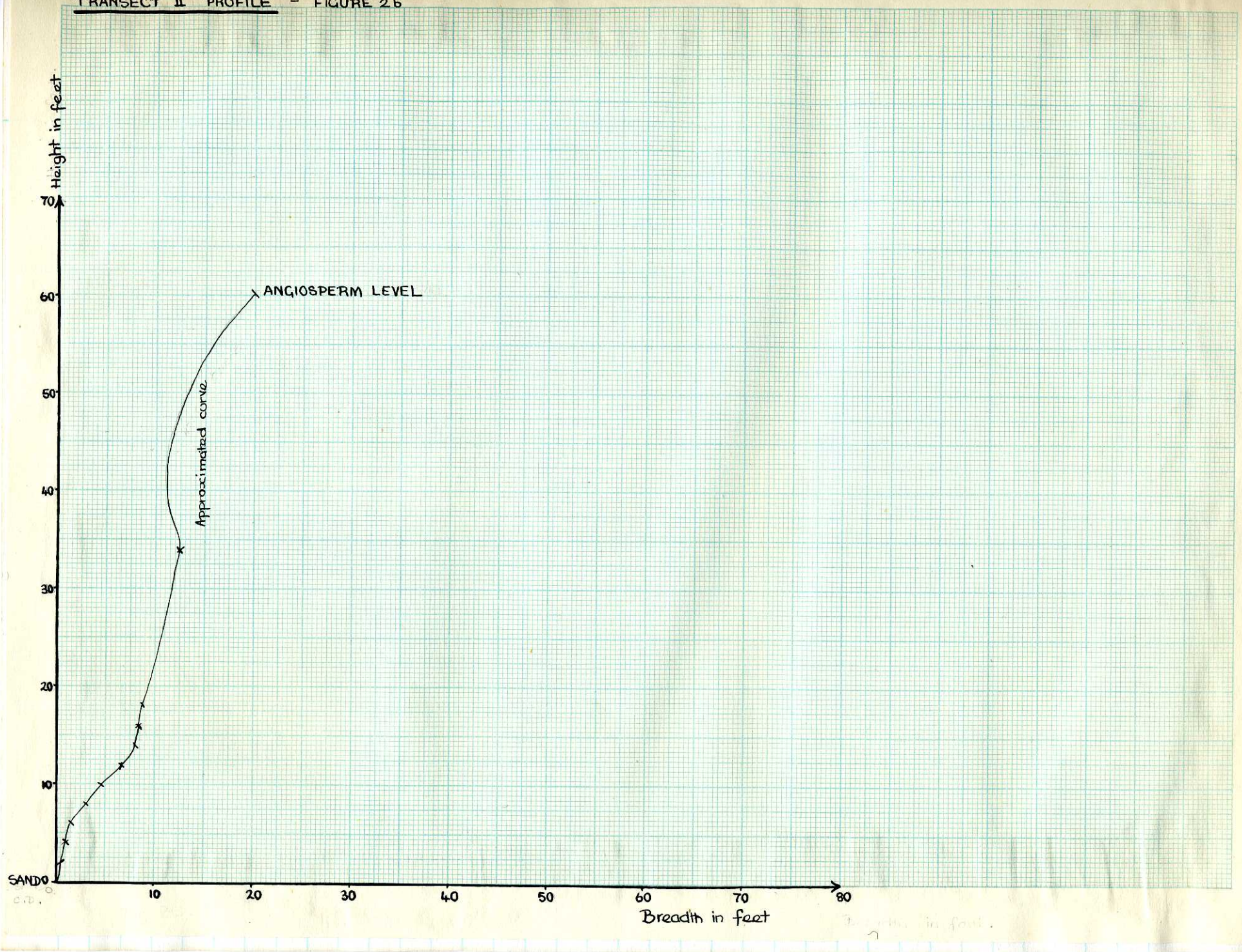
Range in vertical height

I 0 - 48 feet
II 0 - 32 ft. transected, but angiosperm level ≅ 60 ft.
III 0 - 6 unobtainable, 6 - 42 ft.
IV 4 - 42 ft. (4 ft. height sand/rock junction)
V 10 - 34 ft (10 ft. " ")
VI 6 - 30 ft. (6 ft. " ").

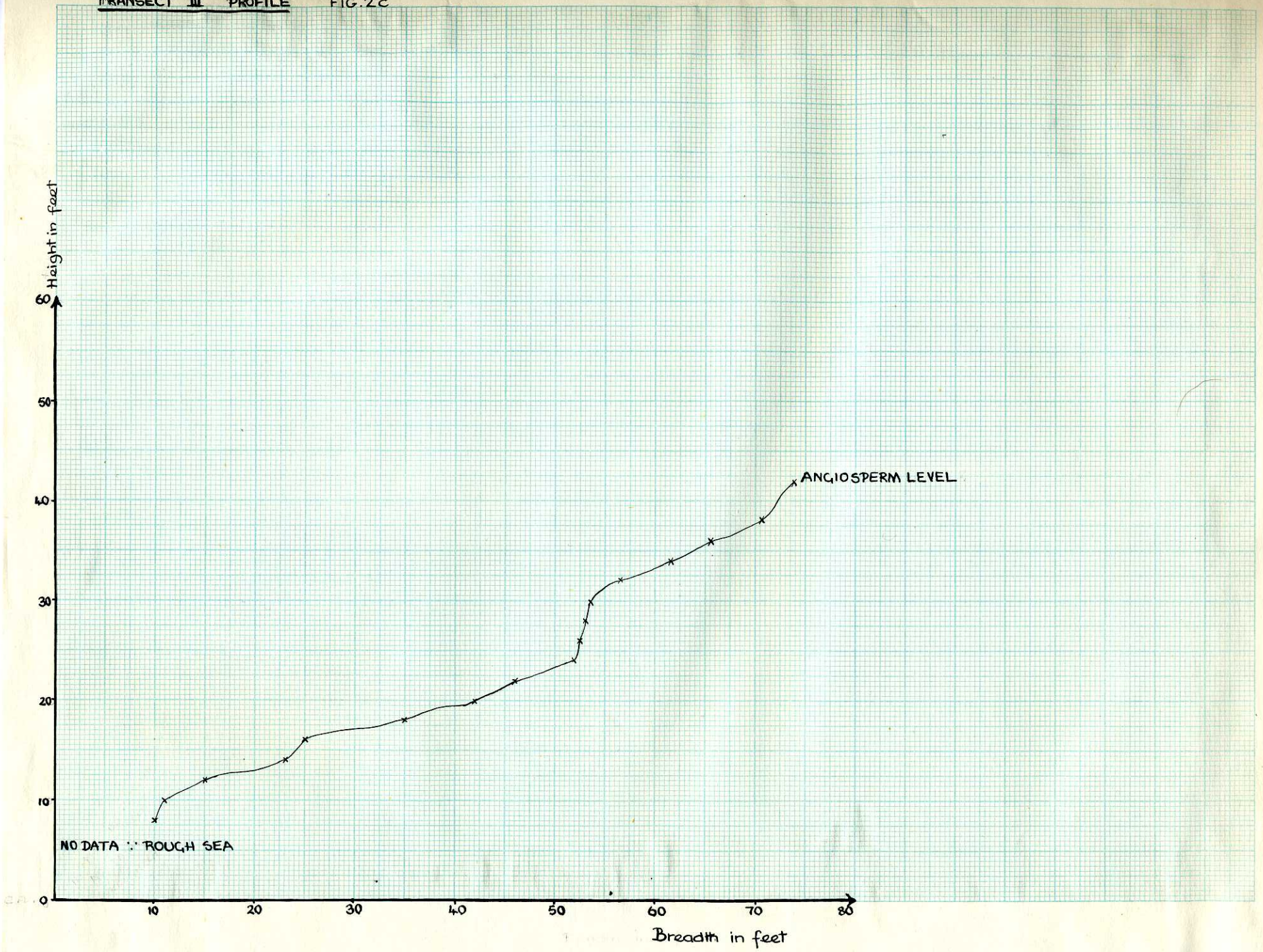
TRANSECT I PROFILE - FIGURE 2a



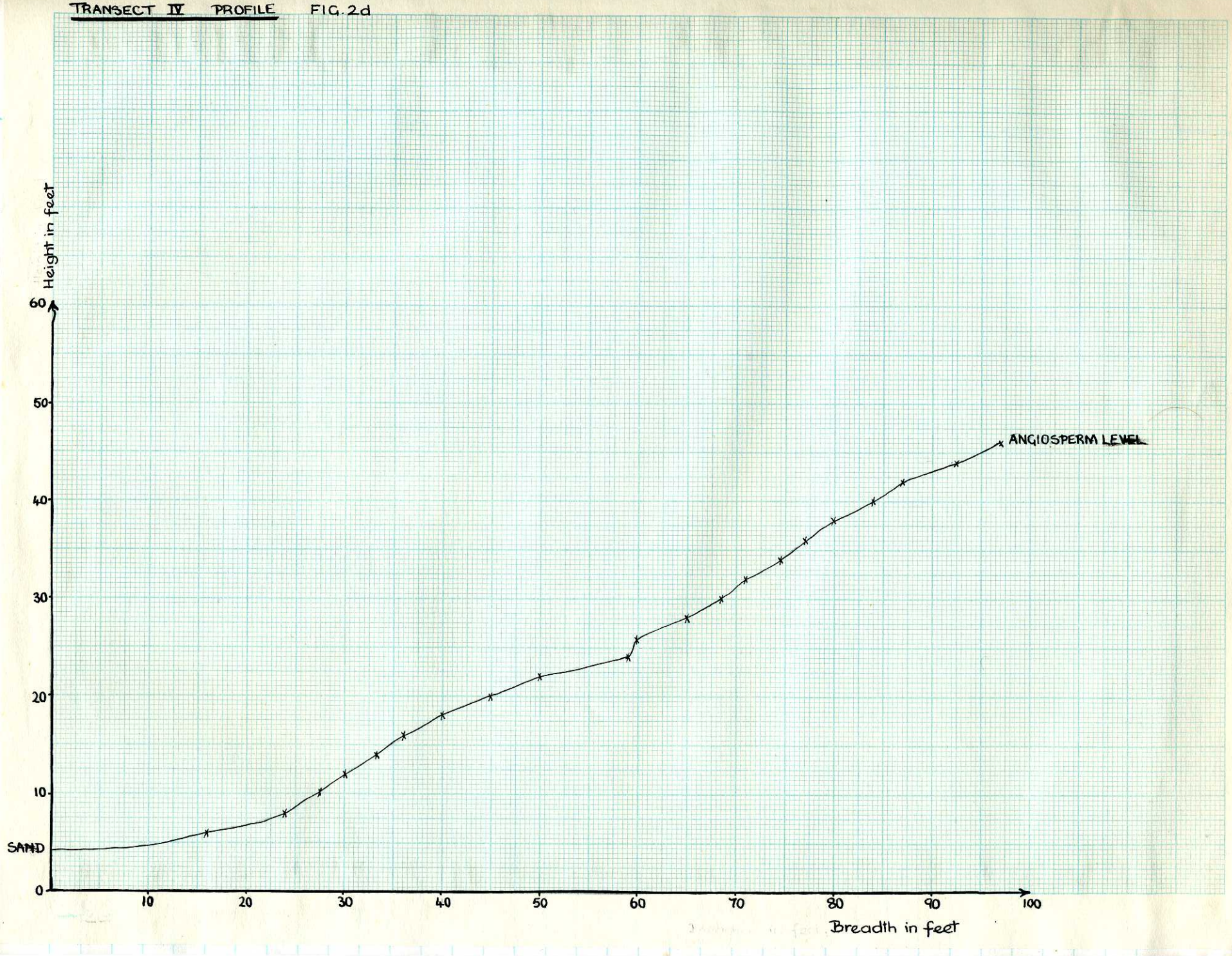
TRANSECT II PROFILE - FIGURE 26



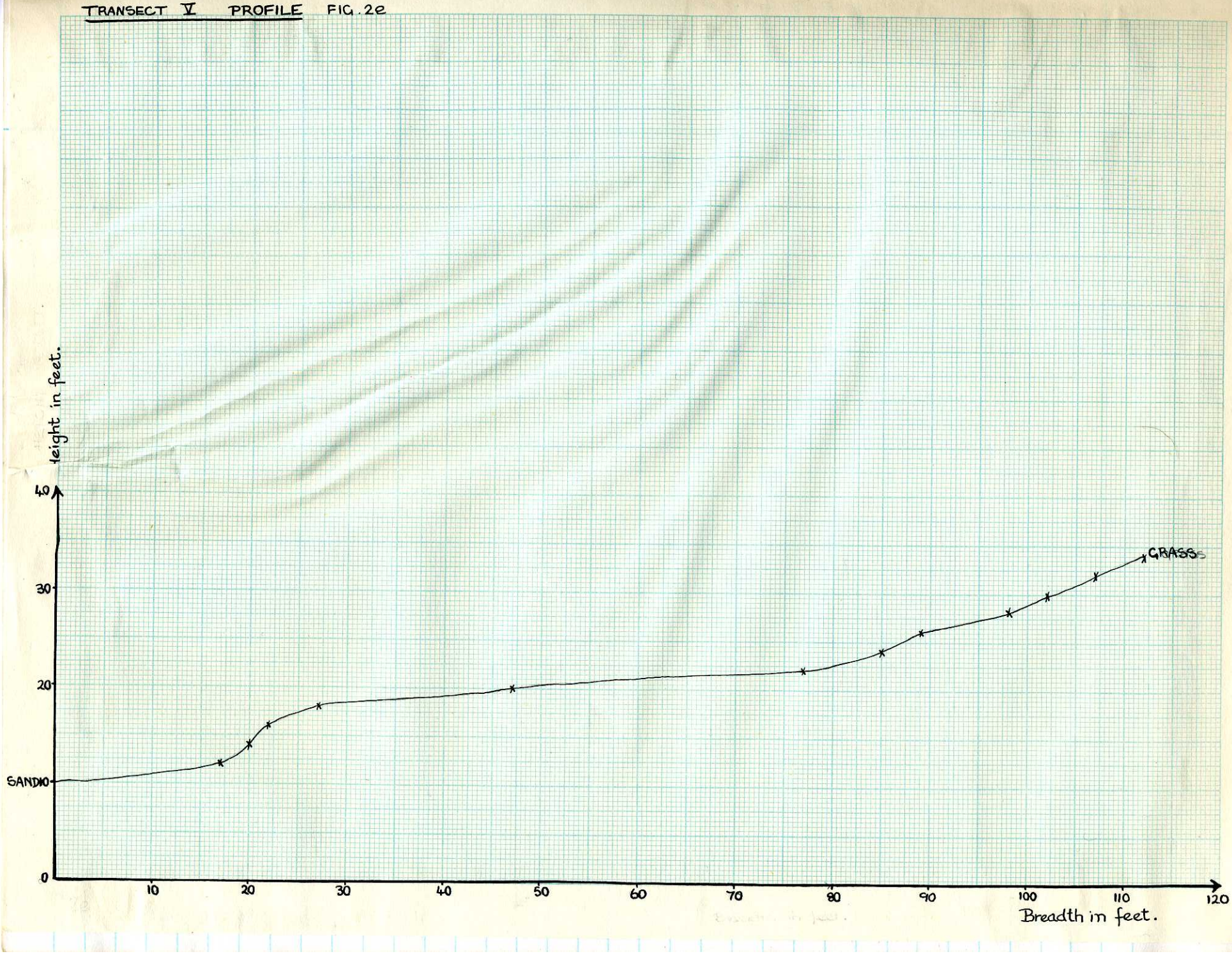
TRANSECT III PROFILE FIG. 2c



TRANSECT IV PROFILE FIG. 2d

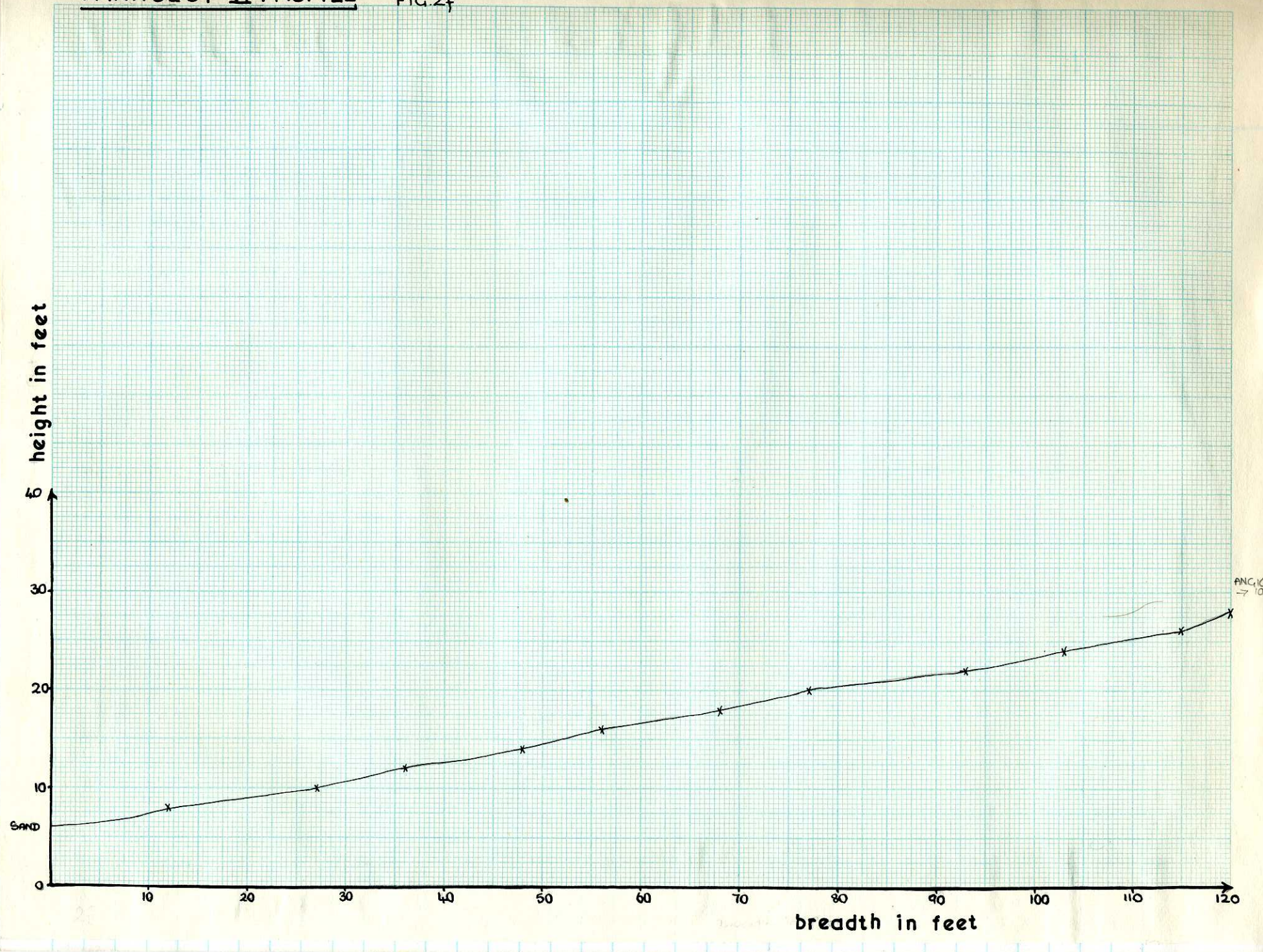


TRANSECT V PROFILE FIG. 2e



TRANSECT VI PROFILE

FIG. 2f



The $\frac{1}{2}$ m^2 quadrat was laid down at each station and general abundance recorded. Since the object of the survey was not only to record zonation but to give a general picture of the type of fauna that was able to survive on the rocky shores of Berry Holms, certain deviations in method of study were used. On transect I, for example, there were many "solution hollows" and crevices. When the quadrat coincided with either of the latter, the individuals present in the pools occupying hollows and in the crevices were recorded. Of course, some species such as Littorina neritoides are usually confined to crevices and would be included anyway.

The rocky cliffs of transect II was almost vertical, and because of this it was often impossible to lay the quadrat horizontally on the rock surface. When a station coincided with a very steep incline, the quadrat was held as near as possible to the horizontal and then the percentage cover or number of individuals was recorded over that part of rock within the square and to a depth of six inches, even if this area was less than $\frac{1}{2}$ m^2.

Although strictly speaking the fauna was being recorded, the Algae were included because they are important indicators of the degree of exposure of a shore and also sometimes a determining factor in the type of fauna present, eg Littorina obtusata (littoralis) on fucoids. For convenience and economy of time, those red algae that could not be readily identified by reference to Barrett and Yonge's "Guide to the Sea Shore", were grouped as Rhodophyceae.

As far as the actual quantitative recording was concerned, where a group was consistently

abundant its percentage cover was noted, eg. lichens, algae, barnacles and Mytilus. When few individuals occurred numbers were counted, eg. limpets, winkles, Actinia and other rarely occurring animals.

Most of the island shores were fairly exposed, but determining exact exposure on the Ballantine scale as modified by A. Nelson-Smith was made difficult by two factors. Firstly there were few indicator species. Secondly I sometimes used percentage cover where Ballantine used the number of individuals as the measure of abundance and vice versa, or Ballantine used a different area so therefore substitution was difficult. The exposure scale is therefore relative and has been calculated from Ballantine's descriptions of the positions of the species on an exposed and sheltered shore. The ratio of species present that were typical of exposed or sheltered shore was used as a measure of the exposure of the shores studied relative to each other. However, I would say that transects I and IV were equivalent to Ballantine's very exposed shore.

Figure 3 over page is a diagrammatic illustration of the positions that species occupy on exposed and sheltered shores.

Shores in order of exposure : I, IV, II, III, V, VI.

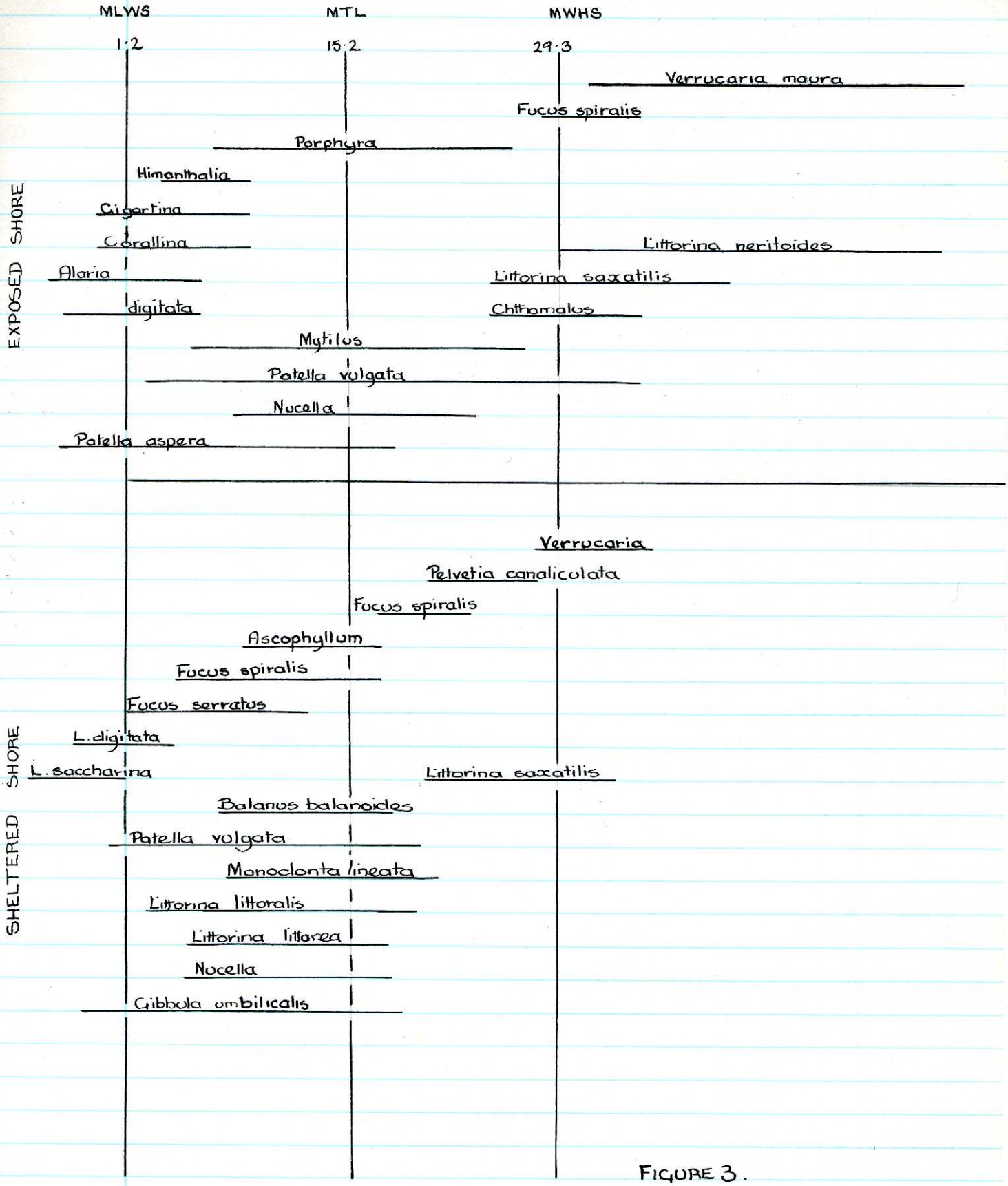

MLWS
MTL
MWHS
1·2
15·2
29·3
EXPOSED SHORE
Verrucaria maura
Fucus spiralis
Porphyra
Himanthalia
Cigartina
Corallina
Littorina neritoides
Alaria
Littorina saxatilis
digitata
Chthamalus
Mytilus
Patella vulgata
Nucella
Patella aspera
Verrucaria
Pelvetia canaliculata
Fucus spiralis
Ascophyllum
Fucus spiralis
Fucus serratus
L. digitata
L. saccharina
Littorina saxatilis
Balanus balanoides
Patella vulgata
Monoclonta lineata
Littorina littoralis
Littorina littorea
Nucella
Gibbula umbilicalis
SHELTERED SHORE

FIGURE 3.

Figure 4 Degree of exposure on transects determined from presence (P) of indicator species (ref. Fig 3)

	INDICATOR SPECIES	I	II	III	IV	V	VI
ANGIOSPERMS	SPERGULARIA MARITIMA	P			P		P
	SPARTINA SP.					P	P
	MOSS OR GRASS					P	P
LICHENS	GREY LICHENS					P	P
	LICHINA PYGMAEA						P
	VERRUCARIA MAURA	P	P	P	P	P	P
	VERRUCARIA MUCOSA	P		P	P	P	P
	CALLOPLACA SP.	P			P		P
	XANTHORIA SP.	P			P	P	P
PHAEOPHYCEAE	PELVETIA CANALICULATA				P	P	P
	FUCUS SPIRALIS						P
	ASCOPHYLLUM NODOSOM						P
	FUCUS VESICULOSIS					P	P
CHLOROPHYCEAE	ENTEROMORPHA				P	P	
	ULVA LACTUCA		P		P		
RHODOPHYCEAE	CHONDRUS CRISPUS				P		
	CERAMIUM				P		
	PORPHYRA UMBILICALIS				P		
	CORRALINA OFFICINALIS					P	
BARNACLES	CHTHAMALUS STELLATUS	P	P	P	P	P	P
	ELMINIUS MODESTUS			P			P
	BALANUS BALANOIDES	P	P	P	P	P	P
	BALANUS PERFORATUS	P			P		
WINKLES	LITTORINA NERITOIDES	P	P	P	P	P	P
	LITTORINA SAXATILIS	P	P	P	P	P	P
	LITTORINA OBTUSATA			P		P	P
GASTROPODS	PATELLA VULGATA	P	P	P	P	P	P
	PATELLA DEPRESSA	P			P		
	NUCELLA LAPILLUS	P	P		P		
	MYTILUS EDULIS	P	P	P	P	P	P
	ACTINIA EQUINA	P	P		P	P	
	HYDROIDS	P	P				
	EULALIA		P		P		
	SPP. TYPICAL OF EXPOSED:	6:2	3:3	3:5	7:4	4:9	2:8
	SPP. TYP. OF SHELTERED						

FIGURE 5 VERTICAL RANGES IN FEET ABOVE CHART DATUM (L = lower limit, U = upper limit).

		I L	I U	II L	II U	III L	III U	IV L	IV U	V L	V U	VI L	VI U
ANGIOSPERMS	SPERGULARIA MARITIMA	46	48					44		28	32	28	
	SPARTINA SP.											28	
	MOSS OR GRASS									32		28	
LICHENS	GREY LICHENS									30	34	28	
	LICHINA PYGMAEA											22	26
	VERRUCARIA MAURA	22	38	28	32	20	28	30	42	24	30	18	24
	VERRUCARIA MUCOSA	22	44	—		—		28	42	24	28	18	
	CALLOPLACA SP.	38	48	—		—		36	42	26	32	20	28
	XANTHORIA SP.	44		—		—		36	42	28	30	24	28
PHAEOPHYCEAE	PELVETIA CANALICULATA							10		22	24	16	20
	FUCUS SPIRALIS											12	16
	FUCUS VESICULOSUS									12	22	8	10
	FUCUS SERRATUS												
	ASCOPHYLLUM NODUSUM											10	12
CHLOROPHYCEAE	ENTEROMORPHA							4	20	18			
	ULVA LACTUCA			—				4					
RHODOPHYCEAE	CHONDRUS CRISPUS							20					
	CERAMIUM							20	22				
	PORPHYRA UMBILICALIS							24					
	CORALLINA OFFICINALIS									18			
BARNACLES	CHTHAMALUS STELLATUS	8	22	6	26	10	18	14	30	16	22	10	20
	ELMINIUS MODESTUS					—						14	18
	BALANUS BALANOIDES	2	16	2	16	8	16	4	22	12	20	8	12
	BALANUS PERFORATUS	6	10				18	20					
WINKLES	LITTORINA NERITOIDES	16	32	16	30	26	30	22	34	22	26	20	
	LITTORINA SAXATILIS	2	30	—		10	24	30		22	24	8	20
	LITTORINA OBTUSATA					—				12	14	14	16
GASTROPODS	PATELLA VULGATA	2	18	2	10	8	12	14	24			8	12
	PATELLA DEPRESSA	18						12	24				
	NUCELLA LAPILLUS	2	16	2	14	8	16	4	20				
	MYTILUS EDULIS	2	20	2	16	8	16	6	22	12	20	8	12
	ACTINIA EQUINA	2	16	—				—		—			
	HYDROIDS	—		—									
	EULALIA			—				—					

The Distribution of Littoral Animals and Plants

Flowering Plants (Angiospermae)

Only two species of flowering plants were recorded. Spergularia maritima was found on transects I and VI at a height of 28 feet; Spartina sp. was also present at the same height on transect VI. This narrow zone occupied by Angiospermae was supra-littoral and merged with grassland at the top of the shore. Both plants are adapted to the high degree of salinity.

Lichens (Lichenes) Fig. 6

Six species of lichen were found on the island. The grey encrusting lichens were not divided up into species. They were only found on the uppermost part of transect I. from 30 - 34 feet above Chart Datum where they never occupied more than 5% of the ½ m² quadrat, and also on transect VI at 28ft.

Lichina pygmaea, a densely tufted black lichen which occurs in short flatten lobes spread over the rock surface, was only found on transect VI from 22-26 feet.

Verrucaria maura, Verrucaria mucosa, Xanthoria sp. and Calloplaca spp. were common to all transects.

Verrucaria maura is a black encrusting lichen often appearing like fine coal dust over the light coloured limestone. The average lower limit of occurrence is 23.7 feet and average upper limit is 32.6 ft. while the range is 8.7 ft.

Verrucaria mucosa is green-black and tarry in appearance and extends over the rock in irregular patches. Its average lower limit is 23 feet and average upper limit is 33 feet with an average

range of distribution of 10.5 feet. It can be seen, therefore, that it tends to occur lower on the shore than Verrucaria maura but has a wider range.

Calloplaca sp. is a dense orange coloured lichen with an irregular but continuous outline. It occurs higher on the shore than either the grey lichens or the black lichens. Its average lower limit is 31.3 feet and average upper limit 39 feet, and average range 9 feet.

Xanthoria spp. are typically more yellow in colouration than Calloplaca, with a feathery irregular outline. It is the highest occurring lichen with an average lower limit of 33 feet, average upper limit 37 feet, and range 5.2 ft. This means that although its first appearance is at a greater height than Calloplaca, it has a smaller range, and therefore Calloplaca always extends higher up the supralittoral zone. A marked example of this can be seen on Transect I where Calloplaca is distributed over 10 feet and Xanthoria over 2 feet.

Brown Algae (Phaeophyceae) Fig. 7

There are surprisingly few brown algae on the shores of Burry Holms. Transects I, II and III had none at all, but IV, V and VI had one or more species. The four species found were as follows. Pelvetia canaliculata, channel wrack, is olive brown and dichotomously branched. The tufted branches are upto 6 inches long, the frond being 1/3 inch across and inrolled to form a channel, ending in divided tips that are often swollen or granular. It occurred on all three transects which were notably the most sheltered on the island. The plants appeared on the upper mid-littoral part of the

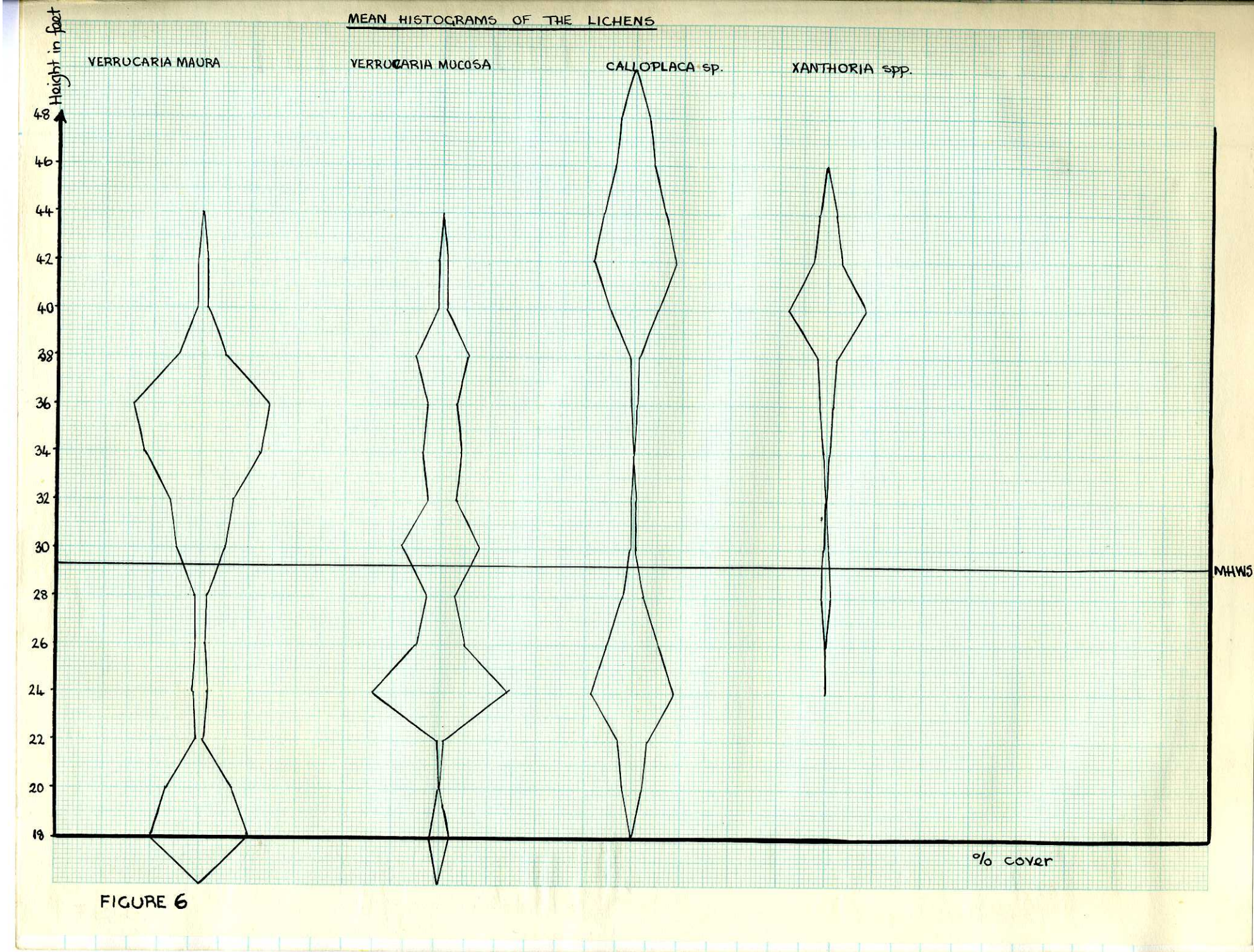

MEAN HISTOGRAMS OF THE LICHENS
Height in feet
VERRUCARIA MAURA
VERRUCARIA MUCOSA
CALLOPLACA sp.
XANTHORIA spp.
48
46
44
42
40
38
36
34
32
30
28
26
24
22
20
18
MHWS
% cover

FIGURE 6

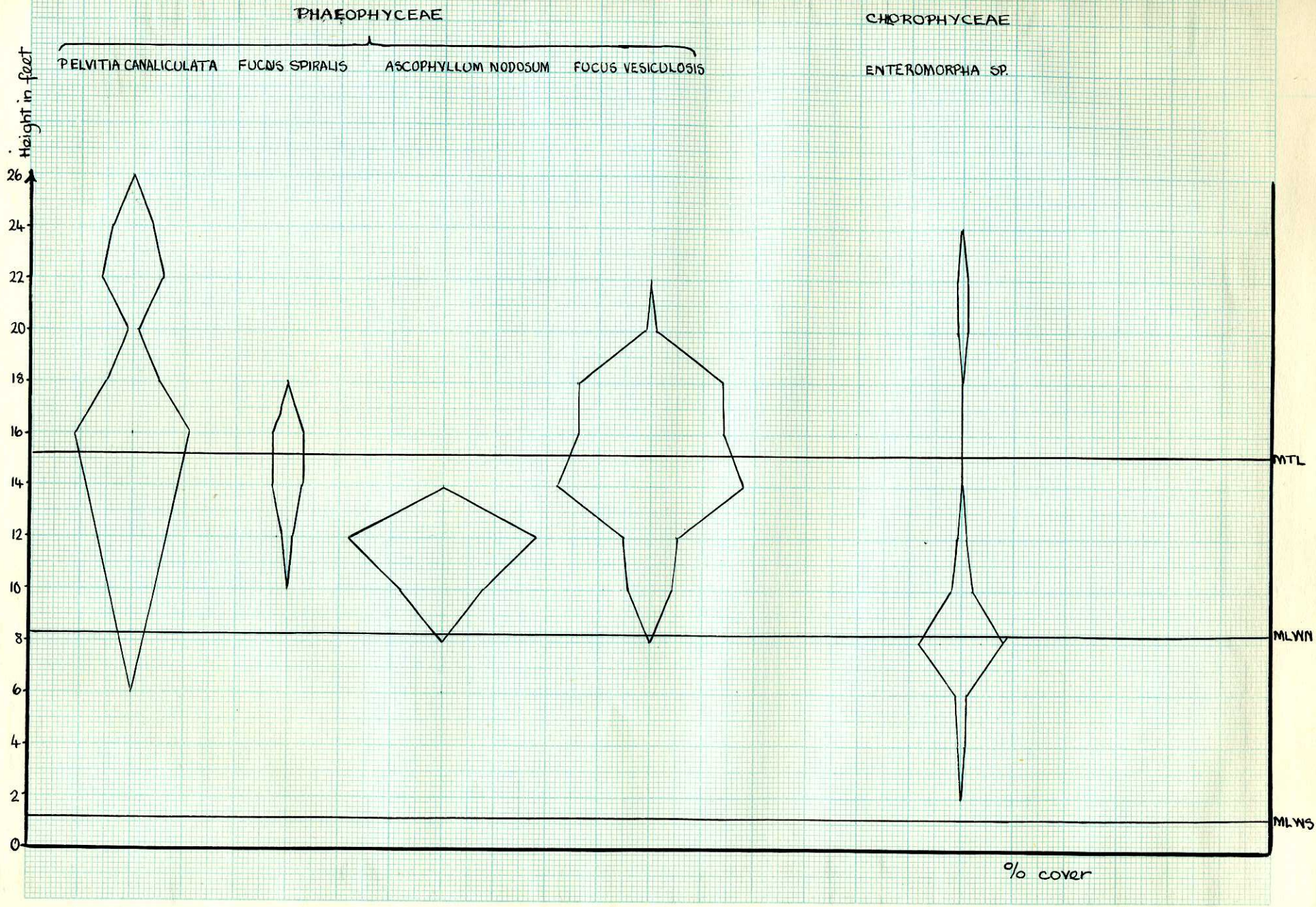
shore, zonation depending on the ability to withstand desiccation. It is a slow growing fucoid with a high oil content. Abundance decreases with height.

Fucus spiralis, flat wrack, has a broad frond with a smooth edge and may be 5-8 inches long. There are no air bladders. The plant appears spirally twisted when suspended. This fucoid was only found on transect VI starting at 12 feet and extending to 16 feet above Chart Datum where it made way for Pelvetia. Fucus spiralis is also a slow growing plant typical of a more sheltered shore.

Ascophyllum nodosum, egg wrack, is olive green, has no mid-rib and possesses single egg-shaped bladders at intervals in the middle of the frond. Ascophyllum only occurred on transect VI (the most sheltered) in a narrow zone below Fucus spiralis. It was slightly more abundant than F. vesiculosis. Here zonation was probably mainly dependant on physical factors such as wave action affecting the growth rate rather than desiccation.

Fucus vesiculosis, bladder wrack, has a prominent midrib and air bladders, commonly in pairs. The form evesiculosis was present in which bladders were absent. Earlier in the year the tips of the lateral branches would bear swollen granular fruiting bodies. At the time of the survey, the plants were beginning to wither and the tips of the fronds were yellow. Fruiting bodies were occupied by small amphipods. This plant was only slightly less abundant than Ascophyllum on transect VI and occupied a range two feet immediately below the latter on the shore. On transects V. Fucus vesiculosis extends over 10 feet (12-22 ft.) and is the most abundant fucoid on that shore.

FIGURE 7 MEAN HISTOGRAMS OF THE COMMON SEAWEEDS



Fucus serratus was found on the leeward side of boulders occasionally.

Green Algae (Chlorophyceae)

As with the brown algae, no green algae (except an isolated plant on transect II) were found on transects I, II and III. Of the two species found, both grew on transect IV and one on V. The species were Enteromorpha sp. and Ulva lactuca.

Enteromorpha has a typically inflated or compressed fronds, branched at least once and usually they are slightly constricted at regular intervals. Where the branches meet the main frond, they narrow, but their tips are blunt. This plant was found on transect IV from 4 - 20 feet and never occupied more than 40% of the transect square. On V Enteromorpha occurred at 18 feet, but was only 5% of the quadrat. Elsewhere it was found to be common between tide levels.

Ulva lactuca, sea lettuce, is a membranous green sea weed. It is broad leaved and translucent and is irregularly shaped. It occurs in bunches 4 - 8 inches high on a solid stalk in pools. It was found only twice, on II and IV, fairly low on the shore. However, it commonly occurs at most levels at other places around the island not transected.

Red Algae (Rhodophyceae)

Four species were found, three on transect IV and one on V. Included Chondrus crispus, Ceramium, Porphyra umbilicalis and Corallina officinalis.

Chondrus crispus has a disc holdfast, short stalk and branches 3-6 inches tall. It is very variable in appearance. Usually it takes the form of a wide, flat frond dividing into rounded dichotomies or sharp divisions. The small end divisions glow with a watery violet iridescence when submerged. Little pustular

fruiting bodies were present in the frond which was dark red in colour. Chondrus was found on the middle shore (20 feet above C.D.) on transect IV.

Ceramium rubrum is a red tufted plant, with many ends which are divided into two inward-hooking points (furcipate). The threads are banded with alternate dark and light sections. Again, this plant was only found on transect IV. at same height as Chondrus, but also further up transect. It was not very abundant.

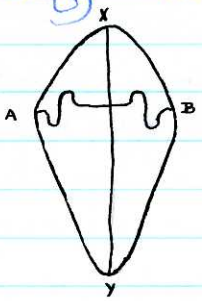
Porphyra umbilicalis is brownish purple and shapeless in appearance. The frond is an expanded thin membrane that is lobed. Fronds are from 5-10 inches long. Appears more purple when pressed between the fingers. At the time of the survey the plants were beginning to wither. They were found in the upper mid-littoral zone, occupying 40% of the quadrat.

Corallina officinalis has a small, disc holdfast and tufts from 2-5 inches high. Branches and sub-divisions are exactly opposite. Branches consist of a long series of minute, articulated sections. The plant has a plum colour at low water levels, but becomes whiter higher on the shore due to exposure to the sun. The coat of the plant has a rough, abrasive texture due to the presence of calcium. It occurs in pools. Although only recorded on transect V, it was far more widely distributed in the rock pools all over the island, and sometimes occurred in quite large masses.

Barnacles (Cirripedia) Fig. 11

Those barnacles found included Chthamalus stellatus, Balanus balanoides, Elminius modestus, Balanus perforatus, and Lepas anatifera (on washed up driftwood and tree trunks).

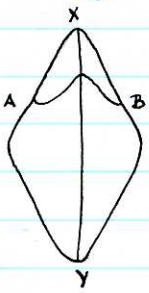
Chthamalus stellatus is an acorn barnacle with hard plates around an operculum and attached by a broad base. It has six plates. The four lateral plates overlap the terminals, but when the plates are closed, this cannot be seen. The width across the area inside the plates is greatest nearer to one end, giving a kite or shield shape which is a useful characteristic by which to identify this barnacle in the field.



The terminal (rostral) plates are narrow because they are overlapped. Greatest width nearer X than Y. AB crosses XY almost at right angles.
Plates white or pale grey.

The average lower limit of Chthamalus on Burry Holms was 10·3 feet, and average upper limit 22·7 feet in vertical height above Chart Datum. Average range was 12·4 feet.

Balanus balanoides has lateral plates which overlap one terminal plate, but which are overlapped by the other. Thus one terminal plate is broad and one is narrow (as in Chthamalus). Width across the area inside is greatest across the middle, giving a diamond



shape. The AB suture crosses XY obliquely. Average lower limit on Burry Holms according to the survey is 6 feet, average upper limit 17 feet, and average range 11 feet.

According to Yonge, where they occur in comparable numbers, Chthamalus occurs on the upper and middle shore pushing Balanus balanoides lower. As exposure decreases, the vertical range decreases. The survey on Burry Holms yielded the following results:

Transects in order of exposure: I IV II III V VI
Range of Chthamalus stellatus: 14 14 20 8 6 10 feet.

Thus the results roughly bear out the above statement. Chthamalus always occurs above B. balanoides on the shore:

	I	II	III	IV	V	VI	
Lower limit B. balanoides :	2	2	8	4	12	8	(av. 6 ft.)
Lower limit Chthamalus :	8	6	10	14	16	10	(av. 10·3 ft.)
Upper limit B. balanoides :	16	16	16	22	20	12	
Upper limit C. stellatus :	22	26	18	28	22	20	

Discussion of Barnacle Zonation Figs. 8a - 8f.

Where two or more closely related species are adapted to the same or similar niche, then interspecific competition becomes important. One species may be eliminated or forced to occupy a new niche, or the two species may be able to live together at a reduced intensity.

Connell in 1961 worked with barnacles in an intertidal gradient in Scotland. Commonly there are two species of barnacles, Chthamalus occupying a band near the upper part of the intertidal zone and Balanus occupying a wider band below.

Larvae of both species were found to settle over a wider range than that occupied by the adult population. Connell concluded that physical factors such as desiccation control the upward limit of Balanus, while biological factors such as competition and predation control the downward

limit of Chthamalus in the lower portion of the intertidal gradient where the physical environment is less limiting.

It appears that these results obtained on the zonation of barnacles on Barry Holms confirm the findings of Connell.

For the abundance of Balanus balanoides and Chthamalus stellatus refer to the histograms on Figures 9 and 10 respectively.

Elminius modestus has only four plates around the operculum compared with six plates in Balanus and Chthamalus. It is easily distinguishable by its pearly white colour, and the four plates are easily counted because they do not fuse. The barnacle leans a little and comes to a point at one side. It occurred high on the middle shore on transects III and VI, but there were only a few individuals and these were scattered.

Balanus perforatus is the biggest acorn barnacle attaining 3/4 inch across the base and one and a half inches in height. However, on Barry Holms specimens were only about a half these dimensions. The plates are smooth or vertically lined, often being separate terminally. There were even fewer individuals than Elminius probably because they were wiped out in the severe winter of early 1963, and they are only just beginning to return. There were many empty shells.

Lepas anatifera is worth a mention because it occurred in such great numbers on drift wood around the island.

Refer to Figure II for illustrations of the barnacles.

FIGURE 8a BALANUS balanoides and CHTHAMALUS stellatus

TRANSECT I

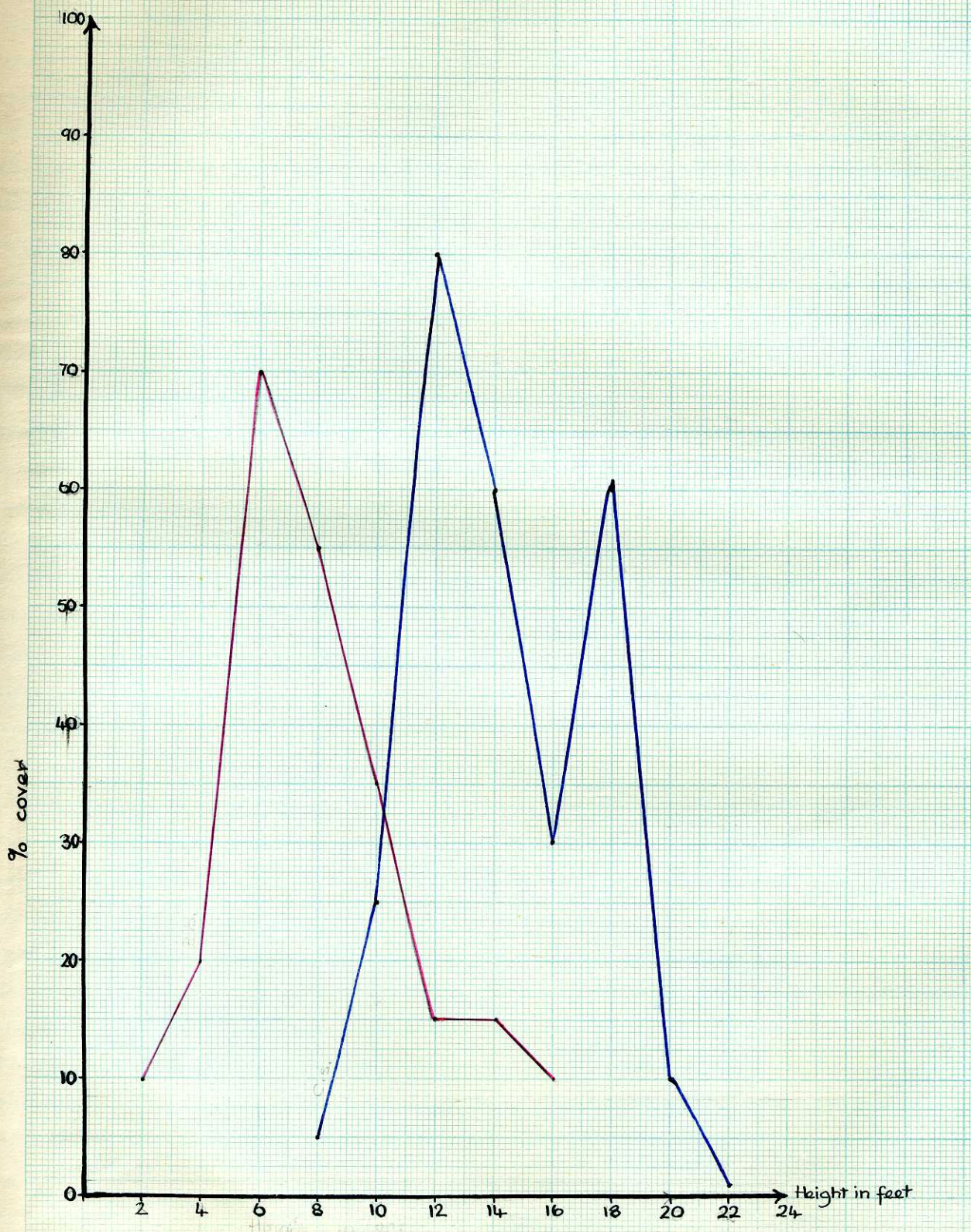


FIGURE 8b

BALANUS balanoides and CHTHAMALUS stellatus

TRANSECT II

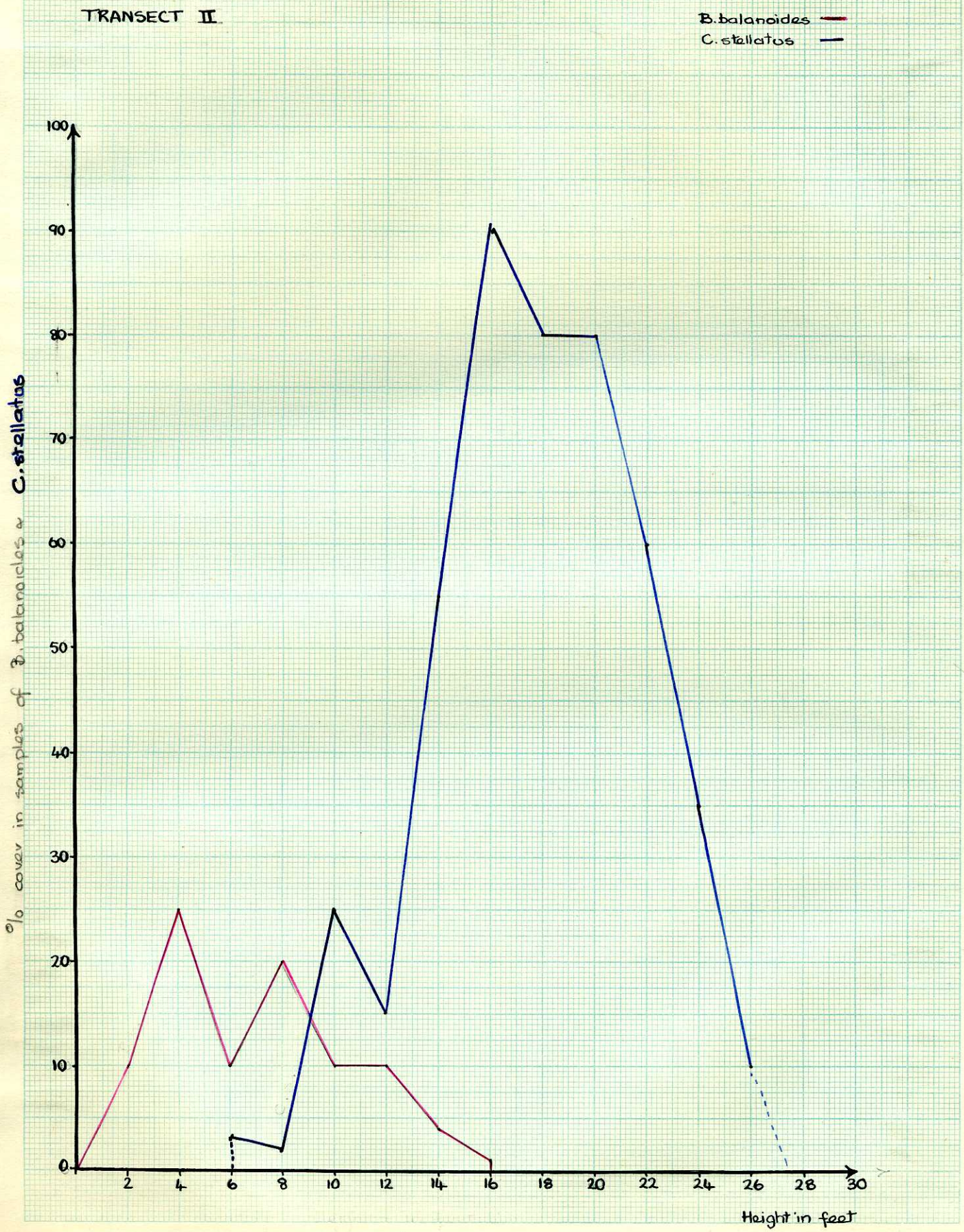


FIGURE 8c

BALANUS balanoides and CHTHAMALUS stellatus

TRANSECT III

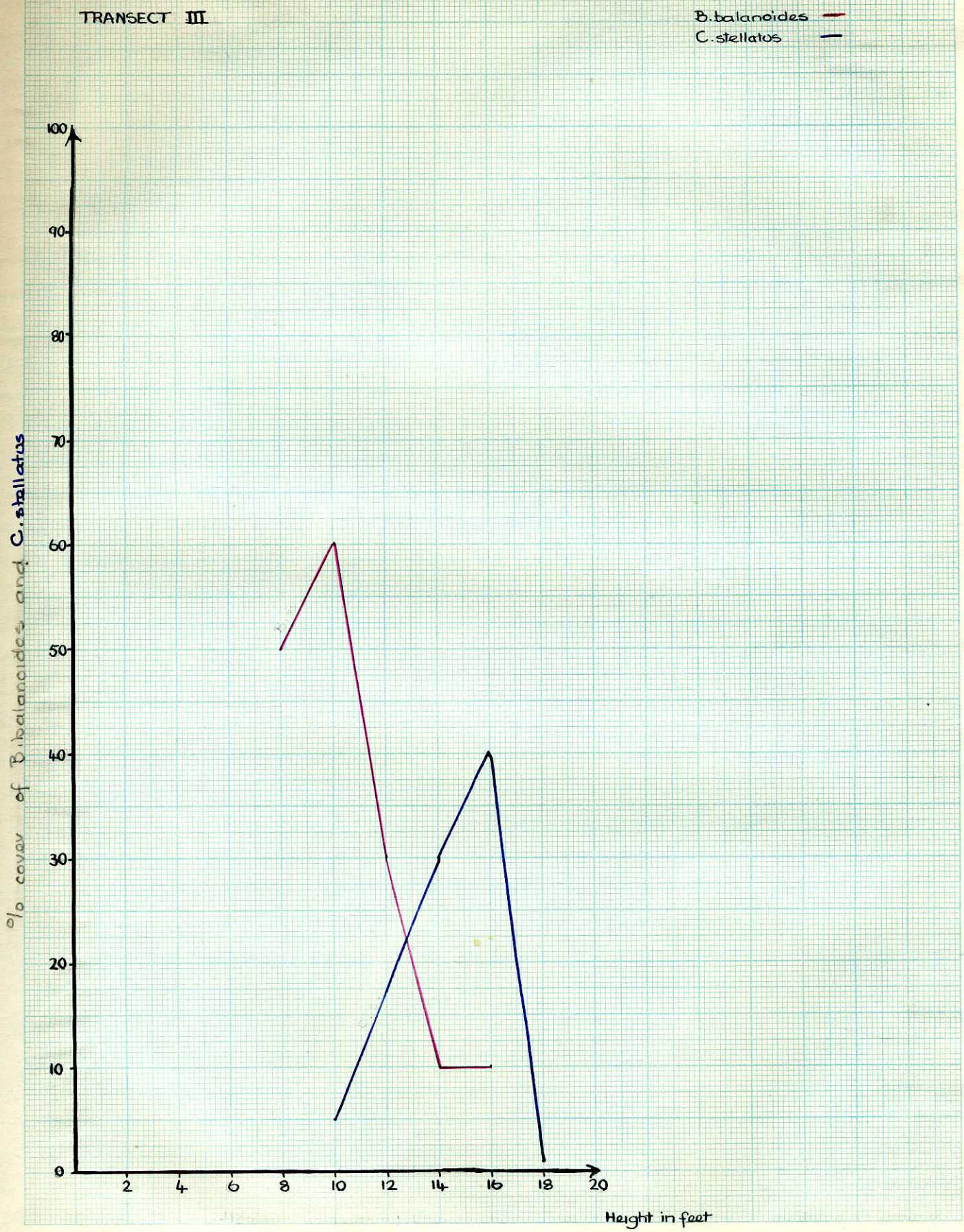


FIGURE 8d

BALANUS balanoides and CHTHAMALUS stellatus

TRANSECT IV

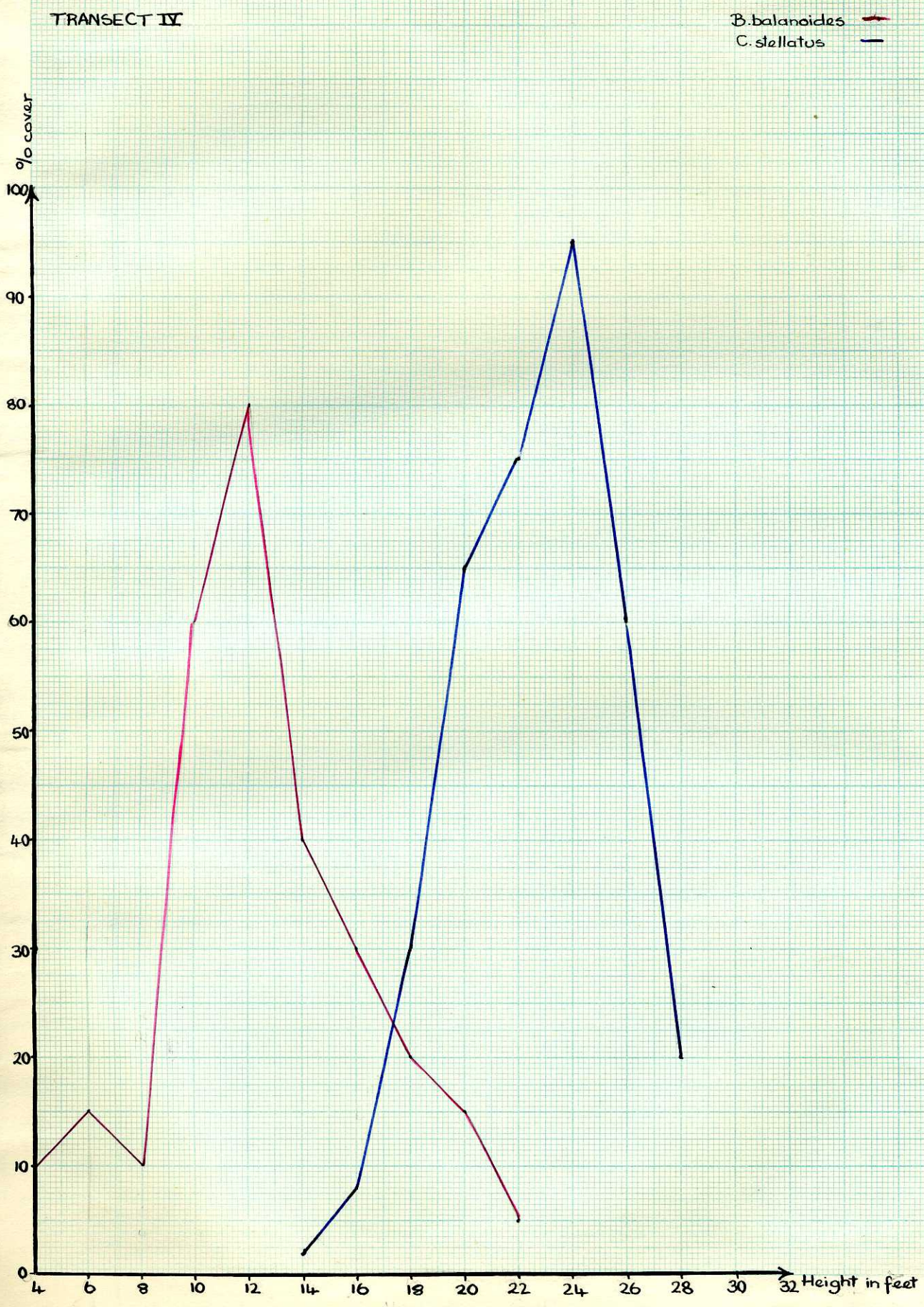


FIGURE 8e

BALUNUS balanoides and CHTHAMALUS stellatus

TRANSECT V

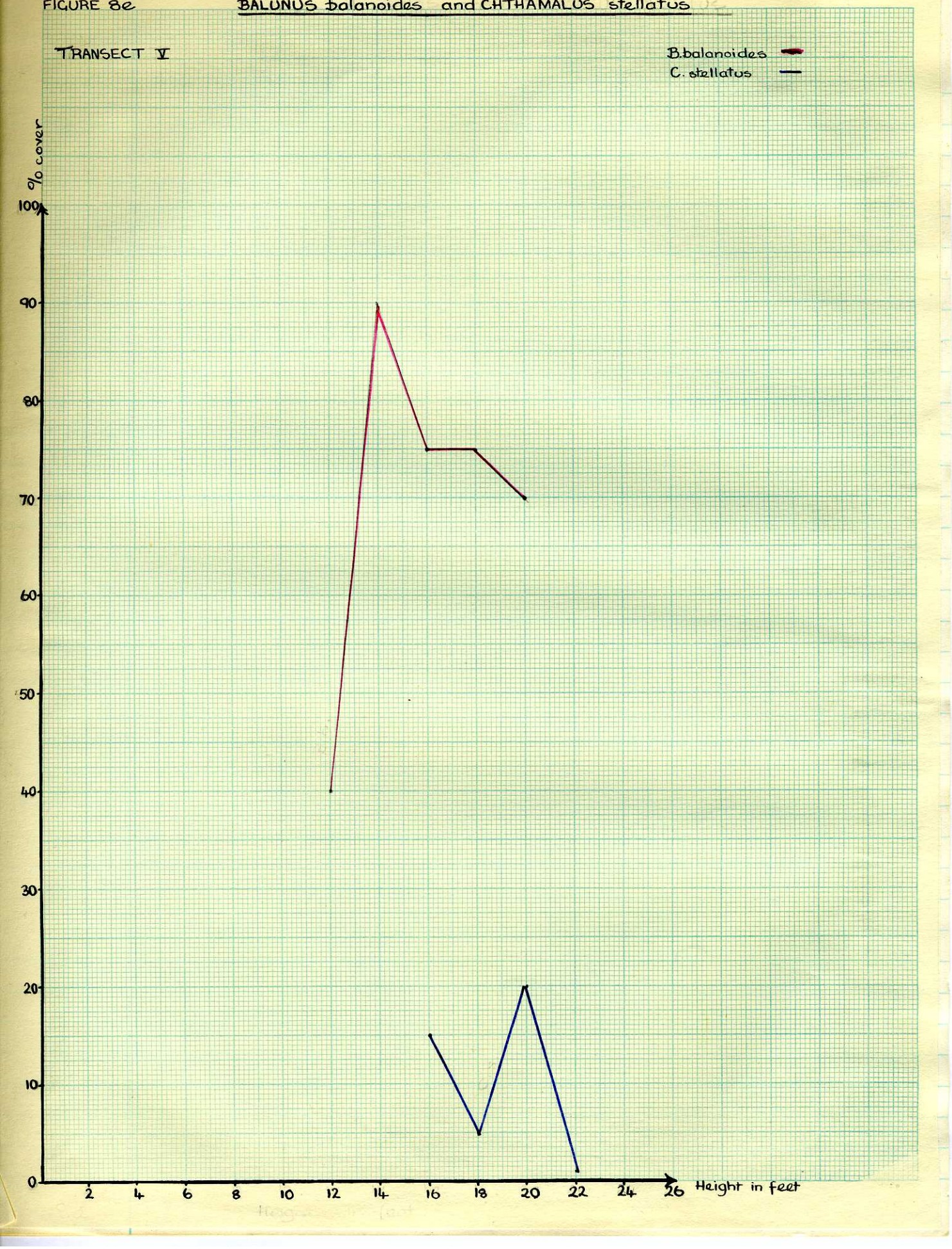


FIGURE 8f

BALANUS balanoides and CHTHAMALUS stellatus

TRANSECT VI

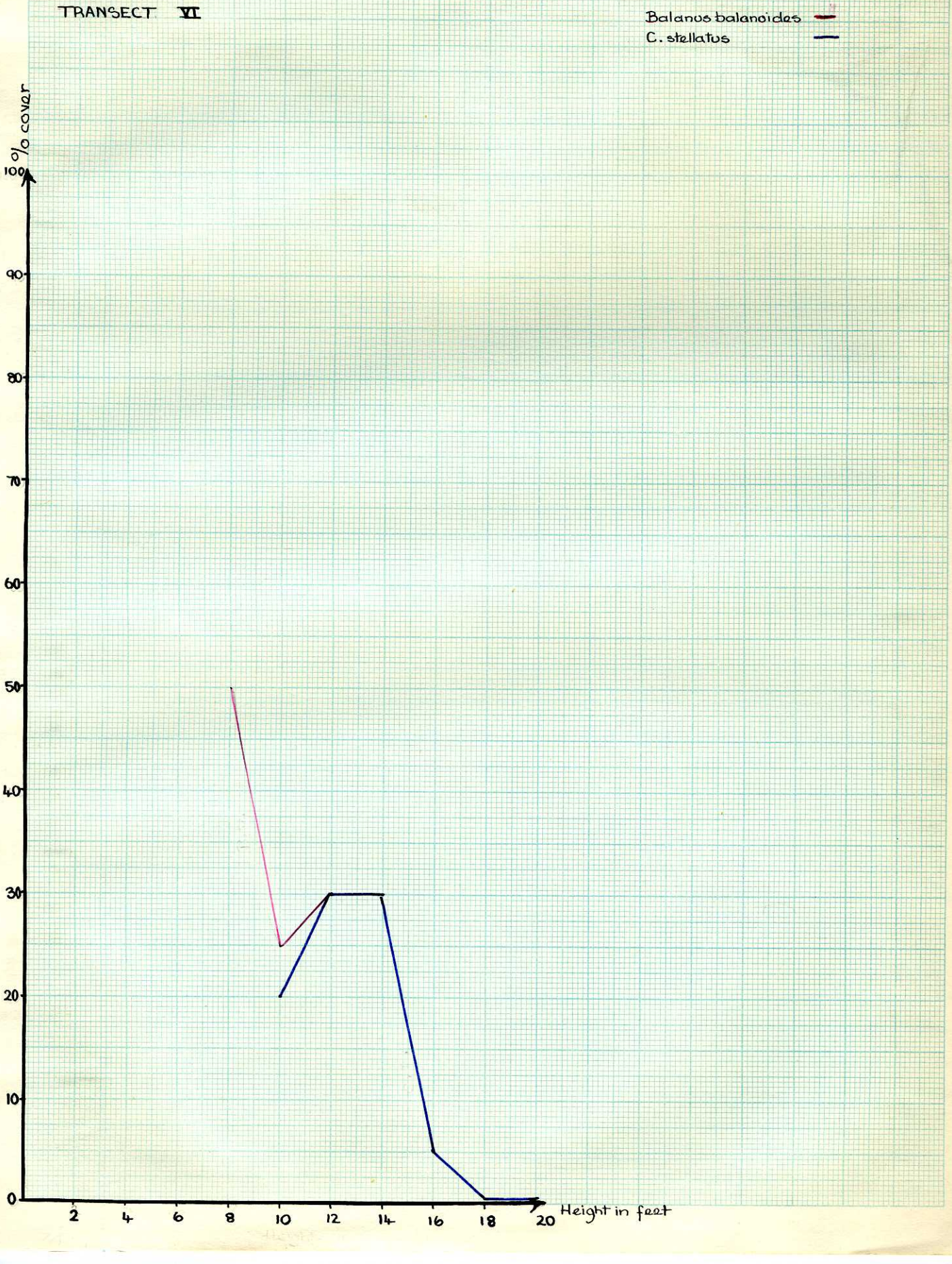


FIGURE 9

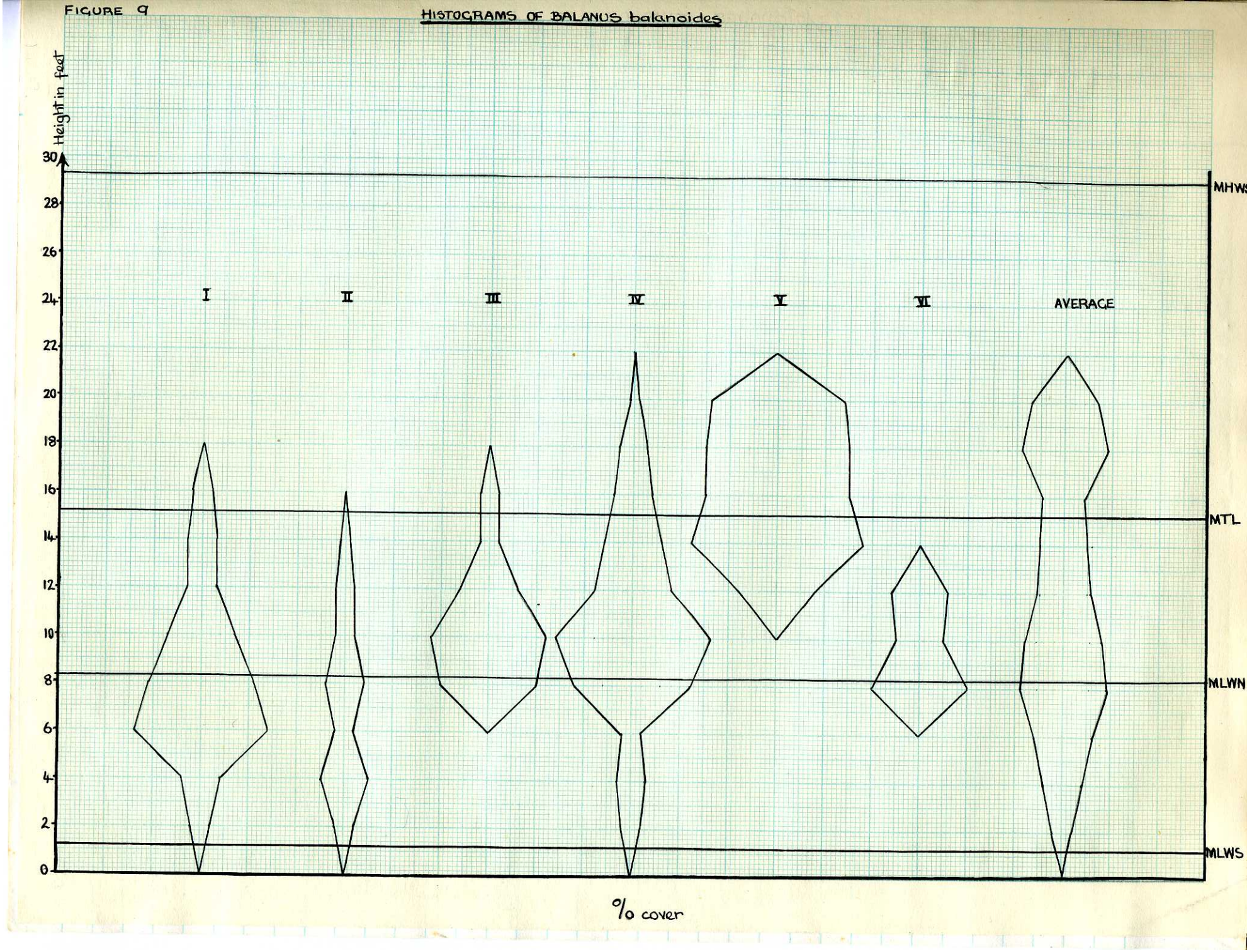

HISTOGRAMS OF BALANUS balanoides
Height in feet
30
28
26
24
22
20
18
16
14
12
10
8
6
4
2
0
I
II
III
IV
V
VI
AVERAGE
MHWS
MTL
MLWN
MLWS
% cover

FIGURE 10

HISTOGRAMS OF CHTHAMALUS stellatus

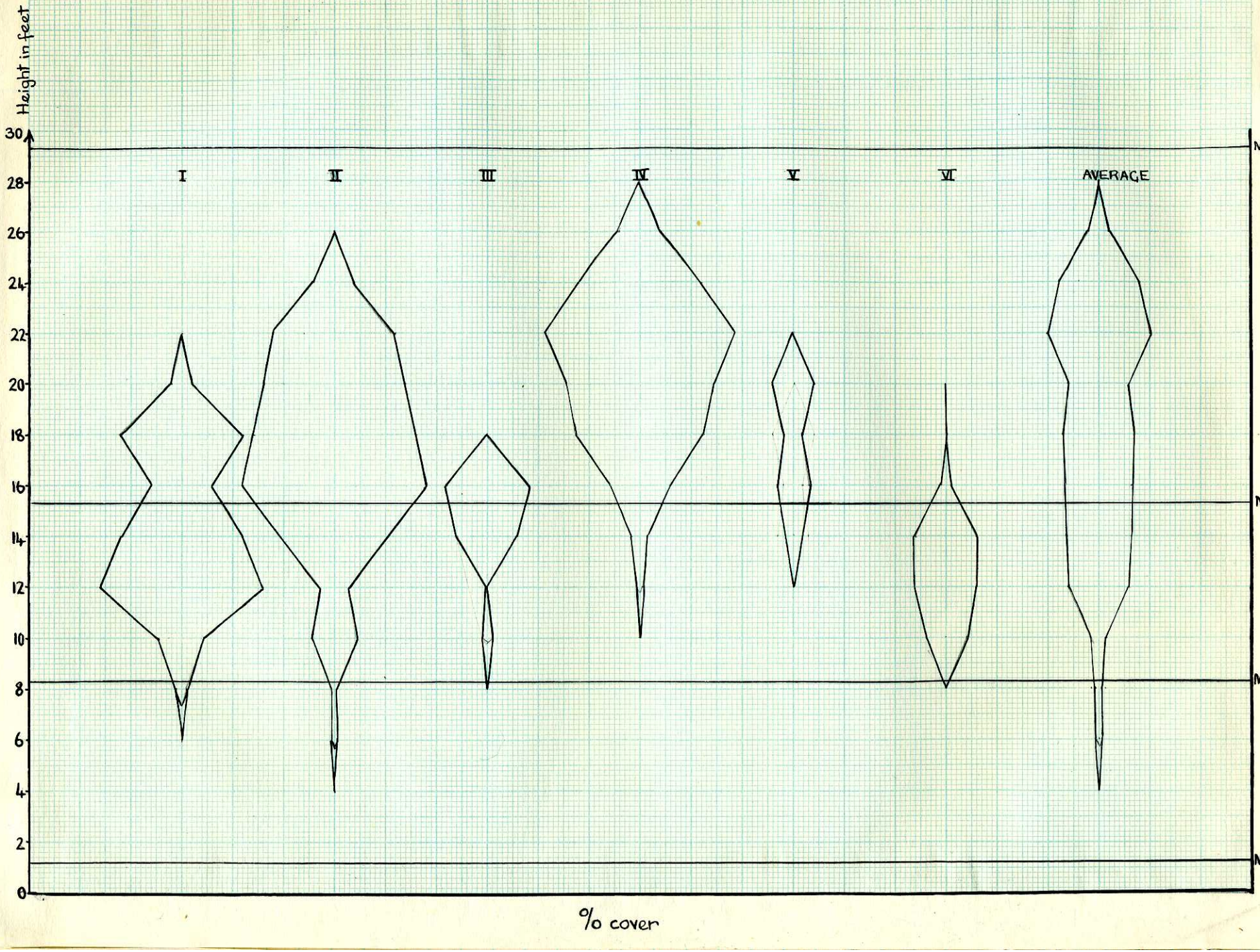
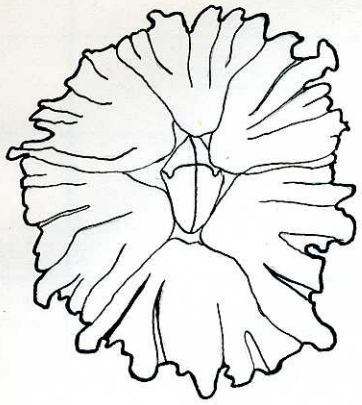
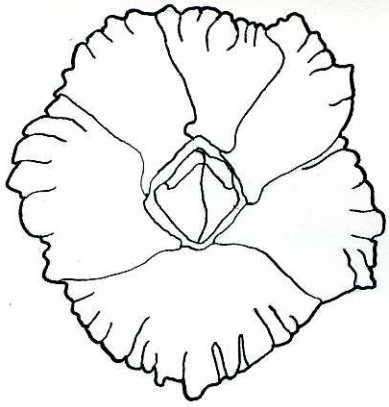


FIGURE II

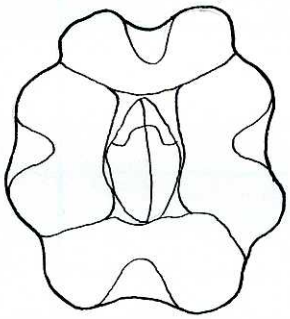
CIRRIPEDIA



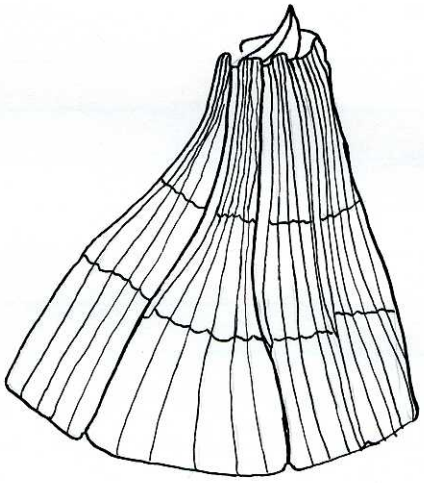
CHTHAMALUS stellatus x 8-10



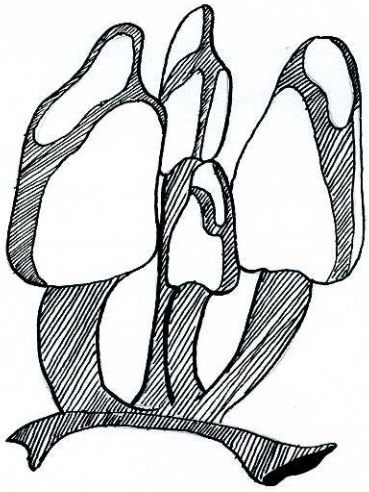
BALANUS balanoides x 8-10



ELMINIUS modestus x 10



BALANUS perforatus x 8



LEPAS anatifera x 1

Winkles (Littorinidae) Fig. 14

Littorina neritoides, Littorina saxatilis and Littorina obtusata were the only winkles recorded on the island shore.

Littorina neritoides, small periwinkle, has a small, pointed, fragile shell which is smooth and dark coloured with a bloom on its surface as on blue grapes. It is upto 1/5 inch high and a little less wide. The average lower limit of occurence is 20 feet above C.D., and the average upper limit 30 feet with an average range of 10 feet. Thus this species is generally typical of the upper shore and splash zone. Commonly found in cracks and crevices and in the empty shells of barnacles. The range and abundance tends to decrease with greater shelter.

Transects in order of exposure : I IV II III V VI

Range of distribution : 16 12 14 4 4

Littorina saxatilis, rough periwinkle. The winkle identified as L. saxatilis on Burry Holms was just over 1/4 inch high with deep sutures and pronounced sculpture lines so that it was rough to the touch. The curve of the aperture of the shell, as it approached the junction with the spire, continued and met the spire at right angles. The columella was almost white in comparison with the rest of the shell which was dark brown. It occurs on the upper middle and upper shore. Average lower limit 12.17 feet and average upper limit is 24.5 feet with an average range 12.33 feet.

Littorina obtusata (littoralis), the flat periwinkle, has a shell which is never more than 1/2 inch high, and is rounded and flat topped. The surface has fine sculpturing appearing initially smooth.

The aperture is large and the colour variable. It is found on the middle and top of the lower shore on Fucus and Ascophyllum on which it feeds. It was recorded only on transects V and VI which had fucoids and Ascophyllum. Lower limits of 12 and 14 feet, and upper limits of 14 and 16 respectively. There was not as wide a range as one would expect.

Limpets (Patellidae)

Patella vulgata has a typically tall, cone-shaped shell. The tentacles fringing the mantle are transparent. It reaches a length of upto 2½ inches. It was found on all shores except for transect V. The average lower limit of occurrence is 6·5 feet and average upper limit 14·8 feet. However, it can be seen from the individual figures for each transect (Fig. 5) that there is a tendancy for the lower limit to be raised and upper limit to be depressed with increase in shelter.

Patella depressa (intermedia) is a much smaller limpet, being flatter with finer ribs and a margin marked with dark rays. The foot is usually dark. Marginal tentacles are opaque. It was only recorded on transect I and IV, which are two of the more exposed shores, where it occurred lower than P. vulgata. Common in pools.

Other Molluscs

Nucella lapillus, dog whelk, has the type of shell which is characteristic of exposed shores. The shell has a short cone with short siphon and many flat spiral ridges. Usually it is coloured white, but this varies. The operculum is oval. The average lower limit is 4 feet and average upper limit 18·5 feet.

The individual figures obtained for each transect on which Nucella was recorded coincide with those obtained for Balanus balanoides. Figures 12a - 12c show graphs that illustrate the similarity in range of Balanus and Nucella. It is not surprising that their ranges coincide since Nucella is a major predator on barnacles, and seems to show a preference for Balanus balanoides rather than Chthamalus stellatus. Figure 13 shows the abundance of Nucella on each transect in histogram form.

Mytilus edulis, the edible ~~mussel~~ mussel, has a dark blue shell from which the frilled edge of the mantle protrudes when the valves are open. It is found in very dense clusters of small individuals over the rocks of the island distributed amongst the barnacles, and also at the bottom of the transects almost covered by sand. The specimens were small and stunted, which is characteristic of Mytilus found on exposed shores. Mytilus was found on all transects, the lower limit increasing with shelter and the upper limit decreasing. Average lower limit was 6.3 feet, upper limit 17.67 feet and average range of 10 feet. Abundance as recorded on the transects is very irregular. A mean histogram shows that they tend to be more abundant lower down the shore, and they decrease in numbers with height.

FIGURE 12a

NUCELLA lapillus AND BALANUS balanoides

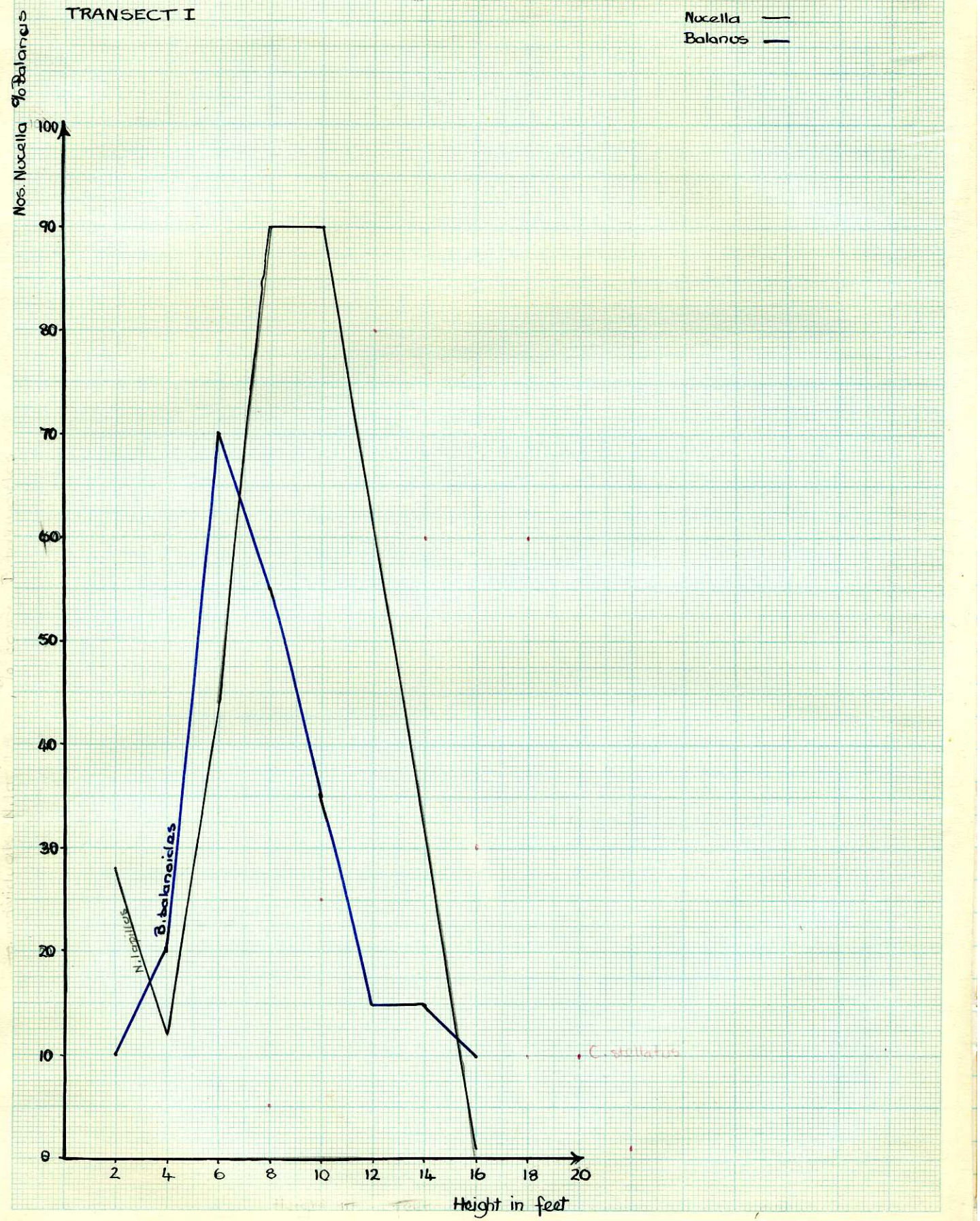


FIGURE 12b

NUCELLA lapillus and BALANUS balanoides

TRANSECT II

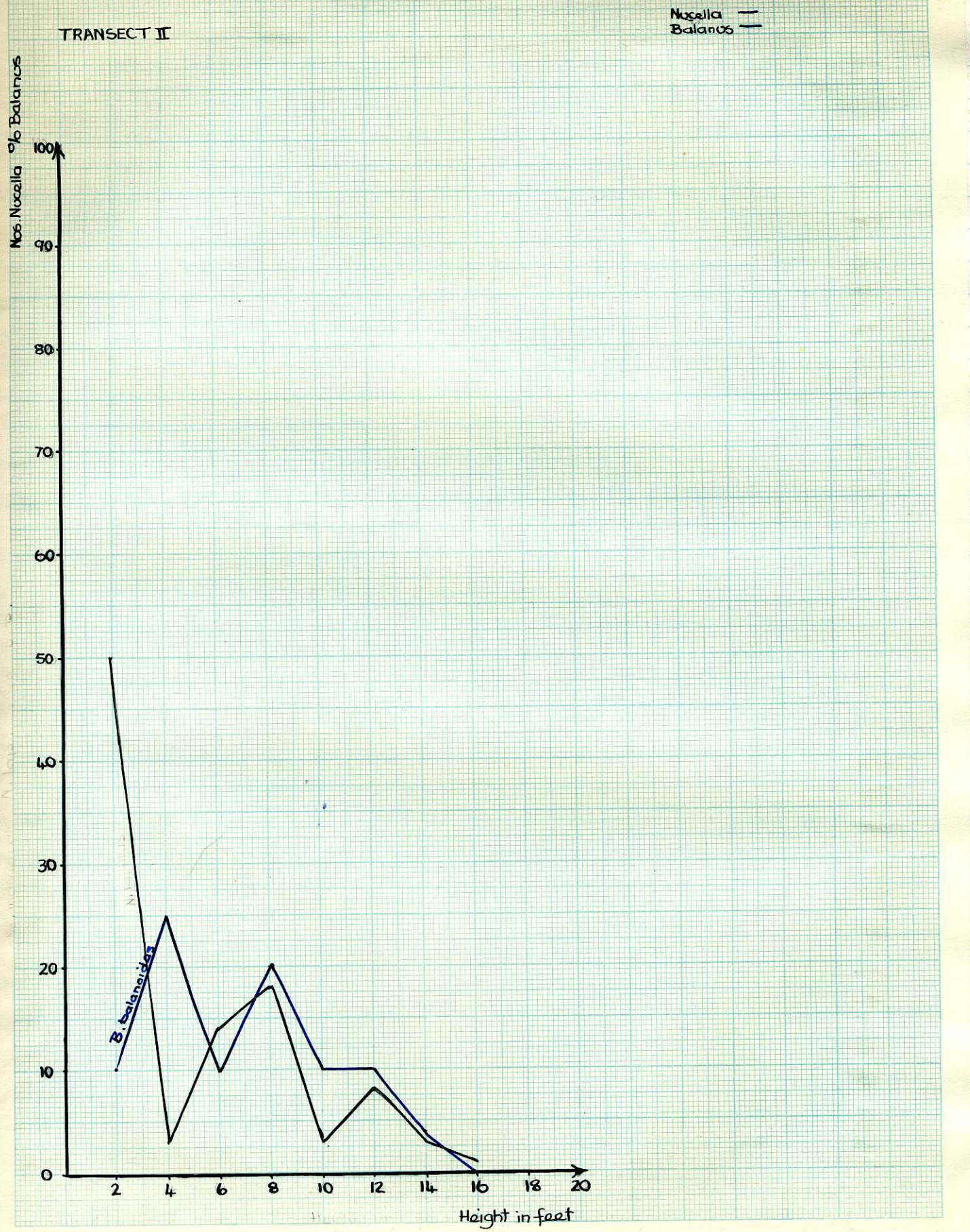


FIGURE 12 c

NUCELLA lapillus and BALANUS balanoides

TRANSECT IV

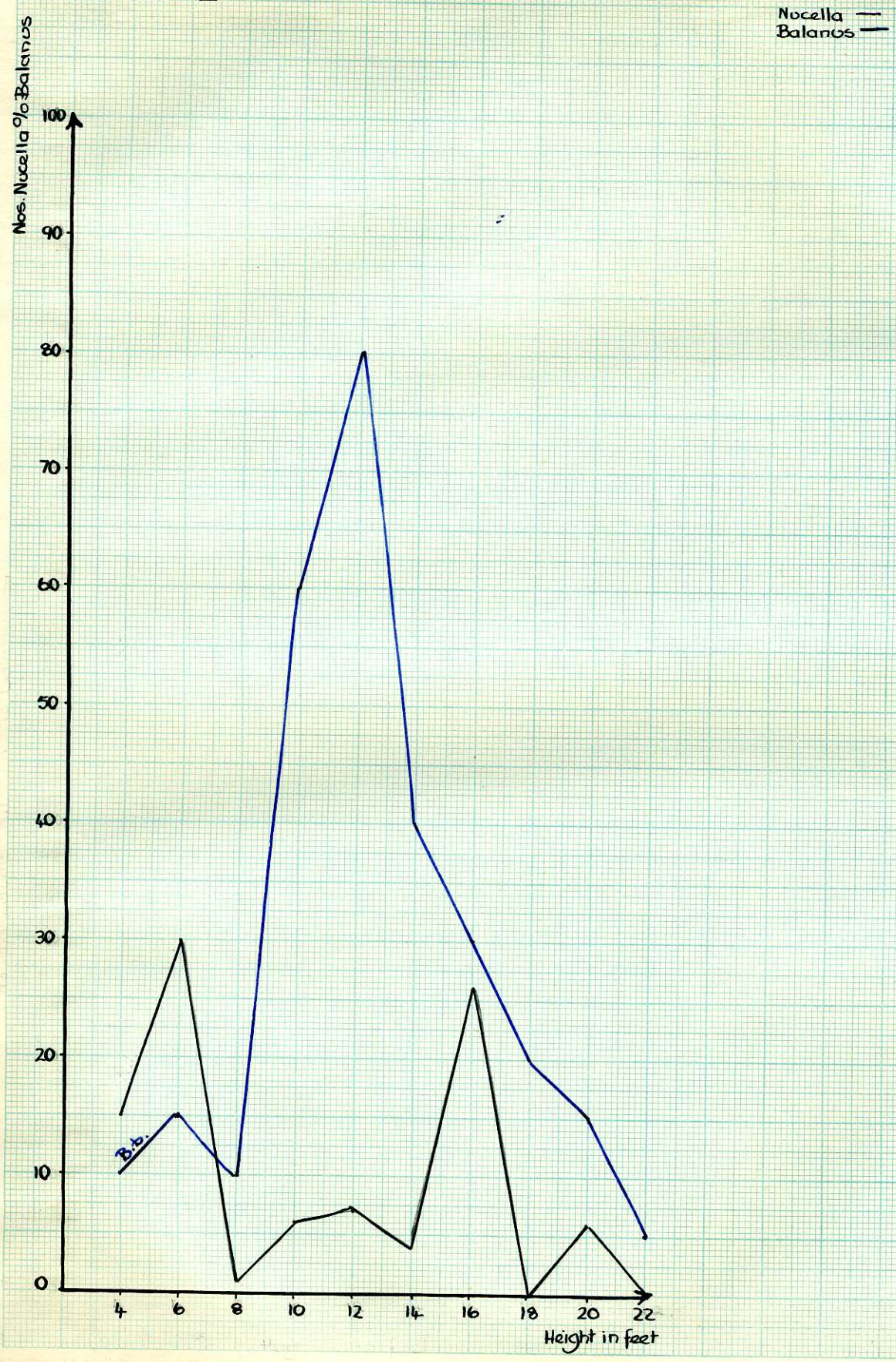


FIGURE 13

HISTOGRAMS OF NUCELLA lapillus

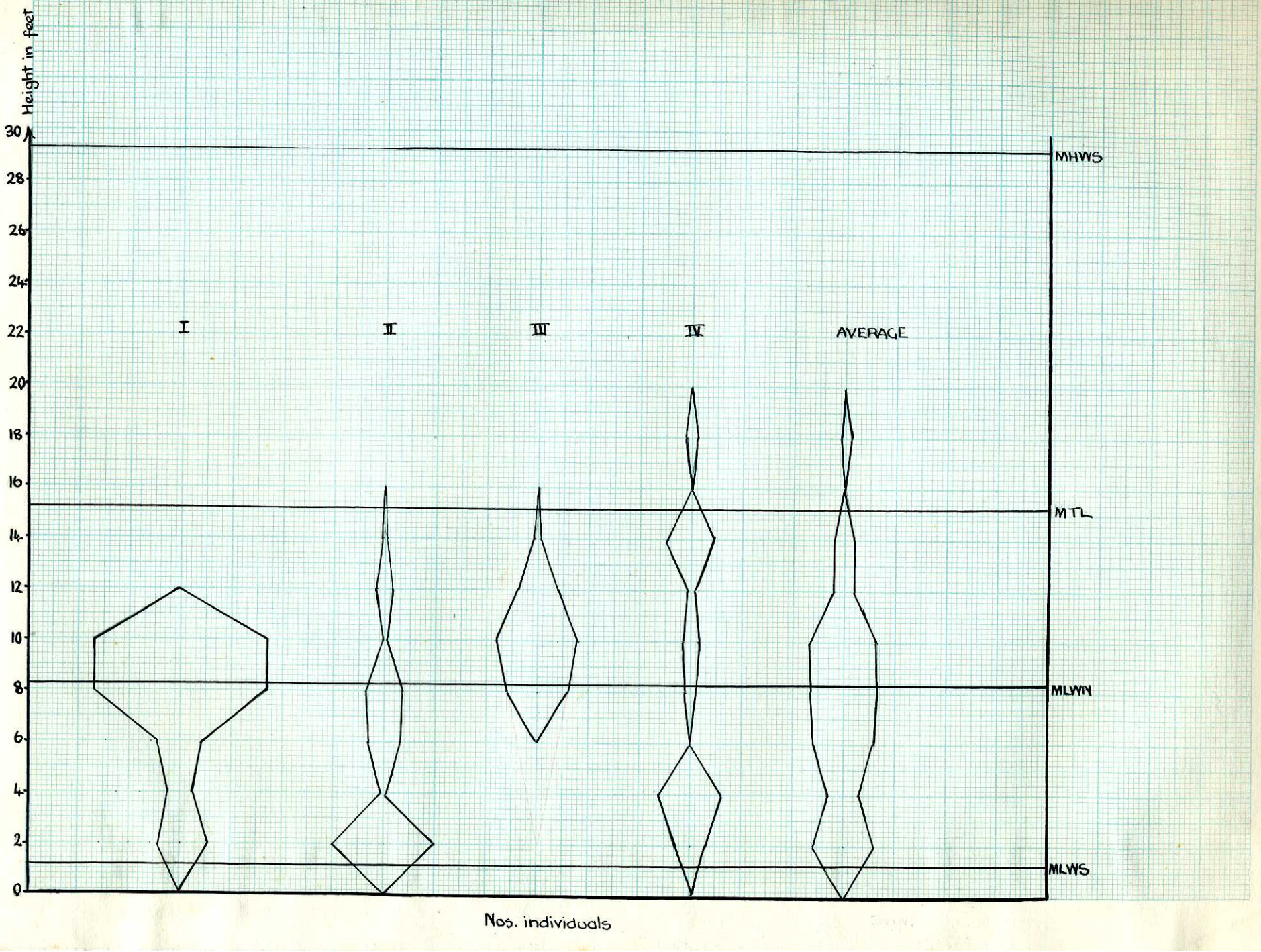


FIGURE 15

HISTOGRAMS OF COMMON MOLLUSCS

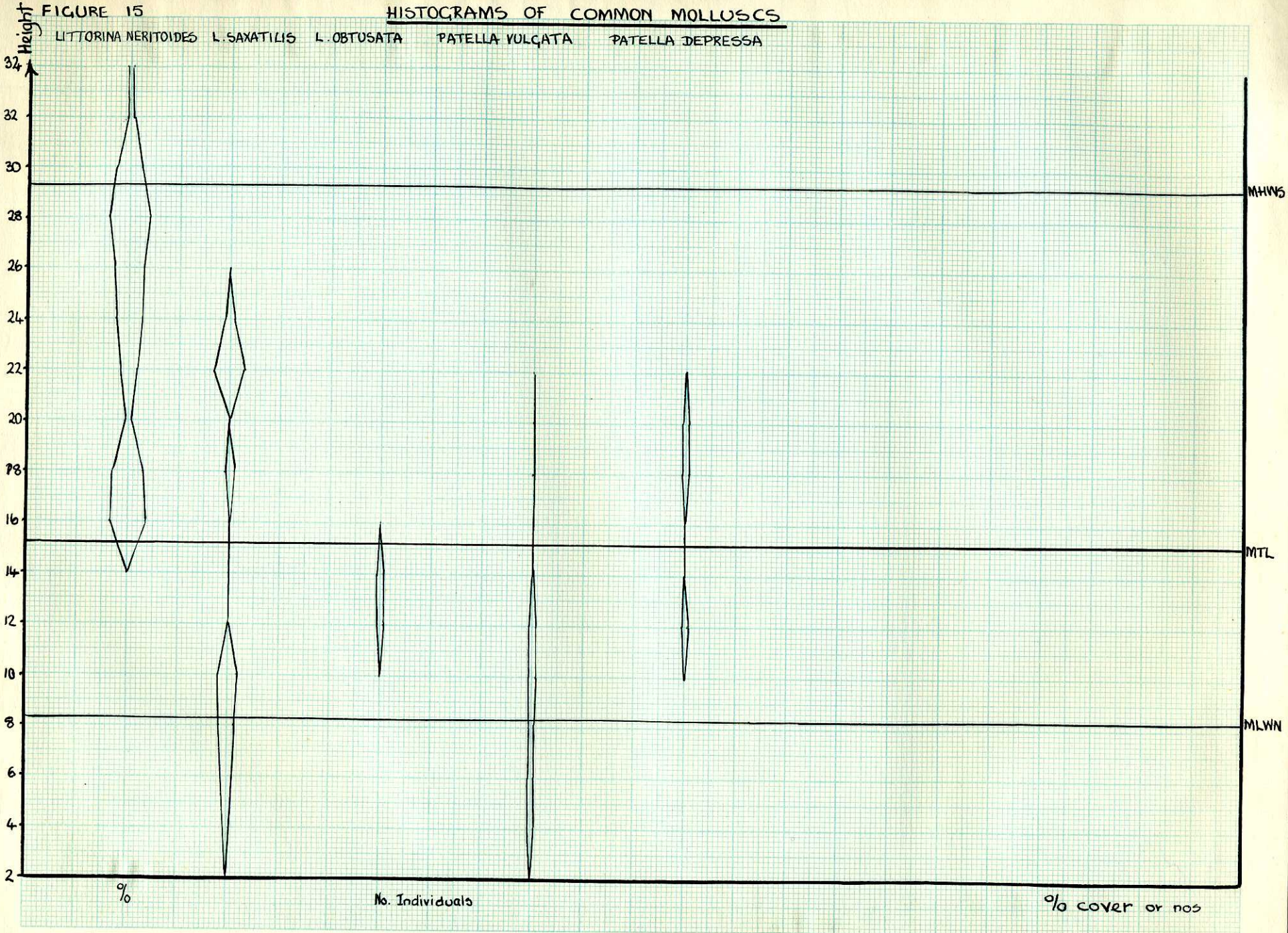
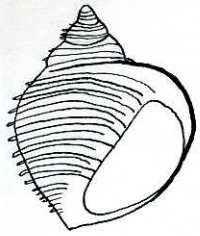
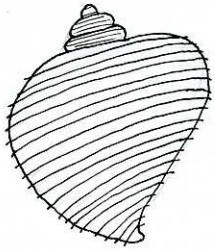


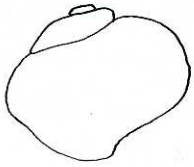
FIGURE 14

MOLLUSCA

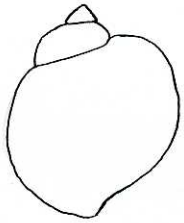




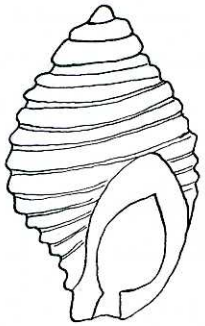
LITTORINA saxatilis x 4

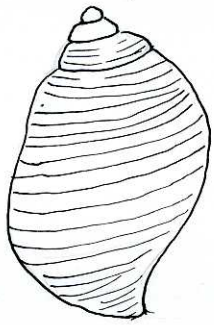


LITTORINA littoralis (obtusata) x 2

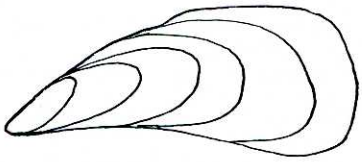


LITTORINA neritoides x 4





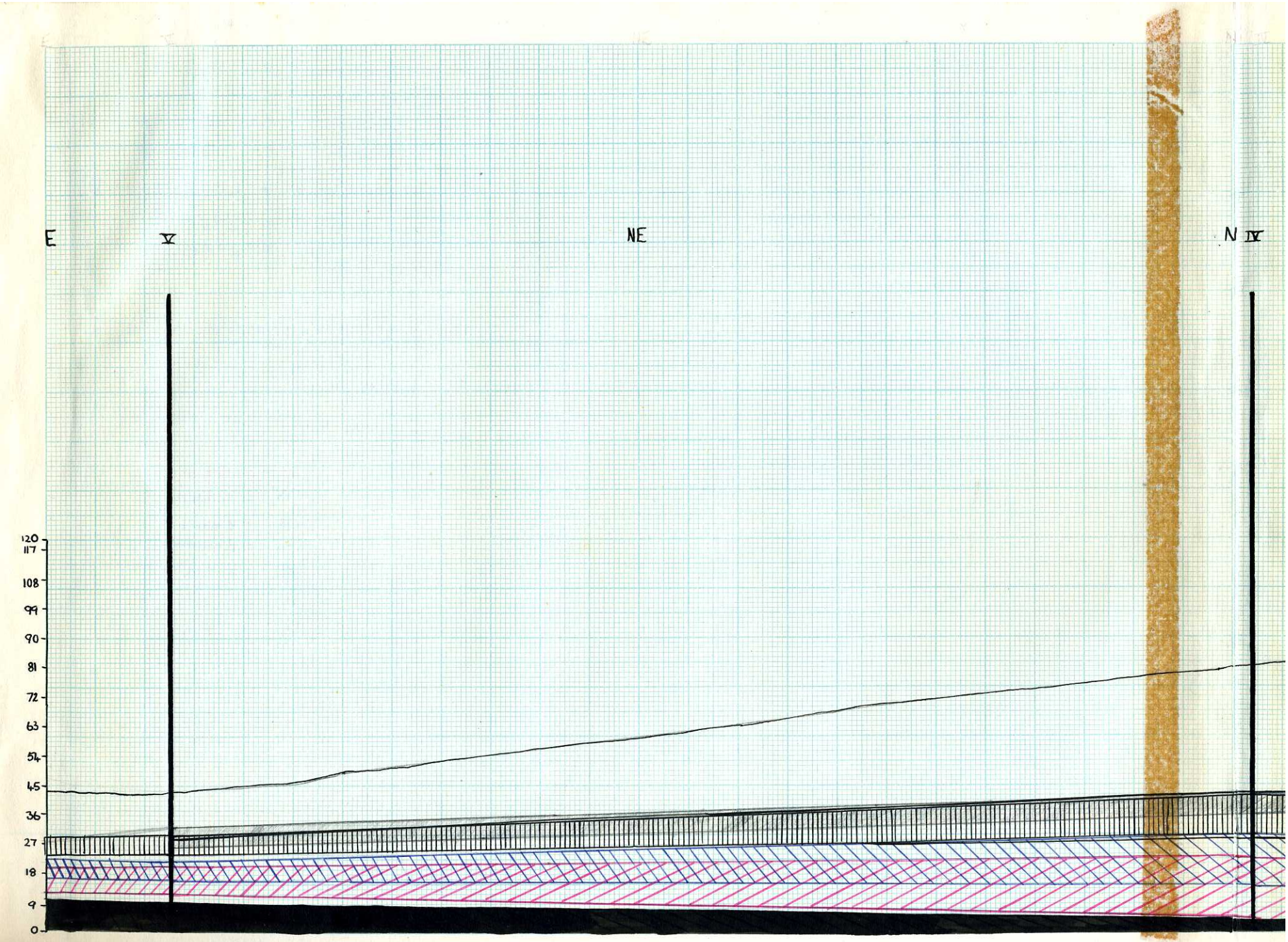
NUCELLA lapillos x 2

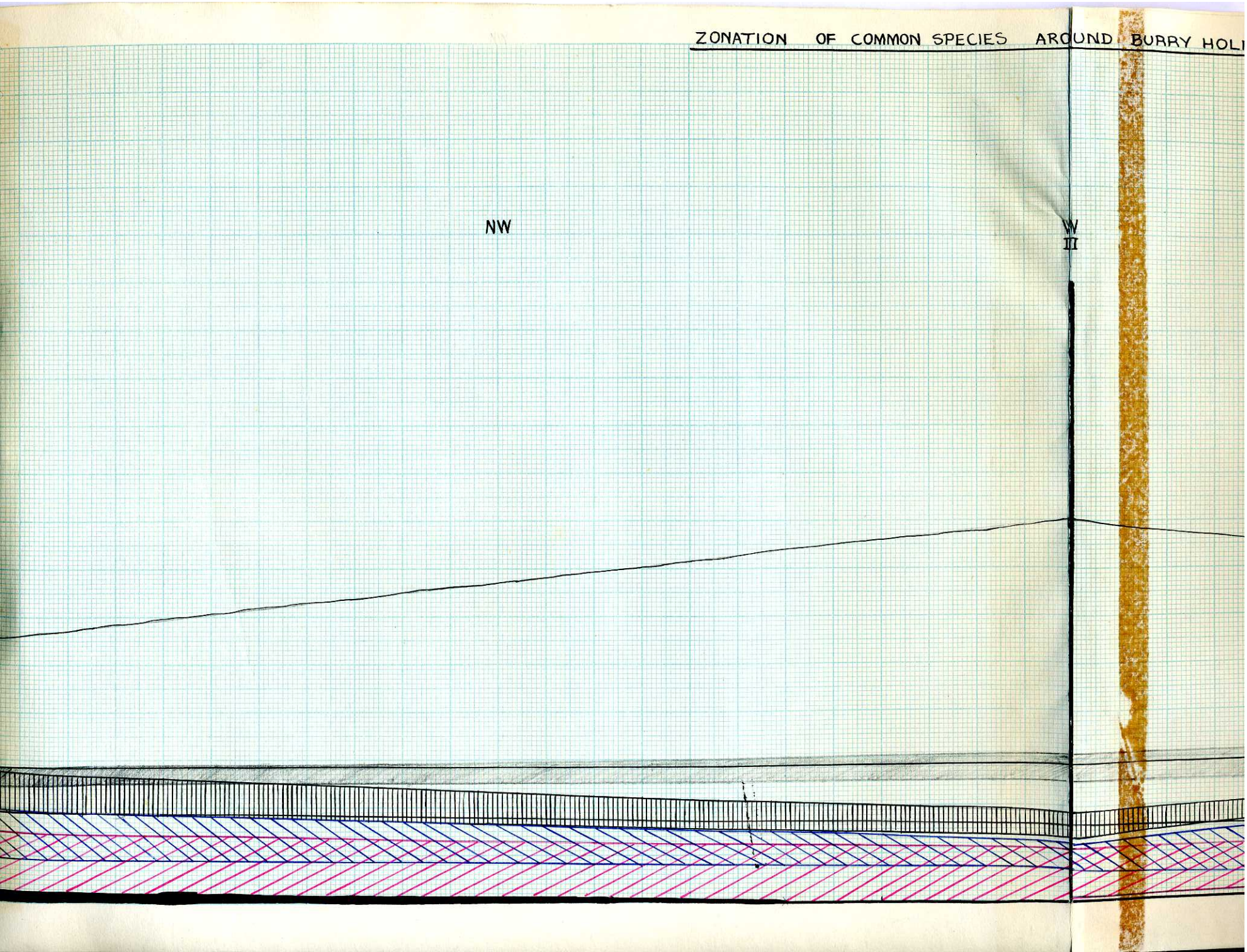


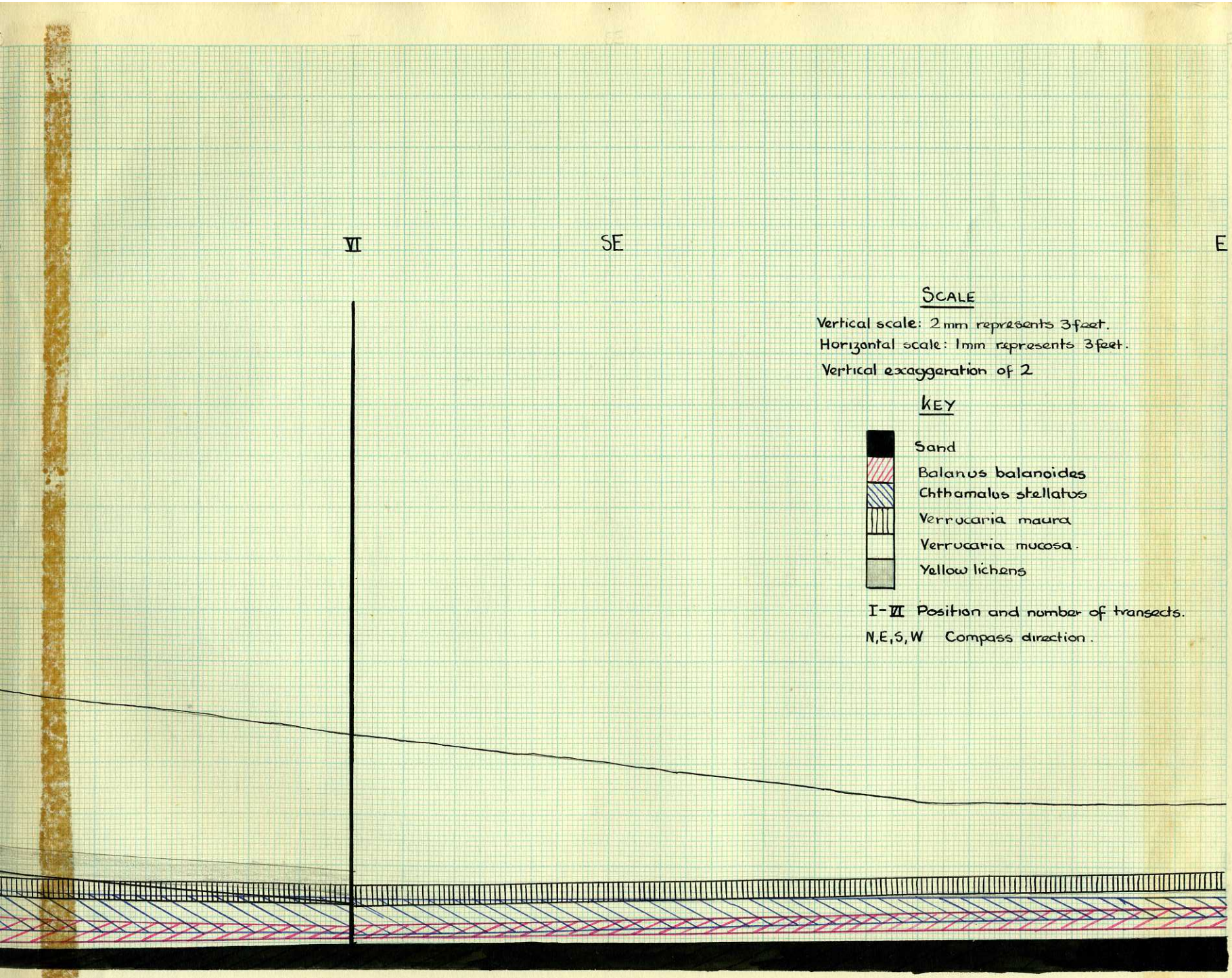
MYTILUS edulis x 1

Actinia equina did not coincide frequently with the stations, but its presence was noted on all the transects, generally occupying the lower tidal levels in pools and on the sheltered side of rock crevices. On the southwest rocks numerous beadlet anemones were found on the vertical faces of limestone quite free of seaweeds. Here, however, they were only uncovered for very short periods during the tidal cycle and were safe from desiccation.

Figure 16 can be regarded as a summary of the zonation of the more common and immediately obvious species on Burry Holms. The diagram represents the complete extent of rocky shore around the island, the positions of the transects and compass directions being marked. The circumference and height of the island were estimated, but the vertical ranges of species are drawn exactly to scale. It is possible to see clearly the relation of one species zone to another, and the general tendencies such as decrease in range with increase in shelter towards the east, that are referred to in the text. A brief survey of the island four months later, in February revealed that the zonation was much the same, but that abundance was greatly reduced. Species such as Nucella lapillus and Actinia equina that were present on the vertical faces of rocks in October were now confined to crevices.


E
V
NE
N
IV
120
117
108
99
90
81
72
63
54
45
36
27
18
9
0


ZONATION OF COMMON SPECIES AROUND BURRY HOLI
NW
W
II



SCALE

Vertical scale: 2 mm represents 3 feet.
Horizontal scale: 1 mm represents 3 feet.
Vertical exaggeration of 2

KEY

- Sand
- Balanus balanoides
- Chthamalus stellatus
- Verrucaria maura
- Verrucaria mucosa.
- Yellow lichens

I-VI Position and number of transects.
N, E, S, W Compass direction.

Bibliography

A Biologically-defined Exposure Scale for the Comparative Description of Rocky Shores, W.J. Ballantine

Marine Biology of Milford Haven: The Distribution of Littoral Plants and Animals, A. Nelson-Smith

Ecology, E.P. Odum.

Guide to the sea shore, J.H Barret and C.M. Yonge.

The Sea shore, C.M. Yonge.