

## ROCKY SHORE COMMUNITIES ON LUNDY. VERTICAL ZONATION AT FOUR SITES

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### INTRODUCTION

Lundy shores are exposed to widely different degrees of wave action and, since wave energy is the single most important factor determining the plant and animal communities which develop on the shore, a wide range of community types are present. The littoral ecology of Lundy has already been described by Professor L. A. Harvey (Anon, 1948; Harvey, 1950 and 1951) and the purpose of the present paper is to describe in greater detail the abundance and vertical distribution of the main species present at four sites exposed to different conditions of wave action. The site on the north side of Rat Island in the Landing Bay is the most sheltered location which could be found and is rarely subject to strong wave action. The site at Brazen Ward on the east coast is sheltered from long-distance swell and is exposed to infrequent though often strong wave action. The Lametry site is open to very strong wave action during frequent storms but is largely sheltered from swell whilst strong wave action is less frequent than on the west coast. The site at Dead Cow Point on the west coast is exposed to almost continuous swell and to very strong wave action during frequent storms. Sites at Rat Island and Brazen Ward were surveyed in July 1976 and at Lametry and Dead Cow Point in July 1977.

### METHODS

At each site an approximately 2 m wide strip of shore was selected extending from low water level to the lichens in the splash zone and, where possible, to the lowest limit of flowering plants. The shore chosen was as unbroken as possible and considered representative of the surrounding area. A tape measure was laid along the strip of shore selected. A 'cross-staff' sighting device was used to locate stations at vertical intervals of 60 cm along the tape starting at sea level at the time of low water. The distance between each station is approximately one-tenth of the spring tidal range and, at other locations in the British Isles, this distance has been found to ensure the inclusion of the main communities at different levels on the shore. Species were identified as far as possible in the field. There was no attempt to identify separate species of limpets (*Patella* spp.) or to separate the winkles *Littorina obtusata* and *L. mariaae* which are here included together as *L. littoralis*. The presence of *Chthamalus montagui* as a part of the *Chthamalus* population in Britain was only noted in the scientific press in late 1976 and, since it was not included in survey checklists, we have had to refer to *Chthamalus* spp. which includes *C. montagui* and *C. stellatus*. No attempt has been made to split the *Littorina saxatilis* aggregate into the many separate species now described.

All conspicuous species on open rock and out of pools were noted. Records were made on checklists used as 'memory joggers' to ensure that the main species were consistently searched for. The percentage cover of plants or their density where they were sparse was estimated and recorded as either percentage cover or as an abundance notation obtained from the scale shown in Table I. The density of animal species was estimated for the width of the transect with the help of rough counts in quadrats of 0.01 or 0.1 m<sup>2</sup> in area and was recorded as estimated density or as an abundance notation obtained from the scale shown in Table I. The position of each survey station along the tape measure was noted to assist in the drawing of a transect profile. Data on the main species present at the four sites were plotted onto separate tables for each species and ordered to provide a basis for the preparation of kite histograms drawn to illustrate the vertical distribution and abundance of species on each shore.

## RESULTS

A total of 114 species or taxa were recorded during the surveys; 81 from Rat Island, 87 from Brazen Ward, 51 from Lametry and 34 from Dead Cow Point. The vertical distribution and abundance of the main species present on the four shores surveyed are shown in Figs. 1 to 4 which also include shore profiles, survey dates and the Ordnance Survey map reference from the 1967 edition of the 1 : 10,560 map. Species recorded but not included in the figures are listed in Table II whilst data on their abundance and vertical extent are held by the authors.

Figs. 1 to 4 clearly illustrate that each species occupied a restricted vertical extent of the shore which was different to most other species but similar on each separate shore for the same species. Many species extended to about 6 to 7 m above Chart Datum level, the height of ordinary spring tides. Several species were present only near to low water level whilst several others were present only in the splash zone above high water level. There were many differences between the sheltered and exposed shores and the main changes which occurred in rock shore communities from sheltered to exposed sites on Lundy are summarized below.

1. Reduction in the variety of species present, particularly between the two sheltered and the two exposed sites.
2. Reduction in the abundance of *Ascophyllum nodosum* and *Fucus serratus* which were only present in significant amounts at Rat Island.
3. Reduction in abundance and absence at the most exposed site of *Laurencia pinnatifida*.
4. Reduction in the abundance of *Fucus vesiculosus* f. *linearis* and *Fucus spiralis*.
5. Absence of *Pelvetia canaliculata* and *Verrucaria mucosa* from the most exposed site.
6. Absence of *Palmaria palmata* from rock at the two most exposed sites.
7. Reduction in the upward extent of *Himanthalia elongata* and *Gigartina stellata*.
8. Reduction in the abundance and extent of the barnacles *Balanus balanoides* and *Elminius modestus*.
9. Reduction in the abundance of the dogwhelk *Nucella lapillus* at the most exposed sites.
10. Absence of the isopods, *Idotea* sp., *Dynamene bidentata*, the barnacle *Balanus perforatus* and the wrinkle *Littorina littoralis* from the two most exposed sites.
11. Increased abundance and upward limit of *Porphyra* spp. (present from 1.4 to 6.8 m at Brazen Ward compared to about 5.0 to 11.0 m above Chart Datum at the two exposed sites). Possibly due to the addition of *P. linearis* and *P. umbilicalis* on exposed shores.
12. Presence of *Alaria esculenta* at the three most exposed sites.
13. Increased abundance and vertical extent of *Lichina pygmaea* and *Verrucaria maura*, particularly at the two most exposed compared to the two most sheltered shores.
14. Greatly increased upward extension of both the lower and upper limits of splash zone lichens, *Caloplaca* sp., *Xanthoria* sp., *Lecanora* sp. and *Lichina confinis* (for instance, *Caloplaca* sp. from between 8.6 and 12.2 m at Brazen Ward to between 14.0 and 19.4 m above Chart Datum at Dead Cow Point).
15. Increase in the abundance and vertical extent, both upwards and downwards, of the wrinkle *Littorina neritoides* (present to a maximum height of 8.4 m at the two sheltered sites compared to more than 14.4 m above Chart Datum at the two exposed sites).

16. Small increase in the upward extent of *Patella* sp. (from 6.0 m at Rat Island to 8.0 m above Chart Datum at Dead Cow Point), *Chthamalus* spp. (from 7.4 m at Rat Island to 10.4 m above Chart Datum at Dead Cow Point) and *Littorina neglecta* (from 6.8 m at Rat Island to 8.0 m above Chart Datum at Dead Cow Point).
17. Increased abundance of *Chthamalus* spp. and *Littorina neglecta* particularly compared to Rat Island.
18. Increased abundance and vertical extent of *Littorina saxatilis* from the most sheltered site to Lametry, then a fall in abundance at the most exposed site.

Some differences in the communities present on each shore did not correlate with differences in exposure to wave action. At Rat Island, and to a lesser extent Brazen Ward, several species extended much further up the shore from low water level than at other sites: e.g. *Himantalia elongata*, *Laminaria digitata*, *Pomatoceros triquetus* and *Balanus perforatus* whilst spirorbinid tube worms were only recorded at Rat Island and extended a considerable distance up the shore.

## DISCUSSION

The species recorded on Lundy shores and their vertical distribution along each transect are typical of sites exposed to similar degrees of wave action in south-west Britain. However, several aspects of the communities present at the four sites investigated make it difficult to assign an exposure grade to the shores using the biologically defined exposure scale described by Ballantine (1961) based on Pembrokeshire shores. For instance, at Rat Island, most of the *Fucus vesiculosus* was of the form *linearis* thus suggesting a grade 5 ('Fairly Sheltered') shore whilst *Ascophyllum nodosum* was Abundant suggesting a grade 7 ('Very sheltered') shore.

The richest shores are those on the east coast where less wave action and greater cover by algae enables the establishment of a wide variety of species. This is particularly the case at Rat Island where the northern aspect of the site and the dense cover of algae leads to the presence of damp conditions which, in turn, enables the survival of lower shore species intolerant of desiccation to a much higher level than on other shores. The Rat Island site is also at the entrance to the gully between Rat and Mouse Islands where strong tidal streams are present leading to the removal of silt and provision of a large food supply for suspension feeders; these conditions encourage a rich growth of organisms. The dense growth of algae on fairly steeply sloping rock at Rat Island is doubtless present because of the shelter of the site whilst, at Brazen Ward, the gradual slope of the rock is important in allowing the development of a fairly dense algal cover on an open coast site.

No topshells (species of *Gibbula* and *Monodonta lineata*) were recorded during the transect surveys though they are present on Lundy. These species are a major component of shore communities in other parts of south-west Britain and their absence is unexplained.

## ACKNOWLEDGEMENTS

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TABLE I

Interpretation of notations used to describe the abundance of organisms included in Figs. 1 to 4. Ex = Extremely Abundant, S = Superabundant, A = Abundant, C = Common, F = Frequent, O = Occasional, R = Rare.

1. Lichens and lithothamnia	2. Algae	
Ex 80%+ cover	Ex 90%+ cover	
S 50-79% cover	S 60-89% cover	
A 20-49% cover	A 30-59% cover	
C 1-19% cover	C 5-29% cover	
F Large scattered patches	F <5% cover, zone still apparent	
O Widely scattered patches, all small	O Scattered plants, zone indistinct	
R Only one or two patches	R Only one or two plants	
3. Live barnacles except <u>B. balanus perforatus</u> , <u>Littorina neritoides</u> , <u>Littorina neglecta</u>	4. <u>Balanus perforatus</u>	5. <u>Patella</u> spp., <u>Littorina saxatilis</u> , <u>Hyale nilsoni</u>
Ex 500+/0.01m <sup>2</sup>	Ex 300+/0.01m <sup>2</sup>	Ex 50+/0.1m <sup>2</sup>
S 300-499/0.01m <sup>2</sup>	S 100-299/0.01m <sup>2</sup>	S 20-49/0.1m <sup>2</sup>
A 100-299/0.01m <sup>2</sup>	A 10-99/0.01m <sup>2</sup>	A 10-19/0.1m <sup>2</sup>
C 10-99/0.01m <sup>2</sup>	C 1-9/0.01m <sup>2</sup>	C 5-9/0.1m <sup>2</sup>
F 1-9/0.01m <sup>2</sup>	F 1-9/0.1m <sup>2</sup>	F 1-4/0.1m <sup>2</sup>
O 1-99/m <sup>2</sup>	O 1-9/m <sup>2</sup>	O 1-9/m <sup>2</sup>
R <1/m <sup>2</sup>	R <1/m <sup>2</sup>	R <1/m <sup>2</sup>
6. <u>Littorina littoralis</u>	7. <u>Nucella lapillus</u> , <u>Actinia equina</u> , <u>Idotea</u> spp., <u>Dynamene bidentata</u>	8. <u>Pomatoceros triquetus</u>
Ex 20+/0.1m <sup>2</sup>	Ex 10+/0.1m <sup>2</sup>	
S 10-19/0.1m <sup>2</sup>	S 5-9/0.1m <sup>2</sup>	
A 5-9/0.1m <sup>2</sup>	A 1-4/0.1m <sup>2</sup>	A 50+/0.01m <sup>2</sup>
C 1-4/0.1m <sup>2</sup>	C 5-9/m <sup>2</sup> , locally sometimes more	C 1-49/0.01m <sup>2</sup>
F 5-9/m <sup>2</sup>	F 1-4/m <sup>2</sup> , locally sometimes more	F 1-9/0.1m <sup>2</sup>
O 1-4/m <sup>2</sup>	O <1/m <sup>2</sup> , locally sometimes more	O 1-9/m <sup>2</sup>
R <1/m <sup>2</sup>	R Always <1/m <sup>2</sup>	R <1/m <sup>2</sup>
9. <u>Mytilus edulis</u>	10. Spirorbinidae	
Ex 80%+ cover		
S 50-79% cover		
A 20-49% cover	A 5+/cm <sup>2</sup> on appropriate substrata, 100+/0.01m <sup>2</sup> generally	
C 5-19% cover or many large patches	C Patches of 5+/cm <sup>2</sup> , 1-99/0.01m <sup>2</sup> generally	
F Small patches. <5% cover. 1-10 large individuals/0.1m <sup>2</sup>	F Widely scattered small groups, 1-9/0.1m <sup>2</sup> generally	
O 1-10/m <sup>2</sup> , no patches except small individuals in crevices	O Widely scattered small groups, <1/0.1m <sup>2</sup> generally	
R <1/m <sup>2</sup>	R <1/m <sup>2</sup>	

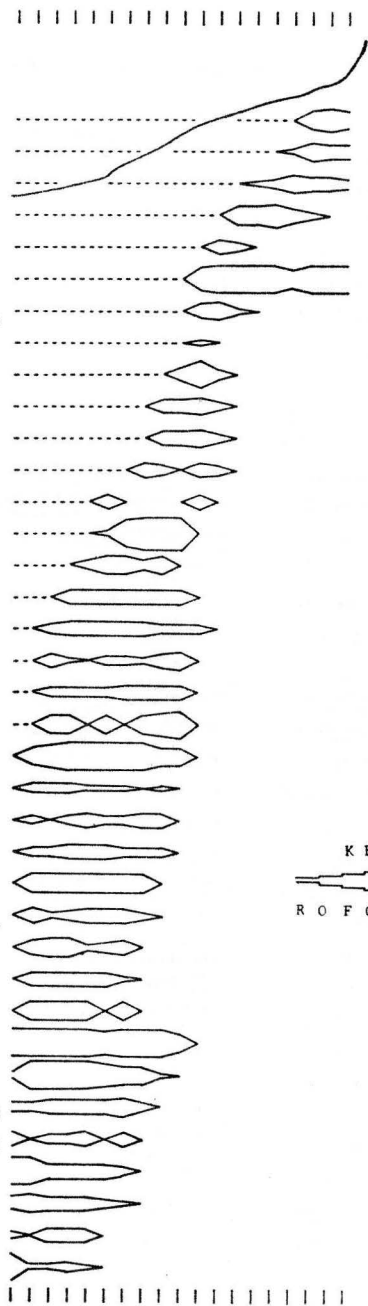
TABLE II

Species and taxa present on transects but not included in figures.

	Rat Island	Brazen Ward	Lametry	Dead Cow Point		Rat Island	Brazen Ward	Lametry	Dead Cow Point
ALGAE					ANIMALS				
<u>Gelidium</u> sp.	+	+	+	-	<u>Hymeniacion</u> <u>perleve</u>	-	-	+	-
<u>Nemalion</u> <u>helminthoides</u>	-	+	+	+	<u>Halichondria</u> <u>panicea</u>	+	-	+	-
<u>Catenella</u> <u>caespitosa</u>	+	-	-	-	Corynidae	+	-	-	-
<u>Calliblepharis</u> <u>jubata</u>	-	+	-	-	<u>Obelia</u> <u>geniculata</u>	-	+	-	-
<u>Cystoclonium</u> <u>purpureum</u>	+	-	-	-	<u>Laomedea</u> <u>flexuosa</u>	+	+	-	-
<u>Rhodophyllis</u> <u>divaricata</u>	-	+	-	-	<u>Dynamena</u> <u>pumila</u>	+	-	-	-
<u>Phyllophora</u> <u>membranifolia</u>	+	-	-	-	<u>Tealia</u> <u>felina</u>	-	-	+	-
<u>Chondrus</u> <u>crispus</u>	+	+	+	+	<u>Diadumene</u> <u>cincta</u>	+	-	-	-
<u>Dumontia</u> <u>incrassata</u>	-	+	-	-	<u>Cereus</u> <u>pedunculatus</u>	-	-	+	-
<u>Calophyllis</u> <u>laciniata</u>	-	+	-	-	<u>Sagartia</u> <u>elegans</u>	+	-	-	-
<u>Gastroclonium</u> <u>ovatum</u>	-	+	+	+	<u>Corynactis</u> <u>viridis</u>	+	+	-	-
<u>Lomentaria</u> <u>articulata</u>	+	+	-	-	<u>Polydora</u> sp.	+	+	-	-
<u>Lomentaria</u> <u>clavellosa</u>	-	-	+	+	Cirratulidae	+	-	-	-
<u>Ceramium</u> sp.	-	+	-	-	<u>Verruca</u> <u>stroemia</u>	+	+	-	-
<u>Ceramium/Callithamnion</u> assoc.	-	+	+	+	<u>Balanus</u> <u>crenatus</u>	-	+	-	-
<u>Plumaria</u> <u>elegans</u>	+	-	-	-	<u>Ligia</u> <u>oceanica</u>	-	+	+	+
<u>Cryptopleura</u> <u>ramosa</u>	+	+	-	-	<u>Carcinus</u> <u>maenas</u> (juv.)	-	+	-	-
<u>Membranoptera</u> <u>alata</u>	+	-	-	-	<u>Anurida</u> <u>maritima</u>	-	+	+	+
<u>Laurencia</u> <u>hybrida</u>	-	+	-	-	<u>Acmaea</u> <u>virginea</u>	+	+	-	-
<u>Polysiphonia</u> sp.	+	-	-	-	<u>Patina</u> <u>pellucida</u>	+	+	-	-
<u>Spongonema</u> <u>tomentosum</u>	+	-	-	-	<u>Rissoa</u> sp.	+	+	-	-
Encrusting red/brown algae	+	+	+	+	? <u>Skeneopsis</u> <u>planorbis</u>	-	-	+	-
<u>Elachista</u> <u>fucicola</u>	+	-	-	-	<u>Ocenebra</u> <u>erinacea</u>	+	-	-	-
Filamentous brown algae	+	-	-	-	<u>Nassarius</u> <u>incrassatus</u>	+	+	-	-
<u>Leathesia</u> <u>difformis</u>	+	+	-	-	<u>Modiolus</u> sp.	+	-	-	-
<u>Petalonia</u> sp.	-	-	+	-	<u>Heteranomia</u> <u>squamula</u>	+	+	-	-
<u>Scytosiphon</u> <u>lomentaria</u>	-	+	-	-	<u>Lasaea</u> <u>rubra</u>	-	+	+	+
<u>Sphacelaria</u> sp.	-	-	+	-	<u>Hiatella</u> <u>arctica</u>	+	+	+	+
<u>Cladostephus</u> <u>spongiosus</u>	-	+	-	-	Crisiidae	+	+	-	-
<u>Ulothrix</u> sp.	+	-	-	-	<u>Membranipora</u> <u>membranacea</u>	-	+	-	-
<u>Spongomorpha</u> <u>arcta</u>	+	+	-	-	<u>Electra</u> <u>pilosa</u>	+	+	-	-
<u>Enteromorpha</u> <u>linza</u>	-	+	-	-	<u>Scrupocellaria</u> sp.	+	+	-	-
<u>Ulva</u> sp.	+	+	-	-	<u>Umbonula</u> <u>littoralis</u>	+	+	-	-
<u>Cladophora</u> sp.	+	+	+	-	<u>Flustrellidra</u> <u>hispida</u>	+	+	-	-
					<u>Alcyonidium</u> sp.	+	+	-	-
					<u>Diplosoma</u> <u>listerianum</u>	-	-	+	-
LICHENS									
<u>Ramalina</u> sp.	+	+	-	-					
Dark grey lichen spp.	-	+	-	-					

RAT ISLAND

- Lecanora sp.  
Xanthoria sp.  
Caloplaca sp.  
Lichina confinis  
Littorina neritoides  
Verrucaria maura  
Pelvetia canaliculata  
Lichina pygmaea  
Fucus spiralis  
Chthamalus spp.  
Elminius modestus  
Littorina saxatilis  
Littorina neglecta  
Aecophyllum nodosum  
Fucus vesiculosus  
Balanus balanoides  
Hyalé nilssoni  
Verrucaria mucosa  
Balanus perforatus  
Actinia equina  
Patella spp.  
Mytilus edulis  
Nucella lapillus  
Enteromorpha sp.  
Idotea sp.  
Corallina officinalis  
 Spirorbiniidae  
Palmaria palmata  
Dynamene bidentata  
 Lithothamnia  
Fucus serratus  
Laurencia pinnatifida  
Pomatoceros triqueter  
Gigartina stellata  
Himantothalia elongata  
Littorina littoralis  
Laminaria digitata



KEY  
 R O F C A S Ex

Fig. 1. Vertical extent and abundance of the main rocky shore species on the north shore of Rat Island (Map Reference: 1464 4382). Surveyed on 13th July 1976. Lowest station 1.0 m above Chart Datum. The figure illustrates the abundance of each species by the width (vertical axis) of the kite and the vertical extent of each species on the shore by the length (horizontal axis) of the kite. The marks at the top and bottom of the figures represent survey stations at 0.6 m vertical intervals up the shore with the lowest station on the left. A profile of the shore is also shown.

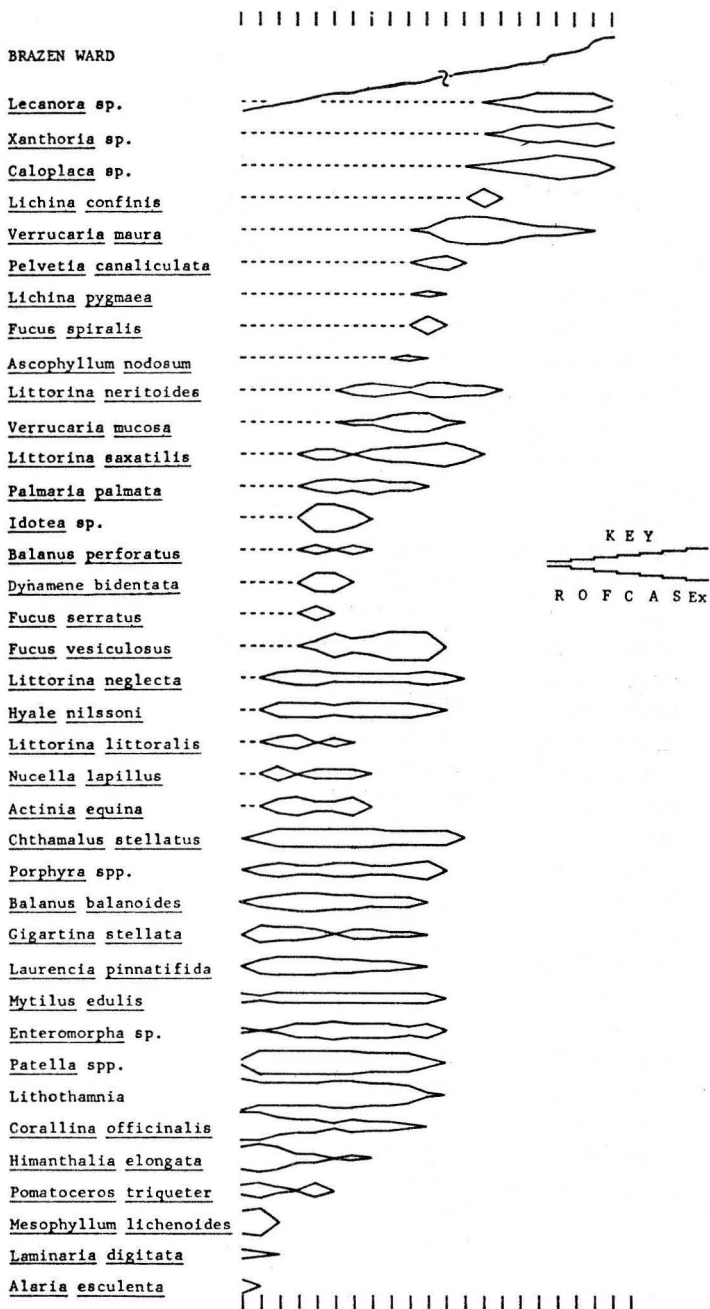


Fig. 2. Vertical extent and abundance of the main rocky shore species at Brazen Ward (Map Reference: 1394 4681). Surveyed on 12th July 1976. Lowest station 0.8 m above Chart Datum (Explanation of diagram in Fig. 1).

LAMETRY

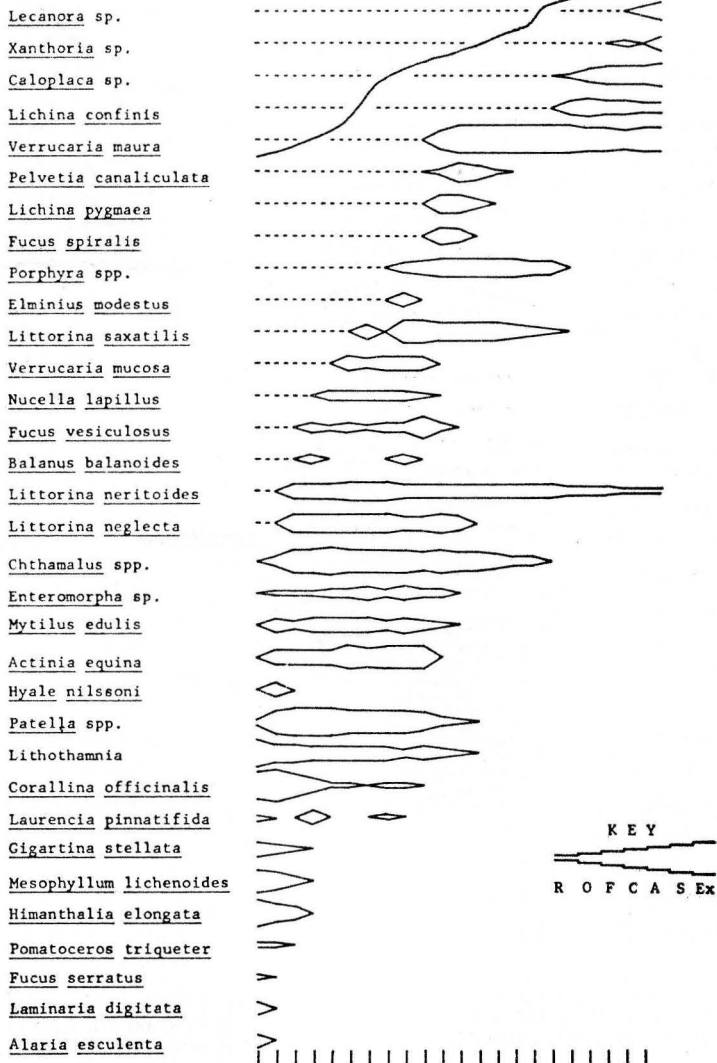


Fig. 3. Vertical extent and abundance of the main rocky shore species to the east of Lametry Bay (Map Reference: 1452 4358). Surveyed 4th July 1977. Lowest station 0.8 m above Chart Datum. (Explanation of diagram in Fig. 1).



DEAD COW POINT

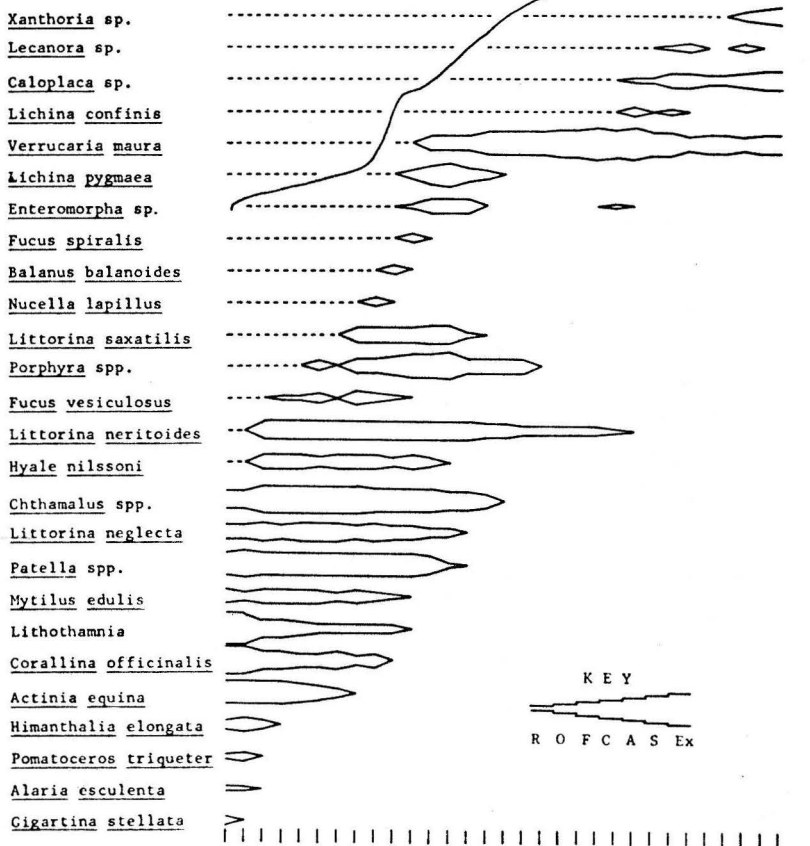


Fig. 4. Vertical extent and abundance of the main rocky shore species adjacent to Dead Cow Point (Map Reference: 1275 4525). Surveyed on 4th July 1977. Lowest station 1.0 m above Chart Datum. (Explanation of diagram in Fig. 1).