Porcupine Newsletter

Volume 3 Number 3

MARCH 1985

ISSN 0309 - 3085

CONTENTS

*****

MEMBERSHIP. We are pleased to report that our membership increases unfalteringly and is now approaching 200. Can we pass this tempting target this year?

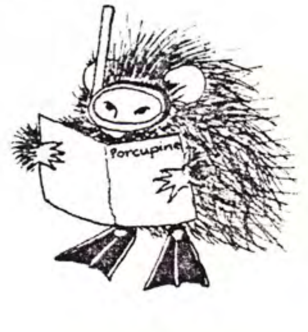
NO INCREASE IN SUBSCRIPTION IN 1986 for those who pay before 1 April 1986 (see AGM report). Your 1986 subscription is due on 1 January. As a concession to those Members who pay in good time, £1 may be deducted from the new subscription rate of £4. Please note that Members who pay by standing order will therefore not need to alter the amount due. If you wish to pay by standing order please obtain a banker's order form from the Hon Treasurer, David Heppell, at the Royal Scottish Museum, Edinburgh EH1 1JF. We hope you will agree that the subscription remains excellent value.

FUTURE MEETINGS. 1. The next "Porcupine" meeting will be a field meeting on the Isle of Skye. The date of commencement is Saturday 29 June and details are given in Notice 1 of this issue.

2. A joint meeting with another society is being sought in the autumn. Details will appear in the next PN.

3. The 1986 AGM will be in Portsmouth.

Frank Evans, Editor,
Dove Marine Laboratory, Cullercoats, North Shields NE30 4PZ, England.



REPORTS OF THE MANCHESTER MEETING, 23 AND 24 FEBRUARY 1985.

PATCHINESS AND FLUCTUATIONS ON MODERATELY-EXPOSED ROCKY SHORES

S. J. Hawkins & R. G. Hartnoll
Universities of Manchester and Liverpool

Small-scale changes in a mid-tide level patchy fucoid-barnacle community were investigated for seven years on a moderately exposed shore in the Isle of Man. A fixed area was repeatedly sampled non-destructively to assess the abundance and spatial pattern of the major species present. Considerable natural change was recorded on this unpolluted shore, expecially in the seaweed cover and number of limpets.

Concurrent manipulative field experiments were run to clarify the role of biological interactions in generating and maintaining the observed fluctuations and patchiness. Local reductions in **Patella vulgata** grazing induced development of **Fucus vesiculosus** clumps. Such clumps dislodged up to 80% of settling **Semibalanus balanoides** cyprids, but encouraged aggregation and recruitment of **Patella, Actinia equina** and **Nucella lapillus.** These **Fucus** clumps, however, have a limited life expectancy ;of 1-3 years. Dense barnacles inhibited **Patella** grazing and growth. A simple model of the generation and maintainance of patchiness was presented.

This work is to be published in full in "Ophelia" later this year.

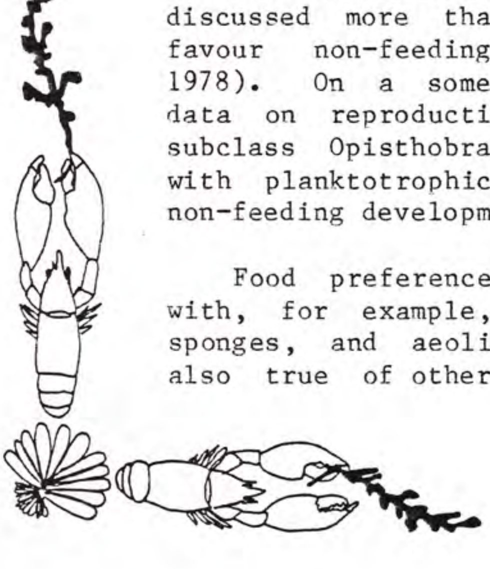
**

THE RELATIONSHIP BETWEEN PREY SPECIES AND LIFE HISTORIES OF NUDIBRANCHS

Alastair Grant
Dove Marine Laboratory, Cullercoats.

The relationship between mode of development and diet has been discussed more than once. It seems that stable food resources favour non-feeding larval development (Clark and Goetzfried, 1978). On a somewhat broader scale, Ros (1981) has argued that data on reproduction, diet and habit indicate that animals in the subclass Opisthobranchia can be divided into r- and K-strategists, with planktotrophic development characterising r-strategists and non-feeding development K-strategists.

Food preferences of nudibranchs closely follow taxonomic lines with, for example, dorids being grazers on Bryozoa, ascidians and sponges, and aeolids preying on hydroids and anemones. This is also true of other orders of opisthobranchs with sacoglossans and



aplysiaceans grazing on algae and bullomorphs being mainly sedimentivores and microcarnivores. The relationship between diet and mode of development within the suborders of nudibranchs is less clear, although direct development is frequently linked with sponge feeding. Whilst the methods used by Ros are interesting, it seems that the pattern which he discerned is only apparent at higher taxonomic levels.

A more specific hypothesis suggesting a relationship between mode of development and diet is Todd and Doyle's (1981) "settlement-timing hypothesis". This study argued that in <u>Onchidoris bilamellata</u> planktotrophic development is most suitable to bridge the time between the optimum spawning time and optimum settlement time. For their hypothesis to hold, it is necessary for both of these to be closely determined by environmental conditions. The evidence that this is the case is by no means convincing (Grant and Williamson, in press).

References

Clark, K.B. and A. Goetzfried, 1978. Zoogeographic influences on development patterns of North Atlantic Ascoglossa and Nudibranchia, with a discussion of factors affecting egg size and number. J. Mollusc. Stud. 44, 283-294.

Grant, A. and P. Williamson, in press. Settlement timing hypothesis: a critique. Marine Ecology Progress Series.

Ros, J. Estrategias ecologicas en los Opistobranquios. Com. Prim. Congr. Nac. Malac. Madrid, 1980 pp85-93.

Todd, C.D. and R. W. Doyle, 1981. Reproductive strategies of marine benthic invertebrates: a settlement timing hypothesis. Marine Ecology Progress Series 4: 75-83.

**

THE PROBLEMS OF BEING A ROCKY-SHORE WADER

R. W. Summers

MAFF Coypu Research Laboratory, Norwich

Wading birds are the commonest group of birds to forage in the intertidal zone of rocky shores. They are generally associated with estuaries, where most studies have been carried out, yet the density and diversity of waders on rocky shores can be as high as in estuaries. Indeed some species, for example the purple sandpiper, are almost entirely restricted to rocky shores.

There are large seasonal changes in the numbers of waders on rocky shores. Generally they occur from autumn to spring, with peak numbers in winter. In late spring they migrate to their breeding areas in arctic and temperate regions.

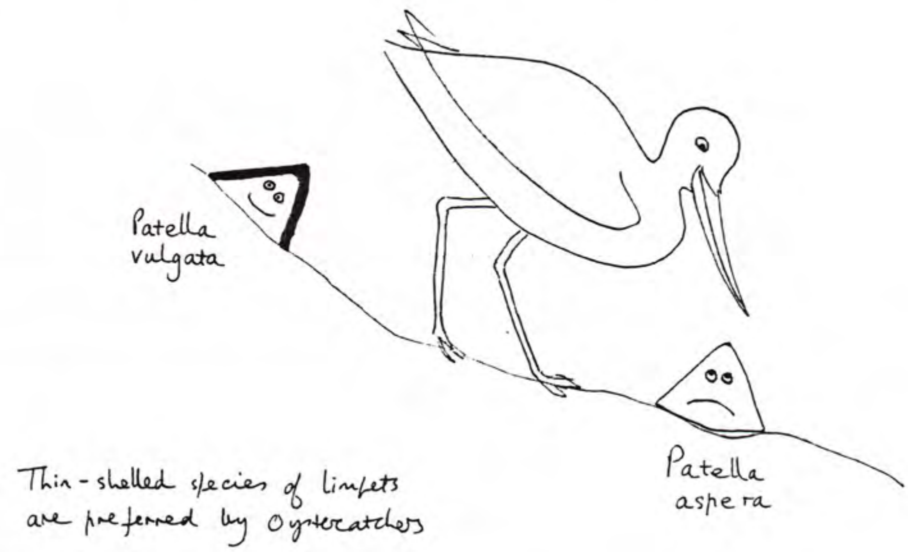
Rocky shore waders face numerous problems. In the intertidal zone they are restricted to feeding at low tide. At high tide they gather to roost at the high water mark or fly inland to feed in coastal fields. Around low tide, invertebrates are at their least accessible to waders because most stop feeding, clamp down on to rocks, close their shells or seek the undersides of rocks to avoid desiccation. However, some organisms may still be active in rock pools. Again, most waders feed close to the water's edge where it is thought that active invertebrates can still be found and shells containing animals can be distinguished from empty shells.

One of the disadvantages of foraging close to the tide line is that much time is lost avoiding waves; 13% in the case of the purple sandpiper. There is nevertheless an advantage in feeding as low down on the shore as possible. Lower-shore invertebrates tend to have thinner shells and so can be more easily smashed e.g. oyster-catchers prefer to feed on the thinner-shelled **Patella aspera** rather than **P. vulgata**, which has a thicker shell

Purple Sandpipers spend 13% of their foraging time avoiding waves.

and occurs higher on the shore (Feare, 1971). Waders vary in size from curlews (c. 1000 g) to dunlins (c. 50 g) and these differences are reflected in the diet. Oystercatchers eat the largest mussels (the valves are usually smashed to obtain the flesh), knots eat mussels up to c. 15 mm, these being swallowed whole (Summers & Smith, 1983), and purple sandpipers rarely eat mussels over 5mm. Even within a wader species there is a partitioning of the diet. Female purple sandpipers, which are bigger than males, eat larger mussels than the males.

Waders have to eat without being eaten - by peregrine falcons, sparrow hawks and owls. Waders tend to form flocks so that they can devote more time to feeding and less to being vigilant. Shore topography which reduces a bird's visibilty



results in the waders having to be more vigilant than on a more open shore (Metcalfe, 1984)

References

Feare, C. J. 1971. Bird Studies, 18, 121-129.
Metcalfe, 1984. Anim. Behav. 32, 981-985.
Summers, R. W. & Smith 1983. Ardea, 71, 151-153.

**

SOME ASPECTS OF PASSIVE SUSPENSION FEEDING

George F. Warner
Department of Pure and Applied Zoology, The University, Reading.

Passive suspension feeders filter particles from environmental currents. They include such animals as hydroids, corals and crinoids. The hydrodynamics of passive suspension feeding can be studied at the scale of filtering units, e.g. tentacle, tube foot, or at the scale of the array of units, e.g. hydroid colony, crinoid arm. Rubenstein & Koehl (1977) and LaBarbera (1984) have developed theoretical models of the filtering mechanisms at the level of the filtering units. Since the units are small, Reynold's Numbers are low and flow is laminar. Particles may be caught by sieving, where the particle diameter is greater than the spaces between units, or by 'aerosol' filtration, in which smaller particles are also filtered. There are four possible types of aerososl filtration, all of which depend crucially on contact adhesion of the particles to the filtering units. The type most frequently found in passive suspension feeders is 'direct interception', in which particles follow streamlines; in the three other types the particles diverge from the streamlines through inertia, gravity or inherent mobility.

Passive suspension feeding by branched, fan-shaped black corals (Antipatharia) was studied in Trinidad (Warner, 1981). The black coral fans were growing in an area exposed to uni-directional currents. The fans were dish-shaped with the concave side facing the current and the polyps were situated on the downstream sides of branches. Dimensions of tentacles and of branches suggested laminar flow over most surfaces at environmental current speeds. Stomach contents of polyps showed that planktonic copepods were the main food items. The dimensions of these copepods suggested that the filtering mechanism is a mixture of sieving and aerosol filtration.

The orientation of black coral fans at right angles to the current direction results in considerable drag at the scale of the entire fan. There is a pressure drop across the fan and gross turbulence on the downstream side where particles can be observed swirling in eddies. I believe that the placement of polyps on downstream sides of branches is an adaptation to facilite feeding from this downstream turbulence. It is possible that the creation of downstream turbulence by the whole filtering array may be more significant for these passive suspension feeders that the details of flow through the array.

Dish-shapes similar to those observed in black corals have been described in other passive suspension feeders exposed to unidirectional currents (see Warner, 1977, for references). Experiments with models suggested that dish-shapes with the concave side facing the current filtered more water than flat shapes of the same surface area (Warner, 1977). The adoption of a dish-shaped form through growth could either be a response to current direction or to the better feeding conditions on one side (downcurrent side) of the dish. Tidal currents in Bahamian blueholes (extensive marine cave systems) carry more suspended food particles **in** on the rising tide than are carried **out** on the falling tide (Warner & Moore, 1984). This environment can therefore be used to test whether hydrodynamic or nutritive factors are more important in controlling the growth and orientation of dish-shapes; i.e. fan-shaped passive suspension feeders will be flat if hydrodynamic factors are most important, and dish-shaped with the concave side facing the mouth of the cave if nutritive factors are most important.

Blueholes were explored in 1981 and 1982 (Warner & Moore, 1984). Only two fan-shaped species were found, the hydroid **Lytocarpus philippinus** and the stylasterine coral **Stylaster rosaceus.** Both species grew as dish-shapes orientated with the concave side facing the cave mouth. Growth to achieve a dish-shape thus responds to better nutritive conditions on one side of the fan, rather than simply to hydrographic factors.

References

LaBarbera, M. 1984. Feeding currents and particle capture mechanisms in suspension feeding animals. Amer. Zool. 24, 71-84.

Rubenstein, D. I. & M. A. R. Koehl 1977. The mechanism of filter feeding: some theoretical considerations. Am. Nat. 111, 981-994.

Warner, G. F. 1977. On the shape of passive suspension feeders. **In** Biology of Benthic Organisms ed. B. F. Keegan et al., Pergamon, Oxford, pp. 567-576.

\- 1981. Species descriptions and ecological observations of black corals (Antipatharia) from Trinidad. Bull. mar. Sci. 31, 147-163.

\- & C. A. M. Moore 1984. Ecological studies in the marine blue holes of Andros Island, Bahamas. Cave Science 11, 30-44.

**

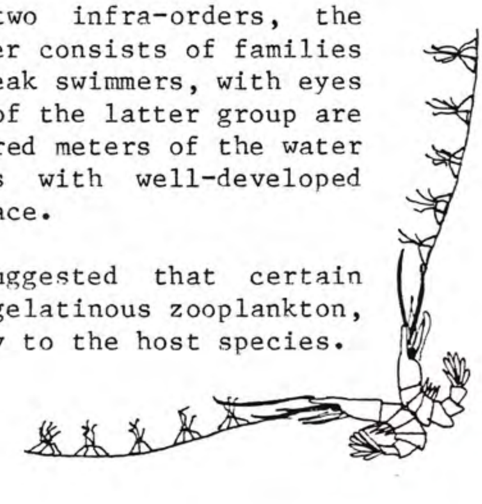
FEEDING IN HYPERIID AMPHIPODS

Martin Sheader
Department of Oceanography, The University, Southampton.

Amphipod crustaceans are widely distributed throughout the world's aquatic environments. The majority are benthic, but the Hyperiidea, of which there are around 500 species, are entirely pelagic and exclusively marine. The diversity of hyperiid species reaches its maximum in the tropical and subtropical open ocean, with a marked reduction in species at high latitudes and in the neritic province.

The group, which is probably polyphyletic in origin (Pirlot, 1932), is divided conveniently into two infra-orders, the Physosomata and Physocephalata. The former consists of families whose species are typically deep-living weak swimmers, with eyes either small or absent, whilst members of the latter group are found predominantly in the top few hundred meters of the water column, and are usually active swimmers with well-developed compound eyes covering most of the head surface.

Records over many decades have suggested that certain hyperiid species might be associated with gelatinous zooplankton, being found within or attached externally to the host species.



Many of these observations are based on net-caught material, where apparent associations may be the result of fortuitous cod-end partnerships. Laboratory-based studies have provided more detailed information on the nature of these associations in a few species (Sheader & Evans, 1975; Laval, 1980), and recently direct observations and collection by divers have confirmed and revealed yet more associations between hyperiids and gelatinous hosts (Madin & Harbison, 1977, 1978).

A wide range of hosts is utilised by hyperiids and include colonial radiolarians, ctenophores, medusae, siphonophores and pyrosomes (Laval, 1980), though the degree of host/prey specificity and the nature of associations is likely to vary. Laval (1980) has suggested that all hyperiids are associated to some degree with gelatinous hosts, and that they are descended from benthic crustacea which maintain a benthic-like existence on gelatinous pelagic substrata.

Detailed studies of hyperiid associations are relatively few. At one extreme both adults and juveniles may feed on the tissues of a gelatinous host and/or the food captured by the host. The hyperiid may be host-specific or utlise a range of gelatinous species. At the other extreme (e.g. **Themisto** and phrosinids) the adults at least may be general predators consuming a wide range of zooplankton, with gelatinous plankton possibly of greater significance to the juvenile stage.

Associated with the adoption of a parasitic mode of life in the pelagic environment, hyperiids show a range of adaptations. Gammarid amphipods produce large yolky eggs which develop within a marsupium formed by plate-like extensions of the basal joints of the pereiopods. Development is direct, with juveniles often remaining and feeding within the marsupium for the first few moult stages. Gammarid eggs may increase in volume by over 200 % during development. Hyperiids, living as parasites in the pelagic environment where they may be subjected to more intense predation than benthic gammarids, would be expected to produce a larger number of smaller eggs than gammarids of a similar body size, and this seems to be genarally the case. Eggs in hyperiids are usually smaller and produced in greater numbers, and during development the increase in egg volume is generally small, permitting more eggs to be carried within the marsupium. Although direct development occurs in some hyperiids (e.g. phrosinids and **Themisto**), in many species the egg hatches as a reduced non-swimming larva with either pleopods and uropods absent (pantochelis larva) or with non-functional pleopods and a reduced urosome (protopleon larva). These larvae are incapable of swimming and must be placed in or on a host by the female, in which case parasitism is obligate. In **Bougisia** the female deposits eggs rather than larvae into the selected host (Laval, 1980). A few species (e.g. phrosinids and **Themisto**) show development more akin to gammarids, with the production of juveniles capable of swimming, but even in these species the female may release her offspring onto a gelatinous host, rather than casting them indiscriminately into the water.

Apart from the use of a gelatinous host as a food source, there are other obvious benefits to the hyperiids involved in these associations. Hyperiids may gain energetically by using the host as a site of attachment and means of transport, and species may possibly gain a degree of protection from potential predators.

Feeding is well documented for relatively few species (see Laval, 1980). The mouthparts of hyperiids are generally reduced compared with gammarids (Bowman, 1978) and the gut in many species is composed of a much reduced foregut armed with a pair of masticatory ridges above the oesophagus. The midgut is expanded into a chamber filling most of the pereion, probably an adaptation for the utilisation of large amounts of gelatinous tissue with a high water content (Sheader & Evans, 1975). Although the structure of the mouthparts and masticatory ridges varies between species, a lack of information on feeding in all but a handful of species makes it impossible at this stage to relate structure to function.

Although the number of hyperiid species in the tropics is high, numerically the group is relatively unimportant. At low latitudes potential gelatinous host species are numerous and, with the reduced seasonality, host populations are constant throughout the year. In response to this it is likely that host specificity is higher in the tropics, and the scant evidence available seems to support this. At high latitudes the number of hyperiid species is markedly reduced, but certain species (**Themisto** spp.) may assume numerical importance. The number of potential gelatinous hosts is reduced and many show seasonal variations in abundance. In such an environment one might expect to find hyperiids with low host specificity, and exhibiting adaptations to utilise a wide range of hosts/prey and once again evidence suggests that this is probably the case; for example **Hyperia galba**, a species common in the norther North Atlantic, uses several species of scyphomedusae as host. One genus in particular, **Themisto**, is abundant at high latitudes (boreal, sub-polar) and feeds on a wide range of prey species, including copepods, chaetognaths, fish larvae, decapod larvae, euphausiids and hydromedusae, frequently attacking and consuming prey items larger than itself (**T. gaudichaudii**, Sheader & Evans, 1975). The species broadens its feeding niche still further by maturing and producing eggs over a wide range of body size, and by exhibiting marked variation in the size and structure of appendages involved in the capture and restraining of prey. The feeding niche of **T. gaudichaudii** is probably broader than any other hyuperiid species, and, with the production of free-swimming juveniles, its dependence on gelatinous hosts is presumably reduced.

Much of the lack of information on hyperiids must stem from the fact that the majority of species are to be found in warm oceanic conditions, where they form a relatively small proportion of the total pelagic fauna. With the financial constraints placed upon biological oceanography, sampling such environments is likely to become increasingly difficult.

References

Bowman, T. E. & Gruner, H.-E. 1975. Smithsonian contributions to zoology 146, 1-64.

Laval, P. 1980. Oceanogr. mar. Biol. ann. Rev. 18, 11-56.

Madin, L. P. & G. R. Harbison 1977. Deep-Sea Res. 24, 449-463.

- 1978. J. mar. biol. Ass. U.K. 58, 559-564.

Pirlot, J. M. 1932. Anns. Inst. oceanogr. Monaco 12, 1-36.

Sheader, M. & F. Evans 1975. J. mar. biol. Ass. U.K. 55, 641-656.

**

BIOENERGETICS IN LIMPET-GRAZED COMMUNITIES

Richard Hartnoll
Department of Marine Biology, Liverpool University, Port Erin, Isle of Man.

In the mid tidal level on northern European shores limpets are usually the most numerous and the most effective grazers; despite this there is a dearth of information on their bioenergetics. This study relates to a community at MTL under conditions of moderate wave exposure, where the limpet present was **Patella vulgata.** The other important elements of the community are the microalgal film on which the limpets graze, the fucoid **Fucus vesiculosus** and the winkle **Littorina littoralis** which grazes on it; and the barnacle **Semibalanus balanoides** and its predator, the dog whelk **Nucella lapillus.**

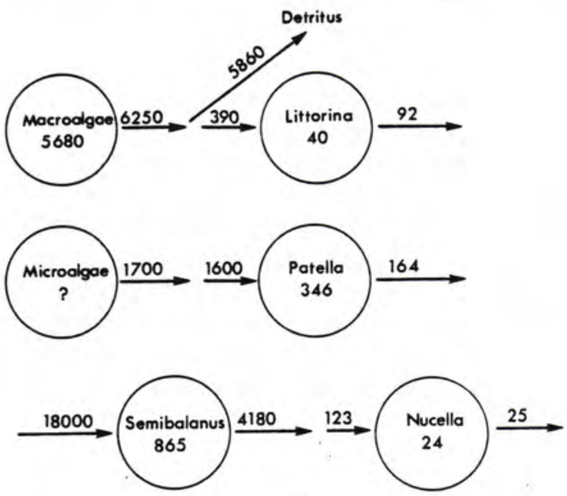
The energy budget for the limpets is as follows, using the revised terminology for the energy budget equation employed by Hawkins & Hartnoll (1983).

The mean biomass is 364 kJ m^{-2} and the budget is in kJ m^{-2} yr^{-1}.

$$1605 = 68 + 95 + 498 + 884 + 1.8 + 58$$
$$(C = P_g + P_r + R + F + S_u + S_m)$$

An energy budget of this type is typical of a population of a long-lived species composed mainly of old and slow-growing individuals.

An attempt was then made to construct a community energy budget, using data from a variety of sources, and involving a number of rather major assumptions and extrapolations. Bearing these provisos in mind, the budget is presented in the figure.



The values in the circles are the mean biomass, the values above the arrows the consumption and production for each category. The units are those used above for the limpets. There are several interesting features. The macroalgal production considerably exceeds the microalgal production, but the former is exported mostly as detritus, whilst the latter is consumed almost entirely by the limpets, and cycled within the communityu. So microalgae are of more immediate benefit. The barnaces consume more organic material from the plankton than is produced by the community's own primary producers; so the community is a net consumer. There is much imput and export of organic material; so the community is a very 'open' one in energetic terms.

Even more tenuous budgets were constructed in conditions of wave exposure and extreme shelter. These suggested the the former location was even more of a net consumer, whereas in the latter there was a substantial surplus of production.

Reference

Hawkins, S. J. & R. G. Hartnoll 1983. Grazing of rocky shores. Oceanogr. mar. Biol. ann. Rev. 19, 235-380.

**

PREDATION BY **Nucella lapillus** ON BARNACLES.

M. T. Burrows
Department of Zoology, University of Manchester.

Introduction

Predation by the dog whelk **Nucella lapillus** (L.) is well known to be a very important factor in the ecology of barnacles. How important thaid whelk predation is on an evolutionary scale has been hotly debated (Stanley & Newman, 1980; Paine, 1981) but on a yearly basis its relative effects on different species can reduce competition between them. I decided to do some preliminary small-scale laboratory experiments as part of a larger study into interspecific interactions between **Chthamalus stellatus** (Poli) and **Chthamalus montagui** Southward and other intertidal barnacles. There is evidence for prey species selection and prey size selection by **Nucella lapillus** on non-chthamalid barnacles, as well as differences in the mode of attack for different species (Barnett, 1979). My experiments were to investigate these phenomena in **Chthamalus** and the species coexisting in the south-west; **Chthamalus stellatus, Chthamalus montagui** and **Semibalanus balanoides** (L.). **(C.m., C.s., S.b.** in table 1.)

Methods

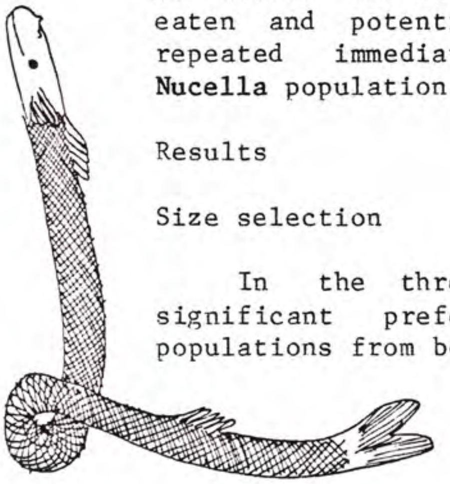
Rocks bearing populations of barnacles were collected from the mid and upper intertidal at Cawsand Bay, near Plymouth, in November 1984. **Nucella** were collected at the same time and both rocks and whelks were brought back to the laboratory.

The initial numbers of each species on each rock were counted prior to the start of the experiment. The **Nucella** and the barnacles were placed in a tidal sea water system mimicking mid tide level emersions for ten days. At the end of this period the rocks were examined. The numbers eaten of each species, the mode of attack and the population/size frequency distributions of both eaten and potential prey were determined. This experiment was repeated immediately using undisturbed rocks and the same **Nucella** population.

Results

Size selection

In the three species considered, **Nucella** showed a significant preference for the larger individuals in the populations from both upper and mid tide levels.



Prey species selection

Table 1. Percentages of barnacles eaten by **Nucella** in the two experimental periods.

	Mid shore			Upper shore		
	C.m.	C.s.	S.b.	C.m.	C.s.	S.b.
Experiment 1	14	56	23	21	23	20
Chi-square		48.4			0.643	
Probability		<.001			>.05	
Experiment 2	16	44	44	32	30	25
Chi-square		75.4			0.227	
Probability		<.001			>.05	

In upper shore populations **Nucella** showed no preference for any species. In populations from the mid shore, however, **C. montagui** was eaten much less frequently than the other two species. **C. montagui** at mid shore was much smaller in size than **C. stellatus** and **S. balanoides**, both the latter being about the same size. There were no significant differences in sizes of the species at the upper shore level.

Mode of attack

Table 2. Ratio of drilled to non-drilled prey.

		Drilled: non-drilled
C. montagui	upper	0.11 : 1
	mid	0.15 : 1
C. stellatus	upper	1.0 : 1
	mid	3.7 : 1
S. balanoides	upper	1.1 : 1
	mid	1.9 : 1

Discussion

The results obtained in this very limited study support Connell's (1961) suggestion that prey preference results in apparent species preference by **Nucella**, so that **Nucella takes the larger individuals of S. balanoides** more often than the smaller **C. montagui.** That **Nucella** shows no preference when presented with similar sized prey is further good evidence for this hypothesis. There has not, to my knowledge, been any investigation into the relative predation of the two

Chthamalus species. Since **C. stellatus** and **S. balanoides** are taken in the same ratio to **C. montagui** it seems reasonable to suggest that size-related species selection is acting on this species in a similar way.

The differences in the mode of attack for each species are probably due to variation in the strength of the muscles which close the opercular valves, together with the thickness and strength of the valves themselves. **C. stellatus** and **S. balanoides are usually found at shore levels below those of C. montagui** and may be better adapted to resist **Nucella** predation. Drilling is thought to be a much more energy-wasteful and time consuming activity during which the whelk may be displaced, allowing the barnacle to survive.

The consequences of the species selection by **Nucella** for field populations are several. Preference for **S. balanoides** at mid shore should reduce the effects of its usually successful competition for space at lower shore levels and permit coexistence with **C. montagui.** This should also apply to **C. stellatus,** although as yet I have seen no evidence that competition between this species and **C. montagui** is important. No preference at upper levels would favour **S. balanoides** in space competition were not its competitive ability limited to other factors.

The actual effects of **Nucella** on the shore on the **Chthamalus** species must now be determined by exclusion experiments.

References

Barnett, B. E. 1979. A laboratory study of predation by the dog-whelk **Nucella lapillus** on the barnacles **Elminius modestus** and **Balanus balanoides.** J. mar. biol. Ass. U.K. a59, 299-306.

Connell, J. H. 1961. The influence of interspecific competition and other factors in the distribution of the barnacle **Chthamalus stellatus.** Ecology 42, 710-723.

Paine, R. T. 1981. Barnacle ecology: is competition important? The forgotten roles of disturbance and predation. Paleobiology 7, 553-560.

Stanley, S. M. & W. A. Newman 1980. Competitive exclusion in evolutionary time: the case of the acorn barnacles. Paleobiology 6, 173-183.

**

ASPECTS OF THE FEEDING ECOLOGY OF MESOPELAGIC DECAPODS AND FISH

H. S. J. Roe
Institute of Oceanographic Science, Wormley, Godalming, Surrey

Analyses of the feeding of some mesopelagic decapods and fish have shown that the concept of animals migrating upwards at night in order to feed is, at best, only partially true. Decapods feed continuously, by day and night, but they change their diet during the diurnal cycle. This change is due to the different migration patterns of predator and prey. Caridean and penaeid decapods show similar feeding behaviour but some penaeids (**Gennadas** spp.) are detritivores, eating radiolaria.

Fish show more varied behaviour. Myctophids e.g. **Benthosema glaciale** feed at night whilst near the surface; **Valenciennellus tripunctatus** feeds during the day; **Argyropelecus hemigymnus** in the afternoon and evening, and **Cyclothone braueri** continuously - one copepod at a time. Some fish, e.g. **B. glaciale** live at the same depth as their prey throughout the diurnal cycle but only feed on it at a particular time. The sole explanation offered for this behaviour is the fact that prey will become more concentrated at night because it migrates up towards the surface - and it may simply be easier to eat it at this time. Prey is selected for in fish and decapods, according to both size and type. **A. hemigymnus** selectively preys upon chaetognaths, **B. glaciale** on the copepod **Metridia lucens**.

**

WHY DO PYCNOGONIDS PREFER INACCESSIBLE ANEMONES?

R. N. Bamber
Central Electricity Generating Board, Fawley, Southampton.

The Pycnogonids are generally carnivorous grazers: they puncture the cell or body wall of their prey and suck out the contents through their proboscis. Smaller prey items may be ingested whole. The food tissue is mascerated by a brush like setal apparatus at the base of the proboscis.

Many animal groups can be ignored as prey items, since pycnogonids are so sluggish that they are unable to hunt fast moving animals. They have been found to feed on various coelenterates and bryozoa, but other prey species recorded are sponges, lamellibranchs, gastropods, echinoids, holothurians and polychaetes, as well as some plants. Many species are not limited to a single prey, and indeed the diet can be broad. **Achelia echinata** feeds on hydroids, bryozoans and thin-walled macroalgae, notably **Griffithsia** and **Enteromorpha** (Bamber & Davis, 1982). Other species can be very choosy:

Phoxichilidium femoratum was found by Loman (1907) to prefer **Tubularia** as food and even preferred gonophores to the body of the polyps. While the majority of "feeding" records are based on pycnogonids being found on or associated with potential prey, there is an increasing body of actual feeding observatons.

There has also been some experimental work. In 1954, Stock undertook experiments on three species, while admitting that numbers of animals, replicates, etc. was small (Stock, 1978). Using the apparatus shown in Fig. 1, he tested pycnogonids for

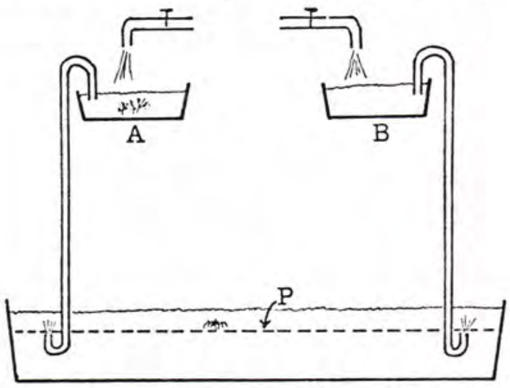


FIGURE 1. Choice chamber apparatus used by Stock (1978) (diagrammatic). A and B are basins for comparative prey items; P is a perforated separation (modified from Stock,1978).

preference between water flowing over combinations of presence or absence of potential prey. He found that **Nymphon brevirostre**, **N. gracile** and **Endeis spinosa** not only showed a preference for prey-associated water, but also distinguished coelenterate species on the basis of species specific chemicals, rather than on quantities of the same chemical varying between species.

Fry (1965) tested Antarctic pycnogonids with a choice of 16 potential prey items presented simultaneously in a circular dish. A clear preference was shown for major prey items, which were those to which the feeding morphology of the pycnogonids (**Austrodecus glaciale** and **Rhynchothorax australis**) was preadapted.

Against this background, my own somewhat preliminary experiments developed from observations on ycnogonum littorale, a common, squat species familiar on rocky shores (though also sublittoral) throughout Britain, where it feeds almost ectoparasitically on anemones. A number of **P. littorale** were maintained at the Dove Marine Laboratory, with **Actinia** and **Tealia** as potential food, both anemones being natural local prey species (vide Bamber, 1983). When these **Pycnogonum** were offered **Adamsia**, they surprisingly consumed the entire anemone. A series of unsophisticated experiments was conducted to investigate this behaviour further.

All anemones used were locally collected and of similar size. Approximately 20 **P. littorale** were used in each experiment, having been previously maintained in culture with low densities of **Actinia** as available prey.

In the first series of experiments the pycnogonids were put in a shallow tray of sea water with a number of anemones of a single species. After 24h the number of **P. littorale** feeding on the anemones was recorded. The results (Table 1) showed that

TABLE 1. Pycnogonum offered single species of prey.

ANEMONE	N	mean no. on each anemone	proportion feeding	No. of P.littorale
Actinia	7	0.86	.27	22
Tealia	4	1.05	.29	17
Calliactis	4	3.25	.65	20
Adamsia	3	6.3	.90	21

TABLE 2. Offered a choice of Actinia or test species.

Anemone	N	No. on Actinia	No. on test sp.	No. not on	Total
Tealia	4	7 (31.8%)	6 (27.3%)	9 (41%)	22
Calliactis	4	1 (5.6)	11 (61.1)	6 (33.3)	18
Adamsia	4	0 (0)	23 (79.3)	6 (20.7)	29
Metridium	1	7	0	5	12

TABLE 3. 10 Pycnogonum offered a multiple choice.

PREY	N	No. of P.litt. on	%	% of those 'on'
Actinia	5	1	10	11
Tealia	4	0	0	0
Adamsia	4	8	80	89
Botryllus	?	0	0	0
Nothing ('not on')		1	10	

proportion feeding and the mean number on each anemone (though biased by the unequal numbers of available anemones) were higher in the presence of **Calliactis** or **Adamsia** than with **Actinia** or **Tealia**, indicating a feeding preference for these first two anemones.

In the second series of experiments, the **P. littorale** were given a choice between **Actinia** (6 no.) and a second, test species of anemone (usually 4 no.); the results are as in Table 2. After 30h no preference was shown between **Actinia** and **Tealia** (chi-squared on numbers actually feeding on each species, $p>0.5$), while a significant preference was shown for both **Calliactis** and **Adamsia** over **Actinia**, with 91.7 and 100% respectively of the feeding pycnogonids on the test anemones (both $p<0.001$). The incidental test with one **Metridium** is hardly worth considering.

Thus, of a **Pycnogonum littorale** stock collected in the field from **Actinia** or **Tealia** and maintained without mortality for up to three months with these species of food, without any reduction in the numbers present, the individuals showed a marked and significant preference for **Calliactis** and (particularly) **Adamsia**, and completely consumed anemones of these species. Yet, in the field, both anemone species occur on hermit crab shells and, owing to the mobility of the crabs, are effectively unavailable to **P. littorale** as a natural food resource.

So, why does this pycnogonid prefer inaccessible anemones? I am afraid that I can only offer suggestions. The first possibility is that its previous feeding biases the experimental choice. However, previous studies quoted above (for other species) showed that there was no such biasing. Indeed, this idea would not account for the complete consumption of the preferred anemones (never observed with **Actinia** or **Tealia**). The single multiple choice experiment still showed a marked preference for **Adamsia**, and preferences persisted for at least 30h.

A second postulate is that the commensal anemones are less repulsive. It is feasible that selection occurs in a natural prey species such as **Actinia** to produce some resistance or deterrent to the pycnogonid predator. However, these species cannot escape predation, nor is eating the pycnogonid successful, since **Pycnogonum** has been found naturally alive within the enteron of **Actinia**. Equally, no clear behavioural responses are observed in anemones during initial "attack" by **P. littorale**. The only anemone of those tested which do have a definite defensive response are **Adamsia** and **Calliactis**, which eject acontia when irritated; yet these are clearly useless against the pycnogonid, as these are the two species most preferred!

A third possibility is that the commensal species are more attractive. However, Stock's (loc. cit.) species showed a preference through chemical attraction to the species on which they naturally feed, and distinction was based on quality rather than quantity of attractant. It is not likely that **P. littorale** has evolved a positive response to a chemical from an unobtainable food source.

Yet this third option seems currently the most likely, and perhaps chemical differences between these anemones are indeed of quantity rather than kind. It must be appreciated that the experiments undertaken were primitive, and further experiments, particularly along the lines of Stock's, are needed to clarify this enigma. It is the likelihood of producing comprehensive, quantitatively conclusive results and yet being unable to account for them that is inhibiting further work.

References

Bamber, R. N. 1983. The Marine Fauna of the Cullercoats District, 12. Pycnogonida. Rep. Dove mar. Lab. 3rd ser. 25, 1-24.

- & M. H. Davis 1982. Feeding of **Achelia echinata** Hodge (Pycnogonida) on marine algae. J. exp. mar. Biol. Ecol. 60, 181-187.

Fry, W. G. 1965. The feeding mechanisms and preferred food of three species of Pycnogonida. Bull. Brit. Mus. (Nat. Hist.) (Zool.) 12, 195-233.

Loman, J. C. C. 1907. Biologische Beobachtungen an einem Pantopoden. Tijd. Nederlands. Dier. Ver. (2) 10, 255-284.

Stock, J. H. 1978. Experiments on food preference and chemical sense in Pycnogonida. Zool. J. Linn. Soc. 63, 59-74.

Annex

Subsequent to presenting this paper at the Porcupine Meeting in February I have been informed by Shelagh Smith that **P. littorale** in her deep water samples on the Porcupine Bank seems to be associated with **Actinauge** as a potential prey species.
I would also like to acknowledge tha suggestion from the audience at the meeting that the commensal anemones may secrete a chemical to attract hermit crab hosts, and it may be this that attracts **P. littorale.** Further suggestions will be gratefully received.

The last of England.

ACCOUNTS FOR THE YEAR ENDING 30 NOVEMBER 1984

Income and Expenditure Account

Dr.	£ p	Cr.	£ p
To Donations	6 - 00	By Printing and Stationery	428 - 19
Subscriptions for 1983	7 - 00	Postage	191 - 45
Subscriptions for 1984	460 - 12	Refund of subscriptions overpayment	5 - 00
Sale of Newsletters	23 - 38	AGM + party expenses	363 - 65
Sale of Christmas cards (1983) ...	19 - 20	Refund of AGM Booking Fee ...	10 - 00
Sale of Christmas cards (1984) ...	40 - 72	Field meeting expenses	10 - 00
Booking Fees for AGM + party ...	472 - 92	Bank commission	0 - 50
Interest from Deposit Account ...	38 - 56	Excess of Income over Expenditure transferred to Balance Sheet ...	59 - 11
	£1067 - 90		£1067 - 90

Balance Sheet

Dr.	£ p	Cr.	£ p
To Subscriptions paid in advance ...	45 - 00	By Cash at Bank (Deposit Account) ...	870 - 00
Uncleared cheques	51 - 41	Cash at Bank (Current Account) ...	72 - 58
Balance at 1 December 1983 ...	795 - 15	Petty Cash in hand	8 - 09
Transferred from Income and Expenditure Account	59 - 11		
	£950 - 67		£950 - 67

M C MacKinnon C W Pettitt
Hon. Auditors

David Heppell
Hon. Treasurer
10 December 1984

THE 1984 A.G.M.

Minutes of the Eighth Annual General Meeting of PORCUPINE, held at the Manchester Museum on Sunday 24 February 1985 at 9.30 am.

Fred Woodward was in the chair. 17 Members were present. The minutes of the Seventh Annual General Meeting (published in Porcupine Newsletter Vol. 2, No. 10) were approved. Matters arising concerned the Christmas cards; it was agreed to continue with them if the artist would provide a drawing.

Reports of the Hon. Secretary, Hon. Treasurer and Hon. Editor were given and approved. The Hon. Records Convenor was not present (apologising for his absence) but gave his report by letter (see p.82) together with a notice of his wish to resign.

Office bearers were elected as follows:

Hon. Secretary	Shelagh Smith
Hon. Treasurer	David Heppell
Hon. Editor	Frank Evans
Hon. Records Co-ordinator (formerly Convenor)	Fred Woodward (caretaker for one year)

The role of Records Convenor was discussed. The post is to be redefined and will become that of a Records Co-ordinator. The new definition will be promulgated later.

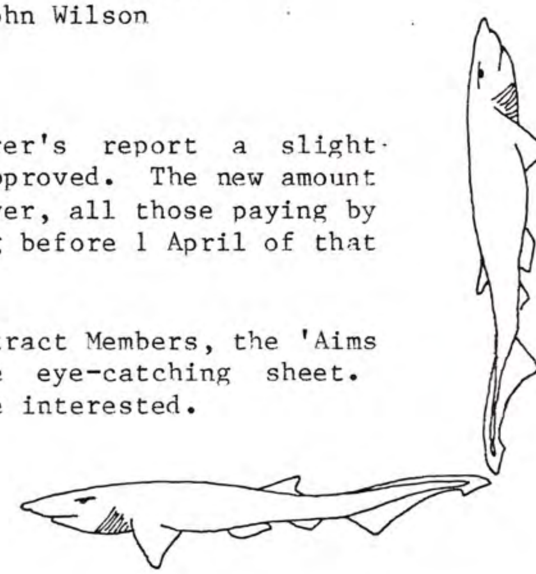
Martin Sheader of Southampton was elected to Council which is now as follows:

Roger Bamber	Norman Holme
Roger Brehaut	Ivor Rees
Peter Davis	Ralph Robson
Bill Farnham	Dennis Seaward
Robin Harvey	Martin Sheader
	John Wilson

The Hon. Auditors were re-elected.

As an outcome of the Hon. Treasurer's report a slight increase in the annual subscription was approved. The new amount as from January 1986 will be £4; however, all those paying by banker's order, new Members, and all paying before 1 April of that year will pay only £3.

It was suggested that in order to attract Members, the 'Aims of Porcupine' should be made a more eye-catching sheet. Postgraduate students in particular would be interested.



The cost of sending out membership cards was considered an unnecessary expense. No more would be issued except at the Hon. Treasurer's discretion or on request together with return postage.

It was agreed that the Marine Conservation Society should be asked to provide a representative to the Porcupine Council. This person would not necessarily have to be a Member of Porcupine.

Amendments to the Wildlife and Countryside Act are now at the Committee stage. It is hoped that there will be provisions to make the Act more workable. It was suggested that Porcupine (per Hon. Secretary) should make its opinion known through the appropriate channels.

*****

REPORT OF HON. SECRETARY.

Shelagh Smith

Porcupine started 1984 with a bang. The Annual General Meeting and the accompanying meeting were held in Edinburgh on 25-26 February. The theme was 'Sampling of the benthos - methods and rationale'. This was definitely the highlight of the year, there being over 70 enthusiastic participants. (There was also a party to celebrate the fact that the Hon. Sec. had reached an age - of cheerful discretion.)

There was a field meeting at Falmouth, Cornwall at the end of September. This, we thought, was happily timed to follow the EMBS conference in Plymouth, but the hoped-for follow-on attendance did not materialise. As field meetings do not seem to be popular we must consider whether they are worthwhile. (Council has resolved to proceed with the 1985 field meeting in Skye - Ed.)

There was no indoor meeting in the autumn as backword was given too late for a complete restart to be made. I bring to the attention of Members there have been very few offers to hold meetings. The Secretary's role seems to be one of arm-twisting, whereas it would be much better if I were organising where meetings could be fitted in and when. Of course, Porcupine meetings suffer the general chill of the economic climate, which makes them expensive to attend; perversely, the total of scientific meetings offered to people of our interests has increased.

There was, alas, a low attendance at the recent Manchester meeting - due to the weather, which seems to have caught those south of the border with their thermal underwear down; or due to its being a less popular theme; or due to being near to the end of the financial year. To those who were unable to be present, it was a very good meeting indeed, with papers of excellent quality, and a grand social evening thrown in. We missed you.

To end on a buoyant note. Membership is still rising steadily, unlike that of many societies; much to do with the value-for-money of the Newsletter. So please support Frank and increase its value-for-money by contributing articles. The number of members at the end of 1984 was 173, an increase of 17, or about the same percentage (11%) as in the preceding year. Can we make it 200 in 1985?

*****

NOTICES

NOTICE 1. PORCUPINE FIELD MEETING, ISLE OF SKYE

The next field meeting of "Porcupine" will be on the Isle of Skye, from Saturday 29 June to Saturday 6 July. The meeting will be centred on Portree. It is planned to book a house to provide accomodation for those who wish it and to act as a centre. Boats and compressed air will be available.

Those who have been to earlier "Porcupine" field meetings will say they make a superb holiday, and this one promises of the best. You can pursue your specialist subject; add, via other Members, to your knowledge of less familiar marine organisms; enjoy the sea-shore; and never for a moment be bored (you get a good laugh, too). The proceedings are informal and non-members may also come. Already we hear that Members with interests in molluscs and in plankton propose to attend.

For further details please write to Member Fred Woodward, The Art Gallery & Museum, Kelvingrove, Glasgow G3 8AG.

**

NOTICE 2. UP-DATING OF MARINE MOLLUSC ATLAS - CONTRIBUTIONS REQUESTED.

From Member Dennis Seaward

Publication in 1982 of the 'Sea Area Atlas of Marine Molluscs of Britain and Ireland' by the Conchological Society in collaboration with the Nature Conservancy Council stimulated further recording to fill gaps and improve cover, and I am now in a position to add many further records. But there are still many under-recorded phyla, e.g. aplacophores, cephalopods; and under-recorded areas, e.g. Liverpool Bay, Cardigan Bay, Cork, and most offshore areas.

I am assembling all additions and amendments to the atlas for a forthcoming paper in the Journal of Conchology. If you can add or comment, all contributions will be gratefully received and acknowledged.

Even confidential or 'pending publication' material will surely not be compromised by inclusion as a dot in the atlas on 'sea area scale'. So, please, search your files, your lab or your memory for those records and send them to the appropriate area representative, or to me at Barn Court, Hamlet, Chetnole, Sherborne, Dorset DT9 6NY.

(Copies of the atlas are still available from Dept. AD, Interpretative Branch, Nature Conservancy Council, Attingham Park, Shrewsbury SY4 4TW.)

**

NOTICE 3. DIVING QUALIFICATIONS FOR SCIENTIFIC DIVERS

The Underwater Association understands that there has been a policy change by the Health and Safety Executive to the effect that amateur sports diving qualifications will no longer be counted towards a Part IV diving certificate. This is the latest indication that the safety regulations drafted to served main stream commercial diving are no longer appropriate to the needs of scientific divers and are eventually likely to halt underwater scientific research in this country. The Association urgently needs information to enable them to present a coherent and persuasive argument to the HSE to prevent the regulations making scientific diving next to impossible.

For further details and questionnaire please contact Dr. Richard Pagett, 19 Pennycress Close, Haydon Wick, Swindon SN2 3RT.

**

NOTICE 4. LAGOON SYMPOSIUM

It is intended to hold a conference on lagoons and other brackish water bodies (not estuaries) at Portsmouth Polytechnic close to Easter 1986 (and not Easter 1985 as appeared in PN 3,2). The organisers are Members Roger Mitchell (NCC) and Bill Farnham (Portsmouth). Contact address: Portsmouth Polytechnic, Marine Laboratory, Ferry Road, Hayling Island PO11 0DG.

*****

Porcupine Notes and News

PORCUPINE QUILLS HAVE BEEN BUSY of late and two more books by Members have recently appeared. One, by Frances Dipper and A. Powell is reviewed elsewhere in this issue. The second, by Paul Horsman, formerly of the Marine Society, is a lavishly illustrated and comprehensive guide to oceanic life intended for use by seamen, and hence largely devoted to high-seas surface forms. We intend to review this excellent work in our next issue.

**

MEMBER FRANCES DIPPER, UNDAUNTED by her scrivening labours (above) is off to Dubai in the United Arab Emirates for two years in August, accompanying her husband, John. She has bravely offered to collect marine specimens for Porcupines, where possible, if requested. Contact her at 1 Smeefield, Hilton, Huntingdon PE18 9NU. Bon voyage, Frances, from Porcupine. We look forward to your safe return. **Thalassiohystrix scuba** comments on p.71.

**

STAMP PRESS. While visiting Whitby recently we called on Tom and Cordelia Stamp in their house in John Street. They are the owners and entire staff of Caedmon Press, a small publishing house specialising in fine volumes, both new and reissued, centred largely on early polar exploration. We purchased William Scoresby's "Journal of a Voyage to the Northern Whale Fishery" with its simple dedicaton "To the King" (George IV). Older Members may recall that the National Institute of Oceanography (now IOS) once had a research vessel named "William Scoresby" in honour of that famous whaling captain, parson and scientist. We commend the Stamps and their publications to Members (see ads., p.80)

**

MICROCORES WELCOME. Still in literary vein, we were pleased to receive some of the copy for this issue on disc (and some in longhand as well, be it noted). Members will be deeply unmoved by the fact that your Editor types every word of PN himself. Consequently he heartily welcomes the arrival of electronic text in the "Applewriter" format. Discs sent through the post will of course be returned once copied.

**

MEMBER TO MEMBERS. Before the committee stage of the Wildlife and Countryside Bill Member Jon Moore drafted a letter supporting the founding of marine nature reserves to seventeen northern MPs, and persuaded eight of his colleagues to join him in signing it. Although his lobbying was unsuccessful (the marine nature reserve bit was deleted from the Bill) he says there is still hope that the Lords will in time restore the proposal. Full marks for effort, Jon.

*****

Porcupine Reviews

Field Guide to the Water Life of Britain. 335pp. F. Dipper & A. Powell (principal authors). 1984. Readers Digest Nature Lover's Library: London. ISBN 0 276 3608 7. £8.25 (approx.).

Reviewer: Shelagh Smith, Royal Scottish Museum, Edinburgh.

This book is part of a series. It is unusual in that it covers both fresh water and marine life. There is an introductory chap ter on Understanding Water Life, followed by a key, How to Identify Water Life. Both are clear and concise, giving an excellent introduction to the subject. This leads on to more detailed descriptions of animals and plants in their environment, starting with fresh water and migratory fish. These are grouped according to obvious physical characters and habitat. Habitats are illustrated by photographs and paintings, the fish by lifelike paintings of very high quality. The text wisely leaves most of the description to the illustration, and concentrates on other aspects of the fish; size, breeding, habits, distribution, if it is preyed upon by other water dwellers, is regarded as a commercial or sporting fish.

Following fish, other freshwater groups are dealt with in the same way, descending the order of classification, with the major water plants (except reeds and reed grasses) last. This brings in the habitats not described with the fish, ending with the estuary. Then there is an unfortunate hiccup, a 14-page guide to freshwater and marine shells, which breaks the continuity of the book without (since it includes so few species) adding to the its usefulness. After that the book reverts to what it does superbly; describing aquatic organisms in their habitat. It starts with mammals and ends with seaweeds, by which time "the species commonly seen in Britain" (an introductory expression which neatly sidesteps depth) and "a wide selection of the more rare species" (wide belittles the true variety of nature) have been illustrated and described, together with major habitats.

There have been a few editorial difficulties and the relation of groups of marine animals to groups of habitats has not been achieved as happily as with freshwater life: placing the strand line in the middle of the cephalopods is clearly an accident! Possibly the sea cucumbers (slug-like animals) which are described adjacent to sea slugs could equally well have been kept in their rightful place, echinoderms being followed by worms. Some sea slugs are very worm-like.

Short sections at the end deal with migration, conservation, pollution and how to study water life. There are suggestions on places at which to see water life (in cpativity, as it were) and a list of addresses of societies and organisations, which would have been more useful if it had been up to date with its information. Sadly lacking is a list of books which help with identification of more species. This appears to be a policy of the Series and is most unfortunate. The reader's interest, well whetted, requires a lead onwards. It is a pity therefore that, on the copy I have seen, the binding is of a quality inadequate to cope with the sort of use this book should get. I expect pages to fall out rather easily.

The value of the book lies in its enthusiastic approach, which encourages one to get out there and learn more. It is of particular use to older children, teachers and amateur naturalists, but not out of place on the bookshelf of anyone with a love of the natural world.

*****

Porcupine Ads.

(Advertisements are published free to Members. Replies should be addressed to the advertisers or to Porcupine Newsletter at the Dove Marine Laboratory, Cullercoats, North Shields NE30 4PZ, England.)

SLIDE SET OF MARINE LIFE OF IRISH AND BRITISH WATERS. £17 including postage. These 40 slides, complete with eight pages of text, are the first of a series to be released. For further information contact Sherkin Island Marine Station, Sherkin Island, Co. Cork, Ireland.

CAEDMON OF WHITBY PRESS (Tom & Cordelia Stamp). 9 John Street, Whitby YO21 3ET England. 'Publishers of books for the discerning minority.' Prices include postage. Titles include:

"Ross in the Antarctic" by M.J.Ross. Contains diary excerpts and many of the letters of J.D.Hooker, the naturalist who accompanied the expedition. Sir James Clark Ross located both the N and S magnetic poles. £12.50.

"Journal of a Voyage to the Northern Whale Fishery, 1822" by William Scoresby, F.R.S. Contains lists of plants found, minerals and animals, as well as the vivid daily journal. £13.95.

"Antarctica Observed" by A.G.E.Jones. Who first sighted the Antarctic continent? William Smith of Blyth, as it happened, in 1820. His ship was little larger than the Dove Marine Laboratory's inshore research vessel currently working out of that port. The culling of many millions of seals closely followed his discovery. £7.95.

"THE SEAFARER'S GUIDE TO MARINE LIFE" by Paul V. Horsman. 1985. Published by Croom Helm in association with The Marine Society. A book intended for ships' bridges, yacht cockpits and fishing boat wheelhouses. The treatment is worldwide and scholarly. Written by a Porcupine Member who is a professional marine biologist and teacher, and who has served in that capacity aboard fourteen merchant ships. We hope to review this work in our next issue. £12.95.

*****

Around the Marine Laboratories

Number 12.

The Institute of Oceanographic Sciences, Wormley

The foundation of a 'British Oceanographic Institute' was first proposed in 1944. Following discussions with the government Scientific Advisory Committee and the Royal Society it was recommended that the work of the proposed Institute should include both physical and biological oceanography.

The National Oceanographic Council was established to advance the science of oceanography in all its aspects and the National Institute of Oceanography was founded on 1 April 1949 with Dr. G. E. R. (later Sir George) Deacon as Director. The new institute incorporated the marine biological work in the southern oceans that had been conducted by the Discovery Committee through the 'Discovery Investigations' since 1925 and the physical oceanographic work of the Oceanographic Group of the Royal Naval Scientific Service based at Teddington.

For the first few years the work was conducted on five separate sites. In 1953, however, the Institute became established in a building at Wormley in Surrey built in 1943 as an extension to the Admiralty Signal and Radar Research Establishment. The building provokes much comment from visitors, particularly concerning its location some forty miles from the sea. Sir George always answered the comment by saying its location was an example of forward planning, as the SE of England is gradually sinking! The total staff in 1953 was 53, including 34 scientists. By 1965 the total had grown to 138, and a new wing was added to the laboratory in 1966.

In 1965 the National Oceanographic Council was dissolved and its work taken over by the new Natural Environmental Research supported by the skills in instrumentation of the applied physics and ocean engineering groups. Although its interests are worldwide, most of the scientific effort is concentrated in the Atlantic, particularly the NE Atlantic.

Institute of Oceanographic Sciences, Wormley, Godalming, Surrey GU8 5UB.

*****

Letters to the Editor

From Member Bob Earll
Marine Conservation Society
4 Gloucester Road
Ross-on-Wye
Herefordshire HR9 5BU

20 February 1985.

Dear Editor,

Due to an ever increasing number of commitments I have decided to stand down from the Porcupine Council and also from the position of Records Convenor. Shelagh Smith has asked me to put a few thoughts on paper about the role of Records Convenor. I hope that these will be conveyed to the AGM, which I regret I cannot attend, and be published in PN.

At Porcupine's inception I suspect the role of Records Convenor was adopted following on from the pattern set by societies like Conch. Soc. and Phyc. Soc. However, the first Porcupine Records Convenor, David McKay pointed out in his retiring speech that nobody had actually sent him any records! Over the last four years nobody has sent me any records in my capacity as Convenor. My view confirms that of David McKay that Porcupine has no need for a Records Convenor to collect and collate records. A small number of novel records are published in PN and that would seem to be the best repository for any records Members wish to send in.

There are a large number of marine recording projects in this country and a recent review I have completed, based on questionnaires returned by co-ordinators, well illustrates the variety of projects currently being undertaken. Fuller details of this will hopefully appear shortly in PN. There are schemes covering everything from dinoflagellates and coral reefs to whales, and including habitat, site and pollution surveys. These schemes are often co-ordinated by 'independent' individuals; however, a number of organisations are also involved, including the Marine Conservation Society (which runs the most). Unless Porcupine becomes involved with a different project I doubt whether it wil receive any more records than those currently published in PN.

During my period as Records Convenor I saw my role as helping to promote Porcupine's interests and role in marine recording. Porcupine as an organisation should have a role in promoting the interests of people who are interested in marine recording. It was with this aim that I put together the programmes for the 1982 and 1983 Porcupine AGMs on marine recording (in Glasgow) and marine biogeography (at Menai Bridge). In retrospect I doubt that these meetings had any effect on influencing government support for marine recording.

In the recent past neither BRC nor, more recently, NCC have been able to provide the support or co-ordination that such a large subject covers. Marine recording from a government finance and guidance aspect is in limbo, and in that respect nothing has really altered since Porcupine came into existence.

On a brighter note a recent Biological Curators Group meeting in Leicester and a planned "Biological Records Forum" at the RGS in London (16-17 April; BCG & ITE Monks Wood) looks like stimulating some of the more positive aspects of BRC's original aims and this could well have a spin-off for marine recording.

In any event, if Porcupine as an organisation is to have any influence on changing the government agencies' policies on marine recording considerably more efforts will have to be made with the wholehearted support of the Members and Council than have been made up to now. The Records Convenor might be the person on Porcupine Council to be responsible for co-ordinating those efforts should the AGM or Council see Porcupine having a role to play in marine recording.

*****

THE RIDDLE OF THE WHIPS

Bob Earll
Marine Conservation Society, 4 Gloucester Rd., Ross-on-Wye HR9 5BU.

In 1982, when deep diving off S. Abbs Head, E. Scotland I started noticing some structures which I called 'sediment whips' attached to hydroid stems (see diag.) They seem to occur below about 15m, but are usually commoner in deeper water, 20m+. Although a number of these whips were collected there was no real clue as to what was building them, until 1984. Then, on a fascinating dive over a sand patch we happened upon some rocks on which hydroids were growing. On the hydroids were some whips but this time they were obviously inhabited by groups of small amphipods. When prodded at one end they shuffled backwards in a line down the whip!

Knowing of Geoff Moore's long-standing interest in amphipods I forwarded them to him and he identified them as **Dyopedos porrectus**, a rarely recorded species whose relatives in America build rods on sea urchin spines. On these rods they 'garden' diatoms and other microscopic algae which they later feed upon! The whips are built of faecal pellets woven in a way so as to provide a strong and flexible whip-like structure.

Not surprisingly, almost nothing is known of the distribution of **Dyopedos** or very much about its habits. This note has been prepared in the hope that Members can help discover more about the biology of the animal. For example:-

* How big are a selection of whips. We only have measurements for about five so far. We need a much bigger collection.

* What depth distribution do they show?

* Are they orientated in any particular direction? Are they found on, or do they twist towards, the down current side?

* A skeleton shrimp and the strange isopod **Astacilla** have also been found on the whips. Further collections of species associated with the whips would be very interesting.

* Why don't the amphipods get eaten? They are rather conspicuous. Do the hydroids they are attached to in some way protect them? Which species of hydroid do they attach to? Do they show any preference?

* The Dyopedos seem to be forming 'family' groups with adults and juveniles on the whips; is this true? Collections of individuals from single whips would solve this question.

* Do they survive all year round?

Diving Members could help to answer these questions by carefully observing and recording these whips underwater and making collections of the hydroid and the individual whips with their amphipods. Each whip should go into a separate specimen tube; preserve with alcohol or formalin.

Please send specimens or observations to Dr. Geoff Moore, University Marine Station, Millport, Is. of Cumbrae, Scotland.

*****

OCCURRENCE OF THE IMMIGRANT ASCIDIAN **Styela clava** Herdman IN HEYSHAM HARBOUR, LANCASHIRE.

J. Coughlan
Marine Biology Unit, Central Electricity Generating Board, Fawley, Southampton.

INTRODUCTION

The solitary ascidian **Styela clava** Herdman is native to the NW Pacific and in particular to Japanese waters, the Sea of Okhotsk and the coasts of Korea and Siberia. In 1953 six specimens were collected near Plymouth (Carlisle, 1954) and were designated **Styela mammiculata** Carlisle until Millar (1960) demonstrated that this new species was synonymous with **Styela clava** Herdman (1882), this latter name having priority.

Houghton and Millar (1960) anticipated the spread of this species around the coasts of Britain and the Continent both by 'natural' means - the dispersal of planktonic larvae - and by the transport of adults in breeding condition on the hulls of vessels. The former route would favour a slow radiation from existing colonies whereas the latter could produce sudden jumps in the distribution. Long distance transport of larvae by currents or in the ballast water of ships is precluded since the larvae are free-swimming for about 24 hours only. The original introduction is believed to have been on the hulls of warships returning to Devonport dockyard at the end of the Korean war.

DESCRIPTION

The adult **S. clava** is large and, being found up to mid-tidal level, is often conspicuous. It is unlikely to be confused with other British sea squirts since it has a distinct stalk (stolon) and totally opaque outer skin (tunic). The stolon may account for as much as one-third of the total length of up to 200 mm. Both body and stolon are longitudinally pleated and the stolon is often twisted, terminating in a membranous attachment to the substrate. On the upper half of the body the pleats are overlain by folds and swellings which become more pronounced towards the anterior (free) end. These protrusions are lighter in colour (creamy-yellow) than the depressions and the lower part of the body and stolon, which are reddish-brown. The body texture is firm and the tunic tough, suggesting the epithet 'leathery' (Coughlan, 1969). The inhalent (oral) siphon is terminal and the exhalent (atrial) siphon is seet close by on the true dorsal surface. Internally there are four branchial folds on each side, a highly folded, longitudinal stomach and narrow intestinal loop. There are 5-8 gonads on the right side and 2-4 on the left, each comprising an elongate ovary surrounded by male follicles.

S. clava breeds from July to September, brooding its larvae till they are close to metamorphosis.

By the first winter the young squirts are up to 60 mm in height and reach full size by the following summer,when they become mature. The majority die in the second autumn so that the species is essentially annual (Holmes, 1969). In Britain **S. clava** has no known predators nor does it appear to support commensals (Holmes, 1969). However, the tunic is attractive to epibionts, including barnacles, solitary and colonial sea squirts, bryozoa and small red and green algae (Coughlan & Holmes, 1972). Illustrated descriptions of the species are to be found in Carlisle (1954), Millar (1970) and of course Herdman (1882).

DISTRIBUTION

S. clava can be found on stones, walls and piles from about mid-tidal level down to at least 4 m below LWS (Holmes & Coughlan, 1975) though individuals have been dredged from at least 10 m below LWS. It is absent from areas of consistently low salinity and appears to be unable to tolerate even short periods of salinity below 5, such as occur in some areas after heavy rainfall (Holmes, 1976, 1982). Conversely, it is intolerant of wave exposure, which limits its choice of full-salinity sites.

After the Plymouth discovery there were no further records until 1957/58 when it was found in both Portsmouth Harbour and Southampton Water (D. Houghton, pers. comm.). In 1959 numerous specimens were found in Langstone Harbour (Houghton & Millar,1960). By 1962 it had become very abundant in Southampton Water and had spread to Shoreham Harbour and Poole Harbour (Holmes,1969 and pers. comm.). In 1968 the author found several attached to stones on Pwllcrochan Flats, Milford Haven (Coughlan, 1969). It had become "well-established" in Cork Harbour by 1971/72 (Guiry & Guiry, 1973) and there are apparently unconfirmed reports of **S. clava** in Dover Harbour (1969?), at Roscoff (1975? W. Farnham, pers. comm.) and on the Is. of Cumbrae (1981, R. Earll, pers. comm.). For completeness it should be noted that Holmes (1976) reported it from fouling panels in Hobson's Bay, Victoria, Australia - the first record from the southern hemisphere.

On 21 April 1983 the author found several specimens, ranging in length from 20 mm to 63 mm, attached to a wire rope hanging from the Fish Quay, Heysham Harbour (OS ref. SD397601). These were from below LWS but a short search revealed similar-sized specimens growing intertidally elsewhere in the harbour. They were probably all from a summer 1982 settlement.

It may be significant that coastal (products) tankers ply between Southampton Water, Poole, Shoreham and Milford Haven and that there is naval traffic between Devonport and Portsmouth/Southampton. Similarly, Cork, Roscoff, Plymouth and Portsmouth are served by the same ferry company with a rotation of vessels between routes; while Dover and Portsmouth are UK terminals of another ferry company.

Warm water discharges from power stations are often implicated in the establishment of exotic species even when, as with **S. clava**, they originate in waters as cold as or colder than those around the British Is. Although the Milford Haven and Heysham specimens were found during surveys around power stations that were under construction, in neither case had any warm water been discharged.

References

Carlisle, D. B. 1954. **Styela mammiculata** n. sp. - a new species of ascidian from the Plymouth area. J.mar. biol. Ass. U.K. 33, 329-334.

Coughlan, J. 1969. The leathery sea squirt - a new ascidian from Milford Haven. Nature (Wales) 11, 192-193.

- & N. J. Holmes. 1972. Established communities of marine fouling organisms in Southampton Water. CERL Note RD/L/N52/72.

Guiry, G. M. & M. D. Guiry. 1973. Spread of an introduced ascidian to Ireland. Mar. Poll. Bull. 4, 127.

Herdman, W. A. 1882. Report on the tunicates collected during the voyages of HMS "Challenger" during the years 1873-1876. Part 1. Ascidiae Simplices Challenger Rept. 6 (2), 296 pp.

Holmes, N. J. 1969. Some aspects of the biology of **Styela clava** Herdman. Ph.D. thesis, Southampton University.

- 1976. Occurrence of the ascidian **Styela clava** Herdman in Hobson's Bay, Victoria: a new record for the southern hemisphere. Proc. roy. Soc. Vic. 88, 253-286.

- 1982. Supplementary paper V in: R. N. Sandiford, & N. J. Holmes (eds.). Final Report, Heated Effluent Study for Victorian Coastal Waters. Marine Science Laboratories, Queenscliffe, Victoria 3225, Australia.

- & J. Coughlan. 1975. The ascidian fauna of Southampton Water. Proc. Hants. field Club archaeol. Soc. 30, 9-15.

Houghton, D. R. & R. H. Millar. 1960. Spread of the ascidian **Styela mammiculata** Carlisle. Nature, Lond. 185. 862.

Millar, R. H. 1960. The identity of the ascidian **Styela mammiculata** Carlisle and **S. clava** Herdman. J. mar. biol. Ass. U.K. 39, 509-511.

- 1970. British Ascidians. Linnaean Soc. Synopses of the British Fauna n.s. 1. London: Academic Press. ISBN 12-496650-0.

******

RESULTS OF THE PORCUPINE NEWSLETTER **Laomedea angulata** ENQUIRY (Ref. PN 2, 113-117.).

Paul Cornelius
British Museum (Nat. Hist.), London.

Probably no other recent enquiry has been so unsuccessful. Other have had great response. References would be superfluous. Couldn't someone, somewhere, have sent in even a single negative return? Unhappily not. Perhaps the species concerned, a hydroid, was too rare. If so, that in itself might prove something. Not least that poor little hydroids don't get the attention they deserve. Every enquiry must end some time. Not that I mind, mark you. Even negative returns would have helped, though. Wherever from. Still, it's too late now. Lost opportunities. Eventually the records will accumulate. There is no doubt. The writer himself, for example, found the species in the Fal and in Langstone Harbour. Exciting it was, too, the feeling of achievement. Rare hydroids cheer some of us up, you know. If anyone else finds it, please let me know. So I can plot the distribution. For an exciting paper in PN, perhaps. Another like the first. Not just a morose note written on a suburban train. That would be too brief. A longer article is intended. Short ones convey too little. That's the trouble. I know that now. Can you take the initial letter of each sentence of this article and form an advertising slogan for Porcupine Newsletter - if so you could easily have sent in a negative record of **L. angulata**, not that I mind, not very much, anyway, it's the hydroids that mind, sitting there and never being discovered, you mostly rubber-suited, puffing and bubbling, hydroid-ignoring, unresponsive lot! [Answer on p567].

Acknowledgements.

Grateful thanks to Roger Burrows and the swarm of SCUBAE who ploshed and spurgled in the Fal all day in 6 June 1982 collecting eel-grass to find a single tiny specimen (first for Cornwall, Stella!); and to Mike Carter and his colleagues for arranging for me to be stranded on 24 June 1982 on the decaying remains of a Mulberry pontoon in Langstone Harbour on a rising tide so that I could collect equally stranded eel-grass on which - yes- the first **L. angulata** for Hampshire was growing, and for taking me back afterwards; and to both groups for kindly providing laboratory facilities. Also to my Mum, the only person to express an interest in the Survey.

(**Editor's Note:** Please address all cheering, waving and gestures to the author and not to the offices of this Newsletter. We have troubles enough without this sort of contribution adding to them.)