

# PORCUPINE NEWSLETTER

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The present Newsletter, the fourth, heralds the beginning of the Society's second year, the first Newsletter having appeared in November, 1976.

Looking back over the last twelve months, much has been achieved: we have had three Newsletters, meetings in Edinburgh, South Shields and Cardiff together with the additional field course in the Orkneys.

In addition a working party has been tackling the problems involved with site recordings at sea, whilst a further group has been compiling 'FLASK' (Faunal lists and Systematic Keys for the Fauna and Flora of the North East Atlantic and Mediterranean), publication of which hopefully will commence in the summer of 1978.

Saturday, 25th February, 1978 has been fixed for the second Annual General Meeting, to be held at Manchester in association with a two day Symposium on "The Species Problem", which is being held jointly with the Littorinid Research Group, whilst a further meeting has been arranged for the 24-25th June, 1978 at the Marine Biological Station, The Strand, Portaferry, Co. Down, Northern Ireland, the theme being "Interstitial Fauna".

From this it would appear that the Society is going from strength to strength, but it should be realised that this is due predominantly to the enthusiasm and work of a dedicated few, and members are reminded, therefore, that suggestions or offers of assistance for future meetings, or contributions for the Newsletter, comprising reviews, notices of forthcoming events, news of personal and joint research projects, requests for information, etc., should be sent to the Hon. Editor of Porcupine, Mr. F.R. Woodward, South Shields Museum and Art Gallery, Ocean Road, South Shields Tyne and Wear, or to the Hon. Secretary of Porcupine, Dr. Shelagh M. Smith, Royal Scottish Museum, Chambers Street, Edinburgh, EH1 1JF.

F.R. WOODWARD  
Hon. Editor.

Committee News

ANNUAL GENERAL MEETING

The Annual General Meeting of PORCUPINE will be held at Manchester Museum on Saturday, 25th February, 1978 at 09.30hrs.

The Agenda will include:-

1. Hon. Secretary's Report.
2. Hon. Treasurer's Report.
3. Hon. Editor's Report.
4. Sub-committee on Recording Grids, Convener's Report.
5. Election of Office-bearers and Council Members.

In connection with election of Office-bearers and Council Members attention is drawn to the relevant Rules of Procedure.

- (2) The maximum and minimum number of members on the Committee shall be left open.
- (4) The Office-bearers retire annually and are normally available for immediate re-election.
- (5) Council members shall at present serve for three years at least two retiring each year, who are not normally available for immediate re-election. Until rotation is established, those who shall retire may be chosen by lot.
- (6) Voting shall take place at the A.G.M. and will be restricted to members present.
- (7) Names of person seeking election to the Committee (as chosen by the Committee) will appear in the Newsletter prior to the A.G.M. together with an intimation that proposals from ordinary members of additional candidates are welcome. Candidates must give their assent in person or in writing before voting takes place.

The Office-bearers, available for re-election, are as follows:-

Hon. Secretary	Shelagh M. Smith
Hon. Treasurer	David Heppell
Hon. Editor	Fred R. Woodward
Records Convener	David W. McKay.

Council Members: The following were co-opted in June, 1977 and now stand for election as full Council Members (addresses and interests in the List of Members).

John P. Cullinane  
Robert C. Earll  
W. Eifion Jones  
Adrian Norris  
Brendan O'Connor  
Eve Southward  
John B. Wilson

Retired: Geoffrey Smaldon and Dr. D. Peacock

6. Discussion on the format, number and timing of future meetings. Although it is desirable that meetings should be arranged so that people, occasionally, should not have to travel far, there are certain practical considerations militating against holding three meetings a year, the main one being that a large number of speakers are required. Ideas are welcome on any aspect of future meetings especially, (a) should there be two meetings only per year? (b) should there be two lecture meetings plus one field or workshop meeting per year? If you will be unable to attend the A.G.M. and have any point you would like to be considered please write to the Hon. Secretary.

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Spring SeminarPORCUPINE SOCIETY/LITTORINID RESEARCH GROUP

Meeting on: THE SPECIES PROBLEM: Aspects relating to European marine fauna and flora.

To be held at: Manchester Museum

on: Friday/Saturday the 24th/25th February, 1978.

Provisional Programme

- FRIDAY**
- 9.30 Welcome by the Director.
  - 9.40 M. Carter (Portsmouth Polytechnic).  
"Actinia equina, a problematical species".
  - 10.20 B.M. Healey (University College, Dublin).  
"Some aspects of the taxonomy of the Enchytraeidae".
  - 11.00 COFFEE
  - 11.30 C.J. Webb (Bristol University).  
"A species problem in a Mediterranean genus of gobiid teleosts".
  - 12.15 LUNCH
  - 2.00 Film (D. Erwin, Ulster Museum).  
"Down-under-Down".
  - 2.40 B. Picton (Ulster Museum)  
Doto spp. How many?!
  - 3.20 TEA
  - 4.00 Short communications and general discussion.  
(D. Heppell - Architeuthis).
  - 5.00 Sherry reception, Manchester Museum.
  - 7.00 Informal gathering, S.C.R. Manchester University.
  - (7.30) Porcupine Committee Meeting).
- SATURDAY**
- 9.30 Porcupine Society A.G.M.
  - 10.20 E. Gosling (University College, Galway)  
"Starch-gel electrophoresis as an aid to marine bivalve taxonomy".
  - 11.00 COFFEE
  - 11.30 Professor A.J. Cain (Liverpool University).  
"Different sorts of species; taxonomic and ecological".
  - 12.15 LUNCH
  - 2.00 C. Hannaford-Ellis (Liverpool University)  
"Sibling species in Littorina 'saxatilis'".
  - 2.30 Roger Bamber (Cullercoats)  
"Morphological taxonomy in Pycnogonids".
  - 3.00 To be arranged
  - 3.30 TEA
  - 4.00 Discussion and concluding remarks.
  - 5.00 EXEUNT ALL.

DEMONSTRATIONS. Some 30 foot run of bench space, and 20 foot run of vertical screens, will be available for anyone (i.e. speakers or non-speakers) wishing to present a demonstration.

If you have something to show please contact the meeting organiser (Below).

FINAL DETAILS. Intending participants should contact the meeting organiser, C.W. Pettitt, Manchester Museum, who will circulate final details in January to those interested.

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### Field Week in Orkney

A week's field course was held at the Field and Arts Centre, Birsay, Orkney from 27th August to 3rd September, 1977 under the auspices of BRISC (Biological Recording in Scotland Committee). The aim was to provide facilities for intertidal field work with informal tuition on the ecology and taxonomy of various phyla. Eighteen people attended. We visited various types of shore as and when tides permitted. These included the very exposed rocky shore at Birsay itself, the sheltered rocky and partly sandy shores at Howton Bay, Bay of Ireland and Taing of Knockhall on Scapa Flow, and the sand and *Zostera* beds at St. Peter's Pool, Deer Sound. Additionally we investigated the Loch of Stenness which has a more or less marine fauna and flora although there is little changes of tide level. Considerable effort was put into catching inshore fish by seine net operated from the shore using the redoubtable wet-suited Graham Oliver either without or with inflatable dinghy to set the net. We also dredged, and there was a splinter group which spent a little time hunting woodlice and land mollusca. The work was of a qualitative nature, and while those used to the Scottish littoral found few surprises although there was much of interest, Louis and Jacqueline Cabioch and Roger Brehaut, used to the south side of the English Channel, remarked upon the number of species which here in Orkney occurred on the shore, while there they were sublittoral.

Disappointing few crustacea of any kind were found, but the fish section fared better. The mollusca were surprisingly poorly represented, the list below includes species found the following week by Shelagh Smith and David McKay.

List of live mollusca with notes on the habitats in which they were found. A=algal fronds, *zostera*; Br=brackish water; Cr=crevices, holdfasts; Gr=gravel; M=mud; R=solid rock, boulders, under boulders; Sd=sand; E=exposed shore; S=sheltered shore; Dr=dredged.

Examples of species marked \* are lodged in the Royal Scottish Museum.

* <i>Lepidopleurus asellus</i>	R	SE	* <i>Goniodoris nodosa</i>	R	S
* <i>Lepidochitona cinereus</i>	R	SE	* <i>Aegires punctilucens</i>	R	E
<i>Callochiton achatinus</i>	R	S	* <i>Linacia clavigera</i>	R	E
			* <i>Acanthodoris pilosa</i>	A	S
<i>Diodora apertura</i>	R	S	* <i>Adalaria proxima</i>	A	S
<i>Emarginula reticulata</i>	R	S	* <i>Cadlina laevis</i>	R	S
* <i>Acmaea testudinalis</i>	R	S	* <i>Archidoris pseudoargus</i>	R	SE
* <i>Acmaea virginea</i>	R	SE	* <i>Doto coronata</i>	A	S
* <i>Patella vulgata</i>	R	SE	* <i>Trinchesia foliata</i>	R	E
* <i>Patella aspera</i>	R	E	* <i>Eubbranchus farrani</i>	R	S
* <i>Helcion pellucidus</i>	A/Cr	SE	* <i>Leucophytia bidentata</i>	Cr	S
* <i>Margarites helicinus</i>	A	S			
* <i>Calliostoma zizyphinus</i>	R	S	* <i>Nucula nucleus</i>	M	Dr
* <i>Gibbula cineraria</i>	R	SE	* <i>Mytilus edulis</i>	R	SE
* <i>Theodoxus fluviatilis</i>	R	Br	* <i>Modiolus modiolus</i>	R	SE
<i>Lacuna vincta</i>	A	S	* <i>Musculus discors</i>	A	S
* <i>Lacuna pallidula</i>	A	SE	* <i>Modiolarca tumida tunicate</i>		S Dr
			test		
* <i>Littorina littorea</i>	R	SE	* <i>Chlamys distorta</i>	R	S
* <i>Littorina neglecta</i>	R/Cr	E	* <i>Chlamys varia</i>	R	S
* <i>Littorina nigrolineata</i>	R	S	* <i>Pododesmus patelliformis</i>	R	SE
* <i>Littorina rudis</i>	R	SEBr	* <i>Heteranomia squamula</i>	R/Cr	SE
* <i>Littorina littoralis</i>	A	SE	* <i>Thyasira flexuosa</i>	M/Gr	Dr
* <i>Littorina mariae</i>	A	SE	* <i>Lucinoma borealis</i>	S	S
* <i>Littorina neritoides</i>	R	E	* <i>Kellia suborbicularis</i>	R/Cr	SE
* <i>Hydrobia ventrosa</i>	M	Br	* <i>Lasaea rubra</i>	Cr	SE
* <i>Hydrobia ulvae</i>	M/Sd	S	* <i>Mysella bidentata</i>	Sd	S
<i>Potamopyrgus jenkinsi</i>	A	Br	* <i>Turtonia minuta</i>	A/Cr	SE
* <i>Rissoa parva</i>	A	S	<i>Parvicardium exiguum</i>	Sd	S
<i>R. parva interrupta</i>	A	S	<i>Parvicardium minimum</i>	Sd	Dr
<i>Rissoa inconspicua</i>	A	S	<i>Parvicardium ovale</i>	Sd	Dr
<i>Rissoa rufilabrum</i>	A	S	* <i>Cerastoderma edule</i>	Sd	S
* <i>Alvania punctura</i>	Cr	E	* <i>Tellina tenuis</i>	Sd	S

*Cingula cingillus	R/Cr	S	*Tellina fabula	Sd	S
*Cingula semicostata	A/Cr	SE	Macoma balthica	Sd	S
*Skeneopsis planorbis	A	SE	*Abra alba	M/Gr	Dr
*S. planorbis trochiformis	A	S	*Abra nitida	M	Dr
*Omalogyraatomus	A	S	*Abra prismatica	M/Sd	Dr
*Rissoella opalina	A/Cr	S	*Dosinia exoleta	Gr	S
*Rissoella diaphana	S/Cr	S	*Dosinia lupinus	Sd	S
Lamellaria latens	R	E	Venerupis rhomboides		
*Trivia monacha	R	SE	*Venerupis pullastra	Gr/Cr	SE
*Nucella lapillus	R	SE	*Clausinella fasciata	Gr	S
*Buccinum undatum	R/Sd	S	*Chamelea gallina	S	S
*Nassarius incrassatus	R	S	*Mya arenaria	A/R/Sd	S Dr/Br
*Oenopota rufa	Sd	S	*Hiatella arctica	Cr	SE
*Odostomia scalaris	Cr	S	*Thracia distorta	Cr	E
*Odostomia turrita	A	S			
Odostomia unidentata	R	S	*Eledona cirrhosa	A	S
*Akeria bullata	A/Sd	S			
*Diaphana minuta	Sd	Dr			
*Philine aperta	M	Dr			
*Retusa umbilicata	Sd	Dr			
*Retusa truncatula	Cr	S			
*Retusa obtusa	Sd	S			
*Alderia modesta	netted	S			
*Limapontia cocksii	A/Cr	SE			
*Elysia viridis	A/R	S			
*Aplysia punctata	R	E			
*Berthella plumula	R	SE			

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Orkney Ascidians

		Howton	St. Margaret's Hope	Birsay
<u>Order Enterogona</u>				
Family Polyclinidae	- Polyclinum avrantium	*	*	
	Aplidium glabrum	*	*	*
	Aplidium pallidum			*
	Sidnyum turbinatum			*
Family Didemnidae	- Trididemnum tenerum		*	*
	Diplosoma listerianum			*
Family Corellidae	- Corella parallelogramma		*	
Family Ascidiidae	- Ascidiella aspersa		*	
	Ascidiella scabra		*	
	Ascidia conchilega		*	
<u>Order Pleurogona</u>				
Family Styelidae	- Bottryllus schlosseri	*	*	*
	Bottrylloides leachii		*	*
<u>Coelenterata</u>	- Alcyonium digitatum	*		
	Myriothele cocksii			*
	Obelia geniculata	*		*
	Dynamena pumila	*		*
<u>Annelida</u>				
Family Aphroditidae	- Lepidonotus squamatus	*		
	Harmothoe longisetis	*		
	Harmothoe impar			*
	Halosydna gelatinosum	*		
<u>Arthropoda</u>				
Insecta: Anurida maritima	- abundant everywhere	*	*	*
Crustacea: Verruca stroemi	(Cimpedia)	*	*	*
	Pravus flexuosus (Mysid)		*	
	Caprella acanthifera (Amphipoda)			
	Hemioniscus balani (Parasitic isopod in Balanus balanoides)	*		

R.N. Brehaut.

## Commensals, Symbionts and Parasites in the Marine Environment

This meeting was held from 29-30th October, 1977 at the National Museum of Wales, Cardiff. Twenty-four members and friends were present from far-ranging places including Skye, Edinburgh, Aberdeen, South Shields, Huntingdonshire, Reading, London, Bristol, Plymouth and the Channel Islands, in addition to those from the immediate vicinity in South Wales.

The meeting was opened by the Director of the National Museum of Wales, Dr. D.A. Bassett and a few words of welcome from the Zoology Department were given by the Keeper, Mr. J.A. Bateman. In the first session there was a general introduction to commensal and symbiotic relationships (by Dr. June Chatfield) followed by a paper on the symbiotic relationship in the green flatworm Convoluta roscoffensis from beaches in Herm (by Miss Shelagh Doonan). This paper gave an insight into the natural habitat and ecology of Convoluta together with some detailed physiological work on the production ecology. In the final paper of the first session, the topic moved to parasitic worms, and an introduction to the monogeneans and the origin of the cestodes (by Dr. H. Harford Williams).

The second session on the Saturday was also concerned with parasitic worms, one paper (by Dr. Brian James) considering the cercariae of digenean flukes with particular emphasis on a sexual reproduction of the larval parasite (parthenogenesis) and the second lecture (by Dr. David Gibson) included a survey of families of nematode worms parasitic in marine hosts. In the final session after tea, the parasitic molluscs were considered (by Dr. Vera Fretter): these ranged from some fairly normal-looking gastropods to bizarre forms so modified as to be difficult to recognise as molluscs.

The concluding session on the Sunday morning was devoted to parasitic crustacea, which were shown to be numerous on marine fish and also exhibiting a range of structural adaptations to a parasitic mode of life. On Sunday morning there was a general discussion session and a business meeting of the Society. Much informal discussion also took place during the coffee breaks and lunch hours. At this meeting various people who had known each other through correspondence in connection with their marine work were able to meet and discuss common interests.

On Saturday and Sunday the Melvill-Tomlin collection of Mollusca was made available for members to view and study and some useful work was accomplished during this time.

Summaries of the lectures from this meeting are given below.

Dr. June Chatfield  
National Museum of Wales.

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## Commensal and Symbiotic Relationships in the Marine Environment

The most familiar animals in the marine environment are free-living and not dependent on a partner of another species for their basic needs (apart from normal predator-prey relationships). In the marine situation there are a number of associations between individuals of different species and these normally come under the headings of commensalism, symbiosis and parasitism.

Commensalism is a partnership between two individuals of different species (and often different phyla) in which one partner gains, but does not harm the other. At a physiological level it is a less intimate relationship than symbiosis or parasitism but there are certainly some cases where it is difficult to decide which category is appropriate. Hermit crabs often enter into commensal (and sometimes symbiotic relationships) with polychaete worms, hydroid coelenterates, sea anemones and sponges. The polychaete Nereis furcata inside the shell of the

hermit crab Eupagurus bernhardus, darts out to seize small scraps of food, and the coelenterates which associate with hermit crabs also probably gain food. Sometimes commensal relationships of one polychaete worm living in the burrow of another could be thought of as an extension of crevice dwelling with a possible food bonus. Other examples of commensal relationships include pea crabs living in the mantle cavity of mussels, certain amphipods in the bells of jellyfish and a number of animals which associate with echinoderms. Coelenterates, e.g. sea anemones, are often found on hermit crabs, but in this situation there is a two way benefit, with the crab receiving protection from predators as a result of the nematocysts of the anemone, and the anemone receiving food scraps from the crab. The mutual benefit of this situation would suggest symbiosis, but at a physiological level the relationship of hermit crab and anemone more resemble commensalism.

Symbiosis is an intimate relationship between two organisms of different species in which both partners gain from the association. One partner is often dependent on the presence of the other.

The classic example of a symbiotic relationship is that of unicellular algae in the tissues of animals. There are a number of examples of symbiotic algae in the Protozoa, Coelenterata, Platyhelminthes and Mollusca. Essentially the plant cells provide food and oxygen (from photosynthesis) and the animal provides shelter, carbon dioxide and mineral salts (from excretory waste). Even unicellular protozoa can be hosts to symbiotic algae and the main example is the radiolaria which have zooxanthellae (unicellular brown algae) inside the cell. In the tropics, zooxanthellae occur in the tissues of reef-building corals and the algae occur in large numbers and it is thought that they are not culled and digested in this case. Perhaps here, oxygen is the major benefit received by the coral, rather than food.

The marine flatworm Convoluta roscoffensis is bright green due to the presence of unicellular green algae, zoochlorellae. In the molluscs zooxanthellae are found particularly in the tissue of the mantle edge of the giant clam Tridacna and the mantle structurally arranged so that a large surface area of symbionts is exposed to the sunlight filtering through the waters. It is possible that the additional food supply from the algae, in addition to normal bivalve feeding, may contribute to the large size attained by these molluscs.

If the dual advantage is a major criterion for defining symbiosis, there are examples of external symbiotic relationships between different animal species. These could include the hermit crabs and sea-anemones and hermit crabs and sponges in which the sponge proliferates and adds to the shell, so eliminating the need for the hermit crab to find a new shell as it grows. In the tropics a fish (Amphiprion) lives amongst the tentacles of sea-anemones. It appears to be immune to the nematocysts of the anemone and here receives protection from predators. The anemone is thought to benefit from extra circulation of water brought about by the movement of the fish.

Fitting examples of animal relationships to definitions is not easy, it all depends how the criteria are weighted. There are also many gaps in our knowledge and the detailed functioning of these relationships is often little studied or understood: there is clearly scope for further investigation.

J.E. Chatfield  
National Museum of Wales.

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#### An Energetic Approach to Symbiosis in Convoluta Roscoffensis

Since the term 'symbiosis' was coined in 1879 by de Bary, there has been both an expansion of the concept of symbiosis and a development in terms of approach and techniques of investigation. It is no longer seen as one of

Nature's 'parlour tricks', and the number of named examples of associations between organisms has increased enormously: besides the more familiar examples of mycorrhizas, lichens, root nodulation in legumes, ciliates in ruminant and insect digestive organs, and algal-invertebrate symbioses, the concept also includes the symbiotic origin of some cell organelles.

Early studies concentrated on taxonomic, and later, on structural aspects; more recently, the emphasis has been on laboratory studies of the biochemical interactions between symbionts. The time now seems ripe for both field studies and for the energetics of symbiotic relationships to be explored. There are very few references to the energetic approach in the literature, and even the recent symposium devoted to symbiosis (Soc. Exp. Biol. 19, 1975) does not contain any contributions on energetics.

My own work deals with a marine algal-invertebrate symbiosis: the acoel Turbellarian Convoluta roscoffensis in association with the unicellular alga, Platymonas convolutae. We can think of this association as a 'compressed food-chain' i.e. a primary consumer (herbivore) with its primary producer right inside it. This leads to many intriguing questions about energy transfer from the sun to producer to consumer: can we measure the ecological efficiency? Can we draw up Eltonian pyramids of numbers or biomass of algal and animal cells? Is it, and by how much is it, more efficient for an organism to have its primary producer right inside it?

Convoluta provides a unique system for tackling some of these questions. Having no mouth or gut after the worm-algal association has been established in the life-cycle, Convoluta cannot ingest solid food, and relies on its autotrophic partner for nourishment. (The alga, in return, receives nitrogenous (waste) compounds from the worm). Two of the main aspects of my work are concerned with:

- (i) Seasonal changes in Convoluta populations in the field, (in Herm, Channel Islands).
- (ii) Rate and efficiency of fixation of carbon by the photosynthetic algae in Convoluta.

Some of the results are summarised below:

## 1. Seasonal changes in abundance

Date	No. worms m <sup>-2</sup> (X 10 <sup>3</sup> ) *	
February, 1977.	182.8	* Density values are for the upper 80 m <sup>2</sup> of a sampling grid.
May, 1977	4.6	
September, 1977.	256.1	

The amounts of chlorophyll 'a' per worm also follow this seasonal trend:

Date	Chl. 'a'/worm (µg)
February, 1977	0.31
May, 1977	0.07
September, 1977	0.39

## 2. Seasonal differences in productivity (rate of Carbon Fixation)

(a) Date	Productivity (g Carbon fixed m <sup>-2</sup> day <sup>-1</sup> ) *	
September, 1976	4.7	* A 'day' for <u>Convoluta</u> means ca. 6hrs. exposure by the tide.
February, 1977	2.6	
June, 1977	0.5	
September, 1977	4.5	

(b) Although the rate of photosynthetic carbon fixation per worm varies widely with season, the 'energy capturing' capacity of the chlorophyll (assimilation number) of the algae remains fairly steady:

<u>Date</u>	<u>Assimilation No. (mg C fixed/mg Chl. 'a'/hr)</u>
September, 1976	3.17
June, 1977	3.97
September, 1977	2.50

Both productivity and assimilation number are useful values because they allow comparisons to be made between this symbiotic association and other very different systems. (One drawback with assimilation number is that it has to be measured at light saturation and so fixation rates at low light intensities are not comparable).

### 3. Comparison of productivity and assimilation number.

(i) <u>System</u>	<u>Productivity (gCm<sup>-2</sup> day<sup>-1</sup>)</u>
<u>Convoluta</u>	0.5 - 4.7
Antarctic phyto-plankton (inshore)	0.9
Reef coral	13.3
Coniferous Woodland	2.2
Inter-tidal Sea-weed	20.0
(ii) <u>System</u>	<u>Assimilation Number (mgC/mgChl. 'a'/hr.)</u>
<u>Convoluta</u>	2.50 - 3.97
New York phytoplankton	3.7
Pacific Lagoon	16.7

### 4. Efficiency of utilisation of solar energy.

This varies with both incident light energy and amount of chlorophyll per worm. The values lie in the region of 1%, the maximum efficiencies being at low light intensities (as is the case for free-living phytoplankton found at lower depths, and therefore, lower light intensities).

I hope to develop this energetic approach further, so that I can measure energy transfer between the symbionts. However, before this can be done, I have to perfect a way of cleanly separating the algae from the animal cells. Any ideas?

Shelagh A. Doonan, Microbiology Dept.,  
Marischal College, Aberdeen University.

### References

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Biol. Rev. 52: 305-347.
- PLATT, T and SUBBA RAO, D.V., (1975) "Primary production of marine macrophytes"  
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Environments". Ed. J.P. Cooper, C.U.P.

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### Monogeneans and cestodes in marine hosts

by Harford Williams

Honorary Research Associate, National Museum of Wales, Cardiff.

1. Introduction. Papers published since 1758, number of species, definition and hypotheses.
2. Objectives of previous work in testing these hypotheses
  - (i) degree of and factors influencing of host-specificity
  - (ii) zoogeography of host and parasite
  - (iii) behaviour of host and parasite
  - (iv) taxonomic and evolutionary
  - (v) elucidation of the life-cycle.

- (i) Egg production in relation to host behaviour Protancyrocephalus on Limanda aspera. Gastrocotyle trachuri on Trachurus trachurus. Mazocraes alosae on Alosa spp.
- (ii) Destiny of eggs. Nitzschia sturionis, Entobdella soleae, E. hippoglossi, Diclidophora spp. Acanthocotyle lobianchi.
- (iii) Incubation period of eggs. Calicotyle kroyeri, Leptocotyle minor, Rajonchocotyle emarginata, Dictyocotyle coeliaca, E. hippoglossi, E. soleae, Acanthocotyle lobianchi, Diclidophora spp., Gastrocotyle trachuri.
- (iv) Hatching of larva which is normally ciliated (same list of species as for iii above) except for Leptocotyle minor and Acanthocotyle lobianchi
- (v) Behaviour of free-living larva.
  - (a) Manner of swimming
  - (b) Longevity
  - (c) Tactic behaviour - Phototaxis, chemotaxis and rheotaxis.
- (vi) Invasion of fish hosts - direct and indirect life-cycles Entobdella soleae, Acanthocotyle lobianchi, Pricea multae and Gotocotyla sp.

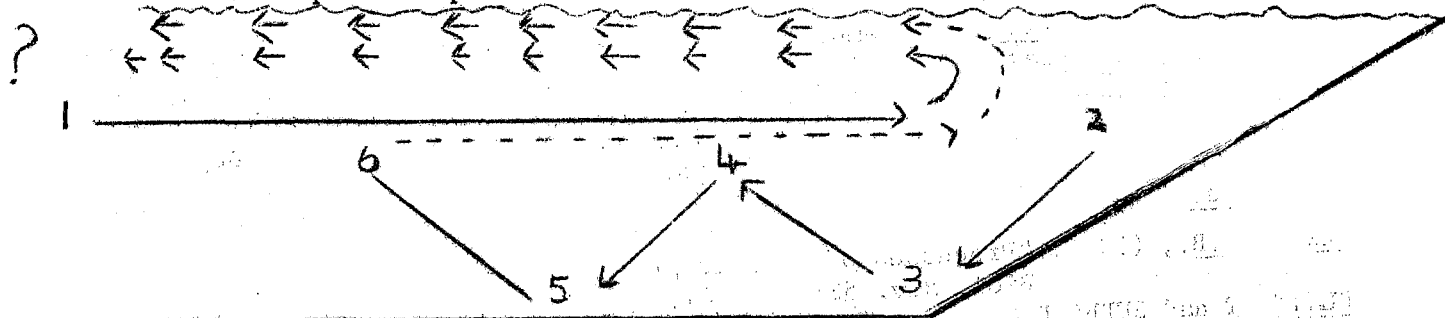
4. Application of monogenean research in evolutionary and fisheries biology. Entobdella hippoglossi, E. soleae, Gastrocotyle trachuri and Diclidophora spp.

5. Conclusions.

Egg production in Gastrocotyle trachuri in relation to behaviour of the scad, Trachurus trachurus.

Two features of the host life-cycle are of particular interest:

1. Disappearance of scad of all ages from the sea-bottom in summer.
2. Confinement of young scad (< 2 years) to coastal waters and their subsequent disposal.



1. 3 to 8 year old spawning scad appear in surface waters off Plymouth from June - September.
2. Spawning. Eggs planktonic and newly hatched young remain planktonic until late September.
3. Young summer-hatched scad migrate to sea-bottom in late September.
4. These young scad appear in surface waters in the following July (13cm.).
5. Return to sea-bottom in October of the same year (18cm.).
6. In July of second year are sexually mature and appear in surface waters before migrating inshore (20cm.).

1. Adults live for about one year but lay eggs only in late August. These sink to the bottom and have an incubation period of 28 days at 13°C.
2. No pelagic young scad are infected.
- 3, 4, 5 and 6. Scad in these areas are heavily infected, and parasite remains on scad as an overwintering stage.

There is a rapidly decreasing degree of infection in scad over 3 years old - they are rarely if ever in contact with the infective stage.

Nematodes parasitic in marine hosts.

Dr. D. Gibson, British Museum (Natural History).

Nematodes are often believed to be mainly parasitic, occurring in both animals and plants; but in fact they occur in huge numbers free-living in the sea, in freshwater and in soil. Several million per square meter can, for instance, be found in sub-littoral mud. Free-living forms tend to feed upon bacteria, fungi and decaying matter, and are usually less than 1mm. in length. They occur in many unusual habitats, such as deserts, hot springs, polar seas, Antarctic soil, vinegar, bill-poster's paste and German beer mats. Parasitic nematodes occur in all of the vertebrate groups and different forms have become adapted to different organs of the body, such as gut, lungs, liver, kidneys, bladder, blood-system, lymphatic system, pancreas, body-cavity, ears, nose, etc.

Nematodes are typically spindle-shaped, unsegmented and bilaterally symmetrical. They lack respiratory and circulatory organs and their excretory organs are unlike those of other invertebrates. Motile cilia or flagella are very rare - even the spermatozoa are amoeboid. The tubular gut has an anterior mouth and a ventrally subterminal anus, the gut itself usually being composed of a buccal cavity, an oesophagus, a ventriculus (only sometimes), an intestine and a rectum. The sexes are separate. Larvae hatch from eggs and moult four times before becoming adult. Parasitic nematodes often, but not always, use other animals as intermediate hosts, and the third larval stage is always the infective stage as far as the final host is concerned.

In our opinion about 30,000 species of nematode have been described, but it is estimated that about twice as many are still waiting to be described. However, there only appears to be about 50 - 60 marine parasitic species in the NE Atlantic region and less than 20 of these are common.

Many of these common worms belong to one group, the Ascaridoidea. This group, which occur as gut-parasites of all of the major vertebrate groups, is characterised by the presence of three distinct lips on the head, and is divided into three main sub groups, each of which has representatives in marine animals, namely the Ascarididae, the Acanthocheilidae and, by far the largest group, the Anisakidae.

The family Acanthocheilidae contains two genera, Acanthocheilus, a parasite of sharks, and Pseudanisakis, a parasite of rays. These worms utilize crustaceans, such as crabs, as intermediate hosts.

The Anisakidae comprises two subgroups, the anisakines which occur in the gut (usually the stomach) of elasmobranchs, crocodiles, aquatic snakes, aquatic birds and aquatic mammals, and the raphidascaridines which occur in teleosts. An example of the former subgroup is Anisakis, a parasite from the stomach of cetaceans, which uses euphausiid crustaceans as a first intermediate host and marine teleosts, such as herring, as a second intermediate host. The third stage larvae occur in the body-cavity of marine teleosts and are often referred to as 'herringworm'. Other marine examples of this subgroup are Phocanema and Contracaecum osculatum from seals, Contracaecum rudolphii from cormorants. These all have similar life-cycles to Anisakis.

The anisakines are the only group of marine nematodes which appear to have any medical importance. In countries where raw fish, especially raw or lightly pickled herring, are eaten, such as Holland and Japan, these worms are something of a problem. Repeated infestations over a short period of time cause inflammation of the intestinal wall, with the result that in certain cases sections of the gut have had to be removed. This is not a problem in Britain because we eat our fish cooked.

The raphidascaridine Thynnascaris is probably the commonest marine parasitic nematode in the NE Atlantic region, as it occurs in the gut of almost all marine teleosts. Again this worm uses crustaceans and marine teleosts as first and second intermediate hosts, but differs from the anisakines in that the final host is also a marine teleost. It is especially common in the larger piscivorous teleosts, such as cod.

The only example of the Ascarididae occurring in the marine environment is Paradujardinia from the dugong. It is a form which is thought to have no intermediate hosts, being transmitted directly between these mammals.

There are several other major groups of nematode in the NE Atlantic region. The seuratoid genus Cucullanus, which occurs in flatfishes and in cod, is interesting because, when food is not available in the host's gut, it feeds directly on the gut-wall. The resulting wounds may, in the case of flatfishes, be responsible for internal infections of the viral disease Lymphocystis. The physalopteroid genus Proleptus occurs in dogfish and rays, and utilizes crabs as intermediate hosts. The habronematoid genera Ascarophis and Crassicauda occur in gadoid teleosts and whales, respectively. Crassicauda, especially, is very interesting as the species are normally very large, often reaching several metres in length. In one particular species, which occurs in blue and fin whales, the males occur in the penis or clitoris, while the much larger females extend from this region down the ureter, through the kidneys and into the blood-system, in some cases reaching as far as the vessels of the liver.

Lastly, a group of some veterinary importance is the pseudaliid metastrongyloids or 'lungworms', which are parasitic in the respiratory system of whales, dolphins and porpoises. If they occur in large numbers in the auditory capsule they can cause deafness, and heavy infestations of the lungs can result in death. They have become particularly important in recent years because of the increase in the numbers of dolphinariums and the resulting increase in the value of trained dolphins.

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#### Some parasitic gastropods, a revelation of our ignorances.

Vera Fretter

Our knowledge of gastropods which act as intermediate hosts of parasites is far in advance of that of gastropods which are themselves parasitic. The hosts of parasitic gastropods are invertebrates of little or no economic value and the damage they do to the host is relatively insignificant.

The life cycle of parasitic gastropods and lemnibranchs is unchanged from that of free-living forms in that the egg develops into a larva which metamorphoses to the adult. In the unionids, freshwater lemnibranchs, it is the larva which is parasitic: it is liberated from the mantle cavity of the female on to a passing fish in the tissues of which it encysts. In the gastropods the larva is free and is responsible for locating the host in relation to which the adult will live. In the less advanced parasitic gastropods the adult lurks close to its host or roams freely over its surface: in the more advanced it is permanently associated with one host individual. The means by which the larva finds and attaches to the host has not been studied. The latter is probably by secretion from a special pedal gland, similar to that possessed by the veliger of free-living species, which gives a secure stance while the rapid metamorphic changes occur. Nor has a study been made of the means by which the proboscis of the metamorphosed snail, which has neither radula nor jaw, penetrates the host tissue, suggestions are that this is done by secretion from the digestive gland. Indeed, they are innumerable ecological, systematic and physiological problems confronting those interested in parasitic gastropods, and, in addition to these, for those working in the British Isles, there may be the problem of obtaining an adequate supply of material.

The pyramidellids are our most common gastropods regarded as parasitic. About a hundred years ago Jeffreys (1867) listed thirtynine species; at that time their feeding relationships were unknown. They are small, two or three millimetres in shell height, and by means of a long proboscis armed with a piercing stylet (a modified jaw), they penetrate the tissues of a sedentary host as they pour out saliva and then suck in the body fluids (Fretter and Graham, 1962). The action of the saliva is unknown. Whether any pyramidellid has a permanent association with a host individual is doubtful. Certainly Odostomia unidentata (Montagu) will suck blood from the tentacle of any Pomatoceros in its vicinity and likewise O. eulimoides Hanley will suck blood from any Pecten. So these

may be better regarded as sedentary predators. For many of the pyramidellids further observations are needed not only in this respect but we are also ignorant of the prey or host of most species; for those living in deeper waters it may be decades before such knowledge is available. The species we are familiar with attack sedentary worms, bivalves, perhaps hydroids, and the gastropod Turritella communis Risso. This suggests that whatever the prey it must be gregarious.

All other parasitic gastropods have lost both radula and jaw and the proboscis penetrates the body wall of the host to get at the tissues. All are associated with echinoderms. They are grouped in four families of which the Capulidae (referring to the cap-shaped shell) stands apart in that it has a free-living species, Capulus ungaricus (L.), which inhabits our coasts. This occurs sub-litorally attached to stones or bivalve shells and has limited powers of movement. It feeds by means of a pseudoproboscis, an elongation of the lower lip, which either collects up particles filtered from the water current passing through the mantle cavity, or extends over the edge of the shell of a living bivalve and takes similar collections from the bivalve. Three species of the genus Thyca are in the same family. They are found on starfish in tropical waters. The foot secretes a calcareous plate immobilizing the snail and giving a permanent attachment to the ambulacral area, and the long proboscis penetrates the tissues to get at the food. In contrast to Capulus the radula is lost and the sexes are separate, the males being dwarf. Such differences between the two genera are greater than might be expected within one family.

The other three families, the Eulimidae, Stiliferidae and Entoconchidae, show increasing specialization for parasiticism. The eulimids, with a conspicuously shiny shell, are not permanently attached to the host and can be collected as apparently free-living. For most species of Balcis and Eulima the host is unknown. However, B. devians (Monterosato) is found on Antedon bifida (Pennant) in the Plymouth area, either free-moving or with the proboscis plunged deeply into the host at the base of a pinnule and reluctant to withdraw. Elsewhere it has been found on Mesothuria, Echinus and Strongylocentotus (Pelseneer, 1928). In the Plymouth area Balcis alba (da Costa) is associated with Spatangus purpureus (O.F. Müller). In both these species the foot is well developed and operculate, and the pedal glands, which secure the position of the snail are hypertrophied. Feeding is by sucking and the structure of the gut in these and other eulimids indicates that they are primarily fluid feeders. The simplicity of the stomach is related to this: as in pyramidellids it appears as an excavation in the digestive gland and has lost all structures related to the mechanical treatment of food.

The stiliferids, with the coiled shell capped by the style-like larval shell, may be found free on the host as Pelseneeria stylifera (Turton) on Psammechinus miliaris (Gmelin) and Echinus esculentus L., with only the feeding individuals attached. Or they may be permanently hidden within the host tissues with means of locomotion lost and perhaps the proboscis permanently attached as in Stilifer celebensis Kükenthal and S. linckiae Sarasin of warmer seas, both inhabiting starfish. In all these parasites a circular fold of tissue, the pseudopallium, arises near the base of the proboscis and is reflected over the shell either temporarily as the animal feeds (Pelseneeria) or permanently (S. celebensis, S. linckiae). It completely covers the shell of the snail embedded in its host. Could it be responsible for enlarging the home of the growing snail by some digestive action on the host's tissues?

The importance of the pseudopallium increases in members of the Entoconchidae, all parasitic on holothurians. In Gastrosiphon inhabiting the body wall of Deima (Indian Ocean) it not only envelops the coiled viscera, replacing the shell, but is drawn out into a siphon connecting the pseudopallial cavity with the outside world, a connection essential for respiration, excretion and reproduction. This parasite has no heart, intestine, eyes or tentacles. In Enteroxenos oestergreni Bonnevie, a vermiform endoparasite without trace of molluscan characters, even alimentary canal, the pseudopallium is said to form the outer covering of the viscera (reduced to reproductive organs). If so it is now the nutritive absorbing surface. Enteroxenos is found in the body of Stichopus in the eastern Baltic

(Ankel, 1936) and I have found one infected specimen of Thyone roscovita Herouard. We need more knowledge about its occurrence. Look for white or yellowish structures a few centimetres long, the shortest attached to the wall of the anterior intestine, the largest free in the coelomic cavity of the holothurian.

Many of the points mentioned need amplification and those with the opportunity of examining echinoderm material may be able to help with this.

Interesting reading on parasitic gastropods from echinoderms will be found in papers by Lützen and his co-workers (1972, 1975).

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#### Parasitic Crustacea - Problems in the Marine Environment

John T. Davey - Institute for Marine Environmental Research, Plymouth.

The parasitic Crustacea, with their often bizarre morphology, have long engaged the attentions of systematic zoologists but, with thousands of species still undescribed, many aspects of the biology of their host-parasite relationships remain virtually unexplored.

The economic implications of some of the copepods parasitic on fishes have, understandably, received priority. The conspicuous gill parasite Lernaeocera branchialis on cod and other gadoid fishes was studied by Kabata (1958) in the context of the Scottish haddock fishery where he estimated that there could be an annual loss of 19,600 cwts of fish if just one ounce of weight-loss was inflicted by each parasite. Because this parasite feeds directly on the blood of its host, Kabata could measure a direct effect on haemoglobin levels as well as depressions in liver fat content and condition factor of haddock carrying one or more mature Lernaeocera.

When the effect of a parasite goes beyond debilitation to the actual death of the host the fact - in the marine environment - may be difficult to observe. The skin copepod, Lepeophtheirus salmonis, is known to damage salmon and at least one record exists (White, 1940) of salmon dying in large numbers because of this parasite. In aquarium conditions Rosenthal (1967) has shown that the free-swimming copepodite stage of Lernaeocera can attack and kill herring larvae that are less than 15 mm long. However, it is anyone's guess what losses are actually inflicted on natural populations of the herring.

Nor are the economic consequences of parasitism confined to those instances where physical damage is inflicted on the host. Aesthetic problems can arise from the mere appearance of parasitized specimens which may make them completely unsuitable for the market.

In assessing the repercussions of any parasite on commercial fishery operations, it is becoming increasingly clear that we need a sound knowledge of the 'normal' condition of the host.

The author and his colleagues at Plymouth have completed a four year study of Mytilicola intestinalis, a copepod parasite in the gut of mussels, which has long been regarded as a most serious pest of shellfish. But their studies have

concluded that this copepod is little more than a harmless commensal and that environmental stresses such as temperature, salinity and food supply, are of considerably greater importance to the mussels (Davey et al., 1977, Gee et al., 1977). Almost certainly it was an inadequate appreciation of host biology and physiology which misled the earlier investigators of Mytilicola. It must therefore be stressed that a similar lack of basic knowledge still pertains in respect of some of our commoner food fishes and that this cannot but undermine assessments of effect attributed to parasites.

Moving beyond the dictates of purely economic interest, the intrinsic appeal of the parasitic crustacea can be illustrated from many angles.

The application of stereoscan electron microscopy to what would otherwise be purely systematic studies can revolutionize our comprehension of both the structure and function of any animal, as Kabata (1974) has shown for the caligid parasitic copepods. He has completely re-interpreted the functioning of the mouth-tube of these creatures, describing hitherto unseen structures. He has also found an organ on the head of these caligids which is almost certainly sensory in function and which may assist in host location.

The modification of host behaviour by parasites provides an especially fascinating field of study. Gadoids infected by Lernaeocera have been observed to linger in estuaries after the main stock of fish have migrated off-shore. It has been suggested (Sproston and Hartley, 1942) that this behaviour, which conveniently ensures the re-infection of the flounder population - necessary for the life-cycle of Lernaeocera, - is mediated by some osmotic imbalance in the host consequent upon the parasite's blood-feeding habits.

On the other side of the Atlantic, Guthrie and Kroger (1974) have found Atlantic menhaden, Brevoortia, coming into estuaries "to recuperate" when infected by isopods, Olencira praegustator, on the gills and in the mouth.

Any parasite may present an unacceptable stress on its host when other environmental factors are also disturbed. Keys (1928) showed that Fundulus sp. infected by the isopod Lironeca survived well under "good aquarium conditions" but succumbed much more quickly than uninfected specimens when subjected to sudden changes in salinity. In 1946, Friend, following the biology of salmon through their spawning migrations, noted that the kelts - salmon returning to the sea after their first spawning migration - were especially susceptible to the effects of Salmincola, a gill copepod considered 'normal' on salmon.

Like many helminths, some parasitic crustaceans have been found to be useful biological tags. Templeman and Squires (1960) used the infection patterns with Sphyrion lumpi to analyse redfish stock migrations in the north-west Atlantic; and Sherman and Wise (1961) separated out four local stocks of cod in the waters off New England by reference to the levels of infection with Lernaeocera.

Finally, no resumé of the parasitic crustacea can omit reference to the phenomenon of parasitic castration. The well-known case of the cirripede parasite, Sacculina, which castrates male shore crabs is but one of a host of examples, for Kuris (1974) tells us that 3% of all crustaceans are parasitic on other crustaceans and castration is a frequent feature of the relationship. Kuris deduces that, as a trophic phenomenon, crustacean castration has more parallels with the insect parasitoid relationships than with true parasitism, and he draws the inference that regulation of host-population density may be involved in more instances than have yet been recognised or investigated.

The foregoing account will, it is hoped, have demonstrated that the parasitic crustacea should not be relegated to the sidelines of zoology, but be seen as providing many facets for the attention of almost every line of investigative biology.

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#### REQUESTS AND INFORMATION

Dr. Vera Fretter is involved in a research project 'The Prosobranch Molluscs of Britain and Denmark and requests research material: Toxoglossans, Eulima, Balcis, Pyramidellids. If anyone can help please contact Dr. Fretter at the Department of Zoology, The University, Whiteknights, Reading, RG6 2AJ.

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I would be extremely grateful for any information on, or sitings of Convoluta on beaches. From a distance, it looks like a spinach-coloured stain on the sand, but on close inspection, hundreds of worms (0.5-4mm. long) can be seen. In Britain, the furthest North (published) records are from the Channel Islands, but at the Cardiff meeting (29/30th October), I heard reports of Convoluta at Aberthaw and even Port Erin, I.O.M. If anyone finds any, perhaps they could send me a few, in sea water, as quickly as possible. Thank you.

Shelagh Doonan,  
Microbiology Department, Marischal College,  
Aberdeen University.

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The dates for the June meeting of Porcupine have now been confirmed. The meeting will be held on 24-25th June, 1978 at the Marine Biological Station, The Strand, Portaferry, Co. Down, No. Ireland. Organised by Dr. P. Boaden; theme 'Interstitial Fauna'. Further details are available from the Hon. Sec. of Porcupine or Dr. Boaden.

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A reminder that subscriptions (£2.) for 1978 are due on 1st January. Please send your remittance to the Hon. Treasurer, Mr. David Heppell, Royal Scottish Museum, Chambers Street, Edinburgh, EH1 1JF.

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A sample page of FLASK (Faunal Lists and Systematic Keys for the Fauna and Flora of the North East Atlantic and Mediterranean) is included in the Newsletter. FLASK will be published by PORCUPINE commencing in summer 1978. The sample page is intended only to indicate style and layout and does not represent the final appearance of the published text which will be typed on an IBM interchangeable head machine (including italic characters) and printed by offset lithography. FLASK will be issued loose leaf, hole-punched for standard binders, with regular updatings of contents and indexes.

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001. THORSON, G., 1944. The zoology of East Greenland. Marine Gastropoda Prosobranchiata. Meddr Grøn. 121 (13): 1-181.

Synopses of species with partial synonymies, extensive distribution records and notes on the development and larvae. Table 2 (p.146-154) provides a checklist of 330 Atlantic Arctic prosobranchs, with distributions indicated for 10 zoogeographical areas.

002. OCKELMANN, W.K., 1959. The zoology of East Greenland. Marine Lamellibranchiata. Meddr Grøn. 122 (4): 1-256, pls. 1-3.

Synopses of species with partial synonymies, extensive distribution records and notes on the development and larvae. Table II (p.194-201) provides a checklist of 294 Atlantic Arctic pelecypods, from 400m or less, with distributions indicated for 11 zoogeographical areas.

003. MADSEN, F.J., 1949. Marine Bivalvia. Zool. Iceland 4 (63): 1-116.

Synopses of species with partial synonymies and extensive distribution records. Table II (p.106-113) provides a checklist of 211 northern Atlantic pelecypods, with distributions indicated for 15 zoogeographical areas, and a note on the bathymetric range of each.

004. PETERSEN, G.H., 1968. Marine Lamellibranchiata. Zool. Faeroes 3 (55): 1-80.

Synopses of species with partial synonymies and extensive distribution records for the Faroes. Table III (p.51-54) provides a checklist and horizontal distribution from 15 zoogeographical area for 145 species of North Atlantic shelf pelecypods.

005. TURK, S.M., 1973. Concordance to the field card for British marine Mollusca. p.1-66. Conchological Society of Great Britain and Ireland. Obtainable from the Secretary, 52 Wychwood Road, Luton, Beds for £0-60.

A checklist of British marine Mollusca occurring down to 100fm, alphabetically arranged within each order. Each entry is referred to Winckworth's list (015) and several standard works. Brief notes on food and distribution of the less common species.

006. RENDALL, R., 1956. Mollusca Orcadensis. Proc. R. Soc. Edinb. (B) 66: 131-201.

A compilation of records of marine Mollusca indigenous to Orkney, with notes on their local distribution.

007. ALLEN, J.A., 1962. Mollusca. Fauna Clyde Sea Area (3): 1-88. Obtainable from S.M.B.A., Dunstaffnage Marine Laboratory, P.O.Box 3, Oban, Argyll for £0-40 + 12p postage.

A checklist of 430 species from the Firth of Clyde and Loch Fyne with details of habitat and distribution within the area for each species, and with a comprehensive bibliography (p.78-86) and index to genera.

008. NICHOLS, A.R., 1900. A list of the marine Mollusca of Ireland. Proc. R. Ir. Acad. (3) 5: 477-662.

Comprises 546 species, including 67 from below 100fm, with distribution records for each and an extensive bibliography (p.480-491).

009. EISMA, D., 1966. The distribution of benthic marine molluscs of the main Dutch coast. Neth. J. Sea Res. 3: 107-163.

An ecological study with an Appendix (p.156-162) of 21 benthic gastropods and 82 benthic pelecypods living off the Dutch coast, with locality data.

010. DAUTZENBERG, P. & FISCHER, P.H., 1925. Les mollusques marins du Finistère et en particulier de la Région de Roscoff. Trav. Stn. biol. Roscoff (3): 1-180.

A checklist of 419 species (including 2 n.spp.) with synonymy and distribution records within the Roscoff area, and an alphabetical index.

A recent stranding of a Sowerby's beaked whale Mesoplodon bidens on the Isle of Skye: a request for more stranding records.

M.C. Sheldrick: Department of Zoology, British Museum (Natural History, London, SW7 5BD)

On 23rd August, 1977 a female Sowerby's beaked whale Mesoplodon bidens stranded alive at Strollamus, five miles north-west of Broadford, Isle of Skye. This animal, which stranded during the late afternoon, was still alive in very shallow water at 19.00 hours but was found to be dead at 09.00 the following morning when the coastguard from Duntulm inspected it. It was then below the high water mark.

At approximately the same time two similar whales were reported to be ashore on the southern end of the Isle of Raasay, less than ten miles away. One of these stranded alive in Raasay Bay and after repeated attempts by two local ferrymen to push it back out the whale eventually swam away. At a nearby rivermouth another whale was successfully rescued by holiday makers, and with the help of a rope and a small boat the animal was towed out into deep water. As the exact timing of all three strandings is not known it is not certain how many individuals were involved as the animal which died at Strollamus might have been one of the previously rescued animals.

The animal stranded on Skye was inspected on 26th August and standard measurements and photographs were taken. The animal was 12' 8½" (3.87 metres) long and the maximum girth approximately 7' 6" (2.29 metres). The stomach, duodenum and the remainder of the intestine were examined for identifiable food remains, but the entire alimentary canal was found to be empty except for a number of parasitic worms. Samples of these worms were taken and those from the fore stomach and fundic stomach have been identified as Anisakis simplex (Nematoda) whilst those from the intestine have proven to be Tetrabothrius sp. (Cestoda). The head of the whale was removed and brought back to the British Museum (Natural History), where investigation showed that there were no parasitic worms in the air sacs or nasal passages.

Eight lamprey scars were present on the left flank in an area ventral to the dorsal fin. Two distinct sizes of scar were apparent, though all made by the sea lamprey Petromyzon marinus. The smaller marks, two in number, were made by fish estimated to be 17-18 inches (44 cms.) in length, and showed distinct whitish scars in the centre where the lingual teeth had attempted to bore into the skin. It is also of interest to note that in two separate cases 'skid' marks, about 4½" (11.5 cms.) long, were clearly shown demonstrating the difficulty these fish have in remaining attached to a fast moving cetacean.

Between 1913 and 1977 thirty strandings of this species have been recorded, including the one described above, and their distribution is shown in Fig. 1.

Cetacea stranded on the British coastline are normally the property of the Crown, and have been so since a statute was enacted early in the 14th century, as are Cetacea caught in our coastal waters. However, in Scotland the pilot whale, the bottle-nosed whale and any other species not exceeding twenty-five feet in length are not 'Fishes Royal' nor are any cetaceans stranded on the coast in areas where the right of ownership has since passed from the Crown to the Lord of the Manor.

Through the involvement of their department, the Receivers of Wreck and Officers of H.M. Coastguard inform the Museum of strandings and provide basic data on specially prepared forms. They have done this since 1913.

Anyone hearing of a stranding is requested to notify either the nearest Receiver of Wreck, H.M. Coastguard Station or this Museum, without delay and preferably by telephone. (British Museum (Nat. Hist.) 01-589-6323). Should any

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local museum, university or any other bona fide institution be interested in obtaining specimens from any 'Royal Fish' they are welcome to contact this museum for permission to do so. In practice this permission will usually be given though under no circumstances should any animal be touched beforehand. When such authority has been granted the institution concerned should liaise with the local Receiver of Wreck or Coastguard Station. It must not be assumed that cetaceans stranded on those parts of the coast that belong to Lords of the Manor can be taken or mutilated in any way without the appropriate permission.

#### Acknowledgements

I would like to thank Mr. A.C. Wheeler, Fish Section, for identifying the lamprey scars and commenting on them, and to Mr. R.A. Bray, Parasitic Worm Section, for identifying the worms.

The following references may be of interest for further reading and information:

- Fraser, F.C. (1934-74). Reports on Cetacea stranded on the British coasts, 11-14. London, British Museum (Natural History).  
 Harmer, S.F. (1914-27). Reports on Cetacea stranded on the British coasts, 1-10. London, British Museum (Natural History).  
 Sheldrick, M.C. Trends in the strandings of Cetacea on the British coasts. 1913-72. Mammal Rev., 6, No. 1., pp. 15-23.

#### Frequencies of the Species 1913-1976

<u>Species</u>	<u>Number of records</u>	<u>Order of frequency</u>
Common porpoise ( <u>Phocoena phocoena</u> )	721	1
Bottle-nosed dolphin ( <u>Tursiops truncatus</u> )	210	2
Common dolphin ( <u>Delphinus delphis</u> )	174	3
Lesser rorqual ( <u>Balaenoptera acutorostrata</u> )	128	4
Pilot whale ( <u>Globicephala melaena</u> )	124	5
White-beaked dolphin ( <u>Lagenorhynchus albirostris</u> )	108	6
Bottle-nosed whale ( <u>Hyperoodon ampullatus</u> )	81	7
Risso's dolphin ( <u>Grampus griseus</u> )	74	8
Killer whale ( <u>Orcinus orca</u> )	49	9
White-sided dolphin ( <u>Lagenorhynchus acutus</u> )	40	10
Cuvier's whale ( <u>Ziphius cavirostris</u> )	37	11
Fin whale ( <u>Balaenoptera physalus</u> )	35	12
Sowerby's beaked whale ( <u>Mesoplodon bidens</u> )	28	13
Sperm whale ( <u>Physeter catodon</u> )	23	14
False killer whale ( <u>Pseudorca crassidens</u> )	18	15
Sei whale ( <u>Balaenoptera borealis</u> )	9	16
Euphrosyne dolphin ( <u>Stenella coeruleoalba</u> )	6	17
Blue whale ( <u>Balaenoptera musculus</u> )	4	18
True's beaked whale ( <u>Mesoplodon mirus</u> )	3	19
Narwhal ( <u>Monodon monoceros</u> )	2	20
Pigmy sperm whale ( <u>Kogia breviceps</u> )	1	21 =
White whale ( <u>Delphinapterus leucus</u> )	1	21 =

In addition to those listed above there have been a number of Cetacea stranded which could not be identified from the information given.

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**Strollamus**

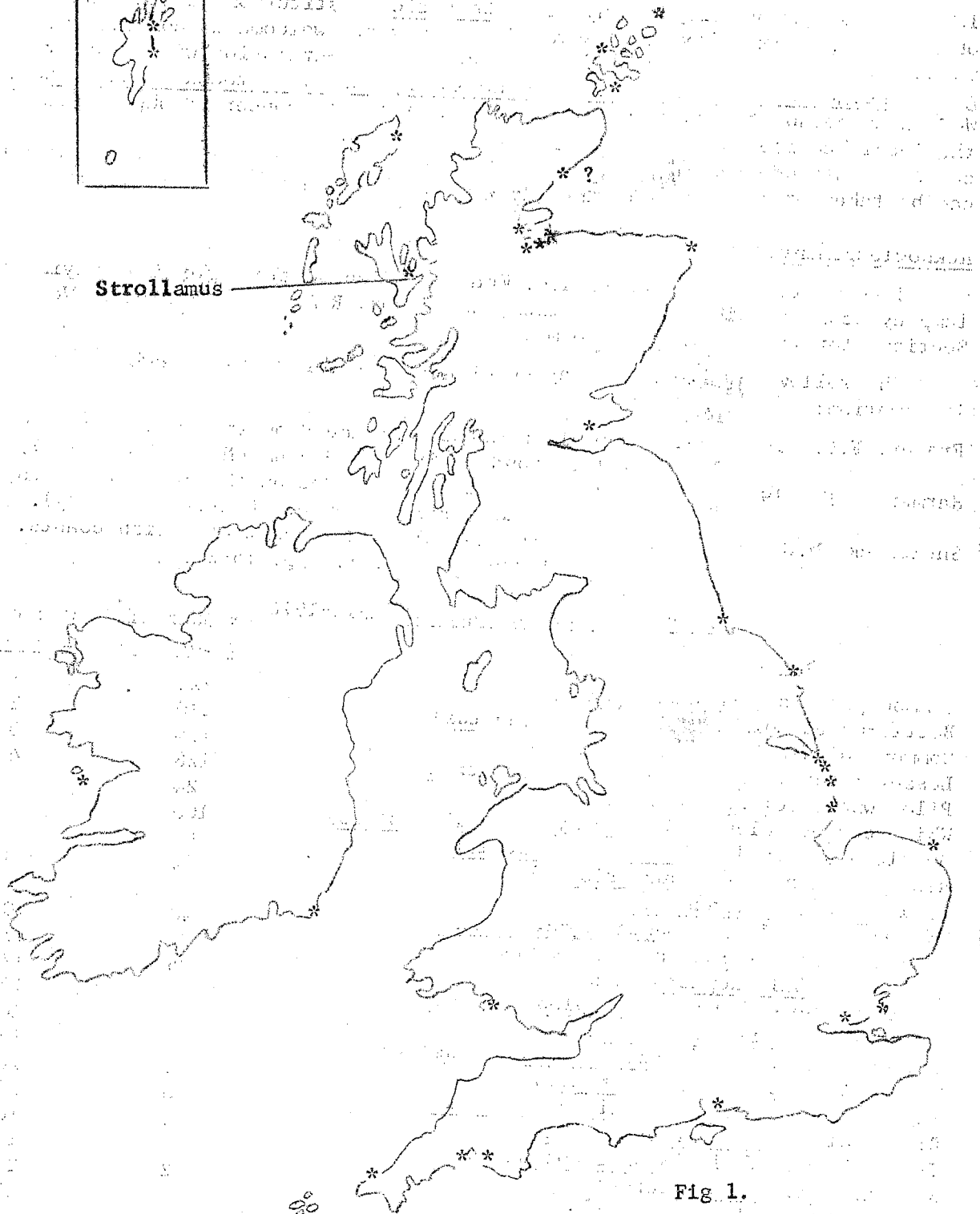


Fig 1.

Ryland, J.S., and Hayward, P.J., British Anascan Bryozoans.

Synopses of the British Fauna (New Series), No. 10. (Ed. Doris M. Kermack)

London, Academic Press. Price £3.90.

The problems involved in the identification of Bryozoa have not been made any easier by the fact that, until recently, the main source of reference was a monograph produced by Hincks in 1880. Over the last fifteen years or so, the task of identifying these delightful, if somewhat confusing little animals has been lightened due to the efforts of Professor Ryland and his co-workers. By publishing this significant synopsis, the Linnean Society has now made a large section of the Bryozoa identifiable by non-specialist workers, and there is the promise of a second synopsis, dealing with the Ascophora, in the near future. In the synopsis under review, the authors carefully describe basic morphological and anatomical features, and relate these to the sometimes baffling appearance of certain species. There are comprehensive sections on reproduction, life-histories and ecology, with notes on predators and a detailed account of fixation, preservation and handling techniques. Keys to genera are concise and clear, and a further key to the planktonic cyphonautes larvae is most useful. Within genera, keys are given for the determination of over seventy species likely to occur in British seas, including those reaching the extreme limits of their range around our southern or northern shores. Illustrations are first-class, and comprehensive notes on each species are appended to the detailed descriptions.

The authors stress, and I would agree wholeheartedly, that a clear understanding of basic morphology and terminology is essential before species can be successfully keyed out. The terminology is complex and the animals may assume amazing forms, but there is no short cut to the successful identification of bryozoa, and the considerable labour of understanding the make-up of these animals cannot be avoided. This is where the profuse accounts of morphology in the beginning of the synopsis come into their own, and the thoughtful addition of a glossary greatly aids a slightly confused newcomer to the phylum.

A few minor criticisms come to mind. An explanation of why formalin should not be used for the preservation of calcareous bryozoa (its acidic properties cause breakdown of carbonates) would have been welcome, since many amateur workers have difficulty in obtaining ethanol. The imprecise nature of 'hypochlorite' for cleaning colonies is a little confusing. Mention in the foreword of the economic importance of bryozoa as fouling organisms has not been elaborated upon in the text, where perhaps it deserves some mention. But these are small details, and should not detract from the fact that this synopsis sets a standard which others will find difficult to follow. In times when value for money has become almost an obsession, this synopsis must be one of the best bargains on the bookshelves.

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#### On Mobile Littoral Environments

An example of the littoral habitat which is perhaps insufficiently considered by marine ecologists is that to be found on ships hulls, the primary concern with which would seem to be its removal. In fact such a habitat answers many of the needs (and criticisms) of biologists with regard to the "rocky" littoral. For example, the effective uniformity of the hull-substrate solves problems of quantitative sampling with regard to sample areas, while the very mobility of this environment allows a degree of remote sampling with the minimum of effort on the part of the biologist. At the same time, the effects of tidal activity are non-existent other than the artificial "incursion" caused by the loading of the vessel.

It must, however, be accepted that the community structure will be relatively artificial with regard to the limitation of pelagic settlement and rapid development

between defouling operations, and the variation in physical conditions of the surrounding water as the ship moves from port to port.

Investigations of such communities are rewarding with regard to community structure, quantitative biology, and records of species (bearing in mind the obvious problems with regard to type/record localities): one would thus hope to see liaison between marine institutions and shipyards where defouling operations make this environment available to the biologist. Such a liaison is developing at the Dove Marine Laboratory with regard to the Tyne yards.

In December, 1974, two dustbinfuls of material were obtained from Redhead's shipyard on the Tyne as they were defouling the M.V. Arctic Shore. The vessel had been cleared in April, 1974, and had spent the intervening months on the Gold Coast of Africa. In this time it had developed a fouling community, based on Balanus tintinnabulum, of an average thickness of 10cm., which was causing a decrease of some thirty per cent in ship's speed. Unfortunately the sample area was not recorded, and no quantitative analyses of community structure have been performed.

No plants were observed in the sample. The dominant animal was B. tintinnabulum, ranging in size from 5 to 85mm. (height), and this species formed a secondary substrate for the remainder of the community, of which the most dominant species were Mytilus perla, a common West African mussel, and a hydrozoan as yet unidentified, forming a dense cover over most of the barnacles. These three species were by far the most dominant, and in the case of the latter two surprisingly exclusive, since no other hydroids or bivalves were found in the sample. Young specimens of other barnacles, e.g. Lepas, Conchoderma, were present, probably having settled on the return voyage.

Within this sessile growth were many polychaetes (most unidentified, but including Nereis sp.) and amphipod crustacea, though the latter were familiar species which may again be assumed to have settled in transit or in the Tyne. Ten specimens of an unidentified tanaid were retrieved, as were twenty-three specimens of a pycnogonid of a hitherto undescribed species: the latter has since been named Endeis picta n. sp. (Bamber, in press), and type specimens are at the British Museum (including the holotype) and South Shields museum. It is possible that the hydroid and tanaid are also new to science.

This example demonstrates the value of fouling communities with regard to obtaining examples of non-local fauna, of unusual community structure and, in this case at least, of unusual species. The identification work already performed on fouling organisms by researchers concerned with de- and anti-fouling means that the appearance of new species is unlikely to be frequent. However the structure and inter-relationships of the fouling population as convenient examples of "young" littoral communities warrants further investigation.

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#### Giant squid stranded at North Berwick

On Saturday, 19th November the Royal Scottish Museum received a report from North Berwick police that a large squid had stranded on the foreshore. Arthur Clarke and David Heppell of the Department of Natural History rushed to the scene and found the squid was a 21 foot specimen of Architeuthis dux Steenstrup in excellent condition. The squid was photographed and measured, then taken to the museum for further study. It was decided to make a dissection of the animal as very little is known of the internal organs of these cephalopods. The dissection was carried out by Graham Oliver with the collaboration of David Heppell and Andrew Packard of Edinburgh University. Photographs were taken at each stage and the animal has been preserved. This specimen, an immature female, will be reported in detail elsewhere; the chief dimensions were as follows:- mantle length 161cm., head 43cm., arms 230cm., tentacles 440cm., caudal fin 67 x 55 cm. These large squids are so seldom encountered that any specimen should be immediately reported, no matter what time of the day or night, to the Royal Scottish Museum, Edinburgh, or British Museum (Natural History), London.

David Heppell.