Porcupine Newsletter

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CONTENTS

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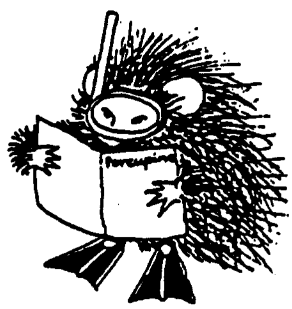

24

PORCUPINE

EDITORIAL

Initially, many thanks to those of you who have been complementary about the appearance of Vol.5 (all moral support being of inestimable value in this job). Of course, all I can do is make it look pretty - I rely on the rest of you to fill the pages with wondrous copy, so don't be shy about contributing. (Please.)

This edition incorporates the further reports from the Swansea Meeting in April, including those from the "related" talks on beasts of the deep-sea. And thereby acts as a convenient hors-d'œuvre for one aspect of next year's spring meeting in Oban (see. p.41). It remains a coincidence that illustratively the issue has ended up with the appearance of an Atlas. Which is a handy link by which to draw your attention to the pending revision of the "Species Directory" (p.42), and your opportunity to have some input into a more than useful publication, to judge by the first edition.

Apropos the future meetings, our normal late autumn meeting has been scheduled for December as it participates in a variety of events organized in celebration of the 400th anniversary of Trinity College, Dublin. It is certainly time that we serviced our Irish Members with a meeting. This also accords with the slightly later-than-normal date for the Spring meeting. We hope that Members biorhythms are not unduly upset.

Further to the **Porcupine** submission to the House of Lords select committee on Science and Technology, the text of which was published in the last issue, I have now received a copy of HL Paper 41 which incorporates all the written evidence received by the committee up to 21st May 1991 (normally available at £21.60); should Members wish to consult this document, they should contact me directly.

Finally, for those of you still shivering during our typical summer weather, a further stock of sweatshirts is on order (of the more popular colours only - but including small human's sizes in red only - OK David?). Orders should be sent to me as usual, or you may pick one up at meetings.

Roger Bamber, Hon. Ed.

25

THE SMBA DEEP SEA BENTHOS SAMPLING PROGRAMME, 1973-1991: A REVIEW

by Robin Harvey & John Gage

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Prior to the start of this programme, our knowledge of deep sea faunas around the British Isles had largely been gained from the results of exploratory dredging and trawling expeditions, for example those of the *Porcupine, Helga* and *Ingolf.* However, the coarse mesh sizes of the trawls and dredges used gave little idea of the richness of the benthic macrofauna, and it was not until the late 1960s that the extraordinarily high diversity of deep sea communities was fully appreciated. This largely resulted from the introduction of fine meshed trawls such as the epibenthic sled, first used in the western Atlantic (Hessler & Sanders, 1967) and large box-corers (Hessler & Jumars, 1974).

Work at SMBA, started by John Gage, was a natural extension of studies in community ecology in sea lochs, and took advantage of the availability of sea time on the then new research vessel *Challenger II.* Although the SMBA studies had (and still have) an exploratory feel to them, their focus has been to sample repeatedly the same station with the epibenthic sled at different seasons in order to remove the element of spatial variability from the equation and thereby detect temporal changes (if any). Generally, a 1 mm square mesh main net with 0.5 mm extension has been used on the sled, but recently there has been greater emphasis on the use of even finer mesh sizes down to 0.3 mm.

Additional samples have been obtained over a wider area on an opportunistic basis with a 0.25 m^2 box corer, 10 mm mesh Agassiz trawl and a small otter trawl, generally fished on a single warp (material from the last is as a bycatch resulting from demersal fish studies by John Gordon at SMBA). Sea conditions in northern waters combined with the low density of the macrofauna preclude the use of quantitative samplers for population studies.

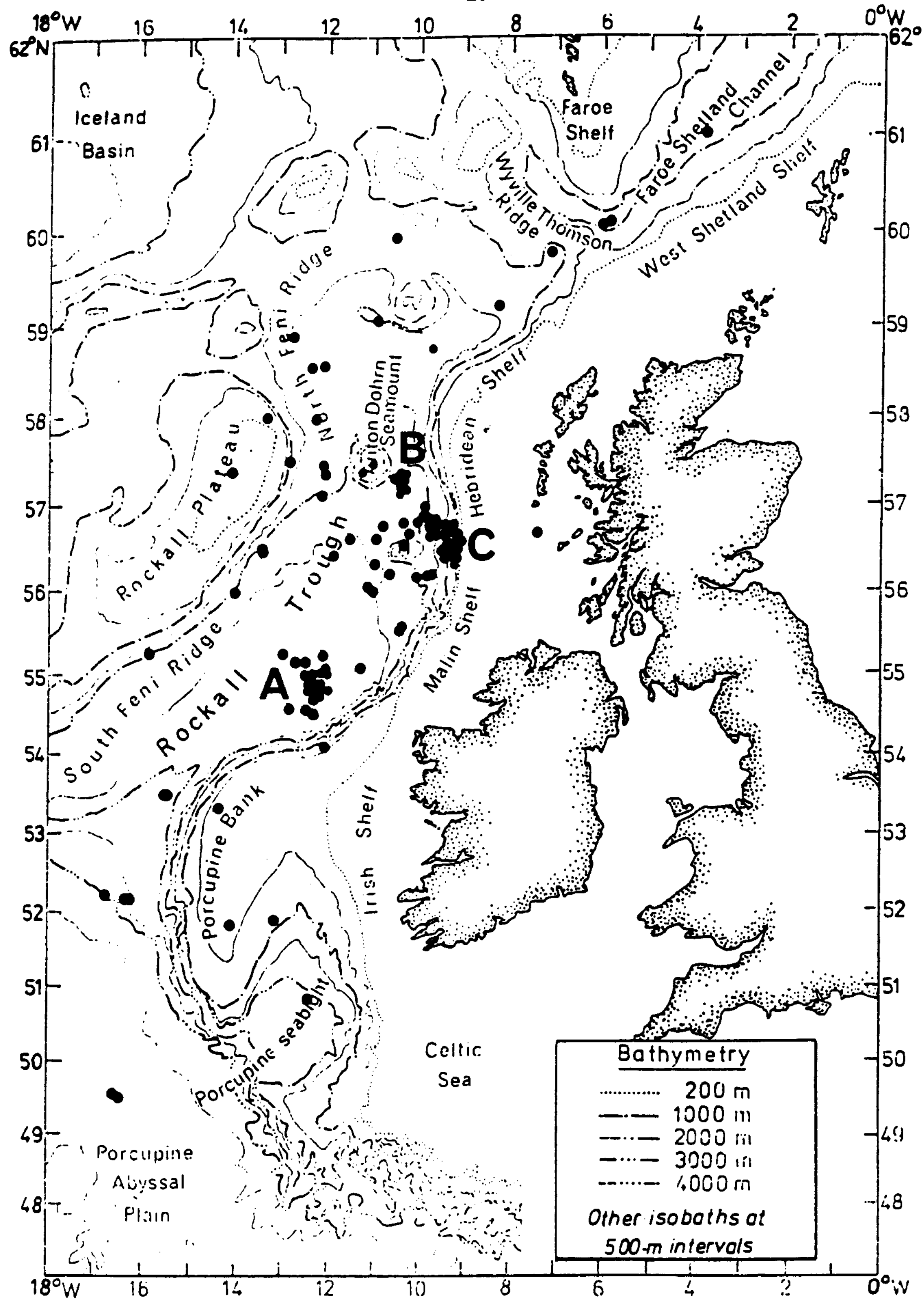
At the SMBA Permanent Station in 2900 m ('A' in Fig. 1) we have taken 36 sled samples covering every month of the year. These have been sorted for their sparse megafauna and at least one subsample from each has been sorted for the rich macrofauna, with additional subsamples being sorted for taxa of particular interest. Staffing levels (currently 2.5) and taxonomic expertise have largely restricted our studies to echinoderms and bivalves so far. Collaboration with Paul Tyler's group at Swansea and later Southampton University, the biology group at IOS Deacon Laboratory and particularly echinoderm specialists at the Natural History Museum, London, to mention but a few, has contributed greatly to the success of this programme and broadened its taxonomic scope. Since 1978 we have also sampled with the epibenthic sled at a more northerly station in 2200 m, Station M ('B' in Fig. 1), but the main focus here has been on the rich megafaunal populations of echinoderms, generally sampled with the Agassiz trawl. Fish trawling has centred on the area marked 'C' in Fig. 1.

What have been the main achievements over the past 18 years?

1) The unexpected discovery of synchronised seasonal reproduction in two bivalve species and one ophiuroid at the Permanent Station, and in two asteroids, one ophiuroid and one echinoid at Station M.

2) Confirmation that, in echinoderms at least, the majority of deep sea species do not appear to breed seasonally (see Tyler *et al.*, 1983, for review), although some appear to have a higher recruitment success during the summer months. Both of these discoveries are likely to be linked to the unexpectedly seasonal input of phytodetritus to the system from surface plankton

26



Porcupine Newsletter, 5 (2), 1991.

27

blooms, discovered by colleagues at the IOS Deacon Laboratory.

3) The discovery of probable seasonal growth rings in the skeletal plates of echinoids and ophiuroids, suggesting an annual growth cycle (Gage & Tyler, 1985; Gage, 1987, 1990). The size-at-age data which these rings provide can be used to estimate annual production. This kind of data has previously been unobtainable due to the apparent absence of any age markers in most species and the difficulties inherent in following growth in size-frequency histograms obtained from irregular seasonal sampling. These results add to the body of evidence that production and turnover rates in the deep sea may be comparable to those in shallower waters.

4) The goegraphic and bathymetric distribution of over 160 species of echinoderm recovered in our samples has been assessed. Many of these are new records for our northern waters (Gage *et al.*, 1983, 1985; Harvey *et al.*, 1988).

5) Among the new species described from these samples are seven echinoderms, including one new genus (Gage, 1985; Paterson, 1985; Gage & Billett, 1986; Harvey, 1989), and a number of tanaidacean crustaceans (Bird & Holdich, 1989, and references therein).

6). A number of PhD studies have been based partly or wholly on our samples, four of which are on-going.

An extensive bibliography of research, biological or otherwise, conducted in the Rockall Trough, is included in Mauchline (1986).

THE FUTURE

Following a brief intensification of sampling during 1990/91, our sampling effort is likely to decline in the coming years and work will concentrate on the analysis of community structure, especially in bivalves and polychaetes, reproduction and growth in bivalves, and growth rates in a number of groups. The role of natural and anthropogenic disturbance is being examined using data from 'vegematic' box cores (in which the core box is subdivided into 25 subcores) obtained on a *Discovery* cruise to Portuguese waters in 1989. This work is being partly funded under the European Community MAST Programme. We intend to continue to monitor populations at the two repeat stations in the Rockall Trough in order to provide longer-term data on natural change.

In addition to the material in our collections which is of immediate interest to ourselves and existing collaborators, there are many groups which have had to be neglected. We invite serious investigators to make use of this material, much of which has already undergone initial sorting and listing. There are also a number of unsorted samples for those who find the joys of sorting irresistable. The underutilised material includes:

Reasonable quantities of

Foraminiferans	Sponges	Actinians
Nematodes (larger ones only)		Sipunculans
Echiurans	Ostracods	Copepods
Cirripedes	Cumaceans	Isopods
Decapods	Pycnogonids	Aplacophorans
Cephalopods		

Small quantities of

Hydroids	Nemerteans
Bryozoans	Ascidians

28

Taxa which are "active" or have been worked up to some degree include:

Actinians	Pennatulids	Polychaetes
Amphipods	Tanaids	Gastropods
Scaphopods	Bivalves	Echinoderms

Anyone wishing to make use of this material should contact either of the authors.

REFERENCES

Bird G.J. & Holdich D.M., 1989. Tanaidacea (Crustacea) of the north east Atlantic: the subfamily Pseudotanainae (Pseudotanaidae) and the family Nototanaidae. Zool. J. Linn. Soc., **97**; 233-298.

Gage J.D., 1985. New Synaptidae (Holothuroidea: Apoda) from the Rockall Trough. J. mar. biol. Ass. UK, **65**; 255-261.

Gage J.D., 1987. Growth of the deep-sea irregular urchins *Echinosigra phiale* and *Hemiaster expergitus* in the Rockall Trough. Marine Biology, **96**; 19-30.

Gage J.D., 1990. Skeletal growth markers in the deep-sea brittle stars *Ophiura ljungmani* and *Ophiomusium lymani*. Marine Biology, **104**; 427-435.

Gage J.D. & Billett D.S.M., 1986. The family Myriotrochidae Theel (Echinodermata: Holothuroidea) in the deep northeast Atlantic Ocean. Zool J. Linn. Soc., **88**; 229-276.

Gage J.D., Billett D.S.M., Jensen M. & Tyler P.A., 1985. Echinoderms of the Rockall Trough and adjacent areas, 2. Echinoidea and Holothuroidea. Bull. Brit. Mus. (Nat. Hist.), Zoology **48**; 173-213.

Gage J.D., Pearson M., Clark A.M., Paterson G.L.J. & Tyler P.A., 1983. Echinoderms of the Rockall Trough and adjacent areas 1. Crinoidea, Asteroidea and Ophiuroidea. Bull. Brit. Mus. (Nat. Hist.), Zoology **45**; 263-308.

Gage J.D. & Tyler P.A., 1985. Growth and recruitment of the deep-sea urchin *Echinus affinis*. Marine Biology, **90**; 41-53.

Harvey R., 1989. A new pterasterid (Echinodermata: Asteroidea) from the deep north-east Atlantic. J. nat. Hist., **23**; 1051-1057.

Harvey R., Gage J.D., Billett D.S.M., Clark A.M. & Paterson G.L.J., 1988. Echinoderms of the Rockall Trough and adjacent areas, 3. Additional records. Bull. Brit. Mus. (Nat. Hist.), Zoology **54**; 153-198.

Hessler R.R. & Jumars P.A., 1974. Abyssal community analysis from replicate box cores in the central north Pacific. Deep Sea Research, **21**; 185-209.

Hessler R.R. & Sanders H.L., 1967. Faunal diversity in the deep sea. Deep Sea Research, **14**; 65-78.

Mauchline J. (Ed.), 1986. The oceanography of the Rockall Channel. Proc. R. Soc. Edinburgh, **B 88**; 1-356.

Tyler P.A., Gage J.D. & Pain S.L., 1983. Reproductive variability in deep-sea echinoderms and molluscs from the Rockall Trough. ***In***: Oceanologica Acta, 1983: Proceedings of the 17th European Marine Biology Symposium, Brest, France, 27 September-1 October 1982; pp. 191-195.

29

PRELIMINARY EVIDENCE FOR SEASONAL REPRODUCTION IN THE DEEP-SEA GORGONIAN *ACANELLA ARBUSCULA*.

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INTRODUCTION

The classic paradigm of ecological studies concerning the benthic environment below the permanent thermocline has been one of continuity and absence of variation (Menzies, 1965). Since the 1980s however, many studies have shown that seasonal changes occur in the deep ocean (reviewed by Tyler, 1988). This report forms part of a joint study of the deep-sea fauna of the N.E.Atlantic with the Scottish Marine Biological Association (SMBA). In a time series, started in 1975, of samples taken at fixed stations in the Rockall Trough, studies of reproductive biology and ecology have demonstrated that seasonality occurs in various benthic echinoderms and molluscs (Gage, 1986; Tyler, 1986, 1988; Gage & Tyler, 1991).

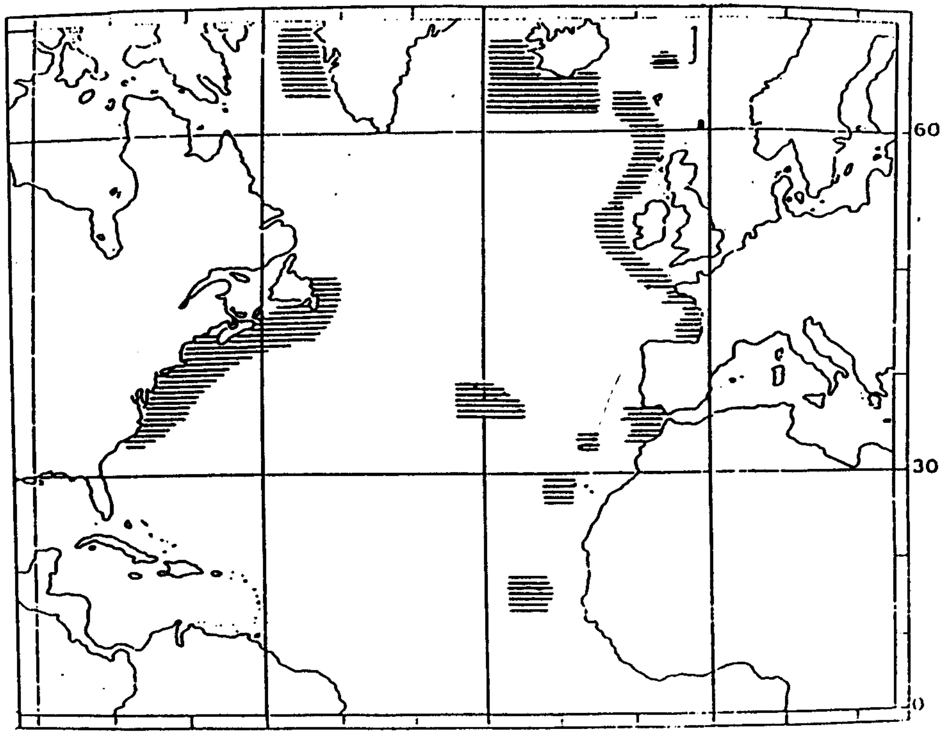
The present study addresses the reproductive biology of *Acanella arbuscula* (Johnson, 1862), a gorgonian found throughout the deep waters of the Atlantic, with a normal depth range of 300-2000 m (Figure 1). The study of deep-sea gorgonians began in 1873 with the voyages of HMS *Challenger*. However the reports were mainly concerned with taxonomy and distribution. Even in shallow water environments where they form an important component of many reef systems, little is known about the biology of the Gorgonacea. The genus *Acanella* belongs in the family Isididae, distinguished from the other holoaxonian families by having a segmental axis - alternating calcareous and horny stretches.

Colonies of *A. arbuscula* have an ovate bushy form, like a fox's tail, with calcareous longitudinally striated internodes, horny nodes and a rhizoid holdfast. Branches arise, in whorls of 3-6, from the horny nodes and bear polyps with a shape between campanulate and infundibuliform. These polyps are incapable of retracting into the thin intervening coenenchyme and bear eight elongate fusiform spicules which protrude beyond the end of the polyp when tentacles are retracted. *A. arbuscula* is dioecious, with the gonads developing on the six asulcal mesentries (sulcal mesentries are sterile). The sex cells arise from interstitial cells in the mesoderm and when mature bulge into the coelenteron. There is no reproductive variability amongst polyps from different areas of the same colony (Lawson, 1990).

MATERIALS AND METHODS

Samples were collected at station 'M' N.E.Atlantic Ocean (Gage & Tyler, 1982). This station is at 2200 m. depth at the base of the Hebridean Fan 57 18' N, 10 11' W (Figure 2). Further details of physical conditions at this station are provided by Gage & Tyler (1982). *A. arbuscula* colonies were collected using a 3 m wide Agassiz trawl, and preserved in 10% formalin/seawater solution. In order to study gonad size and frequency the colonies of *A. arbuscula* were first sexed by removal of a polyp from a branch and gently teasing it open using a dissecting needle and fine forceps under a binocular microscope. Males could be distinguished by their slightly flattened milky-white spermaries; females by their spherical pale yellow/orange oocytes. Once the sex of the colony had been determined polyps were removed randomly from branches and dissected as before. The polyp length and gonad diameters were measured using a calibrated digitising tablet driven by BBC software written by J.D. Gage (SMBA). For each sample 200 gonad diameters of each sex were measured. To test if there was a significant difference in the distribution of gonad diameters amongst the samples a contingency table test was applied to the data (Elliott, 1977). We take the null hypothesis (H_o) to be no difference

Figure. 1 . Distribution of Acanella arbuscula.

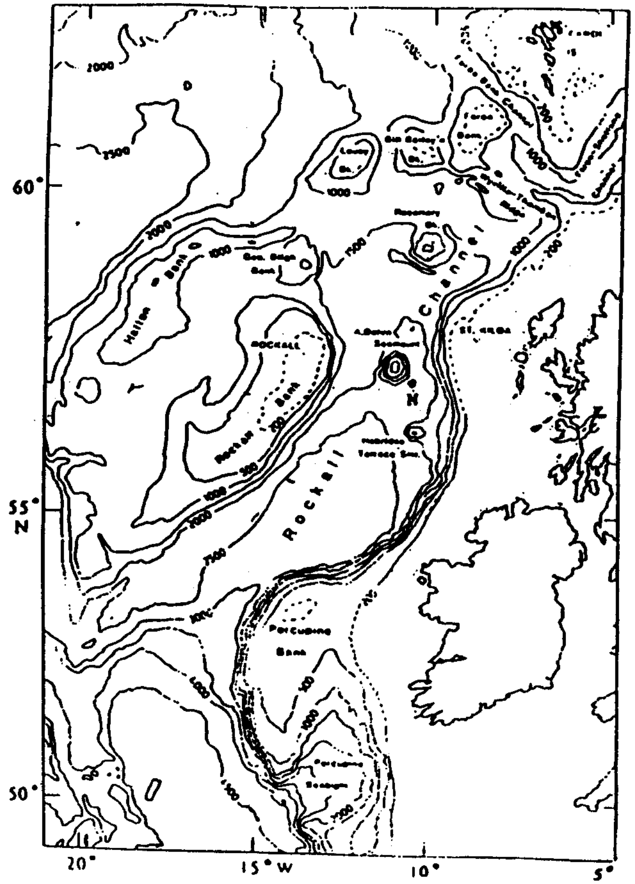


(adapted from Grasshoff 1981.)

Known distribution of Acanella arbuscula.

300-2000 m. Normal depth range.

Figure 2 . Map of study area.



Location of Station M 57° 18' N 10° 11' W
at a depth of 2200 m.
Isobaths in metres.

30

31

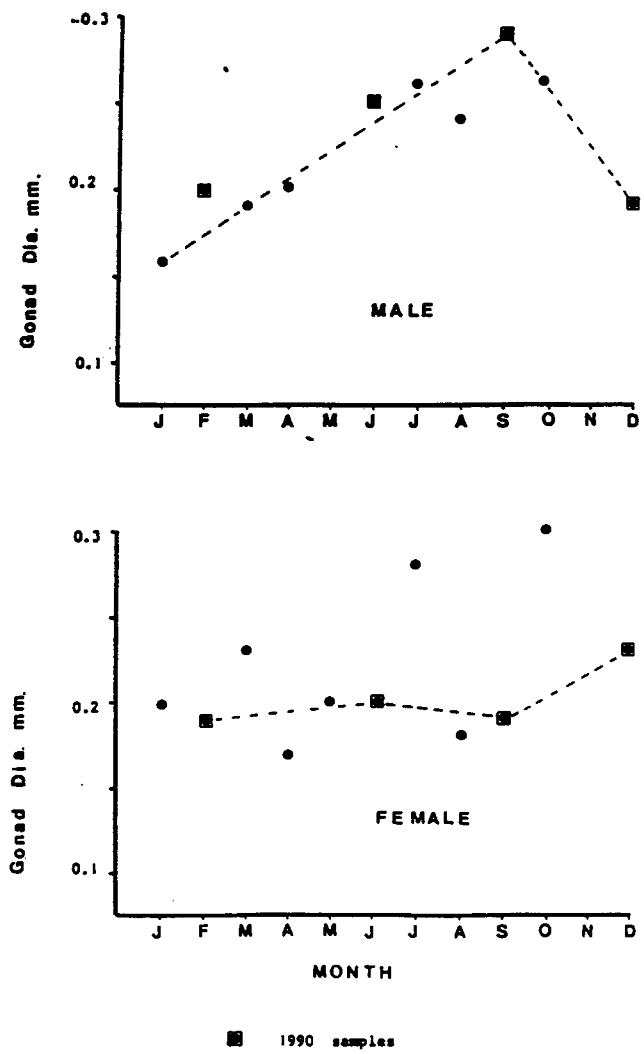
between frequency of gonads in given size ranges from different times of the year. In addition the pharynx and gastric cavity were examined for presence of food.

RESULTS

Comparison of the samples using an r by k contingency table suggested there were significant differences in gonad diameters between samples (for testis diameter $\chi^2=340.49$, 72 d.f., $p=0.01$; for oocytes $\chi^2=195.88$, 72 d.f., $p=0.01$).

For the males there is a clear increase in mean spermary diameter through the year to a maximum in September (Figure 3). In the females there is again an increase in mean oocyte diameter through the year (Figure 3) but it is not as distinct as for the males. Much of the variability may be a result of samples being collected in different years over a 14 year period. In Figures 3,4 and 5 data points marked with a square are from the same year (1990). To look at annual variation, three size ranges of gonad diameters, 'small' 0-0.225 mm, 'medium' 0.225-0.45 mm and 'large' >0.45 mm, were chosen. For the male colonies (Figure 4) there is a decrease in the 'small' diameter spermaries

FIGURE 3. SEASONAL VARIATION IN MEAN GONAD DIAMETERS.



Porcupine Newsletter, 5 (2), 1991.

FIGURE 4. SEASONAL VARIATION IN FREQUENCY OF SPERMARY'S IN GIVEN DIAMETER RANGES.

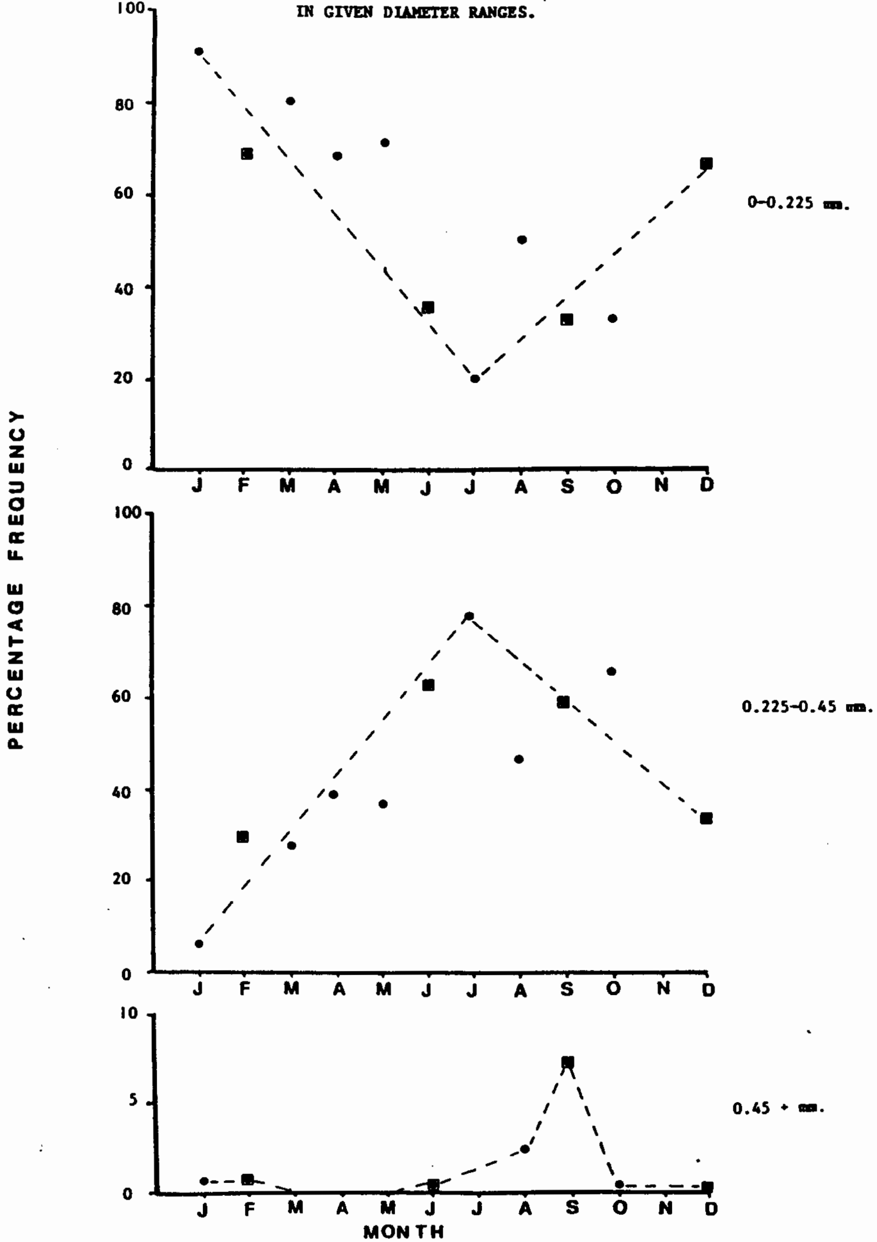
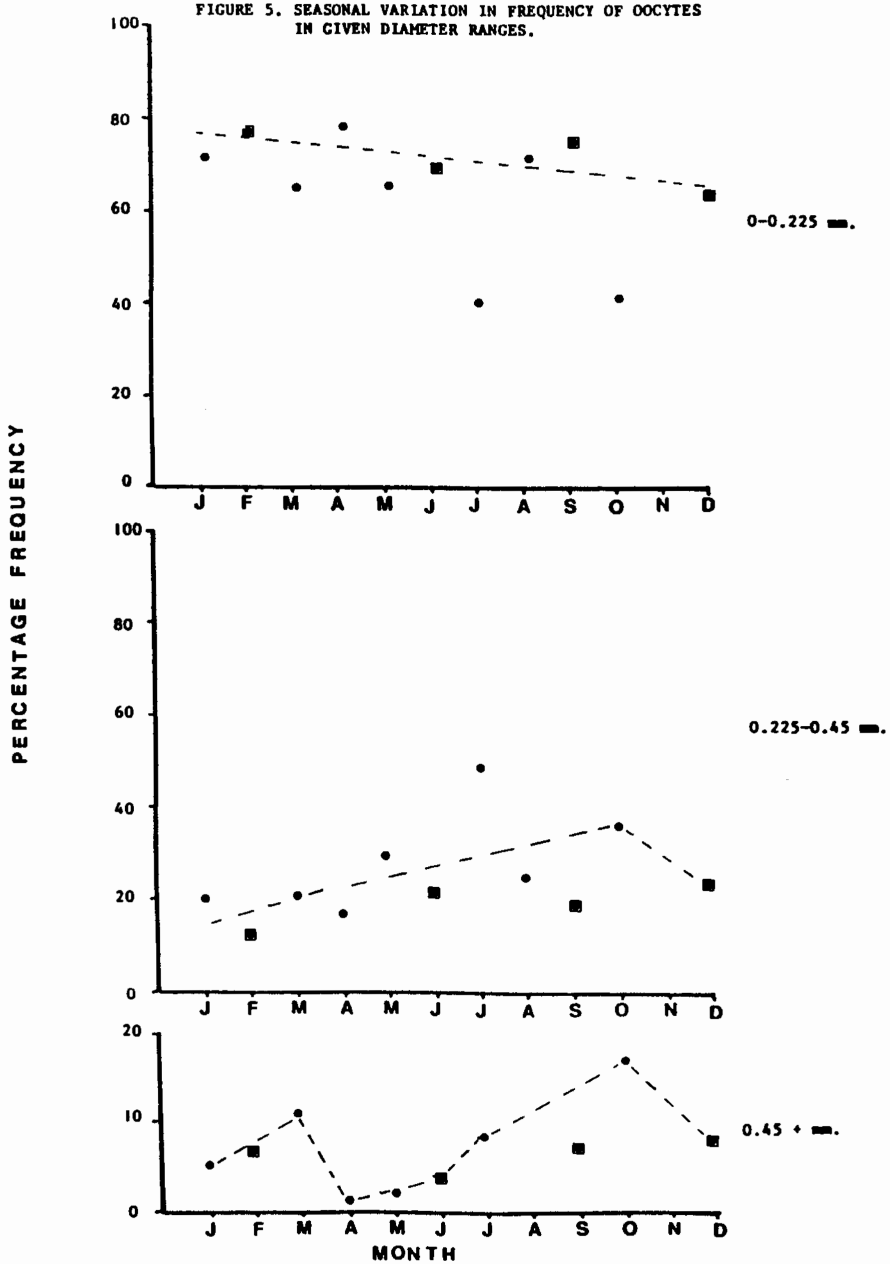


FIGURE 5. SEASONAL VARIATION IN FREQUENCY OF OOCYTES IN GIVEN DIAMETER RANGES.



32

from January to August, and a corresponding increase in medium diameter spermaries January to May with maximum growth May/June. In June of 'large' diameter spermaries appear, which increase in dominance to September and then disappear in October. Thus male colonies show increasing maturity of spermaries from January to May, a rapid increase in size in June, reaching a maximum diameter of 0.57 mm in September, with spawning indicated to occur in October. In the females (Figure 5) there appears to be a fairly constant background level of 'small' diameter oocytes. The 'medium' and 'large' oocytes however show increasing dominance through the year. The largest numbers of 'large' oocytes occurs in October, corresponding to the release time of sperm. The largest diameter is however seen in March (0.73 mm), with minimum numbers of 'large' oocytes in April.

When the contents of the pharynx and gastric cavity of *A. arbuscula* were examined under the microscope they were found to contain detrital material, and many foraminiferans including *Globigerina* sp. This may represent the seasonal flux of surface produced primary production, and was found in samples from April, May, June, July, August and September.

DISCUSSION

To date, there have been limited studies on the reproductive biology of deep-sea octocorals (Rice *et.al.*, in press). However we can compare the reproduction of *A. arbuscula* with the studies made on shallow water reef species. Compared to other anthozoan taxa gorgonians exhibit a limited range of reproductive strategies. In fact all gorgonians appear to be gonochoric brooders (Kinzie, 1970; Grigg, 1977; Brazeau, 1986) or surface brooders (Benayahu & Loya, 1983; Brazeau & Lasker, 1990). The combination of separate sexes and internal fertilization is an unusual strategy in other anthozoans and the rarest strategy displayed by the ecologically similar scleractinians (Szmant, 1986). These studies show that in general gorgonians release mature sperm, often synchronously during June and July. This is followed by internal fertilization of oocytes, whose maximum diameter lies in the range 600-900 μm. Two asexual methods of reproduction have been reported for gorgonians, autotomy of colony ends in *Juncella fragilis* (Walker & Bull, 1983) and fragmentation at axis constrictions in *Plexura* sp. A (Lasker, 1984). The developmental cycles of gonads in *A. arbuscula*, and production of large oocytes (0.6-0.73 mm) seem to indicate internal fertilization and brooding in common with shallow water gorgonians. However, oocytes of *A. arbuscula* are fertilized in October, internally brooded until March and released as planulae in April.

As this study and others have shown, certain deep-sea benthic invertebrates do show seasonality in their reproductive cycles. What is the controlling factor synchronizing reproduction? The physical cues of temperature and salinity are constant in the deep-sea. So along with photoperiod, which is absent, we can consider them unimportant. However one factor that may influence seasonal reproduction and growth in the deep-sea is periodicity in the vertical flux of surface derived organic material (ie. food supply). This downward flux of organic matter is also considered to be the first order parameter that controls the biomass distribution in the deep Atlantic Ocean (Sibuet *et al.*, 1989).

From the study it is apparent that *A. arbuscula* may feed on the flux of surface derived organic material arriving at the seabed. There is no firm evidence in the literature of food being a proximal cause in the initiation of gametogenesis (Giese & Pearse, 1974). However, if, as seems likely, *A. arbuscula* produces planula larvae in the spring months, this sinking organic matter may provide them with a suitable food source. No planulae of *A. arbuscula* have been found in this study, and so we cannot say if they feed, what their internal structure is or how they may settle. Octocoral planulae appear to show lecithotrophic development (Chia & Crawford, 1973; Weinberg & Weinberg, 1979). However a mouth opening has been observed in planulae of *Parerythropodium fulvum fulvum* (Benayahu & Loya, 1983) and *Claularia hamra* (Benayahu, 1989). In deep-sea populations, a seasonal flux of organic material could benefit the newly settled and rapidly growing primary polyps.

34

Alternatively the freshly settled organic material may be a cue in determining the final site of planulae attachment. Many marine invertebrate larvae settle on surfaces covered by micro-organisms and their extracellular products (Cameron, 1986) or algal coating (Chia & Bickell, 1987).

The main input of organic material to the deep-sea in the N.E.Atlantic, occurs late May to August (Lampitt, 1985), which apparently is soon followed by the main period of vitellogenesis in seasonally reproducing species (Tyler, 1986). This correlates well with the results of the present study that show the rapid increase in spermary growth and the first appearance of 'large' (>0.525 mm) oocytes in June. *A. arbuscula* may be using this organic material as a labile energy source for vitellogenesis / gamete production. The physiological mechanisms for maintaining seasonal development may be a strong endogenous rhythmicity free running from birth. This would ensure periodic production of gametes prior to the optimum breeding season. If any offspring produced outside the period of elevated food supply are presumed less likely to survive, then synchronous reproduction of the population will be maintained. Successful spawning dates will be non-random in time and periods of gametogenesis will have a fixed phase relationship to that date (Olive & Garwood, 1983).

CONCLUSIONS

A. arbuscula is dioecious, and appears to show seasonal cycles in both spermatogenesis and oogenesis. It is possible that *A. arbuscula* is a gonochoric brooder in common with shallow water gorgonian species. Although not observed in this study, the planulae or primary polyps may benefit from the seasonal flux of organic material, either as a food source or as a settlement cue. The main period of gamete maturation in *A. arbuscula* appears to coincide with the main influx of surface derived organic material to the deep-sea benthos in late May to August.

REFERENCES

Benayahu, Y. 1989. Reproductive cycle and developmental processes during embryogenesis of *Clavularia hamra* (Cnidaria, Octocorallia). Acta Zoologica (Stockholm), 70(1), 29-36.

Benayahu, Y. and Loya, Y. 1983. Surface brooding in the Red Sea soft coral *Parerythropodium fulvum fulvum* (Forskal, 1775). Biol. Bull., 165, 353-369.

Benayahu, Y. and Loya, Y. 1984. Substratum preferences and planulae settling of two Red Sea Alcyoneans. J. exp. mar. Biol. Ecol., 83, 249-261.

Brazeau, D.A. 1986. Male biased sex ratio in the Caribbean octocoral *Briareum asbestnium*. Am. Zool., 26 (7.a.)

Brazeau, D.A. and Lasker, H.A. 1990. Sexual reproduction and external brooding by the Caribbean gorgonian *Briareum abestinum*. Marine Biology, 104, 465-474

Cameron, R.A. 1986. Introduction to larval biology workshop. A brief background. Bull. mar. Sci., 39, 145-161.

Chia, F.S. and Bickell, L.B. 1987. Mechanisms of larval attachment and the induction of settlement and metamorphosis in Coelenterates: a review. In Settlement and metamorphosis of marine invertebrate larvae. F.S. Chia and M.C. Rice (Ed's). Elsevier. Amsterdam. pp. 73-82.

Chia, F.S. and Crawford, B.J. 1973. Some observations on gametogenesis, larval development and substratum selection of the sea pen *Ptilosarcus guerneyi*. Mar. Biol., 23, 73-82

Elliott, J.M. 1977. Some methods for the statistical analysis of samples of benthic inverterbrates. Freshwater Biological Association. pp. 123-124.

Gage, J.D. 1986. The benthic fauna of the Rockall Trough: regional distribution and bathymetric zonation. Proc. R. Soc. Edinburgh., 88(B), 159-174.

Gage, J.D. and Tyler, P.A. 1982. Growth and reproduction of the deep-sea brittlestar *Ophiomuseum lymani* Wyville Thomson. Oceanologica Acta, 5(1), 73-83.

Gage, J.D. and Tyler, P.A. 1991. Deep-Sea Biology: A natural history of organisms at the deep-sea floor. Cambridge University Press. Cambridge. 504 pp.

Giese, A.C. and Pearse, J.S. 1974. Introduction: general principles. In Reproduction of marine invertebrates. Vol.1. A.C.Giese and J.S.Pearse. eds. New York. Academic Press. pp. 1-49.

Grasshoff, von M. 1981. Die Gorgonia, Pennatularia und Antipatharia des Tiefwassers der Biskaya. I. Allgemeiner Teil. Bull. Mus. natn. Hist. nat., Paris.

Grigg, R.W. 1977. Population dynamics of two gorgonian corals. Ecology, 58, 278-290.

Johnson, J.Y. 1862. Descriptions of two corals from Madeira, belonging to the genera *Primnoa* and *Mopsea*. Proc. Zoo. Soc. Lond., 245-246.

Kinzie, R.A. 1970. The ecology of the gorgonians of Discovery Bay Jamaica. PhD. Thesis. Yale University.

Lampitt, R.S. 1985. Evidence for the seasonal deposition of detritus to the deep-sea floor and its subsequent resuspension. Deep-Sea Research, 32 (8), 885-897.

Lasker, H.R. 1984. Asexual reproduction, fragmentation, and skeletal morphology of a plexaurid gorgonian. Mar. Ecol. Prog. Ser., 19, 261-268.

Lawson, G.S. 1990. The ecology of *Acanella arbuscula* from 2200 m in the North East Atlantic Ocean. MSc. Thesis. Southampton University.

Olive, P.J.W. and Garwood, P.R. 1983. The importance of long term endogenous rythms in the maintenance of reproductive cycles of marine inverterbrates: a reappraisal. Int. J. Invert. Reprod., 6, 339-347.

Menzies, R.J. 1965. Conditions for the existance of life on the abyssal sea floor. Oceanogr. Mar. Biol. Ann. Rev., 3, 195-210.

Rice, A.L., Tyler, P.A. and Paterson, G.J.L. The ecology and biology of the pennatulid *Kophobelemnon stelliferum* (Cnidaria: Octocoralia) in the Porcupine Seabight. J. mar. biol. Assn. U.K. (in press).

Sibuet, M., Lambert, C.E., Chesselet, R. and Laubier, L. 1989 Density of the major size groups of benthic fauna and trophic input in deep basins of the Atlantic Ocean. J. mar. Res., 47, 851-867.

Szmant, A.M. 1986. Reproductive ecology of Caribbean reef corals. Coral Reefs, 5, pp. 43-53.

Tyler, P.A. 1986. Studies of a benthic time series: reproductive biology of benthic inverterbrates in the Rockall Trough. Proc. R. Soc. Edinburgh, 88(b), 175-190.

Tyler, P.A. 1988. Seasonality in the deep-sea. Oceanogr. mar. Biol. Ann. Rev., 26, 227-258.

Walker, T.A. and Bull, G.D. 1983. A newly discovered method of reproduction in gorgonian coral. Mar. Ecol. Prog. Ser., 12, 137-143.

Weinberg, S. and Weinberg, F. 1979. The life cycle of a gorgonian: *Eunicella singularis*. Bijdragen Tot De Dierkunde, 48(2), 128-140.

REPRODUCTIVE BIOLOGY OF AN ACTINIAN FROM THE BATHYAL N.E. ATLANTIC OCEAN

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The gorgonian *Acanella* and its epizooite *Amphianthus dorhni* form a common element in the time series samples that have been collected from Station M (2200 m deep) [*see above, p.25*] in the northeast Atlantic. *Amphianthus* is a common shallow water actinian growing on a variety of gorgonians and was believed to have a depth range down to about 1000 m (Manuel, 1981). Our samples extend this depth range considerably.

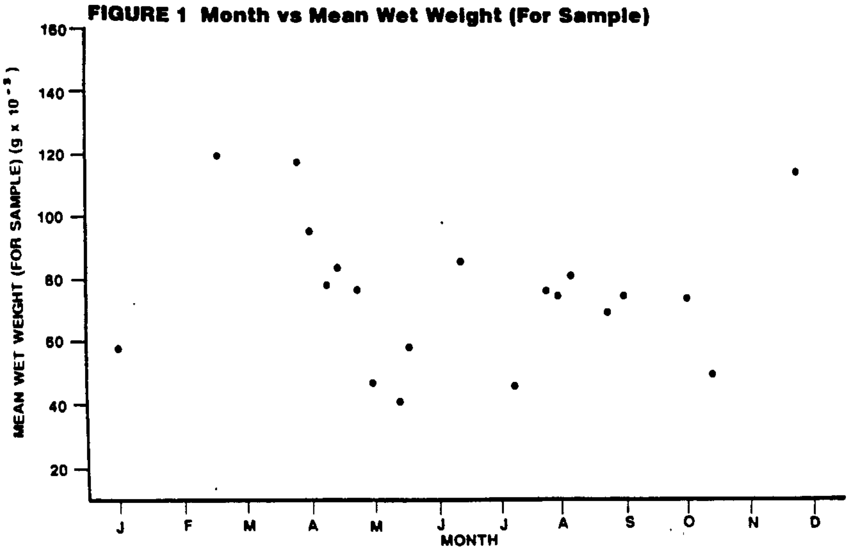
Relatively little is known of the reproductive biology of deep-sea actinians. Some study has been made of other members of the Hormathiidae and there is strong evidence that this family shows seasonal reproduction in the deep sea (Van Praet & Dichateau, 1984; Van Praet *et al.*, 1990; Van Praet, 1990). As a result of these previous investigations and our good time-series samples of *Amphianthus* we considered it worthwhile to examine the reproductive biology of this species.

Amphianthus dorhni was collected at Station M at 2200 m by Agassiz trawl and epibenthic sled. To examine the reproductive biology, 20 individuals from each of 20 samples were wet-weighed, processed, sectioned at 7 μm and stained. Dry weights were obtained from samples for comparison. The diameters of 100 oocytes from each female were measured and the data analysed by a Statgraphics package.

RESULTS

There appears to be a seasonal variation in adult wet weight of individuals from different months of the year (Figure 1). The heaviest individuals are found between February and March of each year.

FIGURE 1 Month vs Mean Wet Weight (For Sample)



37

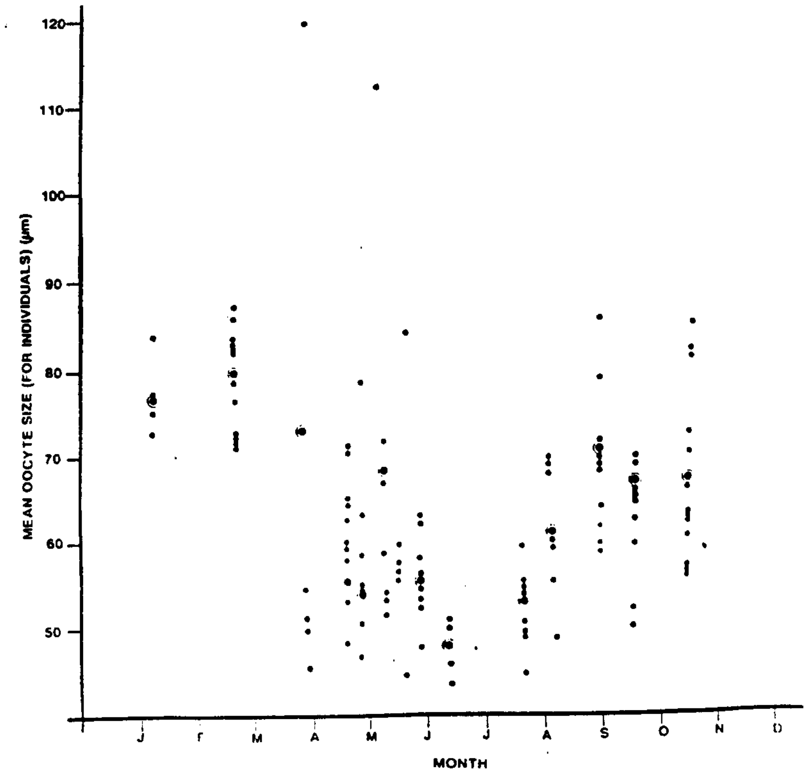
The gametogenic biology of *Amphianthus* appears to be typical of actinians. Oocytes and spermatozoa develop in the imperfect mesenteries in the lower part of the column. The maximum oocyte diameter is approximately 150 μm and sections reveal considerable uniformity of gonadal size within an individual.

The seasonality of gametogenesis is shown in Figures 2, 3 and 4. The development of the oocytes shows a distinctly seasonal cycle. Oogonia and young oocytes are found mainly in the summer months. Oocyte growth really starts by July and continues through until February. After February there is a marked decrease in the oocyte size, indicating a period of spawning. Histological examination of the gonads and the oocyte size frequency figures suggest that spawning is completed by April.

DISCUSSION

Amphianthus dorhni would appear to have both a wide horizontal and vertical depth range. This species has been recorded from shallow water off the southwest of the U.K. and off southern Ireland on the gorgonian *Eunicella* (Plymouth Marine Fauna, 1957) but is now considered to be "rare" (Manuel, 1981). The depth range of 1000 m or more described by Manuel (*ibid*) can now be extended to *ca* 2200 m in the Rockall Trough. At this depth the supporting gorgonian is *Acanella arbuscula*.

FIGURE 2 Month vs Mean Oocyte Size (For Individual)



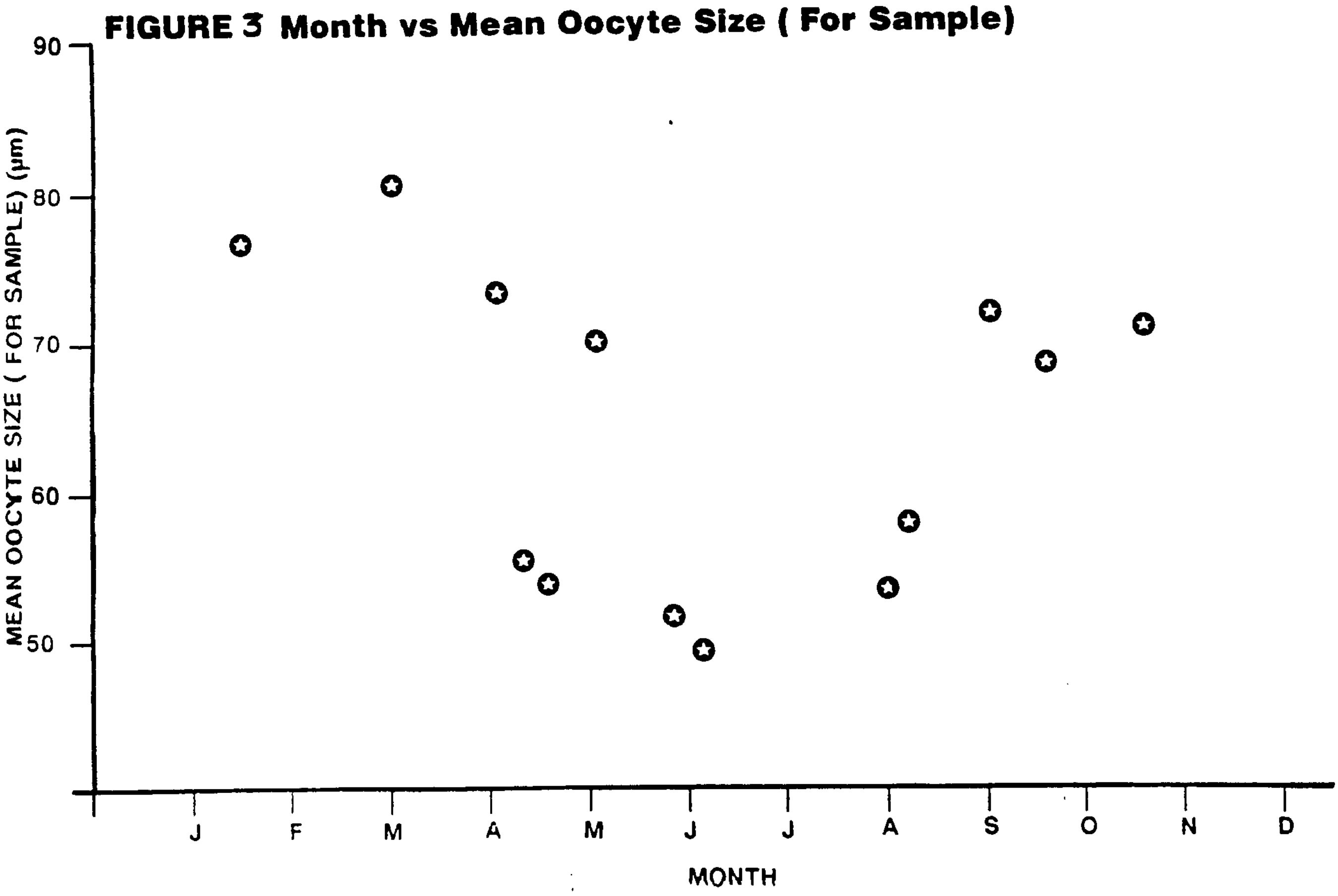


FIGURE 3 Month vs Mean Oocyte Size (For Sample)
MEAN OOCYTE SIZE (FOR SAMPLE) (μm)
90
80
70
60
50
J
F
M
A
M
J
J
A
S
O
N
D
MONTH

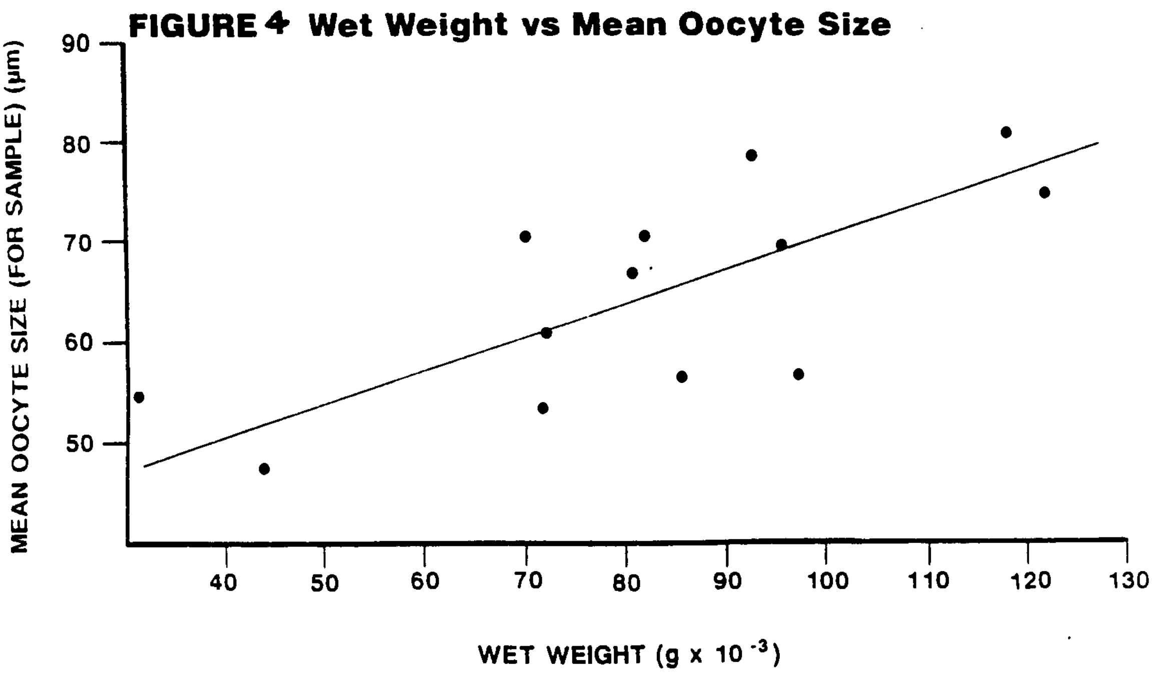


FIGURE 4 Wet Weight vs Mean Oocyte Size
MEAN OOCYTE SIZE (FOR SAMPLE) (μm)
90
80
70
60
50
40
50
60
70
80
90
100
110
120
130
WET WEIGHT (g x 10 -3)

39

There is strong evidence for seasonality in reproduction in *Amphianthus*. The pattern of oocyte growth shows a steady increase from previtellogenesis in the summer months of May and June, through oocyte growth in the autumn and winter months to reach a maximum size in January/February of each year. Spawning appears to occur between February and April. The seasonal pattern in gametogenesis is significantly correlated with seasonal variation in wet weights ($p<0.05$). There is a significant correlation between wet weight and oocyte size, suggesting that the seasonal variation in wet weight may be a result of reproductive development.

The mean wet weight of individuals in the heaviest sample (AT171) is 61% greater than that of the lightest sample (AT175) suggesting that reproductive tissue may account for up to 40% of the wet body weight in a well-developed individual of *Amphianthus*. This large increase in body weight must be fuelled by feeding. *Amphianthus* is a suspension feeder and the increase in gametogenic development would appear to be correlated with the downward flux of phytodetrital material (Billet *et al.*, 1983; Rice *et al.*, 1991) in this region. This material will provide a labile source of organic carbon during the late spring and summer months. At other times of the year this species must rely on less predictable sources of food resulting from a very limited downward flux of material together with that brought into resuspension by local contour currents. Since *Acanella* is a suspension feeder, local currents carrying suspended material may dictate its distribution, thus supplying the needs of the epizooite also.

Other factors must affect the distribution of *Amphianthus*, since *Acanella* is found in many parts of the north Atlantic (Grasshof, 1981; Hecker, 1990), but only in the Rockall Trough is *Amphianthus* recorded as epizoic on it. The distribution of *Acanella* is patchy and it is possible that other populations have not been colonized as a result of this, or simply that our sampling has not been sufficiently comprehensive to detect it.

REFERENCES

Billet D.S.M., Lampitt R.S., Rice A.L. & Mantoura R.F.C., 1983. Seasonal sedimentation of phytoplankton to the deep-sea benthos. Nature, **302**; 522-523.

Grasshoff M., 1981. Die Gorgonaria, Pennatularia und Antipatharia des Tiefwassers der Biskaya (Cnidaria, Anthozoa). Bull. Mus. natn. Hist. nat., Paris, 4th Series, **3** Section A, No.3; 731-766.

Hecker B., 1990. Variation in the megafaunal assemblages on the continental margin south of New England. Deep-Sea Research, **37**; 37-57.

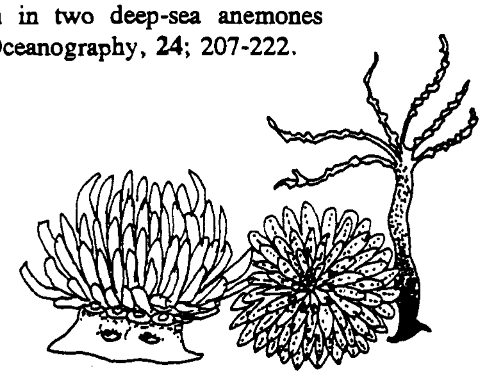
Manuel R.L., 1981. British Anthozoa. Synopses of the British Fauna (New Series), No. 18. Academic Press. 241pp.

Rice A.L., Billet D.S.M., Thurston M.H. & Lampitt R.S., 1991. The Institute of Oceanographic Sciences Biology Programme in the Porcupine Seabight, background and general information. J. mar. biol. Ass. U.K., **71**; 281-310.

Van Praet M., 1990. Gametogenesis and the reproductive cycle in the deep-sea anemone *Paracalliactis stephensoni* (Cnidaria, Actiniaria). J. mar. biol. Ass. U.K., **70**; 163-172.

Van Praet M. & Duchateau G., 1984. Mise en evidence chez une Actinie abyssale (*Paracalliactis stephensoni*) d'un cycle saisonnier de reproduction. C.R. Acad. Sci. Paris, **299** Ser.3; No. 17.

Van Praet M., Rice A.L. & Thurston M.H., 1990. Reproduction in two deep-sea anemones (Actiniaria) *Phelliactis hertwigi* and *P. robusta*. Progress in Oceanography, **24**; 207-222.



40

PALOLO AND CORAL SPAWNING RECORDS FROM FIJIAN REEFS

by Veikila Curu Vuki

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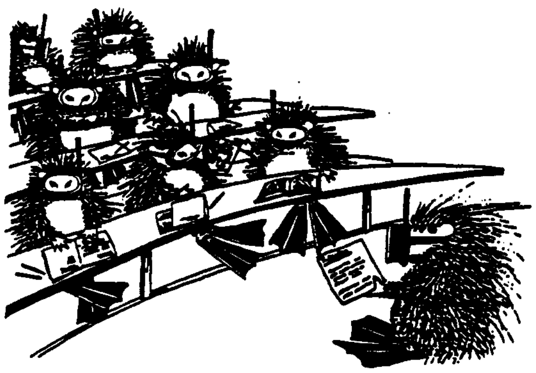
ABSTRACT:

Palolo worm, *Eunice viridis* (Polychaeta: Eunicidae) and many scleractinian coral species were observed spawning in October and November of 1989 on fifteen Fijian reefs. The timing of Palolo worm spawning coincided with coral spawning and it occurred on the ninth night after full moon. More than twenty species of scleractinian corals spawned on the sixth night after the October full moon and also on the fifth and sixth nights after the November full moon of 1989.

The timing of the palolo and coral's spawning was associated with rise in water temperature. Diurnal light cycles, lunar periodicity and tidal amplitude are some of the factors that may have triggered the synchronization of gamete release.



FUTURE MEETINGS

AUTUMN FIELD MEETING - ISLE OF WIGHT

This meeting has been planned to take advantage of the spring tides from the 8 to 10 September. The Isle-of-Wight offers a diversity of marine habitats in a relatively small area. The following itinerary is proposed:

Sunday 8th September: Osborne Bay, a typical Solent shore with rocky outcrops, extensive sandy/silty bay and *Zostera* beds. The shore is part of the private Osborne House estate and is therefore much less disturbed (or recorded) than others in the vicinity.

Monday 9th: morning - estuary, saltmarsh and lagoons at Bembridge. In the afternoon we will examine the extensive series of limestone ledges at Foreland, Bembridge. This is probably the richest area for marine life on the Island.

Tuesday 10th: morning - estuary, saltmarsh and lagoons at Newtown. Afternoon - Hanover Point on the SW coast which comprises a series of clay reefs , rocky ledges and a petrified forest.

A package has been arranged with the Medina Valley Centre, just north of Newport on the following

41

basis: 2 nights b&b, evening meal on Sunday, packed lunch Monday & Tuesday, use of laboratory facilities. The total cost will be £44 incl. VAT. The Centre's minibus will be available and will be charged according to mileage. To coordinate the minibus pick-up it would be helpful if attendees could travel over to the Island on the same ferry/catamaran; we suggest meet at Cowes at 12.20, whence we can coordinate plans over lunch.

For further details contact Roger Bamber (0703 893513) or Roger Herbert at the Medina Valley Centre (0983 522195). Would all intending attendees contact RB as soon as possible.

DECEMBER MEETING - DUBLIN

In collaboration with the Irish Biogeographical Society, the Irish Marine Sciences Association and the University of Dublin, on the theme of **Biogeography of Ireland: Past, Present and Future,** on 16 and 17 December 1991 at Trinity College, Dublin. There will be a reduction in the conference fee for Members of supporting organizations (e.g. **Porcupines**). Particular **Porcupine** involvement relates to the workshop on the Tuesday afternoon on Marine Communities.

Provisional programme:

Monday 16th: 10.00 Registration & Coffee/Tea
11.00 Introduction
11.15 P. Coxon - Quaternary biogeography...
11.40 J.M. Lynch & T. Hayden - mustelids..
12.05 F.J.G. Mitchell - *Arbutus*
12.30 C.A. Duigan - freshwater Cladocera
13.00 Lunch
14.00 T.K. McCarthy *et al.* - aquatic parasites
14.25 B. Connolly - Ephemeroptera
14.50 T. Bolger & R.P. O'Hanlon - Talitridae
15.15 D. Doogue *et al.* - millipedes
15.40 Coffee/Tea
16.00 S. Waldren & M.L. Scally - *Saxifraga*
16.25 P. Buckley & T.K. McCarthy - birds
17.00 End of Day 1
19.00 Conference Dinner

Tuesday 7 December
10.00 R. Raine *et al.* - phytoplankton
10.25 D.T.G. Quigley & K. Flannery - fish
10.50 J.G. Wilson - *Cerastoderma*
11.15 M.C.D. Speight - insects
11.45 D. Minchin - marine fauna & fisheries
12.10 - to be confirmed
12.35 Discussion
13.00 Lunch
14.00 Workshop on Marine Communities

Those planning to attend should contact Mark Costello, Environmental Science Unit, Trinity College, Dublin 2, Ireland, Tel: Dublin 772941, or the Hon. Sec.

APRIL 1992 MEETING AND AGM - OBAN

The 1992 Spring Meeting and 15th Annual General Meeting will be held at th Dunstaffnage Marine Laboratory, Oban, on 25-26 April 1992, on the theme **From Loch to Abyss**. We anticipate that this will allow for a range of presentations, including from the recent NCC (etc.) sea loch surveys to the SMBA deep-sea programme. This is the weekend after Easter, so there should be no shortage of available accomodation. A dinner will be arranged in Oban. The AGM will occur a.m. on Sunday.

Those interested in attending, and those wishing to present talks, videos or poster displays, should ideally contact Robin Harvey (Dunstaffnage Marine Laboratory, PO Box 3, Oban, Argyll PA34 4AD; Tel: 0631 62244), or else the Hon. Sec.

42

NOTICES

FOR SALE - PORCUPINE NEWSLETTER

During a recent trip to Southampton to collect secretarial and archive material it became apparent that one of the main duties of the Secretary was to look after a rather large stock of **Porcupine Newsletter** back issues. I would much prefer to look after a small stock of PN. Therefore I am having a sales drive. Members who have joined in recent years may like to consider completing their set of PN. The back issues are as full of erudite and entertaining articles as today's and are essential reading for **Porcupines**.

Most issues are available (including the "rare" Vol.1 No.1) but we will photocopy the masters for those already sold out. We are offering all back issues at a special Member's price of £1 each incl. postage. Yes, post-free, so the more you buy the more free postage you get. Please send a list of your requirements to me, Ian Killeen (address at front) enclosing a cheque for the appropriate amount.

HAVE YOU SEEN A MERMAID?

If so, we would like to hear from you. We are conducting a survey of mermaids, and mermen, and would like to know about any specimens (extant or destroyed) that may be known to you. References and illustrations in local publications, ephemera, manuscript notes and correspondence may provide important clues to the whereabouts of specimens - if you know of any references to living or preserved merfolk we would be very interested to hear from you. Even records of recent sightings would be appreciated.

David Heppell (to whom replies should be addressed) & Geoff Swinney
National Museums of Scotland, Chambers Street, Edinburgh EH1 1JF

INTERNATIONAL CONFERENCE ON MOLLUSCAN CONSERVATION.

The University of Glasgow will be the venue for an international conference on Molluscan Conservation on 10-12 September 1992. Sessions will include taxonomy; distribution; legislation; conservation. For further information contact Fred Woodward, International Conference on Molluscan Conservation, Kelvingrove Museum & Art Gallery, Kelvingrove, Glasgow G3 8AG, UK. Fax: (041) 357 4537; Tel: (041) 357 3929.

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DIRECTORY OF THE BRITISH MARINE FAUNA AND FLORA

'The Species Directory' was first published in 1987 by the Marine Conservation Society, supported by British Petroleum and the World Wildlife Fund. The Directory is a computer-based checklist of the marine fauna and flora of the British Isles and its surrounding seas (see map), and currently comprises 24 major taxa. It has been edited by Christine Howson and has drawn together a wide body of expertise with substantial contributions from over twenty taxonomists.

The Directory is an up-to-date taxonomic checklist, listing scientific names and authorities with taxonomic or distribution comments where relevant. A restricted synonymy has been given in some cases, in particular where the nomenclature in standard identification works is out-of-date. Each section consists of a short introduction setting the phylum in taxonomic context, a classification table to serve as a brief taxonomic index to the group, the annotated list and a bibliography. An overall introduction gives the background and rationale of the project, and the entire checklist - over 12,100 entries - is

43

included in one alphabetical index.

The need for such a reference list had been seen for some time, particularly with the current proliferation of computer databases. The Species Directory, therefore, brings together into one volume the various disparate lists of British marine species, incorporating recent literature, taxonomic revisions and records from individuals. It aims to standardize the nomenclature as far as possible.

A taxonomic list will never be entirely up-to-date by the very nature of the subject, and thus the present version must be considered provisional. Of the initial 120 copies, half were distributed to contributors, and the rest quickly sold at £25.00; it is no longer available. A major revision is presently underway in consultation with taxonomists and other users of the present version. The revised edition is hoped to include additional phyla and to rectify errors which have come to light since the original publication. The new version is due for publication in 1992 and will be widely available in two version, the annotated printed list and the computer-coded version on 3.5" and 5.25" floppy discs.

Request for assistance:

1. Realising that the field of taxonomy and synonymy is in a state of continual change, I hope to ensure, nevertheless, that the revised Species Directory will be as up to date as possible. I would therefore be very grateful for help, such as information on taxonomic revisions, , new records, new species in your field, either by sending me actual reprints or references enabling me to trace the publication. In addition, any recommendations from users on how the present directory might be improved or made more useful would be much appreciated. All help will be fully acknowledged.

2. If there is anyone out there who would like to contribute to the project by compiling, checking or commenting on particular lists, especially ones not yet included, please contact me as soon as possible.

Brendan Ball, Department of Botany and Zoology, Ulster Museum, Botanic Gardens, Belfast BT9 5AB, Northern Ireland.

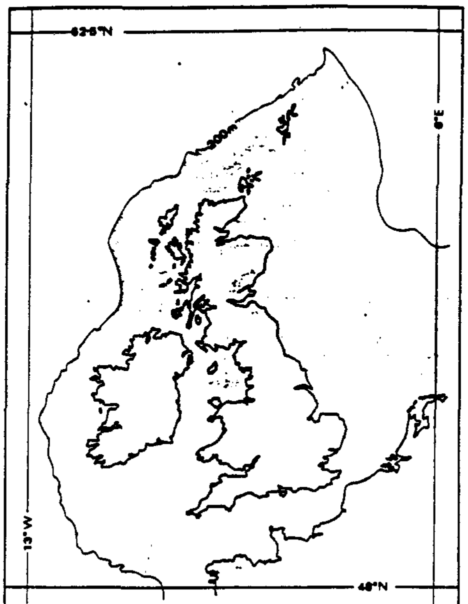

Fig. 1 Area covered by checklist

Porcupine Newsletter, 5 (2), 1991.

44

CRUSTACEAN SPECIMENS AND PAPERS OF G.M. SPOONER (1907-1989)

by Mark Costello

Environmental Sciences Unit, Trinity College, Dublin 2, Republic of Ireland

INTRODUCTION

During his 42 years at the Marine Biological Association, Plymouth, England, Malcolm Spooner made a remarkeable contribution to marine biology. His areas of endeavour included studies on crustacean taxonomy and genetics, interstitial and subterranean fauna, and editing of the MBA journal. His wide faunistic knowledge was put to good work in helping to produce the third edition of the Plymouth Marine Fauna and in conducting Easter vacation courses in marine biology in the 1950s and 1960s. He was also a renowned entomologist and Fellow of the Royal Entomological Society, specialising in Hymenoptera, and concentrated on entomology and the natural history of County Devon on retiring from the MBA in 1972. His vast collection of insects and naturalists diaries are now in the Natural History Museum, London.

The remainder of his notes and specimens largely concern marine organisms and Crustacea. That most of the information has been published is a great credit to Malcolm Spooner. However, specialists wishing to investigate these studies further may well find the notes of value. Furthermore, although a considerable number of specimens were deposited in the British Museum (Natural History) (now the Natural History Museum, London) over the years, some of the remaining material may also be of value to specialists. It is the wish of his wife, Molly Spooner, that this material is made available to researchers. The specimens and papers have thus been deposited in the Natural History Division, National Museum of Ireland, Kildare Street, Dublin 2, Republic of Ireland. The contents of this material are described here.

THE PAPERS

The bulk of the material relates to his publications. These notes are neatly handwritten, held in folders, and are dominated by notes on Gammaridae: taxonomy, growth, salinity tolerance, genetics (heterozygosity, recessive characters), eye colour, distribution (in estuaries, British Isles and the world), and a list of species in the Natural History Museum in London. Two bound notebooks also contain notes on *Gammarus* species. There are extensive notes on Hyperiidea, especially the genus *Cystisoma*, including a draft key. Further notes cover the amphipod genera *Corophium, Jassa, Ingolfiella* and *Bogidiella*, and isopod genera *Jaera, Jaeropsis* and *Microcharon*. There are several hundred annotated references on index cards. These are grouped under Bathynellacea, Bogidiellidae, Hyperiidea, Ingolfiellidae, *Jaera, Jaeropsis, Microcharon, Microjaera, Munna* and Tanaidacea.

Some published and some unpublished sketches and photographs of amphipods occur: *Apherusa bispinosa, A. clevei, Corophium lacustre, Gammarus zaddachi, Eusirus biscayensis, Leptocheirus pectinatus, Parapleustes gracilis, P. megacheir, Protomedia pilosa, Rhachotropis helleri, Sympleustes grandimanus, S. latipes, Syrrhoe affinis, Tmetonyx similis*, Trischizostomae, *Trischizostoma raschii, Unciola planipes* and perhaps others.

There is a large bundle of lists of species identified from samples collected by G.M. Spooner and others. These are largely for the coast of south-west England, but there are records from Scotland (Millport, Hebrides, Aberdeen), Norfolk, Ostend, Ireland (including Lough Hyne), Norway, Stephensen's north Atlantic collections and Bassindale's Gold Coast (Africa) collections.

There are handwritten manuscripts on the "Habits of Bass (*Morone labrax*)" by G.M. Spooner, and a "Survey of an area between Ox Point and Williams Head in the Kingsbridge Estuary" by R. Finlayson and E. Sherrah-Davies in 1940.

45

Correspondence from colleagues and others from 1936 to 1967 is present and may be of interest in a historical context. Any such correspondents wishing to retrieve their letters should write to the museum.

THE SPECIMENS

The collections of specimens can be divided into six groups largely on the way they have been boxed:

(a) Gold Coast collection
(b) Parasites and their hosts
(c) *Jaera*
(d) Hyperiidea
(e) Eddystone shell-gravel and rock
(f) Miscellaneous Crustacea.

As the Gold Coast jars are sealed by wax I did not open them to check their contents. They were collected by R. Bassindale and appear to be mostly amphipods. Some of the tubes containing the remaining material (b - f) have become dehydrated, but can be rehydrated if necessary. The hosts of the parasites appear to be entirely crustacean and from the Plymouth area.

For the Hyperiidea, Eddystone and Miscellaneous Crustacea material, species lists (solely derived from the labels on the specimen tubes) are given in Tables 1, 2 and 3 respectively. Species names are given as labelled (including question marks, in some cases); no attempt has been made to identify unlabelled specimens or deal with synonyms. Species names are only given once, although there may be several tubes of specimens.

The Hyperiidea are from several cruises in the Atlantic, and are dominated by material from Bermuda (Table 1). The Eddystone shell-gravel material is largely of amphipods but isopods, cumaceans and some copepods are also present (Table 2).

I would like to thank Molly Spooner and Joan Ellis for their helpful comments on this article.

TABLE 1. List of Hyperiidae species as labelled in the Spooner collection in the National Museum of Ireland.

AMPHIPODA: HYPERIIDEA

Amphithyrus sculptmati	*Leptocotis tenuirostris*	*Phronima pacifica (?)*
Anchylomera blossevilles	*Lycaea bayensis*	*Primno macropa*
Brachyscelus rapascoides	*Oxycephalus clausi*	*Rhabdosoma brevicaudatum*
Cystisoma spinosum	*Oxycephalus piscator*	*Scina borealis*
Eupronoe minuta	*Paraphronima crassipes*	*Scina crassicornis*
Herrityphis rapax	*Parapronoe crustulum*	Scinidae
Hyperiodes longipes	*Parascina fowleri*	*Streetsia pronoides*
Lanceola	*Paratyphis*	*Tetrathyrus forcipatus*

46

TABLE 2. Crustacea listed from the Eddystone shell-gravel and rock in the Spooner collection in the National Museum of Ireland

AMPHIPODA

Ampelisca spinipes	*Idunella sp.*	*Metopa minutula*
Amphilochus manudens	*Idunella picta*	Metopid A (types)
Apherusa clevei	*Ingolfiella britannica*	*Microjassa cumbrensis*
Bogidiella	*Leptocheirus hirsutimanus*	*Normanion quadrimanus*
Ceradocus semiserratus	*Leptocheirus pectinatus*	*Nototropis*
Cressa dubia	*Leptocheirus tricristatus*	*Nototropis vedlomensis*
Eriopisella pusilla	*Leucothoe sp*	*Parajassa pelagica*
Eurystheus lobatus	*Leucothoe incisa*	*Peltocoxa brevirostris*
Eurystheus maculatus	*Lilljeborgia kinahani*	*Perrierella*
Eusirus longipes	*Maera othonis*	*Photis longicaudata*
Gitana sarsi	*Megamphopus cornutus*	*Socarnes erythrophthalmus*
Guerna coalita	*Megamphopus longicornis*	Stenothoid (?n.sp.)
Halicreon longicaudata	*Metaphoxus fultoni*	*Stenothoe spinimana*
Hyale perrieri	*Metopa* n.sp.	*Sympleustes sp.*
Hyale pontica	*Metopa borealis* ?	Syrrhoid species C (types)

ISOPODA

Eurycope pygmaea	*Janira maculosa*	*Microcharon harrisi*
Eurydice inermis	*Idotea pelagica*	*Microjaera anisopoda*
Gnathia oxyurae	*Microcharon*	*Paramunna bilobata*

TANAIDACEA

Leptognathia sp.	*Strongylurella indivisa*
Leptognathia ? sp. A & sp. B	*Tanais cavolinii*
Paratanais sp	*Typhlotanais microcheles*
Strongylurella	

CUMACEA

Cumella acuta	*Nannastacus simplex n.sp.*
Nannastacus brevicaudatus	*Nannastacus unguiculatus*

OTHER TAXA

Microhedyle (Mollusca)	*Nutricula*
Copepoda	*Leptosynapta minuta* (Holothuroidea)

47

TABLE 3. Miscellaneous material, mostly Crustacea collected from south-west England, in the Spooner collection in the National Museum of Ireland

AMPHIPODA

Apherusa ?	*Hyale*	*Niphargus glennei*
Apherusa clevei	*Hyale nilssoni*	*Niphargus kochianus*
Bogidiella maris	*Hyale pontica*	*Orchomene similis*
Corophium sp.	*Hyale perrieri*	*Orchomenella nana*
Erichthonius difformis ?	*Hyale stebbingi*	*Parajassa pelagicus*
Euthemisto compressa	*Ingolfiella*	*Parandania boecki*
Gammarus insensibilis	*Orchestia gammarella*	*Siphonoecetes dellavallei*
Gammarus locusta	*Maera* n. sp.	*Stenothoe spinimana*
Gammarus salinus	*Metopa sp.*	*Stegocephaloides sp.*
Gammarus zaddachi	*Microdeutopus anomalus*	*Talitroides sylvaticus*
Gammarus zaddachi (dwarf form)	*Microdeutopus chelifer*	*Talitrus saltator*
Haustorius arenarius	*Niphargus aquilex*	*Themisto gracilipes*

ISOPODA

Idotea chelipes	*Jaera albifrons*	*Pseudione callianassae*
Idotea metallica	*Munna minuta*	*Sphaeroma monodi*
Idotea pelagica	*Munna petiti*	
Idotea viridis	*Paragnathia formica*	

DECAPODA

Callianassa subterranea	*Ebalia tumefacta*	*Upogebia deltaura*

TANAIDACEA:	Tanaid	*Tanais cavolinii*
CUMACEA:	*Diastylis laevis*	
LEPTOSTRACA:	*Nebalia bipes*	
MYSIDACEA:	*Mesopodopsis slabberi*	*Gnathophausia zoea*
HARPACTICOIDA:	*Peltidium pupurea*	

OTHER TAXA:

Acarina

Bathynella (Syncarida)

Clunio marinus (Insecta)

Duvaucelia lineata (Nudibranchia)

Noebisium maritineum (Pseudoscorpionidea)

Pallene sp.? (Pycnogonida)

Petrobius brevistylis (Insecta)

Polychaeta

48

TABLE 4. List of slide mounted specimens in the Spooner collection in the National Museum of Ireland.

AMPHIPODA

Bogidiella	*Gammarus zaddachi*	*Niphargus fontanus*
Gammarus duebeni	*Ingolfiella*	*N. kochianus kochianus*
Gammarus sextoni	*Microdeutopus damnoniensis*	
Gammarus tigrinus	*Niphargus aquilex*	

ISOPODA

Jaeropsis	*Microjaera anisopoda*
Microcharon	*Munna petiti*

OTHER TAXA

Acarina	Gastrotrichs	Harpacticoids	Kinorhynch
Copidognathus gracilipes (Acarina)		*C. tamarense*	*Cylindropsyllus* (Harpacticoida)

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CALYPTRAEA CHINENSIS (L. 1758) IN LOCH RYAN

by Shelagh Smith

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Calyptraea chinensis, a southern species, was first reported living in Loch Ryan by Orr (1944) and later by Millar (1961), being considered to have been imported with oysters (*Ostrea edulis* L. 1758). Loch Ryan, at the southeastern end of the Firth of Clyde, contains a large and still thriving bed of oysters which are harvested commercially. This bed is centred on The Wig, a shingle spit on the west side of the Loch, beside which are sand, gravel and shingle flats exposed at low water.

In October 1986 I found but one fresh dead shell of *C. chinensis*. Whether I was not being observant or whether I could blame the fast-disappearing evening light (low water being at dusk), I saw no living specimens then. I revisited The Wig in July 1991, taking advantage of superb tides due to the eclipse of the sun, together with better evening light and morning sunshine. *C. chinensis* proved to be extremely abundant. They were living in shallow pools near low water, a few being stranded out of the water, on dead shells of many species including *O. edulis*, although this was not preferred, and on small stones and pebbles. They occurred both on top and underneath. Many larger specimens (up to 18 mm) had one, two or occasionally three small ones (2-5 mm) upon them. No specimens were seen on live shells, certainly not on oysters. Spawning was in full flush, and hatchlings were found amongst washings of small algae.

Not a lot of living molluscs were found, about 50 common species, and rather less (36) dead

49

shells many of which have already been recorded as living in the loch (Davies, 1989) or found by myself. This area also contains other species not normally common living on the shore, at least this far north, including *Styela clava* Herdman 1882 and *Myxicola infundibulum* (Renier 1804). It would clearly repay investigation by people interested in phyla other than Mollusca (I did not find any pycnogonids!).

REFERENCES

Davies L.M., 1989. Marine Nature Conservation Review. Surveys of Scottish Sea Lochs: Loch Fyne. Nature Conservancy Council CSD Report No.984.

Millar R.H., 1961. Scottish oyster investigations 1946-58. Mar. Res., 3; 1-76.

Orr A.P., 1944. *(Records in)* Faunistic Records. Rep. Scot. mar. biol. Ass., 1943-44; 13.

THE MARINE BIOLOGISTS' UK TIDE MAP

by Jon Moore

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The tides around Britain are constantly changing and very difficult to predict accurately, but they do have a number of easily predictable characters. The map shown herein can be used to predict the approximate state of tide anywhere in the UK with no more information than the state of the moon and the time of day. I have found it particularly useful during the early stages of survey planning, to judge the best times at which to go to different areas.

You will probably know that the times of low tide and high tide move on by just over an hour a day. However, you may not know that if you select a position on the coast and consider the timing of a particular state of the tide (e.g. high water) at a particular state of the lunar cycle (e.g. a neap tide), you will find that it always coincides with approximately the same time of day.

For example - in the area around Milford Haven, south-west Wales, the lowest spring tides always occur around lunchtime (approx. 1 o'clock am or pm). Thus highwater springs are always around 7 o'clock as also are the "neapiest" low tides. Further predictions are easy. If I know that it is three days after the best spring tides and the time is 2 o'clock, I can work out that low tide in Milford Haven will be mid-afternoon and that the ebbing tide has passed the middle shore.

If I want to do some intertidal studies in Orkney during the winter and I need a low tide, I can see from the map that I either need to plan the survey for neap tides or take a good torch!

To aid further the planning process, I have marked on the map the mean spring tide range along the coast.

Much of the information has been adapted from Admiralty Chart No. 5058 and I am grateful to the Hydrographic Department in Taunton for allowing me to reproduce the information here without charge. Note that cotidal lines are lines along which the tide is at the same state. I have found this map to be useful and informative; I would welcome any comments, criticisms or suggested improvements.

50

The Marine Biologists UK Tide Map