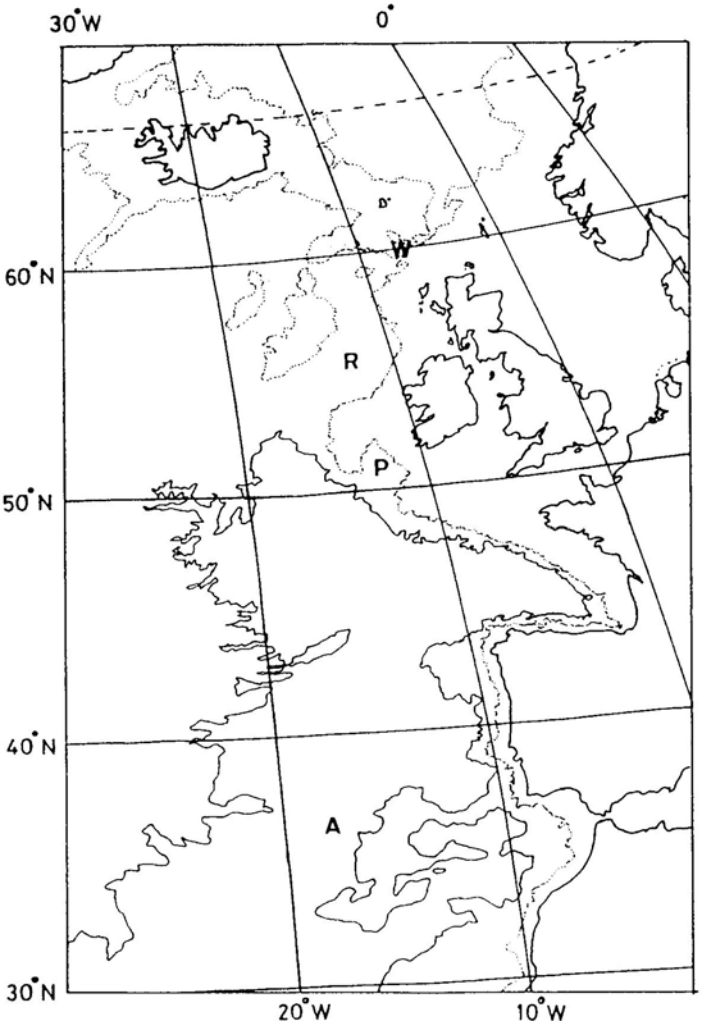
PORCUPINE MARINE NATURAL HISTORY SOCIETY

NEWSLETTER

November 2001 Number 9



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Porcupine Marine Natural History Society

Newsletter

No. 9 November 2001

Hon. Treasurer
Jon Moore
Ti Cara
Point Lane
Cosheston
Pembroke Dock
Pembrokeshire
SA72 4UN
01646 683679
jonmoore@cordah.demon.co.uk

Hon. Editor
Frances Dipper
7 Rutland Green
Hilton
Huntingdon
Cambs
PE28 9NT
01480 830507
fdipper@dial.pipex.com

MEMBERSHIP

Executive Officer
Julia Nunn
Cherry Cottage
11 Ballyhaft Rd
Newtonards
Co. Down BT 22 2AW
porcupine@strangfjord.freeserve.co.uk

Porcupine MNHS welcomes new members- scientists, students, divers, naturalists and lay people. We are an informal society interested in marine natural history and recording particularly in the North Atlantic and 'Porcupine Bight'. Members receive 3 newsletters a year which include proceedings from scientific meetings.

Individual £10 Student £5

CONTENTS

EDITORIAL

Apart from Christmas and your wife/husband's birthday/wedding anniversary, the most important date in next year's calendar has to be **Porcupine 2001**, our AGM and meeting in celebration of Porcupine's 25th anniversary. So put it in your diary **NOW** and see P.3 for details.

I am delighted that over the past few months I have received responses to 'Porcupine Pieces' and 'Information Requests' (More on Mantis Shrimps and Shrimp preys on unwary fishermen) published in the July 2001 newsletter. I have also received an unprecedented number of new observations and requests all of which are published here (see pp. 8-12). This is exactly what this Newsletter is all about so a big thank you to all who have taken the time to send in their material. These short articles and notes should be of interest to many Porcupines. Please keep them coming!! Many of these observations also make very suitable material for inclusion in our Recording Scheme and will (when permission has been obtained from the authors) be included in the scheme.

Roger Herbert has contributed a fascinating and topical report on Estuaries and Climate change (see P.11). In it he reports a very unusual sighting of a juvenile Sun-fish (*Mola mola*) seen at the head of the estuary in Newport Harbour. Perhaps YOU have made equally interesting observations. Let me know!

E-MAIL ADDRESSES

A big thank you all those who have sent me their e-mail address. Hopefully I will soon have collated these and put together a 'Porcupine Group' list so that you can instantly receive updates on meeting etc. If anyone else has not sent me their address or has changed their address, please let me know.

Request for photographs

If anyone has any interesting, embarrassing or funny photos of Porcupine people, meetings or field trips from the past, they would be gratefully received as we would like to illustrate our proposed History of Porcupine (both the publication and the talk at Edinburgh). Please let the Editor know!

Request for Assistance

I would very much like to have an Assistant Editor! The job entails in particular, chasing copy i.e chasing manuscripts from our annual meeting, commissioning interesting articles, writing or requesting book reviews etc. This is a great way of making contacts and friends!! Please contact the Editor!

COPY DEADLINES

Feb 1st for March/April issue
May 1st for July issue

Remember! Your **requests for information and shared observations** can reach a wide audience as they are published both in the newsletter and on our web site

Web site links. If anyone has suggestions for useful links to our web site, please send them to Anne Bunker.

www.pmnhs.org.uk

Summary of Minutes of the Council Meeting held on November 17th 2001 at the Eden Bridge Club, Carlisle.

PRESENT: S Chambers, F Dipper, F Evans, J Foster-Smith, J Moore, J Nunn, I Rees, S Smith.

APOLOGIES: R Bamber, M Bailey, A Bunker, B Betts (Loveday), A Little

ANNOUNCEMENTS:

1. A vote of thanks for S Smith for organising the meeting and cooking a superb buffet lunch.
2. David Heppell a founder member, now retired in Canada, is now recovering from a serious illness and major surgery. It was agreed to send him a get well greeting for his birthday this week *via* e-mail.

FINANCIAL REPORT: Income since 1/1/01: £1705.87. Outgoings since 1/1/01: £914.01 (newsletter No. 9 expences still to come – ca. £420). The account is relatively healthy compared to last year. We have £2,607 in the current account as a result of a small profit from the last meeting and reduced costs for the Newsletter.

WEB SITE: A request to members for suggestions of good links to other web sites will be included in the next Newsletter. A section for marine related questions will be posted on the web site in the near future.

RECORDING SCHEME: Currently there is no easy mechanism for observations to be sent to the Porcupine Marine Recorder. J Moore proposed setting up an email message and circulating it to all potential recorders asking for interesting records and explaining why they are of value. The recording scheme will be advertised in other newsletters.

FIELD MEETING 2001: The Dorset Field Meeting in conjunction with the Dorset Wildlife Trust was very successful because there was an element of interpretation of the intertidal environment by Porcupine members. It was agreed that there should be another field meeting in 2002 with the same emphasis. The site and date would be determined by the tide and access to a field centre. Areas to be considered include North Wales. J Nunn to make enquiries.

CONFERENCE 2002: The meeting is being held in Edinburgh on 14-16th March to mark the 25th anniversary of the society. The local organiser, S Chambers, has several speakers. Publicity will be *via* the web site, e mails to the membership, Newsletter mailing and articles in other newsletters. The field meeting on the morning of the 16th to Dunbar will be organised by S Smith.

POSTER: There has been no progress on the poster. It is in the final stage of the design process and is dependant on available time of the designer. Attempts will be made to ask her to complete the agreed lay-out or to hand the project back to the committee. The aim is to have the poster ready for the 2002 meeting.

NEWSLETTER: It was agreed that the next issue (to be published early December) will be the last before the March 2002 conference. Publication dates will now be April, July and November, with final copy dates being one month earlier. 230 copies of the next issue will be printed. It was agreed that a maximum sum of £100 could be used to train the editor in advanced use of Word. A general discussion re. obtaining fresh copy took place.

MEETINGS, MEETINGS, MEETINGS, MEETINGS, MEETINGS

PORCUPINE MEETINGS

PORCUPINE 2002. THE PORCUPINE MARINE NATURAL HISTORY SOCIETY ANNUAL CONFERENCE

"Changes in Marine Biology over the last 25 years"

EDINBURGH, MARCH 14TH –15TH 2002 (plus Field Trip on 16th)

The Porcupine Marine Natural History Society was launched in the National Museums of Scotland 25 years ago with the aim of promoting marine biology and having fun at the same time.

The **25th** anniversary conference will be held at the National Museums of Scotland on Thursday the 14th and Friday the 15th March in the Lecture Theatre and the field meeting will be on the 16th March at Dunbar, a local shore.

Presentations have been agreed on a wide range of subjects-from deep water corals, mitten crabs, maerl, marine aquaculture, developments in the Firth of Forth to changes in marine law and the influence of new technologies such as IT, satellites, acoustic and visual instruments as well as numerical analysis techniques. There will also be a short overview of the history of Porcupine and a look at some interesting images of various collecting sites around the world.

The venue for the meeting is also known as Lumière, a Film Theatre, in the evenings and at week-ends. We are able to take advantage of this and there will be an opportunity to see a rare archive Jacques Cousteau film for a small price. It is open to members of the public and all Porcupines and their guests will be welcome.

A conference dinner will be organised in a local restaurant or hostelry for approx £20.

The registration fee which includes tea and coffee will be £25.

There is a wide range of B&B's and hotels in Edinburgh. Accommodation information and a map will be sent following booking. Parking is available in nearby car parks but these are expensive (approx £10 a day). There is a good bus service in the city and the museum is 5 minutes walk from the railway station.

The field meeting to Dunbar is on Saturday 16th March. Low tide is at 09.30 GMT therefore we would hope to meet at Dunbar no later than 07.45.

The first part of the meeting will be on the rocky shore west of Dunbar - sandstone rock platform, pools and overhangs. Those who wish to see what has been washed up on the strandline can cross a bridge onto the extensive sands. Also the brackish/freshwater river and lagoons can be visited. From Dunbar, 10mins travel by car and 15mins walk leads to the Tynignhame saltmarsh, the type locality of *Limapontia depressa* Kevan, 1934 and other saltmarsh species. A pub lunch will be arranged. Further details will be provided to those who wish to parcipitate.

OTHER MEETINGS

25-29 November. Baltic Sea Science Congress 2001. Past Present and Future a joint venture. Stockholm, Sweden. Contact smf@smf.su.se

4-5 December. Atlantic Frontier Environmental Network (AFEN). Managing the Resources of the Atlantic Margin – A Sustainable Future? Edinburgh Conference Centre, Heriot Watt University. Contact: Bob Earll on 01531 890415; or bob.earll@dial.pipex.com

8th December. Reef Conservation UK (RCUK) 2001. Zoological Society, London Zoo. The programme of presentations for the Reef Conservation UK meeting on 8th December has now been finalised. The titles of these presentations can now be found on the updated website www.rcuk.org.uk along with details of places to stay while at the meeting and a second workshop on the 9th, "Corals in aquaria".

Jan 23-24th 2002. Coastal Futures 2002. review and Future Trends. To be held at: University of London, SOAS, Russel Square. Coastal Management for Sustainability. Bob Earll: 01531 890415. www.coastms.co.uk

April 2002. Irish Sea Coastlines – Isle of Man. ECSA Local Meeting, theme: Estuaries and coastal waters of the Isle of Man and adjacent areas. Contact: andrew.wither@environment-agency.gov.uk or Tel: 01925 653999

13-15th June 2002. Info'Coast 2. 2nd European Symposium on Knowledge and Information for the Coastal Zone. Noordwijkerhout, The Netherlands. (postponed from October 2001). linda@iprolink.ch +44 223 667050.

8-12th July 2002. Estuarine and Lagoon Fish and Fisheries. Fisheries Society of British Isles Annual International Symposium. University of Hull. www.hull.ac.uk/iecs

Conference and Meetings Proceedings

Coastal Futures 2001. Proceedings of Coastal Management for Sustainability 2001 Review and Future Trends.
Available from: CMS, Candle Cottage, Kempley, Glos. GL18 2BU. Price £35 (includes CD ROM)

REVIEWS

Scaling fisheries, The Science of Measuring the Effects of Fishing, 1855-1955. Tim D. Smith. (Cambridge University Press, 1994).

Review by **Frank Evans**

Almost since the Stone Age marine zoology has been divided into general research (academic) and fisheries research (mathematical). For years in this country the two disciplines even boasted their own funding and their own laboratories, Plymouth and Lowestoft in England, Millport and Aberdeen in Scotland. But beneath the skin we are all brothers with the same biological background, and Tim Smith's book tells us how fellow zoologists have fared under the pressure of applied research since G. O. Sars, was asked in 1864 to enquire about the fluctuating catches of cod in that country. Sars was the renowned author of the multi-volume *Account of the Crustacea of Norway.* Fisheries research was thus launched and continues doggedly to this day. This is partly because it has never really got to windward of its opponents, the politicians and the fishermen, who together pursue different and less noble objectives.

The sun appears to go round the earth every day as anyone can see; yet it is not so. Equally, if we artificially hatch lots of haddock or plaice eggs and return them to the sea we will increase the numbers of adult haddock or plaice; again not true, yet Smith tells us this practice persisted for half a century or more at considerable expense, until someone worked out that the wild Georges Bank haddock alone produce eighteen million million eggs a year unaided, which puts it in perspective.

The term "overfishing" originated in the mid nineteenth century, demanding consequent restrictive legislation. Regrettably the heroic Thomas Henry Huxley opposed this, believing fish stocks were boundless. His view was quoted extensively for many years by those opposed to regulation but his caveat, "given the present mode of fishing", was omitted. Indeed, if anyone today went to sea with grandfather's equipment he would be bankrupt in a week.

Early concepts of population parameters dwelt on migration, predation, pollution and overfishing. To investigate migration the tagging of fish was introduced. This produced a nasty shock for the taggers. At its commencement in 1905 twenty per cent of the tagged North Sea plaice were recaptured within a year and not the one or two per cent expected. Plaice migration was elucidated but the by-catch yield of this experiment was that the plaice shoals were seen to be far from limitless. Sixty or seventy per cent annual catch of some stocks were later recorded.

The demographic problem of age and numbers was next addressed. Since commercial fish are seasonal breeders size distribution is discontinuous and from successive size clusters year classes were deduced. This proved to be rough, ready and regional but fortunately scale and otolith dating soon came along to give precision. At this point arose one of the several bitter disagreements between fisheries experts that have decorated the progress of the science. Although the scales on both laboratory bred and farmed fish in the shape of carp show clear annual rings D'Arcy Thompson of St. Andrew's University at Dundee refused to accept the findings of Johan Hjort that this was so. He in fact believed that, for instance, all the herring in a shoal were of the same age. Smith does not mention the appearance of deformed rings at a particular year, 1904 being a famous case in the Norwegian herring, which can be followed in a population through later years and would appear to give conclusive evidence of annual increase in ring count. The dispute festered for a generation until, after the battle had been won and it had ceased to matter, D'Arcy finally submitted. To this day "port samplers" at major fishing ports measure market fish and collect scales and otoliths for analysis.

Meanwhile the estimate of fish numbers was approached from a different and quite improbable direction. While obviously the fish in the sea cannot be counted directly it is possible to count their eggs (see above for haddock). Hensen had begun this work in the nineteenth century with his own design of egg net but it was carried on by Buchanan-Wollaston, sampling from Lowestoft shortly before the 1914 war. Again we are dealing with vast numbers, some $4x10^{12}$ eggs, referring to twenty million spawning female plaice in the southern North Sea. The method has proved surprisingly convincing.

A thread running through all these investigations was the International Council for the Exploration of the Sea (ICES), formed in 1900. It was something of a misnomer, being almost entirely concerned with European waters; the US was a member for only four years, withdrawing in 1916. Throughout its life ICES has organised meetings between nations, scientists and the industry, has produced numerous publications and has been immensely busy and useful. But throughout the period of industrialised fishing another and darker thread has run, apparent in ICES and elsewhere. According to Smith, whenever distasteful proposals based on scientific calculations appear the industry and governments adopt their usual delaying tactic of sending the scientists back to undertake more analysis. What I am afraid he does not say is that short term commercial and state interests sometimes influence scientists as well as governments and we see fisheries researchers placing national advantage before scientific probity, usually by denying overfishing by fleets of their own flag. Examples not quoted by Smith include the North Sea herring disaster and now perhaps the threatened sand eel population, used to feed farm-bred animals.

Often when proper and prolonged warnings are given by scientist they are simply ignored. The Californian sardine fishery, despite ample notice, crashed in 1952. The early course of its decline may be instructively followed in that notable work, *Cannery Row,* by John Steinbeck. Interestingly, around the time of the demise of this fishery and only shortly before the ending of herring fishing in the North Sea I was told by C. F. Hickling, Director of Colonial Fisheries, while discussing the flying-fish fishery of Barbados that there was no record anywhere in the world of a pelagic fishery being overfished. Even experts can be mistaken.

Both world wars gave a practical example of the "Great Fishing Experiment", showing how fish stocks can recover when the pressure of fishing is reduced. As Smith notes, both examples were totally ignored by the industry.

An object of fishery research is to make predictions of the future size of the fish stock. This was notably undertaken for the Yarmouth herring by W. C. Hodgson. Surprisingly it was he who also worked out the precise relationship between the autumn herring shoals and the phases of the moon. Surprising because it is the sort of practical observation that the fishing skippers might have made but they did so only roughly.

The last part of Smith's book is rather mathematical but retains its historic objective. For instance the Von Bertalanffy and Lotka-Volterra equations are discussed (Reader, have you forgotten?) but we also learn about Signor Vito Volterra, mathematician, and Mr. A. J. Lotka, author of *Elements of Physical Biology*, who claimed priority for the formulation, hence the double-barrelled name. By now we are into the logistic curve, optimum catch, recruits and spawners and other worthy topics. Smith devotes a substantial section to Michael Graham's "Great Law of Fishing" but oddly does not quote it. It is simply stated: *Fisheries that are unlimited become unprofitable*. For evidence of its truth look around you.

The book ends at approximately Beverton and Holt's majestic publication: *On the dynamics of exploited fish populations* which appeared in 1957. Since then its massive central equation expressing yield per recruit has been reduced to spreadsheet dimensions and even undergraduates can vary parameters and watch the result at the touch of a few keys. But for all our hundred and fifty years of experience we are still not completely in command of the fish stock data. This year Iceland discovered to its dismay that its fisheries calculations were mistake and that it had many fewer cod in its waters than had been supposed.

Much work remains to be done. Or would it have been all the same if we had never bothered, if we had eschewed regulation and left the seas fished-out as people and countries took their profits and moved on? It has happened in any case with herring, cod, whales, sardines, mackerel, anchovetta and other species, with more to come.

PORCUPINE PROBLEMS
Information requests

Information request 1.

***Perophora japonica* – an Alien Tunicate Recorded on the English Channel Coast: A Request for Records**

Lin Baldock, 24 Martel Close, Broadmayne, Dorchester DT2 8PL

John Bishop, Marine Biological Association of the United Kingdom, The Laboratory, Citadel Hill, Plymouth, PL1 2PB.

The alien tunicate *Perophora japonica* Oka, 1927 has recently been reported from two locations on the English Channel coast: since 1999 from a marina in Plymouth Sound, Devon (Nishikawa *et al*., 2000) and also from the Fleet Lagoon, Dorset in 2001. This species is a native of the Far East and has been recorded from north-west France in the 1980's (Monniot & Monniot, 1985). In the Fleet *P. japonica* can cover up to 10% of available substrate over a significant area. For photographs of this alien ascidian see the species information pages of the MARLIN website at www.marlin.ac.uk.

P. japonica can be distinguished from the only native British species of this genus, *Perophora listeri* Forbes, by the presence of distinctive bright yellow star-shaped terminal buds in the former species. These terminal buds can be very striking in colonies in the field at some times of year and to date have been found to be present on all collections from the Fleet populations (July to September). Colonies of *P. japonica* tend to be densely packed and have a fluorescent yellow tinge in life. The zooids are opaque with a fine, dusty surface texture. This compares with the native *P. listeri* which lacks terminal buds and has a rather loose arrangement of zooids. In life the zooids of *P. listeri* are transparent with the structure of the branchial sac clearly distinguishable through the smooth test. Zooids have a slight bluish tinge.

Any records of suspected *P. japonica* would be received with interest. Please send your observations to either jbis@mba.ac.uk or lin.baldock@virgin.net. With two records of apparently well-established populations at separate localities on the south coast of England, it would not be surprising to find this species at other similar sites in the region.

Monniot, C. & Monniot, F., (1985). Apparition de l'ascidie *Perophora japonica* sur les côtes et dans les ports de la Manche. *Compte Rendu de la Société de Biogéographie*, 61, 111–116.

Nishikawa, T., Bishop, J.D.D. & Sommerfeldt, A.D., (2000). Occurrence of the alien ascidian *Perophora japonica* at Plymouth. *Journal of the Marine Biological Association of the United Kingdom* (N.S.), 80, 955-956.

Information request 2.

Albino anemones and boring sponges. Information request from:

Jane Lilley, Lance's Cottage, Parkgate Rd., Newdigate, Surrey RH5 5DY.

1: Do you get 'albino' versions of sea anemones? In Lyme Bay, Dorset last August I saw a group of three perfectly normal *Aiptasia mutabilis*, two large

and one small, with another small individual which looked identical except that it was a rather translucent white. It was not nearly as white as *Sagartia elegans* or *Actinothoe sphyrodeta* would be, and the morphology was wrong for either of those species; it appeared to be an ordinary *Aiptasia* but without the usual brown pigmentation. Can anyone comment?

2: The boring sponge *Cliona celata* sometimes appears to become dormant in late summer. The osculae and papillae close and apparently become sealed over, and the whole surface looks as if it is covered with a thick skin which blurs the details; it may become discoloured. Usually the whole sponge is involved, although where one section of a sponge is continually brushed by algae, it may become dormant while the rest remains active. Eventually the sponge becomes active again, initially in one area where a few papillae emerge and one or two small osculae open within the blurred craters where larger old ones were sealed off. One specimen I saw this year had been covered with a thick layer of silt which became consolidated while the sponge was still active (part of the solidified silt was perforated where papillae had opened through it); the silt layer was now breaking away, and the dormant sponge inside had shrunk significantly, leaving a gap of about 1cm. Can anyone confirm what is going on or fill in more details?

Information request 3.
Baillon's wrasse: Observations and request for information from:

Sue Daly, Charleston Cottage, Rue Rouge, CUL, St. Lawrence,
Jersey, Channel Islands, JE3 1NP

Nest building observed from 2nd May to 14th June in Bouley Bay on NE coast of Jersey (a gently sloping bay bound by harbour wall and rocky outcrop, band of mixed weeds down to about 6m then sand among the moorings - max depth on high water 12 m). Nests tend to be built on top of a rock or, quite often here, on a mooring block on the sand but close to the edge of the kelp line. The nest is a gentle dome shape with a hollow on one side, made of crinkly weed. All seem to be decorated with shingle that the fish scoops up with its mouth and sprays over the nest. The nests aren't built among the weeds or in a crevice in a rock like those of the corkwing wrasse. Twice I've observed one fish building two nests at a time, about 5 or 6m apart. I don't know if the nest is built by the male or the female. I haven't seen any courtship behaviour or mating but the nest builder does guard his construction, especially from people with cameras! I have plenty of video footage of the fish and the nest **and would be interested to know what other observations have been made of this fish.** (It definitely isn't a corkwing wrasse - no-where near as colourful but a similar size and shape.)

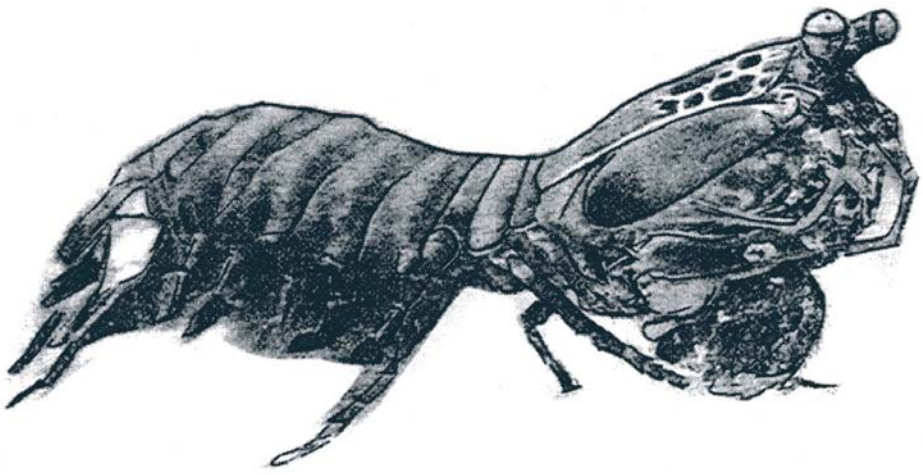
Other observations: Trigger fish - seen in the same bay on 17th & 18th August. (Two caught by angler from the end of the harbour wall a day later!) A group of six observed, also two who seemed very much a pair. Again, video footage available. We've had a good year for basking shark sightings.

Information request reply
Reply to 'Shrimp preys on unwary fishermen' in July 2001 newsletter from:

Dr P. J. Somerfield, Plymouth Marine Laboratory, Prospect Place, Plymouth PL1 3DH

I've just been reading my Porcupine Pieces. You refer to an article from January 1999 stating that *'Rissoides desmaresti* is now classified as a British native'. You ask how long it has been here (i.e. in Britain), and

whether it has been here long enough to be considered a 'native'. A couple of notes. I would have thought that a species should be considered as a native if, and only if, it arrives in a region under its own steam and completely independent of Man. How long it has been there is not the issue. Rabbits have been on the British mainland for a long time, but some would still consider then to be a (highly successful) introduced species. How long a natural immigrant has to live and reproduce in a new region before it may be considered a 'naturalised' native is another issue. Semantics aside, back to the shrimps. A quick squint at the Plymouth Marine Fauna 3rd edition, 1957, shows several records (as *Squilla desmaresti*) of adults, mainly from deeper water off Plymouth but including an intertidal record from Salcombe, going back to 1900. Larvae are also recorded, suggesting a healthy breeding population. My observation would be that these animals have probably always been around, but we don't necessarily know their exact habitat requirements and therefore have not sampled them effectively.



PORCUPINE PIECES

Estuaries and Climate Change

Roger Herbert

Most studies related to the ecological effects of climate change on the marine environment of the NE Atlantic have been concerned with species and communities on rocky shores, plankton and fisheries (Southward, 1991; Southward *et al.,* 1988,1995). The effects upon estuarine ecosystems have so far been given relatively little attention. Yet the combination of higher temperatures, drier summers, wetter winters and greater storm frequency could potentially have a major impact on species distribution and abundance. Possible effects are illustrated with some casual (non-quantitative) observations from the Medina Estuary (Isle of Wight) over the past decade.

Following the warm and dry summers of 1989 and 1990, there was evidence of more marine species reaching the upper reaches of the estuary. During these years, and in subsequent warm summers of 1995 and 1997, the estuary had above average salinity. A greater variety of fish, that has included Dragonet *(Callionymus lyra*), Shore Rockling (*Gaidropsarus mediterraneus*) and Garfish (*Belone belone*), has been noticeable in the upper reaches. The anemone *Actinia equina*, periwinkle *Littorina obtusata*, and the alga *Ascophyllum nodosum* appear to have penetrated higher up the estuary towards Newport.

As observed elsewhere along the coast, the frequency of southern species has increased. Gilthead Bream (*Sparus aurata*), a rare fish until the 1990s, is now frequently caught around the Isle of Wight, and in the past two years has been captured towards the upper reaches of the Medina Estuary. In August of last year, a remarkable observation was that of a juvenile Sun-fish (*Mola mola*) seen at the head of the estuary in Newport Harbour. The southern nudibranchs *Aeolidiella alderi* and *Catriona gymnota* have both been recorded above the Folly Reach of the Medina where the mean summer salinity is 30-32 $^{o}/_{oo}$.

This past winter (2000-2001) has been the wettest on record, and on the south coast rainfall has been above average during the last few winters. On the Medina there has been considerable soil erosion in the upper parts of the catchment where there is arable farming on sandy soils. This has caused high estuarine turbidity and deposition of sandy silt upon mudflats. In the past 5 years, these more sandy sediments have been colonised by the lugworm *Arenicola marina.* The species was previously very rare or absent in the upper estuary and yet now is abundant in many areas. So far, the populations of nereid polychaetes appear to be unaffected, yet changes in the abundance and type of bird prey items in some estuaries could have implications for their designation as special protection areas (SPA), should bird distributions alter.

The heavy rainfall has resulted in a higher frequency of storm-water discharges into the estuary, which combined with high summer temperatures could cause eutrophication problems. Certainly, there is local concern about the greater cover and biomass of *Enteromorpha* on mudflats on the Medina and other estuaries on the Island.

I would be interested to hear of any similar observations from other estuaries.

References

Southward, A.J. (1991). Forty years of changes in species composition and population density of barnacles on a rocky shore near Plymouth. *J. Mar Biol. Ass UK.*, **71** : 445-513.

Southward, A.J., Boalch,G.T. & Maddock, L. (1988). Fluctuations in the herring and pilchard fisheries of Devon and Cornwall linked to change in climate since the 16th Century. *J.Mar.Bio.Ass.UK.,* **68**:423-445.

Southward, A.J., Hawkins, S.J. & Burrows, M.T. (1995). Seventy years observations of changes in distribution and abundance of zooplankton and intertidal organisms in the western English Channel in relation to rising sea temperature. *J. therm. Biol.,* **20** No. 1. :127-155.

Recent observations of the Mantis Shrimp *Rissoides desmaresti* from the Solent.

Roger J.H. Herbert
(contact as above)

Further to recent reports of mantis shrimps in PN, here is an update on records from the Solent region.

The status and distribution of *Rissoides desmaresti* (as *Meiosquilla*) in the NE Atlantic was reviewed in the Porcupine Newsletter by Clark (1985). It is essentially a southern species that is common in the Mediterranean but has been collected from the English Channel and southern North Sea. In 1999 a population was discovered east of the St Tudwal's Islands in Tremadog Bay, North Wales (Ramsay & Holt, 2001). This is the currently the most northerly population, although larvae have been collected near the Isle of Man (Bruce *et al.*, 1963). From the historical records and recent observations it would appear that the Solent has been, and still is, a stronghold for the species along the south coast of England. Indeed Bell (1853) alludes to Bembridge on the Isle of Wight as one of the few places in Britain at which the species may be found. The review by Clark (1985) was prompted by the discovery of two adults and a juvenile caught in a dredge sample in Stanswood Bay near the mouth of Southampton Water in 1984. Since then, there have been several records of animals caught by fishermen dredging for oysters in the Solent. These recent observations are listed below plus four additional historical records obtained from local literature and not cited by Clark (1985). I have also included records and observations by Jenny Mallinson reported in the last issue of PN.

A female collected from Osborne Bay on November 11th 1994 was taken back to the Medina Valley Field Centre and placed in a small, unheated, aquarium. Over the next few days it had made a number of separate burrows into the pea gravel. On 30th November it was observed excavating a new burrow in a corner of the tank, a task that took about 30 minutes, after which it rested within the burrow with head facing outwards. By the morning of December 1st it had abandoned the corner burrow and had tunnelled beneath a rock placed in the middle of the aquarium. Here it remained, making a third entrance on 8th December, almost totally undermining the rock. The animal survived until 7th March 1995 and despite offering various live shrimps and small fish it did not appear to eat.

Upon removal of the dead animal from the tank, a very small clump of spawn was noticed attached to some pea gravel. About 500 pale orange coloured eggs were retained within a loose mass. Twelve of the eggs were measured under the microscope using a micrometer eye-piece. The mean diameter of these newly laid eggs was

found to be 0.53mm (SD = 0.019mm). The egg mass was placed in a smaller aerated tank of clean seawater and one week later the mean egg diameter had increased to 0.66mm. Cleavage had occurred but further development of the brood was not observed. Mauchline (1984) states that the female remains within the burrow to nurse the loose mass of eggs, frequently turning it over and removing debris from the surface of the eggs. She leaves the egg mass at the back of the burrow.

According to local fishermen the frequency of capture has certainly increased over the past decade and it would appear that the population is rising - perhaps in response to higher sea temperatures. From the little habitat data available (reviewed by Clark, 1985) there appears to be some association of *Rissoides* with *Zostera* beds. Although there has been some decline in *Zostera* in the Solent over past years (Tubbs 1983) there remains a narrow zone, in places 100m wide, along the north east shores of the Isle of Wight between East Cowes and Bembridge where most of the recent observations have occurred. Many of the observations have been from oyster fishermen who operate during the winter months. It would be interesting to determine whether the species is as abundant during the summer. Although the majority of the animals recorded have been collected close inshore, the general response from fishermen is that the species is widespread in the Solent.

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Date	Location	Abundance & Size	Notes	Reference
1904	Yaverland, Isle of Wight (also Ryde & St.Helens)	"a good many"	Washed up on beach. Mixed with seaweed and mostly alive. Specimens not infrequently taken between Ryde & St.Helens.	Morey (ed.) 1909
1906	Bembridge, Isle of Wight.	"fairly large number"	Caught in shrimp net. "No-one has ever seen these before in the locality"	Du Boulay (1911) p73-74
14/10/1923	Bembridge, Isle of Wight.	1 individual	Amongst prawns - "a good specimen"	Goodall (1923)
7/1937	Barton Rocks Woodside, IOW	1 individual	Captured in a prawn pot	Adams (1937)
1985	Off Norris Castle, East Cowes, IOW.	Several large individuals	Caught in oyster dredge close inshore in mud near rocks	Herbert (1994)
16/11/1992	Off Kings Quay IOW, 'inside Wreck Bouy'	1 individual 7.5 cm long	Caught in oyster dredge. Substrate mud with some gravel and much *Crepidula*. Depth 5m	Herbert (1994)
21/4/1993	Stanswood Bay Southampton Water. 1 individual	7.5 cm long	Caught in oyster dredge at depth 8m. Mud with some gravel, Cobbles and *Crepidula.*	Herbert (1997)
30/4/1993	Stanswood Bay, Southampton Water.	1 individual	Caught in oyster dredge. Survived in Fort Victoria Marine Aquarium till August "then disappeared!" Ate shell-less hermit crabs placed before it.	Herbert (1997)
12/11/1993	Osborne Bay, Isle of Wight	3 caught including 1 male.	Caught in oyster dredge in shallow water	Herbert (1997)
1-10/11/1994	Between Osborne Bay and Kings Quay, IOW.	20 caught over ten days including 1 female 8.2cm long..	Caught in oyster dredge	Herbert (1997)
11/11/1994	Osborne Bay, IOW.	5 in total. Females 7.1cm; 7cm; 7.5cm; 9.7cm. Male 8.4cm.	Caught in oyster dredge	Herbert (1997)
11/1995	Osborne Bay, IOW.	Several individuals	Caught in oyster dredge at slack water.	H.Matthews pers.comm.
5/8/1996	Off Hurst Spit	Larva caught in plankton haul over silty sand, Water depth 11m.	Length of Larva 0.6cm	M.Sheader pers.comm
24/3/1997	Off Ryde, IOW 01°07.00'W;50°44.55'N	2 individuals, one in each grab sample	Sand & gravel. 3 & 9 phi grain size dominant fractions. Mean water depth 14m.	P.Widianwari pers.comm.
April 2000	Bouldnor, IOW	1 individual	In pool amongst *Zostera* at LWS	G.Berkowitz pers.comm.
18/10/00	Between Reach & Coronation Buoys,	caught in small beam trawl with mud, shell,	Kept in aquarium in deep (6") mud, new burrows	J. Mallinson pers.comm.

	Southampton Water	*Crepidula* and filamentous red algae in 8m.	indicate it is still alive, rarely seen. Catches and eats small *Crangon*	
30/4/01	Off Cashot	1 individual	Caught in Otter Trawl. Kept in aquarium in shallow sand for 4 months.	J. Mallinson pers.comm.
5/8/01	Off Ryde, IOW 01°07.00'W;50°44.55'N	1 Individual in grab sample	Sand & Gravel. Mean water depth 14m	P.Widianwari pers.comm.

New Records of Amphipods and Leptostracans from the Forth Sea Area, with notes on their copepod parasites (Siphonostomatoida: Nicothoidae)

Myles O'Reilly*, Elaine Hamilton, & Lee Heaney

Scottish Environment Protection Agency*South West Area, 5 Redwood Crescent, Peel Park, East Kilbride G74 5PP. e-mail: myles.oreilly@sepa.org.uk

Introduction

In 1986 the Forth River Purification Board (FRPB) commenced monitoring of Lothian Region Council sewage disposal grounds, 17.5km north of St. Abbs Head and 13.5km east of Bell Rock, in the Forth Sea area. Part of the programme included establishing a reference collection of benthic invertebrates as an aid to gauging impact on the biodiversity of benthic fauna. Between 1986 and 1989 a variety of crustaceans were recovered which included species of amphipods and leptostracans new to the Forth Sea area. In view of the current interest in biodiversity, details of the newly recorded species are now provided, along with notes on other species present from the same families and any observed incidences of parasitism by copepods.

Amphipods

The Order Amphipoda comprises small crustaceans such as the familiar shore "shrimps" (*Gammarus spp*.) and beach "sandhoppers" (*Talitrus spp.*) but includes many additional species within the marine realm. There are four sub-orders; Gammaridea, Caprellidea, Hyperiidea, and Ingolfiellidea. The Caprellidea (skeleton shrimps) contains twelve British species which generally lead an epifaunal existence clambering over rocks, stones and hydroids, although they do also turn up in sediment grab samples. *Caprella linearis* (Linnaeus, 1767), *Pariambus typicus* (Kroyer, 1844), and *Phtisica marina* Slabber, 1769, were regularly recovered at both disposal grounds while *Pseudoprotella phasma* (Montagu, 1804) also occurred at Bell Rock. An identification key to British caprellids is provide by Harrison (1944). The only other caprellid species ever identified in FRPB surveys is *Caprella tuberculata* Bate & Westwood, 1868, of which a single female was collected at Hound Point in 1996. The Hyperiidea contains around 50 British species all of which are planktonic. Although these would not be expected in benthic samples, a number of *Parathemisto gaudichaudi* (Guerin-Meneville, 1825) were recovered at St. Abbs - presumably derived from sea-water hoses used to sieve the sediment samples. The Cyamidea (whale lice) are all ectoparasites of cetaceans. Some recent Forth Sea area records from stranded whales are provided by O'Reilly (1998). The Ingolfiellidea is represented by a single British species which burrows in

coarse sediments and is restricted to the English Channel.

The Gammaridea is the largest amphipod sub-order and contains over 270 British species most of which occur in marine waters. The British Gammarideans were studied in detail in a monograph by Lincoln (1979) which has become the standard work for their identification. The amphipods from the Clyde Sea area were reviewed by Moore (1984a). Only gammaridean amphipods are discussed further here. A total of 38 gammaridean amphipods new to the Forth Sea area were recorded at the disposal grounds and included both common species and rare ones. Other benthic faunal studies (Parker, 1984; Dewarumez, *et al.*1992) have also revealed amphipods new to their respective areas indicating that much remains to be learned regarding local inventories of biodiversity. The amphipods new to the Forth Sea area include the first British record of *Paradulichia typica* Boeck, 1870, and in addition two rare species; *Metopa robusta* Sars, 1892, which had been recorded from the Forth by Scott (1906) but seems to have been overlooked by Lincoln (1979), and *Acanthonotozoma serratum* (Fabricius, 1780) first recorded in the UK from St.Abbs, by Moore (1984b).

Leptostracans and nicothoid copepods

The Order Leptostraca comprises small marine crustaceans superficially similar in appearance to brine shrimps. Four species are cited from "British" waters by Mauchline (1984) but only one of these is known from waters less than 200m deep. The taxonomy of leptostracans from the European shelf was revised by Dahl (1985) with the recognition of additional British species.

The Nicotoidae is a family of minute copepods which parasitise other crustaceans including amphipods (Gotto, 1993) and also leptostracans (Gotto, 1984). A number of amphipods from British waters are infested by *Sphaeronella* species which inhabit the brood pouch of females. They are generally overlooked on account of their small size and published records are few and far between (Green, 1958; Gotto & McGrath, 1980; Moore, 1984a; Moore & Wong, 1996; O'Reilly & Geddes, 2000). The records of these parasites in the amphipods *Ampelisca tenuicornis* Lilljeborg, 1855, *Amphilochus neapolitanus* Della Valle, 1893, *Perioculodes longimanus* (Bate & Westwood, 1868) and *Corophium crassicorne* Bruzelius, 1859, from the Forth Sea area were briefly cited in Costello & Myers (1989) and included in Gotto (1993) under "south-east Scotland" but further details are provided here along with an additional record from *Bathyporeia pelagica* (Bate, 1856).

Sampling

The benthic surveys were carried out at St. Abbs in June 1986, '87, '88, & '89 and at Bell Rock in Jan. & Nov.'87, and April & Oct.'89. At St. Abbs the same eleven stations were sampled each year and at Bell Rock the same nine stations (Figure 1). The grabbing stations lie within a radius of 2 nautical miles of the disposal ground centres (St.Abbs Stn.13 - 56 ^{o}04.50'N, 02^{o}07.27'W, and Bell Rock Stn.13 - 56 ^{o}25.00'N, 02^{o}10.00'W). Trawls were carried out at both stn.13's and a single control station, "C", just outside the Bell Rock disposal area. The depths at both disposal grounds varied between 50 - 60m. At each grabbing station 2 van Veen grabs (0.1m^2) of sediment were collected and sieved on 0.5mm mesh. All material was fixed on site with formalin prior to identification in the laboratory.

Notes on new amphipods and leptostracans and parasitic copepods

The order below follows Lincoln (1979), though the nomenclature has been updated to that in Howson &

Picton (1997). For brevity the full authorities and dates are only provided for the species new to the area. Only families which include species new to the Forth Sea area are discussed. The original paper contained notes on the new species which included, for each survey (St Abbs and Bell Rock), the dates collected, the total number of specimens observed, along with the station numbers if recorded at four or fewer stations, or, if found at more than four stations, the total number of specimens and the number of stations at which they were observed. The full paper with this information is available from the author or from the Hon. Editor and can be sent as a e-mail attachment).

Order: AMPHIPODA
Sub-order: GAMMARIDEA

Family Lysianassidae
Acidostoma obesum (Bate & Westwood, 1861). Bell Rock
Euonyx chelatus Norman, 1867. Bell Rock.

A family of robust amphipods, many of which have a peculiar hirsute gnathopod 2 superficially resembling a "cat's paw". *Acidostoma nodiferum* (=*A .sarsi* in Lincoln*) , Hippomedon denticulatus,* and *Tryphosites longipes* also occurred at St. Abbs, while at Bell Rock *A. nodiferum, H. denticulatus, Lepidopecreum longicorne, Orchomene nanus,* and *Scopelocheiros hopei* were observed.

Family Ampeliscidae
Ampelisca diadema (Costa, 1853). St. Abbs & Bell Rock
Ampelisca tenuicornis Lilljeborg, 1855. St. Abbs & Bell Rock
Ampelisca typica (Bate, 1856). Bell Rock

The genus *Ampelisca* was reviewed by Dauvin & Bellan-Santini (1988). These are generally large amphipods, strongly laterally compressed, with distinct cuticular lens eyes. *A. brevicornis* and *A. macrocephala* were both common at St. Abbs and Bell Rock but *A. tenuicornis* was by far the most abundant and was usually found at all the stations. Nine of the *A. tenuicornis* from St. Abbs (5 in '86, 2 in '87, 2 in '88) were found to be harbouring the copepod, *Sphaeronella longipes* Hansen, 1897, in their brood pouch. In each case a single juvenile female was observed. Two *A. brevicornis* from Bell Rock (stn.9, Jan.'87 and stn.9 Apr.'89) were hosts to immature "pupal stages" of *Sphaeronella* copepods.

Family Acanthonotozomatidae
Acanthonotozoma serratum (Fabricius, 1780) [see **Figure 2a**]Bell Rock - Jan.'87 - 1 female (6mm long) trawled at stn.13. The specimen is deposited in the National Museum of Scotland (Registration No. NMSZ 2001.012.1)
The only British record of this arctic species comprised two specimens collected by a diver at Coldringham Bay, near St. Abbs (Moore 1984a). In view of its rarity the new record is mentioned here. The genus was reviewed by Just (1978) who also included notes and figures of copepod parasites.

Family Amphilochidae
Amphilochus neapolitanus Della Valle, 1893. St. Abbs & Bell Rock.
This is regarded as a Mediterranean species at the northern limit of its distribution. Parker (1984) claimed the most northerly British record from Belfast Lough. However, Sheader (1983) cited a single specimen collected from Blyth on the Northumberland coast in 1952. Although Sheader considered this record questionable the present finds from the Forth Sea area suggest *A. neapolitanus* may be widespread in the North Sea. In fact, it has since been found even further north in the Gullmarfjord in western Sweden (Buhl-Jensen & Fossa, 1991). One of the amphipods collected at Bell Rock, stn.11, Nov.'87 contained a mature female and 2 male copepods in its brood pouch, tentatively identified as *Sphaeronella amphilochii* Hansen, 1897.

Amphilochids are small amphipods and identification requires careful examination of the gnathopods. *Gitana sarsi, Paramphilochoides odontonyx* and *Amphilochus manudens* were recorded at both St. Abbs and Bell Rock.

Family Stenothoidae
Metopa latimana Hansen, 1887. St. Abbs & Bell Rock
Metopa tenuimana Sars, 1892. Bell Rock
Metopa robusta Sars, 1892 [see **Figure 2b**]. St. Abbs & Bell Rock. Three adult

females, and 3 juvs., from stn.17 have been deposited in the National Museum of Scotland (Registration No. NMSZ 2001.012.2-7). Material also been deposited in the British Museum (Natural History), London.

The key features of *M. robusta* include the gnathopod structure, telson armature and sinuous ventral border of coxal plate 4. It was in fact recorded from the Forth by Scott (1906) but was not included in Lincoln's monograph. It was also recorded off the Northumberland coast by Sheader (1983).

Stenothoids are also rather small amphipods but with conspicuous large coxal plates. The gnathopods and armature of the telson are important aids for identification. *Metopa bruzelii, M. pusilla* and *Stenula rubrovitatta* were recorded at St.Abbs and additionally *M. norvegica* and *Stenothoe marina* were found at Bell Rock.

Family Melitidae
Cheirocratus assimilis (Lilljeborg, 1852). Bell Rock
Cheirocratus intermedius G.O.Sars, 1894. St. Abbs
Melita dentata (Kroyer,1842). St. Abbs
Melita hergensis Reid,1939. St. Abbs Jun.'87

Melitids are large amphipods usually with elongated uropod 3 and, in males, enlarged gnathopod 2, the latter being diagnostic for each species. The genus *Cheirocratus* exhibits a relatively unusual feature with the first antennae being shorter than the second. *Maera loveni, M. othonis*, and *Abludomelita obtusata* (*Melita obtusata* in Lincoln), were recovered from St. Abbs and *Cheirocratus sundevallii* was also found at Bell Rock.

Family Pontoporeiidae
Bathyporeia elegans Watkin, 1938. Bell Rock

The genus *Bathyporeia* contains a number of species which are abundant in intertidal and sublittoral sandy sediments They all have a distinctive geniculate first antennae. The species can be quite difficult to distinguish and although several species were tentatively identified from the disposal grounds only the record of *B. elegans* was confirmed by P.G. Moore. However additional *Bathyporeia* species have been identified in the Clyde Sea area (Barclay, 1982) and it is likely that further species may also exist in the Forth Sea area. None of the *B. elegans* from the disposal grounds were parasitised by copepods. However a single female of *B. pelagica* collected intertidally from Belhaven Bay, Dunbar in June '88 was infested by a large mature female of *Sphaeronella paradoxa* Hansen, 1897. While the copepod exhibited the typical angular ventrum of this species, the diagnostic umbilical attachment filament was absent.

Family Urothoidae
Urothoe elegans (Bate, 1856). St. Abbs & Bell Rock

Family Oedicerotidae
Pontocrates arenarius (Bate, 1858). St. Abbs & Bell Rock
Synchelidium maculatum Stebbing, 1906. St. Abbs & Bell Rock

Oedicerotids are characterised by their helmet-shaped heads. Five species have previously been recorded from the Forth Sea area of which two, *Perioculodes longimanus* and *Westwoodilla caecula* were common at St. Abbs and Bell Rock. An additional species, *Pontocrates arcticus* Sars, 1893 has only recently been recognised from British waters from the Firth of Clyde (Moore & Beare, 1993) and may well also occur in the Forth Sea area. *Perioculodes longimanus* was a particularly abundant species at the disposal grounds and was frequently parasitised by the copepod *Sphaeronella minuta* Scott, 1904. Eight amphipods from St.Abbs were infested (1 in '86, 3 in '87, 2 in '88, 2 in '89), mostly with juvenile parasites but also one mature, and two ovigerous, females. More infested amphipods were observed at Bell Rock (24 in Jan.'87, 1 in Apr.'89). Again most of the copepods appeared to be juveniles but included two ovigerous females. A single mature female copepod was also recovered from a *P. longimanus* collected at Dunbar in 1988. Scott (1904) figured this species with a short umbilical attachment thread similar to that of *S. paradoxa* (which parasitises *Bathyporeia spp.*). However, none of the Forth specimens appeared to have such a thread.

Family Melphidippidae
Megaluropus agilis. Bell Rock

Family Calliopiidae
Apherusa bispinosa (Bate, 1856). St. Abbs

Family Pleustidae
Parapleustes bicuspis (Kroyer, 1838). St. Abbs & Bell Rock
Stenopleustes latipes (G.O.Sars, 1858). St. Abbs & Bell Rock
Stenopleustes nodifer (G.O.Sars, 1882). St. Abbs

A small family with only 5 British species. Only *Parapleustes assimilis* is previously recorded from the Forth Sea area, and was also found at St. Abbs.

Family Paramphithoidae
Epimeria cornigera (Fabricius, 1779). St. Abbs.
None of the specimens were recovered from grab samples but were found among debris in a fish trawl undertaken at the centre of the disposal ground as an additional part of the monitoring programme.

Dexaminidae
Guernea coalita (Norman, 1868). Bell Rock .
A small species, easily overlooked. In addition to plumose setae on leg 7, the urosome has a knobbly appearance dorsally.

Family Aoridae
Aora gracilis (Bate, 1857) [Lincoln, 1979 as *A. typica* Kroyer, 1845]. St. Abbs & Bell Rock
Autonoe longipes (Lilljeborg, 1852) [Lincoln, 1979 as *Lembos longipes*]. St. Abbs & Bell Rock
Leptocheiros hirsutimanus (Bate, 1862). Bell Rock
Females of this family are often difficult to distinguish, even at generic level. Mature males however have sexually dimorphic gnathopods which are generally diagnostic. The genus *Aora* in British waters was reviewed by Myers & Costello (1984). *Aora typica* is a southern ocean species and does not occur in Britain. Records of *A. typica* from British waters probably refer, for the most part, to *A. gracilis*. However a new species *A. spinicornis* was described by Myers & Costello (1984) from south west Ireland and may be present in other localities.

Family Isaeidae
Gammaropsis maculata (Johnston, 1828). St. Abbs & Bell Rock
Gammaropsis palmata (Stebbing & Robertson, 1891). St. Abbs & Bell Rock
Gammaropsis nitida (Stimpson, 1853). St. Abbs & Bell Rock
Gammaropsis cornuta (Norman, 1869) [Lincoln, 1979, as *Megamphopus cornutus*]. St. Abbs & Bell Rock
Photis longicaudata (Bate & Westwood, 1862). St. Abbs & Bell Rock
Photis reinhardi Kroyer, 1842. Bell Rock. Confirmed by P.G. Moore on basis of female Gnathopod 1.

Although only two species are previously recorded from the Forth Sea area, seven species were identified at the disposal grounds of which, only *Protomedeia fasciata*, was already known. The genus *Gammaropsis* is readily recognised by the acute lateral eye lobes. In *Photis longicaudata* the inner ramus of uropod 3 is so small that that the uropods appear to be uniramous. Morover the uropod 3 rami in this species are frequently upturned. The genera *Photis* and *Gammaropsis* in British waters are reviewed by Myers & McGrath (1981, 1982).

Family Corophiidae
Corophium crassicorne Bruzelius, 1859. Bell Rock
Three of the amphipods collected in Jan.'87 (stns.3,9,25) harboured single copepods in their brood pouch, identified as juvenile female *Sphaeronella danica* Hansen, 1897.
Siphonoecetes striatus Myers & McGrath, 1979. Bell Rock
This species is difficult to distinguish from *S. kroyeranus*. Ideally mature specimens are required which retain their pigmentation patterns on the rostrum and antennae (see Myers & McGrath, 1979). In view of the apparent occurrence of *S. striatus* from the area, previous records of *S. kroyeranus* may be mistaken and the presence of both species in the Forth now requires confirmation.

Corophiids are one of the best known amphipod families, especially "mud shrimps" of the genus *Corophium*. The dorso-ventrally flattened body, huge second antennae and brush of long setae on the gnathopods are characteristic. *Corophium volutator* is often extremely

abundant in intertidal sediments where it forms an important food source for birds and fish. It occurs on the mudflats of the Forth Estuary (eg. FRPB surveys at Kinneil) but surprisingly is not cited from the Forth by Lincoln (1979), who only mentions *Corophium affine, Siphonoecetes kroyeranus*, and *Unciola planipes* from the area. *C. affine* was recorded from St. Abbs and Bell Rock and *U. planipes* also from Bell Rock.

Family Ischyroceridae

Microjassa cumbrensis (Stebbing & Robertson, 1891). St. Abbs

One of the smallest species of the family and difficult to identify. The single specimen collected appears to be the first record from the east coast of Britain.

Ericthonius rubricornis (Stimpson, 1853). St. Abbs & Bell Rock

The genus *Ericthonius* was revised by Myers & McGrath (1984) who recognised four species from British waters. Of the species cited by Lincoln (1979), *E. brasiliensis* does not occur in British waters and records of this species probably refer to *E. punctatus* (Bate, 1857). *E. difformis* is present in British waters though the previous records of *E.difformis* from the Forth Sea area may possibly refer to *E .rubricornis* which has already been recorded in the Forth area by Moore (1984b).

Family Podoceridae

Paradulichia typica Boeck, 1870 [see **Figure 2c**]**.** St. Abbs

Three specimens have been deposited in the National Museum of Scotland (Registration No. NMSZ 2001.012.8-10. Some material has also been deposited in the British Museum (Natural History), London.

Dyopedos porrectus (Bate, 1857). St. Abbs & Bell Rock

The family is generally recognised by the elongated urosomal 1 segment and the presence of only 1 or 2 pairs of uropods. *Dyopedos monacanthus* was also recorded from both St. Abbs and Bell rock. The two *Dyopedos* species are distinguished by the second gnathopods and by spines on coxal plates 1 or 2 of the males. However some small males of *D. monacanthus* were observed at St. Abbs without the characteristic coxal 1 spine. The discovery of *Paradulichia typica* above represents the first British record of this species which has an Arctic distribution in waters up to 550m deep. The genera *Dulichia* and *Paradulichia* were reviewed by Laubitz (1977).

Order: LEPTOSTRACA

Family Nebaliidae

Nebalia herbstii Leach, 1814 [Mauchline, 1984, as *Nebalia bipes* (Fabricius, 1780)] St. Abbs & Bell Rock (Identity confirmed for 1989 specimens only)

Nebalia borealis Dahl, 1985. Bell Rock

Sarsinebalia typhlops (G.O.Sars, 1870) [Mauchline, 1984, as *Nebalia typhlops*].Bell Rock Four specimens, all from Bell Rock Jan.87, have been deposited in the National Museum of Scotland (Registration No. NMSZ 2001.012.11-14)**.**

The only leptostracan noted by Mauchline (1984) in inshore waters was *Nebalia bipes* (Fabricius, 1780). Although this species is widely recorded around the British coast, even intertidally, the review by Dahl (1985) indicated that it is an arctic species and the only confirmed European records are from Iceland and northern Norway. It seems probable that most of the British records of *N. bipes* should in fact refer to *N. herbstii* Leach,1814. Indeed of the *N. herbstii* records from the disposal grounds, all were originally identified as *N. bipes* and only the specimens from 1989 have been re-examined and confirmed as *N. herbstii*. However, Dahl (1985), also described a new species, *N .borealis* Dahl 1985, with a more southern boreal distribution which includes southern Norway, Sweden, and the Shetland Isles. It is distinguished from *N. herbstii* by the acutely pointed (rather than rounded) denticles on the dorsal margin of sixth and seventh pleon segments. *N. borealis* has also now been found at the disposal grounds with a single specimen identified at Bell Rock, stn.15, in 1999, so it is possible some of the unconfirmed *N. herbstii* cited above may be *N. borealis.*

The occurrence of *Sarsinebalia typhlops* at the disposal grounds, with maximum depths around 60m, is somewhat surprising as Mauchline suggests it is restricted to deeper waters from 220-2900m. *S. typhlops* is readily

recognisable by its minute unpigmented eyes and by its rostrum which is surmounted by a small, but distinct, apical spine.

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Figure 1: Location of disposal ground sampling stations at St.Abbs, and Bell Rock

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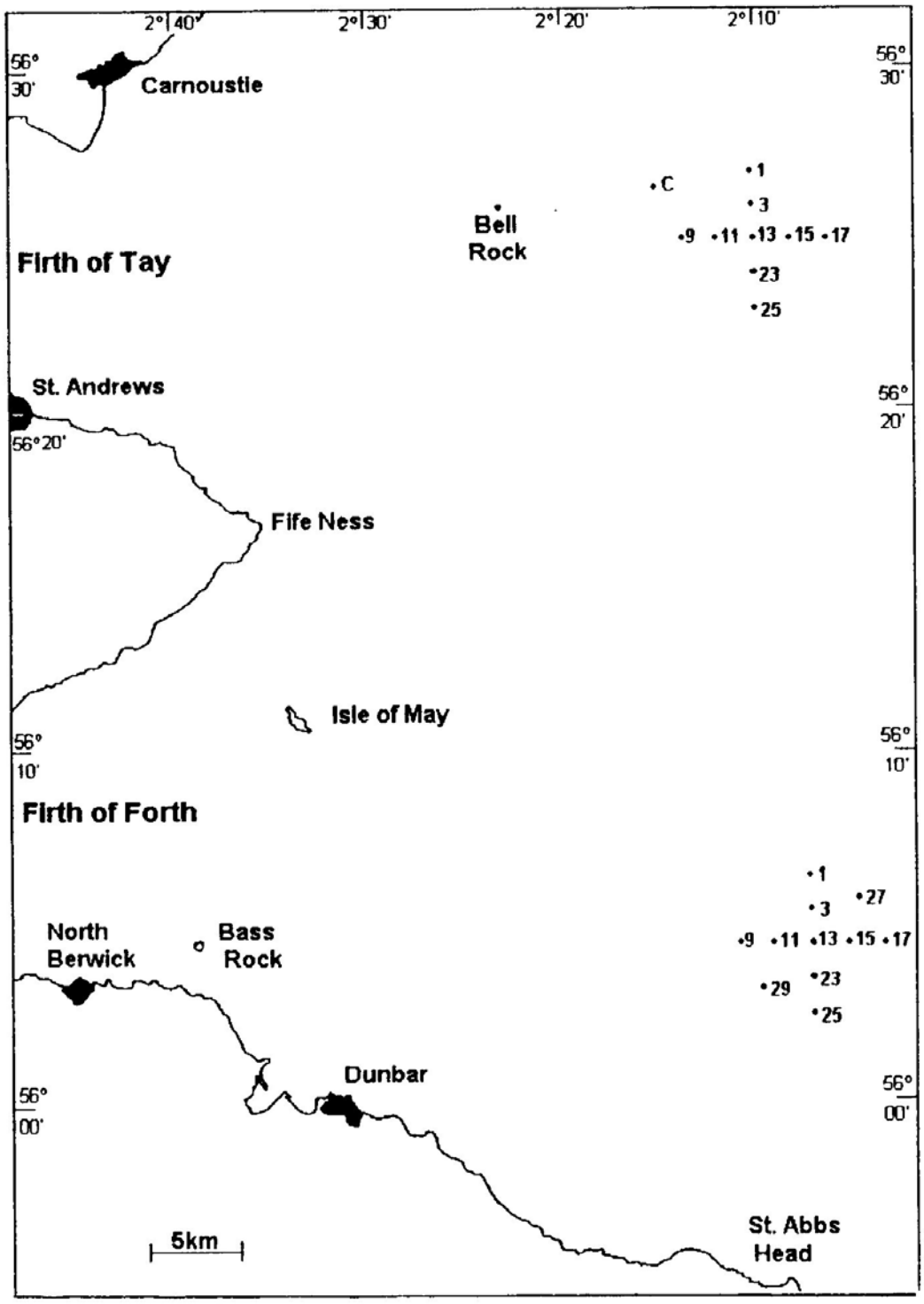
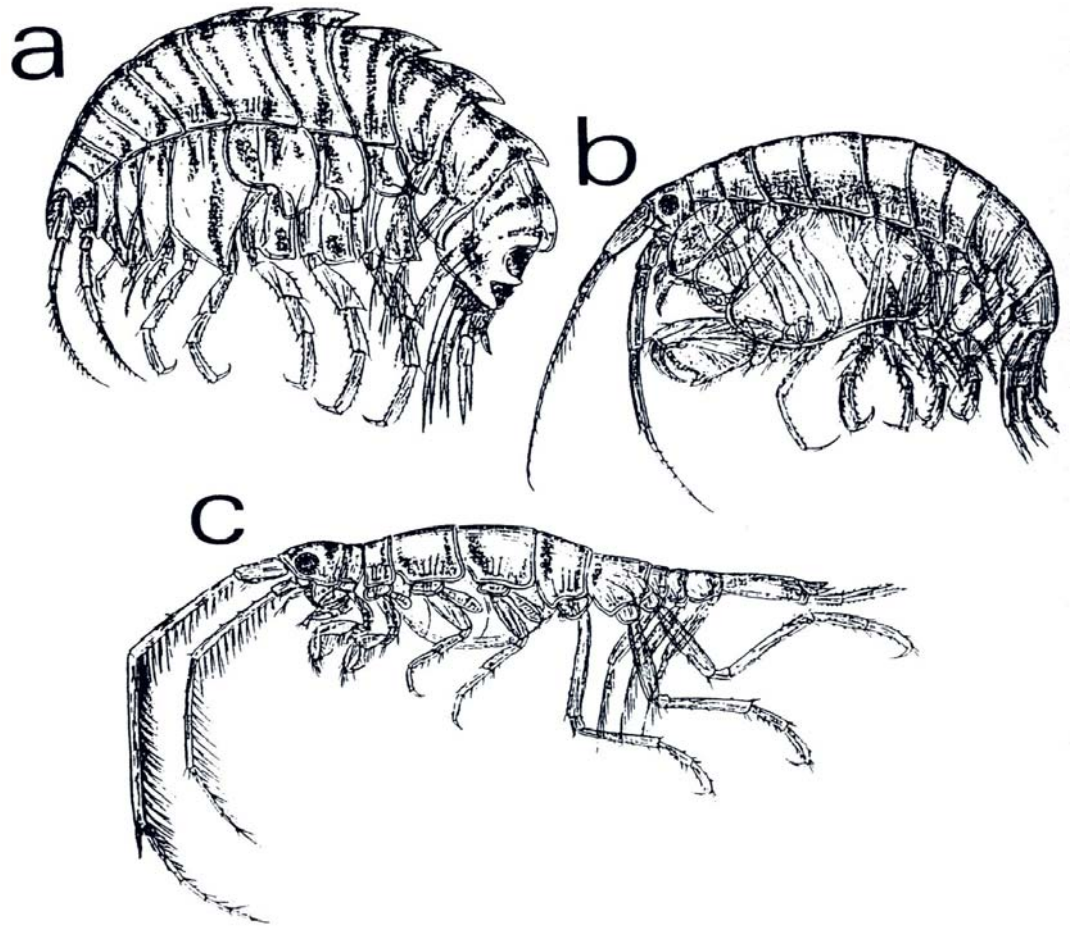


Figure 2: a) *Acanthonotozoma serratum*, length up to 12mm. b) *Metopa robusta*, length up to 6mm. c) *Paradulichia typica*, length up to 5mm.
(All after Sars, G.O. (1890-95). Account of the Crustacea of Norway. Vol.1 Amphipoda. 711pp. Christiania & Copenhagen: Cammermeyer.



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The Porcupine Recording Scheme

Jon Moore Ti Cara, Cosheston, Pembrokeshire, SA72 4UN (jon@ticara.co.uk)

The recording scheme continues to get a slow trickle of records, which we hope will increase. Remember, if you have any additional information or comments on the records given here, we are always interested to hear them and disseminate them.

Mike Bailey reports that he has been finding **'huge'** numbers of *Ensis americanus* in the Wash in recent surveys. This alien razorshell was first reported in the UK in 1989, a long way from the Atlantic coast of N. America where it is native. It has spread around much of the southern North Sea and is found from the Humber to E.Sussex: or is that already out of date? Another alien species, *Sargassum muticum*, has also been on the move in UK. Ivor Rees reports that it has been found on Anglesey for the first time this summer.

A specimen of the crab *Goneplax rhomboides* was found burrowing in the shore in Southampton Water (Netley beach) by Mr Deathe in October while bait digging. He kept it alive and took it to the aquarium at the Southampton Oceanography Centre. *Goneplax* has been recorded from Southampton Water before (see Clark, 1986, NE Atlantic Crabs), but there are very few records from the eastern half of the English Channel. And talking of crabs: Jane Lilley found a large congregation of spider crabs *Maja squinado* on Lundy in August this year. She estimated densities of 10 individuals per m^2, in an area that took her 10^+ minutes to fin across. They appeared to be walking towards deeper water, but showed no signs of moulting or overt mating behaviour.

Roger Herbert reports that he found and photographed the very rare nudibranch *Heamiopsis variopicta* in a rockpool at Bembridge, I.O.W in March 1999. The record was reported in the Proc. of the IOW Natural History Society, and is certainly of sufficient interest to warrant further dissemination. The only previous record from Britain is that found in 1972 at Thurlestone, near Plymouth, although it has recently been recorded from Ireland by Bernard Picton. The general distribution of the species is 'rare from the Mediterranean and Atlantic' and Roger would like to know about any other records from Europe. For a description see the Linnean Society guide (Thompson, 1988).

Sunfish records continue to come in and are passed on to Doug Herdson at the National Marine Aquarium, Plymouth (Douglas.herdson@national-aquarium.co.uk). The latest comes from Steve Hutchinson who found a 2' long (30 lb) specimen 2 miles south of Hengistbury Head in Dorset. Other records in short: *Suberites masa* in Newtown creek, I.O.W (Jenny Mallinson); *Calliactis parasitica* on Turbot Bank, Pembs. in August (Ivor Rees); *Callista chione* off Aberporth in S Cardigan Bay, August (Ivor Rees – the first live one he has seen in the Irish Sea); *Simnia patula* on sea fans on Lundy in July (Jane Lilley); *Chorda filum* stands at 2 sites in W. Cumbria this summer (never seen there before) (Betty Green). Thanks to: Mike Bailey, Mr Deathe, Betty Green, Roger Herbert, Steve Hutchinson, Jane Lilley, Jenny Mallinson, Ivor Rees.

Please keep the records coming! A few people have said they are not really sure what constitutes a record of interest, particularly if they are unsure of the rarity of a species. There is no precise answer to this, but we are interested in anything that YOU found interesting. One of the primary purposes of the scheme is to encourage dissemination and feedback and so increase the understanding of readers and recorders. Obviously, distribution information can be checked in i.d books or databases (try www.jncc.gov.uk/mermaid) for a species before a record is sent, but distribution information is poor for most species and unavailable for many.

' PORCUPINE 2001. THE MARINE NATURAL HISTORY OF THE NE ATLANTIC: Long-term Studies'

Papers from the PMNHS meeting held at the Environment Agency, Brampton, Huntingdon from 16-18th March 2001

Opportunities for long-term studies - monitoring marine Special Areas of Conservation

Eleanor Murray

Maritime Monitoring Officer, English Nature, Northminster House, Peterborough, PE1 1UA

Past data collection by the nature conservation agencies

Historically, the nature conservation agencies have used marine data information on an ad-hoc basis. Data have been used to designate Sites of Special Scientific Interest (SSSI), other data have been gathered to inform the management of SSSIs in response to planning applications etc. In 1979, the Natural Environmental Research Council and the Nature Conservancy Council prepared a paper on nature conservation in the marine environment which recommended that the NCC develop a formal marine conservation policy, undertake some SSSI designation and explore mechanisms for protection and management of subtidal areas (SSSI designation does not go deeper than Mean Low Water). In 1983 NCC were given extra resources to increase its level of expertise in the marine and coastal environment. This led to the establishment of the Marine Nature Conservation Review.

The Marine Nature Conservation Review (MNCR) (Hiscock 1996) was established in 1987 to extend our knowledge of marine habitats, communities and species in the UK. It aimed to achieve this by developing a classification of marine habitats and species to mirror the NVC and other classifications in existence for the terrestrial environment. It also aimed to describe sectors of coastline, through the revision of current knowledge and the production of Area summary documents which provided comprehensive descriptions of marine near-shore areas. The other main function of the MNCR was to identify sites and species of nature conservation importance to provide a network of marine areas protected under the 1981 Wildlife & Countryside Act.

The MNCR was intended as a 10-year project with a specific aim, and not for the long-term collection of biological information.

New opportunities for nature conservation

Whilst the MNCR was gathering momentum, UK government representatives attended the 'Earth Summit' in Rio, where it signed the declaration for the conservation of biodiversity. The EU responded to the Rio convention by producing the Habitats Directive (Council of

European Communities 1992). The UK also developed the Biodiversity Action Plan (DOE 1994) as a further contribution to it's undertaking at Rio. The provision of the Habitats Directive and the updating of the existing Birds Directive led to the designation of marine Special Areas of Conservation (SAC) for habitats and Special Protection Areas for birds. In England, we have designated 57 sites in total, 16 of which are SACs.

Development of monitoring programmes

The aim of the Habitats Directive is to further the conservation of biodiversity, specifically by maintaining *range* and *areas* of natural habitat, maintaining the *structure & function* of those habitats, and maintaining the conservation status of *typical species.* This prescription is fairly high level, and open to considerable interpretation across Europe. The nature conservation agencies were given further guidance via the UK Conservation Regulations (Anon 1994) which demanded that the nature conservation agencies established conservation objectives for each site to meet the aims of directive. This was taken further for the marine environment where we can establish a management scheme for the site, if deemed necessary. The regulations also require us to regularly monitor sites to ensure objectives are being met and, wherever possible, use existing authoritative monitoring schemes.

This is the opportunity given to us to work with a host of authorities to develop a long-term programme of data collection to ensure we can manage an area for marine conservation purposes. Although charged in 1983 to improve our knowledge and understanding in the marine environment, we are still relatively new to the designation, management and monitoring of marine areas for nature conservation purposes.

Trials of monitoring techniques

To facilitate the implementation of the Habitats Directive, the nature conservation agencies, in conjunction with the Scottish Association for Marine Science, bid for European funding to develop best practice for implementation. This project considered trials of novel techniques for monitoring, to develop a full 'toolkit' for site monitoring. This toolkit has been produced as the marine monitoring handbook (Davies *et al*. 2001), which provides guidance on the establishment of monitoring studies on sites, and also a series of procedural guidelines which give detailed accounts of various monitoring methods. This is a massive volume that has been jointly produced by the nature conservation agencies, and contributed to by many marine specialists throughout the UK. This volume has also tried to address quality assurance issues, which is essential for monitoring programmes.

Linking monitoring effort

The nature conservation agencies are currently undertaking a comprehensive review of existing monitoring at each of the sites. This is mainly being done at a local level through the management groups created for each site. We are also investigating other monitoring initiatives at a national and international level, mainly through the work done by the Joint Nature Conservation Committee.

There are many gaps in our knowledge in monitoring marine sites for nature conservation purposes. Until now, a good deal of monitoring has been linked to pollution and other visible impacts. We now have an opportunity to develop our understanding in the functioning of marine ecosystems, as prescribed by the Habitats Directive. We need to gain a better understanding of natural fluctuations in the marine environment, to reduce the apparent need for management when a system is

behaving normally. We also need to understand the cause and effect of activities on habitats and species. We have the pursuit of these questions in our gift now, and the collation and analysis of information is essential to further our knowledge in these areas.

Developing a network of data

There is an increasing amount of biological information in existence from a wide range of sources, from national schemes such as Porcupine through to commercial data collected by industry. The power of pulling all of that information together is vast, and what's more, is attainable now we have fully embraced the Internet age.

The National Biodiversity Network (www.searchnbn.net) is an initiative originally set up by JNCC to fulfil this vision of making data readily available across the internet. The National Biodiversity Network (NBN) is a trust that facilitates the development of web-based technology to deliver data to anyone who wishes to access it. A standard data model has been developed, which will hold any kind of biological records. This data has been made available through a web 'gateway', and can be searched by a number of criteria. The idea of the NBN is to make live data available to all and ensure it is managed properly.

English Nature are also keen to facilitate the management of data through the establishment and continued security for Local Records Centres, to ensure we have well managed, up to data information a mouse click away.

Looking at long term trends

In recent years, the impact of climate change on our surroundings has been an increasing concern. We need to better understand the effects of climate change on our marine habitats and species to prepare us for changes in the marine environment. An emerging initiative to improve our knowledge is the Britain & Ireland climate change project (MarClim) (Hawkins *et al*. 2001). This is a joint study by a number of academic institutions which has been developed mainly by the Marine Biological Association in Plymouth. The aims of the study are to find and collate historical data from known sources. The analysis of these data will enable us to understand the effects of climate change on the distribution and behaviour of marine species in response to parameters such as rising sea temperatures. The project also aims to develop a network of sites to undertake long term monitoring to enable us to model such changes in the future.

Summary

The UK nature conservation agencies have an opportunity to facilitate the consistent collection of good quality marine biological data. Through the National Biodiversity Network, data will be made available efficiently and effectively to inform us about the aspirations we have for marine protected sites. The ease of drawing data together, and the initiation of other projects such as the MarClim work will enable us to study and gain a better understanding of marine ecosystems, which will in turn lead to better management decisions in these areas. We will be able to use data from a wide range of sources to ensure the maintenance of the rich natural heritage that is our marine environment.

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Long Term Biological Monitoring in the Great Ouse Estuary.

Mike Bailey

Ecomaris Ltd, Red House Farm, Wood Walton, Huntingdon, Cambs, PE28 5YL

The Great Ouse is the largest of the four rivers draining into the Wash embayment. The estuarine section is canalised throughout its length until it reaches the Wash. At high water the estuary joins the Wash at a location known as The Point or Cut End (Figure 1B). At low water numerous delta-like sand banks are exposed and the estuary remains channelled through a combination a man-made training wall and natural channels until it reaches the main body of the Wash. The sand banks and channels in the SE Wash 'delta' are highly mobile and the estuary has taken many different routes throughout the last century.

Biological (and chemical) surveys to assess water quality in the Great Ouse estuary and SE Wash were first undertaken in 1973, with repeat surveys carried out in 1982 and 1984. These initial surveys were predominantly sublittoral and showed the infaunal benthos of the canalised estuary to be generally impoverished. The paucity of the fauna was attributed to a harsh salinity regime and strong tidal scour (Gould *et al*, 1986).

Based on the findings of these initial surveys an annual monitoring programme, including biological, chemical and bacteriological surveys, was devised and first undertaken in 1989. The biological surveys instigated at this time (and still undertaken) included subtidal and intertidal benthic surveys and epibenthic trawls. The surveys area is shown in Figure 1, which also shows the main features of this part of the Wash.

The epibenthic and natant fauna of the Great Ouse estuary comprised (and still does) a typical estuarine assemblage, both in diversity and species complement and density. In this respect there are similarities with, for example, the Severn Estuary, where the benthos is severely reduced (owing to sediment instability) but the organic energy within the water column is exploited by dense populations of mysids and caridea (shrimps and prawns) as well as fish (Bamber and Henderson, 1994).

The sublittoral benthos of the canalised estuary has been monitored throughout the 1990s and remains impoverished as a result of scour and a harsh salinity regime (salinity in the estuary between Kings Lynn and the Wash ranges from 0 to 32 ‰ depending on the state of tide, though such extreme fluctuations are usually

encountered only on spring tides). This is in contrast with the SE Wash and the main body of the Wash, where typical and diverse benthic communities are encountered.

A review of all the biological surveys in the Great Ouse between 1974 and 1998 has been published in draft (Bailey *et al*, 1999) and an updated version of this report is currently in press. The remainder of this 'paper' (and the subject of the talk given at the 2001 Porcupine conference) will concentrate on the intertidal benthic surveys that have been carried out annually in the Great Ouse estuary throughout the 1990s.

1989 to 1992 were drought years and the importance of salinity as a controlling influence on the intertidal benthos was clearly demonstrated, with an ingress of estuarine and marine organisms into the lower estuary, the 'training wall' sites. Figure 2 shows that estuarine polychaetes such as *Pygospio elegans* were present as far upstream as West Bank Beacon between 1989 and 1992, but disappeared once freshwater flows returned to normal. Similar distribution patterns were observed for a number of animals. Marine organisms such as *Polydora* spp. were also seen in the canalised section of the estuary during the drought years, but only at sites on the seaward section of the training wall (Bailey,1993).

The intertidal surveys in the early 1990s also identified a likely impact on the benthos from sewage-derived material discharged from Kings Lynn sewage treatment works (stw). The entire length of the training wall was covered by soft mud in the early 90's and as these were the only mud sites in the entire survey, community analysis always separated the training wall sites from other sites, making it difficult to quantify the effects from the stw. For the purposes of the biological review (Bailey *et al*, 1999) all intertidal samples collected between 1974 and 1989 were analysed using community analysis and results confirmed earlier indications that the granulometry is not the principal controlling factor separating the indicated communities, rather it related to the presence of sewage-derived material.

Through the 1990s Hull Sands has built up against the Training Wall (Figure 1) and in ca.1996 Hull Sands engulfed the seaward section of the Training Wall, and extended into the Great Ouse estuary (also creating navigation problems). Since 1996 the extent of Hull Sands on top of the Training Wall has been variable. At sample sites on the lower section of the Training Wall sediment type has shifted between soft mud and sand. Similar shifts in sediment type have also been observed on the east bank of the Great Ouse estuary, with sand banks changing to mud banks and back to sand banks within the space of ca. 2 months. During the latter half of the 1990s there have been considerable improvements to the effluent discharged from Kings Lynn stw, but unfortunately the expected changes in the benthos as a result of this 'clean-up' can not be assessed due to the loss of mud sites on the Training Wall (though bacteriological surveys have shown a large reduction in bacteriological contamination in the lower estuary).

Between 1989 and 1995 the Great Ouse estuary flowed through the easternmost channel shown in Figure 1, to 'Cork Hole'. In 1995 the estuarine section seawards of the Training Wall branched, the east channel as before (to Cork Hole) and a western channel running to the 'Teetotal Channel' opened up (and afforded better navigation at low water). The branching of the estuary resulted in the 't-junction' shown in Figure 1. Since 1995, this 't-junction' has been migrating northwards, cutting into the main sandbanks (Daseley's and Pandora Sands), destroying habitat and re-suspending thousands of

tonnes of sediment. Sampling as recently as September 2001 has shown that the areas affected by the channel migration have still not recovered, the substratum in this area comprises an unstable sandy/muddy 'slop' which is unsuitable for recolonization. The position of the channel in 1994 and 2000 is shown in Figure 1.

Benthic communities encountered in the outer estuary and the SE Wash are typical of fine sands (*Nephtys cirrosa, Tanaissus lilljeborgii, Bathyporeia* spp., *Nephtys hombergi*) and muddy sands (*Nephtys hombergi, Pygospio elegans, Macoma balthica, Hydrobia ulvae, Eteone longa)*. The communities encountered in the SE Wash are less influenced by sewage-derived-organics or by salinity or scour stresses and much more stable over time, though local disturbances are still identified, always a result of bed instability often due to channel changes (but also due to cockle dredging). Localized diverse anomalies are often encountered related to patches of the sand-mason-worm, *Lanice conchilega*. The benthic communities are summarized in Tables 1 and 2.
At the end of the 1990's there was a shift in emphasis in the intertidal sampling programme, with more sampling taking place at greater distances from the unstable channels. These recent surveys have shown that diversity and stability both increase with distance from the main channels, the main influence on the communities being shore height and the type of substratum present.

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Table 1. The top 27 dominant species of the intertidal sites, by total occurrence (numbers per five 0.01m^2 cores

	Total	Occur-rence	Mean	Max
Tubificoides benedii	10544	111	53	1273
Hydrobia ulvae	3019	112	15	1073
Corophium volutator	2977	33	15	1674
Pygospio elegans	2596	94	13	287
Macoma balthica	1895	99	9	234
Nephtys hombergii	918	115	5	73
Eteone longa	918	91	5	137
Cerastoderma edule	617	37	3	344
Cyathura carinata	540	9	3	453
Tharyx spp	448	42	2	77
Nephtys cirrosa	301	39	2	33
Mytilus edulis	278	74	1	37
Tanaissus lilljeborgii	255	33	1	57
Polydora spp	242	9	1	158
Capitella capitata	234	25	1	172
Spio martinensis	231	32	1	40
Phyllodoce mucosa	177	31	1	38
Paranais littoralis	165	11	1	56
Mysella bidentata	159	15	1	49
Scrobicularia plana	146	29	1	24
Lanice conchilega	139	13	1	88
Bathyporeia pelagica	93	10	0	77
Tubificoides pseudogaster	88	15	0	21
Heterochaeta costata	72	11	0	27
Cumopsis goodsiri	67	16	0	18
Heteromastus filliformis	57	9	0	21
Scoloplos armiger	56	19	0	15

Table 2. Mean density (per five 0.01m^2 cores) of the top 27 species by intertidal zone.

	Inner Sites	Train-ing Wall	Outer sites
Tubificoides benedii	19	138	1
Hydrobia ulvae	7	21	18
Corophium volutator	0	14	23
Pygospio elegans	9	27	6
Macoma balthica	3	25	1
Nephtys hombergii	1	8	2
Eteone longa	1	8	3
Cerastoderma edule	0	1	7
Cyathura carinata	0	1	6
Tharyx spp	1	3	2
Nephtys cirrosa	0	0	4
Mytilus edulis	0	2	2
Tanaissus lilljeborgi	0	0	3
Polydora spp	0	0	3
Capitella capitata	0	0	3
Spio martinensis	0	0	3
Phyllodoce mucosa	0	0	2
Paranais littoralis	3	0	0
Mysella bidentata	0	2	0
Scrobicularia plana	0	2	0
Lanice conchilega	0	1	1
Bathyporeia pilosa	3	1	0
Tubificoides pseudogaster	1	0	1
Heterochaeta costata	2	0	0
Cumopsis goodsiri	0	0	1
Heteromastus filliformis	0	0	0
Scoloplos armiger	0	0	1

Figure 1. Features of the SE Wash

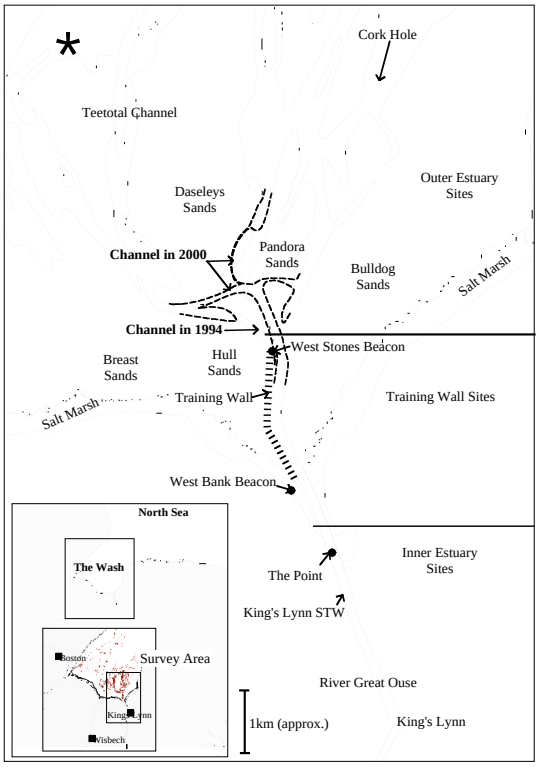
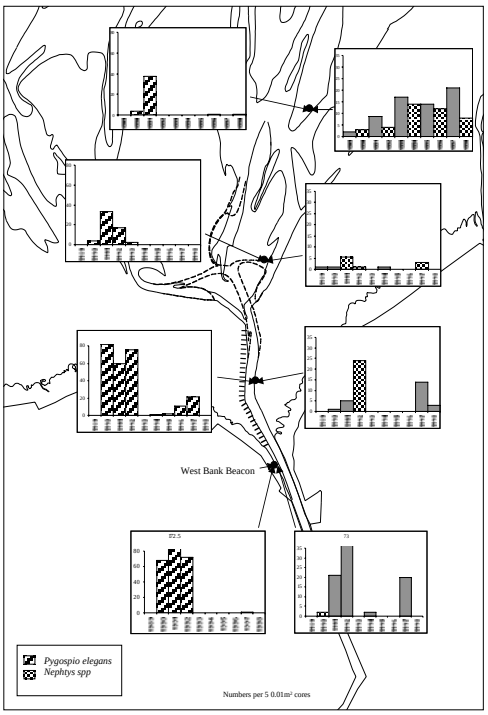


Figure 2. Abundance of Pygospio elegans and Nepthys spp.



Subtidal Benthic Surveys of the Wash in the 1990s

Séamus G. Whyte

Ecomaris Ltd., Red House Farm, Wood Walton, Huntingdon PE28 5YL

Introduction

In August 1999, the Anglian Region of the Environment Agency (EA) commissioned Ecomaris Ltd to undertake a sub-littoral grab survey of the Wash Estuary, a follow-up to surveys undertaken by the National Rivers Authority (NRA) in 1991 and 1993.

All results from 1999 are contained in the full report, Bailey *et al*., 2001, and changes between the three surveys are analysed and discussed.

Methods

In August 1999, benthic grab samples were taken from 32 sites within the sampling grid shown in Figure 1. Samples from all stations (66) were taken in 1991 and 14 stations were sampled in 1993. At each site, three Day grab samples ($0.3m^2$) were collected for the determination of macrofauna. Sub samples were collected for sediment, bacteriological, heavy metals and organic analyses.

Benthic samples were washed over a 0.5 mm sieve and the retained fauna were bottled, labelled and preserved with 5 % formalin solution. In the laboratory, all animals were extracted, enumerated and identified to the lowest practicable taxon, usually species.

Results and Discussion

217 species were identified from 66 sites in 1991, 185 species from 14 sites in 1993, and 200 species from 32 sites in 1999. A full species matrix for all three surveys can be found in Bailey *et al*., 2001.

The sediment characteristics at each station for each year is shown in Figure 2 (visual observations). Only 2 of the 13 sites sampled in all surveys had the same substratum in all years (W42 and W45). Of the 32 sites sampled in 1991 and 1999, 2 had the same substratum in both years (W36 and W56). In the NW section of the grid the change in sediment amounted to a loss of shell and gravel from a sandy substratum (i.e. sediments were more homogeneous in 1999). In the SE Wash along to Hunstanton and at central Wash sites, the substratum was muddier in 1999 than in previous surveys.

Greatest species diversity occurred at deeper sites, which appear stable over time. These deeper sites generally supported higher numbers of individuals, though large numbers of *Phoronis* and Ensis *americanus* (the latter in 1999) were present at shallower sites. Greatest diversity was observed at sites where the 'honeycomb worm' *Sabellaria spinulosa* occurred. Sites where *S. spinulosa* was present in densities greater than 100/0.3m^2 supported, on average, 2.5 times more species and double the abundance compared to sites where *S.spinulosa* was absent or present in low numbers. *S.spinulosa* was associated with an epifaunally-biased community including pycnogonids and mussel spat.

Species diversity and abundance were lowest in the SE Wash, though site averages have fluctuated with no apparent trend; sites in all years were similar (and relatively impoverished).
There has been a general decline in the number of species and individuals at all stations within the Boston channel by 1999.

The benthic community of the Wash was generally typical of a predominantly sandy substratum, dominated by polychaete worms such as *Nephtys hombergii, Nephtys cirrosa*, *Scoloplos armiger*, *Streptosyllis websteri*, *Spiophanes bombyx*, *Pseudopolydora pulchra* and *Pygospio elegans*. Many of these species have shown a decline in numbers in 1999, compared to 1991 and 1993.

The sand-mason worm *Lanice conchilega* was common in patches, and was associated with capitellid polychaetes. Ampeliscid amphipods and the clam *Fabulina fabula* were also typical. The patchy occurrence of ophiuroid brittle stars, correlated with occasionally dense aggregations of their commensal bivalve *Mysella bidentata*. Some muddier stations supported a reduced community dominated by tubificid oligochaetes, the pectinariid polychaete *Lagis koreni* and were commonly associated with the tellinacean clam *Abra alba* and occasionally the immigrant razor shell, *E. americanus*. The most marked changes in 1999 relate to the numbers of *E. americanus*, which was present in extremely high densities, especially at muddy shallow sites in the eastern Wash (Figure 3).

Cluster Analysis

Cluster analyses of the data were performed using the Bray-Curtis similarity index and five cluster groups, illustrated in Figure 4, were identified. The full report uses colour to distinguish cluster groups. Due to the constraints of black & white, the cluster groups are distinguished in Figure 4 using shapes but the colour group names are kept to ease discussion. A full account of the methodology used to distinguish the five cluster groups is given in the full report.

The red-cluster stations are confirmed as those supporting a diverse community characterized by *S. spinulosa* on a presumably stable and coarser substratum with associated epifaunal species (the pycnogonids and mytilids), a variety of polychaetes, notably errant scaleworms and the infaunal *Chaetozone* aff. *setosa* and *S. armiger*, but notably no *Nephtys* species; the characterizing amphipod is *Ampelisca diadema*. These stations lie in a discrete area along the centre of the outer Wash, from station W31 out to the seaward survey limit. Stations from this cluster were hardly sampled during the 1993 and 1999 surveys.

The green-cluster stations support a diverse infaunal community, with similarities to that of the red-cluster but without a significant presence of *S. spinulosa* or its epifaunal associates. This community is characterized by *N. hombergii* with *Eumida bahusiensis*, *S. bombyx* and *L. conchilega* (the tubes of which would be expected to impart a stability to the substratum), *Chaetozone* aff. *setosa* and *S. armiger* (common also to the red-cluster community), *Ampharete lindstroemi*, *Mediomastus fragilis* and the bivalve *A. alba*, also characteristic of both stable communities (red and green clusters) and are not found at other sites. The green-cluster stations are located in the mid Wash, adjacent to the red-cluster area.

Stations of the blue cluster support a less dense *N. hombergii*-associated community, again with *S. bombyx*, *Chaetozone* aff. *setosa* and *S. armiger* (although less dominant here), but also *Spio* spp. None of the remaining characterizing species of the red and blue clusters are typical, *A. alba* being replaced in significance by *F. fabula*, while the cumacean *Pseudocuma longicornis*, the polychaete *Capitella capitata* and the brittle-star *O. albida,* with its possible commensal *M. bidentata,* are typical. This lower density community occurs sporadically outside the previous clusters, more commonly along the Hunstanton side.

The yellow-cluster community is less dense, still with the characterizing spionid polychaetes and *Chaetozone* aff. *setosa* together with *F. fabula*, but with few other species of significant presence. Tanaidaceans (although grouped together, the majority were *Tanaissus liljeborgi*) were typically numerous within this cluster only. The prevailing nephtyid at these stations was *N. cirrosa*. These stations were again peripheral to the Wash, predominantly along the northwestern shore but intermixing with blue-cluster stations in the Hunstanton area. All sites within the yellow cluster had a predominantly sandy substratum. The yellow cluster appears to reflect a reduced version of the blue cluster, with the change in *Nephtys* species dominance, and there is not a clear transition between them.

Figure 4 distinguishes the purple cluster exclusively as 1999 sampled stations. These are stations at which the xenobiotic razor shell *E. americanus* had become predominant, altering the community structure at stations previously in green, yellow and blue clusters, although the characterizing nephtyid here was again *N. hombergii*, and *A. alba* the prevalent tellinacean clam. These stations were predominantly located off the outflow of the River Ouse but one station, W1, was located off the Witham/Welland outflow. *E. americanus* is known to be more tolerant of reduced salinity than its native congeners (I. Killeen, pers. comm.). With the six-year gap between 1999 and the previous sampling period, the progress of *E. americanus*, and the concomitant changes in the associated community, cannot be followed. Changes in the community at *Ensis* dominated sites may be expected to continue.

Station W3, at a shallow site in the vicinity of the Witham/Welland outflow,

has “drifted” from green to blue to yellow over the three sampling periods, indicative of a decline in stability, diversity and density of the community.

The remaining uncharacterised stations are poorly associated, and generally of the sparser *N. cirrosa* community referred to earlier. Within these communities, some small clusterings occur owing to the sporadic appearance of minor species, such as station W60 (1991 and 1993), W9, W28 and W53 (all 1991) (dashed, Figure 21) where *N. cirrosa* and *Spio* spp. are joined by tanaidaceans and *Eteone longa*, or stations W7, W12, W14 and W56 of 1999 (dotted, Figure 21) where the same two dominants are associated unusually with *Magelona mirabilis* and *Bathyporeia elegans*. However, these groupings are not considered significant, rather they are stochastic groupings within sparse and thus poorly characterized stations/samples. These stations would appear to be the most heterogeneous in both space and time.

References

Bailey, M., Bamber, R.N., Coad, P. and Whyte, S.G. (2001). Analysis of sublittoral benthic samples from the Wash estuary 1991-1999. Contract report by Ecomaris Ltd. for the Environment Agency; Anglia region.

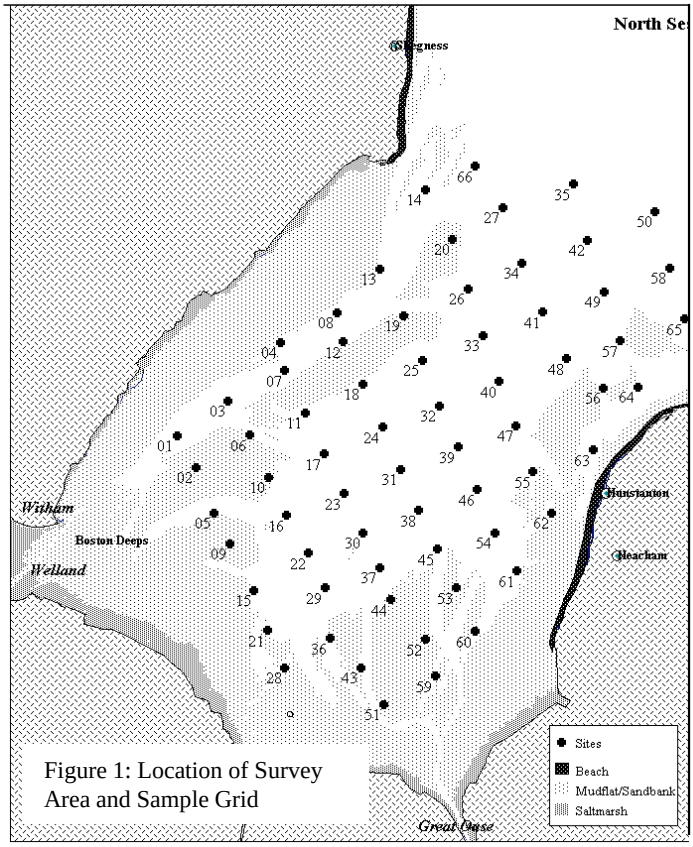


Figure 1: Location of Survey Area and Sample Grid

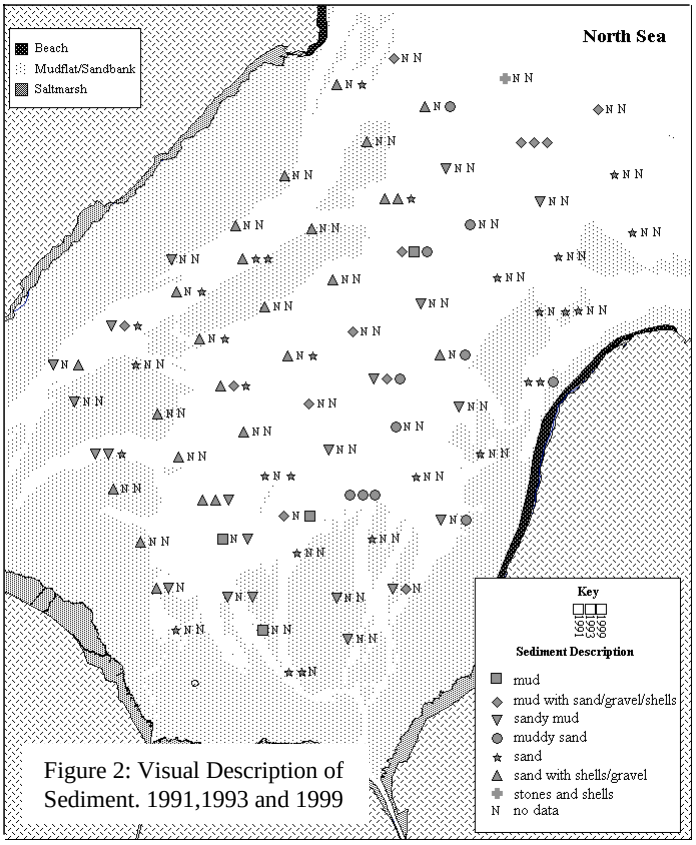


Figure 2: Visual Description of Sediment. 1991,1993 and 1999

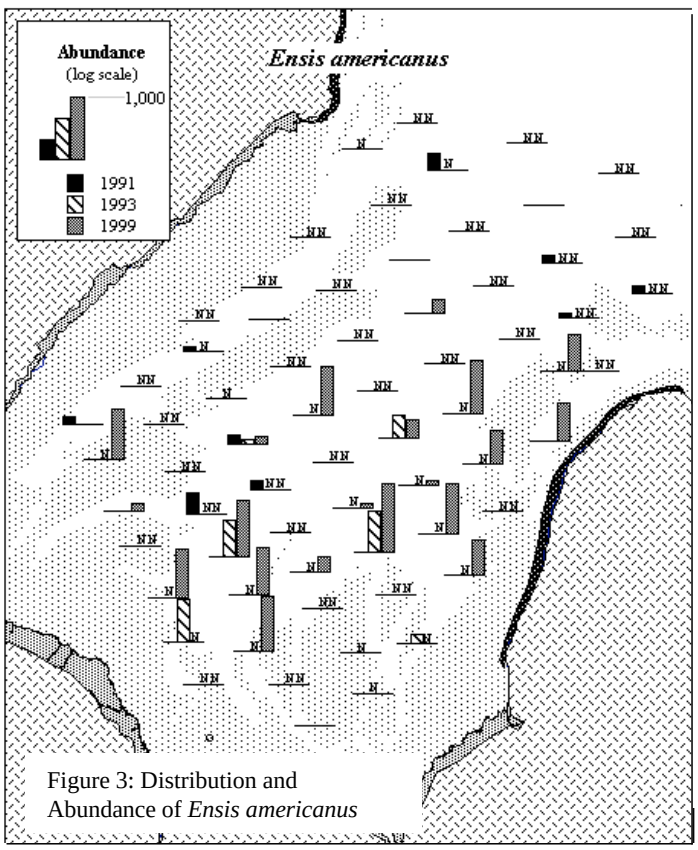


Figure 3: Distribution and Abundance of *Ensis americanus*

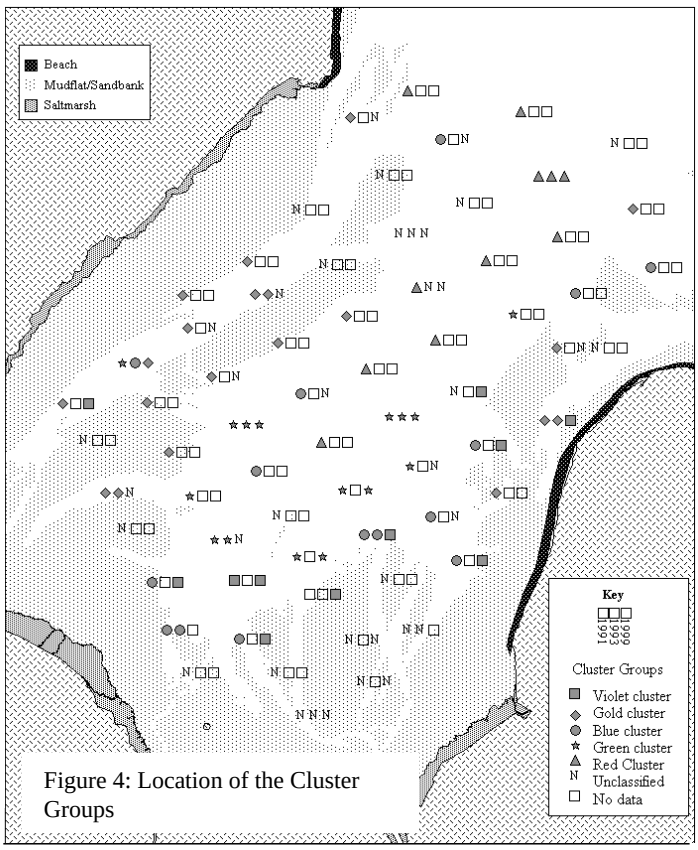


Figure 4: Location of the Cluster Groups