PORCUPINE MARINE NATURAL HISTORY SOCIETY

NEWSLETTER

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Porcupine Marine Natural History Society

Newsletter

No. 8 July 2001

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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

Following the excitement of the Annual meeting and the AGM, things have gone a little quiet on the Porcupine front. A very successful and enjoyable weekend field trip to Dorset was organised by Peter Tinsley – see report later on. The weekend proved useful on two counts; recording (one of the main aims of Porcupine) and 'training'. Those with less marine recording experience said they found it very useful to go onto the shore with 'old hands' and especially to have a chance to identify material in a laboratory afterwards. We will be discussing this element at the next council meeting as I believe this 'teaching' element played a large part in the success of the weekend.

It has proved difficult to persuade speakers from the March meeting to write up their presentations for the newsletter and this issue only carries two further papers. It is hoped to do better than this in the November/December issue! If you are one of the speakers, I would very much appreciate your contribution! As usual, I would also welcome any other contributions to the newsletter. Don't be shy – get writing and recording. We have had some records come in for the Recording Scheme but there must be many of you out there who have something interesting to send us. If so, please do!

OBITUARY

It was with great sadness that we received the news of the death of long-standing Porcupine member Gil Green, who died suddenly in May. Gil was an active and enthusiastic member of both Porcupine and the Marine Conservation Society. A familiar figure at our annual meetings, he will be sorely missed. Our sympathy and thoughts are with his wife Betty and his family.

Summary of Council Meeting Minutes

There have been no meetings since the March 17th Council Meeting and AGM held at Brampton and reported in Newsletter No. 7 (March 2001).

PMNHS Chairman, Julia Nunn, addressing the 2001 AGM at the Environment Agency, Brampton. Photo by Frank Evans.

COPY DEADLINES

Sept 1st for Oct/Nov issue

Feb 1st for March/April issue

MEETINGS, MEETINGS, MEETINGS, MEETINGS, MEETINGS

PORCUPINE MEETINGS

PORCUPINE 2002: 'The Marine Natural History of the North East Atlantic' (In celebration of Porcupine's 25th anniversary.)

Date: Thur 14-Sat 16TH March 2002

Venue: National Museum of Scotland, Edinburgh.

Organiser: Dr Susan Chambers; National Museums of Scotland, Chambers St., Edinburgh, EH1 2JF. E-mail: s.chambers@nms.ac.uk.

The theme of the meeting reflects the underlying interest and 'raison d'etre' of Porcupine. There will be a session on 'Changes in marine natural history over the last 25 years'. Papers on any aspect of marine interest in the NE Atlantic are particularly welcome but, as usual, presentations from other areas around Britain, Europe and the world are welcome. Offers of papers should be made ASAP.

It is also hoped to obtain a print of an old Jacques Cousteau movie to screen once the talks have finished for the day. The Lumiere is an arthouse cinema who screen films at the museum and may be able to organise this, funds permitting.

There will be a field trip on Sat 16th March to Dunbar (marine people) and to Tyninghame saltmarsh, Belhaven burn and lagoon (brackish people).

Details of speakers, costs etc will be in the next newsletter.

OTHER MEETINGS

2-6 August. 7th International Polychaete Conference. Reykjavik, Iceland. Contact: www.ni.is/7ipc

7 August. Achievements of the Continuous Plankton Recorder Survey and a vision for its future. Royal College of Physicians, Edinburgh. Contact: jama@dml.ac.uk and www.npm.ac.uk/sahfos/cprsymposium.htm

19-21 August. The 7th Circumpolar University Co-operation conference. When Distance is a Challenge. Tromso, Norway. Contact: Frits.Jensen@arctic.uit.no and www.arctic.uit.no/cua

20th October. Marine Conservation Society Annual Conference. The confirmed programme and venue will be available at www.mcsuk.org or from the MCS office 01989 566017

21-25 October. 7th International Conference on Coelenterate Biology (ICCB) Annual European Meeting of the International Society for Reef Studies. Eilat, Israel. Contact: team4@congress.co.il and www.congress.co.il

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 first announcement and call for papers for this meeting can now be downloaded from the following site:
www.jiscmail.ac.uk/files/IYOR-UK/

GRANTS and PROJECTS

Royal Irish Academy, Praeger Committee for Field Natural History.

Provides grants of up to £1000 each for field work relevant to the natural history of Ireland. Grantees need not be based in Ireland. Applications are particularly welcome from amateur natural historians. Contact: Ms Sara Whelan, Secretary Praeger Committee, Royal Irish Academy, 19 Dawson St., Dublin 2. Tel: (01) 6764222. E-mail: admin@ria.ie

MUMM – Management Unit of the North Sea mathematical Models.

SUMARE (Survey of marine Resources) is essentially an artificial intelligence project aimed at facilitating underwater monitoring. The project is developing low-cost, reliable autonomous vehicles (AUVs) fitted with intelligent, self-adaptive, platform-independent mission management software and capable of executing complex surveys. The project focuses on the development and use of two different robots (MAUVE and PHANTOM). Details of the project are available on: www.mumm.ac.be/SUMARE/ or contact Georges Pichot on +32 2 773 2111 (Brussels); e-mail: G.Pichot@mumm.ac.be

REPORTS

Porcupine Field Trip , Isle of Purbeck, Dorset, May 5-6th 2001.

Frances Dipper

If you have never been on a Porcupine field trip, then book onto one now! At least, that's what I felt after the weekend in sunny Dorset organised by Peter Tinsley. Peter had arranged both diving and shore trips and whilst he braved the distinctly chilly waters with around 8 other divers, we met up at the Redend carpark at Studland Bay. My first triumph! I had a NT card and so did not have to pay for the car park…. twelve of us then set off down onto the shore. Our first surprise – a strandline consisting of a thick squelchy, slippery mass of rotting seaweed at least a foot thick; carved and sculptured along its edges like sand by the tide. Good deed for the day – rescued a small boy's welly boot from amidst the slime. This strand extended right along the sandy beach between the 2 carparks at Studland, to the point where the shore turns east and the white cliffs leading to 'Old Harry' begin. Our second surprise came well before this, as we gingerly rounded Redend Point on a not yet very low tide. The red sandstone cliffs here are pock marked and peppered with small holes – a housing development for miniature solitary bees.

A welcome picnic below the white chalk cliffs, and then on to the serious business of recording. The extensive chalk platform here supports a wide variety of algae and Nettie Little was kept busy helping with identifications; having a real expert with us means our species list will be extra long! Many of our group had done little in the way of marine recording and this was a great opportunity to introduce them to the

concept of marine biotopes and MNCR style recording. Returning along the beach, the double tide finally rewarded us with a glimpse of an excellent *Zostera* bed in the sand beyond the chalk, populated by large, dopey spider crabs (*Hyas araneus*). The low tide also revealed live masked crabs (*Corystes cassivelaunus*) in the sandy beach around Redend Point.

After a quick detour with Nettie and David Little to watch Dartford warblers up on the heath, we met up with the diving group in the Field Studies Centre at Langton Matravers. Here we had an excellent laboratory with microscopes etc and a chance to wander round the beautiful grounds, avoiding (mostly) a well-aimed bombardment from a large rookery. A meal and a well-earned beer (or six) rounded off an excellent day.

The Sunday saw us meeting up at Kimmeridge Bay car park and another excellent days recording on the very different rocky platforms that make up the famous ledges. Rock-pooling was the order of the day with shannies and clingfish making star appearances. However, the seaweeds again win over everything else with excellent examples of many common algae-dominated biotopes, including large pools dominated by *Sargassum muticum*, and others with beautiful tufts of day-glow *Cystoseira*.

A final meal and (even) more beer and chat, ended a superb weekend in true Porcupine style. Interestingly, Porcupine members were in the minority over the weekend, with participants from Dorset Naturalists Trust, English Nature and others. We were delighted to see them. Hopefully there will be a 'scientific' report on both the shore excursions and dives in a future newsletter. Meanwhile a big THANK YOU to Peter Tinsley for organising such a successful trip.

.

PORCUPINE PIECES

More on Mantis Shrimps

Jenny Mallinson

S.O.E.S., Southampton Oceanography Centre, SO14 3ZH (jxm@soc.soton.ac.uk)

Following an interest in mantis shrimps (*Rissoides desmaresti*), inspired by Rohan Holt's poster at the Bath Marine Conservation Society Annual Conference last year, I believe they are more common than previously thought. They are poorly represented in the popular identification guides and invariably quoted as 'Mediterranean only'. They are illustrated and described in the Hamlyn and Collins Guides to the Seashore under the older names of *Squilla* or *Meiosquilla desmaresti*.

We have known for many years of a small population in the Solent from isolated specimens that are picked up from time to time. On 30th April 2001, Calshot fisherman, Nick Weeks brought me a live specimen that he found in a trawl from Calshot Roads, together with a dozen large pout (*Trisopterus luscus*) and 10 starry smooth hounds (*Mustelus asterias*) for feeding my aquarium animals.

I found 3 mantis shrimps in the stomach of the largest smooth hound (a one metre long female) and one in another smaller one. Even the pout were not innocent of eating these 'rare' crustacea, 3 of them had the characteristic spiny tail section in their stomachs. The rest of their diet appeared to consist mainly of hermit crabs (*Pagurus bernhardus*) plus squat lobsters (*Galathea ?squamifera*.), hairy crabs (*Pilumnus hirtellus*), swimming crabs (*Necora puber* and *Liocarcinus depurator*), spider crabs (*Macropodia* sp.), isopods (*Idotea* sp.), shrimps (*Crangon crangon*), squid (*Sepiola* sp. and *Aloteuthis* sp.?) and small, mostly unrecognisable fish.

This just illustrates (as we keep trying to say) how little is known of what is really under the sea, which species are common and which are not. This also confirms another theory I have held for many years on distribution of species: If the scientist doesn't know, ask a fisherman. If the fisherman doesn't know, ask the fish – they certainly do!

References

Campbell, A.C. (1982). *Hamlyn guide to the Seashore and Shallow Seas of Britain and Europe.* Hamlyn.

Haywood, P., Nelson-Smith, T. and Shields, C. (1996). *Collins pocket guide Sea Shore of Britain and Northern Europe.* Harper Collins.

'Shrimp preys on unwary fishermen'

Frances Dipper, Hon Editor

Receiving Jenny Mallinson's article on mantis shrimps reminded me of a newspaper cutting I tore out of the Sunday Telegraph January 31 1999, titled as above. A short article described how increasing numbers of mantis shrimp (*Rissoides desmaresti*) were being found in fishermen's nets, around Southampton. Apparently 5 specimens were taken to the Sealife Centre in the 'past two months' of 1998 (presumably November and December), compared with two throughout 1997. The author of the article claims that: "*Rissoides desmaresti* is now classified as a British native". It appears in the MCS and Ulster Museum Species Directory of the Marine Flora and Fauna of the British Isles. So how long has it been here? Long enough to be called a 'native'? Comments and observations to me please for the next newsletter!

The Porcupine Recording Scheme: progress and results

Jon Moore

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

The recording scheme is developing gradually, as members realise that it exists and that it is a useful depository of occasional records of interest. It is intended that an article on the received records will be written for each newsletter.

First off is an observation by Bob Earll of some interesting behaviour in the northern urchin *Strongylocentrotus droebachiensis* in Shetland last August. Many of these urchins were seen during a dive off the Out Skerries, and most of them were closely aggregated on top of several boulders. They did not appear to be spawning, but no other reason for the aggregations is known. Any suggestions? Bob has photographs.

Following the records of sunfish *Mola mola* on the south coast of England reported in the last newsletter, David Moss has sent me another record for August last year from the Isles of Scilly (south of St. Mary's). I am jealous because I have still not seen one of these occasional visitors to our waters. I would like to remind readers that Doug Herdson at the National Marine Aquarium, Plymouth (Douglas.herdson@national-aquarium.co.uk), is currently collating sunfish records for a special report. He already has over 200 records dating from early this century up to the present, and he would be pleased to receive any more (old or new) that you can send to him.

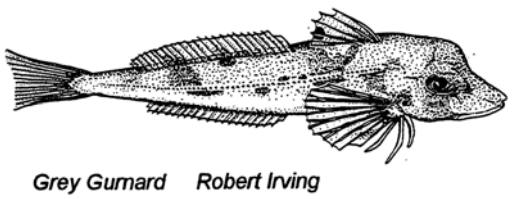
Now a couple of uncommon records from Swanage Bay, Dorset, sent to us by Jane Lilley. First, a large (1m long) painted ray *Raja undulata*, on a maerl bed in 20m. Apparently they are not often seen in such shallow water, but I know from personal observation and received wisdom that large rays sometimes come into shallow water when they are in poor health. This individual was not easily disturbed, even with survey work in progress a few inches from it. Secondly, an imperial anemone *Aureliania heterocera* at a nearby site. For a primarily west coast species (the MNCR database has records from Lundy to the north-west Scotland sea lochs, and a couple of records from the western English Channel) this is an unusual record, but a local population is apparently known for this area. Is it pushing further into the Channel?

Finally, two fish records from Southampton Water taken by Jenny Mallinson: a grey gurnard *Eutrigla gurnardus* collected in a beam trawl off Netley and two sea snails *Liparis liparis* trawled from the *Crepidula* bed near Coronation Buoy. Both species are widely distributed around the south and west coasts of Britain, but are not often recorded. Jenny has also been collating further records of mantis shrimp (see separate article in this issue).

Other records in short: *Boscia anglica* (=*Pyrgoma anglicum*) on *Caryophyllia smithii* in Poole Bay; dogwhelks (*Nucella lapillus*) at 25m depth on *Sabellaria spinulosa* reef in Swanage Bay; large white specimens of *Calliostoma zizyphinum* in Swanage Bay.

Thanks to: Bob Earll, David Moss, Jenny Mallinson, Jane Lilley, John Cross

Please keep the records coming!



Grey Gurnard Robert Irving

' 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

Natural Variations in the Peracarids of a Sandy Beach Community Over Eleven Years

Roger Bamber

Natural History Museum, Cromwell Rd., London SW7 5BD

The infaunal community of a sandy beach on the Solent Coast of Hampshire, UK (Stanswood Bay), has been monitored monthly for eleven years (Bamber, 1992; 1993a, b). After a preliminary survey in August 1987, the regular sampling began in January 1988. At the site, at LWST - +0.6 m CD, quantitative samples have been collected of the macrofauna retained by a 0.5 mm sieve, together with measurements of salinity, water temperature and granulometry.

The substrate is typically 95% sand with no gravel fraction. Salinity was stable around 35‰. The annual temperature cycle is shown in Figure 1, and the monthly deviations from their five-year means (1987 to 1991) in Figure 2. 1989 and 1990 were warmer years, as were 1994 (the warmest) and 1995.

The community is dominated by classic psammophilous polychaetes and peracarids. The full species list is shown in Table 1. The community is characterized by nephtyid, maldanid and spionid polychaetes and by bathyporeid and oedicerotid amphipods.

Multivariate analyses of the numeric data showed a significant predation-related trend with time in the structure of this community: the serendipitous appearance, and subsequently dense population, of the polychaete *Nephtys cirrosa*, caused a decline in putative prey species (including the tanaidacean *Tanaissus lilljeborgi* and the amphipod *Ampelisca brevicornis*). With the stabilizing of the *N. cirrosa* population, this baseline time-trend stopped after 1991 (Bamber, 1993b).

The second most significant trend in the earlier years involved changes in the dominance structure of the community in response to warmer summers. Species of a more northern zoogeography, notably the dominant amphipod *Bathyporeia sarsi*, showed a population collapse during the warm years of 1989 (this whole year having a mean temperature 0.94°C above the 5-year average), 1994 (+1.06°C) and 1995 (+0.87°C). This community trend showed a reversal towards the 1988 condition during the interim (Bamber, 1993a).

The third notable trend in the community involved a seasonal cycle with recruitment commonly in summer - autumn months. The baseline trend of the population was thus expressed by the winter community structure.

With the progression of the study, the effect of the appearance and predatory activity of *Nephtys cirrosa* has diminished in dominance, and other "noise" in the community has become "louder", particularly as shown by the peracarid crustaceans.

Overall, sporadic changes appear to be the norm, such as the novel appearances in 1989 of the amphipod *Megaluropus agilis* which has persisted in the community (Fig. 3), and in spring 1992 of a third species of *Bathyporeia*, *Bathyporeia pelagica*, in high numbers initially followed by its disappearance over the following year and subsequently only sporadic appearance (Fig. 4); conversely, the initially dominant amphipod *Ampelisca brevicornis* has been recorded only sporadically since the spring of 1989 (Fig. 5), attributed to predation by *Nephtys cirrosa*. The commoner cumaceans *Pseudocuma longicornis* and *Cumopsis goodsiri* with a highly seasonal peak of occurrence in late Autumn, showed substantial population increases in the warm years of 1989 and 1990, but have not repeated this pattern in 1994-1995 (Fig. 6).

These apparently random variations are attributed to stochastic settlements of species new to the community often leading to competitive exclusion of other species with time. Given the stability of environmental factors such as granulometry and salinity, these changes in the community, either persisting (*A. brevicornis*), increasing (*M. agilis*), or ephemeral (*B. pelagica*), give an unpredictable dynamism to the community. Thus longer term patterns controlled by edaphic or climatic factors, other than the temperature effect on northern species discussed above, are not apparent in this biologically-controlled community structure.

The recurrence of warm conditions during the mid 1990s has allowed verification and more detailed interpretation of the effect on the "hypothermal" *Bathyporeia sarsi*. The population shows two peaks of abundance, a "spring peak" in February-March, and a "summer peak" in May-June, attributed to recruitment. Therefore, temperature effects on these peaks will relate to the overwinter temperature and the late spring temperature respectively.

The summer peak shows no correlation to late spring temperature deviation, only to the size of the spring peak: therefore the temperature deviation of warm years does not directly affect recruitment (Fig. 7).

The spring peak shows a significant negative correlation to overwinter temperature deviation (November to March), but is also affected by the size of the previous year's recruitment (Fig. 8).

The best fit of the *B. sarsi* population data is expressed by:

$$Spr = Psu * (5.87 - 7.6752\ \Delta T)$$

Where Spr is the spring peak, Psu is the previous summer peak, and ΔT is the aggregate temperature deviation from the 1987-1991 mean over the months November to March ($r^2 = 0.634$; $p < 0.02$).

As recruitment is correlated with adult numbers, we may conclude that individual fecundity is not inhibited by higher temperature.

Therefore, the temperature effect on *Bathyporeia sarsi* results in an overwinter reduction of breeding adults, attributable either to reduced survival to maturity or to emigration away from the area during warmer winters (presumably in a northerly or easterly direction). That the summer peak, at a warmer time of year, is unaffected by temperature, is unaccountable, but may imply differential physiology between different generations.

References

Bamber R N, 1992. Time, tide and Calshot Beach. *ECSA Bulletin*, **10**; 14.

Bamber R.N. 1993. Changes in the infauna of a sandy beach. *J. exp. mar. Biol. Ecol.*, **172**; 93-107.

Bamber R.N., 1993. The structuring of a sandy beach community by *Nephtys cirrosa* Ehlers. *Polychaete Research*, **16**; 37-40.

		Mean			Mean
		per m^2			per m^2
1	**Bathyporeia sarsi**	441.0	36	**Idotea linearis**	2.5
2	*Spio martinensis*	240.7	37	*Eteone longa*	1.6
3	*Euclymene oerstedi*	211.7	38	*Loripes lucinalis*	1.5
4	*Bathyporeia guilliamsoniana*	184.0	39	*Magelona mirabilis*	1.3
5	*Perioculoides longimanus*	175.9	40	*Atylus swammerdami*	1.0
6	*Pontocrates arenarius*	113.4	41	*Scolelepis foliosa*	0.8
7	*Megaluropus agilis*	88.7	42	*Diastylis* juvenile	0.8
8	*Tanaissus lilljeborgi*	79.9	43	*Ensis ensis*	0.7
9	*Pygospio elegans*	72.4	44	*Nucula nitidosa*	0.6
10	*Bathyporeia pelagica*	71.4	45	*Arenicola marina*	0.6
11	*Nephtys cirrosa*	69.5	46	*Corophium crassicorne*	0.5
12	*Scoloplos armiger*	67.7	47	*Tubificoides maureri*	0.4
13	*Leucothoe incisa*	54.2	48	*Parougia* sp.	0.4
14	*Urothoe poseidonis*	49.6	49	*Apherusa ovalipes*	0.4
15	*Aricidea minuta*	44.4	50	*Retusa truncatula*	0.3
16	*Cumopsis goodsiri*	40.3	51	*Erichthonius punctatus*	0.3
17	*Clymenura leiopygos*	37.5	52	*Nephtys caeca*	0.3
18	*Exogone hebes*	36.9	53	*Orbinia latreilli*	0.3
19	*Lanice conchilega*	36.3	54	*Corystes cassivelaunus*	0.3
20	*Hersilioides latericeus*	32.6	55	Nemertean indet	0.3
21	*Pseudocuma longicornis*	30.8	56	*Poecilochaetus serpens*	0.2
22	*Spiophanes bombyx*	23.0	57	*Tanaopsis graciloides*	0.2
23	*Chaetozone christiei*	20.7	58	*Paragnathia formica*	0.2
24	*Ampelisca brevicornis*	19.8	59	*Glycera alba*	0.1
25	*Streptosyllis websteri*	17.9	60	*Achelia echinata*	0.1
26	*Nephtys hombergi*	17.4	61	*Sphaeroma serratum*	0.1
27	*Dexamine spinosa*	13.6	62	Lyssianassid sp.indet.	0.1
28	*Capitella capitata*	10.1	63	*Bodotria scorpioides*	0.1
29	*Microprotopus maculatus*	9.4	64	*Anoplodactylus petiolatus*	0.1
30	*Pontocrates altamarinus*	8.9	65	*Spisula elliptica*	0.1
31	*Pariambus typicus*	8.7	66	Copepod gen & sp nov	0.1
32	*Iphinoe trispinosa*	7.6	67	*Molgula occulta*	0.1
33	*Cerastoderma edule*	6.9	68	*Spadella cephaloptera*	0.1
34	*Malacoceros fuliginosus*	3.6	69	*Eteone picta*	0.1
35	*Phyllodoce maculata*	2.6			

Table 1. Species recorded from Stanwood Bay Beach ranked in order of mean density.

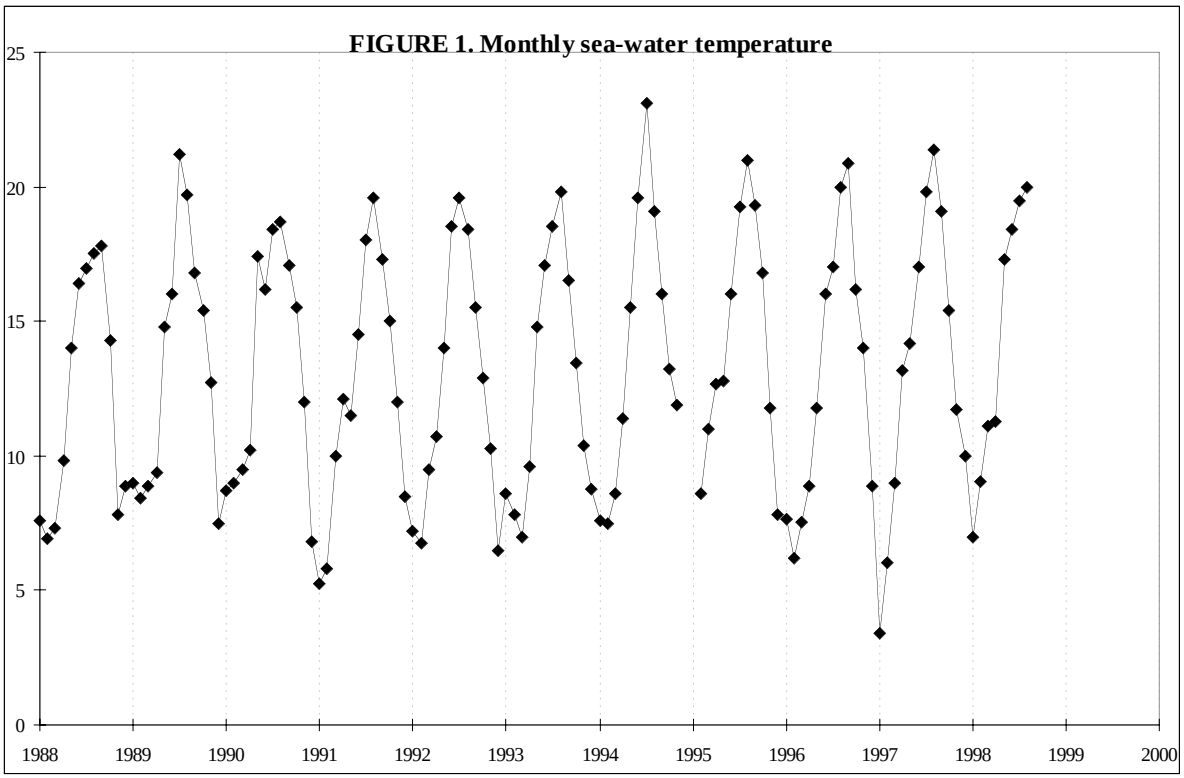


FIGURE 1. Monthly sea-water temperature
25
20
15
10
5
0
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000

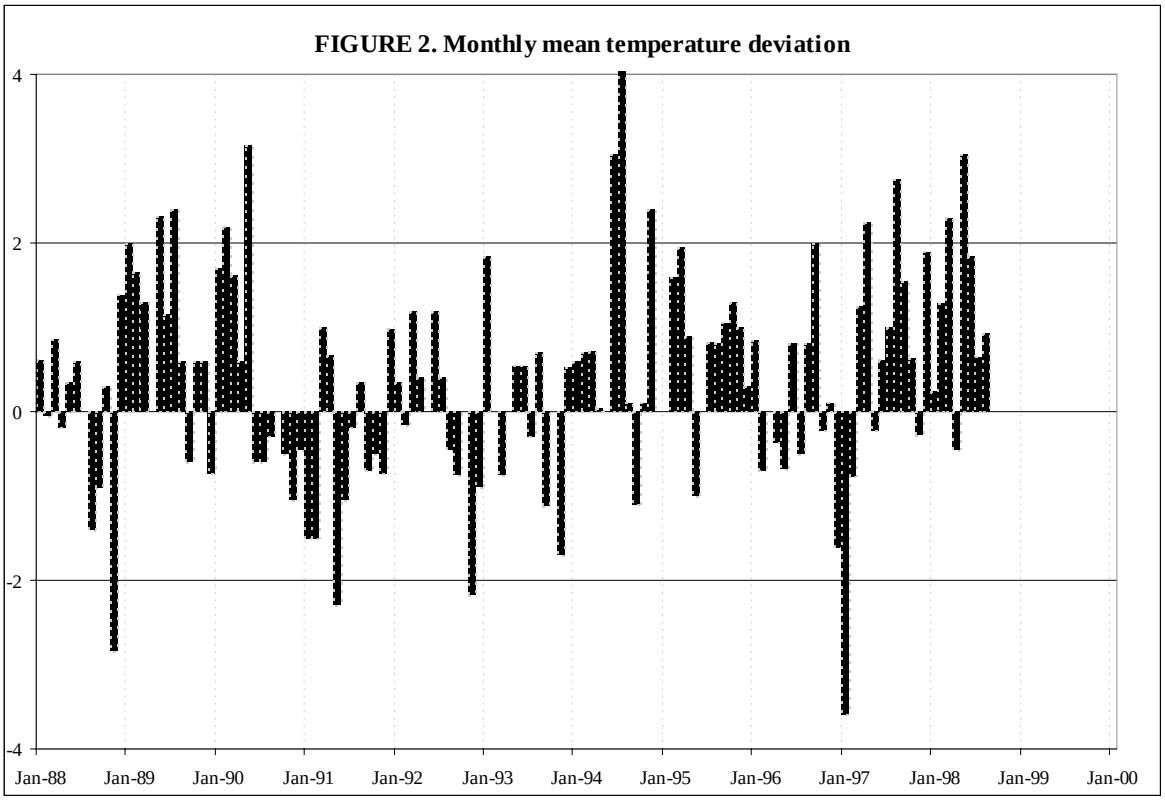


FIGURE 2. Monthly mean temperature deviation
4
2
0
-2
-4
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00

FIGURE 3. Monthly densities of*Megaluropus agilis*

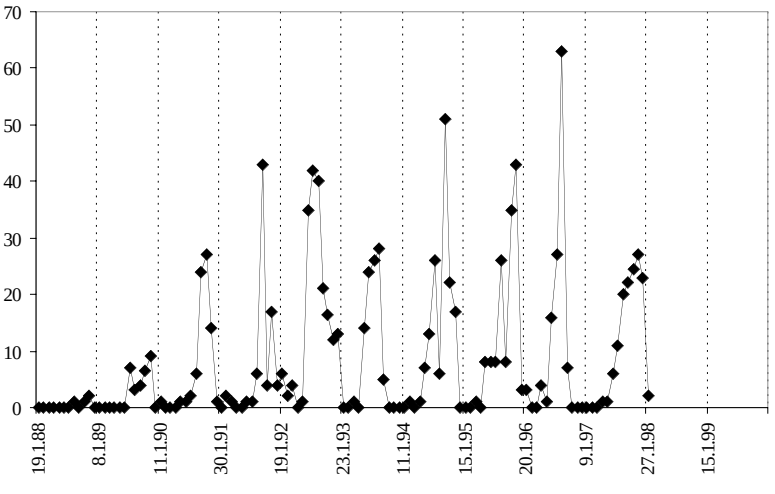


FIGURE 4. Monthly densities of*Bathyporeia pelagica*

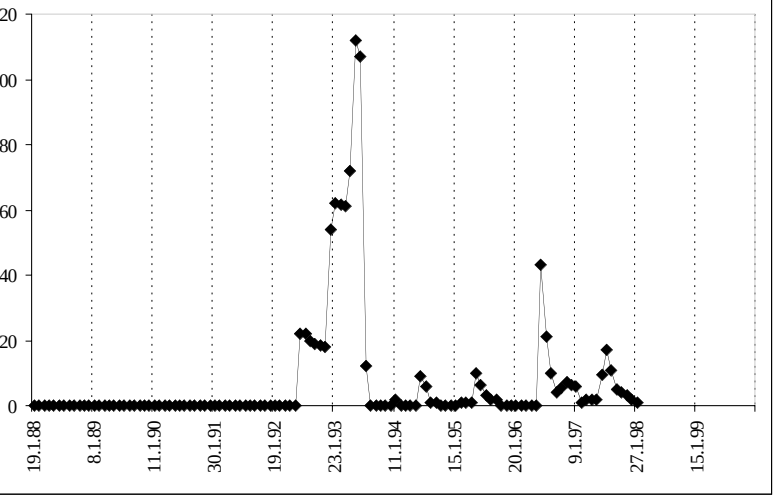


FIGURE 5. Monthly densities of*Ampelisca brevicornis*

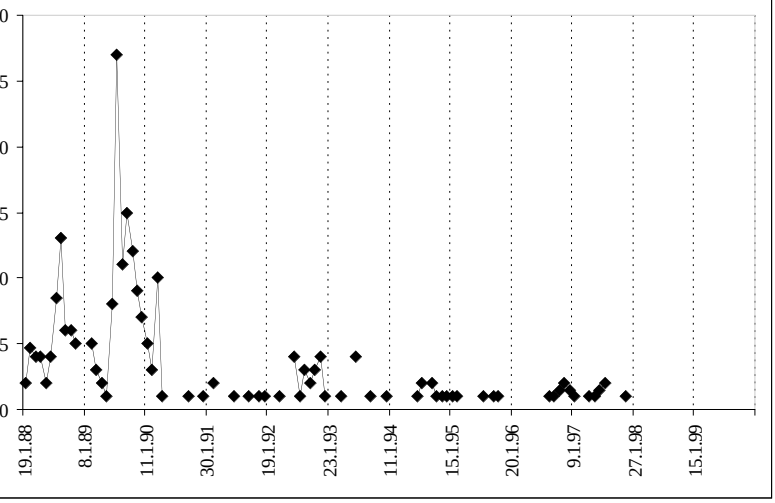


FIGURE 6. Monthly densities of the cumacean *Pseudocuma longicornis*

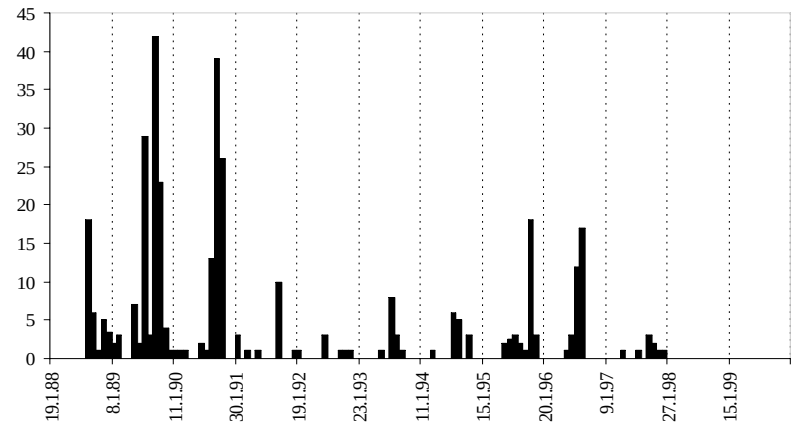


FIGURE 7. *Bathyporeia sarsi* , Summer Peak v. Spring Peak

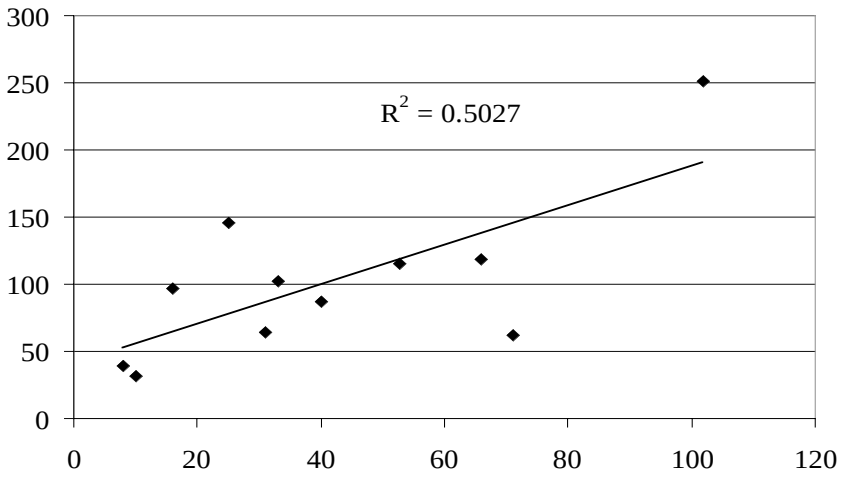
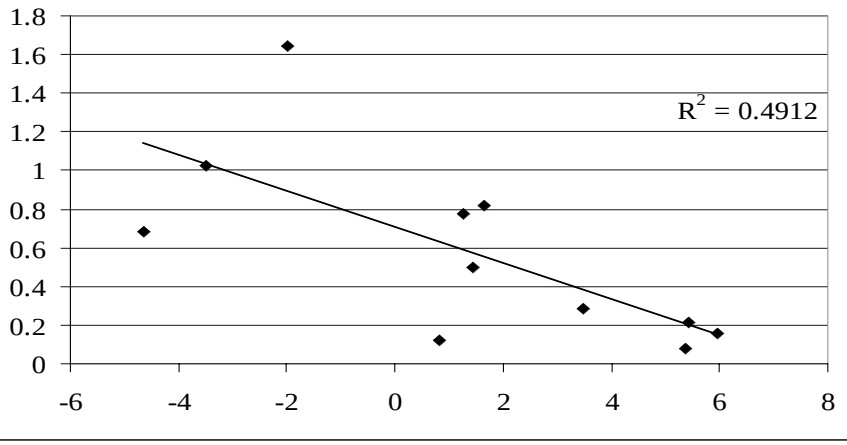


FIGURE 8. *B. sarsi* Spring Peak/Previous Summer Peak v. delta T



Monitoring of Heavy Metals in the Humber Estuary using *Fucus vesiculosus*

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Introduction

Following the establishment of a benthic monitoring programme for the Humber Estuary the biological work was extended to include bioaccumulation components. Arguably the most successful of these has been the monitoring of heavy metals using *Fucus vesiculosus*. The first survey took place in September 1981, and results from early work were published during the eighties (Barnett & Ashcroft, 1985; Barnett et al 1989). This paper considers the long –term trends for three metals [Iron, Zinc and Cadmium] over the two decades of monitoring.

Methods

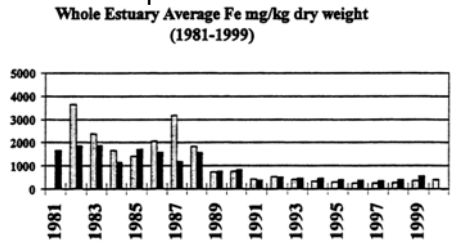
Sampling is undertaken at ten sites along the south bank of the estuary, from approximately 3 km upstream of the Humber Bridge (the low salinity limit of *Fucus* distribution), to Cleethorpes at the seaward end. Details of methods and site locations are provided in the papers referred to above, although it should be noted that analytical methods changed in the early nineties. [Micro-wave digestion was adopted, and AAS was replaced by ICP instrumentation].

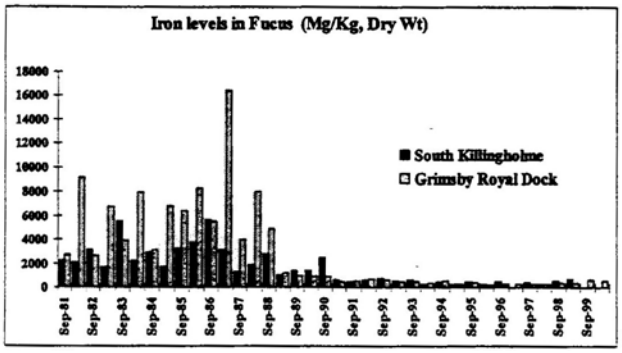
Results and Discussion

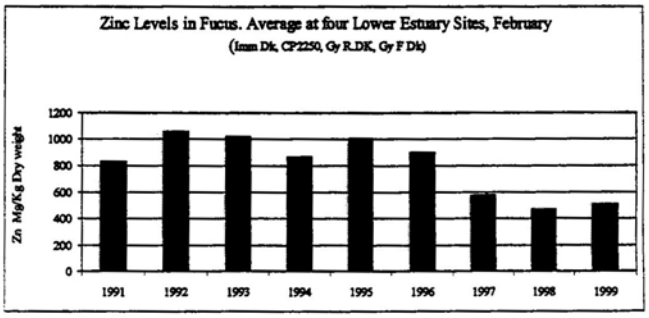
To provide a synoptic overview for the estuary as a whole, a single value for each sampling occasion is derived from the average tissue concentration from all (ten) sites. Changes recognisable at this level represent a major change in inputs to the system. More localised changes (of smaller magnitude) can be illustrated by taking the average value for a small group of sites in the appropriate part(s) of the estuary, and examining the resultant time-series. An alternative means of identifying changes is to examine the spatial distribution pattern for the ten sites, from different years during the monitoring period. This approach not only reveals changes in the recorded concentrations, but enables those areas where the greatest change has occurred to be identified.

Iron

Iron is not normally accumulated in *Fucus* because it forms 'unavailable' complexes with the various ions in sea-water. However, the Humber has been the site of two very large discharges of acid-iron waste. The nature of these effluents causes iron to remain in solution for extended periods and thus be available for uptake. In 1988 new discharge arrangements were implemented and the "whole estuary average" values declined from 1000-2000mg/kg throughout the eighties, to concentrations generally below 500mg/kg throughout the nineties. As might be anticipated, results for the two sites closest to these discharges show an even more pronounced difference for the two periods. During the period up to 1988 iron concentrations were seldom lower than 2000mg/kg and regularly exceeded 4000mg/kg. From 1989 onwards, values rarely exceeded 1000mg/kg and throughout the mid and late nineties concentrations were typically around 500mg/kg or less. The very clear demonstration of much reduced levels of iron in *Fucus* not only illustrates the implementation of the new discharge arrangements, but also endorses the considerable value of the technique.



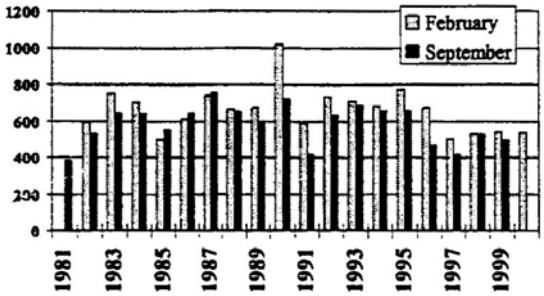




Zinc

In addition to the effluents considered above, the lower part of the Humber has also been the receiving environment for one of the largest discharges of zinc in the U.K. During the mid 1990's the company concerned was required to establish a reduction programme for this discharge. Examination of the "whole estuary average" plot suggests that zinc levels have been generally lower in the late nineties than in previous years, but the pattern is not entirely distinct. [Unlike the case for iron, the nature and magnitude of change(s) would be unlikely to produce a significant change in zinc levels on an 'estuary-wide' basis]. By considering four lower estuary sites which historically showed high levels of zinc, it can be seen that averaged values for the most recent years (97-99) do not exceed 600mg/kg, in contrast to the period 1991-96, when values of 800 to 1,000mg/kg were recorded. These changes indicate that the zinc reduction programme has been successful, although further monitoring is clearly required to confirm this initial indication.

Whole Estuary: Average Zn mg/kg dry weight (1981-2000)

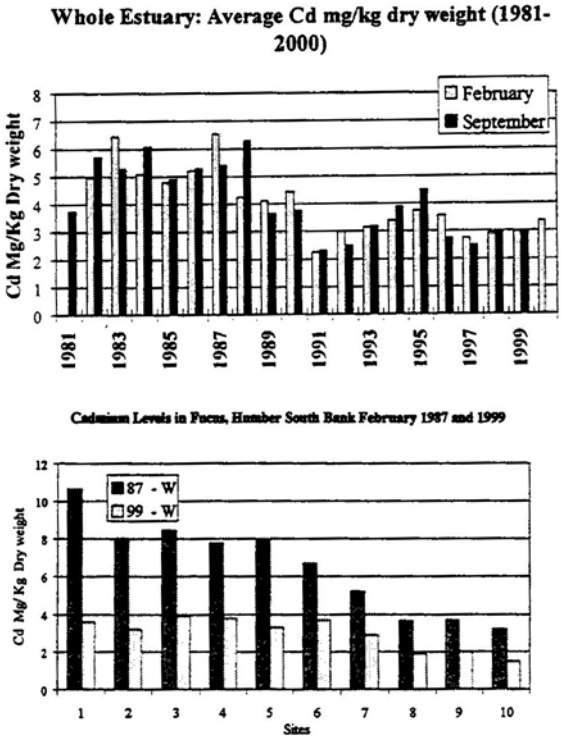


Cadmium

Unlike iron and zinc, direct inputs of cadmium to the Humber have not been previously identified. Early published work recognised that elevated levels of cadmium in the Upper Estuary probably reflected inputs of this metal via the tidal rivers (Trent & Yorkshire Ouse), and the discharge from the Capper Pass smelting works on the upper reaches of the N. bank of the Estuary. Plots of the "whole estuary average" values suggest that the tissue concentrations of cadmium have been lower during the nineties than in the preceding decade. This observation can be further examined by looking at the distribution pattern for the ten routine sites in the late eighties, and contrasting this with the most recent available pattern (1999).

The pattern shown in the late eighties (1987) is representative of the pattern seen throughout that decade, with higher concentrations at the upstream end progressively declining in a seawards direction. {classical "conservative behaviour" for riverine contaminants}. By the end of the nineties it can be seen that this slope is no longer particularly evident, with lower concentrations throughout the Estuary, but with the greatest reductions apparent in the uppermost part of the system. This change in patterns confirms that the principal sources of cadmium were in the upper estuary/tidal rivers, and that considerable reductions in inputs of this metal have been achieved.

Once again, the technique has been effective in identifying important and encouraging trends.



Overall comments & conclusion

Long-term monitoring of heavy metals in the Humber using fucoid algae has been an effective method of demonstrating environmental improvements resulting from the reduction in discharges of certain heavy metals. Recognition of the effectiveness of the technique may be almost as important as the {encouraging} trends which it identifies in justifying/supporting the continued need for such long-term monitoring programmes.

Footnote: The absence of sampling points between Immingham & Grimsby in the early years of this programme [see map of sample sites] testifies to the impact of the acid-iron wastes discharged in this area up to the late 1980's. {Briefly illustrated at the end of the [Porcupine] talk}. The full effectiveness of monitoring in this sector of the Estuary could not therefore be achieved until ca 1990.

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Barnett, B.E. & Ashcroft C.R. (1985). Heavy metals in *Fucus Vesiculosus* in the Humber Estuary. Environ. Pollut. B **9**, 193 – 213.

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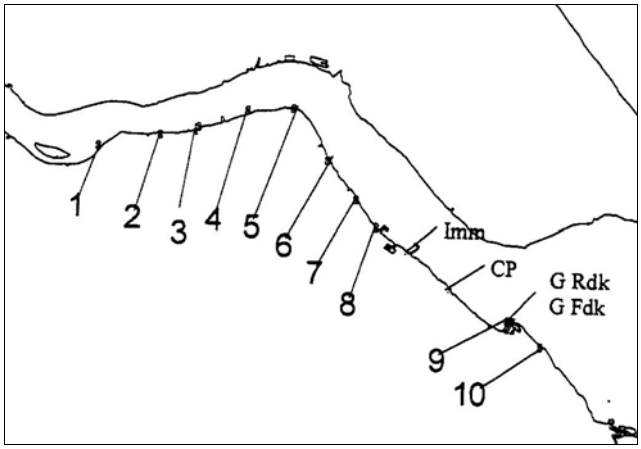

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Habitat details (substratum type and features, or biotope): Depth (m):_____

Other information:

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