

Cyngor Cefn Gwlad Cymru  
Countryside Council for Wales



**Skomer Marine Nature Reserve  
Project Status Report 2009/2010  
CCW Regional Report  
CCW/WW/10/5**

**K. Lock, M. Burton, R. Gibbs  
& P. Newman February 2010**



**Mussel beds *Mytilus edulis* at Bull Hole pink sea fan monitoring site.**

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## **SYNOPSIS**

The 9<sup>th</sup> project status report produced by the Skomer Marine Nature Reserve summarises the progress and status of monitoring projects in the Skomer MNR in 2009. A summary of all established projects in the MNR is provided in a table format. For each project that was worked on in the 2009 field season a detailed account is given including a history and summary of the results so far. This report also includes summaries of the oceanographic and meteorological surveillance projects.

Title: K. Lock, M. Burton, R. Gibbs & P. Newman. (2010). Skomer Marine Nature Reserve project status report 2009/10. CCW Regional Report CCW/WW/10/5.

## **CRYNODEB**

Mae'r 9<sup>ed</sup> adroddiad statws prosiect a gynhyrchwyd gan Warchodfa Natur Forol Sgomer yn crynhoi datblygiad a statws prosiectau monitro yn y Warchodfa yn 2009. Mae crynodeb o'r holl brosiectau sefydledig yng Ngwarchodfa Natur Forol Sgomer ar gael ar ffurf tabl. Ar gyfer pob prosiect y gweithiwyd arno yn nhymor maes 2009, fe geir adroddiad manwl, gan gynnwys hanes a chrynodeb o'r canlyniadau hyd yn hyn. Mae'r adroddiad hwn hefyd yn cynnwys crynodeb o'r prosiectau gwyliadwriaeth eigionegol a meteorolegol.

Teitl: K. Lock, M. Burton, R. Gibbs a P. Newman. (2010). Adroddiad statws prosiect Gwarchodfa Natur Forol Sgomer 2009/10 Adroddiad Rhanbarthol Cyngor Cefn Gwlad Cymru CCW/WW/10/5.

# 1 INTRODUCTION

This is the ninth project status report produced by the Skomer Marine Nature Reserve. It summarises the progress and status of monitoring projects in the Skomer MNR in 2009. The project status table in section 2 provides a summary of all established projects in the MNR. Section 3 details biological projects that were worked on this year and a summary of the results to date. Section 4 provides a summary of the oceanographic & meteorological surveillance projects.

Notable events in the 2009 field season:

- The sediment infauna and surface epifauna projects were combined as a single project. In addition to completing grab samples, each site was dived and a video transect completed to record the surface fauna. Currently awaiting results.
- Drop down video transects were completed at deep sediment areas within the Reserve with the assistance of students from Bangor University.
- The territorial fish volunteer project was successfully run involving 40 volunteers. The data has been analysed and compared to the 2002 and 2005 surveys.
- Nationally rare nudibranch species were recorded and photographed by volunteer divers: *Tritonia nilsodheri* at two sites on *Eunicella verrucosa* and *Trapania tartenella*. The record of *T.tartenella* is a first record for Wales.
- *Mytilus edulis* beds were found at several monitoring sites in the Reserve where not previously recorded.

## **2 SKOMER MNR PROJECT SUMMARY TABLES**

|                                      | <b>Brief description</b>   | <b>Year sets</b>   | <b>Sampling frequency</b>   | <b>Report</b>              | <b>Data summary</b>                                   |
|--------------------------------------|--|--|---|----------------------------|---|
| <b>PHYSICAL</b>                      |  |  |   |                            |   |
| <a href="#">Meteorological data</a>  | Wind, rain, sunshine, temp, humidity, net radiation. Automatic station logging 10 minute means.<br>New met station (2006) is compatible with the ECN and logs files daily, hourly and (since Oct 06) every ten minutes.  | 1993 – ongoing<br>(Old station removed Oct 05)<br>New Met station installed 25 /04<br>2006 - ongoing | Continuous  | No                         | Yes-SMNR office                                       |
| Wave data                            | Height, period, etc. Automatic station logging every 10mins.   | 1993-1998<br>Discontinued  | Continuous  | No                         | No - raw only   |
| Seawater data                        | <a href="#">Temperature</a> , salinity, conductivity, suspended sediment. Data collected by a range of methods.<br><br><a href="#">YSI 6600</a> multi parameter sonde<br>Temp, salinity, dissolved O <sub>2</sub> , Chlorophyll, turbidity & depth<br>OSIL buoy automatically transmitting data from YSI 6600 sonde.<br>Buoy due to be redeployed 2010 | 1992 – ongoing   | Weekly (May -Sept)<br>Temp continuous all year round (since 99)<br>Hourly | No                         | Yes-SMNR office                                       |
|                                      |  | 2007 – ongoing   | 10 Min sampling   | No                         | Yes-SMNR office                                       |
| <a href="#">Seabed sedimentation</a> | Auto sampler   | 1994-1998<br>Discontinued  | Continuous  | No                         | Yes-SMNR office                                       |
|                                      | Sediment trap  | 1994 – ongoing<br>1995 – 98 samples<br>2002 –09 samples analysed                                     | Every 14 days<br>(April-Oct)  | Jones 1998                 | Yes-SMNR office                                       |
| Suspended sediments                  | Idronaut Turbidity logger<br><a href="#">Secchi disc</a><br>YSI 6600 multi parameter sonde   | 2001 – failed 2006<br>1992 - onwards<br>2007 - ongoing   | Continuous<br>Weekly (seasonal)<br>Hourly                                 | No<br>No<br>No             | No - raw only<br>Yes – SMNR office<br>Yes-SMNR office |
| Bathymetry                           | Sidescan & Multi-beam (SAC)<br>Cardiff university trails of “swath”  | 2001   |   | Longdin & Browning<br>2002 | No<br>Raw data at SMNR                                |

|  | <b>Brief description</b>   | <b>Year sets</b>                                   | <b>Sampling frequency</b>                 | <b>Report</b>   | <b>Data summary</b>                    |
|--|--|--|---|---|--|
|  | Multi-beam equipment   | 2006   |   |   | office                                 |
| <b>ACTIVITY</b>                        |  |  |   |   |  |
| Recreation activities                  | Boats, divers, anglers recorded in the Reserve   | 1987 - ongoing                                     | Weekly (May -Sept)                        | Skomer MNR annual reports   | Skomer MNR annual reports              |
| Commercial fishing activities          | Pot buoys and fishing net positions  | 1989 - ongoing                                     | Weekly (May -Sept)                        | Burton 2002<br>SMNR annual reports  | Yes-SMNR office                        |
| Tankers in St Brides bay               | Number and names of tankers and movements  | 1994 - ongoing                                     | Daily                                     | No  | Yes-SMNR office                        |
| <b>BIOLOGICAL</b>                      |  |  |   |   |  |
| <b>Littoral communities:</b>           |  |  |   |   |  |
| Macro scale (view point photographs)   | Time series photos/digitised.  | 1992 - ongoing                                     | Annual                                    | Internal report – Daguett 2000 and Gibbs 2007   | Yes-SMNR office                        |
| <a href="#">Meso scale</a> (transects) | 6 Transects. Time series photos/digitised.<br>9 sites established in 2003 including 3 Marclim sites. Site marking completed in 2004. | 1992 – 2002<br><br>2003 - ongoing                  | Annual<br><br>Annual                      | Adams 1979/ Bunker 1983/ Crump 1993/96<br>Hudson 1995.<br>Burton & Crump 2004                       | Yes-SMNR office<br><br>Yes-SMNR office |
| <b>Sub littoral communities:</b>       |  |  |   |   |  |
| Rocky reef communities                 | Time series stereo photos.   | 1982 - ongoing                                     | Annual                                    | Bullimore 1986 & 1987   | Yes-SMNR office                        |
| Algal communities                      | Survey and report completed<br>Survey completed report in preparation<br>Full survey and method development                          | 1999<br>2005<br>2007                               | Every 4 years                             | Hiscock, S 1983 & 1986<br>Scott 1994<br>Brodie & Bunker 1999/2000<br>Maggs & Bunker 2007<br>in prep | Yes-SMNR office                        |
| <a href="#">Sponge assemblages</a>     | Time series mono-photo/digitised.<br>Species recording at TRK<br>Seasonal monitoring from 15 fixed                                   | 1994 - ongoing<br>2002/3, 2007/8<br>2006 – ongoing | Annual<br>Every 4 years<br>4 times / year | Bunker <i>et al</i> 1992<br><br>Bunker & Jones 2007   | Yes-SMNR office                        |

|   | <b>Brief description</b>   | <b>Year sets</b>  | <b>Sampling frequency</b>                    | <b>Report</b>   | <b>Data summary</b> |
|---|--|---|--|---|---------------------|
|   | quadrats – Dr J Bell   |   |  |   |                     |
| Infaunal sediment                             | Surveys and reports completed  | 1993/1996/<br>1998/ 2003<br>/2007 & 2009                      | Every 4 years<br>Next survey planned<br>2011 | Rostron 1994 & 1996<br>Barfield 1998 & 2003<br>Barfield 2007 & 2010                               | Yes-SMNR office     |
| Epifaunal sediment                            | Survey and report completed  | 1995/ 2001 &<br>2004<br>Video 2009                            | Every 4 years                                | Rostron 1996<br>Moore 2002<br>Moore 2005  | Yes-SMNR office     |
| <b>Flora:</b>                                 |  |   |  |   |                     |
| <i>Zostera marina</i>                         | Extent of NHV bed & density<br>distribution.   | 1997/2002/2006<br>(Boundary maps<br>for 2000, 2002 &<br>2004) | Every 4years<br>Next survey planned<br>2010  | Jones & Hodgson 1980<br>&1981, Jones <i>et al</i><br>1983, Lock <i>et al</i> 1998,<br>2003 & 2006 | Yes-SMNR office     |
| <b>Fauna:</b>                                 |  |   |  |   |                     |
| <a href="#"><i>Eunicella verrucosa</i></a>    | 101 colonies, time series mono-<br>photo/digitised.<br>4 colonies stereo-photo.  | 1993- ongoing<br><br>1982- ongoing                            | Annual                                       | Bunker <i>et al</i> 1985,<br>Bullimore1986 & 1987<br>Gilbert 1998                                 | Yes-SMNR office     |
| <a href="#"><i>Alcyonium glomeratum</i></a>   | Time series stereo-photo/digitised.<br>North wall 5 transects (% frequency)<br>North wall East, Thorn rock & Rye<br>rocks. | 1984- ongoing<br>2002 new<br>transects                        | Annual                                       | Bullimore1986 & 1987  | Yes-SMNR office     |
| <a href="#"><i>Parazoanthus axinellae</i></a> | 6 sites, time series mono-<br>photo/digitised.   | 2001- ongoing   | Annual                                       | Burton <i>et al</i> 2002  | Yes-SMNR office     |
| <a href="#"><i>Pentapora foliacea</i></a>     | 3 sites, time series mono-<br>photo/digitised.<br>New sites established 2002 & 2003.                                       | 1994- ongoing   | Annual                                       | Bullimore1986 & 1987<br>Bunker/ Mercer 1988<br>Gilbert 1998, Gibbs<br>2006                        | Yes-SMNR office     |
| <a href="#"><i>Balanopyllia regia</i></a>     | Time series @ thorn rock stereo-<br>photo/digitised<br>The Wick. 3 transects   | 1984 – 2002 -<br>ongoing<br>2002 - ongoing                    | Annual                                       | Bullimore 1986 & 1987   | Yes-SMNR office     |

|  | <b>Brief description</b>  | <b>Year sets</b>                                 | <b>Sampling frequency</b>                 | <b>Report</b>  | <b>Data summary</b> |
|--|---|--|---|--|---------------------|
| <a href="#"><i>Cayophyllia smithii</i></a> | Counted from sponge project quadrats (stereo-photo/digitised)   | 1993 - ongoing                                   | Annual                                    | No   | Yes-SMNR office     |
| <a href="#">Atlantic Grey Seal</a>         | Surveys and reports.  | 1976- ongoing                                    | Annual                                    | Grey Seal breeding census, Skomer Island 1992-2009, Skomer MNR annual reports.                             | Yes-SMNR office     |
| King scallop<br><i>Pecten maximus</i>      | UCS survey,<br><br>Survey completed, 3 sites- 2000<br>Survey completed, 7 sites 2004 & 2008   | 1979/80,<br>1979-82<br>2000<br>2004<br>2008      | Every 4 years<br>Next survey planned 2012 | Bullimore 1985<br>Jones 1979 & 1980<br>Lock 2002<br>Luddington <i>et al</i> 2004<br>Lock <i>et al</i> 2009 | Yes-SMNR office     |
| Nudibranch species                         | Various surveys<br>MNR survey completed.  | 1975-1991<br>2002 & 2006                         | Every 4 years<br>Next survey planned 2010 | Bunker <i>et al</i> 1993,<br>Luddington 2002   | Yes-SMNR office     |
| <a href="#">Territorial fish</a>           | Survey methods developed.<br>Survey completed.<br><br>N. Sweet drop down video survey<br>R. Bullimore video   | 1997<br>2001/2002<br>2005 & 2009<br>2007<br>2009 | Every 4years<br>Next survey planned 2009  | Lock 1998<br>Lock <i>et al</i> 2006<br>Tompsett 2006<br>Sweet 2009   | Yes-SMNR office     |
| Echinoderm Survey                          | Abundance of <i>Echinus esculentus</i> in Skomer MNR using volunteer survey methods. Data for <i>Marthasterias glacialis</i> , <i>Crossaster papposus</i> & <i>Luidia ciliata</i> | 2003 & 2007                                      | Every 4 years<br>Next survey planned 2011 | Luddington <i>et al</i> 2004<br><br>Lock <i>et al</i> 2008   | Yes-SMNR office     |

### **3 SKOMER MNR BIOLOGICAL PROJECT SUMMARIES**

## LITTORAL COMMUNITIES

**CMS code: RB03/01**

**STATUS** Ongoing. Annual photographic sampling. Annual quantitative survey.

### PROJECT RATIONALE

Littoral communities are susceptible to impacts from the water and the air. They occupy a harsh niche with an extreme range of environmental conditions. Salt tolerant terrestrial species exist within metres of truly marine species. These factors coupled with the relative ease of fieldwork compared to sub-littoral habitats make littoral communities useful for a wide range of environmental monitoring. There is a wealth of literature on the biology of rocky shores to provide guidance and support information for littoral monitoring projects.

### OBJECTIVES

To monitor the littoral communities on bedrock shores over the continuum of exposure and aspect ranges.

### SITES

- North Haven
- South Haven
- South Stream
- The Lantern
- The Wick
- Double Cliff
- Inside of Pig Stone (started 2003)
- Jack Sound / Wooltack (started 2003)
- Martins Haven (started 2003)
- Hopgang (North Marloes Peninsula) Lichen station only (started 1996).

### METHODS

Transects with permanent, fixed position quadrats were established in 1992. The quadrats extend from spring low water into the splash zone at regular height intervals.

Species abundance was recorded using the semi-quantitative SACFOR abundance scale (Hiscock 1990) and photographs taken of each 50 x 50cm quadrat. In addition a selection of close-up photographs of 10 x10cm quadrats were taken within the main quadrat.

### RESULTS

1982: Bunker *et al.* surveyed twenty two sites in the MNR as a baseline littoral survey.

1992: Six permanent transects were established in the MNR and surveyed/ photographed (Crump, 1993).

1992 – 2002: Photographs of the six permanent transects were taken and stored.

1996: Following the Sea Empress oil spill (Feb 1996) the six transects were resurveyed and a lichen monitoring site was set up at Hopgang (Crump, 1996). The littoral shores around Skomer showed no significant changes after the Sea Empress oil spill, with the exception of lichens at Hopgang, which showed signs of necrosis.

2001: Slide photographs from 1992 – 2000 were reviewed and abundance estimates from the photographs compared with abundance records from Crump 1992 & 1996 field data. Photograph quality was insufficient to allow accurate abundance estimates.

2001/02: Digital imaging was tested to obtain pictures of permanent quadrats. Image quality was improved; however estimates of species abundance were still inaccurate due to difficulties with identification of species and individuals from the images. This method cannot replace collection of data in the field for quantitative assessment.

2003: New quantitative methods were tested at the six original sites and four additional sites were established.

2004: Methods established in 2003 were continued. All site marking was completed and all results collected.

2005: All the sites established in 2003 were resurveyed except for the lower shore at Pig Stone.

2006: All sites were completed.

2007: All sites were completed and temperature loggers were placed at the Martins Haven and South Haven sites.

2008: All sites resurveyed except for Double cliff upper shore.

2009 – All sites completed.

### **Littoral community monitoring methods 2004**

(see Crump & Burton 2004 for full details)

At each site samples were taken from 4 heights on the shore:

Lower shore – 1.8m Above Chart Datum (ACD)

Middle shore – 4.2m ACD

Upper shore – 6.0m ACD

Splash zone ~ 9.0m ACD (selected sites only. To include Hopgang)

At each shore zone:

- Four 1m<sup>2</sup> quadrats were placed in relatively homogenous areas of inclined rock (avoiding rock pools and large fissures)
- Presence / absence recorded for all species using a 25 cell grid.
- Digital photographs were taken of the whole quadrat
- Limpets were counted in 5 randomly selected cells
- Photographs of barnacles from 5 randomly selected cells using a 5 x 5cm quadrat
- % cover of barnacle species estimated in 5 random 20 x 20cm cells
- % cover of lichen species recorded in 50 x 50cm quadrats at selected sites

Counting protocols:

- Aggregate rough winkle species
- Aggregate *Verrucaria spp* other than *V. mucosa*
- Only counted limpets > 10mm and aggregate to *Patella spp* (species are separated in the MarClim methodology)
- Aggregate barnacle species for cell frequency counts
- Presence/absence of barnacle *spp* in 1m quadrat; barnacles were identified to species level from close up photographs

### Barnacle monitoring

From each quadrat in the lower, middle and upper shore 5 photographs were taken using a 5 x 5cm quadrat from random locations within the quadrat on flat areas of bedrock. This provided a total of 20 samples from each shore zone. Species counts were carried out for all individuals > 2mm. All photographs were taken at all sites to obtain a complete record for future use, however the number of sites analysed depended on the time involved in analysing the photographs. So far only the Marclim sites have been analysed.

### Limpet monitoring

At all shore levels counts of limpet species were made from 5 random cells (20 x 20cm) from within each quadrat giving a total of 20 cell counts. In the middle shore only, the first 200 limpets were measured to the nearest mm. In areas of low density at least 100 limpets were measured.

### MarClim methodology

The MarClim project (Plymouth Marine Laboratory) offers an opportunity to compare the Skomer shores to the rest of the UK and contribute to the assessment of the effects of global warming.

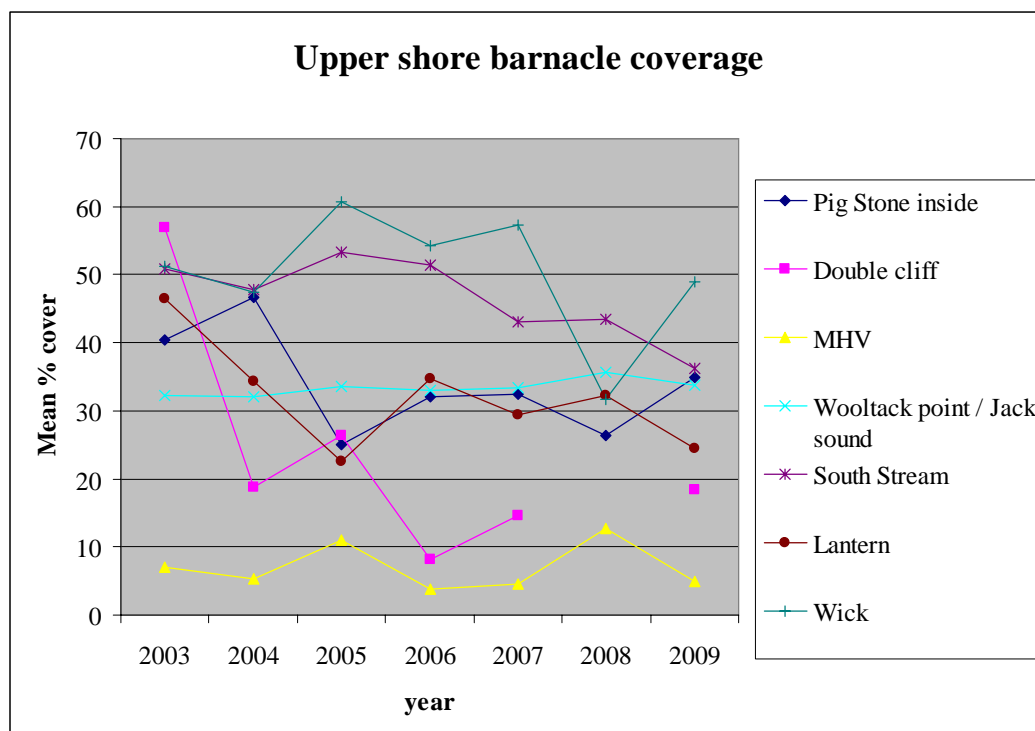
The MarClim methodology was used at Martin's Haven, North Haven and South Haven (see Mieszkowska *et al.* 2002). This involved recording abundances for a selected list of edge of range species, counting barnacles in 5 x 5cm quadrats and limpets in 50 x 50cm quadrats. Timed searches were conducted for *Osilinius lineatus* and *Gibbula umbilicalis* and individuals measured to the nearest mm.

### Shore clingfish (*Lepadogaster lepadogaster*)

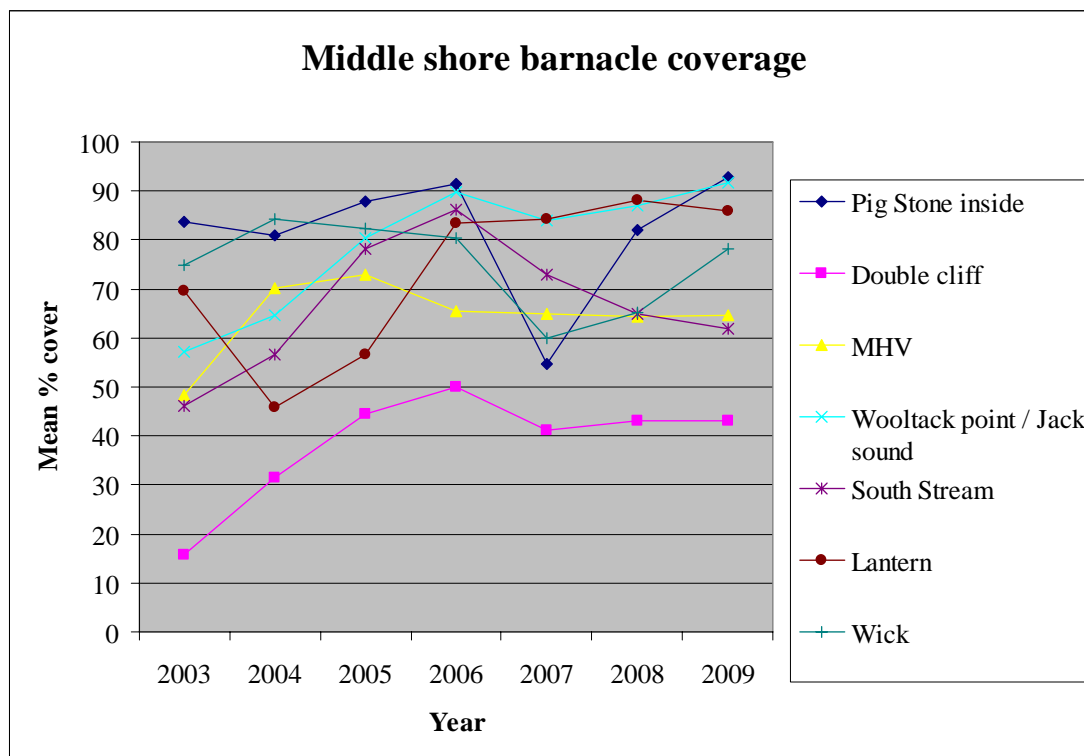
Timed counts of clingfish are carried out at Martins Haven and North Haven together with records of egg masses.

## RESULTS

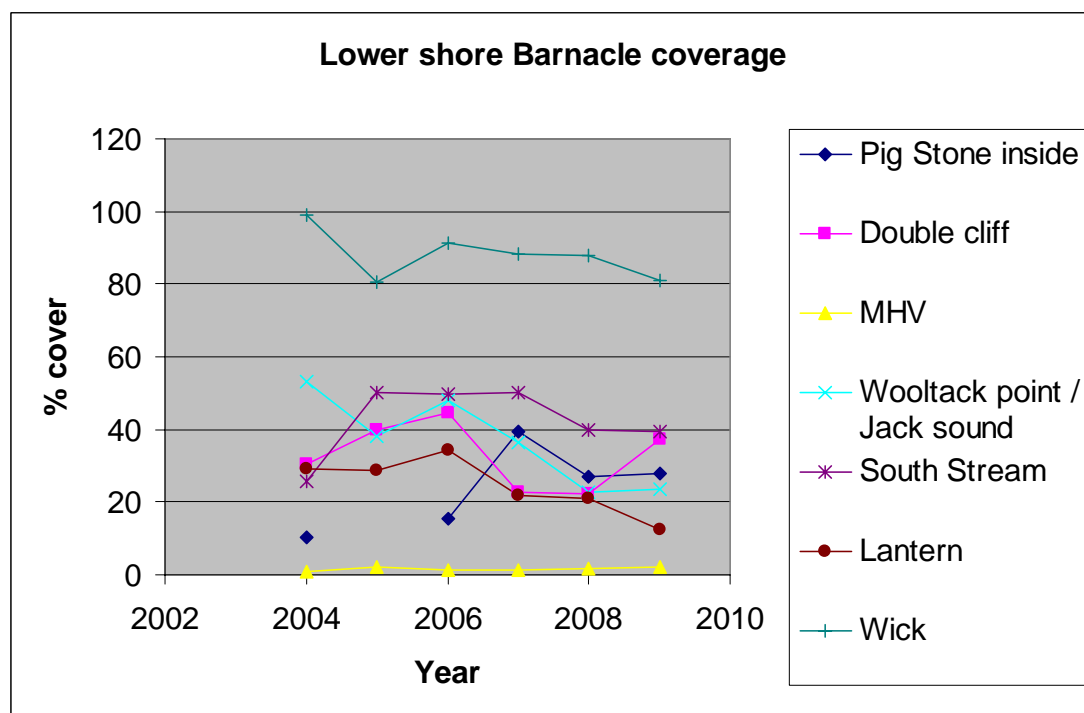
### Mean % cover barnacles



Barnacle coverage in the upper shore appears stable over the 4 years but variable between sites.

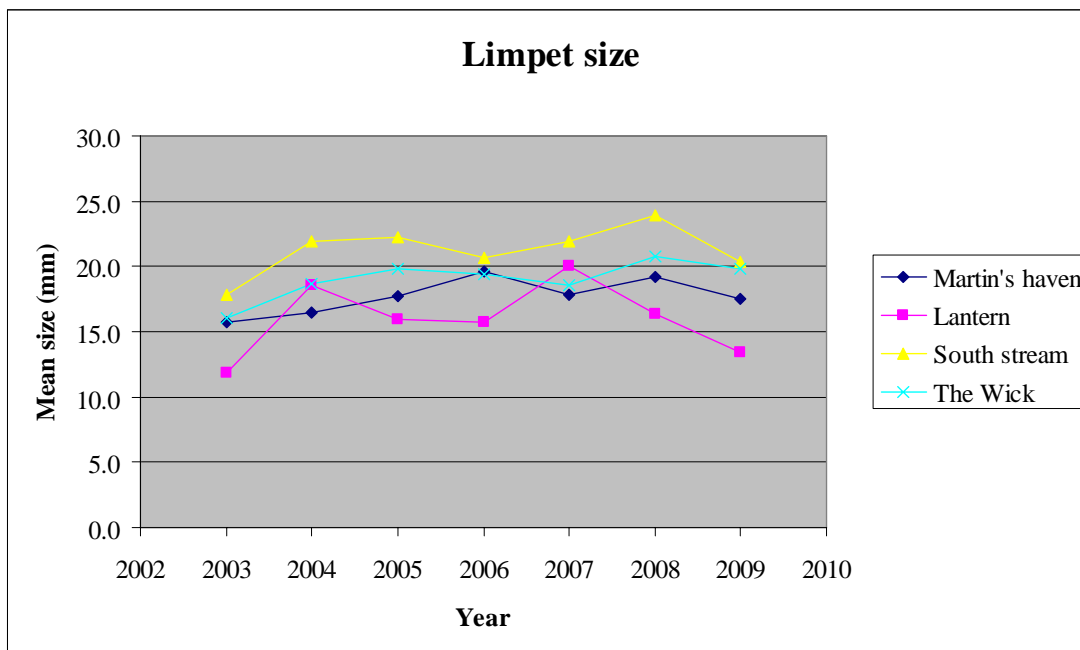


There appears to be an increasing trend in barnacle coverage on the middle shore which has now stabilised. Barnacle and fucoids coverage is known to fluctuate.

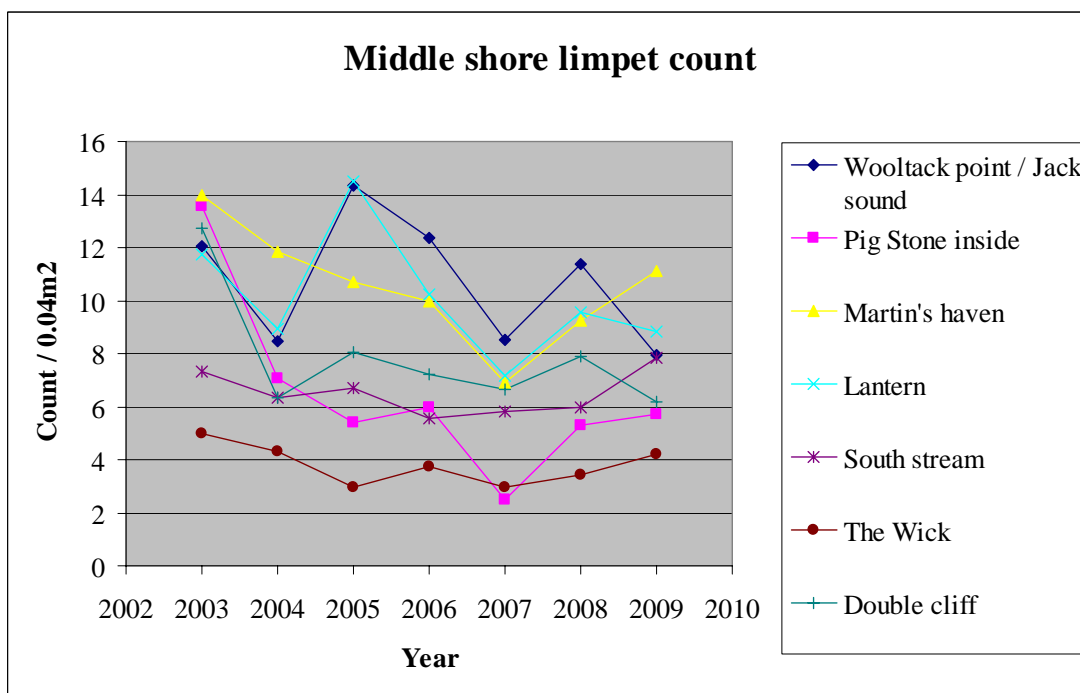


**Limpets**

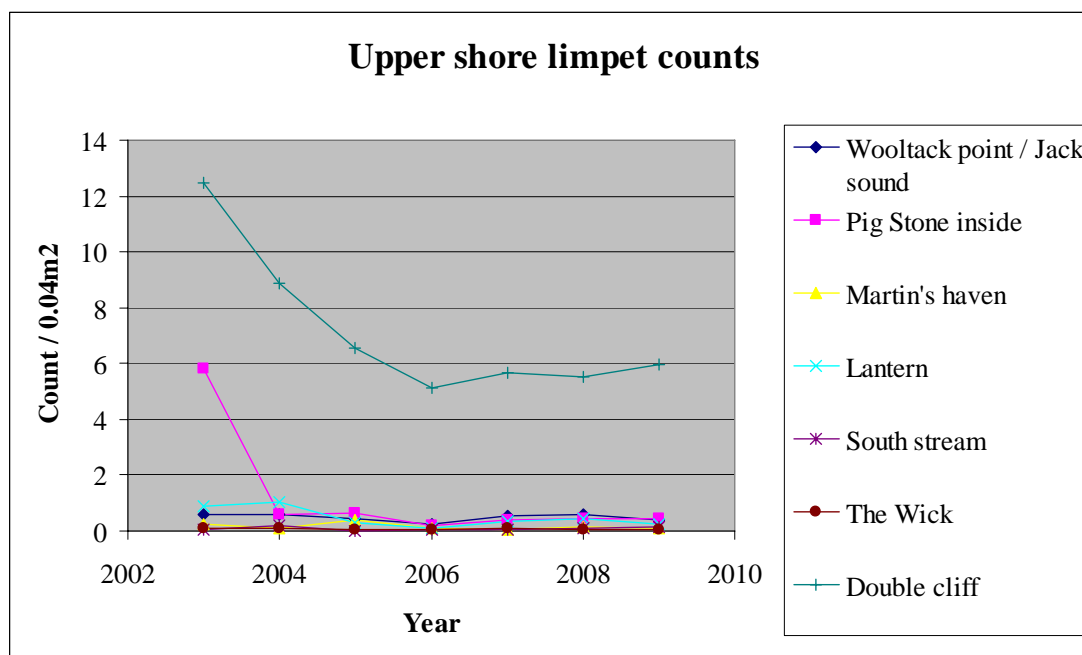
**Size of limpets on the middle shore (mm)**



**Counts of limpets from 5 (20 x 20cm) quadrats**



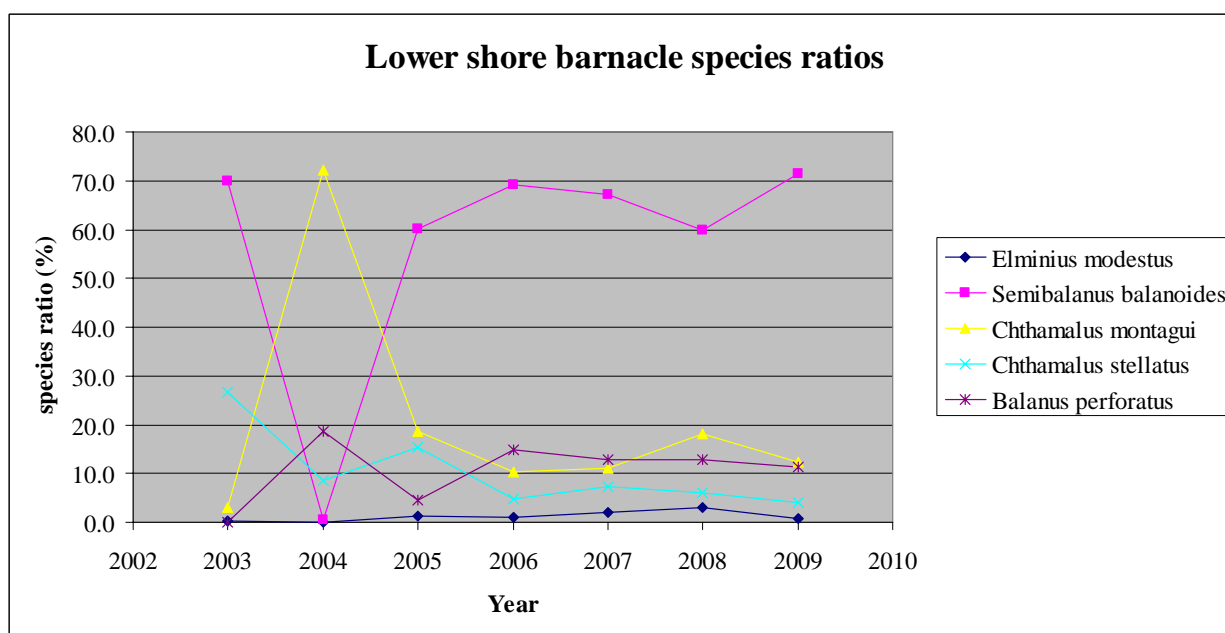
Highest numbers of limpets are found on the North facing shores, but these figures tend to be more erratic. 2007 appears to have had a dip in numbers on 6 of the sites, which all showed an increase the following year.

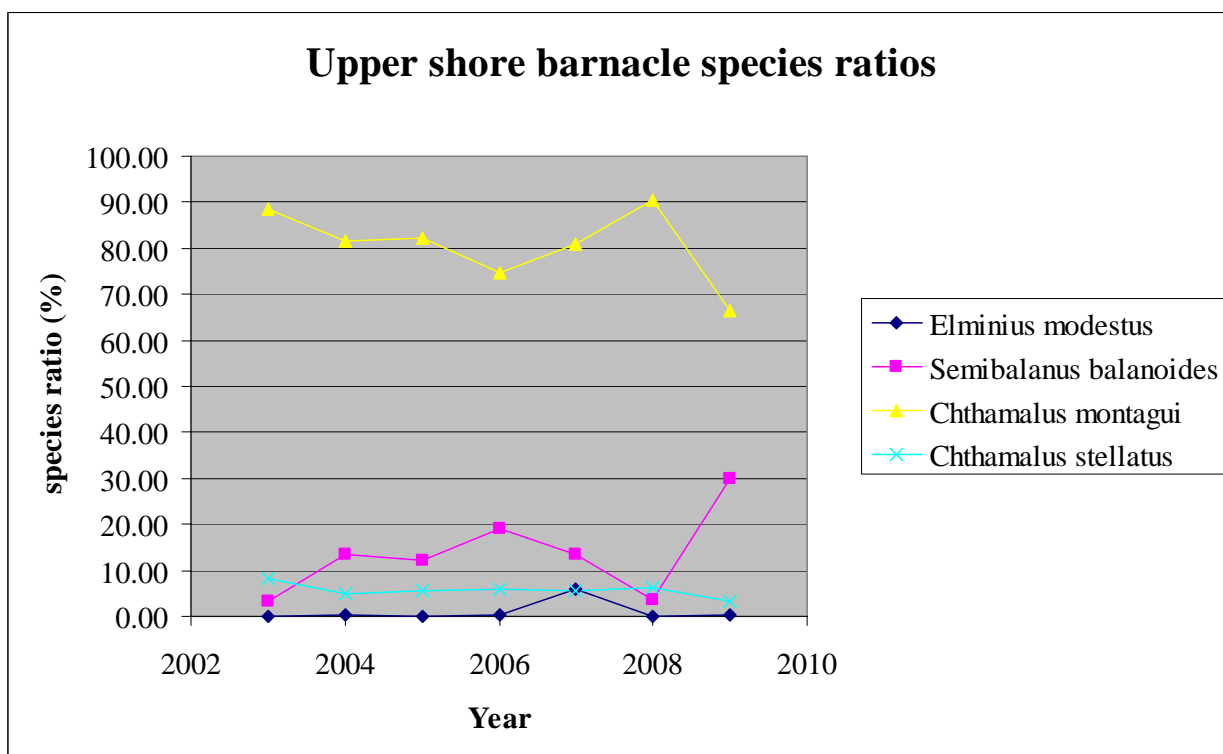
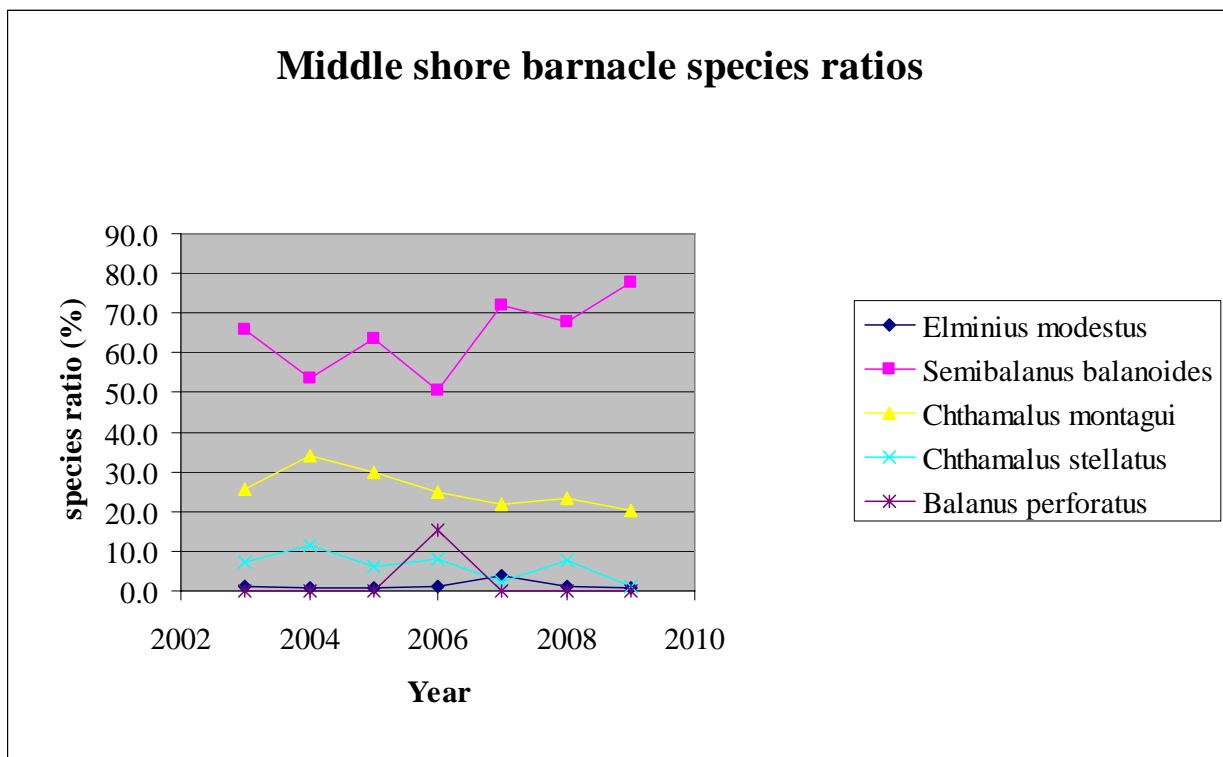


Most sites have a low abundance of limpets in the upper shore, but Double cliff has significantly more limpets than any other site (North facing shaded cliff) and an interesting declining trend from 2003 – 2006 which then stabilises.

### Barnacle species ratios

Results from the 3 Marclim sites. Derived from photographs of 5cm X 5cm quadrats.





Upper and middle shore ratios show small changes in relative abundance. The lower shore has undergone some dramatic changes in 2004 with *Semibalanus balanoides* declining and being immediately replaced by *Chthamalus montagui*. This may be due to a poor settlement of *S. balanoides* spat in the winter of 2002/3 (possibly linked to mild sea temperatures). *Chthamalus montagui* individuals would then benefit from a lack of competition. The Middle & Upper shore is starting to show a trend of an increasing presence of *Semibalanus balanoides* with a corresponding decreasing in *Chthamalus spp.*

## **CURRENT STATUS**

The shores appear to be typical of the area.

## **RECOMMENDATIONS**

- Continue full survey annually including MarClim methods at South Haven, Martins Haven and North Haven
- Contract in field support on an annual basis.
- Encourage and support littoral research in the Reserve.

## **REFERENCES**

Adams 1979, Bunker *et al* 1983, Hiscock, K 1990, Crump 1993, Crump 1996, Hudson 1995.

Burton, Daguet, Lock & Newman 2001. Skomer Littoral Monitoring Manual.

Crump R.G. & Burton. M 2004, Skomer Marine Nature Reserve Littoral monitoring: Development of methods. CCW West Area Report 27.

N. Mieszkowska, M., R. Leaper, A. Southward, S. Hawkins & M. Burrows. 2002. MARCLIM monitoring network: provisional sampling strategy and standard operating procedure.

## **SPONGE ASSEMBLAGES**

(CMS code: RM13/01)

### **STATUS**

Annual sampling of photographs along fixed transects (1993-ongoing);  
Species surveyed every 4 years (2003, 2007, next survey due 2011);  
Seasonal sampling of fixed quadrats photographs (2005 – ongoing).



### **PROJECT RATIONALE**

The sponge communities at Skomer MNR have been identified as rich and diverse with over 80 species. Six are nationally scarce species and eight near the limit of their distribution. Sponges are filter feeders and therefore reliant on water quality which makes them susceptible to changes in sediment deposition. They are therefore useful biotic indicators of changes in suspended sediment and surface sedimentation rates, the cause of which might include dredge spoil dumping.

### **OBJECTIVES**

- To monitor the sponge assemblages in the MNR.
- To identify natural and anthropogenic fluctuations.
- To identify the presence of rare, scarce and edge of range species in the MNR.

### **SITES**

- Thorn Rock (transects & species survey)
- 2009 – Other digital images were used to assess the sponge assemblages around the Reserve

### **METHODS**

**Transects:** Four fixed transects are located at Thorn Rock. Photographs are taken from fixed positions along the transect using a stereo camera set up on a 50 x 70cm frame. The slides are analysed using a stereo viewer to count the abundance of sponge species and morphology types.

**Species survey:** In 2003 all sponge species identified in 16, 50 x 70cm quadrats. In 2007 no quadrats were used, survey completed in the general vicinity of the 4 transects with all species being identified if possible. Species photographs were taken in the field and samples taken, where necessary, for spicule preparations.

**Seasonal survey from fixed quadrats:** In 2005 15 1m<sup>2</sup> quadrats were marked out at 3 sites. The quadrats each consist of 25 cells (20 X 20cm), which are photographed using a digital camera three times between March and October.

## RESULTS

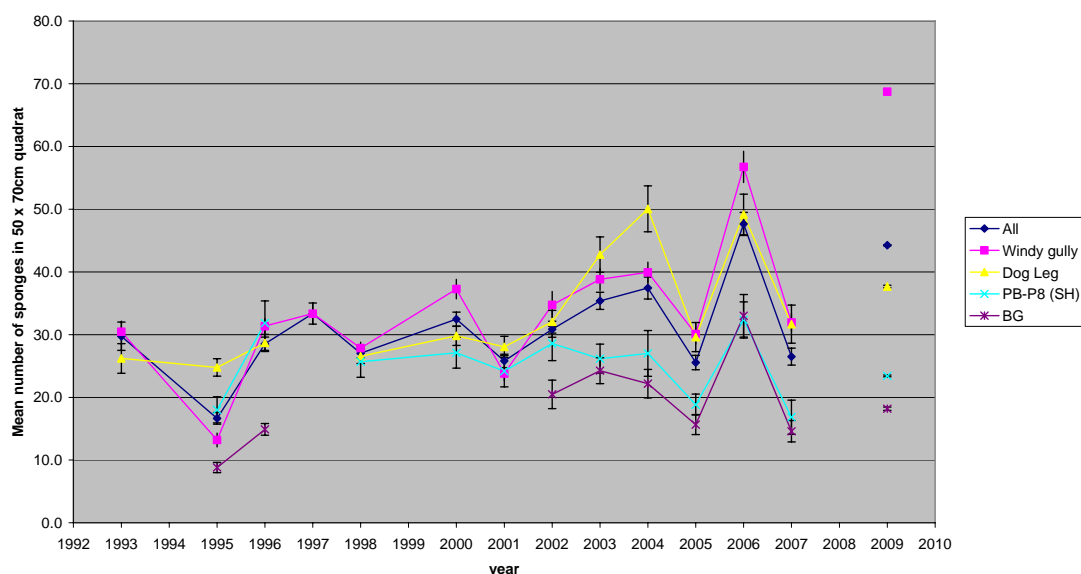
### Transects:

Data gathered from Thorn Rock sponge transects 1993 to 2009:

(Windy Gully =WG, Spongy Hillocks =SH, Broad Gully =BG, Dogleg = DL)

| Year | No of samples | Transects  |
|------|---------------|--|
| 1993 | 24            | WG   |
| 1995 | 77            | WG, WG, BG, DL   |
| 1996 | 72            | WG, WG, BG, DL   |
| 1997 | 20            | WG   |
| 1998 | 60            | WG, SH, DL   |
| 2000 | 63            | WG, SH, DL   |
| 2001 | 62            | WG, SH, DL   |
| 2002 | 81            | WG, WG, BG, DL   |
| 2003 | 79            | WG, WG, BG, DL<br>(Species survey for WG & SH)   |
| 2004 | 80            | WG, WG, BG, DL   |
| 2005 | 80            | WG, WG, BG, DL   |
| 2006 | 79            | WG, WG, BG, DL<br>(Seasonal quadrats photographed in Oct at<br>BG, SH, DL)   |
| 2007 | 81            | WG, WG, BG, DL<br>Seasonal quadrats photographed in May and<br>Sep at BG, SH, DL.<br>Species survey conducted throughout the<br>year at WG, SH, DL |
| 2008 | 0             | Transects were completed but the image<br>quality was very poor and <b>no</b> analysis was<br>possible   |
| 2009 | 81            | Digital SLR used – not stereo 35mm<br>Results very good – better resolution than<br>the 35mm system  |

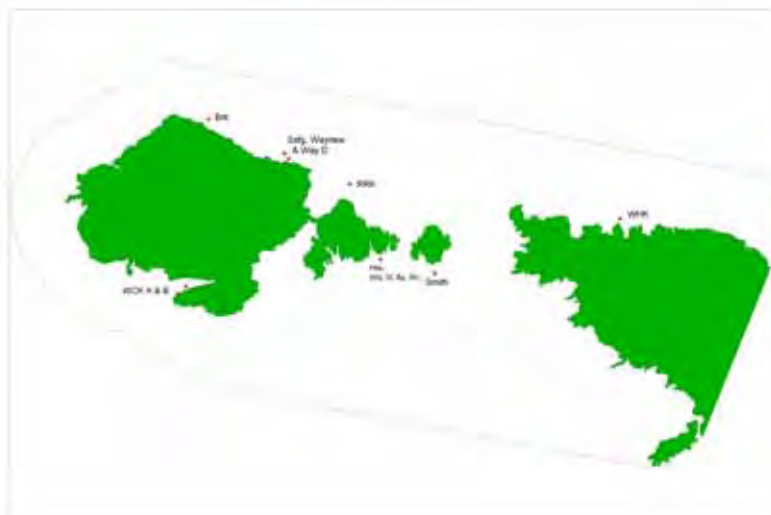
### Mean number of sponges counted at 4 sites 1992 - 2009



The improvement in the image quality & resolution has meant that more sponge entities have been recorded in 2009 than in previous years.

### Sponge assemblages in other areas of Skomer MNR

The digital images from other 2009 monitoring projects were analysed with the standard morphology method used at Thorn rock. The site locations are shown below.

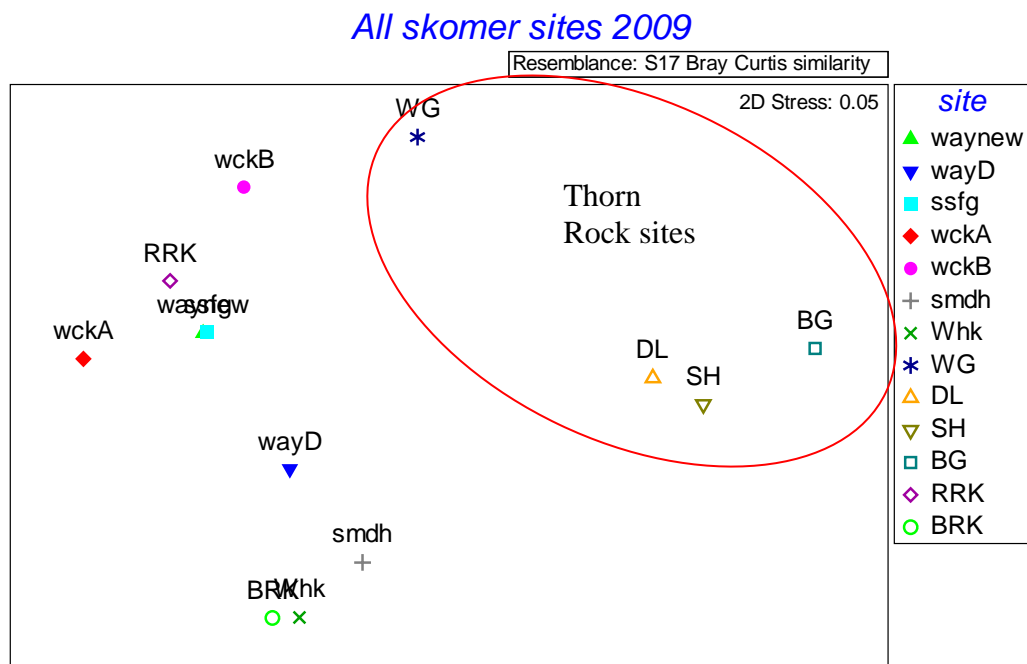


The sites were from a range of habitats:

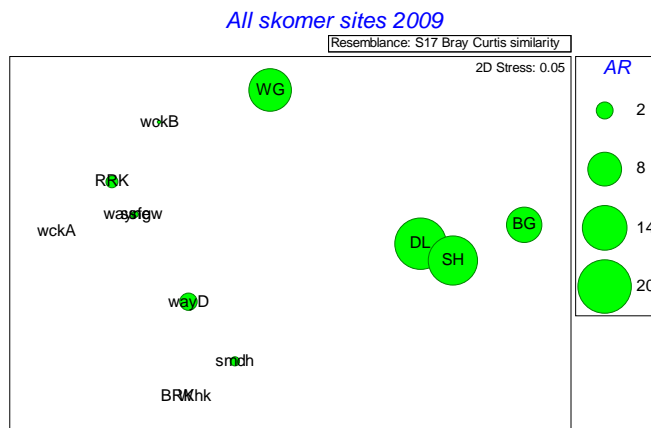
- BRK –horizontal boulder reef at 10m BCD
- SSFG– vertical wall at 10 – 15m BCD
- WAYnew - vertical wall at 10 – 15m BCD
- WAY D - vertical wall at 15 - 20m BCD
- RRK - vertical wall at 15 - 20m BCD
- WCK A – Horizontal reef at 15m BCD
- WCKB -vertical wall at 10 – 15m BCD
- SMDH – Horizontal reef at 15m BCD
- WHK – Horizontal reef on mixed ground at 10 – 15m BCD

All the quadrats were averaged to site and compared to the Thorn Rock transects (WG, SH, DL & BG).

### Primer MDS plot representing the similarity of sponge assemblages found at sites around Skomer MNR :



One of the main morphology groups that separate the Thorn Rock sites from the rest of Skomer is the Arborescent (erect branching) group. Thorn rock has a lot more branching sponges along with papillate, tubular, globular and pedunculate groups.

**Bubble plot of abundance of Arborescent sponges around skomer MNR:**

The diversity of sponge types is much higher at Thorn rock then any other area around Skomer.

**Seasonal variation in sponge assemblages**

A study of the seasonal variation of sponges at Thorn rock has been running since 2006 as a PhD project by Jade Berman at Wellington University New Zealand. A summary of initial results were presented in the Skomer MNR 2009 Project Status Report (Lock et al 2009). The final photo set was completed for the project in July 2009; this data will now be processed and compared with the data of other sponge assemblages in Indonesia and New Zealand by the end of her PhD in July 2010.

The seasonal photo data set will continue to be collected as part of the Reserve's sponge monitoring programme to see if there are any larger-scale patterns that operate on a longer timescale than has currently been recorded. A winter dataset between October and April is also needed provide the full seasonal variation patterns.

**RECOMMENDATIONS**

- Continue transect photo-monitoring programme at Thorn Rock and continue application of morphology method for analysis of photos.
- Thorn Rock has the greatest diversity of sponge types found within the MNR. Other useful sites to collect morphology data from would be areas on the West side of the island. Expand method to sites outside of the MNR. This will provide improved knowledge of the diversity of sponge assemblages.
- Seasonality patterns need further investigation as seasonal changes in the sponge assemblages have been found. Winter data is needed as samples have only been collected from April to October. Encourage continued research on sponge seasonality in the Reserve;
- Continue sponge species recording every 4 years, next survey due 2011.

**REFERENCES**

Picton & Morrow 1993, Bell & Barnes 2001, Clarke & Warwick 2001, Bunker & Jones 2008.  
Ayling, A. L. (1983). Growth and regeneration rates in thinly encrusting Demospongiae from temperate waters. Biological Bulletin **165**: 343-352.

Bell JJ, Burton M, Bullimore B, Newman PB, Lock K (2006) Morphological monitoring of subtidal sponge assemblages. Marine Ecology Progress Series **311**: 79-91

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## **EUNICELLA VERRUCOSA: Population and growth rate**

### **(CMS Code: RM23/01)**

**STATUS** Ongoing. Annual sampling.

#### **PROJECT RATIONALE**

The pink sea fan *Eunicella verrucosa* (Pallas) is a Lusitanian anthozoan soft coral nearing the northern limit of its distribution in North Pembrokeshire. It is a UK Biodiversity Action Plan Species on Schedule 5 of the Wildlife and Countryside Act 1981. Sea fans are a slow growing, erect species susceptible to permanent damage. Recovery and reproduction rates are thought to be very slow.

#### **OBJECTIVES**

To monitor numbers and condition of the recorded sea fans in Skomer MNR and to expand the monitored population.

#### **SITES**

|                                  | <b>Date started</b> |
|----------------------------------|---------------------|
| • Bernie's Rocks (East and West) | (1994)              |
| • Bull Hole                      | (2002)              |
| • The Pool                       | (1997)              |
| • North Wall East                | (2000)              |
| • Sandy Sea Fan Gully            | (1994)              |
| • Thorn Rock                     | (2002)              |
| • Way Bench                      | (1994)              |
| • Rye Rocks                      | (2002)              |
| • South Middleholm               | (2002)              |
| • West Hook                      | (2005)              |

#### **METHODS**

Photographic monitoring using a single camera on a 50 x 70 cm frame. Both sides of the sea fan are photographed and each fan is visually inspected for damage, fouling by epibiota, entanglement with man-made materials, necrosis (loss of living tissue) and the nudibranch *Tritonia nilsodhneri* Marcus, 1983 and *Simnia patula* (Pennant, 1777).

#### **RESULTS**

In 1997 S. Burton (nee Gilbert) developed methods to study the fan area and branch length assessment to assess growth rate. This was completed for all fan images for 1994-1997 data using MapInfo software, (Gilbert 1998).

- 1998-2000 data was analysed using the methods developed in 1997.
- 2001 a re-evaluation of methods used for growth assessment was completed and the 1997 method was discontinued due to many inaccuracies found using the methods due mainly to inconsistencies in the images of individual fans matching between year sets.
- 2001 a method to assess fan condition was developed. This was completed for all photo images in the dataset.
- 2002 field records of fan condition were commenced to support the assessment completed using the photo images.
- 2002 small clippings were taken from some MNR fans for a CCW Species Challenge funded project into the reproductive biology of sea fans. Reef Research undertook the study based sea fan colonies in Devon and at Skomer MNR. The MNR clippings showed

what was thought to be eggs and sperm, although at lower levels than the Devon population. Time of spawning in Devon is thought to be during late August.

- 2007 small clippings were taken from 30 MNR fans to support research at the University of Plymouth and the Marine Biological Association. The research aims to look at the connectivity between populations of pink sea fans using internal transcriber sequences.
- 2008 a digital SLR camera providing high quality images, thereby allowing improved photo analysis, replaced the film camera previously used.
- 2009 further small clipping were taken from MNR fans to support the connectivity research started at Plymouth University. The project is now being co-ordinated by Dr Jamie Stevens at Exeter University. A digital camera set up for close up photography was used along with a graduated ruler for size reference was used to photograph the small fans.
- 2010 all sites visited and photographed.

### Survey results 1994 -2010:

| year   | Sites surveyed | Total fans recorded | Total natural fans | Total attached fans | New recruits (babies) | Losses (confirmed) | Missing (to be confirmed) |
|--------|----------------|---------------------|--------------------|---------------------|-----------------------|--------------------|---------------------------|
| 1994   | 3              | 30                  | 30                 |                     |                       |                    |                           |
| 1995   | 3              | 29                  | 29                 |                     |                       | 1                  |                           |
| 1996   | 3              | 29                  | 29                 |                     |                       |                    |                           |
| 1997   | 4              | 35                  | 35                 |                     |                       |                    |                           |
| 1998   | 4              | 35                  | 35                 |                     |                       |                    |                           |
| 1999   | 0              |                     |                    |                     |                       |                    |                           |
| 2000   | 5              | 50                  | 50                 |                     |                       |                    |                           |
| 2001   | 5              | 52                  | 52                 |                     |                       | 1                  |                           |
| 2002   | 9              | 81                  | 80                 | 1                   |                       | 1                  |                           |
| 2003   | 9              | 95                  | 94                 | 1                   | 1                     |                    |                           |
| 2004   | 9              | 97                  | 96                 | 1                   |                       |                    |                           |
| 2005   | 10             | 108                 | 106                | 2                   | 1                     | 1                  |                           |
| 2006   | 10             | 113                 | 111                | 2                   | 7                     |                    |                           |
| 2007   | 10             | 115                 | 113                | 2                   | 1                     | 2                  |                           |
| 2008   | 10             | 120                 | 117                | 3                   |                       | 1                  |                           |
| 2009   | 10             | 121                 | 115                | 6                   |                       |                    | 4                         |
| 2010   | 10             | 120                 | 115                | 5                   | 0                     | 3                  | 5                         |
| totals |                |                     |                    |                     | 10                    | 10                 |                           |

There were 3 confirmed losses from the 2009 season, NWA 15,NWA 4 & SSG22.

SSG23 has been re-found after not being seen for 2 years.

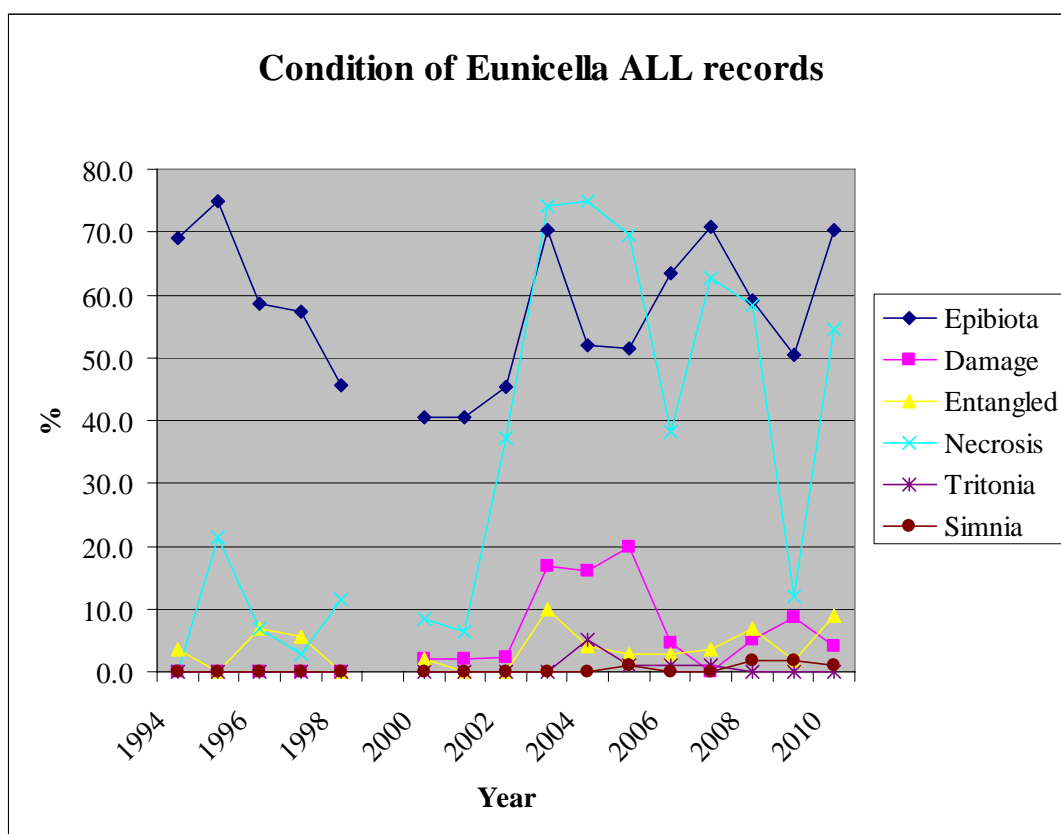
Five sea fans were not found for the first time in 2010, these are BHO23 a “baby” fan at the base of BHO11, TRK6, POL7, RRK9 & MDS3, their status will be confirmed in 2011.

There were no new recruits in 2010. The cluster of 5 baby fans at Bull Hole are all present and clear branching can now be seen in two individuals.



The attached fan pictured above (TRK8) has disappeared from the piton at Thorn Rock and was not seen at all in the 2010 season.

Condition of sea fans in the Skomer MNR from photo images (1994- 2010) and field data (2002-2010) records are shown on the following graph.



Recording of necrosis from the photo images was inconsistent between years 1994 - 2001 due to variable image quality, recording necrosis in the field since 2002 has helped provide improved records. From 2008 onwards the images taken with an SLR digital camera provided excellent quality images and allowed improved recording of necrosis from the photos. In 2009 a large drop in necrosis was observed with records of its presence in only 12% of the surveyed sea fans however the occurrence of necrosis increased in 2010 to 54%.

*Simnia patula* was found on one fans during the 2010 survey.

The Pink sea fan slug *Tritonia nilsodheri* was recorded in June at Prothero's Dock by P Newman.



### **CURRENT STATUS**

- Numbers: There have been 10 confirmed sea fans lost from the monitoring sites between 1994 and 2009 and there are 5 further possible losses in 2010.
- There are no new recruits found in 2010.
- Condition: The necrosis occurrence has returned to previous levels. There was a notable increase in the amount of red algae attached to the fans in 2010.
- Dog fish egg cases were very abundant in 2010.
- Both *Tritonia nilsodhneri* and *Simnia patula* were recorded in 2010.

### **RECOMMENDATIONS**

- Continue annual photographic monitoring programme;
- Complete field records for each colony, recording damage, entanglement, necrosis, levels of epibionts and numbers of *Tritonia nilsodhneri*;
- Observe persistence of biotic fouling/entanglement e.g. Greater spotted dogfish eggs;
- Search for new recruitments at established sites;
- Take close-up photos of all baby/small sea fans found;
- Monitor sea temperature and suspended turbidity levels to provide background data for the biological monitoring;
- Support research work on the biology of sea fans;

**REFERENCES** Bunker 1985, Gilbert 1998, Wood 2003, Muroe 2004, Wood 2008.

## ALCYONIUM GLOMERATUM POPULATION

(CMS code: rm23/03)

**STATUS** Ongoing. Annual sampling.

### PROJECT RATIONALE

*Alcyonium glomeratum* (red sea fingers) is a Lusitanian species near to its northern limit of distribution. Colonies are long-lived and possible indicators of climate change.

### OBJECTIVES

To monitor colony area and to look for damage and disease.

### SITES

- |                       |             |
|-----------------------|-------------|
|                       | Established |
| • North Wall Stereo   | (1982)      |
| • North Wall main     | (2002)      |
| • Thorn Rock          | (2002)      |
| • Sandy Sea Fan Gully | (2002)      |
| • North Wall East     | (2002)      |
| • Rye Rocks           | (2003)      |



### METHODS

North Wall Stereo: three quadrats (50 x 40cm) are photographed using stereo photography.

At all other sites photographs (mono) are taken using a 50 x 70cm framer. Each site follows either a sequence of photos or transects that are prescribed in site relocation proforma.

| Site                | Sequence                    |
|---------------------|-----------------------------|
| North Wall (main)   | five vertical transects     |
| Thorn Rock mooring  | two fixed position quadrats |
| Sandy Sea Fan Gully | two vertical transects      |
| North Wall East     | two vertical transects      |
| Rye Rocks           | one transect                |

The colonies are “wafted” before photographing to make them retract in an attempt to control the variability in colony size. The images are analysed by overlaying a 5 x 5cm grid and recording presence/absence of *A. glomeratum* within the grid squares. See Burton, Lock & Newman 2002 for details.

**RESULTS**

**North wall Stereo:**

These quadrats are difficult to quantify due their variable position and the degree to which the *A. glomeratum* colonies at extended / retracted.

They appear stable up until 2008 at which point there appears to have been a decline in coverage in quadrat 2

**Quadrat 1:**



**Quadrat 2:**



**Quadrat 3:**

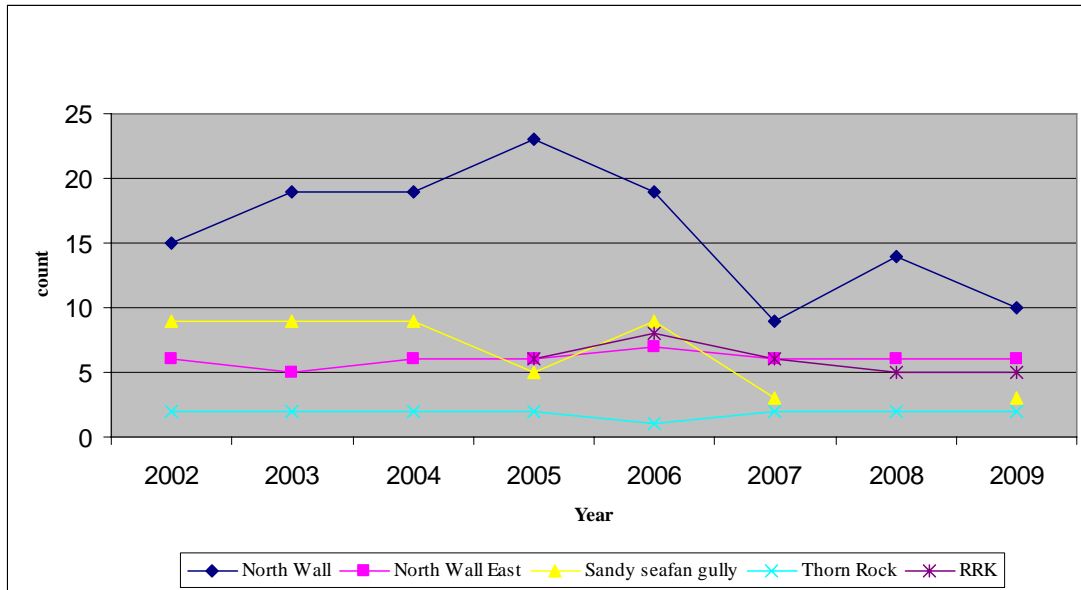


**All other sites: North Wall, North Wall east, Sandy Sea fan gully, Thorn rock and Rye Rocks**

**Number of quadrats with *A. glomeratum* present.**

|            | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 |
|------------|------|------|------|------|------|------|------|------|
| NWA (main) | 15   | 19   | 19   | 23   | 19   | 9    | 14   | 10   |
| NWEast     | 6    | 5    | 6    | 6    | 7    | 6    | 6    | 6    |
| SSFG       | 9    | 9    | 9    | 5    | 9    | 3    |      | 3    |
| TRK        | 2    | 2    | 2    | 2    | 1    | 2    | 2    | 2    |
| RRK        |      |      |      | 6    | 8    | 6    | 5    | 5    |

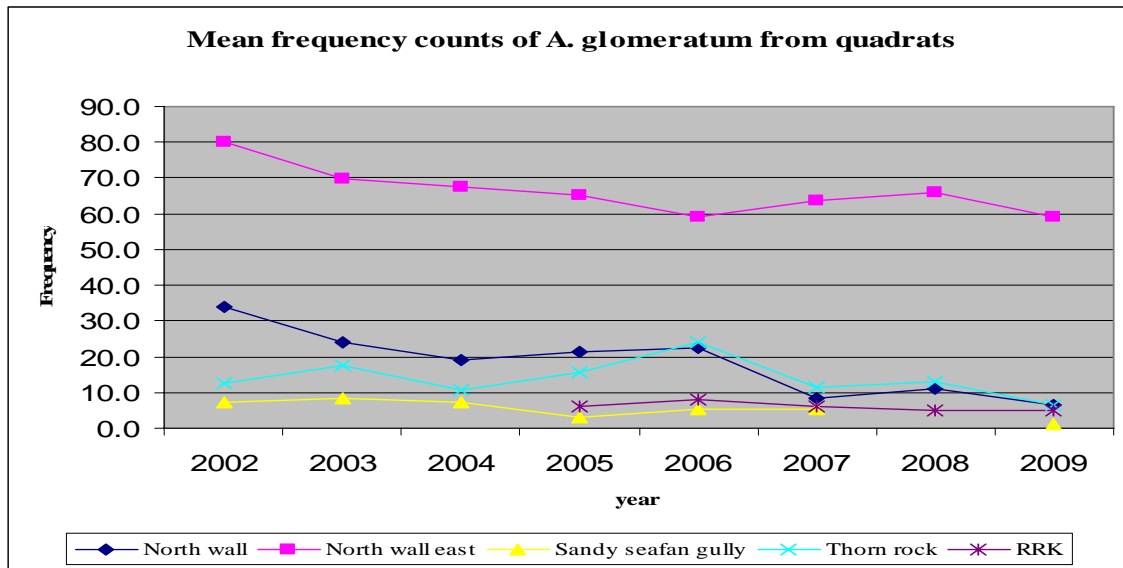
**Graph of the number of quadrats with *A. glomeratum* present:**



The North Wall (main) and Sandy sea fan gully areas have shown a decreasing trend in distribution of *A. glomeratum*, whilst North Wall east, Thorn Rock and Rye Rocks all show a stable area.

**Mean Frequency count from quadrats with *A. glomeratum* occurring**

|            | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 |
|------------|------|------|------|------|------|------|------|------|
| NWA (main) | 34.0 | 23.8 | 19.0 | 21.2 | 22.7 | 8.3  | 11.1 | 6.4  |
| NWEast     | 80.0 | 69.6 | 67.5 | 65.2 | 59.3 | 63.7 | 66.0 | 59   |
| SSFG       | 7.2  | 8.4  | 7.1  | 3.0  | 5.3  | 5.3  |      | 1.0  |
| TRK        | 12.5 | 17.5 | 10.5 | 15.5 | 24   | 11.5 | 13   | 6.5  |
| RRK        |      |      |      | 5.3  | 10.3 | 8.0  | 9.8  | 10.0 |

**Graph of the mean frequency of *A. glomeratum* from within the quadrats 2002 - 2009:**

North Wall (main) has a decreasing trend over the survey period. It is now hard to see the individuals of *A. glomeratum* on the wall. They are all very small colonies, typically the size of a 10p piece.

**CURRENT STATUS**

- North Wall stereo site: the colony is made up of large individual colonies, this has remained stable for over 10 years but may be starting to show signs of a decrease.
- The distribution of *A. glomeratum* at the new transect sites is variable. North Wall east and Thorn Rock show stable colonies, whilst the North Wall main wall shows a dramatic decrease in the number of quadrats with *A. glomeratum* present and there has been a decrease in quadrats at Sandy sea fan gully. Continued monitoring is needed to follow these trends in the long term.

**RECOMMENDATIONS**

- Continue with monitoring at all established sites.
- Improve site marking to allow accurate relocation of quadrats.

## PARAZOANTHUS AXINELLAE POPULATION

(CMS code: RM23/05)

**STATUS** Ongoing, annual sampling.

### PROJECT RATIONALE

The population of *Parazoanthus axinellae* (yellow trumpet anemone) is an important feature of Skomer MNR. *P. axinellae* is a Lusitanian (south-western) species near to the edge of its range and may act as an indicator of climatic change.

### OBJECTIVES

Monitor *P. axinellae* colonies for changes in polyp density and colony area.

### SITES

- Sandy Sea Fan Gully
- Thorn Rock (3 colonies)
- Way Bench (2 colonies)

### METHODS

Density estimates: Close-up photographs are taken using a digital camera. The digital camera is mounted on a 20 x 20cm framer. The number of *P. axinellae* polyps are counted in each quadrat. Area of the colony: A series of transects are placed through the colonies. Photographs are taken using a 50 x 70cm framer. In 2008 a digital SLR camera replaced the film camera providing high quality images allowing improved photo analysis. The images are analysed by overlaying a 5 x 5cm grid and recording presence/absence of *P. axinellae* within the grid squares. See Burton, Lock & Newman 2002 for details.



Density: 20 x 20cm framer



Colony area: 50 x 70cm framer

### RESULTS

2009 fieldwork completed:

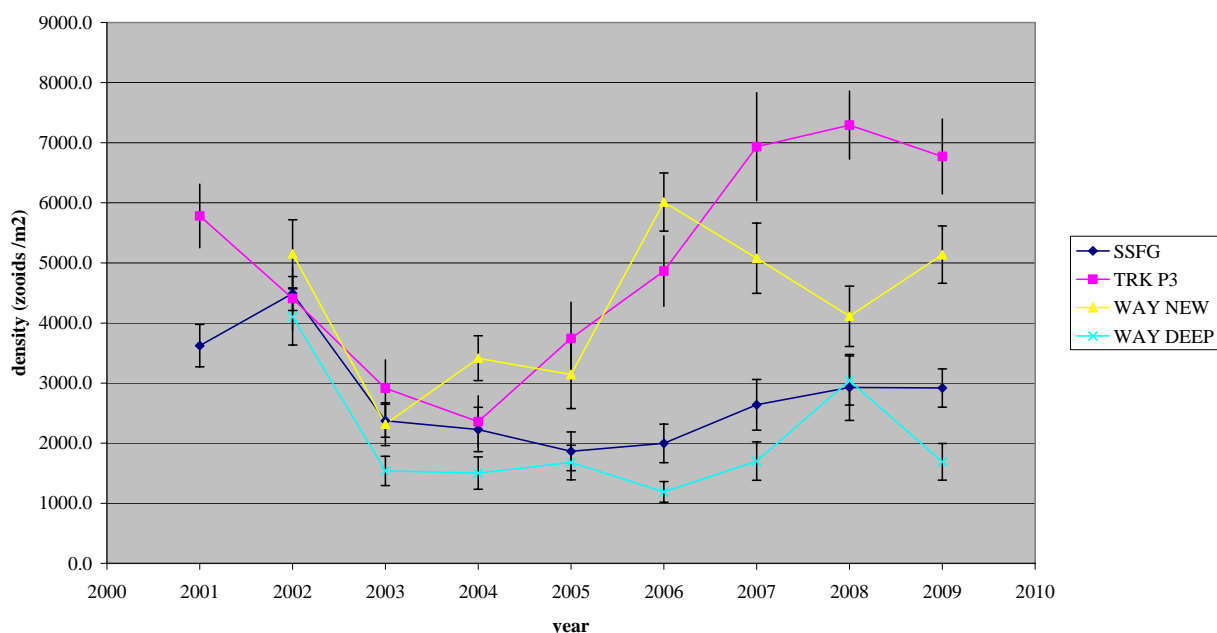
| COLONY AREA                 |                          | DENSITY              |
|-----------------------------|--------------------------|----------------------|
| SITE                        | INDEX OF AREA            | CLOSE UP PHOTOGRAPHS |
| <i>Sandy Sea Fan Gully</i>  | 5 transects (20 samples) | Yes                  |
| Waybench – <i>New Wall</i>  | 9 re-locatable samples   | Yes                  |
| Waybench – <i>Deep Wall</i> | 2 transects (8 samples)  | Yes                  |
| Thorn Rock – <i>Piton 7</i> | 3 re-locatable samples   | Yes                  |
| Thorn Rock – <i>Mooring</i> | 3 re-locatable samples   | Yes                  |
| Thorn Rock – <i>Piton 3</i> | 3 transects (11 samples) | Yes                  |

**Density estimate results (number of polyps / m<sup>2</sup>) 2001 - 2009**

| Site     |             | 2001          | 2002           | 2003          | 2004          | 2005          | 2006            | 2007            | 2008          | 2009          |
|----------|-------------|---------------|----------------|---------------|---------------|---------------|-----------------|-----------------|---------------|---------------|
| SSFG     | <b>Mean</b> | <b>3624.0</b> | <b>4491.2</b>  | <b>2373.3</b> | <b>2227.3</b> | <b>1864.2</b> | <b>1996.9</b>   | <b>2638.3</b>   | <b>2928.1</b> | <b>2918.8</b> |
|          | STDEV       | 1762.4        | 1132.8         | 1554.7        | 2085.9        | 1607.0        | 1820.4          | 2385.6          | 3106.6        | 1802.82       |
|          | n           | 25            | 16             | 32            | 32            | 25            | 32              | 32              | 32            | 32            |
|          | std error   | 352.5         | 283.2          | 274.8         | 368.7         | 321.4         | 321.8           | 421.7           | 549.2         | 318.7         |
|          |             |               |                |               |               |               |                 |                 |               | 0.04          |
| TRK P3   | <b>Mean</b> | <b>5781.2</b> | <b>4408.6</b>  | <b>2914.7</b> | <b>2357.9</b> | <b>3743.4</b> | <b>4863.9</b>   | <b>6933.9</b>   | <b>7294.5</b> | <b>6771.1</b> |
|          | STDEV       | 2176.6        | 2223.4         | 2307.8        | 2432.1        | 3083.9        | 3102.8          | 4016.7          | 2711.9        | 3411.3        |
|          | n           | 17            | 18             | 24            | 32            | 26            | 28              | 20              | 23            | 30            |
|          | std error   | 527.9         | 524.1          | 471.1         | 429.9         | 604.8         | 586.4           | 898.2           | 565.5         | 622.8         |
| Way New  | <b>Mean</b> |               | <b>5151.69</b> | <b>2315.9</b> | <b>3414.1</b> | <b>3143.4</b> | <b>6013.333</b> | <b>5078.676</b> | <b>4112.5</b> | <b>5137.5</b> |
|          | STDEV       |               | 2264.6         | 2075.0        | 2078.4        | 2658.9        | 1872.3          | 3410.9          | 2463.7        | 2331.7        |
|          | n           |               | 16             | 34            | 31            | 22            | 15              | 34              | 24            | 24            |
|          | std error   |               | 566.2          | 355.9         | 373.3         | 566.9         | 483.4           | 585.0           | 502.9         | 476.0         |
| Way Deep | <b>Mean</b> |               | <b>4101.4</b>  | <b>1539.5</b> | <b>1502.6</b> | <b>1679.5</b> | <b>1188.7</b>   | <b>1701.6</b>   | <b>3042.6</b> | <b>1690</b>   |
|          | STDEV       |               | 1871.5         | 1264.6        | 1553.8        | 1494.3        | 958.2           | 1808.3          | 2121.1        | 1666.1        |
|          | n           |               | 16             | 27            | 33            | 27            | 31              | 32              | 27            | 30            |
|          | std error   |               | 467.9          | 243.4         | 270.5         | 287.6         | 172.1           | 319.7           | 408.2         | 304.2         |

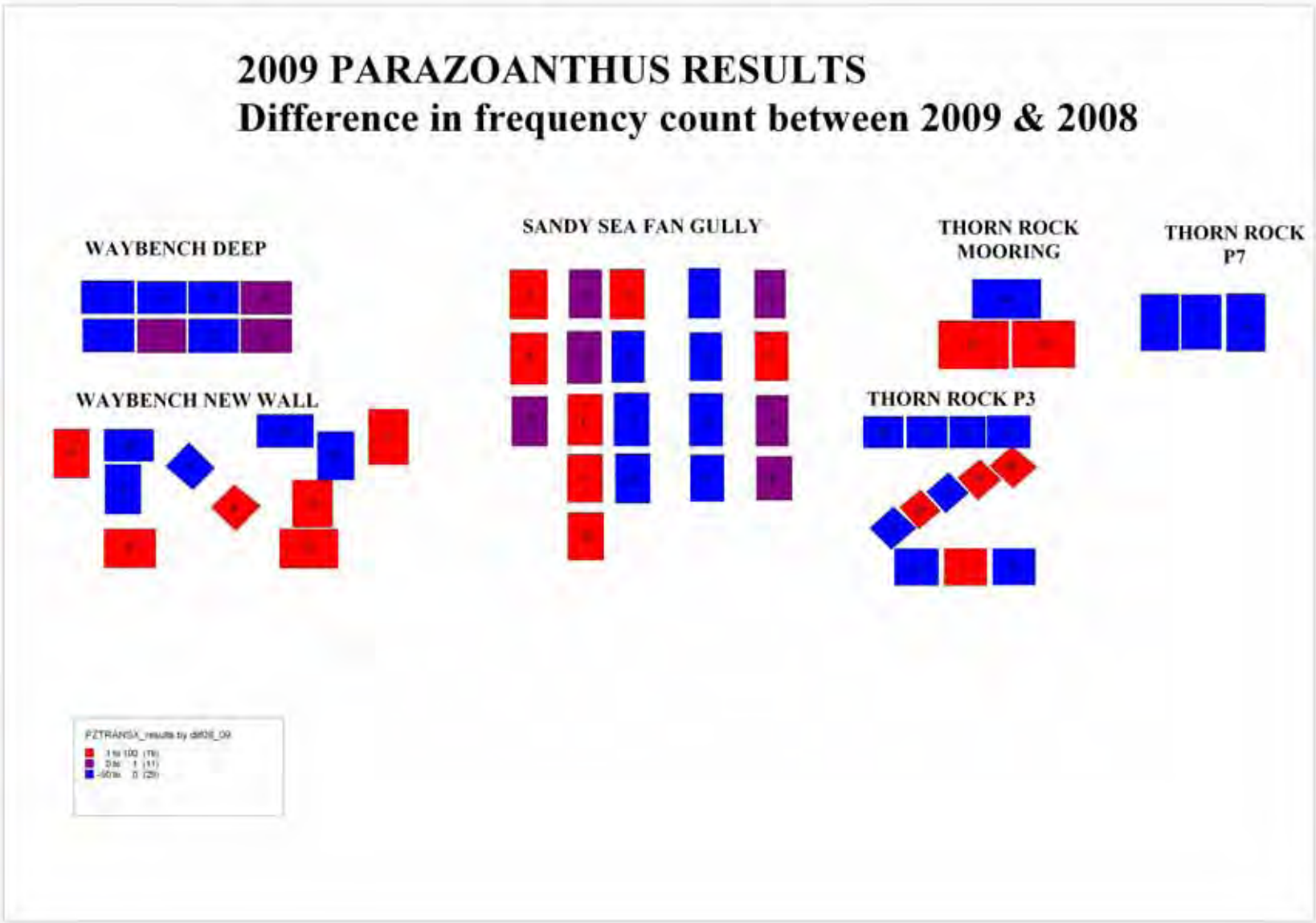
**Density of polyps 2001 – 2009**

**Mean *P. axenellae* density / m<sup>2</sup>**



**RESULTS OF COLONY AREA TRANSECTS FOR 2009**

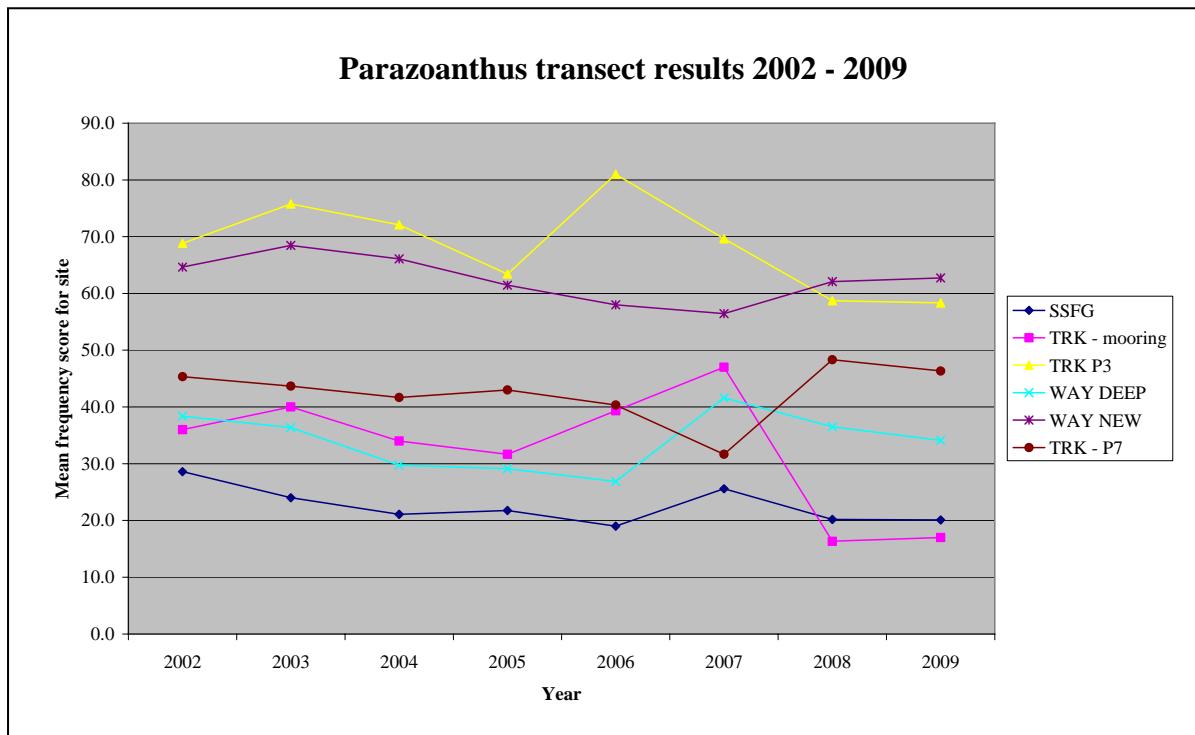
Changes in frequency between 2008 and 2009 (blue shows a loss in frequency red shows an increase)



## Transect results 2002 - 2009

### Mean frequency score from a 120 square grid.

| Site / Year | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 |
|-------------|------|------|------|------|------|------|------|------|
| SSFG        | 28.6 | 24   | 21.1 | 21.8 | 19   | 25.6 | 20.2 | 20.1 |
| TRK P3      | 45.3 | 43.7 | 41.7 | 43.0 | 40.3 | 31.7 | 48.3 | 46.3 |
| TRK P7      | 45.3 | 43.7 | 41.7 | 43.0 | 40.3 | 31.7 | 48.3 | 46.3 |
| TRK Mooring | 36.0 | 40.0 | 34.0 | 31.7 | 39.3 | 47.0 | 16.3 | 17.0 |
| Way Deep    | 38.4 | 36.4 | 29.8 | 29.1 | 26.9 | 41.6 | 36.5 | 34.1 |
| Way New     | 64.6 | 68.5 | 66.1 | 61.4 | 58   | 56.5 | 62.1 | 62.7 |



## CURRENT STATUS

All the colonies are still present. The frequency counts suggest a mixture of gains and losses in area covered between 2008 and 2009. Thorn Rock Mooring showed a decrease in area for 2008 that remained the same in 2009. The density counts have a stable or increasing trend.

## RECOMMENDATION

- Continue current monitoring.
- Continued research is needed on the biology of *Parazoanthus axinellae*.

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Bullimore B. (1986). Burton, M. Lock, K & Newman, P (2002). Brown, A. (2001). Garrabou J. (1999). Gilbert S.E. (1998). Hiscock, K. (1998). Holt R. H. F. (1998) Hughes R.N. Cancino J.N. (1985). Jackson J.B.C. (1977). Lindenbaum, C. *et al.* (2002). Manuel R.L. (1988). Newman P. & Lock K. (2000)

## **CUP CORAL POPULATIONS; *BALANOPHYLLIA REGIA* AND *CARYOPHYLLIA SMITHII***

**(CMS code: RM23/04)**

**STATUS** Ongoing. Annual sampling.

### **PROJECT RATIONALE**

Cup corals are slow growing filter feeders, which are susceptible to changes in water quality and planktonic food supply.

*Balanophyllia regia* is a Lusitanian species; Skomer MNR is close to the northern edge of its range in the UK.

*Caryophyllia smithii* is a common feature of the sub-littoral benthic community of south-western Britain.



### **OBJECTIVES**

Monitor the population for changes in densities and to look for evidence of recruitment.

### **SITES**

- Thorn Rock
- The Wick

### **METHODS**

*Balanophyllia regia*: A fixed position quadrat using a 50 x 40 cm framer at Thorn Rock has been photographed since 1985. In 2002 three transects with 51 quadrats were established at the Wick. Photographs are taken and counts are carried out using GIS techniques (see Burton, Lock & Newman 2002). In 2008 the framer size at the Wick was increased to 50 x 70cm using a digital SLR camera, providing high quality images allowing improved photo analysis.

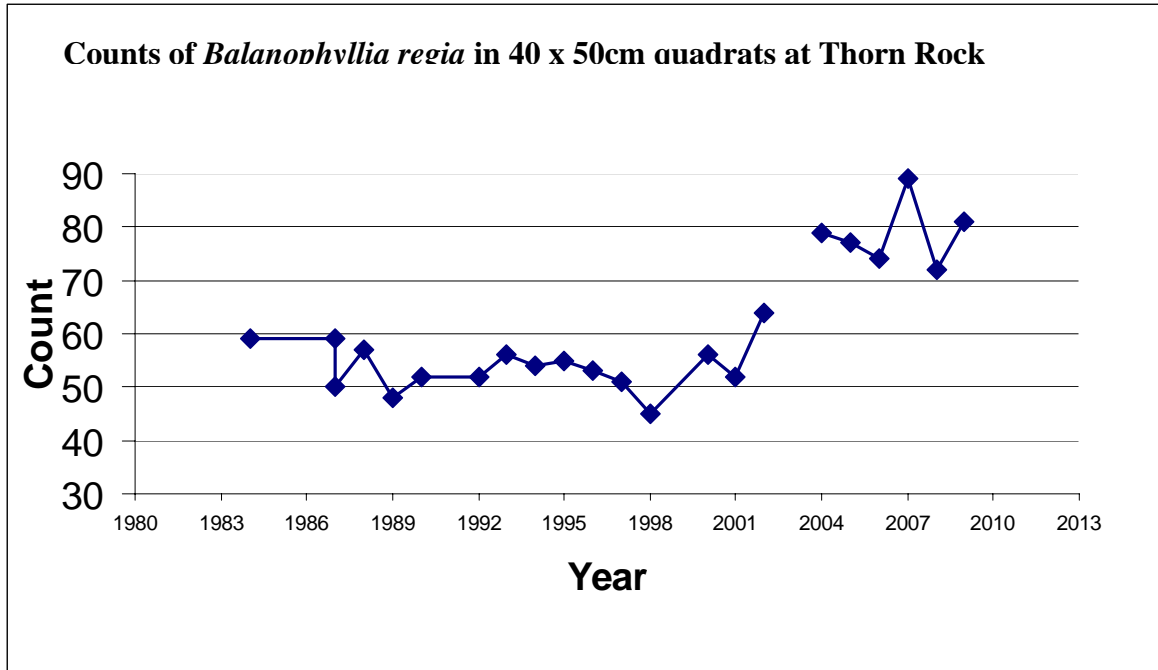


*Caryophyllia smithii*: approximately 70 quadrats have been analysed on a yearly basis since 1993 from photographs taken for the sponge community project at Thorn Rock. Photographs are taken using a 50 x 70cm framer and counts are carried out using GIS techniques.

### **RESULTS**

#### ***Balanophyllia regia*:**

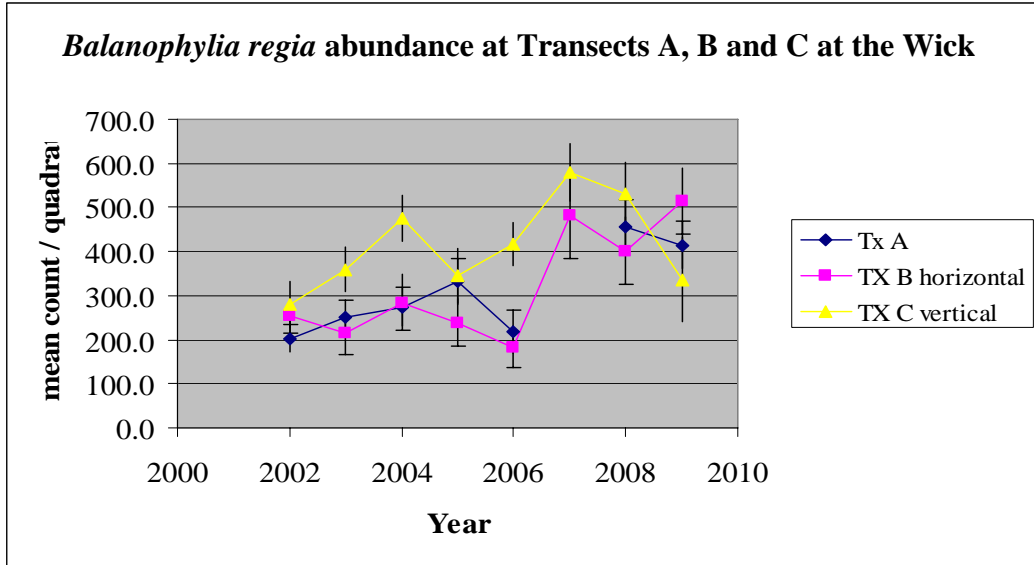
At Thorn Rock individuals have been traced for 20 years in a single 40 x 50cm quadrat. Some evidence of recruitment has been observed, numbers have increased between 1998 and 2005 however this may be due to changes in surface sediment which obscures small individuals.



At the Wick all data has been adjusted to 1m<sup>2</sup> to enable the data from the 50 x 40 cm and the 50 x 70cm framer to be comparable. The average number of *B. regia* has fluctuated but there are no significant differences in densities observed between the 6 years for transects A, B or C. 2007 and 2008 data shows a general increase in abundances for each transect, continued data is needed to monitor this trend.

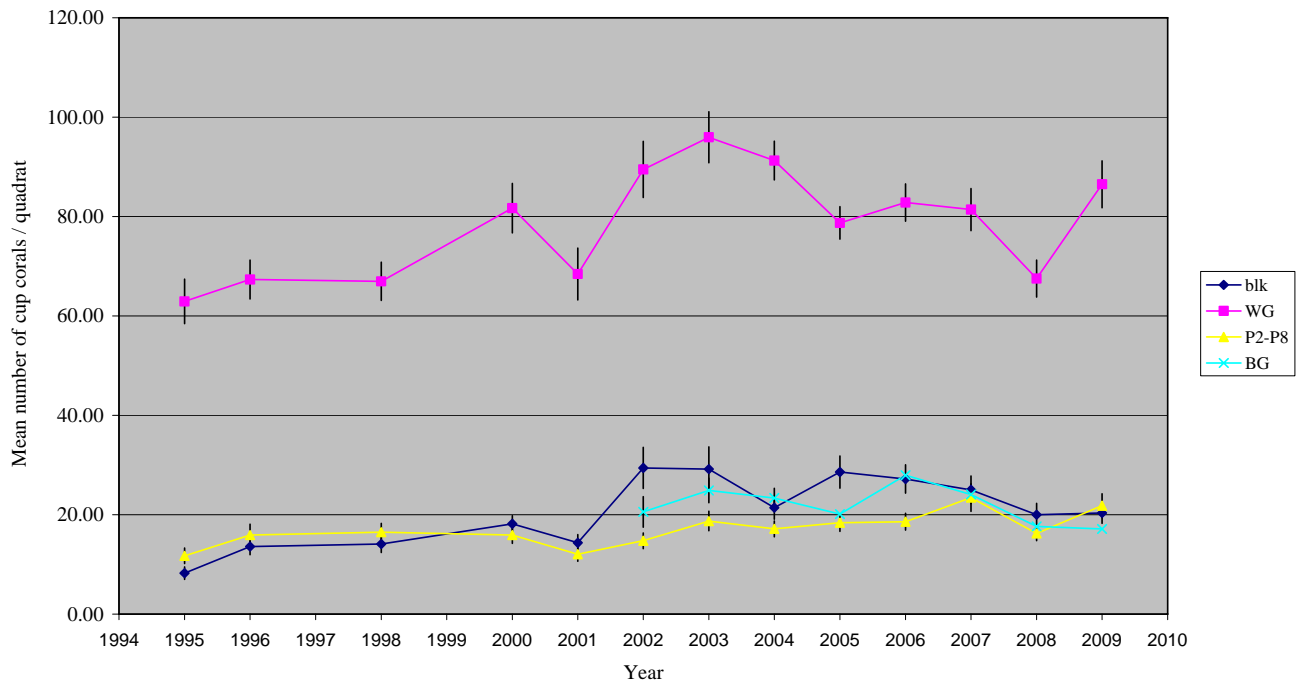
**Abundance of *Balanophyllia regia* in The Wick (adjusted to 1m<sup>2</sup>).**

| Site  | Year | 2002  | 2003  | 2004  | 2005  | 2006  | 2007  | 2008  | 2009  |
|-------|------|-------|-------|-------|-------|-------|-------|-------|-------|
| WCK A | Mean | 202.5 | 251.8 | 274.8 | 333.6 | 217.8 |       | 454.7 | 415.0 |
|       | S.E. | 31.6  | 39.3  | 43.1  | 49.0  | 50.0  |       | 62.3  | 53.4  |
| WCK B | Mean | 252.6 | 214.0 | 283.8 | 239.3 | 183.3 | 483.1 | 401.9 | 515.6 |
|       | S.E. | 37.7  | 47.0  | 63.0  | 54.7  | 46.4  | 97.6  | 76.4  | 74.6  |
| WCK C | Mean | 280.0 | 359.7 | 476.3 | 344.0 | 415.7 | 578.7 | 529.9 | 336.9 |
|       | S.E. | 52.4  | 50.8  | 51.8  | 64.5  | 49.4  | 64.9  | 73.0  | 95.8  |



*Caryophyllia smithii* shows changes in mean abundance, this maybe due to variable levels of surface sediment affecting the actual numbers visible during recording.

Mean number of *C. smithii* per quadrat at 4 sites from 1995 to 2009



**CURRENT STATUS**

Ongoing. Variability in numbers is partly due to varying levels of surface sediment. The populations appear stable although there is no firm evidence of recruitment.

**RECOMMENDATIONS**

- Continue monitoring
- Records of surface sediment levels may help determine whether reduced abundance of cup corals is significant or due to recording inconsistencies.
- Review photographs to test the possibility of tracing individuals from year to year.

## ***PENTAPORA FOLIACEA* (ROSS CORAL) POPULATION**

**CMS code: RM63/01**

**STATUS** Ongoing. Annual survey.

### **PROJECT RATIONALE**

Colonies of the bryozoan *Pentapora foliacea* are fragile structures thought to be moderately slow growing, and long lived. They are important microhabitats for mobile species and are regarded as useful indicators of anthropogenic activity such as mobile fishing gear and anchoring.



### **OBJECTIVES**

1. To monitor the numbers and growth rate of *P. foliacea* colonies.
2. To monitor the amount of damage occurring to the colonies.

### **SITES**

- North of the Neck (2002- onwards)
- North wall (1984 – 2002)
- Way bench (1993/4 restarted 2002- onwards)
- Bernie's Rocks (2 sites 1995 onwards)
- South of Middleholm (2003- onwards)
- West Hook (2004- onwards)

### **METHODS**

Photographs are taken using a single or stereo camera set up on a frame 50 x 70 cm. Photographs of *P. foliacea* are taken along marked transects at each site.

### **RESULTS**

#### ***Pentapora foliacea* photo dataset:**

| Year | North Wall | Waybench | Bernie's Deep | Bernie's Shallow | North Neck | South Middlehom | West Hook |
|------|------------|----------|---------------|------------------|------------|-----------------|-----------|
| 1993 | yes        | yes      |               |                  |            |                 |           |
| 1994 | yes        |          |               | yes              |            |                 |           |
| 1995 | yes        |          | yes           | yes              |            |                 |           |
| 1996 | yes        |          |               |                  |            |                 |           |
| 1997 | yes        |          | yes           | yes              |            |                 |           |
| 1998 | yes        |          | yes           | yes              |            |                 |           |
| 1999 | yes        |          |               |                  |            |                 |           |
| 2000 | yes        |          | yes           | yes              |            |                 |           |
| 2001 | yes        |          |               |                  |            |                 |           |
| 2002 | yes        | yes      | yes           | yes              | yes        | yes             |           |
| 2003 |            | yes      | yes           | yes              | yes        | yes             |           |
| 2004 |            | yes      | yes           | yes              | yes        | yes             | yes       |
| 2005 |            | yes      | yes           | yes              | yes        | yes             | yes       |
| 2006 |            | yes      | yes           | yes              | yes        | yes             | yes       |
| 2007 |            | yes      | yes           | yes              | yes        | yes             | yes       |
| 2008 |            | yes      | yes           | yes              | yes        | yes             | yes       |
| 2009 |            | yes      | yes           | yes              | yes        | yes             | yes       |

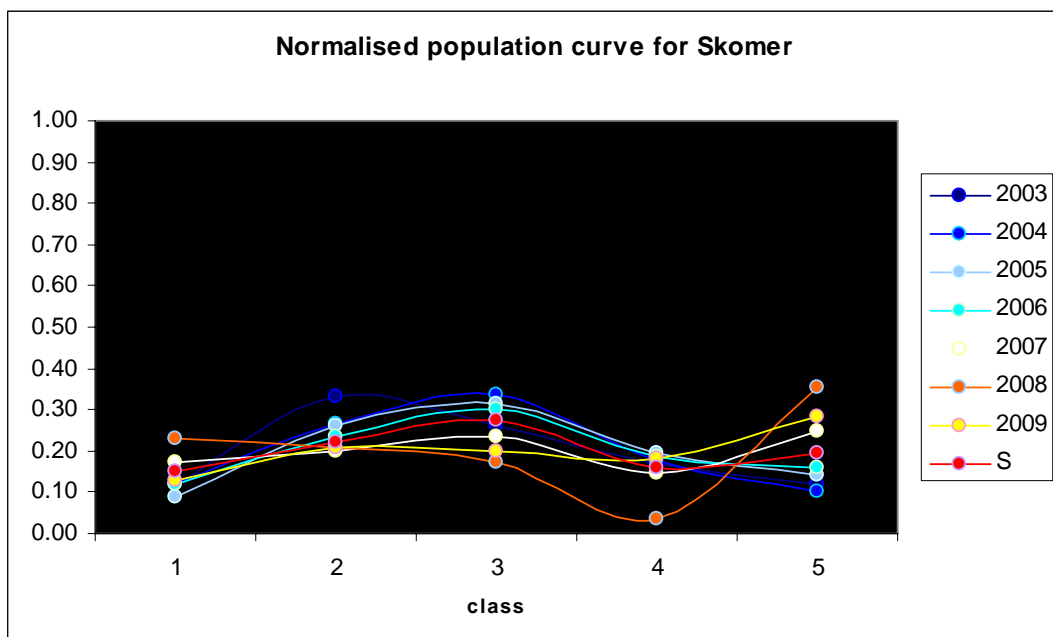
### *Pentapora foliacea* - Growth and community structure

**1998** - Gilbert tested various image analysis methods for assessing growth rate, but concluded that a 3D method would be most suitable. Colonies can be put into size classes using base area (cm<sup>2</sup>) however this is only an approximate measure of colony size.

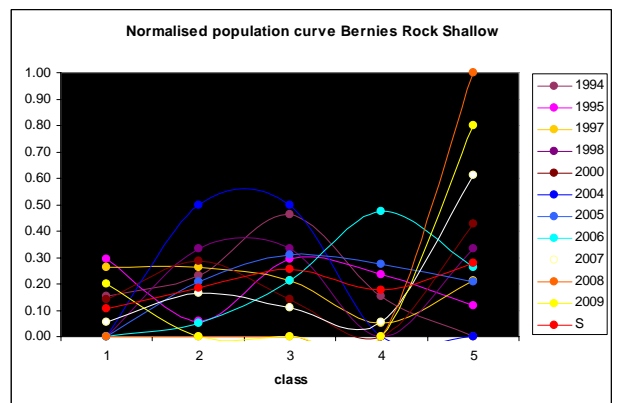
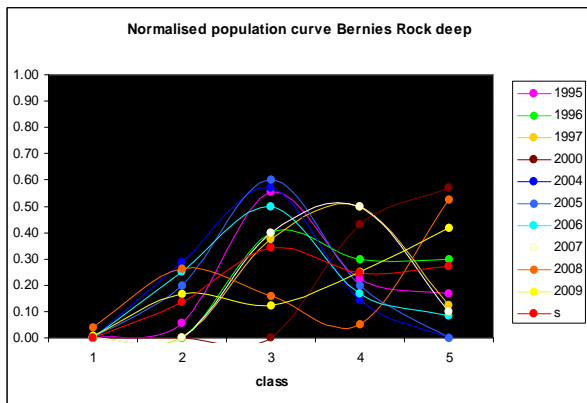
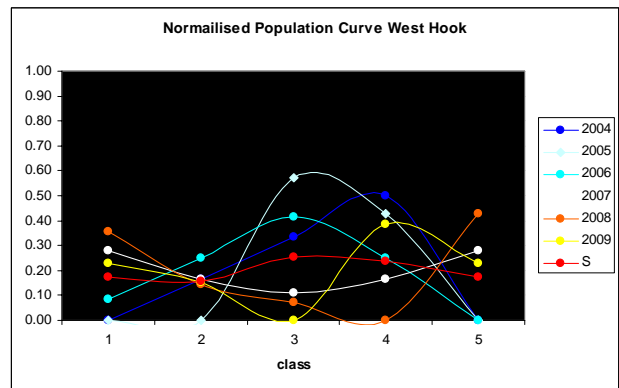
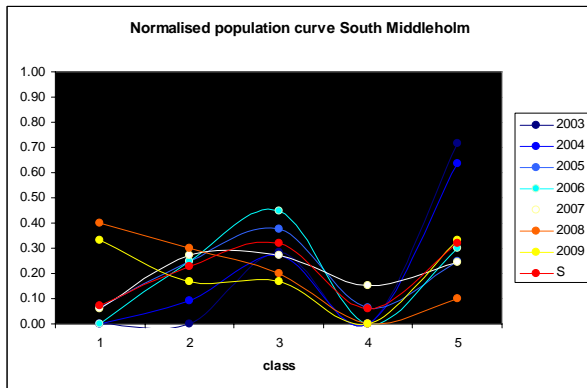
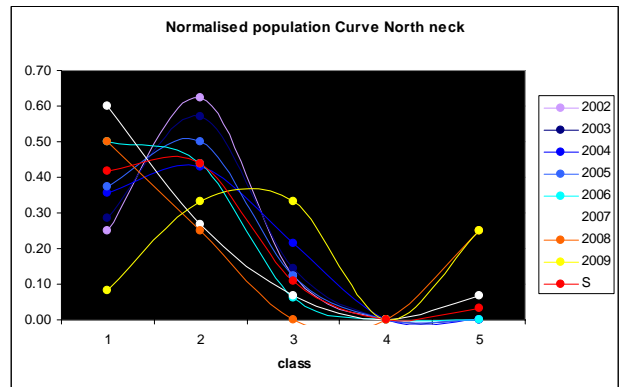
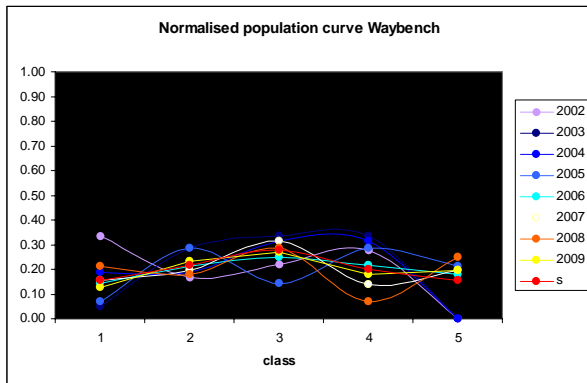
**2005** - Analysis methods were reviewed. The growth of *Pentapora* colonies varies dramatically; one colony showed an increase in base area of over 800cm<sup>2</sup> in one year, whilst other large colonies have all but disappeared. In general colonies that survive tend to grow whilst other colonies of all sizes can just disappear in the space of a year. This suggests that colonies are being physically destroyed or rapidly disintegrate rather than just decrease in size by slow wastage. In 2005 base area measurements were not completed due to inaccuracies in the method.

**2006** - Gibbs developed an empirical calibration method by which a three-dimensional reconstruction of a *Pentapora* colony may be created from stereo-photographs. This method allows the quantification of the growth of the *Pentapora* colony over time. With the historical dataset the precision of data was insufficient for the quantitative method. However a method of useful qualitative interpretation of the data by the creation of time-lapse films (at a rate of 25 days per second) in both monoscopic-colour and dichromatic-stereo was demonstrated. Conclusions drawn from study of the films led to the creation of a 5-stage morphological classification system for *P.foliacea*. The scheme is designed to provide a quick and simple classification of colonies seen during a survey, the distribution of classes within the surveyed population can elucidate the state of the population.

**2007-2009** - The morphological classification method was applied to the current and historical photo dataset, this was continued in 2008 and 2009. The following graph for all Skomer sites shows a general pattern with some fluctuations between year sets. Class 3 stage individuals are the most abundant in the population, these can then either progress into a class 4 and then to a class 5 stage (degradation) or move directly from a class 3 to a class 5 stage missing the class 4 stage out. This is demonstrated by the higher numbers of class 5 individuals compared to class 4.



The morphological classification was applied to the individual sites, the pattern of the population curve varied between sites. Waybench, North of the Neck and South Middleholm sites show a strong pattern between years whilst West Hook, Bernie's Rock shallow and deep sites vary between years.



It is recommended that the method is field tested during in-situ surveys at a selection of sites. Study sites need to include those 'non-impacted' by morphological activities to allow an understanding of normal community functioning of *P. foliacea*. Currently there are none in the Skomer MNR.

### ***Pentapora foliacea* Biological Research by Dr Jo Porter.**

During 2009, collaboration continued with Dr Chiara Lombardi (University of Pavia, Italy) on the genetic variation within and between populations of *Pentapora* with different colony morphologies. To supplement the information collected from locations in the UK (Gateholm, Watwick, Plymouth, Scillies, Channel Isles) and in the Mediterranean (Marseilles, Tino Island, Croatia); the coasts of Spain (Ferrol-Atlantic) and a location on the Spanish Mediterranean coast were targeted for further samples.

Beatriz Luna provided samples from the Mediterranean coast of Spain and Javier Souto provided samples from the Ferrol region in July and August 2009.

These samples are currently being sequenced at Heriot-Watt University using the COI mitochondrial marker and this data will then be incorporated into the phylogenetic tree analysis in order to ascertain whether the different morphologies correspond to separate genetic lineages or whether the colony morphology is the result of environmental factors.

Research into the taxonomy of *Pentapora foliacea* versus *Pentapora fascialis* is ongoing with Mary Spencer-Jones at the Natural History Museum, London, the main hurdle being the lack of a type specimen. Contemporary material was collected from Peveril Ledges in Dorset, close to the type location (Isle of Wight) and that material has been registered at the Bryozoan section, Natural History Museum London. The material corresponds to the foliose colony morphology. A publication is currently being prepared for submission to the International Council for Zoological Nomenclature, to have this contemporary material designated as a neotype. With the taxon stabilised, it will then be possible to generate further publications on the genetics and morphology of *Pentapora* with accurate taxonomic ID to prevent any further confusion.

Honours project student Andrew Ferguson, has been researching the NHM catalogue for *Pentapora*, and is mapping out historical records of its distribution around the British Isles.

### **RECOMMENDATIONS**

- Maintain long-term photographic datasets of individual colonies at a number of different sites.
- Complete in-situ recording of colonies using the morphological classification system identify community structure at a number of different sites.
- Establish a totally non-impacted study area. Until all destructive anthropogenic impacts can be removed from the ecosystem, understanding of its normal functioning cannot begin.
- Continue surveillance to establish the longevity of the colonies and their response to damage.
- Continued research is needed on the biology of *Pentapora foliacea*.

### **REFERENCES**

Bunker & Mercer 1988,  
Bullimore B. 1987, Gilbert S. 1998,  
Gibbs R. 2007.  
Pope A. 2006,  
Cocito S. *et al* 1998,  
Sharp J *et al* 2008,  
Porter J. 2009. pers. comm.  
Knowles T 2009. pers. comm.

## TERRITORIAL FISH POPULATIONS

(CMS code: RA33/01)

**STATUS** Ongoing, sampling every 5years. Presumed favourable

### PROJECT RATIONALE

Fish have received little attention and are poorly described in the survey literature. There is a need to improve knowledge of the diversity and distribution of territorial fish species.

### OBJECTIVES

To assess the distribution and abundance of territorial fish species and to describe their key habitats;

Nine territorial fish species were selected based on common occurrence in the MNR.

|                  |   |   |
|------------------|---|---|
| Wrasse species:  | Ballan wrasse                             | <i>Labrus bergylta</i>                          |
|                  | Cuckoo wrasse                             | <i>Labrus mixtus</i>                            |
|                  | Goldsinny                                 | <i>Ctenolabrus rupestris</i>                    |
|                  | Corkwing wrasse                           | <i>Ctenolabrus melops</i>                       |
|                  | Rock cook                                 | <i>Centrolabrus exoletus</i>                    |
| Benthic species: | Butterfish                                | <i>Pholis gunnellus</i>                         |
|                  | Tompot blenny                             | <i>Parablennius gattorugine</i>                 |
|                  | Sea Scorpion (short spine and long spine) | <i>Myoxocephalus scorpius/ Taurulus bubalis</i> |
|                  | Leopard spotted goby                      | <i>Thorogobius ephippiatus</i>                  |

### SITES

Sites are selected from a range of locations around the North Marloes peninsula (NMPE) and from around the North side of Skomer Island.

### METHODS

The methods have been designed for use with volunteer divers and are fully described in Lock 1998. In 2005 methods were modified to allow improved statistical analysis. The changes allowed some comparison with the 2001 and 2002 surveys. The study sites were marked and GPS positions taken, allowing for replicate transects to be completed and relocation of sites for future surveys. Two depth zones were surveyed 15m and 10m below chart datum. The transect length was increased to 45m (50m tapes used but the first 5m not surveyed to allow for diver disturbance at the start of survey) A speed of 3m/min was maintained to allow consistency of recording and thorough recording of all fish species. Seasearch methods were used for recording seabed substrate and habitat at all transect locations. The revised methods are fully described in Lock *et al.* 2006, these were followed in 2009.

**RESULTS**

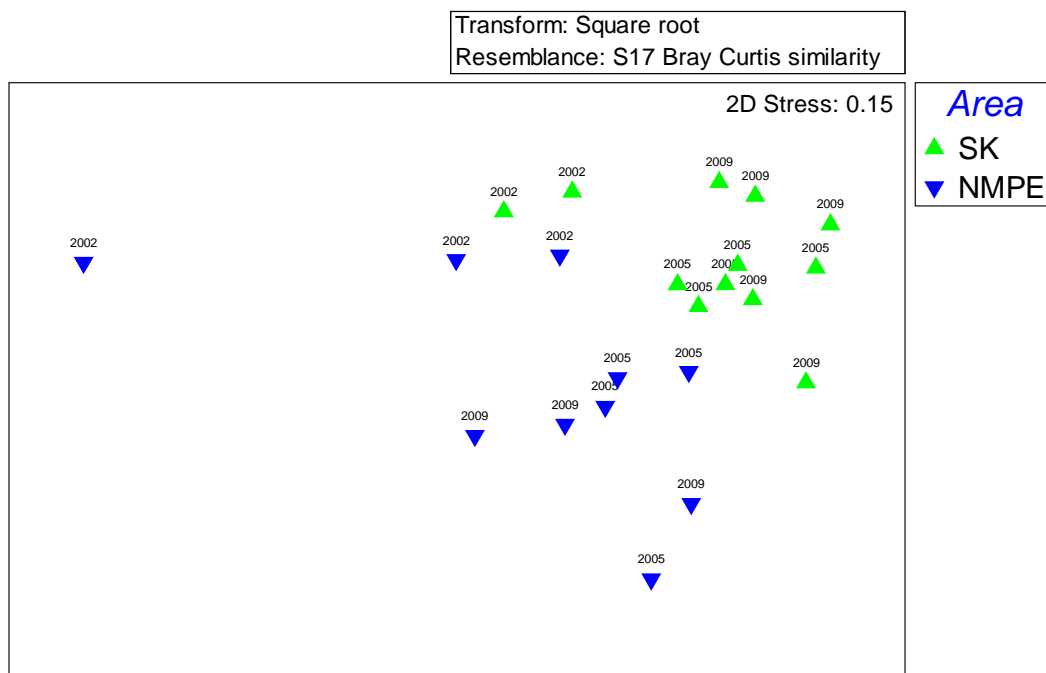
Summary of average fish abundance / 90m<sup>2</sup> from the 4 surveys (2001 – 2009) separated into 2 areas: north side of Skomer Island (SK) & north Marloes peninsula (NMPE).

| year | Area | All fish Species | Wrasse species | Other species |
|------|------|------------------|----------------|---------------|
| 2001 | SK   | 0.4              | 0.6            | 0.2           |
| 2001 | NMPE | 0.2              | 0.3            | 0.2           |
| 2002 | SK   | 1.2              | 1.4            | 0.9           |
| 2002 | NMPE | 0.7              | 1.0            | 0.5           |
| 2005 | SK   | 1.5              | 2.3            | 0.4           |
| 2005 | NMPE | 0.7              | 0.9            | 0.4           |
| 2009 | SK   | 1.7              | 2.6            | 0.6           |
| 2009 | NMPE | 0.7              | 0.9            | 0.4           |

The results show a clear pattern of less fish (wrasse and other species) found at north Marloes peninsula sites compared with a great number recorded at the north Skomer sites. The numbers of wrasse show a greater difference in abundance between the two areas especially in 2005 & 2009. The 2001 numbers are very low. This was due so poor visibility during the survey.

The data was analysed using the PRIMER statistical software to test for differences between the fish communities found at the 2 different areas.

**MDS plot of 2002 – 2009 averaged to Site & year labelled with area**



A 1-way ANOSIM test for area showed a significant difference between the 2 areas:  
 Global Test  
 Sample statistic (**Global R**): **0.445**. Significance level of sample statistic: 0.1%

A 1 way SIMPER test was then run to highlight what species were contributing to this difference:

**Groups SK & NMPE**

Average dissimilarity = 49.90

| Species          | Group SK | Group NMPE | Av.Diss | Diss/SD | Contrib% | Cum.% |
|------------------|----------|------------|---------|---------|----------|-------|
|                  | Av.Abund | Av.Abund   |         |         |          |       |
| Cuckoo Wrasse    | 2.92     | 0.36       | 12.20   | 2.24    | 24.46    | 24.46 |
| Goldsinny Wrasse | 3.71     | 1.67       | 11.01   | 1.53    | 22.06    | 46.52 |
| Ballan Wrasse    | 3.14     | 1.86       | 7.98    | 1.49    | 15.99    | 62.51 |
| Leopard Sp. Goby | 1.68     | 1.29       | 4.80    | 1.11    | 9.63     | 72.14 |
| Rock Cook        | 1.13     | 0.32       | 4.14    | 1.32    | 8.29     | 80.42 |
| Corkwing Wrasse  | 0.85     | 0.30       | 3.50    | 0.99    | 7.01     | 87.43 |

All species abundances are higher at Skomer sites with the Wrasse species contributing most to the dissimilarity.

It is clear there are more fish visible off the Skomer Island coast compared with the mainland coast of the Marloes peninsula. Four separate diver surveys have shown the same pattern of abundance and a video survey (described below) has also come to the same conclusion. Differences between the two areas have been compared:

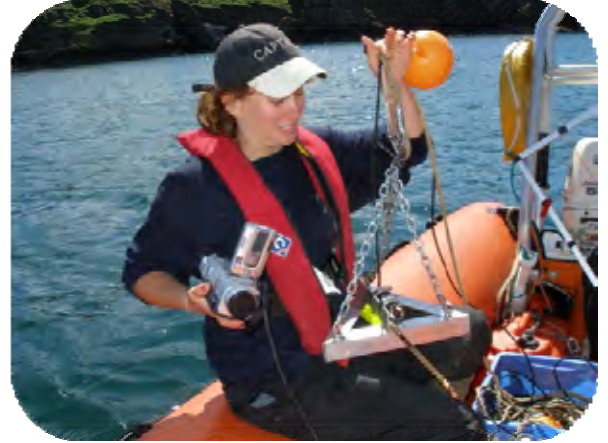
- Habitat: rocky cliffs and boulder slopes in both areas;
- Depth: the surveys were mainly conducted at 10m & 15m BCD, however the Skomer sites do continue deeper down to 40m where as the north Marloes sites flattens out to a sediment seabed at 18-20m BCD;
- Current: the current regime is not the same although both areas do get regular current flow across them;
- Diver visits: both areas regularly visited from May to September;
- Commercial fishing: fishing effort in both areas is comparable in effort and gear type (potting).
- Angling: the obvious difference between the two areas is the amount of recreational angling (see table below). The north Marloes coastline is a very popular area for line fishing from the shore and from boats with 89% of observed angling occurring in this area. The main target species is mackerel (*Scomber scombrus*) but it also popular for Spurdog (*Squalus acanthias*). Wrasse species are not specifically targeted except in species competitions. Recreational angling on the Skomer coast is very rare (1.4%) and it can only be reached by boat.

| YEAR             | NMPE        | Jack Sound | South Skomer | North Skomer | West skomer |
|------------------|-------------|------------|--------------|--------------|-------------|
| 2001             | 98.7        | 0.9        | 0.4          | 0.0          | 0.0         |
| 2002             | 94.9        | 3.6        | 1.5          | 0.0          | 0.0         |
| 2003             | 89.0        | 7.8        | 2.2          | 0.9          | 0.0         |
| 2004             | 94.8        | 4.9        | 0.0          | 0.0          | 0.3         |
| 2005             | 92.3        | 4.4        | 1.3          | 1.5          | 0.5         |
| 2006             | 90.7        | 5.9        | 2.5          | 0.9          | 0.0         |
| 2007             | 84.5        | 4.7        | 6.1          | 2.2          | 2.5         |
| 2008             | 74.6        | 10.2       | 9.4          | 1.5          | 4.2         |
| 2009             | 84.3        | 3.0        | 5.3          | 5.3          | 2.1         |
| <b>Average %</b> | <b>89.3</b> | <b>5.0</b> | <b>3.2</b>   | <b>1.4</b>   | <b>1.1</b>  |

**Summary of observations of recreational anglers (shore and boat) from the Skomer MNR activity records 2001 – 2009 (NMPE & North Skomer are relevant to this study).**

**Fish Drop-down video survey, Natalie Sweet 2007.  
Undergraduate project, Plymouth University.**

In this study, the effects of recreational shore angling pressure on fish assemblage structure and population density within Skomer Marine Nature Reserve were investigated using baited and non-baited remote underwater video camera. Footage was recorded at three sites on the North Marloes Peninsula, popular with recreational anglers, and three sites adjacent to Skomer Island, inaccessible to shore anglers. Relative abundance, species richness and diversity were measured for each sequence, and assemblage structure was examined in order to discover whether significant differences were apparent between fished and non-fished sites.



A total of ten fish species were recorded with the underwater video camera. Kruskal-Wallis tests revealed that the use of bait did not significantly increase the number of fish recorded, and that relative mean abundance and species richness were significantly greater at non-fished sites ( $p < 0.01$ ). ANOVA highlighted significantly greater Shannon diversity at non-fished sites ( $p < 0.01$ ). A significant negative correlation was evident between the number of shore anglers recorded during 2005 and Shannon diversity ( $p < 0.05$ ). Analysis of similarity (ANOSIM) revealed significant differences in assemblage structure between fished and un-fished sites, and similarity percentages (SIMPER) analysis indicated that Goldsinny, Cuckoo wrasse and Poor cod accounted for 73.5% of total abundance.

These results have implications for the management of marine reserves and demonstrate that recreational fishing pressure may have the potential to alter fish assemblage structure and deplete local fish populations.

A further aim of the study was to attempt to assess the effectiveness of this technique in monitoring fish assemblages. It is possible that this could be a reliable method to help provide long-term records that is cost effective and can support the current four yearly diving fish monitoring survey in the MNR.

**Fish Drop-down video survey, Ross Bullimore, 2009  
Undergraduate project, Plymouth University.**

In 2009 Ross Bullimore started a project that aims to develop remote underwater video methods as an economical and low labour intensive tool. This can be used alongside current methods of visual population census at previously studies sites or as a stand alone technique at new sites.

The equipment was built, using a video housing mounted in a lobster pot frame. This was tested during the summer with 15 days at sea completed and 12 hours of raw footage taken. At each deployment a visual diver survey was also completed. Preliminary review of the raw footage confirms the viability of the remote video units for identification and assessing numbers of fish present. Underwater visibility limits the range of the camera view, just as it would a diver. However with the underwater video lights fish can reliably be identified within 2-3m of the video station (4-5m in clearer conditions).

During winter 2009/10 two sets of equipment are being built using smaller lobster pot frames and smaller video housings. This will allow the equipment to be smaller and more manageable to operate. The equipment will be tested in spring 2010 ready for the full planned survey during the 2010 field season.

Sites will be selected in both recreationally fished areas, North Marloes Peninsula, and non-fished areas around Skomer Island, to be comparable with Skomer Marine Nature Reserve visual surveys and previous drop down video studies (Sweet 2007).

### **TARGETS**

To assess the natural distribution and abundance of territorial fish species within the Reserve.

### **CURRENT STATUS**

Baseline survey completed in 2001/2002 and survey repeated in 2005 and 2009.

### **RECOMMENDATIONS**

- Continue with the volunteer survey methodology as established in 1997 with modifications made in 2005 to produce a time series of comparable data.
- Surveys to be repeated every four years, next survey 2013
- Support research projects studying fish populations in the Reserve.
- Continue recording recreational angler numbers and angling locations in the Reserve.

### **REFERENCES**

Lock 1998. Lock *et al.* 2006. Sweet 2008.

## NUDIBRANCH SPECIES DIVERSITY (CMS code: RM54/01)

**STATUS:** Ongoing. Nudibranch species survey every 4 years (next survey 2010).

### PROJECT RATIONALE

Nudibranchs are predators on a wide range of epibenthic species. Most are seasonal and reliant on their prey for food, shelter and a place to lay their eggs. Being near the top of the food chain they can act as an indicator of the health of the communities they rely on. The Skomer MNR nudibranch population have been identified as being rich and diverse with over species including one nationally rare species and four nationally scarce species (Bunker, Picton & Morrow 1992).



### OBJECTIVES

- To produce a species list for the entire Reserve on a 4 yearly basis.
- To record a species check list annually.

### SITES

All of the Skomer MNR

### METHODS

Surveys are done in late spring and late summer to account for variances in species life cycles. Sites from around the whole Reserve are chosen to provide a range of habitat types. The sub-littoral habitat found at each site is described briefly and associated nudibranch species recorded as a list for each site. In addition, an overall list of species is compiled for the Skomer MNR and species recorded photographically.

### RESULTS

Between 1975 and 1991 sixty two species of nudibranchs were recorded during a total of 99 dives at 44 sites were carried out in the Skomer MNR (Bunker *et al.*, 1993).

2002 Twenty dives at 16 sites representing a range of habitats were surveyed for nudibranch species resulting in a total of 32 species. A check list of 16 species was selected for annual monitoring (Luddington 2002).

Checklist species:

|                                  |                               |
|----------------------------------|-------------------------------|
| <i>Acanthodoris pilosa</i>       | <i>Facilina auriculata</i>    |
| <i>Archidoris pseudoargus</i>    | <i>Flabellina pedata</i>      |
| <i>Crimora papillata</i>         | <i>Janolus crisatus</i>       |
| <i>Diaphoradoris luteocinata</i> | <i>Limacia clavigera</i>      |
| <i>Doto fragalis</i>             | <i>Polycera faeronensis</i>   |
| <i>Doto pinnatifida</i>          | <i>Polycera quadrilineata</i> |
| <i>Eubranchus farrani</i>        | <i>Tritonia lineate</i>       |
| <i>Facilina aunulicornis</i>     | <i>Tritonia nilsodhneri</i>   |

2003 and 2004 All 16 species from the checklist were recorded. A notable record is *Tritonia nilsodhneri* on the pink seafan, *Eunicella verrucosa*,. This was recorded at two sites (Bernie's Rocks

and North Wall east) during *E. verrucosa* monitoring. *T. nilsodhneri* is a nationally rare species and is a UK BAP species.

2006 Thirty five nudibranch species were recorded from 13 sites during 21 dives. The sites represented a range of habitats for nudibranch species. The species lists for 2002 and 2006 were compared. Combining the 2002 and 2006 data 41 dives completed at 20 sites recorded 46 species. Notable records were *Doris sticta* a nationally scarce and three species not previously recorded in the historical data set, *Cadlina laevis*, *Doto eireana* (Unconfirmed by specialist) and *Onchidoris pusilla*. 2007 14 of the 16 species from the check list were recorded including *Tritonia nilsodhneri*.

2009 15 of the 16 species from the check list were recorded during the season, nudibranch species recording was boosted by records made by volunteer Seasearch divers in the Reserve. These included nationally scarce and rare species: *Thecacera penigera*, *Doris sticta* and *Tritonia nilsodhneri*. Notable was *Trapania tartenella* a new record for both Skomer and Wales and *Doto hystrix* that was not found on either the 2002 or 2006 surveys these were recorded and photographed by diving volunteers Sarah Bowen and David Kipling.



*Doto hystrix*



*Trapania tartenella*

## TARGETS

- Observe 80% of the 16 check list species annually.
- To complete a species list for the Reserve every 4 years.

## CURRENT STATUS

35 nudibranch species were recorded in 2006 and the combined 2002/2006 data gives 46 species. This is lower than the full species list of 67 species but the survey effort is far less than for the historical data.

In 2009 93% of the checklist species were recorded and additional species recorded by volunteer Seasearch divers including national rare species and a new record for the Reserve.

## RECOMMENDATIONS

- Complete the annual check list;
- Photograph and collect any unusual species for identification;
- Skomer MNR staff to complete nudibranch identification training;
- Complete a nudibranch species survey in the Skomer MNR every 4 years.

## REFERENCES

Bunker, Picton & Morrow 1993, Luddington 2002.

## ATLANTIC GREY SEAL (*HALICHOERUS GRYPUS*) POPULATION (CMS code: RA03/01)

**STATUS** Ongoing. Annual survey.

### PROJECT RATIONALE

Grey seals are a protected species of conservation importance, which live and breed in the Skomer MNR. The west Wales population is the largest in south west Britain and is a feature of the Pembrokeshire Marine SAC.

### OBJECTIVES

To monitor the number and survival rate of seal pups born in the MNR.

### SITES

All pupping beaches and caves in the MNR.

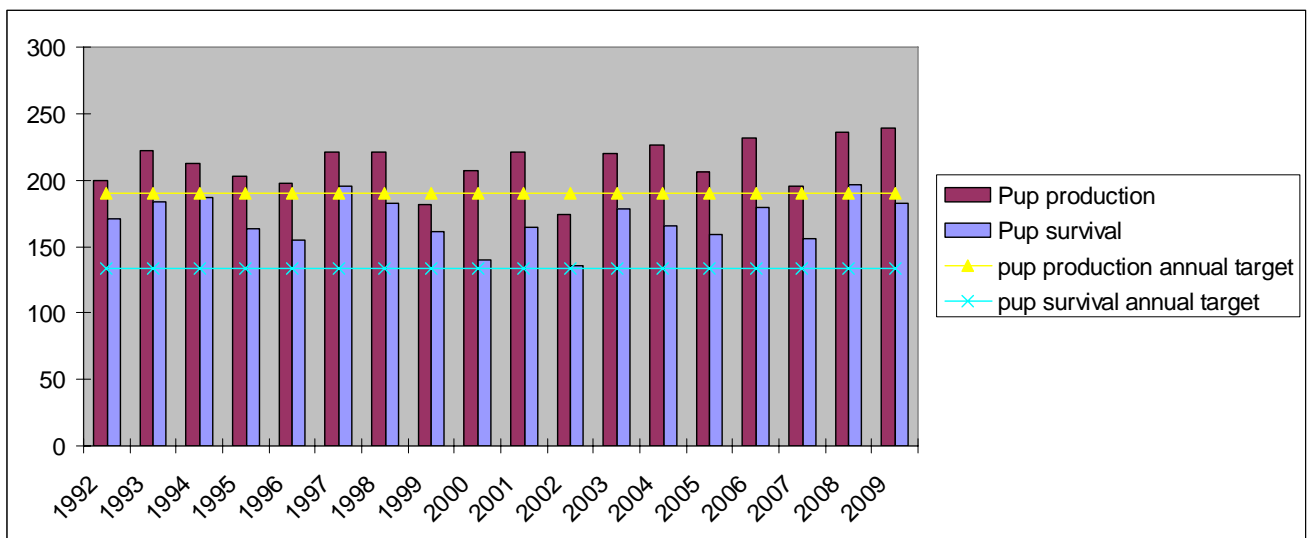
### METHODS

The pups are recorded from birth through to their first moult using the “Smith 5-fold classification system” (Poole 1996). Reason for death is recorded if possible. Additional behavioural observations are recorded for the Island seals (Full method described in ‘Grey Seal Monitoring Handbook’ Poole 1996).

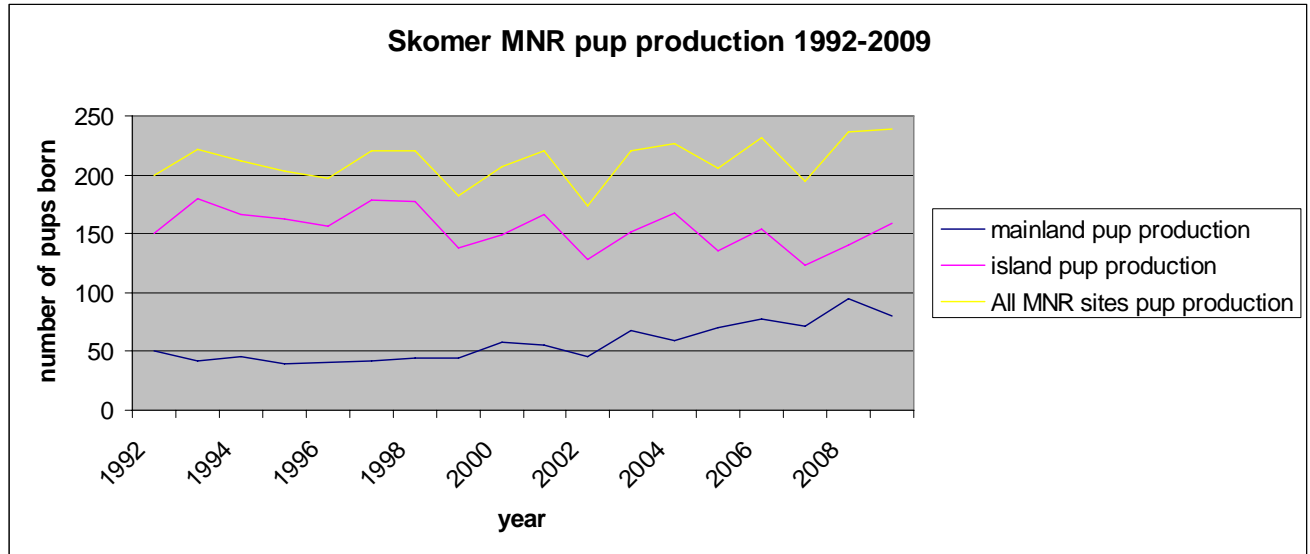


### RESULTS

Regular recording began on Skomer Island in 1974 and surveys have been completed annually since 1983. From 1992 onwards a standard protocol has been adopted to record the pupping success on both the island and the mainland each year.



241 pups were born in the MNR in 2009 and survival was 76%. This is above the annual targets for both pup production (190 births) and survival (70%) set for the MNR.



The number of seal pups born each year fluctuates but looking at the trend lines the number of pups born in the MNR as a whole has remained fairly consistent for the last 18 years. The 241 pup total is the highest total ever recorded. Over the last 8 years there has been a general increase in the numbers born at the mainland sites and this has been mirrored by a general decrease in numbers at the island sites. However in 2009 159 pups were born on the island, the highest numbers since 2004, the island also had a late season with six times more pups born in November than the average for the last 10 years (Boyle 2010).

### ADDITIONAL SEAL STUDIES

**1998** Provision of information about seal watching and current pup numbers at sites around the Marloes Peninsula was commenced at the MNR Visitor Centre.

**2002** Methods to study seal disturbance at mainland sites were tested and a further survey in 2003 by placement students from Pembrokeshire College. A trial MNR 'seal watching' leaflet was produced and distributed at the National Trust car park at Martins Haven. The leaflet included information on how to behave whilst watching seals. The 2003 survey completed a questionnaire on the usefulness of the leaflet. The leaflet was a success and was published ready for the 2004 season and a full report on the seal disturbance study was completed (Lock, 2004).

**2004** A project to identify individual seals was started for mainland sites by a placement student from Pembrokeshire College; this followed methods in the 'Grey Seal Monitoring Handbook' Poole 1996 and tested photo and video methods.

**2005** Photo methods were also introduced to the adult seal identification project on Skomer (Matthews 2006). A Pembrokeshire college student, Liz Coutts, completed a study on the behaviour of bull seals at two island sites (Coutts 2006).

**2007** A project was completed by Dave Boyle studying the bull seals at all Skomer sites during September and October through funding secured by the Wildlife Trust South and West Wales. The

bulls were individually identified by their scars and markings. All bulls were sketched and photographed along with dates, location and dominance being recorded (Matthews & Boyle 2008).

**2008** At Skomer sites photography was extended to include indistinct pupping cows help increase knowledge of site fidelity, longevity and pupping frequency (Boyle 2009). This was continued in the 2009 season. In 2009 228 seals were photographed including 103 (65%) of the pupping cows and 100 individual seals (77 cows, 23 bulls) were positively identified from previous years

### TARGETS

- Number of pups born annually should be greater than 190 (170 in any 4 year period, provided numbers recover to over 190 in the following year)
- Percentage survival of pups greater than 70% (67% in any 4 year period, provided survival recovers to over 72% in the following year).

### CURRENT STATUS

2009 pup numbers reached 241, 29 pups higher than the average for the last 18 years. Pup survival was 76% (4% below the average). There were relatively few periods of harsh weather and little sign of disease; the majority of deaths were caused by abandonment or separation. The most prolific period September with 48% pups born in the reserve, 26% were born in October and 17% in November. The last pup of the season was born on 25<sup>th</sup> December (Sutcliffe pers. comm.) and this was seen to moult on the 21<sup>st</sup> January 2010.

In 2009 monofilament line and netting were recorded entangled on adult seals. Photo records are being maintained. About 15-20 individual seals around the island show signs of having been caught in nets at some time in their lives, most commonly a deep scar around their necks, sometimes with a small amount of netting still embedded. Seven seals seen in 2009 showed more obvious signs of having become trapped in fishing nets, although none seemed especially adversely affected. Three were returning individuals, the other four were seen for the first time in 2009 (Boyle 2010).

**NK-076** returned for the seventh consecutive year, still with monofilament netting embedded in two deep scars around her neck.

### Plate 8.1 NK-076 in 2009



**NK-094**, probably a young bull, returned for the fourth year and still has a length of green chord around his neck

**Plate 8.2 NK-094 in 2009**



**NK-107**, an adult cow new this year, has a long length of green netting around its neck

**Plate 8.4 NK-107 in 2009**



## **RECOMMENDATIONS**

1. To continue annual survey following the 'Grey Seal Monitoring Handbook' Poole 1996.
2. To continue recording seal disturbance at mainland and island sites.
3. To continue the adult seal identification project following methods developed in 2004 (mainland) and 2005 (island).
4. Provide visitors with information about Atlantic grey seals both in the Visitor Centre and through the distribution of the 'seal watching' leaflet developed in 2002.

## **REFERENCES**

Skomer Seal Census Reports: Davis & Davis 1976; Alexander & Alexander 1985; Hellawell, 1987, 1988; Sutcliffe, 1989; Orsman 1990, 1991; Poole, 1992 - 1999; Field 2000; Pillsworth 2001, Boyle 2002, Duffield 2003, Matthews 2004 –2007, Matthews & Boyle 2008, Boyle 2009 – 2010.  
Grey Seal Monitoring Handbook, Poole 1996.  
Bull Seal studies on Skomer: Coutts 2006 and Matthews & Boyle 2008.  
Marloes Peninsula pup production data: Anderson 1977; Cullen 1978; MNR records 1992-2007.  
Seal disturbance studies: Lock 2004.

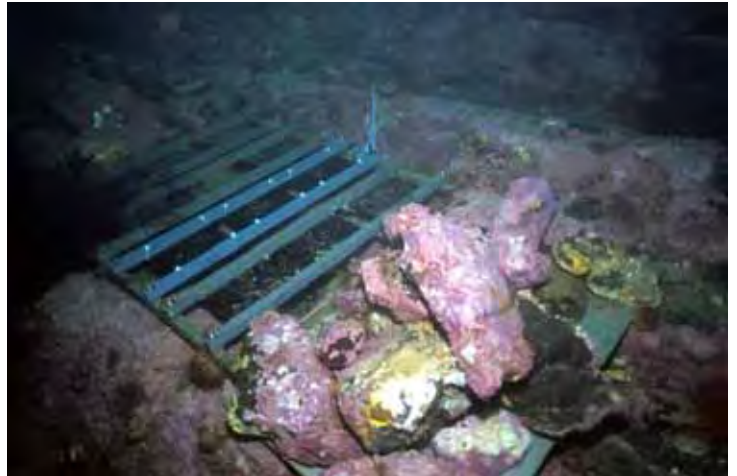
## **SPECIES RECORDING** **(CMS code: RB06/01)**

**STATUS** Ongoing, annual recording.

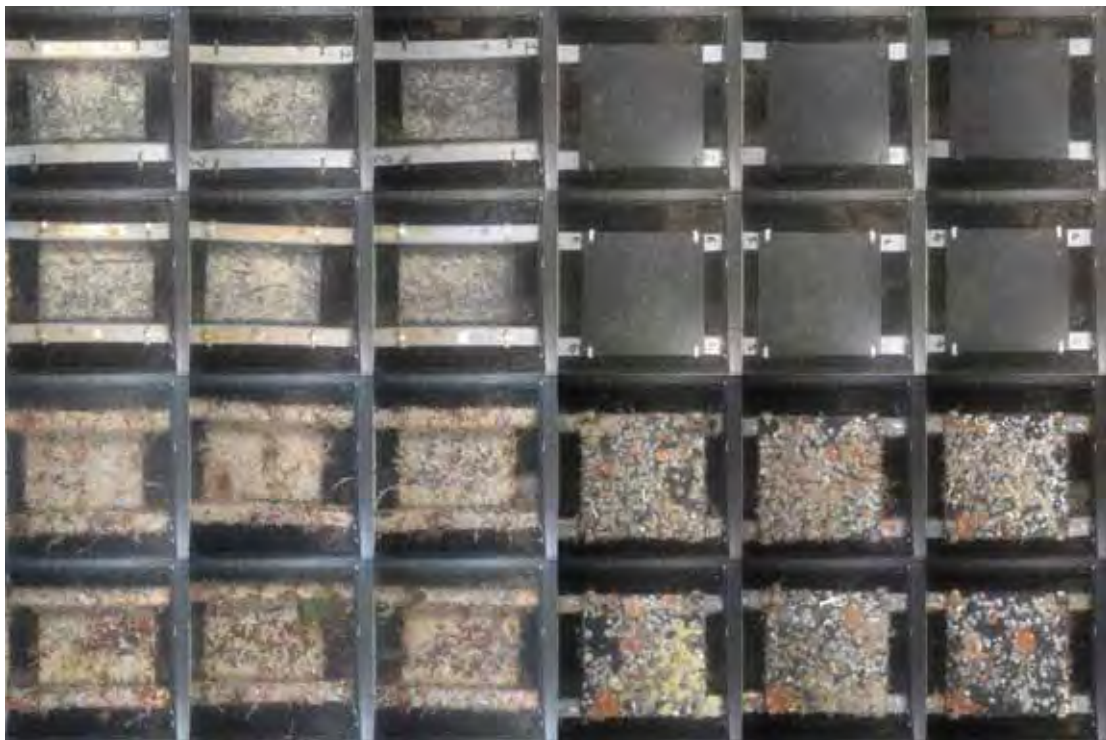
### **PROJECT RATIONALE**

There are many species in the Marine Nature Reserve that do not have a dedicated monitoring project. It is important that species lists are maintained, particularly for phyla that are under-recorded. Records of unusual, rare, scarce or vagrant species are also maintained.

In 2009 the Skomer MNR became host to a new project 'Cryptic fauna colonisation and succession project' lead by Piotr Kuklinski from Warsaw Oceanographic Institute and the Natural History Museum London. Piotr set up settlement plates at two depth locations at Bernie's Rocks on the north side of the island and Thorn Rock on the south side. A programme of sequence photography and panel exchanged is followed on a monthly basis at each site. The panels will be examined by Piotr for colonising fauna. This project is already established at sites in Spitzbergen, Baltic and Mediterranean.



Example of monthly sequence photos of settlement plates:



Crawfish *Palinurus elephas* became a national Biodiversity Action Plan species in 2008. During 2009 it was recorded in very low numbers in the Reserve by MNR staff and volunteers. These records have been entered into the online recording scheme that has been set up on the Seasearch website [www.seasearch.org.uk](http://www.seasearch.org.uk) the aim is to gain better knowledge of the historical and current status of this species in the UK.



*Dromia personata*, the ‘sponge crab’ has been seen a several sites in the Skomer MNR during 2008 and 2009. It cuts a distinct chunk out of the boring sponge *Cliona celata* which it uses to cover itself like a cloak. The numbers of sightings of this crab both in the MNR and at sites in north Pembrokeshire between Porthgain and Strumble Head have increased in recent years.



At the end of 2008 large numbers of common mussel *Mytilus edulis* spat was found on mooring ropes and the hull of RV Skalmey. During 2009 it was evident that the mussel spat had settled at several sites in the MNR. At Bull Hole and Garland Stone on the west side of the island the mussels were particularly abundant; these are high current swept sites. The mussels were also found on the north coast at Bernie’s Rocks and on the reef south of Middleholm. In St Brides bay mussel beds were also recorded at Stack Rocks, Hen & Chicks, Black Scar and a several sites along the North Pembrokeshire coast between Porthgain and Strumble Head.

Seasearch survey forms were completed by volunteer divers during a Seasearch weekend. West Hook, the point east of Martins Haven and west Waybench were targeted as sites where little general recording has been completed. Survey forms were also completed during the Territorial fish survey volunteer diving weekends to provide supportive habitat and species data. The following table shows the species recorded at each site, this data has been entered into the national database Marine Recorder.

(S Super abundant, A Abundant, C Common, F Frequent, O Occasional, R Rare, P Present)

| <b>SPONGES</b>                | <b>RRK</b> | <b>EHK</b> | <b>West WAY</b> | <b>East MHV</b> | <b>WHK</b> | <b>MHV</b> |
|-------------------------------|------------|------------|-----------------|-----------------|------------|------------|
| <i>Cliona celata</i>          | P          | F          | O               | F               | C          | C          |
| <i>Axinella dissimilis</i>    | P          |            |                 |                 |            | R          |
| <i>Raspalia ramosa</i>        | P          |            | F               |                 |            |            |
| <i>Thyrosia guernei</i>       | P          |            |                 |                 |            |            |
| <i>Dysidea fragalis</i>       | P          | F          | O               | O               |            |            |
| <i>Hemimycale collumella</i>  |            | O          |                 |                 |            |            |
| <i>Stelligera sp</i>          |            |            | F               | F               |            |            |
| <i>Leucosolenia sp</i>        |            |            | O               |                 |            |            |
| <i>Tethya celata</i>          |            |            | O               |                 |            |            |
| <i>Haliclona urceolus</i>     |            |            | R               |                 |            |            |
| <i>Amphilectus focurum</i>    |            |            |                 | R               |            |            |
| <i>Polymastia penicilus</i>   |            |            |                 |                 | O          |            |
| <i>Halichondria sp</i>        |            |            |                 |                 | R          |            |
| <i>Pachymatisma johnstoni</i> |            |            |                 |                 |            | R          |

| <b>CNIDERIANS</b>                |   |   |   |   |   |   |
|----------------------------------|---|---|---|---|---|---|
| <i>Eunicella verrucosa</i>       | P |   | O |   | R | R |
| <i>Caryophyllia smithii</i>      | P | F | C | C | A | O |
| <i>Alcyonium digitatum</i>       | P |   | O | A | S | C |
| <i>Alcyonium glomeratum</i>      | P |   | F |   |   |   |
| <i>Nemertisia ramosa</i>         |   | F | F | F | C |   |
| <i>Nemertisia antennina</i>      |   |   | C | C | S | O |
| <i>Halecium halecium</i>         |   |   | O | F |   |   |
| <i>Corynactis viridis</i>        |   |   | O | F | A | O |
| <i>Isozoanthus sulcatus</i>      |   |   | P |   |   |   |
| <i>Aglophenia tubulifera</i>     |   |   | O |   |   |   |
| <i>Obelia geniculata</i>         |   |   | F |   | R |   |
| <i>Kirchenpauria pinnata</i>     |   |   | O |   |   |   |
| <i>Aglaophenia kirchenpaueri</i> |   |   | O |   |   |   |
| <i>Sertularia gayi</i>           |   |   | O |   |   |   |
| <i>Cerus pedunculatus</i>        |   |   |   | O |   |   |
| <i>Anemonia viridis</i>          |   |   |   |   |   | O |
| <i>Metridium senile</i>          |   |   |   |   |   | F |
| <i>Urticina felina</i>           |   |   |   |   |   | R |
| <b>WORMS</b>                     |   |   |   |   |   |   |
| <i>Bispira volantacornis</i>     | P | O | F |   | F | R |
| <i>Phoronis hippocrepia</i>      | P |   | O |   |   |   |
| <i>Myxicola spp</i>              | P |   | P | O |   |   |
| <i>Prostheceraeus vittatus</i>   | P |   | O | F | O | R |
| <i>Sabella pavonina</i>          |   |   | O | O |   |   |
| <i>Pomatoceros spp</i>           |   |   | C | O | O |   |
| <i>Lanice conchilega</i>         |   |   |   | R | F |   |
| <b>CRUSTACEANS</b>               |   |   |   |   |   |   |
| <i>Maja squinado</i>             | P | F | O | O | C | C |
| <i>Balanus crenatus</i>          |   | A | A | A |   |   |
| <i>Inachus spp</i>               |   | P |   |   |   | R |

|                                  | RRK | EHK | WEST WAY | EAST MHV | WHK | MHV |
|----------------------------------|-----|-----|----------|----------|-----|-----|
| <i>Necora puber</i>              | P   |     | O        | F        | F   | C   |
| <i>Hommarus gammarus</i>         | P   |     | F        | R        | F   | O   |
| <i>Cancer pagarus</i>            | P   |     | O        | O        | O   | O   |
| <i>Palinurus elephas</i>         |     |     | P        |          | P   |     |
| <i>Xantho spp</i>                |     |     | R        |          |     |     |
| <i>Dromnia personata</i>         |     |     |          |          | R   |     |
| <i>Carcinus maenus</i>           |     |     |          |          | O   |     |
| <b>MOLLUSCS</b>                  |     |     |          |          |     |     |
| <i>Tritonia lineata</i>          | P   |     | R        |          |     |     |
| <i>Tritonia nilsodhneri</i>      | P   |     | R        |          |     |     |
| <i>Eubbranchus tricolour</i>     | P   |     |          |          |     |     |
| <i>Doto fragilis</i>             | P   |     |          |          |     |     |
| <i>Crimora papillata</i>         |     | P   | O        | C        |     |     |
| <i>Coryphella sp</i>             |     |     | R        |          |     |     |
| <i>Limacia clavigera</i>         |     |     | R        | O        | O   |     |
| <i>Polycera faeroensis</i>       |     |     | O        |          |     |     |
| <i>Flabellina pedata</i>         |     |     | O        |          |     |     |
| <i>Janolus cristatus</i>         |     |     | R        |          | R   |     |
| <i>Doto hystrix</i>              |     |     | R        |          |     |     |
| <i>Facelina annulicornis</i>     |     |     | F        | O        |     |     |
| <i>Doto pinnatifida</i>          |     |     |          | O        |     |     |
| <i>Tritonia hombergi</i>         |     |     |          | O        | R   |     |
| <i>Diaphoradoris luteocincta</i> |     |     |          |          |     |     |
| <i>Aplysia punctata</i>          |     |     | F        |          | R   |     |
| <i>Simnia patula</i>             |     |     |          | O        |     |     |
| <i>Hinia reculata</i>            |     |     |          |          | F   |     |
| <i>Trivia monacha</i>            |     |     |          |          | O   |     |
| <i>Calliostoma zizyphinum</i>    |     |     | O        |          | O   |     |
| <i>Pecten maximus</i>            |     | P   | P        |          |     | P   |
| <i>Gibbula cineraria</i>         |     |     |          |          |     |     |
| <i>Colpodaspis pusilla</i>       | P   |     |          |          |     |     |
| <i>Mytilus edulis</i>            |     |     |          |          |     | A   |
| <i>Eledone cirrhosa</i>          |     |     |          |          |     | R   |
| <b>BRYOZOANS</b>                 |     |     |          |          |     |     |
| <i>Pentapora foliacea</i>        | P   |     | O        | O        |     | R   |
| <i>Alcyonidium diaphanum</i>     | P   |     | F        |          | C   |     |
| <i>Bugula plumosa</i>            | P   | F   | A        | C        | C   | O   |
| <i>Crisia sp</i>                 | P   |     | C        | C        | F   |     |
| <i>Chartella sp</i>              | P   |     |          | F        |     |     |
| <i>Cellaria sp</i>               |     | C   | A        | F        |     |     |
| <i>Bugula flabellata</i>         |     | C   | C        | C        |     |     |
| <i>Bugula turbinata</i>          |     |     | C        |          |     |     |
| <i>Membranipora membranacea</i>  |     |     | F        |          | O   |     |
| <i>Scrupocellaria sp</i>         |     |     | C        |          |     |     |
| <i>Electra pilosa</i>            |     |     |          |          | F   |     |

|                                 | <b>RRK</b> | <b>EHK</b> | <b>West<br/>WAY</b> | <b>East<br/>MHV</b> | <b>WHK</b> | <b>MHV</b> |
|---------------------------------|------------|------------|---------------------|---------------------|------------|------------|
| <b>ECHINODERMS</b>              |            |            |                     |                     |            |            |
| <i>Marthasterias glacialis</i>  | P          |            | F                   | F                   | O          | O          |
| <i>Echinus esculentus</i>       | P          | F          | F                   | O                   | F          | C          |
| <i>Holothuria forskali</i>      | P          |            | R                   |                     |            |            |
| <i>Pawsonia saxicolis</i>       |            | F          | F                   |                     |            |            |
| <i>Aslia lefevrei</i>           |            | F          | O                   |                     | C          |            |
| <i>Neopentodactyla mixta</i>    |            |            |                     | R                   |            |            |
| <i>Asterias rubens</i>          |            |            |                     |                     | O          |            |
| <b>ASCIDIANS</b>                |            |            |                     |                     |            |            |
| <i>Botryllus schlosseri</i>     | P          |            | P                   |                     |            |            |
| <i>Clavalina lepadiformis</i>   |            |            | P                   | C                   | O          |            |
| <i>Aplidium punctum</i>         |            |            | O                   |                     |            |            |
| <i>Ascidia mentula</i>          |            |            | O                   | O                   |            |            |
| <i>Diplosoma spongiforme</i>    |            |            | P                   |                     |            |            |
| <i>Morchellium argus</i>        |            |            | P                   |                     |            |            |
| <i>Dendrodoa grossularia</i>    |            |            |                     | R                   |            |            |
| <i>Ciona intestinalis</i>       |            |            |                     |                     | O          |            |
| <b>FISHES</b>                   |            |            |                     |                     |            |            |
| <i>Labrus mixtus</i>            | P          |            | F                   | O                   | F          | R          |
| <i>Labrus bergylta</i>          | P          | O          | O                   |                     | F          | O          |
| <i>Ctenolabrus rupestris</i>    | P          |            | O                   |                     | F          |            |
| <i>Centrolabrus exoletus</i>    | P          |            |                     |                     |            |            |
| <i>Thorogobius ephippiatus</i>  | P          |            |                     | O                   |            | R          |
| <i>Crenilabrus melops</i>       | P          |            | O                   |                     |            |            |
| <i>Pollachius pollachius</i>    |            | O          | O                   | O                   | O          | O          |
| <i>Gobiusculus flavescens</i>   |            | P          |                     |                     |            |            |
| <i>Callionymus lyra</i>         |            |            | R                   | O                   |            |            |
| <i>Scyliorhinus canicula</i>    |            |            | O                   | O                   | O          | O          |
| <i>Parablennius gattorugine</i> |            |            | R                   |                     |            |            |
| <i>Trisopterus minutus</i>      |            |            | O                   |                     | R          |            |
| <i>Taurulus bubalis</i>         |            |            | O                   | O                   |            |            |

## PLANKTON RECORDING

(CMS CODE RB04/01)

### STATUS

Ongoing, annual survey

### PROJECT RATIONALE

Plankton is a vital ecological component of the marine ecosystem providing primary production and many species have planktonic larval stages. The abundance and composition are influenced by available nutrients, water movement, temperature and light.



### OBJECTIVES

To collect a time series of seasonal data for zooplankton and phytoplankton

### SITES

Transect between OMS (LL N51.73913 W5.26976) site buoy and Lucy buoy (LL N 51.74114 W 5.2769) along the north coast of Skomer.

### METHOD

2008 & 2009: A plankton sample is collected once a week using a 63µm mesh plankton net trawled at less than 2 knots between the OMS and Lucy site markers. Samples are preserved in 2% formalin and seawater.

2010 onwards: A review of the results and objectives called for a change in methods. It is proposed that the sampling from Skomer matches that from other plankton time series projects to make the results comparable. The Plymouth Marine Laboratory have a planktonic sample time series (L4), which would act as a very good comparison site. The methods used at L4 will be replicated at Skomer.

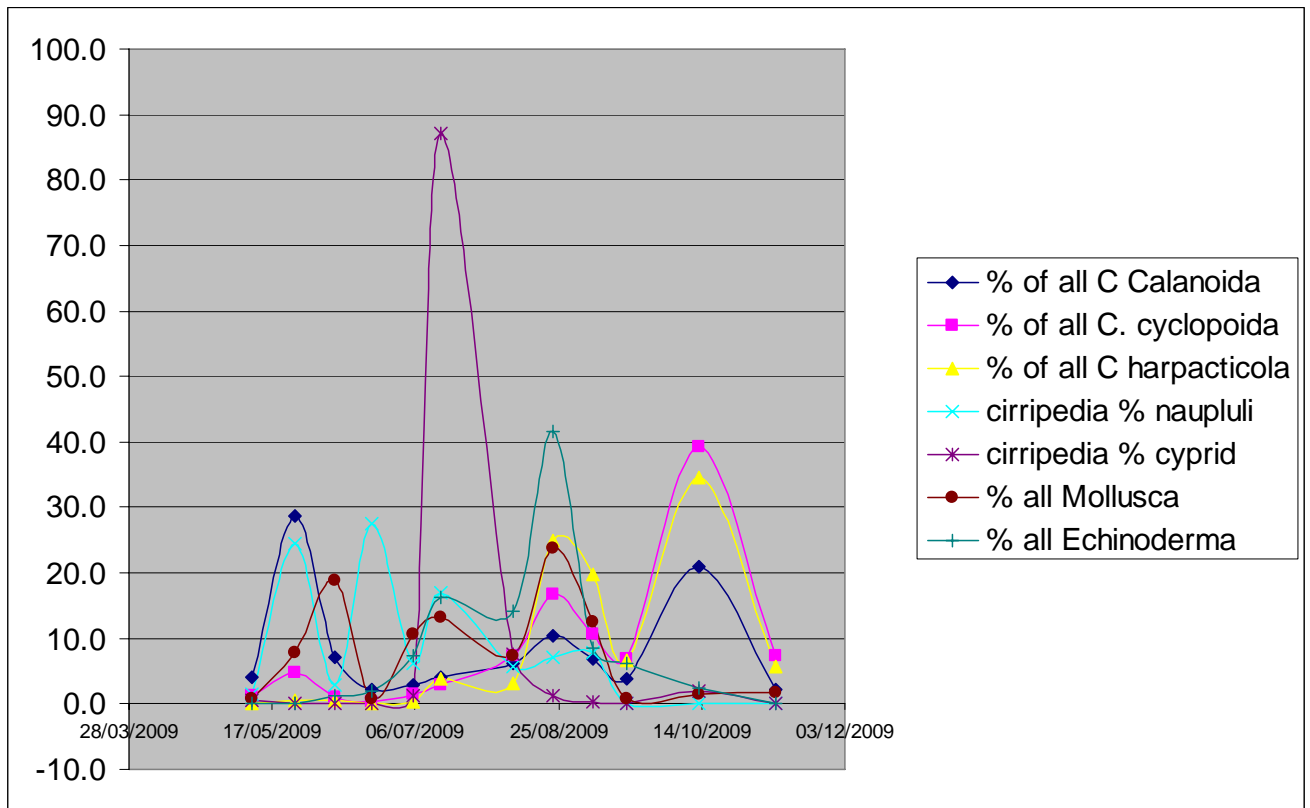
- Zooplankton: 200µm mesh pulled on a vertical haul from 35- 40M depth at 0.2m / sec (3.5 minute haul). The sample from the cod-end bottle are preserved in 4% formalin.
- Phytoplankton: 63µm mesh net trawled at 1m below the surface for 500m with a flow meter to record volume of water sampled. Sample are preserved in 4% formalin

### RESULTS

The 2008 samples were used for an undergraduate project at Aberystwyth University. A report was produced which detailed the species found. The student was not an expert in planktonic identification so it cannot be considered a comprehensive list.

In 2009 12 samples were sent to SAHFOS for identification and enumeration by Dr D. Conway. The sample dates were from the 10<sup>th</sup> May 2009 to the 9<sup>th</sup> Nov 2009. All zooplankton individuals were identified to species if possible and counted. Phytoplankton individuals were identified to species level but their abundance was recorded semi quantitatively.

**Example of results for Copepod groups, Barnacle, Mollusc & Echinoderm larvae.**



**CURRENT STATUS**

Basic data collected in 2009, new methods will commence in 2010.

**RECOMMENDATIONS**

- Establish a time series of seasonal data for phytoplankton and zooplankton.
- Compare data sets to Plymouth Marine Laboratory sites.

## **4 SKOMER MNR METEOROLOGICAL AND OCEANOGRAPHICAL PROJECT SUMMARIES**

## **METEOROLOGICAL DATA**

**(CMS CODE: RP 04/01)**

**STATUS** Ongoing, continuous.

### **PROJECT RATIONALE**

The weather is an important factor that directly affects species / communities on the shore and in the sub-littoral. Climate change is by definition a change in the long-term weather patterns so it is essential to have meteorological data for the site.

### **OBJECTIVES**

To provide continuous meteorological data for the Skomer MNR area.

### **SITES**

Coastguard lookout station, Wooltack point, Martins Haven.

Grid Ref: SM 7588 0922 (LL 51.44.78N 005. 14.78W)

### **METHODS**

May 1993 to October 2005. A Fairmount EMS1200 weather station was mounted on the coastguard hut. The station included an anemometer, wind vane, air temp, humidity, shaded and un-shaded solarimeter, net radiometer, barometric pressure and a tipping bucket rain gauge. The data was automatically downloaded to a computer in the Skomer MNR office where it was stored. An uninterruptible power supply was used but there were occasional problems with data dropout.

April 2006 – current. A Campbell Scientific Environmental Change Network (ECN) compatible weather station with a CR1000 measurement and control system was installed. Hardware consists of: switching anemometer, potentiometer wind vane, temperature and relative humidity probe, 3 temperature probes (air ground and below ground), tipping bucket rain gauge, pyranometer, net radiometer, water content reflectometers and barometric pressure sensor.

The CR1000 is capable of storing the data internally, but as with the Fairmount weather station the data is automatically downloaded to a computer in the Skomer MNR office using “Loggernet software”. The data is saved in three files: daily, hourly and 10 minute intervals.

January 2009 – current. A rain collector and ammonia detector were added to the equipment suite. Monthly collections will be made for precipitation chemistry and ammonia concentration in the air records. A GMS communicator has been added to the CR1000 allowing phone access to the data. This will enable the data to be automatically updated into an external website. The website is still under development and the Skomer data is not available yet.

### **RESULTS**

A continuous data set has been maintained since May 1993. However there are some gaps due to equipment failure, these are: March 1994, January 1998 and from November 2005 to April 2006. The Fairmount weather station was already aging before it was replaced and the solarimeter, net radiometer and rain gauge readings were all unreliable during 2005.

The 2008 data is shown in the following table; no problems were incurred during the year. The graph shows the mean air temperature from 1993 to 2008.

In March 2009 the Skomer MNR data was linked to the Environmental Change biodiversity Network project (ECBN), which links into a UK wide co-ordinated project.

Countryside Council for Wales. Skomer Marine Nature Reserve

## YEAR SUMMARY 2009

Weather station - Coatguard lookout hut, Wooltack point

Grid ref: SM75880922

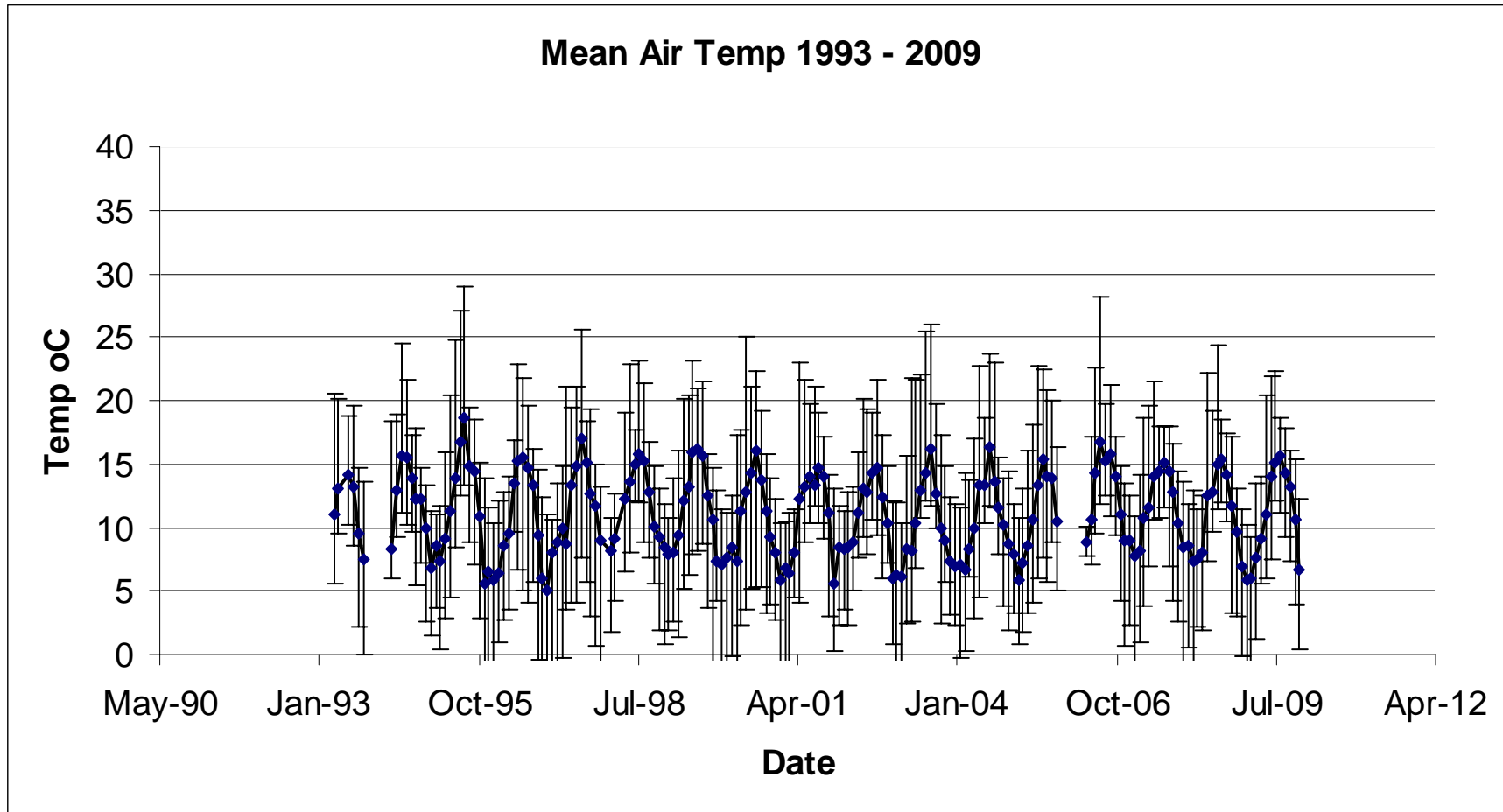
Geographical position: 51.44.78N 005.14.78W

|                           |                      | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec    |
|---------------------------|----------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| <b>AIR TEMP</b>           | MEAN                 | 5.9    | 5.9    | 7.6    | 9.1    | 11.0   | 14.1   | 15.1   | 15.7   | 14.2   | 13.2   | 10.6   | 6.7    |
| <b>T107_1 0c</b>          | MAX                  | 10.2   | 9.2    | 13.4   | 14.0   | 20.5   | 21.8   | 22.4   | 18.7   | 17.8   | 16.0   | 15.4   | 12.2   |
|                           | MIN                  | -1.9   | -1.1   | 1.3    | 5.6    | 6.0    | 7.5    | 12.1   | 11.1   | 9.3    | 7.3    | 4.0    | 0.4    |
| <b>BAROMETRIC PRESSUR</b> | MEAN                 | 1000.3 | 1009.2 | 1008.9 | 1004.7 | 1010.1 | 1010.4 | 1003.9 | 1007.5 | 1015.7 | 1007.7 | 991.1  | 997.7  |
|                           | MAX                  | 1024.0 | 1028.0 | 1030.0 | 1023.0 | 1026.0 | 1022.0 | 1016.0 | 1017.0 | 1032.0 | 1028.0 | 1014.0 | 1026.0 |
|                           | MIN                  | 965.0  | 978.0  | 973.0  | 986.0  | 985.0  | 0.0    | 988.0  | 992.0  | 984.0  | 979.0  | 966.0  | 976.0  |
| <b>RELATIVE HUMIDITY</b>  | MEAN                 | 82.9   | 86.6   | 83.9   | 86.5   | 84.0   | 84.9   | 88.8   | 89.4   | 83.7   | 84.7   | 81.7   | 81.3   |
|                           | MAX                  | 98.2   | 98.5   | 98.1   | 97.7   | 97.7   | 100.0  | 100.0  | 100.0  | 100.0  | 100.0  | 100.0  | 99.6   |
|                           | MIN                  | 50.8   | 53.6   | 46.8   | 60.3   | 37.4   | 42.6   | 63.0   | 64.0   | 55.5   | 54.5   | 51.4   | 50.2   |
| <b>RAINFALL</b>           | TOTAL(mm)            | 105.4  | 12.5   | 15.8   | 30.1   | 21.8   | 23.6   | 111.7  | 22.2   | 9.4    | 39.8   | 122.7  | 51.0   |
| <b>SUNSHINE</b>           | MEAN(kw/m2)          | 0.0    | 0.1    | 0.1    | 0.2    | 0.2    | 0.3    | 0.2    | 0.2    | 0.2    | 0.1    | 0.0    | 0.0    |
|                           | sunshine hours       | 79.0   | 140.0  | 245.0  | 298.0  | 358.0  | 362.0  | 350.0  | 303.0  | 272.0  | 197.0  | 90.0   | 81.0   |
|                           | Sunshine hrs (10min) | 75.2   | 137.5  | 244.0  | 295.3  | 348.0  | 364.2  | 342.8  | 300.2  | 266.3  | 193.0  | 90.2   | 74.2   |
| <b>NET RADIATION</b>      | MEAN                 | -11.3  | 8.5    | 32.7   | 67.8   | 102.1  | 106.7  | 103.5  | 82.6   | 47.4   | 16.7   | -9.5   | -19.9  |
| <b>MAX GUST</b>           | M/sec                | 38.8   | 27.5   | 32.9   | 26.3   | 30.4   | 36.3   | 24.2   | 27.5   | 32.5   | 30.8   | 37.1   | 30.4   |
|                           | direction            | 228.1  | 311.5  | 237.1  | 120.2  | 193.6  | 58.0   | 194.4  | 282.9  | 221.6  | 227.6  | 200.6  | 307.2  |
|                           | Knots                | 75.3   | 53.4   | 64.0   | 51.0   | 59.1   | 70.4   | 47.0   | 53.4   | 63.1   | 59.9   | 72.0   | 59.1   |

### Notes

May data missing - 2 hours missing on 04/06/09

Weather station serviced and calibrated (Cambell scientific) 04/06/09



**CURRENT STATUS**

New weather station is now fully operation with no data loss since its instalment in 2006.

**RECOMMENDATIONS**

- Data to be made available via Internet site to allow for greater public access.

## **SEAWATER TEMPERATURE RECORDING**

**(CMS CODE: RP64 / 01)**

**STATUS:** Ongoing, continuous

### **PROJECT RATIONALE**

Temperature is one of the most important physical factors controlling the distribution of living creatures. Climate change has been highlighted as potential threat to all ecosystems.

### **OBJECTIVES**

To provide accurate seawater temperature records for near seabed and in the water column. To record temperature as continuously as possible to produce an ongoing long-term data set for the site.

### **SITES**

- Oceanographic Monitoring Site (LL 51.73913 -5.26976 W).
- Shore sites: Martins Haven, South Haven;
- Non MNR shore sites: West Angle, Jetty beach, Castle beach.

### **METHODS**

The current equipment and methods used to record temperature is as follows:

Oceanographic Monitoring site:

- 1992 Valeport series 600 MKII CTD probe. A drop down CTD probe used to take a depth profile of temperature at intervals: 1m, 5m, 10m, 15m below sea level and 2m above seabed. This is completed weekly during the field season (March to October).
- Vemco minilog is attached to a fixed steel frame on the seabed (19m below chart datum). The logger maintains a record every hour and is retrieved every six months to download the data. Two loggers are used; these are left out alternately at the site to allow uninterrupted data.
- 2007, YSI 6600 multi parameter sonde is attached to a fixed steel frame on the seabed (19m below chart datum). It records temperature along with: salinity, turbidity, dissolved oxygen, chlorophyll and pressure (=depth). In 2008 the YSI 6600 was linked up to a telemetry buoy to provide live 10 minute readings. The data is sent via VHF to the coastguard lookout hut and then onto the Skomer MNR office via a fibre optic link.

Shore sites:

- 2007, Onset "Hobo" pendant loggers have been deployed at: Martins Haven shore (lower, middle and upper shore). South Haven shore (lower, middle and upper shore). Dale fort Field Centre: Jetty beach (mid shore) and Castle beach (mid shore). West angle bay: upper shore rock pools.

**RESULTS****Oceanographic monitoring site:**

Valeport series 600 MKII CTD probe water profile records:

|      |           |      |            |      |           |
|------|-----------|------|------------|------|-----------|
| 1992 | Jul – Nov | 1999 | May – Nov  | 2006 | Mar – Oct |
| 1993 | Jan – Dec | 2000 | Mar- Oct   | 2007 | Apr - Oct |
| 1994 | Feb – Dec | 2001 | May – Nov  | 2008 | Apr - Dec |
| 1995 | Jul – Dec | 2002 | May – Oct  | 2009 | Feb - Oct |
| 1996 | Mar – Dec | 2003 | Jun – Sept |      |           |
| 1997 | Aug – Dec | 2004 | May – Oct  |      |           |
| 1998 | Mar – Nov | 2005 | May – Oct  |      |           |

Vemco minilog seabed temperature logger deployment:

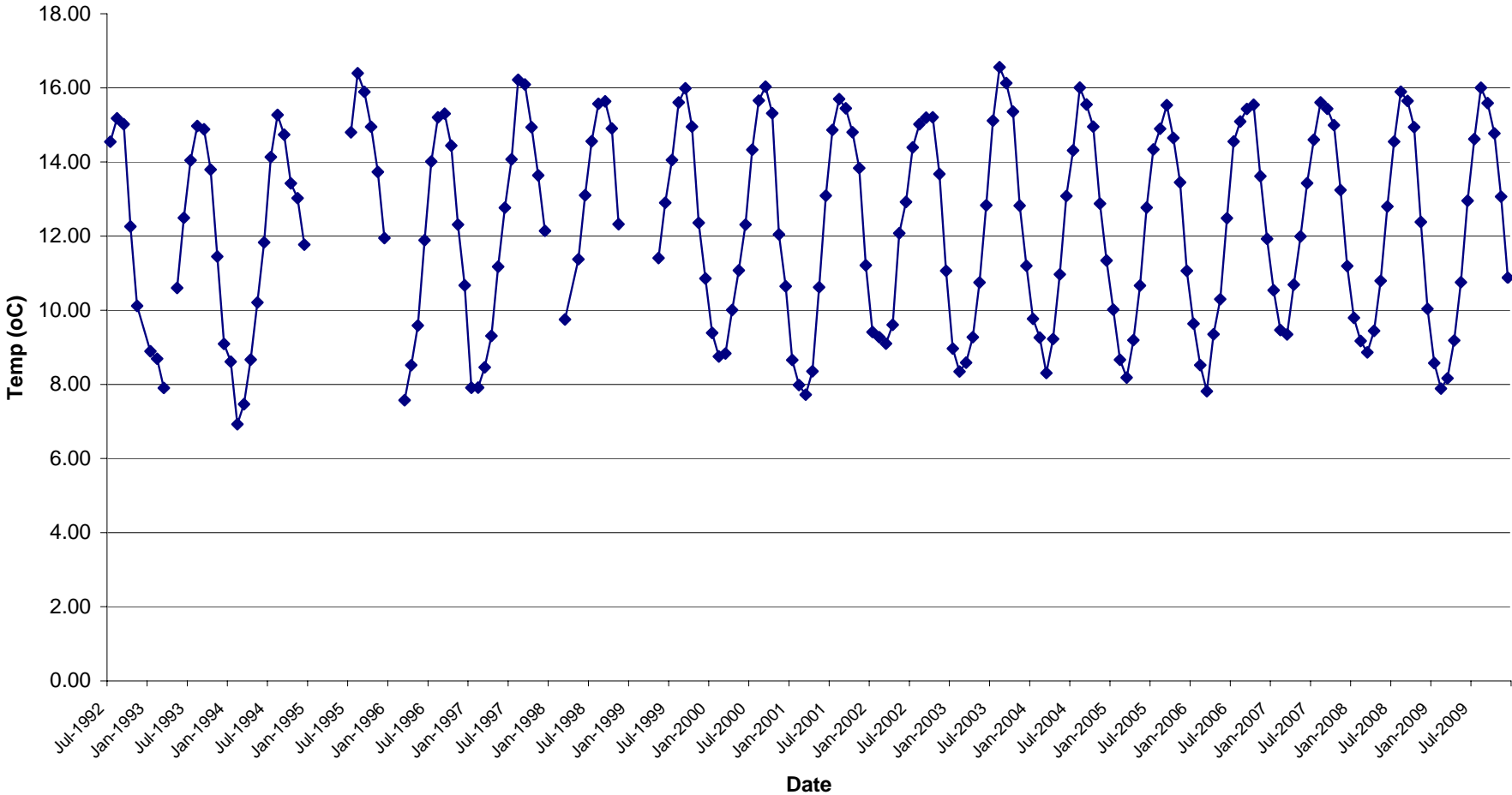
- Aug 1993 – Nov 1994
- Dec 1996 – Sept 1997
- Jul 1999 – Apr 2001
- Jun 2001 – 8<sup>th</sup> May 2002
- 30<sup>th</sup> May 2002 – ongoing

A summary of the seabed temperature (data from Vemco minilog at 19m BCD) is shown in the graph. Monthly means have been calculated from seabed temperature but substituted with the CTD probe data (seabed temp) where logger data was absent.

Annual maximum and minimum seabed temperature records from 2000 to 2009 are as follows (data from Vemco minilog at 19m BCD):

| Temperature °C | 2000  | 2001 | 2002 | 2003 | 2004  | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 |
|----------------|-------|------|------|------|-------|------|------|------|------|------|------|
| Minimum        | 8.4   | 7.27 | 8.7  | 7.6  | 7.7   | 7.36 | 7.5  | 8.8  | 8.4  | 7    | 6.9  |
| Maximum        | 16.27 | 16.3 | 15.6 | 17.1 | 16.76 | 16.4 | 16.3 | 16.3 | 16.3 | 16.8 | na   |

Summary of the seabed temperature °C (data from Vemco minilog at 19m BCD)



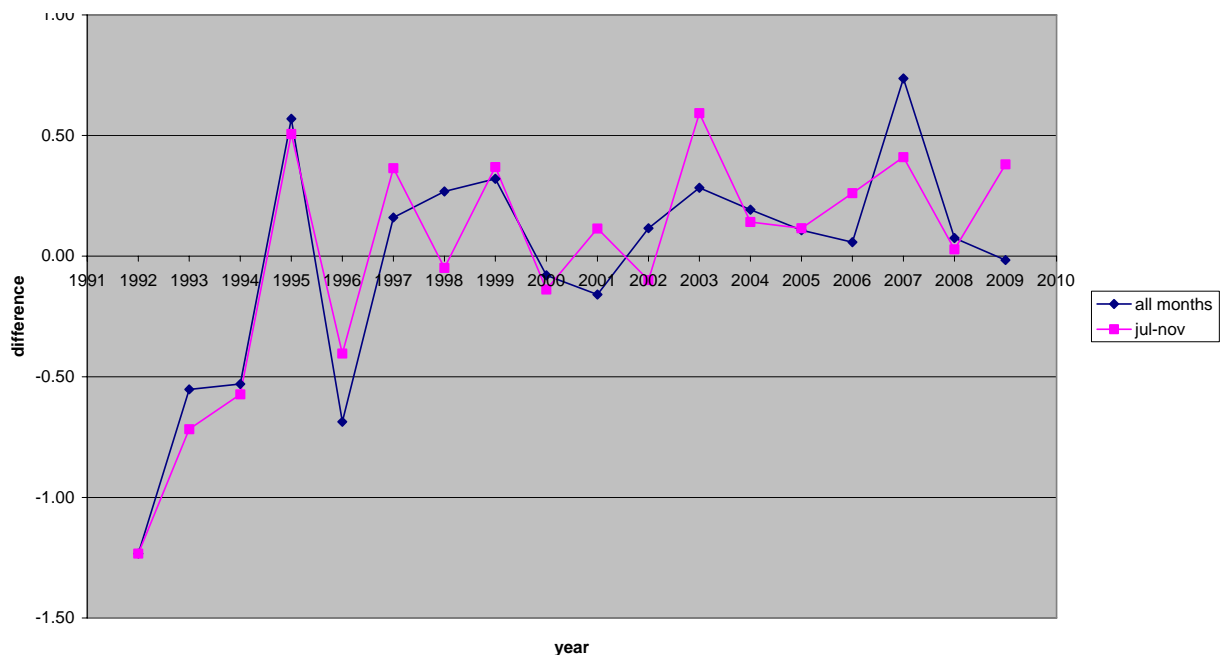
Comparing the overall monthly mean with the monthly mean for each year gives an indication of how cold / warm that particular month was compared to the whole data set.

Difference between overall mean and monthly mean for that year

|             | <b>Jan</b> | <b>Feb.</b> | <b>Mar</b> | <b>Apr</b> | <b>May</b> | <b>Jun</b> | <b>Jul</b> | <b>Aug</b> | <b>Sep</b> | <b>Oct</b> | <b>Nov</b> | <b>Dec</b> |
|-------------|------------|-------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|
| <b>1992</b> |            |             |            |            |            |            | 0.04       | -0.41      | -0.60      | -2.53      | -2.56      |            |
| <b>1993</b> | -0.34      | 0.05        | -0.55      |            | -0.12      | -0.21      | -0.43      | -0.48      | -0.47      | -0.95      | -1.15      | -1.42      |
| <b>1994</b> | -0.63      | -0.97       | -0.48      | -0.66      | -0.74      | -0.85      | -0.60      | -0.28      | -0.80      | -0.85      | -0.21      | 0.71       |
| <b>1995</b> |            |             |            |            |            |            | 0.27       | 0.76       | 0.25       | 0.33       | 1.02       | 0.87       |
| <b>1996</b> |            |             | -0.87      | -0.68      | -1.22      | -0.80      | -0.54      | -0.43      | -0.33      | -0.17      | -0.43      | -1.30      |
| <b>1997</b> | -1.34      | -0.73       | 0.02       | 0.24       | 0.49       | 0.22       | -0.29      | 0.30       | 0.67       | 0.32       | 0.94       | 1.09       |
| <b>1998</b> |            |             | 1.27       |            | 0.62       | 0.49       | 0.11       | -0.10      | 0.14       | 0.29       | -0.58      |            |
| <b>1999</b> |            |             |            |            | 0.67       | 0.24       | 0.57       | 0.10       | 0.51       | 0.34       | 0.43       | -0.21      |
| <b>2000</b> | 0.14       | 0.11        | 0.28       | -0.18      | -0.03      | -0.27      | -0.27      | 0.04       | 0.37       | -0.04      | -0.68      | -0.42      |
| <b>2001</b> | -0.59      | -0.66       | -0.72      | -0.72      | -0.24      | 0.19       | 0.09       | 0.12       | -0.29      | 0.19       | 0.58       | 0.15       |
| <b>2002</b> | 0.17       | 0.63        | 0.65       | 0.79       | -0.66      | 0.19       | -0.29      | -0.73      | -0.47      | 0.16       | 0.95       | 0.00       |
| <b>2003</b> | -0.28      | -0.29       | 0.14       | 0.21       | 0.06       | 0.36       | 0.61       | 0.84       | 0.78       | 0.75       | 0.10       | 0.13       |
| <b>2004</b> | 0.52       | 0.62        | -0.14      | 0.16       | -0.06      | 0.11       | -0.26      | 0.44       | 0.15       | 0.34       | 0.15       | 0.28       |
| <b>2005</b> | 0.77       | 0.02        | -0.26      | 0.12       | -0.08      | 0.02       | -0.19      | -0.46      | 0.06       | 0.56       | 0.72       | 0.00       |
| <b>2006</b> | 0.39       | -0.12       | -0.65      | -0.45      | -0.51      | -0.24      | -0.10      | -0.33      | 0.02       | 0.93       | 0.89       | 0.86       |
| <b>2007</b> | 1.29       | 0.82        | 0.91       | 1.06       | 1.77       | 0.68       | 1.26       | 0.20       | -0.19      | 0.38       | 0.52       | 0.13       |
| <b>2008</b> | 0.55       | 0.53        | 0.42       | 0.11       | 0.05       | -0.13      | 0.01       | 0.42       | 0.20       | 0.32       | -0.71      | -0.87      |
| <b>2009</b> | -0.67      | -0.97       | -0.26      | 0.00       | -0.07      | 0.06       | 0.18       | 0.58       | 0.20       | 0.61       | 0.32       | -0.18      |

Two averages from this data were then used to express how cold / warm each year was. The blue line in the graph below averages all months in a year while the pink line just averages the months July – November (these months were chosen because all of the years have a full set of data for those months).

**Average difference between the monthly mean and the overall monthly mean (1992-2009)**



Mean differences between the average month's temperature and the overall monthly average.

|                              | <b>1992</b>  | <b>1993</b>  | <b>1994</b>  | <b>1995</b> | <b>1996</b>  | <b>1997</b> | <b>1998</b>  | <b>1999</b> | <b>2000</b>  |
|------------------------------|--------------|--------------|--------------|-------------|--------------|-------------|--------------|-------------|--------------|
| Mean yearly difference       | <b>-1.21</b> | <b>-0.55</b> | <b>-0.53</b> | <b>0.59</b> | <b>-0.68</b> | <b>0.16</b> | <b>0.28</b>  | <b>0.33</b> | <b>-0.08</b> |
| Mean difference for July-Nov | <b>-1.21</b> | <b>-0.69</b> | <b>-0.55</b> | <b>0.53</b> | <b>-0.38</b> | <b>0.39</b> | <b>-0.03</b> | <b>0.39</b> | <b>-0.12</b> |
|                              | <b>2001</b>  | <b>2002</b>  | <b>2003</b>  | <b>2004</b> | <b>2005</b>  | <b>2006</b> | <b>2007</b>  | <b>2008</b> | <b>2009</b>  |
| Mean yearly difference       | <b>-0.16</b> | <b>0.12</b>  | <b>0.28</b>  | <b>0.19</b> | <b>0.11</b>  | <b>0.06</b> | <b>0.74</b>  | <b>0.08</b> | <b>-0.02</b> |
| Mean difference for July-Nov | <b>0.14</b>  | <b>-0.08</b> | <b>0.61</b>  | <b>0.16</b> | <b>0.14</b>  | <b>0.28</b> | <b>0.43</b>  | <b>0.05</b> | <b>0.38</b>  |

### **Shore monitoring sites**

10 Onset Hobo temperature / light loggers have been placed at 2 shore sites around the Reserve and 3 other shore locations in Pembrokeshire. These loggers will provide a record of the temperature regime experienced by sessile organisms in the inter-tidal zone.

An example of temperature data from the middle shore, Martins Haven is shown on the graph (next page).

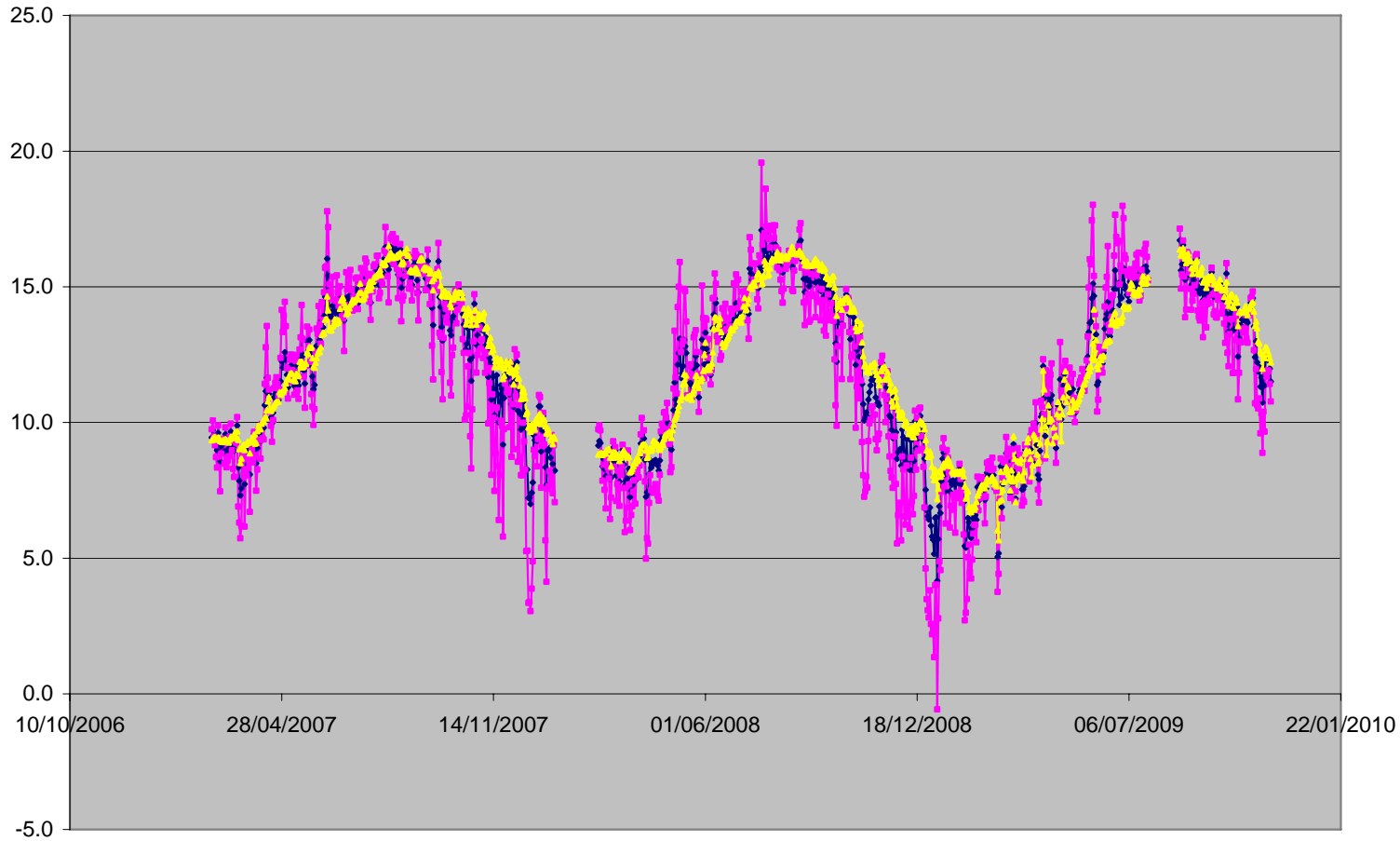
### **CURRENT STATUS**

Seabed temperature is not commonly measured in UK waters, sea surface temperatures being the most common records. Since July 1999 only 1 month of data is missing from the temperature logger record and since June 2001 there have been continuous hourly records for seabed temperature. By adding in the water profile records there is a fairly complete sea temperature record going back to 1992. This makes this dataset not only unusual, but highly important not only for putting MNR/SAC monitoring into context, but also for other applications including academic and fisheries research.

### **RECOMMENDATIONS**

- Continue data set to form a long-term record of variation in seabed temperature at Skomer MNR.
- Keep the data set as complete as possible. An additional logger running at the same time would add redundancy into the methods should the equipment fail (so far when equipment has failed the data has fortunately been retrievable).

**Inter-tidal temperature records for the Middle shore (3.25m ACD) at Martins Haven**



Pink line = logger exposed to the air. Yellow line = logger covered by tide. Blue line = average of all readings

## **SEAWATER TURBIDITY / SUSPENDED PARTICULATES (CMS CODE RP63/01) AND SEABED SEDIMENTATION (CMS CODE RP63/04)**

**STATUS:** Ongoing

### **PROJECT RATIONALE**

Coastal waters are naturally turbid but this turbidity can change due to anthropogenic activities such as dredge spoil dumping or land management. Filter feeders will be adversely affected by large increases in turbidity.

### **OBJECTIVES:**

To provide a long-term record of sediment load in the water column in the Skomer MNR.

### **SITES**

Oceanographic Monitoring Site (OMS): (51.73913 -5.26976) north side of Skomer - 1992  
Thorn Rock: (51.73329 -5.27369) south side of Skomer - 2004

### **METHODS**

**Secchi disk measurements.** The depth to which a white “Secchi disc” can be seen through the water column has been recorded during the field season since 1992 at OMS and 2004 at Thorn Rock.

**Suspended sediment sampler** (pump driven) fixed to the frame on the seabed at OMS site between 1994 and 1997; but with limited success.

**Passive sediment traps** have been deployed at each site since 1994. Sediment dropping out of the water column is collected into a pot. The sample pots are changed every 2 weeks during the field season and the sediment samples are frozen.

**Optical turbidity probe.** A Seapoint OEM turbidity probe connected to an Idronaut data logger has been fixed to the frame on the seabed at the OMS site since 2002. Length of time deployed varied and there were varied levels of success. This was replaced by a YSI 6600 multi-parameter sonde in 2007.

**YSI 6600 multi-parameter sonde** was fixed to the frame on the seabed at the OMS site in 2007. The sonde includes an optical turbidity probe. This has been deployed several times to date and again, with varying levels of success.

**RESULTS - TURBIDITY**

**Secchi disc:** Measurements have been taken reasonably consistently for the months of May through to October since 1992. The results are summarised in the table:

**Summary of Secchi disc data (m) Annual mean:****OMS**

(North of Skomer island)

|                   |             |             |             |             |             |             |             |             |             |
|-------------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|
| Year              | <b>1992</b> | <b>1993</b> | <b>1994</b> | <b>1995</b> | <b>1996</b> | <b>1997</b> | <b>1998</b> | <b>1999</b> | <b>2000</b> |
| Yearly Mean       | 4.3         | 4.2         | 5.5         | 6.15        | 6.0         | 5.3         | 5.933       | 7.53        | 7.2         |
| Number of samples | 29          | 36          | 35          | 20          | 27          | 12          | 23          | 15          | 20          |
| Year              | <b>2001</b> | <b>2002</b> | <b>2003</b> | <b>2004</b> | <b>2005</b> | <b>2006</b> | <b>2007</b> | <b>2008</b> | <b>2009</b> |
| Yearly Mean       | 7.93        | 6.23        | 6.73        | 6.0         | 6.2         | 5.4         | 5.8         | 5.7         | 5.98        |
| Number of samples | 12          | 20          | 17          | 20          | 22          | 23          | 19          | 23          | 26          |

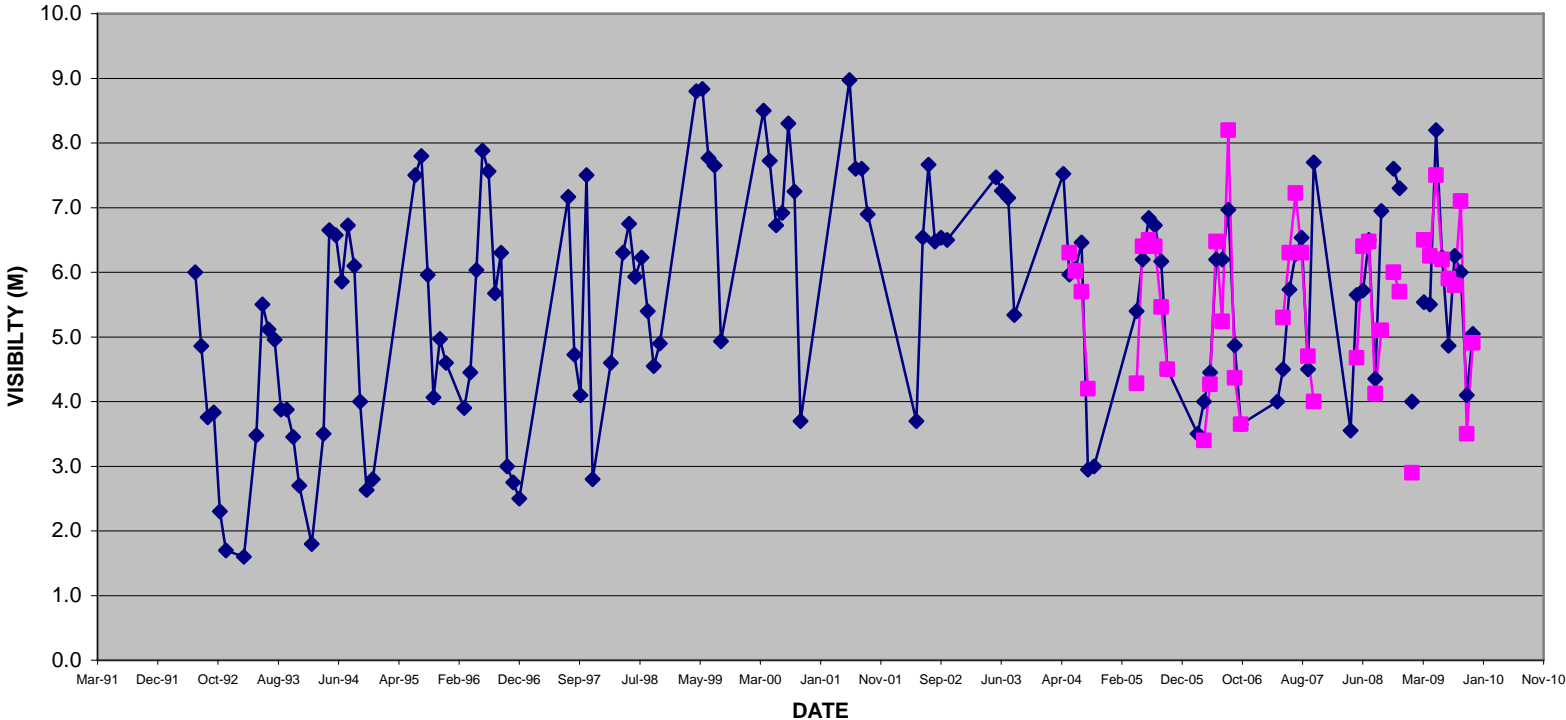
**Thorn Rock**

(South of Skomer island)

|                   |             |             |             |             |             |             |
|-------------------|-------------|-------------|-------------|-------------|-------------|-------------|
| Year              | <b>2000</b> | <b>2001</b> | <b>2002</b> | <b>2003</b> |             |             |
| Yearly Mean       | no data     | no data     | no data     | no data     |             |             |
| Number of samples | no data     | no data     | no data     | no data     |             |             |
| Year              | <b>2004</b> | <b>2005</b> | <b>2006</b> | <b>2007</b> | <b>2008</b> | <b>2009</b> |
| Yearly Mean       | 5.8         | 5.7         | 5.5         | 5.9         | 5.5         | 6.15        |
| Number of samples | 12          | 22          | 22          | 18          | 20          | 23          |

The mean monthly secchi disc readings for OMS and Thorn Rock are shown in the graph. This is followed by a table showing the monthly mean summary at the OMS from 1992 to 2009. Plotting the mean difference between the monthly average and the overall average highlights any significant fluctuations.

MEAN MONTHLY SECCHI READINGS

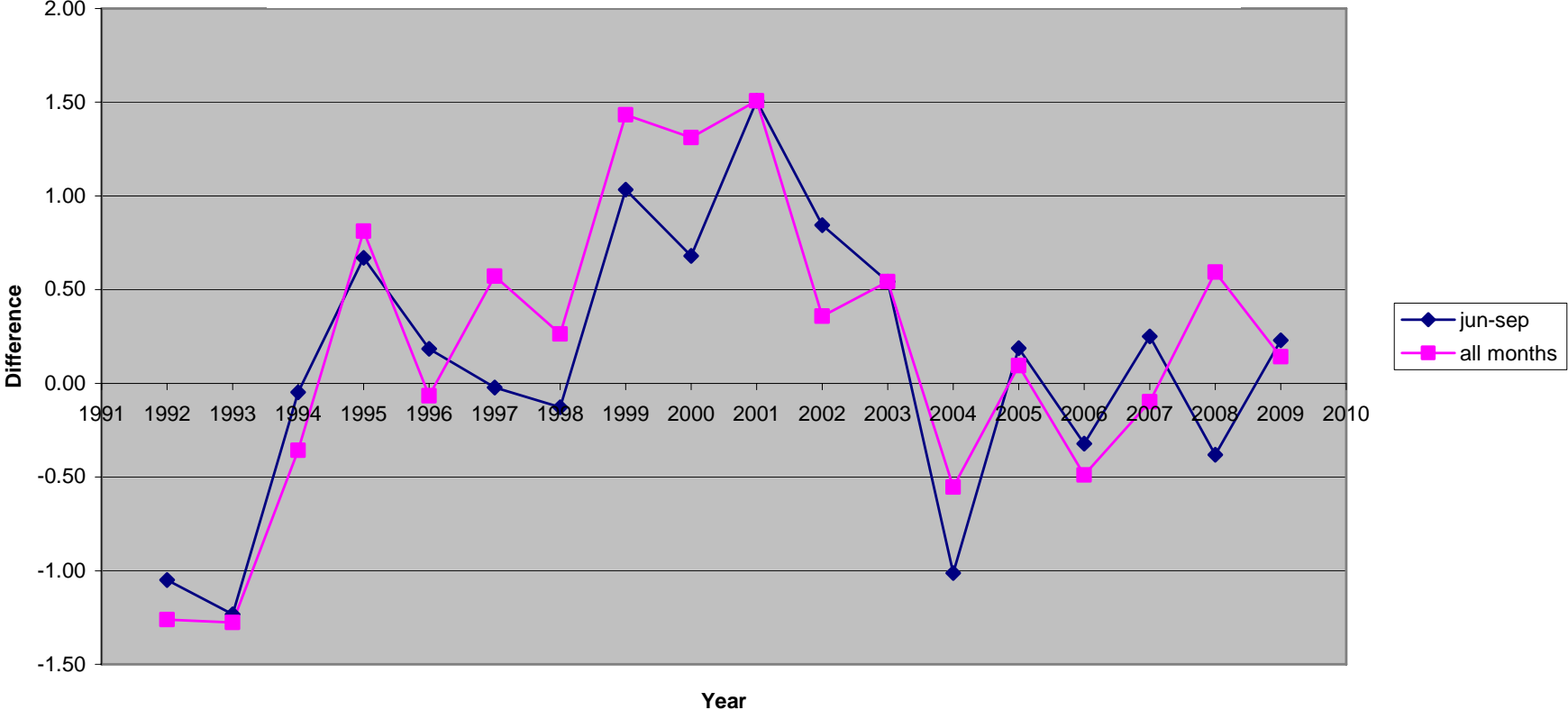


OMS = Blue line, TRK = Pink line

**OMS – Difference between monthly means and the overall mean – Secchi disc depth (m)**

|                          | 1992  | 1993  | 1994  | 1995  | 1996  | 1997  | 1998  | 1999  | 2000  | 2001 | 2002  | 2003 | 2004  | 2005  | 2006  | 2007  | 2008  | 2009  |
|--------------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|-------|------|-------|-------|-------|-------|-------|-------|
| <b>Jan</b>               |       |       |       |       |       |       |       |       |       |      |       |      |       |       |       |       |       |       |
| <b>Feb</b>               |       |       | 0     |       |       |       |       |       |       |      |       |      |       |       |       |       |       | -0.68 |
| <b>Mar</b>               |       | -1.8  |       |       | 0.5   |       | 1.2   |       |       |      |       |      |       |       |       |       |       |       |
| <b>Apr</b>               |       |       | -0.89 |       | 0.06  |       |       |       | 4.11  |      |       |      |       |       |       | -0.39 | -0.84 | 0.86  |
| <b>May</b>               |       | -2.33 | 0.85  |       | 0.23  |       | 0.50  | 3.00  | 1.92  |      | -2.10 |      | 1.72  | -0.40 | -1.35 | -1.30 | -0.15 | -0.27 |
| <b>Jun</b>               |       | -1.25 | -0.17 |       | 1.13  |       | 0.00  | 2.09  | -0.02 | 2.23 | -0.21 | 0.72 | -0.78 | -0.55 | -0.55 | -1.01 | -1.03 | 1.36  |
| <b>Jul</b>               | -0.61 | -1.49 | -0.75 | 0.89  | 0.95  |       | -0.67 | 1.16  | 0.31  | 0.99 | 1.06  | 0.65 | -0.56 | 0.23  | -0.41 | -0.33 | -0.11 | -0.36 |
| <b>Aug</b>               | -1.47 | -1.37 | 0.40  | 1.47  | -0.65 | 0.84  | -0.10 | 1.32  | 1.97  | 1.27 | 0.15  | 0.82 | 0.13  | 0.40  | 0.64  | 0.21  | -1.98 | -1.40 |
| <b>Sep</b>               | -1.53 | -1.41 | 0.81  | 0.67  | 1.01  | -0.56 | 0.11  | -0.36 | 1.96  | 1.61 | 1.24  | 0.05 | -2.34 | 0.88  | -0.42 | -0.79 | 1.66  | 0.90  |
| <b>Oct</b>               | -0.56 | -0.51 | -0.39 | -0.32 | -1.39 | -0.29 | 0.16  |       | -0.69 |      | 2.11  |      | -1.39 | 0.11  | -0.74 | 3.31  |       | 0.65  |
| <b>Nov</b>               | -1.57 | -0.42 | -1.24 | 1.09  | -1.12 | 3.63  | 1.03  |       |       |      |       |      |       |       |       |       | 3.73  | 0.22  |
| <b>Dec</b>               | -1.79 | -0.79 | -0.69 | 1.11  | -0.99 | -0.69 |       |       |       |      |       |      |       |       |       |       | 3.81  |       |
| <b>yearly mean diff</b>  | -1.25 | -1.26 | -0.21 | 0.82  | -0.03 | 0.59  | 0.28  | 1.44  | 1.37  | 1.53 | 0.38  | 0.56 | -0.54 | 0.11  | -0.47 | -0.04 | 0.64  | 0.14  |
| <b>Mean diff jun-oct</b> | -1.04 | -1.21 | -0.02 | 0.68  | 0.21  | 0.00  | -0.10 | 1.05  | 0.71  | 1.53 | 0.87  | 0.56 | -0.99 | 0.21  | -0.30 | 0.28  | -0.36 | 0.23  |

**Plot of the mean differences between the monthly average Secchi reading and the overall average at the OMS site.**  
(All months = pink, June – Sep = blue line)



**Optical turbidity probe:**

Seapoint OEM turbidity probe (2002) -results have been very variable with problems due to data corruption in the logger and fouling of the optical probe. It was vital that the optical sensor is cleaned every 2 weeks (a diver can clean it underwater).

In February 2003 the probe was calibrated in the lab with local seawater / sediment. This calibration suggested that the most sensitive setting (gain 4: 0 – 25 FTU) be used. To correlate the probe readings to actual sediment content, water samples were taken from around the probe (at 19m bcd whilst the probe was deployed). These samples were then filtered and dried to give an actual value of sediment load to compare with the probe readings from the same time.

It is currently very difficult to interpret the results and separate out real changes in turbidity from errors and noise. The probe has shown it can pick up variations with tidal cycle and storm events if it is clean and running properly.

In the winter of 2006/07 the probe suffered some major damage and was not operational during 2007. An YSI 6600 multi-parameter probe has been used in its place. This has an optical turbidity probe with a self-cleaning function. The probe was deployed twice in the 2007 season but on the second deployment the turbidity probe flooded. This had been replaced and the sonde was deployed over the full winter.

In 2008 an OSIL telemetry buoy was deployed at OMS. The buoy was purchased with the intention being to have a suite of buoys deployed at sites around the coast of Wales as part of a Wales Marine Environmental Change Network. However the project has so far failed to attract further funding and so the Skomer remains the only site. The buoy was linked to the YSI 6600 sonde to provide live 10 minute readings. The data was sent via VHF to the coastguard lookout hut and then onto the Skomer MNR office via a fibre optic link. The system functioned for a while but currently telemetry is switched off and the buoy has been removed. The YSI 6600 sonde is recording hourly samples on its internal memory.

**RESULTS - SEABED SEDIMENTATION (PASSIVE SEDIMENT TRAPS)**

The samples from the sediment traps have been analysed for; dry weight, organic content, grain size analysis and metal content.

**Passive sediment trap results:** The table shows the sampling effort from 1994 to 2009 at OMS and Thorn rock (TRK).

| Year       | Months with samples | Sites     | Notes                           |
|------------|---------------------|-----------|---------------------------------|
| 1994       | Jul – Dec           | OMS & TRK |                                 |
| 1995       | Jan – Dec           | OMS & TRK |                                 |
| 1996       | Feb – Dec           | OMS & TRK |                                 |
| 1997       | Mar – Dec           | OMS & TRK |                                 |
| 1998       | Mar – sep           | OMS & TRK |                                 |
| 1999- 2001 | No samples          |           | Re-established 02 Nov 2001      |
| 2002       | Mar – Nov           | OMS & TRK | TRK site damaged                |
| 2003       | May – Sep           | OMS only  |                                 |
| 2004       | May – Sep           | OMS only  |                                 |
| 2005       | Jun- Oct            | OMS only  | Collector damaged               |
| 2006       | Jun - Oct           | OMS & TRK | Repaired and TRK re-established |
| 2007       | May - Sep           | OMS & TRK |                                 |
| 2008       | May - Sep           | OMS & TRK |                                 |
| 2009       | Apr - Sep           | OMS & TRK | Shell fragments in samples.     |

**Yearly results from the OMS site**

|      | grams/day | % organic | % gravel | % sand | % mud |
|------|-----------|-----------|----------|--------|-------|
| OMS  | OMS       | content   |          |        |       |
| 1995 | 2.17      | 9.33      | 7.37     | 18.56  | 74.07 |
| 1996 | 2.16      | 9.95      | 0.40     | 17.08  | 82.52 |
| 1997 | 1.69      | 9.64      | 0.18     | 20.43  | 79.40 |
| 1998 | 1.25      | 9.24      | 5.08     | 42.73  | 52.19 |
| 2002 | 1.05      | 7.91      | 0.17     | 73.51  | 26.32 |
| 2003 | 1.29      | 8.14      | 0.37     | 79.54  | 20.09 |
| 2004 | 1.91      | 7.90      | 0.00     | 75.27  | 24.72 |
| 2005 | 2.20      | 8.80      | 0.00     | 76.86  | 23.14 |
| 2006 | 2.33      | 8.79      | 0.00     | 76.80  | 23.21 |
| 2007 | 2.94      | 7.05      | 0.00     | 74.93  | 25.07 |
| 2008 | 0.56      | 7.34      | 0.00     | 81.48  | 18.23 |
| 2009 | 0.68      | 8.9       | 0.00     | 47.27  | 52.73 |

**Yearly results from the TRK site**

|      | grams/day | % organic |          |         |         |
|------|-----------|-----------|----------|---------|---------|
| TRK  | TRK       | content   | % gravel | % sand  | % mud   |
| 1994 | 3.32      | 9.80      | 0.10     | 16.83   | 83.07   |
| 1995 | 5.76      | 8.59      | 0.41     | 55.76   | 43.83   |
| 1996 | 3.53      | 9.90      | 0.21     | 22.56   | 77.23   |
| 1997 | 5.81      | 9.43      | No data  | No data | No data |
| 1998 | 4.15      | 10.25     | 0.23     | 23.89   | 75.89   |
| 2002 | 2.44      | 7.61      | 0.00     | 61.63   | 38.36   |
| 2006 | 1.74      | 8.65      | 0.00     | 60.35   | 39.65   |
| 2007 | 1.54      | 7.73      | 0.00     | 69.81   | 30.19   |
| 2008 | 1.91      | 7.13      | 0.00     | 78.39   | 21.23   |
| 2009 | 1.78      | 8.66      | 0.0      | 44.1    | 55.9    |

**Note: 2009 values have been adjusted.**

2009 samples were contaminated by large amounts of small shell fragments – probably Mussel shell. These were not removed from the samples before analysis. This meant that the gravel content averaged 10% OMS & 20% for TRK. Normally all obvious foreign material is removed before analysis. As this could not happen (shell fragments too small to remove) it was decided to assume that all the gravel (>250 microns) fraction was shell and therefore was eliminated from the mass calculations. The values in the tables represent the % with the gravel fraction removed.

**General trends:**

1994 – 1998 samples were characterised by higher mud content to sand content.

2002 – 2008 samples had higher sand content to mud content.

2009 the trend has swapped back to higher mud content

**Metal analysis results**

|                    | <b>V</b>     | <b>Cr</b>    | <b>Co</b>    | <b>Ni</b>    | <b>Cu</b>    | <b>Zn</b>    | <b>As</b>    | <b>Se</b>    | <b>Cd</b>    | <b>Sb</b>    | <b>Pb</b>    |
|--------------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|
|                    | <b>mg/kg</b> | <b>mg/kg</b> | <b>mg/kg</b> | <b>mg/kg</b> | <b>mg/kg</b> | <b>mg/kg</b> | <b>mg/kg</b> | <b>mg/kg</b> | <b>mg/kg</b> | <b>mg/kg</b> | <b>mg/kg</b> |
| <b>OMS 1995-98</b> |              |              |              |              |              |              |              |              |              |              |              |
| <b>Average</b>     | 71.89        | 60.98        | 15.50        | 34.71        | 458.75       | 235.07       | Not done     | Not done     | <1           | Not done     | 40.59        |
| <b>OMS 2003</b>    | 71.72        | 43.81        | 7.49         | 22.35        | 79.75        | 113.96       | 8.9          | <5           | 0.13         | 0.44         | 28.23        |
| <b>OMS 2004</b>    | 86.68        | 61.12        | 10.72        | 30.52        | 38.74        | 127.29       | 11.5         | <5           | 0.13         | 0.63         | 37.61        |
| <b>OMS 2005</b>    | 69.79        | 48.23        | 8.87         | 25.06        | 39.19        | 93.55        | 10.3         | <5           | 0.10         | 0.49         | 29.46        |
| <b>OMS 2006</b>    | 102.21       | 62.10        | 10.97        | 30.68        | 37.64        | 115.43       | 11.8         | <5           | 0.11         | 0.63         | 35.63        |
| <b>OMS 2007</b>    | 83.77        | 51.26        | 9.20         | 25.44        | 50.62        | 98.58        | 8.84         | <5           | 0.10         | 0.80         | 32.05        |
| <b>OMS 2008</b>    | 62.15        | 45.53        | 7.83         | 23.58        | 398.75       | 206.43       | 9.85         | <2           | 0.18         | 0.56         | 48.83        |
| <b>TRK 2008</b>    | 87.48        | 61.91        | 10.91        | 30.48        | 43.06        | 118.41       | 12.56        | <2           | 0.13         | 0.75         | 37.07        |
| <b>OMS 2009</b>    | 78.3         | 57.0         | 8.4          | 27.1         | 308.9        | 167.3        | Not done     | 1.2          | 0.1          | 0.6          | 32.3         |
| <b>TRK 2009</b>    | 93.9         | 67.4         | 10.5         | 31.8         | 29.9         | 116.6        | Not done     | 1.1          | 0.1          | 0.7          | 37.7         |

All the metal analysis has been done at the OMS site except for 2008 onwards when TRK samples were also analysed.

Most of the values are very consistent except copper (Cu). The 1995 -8 average and the 2008 values for OMS are a factor of 10 higher than the rest. The most likely reason for this is the use of Copper based anti-fouling paint in the collector and on near by oceanographic equipment.

### **CURRENT STATUS**

- Secchi disc method works well and has provided the most reliable / meaningful estimate of turbidity. The data set is still young but could form a very useful long-term data set if continued regularly.
- The passive sediment traps work well and provide a sample that can be analysed in the future (this may be useful in the event of an unforeseen incident). The samples from 1995- 98 & 2002 – 2009 were sent away and analysed for; dry weight, organic content, grain size analysis and metal content.
- The optical turbidity probe has proved unreliable and difficult to interpret.

### **RECOMMENDATIONS**

- Continue the Secchi disk readings as often as possible to produce a long-term data set.
- Continue with the sediment traps. Keep the samples for use in future analysis.

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