HERMIONE
Month 12 scientific progress report

Each HERMIONE partner is required to complete a progress report detailing scientific activities and advances during the period **1 October 2009 - 31 March 2010**. Please use this document to outline your activities during this period and return by email to Abigail Pattenden by **19 March 2010** (adcp@noc.soton.ac.uk).

Partner organisation name: UGOT (University of Gothenburg)
Partner number: **22**
Lead scientist: **Tomas Lundälv**

1. Scientific progress over the past 6 months (Oct 09 – March 10)

Please give a brief (3 pages max.) account of your institute's progress and contribution to HERMIONE during the last 6 months. Please divide your report according to work package and include details of any deviation from the workplan or delays incurred in your work.

WP4: Over the period, two cruises (18 shiphours) related to HERMIONE were undertaken with R/V Lophelia. The primary objective for these cruises was ROV-aided recovery and re-deployment of long-term recording bottom-deployed instruments at the Tisler reef in collaboration with NUIGALWAY partners. Further cruises were planned during the period, but had to be postponed due to extremely cold weather and heavy ice conditions, preventing R/V Lophelia from leaving harbour between late December 2009 – late March 2010.

Intense preparations for the establishment of a cabled and internet-connected Seafloor Observatory at the Tisler Reef, in collaboration with partners from Jacobs University, Bremen, took place during the period. This involved production of detailed drawings and maps of the planned installation, negotiations with and applications to relevant Norwegian authorities (County Governor of Østfold, Fisheries Directorate and Hvaler municipality) concerning necessary permits. All the permits needed for the installation were obtained by mid-March 2010, and it is now anticipated that the Observatory can be operational within the first half of 2010.

Over the period, much effort was put into the preparation of various publications and presentations related to the data collected within the HERMES-, CORAMM- and early HERMIONE projects (see Publications below). One article was published, one submitted and eight articles are in various stages of preparation. Analysis of material related to observed high mortality in the poriferan *Geodia baretti*, coinciding with periods of unusually high temperatures, has continued. An example from the regularly monitored "coral-recovery" transect at Tisler reef, covering the latest observed period of high temperatures in the autumn of 2008, is shown in Fig. 1. Video mosaics from part of this transect dominated by poriferans, obtained in July 2008 and August 2009 demonstrated an approximate 10% mortality in the sponge population covered by the mosaics over the period. This mortality is in addition to the approximate 50% mortality observed after the first instance of high temperatures (autumn 2006). Considerably higher mortality rates (up to approximately 90% of the already in 2007 highly reduced populations) in *Geodia baretti* was observed in other localities and in lesser depths.

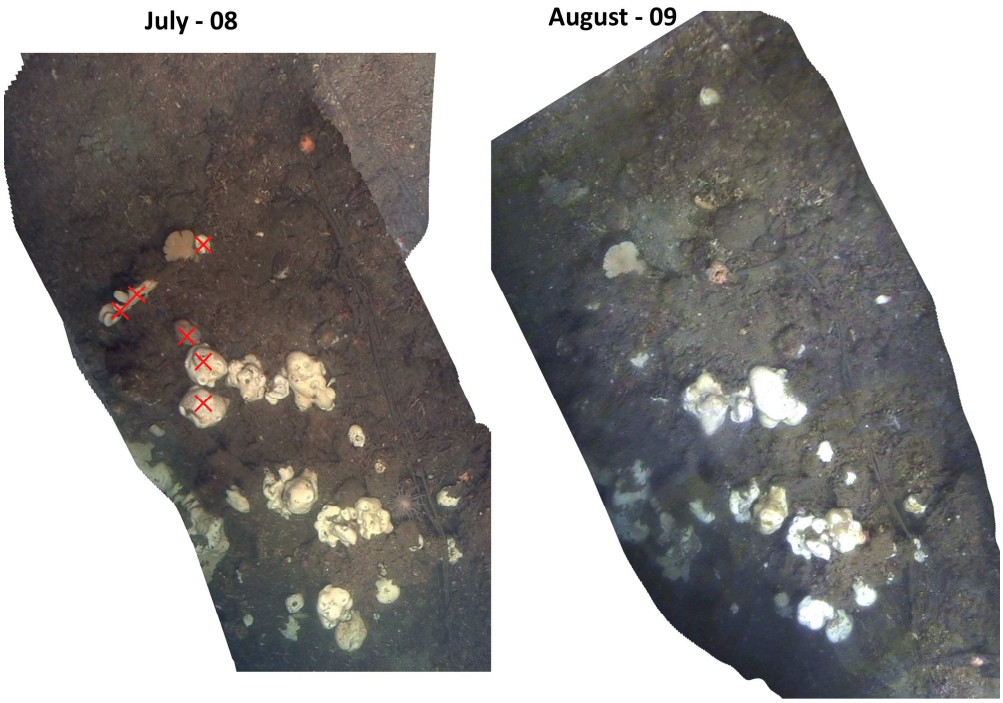

Figure 1. Video mosaics of corresponding parts of coral recovery transect at Tisler reef dominated by poriferans, from July 2008 and August 2009. Sponge colonies disappearing during the covered time interval are indicated with red crosses.

Over the period, funding has been obtained for the acquisition of a new ROV and for refurbishing of R/V Lophelia, to optimise her capabilities for handling of ROV:s and other instrumentation, as well as improving her speed capability. Consequently, much effort has gone into the planning of these acquisitions, which should substantially enhance our capabilities for field work related to HERMIONE.

WP6: Postdoc Andrea Morf has continued collection of relevant data for socioeconomic studies related to the recently established marine national parks in Koster and Hvaler, as well as well as the potential marine SAC Bratten in the open Skagerrak:

a) Case studies Koster/Hvaler/Bratten (AM's actual assignment: deliverable 6.8)
- Status of cases: National parks in Koster and Hvaler area under implementation and possible to study. Planning in Bratten area not started yet, preliminary contacts between authorities and stakeholders. Lobby work ongoing from NGOs and researchers to protect the area. NB: Open how much of a case Bratten will be until data-collection has to be concluded (latest in jan 2011).
- Status of work: Field work in Koster/Hvaler area under way spring 2010. Analysis of data summer 2010. Keeping in contact with authorities on development of Bratten as a case to study.

b) Related work on science-policy interface and maritime spatial planning and ecosystem based management (related to synthesis work within WP 6)
- 2. October 2009, Stockholm: Participation in EU-workshop on Maritime Spatial Planning
- 6. October 2009, Göteborg: Meeting Sweden/Norway/Denmark preparing an application within INTERREG Kattegatt-Skagerrak programme on maritime planning and management of biodiversity and climatic change around the Kattegatt/Skagerrak

- CERF conference Portland, Oregon, USA 8 1.-6. Nov: Presentation of Koster case from an ecosystem approach perspective
- 9. December 2009, Göteborg: Meeting Sweden/Norway/Denmark preparing an application within INTERREG Kattegatt-Skagerrak programme on maritime planning and management of biodiversity and climatic change around the Kattegatt/Skagerrak (asked to sit in reference group for the project)
- 12. March 2010, Copenhagen: Participating as Swedish expert in the 1st meeting of a complementary expert group on maritime spatial planning within the Nordic Council's Aquatic Ecosystem Group (AEG)
- July 2009 - Jan 2012: Participation in INTERREG Baltic Sea programme BaltSeaPlan on maritime spatial planning for the Baltic Sea area, presently working within BaltSeaPlan's WP 3 with analysis of national maritime policies relevant for maritime spatial planning (national reports March 2010).

WP8: Contribution of a large number of photographs, video clips and interviews for books, newspaper articles, TV-programs and information material.

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2. Scientific objectives for the next 6 months (April – Sept 10)

Again, please separate by WP where possible.

WP4: (1) Installation of internet-connected Seafloor Observatory at Tisler reef, in collaboration with partners from Jacobs University. (2) Documentation of Tisler coral recovery transect. Further development of techniques for obtaining high-quality video-mosaics. (3) Joint intense effort with partners from NUIGALWAY, ULIV and NIOZ in a field campaign at Tisler reef to address some of the missing aspects to previous measurements, particularly those regarding dissolved carbon, as well as quantifying the total alkalinity state of the reef waters. It is intended to correlate biogeochemical variability with hydrographic & water quality conditions, zooplankton abundance & variability (incl diurnal migrations) and general reef activity (via imaging) at the reef. Data will be utilized in a food web model for the reef. (4) Continuation of experiments with re-colonisation of trawl-damaged coral habitats. (5) continued work to finalise the many manuscripts in preparation.
WP5: Cruise to the Bratten area for ROV-documentation of chemosynthetic habitats.
WP6: Field work in Koster/Hvaler area under way spring 2010. Analysis of data summer 2010. Keeping in contact with authorities on development of Bratten as a case to study.
WP8: We have been asked to edit videos illustrating the marine national parks on both the Swedish and Norwegian sides of the border. Establishment of the internet-connected seafloor observatory at Tisler reef should offer a unique possibility for public outreach to a broad audience.

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3. Publications, presentations and conferences

Please list below any publications or presentations related to HERMIONE that your team has produced in the last 6 months. You should include details of any conferences or workshops attended as part of HERMIONE research.

Autun Purser, Melanie Bergmann, Tomas Lundälv, Jörg Ontrup, Tim W. Nattkemper, 2009. Use of machine-learning algorithms for the automated detection of cold-water coral habitats: a pilot study. *Marine Ecology Progress Series, 397: 241-251*

Hannes Wagner, Autun Purser, Laurenz Thomsen, Carlos Jesus, Tomas Lundälv, submitted. Particulate organic matter fluxes and hydrodynamics at the Tisler cold water coral reef. *Journal of Marine Systems.*

Mikael Dahl, Tomas Lundälv, Ricardo Pereyra, Carl André, in prep. Fine-scale spatial genetic structure of the cold-water coral *Lophelia pertusa* in the NE Skagerrak.

Martin White, Damien Guihen, George A. Wolff, Kostas Kiriakoulakis, Marc Lavaleye, Gerhard Duineveld and Tomas Lundälv, in prep. Are cold-water coral ecosystems hotspots for carbon cycling?

Damien Guihen, Martin White, Tomas Lundälv, in prep. Flow dynamics and turbulence generation at a cold-water coral reef.

Tomas Lundälv, Damien Guihen, Martin White, in prep. Massive mortality in populations of the poriferan *Geodia baretti* in NE Skagerrak: An effect of recurring temperature chocks?

Ann Larsson, Johanna Järnegren, Sandra Brooke, Mikael Dahl, Susanna Strömberg, Fredrik Pleiel, in prep. Spawning and early development in the scleractinian cold-water coral *Lophelia pertusa*.

Susanna M Strömberg, Lisbeth G Jonsson, Tomas Lundälv, in prep. A settling experiment Part I: Distributional patterns of meio- and macrofauna assemblages in relation to the cold-water coral *Lophelia pertusa* (Linneaus, 1758) at a reef site in the NE Skagerrak.

Susanna M Strömberg, Lisbeth G Jonsson, Tomas Lundälv, in prep. A settling experiment Part II: The effect of substrate orientation and relative position to colonies of *Lophelia pertusa* (Linneaus, 1758) on abundance and diversity of faunal assemblages.

Guihen, D., Lundälv, T. and White, M., Poster Presentation. Recurring Temperature Shock At A Cold-Water Coral Reef, Testing *Lophelia pertusa* Physiological Limits. AGU Ocean Sciences Meeting, 22-26 February 2010, Portland, Oregon

White, M., Wolff, G., Guihen, D., Kiriakoulakis, K., Lundälv, T. Poster presentation. Oxygen Respiration Estimates at a cold water coral ecosystem: Implications for regional benthos carbon turnover. AGU Ocean Sciences Meeting, 22-26 February 2010, Portland, Oregon

Tomas Lundälv and Vikram Unnithan, Presentation. Video-mosaicing techniques for environmental monitoring – experiences from the CORAMM Project and some plans for the future. Presentation at CORAMM Final Workshop, Bremen, January 11-13, 2010.

Tomas Lundälv, Presentation. Capabilities for work related to ROV-techniques and ongoing studies at SLC – Tjärnö. Presentation at ASSEMBLE Workshop, March 23-25, 2010, Tjärnö and Kristineberg.

Ann Larsson, Presentation. Experimental laboratory studies on environmental constraints of *Lophelia pertusa*. Presentation at CORAMM Final Workshop, Bremen, January 11-13, 2010.

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4. Media contact/public outreach

Please list below any HERMIONE-related media coverage you have been involved with (including date and details of newspaper, radio station, etc.)

Contribution with image material and interview to the Norwegian TV and radio Broadcasting Corporation NRK, February 2010. http://www.nrk.no/nyheter/distrikt/ostfold/1.6983290

Contribution with image material and facts to information folders published by the Norwegian Directorate for Nature Management in February 2010 (http://www.dirnat.no/content.ap?thisId=1500)

Contribution with a large number of photographs to a book about National Parks in Sweden, issued by the Swedish Environmental Protection Agency in March 2010.

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5. Staff working on the project

Please list below the people working on the HERMIONE project at your institute. You should indicate whether they are permanent or temporary members of staff, or post-doc researchers. For gender monitoring purposes (a FP7 requirement), please indicate male/female.

Staff name	Position	Perm/Temp	Male/Female
Tomas Lundalv	Researcher	Perm	Male
Lisbeth Jonsson	Postdoc	Temp	Female
Carl André	Assoc. Professor	Perm	Male
Mats Lindegarth	Assoc. Professor	Perm	Male
Ann Larsson	Postdoc	Temp	Female
Andrea Morf	Postdoc	Temp	Female
Lars Hagstrom/Annci Niklasson	Administrative staff	Perm	Male and Female

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6. Students working on the project

Please list below any students working on HERMIONE at your institute (regardless of whether they are funded by the project or not). Please include a brief description of their work (PhD title, etc) and at what level they are working (PhD, MSc, undergraduate project, etc).

Student name	Level (PhD, MSc etc)	Supervisor	Research topic
Mikael Dahl	PhD-student	C. André/T. Lundalv	Coral genetics
Genoveva Gonzales Mirelis	PhD-student	M.Lindegarth/T.Lundalv	Predictive habitat mapping
Susanna Stromberg	Msc-student	T. Lundalv	Coral biodiversity/recovery

7. Person-effort per workpackage

Please enter the person-month effort contributed by your organisation to each WP in the table below for the period 1 October 2009 – 31 March 2010. Please note that under FP7 rules, you are obliged to keep records to support these figures (e.g., timesheets).

WP1	WP2	WP3	WP4	WP5	WP6	WP7	WP8	WP9	WP10	Total
			2.5				*0.5*			
			8		*1*		*0.5*			

Carbon cycling at the Tisler Reef, Kosterfjord

Wolff G.A., Bailey A., White M.[1], Kivimae C.[1], Kiriakoulakis K.[2], Lundälv T.[3], Jaffé R.[4], Cawley K. [4]

School of Environmental Science, University of Liverpool, UK. [1]National University of Ireland, Galway, Eire. [2]John Moores University, Liverpool, UK.
[3]Sven Lovén Centre for Marine Science, Sweden. [4]Florida International University, USA.

Theme 4: Ecosystem distribution and interconnection

1. Introduction

•Tisler Reef, situated near 59°N 11°E, in a channel connecting the Kosterfjord with the northern Skagerrak is a convenient location to study a cold water coral (CWC) community.

•Elevated respiration rates determined "on reef" of 27-67 mmol O_2 day^{-1} (White et al., submitted), consistent with ecosystem modeling studies (van Oevelen et al., 2009)

2. Hypotheses

1. CWCs are a sink for particulate organic carbon (POC) through sedimentation/ trapping, but a source of dissolved organic carbon (DOC) via heterotrophic alteration of POC and CWC exudate.
2. Respiration of DOC released by the CWC via the microbial loop, leads to elevated respiration rates at the reef.

3. Methodology

•To test our hypotheses we carried measured DOC, POC, dissolved oxygen, DIC and alkalinity on and off the Tisler reef on 3rd September, 2010. We used excitation-emission matrix (EEM) fluorescence spectroscopy with parallel factor analysis (PARFAC) to determine potential sources of fluorescent dissolved organic matter (DOM; Jaffé *et al.*, 2008). Samples were collected through the water column using a CTD, focussing on water just above the reef (115 – 131 m) and ~ 20 m above the reef, as well as surface, chlorophyll maximum and at the thermocline.

4. Results

•Water column structure shows stratification, with fresh (warm) water at surface (Fig 2 a, b).

•Surface waters well oxygenated (super saturated, with minimum at ~10 m (Fig. 2c). No obvious on- *vs.* off-reef trends.

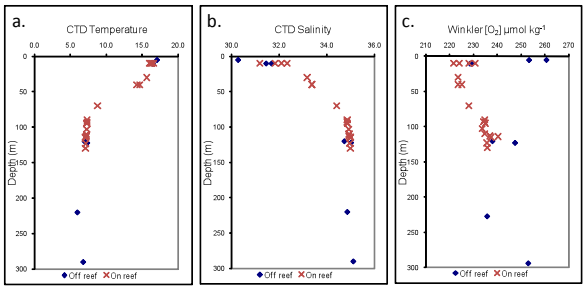

Figure 2 – Depth plots for a. temperature, b. salinity and c. oxygen concentration (determined using the Winkler method) in the Kosterfjord on and off the Tisler Reef

• Apparent oxygen utilisation (AOU)[1] increases with depth on and off-reef.

•DOC shows no real depth trend on or off-reef (Fig 3b)

•AOU tends to increase *vs.* DOC concentration off reef (not including surface, super saturated samples), but is tightly clustered on reef.

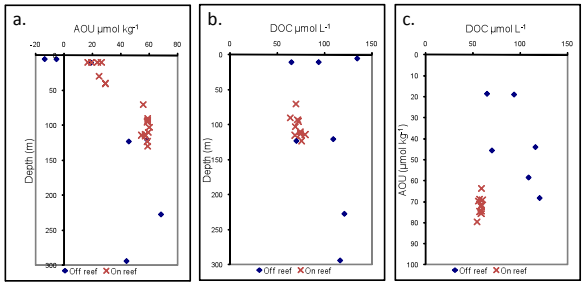

Figure 3 – Depth plots for a. AOU, b. DOC. c. shows DOC vs AOU.

[1] Apparent oxygen utilisation (AOU) = $[O_2]^*$ - $[O_2]_{actual}$ where $[O_2]^*$ is the theoretical saturation concentration of oxygen for a sample of given S & T, and $[O_2]_{actual}$ is its actual concentration

References.

Jaffé , R. *et al.* 2008. Spatial and temporal variations in DOM composition in ecosystems: The importance of long-term monitoring of optical properties. *Journal of Geophysical Research* **113**, G04032.

van Oevelen, D. *et al.* 2009 The cold-water coral community as a hot spot for carbon cycling on continental margins: A food-web analysis from Rockall Bank (northeast Atlantic). *Limnol. Oceanogr.* **54**, 1829-1844.

White M. et al. Are cold-water coral ecosystems hotspots for carbon cycling? Submitted to *Marine Ecology Progress Series.*

Yamashita Y. et al. 2010 Fluorescence characteristics of dissolved organic matter in the deep waters of the Okhotsk Sea and the northwestern North Pacific Ocean. *Deep-sea Research Part II-topical Studies In Oceanography* **57**, 1478-1485

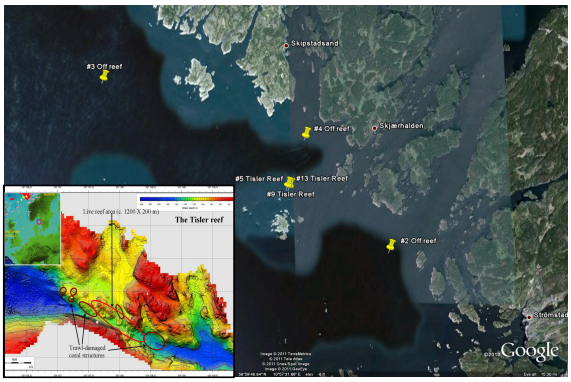

Figure 1 – Google map showing sampling locations off reef and the location of the Tisler Reef. The insert shows the general location of the Tisler reef in the northern Skagerrak with a higher resolution bathymetry map showing the extent of the live (solid) and associated rubble (dashed line).

•EEM-PARFAC analysis identifies four principal components of fluorescent DOM in waters of the study area (see also Yamashita et al., 2010):

- C1 – ubiquitous humic-like component - (λ_{ex} 255 nm, λ_{em} 468 nm).
- C2 – protein-like component (tryptophan) - (λ_{ex} 275 nm, λ_{em} 338 nm).
- C3 – protein-like component (tyrosine) - (λ_{ex} <240 nm), λ_{em} 328 nm).
- C4 – microbial humic-like component – (λ_{ex} 245 nm, λ_{em} 394 nm).

•Consistent with mixed source of DOM (major autochthonous and minor allochthonous). C3 dominates (refractory protein).

•C2 contribution (labile protein) is minor, but most variable, especially marked on-reef (Fig. 4a), e.g. vs C4 (refractory microbial component; Fig. 4b).

•No significant relationship between AOU and fluorescence intensity (data not shown).

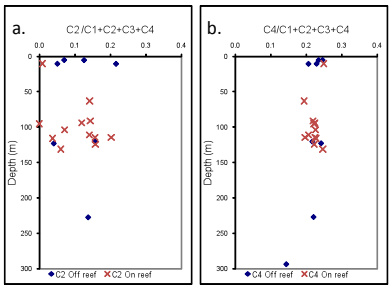

Figure 4 – Depth plots for a. Contribution of C2 to total fluorescence, b. Contribution of C4 to total fluorescence.

5. Discussion/Conclusions

• Water column characteristics typical of fjordic setting.

• Relationship between DOC and AOU implies production and accumulation of DOC with increasing oxygen consumption off reef (POC respiration).

• Tight clustering of (high) AOUs and [DOC] above the reef implies coupling between DOC production and its respiration i.e. no accumulation. Possible reef effect *via* enhanced microbial loop?

• Labile fluorescent DOM highly variable around the reef – a minor component and variability may reflect instantaneous production and/or consumption.

•Hypothesis 1 – not proven, but some evidence to support Hypothesis 2.

6. Acknowledgments

• We are grateful to the Master and crew of the *Nereus* for assistance at sea, to EC FP7 HERMIONE project (grant No 226354) and ASSEMBLE Transnational Access Call 2.

•We thank Dr. Claire Mahaffey for useful discussions.