

## Theme Session G

### Sediment–biota interactions and mapping marine habitats

#### ICES CM 2008/G:01

##### **A practical example of mapping in order to select closed areas to protect cold-water corals in the high seas (Hatton Bank, ICES VIb1 and XIIb)**

P. Durán Muñoz, M. Sayago-Gil, J. Cristobo, S. Parra, A. Serrano, V. Díaz del Rio, T. Patrocinio, M. Sacau, J. Murillo, D. Palomino, M. Domínguez, and L. M. Fernández-Salas

Using conventional fisheries science, geomorphology, sedimentology, and benthic ecology, the research developed by Spain under the ECOVUL/ARPA project has been useful in order to improve our knowledge of the relationship between bottom fisheries, an example of potentially conflicting human use of the seabed in the high seas, and benthic habitats. Applying an interdisciplinary approach, this project identified the relevant deep-water bottom-trawl fisheries in the Hatton Bank western slope (ICES VIb1 and XIIb), mapped the main fishing grounds and the possible interactions with marine features and cold-water corals habitats. This approach was used to select the spatial limits of a suitable additional area closed to fishing as a management measure to protect the corals within the framework of the ecosystem approach to fisheries. This paper presents the methods used to collect the data and the last results derived from the study of the Hatton Bank habitats and the related bottom fisheries, and discusses the measures for reducing interactions with sensitive habitats, particularly cold-water corals.

Keywords: Hatton Bank, deep-water fisheries, cold-water coral, mapping, closed areas, protection.

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#### ICES cm 2008/G:02

##### **Very high-resolution sidescan sonar mapping of biogenic reefs of the tubeworm *Lanice conchilega***

Steven Degraer, Geert Moerkerke, Marijn Rabaut, Gert Van Hoey, Isabelle Du Four, Magda Vincx, Jean-Pierre Henriët, and Vera Van Lancker

Reefs of the tube-building polychaete *Lanice conchilega* are known to represent hotspots of biodiversity within inter- and subtidal soft sediments of the North Sea. However, because of their patchy distribution, point sampling does not appropriately map their subtidal spatial distribution. This study evaluated the feasibility of detecting *L. conchilega* reefs by very high-resolution sidescan sonar imagery. A subtidal very high-resolution (410 kHz) sidescan survey, combined with grab sampling, revealed high densities of *L. conchilega* (up to 1979 individuals m<sup>-2</sup>) coinciding with higher reflectivity, patchy, and grainy acoustic facies. From the sidescan sonar imagery, individual reefs were estimated to reach a maximum size of 15 m<sup>2</sup>. To ground-truth the acoustic facies, the distribution of intertidal *L. conchilega* reefs was mapped at low tide and sidescan sonar imagery was recorded during the following high tide. Intertidal *L. conchilega* reefs had a patch size of 0.8 m<sup>2</sup> up to 11.6 m<sup>2</sup>, elevated 7.5–11.5 cm above the surrounding seabed and covered approximately 10% of the selected area. The very high-resolution (445 kHz) sidescan sonar imagery revealed a similar acoustic facies as in the subtidal. Lower resolution (132 kHz) sidescan sonar imagery was less efficient in detecting physically less-developed *L. conchilega* reefs. We conclude that (i) there are no major technical restrictions to mapping *L. conchilega* reefs using sidescan sonar, (ii) the developmental stage of *L. conchilega* reefs impacts the detectability of the reefs, and (iii) very high-resolution sidescan sonar imagery is considered a necessity when mapping small-scale structures, such as *L. conchilega* reefs.

Keywords: remote sensing, biogenic reefs, sidescan sonar, *Lanice conchilega*.

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#### ICES CM 2008/G:03

##### **From patterns to processes: mapping sediment function**

Lorna R. Teal, Ruth Parker, Gary Fones, and Martin Solan

In order to link biological data on bioturbation to ecosystem processes in the sediment, such as nutrient regeneration, simultaneous *in situ* measurements of infaunal activity and sediment chemistry are required. A novel *in situ* technique has been developed for measuring sediment redox conditions alongside biological activity (bioturbation) by combining DGT (diffusive gradients in thin films) gels and time-lapse sediment

profile imaging (t-SPI). Here we present preliminary findings following deployment of the SPI, including the gels (g-SPI), at two sites within the North Sea (Oyster Ground and Dogger Bank) that support contrasting biological communities. The data reveal that higher levels of infaunal bioturbation occur at the Oyster Ground and that this activity significantly affects background diagenetic processes. We also present data from ongoing work that combines the g-SPI with fluorescent time-lapse sediment profile imaging (f-SPI) which allows tracking of faunal-mediated particle movement (bioturbation) alongside sediment redox conditions. Taken together, these techniques are capable of quantifying organism–sediment interactions within context and over large ecosystem-relevant scales at a fine temporal resolution.

Keywords: benthic habitat, sediment function, bioturbation, sediment profile imaging, DGT gels.

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#### ICES CM 2008/G:04

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### The potential of underwater imaging to evaluate lobster (*Homarus americanus*) density on different habitats

M. John Tremblay, Stephen J. Smith, Pierre M. Clement, and Brian J. Todd.

Habitat relationships of the American lobster have been studied via traps, scuba, and by trawls but to a much lesser extent by underwater video or still photography. Lobsters are often associated with shelters but in some areas are frequently in the open. In this paper we explore the potential of an underwater towed vehicle (Towcam) to estimate the density of lobsters and crabs on different bottom types. Towcam collects high-frequency still images and continuous video. A pilot study was undertaken in an area off southwest Nova Scotia where bottom mapping was available from multibeam and sidescan and where there are productive lobster and scallop fisheries. Lobsters were evident in more than 10% of the still images on some transects. On sand, gravel, and cobble bottoms lobsters were readily seen and could often be measured with reference lasers. On rougher bottoms with boulders, some lobsters were still evident either in the open or partially hidden in shelters. The paper will also discuss (i) methods for measuring field of view and (ii) methods for incorporating relationships between lobsters and bottom type (based on the images), into survey designs.

Keywords: underwater video, lobster, habitat.

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#### ICES CM 2008/G:05

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### Subterranean ground water flux, mudbanks, and seasonal productivity blooms

Joseph Sebastian Paimpillil

Southwest Indian coastal waters (Arabian Sea) have a unique coastal phenomenon—mudbanks—occurring in the southwest monsoon. The formation of these mudbanks is a complex process with physical, chemical, and geological forcing, apparently triggered by subterranean ground water flux to the coastal belt. Recent investigations have indicated nutrient-rich water from “external sources” spreading offshore from localized coastal pockets. These have changed the oligotrophic coastal ecosystem into a productive one with approximately three times ( $14 \text{ mg m}^{-3}$  chlorophyll *a*) greater primary productivity than average values. The decadal trend of chlorophyll shows a “greening” of the nearshore waters. Even after the mudbank season, the narrow coastal strip area had nutrient enrichment, with nitrite ( $0.5\text{--}2.0 \text{ }\mu\text{M}$ ), phosphate ( $0.4\text{--}2.8 \text{ }\mu\text{M}$ ), ammonia ( $1\text{--}7 \text{ }\mu\text{M}$ ), and nitrate ( $1\text{--}6 \text{ }\mu\text{M}$ ) and a band of N/P >15 funnelling out from the coastal region. One of the major factors influencing the interannual variations in the formation of mudbanks seems to be the nutrient-rich low saline ground water fluxes. The ground water flux is controlled by a critical water level difference between the lake and the sea. The water level in the lake depends on monsoon floods and the variability in monsoon precipitation, the sea level is linked with global warming. The present challenges are to predict mudbank formation and its interannual variations, its artificial generation, and integrated management of the mudbank areas, taking into account coastal protection issues and socio-economic development.

Keywords: mudbank, nutrient enrichment, ground water flux.

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**ICES CM 2008/G:06**

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**Investigating the link between *Nephrops norvegicus* burrow density and sediment composition in Scottish waters**

Neil Campbell, Lynda Allan, Adrian Weetman, and Helen Dobby

*Nephrops norvegicus* is a burrowing decapod crustacean found in the North Atlantic Ocean and Mediterranean Sea, from shallow coastal waters to depths of 1200 m. It is a commercially significant species throughout Europe, and is currently the most valuable species exploited by the commercial fishing industry in Scotland. It constructs and inhabits extensive burrow complexes in suitable muddy sediments, the consistency of which governs the size and complexity of burrow architecture. Due to the variable and sex-specific emergence patterns of *Nephrops*, catch rates from traditional trawl surveys are not considered a good estimator of population size. *Nephrops* populations around Scotland are surveyed annually using an underwater television (UWTV) method to estimate burrow complex density along transects. The survey is stratified by sediment type, and sediment samples have been collected at the end of each UWTV deployment to validate this stratification. This study explores the relationship between *Nephrops* burrow density and the physical characteristics of the sediment in which they live, against a background of increasing population size over recent years. We attempt to answer the question of whether changes in population size have represented a colonization of less favourable sediment types, an overall increase in burrow density across habitable sediments, or a marked increase in burrow density in the most favourable sediments. The implications for *Nephrops* UWTV survey design, management and relevance of these findings to the fishery are discussed.

Keywords: *Nephrops norvegicus*, mud, survey design, fishery-independent methods, sediment–biota linkage.

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**ICES CM 2008/G:07**

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**The impact of hydrolic clam dredging and winds on soft bottom communities**

G. G. Thorarinsdóttir, S. A. Ragnarsson, K. Gunnarsson, and E. G. Garcia

Ocean quahogs (*Arctica islandica*) are burrowing bivalves that live in densely packed sand and sand–mud bottom habitats off the coasts of North America, Iceland, and elsewhere in northern Europe. This species can move up and down in the bottom sediment but does not move vertically after the larvae have settled and burrowed down into the sediment. In Iceland this species has been harvested by a hydraulic dredge since 1995 mainly at depths of 10–30 m. A study was carried out to investigate the direct effects of hydraulic dredging at 12 m on ocean quahog population in northeast Iceland as well as on benthic communities, by comparing dredge tracks and undisturbed areas. The rate of the shell breakage of ocean quahog caught in the dredge was 30–50% and of those left in the track 11–29%. The shells left in the track were smaller on average than those caught. The mortality of clams remaining on the seabed after dredging results from shell breakage and/or exposure to predators. The dredge track marks disappeared shortly after dredging and the effects on the benthic community were of short duration with macrofaunal densities, other than ocean quahog, attaining ambient levels only a few weeks after dredging. In April 2006 in the same fjord a heavy storm induced movements of large quantities of ocean quahogs from their natural habitat, the soft bottom at 12 m depth, up onto a hard substratum at lower depth. Here, the clams were unable to bury down again and escape, and were easy prey for predators. A year later, the diver revisited the site and observed only empty shells and shell fragments, but no living clams.

Keywords: *Arctica islandica*, hydraulic dredging, shell breakage, bottom communities, wind disturbance, habitat recovery.

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**ICES CM 2008/G:08**

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**The impact of commercial fishing on the determination of habitat associations of sea scallops**

Stephen J. Smith, Jerry Black, Brian J. Todd, and Vladimir E. Kostylev

The sea scallop (*Placopecten magellanicus*) population off southwest Nova Scotia in Scallop Fishing Area 29 has been monitored by an annual drag survey since the fishery started there in 2001. A new stratification scheme based upon surficial geology maps from a multibeam bottom mapping and geology ground-truth project completed in 2004 in this area have been used for survey design since 2005. Survey data from before 2005 have been post-stratified using the new strata. The efficiency of the design with respect to variance reduction appears to have diminished over time, suggesting that the association between scallop abundance and bottom type may not have been as strong or constant as first assumed. Modelling of the association

between scallop abundance and bottom type and depth using a Bayesian hierarchical approach confirms this diminishing relationship. Results from the inclusion of spatial measures of fishing effort based upon satellite vessel monitoring data into the model suggests that either the habitat is being changed by fishing or the use of abundance as an indicator of the strength of preference or association is misleading when the population is being depleted by the fishery. We were able to track these changes because we had survey data from the beginning of this fishery. These results could have implications on the interpretation of species habitat associations from areas where data are only available from periods when the population had been exploited over a long time.

Keywords: ocean scallop, seabed mapping, multibeam bathymetry.

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## ICES CM 2008/G:09

### **Prediction of habitats on a fishing bank off Northern Norway using a combination of multivariate analysis and GIS classification**

Pål Buhl-Mortensen, Margaret Dolan, and Lene Buhl-Mortensen

MAREANO (Marine AREAdatabase for NORwegian coast and sea areas) is a multidisciplinary mapping programme, focusing on offshore areas in the southern Barents Sea. It was initiated to address the lack of knowledge of the seabed and environment which is required for informed, sustainable management. The mapping programme includes the acquisition of multibeam bathymetry and backscatter data together with a comprehensive, integrated biological, and geological sampling programme. Equipment used includes underwater video, boxcorer, grab, epibenthic sled, and beam trawl. Mapping outputs from the project include bathymetric data, geological maps (morphology, hard and soft seabed, sediment grain size distribution, sedimentary environment, geological genesis), biological maps (including biodiversity and faunal distribution), and benthic habitat maps. Habitat maps are produced by combining information on landscape features, sediment types, and biological communities. The Tromsøflaket fishing bank was used as a case-study area to develop suitable habitat-mapping methods. Multivariate statistical methods were used to relate bottom environment (including multiscale physical descriptors of the seabed derived from multibeam data) and faunal distribution in order to find objective criteria for the definition of habitats and biotopes. Prediction of habitat distribution was performed using a supervised GIS classification using physical seabed descriptors for the faunal groups identified by correspondence analysis. The faunistic results from the bottom samples were used to describe the biodiversity of the identified habitats. For future MAREANO cruises an important task will be to ground-truth habitat predictions and to test the reliability of these predictions in the wider MAREANO area.

Keywords: habitat mapping, habitat prediction, benthic biodiversity

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## ICES CM 2008/G:10

### **Spatial prediction of demersal fish distributions: enhancing our understanding of species–environment relationships**

Cordelia H. Moore, Euan S. Harvey, and Kimberly Van Niel

The aim of this research was to use species distribution modelling to identify key environmental variables influencing the spatial distribution of demersal fish and assess the potential of these species–environment relationships to predict fish distributions accurately. In the past, predictive modelling of fish distributions has been limited, as detailed deeper water (>10 m) habitat maps have not been available. However, recent advances in mapping deeper marine environments using hydroacoustic surveying has redressed this limitation. At Cape Howe Marine National Park (southeastern Australia) high-resolution hydroacoustic data were used to investigate the influence of different environmental variables on the distribution of demersal fish. Both classification trees and generalized additive models were developed for ten demersal fish species. Contrasting advantages were observed between the two modelling approaches. Classification trees were useful for modelling and predicting distributions of common species with clearly defined environmental limits in their distributions. Rare species and species that respond to their environment in a more complex or gradual way, however, were better represented by the generalized additive models. It is suggested that generalized regression is better able to represent how species respond along an environmental gradient when that response is more gradual in nature. Both these modelling techniques provided a more detailed understanding of demersal fish distributions and landscape linkages and provided an accurate method for predicting species distributions across unsampled locations. Information of this type will allow more targeted fishery management and more effective planning and monitoring of marine protected areas.

Keywords: species distribution models, spatial ecology, classification trees, generalized additive models.

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#### ICES CM 2008/G:11

### The Biological Quality Index and the Pollution Load Index in evaluation of coastal area ecological status (the Black Sea)

T. S. Osadchaya and S. V. Alyomov

Bottom sediments, in which most of the substances entering the coastal area, including from various human activities, accumulate and transform, are of primary importance for its ecology. Pollutants are damaging to biota through qualitative and quantitative disturbances in communities structure. Simultaneously, biogeochemical processes in the environment lead to decay and transformation of the received pollutants. Having accumulated in excess, organic matter in the bottom sediment triggers imbalance between production and destruction, leading to higher trophic level of the water body. Unstable meteorological conditions, such as strong autumn and winter storms, may make the seawater turbid down to the seabed, and the stirred up bottom sediment may cause repeated pollution of the marine environment. Macrozoobenthos is one of the main links of the common natural processes of substance turnover and energy transfer in coastal ecosystems. The spatial stability and relative longevity of benthic organisms and communities make them the most convenient objects for study of permanent marine environment changes under various, including anthropogenic, impacts. In addition, lightly interpreted benthic characteristics, such as biomass, abundance, and number of species, are the base for most indices widely used in biological/ecological investigations. An aim of the present work was to investigate the overall ecological status of Sevastopol Bay using the Biological Quality Index (BQI) and the Pollution Load Index (PLI). The BQI is calculated on the proportion of the system assigned to abiotic, opportunistic, or stable (normal) benthic community characteristics, whereas the PLI is based on scoring individual contaminants (oil pollution in our case) according to the set baseline and threshold values and summing the individual scores by geometric mean to derive site and system PLI values. Shannon's evenness proportion was calculated as  $H'_{\text{biomass}}/H'_{\text{numbers}}$  and other community indices were calculated using the PRIMER package. Complex analysis of the chemical and biological data showed good similarity between the sediment and macrozoobenthos indices; the dynamics of the deterioration/improvement of benthic communities from 1985 to 2003 was clearly reflected in correlation between the PLI and BQI and redistribution of the abiotic (A), stable (C) and opportunistic (B) zones. Noted improvement of the overall ecology in the mid-1990s (recession in economic activity) changed in 2000 when the abiotic zones (with complete absence of macrobenthos) were observed again.

Keywords: bottom sediments, oil pollution, macrobenthos, the PLI and the BQI.

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#### ICES CM 2008/G:12

### The role of marine habitat mapping in ecosystem-based management

Christopher B. Cogan, Brian Todd, Tom Noji, and Peter Lawton

Ecosystem-based management (EBM) and the related concept of large marine ecosystems (LMEs) are sometimes criticized as being too broad to allow any "real progress". At the same time there is a great need to develop substantive methods to empower EBM more effectively. Marine habitat mapping (MHM) is one example of an applied set of field methods that directly support this science and contribute essential elements for conducting integrated ecosystem assessments. This paper places MHM practices in context with biodiversity models and EBM. Marine habitat mapping is shown to be a critical process closely integrated with much needed progress on the broader topic of EBM. Advances in MHM and EBM depend on evolving technological capabilities, conservation targets, and policy priorities within a spatial planning framework. In both cases, the evolving and adaptive nature of these sciences require explicit spatial parameters, clear objectives, combinations of social and scientific considerations, and multiple parameters to assess overlapping viewpoints and ecosystem functions. To examine the commonalities between MHM and EBM, we also address issues of implicit and explicit linkages between classification, mapping, and elements of biodiversity with management goals. Policy objectives such as sustainability, ecosystem health, or the design of marine protected areas are placed in the combined MHM-EBM context.

Keywords: ecosystem, management, habitat, mapping, biodiversity, marine, GIS.

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**ICES CM 2008/G:14**

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**Spatial analysis of seagrass ecosystems**

Jeffrey Barrell and Jon Grant

Coastal ecosystems in Atlantic Canada are often characterized by the presence of submerged aquatic vegetation (SAV). SAV is sensitive to disturbance and changes in environmental conditions, and provides many important ecosystem services. SAV communities form habitat mosaics of varying configurations, ranging from continuous meadows to highly fragmented distributions. These mosaics can be mapped with relative ease, providing a suitable medium for studying the influence of environmental variation and scale on habitat mapping. Working in coastal New Brunswick (Gulf of St Lawrence), multi-scale spatial patterning of SAV was mapped using both in-water and acoustic remote sensing techniques. A BioSonics Inc. single-beam sonar unit and aerial images from a helium blimp were used. Various spatial analyses were conducted within geographic information systems (GIS). The pattern was quantified using habitat metrics derived from landscape ecology. A geostatistical analysis was conducted to determine scales of variation and relationships to ecosystem processes. Issues of interpolation and extrapolation of data were explored. The multiscale analysis allowed insight into the ramifications of comparing data from disparate scales or locations, allowing the use of SAV as a measure of ecosystem health to be studied.

Keywords: seagrass, SAV, habitat mapping, multi-scale, remote sensing, sonar, geostatistics, GIS.

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**ICES CM 2008/G:15**

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**Habitat suitability modelling using the Kostylev Approach as an indicator of distribution of benthic invertebrates**

Thomas Noji, Steven Fromm, and Suellen Fromm

The suitability of marine habitats for biota is dependent largely upon hydrography (e.g. temperature, currents) and surficial geology (e.g. substrate type). Recognizing this relationship, researchers in Canada developed a broad-scale modelling approach using primarily a suite of hydrographic data. This approach has become known as the Kostylev Approach, named after the principle developer. Researchers at the Northeast Fisheries Science Center (NEFSC) applied the Kostylev approach to data collected in the Gulf of Maine. The model output is in the form of maps which characterize habitats in terms of their “growth potential” for biota as well as mechanical “disturbance”. Comparisons of these outputs with data from NEFSC benthic surveys revealed strong correlations for many groups of taxa, including echinoids, bivalves, gastropods, and cnidarians. This approach has potential as an important tool for fishery and habitat management.

Keywords: habitat, mapping, invertebrates, model, benthos.

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**ICES CM 2008/G:17**

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**Mapping habitats shaped by *Furcellaria lumbricalis* along the Latvian Baltic Proper coast**

Bärbel Müller-Karulis, Vadims Jermakovs, and Juris Aigars

*Furcellaria lumbricalis*, the only macroalgal species able to withstand the high wave exposure along the Latvian Baltic Proper coast, shapes the characteristics of hard bottom habitats on its underwater slope. Based on video-survey observations with 566 stations on a 400 × 400 m grid along a 35-km-long coastal stretch, we modelled the presence/absence of *Furcellaria* stands in the survey area by generalized additive models (GAM). We then extrapolated the models to predict the distribution of *Furcellaria* stands along the entire Latvian Baltic Proper coast. Explanatory variables included in the GAM modelling were presence of boulders, sand coverage, and water depth, which were available from the video observations, as well as wave impact on the seabed generated by a wave model. The most successful GAM correctly reflected 75% of *Furcellaria* stand presences and 94% of absences in the video-survey area. The probability of *Furcellaria* stand occurrence decreased with water depth and wave exposure, but occurrence probabilities larger than 0.5 were restricted to sites with suitable bottom substrate, either described by boulder presence or by low sand coverage. We then generated a map of *Furcellaria* stand occurrence probabilities for the entire Latvian Baltic Proper coast by extrapolating the GAM results. The extrapolated model correctly reflected a patchy distribution pattern of *Furcellaria* along the coast, but predicting the exact location of *Furcellaria* stands was limited by the low quality of geological and lithological maps for the study area.

Keywords: habitat modelling, GAM, *Furcellaria lumbricalis*.

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#### ICES CM 2008/G:19

### Mapping seabed habitats and biodiversity on the continental shelf of the Great Barrier Reef Region by biophysical prediction

C. R. Pitcher, M. Browne, W. Venables, N. Ellis, Doherty, P. J., J. Hooper, N. A. N. Gribble, and I. R. Poiner

The current lack of knowledge of biodiversity living on continental shelf seabeds makes conservation planning and management for sustainability in these areas a difficult and largely subjective task. Without this knowledge, it can also be difficult to justify management actions to stakeholders. Therefore rigorous and reliable baseline information is an imperative for effective management of fisheries and conservation. Until recently, the deeper shelf seabed between the coral reefs of the Great Barrier Reef (GBR) Marine Park was also largely unknown. From 2003 to 2006, the GBR Seabed Biodiversity Project mapped the distribution, abundance, and diversity of habitats and biota over the length and breadth of the region. The scale of the project was large (>200 000 km<sup>2</sup>; ~1600 sampling sites) and was achieved only by applying multidisciplinary skills to acquire, describe, and analyse the many different data types and diversity of biota and habitats. Methods included analysis of biophysical relationships between the species sample data and the physical environment (e.g. large-scale datasets such as bathymetry, sediments, oceanographic model output, satellite remote sensing), as well as human disturbance, as a basis for biodiversity characterization, prediction, and mapping. The inventories and maps produced by the project have been used to assess the environmental sustainability of fisheries and the comprehensiveness of protected areas. The biophysical modelling methods, their performance, and the relative importance of different physical variables will be highlighted.

Keywords: seabed biodiversity mapping, biophysical prediction, surrogate importance.

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#### ICES CM2008/G:20

### National mapping of upper slope seabed: utility for predicting sediment biota interactions

Rudy J. Kloser *et al.*

A programme to map the upper slope biotopes of the Australian EEZ is underway based on fine-scale acoustic multibeam echosounder (MBES) mapping. These data will be a key input into assessing assets (e.g. canyons, terraces, banks) for regional marine planning, informing the placement of marine protected areas (MPAs) and fishery spatial management. The acoustic data provide detailed (20 m grid) bathymetric and inferred substrate information that can be used with other covariates to predict macrofaunal functional groups based on physical and optical “ground-truthing” for hard and soft substrate. Maps of macrofaunal functional group preference with probability of predictions are estimated based on reference sites with varying disturbance histories. In particular these predictions of faunal functional groups may be effected by modification of the seabed from demersal trawling. In the southeast of Australia the upper slope is a narrow strip of seabed that has high repeated demersal trawling activity. This trawling is primarily targeted on acoustic soft seabed regions with potential increased targeting of acoustic hard seabed regions defined at the 1 to 10s km management scale. We demonstrate how fine-scale mapping can provide a predictive map of faunal functional groups and how this may be modified by a demersal trawl disturbance index at fine scale. In a specific highly productive canyon area the ability of the method to map the potential habitat of a vulnerable charismatic stalked crinoid is outlined.

Keywords: biotope, acoustic mapping, demersal trawling, upper slope, Australia.

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#### ICES CM 2008/G:21

### Polycyclic aromatic hydrocarbon contaminants in black-lip (pearl) oyster (*Pinctada margaritifera*) from Kish Island (Persian Gulf)

Peyman Eghtesadi-Araghi, Peter Douglas Haffner, Ken Drouillard, and Wahab Maghsoudlou

Black-lip oysters (*Pinctada margaritifera*) were collected from various coastal locations in the Kish Island (Persian Gulf) area and were analysed in the analytical laboratory of the Great Lakes Institute for Environmental Research at the University of Windsor according to the chemical analysis procedures

accredited by the Canadian Association for Environmental Analysis Laboratories (CAEAL). The polycyclic aromatic hydrocarbon (PAH) concentrations and compositions (2- to 6-ring parent and branched) were determined for all samples. Oysters from the Big Coral site exhibited a wide range of total PAH concentration (1.07–77.66 ng/g wet weight). The lowest value (oysters from Foreigner's Pelage) was 0.7 ng/g wet weight whereas the maximum concentration was 36.33 ng/g wet weight. The PAH concentration ratios in oysters from the Big Coral and Simorgh stations were consistent with a predominately pyrogenic source for these contaminants, whereas the Water-Distillation and Harireh samples exhibited totally and partly petrogenic origins respectively. Comparisons of the PAH concentrations in oysters with sediments collected from the same locations showed that in areas of high sediment PAH concentration the bioavailability of these contaminants was limited.

Keywords: polycyclic aromatic hydrocarbons, bioaccumulation, black-lip oyster, Kish Island (Persian Gulf), Kish Island.

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#### ICES CM 2008/G:22

### Studies on intercorrelations between biodiversity, total organic carbon, and polycyclic aromatic hydrocarbon concentration in Anzali Lagoon sediments

Peyman Eghtesadi-Araghi, Mehri Seyed Hashtroudi, and Mahshid Jalili

Sediments from aquatic regions are known to be sites for the accumulation of lipophilic contaminants. One of the most important of these contaminants are polycyclic aromatic hydrocarbons (PAHs), which constitute 0.2–7% of petroleum weight and have been noted for their mutagenic and teratogenic properties as well as their ability for accumulation in the nutritional pyramid of aquatic organisms. The accumulation of PAHs in sediments also has been shown to be increasing owing to both their structural stability and the dependency of human communities on fossil fuels. Anzali Lagoon has a special role as a source for food and income for the people living around it. Studies on intercorrelations between benthic organism biodiversity, total organic carbon, and petroleum heavy contaminants in sediments are of vital importance due to their ability to act as markers of environmental pressure. In this study we gathered sediment samples from four stations (with different ecological characteristics) over three (warm, temperate, and cold) seasons in Anzali Lagoon and obtained total concentrations of PAHs ( $\Sigma$ PAHs), total organic matter, and Shannon Biodiversity Index values for benthic organisms. The results obtained demonstrate no significant correlation between  $\Sigma$ PAHs and total organic carbon, but a statistically significant correlation was observed between  $\Sigma$ PAHs and Shannon Biodiversity Index of benthic organisms. Therefore the Shannon Benthic Biodiversity Index seems to be a good candidate for evaluation of sediment quality in terms of PAHs contamination in the studied area.

Keywords: sediment, total concentration of PAHs ( $\Sigma$ PAHs), total organic matter and Shannon Biodiversity Index.

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#### ICES CM 2008/G:23

#### Poster

### The relevance of ecogeographical variables for marine habitat suitability modelling of *Owenia fusiformis*

Els Verfaillie, Steven Degraer, Isabelle Du Four, Marijn Rabaut, Marc Van Meirvenne, Wouter Willems, and Vera Van Lancker

Predictive modelling of ecologically relevant marine habitats requires abiotic or ecogeographical variables (EGVs) to predict the potential distribution of a species or community. This study looked at how different combinations of EGV subsets influenced habitat suitability models of the macrobenthic species *Owenia fusiformis*. This tube-building polychaete lived in a well-defined habitat and is strongly linked to the sediment and topography of the seabed. Subsets of sedimentary (multiscale) topography and other EGVs (e.g. hydrodynamics) were used to predict the distribution of the species. The sediment maps were interpolated using Kriging with an external drift, which is a multivariate geostatistical technique. This technique uses secondary information (bathymetry and its multiscale topographic derivatives) to assist the interpolation. Until now, only sediment and bathymetric EGVs have been considered for *O. fusiformis*. Habitat suitability models were based on ecological niche factor analysis (ENFA). The exercise was executed on two study areas: (i) the Belgian part of the North Sea (BPNS) and (ii) a small area of the BPNS, where *O. fusiformis* is known to occur abundantly. Cross-validation for both study areas showed that topographical EGVs were crucial to a good habitat suitability model. For both study areas, the combination of sediment and other EGVs improved the model.

Keywords: habitat suitability modelling, ecogeographical variables, sedimentology, topography, *Owenia fusiformis*, multivariate geostatistics, ecological niche factor analysis, Belgian part of the North Sea.

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**ICES CM 2008/G:24      Poster**

**Habitat suitability models as tools in marine management**

Wouter Willems, M. Vincx, P. Goethals, and S. Degraer

The decision-making process in marine management needs a good scientific and quantitative basis. In order to prioritize habitats and species for conservation, a good assessment of their current status and the distribution of species is needed. Habitat suitability models (HSM) allow us to get most out of the current data. Based on the relationship between the physical habitat and the species present in samples, full cover species distribution maps can be generated. In the marine environment HSM have only been recently introduced, but their use is rapidly increasing. Several transborder mapping programmes have at least one work package related to species distribution modelling with HSM. In this review the challenges and pitfalls of the modelling are discussed and a future outlook is provided.

Keywords: habitat suitability modelling, species distribution, ecological niche, predictive modelling, North Sea.

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**ICES CM 2008 /G:25      Poster**

**A naturalist method for mapping highly fragmented marine benthic habitats**

Laurent Godet, Nicolas Toupoint, Jérôme Fournier, and Frédéric Olivier

Mapping seabeds is a fundamental step for managing and/or preserving coastal zones. Various methods have been used to map seabeds, primarily benthic macrofauna and sediment sampling along regular grids or transects, bathymetry and/or remote sensing. These methods map very different things (e.g. biotic or abiotic features, benthic assemblages, and/or benthic habitats), and they do not have the same accuracy levels nor do they have the same cost in time and money. Furthermore, such methods cannot be used by non-specialists, such as protected area managers, and consequently, long-term monitoring mapping is often impossible. In this poster, we propose a method called the Naturalist Method (NM), based essentially on direct field observation of specific biotic and abiotic criteria. This method was tested and compared with other classical mapping methods. The results of this comparison show that our NM is relatively rapid and inexpensive given the highly accurate results obtained. Moreover, NM is particularly suitable for highly fragmented intertidal landscapes where other methods are often limited.

Keywords: mapping, naturalist, intertidal, benthic habitats.

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**ICES CM 2008/G:26      Poster**

**Broad-scale invertebrate tube coverage on the seabed. Implications for sediment properties, animal-sediment interactions, habitat characteristics, and habitat mapping on Georges Bank**

Joseph Vitaliano, Robert Reid, David Packer, Vincent Guida, Thomas Noji, Steven Fromm, Jason Link, and Frank Almeida

During a cruise in June 1999 to study the areas closed to fishing on Georges Bank, we found vast areas of the seabed, both inside and outside the closed area, to have a high per cent cover of emergent benthic invertebrate tubes. It was estimated, based on video and still photo data, that the area of the seabed covered by these tubes exceeded 3000 km<sup>2</sup>. Most of these tubes were probably built by the tubicolous amphipod *Erichthonius rubricornis*, which was present in grab samples from the same area. Average densities ranged up to 2000 individuals per 0.1 m<sup>2</sup>. When we returned to the same area in June 2000, the seabed was mostly flat sand with a greatly reduced per cent cover of emergent tubes. It could not be determined from our data if the reduction in tube coverage on the seabed was caused by storms, the limited scallop fishery in July and August 1999, and/or the population dynamics for this tubicolous amphipod. Historical data indicate highly variable densities of *E. rubricornis* in grab samples from location to location and from time to time on Georges Bank. Invertebrates living in or on marine sediments can change the physical and chemical properties of the sediments, and can influence the ability of other organisms to colonize and survive in a specific area. Those invertebrates that have the ability to construct tubes within or on the sediments have recently been called

“bioengineers”. Depending on density and degree of emergence, tubes have been shown to influence sediment stability and near bed flow. Further, they impinge particles from the benthic boundary layer, enhance transport across the sediment–water interface, and provide shelter for other invertebrates. Also, emergent tubes provide habitat for fish species, especially juveniles. In this poster, we will discuss the potential implications of invertebrate tubes especially at the spatial scales seen on Georges Bank in 1999 to sediment properties, animal–sediment interactions, habitat for resource species, and habitat mapping.

**Keywords:** benthic invertebrate tubes, sediment properties, benthic habitats, Georges Bank, habitat mapping.

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**ICES CM 2008/G:27****Poster**

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**Canyons as fishery “hotspots”: habitat complexity and the value of large submarine landforms**

Vincent G. Guida

The shelf terminus of Hudson Canyon, the largest submarine canyon along the eastern US continental margin, yields larger catches of many fishery species than the surrounding shelf areas. Large catches are caused neither by species uniquely occurring in canyons nor by exceptional primary productivity. Rather, fishery species with broad habitat distributions appeared to aggregate in the canyon's complex mosaic of differing benthic and pelagic habitats supported by complex interactions between topography, sediment type, and hydrodynamics. Previously identified areas of high multibeam sonar backscatter around the canyon terminus were visualized with still photos and videos taken by the USGS “Seaboss” drift vehicle during cruises from 2001 to 2004, and biota was sampled from 2001 to 2008. Habitat types in and near the canyon and distant from it were characterized from these visual images, supplemented with sediment grab samples. Distributions of some fish, squid, and megabenthos were also derived from the same images, supplemented by trawl catches. Water column conditions were characterized using a CTD. High counts of nekton and benthos and high benthic diversity were associated with strong clines in substrate texture and water temperature across the canyon rim and sloping walls. The association of this kind of fishery “hotspot” with habitat heterogeneity suggests a role for landscape ecology analysis in understanding the fishery productivity around large topographic features, with implications for ecosystem-based management.

Keywords: canyon, habitat, fisheries, landscape ecology.

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