

Theme Session Q

Evidence of global warming effects on zooplankton populations and communities, including larvae of benthic invertebrates and fish

ICES CM 2008/Q:01

Causes and consequences of decadal changes in the diel vertical migration behaviour of Baltic sprat larvae

R. Voss, J. O. Schmidt, M. A. Peck, and H-H. Hinrichsen

In the Baltic Sea, clear changes in the diel vertical migration behaviour of sprat larvae have been observed in the last 15 years. In the late 1980s, exogenously feeding sprat larvae migrated to the surface at night whereas feeding larvae were found predominately at 30–50 m depth during daylight hours. In 2002–2004, sprat larvae sampled in the same region exhibited no signs of diel vertical migration and were captured at all times of the day in the near-surface waters. We employed long-term (30-year) runs of a coupled three-dimensional hydrodynamic, individual-based model (IBM) to assess the potential causes and consequences of this change in diel migration behaviour. The ambient water temperatures experienced by sprat larvae exhibiting both behavioural scenarios (migrating and non-migrating) were estimated from hydrodynamic model runs conducted over a 30-year period and the IBM was used to simulate impacts on rates of growth and development at various levels of prey resources. We also investigated whether or not changes in migration behaviour were driven by increased food demand resulting from increasing ambient water temperatures experienced by sprat during recent decades. The implications of this modification in behaviour are multifaceted and include changes in (i) larval stage durations, (ii) pathways of larval drift, (iii) nursery areas utilized by surviving larvae, and (iv) the strength and patterns of variability in recruitment of sprat spawned within the Bornholm Basin.

Keywords: sprat larvae, vertical migration, IBM, climate change, Baltic.

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ICES CM2008/Q:02

Copepod production drives recruitment in a marine fish

Martin Castonguay, Stéphane Plourde, Dominique Robert, Jeffrey A. Runge, and Louis Fortier

Predicting fluctuations in the recruitment of commercial marine fish remains the “Holy Grail” of fishery science. In previous studies, we identified statistical relationships linking Atlantic mackerel (*Scomber scombrus*) recruitment to regional climate, zooplankton biomass, and the production of copepod nauplii over a decade (1982–1991), which included the exceptionally strong year class of 1982. Here, we tested the validity of these relationships by adding a second decade (1992–2003) of observations that includes another exceptional year class in 1999. We provide the first field-based evidence linking availability of plankton prey in the sea to early growth of larval fish and to year-class strength in a commercially exploited marine fish. Recruitment is shown to depend strongly on production of the copepod nauplii species that contribute to the diet of mackerel larvae. Both strong year classes were characterized by exceptionally high availability of these specific prey. We suggest that mackerel recruitment can be anticipated three years in advance based on prey availability during the first weeks of planktonic life and predict a strong year class for fish hatched in 2006.

Keywords: recruitment, mackerel, copepod production, nauplii, environmental relationships.

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ICES CM 2008/Q:03

Functional responses and ecosystem dynamics: the influence of satiation, food limitation, and acclimation

Wendy C. Gentleman and Anna B. Neuheimer

Modellers have long been aware that the mathematical form of zooplankton mortality, or closure term, significantly affects the dynamics of planktonic ecosystem models. Another important formulation is the functional response, i.e. how ingestion rates change with prey density. Here we explain why different grazing

responses can have profoundly differing influences on modelled dynamics, and how common practices may limit models owing to misguided characterization of feeding behaviours. Use of different ingestion functions in a nutrient–phytoplankton–zooplankton (NPZ) model result in oscillating vs. constant densities. In contrast to the conclusions of previous studies, it is shown that these results are not the result of zooplankton satiation vs. non-satiation. Analysis of a predator–prey model is used to derive the necessary condition for ecological stability, which is related to food-limited clearance rates. Sensitivity studies demonstrate that zooplankton clearance rates have a strong influence on the dynamics of more complex models. Moreover, it is shown that acclimation time-lags can dramatically alter results from those where zooplankton instantly adapt to changing prey densities, owing to their corollary effect on clearance rates. These results are discussed in terms of practical advice to modellers who face uncertainty in choosing expressions for the functional response.

Keywords: NPZ, ecosystem modelling, grazing, stability analysis, clearance rates.

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ICES CM 2008/Q:04

Interannual variability in abundance and community structure of zooplankton south and north of Iceland in relation to environmental conditions in spring 1990–2007

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An 18-year zooplankton time-series from two standard sections differing in hydrographical conditions (Subarctic water north of Iceland, Atlantic water south of Iceland) was examined in relation to hydrography and phytoplankton dynamics, and large-scale climatic changes in the North Atlantic Ocean (NAO). Both the long-term mean zooplankton biomass and abundance were higher south of Iceland (~ 5.8 g dw m^{-2} and $\sim 160\,000$ individuals m^{-2}) than to the north (~ 4.3 g dw m^{-2} and $\sim 120\,000$ individuals m^{-2}). Biomass and abundance fluctuated markedly between years, with maxima every ~ 5 – 7 years. Copepods (mainly *Calanus finmarchicus* and *Oithona* spp.) dominated the zooplankton, comprising >60 – 70% of the plankton in most years. Among the copepods, *C. finmarchicus* was more abundant south of Iceland ($\sim 45\%$) than to the north ($\sim 35\%$). Abundance and community structure were related to environmental variables using regression and multivariate techniques (PCA, RDA). Temperature and salinity were the most important environmental variables in explaining the differences in species composition north and south of Iceland, with species such as *Temora longicornis* and *Evadne nordmanni* being relatively abundant to the south, and *Metridia longa* and *C. hyperboreus* to the north of Iceland. A significant year-to-year variability in community structure was observed both south and north of Iceland, with salinity dictating the variability south of Iceland and temperature to the north. In neither region was a unidirectional temporal trend in species composition detected.

Keywords: zooplankton, environmental variables, interannual variability, abundance, community structure.

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ICES CM 2008/Q:05

Changes in environmental conditions and the population dynamics of *Calanus finmarchicus* in the Labrador Sea (1990–2006)

Erica Head, Kumiko Azetsu-Scott, Glen Harrison, Ross Hendry, Bill Li, Igor Yashayaev, and Philip Yeats

A suite of physical, chemical, and biological variables are measured at stations along a section across the Labrador Sea between southern Labrador and southern Greenland once a year by scientists from the Bedford Institute of Oceanography. Satellite images of sea surface temperature and chlorophyll are also analysed. From 1990 until 2006 near-surface temperatures increased by about 1°C . Over the same period nitrate concentrations in the central basin increased, whereas silicate concentrations decreased. Carbon dioxide concentrations, measured since the mid-1990s, increased and pH decreased. The phytoplankton community appeared to respond to these changes with an overall increase in annual chlorophyll concentrations, but with changes in size/species composition consistent with the changes in nitrate:silicate ratio. The zooplankton community did not appear to show large changes in biomass or community composition. On the other hand, for *Calanus finmarchicus*, the copepod that dominates the zooplankton biomass in the central basin, the timing of the appearance of young copepodites, and by inference the timing of reproduction, was apparently linked to temperature and the timing of the spring bloom. Warmer conditions in late winter were associated with earlier blooms and earlier reproduction in *C. finmarchicus*. Whether the observed environmental trends are the result of global warming or are part of a normal climatic cycle is still up for debate. Climate model predictions for the Labrador Sea region are for air and sea temperatures to rise. If this occurs, we expect to see changes in the population dynamics of the most importance component of the zooplankton community.

Keywords: Labrador Sea, warming, *Calanus finmarchicus*, timing of reproduction.

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ICES CM 2008/Q:06**Beyond pH and temperature: thermodynamic constraints imposed by global warming and ocean acidification on midwater respiration by marine animals**

Edward T. Peltzer and Peter G. Brewer

The rising levels of anthropogenic carbon dioxide in the atmosphere are responsible for several aspects of climate change. They contribute to an enhanced atmospheric greenhouse effect leading to a warmer world and are causing a slow but inexorable acidification of the world ocean. Although these effects are well known to scientists and are becoming known to the general public on a daily basis, there are secondary effects, which have until recently not been considered. As the surface ocean slowly warms, less oxygen is dissolved in the down-welled waters. Meanwhile, uptake of some 1.2 million tons of CO₂ per hour on average, not only drives down the sea surface pH, but also adds to the pre-formed CO₂ burden of deep waters. As organic matter decays at depth, this amplifies the ambient partial pressure of CO₂. Combined, these effects of lower oxygen concentration and increased carbon dioxide partial pressure lead to a dramatic decrease in the thermodynamic respiration capacity of the midwaters. Areas of already low oxygen concentration will be the first to be affected. Suboxic and anoxic conditions will not only expand laterally, but vertically as well. These expanding suboxic zones will present an ever-increasing challenge to the diurnal vertical migration of zooplankton. Where these areas intersect the coast and the continental shelf, the so-called “dead zones” will expand greatly, affecting the life histories of multicellular organisms.

Keywords: pH, temperature, respiration, ocean acidification.

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ICES CM 2008/Q:07**Variability of the year-class strength of western Baltic spring-spawning herring (Rügen herring)—which factors determine the year-class strength?**

R. Oeberst

A new method was developed for estimating the year-class strength of western Baltic spring-spawning herring (Rügen herring) based on larval surveys of weekly repeated cruises with 35 fixed stations in the Strelasund and the Greifswalder Bodden. The new herring larvae index, N20, is the sum of larvae that reach the length of 20 mm. The N20 index is highly correlated with the acoustic estimation of age group 1 herring of the same year class in the western Baltic Sea, although these estimates are based on different methods, different areas of investigation, and different survey periods. The high correlation suggests that the year-class strength of Rügen herring is mainly determined by factors that influence the survival of larvae smaller than 20 mm—the hatching success, the development of eggs, or early development stages besides the hydrographical conditions, which affect many of the previously mentioned factors. The N20 index varied between 1.1×10^9 and 21.0×10^9 larvae within the period from 1992 to 2007. The development of larvae between hatching and a length of more than 20 mm, in combination with the hydrographical conditions and the spawning-stock biomass, were used to explain as far as possible the high variability of the year-class strength.

Keywords: Baltic Sea, spring-spawning herring, year-class strength, larval development.

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ICES CM 2008/Q:08**Simulation of the impact of climate change on migration pattern and growth of Japanese sardine**

Takeshi Okunishi, Taketo Hashioka, Hiroshi Sumata, Shin-ichi Ito, and Yasuhiro Yamanaka

We developed a multitrophic level ecosystem model including Japanese sardine by coupling to a fish bioenergetics model at a lower trophic level. An oceanic general circulation model developed by CCSR (Center for Climate System Research) was coupled with a lower trophic level ecosystem model: NEMURO (North Pacific Ecosystem Model for Understanding Regional Oceanography) developed by PICES (the North Pacific Marine Science Organization) and the Japanese sardine migration model and applied to the western

North Pacific. To investigate the effect of global warming on pelagic fish ecosystems, such as the economically important Japanese sardine, we conducted present-day and global warming experiments using predicted physical fields with a high-resolution climate model (the CCSR/NIES/FRCGC climate model, which contributed to the IPCC-AR4). Migration patterns and geographical distributions of Japanese sardine can be altered directly through climate-induced changes in temperature variations. During northward migration periods for adult fish, the average geographical distribution of fish moves about 2° northwards under global warming conditions. Spawning periods, which can secure high growth rate for larvae, become significantly shorter than those under present climate conditions, because many larvae are exposed to high temperatures, which are unfavourable for larval growth. The direct effect of temperature can be a trigger to determine recruitment success and consequently the size of sardine populations.

Keywords: pelagic fish, climate change, geographical distribution, multi-trophic level ecosystem model.

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ICES CM 2008/Q:10

Geographical distribution and heat tolerance in the oceanic sea skaters of *Halobates* (Heteroptera: Gerridae) and oceanic dynamics

Tetsuo Harada, Mitsuru Nakajyo, and Takao Inoue

Samplings with ORI net trailing during the Mirai cruise (MR-06-05-Leg 3, 21 December 2005–12 January 2006) were performed in a tropical area of the western Pacific Ocean, and the tolerance to temperature increase was investigated with a temperature paralysis experiment on the adults and fifth instar larvae of *Halobates* collected in this area. At Station 37 (6°N 130°E) and Station 52 (5°N 138°E), large numbers of larvae of *H. sericeus*, which has been known to have a limited distribution in the northern area of 15°N in the Pacific Ocean, were collected. At all three values of TSHP (temperature for semi-heat paralysis), *Halobates germanus* specimens from Station 37 were significantly more heat-hardy than *H. micans* ($P=0.002$). Experimental specimens from the Equator had the highest heat tolerance ($P<0.05$). According to the current dynamics during the cruise, the *H. sericeus* colony at Station 52 could be transferred from the northern area of 14°N by the three currents of NEC, MC, and NECC to the area of 5°N and 138°E. Extremely high heat resistance was shown in *H. germanus* adults in the sea area around the Equator. Dynamic current and air movements in this area known as “warm-sea-water-pool” around the Equator can be related to the high resistance to heat that was shown in this study.

Keywords: oceanic *Halobates*, distribution, oceanic dynamics, heat tolerance, currents.

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ICES CM 2008/Q:12

Time-series analysis of extrinsic drivers on sandeel stock–recruitment relationship with emphasis on *Calanus finmarchicus* abundance during the post-hatching phase and interactions between spawning stock size and population density

Mikael Van Deurs, Ralf van Hal, Maciej Tomasz Tomczak, and Per Dolmer

Following a reduced sandeel (*Ammodytes marinus*) recruitment in 2002 in the North Sea and the indications of total stock collapse in 2005, identifying the drivers that may influence the sandeel has become of high priority. In the present study generalized additive modelling was used to analyse the sandeel stock–recruitment relationship and the effect of selected extrinsic drivers (NAO winter index, *Calanus* zooplankton availability, predation by herring). The study takes off-set in the findings by Arnott and Ruxton (2002) that spawning–stock biomass (SSB) was a poor predictor of numbers at age 0 settling on the fishing areas in July (N0), but predictions of recruitment were significantly improved if a model accounted for an additive effect of population density, expressed as the number of age 1 sandeel (N1), winter mean NAO index (or sea surface temperature) and *Calanus* sp. abundance during early larval stages. A reanalysis showed that the recruitment function put forward by Arnott and Ruxton loses its predictive power when applied in an updated time-series, which is possibly the result of the notable shift in the population dynamics that occurred around 1999 and that have lasted up till today. The analysis indicates that sandeel recruitment N0 is significantly forced by the intrinsic drivers SSB and N1 and the extrinsic driver zooplankton abundance (*C. finmarchicus*) and abundance of northeastern North Sea local herring stock.

Keywords: sandeel, recruitment, zooplankton, herring predation.

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ICES CM 2008/Q:13**Development of long-term larval indices for Atlantic herring (*Clupea harengus*) in the northwestern Atlantic Ocean**

David E. Richardson, Jonathan A. Hare, and William J. Overholtz

One of the major factors limiting insights into the effects of climate change on marine fish is the scarcity of long-term datasets describing their distribution and abundance. Along the northeast coast of the USA, ichthyoplankton surveys have been performed by the Northeast Fisheries Science Center (NMFS/NOAA) many times a year since 1970. However, inconsistency in the spatial and seasonal allocation of this sampling effort has hindered interannual comparisons within this dataset. Here we present a non-linear least-squares approach used to develop annual indices of stock abundance. This approach uses information on the age structure and abundance of the sampled larvae on each survey cruise to derive the indices of abundance, as well as parameters describing larval mortality and the seasonal cycle of spawning. Application of this approach to Atlantic herring (*Clupea harengus*) reveals dramatic population fluctuations over time. The most pronounced of these changes occurred on Georges Bank, where a near absence of spawning herring from the late 1976 to 1988 was both preceded and followed by periods of higher larval abundances. Ongoing efforts seek to couple these trends in the spatial and temporal distribution of Atlantic herring spawning to climate-related changes in the environment.

Keywords: larval fish, Atlantic herring, Georges Bank, ichthyoplankton.

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ICES CM 2008/Q:14**Temperature effects on recruitment of northern shrimp in the Gulf of Maine may be mediated through match–mismatch with bloom timing**

Anne Richards, Maureen Taylor, and Jay O'Reilly

Northern shrimp (*Pandalus borealis*) in the Gulf of Maine occur only in the relatively cold western portion of the Gulf. Water temperatures during the larval period significantly affect year-class strength, but the actual mechanisms are unclear. We evaluated the match–mismatch hypothesis as a potential explanation because the timing of the shrimp hatch is strongly dependent on temperature, and the timing of the spring bloom in coastal waters of the Gulf of Maine is dependent primarily on solar insolation. Timing of the shrimp hatch was estimated from biological sampling of commercial shrimp landings; bloom timing was estimated from satellite ocean colour images. The offset in bloom-hatch timing was correlated with early life survival of shrimp estimated from fishery-independent survey data. Shrimp survival was highest in years when the bloom onset was about 40 days earlier than the median hatch date, and poorest in years when the bloom onset coincided more closely with the median hatch date. We hypothesize that a relatively early bloom leads to higher zooplankton biomass at the time of the shrimp hatch. A strong positive relationship between shrimp survival rates and mean zooplankton volume during the larval period supports this hypothesis. The loose coupling between processes determining the timing of the shrimp hatch and the evolution of their food source suggests that northern shrimp recruitment may become increasingly variable under climate-induced warming of the Gulf of Maine.

Keywords: match–mismatch, temperature effects, Northern shrimp, *Pandalus borealis*, bloom timing, hatch timing, larval survival.

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ICES CM 2008/Q:15**Changes in the spatial distribution of sardine (*Sardinops sagax*) eggs off California over 50 years in relation to hydrographic variables**

Sam McClatchie, Nancy Lo, Steven Bograd, and Richard Charter

We analysed a subset of the CalCOFI time-series (1951–2005, 309 cruises) to determine the environmental characteristics of sardine spawning habitat. Data exploration showed that sardine habitat varied by region along the US–Mexico west coast (north of Point Conception, 34.5°N, in the southern California Bight, and south of Ensenada, 32°N, and by season (spring and autumn). This is sensible considering the regional oceanography. General additive models (GAMs) and the Akaike criterion (AIC) were used to select the best model defining sardine spawning habitat. We tested science-based models based on temperature alone, [temperature + salinity + zooplankton], and [temperature + salinity + zooplankton + mixed layer depth + wind]. The models were developed using coast-wide data from a 20-year period before the sardine fishery

disappeared (1950–1970), and were applied to a 20-year period when the fishery recovered (1985–2005), but data were mainly collected in the southern California Bight.

Keywords: sardine spawning habitat.

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ICES CM 2008/Q:16

Disparate reaction in massive and branching coral reefs to cold stress: evidence for the elimination of massive corals in response to thermal stresses

Peyman Eghtesadi-Araghi, Fatemeh Nozhat, Abdolvahab Maghsoudlou, and Ahmad Savari

The increasing incidence of coral thermal stress has rigorously affected reef-building corals over the past decades. Coral reefs may also be affected by exposure to cold as well as warm temperature extremes as climate change occurs. The Persian Gulf exhibits marked seasonal variability in oceanographic factors. Coral reefs in this area are exposed to annual ranges of temperatures that exceed the temperature extremes reported for any other reef areas in the world. Winter water temperatures in the Persian Gulf rank among the lowest recorded on coral reefs and the annual water temperature fluctuations of $>25^{\circ}\text{C}$, are among the highest known for reef areas. In this study three dominant genera of hard coral reefs of the Kish Island were monitored and sampled for one year and the variation in live hard corals was measured along a permanent transect line. Tissue chlorophyll content and 70 kDa protein density, ambient temperature, and ultraviolet radiation index were recorded seasonally. The results show that a cold stress occurred in winter of 2004 and *Favia* sp. expressed the highest 70 kDa protein density as well as chlorophyll *a* concentration, which are known to be markers of temperature stress for coral reefs. The consequent decline of reef-building corals showed the order *Favia* sp. > *Porites* sp. > *Acropora* sp. This sensitivity to cold stress is in agreement with previous findings about the effects of global change on coral reef communities, which lead to decrease of massive corals and increase of branching ones.

Keywords: coral reefs, thermal stresses, branching, massive, Persian Gulf.

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ICES CM 2008/Q:17 Poster

CAVIAR: climate variability of the Baltic Sea area

K. Getzlaff, R. Voss, H.-H. Hinrichsen, A. Lehmann, and F. Köster

CAVIAR is a newly launched project to analyse the climate variability of the Baltic Sea area and to investigate its impact on biological and physical processes in the central Baltic Sea. A high-resolution model (1 nautical mile horizontal resolution) of the coupled sea ice–ocean model of the Baltic Sea (BSIOM) has been set up and tested by running the model for the past 38 years. Hydrographic and biological observations collected during that period are used to validate the control run. In addition, spatially resolved hydrographic data are used for data assimilation (partly reinitialization) into the numerical model. The so-derived four-dimensional hindcast dataset of the Baltic Sea is then analysed with respect to climate variability and ongoing climate change. Furthermore, with this model version a set of runs is conducted using downscaled regional atmospheric forcing data for the Baltic Sea from different climate scenarios (A1B and B1). This dataset is then utilized for coupled biophysical modelling to investigate and compare the potential impact of future climate change, especially the effect of global warming on inflows of water masses from the North Sea and the spatial distribution, habitat utilization, and recruitment processes of central Baltic fish and zooplankton populations.

Keywords: climate variability, Baltic Sea, modelling.

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ICES CM 2008/Q:19 Poster

Global changes—adaptations of fish in Indian Ocean

Joseph Sebastian Paimpillil

Global warming seems to alter or destroy coastal ecosystems. Some fish in the Indian Ocean have shifted their spawning seasons to cooler months in response to global warming and resultant rises in seawater temperature. The spawning season of the two dominant species off Chennai has changed. In 1980, nearly

38% of the annual spawning was in the warmer months (April–September), when the surface sea temperature was 29–29.5°C. During 2004, spawning had reduced to 5% for the warmer months and 95% for the cooler months, with a sea surface temperature of 27.5–28°C. The catch remained largely unchanged despite the shift in spawning season. Oil sardines have also moved to new geographical zones with surface sea temperature increase and have been observed in new territories along the northwest and northeast coasts of India. Indian mackerel have gone down to different depths and are increasingly becoming the catch of bottom trawlers.

Keywords: ichthyoplankton, image analysis, ZooScan, spatial distribution.

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ICES CM 2008/Q:19 Poster

Automated counting and identification of ichthyoplankton: an attempt with the ZooScan imaging system

Caroline Warembourg, Elvire Antajan, and Sandrine Vaz

Changes in the abundance of important commercial fish species have been reported in the North Sea during the last decade as a result of climate change and/or overexploitation of resources. The spatial distribution of early pelagic stages (ichthyoplankton) is still poorly described in this area, although these stages are particularly sensitive to hydrological and trophic conditions and are critical to fish population life cycles and recruitment monitoring. In this context, the study of the processes affecting survival and transport of ichthyoplankton to nursery areas involves high sampling resolution with time-consuming and labour-intensive phases of sample analyses. Recently, the development of new techniques of automated imagery recognition (here the ZooScan), offering relatively good resolution images at high sampling rates, allow automated taxonomic identification using supervised learning algorithms. We applied this new approach to ichthyoplankton samples from time-series data in the southern North Sea (1997–2008). First, we digitalized fish larvae standards to create a training set and selected the most efficient learning algorithm. Automatic recognition of natural samples containing different fish larvae species were then compared with the results of visual identification in order to validate the method of training used. The data generated allow the characterization of recurrent and potential transport areas of southern North Sea fish species larval stages. This will improve our knowledge of their spatial (location and extent) and interannual variability, as well as our understanding of their relationships to environmental and trophic controls.

Keywords: ichthyoplankton, image analysis, ZooScan, spatial distribution.

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ICES CM2008/Q:20 Poster

Oceanic forcing of the dynamics at the continental margin west of Ireland and the effect on zooplankton distributions

Colm O'Shea and Martin White

The continental margin to the west of Ireland is a complex hydrographic region, situated between the Subpolar and Subtropical gyre systems, and including the polewards flowing Shelf Edge Current (SEC) and large topographic features such as the Porcupine Bank. The region hosts a number of large, and economically important, fisheries and associated spawning/nursery areas. Oceanographic data (sea surface height (SSH) from satellite altimetry, direct current meter measurements, remote sensed sea surface temperature (SST) and windstress curl data) and continuous plankton recorder (CPR) data have been analysed to investigate the seasonal and interannual variability of the SEC west of Ireland in relation to large oceanic forcing. The influence of such variability with keystone indicator zooplankton species was also examined. Seasonality of the SEC flow is highlighted by SSH data and is more pronounced to the south of the Porcupine Bank and is related to changes in the windstress curl, while the interannual variability in poleward extension of continental margin flow is more complex. These changes, however, are reflected in the relative abundances of oceanic species of indicator zooplankton found in CPR records in the region of interest. Key indicator species in CPR records (1960–present) have been examined. Changes in abundance/biomass with respect to changes in temperature and advective processes are highlighted. The abundances of a number of species and assemblages, including *Euchaeta hebes*, *Metridia lucens*, and *Calanus* spp., show close correlation with the large-scale oceanic forcing.

Keywords: continuous plankton recorder, shelf edge current, biophysical interactions.

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ICES CM 2008/Q:21 Poster

Interannual changes in zooplankton community composition on the Scotian Shelf, Northwest Atlantic

Catherine Johnson

The zooplankton community of the Scotian Shelf is diverse, reflecting a mixture of indigenous shelf species and expatriate species that are transported onto the shelf in waters from the Gulf of St Lawrence, the inshore and offshore branches of the Labrador Current, and the continental slope. Since 1999, the Atlantic Zone Monitoring Programme has monitored physical, chemical, and biological oceanographic conditions in this region twice yearly at transect stations and every two weeks at a fixed station. Although the Scotian Shelf zooplankton community consistently reflects the influence of its upstream sources, changes in the relative influence of the source regions are evident from year to year. We will describe changes in the Scotian Shelf zooplankton community and compare them with changes in the water properties on the shelf to determine whether interannual shifts in community composition are consistent with changes in the influence of different upstream water sources to the Scotian Shelf.

Keywords: zooplankton, community composition, interannual variability, monitoring, water mass.

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ICES CM 2008/Q:22 Poster

Zooplankton monitoring in the ICES area: a summary of sites and recent findings

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Every two years, the Working Group on Zooplankton Ecology (WGZE) produces a summary report on the status of zooplankton populations in the ICES area based on time-series obtained from national monitoring programmes. Since its first report in 2000, the WGZE summary has been expanded to include over 32 monitoring sites distributed across the continental margins of both North America and Europe. Ranging in length from 10 to 40 years, these sites monitor zooplankton populations in a broad range of environments, from the temperate latitudes south of Portugal to the colder regions north of Norway, Iceland, and Canada. This collective time-series has been analysed for sustained trends in response to global warming and also for temporal synchrony among zooplankton time-series and/or with climate indices. The extent and direction of any responses (e.g. corresponding increases or decreases in population) varied from site to site, with trends found in one site being completely absent from an immediately adjacent site. This suggests that the extent of climate change effects on a region will depend on the local physics and environmental conditions of that region. This presentation introduces WGZE's online zooplankton time-series metadata portal (<http://WGZE.net>) and summarizes cross-basin and regional time-series comparisons from the newest WGZE zooplankton summary report.

Keywords: North Atlantic zooplankton, zooplankton monitoring, time-series, zooplankton biomass, zooplankton abundance.

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The abundance of John dory (*Zeus faber* L.) in the Irish Sea

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In Europe, the range of John Dory (*Zeus faber*) is reported to extend from Norway to Madeira and the Mediterranean. John Dory is a piscivorous fish that lives at approximately 50–150 m but has been found down to 400 m. Around the British Isles this species is caught in commercial quantities only in the English Channel and Western Approaches, and is infrequently caught elsewhere. The only reports of John Dory larvae around the British Isles are from the English Channel. The catches by the commercial fishing fleet in the Irish Sea increased until 2005 and then declined markedly. The increase could be the result of a change in fishing practices but an increase and subsequent decline since 2005 has also been seen in research surveys carried out since the early 1990s. The research surveys are aimed at either groundfish or *Nephrops*. Groundfish surveys employ a Rockhopper otter trawl with 20-mm codend liner. They have been executed following the same standard procedures and are now coordinated by the International Bottom Trawl Survey. The net fish with a 2.5–3.0 m headline height and 40 m door-spread and the stations are fixed between years. *Nephrops* surveys use a custom-made *Nephrops* trawl of 40 mm nominal mesh size throughout, with a low headline height of about 1 m. In both survey types the trawl is towed over a standard 3.0 nautical mile distance at 3 knots over a set of either groundfish or *Nephrops* stations, depending on the cruise. Although the

increase in numbers of John Dory could indicate an extension of their range owing to climate change, the observed decline could represent a natural oscillation or the affect of fishing.

Keywords: fish populations, climate change.

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Unusual fish in the Irish Sea

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Single specimens of red scorpion-fish (*Scorpaena scrofa*) and black-fish (*Centrolophus niger*) were returned to the Agri-Food and Biosciences Institute (AFBI) in Belfast, Northern Ireland Laboratories during early December 2007. The fish were caught off the Northern Ireland coast in the western Irish Sea by the commercial fishing trawlers MFV “Olive Branch” (*S. scrofa*) and MFV “Silver Fern”. Both vessels were operating about 12 miles south of St Johns’ Point (54°8’N 5°31’W) at a depth of around 55 m. *Scorpaena scrofa* (family Scorpaenidae) is characterized by its large head and large scales, which have a similar size to the pupil diameter of the eye. The head, throat, and bases of the pectoral fins are not scaly and there is a deep square-shaped pit behind the eyes. The dorsal fin has 9–10 rays and the anal fin 5–6 rays. Colouration can be variable, though this specimen was brick red. *S. scrofa* is rare in the eastern Atlantic and British waters, tending to be a southern species ranging to Senegal, Madeira, the Canaries, and Cape Verde Islands and throughout the Mediterranean, but not in the Black Sea. It likes rocky or sandy bottoms from 20 to 200 m and is eaten in France where it is known as *scorpène* or *rascasse*. The specimen measured 37 cm in length, had a girth of 31 cm, weighed 1.12 kg and is possibly the most northern recorded sighting of this species. *Centrolophus niger* (family Centrolophidae) has a typical elongated shape, blunt snout and is black in colour. There are 37–41 fin rays in the dorsal fin and the jaws are relatively small and weak, each with a single series of small teeth, often giving the appearance of no teeth. It is an oceanic species, normally occurring in deep water down to 300 fathoms (550 m) and is the only member of its family to appear in UK waters of less than 50 fathoms (92 m). It tends to be a great wanderer, with vagrant specimens being reported from the North American coast and occasionally penetrating the North Sea and appearing in the shallows of its southern extremity. The specimen reported measured 45 cm in length, had a girth of 24 cm and weighed 0.625 kg. The species was earlier reported when a specimen was captured by an angler off Tory Island, Donegal.

Keywords: fish populations, climate change.

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