

# Abstracts of Papers and Posters

Submitted to the 2009 Annual Science Conference prior to 15 April 2010

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## Theme Session A

### Operational oceanography for fisheries and environmental applications

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#### ICES CM 2010/A:01

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##### **The fate of winter flounder larvae spawned in coastal waters of the Gulf of Maine**

Greg DeCelles, Steven Cadrin, and Geoff Cowles

Historically, winter flounder (*Pseudopleuronectes americanus*) in the Gulf of Maine were considered to be obligate estuarine spawners. This spawning strategy is thought to promote the formation of relatively isolated subpopulations of flounder in estuaries and bays along the coast. Recent evidence, however, has documented the presence of contingent groups of winter flounder that spawn in coastal, rather than estuarine habitats. Although it is likely that coastal spawning increases gene flow and connectivity between meta-populations, the transport of larvae originating in coastal waters has not been studied to date. To address this question, a coupled biophysical individual-based model is being used to track the transport and development of larvae spawned in three coastal regions of the Gulf of Maine. Velocity data generated by the Finite Volume Coastal Ocean Model (FVCOM) is being used to simulate the Lagrangian trajectory of each larva within the physical domain over a period of 60 days. Settlement success is calculated as the average time spent by each particle in suitable habitats (waters <20 m) over the last 18 days of its larval period, and success is averaged over all particles from each release site. Settlement areas have been delineated geographically, and connectivity matrices are being used to estimate rates of settlement success between spawning grounds and nursery areas. The results of this model will offer insight into the population structure of this species in the Gulf of Maine, and will improve the information available for spatially specific management of this species.

Keywords: FVCOM, Gulf of Maine, individual based model, winter flounder.

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#### ICES CM 2010/A:02

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##### **Forecasting Northeast Atlantic cod (*Gadus morhua* L.) stock recruitment based on satellite monitoring of sea surface temperature data**

V. M. Borisov, G. P. Vanyushin, M. Yu. Kruzhalov, A. A. Troshkov, and T. V. Bulatova

The authors attempted to track down the dependence of Northeast Atlantic cod recruitment, estimated at age 3 years+, on the habitat conditions being established in the spawning areas, larval drift, and feeding of young cod. The data used were the 1997–2009 Barents Sea sea surface temperature (SST) satellite monitoring data. The annual indicators of the abundance of 3-year-old cod were plotted against the period-averaged water temperature anomalies shifted back by 3 years for the main spawning area of cod (off the Lofotens) for March–April, and for three regions of early ontogenesis of cod (West Spitsbergen, Nordcap, and Murmansk–Novaya Zemlya) for May–October. The 3+ year classes of cod (up to 400 million individuals) graded as “poor” fall on the years with negative (2001) or high-positive (2006, 2007) SST anomalies in the spawning zone; they are  $-0.3^{\circ}\text{C}$ ,  $+1.5^{\circ}\text{C}$ , and  $+1.6^{\circ}\text{C}$  respectively. The SST anomalies within  $-0.1^{\circ}\text{C}$  to  $+1.1^{\circ}\text{C}$  provided for the medium (400–900 million individuals) or strong (900 million individuals) generations which respectively occurred in favourable (1999, 2003, 2004, 2005) and most favourable (1998, 2000, 2002) years in terms of survival. This relationship becomes even more pronounced if the SST anomaly analysis for the above three zones includes the larval and pelagic young drift for May–October, and for the same period of the previous year whose conditions are likely to affect the quality of future broodstock and their eggs. The satellite monitoring of temperature conditions in benchmark zones

that are the major factor in the formation of year classes of cod might be considered an additional fishery forecasting possibility by ensuring predictions two years in advance.

Keywords: anomalies of SST, Northeast Arctic cod, recruitment, satellite data, strength of year classes.

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## ICES CM 2010/A:03 Poster

### Predicting the bluefin tuna habitat from space: another tool for the future management and control of pelagic fisheries

Jean-Noël Druon

The bluefin tuna habitat in the Mediterranean Sea is mapped using daily sea surface chlorophyll and temperature from satellite remote sensors. Fish demonstrate two main behaviours—feeding and spawning—which are explored in the habitat model. The feeding habitat is associated with oceanic fronts of temperature and chlorophyll while the spawning habitat is characterized by a stable surface layer during spring (surface heating). The use of habitat mapping in fishery management could open up restricted grounds to fishing in order to preserve the resource (e.g. avoiding spawning areas). Increasing the fleet concentration would increase the efficiency with which it could be controlled by traditional means or radar imagery (vessel detection systems). While protecting the resource, the near real-time habitat maps would guide fishers to the best fishing ground in the open area, significantly reducing variable costs (fuel, man-days at sea). In addition, the model applied to a decade of satellite data provides valuable statistics for the scientific community on the preferred habitats of this highly migratory species. Although the first species to be studied is the emblematic bluefin tuna in the Mediterranean Sea, which is endangered by overfishing, the approach is transposable to most temperate and tropical pelagic species from forage fish to top predators.

Keywords: bluefin tuna, chlorophyll, control, chlorophyll, fisheries, habitat mapping, management, SST.

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## ICES CM 2010/A:04

### Towards operational management of pelagic ecosystems

Patrick Lehodey, Inna Senina, Beatriz Calmettes, Francois Royer, Philippe Gaspar, Mélanie Abécassis, Jeffrey Polovina, Denise Parker, Réka Domokos, Olga Hernandez, Morgane Dessert, Rudy Kloser, Jock Young, Molly Lutcavage, Nils Olav Handegard, and John Hampton

Satellite data and operational ocean models provide the necessary inputs for ecosystem models of the lower to mid and upper trophic levels. One key explanatory variable that is usually missing but important for an understanding of the dynamics of key exploited or protected marine species is the dynamic of the micronekton that is at the mid-trophic level (MTL) in the ecosystem. This includes both prey of large predators and predators of eggs and larvae of fish. We present the development of an operational model of mid-trophic functional groups driven by physical and biogeochemical variables. Once a reasonable prediction of MTL organisms is achieved, the number of applications for near real-time management and monitoring of marine ecosystems and resources should increase rapidly, as illustrated by the examples provided here. This includes the prediction of feeding and spawning habitats for many exploited and protected species, their movements and spatial distributions, and their population dynamics under the combined effects of natural (climate variability) and anthropogenic forcings (fishing, climate warming). Keywords: climate, ecosystem, fisheries, habitat, management, micronekton, operational model, ocean forecast, population dynamics.

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**ICES CM 2010/A:05**

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**Oceanographic modelling products as a decision support to the Irish aquaculture sector**

Glenn Nolan, Kieran Lyons, Neil Ruane, David Jackson, Joe Silke, and Robin Raine

As high-resolution physical circulation models in Irish waters have improved, there is a growing demand for operational outputs and products from these models. A regional physical model (ROMS) produces a 7-day forecast for Irish waters daily. Several nested models with a horizontal resolution of several hundred metres have been developed for coastal areas such as Connemara, Bantry, and Killary Harbour. Several applications have been based on forecast and hindcast model output to date. Model flowfields that include the effects of river discharges, meteorological conditions, and wider field oceanographic conditions have been used to accurately define epidemiological units around individual finfish aquaculture sites. In the event of a fish disease outbreak, this information supports decision-making regarding movement of fish and fallowing of sites. In forecast mode, this tool will be used as a real-time decision support tool for the aquaculture industry. Similarly, models have been used in hindcast mode to examine the distribution and transport of sea lice between salmon farming sites. Varying resolution models have been compared to assess the accuracy of hindcasts and predictions under different forcing conditions. Finally, model currents are used to hindcast harmful algal bloom events off southwest Ireland in 2009 to examine transit times of harmful algae from inoculation areas in the Celtic Sea to shellfish and finfish sites in Bantry Bay. This complements a short-range model developed for Bantry based on shifts in wind direction that accurately predicts the onset of toxic algal events in several previous years.

Keywords: fish disease, forecasting, HABs, Ireland, oceanographic products, sea lice.

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**ICES CM 2010/A:06**

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**A 38 years hindcast of a coupled physical–biogeochemical model and its use for fisheries oceanography in the Bay of Biscay**

M. Huret, P. Petitgas, F. Léger, C. Struski, M. Sourisseau, and P. Lazure

Overexploitation and climate change are increasingly causing unanticipated changes in marine ecosystems, such as higher variability in fish recruitment and shifts in species distribution, leading to a pressing need to develop fisheries oceanography. In the mean time, operational oceanography is progressing rapidly and its products are becoming easy to access for a large community, including fishery scientists. We performed a 38 years hindcast (1972–2009) run with a coupled physical–biogeochemical model (ECO-MARS3D of Ifremer) over the Bay of Biscay, using realistic meteorological and run-off forcing. We first describe the model, as well as indices that were derived as potential drivers of fish populations. These relate to mesoscale activity (eddies, plumes, fronts, stratification) or biological production (chlorophyll and zooplankton concentration, primary production), and all refer to the Bakun's triad: enrichment, concentration, retention. We then review the use of this hindcast in relation to anchovy life cycle in the Bay of Biscay. First, the environmental time-series was used to force higher trophic level models. The physical–biological environment was needed either for transport of early life stages of fish, for larval growth in individual-based model, or for adult growth and reproduction with a dynamic energy budget model. Second, the hindcast can be used to derive fish habitats from statistical regression of eggs or adult field distribution on environment covariates, and then extrapolate over simulated years. Third, we integrated the environment variables and indices over appropriate areas and periods in relation to the anchovy life cycle, and tested their ability to explain recruitment with quantile regression.

Keywords: Bay of Biscay, coupled model, *Engraulis encrasicolus*, fisheries oceanography, hindcast.

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**ICES CM 2010/A:07**

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**The ICES WGOOFE Questionnaire—defining oceanographic requirements in the fisheries and environmental communities**

Bee Berx, Mark Dickey-Collas, and Morten Skogen

Although the ICES community is quite operational in how it uses fisheries data for advice, the ICES Council has realized it is much less so when it comes to the use of environmental data in its application towards achieving an “ecosystem approach” to management. The Working Group on Operational Oceanographic products for Fisheries and Environment (WGOOFE) was established to address this by acting as an interface between the producers of oceanographic data products and potential users from across the ICES community. Although the providers produce many operational products, they have approached WGOOFE for guidance on the requirements of users. In order to inform its recommendations, WGOOFE launched a questionnaire for ICES scientists to complete. The survey contained questions on the desired oceanographic parameters, the ideal temporal and spatial resolution, and the delivery method, format, and time-scales. Participants were also asked a few short questions on their background and abilities. In total, 100 surveys were completed by scientists from many different disciplines. Despite this mix of backgrounds, the results demonstrate that the ICES community would prefer oceanographic data to be delivered in an easy-access format with free, quick, and reliable delivery. ICES scientists did not want formats commonly used in the meteorology or oceanography disciplines. Despite the large amount of effort being expended currently to produce real-time and forecast data products at high resolution, most interest from the ICES world is reserved for historic time-series of data at a range of resolutions. It was also clear that WGOOFE itself had not ranked the oceanographic parameters in a manner that completely reflected the needs of the ICES community. Next, the WGOOFE will communicate the results of this questionnaire to the provider community, while continuing to bring exciting new and existing oceanographic data products to the attention of ICES users.

Keywords: data products, operational oceanography, user requirements.

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**ICES CM 2010/A:08**

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**Using a towed profiler to compare satellite primary productivity models with *in situ* measurements of vertical chlorophyll on the northeastern United States continental shelf**

D. Christopher Melrose, Mark S. Berman, Kimberly Hyde, and John E. O'Reilly

A towed undulating sampling platform equipped with a chlorophyll fluorometer was used on three transects across the US Northeastern Shelf Large Marine Ecosystem to study the influence of variations in the vertical distribution of chlorophyll on satellite primary productivity models. The three transects were located off the coast of New Jersey, across the Nantucket Shoals, and from Georges Basin onto Georges Bank. Satellite-based productivity models provide a powerful tool for performing synoptic productivity measurements over entire ecosystems; however, satellite productivity models have greater uncertainty than *in situ* measurements. This uncertainty exists in part because satellite measurements are biased to near-surface chlorophyll and have an inability to resolve vertical structure or deep chlorophyll layers. Comparisons with *in situ* vertical profiles provide a way to test the effect of varying vertical structure on the accuracy of satellite productivity models and allow these models to be regionally and seasonally tuned for greater accuracy. The use of a towed undulating sampler can also provide more representative comparisons with satellite measurements than would be possible with point samples in regions with strong physical and biological gradients, because it can sample continuously over relatively large areas.

Keywords: *in situ*, primary productivity, satellite, towed undulating platform.

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**ICES CM 2010/A:09**

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**Use of otolith chemistry and electronic tags as fishery oceanography tools: a case study of blue marlin in the western Atlantic Ocean basin**

R. J. David Wells and Jay R. Rooker

Fishery oceanography often involves linking fishery-dependent data to a suite of remotely measured oceanographic parameters, including sea surface temperature, salinity, and sea surface height. Here, we present the use of two novel environmental recorders—otolith chemistry and electronic tags—which both record the physico-chemical conditions of the surrounding water mass inhabited and therefore serve as valuable fishery management tools. Otolith chemistry is useful because chemicals incorporated into the aragonite matrix of the otolith are related to the physico-chemical conditions of the surrounding water mass, thus serving as a natural tag. Chemical signatures in the otolith can be used to determine retrospectively an individual's natal origin and migratory history, and therefore serve as useful markers for assessing population connectivity. Electronic tags, such as pop-up archival transmitting tags, measure *in situ* time-at-depth, temperature, and light levels (proxy for geolocation) and are particularly useful for fish capable of long-distance movements and behavioural migrations. In this study, we discuss the complementary results using both tools from a case study of blue marlin in the western Atlantic Ocean and adjacent seas (i.e. Gulf of Mexico, Caribbean Sea) which suggest divergent movement patterns of a highly migratory species. We conclude by putting our results in the context of how these tools can be used in the fishery management decision-making process.

Keywords: behaviour, electronic tags, otolith chemistry, population structure.

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**ICES CM 2010/A:10**

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**Towards operational biogeochemical modelling for resource management of coastal waters**

Karen Wild-Allen, Jenny Skerratt, Farhan Rizwi, and John Parslow

The biogeochemistry of coastal waters can now be modelled in three dimensions with high spatial and temporal resolution to inform managers of current and possible future changes in water quality parameters. Models simulate the transformation, cycling, and dispersion of anthropogenic nutrient loads into coastal waters through phytoplankton, zooplankton, macrophytes, and detrital phases. Nutrient remineralization and dissolved oxygen dynamics are also resolved. Model resolution far exceeds the typical spatial and temporal resolution of biogeochemical observations, making model initialization, boundary forcing, and validation difficult. Novel instrumentation and sensor platforms have the potential to address some of these issues. Recent observations from a moored, continuously recording nutrient sensor and a mobile glider platform are discussed. Validated coastal ocean colour remote sensing with high spatial resolution provides synoptic data comparable with model output and the ability to achieve near real-time model validation of surface features. Simulations of anthropogenic nutrient impacts in southeast Tasmania are shown. Human pressures on local estuarine and coastal waters include river water extraction, industry and sewerage effluent discharge, and an expanding salmon farming industry. Future scenario simulations quantify likely anthropogenic impacts and communication of results to resource managers has resulted in the implementation of an environmental monitoring programme as part of an adaptive management framework.

Keywords: anthropogenic impacts, biological model, coastal-zone management, model validation.

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**ICES CM 2010/A:11**

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**Lunacy in Atlantic cod: assessing the timing of spawning in Atlantic cod using ocean models and electronic data storage tags**

Timothy B. Grabowski, Bruce J. McAdam, Kai Logemann, Vilhjálmur Thorsteinsson, and Guðrún Marteinsdóttir

Understanding the environmental processes determining the timing and success of reproduction is of critical importance to developing effective management strategies for marine fish. Unfortunately, it has proven difficult to comprehensively study the reproductive behaviour of broadcast-spawning fish, such as Atlantic cod (*Gadus morhua*), in the wild. The combination of oceanographic models and electronic data storage tags (DSTs) has the potential to provide insights into the behaviour of fish, allowing for data collection over relatively large spatial and temporal scales that can be correlated to predicted environmental conditions and ultimately be used to refine predictions of year-class strength. In this paper we present data retrieved from DSTs demonstrating that Atlantic cod spawning in Iceland is tied to a lunar cycle with a pronounced semilunar cycle within it. Peak spawning activity occurs around the full and new moon with no evidence of relationship with diel tidal or day/night cycles. We then use a Cartesian coordinate ocean model with three-dimensional adaptive mesh refinement and primitive equations (CODE) to assess the changes in environmental conditions at known cod spawning grounds associated with lunar and semilunar cycles and identify oceanographic conditions that might render this spawning strategy beneficial.

Keywords: Atlantic cod, spawning behaviour, lunar cycles, oceanographic hindcasting.

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**ICES CM 2010/A:12**

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**Use of neural networks to forecast the abundance of Argentine hake in the Southwest Atlantic**

M. Darriba Estévez, L. González Vilas, G. Martínez, and J. M. Torres Palenzuela

The Argentine hake (*Merluccius hubbsi*) is one of the most abundant commercial species in the Patagonian–Malvinas shelf area. In this work, we propose a predictive model of abundance for this species based on a multilayer perceptron (MLP) neural network. The network was developed using fishery data that were collected on board Spanish commercial vessels operating in the area between 1989 and 2006 and environmental data provided by the oceanographic model implemented by MERCATOR Ocean. The MLP output is the cpue (catch per unit of effort; kg h<sup>-1</sup>), which is used as an abundance index. As input variables we included latitude, longitude, Julian day, temperature, and salinity at three depth levels, sea surface temperature gradient, and moon phase. The whole dataset was split into two independent sets, one to train the network and the other one to validate it. GIS techniques and statistical methods were used to analyse and visualize the data and the results. Model results demonstrate a good fitting between the observed and estimated cpue ( $r = 0.74$  using the validation set). This tool might be useful to implement an operational forecasting system.

Keywords: Argentine hake, MLP, neural networks, prediction model.

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**ICES CM 2010/A:13**

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**Investigation on krill transport factors in the Scotia Sea for fisheries and management applications**

Kasatkina Svetlana and Vladimir Shnar

Data from acoustic surveys and oceanographic observations were used to estimate characteristics of krill transport across different polygons in the Scotia Sea. Krill flux over the study polygons was considered to be a passive transport by water masses and assessed by the geostrophic transport. Estimates of water velocity and krill biomass transported across the boundaries (outflow and inflow) of these polygons were made. Variabilities of the spatial–temporal distributions of krill biomass and aggregations characteristics associated with multiple processes of krill inflow–outflow over the study areas were traced. It was revealed that krill transport across fishing grounds affects the operational indices of commercial vessels (mean catch per haul, mean catch per hour). The authors discuss the characteristics of krill transport as important information for krill stock management in the Scotia Sea. It was shown that the annual krill biomass transported across traditional fishing grounds could exceed the precautionary catch limit based on the results of a multi-ship acoustic survey and adopted by the Convention on the Conservation of Antarctic Marine Living Resources (CCAMLR) for the Scotia Sea.

Keywords: acoustic and oceanographic observations, Antarctic krill flux, fisheries, geostrophic transport.

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## ICES CM 2010/A:14

### Operational data distribution at Institute of Marine Research

Sjur Ringheim Lid, Helge Sagen, and Trond Westgård

The Norwegian Marine Datacenter (NMD) started serving operational research data from vessels operated by the Institute of Marine Research in early 2000. Through the EU FP7 project MyOcean the NMD has become the thematic assembly centre for Arctic *in situ* data. As a thematic assembly centre the NMD delivers *in situ* data to the global assembly centre and to the ocean forecasting centres, where it is used for assimilation or validation of model output. The data service has been expanded to include data from other data sources, such as the Coriolis data service. Real-time quality-control procedures have been defined in the MyOcean project and all data go through these procedures and are flagged according to the SeaDataNet Quality flag scale. The Institute of Marine Research has also started work on other data types gathered on research vessels. These data types include different kinds of biological samples and chemical data that will become available to scientists in near real time.

Keywords: automatic quality control, MyOcean, operational data distribution, SeaDataNet.

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## ICES CM 2010/A:15

### Indices for fishery management based on larval transport model predictions

Elizabeth North, Zachary Schlag, and Wen Long

Incorporating the influence of environmental variation and recruitment variability in stock-assessment models is hampered by the complexity of interacting physical and biological processes that operate during the early life of fish and shellfish. The objective of this research is to apply a coupled hydrodynamic and larval transport model to calculate two metrics that summarize the influence of environmental variability in a format that could be used by fishery managers. The metrics that we calculate are (1) a physical baseline and (2) minimum transport-based spawning-stock biomass (SSB). We will use the blue crab, *Callinectes sapidus*, as the model organism and the Middle Atlantic Bight as the study area. We define a physical baseline for a population as the minimum number of offspring needed to “swamp” the physical variability in a system and produce reliable transport between spawning and nursery areas. We define minimum transport-based SSB levels as the minimum biomass of adult females that can produce the offspring needed to meet the physical baseline and ensure relatively stable recruitment. Multiple techniques will be

applied to account for the unknown sources of mortality along transport pathways in order to create an envelope of possible transport-based SSB estimates. The transport-based SSB levels will be compared with the target SSB levels derived from current stock assessments of the blue crab. Application of these metrics in an operational context will be discussed.

Keywords: coupled biological–physical models, fishery management, larval transport.

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## ICES CM 2010/A:16

### MyOcean – operational products for fisheries

Henning Wehde

The EU-supported project MyOcean is the implementation project of the GMES (Global Monitoring for Environment and Security) Marine Core Service, aiming at the deployment of the first Europe-wide concerted and integrated capacity for monitoring and forecasting of the oceans. The project objective is to analyse, forecast and observe the oceans at global and regional European scales in order to provide a monitoring service for the marine environment and security. By combining remote sensing and *in situ* observations and their assimilation into three-dimensional circulation/ecosystem models, MyOcean aims to provide a service that delivers the best information available on global and regional oceans. These data include temperature, salinity, currents, ice extent, sea level, and primary ecosystem parameters. The target applications are marine safety, marine resources, climate and seasonal forecasting, as well as marine and coastal environments. Within this study special focus is laid on the MyOcean key area of marine resources and the value of the service products will be highlighted, specifically on the fisheries within the North Atlantic.

Keywords: GMES project, operational oceanography.

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## ICES CM 2010/A:17

### Influence of mesoscale oceanographic structures on larval distribution and survival in jack mackerel (*Trachurus symmetricus*) off central Chile

Sebastián Vásquez, Marco Correa-Ramírez, and Aquiles Sepúlveda

The jack mackerel, *Trachurus murphy* (Nichols), is a medium-sized pelagic fish that has a wide distribution in the southeast Pacific Ocean and constitutes the most important pelagic fishery in Chile. The jack mackerel population structure includes an extensive dispersion towards the oceanic zone off Chile, where its reproduction occurs during spring. The spatial distribution of jack mackerel larvae during the main spawning season between 2003 and 2005 was addressed through several surveys at 790 plankton stations covering ca. 350 000 square nautical miles. Large numbers of larvae (individuals between 1.7 and 14.9 mm in length) were commonly found up to 1000 nautical miles off central Chile associated with the Subtropical Convergence Zone (STCZ), where strong oceanic mesoscale eddies and meandering currents are typical features during spring. The otolith microstructure shows a significant positive relationship between larval age and distance northward, as well as a relevant association between survival of larvae and mesoscale structures. The eddy definition by the Okubo–Weiss parameter shows that mesoscale oceanographic features have a strong influence on the horizontal distributions of fish larvae and could be providing physical mechanisms that may facilitate the regional self-sustaining of the jack mackerel population off Chile.

Keywords: meandering currents, mesoscale eddies, Okubo–Weiss parameter, otolith microstructure.

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**ICES CM 2010/A:18**


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**Site selection for stock replenishment using a hydrodynamic model: example for the pacific oyster (*Crassostrea gigas*) culture in the Pertuis Charentais region**

I. Bernard, O. Le Moine, J.-Y. Stanisière, S. Pouvreau, P. Gouletquer, and F. Dumas

The critical issue for oyster farmers in the Pertuis Charentais region of France is to obtain a sufficient spat supply on a yearly basis in areas dedicated to spat collecting to sustain oyster production. To address this practical question we searched for the main hydrodynamic factors driving spatfall abundance using a hydrodynamic model. Five hydrodynamic-related factors were included in the simulation: spawning time, pelagic larval durations, wind, broodstock location, and spat collecting location. The main result is that "broodstock location" is the most important factor that impacts larval abundance above spat collection areas at the end of larval life. Northern beds supply spat areas located in the southern areas. This implies that the most important spatfall area in the mouth of the Charente River may be sustained by wild oysters, for which stocks are unknown. The importance of broodstock location implies an improved coordination between policy of eradication of wild oyster beds, aiming to increase productivity, and the policy of replenishment to improve the spatfall level. Moreover, it should be of concern when considering the development of farming of triploid oysters, which do not contribute to reproductive effort. Based upon those results, wild oyster stock assessment is a necessary step for determining where the replenishment should be carried out. The large variability of the contribution of oyster beds, however, seems to indicate that replenishment in well-chosen areas may be successful in improving spat supply.

Keywords: *Crassostrea gigas*, larval dispersal, population connectivity, stock replenishment.

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**ICES CM 2010/A:19 Poster**


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**Chilean jack mackerel aggregations in the southeastern Pacific in winter–spring season 2009 revealed by seabird observations and oceanographic features**

O. Krasnoborodko and F. Litvinov

The complex survey of Chilean jack mackerel habitat and distribution in the southeastern Pacific outside Chile's EEZ 25–42°S/74–126°W was carried out aboard Russian RV "Atlantida" in August–November 2009. Acoustic, ichthyological, hydrological, and ornithological surveys were undertaken. The strong differences in the density of Chilean jack mackerel were revealed, the highest density corresponded to the seasonal position of the Subtropical Southeastern Pacific Front (SSPF) between 33 and 37°S. This frontal zone was affected by the surface wind direction (mainly south–southwest) and subsurface geostrophic circulation (between 0 and 250 m from 0.2–1.0 to 7.0–9.7 cm/s). It was revealed that both the strongest gradients of sea surface temperature in the SSPF zone and the corresponding densest Chilean jack mackerel aggregations were, in turn, clearly marked by the most abundant seabird aggregations. The densest seabird aggregations in the SSPF zone were observed between 34–36°S/85–87°W, 34–38°S/90–96°W, 34–38°S/103–106°W, 34–35°S/112–114°W, and 36–38°S/114–116°W. These zones corresponded to the densest Chilean jack mackerel aggregations and sea surface temperature gradients of SSPF greater than 0.05°C per nautical mile. The information collected may serve as an additional tool for the analysis of Chilean jack mackerel spatial distribution in this region in winter–spring. Maps of the distribution of the bird species (*Daption capense* (occurrence 72%), *Procellaria aequinoctialis* (65%), *Diomedea exulans* (45%), *Diomedea melanophis* (23%), etc.) in relation to Chilean jack mackerel aggregations and oceanographic features are presented.

Keywords: Chilean jack mackerel, seabirds aggregations, southeastern Pacific, Subtropical Southeastern Pacific Front.

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**Lagrangian tracking of *Anguilla anguilla* leptocephali in a 1/12° Mercator-Océan simulation of the North Atlantic**

Bruno Blanke, Sylvain Bonhommeau, Nicolas Grima, and Yann Drillet

European eel (*Anguilla anguilla*) larvae have one of the longest larval migrations of the marine realm, swimming more than 6000 km from their spawning grounds in the Sargasso Sea to European continental shelves. The duration of this migration remains debated, being thought to be between seven months and three years long. This information is crucial, however, because it determines the period over which larvae are affected by environmental conditions and hence the subsequent recruitment success. We investigated the migration pathways and duration of eel larvae using three years of high-resolution (daily, 1/12°) velocity fields available from a Mercator-Océan model configuration without data assimilation. We specifically studied the impact of spatial and temporal resolutions on our estimates by applying various filters in time (from daily to 12-day averages) and space (from 1/12° to 1° gridcell aggregation) to the nominal model outputs. Larvae were released in the eel spawning area and considered as passive tracers at three specific depths (surface, 50 m, and 200 m). We diagnosed the intensity of water transfer between appropriate control sections that encompass the eel larva distribution. Transit ages were also investigated, with a particular focus on the pathways that minimize the connection times between the western and eastern North Atlantic. The study shows that small-scale structures (eddies, filaments) contribute to the existence of faster connections although they also correspond to additional complexity in trajectories. The shortest pathways mostly follow the Gulf Stream and the North Atlantic Drift, whereas more interior connections require time transfers less compatible with biological issues.

Keywords: European eel, operational oceanography, Lagrangian diagnoses.

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**The climate of Icelandic waters, 1948-2009—high-resolution, adaptive grid ocean modelling**

Kai Logemann, Jón Olafsson, and Guðrún Marteinsdóttir

In order to gain deeper insights into the role of physical processes in determining the variability of the Icelandic marine eco-system, the workgroup MARICE, University of Iceland, is running a numerical model of the hydrodynamics of Icelandic waters and adjacent seas. The ocean model CODE (Cartesian coordinates Ocean model with three-Dimensional adaptive mesh refinement and primitive Equations) is used which was recently developed at the University of Hamburg and the University of Iceland. A dataset was created which contains the three-dimensional fields of temperature, salinity, and flow around Iceland for the years 1948–2009 with a spatial and temporal resolution of 1 km and 3 h, respectively. With the focus on decadal variability, the simulation is presented and compared with observations. Successfully simulated structures are analysed and model errors discussed. Finally, model runs describing decadal variability in temperature and salinity are linked with temporal changes in recruitment and abundance of commercially important pelagic and groundfish species. Keywords: decadal variability, ocean modelling, Icelandic waters.

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**Improved estimates of diatom primary production for use in fishery production potential models**

K. J. W. Hyde, M. J. Fogarty, J. A. Hare, and J. E. O'Reilly

Fishery production potential is a function of the amount of primary production, the fraction of this production available to higher trophic levels, the transfer efficiency between successive trophic

levels, and the number of trophic levels through which energy must be transferred. Two pathways are recognized for transfer of primary production in the system—the classical grazing food chain, principally new production by diatoms and direct grazing by mesozooplankton, and nanoplankton production, which includes the microbial foodweb and involves two or more trophic transfer steps before reaching mesozooplankton. The northeast continental shelf of the United States is a highly productive ecosystem with several commercially significant fisheries. This dynamic ecosystem has experienced changes in climate and physical forcings that have contributed to large-scale alterations in ecosystem structure and function. Recent analyses suggest that phytoplankton biomass in the northeast ecosystem has increased up to 33% during the last decade compared with the late 1970s to early 1980s. Furthermore, other studies have indicated that the increase in biomass is associated with a shift from larger diatoms (>20  $\mu\text{m}$ ) to smaller nanoplankton and picoplankton species. Current fishery production models use estimates of diatom production (approximately 30% of total primary production) from MARMAP shipboard surveys (1977–1988), but it is unlikely that these measurements are representative of the current phytoplankton community. Thus this study will evaluate satellite remote sensing models of phytoplankton species composition and/or size fraction to estimate diatom production in order to incorporate these results into current estimates of fisheries potential production.

Keywords: chlorophyll, diatoms, fisheries production models, new production, northeast US continental shelf ecosystem, primary production,

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**Environmental preference of dolphinfish (*Coryphaena hippurus*) derived from remotely sensed data along the Pacific coast of Colombia**

John J. Selvaraj, Adriana Martínez, and Angela I. Guzmán

In this study we looked at the relationship between catch data and satellite-derived oceanographic features to predict potential fishing habitats of *Coryphaena hippurus* off the Pacific coast of Colombia. Catch data were derived from logbooks of industrial longline fishing fleets and satellite data on sea surface temperature (SST) and chlorophyll *a* (Chl *a*) from a moderate-resolution imaging spectroradiometer (MODIS). Data were analysed for the years 2003–2008. Longline data included date, fishing location, number of individuals captured and number of hooks used. Catch per unit effort (cpue) expressed as numbers (fish/1100 hooks) was used as index of relative abundance. To predict the spatial patterns of potential dolphinfish fishing habitats (PDFH), we developed a model using a generalized linear model (GLM) based on the functional relationships between the environmental variables and cpue. The PDFH maps were validated against catch data from the year 2009. It was found that the preferential habitat for dolphinfish corresponded to an SST range of 25.5–27.5°C and a Chl *a* range of 0.2–0.75  $\text{mg}/\text{m}^3$  based on the highest cpue values during the fishing season (November–March). Persistent high cpue was observed along the northern coast, extending longitudinally during the months November–February and in deeper waters during March within the EEZ. Cross-validation of the cpue predicted by the model was reliable ( $r = 0.75$ ) with the observed cpue. The dynamics of the thermal fronts and currents in this region may have contributed to the spatial patterns of the PDFH.

Keywords: dolphinfish, generalized linear model (GLM), MODIS.

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**Study of demersal fish distribution and environmental conditions in the Great Sole Bank using statistical and GIS techniques**

E. Spyarakos, M. Darriba Estévez, Luis González Vilas, and J. Torres Palenzuela

Variations of oceanographic conditions in relation to the abundance and distribution of demersal fish in the Great Sole Bank (ICES Statistical Division VIIj) were studied during the year 2009 in the framework of the project "Study of sea bottom circulation and its environmental and fisheries impacts". In this study we focused on three different commercial species: cuckoo ray (*Raja naevus*), megrim n.e.i. (*Lepidorhombus* spp.), and anglerfish n.e.i. (*Lophiidae*), which represent the majority of the catches database. Fisheries data were collected on board three commercial vessels operating in the study area as part of the Fishing Vessel Owners' Cooperative of the Port of Vigo (ARVI). Daily recordings of sea surface temperature (SST), surface sea salinity (SSS), sea bottom temperature (SBT), sea bottom salinity (SBS), and seabed currents were obtained from the Mercator-Ocean Model. Maps were generated using geographical information systems (GIS) in order to study the spatial distribution of the species. Generalized additive models (GAMs) were developed for the three species. Catch per unit effort (cpue), used as an abundance index, was modelled as a function of bathymetry, location, SST, SSS, SBT, SBS, day, seabed currents, and moon phase. The depth of the catches varied between 100 m and approximately 600 m. The results demonstrated that the different techniques used in this study can provide useful information about demersal fish distribution in the area and their relation to environmental conditions.

Keywords: anglerfish, cuckoo ray, GAMs, GIS, megrim, seabed environmental variables.

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## ICES CM 2010/A:25 Poster

### Physical and biogeochemical MyOcean operational products and end-user applications

Rosa Barciela and Karen Edwards

The provision of free and open operational oceanographic services and products to the wider user community has become a reality through MyOcean, the implementation project of the GMES Marine Core Service. MyOcean strives to deliver the best available oceanographic information from models and also from observations to anyone at anytime (near real-time, short-range forecast, and hindcasts are all available), anywhere (information at global and regional scales, from the deep ocean to the shallow seas) and at any depth (from the surface to the bottom of the ocean). This presentation focuses on the physical and biogeochemical MyOcean products routinely available from the UK Met Office model for the European North Atlantic West Shelf. End-user applications already making use of those products, including a trial tool for the operational prediction of nuisance algal blooms, will also be presented.

Keywords: biogeochemical, MyOcean, North Atlantic, North West Shelf, operational products, physical.

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## ICES CM 2010/A:26 Poster

### Operational oceanography products and services: how can they help in setting the initial state and trends of the oceans?

Sylvie Giraud Saint-Albin, Patrick Lehodey, and Eric Greiner

Scientific understanding and knowledge of the marine environment and its state, on the one hand, and data and models to translate this into meaningful and useful information to support sustainable development and, if necessary, effective interventions, on the other hand, are both crucial for forming marine environmental policy, as carried out by the EU Marine Strategy Framework Directive. MyOcean Ocean Forecasting Systems bring a revolution to European governmental agencies. With a coupled physical–biogeochemical forecasting capacity, monitoring the ocean state and its trends is now feasible. Current state estimates can be provided in real-time as well as interannual statistics to measure variability and trends at various space- and time-scales (required by the ecological processes) against a given "reference" state (or initial state). What-if

scenarios can also be performed by these systems, exploring the impact of specific conditions for the future. The use of operational oceanography products opens the way to objective and scientific analysis and quantification of climate change impacts on the targeted marine ecosystems at different time and spatial scales through model downscaling. A set of environmental indicators is presented here and taken from the halieutic domain. Some challenges are still not resolved as model uncertainties are big when you come to “underobserved” variables such as biogeochemical parameters and habitats, or low-frequency signals such as climate change (50 years). Downscaling climate scenarios to regional scale for coupled physical–biogeochemical models also raises open scientific questions and requires strong interoperability between global, regional, and coastal operational oceanography systems.

Keywords: downscaling, indicators, initial state, MSFD, MyOcean.

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