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Theme session Report

Scientific advances under ICES Science Plan

Conveners: Steven Degraer (Belgium), Brian R. MacKenzie (Denmark), Jos Schilder (Netherlands)

The intent of this session was to allow broad dissemination of important new research in science areas that are not represented by other Annual Science Conference theme sessions. This increases the scope of the ASC and fosters the establishment of more multidisciplinary scientific work and links between scientists.

This session was open to contributions relevant to any of the seven priorities of ICES Science Plan:

- Ecosystem science
- Impacts of human activities
- Observation and exploration
- Emerging techniques and technologies
- Seafood production
- Conservation and management science
- Sea and society

Submissions to this session were assessed on the basis of relevance and scientific excellence. In addition, abstracts rejected from other sessions on grounds of topic were also eligible for this session. Abstracts submitted to this session were expected to have a broader context than just one species or one geographic location and to emphasise the relevance of the findings to the wider marine science community. From the accepted abstracts, a selection between oral and poster presentations was made based on the conveners' assessment of the quality of the submissions and their relevance to the ICES community (8 talks in the session).

Due to the somewhat atypical nature of session Q, this session was not characterized by a general overarching theme or topic. For the same reason, there were no discussions or interactions tailored to a predetermined format, topic or theme. This ultimately leads to a different format, length and content of the session report compared to others.

Session format

Session Q consisted of a total of seven oral presentations (there was one cancellation) and 16 poster presentations. During the two-hours session, we enjoyed two sets of three to four in-person 8-minute oral presentations (there were no video presentations submitted to session Q). Each set of oral presentations was followed by ~20 minutes of open Q&A between the audience and the four presenters. The session ended with 5 poster presenters giving a 1-minute pitch to advertise their work (even though the official poster session had already occurred the posters were still on display at this point). Holding this pitch was optional and not every poster presenter opted to make use of this opportunity.

Content

The first set of talks focused on the spatial distribution of fish and lobster, most notably on the aspects of changing climate and habitat suitability, and on the potential of spatial (fish) distribution models that take habitat preferences of different size-classes of a species into account. Then, the topics diverged strongly, covering aquaculture (mussel spat performance study), the knowledge base on deep-sea ecology for VME-related advice, making the cephalopod fisheries more sustainable and

future-proof, and a thought-provoking plea to consider longer timescales when considering MPAs and related measures in the context of climate change. One talk was nominated for the best presentation merit award. The 16 posters associated with session Q covered an even more eclectic array of topics, ranging from data mining to marine litter and from aquaculture to contaminants in seafood. Despite the wide range of topics in the talks and (arguably) wide range of interests of the audience in the room, the Q&A sessions were lively with questions for all speakers.

Conclusions

Even though session Q was relatively small this year (in 2022 it was considerably larger), the conveners feel it was well worth including it in the session programme. It was well-attended, and the presentations sparked discussion. Moreover, session Q provided a home for those researchers hoping to share work that did not fit into the selected theme sessions. As such, it added breadth to the contents of the ASC and has the potential to widen the audience the ASC appeals to.

Contents

CM 14: Utilizing the ICES library for data mining – examples from the ICES Science Impact and Publication Group

Nils Olav Handegard[1], Ruth Anderson, Ffion Bell, Mark Dickey-Collas, Jan Jaap Poos, Antonina dos Santos, Jörn Schmidt

The Science and Impact Publication Group (SIPG) monitors ICES publication outputs and provides advice on increasing the impact of ICES publications and science communications. An important task over the last term of reference for the group has been to support the transition to a new and modern library solution for ICES publications. The process of adding historical documents to this new library is ongoing. The documents currently date back to 1899, offering a unique time lapse of the evolution of science supported by ICES as well as marine science in general.

In this contribution we showcase how the library can be used for text mining the historical content, providing a resource for scientists interested in text mining research as well as providing a tool for the organizations various committees to assess the changes in their focus areas. We use off the shelf text mining tools and provide examples of how to use these in relation to the API for the library.

Our ambition is that this contribution will facilitate a broader use of the library.

Keywords: ICES library, text mining, API, Figshare, SIPG

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CM 35: Total mercury, methylmercury, and selenium concentrations in blue marlin Makaira nigricans from a long-term dataset in the western north Atlantic

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Mercury in seafood is a neurotoxicant that threatens human health. Dynamic rates of mercury emission, re-emission, and atmospheric deposition warrant studies into mercury concentrations in fish because many are consumed by humans and can serve as sentinels of mercury levels in the environment. We modeled trends in total mercury content in an apex marine fish predator, Atlantic blue marlin *Makaira nigricans*, whose muscle tissues were opportunistically sampled from North Carolina (USA) sportfishing tournaments over a discontinuous time period: between 1975-77 and 1998-2021 (n=148). The model-estimated influence of marlin weight on total mercury concentration was constant across years (shared slope) allowing for comparisons of weight-corrected mercury concentrations among years. Weight-corrected total mercury concentrations revealed an inter-decadal decline of approximately 45% between the 1970s and late 1990s and then variable but relatively stable concentrations through 2021. The mean (SD) wet weight concentration of total mercury was 9.47 (4.11) from 1975-77 and 4.17 (2.61) from 2020-21. Methylmercury and selenium were measured on a subset of fish to address questions related to human health and consumption. Methylmercury levels (mean = 0.72 µg/g) were much lower than total mercury (mean = 4.69 µg/g) indicating that total mercury is not a good proxy for methylmercury in Atlantic blue marlin. Selenium, examined as a Se:Hg molar ratio and as a selenium health benefit value (HBV_{Se}), showed high protective value against mercury toxicity. Long-term trends in the concentration of mercury in blue marlin should continue to be monitored to determine whether policies to mitigate anthropogenic contributions to global mercury are achieving their intended goals and to provide information to inform safe human consumption. Given that mercury toxicity is a worldwide and evolving topic affecting human health and our findings that methylmercury is a minor fraction of total mercury, we encourage more studies to measure both forms of mercury to provide more accurate information about mercuric threats to human consumers of seafoods.

Keywords: marlin, neurotoxicant, methylmercury, selenium, human health, fish consumption

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CM 124: Interspecific synchrony among juvenile marine fishes and climate and environmental forcing in the Bay of Biscay

Erwan Saulnier, Anik Brind'Amour, Jean-Baptiste Lecomte, Eloïse Piette-Semeril, Verena M. Trenkel

The existence of synchronous fluctuations among sympatric species is an important property of a community, potentially reducing its temporal stability and the associated ecosystem services delivered to society. Interspecific synchrony generally leads to lower community stability, because the decline of one or more species is not compensated by an increase of others. Hence, identifying synchrony and its drivers can provide valuable information on ecosystems dynamics, and contribute to ecosystem-based management of exploited living resources. In this study, we analyzed fourteen years (2007-2020) of fish abundance data collected by a scientific beam trawl survey in the Bay of Biscay, a temperate marine ecosystem located in the North-east Atlantic. We used dynamic factor analysis to investigate whether demersal marine fishes shared common trends in abundance during their early life, and to identify potential environmental drivers of fish abundance variations. Our results revealed synchronous changes in juvenile fish abundance among most of the 12 marine species examined in the study. We showed that this temporal coherence was likely explained by climate and environmental factors, notably sea bottom temperature and the East Atlantic Pattern. We also found some support for alternative drivers of early-life fish dynamics, namely the North Atlantic Oscillation and sea surface chlorophyll-a concentration, the later suggesting bottom-up trophic control in the study area.

Keywords: interspecific synchrony, time-series analysis, demersal fish, early life stages, environmental forcing, Bay of Biscay

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CM 127: Behavioral ecology informs fishing gear design: The case study of Black seabream baited structure

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As a response to an increase demand for more sustainable production of marine proteins, there is a strong need for developing alternative fishing technics to trawling such as commercially viable baited pots. However, these fishing methods have low catch efficiency. Knowledge on animal behavior is a key element to understand and improve the capture processes. Advances in underwater video cameras systems have provided novel tools for researchers and facilitated the observation of species interacting with fishing gears in their natural environment. In this study, using a recently published methodology we quantitatively assessed the effect of external and internal factors on the attraction and retention phases of seabreams around and inside baited structures. Weibull distribution describes the distribution of residence times through time and allows testing the effect of fish length, number of congeners or pots design on ingress and egress rate. Fish personality traits (Boldness – Shy continuum) were explored to better understand inter-individual differences observed. We demonstrated size and social effects on attraction and retention processes of black seabream around baited pots and discussed how such findings can be useful to design and improve baited structures.

Keywords: baited pots, behavioral ecology, black seabream

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CM 218: Shore angling in the future Marine Park of the Algarve Reef – Pedra do Valado

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The future Marine Park of the Algarve Reef - Pedra do Valado (Algarve, south Portugal) was co-designed following an inclusive 3-year participatory process that lasted from 2018 to 2021. This soon to be Marine Protected Area (MPA) comprises one of the largest shallow rocky reefs in mainland Portugal and encompasses the most significant hotspots of biodiversity and human activities (such as tourism and fishing) in the southern region of the country. We investigated shore-based angling in the area before the implementation of the MPA to set the basis for inclusive and informed co-management. Angling fishing effort was obtained through instantaneous counts of fishers using a 500 m grid where four sea transects were set. To obtain information about fishing activity, fisher socioeconomic profiles, catch composition and catch rates we conducted face-to-face interviews, using a roving creel survey design. The survey was conducted during two non-consecutive periods (2019/20 and 2022), providing a basis for a comparison of the fishing activity before and after the lockdowns due to the COVID-19 pandemic. The results allowed for quantifying shore angling activity (e.g., effort, catch rates), as well as identifying perceptions, attitudes, fishing habits, and preferred fishing areas. Moreover, these results confirmed the importance of specific species groups (e.g., Sparidae family) for shore angling in this region. These findings are especially relevant, given the ongoing debate on the new species that should be included in the mandatory EU data collection framework.

Keywords: marine recreational fisheries, angling, marine protected area (MPA), roving creel survey, fishing effort, human dimensions, catches

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CM 237: How are changes in the biological traits of a small pelagic fish species influencing its population dynamics through time?

Ana M.[1,2], Teresa R.[1,2], Karim E.[2], Miguel S.[1,2]

The management of small pelagic fish (SPF) has a long history of research effort to account for the dynamics of these species, but there are still a lot of gaps to be filled. The study of juveniles and/or adults life traits has been highlighted as a missing key to the fish life cycle. Knowledge is focused mainly on the early life stages but changes on the fish full life history can have important consequences for its population structure. Biological traits of juveniles and/or adults can be valuable to evaluate vital functions of development, such as growth and the ability to store reserves, that will impact survival potential and reproductive success. Exploring multi-decadal changes on those traits could contribute to address some questions left to be answer on the SPF population dynamics, which is the aim of this work. Data on biological indicators, such as age-length and weight-length relationships, body condition, spawning stage, mesenteric fat reserves, and stomach fullness from fishery dependent and independent surveys of the European sardine (*Sardina pilchardus*) were used. Surveys were conducted in the Western Iberia Upwelling Ecosystem (WIUE) which is situated in the northern part of one of the 4 major Eastern upwelling systems, the Canary current, and it´s highly important for SPF species accounting for more than 50% of the landings in this area over the last 50 years. Results show that there have been changes in the biological indicators, following the patterns of biomass dynamics through the last 30 years. It is discussed what may have contributed for such changes, namely environmental variability, fishing effort, and/or density-dependent mechanisms. This type of research could be applied to other species and/or other systems for an improved fisheries assessment with the integration of the impact of ecosystem variability on fish development and the consequences for its productivity.

Keywords: Ecosystem variability, Stock structure, Fisheries biology and ecology

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CM 289: Forecasted habitat suitability as a predictor for future recruitment failure

Cameron Hodgdon[1], Nathan Willse, Noah Hunt, Jaeheon Kim, Kevin Friedland, Yong Chen

Bioclimate models are a type of predictive spatial model that map the distribution of suitable habitat of a species given environmental and climatic conditions. They have been used to predict and forecast habitat suitability as a way to infer future population distributions. This study implements a bioclimate model for the American lobster (*Homarus americanus*) population of the United States east coast to compare futures across multiple stocks. The Southern New England lobster stock of the United States' east coast has experienced severe declines in productivity and fishery landings over the recent decades due to myriad factors linked to the warming of the region. The warming climate has contributed to increased shell disease prevalence and decreased recruitment levels, leading to fishery collapse. The Gulf of Maine lobster stock borders this population to the north and represents the United States' most valuable single-species fishery. As these waters warm, will the fate of the Gulf of Maine stock be the same as it was for Southern New England? Using habitat suitability as an indicator for recruitment failure and subsequent fishery collapse, this framework was used to determine whether the Gulf of Maine lobster stock would face similar population declines experienced by Southern New England. Spatial means and ranges of hindcasted habitat suitability in Southern New England were calculated to represent suitability levels representative of a collapsed stock. These same means and ranges were estimated for forecasted lobster habitat suitability in the Gulf of Maine over the next 80 years. It was determined that future Gulf of Maine suitability will decline, but not to the levels historically experienced by Southern New England, indicating that a similar recruitment failure and stock collapse in this region is unlikely in the projected timeframe. This habitat suitability comparison framework is highly adaptable to many crustacean and finfish species and can be used to estimate the likelihood of events such as fishery collapse when comparing across multiple stocks.

Keywords: bioclimate models, habitat suitability, fishery collapse, stock forecasts

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CM 322: Marine Litter in the Algal Wrack along the South-East Baltic Sea Coastline

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Beach wrack is considered an important input of organic material to the sandy beaches, especially in the South-East Baltic Sea. On shore accumulated wrack consists from the seaborne organic material such as seagrass and macroalgae, also residuals of dead animals such as fishes, seashells, etc. The importance of beach wrack to the regulating and maintenance of ecosystem services is well known, as it is a major source of nutrients to the sandy coast ecosystems and is a part of habitat formation, also it serves as the natural beach sediment storage and formation material. However, with the increasing exploitation of the cultural ecosystem services, especially recreation and tourism, of the sandy beaches in the Baltic Sea region, the conflict between preserving the natural succession and establishing qualitative recreational sites becomes more evident. The need for timely and clear management solutions is necessary as the increase in recreational activities in the coastal zone also brings the inevitable pressures related to marine litter pollution.

With the increasing knowledge on the presence of various size fractions of artificial items in the marine environment compartments, there is still a lack of knowledge on the quantities and properties of marine litter in beach wrack. Various methods and techniques of microplastic extraction from inhomogeneous/complicated field samples are described in the literature, however no standard method is agreed on. The recently implemented LAT_LIT ESMIC project allowed an international collaboration between Lithuanian and Latvian researchers to investigate the quantities and distribution patterns of marine litter, with an emphasis on microplastics, along the South-East coast of the Baltic Sea. Due to Lithuania's coast exposure to hydrometeorological forces of the Baltic Sea, it is a perfect study area to investigate the marine litter accumulation tendencies in beach wrack.

The poster will present results from research performed in 2021-2022 year the beach wrack accumulation zones along the Lithuanian coast. The presentation will cover a research relevance and strategy, also show links and tendencies between micro plastic litter abundance in different sampling locations in separate coast compartments (beach vs nearshore), also depending on dominated algae compositions. Additionally, microbiologically aspects related to wrack accumulation zones and potentially pathogenic Vibrio and fecal pollution indicator bacteria will be presented. In the discussion part, coastal management alternatives will be discussed in order to reduce and manage the issues raised by physical and biological pollution.

Keywords: marine litter, microplastics, beach wrack, pollution, ecosystem services, management

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CM 348: Landing Obligation: effect on the discards of the Spanish bottom trawl fleet operating in North-western Iberian waters

María Pan[1], Hortensia Araujo, David Espino, Itxaso Salinas, Manuel Marín, Josefina Teruel, Jose Castro

The reformed Common Fisheries Policy (CFP) of the European Union (Regulation (EU) Nº 1380/2013) included in its Article 15 the so-called Landing Obligation (LO), a discard ban intended to reduce unwanted catches by EU fisheries. This LO only affects to regulated species, i.e. those presenting total allowable catches (TAC) in the Atlantic or minimum conservation reference size (MCRS) in the Mediterranean Sea. The LO was progressively implemented, coming into force in 2015 for some stocks and regions and finalising in 2019, when it was fully implemented. Since then, all fish caught should be landed and deducted from the available quota and catches below MCRS cannot be directly used for human consumption. Nevertheless, some exemptions apply to this LO: prohibited species, species damaged by predators, species with high survival rates and *de minimis* exemptions (which allow discards for up to 5% of the total annual catch).

The main objective of this work is to investigate the expected success of the application of LO in the Spanish bottom trawl fleet operating in North-western Iberian waters (ICES divisions 27.8.c and 27.9.a). This fleet is composed by three trawling metiers: bottom otter trawl targeting demersal fish species (OTB_DEF), bottom otter trawl targeting mixed pelagic and demersal species (OTB_MPD) and pair bottom trawl targeting mixed pelagic and demersal species (PTB_MPD). Discards data from 2009 until 2021, obtained through the DCF Spanish at-sea sampling programme, was analysed in order to determine if the LO has had some effect on the discards of frequently caught species (those present in at least 30% of the hauls). For this, we have stratified the historical series into three periods: prior to the LO (2009-2014), transition period (2015-2018) and full implementation (2019-2021). Regarding the species, they were split into two groups: regulated species (with TAC) and non-regulated species (without management measures). For metiers OTB_DEF and OTB_MPD, the data shows a decrease in the discards during the transition period, being this reduction more clear after full implementation of the LO in 2019. Interestingly this appears to happen not just for regulated species but also for those taxa without TAC. For PTB_MPD, discards decrease does not appear to be as clear as in the other two metiers, but a reduction has been also noted mainly after 2019.

Keywords: Landing obligation, LO, discard ban, discards, bottom trawl

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CM 349: Disentangling global market drivers for cephalopods to foster transformations towards sustainable seafood systems

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Aquatic food systems are important contributors to global food security to satisfy an intensifying demand for protein-based diets, but global economic growth threatens marine systems. Cephalopod (octopus, squid, cuttlefish) fisheries can contribute to food security; however, their sustainable exploitation requires understanding connections between nature's contributions to people (NCP), food system policies and human wellbeing.

Our global literature review methodology examined what is known about cephalopod food systems, value chains and supply chains, and associated market drivers. For analysis, we followed the IPBES conceptual framework to build a map of the links between cephalopod market drivers, NCP and good quality of life (GQL). Then we mapped cephalopod food system dynamics onto IPBES (in)direct drivers of change relating to catch, trade and consumption.

This research contributes knowledge about key factors relating to cephalopods that can support transitions towards increased food security: the value of new aquatic food species; food safety and authenticity systems; place-based innovations and empowerment of communities; and consumer behaviour, lifestyle and motivations for better health and environmental sustainability along the food value chain. We outline requirements for a sustainable, equitable cephalopod food system policy landscape that values nature's contributions to people, considers UN Sustainable Development Goals and emphasises the role of seven overlapping IPBES (in)direct drivers of change: Economic, Governance, Sociocultural and Socio-psychological, Technological, Direct Exploitation, Natural Processes and Pollution. We present a novel market-based adaptation of the IPBES conceptual framework – our 'cephalopod food system framework', to represent how the cephalopod food system functions and how it can inform processes to improve sustainability and equity of the cephalopod food system.

This synthesised knowledge provides the basis for diagnosing opportunities (e.g., high demand for products) and constraints (e.g., lack of data about how supply chain drivers link to cephalopod NCP) to be considered regarding the role of cephalopods in transformations towards a resilient and more diversified seafood production system. This social-ecological systems approach could apply to other wild harvest commodities with implications for diverse marine species and ecosystems and can inform those working to deliver marine and terrestrial food security while preserving biodiversity.

Keywords: diet, metasynthesis, nature's contributions to people, policy, seafood, trade

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CM 401: FAR future marine ecology and its conservation implications

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Our projections of the impacts of climate change on marine life are dominated by arbitrary 'dates of convenience' (e.g., 2100) selected because of their political utility rather than any meaningful response timescales in the climate system. Yet climate change impacts do not suddenly dissipate at 2100. In the oceans, long residence and equilibrium timescales mean that some of the most severe changes are projected to happen far beyond 2100. Oceanographers and climate scientists routinely consider longer timescales – so why not marine ecologists and biodiversity scientists? Here we explore the implications of far future (>2100) changes in the global environment for marine ecosystems and their conservation and management. Examples include climate-driven biogeochemical consequences for ecological communities, marine protected areas, and organismal evolution. We ask why and how we should complement our shorter-term conservation and planning with projected longer-term changes, identify key challenges to doing so, and explore how a distant-future marine ecological research program could be shaped to meet these needs.

Keywords: far future, ecology, 2100, climate change, projections, marine ecosystem

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CM 419: Exploring the utility of species distribution modelling for sensitive fish species in the Celtic Seas ecoregion

Bríd O'Connor[1], Julia Calderwood, Thomas Reed, David Reid, Emer Rogan, Paul Holloway

To support sustainable fishing activities and conserve marine biodiversity, we must monitor the status of all fish species, including non-target species as well as those that are commercially important. Biologically sensitive species, such as those with long life expectancies, late age of sexual maturity, and low fecundity, are more susceptible to population declines as a result of overfishing than fast-growing species with high fecundity. Many of these biologically sensitive species are not commercially important, and as a result there is a paucity in their available data, limiting research and management capabilities. As such, there is a need for new research methods to improve our knowledge on the likely distribution of these species, in order to successfully manage fisheries for the protection of sensitive species.

Species distribution models (SDMs) are an important tool that can be used to extrapolate predictions of habitat suitability geographically to regions where there is no known occurrence data. SDMs have been widely used for terrestrial species but are as of now less commonly used in marine environments. Here we use SDMs to predict the distribution of three non-target, biologically sensitive elasmobranch species in Irish waters, (the Data Deficient stingray *Dasyatis tortonesei*, the Vulnerable electric ray *Torpedo marmorata*, and the Critically Endangered flapper skate *Dipturus intermedius*) using observation and environmental data. We have chosen three species that utilise similar habitats and have a range of data availability to test the efficacy of this method for non-commercial, data-poor species. Once this methodology is best refined for marine species, it will be used in further research to identify the geographic and environmental distribution and hotspots of multiple sensitive fish species in Irish waters.

The goal of this project is to highlight areas where these sensitive fish species and threats such as fisheries consistently overlap, in order to support sustainable maritime activities and to maintain biodiversity and overall ecosystem health. Outputs of this work will help to improve the understanding of the local variability of sensitive and data-poor fish species with different life histories and ecologies and provide support to expand and improve the management of protected areas and species, especially those found to be particularly vulnerable.

Keywords: species distribution models, data-poor species, rare species, elasmobranchs, sensitivity, fisheries

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CM 500: Assessment of mussel hatchery production as a tool for stock restoration

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Securing a sustainable shellfish supply from aquaculture is an ongoing challenge that requires the improvement of stock production. As the overexploitation of shellfish beds interfere with the ecosystem's structure and dynamics, bivalve hatchery is increasingly practiced for its restorative potential. Therefore, the improvement of hatchery practices will concurrently enhance stock production and promote the sustainability of future aquaculture. This in-captivity production is mainly altered by larvae performance and spat settlement. Food availability is one of the key factors that highly influence the larvae behavioral, physiological and development patterns. Thereby, in this study, two feeding strategies (Fv: Nb. cells/volume and Fb: Nb. cells/biomass) were applied on *Mytilus galloprovincialis* larvae reared at three different stocking densities (D_5: 5 larvae.ml^{-1}; D_{15}: 15 larvae.ml^{-1} and D_{30}: 30 larvae.ml^{-1}). Results revealed that larvae fed per volume (Fv) scored the highest survival rates in all of the tested densities (0.59%, 0.53% and 0.39% for D_5, D_{15} and D_{30} respectively), comparing to larvae fed per biomass (Fb) (0.40%, 0.39% and 0.32% for, $D_{15,}$ D_{30} and D_5 respectively). On the contrary, in terms of growth, feeding per biomass resulted in high cumulative gain regarding shell length comparing to feeding per volume (211,5 µm and 165.81 µm respectively). However, statistical analysis revealed that in terms of survival, food availability had a significant effect only at low larvae density (D_5: F=20,13; P<0,01), while it influences significantly cumulative gain only at high stocking densities D_{15} (F=148,96; P<0,001) and D_{30} (F=318,74; P<0.001). Through the current study, the efficiency of the adopted feeding strategy control (survival/growth) mass production of seed in hatcheries. For instance, feeding particles dispersal affects not only the production capacity but also the yield quality of the produced spat (absorption efficiency). Furthermore, further investigations to achieve optimized mussel seed production in captivity are needed and as a consequence strengthen the inputs to assess mussel stock recovery in natural habitats.

Keywords: shellfish, seed production, *Mytilus galloprovincialis*, food availability, stock assessment

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CM 501: Seed production in captivity for shell-food purposes: Larvae performance and spat settlement as key factors for mass production improvement

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Seafood production and species conservation are the most recent topics that plays a significant role in both global economy and ecosystems management. However, in-captivity productions are the main recent scope as sustainable alternatives to satisfy the on-growing demand for seafood and to preserve the natural marine resources. Carpet-shell clams represent one of the strategic marine resources classified as the most vulnerable species to be preserved and produced for environment and economic devotions. Thus, the ability of their mass production is being handled in hatcheries for decades and still remain not well optimized. This study aims to improve the effect of the most critical factor (large scale stocking density) during the process of seed mass production in-captivity. Graduate stocking densities during larval development (10, 20 and 40 larvae/mL) and spat settlement (35, 70, 100 and 140 larvae/cm^2) of the clam *Ruditapes decussatus* were carried out during this work. Results showed that low larvae survival was scored at high density (D40: 18 %) comparing to low and moderate densities (D10 and D20: 23 % and 26 %, respectively). In terms of productivity, despite low survival, the produced larvae yield at high density was two to three times higher than at low density. As regards post-larvae, high settlement rate was obtained at low distributed density (35 and 70 larvae/ cm^2 = 36 % and 33 % respectively) while low fixation rate was scored at over-density trials (100 and 140 larvae/ cm^2 = 18 % and 9% respectively). In terms of final yield production, seed productivity was higher at moderate fixation density (x 1,5 to x 2) than high and low densities respectively. Statistical analysis has shown the highly significant effect of density at settlement process ($F= 14.88***, p= 2.4\ 10^{-4}$), while it was moderately significant during larvae development ($F= 11.79*$, $p= 0.043$). To conclude, for large scale production in-captivity, as regards space availability, high stocking densities are advisable since they provide high yield production despite the low recorded survival rates. Additional factors are recommended to be studied to improve in-captivity mass production of carpet-shell clam seed. Regarding the economic and environmental scope that represent clam, the hatchery scale should necessarily be persuaded to maintain its long-term sustainable production and preservation.

Keywords: shellfish, mass production, clam, larvae, spat, hatchery

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CM 506: Evaluation of mussel spat performance in longline rearing systems

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Bivalve suspended culture has become an acknowledged activity for the economical services it provides. Longline farming can be used as a potential strategy either to restore the degraded marine ecosystems, or to enhance the economic purposes of the offshore shellfish culture. As spat production in hatchery represent an efficient source for seed supply, this study highlights the performance of mussel spat on longline farming as an effective tool to achieve their sustainable culture. The performance of hatchery-produced spat of mussel was assessed from December 2020 to November 2021 as regards the season and depth of sea rearing. The effect of depth (d) and season (s) was demonstrated through morphometric (L) and weight (W) measurements that were carried out monthly. Results revealed that the performance of mussels at 4-meters rearing depth was slightly better (5.780 ± 2.372 mm. month-^{1} and 3.404 ± 0.255 g. month^{-1}) comparing to 2-meters depth (5.340 ± 2.884 mm. month-1 and 2.899 ± 2.868 g. month^{-1}) for length and weight growth respectively. Whereas these parameters were greater during summer (8.045 ± 0.866 mm. month^{-1} and 6.07 ± 1.35 g. month-1) compared to their performance during winter (3.072 ± 0.785 mm. month^{-1} and 0.255 ± 0.110 g. month^{-1}). Furthermore, both depth and season had a highly significant effect on mussel performances (F_{wd} = 6.036; df = 1; P ≤ 0.05 and F_{ws} = 892.16; df = 1, P < 0.001 respectively). However, the influence of both studied factors was highly significant as regards length performance (F = 9.933; df = 1; P ≤ 0,001) but not significant in terms of weight gain (F = 3.893; df = 1; P ≤ 0,05). To conclude, in terms of biomass production, mussel sea farming is largely influenced by the season of sea rearing while small scale depth has no (slight) observed effect. Additional information is needed to develop the relationship between the hatchery-produced spat productivity and the carrying capacity of culturing systems and sites, in order to preserve the natural landscapes and to maximize yield production.

Keywords: mussel, longline farming, hatchery, sustainable aquaculture

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CM 515: Assessing spawning behavior at the northern latitudinal extreme of a commercially exploited demersal flatfish

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The Pacific halibut in the Northeastern Pacific is a well-studied fish with decades of historical data. As such, many aspects of its biology have previously been assessed, including reproductive behavior. Current knowledge suggests that individuals spawn annually as far north as Pribilof Canyon in the Central Bering Sea from December to March, during which the directed commercial fishing season is largely closed. However, as conditions in the Bering Sea continue to warm, the latitudinal extent of the species appears to be shifting northward, with Pacific halibut now extending into the Bering Strait region. Pacific halibut at this northern extreme are understudied, with their spawning locations and timing unknown. To assess this, pop-up satellite telemetry tags were deployed at two Northern Bering Sea tagging locations (NBS) on Pacific halibut that had a high probability of being mature females. Recorded depth data and transmitted pop-off locations were used to assess spawning timing and location, respectively. Results indicate that NBS Pacific halibut spawn from January to May, later than their southern counterparts that spawn from December to March. Spawning appears to occur farther north than previously documented, reaching as far north as the Russian shelf edge. Additionally, a large proportion of individuals never occupied spawning habitat, suggesting the presence of skipped spawning, which violates the current annual spawning frequency management assumption. These findings indicate the presence of additional spawning habitat and behavior that is not accounted for in current stock assessment practice, and the potential for commercial exploitation during spawning. As such, these results will aid in estimating annual spawning stock biomass in the NBS and in considering alterations to current management practices, such as shifting the winter fishery closure in the NBS to better represent the spawning season.

Keywords: skipped spawning, climate change, range shift, Pacific halibut

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CM 526: The challenges and opportunities for ICES in providing ecosystem advice in the deep sea

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Recent technological advances (particularly over the last five decades) have made the deep-sea more accessible and led to an increased use of its resources including the expansion of fisheries from coastal to deeper, offshore waters. Much of the deep-sea fisheries in the North Atlantic occur at the same water depths as known Vulnerable Marine Ecosystems (VMEs), such as cold-water corals and sponge aggregations. The growing concern about the state of marine ecosystems has led to a surge in public awareness and a corresponding increase in requests to ICES for advice on deep-sea ecosystem impacts in the early 2000s. Scientific interest in deepwater biology has been re-kindled in recent years due to the improvement in assessment methods and growing knowledge of these ecosystems. Despite this, many aspects of ecology, including spatial distribution of deep-sea species and their connectivity, responses to climate change and understanding of persistent and cumulative pressures from human activities, is limited by a lack of long-term observations of the deep-sea environment.

ICES collates new information on the distribution of VMEs (via the joint ICES/NAFO Working Group on Deep-water Ecology, WGDEC) and fishing activities (via WGSFD) within ICES ecoregions (including the NEAFC Convention Area) and the NAFO Convention Area. The need to integrate advice on fisheries in deep waters with advice on ecosystem effects has created opportunities for the development of new methods/techniques to further our understanding of deep-sea ecosystems and inform the management of Vulnerable Marine Ecosystems (VMEs). Recent ICES workshops (WKEUVME and WKVMEBM) have contributed to develop and document an operational evidence-base to address requests for recurrent ICES advice, including the first ever benchmark assessment on VMEs by ICES in 2022. Here, we reflect on nearly two-decades of advances in deep sea science and consolidation of the evidence base for scientific advice provided by WGDEC, and how the multidisciplinary nature of the Working Group, including links with other ICES Working Groups, is helping advance the conservation of deep-sea habitats in the North Atlantic.

Keywords: vulnerable marine ecosystems, bottom trawling, ecosystem-based management, protection, vessel monitoring systems, significant adverse impacts

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CM 587: Size-specific models of fish distribution: improved accuracy and new ecological insights

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Spatial distribution models (SDMs) have become increasingly valuable tools for predicting the distribution of marine resources and for marine spatial planning. Fish populations exhibit a size-structured organization, with individuals of varying sizes displaying distinct habitat preferences. In this study, we investigated how changes in habitat preferences of the fish species during lifetime growth can result in differences in the distribution and its driving factors between size classes. We tested whether 1) the application of size-specific SDMs improves the accuracy of prediction, and 2) if there are differences in the importance of the predictors of distribution between different size classes within a species. To test our hypotheses, we used Baltic International Trawl Surveys (BITS) data collected from 1991 to 2022. We selected Atlantic cod (*Gadus morhua*) and modeled its distribution using random forest models fitted separately to the different size classes defined based on the percentiles of the general length distribution. Standardized abundance (individuals/km^2) in each size class was modeled as a function of selected environmental variables summarized across multiple time scales. The performance of the model and general prediction accuracy were evaluated using cross-validations. We obtained size-specific partial dependence functions and evaluated the importance of the predictors. We tested the differences in the obtained accuracy between a single combined model and the size-specific model composed of multiple submodels, as well as differences in the predictors' importance between size classes. Our results showed that size-specific SDMs offer a valuable alternative to the models based on the overall species abundance when predicting spatial distribution. Such an approach can be helpful in the more in-depth investigation of the relationships between species and the environment, and provide information on size-specific habitat preferences, which can further serve as a baseline for new ecological hypotheses. This framework has the potential to be applied to a broad range of species, not limited to marine ecosystems.

Keywords: scientific publishing, bibliometrics, sex, diversity, equity, inclusion

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CM 649: Phenological changes in neritic and brackish zooplankton of southeastern Bay of Biscay coastal waters in the last two decades

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Phenology changes are one of the main responses of living organisms to climate change. There are not too many studies of marine zooplankton phenology variations, and even less from those of brackish waters. The aim of this study was to compare the phenological variations during the last two decades in neritic and brackish mesozooplankton from two Basque coast estuaries, the estuaries of Bilbao and Urdaibai (southeastern Bay of Biscay). The estuary of Bilbao became highly polluted and lost a proper brackish community in the inner reaches, whereas in its rehabilitation phase that inner estuary was colonized by several brackish exotic species. In contrast, in the estuary of Urdaibai, due to its hydro-morphological features and lower anthropogenic impact, a lower number of exotic brackish species have settled in its inner reaches. Also, at the community level we observed two shifts, one around 2009-2010 and another one around 2014-2015 in the neritic communities of both estuaries related to temperature variations. Regarding phenology variations, different patterns have been observed in different species. However, in the neritic community of both estuaries the most abundant spring holoplankton species, i.e., *Acartia clausi*, and other ones such as *Oithona similis* showed a delay in their peak abundances from April to May from a colder period between 2009 to 2014 to a period with warmer springs from 2015 to 2020. In contrast, the most abundant summer holoplankton species in the neritic community i.e., *Paracalanus parvus*, showed an advance in their peak abundances in the same time periods in both estuaries. In the brackish community of the inner estuary of Bilbao, the most and second most abundant summer holoplankton species, i.e. the exotic *Acartia tonsa* and *Oithona davisae* have also advanced their peak densities from September to August. No marked changes in phenology have been observed in *A. tonsa* in the estuary of Urdaibai, likely due to the presence of an abundant population of *A. bifilosa* that appears to exert an important competition effect which is partly avoided by *A. tonsa* through a temporal segregation. Another interesting response is the extension of the growing season or the appearance of secondary peaks in some of the periods.

Keywords: zooplankton, phenology, neritic, brackish, Bay of Biscay*, Acartia clausi, Acartia tonsa*

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CM 652: A comparison of acoustic, catch and video data to investigate and monitor grenadier abundance in the Ross Sea

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Since 1997, a longline fishery for toothfish (*Dissostichus* spp.) has operated in the Ross Sea region of Antarctica. A common bycatch of this fishery are grenadiers (*Macrourus* spp.) which comprise the most common prey item of toothfish in this region. Grenadiers are known to be long-lived and slow growing; developing monitoring tools is required to assess their abundance and to detect potential changes to the ecosystem due to fishing. Here we combine and contrast acoustic and catch-effort data from three New Zealand commercial longline vessels with acoustic, catch (research trawl), and Deep Towed Imaging System (DTIS) video still data collected during research voyages to the Ross Sea region onboard RV *Tangaroa*. Preliminary findings indicate that while acoustic data quality from commercial vessels can be low compared with that from research vessels, putative grenadier single-target marks close to the seafloor are coherent with those identified onboard RV *Tangaroa*. We identified a size selectivity between the different monitoring tools; while videos appear to monitor small grenadiers (average total length ± SD: 29.9 ± 16.9 cm), longline catches sample larger individuals (59.3 ± 11.4 cm), bottom trawls detect fish of intermediate sizes (48.3 ± 18.8 cm). Using target strengths from single target tracks we derived length estimates for acoustically identified fish from commercial and research data which seem to give a realistic and broader size class estimate of fish in the water column (*preliminary estimates*: 48.2 ± 20.7 cm and 56. 2 ± 26.3 cm, respectively). This has important implications for the interpretation of fishery and research data to monitor the abundance and biomass of grenadiers in the Ross Sea region.

Keywords: Macrourids, toothfish, single-target detection, image analysis, longlines

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