

Theme session K

Small-Scale fisheries under
global change – threats and
opportunities



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Theme session Report

Small-Scale fisheries under global change – threats and opportunities

Conveners: Heike Schwermer (Germany), Steffen Funk (Germany), Camilla Sguotti (Italy)

Background

Small-scale fisheries (SSF) are not only important for food production but also for local economy and culture. Climate change is one of the biggest challenges for SSF because it causes changes ecosystem functioning and fish stock productivity. But SSF are also increasingly in competition with renewable energy production and environmental conservation as well as tourism. Furthermore, global crises such as the present global energy shortage are threatening the profitability of SSF. As a consequence, SSF are facing structural changes with immense economic and social consequences for local fishing communities along the coast.

The Western Baltic Sea is a textbook example on how overfishing in combination with climate change can cause the collapse of an entire fishery. Drastic declines in stock sizes of the main target species cod and herring resulted in strong quota cuts inducing negative runaway dynamics including declining revenues, exits from the fisheries business, collapses of cooperative structures and thus loss of local infrastructure for the remaining fishers. Urgently, strategies need to be developed to adapt the fishery to the effects of climate change such as lowered target species productivity and other ecosystem changes. Importantly, policy instruments need to be developed and implemented that help transforming the SSF and its social-ecological system into a sustainable future, a task that is likely required in many other coastal regions.

The aim of the session was to explore the effects of global changes on SSF from a multi-layered environmental, economic, and social perspective as a basis for developing ways for a transition into a sustainable future. The session intends also to promote a critical debate on the multiple challenges and opportunities of ensuring healthy and resilient fish communities and their small-scale fisheries, especially in the face of continuing climate change. Results of the session's contributions will be instrumental for decision-makers at the local, national, and international levels that need to address key issues related to SSF, helping to protect a sector rich in culture and tradition in a long-term perspective.

Session summary

To ensure that all participants have a basic understanding of the small-scale fisheries sector, Session K was opened by asking all participants on “How are small-scale fisheries defined and characterized?”. Five different categories have been identified: **i. ecology** (e.g., dependent on species seasonality (Mexico)), **ii. culture** (e.g., traditional fishing craft (Oman), strongly cultural related (UK, France, Spain, Ireland), fishing communities (Germany, North Sea), biographical heritage (Germany), long fishing tradition (global)), **iii. operating area** (e.g., 500km coastline (Germany, North Sea), lagoon coastal zone (Italy)); **iv. fleet characteristics** (e.g., traps, set nets, seines, drift net, hand pole lines, dredges (North Sea), act as a fishing unit (no big companies), small-vessel size (Oman, Germany), fyke net (Italy, Venice lagoon), beam trawler (Germany), mostly passive gear, gillnet, fyke net etc. (Baltic Sea), traps, gillnet (Spain). From this it follows, that small-scale fishery is a highly diverse sector including local, regional, and national differences. These are least based, for example, on the operating area and thus the fishing gear which has been used.

Furthermore, challenges small-scale fisheries are currently facing have been discussed. Pre-identified by the conveners and ranked by all participants, the greatest challenges for the sector are overfishing (55%), climate change (53%), habitat degradation (40%), species shifts (28%), fisheries management regulations (26%), spatial competition (26%), lack of new trainees (21%) and overaged fleet (21%). Further challenges ranked with 17% are unfair competition with big corporations, high operation costs, lack of self-marketing structures and insufficient lobby. A relatively low-ranking score has been attached to eutrophication (15%), invasive species (13%), lack of societal importance (13%), lack of participation in negotiation processes (9%), bureaucracy (9%). These different challenges were further reflected not least in each of the individual presentations and posters representing various case studies around the globe (e.g., Mexico, Oman, Spain, Germany). To explore the root cause of these different challenges, various qualitative (e.g., interviews) as well as quantitative approaches such as a climate risk assessment have been applied.

Drawing on this great variety of talk and posters represented, a closing discussion was held regarding possible solutions and/or ways of adaptation enabling progress towards a sustainable future for small-scale fisheries around the globe. It was pointed out that, first and foremost, more attention should be paid to the great diversity of small-scale fisheries, including their role as "sentinels of the seas", as well as their role within (local) communities/societies. In addition, some participants noted the need to strengthen the collaboration between the SSF and other stakeholders, including science, giving greater recognition to the local ecological knowledge of fishers. To provide a platform for further discussion and insights, participants were invited to a 2-hour follow-up discussion on Wednesday at the ICES ASC.

We would like to thank all presenters as well as participants for their insights, knowledge and discussions.

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CM 101: Small-scale fisheries cultural services value in European Atlantic area coastal communities

Castilla-Espino D.¹, García-del-Hoyo J.J., Murillas A., García-de-la-Fuente L., Curtin R., Muench A., Sousa I.

Small-scale fishing (SSF) has turned into something more than a mere provider of fish in many coastal communities with a long historical fishing activity that marked the lives of their inhabitants. It is relevant to account cultural services as components of value given their important socio-economic bargain. The consideration of these values is an additional argument to preserve SSF and avoid misleading policy-maker decisions for its management.

This research is aimed at use and non-use valuation of cultural services of SSF through heritage in Europe Atlantic area coastal communities using contingent valuation method. This research also insights on the factors that explain willingness to pay (WTP) for conserving and preserving SSF cultural heritage using econometric modelling.

Valuation estimates showed evidence that: (1) use value per visit of heritage elements involving intangible cultural heritage is generally more valued than tangible cultural heritage, (2) mean use value per visit of intangible cultural heritage elements considered exceeds 13PPP€ (power purchasing parity euros) per visit in all cases representing a potential source of revenues for coastal communities, and (3) annual existence and bequest values of different traditional craftsmanship and SSF is approximately 78PPP€ in mean, being an important source of identity of coastal communities. The value of cultural services related to SSF of them is estimated to be of 2.5M PPP€ per year in mean for Spain, Portugal, United Kingdom, and Ireland involving most Atlantic coast of Europe.

Evidence allows to conclude that (1) protest responses to WTP for SSF heritage is explained by age, the visit of the heritage site during the COVID pandemic, and labor situation; (2) household's rent is not a determinant of WTP, in general other factors/variables being more relevant in most of the cases; (3) linkages of household to fishing sector are in some cases relevant with a positive impact in WTP; that (4) education of the respondent also plays an important role in WTP value; and finally (5) sex and nationality seem to be relevant only in some cases.

Results incorporated in this research received funding from the European Union's Interreg Atlantic Area European Regional Development Fund in the framework of CABFishMAN project (EAPA_134/2018).

Keywords: Atlantic, Europe, valuation, cultural services, small-scale fisheries

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CM 110: The role of climate change and socio-economic factors for multiple tipping points in the small-scale herring fishery in the Western Baltic, 1200-1600

Rudi Voss^{1,2}, Marco Scotti, Oliver Lehmann, Jörn O. Schmidt, Daniel Okamoto, Patrick Polte, Kira Lancker

The fishery for autumn-spawning herring in the Western Baltic Sea has a long history. In the late Medieval (years 1200-1600) it was one of the most important fisheries in the world, with a peak output of up to 60.000 tons per year. Salted herring became one of the most important commodities in northern Europe. Still, this activity qualified as a typical small-scale and coastal fishery, carried out mainly by amateurs (farmers, after the work on the fields was done) with simple means. Using available direct and indirect catch data as well as context information we constructed a 450-year catch time-series. This catch time-series could be classified into four periods delimited by three tipping points: (i) expansion, (ii) stagnation, (iii) boom phase, and (iv) collapse. We identified the most relevant factors within the socio-ecological system (SES) of that fishery, which contributed to changes of the catch dynamics, including climate variability. Expert understanding of the SES system in its historic context was then used to construct a qualitative loop model, and to characterize the direct positive or negative links between these variables, without needing to quantify the intensity. Results confirmed that the combined effect of climate change and socio-economic and political factors caused the tipping of the SES, and finally the complete collapse of the fishery. Socio-economic factors were even more important as compared to climate change. Press perturbation analysis allowed understanding how perturbations affected the variable equilibrium in the SES. The still significant role of climate changes for the fate of this iconic fishery was further proven by applying a new bio-economic stock assessment method (BESA), which uses a combination of catch and price data to analyze stock characteristics and reference points.

Our analysis suggests that presently the small-scale Western Baltic fishery is in a comparable situation to this historic example, being threatened by climate change in combination with unfavorable socio-economic factors. However, today management might act to adapt and/or dampen socio-economic pressures, so that a back-shift might still be possible if the fish stocks recover. To preserve this option, stock recovery, based on ecosystem-based fisheries management, should be the top priority.

Keywords: Small-scale fishery, herring, Western Baltic, qualitative loop analysis, climate change, tipping points, SES, historic analysis

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CM 112: A climate change risk assessment for small-scale fishing fleets and fishery-dependent coastal communities in Oman

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The Sultanate of Oman is one of the largest fish producers in the Middle East region. Fisheries have been proposed as one of the five sectors that can help drive diversification of the country's economy (away from oil), with ambitious investment plans amounting to US\$ 2.5 billion. However, modelling studies suggest that small-scale fisheries in Oman may be especially vulnerable to future climate change. In this study, we describe a Climate Risk Assessment (CRA) that was carried out to determine which of 49 fishing fleets and 30 coastal wilayats (districts), might be most 'at risk' due to climate change impacts. Following an approach pioneered by the UN Intergovernmental Panel on Climate Change (IPCC), 'Risk' [R] is considered as being the combined product of: [H] meteorological hazard; [S] species sensitivity; [E] fisheries exposure, and [V] socio-economic vulnerability. The analysis considered the thermal preferences of 150 key fishery species, as well as catch diversity and dominance, revenue per crew member, fisheries landings (value) per km coastline, average household income and income inequality. Overall, the four fishing fleets that emerged as being most 'at risk' from future climate change were all dhow fleets, using either fish traps (FT) or hand and troll line (HL&TL) in Al Batinah and Muscat Governorate. The four coastal wilayats identified as being most 'at risk' were Ja'alan Banī Bū Hassan, Salālah, Mutrah and Al-Jāzer (respectively), but for very contrasting reasons. Practical intervention options need to take account of differing risk profiles if they are to be effective in enhancing resilience.

Keywords: climate change, risk, resilience, vulnerability

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CM 116: How much is the Fish? Adopting an ego-network lens to reconstruct historic seafood trade networks in small-scale fisheries

Rudi Voss^{1,2}, Rudolf Forster, Lotta Clara Kluger

Ecological-environmental crises affecting fisheries social-ecological systems have existed throughout the time, but are now, in the light of ongoing climate change, more pressing than ever. Reduced stock productivity and changes in the distribution of major target species are examples of challenges which strongly impact the small-scale fishery. A textbook example is the Western Baltic Sea, where recent decline in productivity, stock size, and related catch options of the major target species cod and herring have put small-scale fishery to the edge of collapse.

In times of crisis, adaptability is vital to reduce (climate) vulnerability. One important adaptation strategy of small-scale fishers around the world might be individual mobility – moving towards a different place in the search for (alternative) work –as to cope with sudden and gradual changes in resource abundances. We adopt the lens of ego-networks to reconstruct historic seafood trade networks that emerged after the move: with decline of plaice in the Western Baltic (an ecological crisis) and amid the risks of food security during the ongoing First World War (a social crisis), a group of fishers (from Eckernförde, Western Baltic Sea, Germany) took the risk to forage in distant waters (Fehmarn). Using detailed diary material from 1918, we analyse the emergence of informal trade networks in the place of destination, shaping a mutually enriching momentum – a flourishing barter network – to confront the crises of that time. This work highlights the role of social networks for translocal mobility and discusses the utility to embrace past coping mechanisms of small-scale fisheries for shaping adaptation strategies to current social-ecological crises and climate change in general.

Keywords: Small-scale fishery, Western Baltic, ego networks, diary, SES, historic analysis, trade networks

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CM 120: Managing small scale fisheries in the Red Sea - conflict with tourism and limited resources

Rehab Farouk, Keith Farnsworth

We report results of a survey of small-scale fisheries in the Egyptian Red Sea, which is both a tourism hotspot and a resource for artisan and subsistence fishers. Red Sea artisan fishers are subject to a seasonal closure that affects their precarious income, and the fishery is thought to be declining. Separate regulation of 'Tourist' fishing boats is said to be widely abused. Resources for monitoring and management are strongly constrained by budget and availability of technology.

We are exploring the scope for building confidence and a more science-based, equitable and effective management system that includes co-management and co-operation through the fisheries co-operatives, making use of appropriate data limited stock assessment methods. To that end, we conducted a survey of artisan fishers at Egyptian Red Sea ports, collating basic fisheries, social and economic data and gathering fisher's opinions and attitudes. 51% of respondents wanted to discontinue fishing but had no other source of income. Income from fishing was found to be marginal (disposable income ≤ 0) for 87% of respondents. 83% assessed their CPUE and income to have declined over the past 10 years and 76% were not expecting to pass their trade onto the next generation.

16% identified the seasonal closure as the main threat to the viability of their fishery, though 61% blamed over-fishing. There is evidence that the seasonal closures have reduced trust in regulatory authorities and artisan fishers seem to resent the tourist fishers appearing to be regulated less strenuously. 80% believed the seasonal closure failed to protect fish stocks and 58% of those surveyed do not believe that species spawning coincided with the closure. Comparison with published spawning dates for the most relevant species largely confirmed their suspicion. 75% of respondents reported that recreational fisheries (not subject to the seasonal closure) landed substantial quantities of fish.

In the context of very limited fisheries data and management/enforcement resources, these probably declining fisheries, with marginal incomes (worsened by increasing fuel costs and inflation) are in urgent need of effective management. After applying Management Strategy Evaluation (MSE) to investigate the proposed alternatives for the closure, the most efficient approach would be provided to the government fisheries agency for discussion.

Keywords: co-management, small-scale fisheries, fisher knowledge, Egyptian Red Sea

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CM 151: Assessing the impact of the invasive ctenophore *Mnemiopsis leidyi* A. Agassiz 1865 on the artisanal fisheries of the Venice Lagoon: an interdisciplinary approach

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In the last decades, small-scale fisheries (SSFs) all over the world are heavily impacted by global anthropogenic pressures such as climate change and marine invasive species. In the Venice Lagoon, located along the Northern Adriatic Sea coast, SSFs play a fundamental role in the society from an economical and cultural perspective. However, recently, SSFs are threatened by the arrival and the subsequent spread of a highly invasive ctenophore: *Mnemiopsis leidyi*. This ctenophore is a well-known voracious predator that creates massive blooms; small-scale fishers in the Venice Lagoon have started to complain about the large presence of this animal, nonetheless no studies were conducted about its impacts on SSFs and biodiversity in this area.

Here, using a combination of local ecological knowledge, statistical time series analysis, and field sampling, we investigated whether and how the presence of *M. leidyi* has affected SSFs in the Venice Lagoon. We interviewed artisanal fishers using structured interviews to understand when the blooms of *M. leidyi* started in the Lagoon and which was their perception of this species. We also sampled fishers' fyke nets throughout the whole Venice Lagoon in 2020. Finally, we analysed long-term fishery landings in the Lagoon to detect whether changes in landing quantity and composition were observed during the time of the ctenophore invasion. Since the lagoon ecosystem is warming, we also investigated the effects of increasing temperatures on the landings and whether warming could have favoured the expansion of *M. leidyi*. We found that the total landings of the SSFs strongly declined with the blooms, paralleled by an increase in water temperature. Moreover, we detected that the catches of important SSF target species (*Sepia officinalis*, *Zosterisessor ophiocephalus*) were negatively impacted by the blooms, while other species increased with warming (*Carcinus aestuarii*). One of the mechanisms with which *M. leidyi* is impacting SSFs is through the mechanical obstruction of the nets due to the massive blooms. However, additional mechanisms through indirect food-web effects cannot be excluded.

This work is the first demonstration of the impacts of this invasive species on the Venice lagoon fisheries and shows the importance of managing this ctenophore to limit its socio-economic impacts. Understanding and managing the multiple pressures impacting SSFs in the Venice lagoon is crucial to save this lively component of the long-term human-nature relationship in the area and the cultural heritage that these traditional fishing techniques represent.

Keywords: invasive species, local ecological knowledge, time series analysis, temperature, fishery landings

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CM 182: Small-scale fishery mobilities across the West African borderlands in a changing climate

Iddrisu Amadu

Mobility across borders in West Africa is a centuries-old livelihood practice of the Fante fisherfolk from Ghana. These nomadic fishers and fish traders engage in seasonal to permanent migrations both by sea and through land borders to coastal countries mainly in response to the seasonal availability of fish across the Gulf of Guinea and market opportunities for fish trading. But environmental change, especially changes in climatic factors are affecting not only the distribution and seasonal availability of fish but also coastal communities where fisherfolk live. This research, therefore, seeks to first understand the Fante fisherfolk's lived experiences of these changes and also of mobility regimes (border, maritime security measures and fisheries management regulations) and how these shape their fishery practices and im/mobilities. It proceeds to examine the ways particular mobility regimes influence their mobility strategies and how they navigate these regimes in the face of environmental change. From a relational ontology perspective, this research will apply environmental mobilities as an analytic to answer these questions using mobile ethnography, participatory mapping, and cross-sectional surveys. For this presentation, I would focus on preliminary data from observations and scoping interviews conducted in Ghana and Senegal to highlight particular environmental changes and mobility regimes and how the Fante fisherfolk are experiencing them in their im/mobilities in the region.

Keywords: Environmental change; mobility regimes; marine environment; borders; Ghana

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CM 197: CABFishMAN: Conserving Atlantic Biodiversity by Supporting Innovative Small-Scale Fisheries co-Management

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Managing fisheries better, together: CABFishMan project blazed a trail for collaborative, ecosystem-led management of Small-Scale Fisheries (SSF). Innovative tools and new knowledge from the project were set, supporting the facilitation of co-management across the Northeast Atlantic. CABFishMan provided efforts to give stakeholders (fishers, policy makers, NGOs...) the tools to advocate for their fisheries and protect their livelihoods and heritage. Working across the UK, Ireland, Spain, France, and Portugal was sought to work with the SSF sector and facilitate a collaborative approach. CABFishMan worked to address knowledge gaps and develop operational tools for management specific to SSF, although transferable to other inshore fisheries and/or regions outside the Atlantic Area (AA). Using the Northeast Atlantic as a case study, the project explored four key themes to meet emerging needs of the industry: valuing fisheries' cultural heritage, detailed fishing effort maps to support fishing interests within marine spatial planning processes, environmental impacts, and tools for collaborative management. The project also addressed EU Policy and regulatory needs. Especially relevant is the contribution to Common fishery Policy, Art. 2 of Regulation (EU) No 1380/2013 regarding the ecosystem-based fisheries management approach (EBMA) adapted to SSF.

An EBMA requires: (i) focus on maintaining the natural structure and function of ecosystems and their productivity, (ii) incorporate human use and values of ecosystems in managing the resource, (iii) recognize that ecosystems are dynamic and constantly changing, (iv) incorporate a shared vision of all stakeholders and, (iv) scientific knowledge, adapted by continual learning and monitoring. EBMA aims to achieve 'sustainability' in exploiting natural resources reason why CABFishMAN provided knowledge on the effect of SSF activity on the marine and global environment. Moreover, to the most traditional biological variables, impact knowledge is added but also, socio-economic aspects through the monetary assessment of the Ecosystem Services (ES). Employment and income, from the food provisioning ES, provides stakeholders with economic well-being. Furthermore, the nutritional contribution to social well-being is improved. However, there are certain trade-offs, because at the same time, the potential increases of the atmospheric CO₂ concentrations will also expose the whole society to extreme climate events which will produce a reduction of the health and well-being of society. The AA is a region with sizable SSF maintaining strong fish provisioning and cultural services. CABFishMan provides a quantitative assessment of those trade-offs between provisioning and cultural ES, contribution to Climate Change due to the CO₂ emissions and marine impacts associated to SSF.

Keywords: Ecosystem-Based Fisheries Management, Ecosystem Services, SSF Co-Management

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CM 207: Local Ecological Knowledge of SSF fishers in Croatia: socioeconomic factors, support for sustainable management tools, and long-term career prospects

Dražen Cepić¹, Branko Ančić, Mislav Škacan

The importance of diverse epistemologies and the role of knowledge has been well established in fisheries management scholarship. In this paper we contribute to this area of research by analysing Local Ecological Knowledge of Croatian small scale fishers. First, we analyse their perception of the degree of overexploitation of fish species with regard to standard socioeconomic data (targeted species, gear, amount of catch, vessel size and power). Furthermore, we test this with regard to opinions of climate change, and attitudes toward diverse fisheries management tools (no-take zones, closed seasons, greater control of bycatch, VMS). Finally, we explore association between Local Ecological Knowledge and fishers' long term career prospects (e.g. whether they see themselves as fishers in 5 years, whether they want their children to become fishers). Despite the focus on SSF fishers, thanks to the sample which includes both large scale and recreational fishers, we provide a comparative take on diverse fisheries sectors. The analysis is based on the sample of 550 fishers from Croatia, collected as a part of the project "Sustainable fishing: social relations, identity and co-management of Adriatic fishery resources", funded by the Croatian Science Foundation.

Keywords: local ecological knowledge, overfishing, small scale fishers, Croatia, socio-economic factors, fisheries management tools, fishers' career prospects

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CM 208: „Still a certain kind of freedom“-Self-Identity of Fishers in Germany

T. Lasner¹, F. Barz², M. Döring³, K. Gee⁴, A. Kannen⁴, J. Schaper⁴

Fishing as a commercial profession still has the nimbus of being a male world where one of the last traditional interactions with marine wilderness takes places. At the same time, fishers and in particular small-scale fisheries in the North and Baltic Sea currently face many changes and challenges: Climate change, degrading fish stocks, fishing bans in marine protected areas, Brexit, bureaucracy, an overaged fleet, a lack of successors, Covid-19 and increasing spatial competition, e.g., with offshore wind farms, all jeopardize their long-term social and economic viability. While research often focuses on technical and economical dimensions, little is known about the social dimensions of fishing and their influence on the (social) adaptive capacity of small-scale fisheries. Using an open analytical approach based on the Grounded-Theory of Glaser & Strauss (2008), we re-construct the perspectives of fishers on their current practice(s) of fishing and positioning as members of a society. Our analysis is based on a sample of 75 semi-structured interviews conducted between 2017 and 2022 on the German North Sea and Baltic Sea coast with self-employed fishers, vessel owners, CEOs of fishing enterprises, employed fishers, trainee fishers and other sector representatives. Applying three analytical three-steps (open, selective, axial coding) we formulate empirically grounded hypotheses about fishers' self-perception and identity, forms of knowledge adoption and fishers' social adaptive capacity during times of (fundamental) structural change. Our results indicate that the self-identity of fishers is fundamental for their entire lifeworld as professionals. There is little differentiation between work and leisure time. Although freedom is objectively limited by an increasing set of regulations imposed by fisheries management (e.g., quotas, closed areas, closed seasons), it remains as a basic form of life, which is strongly linked to a certain construction of a man-wilderness relationship. The life concept constructed is almost solely male, patrilinear and axiomatic, which means that alternative ways of life or life worlds are not seriously considered in biographical decision-making. Knowledge acquisition within the fishers' community is characterised by different types of knowledge, where practical training and oral communication are valued more highly than other types of knowledge. We conclude that the scientific and political support for transforming fisheries due to unavoidable structural changes in the North and Baltic Sea needs to seriously take the social dimension of fishers into consideration to avoid mismatches between the implementation of new management measures and traditional practices and identity of small-scale fishers.

Keywords: small-scale fisheries, self-Identity, adaptive capacity, social science research, Baltic Sea, North Sea

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CM 231: Developing a fishing effort indicator based on VMS data for the Scottish Brown Crab (*Cancer pagurus*) trap fishery

Carlos Mesquita¹, Helen Dobby, Catherine S. Jones, Graham J. Pierce

Information on fishing effort by vessels fishing with traps in Scotland is limited. The recent availability of VMS data combined with landings information from vessel logbooks provides new opportunities to describe the spatial distribution of effort and catch for small-scale and data-limited fisheries. This study evaluates the use of VMS data applied to trap fisheries and develops an indicator of fishing effort for the offshore brown crab fishery in Scotland. The main objectives were to: (i) identify fishing activity from VMS records by estimating an appropriate speed criterion for trap vessels; (ii) evaluate the suitability of VMS data (2 h interval); (iii) describe the relationship between the number of trap hauls and hours fishing; (iv) estimate fishing effort (hours fished) and describe the spatial distribution of the Scottish offshore brown crab fishery. VMS data seem to provide a valid basis for calculating effort (time fishing), assuming that fishing can be distinguished from other activities by selecting an appropriate speed range. Comparisons between high and low temporal resolution data show that the standard 2-hour transmission interval of VMS data introduces substantial uncertainty into effort estimates. Assumptions related to the relationship between fishing time and the number of traps fished, and on assigning catch data to VMS positions, were explored. The method proposed may be used to identify and inform managers of the main fishing areas for vessels targeting brown crab and can also be applied to fisheries for other data-limited species, provided that VMS or other GPS logger systems are available. The methodology implemented in this study is sensitive to the temporal resolution of the data collection systems. Systems capable of providing higher temporal resolution data would be desirable, to obtain more accurate estimates of fishing effort.

Keywords: brown crab, trap fisheries, VMS, fishing effort, spatial distribution, data-limited

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CM 257: Artisanal fishing targets in eastern Atlantic: regional fishing preferences in front of global fish market

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Small-scale fisheries (SSF), exert much higher fishing effort (more fishing days, trips and vessels) than other fisheries but contributing into the fish market with lower landings. They therefore respond to the fish market demands through adapting their fishing habits and possibilities. However, different fishing habits result on regional differences, or adaptations, that remain unknown. This study applies a standardized and comparable approach for the SSF along the Atlantic Arc, where half of the total European SSF fishing effort (fishing days) is exerted and 63% of the total fish caught is landed, with special focus on regional fishing preferences. Spatial differences are observed regarding the fishing effort between countries that base their fisheries on different fishing gears, therefore targeting different species with specific and sometimes even with regional commercial interest. For instance, while Spain contributes with most of the European fishing effort (53%), mainly exerted by seafood fishers on foot, their landings do not reach the 7% of the total European SSF captures in weight; however, bivalves and barnacles coming from such activity mean the 90% of the total production across the European Atlantic fishery. In contrast, pots and otter trawls from the United Kingdom and Ireland spend around the 10% of the total fishing days of the European SSF targeting crabs (96% of the total captures) and Norway lobsters (85% of captures), respectively; these two species accumulate >18% of all European SSF landings. In France, dredgers targeting scallops are concentrated in the northern French coast, whereas the SSF activity in the Bay of Biscay is mainly for algae. Regarding pelagic species, sardine, Atlantic Chub mackerel, anchovy and horse mackerel are the most common, targeted by purse seiners especially in Portugal (30% of their national landings), whereas the Atlantic mackerel is mainly captured by handlines in Spain and UK, and by otter trawls in France. Accordingly, future regional SSF management should consider two-way approaches: in one side, the effort and landings of each regional SSF covering local fish demands, and the landings fraction exported to other countries. A compromise between such two fractions might help towards an effective development of SSF in a context of future environmental changes affecting targeted fish stocks. The key question is to know the SSF resilience by considering if local consumption from householders could be satisfied with the local production from SSF in a context where rarely SSF production is exported.

Keywords: fishing effort, fishing gear, target species, landing value, fish consumption, spatial variation

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CM 263: Leverage points for sustainable small-scale fisheries

Maraja Riechers, Fanny Barz

Sustainability challenges threaten the integrity of coastal ecosystems worldwide. Anthropogenic climate change leads to higher temperatures, rising sea levels, ocean acidification, and an increase in extreme weather events. Coasts and oceans face pollution from nutrients, plastics, and other contaminants and changing land-use in parts of coastal areas leads to the destruction of ecosystems and biodiversity loss. These ongoing trends can cause irreversible impacts on coastal social-ecological systems – and especially on small-scale fisheries. One hypothesis is that interventions for sustainability have been primarily focused on “easy to fix” aspects and short-term interventions, which achieve a quicker but less transformative result. Such a focus on “quick-fixes” prevents transformative systemic shifts. Yet, strategies to address the current unsustainable trajectory of our oceans require deep transformations. The leverage points perspective can support efforts for transformative change by motivating more research combining empirical and theoretical frameworks to understand the dynamics of complex social-ecological systems. Drawing on seminal work by Donella Meadows, this talk presents a leverage points perspective as a hitherto under-recognized heuristic and practical tool for marine science. A leverage points perspective focuses on places to intervene in complex systems to bring about transformative change and recognizes increasingly influential leverage points relating to changes in parameters, feedbacks, system design, and the intent encapsulated by a given system. We discuss four key advantages of a leverage points perspective: (i) bridging causal and teleological explanations of system change (i.e., change as arising from variables influencing one another, but also from how human intent shapes the trajectory of a system); (ii) recognising influential, “deep” leverage points – places at which interventions are difficult but likely to yield truly transformative change; (iii) enabling the examination of interactions between shallow and deep system changes – sometimes, relatively superficial interventions may pave the way for deeper changes, while at other times, deeper changes may be required for superficial interventions to work; (iv) providing a common entry point for academics from different disciplines and other societal stakeholders to work together. Drawing on these strengths could initiate a new stream of marine science and may yield both practical and theoretical advances. We exemplify the leverage points perspective with the example of the small-scale fisheries of the western Baltic and would like to use the expertise within your session to critically reflect on the usefulness of such a system-thinking approach.

Keywords: Chains of leverage, leverage points, sustainability transformation, Western Baltic Sea

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CM 285: Climate change impacts on marine food systems: a local perspective of Mexican fishing communities

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Climate-related impacts on the ocean pose a growing risk to the livelihoods, food security, and culture of coastal communities. Artisanal or small-scale fishers in the Global South, including Mexico, are particularly vulnerable. Fishers' local knowledge of topics, including sociocultural structures and natural resource management, has proven to be extensive and valuable in assessing changes in marine ecosystems. However, little focus has been placed on climate-related impacts on the socio-ecological relationships that influence communities' food security and health. Thus, this study addresses the primary question of how climate-related impacts on marine food systems affect Mexican fishing communities' livelihoods, food security, and culture.

Through community-based research, this study aims to explore and characterise the socio-ecological factors of the marine food systems of Mexican fishing communities affected by climate-related impacts. Privileging and recognising the voices and experiences of Mexican fishers, this project: (1) Documents the diversity of lived experiences of climate change impacts on marine food systems and (2) Characterises climate-impacted socio-ecological factors that influence how fishing communities respond to the potential nutritional stressors.

In partnership with two fishing communities in the Northwest Mexican Pacific, we use an integrative qualitative approach to document fishers' local knowledge of climate change, food security, health, and well-being. We integrate and analyse co-produced knowledge from unstructured interviews, open-ended filmed interviews, and a photo-elicitation approach to capture fishers' perspectives, thoughts, and feelings. In our initial discussion with both community leaders, we found that while they recognise climate change as a threat to certain marine ecosystem goods and services (i.e. economics and coastal protection), other factors such as food security, health, and cultural goods have been considered less often. We will present an analysis of the conversations and photographs of the communities' relationships with the ocean, including cultural identity, food security, health, and well-being. Specifically, we will show and discuss the most overarching themes and subthemes, together with an inductive analysis of the specific emotions felt and expressed by participants.

The results of this study describe the foundational elements of fishers' well-being in the context of climate change. Climate-related impacts on the marine food system can result in complex physical and emotional responses, from nutritional stressors to cultural and identity loss. Therefore, the findings emphasise the significance of lived experiences and provide critical insight into the threats and opportunities of the socio-ecological risks faced by small-scale fisheries under climate change.

Keywords: Mexican fisheries, socioecology, climate change, food security, well-being, community-based research, co-production, coastal communities

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CM 393: Small-scale fishery mobilities across the West African borderlands in a changing climate

Artūras Razinkovas-Baziukas, Vaidotas Andrašunas, Edgaras Ivanauskas

The Curonian Lagoon, the largest coastal lagoon in Eurasia, has a traditionally developed fisheries and associated fisheries infrastructure, including fishing enterprises, fleet, and fishing gear. The Curonian Lagoon region underwent major geopolitical changes in the 20th century and corresponding changes in the way fisheries are organised. The peculiarities of fisheries organisation, changes in the structure and capacity of the fishery base have had a significant impact on both fish stocks and their management. The hydrological, hydrochemical and hydrobiological conditions relevant for most of the fish species in the Curonian Lagoon have not changed significantly over in the 20th century, there have been significant quantitative and qualitative changes in the fish community. Most authors consider fisheries to be a key factor in shaping the fish communities in the Curonian Lagoon, however the recent climatic trends indicate a clear shift in both temperature and hydraulic regime of the lagoon, partially affected by other anthropogenic pressures as the artificial modification of the Klaipėda channel connecting the Curonian lagoon to the Baltic Sea.

We have collated the results of data based BBN analysis relating the fish catches and CPUE with winter and summer water temperatures, salinity and fishing effort with downscaled climatic scenarios for the Nemunas-River-Curonian lagoon system using the SHYFEM model (Idzelyte et al. in press) to have an outlook at future fishery perspective. Preliminary results demonstrate the dominating influence of fishery efforts on commercial fish stocks as compared to the temperature and salinity projections. However, following the BBN analysis results the increasing temperatures are expected to be favorable for two of main commercial fish stocks, while the foreseen salinity changes are not significant to affect the fish communities. The seasonal regulation of gear in small-scale fishery could have a significant effect on fish populations.

Keywords: small-scale fishery, coastal lagoon, climate change

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CM 399: Baltic Fishers' Agency during times of social-ecological Transformations

Marjan Braun¹, Fanny Barz², Sophia Kochalski³, Maraja Riechers²

The German small-scale fishery in the Baltic Sea is facing one of its most severe crisis' due to several complex interrelated social-ecological changes. Most lately, catch quotas have been lowered to an extent that allows no further directed fishing of the main target species, cod, and herring. This study examines how changes in the social-ecological system influence both livelihoods and the sense of agency of small-scale Baltic fishers in Mecklenburg-Western Pomerania. It is investigated as to what extent diminished agency constrains sustainable livelihoods and how small-scale Baltic fishers can be supported to fulfil their roles as agents capable of freely determining their goals and achieving them, without undermining their livelihoods. Biographic interviews were conducted with five small scale fishers and analysed, using the method of thematic qualitative text analysis. Incorporating sequences into a recently published framework to operationalise agency, this study shows that changes in the social-ecological system diminish the sense of agency of small-scale Baltic fishers. Their ability to be agents of their wellbeing and stewards of their environment decreases, which undermines their livelihoods. Short term and low threshold measures that reduce the risk of livelihood failure include the exploration of the potential to market catches as regional products. Long term and profound measures should instead encourage and support fishers to act politically and focus on co-learning and co-managing strategies to enhance the effectiveness of fisheries management.

Keywords: small-scale fisheries, sustainable livelihoods, agency

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CM 422: Implications of water use beyond the water basin: the telecoupling of terrestrial agriculture and a marine fishery

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Climate change is decreasing water supplies globally while water demand is rising. Water management has shifted towards practices that improve water efficiency balanced within equitable distribution within a water basin. However, links between geographically separated socio-ecological systems, known as telecoupling, can obscure the consequences of water use. This study focuses on a telecoupling with terrestrial water use with small-scale marine fishery in the Gulf of Cádiz (SW Spain). We develop a case study using multidecadal time series of the Guadalquivir river's hydrology, its estuarine community, and the European anchovy (*Engraulis encrasicolus*) fishery in the Gulf of Cadiz. A Long Term Ecological Research Program -GUADALQUIVIR-LTER 1997-2023- has been monitoring the Guadalquivir estuary community - meso- and macro- zooplankton, fish juveniles and decapod crustaceans- monthly since June 1997 to present. As an important nursery area for many marine species from the Gulf of Cadiz, understanding how abiotic and biotic factors determine zooplankton community (prey) and recruitment (predators) variability is essential for small-scale fisheries depending on this key nursery area. Water extracted to irrigate crops decreases the river's flow and seasonality. Anchovies use the estuary as a nursery before recruiting to the ocean, where they are harvested. Anchovy recruitment improves when estuary hydrology matches the Guadalquivir River's historical hydrology (i.e., high discharge and seasonality). By developing a heuristic socio-ecological model, we explore the outcomes of a water policy's objective on the telecoupled socio-ecological systems. A business as usual model focusing on the economic performance of agriculture in the water basin and leads increasing water use. Due to improving water efficiency incentivising more water use and agricultural expansion, to the demonstrate of an external marine fishery yields. A mixed economy requires balancing the benefits to well being derived from marine fisheries and agriculture. In summary, estuaries are critical drivers of marine systems, yet, upriver processes drive estuaries dynamics. Thus, marine-terrestrial telecoupling suggest that the domain of water policy and management will need to be extended beyond the water basin to protect marine ecosystems and coastal communities. Estuaries as socio-ecological telecouplers and their correct management is key for small-scale fisheries future.

Keywords: nursery area, small-scale fishery, climate change, telecoupling, water management, ecosystem based management

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CM 437: Social-ecological dynamics in small-scale sea urchin fisheries: an interdisciplinary glimpse into complex human-nature interactions

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Small-scale fisheries (SSF) provide crucial nutrition and livelihood to coastal communities worldwide, but SSF seafood systems are increasingly under pressure from multiple, combined pressures including climate change, overfishing and habitat degradation. At the same time, SSF value chains are often extremely complex and diverse, with a wide range of stakeholders acting at multiple scales. Understanding complex human-nature interactions as to derive fruitful management actions in times of progressing change is thus obligate.

In Mediterranean coastal areas, the purple sea urchin *Paracentrotus lividus* constitutes a locally praised delicacy. Where harvested, *P. lividus* has undergone overfishing and local collapses. In other areas, where the species is not traditionally consumed, overfishing of its main predators, key commercial fish species such as seabreams, leads to predator release and sea urchin increase. This in turn causes overgrazing from sea urchin on macroalgal forests, reducing biodiversity and driving habitat degradation. These two contrasting conditions can be observed in Catalonia (Spain), where the reduction of seabreams is leading to increase of sea urchin populations and causing widespread barrens; and Sardinia (Italy), where intensive sea urchin harvesting resulted in the collapse of local populations and of the related fisheries.

We present here the results of an interdisciplinary endeavour to capture those two very different case studies through qualitative network modelling. By embracing ecological-environmental dynamics (trophic and non-trophic interactions, environmental change) and human drivers (fishing and its value chain, tourism), we connect this work to the ongoing discourse on social-ecological network analysis. Understanding the different dynamics in the case studies as a first step will then be used to engage in transdisciplinary discussions with stakeholders as to understand adaptation necessities and possibilities, and to co-design management options that help guiding these important social-ecological settings into a sustainable future.

Keywords: sea urchin, kelp forest, Mediterranean Sea, network analysis, social-ecological system, small scale fisheries, fisheries management, regime shifts

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CM 465: Enlightening climate risk assessments with local participatory approaches

Ignacio Pita¹, David Mouillot, Adrien Chevallier, Clea Abello, Fabien Moullec, Yunne Shin

Climate change is rapidly becoming one of the biggest threats to marine life, and its impacts have the potential to strongly affect fisheries upon which millions of people rely. This is particularly crucial for the Mediterranean Sea, which is one of the world's biodiversity hotspots, one of the world's most overfished regions, and where temperatures are rising 25% more than in the rest of the ocean on average. To have a better understanding of the current risk for its fisheries we calculated a vulnerability index for 100 species that compose 95% of the Mediterranean fisheries catches, following a trait-based approach. Through the Climate Risk Assessment methodology (CRA) we subsequently assessed all Mediterranean fisheries' risk to climate change based on their catch composition. This work allowed to contrast the southern and northern Mediterranean regions but has shown its limits by only relying on macro indicators, particularly when trying to quantify fisheries' adaptive capacity. Having an accurate understanding of local efforts in management and socioeconomic assets is essential to reliably address the adaptive capacity of a community. To address these gaps in knowledge, participatory approaches can help to integrate local knowledge and co-construct adaptive responses while considering scientific assessments and projections, as well as local perspectives on feasibility, risks, and benefits. With these objectives in mind, we conducted participatory workshops with fisheries' stakeholders in France and Tunisia (case studies in the northern and southern Mediterranean Sea, respectively). Their purpose was to co-construct a semistructured interview guide that then allowed us to collate further information with a significant number of direct fishers' interviews in the field. Through macro and local approaches that complement each other, we can more reliably determine the main challenges and risks faced by Mediterranean fisheries, their main concerns, and their current capacity to overcome them.

Keywords: Mediterranean, fisheries, Climate Risk Assessment, participatory approaches, adaptive capacity

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CM 485: Following the trace of global change effects on fisheries: **The Canary Islands as a changeover boundary between marine bioregions**

Pablo Martín-Sosa¹, Jesús M. Falcón, S. Jiménez, A. Jurado-Ruzafa, P. Vélez-Belchí, C. Dorta, A. Brito

Marine fishes may respond to ocean warming through range expansion, generally to higher latitudes and deeper waters. Consequently, fisheries should be affected by 'tropicalization' of species. Other than ocean warming, global change also brings about species shifts and introductions via vectors as oil platforms, favouring the presence in the catch of new introduced species typical from the areas of origin of these transport vectors (usually tropical areas).

Citizen and scientific observation networks are providing a great amount of information confirming the presence of new species during the last decades in The Canary Islands, most of them thermophilic species of tropical origin, and some of them having become of common presence in the archipelago.

Thermophilic species recorded in the Canaries seem to respond to a natural process of geographic spreading to higher latitudes, across the biogeographic border located at Cabo Blanco (Mauritania, African coast), where a thermic discontinuity causes a change between warm-temperate and tropical faunas. At the same time, water temperature in The Canary Islands has a longitudinal gradient ought to the cold water upwelling in the close African coast, being the water temperature lower in the eastern islands and higher in the western ones. This fact also influences water warming effects on species along the archipelago.

After 15 years of official landing records with enough reliability, this time series is used to test if global change has had an effect on The Canary Island fisheries from the point of view of particular species landing trends along the series, related to water temperature. We also test the degree of influence of the longitudinal gradient on this species temporal trends.

Several thermophilic species which have been common at The Canary Islands have decreasing trends over the period, but with differences between islands depending on the longitudinal gradient. There are other species which appeared on their own means and have become fisheries resources because they have been benefited by water warming. Other species of this kind have not yet become as common as to produce a fishing yield, and they are not registered on the landing spots although the number of observations increase over time. The same happens to some introduced species with a great increase of appearances but not yet thrown back in landings registry.

Another analysed phenomenon is that one of 'meridionalization', being the benefit of native thermophilic species by water warming, with increases in abundance in the whole archipelago, sometimes appearing for the first time in eastern islands with colder waters.

Keywords: artisanal fisheries, global change, species shifts, marine biogeography

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CM 511: Characterizing the scale of Pacific halibut spatial usage with respect to current management practice in the Bering Sea

Austin Flanigan¹, Julie K. Nielsen, Tim Loher, Andrew C. Seitz

The Bering Sea is a sub-arctic region that is experiencing rapid environmental change, with warming conditions resulting in shifts in the fish species assemblage. These changes have impacts on Alaska Natives and rural residents that rely on small scale fisheries and subsistence harvests. However, while some traditional resources are disappearing, the Pacific halibut has been increasing in abundance. This provides a valuable opportunity that requires informed management to maximize potential fishery benefits. One step towards responsible management is understanding movements and spatial dynamics: Pacific halibut are known to forage in relatively shallow waters during the summer months and spawn in deeper waters during the winter, but knowledge of their spatial dynamics in the Bering Sea is limited. As such, a pop-up satellite tagging study was initiated to obtain spatial dynamic information, where Pacific halibut were tagged at five locations across the Bering Sea. Location, depth, and light data recovered from these tags were analyzed using Hidden-Markov modeling techniques and used to evaluate movement and behavior throughout the region. Results suggest fish display fidelity to feeding grounds, with individuals returning to their tagging location across years. During the winter spawning period, all Pacific halibut tagged on the inner shelf exhibited migratory movements to the shelf edge, while most fish tagged near the shelf edge displayed resident behavior throughout the year. However, a small proportion of fish inhabiting the shelf edge were seen making relatively large-scale movements along the shelf edge, moving in a southeasterly direction. These findings suggest that Pacific halibut display contingent behavior, during which groups of individuals show fidelity to spatially distinct foraging areas across years but occupy common spawning grounds. Additionally, Pacific halibut that occupy the inner shelf appear to be migratory foragers, moving long distances from winter shelf edge spawning habitat to reach their summer foraging grounds, while others remain near the shelf edge throughout the entire year. With commercial fishing occurring during the summer when Pacific halibut are segregated into foraging contingents, and current management treating the Bering Sea as a singular stock, this study suggest there is the potential to overharvest localized contingents, resulting in the overexploitation of small-scale fisheries. As such, Pacific halibut may require spatially explicit management within the Bering Sea.

Keywords: contingent, climate change, site fidelity, Pacific halibut

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CM 522: Governing European small-scale fisheries under climate change conditions – a political science perspective

Paul Müller

Climate Change forces a fundamental re-evaluation of the rational behind the European fisheries governance structure and the way knowledge about marine Socio-Ecological Systems (SES) is produced. Small-scale fisheries face numerous threats through climate change uncertainties that are often rooted in the Common Fisheries Policy's (CFP) structure. In order to analyze the adaptation potentials of political governance structures, the following research question is addressed: What are the systemic constraints of the European small-scale fisheries governance structure under climate change conditions? Three analytical elements are crucial for studying the European political governance system and analyzing its adaptation potentials: polity (institutional sphere), policy (content sphere) and politics (negotiation sphere). Over thirty semi-structured interviews with actors involved in the German Brown Shrimp fishery were done – from politicians to fishermen – and qualitatively analyzed, as well as three focus groups with fishermen and an in-depth document analysis.

The EU's fisheries *polity* is not designed to deal with the uncertainty and non-linear behavior that characterizes climate change and with which it will be confronted – either directly or indirectly through mitigation measures. Its *policy* structure is designed with the large-scale commodification of fisheries resources at its core, which favors large-scale when compared to small-scale fishing operations. A path dependency the European fisheries policy has followed since the outset of the CFP. The EU's *politics* often does not meaningfully include small-scale fishing actors when negotiating new policies, e.g. wind parks. Moving beyond a mere normative conceptualisation of inclusive governance is necessary to ensure the ecological as well as social sustainability of fisheries in the European Union. As complex adaptive systems, fisheries are characterized by uncertainty, non-linear behavior, path dependencies and emergent phenomena. Such a systems understanding has to be reflected in the political governance system if European fisheries are to be able to adapt to future changes.

However, simply producing more knowledge about fisheries will not be the solution. What is needed is a shift from producing more knowledge about the system, to changing the rational of the governance system. The *Crangon crangon* fisheries of the North Sea are an example of a non-quota species fishery that is undergoing drastic changes. The current non-quota species system can incentivise overcapacities through unregulated harvesting quantities, which, coupled with limited biological information and climate change uncertainty, pose a serious threat. The first indicators that compounding effects are negatively influencing *Crangon c.* fisheries may already be visible and show that a change of the fisheries system rather than just more knowledge about it is necessary. Analyzing the political structures that are underlying the fisheries system is necessary to create a framework in which small-scale fisheries experience opportunities in a continuously changing world.

Keywords: small-scale fisheries, governance, climate change, complex systems, socio-ecological systems

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CM 528: Diversity, abundance, and size composition of pelagic teleost species from the Azores assessed through commercial landings data

Osman Crespo¹, Wendell Medeiros-Leal, Bruno Mourato, Hélder Silva, Régis Santos

Fishing has always been an important cultural and economic activity in the Azores, being a typically artisanal and small-scale fleet with the majority of the vessels measuring less than 12 m, operating near the islands and seamounts, and using basically hooks and lines. The pelagic teleost is one of the main groups of fish caught in the Azores archipelago, mainly through the tuna pole-and-line fishery, but also with a relevant role from the pelagic long-line fleet and the artisanal multispecies local fisheries. This study aims to analyze commercial landing data (catch, effort, and size) from the Azorean fleet (Auctions service of the Azores – LOTAÇOR/OKEANOSUAc databases) for pelagic teleost species caught over the past 40 years (1982 to 2021) in the region to describe their distribution and evaluate temporal changes in their observed abundance and length composition. During the studied period, pelagic teleosts were represented by 25 species (18% of the total number of species landed in the region), classified as small pelagics (small, often schooling, short-living, and highly productive species; 10 spp.), medium pelagics (medium-sized fish, tuna and tuna-like species, 8 spp.), and large pelagic (large tuna and billfishes; 7 spp.). Total landings varied between 5767t and 22042t, and 1011€ to 20088€ per year for all species caught considering the studied period, with the pelagic species representing on average 63% of the total catches and 32% of the value in Euros. Abundance indices for these species were calculated as landings per unit effort (kg per landing per vessel). The overall trend of pelagic teleosts landings showed a reduction of total catches from the 90's to the first years of the 2000's, with a peak of higher catches in 2010 and posterior reduction until 2021. This baseline information can provide valuable insights into the possible effects of artisanal fishing on the pelagic fish community. Although the available data are insufficient for a complete assessment on the status of exploited species, the long-term analysis of commercial landings was used as a basis to assess pelagic teleost fisheries in the Azores and support decision-makers with relevant scientific information for future management measures.

Keywords: small-scale, pelagic, landings, pole-and-line

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CM 571: Hooked on sustainability: optimising quota allocation for Western Baltic cod small-scale fisheries

Christopher Robin Fleet¹, Martin Quaas^{2,3}, Marie-Catherine Riekhof¹

The EU Common Fisheries Policy (CFP) aims to achieve environmental and socio-economic objectives using various instruments, including fishing opportunities like quotas or effort quotas. To date, fishing opportunities are allocated based on the principle of relative stability, but this approach tends to favour large-scale commercial fishery over low-impact small-scale fishery. Within the policy framework of the CFP, Article 17 mandates further objective criteria for allocating fishing opportunities, e.g., environmental impact, past compliance, local economic contributions, and historical catches. However, only a few EU Member States have adjusted their allocation of quotas to these criteria.

The Western Baltic Sea face multiple stressors, including climate change, eutrophication, and overfishing, with major impacts on fish species such as Western Baltic (WB) cod. Particular climatic effects (i.e., increase in temperature) has led to a sharp decline in spawning stock biomass (SSB), resulting in a significant reduction in fishing opportunities. Consequently, WB cod is only allowed to be caught as a bycatch since 2022. But WB cod has been one of the most economically important fish species for the WB fisheries using either active (e.g., bottom trawls) or passive fishing gear (e.g., bottom-set gillnets). However, existing bio-economic models fail to differentiate between these methods, hindering the assessment of their impact on the population and the further development of future management measures.

Therefore, we aim to quantify potential effects of distinguishing between passive and active-gear in the WB cod fishery applying an age-structured ecological-economic single-species optimization model with two fleets (a. WB cod fishery using active gear, b. WB cod fishery using passive gear). We intend to compare the current situation with the laissez-faire outcome. In addition, we will explore different fisheries management measures according to CFP Art. 17 including the inherent trade-offs related to the two different fisheries. The model results provide guidance on robust quota allocation with respect to ongoing climate change, allowing for a future and sustainable WB small-scale fishery. To achieve the CFPs objectives, a more effective quota allocation system is needed that considers sustainable fishing practices and provides incentives to reduce environmental harm.

Keywords: Western Baltic Sea, fishery management, Article 17, bio-economic model, cod, fishing gear

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CM 597: How global fisheries have changed: evidence from a systematic mapping study

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Fisheries, including small-scale fisheries, play a critical role in providing food and livelihoods to millions of people worldwide. However, overfishing, habitat destruction, and climate change have led to significant changes in fish populations and ecosystems, which have had a disproportionate impact on small-scale fisheries. Understanding the past development of small-scale fisheries, as well as marine and inland fisheries more broadly, is essential for developing effective management strategies that ensure the long-term sustainability of fish populations and the livelihoods that depend on them. Therefore, this study conducts a systematic mapping review of the scientific literature published over the last 30 years to identify key trends in fisheries change on a global scale, including small-scale fisheries. Through the use of systematic search, citation networks, and quantitative and qualitative analysis, this study (i) identifies the subfields of fisheries science that deal with change processes, (ii) summarizes how changes and transformations in each of these fields have been understood, (iii) describes which drivers and change processes were considered relevant in each case, and (iv) reflects on where gaps exist in the scientific literature and opportunities for learning and exchange between subfields. Based on the findings, this study explores pathways for social change to guide future initiatives and achieve desirable ocean futures. This research provides valuable insights into the history and future of fisheries and offers crucial guidance for policymakers, resource managers, and stakeholders working to promote the sustainable use of marine and inland fisheries.

Keywords: Fishing, social change, transformation, transition, resilience, adaptive, adaptation, shift

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CM 604: Building equity into ocean governance as a core component of sustainable small-scale fisheries

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Small-scale fishing is characterized by a high level of diversity, flexibility and adaptability, but it also faces a variety of well-known and new, emerging challenges, including those related to the concepts of 'Blue Economy' and 'Blue Justice'. This paper focuses on the practical steps and aspects to strengthen small-scale fishers' agency, enable them to participate in negotiation processes, successfully meet challenges and become active agents in management and governance processes of marine resources. Picking up the threads from the presentations and discussions in Session N during the ICES ASC 2022, this paper weaves together the different challenges that small-scale fishers are facing, on the backdrop of critical documents such as FAO's *Voluntary Guidelines for Securing Sustainable Small-Scale Fisheries in the Context of Food Security and Poverty Eradication* (SSF Guidelines, 2015), the *Kunming-Montréal Global Biodiversity Framework* (2022) and its related target to protect 30% of the planet's surface by 2030 ('30 by 30' target), the lessons from the International Year of Artisanal Fisheries and Aquaculture (IYAFA, 2022), and the recently launched report of the *Illuminating Hidden Harvests* project (FAO, Duke University and WorldFish 2023). Questions remain on how to ensure sustainability with stakeholder participation, while safeguarding the rights and hearing the voices of those who depend on aquatic resources for their food and livelihood. These were highlighted in Session N in 2022, and often include lack of rights of use and access to marine resources and markets (reflected in SDG 14.b), no representation or unified voice in decision-making processes, and competition with industrial fisheries and other sectors of the growing 'Blue Economy'. Besides the '30 by 30'-related requirements, another concern of the session participants revolved particularly around the lack of political voice and the competition with large-scale fisheries. Science can make valuable contributions at different levels, be it in relation to resource use, in relation to political, social and cultural dimensions, or in relation to the integration of fisheries into maritime governance. During ICES 2022, practical examples for this were presented; however, there were fundamentally different opinions among the participants as to whether scientists should (1) focus on generating knowledge and be objective observers, (2) build bridges and act as knowledge brokers, and/ or (3) also be advocates for change (call to "cross the boundary between science and social engagement").

Keywords: small-scale fisheries, equity, participation, ocean governance, marine resources, sustainability

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CM 605: Comparison of sea urchin population *Paracentrotus lividus* densities from various inter-site surveys in the north-western Mediterranean: ranking of various variability factors and temporal trends

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The edible purple sea urchin (*Paracentrotus lividus*) is common on shallow subtidal areas in the Mediterranean. This species is fished for the consumption of its gonads and it is very vulnerable to fishing (recreational and commercial), due to its high commercial value and its highly accessible habitats. A decline of wild stocks of sea urchins has been observed notably by fishermen in the NW Mediterranean Sea. In this sense, a better knowledge of the state of the stock as well as the annual recruitment and spatio-temporal variability factors is necessary for a sustainable management of this fishery resource. The objectives of this study was to describe the spatio-temporal evolution of densities on the scale of the French Gulf of Lion and to make inter-site surveys comparison. Several variability factors (abiotic, spatio-temporal and management) have been hierarchized (on the 2012-2017 period, common to all areas) such as year, moment of fishing calendar, marine area, site, level of protection, substrates of transects and depth classes. We also aimed to identify inter-annual evolution trends over almost 3 decades (between 1994 and 2021) for one marine area and made predictions for the next years. Monitoring of *in situ* urchins' densities was carried out by size classes (smaller than 40 mm, greater than 40 mm and total sea urchins) with the use transect underwater visual census methods within 4 marine areas of Gulf of Lion. In addition to PERMANOVA, Multivariate Regression Trees (MRT) and Generalized Linear Models (GLM) were used for hierarchy of the factors explaining sea urchins' densities in the study area. We were able to identify that the site and depth class factors, were these influencing the most densities and it was the opposite for the level of protection. The ARIMA modeling of the series indicated a general decreasing inter-annual trend of the densities whatever the size on the Côte-Bleue Marine Park. The seasonal trend was of low amplitude. The orders of magnitude of densities were similar to those of other sites (e.g., Sardinia for the small size classes) but lower for the larger size classes. Recognizing that other factors can influence the variability, we nevertheless offer some recommendations for fisheries management such as the establishment of fallow areas. Ultimately, this study will contribute to improving the environmental sustainability of small-scale fisheries in the Mediterranean.

Keywords: marines protected areas, recruitment, *Paracentrotus lividus*, fishery resource, spatio-temporal variations

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