MSEAS 2016

Understanding marine socio-ecological systems

Including the human dimension in integrated ecosystem assessment

BOOK OF ABSTRACTS

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MSEAS 2016

The focus of the symposium will be on integration and assessment across multiple ocean uses and sectors, including: fisheries, renewable energy, coastal development, oil and gas, transport, and conservation.
There will be a particular emphasis on the methodological and empirical challenges involved in including human dimensions in integrated ecosystem assessments.
The symposium will be global in scope, with a focus on regions in which integrated ocean management policies have been developing in the last two decades.

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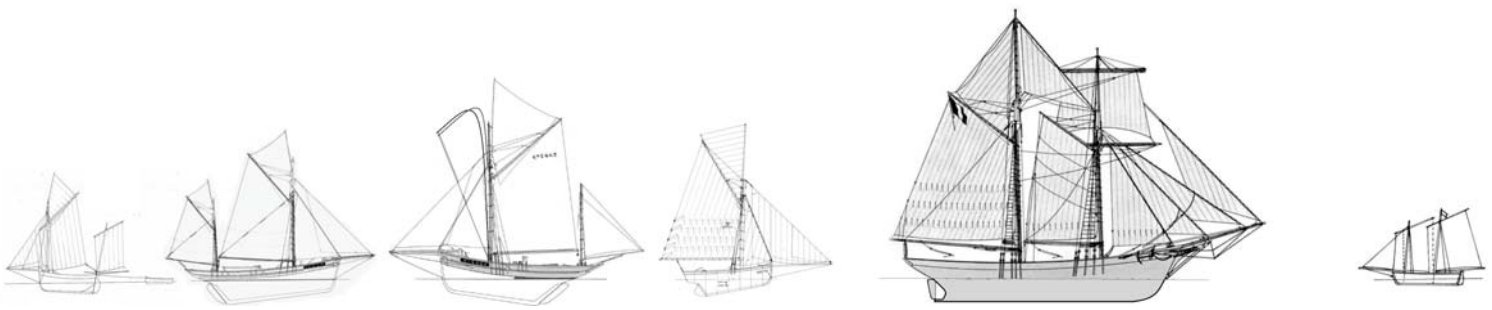

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Keynotes

Keynote 1 – Monday 30/05 (9h30-10h30)

Fisheries: from biological clockworks to socioecological systems and ecosystem services

Dr Serge Michel García

(Chair IUCN-CEM-FEG, Brussels - Belgium)

Driven by the evolution of data availability, science, computing capacity, governance and institutional developments, technological innovation, political and economic contexts and societal requirements, the world of fisheries has progressively revealed its complexity. The constraints that imposed drastic simplifications on our representations of the world and on our resulting action for decades have progressively been relaxed allowing more realistic representations of the fishery sector's functional mechanisms. At the same time, evolving governance processes have become more complex and our capacity to predict at the appropriate scale and to authoritatively « govern » the system has decreased, calling for a significant increase in in actor's participation in research and decision-making. The originally mechanistic « biological » fishery system has progressively been recognized as a fluid and integrated « social-ecological » system and many important consequences of that change have still to be fully understood and faced effectively. In addition, the cross-sectoral nature of the ocean economy is emerging very rapidly calling for even higher levels of governance integration with higher degrees of involvement of the private sector and civil society.

The presentation will describe the trajectory of fishery systems over time and highlight some of the key changes looming in the near future.

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Keynote 2 – Monday 30/05 (13h00-14h00)

Fisheries Governance in an SES system: All Things for All People or All Things for All Creatures?

Dr Jake Rice

(Chief Scientist–Emeritus Dpt. Fisheries and Oceans DFO, Ottawa - Canada)

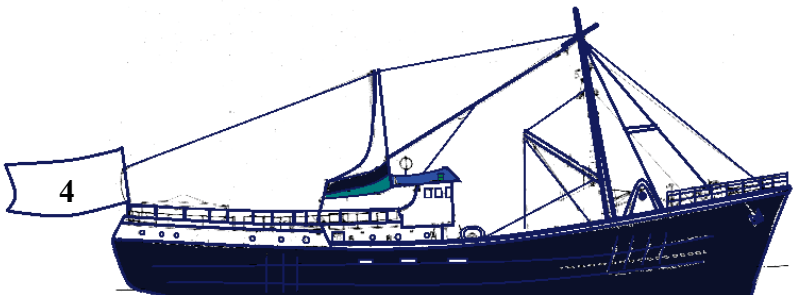
The institutions and processes of governance are designed to provide the processes and rules by which the sectors of society considered to have a right to participate in decision-making are able to access, share, and exchange views on the information considered relevant to the decision. These processes evolve over time reflecting changes in views about:

☐ The sectors of society with a right to participate in making a decision

☐ The relative power given to (or taken by) the various sectors

☐ The scope of information considered relevant to the decision being made.

In addition, the dynamics of the processes and operations of the institutions may change as the methods for accessing, sharing, and exchanging views about the relevant information change. (e.g. social media), even if the explicit rules don't change.



In little more than two decades, fisheries policy-making and management has changed in two fundamental ways. The first is from either largely-top-down management, particularly of large-scale fisheries and largely bottom up management of artisanal and some small scale fisheries to a mosaic of scales of management with a diversity of participants and rules of engagement.

The second is an expansion of the factors considered explicitly relevant to the decision-making, from producing maximum sustainable yield from the target species, to considering for each decision:

☐ many social and economic consequences of available options,

☐ interactions of fisheries with other sectors, and

☐ a broad range of ecosystem impacts, particularly on biodiversity.

These are major changes often individually planned systematically. However rarely has there been an evaluation of the degree to which the many individual changes have been coordinated and coherent. In this presentation I will undertake such an evaluation by:

☐ describing what properties a set of institutions and processes would have to have, in order to ensure coherence for governance taking account of all the aspects of integrated socio-ecological sustainability in a true ecosystem approach context, and

☐ asking if the types of changes in institutions and processes being undertaken are actually showing those properties

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Keynote 3 – Tuesday 31/05 (9h30-10h00)

What's easy and hard about modelling socioecological systems

Dr Elizabeth A. Fulton

(CSIRO, Hobart - Australia)

Co-Authors: Ingrid van Putten, Rebecca Gorton, Éva Plagányi (CSIRO, Brisbane - Australia)

Integrated coastal zone and oceans management is increasingly the global standard for management of these increasingly crowded areas. This form of management has been demonstrated to be the most effective (perhaps only) means of achieving sustainability under cumulative impacts of global change. Integrated assessments can be a key component of such management and they must explicitly reconcile the effects and interactions of all the active and developing sectors in the region – including: fisheries, aquaculture, catchment use, coastal development, oil and gas, renewable energy, ports, transport and conservation. Pulling together information on all these industries, as well as the biophysical parts of the system, is not a trivial exercise. Dynamic modelling of such complex systems has been (surprisingly) successful, but challenges remain. Drawing on examples from the IndoPacific, we discuss what's easy and what's not when modelling socioecological systems in support of integrated assessments and sustainable multiple use management.

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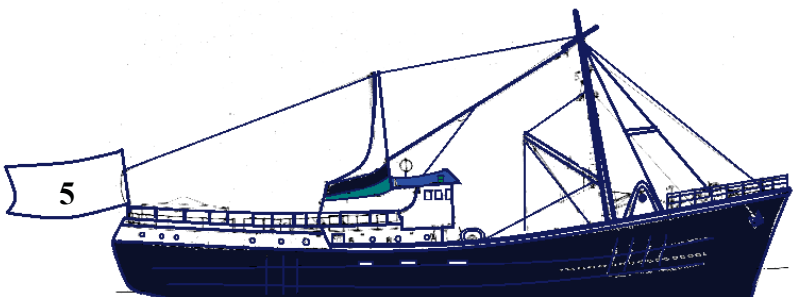

Keynote 4 – Wednesday 01/06 (09h00-10h00)

Indicators, indices, and essential variables: Oh my! A decidedly non-statistical take.

Linwood Pendleton

(International Chair of Excellence AMURE/LABEX/IUEM, Brest - France)

A proliferation of indicators, indices, and essential variables have emerged to better understand and manage marine socio-ecological systems. But, what do they mean? Which ones should you use? What are the limits? Do these « essential statistics » represent empirical measures of the « state » of socio-ecological systems or are they hypotheses about intangible and difficult to measure attributes of these systems? Are they data or results? What values, preferences, and societal assumptions are embedded in essential statistics and how are they expressed? How do indicators, indices, and essential variables change over time? Should they change over time? What are the risks and benefits of condensing knowledge into a handful of essential statistics? What happens when we have too many indicators, indices, and essential variables? This keynote will lay out key challenges to be considered during the course of Theme C: From data to indicators to reference points and performance evaluation.

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Keynote 5 – Thursday 02/06 (09h00-10h00)

Adventures in Integration: Unexpected Insights for Coastal and Marine Governance from Interdisciplinary Assessment

Dr Edward Hugh Allison

(School of Marine and Environmental Affairs, Seattle - USA)

Coastal and marine issues are embedded in systems that are multi-scalar and characterised by complex interactions and non-linear feedbacks. Disciplinary traditions have allowed us to understand how different elements of the system work and how to govern them in ways that benefit coastal societies and economies. We know a lot about how to manage fisheries for optimal yield, how to treat effluents to meet water quality standards, and how to deal with oil spills. When we extend our assessments beyond the sectoral and disciplinary foundations upon which we have built our understanding of the sea, however, we discover surprising and sometimes disturbing things. By combining epidemiology, sociology and occupational health, we discover that fishing ports and landing beaches can be centers of high prevalence of HIV and AIDS among the people who live and work there. Studies of illegal fishing by criminologists, when broadened to consider other illegal activities, reveal a world in which slave labourers work in global shrimp value chains and fishing boats are redeployed to smuggle people, drugs and weapons. This suggests that the benefits of improved fisheries governance might transcend lost fish. More positively, by combining nutrition science, food policy and fisheries and aquaculture studies, we can identify and promote the contribution that fish makes to human health through the supply of critical micro-nutrients. The papers in this theme sessions provide experiences on how integrated approaches can be a a practical means to resolve complex inter-sectoral problems. But integration of previously unconnected bodies of work can also help us redefine the human relationship with the sea so that, in the Anthropocene, both human well-being and marine and coastal ecosystem health are sustained and enhanced.

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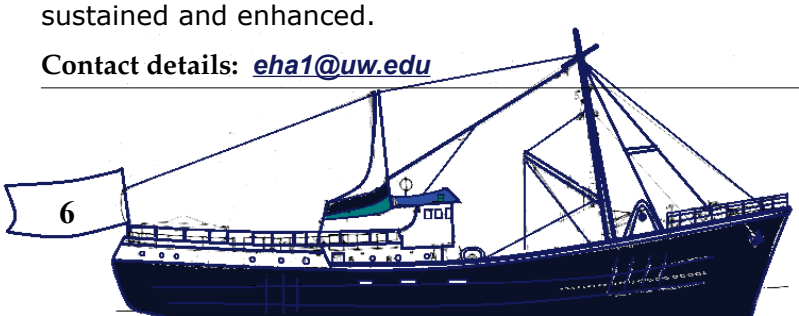

Keynote 6 – Thursday 02/06 (16h30-17h30)

Dealing with Public Goods and Common-Pool Resources

Simon Levin

(Princeton University, Princeton - USA)

Ecological and economic systems are alike in that individual agents compete for limited resources, evolve their behaviors in response to interactions with others, and form exploitative as well as cooperative interactions as a result. In these complex adaptive systems, macroscopic properties like the flow patterns of resources like nutrients and capital emerge from large numbers of microscopic interactions, and feedback to affect individual behaviors. In this talk, I will explore some common features of these systems, especially as they involve the evolution of cooperation in dealing with public goods, common-pool resources and collective movement. I will describe examples from bacteria and slime molds to vertebrate groups to insurance arrangements in human societies and international agreements on environmental issues.

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Keynote 7 – Friday 03/06 (09h00-10h00)

Assessing and Managing a Multi-Sectoral Multi-Objective Ocean: Challenges of Integration and Participation

Dr Anthony Charles

(Saint Mary's University School of the Environment & School of Business, Halifax - Canada)

In recent years, there has been remarkable growth in the attention paid, within marine systems, to ecosystem-based management and more recently integrated ecosystem assessment. Underlying this trend is the complexity and multi-sectoral reality of oceans, including multiple uses of ocean space and conflicting values and objectives across economic sectors (and « non-use » values). These considerations call for combining ecosystem-centred and people-centred thinking, in the form of social-ecological systems approaches that include human dimensions – socio-cultural, economic, political, institutional, and technological, all driven by needs and values. Indeed, the human side of the marine social-ecological system can (and should) receive equal attention to the ecological side, with human dimensions included from the start, not as « add-ons ». While these approaches are becoming well accepted, in practice significant challenges arise in integrating assessment and management across ocean use sectors, across scales, and across varying perspectives (social, ecological, economic, institutional, etc.). The challenges include: (1) the reality of competing objectives, (2) the range of implementation scales, from local to global, and the difficult issues around setting boundaries, (3) the variety of benefits and costs, seen from social, economic, ecological and management perspectives, and (4) the difficult choices of incentives and institutions. This presentation explores these challenges, focusing on the problems and solutions arising in integration, participation and decision-making within multi-sectoral, multi-use, multi-objective marine systems. The discussion leads to a conclusion that effective integrated ecosystem assessment and management must begin from a base in integrated 'systems' thinking, and proceed using a suitable participatory approach. The latter is tied closely to the creation of appropriate governance arrangements, participatory processes for consultation and decision making (such as inter-sectoral advisory committees), the options for adoption of rights-based approaches, and attention to ubiquitous issues of power and equity.

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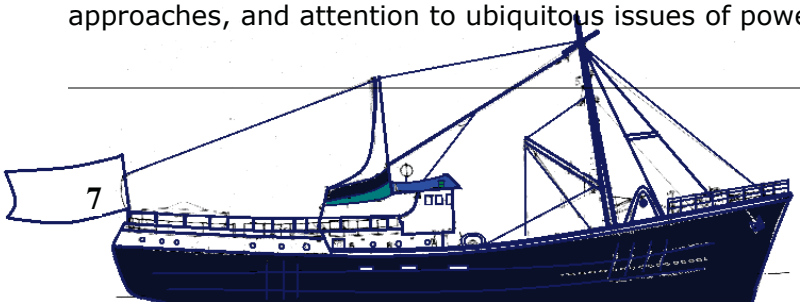

Oral presentations

Theme session A

Identifying needs for managing multiple ocean use sectors – policy, management and industry needs.

Introductory talk 1 – Monday 30/05 (11h-12h)

The Future of the Ocean Economy project is the first endeavour by the OECD to consider the ocean from an economic perspective.

Torgeir Edvardsen

(Senior economist at OECD Norway)

The Future of the Ocean Economy project is the first endeavour by the OECD to consider the ocean from an economic perspective.

The « Future of the Ocean Economy » project to explore the growth prospects for the ocean-based industries, and their capacity for value and employment creation and innovation. In this vein, the project examines the risks and uncertainties surrounding the future development of ocean industries, the innovations required in science and technology to support their progress, the environmental impacts of the industries, their potential contribution to green growth as well as their negative externalities, and some of the implications for planning and regulation. Finally, the project explores possible avenues for action that could boost its long-term development prospects while managing the use of the ocean itself in responsible, sustainable ways – and provides policy recommendations to support such national and international efforts.

The final report from the project, The Ocean Economy in 2030, released on April 27 this year, analyses the economic perspective of the Ocean Economy whilst observing the goals of more sustainable development, and provides OECD policy recommendations to support such national and international efforts.

The many economic activities that make use of the ocean possess great potential for boosting economic growth, employment and innovation. Together, ocean-based industries play a key role in the world economy. Calculations on the basis of the OECD's Ocean Economy Database estimate the ocean economy's output in 2010 (the base year for the calculations) at USD 1.5 trillion in value added, or approximately 2.5% of world gross value added (GVA).

The report puts forward a number of recommendations to enhance the sustainable development of the ocean economy:

☐ foster greater international co-operation in maritime science and technology as a means to stimulate innovation and strengthen the sustainable development of the ocean economy

☐ strengthen integrated ocean management

☐ improve the statistical and methodological base at national and international level for measuring the scale and performance of ocean-based industries and their contribution to the overall economy

☐ build more capacity for ocean industry foresight.

The presentation will brief on and discuss these issues.

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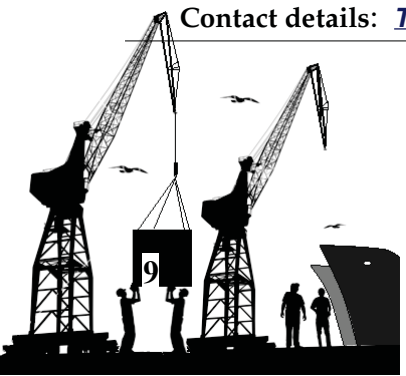

Marine Ecosystems and the Growing Ocean Economy: Challenges and Opportunities for Sustainable Development and Science

Paul Holthus

(World Ocean Council, Hawaii - USA)

The ocean is increasingly crowded - with more users and a greater range, intensity and duration of use. This creates complex challenges for ocean businesses regarding environmental impacts, conflicts among users, and interaction with other values, e.g. conservation. Many of the critical issues affecting the ocean use access and social license that industries require are cross-cutting and the best efforts by a single company, or an entire industry sector, are not enough.

Collaboration can bring business benefits through synergies and economies of scale. The World Ocean Council (WOC) brings together ocean industries to catalyze global leadership and collaboration in addressing shared responsibility, stewardship and science in support of a sustainable global ocean economy.

Multi-sectoral ocean industry leadership and collaboration can catalyze global ocean economy cooperation to address shared ocean sustainable development challenges. This collaboration can also engage the ocean social and natural science communities in areas of mutual interest, value and opportunity.

The WOC is creating multi-stakeholder « Ocean Platforms » to address cross-cutting sustainability challenges, e.g. ocean governance, marine planning, cumulative ecosystem impacts (e.g. marine sound, biofouling/invasive species), adaptation to sea level rise and extreme events, etc. The « Smart Ocean - Smart Industries » Ocean Platform is working to increase the number of company's collecting and sharing ocean, weather and climate data from industry vessels and platforms.

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The North Sea Case. Sea Bottom Protection (Natura 2000 and EMFD) Fishing Industry Stakeholder Involvement

Pim Visser

(VisNed, Urk - Netherlands)

The Common Fisheries Policy has led to sustainable harvesting from the North Sea Sole and Plaice stocks. European Fisheries provide food for a growing population. Innovation and transition has led to a significant reduction in the environmental impact of Dutch demersal fisheries. Dutch Demersal fisheries is of great importance to a specific number of rural communities. In the last decade environmental legislation has a growing influence in fisheries. Natura 2000 sites have been designated and the implementation of the Marine Strategy Framework Directive is of influence. Fishing Industry representatives and NGO's have opposing views in relation to the Implementation of this legislation and accompanying measures. Stakeholder involvement is at the core of this process. Pim Visser will share his experience, and lessons learned on the complex North Sea Doggerbank process, which took place under the precious CFP. He will also share his views on the many multi member states and multi fisheries processes to come. Stakeholder processes must lead to clear answers on three basic questions: WHAT are we protecting, WHY are we protecting it and HOW are we accomplishing effective protection. His core message is that everybody is entitled to an opinion, but the real involvement of those who are really influenced by these decisions: the fishermen, must be valued most and must be given the recognition it deserves. In this respect, he will also share his thoughts on a required line of approach by fishing industry representatives.

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Introductory talk 2 – Monday 30/05 (14h-15h)

Understanding and managing marine socio-ecological systems: challenges and prospects from the French Marine Protected Areas Agency point of view

François Gauthiez

(Deputy Director at the French Marine Protected Areas Agency, Brest - France)

Co-Author: Diane Vaschalde

The French Marine Protected Areas Agency implements the national strategy for the creation and management of marine protected areas (MPAs) and supports the implementation of European directives in the field of marine protection (Natura 2000 directives, Marine Strategy Framework Directive, Marine Spatial Planning directive). To this end, the Agency faces various challenges, develops and participates to various collaborative projects in relation to integrating the human dimensions in its work, which is primarily dedicated to the conservation of marine biodiversity. This communication aims at giving a broad overview of these challenges and on-going projects, across the different themes of this symposium. Needs for creating and managing multi-objectives MPAs range from methodological needs (ex: building initial diagnosis on uses) to operational ones (ex: collecting data). To this end, partnerships with researchers in human and social sciences are crucial, this is why the Agency contributes to the development of the GIS HomMer, a network of researchers and MPAs managers; a key contribution of the Agency to this network is to express managers needs. On assessment matters, the Agency has a strong experience with the « dashboard approach », which aims at measuring the extent to which long-term goals of MPAs are met, including on sustainable development goals. Also, most MPAs have specific governance frameworks, which enable the representation and participation of the main stakeholders both for the creation and management of a MPA. Examples of marine nature parks, with consultation processes and a specific governance body (the Management Council) can be given to illustrate this point. Finally, the Agency participates in or supports punctual projects to better understand the relationships between humans and the marine environment, such as projects on ecosystem services or social representations. Practical examples or feedback would be used to give shape to each point of this cross-disciplinary presentation.

Keywords: marine protected areas, needs, assessment, governance.

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Identifying needs for managing multiple ocean use sectors – policy, management and industry needs.

Mark Dickey-Collas

(ICES, Copenhagen - Denmark)

Co-Authors: Jason S. Link (NOAA, Woodshole - USA), Gabriella Bianchi (FAO - Italy), M. Robin Andersen (DFO - Canada)

An Atlantic focused workshop held in January 2016 considered « where are we and where do we want to go, in moving from single to cross-sectoral implementation of the ecosystem approach (EA)? » It was supported by the EU, NOAA, DFO, FAO and Norway to further the Galway Statement for trans-Atlantic cooperation in marine research. It focused on the main sectors that operate in the Atlantic Ocean and adjacent seas, namely shipping and ports, oil and gas, renewable energy, fishing, tourism and aggregate extraction; specifically in relation to the blue growth/blue economy. The workshop created an opportunity for stakeholders to come together to review concepts and address scientific, institutional, legal and socio- economic challenges related to operationalizing the ecosystem approach. Case studies from across the region where used to highlight progress and illustrate challenges. This talk will summarise the main findings of the workshop including the current status of the EA in member countries and around the world with respect to implementation of Ecosystem Based Management (EBM) and the challenges to such implementation.

Keywords: management, Atlantic, EBM, stakeholder, governance

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How can natural science and social science research be integrated into science advice so that it is useful to policy makers and the broader society?

Alida Bundy

(Bedford Institute of Oceanography, Dartmouth – Canada)

Co-Authors: Liam Campling (Queen Mary Univ. - UK), Alan Haynie (NOAA, Seattle – USA), Mitsutaku Makino ((National Research Institute of Fisheries Science NRIFS, Fisheries Research Agency FRA - Japan), Jörn O. Schmidt (Christian Albrechts University CAU, Kiel - Germany)

In recognition of the role of humans as both the main driver and the ultimate recipient of environmental change, and that it is necessary to engage humans, as individuals, communities and societies, to approaches that lead towards sustainable futures, several large scientific programs have formed sub groups focussed on the human dimensions of fisheries and global change writ large. These large scientific programs, such as IMBER, ICES and PICES, have not traditionally included the social sciences, and arguably are still working out the optimal way to integrate natural and social science research into to their programs and into their science advice. Issues to be addressed include, but are not limited to how to acquire, mobilize and make available to marine managers, policy-makers, and other end-users of scientific information and knowledge contributing to secure transitions towards marine sustainability.

The above is a description of a session that the authors will Chair at the 7th World Fisheries Congress in May 2016. The objective of the session is to explore the questions outlined above, within and outwith large scientific programs and to pose the following questions:
(i) What natural and social science evidence-based knowledge do marine policy makers and policy advisors want, consider, and need?

(ii) What natural and social science evidence-based knowledge do marine dependent communities and stakeholder want, consider, and need?

(iii) Are large scientific programs a good platform to stage this science and provide advice?

(iv) What improvements, if any, would be recommended?

(v) What is required to improve the marine science-policy-society interface?

In this paper, we will provide a review and synthesis the outcomes of this session, selecting salient points for further discussion at MSEAS.

Keywords: integration, natural and social science, policy, large scientific programs

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Parallel session 2 – Tuesday 31/05 (10h30-12h30)

A1-52

Re-inventing environmental impact assessment with a systems-based approach.

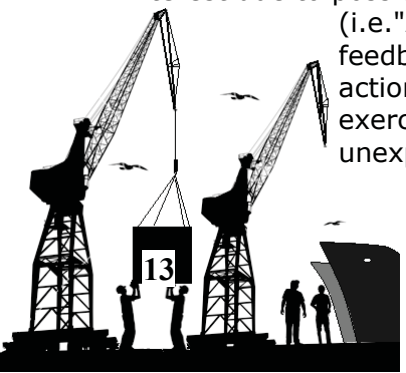
Jennifer Coston-Guarini

(The Entangled Bank Laboratory, Banyuls/Mer – France *and* Ecole Doctorale des Sciences de la Mer Univ. de Bretagne Occidentale / IUEM, UMR 6539 LEMAR, Plouzané - France)

Co-Authors: Jody Edmunds (LimOce Environmental Consulting Ltd. - UK), Jean-Marc Guarini (UPMC/IUEM – France), Laurent Chauvaud (IUEM - France)

Environmental impact assessment (EIA) relies on the identification of « receptors » that may be impacted from development projects and for which potential changes are predicted. These predictions are loosely based on ecological principles, which often lack proof of generality or predictive capacity. With the objective of developing an ecosystem-based EIA, our presentation explores the limits of combining frameworks in social sciences and ecology, when ecology uses reasoning based on theoretical principles rather than phenomenological descriptions. We reject current paradigms, developing instead new directions for investigating so-called « socio-ecological » systems.

Since the 1990s, economists and regulators have concluded there is a need to explicitly link the dependence of economic systems on ecological processes (e.g. population dynamics) with environmental (e.g. climate) fluctuations. Ecology, as the study of the interactions between individuals, populations and their environments always encompassed any human behaviors and activities, but has limited its understanding to plausible effects without possible feedbacks. Treating a « socio-ecological system » using systemic principles generates outcomes with little interest due to possible socio-economic feedbacks not connecting as reactions in a physical system (i.e."A" has an action on "B", and in return, "B" modifies "A"). The notion of feedbacks can be revised as "A" has an action on "B" until "A" realizes that the action on "B" can be favorable to its own development. But decision-making exercises, even when well intentioned and informed, will continue to have unexpected outcomes.



We suggest that an ecosystem-based approach to EIA, in which the social system is an evolving driver of the ecological one, is more promising than a socio-ecological system where variables are treated as equal. This refocuses the debate on issues of cause-and-effect, processes, and identification of essential, portable variables that can be used in the scope of EIAs.

This allows the development of a systems-based approach where quantitative comparisons are possible.

Keywords: environmental impact assessment, ecosystem-based approach, quantitative assessment, portable variables.

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A1-62

Connectivity of policies, sectors and stakeholders in the marine environment: a network approach.

Dr Leonie A. Robinson

(School of Environmental Sciences, University of Liverpool - UK)

Co-Authors: Anthony M. Knights (Marine Biology & Ecology Research Centre / Univ. Liverpool – UK), Fiona Culhane (Univ. Liverpool - UK)

In this paper we present an approach for exploring how policy objectives are linked to sectoral activities and stakeholders through a network of interactions where all linkages are identified between policy objectives, ecosystem components, pressures, human activities and ecosystem services. Through analysis of this network it is possible to draw out the connectance between sectors and policies using an approach that is not constrained by traditional formal policy-stakeholder relationships. For example, the sectors with the highest levels of connectance with objectives of the Marine Strategy Framework Directive or the EU Biodiversity Strategy can be identified, based on either the pressures caused by sectors (and thus the potential to have detrimental effects on policy objectives), or conversely, in terms of the needs for ecosystem services where good status of objectives may be required. These inter-relationships are explored and similarity in interactions also analysed to consider where sectors have commonalities in terms of their interactions with policies. We discuss how this might inform the potential for efficiencies in management in meeting the needs of multiple sectors and policy objectives.

Keywords: marine policy, biodiversity strategy, sectors, network analysis, connectance, ecosystems, regional seas

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A1-115

Spatial and temporal potentials and limitations for the integration and management of fisheries, aquaculture and other activities in the coastal areas – the ECOAST project

Erik Olsen

(Institute of Marine Research, Bergen - Norway)

Co-Author: Fabio Grati (CNR-ISMAR - Italy)

ECOAST is an EU (COFASP) funded project for 2016 – 2019 that aims to identify, develop and test new methodologies for spatial and temporal management of fisheries and aquaculture in coastal areas. The overall approach will assess the impact of fisheries and aquaculture on coastal ecosystems, including essential fish habitats and conservation priority habitats, as well as synergies and conflicts between human activities. Seven case studies spanning the Adriatic Sea, Ionian Sea, Black Sea, Tyrrhenian Sea, Baltic Sea, Norwegian Fjords and NE Atlantic Coasts have been chosen to illuminate the needs and challenges when managing multiple uses in the coastal zone.

Through a stakeholder process ECOAST will identify future management goals and scenarios in the seven case studies, which will be studied using state-of-the-art ecosystem service and trade-off analyses (open-source InVEST tool). The trade-offs will be presented spatially (using maps) and will include indicators of socioeconomics and ecosystem impacts of the management scenarios.

Expected results will include maps of the cumulative impact of fisheries and aquaculture on coastal ecosystems, and maps visualizing arisen conflicts and synergies between activities. An analysis of future scenarios will provide useful indicators to be used in actual MSP and enhance related decision- making processes. Furthermore, ECOAST will allow integration of fisheries and aquaculture requirements (e.g. designation of priority areas for fishing or aquaculture) in MSP and ecosystem- based management.

Keywords: fisheries, aquaculture, management, multi-sector, marine spatial planning, ecosystem- services, trade-off analysis, scenarios

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A1-235

Sustainable fisheries in a social-minded world: challenges and perspectives from a seafood certification perspective

Catherine Longo

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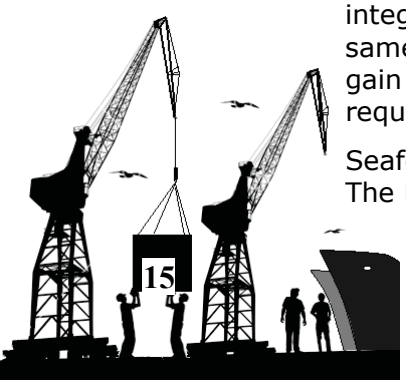
Co-Authors: Taylor Gorham, Peter Hair, Robert Lefebure, Hannah Norbury, Oluyemisi Oloruntuyi, and David Agnew



A holistic approach to fisheries management is increasingly viewed as an integrated perspective, whereby both nature and people are viewed as part of the same coupled socio-ecological system. As socio-economic dimensions of fisheries gain more attention in public perceptions and management frameworks, they require more attention also on the part of seafood certification standards.

Seafood certification is a market-driven approach to achieving sustainable fishing. The Marine Stewardship Council (MSC) is an internationally-recognized standard-

setter focused on environmental seafood sustainability. Theoretically, sustainable fisheries and healthy ecosystems should help support livelihoods and provide food in the long term. In addition, socio-economic benefits have often been reported as an effect of certification and represent an incentive to fisheries entering the program. However, economic and social criteria are not explicit MSC standard requirements, and there may be a tradeoff between prioritizing social or economic objectives, such as maximizing yield, or jobs, and ecosystem objectives, such as biodiversity conservation. In other words, targeting one aspect of sustainability, be it ecological, social or economic, does not necessarily deliver the others. In order to be credible yet accessible, the standard has to balance the tension between the complexity necessary for a transparent and scientifically robust certification process, and the practical constraints of time and cost. The MSC standard requires a fishery not only to exploit its target population(s) sustainably, but also take into account the health of bycatch species and habitats. Socio-economic considerations represent a challenging addition of a layer of complexity.

Here we review several case-studies of social and economic implications of achieving MSC certification in its current form, and explore future scenarios and potential developments for the inclusion of a social dimension in ecological standards.

Keywords: socio-economic, integrated management, trade-offs, certification

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A1-13

Integrating different user groups into fishery management

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Different user groups have different stakes in fisheries. The societal challenge is that, exploiting the same fish stock, or ecologically interacting stocks, recreational and customary fishermen interact with a continuum of commercial fishermen, ranging from very small-scale and part-time artisanal fishermen to large-scale fishing firms. In this paper we develop a theoretical framework of fisheries management that integrate different user groups and internalize externalities between them. An optimal allocation of resource use rights among user groups is required (a) to maximize the societal benefits withdrawn from living marine resources, (b) to prevent overexploitation of fish stocks and (c) to improve the economic benefits derived by the various users of the fishery. Tackling the conservation, social equity, and economic efficiency challenges inherent to resource allocation, we identify, in a first stage, general principles of optimal quota allocation among the different user groups, given an exogenous TAC. We proceed to an numerical application of our static optimization framework to the case of the German commercial and recreational cod fisheries in the western Baltic sea. Drawing on this application of our model, we assess the deadweight loss subsequent to an imperfect harvesting quota market. In a second stage, we derive the joint total allowable catch (TAC) for all user groups at a socially optimal level. The TAC is optimal in the sense of maximizing the total economic value of the resource in consistency with sustainability and social goals, jointly for the different user groups.

Keywords: integrated fishery management, harvesting quotas, ecosystem approach

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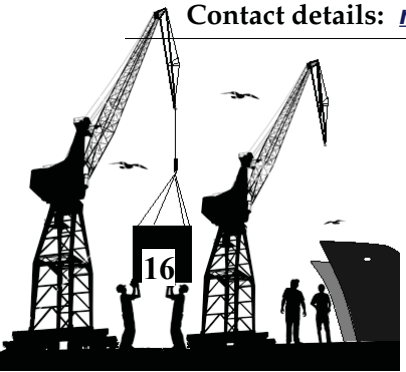

Parallel session 4 – Tuesday 31/05 (16h00-17h40)

A2-247

Challenges and opportunities for integrated planning for multiple sectors and interests through Marine Spatial Planning.

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Marine spatial planning (MSP) requires evaluation of multiple sectors and interests, to enable informed public negotiation regarding resource use. It is a practical tool which has resulted from the increasing emphasis on holistic approaches necessary to address competing demands of growing and diversifying maritime economies, within complex interdependent socio-ecological systems. As an integrated framework, MSP presents an opportunity to review, evaluate and rationalise current approaches to the governance of marine activities, and provides a focus for making the transition away from fragmented sector-specific approaches to more co-ordinated, efficient and cost-effective resource management.

As it is neither specifically « policy » nor « management » the implementation of MSP has to bridge a gap between the development of national and regional policy and the decision-making frameworks governing marine activities. Its' task, therefore, is to integrate and balance a range of sector and interest objectives arising from different socio-political drivers (e.g. energy or food security), and translate them into coherent and spatially-explicit plans which guide the licensing and management of marine activities.

While conceptually straightforward, in reality this poses a number of challenges, which this paper explores. So far MSP has predominantly only been « integrated » in the sense that areas are set out for different types of marine activities within a single plan (with an emphasis on « zoning » and designation of marine space for use by specific sectors). In order to achieve the aims of optimising marine resource use (set out here as maximising the benefits obtained from a particular area), doing so with minimal risk of negative effects and within limits (sustainable development), much greater integration is required, and represents a significant change in the way we currently plan and develop our marine resources.

Firstly, marine planning aims to address trade-offs between sectors and implicit in this is the need to integrate existing sector-specific approaches, and compare and contrast different development options to evaluate and negotiate preferred scenarios. Understanding the « cumulative » effects of multiple activities is required through existing regulatory mechanisms (associated with Environmental Impact Assessment processes applied to projects and sectors) but the limitations of approaches to so-called « cumulative impact assessments » (CIA) are well documented (e.g. Maclean et al. 2014). The possibly contentious and highly politicised nature of determining sector development options requires careful consideration of the best ways to ensure evidence-based and cost-effective mechanisms of assessment.

Secondly, in order to ensure optimised use of resources in a marine, we need to consider for co-location and multi-use areas. Emphasis on this is growing, and focus is needed on the planning and regulatory regime which can provide a barrier to innovative opportunities. The integration of activities, including perhaps the sharing of infrastructure, will require even further integration of understanding impacts of multiple activity types, and flexibility in current sector-specific planning processes.

The hurdles in developing truly integrated planning practice in MSP are significant and require reflection on current practice and, importantly, a willingness to adapt. This paper explores these challenges, and the opportunities to rationalise and reduce the planning and licensing burdens for each sector, ultimately achieving the best for society in cost-effective and optimised use of marine areas.

Keywords: Marine Spatial Planning, cumulative impacts, governance, co-location

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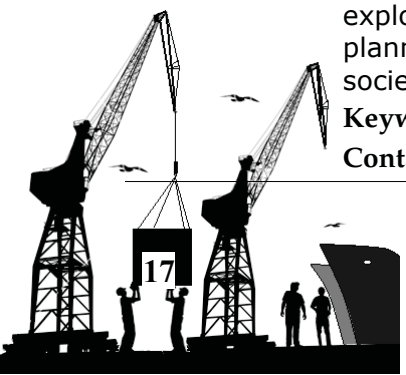

A2-180

Marine Environmental Values as the basis for ecosystem based management within the Australian EEZ.

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Identifying significant or important areas, especially for biodiversity conservation or ecosystem health, is the traditional purview of scientists often working independently from the local community or government who are then expected to act on this information. This approach has arguably had limited success effecting sustainable use ocean ecosystems and marine resources, and more success in improving scientific critique. An alternative approach that is gaining some momentum is for deliberative workshops that gather « experts » to identify specific areas that they see as particularly important or relatively more important, sometimes supported by agreed criteria. Australia identified a set of Key Ecological Features and Biologically Important Areas based on available evidence , including regional experts, and broadly described criteria and are clear descriptions of ecological value and share many similar concepts with the socio-economic valuations that include natural capital.
The ecological values described by the KEF criteria have been used for developing national sets of indicators of ecosystems health and as assessment tools for governments (e.g. against activities in the Oil & Gas industry, Shipping and Maritime safety, and Fisheries). In a similar way, the CBD developed Ecologically or Biologically Significant Areas against a set of well-defined and internationally agreed criteria. We examine the benefits and drawbacks in these two approaches and suggest that there are a set of 7 criteria that appear consistently in the identification of special areas for conservation management, from many sectors including shipping and fisheries, suggesting a common set of criteria. Finally we propose the use of expert-derived qualitative models (or structured stories) that identify the major system components of identified areas as a check on the logical consistency of the application of the criteria.

Keywords: EBSA, KEF, BIA, ecological values, qualitative models
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A2-118

Understanding Integration Challenges in Maritime Spatial Planning.

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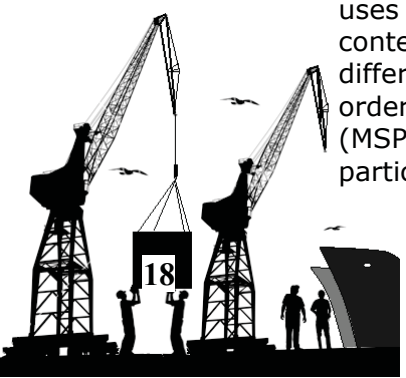
Today, increasing use intensity and establishment of new sea uses such as offshore wind farming can be observed in coastal and marine waters. This development also increases the pressure on coastal and marine ecosystems. The Exclusive Economic Zone (EEZ) of the German North Sea can serve as an example for this development, in particular illustrating the need to combine multiple uses and societal demands within a given sea area. While the sea becomes a contested, but at the same time politically recognised area, conflicts rooted in different perceptions, values and attitudes of coastal people can be observed. In order to deal with current challenges in marine areas, Maritime Spatial Planning (MSP) and similar tools for integrated planning are currently developing, in particular in Europe.



The presentation will derive and illustrate integration challenges as they emerge from trends in sea use development in the (German) North and Baltic Sea and put them into the context of MSP processes. Integration in MSP has a multidimensional character and includes challenges of horizontal integration across multiple sectors/policy, vertical integration through levels of government, and stakeholder and knowledge integration across diverse interests and epistemologies. In this presentation MSP will be established as a social process embedded in (and aiming to integrate across) political and policy processes of various sectors and at various policy levels, but also needs to be able to integrate qualitative and quantitative information in order to span an informed dialogue between groups of society. The presentation will then introduce selected approaches and tools, which may help to address some of these integration challenges, drawing in particular on approaches and cases from the BONUS BALTSPACE project, but also projects like BaltSeaPlan and KnowSeas.

Keywords: Maritime Spatial Planning (MSP), policy integration, knowledge integration

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A2-121

Does the use of ecosystem services concepts support local stakeholder participation and improve the marine spatial planning process?

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It is clear that significant improvements can be made to marine spatial planning through better understanding of the range of potential ecological trade-offs by all those involved in decision making, from stakeholders to policy makers. Greater and especially shared understanding early in the process can reduce the potential for conflict and lead to more efficient negotiation of agreed sustainable uses of our oceans. A process, within the existing regulatory framework, is required to encourage perceptions of ecosystem services (ES) and their benefits to be shared among cross sectoral stakeholder groups. Secondly, potential changes to the system need to be jointly explored within a process that integrates ecological assessment of these changes with stakeholder perceptions and valuation of a range of ES trade-offs.

The transdisciplinary project « Cooperative participatory assessment of the impact of renewable technology on ecosystem services: CORPORATES » brought together natural and social scientists, experts in law and policy, and marine managers with the aim of promoting more integrated decision making using ES concepts in marine management. Using a real-world current issue – the co-location of wind farms, MPAs and industrial fishing – CORPORATES developed a process to incorporate ES concepts into stakeholders' awareness by bringing together representatives of maritime industries and regulatory/advisory partners with a range of additional stakeholders (Non-Governmental Organisations, Small and Medium Enterprises, recreationalists, local government) and facilitating discussions about ES and benefits. The process, based around two workshops, incorporated knowledge exchange about key ecological processes underpinning ES, mapping of different types of activities and ES benefits, participatory concept system modelling, and deliberation on the impacts of potential future policy developments on different sectors. We will explain the aspects of the participatory process that successfully built a shared understanding

of inter-linkages and interactions between different ES, benefits, activities, and economic and cultural values between emerging industries and existing stakeholders.

Keywords: Ecosystem services, participatory, cross-sectoral stakeholders, ecological trade-offs, Marine Spatial Planning

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A2-221

Transitioning to a brave new world: the need for, and challenge of, interdisciplinary research.

Pr Stewart Frusher

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Co-Authors: Marcus Haward (Univ. Tasmania – Australia), and Alistair Hobday (CSIRO, Hobart - Australia)

The world rapidly needs to respond to global challenges such as food security, population growth and climate change amongst an ever increasing rate of globalisation that is also reshaping trade and markets.

The world's oceans cover 71% of the earth's surface and, like many of the terrestrial deserts, are underutilised for food production. However, unlike deserts, virtually all regions of the oceans support commercial fisheries from krill and toothfish in Polar Regions to tunas in tropical regions. Modern commercial fisheries are still based around a « hunter-gather » genre whereas agriculture replaced the « hunter-gather » sector thousands of years ago. The equivalent change is commencing in marine production systems where aquaculture has been the fastest growing production system globally over the last three decades. However, marine aquaculture is largely contained within the coastal zone – a region coming under increased stress through population growth, recreational use and concerns for the conservation of biodiversity. This coastal zone represents only 8% of the earth's surface.

A brave new world will see the development of offshore marine production systems and these are likely to be multi-sector (e.g. food production, conservation, energy production, tourism). In Australia, a country with the third largest marine jurisdiction globally, this journey is still in its conceptual phase although interest is increasing.

At the global scale there is increasing interest in the oceans and given the rapid pace of technological change, development needs to be controlled so that sufficient research can underpin the development of policy if we do not want to repeat some of the disasters associated with the green revolution. Such research will require strong inter- and trans-disciplinary teams and greater global cooperation.

Keywords: marine production systems, interdisciplinary, transformation

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Theme session B

Coupled ecological, economic and social process understanding of the drivers of change: methods and tools for scenario development and prediction

Parallel session 1 – Monday 30/05 (15h45-17h45)

B1-93

Ecosystem functioning modifications due to the climate change and possible socio-economic implications

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Co-Authors: Simone Libralato (Istituto Nazionale di Oceanografia e di Geofisica Sperimentale OGS - Italy), Jason S. Link (NOAA, Woodshole – USA)

The evaluation of modifications to marine socio-ecological systems, in the context of climate change, represents one of the major scientific challenges facing us. Ecosystem services for coastal societies are expected to be deeply impacted by climate driven modifications. For example, distributional ranges of marine populations will be deeply influenced by climatic changes and anthropogenic pressures, causing conditions ripe for invasive species. However, the success of invasive species depends on local physical and ecological conditions that include temperature and trophic niche availability. To explore the susceptibility of invasives in response to climate change, we used a trophodynamic model for the northern Adriatic Sea (NAS), in which thermal and trophic niches are explicitly represented for each thermophilic non-indigenous (NIS) and native species, while the degree of invasion is represented by simulating a sea surface temperature (SST) increase. Model results showed that effects of warming and invasion produced complex, non-linear changes on biomasses, species or groups of species that are partially substituted by new invasive species, but also some local species that hamper invasion. In order to summarize results from different scenarios, an analysis of the biomass accumulation across trophic levels has been performed, disentangling the effects of different drivers (e.g temperature vs primary production trends). These scenarios were explored relative to possible socio-economic conditions, as they relate to fishing activities and associated revenues. This approach allows us to delineate key patterns of predictability of NIS, highlighting the complex dynamics linked to temperature-driven species invasion', in terms of both the predicted strength of impacts and the direction of biomass change.

Keywords: thermophilic species, ecosystem functioning, cumulative biomass, trophic level, fishing activity
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B1-99

Mitigating eutrophication of the Baltic Sea by steering people's food consumption

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Eutrophication is a major problem in the Baltic Sea. This problem is related to old and current inflow of nutrients from the society, and many people would appreciate that measures are taken to reduce the eutrophication. In Sweden, there is high awareness of the low status of the marine environment.

However, there is much lower awareness of what can be done about the problems, and especially low awareness of what each one can do to contribute to these efforts. One of the drivers of the current flow of nutrients to the sea is the mix of food that people eat, in particular the high intake of animal protein. Hence, it is desirable to find measures to reduce this intake.

The public and private consumption of animal protein is supplied by market actors. These are driven by market conditions although many have environmental goals as well and sustainability is a concept that may function as a selling factor. The actors that dominate the private food market in Sweden are very few. The public consumption (schools, hospitals etc) is supported in their food supply by the public contracts set up by authorities, and steered by political goals. Currently, the environmental goals related to food aim at reducing climate change and increasing the fraction of food that is organic. But there are no measures of any type to address the impact of food habits on the eutrophication of the marine environment.

In this presentation, we assess the potential of reducing nutrient inflow to the Baltic Sea by reducing consumption of animal protein.

Keywords: consumption, marine eutrophication, animal protein

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B1-174

Linking watershed processes to coastal fisheries: ecological and economic effects of nutrient enrichment on the Gulf of Mexico shrimp fishery

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Co-Authors: Martin D. Smith (Duke University - USA) and James M. Nance (NOAA, Galveston - USA)

The northwestern Gulf of Mexico drains the largest watershed in the continental United States via the Mississippi-Atchafalaya river system. Three-fold increases in nutrient loads since the 1950s now result in one of the largest seasonal hypoxic (dissolved oxygen ≤ 2 mg l-1) zones in the northern hemisphere. Hypoxia is most severe during the summer (Jul-Aug) when major fisheries in the region are at their peak, yet the consequences of nutrient pollution for coastal fisheries are largely unknown. We conducted retrospective analyses of long-term survey, landings, and shrimp price data, as well as process-oriented field and laboratory studies to quantify the ecological and economic effects of hypoxia on brown shrimp and the shrimp trawl fishery, historically the most valuable single-species fishery in the region. Brown shrimp avoid severely hypoxic areas but occur at high densities in waters with sublethal oxygen levels near the edge of the hypoxic zone.

Likewise, shrimpers avoid regions of low bottom DO and re-distribute fishing effort to nearby oxygenated waters, presumably in response to changes in the spatial distribution of their target species. These spatially-mediated responses of the shrimp fleet to hypoxia alter catch rates but are difficult to detect in aggregate landings data. Analysis of seafood prices indicates that hypoxia alters the relative price of small and large shrimp, and this shift has economic consequences for the fishery. Our results indicate that spatial- dynamic feedbacks between the natural (shrimp) and human (shrimp fleet) system are critical to understanding how watershed processes influence downstream coastal fisheries.

Keywords: Eutrophication, coastal watersheds, hypoxia, fisher behavior, spatial dynamics, shrimp fishery

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B1-194

Assessing climate change impacts on the small pelagics fishery from the southern Benguela system

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Co-Author: Kevern Cochrane

The southern Benguela system supports a productive fisheries sector including several fishing communities that depend on these resources for their livelihoods. The small pelagics fishery is the second most valuable fishery in economic terms in South Africa. This fishery targets anchovy and sardine, with round herring and horse mackerel as by-catch. Sardine and anchovy have shown considerable variability in biomass and distribution over the last two decades, which resulted in high inter-annual variability of their catches and economic repercussions for the stakeholders in this fishery.

This study aims to explore the impacts of climate change on the biomass of anchovy and sardine, and the socio-economic implications for the management of this fishery using the ABACuS model (Atlantis on the Benguela and Agulhas Current Systems). Climate change scenarios (IPCC RCP 2.5 and 8.5) are simulated using a 100 year time series (200-2099) of physico-chemical parameters derived from the NEMO – MEDUSA 2.0 model.

This study will test different management strategies for the small pelagic fisheries in the context of climate change and evaluates the socio-economic implications of possible changes on the biomass of target species. The results of this work are expected to contribute to identifying adaptive strategies that consider ecological and economic trade-offs for this fishery while strengthening their resilience to climate change.

Keywords: Southern Benguela, sardine, anchovy, small pelagics fishery, climate change
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B1-237

Review of current and future harvest policies for use in projecting climate change impacts on fish and fisheries; a framework for developing Representative Fishery Pathways.

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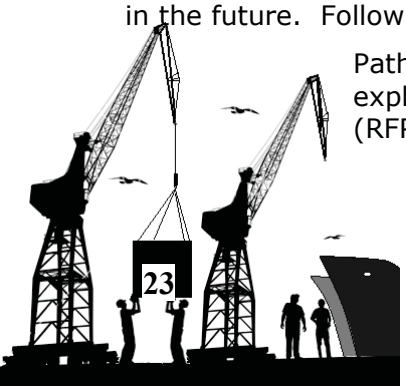
Co-Authors: Alan C. Haynie, Kristin Holsman (Joint Institute for the Study of the Atmosphere and Ocean JISAO, Univ. Washington - USA)

The 5th Assessment Report (AR5) of the Intergovernmental Panel on Climate Change (IPCC) challenged scientists to fully integrate the implications of changing climate conditions within the context of changing anthropogenic responses. In the context of fish and fisheries, this challenge requires the formation of integrated, interdisciplinary partnerships. This requires that regional modeling teams responsible for the development of scenarios of future impacts on fish and fisheries carefully consider the expected changes in harvest strategies that are expected to occur in the future. Following the approach that the IPCC used to develop Representative Concentration Pathways (RCPs), the ICES/PICES Strategic Initiative on Climate Change are exploring frameworks for the development of Representative Fishing Pathways (RFPs).



In support of this global focus on RFPs we conducted a review of the range of potential harvest strategies worldwide, with specific focus on their performance relative to different national value systems. This review catalogs and characterizes the similarities and differences in harvest strategies and provides a starting point for the selection of RFPs for regional modeling teams worldwide. Characteristics of RFPs that should be robust to the expected non-stationarity in ecosystems emerging from climate change are identified. This review provides a foundation for the discussion of what future changes in harvest policies may change. A case study for groundfish management in the Bering Sea is provided.

Keywords: Climate change, harvest policy, fisheries management

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B1-182

Ecosystem-based fisheries management procedures for the Northeast US: coupling ecological and economic models to quantify societal and ecological tradeoffs

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Co-Authors: Sarah K. Gaichas (NOAA, Woodshole - USA), Geret S. DePiper, Robert J. Gamble, Jason S. Link

The performance of options for ecosystem-based fisheries management must be tested with respect to operational objectives that encompass both ecological and socioeconomic goals. We explore alternative status determination criteria and reference points that could simplify fisheries management using a multispecies/ecosystem-based management procedure, and use a set of multispecies and ecosystem models for the Northeast US continental shelf marine ecosystem to demonstrate the approach and evaluate management performance. Components of the management procedure include: (a) specification of ceilings on total removals for the ecosystem and allocation of ceilings to aggregate species groups, (b) minimum stock size thresholds for individual species; and (c) guidance for optimizing the species mix (within aggregates) based on economic risk analysis using portfolio theory. We compare approaches for setting reference points using analyses of threshold responses in economic, environmental, and ecological indicators. The performance of individual species and multispecies aggregates are then compared with respect to yield and biomass objectives. For one end-to-end ecosystem model, we link the harvest output from management scenarios to an input-output regional economic model for the Northeast US to calculate changes in socio-economic indicators (such as jobs and earnings). By defining a hierarchical management procedure that allows for flexibility in the targeted species mix of quota given constraints, it is possible to more simply balance economic and conservation needs, and allow for changing environmental pressures, than a set of individual single-species management strategies. Applied in a multi-model inference context, our worked example provides a framework for evaluating the tradeoffs between management simplicity, risk, yield, and biomass status at both multispecies fisheries and whole-of-system scales.

Keywords: management strategy evaluation, Atlantis, simulation modeling, fishery ecosystem plan, ecosystem model, portfolio analysis, input-output model

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Parallel session 2 – Tuesday 31/05 (10h30-12h30)

B2-196

Marine protected Areas. A dangerous management tool, the case of the Juan Fernández ecosystem.

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Co-Authors: Carolina E. Parada Veliz (University of Concepción - Chile), Billy Ernst.

The lobster fishery in Juan Fernández archipelago is one of the oldest crustacean fisheries in the country and the main economic resource in the Juan Fernández Archipelago. From the mid 1960's to 2000, landings showed a negative trend, which has been attributed to an overfishing effect. Several management strategies have been proposed, including the establishment of a marine protected area (MPA) in the north side of the Robinson Crusoe island (RC). Given the major social and economic implications of this management strategy and the uncertainty about the potential benefits of this initiative, we developed a modeling framework to assess the effectiveness of a MPA using models that simulate the entire life cycle of *Jasus frontalis* and its fishery. A biophysical model for the pelagic life cycle (early life stages), together with a spatially explicit size-structured model for benthic component was used to assess the performance of a MPA. The main results of the MPAs implementation in different areas don't show significant differences with a base case model without MPA for all evaluated performance statistics (catch, average size, recruitment and spawning stock).

The implementation of an MPA in RC should not be recommended for three main reasons: a) lack of a significant effect on the performance variables evaluated in this study; b) high difficulty in the redistribution of fishing effort, mainly due to a complex tenure system of fishing spots; and c) low level of user engagement with this measure which would be on a high level of effort of the fisheries authority in trying to implement it.

In conclusion, the MPA would not have a positive result for the fishery and can have a very negative socio-economic effect in the Archipelago, generating a serious problem for the sustainability, governance and the management.

Keywords: Marine protected areas, Biophysical model, size structured model, Marine tenure, Sustainability, Governance.

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B2-249

Impact of human and climatic drivers over fishing patterns dynamics in a marine protected area: the Galápagos Marine Reserve

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The establishment of marine protected areas (MPAs) represents a potential solution to build resilience in small-scale fisheries. There is well-grounded evidence about the ecological benefits produced by MPAs. However, their human dimensions remain poorly understood, particularly in those developing countries in which the dominance of data-poor fisheries usually precludes employing before-after approaches to assess the biological and socioeconomic outcomes of MPAs. To our knowledge, no study has examined yet how fishers respond to those situations in which, besides the implementation of an MPA, they have to cope with the interaction of different climatic and human drivers of change, and how their adaptive responses could influence the interpretation of no-take zones effectiveness assessments. Every driver of change can produce « cascade effects » on the socioeconomic dynamics of fishing communities, which could lead fishers to adapt their fishing patterns in order to prevent or mitigate the damage on their livelihoods. If the main reasons behind these adaptations are not well understood, a potential bias in the interpretation of the observed patterns could be produced, particularly if the main assumption of a no-take zone effectiveness assessment is that all those adaptations occurred as a result of the establishment of an MPA. In this context, the Galápagos Marine Reserve (Ecuador) represents a unique case study in Latin America to evaluate how local fishing communities coped with the interactions of different human and climatic drivers, before and after the implementation of a marine zoning. We evaluated how the spatio-temporal allocation of fishing effort of three fishing communities was affected by six drivers between 1997 and 2011, including: (1) El Niño 1997/1998; (2) the implementation of a multiple-use MPA implemented in combination with a co-governance and a common property regime; (3) the boom-and-bust exploitation cycle of an alternative fishery; (4) the establishment of a marine zoning; and (5) the most recent global financial crisis. Fishery related data were collected by interviewers (1997-2011) and fishery observers on-board (2000-2006) at the three main ports of Galápagos on a daily-basis. We used geographic information system (GIS) modelling techniques in combination with boosted regression models to identify how different human and environmental factors influenced fisher's behaviour, evaluating the potential management implications of fishing pattern identified. Our results show how the interaction of different large-scale human and climatic drivers have influenced the micro-scale spatio-temporal dynamic of fishing patterns around no-take zones within the Galápagos Marine Reserve.

Keywords: Marine Protected Area, marine zoning, drivers, fishing patterns, Galápagos.

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B2-184

Utilizing the spatial economics toolbox for fisheries to model the economic impacts of fisheries management actions and environmental change

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NOAA Fisheries and partners have developed the Spatial Economics Toolbox for Fisheries (FishSET) to provide better information to managers and the public about the economic tradeoffs among different uses of our marine resources. Economists have modeled the factors that influence fishers' spatial and participation choices to understand the trade-offs of fishing under different conditions. This knowledge can improve predictions of how fishers will respond to the creation of marine reserves, to changes in market conditions, to increases in target or bycatch stock abundance, or to management actions such as the implementation of catch share programs. As well as enabling efficient data organization communication of best practices, FishSET facilitates robust model development, execution, comparison, and interpretation. Here we compare results from projects from around the U.S. in the context of multispecies fisheries and the interaction of target fisheries and protected species. We also demonstrate how FishSET can allow models of fisher behavior to be better integrated with ecosystem and stock assessment models.

Keywords: fisher behavior, discrete choice, location choice, model comparison.

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Parallel session 3 – Tuesday 31/05 (14h00-15h40)

B3-12

The eco² model – a basic bio-economic module describing the dynamics of the cohort biomass to exploitation.

Eckhard Bethke

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The aim of this paper is the provision of a set of simple equations, which can serve as a basic module of an ecosystem and which can be used to describe the dynamics of cohort-biomass to exploitation sequentially. The approach is based on two growth equations, which are commonly used to describe individual mass of fish as a function of time. In the management of wild fish stocks, the von Bertalanffy-growth function is applied, while research in aquaculture primarily refers to a simple exponential growth model. In this study, both models are merged into a single model and a relationship between growth and feed intake was added. The resulting equation in conjunction with the traditional abundance equation offers advantages for modeling of the dynamics of the biomass of a single cohort of a fish stock as a function of assimilation rate, catabolism rate, natural mortality, fishing mortality and time. The approach provides also a simple link between ecology and economy. Model validation was carried out by computing the annual yield per recruit applying the Beverton and Holt yield model. A simple example for limited food resources shows that overstocking generates an economic loss in the same order of magnitude as overfishing. Obviously, it is not sufficient only to protect the fish stocks. Fish needs also feed. This work aims to move this fact more into the focus of fisheries research.

Keywords: Assimilation rate, bio-economic modeling, ecosystem, fisheries management, growth function, stock dynamics, VPA

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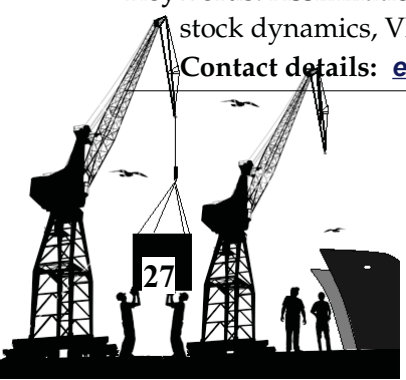

B3-152

A bio-economic agent-based model to investigate trade-offs in quota governance systems in fisheries

Claire Macher

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Co-Authors: Manuel Bellanger, Olivier Guyader, Mathieu Merzéréaud

The question of efficiency of quota governance systems is one of the major issues in the context of the Common Fisheries Policy Reform. Pro and cons of a quota market or of alternative systems have been largely discussed during the process. In France, quotas management is mainly based on a system of pooling and reallocation of rights operated by Producer Cooperatives while market-based management has been rejected by the sector. A bio-economic agent-based model (IAM) is presented in this paper and used in the case of the sole fishery to investigate two alternative systems of governance from a multi-criteria perspective. Biological and socio-economic impacts of a quota- market scenario are compared to the current co-management system relying on Producer Cooperatives. The model integrates biological, economic and social dimensions. It represents individually the interactions between the vessels of the sole fishery through resource and market. The Bay of Biscay sole fishery offers a good example to illustrate existing governance mechanisms for quota management and consequences of possible alternatives in a context of a management plan. Sole fishery is also one of the emblematic fisheries in the Bay of Biscay as being a high valued fishery and being one of the first fisheries where individual quotas were implemented by fisheries cooperatives. The impacts of the two options in a context of management plan towards the Maximum Sustainable Yield, are analyzed in terms of biological and socio-economic viability. Impacts are described in particular in terms of distributional effects and fleet structure. Trade-offs are highlighted and efficiency of governance scenarios are discussed with regards to the challenge of capacity adjustment and initial allocation.

Keywords: Agent-based model, bio-economic modeling, governance, fisheries management, ITQ, quota management, sole fishery in the Bay of Biscay

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B3-157

A Bioeconomic modeling of Sardinella fisheries in Senegal

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A bioeconomic model of sardinella fisheries in Senegal is built. This model is produced to analyze the responses of the fishery (mainly small-scale units but other fishing units types such as industrials units maybe include if necessary) to economic (price, costs), biologic (growth, mortality, recruitment) and management (taxes/subsidies, licenses, spatial regulation) parameters. It focuses on the main small pelagic species caught in Senegal (*S. aurita* and *S. maderensis*). The model is based on an analytical spatial population dynamics model (obtained by virtual population analysis) and a spatial fleet dynamics model (Based on species and fishermen migration and the earnings expectations too). Main model's outputs are catch, revenue, private profit and economic rent, and also the spatial distribution of fishing units.

A first version of the calibrated model and the preliminary analyzes of the results will be presented.
Keywords: Small pelagic, fisheries, Senegal, modeling, bioeconomic.
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B3-163

Understanding the interplay of fishing selectivity and economic drivers for resilience and collapse of an unregulated fishery

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Most bio-economic models aim to give optimal harvest strategies. Unfortunately, many real world fisheries are very far away from such optimum and much closer to the state of collapse. The focus of this study is to investigate the role of economic incentives and behaviour in order to assess the likelihood of fish stock collapse.

Selectivity affects stock resilience in two ways. First, truncated size and age structure of the population reduces its reproductive value. Second, selectivity affects size and age diversity, which is well known to impact population variability. In the light of the ongoing discussion about balanced harvesting, it is an open question whether catching only the largest fish increases or reduces resilience of the stock.

Clearly, there is an interdependency of fishing gear selectivity and open access dynamics. This can promote age and size truncation thus facilitating population collapse.

We compare the selectivity of commonly used fishing gears with an age-structured population model for a cod-like open access fishery. Long term sustainability and profitability of sparing large fish is discussed. We further analyze how harvesting and environmental pressure affect the conservation value and resilience of large fish which can buffer environmental and fishing fluctuations.

Thus, our research illustrates the link between fishing gear selectivity and the dynamics of an open access fishery, indicating a « window of opportunity » for effective fisheries management.

Keywords: gear selectivity, open access, collapse, fisheries management, matrix model
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B3-43

High-grading and over-quota discarding in mixed fisheries

Jurgen Batsleer
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Co-Authors: Katell G. Hamon (Landbouw Economisch Instituut LEI, Wageningen Univ. - Netherlands), Harriet M. J. van Overzee (IMARES/Wageningen Univ. - Netherlands), Adriaan D. Rijnsdorp, Jan Jaap Poos

High-grading is the decision by fishers to discard fish of low value that allows them to land more valuable fish. A literature review showed high-grading is reported in commercial and non-commercial fisheries around the world, although the number of observations is small. High-grading occurs in fisheries that are restricted to land their total catch due to management, market or physical constraints. Using the mixed flatfish fishery as a model system, a dynamic state variable model simulation showed that high-grading of certain grades occurs throughout the year when their ex-vessel price is low. High-grading increases with the degree of quota restriction, while the level of over-quota discarding is unrelated to the quota level. The size composition of the high-graded catch differs from the landed catch. Due to the differences in the seasonal variation in size specific ex-vessel price, the effect of quota restrictions on the size composition of the discarded catch is nonlinear. High-grading is difficult to detect for the fishery inspection as it occurs on-board during the short period when the catch is processed.
We conclude that high-grading is under-reported in fish stocks managed by restrictive quota, undermining the quality of stock assessments and sustainable management of exploited fish stocks.

Keywords: By-catch, Discards, Common fisheries policy, Fisheries management, Flatfish
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Parallel session 4 – Tuesday 31/05 (16h00-17h40)

B4-77

Exploring socio-ecological models of fishery management using multi-agent social simulation

Samaneh Heidari
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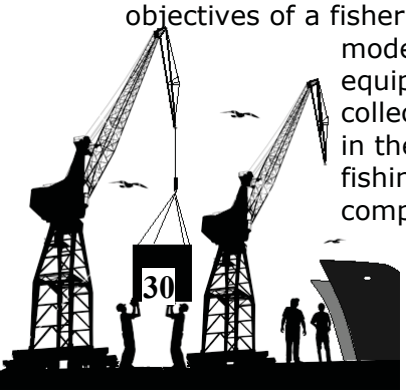
Co-author: Frank Dignum

Nowadays, policy makers start realizing that fishery management does not only include the catching of fish (e.g. the conditions of resources, technologies, economy) but also considering the social structure of the fishing communities. Thus, the fishery industry should be modeled as a complex socio-ecological system (CSES). In such a system, almost all of the elements are influenced by social phenomena such as culture and social norms. In the real world, people decide and act based on the feedback that they get from other people. For example, one of the significant objectives of a fisherman is to maintain profit. In a community of fishermen, if a fisherman buys a modern boat, his neighbors will be inclined to compete and invest in new equipment. However, in a collectivistic culture, a new boat might be bought collectively and benefit all. Thus, the existing social norms play an important role in the development of the fishing industry, its ecological impacts, and the effects of fishing policies. As an another example, we know that men are (on average) more competitive and women are more directed to long-term well-being. Due to physical



constraints more men worked on boats because more strength being needed on the boats for fishing. At a certain moment, this situation has turned into a social norm of the fishing communities. However, this norm might become unnecessary long after technological advances make this restriction obsolete.

This raises new questions such as: How long does it take for the norm to change over time? What are the consequences of the norm for the industry and ecosystem? Could more women on the boats lead to a sustainable fishing practice? We aim to include social norms in our CSES simulations used to support policy makers as they are very influential factors in the effectiveness of policies.

Keywords: Socio-ecological model, complex system modeling, multi-agent simulation, social simulation.

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B4-84

Bio-economic model-based scenarios for the management of the shrimp fishery in French Guiana facing global change

Fabian Blanchard
(IFREMER, Cayenne – France)
Co-authors: Christian Chaboud (IRD - France), Olivier Thébaud (IFREMER, Plouzané - France)

The French Guiana shrimp fishery has known dramatic evolutions driven by global changes: the globalization of the shrimp market, with trends in prices, and the long-term increase in fuel prices, and hydroclimatic modifications linked to climate change leading to decreased recruitments of the shrimp.

In 2008, a bio-economic model of this fishery was developed to analyze its dynamics based on field data from the nineties up to 2006. Simulations were based on scenarios of changes: prices decreasing for small sized shrimp, stable prices for medium ones and increasing prices for large ones, fuel price increasing, and a decrease of the incentives, with a stable recruitment. These simulations led to a strong decrease of the number of boats, leading to an increase of the stock.

In 2015, the real observed trajectories of the key drivers and the responses of the fishery were compared to those simulated in 2008. The fuel value finally increased more slowly than previously thought because of a strike, the incentive increased because of political actions, and the shrimp price increased because of the conjunction of ending of the economic crisis and natural factors. Finally, the recruitment went on decreasing. This resulted in a number of boats corresponding to that predicted but the stock still showing a decreasing trend.

Conclusions are brought about our capacity to build more realistic scenarios for economic and ecological key drivers. If introducing uncertainty in the models is a way to give a wider range of possible future trajectories, we need to know if scenarios have to be pessimistic or optimistic. Increasing knowledge about the dynamics of the key drivers such as social and political awareness, sea-food market and climate change effects on resources is then necessary.

Keywords: Tropical shrimp fishery, seafood market, climate change, simulation

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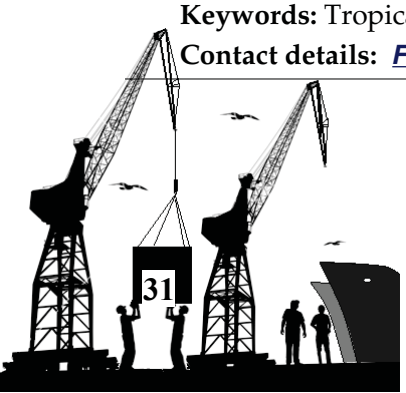

B4-100

Towards an effective social-ecological approach of fisheries management in coral reefs

Mélodie Dubois
(Centre de Recherches Insulaires et Observatoire de l'Environnement CRIOBE, Perpignan – France)

Co-author: Joachim Claudet

Worldwide, fisheries provide benefits to many countries, especially in tropical environments where exploitation of reef marine resources provide to coastal communities valuable services such as food and economic security, and contribute to their societal and cultural identity. However, coral reef ecosystems evolved under several natural disturbance regimes which, combining with increasing multiple human stressors, may cause irreversible shifts in community structure, and thus in the delivery of ecosystem services.

While the conservation of coral reefs is generally recognized as a priority, fisheries management plans are often poorly efficient for the simple reason that they omit the local socioeconomic and social-ecological context that influence how societies interact with coral reef ecosystems.

The ways that communities use marine resource through fishing is socially complex, especially in coral reef systems where attachment to fishing is not only driven by economic motivations but also by social (fishing to eat) and cultural (fishing for identity) . While some recent modelling approaches to fisheries attempted to incorporate more variability into the human dynamics through, for instance, fisher decision-making processes, such approaches have never been applied for decisions motivated by goals other than only economic benefits. Furthermore, little is known about how changes in ecological state may in return influence fishers' decision-making.

With the objective to better integrate the human dimension into fisheries recommendations, we developed a model that assesses not only the direct fisheries impacts on the ecosystem but also address how fishing pressure is driven by changes in the social-ecological system.

Based on a case study in Moorea island (French Polynesia), we show how a tropho-dynamic model (Ecopath with Ecosim) can be improved with social and economic data to better inform fisheries management.

Keywords: Tropho-dynamic model, Social-Ecological Systems, Coral reef fisheries, Phase Shift, Fisheries management, Feedbacks, Complex Systems

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B4-20

Exploring socio-ecological systems with Bayesian belief networks: Examples from the Pacific and Southern North Sea

Dr Vanessa Stelzenmüller
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Co-authors: Pierre Leenhardt (France Filière Pêche - France), Joachim Claudet (CRIOBE - France)

An in-depth understanding of the dynamics of socio-ecological systems (SES) is the key for a sustainable implementation of an ecosystem-based management of marine areas. Often the assessment and dynamics of SES can be broadly characterized as cross-scale, non-linear and uncertain. Thus integrated and flexible modelling approaches are required to both address trans-disciplinary research questions and combine various data sources. Here we demonstrate the use of

spatial explicit Bayesian belief networks (BNs) to assess alternative management options for two case study areas in the Pacific and Southern North Sea. Building on a participatory modelling approach we modelled the linkages between key pressures and ecosystem state for the lagoon and fringing reef of Moorea Island, French Polynesia. Results showed potential risks for coral reefs and related ecosystem services due to changes of economic and environmental drivers. For the southern North Sea case study we combined a BN with Geographic Information System (GIS) to assess changes of the disturbance of benthic communities due to trawling activities of primary fishing fleets. This innovative approach allowed us to indicate areas where the risk of benthic disturbance would likely increase or decrease as result of potential spatial management measures such as the development of offshore renewables and a related spatial shift of benthic trawling. We conclude that the use of BNs give valuable insights into the cause-effect pathways and interrelationships of key elements of a given SES. Predicted uncertainties can inform stakeholders and management alike to support the definition of management priorities and allow for risk based decision-making.

Keywords: Bayesian belief networks (BNs), evaluation, risk, spatial management, uncertainty

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B4-223

Quantitative analysis methods to explore relationships between recreational uses and biodiversity in a Marine Protected Area network context: Case study of New-Caledonian lagoon.

Charles Gonson
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Co-authors: Dominique Pelletier, Jocelyne Ferraris, Frédérique Alban

Recreational activities in coastal area are increasing worldwide through tourism and demographic development. Coastal managers seek to reach environmental goals (e.g. biodiversity protection, resources management) as well as social ones (e.g. sustainable uses, experience quality). Relationship between recreational users and the natural environment is both multiple and reciprocal. In one hand recreational users are seeking for a given combination of biophysical, managerial and social condition according to their activity and characteristics and in another hand, they engendered impacts on these conditions. Assessing such relationship could adapt management measure to be more effective. Unfortunately, lack of data on biodiversity and uses at comparable scale (temporally and spatially) are often lacking, even more for recreational uses.

In a Marine Protected Area network in a coral reef lagoon near urbanized inland area with islet and reefs which are popular destination for recreational users and encompass diversity of setting's types. We collected data on a seven year period on marine biodiversity (remote sensing camera) and on recreational uses (boat-count survey and *in-situ* face-to-face interview) with protocols adapted to managers needs and constrains. Using a spatial reference framework, metrics of biodiversity and pressures engendered by recreational users is computed at fine to larger spatial scales (from habitat to MPA network). Quantitative models were used to assess impact of recreational users on biodiversity while recreational opportunity spectrum was used to assess potential effects of biodiversity changes on spatial distribution of recreational users.

Our presentation will focus on methods allowing assessment of recreational users/biodiversity relationship from observation protocols to quantitative assessment.

Keywords: Recreational uses, Marine Protected Area, Impact assessment, Coral reefs, Biodiversity, Recreational opportunity spectrum

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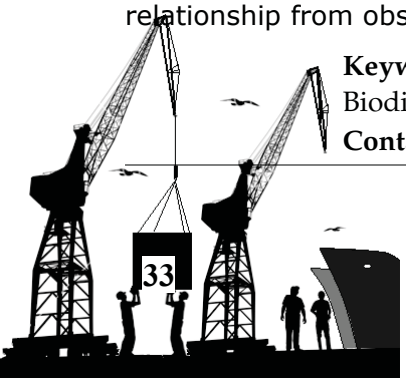

Parallel session 6 – Wednesday 01/06 (13h30-15h30)

B5-131

A new conceptual framework to investigate social-transformations of marine social-ecological systems

Sebastián Villasante Larramendi
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Co-authors: Olivier Guyader (IFREMER, UMR AMURE - France), Marta Coll (IRD, UMR MARBEC - France), Katia Frangoudes (UBO - France), Bibiana García Soto (USC - Spain), João Garcia Rodrigues, Priscila Lopes (Federal Univ. of Rio Grande do Norte - Brasil), Gonzalo Macho Rivero (Univ. of Vigo - Spain), Cristina Pita (UoA – Scotland, UK), Graham John Pierce, Olivier Thébaud (IFREMER, Plouzané - France), Begoña Santos (Instituto Español de Oceanografía IEO - Spain), Edelmiro Ulloa Rodríguez (Cooperativa de Armadores de Vigo ARVI - Spain)

Although there is general agreement that understanding how humans use oceans is an essential component of marine resource planning and management, the associated social transformations are still largely unexplored. A new conceptual framework is proposed to identify the nature, scale, magnitude and immediate outcomes derived from social transformations experienced by key social actors in the field of marine social-ecological systems (MSEs). The framework shows that multiple and often-interconnected drivers (i.e., collapse of fish stocks, introduction of fishery regulations, major economic shocks, etc.) can create large and abrupt shifts in social system's structure and behaviour, which may feed back into the ecological system. The framework will provide stakeholders and policy makers with key basic information about local dynamics of MSEs currently unavailable in integrated ecosystem assessments, and contribute to better understand the adaptive strategies social actors have been developing over time to deal with changes in marine ecosystems. The framework is intended to also identify innovative early-warning indicators and appropriate actions that enhance societal resilience and adaptive governance and, ultimately, reduce the danger of social failure to marine policies.

Keywords: social transformations, social thresholds and innovation, marine social-ecological systems
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B5-67

Coupling of socio-ecological systems from the supply side: exploring inter-relationships between ecosystem state and capacity to support services

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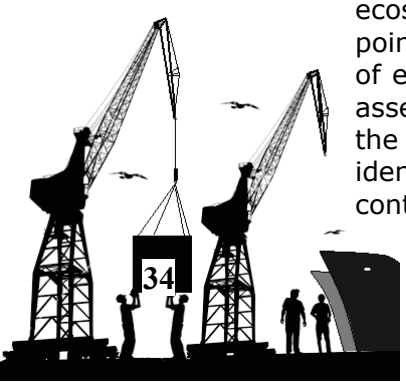
In this paper we focus on work that is helping to develop the understanding of socio-ecological systems from the perspective of exploring how supply of ecosystem services might vary with state of ecosystem components. The starting point was an assessment that was developed to look at drawing in understanding of ecosystem state-service relationships to operational policy-relevant ecosystem assessment at European regional sea scales, in response to the requirements of the EU Biodiversity Strategy. The assessment consists of three key steps: (1) identifying all the linkages where a marine ecosystem component can potentially contribute to the supply of a marine ecosystem service; (2) a critical pathway



analysis to identify the major ecosystem component(s) contributing to the supply of a given service; (3) interpreting available indicator information on the state of contributing ecosystem components with knowledge of the state-service relationship, to assess the potential capacity for service delivery. The assessment can be explored in terms of current capacity and likely future trends given scenarios on changes in relevant drivers (including management scenario evaluation). It provides a common approach that can be applied across regions and in data rich or data poor situations. We discuss how our work on the supply side can help inform overall understanding of the dynamics of marine socio-ecological systems, also commenting on steps we are taking to consider resilience, vulnerability and adaptive capacity in this relationship.

Keywords: ecosystem services, assessment framework, supply-side, marine ecosystem state, marine policy, biodiversity strategy, regional seas

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B5-210

Transitioning through the looking-glass in natural resource management

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There is a long history of observing, analysing and modelling individual species and the ecosystems they form part of, both to improve understanding and management of natural systems. This has largely been done considering natural populations and ecosystems as unconnected from humans, apart from direct removals such as through fishing, hunting and harvesting. However, humans are integral components of global natural resource use systems but are mostly ignored in natural resource management models. Here we show how understanding human species as an integral part of the ecosystem, is increasingly playing a critical role in advancing understanding of the functioning of ecosystems, but also in and supporting decision-making to better manage individual resources and the broader systems they are in. Our first example uses the Torres Strait tropical rock lobster (*Panulirus ornatus*) fishery as an illustration of a Management Strategy Evaluation (MSE) application that simultaneously integrates social, cultural, and political aspects with economic and biological considerations. Our integrated analysis advances efforts to quantify and make explicit the trade-offs in the impact of alternative management strategies on social and cultural outcomes, traditional fisher aspirations, economic profitability and resource status – the « triple bottom line » sustainability objectives. Our second example focuses on the development of a framework for dynamically modelling the two-way feedbacks between ecological and human systems as part of broader socio-ecological frameworks. We use MICE (Models of Intermediate Complexity for Ecosystem assessment) together with a Sense of Place Index (SoPI) that allows the quantitative integration of environmental psychology into socio-ecological models. We motivate for scientifically documenting and analysing the two-way feedbacks between human users and natural systems. One way to achieve this is to objectively place ourselves on both sides of the looking-glass, as dynamic variable and analyst, in natural resource management models.

Keywords: socio-ecological models, MSE, triple bottom line, sense of place, traditional fisher, MICE, intermediate complexity model

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B5-132

Complex and interconnected drivers in marine social-ecological systems: local evidence of social transformations in European fisheries

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Most of the research done on marine social-ecological systems (SESs) has focused on the ecological processes and dynamics of marine ecosystems, and the natural and human drivers which impact on the ecosystems. However, it is difficult to address today's great challenges in global marine change and sustainability without a better understanding the social consequences of ecosystem changes, i.e. of how real and enduring social transformation comes about and how it can be initiated, promoted or redirected. This paper documents large and abrupt social transformations of SESs in Europe which occurred over the last decades due to deep, complex and interconnected drivers (e.g., stock status, climate change, EU regulations, economic and financial crisis, seafood market changes) impacting marine resources and ecosystems. We carry out a literature review of the social transformations of SESs combined by a consultation to experts who are engaged in the social dimensions of marine ecosystems. Case studies from France, Portugal, Spain and the United Kingdom are used to illustrate these social transformations, in systems that include a wide range of large and small-scale fisheries with diverse socioeconomic characteristics targeting different commercial species (pelagic, demersal, crustaceans and molluscs) under a variety of fisheries management systems and tools (TAC, ITQs, co-management, fishing effort) in the EU. The paper provides local evidence of the socioeconomic impacts of these transformations currently unavailable in marine SESs assessments that are key for successful delivery of EU policies and regulations.

Keywords: social transformations, narrative analysis, marine social-ecological systems, European Union
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B5-181

Spatial-temporal analysis of official Portuguese landings between 1989 and 2014

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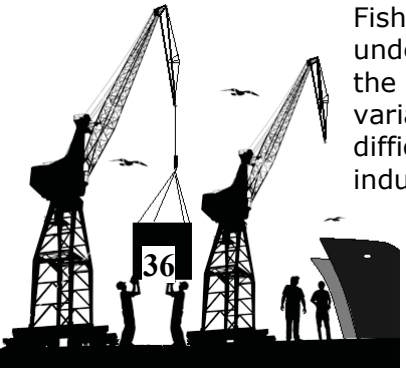

Fisheries catch show strong variations over space and time. Spatial variations are underpinned by the spatial distribution of the populations, which itself depends on the distribution of suitable benthic and pelagic habitat patches. Temporal variations are controlled by a variety of factors -which interact in ways that are difficult to unravel- such as natural climatic fluctuations, anthropogenically-induced climate change, biological interactions, and trends in fishing pressure and

economic incentives. In the Portuguese coast, long term trends in fishing landings have been observed, which are correlated with changes in seawater temperature (warm water species show an increasing trend; the reverse occurs for species with temperate affinity) and during recent years a steady decline of sardine recruitment has been observed, with a parallel decrease of spawning stock biomass. In this work we look at the recent spatial-temporal patterns of landings at the ports of Portugal, from 1989 to 2014. To this end we employ a three-mode principal component analysis (3-mode PCA), which allows us to disaggregate the variance of landings into separate modes (i.e. spaces: species, years, ports), and to analyse the interdependence between the modes. Hence, from the temporal point of view, we define different periods of activity in fishing activities, and determine which are the factors affecting the different intensities of the activity. From the spatial perspective, we examine the differences between regions and seek for plausible explanations for these patterns. And finally, the biological information give information on the patterns of exploitation through the different ports and during the period of study. These analysis will be carried out considering three different gears (trawling, purse-seine and multipurpose), so this incorporates a fourth axis of variation in our study.

Keywords: Fisheries, Portugal, 3-mode PCA, Principal component analysis, trawling, purse-seine, multi-gear

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B5-251

Reducing Illegal Fishing Using Behavior Change Interventions.

Willow Battista

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Illegal, Unreported, and Unregulated (IUU) fishing is a serious problem that threatens the sustainability of fisheries around the world. Historically, policy makers and fisheries managers have relied on « deterrence models » to address the problem of IUU fishing through the imposition of stricter sanctions and improvements to monitoring and enforcement programs in an attempt to increase the costs of illegal behavior. Experience and scientific research show that non-monetary factors, whether they be personal, cultural, social or psychological, can influence and encourage illegal fishing behaviors. Failing to address these factors can undermine the efficacy of an otherwise effective and well-designed fishery management system. Furthermore, in many of the world's fisheries, and indeed in most of the world's small scale and/ or developing fisheries, strong and reliable monitoring and enforcement has proven to be an elusive goal. In such cases, interventions designed to address the social, moral, and cognitive drivers of illegal behavior can potentially supplement conventional deterrence methods. We describe insights from the behavioral sciences derived from an extensive literature review that may be applicable to the design of interventions aimed at strengthening social incentives and psychological motivations for complying with fishery regulations. We also describe a process for designing such interventions which starts with in-depth stakeholder characterization to capture existing norms, beliefs, and modes of thinking about illegal fishing. Potential interventions that may disrupt undesirable beliefs, norms, and thought modes are then developed by applying principles gleaned from the behavioral science literature. Testing is conducted using artifactual experiments (with small groups of actual stakeholders) and games prior to piloting and scaling. Preliminary work in small-scale fisheries of the upper Gulf of California is used to illustrate these principles and the intervention design and implementation process.

Keywords: Decision science; Behavioral Science; Behavioral Interventions; Illegal Fishing; Social Norms; Cognitive Biases

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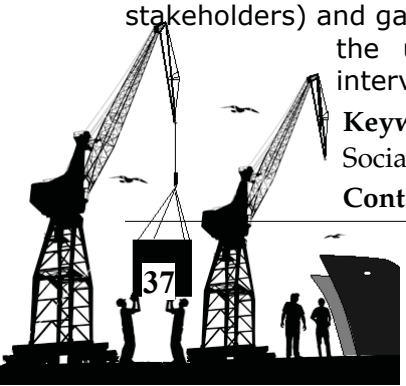

Parallel session 7 – Wednesday 01/06 (16h00-17h40)

B6-30

La Machine Infernale—How the Interplay of Social, Ecological, and Environmental Factors Influences the Observability and Controllability of Fishery Social Ecological Systems

Keith R. Criddle
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The sustainability of fisheries and fishery dependent communities is dependent on the intrinsic characteristics of ecological and environmental systems that govern the response of fish stocks to environmental forcing and exploitation as well as the intrinsic characteristics social, economic, and legal systems that determine who is allowed to fish and how fishing takes place. Some fisheries and fishery dependent communities have proven resilient to changes in fish abundance and distribution, changes in exvessel prices, changes in the cost of factors of production, changes in macroeconomic conditions, changes living costs and employment opportunities within the community, and demographic changes.

Factors that affect resilience are illustrated by reference to sub-Arctic fisheries that have weathered or recovered from the influence of adverse forcing and others that have not. Key factors are within the scope of fisheries policy include tradeoffs between economic efficiencies associated with specialized single species fisheries and heightened sensitivity to variations in the magnitude or unit value of that species. In contrast, generalist fleets trade reduced economic efficiency for reduced exposure to losses associated with variations in the abundance or value of any one species. Durable individual entitlements to shares of the allowable catch increase profitability and help fishermen adapt to modest adverse changes in stock abundance, exvessel prices, and input costs but these highly constrained management strategies reduce resilience to non-stationarities and large perturbations. In addition, while durable entitlements increase choice and therefore resilience from the perspective of individuals, they decrease the resilience of some fishery dependent communities.

Keywords: observability, controllability, fishery social ecological systems, fisheries governance

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B6-22

Overview of the Marine Ecosystem Health and Human Well-being (MarWeb) project

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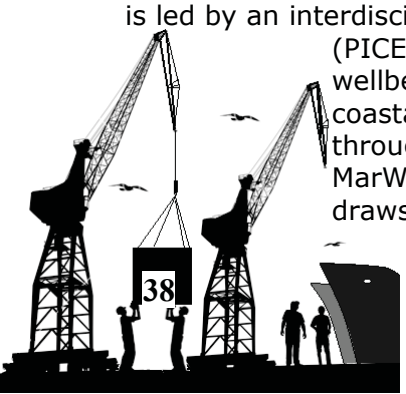
This presentation provides an overview of and initial results from the 5-year « Marine Ecosystem Health and Human Well-Being » (MarWeb) project. Funded by the Japanese government, MarWeb is led by an interdisciplinary science team from the North Pacific Marine Sciences Organization (PICES). MarWeb is guided by the Japanese concept of a « Sato-umi », and by the wellbeing analytical perspective. Sato-umi management systems describe specific coastal areas where biological productivity and ecosystem health has increased through human interaction. With a research focus and development/aid mandate, MarWeb has adopted a multi-pronged approach to the project. The first prong draws on the psychology literature and well-being definitions from UN Millennium



Ecosystem Assessment to implement a comparative survey of perceived wellbeing (as it relates to the sea) in PICES member countries. The second prong focuses specifically on Karawang, Indonesia. In the 1990s, intensive shrimp aquaculture in the area led to mangrove deforestation, pollution, disease, and pond abandonment. In collaboration with the Agency for the Assessment and Application of Technology of Indonesia, MarWeb is studying the potential for integrated multi-trophic aquaculture (seaweed, shrimp and fish) to promote lower emissions of deleterious materials into the natural environment and to provide alternative sources of protein and livelihoods. This work is complemented with characterizing the complex commodity chains associated with seafood products and how a shift towards IMTA might reverberate through those chains to affect well-being. The third major prong is in Guatemala and involves collaborating with researchers at the University of San Carlos, Guatemala City, and with the Integral Fisheries Cooperative, to test the feasibility of growing, processing and marketing Crassostrea gigas (mangrove oyster) using a multi-trophic integrated approach. This work is complemented with a community needs assessment to better understand how access to seafood (from fishing or aquaculture) affects well-being.

Keywords: well-being, integrated multi-trophic aquaculture;

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B6-30

Disentangling seafood value chains: tourism and the local market driving small-scale fisheries in São Vicente, Cape Verde (West Africa)

João Garcia Rodrigues
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Co-author: Sebastián Villasante Larramendi

This study maps the structure of the value chains of fish and marine invertebrates caught in small-scale fisheries of the island of São Vicente, Cape Verde (West Africa). This paper also examines the main drivers behind the seafood trade on the island. Specifically, it shows how these drivers shape the preferences for certain species and how they affect the distribution of income among agent groups involved in the seafood trade. To collect this information, interviews were done with fishers, small-scale traders, market vendors, and restaurant owners, in four fishing communities of the island of São Vicente, during July and August 2015.

The results of this study show that socioeconomic drivers such as tourism and the local market affect the exploitation of a wide variety of marine species, from small demersal low-trophic fish and marine invertebrates, to large pelagic high-trophic fish species. Tourism was also found to drive the unequal distribution of income among agent groups. Restaurant owners, due to their direct access to tourist consumers, are able to charge prices and generate incomes one order of magnitude higher than those of fishers, small-scale traders and market vendors. These findings are useful to understand local social-ecological dynamics that need to be taken into account for designing management strategies able to improve small-scale fisheries and their related value chains.

Keywords: seafood trade, value chain, small-scale fisheries, social-ecological system, Cape Verde, West Africa.

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Parallel session 8 – Thursday 02/06 (10h30-12h30)

B7-25

Changes in fishing behaviour of two fleets under fully documented catch quota management: same rules, different outcomes.

Edwin van Helmond
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Co-authors: Chun Chen, Brita K. Trapman, Marloes Kraan, Jan Jaap Poos

Catch quota management (CQM) is increasingly being proposed to encourage selective fishing practices. In CQM all catches are counted against quota, in contrast to landings quota management, where only landings are counted against quota. However, little is known about how CQM changes fishing behaviour exactly. A number of studies used models to forecast fishing behaviour under a CQM. Often those models used simplifying assumptions in the absence of data from implemented CQM and as a consequence important elements in the rationale of fisher behaviour are potentially overlooked. A Dutch pilot study of fully documented fisheries provided the opportunity to observe actual changes in fishing behaviour under CQM. Interviews with fishers in the pilot study aided in interpreting the results and giving insight in the decision making process and reasoning of fishers. The CQM pilot study entailed, a fleet of small bottom trawlers and a fleet of large demersal seiners. For these vessels, all cod catches were counted against quota, including catches of individuals below minimum landings size. To obtain reliable catch data all vessels were equipped with electronic monitoring (EM) systems, recording videos of all fishing and processing activities on board. In return, fishers received a 30% quota bonus for cod and were compensated with more flexibility on effort regulations. We hypothesized that vessels in the CQM will (i) increase their landings by 30% according to their quota bonus, (ii) increase the use of gear with large mesh size, and (iii) change effort towards fishing locations with high catch rates of large cod and avoid areas with high catch rates of undersized cod. To analyse the changes in landings and mesh size usage in the pilot study a before-after control-impact (BACI) study was used. Changes in fishing locations were compared to abundance estimates of research vessel surveys. The results show that CQM had no effect on fishing behaviour of the small vessels. In contrast, large vessels significantly increased their cod landings (216%) and avoided undersized cod. This difference in response of different fleets suggest that implementation of CQM, for instance in the context of the European common fisheries policy, should consider fleet characteristics.

Keywords: catch quota management, fully documented fisheries, fishing behaviour, landing obligation, mixed fisheries, electronic monitoring, North Sea cod.

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B7-44

Mixed fisheries management: Is the ban on discarding likely to promote more selective and fuel efficient fishing in the Dutch flatfish fishery?

Jan Jaap Poos
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Co-authors: Jurgen Batsleer (VisNed and IMARES/Wageningen Univ. - Netherlands), Adriaan D. Rijnsdorp (IMARES/Wageningen Univ. - Netherlands), Katell G. Hamon, Harriet M.J. van Overzee

We model the potential effects of a discard ban on the annual fishing strategy of individual fishers in a mixed fishery under individual quota management. The North Sea beam trawl fishery, which catches large amounts of undersized plaice, is used as a model system. Under a discard ban, fishing is restricted to the fishing grounds and weeks where the maximum revenue can be realised with other species while catching the quota of the restricted species with a reduced bycatch of

undersized fish. Model results suggest that, if properly enforced, a discard ban provides an incentive to implement more selective fishing gears that catch fewer small fish and are more fuel efficient (pulse trawl). If a discard ban is not properly enforced, restrictive quota do not necessarily result in the intended decrease in discarding as the fishery continues to fish while discarding the over-quota catch and least valuable size classes caught.

Keywords: landing obligation, Beam trawl, Pulse trawl, Quota

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B7-53

Development of a new agent-based model for the exploration of fisheries management approaches; incorporating fisher behaviours

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Fisheries are complex coupled social-ecological systems, but ecological aspects often receive greater research attention. We present a new mechanistic agent-based modeling platform aimed at incorporating fisher behaviour in to a fuller description of the system. Behaviour is specified at the vessel level and each vessel in the model makes daily fishing decisions based on relatively simple incentives, using knowledge of its own cost structure and catch history, and the histories of catch and quota markets. The model is calibrated to a simplified representation of the U.S. west coast groundfish fishery.

Highly realistic macro-patterns of vessel behaviour emerge under a wide range of simulated policy-combinations. For example, our vessels naturally « fish the line » to benefit from spillover from marine protected areas (MPAs), but they avoid the line when either individual transferable quotas (ITQs) or landing taxes are used in combination with MPAs that protect bycatch hotspots. With ITQs, we find emergent lease prices to have realistic sensitivities to species' relative abundances and catch quotas.

These model experiments indicate that agent based modeling approaches hold much promise for simulating fisher behaviours and reducing the uncertainty that can affect management performance. Additional processes affecting behaviour, informed by surveys, are continually being added to the model. Further coupling of the fisher behaviour model to a spatial ecosystem model will provide a fully integrated social, ecological, and economic model for policy exploration.

Keywords: fisher behavior, human dimension, fisheries management, agent based models, complex systems

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B7-199

Towards a better understanding of fisheries behaviour

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Co-authors: Adriaan D. Rijnsdorp, Katell G. Hamon, Jan Jaap Poos

Successful fisheries management requires a thorough understanding of « fishers' behaviour », the collective set of decisions made every day on board of fishing vessels. Sudden and drastic changes in fisheries management, as e.g. in the case of the current implementation of the European landing obligation, poses the challenge whether our current knowledge of fishers' behaviour is sufficient to forecast changes in fisheries. For now, most will agree that it is unclear how fishers will respond to new rules and regulations.
This paper will review different approaches to understanding fishers' behaviour from the different sciences (biology, economy and social science). We describe studies where qualitative methods from social sciences such as interviews and participative observation help understand observations of changing fishers' behaviour that can be used to develop predictive models of the dynamics of fishers.
In general, it appears that when qualitative information is used, it is collected in support of quantitative information which is collected systematically through fisheries data collection frameworks. A more systematic collection of qualitative data on fishers' behaviour may improve our understanding and improve forecasts of the response of fishing fleets to changing policy.
Keywords: qualitative methods, landing obligation, fishers' behaviour
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B7-128

An Agent Based Model of the South African Offshore Hake Trawl Fishery that Examines the Relative Importance of Drivers

Rachel Cooper
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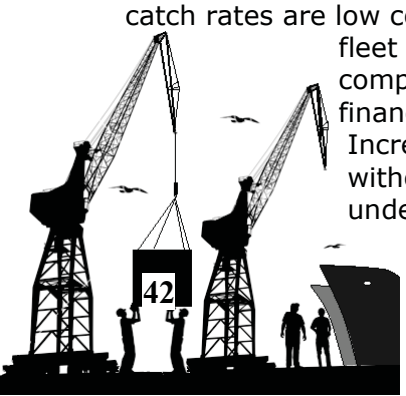
The complex interactions and relative importance of drivers like fuel price and environmental variability are important to South Africa's offshore demersal hake trawl fishery and its profits. The offshore trawl is the largest sub-sector of the hake (*Merluccius capensis* and *M. paradoxus*) directed fishery, accounting 85% of the catch. The hake fishery generates ~30 000 jobs and comprises more than 50% of the country's total fisheries value. HakeSim, a novel agent based model of the offshore hake trawl industry, has been developed in NetLogo 5.0.1. Its purpose is to allow for exploration of scenarios that examine trade-offs and interactions between various drivers to provide insights of value to decision makers and stakeholders. Clear interactions of variables such as total allowable catch, catch per unit effort, (a proxy for) environmental variability, fuel price, foreign exchange rate and market factors emerge from the model. Low catch per unit effort and high fuel prices can lead to financial losses. These can be partially mitigated through increased hake market value achieved through product displacement. When allocated catches are high and catch rates are low companies make a loss, which can be reduced by having a somewhat larger fleet size. The present fleet size of industry may have been chosen to ensure companies continue to catch quota, meet contractual obligations and reduce financial losses in such situations.
Increasing the proxy for environmental variability increased risk to all companies without increasing profits. This warrants further investigation given that HakeSim underestimates the multiplicity of environmental stochasticity effects on processes



such as hake recruitment in the real world. It would be valuable to incorporate more realistic environmental effects and feedbacks with industry.
HakeSim has therefore been designed in a way to facilitate linking it to an ecological (e.g. ecosystem) model in future.

Keywords: agent-based model, model development, hake trawl, fishery, economic-ecological system

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B7-81

Understanding investment in innovative fishing gears to improve the uptake of new technology

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The benthic ecosystem provides important ecosystem goods and services. It provides habitat, spawning grounds and food for bottom dwelling fish species which contribute about 50% of the landings in the North-East Atlantic. However, fishing, and particularly the towed bottom contact gears used on the continental shelf, have a major impact on benthic ecosystems. Therefore technical and management measures are being developed in an attempt to lower the impact of fishing on the sea bottom. In this study we look at the North Sea flatfish fishery. The traditional gears used in the fishery are beam trawls, gears that lay heavily on the bottom and are expensive to operate due to the associated high fuel consumption. In recent years, the Dutch part of the fishery underwent a deep transformation and alternative gears have been increasingly used. The transformation was initially driven by the increasing fuel prices worldwide: fishers choosing lighter trawls with better fuel efficiency. Being lighter, those alternative gears rest less on the bottom and therefore have a lower impact on the benthic ecosystem. To evaluate the adoption and economic viability of alternative gears, we investigated the investment behaviour in such gears with a model. The results of the study suggest that although the economic performance of alternative gears is important in the decision to invest, the uptake of innovative gears could not only be explained by a change in profitability. Thus additional drivers have played a role in the investment decisions. Knowing the expected change in profitability, investment barriers as well as incentives to invest can help implement management measures to stimulate investment in innovative gears.

Keywords: investment, model, interviews, drivers

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Theme session C

From data to indicators to reference points and performance evaluation

Parallel session 1 – Monday 30/05 (15h45-17h45)

C1-209

Purse seine tuna fisheries in the South Pacific: Mapping the distribution of their benefits around the globe

Evangelia Drakou
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Co-authors: John Virdin (Nicholas Institute for environmental policy solutions, Duke Univ. - USA)

Purse seine tuna fishery is prominent in the West and Central Pacific Ocean (WCPO) region since the 1950s. The amount of tuna being caught in the area increases almost exponentially every year with most of it being skipjack and yellowfin, followed by bigeye and albacore. The benefits generated from fishing these stocks accrue to different groups of people from the local fishermen and the canning and loining companies, to the final consumers who receive the nutritional value of the tuna. In this work we assessed and quantified the benefits generated throughout the purse seine tuna fisheries supply chain, to better understand the interactions of the different actors and how this influences the distribution and access to benefits.
To do this, we deconstructed the supply chain from the point of harvest till the final phase of tuna consumption. For each component of the chain we identified the direct and indirect costs and benefits and the scale and location of different beneficiary groups (e.g. fishermen, loining companies, canning companies, consumers in the USA and EU). We spatially represented the supply chain on a global map that shows the impact the WCPO fisheries have globally in terms of financial and nutritional benefits. Most of the financial revenues coming from the WCPO region accrue to the retailers and the canning companies in USA and EU, while the highest nutritional value is also received in EU and USA. Our approach revealed that although there is a lot of information available for the upstream and downstream parts of the supply chain, what happens in between remains a « black box ». Such an approach can be useful to inform policies related to the distribution of benefits and the right of access to resources by different users, but also to address different future states under diverse policy scenarios.

Keywords: ecosystem services, tuna fisheries, South Pacific, distribution of benefits, mapping, conceptual framework

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C1-218

Single species vs multispecies management when economic objectives are in place and transitional period considered.

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Management of fish stocks is biologically driven in the sense that MSYs have been set as targets for stocks. The current CFP has change the way in which management of European fish stocks has to be made. In principle the main change has to be done by a multiannual plan where single or multispeciescharacteristics have to be taken into account in a regional basis. The main setting of this management plans coming from the regulation and in fact from the regulators are the MSY level (or a range of them) and a deadline but not a path (that is a HCR) to reach the defined targets. The transition period is important given that the targets are defined by conventions. MSY has been set as a target or even as limit for stocks.

Paths are extremely important, since what they do is to define the present sacrifice to obtain future potential benefits. When paths are considered three issues arise: Firstly given that the target is defined legally and without any economic considerations the economic logic could be included in the management procedure by using the Net present value as the main indicator of the performance of the path. The sum of the value of the landings can be considered from the current perspective that is, discounting the future values by a fixed discount rate. Secondly fleets as economic units have to be considered in an economic inclusive way. They have financial objectives, as well as economic incentives to react to the economic incentives in places set up by managers.

Finally management of stocks on multispecies fisheries does not affect fleets in the same manner. Fleets, who share the exploitation of the same stock, have different technical characteristics, costs and landing profiles. It implies that any optimality (according to the NPV) of a path can be positive or not when a fleet by fleet analysis is performed. The objective is to compare how to manage a fishery from an economic perspective, when it is fleet based under two main approaches. Single species management and multispecies fisheries. In fact the main idea is to focus on the transitional period, that is, the objective of reaching MSY is still there, but we analyse how to reach to this MSY objective from a fleet by fleet perspective.

Keywords: MSY, transitional paths, constant elasticity of substitution.

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Management and mixed fisheries

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When defining management strategies in a mixed fishery context it is important to take into account all species being part of the total catches and then indirectly of the revenue of each fleet. In fact, inconsistencies in single species TACs can lead on either over catching some species to reach the TAC of other species caught by the same fleets, or not reaching the TAC for some species when the TAC for other species is fully taken. WGMIXFISH, an ICES Working Group, has been producing mixed fisheries advice from 2012 in the North Sea, taking into account the single species advice from the six main stocks exploited in the North Sea and showing possible inconsistencies in order to provide more knowledge and information to managers when fixing the single species TACs.

Recently, the concept of ranges for FMSY, corresponding to fishing mortality values leading to at least 95% of the maximum long term yields while not resulting in a prob(SSB<Blim) larger than 5%,was developed to introduce more flexibility in the management system. In a mixed fisheries context, STECF and WGMIXFISH has worked to explore whether the FMSY ranges could be used to reduce the incompatibilities between the single species TACs. Building on these Fmsy ranges, WGMIXFISFH developed a method to optimize, within the ranges of
each species, the fishing mortality values which would result in the smallest possible incompatibility between single species TACs in the mixed fisheries context.
In the same time, this group worked on methods to incorporate data-poor stocks and protected endangered and threatened (PET) species into mixed fisheries advice. In fact those species can also represent a limit in the fishing possibilities of the different fleets and creating disturbance in the application of management strategies.

The paper presents the approach adopted to take up the challenge of providing advice in a mixed fisheries context. It will present the methods developed by the group and the data needed to provide the actual advice but also the data needed to progress on providing advice on species that are not actually taken into account but can be limiting the fishery and then limiting the impact of the management measure in place.

Keywords: Mixed fisheries, advice, F_{msy} ranges, PET

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C1-70

Dimension of Human impact in the protection of the marine environment: case of Guard cape area in east Algerian territory

Amal Seridi

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Co-author: Abdallah Borhane Djebar

The Mediterranean Sea, a natural and cultural heritage, which in the last century has spent the increase of anthropogenic impact, in extreme proportions. In front of all these facts, most Mediterranean countries including Algeria, with it's 1600km of coasts, has engaged within the framework of the Barcelona Convention and its Protocol SPA / BD, to contribute to the objective of the protection until 2020, at least 10% of coastal and marine areas with national and regional systems of Protected Marine Areas, well managed and ecologically representative. "In this momentum, Algeria launches many projects of protection in collaboration with more than 20 national and international organizations, such as:. MedPan network, WWF, NLC etc ... These projects aim at the protection and preservation of many endangered sites, and this is possible only through the creation of a marine area network protected and well managed.

It's in this dynamic of preservation, where our work whose ultimate purpose is to designate the coastal area of « Cap de Garde » with here 3800 ha and a 9.5 km of coastlines with a single and exceptional ecological and aesthetic characteristics, as a protected marine reserve. But before reaching such a result, we performed a socio-economic study, a primordial step in a region where multiple uses are (fishing, tourism, agriculture ... etc).

That was held in 2 stages: The first stage is a sociological survey on land in the form of questionnairy and interviews semi-closed with the various users of the medium. The 2nd step wich is the economic survey in the harvest of a series of statistics on fisheries, tourism, trade, agriculture...etc in the last decade, which will give an encrypted economic value to the area and the marine environment health. Thus, analysis of the data from the surveys confirms the interest of users in this environment and the desire they have to want to be engaged in protection from destructions, due to anthropogenic impacts.

Keywords: Mediterranean, Algeria, marine protected area, socio-economic survey.

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C1-68

Scaling up a global tool for fisheries improvement: adding economic and social dimensions to FishSource.com

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Profiling the sustainability status of a specific fishery is key for detecting weak spots needing improvement as well as strengths that should be preserved for good management. It is vital for many fisheries, though, to integrate the three pillars of sustainable development – aka, the ecological, economic and social dimensions. Various sets of indicators have been constructed over the last two decades to assess the status of natural resource exploitation. Some of these can serve as a base for fisheries certification, although presently no major certification standard extensively integrates the three pillars.

FishSource is an online global database profiling the sustainability status of more than 1900 fisheries covering all seafood sectors. It has been developed to offer a standardized approach for presenting information on fisheries that stakeholders can easily understand and act upon. Scores is a key component of FishSource that consists of standardized measures comparable from one fishery to the other, based on a robust methodology accounting for data-rich and data-poor situations. The main goal of FishSource scores is to highlight areas needing improving, and then other components of FishSource provide recommendations for improvement and tracking of progress.

FishSource currently delivers information for only one pillar: the ecological dimension. The project presented in this paper explores the expansion of FishSource by incorporating economic and social dimensions, the end goal being to provide a better, more comprehensive understanding of the dynamics of marine socio-ecological systems and of seafood as a global commodity. Key scores to be potentially incorporated in FishSource were derived from a review of major existing sets of indicators. The proposed methodology to generate scores is presented and discussed in this paper. The scoring procedure has been tested on several fisheries already included in FishSource.

Keywords: Fisheries, FishSource, Improvement, Scores, Seafood, Socio-economic dimension

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Parallel session 3 – Tuesday 31/05 (14h00-15h40)

C2-42

Indicator decision tree for managing fisheries

Sigrid Lehuta

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Co-author: Stéphanie Mahévas

Within the Marine Strategy Framework Directive, it is recognized that a collection of indicators is necessary to reflect the status and evolution of ecosystems and support management decisions. In fisheries, however, a limited number of indicators is used to trigger management actions, commonly fishing mortality and

spawning stock biomass. A reason for this lies in the lack of methods to combine multiple indicators within a decision support tool. It also pertains to the disregard of interactions between indicators when establishing reference points. Independently defined reference points for multiple variables might not actually be compatible or simultaneously achievable. It is also possible that the reference point for a metric (i.e. mean length of the population) that should trigger action is not the same depending on the value of another metric (i.e. fish price) and conditional reference points are needed. To derive relevant combinations of metrics with associated references points, we start by defining desirable and undesirable states of the fishery and track down the combinations of metric values that led to it.
We use the fishery dynamics model ISIS-Fish to simulate the behavior of the Eastern English Channel fishery in a variety of situations in terms of biological condition of the stocks, fisher's behavior, economic conditions and management constraints, generated by an efficient simulations design. All simulations are characterized using several metrics possibly monitored (e.g. mean length in the population, TAC of other stocks involved, levels of effort, fish prices). The issue of the simulations in term of achievement of management objectives is used as the independent variable in regression trees to sort out the most influential factors in failures and successes and their associated conditional thresholds. The tree could then be used to trigger complementary measures, if the conditions encountered by the fishery are likely to jeopardize current management efficiency.
Keywords: indicators, reference points, management decision tree, regression trees
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C2-50

Optimal biodiversity loss in multispecies fisheries

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Multispecies fisheries face important management challenges arising from the combination of technical and biological interactions. A consistent ecosystem-based fishery management (EBFM) is expected to embrace these complexities. In this regard, optimum yield strategies have been argued to be relevant tools to operationalize EBFM in multispecies fisheries. Yet their consistency with ecological and economic objectives is still in question. Here we assess the bioeconomic consequences of multispecies MSY and MEY in a multispecies fishery model with technical interactions. We show under which conditions a species is susceptible to be overharvested or driven to extinction at these optimum yields. It notably appears that a multispecies MSY can lead to the extinction of species with a low rate of growth and a high catchability. While MEY generally remains more conservative than MSY in multispecies contexts, it comes out that it can still lead to the overharvest and extinction of susceptible species. In this case, the extinction is mediated by fishing costs and by the relative prices of the harvested species, so that low-priced species are more susceptible to get overharvested than higher priced ones.
We discuss regulations on costs and prices that could reduce biodiversity losses at MEY. Potential unsustainable consequences of multispecific MSY and MEY are illustrated in a tropical artisanal fishery in French Guiana. In this fishery, both strategies are shown to lead to the extinction of several species.
Keywords: multispecies fishery, technical interactions, MSY, MEY
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C2-147

The information value of full-retention policies: An analysis of the North Sea demersal fishery.

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Discard rates in marine fisheries have been estimated at more than 80% for some individual fisheries, with an average global discard rate of 8%. Discarding of catch can be problematic for three main reasons: (1) in the absence of accurate and precise discards estimates, unreliable catch data distort estimation of the appropriate quotas; (2) bycatch imposes a cost on the resource as survival rates are generally low; and (3) bycatch-induced mortality of charismatic species presents a loss of non-use values. Policy instruments to limit discarding vary from taxes on bycatch, to subsidies for selective fishing gear, to outright bans on discarding, also called full-retention policies. The 2013 reform of the European Union's Common Fisheries Policy features the introduction of such an obligation to land all catches « of species which are subject to catch limits.» In this paper we aim to estimate the economic effects of a full retention policy in a mixed fishery.

More specifically, we estimate the economic value of the data distortion caused by discarding of fish, and how these economic losses are ameliorated by a ban on discards. We present a bioeconomic model capable of investigating these questions in a mixed fishery for a variety of stock assessment methods, harvest control rules, and discarding policies. We apply the model to the North Sea demersal fishery, focusing on the two main commercial species plaice (*Pleuronectes platessa*) and sole (*Solea solea*). We find that the information value of discard bans depends largely on the prevailing harvest control rule.

Keywords: Discards, sole, plaice, economics, value of information, Bayesian model

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C2-168

Understanding the effects of catch share programs: Insights into social vulnerability and fishing participation in the Bering Sea and Aleutian Islands crab fisheries.

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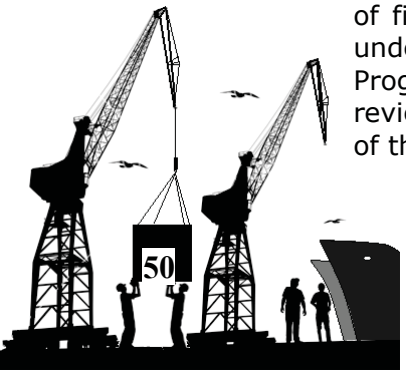
National Standard 8 of the U.S. Magnuson-Stevens Act mandates the consideration of socio-economic impacts of regulatory change on fishing communities. For the past five years, social scientists in each of the National Marine Fisheries Service regions have been collaborating on the development of a national database of social vulnerability and fishing dependence indices for nearly 6,000 coastal communities in the United States. These indices can be used as measures of community resilience/vulnerability as well as the performance of fisheries, including social impacts of fishery regulatory action. This study focuses on using these indices to better understand the impact of the Bering Sea and Aleutian Islands Crab Rationalization Program (CRP) on fishing communities. We provide background on the CRP and review the methods used to create the indices and present a time series analysis of the indices to evaluate change in crab dependent communities over time from



a baseline period 3 years before the implementation of the CRP through 2013.
This time series enables us to make comparisons of the changes in social vulnerability between communities that are dependent on the crab fisheries and those that are not participating in these fisheries. Ultimately, this type of analysis deepens our understanding of the complex impacts that a catch share program can have on communities and individuals that depend on such fisheries. In addition, such indices provide a novel metric of catch share program performance with regards to CRP defined goals and objectives such as sustaining community participation.
Keywords: fisheries performance indicators, community vulnerability, catch share program, Bering Sea and Aleutian Islands Crab Rationalization Program
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C2-192

Harvest Control Rule vs Optimal Harvesting of an Age-structured Population: The Case of the Ibero-Atlantic Sardine Fishery

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The sardine fishery plays a crucial role in the Portuguese fishing sector. Recently, however, this stock has drastically reduced, threatening the sustainability of this sector. To deal with this problem a management plan was established for the period 2012-2015. Notwithstanding the reduction in catches imposed by this plan, the current stock is still at low historical levels. The latest ICES advice report, proposing an upper catch limit of 1587 tons for 2016, reveals the concern of the scientific community regarding the sustainability of this resource. The definition of very low quotas imposes high costs on the fishing sector and has resulted in an increasing hostility of fishermen towards the current policy. It is in this context that a new regulatory framework will have to be defined. This new regulatory framework should therefore rely not only on solid ecological tools but also should explicitly take into account the interests of the main stakeholders of the sector. In this study we develop an age-structured bio-economic model for the Ibero-Atlantic Sardine Fishery. We evaluate the performance of the optimal harvesting path that maximizes profits with the ongoing harvest control rule, showing that higher economic returns come at the cost of reducing biomass below acceptable reference points. Taking this into account we extend the model to consider multiple objectives that explicitly include precautionary concerns, thereby assessing the trade-offs associated with alternative scenarios and management strategies. Our analysis shows how the use of this bio-economic model provides a useful tool to assist the definition of harvest control rules, which are the basis of policies for the sustainable management of marine social ecological systems.
Keywords: fishery management; Harvest rule; Optimal harvesting; Age-structured model.
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C3-141

Multiple management objectives: how to strike a bargain?

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A wide range of stakeholders are typically involved in fisheries, including fishermen, managers, scientists, environmentalists, economists, public decision makers, etc. Each of these groups has an interest in particular outcomes, which may be conflicting. Understanding the underlying trade-offs among management objectives is thus important in designing policies to manage ecosystems, as it might facilitate reaching agreement between stakeholders. The objective of this paper is (i) to propose a model-based framework that characterizes the trade-offs associated with alternative management strategies in a mixed fishery, and (ii) to help stakeholders reaching consensus and defining reference points for management. The stochastic co-viability framework we propose is applied to the evaluation of alternative management strategies in the Australian Northern Prawn Fishery (NPF), with specific emphasis on the consequences of pursuing biological, socio-economic and non-target species conservation objectives. The trade-offs associated with respecting biological, socio- economic and non-target species conservation constraints with high probability and maximizing the net present value of the fishery are quantified. Results from sensitivity analyses can assist in defining reference points. Furthermore, the proposed framework, by providing a « bargaining space », can assist fisheries managers and stakeholders in seeking consensus when assessing management strategies.

Keywords: Bio-economic modeling, co-viability analyses, multiple management objectives, uncertainty, decision-making

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C3-66

Ecoviability for Ecosystem Based Fisheries Management

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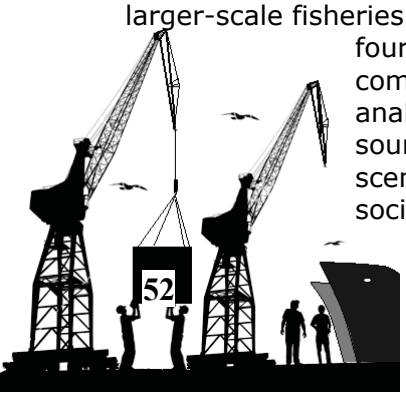
Reconciling food security, economic development and biodiversity conservation is a key challenge, especially in the face of the demographic transition characterizing most of the countries in the world. Fisheries and marine ecosystems constitute a difficult application of this bio-economic challenge. Many experts and scientists advocate an ecosystem approach to manage marine socio-ecosystems for their sustainability and resilience. However the way to operationalize ecosystem-based fisheries management (EBFM) remains difficult. We propose a specific methodological framework - viability modeling - to do so. We show how viability modeling can be applied in four contrasted case studies: small-scale fisheries of French Guiana and the Solomon Islands, and larger-scale fisheries of the Bay of Biscay (Europe) and the Gulf of Carpenteria (Australia). The four fisheries are analyzed using the same modeling framework, applying a set of common methods, indicators and scenarios. The calibrated models used in this analysis are dynamic, multi-species and multi-fleet and account for various sources of uncertainty. A multi-criteria evaluation is used to assess the outcomed scenarios over a long time horizon with different constraints based on ecological, social and economic reference points. Results show that the bio-economic and



ecosystem risks associated with the adoption of status quo strategies are relatively high. In contrast, strategies called eco-viability or co-viability strategies that aim at satisfying the viability constraints reduce significantly these ecological and economic risks. The gains associated with the reduction of bio-economic and ecosystem risks, however, decrease with the intensity of regulations imposed on these fisheries.

Keywords: Ecosystem approach, Ecological economics, Modeling, Viability, Biodiversity

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C3-120

Social tipping points and environmental management decision-making: a biodiversity offsets example

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While the recent literature on environmental management has emphasized the existence of ecosystem tipping points and the risks associated with irreversible changes in bio-physical processes, relatively limited attention is being paid to the role of social tipping points in decision-making processes. Indeed, despite an increasing awareness of environmental issues and of the potentially large losses in ecosystem services associated with degraded marine and coastal ecosystems, lags are still often observed in the societal response to such losses. These lags may arise from a lack of understanding of ecological systems, poor measurement of system properties or natural inertia in the social processes that determine collective action towards environmental protection. In addition, social response to environmental degradation may occur in strongly non-linear patterns. Depending on their importance relative to the speed of environmental change, these lags and non-linearities in social response may have a determining impact on the effectiveness of management. We develop a stylized system dynamic modelling framework of a biodiversity offsets policy regime applied to a marine-based example, where resource abundance depends on a habitat that is affected by a sequence of development projects, and biodiversity offsets are understood as habitat restoration actions. The model incorporates a social response function which relates habitat degradation and loss in utility from the resource to a requirement for policy intervention in the form of compensatory habitat restoration. We consider the consequences on the policy and its effectiveness of alternative assumptions regarding the social response function, including cases where it exhibits « tipping points ». Based on the simulation results, we discuss the key components of social response which would require further research, in order to strengthen policy advice.

Keywords: social tipping points, ecological-economic modelling, biodiversity offsets

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C3-127

Co-viability in fisheries management, an example framework from the Southern Benguela

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Co-authors: et al. (in process)

The viability approach has been suggested as a useful way to operationalize ecosystem based fisheries management. Broadly speaking, a viability approach seeks to discover what states and associated regulations will assure a desirable (e.g. healthy or operational) system, which might be represented through desirable, measurable objectives for a system, over time. In the context of fisheries management, it examines how economic, social and environmental constraints might be met through time with various management conditions. As opposed to managing for an optimal or steady state of a system where management seeks to achieve target reference points, in the viability approach the linked human-natural system is managed to be maintained within the bounds of acceptable limits (limit reference points) for the various ecological, economic or other criteria, which are determined according to management objectives. A review of the international literature on the viability and coviability approach (co-viability is a term often used to refer to where a system is managed to simultaneously achieve desirable ecological and social/economic states), with specific reference to marine fisheries management, is made. It examines how the conceptual thinking around the viability approach has been or is proposed to be implemented into fisheries management worldwide. The Southern Benguela ecosystem off of the coast of South Africa is used as an example of how this approach might be translated into a local framework for fisheries management, including how it might relate to ecosystem and economic objectives. An assessment is then made of what appropriate indicators can be extracted from existing ecosystem and economic models for the region that speak to the objectives of the management framework. Finally, suggestions are made for future developments of the existing models that might inform management in the context of the viability approach in the Southern Benguela.

Keywords: co-viability, fisheries management, coupled system, South Africa, socialecological

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C3-178

Effects of European multi-annual management plans: a viability approach

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In Europe, global management plans are set for most commercial fish stocks. These management plans include conservative measures as total allowable catches (TACs). In this paper, we study at the scale of a region the impact on the fleet fishing strategies of conservative measures resulting from global management plans. We focus on the fleets located in the French Aquitaine region fishing mainly in the Bay of Biscay. About 160 coastal vessels are involved.

The developed bio-economic model is multi-species and multi-fleets and takes into account technical interactions. The dynamics of the main exploited species (Hake (*Merluccius merluccius*) and Sole (*Solea solea*)) are modelled using an age-structured population model derived from the standard fish stock assessment approach, with stochastic recruitment functions. Different management strategies

and scenarios are compared from a viability viewpoint, thus accounting for biodiversity preservation, fleet profitability and constraints linked to conservative measures as quotas.

Keywords: Viability, scenarios, multi-species, multi-fleets, quotas

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C3-198

Strengthening the resilience of small-scale fisheries: a modelling approach to explore the use of in-shore pelagic resources in Melanesia

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The present paper deals with sustainable management and the resilience of small scale fisheries that face more and more uncertainties arising from ecological and anthropological drivers. From this perspective, the Solomon Islands represents a challenging case study we address by the use of a bio- economic model based on multi-species and multi-fleet dynamics with both ecological and economic stochasticity. A measure of resilience relying on viability and the satisfaction of bio-economic viability constraints is proposed. The modelling results indicates that the current state of fishery is unsustainable. It is shown how the coral reef fish is already under threat and how the pelagic resource exploitation can ease this eventuality, especially with the use of inshore FADs (Fishing Aggregative Devices) which can improve the resilience in a significant way notably at the provincial level. We demonstrate that a specific use of this available pelagic resource can strengthen this resilience through a decrease of 20 % of fish quantities for subsistence needs and an increase of 20 % for cash purposes. Finally, one tipping point is identified and corresponds to a minimum share of this pelagic resource for direct consumption.

Keywords: Small Scale Fishery, Resilience, Viability, Bio-economic Model, Poverty, Fishing Aggregating Device, Multi-scale, Western Pacific

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C4-21

Ocean productivity index as a decision tool for Maritime Spatial Planning

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EU Maritime Spatial Planning (MSP) has the challenging aim to spatially organize almost exclusive human activities at sea as efficiently and sustainably as possible. Mapping productive marine habitats should help MSP as changes in ecosystem productivity impact human activities such as fisheries, marine conservation and tourism. We explore the potential of the Ocean Productivity Index (OPI) to monitor the relative production of fish at the EU scale. The OPI is analysed as regards to the main fish catches of a given regional water body and year. The index will provide useful spatial information to the first implementation of MSP as well as to monitor its relevance as regards to upcoming environmental changes. The OPI uses as a proxy for food web productivity the daily occurrence of satellite-derived chlorophyll-a fronts at the spatial resolution of 4km. Productive frontal systems indeed stand long enough in time to sustain a well-developed marine food chain. Potentially eutrophicated waters, which mostly correspond to disrupted food chains, are excluded from the OPI by removing high levels of daily chlorophyll-a contents. Hence, as an indicator of healthy food chains, the OPI can be used to gain insights on the Good Environmental Status. As independent information, the OPI may contribute to harmonize cross-border planning and may foster communication among all maritime sectors for the MSP implementation. The OPI layer is among one of the several layers of georeferenced information on maritime transport, fishing effort and energy-related activities that are collected by the JRC Maritime Affairs Unit to support the coherent implementation of MSP at EU level.

Keywords: Ocean productivity, maritime spatial planning, spatial indicator, multi-use of environment

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C4-21

Trends in time series observations of human dimension indicator data for the North Pacific ecosystem

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The North Pacific Marine Science Organization (PICES) Section on Human Dimensions of Marine Systems (S-HD) developed a list of variables to characterize human dimensions of the state of the North Pacific ecosystem for inclusion in the upcoming North Pacific Ecosystem Status Report. This presentation describes spatial and temporal trends in time series observations (TSOs) of these indicator variables and reports on exploratory analyses that relate the observed trends to observed variation in environmental, economic, social, and political drivers.

Keywords: human dimensions, ecosystem status

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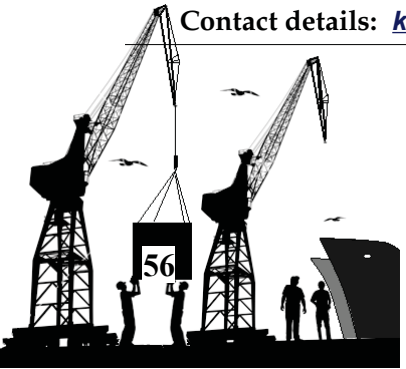

C4-83

NOAA's approach to Integrated Ecosystem Assessments: A framework and tool to support ecosystem-based approaches to management in socio-ecological systems

Rebecca Shuford

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Co-author: Douglas W. Lipton (NOAA, Silver Springs and Univ. Maryland - USA)

Approaching marine ecosystems as socio-ecological systems means that we are focusing on the ecosystem services they support that contribute to human well-being. Resource management in these systems is extremely complex and challenging. To better guide decision-making and to understand ecological and social trade-offs associated with those decisions, we need to move towards a more holistic ecosystem-based approach to management (EBM). The overarching goal of NOAA's IEA approach is to inform decisions that will promote an ecosystem that is both sustainable and capable of providing the diverse ecosystem services upon which our society depends. NOAA's IEAs are the analytical « engine » that provides information on the current and predicted future state of the ecosystem, including analysis of individual and competing human activities and environmental variability. To guide management decisions, NOAA's IEA approach assesses ecosystem status relative to societal and ecological goals and objectives and evaluates the benefits, risks, and tradeoffs of alternative management actions from social and ecological perspectives. NOAA's IEAs provide the science based framework to build towards full EBM on a platform that incorporates a wide breadth of multi- disciplinary knowledge. By assessing tradeoffs that can be used to support decision-making along the ecosystem management continuum, the process provides an ecosystem context to current, more traditional single-sector decisions, making it relevant for the extant management structure.
In this presentation we will use specific examples from the NOAA IEA program to demonstrate how they have been designed to address management needs along the continuum of individual sector management to a holistic ecosystem-based management approach. We will use selected examples of how NOAA IEA regions are incorporating ecological, economic, and social processes into analysis of socio-ecological systems, and the challenges in applying this approach.

Keywords: ecosystem approach, Ecosystem-based management, Integrated Ecosystem Assessment, Ecosystem Services, Socio-ecological System

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C4-113

International comparison of Human Well-being structures and factors: A study of the PICES 6 countries

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« Human well-being » is a fuzzy concept; until 2000, many had thought it would be difficult to be quantified as a science. Recently many scientists in a variety of disciplines such as psychology, economics, politics, have started to apply it as a tool for scientific measurement. Why don't we evaluate progress of nations and environmental conditions in these terms (such as Human Well-being), instead of economic measurements (GDP, etc).
To understand marine socio-ecological systems, we think that it will be necessary to consider the « Human well-being » as the part of environmental system, and

psychological approaches can contribute fruitful results to questions. In the psychological perspective, « Human well-being » involves people's positive evaluations of their lives in terms of positive emotions, engagement, satisfaction, meaning, enjoyment of social interaction, and so on. As the first step of this study, we tried to considering and discussing about the structure of Human Well-being. We use « Daily life satisfaction data » as the dependent variable for the structural equation modeling (SEM) analysis. In SEM, the structural model includes the relationships among latent constructs. Some initial findings include the fact that many countries surveyed have similar general concepts of Human Well-being for marine ecosystem services. However, the specific understanding on how the marine ecosystem affects Human Well-being differs among the countries surveyed. Therefore, the concept about what makes for a desirable relationship between people and the sea is different among PICES 6 countries. In addition, we consider that the results of our study on Human Well-being can help explain the importance of social relationships in understanding marine socio-ecological systems.

Keywords: Well-being, International comparison, Satisfaction, Social relationships

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Parallel session 7 – Wednesday 01/06 (16h00-17h40)

C5-149

What can marine strategy framework directive indicators tell us about ecosystem services?

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Co-authors: Melanie Austen, Nicola Beaumont

The EU Marine Strategy Framework Directive (MSFD) requires each member state to carry out assessment of Good Environmental Status (GES) of marine ecosystems using 11 descriptors. Three descriptors are directly concerned with biodiversity: D1 Biodiversity, D4 Food webs and D6 Seafloor integrity. The MSFD aims for marine ecosystems and the services they provide to be in GES by 2020 but does not provide guidance on ecosystem service assessment. To address this gap this study assesses whether MSFD indicators that give information on the environmental status of the ecosystem can also inform on the status of ecosystem services. Peer-reviewed lists of indicators of 13 ecosystem services were compared to indicators of GES suggested in the European project DEVOTES (n=282). 181 GES indicators could be used towards assessment of eight of the 13 marine ecosystem services (double counting possible because several services may be addressed). However, there were no indicators for some of the regulatory ecosystem services. Indicators suggested for these services may not take ecological processes into consideration or because they are not addressed by the GES indicators. 65 GES indicators could not be used for ecosystem service assessment. 104 of GES indicators are useful for some ecosystem processes that contribute to ecosystem services. The majority of GES indicators for D1, D4 and D6 are concerned with marine mammals, birds and fish. These could be useful indicators for Aesthetic experience and Leisure and Recreation services, but would require further development. This paper will discuss the results in terms of how to improve ecosystem based management by including indicators for ecosystem services into the assessment of GES under the MSFD. Understanding the ecosystem services delivered will enable environmental managers to make the sustainable and equitable trade-offs which are increasingly required in the context of use of the marine environment within the EU.

Keywords: Marine Strategy Framework Directive, Indicators, ecosystem services, Good environmental status, biodiversity

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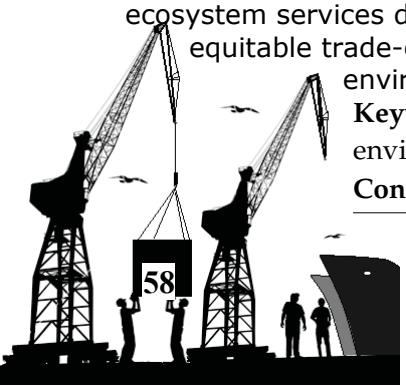

C5-167

Vulnerability of the habitats potential to deliver ecosystem Services in Peniche Nazaré, Portugal

Ana Isabel Lillebø

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Co-authors: Tom Willaert (School of Business and Economics, UNL - Portugal), Ana García-Alegre Garralda (CESAM - Portugal), Henrique Queiroga (Centre for Environment and Marine Studies CESAM, Univ. Aveiro – Portugal), Maria Antonieta Cunha e Sá (School of Business and Economics, UNL - Portugal)

The condition of benthic habitats is a key determinant of the marine ecosystem services they can provide. This condition can, however, be adversely affected by biological, chemical and physical pressures caused by multiple human activities including among others fishing, off-shore constructions, and pollution. Following the Marine Strategy Framework Directive (MSFD), marine strategies should ensure that the cumulative pressure of such activities is kept within levels that are compatible with the achievement of good environmental status, while enabling the sustainable use of marine goods and services. Therefore, and since human activities continue to intensify, there is a need for quick and repeatable ways of assessing the risk posed by these activities under various management plans.

We assess the vulnerability of the benthic habitats potential to deliver ecosystem services (ES) in the Peniche-Nazaré marine area in Portugal using the InVEST habitat risk assessment (HRA) tool of the Natural Capital Project. We collect spatial data on marine activities in the area and construct data layers for the resulting marine pressures, defined according to the MSFD. Habitats are classified according to the EUNIS habitat classification level 3. Habitat risk is then calculated by scoring each habitat-pressure relationship for a set of exposure and consequence criteria such as temporal overlap, intensity and structural change. The cumulative risk is calculated at the cell size level using the Euclidian risk equation, being a function of both exposure and consequence. By combining expert data on ES availability and the risk calculated by the HRA model, we analyse spatially the vulnerability of the ES potential in the case study area. Furthermore, we compare the baseline situation with possible future scenarios, i.e. a near future scenario describing changes in human activities and an end of the 21st century scenario focusing on the possible effects of climate change in the region.

Keywords: MSFD, Risk Assessment, Benthic Habitats, InVest, Marine goods and services

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C5-187

A framework for practical integration of ecological, economic, social and institutional aspects in integrated management

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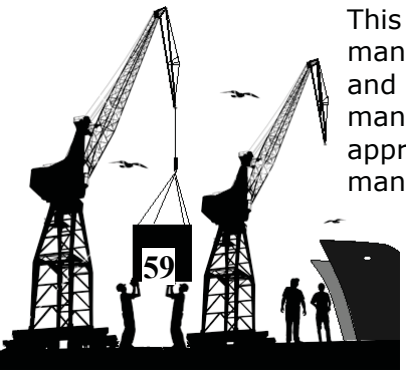
The failure to integrate ecological, social, economic and institutional aspects remains a major impediment to successful management of marine activities. There is increasing need for methods and institutional structures that will allow practical integration of these aspects across marine activities.

This presentation examines recent trends and anticipated evolution in management planning and of third party certification with the objective of defining and overcoming key gaps related to the incorporation of social aspects of management. In many jurisdictions, there seems to be a lack of public appreciation that policy reflects societal priorities (perceived policy gap), or that management is achieving desired objectives (implementation gap). This is



complicated by the need for more diverse and explicit objectives (including ecological, social, economic and institutional/governance goals), the obvious conflicts and trade-offs required with diverse objectives, difficulty in establishing participatory governance processes with better defined decision-support frameworks, and an ongoing problem of engagement and communication.
This presentation summarises the development and initial use of a framework for comprehensive scenario development and comparison that explicitly includes ecological, economic, social and institutional aspects. The framework, developed by an interdisciplinary team of academics, industry and government for fisheries, has been useful in structuring conversations regarding objectives and management options, and is being applied more widely for comparison of potential management scenarios against diverse ecological, economic, social and institutional considerations of integrated management in relation to coastal communities. Although rooted in Canadian legislation, policies and international agreements, the framework provides a basis for development of objectives and related performance indicators for management scenario comparison, investigation of tradeoffs, and decision support, that is of relevance elsewhere.
Keywords: integrated management, socio-economic, scenario comparison, sustainability
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C5-206

Integrating environmental, climatic and human processes on a Mediterranean semi-enclosed embayment (Amvrakikos Gulf, Greece): a food-web modelling approach for assessing ecosystem status

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Co-authors: Dimitrios K. Moutopoulos (Technological Education Institute of Western Greece - Greece), Chiara Piroddi (Institute of Marine Science, Barcelona - Spain), Joan Gonzalvo Villegas (Tethys Research Institute – Italy).

Understanding the functioning and the response of marine systems to multiple stressors is essential for defining their good ecological status (GES), particularly in the context of the Marine Strategy Framework Directive (MSFD). Ecosystem modelling tools have been increasingly used worldwide because they can assess the dynamics and interactions between different levels of biological organization (either species or functional groups), the main drivers and stressors, incorporating as well socio-economic parameters.
Ecosystem models can also provide indicators and metrics useful for assessing ecosystem status and for informing on effective marine policies and management strategies. In this respect, we developed a food web model to assess and quantify the health status of the Amvrakikos Gulf (western Greece), a semi- enclosed embayment characterized by a fjord-like oceanographic regime. One of the main goals of our study was to investigate dynamics of marine resources over the last three decades considering the effects of rivers run off, climatic induced changes, development of fish and shellfish farming and modernization of fisheries as the major drivers impacting the system. Results obtained from simulations tuned for 1980- 2013 period showed the dynamics of a selected set of model-derived indicators to assess biodiversity, structural and functional ecosystem changes through time. In addition we explored socio-economic indicators (e.g., market price, employment), based on available survey data for the study area, to assess different management strategies scenarios. Overall our approach aims at supporting the planning and implementation of the MSFD, which requires the assessment of all European marine ecosystems and pressures associated, as well as the establishment of environmental targets (e.g., indicators) to achieve « Good Environmental Status » by 2020.

Keywords: food web model, bio-economic interaction, human activities, Amvrakikos gulf, Mediterranean Sea

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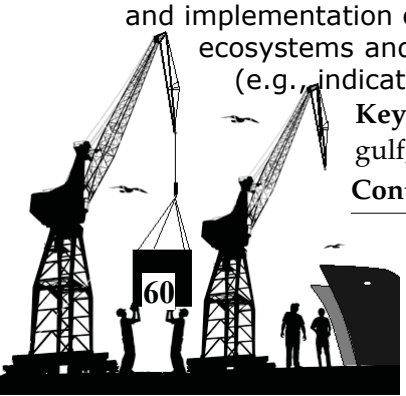

C5-225

Which dashboard approach for sustainable development goals in marine nature parks?

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There are 15 categories of marine protected areas (MPAs) in France; some of them are multi-objectives concealing biodiversity protection goals and sustainable development ones. Through a participative process, marine nature parks develop their management plan, where long-term goals are set up: responsibility, expected results and targets to be reached in 15 years time. As marine nature parks are multi-objectives MPA, goals are set up regarding the protection of marine biodiversity but also regarding the maintenance and support of activities. In order to assess effectiveness of management and whether the marine nature park achieves its goals set, indicators are used to measure results within a dashboard approach allows short- and medium-term management priorities to be defined. Although methodological framework and decision criteria are well developed for natural heritage and ecological goals, establishment of goals regarding the sustainable development of activities and associated indicators is a complex scientific and empirical process with a critical lack of knowledge in terms of methods and tools. One of the difficulties lies in determining reference criteria to prioritize the different socio economical stakes and targets. There exists indicators related to activities but most of them allow analyzing activities as pressures, and very few are able to account for the attending effects of MPAs on activities and users. This communications aims at presenting the dashboard approach, with a focus on the main challenges as regards the sustainable goals that can have some categories of French MPAS; for example « how to prioritize the different socio-economic stakes at local scale? Which reference status? » There is indeed room to improve on the integration of human-related data into the construction of relevant indicators in order to assess MPAs' goals, and this should be shared within the scientific community so as to develop MPAs' managers capacities and give empirical challenges to researchers.

Keywords: marine protected areas, dashboard approach, sustainable development goals, social and economic indicators.

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C6-236

Reaching for integrative bio-monitoring tools to assess chronic chemical contamination in the coastal environment

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Marine and coastal areas are affected by human activities that cause chronic and diffuse pollution. Fisheries, shipping, agriculture, industry and waste-water treatment contaminate coastal seawater, sediments and biota with heavy metals and organic pollutants. In this context, the European Union's Marine Strategy Framework Directive (MSFD Dir. 2008/56/EC) was adopted in June 2008. This work is divided into 2 parts: the first part is intended to conduct methodological development for the assessment of the impacts of chronic chemical contamination, based on multiple, integrated tools (« omic » approaches, ecophysiology and ecotoxicology): (1) the acquisition of transcriptomes/proteomes for *Mimachlamys varia*, a potential sentinel species (what has never been done before); the aim will be to define peptides specific biomarkers of interest; (2) the functional validation of these peptides via their modulation in response to biological factors but also by comparing the measurement of the protein of interest with respect to enzyme activity (biomarkers); (3) the validation of methodological development will be considered part of a field campaign research program that will examine the approach of chemistry/ecotoxicological on bivalves collected from impacted or not impacted natural sites .
The second part concerns the legal and institutional dimensions (socio-legal approaches) of bio-monitoring: the contribution of legal will be organized in two parts. The first part will focus on the establishment of an inventory of legal references and methodologies used by texts (international, UE, French law) and case law regarding liability and compensation of environmental damage (evidence, assessment, reinstatement). The analysis (prospective) then focuses on the possibilities for integrating the results of Phase 1 in public policy and management tools and conservation of coastal and nearshore waters.

Keywords: *Mimachlamys varia;* biomarker; chronic chemical pollution; Omic approaches; Bay of Biscay

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C6-250

Ecosystem Risk Assessment using the Comprehensive Assessment of Risk to Ecosystems (CARE) Tool

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Effective Ecosystem Based Management requires a localized understanding of the health and functioning of a given system as well as of the various factors that may threaten the ongoing ability of the system to support the provision of valued services. Several risk assessment models are available that can provide a scientific basis for understanding these factors and for guiding management action, but these models focus mainly on single species and evaluate only the

impacts of fishing in detail. We have developed a new ecosystem risk assessment model – the Comprehensive Assessment of Risk to Ecosystems (CARE) – that allows analysts to consider the cumulative impact of multiple threats, interactions among multiple threats that may result in synergistic or antagonistic impacts, and the impacts of a suite of threats on whole-ecosystem productivity and functioning, as well as on specific ecosystem services. The CARE model was designed to be completed in as little as two hours, and uses local and expert knowledge where data are lacking. The CARE tool can be used to evaluate risks facing a single site; to compare multiple sites for the suitability or necessity of different management options; or to evaluate the effects of a proposed management action aimed at reducing one or more risks. This analysis can help users identify which threats are the most important at a given site, and therefore where limited management resources should be targeted. CARE can be applied to virtually any system, and can be modified as knowledge is gained or to better match different site characteristics. CARE builds on previous ecosystem risk assessment tools to provide a comprehensive assessment of fishing and non- fishing threats that can be used to inform environmental management decisions across a broad range of systems.

Keywords: Ecosystem Risk Assessment, Comprehensive Risk Assessment, Data-Limited, Rapid Ecosystem Assessment, Ecosystem Services

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C6-241

What are we managing for: Values and the Management of Marine Social-Ecological Systems

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In marine management contexts, the notion of value is used in many ways including, *inter alia*, describing desired end states or qualities for a given social-ecological system, measuring the assigned economic value (or price) and/or non-market values placed on harvested natural resources or ecosystem characteristics, and respecting and incorporating the « traditional values » of local communities in decision-making. While including these types of values in resource decision-making is conceptually appealing, research in the area has been characterized by a tension between the quantification (and often monetization) of various values on the one hand and, on the other, qualitative approaches that are attendant to rich detail and context specificity. There has also been a dearth of empirically-based research on values associated with the production and consumption of seafood (processes which have been changing quickly and profoundly). This presentation presents results from two Canadian research projects, each of which developed holistic understandings of values related to seafood production using mixed methods approaches combining qualitative and quantitative elements. The first project draws on linked interview and survey work to examine the impacts of shellfish aquaculture (a growing component of seafood production systems) on the well-being of local communities. The second utilizes the Q-method to develop a characterization of the values associated with seafood generally, from harvest to processing to consumption in a single community. Together, findings highlight that values often « bundle » (i.e. certain values are strongly associated with others), that values are often highly variable at local scales, that they do not necessarily correspond with the social position of actors, and that they are multi-dimensional (moving well beyond simple environment/economy dichotomies). The presentation concludes with a discussion of the implications of these findings, including ongoing efforts to value « ecosystem services » and to improve governance structures and processes.

Keywords: social-ecological systems; values; seafood; mixed-methods

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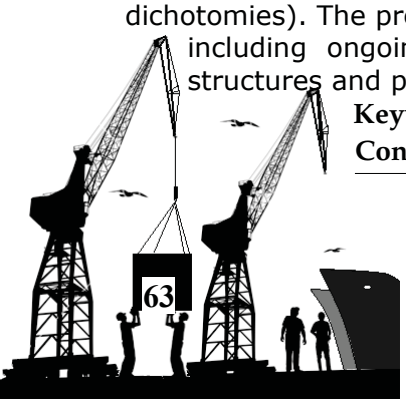

C6-34

Using Socio-Economic and Fisheries Involvement Indices to Understand Alaska Fishing Community Well-Being

Stephen Kasperski

(NOAA, Alaska Fisheries Science Center, Seattle - USA)

Co-author: Amber Himes-Cornell

Over recent years, fisheries managers have been going through a paradigm shift to prioritize ecosystem-based management. With this comes an increasing need to better understand the impacts of fisheries management decisions on the social well-being and sustainability of fishing communities. This presentation summarizes research aimed at using secondary data to develop socio-economic and fisheries-dependence indices to measure fishing community well-being in Alaska. Data from more than 300 communities in Alaska were used to create a database of socio-economic and fisheries dependence indices of well-being and adaptability for Alaskan communities dependent on marine resources. Several applications of the indices are discussed including groundtruthing the indices, assessing their predictive accuracy, and predicting vulnerability to fishery management changes. We find that creating performance measures, such as the indices presented here, provides a useful way to track the status of important fisheries and social variables over time.

Keywords: fishing dependence, community vulnerability, well-being and resilience, Alaska, fishing community

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C6-39

Social Indicators of Fishing Community Vulnerability and Resilience in the United States: An Emergent Method to Assess the Impacts of Changing Fisheries Management and Climate Conditions

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Co-authors: Michael Jepson (NOAA, St. Petersburg – USA), Changhua Weng (NOAA, Providence - USA)

A challenge for using ecosystem approaches in managing marine resources is to find practical methods to link assessments of both human and natural systems. By definition, stock assessments of exploited marine resources and management efforts that seek to balance human and ecosystem needs are included in such a socio-ecological system. Another key component of this system is the ability of coastal communities and economies to respond to both marine ecosystem change and management decisions. A goal of NOAA Fisheries is to understand the resilience of United States coastal communities and economies through their adaptability to changing ecosystem conditions. To meet this goal, indicators of fishing dependence and social and climate change vulnerability were developed for nearly 4,000 coastal communities in the United States. The indicators are derived from existing and measurable social factors that can influence either an individual or community's well-being. Seventy-five different variables from seven secondary data sources were used to create 12 indices. Quantitative and qualitative methods were used to establish their reliability. Although widely-used indices of vulnerability and sustainability have been developed at national and regional levels, our research focused on community-level indicators. Such indicators are essential to systematically assess the social impacts of changing conditions in fishing communities. The development, utility, and validity of these indices for social impact assessments of fishing communities will be discussed in the context of stock and ecosystem assessments.

Keywords: Social indicators, fishing communities, fisheries management, climate change

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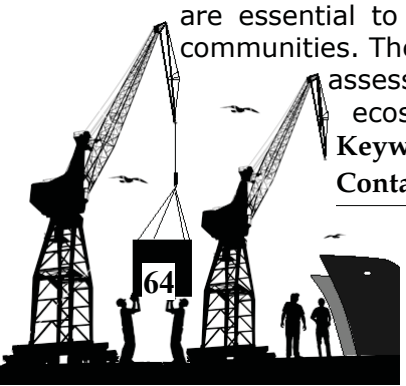

C6-41

It is all about the 'T' – Trajectories of Icelandic fishing villages in times of transferable quotas

Matthias Kokorsch

(University of Iceland, Reykjavík - Iceland)

Icelandic fisheries underwent privatisation in 1990, when existing fishing quotas were made fully transferable. The system of individual transferable quotas has since been held up as a paragon of virtue for sustainable fisheries. This might be valid for ecological and macro- economic concerns, but for a truly sustainable fisheries management system the question of social compatibility has to be addressed as well. This paper evaluates the performance of Icelandic fisheries from a spatial and social point of view. Possible shortcomings are detected through the concepts of resilience and vulnerability with the calculation of a vulnerability indicator that includes both social and economic variables. Different development trajectories of Icelandic fishing villages since 1990 are revealed.
The indicator has two main functions: It is an early warning for detrimental change, targeting policy makers both domestic and international. Furthermore it sheds light on a heated debate about the consequences of transferability for a socially sustainable and resilient fisheries management system. The indicator makes possible a balanced retrospective evaluation of the social implications that have occurred since the policy change. It answers the question about the long-term effects of the loss of quotas for the livelihood of fisheries-dependent localities, their socio-economic well-being and demographic circumstances. As even small disturbances may cause dramatic social consequences in vulnerable systems, it is essential to evaluate the different development trajectories and how fishing villages have responded to the external changes.
Keywords: transferable quotas, vulnerability indicator, resilience, social sustainability
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Parallel session 9 – Thursday 02/06 (14h00-16h00)

C7-243

A scientist and stakeholder partnership for developing fisheries management plans: DAMARA

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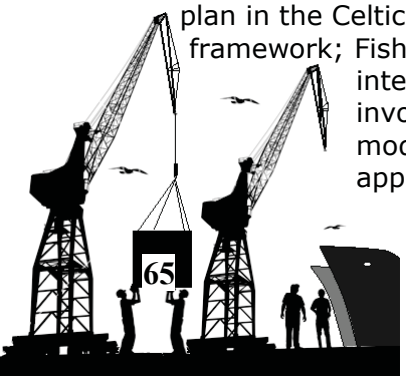
DAMARA (DemersAl Mixed fishery Analysis tool for Regional Advice) is a Decision Support Tool (DST) that's been built to enable regional stakeholders to evaluate trade-offs between management potential interventions from a biological and economic perspective. In this first implementation, it has been created to support the development of a mixed fisheries multi-annual plan in the Celtic Sea. Alongside the development of the bioeconomic model (using the FLBEIA framework; Fisheries Library Bioeconomic Impact Assessment in R with a user- friendly interface based around Shiny), the project organised five one day workshops involving science, industry and authorities to convey the basic elements of the model, including the limitations, with the goal of defining relevant scenarios and approaches to communicate complex model outputs.



A combined view of everyone involved in the project is that the science-industry- authorities collaboration is a prerequisite for advancing effective management in mixed fisheries. The outcome of DAMARA showcases that science, industry and authorities can jointly develop a decision support tool that uses the best available information to support management decisions. The project and the approach taken have been developed to be generic and could in future also be applied to other regional seas.

Keywords: Bioeconomic modelling, decision support tool, mixed fisheries; stakeholders, regional approach, trade-offs, uncertainty, simulations, profit maximisation

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C7-89

Linking ecosystem processes to communities of practice through commercially fished species in the Gulf of Alaska

Stephani Zador

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Co-authors: Stephen Kaspersky (NOAA, Seattle - France)

Full inclusion of social and economic dimensions in integrated ecosystem assessments of marine ecosystems requires understanding how ecosystem processes are linked to both human communities of place and communities of practice. Communities of place refer to locations, e.g., towns, either within or outside the ecosystem but imply a geographic scale effect on linkages. Communities of practice refer to communities linked by economic activities, defined for this project as fisheries sectors that can have participants across multiple geographic communities. We used commercial fished species such as walleye pollock (*Gadus chalcogrammus*), Pacific halibut (*Hippoglossus stenolepis*), and pink salmon (*Oncorhynchus gorbuscha*) as focal points to define linkages between ecosystem indicators and suites of related fisheries sectors. Our goal was to be able to describe the spatial and temporal scale of the linkages between the ecosystem indicators and communities of practice, and to develop indicators of these communities of practice that were responsive to ecosystem change. We developed conceptual models, limiting linkages to those that could be defined mechanistically with support from the primary literature. Dynamic factor analysis was used to define common patterns among the linkages. Data limitations differed among the focal species models. Indicators for communities of practice with defined linkages to ecosystem components fill an immediate need for integrated ecosystem assessments in Alaska, where indicators of human response and impact are rapidly gaining traction in current assessment efforts.

Keywords: Gulf of Alaska, indicators, linkages, fisheries , dynamic factor analysis

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C7-114

Social data for integrated assessment under the future European Data Collection Multi Annual Programmes

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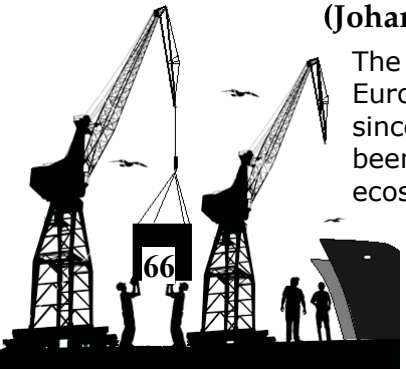

The European Data Collection Multi Annual Programmes (DCMAP) will be the 3rd European fisheries data collection programme for the collection of fisheries data since the inception of the Data Collection Regulation in 2000. Since then there has been a broadening of scope from a more biological focus to the introduction of an ecosystem approach and the inclusion of the processing and aquaculture sectors,

the next step being the introduction of social data. Indicators based on basic social data on employment have been timidly used before in some working groups of the Scientific, Technical and Economic Committee of the EU (STECF), but without continuity. The necessary inclusion for this type of data at regional and EU level in integrated assessments makes the demand more obvious, as wider and deeper collection and use of social data is required to measures key aspects of the sustainability of European fisheries, including the unequal impact of policies across geographic areas and genders, as well as the continuity of some fisheries under new challenges, such as the landings obligation or the evolution of the more general economic situation. This contribution will analyse the advantages and disadvantages of introducing social data at the DCMAP level, as well as some pilot studies already developed around certain EU case studies and more advanced experiences of other world regions (e.g. USA and Australia). Suggestions for further steps in the integration of social and economic data into integrated assessments will be presented as a conclusion.

Keywords: EU fisheries data collection, fisheries social data, integrated assessment

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C7-227

Discussing the need to perform full Socio-Economic Impact Assessments with multiplier effects in order to reach robust policy recommendations

Magni Laksáfoss

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Most Socio-Economic Impact Assessments (SEIA) limit their scope to direct impacts on the fisheries sector and very few take on a broader scope and estimate the impacts on derived industries and society and economy in general.

A limited SEIA may be misleading to policy makers because a proposed policy that, for example, creates a limited number of jobs in the fishing industry but has a large impact on derived industries and society as a whole through multiplier effects, may be seen as an inferior policy when measured in a limited SEIA that only includes the direct effects on the fishing industry.

This paper proposes a new methodology for conducting SEIA. It describes how a full SEIA differs from a limited SEIA (a SEIA that only measures the impact on the fisheries sector), and then goes on to discuss the problems of conducting a SEIA with limited scope compared to a full-scope SEIA. The problem is exemplified by comparing the impacts of two scenarios: One with many small fishing vessels and a large job creation in the fishing industry but which has limited effects on derived industries, and another with a small number of large trawlers with limited job creation in the fishing industry but which has large effects on the derived industries.

The paper then describes how to include multiplier effects and effects on society in a traditional SEIA, so that the full impacts of potential policy changes can be measured.

The clear conclusion is that a more comprehensive SEIA is necessary to estimate the full impacts on society as a whole, since a SEIA with a limited scope can lead to misleading conclusions and hence to misguided policy recommendations.

Keywords: Socio-economic impacts assessment, multiplier effect, methodology, fisheries management

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Theme session D

Participatory assessment processes: opportunities and challenges

Parallel session 1 – Monday 30/05 (15h45-17h45)

D1-111

Cognitive, abundance and closed area maps: a stakeholder centered approach to management advice in the Irish Sea ray fishery

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Co-authors: Simon Dedman (GMIT - Ireland), Mike Fitzpatrick (Coastal and Marine Research Centre CMRC - Ireland), Sam Shephard (Inland Fisheries Ireland - Ireland)

The Irish Sea skate and ray fishery is a classic data-poor situation, with many, poorly differentiated species, and no stock assessments nor MSY reference points. Several species are considered as vulnerable. While only two vessels operate a targeted fishery, a significant number of others take a ray bycatch. Stakeholder knowledge and input to management is therefore particularly important.

We present a dual stakeholder-focused approach to developing advice for this fishery. Firstly, we used a cognitive mapping approach to elicit stakeholders' perceptions on the principal issues affecting the fishery. This started with an open process, asking fishermen to describe significant elements of the social-ecological system and influences on the stock. These could be biological, ecological, social, economic or legislative. We also asked about their perception of the effects of specific management measures. This provided the data for a group-derived causal model which we used to qualitatively model the effect of different management measures. Importantly, stakeholders identified spatial management approaches as key. Secondly, we developed abundance distribution maps for four ray species, using custom-designed Boosted Regression Tree software, and based on surveys and environmental parameters. Using published MSY-based harvest ratios for these species we developed proxies for escapement biomass, representing the biomass proportion that should be conserved to maintain MSY. From these abundance maps we developed maps showing the best candidates for closed areas to protect this biomass. Two elements were used in these: ray abundance and fishing pressure. Fishermen were invited to choose how these factors could be weighted and to determine the best areas to close, from the data and their own knowledge. Using an interactive Decision Support Tool we could then show them the effects of their choices on the ray abundance, and on the displacement of fishing effort. The results of both strands are presented and discussed.

Keywords: skates and rays, Irish Sea, cognitive maps, abundance maps, DST

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D1-151

Participative methods for a better understanding of moored fish aggregating devices (MFADs)

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Co-authors: Mathieu Woillez (STH, IFREMER , Plouzané – France), Katia Frangoudes (UBO, AMURE – France), Robert Bauer (IFREMER, MARBEC, Sète – France), Loic Quemener (IFREMER, Plouzané - France)

Moored fish aggregating devices (MFADs) are increasingly being used by small-scale fishers to access fish species that are otherwise difficult to harvest in large numbers. Little attention has so far been paid to the monitoring of MFADs in coastal areas, probably due to the small-scale nature of most of these fisheries and their presumed lower impact on exploited resources and ecosystems. The aim of the communication is to present the different methodologies carried out over the last years to better understand knowledge of MFADs in Guadeloupe (Caribbean area) as a socio-ecological system. In a data poor context, most of the methodologies are participative, involving fishers through qualitative interviews, air plane surveys, vessels geo-tracking and landings self-recording. The main findings are presented showing evidence of territoriality along MFAD tract lines forming quasi-privatized territories. Harvesting strategies are highly itinerant in nature, which can be explained by the type of resource targeted and territory defendability issues. Based on an analysis of the drawbacks of the current system, collective Moored fish aggregating devices failure is analysed and opportunities for co-managed territorial use rights fisheries are discussed.

Keywords: territoriality, economic defendability, small-scale fisheries, dolphinfish, fisheries management

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D1-179

Participatory modelling of ocean warming and acidification impacts on a subarctic marine system

Stefan Koenigstein

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Co-authors: Matthias Ruth (School of Public Policy and Urban Affairs, Northeastern Univ. - USA); Stefan Gößling-Reisemann (ARTEC - Germany)

Changing environmental drivers are anticipated to affect the dynamics of marine ecosystems, impacting various uses by human societies and creating additional challenges for management. We present a case study from the Barents Sea and Norwegian Sea, where climate-related shifts in fish stocks are already observed and rapid changes in environmental drivers are projected for the near future. In a participatory assessment of the marine socio-ecological system, we constructed an integrated model which links climate change scenarios to the response of the marine food web and to the provision of living resources and other ecosystem services to human societies.

Stakeholders such as fisheries associations, ecotourism providers and other businesses, environmental organizations and governmental agencies were engaged through personal interviews, two local workshops, and online surveys. Based on stakeholder interests and concerns about marine ecosystems, a multi- species model structure was developed. The model incorporates scientific knowledge about ocean warming and acidification effects on biological processes in fish populations. Marine mammal and seabird species relevant for the tourism sector, and changes in lower trophic level

dynamics are linked through feeding interactions. Indicators for carbon uptake, biodiversity and ecosystem functioning were included.
The model thus integrates the effects of environmental and anthropogenic drivers on fish populations and ecological community dynamics across different scales. The model was used to let stakeholders evaluate potential ecosystem changes under ocean warming and acidification scenarios and to identify and discuss management and adaptation options.
The participatory modelling process has succeeded in incorporating multiple user groups into an ecosystem assessment and evaluating potential socio-ecological changes under climate change scenarios. It can serve as a tool for assessing adaptation potential to climate change and addressing multiple management objectives.

Keywords: participatory modelling, climate change, Norway, stakeholders, process-based model

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D1-215

Integrating socio-economic drivers in an explicit-time, qualitative fisheries model: EcoMata

Christine Largouët

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Co-authors: Yves-Marie Bozec (Marine Spatial Ecology Lab, Univ. Queensland – Australia), Yulong Zhao (MediCIS / INSERM, Rennes - France)

EcoMata is an explicit-time, qualitative modelling tool for assessing the ecosystem impacts of fishing and evaluating options for fishery management. EcoMata relies on the theory of timed automata, an original approach for modelling and verifying discrete-event systems where timing is important. Early developments of EcoMata have focused on the dynamics of predator-prey responses in a food web, under a variety of fishing intensities and natural disturbances. The dynamics of these interacting modules (food web, fishing and external disturbance) are ruled by explicit timing constraints on state transitions, with the possibility of integrating time delays in their execution. System states and properties can be verified over time using efficient model-checking techniques with the help of a dedicated high-level query language. EcoMata provides non-expert users (i.e., managers) with a friendly interface that allows the expression of user-oriented queries for testing the sustainability of fishery policies. Here, the model is being developed further by integrating simple socio- economic drivers in the fishery system. Specifically, we introduce a new module of automata that describes the profits associated to a specific fishing intensity and specific timing. This new module allows the evaluation of management strategies that are economically viable. The approach is illustrated on a coral- reef fishery in the Pacific that has been the focus of previous modelling work. Timed automata offer a unified formalism for describing a variety of processes in which timing is critical. We show that ecological, economic and social drivers can be easily integrated in the EcoMata framework for exploring the sustainability of fisheries in a data-poor context.

Keywords: Qualitative reasoning, timing constraints, trophic interactions, fishing policy, fisheries profits, coral reefs.

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D1-229

Lessons from a multi-model participatory approach for the evaluation of discard reduction scenarios in the Eastern English Channel

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Co-authors: Marie Savina-Rolland (IFREMER, Boulogne-sur-Mer – France), Pierre Bourdaud, Morgane Travers-Trolet , Youen Vermard (IFREMER, Nantes - France)

Within the European H2020 DiscardLess project, participatory approaches are implemented to associate stakeholders to the design of alternative fishing strategies aiming at reducing unwanted catches in response to the implementation of the landing obligation. In the Eastern English Channel mixed demersal fishery, these strategies include changes in gear characteristics but mostly changes in spatio-seasonal fishing tactics. Scenarios are the results of a participatory approach where scientists and fishers bring their own knowledge and perception of the exploited system to identify the most potentially efficient and feasible strategies as well as relevant evaluation criteria. The evaluation of the performance of the scenarios is then conducted using three different models of various complexity and specificities: ISIS-Fish, Osmose and Atlantis. All three models are spatialized and multi-specific but ISIS-Fish is focused on fleet dynamics and management, Osmose couples trophic interactions and technical interactions, and Atlantis is an end-to-end model.

The paper presents the approach adopted to take up the two-fold challenge of using complex models within a participatory approach adding the difficulty of using several complex models. Stakeholders' reactions and solutions to work pitfalls out are reported. The advantages and drawbacks of the approach are discussed. Finally, the results of the evaluation of the base case scenarios by the different models are presented. Differences across models are discussed and conclusions are drawn on the robustness of the scenario evaluation.

Keywords: Eastern English Channel mixed demersal fishery, landing obligation, alternative fishing strategies, multi-model approach, stakeholder participation.

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Parallel session 2 – Tuesday 31/05 (10h30-12h30)

D2-26

The «Territory game»: a traceability of drivers and actions' design on the maritime integrated management in the southwestern Pacific

Anne Littaye

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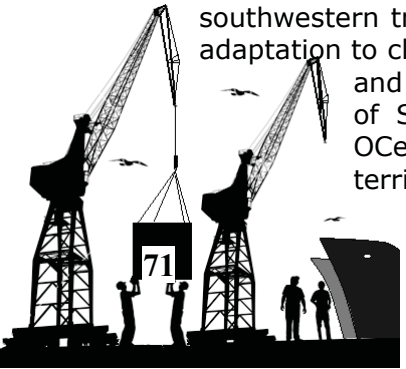
The identification of territory challenges is a crucial phase in a marine spatial planning approach. It was conducted until recently as a technical spatial representation and zoning; The development of diverse computer technology facilitates this approach. The 22 countries and territories of the southwestern tropical Pacific are meeting global challenges: the biodiversity conservation, the adaptation to climate change, food security, the potential deep sea mining and the governance and dependency from external states. In the interest of ensuring the coordination of Strategies between states and the related actions, the PACIOCEA (PACIfic OCean Ecosystem Analysis) project's goals was to build a shared vision of territorial issues, at the regional scale. To this end, a participatory approach has



been implemented with scientists from the maritime fields and institutional stakeholders of regional organizations and countries. The method « territory game » has been adapted to build collectively some spatial representations of the dynamics and issues of the tropical southwestern Pacific; then, issues-based scenarios have been designed to imagine innovative actions. The method used tracked the underlying reasoning which has been gradually built during the process. The outcomes were pluridisciplinary dialogue between stakeholders; it was particularly visible while talking of tourist sector or adaptation to climate change. The suggested actions showed that the environmental conservation should not be considered as a burden to maritime activities but a driver for change to address potentially social and economic development.

Keywords: Reasoning traceability, pluridisciplinary, marine spatial planning, scenario

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D2-75

Understanding the behavior of policy decision makers through participatory experiments, a role playing game to explore management of the Atlantic Bluefin tuna fishery.

Jules Selles

(IFREMER, University of Nantes - France)

The Atlantic and Mediterranean Bluefin tuna fishery has been considered the archetype of an overfished and mismanaged fishery. While this crisis has been widely communicated by the media, it has also demonstrated the role of public awareness and the importance of the interactions between science and management, in a context of uncertainty on the status of the biological resource and facing economic risk for an important sector of the fishing industry. We investigate the policy making process associated with this regional fisheries management, using an innovative socio- economic experiment based on a role-playing game.

We propose a computer-based experimental approach to explore the effects of key factors on the cooperation process in a complex straddling stock management setting. The approach is based on a « standard » multi-gear, age structured bio-economic model which explicitly represents the decision making process. Each participant plays the role of a stakeholder of the International Commission for the Conservation of Atlantic Tunas and represents a national fishing industry involved in the fishery, deciding on a policy for the coming year. In a context where lobbies influence the public opinion for conservation or exploitation, the participants must deal with the uncertainty in the scientific advice about the stock status, to develop their contribution to the fishery and to set common management plans for the stock during the negotiation process in a Commission session. The model is set as an experiment which specifies lobbies' interventions, as well as the uncertainty associated with scientific advice, according to a factorial plan. The context of the experiment induces the incentives for exploitation and collaboration to achieve common sustainable harvest plans at the Atlantic Bluefin stock scale.

Keywords: Participatory simulation, Role playing games, Fisheries management, Policy making, Atlantic Bluefin Tuna.

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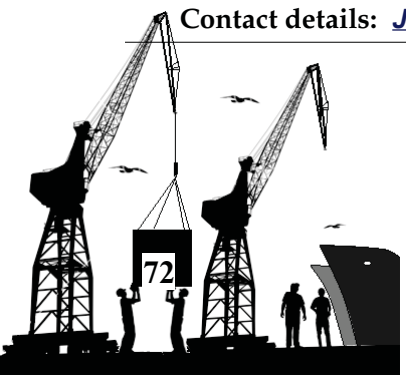

Informing ecosystem-based management of the range extending long-spined sea urchin using a structured decision making process

Martin P. Marzloff

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Co-authors: Lucy M. Robinson (IMAS and Commission for the Conservation of Antarctic Marine Living Resources – Australia), Sarah Jennings (Tasmanian School of Business and Economics - Australia), Stewart Frusher (IMAS - Australia), Sam Nicol (CSIRO, Brisbane - Australia), Gretta Pecl (IMAS - Australia), Ingrid van Putten (CSIRO, Hobart - Australia), Alistair J. Hobday, Marcus Haward (IMAS - Australia), Sean Tracey, Klaas Hartmann

Following climate-driven ocean changes, the long-spined sea urchin (*Centrostephanus rodgersii*) has extended its range from Australia's mainland to eastern Tasmania. Due to the depletion by fishing of large rock lobster (*Jasus edwardsii*), its main predator on Tasmanian reef, *C. Rodgersii* has demonstrated the ability to form and maintain extensive « barrens », via destructive grazing. Relative to dense seaweed beds, sea urchin « barrens » represent a dramatic loss of habitat, biodiversity and productivity for important commercial reef species such as southern rock lobster and abalone. Thus, the range extension of *C. rogersii* to eastern Tasmania generates conflicts between stakeholder groups and poses complex challenges for the regional management of reef communities and fisheries.

In this paper, we applied a participatory Structured Decision-Making framework to help identify cost-effective interventions that perform well against conflicting management objectives. We conducted a workshop and two successive surveys involving key stakeholder groups to elicit and rank a suite of performance objectives and management scenarios. We assessed the 10-year consequences of alternative management scenarios on reef state and fisheries productivity, using the TRITON model, which realistically captures the dynamics of Tasmanian reef communities. Cost and feasibility were also assessed for each management interventions. Using this information, we directly and indirectly elicited stakeholders' preferences for different scenarios. We estimated alternative scenario ranking metrics based on stakeholders' preferences, as well as benefits, cost and feasibility of management interventions. The range of performance metrics allowed to rank both scenarios overall performance, and benefits to individual stakeholder groups. This participatory model-informed structured decisionmaking process contributed to overcome some of the initial conflicts and led to a larger agreement between the different interest groups about best management scenarios. Enforcement of a zonal cap on both recreational and commercial catches of rock lobster combined with either, sea urchin harvesting, or lobster biomass translocation ranked as most cost-effective management scenarios.

Keywords: Decision-support tool, ecosystem modelling, consultative management, multi-criteria analysis, cost and benefits

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D2-97

A learning experiment for integrated assessment of the sensitivity of North Sea living marine resources to climate change

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Co-authors: Bianca Haas, Steffen Funk, Richard Klinger, Vivien Kudelka , Nicole Smialek, Stefan Spreitzenbarth, Ming Sun, Melina Varnas

Integrated assessments require a holistic understanding of the sensitivity of marine exploited ecosystems to climate change. Cumulative effects of changes in temperature, oxygen, salinity as well as ocean acidification will increasingly cause altered phenology, biogeography and overall productivity of marine living resources. Consequently marine ecosystems and their food webs will reorganize in unpredictable ways challenging quantitative modelling approaches applied in natural resource management. Qualitative and semi-quantitative assessments may be valuable alternative and complementary methods to support the development of mitigation and adaptation strategies within future ecosystem-based management. Here we show results of a learning experiment conducted by a class of graduate students leading to a rapid assessment of the potential effects of climate change on 26 fish and shellfish species of the North Sea. Our experiment combined extensive literature reviews with questionnaire-based surveys among marine ecology and fisheries experts. Using the derived knowledge-base we produced concensus assessments for each resource species considered. Our study suggests ongoing and future temperature increases as well as the expected ecological changes to be of predominant importance and the main areas of concern for future ecosystem-based resource management. We furthermore identified significant knowledge gaps on other drivers potentially leading to uncertainties in the perception of climate change effects on living marine resources in the North Sea.

Keywords: climate change, ecosystem-based management, living marine resources, literature review, North Sea, qualitative and semi-quantitative methods, risk assessment, questionnaires

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D2-231

Improving the governability of small-scale fisheries: the need for fisheries action research

Marc Léopold

(IRD, Sète - France)

A number of studies have shown that co-management offers unique opportunity for addressing sustainability challenges of small-scale fisheries (SSF) worldwide. This is supported by the sociological approach to SSF systems that highlights that SSF conditions are governed by social interactions between actors, within natural limits. Fisheries researchers have undoubtedly involved in these interactions as management experts or knowledge providers, which has consequently questioned their role in SSF governance. This study builds upon my 10-year experience in SSF action research projects in Pacific island countries to emphasize how fisheries researchers may contribute to improve the governability of SSF. Specifically our research projects were interpreted in regard to their global capacity to initiate, organize and implement co-management actions in different SSF systems according to fisheries and societal contexts. Analysis results were threefold.

First providing multidisciplinary knowledge on SSF to fisher communities and/or public authorities was not sufficient, per se, to lead to co-management actions. Second adaptive co-management implied permanent linkage between

researchers, fisher organizations (and other actors of the fish chain) and public authorities to account for unexpected or undesirable social, socioeconomic and/or ecological change in SSF. Third fisher organizations provided insights in terms of resource status, local incentives, management instruments and governance rules that were innovative and necessarily accounted for in the co-management actions. All together, these results acknowledge the legitimate and key role of researcher-actors in fisheries in collective problem-solving by facilitating and supporting long-term cooperation with and between other actors of SSF. This role promotes social action for change in SSF governance and management and aligns with emerging needs for transdisciplinary research in SSF.

Keywords: small-scale fisheries, governability, co-management, action research, transdisciplinarity

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D2-232

How to implement a management plan measures for shark stocks? Four complementary tools to help policy-makers

Cécile Brigaudeau

(Des Requins et des Hommes, Plouzané - France)

Co-authors: Armelle Jung

Following scientific advices, policy-makers have understood that elasmobranch species as top predators are essential to maritime health. Then, in some countries, policy-makers decide management plans to preserve these species. However, sharks knowledge is underestimated and population involved in these fisheries completely forgotten. In order to fill these failures, « Des Requins et des Hommes » proposes fours axes to preserve natural resources. One methodology has been applied for two different oceans and two different species: the pelagic thresher shark (*Alopias pelagicus*) is one of the largest and most abundant open ocean predators in the Eastern Tropical Pacific (ETP), and one of the most exploited sharks in the sub-region. *A. pelagicus* has been classified as Vulnerable on the IUCN Red List since 2004. Sawfishes (*Pristidae* sp.) are classified as almost extinct in Western Africa and have not nearly been seen since years in the sub-region.

« Des Requins et des Hommes » with the Ministries of Fisheries of each country concerned (Colombia, Senegal, Mauritania, Gambia, Guinea Bissau, Guinea Conakry, Sierra Leone) had created in 2012 the COLSHARK program to study *Alopias pelagicus* in the Eastern Tropical Pacific, Colombia and AfricaSaw Project for *Pristidae* sp. in Western Africa. Four axes of research have been developed: the tagging sessions to understand movement patterns which were successful in Colombia and in progress in Western Africa; genetic analysis to determine if distinct populations exist; an observers network to collect data along the coasts; concertation with fishermen to elaborate collaborative conservation plan, game designed to emulate the incentives in the context of the tragedy of the commons and to demonstrate why the individual and group incentives diverge.

This presentation will report the results from these two field experiments in Colombia and Western Africa, combining these four tools to implement management plans.

Keywords: tagging, sharks, genetic, experimental economy, elasmobranchs, concertation, policy-makers, Colombia, Senegal, Mauritania, Gambia, Guinea Bissau, Guinea Conakry, Sierra Leone

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Parallel session 4 – Tuesday 31/05 (16h00-17h40)

D3-238

Science - industry collaboration on the Eastern English Channel common sole stock

Marie Savina-Rolland

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Co-authors: Youen Vermard, Caroline Gamblin (Comité National des Pêches et des Elevages Marins CNPEM - France), Alain Biseau (IFREMER, Lorient - France)

The common sole is amongst the main commercial species in the Eastern English Channel (VIId). This stock is targeted by two different kinds of fleets. The French and English small inshore vessels use trammel nets and trawls, and fish mainly along the English and French coasts. The English and Belgian beam trawlers are able to direct effort to different ICES divisions as well as to other species. They can catch sole in the middle of the channel in winter, before the fish move inshore and become accessible to the local fleets. The proportion of French landings fluctuates around 60% of the Eastern Channel landings, with the netters accounting for 2/3 of it. The French inshore vessels have become highly dependent on sole (>50% of annual revenue) since the implementation of the cod management plan and of restrictive TAC on rays.
The move towards F_{msy} as well the uncertain but low recruitments over the last few years has led to repeated ICES advice to decrease the TAC (-60% for 2015, -32% for 2016). These recommendations triggered a discussion between the French industry representatives, the French fisheries administration and IFREMER about the exploitation of this stock and the pitfalls in its assessment and management.
Management measures have been discussed between the industry representatives, evaluated by IFREMER and the French fisheries administration with regards to their potential efficiency and feasibility, and assessed and validated at the European level. A management plan is now under discussion. The main knowledge gaps around this stock have also been agreed on, and a collaborative scientific project has been defined and funded by a consortium of scientific, industry and local government agencies.
This paper will analyze this iterative process between French fishermen /administration/scientist, from a highly restrictive TAC proposal from the commission to the design of a management plan from propositions from the fishermen and the development of a scientific project SMAC running for the next three years.

Keywords: common sole, Solea solea, management plan, scientific-industry partnership

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D3-65

Social-ecological systems in practice – understanding the potential for use in UK marine policy and management

Kieran Hyder

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Co-authors: Hannah Tidbury, Tiziana Luisetti

Policy and management questions are generally framed in terms of social, economic and environmental drivers, but linking changes in ecosystem structure and function to the services they provide, and to the consequences that these changes have in terms of human welfare is challenging. However, decision-makers need to understand links between human and environmental pressures and the state of the environment to determine suitable management measures to meet both environmental and human objectives, to track progress in relation to

those objectives, and to assess the performance of management options.
Social-ecological models provide a useful framework to address the increasing number of policy and management questions that interlink ecological, social and economic system components. However, it is unclear how these interdisciplinary models could be most effectively deployed to support an integrated approach to marine management. In this study, an assessment was made of how best to deploy social ecological modelling in support of UK marine policy and management. A workshop brought together decision- makers, evidence gatherers, social scientists, modellers, data scientists and economists to review the contribution of current UK marine social-ecological models to integrated marine management in the context of biological sustainability, societal and economic benefits and needs. The potential for the application of social-ecological models was assessed for two policy relevant case studies: the implementation of maximum sustainable yield in the multispecies context; and the impact of cumulative pressures on ecosystem services. Key obstacles, challenges, and future interactions were identified that are needed to increase awareness, utility, and uptake of social-ecological modelling in marine policy and integrated marine management.

Keywords: social-ecological models, marine policy, integrated marine management

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D3-106

The end of the comfort zone: Co-creation for implementing the Ecosystem Approach to Fisheries Management in the European Union

Marta A. Ballesteros

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Co-authors: José Luis Santiago Castro-Rial, Rosa Chapela Pérez

Combined advance of knowledge and action has become critical to bridge the gap between environmental problems and our capability to solve them. Nevertheless, connecting science and decision making for governing social-ecological systems creates puzzles that call for innovative approaches. In 2014 we presented at the ICES ACs Conference the preliminary results of a proof of concept study within the MareFrame project(www.mareframe-fp7.org), introducing the co-creation approach for the implementation of the Ecosystem Approach to Fisheries Management in the European Union. Co-creation is a theory of interactions that combines analytical and participatory tools to generate knowledge that has scientific acceptability, policy relevance and social robustness. It is currently being applied in 7 European sea-basins case studies that include scoping, definition of management priorities, and use of the outputs of ecosystem-modelling (Gadget, EwE, Atlantis, SMS) to support structuring decision-making (bayesian belief networks and multicriteria Analysis) in a iterative stakeholders engagement process.
Findings so far evidence that co-creation addresses the changes in our systems for generating, sharing and discussing human knowledge (globalization, technological developments, interdependency, etc.); it also broadens the knowledge based and supports learning how to work deliberatively with imperfections; and potentially could contribute to improve both science and policy making performance.
The cognitive, scale and institutional challenges identified in 2014 have been partially tackled and the insights translated in a review of the approach. On-going implementation has however pointed out new barriers that may hamper its implementation in the real policy context, particularly: i) the risk of participation becoming a new panacea; and ii) the need to build engagement under basic requirements that address the legitimacy of the constituencies, the capacity to influence and the dialogue based on equal footing.

Keywords: co-creation, EAFM, stakeholders, knowledge, policy.

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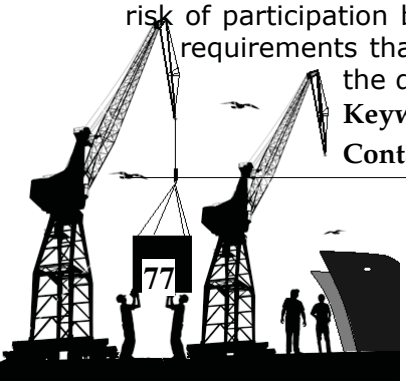

D3-110

Marine Ecosystem Health and Human Well-Being (PICES-MarWeb) - A good relationship between local communities and seafood diversity.

Masahito Hirota

(NRIFS, FRA, Yokohama - Japan)

Co-authors: Mark L. Wells (School of Marine Sciences, University of Maine – USA), Mitsutaku Makino (NRIFS, FRA - Japan)

Shrimp pond cultures have been widely developed since the 1980s in South East Asian countries. But after 2000s, their abandonment due to mass diseases, have resulted in a threat to the livelihood of the local inhabitants, giving rise to social instability at the local community level. To consider how to rectify this condition, the PICES S-HD is studying the use of an environmentally friendly aquaculture technology, while applying a social science approach by working together with the local community. In Indonesia (Java Island), the work plan has been carried out with two approaches; the first is pond experiment of IMTA (A method of aquaculture in which fish, scallop and seaweed are managed tropically by bio-recycling so that the by-products from one species are used as food or fertilizer for another).

The main purpose this experiment is to investigate the effects of IMTA on the economic return of pond operations, and the improving pond water quality and successful growth of multi species. Another one is social science approach, using a commodity chain mapping analysis of the products, which has been prepared to assess what kind of businesses are locally supported, who and how consume the multi-species produced (shrimps, milkfish, crab, etc.) to ensure a rich variety of seafood as ingredients of everyday life, and to lead new diverse job creations in the community.

To understand this sustainability approach, the PICES has held three international workshops in Indonesia, and we have successfully raised the awareness of the general public about seafood sustainability. For the future, it is expected that many communities will establish and lead local IMTA programs in order to rectify their own well-being. This research is a part of a 5-year project on « Marine Ecosystem Health and Human Well-Being » (PICES-MarWeB) supported by the Ministry of Agriculture, Forestry and Fisheries (MAFF) of Japan. (https://pices.int/projects/MarWeB.aspx)

Keywords: well-being, social approach, sustainability, IMTA, seafood diversity

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D3-238

Developing strategies for Seagrass Conservation: a focus on food security provision

Benjamin Jones

(Cardiff University - UK)

Co-authors: Leanne Cullen-Unsworth, Richard K.F. Unsworth (Swansea Univ. - UK)

The aim of this work is to understand the interface between marine biodiversity conservation and socio- economic activities, with a view to enhancing conservation efforts for seagrass meadows. Seagrasses are critical components of marine systems supporting a diversity of taxa. Important fishing grounds in their own right; they also play a significant role in supporting other fisheries productivity. At different stages of their lifecycle, many economically important fish and invertebrates utilise seagrass for shelter and food. Protecting seagrasses as foundation species can protect species richness, biodiversity, ecosystem structure, fisheries support, climate regulation through carbon sequestration and

other essential ecosystem services. However, seagrass meadows are declining globally at an unprecedented rate and marine conservation priorities often do not recognise the value of the goods and services provided.
Southeast Asia is one of the world's marine biodiversity hotspots. However, knowledge of seagrass meadows, recognition of their social and ecological importance and effective conservation strategies are lacking. With rapid coastal development, these nearshore marine ecosystems are subject to increasing pressure from anthropogenic sources. Using a case study approach, this research is engaging local scientists, stakeholders, community groups and public administrators to evidence the value of seagrass meadows, highlighting conservation priorities for marine biodiversity protection using food security as a primer, and aiming to develop realistic management strategies.

Keywords: seagrass meadows; food security; ecosystem services; fisheries; socio-economic practices, management

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Parallel session 5 – Wednesday 01/06 (10h30-12h30)

D4-124

Ecosystem Services as integrating element in Integrated Ecosystem Assessments?

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Co-authors: Andreas Kannen, Roland Cormier

As shown in the Coastal Futures research project in Germany, the spatial distribution of uses in the sea can be conceptually linked to ecosystem services. However, while there are many studies, focussing on the ecological and economic values provided by the sea, it is less common to regard the sea as a place defined by cultural meanings. While Strategic Environmental Assessments allow to routinely taking ecological considerations into account, information on social and cultural attachments is rare and therefore not considered. For planners and managers, the key question in this context is how to take account of these immaterial values in risk assessments in a way that is commensurate with ecological or economic values.
Against this background a workshop on « Mapping Cultural Dimensions of Ecosystem Services » (WKCES), organised by the ICES Working Group on Marine Planning and Coastal Zone Management (WGMPCZM), developed an approach to identify and map culturally significant areas as well as related risk assessment criteria. Given the wide range of cultural contexts, a key conclusion is that cultural values cannot be defined through universally valid pre-set criteria. They need to be defined by the communities of interest within the planning area and in those spatial areas that will experience the impacts of a planned project. In this context « Culturally significant areas » are proposed in analogy to « ecologically significant areas » in order to link up with the nature of spatial planning processes. An area may be seen as culturally significant when it provides cultural services that are critical to the well-being and identity of the given community. Linked on such a baseline, risk assessment may identify vulnerable ecosystem services based on existing and future pressures in the planning area.
The presentation will introduce this approach, discuss underlying assumptions and frame it in the context of Integrated Ecosystem Assessments.

Keywords: Cultural Ecosystem Services, knowledge integration, marine planning

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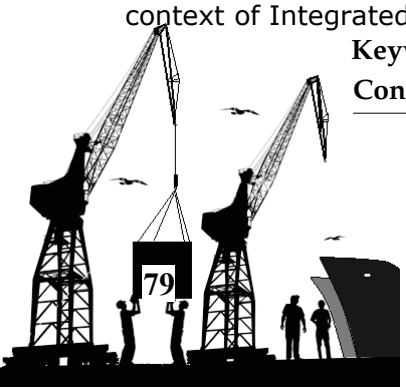

D4-134

The SYNOPSIS platforms: tools for integration and sharing of knowledge in support of sustainable environmental management

Johanna Ballé-Béganton

(UBO, UMR AMURE, Brest - France)

Co-authors: Michel Lample, Denis Bailly, Manuelle Philippe

The increasing environmental scientific knowledge with its joint development of computing and communication technologies supports the belief that knowledge is readily available on any particular subject. However, environmental managers and policy makers in marine and coastal areas are faced with rapidly evolving complex systems and are in need of tools for integrated assessments to support their deliberation and decision making. In order to efficiently support sustainable environmental management, applied research should offer knowledge integration and simulation tools co-constructed with managers and stakeholders and which take into account local knowledge and expertise and represent the necessary social and environmental trade-offs and management levers.

Through several European projects (SPICOSA, VALMER, VECTORS) and in different coastal and marine study sites, we have developed SYNOPSIS platforms for knowledge sharing and system modelling, using the ExtendSim software. Each SYNOPSIS platform addresses a policy issue identified with local stakeholders and is organised around four axes: hierarchically structured knowledge, conceptual graphical representations of the system, numerical system models with user friendly control panel boards and animated graphical outputs and scenario narratives and assessments. For mapping and simulation purposes, the SYNOPSIS platforms offer a GIS (Geographic Information System) component and can be interfaced with external models.

The platforms are co-constructed with local managers and stakeholders through meetings and workshops. With coastal and marine issues ranging from freshwater mitigation between watershed farmers and coastal shellfish farmers, microbiological and heavy metal contaminations, wetland and seagrass meadows conservation to assessment of the impact of trawling on benthic ecosystems, we test how this participatory tools and methodologies foster science and policy integration.

Keywords: Knowledge sharing, system modelling, participatory assessment

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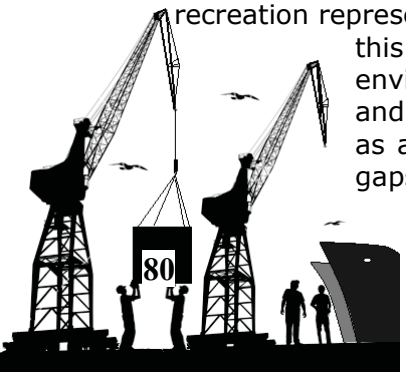
D4-139

Understanding the Socioeconomic Importance of the Ocean Recreation Use Sector in Integrated Ecosystem Assessments and Ocean Planning

Kate Longley-Wood

(SeaPlan, Boston - USA)

Understanding the relationship between human uses of the ocean and marine ecosystems is a fundamental goal of both integrated ecosystem assessments (IEAs) and ocean planning. High quality data on human uses are integral to both processes. Generating an estimated $70 billion (51%) of the United States' ocean economy's gross domestic product, coastal tourism and recreation represent a socioeconomically important human use sector; however, data describing this sector are sparse. The ocean recreation sector derives benefits from marine environments which are coupled with the sector's effects on marine ecosystems and interactions with other uses, thereby exemplifying the concept of the ocean as a socio-ecological system. To examine these interactions and to address data gaps, ocean planners in the Northeast U.S. have conducted multiple studies which



characterize a variety of recreational activities, including boating, whale watching, SCUBA diving, sailing, paddle-sports, and other activities. These stakeholder-driven studies have employed a combination of methodologies and tools to collect spatial and socioeconomic data on these activities, in addition to qualitative information on stakeholder concerns and predicted trends. For example, a survey of recreational boaters used an online map-based survey tool to collect robust quantitative data which characterize the industry's economic impact in the region and depict important areas to recreational boaters on public mapping portals. Follow-up studies on other activities have used both online and in-person participatory mapping techniques to collect data from recreational stakeholders. Coupling social science research with stakeholder-informed data collection has resulted in data products that will help policy-makers understand current and future trends and needs. This paper will detail the methodologies, results, and outcomes of regional recreational use characterization studies, while identifying the challenges of engaging and characterizing a diverse sector. These studies demonstrate how recreation data are essential to analyses of ecological, economic and social-trade-offs in IEAs and ocean planning.

Keywords: recreation, ocean planning, human uses, stakeholder engagement

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D4-145

Assessing the role of perceptions in social conflict among natural resource users: the case of shark provisioning in French Polynesia

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Co-authors: Joachim Claudet, Serge Planes

The rise of conservation conflicts requires management to minimize averse effects on both biodiversity and humans livelihoods. While strategies aiming to reduce environmental impacts have long been developed, the mitigation of human-human contentions inherent to conservation conflicts presents a greater challenge. Indeed, social conflict among natural resource users is assumed to inhibit adaptation in social-ecological systems. It arises from gapping attitudes, wich are in turn partly induced by differences in individual perceptions. In this study, we explored the relationship between people's attitude towards shark provisioning, a highly controversial wildlife-watching activity, and the perception of these operations in French Polynesia. In order to develop a simple content-valid method to measure individual perceptions, we first constructed a perception model through qualitative interviews with 25 local experts and shark specialists. We built the perception model by converting the most redundant topics about the shark provisioning controversy into questionnaire items. The selected topics included the impacts of shark provisioning activities on (a) the individual, (b) society, and (c) the ecosystem. Then, an extensive quantitative survey was conducted among over 490 ocean users. Respondents were asked to indicate their attitude on shark provisioning activities and rate each perception item on a Likert-scale. In order to determine which perceived aspects of shark provisioning were most influential on people's attitude, we performed logistic regression on the questionnaire data. Declared attitude to provisioning was set as the dependent variable and ratings for each perception item were set as the predictor variables.

Perceived individual and society-level impacts of shark provisioning were the strongest predictors of attitudes towards the activity, while the perception of ecosystem-level impacts did not significantly differ across attitudinal groups. These findings suggest the critical importance of individual and society-level considerations in management strategies and the role of social science investigations in identifying sources of social conflict in the context of natural resource management.

Keywords: shark provisioning, user conflict, social perceptions, assessment tools, human-wildlife interactions

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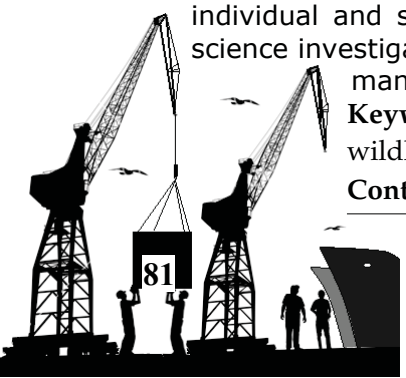

D4-148

Stakeholders' Perceptions on the Marine and Coastal Ecosystem Services at Peniche-Nazaré

Tom Willaert

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Co-author: Margarida Simão Ramalho Ortigão (UNL - Portugal)

This paper presents the results from a survey conducted in the West Coast of Portugal (Peniche-Nazaré) to analyze the perceptions of stakeholders regarding the value and location of Marine and Coastal Ecosystem Services (MCES). Given that relevant stakeholders are expected to have a better knowledge of the study area, the information provided will be useful to complete its characterization. The results of this study may facilitate the involvement of the stakeholders in the decision making process, thus helping solving potential conflicts of interest and contributing to the creation of a global strategy for the area.

The method used (Public Participation Geographic Information Systems) combines a range of geo-spatial information management tools and methods to measure participants' spatial knowledge in the form of maps. Our sample covers 27 individuals working in different sectors of activity directly related to the ocean, and seven MCES were selected following the CICES classification for MCES. Respondents provide a relative value to each of the MCES, specify the related human activities and indicate in a map the areas where these are located.

The maps produced help identifying the location of each MCES across the study site. We have also used the Shannon Diversity Index to measure the number of different MCES in each area, since locations that are important for several ES will deserve more attention. We conclude that food provisioning and leisure and recreation are generally the most valued ES. The areas around the two largest urban areas (Peniche and Nazaré), as well as around Berlengas Archipelago, Obidos Lagoon and São Martinho do Porto Bay are the most valued places.

Keywords: Ecosystem Services, PPGIS, Portugal

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D4-222

Marine coastal communities: ecosystems of human change

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While effort has been expended on understanding the impacts of environmental change on biological communities and their associated ecosystems, less focus has been directed towards understanding the ramification of change in the human ecosystem. Species specific impacts on industries have been reported and adjustments to species specific assessments are seen as the solution. Reducing the quota for a commercial species, reducing the bag limit for a recreational species, closing a fishery when exposed to a harmful algal bloom are some of the responses. These responses fail to take into account the inter-connectivity of the human system at a human ecosystem level.

Australia is a coastal nation with over 85% of the population living within 50 km of the coast. Many of the coastal towns in Australia started as fishing villages but with changes in technology, fisheries management and population growth, the fisheries component of these coastal towns has diminished. Other marine related industries such as tourism (including seasonal recreational fishing), aquaculture and conservation (diving) are becoming the main centres of marine focus in these

coastal towns. In a latitudinal study in Australia we analysed information from all marine sectors in 3 coastal towns and developed a socioecological vulnerability index. While the focus of this index was on the impacts of climate change, human skills are often transferable across sectors and that a whole of marine sectors approach, the human ecosystem, needs to be understood to both understand the ramifications of change at the community level and to be able to develop appropriate adaptation responses with the human ecosystem.

Keywords: socioecological vulnerability, coastal communities, adaptation

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Parallel session 8 – Thursday 02/06 (10h30-12h30)

D5-60

Strategies and tools for visioning alternative futures for marine ecosystems and coastal communities

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Anticipating and planning for alternative futures for the management of marine resources presents challenges to researchers that spans both the scale and complexity of marine ecosystems, but also the policy and decision making arenas that govern multi-sector resource use by coastal communities. In building scenarios for possible futures that are relevant to these arenas, researchers must go beyond their traditional role of answer providers and tool developers, and also take on the role of facilitators and engage more deeply with community stakeholders to 1) identify solutions and strategies that are acceptable to communities, 2) provide visualization and communication of analyses of complex systems (especially with a spatial context), 3) provide a platform for negotiation and conflict resolution, and 4) introduce consideration of a much broader uncertainty than is typically intuitively included.

Here we describe a diversified array of efforts to meet these challenges through modelling and complex analyses tools that are applied with an emphasis on participatory modelling and gaming. Narratives of possible futures are formally elicited from stakeholders and then transcribed into process models. Model analysis reveals underlying system dynamics and also identifies informative indicators of change. Model predictions and simulations are then used to engage with stakeholders through gaming scenarios, with the primary goals of education (or training the intuition), and the identification and evaluation of policy and management plausible options.

Keywords: scenario development, narrative analysis, mental models, marine resource management, gaming.

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D5-63

Weighing up management options for marine ecosystems: a participatory approach

Dr Leonie A. Robinson

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Through a series of roadshows we explored a participatory approach to management strategy evaluation (MSE) based on designing programmes of management measures to meet the commitments of the Marine Strategy Framework Directive (MSFD). Participants were asked to rank management options based on their initial feeling in terms of likelihood in leading to improvement against particular policy objectives of the MSFD. Following this, they undertook three exercises in small groups to explore how the same management options (MOs) performed in terms of: (1) reduction in ecological risk, (2) effects on supply of ecological services, and (3) governance complexity, using methodologies developed in the ODEMM project (www.odemm.com). After each exercise they ranked the MOs again, finally reviewing their overall preferences in light of completing all the exercises. Participants represented those involved in advising decision-makers on management of each of the four major European regional seas. The approach is presented and feedback from participants discussed in terms of exploring the utility of the overall approach for operational decision- making.

Keywords: management strategy evaluation, participatory approach, decision-making, trade-offs, European regional seas, policy objectives

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D5-74

Mental models, computer models and attitudes towards the Future

Fabio Boschetti

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We discuss two dualisms affecting the stakeholders' engagement in Natural Resource Management (NRM).

The first dualism refers to a « system dynamic » vs an « attitudinal » view of the mental models stakeholders employ to understand NRM. The first sees mental models as small-scale versions of reality and includes analogues of socio-bio- physical variables and causal relations. The second includes values, emotions and intuitive perceptions in a social psychology sense. This dualism affects our understanding of whether the purpose of a mental model is to determine policy preferences by predicting the consequences of available options (model → preference) or to justify policy preferences by constructing models which fit their rationale (preference → model). In order to increase support for specific policies, interventions should target system understanding or policy framing depending on which of these views prevail.

This also affects our perception of the relation between a system's past, present and future. The « system dynamic » view imposes dynamical constraints on a system's evolution. The « attitudinal » view allows beliefs about the past, present and future to hold different functions. This leads to the second dualism which is particularly relevant when the impact of policy options need to be projected

several years, or decades, into the future. When stakeholders think of a distant future they employ cognitive styles different from the ones commonly used for shorter-term planning and decision making. This may affect the reception of modelling efforts since stakeholders may question the very purpose of trying to say anything meaningful about such a distant future; may consider model outputs as irrelevant to planning; or may provide emotional, often unconscious, responses motivated by deeply held fears and aspirations.
We review the relevant literature, discuss a number of empirical results including an experiment which shows how the very act of thinking at depth about the future can significantly change the perception of future time horizon and future concerns and discuss the possible implications for modelling projects.
Keywords: Mental models, Computer models, Cognitive psychology, System Dynamics, Decision Making, Attitudes toward the Future.
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D5-60

Beyond the Soft System Methodology

Michel Lample

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Co-author: Denis Bailly, Pascal Raux, José A. Pérez Agúndez (IFREMER, Plouzané - France) , Johanna Ballé-Béganton (UBO, UMR AMURE - France)

Most environmental issues are highly linked to society and increasingly rely on the use of participatory techniques. Many of those techniques are inherited from the Soft System Methodology (SSM) and we can measure how much this methodology continues to be an increasing reference. Going back to the origins of the SSM shows us how this methodology was designed to deal with the Soft and Hard issues: in particular, facing the complexity of the Soft-System, the authors of the SSM had tried to apply the « hard-System » proven-approaches to the Soft issues encountered in business management and later, to tackle complex real-world problems.
This intrusion of hard methodologies into the soft-system leads us to consider the SSM as an attempt to apply rational « hard » methodologies to the social field. To achieve this goal, the SSM can be perceived as an attempt to force a « malleable » stakeholder group to be compatible with the proven engineering methods. One way of doing this is to help the stakeholders to change their perception of reality in terms of « design » and « objective » even if this constructed reality does not correspond to what exists. This leads us to say that the social field and its complexity always appear to be nothing else than a thorn in the side of these engineering solutions. The SSM rationale appears not to deal with the social complexity but to apply engineering methods to only a shadow of this complexity. It is not surprising to find the SSM's weaknesses when this social complexity is the main driver of the issue.
We have to devise a new paradigm for renewed stakeholder engagement: this new paradigm should really foster the co-construction of a new future with the stakeholders and not serve an « engineering design ». Stakeholder engagement could thus become a profitable opportunity for all, rather than a necessary evil.
Keywords: Soft System Methodology, SSM, participatory stakeholders' engagement, co-construction, soft-system.
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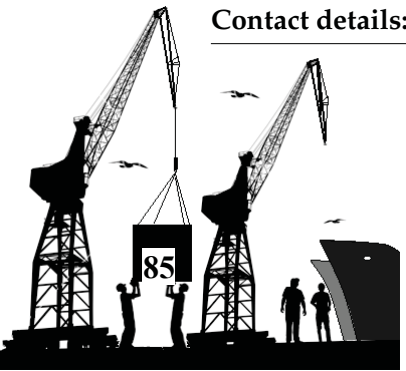

D5-137

The System Approach Framework as a new protocol for the integration of science and society in coastal and marine socio-ecosystems

José Antonio Pérez Agúndez

(Ifremer, UMR Amure, Plouzané - France)

Co-author: Michel Lample, and Pascal Raux

The sustainability of socio-ecosystems is often threatened by a large panel of multidimensional processes. Decision-making needs to be supported by adapted scientific knowledge and being legitimated by participatory processes. The Ecosystem Approach provides a framework that promotes the integration of the ecological, economic and social dimensions and also the stakeholders' involvement through bottom-up processes. Guidelines and tools have been developed in recent years, but their operational implementation and consequently the role of the scientific knowledge in these processes remains a key issue.
The System Approach Framework (SAF), initially developed under the FP6-SPICOSA project (2007-2011), has been improved and updated by recent experiences. This framework constitutes a formal protocol for accompanying the implementation of the ecosystem approach. It is based on modelling tools for (1) the co-construction of common visions of societal issues with stakeholders thought companion-modeling related procedures and (2) knowledge integration to support decision making processes through the exploration of scenarios for sustainable socio-ecosystems. This paper addresses the main principles and concepts of the SAF approach as a new paradigm of sciences and society integration in support of the sustainability of marine and coastal

Keywords: Science integration, ecosystem approach, modelling, stakeholders' involvement, coastal and marine socio-ecosystems

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Parallel session 9 – Thursday 02/06 (14h00-16h00)

D6-214

INFORMD: an environmental decision support tool for coastal salmon aquaculture in Tasmania, Australia

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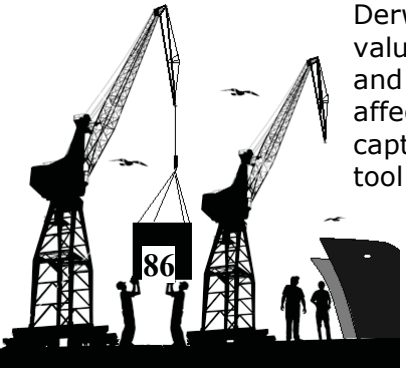
Co-author: Scott Condie, Catriona MacLeod (IMAS, Univ. Tasmania – Australia), Jeff Ross, Emily Ogier, Rebecca Gorton (CSIRO, Hobart - Australia), Miriana Sporcic

A range of human activities influence water quality and other marine environmental values. Given the multi-user nature of the marine environment, it is important to recognise the diverse needs and expectations of the broader community, when identifying values and evaluating trade-offs, in the system as a whole. We are developing a tool to support consultation, planning and management of aquaculture and other uses of southern Tasmanian coastal waters used for salmon aquaculture. INFORMD (the Inshore Network for Observation and Regional Management of the Derwent-Huon) relies on two important pillars: 1. Capturing a snapshot of the values stakeholders have towards the marine environment in southern Tasmania, and 2. A model to show how planning activities for salmon aquaculture farming affect those values. In this talk we will report on the stakeholder values that were captured, and the decision support tool being developed. The decision support tool consists of a simple biogeochemical model emulator combined with a



hydrodynamic model called CONNIE. The user-interface to the model is browser based and supported in the cloud. The emulator uses a BGC or similar ecosystem model to provide the background conditions from which the emulator projects water quality conditions spatially based on a simple empirically derived model.

Keywords: model emulator

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D6-153

Developing operational bio-economic decision-support tools with stakeholders to help in multi-annual plan design: challenges and opportunities

Claire Macher

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Co-author: Michel Bertignac (LBH/STH IFREMER, Brest - France), Olivier Guyader (IFREMER, UMR AMURE - France), Mathieu Merzéréaud, et al.

The development of multi-annual management plans for fisheries and the stakes of annual quota negotiation in an increasingly constrained system generate high demand from the managers and stakeholders for impact assessment. It thus stresses the need for bio-economic decision support tools to highlight trade-offs of different alternatives and help in decision.

An integrated approach has been developed on the Bay of Biscay case study since 2010 based on the development of bio-economic tools for impact assessment of scenarios in the framework of a partnership with stakeholders (producer organizations, fishermen representatives, administration and scientists). The paper highlights key challenges and opportunities identified within the partnership bio-economic working group project. It presents lessons learned from the Bay of Biscay sole case study.

Solutions to the key challenges were found in (i) developing a partnership platform to discuss data, fisheries dynamics, assumptions, results and limits (ii) developing operational methods to describe the fishery context and to create the input file for the model (iii) developing a bio-economic model in with a modular structure.

Keywords: decision-support, bio-economic model, partnership approach, stakeholders, multi-annual plan

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D6-224

ELFSim: a fisheries decision support tool for coral reef line fish on the Great Barrier Reef of Australia

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Management Strategy Evaluation addresses the challenge for contemporary society of managing competing human uses of, and effects on, natural resources. ELFSim is a decision-support tool designed to evaluate options for managing coral trout and red-throat emperor in the Reef Line Fishery on the GBR. It contains several components, with the most important being a spatially- structured biological model of coral trout and red-throat emperor population dynamics and a model of fishing behaviour, which can be operated in a social network of information sharing. The model is

parameterised with scientific fisheries and hydrodynamic data, and an economic survey.
We evaluate the merits for managers and stakeholders of alternative strategies for managing the coral reef line fishery on the GBR. The objectives for the future status of coral trout, and more recently red-throat emperor, have been developed from a series stakeholder workshops. Fishery objectives included preserving spawning biomass in areas closed to fishing at near pre-exploitation levels, ensuring adequate population levels for harvest, maintaining economical catch rates and recreationally rewarding catches.
This work highlights some of the inevitable trade-offs of management. These trade-offs are evaluated in relation to objectives specified by a range of stakeholders in the fishery. In doing so we hope that the costs and benefits of different management options are more transparent, and that this leads to effective management for a sustainable fishery.

Keywords: management strategy evaluation

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D7-255

Lessons learned when conducting community-based trans-disciplinary research in Canadian Arctic coastal communities.

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Conducting research in coastal Arctic communities presents many opportunities and challenges. Using a community-based research approach, we explored local (Inuit and non-Inuit) knowledge about significant ecological and socio-cultural marine areas, their importance and sensitivity to shipping, barriers to northerners' continued use of them, and resulting impacts on northerners' well-being. Our goal was to ensure northerners' use of marine environments and Inuit traditional knowledge are fully infused into the prioritization of the Northern Marine Transportation Corridors, an ocean governance initiative lead by the Canadian Coast Guard.
This study was developed and implemented with the participation of multi-disciplinary academic researchers, 11 Inuit community researchers, 14 key informants residing in the Arctic, the program lead and coordinator of Ikaarvik: Barriers to Bridges, members of Arctic and community organizations and national and regional Inuit organizations, Hamlet councillors, and Territorial and Federal government employees.
Lessons learned include the importance of researching a topic proposed by and relevant to the community; building relationships, partnerships, support, and trust in the community; hiring bilingual, bicultural (i.e. discussion facilitator and community member) community researchers; and exercising humility, adaptability, open-mindedness, and respect for all knowledge types to enable co-learning. Additional insights include identifying and addressing sensitive topics within the community with which the research may intersect; ensuring community members have an accurate understanding of the proposed research including funding sources, institutional affiliation, and likely project outputs; managing community expectations of results impacts; and using culturally appropriate methods and materials. Methodological and practical lessons presented here can provide guidance to trans-disciplinary research practitioners about how to facilitate the participatory inclusion of stakeholders, enabling co-learning and improved community engagement, investment, and sense of ownership in research.

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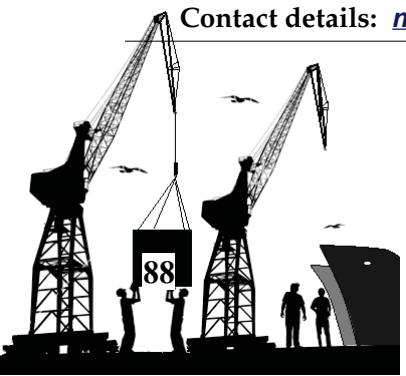

Theme session E

Governance and institutional frameworks

Parallel session 1 – Monday 30/05 (15h45-17h45)

E1-242

What makes the Ecosystem Approach work in natural resource management – or not

Anthony D.M. Smith

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Co-author: Jake Rice (Dpt. Fisheries and Oceans DFO, Ottawa - Canada)

The ecosystem approach (EA) has been widely endorsed at international, regional and national levels as a basis for natural resource management. Four different factors characterize most interpretations of an EA (Rice 2011):

☐ Giving greater consideration to how environmental conditions and variation may act as forcers of change in the ecosystem components being used or protected;

☐ Taking greater responsibility for the full ecological footprint of the use being managed, or of the socio-economic footprint of actions taken to conserve specific ecosystem components;

☐ Integrating decision-making about the use and protection of resources used or impacted by different industry sectors or communities. The integration takes account of interactions across multiple human activities in an ecosystem, to facilitate coexistence of the uses and protection effects;

☐ More participatory and inclusive approaches to governance of the resources themselves or of the places where the resources are found. The more inclusive governance extends to both policy decision-making and implementation of management and conservation measures.

Despite general agreement and wide adoption of the principles of EA, success in implementation has been more limited. Here we contrast three applications of EA in Australian marine resource management and conservation – in the Great Barrier Reef, in ecosystem based fisheries management, and in Australia's Oceans Policy. We discuss the factors leading to success or failure in each case, focusing particularly on aspects of governance.

Keywords: ecosystem approach, Great Barrier Reef, ecosystem based fisheries management, oceans policy

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E1-38

Trust, confidence and equity affect the legitimacy of natural resource governance

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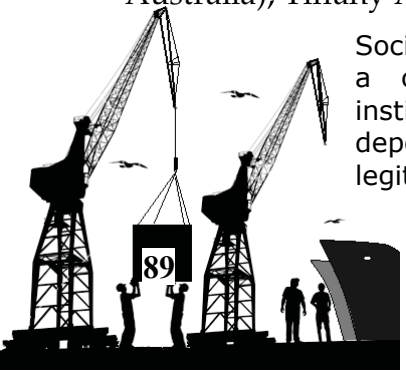

Social-ecological systems are often highly complex, making effective governance a considerable challenge. In large, heterogeneous systems, hierarchical institutional regimes may be efficient, but effective management outcomes are dependent on stakeholder support. This support is shaped by perceptions of legitimacy, which risks being undermined where resource users are not engaged

in decision-making. Although legitimacy is demonstrably critical for effective governance, less is known about the factors contributing to stakeholders' perceptions of legitimacy, or how these perceptions are socially differentiated. We quantitatively assessed stakeholder perceptions of legitimacy (indicated by support for rules), and contributory factors, among 329 commercial fishers and tourism operators in Australia's Great Barrier Reef Marine Park (GBRMP). Legitimacy was most strongly associated with trust in information from management agencies, followed by perceptions of institutional performance and the equity of management outcomes. Legitimacy differed both within and among resource user groups, which emphasizes the heterogeneous nature of commonly defined stakeholder groups. Overall, tourism operators perceived higher legitimacy than commercial fishers, which was associated with higher trust in information from management agencies. For fishers, higher levels of trust were associated with: 1) engagement in fisheries that had high sub-sector cohesion and positive previous experiences of interactions with governing bodies, 2) location in areas with greater proximity to sources of knowledge, resources and decision-making, and 3) engagement in a Reef Guardian scheme. These findings highlight the necessity of strategies and processes to build trust among all user groups in large social-ecological systems such as the GBRMP. Furthermore, the social differentiation of perceptions seen within user groups in this study underscores the importance of targeted strategies to engage groups that may not be heard through traditional governance channels.

Keywords: legitimacy, trust, fisheries, tourism, marine conservation, Great Barrier Reef

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E1-91

Tidying up the knot: science-policy-society interfaces for the implementation of the Ecosystem Approach to Fisheries Management (EAFM) in the European Union (EU).

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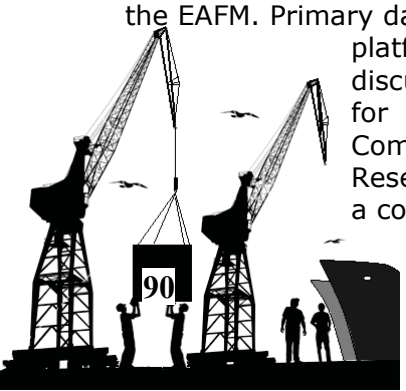
Advances towards the implementation of the EAFM in the EU can be found in several dimensions: habitat protection, development of legal frameworks, integration of core principles into policies, or the financial funding available to address socioeconomic concerns. Nevertheless, there are evidences that we are lagging behind in EAFM's hallmarks, particularly governance. Clearly the institutional interplay of fisheries management in the EU (*sensu* who decides what within the EU institutions based on the Common Fisheries Policy 2013) will remain unchanged in the coming time. Therefore any EAFM push forward should not rely on establishing new decision-making processes but a combination of soft mode of governance to allow collaboration on the regional level and on innovations in the provision of advice and the stakeholders' engagement in the process.

Building on research developed under the MareFrame project (www.mareframe-fp7.org) this paper shed light on the pathway to secure adequate science-policy-stakeholder interactions in support of the EAFM. Primary data were collected during a Focus Group with the fisheries stakeholders' platforms (5 Advisory Councils), informant interviews and a Round Table discussion with the European Commission (DG-MARE), the International Council for the Exploration of the Sea (ICES), the Scientific Technical and Economic Committee for Fisheries (STECF) and the European Fisheries and Aquaculture Research Organization (EFARO). Our findings contribute to literature and provide a coherent presentation on the operational issues hindering the EAFM



implementation (lack of a formalized strategy, information gaps, missing link between environmental and fisheries policy, deficient stakeholders' engagement, lack of appropriate institutional structures for regional cooperation, etc.). Furthermore, the prevalent science-policy dynamics of established fisheries management in the EU is perceived by stakeholders to be inappropriate for EAFM.
The paper present a « co-creation » approach to strength coordination and cooperation across a presently fragment policy landscape as a way forward for implementing EAFM in EU fisheries.
Keywords: science-policy-society interfaces, EAFM, governance, stakeholders.
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E1-244

Advancing Integrated Approaches to Marine Ecosystem Management through Multi-Stakeholder Engagement

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Regional seas and shared marine waters present challenges in terms of management. Typically these environments are often bordered by numerous maritime jurisdictions, accommodate multiple uses and multi-sector activities, and are subject to differing governance arrangements. Within the European Union, a range of policy and legal instruments have been introduced to safeguard the ecosystem goods and services provided by the marine environment (e.g. Integrated Maritime Policy, Marine Strategy Framework Directive). Many of these instruments are underpinned by a requirement to adopt an ecosystem based approach to management and planning, which in turn places an emphasis on integration. Within a coastal and marine context, integrated approaches are characterised by an explicit requirement for broad levels of engagement with multiple actors framed within participatory processes. To assist with the implementation of ecosystem based management, the development of integrated approaches has been the research focus of numerous project-based initiatives at regional and national scales. However, the translation of learning from the project environment into operational practice of those tasked with regulating the coastal and marine environment is often not seamless or straight-forward; a situation that can be further complicated by the need to work in a transboundary context. Additionally, the interpretation of the ecosystem-based approach (EBA) across different policies, that are largely single sector-focussed, potentially leads to inconsistent practices. Using examples from the regional scale in Europe and Asia where stakeholder engagement was employed as a key element in marine management, analysis is undertaken to identify the key challenges to effective delivery of integrated management, which in turn have implications for the implementation of EBA and related policy and legal instruments.
Keywords: integration, ecosystem-based management, marine management, stakeholder engagement
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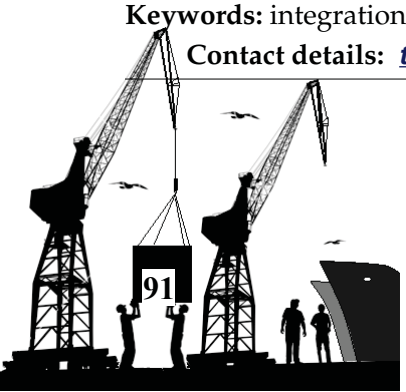

E1-64

EU Integrated Maritime Policy and Data Sharing – a Legal Approach

Betty Queffelec

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Marine policy has to be based on the best understanding of socio-ecological systems. The raw material to built this knowledge is marine and maritime data. Availability and accessibility to these data are consequently major drivers to improve marine policy. All stages of marine policy are concerned from elaboration to implementation and adaptation to evolutions. However, gathering all needed data, concerning natural and socio-economic aspects, still remains a challenge for scientists but for administrations too. This is especially true concerning integrated approach since data set can be particularly fragmented. Several obstacles have been identified including interoperability, intellectual property rights, confidentiality, personal data issues.

From the very beginning of European Integrated Maritime Policy elaboration, European Commission (EC) has identified this topic as a major issue to achieve a real integrated approach. The added-value of an EU level action to cope with it is strongly supported by EC. Consequently, two main and clearly distinct actions are currently developed. In the framework of Marine Knowledge 2020, which focus on science developments, the European Marine Observation and Data Network, EMODnet, is progressively implemented. It assembles bathymetry, geology, seabed habitats, chemistry, biology, physics and more recently human activities data to provide a single gateway for all users (scientists, administrations, private organisations...). In the framework of the integrated maritime surveillance policy, EC is developing a Common Information Sharing Environment, CISE, which aims to make available surveillance data between authorities from different countries and different sectors following an integrated approach in order to provide an enhanced basic maritime situation awareness picture.

Far from a strictly technical matter, the legal framework organizing data sharing results from political choices combining different general interest objectives (from personal data protection to environment conservation). These choices are strongly impacting Integrated Maritime Policy itself.

Keywords: Legal Analysis, Data sharing, Integrated Maritime Policy

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E1-166

Cooperation in planning the EU regional seas: lessons learned in the development of a marine planning resource and network for the North Sea

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Marine planning is required in EU waters by 2021 (Maritime Spatial Planning Directive 2014). Member states must cooperate through existing regional and institutional structures, such as regional sea conventions and networks to ensure that maritime spatial plans are coherent and coordinated (Art11).This paper is a consideration of the challenges and issues that arise in the creation a regional sea network and data resource, designed to enable and facilitate regional marine planning. It describes a project based on identification, collation and input of the relevant law and policy for the North Sea. It explains the context and the background and considers the questions and barriers around the creation of an appropriately accessible resource.

Workshops in 2015, attended by those with an interest in North Sea marine planning, provided support for the proposed legal and policy resource. It also confirmed that no other such network or resource existed. Concerns were raised in relation to its usefulness in actually undertaking marine planning, as well as the importance of ensuring that the information was up-to-date and correct. The

initial 12 months of work revealed that the amount of relevant law and policy was immense and that the overlapping nature of many of the laws, including relating to jurisdictional boundaries was a challenge.
This paper will demonstrate the complexity of the legal and policy framework for marine planning, with a focus on the North Sea. It will argue that notwithstanding the intricacy of the legal and policy landscape that an awareness of it, or at least access to appropriate knowledge about it, is essential for marine planning for regional seas. It will consider the balance between providing an encyclopaedia of North Sea law and policy and the ability to create and maintain a marine planning network to facilitate effective cooperation in this planning marine region.

Keywords: North Sea, marine spatial planning, legal framework, cooperation, maritime spatial planning directive

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Parallel session 2 – Tuesday 31/05 (10h30-12h30)

E2-103

Political overfishing: Social-economic drivers challenge sustainability goals

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Despite having defined sustainable use of marine resources as a global and internationally highly ranked policy goal, overfishing remains to be a severe worldwide problem. Within the European Union total allowable catch limits continue to be set above scientifically advised, and unsustainable levels. These political decisions are seemingly made without any scientific, or transparent decision-making background. Here we show that decisions on harvest levels were driven by socio-economic forcing factors, and are not related to ecological stock status. Instead, economic factors (i.e. unemployment rates), as well as socio-cultural factors (i.e. per capita fish consumption) significantly affected the decision making process. Increasing socio-economic pressures led to higher deviations between advised and agreed TACs. Our results demonstrate that socio-economic factors need to be taken into account, if the triple bottom line of equally respecting social, economic as well as conservation goals shall be reached. There is a clear need in worldwide fisheries management to include these aspect already in the advise process in order to provide a sound and transparent basis for political management decisions.

Keywords: GAM, TAC setting, economic drivers, social drivers, interaction, decision making, fisheries

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E2-107

Integrating Ecosystem Models of the North Sea with Hypotheses about the Social Consequences of Fisheries Regulation Gridlock.

John G. Pope

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Co-authors: Charlotte T. Webber (UiT Arctic University of Norway), Melania Borit

Successful fisheries management depends on a culture of broad compliance with regulations. It fails if regulation moves from being enabling regulation to a state when rule breaking might again become endemic and sanctioned by cultural cohesion. Fisheries in the North Sea and elsewhere in Western Europe are frequently governed by a extensive range of input, output and technical regulations. In recent years EU fishers have learned to live with these regulation, in part by using discarding of small or over quota fish to provide a safety valve that allowed reasonable compliance with conflicting regulations. The upcoming landing obligation, the progressive requirement to land all catch, will however remove this safety valve and may well lead to regulation gridlock. Hence, key questions are therefore to what extent might fishers revert to rule breaking if key choke points are not eased, when and in what circumstances will the gridlock be most severe and how might the response of fishers be described.

Multispecies modelling of the EU North Sea fishing fleets provide a background to such a study while, in the absence of appropriate social data, simple hypotheses of how fishers may react to regulation gridlock can provide a range of possible outcomes. Such multidisciplinary models will also help identify data sets that will test the hypotheses. This approach will provide a multidisciplinary approach where biological and economic models of fisheries can be combined with the models and ideas of fishery social scientists. Such multidisciplinary collaborations are key to a successful outcome to the EU Framework 7 MAREFRAME project of which this work forms a part.

Keywords: Integrating Models, Eco ecosystem. Fishers Behaviour, Enabling Regulation, Regulatory, Gridlock.

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E2-73

A new meaning of community traditional use right of inshore resources: Case study of Shiraho Village, Okinawa, Japan

Aoi Sugimoto

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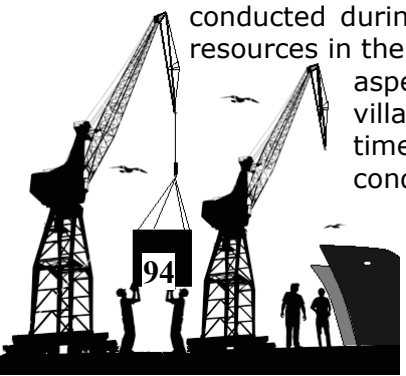
Tropical coastal marine socio-ecological systems has now increasingly been recognized as « unique » which means there are significant difference from other systems such as terrestrial ones. For example, such characteristics as « Large ethno-linguistic diversity due to higher levels of migration, » and « Systems of ownership and entitlements often unclear as territories are harder to define, » are recognized as major uniqueness of the systems (Ferrol-Schulte et al. 2013). Our study in sub-tropical Shiraho village, Okinawa, Japan, has an evidence to deepen and widen the discussion over the uniqueness of coastal marine socio-ecological systems still much than ever. Based on the results of our literature work, in-depth interviews and participatory observations conducted during 169 days' fieldwork, we gained a new meaning of a use right of inshore resources in the local coastal communities. We found that Shiraho village lagoon has two aspects; one is « open-access » in terms of the accessibility even for non-villagers, and the other is « traditional use rights in the village » at the same time, and that community people are flexible to acknowledge these two conflicting conditions. Our case also shows that Shiraho is a unique case among Japanese



fishing rights systems which usually refuse use rights of non-community people (Kumamoto 1995; Yanaka 2001). Our study can contribute to the discussion over customary traditional rights of small-scale fisheries (e.g. FAO 2013) in a sense that a right-based fishery management in tropical or sub-tropical areas could be better accepted by the community people if the design of such system permits certain level of flexibility on the access to the resources.

Keywords: traditional use rights, small-scale fishery, fishing rights, tropical coastal marine socio-ecological systems

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E2-46

The Artisanal Bluefin tuna Fishery in Malta: A decade of socio-ecological shifts, misfits and rifts

Alicia Said

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The Bluefin Tuna (BFT) fishery in Malta demonstrates a typical socio-ecological system that has been under a constant flux of policy change which did not warrant a social, economic and ecological harmony throughout the fishing sector. The major policy shifts of the fishery include the institutionalization of Individual Transferable Quotas (ITQs) as a fishery management tool that enabled the transfer of fishing rights between artisanal and industrial fleet segments, and the parallel introduction of the purse seine industry that has gradually replaced the artisanal long-lining sector by becoming the main leaser of the ITQs. This study takes an exploratory mixed-method approach to qualitatively understand the processes of how the BFT policy underpinnings interplay with the sustainability dimension of the artisanal fishing sector.

Results show that the introduction of the purse seining industry as a new powerful fleet segment in the BFT fishery, along with the distributive scheme of fishing rights that favoured only a small segment of the artisanal fleet, have synergistically created a series of socioecological misfits that not only affected the BFT fishery, but have permeated the sustainability of artisanal fisheries systems at large. These systems are experiencing ecological discord due to intensified fishing effort on other fisheries which are not equivalently managed as BFT; and social consequences onto the fishers who have become the victims of irreversible rifts that has ruptured the community cohesion. It is concluded that the embeddedness of the BFT policy within the neo-liberal trajectories of economic efficiency and conservation of the species, have not catered for the continued sustainability of the artisanal fisheries and the communities dependent on them. This study illustrates that a holistic qualitative approach towards understanding the on-the-ground implications of policy trajectories is needed to reduce the socio-ecological dissonances that are implicitly triggering the disappearance of the artisanal fishing systems.

Keywords: EU accession, Privatisation, Socio-ecological Implications, Mediterranean, ITQs

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E2-47

Fishers' knowledge as smart fishing compass and management tips

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Fishers' traditional or local knowledge is recognized as more useful strategies for participatory fisheries management compared to government-based top down control, especially in developing countries. Increasing local fishers' commitments and responsibilities to ecosystem management were observed to be beneficial both at ecological and economic levels. Ecosystem co-management in Sri Lankan coastal ecosystems is proven to be more efficient in improving fisheries productivity while minimizing fishing and effort costs. In the present communication, an attempt was made to synthesize how local fishers' knowledge would be utilized by two types of coastal fisheries in southern Sri Lanka; beach seining and stilt fishing. In beach seining, traditional fishers use their local knowledge to predict the commencement of fishing season, and identify and quantify the species composition occurring at their fishing territory. The veracity in using knowledge by fishers in their fishing activities have been confirmed empirically, and fishers' predictions were based on the changes of seawater colour (folk oceanography) and the behaviour of sea terns (*Sterna* sp.). Stilt fishing, which is a unique fishing method of small-scale exploitation in the southern coast of Sri Lanka and is highly efficient in the capture of bluestripe herrings (*Herklotsichthys quadrimaculatus*) in using fishers' local knowledge and expertise. High reliability of fishers' knowledge is evident on ecology, occurrence and distribution of target fish species in this fishing method too. Precision in catches was consistent with fishers' level of technical skills and varying expertise. Proficient local knowledge uplifts the fishers' revenue by maximizing harvest and minimizing damages to gears. Use of local knowledge of resources highly complements scientific information for better management and exploitation of coastal fisheries in Sri Lanka.

Keywords: Sri Lanka, small-scale fisheries, indigenous knowledge, management decision-making, beach seining, stilt fishing

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E2-56

The Spanish Mediterranean coast guilds: their role in the Integrated Coastal Zone Management

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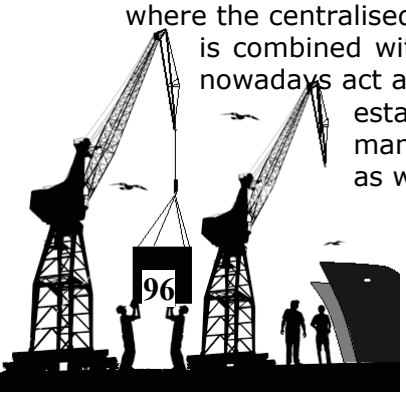
Within Spain, the management of coastal fisheries is based on a mixed model of management where the centralised action of the Government (Ministry of Agriculture and regional governments) is combined with the self-organisation of fishermen within their associations (guilds), which nowadays act as consultative and cooperation agencies with the government. This one establishes the general regulatory framework for the whole fisheries management, while the fishermen's associations organise and govern resources, as well as communicate to the government their sector's requests and demands.



These fishing communities, with a long tradition in Spain, have survived the modernisation process in many aspects. The most important features of survival are their own culture and the role of the community in the maintenance of discipline and cohesion.
Besides the economic functions –infrastructure services, commercialisation and management-, they also accomplish political functions, intermediating between the State and the fishing sector and mediating in the conflicts that may occur. Although to a lesser extent, they also have welfare and mutualist functions.
This study shows, on the one hand, a comprehensive overview of the Spanish Mediterranean coast guilds and, on the other hand, a complementary qualitative analysis of interviews with persons responsible for guilds. The final aim is to explore the possibilities that these original institutions can give to improve the Integrated Coastal Zone Management.
Keywords: Guild, fisheries, coastal zone management, governance, Spanish Mediterranean coast.
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Parallel session 3 – Tuesday 31/05 (14h00-15h40)

E3-59

Applying Social-Ecological Systems (SES) analysis to unassessed fisheries in the southeastern United States

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Changes in 2006 to US fisheries law require regional fishery management councils to set per-species catch levels that do not exceed the recommendations of their scientific and statistical committees (SSCs). All federally managed stocks now have catch levels that incorporate precautionary buffers to account for management and scientific uncertainty. Unassessed stocks may therefore require larger buffers to minimize the danger of overfishing, but increased buffers also add considerable opportunity costs for the fishing fleet.
Ostrom's social-ecological systems framework is recognized as an important tool for understanding the institutional and ecological dynamics at work in fisheries, but has not been not widely applied in regulatory settings. As members of an SSC, we demonstrate how the SES framework can systematically assess the strengths and vulnerabilities of two unassessed stocks in our region (wreckfish and golden crab) when analysts are confronted with a reduce-information setting. Analysis guided by the SES Framework have the potential to guide scientists and managers in determining the relative risk of setting catch levels either too high or too low.
Keywords: SES Framework, Social-Ecological Systems Framework, stock assessment, wreckfish, golden crab
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E3-217

Specificities of marine spatial planning in Tropical Areas

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Co-authors: Betty Queffelec (UBO, UMR AMURE - France), Solange Teles da Silva (Universidade Presbiteriana Mackenzie UPMK - Brazil)

In tropical marine ecosystems implementing a marine spatial planning (MSP) have specificities. According to the IOC-Unesco, MSP aims at conciliating human uses and conservation. In tropical areas, MSP faces a critical challenge, the sea grabbing. The political instability in various countries, particularly in Africa, and the economic power of transnational companies affect power relationships. An increasing surface of ocean is affected by activities. The current effort to better organise these activities at sea in western Africa and Brazil illustrates this new framework. In such context it is important to determine whether MSP can intensify the problem of ocean grabbing. Such question is directly related to the role of governments in the implementation and definition of MSP. Adapting MSP to tropical countries can also be a way to question and improve this process that have been developed by and for developed countries. In particular MSP could better account for traditional knowledge and uses, and ecosystem dynamics.

Keywords: Marine spatial planning, Environmental law, West-Africa, Brazil.

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E3-246

Which governance for marine biodiversity offset?

Céline Jacob

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At a time when numerous governments encourage the development of economic activities within the marine realm following broader calls for « Blue Growth », we can wonder to what extend we have the ability to tackle their negative impacts on marine ecosystems. Environmental policies increasingly call upon biodiversity offset instrument to reconcile economic development and biodiversity conservation, with the objective of achieving a No Net Loss (NNL) of biodiversity. The principle of offset is to counterbalance negative impacts on biodiversity arising from development projects by providing ecological gains through conservation or restoration actions. Currently, information on marine biodiversity offset practices are very scarce and focus either on specific emblematic coastal ecosystems, such as mangrove swamps, coral reefs or seagrass environments or on a particular sector, such as the one of offshore wind farms in Europe. Relying on data collected among representatives of environmental agencies, environmental consultancies and researchers in France and the United States, we propose to investigate the different forms of environmental governance structured around marine offset. Indeed, the diversity of impacted ecosystems (e.g. hard bottom, soft substrate biocenosis, seagrass beds, kelps) and pressures' sources (e.g. dredging, port extension, oil drilling, wastewater discharge, offshore windfarms) has led to various institutional arrangements.

Through a comparative analysis between these two countries, we intend to study the criteria that influence the choice of governance modes (regulations, tools, methodologies, etc.) for the implementation of marine offset. These considerations will help to feed a broader discussion on the applicability of the mitigation hierarchy to marine and coastal development projects and on the challenges faced by current mitigation systems.

Keywords: biodiversity offset, marine ecosystems, environmental governance

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E3-256

Practical steps toward integrating economic, social and institutional objectives and indicators in fisheries management

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While international agreements and legislation in most jurisdictions call for incorporation of four pillars of sustainability, the social, economic and institutional aspects (the « human dimension ») have been relatively neglected to date within the practice of fishery assessment and management, and nations are failing to achieve the aspirations of ecosystem-based and integrated management legislation and policies. The literature and recent symposia point to three impediments: a relative lack of explicit social, economic and institutional objectives; a general lack of process (framework, governance) for routine integration of ecological, economic, social and institutional aspects; and assessment and management processes that are biased towards biological considerations. The practical integration of ecological, economic, social and institutional aspects of management requires a « systems » approach with explicit consideration of strategic and operational aspects of management; multidisciplinary or transdisciplinary evaluations; practical objectives for the four pillars of sustainability; appropriate participation; and a governance system that is able to address diverse objectives in both strategic and operational aspects of management. We challenge all involved in fisheries to immediately take seven practical steps toward integrating ecological, economic, social and institutional aspects: 1) Think of the fishery as a « systems » with interacting natural, human and management elements; 2) Be aware of both strategic and operational aspects of fisheries management; 3) Articulate objectives that incorporate all four pillars of sustainability; 4) Collaborate across disciplines on all relevant research and management issues; 5) Encourage and participate in interdisciplinary evaluations; 6) Encourage appropriate (diverse) disciplinary participation in all aspects of evaluation and management; and 7) Encourage development of (or emulate) a participatory governance system.

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Parallel session 5 – Wednesday 01/06 (10h30-12h30)

E4-201

The IPBES Approach to Multiple Knowledge Systems, Multiple Values Systems, and Why Fisheries Should be Engaged.

Dr Jake Rice

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The Intergovernmental Panel on Biodiversity and Ecosystem Services (IPBES) is tackling two challenges core to this Symposium. Both get lip service in the context-setting introduction to marine assessments, and then usually are subsequently treated superficially, if at all. The first is to give multiple knowledge systems truly equal legitimacy as ways of gaining understanding of the natural world, and thus equal status as information in the assessments. To meet this

challenge IPBES is assembling a wide array of tools for accessing and using Indigenous and Local Knowledge in parallel with, rather just than filling gaps in, « science knowledge ». The second is to give equal legitimacy to the diverse value systems of the diverse cultures that must share our ecosystems. Consequently IPBES is finding ways to report status and trends of biodiversity and ecosystem services (BES) that do not explicitly or implicitly give any one set of societal values a dominant position in interpreting BES status and trends. Unlike the terrestrial science and policy communities, the corresponding marine communities have been slow to pick up on IPBES. To promote more engagement in the global assessment, which will give substantial attention to the ocean and fisheries, this presentation will summarize some of the major tools being applied and extended to meet these challenges. It will then present possible ways to address some of the remaining tasks. Specifically it will discuss potential institutional arrangements for better accessing ILK, and Identity Decompositions of the value systems applied by different cultures to vectors of ecosystem services that could function in BES assessments as the Kaya Identity does in facilitating discussions of strategies for emissions reductions in IPCC Assessments.

Keywords: biodiversity, ecosystem services, assessments, Indigenous and Local Knowledge, Values

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E4-146

Applying Social Network Analysis to Understand ICES Institutional Frameworks applied to Integrated Ecosystem Assessments

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How does ICES function as a network organization to realize integrated ecosystem assessments? How could ICES function as a network organization to realize integrated ecosystem assessments? The ICES Working Group Marine Systems (WGMARS) realized the first-ever social network analysis of ICES Expert Groups (EGs) in 2010 and continued this work with seed-funding from the ICES Science Fund. WGMARS used ICES data from 2010-2013 representing active participation of individual scientists in ICES EGs, and identified the EGs required to implement a regional ecosystem-based approach in the Baltic Sea. We anticipated that different EGs required for science or advice in an integrated ecosystem assessment work stronger together than randomly-drawn EGs. For the Baltic Sea, the integrated ecosystem assessment group was marginal within the sub-network while other EGs played a more important role of connecting different groups or clusters within the sub-network. This paper demonstrates how social network analysis gives insights into institutional frameworks and shows how qualitative information through interviews can also give insights to to topic of governance and institutional frameworks in relation to integrated ecosystem assessments.

Keywords: integrated ecosystem assessment, science networks, institutional networks, social network analysis, ethnography, interviews

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E4-126

From governance of ecosystems to management of human activities through legislative mechanisms

Roland Cormier

(Institute for Coastal Research, Centre for Materials and Coastal Research, Helmholtz Centre Geesthacht, Geesthacht - Germany)

Co-authors: Andreas Kannen, Kira Gee

The earlier approaches to governance in oceans management of human activities consisted mainly public policy setting exercises aimed at identifying ecosystem conservation objectives and protected areas. This approach was also based on extensive stakeholder participation supported by advances in ecosystem science. With the advent of marine planning, governance in oceans management moves from an integration of multi-stakeholder policy objectives to allocating space for different human activity to achieve environmental and socio-economic objectives. Although integrated assessments are considered as the way forward in understanding a broader range of risks in decision-making related to planning, analysis of the existing legislation and related program policy is also required to determine how best to implement spatial and other management measures needed to achieve such planning objectives. Whereas planning may have been attributed to a particular competent authority to lead the process, implementation will, however, depend mostly on other competent authorities that have spatial jurisdiction and sector specific legislation.

This paper discusses the need to analyse existing legislation, policies and guidelines used to manage human activities to inform the governance process as to the options available for implementation given the need to implement management measures on the ground. Governance will likely need to shift the planning discussions from strategic objectives discussed at the scale of regional sea and ecosystem boundaries to local scales of management that is aligned with jurisdictional authorities, legislation and local stakeholders.

Marine planning is generally understood as a strategic approach to management often considered as key inputs for regulatory exercises such as strategic environmental assessments or environmental impact assessments of development proposals. The implementation of a system of management measures will most likely depend on existing legislation and competent authorities instead of the complexity of introducing new legislation in a political process.

Keywords: governance, legislative mechanisms, management options assessment

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E4-104

Public participation to Ocean Renewable Energy projects in French law

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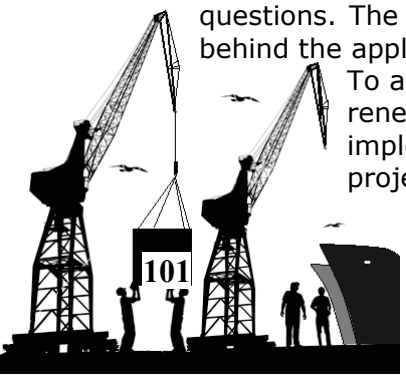
Co-authors: Andreas Kannen, Kira Gee

The legal framework for information and public participation is well known. But, applying the public participation principle to Ocean Renewable Energy (ORE) development in French law raises difficult questions. The aim of this contribution is to highlight the stakes and legal problems hidden behind the application of public participation rules.

To achieve his renewable energy objectives France has decided to promote marine renewable energy. It develops a new marine governance framework which implementation is in progress. But the whole authorization process of ORE projects is extremely complicated. Several sources of legislation provided for



administrative consents are applicable to offshore energy projects. Even if, State simplified the legal regime while launching a couple of tenders for offshore wind farm in 2011 and 2013.
Public participation is actually a requirement, but it is also a condition to succeed a marine renewable energy project. Although the public participation is a key component of the ORE regulation, the way chosen by the government to develop the ORE is not really clear and presents some dangerous lacks of effectiveness.
The French State must respect principles and provisions which are defined in international and European instruments, such as the Aarhus convention, the Directive 2001/42/EC and the Directive 2001/92/UE (concerning the environmental impact assessment). In national legislation, the environmental code contains at least three important procedures for the public information and participation: the environmental impact assessment, the public debate and the public inquiry. State is implementing those procedures in a specific manner for the ORE. The risk is that lacks of participation could be a source of legal dispute and at least endangered development of ORE projects.

Keywords: public participation, ocean renewable energy, planning, consent process, public debate

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E4-119

The role of the legal and policy framework in facilitating an effective balancing of ecosystem services in decision making in the marine environment in Scotland

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An assessment of the role of law and policy formed part of a recent NERC Knowledge Exchange (KE) Biodiversity and Ecosystem Service Sustainability (BESS) funded project. It also explored the development of a marine spatial planning decision support system, which aimed to effectively incorporate ecosystem services, knowledge and values. The project drew on a real location in Scotland, which was subject to a number of large scale applications for offshore wind farms, was an area of high fishing presence and also the location of Marine Protected Areas. The support system was developed and tested with a wide range of highly experienced stakeholders over two day-long workshops in November 2014 and March 2015.
This paper will explain the relevant overlapping law and policy for offshore wind farms in this location, using mind maps and other visual aids. It will then consider the increasing importance of marine spatial planning in Scotland, the UK and the EU, as both a legal process and a policy driver. The outcomes from the workshops concluded that there existed a need to explain the marine planning regulatory framework to both the project members and the workshop participants. The findings reveal that much benefit was derived by the participants in learning and understanding the role of law and policy. It is also concluded that the process of assessing ecosystem services used in the workshops could fulfill existing legal requirements for public participation as part of licensing and planning processes. The paper will conclude with proposals as to how the existing legal and policy framework can facilitate development of the model for an effective balancing of ecosystem services in decision making. In particular it will consider its role in future marine regional planning exercises in Scotland, which require the implementation of the ecosystem based approach to decision making.

Keywords: marine spatial planning, ecosystem services, ecosystem approach, legal framework, governance

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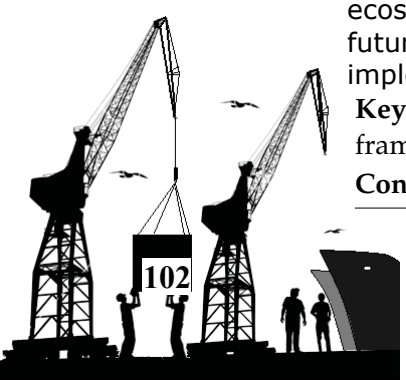

E5-205

The relationship between governance and fisheries outcomes

Ray Hilborn

(School of Aquatic and Fishery Sciences, Univ. Washington, Seattle - USA)

Co-authors: Mike Melnychuk, Christopher Costello (UCSB - USA)

This talk will merge two recent studies to evaluate the relationship between the management of individual fisheries and (1) the current status of the stock (biomass and fishing mortality rate, catch, profit), and (2) the potential stock abundance, catch, and profit under different scenarios. The scenarios include (1) business as usual, where open access fisheries evolve towards a bionomic equilibrium, (2) FMSY where each stock could be managed to maximize catch, and (3) fisheries reform in which competitive fishing is eliminated and fishing pressure is reduced to the point where profit is maximized. We find that in countries that have strong fisheries management systems there is little increased profit or catch to be obtained, but there is a triple bottom line – more catch, abundance and profit to be obtained from countries that currently have poor fisheries governance.

Keywords: governance, fisheries status, economics

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E5-109

The application of the Kotter change management model (Kotter, 1996) to evaluate the lack of fisher engagement in a recently introduced voluntary fishery improvement scheme in Belgium.

Arne Kinds

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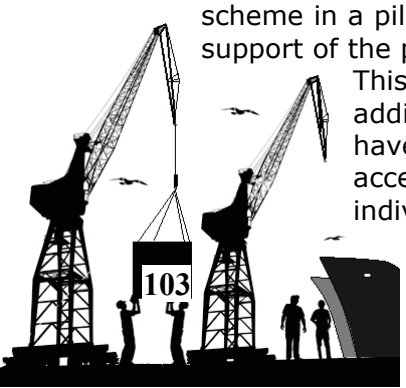
Co-author: Hans Polet

In 2011, the Belgian fishing industry made an explicit commitment to sustainable fishing by signing a covenant for the promotion of a sustainable Belgian fishing sector. This covenant is proof of the recognition that the situation at that time was unsustainable and that a sustainable fishing sector could only be achieved through joint effort. Subsequently, two projects (the « VISTRAJECT » and « VALDUVIS » projects) were introduced that eventually led to the implementation of a voluntary fishery improvement scheme in 2015.

Integrated Sustainability Assessment (ISA) was used as a framework to develop the scheme and to initiate the transition towards sustainability. ISA ensures stakeholder participation at every stage, so that major decisions with respect to the development and implementation of the scheme were stakeholder-driven. This was expected to ensure widespread support of the scheme, not only by the signing partners of the covenant, but also by the fishers. However, only a handful of fishers (n=8) could be engaged to contribute to the discussions that shaped the fisheries improvement scheme and an even smaller number of fishers (n=5) signed up to voluntarily participate in the scheme in a pilot test, despite numerous calls launched by the research team and the formal support of the producer organization (of which all fishers are members).

This raises questions about the legitimacy of the scheme and the probability that additional fishers will participate in it. In this study, we examine the factors that have prevented fisher participation in the development and the subsequent acceptance of the scheme. First, competing commitments (subconsciously hidden individual goals that conflict with an individual's publicly stated commitment) and



big assumptions (core beliefs that result from a persistent lack of critical examination of one's assumptions, e.g., that one will be criticized or forced to change their fishing practice) are identified through interviews with fishers and representatives of the producer organization. Subsequently, Kotter's change management model (Kotter, 1996) is applied to identify which actions in the ISA were less successful than anticipated and why.

Keywords: Change management, fishery improvement scheme, Integrated Sustainability Assessment

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E5-125

The tragedy of a lack of brown shrimp fisheries management in the North Sea

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Co-author: Brita K. Trapman, Jan Jaap Poos, & Tobias van Kooten.

Fisheries targeting brown shrimp (*Crangon crangon*) in the North Sea in European waters are largely unregulated in landings and effort. Since the 1970ies landings of brown shrimp have steadily increased. As a result, the market for shrimp is oversaturated, resulting in low prices for the fishermen. Hardin's theory of the tragedy of the commons predicts that a common resource that is exploited by self-interested individuals will, against the interests of the group, get depleted. Although depletion of the fast growing shrimp stock is not seen as a direct threat, recent research has shown that due to growth overfishing the exploitation of brown shrimp is not optimal. The theory of the tragedy of the commons has been criticized by many, among others Elinor Ostrom, who found that local solutions are often found for commons problems. This research illustrates how locally found solutions for the management of brown shrimp fisheries in the North Sea failed in the Netherlands due to a number of factors. First, due to the lack of consensus among the diverse resource users. Second, due to the intervention of the Dutch Competition Authority who, with the lack of an ecological substantiation of the management measures, classified the initiatives as cartel forming. And third, due to the lack of consensus among the relevant governments, and a consequent lack of action to establish a management system for shrimps. This paper argues that without international consensus on a framework for management, the tragedy of the commons poses a serious threat to North sea shrimp fisheries.

Keywords: tragedy of the commons, Brown shrimp fisheries, fisheries management, growth overfishing

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E5-135

Understanding the role of institutional frameworks for fisheries: indicators of meso-institutions

Claire Delpeuch

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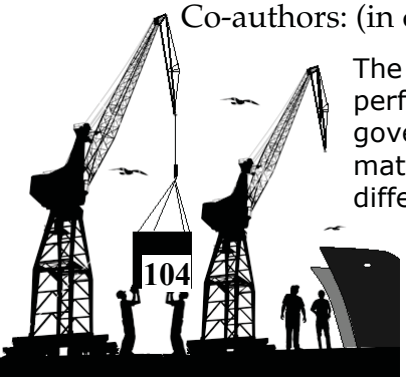
Co-authors: (in discussion)



The impact of institutions on fisheries management, and ultimately on fisheries performance, is increasingly recognized. The literature points to the fact that governance directly impacts policy choices both because who makes decisions matters and because how decisions are made influences their acceptability by different stakeholders. This impact is however rarely empirically assessed.

This paper builds on the new institutional economics literature to propose a set of indicators that qualify institutional systems for fisheries. Once validated and compiled for a large set of countries, these indicators could be useful inputs into empirical assessment of the impact of fisheries governance on fisheries management and performance.
Macro institutions such as the political system, the judiciary or the administration define the rules of the game. These institutions are relatively stable, sticky and independent of fisheries management objectives. Institutional arrangements through which fisheries policies are adopted and implemented and through which feedback is provided to policy-makers are more amenable to change with a view to improve fisheries governance. Examples of such meso-institutions are bureaus, agencies, regulatory entities or regional councils.
The paper focuses on these meso-institution and identifies institutional characteristics that matter for better and more efficient governance. Better governance refers to being adequate to the goals pursued and more efficient to achieving these goals at minimum cost. It then defines indicators for each of those characteristics and compiles a database of these indicators for a sub-set of OECD and non-OECD countries.
Keywords: governance, indicators, meso-institutions
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E5-33

Behavioural Economics may inform improving Institutional Settings in Fisheries Management

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Co-authors: (in discussion)

Based on a review of behavioural experiments, Samuel Bowles (2008; Science 320: 1605-1609) concluded that « small differences in institutional design may lead to very different outcomes at the societal level ». The conclusion is based on findings that people do not only, or not even necessarily positively, respond to economic incentives. The new discipline of behavioural economics distinguishes itself from economics, in that it emphasizes the « irrational » aspects of human behaviour that are rooted in our biology (and are therefore not really irrational). While economics assumes that we have a comprehensive set of conscious preferences driving our decision-making, rationally calculating costs and benefits of different courses of actions, and serving our own best interests, behavioural economics has found through experiments how human beings use heuristics and are often subject to cognitive biases and emotional reactions and may also have altruistic preferences. One of the pillars of the discipline is Nobel laureate Kahneman's distinction of thinking fast ('system 1') and slow ('system 2'): System 1 consists of processes that are intuitive, automatic, error-prone, experience-based, and relatively unconscious; System 2 is reflective, controlled, deliberative, logical and analytical. Another pillar is the « nudge » concept, popularised by Thaler and Sunstein: the active engineering of the choice architecture to change behaviour at an automatic level and in a predictable way without forbidding any options or significantly changing their economic incentives. Furthermore, the experiments that Bowles reviewed suggest that incentives that appeal to self-interest may fail when they undermine people's inherent moral values that lead them to act altruistically or in other public-interested ways. In this presentation I will briefly review the findings of these scientific disciplines and subsequently brainstorm whether and how we can apply them to improve fisheries-management institutional settings, with the aim to induce sustainable fishing practices.

Keywords: altruistic preferences, behavioural economics, human behaviour, institutional settings, intrinsic motivations, nudge, predictably irrational, social capital, thinking fast and slow

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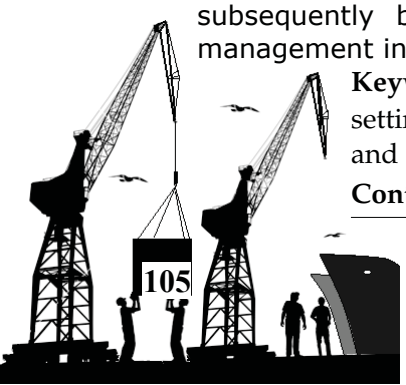

E6-138

Participatory governance across scales and purposes. To what extent can inshore fishing communities shape their future?

Carole White

(International Development, University of East Anglia, Norwich - UK)

How the marine environment is managed is influenced by a mix of rules and priorities set at international, national to local governance levels with differing timeframes and concerns with implications for the future of coastal communities.
This paper examines how justice is understood by different organisations involved in coastal governance and used to prioritise certain goals. In particular, I focus on the use of notions of justice to argue for intergenerational equity. A case is used from rural Norfolk, in the East of England where the inshore fishing community is facing increasing tensions over space in terms of legitimacy and resource use. A Marine Conservation Zone is being designated on a chalk habitat traditionally fished by local fishermen and licenses for offshore energy developments have been granted. International political agendas for the marine environment and climate change have shaped discourses at the local level. Conservation organisations emphasise the need to restore biodiversity and the climate to leave a better environment for future generations. On the other hand, community groups representing fishing families express concerns for their children over the future of their livelihood and fishing heritage. Both sides are officially represented in local coastal governance processes. However, decision-making has become increasingly centralized in the UK with international climate change and marine conservation targets being prioritized at the expense of local coastal communities. A utilitarian 'greater good' argument for global environmental justice and intergenerational equity concerns is being used. This is somewhat disconnected from other policy objectives aimed at encouraging localism and community development. Until such time as the issues raised around legitimacy representation and participation persist, the well-being and agency of local communities will remain compromised.

Keywords: governance, fisheries status, economics

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E6-172

A Fishery Management Index: Factors affecting fisheries management and stock status in major fishing countries

Michael Melnychuk

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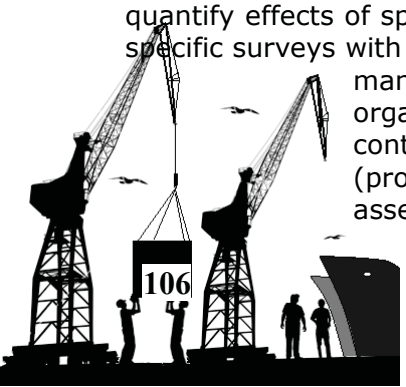
Co-authors: Ray Hilborn, Emily Peterson (California Environmental Associates - USA), Matthew Elliot

Diverse approaches to the governance of marine fisheries are used by countries around the world and impact the effectiveness in meeting conservation and socioeconomic objectives. We aimed first to characterize the variability in fishery management systems of 28 major fishing nations and attribute this variability to economic, geographic, and fishery-related factors, and second to quantify effects of specific management attributes on stock status. We conducted detailed fishery-specific surveys with 191 national fishery experts from diverse backgrounds: government science, management, academia, industry, environmental NGOs, and external organizations. Survey questions gauged the effectiveness of specific attributes in contributing to meet management objectives, covering aspects of research (programs for collection of landings data and body size/age data; surveys; stock assessments), management (management plans; limits on fishing pressure; and



capacity to adjust fishing pressure), enforcement (monitoring and observing programs; penalties; protection of sensitive habitats; discarding or by-catch measures), and socioeconomics (access into the fishery; transparency; community involvement; subsidies). Survey answers were used to generate a Fishery Management Index (FMI) for individual stocks and for countries as a whole. The background expertise of respondents explained some of the observed variability in country FMI values, but other factors had greater influence. Per-capita GDP was the strongest predictor, with a positive influence as expected, suggesting that wealthier countries have greater capacity for implementing effective fishery management systems. Country FMI was negatively associated with capacity-enhancing subsidies. Three management attributes had particularly strong influence on the current abundance, fishing pressure, and trends towards desirable states of abundance and fishing pressure: the comprehensiveness of stock assessments, the strength of fishing limits, and the level of enforcement of these limits. Countries that currently have more limited fishery management systems have the greatest potential for improving socioeconomic and conservation outcomes through investment in these systems.

Keywords: fisheries management, coastal governance, marine conservation, enforcement, regulations, fishing mortality, stock status, integrated assessment, survey design, mixed-effect models

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E6-195

The fabric of the sea government: Integrating the political dimension in the studies of the « governance » of social-ecological systems

Camille Mazé

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Co-authors: Olivier Ragueneau, Julien Weisbein (LASSP, Science Po Toulouse - France)

This contribution supports the idea that the social sciences of politics (SSP) are a key discipline to enrich our knowledge of the vague category of « governance » of the sea, mobilizing the concept of « public action » to question its effective « government »- in relation to Power, in the meaning of Max Weber. The sea will be considered as an object of collective action, public policy but also mobilizations. We call here for a sociological and anthropological understanding of institutions, instruments, actors and networks governing the sea and coastal areas. It will be explained, how the fabric of the government of the Sea could be investigated through SSP, combining qualitative (socio-history, ethnography) with quantitative (social network analysis) approaches, in close interaction with others human and social sciences (e.g.: law, economy, geography) as well as with natural sciences (ecology, biogeochemistry) and engineer sciences (ecology, environmental assessment and protection). This research proposition will rely on ongoing studies carried out in one French Long Term Ecological Research (LTER) site: the Bay of Brest and Iroise Sea area. This site will constitute a demonstrator, to grasp the changes and the complexity of the « sea governance », as a mirror of the contemporary transformations of the politics. It will be considered in its multi-level and multi-site dimension, from the local to the international level, with a special focus on the Europeanization dynamics.

Keywords: governance, Government, Institutions, actors, Social-ecological system

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E6-252

A Comprehensive Method for Assessing Marine Resource Governance: Comparative Study of Fisheries Governance in the United States and the European Union

Willow Battista

(Research and Development Team, EDF, San Francisco – USA)

Co-authors: Rod M. Fujita, Ryan P. Kelly (School of Marine and Environmental Affairs, Univ. Washington – USA), Ashley Erickson (Center for Ocean Solutions, San Francisco -USA)

Understanding factors related to successful project outcomes is necessary to improve natural resource management. A recent meta-analysis identified three management attributes—spatial scale, explicit management of system thresholds, and routine monitoring—associated with successful management of threshold-based systems. However, high variance among case studies indicates that these attributes do not guarantee good conservation outcomes, suggesting that additional factors may be at play. To better understand these additional factors, we created a systematic analysis framework to study the roles of governance and social characteristics that can influence management outcomes. We compiled a list of effective governance attributes from the literature, and developed guidance for evaluating their presence, absence, and the extent to which each attribute is actually manifested in a given case study.

We also examine the distribution of rights and responsibilities within a system, and the resulting impacts on stewardship incentives. Here we present the results of this analysis as applied to fisheries management in the US, as governed by the Magnuson-Stevens Fishery Conservation and Management Act (MSA), and the analogous management system in the EU, as governed by the Common Fisheries Policy (CFP). Our results confirm that absent or incomplete effective governance attributes can negatively impact conservation outcomes. Differences in ecological outcomes under the CFP and the MSA may be related to differences in the quality and completeness of specific governance attributes, including regulatory authority, efficient enforcement mechanisms, clear objectives and directives, and appropriate spatial scale, and to uneven distributions of rights, responsibilities, and incentives.

Keywords: Effective Governance Attributes; Institutions; Rights and Responsibilities; Fisheries Management

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Theme session F

Lessons learned from practical case studies

Parallel session 3 – Tuesday 31/05 (14h00-15h40)

F1-101

Management of marine environments in a changing world

Anders Grimvall

(Swedish Institute for the Marine Environment, Göteborg - Sweden)

Co-authors: Eva-Lotta Sundblad

Measures to protect or restore marine environments have long focused on regulation of activities in the sea and direct emissions to the sea from production of goods and handling of waste. However, the climate issue has paved the way for a broader perspective on the root causes of the pressure on valuable ecosystems. This could recently be noted when UN adopted « Responsible consumption and production » as a sustainable development goal. Interestingly, this goal also emphasizes that both international companies and organizations involved in public procurement have a special responsibility for achieving the goal. Moreover, individual consumers have a responsibility, provided that they have access to relevant information.

Here, we argue that some important marine environmental issues are most efficiently addressed by combining conventional regulations with other instruments. In particular, we show how societal drivers of the eutrophication of Swedish marine waters can be elucidated and addressed using a method involving the following steps:

- ☐ Map societal phenomena that can influence the pressure on marine environments
- ☐ Define desirable changes and identify key actors
- ☐ Suggest potential measures or economic instruments

Some of the identified societal phenomena were closely related to trends in the flow of products from producers via wholesalers and retailers to consumers. Others illustrated unconscious limitations of the system under consideration. The measures that were suggested illustrated that actors forming the market of consumer products can play a key role and that measures directed towards such actors require instruments other than conventional regulations based on "end-of-pipe" approaches. In summation, the case study demonstrated that many can do more and, in fact, more than they know.

Keywords: driving forces, societal phenomena, market actors, eutrophication

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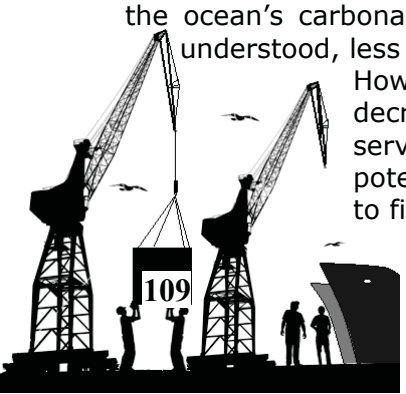
F1-101

An acidic future for Norwegian fisheries? Assessing the socio-economic vulnerability of the Norwegian fishery sector to the threat of ocean acidification

Luise Heinrich

(Lund University - Sweden)

Ocean acidification, caused by the increased uptake of anthropogenic CO2, describes a change in the ocean's carbonate chemistry. While the chemical processes of ocean acidification are well understood, less is known about its biological and subsequently socio-economic consequences. However, there is evidence that marine organisms will be adversely affected by a decrease in pH and carbonate saturation levels. Fishery is one of the ecosystem services likely to be affected by an increase in OA. In order to understand any potential consequences and develop corresponding response strategies it is crucial to first understand the complex environmental, economic and social interaction of



relevant factors. Following the example of Mathis et al. (2014), I applied an integrated risk assessment framework taken from the IPPC's Special Report on managing the risks of Extreme Events and Disasters to Advance Climate Change Adaptation (SREX) with the aim to compare the 19 Norwegian counties with regard to their performance in terms of « environmental hazard », « economic exposure », « social sensitivity » and « adaptive capacity ». The counties receive individual scores for all four categories, which are then combined into a final risk index. Overall, the final assessment points out that 13 out of 19 counties face moderate to high risk from OA. My research shows that the SREX framework is applicable for evaluating the impacts of OA. In the case of Norway however, improvements can be achieved by increasing the availability of detailed data, such as long-term monitoring of oceanic conditions, better information regarding the biological impact of species, and more detailed employment and income statistics. My research is the first attempt to apply this specific framework to OA on a sub-national level in Europe. It shows that integrated risk assessments are an important prerequisite for any form of interdisciplinary ocean acidification research and the development of successful response strategies.

Keywords: Ocean acidification, fishery, risk assessment, vulnerability, Norway, SRE

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F1-80

Changing endowments and growth trajectories after a resource crises: Lessons from a small Island economy

Pascal Le Floc'h

(UBO, UMR AMURE, Quimper - France)

Co-author: James Wilson (Univ. Maine - USA)

The Islands of St. Pierre and Miquelon (SPM), a territory of France, was implicated in one of the most important resource disasters of the 20th century; the collapse of the northern cod stocks. This collapse led to the Moratorium on the fishing of cod, imposed by Canada, its close neighbor, in 1992. The moratorium engulfed the territorial waters of SPM as well. The economy of SPM, traditionally a fishing territory from the middle ages with three distinct cultures, was faced with economic bankruptcy. The government of France, from that time onward, sought to keep the economy afloat by replacing value added from the fishery with value added from the public sector, in effect creating public sector jobs. However, although the collapse of the economy was averted, this may have come at unnecessary cost to French taxpayers, and a number of other challenges arose which may have acted to slow the economy. We believe that the slowing of the economy was due to several effects of broad public sector investments may have had on the dynamics of growth trajectories. For example entrepreneurial capacity may have undergone an eviction, aided in part by bidding human resources away from traditional sectors of employment. Programs of education may not have provided enough incentives to encourage repatriation of human resources. Finally, the remaining fishers themselves, under the new regimes of co-management between SPM and Canada, appeared able to diversify their fishing activities into other species and to learn new methods of sustainable small scale fishing. Although this likely would not have happened without France intervening, this intervention might have been better tailored to help the economy make necessary structural changes more efficiently. The collapse of the cod stocks in 1992 was a trigger for Canada and SPM to change the course of their respective economies. Canada, the more diversified economy, could afford to be inefficient in its response, which it was. SPM aided by France on the other hand, because to the fragility of the SPM economy, cannot afford these same inefficiencies without outside help. Resource endowments were replaced by taxpayer endowments, which may have engendered these inefficiencies. The economy of SPM, while having the outer appearance of having survived the crisis, was saved at great cost by France, and will continue to experience limited growth and diversification because of the secondary effects of these public investment decisions.

Keywords: governance, fisheries status, economics

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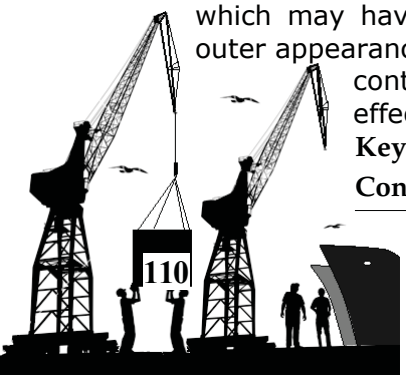

F1-88

Perspectives of small scale fishermen in Sri Lanka

Mary Mackay

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Co-authors: Meriwether Wilson (Univ. of Edinburgh - Scotland, UK), Clare Hall (Cardiff Univ. - UK)

Global fisheries are being exploited due to increases in population, economic development and technical changes compounding pressure on the resources, with small-scale fisheries being the most vulnerable. More pressure on the resources results in increased competition as stocks decline and collapse, ultimately leading to resource conflicts.

Resource conflicts occurring in Sri Lanka are causing a breakdown in fisheries management and an increase in non- compliance. Therefore, policy recommendations should be based upon a better understanding of the stakeholder perspectives in order to identify the drivers of human behaviours to then encourage compliance. One participatory method of integrated socio-economic assessments, combining qualitative and quantitative elements, is Q-methodology.

Q-methodology is a way in which social perspectives can be revealed by analyzing the patterns in the ways people associate opinions. The application of this method in Sri Lanka is to focus on two fishing communities; Galle and Kalpitiya, where communities engage and comply with the policies differently. From this analysis three distinct social perspectives are identified. The first, governmental cooperatives, represented an opinion that accepts little personal responsibility, yet would follow « top-down », government led initiatives, and are aware of the long-term implications.

Justified non-cooperatives grouped towards justifiably breaking the rules and focused on short-term goals. Thirdly, fatalistic coalition gamers orientated around pessimistic projections for the future with little faith in either government of community management schemes. The perspectives identified a range in values and opinions and management needs to incorporate them all in order to have effective compliance. The power in identifying these social perspectives enables policy makers to be more informed and aware of the stakeholders they are creating policies for. The results suggest a balanced approach with both « top-down » and « bottom-up » management, whilst maintaining legitimacy to prevent corruption will encourage compliance, which could be applied through co-management.

Keywords: compliance, Q-methodology, co-management, small-scale fisheries, resource conflicts

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F1-82

Circular economy, as a promising new approach and policy to combine environmental constraints and issues of the « Blue Growth » ?

Raphaëla le Gouvello

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Co-authors: Denis Bailly, Pascal Le Floc'h (UBO, UMR AMURE, Quimper - France)

Although proposed by various economists since the years 1970-1980's, the Circular Economy (CE) has been emerging as an economic alternate model only for the past decade. CE is opposed to the « linear » dominant economy, so called « take, make, and dispose », which negative externalities have been threatening the stability of economies, natural ecosystems, and humanity's survival. CE refers to cyclic models, « cradle to cradle »product lives, eco- design, waste reduction and re–use of materials, industrial synergies-symbioses, and almost mimicking natural ecosystems, for a better eco-efficiency of resource use, lesser environmental impact and mutual benefits for actors. It is considered to be of a « strong » sustainability for some scientists, policy Makers, NPOs, but also major private corporates. CE can be declined through several fields and levels, at a micro-scale (products, consumers, and companies), meso-scale (territories, eco-industrial parks) and a state macro-scale. For marine and

Coastal territories, the question is raised whether CE constitutes a promising new approach to decouple economic Blue Growth from environmental impacts.
This paper is a first step of a thesis work applied in Brittany, « La Cornouaille », a 330 km coast line territory including 6 fishing harbors, marine cultures, potential marine renewable energy, and a touristic increasing sector. The history, various aspects and implementation tools of CE are explored with regards to marine activities and their environmental impact. A frame is proposed to analyze and to compare the published cases with the followings: 1/Drivers (anticipated or suffered), 2/Marine and coastal activities (producers and processers of living resources, energy, logistics and services), 3/Socio-environmental constraints and characteristics, 4/CE description (scale, focus, type, synergies, tools, management, actor's diversity, indicators). A proposal is made to implement CE on the study area of La Cornouaille, on a model based upon fisheries and marine aquaculture, as major local activities, participating to its claimed identity.
Keywords: circular economy (CE), industrial and territorial ecology, marine economy, coastal economy, blue growth
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Parallel session 4 – Tuesday 31/05 (16h00-17h40)

F2-175

Can we unpack social-ecological vulnerability into quantitative metrics: case study from Kenyan coral reef fisheries

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Co-authors: Joshua Cinner (JCU - Australia), Tim McClanahan (Wildlife Conservation Society - USA)

How the marine environment is managed is influenced by a mix of rules and priorities set at international, national to local governance levels with differing timeframes and concerns with implications for the future of coastal communities. This paper examines how justice is understood by different organisations involved in coastal governance and used to prioritise certain goals. In particular, I focus on the use of notions of justice to argue for intergenerational equity. A case is used from rural Norfolk, in the East of England where the inshore fishing community is facing increasing tensions over space in terms of legitimacy and resource use. A Marine Conservation Zone is being designated on a chalk habitat traditionally fished by local fishermen and licenses for offshore energy developments have been granted. International political agendas for the marine environment and climate change have shaped discourses at the local level. Conservation organisations emphasise the need to restore biodiversity and the climate to leave a better environment for future generations. On the other hand, community groups representing fishing families express concerns for their children over the future of their livelihood and fishing heritage. Both sides are officially represented in local coastal governance processes. However, decision-making has become increasingly centralized in the UK with international climate change and marine conservation targets being prioritized at the expense of local coastal communities. A utilitarian « greater good » argument for global environmental justice and intergenerational equity concerns is being used. This is somewhat disconnected from other policy objectives aimed at encouraging localism and community development. Until such time as the issues raised around legitimacy representation and participation persist, the well-being and agency of local communities will remain compromised.

Keywords: resilience, coral bleaching, adaptive capacity, ecosystem-based management, synthesis
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F2-186

How can transdisciplinary methods help us better understand historical community adaptations to environmental change in order to develop culturally specific and participative coastal adaptation policies today?

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Our research team from the Université de Moncton is studying adaptation to climate and environmental change in the communities of the Cocagne River Watershed, a largely French-speaking coastal zone of the Canadian province of New Brunswick. The inhabitants have demonstrated resilience through the creation of local institutions such as the Pays de Cocagne Sustainable Group. In addition, local municipalities are currently working on rural development plans to address economic, demographic and environmental challenges. By partnering with these groups and co- creating knowledge in participative exchanges with them, we aim to provide a nexus of scholarly expertise to support current adaptation strategies to the increasing threats of climate change. We have accomplished this through a transdisciplinary framework leveraging natural sciences, social sciences and history approaches towards integrated policy recommendations. We are convinced that adaptation to climate change cannot be studied in isolation from the human dimensions of socio-ecological system. This conviction is shared by our international partners; together we form the Belmont Form-funded research project ARTISTICC (Adaptation Research, a Transdisciplinary, Transnational Community and Policy-Centred Approach). This paper is feature an innovative methodology, namely, the combination of archival and sediment analysis to reconstitute the evolving communities of the Cocagne River Watershed from the beginning of industrialization to the present day. Specifically, we have reconstituted the local population with the 1871 and 1921 Canadian Censuses and we have sampled aquatic sediment cores from three distinct sites in order to reconstruct aquatic productivity and the presence of metals. In short, we use two types of data (archival and biogeochemical) towards the same research goals. Our findings highlight the vulnerability and the resilience of small communities in constant change. Better understanding past adaptations as well as local culture allow us to propose specific coastal adaptation policies to combat climate and environmental change going forward.

Keywords: transdisciplinary framework, adaptation, climate and environmental change, vulnerability, resilience, human dimensions, participative action research, socio-ecological system, local culture, adaptation policies.

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F2-112

Multi-criteria analysis of the Icelandic cod fishery

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The Icelandic cod fishery is by far the most important fishery in Iceland, accounting for 37% of the country's total export values of seafood in 2014. Sound biological and economic management of the fishery is therefore essential for both the nation as a whole, as well as individual communities. In this paper we present a multi-criteria analysis (MCA) undertaken of the cod fishery, which forms part of the EU-funded research project MareFrame. The project seeks to develop integrated Ecosystem-based assessment methods and a decision support framework for management of marine resources. The analysis is done in two main steps. We first use the statistical multispecies model Gadget, developed by the Icelandic Marine Research Institute, to estimate the development of catches by fleet segments (trawl, net and longline) and stock size. Comparisons are made to two scenarios a) adhering to the present harvest control rule until the year 2030 or b) changing effort to a level corresponding to fishing mortality associated with maximum sustainable yield (FMSY). In the second step, the two outcomes and their socio-economic effects are examined using a three-stage Analytic Hierarchy Process. In the first stage stakeholders are asked whether they believe results are more important in the medium term (year 2020) or long-run (2030). In the second stage they are asked to compare effects on environment, society and industry, and in the third stage compare different impacts on environment (size of cod stock, CO2 emissions and condition of seabed), society (value of export earnings, employment) and industry (labour productivity and profits). The case study has been developed in close cooperation with Icelandic stakeholders, and in this paper we present the results from a MCA stakeholder workshop undertaken in October 2015.

Keywords: Stakeholder interactions, Multi criteria analysis, ecosystem model, EAFM

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F2-116

Mapping marine social science research: A conceptual framework

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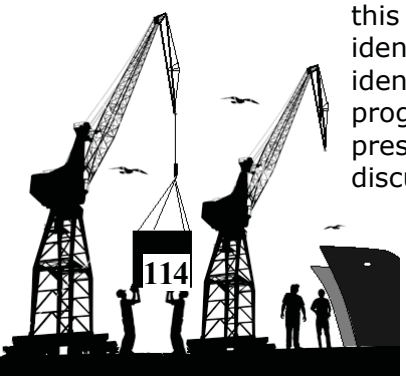
Marine management is increasingly acknowledged as a wicked problem - a complex problem with a diverse set of stakeholders, disciplines, perceptions, and interests. The multitude of questions open to managers, researchers, and stakeholders, combined with the wide range of social science and natural science disciplines covered by these questions, makes it difficult to see the forest for the trees. This paper presents a conceptual framework to understand and map research questions in social sciences in relation to marine resource management. This framework is based on the dichotomy between positive and normative research, which is common in economics, and extends this dichotomy to a classification along two dimensions. The first dimension distinguishes research questions that entail value judgements from research questions that do not, The second dimension distinguishes research questions referring to the situation 'as is' from research questions that explicitly regard policy recommendations. The four categories of research questions following from this framework can be understood along a medical analogy of (1) diagnosis: the identification of the problem and initial assessment of its gravity; (2) etiology: the identification of the immediate and fundamental driving forces of the problem; (3) prognosis: the setting of objectives for a policy to address the problem; and (4) prescription: the development of interventions to attain the goal. The paper discusses the suitability of the framework for economics and governance,



demonstrates how the framework can be used to map urgent social science research questions in marine policy, and explores how the framework can help set priorities and identify knowledge gaps for marine social science research.

Keywords: economics, social science, marine policy, philosophy of science

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Parallel session 5 – Wednesday 01/06 (10h30-12h30)

F3-183

The right bycatch tool for the right problem: how catch shares and incentive programs are being utilized and how they can be improved

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The 5th Assessment Report (AR5) of the Intergovernmental Panel on Climate Change (IPCC) challenged scientists to fully integrate the implications of changing climate conditions within the context of changing anthropogenic responses. In the context of fish and fisheries, this challenge requires the formation of integrated, interdisciplinary partnerships. This requires that regional modeling teams responsible for the development of scenarios of future impacts on fish and fisheries carefully consider the expected changes in harvest strategies that are expected to occur in the future. Following the approach that the IPCC used to develop Representative Concentration Pathways (RCPs), the ICES/PICES Strategic Initiative on Climate Change are exploring frameworks for the development of Representative Fishing Pathways (RFPs). In support of this global focus on RFPs we conducted a review of the range of potential harvest strategies worldwide, with specific focus on their performance relative to different national value systems. This review catalogs and characterizes the similarities and differences in harvest strategies and provides a starting point for the selection of RFPs for regional modeling teams worldwide. Characteristics of RFPs that should be robust to the expected non-stationarity in ecosystems emerging from climate change are identified. This review provides a foundation for the discussion of what future changes in harvest policies may change. A case study for groundfish management in the Bering Sea is provided.

Keywords: climate change, harvest policy, fisheries management

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F3-130

Effects of the EU CFP discard landing obligation analyzed with an ecosystem model in the Gulf of Trieste, Adriatic Sea, Italy

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The introduction of the discard landing obligation (EU 1380/2013 and 1392/2014) in the reformed Common Fishery Policy has been heavily criticized for its possible overall negative impact on the ecosystem. The Northern Adriatic Sea, characterized by multi-gear/multi-target fisheries typical of the Mediterranean Sea, was used as a case study to simulate the bio-economic effects of the discard landing obligation. In the study area of approximately 1000 km2, operate high discard rate fisheries such as the rapido trawl, otter trawl, hydraulic dredge and to

a less degree the mid-water pelagic trawl and more than 40% of the total catch is discarded. An ecosystem model, representing dynamics from detritus and phytoplankton to top predators and fisheries, was used to evaluate the implications of the new EU regulation by comparing scenarios with and without landing the discard. The model can simulate the variation of the species' biomasses, and it allows assessing economic and ecologic indirect effects and trade-offs due to the application of the new regulation. Moreover, the bio-economic evaluation is done by including the potential benefit of the marketed discard species and a long-term variations of the biomasses of the target species and the effect on the revenues.
Species' responses to introduction of regulation included direct and indirect effects. For crustacean species characterized by high degree of scavenging, for example, the decreased pressure from their predators (also exhibiting some scavenging activity) had higher impact than the reduced food because of reduction of discard. The overall simulation results indicate an increase of landing, thus of fishermen's workload, and the decrease of fisherman earnings.
Therefore, the potential revenues obtained by landing the discards do not compensate the loss of income given by the biomass reduction of more valued target resources. Possible future integrations should evaluate further reduction of the fishing effort or/and an adoption of more selective fishing gears.

Keywords: Adriatic Sea, landing obligation, Ecopath with Ecosim, fishery discards, fishery economy.

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F3-40

Voices from the shore – Icelandic coastal communities in times of fisheries privatisation

Matthias Kokorsch

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Icelandic coastal communities have faced major challenges on the socio-economic and demographic level since the privatisation of fishing rights in 1990. Some have developed successful strategies and diversified the previously monotonous economic structure. Others, however, have experienced severe population loss and face a rapidly accelerating downward spiral.

Based on a previous quantitative evaluation of different development trajectories, two (former) fisheries-dependent locations get selected for case studies and analysed through the lens of resilience. Those communities are defined by the same starting conditions in 1990, and have followed contrasting developments path since. Possible reactions to local changes that occur due to forces of outside powers are described by adaptation over time or adjustment to sudden shocks (here in a sense of policy change and/or quota loss). Thus, one of the communities represents for a seemingly successful adjustment and adaptation in terms of resilience, whereas the other embodies a more problematic development trajectory. The main question of the project then becomes how Icelandic coastal communities have managed to adapt or adjust to the implemented changes in fisheries management that have taken place in a dynamic social and economic context. The case studies make use of a mixed methodology, including interviews, participant observation and workshops. The main task is to identify potentials, capacities and strategies that have been developed for an increased social robustness and in how far they are transferable to other communities. With a prior established vulnerability indicator and the case studies at hand, this methodological triangulation enriches the discussion of a truly sustainable fisheries management system.

Keywords: quotas, Iceland, resilience, fishing communities

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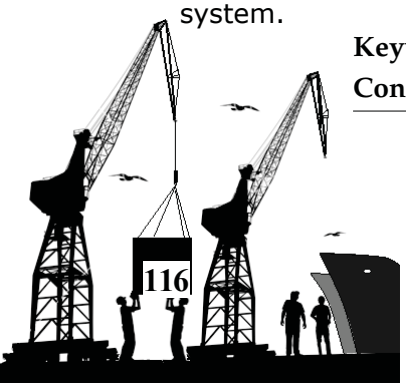

F3-40

Does Ecosystem-Based Fisheries Management suit all fisheries? - a case study with Chilean fisheries.

Javier Porobić Gárate

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Co-authors: Elizabeth A. Fulton, Billy Ernst (Univ. of Concepción - Chile), Stewart Frusher (Univ. Tasmania – Australia) , Carolina E. Parada Veliz (Univ. of Concepción - Chile)

The collapse of many fisheries, the degradation of the ecosystem because of human pressures and their impact in the economy and society has generated a evaluation of management approaches and the incorporation of new goals. Consideration of fisheries and their management as a social-ecological system, explicit consideration of biodiversity and the inclusion of all stakeholders (or at least their representatives) in management oriented discussions has shaped the change to a more holistic management approach. In 2013 Chile recognised this shift by incorporating the concept of ecosystem-based fisheries management (EBFM) in their new fisheries legislation. These concepts are new in Chilean law and present new challenges for authorities and for the scientific community. One of the most challenging issues is how to implement the ecosystem-based management approach in a way that suits and embraces all the different type of fisheries that operate in Chile. To address this, the Chilean government has taken a number of strategic approaches and introduced a range of policies that attempt to solve this management problem. In this study, we reviewed these Chilean strategies and policies and compared them with the approaches used by other countries that have also moved to EBFM. The outcome of this study attempts to provide a set of tools and guidelines that highlight best practices and assist fishing communities to avoid problems in transitioning to EBFM, using examples drawn from the experience of Chile and other countries.

Keywords: coastal ecosystems, ecosystem-based management, small-scale artisanal fisheries, socio-ecological systems.

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Parallel session 6 – Wednesday 01/06 (13h30-15h30)

F4-212

Integrated management plan proposal for a small-scale mussel growing organization in Chiloe island

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Aquaculture is a growing activity worldwide which plays a fundamental role in human feeding. Chile is the biggest exporter of bivalves in Latin America and the Caribbean, and one of the ten biggest producers around the world. 99.6% of the national production of *Mytilus chilensis* (Chilean mussels) is located in Chiloe Island. This cluster is formed by 97.7% of micro or small companies of small scale aquaculture, which work mainly in a rural context, in rigorous weather conditions, with special cultural, social environmental and labour features, under a complex frame of economic, political and administrative system.

The main purpose of this research was to analyse, describe and propose an integrated management plan in the following areas: environment, society and labour in a mussel-growing productive micro-organization located in the Quiquel bay, Dalcahue, Chile. In order to do this, a multidimensional integrated

management plan was created, in which its organization and context was evaluated through data analysis, interviews with the stakeholders and fieldwork information gathering. After that, the gaps were founded in each field studied and then ranked through a system of multiple criteria. Subsequently, the gaps were analysed in order to find their causes and an action plan was established to shorten them. The main results in each area showed the following: Environment: Plastic pollution without management and a 26% of legal environmental fulfilment. Labour: 0% of basic sanitation rules fulfilment and 36% of legal maritime and ergonomic risks fulfilment. Society: A socio-productive isolation was observed with a high-risk organizational context, which threatens the organization sustainability. Finally, a cooperative model was proposed for the mussel-growing companies at small scale to add extra value and to develop a sustainable aquaculture model in Chiloe Island, as well as to improve the conditions of the rural communities in which these organizations are located.

Keywords: Integrated Management, Small-scale aquaculture, mussels farming.

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F4-239

Applying socio-economic and ecological criteria in the allocation of fishing opportunities

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Article 17 of the reformed EU Common Fisheries Policy states that Member States should allocate fishing opportunities using transparent criteria including those of an environmental, social and economic nature.

There are also large benefits that could be obtained if Member States use this policy and target certain outcomes for their fishing fleet.

In a series of case studies around the EU (English sea bass, Scottish nephrops, Irish pelagic fish and Belgium flatfish), fishing opportunities that are currently in high demand from diverse fleets are analysed using a series of socio-economic and ecological criteria.

Each of these case studies presents unique challenges both in terms of data collection and analysis as well as the unique management regime that governs each fishing opportunity.

As different Member States have established systems of quota allocation in place, applying Article 17 must take these unique situations into account. A discussion on how, and whether, Article 17 can be implemented in all cases is provided.

Keywords: Common Fisheries Policy, multi-criteria decision analysis, quota allocation

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F4-160

Modelling impacts of offshore wind farms on trophic web: the Courseulles-sur-Mer case study, an example of cumulated impacts

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Co-authors: Samuele Tecchio (CNRS, Univ. UNICAEN - France), Jean-Claude Dauvin (CNRS, Caen and Univ. UNICAEN - France), Jean-Philippe Pezy, Steven Degraer (Royal Belgian Institute of Natural Sciences RBINS - Belgium), Marie Cachera (IRD, Plouzané – France), Karine Grangeré (CNRS, Univ. UNICAEN - France), François Le Loch (IRD, Plouzané – France), Jeffrey Dambacher (CSIRO, Hobart & Brisbane - Australia), Nathalie Niquil (CNRS, Univ. UNICAEN - France)

The French government is planning the construction of three offshore wind farms in Normandy. These offshore wind farms will integrate into an ecosystem already subject to a growing number of anthropogenic disturbances such as transportation, fishing, and sediment dredging. The possible effects of this cocktail of stressors on ecosystem functioning are still unknown, but they could impact their resilience, making them susceptible to changes from one stable state to another. Understanding the behaviour of these complex systems is essential in order to anticipate potential state changes, and to implement conservation actions in a sustainable manner.

Currently, there are no global and integrated studies on the effects of construction and exploitation of offshore wind farms. Moreover, approaches are generally focused on the conservation of some species or groups of species. Here, we develop a holistic and integrated view of ecosystem through the use of complementary trophic webs modeling tools (quantitative and qualitative models). In fact, trophic models such as Ecopath are based on the quantification of flows between the ecosystem components (ecological processes). This approach allows modelling the ecosystem complexity from phytoplankton to top predators. Moreover, interactions with the ecosystem and human activities are then be added through qualitative models. These models allow to introduce unquantified actions of various actors.

Results of these two complementary models contribute to a better knowledge of the impacts of the offshore wind farms on ecosystems and cumulated impacts. They also allow to define recommendations for environmental managers and industry in terms of monitoring the effects of Marine Renewable Energy, not only locally, but also on other sites, national and European levels. Finally, this combined approach could contribute to a better social acceptability of Marine Renewable Energy projects allowing a holistic vision of all pressures on ecosystems.

Keywords: Marine Renewable Energies, cumulated impacts, trophic model

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F4-162

Dynamic simulations of the Seine estuary food web: Towards a holistic and integrated approach of management scenarios on ecosystem functioning

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The Seine estuary is a transitional water system in northern France that is commonly referred to as an example of a productive habitat highly modified by human activities. A new expansion of Le Havre harbour (Port2000) was built between 2002 and 2005, with the purpose of optimizing its access and expanding the available space for container ships. In parallel, mitigation and compensatory measures have been carried out: dredging of channels, restoring water circulation by reopening connections between flanks, and building an island as a sea birds repository. Since 2005, the monitoring of the ecosystem realised, corresponded to a period of low precipitation, with no major flood. The strategy of applying dynamic trophic model Ecosim is presented here in a framework of decision making about mitigation and compensatory measures. Trophic models describe the interaction between species at different trophic levels and are based on the quantification of flow of energy and matter in ecosystems. They allow the application of numerical methods for the characterisation of emergent properties of the ecosystem, also called Ecological Network Analysis (ENA). These indices have been proposed as ecosystem health indicators as they have been demonstrated to be sensitive to different impacts on marine ecosystems. We present here the strategy for simulating scenarios of environmental management and with the objective of deconvoluting the different effects of human activities and of climate change in estuarine ecosystems.

Keywords: harbour, environmental management, food web, climate change

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Parallel session 7 – Wednesday 01/06 (16h00-17h40)

F5-51

Economic Integration in the Chesapeake Bay Program, Too Little, Too Late?

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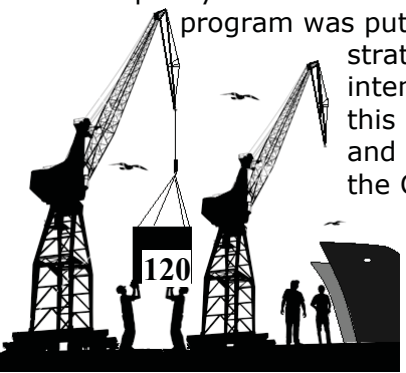
Co-author: Jorge Holzer (Univ. Maryland - USA)

It has been 33 years since the signing of the first Chesapeake Bay Agreement, a multi-state, multi-agency pact to restore the ecological integrity of the Bay, the largest estuary in North America. In many aspects, the Chesapeake Bay Program that was formed evolved into an integrated ecosystem assessment. Stakeholder involvement was integral to establishing restoration and management goals. An integrated suite of land use change, watershed and water quality models were developed and continue to be refined and used. A comprehensive monitoring program was put in place, and the monitoring outcomes were used to revise management strategies and improve the scientific basis of the modeling effort. Despite this intensive effort, the Bay Program has struggled to meet management targets. In this paper, we argue that the lack of consideration and integration of economics and human dimensions in the effort has contributed to the limited progress. While the Chesapeake Bay was a test bed for the development of non-market valuation



tools of ecosystem services, these approaches were never adopted and applied systematically. In the last couple of years, the US Environmental Protection Agency has been conducting a suite of economic studies that begin to estimate the costs and benefits of the already adopted restoration goals. The lack of integration of human dimensions from the beginning has led to these studies having to be a bit ad hoc. It is also quite likely that management goals and strategies that were adopted would have been different if they were informed by economic analyses along the way.

Keywords: ecosystem restoration, human dimension, economics

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F5-129

Are Integrated Ecosystem Assessments doomed from the start?

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Co-authors: Rod M. Fujita, Ryan P. Kelly (School of Marine and Environmental Affairs, Univ. Washington – USA), Ashley Erickson (Center for Ocean Solutions, San Francisco -USA)

The state-of-the-art of IEAs is pointing strongly in the direction of a push towards a « technological lock-in » where quantitative modelling is the method of choice. Experiences show that once a technology process is locked-in, any efforts to reform will be an uphill battle (i.e. the use of gas-powered automobiles for personal transport). If IEAs are to be designed for high credibility, legitimacy and societal saliency, a combination of quantitative and non-quantitative disciplines needs to be integrated early-on in the process. Experiences from other integrated assessment cases show clear disciplinary biases when purely model-based: number-hungry methods and disciplines like bio-economics overshadow relevant disciplines and theory such as moral philosophy, narratives or cultural theory and the unclear label of « integration » can be a major barrier to sustainable actions. For lack of its own methods, ICES adapted the North American IEA process in 2006, and currently a common framework for IEA in ICES is still lacking; there is still time to define how IEAs should work to reach its transdisciplinary potential and have impact on sustainable actions. A pessimistic prediction is that in a few years IEAs have developed into yet another engineering craft, which can show glossy results on paper but with little true societal impact. How could one conceptually, institutionally and in very practical terms, in spite of strong forces pushing in the opposite direction, develop and maintain a new paradigm for dealing with a core problem facing human societies: where policy is developed not by what can be done but from what needs to be done? This paper will address many of these concerns using ICES as an institutional case.

Keywords: integrated ecosystem assessment, values, norms, ethos of science, responsible research and innovation, science with and for society, philosophy of science, STS, technoscience

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F5-113

Fisheries and the operationalization of sustainability

Matilda Valman

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Co-author: Emma Björkvik

To fish sustainable has become a manifest not only to generate regrowth of fish but also to allow for growth of the fishing industry. The introduction of the concept « sustainability » and « sustainable harvest » has since the 1990s in several ways impacted on how the fishing industry operates. However, to what degree and in what way the sustainable discourse have had an impact within the fishing industry remains unclear. This paper showcase the operationalization of the sustainability discourse – including sustainability, green growth and blue growth – by two fisheries: The white fish industry within the Norwegian EEZ and the Vendace (*Coregonus albula*) roe fishery in the Bothnian Bay, Sweden. These two industries exemplify two different fisheries when it comes to scale – one is big and the other one is small. The denominator however is their respective big revenues and their movement towards sustainable harvests. We show that to fish sustainable – either if you are a big or small – the most important factor is diversified fishing. We demonstrate that both the large scale and the small scale fisheries during the last 20 years have moved towards a more diversified fishing style to sustain or to become sustainable..

Keywords: fisheries, sustainability, growth, diversified fishing

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F5-55

Modeling to uncover social factors in small scale fisheries: The Bayesian story of many and varied fisheries

Ingrid van Putten

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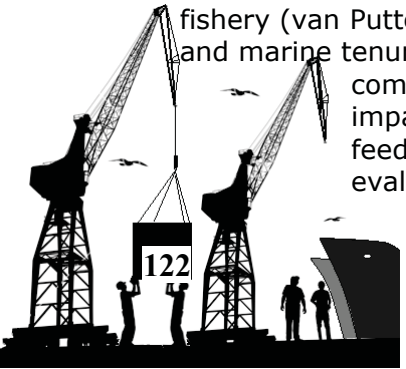
Co-authors: Eriko Hoshino (Univ. Tasmania - Australia), Helven Naranjo Madrigal (Univ. Nacional de Costa Rica – Costa Rica), Mariska Weijerman (NOAA, Hawaii - USA)

Small-scale fisheries contribute to sustainable livelihoods and food security globally, but especially in developing countries. To achieve effective self-governance and reflexive management institutions, gaining an understanding of fishing behavior in small-scale fisheries is necessary. Probabilistic modeling approaches can help gain insight into social and cultural factors that influence fishers decisions and factors that influence community and multi use management outcomes. Incorporating management relevant insights of social factors is important in both single species or whole of system ecosystem models.

Bayesian models are applied at resource user level in a multi-species artisanal dive fishery in Costa Rica and an indigenous fishery in the Torres Strait, Australia. In Costa Rica location choice behavior varied with the community's dependence on cultural assets, social interactions, and food security as well as the environmental variability (Naranjo- Madrigal et al 2015). The availability of a government employment program, social capital and capacity, and infrastructure availability contributed to the differences of different fisher types entering into the Australian indigenous fishery (van Putten et al 2013). In the Kei Islands in Indonesia, the socio-economic conditions and marine tenure that contribute to successful functioning of self-governance institutions for common-pool resources was uncovered (Hoshino et al in press). In Guam, the impact of different management options on coral reef ecosystem indicators and feedback on participation in reef-fish fishing and diving (marine tourism) was evaluated (Weijerman et al 2015).



This comparative review of probabilistic modeling in culturally very different countries, and different fisheries, shows that it is a useful way to expose social and cultural factors that affect artisanal, traditional, and indigenous fisheries. Most importantly the models are useful as independent models of fisher behavior (as in Costa Rica and Indonesia) or they can be coupled to single species model as in the Torres Strait, or marine ecosystem models as in Guam.

Keywords: Bayesian models, tropical, socio-ecological systems, small scale fisheries

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Parallel session 8 – Thursday 02/06 (10h30-12h30)

F6-219

Managing toward the triple bottom line: why qualitative social science is needed for quantitative trade-off analyses.

Phillip S. Levin

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The roots of conflict in marine conservation and natural resource management lie in the systematic differences in priorities pursued by various « players ». Indeed, the complexity of management of marine systems is based on the natural tension between the three pillars of sustainability—conservation, economic performance and socio-cultural well-being. The tools of quantitative science have served us well for articulating trade-offs between the ecological and economic. While the metrics of such trade-offs are incommensurate, tools exist to overcome this challenge. However, the socio-cultural axis is more difficult because the data are often not quantitative, making conventional trade-off analyses impossible. Here, we use a case study from Haida Gwaii, British Columbia, Canada to explore the qualitative tools available to enumerate socio-cultural attributes, and to highlight how such information can be used in quantitative trade-off analyses. Our approach relies on rapid ethnographic assessment in concert with bioeconomic models. The incremental approach we are using, we hope, will shed light on the underpinnings key areas of conflict and yield decisions that are more transparent and equitable.

Keywords: trade-off, culture, incommensurate values, management strategy evaluation

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F6-208

Assessing Marine Ecosystem Services to Build an Initial Diagnosis: Feedback from the VALMER Project in the GNB

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While economic valuation of ecosystem services (ES) is widely acknowledged as a tool to support decision-making processes, studies have also shown that there exists a literature blindspot on the use of economic valuation. The VALMER project seeks to bridge this gap between theory and practice by looking at how ecosystem services assessment (ESA) can support marine management and planning. Natural scientists, economists and managers from various institutions undertook ecosystem services assessments in six pilot sites over the two sides of the Channel. The objective of this communication is to present one of them, in the Golfe normand-breton (GNB). In this pilot site, the objective of the ESA was to provide an initial diagnosis of marine ES in a context of a creation-process of a potential marine natural park. Substantial work was carried out in order to analyze the links between the habitats, ecological functions and ES of the GNB. Various tools and methodologies were then developed in order to characterize the current state of some of the marine ES: an ecosystem-based activity accounting; a mapping approach to ES intensity; and a characterization of the provision of fish by subtidal sandy and muddy habitats through historic and economic analysis. In parallel, a participative scenario-building exercise was undertaken so as to co-construct possible futures about the level of two ES (fish provisioning from open-seas and recreational activities at the foreshore) in relation with general economic trends and the state of marine waters. Challenges and prospects from this case study will be highlighted.

The VALMER project was selected under the European cross-border cooperation programme INTERREG IV A France (Channel) – England, co-funded by the ERDF.

Keywords: ecosystem services assessment, scenarios, marine protected areas

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F6-220

When Resource users' perceptions drive MPA social acceptance : the case of Reunion island natural reserve

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Previous studies has showed that assess the social acceptance is a key component of the MPA's governance (David et al., 2010 ; David, 2011 ; Thomassin, 2011). The marine natural reserve of Reunion Island was created in May 2007 to reduce anthropogenetic pressures affecting the coral reefs and try to improve their health. More than ten years were needed to build social acceptance. But this process crossed stormy waters since 2011 with a fifteen bulldog and tiger sharks attacks in the vicinity of the marine reserve. Media and most of marine users accuse the reserve of being responsible of the sharks presence. To assess the social acceptability of the reserve faced to these sharks attacks threats, a study of perceptions of stakeholders were carried out during 2015. The study was organized in two parts. First, in-depth interviews were conducted within a period of two months (April-May July) and cognitive graphs were drawn. 29 key stakeholders were interviewed: 10 scuba diving club managers, 9 hotel managers, 5 fishers and a

mix of 5 other stakeholders, including scientists. The analysis of cognitive graphs was conducted to build an ontology of the stakeholders' perceptions in order to understand the logics which organize these perceptions. Second, more than 300 questionnaires were administrated in the Reunion Island university to collect the perceptions of students. Except the age of the responders, this population could be seen as a proxy of the public opinion in Reunion Island. Results show that the couple cognitive graphs /ontology is a powerful tool to collect stakeholders' perceptions and assess MPAs acceptance during critical periods where stakeholders are very reluctant to answer properly questionnaires.

Keywords: MPAs, social acceptance, perceptions, cognitive graphs, ontology, governance.

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F6-165

Food-web models and political decision: what could be learned from simulations of cumulated impacts on the Bay of Seine food-web properties?

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The Baie of Seine is a highly impacted ecosystem of the English Channel subjected to fishing, harbour building, dredging, dredged material disposal, pollution etc. It is also highly sensitive to climate change and associated species distribution changes. Moreover, 3 projects of offshore wind-farm building are under negotiation in this ecosystem. Several of those pressures have been studied by food-web modellers, looking at functional and holistic properties derived from the Ecological Network Analysis (ENA) indices (see poster Tecchio et al. and Raoux et al.) like connectance, redundancy, trophic efficiency, mean trophic level, recycling or omnivory. These studies are based on different methods where network interactions are quantified or not (qualitative modelling), static or dynamic, statistic (allowing uncertainty estimation) or not.

These different models were analysed in order to answer the question: what would be useful, in these ecological studies in the decision and policy-making process? This analysis is based on the conclusions about the understanding of effects of human pressures on the complexity of the functioning of ecosystems and their integration into social-ecological system, with a special interest in interactions of scales, uncertainty estimation, possible use of scenarios and indirect interactions between decisions, through ecosystem changes.

Keywords: interdisciplinarity, Marine Renewable Energies, climate change, cumulated impacts, trophic models, decision, policy-making process

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Posters

A-230

Using a compensation framework on coastal structures to balance natural resource protection with private property rights and needs: A policy for Connecticut's Long Island Sound coastline

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The Office of Long Island Sound Programs (OLISP) is mandated by the State of Connecticut (U.S.) to regulate all activities conducted in state tidal, coastal, and navigable waters. With its statutory authority established since 1980, OLISP holds a longstanding policy of promoting non- structural solutions to address shoreline erosion. In the wake of Storms Sandy and Irene, however, there was pressure on and from the Connecticut legislature to facilitate coastal rebuilding and increase shoreline protection, with public sentiment emphasizing greater coastal armoring. Such pressure continues to pose a challenge for OLISP, which aims to balance natural resource protection with private property owner's rights, including meeting the needs of statutorily protected water-dependent and public access uses.

OLISP aims to address this issue by utilizing an impact mitigation approach, specifically structural compensation. At present, each new stretch of hardened shoreline in state waters represents a fixed boundary beyond which the public trust, and the resources it supports—both natural resources and public access—may never pass. When the prospect of sea level rise is added, each new stretch of hardened shoreline represents an incipient purpresture, an uncompensated taking of public property for private use. However, if each new increment of hardening is balanced by an equal (or greater) and opposite increment of re-naturalization, the State may preserve the existing possibilities for landward migration of tidal wetlands and intertidal public access corridors.

This paper details the preliminary findings of the U.S. National Oceanic and Atmospheric Administration Coastal Management Fellowship project tasked with developing this compensation program. In particular, this paper addresses OLISP's statutory authority with regards to coastal armoring, case studies of structural mitigation measures employed across the U.S., and the theoretical basis of the working compensation methodology. The paper concludes by suggesting next steps for implementing the compensation methodology into State regulatory processes.

Keywords: Coastal armoring, shoreline protection, structural compensation, mitigation, statutory authority, Connecticut, U.S.

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C-45

MeRamo – An assimilative biogeochemical model system for the support of public authorities dealing with the Marine Strategy Framework Directive

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The European Marine Strategy Framework Directive (MSFD) calls for the establishment of a Good Environmental Status (GES) of the marine environment until 2020. In the current reporting, mostly in-Situ data is used to determine the status of the marine environment. Although close to the real status, in-Situ data are only point measurements and are sparse in time and space when looking on a regional scale. The MeRamo project aims at supporting the public authorities with results and products from an assimilative hydrodynamical-biogeochemical model system (HBM-ERGOM) for the North and Baltic Sea. Thus, a high quality data set can be generated, which is

consistent in time and space. The project consists of three main parts. A data assimilation component will be included which can handle Sentinel data from the European Copernicus initiative. Additionally a nutrient tagging routine will be implemented, which will be able to track the fate of specific nutrients depending on its source . Special focus will be placed on the effect of shipping emissions on the marine ecosystem by utilizing a data set for atmospheric deposition which especially accounts for deposition from shipping emissions. As the final step, the model output will be transformed into indicators which can be directly used for reporting. This will allow direct usage of different data sets via the operational model system optimized for the reporting for the MSFD.

Keywords: Marine Strategy Framework Directive, Biogeochemical Modelling, Data assimilation, Nutrient Tagging, Shipping emissions

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C-105

Indicators to evaluate the sustainability of snapper and grouper fisheries

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Evaluating the long-term fisheries sustainability based on the best available data is of primary importance for improved management and conservation. In recent years there has been an increasing interest to develop dedicated methodologies to evaluate the status of fisheries and to highlight areas where improvements are due toward long-term sustainability. These methods use indicators that summarize status and capture direct and indirect effects of marine fisheries upon target stocks and environment and should preferably serve a wide range of fisheries types (artisanal to industrial, coastal to high seas, data-deficient to data-rich, multi-gear and multi species). Snapper and grouper are important fisheries resources with a great commercial value, inclusively for the livelihoods and food security of many local, small-scale, communities worldwide. The life history characteristics of these species (e.g. slow-growing, late maturing, seasonal spawning aggregations) make them particularly susceptible to overexploitation. However, the status of many snapper and grouper stocks is unknown, particularly in the multispecies small-scale fisheries in developing countries where the reporting system is absent or insufficient. The type of studies and the stock assessments used as a basis for management in many temperate regions are impractical in many tropical environments. Local knowledge has been useful in places where there is lack of scientific data, such as many tropical fisheries, and shown to be a powerful tool for determining appropriate policies regarding management of target species. Co-management practices integrating the local populations will be crucial for the success of the measures applied in the sustainability exploitation of these resources. The main objective of this study is to review the current methodologies used to assess snappers and groupers stocks and develop and test the efficiency of new methodologies and indicators for evaluating the sustainability status (i.e. stock status, environmental impacts, management practices, social-economic aspects, etc.) of these resources worldwide.

Keywords: groupers, indicators, local knowledge, snappers, stock assessments, sustainability

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C-228

Application of the DPSIR framework as tool for coastal and marine monitoring related to management of a potential impacted area of Adriatic sea (Mediterranean sea)

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The marine environment can be perceived to be a system formed through the interconnection between natural systems, designed systems (such as extractive industries, tourism, transportation, power generation) and social systems (stakeholders, fishing communities, etc.). A holistic approach is therefore needed to gain an understanding of the connections that exist within and between these elements to support policy makers in their decision making. The management of the marine environment requires an approach that recognises the complexity of the system and accommodates the full user community and their current, multiple, interacting uses. This can be provided by an integrated methodology based on the DPSIR (Drivers–Pressures–State Change–Impact– Response) framework that has developed as a systems-based approach which captures key relationships between society and the environment. The impact module in traditional DPSIR models focuses attention upon negative anthropomorphic impacts on the ecosystem and this result may be essential to address monitoring programs. We applied the DPSIR conceptual model in the area of the Adriatic sea where remain the first offshore Liquefied Natural Gas (LNG) terminal in Italy for unloading, storing and re-gasifying liquefied natural gas. We used in the DIPSIR framework all the data obtained from the multidisciplinary monitoring plan that ISPRA is carrying on in order to verify possible impacts on marine environment associated to the project. In particular, we used geomorphological information, physical-chemical data in different marine matrices waters, sediments and biota, the soft-bottom macrozoobenthic community characterization, remote sensing analyses and fishing activities data. Understanding the relationships between the pressures of the offshore structure and the status of ecosystems is crucial to develop spatial plans whose main goal is the cartographic visualization of the results of different management alternatives.

Keywords: monitoring, DPSIR framework, human impacts

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E-257

Future MPA of Gouraya: Assessment and Lessons Learned from the Stakeholders Integration Experience

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Classified as the smallest one at the national level, the National Park of Gouraya (NPG) is an urban park with three outstanding ecosystems: terrestrial, marine and lacustrine. It has national and regional importance owing to its exceptional biodiversity, aesthetic and historical luxuriousness.
The NPG being located entirely within the City of Bejaïa, this metropolis that knows over recent years a significant expansion in urbanization, industrialization and tourism can cause irreversible damage to different ecosystems.
Besides its terrestrial area protected since 1984, the park managers and by dint of their protection and preservation mission proposed the extension of the park towards the marine part by classifying it as a marine protected area (MPA); this occurred after the study conducted in 2002 by the National School of Marine Sciences and Coastal Management (ENSSMAL) which highlighted the

presence of several endemic, rare and endangered species as well as the presence of remarkable landscapes of international matter.
The multiplicity of stakeholders and users of the marine area, conflict of interests and the lack of awareness about the protection and preservation of this area (which should primarily impact positively their activities) are among other, factors that may hinder the classification process and even the effective management of the future MPA.
The work done so far, as part of a PhD thesis, has allowed the identification of the actors, their role and their effective weight. One major conclusion was that the current method of stakeholder involvement has not brought its fruits, as expected, since the marine area is still not protected and natural heritage is in a constant deterioration.
The purpose of this paper is to review the diagnosis and give an overview of the NPG. Integration of stakeholders as well as the methodology followed and to implement for an effective involvement of all stakeholders before, during and after the classification of the area are presented. This essential step will allow the actual and effective participation of the stakeholders as well as the optimization of their roles and beyond, an effective management and optimal conservation of the future MPA of Gouraya.

Keywords: integrated coastal management, stakeholders, participatory process, coastal park, MPA

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E-258

Assessing the implementation of the Algerian coastal law Case : West localities of Algiers

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The will of the protection of the coast has been a priority for the Algerian governement these recent years. Nearly 40% of the Algerian population is established in only 2% of the Algerian territory, in the Northern part of the country, especially on « coastal strip » of 50-100 km.
In response to all the environmental problems created by this high concentration, Algeria has set up a specific law for the coast: Law No. 02-02 for the protection and enhancement of the coastline. This work is the result of a collaboration between the National High School of marine science and Coastal management (ENSSMAL) and the National commissionership for the Coast (CNL), which is responsible for the conservation and management of coastal areas in Algeria. This work has been done in the framework for the refinancing by the french fund for the environment.
First, an overview has been established of the implementation of the Coastal Law in the *wilaya* of Algiers, by using a range of indicators related to land uses, the urbanisation and other parameters. After that, a list of the major achievements made since the implementation of this law and offenses being committed has been elaborated in the local communities of Algiers.

Keywords: coastal law, indicators, urbanisation, pollution, GIS

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E-259

Management and development of Protected Marine Areas example: Taza National Park, Jijel

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In the eighties, the Algerian authorities have established a legal framework to develop, manage and conserve the environment and natural resources. In this process, several protected areas have been created, among them; the National Park of Taza (PNTaza). Actually, the managers of the Park are working on the classification of the adjacent marine zone as a marine protected area (MPA).

The establishment of this MPA is part « of the strategic partnership for major ecosystems of the Mediterranean for the conservation of marine and coastal biodiversity and development of the network of marine protected areas ». The governance for the management of this area is based on the co-management and involvement of all sectors and stakeholders.

The aim of this study is the development of indicators for each sector this will serve to understand and precise the need for enhancing management and sustainable development of PNTaza, such as fisheries and tourism.

Key words: Sustainable development, Integrated Coastal Zone Management, Gouvernance, Marine Protected Area, National Park of Taza.

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F-94

Balearic Islands boat seine fisheries: the transparent goby fishery an example of co-management

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An important, in economic terms, small-scale fishery in Mallorca uses a special surrounding net which is hauled over sand and mud bottoms at depths down to 40 m inside bays during winter months. The fishery targets transparent goby and as by-catch other two small goby species and juveniles of *Pagellus* spp. similar fisheries are carried out on the Spanish coast and on Italy. The fishery was managed with specific licenses, gear control and close seasons (related to species availability). In recent years the administration in accordance with the fishers, established a daily quota of 25 kg/day/boat for *Aphia minuta* and 40 kg/day/boat for *Pseudaaphya ferreri*. This quota was based on economic reasons to sustain the sale price of the species. A management plan in 2013 has been set up in accordance to European Union rules with the specific mission of ensuring a sustainable fishery. The quota has been set to 30 kg/day/boat for *A. Minuta* and 50 kg/day/boat for *P. ferreri*. The by-catch could not exceed 10% of total catch. Landings can only be in 11 fixed ports and only 51 boats can operate with the specific net from December 15th to April 30th. A co management committee was created with the participation of the public administration, fishermen's associations, researchers and NGO. The first management phase of a comprehensive study of the fishery and subsequent advice for the refinement of the management plan is under way. A detailed study of the by-catch and of the excess quota survival using slipping is described in the context of an adaptative co-management process. The lessons learned in this first phase are summarized to respond to the requirements of an ecosystem approach to fisheries.

Keywords: W Mediterranean, *Aphia minuta*, fisher's guilds, MINOUW project

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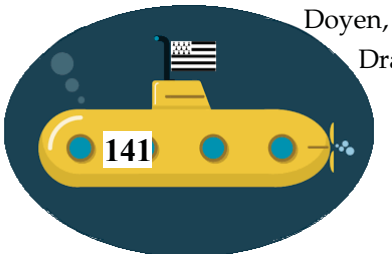

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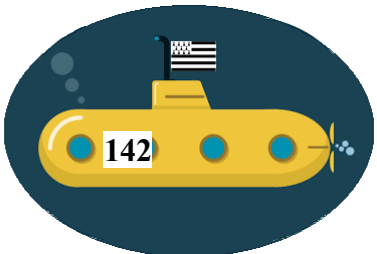

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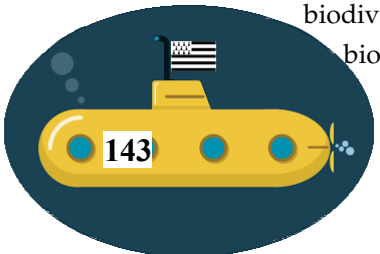

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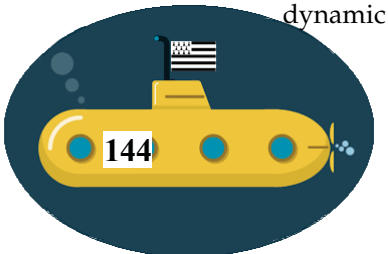

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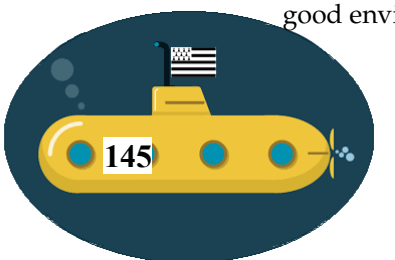

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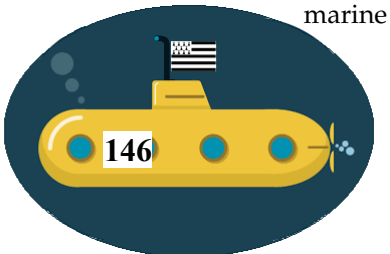

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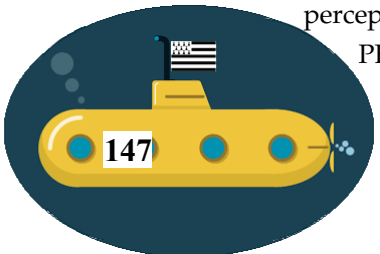

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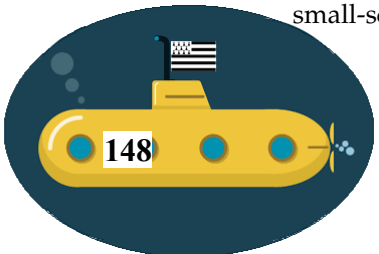

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