BOOK OF ABSTRACT

I. SESSION DESCRIPTION

ID: T6a

Valuing marine ecosystems services in the anthropocene

	Title	Name	Organisation	E-mail
Host:	Prof.	Sebastian Villasante	University of Santiago de Compostela	Sebastian.villasante@usc.es
Co-host(s):		Gregorry Verutes	University of Santiago de Compostela	

Abstract:

Global oceans provide a wealth of ecosystem services (ES) and benefits such as food from capture fisheries, aquaculture and wild foods. Despite international commitments, the vast majority of the world's nations declared that human actions were dismantling the Earth's ecosystems at an alarming rate, crossing safe planetary boundaries. In fact, Humanity has entered the Anthropocene era, with human activity a major driving force behind many environmental changes on the planet.

It is difficult to manage ocean and coastal ecosystems and to deal with the effects of climate change without better incorporating the ES and natural capital value and importance of marine and coastal ecosystems into policy and decision making. Focusing on sustainability means that we also take into account the potential for marine ecosystems to provide sustained benefits in the future. By evaluating the impacts of human activity on ES and their social and economic consequences we can highlight the trade-offs between actions to reverse the declining states of marine biodiversity and ecosystems, and possible competing economic interests from different sectors (e.g., commercal and recreational fisheries, aquaculture, coastal tourism, etc.).

Goods and benefits are from ES obtained that improve human welfare and wellbeing, and hence from which value can be derived. Marine and coastal ES can be valued in quantitative

terms using metrics such as monetary value or health value or in qualitative terms, which will always be non-monetary and usually have some consideration of health, socio-cultural or conservation value. A whole array of methods and techniques for ecosystem valuation exist but are only occasionally implemented in policy decisions.

With this session we want to provide a platform for sharing research on the role of coastal and marine ecosystems in providing wealth and health to humans. We welcome all contributions that shed light on marine and coastal economic and socio-cultural benefits, that cover topics on -but not limited to-:

- Better understanding of the co-production processes of marine and coastal ES,
- Know the ecological, economic and social factors which undermine *supply* and *demand* of marine and coastal ES across the seascape,
- Provide empirical evidence of marine and coastal ES by using pluralistic (including monetary and non-monetary) methods,
- Identify critical thresholds and tipping points related to marine and coastal ES changes and their associated social transformations of beneficiaries and/or actors (e.g., fishers, enterprises, institutions, etc.),
- Improvement modelling approaches and valuation methods to support ecosystem valuation and decision making.

The discussion will host presentations of members of both ICES and ESP working groups and will be followed by an open discussion on the key points discussed, facilitated by the hosts. The panel discussion is a joint effort of the Future Earth, the Euro Marine Science Network, the ICES Strategic Initiative on the Human Dimension and the Working Group on Economic & Monetary Valuation of the Ecosystem Services Partnership (ESP) with the objective to bring together these scientific groups. To achieve this, the session collects interdisciplinary research linking valuation of marine ES and policies to create successful seeds to navigate into the *Anthropocene*.

Goals and objectives of the session:

The objective of the session is to bring together researchers, who have an interest in a wide range of benefits (namely wealth and health) of coastal and marine ES globally. We aim at stimulating the exchange of ideas and knowledge and the establishment of regular cooperation, networks and research collaboration promoted by the ESP.

Planned output / Deliverables:

Scientific knowledge on research activities is to be shared, including information on available initiatives, projects, case studies, databases, models, valuation methods, and institutional and policy analysis. The results will be shared through the groups and networks involved in the

session and be further disseminated by members who will not able to attend (e.g., the ICES Strategic Initiative on the Human Dimension, Future Earth, etc.). A positioning paper will be discussed to publish in Science or Nature, and a Special Issue "Valuing marine ecosystems services in the Anthropocene" on the benefits of coastal and marine ES related to the wealth and health will be considered.

Related to ESP Working Group/National Network:

Thematic working group: TWG 6 – Integrated valuation of ES

II. SESSION PROGRAM

Date of session: Tuesday, 22 October 2019
Time of session: 10:30 – 18:00

Timetable speakers

Time	First name	Surname	Organization	Title of presentation
10:30-10:45	Kamaljit K	Sangha	Charles Darwin University	A state-wide economic assessment of coastal and marine ecosystem services to inform sustainable development policies in the Northern Territory, Australia
10:45-11:00	Anna	Phelan	University of Queensland	The confinement of the socio-ecological poverty trap for small-scale fishers; A case study from Indonesia, is there room for escape?
11:00-11:15	Margrethe	Aanesen	UiT Arctic University of Norway	Uncertain info – uncertain answers? How does uncertain information affect responses in choice experiments conducted as valuation workshops?
11:15-11:30	Marianne	Falardeau	McGill University	The Arctic Ocean in the Anthropocene: Linking changes in marine food webs, to ecosystem services and human well-being in the Canadian High Arctic
11:30-11:45	Serena	Zunino	OGS	Impacts of marine acidification on the ecosystem functions and services provided by coralligenous reefs and seagrass systems

Time	First name	Surname	Organization	Title of presentation
11:45-12:00	Liisa	Saikkonen	University of Helsinki	How the trade-off among ecosystem services affects the value of natural capital? Valuing marine ecosystem with multiple ecosystem services
13:30-13:45	David	Castilla-Espino	University of Huelva	Characterizing and valuing intangible cultural heritage related to fisheries in the EU Atlantic Arc
13:45-14:00	Claire	Shellem	King Abdullah University of Science and Technology	Linking fisheries revenues to coral reef health in the Red Sea
14:00-14:15	Ana	Lillebo	CESAM, University of Aveiro	A spatial explicit vulnerability assessment for a coastal socio-ecological Natura 2000 site to provide ecosystem services
14:15-14:30	Julidi	Ahi	UiT The Arctic University of Norway	Arctic coastal cod: The preferences for different uses
14:30-14:45	Adrien	Comte	CIRED - AgroParisTech	The ecological debt to maintain marine ecosystems: a promising economic valuation approach to inform policy
14:45-15:00	Rachel	Carrie	University of Leeds	Understanding Social and Spatial Differences in the Perspectives Held by Coastal Communities about Mangrove Ecosystem Services and Benefits
16:30-16:45	Fernanda	Cid	Scientific and Technological Bioresource Nucleus (BIOREN), Universidad de la Frontera, Chile., Germany	Assessment of coastal and marine ecosystem services in the Ascención Island in Southern Chile: tools toward sustainable management of natural resources

Time	First name	Surname	Organization	Title of presentation
16:45-17:00	Arantza	Murillas-Maza	AZTI	Linking Natural Capital to maritime activities via Ecosystem Services: a decision-making tool based on a Bayesian Belief Network approach
17:00-17:15	Yuqiao	Huang	Tsinghua University	The Ecosystem Service Comprehensive Index: A world premiere application in the Northern Mozambique Channel region
17:15-17:30	Arantza	Murillas-Maza	AZTI	Improving knowledge on the link that exists between diadromous fish and the total benefits gained through identifying ecosystem services provided in EU Atlantic river ecosystems
17:30-18:00				Discussion

III. ABSTRACTS

The abstracts appear in alphabetic order based on the last name of the first author. The first author is the presenting author unless indicated otherwise.

1. *Type of submission:* ***Abstract***

T. Thematic Working Group sessions: T6a Valuing marine ecosystems services in the anthropocene

Uncertain info – uncertain answers? How does uncertain information affect responses in choice experiments conducted as valuation workshops?

First author: Margrethe Aanesen

Other author(s): Claire Armstrong, Vera Hausner, Reinhold Fieler, Trude Borch, Ståle Navrud, Henrik Lindhjem, Gorm Kipperberg

Affiliation: UiT Arctic University of Norway, Norway

Contact: margrethe.aanesen@uit.no

Stated preferences methods are widely applied to value ecosystem services. Often, human activities have negative impacts on the provision of various ecosystem services, but the relationship between the activities and the impacts are uncertain. The most prominent example of uncertain environmental effects of human activities is climate change effects. Another example is the impacts on marine resources and habitats of aquaculture activities. To explore possible effects of uncertainty about environmental impacts from human activities we set up a split sample survey among inhabitants in Arctic Norway. Half of the survey participants received "certain" information regarding the effects of aquaculture expansions on marine resources and habitats, whereas the other half got "uncertain" information. Our results show that there is significant variations in stated preferences for a set of attribute across the two samples. Moreover, the two samples also make their choices with various consistency, where the participants receiving "certain" information made significantly more consistent choices compared to participants receiving "uncertain" information. Our results indicate that people are sensitive to the precision with which survey information is presented and that more uncertain information regarding the good under consideration tend to produce lower willingness-to-pay estimates.

Keywords: choice experiment, valuation workshop, information provision, aquaculture expansion, Arctic Norway

2. *Type of submission:* ***Abstract***

T. Thematic Working Group sessions: T6a Valuing marine ecosystems services in the anthropocene

Arctic coastal cod: The preferences for different uses

First author: Julide Ceren Ahi
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Coastal cod stocks in the Arctic Norway have been in a declining trend in the recent decades, which results in an intensified competition among different stakeholders. The stock is primarily utilized by the commercial fishermen as a provisioning ecosystem service (ES), however it is also vital for the local recreational anglers and the expanding industry of marine fishing tourism. While the commercial fisheries are managed under a strict system, the recreational fishermen and the tourists remain less monitored, further contributing to the stakeholder competition in the region. In this study, we elicit the preferences of the Arctic Norway residents regarding the use of the given ES by different groups and quantify the monetary benefits associated with them by applying an online discrete choice experiment. The attributes of the choice experiment consist of spawning coastal cod biomass, coastal fishermen quotas, catch of recreational fishermen, economic contributions of marine fishing tourism, regulation of non-commercial fishing and cost. Hence, the preliminary results are to reflect the local population's trade-off between the use of coastal cod by different groups and conservation of the stock for a sustainable fishery.

Keywords: ecosystem services, valuation, choice modeling, coastal cod, fishery regulation

3. *Type of submission:* ***Abstract***

T. Thematic Working Group sessions: T6a Valuing marine ecosystems services in the anthropocene

Understanding Social and Spatial Differences in the Perspectives Held by Coastal Communities about Mangrove Ecosystem Services and Benefits

First author: Rachael Carrie

Other author(s): Claire Quinn, Lindsay Stringer, Quang Hong, Nguyen Hue Van Thi, Le Nga Pham Thi, Than Tan Van, Dao Chris Hackney

Affiliation: Sustainability Research Institute, University of Leeds, United Kingdom

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Mangroves are a vital part of many coastal socio-ecological systems, and are of particular importance to those who rely directly on the ecosystem services they provide. Change in ecosystem service provision can disproportionately affect those most reliant on associated benefits. Yet, it is not commonplace for beneficiaries' perspectives about the full range of ecosystem services to be assessed. Furthermore, little regard has been paid to the ways in which local-level difference in social characteristics of mangrove socio-ecological systems can influence perspectives. This is problematic because knowledge about, and concerns and priorities associated with mangroves are unlikely to be uniformly held. The purpose of this study was to disaggregate social and spatial perspectives held by coastal household beneficiaries about the importance of mangrove ecosystem services and perceived service providing areas. The objective was to gain insights that could help to: a) improve mangrove stewardship and the legitimacy of decision-making that has consequences for mangrove ecosystem service provision, and b) reduce unequal outcomes resulting from change in the services they provide. We adopted a spatially-explicit mixed-methods approach to work with two communes that formed part of Vietnam's Red River Delta mangrove socio-ecological systems during 2017/8. Twelve ecosystem services were identified during focus groups and transect walks and linked to associated household benefits. Polygons representing locations perceived to provide ecosystem services were drawn by respondents on 1:15,000 scale maps during household surveys, when livelihood data was also gathered. We disaggregated responses and generated disaggregated service heat maps. Preliminary findings indicate specific material and regulating services were of highest relative importance to all groups, were linked most often to multiple benefits including livelihood opportunities, security and health, and that difference exists in perceptions about the places that provide them. Full findings will be presented and discussed during the conference.

Keywords: Socio-ecological systems, Vietnam, GIS, participatory mapping, ecosystem service hotspots

4. *Type of submission:* ***Abstract***

T. Thematic Working Group sessions: T6a Valuing marine ecosystems services in the anthropocene

Assessment of coastal and marine ecosystem services in the Ascención Island in Southern Chile: tools toward sustainable management of natural resources

First author: Fernanda Cid

Other author(s): Enrique Higuera, Karla Locher-Krause

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The increasing anthropogenic impacts on coastal and marine areas have underpinned drastic and rapid changes affecting these ecosystems and the benefits that we obtain from them. These modifications have altered the landscape and seascape composition and configuration, which is the habitat to a diverse range of species. Marine and coastal ecosystems provide crucial benefits to local communities, particularly in the case of vulnerable and isolated areas. This is the case of the Ascensión Island, Las Guaitecas archipelago in Southern Chile, an area with large conflict because of the use of natural resources and its crucial importance for conservation. The coastal ecosystem in this area provides ecosystem services to support local communities together with an intense salmon industry. In addition, the presence of top predators such as big marine mammals, and endemic species, reflects the rich biodiversity of an area identified as a conservation priority. Despite its need for sustainable resources management, no efforts have been conducted yet to evaluate, monitor, and analyze the consequences of these activities and their impact on natural resources. Hence this study intends to analyze the current state of the ecosystems services in the area, to determine the impacts of the different activities on the socioecological systems and develop scenarios to inform the decision-making process. The approach integrates the identification of supply and demands for ecosystem services from the local communities, salmon industry, together with the need to determining special conservation sites. Concerns as aquaculture and its impacts to the benthic fauna and biodiversity together with changes in the physicochemical properties of the water column and sediments close to and bellow salmon cages are taken into account. The research explores the implications of management options for the sustainable development of coastal and marine systems and attempts to improve the understanding of complex interactions within socio-ecological systems.

Keywords: coastal and marine ecosystem services, conservation priority area, salmon industry, socio-ecological systems

5. *Type of submission:* ***Abstract***

T. Thematic Working Group sessions: T6a Valuing marine ecosystems services in the anthropocene

Characterizing and valuing intangible cultural heritage related to fisheries in the EU Atlantic Arc

First author: Juan-José García-del-Hoyo
Other author(s): Celeste Jiménez-de-Madariaga, David Castilla-Espino
Presenting author: David Castilla-Espino
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The valuation marine ecosystem services have been receiving increasing attention in scientific literature during last decades (Costanza et al. 1997, 1998; Toivonen et al. 2004; McVittie and Moran 2010; Wattage et al. 2011; Ressurreição et al. 2011; Börger et al. 2014; Jobstvogt et al. 2014), however most of the research is focused in marketed goods and services and does not consider the part of the total economic value (Pearce y Turner 1990) that is not marketed direct or indirectly (Beaumont et al. 2008; Barnes-Mauthe et al. 2013) like cultural services that are not touristically exploited as part of existence and legacy value of ecosystems and particularly fisheries (Garcia Rodrigues et al. 2017; Jiménez de Madariaga and García del Hoyo 2014, 2019).

Fishing influences the way of life and world view of communities devoted to this activity since their origins. Fishing has become not only a harvesting activity but also a way of living for them as a result of the close interaction between fishing, communities and natural resources. Fishing refers to all facets of culture producing know-how, skills and techniques passed down from one generation to the next. Fishing also involves the creation of devices, gears or tools among other technological products, and catalyzes some other closely related activities; characterizing society as a whole. Cultural Fishing Heritage is fishing societies and the culture of fishing all together.

This paper is aimed at classifying and characterizing intangible fishing cultural heritage according the kind of fishing activity and the exploited natural resources using multivariate analysis; and proposing proper valuation techniques for these elements of cultural heritage according identified common patterns in the Atlantic arc. This paper provides a set of tools to valuate intangible cultural heritage related to fishing accounting for intangible cultural heritage elements specific characteristics.

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

Keywords: Fisheries, Intangible Cultural Heritage, Valuation

6. *Type of submission:* ***Abstract***

T. Thematic Working Group sessions: : T6a Valuing marine ecosystems services in the anthropocene

The ecological debt to maintain marine ecosystems: a promising economic valuation approach to inform policy

First author: Adrien Comte
Other author(s): Harold Levrel, Yann Kervinio, Rémi Mongruel, Pierre Scemama
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The current mainstream approach of environmental accounting to inform the sustainability of an economy relies on estimating a monetary valuation of the loss of benefits coming from ecosystem services erosion. While this work is extremely useful at shining a light on nature's contribution to the well-being of human population and informing policies, it rests on weak sustainability principles since it is possible to substitute a loss of wealth coming from ecosystem degradation by a gain coming from other components of the wealth of nations (such as physical or human capital). In addition, it requires intensive resources to implement such valuation at a broad scale. Another normative perspective can be adopted to inform the ecological debts, resting on a strong sustainability principle which assumes that it is necessary to set and maintain a certain level of ecosystems health. Using accounting principles grounded in the Experimental ecosystem accounting framework of the System of environmental-economic accounting (SEEA-EEA), we propose a framework to calculate the ecological debt for the French marine ecosystems as the difference between current incurred costs and maintenance and restoration costs necessary to reach a good ecological status as mentioned in the French law and the EU Directives. The feasibility of calculating such an ecological debt is discussed, using the Marine Strategy Framework Directive as a practical case study. We discuss how this information can complement the mainstream valuation of ecosystem services and be useful for decision-making at the national scale.

Keywords: ecosystem accounting, ecological debt, sustainability, economic valuation, cost of degradation

7. *Type of submission:* ***Abstract***

T. Thematic Working Group sessions: T6a Valuing marine ecosystems services in the anthropocene

The Arctic Ocean in the Anthropocene: Linking changes in marine food webs, to ecosystem services and human well-being in the Canadian High Arctic

First author: Marianne Falardeau
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Climate change is more rapid in the Arctic than anywhere else on the planet, where one of its impacts is on Arctic marine food webs. These changing food webs can, in turn, alter the supply of marine ecosystem services (ES), including food provision, biological control of pests, and opportunities for cultural engagement with the seascape. We assessed changes in an Arctic marine food web of the Canadian High Arctic from 1987 to 2016, and the potential implications—present and future—of these changes for marine ES and human well-being. We give special attention to the linkages of Arctic char fisheries with the marine food web, as these fisheries play a critical role in supporting human well-being in the region's coastal communities, where most population is Inuit. We used mixed methods including quantitative analysis of food web tracers (δ13C and δ15N), interviews and surveys with Indigenous and local knowledge holders, and participatory scenario planning to look into both present and future social-ecological changes. We detected important alterations in the food web, including a shift in the Arctic char's ecological niche from sea ice/benthic to pelagic marine habitats (average δ13C shifting from -21.8 in the 1990s to -23.2 in the 2010s) that aligns with earlier sea ice break-up ($p<0.001$), and the invasions of species from the Pacific Ocean. In the short-term, these changes have led to increased harvesting opportunities. However, the long-term implications are highly uncertain and could be both positive, or negative, depending on the ES; for instance, climate change might lead to increased fisheries productivity, while it could also impair Arctic marine mammals that rely on sea ice. This research sheds light on the ways changing marine food webs can affect ES provision in the rapidly changing Arctic while advancing methods to study marine ES in an Arctic Indigenous context.

Keywords: Arctic social-ecological system; Marine ecosystem services; Climate change; Knowledge co-production; Indigenous and local knowledge

8. Type of submission: ***Abstract***

T. Thematic Working Group sessions: T6a Valuing marine ecosystems services in the anthropocene

Ecosystem Service Comprehensive Index: A world premiere application in the Northern Mozambique Channel region

First author: Yuqiao Huang

Other author(s): Andrea Ghermandi, Camilla Knudsen, Can Wang, David Obura, Paulo A.L.D., Nunes

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The Northern Mozambique Channel (NMC), with its prominent natural resources in terrestrial and marine biodiversity, is faced with a strong and urgent need to achieve poverty reduction and sustainable livelihoods without compromising natural resource conservation. A proper sustainable management system is required under such socio-economic pressures for the coastal livelihoods in the area. This paper assesses the performance of key coastal and marine ecosystem services in the region through a purposely developed Ecosystem Service Comprehensive Index. The index is constructed using a multi-criteria analysis framework, in which economic valuation and geospatial analysis are combined to estimate the economic value of six components across three ecosystem service dimensions: cultural services (coastal tourism and coastal recreation), provisioning services (fisheries and mariculture) and regulating services (carbon sequestration and coastal shoreline protection). The paper analyzes the index scores at three distinct levels. At the NMC regional level, the Ecosystem Service Comprehensive Index is calculated with variance and irregularities among the selected dimensions and underlying components. For example, within the provisioning service dimension, fishery obtains the highest score for the region while mariculture scores the lowest. At the national level, the paper identifies strengths and weaknesses among ES categories for each country and in comparison with its peers. For example, Madagascar shows high scores across the three service categories while scores are relatively low for Mozambique. At the individual ES level, the paper investigates the general performance of ES categories and components using the region mapping. Provisioning and cultural services obtain the highest scores in the NMC region primarily due to fishery and tourism. Finally, the paper provides suggestions to decision makers and stakeholders for the sustainable development of ecosystem services based on the component performance diversity in different areas, so as to support investment in coastal and marine ecosystem services in the region.

Keywords: Marine ecosystem services; comprehensive index; multi-variant analysis; Northern Mozambique Channel; ecosystem service mapping

9. *Type of submission:* ***Abstract***

T. Thematic Working Group sessions: T6a Valuing marine ecosystems services in the anthropocene

How the trade-off among ecosystem services affects the value of natural capital? Valuing marine ecosystem with multiple ecosystem services

First author: Tin-Yu Lai
Other author(s): Liisa Saikkonen
Presenting author: Liisa Saikkonen
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Valuing marine natural capital requires the consideration of multiple ecosystem services, which may conflict or have synergistic effects on each other. This study assesses the value of marine natural capital including the present and future value of herring and salmon provisioning services to commercial fisheries, and the cultural value of recreational salmon fishing and seal protection/watching in the Northern Baltic Sea. The ecosystem services for commercial fisheries conflict with the cultural services since grey seals are the predators of salmon and herring. In addition, less salmon harvested from commercial fisheries or eaten by grey seals at sea makes more salmon available for recreational fishing. Since the value of natural capital depends on its potential to provide ecosystem services in the future, we use a multispecies bio-economic model to take into account the conflicts between different ecosystem services in the valuation of natural capital. To estimate the value of marine ecosystem assets, we apply different natural capital valuation methods such as the approximation approach by Fenichel et al. (2018). These valuation methods and their results will be examined if and to what extent they align with the System of Environmental-Economic Accounting – Experimental Ecosystem Accounting (SEEA-EEA). The research is a pilot study to: (1) extend the approximation approach by Fenichel et al. (2018) to cultural and non-market ecosystem services; (2) compare different asset valuation methods for an asset with both provisioning and cultural ecosystem services; and (3) test the coherence of these methods to the SEEA-EEA standard.

Reference: Fenichel, E. P., Abbott, J. K., & Do Yun, S. (2018). The nature of natural capital and ecosystem income. In Handbook of Environmental Economics (Vol. 4, pp. 85-142). Elsevier.

Keywords: marine natural capital, ecosystem valuation, ecosystem accounting, multispecies bio-economic model, non-market ecosystem services

10. Type of submission: ***Abstract***

T. Thematic Working Group sessions: T6a Valuing marine ecosystems services in the anthropocene

Improving knowledge on the link that exists between diadromous fish and the total benefits gained through identifying ecosystem services provided in EU Atlantic river ecosystems

First author: Arantza Murillas-Maza
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The EU Atlantic Area´s (AA´s) rivers provide numerous benefits to the society known as ecosystem services (ESs). This AA´s rivers support diadromous fish populations which are valued for use and non-use aims. First in this research, developed under the framework of the INTERREG Atlantic Area DiadES Project, ESs linked to diadromous fish are identified by considering a set of case studies across the AA (from Gipuzkoa rivers in Spain, Loire and Mondego rivers in France and Portugal, to Rivers Tamar, Frome & Taff in UK) for which, DiadES will address fishing activities as provisioning services, nutrient exchanges between coastal and inland habitats as regulating services, recreational fishing and tourism as linked to the societal interest for diadromous fish and thus to cultural services, which also relate to several gastronomic festivals and Knowledge systems (environmental education). Secondly, as river systems provide other general services, this research also identifies potential trade-offs among services from fish and non-fish activities (i.e. flood control; electricity production; agriculture (pollution); sand extraction. Finally, a common standardised assessment framework for selected ESs is provided and will be used to define ES trajectories in the context of climate change.

Keywords: river ecosystems, diadromous fish, Atlantic Area, ecosystem services, assessment framework

11. Type of submission: ***Abstract***

T. Thematic Working Group sessions: T6a Valuing marine ecosystems services in the anthropocene

Linking Natural Capital to maritime activities via Ecosystem Services: a decision-making tool based on a Bayesian Belief Network approach

First author: Ibon Galparsolo
Other author(s): Jordan Gacutan
Presenting author: Arantza Murillas-Maza
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Economic activities are reliant on natural capital (NC), which are responsible for the provision of 'Ecosystem Services' (ES). Understanding the dependency of activities to specific NC provides insight into the capacity of an ecosystem to maintain and develop such activities. To determine NC dependencies, we link NC to maritime activities via ES, using a spatially explicit Bayesian Belief Network (BBN). Using the Basque coast (SE Bay of Biscay), the model links the supply of ES from NC components to its utilisation by four maritime activities (artisanal fishing, benthic trawling, mussel aquaculture and marine tourism). This research provide knowledge on the different habitats and biological components, together with the economic factors which undermine supply and demand of marine ES across the Basque coast. Building on previous BBN a tool for improving the integration of such supply and demand of marine ES in decision-making have been developed with the final aim of supporting policy-makers under a context of ecosystem-based spatial planning. For instance, it might allow for blue growth scenario generation and therefore, the potential assessment of socio-economic consequences of management decisions, among others.

Keywords: coastal and marine ecosystem services, marine spatial planning, Blue Growth, tool, policy-making

12. Type of submission: ***Abstract***

T. Thematic Working Group sessions: T6a Valuing marine ecosystems services in the anthropocene

The confinement of the socio-ecological poverty trap for small-scale fishers; A case study from Indonesia, is there room for escape?

First author: Anna (Anya) Phelan
Other author(s): Clement Tisdell, Russel Richards
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Small scale fisheries directly or indirectly maintain livelihoods of millions of people living in coastal communities in Indonesia. Previous research has shown that small-scale primary producers receive the lowest economic benefits relative to other value chain actors. The tragedy of the commons phenomenon along with pervasive socio-economic challenges are often linked to overfishing, destructive fishing practices, and broken supply chains. We use the Ecosystem Services approach to examines the poverty-trade dynamics of small scale fisheries in Sumbawa, Indonesia, and whether a commercially sponsored, long-term asset creation approach from a foreign direct investment company can help improve benefit distribution for small-scale fishers. This case study examines the complex interplay between commercially sponsored fisheries management, pressures on marine ecosystems, and the socio-cultural and institutional dynamics contributing to the downward spiralling effect of the socio-ecological trap confining many small-scale fishers.

Keywords: Small-scale fisheries, distribution of benefits, supply chain, social-ecological systems, integrated fisheries management

13. Type of submission: ***Abstract***

T. Thematic Working Group sessions: T6a Valuing marine ecosystems services in the anthropocene

A state-wide economic assessment of coastal and marine ecosystem services to inform sustainable development policies in the Northern Territory, Australia

First author: Kamaljit K Sangha
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Affiliation: Charles Darwin University, Australia
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This paper offers a state-wide assessment of coastal and marine ecosystems services (ES), including Indigenous perspectives, in the Northern Territory (NT) of Australia, to inform policy developments in the region. An economic impact of AUD 1.3 billion/yr and additional economic contribution to the NT economy of AUD 1.4 billion/yr was estimated for the selected key services, in addition to affording >6,000 jobs. The selected ES include: provisioning—commercial fisheries, and pearl and crocodile cultivation; regulating and maintenance—blue carbon, storm protection and erosion control, and genepool protection; cultural—recreational fishing, tourism, amenity and other non-fishing recreational, and Indigenous cultural values, which were evaluated applying a mix of market and non-market valuation tools. A simple framework of measuring each ES both for its 'Economic Impact'—direct and indirect market value (i.e. reflection in GDP), and 'Economic Value'—market and non-market values for their contributions to the broader NT economy (i.e. human well-being), was applied. Due to methodological limitations, Indigenous cultural values were partially measured using a substitute value for 25% of government Indigenous expenditure on four welfare sectors that relate to benefits people obtain from their coastal and marine resources. It advocates for payments for ES (PES) mechanisms to support equitable enterprises involving Indigenous communities. Overall, this economic assessment of the NT coastal and marine resources presents integrated information to initiate a dialogue on alternative and sustainable development options in the region, and can help in addressing similar development issues occurring in many parts across the globe.

Keywords: Ecosystem Services, Coastal and Marine resources, Indigenous well-being, Value of ecosystem services, Economic assessment

14. Type of submission: ***Abstract***

T. Thematic Working Group sessions: T6a Valuing marine ecosystems services in the anthropocene

Linking fisheries revenues to coral reef health in the Red Sea

First author: Claire Shellem
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Red Sea coral reefs are recognized as having high levels of biodiversity and endemism yet there is a significant lack of ecosystem service (ES) assessments for the region. Based on global case studies of 16 biomes, coral reefs were estimated as having the highest value of ecosystem service delivery in monetary units ($352,915/ha/yr); much of that value comes from the benefits of fisheries, reef associated tourism, and coastal protection. The Saudi Arabian region of the Red Sea is unique because currently there is very limited international tourism, thus a primary ES benefit on coral reefs is generated from small-scale artisanal fisheries which account for 74% of the total catch in the Kingdom. However, Saudi Arabian fisheries are experiencing increasing pressures from overfishing and habitat degradation with associated economic and social consequences. Notably a mass bleaching event occurred in the Farasan Banks, in the Southern Red Sea in 2015, causing up to 90% coral mortality in some areas. Based on reef surveys conducted before and after the bleaching event, the level of coral mortality and recovery varies greatly throughout the region. Our study therefore aims to assess fisheries revenue generated by healthy reefs compared to degraded reefs. Many studies have linked benthic reef state to fish community composition, we further link those fish communities to fisheries revenues. We combine in-situ fish community data, species specific prices from local fish markets and questionnaire responses from local fishermen to assess the changes in fisheries revenue in the region. Our results provide initial fisheries valuation information which can inform the implementation of effective fishing regulations and sustainable coral reef management plans in the region.

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T. Thematic Working Group sessions: T6a Valuing marine ecosystems services in the anthropocene

Impacts of marine acidification on the ecosystem functions and services provided by coralligenous reefs and seagrass systems

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Global changes are major perturbation sources for ecosystem functioning, influencing ecosystem services (ES) in marine ecosystems. Along with warming, oceans are also experiencing the impacts of water acidification due to the increased dissolution of CO2 in the seas, which alters the carbonate chemistry and lowers the pH of the seawater. This process, known as ocean acidification (OA), could have large implications on many marine ecosystems sustained by habitat-forming species and their related ES, with potentially significant impacts on human well-being. Assessing the impacts of OA on structured ecosystems and on ES is a challenging task that requires synthesis and knowledge integration at the ecosystem scale. So far, studies and reviews mainly focused on physiological responses of marine species to the OA. Here we provide an assessment of direct and indirect impacts of OA on ES provided by Posidonia oceanica meadows and coralligenous reefs, which are two endemic ecosystems of the Mediterranean Sea. The changes in the functioning of coralligenous reefs and P.oceanica meadows promoted by OA were investigated by i) synthesizing current knowledge into conceptual models. The models were then used to, ii) assessing the impacts of exposure of the selected taxa at the acidification level associated with two CO2 emission scenarios and iii) using the conceptual model outputs to project the cascading impacts from individuals to functions to ES. The synthesis and integration of a large but fragmented amount of information highlight that the OA will alter many functions of both coralligenous and P.oceanica systems triggering habitat modifications and the loss of highly valuable ES. The combination of the direct and indirect effects of OA enabled us to provide a qualitative and sometime semi-quantitative assessment of the impacts even if the exact timing of the expected changes will depend on the severity of the emission scenarios.

Keywords: Marine Ecosystem services, Ocean acidification, Posidonia oceanica, Coralligenous, Conceptual models

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A spatial explicit vulnerability assessment for a coastal socio-ecological Natura 2000 site to provide ecosystem services

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Climate change and human activities are affecting the way habitats provide ecosystem services (ES) and support human well-being. These impacts are especially apparent in coastal areas where sectors with different economic interests depend on benefits from the ocean. The Natura 2000 site Ria de Aveiro (Portugal) is a coastal territory of paramount importance due to its variety of ES and biodiversity, which has enabled a socio-economic development in the area (e.g. harbor activities, aquaculture, tourism). The overlap in space and time of the anthropogenic pressures, namely land and water uses, and natural areas, make this area complex in terms of environmental management. In this context, Ecosystem Based Management (EBM) aims to balance both, the natural capital and human well-being. The main objective of our work is to promote EBM using the InVEST (Integrated Valuation of Ecosystem Services and Trade-offs) toolbox, with Ria de Aveiro as case study. The risk of a set of coastal habitats posed by human activities (i.e. stressors) were mapped and measured with the InVEST Habitat Risk Assessment (HRA) model. The model inputs include spatial datasets of habitats with the EUNIS classification. In addition, ES layers were obtained from expert elicitation and model validation by stakeholders through participatory GIS (Geographical Information Systems) processes. Finally, a set of defined criteria (e.g. intensity, duration, habitats ability to recover) were scored to obtain the potential of these habitats to deliver ES.
The resulting maps of the habitats' vulnerability enable the prioritization of natural capital

stocks depending on their adaptability to the stressor, availability in the system and capacity to provide ES. This approach allow decision-makers and managers to establish the appropriate scales to implement the policies (e.g. Habitats Directive-Natura 2000 framework, Water Framework Directive) in the complex Ria de Aveiro site.

Keywords: Ria de Aveiro, InVEST, EBM