

ICES SCIENCE FUND REPORT

“Social Transformation of marine social-ecological systems”

Research team: Sebastian Villasante¹, Olivier Guyader², Cristina Pita³, Katia Frangoudes², Gonzalo Macho⁴, Ana Moreno⁵, Graham Pierce⁶, Begoña Santos⁷, Bibiana Garcia⁸, Olivier Thébaud²

¹University of Santiago de Compostela, Spain. Email: sebastian.villasante@usc.es

²IFREMER, France. Email: oguyader@ifremer.fr

³University of Aveiro, Portugal

⁴University of Vigo, Spain

⁵Instituto Português do Mar e da Atmosfera, Portugal

⁶CSIC-IIM, Vigo, Spain

⁷Spanish Institute of Oceanography, Vigo, Spain

⁸Cooperativa de Armadores de Vigo, Spain

Background

Research on marine social-ecological systems (SES) and sustainability goes with calls for deep social change (Steffen et al. 2015). Resilience is the ability of socio-ecological systems to cope with and adapt to change (Folke et al. 2002). Resilient systems are adaptable, flexible, and prepared for change and uncertainty (Hughes et al. 2005). Most of the research done on MSEs was focused on the transformations of the marine ecosystems and their ecological functions (Folke et al. 2011). It is almost impossible to address today's great challenges in global marine change and sustainability without a better understanding of how real and enduring social transformation comes about and how it can be initiated, promoted or (re)directed.

Although there is general agreement that understanding where and how humans use oceans is an essential component of marine resource planning and management (Chapin et al. 2011), knowledge on the social transformations is still largely unknown and unexplored (Villasante and Österblom, 2015). This project goes beyond the state of the art by proposing to expand the research towards the social transformations of marine SES.

Aims

The general objective of this project is to investigate the social transformations of MSE systems. This will be done by investigating global cases of social transformation and the reasons for such transformation and a detailed study of key case studies in Europe.

The specific objectives of project are:

- a) Investigate what are the type and magnitude of the social transformation experienced by these relevant MSE systems and, what type of (un)predictable changes are currently driving these transformations,

- b) Reconstruct social transformations to investigate how natural capital, institutions and the fishers' organizations responded to ecological, economic and institutional drivers and changes during the last decade.

In order to address each of these objectives, we used two methodological approaches. First, we have developed a systematic literature review to collect all available information about social transformations.

This report presents main preliminary findings achieved during the development of the tasks proposed in the project. The work will continue with further refinement of these results and description of social transformations during the year 2017.

Methods applied

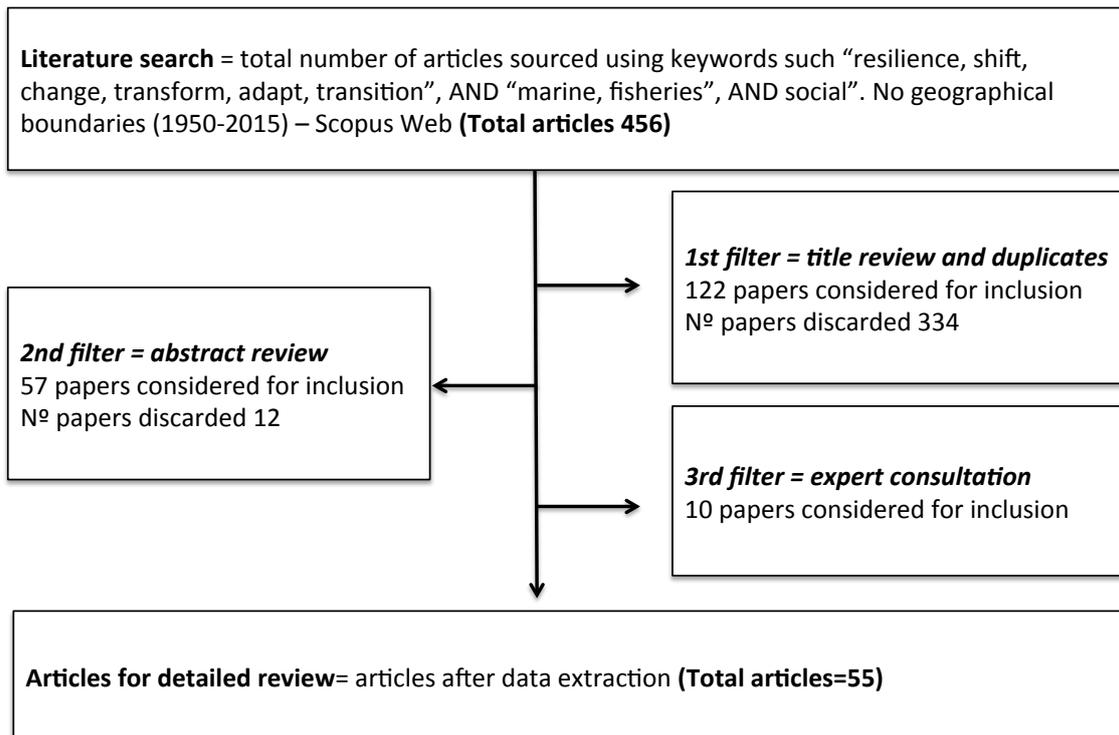
Literature review

To date there has been no systematic review of the social transformation of marine SES globally. Such a review serves as a decision-making framework for determining which critical factors may have greater impacts in achieving integrated understanding of marine ecosystems from an interdisciplinary perspective. The literature review included peer-reviewed literature to identify studies documenting the large social transformations and key factors explaining them. This analysis will enable us to know the previous and current status of the marine SES after the occurrence of the large social transformation as well as to develop the content of the questionnaire for the expert consultation.

Systematic reviews are standardised guidelines for the search and reviews of scientific studies and for the recording of the results that is guided by explicitly structured research techniques. This approach was followed here to investigate whether or not social adaptation, changes and transformations have been addressed by the scientific community. The systematic review has been also done to identify what are the key drivers and impacts which are documented and usually lead to social transformations in the marine arena. The process of sourcing and selection of studies for detailed review is summarised in Figure 1.

We searched for scientific papers published between 1950-2015 period in the Web of Scopus, by using the following criteria: "resilience", OR "shift", OR "change", OR "transform", OR "adapt", OR "transition", AND "marine", OR fisheries", AND "social". No geographical boundaries were stated in the selection criteria as preliminary test. Searches included all articles published until our cut-off date of 31 December 2015. These articles were then filtered at three different stages of detail, each filter excluding studies which are not related to the key words used in the search. A total of 456 articles were sourced from peer-reviewed literature and as a consequence of the filters and selection criteria employed and described above, 122 articles were reviewed fully in detail.

Figure 1. Schematic representation of the systematic literature review



Of these, 60 articles were used for data extraction and 56 were finally included in the analysis which explicitly addressed the topic of social transformation. We found a considerable asymmetry in the number of studies available for the fisheries sector. The findings were also grouped according whether or not the studies effectively addressed the topic of social changes or transformations in each reviewed paper.

Before starting the data collection, we carried out a ‘calibration’ exercise to attain a uniform data collection procedure among co-authors. This consisted of reviewing a randomly selected publication that had been previously identified for quantitative synthesis. Each co-author assessed this publication individually and subsequently the results were compared against each other. The outcome of the exercise resulted in our template for the data collection process.

Social Transformation Database

We constructed a database with detailed information about the different human dimensions of the oceans and their drivers that have been documented. The database will provide a high-quality, descriptive, open-source information resource for students, lecturers, ecosystem managers and researchers.

The database provides the basis for future inclusions of case studies in order to create a repository of knowledge on this topic. We have extracted from the literature review key information on 20 the most common variables that helped to evaluate whether social transformations could be applied to marine SES (Table 1). Data variables included name of the authors; year of publication; objectives and key words of the papers; scale of the study; type of social transformation; economic sectors affected;

synergies and trade-offs identified; links between habitats, CES, and human wellbeing; countries of case studies; drivers of change affecting ecosystems and their CES; among others.

Table 1. Summary of information of social transformations (ST) extracted from each paper for the literature review.

Field ID	Description
1. Authors	Name of article authors
2. Year	Year of publication
3. Key-words	Selected key words of the paper
4. Objectives	Specify the objectives as in the paper
5. Discipline authors	The main discipline of each author of the paper (e.g., ecology biology economics other (specify))
6. Country affiliation	Country of institutional affiliation of first author
7. Country study	Country(ies) where the case study(ies) took place
8. Type of paper	Empirical conceptual review
9. Social Transformation	Yes Not
10. Type of ST	Restructuring the fisheries sector employment opportunities changes in catches diversification of seafood markets Other (specify).
11. Targeted species	Demersal pelagic crustaceans molluscs other (specify).
12. Economic sectors	Small-scale fisheries industrial fisheries aquaculture canned industry
13. Scale of ST	Local regional national continental global
14. Drivers of ST	Introduction of new regulation change in market demand environmental shifts, etc.
15. Impacts on species	Commercial species habitats ecosystems other (specify).
16. Impacts of human-well being	Food security or Nutrition Income and employment Security of housing and infrastructure Leisure and recreation Cultural heritage Social relations No direct impacts Others (e.g., demography, health, education, etc.).
17. Time scale of ST	Months Year Decades Unknown
18. Reversibility of ST	Irreversible difficult to reverse easy to reverse unknown
19. Sources of evidence	Field work time series models literature references Other (specify)
20. Confidence of evidence	Speculative – Social transformation has been proposed, but little scientific evidence as yet, Contested – Reasonable evidence both for and against the existence of social change,

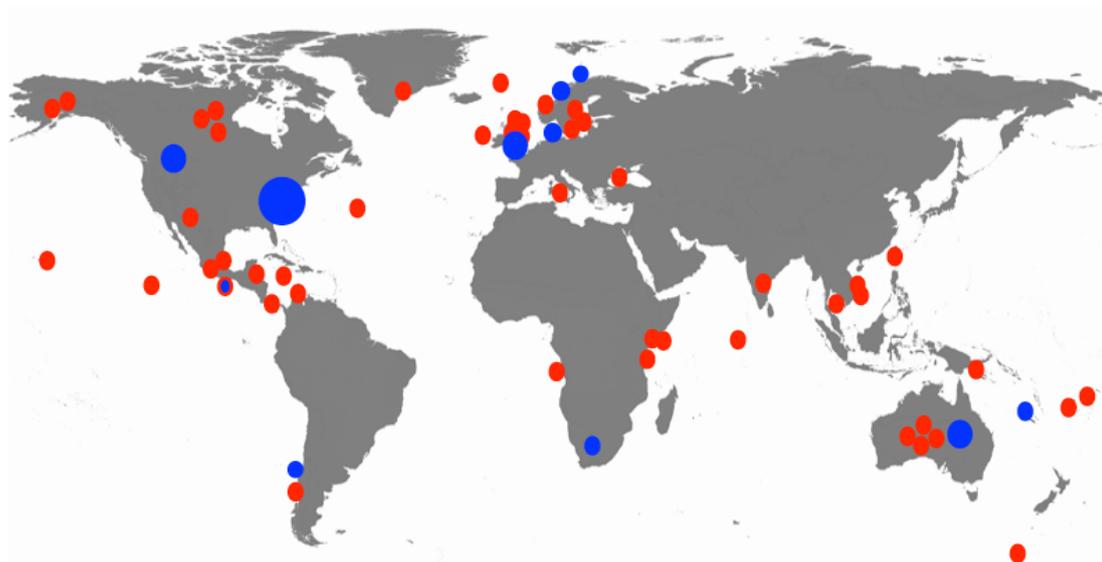
Members of the research team created a template to collect detailed information to provide evidence for the selected case studies included in the project has been gathered by using a template developed by the research team. The detailed content of this template is included in the Supplementary Material of this progress report.

Preliminary results

Literature review

The results of the literature review show that the topic of social adaptation, change and transformation in marine SES attracted little attention for the scientific community in the 1950-2014 period (Figure 2). Figure 2 indicates that these topics started to receive important attention only since the year 2010, when a total 10 papers have been published, while the highest number of papers (15) has been published in 2015. The results obtained from the systematic review indicate that most of the papers are review (42%) or empirical studies (41%), and only a few (17%) of them are conceptual papers.

Figure 2. Global distribution of transformations case studies (in red) and affiliations of first author (blue)



Given the high number of case studies we further explored the spatial scale at which these assessments were carried out. The largest percentage of the case studies was carried out either at local level (39%), followed by global (18%), regional and national scales (8% each). The geographical locations of the topics within the reviewed papers are shown in Figure 2. It is noticeable that while most of the first authors of the published papers comes from the developed world (namely Sweden, United Kingdom

and the USA), the location of the case studies are equally balanced between developed and developing countries.

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

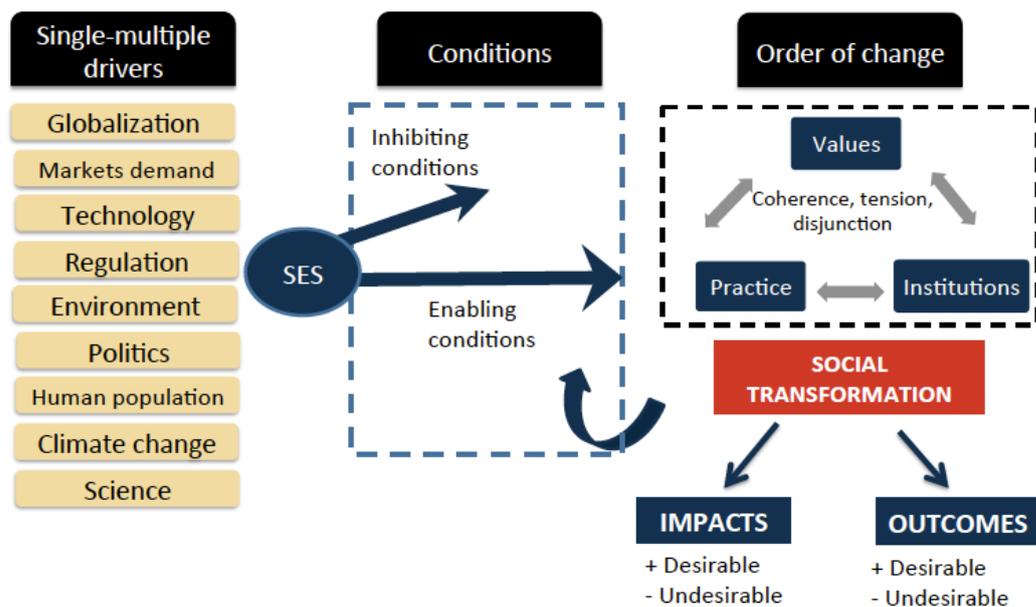
Here we define a social transformation in marine SES as a fundamental and critical change of values, institutions and practices of a social structure at the same time. To analyse the phenomena of social transformations in the marine arena, we examine the following core elements: (1) *values*, which refers to shared ways of living and thinking that include symbols and language (verbal and non-verbal); knowledge and beliefs (what is “good” and “bad”); (2) *institutions*, which contains the diversity of laws, regulations and costumes with competence to adopt decision on marine activities, and (3) *practices*, which includes the changes experienced by different marine activities (e.g., industrial and small-scale fisheries).

As founded in the systematic review, a single or multiple factor can drive a social transformation. The capacity of a SES to minimise or absorb the impact of a single or multiple driver(s) depends on the existence of inhibiting conditions present in it, which usually act as barriers to avoid social transformations. For example, inadequacies associated with using MPAs as a fisheries management tool can also be exacerbated by a failure to successfully manage surrounding fisheries.

However, there are also enabling conditions which facilitate the navigation towards a social transformation. Enabling conditions generally encompass a suite of governance, community and capacity-related factors that can vary over space and time and may influence the degree of success of a particular management intervention. For example, the existence of formal regulations and legal regimes, the need for a high degree of information, and national or municipal governance capacity were identified as key enabling conditions in small-scale fisheries. The schematic representation for the analysis of a transformation in marine SES is described in Figure 3.

In addition, it has been demonstrated that a successful implementation of co-management systems around the world is highly dependent on the leadership of local and well-recognized experts in coastal communities (Gutiérrez et al. 2011). It is important to differentiate the concept of social transformation compared to other related social-ecological concepts such as adaptation (Folke et al. 2010). Adaptation reflects the capacity of a system to adjust its responses to change in external drivers and internal processes. For example, the diversification of harvested species can be an adaptive strategy developed by fishers to deal with the scarcity of fishery resources (Villasante et al. 2013).

Figure 3. Conceptual framework for social transformations in marine social-ecological systems



On the other hand, social transformation means a fundamental and critical shift in the institutional dimension and patterns of practices through time. We argue that social transformation supposes both the change of practices as well as changes in laws, regulations and customs of the social structure. For example, the creation of a new co-management system supposes the change of laws and regulations such as the introduction of a limited entry program (institutional change) and the elaboration of exploitation plans (practices change) developed jointly by the administration and fishers (Macho et al. 2013). Finally, a revolution means a change that is more significant than adaptation or transformation, one that recombines existing elements of a system in radically novel ways of thinking, institutions and practices.

In using these three core elements (values, institutions and practices), we build on previous research that has demonstrated that natural and social capital and their interactions can deliver human well-being and maintain social health of SES (e.g., Chapin et al. 2011). These three elements provide a critical point of linkage between the social systems, and thus, if deliberate social transformations can be expected to alter a linked social system, it is these elements that are likely to be changed.

It is important to highlight that the effects of a social transformation can be positive desirable or undesirable. A desirable impact is usually conceived as a positive contribution for the welfare of people and institutions which depend on marine activities. For example, if the introduction of a co-management system leads to the reduction of poverty and inequality of small-scale fishers by improving the revenues and social benefits that ecosystem services provide. On the other hand, an undesirable impact of a social transformation would be reducing the effectiveness of a management plan if the level of compliance of fisheries laws by the fishing industry is low.

Operationalizing guidelines for social transformations

We argue that a social transformation experienced by marine SES can be triggered by a fundamental and critical change of practices and institutions of the social structure of the system. This change has different drivers and impacts at different time and spatial scales. Given that there is a wide range of drivers and impacts generating social transformations which are often difficult to systematize, we also propose a new guideline which includes a set of seven steps for analysing social transformations of marine SES:

- First, describe the biophysical, social and governance boundaries of the system, which also suppose to clearly define the unit of analysis which is involved in the social transformation (e.g., a metier, a fishing fleet, a coastal community),
- Second, identify “what” (e.g., environmental shock, introduction of a new regulation such as a landing obligation, a MPA, etc.), “who” (e.g., government, fishing industry, a coastal community) drives the process of a social transformation, “why” (e.g., increasing biomass of commercial fisheries, improving compliance and monitoring of fishing activities) and “when” (e.g., year, decade, etc.) the event take place,
- Third, identify and describe the enable and inhibiting conditions which facilitate (or not) the existence of a social transformation in the system,
- Fourth, analyse the relationships (e.g., conflict, tension, disruption) between the practices, institutions and values present in the system,
- Fifth, analyse the type of single or multiple factors (e.g., environmental, economic, institutional, social) driving the transformation, and the fundamental and critical impacts (desirable or undesirable) of drivers, identifying what are the consequences for the different actors (fishers, institutions, coastal communities) of the social structure,
- Sixth, depending on the availability of data, select and validate the most suitable quantitative and/or qualitative with the participation of the main stakeholders affected by the social transformation, and use social indicators to monitor the progress of the social transformation over time, and
- Seventh, design and evaluate (if necessary) alternative strategies and scenarios to successfully navigate into resilient and sustainable trajectories of the social structure.

The new knowledge generated by this project contributes to: a) provide key information about the local dynamics of the marine SES currently unavailable in official databases and reports but with potential global effects on the management of marine SES, b) recognize the spatial and temporal dimensions of social transformations, c) indicate what are the adaptive strategies social actors have been developing over time, d) identify the barriers (if any) that fishers, enterprises and institutions are facing in relation to current social transformations, and f) identify the best plausible management strategies and scenarios in which they could start or continue navigating into resilient and sustainable trajectories.

The Social Transformations DataBase

The Social Transformations Database includes scientific evidence currently unavailable in official statistics and reports related to: a) Identify the main drivers (e.g., stock status, climate change, EU regulations, economic and financial crisis, seafood market changes, etc.) which generated social transformations; b) Analyse the major economic and social consequences of these transformations; c) Examine the adaptive strategies developed by marine social-ecological systems to navigate into successful transformations towards sustainability.

The Social Transformations DataBase provides examples of different types of transformations that have been documented in marine social-ecological systems. The database focuses specifically on fundamental and critical changes that have large impacts on marine SES. It includes several examples to illustrate the diversity of case studies in which the phenomena of social transformations can take place. These examples serve as a basis to better understand the social transformation phenomena and also to extend the use of the conceptual framework presented here for future research. We welcome contributions from the scientific community to add new examples of case studies which experienced social transformations in Europe documented.

Conclusions and further research

The specific objectives of project were 1) to investigate what are the type and magnitude of the social transformation experienced by MSE and, 2) to reconstruct social transformations to investigate how natural capital, institutions and the fishers' organizations responded to ecological, economic and institutional drivers and changes during the last decade.

Both objectives have been fully addressed during the course of the project. Regarding objective 1), we have developed a new conceptual framework to better understand the scale, type and effects of social transformations of MSE by focusing on key economic sectors for the European Union: small-scale fisheries, industrial fisheries, aquaculture and canned industry. The conceptual framework will be used to test the different ST occurred in Europe during the last decades. Preliminary findings showed in this report will be also extended to other sectors included in the Blue Growth Initiative (e.g., coastal tourism, marine biotechnology and ocean energy).

In relation to objective 2), we have developed an innovative tool to collect evidence of ST across Europe by creating a ST database. The database can be used not only by researchers involved within the ICES community, but also from the other researchers, officials from national governments, NGOs and representative from different industries around the world.

Potential global users of the social ST database will have the opportunity to extract useful information from each case study included in the database which will be allocated at the ICES website. By using the case study template included in the Supplementary Material of this report, users of ICES website are also warmly invited to contribute to the further development of the ST database by providing with their own data and case studies for future inclusion. The high potential of the ST database will

provide the users around the world to include the social dimension of marine ecosystems into their integrated ecosystem assessments.

Presentations

Preliminary results of this project were presented at the ICES MSEAS “Understanding marine socio-ecological systems: including the human dimension in Integrated Ecosystem Assessments” hold in Brest (France) in 30 May-3 June 2016:

-Villasante S, Jentoft S, Guyader O, Pita C, Frangoudes K, Garcia B, Macho G, Moreno A, Pierce GP, Santos MB, Ulloa E, Chuenpadgee R, Himes Cornel A, Laurans M, Mongruel R, Pascual- Fernández J, Scemama P, van Holt T, Coll M, Thébaud O (2016a) *A new conceptual framework to understand social transformations of marine social-ecological systems*, ICES Conference Brest (France), June 1st, 2016.

-Villasante S, Jentoft S, Guyader O, Pita C, Frangoudes K, Garcia B, Macho G, Moreno A, Pierce GP, Santos MB, Ulloa E, Chuenpadgee R, Himes Cornel A, Laurans M, Mongruel R, Pascual- Fernández J, Scemama P, van Holt T, Coll M, Thébaud O (2016) *Complex and interconnected drivers in marine socio-ecological systems: evidence of social transformations in European fisheries*, ICES Conference Brest (France), June 1st, 2016.

Activities and results connected to the ICES Science Fund Project

Different activities have been developed during the development of the project. Members of the research team have been co-organized a Workshop “*Social transformations of marine social ecological systems*” hold in Brest (France) 24th-26th February (2016). In addition, the topic of social transformations has been also incorporated into the thematic areas of the *Working Group of Resilience and Marine Ecosystem Services (WGRMES)*, which ensures the development of further activities related to the topic.

Plans for future

The Social Transformations Database will be completed with detailed information from the case studies proposed in the project. Except one case study from Spain (purse seine fishery), all case studies have been completed and will be incorporated into the database.

The final results of the project will be also disseminated through the publication of scientific papers in peer review journal. The research team also plans to organize a Special Issue to be published in a high quality journal with the inclusion of ca. 8-10 papers, including the development of the new theoretical framework to investigate social transformations of marine social-ecological systems as well as the empirical evidence of such transformations by using several case studies.

The social transformation paradigm will increase the use of such knowledge by policy makers, practitioners, the private sector, citizens and activists. To tackle the challenge of developing integrated social-ecological assessments, the development of the instrumental framework presented here will also help to set up the priorities of the

governments that should be directed at the improvement of the knowledge about the social dimensions of the oceans.

Financial overview

The total amount of 4800 EUR (40% of the total funds) has been received from the ICES Science Fund. A total of 4700 EUR was spent on data collection from case studies in Portugal and the United Kingdom, leaving the possibility to use the remaining funds for the rest of case studies and for another meeting at the later stage of the project.

References

- Chapin, F. et al. (2011) *Journal of Environmental Studies and Sciences*, 1: 44-53.
- Folke, C et al. (2011) *Ambio*, 40(7): 719-738.
- Folke, C. et al. (2002) *Ambio*, 31(5): 437-440.
- Gutiérrez, N. et al. (2011) *Nature* 479: 386-389.
- Hughes, T. et al. (2005) *Trends in Ecology and Evolution*, 20(7): 380-386.
- Macho, G. et al. (2013) *Ambio* 42, 1057-1069.
- Steffen, W. et al. (2015) *Science*, 437: 6233.
- Villasante, S. et al. (2016a) A new conceptual framework to understand social transformations of marine social-ecological systems, ICES Conference Brest (France), June 1st, 2016.
- Villasante, S. et al. (2016) Complex and interconnected drivers in marine socio-ecological systems: evidence of social transformations in European fisheries, ICES Conference Brest (France), June 1st, 2016.
- Villasante, S., Österblom, H. (2015) *Ecology and Society* 20(1): 8.
- Villasante, S. et al. (2013) *Ambio* 42, (8): 905-909.

SUPPLEMENTARY MATERIAL

ICES project Social transformations of marine social-ecological systems

Social transformations database

Case study template

GREEN = Free text, paragraph style

BLUE = Free text, brief keywords

RED = Choose from predefined keyword alternatives

BLACK= Optional information

BASIC INFORMATION OF THE CASE STUDY

1. Main Contributors (surname, name, institution and email address)

2. Name of the case study

Short name for the case study (e.g. North sea cod fishery)

3. What is the social transformation is your case study? (Please keep in mind that the transformation might generate desirable (+) or undesirable (-). You can choose more than one option. Add other options in case of necessary for your case study).

- Restructuring the sector: ___
- Employment opportunities: ___
- Changes in catches: ___
- Diversification of seafood markets: ___
- Diversification of fishing grounds: ___
- Migration of people from coastal communities to: ___
- Cultural diversity: ___
- Other (please specify): ___

4. How desirable (+) or undesirable (-) has been the social transformation in your case study?

- Restructuring the sector: Desirable__ Undesirable__ Unknown__
- Employment opportunities: Desirable__ Undesirable__ Unknown__
- Changes in catches: Desirable__ Undesirable__ Unknown__
- Diversification of seafood markets: Desirable__ Undesirable__ Unknown__
- Diversification of fishing grounds: Desirable__ Undesirable__ Unknown__
- Migration of people from coastal communities: Desirable__ Undesirable__ Unknown__
- Cultural diversity: Desirable__ Undesirable__ Unknown__

- Other (please specify):__

5. What region is the case study located in?

6. What country is the case study located in?

7. What ecosystems are located in the case study area?

- Marine
- Coastal
- Freshwater systems
- Other (please specify):_____

8. What species do fishers/aquaculture farmers/canned enterprises target in your case study?

- Fishes
Demersal (e.g., hake, cod and haddock)
Pelagic (e.g., sardines, anchovies)
- Crustaceans (e.g., lobsters)
- Mollusks (e.g., cephalopods)
- Other (please specify): __

9. What types of economic activities are examined through in your case study?

- Aquaculture
- Large scale commercial fisheries
- Small-scale commercial fisheries (e.g. < 25 meters longitude)
- Canned industry
- Shellfish gathering
- Other (please specify):_____

10. Which marine ecosystem service(s) are been affected by the social transformation in your case study?

- Products obtained from ecosystems (e.g. fish as food, medicinal resources including pharmaceuticals, chemical models)
- Benefits obtained from the regulation of ecosystems (e.g. carbon sequestration, climate regulation, waste decomposition, purification of water and air, disease control)
- Non material benefits obtained from ecosystems through cultural (use of nature as motif in books, film, painting, folklore, national symbols, architect, advertising), spiritual and historical (use of nature for religious or heritage value or natural), recreational (ecotourism, outdoor sports, and recreation), science and education (use of natural systems for school excursions, and scientific discovery)

11. How many sector(s) the social transformation impact? (Can be single, two or multiple sectors)

- One sector (e.g. industrial fisheries)
- Two sectors (e.g. small-scale fisheries and industrial fisheries or aquaculture)
- Multiple sectors (more than two, e.g., small-scale and industrial fisheries, aquaculture, canned industry)

12. What are the key characteristics of the management system in your case study before and after the social transformation (please select more than one option if necessary)

Before the transformation

- Effort management system
- Lack of local leadership
- Strong local leadership
- Individual transferable quotas
- Lack of co-management
- Strong co-management system
- Marine protected area
- Top-down system
- Other (please specify):__

After the transformation

- Effort management system
- Lack of local leadership
- Strong local leadership
- Individual transferable quotas
- Lack of co-management
- Strong co-management
- Marine protected area
- Top-down decision making
- Other (please specify):__

13. What are the key stakeholders in your case study?

- Administrations (regional or national) (Regional)
- Scientists
- NGOs
- Key leaders of coastal communities: the fishers community leaving from this activity
- Others (please specify):_See below

14. What is the spatial scale of your case study?

- Local/seascape (e.g. local, community, regional)
- National (country)
- Transnational (e.g. more than one region or country)
- Sub-continental (e.g. Southern Europe)
- Continental (e.g. Europe)
- Global

15. What are the key drivers of change in your case study (Please select the most important one, mark as many as you need and add other options as necessary)

- Change in costs for the economic activity (e.g. increase fuel oil)
- Change in governance systems (e.g. from centralized to co-management, from sectorial to integrated management, etc.)
- Change in social benefits (e.g. social security benefits)
- Climate change impacts (e.g. migration of fish species, level sea rise, increase of temperature)
- Environmental shocks (e.g. forest fires, oil spills, hurricanes, etc.)

- Overexploitation or overfishing (e.g. collapse of species)
- High mortality of fish farming (e.g. bacteria or virus)
- Introduction of new regulations (e.g. EU landing obligation, introduction of marine protected areas, co-management systems, individual transferable quotas systems)
- Introduction of new technology (e.g. fishing gear or GPS on board)
- Interaction with other activities (e.g. development of new activities which displace traditional ones)
- Introduction of new infrastructures (e.g. port development, windmills)
- Introduction of invasive species impacts (e.g. local habitat damage)
- New way of selling fish products (e.g. new presentations or new products)
- Non-compliance of fisheries policies (e.g. insufficient TAC/quota, IUU activities)
- Market demand for seafood
- Other (please specify):_____

16. What are the impacts of the social transformation on marine ecosystems' components of your case study?

- Key commercial species (e.g., cod, hake, anchovy)
- Other commercial species (not yet established or unknown)
- Non commercial species (not yet established or unknown)
- Habitats (not yet established or unknown)
- Entire ecosystem
- Other (please specify):__

17. What are the impacts of the social transformation on human wellbeing?

- Food security and nutrition_
- Income and employment_
- Security of housing and infrastructure_
- Leisure and recreation_
- Cultural heritage_
- Social relations _
- No direct impacts
- Others (e.g., demography, health, education, etc.)__

18. What is the time scale over which social transformation occurred in your case study?

- Months
- Years
- Decades
- Unknown

19. How reversible do you think this change is?

- Irreversible (on 100 year time scale)
- Difficult to reverse
- Easy to reverse
- Unknown

20. What are the sources of evidence used in your case study (please add others in case of necessary)

- Field work
- Time series
- Models
- Local ecological knowledge
- Literature references
- Other (please specify): _____

21. How robust is the evidence in your case study to demonstrate that a social transformation exists?

- Speculative – Social transformation has been proposed, but little scientific evidence as yet
- Contested – Reasonable evidence both for and against the existence of change
- Well established – Wide agreement that the social transformation exists

22. What are the barriers for adaption after social transformation?

In your case study, what are the barriers (if any) that fishers, enterprises and institutions are facing in relation to current social transformations in your case study to navigate into successful adaptive strategies to deal with the change.

23. What are adaptive strategies adopted after social transformation?

Describe what are/were the innovative adaptive strategies developed by key actors (e.g. enterprises, institutions, fishers, etc.) to deal with the transformation.

24. What are the key references used in your case study

Please provide key sources to get more information about the case study (e.g. scientific papers, reports, grey literature, newspapers, etc.)

25. Diagrams, Photos and Videos

Please provide diagrams, photographs or videos that illustrate the social transformation in your case study. Include a caption as well as the source. Only include material that can be freely distributed.

Additional comments

Please provide any additional comment you consider necessary to describe your case study.

Thank you for your collaboration!