



# CASE STUDY TEMPLATE FOR IMBER- ADAP<sub>T</sub>

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Integrated Marine Biogeochemistry and Ecosystem Research

[www.imber.info](http://www.imber.info)

The purpose of this case study template is to collect case studies to develop a decision support tool to enable managers, researchers and local stakeholders to: (1) make decisions efficiently, (2) improve their response and (3) evaluate where to most effectively allocate resources to "reduce" vulnerability and enhance the capacity of coastal peoples to adapt to global change. This decision tool, IMBER-ADAP<sub>T</sub> (Assessment based on Description, Responses and Appraisal for a Typology), will build on knowledge learned from existing marine case studies, where some action was taken to counteract the environmental, social or other impacts of global change. The case studies should take into account the highly interconnected natural and human systems of today. Here we explicitly ask what can be learned from existing responses that were taken to global change generally and how this information can be used to decide how best to respond to current and future global change. Thus, the information that you will provide is key to the development of this decision support tool.

IMBER-ADAP<sub>T</sub> is being developed by the Human Dimensions Working Group of IMBER (Integrated Marine Biogeochemistry and Ecosystem Research project, [www.imber.info](http://www.imber.info)). The overall goal of IMBER is to provide a comprehensive understanding of, and accurate predictive capacity for, ocean responses to accelerating global change and the consequent effects on the Earth System and human society. One program focus area is the interactions between human and ocean systems and investigation of what human institutions can do to mitigate or to adapt to global change. IMBER-ADAP<sub>T</sub> has the capacity to be applied to a wide range of global change issues in the terrestrial and marine realms, but our current focus is on marine social and ecological systems related to fisheries and aquaculture with respect to global change. By taking a broad perspective on human-ocean interactions, from biogeochemistry to governance, and recognising the interconnections and feedbacks, we address the complex nature of both the marine ecosystems and of the human interactions. As marine ecosystems are subjected to a complex set of natural, social and/or governance drivers, with responses and interactions occurring at multiple levels and scales, focusing on understanding how humans interact with the marine environment can help us address issues threatening security of food, shelter, livelihoods, and human health.

The development of such a framework necessarily requires an interdisciplinary approach. The case study template is comprised of six sections (A-F in "Contents" below) with a total of 30 questions, which will probably require input from several people. We encourage you to consult with your colleagues in order to complete the case study template. The case study template is designed around an "Issue" affecting fisheries and aquaculture that links the natural properties of the marine ecosystem with the social and governance systems. In completing this case study



template, please focus on only the most prominent **issue** (e.g. over-fishing, invasive species, ocean acidification, globalised markets, tourism etc.). If there are other relevant issues, please note these in the background section and where appropriate in the case study template. Sections A-F should be completed in full and Section G is a glossary of terms.

Our longer term intention is to develop a database of global case studies as an open-access web site to help decision makers, researchers and stakeholders decide how to respond when faced with difficult choices and trade-offs. This means that some of the information and data that you provide will be made accessible to other users. By returning the completed case study template to us, it is understood that we have your permission to include this information on-line. If you do not agree to this, please let us know by returning a completed non-consent form (Section I).

We are also planning to publish a book that will describe IMBER-ADApT and synthesise lessons learned from its application to specific case studies. We would like to invite you to join us and contribute a chapter about your case study. Please let us know if this is of interest to you.

Thank you once more for agreeing to complete this case study template. This case study template is downloadable from our website (<http://www.imber.info/index.php/Science/Working-Groups/Human-Dimensions/IMBER-ADApT>). We have also provided an example of a completed case study template for a case study from Uruguay for your guidance. Please submit your completed case study template to IMBER HDWG at: [imber@imr.no](mailto:imber@imr.no). We will keep you informed of progress and in the meantime please visit our website <http://www.imber.info/index.php/Science/Working-Groups/Human-Dimensions>

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*If you have any questions, please contact us at [imber@imr.no](mailto:imber@imr.no)*

***Many thanks for agreeing to complete this case study template!***



# CASE STUDY TEMPLATE SECTIONS

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A. BACKGROUND INFORMATION.....	ERROR! BOOKMARK NOT DEFINED.
B. DESCRIPTION OF THE STRESSORS AND THEIR IMPACTS .....	ERROR! BOOKMARK NOT DEFINED.
C. VULNERABILITY (6 QUESTIONS) .....	ERROR! BOOKMARK NOT DEFINED.
D. GOVERNANCE AND GOVERNABILITY (8 QUESTIONS).....	<b>13</b>
E. RESPONSE (2 QUESTIONS).....	ERROR! BOOKMARK NOT DEFINED.
F. APPRAISAL (7 QUESTIONS).....	ERROR! BOOKMARK NOT DEFINED.
G. GLOSSARY .....	ERROR! BOOKMARK NOT DEFINED.
I. NON-CONSENT FORM .....	ERROR! BOOKMARK NOT DEFINED.



### A. BACKGROUND INFORMATION

In this section, please provide background information about yourself and your case study, as well as a clear description of the Main Issue affecting fishing or aquaculture in your case study. Please provide as much information as necessary to understand the Main Issue. If required, use an extra page and feel free to provide references where relevant.

INFORMATION	DETAILS		
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<b>NAME OF STUDY AREA</b>	La Coronilla-Barra Del Chuy, Rocha, Uruguay		
<b>COUNTRY/COUNTRIES WITH JURSDICTION</b>	Uruguay		
<b>GEOGRAPHIC LOCATION</b> (Temperate, Tropical or High Latitude)	Temperate		
<b>ECOSYSTEM TYPE</b> (Coastal, Lagoon, Shelf or Open Ocean, other)	Sandy beach (coastal)		

<p><b>MAIN ISSUE</b></p> <p>(a) Provide a concise, detailed description of the Main Issue affecting the case study. Include the information detailed to the right to show the extent of the effect of the Main Issue:</p>	<p><b>Description of Main Issue</b></p> <p>Sandy beach clams of the genus <i>Mesodesma</i> are a valuable resource along the Atlantic and Pacific coasts of South America. In the Atlantic, the yellow clam <i>Mesodesma mactroides</i> inhabits sandy beaches of Brazil, Uruguay and Argentina. Mass mortalities decimated populations of <i>M. mactroides</i> along its entire geographic range during the last 20 years. These mass mortalities have been attributed to a number of factors, namely positive sea temperature anomalies, harmful algal blooms, environmental stress, parasitism and storms. The effect of these mortalities may swamp management measures.</p> <p>The study area, comprised between La Coronilla and Barra del Chuy resorts in the NE of Uruguay, is also affected by an artificial freshwater canal discharge (Andreoni Canal) used for agriculture and cattle rearing (Figure 1). This freshwater effluent causes a broad deterioration in habitat quality and affects resident sandy beach populations, which experienced reduced survival, growth and fecundity rates. These impacts spread to the community level, affecting macrofauna diversity, abundance and structure. In addition, the artisanal communities that harvest the yellow clam are affected because of the reduction of the stock towards the proximity of the effluent discharge. Mass mortalities and freshwater discharges are the two Main Issues considered in this case study, even though special emphasis will be given to the effect of mass mortalities in the ecological, social and governance systems.</p> <p><b>location</b> La Coronilla and Barra del Chuy resorts in the NE of Uruguay</p> <p><b>size of marine area in your case study (km<sup>2</sup>)</b> Total area = a narrow beach fringe of 23 km length x 0.1 km width = 2.3 km<sup>2</sup>.</p> <p><b>main species</b> yellow clam <i>Mesodesma mactroides</i></p> <p><b>main habitats</b> sandy beach</p>
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	<p><b>size of area inhabited by people in your case study (km<sup>2</sup>)</b> 150 km<sup>2</sup></p> <p><b>key stakeholders</b> artisanal fishing communities</p> <p><b>number of people affected by the Main Issue</b> Some 40 fishers and their families: ca. 200 persons directly affected by the issue</p> <p><b>total number of people in your case study area</b> Some 20,000 inhabitants (up to 50,000 in summer) live close to the beach. Not only are the fishers affected by the issues, but also tourism activities.</p>
<p>(b) When did the Main Issue occur?</p>	<p>The first mass mortality event occurred in 1994</p>
<p>(c) Are there other geographical areas that are also affected by this issue, but not included in this case study? If so, please indicate what they are.</p>	<p>Mass mortalities decimated populations of <i>Mesodesma mactroides</i> along its entire geographic range during the last 20 years, from Southeastern Brazil to Argentina. These geographical areas of Brazil and Argentina are not included in this case study.</p>

Please insert a map of the area of your case study here

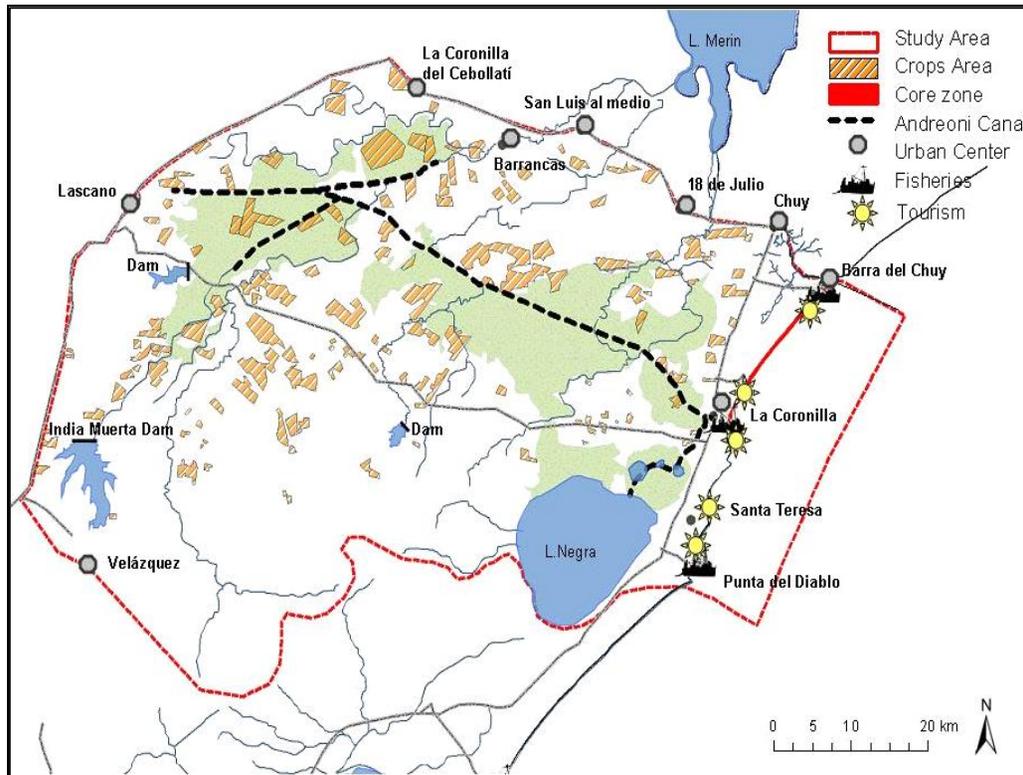


Figure 1. Main ecosystem services identified in the influence area of the Barra del Chuy beach. Main urban centres located in the area, the main coastal lagoons and the dams used for water management are also shown.

**B. SCALE-LEVEL- STRESSORS-CHANGE-IMPACT**

This section aims to gather information about the scale of the affected natural and social systems, and the governing systems, the main stressors affecting these systems, the consequent changes that these cause, and their impacts. Please provide as much information as necessary, but in no more than 200-300 words for each question. Please provide references where relevant.

Questions	Natural system	Social system	Governing system
1. What are the boundaries of the natural, social and governing systems?	Sandy beach delimited by a freshwater canal (SW) and a stream (NE).	The main stakeholders are fishers of the local community.	National Direction of Aquatic Resources (DINARA) is the main national management agency.
2. Which of the following levels is the Main Issue related to? Please describe for each system and level, where appropriate.	<p>A. LOCAL sandy beach located in the Uruguayan coast. The deleterious effects of freshwater discharges at the local levels were superimposed by mass mortality events that decimated the local yellow clam population.</p> <p>B. REGIONAL</p> <p>C. NATIONAL</p> <p>D. INTERNATIONAL mass mortalities decimated yellow clam populations throughout the whole distribution range of the species</p>	<p>A. LOCAL the local fishery in the sandy beach stretch of the Uruguayan coast</p> <p>B. REGIONAL</p> <p>C. NATIONAL</p> <p>D. INTERNATIONAL all the artisanal yellow clam fisheries in Argentina, Brazil and Uruguay were affected.</p>	<p>A. LOCAL the local governing system in Uruguay.</p> <p>B. REGIONAL</p> <p>C. NATIONAL</p> <p>D. INTERNATIONAL all yellow clam fisheries were affected by mass mortalities, which generated serious concerns in the Management Agencies throughout the Atlantic coast of Brazil, Argentina and Uruguay.</p>
3. What are the main natural, social and/or governance stressors that affect this system?	Since the early 80's, the freshwater discharge by the Andreoni Canal. The Andreoni canal, with a total length of 68 km, allowed increasing the drained surface in some 95000 ha, which has	Conflicts between stakeholders, lack of social cohesion and uncertainty about the behavior of the resource and the governmental agencies.	During the 70' and 80's the fishery was managed as an open access system and the fishery was closed in 1987 as a result of low yields.

	<p>been mostly used for rice crops. The canal discharges freshwater and agrochemicals into the Atlantic Ocean, on the SW extreme of the 22 km exposed sandy beach located between La Coronilla and Barra del Chuy.</p> <p>Since the early 90's mass mortalities have been occurred, mainly as a response to increasing Sea Surface Temperature Anomalies (SSTA) (Ortega et al. 2012). In relation to this increasing trend in SSTA, recent results suggest an increasing influence of sea level rise and onshore winds that affect the capability of the fishers to extract the resource in the intertidal zone.</p>		
<p>4. What changes in the natural, social and governing systems do these stressors cause and where?</p>	<p>The freshwater discharge affected resident sandy beach populations (including the target species), which experienced reduced survival, growth and fecundity rates (Defeo and de Alava, 1995; Lozoya and Defeo, 2006). These impacts spread to the community level, affecting macrofauna diversity, abundance and structure (Defeo and Lercari, 2004; Lercari and Defeo, 2003; Lercari et al., 2002). The freshwater effluent has also caused erosion and modification of the coastline, which imply a deterioration in habitat quality for the macrofauna community, including the</p>	<p>The freshwater canal discharge impacted the resource and its habitat, and therefore the availability of clam for harvesting. This has reduced the income of the fishers.</p> <p>Mass mortalities caused the collapse of the stock. The fishery was closed and affected the economic livelihood of the fishers' community.</p>	<p>The decline in fishery yields generated conflicts among stakeholders and the closure of the fishery in 1987. This crisis was conceived as a window of opportunity to improve governance. The fishery was reopened as a co-managed system in 1989, which was successful until 1994, when mass mortalities decimated the targeted population..</p> <p>After several years in which successful co-management was in place, the fishery collapsed because of the occurrence of mass mortalities and the fishery was closed again until the</p>



	<p>target species. Erosion of the site and sandy beach deterioration affected also tourism activities.</p> <p>After the mass mortalities that began in 1993, the adult (commercial) component of the stock decreased to almost zero ind/m<sup>2</sup> and it has not been recovered, despite the uninterrupted closed season from 1994 to 2006. The stock recovered during 2007/2008, after cold winters. Recruitment seems to be improving but never reached pre-mass mortality figures. The fishery has been re-opened under a precautionary approach.</p>		<p>resource was recovered in 2008/2009. Then the fishery was reopened with a co-managed system following the previous successful experience during the early 90's. The fishing season takes place between late December and early March (i.e., summer).</p>
<p>5. What are the impacts or consequences of this change on the natural, social and governing systems?</p>	<p>Freshwater canal discharge impacted the resource and its habitat, and therefore the availability of clam for harvesting. This has reduced the income of the fishers. Mass mortalities caused the collapse of the stock.</p>	<p>The fishery closure affected the economic livelihood of the fishers' community, generating loss of incomes and unemployment.</p>	<p>The governance system realized that open access was a weak strategy and promoted co-management as an alternative way of governance.</p>

### C. VULNERABILITY (6 questions)

Please provide as much information as necessary in no more than 200-300 words for each question, and provide references where relevant.

**NB: These questions refer to the period PRIOR to the Main Issue**

QUESTION	Details
6. What was the ecological status of the affected ecosystem (e.g., eutrophication, changes in size and/or trophic level, loss of key species, habitat quality, invasive species structure, dead zones)?	Prior to the main issue (mass mortality of yellow clam), the ecosystem was relatively healthy and the yellow clam dominated in abundance and <b>biomass the intertidal benthic community. The yellow clam fishery was developed based on an informal co-management arrangement between the authorities and local fishers. Only the freshwater discharge by the Andreoni Canal</b> impacted the ecosystem close to its discharge (local effect) and a decrease in species richness, biomass and also in salinity was observed in this part of the beach.
7. What was the productivity of the system (low, medium or high)	Very high, when compared with other sandy beaches. Greater abundance and biomass of filter feeders as the yellow clam in Barra del Chuy could be attributed to greater food availability, due to greater productivity mainly provided by abundant benthic fauna and surf zone phytoplankton. The presence of enormous surf diatom accumulations in Barra del Chuy are typical of dissipative beaches that behave as semi-closed ecosystems, in contrast to reflective beaches, defined as interfaces with low productivity, subsidized by organic inputs from the sea.
8. What were the main livelihood activities (e.g., fishing, tourism, etc.) directly affected by the Main Issue?	Artisanal fishing and tourism.
9. What other livelihood opportunities (e.g., farming, manufacturing, forestry, etc.) were there in the affected area?	Agriculture (mostly rice production) and firewood.
10. What % of the total catch/production from fisheries and	Less than 5% of household consumption. The remaining 95% goes to the domestic market either by local sales or sales to middlemen. An increasing proportion of the catch is being sold in resorts during the summer.



or aquaculture was used for own household consumption (not sold)?	
11. What proportion of household income came from fish caught or produced locally (including post-harvesting activities)?	During the fishing season (late December to early March (i.e., summer)) fishing represents almost 100% of the household income. During the closed season (autumn, winter and spring), agriculture and firewood activities represent 100% of the household income.

## D. GOVERNANCE AND GOVERNABILITY (8 questions)

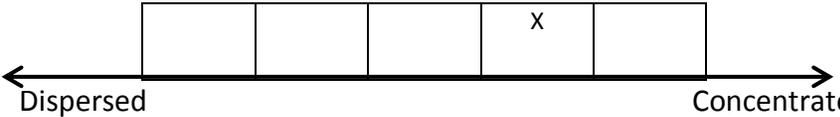
Please provide as much information as necessary, but in no more than 200-300 words for each question, and provide references where relevant.

**NB: These questions refer to the period PRIOR to the Main Issue**

QUESTION	Details
12. What were the relevant organisation(s) or individual(s) (including state, market and civil society) responsible for governance of fisheries and aquaculture at local, regional and national levels in this area?	<p><b>LOCAL:</b> The National Direction of Aquatic Resources (DINARA), which belongs to the Ministry of Cattle, Agriculture and Fisheries, is the relevant organisation responsible for governance of fisheries and aquaculture at the local, regional and national levels in this area.</p> <p><b>REGIONAL:</b> National Direction of Aquatic Resources (DINARA)</p> <p><b>NATIONAL:</b> National Direction of Aquatic Resources (DINARA)</p>
13. What was the mode of governance (e.g., self-, co-, hierarchical (local), hierarchical (larger scale), mixture). Please describe.	<p>Prior to the main issue, there was <b>an informal co-management arrangement between authorities and local fishers, which lasted until 1994 when mass mortalities of the yellow clam (target species) began.</b></p>
14. What were the long-term management objectives?	<p>To sustain the resource and the fishery in order to improve the well-being of the local community</p>



<p>15. What were the key rules, regulations, instruments and measures employed to achieve the management objectives?</p>	<p>Prior to the main issue there was an informal co-management arrangement that was accompanied by several management tools that included: a) a total allowable catch; b) a restricted number of fishing licenses; c) an individual quota per fisher; d) a minimum individual clam size; e) only hand-gathering techniques allowed.</p>
<p>16. Were there any informal rules, regulations, instruments and measures that play an important role in the governance of fisheries and aquaculture?</p> <p>Please describe.</p>	<p>No.</p>
<p>17. What was the nature of the relationship between the different sectors or livelihood occupations in this system (i.e., is there conflict or cooperation)?</p> <p>Are there any special circumstances in their relationships that should be noted?</p>	<p>Please tick the box corresponding to the most appropriate situation</p> <div style="text-align: center;"> <p>← Conflict <span style="margin-left: 100px;"><input type="checkbox"/></span> <span style="margin-left: 20px;"><input checked="" type="checkbox"/></span> <span style="margin-left: 20px;"><input type="checkbox"/></span> <span style="margin-left: 20px;"><input type="checkbox"/></span> <span style="margin-left: 20px;"><input type="checkbox"/></span> Cooperation →</p> </div> <p>The Andreoni Canal decreases salinity in the surf zone close to its discharge and also contains unknown concentrations of herbicides, pesticides, fungicides and a considerable amount of suspended solids. This issue generates conflicts with the agriculture sector (mostly rice) because fishing and tourism activities are affected by this discharge.</p>

<p>18. Who dominated or wielded the most social power in the area (e.g., fishers' associations, unions, corporations, governments, business owners, etc.)?</p>	<p>The main activity is rice production, which is a very important product at the local and national levels. The rice farmers have a strong influence on governmental decisions.</p>
<p>19. How concentrated was social power in the area (ie., was power held by a few people/1 organisation (concentrated) or was it dispersed over several organisations ?</p>	<p>Please tick the box corresponding to the most appropriate situation of the social system</p> <div style="text-align: center;">  <p>← Dispersed <span style="margin-left: 150px;"></span> Concentrated →</p> </div>
<p>20. Were there any structural changes in the governing system or individuals prior to the main issue? Please describe the changes and why they occurred?</p>	<p>BEFORE THE ISSUE the fishery was managed, first as an open access system, and in the years preceding mass mortalities, as an informal co-management mode.</p>
<p>21. Were there any changes to the key rules, regulations, instruments and measures, or have any new ones been introduced prior to the main issue? Please describe the changes and why they were introduced</p>	<p>During the 1970s and early 1980s the fishery was an open access system. Then, DINARA imposed a set of management tools described above and in 1987 it decided to close the fishery because of overexploitation concerns. After 32 months closed, the fishery was reopened in 1990 with a set of regulation tools mentioned above.</p>

**RESPONSE (2 questions)**

The objective of this section is to describe the response of the natural, social and governing systems to the Main Issue. We ask for information about Short Term (within 2-5 years) and LongTerm responses for the natural, social and governing systems. Please provide as much information as necessary, but in no more than 200-300 words for each question. Please provide references where relevant.

	Natural	Social	Governing
<p>22. a. What were the <b>short term</b> responses of the social and governing systems to the main issue?</p> <p>(Include structural changes in the governing system(s) or individuals, or the changes in key rules, regulations, instruments and measures etc.)</p>	<p>NA</p>	<p>TYPE OF RESPONSE (eg behavioural change, exit of actors) During the extended closed season, all fishers immediately moved to work in other sectors of the economy (construction, agriculture, forestry).</p> <p>LEVEL OF RESPONSE (national, regional , local) of response)) Local</p>	<p>TYPE OF RESPONSE (eg management measure, technological change, \$ aid )</p> <p>Management authorities imposed the closed season almost immediately after the mass mortalities began, but no options were provided to the fishers to mitigate the economic impact on their livelihoods. There was a clear increase in the perception of risk to mass mortalities and the government was aware for the first time of the occurrence of this kind of events. However, the government by itself was unable to find mitigation measures to cope with these unusual changes in the system. There were no clear responses from the managers, which were not prepared for “surprises” of this kind. Even though governance and management have been improving through time, regulatory agencies in Uruguay tend to respond late to the</p>



			<p>problems at hand, once they are more difficult or even impossible to resolve.</p> <p>LEVEL OF RESPONSE (national, regional , local) of response) Local measure imposed by the National government.</p>
<p>b. What were the <b>long term</b> responses of the social and governing systems to the main issue?</p> <p>(Include structural changes in the governing system(s) or individuals, or the changes in key rules, regulations, instruments and measures etc.)</p>		<p>TYPE OF RESPONSE (eg behavioural change, exit of actors)</p> <p>In the longer term, the main fishery leaders, who were in close contact with scientists of the management agency, worked with the Agency to find ways to consolidate the co-management system and to be prepared in case of stock recovery. At the first time ONLY fishery leaders play a key role, because the fishery community was not organized (most of the fishers have been working in other primary sectors of the economy).</p>	<p>TYPE OF RESPONSE (eg management measure, technological change, \$ aid )</p> <p>During the last 2 governmental periods (last 7 yrs) more emphasis has been placed on artisanal fishers and the development of co-management institutional arrangements. In this context, new bodies were created to strengthen this co-governance mode: local fishery councils. They have improved the quality of the interactions between the government and fishers. The local government and the maritime authority (Navy Prefecture) also participate in these councils. The management authority</p>



		LEVEL OF RESPONSE (national, regional , local)	operates at the local, regional and national levels. One of the first local councils created in Uruguay was for the yellow clam fishery developed from La Coronilla to Barra del Chuy.  In the longer term, governmental authorities planned to build an interdisciplinary body directed to create a database from several key organizations working on the effect of climate change on fisheries, forestry and agriculture. Nowadays this organization is being consolidated.  LEVEL OF RESPONSE (national, regional , local)
23. a. What were the objectives of the <b>short term</b> social and governing responses for the natural, social and governing systems?	The main objective was to rebuild the stock at levels similar to those found before the occurrence of mass mortalities.	The objective of the response by the fishers was to immediately seek alternative livelihoods in other sectors of the economy (construction, agriculture, forestry) in search for. As the ecological system reacted very slowly and the targeted stock did not recovered for almost 2 decades, this short-term objective became a long-term one.	The closure of the fishery was the short-term reaction of the management agency, in order to rebuild the depleted stock. The measure was in placed for several years until the stock showed evident and persistent signs of recovery.
b. What were the objectives of the <b>long term</b> social and governing responses for the natural, social and governing	The main objective was to rebuild the stock at levels similar to those found before the occurrence of mass mortalities.	To be prepared with an improved co-management system in case of stock recovery	During the fishery closure (transition phase), a main objective of the management agency was to consolidate a co-management



systems?			<p>arrangement to be implemented when the fishery re-opened. The main objective was to improve social-ecological trajectories to sustain and enhance marine ecosystem services and human well-being. Critical elements in the transition phase of the transformation were (i) recognition of the depletion of the stocks, (ii) scientific knowledge of the ecology and resilience of targeted species and their role in ecosystem dynamics, and (iii) the recognition of the key role that the previous successful co-management experiences (developed in the yellow clam until mass mortalities occurred) played in generating wise management and governance practices.</p>
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**APPRAISAL (7 questions)**

The objective of this section is to evaluate the response of the natural, social and governing systems to the Main Issue. We ask for information about Short Term (within 2-5 years) and Long Term responses for the natural, social and governing systems. Please provide as much information as necessary, but in no more than 200-300 words for each question. Please provide references where relevant.

	Natural	Social	Governing
24. a. What were the results of the <b>short term</b> response for the natural, social and governing systems (ie were the objectives in Q. <b>Error! Reference source not found.</b> achieved)?	Some stock rebuilding, but not to levels comparable to those found before mass mortalities occurred	Fishers found alternative livelihoods to survive and sustained their well-being.	
b. What were the results of the <b>long term</b> response for the natural, social and governing systems (ie were the objectives in Q. <b>Error! Reference source not found.</b> achieved)?	Some recovery of the ecological system from the perturbation after several years of fishery closure.  Some stock rebuilding, but not to levels comparable to those found before mass mortalities occurred”	Social cohesion and trust increased during the preparatory phase of the co-management arrangement. Main results: (i) increase social cohesion, trust and organization of the community; (ii) community empowerment.	Main results: (i) develop and adopt a co-governance mode; (ii) develop, adopt and implement a site-specific plan by local stakeholders, taking into account an ecosystem approach to fisheries (EAF) in order to stop overfishing.
25. Was the Main Issue addressed (Section A)? Please describe.	Yes, the stock was partially recovered. The objective of the closure was to rebuild the stock at pre-closure levels. This objective was not totally achieved, because even though the stock was recovered, it never reached abundance levels	The fisher community was strengthened.	Partially. The fishery was reopened several years after mass mortality events. The stock shows some signs of recovery and allowed a sustained fishery development during the last 5 years (2008-2013).

	similar to those found before mass mortalities occurred.		Co-management was consolidated as a governance mode. However, the management agency did not develop any proactive and precautionary plan to react to external shocks mainly driven by climate variability.
26. a. What factors contributed to the successful <b>short term</b> results described in Q <b>Error! Reference source not found.</b> (e.g., enabling policy, government funding)	Long-term fishery closure		Government funding Continuous monitoring of the resource Periodic meetings between scientists and fishers Long-term policy towards the implementation of co-management: creation of a Local Fishery Council
b. What factors contributed to the successful <b>long term</b> results described in Q <b>Error! Reference source not found.</b> (e.g., enabling policy, government funding)		Traditional roots, leadership, cohesion among most community members, willingness to enhance fishery practices.	Government funding Continuous monitoring of the resource Periodic meetings between scientists and fishers Long-term policy towards the implementation of co-management: creation of a Local Fishery Council
27. a. What factors (if any) prevented the <b>short term</b> objectives from being fully achieved? (e.g., regulatory barrier, lack of social cohesion, costs too high, climate variability, judicial decisions).		Social cohesion is threatened by some members of the fishing community, due to violence and threats among fishers, and this is still an issue undermining trust and willingness to improve collective actions.	Monitoring, control and surveillance (MCS) costs are too high for a developing country and for a very small fishery, with a very low number of fishers and with minimal economic importance in for the national economy. The management agency still shows poor institutional capacity to learn, self-reorganize and adapt to climate change related factors.



<p>b. What factors (if any) prevented the <b>long term</b> objectives from being fully achieved? (e.g., regulatory barrier, lack of social cohesion, costs too high, climate variability, judicial decisions).</p>	<p>Unknown – the stock has never recovered to pre-mortality levels</p>	<p>Social cohesion is threatened by some members of the fishing community, due to violence and threats among fishers, and this is still an issue undermining trust and willingness to improve collective actions.</p>	
<p>28. Has there been a formal evaluation of the responses? If so, how was this done and when?</p>	<p>Yes. It is being done by comparing the first 2 years after the reopening of the fishery (2009-2010) with the period 2011-2013. The first period is considered as the implementation of the governance mode and ecosystem approach. The second is the post-implementation phase. Indicators gathered at different organizational levels (individuals, populations, community and ecosystem) are being compared through Before-After procedures and Response ratios.</p>	<p>Yes. Following the same approach as in the natural system, economic indicators are being compared. In addition, case study templates have been developed to assess the perception of the local community about social issues (cohesion, organization, impact of the governance mode).</p>	<p>The management authorities are assessing the performance of the governance mode and the EAF through periodic meetings.</p>
<p>29. a. What were the benefits related to costs of the <b>short term</b> response?</p>		<p>Benefits were much higher than costs. The active participation of fisheries through meetings among themselves and with scientists and managers generated a sense of ownership and improve their well-being.</p>	<p>The costs of implementing the co-governance mode and the EAF, together with monitoring, control and surveillance procedures are much higher than the perceived benefits in strict economic terms. However, it is expected that this pilot site will provide insights about the usefulness of this approach to</p>



<p>b. What were the benefits related to costs of the <b>long term</b> response?</p>		<p>Benefits were much higher than costs. The active participation of fisheries through meetings among themselves and with scientists and managers generated a sense of ownership and improve their well-being.</p>	<p>sustain artisanal fisheries over time in the whole country. The costs of implementing the co-governance mode and the EAF, together with monitoring, control and surveillance procedures are much higher than the perceived benefits in strict economic terms. However, it is expected that this pilot site will provide insights about the usefulness of this approach to sustain artisanal fisheries over time in the whole country.</p>
<p>30. Were other options considered for either the short and/or long term responses?  Why were these not selected?</p>	<p>No other options considered</p>	<p>No other options considered</p>	<p>No other options considered</p>

## G.GLOSSARY

### Driver

Any natural or human-induced factor that directly or indirectly causes a change. (<http://www.greenfacts.org/glossary/def/driver.htm>)

### Ecosystem

A discrete unit that consists of living (e.g. assemblage of plant and animal species) and non-living parts (e.g. the physical environment), interacting to form a stable system.<sup>[1,2]</sup>

### Eutrophication (Q#6)

The process of nutrient enrichment (usually by nitrates and phosphates) in aquatic ecosystems, such that the productivity of the system ceases to be limited by the availability of nutrients. The increased growth of plants and algae depletes the dissolved oxygen content of the water and often causes a die-off of other organisms. It occurs naturally over geological time, but may be accelerated by human activities (e.g. sewage disposal or land drainage); such activities are sometimes termed 'cultural eutrophication'.<sup>[1]</sup>

### Governance

Governance refers to groups of people coming together to achieve a particular outcome. It involves all interactions among government, private firms, civil society, citizens as well as any other relevant stakeholder groups to solve societal or environmental problems and to create opportunities. In addition to the day-to-day management tasks, the boundary of governance includes the formulation and application of principles and visions guiding those interactions and care for institutions that enable and structure them.<sup>[4,6]</sup>

Governance refers to mechanisms, processes and institutions through which public and private sectors articulate their interests, exercise their rights, meet their obligations and mediate their differences in order to make decisions affecting society (Rosenau, 1999).

### Habitat (Main Issue)

The natural environment, characterized by its physical features (e.g., temperature range, availability of light, food availability or dominant plant types) in which an organism or population normally lives. Marine habitats include, for example, mangroves, intertidal zones, coral reefs, deep sea.

**Household (Q#10, 11)**

A household is a domestic unit consisting of the members of a family, as well as any non-relatives who live together in the same dwelling.

**Instruments (or measures) (Q#15, 16, 21, 22)**

Instruments are tools used in governance to overcome problems or obtain a desired effect. They are usually of a regulatory or economic nature. There is a large variety of instruments including 'soft' ones, like information and advice, and 'hard' ones such as taxes and regulations. Laws, treaties and appointments are formal instruments, while oral agreements, visits, or making a speech are more informal.<sup>[4]</sup>

**Invasive species (Q# 6)**

A species that is not native to an area that it colonizes and that is capable of causing harm to native species or the natural environment, and incur economic damage, or injury to human health.<sup>[1]</sup>

**Mode of governance (Q#13)**

There are three forms of governance: hierarchical, co-governance or self-governance. Hierarchical governance is a top-down 'steering and control' style of intervention, that uses policies and in law. Co-governance requires involvement from various parties with a common purpose (e.g. fisheries co-management). In self-governance (e.g., community- or market-based) the actors take care of themselves, outside the purview of government. While self-governance may be initiated by governments through deregulation or devolution, it can also come about of its own accord.<sup>[5,6]</sup>

**Power (relations) (Q#18)**

Power is the ability to influence the behaviour of others and in social relationships is determined by the actors' access to power resources. Besides obvious power resources such as wealth and control over jobs, many others exist, for example, organizational capacity, expert knowledge, control of information, being in certain social positions, and even having a reputation of being powerful. Power has a reciprocal nature: A acts, B reacts, A reacts to B's reaction, and so on.<sup>[7]</sup> This can manifest as power to exclude, power to influence markets or power to influence decision-making

**Primary Productivity (Q#7)**



The photosynthetic fixation of carbon by chlorophyll containing organisms, such as phytoplankton, macroalgae, mangroves, sea grasses and other sea plants. It is measured as the weight of carbon fixed per unit area per time, usually as  $\text{g.C. m}^{-2} \cdot \text{yr}^{-1}$

**Rules (formal and informal)** (Q# 15, 16, 21, 22)

Formal rules (e.g., constitutions, laws and regulations) are consciously designed and often codified in written form. They are often enforced by an external authority such as the police and the courts. Informal rules evolve spontaneously and unintentionally over time through human interaction, and take the form of unwritten conventions, routines, customs, and behavioural norms. Informal rules are often self-enforced, because all (or most) actors find it beneficial to adhere to them (as long as others do too). Those who do not abide by the informal rules of society can expect the other actors to show their disapproval even to the extent of expelling them from the group.<sup>[3]</sup>

**Social system**

Organisation of individuals into groups or structures that have different functions, characteristics, origin or status.<http://www.businessdictionary.com/definition/social-system.html>. Characteristic pattern of interrelationships between individuals, groups, and institutions to form a coherent whole[http://www.merriam-webster.com/dictionary/social system](http://www.merriam-webster.com/dictionary/social%20system)

**Stressor** (Section B, Q# 3, 4)

An event, condition, individual, or other stimulus that causes stress to a system.<sup>[9]</sup>

**Structural changes** (Q#20, 22)

Changes to the structure of an organization to achieve its goals. These can be either a partial adjustment or a total overhaul of the duties, tasks, and responsibilities of individuals and departments, as well as reporting relationships and the number of levels in the organization's hierarchy.<sup>[8]</sup>

**Trophic level** (Q#6)

The position that an organism occupies in a food chain. For example, green plants (which obtain their energy directly from sunlight) are the primary producers, and herbivores are primary consumers (and secondary producers). A carnivore that eats only herbivores is a secondary consumer and a tertiary producer. Many animals feed at several different trophic levels.<sup>[2]</sup>

**References**



<sup>1</sup>Allaby, M. 2010. A dictionary of ecology, 4th ed. Oxford: Oxford University Press.

<sup>2</sup> Martin, E., Hine, R. 2008. A dictionary of biology, 6th ed. Oxford: Oxford University Press.

<sup>3</sup>Skoog, G.E. 2005. Supporting the development of institutions – formal and informal rules. UTV Working Paper No. 3. Stockholm: Swedish International Development Corporation Agency.

<sup>4</sup>Kooiman, J. 2003. Governing as governance. London: Sage Publications.

<sup>5</sup>Chuenpagdee, R. 2011. Interactive governance for marine conservation: an illustration. Bulletin of Marine Science 87(2): 197-211.

<sup>6</sup>Kooiman J., Bavinck, M., Jentoft, S., Pullin, R.S.V., eds. 2005. Fish for life: interactive governance for fisheries. Amsterdam: Amsterdam University Press.

<sup>7</sup> Scott, J., Marshall, G. 2009. A dictionary of sociology, 3rd ed. Oxford: Oxford University Press.

<sup>8</sup> Law, J., ed. 2009. A dictionary of business and management, 5th ed. Oxford: Oxford University Press.

<sup>9</sup> "Stressor" Merriam-Webster online: dictionary and thesaurus, accessed August 14, 2013, <http://www.merriam-webster.com/dictionary/stressor>



## I. NON-CONSENT FORM

### Purpose

The Human Dimensions Working Group of the Integrated Marine Biogeochemistry and Ecosystem Research project (IMBER) is developing a decision support tool known as IMBER-ADApT (Assessment based on Description, Responses and Appraisal for a Typology). It will be built from lessons learned from case studies collected from around the world, dealing with issues relating to global change impacts on marine fisheries and aquaculture, and the people who depend on them. Its aim is to provide managers, decision makers and other stakeholders faced with difficult decisions with considered options on how to respond effectively.

### Information and data

Once developed, the IMBER-ADApT will be made available as an open-access web application available to all stakeholders. This means that some or all of the information that you provide in the ADApT Case study template will be available on-line. By signing this form, you have indicated that you do not agree to having the information that you have provided made available on-line.

### If you have questions regarding this study, contact:

Dr. Alida Bundy, Chair Human Dimensions Working Group  
Alida.Bundy@dfo-mpo.gc.ca

### Statement:

The nature and purpose of this project have been adequately explained to me but I do not agree to the use of my data and research as indicated above.

**Signature:** \_\_\_\_\_ **Date:** \_\_\_\_\_

**NAME:**

**ADDRESS:**

**Email:**

Please send this form with your completed case study to [imber@imr.no](mailto:imber@imr.no). You will receive a copy of this form for your records.