SAMUDRA Monograph

Traditional knowledge Use for the Sustainable Management of Marine and Fishing Resources

by

CoopeSoliDar

International Collective in Support of Fishworkers
www.icsf.net

About the Author

CoopeSoliDar R.L.

The Self-managed Cooperative of Professional Services for Social Solidarity RL (CoopeSoliDar RL) is an initiative of a group of professionals interested in establishing meeting points between conservation and development, mainly for local communities, located in Costa Rica.

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Cover
CoopeSoliDar R.L 2016. Doña Flor and don Miguel Adanís present their traditional knowledge concerning mollusks in Tárcoles, Costa Rica in a guided visit to the Responsible Fishing Area

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EXECUTIVE SUMMARY

INTRODUCTION

Incorporating traditional knowledge in the process of sustainable use of marine resources in a participatory and transparent manner can result in the integration of local people and their perceptions into a management and planning process, helping develop a sense of ownership and representation while giving a voice to locals. (Johannes 1978, Moreno-Báez et al. 2010).

Efforts to capture traditional knowledge can address information gaps in fisheries data, such as the spatial and temporal distribution of fishing activities. Availability of such information is essential as part of the incorporation of social data for management (Moreno-Báez et al. 2010).

Categories of traditional knowledge of coastal communities, both men and women, include: technical knowledge, fisheries knowledge, ethological knowledge, taxonomic knowledge, ecological knowledge, biodiversity-related knowledge, therapeutic knowledge, geological knowledge, astronomical knowledge, wave and tidal knowledge, climatological knowledge, nutritional knowledge, culinary knowledge, etc. The traditional knowledge of coastal communities would further encompass certain types of customary practices and institutions; knowledge about natural calamities, disaster protection and mitigation measures; and knowledge about conflict resolution within and across sectors. Several such elements are relevant and could be successfully integrated with scientific knowledge for proper fisheries conservation and management (Mathew 2015). Some of the most important characteristics of traditional knowledge are that it develops over a long period of time, that it is experience-based, and that it has important socio-cultural and biological dimensions (Murray C., Wieckowski K., Hurlburt D., Soto C., and Johnnie K. 2011).

As has frequently been demonstrated, when fishers are involved in research and in decision-making processes, management guidelines are more likely to be effective (Berkes et al. 2001, Hagan et al. 2007, Gerhardinger et al. 2009).

It is essential to increase the confidence of both those providing the traditional knowledge and those being asked to consider it for management decisions. This process intensifies the opportunity for dialogue between local fishers, natural resource managers and researchers through systematic and participatory efforts. It can therefore be an aid to understanding, corroborating and using traditional knowledge in support of fisheries-management efforts that incorporate multiple fishing communities and highly diverse fishing activities (Moreno-Báez et al. 2010).

It also reveals how re-engagement of local fishers can bring transparency to integration of traditional knowledge with fisheries management. This traditional knowledge could ultimately help empower stakeholders by bringing recognition to their work, while promoting cooperation among fishers, managers and scientists that is ultimately essential for successful management of coastal and marine resources (Berkes 2003, Moreno-Báez et al. 2010, Murray C., Wieckowski K., Hurlburt D., Soto C., and Johnnie K. 2011).

It is critical that we do everything possible to improve our marine environmental information base and share our expanded knowledge with those interacting with marine ecosystems to increase our collective capacity for stewardship and enhancement of fisheries. Fishers' knowledge may often be the only source of information on the history of changes in local ecosystems and on their contemporary state that is reliable enough to help us design ways to protect stock and critical habitats (Haggan et al. 2007).

The knowledge that fishers and marine hunters have about the sea has often proven a fast and inexpensive way to information essential to our scientific understanding of the marine environment, even when that knowledge is from the distant past. Juxtaposing their observations and interpretations with the results of scientific work can provide important insights for scientists and managers, as well as for fishers themselves. As with science, concerns that fishers' interpretations of observations may be mistaken should not preclude paying attention to the observations themselves (Haggan et al. 2007).

Some of the information possessed by fishers in developing and developed countries may well never become available to science if we depend solely on conventional research to obtain it. Conversely, if natural and social scientists and fishers do not begin working together more effectively, we are unlikely to protect the fish that remain, let alone enhance the potential for recovery (Haggan et al. 2007).

The use of traditional knowledge can be a powerful conservation tool, providing community support for conservation plans and enabling the inclusion

of customary ecological management practices in their design (Murray C., Wieckowski K., Hurlburt D., Soto C., and Johnnie K. 2011).

This study offers systematization of three experiences in Central America where traditional knowledge has been used to improve marine spatial planning and frame a new policy oriented towards human rights approaches to fisheries and has given better tools for the governance of community-managed protected areas.

METHODOLOGY

With the support of the International Collective in Support of Fishworkers (ICSF), CoopeSoliDar R.L. selected the case studies based on processes that allowed observation of the contribution of traditional knowledge in the generation of information for coming up with a policy for the sustainable use of fishing resources and management practices geared towards marine conservation.

For the above, the following criteria were assessed:

1. From a technical point of view: Development of experiences in the Central American region that have used the technique of participative zoning and participatory mapping in conservation and use of marine resources.
2. Regional Scale: Regional examples of analysis at different scales: local scale, national scale.
3. Replicability: Case studies, which have developed methodologies that enhanced the use of traditional knowledge for conservation and sustainable use of marine resources.
4. Impact: Processes that have achieved significant relevance in their social and environmental contexts to ensure a common thread and the comparison between the results of each.

Common questions prepared for the researches are as follows:

1. What is traditional knowledge and how is it different from other forms of positive knowledge?
2. What similarities and differences can be identified between traditional and scientific knowledge?
3. What strengths and characteristics can be identified as a result of exercises focused on the integration of the traditional knowledge?
4. How do you analyse the application of traditional and scientific knowledge in decision-making?

5. Are there elements of traditional knowledge-based research that can be applied in the processes of scientific research? Or vice versa?
6. What characteristics should methodologies have that will allow them to deepen the scope of traditional knowledge in the generation of new marine information?
7. How was the application of participatory mapping and zoning evaluated in the case studies?
8. How can the use of traditional knowledge in decision-making processes be seen as a potential for conservation and sustainable use of fishing resources?

For the case studies that documented the participative mapping and zoning using traditional knowledge, the following methodological steps were used:

1. The research coordination team provided a conceptual framework to broadly categorize the different types of traditional knowledge.

The Costa Rican studies: Case study on traditional knowledge and its integration in the Costa Rican Pacific and Caribbean shrimp fishery; and in the Honduran experience—case study on the participatory mapping undertaken by the artisanal fishermen of APROCUS, La Ceiba, Honduras. Information-gathering instruments (interviews) were shared so that the case studies could reach comparable products. In both cases, interviews were conducted with artisanal fishermen, technicians, academics and other actors. However, the modifications and adaptations made in each case were respected.

2. The systematization of the cases was carried out by researchers who participated actively in the development of the experiences to ensure an adequate identification of key contacts and informants, institutions and sectors and, in particular, with a view to ensuring a serious and objective analysis of what happened in each case study.

In the case of the CoopeTárcoles R.L case study, to look at the process of systematization of the fishery data, it was proposed that the systematization be done through a descriptive and qualitative technique, which would allow an integrated view of the example.

Finally, based on general guidelines, the case studies were selected depending on the context and experience of fishing communities, and the methodology developed accordingly.

SUMMARY OF CASE STUDIES

Case 1: The Experience of CoopeTárcoles R.L.: A Fishers Database, Costa Rica

This document presents the systematization of the data collection and analysis process that has been undertaken by the fisherfolk of Tárcoles since 2006. CoopeTárcoles R.L. is a fishing cooperative endeavour that has been active for more than thirty years in the Central Pacific coast of Costa Rica.

CoopeTárcoles has spearheaded processes of responsible fishing in Costa Rica, and has done so with the technical guidance and support of CoopeSoliDar R.L., a professional services cooperative that has its headquarters in San José, the capital city of the country.

The collaborative relationship established by both institutions in 1999 has paved the way for the adoption of FAO's responsible fishing code of conduct by the Tárcoles fisherfolk and also for the collaborative mapping of the sites used for fishing, which led to the design of a Responsible Fishing Area for Tárcoles, later granted by the Costa Rican government via INCOPESCA, the National Fisheries and Aquaculture Institute.

All of these benchmark accomplishments can be traced back to a historic decision: back in 2005, the Tárcoles fisherfolk began collecting their fishing data and organizing it in a Microsoft Excel spreadsheet. Ten years later, this is the best, and only, example, of a locally managed fisheries database. Because of the comprehensive and methodical data collection, this is now the longest-running data set to exist outside of INCOPESCA's own records, and has proven to be a readily organized and complementary data set to those used by INCOPESCA to inform their management decisions.

The past and present of the CoopeTárcoles Fisheries Database is summarized herein, so that its valuable lessons can be replicated elsewhere.

Case 2: Shrimp fishing baseline for the sustainable shrimp fishing Pacific: The use of participatory mapping and traditional knowledge at the National Level in Costa Rica

The research group, part of a national dialogue gathered for the establishment of a national policy towards the sustainable use of shrimp in Costa Rica, took into consideration both scientific and traditional knowledge. These inputs were reflected in the process of participatory mapping. The mapping was developed with the idea of generating a marine spatial planning process that can reconcile

conservation and utilization of coastal and marine resources in a more equitable manner.

In this experience, traditional knowledge has played a prominent role not only in the light of the scarcity of scientific information, but by opening a space for a respectful discussion among all the participants. The process has incorporated the immeasurable contributions generated from the practical experience of fishers (these have had a high level of agreement with regard to scientific knowledge).

In this case study, other aspects related to the subject were also considered, e.g., promoting the use of traditional knowledge in decision-making, the role of participatory mapping in the application of different types of knowledge, assessment of the interaction between scientists and fishers, among others.

Among the main results that have been generated in this area is the formulation of a first sampling on ecosystems and coastal resources in the Pacific and Caribbean (Barra del Colorado) coast of Costa Rica. Furthermore, it also aimed at building trust and respect among the participants of the research group towards the sustainable harvest of shrimp.

Case 3: La Rosita Traditional Mapping for the sustainable use of marine and coastal resources, Honduras

The Wildlife Refuge Cuero y Salado is located approximately 30 km west of La Ceiba city. It was declared a protected area by Decree 99-87 of 29 July 1987 in order to safeguard all marshland located in the mouths of Leather, Salado and San Juan rivers in the Department of Atantida, including a system of coastal lagoons, rivers and mangrove channels. Later amendments to the decree were made in order to ensure the co-management of the area through the Foundation Cuero y Salado (Decree 38-39 of 30 March 1989). Recently its limits have been redefined to incorporate the marine area for an extension of 14,027 hectares as (7989.53 hectares of land and 5037.47 of marine environment). The marine area of this refuge is categorized into two sub-zones, one for preservation and the other for the development of artisanal fishing that is spread over 335.88 hectares (7 per cent of Refugio).

The fishermen of different communities have organized themselves under the umbrella of the Association of Fishermen of La Rosita, Cuero y Salado (APROCUS). The fishermen of this organization have the right to carry out their fishing activities within the marine protected area limits on specific

fishing sites. This case study has been part of the work of RECOTURH[1] to develop a process to strengthen local governance in the area. The exercise has documented some of the traditional knowledge, leading to a participatory mapping exercise oriented towards the identification of the traditional fishing spots used by fishermen using traditional techniques. This knowledge was complemented with scientific techniques to map productive activity and its characteristics. This information has been used for making the final decisions among agencies, government institutions and fishing organizations for the management of the area.

LESSONS LEARNED FROM THE CASE STUDIES

1. Fishermen and fisherwomen have important traditional knowledge that, when integrated with scientific knowledge, can generate valuable agreements for the generation of new knowledge, management and conservation of marine resources.
2. Neither academic nor state institutions seem to have capabilities for the use of methodologies through which this knowledge can be integrated into decision-making. More research and practice should be developed and shared.
3. There are few systematized examples on the generation of knowledge through the integration of traditional and scientific knowledge. Generally it takes time to gain the confidence of the parties regarding how that knowledge will be used. It is difficult to develop this process if there is no clear objective of how the information will be used.
4. It is necessary that we generate experience that allows for reducing the uncertainty that the use of traditional knowledge generates in academia and public institutions and helps in recognizing traditional knowledge as a valid source of knowledge.
5. These processes of generation of new knowledge that includes traditional knowledge also bring information of areas where there is no knowledge at all, which allows information gaps to be diagnosed and consensual research priorities to be defined.
6. The process by which different sectors with different knowledge types get together to generate new knowledge is a tool for the resolution of conflicts, which is important for the sustainable use of the sea. Decision-making becomes more fluid and occurs almost immediately.

1 La Red de Comunidades Turísticas de Honduras

7. Traditional knowledge, similar to scientific knowledge, is location specific. It is important there are enough spaces created for the participation of the holders of traditional knowledge in different management process, taking into account the cultural, age and gender diversity.
8. In the case of Costa Rica, the study shows that the main generators of scientific knowledge are state institutions and universities. Other sectors such as environmental NGOs use and interpret that knowledge but do not generate it.
9. In the Honduras case study, it seems that only one actor benefits from the integrated information generated. It is not only important to demonstrate how knowledge is used but also think about strengthening the local fishers' capacity to use it. The knowledge must be returned to the communities that are its true owners.
10. It is evident in the case of Costa Rica's dialogue that the traditional knowledge of fishermen has not been recognized for a long time, which in many cases has weakened the self-esteem, the local bases and institutions that generate and apply this knowledge.
11. In the case of Tarcoles, the recognition of this knowledge for more than a decade and its integration with scientific knowledge allow it to be used in decision-making in an agile, operational and adaptive way.
12. It is important that these processes generate information from the universities that transform that knowledge of fishermen into scientific articles.
13. In the Costa Rican case study, the participation of local leaders in the process has allowed processes of use of traditional knowledge to be initiated in each of their communities.
14. It must be recognized that in the case of INCOPESCA Costa Rica, the marine areas for responsible fishing have been demarcated through participative zoning that took into consideration traditional knowledge.
15. In the case of Honduras, an alliance between an NGO and a research institution has been established to systematize traditional knowledge, which seems a rather innovative element.
16. Traditional knowledge of fishers need to be recognized at both the local and national levels, as their relevance varies with context and spatial area.

RECOMMENDATIONS

1. It is important to continue strengthening the capacity to use and share traditional knowledge for marine management and conservation as mentioned by the Convention on Biological Diversity (CBD) and orient these efforts towards the fulfilment of Objective 14 of the Sustainable Development Goals (SDGs).
2. It is necessary to reinforce the capacities of state institutions aimed at strengthening the importance of the recognition of traditional knowledge and the methodologies to be developed to use this knowledge together with scientific knowledge towards the management of marine territories.
3. Universities must strengthen the processes aimed at recognizing traditional knowledge and its systematization and practical use.
4. It is important to analyse, differentiate and recognize the traditional knowledge of women and the recognition of the existence of this knowledge.
5. Clear rules need to be defined for the use of traditional knowledge that has been used by non-governmental organizations and the academy in a silent way and with little recognition in the past.

CONCLUSIONS

Traditional knowledge in the cases presented have resulted in better policies and consensual management agreements that had been hard to reach with no information at all about different fisheries. The participation of fishers and the fact that the methodologies used promoted discussion and informed participation resulted in greater unanimity between the various parties. In all cases, the processes permitted the definition of agreed sites where new information needs to be acquired and ways in which this could be done using the different types of knowledge available.

It was evident that the use of traditional knowledge in policy making and management of resources is new and there are very few examples of this being systematized. More information and methodologies need to be discussed and analysed to promote ways in which different knowledge types can be integrated.

Participative methodologies using traditional knowledge strengthen the capacity of small-scale fishers further. Fishing communities are now empowered to bring together scientific and other knowledge on fisheries with their traditional knowledge, which was earlier never acknowledged nor was it put to use. It is important to recognize traditional forms of knowledge as well as to get prior informed consent from fishers before these are used for other purposes.

More information and more studies need to be developed to show the importance of systematizing and using traditional knowledge for the development of management policies concerning fisheries. These cases illustrate a few examples where this knowledge has been used towards better and improved policies oriented towards sustainable use of marine resources.

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CASE STUDY 1

INTEGRATING TRADITIONAL KNOWLEDGE FOR THE SUSTAINABLE MANAGEMENT OF SHRIMP FISHERY IN THE COSTA RICAN PACIFIC AND CARIBBEAN COASTS

SUMMARY

The research group was created as part of a national dialogue that had as its main objective the generation of a national policy for the sustainable use of shrimp in Costa Rica. This was a space for dialogue and proposals reaching a consensus and they took into consideration both scientific and traditional knowledge. These inputs were shaped in the process of participatory mapping. The mapping was developed with the idea of generating a marine spatial planning process and management that can reconcile conservation and sustainable use of coastal and marine resources in a more equitable manner.

In this experience, traditional knowledge has played an essential role, not only because of the lack of scientific information, but also because it opened a space for respectful discussions among all the participants. The process has incorporated the immeasurable contributions generated from the practical experience of fishermen. Also there was a high level of agreement between traditional and scientific knowledge.

Other aspects related to the subject, for example, promotion of the use of traditional knowledge in the decision-making processes, the role of participatory mapping in the application of different types of knowledge, assessment of the interaction between scientists and fishers, amongst others, were also considered in this case study.

Among the main results that have been generated in this area is the formulation of a first participatory mapping of ecosystems and coastal resources in the Pacific and Caribbean (Barra del Colorado) coasts of Costa Rica. Further more, it has helped in building trust and respect among the participants of the research group towards the sustainable use of shrimp.

INTRODUCTION[1]

At the beginning of 2015, the government of the Republic of Costa Rica signed a decree oriented towards the development of a national dialogue with all interested sectors for the formulation of a national policy for the sustainable use of shrimp, employment generation and fight against poverty. The research group was a result of the assessment of inputs generated in the first stage of the dialogue process to organize shrimp fishery where there was evidence of the need to discuss knowledge generation for decision-making on the subject. The executive decree provided a space for dialogue, where technical and scientific options could be discussed, in order to mitigate the environmental and social impacts of the use of fishing trawls (both semi-industrial and artisanal),[2] as ordered by the Constitutional Chamber in the vote N ° 201310540 that restricted trawling licensing (both artisanal and semi-industrial) in the country.

The research group for the sustainable use of shrimp was formed by representatives from the University of Costa Rica (through the CIMAR), the Costa Rica Fishery and Aquaculture Institute (INCOPESCA) and other participating institutions, as well as fisher representatives from the Pacific and Caribbean coasts of the country. Through dialogue and the gradual generation of trust, the research group has evolved as a space where scientific knowledge and traditional knowledge have generated consensual inputs. However, traditional knowledge has played a fundamental role in making a first assessment of shrimp and other marine species on both coasts of the country as a resource.

1 We deeply thank all representatives: academic, the technicians, the people who work for the public institutions and the fishermen that participated. The experiences that these people have shared are invaluable.

2 The only area of the country where artisanal trawls can be used legally is in the Caribbean coast of the country (Barra del Colorado).

GOALS

1. General goal

Development of a case study to investigate the role of traditional knowledge in the management of shrimp fishery in the Costa Rican Pacific and Caribbean coasts; promote the management of this resource in a more effective and equitable way.

2. Specific goals

a) To know the point of view of the participants in this process regarding the use of traditional knowledge applied in that collaborative space.

b) Identify the importance of the methodological participatory mapping as a tool to facilitate the integration of traditional and scientific knowledge.

c) Establish criteria to promote entailment between traditional knowledge and scientific knowledge regarding fisheries.

d) Inquire about the opinion of scientist and technicians who participate in the research group regarding the traditional knowledge and its application in decision-making.

METHODOLOGY

In order to develop this case study, the following methodology was used:

Step 1. Planning of the research proposal.

Step 2. Starting from the goals that were set, build a series of thematic cores (traditional knowledge, integration of knowledge and mapping), and from these, develop different questions that allow the research to discuss the importance of traditional knowledge in policy generation. The questions were added to three different questionnaires for each of the participant parties (institution, fishery community and support team).

Step 3. Implementation of the interviews. For the creation of these interviews a criteria was defined in order to select the population that would be interviewed, since different people participated at different times in the research group. Therefore, only those who have worked all along and/or have been involved in the year 2016 for four or more sessions were interviewed.

Step 4. Analysis and connection of the information.

REPRESENTATION

In this section we will develop a brief conceptual framework in order to clarify the most important definitions and contextualize the principal argument. The first term refers to traditional knowledge (TK): 'It uses conceptual frameworks and theoretical structures, verifies its external coherence and empirically tests some of its theoretical aspects or hypotheses.' Later, the authors point out: 'Scientific knowledge discards knowledge or facts, produces new ones and explains them. That is, it is not limited to the observed facts; but it analyses the reality in order to go further. Rejecting some facts, it selects those that are considered relevant, verifies them and to the extent possible, reproduces them. Scientists do not accept new facts, unless they can validate their authenticity by showing that they are compatible with what is known at the time. Scientists do not value their own experience, they rely on collective experience and theory. This experience not only describes reality, but rationalizes it through hypotheses and hypothesis systems, which give birth to theories' (Mouriño et al, p.3 and p.4 1991).

This form of knowledge has had a hegemonic role compared to other types of knowledge. Scientific knowledge, for some academic and political areas, has been used times as the only valid option to develop an investigation and/or to make decisions.

Another type of knowledge that has been marginalized by scientific knowledge is traditional knowledge. UNESCO (2016) defines traditional knowledge as 'the accumulated and dynamic ensemble of the theoretic knowledge, the practical experience and the representations owned by communities with a long history of interaction with their environment. The holding of this knowledge, which is extremely linked to language, social relations, and spiritual vision of the world, is usually collective'.[3]

According to the United Nations Food And Agriculture Organization (FAO, 2015), there are different types of traditional knowledge.

Local ecological knowledge: Knowledge of ecosystems and local environment of residents, users of the resources such as fishers and land workers and/or other people who have an experience in the environment.

Ecological traditional knowledge: The ecological knowledge that is considered as traditional, because it comes from the history and oral cultural

3 Due to a variety of definitions of traditional knowledge, only the definition provided by UNESCO will be taken into consideration. However, it is also intended to show some of the polysemy that has risen regarding this subject.

practices or customs of a society. A common characteristic is that it always passes from one generation to another.

Native knowledge: Knowledge owned by native people. Usually, it contrasts with 'eastern knowledge' (knowedge derived from colonialism).

Some characteristics of traditional knowledge are:

1. Practical dimension (denoting the largely tacit dimension of traditional knowledge, which is evidenced and manifested in the form of social and cultural practices carried out by human groups within a given space-time).
2. Territorial rooting (links the content of knowledge directly to the context, medium or environment around which an indigenous community develops; usually associated with a particular ecosystem).
3. Collective character (which recognizes as owners, bearers and/ or generators of knowledge a community, people or indigenous community).
4. Lineage or historical origin (which emphasizes the historical development of knowledge and its transmission, retention and intergenerational preservation).
5. Intergenerational dynamism (which refers to the permanently open possibility that they have had and have of this knowledge, of developing and innovating it throughout generations).
6. Economic and socio-environmental value (referring to the potential of this knowledge to contribute in the future to environmental conservation and to the social and economic development of a country).
7. Oral and linguistic characteristic (emphasizes the importance of indigenous mother tongues as means of preservation and intergenerational transmission of this knowledge, frequently, in the absence of a written material support as a form of registration and codification of traditional knowledge) (Valladares and Olivé, p. 77-78, 2015).

It is also necessary to keep in mind that traditional knowledge can vary according to gender, age and hierarchy of the person in a group. Regarding gender, '*Man and women usually have different and complementary roles in production activities, in the use of resources and in social restrictions. Thus, some of the local knowledge of fishery belongs exclusively to women. If this is overlooked and not integrated into the general local knowledge, the comprehension of the management systems of the fisheries will have gaps'*

(Ruddle, p. 173, 1994). In Costa Rica, the role of the women in fishery is key to the development of the fishery activity; not only in the actual act of fishing but also in the processes before and after the capture of the fish, where they use their knowledge for the *lujado* (place the fishing lines and untangle them), the peeling of the shrimp and of course, taking care of the family.

Furthermore, there's a series of normative frameworks that support the importance of traditional knowledge, for example: Agreement 169 of the International Labour Organization (ILO) concerning native people in the year of 1989; the agreement of biological diversity of 1992; the Conduct Guideline for responsible fishing of the FAO introduced in 1995, and exclusively for Costa Rica, there is a 1988 law regarding biodiversity. Moreover, the FAO has launched a proposal called Ecosystem Focus of the Fisheries (EEP, in Spanish). It's a management guideline for fisheries that allows integrating scientific knowledge with traditional knowledge in the decision-making process as a more assertive way of integration of wisdom and interests of the fishing areas.

One example of the relevance of the use of traditional and scientific knowledge is provided by FAO 2015, and relates to the creation of bycatch reduction devices (BRD) for fishes and also the turtle excluder device (TED), looking for more sustainable trawling fisheries. This coordinated work between scientists and fishers has generated a wide range of tools of international level that have contributed to mitigate the environmental impacts of this specific fishing activity.

However, it is important to clarify something regarding the use of traditional knowledge in fishing. Even though this information is fundamental for spiritual and/or material subsistence of the groups that make use of it, it doesn't necessarily make it sustainable for the environment, because, if users don't apply mechanisms of auto regulation to guarantee this sustainability, hydro-biological resources will deteriorate.[4]

Finally, it's appropriate to indicate that different public and private institutions, organized groups of society (such as fishers associations and cooperatives, etc.), non-governmental organizations (NGO) and universities, have also made efforts to protect and use in a sustainable manner marine coast resources. An example of this is the configuration of the Áreas Marinas de Pesca Responsable (AMPR, Marine Areas for Responsible Fishing) in the Pacific

4 For more information regarding the deterioration of fishing resources, consult BIOMARC SINAC GIZ (2013), Estado de la Nación (2014 and 2015) and Palacios (2014 and 2015).

coast of the country. Efforts are being made towards gradual changes regarding the marine coast management.[5]

RESULTS

Participatory mapping was the methodological instrument that allowed the use of scientific and traditional knowledge in the research group. The maps of the Pacific and Caribbean coast had the following characteristics: 'Atlas ITCR 2008 and Atlas Marino Costero of Costa Rica (SIGMAR) 2008; projection: CRTM05—Costa Rica Transversal de Mercator 2005; datum: WGS84—World Geodetic System 1984; scale: printed 1:00000' (Pérez, personal communication, 2016).

Mapping was a successful tool that facilitated the integration of scientific and traditional knowledge (there was an agreement among the interviewed regarding this particular aspect). Since it's a visual representation (accessible for anyone who doesn't know how to read nor write) that everyone from both sides is familiar with,[6] it enabled all participants to use their knowledge in a direct way.

Fig. 1 Participatory mapping session in the Caribbean (Barra del Colorado norte)

Image provided by INCOPESCA (2016)

5 The institutional weakness and the internal and external conflicts in the sectors have a negative effect, since they represent an obstacle in the articulation of efforts regarding fishery management.

6 It has to be acknowledged that people dedicated to fishing are not highly educated and a significant number doesn't know how to read or write. This is why visual techniques are paramount tools for the work in this area.

More important than the methodological technique is the traditional knowledge supplied by the people who represent the fishing area.[7] Traditional knowledge has had a prevailing role in the group, because it allowed identification of the following elements: areas where an interaction between fleets took place (areas of shrimp exploitation for each fleet and latent conflicts); weather conditions (that result in seasonal closure of the resources); areas where marine species thrive (commercial and non-commercial species), species and habitats that require exclusively to be preserved and/or investigated (information provided by the academy); types of ocean floors; types of shrimp according to bathymetry and the ecological implications of their capture.

Without the input of traditional knowledge, it would have been impossible to create such a detailed diagnosis of each area and of the hydro-biological resources of the Pacific and Caribbean (Barra del Colorado) coast of Costa Rica. On a national scale, this represents an immense contribution, since there was no information of this kind in the country.

Moreover, during the work of the research group, it was demonstrated that the academy and public institutions lack information.[8] However, traditional knowledge wasn't applied only to offset this lack of scientific information; it was considered equally important from the very beginning. The predisposition to a dialogue on the part of both parties facilitated the integration.

Next, the presentation of the opinion of the participants during the process, regarding traditional knowledge:

7 Throughout the mapping process we worked alongside representatives of the handcraft sector that was being zoned. This allowed us to consider the position of the resource users and apply their traditional knowledge.

8 INCOPESCA as well as the academy possess a significant amount of grey literature (non-published information).

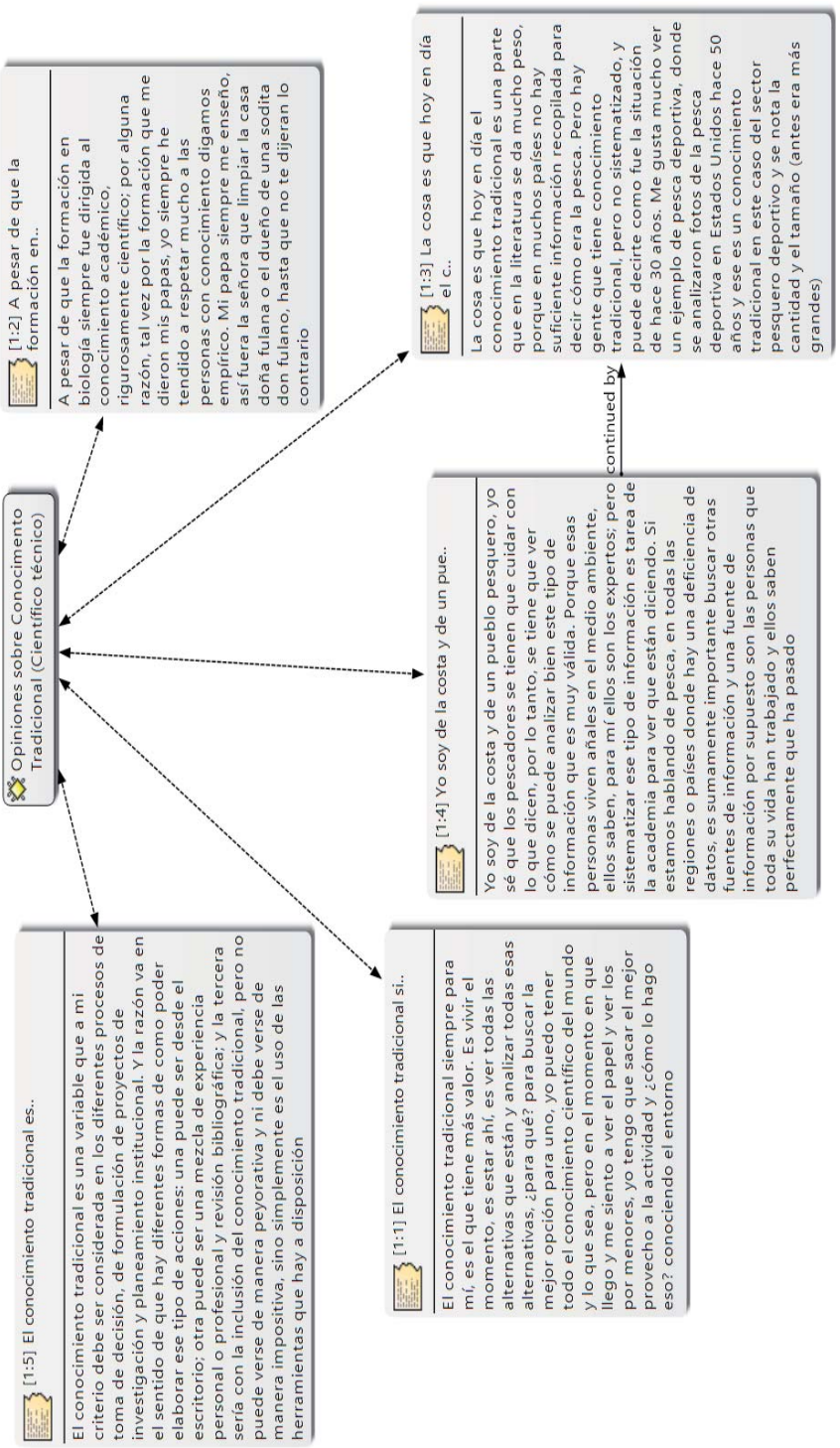


Fig. 2 Opinions of the participants regarding traditional knowledge (technical and scientific sector)

Opinions about traditional knowledge (technical scientific):

a) Traditional knowledge is a concept that I believe must be considered in the many processes of decision-making, creation of investigation projects and institutional planning. This is because there are many different ways of elaborating these actions: one could be from your own desk; another a mixture of personal and professional experience and bibliographical revision; a third would include traditional knowledge, it cannot be seen as pejorative or imposing though, but simply as a tool that is available.

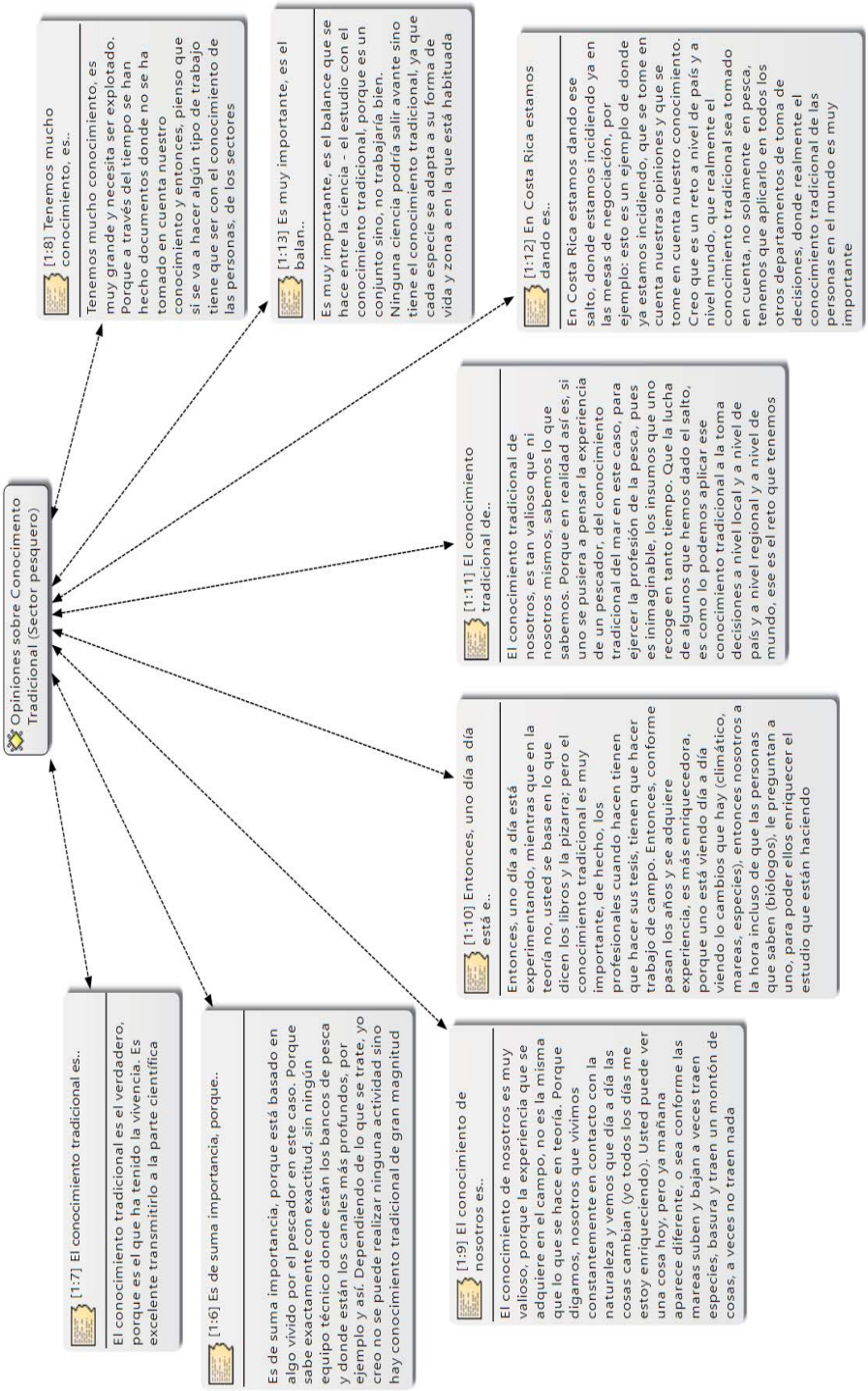
b) Traditional knowledge is for me the most important. It's about living the moment, it's being there, it's about seeing all possibilities available and analyse them. For what? To search for the better option for each of us. I can have all the scientific knowledge in the world and whatever, but when I have to sit down and look at all the details on a piece of paper, I have to be able to make the most of my activity and how do I do that? By knowing my environment.

c) I live in the coast and come from a fishing community. I know that fishermen must watch what they say and that's why it's important to find a good way to analyse this information, which is so important. Because these people have lived for years in the environment, they know, to me they're the experts. However, organizing this information is a task for the institutions, they must control what they're saying. If we're talking about fishing, in all countries or regions where there's a lack of information, it's extremely important to look for other information sources, which of course are the people who have lived there their whole lives, and they know exactly what they've been through.

d) The thing is, nowadays, traditional knowledge is given an important place in literature. In many countries there isn't enough information about fishing. There are people who have traditional knowledge but this is not organized; however, they can tell you how fishing was thirty years ago. I enjoy watching a case of recreational fishing, where pictures where taken in the United States fifty years ago. It shows an example of traditional knowledge, in this case, of sport fishing, and you're able to see the quantity and the size (they were bigger before).

e) Even though biological training has always been oriented towards an academic knowledge, a scientific one, for some reason, maybe because of the education I got from my parents, I have always felt respect for the people who own empirical knowledge.

Fig. 3 Opinions of the participants regarding traditional knowledge (fishing sector).



Opinions regarding traditional knowledge (fishing sector):

a) Traditional knowledge is real, because it is based on experience. It's an excellent idea to integrate it with scientific knowledge.

b) It is valuable since it's based on the experiences of, in this case, the fishermen. Because he doesn't need a technological device to know where the fish or the deep channels are. Depending on the subject, I believe you can't run an activity without a substantial amount of traditional knowledge.

c) Our experience is important because you get it in the field, and not study it in theory. Because we are constantly in touch with the environment and we can see how things change day by day (I learn new things each day). You may see something today, but tomorrow it may appear to be different, I mean that there are high and low tides, which sometimes bring species, garbage and a lot of other things, and sometimes they don't bring anything.

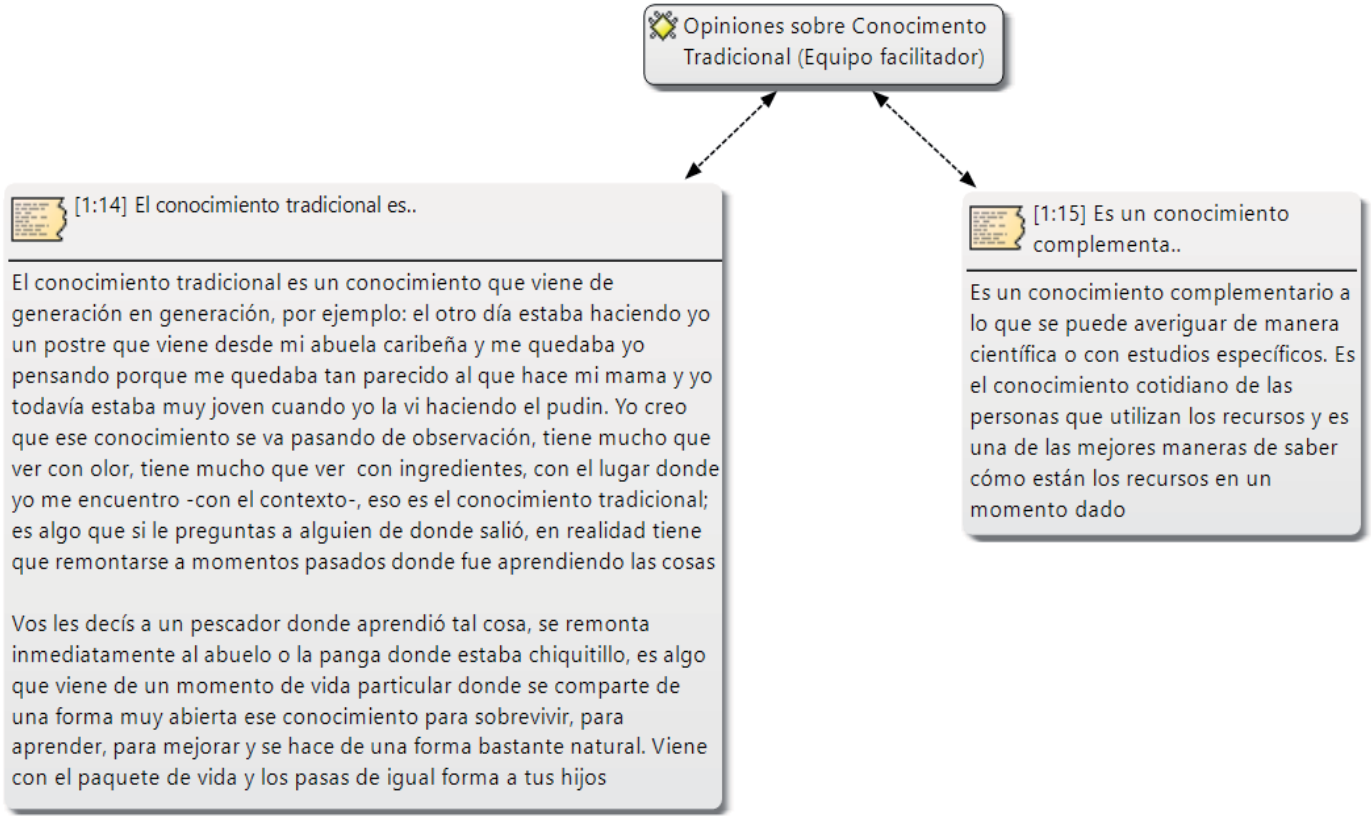
d) So you are living experiences day by day, while by learning theory from books and boards, you're not. So traditional knowledge is very important, in fact, professionals have to do some work in the field when they write their thesis. So, as years go by and you accumulate experiences, it's much more enriching, because you get to see the changes day by day (changes in the weather, the tides and the species). People who know (biologists) actually ask us things in order to enrich their studies.

e) We're taking this big step in Costa Rica, where we're already having an influence in the negotiations. Our opinions and experiences are being considered. I believe it's a national and international goal for traditional knowledge to be taken into consideration, not only in the fishing field, but in all other departments, because traditional knowledge of the people in the world is very important.

f) The balance between traditional knowledge and science is important, because without one of them, it wouldn't work properly. No science would be able to function without traditional knowledge.

g) We have a lot of knowledge, it's vast and needs to be taken advantage of. Because in the course of time, documents were made without taking our knowledge into consideration. I think that if a work is to be done, it has to be with the knowledge of the people and the areas.

Fig. 4 Opinions of the participants regarding traditional knowledge (facilitator team)



Opinions regarding traditional knowledge (facilitator team):

a) Traditional knowledge is knowledge that is passed from one generation to another. For example, the other day, I was preparing a dessert with a recipe that belongs to my grandmother, who comes from the Caribbean, and I was wondering why it looked so much like the one my mother does. When I was young I saw her preparing the pudding. I believe this knowledge passes on by observations, it has to do a lot with scents, with ingredients, with the place I'm in, with the environment, with traditional knowledge. It's something that when asked where it comes from, you have to go back to the days where you started learning. If you asked a fisher where he learned something, he goes back to his grandfather or the boat when he was little. It's something that comes from a specific moment of your life, where information was shared in an open way in order to survive, in order to learn, to get better, and it's done in a very natural way. It comes with your life kit and you pass it on to your children the same way.

b) It's a complementary knowledge that you can add to the scientific one. It's the daily knowledge of the people who use the resources and it's the best way to know how the resources are doing in a specific moment.

It becomes evident from the above that there's a positive acknowledgement of traditional knowledge. However, it's important to remember that the knowledge is passed on verbally, and can vary according to a person's expertise. This is why it's necessary to structure it.

During the research sessions, there was a sort of intertwined control between the artisanal fishers and the semi-industrial trawling representatives. Each area was keeping track of their own inputs, and that's why we can confirm the validity of the information provided by the different areas (Molina, personal communication, 2016).

Regarding the level of coherence between traditional and scientific knowledge, it must be said that both types of knowledge have had a wide range of coherence (even though it's not total), as informed by the representatives of the different sectors and the facilitator team. This confirms again the validity and relevance of the knowledge of the coastal people.

Even though there were practically no discrepancies between scientific and traditional knowledge, we consulted representatives of the different areas regarding the following argument: What happens when there's a disagreement between both parties and a decision must be made?

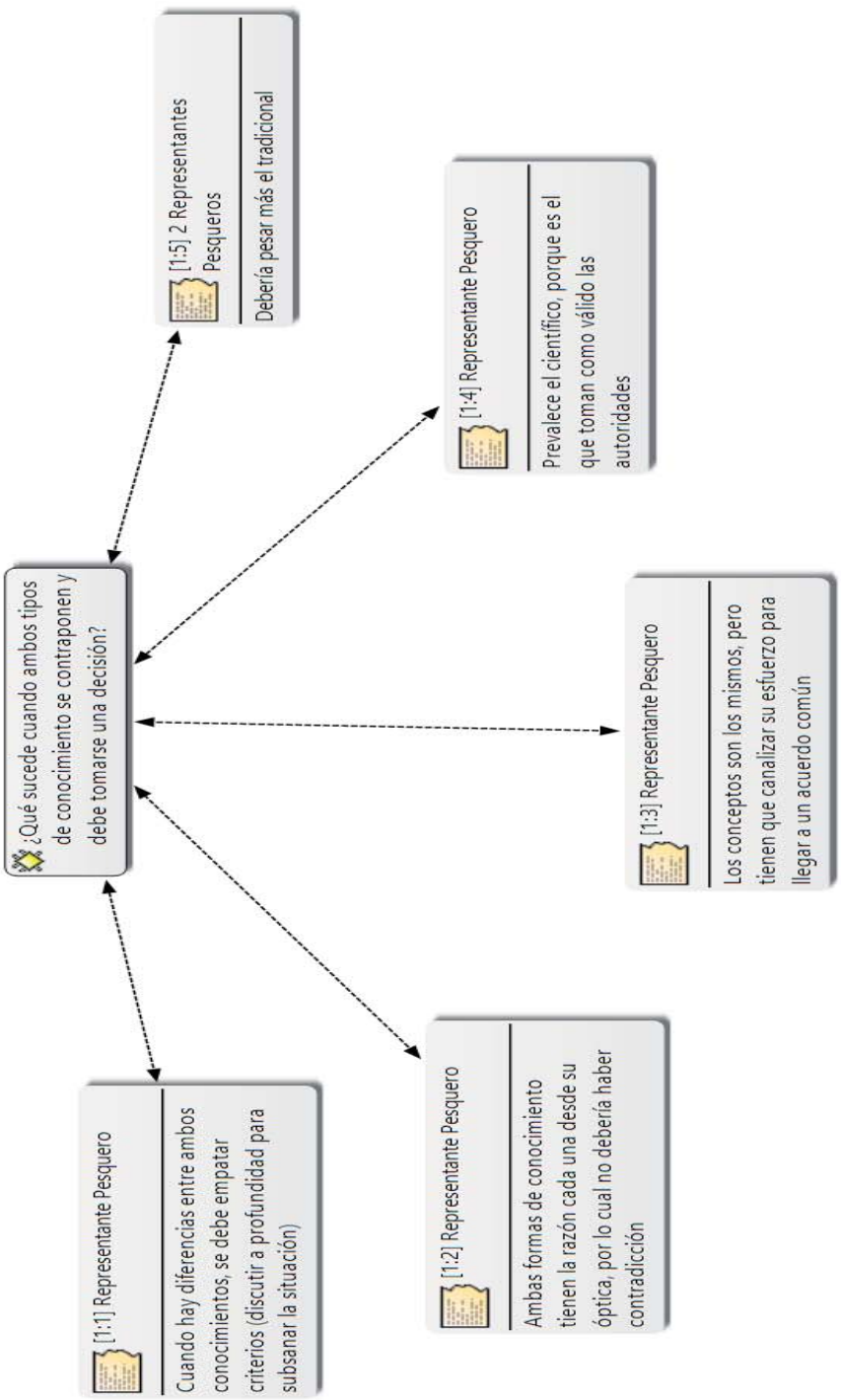


Fig. 5 Opinions of the representatives regarding the types of knowledge and the decision-making process

What happens when both types of knowledge oppose each other and a decision must be made?

a) When there are discrepancies between both types of knowledge, the only way ahead is to discuss until an agreement is made.
b) Both types of knowledge are right if considered through their own perspective, therefore there shouldn't be contradictions.
c) The concepts are the same, but they have to channel their efforts into a common agreement.
d) The scientific knowledge prevails, because it's the one taken as valid by the authorities.
e) The traditional knowledge should have more weight.

As you can see, most of the opinions reflect that there should be a more mediated position between both types of knowledge. This is important, as it reflects that there's an open dialogue and a search for consensus.

Furthermore, the contribution of traditional knowledge allowed, although it wasn't premeditated, to balance the power between scientists and fishermen. Generally, scientists are considered to own all knowledge and that's why, on purpose or not, discussions usually follow the information they have or their point of view. Thanks to the contribution of the fisher community, a more equal participation between both parties was achieved.9 Besides, both scientists and fishers have had to take into consideration the point of view of the other regarding conservation and the use of resources in order to create a balance.

Because it wasn't so common to use the knowledge of the fishermen in the process of making important decisions on a national level (as indicated by the interviewed), we asked the representatives of the fishing community how they felt about contributing with their traditional knowledge to the research group. There was a consensus, mainly because of two reasons: a) historically their opinion had never been taken into consideration in decisions that affected them directly, and now it will be taken into consideration; b) a space has been opened where scientists can listen to them. However, at the beginning there was one participant who mistrusted the research group, because he didn't know how his knowledge would be used and whether it'd be used against him. Notwithstanding, the situation changed in the course of time and one representative actually said, 'Even if they cut my head off, I'm happy when I'm going to the research group' (Representative of the fishing area, personal communication, 2016).

Seeing that their traditional knowledge wasn't frequently used, a series of suggestions will be presented, in order to enhance its use:

9 Other elements that helped balance the power were the political and socioeconomic conditions created by the vote n° 201310540 of the Constitutional Court.

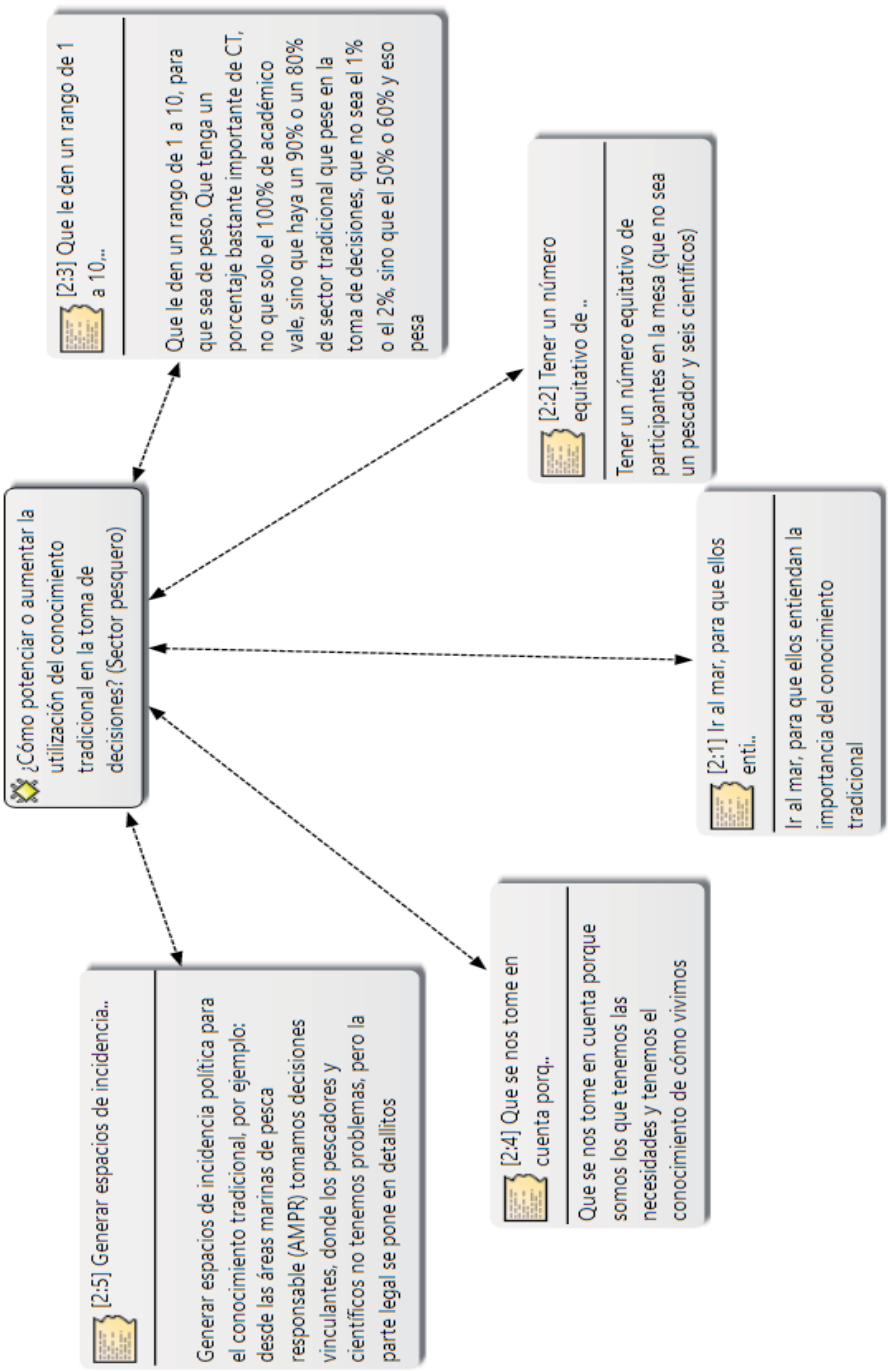


Fig. 6 Opinions of the participants: How to enhance or improve the use of traditional knowledge in the decision-making process

Opinions of the participants: How to enhance or improve the use of traditional knowledge in the decision-making process. (Fishing sector):

a) Create political spaces to talk about traditional knowledge, for example: from the areas for responsible fishing (AMPR) we took some binding decisions, which are agreed upon by fishermen and scientists, but the legal part is complicated.
b) We want to be considered, because we're the ones in need and we have the knowledge of how we live.
c) Go to the sea, so that they understand the importance of traditional knowledge.
d) To have an equal number of representatives at the table (not one fisherman and six scientists).
e) For traditional knowledge it is important to give a rank of importance from 1 to 10, because that way we can create a balance between the traditional and the scientific. In research and decisions-making, it is necessary to give equal weightage to both.

Scientific technicians pointed out that 'methodologies should be established in order to systematize, contextualize (geographically, historically and geologically) and filter the pertinent information' (Molina, Porras and Wehrtmann, personal communication, 2016). If there are no registries and verification of the contributions, you cannot prove their relevance and even less value or support their integration with the research and the decision-making.

The above could be facilitated through a coordination of institutional roles and responsibilities.[10] 'INCOPESCA is the guiding entity and should be responsible for telling the universities to do the research and to tell the National Learning Instituto (INA) to convert this research into technologies. All this in hand with the disposition and regulation of the area' (Aguilar, personal communication, 2016). This institutional triad can facilitate the collection and validation of the information supplied by traditional knowledge, and also its implementation in guidelines for fishing.

The facilitator team pointed out:

Facilitator 1: 'I believe in creating awareness in the people who do more fieldwork, technicians of National system of Conservation Areas (SINAC), Ministry of Environment (MINAE) and Costa Rican Fishing and Aquaculture Institute (INCOPESCA), so that they develop a protocol, to include that kind

10 Perhaps the current coordination between some institutions isn't adequate.

of initiative in their daily work. Also, that fishermen continue to talk to other members of the Legislative Assembly, in order to bear witness to their valuable knowledge. It's important to move members of parliament closer to the people who elected them. Universities have to start teaching their students how to organize traditional knowledge, so that it becomes an accessible source of information and can be easily consulted by future students.'

Facilitator 2: 'I believe we can promote the use of this knowledge by sharing practical experiences between the Responsible Fishing Marine Areas (AMPR) and other community initiatives, who have used such knowledge. Women and fishing forum have to be roped in. I'm also glad to see that, if universities start incorporating this information in their learnings, we'll very soon be able to obtain a strong validation for the use of this knowledge in the decision making process.'

However, there was another type of knowledge inside the research group, the scientific one, which contributed many inputs for the sustainable fishing of shrimp. This academic section was represented by two public workers from the Marine and Limbology Center (CIMAR) of the University of Costa Rica.[11] The academy had a double role: 1) as a participant, because it complemented the information supplied by the fishers and gave inputs during the discussions (regarding shrimp and other species that live in the fishing areas), which enriched the discussion significantly. 2) As a sort of arbitrator due to its impartial character,[12] because, when the representatives of the fishing community and those of the semi-industrial trawling couldn't arrive at a consensus regarding the delimitation of an area, its academics were asked to give their opinion in order to use and preserve the resources.

Next, we show the request to an academic representative for a zoning proposal, with the goal of setting an isobath (depth curve in the map), in order to protect pregnant sharks. 'From 0 to 40 metres of depth only artisanal fishery is allowed, and to the west of del Caño island a priority research area is indicated (with the goal of establishing what kind of fleet can be used and what kind of fishing can be done)' (Borrás, personal communication, 2016).

11 It's important to underline that academic participation in this fishing organization process doesn't guarantee what is being undertaken. The representatives' job is to incorporate the best scientific information in the decision-making process.

12 In spite of the impartial position of the participating scientists, they have been questioned by opposition groups, because they don't believe trawl fishing to be viable. However, researchers have maintained an impartial role facing the different situations, with a high ethic sense and bravery.

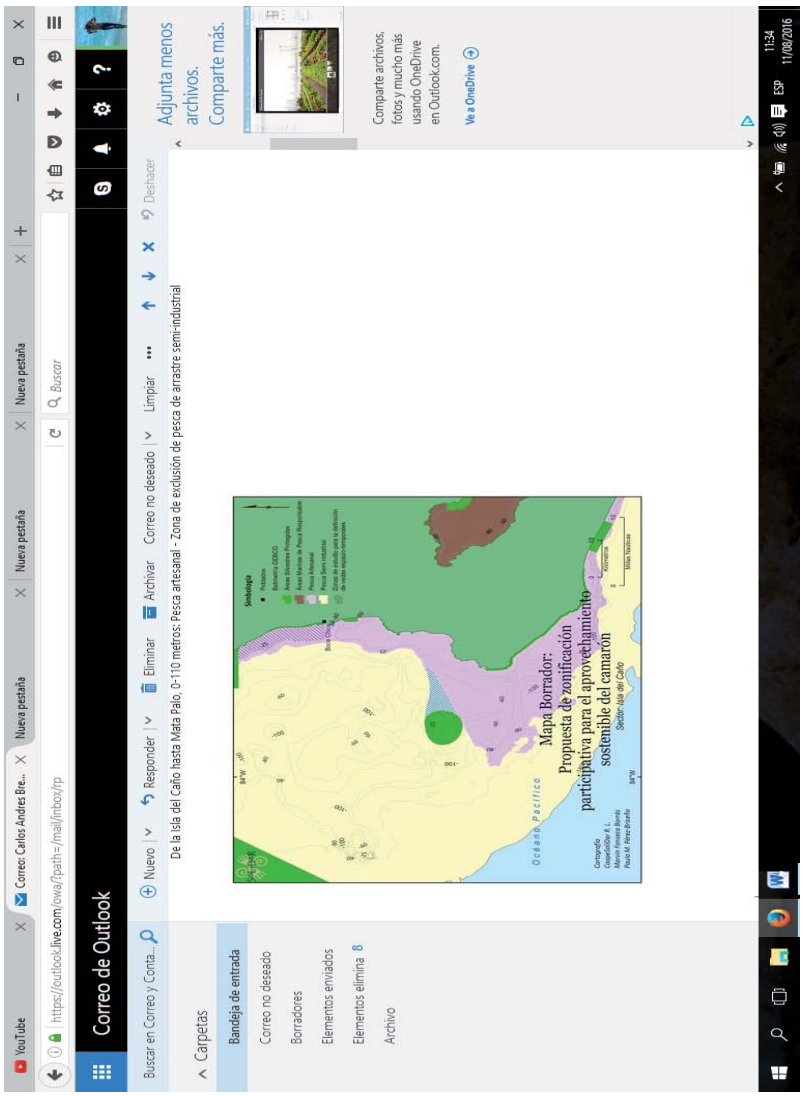
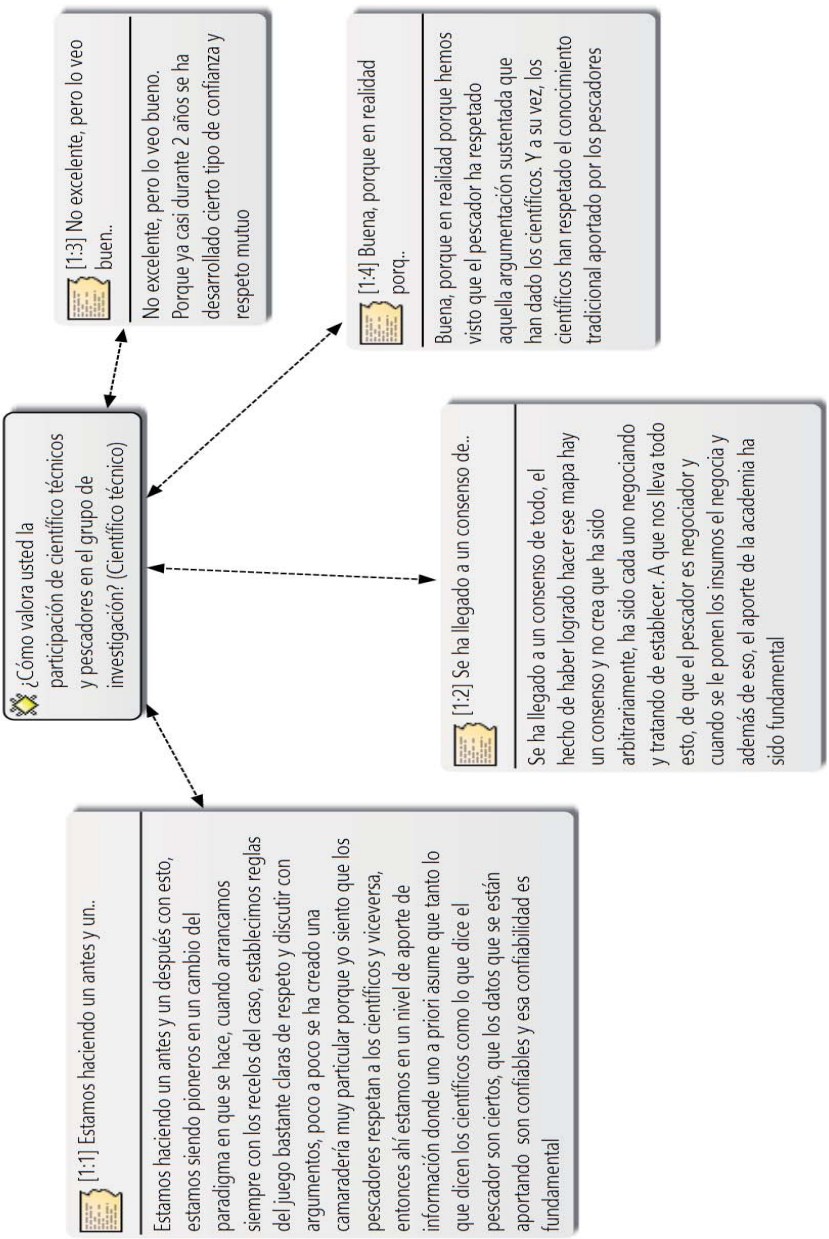


Fig. 7 Zoning proposal suggested by the academic representatives in zone 12 (from the south boundary of the Marino Ballena National Park to Boca Sierpe; it includes Violines, Caño and Mata Palo islands)

Image provided by CoopeSoliDar (2016)

On the other hand, the research group's work wasn't only relevant because it facilitated the incorporation of traditional knowledge to the scientific one, but also because of the interaction between scientists and fishers. We asked the participants how they evaluated the participation between scientists and fishermen in the research group. Scientists, as well as fishermen, qualified their interaction as good. And now the reasons for this evaluation:

Fig. 8 Opinions of the participants, how do you evaluate the participation of the scientists and fishermen in the research group? (Scientists)



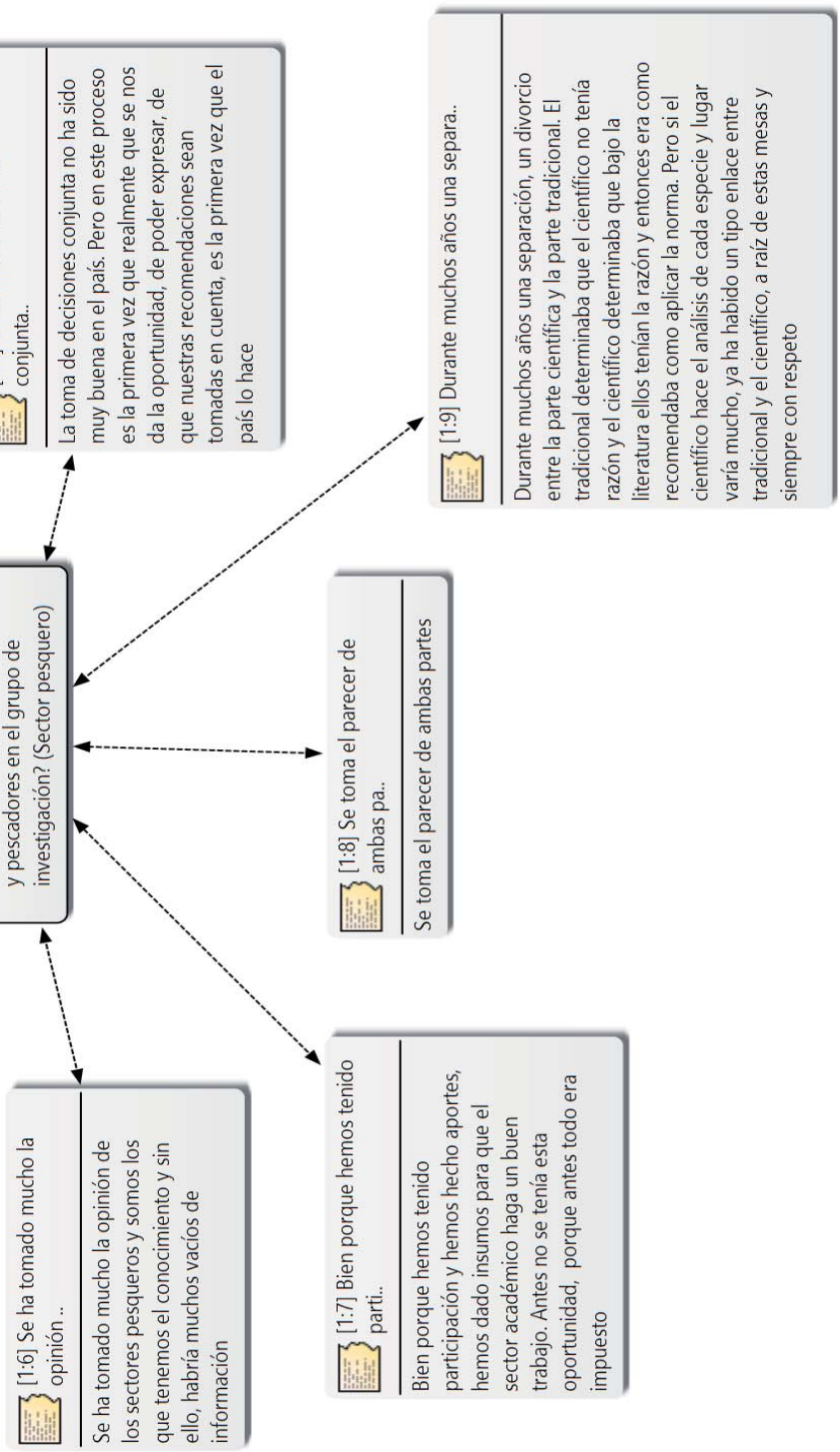
a) We're building a before and an after with this, we're pioneers in the way it's done. When we started this, there was a little bit of mistrust initially. We decided to establish very clear rules, regarding respect and well-founded arguments. Little by little we created a very particular comradeship, because I feel they respect us and so do we. We are at a point where you believe beforehand that what scientists and fishermen say is true, that the data they're using comes from a reliable source, and that trust is essential.

b) We have achieved an agreement for everything, the fact that we were able to create this map proves it. I don't believe it was made arbitrarily, each one of us has negotiated and tried to accommodate each others' opinions. Fishermen are negotiators, and also the academic support has been very important.

c) Good, because we've seen that fishermen respect scientific opinions, and at the same time, scientists have respected the traditional knowledge of the fishermen.

d) Not excellent, but it's good. It's almost two years now and a certain kind of mutual trust and respect has started to develop.

Fig. 9 Opinions of the participants, how do you evaluate the participation of the scientists and fishermen in the research group? (Fishermen)



a) The opinions of the fishermen have been taken into consideration; we are the ones with the knowledge, without it there would be gaps of information.

b) Good, because we have participated and given our contribution, we have given our inputs so that academics can do a good work. We couldn't do this before, because everything was imposed.

c) Opinions of both parties are taken into consideration.

d) For many years there was a distinction between the scientific and the traditional sides. The traditional side decided that the scientific one wasn't right, and the scientific side decided it was right, and advised a way to apply the law. But if the scientific side analysed each species and area, the results would vary. Thanks to these discussions, always made with respect, there's a link between the traditional and scientific side.

e) Joint decision-making hasn't been very good in the country. During this process we have had, for the first time, the opportunity to express ourselves, the opportunity for our suggestions to be taken into consideration. It's a first in the country.

This positive evaluation of the interaction between scientists and fishermen is due to a complex and long process of combined work between both parties. Regardless of the differences between both sectors, the participants have proved to be open to dialogue and consensus in order to achieve a sustainable use of shrimp.

Finally, since the research group has worked for more than a year towards reaching agreements between scientific and traditional knowledge, participants have learned many things. Some of these insights are highlighted below:

Technic scientific	Fishing sector	Facilitator team
✓ 'Get to know other fishing areas.' ✓ 'Any conversation with a fisherman means learning, for example: the way they use the nets, which species there are, and the different periods. It's valuable knowledge they've accumulated over decades.' ✓ 'Differences between the academic sectors.' ✓ 'The technical and political processes were approached separately, which allowed the group to work more calmly.' ✓ 'There are things that can be done properly if each sector gives in a little bit.' ✓ 'Each person can contribute with feedback.' ✓ 'The criteria for the distribution of the resource, thus of the fishing efforts (in the Pacific the resource is used by bathymetry, in the Caribbean by distance of the coast).' ✓ 'Management of groups (how do you manage them? What works and what doesn't?, which mistakes have been made and what can be improved?).' ✓ 'View of the real conditions of the fishing areas (what they endure day by day, understand and respect what they do).'	✓ 'How to do zoning.' ✓ 'Knowledge of other types of shrimp.' ✓ 'Which resources does each area have.' ✓ 'Different ways of expressing and analysing statistics. I've learned to evaluate things like sizes, volumes, and not only seeing the capture.' ✓ 'I've learned some technical terms such as bathymetry and curve levels.' ✓ 'You can achieve good results with dialogue.' ✓ 'We are thinking about how to have a political influence, it's not about who wins and who loses. We need to find a good agreement for everyone.'	✓ 'I've learned a lot regarding the realities of each sector, the conflicts and the alliances.' ✓ 'The importance of creating confidence in the participating areas.' ✓ 'The importance of taking into consideration the daily routines of the people who use the resource.' ✓ 'Areas where you can find the resource, species by depth and conflict zones.'

CONCLUSIONS

Traditional knowledge

Though there are some regulation frameworks and real international experiences regarding the importance of traditional knowledge, its integration in research is mediated by available economic resources, time limitations and wilfulness of the participants concerning the use of traditional knowledge.

The integration of traditional knowledge responds also to a 'democratic vision' of understanding and managing natural resources, because it combines different uses and views regarding a public resource.

Throughout history, the fishing sectors have been marginalized from the political level and from decision-making. Nonetheless, by using their knowledge in the research group, the representatives of the fishing sector have been able to empower themselves in an environment where their inputs are taken into consideration at a national level.

Without the information provided by traditional knowledge, it wouldn't have been possible to get to a detailed understanding of the marine resources in the mapped areas. In addition, it wouldn't have been possible to agree on criteria concerning the use of the resources in each area.

Both scientific and traditional knowledge are different ways of understanding the world. They don't stand in opposition to each other. However, each has its limits. Unless scientists and fisherfolk engage in acknowledging each other (which entails setting the ego aside), dialogue won't be possible. This was a key element of the research group, because both parties were open to dialogue and debate.

About participatory mapping

The knowledge (scientific and traditional) applied on the map, on both coasts, reflect a historical and natural moment. This is why these maps have to be frequently reviewed and/or modified, in order to adapt to the dynamic character of hydro biological resources.

Participatory mapping has helped the coming together of information; however, there's another series of methodological techniques that can be used for this purpose (check suggestion section). Be that as it may, the approach implied by the technique is more important than the technique itself. People interviewed during the research pointed out the following guidelines in order to create a methodological approach of this sort:

- 'Clear definition of a goal and a methodology to overcome that fear (between scientists and fishermen)' (Wehrtmann, personal communication, 2016); it must be visual, enabling location of the contributions in an immediate way and allowing people who don't know how to read and/or write, to comprehend what's going on (Aguilar, Solís y Muñoz, personal communication, 2016);
- It must be interactive in three different ways: a) 'you can't listen to the same person for four hours in a row, while we are seated and listening' (Chacón, personal communication, 2016); b) the tool must allow the displacement of the participants, in order to make the long days more bearable (specially for the fishermen, who aren't used to staying in one place for a long time), and c) it must allow the people to conduct well-argued discussions, and not only answering yes or no to a question.

About the research group

It's extremely interesting to notice how the work of the research group developed—although in a more spontaneous way—with parameters similar to the ones pointed out by FAO (2015, p. 55), to achieve success in collaborative research, more specifically in the following elements: 'promote fields that facilitate the interaction and collaboration between fishermen, scientists, managers and other parties'; 'foresee well-established compromise laws, based on mutual respect and transparency premises'; 'promote collaborative research'; 'identify the most important and reasonable goals of the investigation for one or more of the parties collaborating'; 'emphasize on practical approaches'.

The work performed by the research group has marked a milestone in the way of organizing the fishing resources of Costa Rica. However, it's been a long process of agreements and disagreements (with elevated rates of conflict), where trust and dialogue became the tools needed in order to 'organize the human activities that depend on the resources, because the resources organize themselves' (Molina, personal communication, 2016).

During the organization process, relationships between some representatives of the artisanal fishing sector and of the semi-industrial trawling (who have had a history of dispute for the use of different marine resources) have improved. They both acknowledge the right to eat (by means of the fishing activity), but they also have to carry it out in a sustainable way for the environment. Both parties were able to express their opinions regarding the different areas for the use of shrimp and of other species that live in a particular zone (there are significant similarities regarding the information provided by the representatives

of the artisanal fishing and those of the semi-industrial area). This helped an alternative resolution of conflicts between both parties.

Finally, each organizing process is very particular; it is impossible to establish guidelines that must be strictly executed. All human relations are based on assertive communication, which is the key element to promote dialogue and eventually, to build trust (where time and spontaneity—no pressure from third parties—of the interaction are key elements).

Towards a public policy

The knowledge provided by all participants has allowed the creation of a public policy, in the wide sense of the word. The long process of dialogue allowed the integration between both types of knowledge and the different needs of the participants, and generated an agreed proposal in order to find a balance between the protection of the ecosystems, the sustainable use of the hydro biological resources and improvement of the distribution of benefits obtained with these resources.

In order to allow traditional knowledge to be considered in the decision-making process on a national level, it needs to be systematized and verified. The work of the research group that followed from the national dialogue table on sustainable use of shrimp has been successful. Even though there's a need for more combined investigations between scientists and fisherfolk, this experience can contribute to help create a practical and methodological reference for future projects that intend to incorporate traditional knowledge into decision-making.

RECOMMENDATIONS

In order to develop an assertive communication between sectors with different types of knowledge, the following elements need to be taken into consideration:

- It must be developed in an impartial physical space (it's important to guarantee the serenity of the participants);
- Setting of informal areas for varied conversations (coffee and lunch hours were essential for participants to have moments of interaction regarding personal topics. They improved their interpersonal relations);
- Rules must be applied and verified from the beginning (when participants behave arbitrarily this helps re-establish order);
- Equal number of representatives (this helps participants to feel more secure when expressing themselves);[13]
- An impartial mediator who is able to establish common interests, reconcile the parties involved and guide the dialogue towards a propositional field. This mediator must give the same acknowledgement to the inputs provided by both parties.

Traditional knowledge and decision-making

The first steps towards boosting use of this knowledge during research or decision-making processes are generated by respectful dialogues, which create synergy amongst participants. This allows integration of inputs and necessities of the many participants for a common good (this is one of the most relevant results of the research group regarding the sustainable use of shrimp).

Furthermore, one of the goals should be to make the owners of traditional knowledge agree on the information they are providing. This entails gathering all the information, from the one belonging to the youngest and to the oldest, and more experienced, representatives, in order to compare it (this will help create a sort of internal control).

Processes entailing traditional knowledge should be carried out separately from political processes. This might help ease any kind of pressure that makes the natural flow of a research process, using traditional knowledge, difficult.

13 Scientists were a minority vis-à-vis the representatives of the fishing area, however, this wasn't an inconvenience for the group work. The suggestion of having an equal number of representatives arises because it may affect negatively the fishermen's side.

About participatory mapping

Participatory mapping is an adequate tool for the integration of scientific and traditional knowledge. However, the following issues should be taken into consideration: The organization of the fishing fleet serves a particular resource, and even though some rules have been established to protect other marine species, mapping should start from an ecosystem point of view, integrating other fleets and other non-fishing uses in the whole marine territory.

'There are fishermen who have difficulty interpreting bi-dimensional maps, they often use points of reference in the coast to tell where they are. It's very difficult to tell when you are on a boat, far away from the coast, and you can't see it properly. This is the reason why names of local places used by them should be used for smaller scales. We are already doing this on a large scale, but there will be challenges arising during the use of certain areas, but with time it'll be easier' (Molina, personal communication, 2016).

The map was created from a perspective regarding both traditional and scientific knowledge, yet it still must be integrated by a control and security approach.

Methodological techniques to facilitate the incorporation of scientific and traditional knowledge

Considering that the methodological approach of a technique must adjust to the characteristics of a population, there are certain techniques that can facilitate the integration of scientific and traditional knowledge:[14] databases (that allow the incorporation of scientific and traditional knowledge, enabling a comparison of data), field trips (with the goal of contrasting and/or verifying the information), mapping (by stratums and bathymetric), use of points of reference of the fishermen and geographic information systems (GIS).

Result validation

In order to carry out joint investigations (scientists and fishermen) that allow a validation and/or modification of the information shown on a map, we need a joint effort from INCOPESCA, the fishing sectors that are directly involved in the shrimp fishing, and the universities. If these investigations were to be exclusively scientific, we would go back to the initial mistake of considering only scientific knowledge. If such joint efforts were to happen, the experience of the research group could be considered as a reference for decision-making including the use of traditional knowledge.

14 Only the opinions of the support team and the scientific technicians are taken into consideration, because the questions were not asked properly to the representatives of the fishing area.

It is essential that the facilitator team accompanies the representatives of the different sectors when presented with the results of a process like this one, so that the information is delivered more accurately to the members.

ANNEXES

ANNEX 1

How can the research group's work be improved?

The participants of the research group were positive regarding the work described in this case study. However, they shared some suggestions based on their experiences in the group:

SUGGESTIONS	
Scientific technic sector	**Fishing sector**
Increase the representation of the fishing representatives (to have more information and take some of the responsibility off the representatives)	Find a way to give more assistance, because in the end there are always fewer people left.
Invite other universities and academic institutions to participate (everything is concentrated on the group coordinator)	Discuss arguments more thoroughly
More institutions (like MINAE, but with a greater presence, municipalities, universities, etc.)	There has been no proper or continuous follow-up of what has been done
Improve the broadcast of information, but invite the people to come and see with their own eyes what we are doing (so that they don't just hear it from the news)	Invite more institutions to participate
Improve the representation of the fishing sectors	
Stop people who talk too much	
Have a better structure of the work's timetable, of the information required and of the agreements	

ANNEX 2

List of the people who participated in the interviews.

Technic scientific sector	
Johnny Aguilar	INA, Núcleo Náutico Pesquero
Helena Molina	UCR
Antonio Porras	INCOPESCA
Ingo Wehrtmann	UCR

Fishing sector	
Roy Carranza	CAMAPUN
David Chacón	CoopeTárcoles R.L
Jesús Chávez	Barra del Colorado, Caribe
Aracelly Jiménez	CoopeMoluscos de Chomes
Rolando Ramírez	Zona 201
Marcial Parra	CAMAPUN

Facilitator team	
Marvin Fonseca	CoopeSoliDar R.L
Alejandro Muñoz	CoopeSoliDar R.L
Vivienne Solís	CoopeSoliDar R.L
Paula Pérez	CoopeSoliDar R.L

ANNEX 3

Personal communications in chronological order.

Alejandro Muñoz, personal communication dated 20 June 2016.

Marcial Parra, personal communication dated 21 June 2016.

Johnny Aguilar, personal communication dated 12 July 2016.

David Chacón, personal communication dated 12 July 2016.

Helena Molina, personal communication dated 19 July 2016.

Vivienne Solís, personal communication dated 20 July 2016.

Ingo Wehrtmann, personal communication dated 22 July 2016.

Paula Chavarría, personal communication dated 11 August 2016.

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CASE STUDY 2

SYSTEMATIZATION PROCESS OF FISHING DATA COLLECTION OF COOPE TÁRCOLES R.L.

TOWARDS A COMMUNITY MANAGEMENT OF FISHING INFORMATION BASED ON TRADITIONAL KNOWLEDGE

Prepared by:

M.Sc. Alejandro Muñoz Rivera

SUMMARY

This document presents the systematization of the process of data collection and analysis undertaken by the fisherfolk of Tárcoles since 2006. Coope Tárcoles R.L. is a fishing cooperative endeavour that has been active for more than thirty years in the Central Pacific Coast of Costa Rica.

Coope-Tárcoles R.L. has spearheaded processes of responsible fishing in Costa Rica and has done so with the technical guidance and support of Coope SoliDar R.L., a professional service cooperative that has headquarters in San José, the capital city of the country.

The collaborative relationship established by both institutions in 1999 has paved the way for the adoption of FAO's responsible fishing code of conduct by the Tárcoles fisherfolk, and also for the collaborative mapping of the sites used for fishing, which led to the design of a Responsible Fishing Area for Tárcoles, later recognized by the Costa Rican government via INCOPESCA, the National Fisheries and Aquaculture Institute.

All of these benchmark accomplishments can be traced back to a historic decision: back in 2005, the Tárcoles fisherfolk began collecting their fishing data and organizing it in a Microsoft Excel spreadsheet. Ten years later, this is the best, and only, example of locally managed fisheries' database. Because of the comprehensive and methodical data collection, this is now the longest running data set to exist outside INCOPESCA's own records, and has proven to be a readily organized and complementary data set to those used by INCOPESCA to inform their management decisions.

The past and present of the Coope Tárcoles' fishing database is summarized herein, so that its valuable lessons can be replicated elsewhere.

FISHING ACTIVITIES' DATABASE OF COOPE TÁRCOLES R.L.

INTRODUCTION

Coope-Tárcoles R.L. is an artisanal fishing cooperative located in árcoles, Puntarenas, in the central area of the Costa Rican pacific shore (Fig. 1). With more than thirty years' experience as a cooperative, this organization is one of the most important references in the country regarding artisanal fishing, and especially, in managing the community's fishing data.

Figure 1. Location of a fishing community of Tárcoles in the Costa Rican pacific coast

Coope-Tárcoles R.L. has become a unique fishing cooperative due to the effort of its members in the last ten years. It has acknowledged and used the responsible fishing guidelines provided by FAO. It has also achieved the creation of a Responsible Fishing Marine Area (AMPR), where fishers have special conditions to develop their activities and also have the power to influence decision-making that affects the resource. Coope Tárcoles R.L. has also developed the largest fishing database of a small-scale fishing community.

The information contained in the Coope Tárcoles' fishing database has enabled the indirect monitoring of the state of different fish caught by fishermen. It has also helped in the indirect monitoring of fluctuations in the patterns of the different marine and coastal areas throughout time, and, in some occasions, of the variation in profit due to fishing activities. The information in this database has proven to be extremely valuable for the growth of Coope Tárcoles R.L. as an artisanal fishers' organization.

In 2016, the fishing activities database of Coope Tárcoles includeed information concerning a period of ten years, from 1 January 2006 to 31 December 2015. Data regarding 2016 wait to be included in the database.

Figure 2. Fishermen in the Tárcoles sea

Genesis of the database

In 2005, a volunteer Kyra Mumbauer visited Coope Tárcoles R.L. She had earlier collaborated with a process of data systematization in order to comprehend the existing tendencies in the catches of the cooperative's fishers (Coope SoliDar, 2005). This effort was later supported by Coope SoliDar R.L., a professional services cooperative based in San José, and an associative relationship was established between this two co-ops.

Jeannette Naranjo, a fisher and a Coope Tárcoles member, showed interest in this effort and became responsible for gathering information regarding fishers catches (Fig. 3). With Kyra's help a Microsoft Excel calculation sheet was designed, which Jeannette used to organize all data for the months of August and September.

Figure 3. Jeannette Naranjo (right) answering questions regarding the work of Coope Tárcoles R.L. during a tour of the cooperative's facilities

Jeannette continued her work of collection and digitalization of information regarding fishing activities of members of Coope Tárcoles R.L. This work, which requires a lot of time and effort, attention to detail and discipline, has allowed one to comprehend and characterize the nature of the fishing done in Tárcoles. This data systematization initiative is the first in the country done by a group of fishermen, and its value resides in the fact that it has been an ongoing business, with information still being gathered, systematized and analysed year after year.

In 2007, Coope SoliDar R.L. started an accompaniment and technical guidance process for data collection. The information contained in the original documents from Kyra and Jeannette was reviewed, organized, clarified and corrected for analysis. The next year, in 2008, the first report that contained detailed information concerning the results of the analysis, was given to the fishermen. This report covers the years 2006, 2007 and 2008, and is considered a guideline for annually analysing information that nourishes and expands the fishing database of Coope Tárcoles R.L.

Coope Tárcoles' characteristics that allowed developing the process

The fishing database construction process of Coope Tárcoles R.L. has had a special characteristic which permitted the idea of systematization of fishing data, collected by a group of fishers, to become a reality.

Because Coope Tárcoles R.L. is an organized and old cooperative, it has had a well-designed calculation system for decades now, which keeps track of the gains that each fisher makes when selling his catch to the cooperative.

The system used by Coope Tárcoles R.L. allows calculation of profit made by each fisher in one of their fishing trips. The members of Coope Tárcoles R.L. (and other fishermen who are not members) deliver their catch at the end of the day to the cooperative's collection centre. The weight of the species caught by fishermen is calculated at this centre and arrangements made for storage of the fish (Fig. 4).

Figure 4. Collection Centre of Coope Tárcoles R.L.

In the collection centre, a receipt is given with the details regarding the kilograms of each caught species or captured fish, which the fisher takes to a cashier, and an accounting team of the cooperative pays the fisher according to the information in the receipt (Fig. 5).

Figure 5. Captured fish delivered in the collection centre of Coope Tárcoles R.L.

The fact that each receipt corresponds to a fishing trip has proved to be perfect for tracing fishing information of the database of Coope Tárcoles R.L. From a biological and information analysis point of view, this method of data registration allows you to use a very valuable combination of information, because each trip has different characteristics.

A fishing trip has a precise duration, is done at a certain moment of the day, and is usually repeated for several days. Over the year, the actual moment in a day for fishing can vary, depending on the species that are abundant all year long and on the natural processes that define the behaviour of each species and their populations. Each fishing trip also has a defined route, which can be repeated several times in a year by a fishermen or can vary. The length of the fishing trip and the location chosen by a fisher depend also on the type or types of fishing methods they use.

These variables are extremely important when analysing and interpreting the results obtained from the information in the database. Over the years and after many analysis, one of the most important conclusions and lessons learned is: *the fishing trip is the natural unit for gathering fishing information.*

At the beginning, Kyra and Jeannette used receipts saved by the cooperative's calculation department as a source of information, which, as we said before, they digitalized and organized in a Microsoft Excel calculation sheet. Receipts must be stored for a period of years due to legislation that regulates accounting activities, and therefore they turned out to be the ideal source of information to transcribe and help create a database.

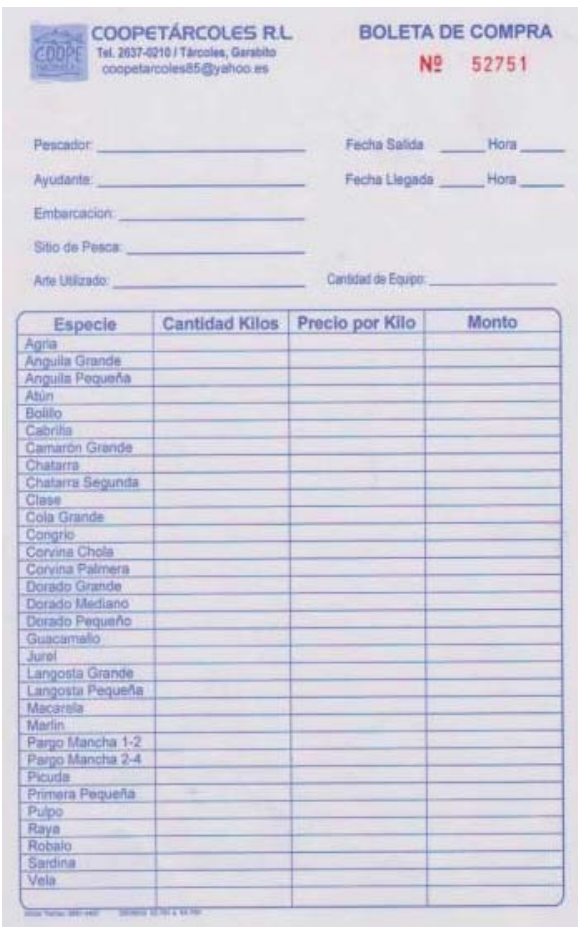
During these first years of work, thanks to her knowledge of the fishing activity of the cooperative, Jeannette contributed with information regarding

the fishers' activities and preferences, the duration of the fishing trips, and the locations to where all fishermen went.

Once Coope SoliDar R.L. hired a biologist who provided help and technical guidance for the data collection, we started to refine this system. One of the first technical suggestions made to Coope Tárcoles R.L. was a simple modification in the receipt's structure.

Spaces were added in the upper part in order to register departure and arrival date of the fishing trip, as well as start and end time. Spaces to indicate location of the fishing and the method used by the fisherman were also added, as well as number of equipment (how many nets or hooks, for example). This modified receipt used by Coope Tárcoles R.L. nowadays, is shown in Fig. 6.

Figure 6. Example of the receipts used by fishermen of Coope Tárcoles R.L., in order to describe in detail the catches of fishers and calculate the profit of each fishing trip.



COOPETÁRCOLES R.L.
Tel. 2637-0210 / Tárcoles, Garabito
coopetarcoles85@yahoo.es

BOLETA DE COMPRA
Nº 52751

Pescador: _____ Fecha Salida _____ Hora _____
Ayudante: _____ Fecha Llegada _____ Hora _____
Embarcacion: _____
Sitio de Pesca: _____
Arte Utilizado: _____ Cantidad de Equipo: _____

Especie	Cantidad Kilos	Precio por Kilo	Monto
Agria			
Anguila Grande			
Anguila Pequeña			
Atún			
Bolillo			
Cabrilla			
Camarón Grande			
Chatarra			
Chatarra Segunda			
Clase			
Cola Grande			
Congrio			
Corvina Chola			
Corvina Palmera			
Dorado Grande			
Dorado Mediano			
Dorado Pequeño			
Guacamallo			
Jurel			
Langosta Grande			
Langosta Pequeña			
Macarela			
Marlin			
Pargo Mancha 1-2			
Pargo Mancha 2-4			
Picuda			
Primera Pequeña			
Pulpo			
Raya			
Robalo			
Sardina			
Vela			

It's important to point out that these changes in the receipts weren't immediately implemented. One of the biggest obstacles that the process of data collection has had over the years has been the reluctance of fishermen to add activities to their work routine, especially when it concerns the information relevant to a fishing trip.

Fishermen take their catch to the collection centre when they finish their work, after which they are tired, and they want to get home to shower, change, eat and rest. The time they spend waiting in the collection centre, where they receive the receipt, is a very sensitive one, because most of them need to be paid to be able to go home and rest. This is why fishers haven't welcomed these changes, having to answer questions like where did you go fishing, how many nets did you use, when did you set sail and when did you come back? For a very long time, Jeannette took care of filling these blank spaces herself, because the receipts hadn't been filled when they reached her.

To get fishers to understand the value of this data has been hard, and it's essential that they provide this information when they deliver their catch in the collection centre. This is because the information will be more authentic and reliable if supplied by the fishermen who made the fishing trip.

A recurring suggestion made to Coope Tárcoles R.L. is the one concerning information regarding departure, arrival, start, end, location and fishing methods, suggesting that this information be made mandatory for the collection centre to receive fish, and other fishing products. This regulation still needs to be implemented by Coope Tárcoles R.L.

Content and characteristics of the database

The basic information that forms the fishing database of Coope Tárcoles R.L. comes from the receipts mentioned above, which mentions the following:

- Date (year, month, day) in which the work took place.
- Departure and arrival time. *Based on this data the hours of a working day are calculated.*
- Location (commonly locations used by fishermen).
- Fishing method.
- Information regarding the fishing method (how many hooks or nets were used, etc.).
- Kilograms of fish caught (for each species that members of Coope Tárcoles R.L. are allowed to catch).

- Identity of the fisher and the people that accompanied him during the trip.

In addition, the moon phase is also recorded. People get this data from tidal calendars and other resources used regularly by Tárcoles' fishermen.

The most frequent species and fishing categories caught by members of Coope Tárcoles R.L. are listed in Chart 1. The scientific names and descriptions for these species and fishing categories are presented in Chart 2.

Chart 1. List of species and fishing categories included in the fishing database of Coope Tárcoles R.L.

Species	Fishing categories
Big red pike conger	Junk
Small red pike conger	Second Junk
Tuna	Class
'Bolillo'	First Big ('Corvina Chola' + 'Corvina Palmera')
Broomtail Grouper	First Small
Squid	
Shrimp	**Note:** Fishers of Tárcoles have traditionally used the First Big category to include all catches of corvina and snook fish.
'Cola Grande'	
Conger eel	
'Corvina agria'	This category was eliminated in 2007, and substituted in the database by individual categories for 'snook', 'corvina palmera', and 'corvina chola'.
'Corvina chola'	
'Corvina palmera'	
Big mahi-mahi	
Medium mahi-mahi	
Small mahi-mahi	In order to establish comparisons between 2006 and the years following 2007, the categories for 'corvina chola' and 'corvina palmera' were mixed in the additional column under First Big. This additional column adds up the kilograms of both species.
Guacamayo snapper	
Atlantic horse mackerel	
Big Lobster	
Small Lobster	
Mackerel	
Marlin	
Porgy 0-1 (red)	
Porgy 1-2	
Porgy 2-4	
Sharpnose Corvina	
Octopus	
Stingray	
Snook	
Sardine	
Sailfish	

Chart 2. Biological identity of the species and fishing categories that appear on the fishing database of Coope Tárcoles R.L.

Species or category	Identification
Big Red Pike Conger	Includes *Cynoponticus coniceps* species weighing more than 3.0 kg.
Small Red Pike Conger	Includes *Cynoponticus coniceps* species weighing less than 2.9 kg.
'Bolillo'	This category includes different species of sharks. These vary according to season.
Broomtail Grouper	Includes *Epinephelus acanthistius* species weighing more than 2.5 kg.
Shrimp	Also known as whiteleg shrimp, includes *Litopaenus occidentalis, L. stylirostris, and L. Vannamei* species.
Junk	This category includes species of a low commercial value that don't reach a considerable weight. Some of these are: *Oligoplites altus, Diapterus peruvianus, Peprilus medius, Caranx caninus, Scomberomorus sierra, Bairdiella ensifera*, amongst others.
Class	This category includes species with a higher commercial value than the junk category, and weights are very variable. Some of these are: *Nebris occidentalis, Centropomus robalito, Cynoscion albus, Paralonchurus petersi, Umbrina xanti, Bairdiella ensifera.* The species that belong to this category have usually good meat, but don't achieve high sale prices do to their low weight.
'Cola Grande'	This category includes species of the *Ariidae* family, weighing more than 800g. Species with a lower weight go to the junk category.
Conger Eel	Includes *Brotula clarkae* species.
'Corvina Agria'	Includes *Micropogonias altipinnis* species weighing more than 1kg.
Guacamayo Snapper	Includes species such as: *Lutjanus colorado, L. argentiventris* and *L. novemfasciatus* weighing more than 0.5 kg.

Big Lobster	Includes *Panulirus gracilis* and *Panulirus inflatus* species weighing more than 300g.
Small Lobster	Includes *Panulirus gracilis* and *Panulirus inflatus* species weighing less than 300g.
Mackerel	Includes *Scomberomorus sierra* species weighing more than 450g.
Red Porgy	Includes *Lutjanus guttatus* species weighing less than 0.5kg and the *L. peru* species.
Porgy 1-2	Includes *Lutjanus guttatus* species with a weight between 0.5 and 1kg.
Porgy 2-4	Includes *Lutjanus guttatus* species weighing more than 1 kg.
First Big	This category includes generally *Centropomus* species weighing more than 2400g.
First Small	Includes species such as *Cynoscion albus, Centropomus viridis*, and *C. nigrescens*, with weights that vary between 450 and 2400g.
Snook	Although this species, *Centropomus viridis*, is usually included in the First Big and First Small categories according to size, snooks were separated from the commercial categories in this study.

Participative zoning process: Zone delimitation inside and outside the Responsible Fishing Marine Areas of Tárcoles

One of the most significant achievements of Coope Tárcoles R.L., due to the implementation of guidelines for responsible fishing and data systematization, has been the recognition by the government of the Marine Responsible Fishing Area of Tárcoles by the National Institute of Fishing and Aquaculture (INCOPESCA) of Costa Rica.

The delimitation is based on the division into different areas of use and the management for each one as suggested by Tárcoles' fishermen. The participatory mapping process of the fishing locations was carried out with the guidance and technical assistance of Coope SoliDar R.L.

A process of participatory mapping, that used the traditional knowledge of fishers, was carried out. The fishing locations were put on a map. Once the

first map was done, the task was to understand the way each area was used. For example, whether a location was good for fishing with hooks or nets, whether it was regularly visited throughout the year or just seasonally, whether it belonged exclusively to one species (like lobsters) or if it was important for catching species with high commercial value.

Once the data from traditional knowledge was collected and systematized, the process promoted zoning of the fishing locations, which led to the establishment of six different areas of fishing use. The areas 1, 2, 3 and 4 are located near the coast and are suitable for fishing with nets. Areas 5 and 6 are located in deeper waters and represent locations for fishing with ropes or hooks.

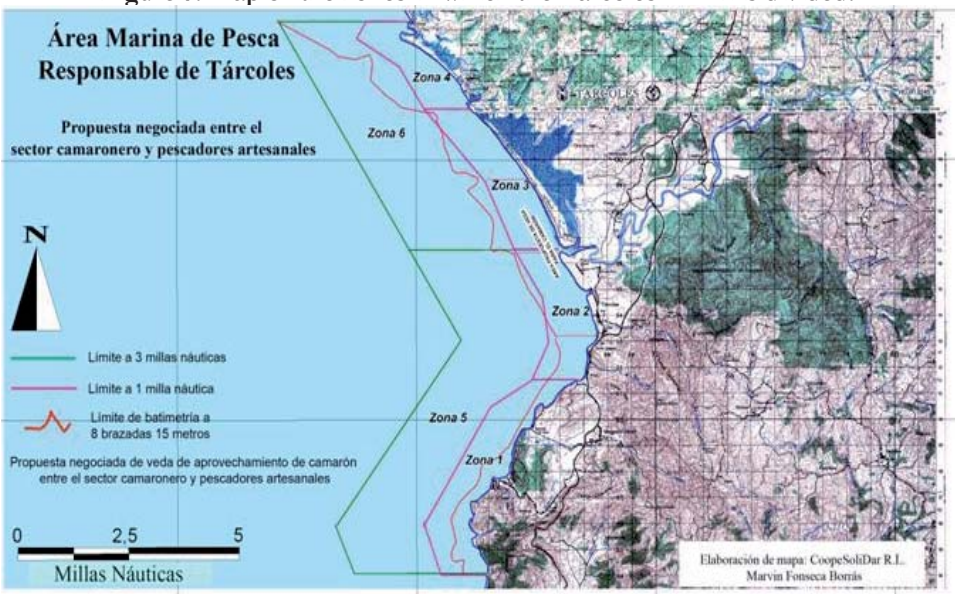
These are the areas that fishers wanted to include in the Responsible Fishing Marine Areas (AMPR) of Tárcoles. Each individual location of each zone are represented in Chart 3.

Chart 3. List of locations, according to zone, included in the fishing database of Coope Tárcoles R.L.

<table>
<tr><th colspan="2">Inside the Tárcoles AMPR</th><th>Outside the Tárcoles AMPR</th></tr>
<tr><td><u>Zone 1</u>
Agujas
Bajo Juan Chaco
La Gallinera
Pesebre
Punta Leona</td><td rowspan="2"><u>Zone 5</u>
Agujas
Bajo Juan Chaco
Cerro Mar
La Gallinera
Pesebre
Nativa
Punta Leona
Playa Azul
Rompio
Tárcoles</td><td><u>Front</u>
Tortugas</td></tr>
<tr><td><u>Zone 2</u>
Cerro Mar
Nativa
Playa Azul
Rompio
Tárcoles</td><td><u>Nearest south</u>
Frente a las Cabinas
Herradura
Jacó
Oscuranas
Playa Hermosa
Punta Mala</td></tr>
<tr><td><u>Zone 3</u>
Frente al Río Tárcoles
Guacalillo</td><td rowspan="2"><u>Zone 6</u>
Frente al Río Tárcoles
Guacalillo
Los Peñones</td><td rowspan="2"><u>Furthest south</u>
Cortés
Esterillos
Parrita
Quepos</td></tr>
<tr><td><u>Zone 4</u>
Los Peñones</td></tr>
<tr><td colspan="2"></td><td><u>Furthest north</u>
Canalón
Los Negros
Tambor</td></tr>
</table>

The Tárcoles AMPR proposal was supported by the data analysis of the fishers, since they had been collecting and organizing it for years. This helped support and justify the fishermen's request, which was eventually approved by INCOPESCA. The database turned out to be invaluable when creating the Tárcoles AMPR. Figure 7 shows the participatory map used by Tárcoles' fishers for creating the AMPR.

Figure 7. Map of the zones in which the Tárcoles AMPR is divided.



The database also shows information regarding fishing activities carried out in different locations outside the boundaries of the communal area suggested by Coope Tárcoles' fishers. These areas located outside the communal one were grouped together in zones that could be compared with each other, and that were defined based on their location regarding the communal one. These zones are the following:

'Front' Zone: Is a location known as 'Tortugas', located just outside the western border of the AMPR, parallel to the Tárcoles' coast. The fishing carried out in this area is mainly done with a line of hooks.

'Nearest south' Zone: Corresponds to the areas located south of the south border of the communal area. These are locations frequently used by Coope Tárcoles' fishermen that go along the edge of the communal area or are located near it. Lines of hooks are mainly used during fishing days, and occasionally nets type 3.

'Furthest south' Zone: Corresponds to the areas located far away from the communal one, many kilometres to the south. Fishers have to make long journeys, at least a couple of days, in order to reach them. During these long trips, fishermen usually seize the occasion to use nets type 5 and 7. The use of a line of hooks is much more unlikely, but can occur. Occasionally a rope can be used for fishing.

'Furthest north' Zone: Corresponds to the areas located far away from the communal one, many kilometres to the north in the Nicoya Gulf. Fishers have to make long journeys in order to reach this zone. These long trips are mainly used for fishing with a line of hooks.

Fishermen have to write the data regarding the location of their principal fishing activity in the receipt. In the database, the zone is indicated in an additional column. Whether it's located 'inside the AMPR' or 'outside the AMPR' of Tárcoles is also mentioned. This allows comparisons between activities, catches and efforts done inside and outside the Tárcoles' AMPR. Which in turn shows the effectiveness of the creation of an AMPR, and helps make decisions regarding the management around and inside the AMPR. Figure 8 shows an example of how the database on a Microsoft Excel sheet looks like.

Figure 8. Example of a section in the fishing database of Coope Tárcoles R.L. (Columns from left to right: Receipt, day, month, year, month-year, departure, arrival, work day, fisher, helpers, location, zone, inside-outside, method, methods, performance).

1	Factura	Día	Mes	Año	Mes-Año	Zarpe	Llegada	Jornada	Pescador	Ayudantes	Sitio	Zona	Dentro-Fuer	Arte	Artes Reunid	Esfuerzo Art
2713	73059 73060	25	12	2013	dic-13	04:00 PM	08:00 AM	16.0	Marcelino León (Macho L		Rompio	Zona 5	Dentro	Línea	Línea	600.0
2714	73061 73062	25	12	2013	dic-13	04:00 PM	08:00 AM	16.0	Edwin		Jacó	Zona 5	Sur Cercano	Línea	Línea	800.0
2715	73063 73064	25	12	2013	dic-13	04:00 PM	08:00 AM	16.0	Gerardo Gómez (Gringo)		Frente a Nat	Zona 5	Dentro	Línea	Línea	1300.0
2716	73068	26	12	2013	dic-13	04:00 PM	08:00 AM	16.0	Edwin		Los Peñones	Zona 6	Dentro	Línea	Línea	1300.0
2717	73077	26	12	2013	dic-13	04:00 PM	09:00 AM	17.0	Gerardo Adanis (Pico)		Nativa	Zona 5	Dentro	Línea	Línea	1300.0
2718	73081	26	12	2013	dic-13	04:00 PM	09:00 AM	17.0	Jairo Vargas (Jairo)		Los Peñones	Zona 6	Dentro	Línea	Línea	1400.0
2719	73087	26	12	2013	dic-13	04:00 PM	09:00 AM	17.0	Mainor Serrano Soto (Hijo		Nativa	Zona 5	Dentro	Línea	Línea	1300.0
2720	73091	26	12	2013	dic-13	04:00 PM	09:00 AM	17.0	Rafael Adanis		Frente a las (	Zona 5	Dentro	Línea	Línea	1300.0
2721	73092	26	12	2013	dic-13	04:00 PM	09:00 AM	17.0	Gabriel Hernández Chacó		Jacó	Zona 5	Sur Cercano	Línea	Línea	600.0
2722	73067 73068	26	12	2013	dic-13	04:00 PM	08:00 AM	16.0	Pablo González		Frente a Nat	Zona 5	Dentro	Línea	Línea	1300.0
2723	73069 73070	26	12	2013	dic-13	04:00 PM	08:00 AM	16.0	Anthony Agüero (Chapat		Nativa	Zona 5	Dentro	Línea	Línea	1300.0
2724	73071 73072	26	12	2013	dic-13	04:00 PM	09:00 AM	17.0	Vinicio Méndez		Los Peñones	Zona 6	Dentro	Línea	Línea	600.0
2725	73073 73074	26	12	2013	dic-13	04:00 PM	08:00 AM	16.0	William Vargas		Los Peñones	Zona 6	Dentro	Línea	Línea	1300.0
2726	73075 73076	26	12	2013	dic-13	04:00 PM	09:00 AM	16.0	Ariel adanis adanis ((cabr		Frente a Nat	Zona 5	Dentro	Línea	Línea	1200.0
2727	73078 73079	26	12	2013	dic-13	04:00 PM	09:00 AM	16.0	Vinicio Méndez		Los Peñones	Zona 6	Dentro	Línea	Línea	1300.0
2728	73082 73083	26	12	2013	dic-13	04:00 PM	09:00 AM	16.0	Francisco López (Pecho)		Nativa	Zona 5	Dentro	Línea	Línea	1300.0
2729	73084 73085	26	12	2013	dic-13	04:00 PM	09:00 AM	17.0	Gabriel Hernández Chacó		Los Peñones	Zona 6	Dentro	Línea	Línea	1300.0
2730	73088 73089 73	26	12	2013	dic-13	04:00 PM	09:00 AM	16.0	Johatson González (Mun		Los Peñones	Zona 6	Dentro	Línea	Línea	1300.0
2731	73086	27	12	2013	dic-13	06:00 AM	10:00 AM	4.0	Wilberth Vargas		Los Peñones	Sur Cercano	Dentro	Buceo	Buceo	4.0
2732	73093	27	12	2013	dic-13	04:00 PM	08:00 AM	16.0	David Chacón		Agujas	Zona 5	Dentro	Línea	Línea	1300.0
2733	73094	27	12	2013	dic-13	04:00 PM	08:00 AM	16.0	Vinicio Méndez		Nativa	Zona 5	Dentro	Línea	Línea	1300.0
2734	73097	27	12	2013	dic-13	04:00 PM	08:00 AM	16.0	Anthony Agüero (Chapat		Nativa	Zona 5	Dentro	Línea	Línea	1300.0
2735	73095 73096	27	12	2013	dic-13	04:00 PM	08:00 AM	16.0	Mainor Gonsales (Pinqui		Los Peñones	Zona 6	Dentro	Línea	Línea	1300.0
2736	73098 73099 73	27	12	2013	dic-13	04:00 PM	09:00 AM	16.0	Hugo Mora		Nativa	Zona 5	Dentro	Línea	Línea	1300.0

Data analysis

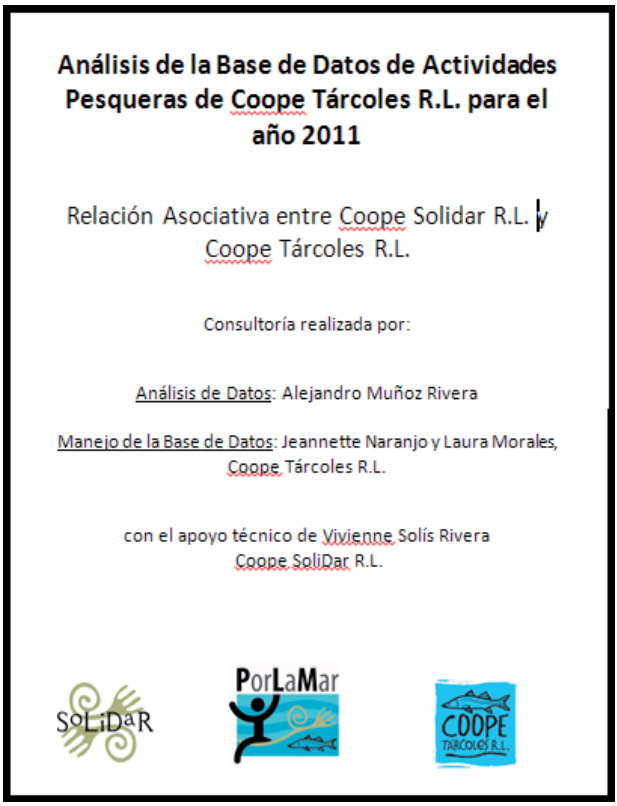
The information analysis produced by Coope Tárcoles' R.L. fishermen constitute an initiative that comes from Coope Tárcoles R.L. and Coope SoliDar R.L. This is due to the acknowledgement of the importance of the collected information in the database and the need to use this resource in order to examine the principal tendencies of fishing activities, as well as monitor the state of the species that are of a high economic value for Tárcoles' fishermen and for adjacent areas.

The main goal of the analysis is to provide objective information that helps make decisions concerning the management and improvement of the Tárcoles' AMPR, in order to guarantee the sustainability and continuance of the fishing exploitation carried out in areas frequently visited by members of Coope Tárcoles R.L. and fishers of the area or bordering areas.

Coope SoliDar R.L. has sought to provide long-term guidance during the process of collection and systematization of information. Fishermen of Coope Tárcoles R.L. have received guidance and technical support over many years, especially during processes regarding care and improvement of the database.

Each year, an analysis of the information in the database is carried out (Fig. 9). The results are then compared to others regarding previous years, with the goal of finding differences or trends in the fishing activities, as well as in populations exploited by fishermen.

Figure 9. Front page of the analysis report of Coope Tárcoles' R.L. fishing database, for the year 2011.


Análisis de la Base de Datos de Actividades Pesqueras de Coope Tárcoles R.L. para el año 2011

Relación Asociativa entre Coope Solidar R.L. y Coope Tárcoles R.L.

Consultoría realizada por:

Análisis de Datos: Alejandro Muñoz Rivera

Manejo de la Base de Datos: Jeannette Naranjo y Laura Morales, Coope Tárcoles R.L.

con el apoyo técnico de Vivienne Solís Rivera Coope SoliDar R.L.

SOLIDAR PorLaMar COOPE TÁRCOLES R.L.

In these reports, the analysis are grouped by fishing method, because it's the easiest way to make an analysis with the collected information. It's also the best way to present the data, because catches done with different fishing methods can't be compared between each other. It's essential to be careful when comparing totals and averages produced by different fishing methods.

For example, fishermen in Tárcoles use different types of nets. Nets with a hole diameter of 3 and 5 inches are the same size (4m wide x 100m long), while nets with a hole diameter of 7 inches are a little less long (generally 80m). However, fishers agreed that for the analysis, nets with a different hole diameter could be grouped under the same category, because they didn't think this difference to be significant. Notwithstanding, when identifying the most important species for each fishing method, the different types of nets are analysed separately in the report.

One of the most difficult calculations is the one regarding the performance and fishing effort of the fishermen. In the reports presented to Coope

Tárcoles R.L., the 'fishing effort' quantity is calculated by dividing the catch by the amount of hours dedicated to fishing activities by the fisherfolk. This number is then divided by the number of nets or the number of hooks used by the fisherfolk. This number, then, reflects the amount of fishing effort, measured as time dedicated to fishing and amount of gear used.

Even though effective fishing time, which corresponds to the time actively used for catching fish, is the ideal value for calculating efficiency in fishing activities, this doesn't really show each day's work cost. Other activities, such as time dedicated to arrive at the fishing locations, or to locate the best places to fish, are excluded.

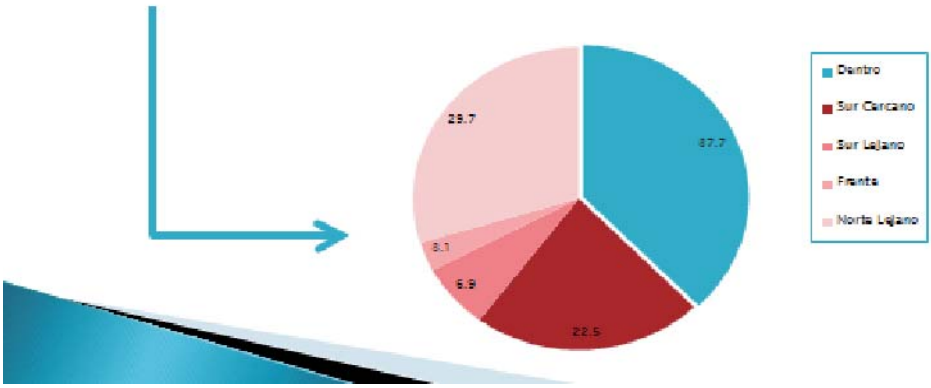
Examples of analysis' results

Reports presented to Coope Tárcoles R.L. provide the information in a simple but instructive way. Figures and graphics are created in a way that is easy to understand, so that they can be presented to fishermen, but they also have to be scientific enough to be presented to the authorities that regulate fishing activities in the country.

One of the most common analysis is the one that compares catches inside and outside the Marine Responsible Fishing Area (AMPR). This allows fishers to tell if they can meet their economic needs with the resources protected by the Tárcoles AMPR, or if they actually need to go outside this area for more profit (Fig. 10).

Figure 10. Comparison between catches inside and outside the boundaries of the Tárcoles AMPR in 2011.

Zona	Kilos	Porcentaje
Dentro	52349.7	37.7
Frente	4344.9	3.1
Norte Lejano	41223.3	29.7
Sur Cercano	31248.7	22.5
Sur Lejano	9636.3	6.9
Total	138802.9	100.0



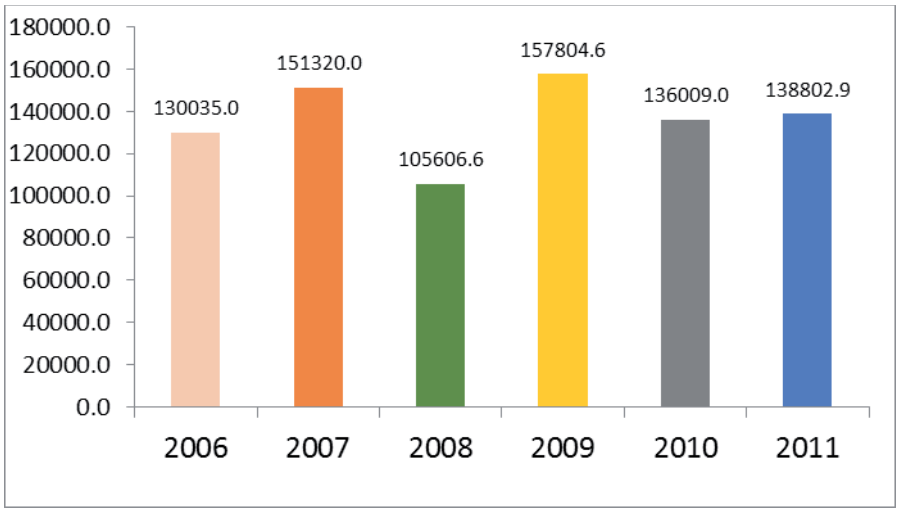
Using the following chart, comparing the number of fishing journeys in a year for each fishing method, it's possible to show the fishing effort put into each different activity by Tárcoles' fishers (Fig. 11).

Figure 11. Number of fishing journeys registered in the fishing database of Coope Tárcoles R.L., according to method, inside and outside the Tárcoles' AMPR. Period January-December 2011. (Horizontal axis, left to right: diving, rope, line, net 3, net 3.5, net 7, total. Vertical axis, up to down: inside, nearest south, farthest south, front, farthest north, total)

	Buceo	Cuerda	Línea	Malla 3	Malla 3.5	Malla 7	Total
Dentro	52	34	762	485	18	198	1549
Sur Cercano	17	8	301	9	12	4	351
Sur Lejano	1	5	1	–	1	25	33
Frente	–	–	59	–	–	–	59
Norte Lejano	–	–	576	2	–	–	578
Total	70	47	1699	496	31	227	2570

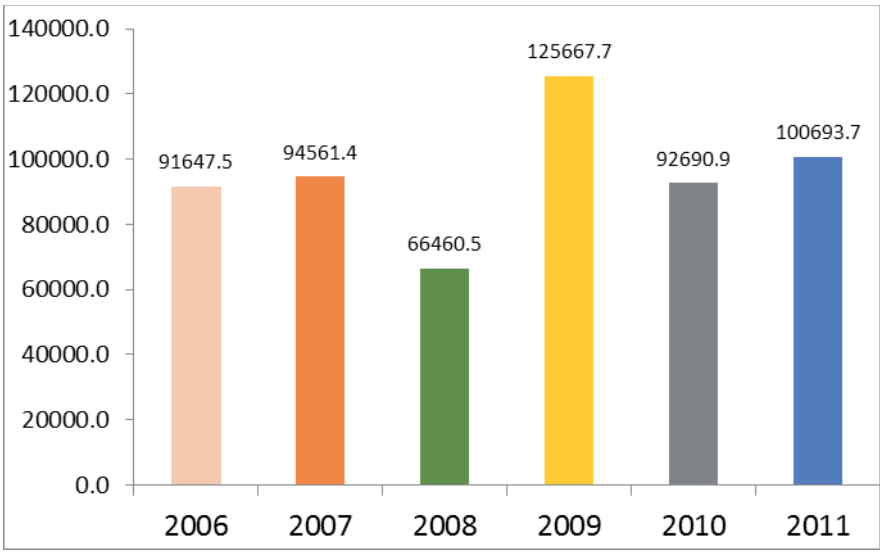
Reports show figures that summarize annual catches in order to tell if there are differences from year to year, or trends in fishing (Fig. 12).

Figure 12. Total kilograms of catches inside the Tárcoles AMPR. Period January-December 2011.



Information concerning annual catches for each different fishing method is shown the same way, but separately (Fig. 13).

Figure 13. Total kilograms of catches inside the Tárcoles AMPR. Period January-December 2011.



Because the Tárcoles AMPR has been divided into different zones, there are comparative analysis for fishing in each zone with different fishing methods. There are also graphics that compare the catches obtained in the different locations visited by fishermen, so as to confirm if the observed trends throughout the year are expressed correctly in the database (Figs. 14 and 15).

Figure 14. Fishing performance (kg/hour/hook) according to zone, of catches made in the Tárcoles AMPR. Period January-December 2011. (Horizontal axis, left to right: zone 5, zone 6, nearest south, farthest south, front, farthest north)

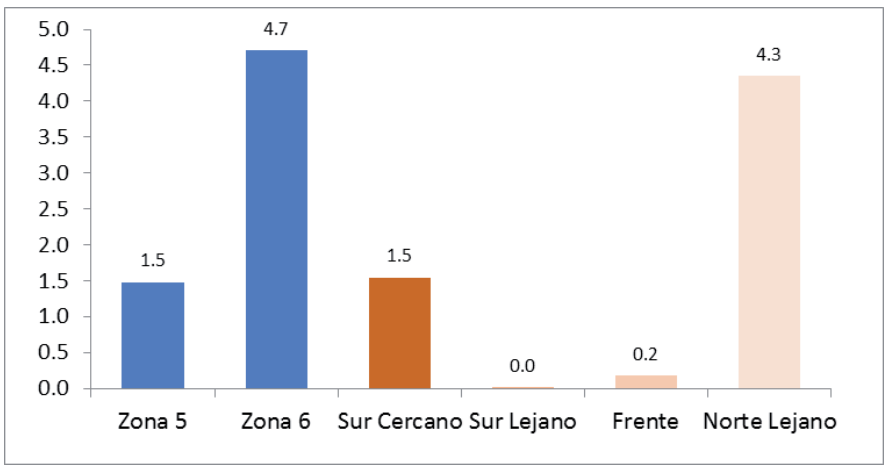
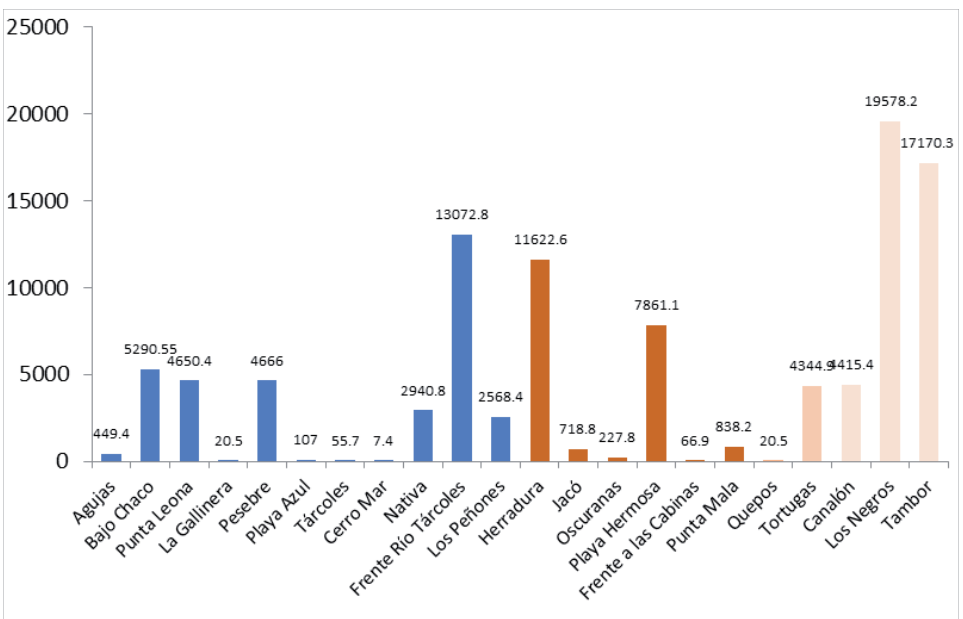
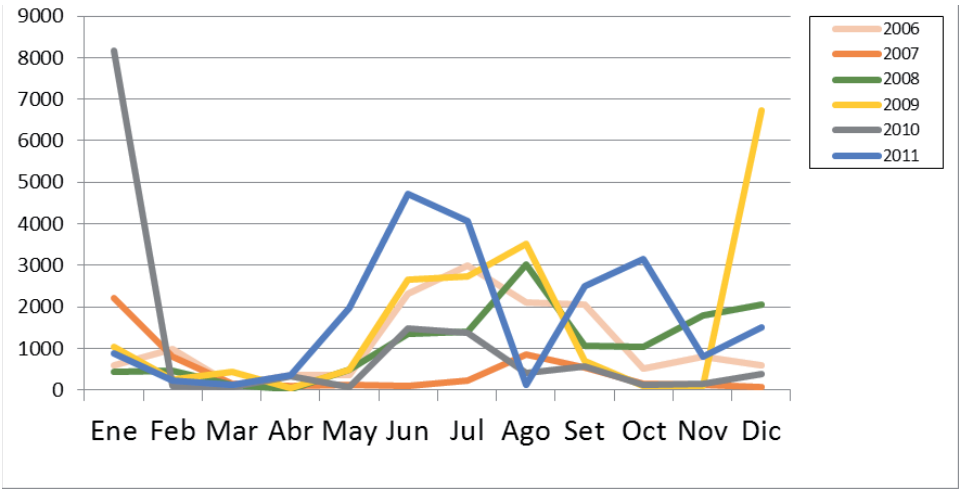


Figure 15. Total kilograms according to fishing location for line fishing inside Tárcoles' AMPR. Period January-December 2011.



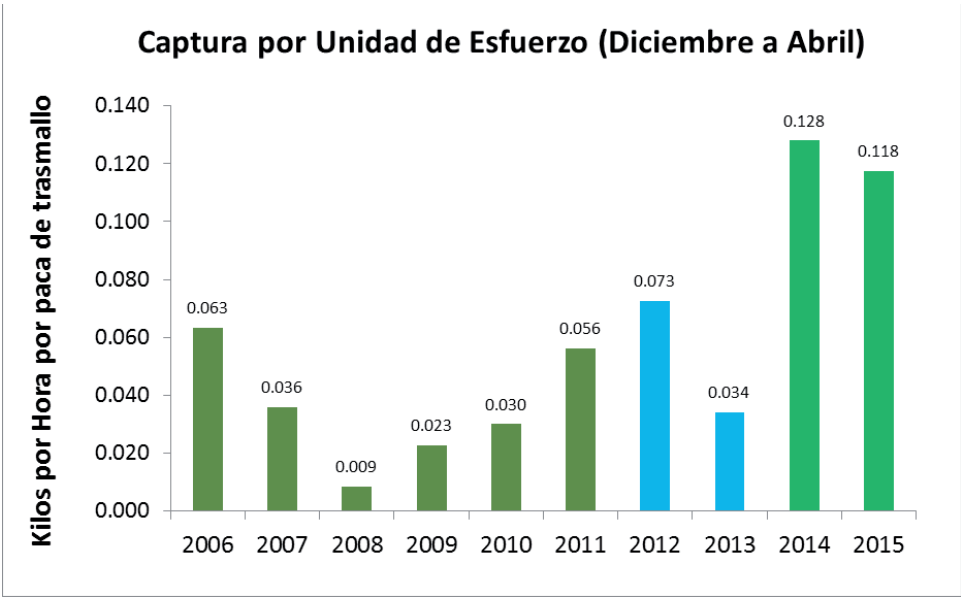
Tárcoles' fishers have identified for each fishing method the species with the highest commercial value and the species that are usually caught. Reports keep a monthly track of the main species, in order to allow fishermen to establish patterns in their behaviour. This enables more accurate management decisions, and better feedback for decision-making year by year (Fig. 16).

Figure 16. Total kilograms of porgy, shown month by month in the Tárcoles' AMPR. Period January-December 2011.



The value of the information collected in the database can be appreciated when making comparisons over time in fishing trends. In the case of Tárcoles, one of the biggest obstacles in creating the AMPR was the reluctance of the trawling sector to respect the boundaries suggested by Tárcoles' fishermen. Thanks to the data provided by Coope Tárcoles, authorities agreed to establish a yearlong ban inside the AMPR in order to carry out studies regarding the impact of trawling. Figure 17 shows shrimp catches before this ban (orange bars), during the ban (blue bars) and after the ban (green bars). This graphic helps demonstrate the positive aspects of such a ban on trawling fleets near the coast in the performance of shrimp catches by artisanal fishers of Tárcoles.

Figure 17. Historical performance of shrimp fishing inside the Tárcoles AMPR. (Catch for effort unit)



Devolution and validation of information

One of the most important characteristics of information analysis processes in Tárcoles is that the reports are presented to fishers and validated by them.

The cooperative in Tárcoles convenes to a general meeting that takes place on the beach in front of the collection centre, to which all fishermen and town residents are invited (Fig.18). Snacks or lunch are usually served to participants so as to promote attendance.

During these meetings, results are presented on a flip chart, it's verified that fishers understand the information and that it matches their perception based on traditional knowledge, and then results are validated. Fishermen also express their doubts and ask questions, share their suggestions for improvement and formulate new questions to add to the database for future analysis.

This process of devolution of information is essential and key for the fishermen's understanding of the value of the information included in the database. It also helps them understand the results of the sacrifice they make, in terms of the time they spend when providing the information for filling the fishing journey's receipts. No true progress can be made in the data collection front if fishermen don't comprehend the value of the information they provide.

Figure 18. Meeting on a Tárcoles beach to present the results of a report to members of Coope Tárcoles R.L.

Limitations of the Analysis

Data included in the analysed database correspond to the catches that are delivered to the collection centre of Coope Tárcoles R.L.

A part of the fishing product is not registered in the collection centre because fishers use it to provide food for their own families. It is clear that fishermen associated with Coope Tárcoles R.L. and other fishers who bring their catches to the collection centre are actually providing for a part of their food requirements through the fishing activities they undertake. This is the reason why it's important to monitor the amount of fish that is used locally by members of the community. It's not only important for the economic stability and development of local fishermen, but also for guaranteeing them, at least partially, access to food.

This information corresponds to data collected by Coope Tárcoles' R.L. members and other local inhabitants from the community or neighbouring communities who sell their catches to the collection centre and practise artisanal fishing. It doesn't correspond to the total amount of fishing done in the reported zones, and doesn't include data regarding fishing activities of other fishers who sell the product directly and/or other fleets that interact in the area.

Finally, it's relevant to clarify that even if the collection centre of Coope-Tárcoles R.L. buys fish from people who aren't members of the cooperative, this isn't done to keep certain products always available for customers. The collection centre sells what's being caught and doesn't make efforts to keep certain products always available. This characteristic of the information reports help shows much more trustworthy information regarding the reality of what's happening to fish populations on the Coope Tárcoles' R.L. database.

Establishment of the 2011-2012 Trawling Ban

The Marine Area for Responsible Fishing in Tárcoles was created in 2009, according to legislation A.J.D.I.P 138-2008 and the executive decree Nª35502-MAG, published in the newspaper *La Gaceta* Nº 191 of 1 October 2009.

Due to the efforts made in the data collection, registration and analysis, it has been possible for Coope Tárcoles R.L. and Coope SoliDar R.L. to undertake research, and together with the information collected by INCOPESCA, a Fishing Management Plan of the Tárcoles' AMPR was established. It was defined technically, putting together technical and traditional knowledge of fishermen, obtained throughout a year of meetings set by these three entities.

According to the Fishing Management Plan, and on the request of Tárcoles' artisanal fishers, information that justifies the need to keep the shrimp fishing fleet away from the AMPR was presented to INCOPESCA. A request for the semi-industrial fleet to stay five nautical miles away from the border was originally filed. The negotiation process came to an agreement, which allowed the semi-industrial fleet to work nearer the border than it was actually requested by artisanal fishers:

'Due to the arguments presented, a shrimp fishing ban, artisanal as well as semi-industrial, will be agreed upon for a year, three nautical miles towards open sea, taking as reference point the north border of the Marine Area for Responsible Fishing—mouth of the Jesús María river—and following an invisible straight line to the Tárcoles community. This marine area includes zones 2, 3, 4 and 6 of the Marine Area for Responsible Fishing. In the case of zones 3, 4 and 6 because they're linked to swamp and muddy areas. In the case of zone 2, because it has a muddy and sandy floor.'

Further negotiations led to a fishing ban for areas located 15 meters deep. This ban was established between 19 August 2011 and 19 August 2012. During this period, fleets for shrimp fishing were not allowed access to the area. No other kind of fishing was allowed, except for ropes and hooks. It's also relevant to say that fishing with 5-inch nets disappeared, and was substituted by 3.5-inch nets.

It is of paramount importance to point out that for the creation of the Tárcoles' AMPR, the information provided by Coope-Tárcoles' R.L. fishers was invaluable. When the official request was presented to INCOPESCA's board of directors in 2009, the information of Coope-Tárcoles' R.L. fishing database allowed validation of the request of fishermen.

Later on, in 2011, when fishermen requested the authorities of INCOPESCA that semi-industrial trawling fleets respect the boundaries of the AMPR established in the Fishing Management Plan, it was the information provided by fishers that helped point out the need of establishing a restriction in favour of artisanal and responsible fishing by Tárcoles' fishermen (Fig. 19).

Figure 19. Presentation of information regarding data in the fishing database of Coope Tárcoles R.L. before INCOPESCA's board of directors. Information provided by fishers allowed INCOPESCA to endorse a certain distance from the coast for trawling fleet in order to respect the boundaries of the AMPR and the artisanal fishing activities inside it.

CONCLUSIONS AND LESSONS LEARNED

- Processes regarding collection and systematization of fishing information must be developed over a long period of time, because the support and guidance needed for fishers to empower themselves in this activity take a long time and need a reiteration of activities.
- Technology must be shared with fishers. The use of technology in order to manage correctly the information they provide is important.
- Artisanal fishers are involved with the generation and use of their knowledge. The appropriation and use of this knowledge, once it's made public and integrated, is immediate and points to the resource's management, which allows taking preventive measures more quickly and efficiently.
- This effort necessarily entails a reflection, learning and trust process that are built during medium and long periods.
- Fishermen have to develop trust and responsibility towards the facilitating organization of the process, so as to provide the information and use it in a positive and propositional way regarding the marine resource's management.
- Information needs to be returned in a transparent and responsible way to fishers, so that it can be used for decision-making. It has to belong to local organizations.
- Ban periods should be promoted and used for doing research on the situation of fish populations and other populations, on the effects that these bans have on them, and on the best way to enable a sustainable use of the resource.
- This is a process that must be directed by local fishers' organizations, and it should be managed inside this local framework.
- Any use of it must be analysed by the structures that deal with local decisions, followed by an agreement concerning whether the information should or shouldn't be shared, and if so, under what terms and circumstances.
- The methodology for data collection goes through phases of test and error. These must be flexible without neglecting the need for accuracy and certainty of the information from a theoretical science point of view.

- The analysis requires validation of information and a constant exchange of knowledge when answering questions regarding the fishing area, which require a medium- and long-term process.
- An integral vision that transcends environmental aspects of marine investigation and conservation is essential.
- There's a lack of comprehension and support by academic and official sectors (of the government) regarding the value and acknowledgement of the kind of processes that generate knowledge, and the need for respect and assessment of such initiatives.
- Besides conservation goals, social and welfare goals must be integrated in order to achieve actions that create environmental sustainability and result in an improvement of the quality of life.
- Generation of knowledge does not end, it's a learning process that allows people, such as artisanal fishers, to empower themselves, people who until now didn't have neither voice nor vote inside the management entities.
- Information turns quickly into power if the process is done in an ethical environment, which empowers local governance, and with it, a sustainable management of fisheries.
- The work of integrating scientific and traditional knowledge is a strengthening process for decision-making, rather than an academic exercise.

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CASE STUDY 3

TRADITIONAL KNOWLEDGE OF ARTISANAL FISHERMEN LINKED TO THE CUERO Y SALADO WILDLIFE REFUGE AND MARINE SPACE GOVERNANCE

CASE STUDY ON PARTICIPATORY MAPPING OF APROCUS' ARTISANAL FISHERS, LA CEIBA - HONDURAS

EXECUTIVE SUMMARY

The Wildlife Refuge Cuero y Salado is located approximately 30 km west of La Ceiba city. It was declared a protected area by Decree 99-87 of 29 July 1987, in order to safeguard all marshland located at the mouths of Cuero, Salado and San Juan rivers in the department of Atlántida, which includes a system of coastal lagoons, rivers and mangrove channels. Later amendments to the decree were made in order to ensure the co-management of the area through the Foundation Cuero y Salado (Decree 38-39 of 30 March 1989). Its borders are being recently redefined to incorporate the marine area of 13,027 hectares (7989.53 hectares of land and 5037.47 of marine environment). The marine area of this refuge has two sub-zones, accounting for 335.88 hectares (7 per cent of the refuge), one for the preservation and the other for the development of artisanal fishing.

The fishermen of different communities have organized themselves under the Association of Fishermen of La Rosita, Cuero y Salado (APROCUS). The fishermen of this organization have the right to carry out their fishing activities within the marine protected area limits on specific fishing sites. This case study has been conducted under the RECOTURH (Rural Touristic Communities of Honduras) framework for the development of a process to strengthen governance of the local sector. The exercise has rescued some of the traditional knowledge that ultimately led to a participatory mapping exercise oriented towards the location of the traditional fishing spots used by fishermen, which for years have been used for fishing with traditional techniques. This knowledge was integrated with scientific techniques to map productive activity and its characteristics. This information has been used for making the final decisions among co-manager agencies, government institutions and fishing organizations for the management of the area.

INTRODUCTION

This case study's main goal is to help contribute to a better understanding of how traditional knowledge has an ecological, social and cultural relevance in the management of natural resources, in this particular case, marine and coastal resources. It also hopes to show how this knowledge helps make better decisions regarding protection of human rights, management, sustainable use and preservation of natural resources, as well as technical and political elements for a sustainable co-management.

Traditional knowledge is essential for guaranteeing governance of marine space by small-scale fishermen, defining fishing methods and ensuring a sustainable use of the marine resources.

The following case systematizes how artisanal fishermen of APROCUS[1] carry out their fishing activities within the boundaries of the Cuero y Salado Wildlife Refuge[2] (RVSBCS), in the Caribbean coast of Honduras. Such fishing activities have been validated and made official in several regulations, such as the Management Plan and the Public Use Plan, that grant them an exclusive right to practise responsible fishing. Traditional knowledge of artisanal fishermen has been a key instrument for defining the rules, and its approach reflects on the participatory mapping carried out by local communities.

The RVSBCS is part of the so-called Caribbean corridor that connects five protected areas of the north: Punta Izopo National Park, Texiguat Wildlife Refuge, Pico Bonito National Park, Nombre de Dios National Park and the

1 APROCUS – Fishermen association of La Rosita, Cuero y Salado.

2 Location: 15°46'00.22" N – 86°59'57.52" O

Cuero y Salado Refuge. Because it's a marine-coastal wetland system, its importance has transcended national limits, and it was declared Ramsar Site #619 on 26 June1994.[3]

The RVSBCS is a natural breeding centre for many resident species and for other species that develop in this area in their first stages of life. It's an important refuge for a considerable number of birds and wild animals, for example the Manatí Antillano (*Trichechus manatus manatus*), a species of the Central and South American coasts (Reynolds & Powell 2002). Furthermore, it's a fish-rich zone, that according to Carrasco's studies (2012) include eighty-eight different species, of which thirty-eight are consumed locally and seventeen are of commercial interest.

On a commercial scale, amongst the reported species that form the red fish category, we find: Calale (*Lutjanus synagris*), Yalatel (*Ocyurus chrysurus*), Mantequilla (*Epinephelus cruentatus, Epinephelus guttatus*) and Pardos (*Lutjanus analis*), species that live in the reef (López 2007). Amongst the species reported that form the white fish category, there are: Roncos (*Haemulon plumieri*), Yarano (*Conodon nobilis*), Peje plumas (*Calamus sp.*), Culila (*Caranx crysos*), Corvina (*Cynoscion arenarius*), King fish (*Scomberomorus cavalla*), Sierra or Serrucho (*Scomberomorus maculatus*) and Barracuda (*Sphyreana barracuda*), which are coastal species linked to the reefs (López 2007). Amongst the river species there are the Machaca (formerly known as Maculicauda), Guapote (*Parachromis sp.*) and Dormilón (*Gobiomorus dormitor*), which are generally meant for a family consumption.

The marine area represents 36 per cent of the refuge and includes two sub-zones, one for preservation and the other one for development of artisanal fishing. A further sub-zone has been defined, a small fishing area of approximately 335.88 hectares (7 per cent of the refuge), for fishing in five specific locations with a radius of 500 meters. This is due to the fact that fishing is the second most important economic local activity. There is also a Non Fishing sub-zone that includes about 93 per cent of the marine area designated as protected in order to guarantee conservation of marine species, such as the manatee, and other important fish of ecologic and commercial value.

Fishermen of different communities have organized themselves under the La Rosita Association for Fishermen, Cuero y Salado—APROCUS. It is an

3 Ramsar sites are wetlands of international importance protected by the Convention of Wetlands (Ramsar, Iran, 1971), for a long-term conservation and sustainable, as well as rational, use. Check glossary of terms 'Wetlands according to RAMSAR'.

organization for profit and undefined duration that will be regulated by the country's law of industry and commerce, through the granting of a legal entity, a Constitution, as well as status, laws and registry approval. The following entities are part of the organization: General Assembly of Members (at least thirty-five fishermen), Board of Directors and Audit Board, with three members, one for each community. Members of APROCUS have the right to fish inside the protected marine areas in the fishing locations.

This case study has been developed under LA_RECOTURH's project for the support of community governance of marine protected areas. Participatory mapping allowed artisanal fishers of APROCUS to make progress towards a participatory zoning, identifying fishing locations, traditional methods and techniques for the use of the resource. Traditional knowledge of fishermen was integrated with scientific techniques, with the purpose of putting that knowledge on a map to visualize names and coordinates in a graphic way. This way, fishermen, the different co-managing entities and the institutions and organizations who support them, make better decisions and have a certainty regarding this subject.

TRADITIONAL KNOWLEDGE FROM THE ARTISANAL FISHERS' POINT OF VIEW

According to fishermen who work in RVSBCS' fishing sub-zone, their traditional knowledge—seen as an art of fishing—has been key to the families' subsistence. This information translates into methods and knowledge that can clearly be seen in small-scale artisanal fishing, considering aspects such as collective historic memory in its catch levels, species, materials used for fishing, fishing methods and the contemporary situation from the fishers' world view.

Traditional knowledge[4] is seen as a mixture of theoretical wisdom, practical experience and the representations of people with their natural environment throughout history. Traditional knowledge could put into question many positive basic notions. Communities can no longer be seen as passive receptors of development aids, because they own much knowledge regarding the environment, social, economic and cultural organization aspects, as well as a vision of how their territory should be managed.

4 http://www.unesco.org/bpi/pdf/memobpi48_tradknowledge_es.pdf

GOALS

This case study collects, compares and complements the collective traditional knowledge of APROCUS' artisanal fishermen in subjects linked to fishing locations, marine zoning and artisanal fishing methods. It also takes into consideration the knowledge of scientists and technicians in a participatory mapping framework of the RVSBCS. Regarding the above, the goals of this case study are the following:

General goal

Systematize the mapping experience of marine areas carried out by local communities linked to the Barras Cuero y Salado Wildlife Refuge in Honduras, and also how traditional knowledge contributes to the strengthening of the governance of marine areas, as well as the identification of artisanal fishing or small-scale fishing locations.

Specific goals

- Open a space where artisanal fishers and technicians can reflect on traditional knowledge and how it can contribute in the decision-making processes of marine organization.
- Discuss how artisanal fishers' traditional knowledge develops and how it is being passed on to the new generations.
- Delve into how participatory mapping methodology can allow artisanal fishermen to express their traditional knowledge.
- Get to know how scientific and traditional knowledge can be linked in order to establish criteria that facilitate fisheries management and conservation.

METHODOLOGY

The experience systematized pertained to the use of traditional knowledge that promotes spatial planning and governance that defined the fishing locations inside the Cuero y Salado Wildlife Refuge in the department of Atlántida.

The methodology used in the many stages of the systematization process was participatory, meaning that the people involved in the process played a prominent role and participated in the activities, which permitted better inputs, conclusion and the formulation of lessons learned from the experience.

The methods used in the process stage included the following:

- Review of documents, inventories and descriptions. This information provided inputs for the reconstruction of the processes and the timeline.

- Analysis and formulation of research questions. This derives from the joint analysis of regional experiences with the CoopeSoliDar R.L. team. These inputs helped organize the tools for the data collection. The tools were:
    - Open interview carried out with fishermen members of APROCUS, especially from the communities of Salado Barra, Boca Cerrada and La Rosita.
    - Open interview with technicians of the different institutions that participated in the creation of the maps through information provided by fishers. Centro de Estudios Marinos—CEM, Cuero y Salado Foundation—FUCSA, and the Pro Comunidades Turísticas de Honduras Association—LARECOTURH.
- Interpretation: This was carried out by a consultant based on the inputs of the various structured interviews and with open questions.
- Communication: CoopeSoliDar R.L. and LARECOTURH took care of the communication and socialization in the communities and amongst others at which this exercise is directed. Their opinions enriched the conclusions, the lessons learned and above all, the suggestions.

Interviewed participants

No.	Entity	Category	Men	Women
	APROCUS	Fishers[1]	4	0
	Fundación Cuero y Salado	Director	0	1
	Fundación Cuero y Salado	Technician	1	0
	Centro de Estudios Marinos	Director	0	1
	Centro de Estudios Marinos	Technician	1	0
	LARECOTURH	Coordinator	1	0
Total			7	2

The systematization of traditional knowledge concerning fishing locations and governance was based on the following aspects:

- Traditional knowledge and how it differs from other types of knowledge.
- Qualities and virtues of traditional knowledge.
- Similarities and differences between traditional and scientific knowledge.
- Traditional and scientific knowledge in marine decision-making.

- Contrast between traditional and scientific knowledge.
- Mapping as a methodological tool.
- Contribution of scientific knowledge in identifying fishing locations.
- Advantages and disadvantages of traditional knowledge and methodological tools.
- Fields to which traditional knowledge can be applied.
- Strengthen the role of traditional knowledge in the country's decision-making.

RESULTS

Data collected through interviews with fishermen and the institutions that contributed to the participatory mapping for identifying fishing locations that fishers usually use, led to the following results or findings that enriched this case study:

Artisanal fishermen and technicians:

According to the fisher members of APROCUS, traditional knowledge in artisanal fishing and marine spatial planning of fishing locations is an inherited art that develops at home. It's a survival tool that guarantees food and an economic means or income to sustain the family. Most fishermen have a good knowledge of artisanal fishing, although there are some young people who are losing it, which is why they have more difficulty when fishing.

There are many elements that demonstrate a fisher's traditional knowledge, and these can be seen during the following:

a) When the fish hook is thrown and pulled back.
b) When they feel that they've caught a fish and know, without seeing it, which species it belongs to.
c) Their way of sailing and managing wind currents.
d) The use of cast nets and sailing in open sea.
e) Knowledge about location based on reference points such as mountains, currents and the beach.
f) Instinctive knowledge about bad weather, because he or she can tell the trend of waves from the sound of the ocean and the breeze.
g) The use of plump bobs.

An important aspect that sets a limit to traditional knowledge is when there's bad weather, because the fisher turns almost blind and can fail in open sea. Scientific knowledge is important in this case, with tools like a GPS or a compass.

Good traditional knowledge in artisanal fishing and the ability to identify fishing locations are important to enable better decisions, especially if it's necessary to go far away for fishing. Scientific knowledge and tools help identify shoals if located far away, although most fishers have dugout canoes and it's difficult to move with them.

Mapping of fishing locations has helped graphically orient new fishermen and tell them if they are located inside the area's boundaries. Each fishing community of the Cuero y Salado Wildlife Refuge has its own identified locations and these are respected. These are:

a) Salado Barra: Piedras, Jurel, Pluma, La Cubera, Mota 1, Mota 2, Raul, Famosa de Cuero, Pargo, La Redonda, Calale y Yalatel, Picuda, Calale Grande, 019, Culilla, Yalatel, Lamparo.

b) Boca Cerrada: Coco 1, Coco 2, Iguana, Ivetts, Culi, Yuri, Gato / Cantil, Blanquisal, Ladio, Toca 2, Lodo 15, Leonardo, Cubera.

c) La Rosita: La Guara, 31, Las Cuberitas, La Marena, Nuevago, La Red y Cubera, Pi, El León, Los Pardos, El Hoyo, Peje Pluma, Secas, La Coroza, Pimienta y La Uva.

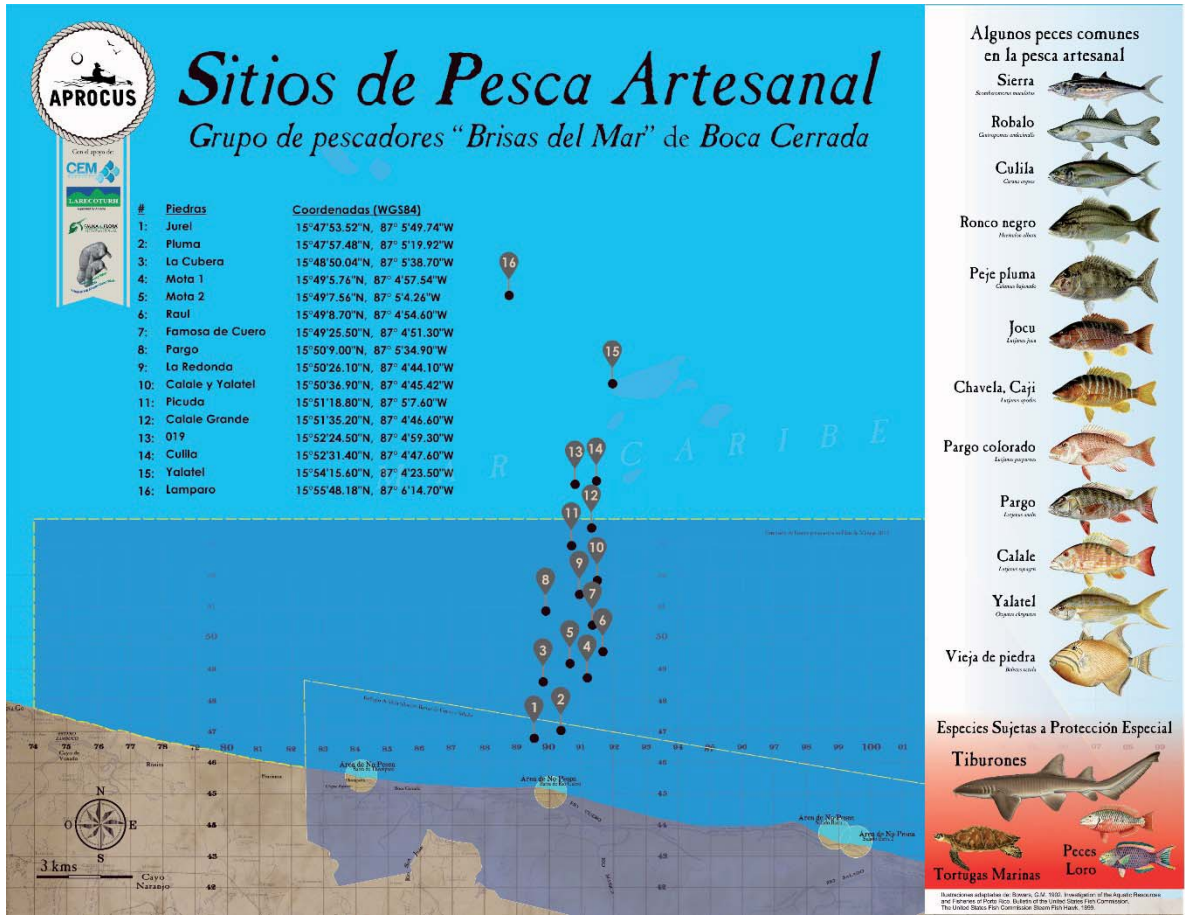
Preparing equipment for georeferencing fishing locations together with fishermen members of APROCUS

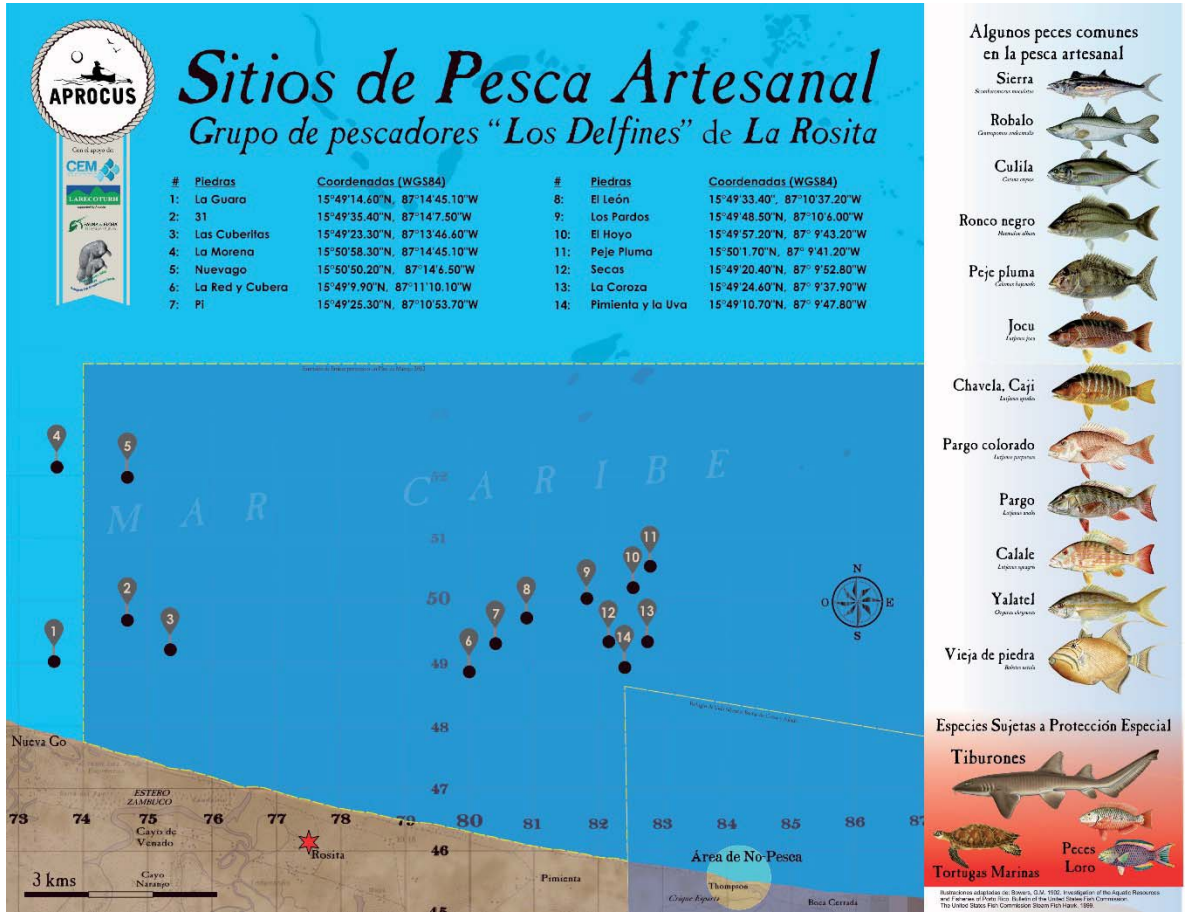
Fishermen of the community of Boca Cerrada, members of APROCUS, while identifying fishing locations

Map of Fishing Locations[5]

The following maps were made using the fishers' traditional knowledge.

5 Map: green dots belong to La Rosita community, blue dots to the Boca Cerrada community and red dots to the Salado Barra community.


APROCUS
Con el apoyo de:
CEM
LAMEC OTURB
Sitios de Pesca Artesanal
Grupo de pescadores "Brisas del Mar" de Boca Cerrada
Piedras Coordenadas (WGS84)
1: Jurel 15°47'53.52"N, 87° 5'49.74"W
2: Pluma 15°47'57.48"N, 87° 5'19.92"W
3: La Cubera 15°48'50.04"N, 87° 5'38.70"W
4: Mota 1 15°49'5.76"N, 87° 4'57.54"W
5: Mota 2 15°49'7.56"N, 87° 5'4.26"W
6: Raul 15°49'8.70"N, 87° 4'54.60"W
7: Famosa de Cuero 15°49'25.50"N, 87° 4'51.30"W
8: Pargo 15°50'9.00"N, 87° 5'34.90"W
9: La Redonda 15°50'26.10"N, 87° 4'44.10"W
10: Calale y Yalatel 15°50'36.90"N, 87° 4'45.42"W
11: Picuda 15°51'18.80"N, 87° 5'7.60"W
12: Calale Grande 15°51'35.20"N, 87° 4'46.60"W
13: 019 15°52'24.50"N, 87° 4'59.30"W
14: Culila 15°52'31.40"N, 87° 4'47.60"W
15: Yalatel 15°54'15.60"N, 87° 4'23.50"W
16: Lamparo 15°55'48.18"N, 87° 6'14.70"W
Algunos peces comunes en la pesca artesanal
Sierra
Robalo
Culila
Ronco negro
Peje pluma
Jocu
Chavela, Caji
Pargo colorado
Pargo
Calale
Yalatel
Vieja de piedra
Especies Sujetas a Protección Especial
Tiburones
Tortugas Marinas
Peces Loro
N
O
E
S
3 kms
Cayo Naranjo


APROCUS
Sitios de Pesca Artesanal
Grupo de pescadores "Los Delfines" de La Rosita
Piedras Coordenadas (WGS84)
1: La Guara 15°49'14.60"N, 87°14'45.10"W
2: 31 15°49'35.40"N, 87°14'7.50"W
3: Las Cuberitas 15°49'23.30"N, 87°13'46.60"W
4: La Morena 15°50'58.30"N, 87°14'45.10"W
5: Nuevago 15°50'50.20"N, 87°14'6.50"W
6: La Red y Cubera 15°49'9.90"N, 87°11'10.10"W
7: Pi 15°49'25.30"N, 87°10'53.70"W
Piedras Coordenadas (WGS84)
8: El León 15°49'33.40", 87°10'37.20"W
9: Los Pardos 15°49'48.50"N, 87°10'6.00"W
10: El Hoyo 15°49'57.20"N, 87° 9'43.20"W
11: Peje Pluma 15°50'1.70"N, 87° 9'41.20"W
12: Secas 15°49'20.40"N, 87° 9'52.80"W
13: La Coroza 15°49'24.60"N, 87° 9'37.90"W
14: Pimienta y la Uva 15°49'10.70"N, 87° 9'47.80"W
MAR CARIBE
Nueva Go
ESTERO ZAMBUCO
Cayo de Venado
Rosita
Cayo Naranjo
3 kms
Pimienta
Área de No-Pesca
Thompson
Boca Cerrada
Algunos peces comunes en la pesca artesanal
Sierra
Robalo
Culila
Ronco negro
Peje pluma
Jocu
Chavela, Caji
Pargo colorado
Pargo
Calale
Yalatel
Vieja de piedra
Especies Sujetas a Protección Especial
Tiburones
Tortugas Marinas
Peces Loro

The joint effort of fishermen sharing their traditional knowledge regarding fishing locations and the scientific support of participatory mapping has yielded positive results, because all fishing locations that have been traditionally used in the marine protected area were included. As a result of this process, a part of the co-managed area was declared fishing site, which allowed access, use and control rights of fishing resource to fishermen who live in the refuge. Maps also confirm this right graphically.

DISCUSSION: ANALYSIS AND REFLECTION ABOUT THE EXPERIENCE

Fishermen have, for many years, used their traditional knowledge to identify fishing locations. They still use it nowadays to catch different commercial species. The RVSBCS started a review of its protected area boundaries, especially in the marine space. The review led to a joint effort between technicians of various institutions that are working in the interested zone and artisanal fishermen as main community representatives, to determine exact fishing sites as well as approved fishing locations and those that are not, which are spaces for the regeneration of species.

The insights gained were put together to validate fishing locations frequently visited by fishermen. Participatory mapping allowed more clarity among members of the same community. Each community pointed out which fishing locations were used by fishers in the locality.

Also, for the Co-managing Foundation of the protected area, zoning allowed a better understanding of the locations used for fishing. This resulted in information enabling limiting access to fishermen of other regions who enter without any authorization to profit from the resource.

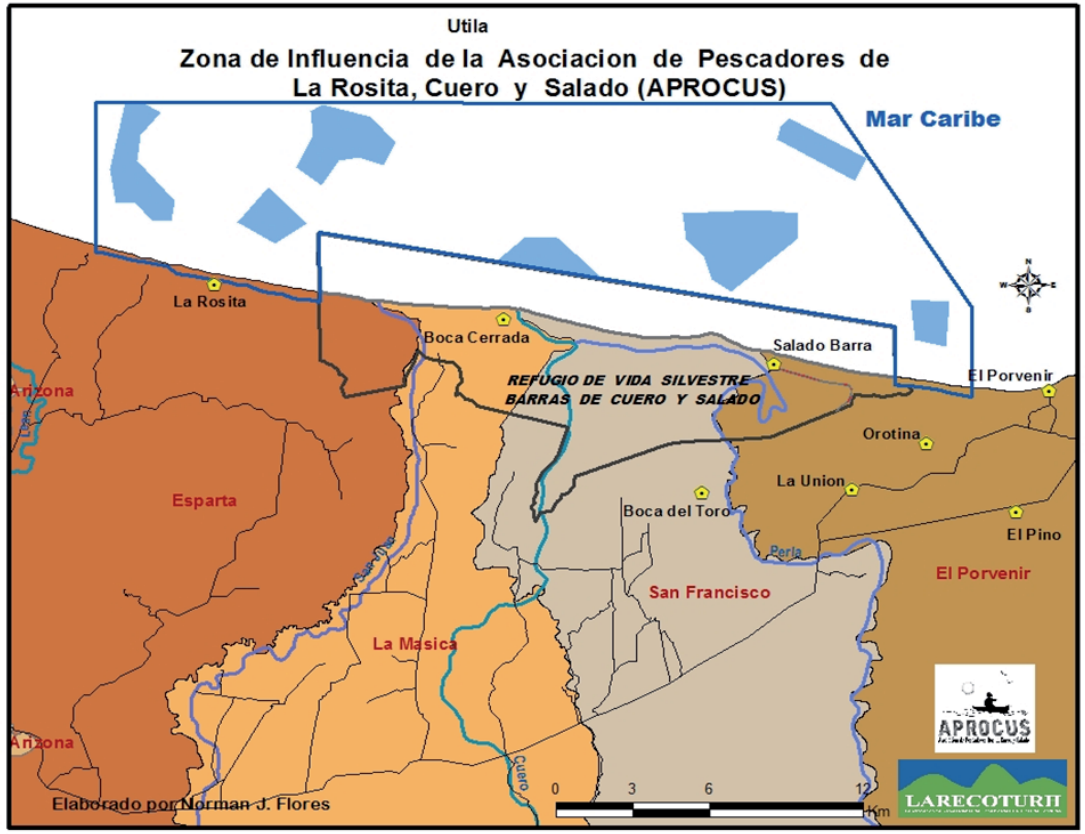
One of the most important results of the present case study is the complementarity amongst the different parties, which led to a better synergy between representatives and communities. From this, we have the necessary information to work on the strengthening of alliances, effect of laws, lobbying and demand elements that strengthen the governance of use, control and access to natural resources.

CONCLUSIONS

Traditional knowledge of fishermen, regarding artisanal fishing or small-scale fishing, is important, because it's been, for many years, a tool to guarantee f ood supplies and an income to their families. Concerning the above, the following reflections were made:

- A result of the different spaces created for fishers and technicians led to an understanding among both sides that traditional knowledge is at the basis of scientific knowledge. Scientific knowledge develops from the inputs given by artisanal fishermen, and it validates them through methodological tools.
- Fishermen are conscious of the fact that they have acquired traditional knowledge from their families. Practice has enabled them to get to know the area perfectly, and it gives them an extra power to exercise marine governance of their fishing locations, as well as demand these locations to be demarcated and included in the maps or documents that are created by technicians of various institutions that support and co-manage the protected area.
- An artisanal fisherman is satisfied and confident with the fishing method used with traditional knowledge. However, there have been some changes in the weather conditions of the area and sometimes fish aren't located near the communities, which is where scientific tools come into play to enable increasing the catch. Artisanal fishers point out that if these scientific tools stop working for any reason, their traditional knowledge won't fail them in case of an emergency.
- Artisanal fishermen have managed to get their fishing locations to be acknowledged by the tools that regulate public activities inside the protected area. Therefore, their interests are being respected.
- Traditional knowledge is the basis for processes concerning management, alliances and effectiveness that allow a change in laws, projects and above all, the decision-making at all levels.
- All fishermen members of APROCUS feel satisfied with the participatory mapping process, because it allowed them to put their traditional knowledge on paper, and in this manner, pass the information to new generations in a better way. Especially, if they need to locate young fishers in a precise fishing point when there's bad weather, which makes it hard to tell where they are using traditional reference points.

Map of Cuero y Salado Wildlife Refuge's area



1 Interviewed fishers: Ramón Gómez and José Ángel Guardado of La Rosita community, Justo Montero of Boca Cerrada community and Armando Gavino of Salado Barra community.

SAMUDRA Monograph

Traditional knowledge Use for the Sustainable Management of Marine and Fishing Resources

The use of traditional knowledge can be a powerful conservation tool, providing community support for conservation plans and enabling the inclusion of customary ecological management practices in their design.

This study documents three experiences in Central America where traditional knowledge has been used to improve marine spatial planning and frame a new policy oriented towards human rights approaches to fisheries and has given better tools for the governance of community managed protected areas.

With the support of the International Collective in Support of Fishworkers (ICSF), CoopeSoliDar R.L. selected the case studies (two in Costa Rica, one in Honduras) based on processes that allowed observation of the contribution of traditional knowledge in the generation of information for coming up with a policy for the sustainable use of fishing resources and management practices geared towards marine conservation.

ICSF

ICSF is an international NGO working on issues that concern fishworkers the world over. It is in status with the Economic and Social Council of the UN and is on ILO's Special List of Non-Governmental International Organizations. It also has Liaison Status with FAO. As a global network of community organizers, teachers, technicians, researchers and scientists, ICSF's activities encompass monitoring and research, exchange and training, campaigns and action, as well as communications.

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