

MAPPING HUMAN DIMENSIONS OF SMALL-SCALE FISHERIES IN THE
NORTHERN GULF OF CALIFORNIA, MEXICO

By

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DEDICATION

Para Jorge y Alba, mis padres.

Su amor, sabiduría y compasión, me han inspirado siempre.

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ABSTRACT

Recurrent crises due to overexploitation of fishery resources have been among the biggest natural resource management failures of the 20th century. This problem has both biological and socio-political elements and understanding of human dimensions represents a key step toward the formulation of sound management guidelines for natural resources. One of the strategies proposed to understand human dimensions is through the use of local knowledge. Integrating local peoples' knowledge with scientific research and data analysis, could aid in the design of fisheries management strategies in a cost-effective and participatory way.

I introduce an approach to incorporating fishers' local knowledge at a large, regional scale. I focused on the spatial and temporal distribution of fishing activities from 17 communities in the Northern Gulf of California, Mexico. Participatory mapping (maps produced by local fishers) through a rapid appraisal (survey methodology) were used to identify the spatial and temporal dimensions of fishing activities. A geographic information system was used to generate 764 map layers used for a preliminary analysis of rapid-appraisal spatial data. Post-survey workshops with fishers were organized to facilitate an internal validation of spatial information using geographic information system software. We characterized the information based on fishing communities, fishing methods, target species and spawning sites. We also applied spatial analysis techniques to understand the relative importance and use of fishing grounds, fishing seasons and the influence that fishing communities have over the region. This dissertation addressed the

problem of integrating the human dimensions of small-scale fisheries using geospatial tools and local knowledge (LK) – data collection, integration, internal validation, analysis and access – into a multidisciplinary research to support decision making in natural resource planning for small-scale fisheries management and conservation in the Northern Gulf of California, Mexico.

CHAPTER 1. INTRODUCTION

Human Dimensions in Fisheries Management

Recurrent crises due to overexploitation of fishery resources have been among the biggest natural resource management failures of the 20th century. The problem is further exacerbated as we increasingly operate in a global economy with fishery stock depletions occurring at rates that exceed the abilities of local regulatory institutions to respond and adapt management plans (Berkes et al. 2006). Long-term global marine fisheries prospects also suggest declining global catches, serious impacts on biodiversity, and expansion of bottom fisheries into deeper waters (Pauly et al. 2003). Part of the failure in fisheries management worldwide is due to approaches that ignored wider coastal and marine ecosystems complexity and the need to integrate social, biological and physical information to address these issues effectively (Finlayson and McCay 1998). Over time it has become clear that approaches that ignore the human dimensions result in failures in meeting the need for environmental protection.

New approaches such as "adaptive management" (Walters 1986), "ecosystem management" (Schramm Jr. and Hubert 1996; Pikitch et al. 2004; Leslie and McLeod 2007), "responsible fisheries" (Garcia 2000) and "spatial marine planning" (Douvere 2008) have acknowledged the importance of the human dimensions of natural resources management and some of them have been recognized in fisheries management (Pitcher and Pauly 1998; Pikitch et al. 2004; Leslie and McLeod 2007). The evolving definition of human dimensions includes recognition of people and their actions in space and time as

part of ecosystems that need to be included in the decision-making process for natural resources management.

The Role of Social Science

The blame for deterioration in the marine environment cannot be easily addressed; however, failures in fisheries management have also been analyzed from a social and political point of view. Politicians and scholars have pointed to the “commons dilemma” (Hardin 1968) as the root of the overexploitation of fisheries. Since Garrett Hardin popularized “the tragedy of the commons” 40 years ago, his ideas about common property regimes have become one of the most widely accepted explanation for overexploitation due to mismanagement of commonly held resources (Fenny et al. 1990).

While it is clear that open access and commonly held resources present a dilemma, natural resources management are still searching for better ways to incorporate social perspectives into management strategies. Berkes (1999) formulated, as part of a management system structure, different levels of social analysis regarding local observational knowledge of the land (property), resource management systems, social institutions (or rules-in-use), and the world view. He represented it as a hierarchical system that falls short of showing the feedbacks of information and interaction among the ellipses (Figure 1), and the close coupling of some parts of the system, especially management systems and social institutions. However, it does express the idea of embedded local knowledge (LK) and rules/norms in the world view of a particular culture.

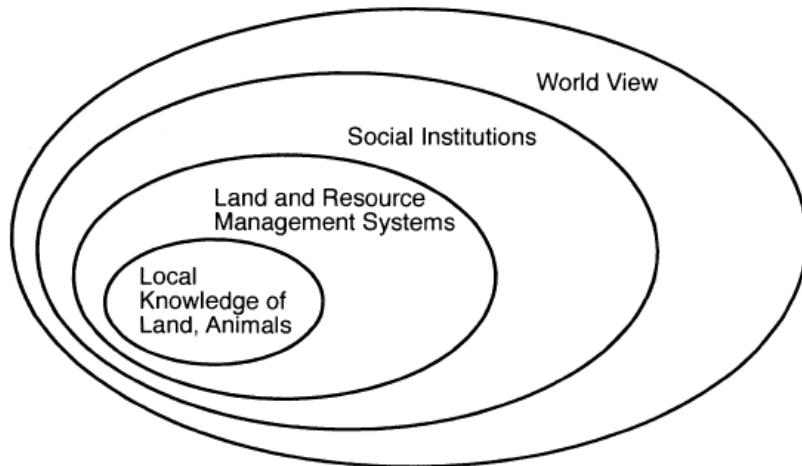


Figure 1. Levels of social analysis from a management system structure – Berkes (1999)

There is some agreement in support of this view, specifically on the recognition of LK that adds value to fisheries science and hence produces more enlightened, effective and equitable solutions to the management challenge (Dyer and McGoodwin 1994). Secondly, the participation of users in the planning and management process can provide legitimacy to the regulatory system, and, therefore, agreement. With an agreement, users are likely to become more knowledgeable of, committed to and, supportive of regulations if they have had some participation in the process. Hence, social institutions become stronger and the feedback is greater (Ostrom et al. 1994; Ostrom 2000).

Incorporating Local Knowledge

Interest in LK has been growing and incorporated in natural resources management due to its contribution to conservation and natural resources management in a variety of ways (Ruddle 1994; Berkes 1999; Gadgil et al. 2003; Close and Hall 2006). Social scientists have emphasized the importance of knowledge produced and orally

transmitted by traditional fishermen and how it has an important role in the development and implementation of fisheries management strategies. LK continues to guide and sustain the management of many traditional, community-based fishing systems, as well as govern fishing decisions and fishing strategies (Ruddle 2000; Aswani and Lauer 2006; Hall and Close 2007).

LK differs from that of scientific knowledge in that it is largely dependent on local social mechanisms and is empirically based and designed for practical purposes. LK domains include much valuable information with respect to social, physical, and biological components (Berkes 1999; Neis and Felt 2000; Neis et al. 2006). This helps fishing communities to maintain and constantly renew connections to fishing sites and access to a supply of marine resources. Areas of LK also include references to classification of aquatic species, fish behavior, taxonomy, patterns of reproduction and migration of fishes, feeding interrelationships among species, physical and geographic characteristics of the aquatic habitat, climate (weather change, winds, storms, and tides), principles of navigation, and functioning of diverse fishing techniques. LK reflects the human relations as social networks and the interaction with nature in association with values, culture and traditions.

Property and Resource Management Systems

Some management systems serve the purpose of maintaining ecosystem process and function (Berkes et al. 2000). Concepts such as adaptive management, ecosystem management, and responsible fisheries often recognize the importance of understanding

and achieving the balance between social, economic, and ecological sustainability. A key component for successful management of fisheries requires better understanding of these feedbacks and a multidisciplinary approach that includes the associated human population and economic/social systems as integral parts of the ecosystem.

One of the insights provided by social scientists is the bottom-up approach that focuses on decentralized users and grants both rights and responsibilities through delegation of management authority. A term increasingly used for this approach is "co-management", defined as the collaborative and participatory process of regulatory decision-making among representatives of user-groups; participation is decentralized and delegated to user-organizations at national, regional and/or local levels the management functions. This implies autonomy of users within an overall institutional framework. (Pomeroy et al. 1997; Jentoft et al. 1998; Silva 2004).

Like the specific study of co-management, other research about management from the social point of view, has provided many insights and understanding of many types of organizations including fishing communities. This has led to better comprehension of how communities are organized and how they manage their resources using formal or informal rules. In communities with no formal management of resources, informal ownership of fishing spots may determine the basis for local management (Basurto 2005; Cudney-Bueno and Basurto 2009; Cinti et al. 2010).

Rules give substance and structure to property rights by defining how a right is to be exercised. On the other side, basic rules define geographical areas to which rights are applied. When rights entail geography, the terms 'sea tenure' (McGoodwin 1995), and

territories associated with fishing regulations are used (Berkes et al. 1998). This has been well studied by Christy (1982) in regard to territorial use rights (TURFs) and Begossi (1995; 1998; 2003) with fishing spots and sea tenure in Brazil. These authors describe territoriality as a management alternative that includes the reduction of competition for limited resources and increases in individual or communal control over those resources.

It is viable to have formal and informal rules in fisheries management or joint management where government and local people are involved; there are several examples of groups that regulate their own joint use (Fenny et al. 1990). Whether different rules govern fisheries or not, in terms of changing the focus of coastal fisheries management, it is important to take into account that restriction to access is one tool to regulate marine resources. Most techniques of conventional management do not restrict access to fisheries (Pomeroy 1994) however the concept of *space* and human dimensions in fisheries management are now being proposed and used as a management strategy in fisheries (St. Martin 2004, Douvere et al. 2007).

Social Institutions

‘Institution’ is a concept that may have different meanings for different groups and people, including members of various academic disciplines. Despite the many different views of institutions, it is commonly accepted that institutions are a strong entity with robust characteristics. Institutions in fisheries are made up of families, firms, communities, social networks, private organizations (NGOs), research institutes, government agencies and legislative bodies (Jentoft 2004). The structure and dynamics of

institutions are critical for implementation of management practices based on ecological understanding in any society (Cortner et al. 1998).

Ostrom's (2000) defines 'property', as a core institution structuring social relations. In fisheries, 'property' determines rights of access to the natural resources. For example, Basurto (2005) explains that rules (or institutions) in the Seri community in Mexico play an important role in controlling fishing effort and access using the boundary rules and access rights. This supports the idea that providing an individual or group with secure tenure over a part of the resource (either physical possession or the right to beneficial use), serves both to restrict access and to encourage greater concern for improving resource management. However the provision of tenure per se does not guarantee better resource management and, establish an institution for management of natural resources (Christy 1982). As changes among social institutions are accelerated, it is of a particular importance to be able to visualize the 'social landscape' and understand how social systems work and how institutions can contribute to natural resource management in space and time.

The Social Landscape

Social scientist can play an important role in fisheries management due to the emphasis on recognizing the cultural behavior in particular settings and the social structure for natural resources management activities. The recognition of human behavior is, for the most part, historically and place bounded. However, even while fisheries are central to both ecological and social/cultural understandings for the marine environment,

the human dimension remains largely undocumented. For example, in most situations, detailed information concerning which fishing communities utilize the marine resources and maintain local knowledge concerning the habitat and life history of species, is only vaguely documented and available to resources managers (St. Martin and Hall-Arber 2008). It is increasingly clear that local and regional schemes for sustainable resources management work best when documentation of and engagement with local communities and resources users is included in the process (Cudney-Bueno and Basurto 2009).

Ecosystems-based approaches in fisheries have suggested that local ecological knowledge from fishers directly will only work in the long-term if fishers are partners in the scientific and management process (Neis et al. 1999; Basurto 2005). One of the main contributions that social science has provided to fisheries management is giving voice to institutions through different mechanisms portraying the ‘social landscape’ in management plans for natural resources. Converting peoples’ knowledge and along with scientific knowledge using common tools to portray the biophysical and social landscape of fisheries, could aid in the design of fisheries management strategies in a cost-effective and participatory way.

Geospatial Tools

Geospatial tools have become an important part of the planning process of natural resources management (Scholz et al. 2004). Among the important trends in the development of geospatial tools has been the shift toward geo-referencing all data into a single real-world coordinate system and developing new software for geographic

information systems (GIS) or remote-sensing (RS) to integrate spatial data from a number of sensors and devices in a quickly and effectively manner.

But the crucial question is how can geospatial tools contribute in integrating social science into natural resources management? A simple answer: by adopting and adapting – at the required scale – the necessary tools and technology to the needs of planning and management. The role that information plays in this continuing process is important. As more information is available and readily accessible using geospatial tools, there will likely be reconsideration of options, shifts in priorities, and eventually new or modified future scenarios, in an ‘iterative loop’ between society, nature and natural resource management. The collection, management and analysis of the data related to natural resources, landscape features and the “social landscape” of an ecosystem in both space and time, can be part of a planning process to allow a successful information flow for decision making. Geospatial tools have become an essential part of the planning and management process giving support to decisions.

Integrating geospatial tools into a multi-disciplinary approach for natural resources management has become a priority. The inclusion of geospatial tools and the reliance upon GIS to understand the spatial dimension of natural resources has also required a shift towards technical methods to approach management/planning. GIS is quickly becoming the platform where marine spatial data is aggregated, planning options are visualized, impact analyses are performed, and regulatory zones are established and mapped. For example, the challenge of incorporating GIS to produce new geo-encoded data is already being met by a wide range of initiatives that include the deployment of

remote-sensing technologies (e.g., Marinone and Lavín 2005), finer scale and more localized data collections (e.g., Soria, G., unpublished material), as well as the incorporation of local knowledge of fishers into existing assessments and management (Cudney-Bueno 2007).

Geospatial tools are rapidly becoming essential strategies for assessments, planning, and decision-making relative to a host of competing uses of natural resources. In addition, new forms and techniques to represent and analyze information have become allies with new approaches for ecosystem management and for developing conservation priorities and defining protected areas in general. This new and expanding capability for integrative multidisciplinary data, has led to a new vision where the incorporation of human dimensions has become essential into the spatial planning of natural resources. Geospatial tools and GIS have made it possible to integrate LK, with emphasis on spatial and temporal dimensions, into the development of local, regional and even global strategies for natural resources management and conservation.

This Dissertation

This dissertation addressed the problem of integrating the human dimension of small-scale fisheries using geospatial tools and local knowledge (LK) – data collection, integration, internal validation, analysis and access – into research to support the different levels of decision making in the planning for small-scale fisheries management. My study focuses in the area defined as the northern Gulf of California (NGC), Mexico and is part

of the PANGAS Project, a larger initiative for ecosystem-based management (EBM) of coastal fisheries in the NGC.

My goal was to provide support to a multidisciplinary process with information that reflects the spatial and temporal dimension of fishing activities with the aim of developing sound management strategies for small-scale fisheries in the NGC (Figure 2). I also explain the importance of integrating LK into a fisheries management planning process - considering fishers spatial and temporal perception of a place and a resource. This process entails the consideration of social sciences and its contributions to natural resources management; a piece of the puzzle that has been too often missing in the field of natural resources management.

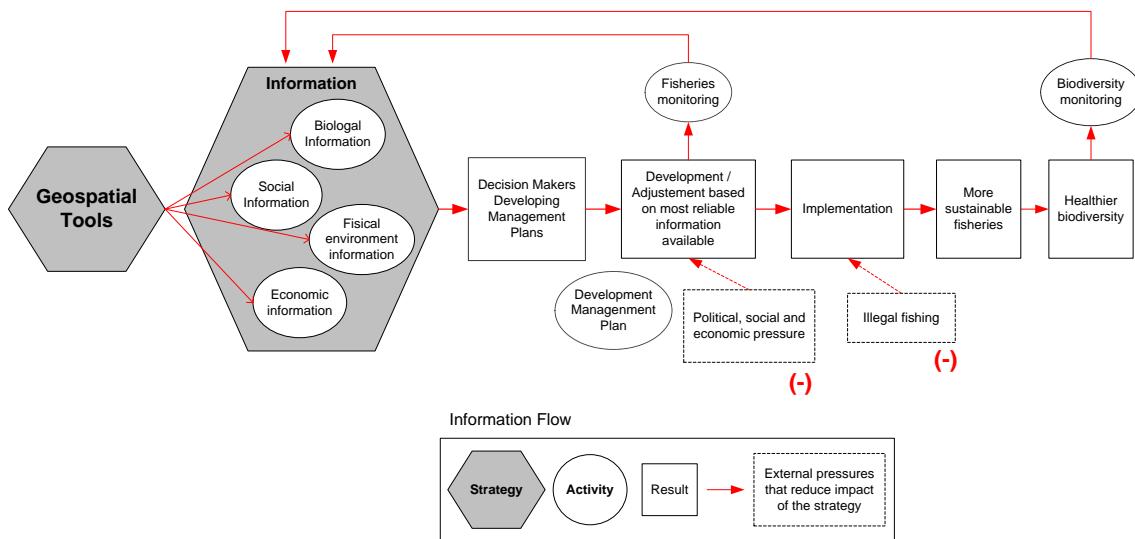


Figure 2. Flow diagram of a planning process for fisheries management

Using geospatial information tools – such as geographic information systems (GIS) – we can interpret and evaluate opportunities to implement sound management

strategies. This dissertation shows how the human dimensions of small-scale fisheries translated into spatial information provide a geographically referenced portrayal of fishing activities and relevant resource information. Furthermore this graphical representation aids in the communication to those responsible for implementing decisions. GIS has been used for its graphical potential and can be used to achieve an understanding of the diverse interactions that take place between people and natural resources in conjunction with the ecosystem. Additionally, GIS facilitates better planning and promotes informed decision-making.

The goal of this dissertation is to demonstrate the relevance of LK in understanding the spatial and temporal dimensions of small-scale fisheries and provide a social foundation to improve the decision-making process in the design of fisheries management strategies in the NGC, Mexico.

The specific objectives were:

- To develop a GIS as base-line information combining social and biophysical data.
- To portray LK about the spatial and temporal dimensions of fishing activities and the marine habitat into a GIS
- To characterize the small-scale fisheries based on the social information collected to evaluate: (a) spatial and temporal distribution of fishing activities; (b) the level of overlap of communities activities to be translated as possible opportunities or conflicts for decision-making in the design of management

strategies; (c) relative importance and use of fishing grounds; and, (d) spatial distribution of spawning and reproductive sites for commercial target species.

- To show the potential contributions of social science and geospatial tools – specifically the incorporation of LK – into fisheries management

Explanation of Dissertation Format

The results of this dissertation are presented as two separate appended manuscripts (Appendix A, B) and an Atlas (Appendix C). The manuscripts present a detailed account of specific research questions addressed, methodology, results, and discussion. The Atlas provides a comprehensive, visual presentation of scientific information and LK on the human dimensions of small-scale fisheries acquired and assessed through my research. Various colleagues appear as co-authors based on our mutual collaboration through the development of my doctoral research and subsequent dissertation. However, the responsibility for data collection, analysis, and writing these manuscripts is entirely my own and the dissertation as a whole represents my original and independent research. The support material used for this dissertation is presented in another four separated appended documents (Appendix D, E, F, and G).

Appendix A “Using Fishers' Local Knowledge to Aid Management at Regional Scales: Spatial Distribution of Small-scale Fisheries in the Northern Gulf of California, México ” is a manuscript submitted to the Bulletin of Marine Science. Results of this research have been presented in various seminars. This study provides an example of how key local knowledge can be incorporated into fisheries management. It describes how

data was collected and corroborated on a large regional scale with multiple fishing communities and highly diverse fishing activities. I wrote it in collaboration with Barron Orr, William Shaw and Richard Cudney-Bueno. They collaborated with me in revisions of the manuscript. I provide supporting material, including base-maps utilized for this research (Appendix D). In addition, results from an internal data validation are provided in Appendix E. This document I have included could be useful for anyone studying the coastal and marine environment or fisheries in the NGC.

Appendix B “*Place-based Planning for Fisheries at Regional Scales: Small-scale Fisheries in the Northern Gulf of California, México*” will be submitted to the journal Ocean and Coastal Management. This study involves the incorporation of fishers’ knowledge into a process for understanding the spatial and temporal behavior of fishing activities in the NGC. This research represents an important source of information for the development of strategic management plans that incorporate a representation of users, the spatial and temporal dimensions of the fishing activities and provides information for place-based management at a regional scale. I worked and co-authored this paper in collaboration with Richard Cudney-Bueno, Jorge Torre, Rene Loaiza, Mario Rojo, William Shaw and, Barron Orr.

Appendix C “*Atlas: the Social Landscape of Small-scale Fisheries in the Northern Gulf of California, México*” will be published online and potentially submitted to the University of Arizona, Press. The purpose of this atlas is to provide a synthesis of a collection and analysis of more than 700 maps representing local fishers’ knowledge. Our objective is to provide a regional space-based assessment of the social and biophysical

landscape in order to inform policymakers and local citizens about spatial and temporal dimensions of small-scale fisheries and the interaction with the coastal and marine resources in the NGC. The collection of local and scientific knowledge, its compilation and the analyses presented here are intended to inform the design of management strategies for small-scale fisheries in the NGC.

In addition to these research articles, Appendices D through F contain information that could be useful for anyone studying the environment or small-scale fisheries in the NGC. Appendix F is devoted to a list spawning sites for 11 target commercial species and a brief description of their life history.

CHAPTER 2. PRESENT STUDY

The methods, results, and conclusions of this study are presented in the manuscripts appended to this dissertation. These three studies fill important gaps in our understanding of the human dimension of small-scale fisheries activities in the Northern Gulf of California, Mexico (herein referred to as the NGC). It is my hope that the findings presented here are of wide interest to fishery managers concerned about the interaction of fishers with the marine and coastal environment. Below I provide a summary of the methods, results, and the most important conclusions my work.

Study Area: The Northern Gulf of California

We conducted our study in the NGC, extending from north of Bahía de Kino in mainland Sonora and El Barril, in Baja California. Driven by seasonal wind-driven upwelling and constant tidal mixing, the NGC is a highly productive ecosystem, supplying most of Mexico's fishery resources and recognized as a key marine-conservation site (Cudney-Bueno et al., 2009). Within the area are 17 permanent small-scale fishing communities and at least four other temporary fishing camps distributed along approximately 2000 km of coastline (PANGAS Project, unpubl. data). These communities range from 5 (i.e., Campo Don Abel) to almost 50,000 inhabitants (i.e., Puerto Peñasco) (INEGI, 2005). The NGC, small-scale fishers play an important role in the economy of the region (Carvajal-Moreno et al. 2004). The communities harbor numerous fishing vessels locally called *pangas*, which are small (6–9 m) fiberglass

fishing skiffs powered by outboard motors (75–115 hp), each usually operated by 2–3 fishers (Ulloa et al., 2006).

Integration of Local Knowledge and Geospatial Tools in the Adaptive Planning Process – The Ontology

In this study, I present an approach to incorporate local knowledge and geospatial tools to improve understanding of the human dimensions of small-scale fisheries. This process represents only a stage on a planning process. However, the present study expose an emphasis on the incorporation of local and scientific knowledge and the use of geospatial tools for transforming the data into information for the design of place-based management strategies. This works also shows an approach to link nature, society and natural resources management through geospatial tools.

Rapid Appraisal and Participatory Mapping

Data for the first two manuscripts come from a rapid appraisal to understand and characterize small-scale fishing activities and it was conducted by field technicians and scientist working in PANGAS project. A semistructured interview (including the base maps) was designed and tested during November 2005 to be refined with fishers and researchers. . The interview was designed to capture broad-scale information about the human dimension of small-scale fishing activities in the region. It included a combination of closed and open-ended questions about demographics, fishing experience, spatio-temporal distribution of fishing activities and ecological knowledge related to targeted

commercial species. The base-map interviews included a variety of printed maps with basic information such as the coastline (INEGI 1:50,000 topographic maps), isobaths extracted from bathymetry data (Marinone and Lavín 2005), and general landmarks and their local names. The base maps were printed at six different scales ranging from 1:800,000 to 1:15,000 (Appendix E). The rapid appraisal was conducted from December 2005 to July 2006 focusing on seventeen fishing communities and camps in the region. A team of field technicians and researchers conducted 376 semistructured interviews and 769 base-map interviews with a stratified random sample of small-scale fishing captains in these communities.

Overview of the Three Manuscripts

Appendix A. Using Fishers' Local Knowledge to aid Management at Regional Scales: Spatial Distribution of Small-scale Fisheries in the Northern Gulf of California, Mexico

Understanding the spatial distribution of small-scale fisheries, a key step toward the formulation of sound management guidelines where these fisheries predominate, represents a challenge, as reliable data for small-scale fisheries is often limited. Small-scale fisheries have been largely neglected during development of environmental and economic policies and management approaches worldwide. Part of this neglect is rooted in the lack of basic—yet essential—reliable data (e.g., landings, fishing effort, spatial distribution of fishing activities) required for the formulation of management guidelines. Not surprisingly, recognition is growing of the need to bring to the table the best

available information at a regional scale for management (St. Martin et al., 2007). One way to cope with “data-poor” fisheries is to capitalize on the accumulated local knowledge of fishers as part of the research and management process.

We introduce an approach to incorporating fishers’ local knowledge at a large, regional scale. Participatory interviews and mapping through rapid appraisal ($n = 376$ fishers) were used to identify fishing grounds and fishing seasons. We documented information related to names of fishing zones and specific sites that fishers recognized as landmarks or fishing grounds in the geographic information system. We also captured the data related to fishing seasons and associate that with our spatial data. A GIS was used to generate 769 map layers used for a preliminary analysis of rapid-appraisal spatial data. We organized postsurvey workshops with fishers to facilitate an internal validation of spatial information. The internal validation process involved six workshops in two of the largest fishing communities of the NGC: three in Puerto Peñasco, Sonora (November 2006), and three in Bahía de Kino, Sonora (January 2007). We organized the workshops to validate the spatial distribution of fishing activities, fishing calendars, and basic life-history information about target species (Appendix E). These exercises generally resulted in agreement with the general distribution of fishing areas originally mapped but also led to the addition of new areas not registered during the rapid appraisal and important adjustments for some species, particularly in areas where depth contours are pronounced. In all, cross-checking during the validation workshops led to an aggregated increase in total fishing area of 1.08%. Overall, adjustments to the spatial information were more pronounced than those made to the temporal data.

The GIS database resulting from the rapid appraisal incorporates vector-based layers of spatial information depicting the spatial distribution of harvest locations of 52 different species from 17 different fishing communities. From a regional perspective, the total area fished, as mapped by fishers, is approximately 35,170 km², which corresponds to 60% of the 58,000 km² (total area) of the NGC. Results suggest that most (89%) of the coastline of the NGC and surrounding islands is used by fishers as fishing grounds and that most fishers use more than one gear type and fish for multiple species. Gill nets are used for at least 26 of these main target species, diving for 16, longlines for four, and traps for four. The remaining six target species are harvested by a mix of gear types and methods. In addition, we identified patterns of distribution by season as well as nursery grounds for the target species.

Our study provides an example of how key local knowledge can be incorporated into and corroborated during the data-collection process within large, regional scales with multiple fishing communities and highly diverse fishing activities. During the rapid appraisal, some respondents reported that mapping in particular circumstances such as areas located near the islands or open sea was particularly problematic when limited to printed maps, even when those maps were available at multiple scales. Our results suggest that local knowledge can be elicited with greater precision through a combination of field interviewing, ancillary data, and further interaction with fishers by means of geographic information systems.

This process increases the opportunity for dialogue between local fishers, natural resource managers, and researchers through systematic and participatory efforts. It also

reveals how re-engagement of local fishers can bring transparency to integration of local knowledge. The information collected allowed us to step back and take a more holistic view of the spatial dimensions of fishing activities in the NGC, one we believe is essential to a fuller understanding of the implications and cumulative effects of management plans and policies at different scales.

Appendix B. Place-based Planning for Fisheries at Regional Scales: Small-scale Fisheries in the Northern Gulf of California, México

Place-based ecosystem management system or ocean zoning is a process that reduces conflict, uncertainty and costs by separating incompatible uses and specifying how particular areas may be used (Russ and Zeller 2003; Norse et al. 2005). In some coastal countries, a place-based management agenda programs have been formally incorporated. The United States, for instance, recently saw the signing of a Presidential memorandum that established an Interagency Ocean Policy Task Force to develop recommendations for a national ocean policy, a framework for improved stewardship, and effective coastal and marine spatial planning (NOAA) (Douvere et al. 2007).

In Mexico, a new agenda for fisheries management has been established to include the development of regional fishery management plans, ecological zoning programs, and the establishment of networks of marine protected areas that take into consideration comprehensive planning in relation to socio-economic activities such as small-scale fisheries.

This study involves the incorporation of fishers' knowledge into a process for understanding the spatial and temporal behavior of fishing activities in the Northern Gulf of California (NGC). The central component to capturing LK was a rapid appraisal (Beebe 1995) that was designed to develop a preliminary, region-wide overview of the socio-economic and demographic patterns of small-scale fisheries in the NGC. This included fishers' knowledge regarding what, where and when they fish. The methodology entails aggregating the LK of a representative set of individual fishers and further refining this base information through a participatory, internal data validation process.

I applied basic spatial analysis to understand the distribution of fishing activity based on the different attributes collected such as species, communities and fishing gear. In order to understand the influence that each of the 17 communities has in the study area, I applied different relational algebra operators to analyze the influence of each community fishing activity. In order to understand the main characteristics of fishing zones by fishing method, we applied queries to the data and identified the distance from the shore, depth ranges and the communities and species being targeted. To understand the spatial and temporal distribution of fishing activities and the overlap between communities, we separated the data by fishing methods: diving, gillnets, hand fishing line or longline, and traps. For all the spatial analysis, we created a vector-grid map consisting of 5630 cells that were each 2.8 km x 2.8 km of spatial resolution to standardize and represent the spatial units. This was because the fishing zones and areas drawn by fishers on the printed maps, varied in detail, size and extension. Each cell was used as the base standard unit of analysis throughout the study area.

We identified a total of 73 commonly captured species and, 58 species for which fishers make a dedicated trip to fish. However, a total of 52 key target species from the overall list were selected by the interviewees as the most important and for which we collected a total of 769 individual maps with their spatial and temporal information based on the interview process. In general, 13 communities traveled more than 50 km. to reach their fishing grounds. However, we identified five communities traveling distances that range from 100 km. to 200 km. for gillnets and traps fishery. According to the spatial information provided for the 52 target species, communities utilize an average of three different fishing methods, 12 communities' fish by diving, 15 communities use gillnets, 12 hand fishing line and longline and 12 traps. Fishing activity in general happens year-round in the NGC. Through temporal analysis, we obtained the fishing activity distribution for each fishing method and we were able to visualize how communities interact at a regional scale in space and time.

The present study provides a picture of the spatial extent and distribution of fishing activities over a year and the relative importance and use for four different fishing methods. The characteristics identified by community or by fishing method can help us determine the relationship between social and biological connectivity when identifying the main species being captured and those important sites related to them.

My research produced a picture of the spatial and temporal distribution of fisheries activities at a regional scale that would not be possible to understand without this large-scale effort. By depicting the spatial and temporal interactions of small-scale fishers in the NGC, we show ways in which communities of fishers can be defined by

their interests and not only by a geographic place to answer questions such as, “what is the real spatial influence from one community?”, “how are the different species being fished?”, “where are the fishing activities concentrating? And, “when are those fishing activities happening?”

Future studies might include the integration of other human activities at a regional scale to support marine spatial planning (Douvere 2008) and the integration of biophysical information to improve the understanding of the relationship and connectivity between humans and the marine resources in the NGC. Planning at a spatial and temporal scale provides new opportunities for the management of fisheries, both for the Mexican government and local interests.

Appendix C. Atlas: the Social Landscape of Small-scale Fisheries in the Northern Gulf of California, México

This atlas exists as a resource for people interested in the knowledge accumulated by the people who live, study and depend of the marine resources of the Gulf of California. This atlas presents a synthesis of a collection and analysis of more than 700 maps representing local fishers' knowledge. My objective is to provide a regional picture of the social landscape in order to inform policymakers and local citizens about spatial and temporal dimensions of small-scale fisheries and the interaction with the coastal and marine resources in the NGC.

The purpose of this atlas is to provide a regional-scale perspective of the social landscape about small-scale fisheries in the NGC. Through the aggregation of information from so many local fishers, I provide with a picture of local information to help understand the human dimensions of small scale-fisheries and the local fishers' knowledge of the marine environment. The collection of local and scientific knowledge, its compilation and the analyses presented here are intended to complement, and not substitute for, research and more detailed analyses that are possible at individual sites, and at local scales.

**MY OBJECTIVE IS TO GENERATE AWARENESS OF THE HUMAN
INTERACTION FROM SMALL-SCALE FISHING ACTIVITIES WITH THE
MARINE ENVIRONMENT TO UNDERSTAND THE SOCIAL LANDSCAPE
AND INFORM POLICYMAKERS AND LOCAL CITIZENS ABOUT SPATIAL
AND TEMPORAL DIMENSIONS OF SMALL-SCALE FISHERIES IN THE
NGC. THE ATLAS INCORPORATES LOCAL KNOWLEDGE COLLECTED
AND SCIENTIFIC RESEARCH CONDUCTED DURING 2005-2006 IN AN
EFFORT TO CAPTURE THE DYNAMICS OF THE MARINE ECOSYSTEM OF
THE NGC.**

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**APPENDIX A. USING FISHERS' LOCAL KNOWLEDGE TO AID
MANAGEMENT AT REGIONAL SCALES: SPATIAL DISTRIBUTION OF
SMALL-SCALE FISHERIES IN THE NORTHERN GULF OF CALIFORNIA,
MEXICO**

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Key words: local knowledge, internal validation, geographic information systems, small-scale fisheries, Gulf of California, Mexico

Using Fishers' Local Knowledge to Aid Management at Regional Scales: Spatial Distribution of Small-scale Fisheries in the Northern Gulf of California, Mexico

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Abstract

Understanding the spatial distribution of small-scale fisheries, a key step toward the formulation of sound management guidelines where these fisheries predominate, represents a challenge, as reliable data for small-scale fisheries is often limited. One way to cope with “data-poor” fisheries is to capitalize on the accumulated local knowledge of fishers as part of the research and management process. We introduce an approach to incorporating fishers’ local knowledge at a large, regional scale. We focused on the spatial distribution of fishing activities from 17 communities in the northern Gulf of California, Mexico. Participatory interviews and mapping through rapid appraisal ($n = 376$ fishers) were used to identify fishing grounds and fishing seasons. A geographic information system was used to generate 769 map layers used for a preliminary analysis of rapid-appraisal spatial data. We organized postsurvey workshops with fishers to facilitate an internal validation of spatial information using geographic information system. These exercises generally resulted in agreement with the general distribution of fishing areas originally mapped but also led to the addition of new areas not registered during the rapid appraisal and important adjustments for some species, particularly in areas where depth contours are pronounced. In all, cross-checking during the validation workshops led to an aggregated increase in total fishing area of 1.08%. Our study

provides an example of how key local knowledge can be incorporated into and corroborated during the data-collection process within large, regional scales with multiple fishing communities and highly diverse fishing activities.

Introduction

Small-scale fisheries are central to the economic vitality and food security of many coastal developing nations and employ at least 50 million fishers worldwide (Allison and Ellis, 2001; Berkes et al., 2001), yet the very resources upon which they depend are often under threat (Béné et al., 2007). Furthermore, most small-scale fishing communities are dealing with human population growth and displacement in addition to increased competition with large-scale industrial fisheries that leave many fishers with limited or no employment alternatives (FAO, 2005).

Nevertheless, small-scale fisheries have been largely neglected during development of environmental and economic policies and management approaches worldwide. Part of this neglect is rooted in the lack of basic—yet essential—reliable data (e.g., landings, fishing effort, spatial distribution of fishing activities) required for the formulation of management guidelines (Berkes et al., 2001).

A more comprehensive understanding of the distribution, migration, and reproduction areas of target species for small-scale fisheries would result in better-informed decisions. One way to cope with these “data-poor” fisheries is to capitalize on the accumulated local knowledge (LK) of small-scale fishers. The incorporation of LK into conservation science and management of natural resources is increasing (Berkes,

1993; Johannes, 1993; Wavey, 1993). When combined with more traditional archival sources (e.g., historic government agency records and newspaper accounts), LK can also be used to reconstruct and interpret the history of fishers and their interaction with the environment (Sáenz-Arroyo et al., 2005 a, b). In addition to providing useful data, the incorporation of LK 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 in the process (Johannes, 1978; Smith and Berkes, 1991; White et al., 2002).

Although the need for LK has been increasingly recognized, most efforts to incorporate it for management purposes have been limited to “local” or community-specific case studies. Small-scale fisheries, however, can be ubiquitous within a regional seascape, in which multiple users and communities compete for the same fishing zones and fishery resources found within that seascape. Not surprisingly, recognition is growing of the need to bring to the table the best available information at a regional scale for management (St. Martin et al., 2007). As the spatial scales of management increase, however, so does the difficulty of adequately capturing the relevant information and of incorporating fishers’ knowledge. Furthermore, like that of any type of data, the reliability of LK must be assessed before management policies are formulated or this information is integrated with that from scientific research (Ames et al., 2000).

We show how key LK about the spatial dimensions of fishing activities can be incorporated as a first step toward addressing management at large, regional scales harboring multiple small-scale fishing communities and highly diverse fishing activities.

We capitalize on the ability to integrate LK to provide the first regional perspective on the spatial dimensions of small-scale fisheries throughout the northern Gulf of California (NGC), Mexico, a region that supplies most of Mexico's fishery resources (Carvajal et al., 2004; Cudney-Bueno et al., 2009). We also introduce and discuss an approach to improving data accuracy of participatory mapping efforts through a focus group-based internal validation using geographic information systems (GIS). Because corresponding scientific data, such as the location of fishing zones, that can be integrated with this effort are rarely available, the internal-validation approach proposed is based on cross-checking LK with additional information from local experts. We exemplify these approaches by providing an "order zero" first view of the extent of spatial distribution of fishing activities throughout the NGC and interpreting the results obtained during the data validation exercises for two of the main fishing communities of the region. This study is part of a larger initiative for the design of ecosystem- based management guidelines in the NGC and reveals the positive impact of integrating spatially explicit LK designed for research, management, and stakeholder communication.

Methods

Broadly defined, the method entails aggregating the LK of a representative set of individual fishers and further refining this base information through a participatory, internal validation process. The central component to LK capture was a rapid appraisal (Beebe, 1995) that was designed to develop a preliminary, region-wide overview of the socioeconomic and demographic patterns of small-scale fisheries in the NGC, including

fishers' knowledge about what, where and when they fish. Here, we focus our discussions on the methods used and analysis of to the spatial data gathered.

Study Site

We conducted our study in an area of the NGC extending north of Bahía de Kino in mainland Sonora and El Barril, in Baja California (Fig. 1). Driven by seasonal wind-driven upwelling and constant tidal mixing (Thomson et al., 2000), the NGC is a highly productive ecosystem, supplying most of Mexico's fishery resources and recognized as a key marine-conservation site (Cudney-Bueno et al., 2009). Within the area are 17 permanent small-scale fishing communities and at least four other temporary fishing camps distributed along approximately 2000 km of coastline (PANGAS Project, unpubl. data). These fishing communities harbor numerous fishing vessels locally called pangas, which are small (6–9 m) fiberglass fishing skiffs powered by outboard motors (75–115 hp), each usually operated by 2–3 fishers (Ulloa et al., 2006).

Preparation for Rapid Appraisal

From August through October 2005, before conducting any fieldwork, we conducted an exhaustive review of existing data and previous work carried out in the region in order to develop a baseline database of the state of knowledge of small-scale fisheries in the NGC. Sources of data included assessments of relevant local, national, and international policies; census data; previous studies and associated data (including information on the biology and ecology of known harvested species); and management

plans and other reports obtained from governmental and nongovernmental organizations (NGOs). On the basis of this information, we developed a first draft of a semi-structured interview designed to capture, among other data, fishers' LK about what, where, how, and when they fish. During November 2005, the semi-structured interviews were tested and refined with fishers and researchers.

Before designing the sampling strategy for the rapid appraisal, we first obtained listings of registered pangas; held meetings with focus groups, local fishery officials, and fishing cooperative leaders; interviewed key fishers; and conducted extensive coastline transects to count active pangas in each of the main fishing communities of the NGC. Cross-checking between these sources with the aid of two knowledgeable local NGOs resulted in a reliable list of fishing cooperatives as well as number of pangas and their captains. This was an essential first step for the project, given that official boat registries often do not represent the reality of actual fishing effort (Bourillón-Moreno, 2002; Cinti et al., 2010). Through this process we also broadened our baseline knowledge of spatial and temporal patterns of fishing and refined a list of small-scale fishers' target species. This baseline information was compiled through the cumulative experience of researchers working on the project (some of whom had over 10 yrs of experience working with small-scale fishers in the region) and the assessment of earlier research and government documents.

We developed a list of active pangas for each community and identified their captains. We relied on these boat captains as our unit of analysis, given that captains are generally the most experienced and knowledgeable fishers and those who tend to make

the decisions about where and when to fish. Once we knew what our universe for sampling would be (i.e., number and names of existing captains of active boats), we used stratified random sampling and calculated the sample size for each community as established by Krejcie and Morgan (see Bernard, 1995: 77–78), ensuring a 90% probability sample with at least a 10% confidence interval for each fishing community sampled (for fishing communities with 10 pangas or fewer, all captains were interviewed).

Semi-structured Interviews and Participatory Mapping

Between December 2005 and July 2006, nine researchers invested at least 6000 person-hours in the field, covering approximately 2000 km of shoreline of the NGC to conduct 376 semi-structured interviews with captains of randomly selected pangas in 17 fishing communities of the NGC (Fig. 1). As part of the interviewing process, we explained to interviewees the overall goal of the project and how the data could potentially help with the design of fisheries management plans. In each interview, we asked respondents to identify all the species that they harvested and, of those, to select up to three of their main target species. Once these were selected, we asked fishers questions about the spatial and temporal distribution of fishing activities for those species. In addition, we asked them to portray this information on printed maps (leading to the creation of 769 maps).

The participatory mapping involved the use of a variety of printed maps that included basic information such as the coastline (INEGI 1:50,000 topographic maps),

isobaths extracted from bathymetry data (Marinone and Lavín, 2005), and general landmarks and their local names. The base maps were printed at six different scales ranging from 1:800,000 to 1:15,000.

We gave each interviewee instructions on how to depict the information requested. When the interviewee asked for help in drawing any information, we asked specifically how the information should be placed in the map. For each of the up to three selected target species, fishers delineated the primary (most frequently visited) and secondary (less visited) fishing zones with different colors. We also asked fishers to identify the fishing seasons for the species in question in two ways: the total season (all the months in which the species is harvested) and main season (months in which that fisher concentrated fishing effort on that particular species). We gathered other information, including spawning sites, past and present health of the fishery, gear used, and related management information about the target species such as threats and problems. We encouraged respondents to record spatial information such as key reproductive sites and the distribution of fishing activities as discrete areas (polygons) on the map. We recorded any other relevant information in notes, which were later transcribed.

Integration of Local Knowledge

After capturing the content of the interviews in a digital spreadsheet, we standardized and transferred the data to a relational database. We devoted more than 2000 person-hours to digitizing, georeferencing, and integrating participatory maps into a GIS

using ArcGIS 9.2 (ESRI, 1999–2008). We compiled the fishing areas drawn by fishers onto the individual paper maps in a digital format using on-screen digitizing. We coded the location-based data individually and joined associated attributes representing additional information from the interviews into the GIS database in preparation for spatial integration and analysis. We coded transcribed interview notes and, where appropriate, associated them with the spatial data. Although we recorded the majority of spatial data as areas (polygons), we converted responses reported as point locations to circular polygons based on the point centroid encircled by the approximate fishing area surrounding the point as suggested by fishers. Through topological map overlay, we created across-respondent maps aggregated by species and fishing activity. These allowed us to visualize, for example, harvest surfaces obtained for a combination of species, fishing gears, and/or communities. We documented information related to names of fishing zones and specific sites that fishers recognized as landmarks or fishing grounds in the GIS. We also captured the data related to fishing seasons in an Excel spreadsheet database that we then joined to the associated spatial data.

Internal Validation Workshops

Despite the flexibility that geospatial tools provided for digitizing and spatial analysis, potential inaccuracies emerged when fishing zones were portrayed on a map (Close and Hall, 2006). Furthermore, some respondents might provide outlying information. To address this problem, we developed and implemented an internal validation process with the purpose of refining and cross-checking the rapid-appraisal

data as well as reinforcing fishers' participation in the research. An additional benefit of this approach was that the actual process of obtaining corroborating evidence provided further opportunities to engage fishers in the research process and to share with them information generated from both the aggregated LK and ancillary data.

The internal validation process involved six workshops in two of the largest fishing communities of the NGC: three in Puerto Peñasco, Sonora (November 2006), and three in Bahía de Kino, Sonora (January 2007). We organized the workshops to validate the spatial distribution of fishing activities, fishing calendars, and basic life-history information about target species. Resource limitations led us to choose these two communities because they encompassed the most representative range of fishing-activity variability found in the communities participating in the original rapid appraisal. These communities are two of the main fishing communities of the NGC in terms of both numbers of fishers and extent of fishing activities. They are also home to two key local NGOs participating in the project, the Intercultural Center for the Study of Deserts and Oceans and Comunidad y Biodiversidad, A.C., which brought advantages such as increased knowledge about the local fisheries and an understanding of local social networks. Their strong relationship with local fishers of Puerto Peñasco and Bahía de Kino facilitated the workshop logistics and participation.

The criteria for selecting key fishers for the internal validation exercise were: (1) 10 or more years working in the area and/or fishery, (2) 10 or more years living in the community, and (3) prior involvement in the project (we recruited a combination of fishers who participated in the rapid appraisal and other fishers who had not). We chose

these criteria to involve knowledgeable fishers and to attempt combining, in similar proportions, those who had contributed to the original participatory maps (and thus had mapping experience) with those essentially independent of the original effort. The number of participants invited for each workshop ranged from 5 to 12 fishers. In all, 50 fishers participated in the workshops (Table 1).

Because fishers used different methods to harvest different species, we organized the workshops to cover the four main fishing-gear types and methods used in the NGC: diving, gillnets, longline, and traps. On the basis of the results from the rapid appraisal, we selected for the validation exercise the most representative target species for each fishing method (Table 1). During each workshop we worked with focus groups (Morgan, 1997) of fishers who were experts in the representative target species.

Each workshop began with a description of the project and its overall goal and objectives. Once these were successfully communicated, the internal validation exercise began with a wall projection of parameters that, during the original participatory mapping interviews, had been determined to be essential to the way fishers had delineated the spatial extent of their fishing activities. We introduced key spatial variables drawn from the data as background maps: satellite images (GeoCover Landsat ETM+ mosaics 1993–2001), a high-resolution coastline base map (INEGI 1:50,000 topographic maps), point bathymetry (Marinone and Lavín, 2005), and typical landmarks and local site names used by fishers (M. Moreno-Baez, University of Arizona, unpubl. data). Next a presentation of the integrated data from the rapid appraisal associated with the fishery in question was

displayed for the participants. We projected this information on the wall to facilitate the visualization of data and fishers' participation in the associated group discussion.

During the workshops, personal respondent data collected during the rapid appraisal, as well as information about specific "fishing holes," remained confidential, but through the use of aggregated and smoothed polygons, fishers were able to see what others from their community and elsewhere in the region had shared about a particular species during the rapid appraisal. We overlaid these preliminary results on different layers, such as coastline, bathymetry, and landmark maps. We then facilitated a discussion of the reported data and made changes on the basis of fishers' suggestions. With each proposed change (elimination of a polygon, addition of a polygon, or change in the shape of a polygon), we recorded what led to the change (e.g., fishers' expert knowledge or clarity provided by the ancillary scientific and baseline data). The interaction during the workshops with fellow fishers and the spatial information projected by means of GIS allowed participants to measure distances, depths, and locations on the basis of landmarks such as rocky outcrops and other landscape features that they use to position themselves and navigate while fishing.

After the spatial data had been evaluated, fishing calendars for the same list of species were presented for validation of temporal information about the "main" and the "total" fishing seasons for each species. Thereafter, we integrated the spatial data generated through the internal validation process into the overall project GIS database and gave a presentation of the adjusted results to participants at the end of the workshop. A discussion among the workshop participants followed, about how this information

could be used (and might not be used) by those developing fisheries-management plans and formulating policy, intended to make the process more transparent.

For the communities of Puerto Peñasco and Bahía de Kino, Sonora, we compared fishing zones produced during the original participatory mapping exercise to the adjusted fishing zones produced during the internal validation process for each target species. These areas were quantified with ArcGIS 9.2 (ESRI, 1999–2008) and then differentiated by means of a spatial union function. We calculated the magnitude and direction (increase or decrease) of the difference by dividing the original area by the area obtained after cross-checking. For fishing calendars, we measured changes by calculating the percentage of target species showing a change on the original calendar resulting from the internal validation workshops.

Results

The GIS database resulting from the rapid appraisal incorporates vector-based layers of spatial information depicting the spatial distribution of harvest locations of 52 different species from 17 different fishing communities (Table 2 gives scientific names of those further discussed here). Because the amount of spatial data obtained during this study was so vast, it will be presented through a series of scientific papers and other documents. Here, we focus on providing an “order zero” first view of the spatial distribution of fishing activities in the NGC as well as more detailed results for the validation exercises conducted in Puerto Peñasco and Bahía de Kino, two of the main fishing communities of the region.

Rapid-Appraisal Results

From a regional perspective, the total area fished, as mapped by fishers, is approximately 35,170 km², which corresponds to 60% of the 58,000 km² (total area) of the NGC (Figure 2). Results suggest that most (89%) of the coastline of the NGC and surrounding islands is used by fishers as fishing grounds and that most fishers use more than one gear type and fish for multiple species. Gill nets are used for at least 26 of these main target species, diving for 11, longlines for seven, and traps for one. The remaining seven target species are harvested by a mix of gear types and methods. In addition, we identified patterns of distribution by season as well as nursery grounds for the target species.

Rapid-appraisal results revealed that most fishing areas for diving are located within 400 m of shore and are between 1 and 26 m deep. Within the midriff island region (the lower part of our study area, dominated by Isla Tiburón and Isla Ángel de la Guarda and the areas most used by fishers of Bahía de Kino), fishing areas are concentrated within 100 m of the coastline of the mainland and islands. In the upper region (largely dominated by fishing activities of Puerto Peñasco), where the depth contour is less pronounced and rocky reefs are more “patchy,” diving activities commonly take place more than 100 m from of the shoreline (up to 20 km offshore). For gill nets and longline, most fishing zones are located in depths of up to 120 m and are generally located offshore. Finally, for traps, fishing zones are located close to shore, between the 5 m and 30 m isobaths. Figure 2 also depicts the spatial distribution of fishing zones and the geographic convergence of fishing methods.

Internal Validation

Fifty fishers participated in the internal validation exercises, of which 25% had previously been involved in the rapid appraisal (Table 1). These exercises resulted mostly in agreement with the general distribution of fishing areas mapped during the rapid appraisal, but fishing areas of target species were adjusted at some level for all but two of the 16 species under consideration (Table 3). These changes were composed mostly of the addition of new zones not captured during the rapid appraisal. Nevertheless, cross-checking the information also refined some of the existent areas mapped during the rapid appraisal, usually decreasing the extent of mapped areas, particularly for fishing activities taking place where depth changes were pronounced. We must clarify that, even though these adjustments often led to decreases for a given species, by the end of the validation exercise, the overall fishing area for that species might have increased as a result of the addition of previously unidentified fishing zones. In all, cross-checking during the validation workshops led to an aggregated increase in total fishing area of 1.08%.

Participants reported that the majority of their recommended changes resulted from the ability to assess data in greater depth and detail than was possible on the less versatile paper maps used during the rapid appraisal. Other changes were made as a result of the availability of higher-resolution coastline delineation, precise locations of coastline reference points, actual bathymetry point data, and, in some cases, the ability to interact freely with the data. Interaction with the digital spatial data projected during the workshops upon the participants' demand included the capacity to use tool functions such

as “zoom,” “pan,” “select,” and “classify,” all of which helped to reveal more appropriate and often scale-dependent detail on the different layers overlaid.

For Puerto Peñasco, Sonora, two of the 11 species analyzed for this community, Warrior swimming crab and shovelnose guitarfish, showed no changes after the data cross-referencing. Cross-checking helped confirm and refine results (by forming more detailed zones) for black murex snail, rock scallop, two-spotted octopus, Pacific sierra, and shortfin corvina. We obtained more precise and additional delineation of fishing areas for Gulf grouper and leopard grouper, barred pargo, flounder, and Gulf coney. See Table 2 for scientific names. For Bahía de Kino, bathymetry data influenced the workshop results for all eight species assessed. Fishers recommended some important changes in the spatial location and extent of the fishing zones, ranging from a 93% decrease in the case of the diamond stingray to a 396% increase in area reported for the gray smoothhound shark (Fig. 3). In addition, we identified increased fishing areas for blue spiny lobster and groupers, whereas the total estimated fishing area for the Warrior swimming crab (fished with traps) decreased.

Overall, adjustments to the spatial information were more pronounced than those made to the temporal data. After validation, seven of the 16 species validated ended up with the same fishing season as originally reported by participants in the rapid appraisal. The overall fishing calendars of five species were reduced by one or two months in their main fishing season, and those of four species were increased by one or two months in their main fishing season. Results from the rapid appraisal for total fishing season remained the same for all species after the internal validation.

Discussion

Efforts to capture LK 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 (Olsson and Folke, 2001). For example, it can help us understand the interaction and potential overlap of multiple communities' fishing activities and the convergence of fishing gear and practices, but capturing this information with mapping techniques that require printed maps at a regional scale can not only have accuracy problems (Close and Hall, 2006) but also limit the spatial extent of a fishery when fisheries activities are mapped at a regional scale. During the rapid appraisal, some respondents reported that mapping in particular circumstances such as areas located near the islands or open sea was particularly problematic when limited to printed maps, even when those maps were available at multiple scales. Our results suggest that LK can be elicited with greater precision through a combination of field interviewing, ancillary data, and further interaction with fishers by means of GIS.

During the internal validation of our study, researchers provided additional information to aid in refining the original participatory mapping data as well as the ability to interact with the information projected on the wall. These, and the input of new fishers who had not participated in the rapid appraisal, led to the addition of new fishing zones and adjustments to those identified during the rapid appraisal. Questioning fishers about the basis for changes made clear that the interaction with geospatial tools and ancillary information (bathymetry, coastline, landmarks, and local site names) gave workshop

participants the means to address the limitations of the printed base maps used in the original rapid appraisal.

The results demonstrated how potential errors associated with the collection of LK through a base-map interview can be identified and corrected once the data are integrated and made interactively accessible through GIS and helped explain why the changes in spatial distribution of some rocky-reef species (mainly groupers) harvested by divers were more evident for Bahía de Kino than for Puerto Peñasco. Most diving activities in Bahía de Kino take place along the shoreline of islands, where depth changes marked over relatively shorter distances than on the Puerto Peñasco diving grounds.

Eliciting information from individual fishers through the use of printed maps may be sufficient when only a broad, holistic view of fishing activities at large scales is needed, but the interaction among participants in focus groups and the use of GIS is an important part of participatory mapping processes in areas where more specific detail is needed. The collection of LK related to a specific geographical area can be significantly increased in quality and precision when respondents can interact with each and all relevant data, whether gathered locally or otherwise, using geospatial tools from the outset. By cross-referencing with fishers in focus groups, we were able to refine and correct the information collected so that it provided a more accurate representation of fishing activity in the region. This method is relevant not only for understanding fishing activity at a regional level but for comparison with other parameters that are both spatially-explicit and locally known (e.g., area-specific fishery catches). This information could therefore ultimately lead to improved space-based management strategies,

including the development of regional fishery-management plans, ecological zoning programs, and networks of marine protected areas that take into consideration the spatial interaction between various fishing communities.

The approach outlined here effectively engaged fishers in the data collection process, from rapid appraisal to an interactive internal validation. The information collected allowed us to step back and take a more holistic view of the spatial dimensions of fishing activities in the NGC, one we believe is essential to a fuller understanding of the implications and cumulative effects of management plans and policies at different scales. This large-scale perspective comes, however, at the sacrifice of finer-scale resolution and specificity. The collection and analysis of LK as presented here are therefore intended to complement, and not replace, scientific research and the more detailed analyses that are possible at individual sites and local scales.

As has frequently been demonstrated, when fishers are involved in the research and decision-making process, management guidelines are more likely to be effective (Johannes et al., 2000; Berkes et al., 2001; Cudney-Bueno and Basurto, 2009). As a result, increasing the confidence of both those providing the LK and those being asked to consider it for management decisions is essential. This process increases 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 LK in support of fisheries-management efforts that incorporate multiple fishing communities and highly diverse fishing activities. It also reveals how reengagement of local fishers can bring transparency to integration of LK. These assets

could ultimately help empower stakeholders by bringing recognition to their work, while promoting the cooperation among fishers, managers, and scientists that is ultimately essential for successful management of coastal and marine resources.

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Figures and Tables

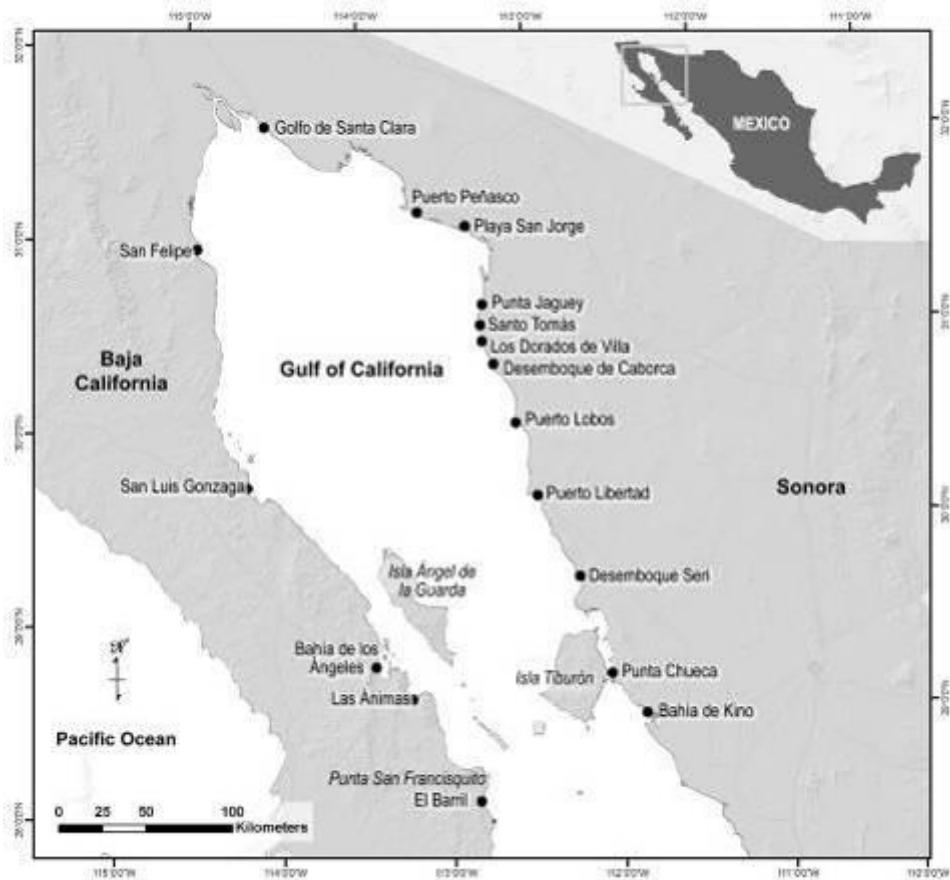


Figure 1. Study zone and fishing communities where interviews were conducted

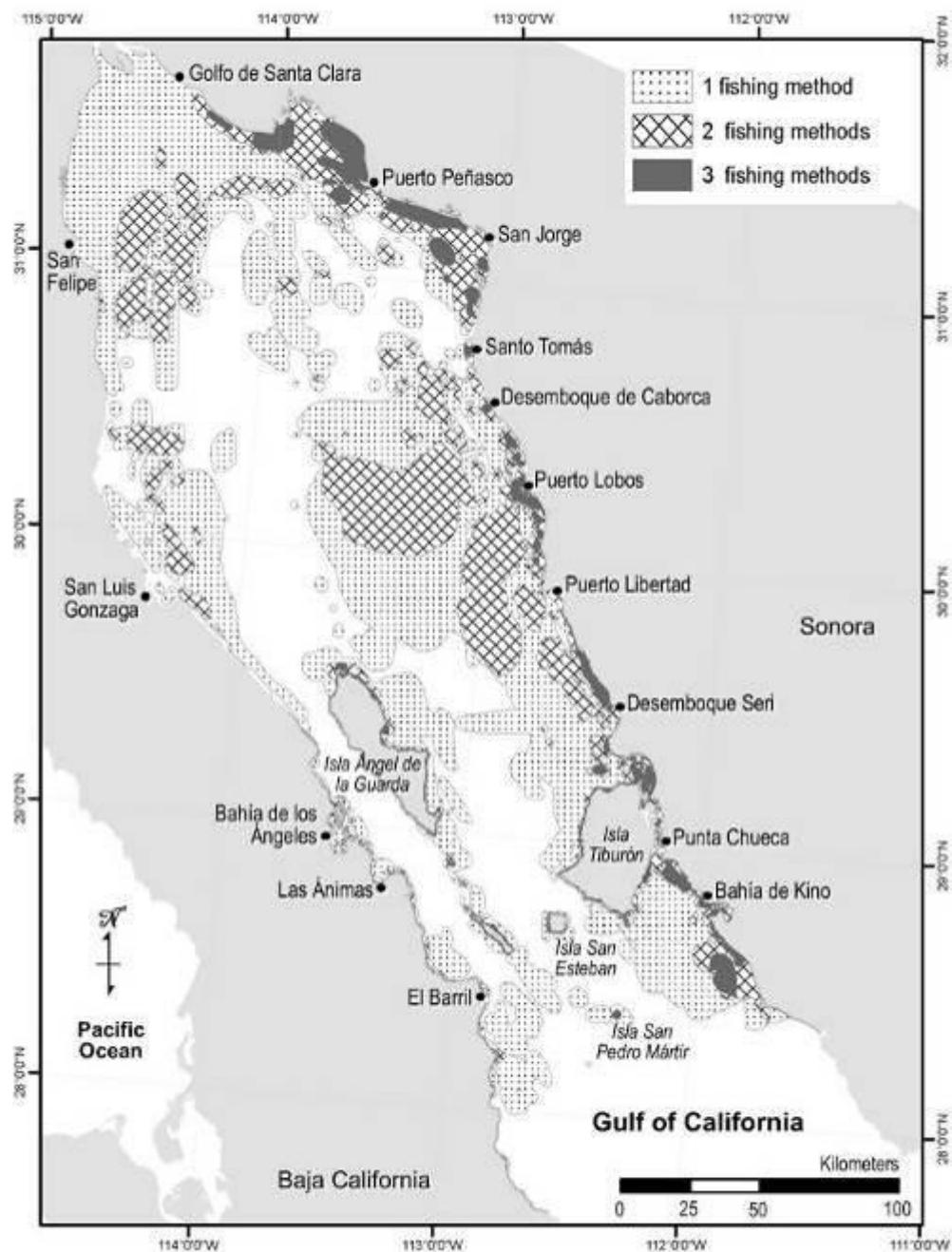


Figure 2. The spatial distribution and overlap of fishing methods in the northern Gulf of California, Mexico. Of the four methods used in the region—diving, gill nets, longlines, and traps—the shaded areas show where use of any one, two, or three overlap.

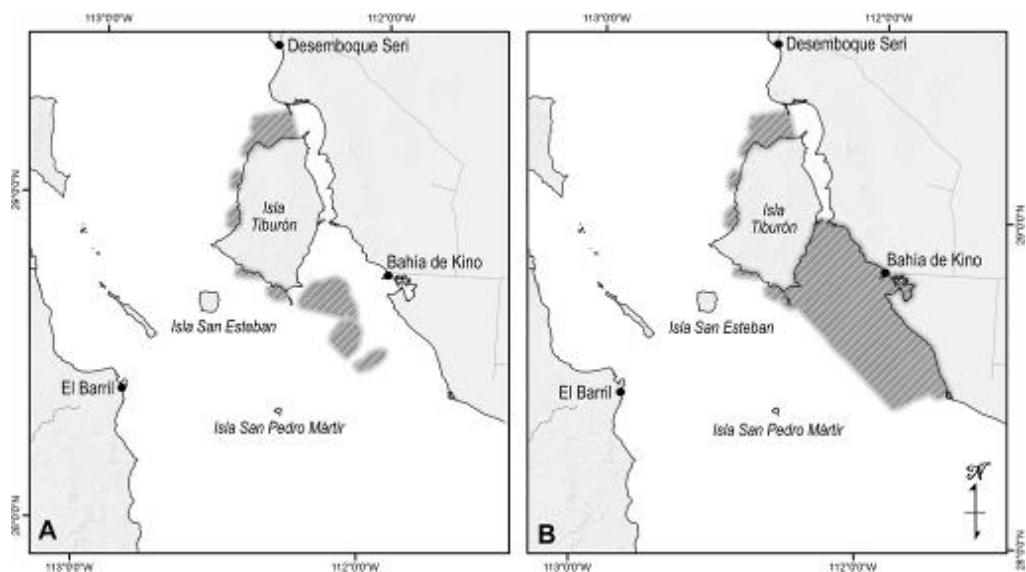


Figure 3. An example of a fishing area adjusted after an internal validation workshop. Bahía de Kino fishing zones for gray smoothhound shark (*Mustelus californicus*) (A) as obtained during the rapid appraisal and (B) adjusted after validation.

Table 1. Number of participants from Puerto Peñasco and Bahía de Kino participating in the internal validation exercises, species addressed during the validation, and their corresponding number of interviews conducted during the rapid appraisal. Scientific names of the species appear in Table 2

Workshop participants	Fishing method	Common name	Rapid-appraisal interviews
<i>Workshop in Puerto Peñasco, Sonora (November 2007)</i>			
5	Diving	Black murex snail	6
		Rock scallop	8
		Two-spotted octopus	8
		Barred pargo	3
		Leopard and gulf groupers	3
12	Gill nets	Shovelnose guitarfish	22
		Flounder	4
		Pacific sierra	8
		Shortfin corvina	5
11	Longline	Gulf coney	9
	Traps	Warrior swimming crab	21
<i>Workshop in Bahía de Kino, Sonora (January 2008)</i>			
9	Diving	Two-spotted octopus	10
		Blue spiny lobster	6
		Leopard and Gulf groupers	2
		Tuberculate pen shell	11
9	Gill nets	Pacific sierra	10
		Gray smoothhound shark	1
		Diamond stingray	3
		Butterfly ray	1
4	Traps	Warrior swimming crab	9

Table 2. Scientific names and authorities of species mentioned.

Common name	Scientific name
Tuberculate pen shell	<i>Atrina tuberculosa</i> (Sowerby 1835)
Warrior swimming crab	<i>Callinectes bellicosus</i> (Stimpson 1859)
Shortfin corvina	<i>Cynoscion parvipinnis</i> (Ayres 1861)
Diamond stingray	<i>Dasyatis dipterura</i> (Jordan & Gilbert, 1880)
Gulf coney	<i>Epinephelus acanthistius</i> (Gilbert 1892)
Butterfly ray	<i>Gymnura marmorata</i> (Cooper 1863)
Black murex snail	<i>Hexaplex (Muricanthus) nigritus</i> (Philippi 1845)
Barred pargo	<i>Hoplopagrus guentherii</i> (Gill 1862)
Gray smoothhound shark	<i>Mustelus</i> spp., mainly <i>M. californicus</i> (Gill 1864)
Leopard and Gulf groupers	<i>Mycteroperca jordani</i> (Jenkins & Evermann 1889); <i>M. rosacea</i> (Streets 1877)
Two-spotted octopus	<i>Octopus bimaculatus</i> (Verrill 1883); also possibly <i>O. hubssorum</i> (Berry 1953)
Blue spiny lobster	<i>Panulirus inflatus</i> (Bouvier 1895)
Flounder	<i>Paralichthys aestuarius</i> (Gilbert & Scofield, 1898)
Shovelnose guitarfish	<i>Rhinobatos productus</i> (Ayres 1856)
Pacific sierra	<i>Scomberomorus sierra</i> (Jordan & Starks 1895)
Rock scallop	<i>Spondylus calcifer</i> (Carpenter 1857)

Table 3. Change in area of fishing zones mapped before and after the validation exercise for Puerto Peñasco and Bahía de Kino

Fishing method	Species	Before (ha)	After (ha)	Diff. (%)	Explanation
<i>Puerto Peñasco, Sonora</i>					
Diving	Black murex snail	51,972	34,907	-33	Bathymetry queries aided in refining original maps.
	Rock scallop	55,429	36,185	-35	Bathymetry queries aided in refining original maps.
	Two-spotted octopus	31,986	23,365	-27	Bathymetry queries aided in refining original maps.
	Barred pargo	12,661	31,957	152	Interactive queries of coastline landmarks allowed more precise and additional delineation.
	Leopard and Gulf groupers	16,353	38,655	136	Interactive queries of coastline landmarks allowed more precise and additional delineation.
Gill nets	Shovelnose guitarfish	180,437	180,437	0	No changes reported.
	Flounder	39,303	126,299	221	Multiple small areas (polygons) were lumped into a fishing corridor.
	Pacific sierra	111,830	104,958	-6	Bathymetry queries aided in refining original maps.
	Shortfin corvina	73,957	37,777	-49	Overlay and zoom (with supplemental data such as bathymetry and coastline reference points) helped in refining areas.
Longline	Gulf coney	356,598	429,149	20	Bathymetry, coastline reference points, and interactive process with GIS identified fishing holes and channels not mapped originally.
Traps	Warrior swimming crab	190,000	190,000	0	Bathymetry queries helped confirm original maps.

Table 3. Cont...

Bahía de Kino, Sonora

Diving	Two-spotted octopus	73,627	44,741	-39	Bathymetry queries aided in refining offshore areas
	Blue spiny lobster	33,798	50,704	50	Overlay and zoom (with supplemental data such as bathymetry and coastline reference points) helped participants identify additional areas
	Leopard and Gulf groupers	8,843	30,323	243	Overlay and zoom (with supplemental data such as bathymetry and coastline reference points) helped participants identify additional areas
	Tuberculate pen shell	52,168	46,203	-11	Bathymetry queries aided in correcting areas mapped
Gill nets	Pacific sierra	100,985	83,144	-18	Bathymetry queries aided in refining offshore areas
	Gray smoothhound shark	38,169	189,489	396	Fishers confirmed original maps and helped identify additional offshore areas with bathymetry queries.
	Diamond stingray	53,234	3,633	-93	Some areas were moved; others eliminated with aid of bathymetry queries and coastline reference points.
	Butterfly ray	31,372	27,769	-11	Some areas were moved; others eliminated with aid of bathymetry and coastline reference points
Traps	Warrior swimming crab	126,798	70,093	-45	Bathymetry queries aided in refining and correcting original maps
Total		1,639,520	1,779,788	1.08	

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**APPENDIX B. PLACE-BASED PLANNING FOR FISHERIES AT REGIONAL
SCALES: SMALL-SCALE FISHERIES IN THE NORTHERN GULF OF
CALIFORNIA, MEXICO**

TO BE SUBMITED TO OCEAN AND COASTAL MANAGEMENT

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Place-based Planning for Fisheries at Regional Scales: Small-scale Fisheries in the Northern Gulf of California, México

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Abstract

Place-based planning or coastal zoning on coastal and marine environment enhances the use of space and time and addresses distribution of human activities. The Gulf of California has seen a rapid evolution of institutional change and the development of numerous territorial conflicts over access to fishery resources in the absence of clear rules defined in space and time. A fundamental step to aid in Mexico's fisheries management agenda to help reducing conflicts over access to fishery resources involves an understanding of the distribution in space and time of fishing activities. However, efforts to compile comprehensive fisheries information have been hampered by the lack of basic – yet essential – reliable data on human activities. One way to cope with specific data about the spatial and temporal dimension of fisheries is to capitalize on fishers' local knowledge. Our study involves the incorporation of fishers' knowledge into a process to understand the spatial and temporal behavior of fishing activities in order to address management at large, regional scales harboring multiple small-scale fishing communities and high diversity of fishing activities in the Northern Gulf of California, Mexico. This approach represents an important source of information for the development of strategic management plans providing an approach for the incorporation of LK through the use of

GIS to help build a “backbone” for place-base ecosystem management in the Gulf of California, Mexico.

Introduction

Place-based ecosystem management system or ocean zoning is a process that reduces conflict, uncertainty and costs by separating incompatible uses and specifying how particular areas may be used (Russ and Zeller 2003; Norse et al. 2005). Research on the spatial and temporal heterogeneity of marine ecosystems has typically focused on characterizing biological and physical processes of the environment and not on human activities (Field et al. 2003; Thompson 2004). However, place-base planning can be a powerful tool to facilitate integrated strategic and comprehensive planning in relation to socio-economic activities taking place in marine, areas. In some coastal countries, a place-based management agenda programs have been formally incorporated. The United States, for instance, recently saw the signing of a Presidential memorandum that established an Interagency Ocean Policy Task Force to develop recommendations for a national ocean policy, a framework for improved stewardship, and effective coastal and marine spatial planning (NOAA) (Douvere et al. 2007).

A place-based management system has the potential to enhance the use of space over time (Norse et al. 2005; Douvere et al. 2007), but its success relies heavily on the availability and quality of spatial and temporal data, which is often lacking. This can be particularly true in seascapes dominated by small-scale fisheries, which often lack of formal mechanisms to systematically record basic data related to fishing activities (e.g.

landings, fishing effort, spatial distribution of fishing activities) that is essential for management purposes (Berkes et al. 2001). Furthermore, the larger the geographic scale at which management is to be addressed and the higher the number of fishing communities and diversity of fishing methods involved, the more complex and cumbersome planning can be. Therefore, successful fisheries management plans will require an understanding of the spatial and temporal heterogeneity of the marine and coastal ecosystem components specifically, the distribution of fishing activities in space and time (Crowder and Norse 2008).

The Gulf of California, which supplies most of Mexico's fishery resources and is recognized as a key marine conservation site, has seen a rapid evolution of institutional change and the development of numerous territorial conflicts over access to fishery resources (Cudney-Bueno 2000; Cudney-Bueno et al. 2009; Cinti et al. 2010). This is due to the importance of spatial convergence over fishing activities in many coastal communities of the Gulf of California. However, in most situations, detailed information concerning how fishing communities utilize common fishing grounds and marine resources, is only vaguely documented and rarely shared by government scientists in Mexico (Hernández and Kempton 2003). Moreover, one of the constraints to understanding the spatial distribution and fishing effort at a local and regional level is that the fishing production reported by fishers does not specify where the product comes from. Consequently, the region has experienced a rapid evolution of institutional change and the development of numerous territorial conflicts over access to fishery resources in

the absence of clear rules defined in space and time (Cudney-Bueno et al. 2009; Cinti et al. 2010).

A previous publication by Moreno-Baez et al. (2010), suggested that one way to cope with specific data about the spatial and temporal dimension of fishing activity is to capitalize on fishers' local knowledge (LK) in order to address fisheries management within large, regional scales. In addition to providing much needed data, the incorporation of LK in a participatory and transparent manner can result in the integration of fishers and their perceptions into a management and planning process, helping to develop a sense of ownership and representation while giving voice to locals in the process (Johannes 1978; Smith and Berkes 1991; Johannes 1993; Berkes et al. 2001; Obura et al. 2002). The inclusion of LK can be enhanced through the use of geospatial tools such as geographic information systems (GIS) (Anuchiracheeva et al. 2003; Close and Hall 2006; Riolo 2006). Integrating LK into GIS in support of place-based planning can help coordinate and plan fishers' future activities and potentially reduce cost of fishing effort and over-harvesting (Hall and Close 2007; St. Martin and Hall-Arber 2008).

With the passage of a new Fisheries Law (Ley General de Pesca y Acuacultura Sustentable, 2007), Mexico's fisheries administration for the first time has called for an explicit definition of place-based management including the development of regional fishery management plans, zoning programs, and the establishment of networks of marine protected areas (also see www.conapesca.sagarpa.gob.mx). However, the geographic scale at which these plans are to be made operational is still unclear given that efforts to compile comprehensive fisheries information on fishing activities (e.g.

landings, fishing effort, spatial distribution of fishing activities) have been hampered by the lack of basic – yet essential – reliable data on human activities, particularly for small-scale fisheries.

This investigation presents additional results from information collected during the same research period and using the same methodology, that involves the incorporation of fishers' knowledge providing with a “regional picture” of the spatial and temporal extent and distribution of small-scale fisheries. Specifically, we capture the heterogeneity of fishing activity by a) identifying main target species and the methods used to capture them, b) identifying the spatial dimension of fishing diversity, c) comparing communities travel distances to reach their fishing grounds and by, d) identifying the spatial and temporal distribution and convergence of fishing activities and communities. This information provides with a “backbone” for comprehensive place-based planning, within one of Mexico's core fishing regions.

Methods

Study Area

We conducted our study in the Northern Gulf of California (NGC), Mexico, a region extending north from the fishing town of Bahía de Kino in the state of Sonora and El Barril, Baja California (Figure 1). Due to its unique physical features and its ecological and economical significance, this region is considered a highly productive ecosystem and has been subject national and international conservation efforts that have led to, among other things, the creation of marine protected areas and biosphere reserves (Aburto-

Oropeza and López-Sagástegui 2006; CONANP 2009; Pfister et al. 2009) (Figure 1). It has also been recognized as a stand-alone faunal subdivision of the Gulf of California due to its zoogeographic characteristics (Thomson et al. 2000). The NGC is used by at least 17 fishing communities and numerous temporary fishing camps. Small-scale fishing, characterized by the use of 20-24 ft outboard motor (55-115 hp) skiffs and multiple types of fishing gear and methods, is the most prevalent type of fishing activity taking place in the NGC. However, industrial fishing for sardines (using purse-seine nets) and shrimp (through bottom trawl boats) as well as recreational sport fishing also takes place in the region. Our analysis focuses on the spatial-temporal dynamics of the small-scale fishing fleet.

Data Collection

The central component to capturing LK was a rapid appraisal (Beebe 1995) that was designed to develop a region-wide overview of the socio-economic and demographic patterns of small-scale fisheries in the NGC. This included fishers' knowledge from the region's 17 fishing communities regarding what, where, when and how they fish. The methodology entailed aggregating the LK of a representative set of individual fishers (captains) through semi-structure interviews collected between December 2005 and July 2006.

As part of the survey, we provided the interviewee with a list of 54 different species that researchers already knew were fished in the region and asked which of these he fished and if there were any other species he fished but were not mentioned on the list.

Next, we asked the interviewee to indicate which of the species identified previously, were considered target species (i.e. species for which he organizes a fishing trip). Lastly, we asked to select his three main target species or groups of species¹. Once these were selected, for each we asked to display the main and secondary fishing zones on a pre-tested base-map (Moreno-Báez et al. 2010) and recorded the fisher's local knowledge related to the spatial and temporal information based on their current and no older than five years, fishing grounds. In general, questions were classified by a) the spatial and temporal distribution of fishing activities by target species, b) type of fishing gear utilized, and c) traditional ecological knowledge (TEK) on reproductive and nursery sites. We also recorded the fisher's perception of the state of the fishery and his management recommendations. Afterward we conducted internal data validation workshops to cross-check the information among fishers and the adjustments were applied prior to analysis (Moreno-Báez et al. 2010). For the purpose of this paper, we focus our analysis on the spatial-temporal distribution of fishing activities. Results on TEK, fishers' management recommendations and their perceptions on the state of their fisheries will be presented elsewhere.

We interviewed a total of 376 fishers, each interview comprising up to three base-maps containing detailed spatial and temporal information of their main target species. The data from the semi-structure interviews were captured in a spreadsheet database that

¹ In some cases (e.g. some large sharks, flounders) fishers don't target a specific species but rather a group of similar species and, thus, were lumped as one.

contained the general information with the list of species being fished. We calculated the number of different target species they commonly capture, those that they make a dedicated trip and those considered the three most important species.

Spatial and Temporal Analysis

From the collection of interviews, we obtained a total of 769 base-maps and counted a total of 52 different main target species and groups of species. The 769 maps were digitized using GIS shapefile² and ArcGIS™ 9.2 (ESRI 1999 - 2008) (Moreno-Báez, et al., 2010). The shapefile attribute table stored basic information regarding the fishing zones (e.g., codes by interview, fishing zones names, species, and communities) of the target species mapped by fishers. All of the tables contained an identifier that was used to join spreadsheets tables (Excel) with GIS shapefile for the analysis.

We classified the 52 different species by fishing method using the information provided by fishers in additional notes within the interview. In some cases, we did not obtain information on the fishing method use for a specific species. However we were able to obtain additional information regarding fishing methods use to harvest target species through the internal data validation workshops (Moreno-Baez, et al 2010) and through experts during internal meetings. For example, some species such as groupers (groupers *Mycteroperca spp.*) can be captured using different fishing methods such as longline, diving and sometimes gillnets. If the fisher specified the fishing method used

² “Shapefile” refer to geospatial vector data format for geographic information systems software.

for that particular species, the fishing zones were then assigned to that specific fishing method.

Characterization of Fishing Activities by Species

The shapefile containing the fishing zone information from the 769 maps and 52 different target species was utilized to generate different thematic maps such as the distribution of fishing activity by species, communities and fishing method. In order to understand the spatial and temporal distribution of fishing activity by species, fishing community or fishing method, we applied simple or complex standard query commands using the attribute table of a shapefile. We applied different calculations such as total fishing area used by each community and fishing method and the distance traveled by community to their fishing grounds also classified by fishing method. The total area of fishing activity by community and fishing method was calculated by 1) using standard query commands based on the community's name and fishing method; 2) dissolving all polygons corresponding to a particular community and fishing method; and, 3) calculating the geometry in order to obtain the total area. We then calculated the maximum and median distance traveled from a community to their fishing grounds using Euclidean distance.

For the purpose of the spatial analysis in this publication, we created a vector-grid map consisting of 5630 cells that were each 2.8 km x 2.8 km of spatial resolution to standardize and represent the spatial units. This was because the fishing zones and areas

drawn by fishers on the printed maps, varied in detail, size and extension. Each cell was used as the base standard unit of analysis throughout the study area.

Target Species Distribution and Diversity

In order to understand the fishing activity distribution and its diversity, we utilized the vector-grid map and assigned values of presence or absence for the 52 target species mapped during the rapid appraisal. We used standard query commands to classify the original shapefile with fishing zones by target species and by means of a spatial selection based on location, we assigned to our vector-grid map cells a value of 1 (presence of fishing activity for a particular species) or 0 (absence of fishing activity for a particular species). Consequently, we obtained a binary vector-grid map of presence and absence of 52 different target species. We then calculated the total number of target species by spatial unit using Field Calculator. Finally, we classified the layer by number of target species being captured in a single spatial unit to represent the diversity. By displaying the diversity, were represented also the total distribution of fishing activities throughout the NGC.

Compatible Users and Fishing Zones

In order to answer the question of who interacts in space and time throughout the NGC, we integrated into our analysis the information related to total fishing season provided by fishers for each target species they mapped. Since we obtained detailed information about fishing seasons and fishing methods by target specie, we were able to

classify the fishing zones by applying queries based on its attributes (e.g., community name, target species, fishing method, etc.). By doing this, we displayed the spatial distribution and overlap of fishing methods, fishing communities or target species to understand the spatial convergence.

In order to represent the community overlap over the timeframe of a year (e.g., from January to December) by fishing method, we selected and included the most representative target species by fishing methods (diving, gillnets, hand fishing line and longline and, traps) (see Table 1). Only for traps fishery we utilize the information from the most representative target species, blue crab (*Callinectes bellicosus*) considering that deep fish fishery using traps use a larger trap and it is not common compared with blue crab fishery. Subsequently, we related the spreadsheet containing the fishing calendar attributes month by month with the attribute table of the shapefile using ArcGIS™ 9.2 (ESRI 1999 - 2008).

By means of a spatial selection based on attributes (e.g., month, fishing method and community) we selected the fishing grounds. Then, by means of a spatial selection based on location, we utilized the vector-grid map created before to assign to each cell the value of 1 (presence of fishing activity by community) or 0 (absence of fishing activity by community) by month. In this particular case, the presence or absence indicated fishing activity by single community in a monthly basis for each target species. Given that each fisher provided specific information by target species, we were able to depict detailed information about seasonal fishing activity and the specific fishing grounds by interviewee. Hence, we were able to visualize and represent fishing activity

by community in a monthly basis without having to generalize seasonal fishing activity by specific fishery for the whole region. As part of this analysis, we calculated the number of communities working in common fishing grounds represented by the cells or spatial units. Finally, we created a layer by fishing method that included all representative target species showing fishing activity over the timeframe of a year (e.g., from January to December). We depicted by means of classification, the presence or absence of fishing activity and the number of community overlap throughout the study area.

Results

Characterization of Fishing Activities

We identified a total of 73 commonly captured species and, 58 species for which fishers make a dedicated trip to fish. However, a total of 52 key target species from the overall list were selected by the interviewees as the most important and for which we collected a total of 769 individual maps with their spatial and temporal information based on the interview process (Table 1). From the 52 commonly target species, 13 species are capture using two different fishing methods, 4 species are captured using three fishing methods and 1 is capture using four fishing methods and the remaining 34 species are capture using only one fishing method. From the 17 fishing communities, we identified 7 fishing between 1 and 40 different target species and the rest, targeting more than 41 species in a regular basis. The target species that stand out by being the most commonly harvested by all communities are: the diamond stingray, gray smoothhound shark,

shovelnose guitarfish, finescale triggerfish, Gulf coney, grouper, spotted sand bass, sand bass and flounders.

The distances traveled by community and classified by fishing method, is represented in Figure 3. In general, 13 communities traveled more than 50 km. to reach their fishing grounds. However, we identified five communities traveling distances that range from 100 km. to 200 km. for gillnets and traps fishery. Bahía de Kino was the only community that reported traveling maximum distances of 200 km. to reach fishing grounds represented by three different fishing methods. In general, the overall median distance traveled is 26 km. for diving fishery, 29 km., for gillnets, 43 km., for hand fishing line and longline and 28 km., for traps. According to the spatial information provided for the 52 target species, communities utilize an average of three different fishing methods, 12 communities' fish by diving, 15 communities use gillnets, 12 hand fishing line and longline and 12 traps.

Target Species Distribution and Diversity

From a regional perspective, the total area fished, as mapped by fishers was approximately 35,170 km², which corresponds to 60% of the 58,000 km² (total area) of the NGC. The total number of target species representing the distribution and diversity of small-scale fishing activity for the 52 different target species is represented in Figure 2. These results show that small-scale fishers target up to 16 different species in single areas located mostly in coastal waters and close to the islands. In the total area representing fishing grounds, 5 species were targeted in 78% of the area, 6 to 10 species were targeted

in 18% of the area, and 11 to 16 species are targeted 4% of the total area. Places such as San Felipe, El Borrascoso, Puerto Peñasco, the coast of Sonora (from Puerto Lobos to Bahía de Kino) and the surroundings of Isla Ángel de la Guarda and Isla Tiburón appeared as the most diverse in terms of number of target species being caught.

Compatible Users and Fishing Zones

Fishing activity in general happens year-round in the NGC. Figure 4 presents the spatial and temporal representation of fishing activity for the diving fishery and the community overlap by month over a year. For the diving fishery, activity doesn't vary spatially since the fishing zones occupy the same space year-round. The highest community overlap (4 to 5 communities) takes place on the east side of Isla Ángel de la Guarda, the north side of Isla Tiburón, and in the Sonoran coast in front of Isla Tiburón from January to March. However, the fishing activity in the southernmost portion of Isla Ángel de la Guarda with 3 communities overlap appears from January to September.

Figure 5 presents the spatial and temporal fishing activity for gillnets fishery. Fluctuations are marked by the shrimp fishery that, according to the rapid appraisal, goes from September to March. The highest number of communities overlapping in the map is shown from September to December period in the upper Gulf of California in the north part of Isla Tiburón from February to May. Figure 6 shows the spatial and temporal representation of fishing activity for the hand fishing line and longline fishery. Fishing activity presents the higher overlap from October to April between the upper Gulf and the midriff islands. For this specific case, those fishing areas are mostly represented by the

Gulf coney (*Epinephelus acanthistius*) fishing activity. Finally, Figure 7 presents the spatial and temporal fishing activity for traps fishery or blue crab. Fishing activity is concentrated in the same areas throughout the year-round but the number of communities overlapping is highest from August to December in the northernmost part of the NGC and from July to September in the Canal del Infiernillo. Common fishing grounds for different communities were localized in Bahía San Jorge in the northernmost part of the Gulf.

Discussion

The present study was designed to incorporate fishers' knowledge into a process for characterizing and understanding the regional picture of fishing activities in the NGC in order to aid in the design of management plans, zoning programs, and/or the establishment of networks of marine protected areas. Overall, we were able to identify 73 different target species, the different or combination of fishing methods they utilize to fish and the communities that actively harvest those species by collecting fisher's knowledge. This can be interpreted as an opportunistic way of living where competition is invariable. Also, this information helped us to understand the diversity of species targeted and the spatial and temporal distribution of fishing activities throughout the NGC.

We were also able to understand the ability that communities have to harvest in terms of numbers of target species and their capacity to travel long distances. All this can be translated into markets demand for México (e.g. Mexico City) and other countries in

Asia (e.g. geoduck clam) and the United States (e.g. shrimp). By measuring the distance traveled among the 17 fishing communities in the NGC (Figure 3) we were able to identify the communities' "interest" or "apathy" for different locations and their capacity to move long distances. The characteristic of long distances can be an indicator of the condition (e.g., health) of local fishing grounds for some of the communities. Saez-Arrollo (2005- pg. 1959) calls this phenomena a rapidly shifting environmental baseline among fishers of the Gulf of California, showing that after fishing activities depleted the local fishing grounds, fishers moved further offshore.

One example is the community of Bahia de Kino where fishers have the capacity or the need to travel more than any other community in the NGC. Their fishing activities for diving, gillnets and hand fishing line according to the interviews, reach fishing grounds located at 200 km (maximum distance) away from the community. Bahía de Kino is the nearest fishing community analyzed to a major city, Hermosillo, capital of the state of Sonora, and approximately 400 km from the USA-Mexico border, thus the access to major roads, facilities and commerce is close at hand. In addition, Bahía de Kino is the oldest fishing town (ca. 1930s) of the study area, thus probably intense harvesting over the years helped on depleting its fishing grounds. Other communities such as Puerto Libertad and Puerto Peñasco also travel long distances (more than 100 km.) to reach their fishing grounds. Puerto Peñasco is a major touristic town with good access to major roads while Puerto Libertad, is considered exclusively a fishing town. Differently than these examples, the fishing community Los Dorados de Villa, which represents a temporary camp with a difficult road access, reported a maximum distance of 18 km., and a median

of 9 km. In addition to this, the present information can provide managers the opportunity to calculate what might be the economical investment needed to travel long distances through land or sea in order to access different fishing grounds and to develop indicators to measure the fishing grounds condition or stress.

By using spatial analysis, we developed the first step to highlight the spatial and temporal heterogeneity of fishing activities at a regional scale and identified that 89% of the study area is being used by small-scale fishing activities. Visualizing the maps provided by fishers, we can understand how dynamic and highly disperse small-scale fishing activity in the NGC can be. This information gives us the opportunity to compare areas of use, compatibility and potential conflicts within small-scale fishing activity and with other sectors in space and time. The diversity of target species harvest by fishers (Figure 2) highlighted hotspots where up to 16 different target species are being caught. The diversity and representation of fishing zones identified by fishers also highlights the level of knowledge and interest of the different fishing communities for these areas. Hence, the analysis provides with spatial patterns in the distribution of “hotpots” -- in this case for commercial fishing activities -- that can be interpreted as areas of high diversity and that can be used as proxies of biological and ecological important areas. Some of those hotpots identified are in front of Puerto Peñasco, El Borrascoso, in front of San Felipe, Puerto Lobos and the surroundings of Isla Tiburón. These results might be related to the communities’ closeness but this can also be interpreted as the health of fishing grounds surrounding these communities or vice versa.

The understanding of the spatial and temporal dimension of fishing activities helped us on identifying important biological sites, access to resources and where different levels of social organization might be needed. One example is the representation of gillnets fishing activity (Figure 5) where results suggest that the concentration of interest by 4 or 5 communities is in the uppermost Gulf of California and where the Area de Refugio de la Vaquita Marina was formally decreed as a “no-take zone” in December 2005 (DOF 2005). Also, concentration of fishing activity is dispersed within the Reserva Alto Golfo de California y Delta del Río Colorado. According to the management program for the Reserva de la Biósfera (DOF 25 September 2009), one of the constraints to understanding the spatial distribution and fishing effort within the reserve, is that the fishing production reported by the fishing communities (users of marine protected areas and no-take zone) does not specify where the product comes from. The spatial and temporal data may provide a solution that helps managers balance the local demand for the resource and the ecological integrity of the system by collaborating with all users. Even though the Mexican government has established a new strategy to stop the use of gillnets in that area, nowadays the Area de Refugio de la Vaquita Marine is still a subject of conflicts due to the enforcement taking place (Nava 2009).

Prior studies have noted the importance of place-based planning and ocean zoning for management activities in coastal and marine waters to understand how human interactions with the environment are distributed in space and time and what factors influence these distributions (Norse et al. 2005; Douvere 2008; St. Martin and Hall-Arber 2008). In general, the overall spatial and temporal characteristics identified in small-scale

fishing activity in the NGC, can help us determine the relationship between social and biological connectivity when evaluating the main species being captured and the important sites related to them. According to Douvere (2008), once the spatial distribution of human activities, including potential conflict between users, is understood, management of marine space can be more precisely applied over time. This would provide greater capacity to manage multiple potential competing uses. According to our results, small-scale fishing activities in the NGC showed common interest in different fishing grounds and helped us to visually locate and understand the social landscape of fisheries providing useful input for decision making when defining and implementing place-based management strategies or regulations based on ocean zoning.

Our research produced a picture of the spatial and temporal distribution of fisheries activities at a regional scale that would not be possible to understand without this big-scale effort and collaboration with fishers. By depicting the spatial interactions of small-scale fishing activity throughout a year in the NGC, we show ways in which communities can be defined by their interests and not only by a geographic place. The information presented helped us to answer questions such as, “what is the spatial distribution of fishing activity by community?”, “how are the different species being fished?”, “where are the fishing activities concentrating?” and “when are those fishing activities happening?”

With our research we were also able to demonstrate the vast knowledge that local users can provide in terms of the usage of space and time and the co-production of scientific information for decision making. However, it is important to take into account

that human activities and interest are not static. Even though change, adaptability, contingency and uncertainty need to be part of planning, the significance of understanding the connections, interest and interactions in space and time, provide the backbone needed for decision making processes when identifying best management strategies to implement in a multi-user area.

Future studies might include the integration of other human activities at a regional scale to support marine spatial planning (Douvere 2008) and the integration of biophysical information to improve the understanding of the relationship and connectivity between humans and the marine resources in the NGC. Planning at a spatial and temporal scale provides new opportunities for the management of fisheries, both for the Mexican government and local interests.

Conclusions

As more conservation and management efforts are undertaken in the NGC and considerations are made about how space should be allocated to specific uses, it is important to understand how people are already using certain areas of the marine environment. Results presented here demonstrate how small-scale fisheries are diverse and fluctuate in space and time in the NGC. We were also able to understand the vast amount of knowledge that fishers have with respect to their work. Findings show that there is fishing activity throughout the year with multiple users in different areas where common interest play a big role in decisions regarding where to go.

Understanding the human dimension of fisheries will help on highlight areas of intense use or areas where multiple users work together in space and time demonstrating how people also interact with the natural environment and whether they are following current spatial policies. Even though this study focuses on the small-scale fisheries sector in the NGC, this information provides an opportunity in that it can be translated into products that can be used for more spatially and temporally explicit implementation of management strategies, including the development of regional fishery-management plans, place-based management guidelines or zoning programs, and networks of marine protected. Because data are collected and evaluated at a regional scale, other data on natural or social systems can be integrated into the equation with relative ease. This information can also outline the baseline from a user's perspective to aid in the establishment of guidelines for marine spatial planning aimed to include different sectors interested in sharing the marine resources of the NGC. While our study focuses on the NGC, this approach for characterizing and analyzing human activities in coastal and marine waters could be applied to other coastal ecosystems.

Figures and Tables

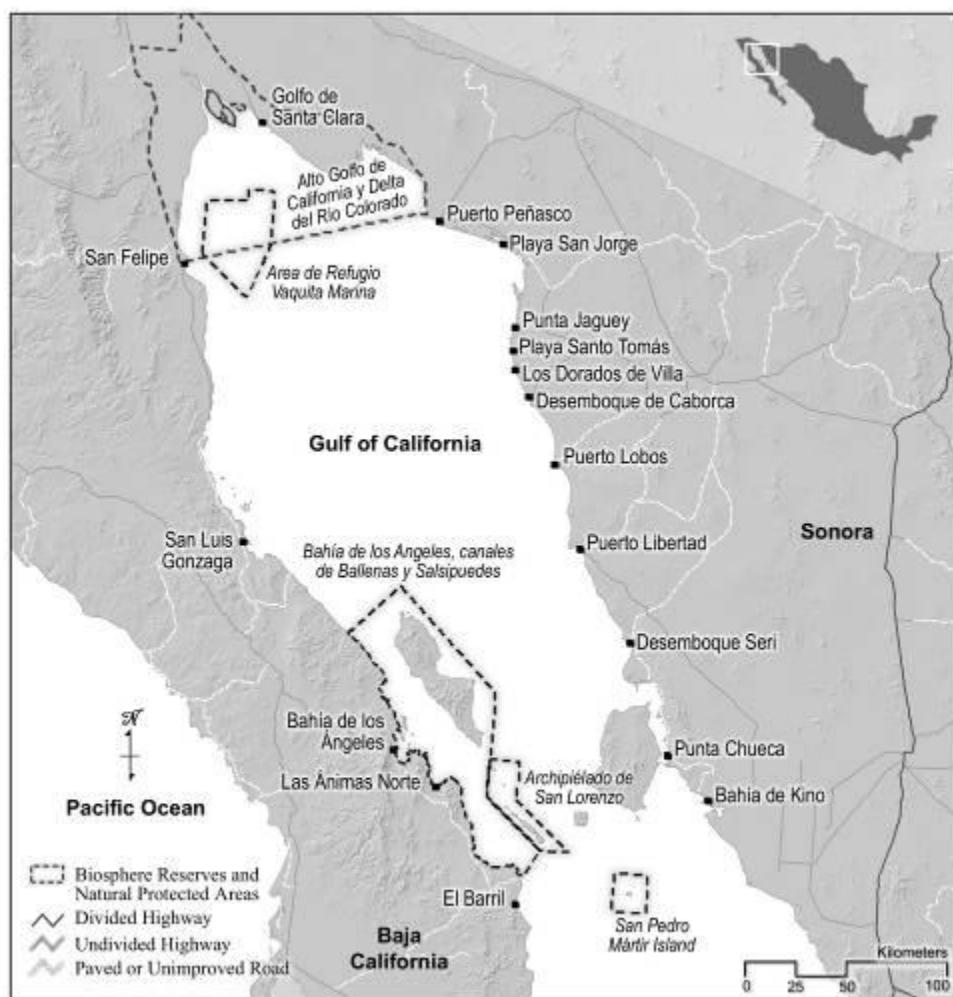


Figure 1. Study zone and fishing communities where interviews were made and the Natural Protected Areas and Biosphere Reserves decreed in the NGC.

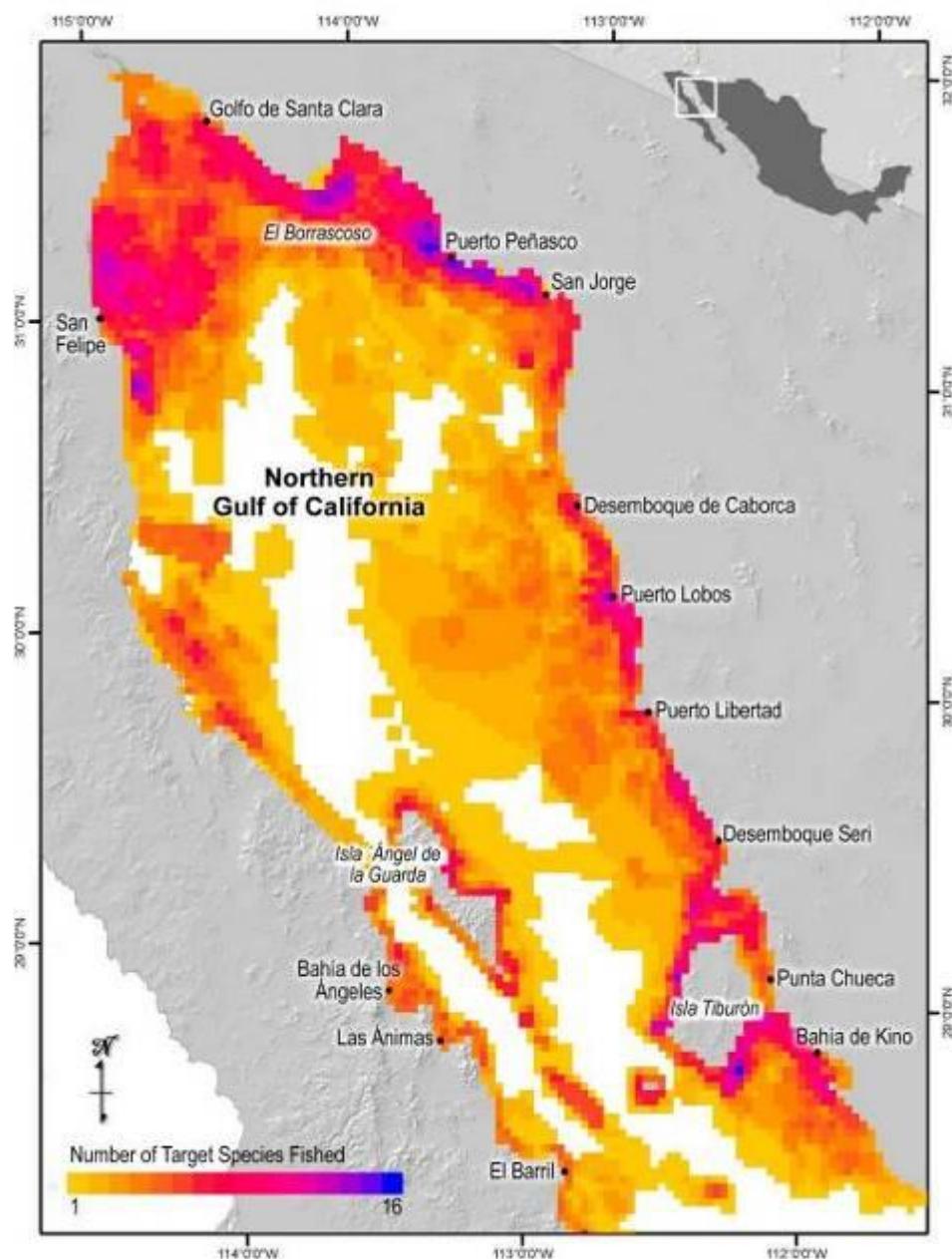


Figure 2. Distribution of number of target species being caught by 17 fishing communities in the NGC. Data collected between December 2005 and July 2006.

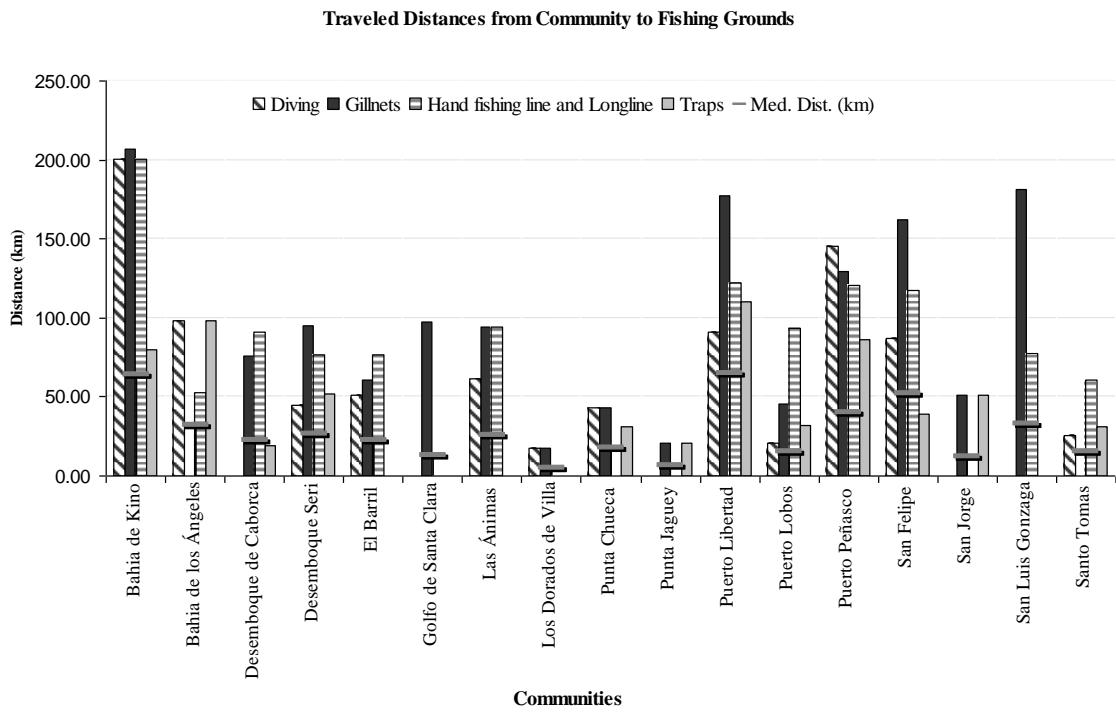


Figure 3. Maximum distance traveled from the community to fishing grounds by fishing method and total median distance.

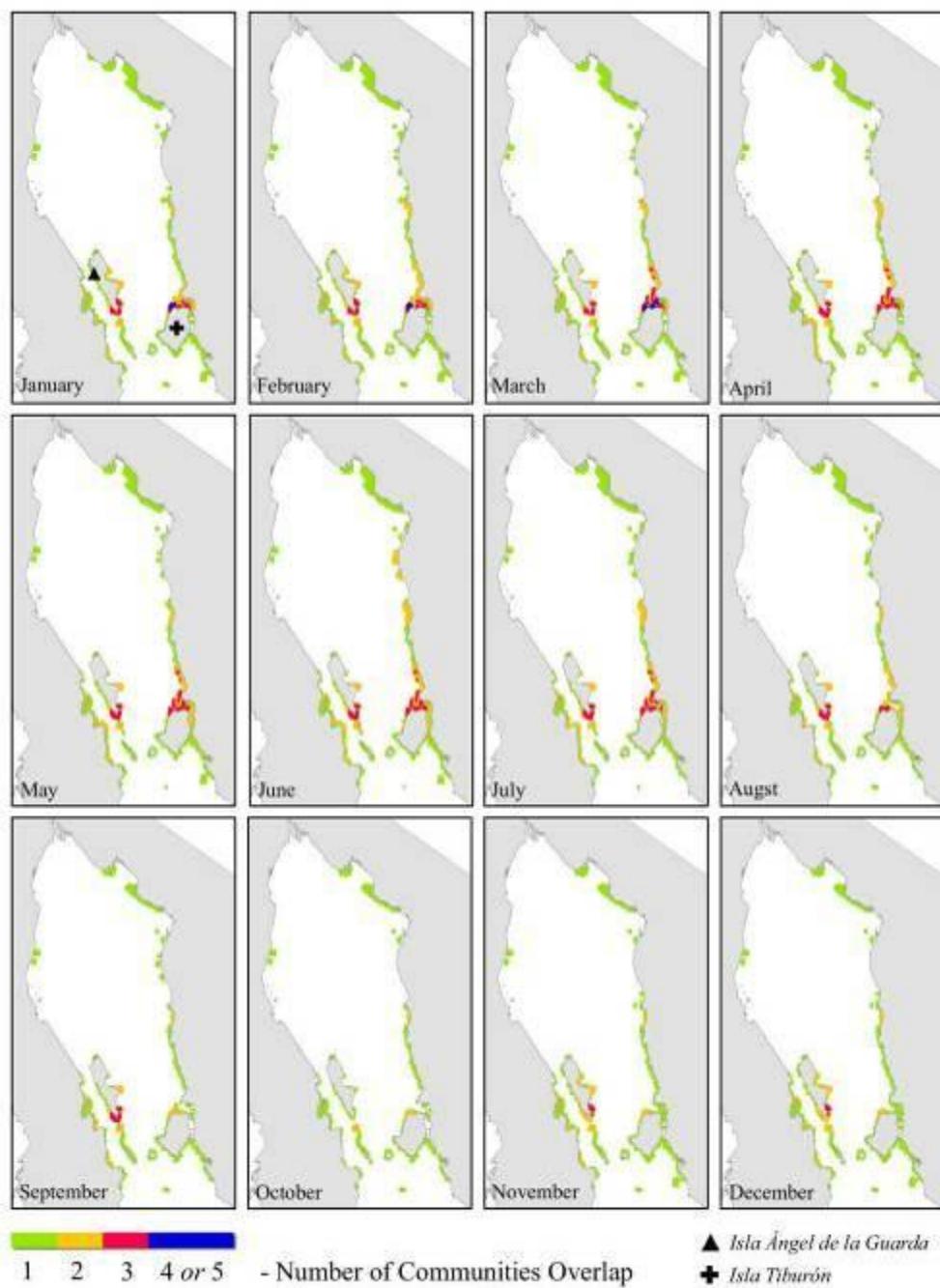


Figure 4. Number of communities working coincidentally in fishing grounds by month for diving fishery. Data collected between December 2005 and July 2006 and compiled across all 17 communities assessed.



Figure 5. Number of communities working coincidentally in fishing grounds by month for gillnets fishery. Data collected between December 2005 and July 2006 and compiled across all 17 communities assessed.



Figure 6. Number of communities working coincidentally in fishing grounds by month for hand fishing line and longline fishery. Data collected between December 2005 and July 2006 and compiled across all 17 communities assessed.

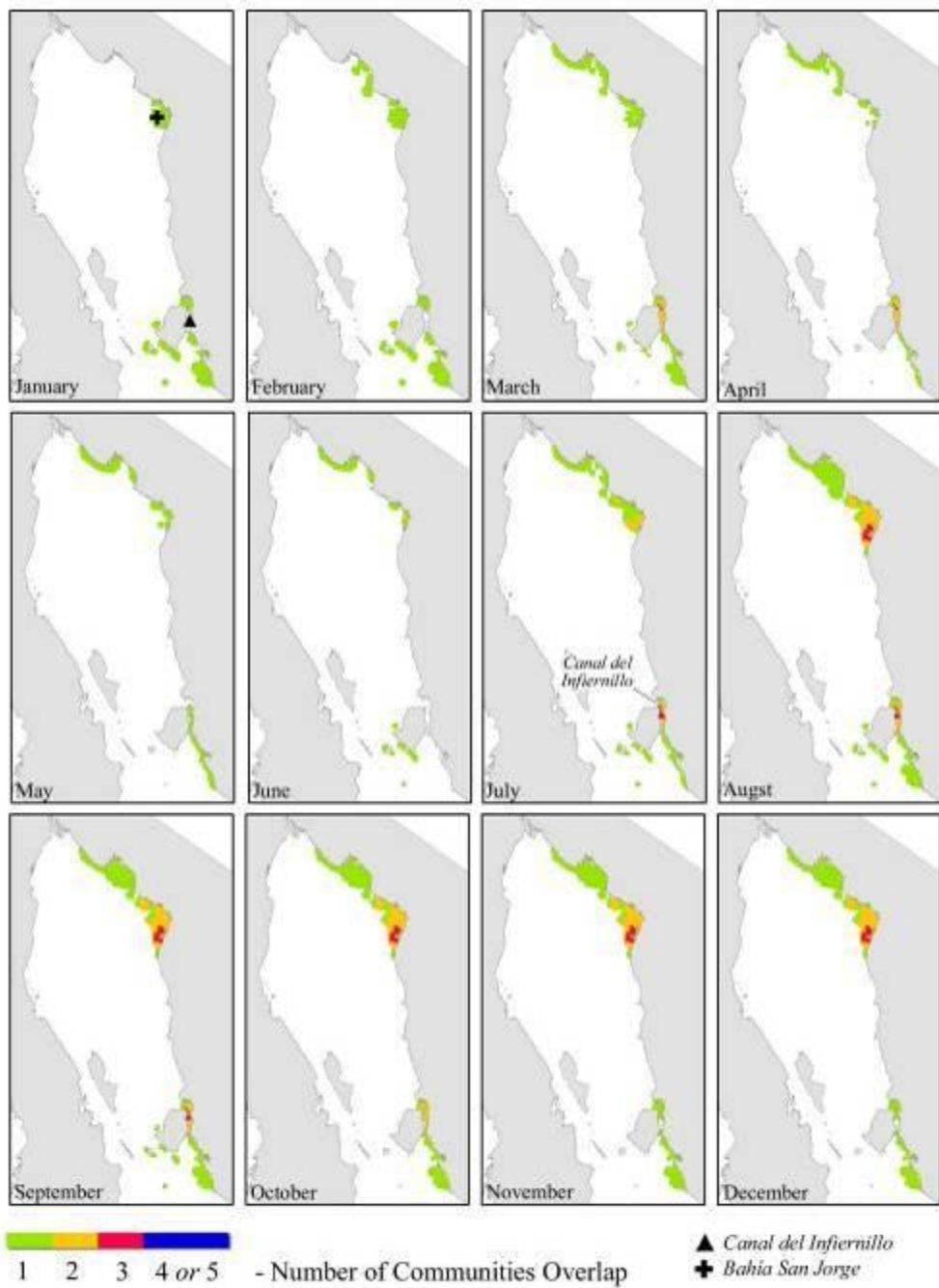


Figure 7. Number of communities working coincidentally in fishing grounds by month for swimming crab traps fishery. Data collected between December 2005 and July 2006 and compiled across all 17 communities assessed.

Table 1. List of species captured by fishers in the NGC.

Scientific Name	Common Name (English)	Fishing Method	Communities
<i>Carcharhinus limbatus</i>	blacktip shark	G	12
<i>Carcharhinus spp.</i>	shark	G	1, 2, 4, 5, 6, 9, 11, 12, 13, 14, 16
<i>Caranx spp</i>	jurel	H	5, 7
<i>Dasyatis dipterura, spp.</i>	diamond stingray	G	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17
<i>Gymnura marmorata</i>	butterfly ray	G	1, 2, 3, 4, 5, 6, 7, 9, 10, 11, 12, 13, 14, 15, 16, 17
<i>Mustelus californicus, spp.</i>	gray smoothhound shark	G, L	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17
<i>Mustelus lunulatus</i>	brown smoothhound shark	G	1, 2, 3, 4, 5, 6, 7, 9, 10, 11, 12, 13, 14, 15, 16, 17
<i>Myliobatis californica</i>	bat ray	G	1, 2, 3, 4, 5, 6, 7, 9, 10, 11, 12, 13, 14, 15, 16, 17
<i>Myliobatis longirostris</i>	longnose eagle ray	G	1, 2, 3, 4, 5, 6, 7, 9, 10, 11, 12, 13, 14, 15, 16, 17
<i>Rhizoprionodon longurio</i>	pacific sharpnose shark	G	1, 2, 3, 4, 5, 6, 7, 9, 11, 12, 13, 14, 15, 16, 17
<i>Rhinobatos productus or spp.</i>	shovelnose guitarfish	G	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17
<i>Sphyraena spp.</i>	hammerhead shark	G	1, 2, 3, 4, 5, 6, 9, 11, 12, 13, 14, 15, 16, 17
<i>Squatina californica</i>	pacific angel shark	G	1, 2, 3, 4, 5, 6, 7, 9, 11, 12, 13, 14, 15, 16, 17
<i>Atractoscion nobilis</i>	white seabass	G	1, 2, 4, 5, 6, 7, 9, 11, 12, 13, 14, 15, 16, 17
<i>Balistes polylepis</i>	finescale triggerfish	D, H, T	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17
<i>Cynoscion othonopterus</i>	Gulf corvina	G, H	6
<i>Cynoscion parvipinnis</i>	shortfin corvina	G	1, 2, 3, 4, 5, 6, 7, 8, 9, 11, 12, 13, 14, 15, 16, 17
<i>Cynoscion spp.</i>	corvina	G	1, 2, 3, 4, 6, 9, 11, 12, 13, 14, 15, 16, 17
<i>Epinephelus acanthistius</i>	Gulf coney	L	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17
<i>Epinephelus spp.</i>	Gulf coney	L	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 16, 17
<i>Epinephelus niphobles</i>	star-studded grouper	L	1, 2, 3, 4, 5, 6, 7, 9, 11, 12, 13, 14, 15, 16, 17
<i>Epinephelus analogus</i>	spotted cabrilla	D, H	1, 2, 3, 4, 5, 6, 9, 11, 12, 13, 14, 15, 16, 17
<i>Mycteroperca jordani</i>	Gulf grouper	D, G, L, H	1, 2, 3, 4, 5, 6, 7, 9, 11, 12, 13, 14, 15, 16, 17
<i>Mycteroperca prionura</i>	sawtail grouper	D, H	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17
<i>Mycteroperca rosacea</i>	leopard grouper	D, H	1, 2, 3, 4, 5, 6, 7, 9, 11, 12, 13, 14, 15, 16, 17
<i>Paralabrax auroguttatus, spp.</i>	goldspotted sand bass	L, T	1, 2, 3, 4, 5, 6, 7, 9, 11, 12, 13, 14,

				16, 17
<i>Paralabrax maculatofasciatus</i>	spotted sand bass	D, T, H	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17	
<i>Stereolepis gigas</i>	giant sea bass	H	1, 2, 3, 4, 6, 9, 11, 12, 13, 14, 15	
<i>Hoplopagrus guentherii</i>	barred pargo	G, D, H,	1, 2, 3, 4, 5, 6, 7, 9, 11, 12, 13, 14, 15, 16, 17	
<i>Lutjanus argentiventralis</i>	yellow snapper	G, D, L	1, 2, 3, 4, 5, 6, 9, 11, 12, 13, 14, 15, 16	
<i>Lutjanus peru</i>	Pacific red snapper	D, H	1, 2, 4, 5, 11	
<i>Micropogonias megalops</i>	Gulf croaker	G	1, 2, 3, 4, 6, 9, 11, 12, 13, 14, 15, 16, 17	
<i>Mugil spp.</i>	mullet	G	1, 2, 3, 4, 6, 7, 8, 9, 11, 12, 13, 14, 15, 16, 17	
<i>Paralichthidae / Pleuronectidae (P. aestuarius)</i>	flounders	G, H	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17	
<i>Scomberomorus spp.</i>	sierra	G	1, 2, 3, 4, 6, 8, 9, 11, 12, 13, 14, 15, 16	
<i>Callinectes bellicosus</i>	swimming crab	G, T	1, 2, 3, 4, 6, 9, 10, 11, 12, 13, 14, 15, 16	
<i>Litopenaeus stylirostris</i>	blue shrimp	G	2, 3, 6, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17	
<i>Panulirus inflatus</i>	blue spiny lobster	D	1, 2, 6, 9, 14	
<i>Atrina tuberculosa</i>	tuberculate pen shell	D	2, 4, 9, 11, 12, 13	
<i>Dosinia ponderosa</i>	giant dosinia	D	1, 2, 4, 6, 9, 11, 12, 13, 16	
<i>Hexaplex (Muricanthus) nigritus</i>	black murex	D	2, 3, 4, 6, 9, 11, 12, 13, 14, 15, 16	
<i>Octopus sp (possibly O. hubssorum)</i>	octopus	D	1, 2, 4, 5, 6, 7, 11, 12, 13, 14, 16	
<i>Octopus bimaculatus</i>	two spotted octopus	D, T	1, 2, 3, 4, 5, 7, 9, 11, 12, 13, 14, 15, 16	
<i>Panopea generosa</i>	goeduck clam	D	4, 9, 14, 15	
<i>Phyllonotus erythrostoma</i>	pink murex	D, T	1, 2, 3, 4, 6, 9, 11, 12, 13, 14, 15, 16	
<i>Pinna rugosa</i>	rugose pen shell	D	1, 2, 4, 9, 11, 12, 13, 15	
<i>Spondylus calcifer</i>	rock scallop	D	1, 2, 4, 9, 11, 12, 13, 14, 15, 16	
<i>Isostichopus fuscus</i>	Sea cucumber	D	1, 2, 7, 9, 11, 14	

Fishing Methods: D) diving; G) gillnets; L) longline; T) traps; H) hand fishing line.

Communities: 1) Bahia de los Ángeles; 2) Bahía de Kino; 3) Desemboque de Caborca; 4) Desemboque Seri; 5) El Barril; 6) Golfo de Santa Clara; 7) Las Ánimas; 8) Los Dorados de Villa; 9) Punta Chueca; 10) Punta Jagüey; 11) Puerto Libertad; 12) Puerto Lobos; 13) Puerto Peñasco; 14) San Felipe; 15) San Jorge; 16) San Luis Gonzaga; 17) Santo Tomas.

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**APPENDIX C. ATLAS: THE SOCIAL LANDSCAPE OF SMALL-SCALE
FISHERIES IN THE NORTHERN GULF OF CALIFORNIA, MEXICO**

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Key words: atlas, small-scale fisheries, Northern Gulf of California, Mexico, local knowledge, geographic information systems

Atlas: the Social Landscape of Small-scale Fisheries in the Northern Gulf of California, México

Marcia Moreno-Báez

Abstract

This atlas exists as a resource for people interested in the knowledge accumulated by the people who live, study and depend upon of the marine resources of the Gulf of California. In order to understand the interaction between humans and nature, it is essential to incorporate both scientific and local knowledge. Without the big picture, we will not be able to fully understand the complexity of small-scale fishing activities and the opportunities we have to better manage the Gulf of California's marine resources.

This atlas presents a synthesis of a collection and analysis of more than 700 maps representing local fishers' knowledge. The main purpose of this large-format atlas is to document visual evidence of the human dimension of small-scale fishing activities. Specific objectives of the atlas include generating awareness of human interactions with the marine environment and understanding how the aggregation of local scale information leads to improve understanding of the regional social landscape. This atlas is intended for environmental policy makers, non-governmental organizations, the private sector, academics, teachers and citizens. This atlas contains integrated local knowledge and scientific analysis, photographs, maps and narratives that provide insights into the many ways fishers in the Northern Gulf of California (NGC) have utilized the marine resources and develop a base of rich experiences and knowledge about this ecosystem.

While the atlas deals specifically with the NGC we believe the approaches applied can serve as a model for similar efforts in other areas.

Overview

Atlas of The Social Landscape of Small-scale Fisheries in the Northern Gulf of California provides a comprehensive, visual presentation of scientific information, on the human dimensions of small-scale fisheries acquired through a rapid appraisal survey process that produced data that was analyzed using geospatial tools. This atlas is intended for environmental policy makers, non-governmental organizations, the private sector, academics, teachers and citizens.

The Challenge and Response

The challenge to develop this atlas was to characterize and synthesize a vast and rich body of information provided by local fishers, field technicians and scientists concerning interaction of humans and the marine environment in the NGC. The information provided in this atlas will enhance our understanding of the spatial and temporal dimensions of ecological and social processes related to small-scale fisheries. The atlas incorporates scientific research and local knowledge collected during 2005-2006 in an effort to capture the dynamics of the marine ecosystem of the NGC.

Purpose of the Atlas

The purpose of this atlas is to understand the interaction of humans with the marine environment in the Northern Gulf of California, Mexico, through the visual

representation of the spatial and temporal dimension of small-scale fisheries activities.

Specific objectives of the atlas includes are:

- Visually portray a regional-scale perspective of the spatial and temporal dimension of small-scale fishing activities;
- Understand how the aggregation of local scale information leads to the understanding of the regional social landscape.

To meet these objectives, the atlas provides:

- a compilation of marine environmental and conservation maps;
- a compilation of local knowledge from different fishing communities in the NGC;
- a collection of maps on various themes for different fishing communities, fishing methods and target species;
- the spatial and temporal dimension of small-scale fishing activities;
- a picture of the interactions among fishing communities.

In essence, we step back and look at the big picture, a picture we believe is essential to more fully understand the implications and cumulative effects of management plans and policies to society. Through the aggregation of information from over 350 local fishers, we effectively use local knowledge to help understand a much larger regional ecosystem. However, we should acknowledge that this short-term picture, large-scale perspective comes at the sacrifice of a long-term period and finer resolution and

specificity. Thus, the collection of local and scientific knowledge, its compilation and the analyses presented here are intended to complement, and not substitute for, research and more detailed analyses that are possible at individual sites, and at local scales. Our intention is to generate awareness and understanding of how these fishers interact with the marine environment. We believe this information can inform policymakers and local citizens about spatial and temporal dimensions of small-scale fisheries in the NGC and as a consequence, contribute to improve management policies aim to the sustainable use of these resources.

Structure of the Atlas

This atlas presents a synthesis of a collection and analysis of more than 700 maps representing local fishers' knowledge. The atlas begins with an overview of *Pesca Artesanal del Norte del Golfo de California - Ambiente y Sociedad* – the PANGAS project which led to this work. Next, we present a general description of the Gulf of California followed by a close-up view of our study area in the northern part of the Gulf. This is followed by a description of the research presenting the survey methodology and the evolution from a compilation of maps to a cumulative base of knowledge regarding the social landscape of small-scale fisheries in the NGC. This introduction sets the stage for the more detailed information that follows in subsequent sections. The body of the atlas is made up of chapters divided into the following themes: (a) general fishing distribution of the 17 communities in the NGC, (b) the distribution of small-scale fishing activity based on fishing methods (i.e., hand fishing line and longline, gill nets, diving

and traps), (c) the distribution of fishing activity based on habitat types (i.e., deep water rocky reefs, coastal rocky reefs, rocky reef benthic invertebrates and sand bottom habitats) with the corresponding spawning areas by species and finally, (d) a social networks analysis of small-scale fisheries (Duberstein et al. unpublished). Only by understanding how fisheries operate can decision-makers and stakeholders understand the interactions between people and the environment and hence make informed decisions about future coastal and marine management. The present study is based on the stock of scientific and technical knowledge, experiences of people and databases accumulated by project PANGAS and other academic institutions and non-government organizations (NGO's) in Mexico.

Introduction

The Gulf of California, Mexico, is a unique ecosystem being the only major sea completely under the jurisdiction of a single nation (Sarukhán 2001). This region is one of the most productive marine ecosystems in the world, providing the majority of Mexico's fishery resources and a large component of fish products commercialized in the southwestern United States and eastern Asia, primarily Korea and Japan. Small-scale fisheries is an important socio-economic activity that supports coastal communities and economies where marine organisms are pursued by vessels, using a variety of gear types, fishing strategies, and covering a large part of gulf. While large-scale or industrial fishing is still important, there are now more people dedicated to small-scale fishing activities in this region, and their numbers are expected to grow, particularly with recent efforts by the Mexican government aimed at reducing the size of the large-scale trawling fleet

(Bezaury-Creel 2005; Ulloa et al. 2006). However, within the past century, resources in the Gulf of California have declined in abundance and diversity (Sagarin et al. 2008) and it has become crucial to understand what are the interactions and relationships between humans and the marine environment.

Despite the significance of this region for the economy of its inhabitants, fishing activities, particularly those that include small-scale fisheries, are poorly understood. While a variety of data are collected by state and federal agencies (Comisión Nacional de Acuacultura y Pesca, Centro Regional de Investigación Pesquera) to monitor and enforce fisheries, the thematic, temporal and spatial resolution of these data sets varies significantly. Additional information types and sources also vary considerably depending on the community. They include agency observer data, daily logbooks with detailed location information and reports from NGO's, and/or landing receipts using large statistical reporting blocks in others. While these data sets are useful, they are not sufficient nor well enough integrated and synthesized. Moreover, they are broadly dispersed, and as a consequence, it has been challenging to integrate the human and biophysical dimensions of this ecosystem.

The need to understand the biophysical and social aspects of fisheries encourages scientist and managers to incorporate holistic approaches into conservation and management. Ecosystem-based management (EMB) is an innovative management approach that aims to address these challenges. Although EMB remains an evolving concept, one of the suggested definitions by Grumbine (1994:31) is: "EBM integrates scientific knowledge of ecological relationships within a complex socio-political and

values framework toward the general goal of protecting native ecosystem integrity over the long term.” EBM is central to informing policy decisions with marine and fisheries management becoming more focused on ecosystem-based approaches, using tools such as time and area closures, and accurate spatial information about the “social landscape” (i.e., extent of fishing activities and existent institutions involved in those activities) (St. Martin and Hall-Arber 2008).

Local knowledge (LK) has been one of the central components in documenting, to some extent, the social landscape of small-scale fisheries at a local scale in some communities in the Northern Gulf of California (NGC) (Cudney-Bueno and Turk-Boyer 1998; Basurto 2005). However synthesis of these interactions at a regional scale remains largely undocumented. Detailed information concerning the marine environment which fishing communities utilize, rely upon, and maintain LK about is only vaguely known. Yet, the success of planning and management requires information about the spatial distribution of habitats, the species interactions within the ecosystem (Crowder and Norse 2008) as well as the understanding of how the social landscape of communities, fishing activities, local knowledge and other resource-independent practices, vary across space and time (St. Martin et al. 2007). These kinds of information are critical to promote informed decisions and self-regulation in the fishing communities of the Gulf of California where the ecosystem and local economies depend on spatially and temporally dynamic information for their longer-term sustainability. The same kinds of information are needed to guide management and enforcement (Cudney-Bueno et al. 2009; Cinti et al. 2010).

PANGAS Project

In order to understand the marine ecosystems and the relations among economic, social and ecological influences, a proposal to develop a multidisciplinary ecosystem-based research initiative designed to inform management called PANGAS (Pesca Artesanal del Norte del Golfo de California, Ambiente y Sociedad), was launched in 2005. PANGAS is an interdisciplinary partnership of three academic institutions (University of Arizona, University of California Santa Cruz, and the Centro de Investigación Científica y de Educación Superior de Ensenada-CICESE) and three research and conservation NGO's (Intercultural Center for the Study of Deserts and Oceans-CEDO, Pronatura Noroeste, A.C. and, Comunidad y Biodiversidad-COBI) for ecosystem-based research and management of coastal fisheries.

The goal of PANGAS is to develop and test interdisciplinary frameworks for ecosystem-based research and management of coastal fisheries. In order to understand the marine ecosystems and the relations among economic, social and ecological influences, PANGAS has explored ways to develop more holistic efforts towards research and planning to improve management plans for small-scale fisheries (Pfister et al. 2009). Consortiums such as PANGAS have initiated a new generation of multidisciplinary conservation, research and, management efforts where the society and its interaction with the marine environment are included.

PANGAS has explored ways of developing improved management plans for the NGC through the study of different biophysical and social processes related to fisheries

management. Focusing on these needs, PANGAS has generated a rich base of information regarding the biophysical and social aspects of small-scale fisheries that illustrate at a regional level the complex interaction between the fishing communities and the marine environment. This project has provided the baseline of information necessary to understand the social dimensions of fisheries. The social significance of space at which small-scale fisheries operate can be now portrayed to support decision making in the design of management strategies for small-scale fisheries in the NGC.

The Role of Maps

The traditional approach of fisheries management through inventory assessment (aggregated logs of product arrivals) cannot possibly capture the spatial and temporal complexity of the ecological and social patterns of a dynamic marine environment. One currency which can provide more perspective is maps. Maps are one of the oldest innovations of humans to represent concepts of place, space and landscape, and in recent years have become central to some of the most exciting developments across the field of the humanities and social science (Jackson 1989). Maps provide a means to both collect and display information. Individually, they can represent not only vital scientific themes (e.g., bathymetry, currents, etc.), but also the indispensable knowledge of each fisher in the region. Taken together, these data can answer the vital questions of “Who?”, “Where?”, “How?” and eventually, “Why?” Once aggregated and analyzed, a collection of maps in a thematic atlas can make important knowledge available in an organized, explicit, usable form. The main benefit of maps is to provide a useful and visual language

to integrate and display complex information in a coordinated, efficient, purposeful and consistent manner.

The geographic knowledge represented in this atlas integrates data and analysis from different disciplines, different scales, and perspectives ranging from local fishers to researchers in order to provide resources for the development of sound management strategies for small-scale fisheries in the NGC. In addition to the maps included, this atlas shows where to find important sources of relevant data and knowledge and repositories of important documents or other forms of codified knowledge about the NGC.

This atlas presents the synthesis of a collection and analysis of scientific research and more than 700 maps representing local fishers' knowledge. Additionally, we compiled a series of cartographic resources to describe the biophysical environment and the human dimensions of fishing activities in this region. Scientists provided their expertise in social science while fishers presented different perspectives of their activities, species distributions and an historical view of fisheries. The atlas exists as a resource for people interested in the knowledge accumulated by the people who live, study and depend of the marine resources of the Gulf of California, Mexico.

Characterization and Synthesis of Information

Datasets Collection

Before beginning any fieldwork, we conducted an exhaustive review of existing data and previous work carried out in the region in order to develop a baseline database

of the state of knowledge of the biophysical and social aspect in the NGC relative to small-scale fisheries. Sources of data included assessments of relevant local, national, and international initiatives and policies; census data (INEGI³); previous studies and associated data (including information on the biology and ecology of known harvested species); and, management plans and other reports obtained from governmental and nongovernmental organizations (NGOs).

Social Research

The social research in PANGAS was completed through an extensive survey of the region's small-scale fisheries. This survey entailed visiting 17 communities and fishing camps, and investing at least 600 person-days in the field. We interviewed 376 boat captains concerning a wide variety of topics, including fishers' recommendations for better management of their region's fisheries (Figure 1). The information was organized as preliminary results and then these findings were discussed with two main fishing communities to cross-check the information among fishers (Moreno-Baez et al., In press) (Figure 2). We also conducted in-depth research in Bahía de Kino and Puerto Peñasco regarding social networks, existing rules in use, and local market processes affecting small-scale fisheries (Cinti et al., In press). This intensive effort has provided a wealth of information on the social dynamics of small-scale fisheries (Duberstein et al. In review). We have developed an extensive database with qualitative and quantitative social data to understand the human dimension of small-scale fisheries. In order to integrate the spatial

³ Instituto Nacional de Estadística y Geografía (INEGI)

information, geospatial tools such as geographic information systems (GIS) were used to support the management of a large amount of datasets and information that incorporated, among other things, at least 3000 layers of spatial information (shapefile⁴) depicting social and biophysical characteristics of the Gulf and the spatial and temporal distribution of fishing activities for 52 different species, local ecological knowledge on key nursery and reproductive grounds, and sites of historical exceptional catches in the NGC. The information was then refined and compiled to produce and analyze the fishing zone shapefiles that represent small-scale fishing activities. These portrayals of the spatio-temporal distribution of fishing activities can help us to relate information regarding the fishing effort within an area of fishing.

GIS and spatial analysis tools in combination played a role in the social network analysis. We calculated proximities and convergence, and combined these with associated community attributes in order to understand the spatial connectivity among fishing communities. We utilized social network analysis and spatial networks in order to understand the correlation and structural equivalence of the NGC (Duberstein et al. unpublished).

In the current study, the spatial and temporal dimension of human activities helped us to visually locate and understand the part of the social landscape occupied by small-scale fisheries in the NGC in a format that should be useful for decision making regarding the implementation of management and conservation strategies. Our research

⁴ Geospatial vector data format for geographic information systems software

produced a picture of the conservation and management trends in the NGC. It also portrays the fishing activities distribution at a regional scale that would not be possible to understand without this larger, integrated effort. By depicting the spatial and temporal interactions of small-scale fishers in the NGC, we show ways in which communities of fishers can be defined not only by a geographic location (such as where they live), but also by their interests and activities. This combination allows us to answer an important question, “What is the real spatial influence from the different NGC communities?” Finally, with our research we were able to demonstrate the vast knowledge that users of local natural resources across an entire ecosystem can provide across spatial and temporal scales.

Atlas

The Gulf of California

The Gulf of California (also known as the Sea of Cortez or Sea of Cortés) region is recognized worldwide for its biological richness, high number of unique species, productive waters and scenic beauty (Aburto-Oropeza and López-Sagástegui 2006). The Gulf of California is more than 1,050 kilometers from the mouth of the Colorado River to a line between Cabo San Lucas and El Faro on the coast of Jalisco (Figure 3). It averages about 175 km in width, widening towards the south. Within its rich diversity of marine resources are some 900 desert islands.

The Gulf of California was formed only about 4.5 million years ago, the result from a crustal movement which began to detach the peninsula from the continent

between 17 to 25 million years ago. The separation is continuing, and faulting in the northernmost part of the Gulf related to tectonic movements has thrown up many plant, coral and animal fossils dating from a warmer past. During its formation, temperate eastern Pacific waters were trapped in the upper Gulf while the lower Gulf remained tropical. This has created a unique marine ecosystem, which contains a variety of pelagic (open ocean) and benthic (sea bottom) environments and extends from wetlands to coral reefs. Within the Gulf many oceanographic processes interact including: different systems of upwelling currents, wind-driven currents, high tidal mixing and hydrothermic vents. These phenomena have contributed to the high biodiversity and marine productivity of the Gulf of California (Ezcurra 1998).

The Gulf's marine fauna is so rich that it was called 'the world's aquarium' by Jacques-Yves Cousteau. The Gulf of California is home 891 fish species, 90 of them endemic, and it contains 39% of the world's total number of species of marine mammals and a third of the world's marine cetacean species (Thomson et al. 2000; Brusca 2002). But having evolved in isolation, the marine wildlife is also vulnerable to introduced predators and disturbance by man, as is the sparser terrestrial fauna.

The temperate climate of the desert and the number of large and small islands contributes to Gulf of California coastline rich in environmental resources and the existence of diverse animal species. The abundant marine and coastline resources are fundamental to the livelihoods of the inhabitants of local communities. As of 2005, approximately 8.6 million people inhabited the Gulf of California region, and this number is expected to rise to 10.4 million by the year 2010 (Aburto-Oropeza and López-

Sagástegui 2006). Population density is considered to be low now; however this entire region is attracting people at a rapid pace (Figure 4). All the Gulf islands are uninhabited except for six where there are populations of between 35 and 60, mostly fishers. The abundant natural resources and associated economic activity have created new investment opportunities that encourage regional economic growth. The cities and ports of the region have become specialized in the primary (i.e., agriculture, forestry, mining, fishing and livestock) and tertiary sectors (transportation, commerce and services), transforming the Gulf of California into one of the highest per capita income regions in México (CSGC 2004). Given its ecological, cultural, economic, and political significance, the region is recognized worldwide as a key conservation site and has been subject to numerous national and international conservation efforts (Aburto-Oropeza and López-Sagástegui 2006).

In the last two decades, conservation groups and NGO's working in the Gulf of California have worked to develop science-based conservation plans at different physical and biological scales that have different inherent characteristics, components, patterns and processes. One of the main institutions in charge of understanding and managing information related to biodiversity and ecosystems in Mexico is the National Commission on knowledge and use of biodiversity (CONABIO). This institution decided to establish conservation priorities for the proper management and sustainable use of marine ecosystems in 1998, organizing a workshop where marine and coastal priority areas were defined (Arriaga Cabrera et al. 1998). Additionally, national and international NGO's

have also established conservation plans that range from specific sites to regions and ecoregions and bring together the conservation priorities for a regional agenda.

Some of these conservation planning efforts started in 2001, when a ‘Coalition’ of organizations (World Wildlife Fund, Conservation International and Fondo Mexicano para la Naturaleza) gathered 180 people in a workshop that took place in Mazatlan in order to bring a consensus on the Biologically Important Areas (BIAs) (Enriquez-Andrade et al. 2005). During this workshop participants identified 22 marine BIAs and 20 terrestrial BIAs that together covered a large portion of marine, coastal and terrestrial critical habitats of the region. In 2005, with the hopes of contributing to regional conservation efforts and to improve marine and coastal management, Comunidad y Biodiversidad (COBI) and The Nature Conservancy (TNC) teamed up to develop a new exercise to identify priority areas in the Gulf of California (Ulloa et al., 2006). In combination, these conservation priority areas cover 86% of the total Gulf of California and underscoring the richness and importance of the marine resources of this region (Figure 5).

Conservation and management efforts have led to, among other things, the creation of marine protected areas, biosphere reserves and some of the most long standing community-based fisheries management and environmental education work in the entire Gulf of California (CONANP 2009; Pfister et al. 2009). In Mexico, the governmental institution that administers the federal Protected Areas is called the National Commission for Natural Protected Areas (CONANP). The commission is entrusted with ensuring that a representative sample of each of the different ecosystems present in

Mexico is conserved. Site conservation is the principal public biodiversity conservation instrument in Mexico, and just over 10% of the country currently has protected status (CONANP 2008). In the Gulf of California, there are 10 formally established protected areas (Table 1). These sites comprise 7% of the area of the Gulf of California and form the third largest World Heritage marine property. The Gulf is an area valuable to science, increasingly important for tourism and is an important economic fishery. To control burgeoning tourism, CONANP, local governments and the Navy enforce revised regulations. To control fisheries and the overfishing of commercial stocks, fishing in marine protected areas is prohibited and in other protected areas, permitted only by traditional fishing methods. The protected areas are managed by CONANP from five regional and six local offices. CONANP has Regional Divisional Directors for Baja California, Baja California Sur, Nayarit and Sonora, where there is also a coordinating Director for the four regions in Hermosillo. There are also local Directors for the Bahía de los Ángeles, the Upper Gulf and Colorado River Delta Reserve, Bahía de Loreto National Park, Cabo San Lucas and Cabo Pulmo, Isla Isabel National Park and El Vizcaíno Biosphere Reserve (Figure 6).

The Gulf of California is a biologically diverse and culturally rich region. The great number of unique species and the variety of habitats make it a region of great conservation importance and a productive marine ecosystem. In the region, local communities have a close relationship with natural resources and the region's development is based on the availability of those resources. Despite the clear importance of the region and the various efforts that have taken place over the years to study the

natural and ecological aspect of the marine resources, the human dimension is still under-studied and underrepresented.

It is crucial that the region has management and conservation plans that ensure ecological sustainability while promoting economic development involving local research and stakeholders. All of these conservation efforts are parts of a continuing process, not an end. More information will likely lead to reconsideration of options, shifts in priorities, and eventually new or modified future scenarios, in an iterative loop between society, nature and management evaluations based on scientific research.

The Northern Gulf

We focused our study in the northern Gulf of California (NGC), Mexico, extending south of Bahía de Kino in mainland Sonora and El Barril, in Baja California (Figure 7). The NGC is a highly productive ecosystem, supplying most of Mexico's fishery resources and is recognized as a key marine-conservation site (Cudney-Bueno et al., 2009). The northernmost portion of the Gulf is dominated by the Colorado River delta and virtually divided by the midriff island (i.e., Isla Ángel de la Guarda, Isla Tiburón, Isla San Esteban, Isla San Pedro Martir) resulting in a unique ecosystem. The surface area of the NGC is around 58,000 km² (total area) and includes 3,000 km (including islands) of irregular coast line with great number of estuaries, coastal bays and lagoons (Table 2).

The northernmost section of the study area is shallow, with depths ranging from 0 to 200 m, due to the large amount of silt deposited over the millennia by run-off from the Colorado River. Further south, the sea floor is characterized by underwater canyons and

depressions that, in places such as the Canal de Ballenas, are over 1 kilometer deep. These underwater canyons form a series of depressions that increase in depth towards the mouth of the gulf. The NGC comprises 123 islands and islets that have been called a natural laboratory for the investigation of speciation (CONANP 2008). Moreover, almost all major oceanographic processes occur in the NGC giving an extraordinary importance to the study area from an oceanographic and biophysical perspective (Johnson and Ledesma-Vásquez 2009).

In the NGC, there are 17 permanent small-scale fishing communities and temporary fishing camps distributed along approximately 2000 km of coastline (PANGAS Project, unpubl. data) (Figure 8). These fishing communities and camps range from 5 (i.e., Punta Jagüey) to almost 50,000 inhabitants (i.e., Puerto Peñasco). These communities harbor small-scale fishing boats called pangas, which are small (6-9 m) fiberglass fishing skiffs (2-3 fishers/boat) used throughout the region, usually operating with 75-115 hp outboard motors (Ulloa et al., 2006) [S. Pérez, Loaiza R., Moreno, C., unpublished data]. Today, over 1,300 pangas operate in the NGC [S. Pérez, Loaiza R., Moreno, C., unpublished data]. In Figure 8 we present an estimated number of pangas operating in each fishing community and the access of these communities.

In general, access to important resources for fishers such as ice, is through roads which are the primary connections to the main cities in the region. Terrestrial infrastructure access and proximity to markets is particularly important for community members that must travel long distances, sometimes involving several days, to bring marine resources back to shore. As development in the NGC continues, more

communities will have access to electricity, ice, and other resources that will make it possible for them to expand their fishing zones (Duberstein et al. unpublished).

Small-scale Fisheries and the Communities

The local economy in the NGC depends largely on artisanal or small-scale fishing. Fishing thrives all year, with fishers following preferred species around the sea with the seasons to selected fishing grounds. Some 70 commercial fish and 12 invertebrate species are regularly taken (Cudney-Bueno and Turk-Boyer 1998). As a result, the NGC is considered an important and productive marine ecosystem, providing the majority of Mexico's fishery resources and a large component of fish products commercialized in the southwestern United States and eastern Asia, primarily Korea and Japan.

In the NGC, small-scale fisheries play an important role in fishing communities' economies. Some communities, like Bahía de Kino, still have economies that rely heavily on small-scale fishing. Others, like Puerto Peñasco, have been successful in marketing themselves as a tourist destination, although fishing (including industrial, small-scale commercial and sport fishing) remains a critical part of the economy. There is also variation in community demographics and function, including indigenous fishing communities, such as Desemboque de los Seris, and temporal small-scale fishing camps, such as Punta Jagüey.

Fishing Extent and Distribution

In general small-scale fishing activities in the NGC region, as mapped by fishers, are distributed over approximately 35,170 km², which corresponds to 60% of the 58,000 km² (total area) of the NGC (Moreno-Báez et al. 2010). During 2005 and 2006, we obtained information about the distribution of the fishing activities for 17 fishing communities for 52 different target species. Each community is presented with a code, number of maps collected, a total fishing area and a brief description of their fishing zones in Table 3. Fishing activity in general shows that almost 89% of the coastline and surrounding islands are used as fishing grounds. Figure 9 presents a picture of each total community's fishing grounds represented by colors and communities' codes.

Fishing Methods

The characterization of fishing activities shows that most fishers use more than one gear type and fish for multiple species. From the information collected for 52 species, gill nets are used for at least 26 of these main target species, diving for 16, hand fishing lines or longlines for 4, and traps for 4. The remaining 6 target species are harvested by a mix of gear types and methods (Moreno-Báez et al. 2010). In addition, we identified patterns of distribution by season as well as nursery grounds for the target species.

Gillnet

Figure 10, shows the spatial distribution of gillnets' fishing activity and an approximate number of species being captured represented by different colors using this

fishing method according to the rapid appraisal. This figure shows higher biodiversity in sites such as (1) the upper Gulf of California and (2) in Isla Tiburón where between 10 and 13 species are being caught with this fishing method.

Diving

Rapid-appraisal results revealed that most fishing areas for diving are located within 400 m of shore and are between 1 and 26 m deep. In the upper region (largely dominated by fishing activities of Puerto Peñasco), where the depth contour is less pronounced and rocky reefs are more “patchy,” diving activities commonly take place more than 100 m from of the shoreline. However, diving can also take place up to 20 km offshore. Figure 11, shows the spatial distribution of diving’ fishing activity and the number of species being captured using this fishing method. The numbers of species being caught with this fishing method are higher in (1) the area surrounding the community of Puerto Peñasco, from La Choya to Los Tanques; (2) the surroundings of Puerto Lobos; and (3) the midriff island region (the lower part of our study area) fishing areas such as Las Cuevitas, the north and southwest part of Tiburón Island, east side of Isla Ángel de la Guarda, Isla San Esteban, in front of the community of Bahía de Kino.

Hand Fishing Line and Longline

Hand fishing line and longline’ fishing activity and the number of species being captured is presented in Figure 12. Fishers reported that occasionally they use traps to capture some of the same species. Some of the sites with highest diversity of species

being capture with longline were (1) Puerto Lobos and (2) the midriff islands in Isla Ángel de la Guarda, Isla Patos, the north and southwest part of Isla Tiburón and Isla San Esteban.

Traps

Figure 13, shows the spatial distribution of traps fishing activity and the number of species being captured using traps. Some of the sites where two different species are being caught using traps are (1) in San Felipe, (2) from Playa Santo Tomás to Puerto Lobos, and (3) Isla Ángel de la Guarda and the southwest part of Isla Tiburón.

Commercial Small-scale Fishing Activity of Predatory Fish in Deep Water Rocky Reefs

The sub-sector of small-scale commercial fishing that are associated with the deep water reefs in the NGC, include a large number of species. This sub-sector commonly use fishing line (i.e., longline) to target the predatory fish. For the purpose of this atlas we have focused on only three species, the Gulf coney (*Epinephelus acanthistius*), Gulf grouper (*Mycteroperca jordani*) and, Gold-spotted sand bass (*Paralabrax auroguttatus*) due to their representativeness and importance for this fishery in the NGC. For decades the large-scale and small-scale commercial fishing sectors in the NGC have been targeting these predators leading to the depletion of stocks throughout the region. Many researchers believe that this selective targeting by the commercial sector of the top predators on the reefs has led to a drastic change in the trophic chain associated with deep

water rocky reefs (Cudney-Bueno and Turk-Boyer 1998). In this collection of maps, the distribution and description of deep water rocky reefs fishery is presented.

Gulf Coney

The Gulf coney (*Epinephelus acanthistius*) is found on patch reefs with sandy bottoms between 45 m. and over 90 m. deep in the water column. Being a deep water species, the golf Coney fishery is one of the most dangerous and demanding activities for fishers (Cudney-Bueno and Turk-Boyer 1998). Yet, this is one of the most well paid fisheries.

In Mexico, Gulf Coney is almost universally referred to by its Spanish name, Baqueta. Because of its unique coloration, the Baqueta cannot be easily confused with other species. In the NGC fishers use between 300 and 1000 hooks (size 6 or 7) in each longline bringing between 2 or 3 lines in the *panga* for the Gulf coney fishery. There is another species that can be fished together with Gulf coney called Star-studded grouper (*Epinephelus niphobles*) and is occasionally fished in deep waters with the same equipment but with a different size of the hook. The seven communities that considered Gulf coney a target species are Puerto Peñasco, Santo Tomás, Desemboque de Caborca, Puerto Lobos and, Puerto Libertad, in Sonora; and the communities of San Felipe and San Luis Gonzaga in Baja California.

Total and principal fishing seasons were identified for this fishery. According to fishers, the total fishing season is from September to June. The principal fishing season for the communities from the northernmost part is the same as the total fishing season.

However, the southernmost part of the NGC, start their principal fishing activity in October and they usually stop at the end of March.

The spatial distribution of fishing activities stratified by relative level of importance for Gulf coney is presented in Figure 14. The northernmost part of the Gulf of California is utilized by the communities of San Luis Gonzaga, San Felipe, Santo Tomás and Puerto Peñasco. The overlap between communities in this region is minimal. The main concern expressed by fishers from the upper region of the Gulf included (a) trawling vessels and the impact trawlers have over this species population (i.e., fishers believe trawling is removing critical habitat for juveniles); and (b) they believe that 'Asian trawling' vessels are coming to extract resources from the NGC.

Fishers for the communities of Desemboque de Caborca, Puerto Libertad and Puerto Lobos utilize the southern part of the region. In order to target Gulf coney, communities travel longer distances than those communities in the northern part of the region due to the need to seek deeper waters. Puerto Libertad is one of the communities that travel the most to reach deeper areas for this species. According to fishers' from these communities, their major problem is competition from larger predators such as giant squid and seals. Some of the most important sites and the communities that use those sites are:

- (1) Rocas Consag: - San Felipe
 - Puerto Peñasco
- (2) Este del Canal: - Puerto Peñasco
 - Desemboque de Caborca
- (3) Los Conchales: - San Felipe

- Puerto Peñasco
- (4) El Kinder: - Desemboque de Caborca
- (5) Las Cuevitas: - Puerto Libertad

Goldspotted Sand Bass

The Goldspotted sand bass (*Paralabrax auroguttatus*) is often unwanted bycatch or captured together with Gulf coney (*Epinephelus acanthistius*). While fishers are targeting Gulf coney, they might find big quantities of Goldspotted sand bass, subsequently fishers switch exclusively to this fishery (Cudney-Bueno and Turk-Boyer 1998). They refer to this phenomenon as the start of their Goldspotted sand bass season. This species is found on rocky bottoms, between 40 and 107 m depth. In the NGC, Goldspotted sand bass is referred to by its Spanish name, *Extranjero*. Goldspotted sand bass is usually caught using longline. However, metallic traps with sardine as bait are also used as a fishing method.

The communities that considered Goldspotted sand bass a target species were Puerto Lobos, Puerto Libertad and Bahía de Kino in Sonora and El Barril, Las Ánimas, San Felipe and Bahía de los Ángeles in Baja California. According to the interviews, the fishing season for this species is the whole year for all communities with no distinction between total and principal fishing season.

The spatial distribution of fishing activities represented with a relative level of importance for Goldspotted sand bass is presented in Figure 15. In the northwest part of the NGC we can see two clusters of fishing zones where the fishers from the community

of San Felipe work. They travel close to San Luis Gonzaga to capture this species and they specified using around 7 or 8 traps as a fishing method. On the northeast side of the Gulf, we can find a third patch of fishing zones. The community of Puerto Lobos captures this fish in front of their community. They usually harvest Goldspotted sand bass using longline as a fishing method and according to the interviews they fish baqueta at the same time.

The fishing zones located in the midriff islands are used by the communities of Puerto Libertad and Bahía de Kino. These communities usually travel to Isla Angel de la Guarda, Isla Tiburón, Isla San Esteban and Isla San Pedro Martir to harvest Goldspotted sand bass. The communities of Bahía de los Ángeles, El Barril and Las Áimas work mainly in the coast of Baja California, Isla Ángel de la Guarda Island and the archipelago San Lorenzo. According to the interviews, the community of El Barril is the only community from Baja California that travels –not frequently– to Isla Tiburón. The communities of Bahía de los Ángeles and Bahía de Kino specified using both traps and longline as a fishing methods. Some of the most important sites and the communities that use those sites are:

- | | |
|-------------------------------|--|
| (1) Punta Víboras: | - Puerto Libertad
- Las Áimas
- Bahía de los Ángeles |
| (2) Isla San Esteban: | - Bahía de Kino
- El Barril |
| (3) Archipiélago San Lorenzo: | - El Barril |
| (4) Ensenada Blanca: | - Bahía de Kino |

Gulf Grouper and Sawtail Grouper

The Gulf grouper (*Mycteroperca jordani*) can be found over rocky reefs at depths that vary with the seasons, typically in the first 30 m. of the water column; but between 30 m. and 45 m. during the summer. Although not as abundant as some of the other groupers, the Gulf Grouper is one of the more important fishes harvested for food in the Gulf of California. According to reviews of historical evidence, naturalists' observations and a systematic documentation of fishers' perceptions of trends in the abundance of this species, populations of these fish have declined dramatically over the last 60 years (Sáenz-Arroyo et al. 2005).

The Sawtail Grouper (*Mycteroperca prionura*) is found in rocky reefs within the first 45 m. of the water column. The Gulf Grouper and the Sawtail Grouper are members of the Serrandae or Sea Bass and Grouper Family. In Mexico, Gulf grouper is referred to by its Spanish name, *Baya*; while Sawtail grouper is known as *Cabrilla pinta*. Fishers usually utilize a line and bait (sardine) to capture this fish. This species is considered bycatch for gillnet fishery.

Gulf grouper and Sawtail grouper is considered as target species by 6 communities. These communities are Puerto Peñasco, Desemboque de Caborca, Puerto Lobos, Puerto Libertad and, Desemboque Seri, in Sonora. In Baja California the community of El Barril also provided information. According to the interviews, the

fishing season for Gulf grouper is the whole year around for all communities with no distinction between total and main fishing season.

The spatial distribution of fishing activities represented with a relative level of importance for Gulf grouper and Sawtail grouper is presented in Figure 16. Most of the fishing zones activity obtained for Gulf grouper and Sawtail grouper are located in the east coast of the NGC. Fishing zones appear to be widely scattered but we identified some areas with a high relative level of importance. Puerto Peñasco and Puerto Libertad seem to be the communities that move long distances to approach the fishing zones. The most common method used for harvesting this species is hand fishing line or longline. However, some fishers specified that this species is in fact a bycatch when using gillnets. Some of the most important sites and the communities that use those sites are:

- (1) El Borrascoso: - Puerto Peñasco
- (2) La Choya-Los Tanques: - Puerto Peñasco
- (3) Bahía Tepoca: - Puerto Lobos
- Puerto Libertad
- (4) Punta Tepopa: - Puerto Libertad
- Desemboque Seri

Commercial Small-scale Fishing Activity of Predatory Fish in Coastal Rocky Reefs

The sub-sector of small-scale commercial fishing that are associated with coastal rocky reef in the NGC, include species of the coastal margin within any rocky substrate that occurs from zero to thirty meters from the surface. These reefs can be comprised of extrusive or intrusive volcanic, sedimentary and metamorphic rock types. These reefs are

extensive and provide substrate for a diverse assemblage of algae, vertebrates and invertebrates. This includes sargassum and black coral forests, coralline algae such as rhodolith beds and many other important habitats that occur in the Gulf of California.

Many of the commercial species exploited by the small-scale fishing sector in the NG live on or around these coastal rocky reefs. Since these reefs are along the coastal margin of the mainland, peninsula and islands they are especially vulnerable to human disturbance and exploitation. The commercialized predatory fish that are associated with the coastal and rocky reefs in the NGC include Leopard Grouper (*Mycteroperca rosacea*), Amarillo snapper and pacific red snapper (*Lutjanus argentiventris* and *Lutjanus peru*) and, Barred Pargo (*Hoplopagrus guentherii*).

Leopard Grouper

The Leopard grouper (*Mycteroperca rosacea*) lives in relatively shallow water up to 45 m. in depth with rocky bottoms and close to shore. It is most active just after dark, but also throughout the day. Leopard grouper is referred to by its Spanish name, "cabrilla sardinera". According to some studies, the fishery of leopard grouper decreased but, but they are still commonly caught (Sala et al. 2004). The most common fishing method used for leopard grouper is hand fishing line. However, practices such as spearfishing at night using air compressors and hoses 50 or more meters long are common.

We obtained 7 interviews from three communities that considered Leopard grouper a target species. These communities are Puerto Libertad, Desemboque Seri and Bahía de Kino, in Sonora. The total fishing season for this species starts in November and

finishes in August. However, according to the interviews, there is no fishing activity in March. The principal fishing season starts in November but ends in June.

The spatial distribution of fishing activities represented with a relative level of importance for Leopard grouper is presented in Figure 17. We obtained information from only 3 communities regarding this fishery. Fishers from Puerto Libertad and Bahía de Kino travel the furthest distances to harvest this species. According to the interviews, Seri fishers from Desemboque travel around 50 km to the furthest fishing zones delineated by them. This region is mainly used by the community of Bahía de Kino. The distributions of the fishing zones provided by Bahía de Kino cover the south and west side of Isla Tiburón as well as the surroundings of Isla San Esteban.

Fishers also consider Isla San Pedro Mártir as well as archipelago of San Lorenzo important fishing zones. Finally the Baja California coast is utilized from Cabo San Miguel to Punta Trinidad. The community of Bahía de Kino specified using a technique called “*lampareo*”⁵ when diving at night to kill the pray but hand fishing line is also used. According to fishers, groupers are easier to catch when they are “sleeping”. The main concern about this fishery expressed by fishers from Puerto Libertad and Bahía de Kino is the controlled access by the Seri community. According to the interviews, in the 1970’s fishers’ used to catch Leopard grouper using dynamite. Some of the most important sites and the communities that use those sites are:

- | | |
|-----------------|--|
| (1) El Refugio: | <ul style="list-style-type: none"> - Puerto Libertad - Bahía de Kino |
|-----------------|--|

⁵ Shining the light on the animal

- (2) Punta Tepopa-Isla Patos: - Puerto Libertad
 - Desemboque Seri
 - Bahía de Kino
- (3) La Vaporeta-Tecomate: - Puerto Libertad
 - Desemboque Seri
 - Bahía de Kino
- (4) Isla Tiburón Sur - Bahía de Kino
- (5) Isla San Esteban - Bahía de Kino

Barred Pargo

The Barred pargo (*Hoplopagrus guentherii*) grows to 90 cm in length but actually catching one this size is virtually an impossible feat since according to fishers, the species is becoming rare. Barred pargo can be found in depths of up to 30 m. This species normally feeds on crustaceans and small schooling fish such as grunts and sergeant majors. The most common fishing method used for Barred pargo is hand fishing line however, practices such as diving at night using air compressors and hoses 50 or more meters long are common. According to the interviews, in almost every site where they fish this species, they have seen juveniles.

We collected 9 interviews from four communities that considered barred pargo a target species. These communities are Puerto Peñasco, Puerto Lobos and, Bahía de Kino in Sonora. According to the interviews, the community of Puerto Peñasco has a different principal season for this fishery starting in November and ending in September. The communities from the southern part (Bahía de Kino and Puerto Lobos) also start fishing in November but their season ends in February.

The spatial distribution of fishing activities represented with a relative level of importance for Barred pargo is presented in Figure 18. The fishing zones for this species according to the interviews are clustered in three main regions: (1) the northernmost part is utilized by the community of Puerto Peñasco, (2) in front of Puerto Lobos where this community harvests this species and, (3) in the region of Isla Tiburón, where Bahía de Kino provided information about fishing areas. Fishers from Puerto Peñasco specified the use of harpoon but they did not specify diving at night. The main concern fishers from Puerto Peñasco have is the trawling vessels and the impact this activity has over this species population. Some of the sites mentioned the most were El Borrascoso, La Choya and Los Tanques.

According to the interviews, fishers from Puerto Lobos utilize gillnets to capture this species. Consequently one concern fishers from this community have is what they call “*arponeo nocturno*” which is diving at night and using a harpoon to hunt fish. Some of sites mentioned the most were Bahía Tepoca and Piedra Cerro Prieto. Finally, fishers from Bahía de Kino reported using gillnets from the shore and extending them around the rocky reef. Some of the important sites recognized and highly utilized by fishers from Bahía de Kino were La Reina, El Tecomate and Mancha Blanca.

Commercial Small-scale Fishing Activity of Benthic Invertebrates in Rocky Reef

The invertebrate species included in this atlas are black murex (*Hexaplex nigritus*) and pink murex snail (*Phyllonotus erythrostoma*) and, octopus (*Octopus bimaculatus*). The octopus fishery is extremely important to the small-scale fishing sector of the NG

and is harvested primarily by diving but also with traps and even using chlorine (i.e., Bahía de los Ángeles). It is very important to development better management policies for this fishery before we begin to see severe declines in regional stocks. The spiny lobster fishery of the NG is also under special management but because of poor fisheries practices stocks are declining and the average size class is decreasing.

Black and Pink Murex

The artisanal fishery for Black murex (*Hexaplex (Muricanthus) nigritus*) and Pink murex (*Phyllonotus erythrostoma*) in the Gulf of California is a locally important fishing activity. These species are greatly appreciated seafood with high commercial value. Black murex is the most important in terms of quantity and revenue in the seafood market (Cudney-Bueno and Turk-Boyer 1998). Black and Pink murex are harvest using simple air compressors and hoses 50 or more meters long together with a knife and bags to carry the product. Fishers usually carry the snail with the seashell and clean them when they arrive at the shore.

We collected 11 interviews from four communities (i.e., Puerto Peñasco, Puerto Libertad, Punta Chueca and Bahía de Kino in Sonora) that have Black and Pink murex as target species. Most of the interviews for black murex were provided by the Puerto Peñasco divers. The principal fishing season for black murex starts in April and ends in August. For Pink murex the season starts in January and ends in July. According to the interviews, the fishing season for black murex starts at the same time as the spawning season and focuses on breeding aggregations.

The spatial distribution of fishing activities represented with a relative level of importance for Black and Pink murex is presented in Figure 19. The fishing zones for this species according to the interviews are clustered in three main regions: (1) the northernmost part is utilized by the community of Puerto Peñasco, (2) the community of Puerto Libertad is the one that utilizes the patches located north and south of the community and, (3) the communities of Punta Chueca and Bahía de Kino utilize the patches located in the southeast part of Isla Tiburón and Canal del Infiernillo.

According to the interviews from the community of Puerto Peñasco, when Black murex starts to become sparse, fishers switch to the Pink murex fishery. Some of the fishing zones with high relative level of importance according to fishers are El Borrascoso, Cerro Prieto and La Choya. Additional fishing zones are “in front of CEDO” where fishers claim to find murex but in smaller sizes and Isla San Jorge. A specific fishing zone for black murex is known as Los Anegados and is located on the north side of Isla San Jorge. According to fishers, distance is one of the factors that influence the decision to travel to Isla San Jorge and for that reason is not considered a main fishing zone. Most of the fishing zones are located within depths that range from 1 to 22 meters according to fishers. Main concerns about the Black murex fishery expressed by the fishers from Puerto Peñasco include (a) harvesting of the species during the spawning season, (b) fishers from other communities that come to the Puerto Peñasco area to harvest murex.

Puerto Libertad only provided information of fishing zones for Pink murex. The fishing areas delineated by this community were around Bahía Tepoca and Las Cuevitas.

Finally, the communities of Punta Chueca and Bahía de Kino mentioned some specific important sites located in the southeast part of Isla Tiburón and close to the Estero Santa Rosa. According to the interviews, concerns about this fishery include harvesting black murex during the spawning season.

Octopus

Octopus is found in intertidal and benthic zones from the low tide zone to subtidal depths of about 20 meters (65 ft). Octopus prefers sandy substrate and caves or debris. There are two species fished in the NGC, the green octopus (*O. hubssorum*) and the two spotted octopus (*O. bimaculatus*). Octopus is also harvested among the shorelines during low tides but this activity was not covered in this study (Cudney-Bueno and Turk-Boyer 1998). The fishing gear utilized for octopus includes simple air compressors, hoses 50 or more meters long, a hook and bags to carry the product.

We collected 43 interviews from eight communities that considered Octopus a target species. These communities are Puerto Peñasco, Puerto Lobos, Puerto Libertad, Desemboque Seri, Punta Chueca and Bahía de Kino in Sonora; and the communities of Bahía de los Ángeles and Las Áimas in Baja California. The principal fishing season for the northern communities is from November to August. However, for the communities in the south of the region fishing is year-round. According to some of the interviews, September is when fishers travel to Isla Ángel de la Guarda, Isla San Lorenzo and the peninsula of Baja California to target octopus. Also, the fishing season coincides with the spawning season according to some interviews.

The spatial distribution of fishing activities represented with a relative level of importance for octopus is presented in Figure 20. In general, fishing zones for this fishery seem to be well localized. The main factors affecting decisions to harvest the species are visibility and currents. Also, for some fishers (specifically from Bahía de Kino) the availability of resources to travel long distances was a factor in determining when to target octopus. From the Puerto Lobos community to Punta Tepopa, fishing zones for octopus appeared to be well known based on the relative level of importance. Most of the islands are visited to harvest octopus except Isla San Pedro Martir. Fishing zones located in Baja California, specifically those in the southernmost part, are areas shared by the communities of Las Ánimas, El Barril and Bahía de Kino. Punta Trinidad is one of the sites specified as a fishing zone by Bahía de Kino which is around 140km away from the community.

Some of the concerns expressed by fishers from most of the communities were (a) the “outsiders” that come and utilize their same fishing grounds and, (b) the lack of regulations that determine the size of the product for the market (i.e., “too many” fishers and small product sizes, unclear limits for this fishery in permits, etc.). The communities from Baja California expressed other concerns such as the overexploitation of octopus and fishing octopus using Clorox. Some of the most important sites and the communities that use them are:

- (1) La Choya: - Puerto Peñasco
- (2) Estero Morúa–Los tanques: - Puerto Peñasco
Also known as Primer y Segundo Tanque

- (3) Isla San Jorge: - Puerto Peñasco
 200 – 300 m. off from the island
 Also known as: *Piedra del Cuco*
- (4) Bahía Tepoca: - Puerto Peñasco
 - Puerto Libertad
 - Puerto Lobos
- (5) Las Cuevitas: - Puerto Libertad
 - Desemboque Seri
 - Bahía de Kino
- (6) Punta Tepopa - Puerto Libertad
- (7) Punta Víboras - Bahía de los Ángeles
 - Las Ánimas
 - Bahía de Kino
- (8) Isla Coronados y Bahía de los Ángeles: - Bahía de los Ángeles
 - Las Ánimas
- (9) Archipiélago San Lorenzo: - Bahía de Kino
 - Bahía de los Ángeles

Fishing Activity of Commercial Fish over Sand bottom

The commercial sand bottom species included in this atlas are Warrior swimcrab (*Callinectes bellicosus*), Curvina golfina (*Cynoscion othonopterus*) and, Blue shrimp (*Litopenaeus stylirostris*). The Warrior swimcrab fishery is extremely important to the small-scale fishing sector of the NG and is harvested primarily using traps. The rest of the species are capture using gillnets. Curvina golfina and blue shrimp are the primary

fisheries for the communities in the upper Gulf and Sierra has been an important fishery for the Gulf of California.

Warrior swimcrab

This fishery usually includes three species of crab even though the Warrior swimcrab is the principal one. In less volume the blue crab (*Callinectes arcuatus*), the black crab (*Callinectes toxotes* (*C. arcuatus*)) and the giant crab (*C. toxotes*) are included. The states of Sonora and Sinaloa are the major states involved in this fishery and they live in sandy bottom habitat. During the 1990's the Warrior swimcrab has become one of the most important fisheries in the NGC (Cudney-Bueno and Turk-Boyer 1998; Torre et al. 2004). According to the National Fisheries Chart (Carta Nacional Pesquera) this fishery Harvest the 87% of the total pacific production in Mexico through fishers working in 2,100 pangas. Some of the bycatch species captured together with this species are finescale triggerfish (*Balistes polylepis*) and black and pink murex (*Hexaplex sp.* and *Phyllonotus sp.*).

We collected 60 interviews from eight communities that considered crab a target species. These communities are Puerto Peñasco, San Jorge, Punta Jagüey, Santo Tomás, Desemboque de Caborca, Desemboque Seri, Punta Chueca and, Bahía de Kino in Sonora; and San Felipe in Baja California.

According to the interviews, the northernmost communities such as Puerto Peñasco, San Jorge, Punta Jagüey, Santo Tomás, Desemboque de Caborca and San Felipe, harvest this species from February to November. For the communities in the south

part of the NGC, the total fishing season is from July to May nevertheless, fishers recognize that July the crab still thin and not good for the market. The total fishing season is from April to September and the main season for this fishery is from August to December.

The fishing method utilized to capture this species in the state of Sonora are traps mainly during neap tides (August). However, in the states of Sinaloa and Nayarit fishers utilize a hoop. For the southernmost communities such as Bahía de Kino, the fishing gear might vary during May changing from traps to gillnet (Torre et al. 2004). The traps dimensions are 60 x 60 x 40 cm, made of metallic mesh with an aperture of 2.75 and 3.0 in. Those traps have four conic entrances and a space for the bait. Three are the maximum number of fishers traveling in one panga for this fishery.

Figure 21 shows the general distribution of the fishing zones for swimcrab. The upper Gulf area has 4 users: Puerto Peñasco, San Jorge, Santo Tomás and Desemboque de Caborca only until Bahía San Francisquito. The fishing zones with high importance are El Borrascoso, Cerro Prieto, and the area of Bahía San Jorge.

In the southernmost part of our study area, there were four main fishing zones delineated by fishers: Canal del Infiernillo, Punta Sargentito, Estero Santa Rosa and Estero Santa Cruz. The fishing zone is utilized by 3 communities, Desemboque Seri, Punta Chueca and Bahía de Kino. Those fishing areas are frequently visited during February until April. The communities of Punta Chueca and Desemboque Seri are frequent users of Punta Sargentito in the north mouth of Infiernillo Channel.

Curvina Golfinia

The Gulf curvina is an endemic species of the Gulf of California and travels to the waters of the upper Gulf of California to reproduce. Its distribution goes from La Paz in the state of Baja California to the upper NG. The curvina is considered a target species fished with gillnets and is considered an important fishery for being one of the main incomes for the fishery communities (Cudney-Bueno and Turk-Boyer 1998). This is a demersal species that lives in sandy bottom and muddy habitat.

We collected 56 interviews from two communities that considered Gulf curvina a target species. These communities are Golfo de Santa Clara, in Sonora and San Felipe in Baja California. This is one of the fisheries that provide with more income to these communities in the NG. According to the interviews, the fishing season for Gulf curvina is during neap tides from February to May. This is when the annual migration to the upper Gulf of California – Colorado River Delta – occurs due to the Gulf curvina spawning season.

Since 2005 a temporal closure season from the 1st May to the 31st August was established in the Biosphere Reserve of the Upper Gulf of California and Colorado River Delta. The fishing method utilized for Gulf curvina is gillnets with a mesh size 5 and 6 inches. One of the techniques used by fishers to decide where to go is to observe birds and see where they are fishing. But for many other fishers, the best technique is just to follow others to those sites they consider good for fishing. The communication of sites

known or places with good opportunities of harvesting during the season is also common according to fishers.

Some of the concerns that fishers have is the lack of regulation in the amount of vessels operating in the NG. This also leads to the low prices that this target species reach and the cost of the gasoline in order to travel to the fishing grounds. Also the lack of regulation on fishing Gulf curvina during the spawning season or when is carrying eggs. Related to this, one of the main resources needed for the spawning period of this species is the Colorado river water. Fishers claim that the lack of freshwater is one of the reasons why this species is declining.

The fishing zones for this species (Figure 22) are utilized by the communities of El Golfo de Santa Clara and San Felipe. As the map indicates, the most frequented sites are close to the community of Golfo de Santa Clara and according to the interviews, the most important site is identified as "La Punta" of Isla Montague; also known as the "Y". In addition of being considered an important place fro fishing this species, the area is also recognize as a spawning zone for several species such as totoaba, curvina and other species.

Blue and Brown shrimp

The shrimp fishery Penaeus (*Litopenaeus stylirostris*) and (*Panaeus (Litopenaeus) californiensis*) has been one of the most important for fisheries in the northern Gulf of California. Fifty seven percent of the Mexican vessels that are devoted to shrimp fishery are located in the Gulf of California. The shrimp fishery is among the species that are at

the maximum exploitation level in the Gulf of California. Those species are sardine, lobster, blue crab, corvine, porgy, sole, whitefish, sea bass, octopus and shark. This fishery is one of the few that is regulated in Mexico. The management plan for the Biosphere Reserve establishes a fishing season that goes from September 15th to February 15th and it applies for all type of vessels. This management regulation can be modified by the Management Program of the Biosphere Reserve of the Upper Gulf of California and the Colorado River Delta (Programa de Manejo para la Reserva del Alto Golfo de California y Delta del Río Colorado).

We collected 119 interviews from seven communities that considered shrimp a target species. These communities are Golfo de Santa Clara, Puerto Peñasco, San Jorge, Santo Tomas, Desemboque de Caborca and, Bahía de Kino in Sonora; and the communities of San Felipe and San Luis Gonzaga in Baja California. The community of San Felipe provided 38% of the information while Golfo de Santa Clara the 38% being these two communities the most involved in this fishery. According to the interviews, the main fishing season for shrimp is from September to November. The fishing gear utilized for this fishery is gillnets (called “chinchorro camaronero” or “chinchorro de línea”). Gillnet of different sizes such as: 2 - 3/4, 2 - 1/2, 2 - 1/3 with longitudes of 75 to 85 (called “mallas de calado”) utilizing what they called 5 fardos which translates into one or two gillnets.

Some of the decision factors that fishers consider in order to decide where to go fishing are the knowledge that other fishers share with them. This include following other *pangas* when traveling to those sites. They also call “marcas” to those sites well known

by fishers. Some fishers mentioned water temperature (warm water) as one factor affecting the abundance of the product.

Figure 23 shows the distribution of fishing activity for shrimp and the relative importance of different sites. Some of the most important zones recognized for this species was Rocas Consag also known as “El Piedrón”. Most of the upper Gulf is utilized by 4 communities: Golfo de Santa Clara, San Felipe, Puerto Peñasco and, San Luis Gonzaga and is considered the core area of protected area for the Vaquita marina (*Phocoena sinus*). Some other important fishing sites recognized by the community of El Golfo de Santa Clara are “El Tornillo” and “La Salina”. This was the second area with the highest relative importance for fishers after El Piedrón. On the other hand, in front of “Punta Estrella” is another important fishing area recognized by the communities of San Felipe and San Luis Gonzaga.

On the east side of the upper Gulf, Bahía San Jorge is recognized as an important fishing site for this species. The communities that utilize this area are Puerto Peñasco and San Jorge. Finally, Bahía de Kino provided with some information regarding fishing zones for this species and they were clustered in the bay in front of the community.

The Social Connectivity

Networks and social connectivity are often mentioned as being important for sustainable management natural resources. The combination of spatial and social network analysis has helped to show how small-scale fishing communities in the northern Gulf of California, Mexico (NG) are connected by their use of fishing zones and Marine

Protected Areas. We found that convergence of fishing zones between communities is generally divided along geographic lines: communities that are closer together generally have more points of convergence in fishing zones. Understanding which communities are fishing in different areas may help fishers, as well as those working in management and conservation, to better develop, implement, and enforce boundary rules.

Based on the spatial analysis, we identified the communities working within five MPA's that located in our study area: (1) Alto Golfo de California y Delta del Río Colorado and, Área de Refugio de la Vaquita Marina, (2) Bahía de los Ángeles, Canal de Ballenas y Salsipuedes, (3) Archipiélago de San Lorenzo and, (4) Isla San Pedro Martir. No single community demonstrated sole use of any of the MPA's in the study region. The Bahía de los Ángeles Reserve has the most diverse user group (six different communities). The Upper Gulf Biosphere Reserve and the Vaquita Marine Refuge were used by the same communities, and they, as well as the San Lorenzo Marine Park were used by five communities. The San Pedro Martir Biosphere Reserve is used by just two communities (and principally by just one: Bahía de Kino). Out of the five MPA's in the region, the highest number of MPA's used by a community was three (Bahía de Kino and El Barril).

The results showed that MPA's are used by 10 communities from the NGC (Figure 24). In this case, structurally equivalent communities tended to fish in the same MPA's. The region was split into three main groups: those that did not fish in MPA's (red: Puerto Lobos, Punta Chueca, Punta Jagüey, San Jorge, and Los Dorados de Villa), those that fished in the southern portion of the region (light and dark blue: Bahía de Kino,

Bahía de los Ángeles, Puerto Libertad, El Barril, and Las Áimas Norte), and those that fished in the northern portion of the region (Golfo de Santa Clara, San Felipe, Puerto Peñasco, and Desemboque de Caborca). The southern portion can further be divided into communities that fished in the San Pedro Mártir MPA (Bahía de Kino and El Barril) and those that fished only in Bahía de los Ángeles and San Lorenzo MPA's (Bahía de los Ángeles, Las Áimas Norte, and Puerto Libertad). Fishers from the community of San Luis Gonzaga were a special case and act as a link between the two main groups by working in MPA's from both the northern and southern portions of the study region.

Results of use of MPA's also provide guidance for management and enforcement activities those areas. In order to implement effective management of MPA's, managers must know who is using the resource. This information is important in designing targeted education and outreach campaigns and in helping to determine which communities should be the focus of efforts. By expanding the definition of 'community' to include not just physical town boundaries but users with a common interest, we can improve our understanding of how management strategies and decisions will influence or impact the true community of users (Duberstein et al. Unpublished).

Conclusions

In Mexico, 82% of the fisheries fully exploit or over-exploit their target species (Hernández and Kempton 2003). Consequently, efforts to protect and propose conservation strategies in the Gulf of California have brought special attention to national and international conservation institution to protect and recognize the need of better

strategies for management of the marine resources (Aburto-Oropeza and López-Sagástegui 2006). Conservation groups and natural resources managers have had their attention into small-scale fisheries as one of the most important socio-economical sectors for the NGC. One of the reasons is that small-scale fisheries is an important socio-economic activity that supports coastal communities and economies and their activities cover a large part of gulf. However, fishing activities particularly those that include small-scale fisheries are relatively poorly understood. Consequently, an approach to understand the spatial and temporal dimension of small-scale fisheries from a social perspective was needed. This atlas represents the response to that need. Efforts to capture LK can address information gaps in fisheries data and the availability of such information is essential as part of the incorporation of the social aspect of natural resource management (Olsson and Folke 2001).

The approach of incorporating local knowledge effectively engaged fishers in the data collection process. The information collected allowed us to step back and take a more holistic view of the spatial dimensions of fishing activities in the NGC, one we believe is essential to a fuller understanding of the implications and cumulative effects of management plans and policies at different scales. This large-scale perspective comes, however, at the sacrifice of finer-scale resolution and specificity. The collection and analysis of LK as presented here are therefore intended to complement, and not replace, scientific research.

The atlas exists as a resource for people interested in the knowledge accumulated by the people who live, study and depend of the marine resources of the Gulf of

California, Mexico. These assets could ultimately help empower stakeholders by bringing recognition to their work, while promoting the cooperation among fishers, managers, and scientists that is ultimately essential for successful management of coastal and marine resources.

Figures and Tables



Figure 1. Interviewing a fisher during the rapid appraisal. Credits: COBI/M. Rojo.

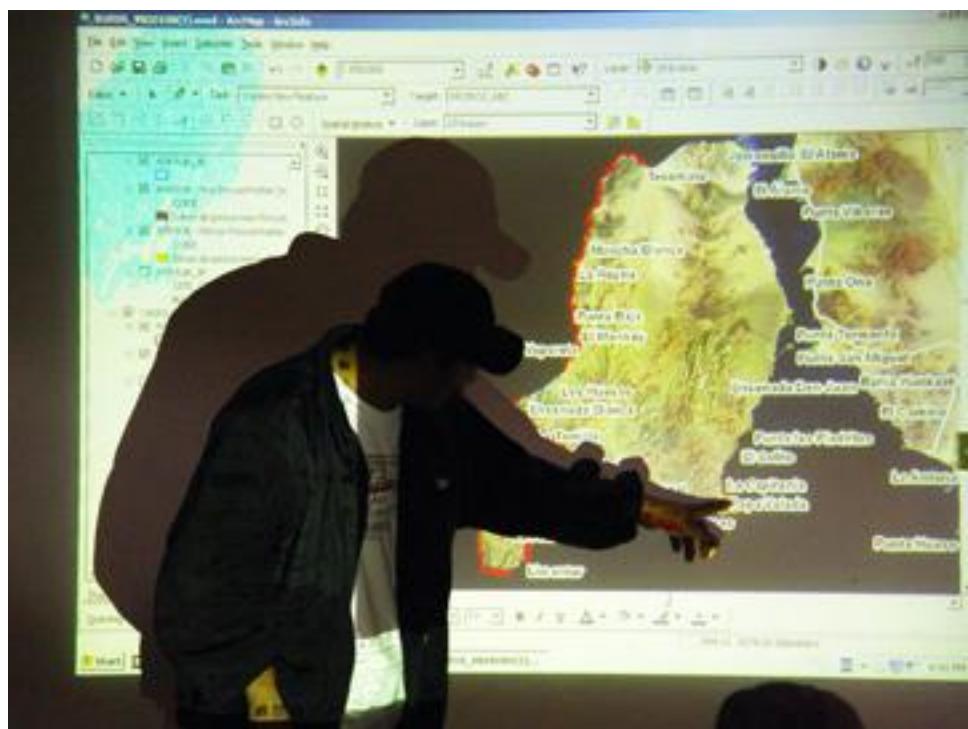


Figure 2. Fishermen pointing out a known site during the internal validation workshop.

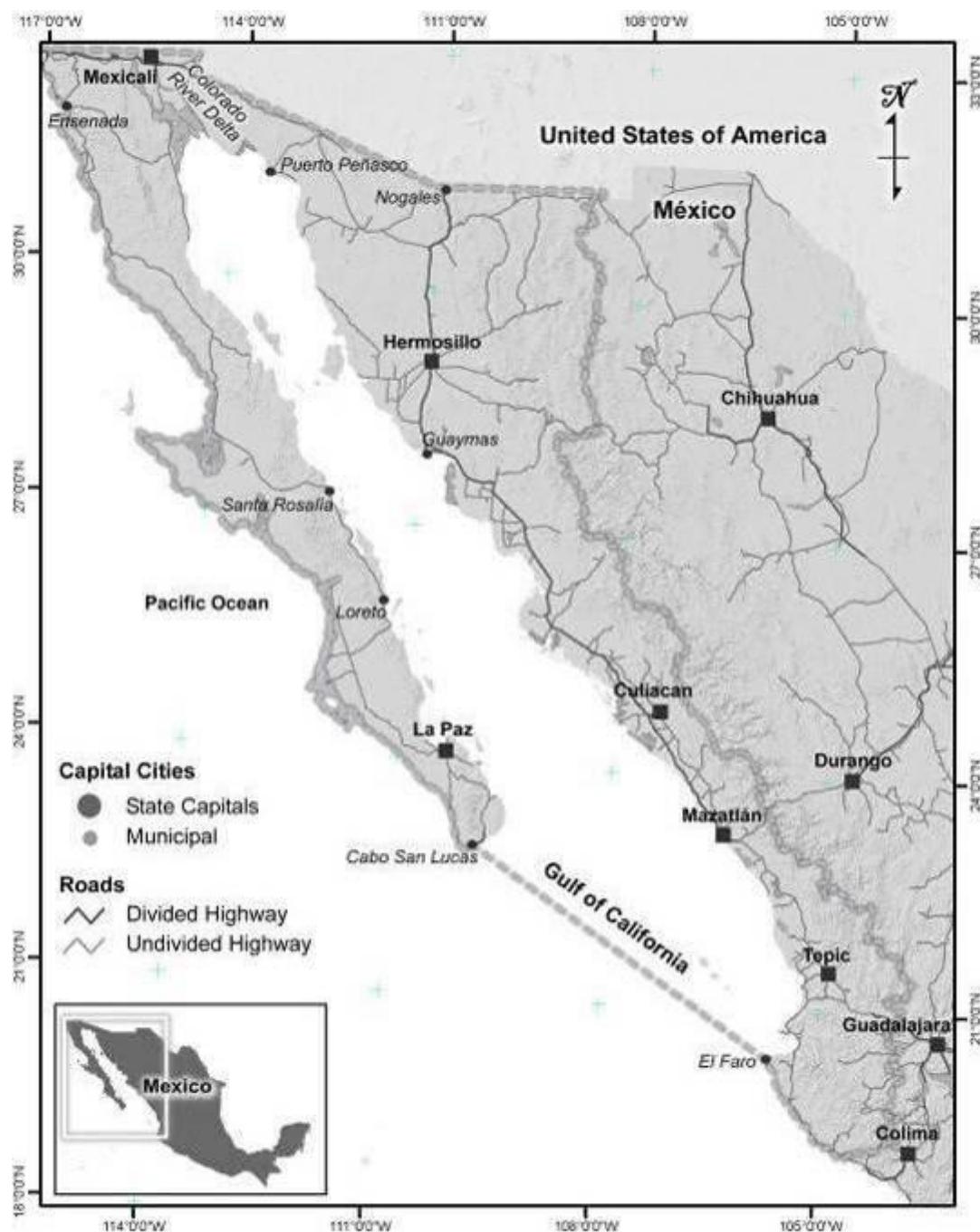


Figure 3. The Gulf of California.

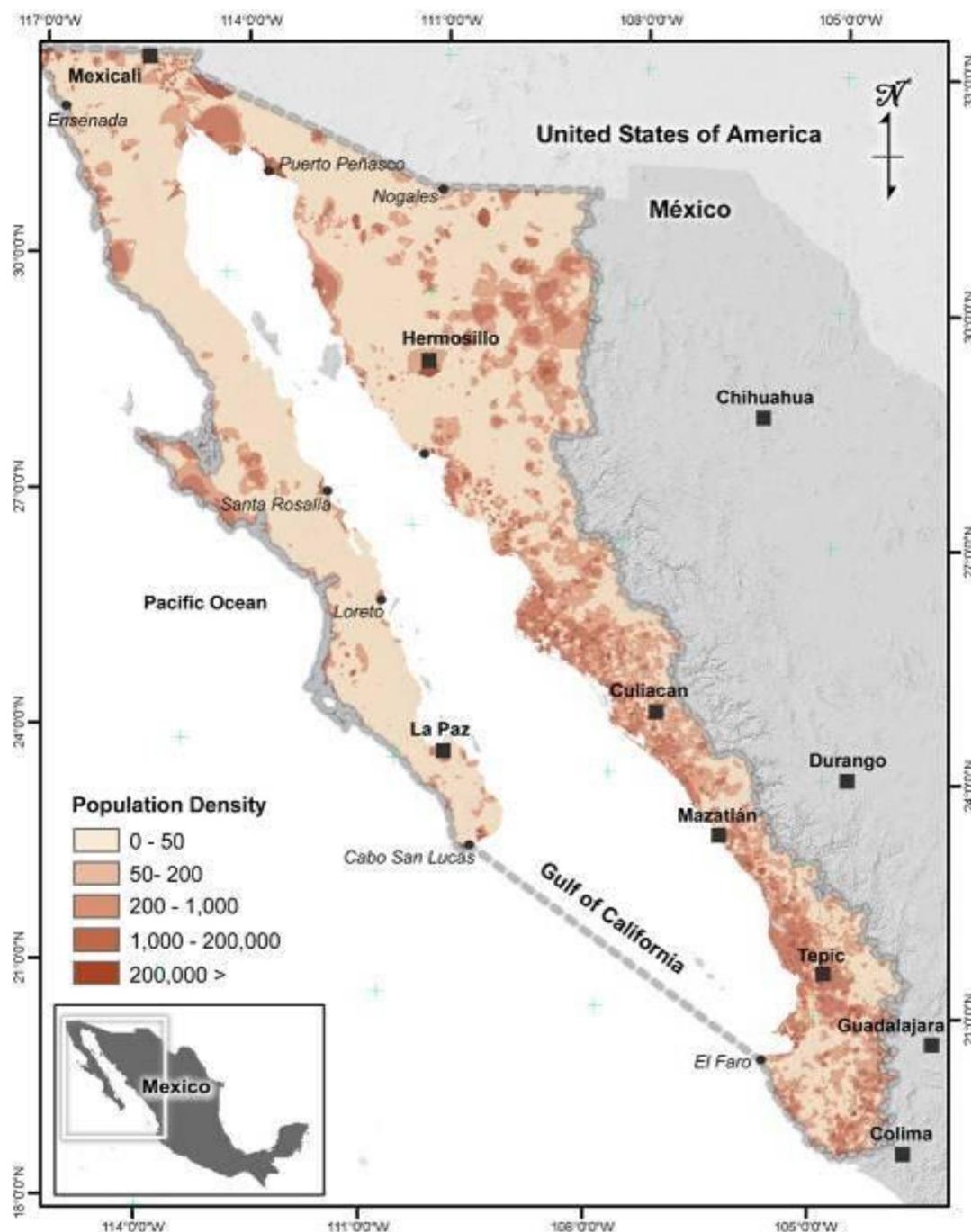


Figure 4. Population density in the Gulf of California.

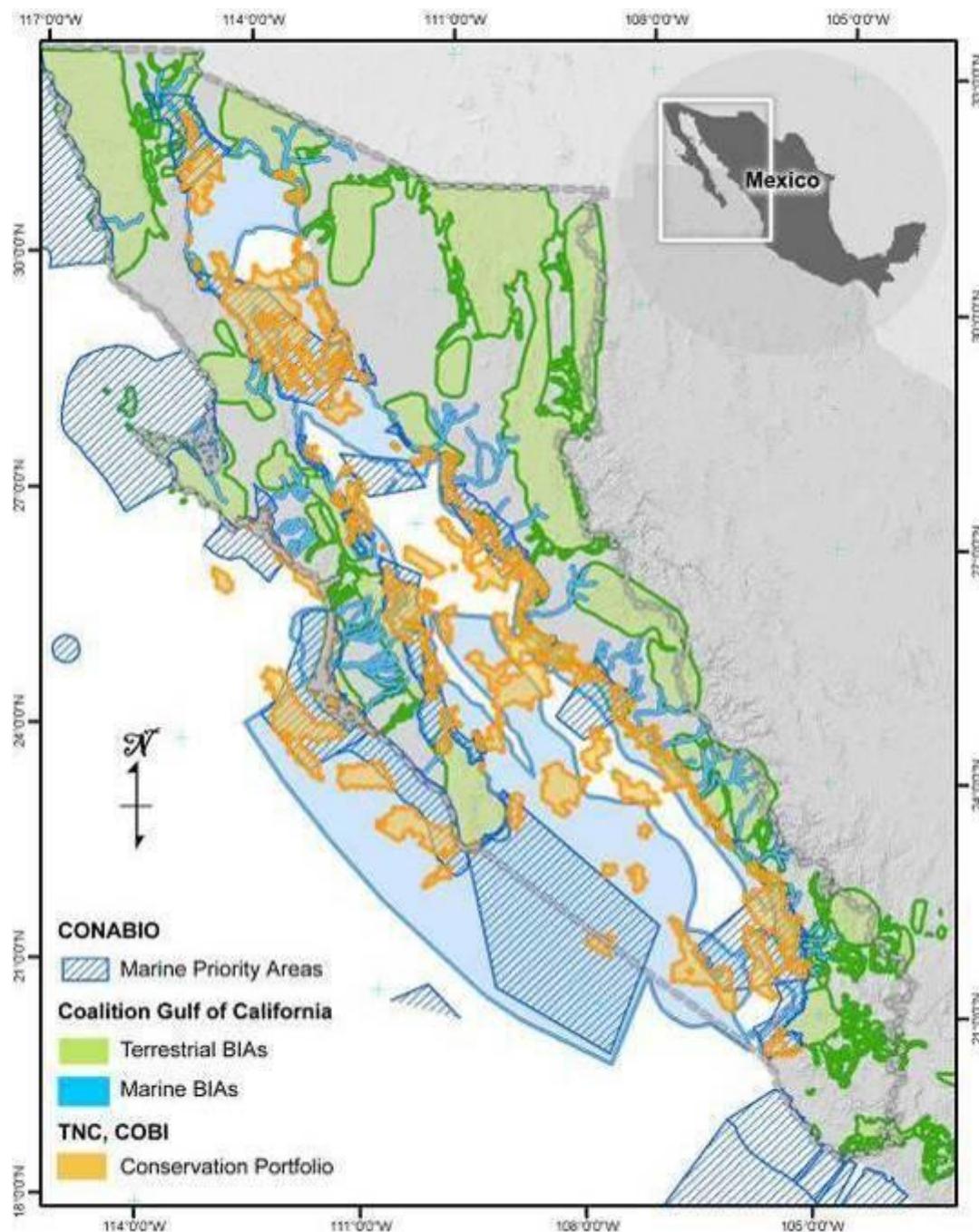


Figure 5. Most recent regional conservation efforts in the Gulf of California.

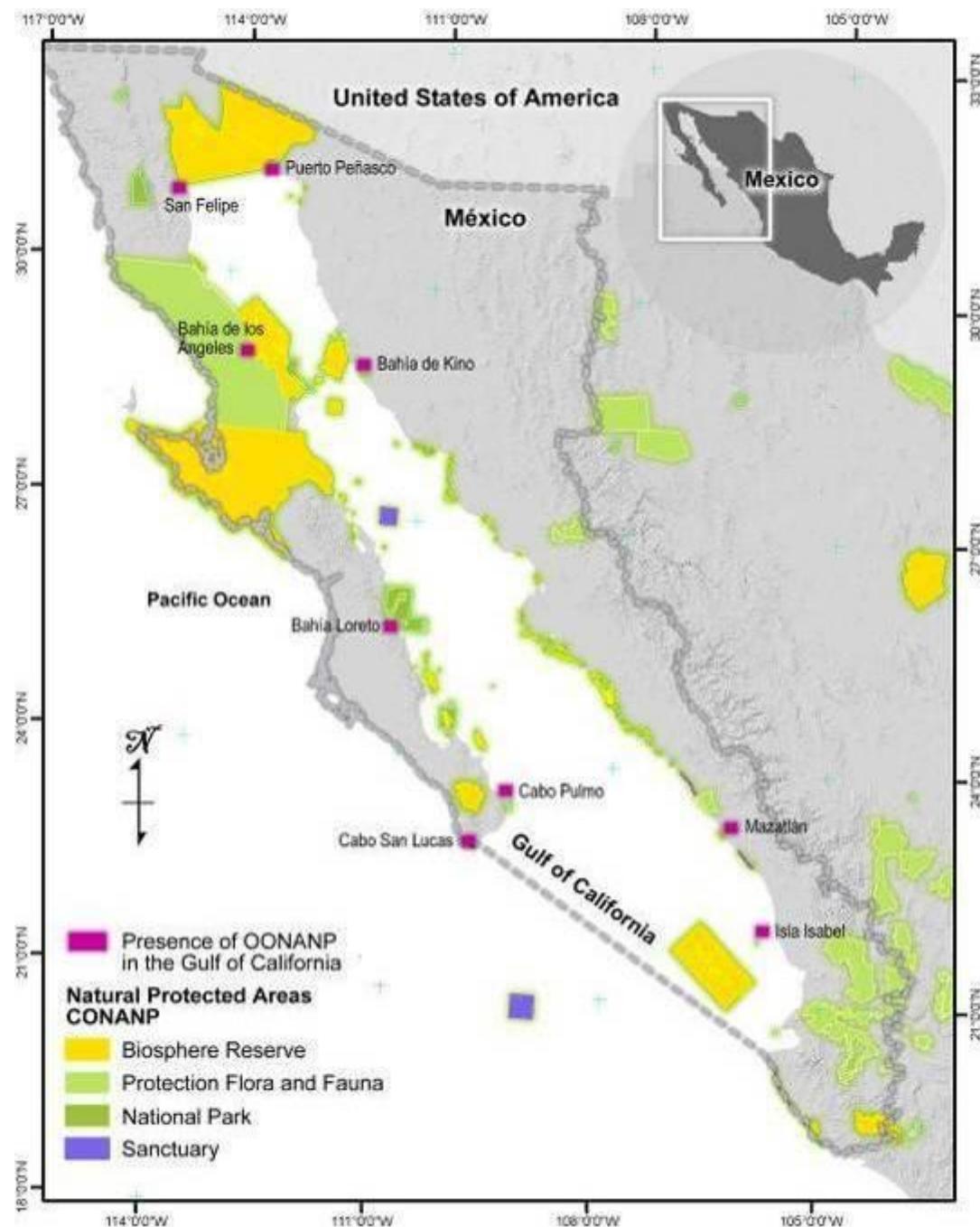


Figure 6. Natural Protected Areas in the Gulf of California.

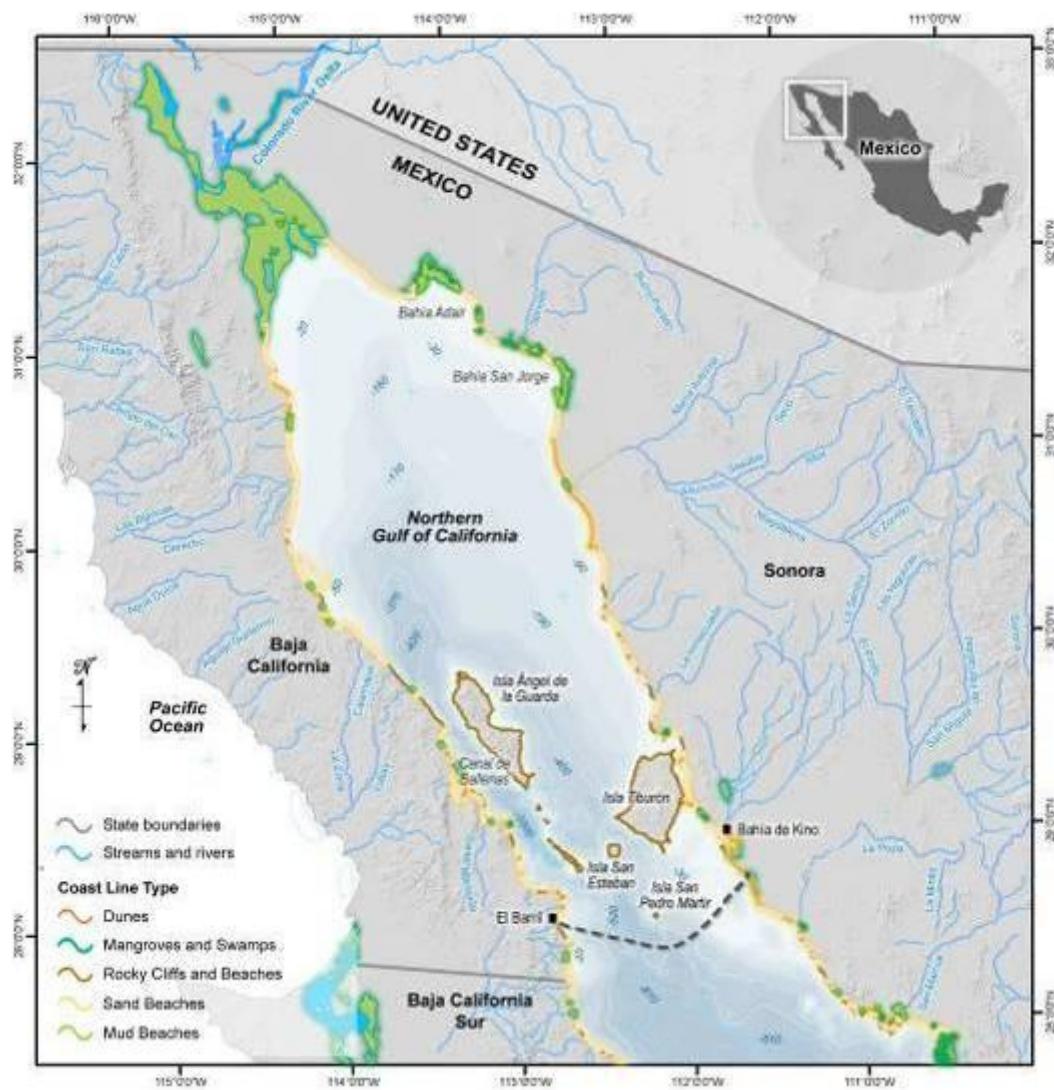


Figure 7. The Northern Gulf of California.

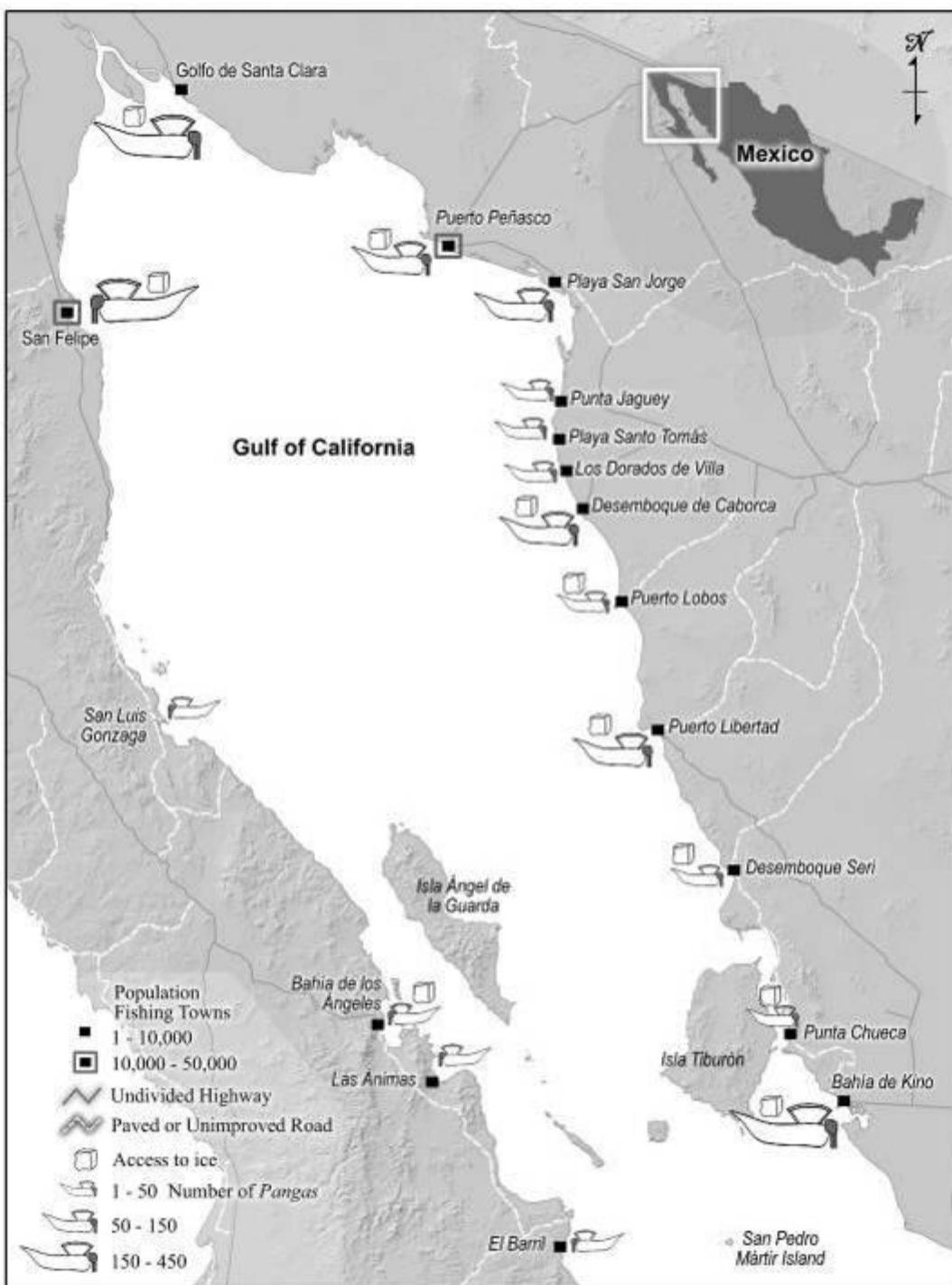


Figure 8. Fishing communities, access to ice and approximate number of pangas. Source: Duberstein et al., unpublished. PANGAS, unpublished data.

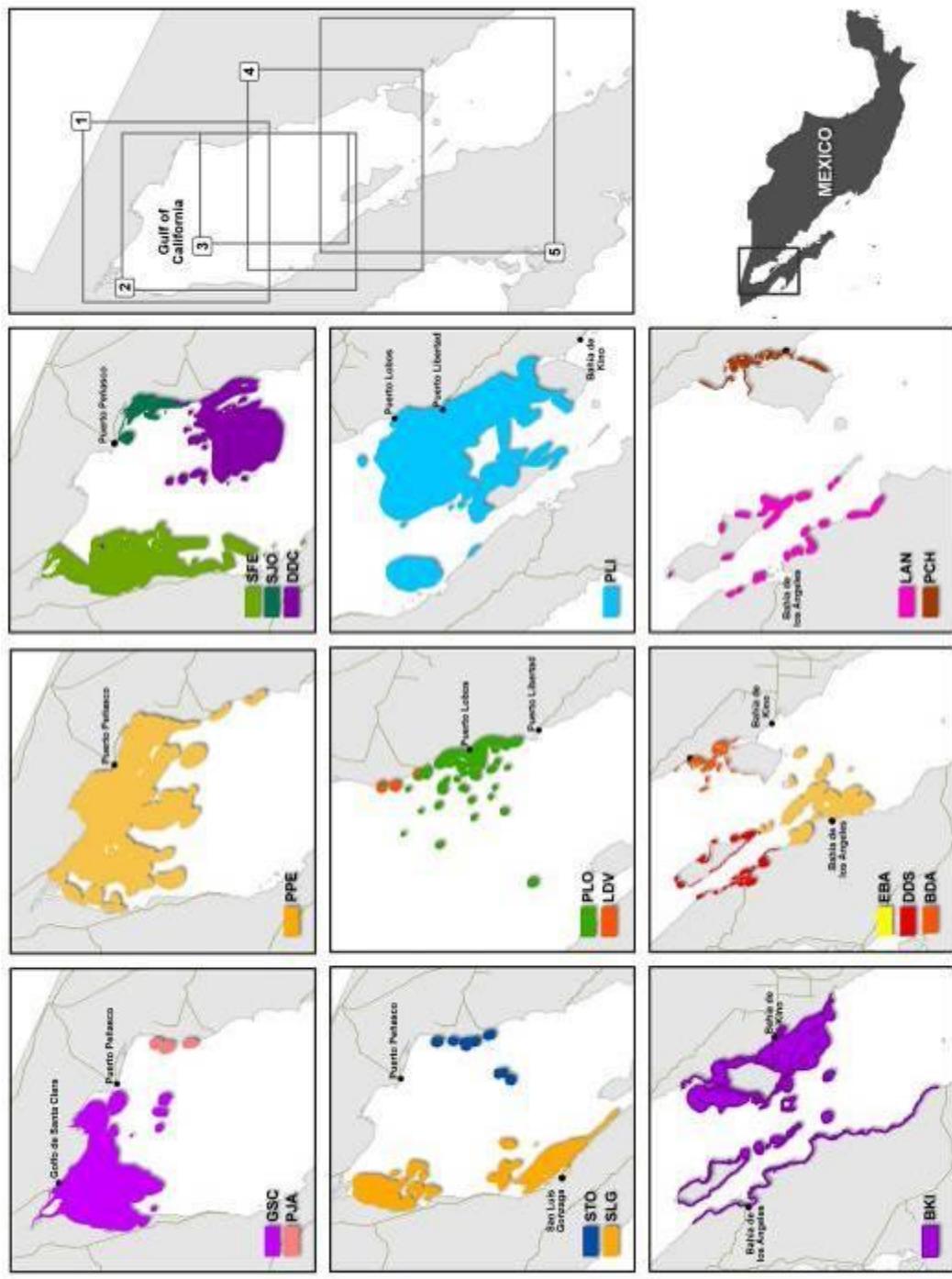


Figure 9. Fishing zones by community.

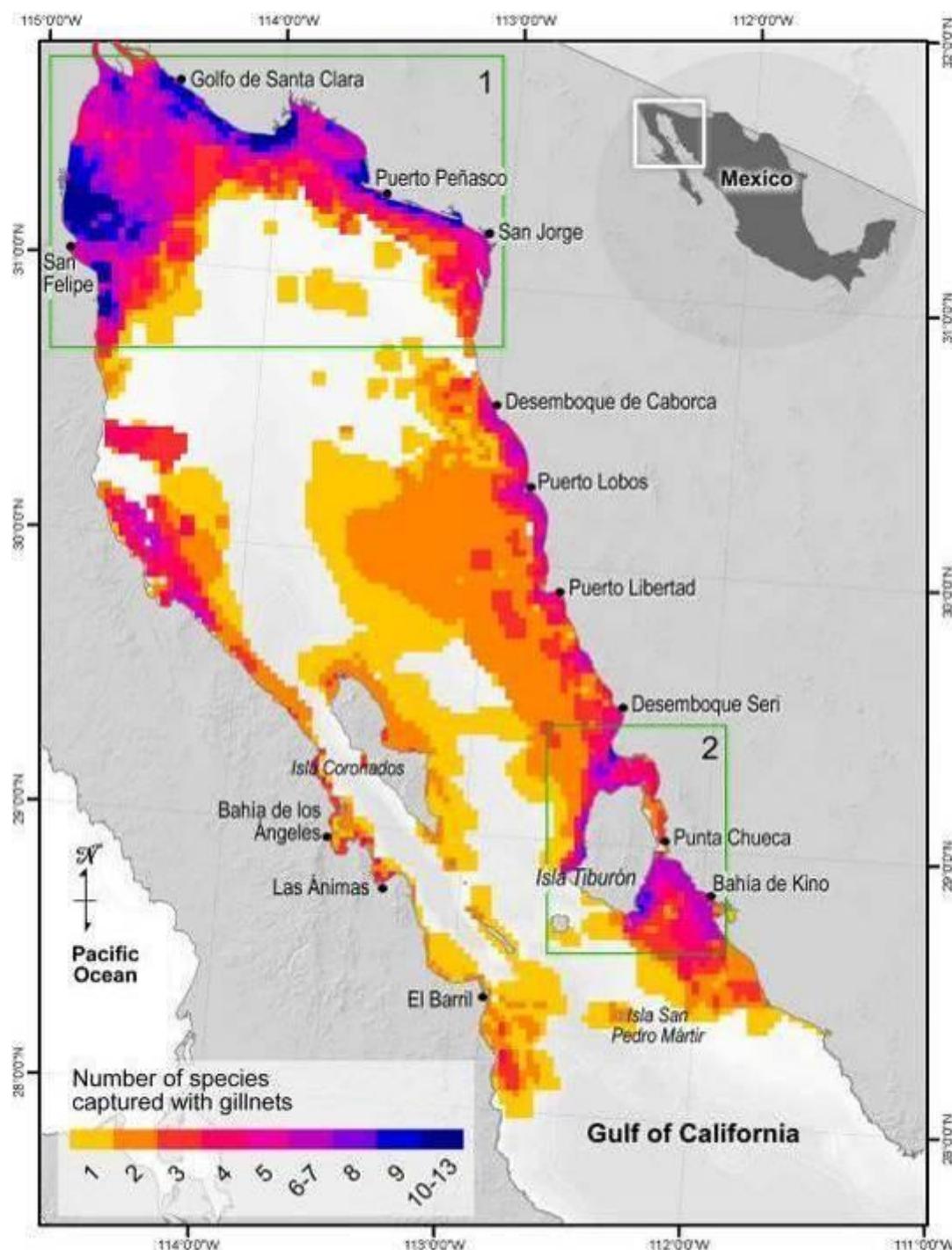


Figure 10. Number of species captured using gillnets.

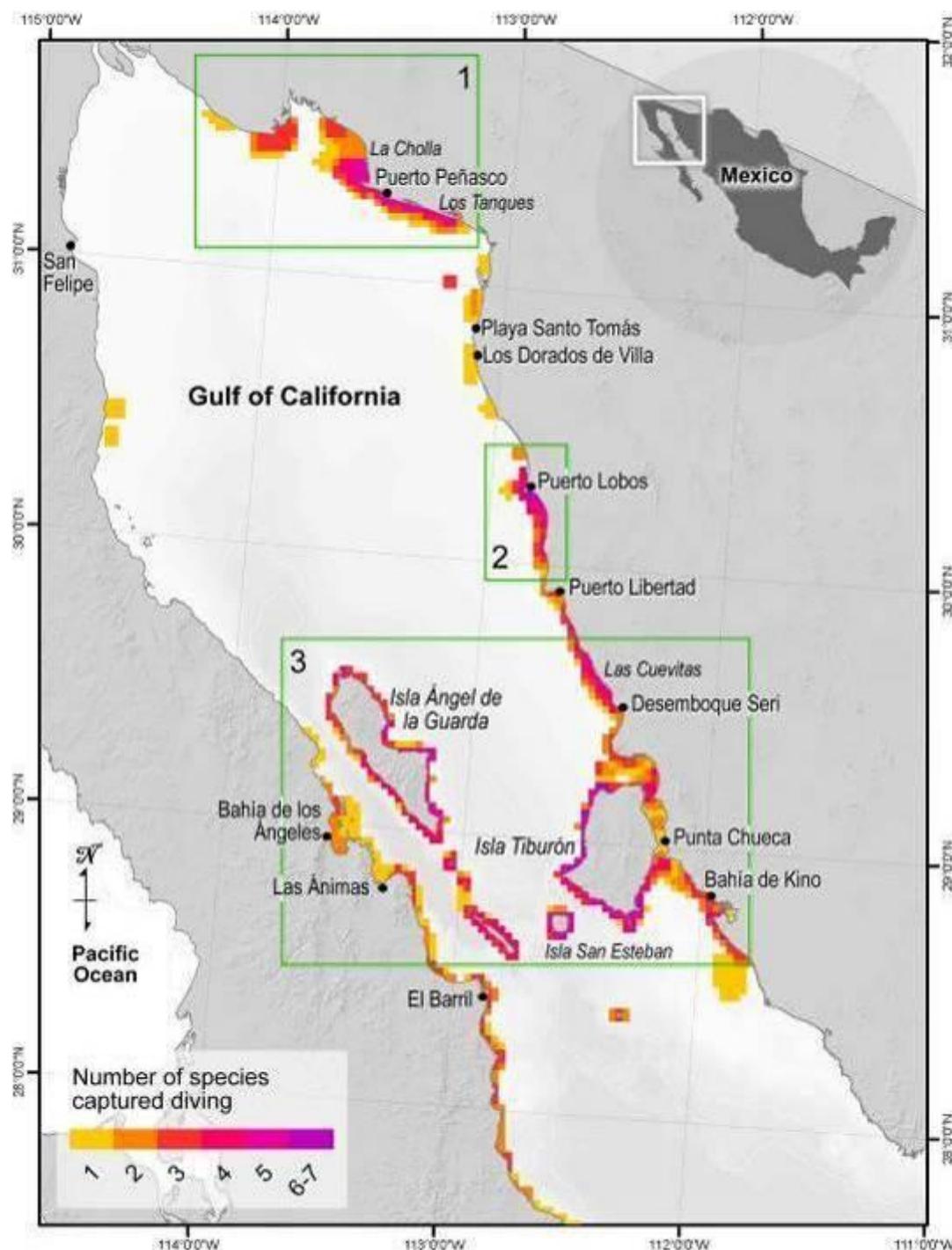


Figure 11. Number of species captured by diving method.

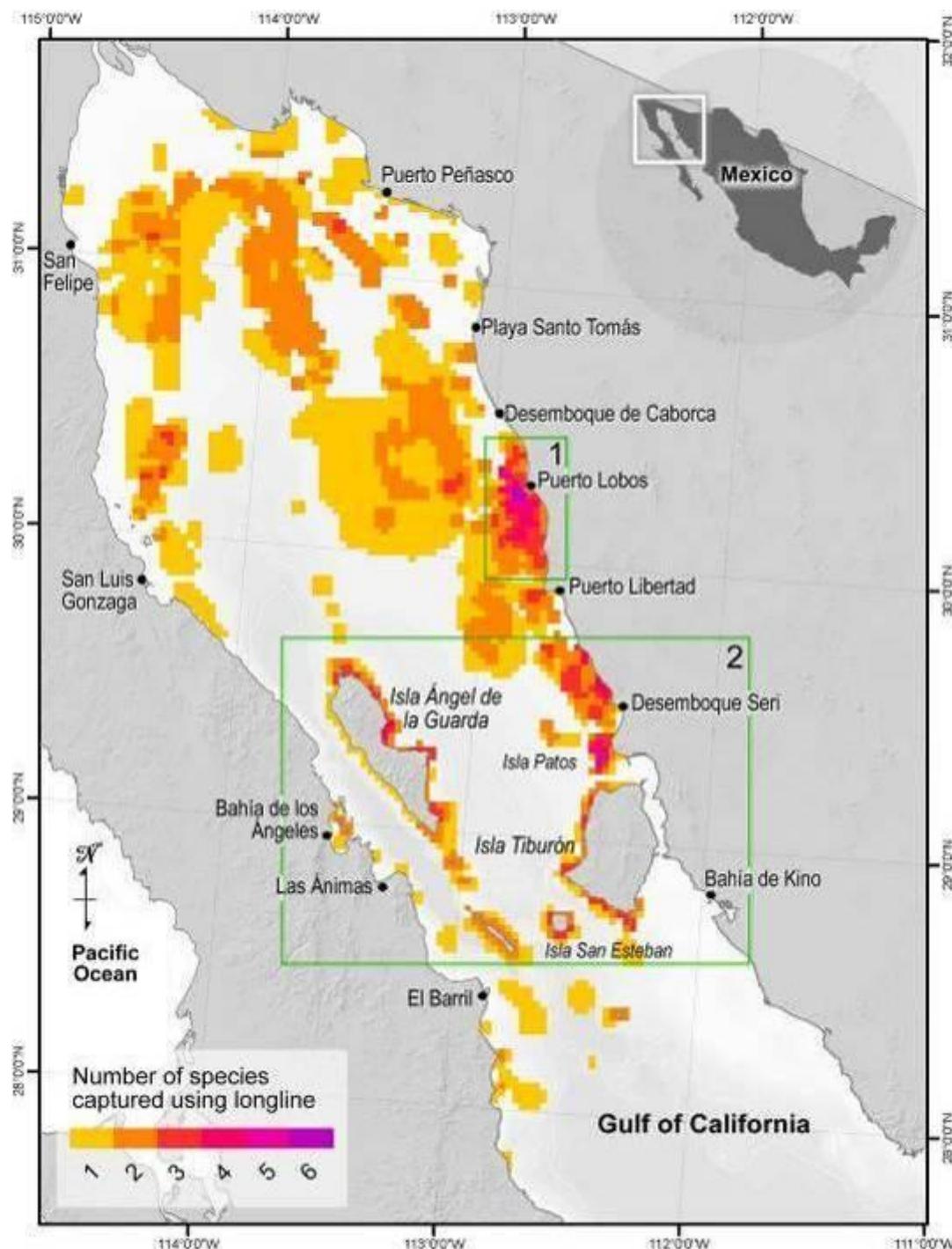


Figure 12. Number of species captured using hand fishing line or longline.

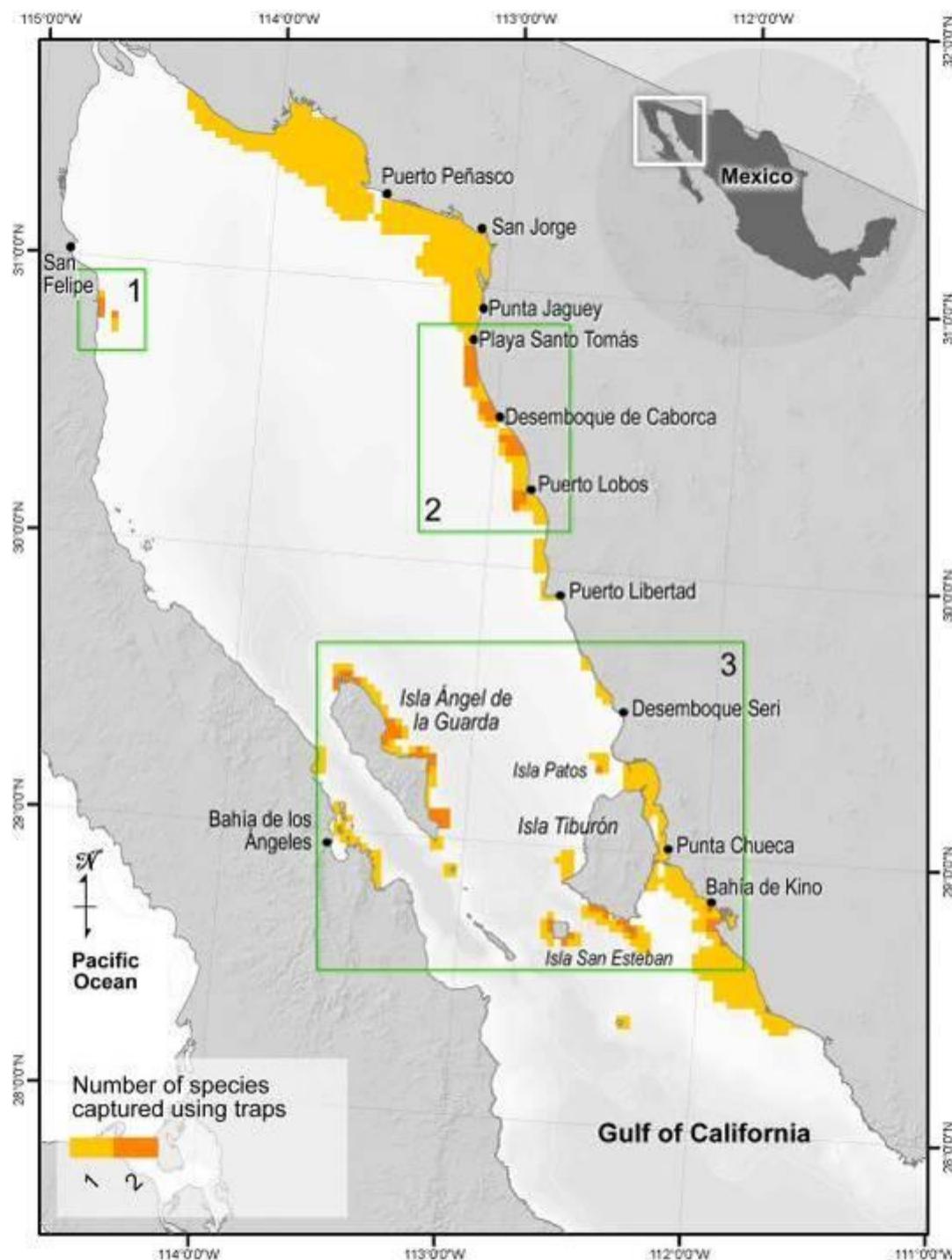


Figure 13. Number of species captured using traps.

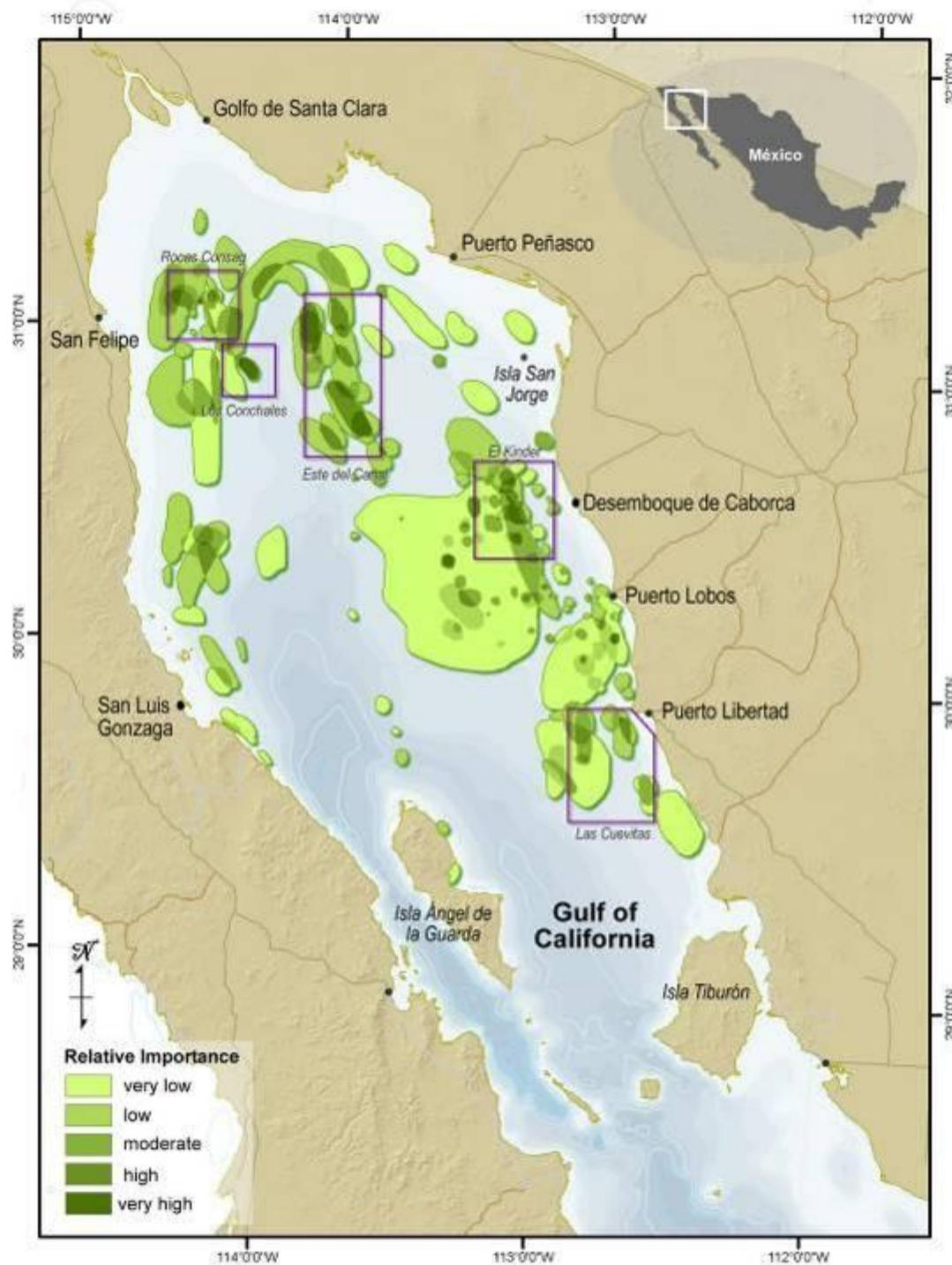


Figure 14. Spatial distribution of fishing activity for Gulf coney (*Epinephelus acanthistius*).

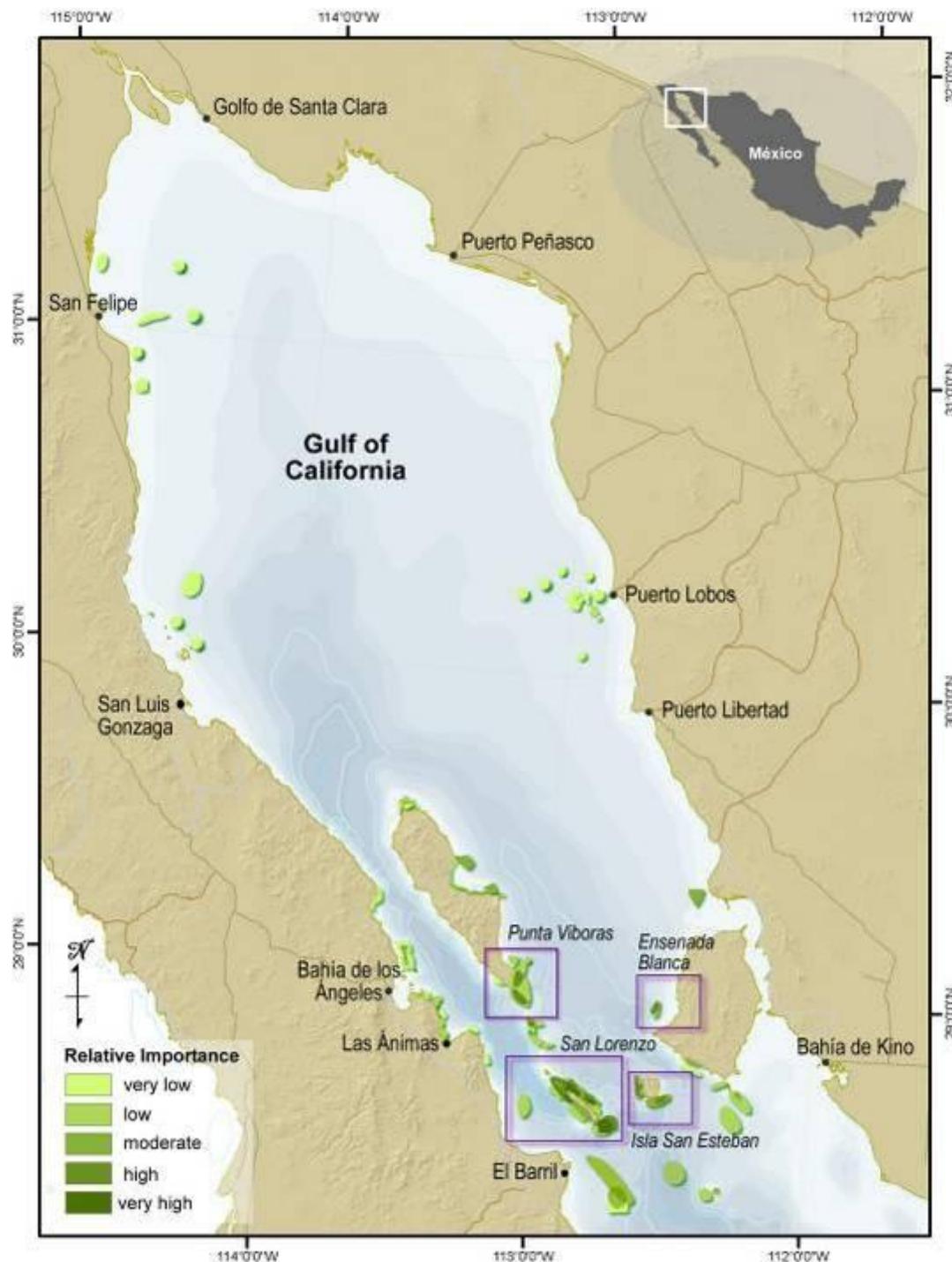


Figure 15. Spatial distribution of fishing activity for Goldspotted sand bass (*Paralabrax auroguttatus*).

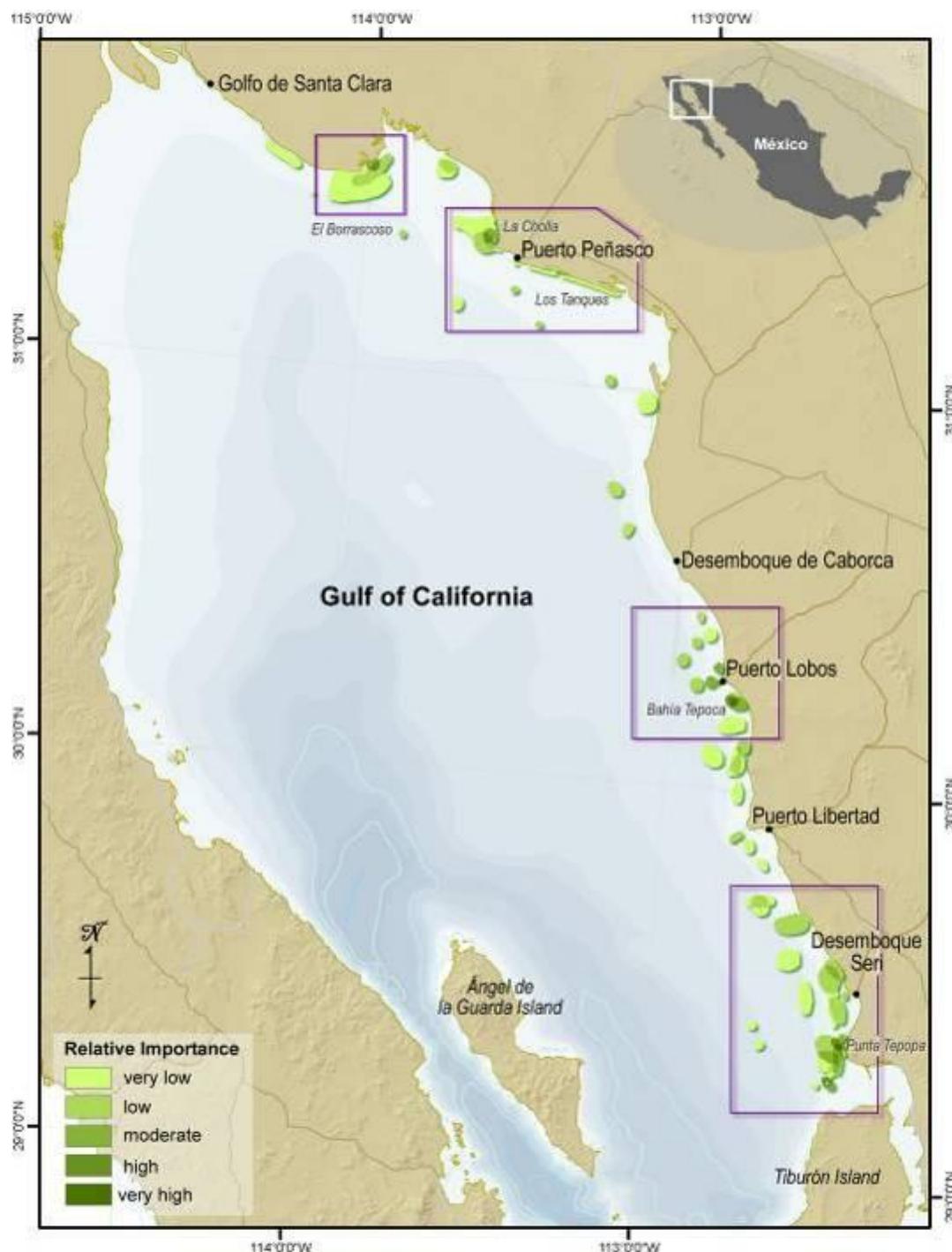


Figure 16. Spatial distribution of fishing activity for Gulf grouper (*Mycteroperca jordani*) and Sawtail grouper (*Mycteroperca prionura*).

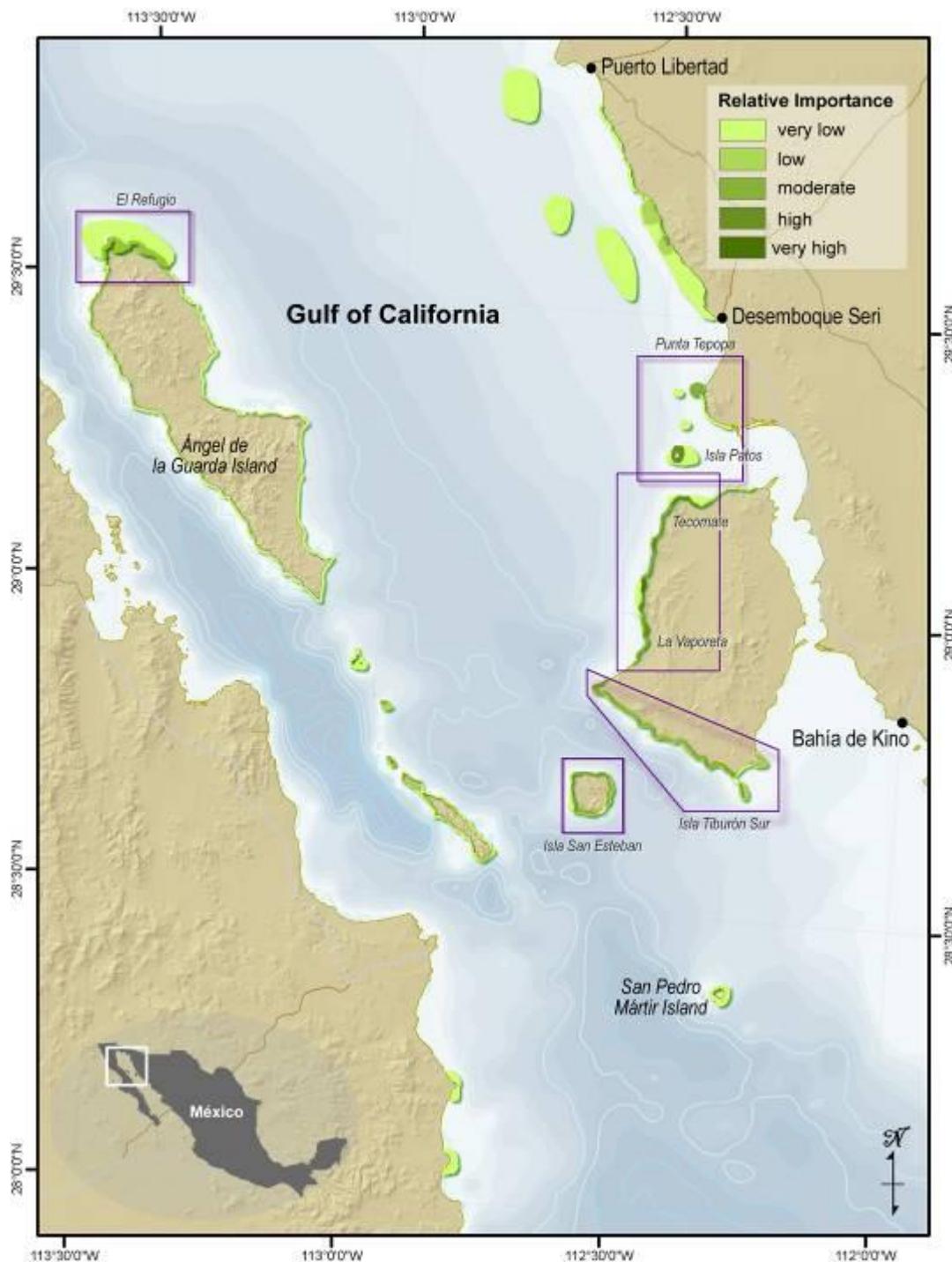


Figure 17. Spatial distribution of fishing activity for Leopard grouper (*Mycteroperca rosacea*).



Figure 18. Spatial distribution of fishing activity for Barred pargo (*Hoplopagrus guentherii*).

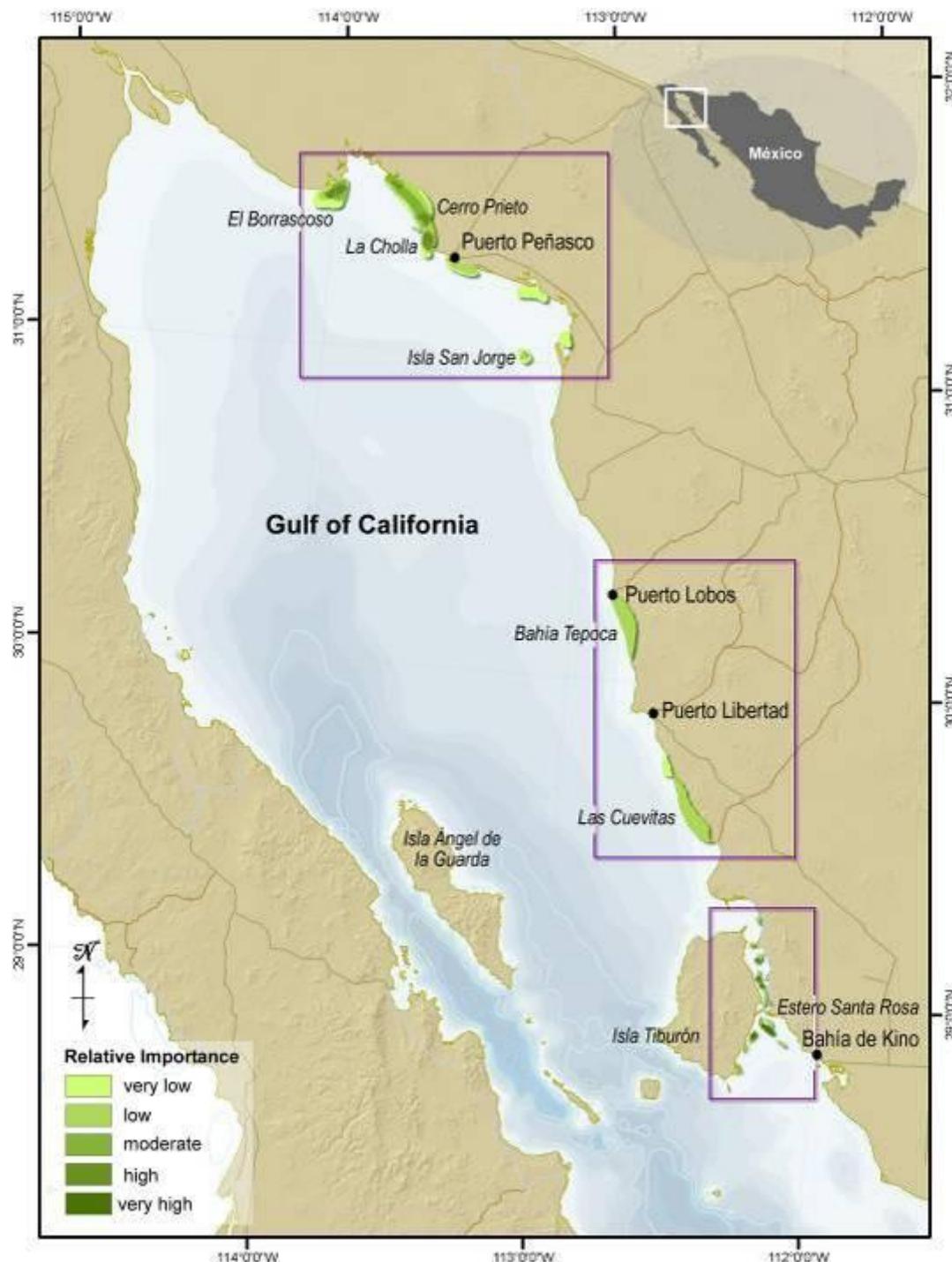


Figure 19. Spatial distribution of fishing activity for Black murex (*Hexaplex nigritus*) and Pink murex (*Phyllonotus erythrostoma*).

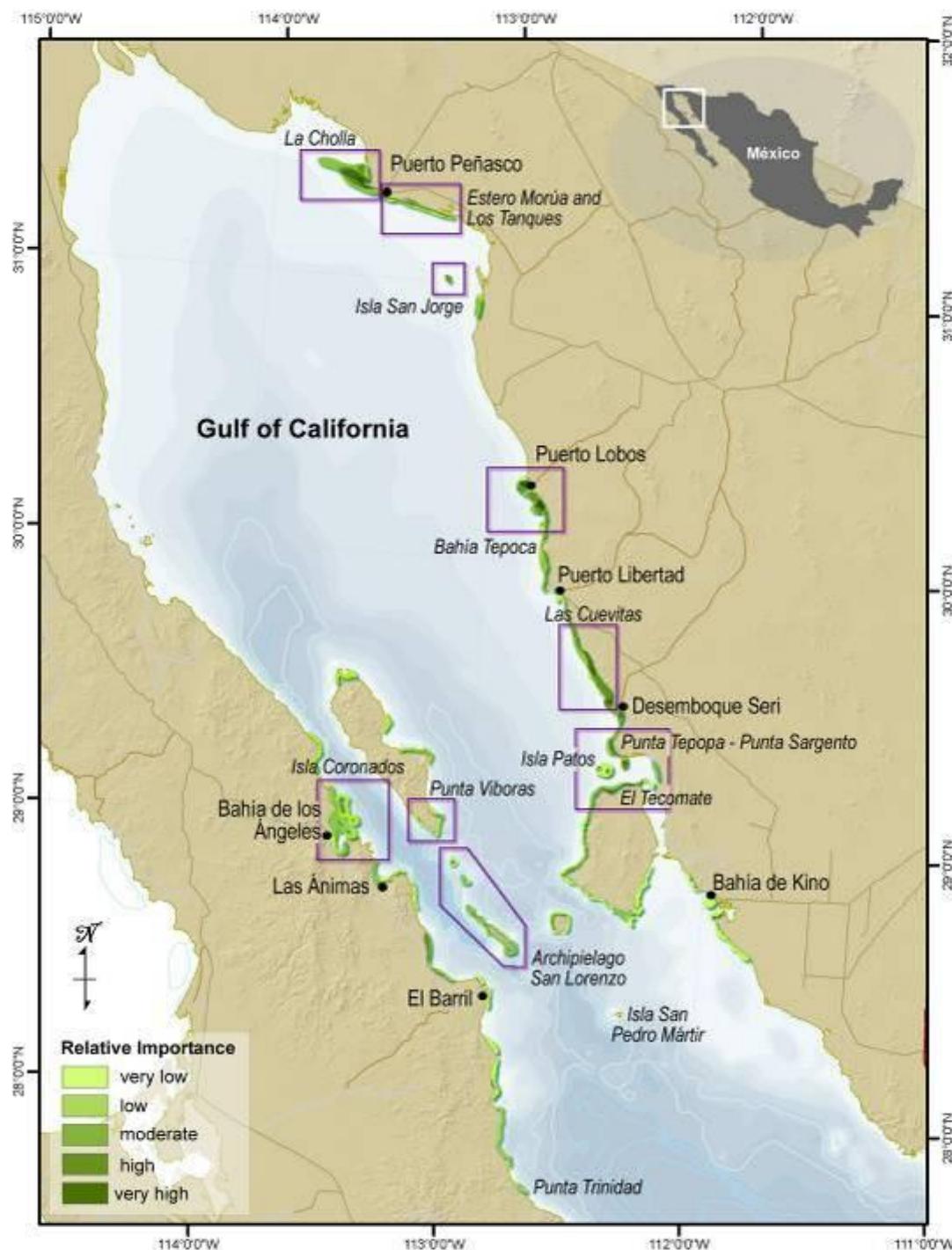


Figure 20. Spatial distribution of fishing activity for Octopus (*Octopus bimaculatus* and possibly *O. hubssorum*).

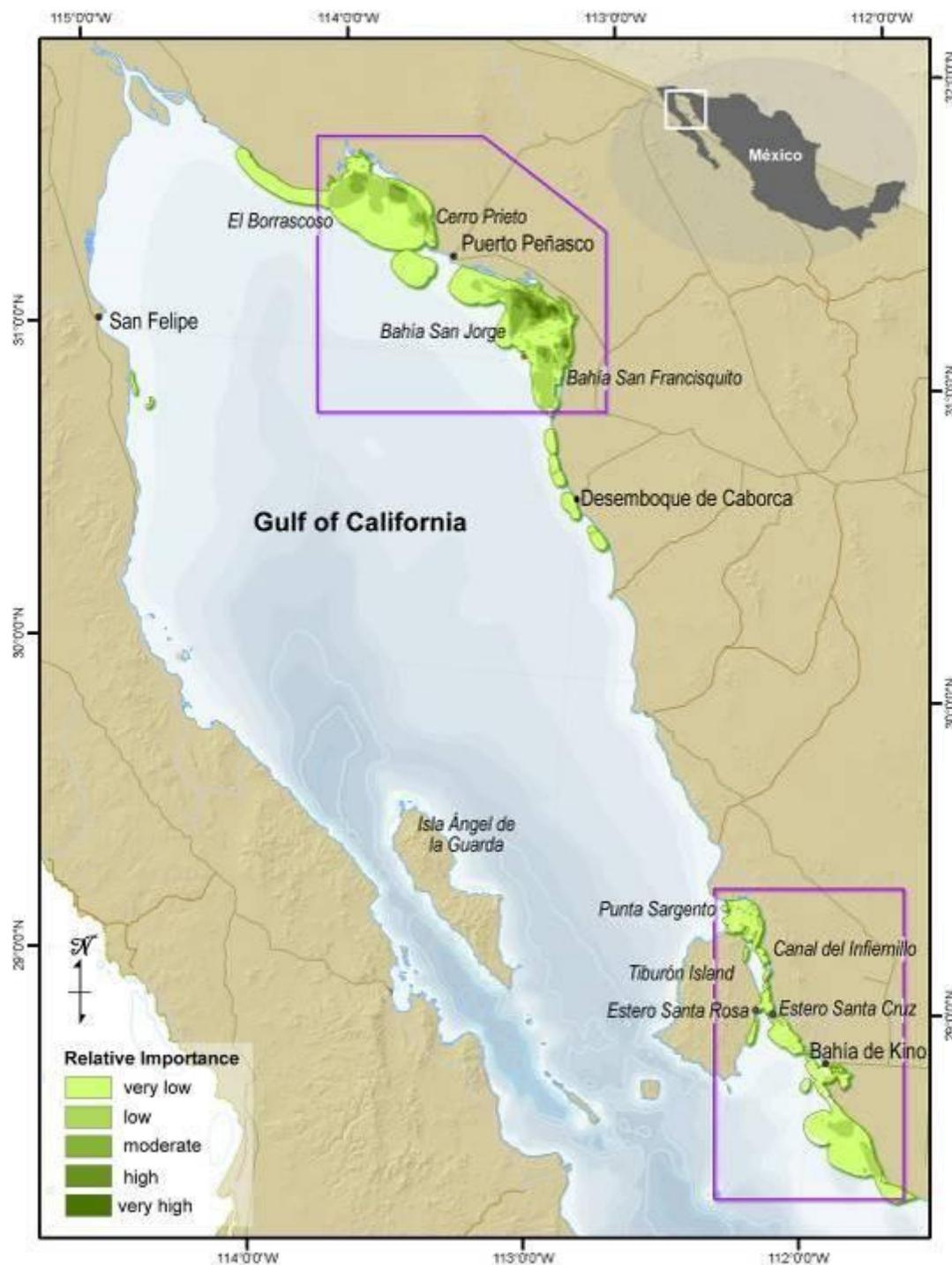


Figure 21. Spatial distribution of fishing activity for Warrior swimcrab (*Callinectes bellicosus*).

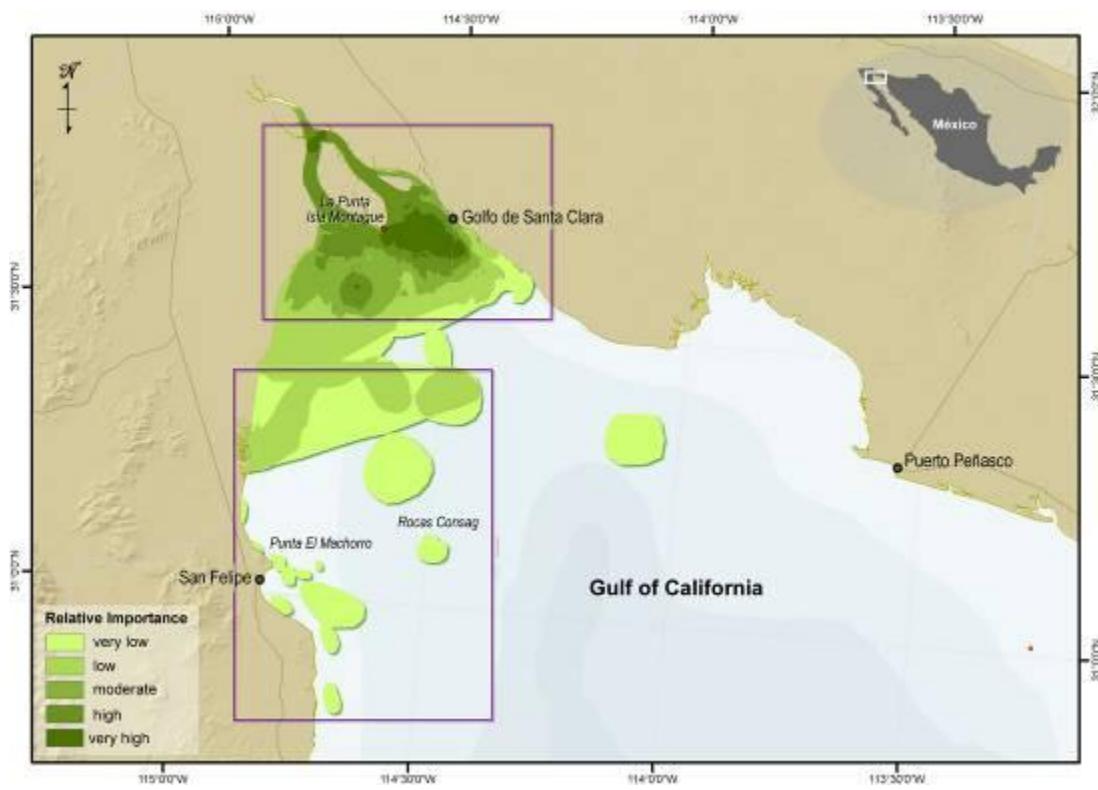


Figure 22. Spatial distribution of fishing activity for Curvina golfina (*Cynoscion othonopterus*).



Figure 23. Spatial distribution of fishing activity for shrimp (*Penaeus (Litopenaeus) stylirostris*) and (*Panaeus (Litopenaeus) californiensis*)

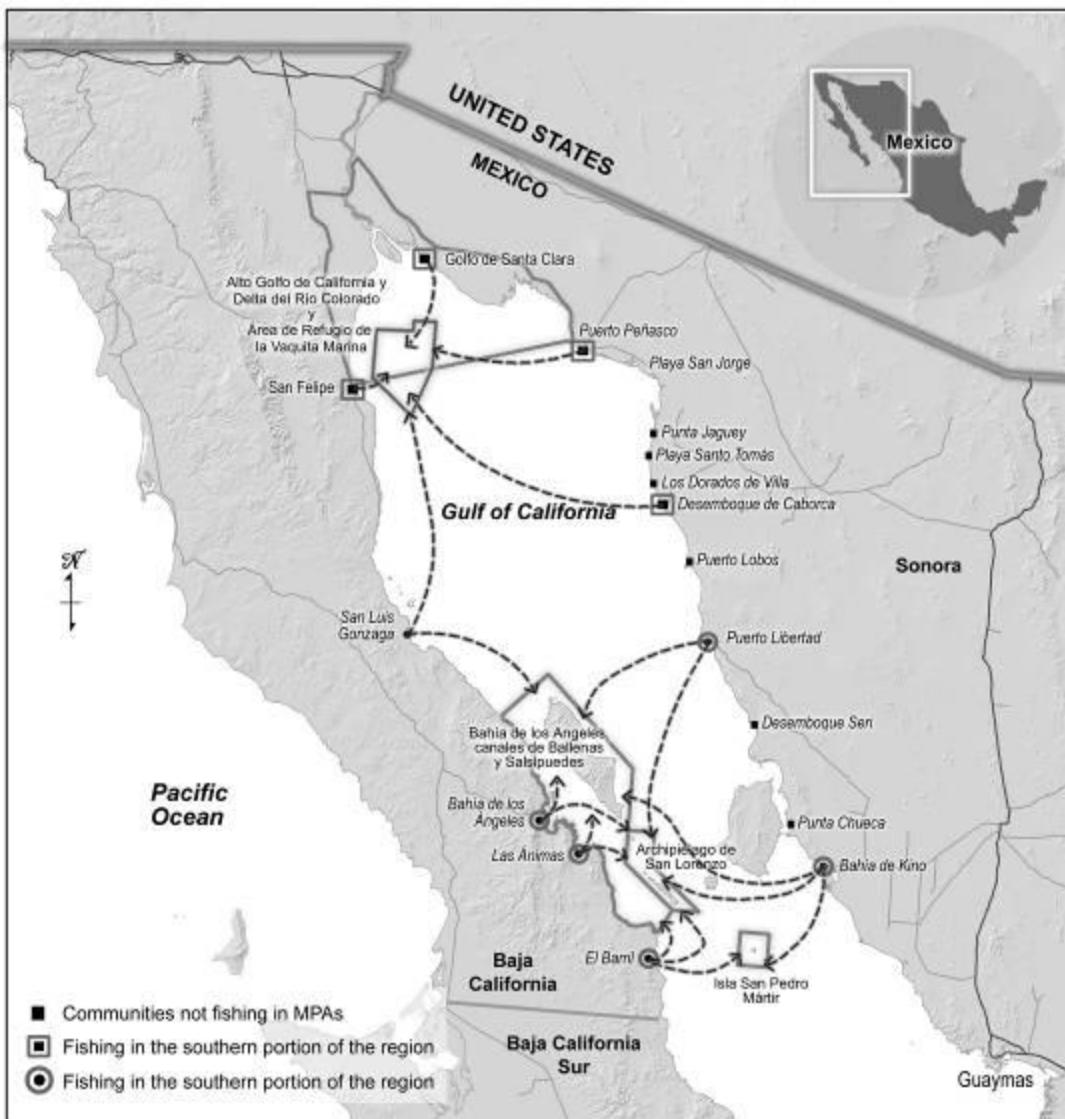


Figure 24. Social connectivity through MPA's.

Table 1. MPA's in the Gulf of California. Source: CSGC, 2004; CONANP, 2008

Natural Protected Areas in the Gulf of California that include the protection of marine and coastal habitats		
Name	Year	Area (ha)
Area for the protection of Flora and Fauna Cabo San Lucas	1973	3,785
Biosphere Reserve El Vizcaíno	1998	49,451
Biosphere Reserve Alto Golfo de California y Delta del Río Colorado	1993	541,636
National Park Cabo Pulmo	1995	7,111
National Park Bahía de Loreto	1996	183,711
Biosphere Reserve Islas Marías	2000	617,257
Biosphere Reserve Isla San Pedro Martir	2002	29,887
National Park Archipiélago San Lorenzo	2005	58,443
National Park Islas Marietas	2005	1,311
Bahía de los Ángeles, Canal de Ballenas y Salsipuedes	2007	387,956
Total		1,880,548

Table 2. Different type of coast line in the Gulf of California

Coast type	Percent --%--
Dunes	12
Mangroves and Swamps	3
Rocky Cliffs and Beaches	31
Sand Beaches	31
Mud Beaches	24
Total	100

* adapted from Ulloa *et al.* 2006

Table 3. Fishing zones by community, number of maps collected area and description.

Community	Code	No. map-interviews	Fishing Area (km²)	Description
Bahía de los Ángeles	BDA	25	695 km ²	Fishing zones go all over the coast line in Ángel de la Guarda Island and also, the coast line from Sierra los Candeleros to Bahía las Ánimas in Baja California
Bahía de Kino	BKI	87	5392.28 km ²	The area covered by fishing zones goes from the coast line in Sierra La Tordilla to Estero Cardonal in Sonora surrounding Tiburon Island. In Baja California fishing zones cover the islands of Ángel de la Guarda, Rasa, San Lorenzo and the coast line from Bahía las Ánimas to Punta San Francisquito
Desemboque de Caborca	DDC	54	4962 km ²	Fishing zones cover the coast line from Punta Gavilán (north) to Cabo Tepopa (south)
Desemboque Seri	DDS	28	510.14 km ²	Fishing zones are patches that go along the coast from Las Cuevitas to Punta Víboras in El Infiernillo Channel. They also surround Tiburon Island on the Northwest part
El Barril	EBA	9	1725.62 km ²	Fishing zones surround the Islands of San Lorenzo, Raza and San Pedro Martir; they also go along the coast from Estero San Rafael to Punta San Carlos in Baja California
Golfo de Santa Clara	GSC	156	7226.58 km ²	The fishing zones cover the entire upper Gulf of California from Puerto Peñasco, Sonora (east) to Estero Percebú in Baja California.
Las Ánimas	LAN	3	225.73 km ²	Fishing zones surround the Island of Ángel de la Guarda (south part) and the coast line from Bahía Guadalupe to Bahía San Rafael in Baja California
Los Dorados de Villa	LVD	1	35.76 km ²	Fishing areas are patches covering the front part of Punta Gavilán, Los Dorados de Villa and Desemboque de Caborca
Punta Chueca	PCH	20	236 km ²	Most of the fishing zones are delineated are inside the Infiernillo Channel; from Punta Sargent (north) to El Solito in Tiburon Island (south)
Punta Jagüey	PJA	6	112 km ²	Fishing zones go from San Francisquito to Punta Gavilán in Sonora
Puerto Libertad	PLI	65	14027.44 km ²	Fishing zones cover most of the area between Cabo Tepopa and Tiburon Island in Sonora and El Huerfanito Island and the north point of Angel de la Guarda Island in Baja California

Table 3. Cont...

Community	Code	No. map-interviews	Fishing Area (km²)	Description
Puerto Lobos	PLO	43	790.95 km ²	Fishing zones cover from Los Tanques to Punta Tepopa in Sonora and they go about 50 km offshore
Puerto Peñasco	PPE	123	8210.19 km ²	Fishing zones cover the coast line from Golfo de Santa Clara to San Francisquito; they also were delineated in several marine channels in the upper Gulf and the areas surrounding the Isla Consag and Islote Encantado
San Felipe	SFE	104	4253 km ²	Fishing zones cover the area from Montague Island down to Puertecitos; there are other set of zones clustered near by the islands (Isla Lobos, Isla el Muerto) and Punta Final
San Jorge	SJO	36	722 km ²	Fishing zones cover San Jorge Island and from Puerto Peñasco (north coast) to Punta Gavilán (south coast)
San Luis Gonzaga	SLG	9	3242 km ²	There are two clusters of fishing zones; the first one covers an area in front of Esteros Ramada; the second one goes from Punta San Fermín to the northern point of Isla Ángel de la Guarda
Santo Tomás	STO	27	169.25 km ²	Fishing zones cover the coast line from San Jorge to Desemboque de Caborca including San Jorge island
Total		796		

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APPENDIX D. BASE MAPS UTILIZED FOR THE RAPID APPRAISAL

Overview

The participatory mapping involved the use of a variety of printed maps that included basic information such as the coastline (INEGI 1:50,000 topographic maps), isobaths extracted from bathymetry data (Marinone and Lavín, 2005), and general landmarks and their local names.

These maps were developed using ArcGIS 9.2 (ESRI, 1999–2008). The maps were printed at six different scales ranging from 1:800,000 to 1:15,000. The original maps were utilized during the interviews but some changes were made based on the needs and feedback obtained during the interviews. Therefore, the maps presented here might incorporate additional information provided by fishers, field technicians or scientist.

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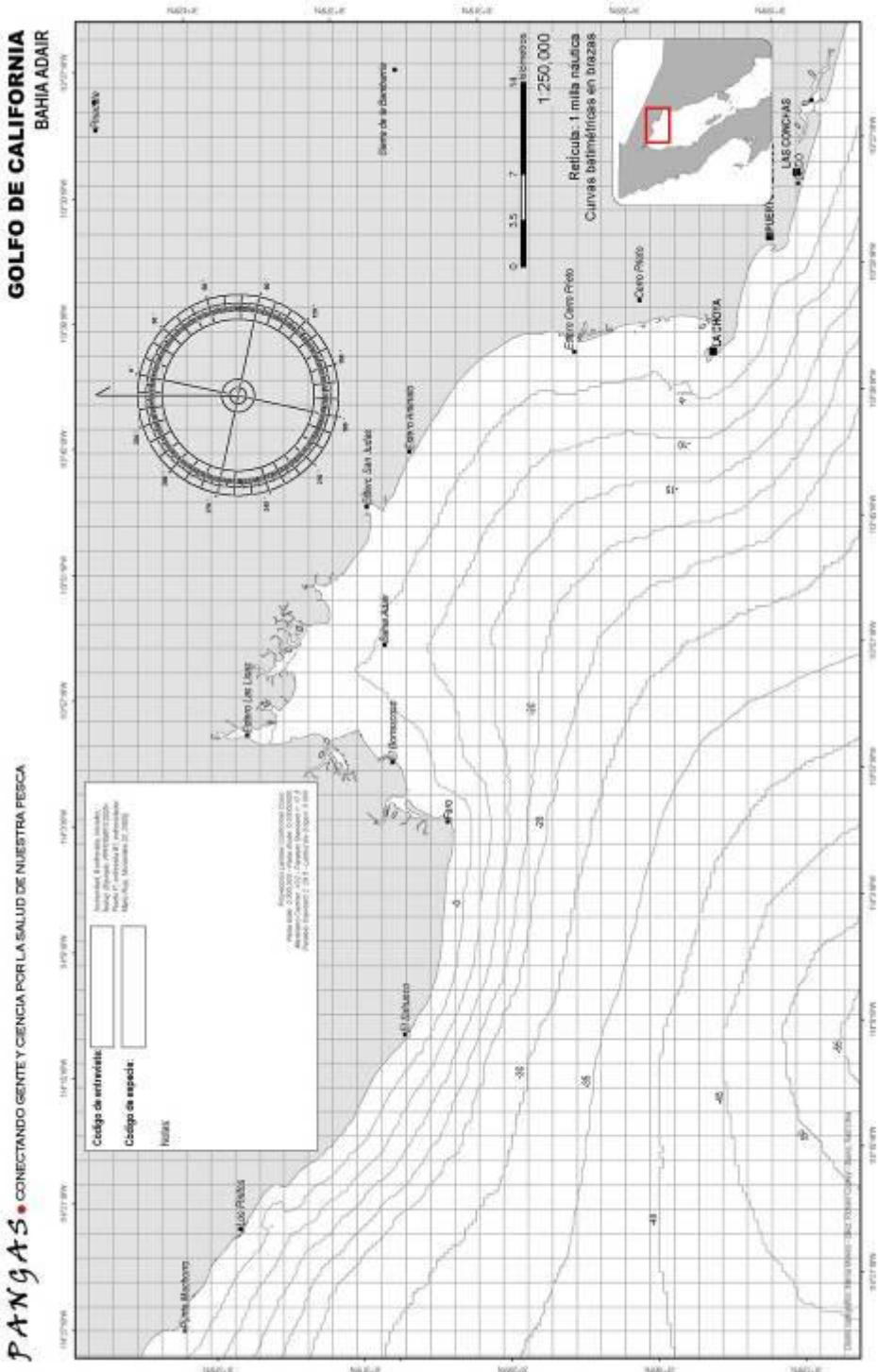


Figure 1. Bahia Adair. Scale 1:250,000

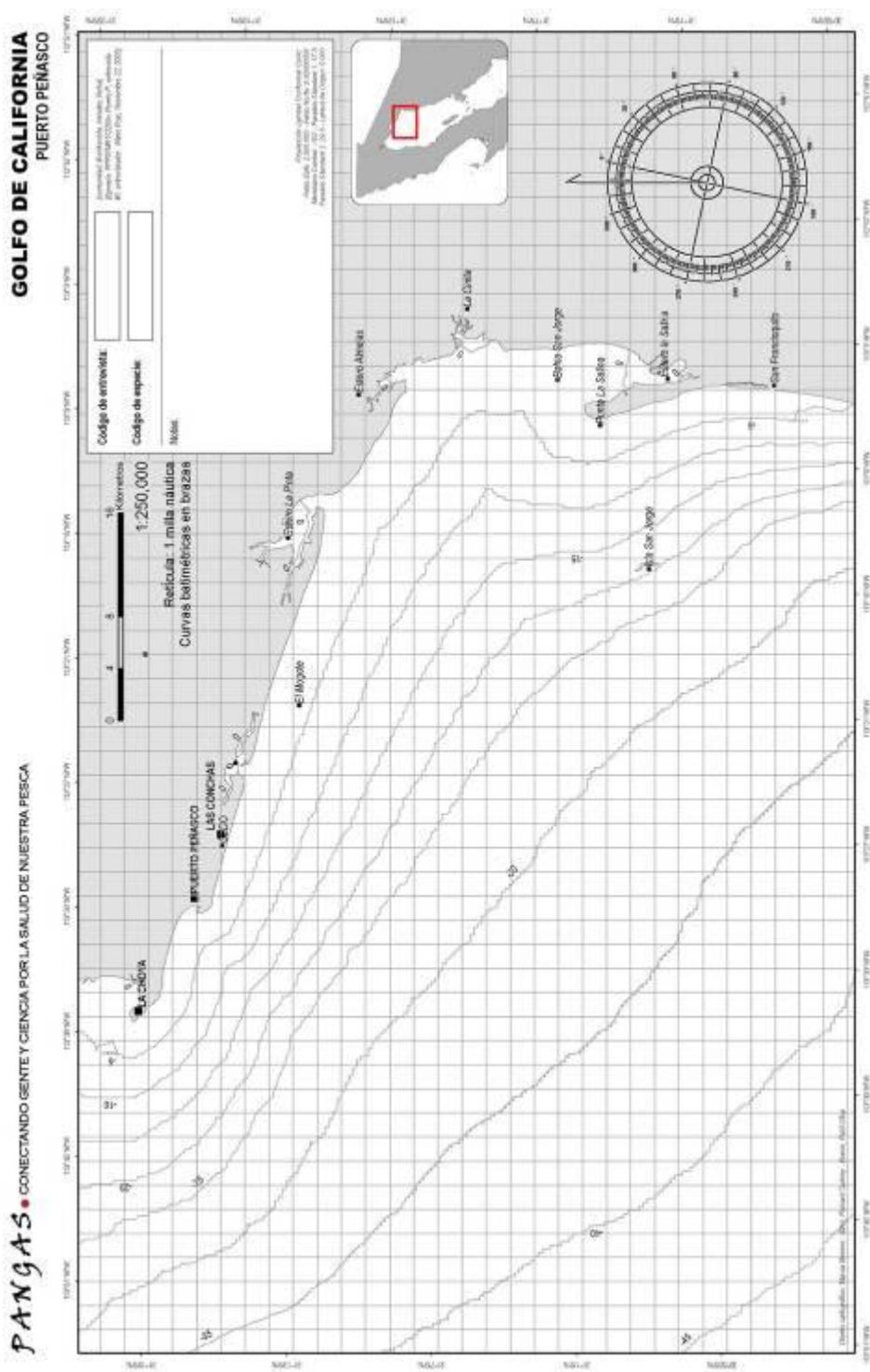


Figure 2. Puerto Peñasco area. Scale 1:250,000.

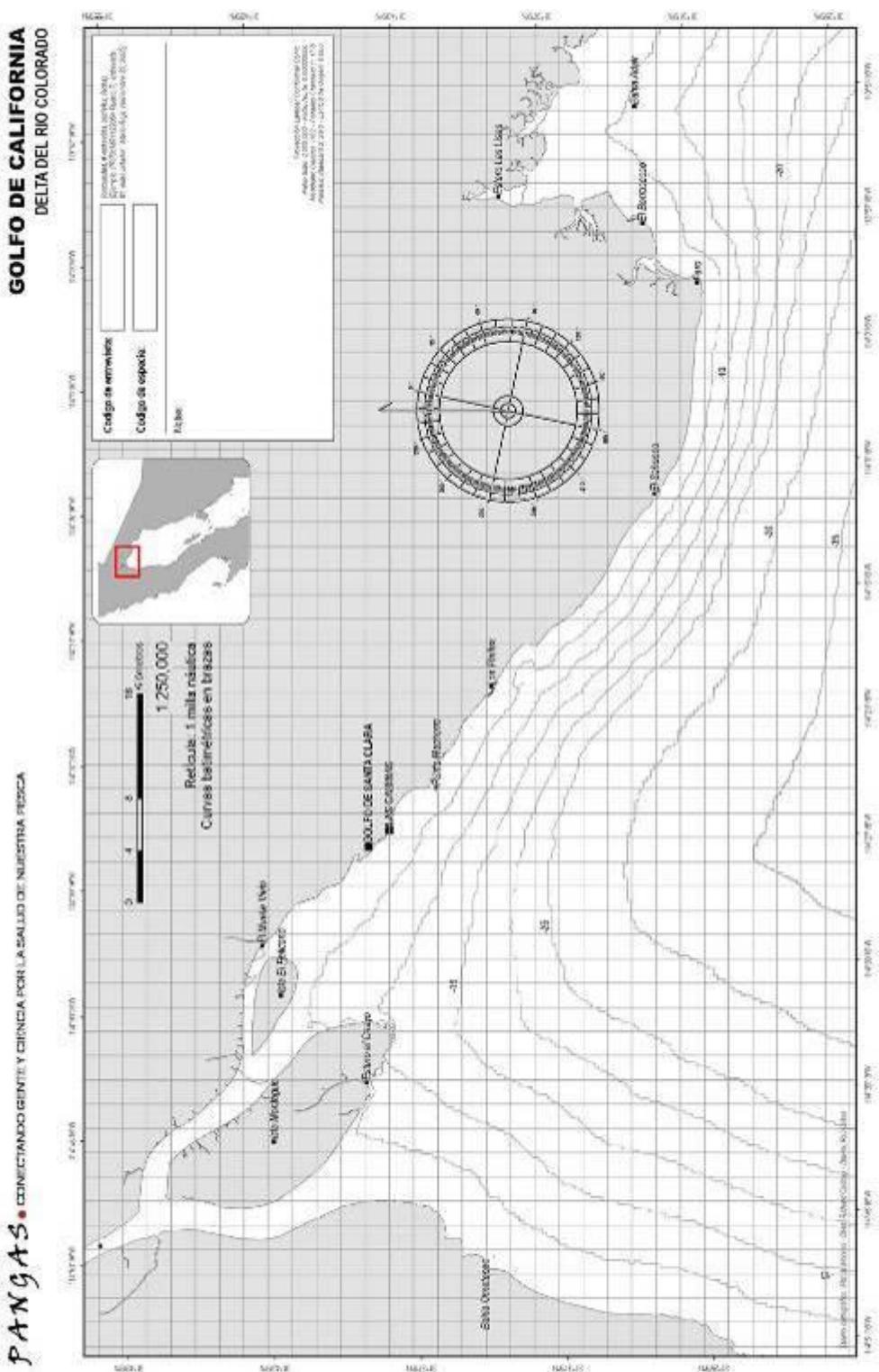


Figure 3. Delta del Rio Colorado. Scale 1:250,000.

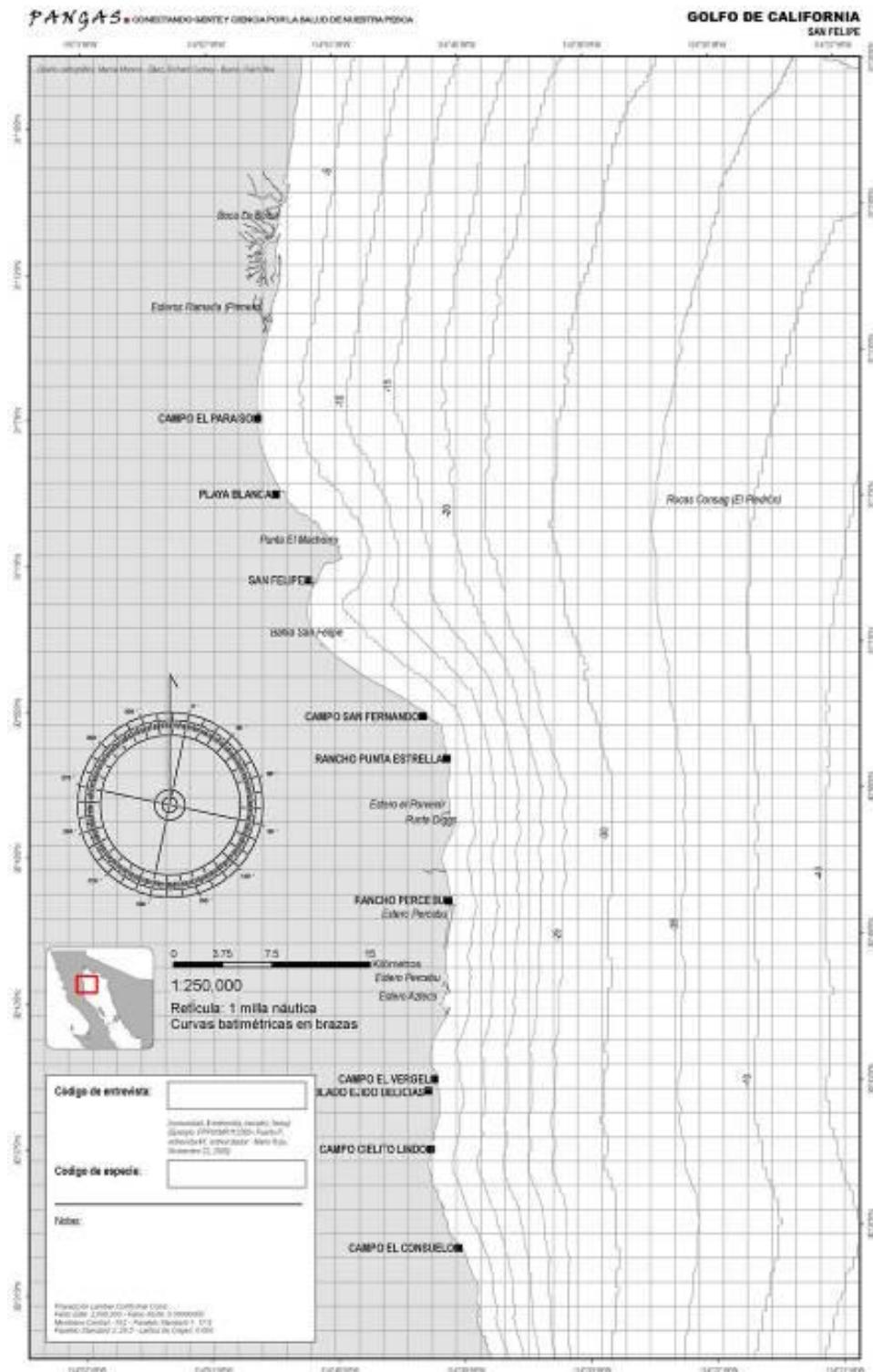


Figure 4. San Felipe. Scale 1:250,000.

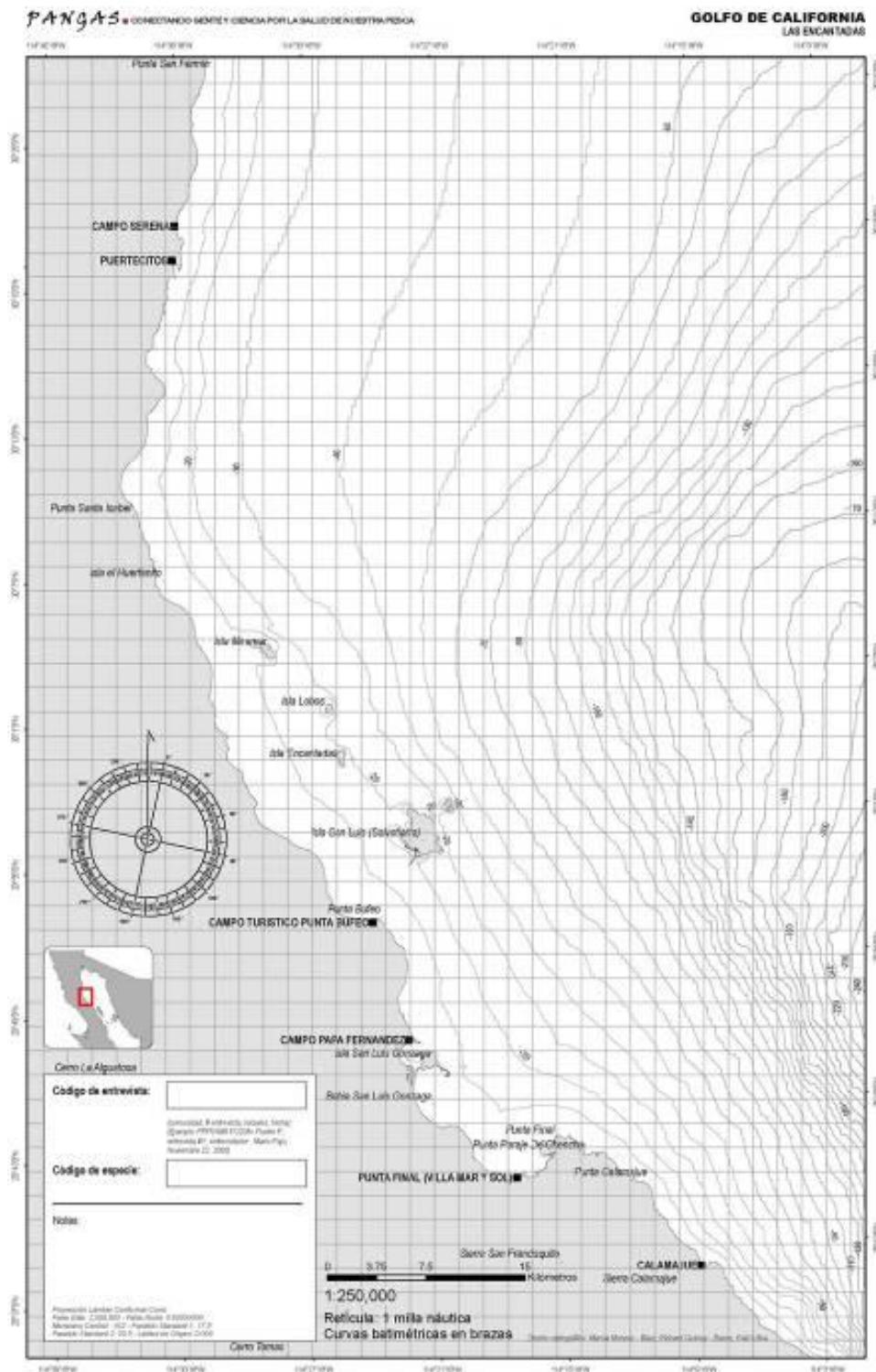


Figure 5. Las Encantadas. Scale 1:250,000.

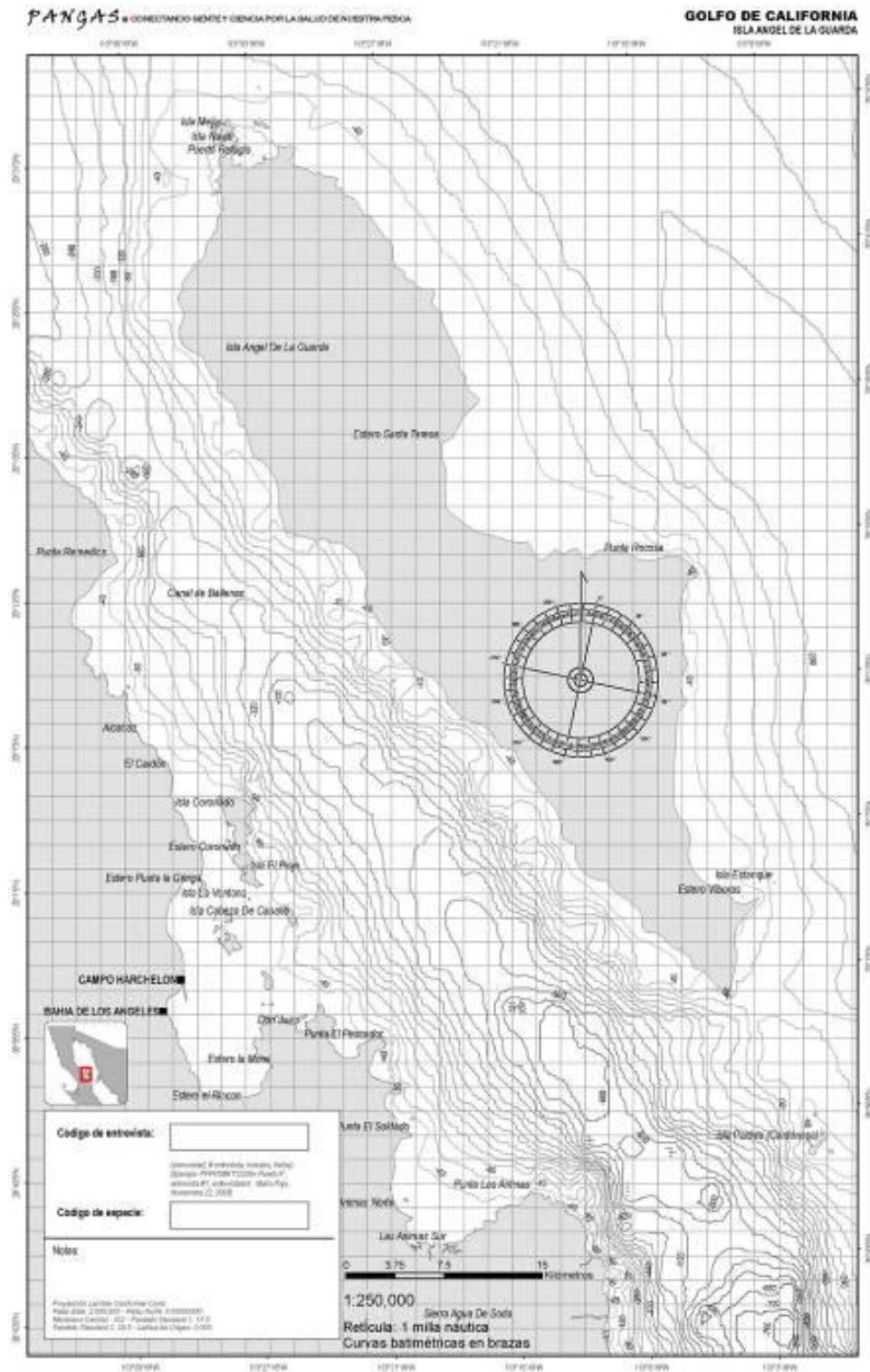


Figure 6. Isla Ángel de la Guarda. Scale 1:250,000.

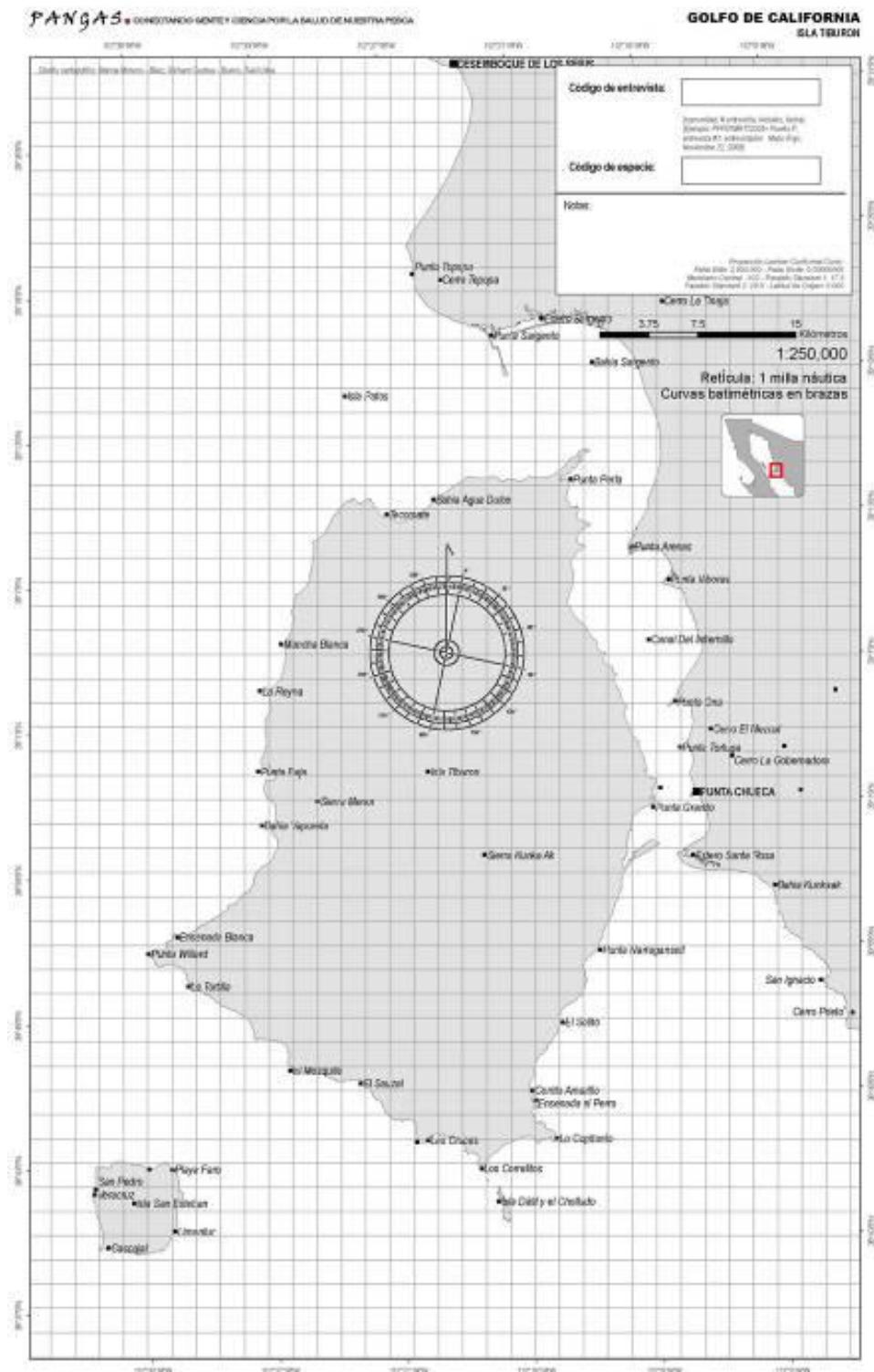


Figure 7. Isla Tiburón. Scale 1:250,000.

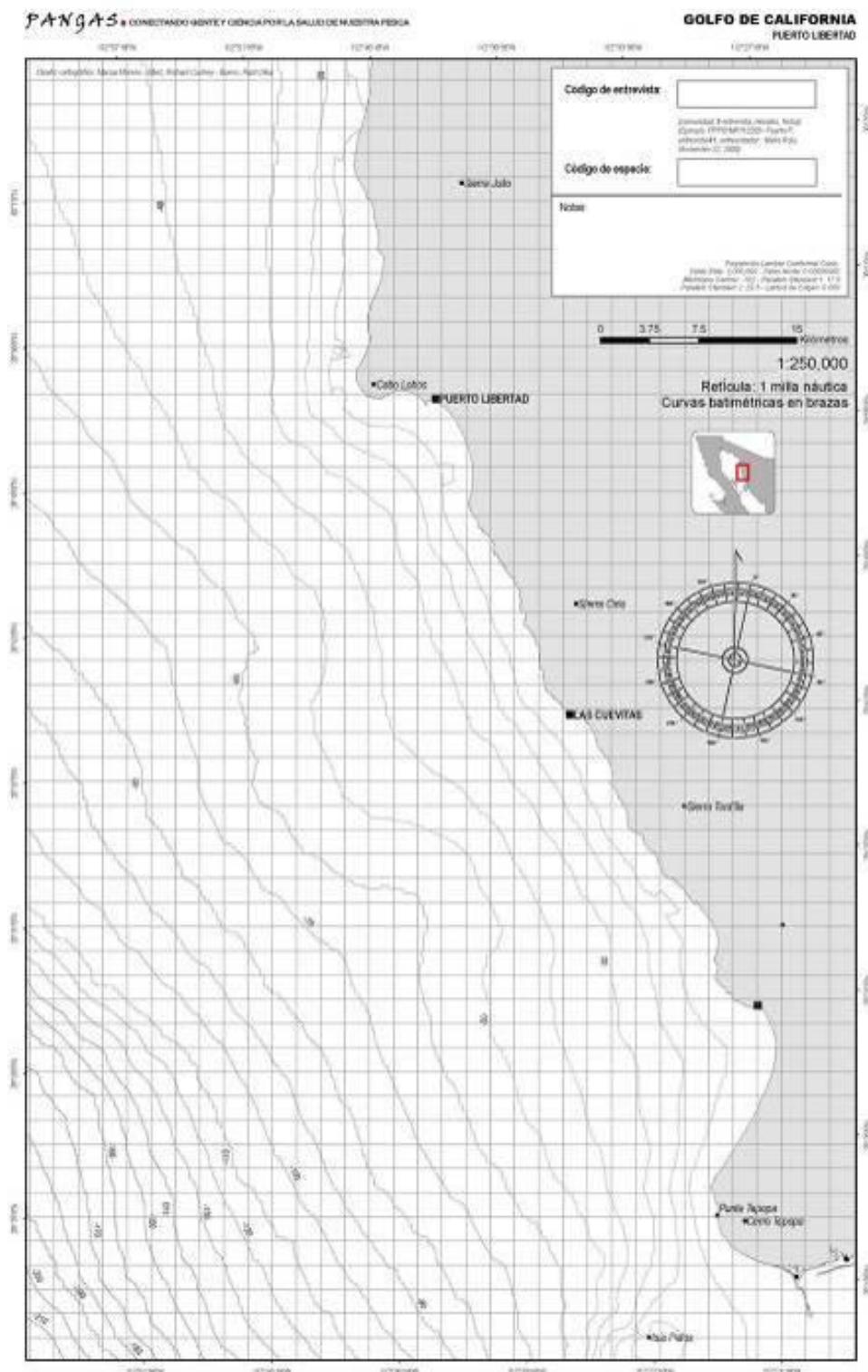


Figure 8. Puerto Libertad. Scale 1:250,000.

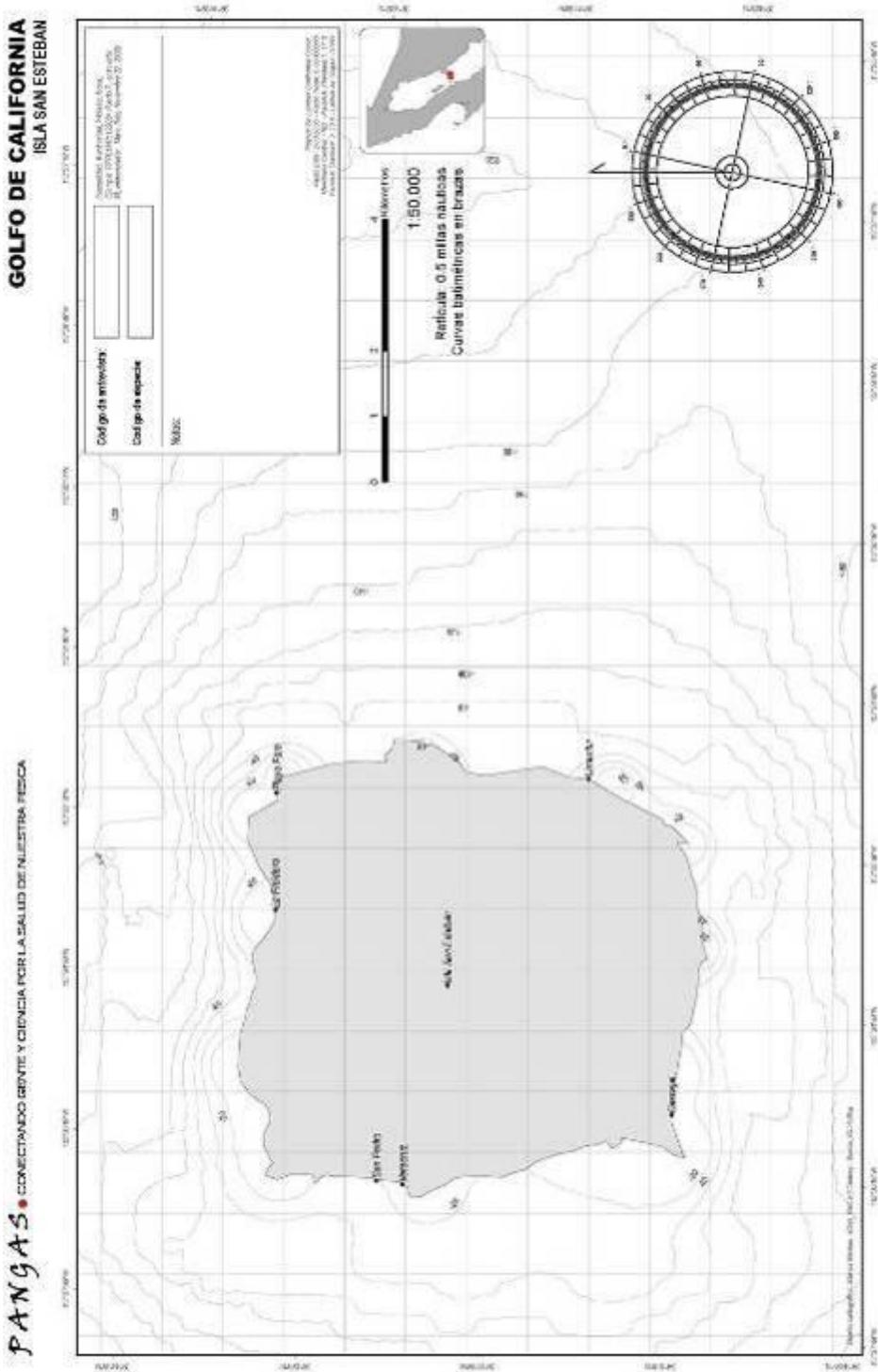


Figure 9. Isla San Esteban. Scale 1:50,000

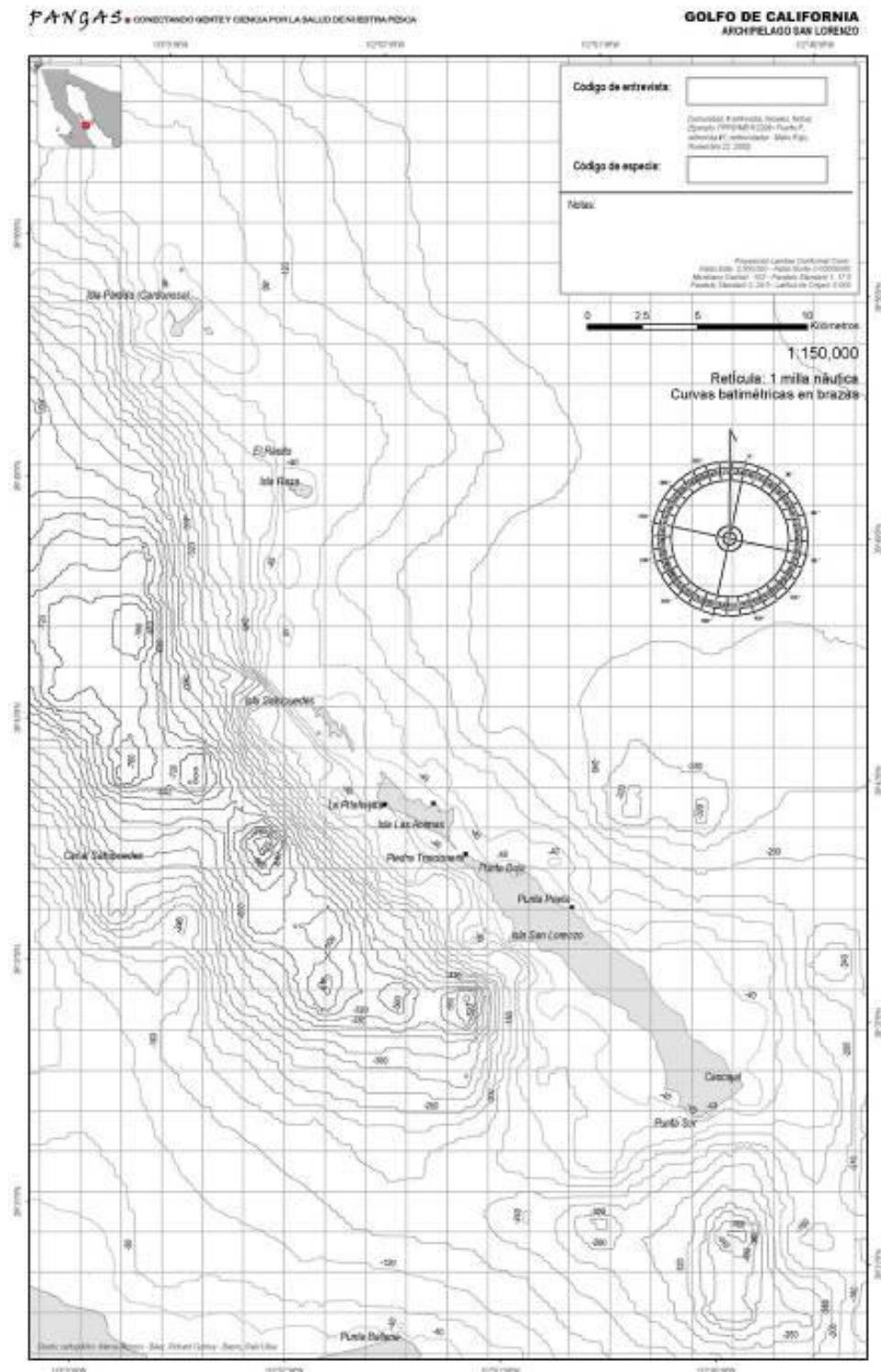


Figure 10. Archipiélago de San Lorenzo. 1:150,000

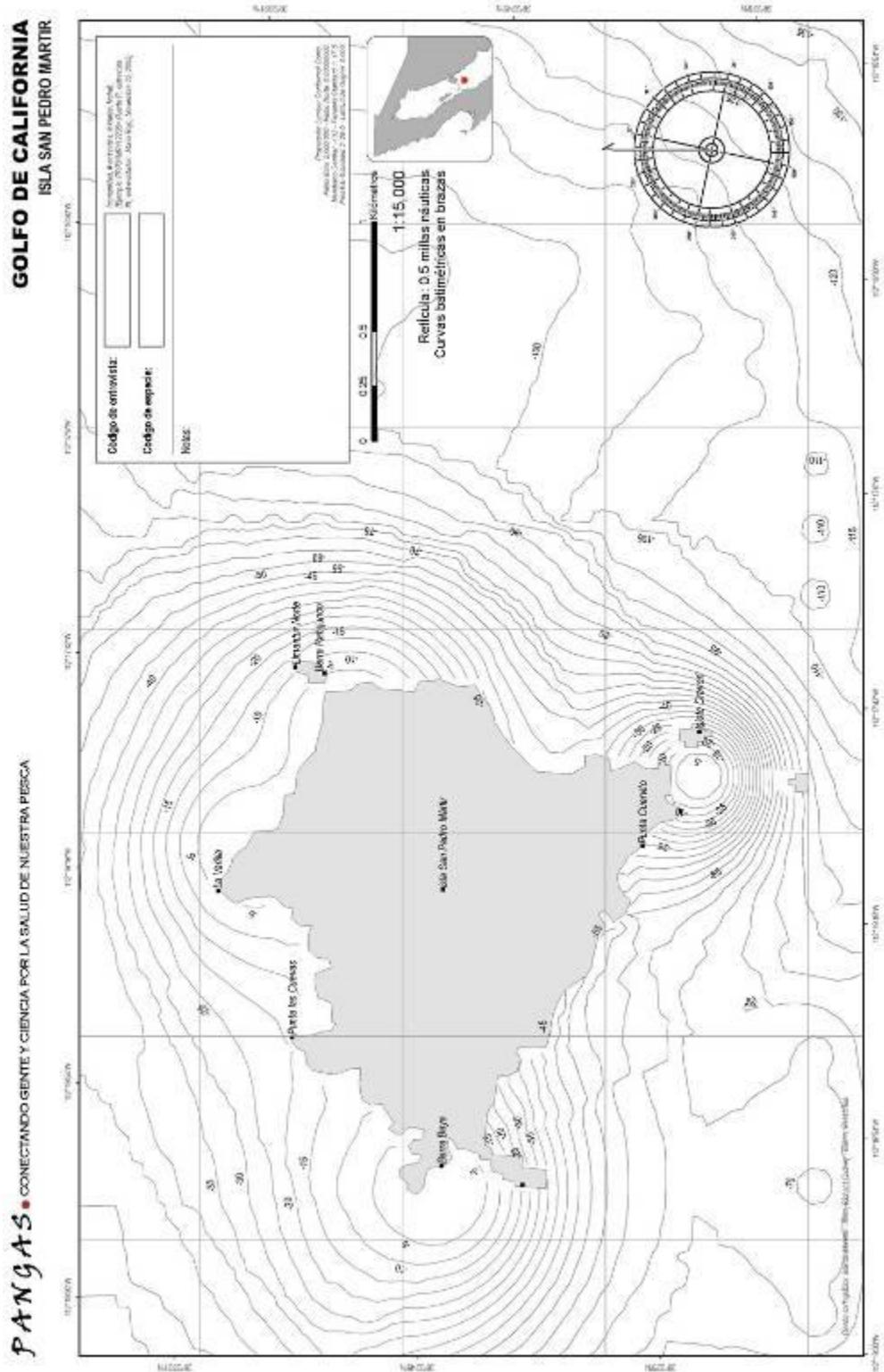


Figure 11. Isla San Pedro Mártir. 1:15,000

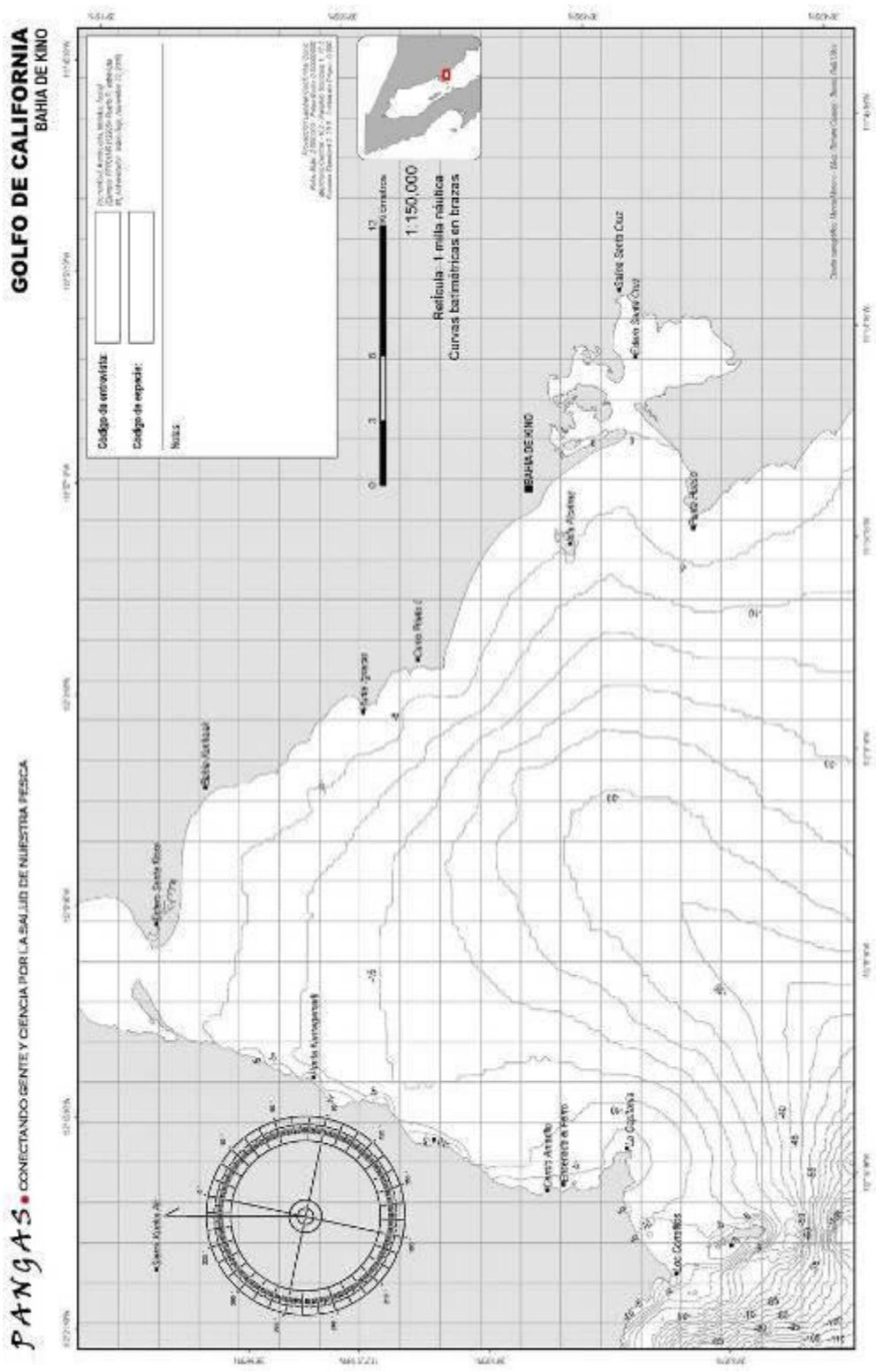


Figure 12. Bahía de Kino. 1:150,000

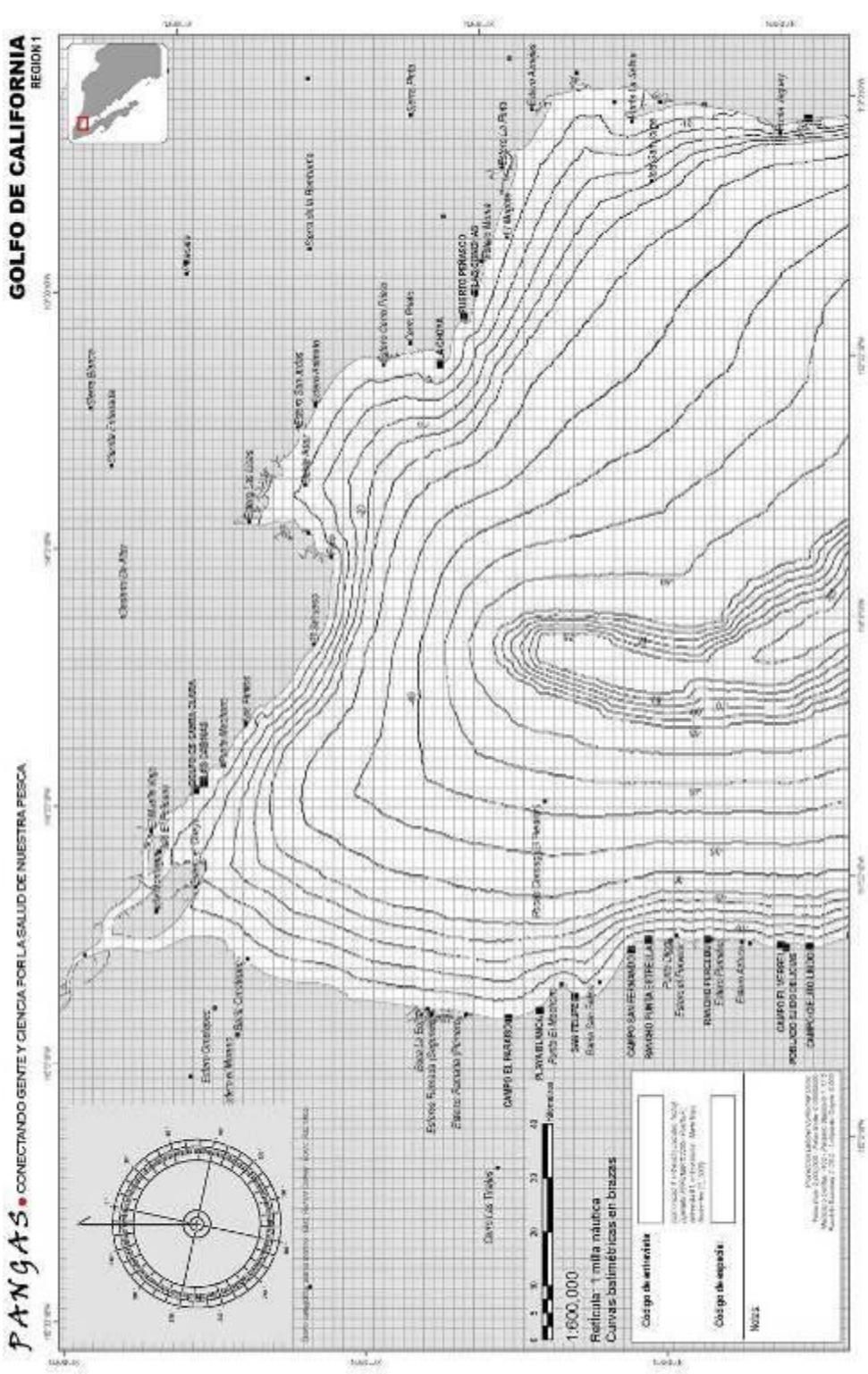


Figure 13. Region 1 - The upper Gulf. Scale 1:600,000

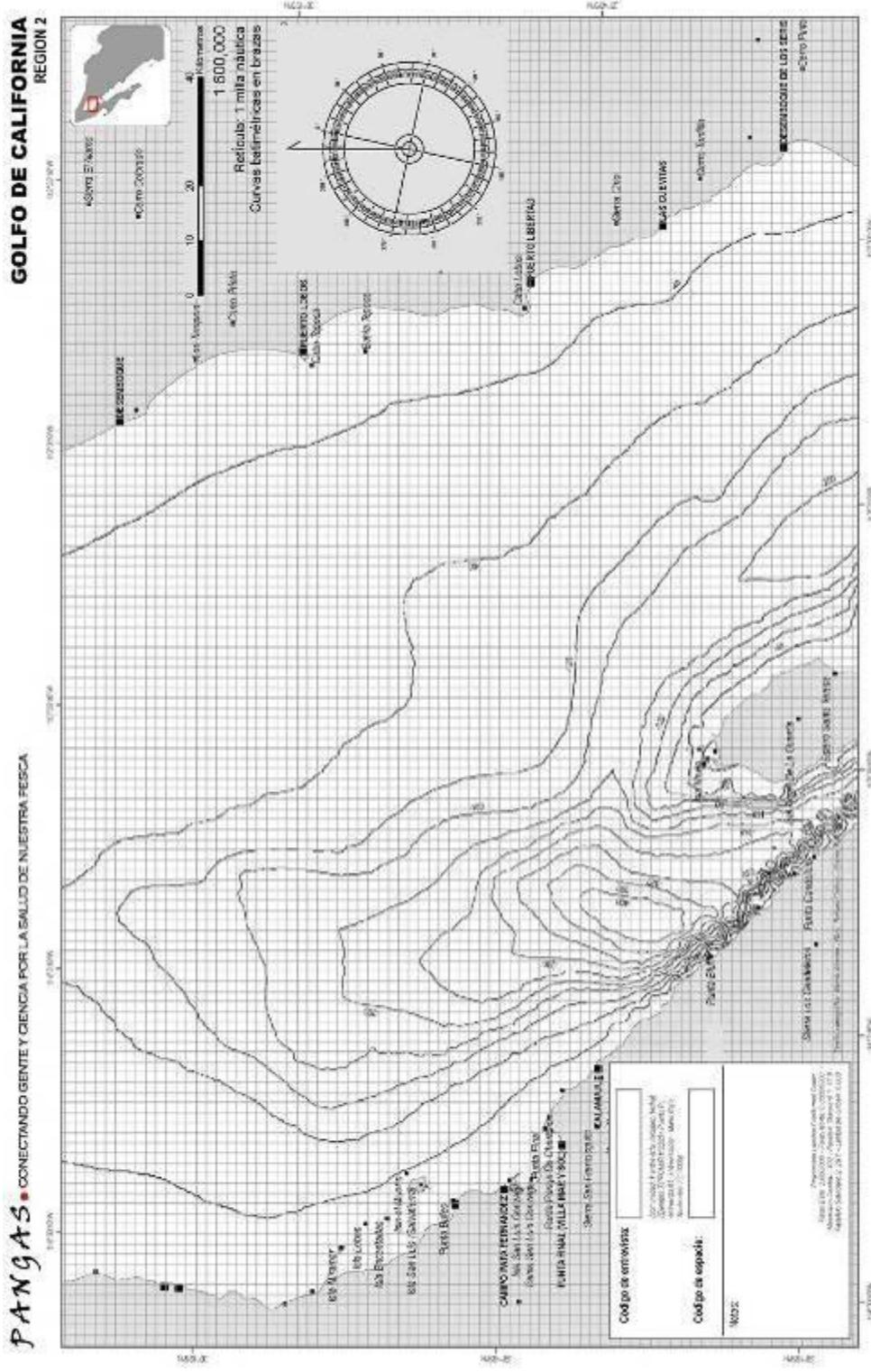


Figure 14. Region 2 – Puerto Libertad and Puerto Lobos. Scale 1:600,000

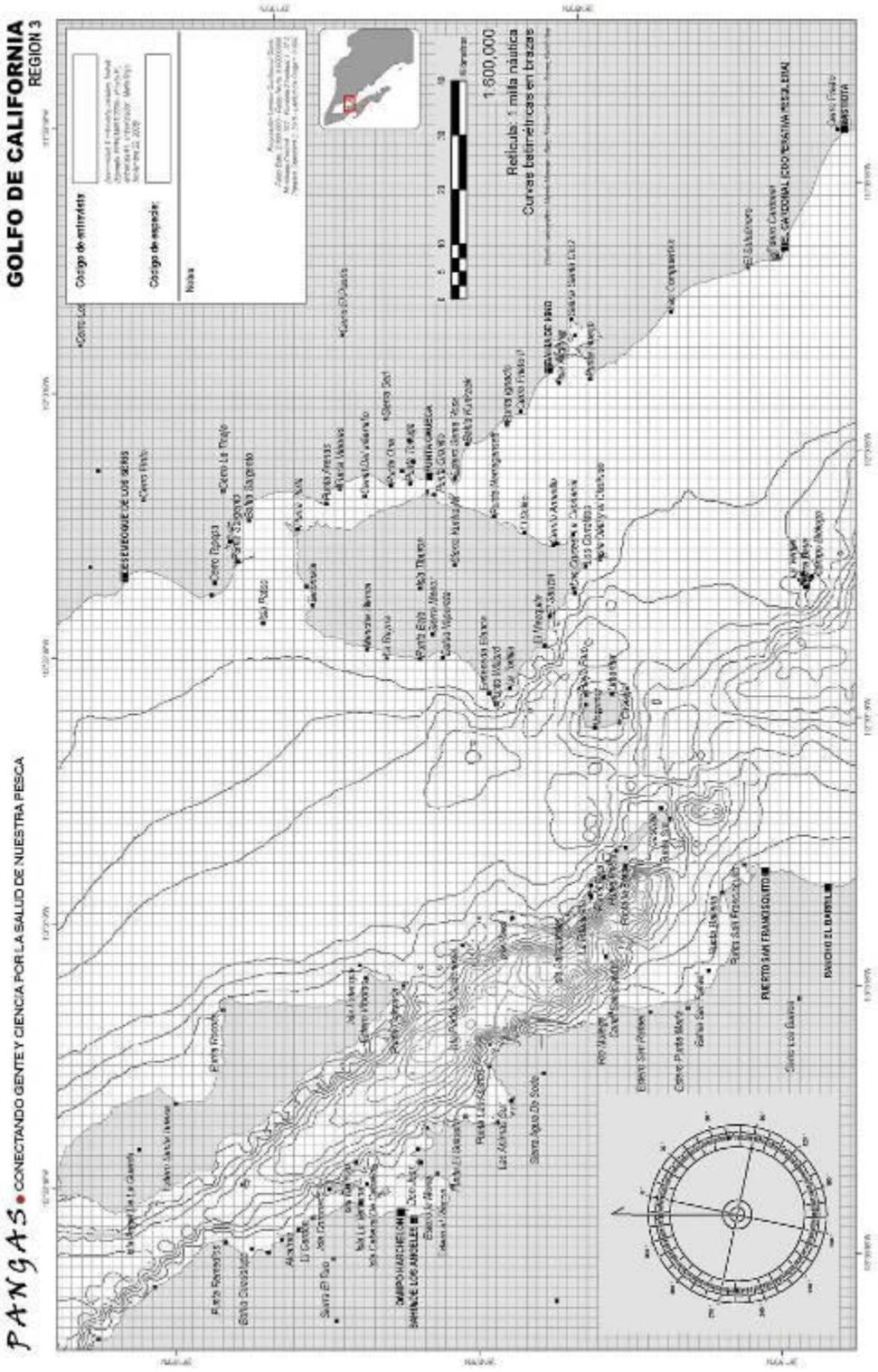


Figure 15. Region 3 – Midriff Islands. Scale 1:600,000

APPENDIX E. INTERNAL VALIDATION WORKSHOPS

**TALLERES DE VALIDACIÓN DE DATOS ESPACIO-TEMPORALES
POR ESPECIE**

**PUERTO PEÑASCO Y BAHÍA DE KINO
SONORA, MÉXICO**

Febrero 2008

University of Arizona
Centro de Océanos y Desiertos, A.C.
CICESE
Comunidad y Biodiversidad, A.C.
University of California Santa Cruz

Reporte elaborado por:

Marcia Moreno-Báez, Ana Cinti

Acerca de éste reporte:

Este reporte presenta los resultados sobre la validación a nivel interno de datos espacio-temporales en las comunidades de Puerto Peñasco y Bahía de Kino, Sonora. Los talleres y este documento fueron realizados con el apoyo del proyecto PANGAS y dirigido por la Universidad de Arizona, Centro Intercultural de Estudios de Desiertos y Océanos A.C. (CEDO) y Comunidad y Biodiversidad A.C. (COBI) en los meses de noviembre, 2007 y enero, 2008. La información descrita es el resultado de un esfuerzo realizado en conjunto con los pescadores ribereños de Puerto Peñasco y Bahía de Kino, Sonora.

Esta validación surge a partir de la evaluación rápida realizada por PANGAS para corroborar los datos compilados a través del período de noviembre del 2005 y septiembre del 2006. El apoyo financiero para desarrollar tanto el proceso de evaluación rápida como la validación de los datos ha sido proporcionado por David and Lucile Packard Foundation. A lo largo de este proceso de validación han colaborado: Richard Cudney-Bueno, Jorge Torre, Peggy Turk, William Shaw. Se pide una disculpa por cualquier omisión.

Reporte elaborado por:

Marcia Moreno-Báez, Ana Cinti

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- d) Marcia Moreno-Báez (Universidad de Arizona)
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- f) Mario Rojo (COBI)
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Coordinación en el manejo de sistemas de información geográfica y preparación de cartografía: Marcia Moreno-Báez

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Fotografías: Ana Cinti, Jennifer Duberstein, Nabor Encinas Cazares, Marcia Moreno-Báez, Mario Rojo, Ángeles Yazmín Sánchez Cruz.

Lugar y fecha de elaboración: Tucson, Arizona, EUA.

Introducción

La escuela de Recursos Naturales (School of Natural Resources, SNR) de la Universidad de Arizona (UA) y otras cuatro instituciones, la Universidad de California en Santa Cruz (UCSC), el Centro Intercultural de Estudios de Desiertos y Océanos, A.C. (CEDO), el Centro de Investigación Científica y de Educación Superior de Ensenada (CICESE) y Comunidad y Biodiversidad, A.C. (COBI), hemos estado trabajando en un proyecto enfocado a la pesquería artesanal del norte del Golfo de California. Este proyecto denominado *Small-scale fisheries in the Northern Gulf of California, Mexico: Linking human and biophysical processes* (PANGAS) es un proyecto interdisciplinario con una duración en su primera fase de tres años (2005-2008) y está financiado principalmente por The David and Lucile Packard Foundation dentro de su iniciativa de ciencia Ecosystem-based management.

Los objetivos del proyecto son:

- Caracterizar las pesquerías artesanales del Norte del Golfo de California.
- Desarrollar una aproximación integral para la investigación y manejo de casos específicos de pesquerías artesanales.
- Contactar a los actores claves y autoridades pesqueras para aconsejar e implementar el manejo adaptativo y las recomendaciones de los resultados.
- Proporcionar entrenamiento a estudiantes mexicanos y estadounidenses, así como a los pescadores locales sobre herramientas para el manejo, investigación y conservación de los recursos marinos con una perspectiva de ecosistema

Como parte del primero objetivo general del proyecto, se llevó a cabo durante 2005 y 2006, una evaluación rápida para caracterizar la pesquería artesanal donde se realizaron 376 entrevistas en 16 comunidades del norte del Golfo de California. Estas entrevistas son semi-estructuradas y comprenden dos componentes principales: socio-cultural y espacio-temporal. Las entrevistas que corresponden a la parte espacio-temporal se realizaron enfocadas a especies objetivo en particular (Figura 1).

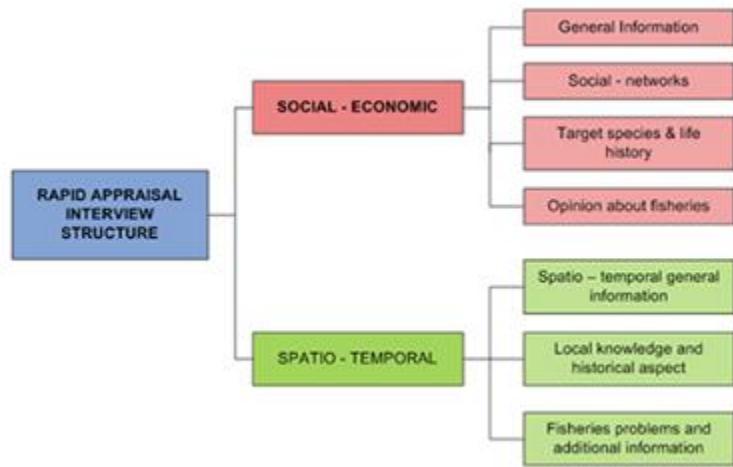


Figure 1. Estructura de la entrevista aplicada en la evaluación rápida.

La información colectada correspondiente al componente espacio-temporal, fue integrada en un sistema de información geográfica (SIG) para su manejo y análisis. Esta información fue colectada durante las entrevistas hechas a los pescadores, utilizando mapas impresos de diferentes escalas (1:800,000 a 1:15,000). Una vez recolectada toda la información, se digitalizó y se organizó en el SIG. El proceso de colección, procesamiento e integración de datos se puede visualizar en la Figura 2.



Figure 2. Proceso de diseño, obtención y manejo de datos de la evaluación rápida.

Una vez hecha la integración fue necesario planificar la validación de dicha información espacio-temporal debido a la naturaleza del proceso de colección de datos, es decir, a la variación en escalas y cobertura espacial de los mapas utilizados en las entrevistas. Se llevaron a cabo dos talleres de validación de datos en las comunidades de Puerto Peñasco y Bahía de Kino. Se seleccionaron estas comunidades porque estos sitios son considerados como importantes en la zona norte del Golfo de California en cuanto a su influencia dentro de la pesca ribereña. Igualmente, se seleccionaron estas dos comunidades por ser los dos sitios donde se colectaron un número considerable de entrevistas. Para Puerto Peñasco se obtuvieron en total 46 entrevistas y para Bahía de Kino 48. Los talleres se realizaron en formato de “focus group” (Morgan 1997) con la participación de entre 3 y 12 pescadores por taller.

Por último, este primer informe interno se presenta al proyecto PANGAS para resumir y poner a disposición de los integrantes del proyecto los resultados de los talleres. En general las actividades se concentraron en afinar la información espacio-temporal, misma que será utilizada en futuros análisis y procesos de toma de decisiones.

Objetivo

El objetivo de estos talleres fue validar de forma interna la información de zonas de pesca y obtener información adicional sobre temporadas de pesca y problemáticas por especie. La información a validar fue recolectada durante la evaluación rápida realizada por integrantes del proyecto PANGAS (personal de CEDO y COBI) durante 2005-inicios de 2006.

Metodología

Evaluación Rápida

La captura de la información espacial durante la evaluación rápida se realizó a través de la metodología denominada mapeo participativo, esto es, utilizando mapas impresos donde los entrevistados delimitaban – según las preguntas de la entrevista – las zonas de pesca más frecuentadas (principales) en rojo y aquellas que no son visitadas tan frecuentemente (secundarias) en amarillo (Figure 3). Igualmente proporcionaron información correspondiente a las temporadas de pesca y los sitios de agregaciones reproductivas o avistamiento de juveniles conocidos.

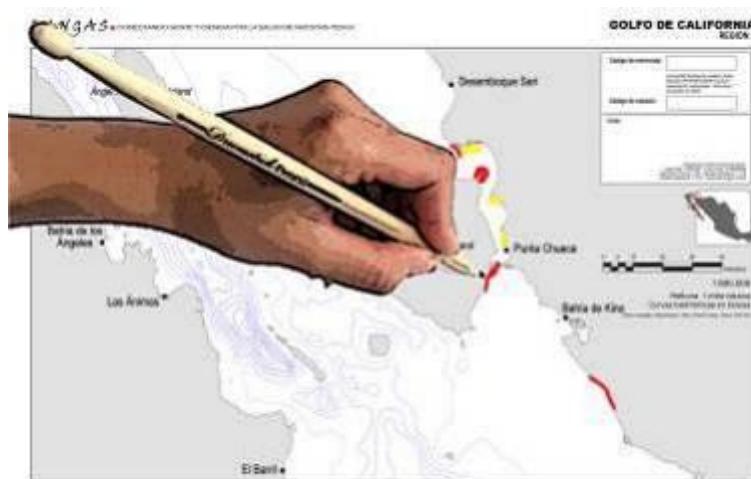


Figure 3. Representación de la captura de información en mapas impresos.

La información fue capturada en un sistema de información geográfica (SIG) y se incorporó la información de las entrevistas semi-estructuradas. Esta información se utilizó para generar resultados preliminares que después fueron corroborados en los talleres de validación interna en las dos comunidades.

Selección de Participantes para los Talleres

La selección de participantes estuvo a cargo de personal de COBI y CEDO, dada su larga trayectoria de trabajo en estas comunidades y su cercanía con los pescadores. Los participantes de los talleres fueron seleccionados tomando en cuenta principalmente criterios como (a) años de experiencia en la pesca de las especies que se trabajaron en el taller y (b) su participación (o no participación) en las entrevistas de la evaluación rápida esto para asegurarnos de que asistieran al taller pescadores que hayan sido entrevistados anteriormente y pescadores que no hayan sido entrevistados en dicha evaluación.

Talleres de Validación Interna

A diferencia de la evaluación rápida, en los talleres de validación se trabajó con un método interactivo utilizando un software para el manejo de información espacial llamado ArcGIS 9.3 (ESRI 1999 - 2008) *in situ* proyectando la información (mapa base y resultados de la evaluación rápida) en pantalla. Al inicio de la dinámica se hizo un ejercicio de ubicación de la zona de estudio asegurándonos de entender la información proyectada. Una vez ubicada la zona de estudio, se procedió a presentar los resultados de las zonas de pesca ‘principales’ y ‘secundarias’ para asegurarnos de que los límites de dichas zonas correspondieran a las zonas donde ellos generalmente trabajan. Para detallar la información se utilizó un mapa base que consistía en la integración de datos de profundidad (batimetría) puntuales y lineales (Marinone and Lavín, 2005), toponimia (nombre de los sitios o zonas de pesca) y la línea de costa (INEGI 1:50,000 mapas topográficos). Después se utilizó la herramienta de escala para tomar medidas y distancias de o hacia la costa.

Igualmente para las zonas de avistamiento de juveniles y zonas de reproducción, se utilizó la misma dinámica de corroboración de datos como en la de zonas de pesca principales y secundarias. Cuando fue posible se colectó información adicional sobre temporadas de pesca y problemáticas pesqueras por especie, con el fin de completar huecos de información sobre todo en especies cuyo número de entrevistas fue escaso. Finalmente, la información quedó integrada en el SIG para su procesamiento y evaluación.

TALLERES EN PUERTO PEÑASCO, SONORA

Fecha: 15, 17 y 18 de Noviembre, 2007

Lugar: Plaza "Del Camarón"

Logística:

Facilitadores: Ana Cinti, Sergio Pérez y Mario Rojo

Manejo de información: Marcia Moreno-Báez y Rene Loaiza

Notas: Ana Cinti, Nabor Encinas Cazares, Mario Rojo y Ángeles Yazmín Sánchez Cruz

En los tres talleres realizados en Puerto Peñasco la logística tuvo un formato similar en la parte operacional y fue el siguiente:

- Comienzo oficial de la reunión (por Rene Loaiza)
- Bienvenida
- Presentación del equipo de trabajo
- Presentación de los participantes
- Presentación breve del proyecto PANGAS y explicación del proceso de evaluación rápida (por Sergio Pérez).
- Descripción del procesamiento de los datos colectados (mapas) y de la dinámica de trabajo a tener durante el taller (por Marcia Moreno-Báez).
- Proyección de datos en pantalla y ejercicio de reconocimiento para que los participantes se ubiquen bien con la información proyectada (por Marcia Moreno-Báez).
- Comienzo de la dinámica con el siguiente orden:
 1. Proyección y validación de datos espaciales por especie zonas de pesca visitadas con mas frecuencia (principales); zonas de pesca visitadas con menos frecuencia (secundarias); zonas de avistamiento de juveniles o de reproducción) (por Marcia Moreno-Báez).
 2. Validación de datos temporales (calendarios de pesca) por especie (temporada total y principal) (por Ana Cinti).
 3. Problemáticas por especie (por Ana Cinti).
- Se realizaron descansos cuando fue necesario ofreciendo servicio de café, sodas y bocadillos.
- Conclusiones, agradecimiento, entrega de reconocimientos y de un mapa del golfo a modo de obsequio.

TALLER DE BUCEO

15 de noviembre, 2007

Número de participantes: 3

Inicio del taller: 10am

Notas de reconocimiento de información proyectada:

- *Pescador 1*: indica como zona principal de trabajo fuera de la Choya, donde empieza los hoteles, en el estero del CEDO.
- *Pescador 2*: marcó por fuera de la Choya: “esa es la zona principal de trabajo”.
- Por fuera del “4 ases”, a unos 700 metros de la orilla.
- Desde Puerto Peñasco por toda la orilla (entre el CEDO y estero Morúa, en el primer tanque, en los tanques, el segundo tanque) hasta 500-600 metros de la orilla. Hay roca todo en frente del estero. Hay un lado que hay arena.

Caracol chino negro (*Hexaplex (Muricanthus) nigritus*)

ZONAS DE PESCA

Esta es una lista de las zonas de pesca más frecuentadas o principales para caracol chino negro y una breve descripción proporcionada por los pescadores:

- El Borrascoso Es una zona principal de pesca. Se pesca a unas 5–6 brazas de profundidad (máxima). La zona de pesca se extiende unos 5 Km. de la costa (distancia de la orilla al pescadero). Entre 1, 2 y 5 brazas de profundidad mínima.
- San Judas Cubre unos 2 kilómetros de largo y es una zona de graba, pedregalillo.
- Los Paredones Entre 4 y 7 brazas.
- Cerro Prieto Por debajo de los paredones, entre 3 – 7 brazas.
- La Choya Por la orilla de la Choya, los 4 ases, el nido de la aguililla, son todas marcas dentro de la zona que llaman la Choya.
- Peñasco También se pesca, entre 5 – 8 brazas. Allí se encuentra el caracol rosa también.
- CEDO Entre las 5 y 8 brazas de profundidad. También van los demás pescadores de Peñasco a pescar allí pero sale caracol pequeño (*pescador 1* no va tanto a pescar ahí).

- Isla San Jorge En la isla están los anegados (8 – 14 brazas), parte sur. Nosotros pescamos en medio de los anegados y la isla. Parte sur de la isla: de 45 a 56 pies de profundidad (se marcó la zona en el mapa).

Zonas de pesca menos frecuentadas o secundarias (zonas Y en evaluación rápida):

- Frente a CEDO
- Estero de los Tanques
- Bahía San Jorge

Los cambios en las zonas de pesca tanto principales como secundarias se reflejan en la Figura 4.

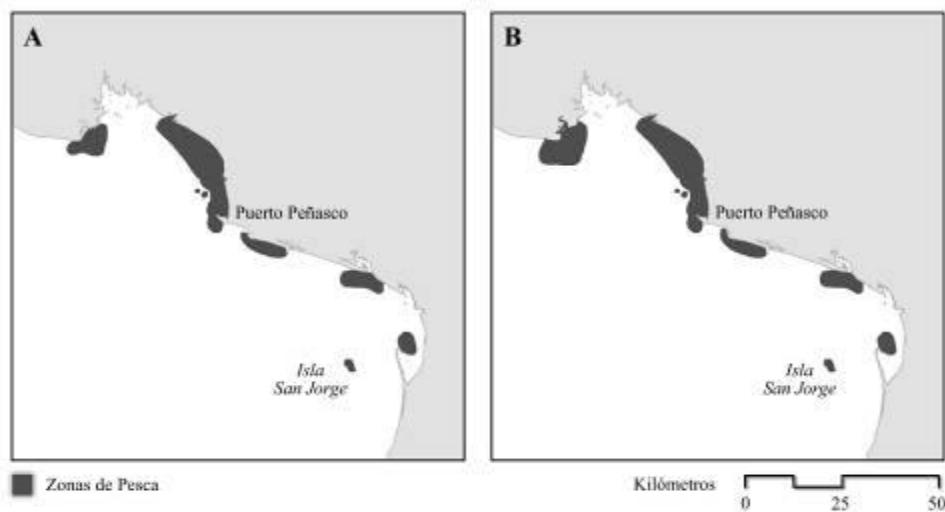


Figure 4. Zonas principales y secundarias de pesca para caracol chino negro. Derecha: evaluación rápida. Izquierda: taller de validación interna.

Para las zonas de avistamiento de juveniles y de reproducción, las zonas resultaron las mismas que las zonas de pesca. Sin embargo, se corrigió la zona de la Coya, de 9 a 5 brazas, a 2 Km. de la costa.

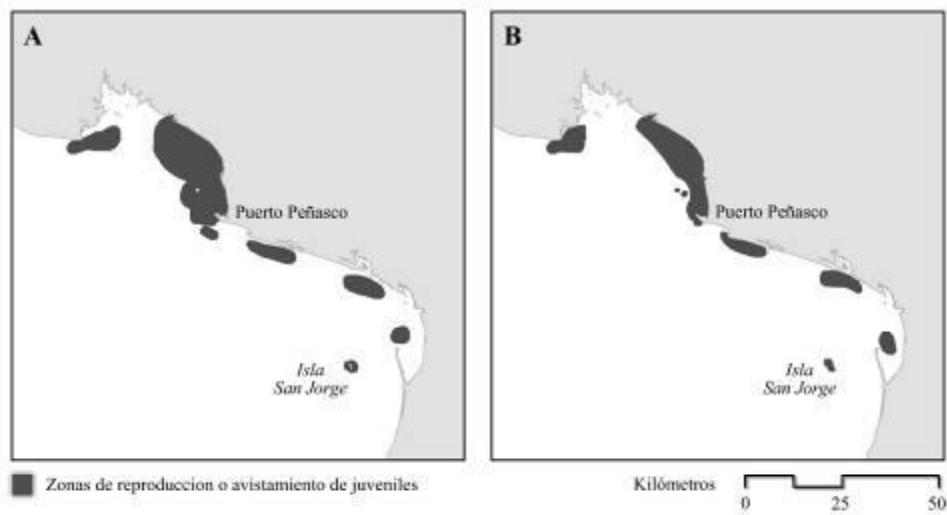


Figure 5. Zonas de avistamiento de juveniles y de zonas de reproducción para caracol chino negro. Derecha: evaluación rápida. Izquierda: taller de validación interna.

Notas adicionales: Cuando está la temporada de caracol y pulpo, también pescan callo pero en menor cantidad que en la temporada fuerte de callo. La temporada principal de caracol sería todo abril y de septiembre a noviembre.

CALENDARIO DE PESCA

Resultados de la evaluación rápida (Figura 6):

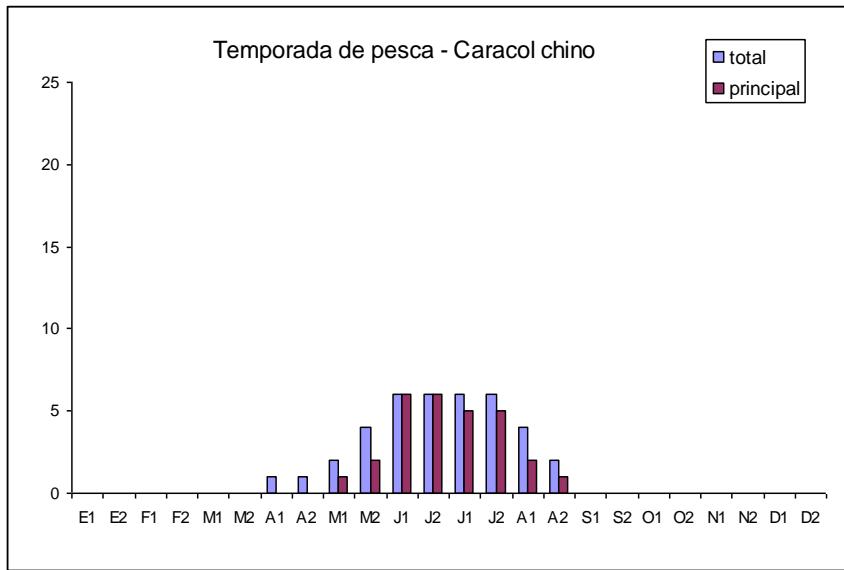


Figure 6. Temporada de pesca total y principal para caracol chino negro durante 2005. Los meses se dividieron en primera y segunda quincena (Ej., E1: primera quincena de enero; E2: segunda quincena de enero). El eje Y muestra el número de personas que indicaron que el caracol se pesca durante esos meses.

Resultados obtenidos en el taller:

- Temporada total: de abril a agosto.
- Temporada principal: de mayo a agosto.
- El caracol chino se pone en la misma época del año en todas las zonas de pesca.

	E ₁	E ₂	F ₁	F ₂	M ₁	M ₂	A ₁	A ₂	M ₁	M ₂	J ₁	J ₂	J ₁	J ₂	A ₁	A ₂	S ₁	S ₂	O ₁	O ₂	N ₁	N ₂	D ₁	D ₂	
T																									
P																									

Para caracol chino negro, los picos de frecuencia obtenidos en la evaluación rápida coinciden con los resultados obtenidos en la validación durante el taller.

PROBLEMÁTICAS

Categorías de problemáticas resultantes de la evaluación rápida (los números no indican orden de importancia):

1. Problemas de comercialización
2. Muchas pangas/muchos pescadores.
3. Sobreexplotación del producto.
4. Se pesca con hueva o juveniles.

Información obtenida durante el taller para cada uno de los puntos anteriores y categorías nuevas:

1. Problemas de comercialización: dijeron que ahora no es un problema porque están comprando todo el producto. Si bien puede haber sido un problema en el 2005, ha cambiado últimamente. Dijeron que al estar sobreexplotado (hay poco producto) los compradores compran todo lo que sale.
- 2 y 3. Muchas pangas/muchos pescadores y sobreexplotación de producto: los pescadores indicaron que esta problemática se da porque mucha gente lo pesca (de fuera y de Puerto Peñasco) y por ello está sobreexplotado (punto 3). También añaden que se da esta situación cuando hay buenas temporadas de caracol (mucho producto).
4. Se pesca con hueva o juveniles: indicaron que el problema es que se pesca cuando se agrega a reproducirse y los comerciantes lo compran por que no hay mucho producto. La pesca de juveniles no sería un problema ya que pescan el caracol cuando reproduce y son individuos adultos.
5. Problemática nueva: mencionaron como problema la cantidad de pangas tanto de fuera como de peñasco que trabajan amparadas por permisos de permisionarios o de cooperativas que no tienen buzos. Esto se da mayormente en temporadas buenas de caracol y mencionaron que el amparo ocurre con mucha frecuencia.

La priorización de problemáticas resultó en:

1. Muchas pangas / muchos pescadores.
2. Sobreexplotación del producto (la cantidad de pangas lleva a sobreexplotación).
3. Se pesca con hueva
4. Amparo de pangas por permisionarios o cooperativas sin buzos

Callo escarlopsa (*Spondylus calcifer*)

ZONAS DE PESCA

Esta es una lista de las zonas de pesca más frecuentadas o principales para callo escarlopsa y una breve descripción proporcionada por los pescadores:

- Desde las Cruces al Faro De 3 - 6 brazas. Hay intervalos de arena como de 2 Km. de ancho y luego roca. Es una franja que se encuentra como a 6 Km. de la orilla pero no se trabaja todo, hay zonas de arena y zonas de roca, se trabaja en las de roca.
- La Choya Empieza en Cerro Prieto y se ubica como a unos 15 Km. de distancia de la costa (límite exterior de la zona de pesca). Todo el tiempo hay callo ahí, a veces se enlama el terreno y dejan de trabajar por 4-5 meses. Cuando vuelven a visitar el sitio, encuentran callo de nuevo.

- Entre el CEDO y los Tanques Cuando hay mucha corriente para las zonas que se encuentran más al norte (la Choya y alrededores de Puerto Peñasco) van a la zona entre el CEDO y los Tanques. Los pescadores consideran que hay muy poco callo en esta zona.
- Isla San Jorge Se extiende 50 m por el lado Este, 200 m al Oeste, 500-600 m en los Anegados, y la parte Sureste se extiende 1,5 km; misma zona que para la pesca de pulpo.

Las zonas de pesca menos frecuentadas o secundarias son:

- El Borrascoso Zona secundaria según tres pescadores presentes. Consideran que hay poco callo en este sitio y que es una zona buena para caracol chino.
- San Francisquito Zona secundaria para la gente de Puerto Peñasco según los presentes. Esta zona estaba marcada como principal por algún pescador. Pescan entre 4 - 8 brazas. De la orilla a las piedras es como 1,5 Km., aquí empieza la zona de pesca y se extiende como 2 Km. hacia mayor profundidad (en dirección perpendicular a la orilla). Los de la cooperativa de buzos no van a pescar aquí desde hace un año.

Los cambios en las zonas de pesca tanto principales como secundarias se reflejan en la Figura 7.

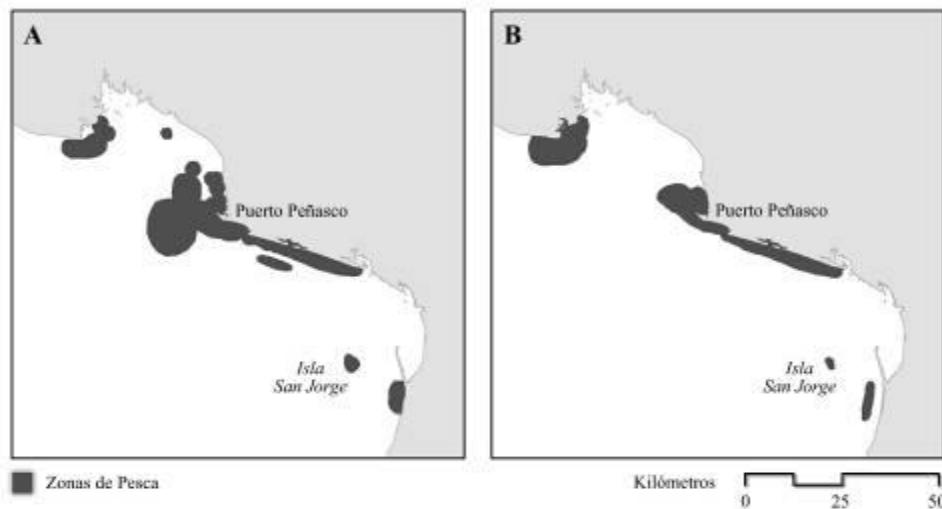


Figure 7. Zonas principales y secundarias de pesca de callo escarlopsa. Derecha: evaluación rápida. Izquierda: taller de validación interna.

Para las zonas de avistamiento de juveniles y de reproducción, los presentes consideraron que son las mismas que las zonas de pesca descritas anteriormente. Uno de los pescadores afirmó que se ven callos pequeños. Dicen haber visto callo pequeño a 2,5 millas hacia el norte de la Choya, pero estuvieron 4 meses sacando 30 - 40 Kg. Según los pescadores, se saca esta cantidad a diario (“la pesca duró mucho ahí”). De acuerdo a la descripción hecha por algunos presentes, la Choya se cuidó por tres años en el 2005 y se estuvo sacando una cantidad similar a la mencionada anteriormente.

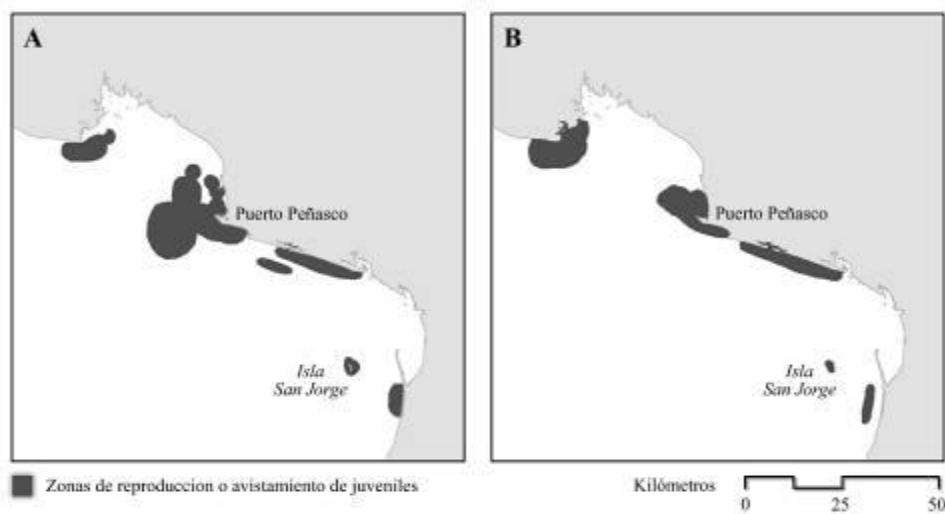


Figure 8. Zonas de avistamiento de juveniles y de reproducción de callo escarlopsa. Derecha: evaluación rápida. Izquierda: taller de validación interna.

Notas adicionales:

- Para el lado del San Judas no sacan callo escarlopsa. Para pescado y caracol el borrascoso es zona principal (van con frecuencia) pero ya no lo es para el callo. En isla San Jorge y afuera de la Choya se ve mucha concha chica, pero piensan que la escarlopsa se reproduce en todas las áreas donde se encuentra callo.
- Pareciera que relacionan las zonas de reproducción y avistamiento de juveniles con zonas donde ven mucha cantidad de callo.

CALENDARIO DE PESCA

Resultados de la evaluación rápida (Figura 9):

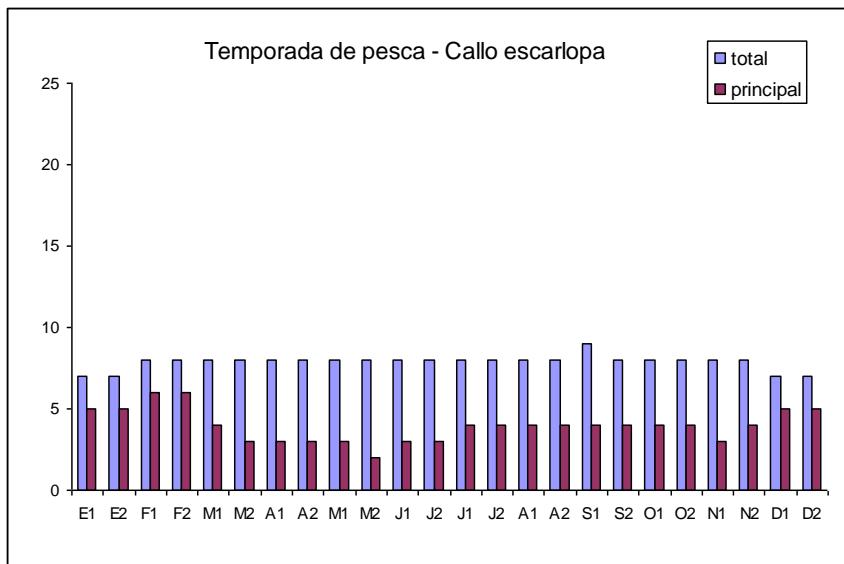


Figure 9. Temporada de pesca total y principal para callo escarlopsa durante 2005. Los meses se dividieron en primera y segunda quincena (ej. E1: primera quincena de enero; E2: segunda quincena de enero).

El eje y indica el número de personas que indicaron que el callo se pesca durante esos meses.

Resultados obtenidos durante el taller de validación interna:

- Temporada total: Todo el año se pesca callo aunque se pesca en menor cantidad cuando coincide con la temporada de caracol chino (de mayo a agosto) y pulpo (de diciembre a marzo).
- Temporada principal: Todo abril, y de septiembre a noviembre.

	E ₁	E ₂	F ₁	F ₂	M ₁	M ₂	A ₁	A ₂	M ₁	M ₂	J ₁	J ₂	J ₁	J ₂	A ₁	A ₂	S ₁	S ₂	O ₁	O ₂	N ₁	N ₂	D ₁	D ₂	
T	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
P	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■

Para callo escarlopsa la temporada total de pesca obtenida durante la evaluación rápida coincidió con los resultados obtenidos en este taller. Sin embargo, la temporada principal difirió y quedó restringida a dos épocas del año, el mes de abril, y de septiembre a noviembre.

PROBLEMÁTICAS

Categorías de problemáticas resultantes de la evaluación rápida (los números no indican orden de importancia):

1. Problemas de comercialización
2. Muchas pangas/muchos pescadores

3. Sobreexplotación del producto
4. Se pesca con hueva o juveniles
5. Factores naturales
6. Falta de control ó regulación

Información obtenida durante el taller para cada uno de los puntos anteriores y categorías nuevas (si aplica):

- 1 y 2. Problemas de comercialización y muchas pangas / muchos pescadores: ya no son importantes. Estos problemas fueron importantes cuando recién se abrió la pesca en las zonas que estaban cuidando (en el 2005). Una vez que se abrió se sacó mucho, vinieron pangas de afuera (de Bahía Kino) y bajó el precio del producto por haber tanta cantidad. Ahora no han tenido ese problema. Comentan que cuando se hicieron las vedas les fue conveniente, sirvió para que hubiera más producto.
3. Sobreexplotación del producto: dijeron que sí está sobreexplotado el producto.
4. Se pesca con hueva o juveniles: dijeron que el problema es que se pesca cuando está desovando y también una vez que ya desovó, cuando el callo enflaca y ya no conviene sacarlo porque lleva mucho esfuerzo capturarlo y da poco rendimiento (en tiempo de calor). Capturar el callo cuando está flaco es más un problema de rentabilidad.
5. Los factores naturales no son un problema.
6. Falta de control o regulación: dijeron que esta es el principal problema en la pesca de callo escarlopsa.

Priorización de problemáticas

1. Falta de control y regulación
2. Sobreexplotación del producto
3. Se pesca cuando reproduce y cuando el callo está flaco

Uno de los buzos comenta que existe corrupción de autoridades, ya que gente que no tiene permisos de especies de buceo (en su mayoría son gente de fuera) se ampara con gente que si los tiene.

Pulpo (*Octopus spp.* o posiblemente *O. hubssorum*)

ZONAS DE PESCA

Esta es una lista de las zonas de pesca más frecuentadas o principales para pulpo y una breve descripción proporcionada por los pescadores. Indican como zona de pesca un polígono pegado a la orilla hasta 45 pies de profundidad.

- La Choya y Puerto Peñasco Indican como zona de pesca un polígono pegado a la orilla hasta 45 pies de profundidad.
- La Choya Entre los 45-50 pies en el límite más profundo y unos 25 pies en la orilla.
- Por fuera de la Choya Es una zona de pesca importante; más a lo hondo le dicen “fuera de la Choya” y mas a la orilla es “la Choya”. Pero en general, todo queda dentro de la zona a la que llaman “la Choya”.
- Cerro Peñasco y frente a CEDO No dieron mucho detalle sobre estas zonas.
- Frente a estero Morua Primer tanque y segundo tanque. Al costado del muelle le dicen la casa del perro.
- Isla San Jorge A unos 200-300 metros alrededor de la isla. Le dicen “la piedra del cuco”
- Este Isla San Jorge La zona de pesca se extiende como 50 metros de la orilla, y la costa Oeste unos 200-300 m. de la orilla. El lado sur se extiende desde la orilla a unos 1000 metros de la costa, es una zona continua. En el lado Noroeste están “los anegados” y se extiende desde la orilla hasta unos 400 metros de la costa.

Zonas de pesca menos frecuentadas o secundarias (zonas Y en evaluación rápida):

- San Francisquito O también conocido como el Jagüey, se va con menos frecuencia por tanto se considera una zona secundaria
- Varias (no indicadas) Para los presentes las demás zonas que salían marcadas como secundarias (además de San Francisquito) no eran zonas de pesca. Sin embargo, no se eliminaron del mapa porque para algunos pescadores pueden haber sido sus zonas secundarias de pesca (se hizo la observación en el mapa).

Los cambios en las zonas de pesca tanto principales como secundarias se reflejan en la Figura 10.

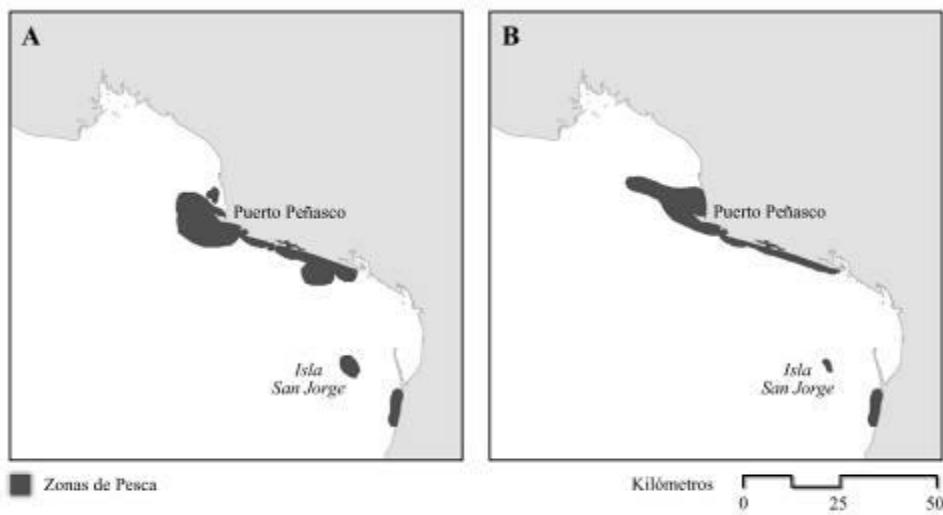


Figure 10. Zonas principales y secundarias de pesca para pulpo. Derecha: evaluación rápida. Izquierda: taller de validación interna.

Zonas de avistamiento de juveniles y de reproducción (zonas J y R en evaluación rápida): Las zonas de juveniles y reproducción, son las mismas que las zonas de pesca. Esto porque el pulpo se arrima a la costa a desovar y ahí es cuando se pesca. El bicho pasa de blanco a café (el color de la hueva cuando madura). Como están cuidando a sus crías no se alimentan, así que luego mueren. Las mismas áreas que marcaron al comienzo es donde se reproduce. La temporada principal es de diciembre a marzo pero en las áreas cerca de Puerto Peñasco. Para Isla San Jorge los meses de trabajo son abril y mayo, siendo el mes de mayo el mes principal para la pesca de pulpo.

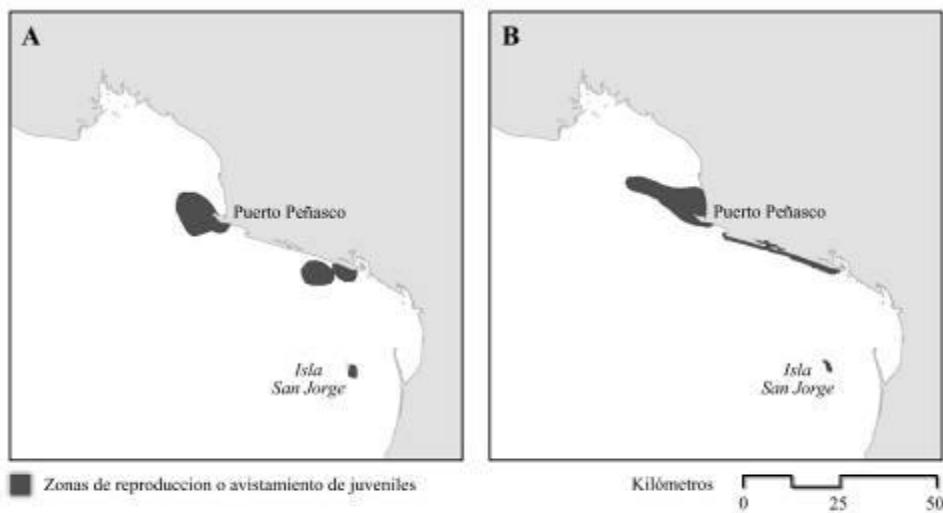


Figure 11. Zonas de avistamiento de juveniles y de reproducción para pulpo. Derecha: evaluación rápida. Izquierda: taller de validación interna.

Notas adicionales: Las zonas de pesca que aparecen cerca de Puerto Lobos son zonas de pesca de gente de Puerto Libertad, los de Puerto Peñasco ya no van a pescar allí. El “Burragacha” indicó esas zonas según René.

CALENDARIO DE PESCA

Resultados obtenidos durante el taller:

- Temporada total: Desde la segunda quincena de noviembre a mayo.
- Temporada principal: De diciembre a mayo.
- Estacionalidad de la pesca por zonas: De diciembre a marzo se trabaja en las áreas cercanas a Puerto Peñasco (la Choya, frente a Puerto Peñasco). En Isla San Jorge se trabaja en abril y mayo, siendo mayo el mes principal para la pesca de pulpo en la isla. En todas las zonas de pesca (incluyendo la isla) la temporada principal de pesca va de diciembre a mayo.

Para pulpo, las temporadas de pesca total y principal obtenidas en la evaluación rápida coincidieron bastante con los resultados de este taller de validación interna. Sin embargo, los meses de junio y julio no fueron mencionados por los presentes como meses en que la pesca de pulpo tenga lugar. Resultados de la evaluación rápida (Figura 12):

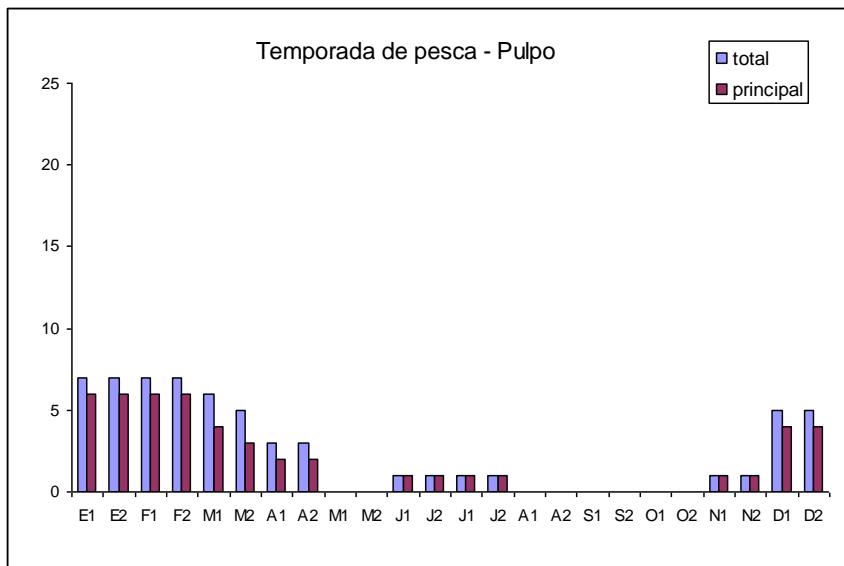


Figure 12. Temporada de pesca completa y principal para pulpo durante 2005. Los meses se dividieron en primera y segunda quincena (ej. E1: primera quincena de enero; E2: segunda quincena de enero).

El eje y indica el número de personas que indicaron que el pulpo se pesca durante esos meses.

PROBLEMÁTICAS

Categorías de problemáticas resultantes de la evaluación rápida (los números no indican orden de importancia):

1. Problemas de comercialización
2. Muchas pangas y muchos pescadores
3. Sobreexplotación del producto
4. Se pesca con hueva o juveniles

Información obtenida durante el taller para cada uno de los puntos anteriores y categorías nuevas (si aplica):

1. Problemas de comercialización: este problema se da solo cuando hay mucho producto y los precios bajan mucho.
2. Muchas pangas / muchos pescadores: este problema se da también cuando hay temporadas buenas de pulpo y vienen pescadores de otros lados a capturarlo sin tener permisos.
3. Sobreexplotación del producto: dijeron que no es importante este problema porque el pulpo, al ser de arribazón, no se sobreexplota. El pulpo se arrima a la costa a desovar y luego desaparece y por más que lo quieran capturar ya no lo

encuentran, por eso dicen que no tienen oportunidad de sobreexplotarlo, además de que todos los años vuelve a haber pulpo.

4. Se pesca con hueva o juveniles: este problema se da más al empezar y finalizar la temporada de pesca, ya que se pesca muy chico al iniciar la temporada o con hueva al finalizar la temporada. Esto se da porque lo reciben los compradores según los presentes.
5. Problemática nueva: muchas pangas (de fuera o de peñasco) amparadas por permisos de permisionarios o de cooperativas que no tienen buzos. El problema con los permisos esta relacionado con la 2do problemática (muchas pangas/pescadores), ya que cuando hay mucho producto además de que llegan pescadores de otra región también son amparados por permisos de permisionarios o cooperativas que tienen permisos para productos de buceo pero que no son buzos. Hay mala distribución de permisos de pesca, gente que es buzo y no tiene permiso, y gente que no lo es y si los tiene. Los pescadores de fuera hasta se toman fotos y cambian el nombre de la panga para que cuando las autoridades les pidan el permiso tengan como respaldarse.
6. Problemática nueva: Corrupción de las autoridades. La gente que se dedica al turismo o a la pesca deportiva se vuelven pulperos con permiso de otros cuando hay mucho pulpo (no hay control de pesca) y eso se da porque las autoridades son corruptas según los pescadores.

Priorización de problemáticas:

1. Muchas pangas (de fuera o de Puerto Peñasco) amparadas por permisos de permisionarios o de cooperativas que no tienen buzos. La categoría “muchas pangas / pescadores” quedó incluida en esta categoría ya que el problema no es tanto que vengan muchas pangas sino que vengan sin tener permiso para trabajar o se amparan con permisos de gente de peñasco que no se dedica al buceo en otros momentos del año y ellos que son cooperativa de buzos no tienen permisos para todos los productos de buceo que trabajan (los están intentando conseguir). Este problema se da solo cuando hay mucho producto y vienen a pescarlo de otras partes.
2. Se pesca con hueva o juveniles.
3. Corrupción de las autoridades.
4. Problemas de comercialización – aunque solo se da cuando hay mucho producto.

Pargo coconaco (*Hoplopagrus guentherii*) y Baya (*Mycteroperca jordani*)

ZONAS DE PESCA

Esta es una lista de las zonas de pesca más frecuentadas o principales para pargo coconaco y baya de acuerdo a los pescadores:

- | | |
|-------------------------------------|--|
| - Cerro Prieto y la Choya | Mismas profundidades que para pulpo. |
| - Cerro de Puerto Peñasco | No estaba marcado como zona principal para pargo en los resultados de las encuestas. |
| - CEDO a Estero Morua | Desde la orilla hasta 500 - 600 metros de la costa. |
| - Los Tanques hasta el Mayan Palace | El área de pesca abarca 1 Km. desde la costa. |

Zonas de pesca menos frecuentadas o secundarias:

- Los Pinitos y La Salina Es una zona secundaria según pelón. Las piedras están muy separadas ahí, es un área grande con grandes intervalos de arena. Se pesca entre 7 y 9 brazas. Hay mucha panopea allí.

Los cambios en las zonas de pesca tanto principales como secundarias se reflejan en la Figura 13.

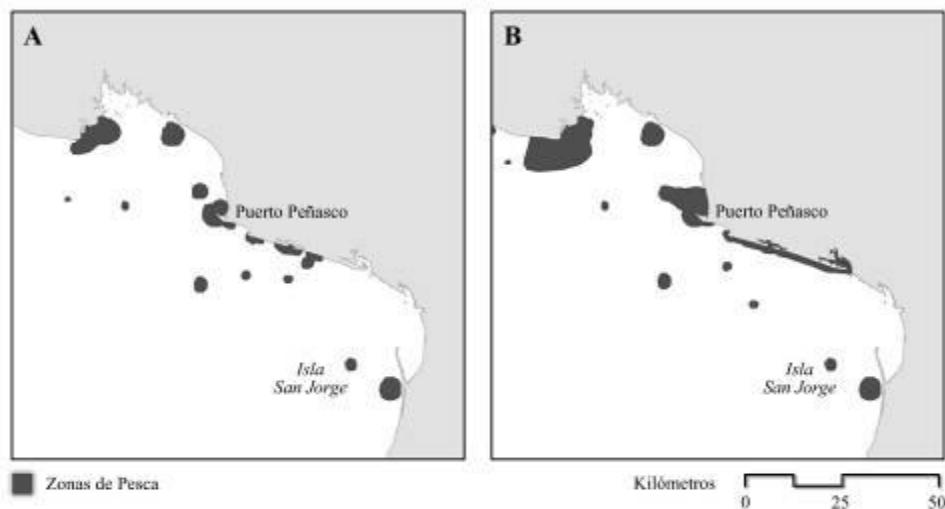


Figure 13. Zonas principales y secundarias de pesca para pargo coconaco y baya. Derecha: evaluación rápida. Izquierda: taller de validación interna.

Zonas de avistamiento de juveniles y de reproducción (zonas J y R en evaluación rápida). Se encuentra mas pargo chico en el estero, cerca de CEDO. Entre CEDO y el estero

Morúa se ve mucho parguito chiquito. Y también en los Tanques, por el segundo tanque. Pargos de 10 -12 Kg. en el Borrascoso y la Choya (Figure 14).

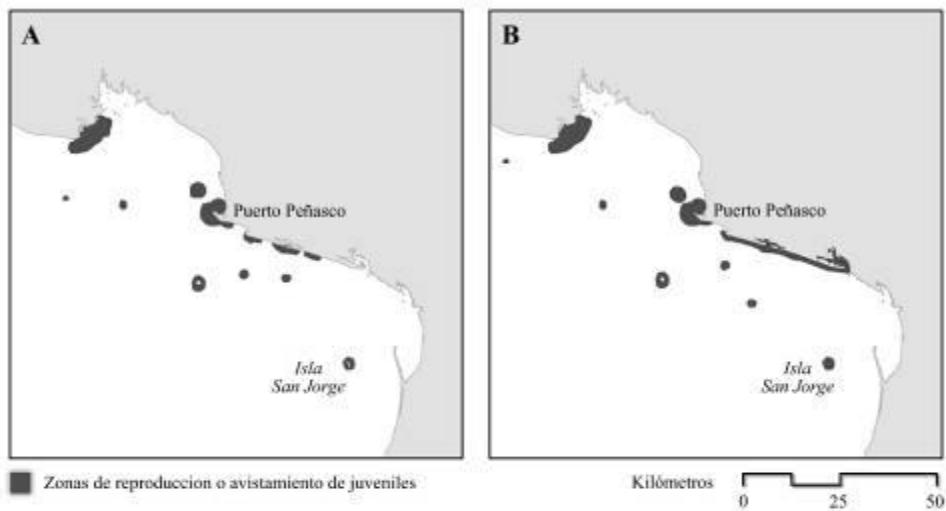


Figure 14. Zonas de avistamiento de juveniles y de reproducción para pargo coconaco y baya.
Derecha: evaluación rápida. Izquierda: taller de validación interna.

Notas adicionales: A la isla San Jorge casi no van al pescado.

CALENDARIO DE PESCA - Para Pargo Coconaco

Resultados de la evaluación rápida (Figura 15):

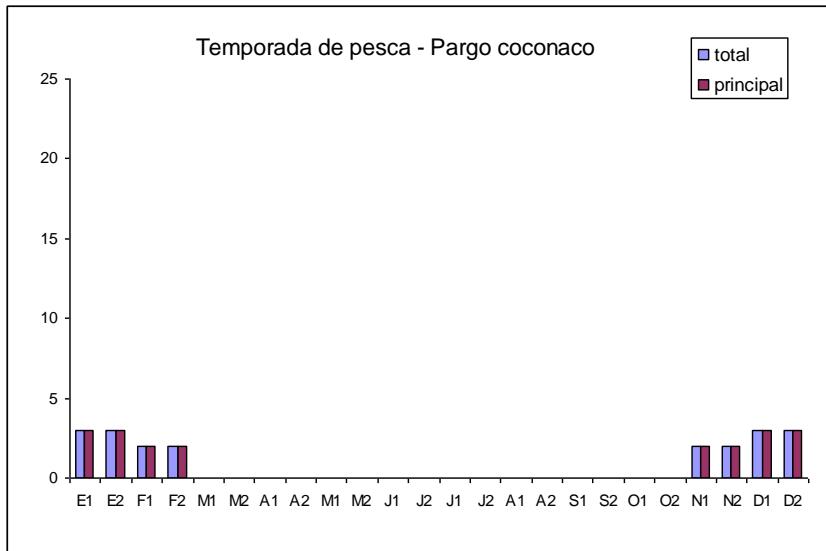


Figure 15. Temporada de pesca total y principal para pargo coconaco durante 2005. Los meses se dividieron en primera y segunda quincena (ej. E1: primera quincena de enero; E2: segunda quincena de enero).

El eje y indica el número de personas que indicaron que el pargo coconaco se pesca durante esos meses.

Resultados obtenidos durante el taller:

- Temporada total: de noviembre a febrero. Recién en noviembre empieza a arrimar.
- Temporada principal: de diciembre a febrero. En diciembre se han registrado capturas de 150 - 200 Kg. / panga (año 2006). En enero y febrero las capturas rondan los 30 – 40 – 50 Kg. por salida por panga.

T	E ₁	E ₂	F ₁	F ₂	M ₁	M ₂	A ₁	A ₂	M ₁	M ₂	J ₁	J ₂	J ₁	J ₂	A ₁	A ₂	S ₁	S ₂	O ₁	O ₂	N ₁	N ₂	D ₁	D ₂	
P																									

Para pargo coconaco, las temporadas de pesca total y principal obtenidas en la evaluación rápida coincidieron con los resultados del taller

PROBLEMÁTICAS - para Pargo coconaco

Categorías de problemáticas resultantes de la evaluación rápida (los números no indican orden de importancia):

1. Los barcos
2. Inconvenientes con los equipos (robo, abandono, pérdida)

Información obtenida durante el taller para cada uno de los puntos anteriores y categorías nuevas (si aplica):

1. Los barcos no son un problema ni para los pargos adultos ni para los juveniles según los presentes.
2. Inconvenientes con los equipos (robo, abandono, pérdida): el único problema que mencionaron tiene que ver con las redes que se pierden o quedan tendidas y los pargos quedan enmallados en ellas, a pesar de no ser especie objetivo de los de chinchorro.

CALENDARIO DE PESCA - para Baya

Resultados de la evaluación rápida (Figura 16):

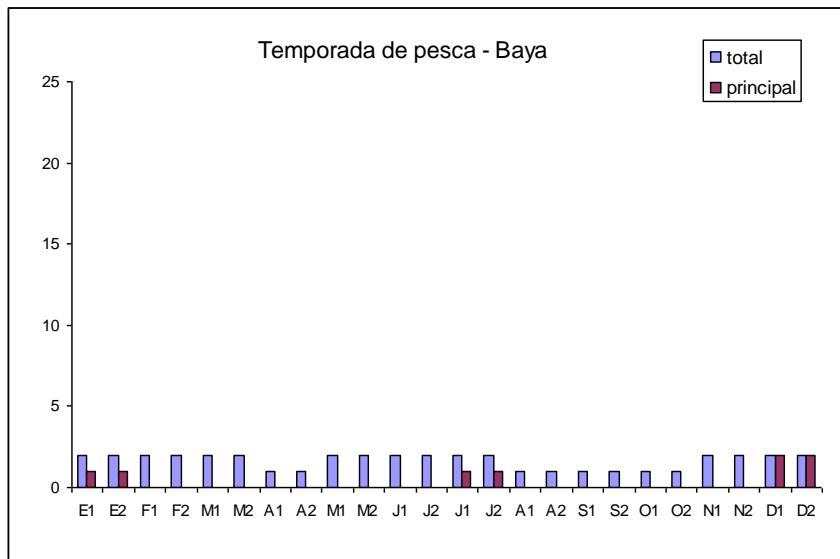


Figure 16. Temporada de pesca total y principal para baya durante 2005. Los meses se dividieron en primera y segunda quincena (ej. E1: primera quincena de enero; E2: segunda quincena de enero).

El eje y indica el número de personas que indicaron que la baya se pesca durante esos meses.

Resultados obtenidos durante el taller:

- Temporada total: de noviembre a febrero (misma que para pargo).
- Temporada principal: de diciembre a febrero (misma que para pargo).
- En abril y mayo sale más Baya en el área del CEDO - estero Morúa.
- Entre marzo y octubre la baya se encuentra fuera de las cuevas y es más difícil de capturar por los buzos.

	E ₁	E ₂	F ₁	F ₂	M ₁	M ₂	A ₁	A ₂	M ₁	M ₂	J ₁	J ₂	J ₁	J ₂	A ₁	A ₂	S ₁	S ₂	O ₁	O ₂	N ₁	N ₂	D ₁	D ₂
T																								
P																								

Para la baya, durante el taller las temporadas de pesca total y principal quedaron acotadas a 3-4 meses durante el año.

PROBLEMÁTICAS - para Baya

Categorías de problemáticas resultantes de la evaluación rápida (los números no indican orden de importancia):

1. Los barcos
2. Sobreexplotación del producto
3. Uso de artes de pesca dañinos

Información obtenida durante el taller para cada uno de los puntos anteriores y categorías nuevas (si aplica):

1. Los barcos: no es un problema para la baya.
2. Sobreexplotación del producto: no es un problema ya que como es de corrida piensan que no se sobreexplota.
3. Uso de artes de pesca dañinos: no hay mucho buceo de noche y por ello indicaron que esto no sería un problema.
4. Problemática nueva: Falta de control a la pesca deportiva. Comercializan el producto a pesar de ser pesca deportiva y es ilegal.

Problemática nueva: Se capturan de pequeño tamaño (juveniles).

Priorización de la problemática para Baya:

1. Falta de control a la pesca deportiva.
2. Se capturan de pequeño tamaño (juveniles).

Término del taller: 3:30pm

TALLER DE CHINCHORRO

17 de noviembre, 2007

Participantes:

Inicio del taller: 10:30am

Guitarra (*Rhinobatus productus*)

ZONAS DE PESCA

No hubo cambios en las zonas principales o secundarias en cuanto a límites de la costa a mar abierto en general sin embargo, se ajustaron los límites por la costa hacia el Borrascoso y bahía San Jorge. Esta pesquería se realiza en profundidades de 20 brazas, comenzando desde la costa (orilla). A más profundidad es donde los barcos trabajan (pesca industrial). Los pescadores de Puerto Peñasco identificaron los límites de las zonas de pesca desde Isla San Jorge hasta El Borrascoso. La pesca de guitarra en Bahía San Jorge también va junto con la de jaiba.

Para las zonas de pesca menos frecuentadas o secundarias (zonas Y en evaluación rápida) obtuvimos detalles para algunas zonas:

- La Salina Esta considerada una zona secundaria que frecuentan pero no mucho. Ellos aseguran que no van más al norte pues ya pertenece a otros grupos o comunidades.
- Las 7 millas Le dicen a una zona de pesca que se encuentra a esa distancia de Puerto Peñasco. Si se enteran que otro pescador ya tiró el chinchorro en este sitio, el resto de los pescadores ya no van allí porque es una piedra que da para que pesque un solo chinchorro por su pequeño tamaño. Si tiendes el chinchorro más afuera de las piedras ya te metes en la zona de arrastre de los barcos y uno corre el riesgo de que te arrastren los chinchorros

Los cambios reflejados en las zonas de pescas principales y secundarias se muestran en la Figura 17.

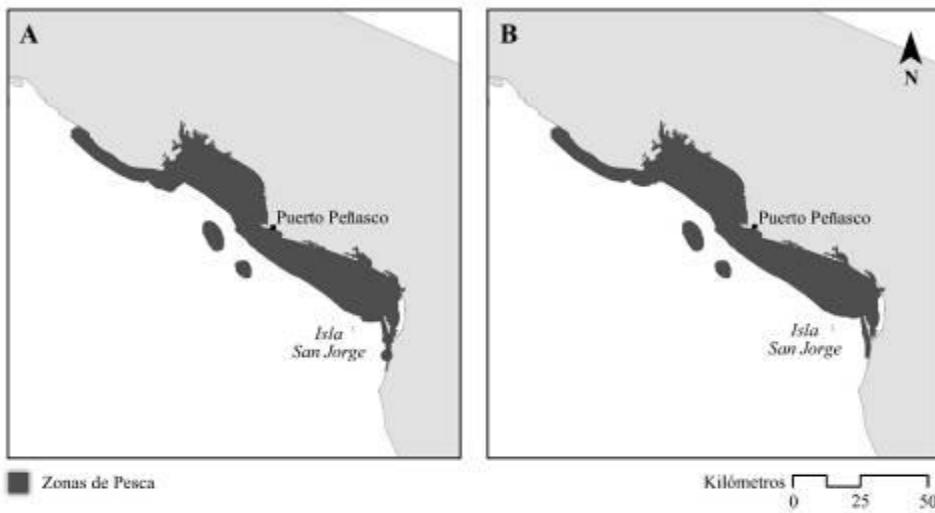


Figure 17. Zonas principales y secundarias de pesca para guitarra. Derecha: evaluación rápida. Izquierda: taller de validación interna.

Para las zonas de juveniles y de reproducción (zonas J y R en evaluación rápida), no hubo cambios. Los pescadores indicaron que estas zonas son las mismas zonas de pesca porque ahí mismo llega esta especie a reproducirse. De abril a junio viene la guitarra a dejar la hueva y ahí mismo se pesca. La guitarra se pesca todo el año pero la temporada principal es de abril a junio (inclusive). Esta especie recalca primero en la pinta y después se va hacia la Choya, ahí es donde entra en tiempo de calor.

Notas adicionales:

- Cuando los pescadores andan en otras pesquerías, van mas afuera de la zona indicada (en cimbra por ejemplo). Dependiendo de la temporada van a ciertas zonas.
- Uno de los pescadores apuntó que las zonas principales son desde Las Salinas hasta Isla San Jorge, aclarando que esos eran sus límites (de Puerto Peñasco). Cuando ellos salen de esos límites, ellos reconocen que son zonas de otras comunidades como Puerto Libertad, Puerto Lobos, Desemboque de Caborca y Golfo de Santa Clara.
- De abril a junio pescan a profundidades de 1 - 3 brazas y a 11 - 12 brazas. La guitarra llega en esa época a desovar.
- Consideran entonces zona de Puerto Peñasco desde La Salina al Borrascoso; más allá le toca a los golfeños (Golfo de Santa Clara). Mas allá de la salina les pertenece a los que son de la salina así que los peñasqueños (Puerto Peñasco) ya no se meten ahí.
- Muchos pescadores que son de peñasco pescan en Puerto Peñasco y en el Golfo de Santa Clara, por eso puede ser que algunos pescadores hayan

- marcado las zonas más allá de la salina (que corresponden a los de Golfo de Santa Clara).
- Generalmente no van más allá de la Salina por el gasto de gasolina. Nadie va para el Tornillal a pescar guitarra, pero sí van allí a pescar curvina y cabicucho.
 - Manta y guitarra se trabajan juntas.

CALENDARIO DE PESCA

Los resultados durante la evaluación rápida se presentan en la Figure 18.

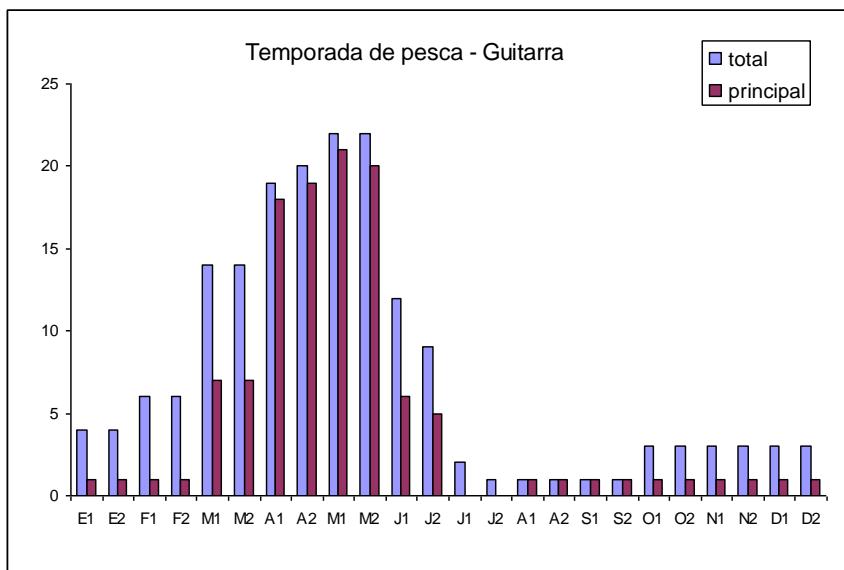


Figure 18. Temporada de pesca total y principal para guitarra durante 2005. Los meses se dividieron en primera y segunda quincena (ej. E1: primera quincena de enero; E2: segunda quincena de enero).

El eje y indica el número de personas que indicaron que la guitarra se pesca durante esos meses.

Resultados obtenidos durante el taller:

- Temporada total: Se pesca todo el año.
- Temporada principal: De abril a junio.

PROBLEMÁTICAS

Categorías de problemáticas resultantes de la evaluación rápida (los números no indican orden de importancia):

1. Problemas de comercialización
2. Los barcos

3. Esta sobreexplotado
4. Se pesca con hueva o de pequeño tamaño
5. Demasiado control / restricciones
6. La gente no respeta las reglas
7. Falta de control o regulación por autoridades
8. Inconvenientes con los equipos (robo, abandono, pérdida, averías)
9. El uso de artes de pesca dañinos

Información obtenida durante el taller para cada uno de los puntos anteriores y categorías nuevas (si aplica):

1. Problemas de comercialización: Todos los productos antes de semana santa tienen buen precio. En el caso de la guitarra esta arrima a la costa después de la cuaresma cuando no hay mucha demanda por lo que el precio es bajo.
2. Los barcos: Se refiere a que los barcos no respetan el área de captura del camarón, invadiendo el área de pesca de la guitarra, en zonas poco profundas. Los barcos arrastran en 5 o 6 brazas de profundidad sacando muchas crías de guitarra y de muchas especies. Desde hace unos 15 años hasta hoy los barcos han arrastrado en estas zonas.
3. Esta sobreexplotado: Hace 25 años había más pescadores que ahora en Puerto Peñasco ya que había de 200 a 300 pangas. Pero también los barcos no se dedicaban a la escama en esos tiempos. Por eso es que hoy esta sobreexplotada la pesca de guitarra. Las pangas y los barcos tienen culpa de que haya sobreexplotación. Los barcos industriales que pescan en las zonas de pesca de los ribereños, no respetan las vedas y trabajan en los tepetates y ahí es donde los pescados se reproducen (marzo-abril arriban los barcos escamaros). El problema son también las pangas que vienen de fuera (de Desemboque, Paredón Colorado, Paredoncito, Puerto Libertad, Puerto Lobos). Recalcan que si solo existieran en la pesca la gente de Puerto Peñasco, no tendrían tanta sobreexplotación.
4. Se pesca con hueva o de pequeño tamaño: actualmente se pesca con hueva y también juveniles por parte de las pangas y de los barcos de arrastre. Antes no había una regulación por especies, no está reglamentado las mallas que debemos de trabajar. Se están usando mallas más chicas para capturar la guitarra porque sale cada vez más pequeña. El pescador ribereño se puede ordenar utilizando malla adecuada y adecuándose a la temporada de desove de la guitarra (dando a entender que es posible cuidar la pesquería pero como compiten con los barcos, terminan usando mallas pequeñas los ribereños para capturar algo al menos).
5. Demasiado control / restricciones: Los buzos asumieron que este problema junto con el 7 (falta de control o regulación por parte de autoridades) se generan a partir del problema con los barcos industriales (problema 2). Explican que los pescadores ribereños se quejan porque hay demasiadas restricciones para ellos en

comparación al escaso control que se le da a la pesca industrial cuyos barcos pescan en las zonas de pesca de las pangas. “Las autoridades solamente revisan a los pescadores ribereños y no a los barcos que están infringiendo la ley (arrastran en áreas que no les corresponden)”. Explican que las autoridades aplican la misma intensidad de castigo a un pescador que a un barco cuando las condiciones son diferentes entre ambos (dio el ejemplo de una multa bastante alta). Por ello sugirieron cambiarle el nombre al problema 5 “demasiado control/restricciones” por este otro “adecuar las restricciones por tipo de embarcación”.

6. La gente no respeta las reglas: indicaron que los que no respetan las reglas son los barcos ya que no respetan las vedas, la luz de malla y sobre todo existen barcos camarones de otras comunidades.
7. Falta de control o regulación por autoridades: se refiere a la falta de control por parte de las autoridades a la pesca industrial porque pescan en zonas que no les corresponden y también porque roban y rompen las redes de los pescadores ribereños al arrastrar sus chinchorros. “Las autoridades no aplican bien las reglas y los barcos pescan donde les da la gana”. “Es urgente que nos pongan atención a los ribereños por que estamos quedando abandonados.”
8. Inconvenientes con los equipos (robo, abandono, pérdida, averías): se refiere a robo o averío de chinchorros por parte de los barcos.
9. El uso de artes de pesca dañinos: explican que han tenido necesidad algunos pescadores de ser partícipes de ello ya que los barcos u otras embarcaciones no respetan lo que dice la ley. Un ejemplo es el chinchorro cuando le quitan la boyo por competencia.

Problemática nueva: Falta de acceso a permisos y apoyos económicos para pescadores libres. Los escameros se sienten bastante abandonados en este aspecto. Indican que no hay un programa de regulación de permisos adecuado para escameros. “Los beneficios llegan para los permisionarios disfrazados de cooperativas, CEDO no ha trabajado con pescadores libres, solamente con las cooperativas antes mencionadas. Las cooperativas rentan los permisos a los pescadores libres.”

Notas adicionales.

Por Ángeles Sánchez y Mario Rojo

El problema de los camarones es de verdad serio, ya que a parte de que hacen arrastres en zonas no permitidas, estas zonas son tepetates que son destruidos por el arrastre. El camarónero no respeta la veda. Cabe aclarar que los pescadores tienen conocimiento de la ley de pesca, pero también saben que cuando se hizo ésta aún no existía la pesquería de guitarra. Los pescadores sugieren que debería reestructurarse la ley para tenga en cuenta esta pesquería. La manta se inicio pescando como pesca incidental.

Priorización de Problemáticas:

1. Falta de control o regulación por autoridades y falta de acceso a permisos y apoyos económicos para pescadores libres.
2. Los barcos
2. Adecuar las restricciones por tipo de embarcación (relacionado con los barcos)
2. Inconvenientes con los equipos (robo, pérdida, roturas) (relacionado con los barcos)
3. Sobreexplotación del producto (relacionado con los barcos y pangas de fuera)
3. Se pesca con hueva o de pequeño tamaño (relacionado con los barcos y pangas)
3. La gente no respeta las reglas (relacionado con los barcos y pangas)
4. Problemas de comercialización

Lenguado (*Paralichthidae / Pleuronectidae*)

ZONAS DE PESCA

En cuanto a las zonas principales y secundarias de pesca del lenguado, se delimitó una zona continua siguiendo a una distancia entre 1 y 10 Km. de la costa. Las zonas para lenguado de Puerto Peñasco comprenden desde la isla San Jorge hasta el Borrascoso o la Salina. Cambios reflejados en las zonas de pesca principales (Figura 19). Esta es una lista de las zonas de pesca más frecuentadas o principales para pulpo de acuerdo a los pescadores:

- Fuera de isla San Jorge	Cerca de la isla hay mucho lobo marino y como a 1 Km. retirado tiran los chinchorros.
- Fuera de los Huesos hasta el estero Morúa	Se pesca el lenguado frente a Puerto Peñasco también. El lenguado se trabajan de 8 a 10 brazas
- La Salina hasta 13 millas	A 20 brazas y a 32 millas de la Choya también encuentran.
- Piedra la Salinita	Se encuentra a 13 millas de la Choya. Ahí también se pesca lenguado

Los cambios en las zonas de pesca tanto principales como secundarias se reflejan en la Figura 19.

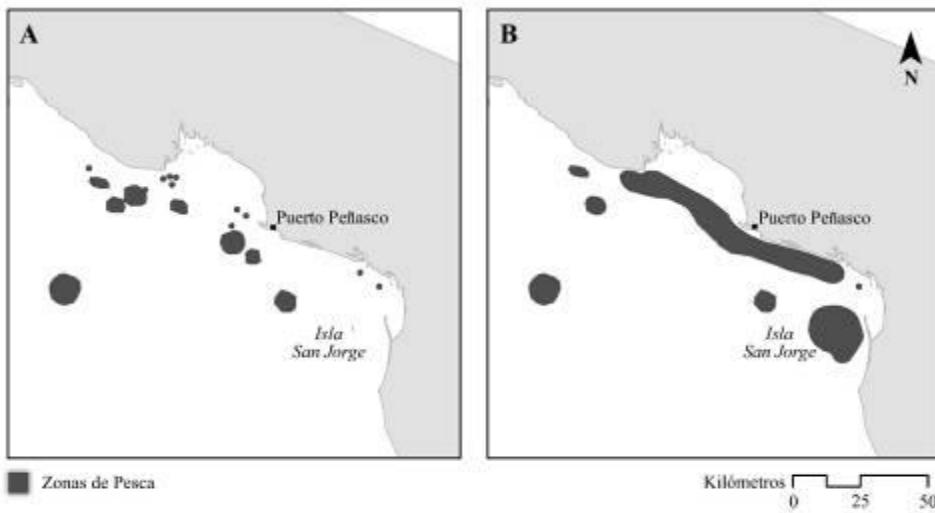


Figure 19. Zonas principales y secundarias de pesca para lenguado. Derecha: evaluación rápida. Izquierda: taller de validación interna.

Para las zonas de avistamiento de juveniles y de reproducción, hubo cambios en zonas de juveniles y sitios de reproducción. Los cambios fueron básicamente la adición de zonas que no fueron especificadas anteriormente. Solo se habían identificado tres zonas y con la validación se delimitó casi toda la costa desde el estero la Pinta hasta el Borrascoso. Los juveniles los ven en la bahía San Jorge, Bahía Adair, la Choya. Por fuera de la Choya hasta por fuera del Borrascoso por 9 hasta 11 brazas de profundidad.

En la zona desde la pinta hasta la Salina (estero), se capturan o se observan los juveniles. Las zonas de pesca del lenguado también son zonas de avistamiento de juveniles; por toda la orilla se pueden apreciar los juveniles del lenguado, desde 200 m. hasta bajamar. La zona desde la bahía San Jorge hasta el Borrascoso también se considera zona de juveniles. Nota: En la orilla sale lenguado chico. Los cambios se ven reflejados en la Figure 20 de las zonas de avistamiento de juveniles y zonas de reproducción.

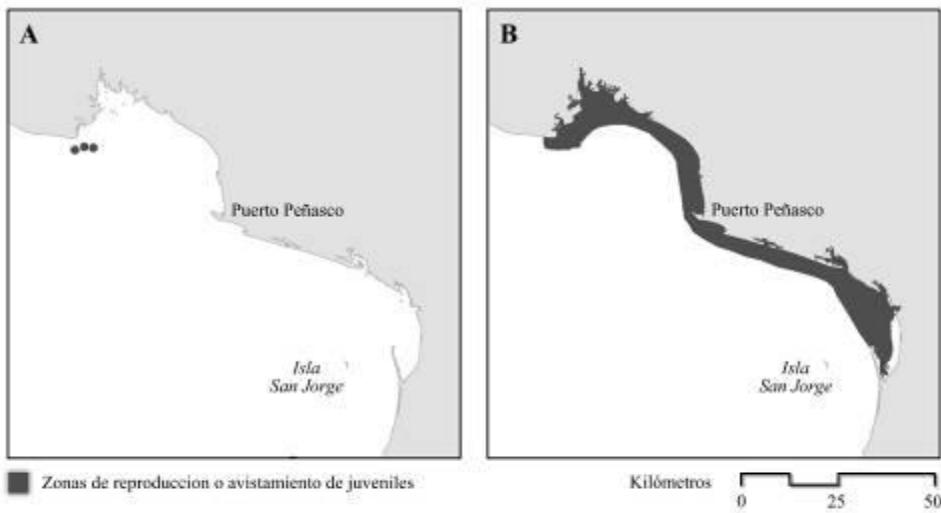


Figure 20. Zonas de avistamiento de juveniles y de reproducción para lenguado. Derecha: evaluación rápida. Izquierda: taller de validación interna.

Notas adicionales

- Para esta especie, se limitan en sus zonas por el gasto de gasolina principalmente.
- La temporada de pesca de diciembre a enero es la mejor para el lenguado y para quienes no van al camarón desde septiembre a enero. Los demás meses hasta mayo se deja de pescar lenguado.
- Comentario de Rene o algún pescador en el taller: “aunque el canelo me dijo que él en junio / julio sale a unas piedras y saca mucho lenguado”.
- Se tienen que cuidar mucho de los barcos porque terminan con el camarón y siguen arrastrando la escama.
- Casi no tiran en zona arenosa porque los barcos arrastran en esa parte, buscan las piedras para que los barcos no se lleven el chinchorro.
- El lenguado tiende a protegerse entre las piedras. Esto para no ser capturado por los barcos, y es en la zona de pesca de los ribereños que a la vez protegen sus redes en las piedras de los barcos (Nota de Ana: creo que se refiere a que los pescadores ribereños tienden sobre las piedras para que los barcos no arrastren sus chinchorros y es ahí mismo donde se “guarece” el lenguado).
- Los pescadores ya no visitan el Piedrón para pescar lenguado, nada más para pescar baqueta.

CALENDARIO DE PESCA

Resultados de la evaluación rápida (Figura 21):

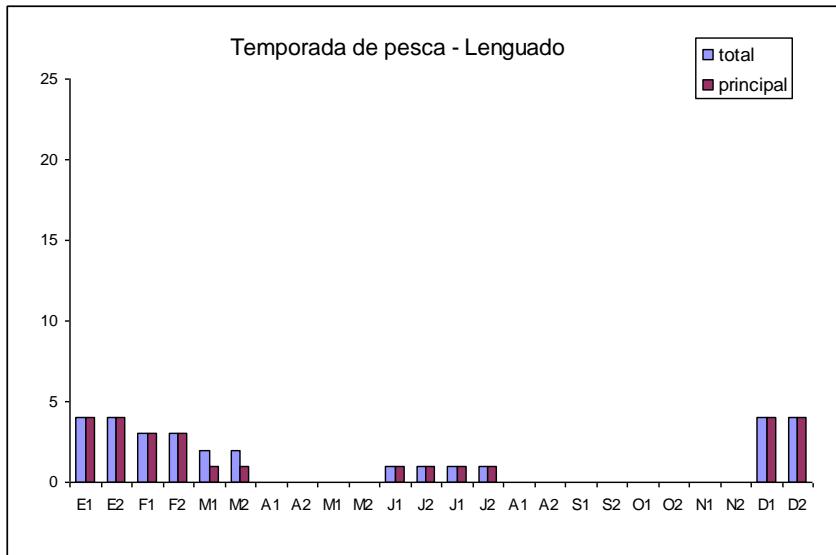


Figure 21. Temporada de pesca total y principal para lenguado durante 2005. Los meses se dividieron en primera y segunda quincena (ej. E1: primera quincena de enero; E2: segunda quincena de enero).

El eje y indica el número de personas que indicaron que el lenguado se pesca durante esos meses.

Resultados obtenidos durante el taller:

- Temporada total: De septiembre a mayo. No se captura en julio-agosto, para darle preferencia al camarón.
- Temporada principal: De diciembre a enero sale en mayor cantidad.

T	E ₁	E ₂	F ₁	F ₂	M ₁	M ₂	A ₁	A ₂	M ₁	M ₂	J ₁	J ₂	J ₁	J ₂	A ₁	A ₂	S ₁	S ₂	O ₁	O ₂	N ₁	N ₂	D ₁	D ₂	
P																									

Para lenguado, las temporadas de pesca total y principal de la evaluación rápida coinciden medianamente con los resultados obtenidos durante el taller. Según los pescadores de Puerto Peñasco, junio y julio no son meses de pesca de lenguado según los participantes del taller. Se agregaron algunos meses que no fueron indicados en la evaluación rápida (abril, mayo, primera quincena de septiembre, octubre y noviembre).

PROBLEMÁTICAS

Categorías de problemáticas resultantes de la evaluación rápida (los números no indican orden de importancia):

1. Los barcos
2. Demasiado control/restricciones por parte de las autoridades

3. Información obtenida durante el taller para cada uno de los puntos anteriores y categorías nuevas (si aplica):
 4. Los barcos: Arrastran los chinchorros y pescan incidentalmente los juveniles de lenguado. Los barcos son “depredadores de pangas”. Casi no se trabaja debido a que se tiene que pescar muy afuera y es donde ocasionan problemas los barcos.
 5. Demasiado control / restricción es por parte de autoridades: Cambió por “adecuar los controles al tipo de pesca ribereña” como en el caso de la guitarra.

Priorización de problemáticas:

1. Los barcos
 2. Adecuar los controles al tipo de pesca ribereña

Sierra (*Scomberomorus sierra*)

Tres personas de los presentes son sierreros, se dedican a la sierra como especie objetivo.

ZONAS DE PESCA

Para Sierra el área de pesca más frecuentada quedó igual, a excepción de una zona que se quitó (ver figura 5). La sierra atraca en los meses de septiembre - octubre (dos meses). Inicia en la isla San Jorge y se pesca en el estero Morúa y Borrascoso. Va en corrida, entra un mes y sigue hasta el Borrascoso y hasta el Golfo de Santa Clara (se va corriendo). Otros sitios específicos indicados fueron: estero Morúa, Primer Tanque, Segundo Tanque. En el Borrascoso y la Choya se puede encontrar una buena cantidad de producto. En junio se trabaja con tubitos pero agarras hasta 150 kg.

Cuando hay mucha producción es en septiembre y octubre (cuando viene del sur - Guaymas, Baja California); y hay poca en junio (cuando regresa la corrida). Esta es una lista de las zonas de pesca más frecuentadas o principales para pulpo de acuerdo a los pescadores:

- Los Tanques Primero y Segundo Tanque, están dentro de la zona que ellos llaman el “estero Morúa”. Este es un punto de pesca (una marca) en la zona del estero. Se trabaja en las 3 brazas.

En los tanques se pone bien en septiembre - octubre. Hay producciones de media tonelada, 300kg. La sierra recalca primero en los Tanques y va subiendo hasta el Borrascoso, no van más al norte porque ahí trabajan los del Golfo de Santa Clara.

- Isla San Jorge Ahí van los pescadores que se quedan (acampan) por dos o tres días porque es lejos. En septiembre - octubre la isla es una buena zona para encontrar producto. Se trabaja en las 10 brazas.
- El Borrascoso Se trabaja en las 2 y 3 brazas.

Para las zonas de pesca secundarias, no hubo cambios, sin embargo se hicieron algunos comentarios. Casi siempre atraca en el Borrascoso pero no van tanto porque es lejos, en septiembre y mediados de octubre se pesca porque después de esas fechas entra la curvina. En Isla San Jorge se trabaja con puro curricán y tubitos, por los lobos que rompen los chinchorros. Por lo tanto, Borrascoso no sería zona principal porque no van con tanta frecuencia, pero cuando van sacan buena pesca.

Los cambios en las zonas de pesca tanto principales como secundarias se reflejan en la Figura 22.

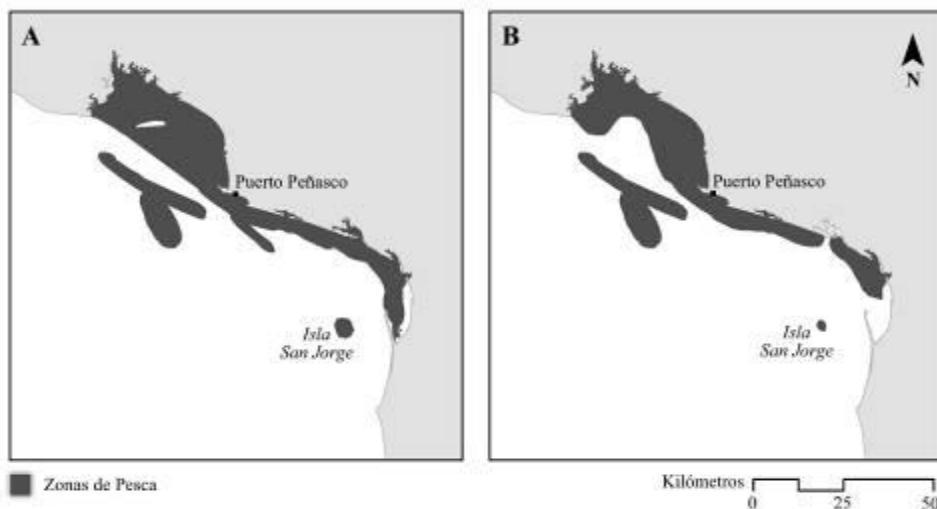


Figure 22. Zonas principales y secundarias de pesca para sierra. Derecha: evaluación rápida. Izquierda: taller de validación interna.

Zonas de avistamiento de juveniles y de reproducción (zonas J y R en evaluación rápida) En las zonas de avistamiento de juveniles y sitios de reproducción no hubo cambios. Sin embargo, se adicionó una zona a las ya existentes: Isla San Jorge. Se anexo esta zona de Isla San Jorge porque ahí atraca a desovar. Esto debido a que todo el tiempo la sierra viene desde abajo (Guaymas, Kino, Baja California) y llega a la isla San Jorge enhuevada, según explicaron los pescadores.

Los cambios en las zonas de avistamiento de juveniles y zonas de reproducción se reflejan en la Figura 23.

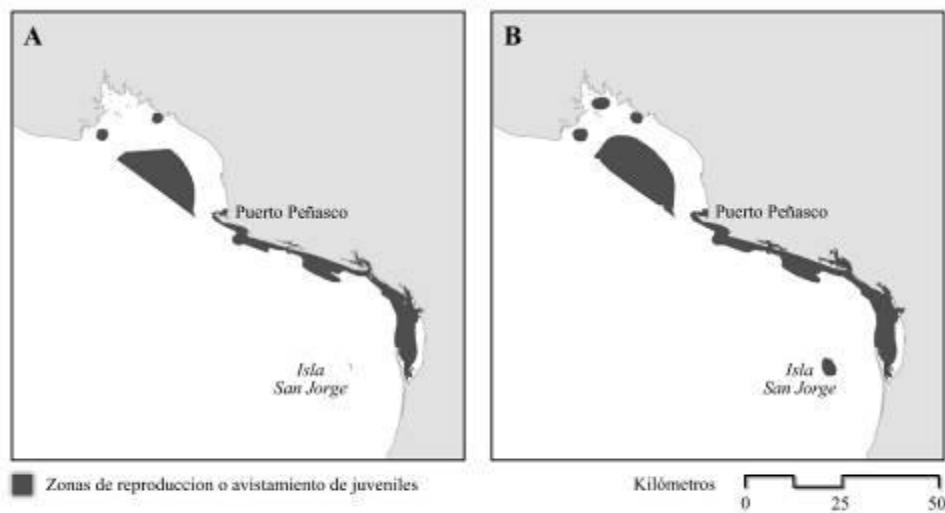


Figure 23. Zonas de avistamiento de juveniles y de reproducción para sierra. Derecha: evaluación rápida. Izquierda: taller de validación interna.

Notas adicionales:

- En junio y julio es cuando se trabaja con curricán.
- Septiembre – octubre con chinchorro.
- Cuando está el agua helada no hay sierra. De los tanques para Puerto Peñasco entra, de los tanques hacia Puerto Peñasco, en abril y mayo. En Junio y julio solo se pesca con curricán.

CALENDARIO DE PESCA

Resultados de la evaluación rápida (Figura 24):

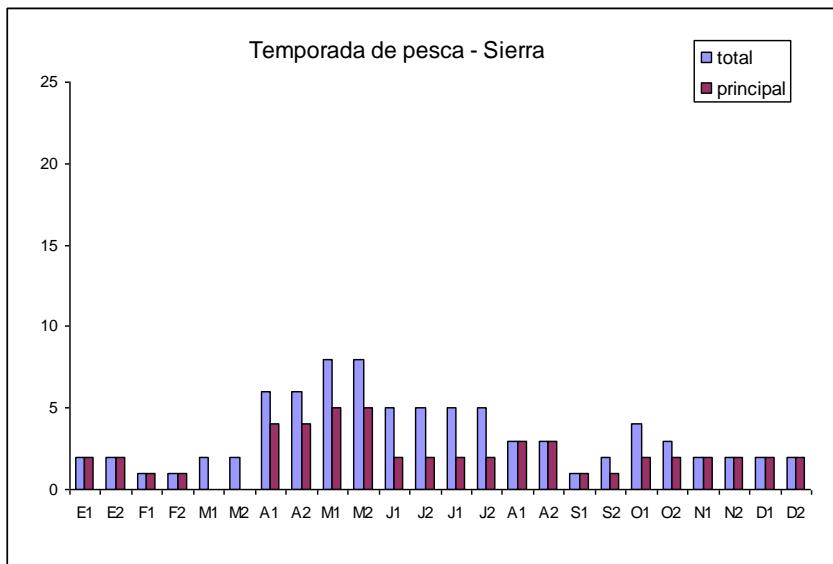


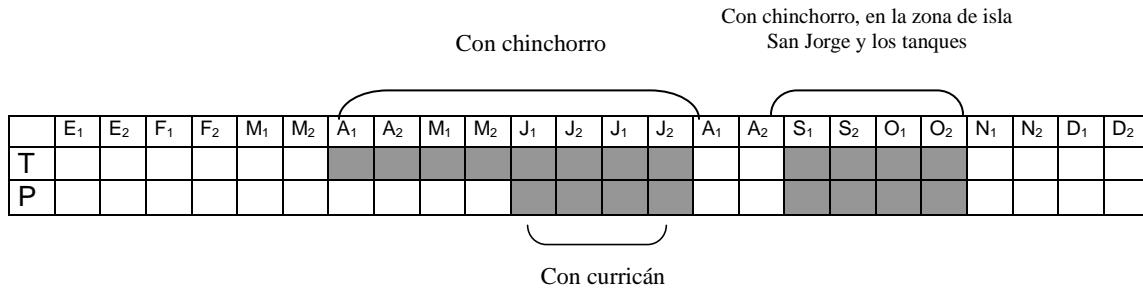
Figure 24. Temporada de pesca total y principal para sierra durante 2005. Los meses se dividieron en primera y segunda quincena (ej. E1: primera quincena de enero; E2: segunda quincena de enero). El eje y indica el número de personas que indicaron que la sierra se pesca durante esos meses.

Resultados obtenidos durante el taller:

- Temporada total: De abril a julio y de septiembre a octubre se pesca con chinchorro. En junio y julio también se pesca con curricán.
- Temporada principal: Junio y julio, y septiembre y octubre.
- Para el lado de la Isla San Jorge se pesca de septiembre a octubre, al igual que en la zona de los Tanques con producciones de 300 - 500kg. En junio se trabaja pero agarras alrededor de 150 kg.
- Cuando hay mucha producción en septiembre y octubre, viene gente de otros lugares (Guaymas, Baja California), y escasea en junio.
- Con el agua fría no se encuentra sierra.

	Con chinchorro														Con chinchorro, en la zona de isla San Jorge y los tanques									
	E ₁	E ₂	F ₁	F ₂	M ₁	M ₂	A ₁	A ₂	M ₁	M ₂	J ₁	J ₂	J ₁	J ₂	A ₁	A ₂	S ₁	S ₂	O ₁	O ₂	N ₁	N ₂	D ₁	D ₂
T																								
P																								

Con curricán



Para sierra, las temporadas de pesca total y principal de la evaluación rápida no coinciden mucho con los resultados obtenidos durante el taller. En el taller se afinaron los datos de temporada de pesca y se obtuvo información acerca de la estacionalidad de la pesca en algunas zonas de trabajo.

PROBLEMÁTICAS

Categorías de problemáticas resultantes de la evaluación rápida (los números no indican orden de importancia):

1. Problemas de comercialización
2. Los barcos
3. Factores ambientales/naturales
4. Contaminación (por ruido, luz, desperdicios)

Información obtenida durante el taller para cada uno de los puntos anteriores y categorías nuevas (si aplica):

1. Problemas de comercialización: se refiere a problemas de precio del producto. Dicen que el precio está estancado desde hace años, no se relaciona tanto con la oferta/demanda. Siempre ha estado a 9.00 pesos mexicanos y lo ideal para ellos sería que lo paguen a 15.00 pesos.
2. Los barcos: Indicaron que los barcos no afectan tanto al producto y deciden eliminarlo de la lista.
3. Factores ambientales/naturales: Indicaron que no sería un problema y deciden eliminarlo de la lista.
4. Contaminación (por ruido, luz, desperdicios): hay contaminación por los desarrollos turísticos principalmente por el ruido que generan (motonetas, bananeros, tráfico de embarcaciones), que ahuyenta al pescado y esto provoca que

vayan mas lejos y no les sea rentable. La contaminación estaría provocando el problema 6.

5. Problemática nueva: Apoyo a pescadores libres (acceso a permisos, apoyo económico, apoyo para organizarse en cooperativas).
6. Problemática nueva: Se tienen que ir cada vez más lejos a pescar.

Priorización de problemáticas:

1. Apoyo a pescadores libres (acceso a permisos, apoyo económico, apoyo para organizarse en cooperativas). “Es lo que más se requiere ahora.”
2. Contaminación.
3. Que se tiene que ir más lejos (lo relacionan con la contaminación por ruido).
4. Problemas de comercialización.

Curvina Plateada (*Cynoscion parvipinnis*)

ZONAS DE PESCA

En cuanto a las zonas principales para la curvina, los resultados muestran diferencias con lo planteado originalmente en los resultados de la evaluación rápida. Las zonas en general (nombres) son las mismas pero difieren en cuanto a la extensión de las zonas principales y la percepción que ellos tienen sobre zonas secundarias. Esta especie se trabaja en zonas rocosas.

- Estero la Pinta	Se trabaja todo el estero y los tanques (por dentro de la pinta), y por la orilla en los huesos, a dos y cuatro brazas de profundidad.
- La Choya y Puerto Peñasco	Choya trabajan a 2-3 brazas; se van desde la Choya hasta Cerro Prieto, todo por la orilla
- Los Tres Ases	Son tres casitas que también quedan dentro del área que llaman la Choya y es una marca dentro de la Choya.
- El Borrascoso y la Pinta	Son zonas que frecuentan, también en San Judas. En estas zonas se trabaja casi a una braza de profundidad y casi varándose por la orilla

En cuanto a las zonas de pesca menos frecuentadas o secundarias, Cerro prieto fue uno de los mencionados pues solamente se trabaja durante el mes de septiembre. Trabajan a 1-2 brazas de profundidad. Son partes muy bajas y se quedan varados, se aleja mucho el agua

cuando baja la marea porque es muy plano el terreno. Los cambios en las zonas de pesca tanto principales como secundarias se reflejan en la Figura 25.

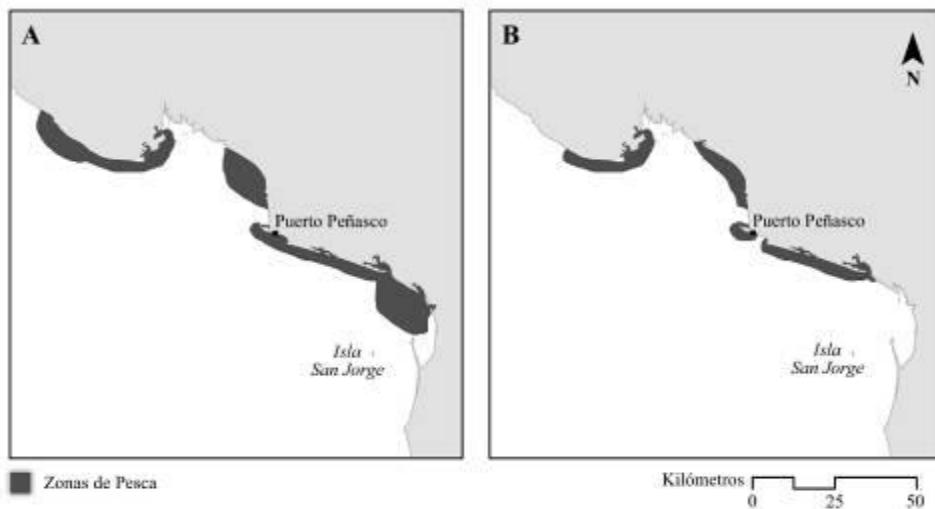


Figure 25. Zonas principales y secundarias de pesca de curvina plateada. Derecha: evaluación rápida. Izquierda: taller de validación interna.

Para las zonas de avistamiento de juveniles y de reproducción, los pescadores consideran que solamente se deben de dejar algunos esteros. La mayoría de los esteros según los pescadores, son utilizados para entrar a tirar la hueva. No trabajan esta especie en los esteros porque no lo permiten y porque no les conviene. La zona principal donde se reproduce es Bahía Adair. Tanto el camarón como la curvina se reproducen allí. Dicen que no les conviene pescarla porque esta desovando y no es bueno capturarla para cuidar el producto; además de que no se permite. En agosto esta especie se va a desovar en Bahía Adair. Hay muchos esteros también pero son pequeños y no entra el pescado. San Judas es un estero muy pequeño, y el estero Morúa y el Borrascoso se quedan sin agua al bajar la marea; así que todos dijeron que no creen que se reproduzcan allí porque quedan secos. En el estero la Pinta sí creen que se reproduce. Los cambios en las zonas de avistamiento de juveniles y zonas de reproducción se reflejan en la Figura 26.

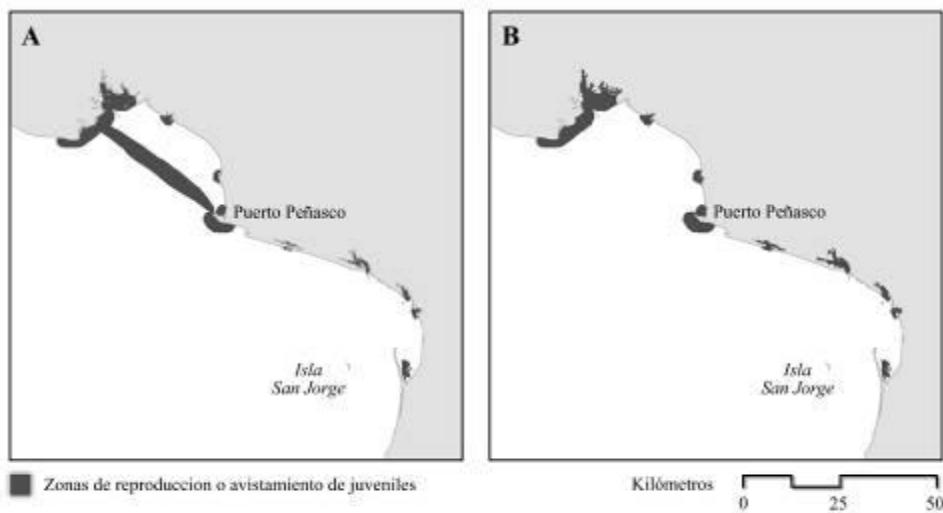


Figure 26. Zonas de avistamiento de juveniles y de reproducción de curvina plateada. Derecha: evaluación rápida. Izquierda: taller de validación interna.

Notas adicionales:

- El sitio denominado como “Los caballos” es “el caballo” (es una piedra debajo del agua) y esta corrido en el mapa, la posición correcta es en Punta Pelícanos (dentro del área que llaman la Choya, es una marca dentro de la Choya).
- En Sandy Beach no los dejan trabajar por el turismo. Antes trabajaban allí pero ahora no.
- En la Pinta entran pero en junio-julio.
- En agosto es cuando esta desovada en la pinta, pero no la pescan en esa época.
- Bahía San Jorge es zona de reproducción de curvina y de camarón.

CALENDARIO DE PESCA

Resultados de la evaluación rápida (Figura 27):

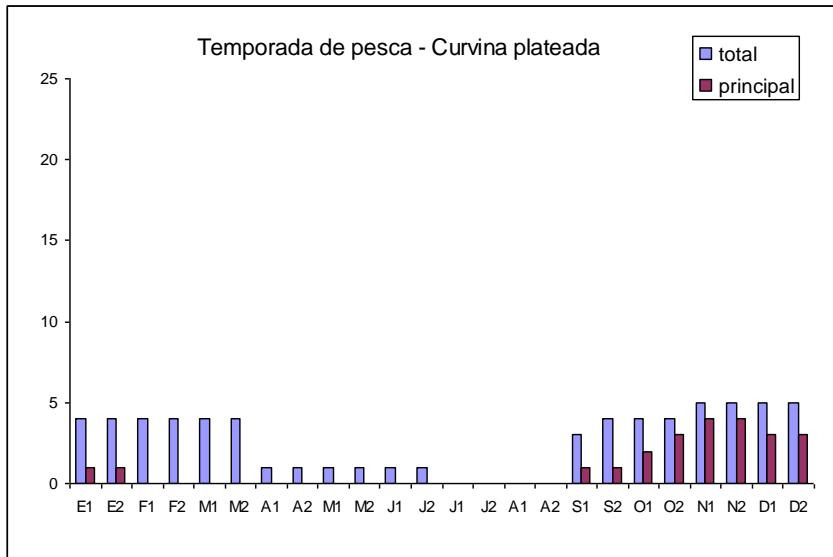


Figure 27. Temporada de pesca total y principal para curvina plateada durante 2005. Los meses se dividieron en primera y segunda quincena (ej. E1: primera quincena de enero; E2: segunda quincena de enero). El eje y indica el número de personas que indicaron que curvina plateada se pesca durante esos meses.

Resultados obtenidos durante el taller:

- Temporada total: De septiembre a marzo
- Temporada principal: De septiembre a octubre, y en diciembre.
- En agosto no la permiten la pesca por que es época de veda.

	E ₁	E ₂	F ₁	F ₂	M ₁	M ₂	A ₁	A ₂	M ₁	M ₂	J ₁	J ₂	J ₁	J ₂	A ₁	A ₂	S ₁	S ₂	O ₁	O ₂	N ₁	N ₂	D ₁	D ₂	
C																									
P																									

Para curvina plateada, las temporadas de pesca total y principal obtenidas en la evaluación rápida coincidieron bastante con los resultados del taller.

PROBLEMÁTICAS

Los pescadores indicaron que las problemáticas para curvina plateada son las mismas que para la pesca de sierra (ver sección anterior).

TALLER DE CIMBRA Y TRAMPA

Puerto Peñasco, 18 de noviembre de 2007
 El taller inició a las 11:23am.

Jaiba (*Callinectes bellicosus*)

ZONAS DE PESCA

El área que se presentó como zonas principales fue considerada como correcta. La profundidad a la que se saca la Jaiba depende de la época del año. Esta es una lista de las zonas de pesca más frecuentadas o principales para pulpo de acuerdo a los pescadores:

- Isla San Jorge La profundidad a la que se saca la Jaiba depende de la época del año.
 Ellos la sacan a 15 brazas en el estero, como en la isla San Jorge.

- La Choya Desde la Choya hasta la Pinta la sacan a unos 100 mts de la costa, a 12 - 15 brazas de profundidad, y mínimo a 3 brazas por la zona de las piedras.

- Estero La Pinta hasta Estero Salinas Toda la zona pegada a la costa, pasando al lado de la isla, a una distancia de 100mts y la profundidad varía. La orilla del estero Almeja también se trabaja.

Para las zonas de pesca menos frecuentadas o secundarias uno de los sitios que se mencionó fue la Choya -- porque pasan los 15 mts de profundidad -- (quedó duda en esta declaración). Las zonas marcadas como secundarias, mismas que son resultado de la evaluación rápida, fueron consideradas como zonas de pesca principal; se reconoció que las decisiones de zonas secundarias y principales dependen de cada pescador. No hubo cambios en los límites de las zonas de pesca.

Para las zonas de juveniles y de reproducción (zonas J y R en evaluación rápida), no hubo cambios. Sin embargo, resaltaron que para las zonas de avistamiento de juveniles y de reproducción, en los esteros es donde los pescadores declararon encontrar juveniles. En zonas rocosas se haya con hueva. Cuando entra el frío ya se ven juveniles o animales enhuevados.

- Isla San Jorge Se ven en noviembre y diciembre. De mayo a abril salen con hueva.

- Estero Almeja Se ven en noviembre y diciembre. De mayo a abril salen con hueva. Salen a una braza en este estero con hueva.
- Estero Morúa Se ven en noviembre y diciembre. De mayo a abril salen con hueva.
- Cerro Prieto De Cerro Prieto a la Choya siempre hay en abril y octubre.
- La Choya De abril a julio se ven animales con hueva en esta zona.
- Los Pinitos De mayo a julio salen en esta zona a una braza aproximadamente.

Notas adicionales: Sí entran a pescar guitarra en Bahía San Jorge y también jaiba.

CALENDARIOS DE PESCA

Resultados de la evaluación rápida (Figura 28):

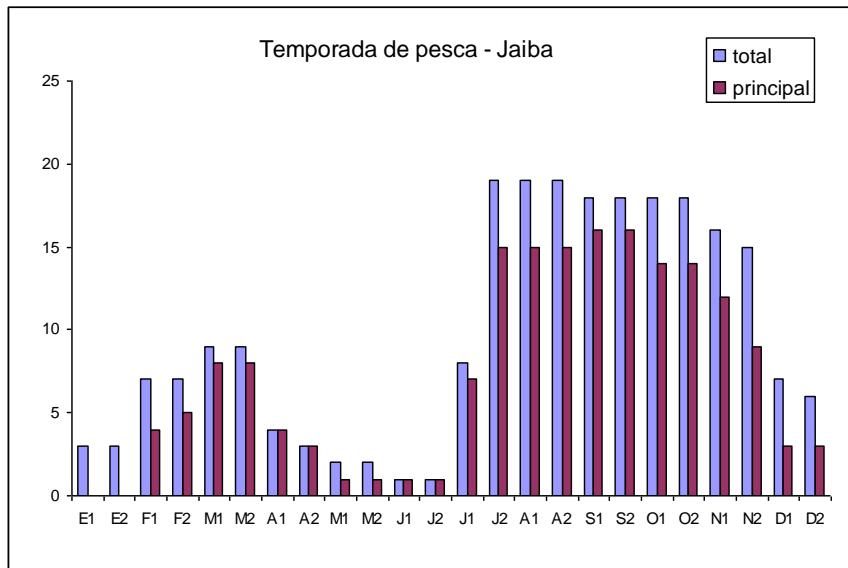


Figure 28. Temporada de pesca total y principal para jaiba durante 2005. Los meses se dividieron en primera y segunda quincena (ej. E1: primera quincena de enero; E2: segunda quincena de enero). El eje y indica el número de personas que indicaron que jaiba se pesca durante esos meses.

Resultados obtenidos durante el taller:

- Temporada total: De febrero a noviembre.
- Temporada principal: De abril a septiembre. En esta época salen machos y hembras en toda la zona de pesca.

	E ₁	E ₂	F ₁	F ₂	M ₁	M ₂	A ₁	A ₂	M ₁	M ₂	J ₁	J ₂	J ₁	J ₂	A ₁	A ₂	S ₁	S ₂	O ₁	O ₂	N ₁	N ₂	D ₁	D ₂
T																								
P																								

Para jaiba, los picos de frecuencia obtenidos en la evaluación rápida coinciden parcialmente con los obtenidos en el taller. En el taller demarcaron un período principal de pesca continuo que incluye los meses de abril a junio, los cuales no fueron mencionados con frecuencia durante la evaluación rápida. Si bien febrero y marzo fueron parte de uno de los picos de frecuencia para meses principales durante la evaluación, no fueron mencionados como tales en el taller.

PROBLEMÁTICAS

Categorías de problemáticas resultantes de la evaluación rápida (los números no indican orden de importancia):

1. Problemas de comercialización
2. Los barcos
3. Se pesca con hueva o juveniles
4. La gente no respeta las reglas
5. Mayores gastos
6. Inconvenientes con los equipos (robo, abandono, pérdida, averías)
7. Falta de control o regulación por parte de autoridades

Información obtenida durante el taller para cada uno de los puntos anteriores y categorías nuevas (si aplica):

1. Problemas de comercialización: Por los precios bajos, siempre la venden entre 9, 5 -12 pesos, los precios siempre son los mismos y los costos aumentan.
2. Los barcos: indican que el problema que ocasionan los barcos a la pesca de jaiba es mínimo, el único problema que ven es que desde peñasco a la isla el camaroneiro saca juveniles de jaiba. El arrastre de trampas es mínimo actualmente. El tipo de jaiba es diferente a la que pescan los camarones.
3. Se pesca con hueva o juveniles: Los mismos pescadores pescan la jaiba juvenil y con hueva. Si la vigilancia fuera más estricta con las plantas en cuanto a la talla de comercialización, los pescadores no la sacarían. Las autoridades no controlan la pesca de juveniles, la pesca en bahías y esteros, ni las hojas de arribo. La ley de jaiba debe ser más específica acerca de lo que es un estero y una bahía y las tallas de tamaño legal. Hace falta especificar mejor las áreas de exclusión (donde no se permite pescar) y de pesca (dónde sí se puede). 11,5 marca la talla la ley de pesca.
4. La gente no respeta las reglas: "La gente solo respeta lo que dice la ley." Hace 10 -15 años había mucha jaiba y actualmente ya no hay, y eso es porque los

pescadores la pescan en gran cantidad y no respetan cuando hay jaibas enhuevadas. La ley no especifica vedas. También hay muchos pescadores que pescan sin permiso, y la gente que viene de otros lugares tampoco tiene permiso - como es el caso de las 6000 trampas en el área de los pinitos para los pescadores del golfo de Santa Clara que se traslapan con las áreas de pesca de Peñasco. Dijeron que las vedas deben ser para todos, que haya vigilancia efectiva ya que la ley sí especifica la cantidad de trampas permitidas pero no la respetan.

5. Mayores gastos: los precios están siempre igual, varían de uno a dos pesos nomás pero el costo de gasolina y de la salida de pesca aumentó. En relación con esto los pescadores indicaron que lo que falta es tener mayor acceso a apoyos económicos por parte del gobierno para renovación de equipos (motores, etc.). Piensan que esto les ayudaría a hacer más eficientes sus salidas de pesca.
6. Inconvenientes con los equipos (robo, abandono, pérdida, averías): tienen problemas con el robo de trampas entre los pescadores. Piden mayor vigilancia por parte de las autoridades.
7. Falta de control o regulación por parte de autoridades: este problema está muy vinculado al problema 4 “la gente no respeta las reglas”. Sugirieron juntarlo porque explican que la gente no respeta las reglas porque no hay quien las controle, y también falta que se generen reglas como es el caso de la necesidad de instalar una veda para jaiba y especificar mejor las zonas de exclusión (ej. esteros y bahías).

Notas adicionales: Época sugerida por los pescadores para vedar la jaiba: Los pescadores opinan que la época de veda podría ser de 5 meses en tiempo de frío iniciando en noviembre. Siempre y cuando después de estos 5 meses de veda ellos reciban mejor precio de las comercializadoras al levantarse la veda (de abril a octubre). El periodo que proponen los pescadores abarca gran parte del tiempo en que las jaibas están enhuevadas.

Priorización de problemáticas

1. Problemas de comercialización: en primer lugar ya que de esto dependen varios de los otros problemas (no pueden reponer las trampas robadas, extraen juveniles y jaibas enhuevadas para hacer los costos de la salida de pesca, etc.).
2. Falta de control o regulación por parte de autoridades y la gente no respeta las reglas.
3. Se pesca con hueva o juveniles.
4. Robo de trampas.
5. Mayores gastos/acceso a apoyos del gobierno para renovación de equipo.

Baqueta roja (*Epinephelus acanthistius*)

Los comentarios hechos para las zonas principales y secundarias de baqueta en general fueron, que las zonas de baqueta son zonas donde existe un lodo verdecito y es ahí donde se echa la baqueta. El animal se pega al lado para su protección y también son zonas donde toda la parte del fondo tiene declive. De 36 a 50 brazadas, a 26 km de la costa, es donde salen a pescar. Esta es una lista de las zonas de pesca más frecuentadas o principales para pulpo de acuerdo a los pescadores:

- Las Pocitas Es frente a Puerto Peñasco.
- Los Linderos Es una zona que va de las 36 brazas – 50 brazadas, a 26km aproximadamente de la costa en el lado de la Choya. La gente lo llama el “210”
- Fuera de el Piedrón Afuera de la isla, en el “270” tirándole a San Felipe se encuentra la zona
- El Caído Es un canal profundo, hay una franja de posas a una profundidad de 40 – 50 brazas; después existe una parte plana. A unas 50 o 60 brazas es una zona que se marca bastante bien en el canal profundo.
- Sur de Puerto Peñasco (Oeste o “weste”), el “240” al lado de la piedra.
- Puertecitos Una zona bien definida
- Pedregudos 58 brazas
- Tres Chinitas Esta a 45 brazas por el “210” a 1 hora antes del canal.
- Los Picachos Es por la Choya a 50 – 55 brazas. Es extenso este pescadero.

Para las zonas de pesca menos frecuentadas o secundarias, se indicó que en realidad depende del tiempo de pesca. “Cuando está bueno se va hasta abajo, y cuando hay mal tiempo están los miradores (36 – 40 brazas) hasta llegar al sur de la Choya”. Los cambios en las zonas de pesca tanto principales como secundarias se reflejan en la Figura 29.

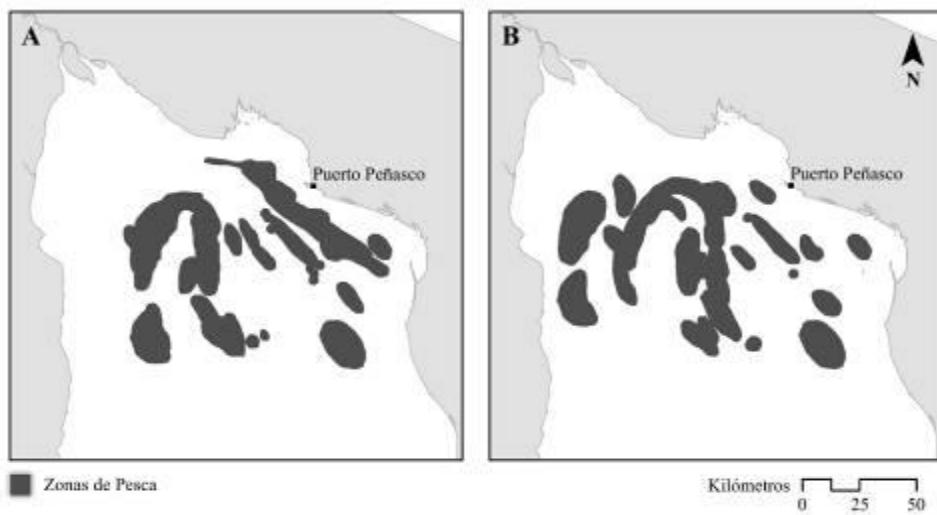


Figure 29. Zonas principales y secundarias de pesca para baqueta roja. Derecha: evaluación rápida. Izquierda: taller de validación interna.

Para las zonas de avistamiento de juveniles y de reproducción los pescadores indicaron que en el mes de julio salen con hueva en el área del polígono nuevo que se marcó (frente a los pinitos). Igualmente indicaron que los juveniles se ven a 20 brazas frente de Puerto Peñasco y en el Tornillal y en el Cantiloso se ven juveniles. Un participante indicó que “frente a la zona de Puerto Peñasco se ha visto que salen juveniles en los camaroneseros”.

Los cambios en las zonas de avistamiento de juveniles y zonas de reproducción se reflejan en la Figura 30.

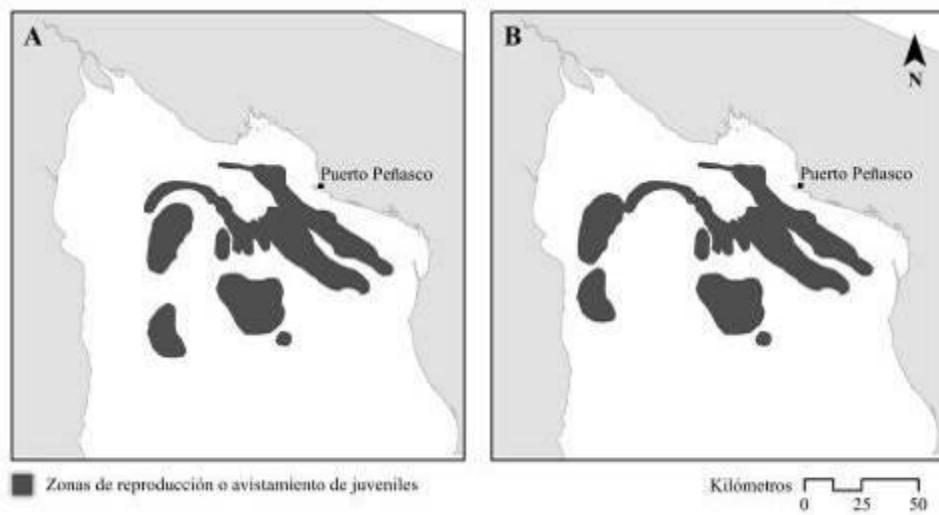


Figure 30. Zonas de avistamiento de juveniles y de reproducción para baqueta roja. Derecha: evaluación rápida. Izquierda: taller de validación interna.

Algunas de las nuevas zonas de pesca que indicaron los pescadores como nuevas dentro de toponomía y como parte de la aportación de los cimbreros y tramperos (ver archivo toponomía): Los Picachos, Las Chichitas, Los Pedregudos.

CALENDARIO DE PESCA

Resultados de la evaluación rápida (Figura 31):

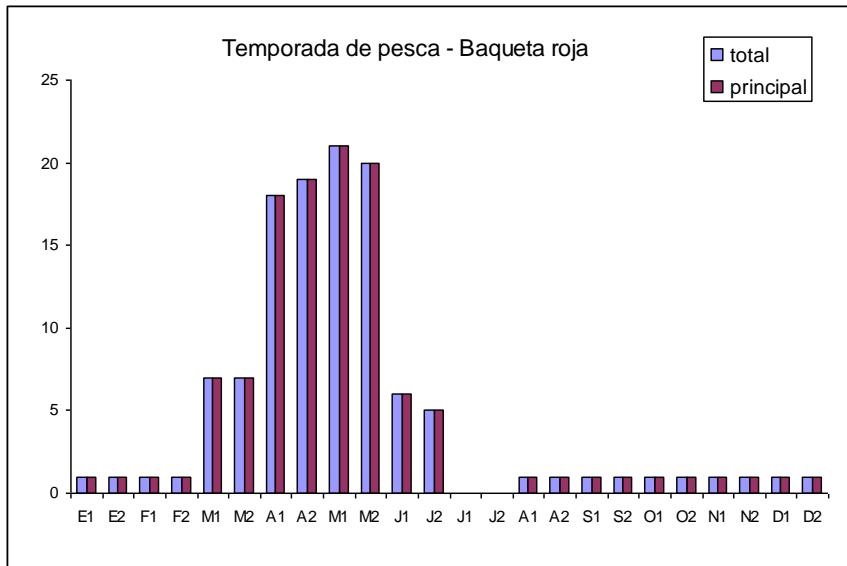


Figure 31. Temporada de pesca total y principal para baqueta roja durante 2005. Los meses se dividieron en primera y segunda quincena (ej. E1: primera quincena de enero; E2: segunda quincena de enero).

El eje y indica el número de personas que indicaron que baqueta roja se pesca durante esos meses.

Resultados obtenidos durante el taller:

- Temporada total: de noviembre a abril.
- Temporada principal: de noviembre a febrero se encuentra en mayor cantidad. En marzo se aleja. En mayo todavía hay baqueta pero suele ser un mes de mal tiempo y no les conviene pescarla. En octubre sale baqueta pero es raro encontrar.

	E ₁	E ₂	F ₁	F ₂	M ₁	M ₂	A ₁	A ₂	M ₁	M ₂	J ₁	J ₂	J ₁	J ₂	A ₁	A ₂	S ₁	S ₂	O ₁	O ₂	N ₁	N ₂	D ₁	D ₂	
T																									
P																									

Para baqueta roja, el pico de frecuencia para calendarios de pesca obtenidos en la evaluación rápida difiere marcadamente de los resultados del taller.

PROBLEMÁTICAS

Categorías de problemáticas resultantes de la evaluación rápida (los números no indican orden de importancia):

1. Problemas de comercialización
2. Los barcos

3. Factores ambientales/naturales
4. Mayores gastos
5. Las condiciones de trabajo (riesgo, esfuerzo, precariedad).

Información obtenida durante el taller para cada uno de los puntos anteriores y categorías nuevas (si aplica):

1. Problemas de comercialización: precios bajos y estancados (relativamente constantes) en relación a la variación del costo de la salida de pesca. Además, solo tienen El Mariscal para vender y dependen de él para vender su producto. Necesitan más compradores (mercados). Dependencia con el comprador.
2. Los barcos: los barcos camarones trabajan todo el año y pescan incidentalmente baqueta adulta y juvenil. El recurso ha diminuido de 10 años para acá porque los barcos camarones siguen pescando al terminar la temporada de camarón, y arrastran en zonas de baqueta.
3. Factores ambientales / naturales: los factores ambientales no se pueden manejar pero dicen que condicionan el costo de la salida de pesca (por la distancia a recorrer hasta los pescaderos y el riesgo que implica el mal tiempo tanto para ellos como para los equipos).
4. Mayores gastos: gasto de gasolina, refacción de artes de pesca, etc.
5. Las condiciones de trabajo (riesgo, esfuerzo, precariedad): Sienten que su esfuerzo no es valorado porque no hay apoyo para mejorar las condiciones de trabajo. Falta apoyo para equipos, acceso a créditos para comprar artes de pesca, motor, pangas.

Priorización de problemáticas

1. Problemas de comercialización
2. Las condiciones de trabajo/necesidad de apoyo para mejorar equipo
3. Los barcos
4. Mayores gastos

TALLERES EN BAHÍA DE KINO, SONORA

Fecha: 30 y 31 de Enero y 1º de Febrero, 2008

Lugar: Restaurante "El Marlin"

Logística:

Facilitadores: César Moreno

Manejo de información: Marcia Moreno-Báez y Mario Rojo

Notas: Ana Cinti

Comunicación y diseño: Jennie Duberstein

Apoyo en logística: Nabor Encinas Cázares

En los tres talleres realizados en Bahía de Kino la logística tuvo un formato similar en la parte operacional y fue el siguiente:

- Comienzo oficial de la reunión (por César Moreno)
- Bienvenida
- Presentación del proyecto PANGAS (por César Moreno)
- Descripción del procesamiento de los datos colectados (mapas) y de la dinámica de trabajo a tener durante el taller (por Marcia Moreno-Báez).
- Proyección de datos en pantalla y ejercicio de reconocimiento para que los participantes se ubiquen bien con la información proyectada (por Marcia Moreno-Báez).
- Comienzo de la dinámica con el siguiente orden:
 1. Proyección y validación de datos espaciales por especie zonas de pesca visitadas con mas frecuencia (principales); zonas de pesca visitadas con menos frecuencia (secundarias); zonas de avistamiento de juveniles o de reproducción) (por Marcia Moreno-Báez).
 2. Validación de datos temporales (calendarios de pesca) por especie (temporada total y principal) (por Ana Cinti).
- Se realizaron descansos cuando fue necesario ofreciendo servicio de café, sodas y bocadillos.
- Conclusiones, agradecimiento, entrega de reconocimientos y de un mapa del golfo a modo de obsequio.

TALLER DE TRAMPA

Bahía de Kino, 30 de enero de 2008
El taller inició a las 3:50pm.

Jaiba (*Callinectes bellicosus*)

ZONAS DE PESCA

De las zonas ya especificadas durante la evaluación rápida, se hicieron ajustes y se tomaron algunas notas. Por ejemplo, los pescadores indicaron que el área que se había delimitado ahora quedó partida en dos: del 2 cerro prieto hacia el norte, y el área por detrás del alcatraz hacia el sur, excluyendo la zona de Kino (de la orilla a la isla Alcatraz). Igualmente indicaron que en la boca del canal no se trabaja tanto por la corriente y que la franja que recorre la ensenada don Juan la trabajan más que nada los Seris, no es tan importante para los kineños. Desde la Punta San Miguel hacia el sur lo trabajan los de Kino, del bajo de la boca del canal hacia la orilla continental. Unas 5-6 personas de Kino trabajan en la franja de la Ensenada Don Juan. Otras notas fueron para la zona de Kino Nuevo se debía quitar la zona especificada porque por el tráfico de pangas no van a pescar allí.

Los pescadores igualmente indicaron que las bitácoras tienen información sobre donde trabajan. Nota: hicieron comentarios acerca de los cuadritos en el mapa de las bitácoras, dijeron que no saben qué distancia representa un cuadrito en el mapa de las bitácoras. Estacionalidad de las zonas de pesca: En frente de los 4 mogotes, del tumor hacia delante, ahí empiezan en tiempo de julio, pescando a 6-7 brazadas. Si empieza la temporada con marea muerta tiran las trampas en 9 brazas cuidando que no les roben. Viniendo la marea viva empiezan en las 4 brazadas (se van más a la orilla) (todo frente a los 4 mogotes=el tumor). Desde el 15 de julio al 15 de agosto trabajan allí. A esta área en general le dicen los tepetates. El 15 de agosto agarra demanda la hembra (los Coreanos empiezan a comprarla) y los pescadores se van de las compuertas hacia el Sahuímaro (si es en marea muerta tiran a 8 brazadas y si es en viva tiran hacia la orilla). La pesca en esta zona dura agosto, septiembre y octubre. Cuando abre la temporada de los barcos en septiembre, se orillan de 8 brazadas a menos profundidad por unos 15 días. En septiembre se mueven en frente al Sahuímaro (la primer semana de apertura de la temporada de pesca de los barcos). De ahí se van en frente del alcatraz (este año hicieron eso) y la temporada termina en alcatraz. La hembra tiene demanda mientras tenga cargada la hueva, después de desovar ya no la piden.

Esta es una lista de las zonas de pesca más frecuentadas o principales para jaiba de acuerdo a los pescadores:

- Huesos - Las Compuertas Frente al Sahuímaro. Empezando la temporada (15 de julio) los compradores piden puro macho. Los pescadores tiran en áreas donde sale 80% de macho y 20% hembras según uno de los pescadores (frente de las compuertas a unas 8 brazadas). Cuando los compradores piden más la jaiba hembra, los pescadores trabajan hacia el Sahuímaro (sale 70% hembras y 30% machos)
- Las Compuertas - El Sahuímaro Se trabaja la hembra. Por la pura orilla empieza y máximo a 9-8 brazas (15 Km. de distancia desde la orilla). Trabajan más o menos a las mismas profundidades en las distintas zonas de pesca, la distancia a la costa varia dependiendo de la inclinación del terreno.
- Punta Gorda Punta Saliente. Normalmente los que pescan jaiba se alejan como 15 Km. de la costa, y trabajan a una profundidad de no más de 10 brazas, de 10 a 8 brazas máximo y hasta la orilla

En la Punta Gorda es muy hondo así que no trabajan a más de 2 Km. de la costa. Como hay mucho caracol en tiempo de calor se ponen muy pesadas las trampas si las tiran muy profundo
- El Cardonal Esta lejos de la costa lo cual lo hace ser (quizá) una zona secundaria.
- Frontera Sur Para la pesca de jaiba: trabajan en una franja desde 2 a 10 brazas. En mareas vivas se corren más a la orilla. En las muertas se van mas afuera (escasean en la orilla).
- El Tumor No se trabaja muy afuera, cuando mucho a 10 brazas. En la zona de los tepetates y hacia el sur.
- Punta Huesos, Almejitas y Punta Blanca Todas las zonas hasta la ensenada blanca en la isla tiburón. En frente del canal también. Se trabaja en estas zonas desde 3-2 brazas a 7-8 brazas y toda la franja que se marcó como continua en color rojo.
- Cerro Prieto La parte norte hasta la boca del canal, punta San Miguel. La zona de isla Tiburón se trabaja hasta 9 brazas de profundidad

Algunas de las zonas secundarias entran dentro de las que se indicaron como principales. Acordaron que para algunos pescadores estas zonas pueden ser frecuentadas más seguido. Esta es una lista de las zonas de pesca menos frecuentadas o secundarias para jaiba de acuerdo a los pescadores:

- El Tumor - El Sahuímaro Se trabaja nomás de julio hasta septiembre (es el sitio mas importante que tienen por la cantidad que sacan, sólo que dura tres meses nomás la pesca allí).
- El Alcatraz - Estero Santa Rosa Esta zonas no son tan buenas pues sacan menos cantidad de producto
- El Egipto Es una zona muy buena pero no los dejan trabajar ahí
- El Canal del Infiernillo Es una zona muy buena pero no los dejan trabajar ahí
- Estero el Sargentos La trabajan los de desemboque, los de Bahía de Kino podían entrar. En una época hicieron un convenio con los Seris a través de un arreglo con una compañía comercializadora (hace como 2 años). Si hicieran un acuerdo con los Seris aun podrían acceder a los sitios

Los cambios en las zonas de pesca tanto principales como secundarias se reflejan en la Figura 32.

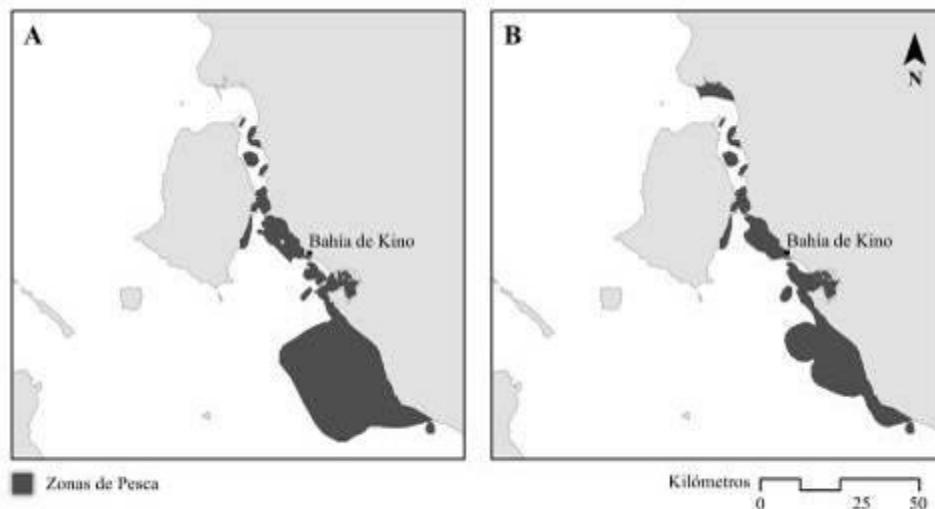


Figure 32. Zonas principales y secundarias de pesca para jaiba. Derecha: evaluación rápida.
Izquierda: taller de validación interna.

Para las zonas de avistamiento de juveniles y de reproducción, los pescadores dijeron que de acuerdo a la carnada que meten en las trampas es lo que sacan, es decir, pueden salir juveniles en las zonas de pesca. Con pescado sale jaiba macho, con camarones sale jaiba macho, hembra y juvenil mezclado. En Sahuímaro (del Sahuímaro hacia el sur) empieza a salir la hembrita enhuevada en agosto-septiembre (cuando el calor está en su apogeo). Algunos de los sitios indicados son:

- El Sahuímaro Se ven con hueva pero no juveniles. Es un sitio de reproducción igual como para El Cardonal hasta Tastiota.
- Estero Santa Cruz Son áreas de juveniles, cuando refresca el agua se ven juveniles
- Punta Blanca Salen juveniles
- Bajos de Santa Rosa No sale con hueva pero si salen juveniles

Los cambios en las zonas de avistamiento de juveniles y zonas de reproducción se reflejan en la Figura 33.

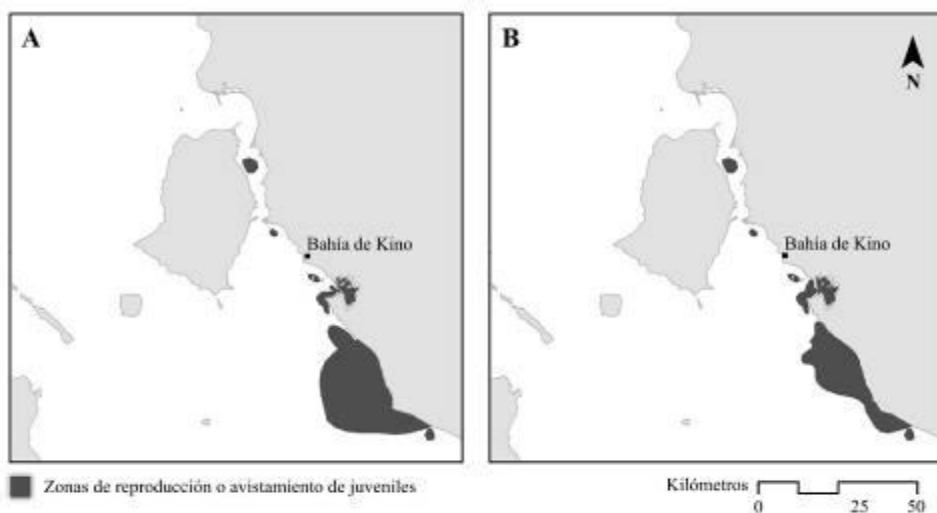


Figure 33. Zonas de avistamiento de juveniles y de reproducción para jaiba. Derecha: evaluación rápida. Izquierda: taller de validación interna.

CALENDARIO DE PESCA

Resultados de la evaluación rápida (Figura 34):

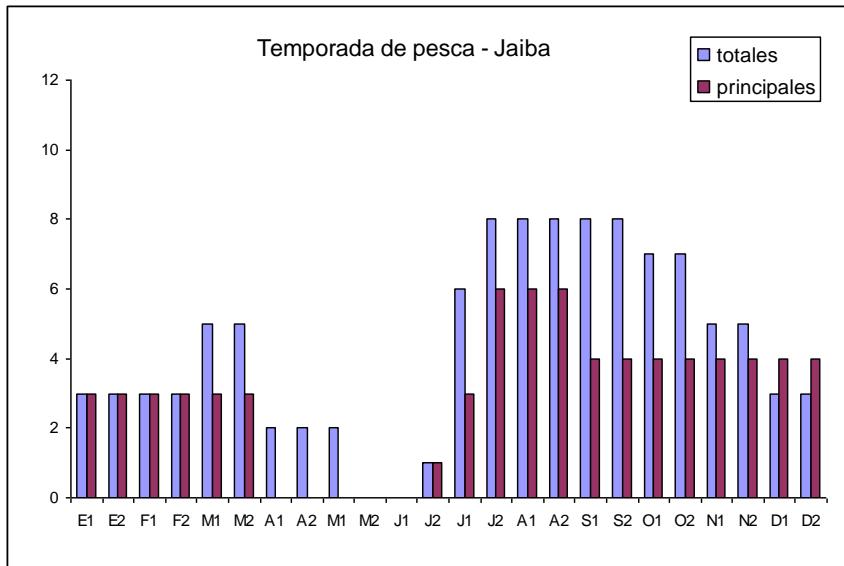
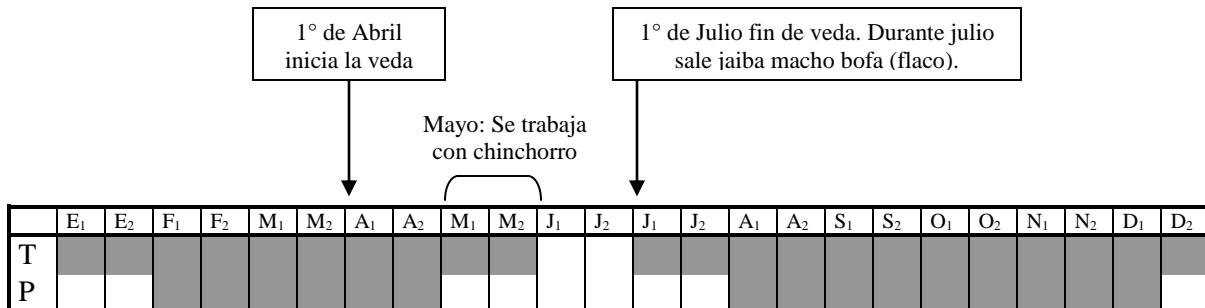


Figure 34. Temporada de pesca completa y principal para la pesca de jaiba durante 2005. Los meses se dividieron en primera y segunda quincena (ej. E1: primera quincena de enero; E2: segunda quincena de enero).

El eje y indica el número de personas que indicaron que la jaiba se pesca durante esos meses.

Resultados obtenidos durante el taller:

- En el 2005 fue cuando mas se vedó la jaiba (o mejor dicho cuando más se respetó la veda). La jaiba se trabaja con trampa de enero a abril (inclusive), en mayo se trabaja pero con chinchorro. Supuestamente el 1° de abril empezaba la veda oficialmente y duraba mayo, junio, hasta el 1 de julio. Pero no eran oficiales las vedas (ahora si van a empezar a serlo, el CRIP es el encargado de decir cuando se cierra ahora). En años anteriores se atrasaba la apertura de la temporada. En mayo se la empieza a trabajar con chinchorro, ellos dicen que van al payaso pero en realidad van a la jaiba (dice un pescador). En junio ya no se trabaja la jaiba. En el 2005 no se trabajó en junio pero el resto de los años (2006 y 2007) si se trabajó.
- En julio hay mucha jaiba que no es buena para el comercio, el macho esta flaco. Agosto, septiembre, octubre, noviembre, hasta mediados de diciembre son buenos meses para la pesca de jaiba.
- Febrero, marzo y abril también son meses buenos para la jaiba y se trabaja en el área entre el estero Santa Cruz y Santa Rosa.
- Empezando la temporada se trabaja desde el Sahuímaro hasta el cardonal.



En el 2005 fue cuando más se respetó la veda. La jaiba se trabaja con trampa de enero a abril (inclusive), en mayo se trabaja pero con chinchorro. Supuestamente el 1° de abril empezaba la veda oficialmente y duraba mayo, junio, hasta el 1 de julio. Pero no eran oficiales las vedas (ahora si van a empezar a serlo, el CRIP es el encargado de decir cuando se cierra ahora). En años anteriores se atrasaba la apertura de la temporada. En mayo se la empieza a trabajar con chinchorro, ellos dicen que van al payaso pero en realidad van a la jaiba (dice un pescador). En junio ya no se trabaja la jaiba. En el 2005 no se trabajó en junio pero el resto de los años (2006 y 2007) si se trabajó.

En julio hay mucha jaiba que no es buena para el comercio, el macho esta flaco. Agosto, septiembre, octubre, noviembre, hasta mediados de diciembre son buenos meses para la pesca de jaiba. Febrero, marzo y abril también son meses buenos para la jaiba y se trabaja en el área entre el estero Santa Cruz y Santa Rosa. Empezando la temporada se trabaja desde el Sahuímaro hasta el cardonal. Para la jaiba, los picos de frecuencia obtenidos en la evaluación rápida coinciden bastante con los resultados obtenidos en la validación durante el taller. Se obtuvo información adicional sobre estacionalidad de la pesca en las zonas de trabajo.

PROBLEMÁTICAS

Categorías de problemáticas resultantes de la evaluación rápida (los números no indican orden de importancia):

1. Problemas de comercialización
2. Los barcos
3. Se pesca con hueva o de pequeño tamaño
4. La gente no respeta las reglas
5. Mayores gastos
6. Problemas con los equipos

Información obtenida durante el taller para cada uno de los puntos anteriores:

1. Problemas de comercialización: El problema es el precio, siempre ha estado bajo. Hace 4 años estaba con mejor precio que ahora (estaba a \$16 y ahora la pagan a

\$6. La pagan a \$12 cuando mucho en el mercado negro). En los meses de julio hay poca demanda porque esta fofa (enflaquece después de desovar). Sin embargo, los precios de reventa son muy buenos (lo que reciben quienes la procesan).

2. Los barcos: Se meten a capturar el camarón cuando ellos empiezan a trabajar la jaiba y trabajan en sus zonas de pesca. En las compuertas arrastran las trampas. El mayor problema es la pérdida de trampas que son arrastradas por los barcos porque están muy caras.
3. Se pesca con hueva o de pequeño tamaño: el problema es la pesca de hembras enhuevadas. En diciembre y enero se entrega enhuevada a las plantas, no hay quien las vigile.
4. La gente no respeta las reglas: no se respetan las reglas, habiendo comprador se pesca igual, nadie respeta, desde autoridades, compradores, pescadores. Se busca hacer volumen y se mete lo que sea (enhuevada, pequeña). Falta de control.
5. Mayores gastos: gastos de gasolina y costo de las trampas.
6. Problemas con los equipos: el problema es el robo de trampas.
7. Problemática nueva: El clima (aunque no hay nada que se pueda hacer al respecto).
8. Problemática nueva: hay muchas pangas que no tienen permiso. Cualquier persona puede trabajar la jaiba. Hace falta hacer una verificación de quién trabaja, que los permisos sean entregados al pescador, los permisos están mal repartidos. Hay gente que tiene permisos pero no los trabajan y venden la factura.
9. Problemática nueva: los apoyos del gobierno que no llegan a los pescadores, los reciben los permisionarios (ej. Facilidades para compra de motores, los reciben los permisionarios y los venden a los pescadores al precio que quieren). Falta de apoyos directos al pescador (sin intermediarios).

Priorización de problemáticas

Todos las problemáticas siguientes son igualmente muy importantes para los presentes:
Robo de trampas

1. Falta de respeto a la jaiba chica y enhuevada (pesca indiscriminada), junto con que el comprador la recibe y que la gente no respeta las reglas.
2. Problemas de comercialización (precios bajos)
3. Cualquier persona puede trabajar la jaiba. que los permisos sean entregados a los pescadores, permisos mal repartidos
4. Falta de apoyos directos al pescador.

Un comentario de Cesar Moreno sobre la nueva norma antes de finalizar el taller: antes el Subcomité de jaiba formaba parte de un acuerdo administrativo. Ahora el pescador puede

denunciar legalmente. Los pescadores que confirman su participación en el subcomité ahora no van a tener excusas para no participar o no denunciar los problemas. Es necesario fortalecer el subcomité sobre todo pensando que ahora existe una norma oficial. Existe la posibilidad de hacer planes de manejo para diferentes áreas. Ej. En el Jagüey y en San Jorge se saca mucha jaiba enhuevada, pesca indiscriminada. En tema vigilancia, el rol del subcomité es central, para obligar a las autoridades a que se controle y los mismos pescadores controlen.

Finalización del taller: 6:15pm

TALLER CHINCHORRO

Bahía de Kino, 31 de enero de 2008
El taller inició a las 3:30pm.

Sierra (*Scomberomorus sierra*)

Lo más al sur que llegan los pescadores de sierra de Kino es la boca de Tastiota y el Choyudo. Los pescadores que trabajan la sierra encerrándola con el chinchorro la trabajan mas hacia la orilla y son los que llegan hasta Tastiota (lo trabajan de noche, en una franja que va desde la orilla hasta los 100-200 metros de la orilla, en noviembre y diciembre). Los pescadores que trabajan la sierra tendiendo el chinchorro trabajan a más profundidad que los que la encierran. Trabajan en la zona de la boca del cardonal hacia fuera (hacia mayores profundidades). Se trabaja así durante la cuarentena, con chinchorro tendido y aboyado. No importa la profundidad de la zona de pesca ya que se trabaja aboyado.

ZONAS DE PESCA

La sierra se pone hasta punta Tepopa y Desemboque, aunque no van con tanta frecuencia. Lo más al norte que van los de Bahía de Kino a pescar sierra es a Las Cuevas. Comprende toda una franja que abraza desde la orilla hasta 300 mts de la orilla, desde Las Cuevas hasta Tepopa. Esta la franja es zona secundaria. Los cambios en las zonas de pesca tanto principales como secundarias se reflejan en la Figura 35.

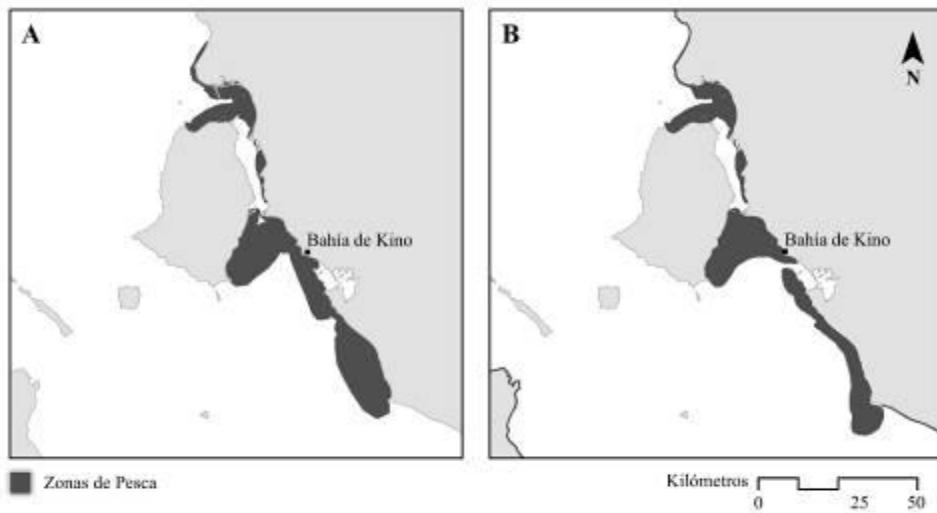


Figure 35. Zonas principales y secundarias de pesca para sierra. Derecha: evaluación rápida. Izquierda: taller de validación interna.

Para las zonas de avistamiento de juveniles y de reproducción los pescadores evaluaron como correctas las zonas que se mapearon en la evaluación rápida.

CALENDARIO DE PESCA

Resultados de la evaluación rápida (Figura 36):

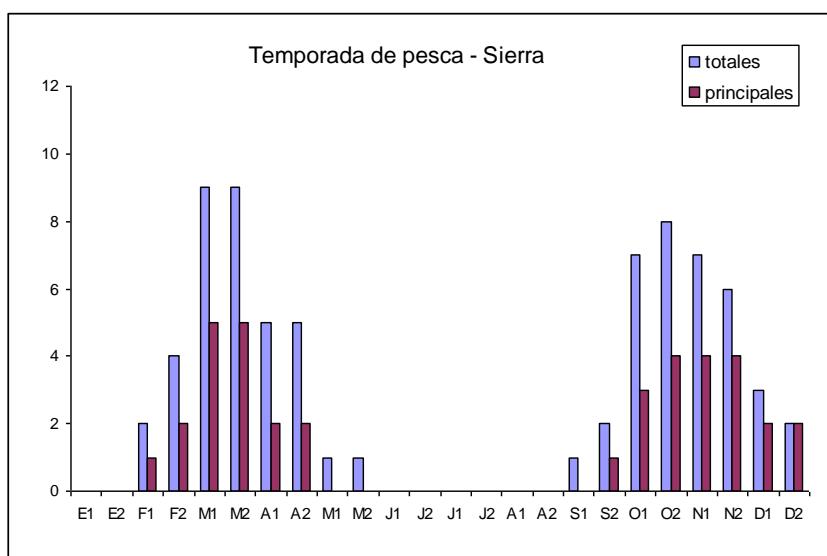
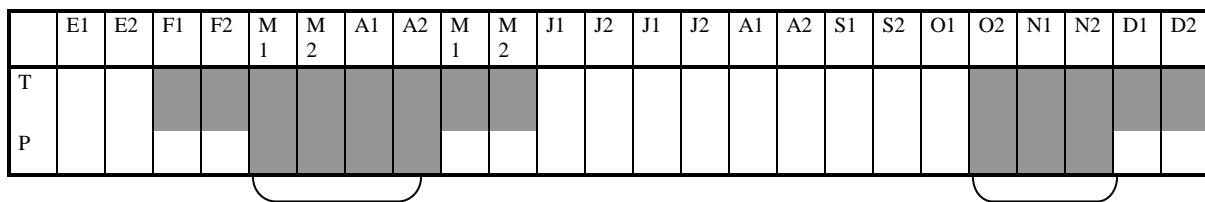


Figure 36. Temporada de pesca completa y principal para la pesca de sierra durante 2005. Los meses se dividieron en primera y segunda quincena (ej. E1: primera quincena de enero; E2: segunda quincena de enero).

El eje y indica el número de personas que indicaron que la sierra se pesca durante esos meses.

Resultados obtenidos durante el taller:

- Temporada total: En enero no se pesca sierra. En junio no se trabaja porque hace mucho calor, recién abre a mediados de octubre (septiembre no se trabaja). Diciembre casi no pero hay algunas pangas que lo trabajan.
- Temporada principal: Marzo, abril, 2° mitad de octubre, y noviembre.
- En marzo y abril empiezan en isla tiburón y en los bajos del cardonal. Se mueven entre la Isla y El Cardonal. En octubre y noviembre la trabajan en los Bajos del Cardonal y en el Sargento.



Marzo-Abril: Bajos del Cardonal a
I. Tiburón.

Mediados de Oct y Nov: Bajos del
Cardonal y el Sargento.

Para la sierra, los picos de frecuencia obtenidos en la evaluación rápida coinciden bastante con los resultados obtenidos en la validación durante el taller. Se obtuvo información adicional sobre estacionalidad de la pesca en cada zona de trabajo.

Nota: *Cambio de dinámica*: Para facilitar la validación de las zonas de pesca de aquí en más se modificó la dinámica de trabajo. Mario ayudó a Marcia con el trabajo en pantalla y Marcia se concentró en marcar las zonas y realizar anotaciones a medida que Mario avanzaba en la identificación de las zonas con los pescadores. En primer lugar se determinó la zona general de pesca de cada especie y una vez identificados los límites generales se les solicitó a los pescadores indicar las zonas más visitadas por los pescadores de Kino. Las zonas secundarias quedaron definidas por defecto.

El taller inició a las 4:30pm

Cazón dientón (*Mustelus californicus*)

ZONAS DE PESCA

Esta es una lista de las zonas de pesca más frecuentadas o principales para cazón dientón de acuerdo a los pescadores:

- El Tecomate	No se había indicado esta zona anteriormente
- Isla Patos	
- Isla Tiburón	Desde el Jamoncillo hasta Punta Mala. Es un polígono nuevo en el mapa.
- Isla Dátil	A 30 brazas. Los pescadores le dicen cazón dientón.
- El Solito, Los Cartelones, La Ballena y Ensenada Don Juan.	Todos estos sitios van hasta la boca del canal. Son polígonos nuevos en el mapa.
- Dátil - El Cardonal	Esta franja se haya a una distancia de 40 Km. de Bahía de Kino, entre 15 y 50 brazas de profundidad. El cazón se trabaja con chinchorro y cimbra en esa franja (de los presentes Beni y Gastón la trabajan con cimbra y también con chinchorro)
- San Pedro Mártir y Kino	En esta franja se trabaja el tiburón tripa, no se trabaja el cazón.

Esta especie se trabaja en la franja de más afuera (entre 15-50 brazas de profundidad) en el mes de octubre. Desde abril a mayo van mas pegados a la orilla, trabajan en la franja que queda frente a Bahía de Kino.

Para las zonas de pesca menos frecuentadas o secundarias, algunos sitios mencionados fueron Las Cruces y el Sauzal (estaban en rojo y no son visitadas con frecuencia según los presentes). Las zonas detrás de la isla tiburón hacia desemboque son secundarias también. Cuando se escasea el cazón en frente a Bahía de Kino, algunos se mueven al Ángel (Isla Ángel de la Guarda) pero como es ilegal no se animan mucho a ir. En la Cardonosa también sale cazón.

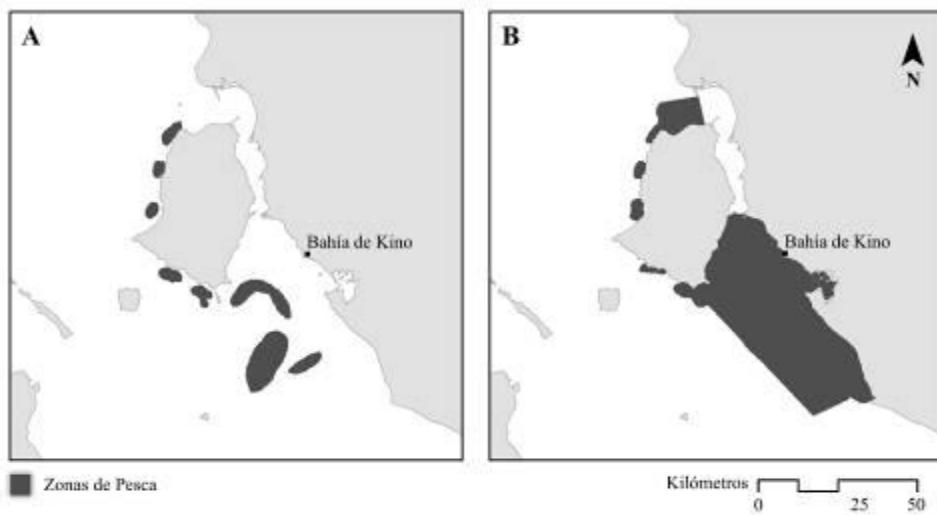


Figure 37. Zonas principales y secundarias de pesca para cazón dientón. Derecha: evaluación rápida. Izquierda: taller de validación interna.

Uno de los pescadores dijo haber visto juveniles mientras buceaba en el Sauzal durante los meses de junio y julio. La zona que estaba marcada en el mapa no es de reproducción de cazón según los presentes. Zonas de reproducción: Entra a desovar el tiburón grande en El Tecomate, Punta Tepopa, Canal del Infiernillo (en todo el canal). Se ven juveniles también en estas zonas. En mayo se ven pequeñitos. Zonas de juveniles: En la orilla de Los Huesos por la orilla hasta el faro del Cardonal, bien pegado a la orilla. En abril hay más juvenil en esta zona. En el estero Santa Cruz sale juvenil en temporada de camarón, los sacan en las redes. Los cambios en las zonas de avistamiento de juveniles y zonas de reproducción se reflejan en la Figura 38.

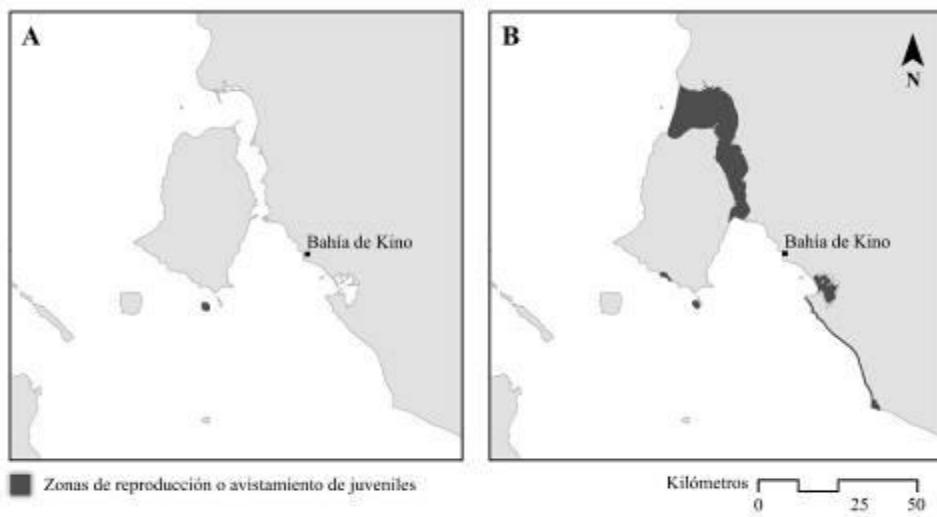


Figure 38. Zonas de avistamiento de juveniles y de reproducción para cazón dientón. Derecha: evaluación rápida. Izquierda: taller de validación interna.

CALENDARIO DE PESCA

Resultados de la evaluación rápida (Figura 39):

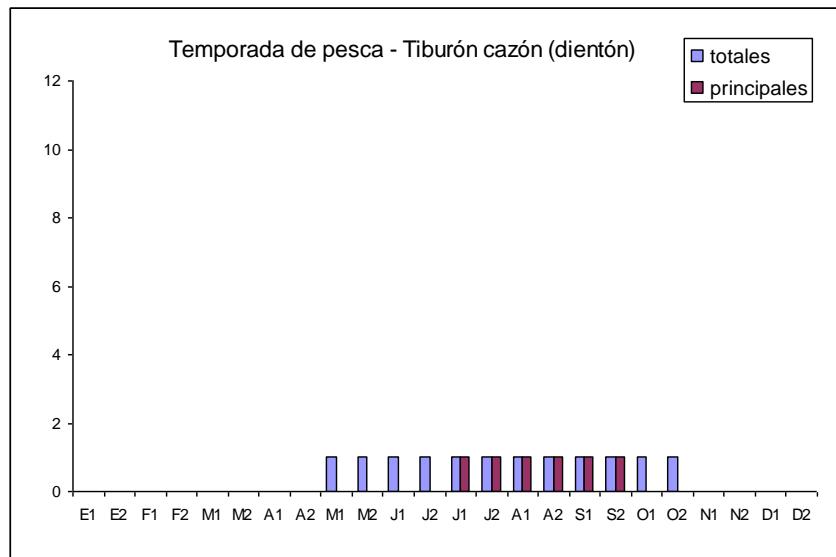
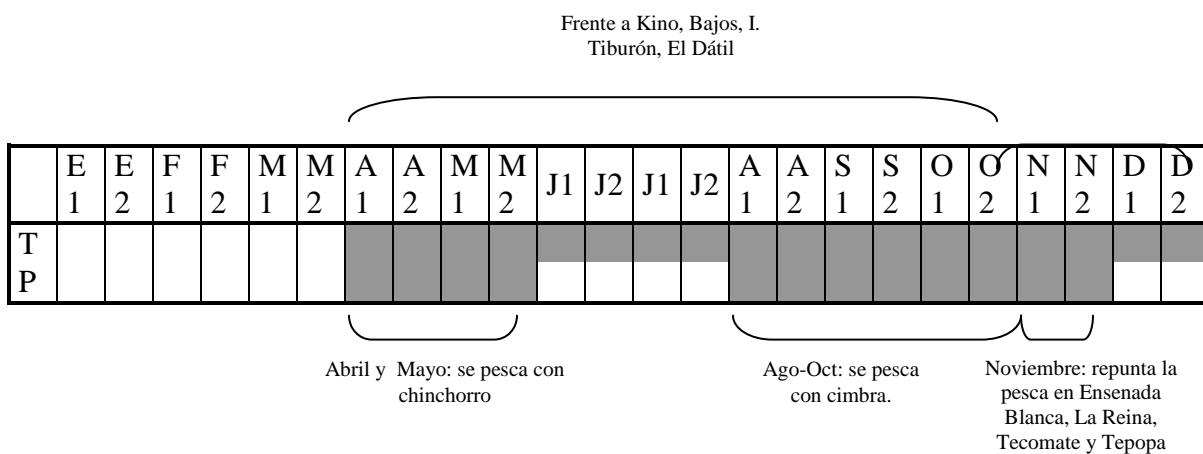


Figure 39. Temporada de pesca completa y principal para la pesca de tiburón cazón durante 2005. Los meses se dividieron en primera y segunda quincena (ej. E1: primera quincena de enero; E2: segunda quincena de enero).

El eje y indica el número de personas que indicaron que la sierra se pesca durante esos meses.

Resultados obtenidos durante el taller:

- Temporada total: De abril a octubre se trabaja en frente a Kino, en los bajos, el Dátil, y frente a isla Tiburón (toda la zona que se marcó previamente). En noviembre y diciembre se trabaja en el Tecomate, Ensenada Blanca, la Tordilla, Isla Patos.
- Temporada principal: Abril y mayo se trabaja en frente a Kino con chinchorro. En agosto, septiembre y octubre se trabaja con cimbra en frente de Bahía de Kino. En noviembre repunta en Ensenada Blanca, La Reina, Tecomate, Tepopa.



Para tiburón cazón, los resultados obtenidos en la evaluación rápida en cuanto a temporada completa de pesca se condicen medianamente con los resultados obtenidos en la validación durante el taller (se agregan tres meses más de pesca). Sin embargo, se obtuvo información nueva acerca de la temporada principal de pesca, el tipo de arte de pesca que utilizan en cada época (chinchorro y cimbra), y la estacionalidad de la pesca en cada zona de trabajo.

Manta arenera (*Dasyatis dipterura*) y tecolota (*Myliobatis californica*)

Nota: Los mapas correspondientes a manta arenera y manta tecolota se trabajaron juntos ya que los pescadores nos indicaron que sus zonas de pesca coinciden y suelen pescarlas juntas.

ZONAS DE PESCA

Esta es una lista de las zonas de pesca más frecuentadas o principales para manta arenera y tecolote de acuerdo a los pescadores:

- El Sahuímaro Para esta pesquería también sale de la manta tecolota. En esta zona marca a 20 - 30 Km. de la costa y a 20 – 30 – 40 brazas de profundidad
- San Lorenzo Esta zona es mas para arenera y tecolota, no de mariposa
- Cerro Prieto - Al Monumento Toda la bahía. Para la boca sacan más de la tecolota.
La zona entre Ensenada Blanca y La Vaporeta (quitar zona marcada en amarillo en frente a ensenada blanca).
- Los Huesos A 20 - 30 Km. de la orilla y a 12 -15 - 20 brazas.
- El Tecomate Sale mas la manta arenera
- Boca del Canal En febrero es buena para la manta tecolota
- Ángel de la Guarda Aunque no es una zona importante, también se marco.
- San Rafael Es en Baja California. Iban hace 2 - 3 años y hay mucha cantidad pero ya no van porque esta prohibido. 1 tonelada se las pagaban a 7 mil pesos y 7 mil pesos les costaba la salida, no convenía

La manta tecolota anda por todos lados (no solo en la orilla), la arenera es más costera. Los pescadores indicaron que no pescan estas mantas frente a Mancha Blanca (quitar marca). Las zonas frente al tecomate que estaban marcadas desde la evaluación rápida también la quitarían (no son de arenera o tecolota, es mas para la manta trompa de pato). Los pescadores mencionaron que tampoco sacan de estas mantas en San Esteban.

En cuanto a las zonas de pesca menos frecuentadas o secundarias, las 4 zonas que quedaron marcadas menos la de frente al Sahuímaro. En el estero Santa Rosa un pescador echó 10 toneladas por día de tecolota, en unas horas en esta temporada. Los cambios en las zonas de pesca tanto principales como secundarias se reflejan en la Figura 40.

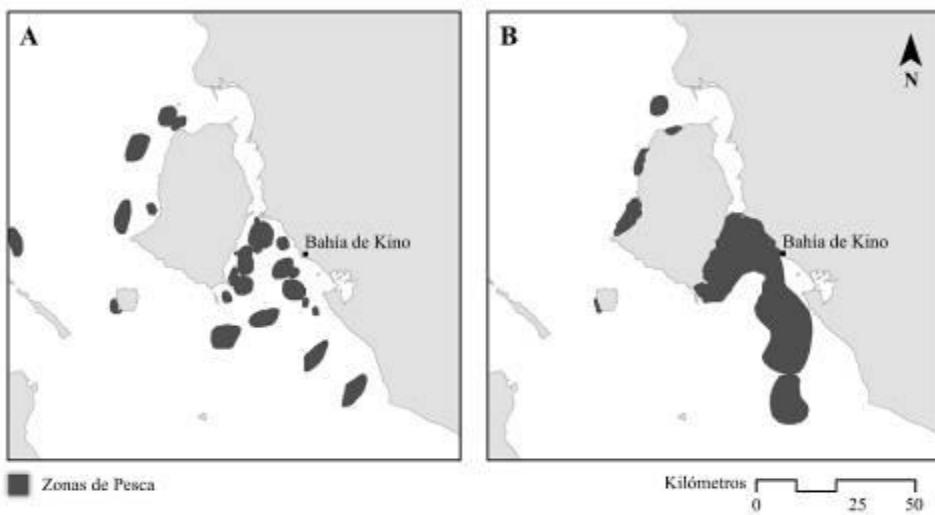


Figure 40. Zonas principales y secundarias de pesca para manta arenera y tecolota. Derecha: evaluación rápida. Izquierda: taller de validación interna.

Para las zonas de avistamiento de juveniles y de reproducción se mencionó que para arenera, en todo el canal del Infiernillo hay cantidad de chiquita en el mes de septiembre. En el tepetate también se ven juveniles. Para la manta tecolota: En frente del pueblo en tiempo de calor (entre los tepetates a atrás del alcatraz en tiempo de calor).

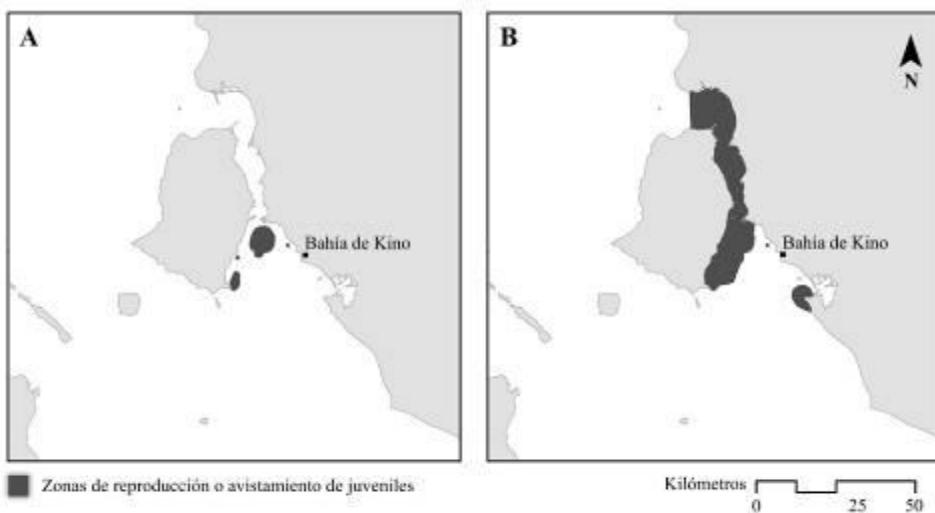


Figure 41. Zonas de avistamiento de juveniles y de reproducción para manta arenera y tecolota. Derecha: evaluación rápida. Izquierda: taller de validación interna.

CALENDARIO DE PESCA Para Manta Tecolota.

Resultados de la evaluación rápida (Figura 42):

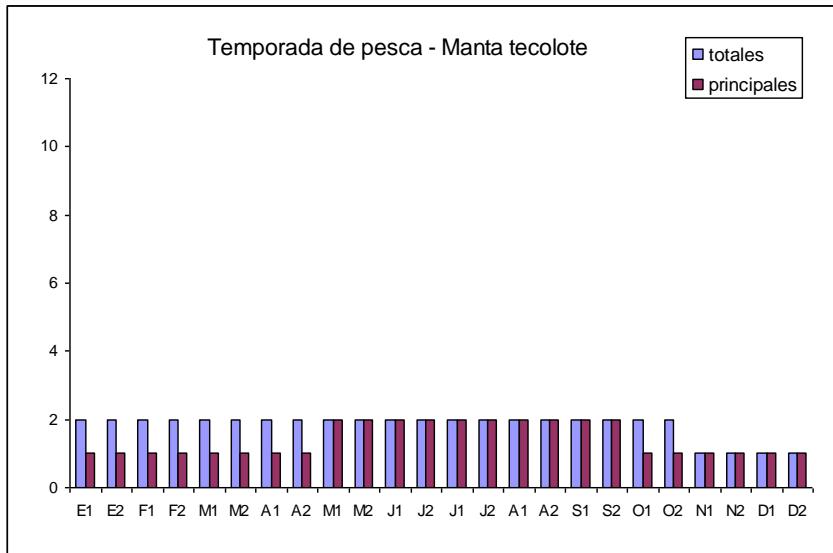


Figure 42. Temporada de pesca completa y principal para la pesca de manta tecolota durante 2005. Los meses se dividieron en primera y segunda quincena (ej. E1: primera quincena de enero; E2: segunda quincena de enero).

El eje y indica el número de personas que indicaron que la manta tecolota se pesca durante esos meses.

Resultados obtenidos durante el taller:

- Temporada total: Todo el año.
- Temporada principal: De enero a octubre. En noviembre y diciembre escasea.

	E ₁	E ₂	F ₁	F ₂	M ₁	M ₂	A ₁	A ₂	M ₁	M ₂	J ₁	J ₂	J ₁	J ₂	A ₁	A ₂	S ₁	S ₂	O ₁	O ₂	N ₁	N ₂	D ₁	D ₂	
T																									
P																									

Para manta tecolota, los resultados obtenidos en la evaluación rápida coinciden bastante con los obtenidos en la validación durante el taller. Los meses de noviembre y diciembre no son temporada principal (igual se pesca pero no tan intensamente).

Para Manta Arenera.

Resultados de la evaluación rápida (Figura 43):

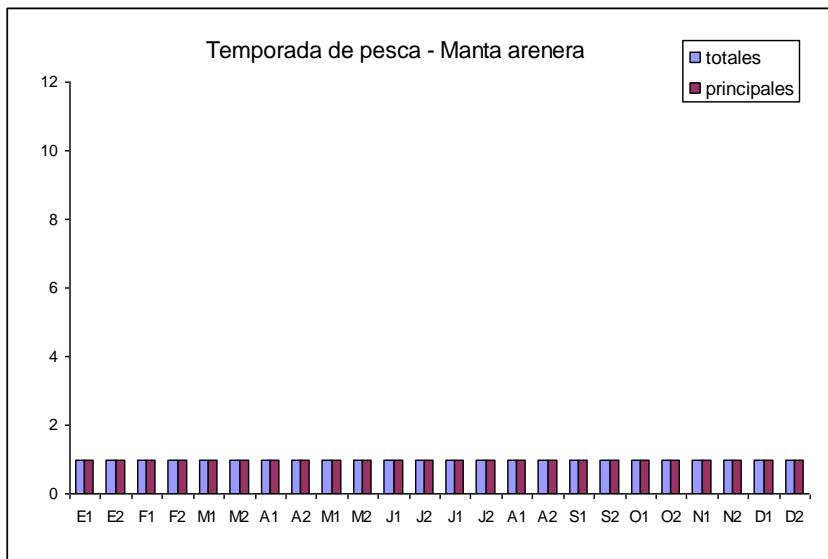


Figure 43. Temporada de pesca completa y principal para la pesca de manta arenera durante 2005. Los meses se dividieron en primera y segunda quincena (ej. E1: primera quincena de enero; E2: segunda quincena de enero).

El eje y indica el número de personas que indicaron que la manta arenera se pesca durante esos meses.

Resultados obtenidos durante el taller:

- Temporada total: todo el año.
- Temporada principal: sale más en tiempo de calor (de marzo a julio).
- En tiempo de calor sale tanto manta arenera como tecolota en más cantidad que en el resto del año.

	E ₁	E ₂	F ₁	F ₂	M ₁	M ₂	A ₁	A ₂	M ₁	M ₂	J ₁	J ₂	J ₁	J ₂	A ₁	A ₂	S ₁	S ₂	O ₁	O ₂	N ₁	N ₂	D ₁	D ₂	
T																									
P																									

Para manta arenera, los resultados obtenidos en la evaluación rápida en cuanto a temporada completa de pesca coinciden con los obtenidos en la validación durante el taller. Sin embargo, la temporada principal de pesca difirió y quedó restringida a los meses de marzo a julio.

Manta mariposa (*Gymnura marmorata*)

Nota: Se pesca a mayor profundidad que las otras mantas.

Comienzo: 5:15pm

ZONAS DE PESCA

Esta es una lista de las zonas de pesca más frecuentadas o principales para manta mariposa de acuerdo a los pescadores:

- | | |
|----------------------------------|---|
| - El Dátil | Del Alcatraz derecho al Dátil. Comprende una franja de entre 6 - 8 a 20 - 25 brazas desde el Dátil en dirección hacia el Perro. |
| - Ensenada Blanca | Es muy bueno para la mariposa también, en tiempo de frío (noviembre) |
| - Ensenada Blanca to La Vaporeta | Sale mucha manta |
| - La Reina - Punta Baja | Sale mucha manta |
| - Isla Patos | Para esta zona, los pescadores dijeron que estaba bien que se haya marcado esta zona aunque agarran menos cantidad |

Las zonas que visitan con más frecuencia son: Dátil y área de Ensenada Blanca. En estas fechas se va frecuentemente a la Ensenada y a Isla Patos. En tiempos de calor se trabaja en el Dátil.

En cuanto a las zonas de pesca menos frecuentadas o secundarias, los pescadores indicaron que cuando salen, no van a pescar mariposa a la zona frente al Sahuímaro. Sale pero una que otra. Esa zona es más adecuada para la manta arenera y tecolota.

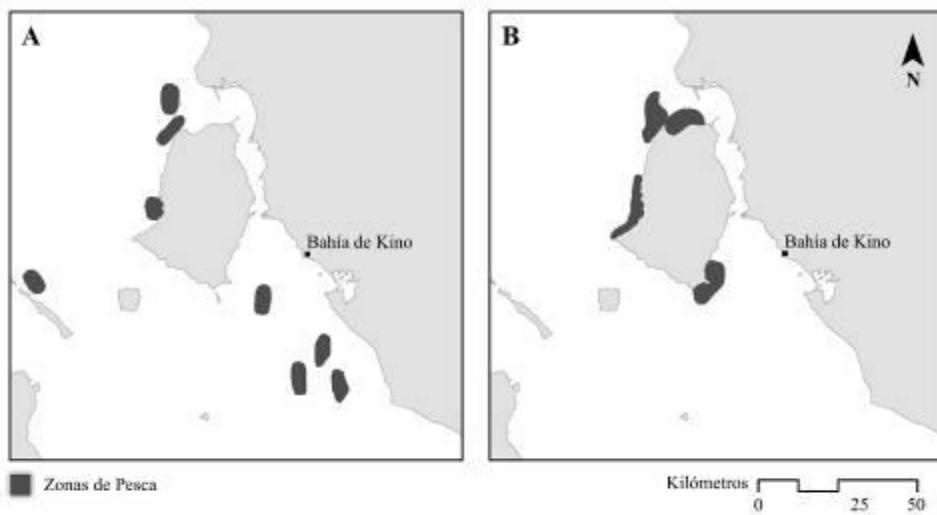


Figure 44. Zonas principales y secundarias de pesca para manta mariposa. Derecha: evaluación rápida. Izquierda: taller de validación interna.

Para las zonas de avistamiento de juveniles y reproducción, se indicaron los siguientes sitios:

- La zona del Dátil es zona de juveniles.
- De la Ensenada Blanca a la Vaporeta.
- Por el lado de afuera de Isla Patos. A mitad de camino entre Isla Patos y el Alcatracito.

Los cambios en las zonas de avistamiento de juveniles y zonas de reproducción se reflejan en la Figura 48.

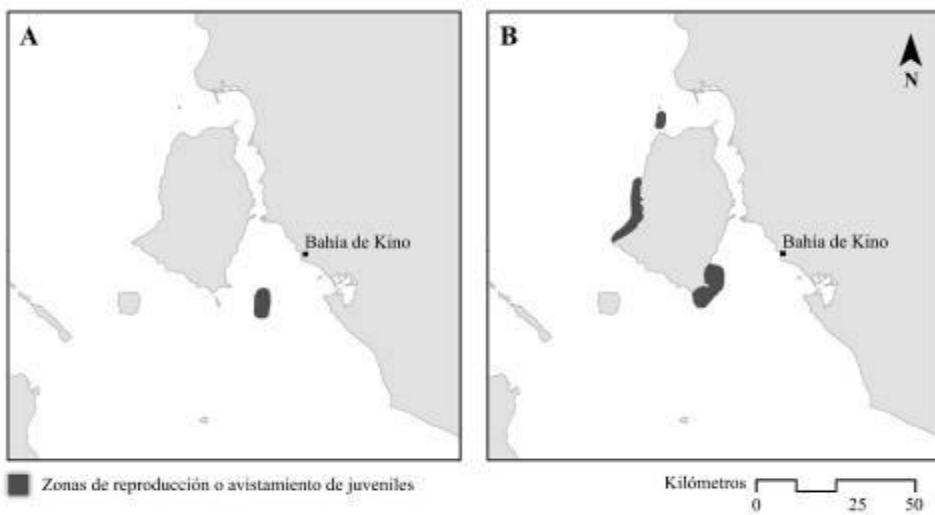


Figure 45. Zonas de avistamiento de juveniles y de reproducción para manta mariposa. Derecha: evaluación rápida. Izquierda: taller de validación interna.

CALENDARIO DE PESCA

Resultados de la evaluación rápida (Figura 46):

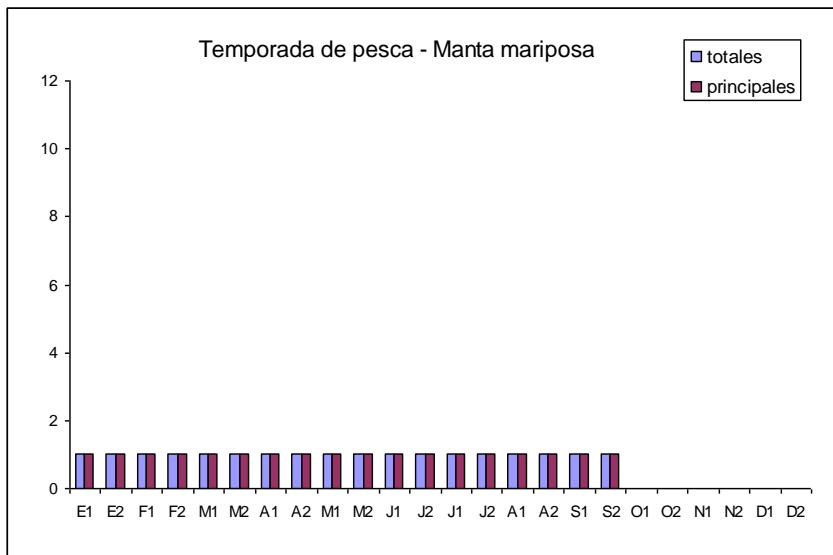
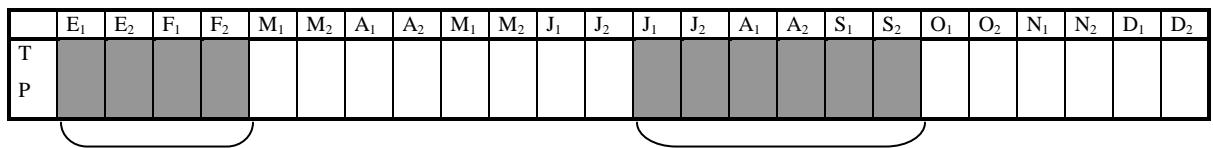


Figure 46. Temporada de pesca completa y principal para la pesca de manta mariposa durante 2005. Los meses se dividieron en primera y segunda quincena (ej. E1: primera quincena de enero; E2: segunda quincena de enero).

El eje y indica el número de personas que indicaron que la manta mariposa se pesca durante esos meses.

Resultados obtenidos durante el taller:

- En enero y febrero se trabaja en Ensenada Blanca e I. Patos. De julio a septiembre se pesca en el Dátil.



Enero y Feb: Ensenada
Blanca e I. Patos

Julio-Sept: El Dátil

Para manta mariposa, los resultados obtenidos en la evaluación rápida difirieron de los obtenidos en la validación durante el taller. Quedaron definidas dos temporadas de pesca tanto para completa y principal, de enero a febrero, y de julio a septiembre. Se obtuvo información adicional de estacionalidad de la pesca en las zonas de trabajo.

El taller finalizó alrededor de las 6:00pm.

TALLER DE BUCEO

Bahía de Kino, 1 de febrero de 2008
 El taller inició a las 3:30pm.

Pulpo (*Octopus spp.* o *O. hubssorum*)

Nota: Empezamos con calendarios de pesca por problemas técnicos (ver sección calendarios).

ZONAS DE PESCA

Esta es una lista de las zonas de pesca más frecuentadas o principales para pulpo de acuerdo a los pescadores:

- El Tumor Trabajan en una piedra pequeña que se llama la collera (arrecife artificial).
- Punta Gorda - Las Almejitas Se marcó un polígono a 100 mts de la orilla, 2 - 4 brazas de profundidad.
- Isla Alcatraz Por fuera, a unos 500 mts de la orilla. Es una franja, a 2 - 4 brazas de profundidad. Por el frente de isla Alcatraz se trabaja pegado a la orilla, a 2 - 4 brazas.
- Canal del Infiernillo En la pura boca del canal.
- Isla Tiburón Desde Ensenada Don Juan por toda la orilla de la isla. Alrededor de la isla. De 15 a 2 brazas. En la isla se pesca a más profundidad que en las zonas anteriores. En la Isla varía bastante la profundidad de los sitios de pesca (2, 4, 10, 15 brazas)
- El Dátil A 10 brazas máximo.
- Isla Patos Las zonas son todo alrededor (contestaron con mucho énfasis), en la parte norte y al oeste te sales hasta 15 brazas. El lado Este de Isla Patos no es tan hondo. En Isla Patos se pesca desde lo seco hasta 15 brazas
- Tepopa Todo alrededor
- El Jamoncillo al Tepetates pequeños

Tecomate

- Cerro Prieto - Paredones	Se van hasta Santa Rosa, pegado a la orilla, 2 brazas de profundidad.
- Compuertas - Bahía de Kino	Las zonas de pesca van hasta el Sahuímaro. Toda la costa hasta el Hueso (incluyendo las Almejitas).
- Compuertas - Tepetates	Desde los 100 m. de la costa, 2 - 4 brazas y luego hay una zona de arena que no se trabaja hasta llegar al Tumor.
- Frente a Desemboque Seri	Las zonas de pesca son a una distancia de 5 Km. desde la orilla.
- Isla San Esteban	Ahí se pesca todo alrededor. Desde lo seco hasta 10 - 15 brazas
- Isla San Lorenzo	Ahí se trabaja todo alrededor. Desde lo seco hasta 10 - 15 brazas.
- Isla Ángel de la Guarda	Las zonas de pesca son en la Cardonosa y demás islotes, y en Punta Colorada.
- Baja California (costa)	Zona en Bahía San Rafael.
	Puerto Mujeres y San Francisquito.
	En la Jerga.
	Toda la orilla desde la Jerga hasta Punta Trinidad a 6 - 8 hasta 10 brazas.
	En El Rasito.
	Los Corrales, Cabo San Miguel.

Las zonas de pesca más frecuentadas son en isla Tiburón: Desde el Perro hasta el Sauzal. Desde la Tordilla a Tecomate. También en Isla Patos: todo alrededor. Y finalmente en la Baja California: Los Corrales, San Miguel y el Rasito.

En cuanto a las zonas de pesca menos frecuentadas o secundarias, estas se encuentran frente al faro de desemboque hasta las Cuevitas todo por la orilla, 4 - 5 brazas (muchos de los presentes no han ido a trabajar allí). Uno que otro de Bahía de Kino va a trabajar ahí. Los Ramírez trabajan mucho en esta zona. Antes no había tanto problema con los Seris y los de Puerto Libertad. Por eso iban mas los de Kino a pescar allí, ahora es mas la gente de Puerto Libertad la que va a pescar. Otras zonas secundarias: San Lorenzo, a veces hay

temporadas buenas y otras veces no, es muy variable pero sí es buen sitio de pesca. Uno de los pescadores insistió: “Todos los días sale producto cuando hay”.

Los cambios en las zonas de pesca tanto principales como secundarias se reflejan en la Figura 47.

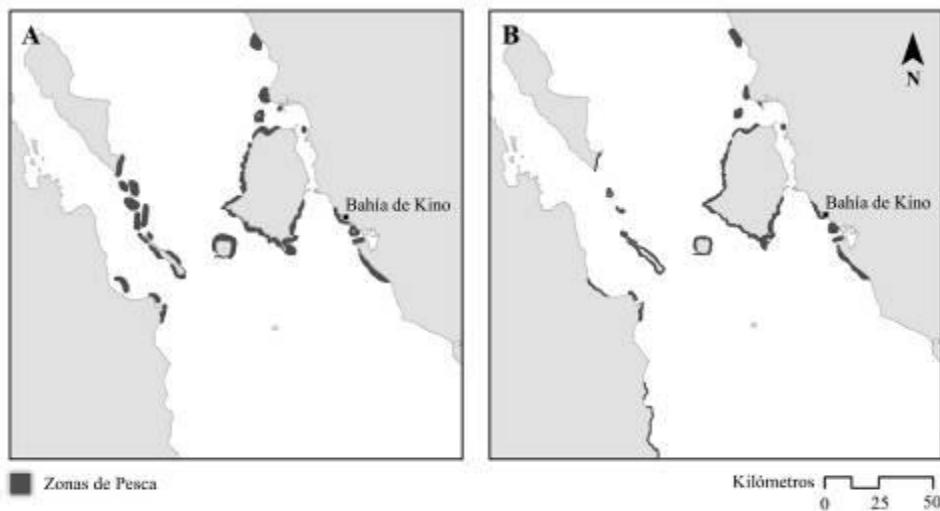


Figure 47. Zonas principales y secundarias de pesca para pulpo. Derecha: evaluación rápida. Izquierda: taller de validación interna.

Las zonas de avistamiento de juveniles y de reproducción no tuvieron cambios sin embargo, se ajustaron las distancias de la costa hacia mar adentro basándose en la batimetría. Los participantes recalcaron que estos sitios se encuentran en los mismos sitios de pesca que frecuentan.

CALENDARIO DE PESCA

Resultados de la evaluación rápida (Figura 48):

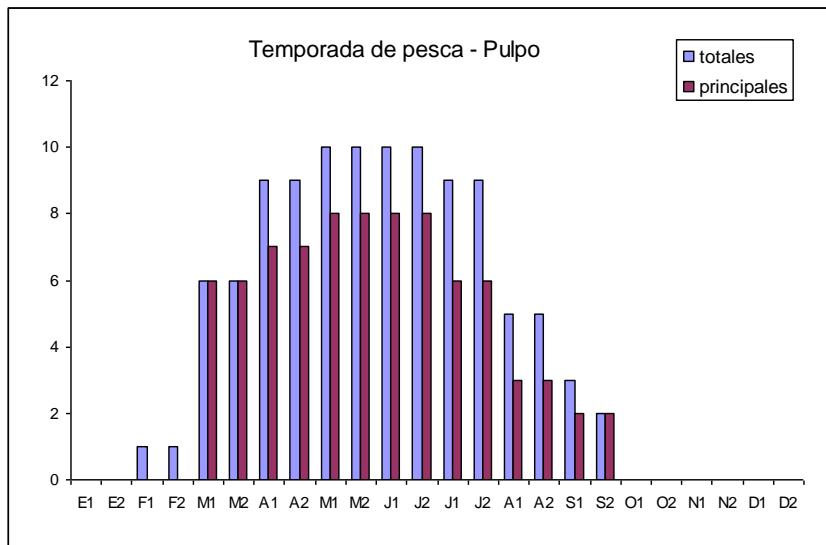


Figure 48. Temporada de pesca completa y principal para la pesca de pulpo durante 2005. Los meses se dividieron en primera y segunda quincena (ej. E1: primera quincena de enero; E2: segunda quincena de enero).

El eje y indica el número de personas que indicaron que el pulpo se pesca durante esos meses.

Resultados obtenidos durante el taller:

- Pulpo a veces hay a también en diciembre. A veces también en enero.
 - Pulpo colorado y lunarejo (los sitios de pesca del lunarejo son específicos pero la temporada de pesca de pulpo en general (ambas especies) es la siguiente:
 - Temporada total: febrero a septiembre. En septiembre van a la baja, el Ángel, San Lorenzo, mucha gente en agosto se empieza a ir a la baja porque se pone mas fuerte allá el pulpo. En octubre ya merma. Empiezan primero en la isla Tiburón (febrero, marzo, abril). En Bahía de Kino en febrero, desde tepetates a 2° Cerro Prieto.
 - Temporada principal: abril, mayo, junio, julio.

Feb. a Abril se pesca en Isla Tiburón. En la bahía de Kino empieza en febrero, desde Los Tepetates a 2° Cerro Prieto
Tepetates a 2° Cerro Prieto

Septiembre: en Baja California: Angel de la Guarda, San Rafael, San Lorenzo
Lorenzo

Para el pulpo, el pico de frecuencia obtenido en la evaluación rápida en cuanto a temporada principal de pesca coincide con los resultados obtenidos en la validación durante el taller. Se obtuvo información adicional sobre estacionalidad de la pesca en cada zona de trabajo.

Langosta (*Panulirus inflatus*)

ZONAS DE PESCA

Esta es una lista de las zonas de pesca más frecuentadas o principales para langosta de acuerdo a los pescadores:

- | | |
|----------------------------------|---|
| - El Tepetate | Se pone en unas piedritas específicas. Punta San Nicolás, misma profundidad que para pulpo. |
| - Los Pinitos | En las mismas zonas de pesca que el pulpo. |
| - Segundo Cerro Prieto | En las mismas zonas de pesca que el pulpo. |
| - Boca del Canal | En las mismas zonas de pesca que el pulpo. |
| - Isla Tiburón | Desde ensenada Don Juan hasta la punta antes de llegar al Tecomate. No hay en el tecomate ni en patos. Las zonas de pesca tienen la misma profundidad que para pulpo. |
| - El Dátil | En las mismas zonas de pesca que el pulpo. |
| - Isla San Esteban | Todo alrededor |
| - El Peludo | En las mismas zonas de pesca que el pulpo. |
| - Isla San Lorenzo a Salsipuedes | Todo el corredor de islas. Específicamente al sur de Isla Ángel de la Guarda |
| - Isla Ángel de la Guarda | Desde las 10 hasta las 15 brazas. |
| - Baja California (costa) | Desde las Ánimas hasta San Rafael. Y desde Puerto Mujeres a Santa Rosalía. |
| - Isla San Pedro Martir | Se pesca todo alrededor de la isla en la misma profundidad que para pulpo, 15 brazas. |

- Isla Tortuga

Las zonas de pesca más frecuentadas son: En la Baja: La Trinidad, Los Corrales, San Miguel, San Lorenzo, San Esteban. En Isla Tiburón: Del perro hasta La Tordilla, pero toda la isla se visita frecuentemente. En Isla Ángel de la Guarda: la Punta del Diablo, La Víbora (van pocas pangas pero van frecuentemente, de 100 irán unas 20 pangas de Kino). En San Lorenzo es una parte céntrica para los pescadores, se mueven para varias partes desde allí, es donde suelen acampar para moverse a pescar langosta en otras zonas.

En cuanto a las zonas de pesca menos frecuentadas o secundarias las que no fueron marcadas como las más frecuentemente visitadas fueron las que quedaron. Isla San Esteban y San Pedro Mártir quizá no se frecuenten tanto. Desde Bahía las Ánimas hasta cabo Vírgenes es otra zona secundaria.

Los cambios en las zonas de pesca tanto principales como secundarias se reflejan en la Figura 49.

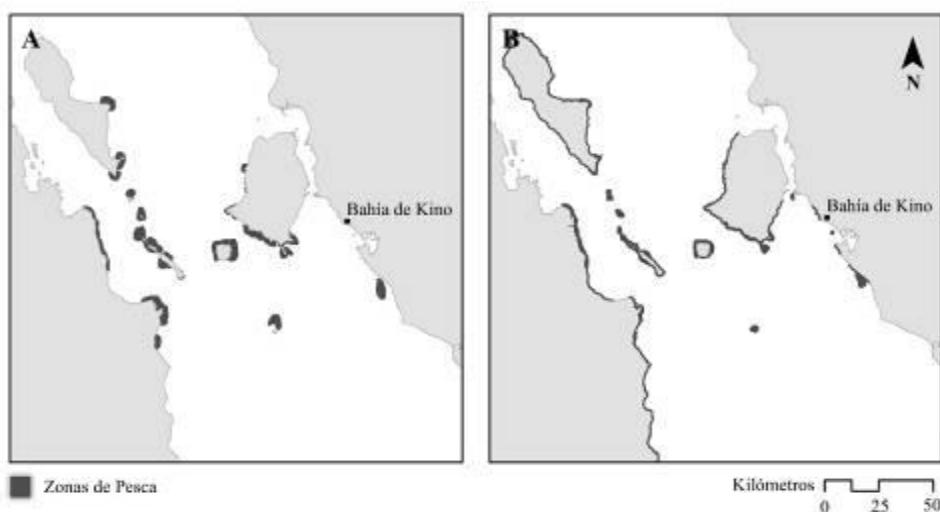


Figure 49. Zonas principales y secundarias de pesca para langosta. Derecha: evaluación rápida. Izquierda: taller de validación interna.

Las zonas de avistamiento de juveniles y de reproducción son las mismas zonas de pesca frecuentadas. Los cambios en las zonas de avistamiento de juveniles y zonas de reproducción se reflejan en la Figura 50.

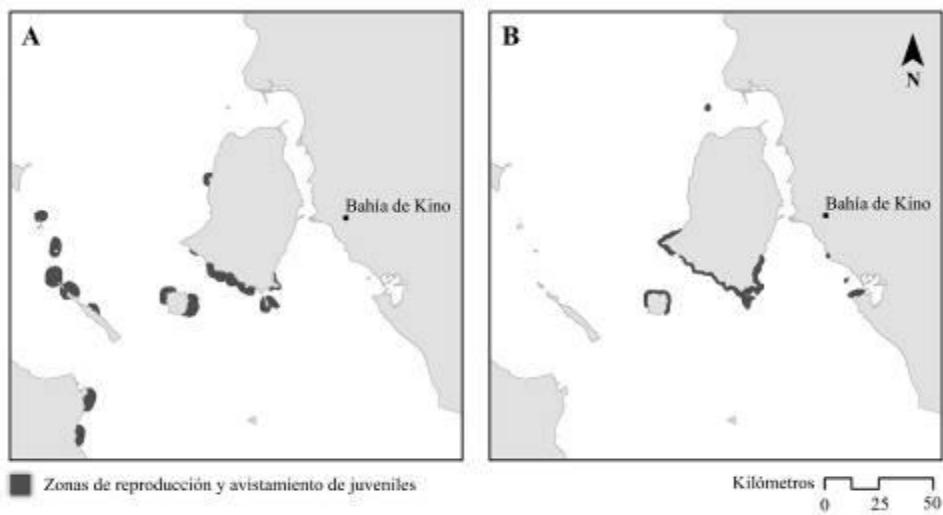


Figure 50. Zonas de avistamiento de juveniles y de reproducción para langosta. Derecha: evaluación rápida. Izquierda: taller de validación interna.

CALENDARIO DE PESCA

Resultados de la evaluación rápida (Figura 51):

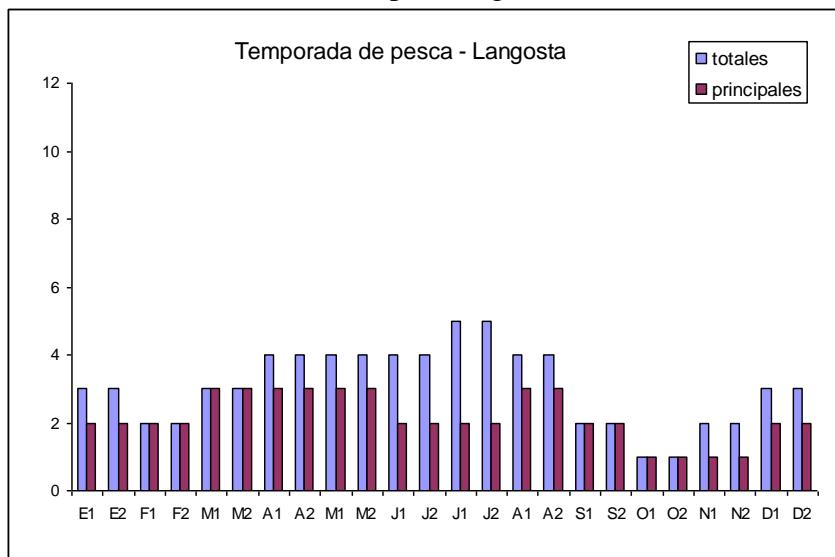


Figure 51. Temporada de pesca completa y principal para la pesca de langosta durante 2005. Los meses se dividieron en primera y segunda quincena (ej. E1: primera quincena de enero; E2: segunda quincena de enero).

El eje y indica el número de personas que indicaron que el langosta se pesca durante esos meses.

Resultados obtenidos durante el taller:

- Temporada total: Todo el año traes.
- Temporada principal: tiempo de calor es la mejor época. De diciembre a agosto la trabajan más intensamente. Diciembre y enero se arrima a tirar el carapacho. En mayo, junio y julio se arrima a tirar la hueva.
- Se trabaja en todas las zonas (Baja California, Isla Tiburón, etc.) durante la temporada principal de pesca.

Mayo-julio: se arrima a
tirar la hueva

	E 1	E 2	F 1	F 2	M 1	M 2	A 1	A 2	M 1	M 2	J1	J2	J1	J2	A 1	A 2	S 1	S 2	O 1	O 2	N 1	N 2	D 1	D 2
T P																								

Para langosta los resultados de calendarios de pesca principales se acotaron más durante la validación durante el taller.

Cabrilla sardinera (*Myctoperca rosacea*)

ZONAS DE PESCA

Primeramente se definió una zona general para la pesca de la cabrilla sardinera indicando que se trabaja a las mismas profundidades que pulpo y langosta. Esta es una lista de las zonas de pesca más frecuentadas o principales para cabrilla sardinera de acuerdo a los pescadores:

- Isla Tiburón Monumento a Ensenada Blanca; y de los Huesos al Jamoncillo.
- Isla Patos
- Punta Tepopa Desde esa zona hasta el Dólar
- San Lorenzo Todo alrededor
- Isla Dátil Todo alrededor
- Isla Raza a La
Cardonosa
- Isla Ángel de la todos los del Nando trabajan ahí

Guarda

- La Jerga
- San Miguel A cabo San Miguel le dicen a un sitio más abajo de cabo San Miguel (fue marcado en el mapa).
- Trinidad
- San Pedro Mártir Todo alrededor

Los sitios mas frecuentados son: En Isla Ángel de la Guarda: El Diablo, Las Víboras, y El Barco. En San Lorenzo: Punta Prieta, Punta Sur (hay un barco sardinero varado). En Isla Tiburón: de La Vaporeta hasta El Tecomate; y del Perro hasta Ensenada Blanca. En todo el Dátil, El Choyudito, El Peludo y la Isla San Esteban

En cuanto a las zonas de pesca menos frecuentadas, los sitios seleccionados fueron:

- Isla Ángel de la Guarda
- San Lorenzo
- Isla San Pedro Mártir
- Punta Trinidad
- Punta Gertrudis
- Cabo San Miguel

Los cambios en las zonas de pesca tanto principales como secundarias se reflejan en la Figura52.

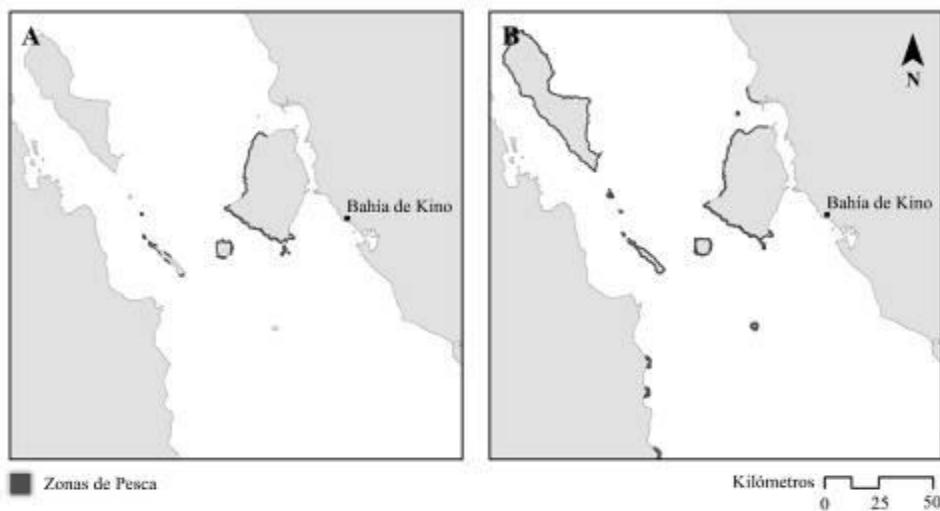


Figure 52. Zonas principales y secundarias de pesca para cabrilla sardinera. Derecha: evaluación rápida. Izquierda: taller de validación interna.

Las zonas de avistamiento de juveniles reconocidas por los pescadores son:

- San Pedro Mártir: se ve mucho juvenil.
- También en la Isla tiburón se ve mucho juvenil (están trayendo cabrilla juvenil para vender). Desde la Vaporeta hasta el Jamoncillo, y desde Ensenada Blanca hasta el Monumento.
- San Esteban también es zona de juveniles.

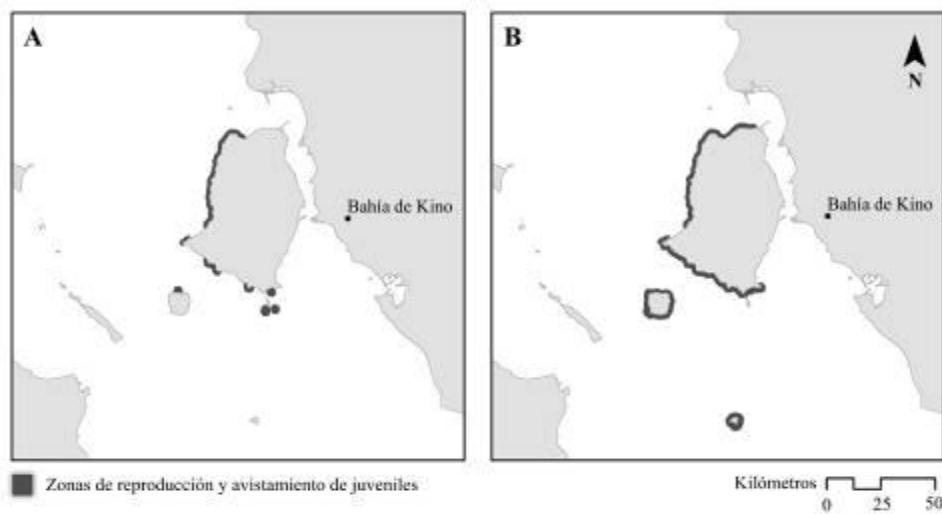


Figure 53. Zonas de avistamiento de juveniles y de reproducción para cabrilla sardinera. Derecha: evaluación rápida. Izquierda: taller de validación interna.

CALENDARIO DE PESCA

Resultados de la evaluación rápida (Figura 54):

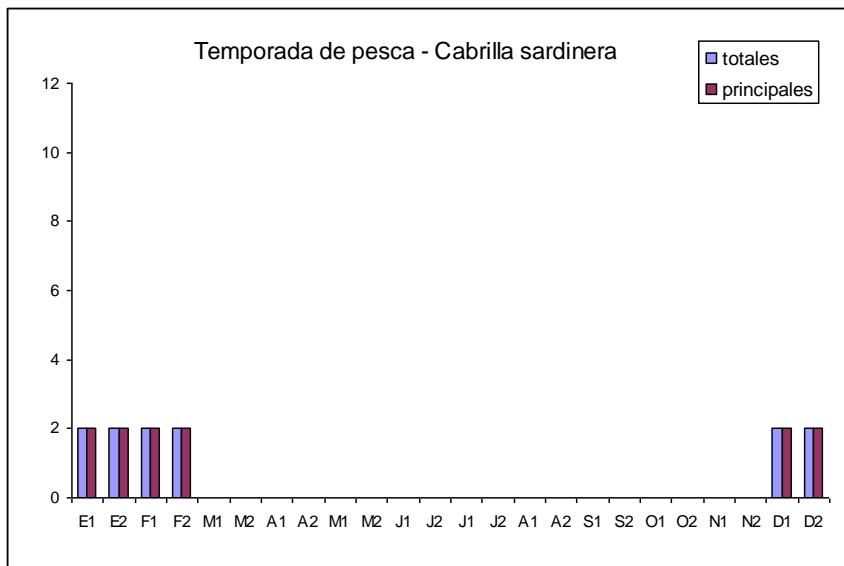


Figure 54. Temporada de pesca completa y principal para la pesca de cabrilla durante 2005. Los meses se dividieron en primera y segunda quincena (ej. E1: primera quincena de enero; E2: segunda quincena de enero).

El eje y indica el número de personas que indicaron que el cabrilla se pesca durante esos meses.

Resultados obtenidos durante el taller:

- Temporada total: Desde noviembre se empieza a trabajarla de noche. Por buceo se trabaja de noviembre a febrero.
- En el verano se pesca a piola. Mayo - junio lo trabajan los chinchorreros encerrándola.
- Se trabajan por igual todas las zonas de pesca cuando está el agua helada, no se trabaja por buceo en verano porque no aguanta el hielo, requiere mucho hielo para conservarla.
- Temporada principal: igual a la completa.

	Mayo-junio: con chinchorro																							
	E1	E2	F1	F2	M1	M2	A1	A2	M1	M2	J1	J2	J1	J2	A1	A2	S1	S2	O1	O2	N1	N2	D1	D2
T																								
P																								

Para cabrilla sardinera los resultados de calendarios de pesca obtenidos en la evaluación rápida coinciden con los de la validación durante el taller.

Callo riñón (*Atrina tuberculosa*)

ZONAS DE PESCA

Esta es una lista de las zonas de pesca más frecuentadas o principales para Callo riñón de acuerdo a los pescadores:

- El Sahuímaro A 10 brazas de profundidad máxima, a unos 10 Km. de costa.
- Los Tepetates A 1 Km. afuera, 6-7 brazas.
- Los Morritos Son dos morritos y quedan entre el Hueso y San Nicolás.
- Los Huesos - Almejitas
- Cerro Prieto Desde 4 a 5 brazas. En el segundo Cerro Prieto de 6 a 7 brazas. Se trabaja en una franja en la orilla y en una zona mas afuera (en frente a los cerro prietos).
- Ronquido
- Tordillos Pegado a la orilla
- Las Casitas A 1 braza
- El Monumento A 8 brazas
- Bajo el Álamo De 2 a 8 (máximo) brazas.

Esta es una lista de las zonas de pesca menos frecuentadas o principales para Callo riñón de acuerdo a los pescadores:

- Cerro Amarillo Aproximadamente a 8 brazas pero hay poquito callo ahí.
- Frente a Bahía de Kino De 2 a 5 brazas.
- Los Bajos de la Boca De 2 a 7 brazas
- Ensenada Don Juan A las piedras de 4 brazas
- Canal del Infiernillo Desde el canal en la boca del estero hasta en frente de la punta Blanca a 2 brazas.

- El Tumor A unas 7 brazas.
- La Ona De 1 a 2 brazas.

Específicamente entre punta Ona y Víboras. Igual frente a Cerro Prieto y Segundo Cerro Prieto y entre el Tumor y las Compuertas y frente a esa misma zona también.

Los cambios en las zonas de pesca tanto principales como secundarias se reflejan en la Figura 55.

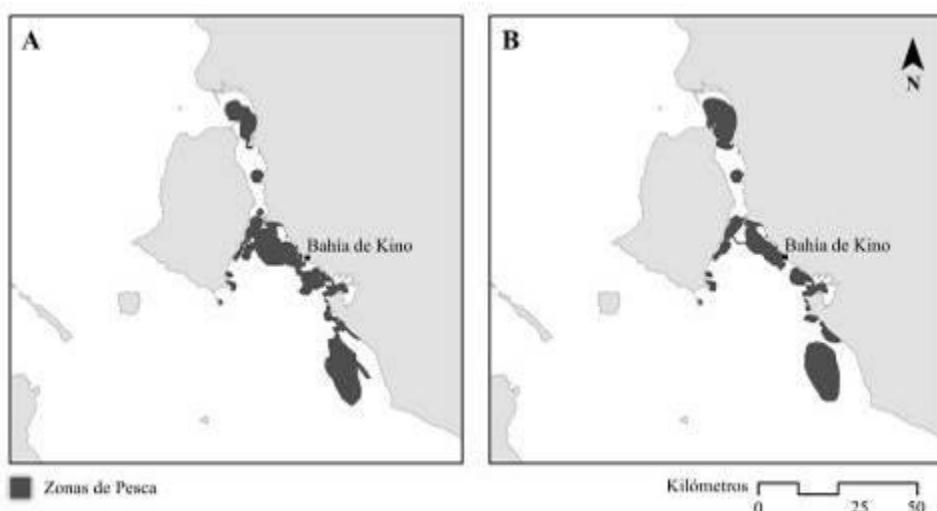


Figure 55. Zonas principales y secundarias de pesca para callo riñon. Derecha: evaluación rápida. Izquierdo: taller de validación interna.

Para las zonas de avistamiento de juveniles y de reproducción, los sitios son:

- Las Almejitas
- La orilla de Kino
- Los Tordillitos
- Estero Santa Rosa
- Boca del estero Santa Rosa hasta adentro del canal
- Punta San Miguel (dando vuelta hacia adentro del canal)
- Por dentro de la Punta Mala
- El bajo del Álamo
- En frente a la Punta Mala
- El Jamoncillo
- Frente al Alcatraz y frente a Kino

Los cambios en las zonas de avistamiento de juveniles y zonas de reproducción se reflejan en la Figura 56.

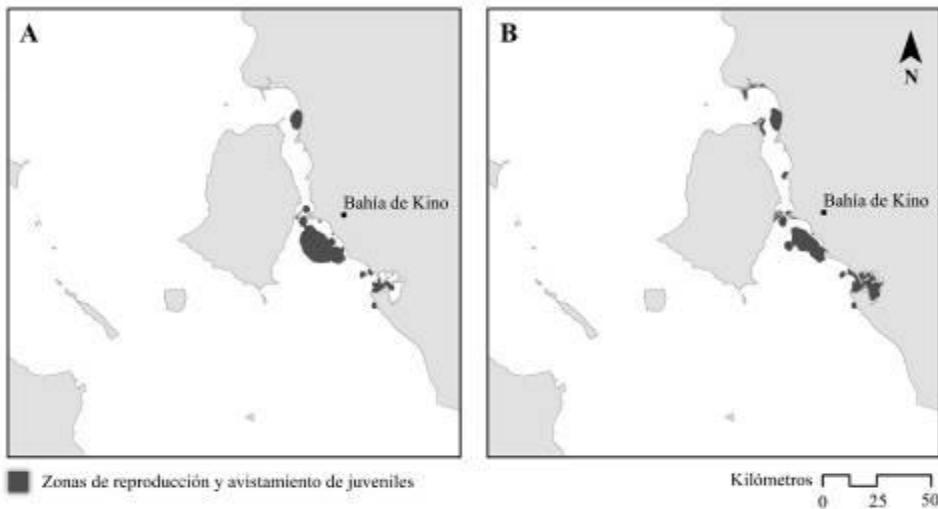


Figure 56. Zonas de avistamiento de juveniles y de reproducción para callo riñón. Derecha: evaluación rápida. Izquierda: taller de validación interna.

CALENDARIO DE PESCA

Resultados de la evaluación rápida (Figura 57):

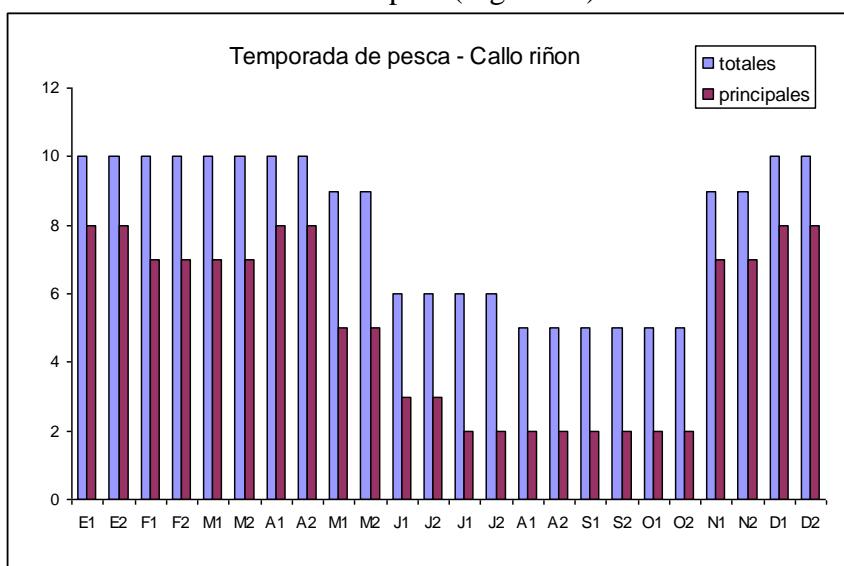


Figure 57. Temporada de pesca completa y principal para la pesca de callo durante 2005. Los meses se dividieron en primera y segunda quincena (ej. E1: primera quincena de enero; E2: segunda quincena de enero).

El eje y indica el número de personas que indicaron que el callo se pesca durante esos meses.

Resultados obtenidos durante el taller:

- Temporada total: todo el año.
- Temporada principal: Noviembre a mayo.

	E1	E2	F1	F2	M1	M2	A1	A2	M1	M2	J1	J2	J1	J2	A1	A2	S1	S2	O1	O2	N1	N2	D1	D2
T																								
P																								

Para callo riñón, los picos de frecuencia obtenidos en la evaluación rápida (figura) coinciden bastante con los obtenidos en la validación durante el taller.

El taller finalizó alrededor de las 7:00pm

CONCLUSIONES

El método de evaluación rápida utilizado en este proyecto de pesquería artesanal en el norte del Golfo de California, fue seleccionado por ser un proceso rápido y eficiente para la obtención de datos. Este proceso fue seguido por la validación interna de los datos que nos permitió refinar y consolidar con los pescadores los datos obtenidos durante el proceso de la colección de datos para una evaluación y caracterización de la pesquería artesanal en el Norte del Golfo de California. Los resultados obtenidos durante el proceso de validación rápida nos mostraron una perspectiva general de las zonas de pesca y sitios de reproducción y avistamiento de juveniles, aunque con menor nivel de detalle al alcanzado durante los talleres. Por otro lado, si bien para varias especies se contó con información proveniente de un número significativo de entrevistas, algunas especies estuvieron poco representadas y la validación interna nos proporcionó información adicional sobre ellas.

Por ello, para realizar la validación interna de los datos se seleccionó una lista de especies abarcando diferentes artes de pesca –buceo, chinchorro, cimbra y trampa– que en conjunto representan recursos de importancia para las comunidades de Puerto Peñasco y Bahía de Kino. El propósito de esta validación interna fue corroborar y afinar la información utilizando un método más eficiente que el utilizado en la evaluación rápida, de modo tal que nos permitió identificar huecos significantes de información y corregirlos.

Podemos decir ahora que los resultados obtenidos en los talleres de validación interna de los datos que realizamos con pescadores muestran un detalle importante especialmente en los mapas de zonas de pesca correspondientes a la pesquería por buceo. Las zonas de pesca que identificaron los buzos tanto de Puerto Peñasco como de Bahía de Kino, quedaron definidas con mayor detalle durante la validación. Se obtuvo una mayor especificación de las zonas de pesca en base a la especificación de profundidades, distancias a la costa y/o extensión de los pescaderos.

Para la pesquería de chinchorro, las zonas de pesca validadas no mostraron gran diferencia con los resultados de la evaluación rápida debido a las zonas adicionales identificadas por los pescadores. Las zonas de pesca ya existentes se afinaron en base a profundidades y distancias a la costa. Por ejemplo, para Puerto Peñasco, los únicos datos que se vieron significativamente mejorados durante la validación fueron los de la pesquería de lenguado (*Paralichthys aestuarius*). Para las especies como sierra (*Scomberomorus sierra*), curvina plateada (*Cynoscion othonopterus*) y guitarra (*Rhinobatus productus*), las zonas de pesca no mostraron cambios significativos.

Por otro lado, las zonas de pesca correspondientes a la pesquería de chinchorro de Bahía de Kino fueron afinadas notoriamente para las especies de manta mariposa (*Gymnura marmorata*), manta arenera (*Dasyatis dipterura*) y manta tecolota (*Myliobatis californica*), sierra y cazón dientón (*Mustelus californicus*). Para las pesquerías de cimbra y trampa en Puerto Peñasco y trampa en Bahía de Kino, las zonas de pesca no mostraron muchos huecos de información más bien solo se afinaron las zonas en base a profundidades y distancias a la costa.

Los cambios realizados durante la validación interna de los datos mostraron cambios importantes sin embargo, con esto no queremos decir que la información obtenida durante la evaluación es errónea, sino más bien que el método utilizado no permite llegar al nivel de detalle que fue alcanzado durante la validación. Al proyectarse la información en pantalla los pescadores tenían acceso a información que no estaba disponible tan claramente al utilizar mapas en papel, tales como mayor detalle de puntos de referencia sobre la costa, profundidades, y posibilidad de medir distancia del pescadero a la costa o extensión de los sitios de pesca.

Finalmente, es importante mencionar que fue indispensable para el trabajo de validación de las zonas de pesca ya digitalizadas e integradas, la tecnología disponible de los sistemas de información geográfica. El detalle que se obtuvo de las zonas de pesca, reproducción y avistamiento de juveniles fue gracias a la participación interactiva de los pescadores con la información integrada y proyectada en pantalla utilizando SIG. Esto

muestra evidentemente parte del potencial de utilizar este tipo de sistemas – cuando están disponibles – en la toma de decisiones.

En el caso de los datos de calendarios de pesca por especie, en general hubo coincidencia entre los resultados de la validación y de la evaluación rápida en especies que contaron con un número significativo de entrevistas. Siete de las 16 especies resultaron con el mismo calendario de pesca que el obtenido en el proceso de colecta de información para la evaluación rápida. Cinco de los calendarios de pesca al final se redujeron por dos meses en total y finalmente, las cuatro especies restantes incrementaron su calendario por dos meses en total. Los resultados de los calendarios de pesca principal permanecieron como se asignaron en el proceso de la evaluación rápida.

No hubo coincidencia entre los resultados de ambos métodos cuando el número de entrevistas realizadas por especie fue muy bajo (Ej.: mantas y cazón dientón). En algunos casos en que los picos de frecuencia de temporada principal no estaban muy bien definidos -a pesar de contar con un número no muy bajo de entrevistas- se logró afinar dicha información durante la validación interna (Ej.: callo escarlopsa, sierra en Bahía de Kino). En relación con las problemáticas por especie se logró priorizarlas y actualizarlas en los casos en que por disponibilidad de tiempo se pudo realizar este ejercicio (mayormente en Puerto Peñasco).

Por último, en base a los resultados obtenidos pensamos que este tipo de validación interna es importante para completar huecos de información e igualmente para afinar los mismos por las inconsistencias, errores o mala interpretación que podrían surgir en un proceso de mapeo análogo en un proceso a escala regional como éste. Recomendamos para futuros ejercicios, hacer talleres interactivos con la información disponible en SIG para una captura de datos más efectiva.

Bibliografía

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APPENDIX F. SPAWNING SITES FOR ELEVEN TARGET COMMERCIAL SPECIES

By Marcia Moreno-Baez, Tad Pfister and Erika Koltenuk

Overview

This document presents a synthesis of spawning sites for 11 target species. The purpose is to visually portray the information and make it available to inform stakeholders, managers and scientist. The information presented is a product of the collection and analysis of 700 maps representing local fishers' knowledge (see Appendix A, B and E).

In order to portray in maps the spawning zones, we selected the information provided by fishers during the rapid appraisal and during the internal validation sessions. We present the zones where fishers indicated the presence of juveniles, or zones of reproduction, or both. In January 2009, Tad Pfister provided information about additional spawning zones and the specific spawning habitats of the 12 species, and validated the points selected to represent a diverse and holistic sampling of spawning sites.

All of the points presented here are the result of a calculation of the centroid from areas (or polygons).

Spatial Reference

- GCS_WGS_1984

Blue swimcrab (*Callinectes bellicosus*)

Spawning habitat: outer margins of shallow shelf, not in estuaries.

Table 1. Latitud and longitude for Blue swimcrab spawning sites.

Number	Coordinates - Where it Spawns	
	X	Y
1	-114.622647	30.75945
2	-113.832355	31.440268
3	-113.285903	31.108982
4	-113.013731	30.523529
5	-112.287589	29.27405
6	-111.963314	28.754576
7	-111.765313	28.538236



Figure 1. Spawning sites for Blue swimcrab.

Gulf coney (*Epinephelus acanthistius*)

Spawning habitat: deep, open water.

Larvae duration: 15 – 30 days

Table 2. Latitud and longitude for Gulf coney spawning sites.

Number	Where it Spawns	
	X	Y
1	-114.409751	30.741201
2	-114.410354	31.415472
3	-114.165108	31.285476
4	-113.888828	30.797099
5	-113.612803	31.038013
6	-113.389051	30.52202

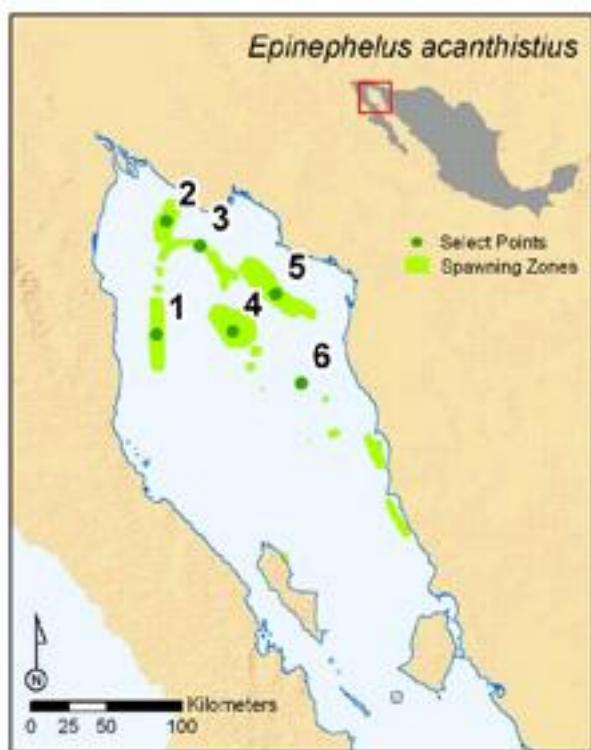


Figure 2. Spawning sites for Gulf coney.

Black murex (*Hexaplex (Muricanthus) nigritus*)

Spawning habitat: close to shore.

Larvae duration: 7 – 15 days

Table 3. Latitud and longitude for Black murex spawning sites.

Number	Where it Spawns	
	X	Y
1	-114.008419	31.485505
2	-113.659278	31.431665
3	-113.247756	31.015177
4	-112.21386	29.060291

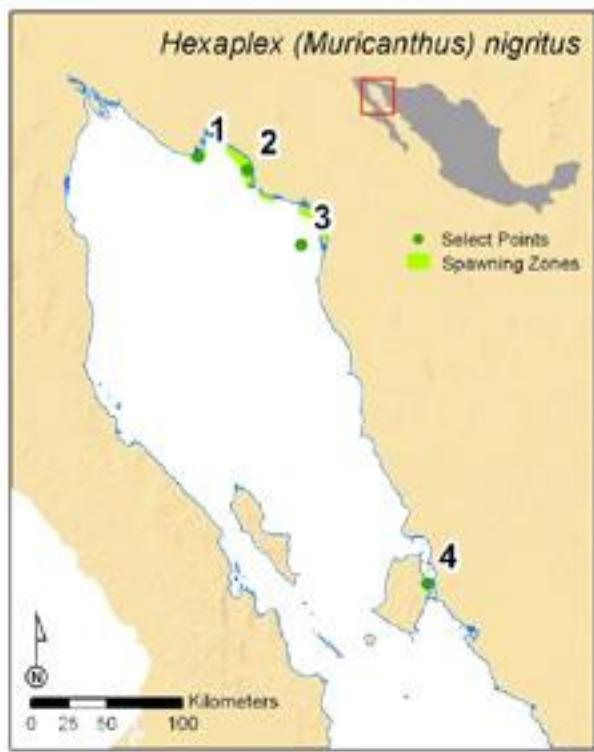


Figure 3. Spawning sites for Black murex spawning sites.

Barred pargo (*Hoplopagrus guentherii*)

Spawning habitat: rocky reefs, not in estuaries, they tend to aggregate on exposed points.

Larvae duration: 22 days.

Table 4. Latitud and longitude for Barred pargo spawning sites.

Number	Where it Spawns	
	X	Y
1	-113.984439	31.507216
2	-113.542858	31.290298
3	-112.81155	30.245429
4	-112.491838	29.110997
5	-112.836724	28.659515
6	-112.300317	28.369533
7	-112.570026	28.658834

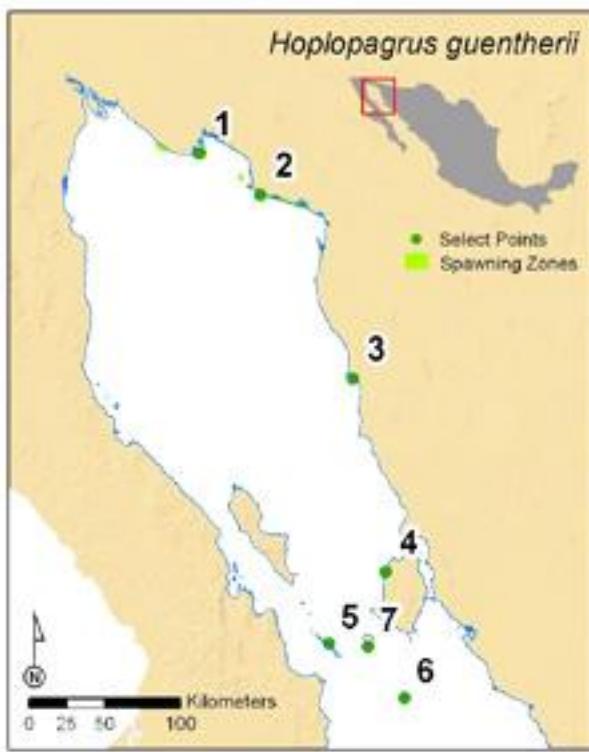


Figure 4. Spawning sites for Barred pargo spawning sites.

Note: Additional suggestions include the South end of Isla San Pedro Matir, Isla San Esteban and El Punto del Diablo in Isla San lorenzo.

Sea cucumber (*Isostichopus fuscus*)

Larvae duration: 30-60 days.

Table 5. Spawning sites for Sea cucumber spawning sites.

Number	Where it Spawns	
	X	Y
1	-113.153002	29.138253
2	-112.24334	29.198194
3	-112.288302	28.708905



Figure 5. Spawning sites for Sea cucumber spawning sites.

Gulf grouper (*Mycteroperca jordani*)

Spawning habitat: Outer margin, deepest outer margins and islands
 Larvae duration: 15-30 days

Table 6. Spawning sites for Gulf grouper spawning sites.

Number	Where it Spawns	
	X	Y
1	-113.711487	31.169391
2	-113.15903	30.640756
3	-112.812692	30.165472
4	-112.540815	29.484578
5	-112.570026	28.658834
6	-112.315811	28.376118

Note: Points 5 and 6 were suggested points and not data gathered in the surveys, nor the validation process.

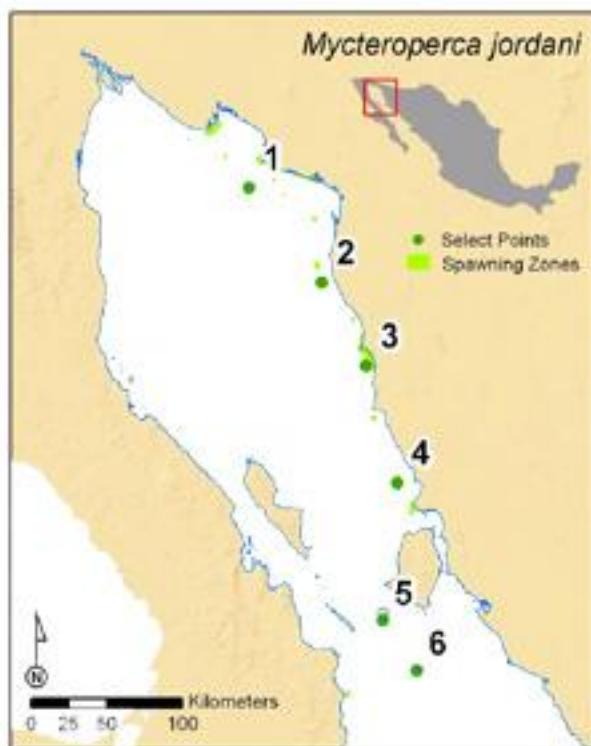


Figure 6. Spawning sites for Gulf grouper spawning sites.

Note: Additional suggestions included the southwest side of Isla San Pedro Matir and the south margin of Isla San Esteban.

Leopard grouper (*Mycteroperca rosacea*)

Larvae duration: 21 days

Table 7. Spawning sites for Leopard grouper spawning sites.

Number	Where it Spawns	
	X	Y
1	-112.8965	30.144043
2	-112.492301	29.121023
3	-112.358306	28.756941
4	-112.578115	28.665861
5	-112.307089	28.366497

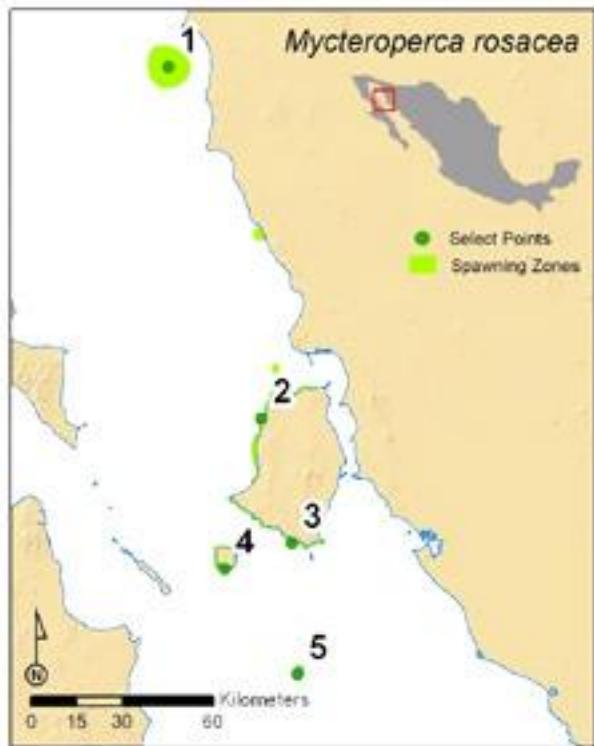


Figure 7. Spawning sites for Leopard grouper spawning sites.

Octopus (*Octopus sp.*)

Spawning habitat: Rocky reef.

Larvae duration: direct.

Table 8. Spawning sites for Octopus spawning sites.

Number	Where it Spawns	
	X	Y
1	-113.336652	31.255445
2	-112.877985	30.266531
3	-112.48771	29.583659
4	-112.313376	28.742272
5	-112.58457	28.733971
6	-113.512873	29.042045
7	-113.50463	28.89365
8	-113.549036	29.032795

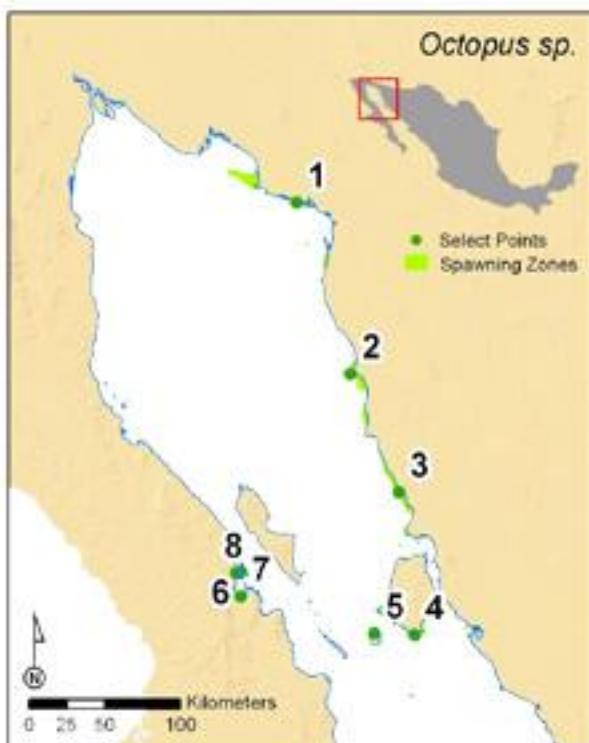


Figure 8. Spawning sites for Octopus spawning sites.

Blue spiny lobster (*Panulirus inflatus*)

Larvae duration: more than 90 days.

Table 9. Spawning sites for Blue spiny lobster spawning sites.

Number	Where it Spawns	
	X	Y
1	-112.503273	29.052111
2	-113.04227	28.907632
3	-112.913821	28.703128
4	-112.355711	28.755846
5	-112.534749	28.707978
6	-112.294177	28.382243

Point 6 is a suggested point and not found in the data gathered in the surveys, nor the validation process.

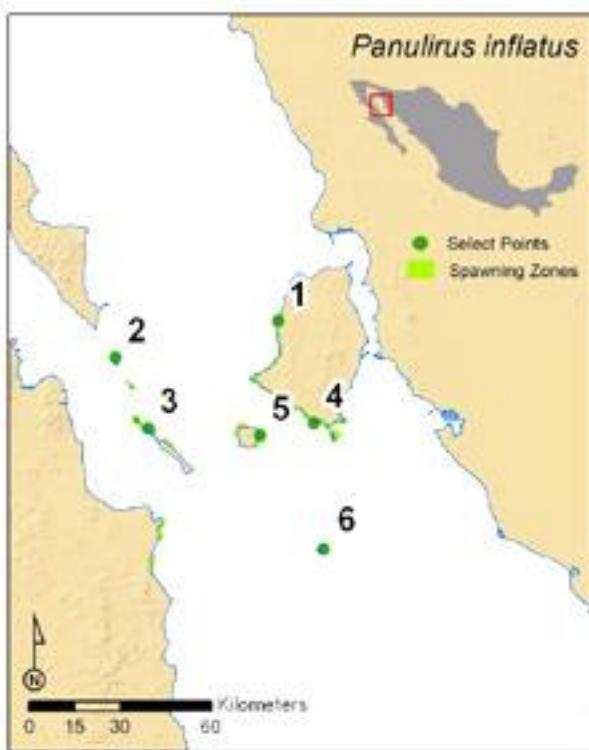


Figure 9. Spawning sites for Blue spiny lobster spawning sites.

Note: One additional suggestion is to include the N.E. corner of Isla San Pedro Martir

San bass (*Paralabrax spp.*)

Spawning habitat:

Larvae duration: 15-30 days

Table 10. Spawning sites for Sand bass spawning sites.

Number	Where it Spawns	
	X	Y
1	-114.407155	30.197033
2	-112.932367	30.277027
3	-113.318596	29.381511
4	-113.238857	28.847395
5	-112.576955	28.954744
6	-112.310915	28.391229

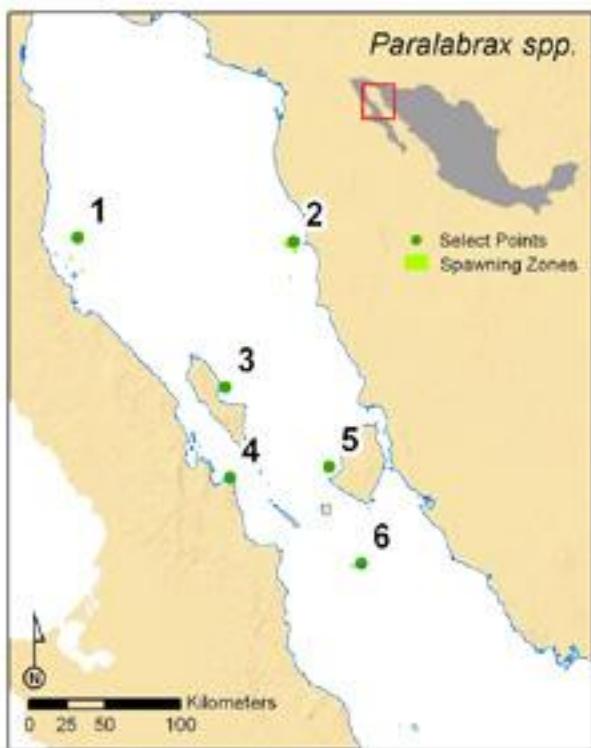


Figure 10. Spawning sites for Sand bass spawning sites.

Rock scallop (*Spondilus calcifer*)

Spawning habitat:

Larvae duration: 15 days

Table 11. Spawning sites for Rock scallop spawning sites.

Number	Where it Spawns	
	X	Y
1	-114.013398	31.469897
2	-113.690002	31.371369
3	-113.436466	31.263958
4	-113.246411	31.012882
5	-113.13491	30.945582
6	-112.863876	30.31593
7	-112.551692	29.680664
8	-113.550043	29.571453
9	-112.961231	28.734263
10	-112.618554	28.706122
11	-112.463957	28.800049
12	112.300317	28.369533

Note: Points 8-12 were suggested by experts and not data gathered in the surveys from the rapid appraisal, or the validation process.

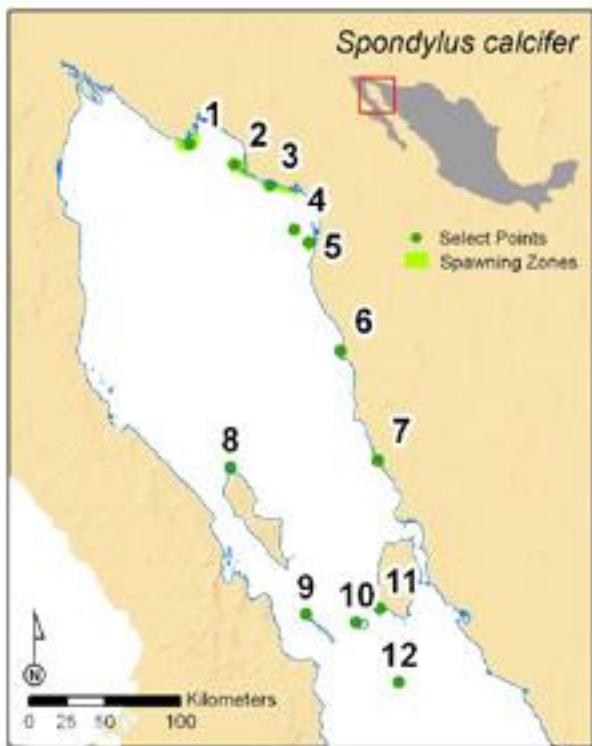


Figure 11. Spawning sites for Rock scallop spawning sites.

Note: Additional suggestions include adding the south margin of Isla San Pedro Martir, west of Isla San Esteban, Midpoint of Isla Tiburon, north point of Isla San Lorenzo, and north point of Angel de la Guarda.