ADVANCED CONSERVATION STRATEGIES

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A Marine Conservation Assessment in Peru
December 2014

A Report Prepared for
The David and Lucile Packard Foundation
& Fondation Ensemble

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ABBREVIATIONS

ACOREMA	*Áreas Costeras y Recursos Marinos*
AECID	*Agencia Española de Cooperación Internacional para el Desarrollo*
ANEPAP	*Asociación Nacional de Empresas Pesqueras Artesanales de Perú*
APEGA	*Sociedad Peruana de Gastronomía*
CAP	*Comisión Asesora Permanente*
CeDePesca	*Centro Desarrollo y Pesca Sustentable*
CENPAR	*Censo Pesca Artesanal*
CITES	Convention on International Trade in Endangered Species
COPMAR	*Asociación Comunidad Pesquera Artesanal del Puerto San Juan de Marcona*
COTESU	*Cooperación Técnica Suiza*
ENSO	El Niño-Southern Oscillation
DICAPI	*Dirección General de. Capitanías y Guardacostas del Perú*
FAO	Food and Agriculture Organization of the United Nations
FIP	Fisheries Improvement Project
FIUPAP	*Federación de Integración y Unificación de los Pescadores Artesanales del Perú*
FONDEPES	*Fondo de Desarrollo Pesquero*
GDP	Gross National Product
GEF	Global Environment Facility
HIDRONAV	*Dirección de Hidrografía y Navegación Marine de Guerra del Perú*
IFOP	*Instituto de Fomento Pesquero, Chile*
IFFO	International Fishmeal and Fish Oil Organization
IMARPE	*Instituto del Mar del Perú*
ITA	*Inkaterra Asociación*
ITP	*Instituto Tecnológico de la Producción*
IREA	*Instituto de Recursos Acuáticos*
IUCN	International Union for Conservation of Nature
IVQ	Individual Vessel Quota
JICA	Japan International Cooperation Agency
KfW	Kreditanstalt für Wiederaufbau
LGP	*Ley General de Pesca*
LME	Large Marine Ecosystem
MEM	*Ministerio de Energía y Minas*
MINAM	*Ministerio del Ambiente*
MSC	Marine Stewardship Council
MPA	Marine Protected Area
NOAA	National Oceanic and Atmospheric Administration
NGO	Non-governmental Organization
OSPA	*Organizaciones Sociales de Pescadores Artesanales*
PCB	Polychlorinated biphenyl
PROABONOS	*El Proyecto Especial de Promoción del Aprovechamiento de Abonos Provenientes de Aves Marinas*
PRODUCE	*Ministerio de la Producción*

PROFONANPE	*Fondo de Promoción de las Áreas Naturales Protegidas del Perú*
ROP	*Reglamentos de Ordenamiento Pesquero*
SERNANP	*Servicio Nacional De Áreas Naturales Protegida*
SNP	*Sociedad Nacional de Pesquería*
SPDA	*Sociedad Peruana de Derecho Ambiental*
TAC	Total Allowable Catch
TNC	The Nature Conservancy
USAID	United States Agency for International Development
WWF	World Wildlife Fund for Nature

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EXECUTIVE SUMMARY

Peru stretches approximately 2,500 kilometers along the Pacific Coast between Ecuador and Chile. Its biological diversity is among the richest in the world: from the Amazon to the Andes to the Humboldt Large Marine Ecosystem (LME). Supporting the world's largest single fishery, the latter is one of the most productive marine ecosystems. We provide an assessment of coastal and marine conservation in Peru, focused on the state of marine biodiversity, its current impacts and threats, and the organizations and programs focused on marine conservation and management.[1]

Peru is one of South America's fastest growing economies, which relies heavily on natural resource extraction. It is the world's second largest producer of silver and third largest producer of copper. Fisheries are a significant contributor to the Peruvian economy: recent estimates suggest fisheries contribute between 1-2 percent of GDP. Fishmeal is Peru's fifth largest export product, valued at nearly US$2 billion[2] annually with approximately 45 percent going to China.

Peru's population of 30 million people is hyper-urbanized: over 70 percent live in urban areas. Between 1997 and 2007, the population living on Peru's coast grew from 9.6 million to 13.5 million. Peru's coastal population scores higher on socioeconomic and human development indicators compared to the populations in the Amazon or the Andes mountains. Overall coastal poverty levels range between 10 and 37 percent, while average annual family income ranges between $1,200 and $1,800.

The Humboldt LME, the world's largest upwelling system, dominates Peru's marine environment. With the exception of extreme northern Peru (~5° to ~3° S), a suite of complex and variable oceanographic conditions heavily influences the entire coast. The Humboldt LME is associated with seasonal, inter-annual, decadal, and even longer-term changes that have major impacts on fisheries dynamics and marine biodiversity in general. In particular, inter-annual variability is driven by the El Niño-Southern Oscillation cycle, and its warm (El Niño) and cold phases (La Niña). Within the Humboldt LME, three areas of high biodiversity have been recognized: two in Chile and one in northern Peru (between 5° and 8° S). Further north, Peru's marine environment is part of the Pacific Central-American Coastal System; the border of these two LMEs is dynamic. With the southern limit of tropical Pacific mangroves, the extreme northern coastline is also part of Tumbes-Chocó-Magdalena biodiversity hotspot that includes mangroves, beaches, rocky shorelines, and coastal wilderness stretching from southern Panama to northern Peru. A recent eco-regional assessment identified 59 areas of high conservation value along the entire Peruvian coast.

Governance and Stakeholders

The administration of Peru's marine environment is complex, with multiple government agencies having the power to establish, veto, and administer the governance and management of coastal and ocean resources. The Ministry of Production (*Ministerio de la Producción*, PRODUCE) is responsible for all fisheries and aquaculture activities, and oversees the formulation, approval, and supervision of all policies. There are a number of important agencies that operate within PRODUCE, including *Instituto del Mar del Perú* which heads up scientific and technical research, *Instituto Tecnológico de la Producción* which focuses on the development and commercialization of fishery resources, and *Fondo Desarrollo Pesquero* which provides technical and financial support to the artisanal fishing sector. The Ministry of the Environment (*Ministerio del Ambiente*, MINAM) is in charge of the design, establishment, execution, and

[1] Our assessment focuses on the marine environment in Peru, but naturally includes coastal ecosystems (and human communities) immediate adjacent to the marine environment (e.g., mangroves), as well as terrestrial-based activities that influence the marine environment. For simplicity, we refer to these marine and coastal systems as marine.

[2] All dollar figures are in US$ unless noted otherwise.

oversight of environmental policy at all levels. MINAM's jurisdiction includes species protection, spatial planning, pollution, environmental standards, and climate change. A number of important environmental agencies are associated with MINAM, including the National Service of Protected Areas (*Servicio Nacional De Áreas Naturales Protegida*, SERNANP) that was formed under the MINAM in 2008. With some exceptions, resources within PRODUCE and MINAM for enforcement are weak, as is capacity for activities focused on marine conservation and sustainable fisheries management.

Since 2002, Peru has implemented an institutional decentralization process, transferring some national government functions to the regional level. In addition to its 25 regions (11 of which are coastal), Peru has 196 provinces (77 are coastal) and 1,846 municipalities (691 are coastal). The goal of decentralization was to empower regional actors in policy, social, and economic activities. However, due to a lack of resources and political will, the process has faced challenges and increased corruption. The decentralization process divided fisheries responsibilities between PRODUCE and the regional governments. In coordination with PRODUCE, the regional governments are responsible for regulating artisanal fisheries, along with small-scale aquaculture. At the level of the regional government, the decentralization process has precipitated major challenges for marine conservation and the promotion of sustainable fisheries, including lack of capacity, increased corruption, weak institutions, lack of coordination, and vaguely defined responsibilities.

The marine conservation sector is younger and less developed compared to organizations working on biodiversity conservation and sustainable development outside of the marine environment. Much of the focus in Peru has been on the Andes and the Amazon. While capacity, resources, and activities focused on marine conservation and sustainable fisheries have been limited in the NGO sector historically, that situation is changing rapidly. There are an increasing number of both international and national NGOs actively working on marine and fisheries conservation in Peru. It is a similar situation in academia and the private sector: interest, capacity, programs, and initiatives focused on marine conservation and sustainability is growing.

Funding for biodiversity conservation in Peru has been largely focused on the Andes and Amazon. Until recently, funding for marine conservation has largely come in the form of international aid assistance, financing from development banks, and small to medium-sized grants from international zoos, universities, and small foundations. The funding environment for marine conservation, however, is shifting. The Walton Family Foundation and the Lenfest Oceans Program have made some investments in Peru over the past five years. Two large marine conservation projects funded by the Global Environment Facility are underway. The NGO Oceana recently announced that the Wyss Foundation has committed up to $10 million in matching funds, over the next five years, to help rebuild fisheries in Peru and Canada through supporting science-based policy reform. Lastly, the Rockefeller Foundation is in the process of assessing Peru for potential investments in sustainable fisheries.

Marine Protected Areas & Other Conservation Tools

Less than two percent of the entire Humboldt LME is protected. Within Peru's Natural Protected Areas System, marine ecosystems are underrepresented. There are currently three marine protected areas, totaling ~6,300 km^2, that take the form of National Reserves: Paracas, San Fernando, and the National Reserve System of Guano Islands, Isles, and Capes. Created in 2009, the latter consist of 22 islands and 11 capes that stretch the entire Peruvian coastline. In addition, there are two coastal Reserved Zones that may eventually include a marine component.[3] There are four coastal protected areas, including the Mangroves of Tumbes National Sanctuary in northern Peru.

[3] A Reserved Zone is a transitional status for an area deemed important for conservation, but which has not yet been categorized into one of the several forms of protected areas in Peru.

There are number of challenges surrounding the designation of marine protected areas in Peru. First, in contrast to forests, there is no strong cultural history of marine conservation. Rather, the focus has been on the extraction of marine resources. Second, as a consequence of the low levels of marine conservation training and culture, there is currently no cohesive marine conservation initiative or movement that is advocating for policy changes. Third, there is no strong governmental institution leading marine conservation. Fourth, there is a legal gap regarding the role of regional governments in the creation of marine protected areas. The decentralization process has granted regional governments jurisdiction over terrestrial areas and the power to create Regional Conservation Areas, but not in the marine environment. Lastly, recent legal changes by the government have made it even more difficult to create marine protected areas: a recent Supreme Decree makes it impossible to create a protected area without formal permission from the owners of any pre-existing concessions (e.g., oil and gas) in the area, and the Ministry of Environment recently lost its power to create Reserved Zones—often a first step in creating a protected area.

Voluntary conservation activities also face some policy challenges in the marine environment. In terrestrial ecosystems, there is a portfolio of legal options for voluntary conservation that enjoys a long history in Peru (e.g., private conservation areas or ecotourism concessions on public land). These options are not applicable, however, to marine environments. Currently, there are no explicit laws that enable the voluntary conservation of marine areas for the explicit purpose of biodiversity conservation. Three exceptions exist:

1. Civil participation in marine management within existing, formal marine protected areas;
2. Marine concessions granted under the law regulating aquaculture; and
3. A bottom-up approach to a rights-based management involving a single demonstration project in *San Juan de Marcona*.

Over the past decade, there have been on-going discussions about granting territorial use rights in fisheries or similar mechanisms to organized groups of artisanal fishers. However, until today, the government has feared the rejections of such mechanisms by those fishing groups that would be excluded from the designated areas. A number of organizations are in the process of designing pilot projects with artisanal fishing communities that are focused on testing rights-based management schemes.

Non-Fishing Impacts and Threats

Main non-fishing impacts and threats to Peru's coastal and marine environments include pollution, coastal development, and oil and gas developments.[4] Serving the large anchovy fishery, there are ~140 fishmeal plants along the Peruvian coast. The environmental and health impacts of fishmeal plants have a long history in Peru, and in some cities like Chimbote, they have been linked to major issues, including allergies, fungal skin diseases, and respiratory diseases. Major reforms and regulations for fishmeal and fish processing plants were introduced in the late 2000s, including new effluent and emission standards. Due to an established grace period, these new regulations are just now coming into compliance. Even more recently, many fishmeal plants in Peru are achieving certification under the Organization of Marine Ingredients Global Standard for Responsible Supply (IFFO RS).[5] Due to lack of data and transparency,

[4] A series of expert-opinion workshops in 2006-07 identified and ranked key threats to marine and coastal biodiversity in Peru in the following order: pollution, overfishing, coastal development, resource extraction, oil and gas development, and climate change.

[5] IFFO is an international NGO that represents and promotes the fishmeal, fish oil, and the wider marine ingredients industry worldwide. IFFO holds observer status at the UN Food and Agriculture Organization and the EU Commission and Parliament.

however, it is difficult to assess the environmental benefits of these recent changes or even assess the current situation. There is little scientific information available, and even less in the peer-reviewed literature, with respect to the environmental (and health) impacts of fishmeal plants in Peru.

It is similar situation with wastewater discharge in Peru: major improvements are coming online; however, objective and transparent information is rare and inaccessible. Water access and sanitation has drastically improved over the past two decades: over 80 percent of the population has access to improved sanitation. In rural areas, however, that number drops to 45 percent. The discharge of untreated wastewater is still a common occurrence in Peru. In urban areas alone, the percentage of treated wastewater was 22 percent in 2005. New wastewater plants are being built and commissioned in Lima, which is estimated to have 100 percent treatment by 2015.

The oil and gas industry has a long history in Peru, including some controversial events surrounding social and environmental impacts. There are four main productive areas in Peru with respect to oil and gas deposits: three in the Amazon and one on the north coast. Currently, there are over 100 active oil and gas contracts; the number of contracts has increased significantly since 2005 and the government continues to promote new contracts and developments. The majority of the country's coastline consists of oil and gas concessions. Actual coastal operations are currently centered in the north, which can be broken down into two phases: an exploration phase which can last up to seven years and an production phase which is much longer—around 40 years. In Peru, only five blocks are currently in the production phase; the rest are in the exploration phase. Oil and gas companies routinely engage in long-term relationships with coastal communities during all phases of operations. Results and outcomes have been mixed, with many differing opinions and perspectives. While environmental negative impacts from oil and gas operations have occurred in Peru, we are not aware of any documented, major environmental impacts in marine waters. While biodiversity impacts to coastal oil and gas activities have been documented elsewhere, there appears to be a lack of available scientific information to assess the potential impacts and risks of the oil and gas industry along the Peruvian coast. While place-based information is lacking, onshore and offshore oil and gas operations are likely generating at least some biodiversity co-benefits: all activities (e.g., fishing) are generally prohibited within one kilometer of oil and gas platforms, which have recently been shown to have among the highest secondary fish production of any marine habitat studied.

Fisheries and Aquaculture Sector

Fisheries are an important economic engine and job producer in Peru, both locally and nationally. The overall contribution to the GDP by the fisheries sector was conservatively estimated to be $3.4 billion in 2009. Total employment for the fisheries sector is conservatively estimated at 232,000 full-time jobs. Across the entire fisheries sector, fishmeal plants generate the most revenue; however, restaurants generate the most employment. The anchovy fishery makes up ~30 percent of fishing sector's contribution to the overall GDP, while accounting for 23 percent of employment. Marine invertebrates overall generate similar economic productivity and jobs; shrimp and jumbo squid are the two main species. Even though the anchovy is the major focal species for the Peruvian fisheries sector, it is far from the only one of importance. A diverse group of species contribute more than two thirds of the contribution from the fisheries sector to Peru's GDP, and more than three quarters of the estimated total employment.

Over the past two decades, Peru has become the center for cuisine in Latin America, and increasingly the world. Seafood has played a central role in Peru's gastronomic revolution, which is paying off: restaurants alone account for three percent of Peru's GDP, and 7,300 restaurants opened in 2010. Peruvian chefs enjoy rock star status, and have huge influence over the general public. Yet like much of Peru's economy, the supply chains, including seafood, still operate largely in an informal fashion. The absence of cold chains, standardization, sustainability practices, and product traceability hinder and

threaten restaurant capacity, as well as food producers. Restaurateurs and industry groups like the Peruvian Gastronomic Society (*Sociedad Peruana de Gastronomía*) are beginning to support efforts that address these challenges. Successfully doing so will ultimately secure and improve the efficiency of supply chains.

Artisanal fishers provide the overwhelming majority of seafood for human consumption in Peru. Much of the artisanal sector lacks sufficient structure, formality, and capacity. Thus, processing, handling, packaging, and transportation are major challenges. Direct access to markets by artisanal fisheries is minimal. Third-party seafood providers, that control procurement and logistics, dominate the supply chains. Many restaurateurs view seafood sustainability as a requisite for future viability. But, the lack of direct involvement with fishers creates additional challenges around potential fishery improvements. Direct procurement with fishers is viewed as challenging because of (a) variability in seafood catches, (b) the need for diverse products from different geographies, (c) the need for additional financing to fund improvements, and (d) the possibility of threatening commercial relationships with current seafood providers along the supply chain.

The General Law on Fisheries (*Ley General de Pesca*, LGP) regulates fisheries in Peru. It defines fisheries under the following framework: (a) purpose of extraction (i.e., commercial, research, recreational, or subsistence), (b) scale (i.e., artisanal, small-scale, or large-scale), (c) geographical area, and (d) destination of the end product (i.e., direct or indirect human consumption). As part of the LGP, the PRODUCE can create *Reglamentos de Ordenamiento Pesquero* (ROPs). ROPs are management instruments that can establish a suite of potential restrictions on a fishery, such as access regimes, fishing seasons, total allowable catch, fishing gear requirements, minimum size requirements, or designated fishing areas. Currently there are only nine ROPs, which cover seven species. Of the 72 most important commercial species in Peru, 35 percent are not subject to any management regulations, 35 percent are subject to a minimum catch size regulation, 20 percent are subject to two management measures (minimum size and gear restrictions), and just ten percent (seven species) have more than these two management measures in place. A lack of management measures and enforcement commonly precipitates fishing practices that are unsustainable and environmentally damaging (e.g., dynamite fishing is still commonly reported in some regions of Peru).

The Peruvian anchovy fishery is the largest single species marine fishery in the world, representing around 10 percent of worldwide marine landings. It typically accounts for over 80 percent of Peru's annual landings. Anchovy is also the most studied and political fishery in Peru. By law, all of the industrial fleet's catch must be processed into fishmeal, which feeds into the global food supply chain. In 2010, approximately 60 percent of the world's supply of fishmeal was consumed by the aquaculture sector, followed by pork (30 percent) and poultry production (nine percent). Peru's anchovy industry has been categorized into three historical phases: an explosive and uncontrolled growth phase that resulted in a collapse (1950s – 1972), unfavorable conditions and low landings phase (1973 – 1984), and a period controlled growth followed by sustainable landings phase (1984 – present). Landings have stabilized between five and nine million tonnes annually.

Anchovy is one of two Peruvian fisheries that are managed under a non-transferable individual vessel quota system. In 2008, PRODUCE moved away from an open access regime and enacted individual vessel quotas in an effort to improve management and reduce the "race to fish." By 2012, effective fishing days of the anchovy fishery increased, while the number of vessels decreased. The non-transferability of the quota system was designed to avoid the potential consolidation of quota. Some consolidation, however, has taken place. As of 2012, 70 percent of the quota belongs to just seven companies. Many of those companies are vertically integrated along the supply chain.

In addition to anchovy, the Peruvian industrial fishery targets three species: jack mackerel, chub mackerel, and Peruvian hake. In 2002, PRODUCE implemented a Supreme Decree that prohibited the use of jack and chub mackerel for fishmeal. This resulted in a fleet reduction since only vessels with cold preservation systems were permitted to fish for mackerel in order to meet standards for human consumption. Currently, there are ~20 purse seiners in the mackerel fleet. Information on the stock status of jack and chub mackerel is weak and insufficient. There is a small industrial trawling fleet that fishes for hake for direct human consumption; it operates in the northern Peru. The fishery was closed in 2002 after a period of mismanagement and overfishing. It was reopened in 2004, but recovery has been limited.

The artisanal fishery has exclusive fishing rights within five nautical miles of the coast; however, this does not exclude them from fishing beyond the five-mile boundary. Current estimates suggest there are around 44,000 artisanal fishers; the region of Piura has the most fishers and vessels, representing ~30 percent. About half of artisanal fishers are under thirty years of age, and ~65 percent have more than ten years of fishing experience. There are an estimated 12,398 artisanal boat owners, approximately ¾ of them own only one boat. Approximately 1,300 women are involved in artisanal fisheries; the majority are associated with intertidal and seaweed harvesting. Artisanal fishing organizations are common in Peru; however, many, if not most, are considered small, unorganized, and fragmented. There are two organizations that are considered the largest and most active: *Federación de Integración y Unificación de los Pescadores Artesanales del Perú* and *Asociación Nacional de Empresas Pesqueras Artesanales de Perú.*

The artisanal fishing sector in Peru is informal and diverse, consisting of a wide range of activities, vessels, and seasons. Landings include pelagic finfish, benthic resources, and algae. Important species include jumbo squid, anchovy, jack mackerel, and mahi mahi. Between 2001 and 2012, jumbo squid contributed 45 percent, on average, to annual artisanal landings, followed by jack mackerel, anchovy, and mahi mahi. Sharks are also explicitly targeted by the artisanal fishing sector. Anchovy is one of the main pelagic species for which artisanal landings have increased over the past decade, reaching a maximum of 120,000 tonnes. By law, artisanal landings for anchovy must be for human consumption. However, it is common for artisanal fishers to sell anchovy landings illegally for indirect human consumption due to higher prices for fishmeal.

Fisheries bycatch is well documented along the Peruvian coast; in particular, research with the artisanal fisheries is active. Collectively, the artisanal fishery is having significant impacts on marine megafauna—seabirds, sea turtles and marine mammals. Small cetacean mortality is a combination of bycatch and direct take for bait (and human consumption).[6] Dolphin meat is desirable bait for the shark fishery because of its durability on the hook, and fishers believe it is effective at attracting sharks. In the port of Salaverry, overall bycatch mortality rates of small cetaceans is estimated to be 2,412 animals a year—approximately an equivalent rate for all recorded fisheries in the United States. Artisanal fisheries are also having significant impacts on marine turtles: the annual number of interactions is estimated to be in the tens of thousands. Turtle bycatch rates for gillnets in Peru are among the highest documented in the world; long line rates are lower but still significant, especially given the current growth of long line vessels being observed in Peru.

The Peruvian aquaculture sector is small and young compared to other South American countries with aquaculture. Yet, because of desirable conditions, species, and access, the sector is growing rapidly. It is currently dominated by a few species: shrimp, Peruvian scallop, trout, tilapia, and some Amazonian fish.

[6] Historically there was an active dolphin fishery in Peru. Landings are thought to have peaked in the early 1990s with estimates of 15,000 – 20,000 animals per year for both the artisanal and commercial fleets. A series of laws in the mid-1990s prohibited the intentional take, landing, and sale of small cetaceans in Peru. While not 100 percent effective (i.e., a black market exists), intentional take of small cetaceans has decreased drastically.

Undercapitalization has resulted in most enterprises being small-scale. Nonetheless, there is an increased focus on aquaculture in Peru: the National Plan for Aquaculture Development states a number of goals for 2015, including increasing overall harvest, both domestic and export production, private investment, and number of concessions.

By volume, the Peruvian scallop is the largest aquaculture activity, followed by shrimp. In Peru, the production of scallops, which is a native species, includes both wild harvest and aquaculture. Wild harvest is dominated by the artisanal sector, while there are few larger-scale operators in the aquaculture sector. Aquaculture production is rapidly increasing and becoming an export-oriented industry, while scallops harvested under the fishing sector are mainly for the domestic market. Production has gone from ~10,000 tonnes in 2003 to over 50,000 tonnes over the past few years. Most of the production is in Piura, with some activities in in Ancash. Main export countries are France and the United States.

Shrimp is the most developed and capitalized part of the aquaculture sector in Peru. It takes place along the northern coastline; the center of activity is in the Tumbes region. Using semi-intensive production systems, shrimp is cultivated in ponds in coastal mangrove areas. Over the past decades, the Peruvian shrimp industry has experience a number of challenging setbacks. Heavy rains during the 1997-98 El Niño destroyed production facilities and infrastructure, and an outbreak of white spot disease in 1999 further reduced production levels. Many companies went out of business during this period, and the industry went through a period of intensification in the early 2000s. Currently, there are around 50 producers, half of which are small-scale producers. Most production is exported.

Conclusion

In our view, momentum is growing for marine and fisheries conservation in Peru, and it is a strategic time to be investing wisely. Investments could leverage other projects and resources that are ramping up in the marine environment. While not as strong as some other Latin American countries, capacity is present in Peru for marine conservation, and it is not the limiting factor. Based on our experience, below are nine broad areas that we believe fall under the category of strategic opportunities for supporting activities that are likely to produce beneficial outcomes for marine biodiversity conservation and coastal communities in Peru. These opportunities build on the current socio-political climate, capacity, and momentum within Peru. This is by no means an exhaustive list of recommendations; rather, we attempt to highlight certain areas or intervention types that are likely to have high impacts with investment and successful execution.

1. Filling information gaps and promoting transparency.
2. Developing policy reforms that support marine spatial planning, rights-based management, and voluntary conservation.
3. Supporting policy reforms and other strategies to improve artisanal fisheries management with leadership capacity building.
4. Improving artisanal seafood markets along the value chain.
5. Developing incentive-based programs for sustainability improvements for artisanal fisheries.
6. Supporting the scoping of Peruvian scallop aquaculture as a business model with livelihood and biodiversity co-benefits.
7. Supporting pilot projects that test rights-based approaches to incentivize environmental stewardship.
8. Supporting the scoping of a multi-sector artisanal fisheries fund that would provide economic incentives and technical assistance to improve the sustainability, efficiency, and value of artisanal fisheries.
9. Mainstreaming and scaling environmental education.

Some of the main challenges include weak regulation and enforcement, informal markets and economies, a relatively weak entrepreneurial sector, and lack of information and transparency. Some of the major assets include one of the world's most productive marine ecosystems, marine resource users with major capital, strong demand for seafood, private sector capacity, and a growing younger generation of social entrepreneurs and conservation practitioners. Most, if not all, of our recommendations will involve regional and local governments in some capacity. In many cases, the decentralization process has resulted in major capacity and resource gaps at these lower levels of governments. It will likely be the case that specific investments targeting our recommendations will need to include support explicitly focused on building capacity within regional and local governments for conservation and management activities, as well as the provision of technical and financial assistance when needed.

OBJECTIVE AND STRUCTURE

Our objective is to provide an assessment of marine conservation in Peru[7]. We do so by synthesizing the relevant literature and conducting in-country interviews across all relevant sectors. Our report focuses on the following main themes as they relate to Peru's marine environment:

- Marine biophysical characteristics,
- Institutions and stakeholders,
- Coastal human demography,
- Seafood markets,
- Marine protected areas and policy,
- Impacts and threats,
- Fisheries, and
- Aquaculture.

This report is not intended to be an exhaustive review of marine conservation in Peru. Rather, we highlight activities occurring across a diversity of sectors and geographies. In a separate report, we provide recommendations on what we believe to be high-impact opportunities both in the short- and long-term to improve marine biodiversity protection and sustainable management in Peru.

Peru's marine environment is unique and globally important from many perspectives. It supports the *anchoveta* fishery—the world's largest fishery. The Humboldt Large Marine ecosystem is one of the world's most productive ecosystems—both its complexity and biodiversity are staggering. And Peru's marine environment supports jobs and livelihoods. A recent study estimates that Peru's fisheries sector alone provides over 200,000 jobs, the majority of which are connected to the artisanal fishing sector.

Compared to the Amazon and other terrestrial ecosystems, biodiversity conservation and sustainability in the marine environment is relatively new in Peru. It has received less focus, resources, and attention. This, however, is beginning to change. New marine protected areas are being declared. A new generation of Peruvian scientists, practitioners, and entrepreneurs are turning the efforts toward the sea. And new streams of investment for marine protection and sustainable fisheries are starting to come online. The main goal of this report is to capture some of these developments, as well as provide insights on the challenges and opportunities that lay ahead with respect to improving marine biodiversity protection, management, and sustainability in Peru.

Throughout the report you will find brief sections entitled "What Is Happening Now?" The purpose of these vignettes is to give the reader some additional context on activities that are happening today across the various sectors that influence marine conservation and fisheries in Peru. For obvious reasons, the activities we highlight are by no means exhaustive.

[7] Our assessment focuses on the marine environment in Peru, but also naturally includes coastal ecosystems (and human communities) immediate adjacent to the marine environment (e.g., mangroves), as well as terrestrial-based activities that influence the marine environment. For simplicity, we refer to these marine and coastal systems as marine.

COUNTRY BRIEF

Peru stretches approximately 2,500 kilometers along the Pacific Coast between Ecuador and Chile. It is a country with rich biological and climatic diversity, ranging from the tropical ecosystems of the eastern lowland Amazon Basin to the high Andes to the dry coastal deserts in the west. Thirty million people inhabit Peru, with over ¾ residing in urban centers [1, 2]. Over half of the population resides in the coastal zone; nine million people live in the capital city of Lima.

The Republic of Peru is a constitutional monarchy, and is broken down into 25 administrative regions, along with the single province of Lima (Fig. 1). Nationally, the President is elected by popular vote for a five-year term; the next elections are to be held in April 2016. Voting is compulsory. The current President Oilanta Humala was elected with 51.5 percent of the vote. The 130 members of the unicameral Congress are elected by popular vote to serve five-year terms, and are on the same election cycle. There are at least eight active political parties, with four holding more than ten congressional seats. Each region has an elected government composed of a president and council that serve four-year terms.

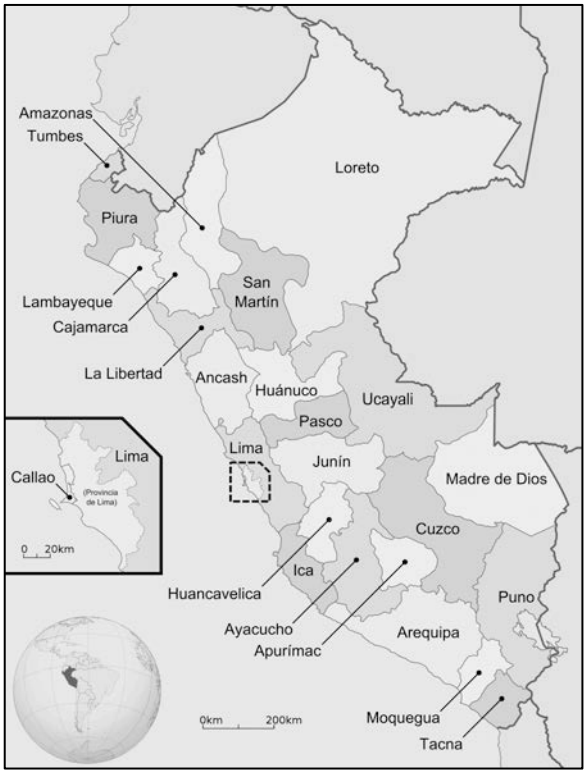

Figure 1. Peru's 25 regions, 11 of which are coastal.

Since 2002, Peru has implemented an institutional decentralization process, transferring some national government functions to the regional level. In addition to its 25 regions, Peru has 196 provinces and 1,846 municipalities—many more levels of government compared to Chile or Columbia [3]. The goal of decentralization was to empower regional actors in policy, social, and economic activities. However, due to a lack of resources and political will, the process has faced challenges and increased corruption. During the last government (2006-2011), the National Decentralization Council was dissolved and decentralization continued with little supervision or transparency. Of the 25 outgoing regional government presidents, 22 are being investigated for embezzlement, three are in prison awaiting trail, and one is a fugitive [3].

Over the past decade, Peru has made major improvements in economic and development indicators. Macroeconomic policies and favorable environments have resulted in a GDP growth rate of 6.4 percent between 2002 and 2012 [2]. This growth has driven an increase of more than 50 percent in Peru's per capita income during the last decade, after three decades of stagnation. Economic growth has helped drive down poverty rates: the national rate fell from 48 percent in 2004 to 24 percent in 2013. However, demographic and spatial inequalities remain a major challenge, particularly between rural and urban areas. While urban poverty rates have dropped significantly, roughly half of the 8.2 million rural Peruvians live below the rural poverty line [4]. Rural poverty in Peru's mountainous regions is the most severe: 20 percent of people in this region are considered extremely poor, and food security is a chronic issue. Inequality remains high: Peru's GINI Index is 0.45, despite a reduction over the past decade [2].

Much of Peru's economy remains informal, including much of the fisheries sector. In the early 1980s, the famous economist Hernando de Soto founded the think tank Institute for Liberty and Democracy in response to Peru's informal economy—in order to understand it and innovate solutions [5]. While efforts have been successful in integrating small enterprise into the formal economy over the past few decades, much of the economy still remains informal. One study estimates that the share of hidden economy as expressed as a percentage of total GDP between 1979-2005 was between 44-50 percent [6].

Peru's economy is largely based on the extraction of natural resources. It is the world's second largest producer of silver and third largest producer of copper. High metal and mineral prices on the international markets have played a major role in Peru's recent economic growth. Main exports are mining and mineral products, natural gas and petroleum products, coffee, fruits and vegetables, fishmeal, fish, and textiles (Fig. 2). Main export countries are China (20 percent), United States (16 percent), Canada (9 percent), Japan (6 percent), Spain (5 percent), and Chile (5 percent).

Fisheries are a significant contributor the Peruvian economy; recent estimates suggest fisheries contribute between 1-2 percent of GDP [2, 7]. Fishmeal is the most valuable export for Peru, after gold, copper ore, refined petroleum, lead ore, and refined copper (Fig. 2). It is valued at nearly US$2 billion annually (4 percent of total exports) [8].[8] Valued at $500 million annually, fish oil is the 15th most valuable export [8]. Responsible for ~25 percent of the market, Peru is by far the largest exporter of fishmeal, followed by Chile (10 percent) [9]. China is the leading importer of fishmeal from Peru, followed by Germany, Japan, and Norway (Fig. 3).

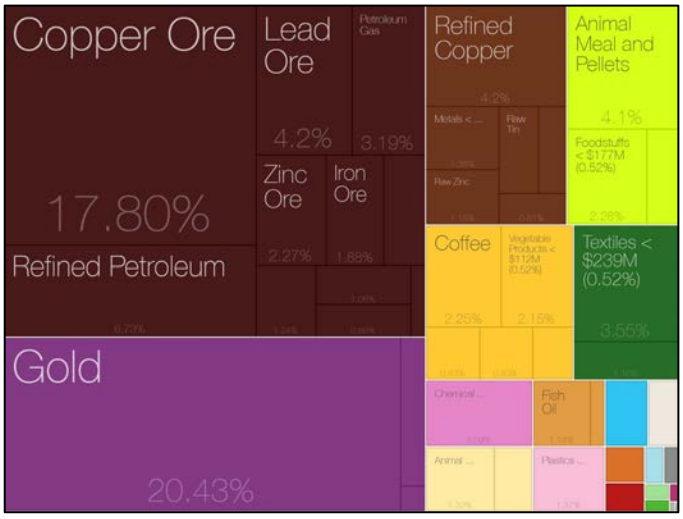

Figure 2. Products exported by Peru in 2012 and the percentage of total exports (Total value = $47.7 billion). Animal meal and pellets (4.1 percent of total) was valued at $1.94 billion, while fish oil (1.1 percent) was valued at $539 million. Source: BACI International Trade Database (Harmonized System). MIT Observatory of Economic Complexity.

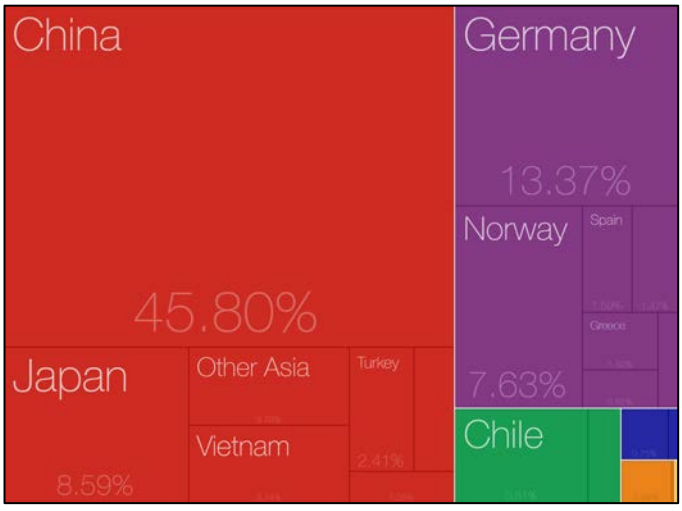

Figure 3. Export destinations of animal meal and pellets from Peru in 2012 by percentage (Total value = $1.94 billion). China imported $890 million (45.8 percent) of Peru's animal meal and pellets. Source: BACI International Trade Database (Harmonized System). MIT Observatory of Economic Complexity.

[8] All dollar figures are in US$ unless noted otherwise.

MARINE BIOPHYSICAL OVERVIEW

In this section, we provide a brief overview of the oceanography, biodiversity, and ecological communities of Peru's marine ecosystems. The purpose of the introduction is to provide a biophysical foundation for the remainder of the report.

Oceanography

Nearly the entire Peruvian coast is dominated by the Humboldt Large Marine Ecosystem, which extends from central Chile (~ 40° S) to northern Peru (~ 4-5° S) where it borders Pacific Central-American Coastal System (Fig. 4). The border of these two Large Marine Ecosystems (LME) is dynamic [10]. The southernmost limit of the tropical Pacific mangrove ecosystem is also located in northern Peru.

Covering 2.5 million km^2, the Humboldt LME is the world's largest upwelling system. Less than 2 percent is protected [12, 13]. The Humboldt LME is commonly divided into two biogeographic provinces: the Peruvian Province (north of 30° S) that is under a subtropical influence, and the Magellanic Province (south of 41°S) that is under a sub-Antarctic influence. A transition zone is recognized between the two provinces. Unlike Chile, the Peruvian coast experiences nearly permanent coastal upwelling as a result of southeastern trade winds [10]. Upwelling is more intense during the winter, due to the wind patterns off the Peruvian coast [14].

In Peru, the Humboldt LME is broken into two oceanic fronts (i.e., a boundary between two water masses) [15]. The Peruvian Upwelling Front extends along the shelf break from 5° S to 19° S, and is a result of wind-induced coastal upwelling (Fig. 4). Further south, the Nazca Front extends northward from Chile and is most developed during March. Here, the coastline is not favorable to wind upwelling due to the coastline orientation.

The Humboldt LME is complex and variable: the system has high climatic and oceanographic variability associated with seasonal, inter-annual, decadal, and even longer-term changes [12]. Multiple currents interact off the Peruvian coast resulting in a complex mosaic of oxygen levels that affect the

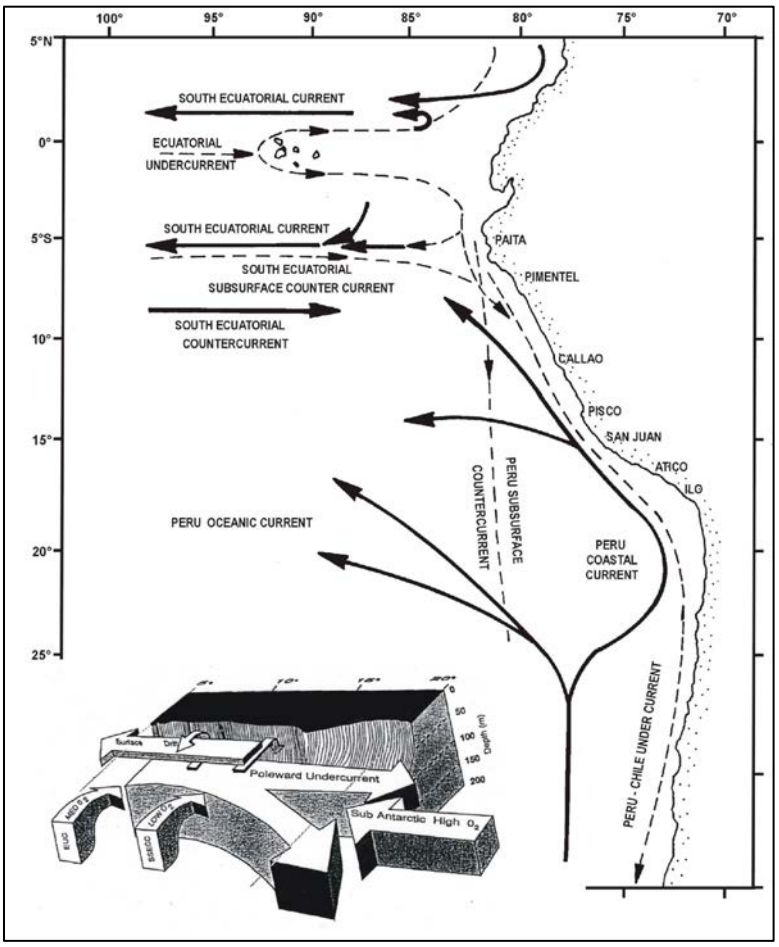

Figure 4. Generalized oceanographic and upwelling scheme for the Peruvian marine environment [11]. Reproduced from Codispoti 1989.

biological communities and biogeochemical processes in both the water column and sediments [10] (Fig. 4). Inter-annual variability is driven by the El Niño-Southern Oscillation (ENSO) cycle, and its warm (El Niño) and cold phases (La Niña). El Niño accompanies high air surface pressure in the western Pacific, while La Niña is related to low air surface pressure. Compared to Chile, the Peru section of the Humboldt LME is strongly affected by ENSO events.

Over the past three decades, the Humboldt LME has experienced a cooling trend in sea surface temperatures [12]. This cooling suggests an increase in upwelling intensity, resulting from an increase in the strength and persistence of favorable winds. Long-term wind intensification, and its connection with climate change, has recently been documented for eastern boundary current systems, including the Humboldt LME [16]. The ecological and fisheries impacts of these changes are uncertain.

Biodiversity

The Humboldt LME is the one of the most diverse marine regions in South America: over 10,000 species have been recorded, with an average of 146 species per 100 km of coastline [13]. In particular, the Humboldt LME is a biodiversity hotspot for crustaceans with over 40 species per 100 km of coast [13]. Across the entire Humboldt LME, there are three zones with high species diversity: 1) the northern Peruvian coast (between 5° and 8° S), the northern Chilean coast (between 22° and 24° S), and the southern Chilean coast (between 52° and 56° S) [13]. With the southern limit of tropical Pacific mangroves, Peru's extreme northern coastline is also part of Tumbes-Chocó-Magdalena biodiversity hotspot that includes mangroves, beaches, rocky shorelines, and coastal wilderness stretching from southern Panama to northern Peru. A recent eco-regional assessment identified 59 areas of high conservation value along the entire Peruvian coast; this assessment provides a foundation for identifying marine priority areas with respect to biodiversity conservation (see Marine Protected Areas and Policy Section). For example, the northern part of Peru is currently target area: it has a high number of areas of high conservation value and little formal protection.

Ecological Communities of the Humboldt LME in Peru

Plankton. Plankton communities in Peruvian waters are diverse, successional, and influenced by distance from shore. Small and large diatoms dominate coastal communities; dominant species are influenced by a transition from turbulent to more stable conditions in upwelled waters. In oceanic waters, the phytoplankton is dominated by dinoflagellates. In upwelled waters, copepods and meroplanktonic larvae dominate the zooplankton. Oxygen levels influence the vertical distribution of zooplankton, limiting the majority to the upper water column (<50 meters) [17].

Benthic Species. Oxygen levels heavily influence the benthic community. Polychaete worms dominate bottom waters (>30 meters), where oxygen is deficient, and biomass, density, and diversity is low [10]. Off central and southern Peru where oxygen levels are even more reduced, dense mats of the giant sulfur bacteria often cover muddy shelf sediments. In the oxygen minimum zone (i.e., where oxygen saturation in seawater is at its lowest), a unique community has evolved that persists of organic matter; this includes endosymbiont-hosting oligochaete worms, nematode worms, and foraminifera [18].

Nekton. The Humboldt LME supports the world's largest fisheries: Chile and Peru landings account for 16-20 percent of global fisheries landings [12]. The majority of those landings are small schooling pelagic fish—anchovies, sardines, jack mackerel, chub mackerel, and hake. Two species dominate the pelagic upwelling zone: the Peruvian anchovy (*Engraulis ringens*) and the sardine (*Sardinops sagax*) (Fig. 5). The anchovy is associated with cold, upwelled waters (< 17°C), and reaches impressive biomass levels (up to 30 million tonnes before the 1971-72 fishery collapse) [19]. The sardine is most abundant around the boundary between upwelled and oceanic waters. Further offshore in warmer waters and along the

shelf margin, the dominant species are chub mackerel (*Scomber japonicus*), jack mackerel (*Trachurus murphyi*), jumbo squid (*Dosidicus gigas*), and yellowfin tuna (*Thunnus albacares*) (Fig. 5) [19]. Lantern fish (e.g., *Vinciguerria lucetia*) dominate the mesopelagic zone (200 - 1,000 meters). The distribution of demersal nekton in the Humboldt LME is largely limited by oxygen deficiency [19]. The most abundant demersal species is the Peruvian hake (*Merluccius gayi peruanus*), whose main area ranges from Ecuador to north-central Peru. Coastal nekton includes a suite of fish species, shrimps, and crabs (Fig. 5).

Intertidal and Subtidal. Shallow coastal areas in Peru are also influenced by hypoxic events and other oceanographic changes caused by ENSO. In general, temperature and dissolved oxygen decreases from north to south. Coastal waters are relatively cold (13° to 23° C) due to upwelling, and dissolved oxygen decreases rapidly with depth (e.g., hypoxia can be present at depths of 20 meters) [20]. There are two main rocky intertidal communities, both dominated by mussels: *Perumytilus purpuratus* and *Semimytilus alogosus* [10]. Along the central and southern coast, kelps dominate the subtidal ecosystems (*Macrocystis pyrifera, M. interifolia, and Lessonia trabeculata*). Subtidal fish species include a high diversity of sciaenids (e.g., croakers), flatfish, rays and mullets (Fig. 5). Fish diversity and abundance diminishes rapidly below 30 meters due to oxygen deficiency [10].

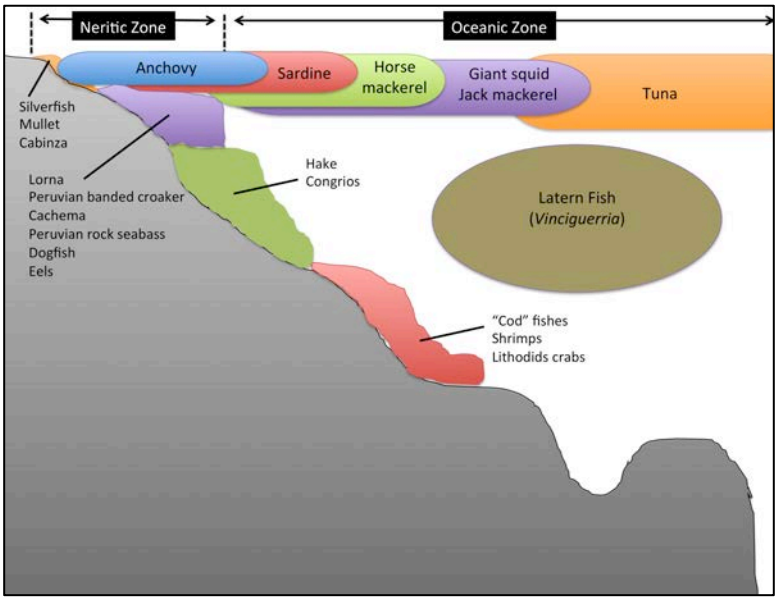

Figure 5. Distribution of some commercial nekton species in the Humboldt LME. Reproduced from Tarazona et al. 2003. See Table 10 for Spanish common names and scientific names.

Mangrove Ecosystem

Covering approximately 6,000 hectares (60 km^2), mangroves in Peru are found from the border with Ecuador (i.e., the mouth of the Zarumilla river, 3° 24' S) to south of the Tumbes River (3° 34' S) [10]. Several factors are thought to limit the distribution of mangroves in Peru, including soil conditions (e.g., salinity and organic matter), aridity, topographic conditions, and river flows [21, 22]. Five species of mangrove trees have been documented; *Rhizophora mangle* is the dominant species. Seagrass beds are present among the mangrove forests. Over hundred fish species have been documented, along with a variety of shrimp and crab species (e.g., *Penaeus* spp. and *Calinectes* spp.) [10]. The mangroves also support a diversity of birds, mammals, and reptiles. Detailed studies on the ecological and ecosystem dynamics of Peruvian mangroves are lacking.

INSTITUTION AND STAKEHOLDER OVERVIEW

We provide a brief overview of the institutions that are involved in marine ecosystems. This includes government, civil society, funders, and the private sector. This overview is not exhaustive; rather, the goal is to provide an introduction of some of the active players in the development, management, and conservation of Peru's marine ecosystems.

National Government Institutions

Ministry of Production. Ten years ago, the Ministries of Industries and Fisheries were combined to create the Ministry of Production (*Ministerio de la Producción,* PRODUCE). The Minister of Production is one of 18 Ministers that form the Cabinet of Ministers, which is overseen by the Prime Minister and President. The Cabinet has powerful decision-making authority and influence within the Government. PRODUCE oversees the formulation, approval, and supervision of policies connected to fisheries and aquaculture.

The Vice-Ministerial Office of Fisheries has the immediate authority within PRODUCE on all matters related to fisheries, including policy, management, and enforcement. This includes small- and large-scale fisheries and aquaculture. It is charged with ensuring the sustainable use of all "hydrobiological resources," and its favorable impact on the economy, society and the environment. As a result of a restructuring of PRODUCE in 2012, the Vice-Ministerial Office of Fisheries overseas a number of Directorates: Fisheries Policy and Development, Fisheries Extraction and Production for Direct Human Consumption, Fisheries Extraction and Production for Indirect Human Consumption, and Monitoring and Enforcement, Sanctioning, and Sustainable Fisheries. In addition, three agencies affiliated with PRODUCE are relevant and influential with respect to marine conservation and fisheries (Table 1).

Table 1. Government agencies that are affiliated with PRODUCE that are relevant to marine conservation and fisheries.

National Fund for Fisheries Development (*Fondo de Desarrollo Pesquero*, FONDEPES)	Provides technical and financial support for the development of the artisanal fishing sector. It includes a fisheries training center in Paita (*Centro de Entrenamiento Pesquero*).
Institute of the Sea of Peru (*Institute del Mar del Peru*, IMARPE)	Conducts scientific and technical research. Research objectives include (a) increasing knowledge about fisheries resources, (b) promoting the conservation and sustainable use of aquatic resources, and (c) assisting PRODUCE in decision-making related to fisheries, aquaculture, and marine conservation.
Technical Institute of Production (*Instituto Tecnológico de la Producción*, ITP)	Focused on four areas: (a) research and technology development on the optimal use of fishery resources, (b) technology transfer and consumer development, (c) promotion of new fisheries technologies, and (d) ensuring health and sanitation standards within the fisheries sector. It is responsible for the inspection of all fisheries and aquaculture products. It is also responsible for technology transfers and piloting new technology that result from fisheries research.

Ministry of the Environment. In charge of the environment, the Ministry of the Environment's (*Ministerio del Ambiente*, MINAM) functions include the design, establishment, execution, and oversight of environmental policy at all levels: national, sectoral, regional and local. MINAM's jurisdiction

includes species protection, spatial planning, pollution, environmental standards, and climate change. A number of important environmental agencies are associated with MINAM, including the National Service of Protected Areas (SERNANP) that was formed under the Ministry in 2008 (Table 2). While the environmental impact and project approval process has been strengthened, it is common for certain policies or development projects to be determined to be of "national interest," and as a result, environmental impacts are not systematically nor sufficiently evaluated for environmental impacts [23].

Table 2. Government agencies associated with MINAM.

National Service of Meteorology (*Servicio Nacional de Meteorología*, SENAMHI)	Provides public services, consulting, and scientific research in the areas of meteorology, hydrology, and environmental issues.
Geophysical Institute of Peru (*Instituto Geofísico del Perú*, IGP)	Focused on scientific research on all issues related to the structure, physical conditions, and evolutionary history of the Earth. Includes research on El Niño and climate change.
Research Institute of the Peruvian Amazon (*Instituto de Investigaciones de la Amazonía Peruana*, IIAP)	Focused on scientific research and technology development for the sustainable use of the Amazon.
Agency for Assessment and Environmental Control (*Organismo de Evaluación y Fiscalización Ambiental*, OEFA)	Governing body of the National Environmental Assessment and Monitoring System. It is responsible for verifying environmental compliance for the entire country.
National Service of Protected Natural Areas by the State (*Servicio Nacional de Áreas Naturales Protegidas por el Estado,* SERNANP)	Charged with ensuring the conservation of Peru's Protected Areas, including biological diversity and ecosystem services. It does so by developing various partnerships. It is the governing body of the National System of Protected Natural Areas (SINANPE). As the regulatory authority, it collaborates with private citizens, and regional and local governments.
National Environmental Certification for Sustainable Investments (*Servicio Nacional de Certificación Ambiental para las Inversiones Sostenibles*, SENACE)	Responsible for the review and approval of Environmental Impact Studies for all development projects (public, private, and public-private).

Ministry of Defense. The Peruvian Navy is in charge of the General Directorate of Captains and Coast Guard of Peru (*Dirección General de Capitanías y Guardacostas del Perú*, DICAPI) and the Directorate for Hydrography and Shipping (*Dirección de Hidrografía y Navegación Marine de Guerra del Perú*, HIDRONAV). Throughout the marine environment, the Coast Guard is responsible for human safety, environmental protection, and the monitoring and enforcement of illegal activities. The Coast Guard plays a key role in supporting any surveillance and enforcement programs for marine national reserves. HIDRONAV supports safe navigation in the marine environment. It overseas research and other activities in order to provide assistance and security for naval forces and seafarers in general.

Special Project to Promote the Use of Fertilizer from Seabirds. Established in 1997 and now under *Agrorural* (*Desarrollo Productivo Agrario Rural*) in the Ministry of Agriculture, PROABONOS[9] facilitates the collection and marketing of guano from Peru's coastal islands. The project promotes the use and access of guano-based fertilizers for small-scale farmers, peasants, and indigenous communities to improve crop productivity as means of poverty alleviation. Seabird protection and rational exploitation is part of their mission. PROABONOS exercises management and conducts activities on 22 islands and 9

[9] *El Proyecto Especial de Promoción del Aprovechamiento de Abonos Provenientes de Aves Marinas*

capes along the coast, covering over 2,800 hectares (28 km^2). The majority of locations are located inside the Islands and Capes National Reserve (See Marine Protected Areas and Policy Section).

Ministry of Energy and Mining. The Ministry of Energy and Mining (*Ministerio de Energía y Minas*, MEM) develops and evaluates policies at the national level on the development of mining. It promotes competitive private investment in mining- and energy-related activities. It is also the authority on environmental issues related to mining. Due to a number of social conflicts over the last decade, which has caused concerns for some foreign investments, MEM is expressing an increasing interest in avoiding and minimizing environmental and social conflicts around mining activities [24].

PeruPetro S.A. A state-owned company, PetroPeru is responsible for promoting, negotiating, underwriting, and monitoring contracts for exploration and exploitation of hydrocarbons in Peru.

Regional Governments

The decentralization process divided fisheries responsibilities between PRODUCE and the regional governments. In coordination with PRODUCE, the regional governments are responsible for regulating artisanal fisheries, along with small-scale and subsistence aquaculture. They are also responsible for creating and promoting co-operatives, small-scale enterprises, and local commerce. Regional governments have political, economic, and administrative autonomy in matters that fall under their jurisdiction, and are responsible for coordinating with municipalities (i.e., local governments). They can create rules and regulations so long as they do not conflict or negate with those of the national government or other regional governments. Much of the functions of regional government have influence over fisheries, spatial planning, and the environment [23]. At the level of the regional government, the decentralization process has created at least four major challenges for marine conservation and the promotion of sustainable fisheries.

Lack of Capacity. The aim of the decentralization process was to empower regional actors in the creation of regional policy, along with supporting regional social and economic development. The process was originally designed to occur under conditions that provided the resources and capacity to those regional actors. Unfortunately, the transfer of roles and responsibilities occurred, in many cases, without the accompanying transfer of resources and capacity.

For example, the appointment of Regional Directors (i.e., the regional leaders of their respective sectors) was to take place according to a number of prerequisite conditions:

- Directors were to be nominated through a competitive public process,
- Directors would have sufficient number of trained personnel to fulfill necessary functions,
- Directors would have the necessary resources and infrastructure to fulfill their roles, and
- Directors would be capable of budgeting and administrative tasks.

Following the dissolution of the National Council for Decentralization, however, transfer of powers took place unsupervised and with disregard for prerequisite conditions. In several cases, Regional Directors were appointed via a non-transparent process; some regional governments simply appointed people they trusted. There has been little follow-up or accountability on performance with respect to achieving decentralization objectives and regional development. In the coastal regions, a lack of capacity is particularly evident demonstrated by regional governments' inability to control illegal activities and enforce the law [25].

Corruption. Regional governments have been accused of widespread corruption, due in large part to the lack of oversight during the decentralization process [3]. Corruption in turn has translated into poor

governance for many sectors. The fisheries sector is considered to be particularly corrupt, posing a threat to the management of Peru's marine resources. Close relationships between regional governments and local actors facilitate corruption.

Lack of Coordination and Vague Responsibilities. The decentralization process dictated new roles and responsibilities of the regional governments, including those that they share with the national government. For the fisheries sector, those roles and responsibilities are unclear and imprecise. In some cases, certain roles and responsibilities have been assigned to both PRODUCE and regional governments, which has generated conflict and political maneuvering. For example, the Moquegua Regional Government acted against national policy when it created a Regional Food Aid Program, which allowed artisanal anchovy fishers to fish for both direct and indirect human consumption. Under national policy, artisanal fishers are not allowed to fish anchovy for indirect human consumption (i.e., fishmeal).

Weak Institutions. Regional institutions are currently weak, which is negatively impacting the management of marine and coastal areas, including fisheries. Examples include weak monitoring and enforcement capabilities, few resources available for fisheries-related activities, and little control over artisanal fisheries.

Local Governments

There are 77 provincial municipalities and 691 local municipalities along the Peruvian coast [23]. Local governments administer local public services, plan and implement development projects, facilitate local infrastructure, and regulate local activities and services, including those impacting the environment and natural resources (e.g., tourism). Their role in spatial planning is important with respect to marine conservation and sustainable coastal development.

Non-Governmental Organizations (NGOs)

The marine conservation NGO sector is younger and less developed compared to NGOs working on biodiversity conservation and sustainable development outside of the marine environment. Peru experienced a surge in environmental conservation activities between the 1980s and 2000s: protected areas expanded from 56,000 km^2 in 1985 to over 190,000 km^2 by 2008 [26]. The boom was largely focused on the Amazon and the establishment of national protected areas. Many biodiversity conservation gains were made in the mid and late 1980s, prior to the economic and political turmoil of the Shining Path and the Alberto Fujimora regime (1990-2000) [26]. A new surge of protected area establishment occurred in the early 2000s. While historically capacity, resources, and activities focused on marine conservation and sustainable fisheries have been limited in the Peruvian NGO sector, that situation is changing rapidly. Below, we briefly describe some of the environmental NGOs working on marine and coastal issues.

Áreas Costeras y Recursos Marinos (ACOREMA) conducts research (e.g., monitoring) and environmental education programs, largely focused on dolphins and other marine megafauna. Based in Pisco, much of ACOREMA's work takes place in the Paracas and Islands and Capes National Reserves. Funders include Society for Dolphin Conservation (Germany), Avina Foundation, National Oceanic and Atmospheric Administration, Duke University, and a number of US-based zoos.
http://www.acorema.org.pe

Centro Desarrollo y Pesca Sustentable (CeDePesca) is headquartered in Buenos Aires, but has active staff and projects in Peru. Projects are focused on multi-stakeholder engagement and improving fisheries sustainability. Their efforts are currently focused on a fishery improvement project for hake. It is developing projects with jumbo squid, white shrimp, and Peruvian scallop. *http://cedepesca.net*

ConCiencia is a community-building NGO that develops environmental education programs for schools and communities in coastal Peru. They use human-centered design methodologies (e.g., IDEO Design Toolkit) to create outdoor science-based learning programs and platforms. Programs vary from multiple days to yearlong programs. They work with public and private schools, as well as provide environmental education as a service to corporations. *http://conciencia.strikingly.com*

Conservation International has been active in Peru since the late 1980s, with a major focus in the Amazon and supporting national protected areas. In the early 2000s, it was part of the BIOMAR consortium that advocated for the Island and Capes National Reserve. While Conservation International is currently focused on the San Martin and Madre de Dios regions, it is in the process of scoping marine projects [27]. They recently agreed to sponsor a workshop to support a newly formed governmental working group on the Ocean Health Index [28].
http://www.conservation.org/global/peru/Pages/partnerlanding.aspx

EcOceánica is a science-based NGO focused on applied research and conservation programs in northern Peru. Much of their research is focused on flagship species such as sharks, turtles, and manta rays. The group has a high-level of scientific capacity. They also run some education and outreach activities. Funders have included Patagonia, Jack Johnson, *Petrobras*, Rufford Small Grants Foundation, and Save Our Species. *http://www.ecoceanica.org*

EcoSwell is creating learning platforms for the economic development of coastal Peruvian communities focused on shared value. They are taking on a multi-stakeholder approach that includes the public sector, large enterprises, NGOs, grassroots organizations, and communities. EcoSwell's current project site is the town of Lobitos in northern Peru. *http://www.ecoswell.org*

E-Tech International is a US-based NGO that works in Ecuador and Peru and provides environmental technical support to communities on the potential environmental impacts of large development projects. They have a long-standing presence in Peru, working with multiple communities on oil and gas developments. They take a science-based approach and work across all sectors. They have developed best practice guidelines for hydrocarbon projects in tropical forests. *http://www.etechinternational.org*

Fondo de Promoción de las Áreas Naturales Protegidas del Perú (PROFONANPE) has managed a number of key funds supporting environmental activities in Peru over the past two decades. This includes a number of investments from foundations such as John D. and Catherine T. MacArthur Foundation, multilateral organizations, developments banks, and debt-for-nature swaps with other governments. PROFONANPE is one of the executing agencies for a Global Environment Facility project focused on the Islands and Capes Reserve, as well as the recently approved KfW grant targeting infrastructure improvements for the same reserve (See Intergovernmental Organization Section).
http://www.profonanpe.org.pe

Green Anchoveta is a new NGO focused on creating and promoting new markets for the direct human consumption of anchovies. In particular, they are interested developing new international niche markets for anchovies and linking those market to the use anchovy-based food products for poverty alleviation efforts. *http://greenanchoveta.org*

Inkaterra Asociación (ITA) focuses on research and conservation of Amazonian, Andean, and marine ecosystems of Peru. With a foundation in ecotourism, the Inkaterra Asociación develops research, conservation, and education programs through sustainable development models, and promotes environmentally friendly businesses to benefit local communities. It is leading an effort to create a new marine protected area in northern Peru. *http://www.inkaterra-asociacion.org*

Instituto de Recursos Acuáticos (IREA) is an NGO focused on sustainable fisheries and developing new solutions and learning platforms by integrating science and technology through collaborative processes. IREA has decades of experience in fisheries and aquaculture, as well as science and technology. It is currently leading an effort to establish, empower, and promote industrial fishing vessels as data collection platforms. *http://www.irea.org.pe*

Mundo Azul is largely focused on the conservation of marine megafauna. Much of their work has been focused on reducing illegal dolphin killing, which occurs to procure fishing bait and for human consumption. Viewed as confrontational and controversial by some, Mundo Azul released an undercover video of dolphin killing for bait by shark fishers in 2013, which received widespread media coverage. Mundo Azul also promotes ecotourism. *http://mundoazul.org*

The Nature Conservancy (TNC) is actively working on improving the management of Peru's marine ecosystems. Their work is currently focused on two main themes: improving the management of the anchovy fishery and reforming the management of artisanal fisheries. They are working with *Sociedad Nacional de Pesquería* to help improve the management of the artisanal anchovy fleet. They are working with multiple government agencies to design and pilot rights-based artisanal fisheries projects. *http://www.nature.org/ourinitiatives/regions/southamerica/peru/*

Oceana recently announced that the Wyss Foundation will, over the next five years, provide up to $10 million in matching funds to help rebuild fisheries in Peru and Canada by supporting science-based policies that aim to both improve fishing and restore ocean health [29]. Oceana is expected to open a Lima office soon. *http://www.oceana.org*

Planeta Océano focuses on research, sustainable development, and education and awareness. Their programs are largely focused in northern Peru. Current projects include scientific research, education, and ecotourism development around giant manta rays that migrate from Ecuador to northern Peru. They also are working to create a functioning marine education network. Funders have included ABC Foundation, US Fish and Wildlife Service, and Ashoka. *http://www.planetaoceano.org*

ProDelphinus is a science-based NGO focused on research and conservation of marine megafauna. Fisheries research and bycatch mitigation programs make up a major component of their activities. They also run a number of environmental education activities, and regularly work directly with fishers. Most recently, they are working on designing programs to incentivize behavioral changes to reduce bycatch. Funders have included Darwin Initiative (UK Government), National Fish and Wildlife Foundation, Oak Foundation (via Duke University), National Oceanic and Atmospheric Administration, Oregon Zoo, and others. *http://www.prodelphinus.org*

Pronaturaleza works throughout Peru focused on four main areas: protected area management, enhancing biodiversity value with economic incentives, environmental education, and brokering environmental sustainability practices with extractive industries. They are largely focused in terrestrial settings, but have programs in coastal environments. *http://www.pronaturaleza.org*

Sociedad Peruana de Derecho Ambiental (SPDA) is the prominent environmental law organization in the country. It has had a major influence in much of the existing national environmental policy framework. Historically, it has focused on terrestrial issues; however, SPDA has recently begun to work in the marine realm. It works in three strategic areas: natural heritage, law and governance, and environmental justice. It received a MacArthur Award for Creative & Effective Institutions in 2006. The current Minister of the Environment, Manuel Pulgar Vidal, is a former Director of SPDA. Funders have included the Belgian Development Corporation, Gordon and Betty Moore Foundation, Blue Moon Fund, European Union, John D. and Catherine T. MacArthur Foundation, and others. *http://www.spda.org.pe*

World Wildlife Fund for Nature (WWF) has a long-standing presence in Peru, helping establish the country's first protected area. WWF-Peru's work is focused in select coastal ecosystems, the Andes, and the Amazon. It is working on a number of marine projects, including a mahi mahi fisheries improvement project. Funders have included United States Agency for International Development, UK Department for International Development, Gordon and Betty Moore Foundation, John D. and Catherine T. MacArthur Foundation, European Union, and the WWF International Network. *http://peru.panda.org*

Academia

Like the NGO sector, marine conservation has not been a strong or active discipline across the Peruvian university system. Historically, opportunities, training, and programs have focused on fisheries management and basic research, as opposed to programs focused on biodiversity science, sustainable management, or conservation biology. But also like the NGO sector, that situation is rapidly changing. Academic capacity, leadership, and mentorship are present within marine and fisheries conservation, and a younger generation of researchers is growing. We briefly describe some of the Peruvian academic institutions and programs involved in marine conservation and fisheries.

Universidad Peruana Cayetano Heredia has experience and expertise in marine science and conservation, mainly through the *Centro para la Sostenibilidad Ambiental.* They have programs focused on ecosystem-based fisheries, marine protected areas, threatened species, and policy reform. Researchers include Patricia Majluf, Juan Carlos Sueiro, and Santiago de la Puente. *http://www.csa-upch.org*

Universidad Nacional Mayor de San Marcos has a number of laboratories conducting scientific investigations on marine ecosystems, including laboratories focused on marine ecology, ichthyology, and marine biodiversity. Researchers include Carlos Paredes Salazar and Juan Tarazona Barboza. *http://biologia.unmsm.edu.pe*

Universidad del Pacífico has a research group, *Centro de Investigación*, focused on natural resource economics, including work on industrial and artisanal fisheries. Researchers include Elsa Galarza Contreras and Francisco Galarza Arellano *http://www.up.edu.pe/ciup*

Universidad de San Martin de Porres houses the *Instituto del Perú* that has an environmental economics group that is currently working on fisheries policy, including research on policy reforms of the anchovy fishery. Researchers include Carlos Paredes lanatta and Migueal Santillana Santos. *http://institutodelperu.org.pe*

Universidad Nacional Agraria La Molina has a graduate program on fisheries and aquaculture. Researchers include Jaime Mendo Aguilar and Patricia Gil Kodaka. *http://www.lamolina.edu.pe*

Private Sector (and other initiatives)

Peru's marine ecosystems have a large number of diverse stakeholders. This includes artisanal fisheries group, industrial fisheries groups, different players along the seafood supply chain, and the oil and gas industry. We describe a few of those stakeholders below.

Alin Kausay is a small enterprise that is sourcing and supporting high quality products from artisanal fisheries, and connecting those products with leading seafood restaurants in Lima. Alin Kausay is working toward improving seafood traceability and quality, while also shortening the supply chain between artisanal fishers and markets. *http://allinkausay.pe*

Asesorandes is a consulting firm that specializes in finance and business development. It is active in the sustainable business and impact investing space, including fisheries and aquaculture. Asesorandes has a strong national and international network across multiple sectors. It has a number of active projects that range from environmental fund design to impact investing to creating and connecting niche sustainable markets between Peru and China. *http://www.asesorandes.com*

Asociación Nacional de Empresas Pesqueras Artesanales de Perú (ANEP) is one of the larger artisanal fishing organizations in Peru. As an association of boat owners, it works with the private and public sector to leverage investments for the artisanal fishing sector. Founded in 1996, it strives to represent many different stakeholders, including boat owners, processors, businesses, and fishers. *https://www.facebook.com/ANEPAP*

Compañía Americana de Conservas is based in Pisco, and has eleven processing plants dedicated to the production of anchovy products for direct human consumption. The company is creating new products and markets for anchovies by working with different players along the supply (and value) chain. *http://www.companiaamericana.com.pe*

El Tamaño Sí Importa is an environmental education campaign targeting seafood consumers. It is led by Gabriel Aller and Fabio Castagnino, and supported by a number of organizations including WWF-Peru, *Pesquera Diamante*, *Fresco Mar*, APEGA, and *Pontificia Universidad Católica del Peru*. It provides information on the importance of minimum sizes and other information regarding Peruvian seafood. *http://awsassets.panda.org/downloads/guia_pescados.pdf*

Federación de Integración y Unificación de los Pescadores Artesanales del Perú (FIUPAP) is the largest artisanal fishing organization in Peru. It is the most politically active organization and is engaged with the overall fishing industry (see Artisanal Fisheries Section).

Moche Energy is an SK group company (South Korean conglomerate) that is currently the operator of an offshore oil and gas concession near Trujillo in the region of La Libertad. Operations have been focused on a marine seismic evaluation that ended in 2013. The company has plans to drill an offshore well in 2016. As part of the planning process, they have a number of studies and evaluations underway, including ones focused on environmental and social factors. *http://mocheenergy.com*

SeaCorp is an aquaculture company focused on the production and export of Peruvian scallop. A business-to-business company, SeaCorp has combined technology with sustainable practices to deliver reliable, year-round, and safe scallops for export. *http://www.seacorperu.com*

Sociedad Nacional de Pesquería (SNP) is the most important and powerful stakeholder in Peruvian fisheries. It represents dozens of fisheries and seafood companies in Peru, including over 50 percent of the fishmeal companies. SNP is organized and connected, with strong lobbying power and influence. While most of their activities are within industrial fisheries, they have recently begun researching and designing an artisanal fisheries development and social responsibility plan *http://www.snp.org.pe*

Sociedad Peruana de Gastronomía (APEGA) was created in 2007 to bring together key actors of cuisine and cooking sectors in order to promote Peruvian cuisine and culture. Their work and interests includes the promotion of sustainable seafood and support for improved management measures. *http://apega.pe*

Funders, Intergovernmental Organizations, and other International Organizations

By far the largest active funding for marine protection and management in Peru is from the Global Environment Facility (GEF). KfW is also supporting one of the GEF projects with a large donation. A number of international development agencies have invested in strengthening artisanal fisheries, including AECID (Spain), JICA (Japan), COTESU (Switzerland), USAID (USA), and the European Union. The World Bank and Inter-American Development Bank have made some investments related to fisheries in Peru, including support for the development of catch shares within the anchovy fishery and research on climate change impacts on fisheries. The FAO recently funded and contracted the development of a National Action Plan for the Development of Sustainable Artisanal Fisheries in Peru. The Plan will be released in 2015. In April of 2014, the World Bank and FAO announced a new program, in collaboration with PRODUCE, to further develop aquaculture in Peru [30]. The program will include developing strategies for the modernization of research facilities and the implementation of technological improvements.

In contrast to terrestrial ecosystems, foundations have not been particularly active within the marine environment in Peru. The Walton Family Foundation has made some investments over the past five years, while the Wyss Foundation just recently announced a large investment to support sustainable fisheries work in Peru [29]. Walton's investments have focused on anchovy fisheries reform via fishery improvement projects. They also have supported research on the anchovy fishery: a Marine Stewardship Council pre-assessment study and some economic analyses [31]. The Lenfest Oceans Program[10] has funded research on the anchovy fishery and the seafood value chain in general. The majority of the marine-focused NGOs in Peru rely on small to medium-sized grants from international organizations, such as zoos, universities, and small foundations.

Global Environment Facility

There are two active GEF projects in Peru that are focused on marine ecosystems. They are briefly described below.

Towards Ecosystem Management of the Humboldt Current Large Marine Ecosystem
GEF Agency: UNDP | Execution Agency: IMARPE (Peru) and IFOP (Instituto de Fomento Pesquero, Chile)
GEF Grant: $6.9 million ($25 million in co-financing) | Timeline: 2011 - 2016

The objective is this bi-national project is to advance ecosystem-based management in the Humboldt LME through a coordinated framework that provides for improved governance and the sustainable use of living marine resources and services. The main components of the project include,

1. Formulating a long-term strategy, framework, and plan for the identification and prioritization of actions needed to preserve and maintain Humboldt LME ecosystem benefits and services.
2. Implementing three pilot projects that validate different management approaches and targeted responses.
3. Identifying priority interventions for effective multi-disciplinary management of the Humboldt LME thru the development of fisheries management collaboration experiences, specific marine protected area management tools and legislation, and common management strategies.
4. Linking the priorities, instruments, and tools developed under the activities above by strengthening capacities for implementing the strategic planning frameworks by both public and private sectors, including through advancement of market-based mechanisms.

[10] The Lenfest Ocean Program is managed by The Pew Charitable Trusts.

Collaborative pilot projects are being developed at three sites: the San Juan Islands, the Ballestas Islands, and Lobos de Tierra Islands. Activities include developing biological indicators, zoning plans, and custom management plans at each location.

A second phase of the program is being planned, which would include a $10 million request from GEF. This phase would focus on making the investments that will be identified from the Strategic Action Plan [28]. It also would include the objective of creating a Humboldt Current Commission, similar to Benguela Current Commission [28]. The Benguela Current Commission is a multi-sectoral and inter-governmental initiative by Angola, Namibia, and South Africa. It promotes the sustainable management and protection of the Benguela Current LME, and has provided a vehicle for fundraising and promoting an ecosystem approach to ocean governance.

Strengthening Sustainable Management of the Guano Islands, Isles, and Capes National Reserve System
GEF Agency: World Bank (International Bank for Reconstruction and Development**)**
Execution Agency: Peruvian Trust Fund for National Parks and Protected Areas (PROFONANPE) and National Service of Protected Areas (SERNANP)
GEF Grant: $8.9 million ($32 million in co-financing) | Timeline: 2013 - 2018

The overarching goal of the project is to improve the management of marine and coastal ecosystems and protect biological diversity through institutional strengthening and support for collaborative regional projects for the newly created National Reserve (see Marine Protected Areas Section). In addition to the $8.9 million GEF grant, the project includes a €10 million grant from KfW. The KfW support will include investments in infrastructure and will be executed in the third year of the project (e.g. piers, ecotourism infrastructure, seabird monitoring systems, etc.). Multiple government agencies are participating and contributing matching funds, including SERNANP, PROANOBOS, IMARPE, and the Peruvian Coast Guard.

There are four main components to the five-year project, whose execution is just now beginning,

1. Build capacity at SERNANP and other institutions involved in the management of marine resources.
2. Develop collaborative management projects in at least ten priority zones of the National Reserve that include strong participation of local communities and other stakeholders (e.g., regional governments, research institutions, and NGOs).
3. Monitor and evaluate activities at three levels: management effectiveness, biodiversity at the sites of the collaborative management projects, and finance and administration.
4. Coordinate among and between all project components and the various actors involved in project implementation.

MARINE PROTECTED AREAS AND POLICY

Marine Protected Areas

After 53 years since the designation of Peru's first national park, there are now 83 national protected areas (Fig. 6) [32, 33]. Institutionally, national protected areas are young in Peru; in 2008, the National Service for Natural Protected Areas (SERNANP) was placed under the newly created Ministry of Environment. On land, the Natural Protected Areas System now covers ~22 million hectares (220,00 km^2, ~17 percent of the country's total terrestrial area) [33]. Budgets for protected areas, however, remain low and inadequate [32].

Marine protected areas (MPAs)[11], where biodiversity conservation is a primary goal, are currently only possible with national policy, mainly through National Reserves (*Reservas Nacionales*). Marine and coastal habitats are underrepresented within Peru's Natural Protected Areas System: there are three MPAs, which make up a total of 630,549 hectares (6,305 km^2) [34, 35]. These are,

- National Reserve System of Guano Islands, Isles, and Capes (*Reserve Nacional Sistema de Islas, Islotes y Puntas Guaneras*),
- Paracas National Reserve (*Reserva Nacional de Paracas*), and
- San Fernando National Reserve (*Reserva Nacional de San Fernando*).

National Reserves correspond to IUCN category VI Protected Areas, whose primary objective is *to protect natural ecosystems and use natural resources sustainably, when conservation and sustainable use can be mutually beneficial* [36]. In addition, there are two coastal Reserved Zones that may eventually include a marine component: Reserved Zone Illescas (*Zona Reservada Illescas*) and Reserved Zone Ancon (*Zona Reservada Ancon*). A Reserved Zone is a transitional status for an area deemed important for conservation, but which has not yet been categorized into one of the several forms of protected areas.

There are a number of protected areas that protect coastal ecosystems. These include,

- Lagunas de Mejia National Sanctuary (*Santuario Nacional Lagunas de Mejia*),
- Mangroves of Tumbes National Sanctuary (*Santuario Nacional los Manglares de Tumbes*),
- Swamps of Villa Wildlife Refuge (*Refugio de Vida Silvestre Pantanos de Villa*), and
- Reserved Zone Wetlands of Puerto Viejo (*Zona Reservada Humedales de Puerto Viejo*).

Established in 1975 and located in the Ica region, the Paracas National Reserve makes up 335,000 hectares, 217,000 of which are coastal waters (Fig. 6). It was designated a RAMSAR site in 1992. A few hours south of Lima, the area receives a steady flow of tourism. This includes ecotourism tours to the Ballesta Islands to observe seabirds and sea lions, as well as a number of adventure sport activities.

Located outside of Nazca, the San Fernando National Reserve protects 154,716 hectares of both marine and terrestrial habitat (Fig. 6). It was designated in 2011. The area includes important algal resources, and has high bird, fish, and invertebrate diversity. The Bay was protected partially in response to concerns about the impacts from the establishment of a mega-port on a neighboring cape, which is meant to receive large cargo ships and connect to the inter-oceanic highway going from the Andes to Brazil. An economic evaluation of the ecosystem services of the San Fernando National Reserve was recently undertaken, producing an annual value of $44 million (S/. 122,900 million) [37].

[11] In this report, MPA refers to all possible types marine protected areas that can vary widely in intended purpose, exploitation, and active management.

Created in 2009, the National Reserve System of Guano Islands, Isles, and Capes (hereafter, Islands and Capes National Reserve) consist of 22 islands and 11 capes that stretch the entire Peruvian coastline. The Reserve makes up 140,833 hectares, which includes the actual islands and capes, along with two nautical miles around each site. These sites represent important refuges for seabirds and marine mammals, including Guanay Cormorants (*Phalacrocorax bougain-vilii*), Peruvian Pelicans (*Pelecanus thagus*), Peruvian Boobies (*Sula variegata*), South American sea lions (*Otaria flavescens*), and Humboldt penguins (*Spheniscus humboldti*).

Because the Islands and Capes National Reserve spans nearly 3,000 km, the socio-economic and ecological conditions are highly variable. Some areas of the Reserve face challenges with artisanal fishing pressure, while other areas are threatened by informal, unregulated, and growing ecotourism. Regional workshops have been held to establish baselines for the 33 sites; specific objectives and strategies are currently being developed [38]. A provisional master plan for the entire Reserve will be presented by the end of 2014, which will include provisional zoning for the 33 areas and define direct use zones [38]. The provisional master plan must be approved by SERNANP's Department for Strategic Development, as well as by the 20 presidents and 20 vice-presidents of the Reserve's management committees.[12] Updated every five years, the master plan is the highest level of strategic planning for the Islands and Capes Reserve. Created via a participative process, it defines the zoning, strategy, and general policies of the Reserve, as well as its organization, objectives, and specific management plans and programs. It requires approval by SERNANP.

The Islands and Capes National Reserve's management committees consist of representatives from the public and private sectors, who have local-level interest or investments in the Reserve's sites. The committees serve as platforms for citizens interested in participating in and supporting the management of the Reserve. The management committee's main purpose is to ensure the proper functioning of the protected area, ensure the execution of the Master Plan and associated monitoring, and evaluate activities to ensure they are in compliance with work plans and relevant legislation.

Marine Protected Area Policy

There are a number of reasons why MPAs are underrepresented within Peru's National Protected Areas System. Below, we discuss some of the major challenges to creating MPAs in Peru.

First, in contrast to forests, there is no strong cultural history of marine conservation in Peru. Rather, the focus has been on the extraction of marine resources. This is evident throughout Peru's legal and policy frameworks. For example, on land, undomesticated terrestrial fauna living in its natural habitat is considered wildlife and can be protected as such.[13] Yet, all fauna "born at sea" is legally classified as a "marine resource." There is little awareness about the need for marine conservation across all sectors in Peru, including all levels of the government. Environmental education in Peru is weak, including at the university level: there are no university programs explicitly focused on marine conservation or related issues. As a consequence, few professionals in government institutions have formal degrees or training in marine conservation.

[12] Currently only 20 out of the 33 sites of the Islands and Capes Reserve have management committees.

[13] Article 3.69 of the Regulations in Law 2976

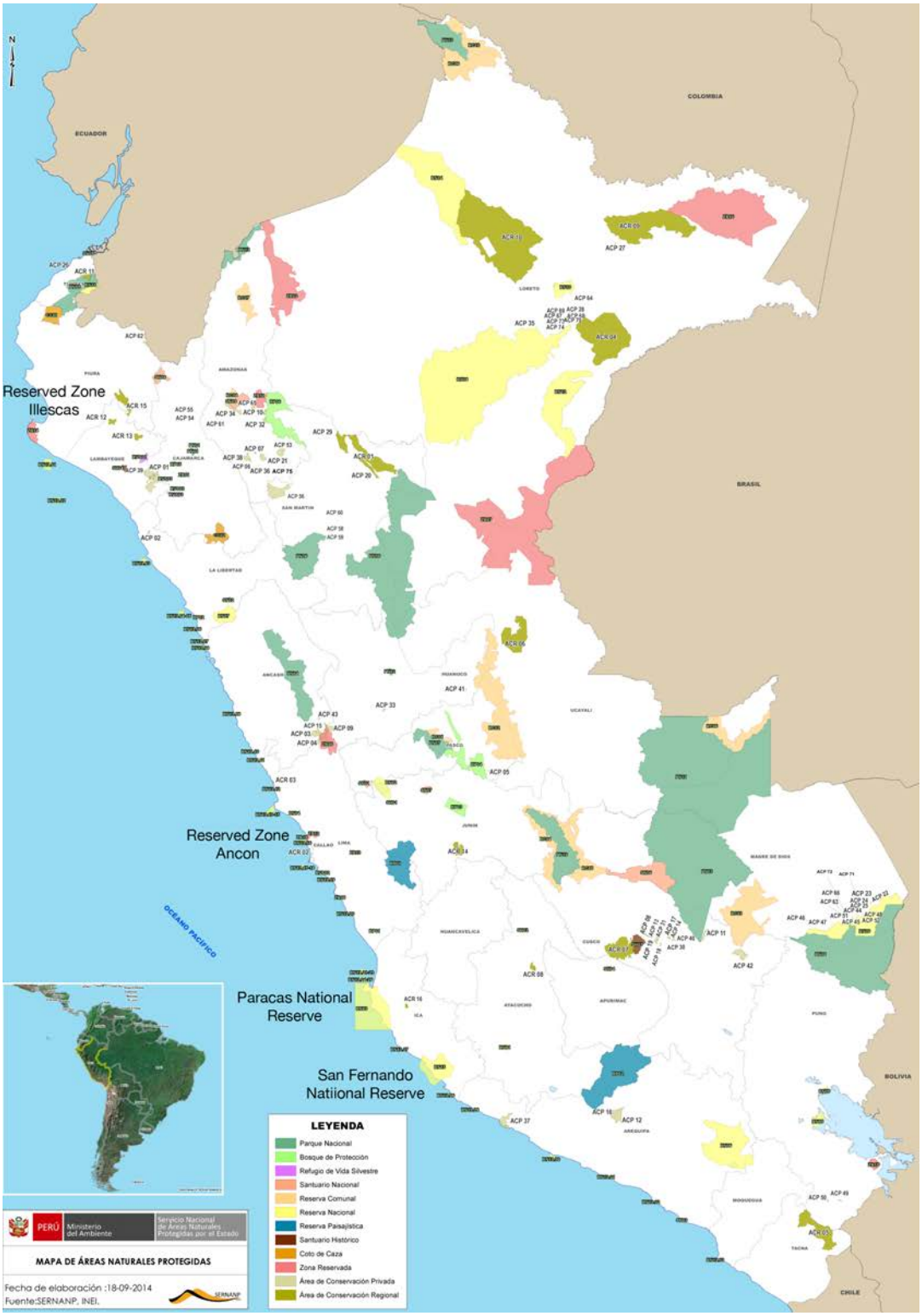

Figure 6. Peru's Natural Area Protected System, which includes three MPAs. The Capes and Islands National Reserve includes 33 locations along the entire coast, while Paracas and San Fernando National Reserves are in central-southern Peru.

Second, as a consequence of the low levels of marine conservation training and culture, there is currently no cohesive marine conservation initiative or movement that is advocating for policy changes. Attempts to date have been met with limited success. Once exception is the BIOMAR Peru consortium, which was a multi-sector alliance created to promote the creation of the Islands and Capes National Reserve. The group is no longer active [39].

Third, there is no strong governmental institution leading marine conservation. While PRODUCE is officially in charge of marine resources, by definition it treats marine biodiversity first and foremost as a resource. For example, PRODUCE has the power to establish no-take zones in the marine environment, but has yet to do so. Within MINAM, SERNANP has only recently created a small department in charge of MPAs, which is currently focused on the management of Islands and Capes Reserve as opposed to the creation of new MPAs. While one of the strongest marine institutions, IMARPE focuses on fisheries, is chronically underfunded, and does not have a close relationship with the marine conservation community.

Fourth, there is a legal gap regarding the role of regional governments in the creation of MPAs. The decentralization process has granted regional governments jurisdiction over terrestrial areas (including islands), but not the marine environment. SERNANP has interpreted this process to mean that Regional Conservation Areas—an important form of protected area that can be led by regional governments—are not an option for marine areas. For example, the Piura Regional Government sought to create a Regional Conservation Area around Foca Island; in the end, they were prohibited to do so. The Piura Regional Government is now proposing an MPA for the reefs of Punta Sal, El Ñuro, and Foca Island. To date, they have been unsuccessful.

Lastly, there is a history of negative relationships between the oil and gas industry and the marine conservation community. This negative relationship coupled with the political influence of the oil and gas industry has led to restrictive and inhibitive legislation regarding the creation of MPAs, as well as transitory forms of protection such as Reserved Zones. Two recent legal changes has created conditions that make MPA creation nearly impossible without the consent of the oil and gas industry:

- A recent Supreme Decree makes it impossible to create a protected area without formal permission from the owners of any pre-existing concessions in that area. This law was passed following heavy lobbying by the extractive industries [40].[14] If permission is granted for the creation of a protected area, it cannot include a no-take zone if it overlaps with existing resource use rights. For a no-take zone to be created, the concession holder would have to give up any overlapping section of its concession. In a marine context, this poses serious challenges to creating new MPAs given the number and coverage of coastal oil and gas concessions (see Impacts and Threats Section). A culture of viewing protected areas as incompatible with private interests is driving oil and gas companies to reject the creation of MPAs, even in areas where there are no plans for oil and gas activities. For example, there are plans to expand the Illescas Reserved Zone to include a marine zone. However, the oil and gas company that owns the overlapping concession is so far unwilling to permit the MPA.

- In 2014, MINAM lost its power to create Reserved Zones. Historically, MINAM was able to create such zones using a Ministerial Resolution. The National Government recently executed

[14] Originally, Peruvian law stated that the creation of a protected area does not affect existing concessions on the same piece of land (e.g., an existing oil exploration concession). However, in 2006, the San Martin Regional Government took oil and gas companies to court, requesting the suspension of oil exploration in the Regional Conservation Area *Cordillera Escalera*, where companies had pre-existing oil and gas concessions. In 2009, the Constitutional Court ruled in favor of the Regional Government, and oil and gas activities were suspended. As a result, the Ministry of Energy and Mining started a lobbying campaign against the general concept of protected areas, stating that protected areas limit Peru's growth and investment in mining. Their efforts resulted in the passing of the Supreme Decree. For more information see reference 40.

a number of legal changes focused on boosting the Peruvian economy, which included this change. It is now only possible to create a Reserved Zone through a Supreme Decree, which requires the full approval of the Council of Ministers. While PRODUCE has been known to grant extractive concessions within established Reserved Zones prior to this change, extractive industries successfully lobbied for the change in response to the NGO Inkaterra Asociación lobbying for the creation of a Reserved Zone within the Banco of Mancora—one of the most productive marine areas in northern Peru. Efforts by special interest were able to create changes in the law to make the process of creating Reserved Zones more difficult.

Voluntary Marine Conservation and Policy

Private and community-based conservation strategies have a long history in Peru; however, they have been largely limited to terrestrial settings. Voluntary conservation by private individuals and groups is supported by a flexible legal framework, which includes the possibility of,

- Creating (a) private conservation areas or (b) conservation agreements based on easements (or civil law schemes) on private lands, and
- Obtaining (c) conservation concessions, (d) wildlife management concessions, or (e) ecotourism concessions on public land.

Civil society can also participate in protected areas through administration contracts for NGOs or ecotourism concessions within a protected area. Although the legal framework continues to require improvement, these options for conservation have been a positive development for biodiversity conservation in Peru.

These legal mechanisms, however, are contained within the Forestry and Wildlife Law, and were not designed with marine or coastal ecosystems in mind. In fact, Article 10 of the Forestry and Wildlife Law states that ecotourism or conservation concessions may only be granted for "forests under protection" or "lands for forestry use," thereby explicitly excluding all other types of ecosystems. In practice, conservation concessions have been granted on terrestrial coastal land, but the Department of Forestry and Wildlife within the Ministry of Agriculture has recently begun to annul such concessions, on the grounds that the designated legal framework does not support them. For marine areas, conservation or ecotourism concessions have never been granted.

Under Peru's current legal framework, there are no explicit laws that enable the voluntary conservation of marine areas for the explicit purpose of biodiversity conservation. Some limited forms of voluntary conservation are possible through existing laws aimed at regulating aquaculture activities (see Rights-based Management Section), as well as a number of other mechanisms that allow civil society participation in existing marine protected areas. Private individuals or groups, including NGOs, may request to participate in the use of resources, conservation, and management of MPAs through the following mechanisms:

- Agreement for the administration of a MPA,
- Concessions for the provision of ecotourism services within a MPA,
- Contracts for the use of natural resources within a MPA,
- Agreements for conducting research projects or programs within a MPA,
- Authorizations for conducting touristic activities on private property that lies within a MPA,
- Permissions for small-scale activities within a MPA, or
- Special aquaculture concessions in bodies of water within a MPA.

SERNANP, however, remains the final authority over any protected area. In conclusion, for voluntary marine conservation to be viable in Peru under similar conditions as in terrestrial areas, the existing legal framework would have to be changed significantly, and a number of new legal mechanisms would have to be developed.

Marine Prioritization Planning

In 2012, The Nature Conservancy (TNC) undertook a marine spatial prioritization for coastal Peru using TNC's eco-regional assessment methodology. Within three designated ecoregions, 59 areas of high conservation value were identified, which made up a total of 2.9 million hectares (29,000 km^2, Fig. 7). Those 59 sites consisted of 4.3 percent of Peru's total maritime jurisdiction and 23 percent of the coastal zone. Two of the recommendations resulting from the prioritization were (a) Paracas National Reserve, San Fernando National Reserve, and several sites in the Islands and Capes National Reserve should be extended beyond existing borders to conserve endangered marine species and (b) action is needed in northern Peru where a high percentage of areas of high conservation value are located but there is little formal protection [41]. This includes areas such as *Banco de Mancora*, *Illescas*, *Vila Vila*, and *Morro Sama*. TNC later built upon the national prioritization by conducting a more detailed coastal zone prioritization for the Puira region in northern Peru. The proposal, however, did not progress due to a lack of proper policy and legal frameworks to support regional marine spatial planning [42].

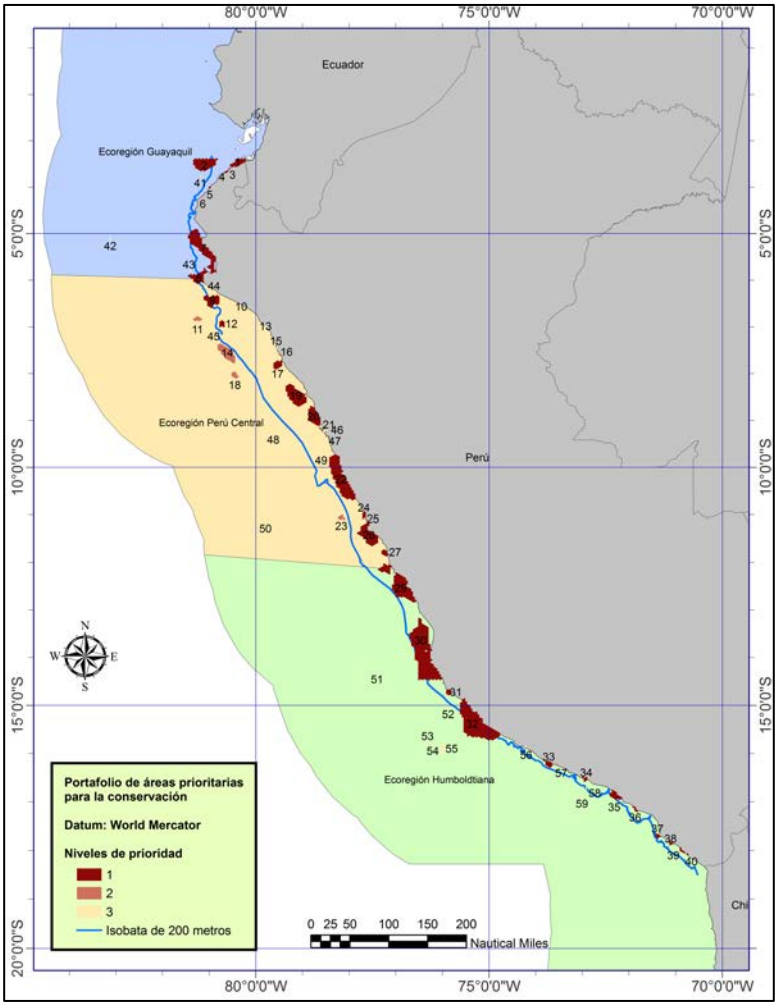

Figure 7. 59 marine areas of high conservation value identified for Peru using TNC's eco-regional assessment and the spatial planning software MARXAN. From Nakandakari 2012.

What Is Happening Now?

- With the support of GEF, SERNANP is planning to establish management and conservation pilot projects at three sites within the Islands and Capes National Reserve. These pilots will focus on establishing improved fisheries practices, sustainable ecotourism, and environmental education. Marine spatial zoning and the establishment of territorial use rights for fisheries are gaining interest and traction as tools for the management of the Islands and Capes National Reserve.

- A major challenge SERNANP faces is the lack of personnel to conduct monitoring and enforcement of the Islands and Capes National Reserve. SERNANP is currently exploring a strategic partnership with PROABONOS (under *Agrorural*), the organization responsible for the extraction of guano from islands. This collaboration could help with developing monitoring systems to identify early warning signs for potential threats and impacts associated to many of the sites located in the Island and Capes Reserve.

- TNC is working with multiple government agencies (PRODUCE, IMARPE, and SERNANP) to design and implement two pilot projects that aim to demonstrate that territorial use rights in fisheries management systems can result in improved livelihoods and sustainable fisheries for artisanal fishers in Peru. Building on their work in Chile, the pilots will embrace three approaches: (a) establishing access rights to local fishing grounds, (b) increasing the capacity to carry out data poor stock assessments that allow for setting sound harvest rules, and (c) bringing access to markets for sustainably caught products to artisanal fisheries via traceability systems and business skills capacity building.

IMPACTS AND THREATS OVERVIEW

A series of expert-opinion workshops in 2006-2007, led by TNC, resulted in information regarding key threats to coastal and marine biodiversity in Peru. Main threats according to expert opinion include pollution, overfishing, coastal development, resource exploitation, and oil and gas development [34]. Pollution was considered the main threat, followed by overfishing (Fig. 8).[15] The two main sources of pollution for coastal ecosystems are industry and urban centers. While some coastal pollution monitoring programs are in place, there is very little information available on marine pollution trends in Peru, either in the published or grey literature [34, 43].

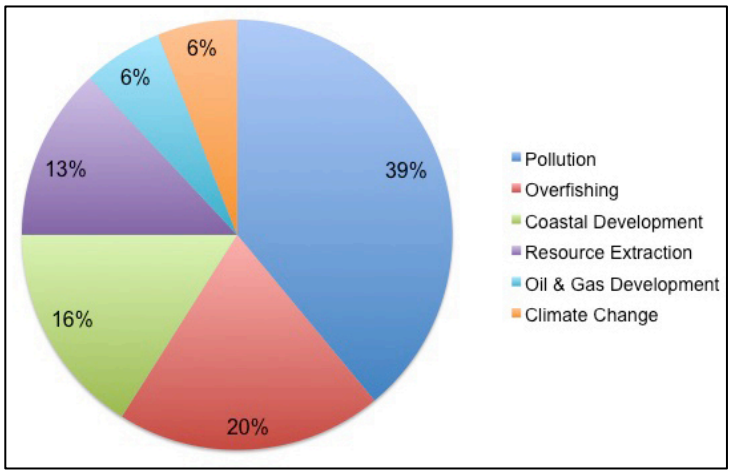

Figure 8. Key threats to marine and coastal biodiversity in Peru, according to expert opinion. In a workshop setting, experts (n = 29) identified the top four threats to conservation targets. Source: Fernandez-Baca et al. 2007.

Pollution

Fishmeal Processing Plants

Fishmeal processing plants and their environmental and health impacts has a long history in Peru. With untreated industrial waste streams being deposited into the water and air, the fishmeal industry was often accused of causing human health problems and being the worst pollution problem in Peru's coastal cities. With some forty fishmeal plants, the northern fishing city of Chimbote has been one of the epicenters for the negative impacts of the fishmeal industry—and a flashpoint for conflict [44]. The majority of the fishmeal plants are located alongside poor, residential neighborhoods, were they once discharged untreated effluents directly into domestic drains. This mixing of industrial and domestic waste has been linked to major health problems for Chimbote, including allergies, fungal skin diseases, and respiratory diseases [44]. Some have even suggested a link between fishmeal plant pollution and the cholera epidemic of 1991-1993; however, available evidence suggests other factors were more important drivers [45]. Throughout the 1990s and 2000s, Goldman Prize recipient Maria Elena Foronda Farro led a successful long-term effort to bring together stakeholders and work with progressive fishmeal operators to reduce pollution. Those efforts helped precipitate reforms within the fishmeal industry.

Fishmeal processing plants are concentrated in the bays along the entire Peruvian coast. There is up to four times overcapacity, with ~160 fishmeal plants currently in operation [46-48]. Production can be divided into two sectors: fishmeal plants and residual plants, with the former making up more than 97 percent of the total processing capacity (~9,0000 tonnes per hour or ~23 million tonnes per year). For fishmeal plants, whole fish are used as inputs; residual plants receive left over raw material that does not

[15] In a workshop setting, 29 experts were asked to identify four top threats to conservation targets. Results were tabulated and the threats that collectively represented approximately 90 percent of expert opinions were deemed key threats. See Fernandez-Baca et al. 2007.

meet sanitary standards. For sanitation reasons, fishmeal plants that are for direct human consumption are required to have an adjacent residual plant to convert residual material to fishmeal.

Important reforms occurred within the fishmeal sector during the late 2000s, which is expected to significantly reduce pollution. Between 2008-2009, new effluent and emission standards were set for fishmeal and fish processing plants [43]. The industry was granted a four-year grace period to achieve full compliance [47].[16] New maximum permissible limits were set for oil and fats, total suspended solids, biochemical oxygen demand, and acidity-alkalinity [43]. It is now forbidden to discharge effluents into certain areas, such as wetlands, estuaries, protected areas, or areas adjacent to guano islands. Some of the measures taken to reduce pollution also result in significant cost savings. For example, research on fishmeal plants in Pisco in the 1990s suggested that average losses in the pump water alone amounted to ~20 percent of landings, estimated to be worth >$2.5 billion over a ~50 year period [49]. In 2014, ten Peruvian fishmeal and fish oil companies achieved certification under the Organization of Marine Ingredients Global Standard for Responsible Supply (IFFO RS).[17] Those companies represent over 50 plants and include Austral Group, CFG Investments, *Compañía Pesquera del Pacífico Centro, Corporación Pesquera Inca*, *Pesquera Cantabria*, *Pesquera Centinela*, *Pesquera Diamante*, *Pesquera Exalmar, Pesquera Hayduk*, and TASA [50].

Like other aspects of the anchovy industry in Peru (e.g., landings), it is difficult to objectively assess the current situation with respect to fishmeal plants and pollution [51]. There is little scientific information available, and even less in the peer-reviewed literature. Further, regulators of the anchovy fishery lack transparency [51].[18]

Wastewater Discharge

Water access and sanitation in Peru has made important advances in the last two decades: access to water increased from 75 percent in 1990 to 87 percent in 2012. Coverage in rural areas, however, is still reduced (71 percent) [52]. Over 80 percent of the population has access to improved sanitation; however, in rural areas the number drops to 45 percent [52]. The discharge of untreated wastewater is still a common occurrence in Peru. In urban areas alone, the percentage of treated wastewater was 22 percent in 2005 [53]. The fifty water utilities throughout Peru collected 798 million m^3 of raw wastewater in 2011—only 32 percent of that wastewater was treated prior to final disposal [54]. Over the past few years, a number of new wastewater plants have been built and become operational, drastically increasing the percentage of wastewater treated in Peru. In 2013, the Taboada wastewater treatment plant was commissioned in Lima; it is the largest wastewater treatment plant in South America [55]. The plant is expected to raise sewage treatment coverage to 75 percent in Lima. Another treatment plant is scheduled to be commissioned by 2015, which is expected to provide the additional coverage to meet 100 percent in the capital city [55]. Despite the low treatment rates, standards and laws are in place: the Law of Water Resources and its regulations state that all wastewater must be treated prior to final discharge to the environment. While fines and remediation requirements are in place, enforcement is lax [54]. Published scientific studies on the coastal and marine impacts of wastewater discharge in Peru are lacking [56].

[16] The grace period was extended to December 2013.

[17] IFFO is an international NGO that represents and promotes the fishmeal, fish oil, and the wider marine ingredients industry worldwide. IFFO holds observer status at the UN Food and Agriculture Organization and the EU Commission and Parliament.

[18] Interviewees commonly expressed a lack of transparency with the agencies involved in the regulation of the anchovy fishery as a major challenge to increasing its sustainability.

Invasive Species

An invasive green algae recently invaded southern Peru: in 2010, *Caulerpa filiormis* established in the Paracas National Reserve and other areas around Pisco. The source of the introduction is likely northern Peru (e.g., Piura) where it is native. Movement of scallops (*Argopecten purpuratus*) connected to the aquaculture sector has been hypothesized as the source. Other species of *Caulerpa* have become invasive in the Mediterranean Sea, Australia, and southern California. Its negative impacts and invasiveness are well documented [57].

Marine Megafauna Stranding

In early 2012, a major marine mammal stranding occurred in northern Peru. Over 1,500 animals were observed, the majority of which were long-beaked common dolphins *(Delphinus capensis)* along with fewer Burmeister's porpoises (*Phocoena spinipinnis*). The event was covered in the national and international media, and the potential cause quickly turned controversial [58]. Accusations include seismic testing from the oil and gas industry or immune suppression from PCBs or some other pollutant [59]. Multiple autopsies were conducted, both by the government and a NGO. With assistance from US scientists, the Peruvian Government (IMARPE) officially concluded that the stranding was caused by morbillivirus, which is similar to canine distemper in its effects [60]. The controversy around the cause, however, was never settled.

Marine megafauna strandings and die-offs are not uncommon in Peru. In 2012, there were die-offs of Peruvian Pelicans, Peruvian Boobies, and Guanay Cormorants in four separate locations in the north. Large avian die-offs have occurred before during El Niño events. Strandings of sea lions have also occurred. Anthropogenic causes have not been linked to these recent strandings or die-offs. The Ministry of Environment overseas a Peruvian Stranding Network that includes representatives from the government, academia, and NGOs [61].

Oil and Gas Extraction

The oil and gas industry has a long history in Peru, including some controversial events surrounding social and environmental impacts. This includes disregard for uncontacted indigenous people, significant environmental damage, and in general a high risk—low cost operating culture [62]. Violent conflicts are not uncommon. Most of the controversy, albeit it not all, has occurred in the Amazon [63, 64]. The government support for the continued development of mining and fossil fuel activities is strong and often controversial: in 2014, President Humala signed a law that reduces most fines for environmental damages, forces environmental impact studies to be done in 45 days, and will allow oil and gas activities in any newly-formed protected area [64]. All activities likely to cause environmental impacts (e.g., seismic exploration) require a formal environmental assessment, of which there are three categories depending on the severity of the impacts. Additional requirements include permitting, licenses,

Figure 9. A nearshore oil and gas platform in northern Peru. Photo: Lorraine Caputo.

and authorizations with respect to wastewater, archeological sites, forest clearing, and water use.

The first oil well drilled in South America was on the north coast of Peru in 1863 [65]. There are four main productive areas in Peru with respect to oil and gas deposits: three in the Amazon and one on the north coast. Currently, there are over 100 active oil and gas contracts; the number of contracts has increased significantly since 2005 [65]. The government is heavily promoting oil and gas investment and new contracts, including onshore and offshore exploration in the north coast [65].

The majority of the country's coastline is made up of oil and gas concessions (Fig. 10). Actual coastal operations are currently centered in the north, which can be broken down into two phases: an exploration phase which can last up to seven years and an production phase which is much longer—around forty years. In Peru, only five blocks are currently in production phase; the rest are in exploration phase. A number of marine blocks are currently under international bidding. The total number of companies holding onshore and offshore concessions is limited, and includes Savia Peru, Moche Energy, BPZ Energy, Corvina, Petrotech Peruana S.A., and Gold Oil Peru. Oil and gas companies routinely engage in long-term relationships with coastal communities during all phases of operations. Results and outcomes have been mixed, with many differing opinions and perspectives. Regardless, social capital and community buy-in is increasingly important for oil and gas companies operating along the coast, and throughout the country, particularly given the long-term nature of the operations [66].

The potential negative environmental and social impacts of oil and gas exploration, drilling, and extraction are well documented globally [67]. While major impacts have occurred in Peru [68], we are not aware of any documented, major environmental impacts in Peruvian marine waters. For example, there has not been any major oil spill in the marine environment. Hence, while biodiversity impacts to coastal oil and gas coastal have been documented elsewhere (e.g., seabirds [69]), there appears to be a lack of available scientific information to assess the potential impacts and risks of the oil and gas industry along the Peruvian coast. Published scientific studies on past or potential impacts are lacking.

What Is Happening Now?

- Moche Energy recently completed marine seismic evaluations on a marine oil and gas block near Trujillo, La Libertad. They are planning to drill an offshore well in 2016. While there are no active operations at the moment, Moche Energy is in the process of planning for future activities, which include assessing and mitigating any social and environmental impacts [66]. Some studies are underway, including dialogue with local stakeholders [70]. Moche Energy is interested in exploring new innovative approaches to work with artisanal fishing communities and other stakeholders, especially given the long-term (e.g., decades) nature of oil and gas projects [66].

- The NGO Ecoswell is working with the town Lobitos in Piura to help guide them through a sustainable development plan that is focused on shared value and positive impacts for the local population and environment. The approach is to work with and integrate multiple opportunities and challenges, including ecotourism, a growing local population, and the presence of the oil and gas industry. An overarching goal is to create a 2021 development plan.

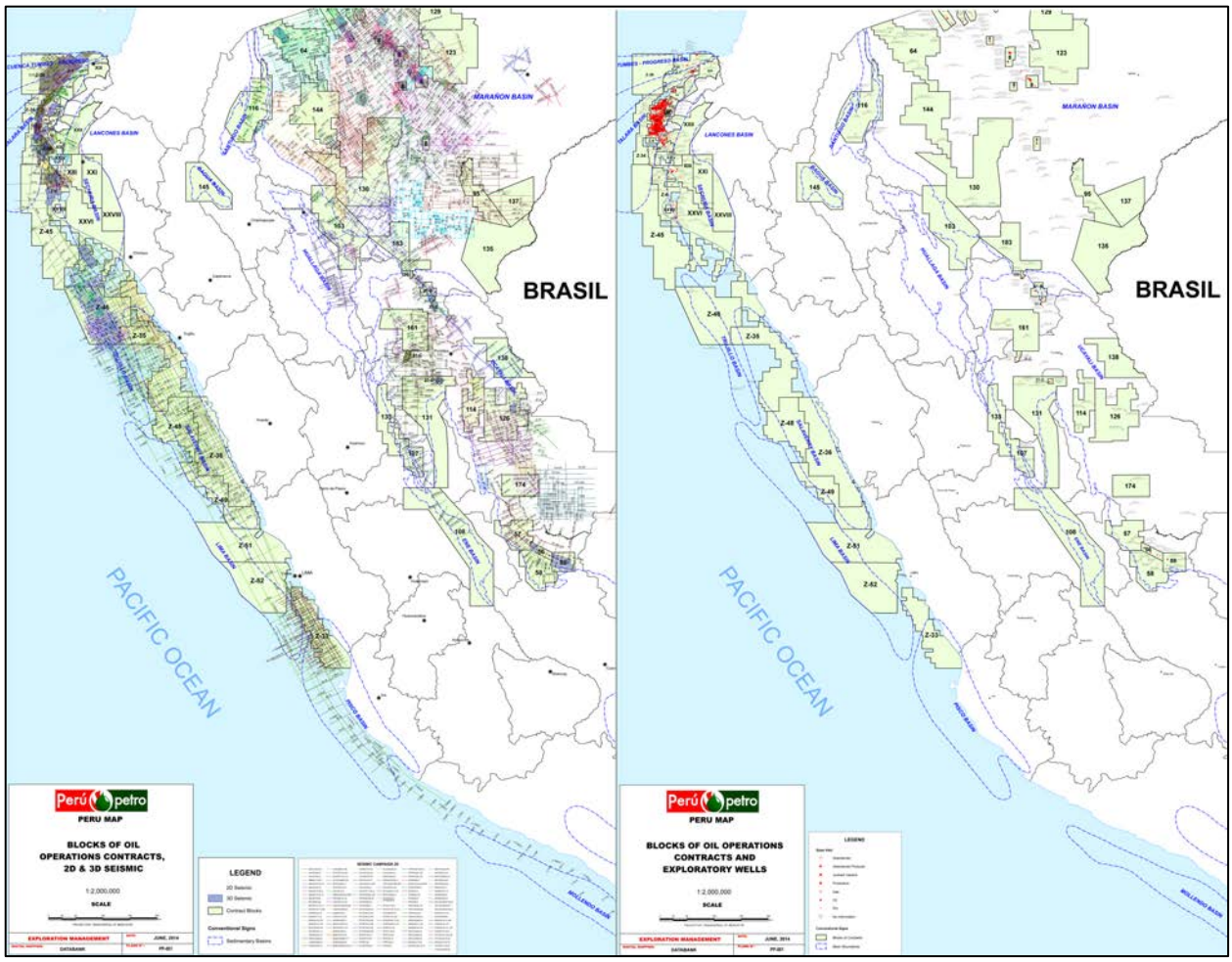

Figure 10. Oil and Gas blocks in Peru. A) Blocks currently in the exploration phase, conducting seismic activities. B) Blocks with operations contracts and exploratory wells, which in the marine realm are heavily concentrated in northern Peru. Source: PeruPetro.

COASTAL DEMOGRAPHY AND THE SEAFOOD MARKET

Demography and the Fisheries Value Chain

Peru's human population is hyper-urbanized: the overall percentage of people living in urban areas rose from 47 percent in 1960 to 71 percent in 2005 (the global average is 49 percent) [71]. Between 1997 and 2007, the population living on Peru's coast grew from 9.6 million to 13.5 million, which is approaching half of the entire population [72]. More than half of Peru's coastal population lives in Lima and Callao. In 2011, 8.2 million people were employed along the Peruvian coast. Over the past decade, the Economically Active Population (*Población Económicamente Activa*) along the coast has increased at an average annual rate of 2.8 percent [72].

Peru's coastal population scores higher on socioeconomic and human development indicators compared to populations in the Amazon or the Andes mountains [23, 73]. The revenues generated by the various economic activities on the coast, including fisheries, agriculture, tourism and commerce, have fueled the economic development of coastal regions. The development has resulted in improved living conditions for coastal populations, but is also has resulted in environmental degradation, particularly in major coastal urban centers such as Lima and Callao.

Overall coastal poverty levels range between 10 and 37 percent (Fig. 11). Educational levels on the coast are higher than national averages: school attendance rates, literacy rates, and educational achievement rates have all increased over the past two decades [73]. Children malnutrition is also lower on the coast compared to the national average (14 percent versus 24 percent in 2009) [72].

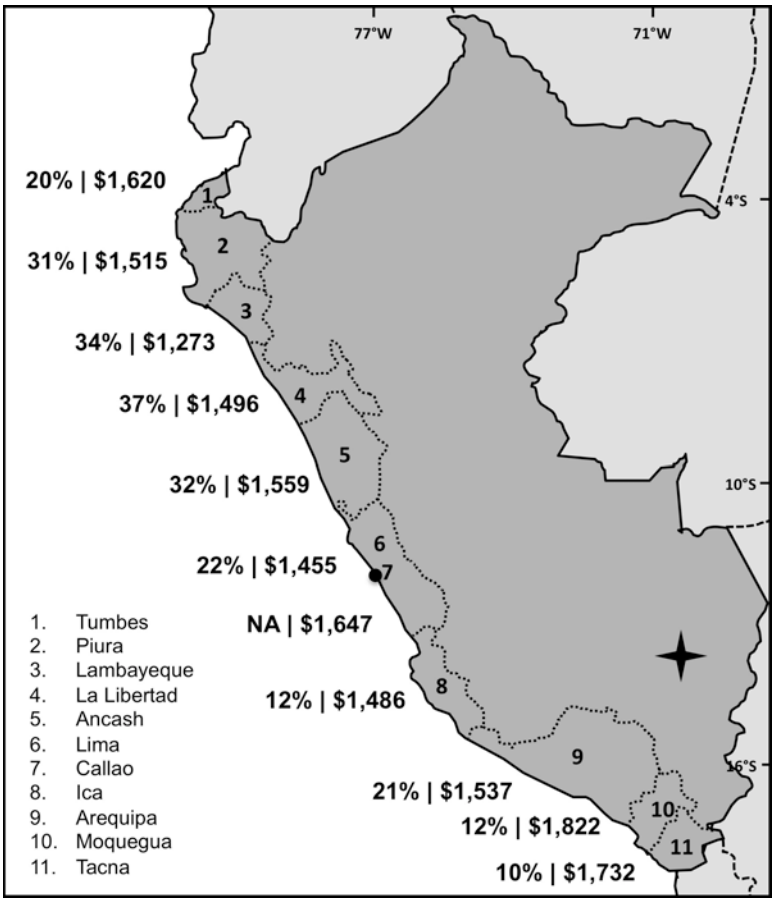

Figure 11. Percentage living under the national poverty rate (2009) and average annual income (2007) for coastal provinces averaged across Peru´s 11 coastal regions. Income is per capita annual income per family (US$). Data are averaged across all (and only) coastal provinces and grouped by region. Note that in some cases, there is high variability across provinces within a region. Source: de la Puente and Sueiro 2013 and PNUD 2009.

Fisheries are an important economic engine and job producer, both locally and nationally (Table 3). The overall contribution to the GDP by the fisheries sector was conservatively estimated to be $3.4 billion in 2009 [7]. This does not include freshwater

fisheries and aquaculture; illegal, unreported, and unregulated fisheries; and restaurants that do not specialize in seafood. Total employment for the fisheries sector is conservatively estimated at 232,357 full-time jobs (Tables 3 and 5) [7]. Across the entire fisheries sector, fishmeal plants generate the most revenue; however, restaurants generate the most employment.

Table 3. Estimated total revenue, GDP contribution, jobs, and salaries from the Peruvian fisheries sector in 2009. Economic parameters are in US dollars (B=billion, mm=million). GDP contribution shows the percent contribution to the sector-wide GDP for each enterprise category. Source: Christensen et al. 2014. According to the Central Bank of Peru, average wages over 2013-2014 were $6,215 annually.

	Producer	Processing	Distribution	Wholesaler	Retailer	Total
Total revenue	$1.7 B	$2.8 B	$539 mm	$603 mm	$2 B	$7.7 B
GDP contribution	34%	34%	2%	3%	27%	$3.4 B
Jobs, total	79,449	50,390	953	6,260	95,295	232,357
Jobs, percent female	0.01%	39%	14%	17%	57%	33%
Average salary	$5,800	$4,900	$3,800	$3,500	$3,500	$4,600

The anchovy fishery makes up ~30 percent of fishing sector's contribution to the overall GDP, while accounting for 23 percent of employment. Marine invertebrates overall generate similar economic productivity and jobs; shrimp and jumbo squid are the two main species (Table 4). The recent value chain work by Christenson and colleagues demonstrates that even though the anchovy is the major focal species for the Peruvian fisheries sector, it is far from the only one of importance [7]. A diverse group of species contribute more than two thirds of the contribution from the fisheries sector to Peru's GDP, and more than three quarters of the estimated total employment.

Table 4. Estimated contribution to GDP (10^3 $US) and employment (jobs) for different types of fisheries from the primary (i.e., fleet) and the entire fisheries sector. Source: Christenson et al. 2014.

	GDP Contribution		Employment	
	Fleet	Sector	Fleet	Sector
Invertebrates	$ 414,643	$ 1,057,683	22,635	63,712
Anchoveta	389,340	1,075,649	24,260	53,461
Medium/Large Pelagics*	112,261	360,312	12,609	32,003
Mackerel	102,089	510,374	4,218	37,806
Medium/Large Demersals	89,326	251,882	7,510	24,080
Other*	22,836	76,572	2,317	6,926
Small demersal	19,937	47,789	3,544	9,335
Sharks and rays	13,690	50,341	2,366	4,606
Total	$ 1,164,121	$ 3,430,602	79,459	231,929

*Other includes small pelagics, sardine, silverside, macroalgae, and guano. Large = asymptotic length >90cm; Medium = 30-89cm; Small <30cm

Seafood Markets in Peru

Over the past two decades, Peru has become the center for cuisine in Latin America, and increasingly the world. Seafood has played a major role in the rise of Peruvian gastronomy. No fewer than seven of the leading 15 gourmet eateries in Latin America are in Lima [74]. Peru's gastronomic revolution is paying off: restaurants alone account for 3 percent of the Peru's GDP and the sector is growing faster than the

economy as a whole [74]. In 2010, 7,300 restaurants opened in Peru [75]. Peruvian chefs enjoy rock star status, and have huge influence over the general public. Yet like much of Peru's economy, the supply chains, including seafood, still operate largely in an informal fashion. The absence of cold chains, standardization, sustainability practices, and product traceability hinder and threaten restaurant capacity, as well as food producers. Restaurateurs and industry groups like APEGA are beginning to support efforts that address these challenges; successfully doing so will ultimately secure and improve the efficiency of supply chains. For example, Chef Gastón Acurio's holding company *La Macha* spent $700,000 in seafood to supply its restaurants in 2010 [75].

Table 5. Sector-wide employment and its multiplier for distinct fishing activities. Multipliers give ratios between the primary sector (i.e., fishing fleet) and the total sector. For example, an estimated 8,504 fishers make up the squid boat fleet (which is exclusively artisanal), which supports 39,121 jobs sector-wide. Source: Christenson et al. 2014.

Enterprise	Sector-wide Employment	Multiplier
Steel purse seiners	37,862	3.5
Artisanal purse seiners	59,598	5.7
Squid Boats	39,121	4.6
Compressed air divers	13,288	1.9
Longliners	19,239	2.9
Intensive aquaculture	3,497	1.5
Wooden purse seiners	9,328	1.5
Gillnets	25,288	1.7
Trawlers	6,428	4.2
Semi-intensive aquaculture	5,075	1.2
Hook and lines	7,018	1.7
Traps	2,158	5.9
Shore fishers	5,034	2.6
Guano harvesters	426	1.0
All	233,360	2.9

Artisanal fishers provide the overwhelming majority of seafood for human consumption in Peru. Much of the artisanal sector lacks sufficient structure, formality, and capacity. Thus, processing, handling, packaging, and transportation are major challenges. Direct access to markets by artisanal fisheries is minimal. Third-party seafood providers, that control procurement and logistics, dominate the supply chains. Non-retail intermediaries have direct links to distributors and act as artisanal fishery investors to keep the supply chain at the status quo. In some cases, restaurants and other commercial players have been able to bypass some intermediaries in the supply chain, but still lack direct relationships with artisanal fishing groups. Though retailers and restaurateurs in Peru have expressed the need to break the supply chain gridlock, and engage in direct relationships with artisanal fishers, the need for logistical partners to secure procurement makes doing so challenging.

Restaurants require direct procurement from seafood markets. Many restaurateurs view seafood sustainability as a requisite for future viability [76]. But, the lack of direct involvement with fishers creates additional challenges around potential fishery improvements. Direct procurement with fishers is viewed as challenging because of (a) variability in seafood catches, (b) the need for diverse products from different geographies, (c) the need for additional financing to fund improvements, and (d) the possibility of threatening commercial relationships with current seafood providers along the supply chain.

In general, seafood products in supermarkets and other retail outlets in Peru are poorly developed (Fig. 12). A third party most often executes seafood procurement. Quality and choice are limited: the capacity to provide seafood products is a higher priority that product quality. In some mainstream Lima supermarkets, the seafood department consists of a single cooler with frozen products and few ready-made seafood products (Fig. 12). Higher-income supermarkets have larger seafood departments, but have limited variety and freshness. Most products have been previously frozen or are processed with little to no value added. Point of sale marketing of seafood products is rare to non-existent. Thus, while retailers that we spoke with believe that sustainable seafood products could potentially improve sales and branding, it

is unclear if there is sufficient demand, retail infrastructure, and market maturity to support such products and initiatives.[19]

Figure 12. Current seafood products offered in Peruvian supermarkets are limited. Few, if any, value added products are available. The majority of seafood is frozen or previously frozen; even products imported from Chile were observed. Playa Vea Supermarket, San Isidro, Lima.

What is happening now?

- Headed up by Jessica Pino (previously with the Vice Ministry of Fisheries), Alin Kausay is working with artisanal fishers, supermarkets, and restaurants to deliver high-quality sustainable seafood products from artisanal fishers in Peru. Their strategy is not focused on a single service; rather, a portfolio of artisanal fishery needs that includes training, quality improvement measures, and commercialization processes. Alin Kausay is also perusing options for seafood traceability in Peru. They are working closely with a number of artisanal fishing organizations, including groups close to Lima.

- Launched a few months ago by a group of Peruvian entrepreneurs, the NGO Green Anchoveta is focused on creating new international markets for anchovy-based products. Previous attempts to create domestic markets have been met with limited success [77]. After scoping and assessing potential products, Green Anchoveta has identified three promising products. They are in the process of testing production and developing a demand generation strategy for an international niche market.

[19] Much of the information in this section is based on multiple interviews conducted with restaurateurs, supermarket executives, and others working in the seafood sector. See interview list for details.

FISHERIES

Regulation

The General Law on Fisheries (*Ley General de Pesca*, LGP) regulates fisheries in Peru; three versions have been passed, with the first being in 1968.[20] The LGP describes all aspects of fisheries regulations and management. It defines fisheries under the following framework:

- Purpose of extraction (i.e., commercial, research, recreational, or subsistence),
- Scale (i.e., artisanal, small-scale, or large-scale),
- Geographical area, and
- Destination of the end product (i.e., direct or indirect human consumption).

The law also defines the requirements of fish processing types, differences between artisanal and industrial fishing sectors, the state of the fisheries resource (e.g., fully exploited), and management requirements. Any management measure designated by PRODUCE must include a supporting technical report from IMARPE and a socio-economic impact assessment.

As part of the LGP, the Government can create *Reglamentos de Ordenamiento Pesquero* (ROPs). ROPs are management instruments that can establish a suite of potential restrictions on a fishery, such as access regimes, fishing seasons, total allowable catch, fishing gear requirements, minimum size requirements, or designated fishing areas [78].

Currently there are nine ROPs, which cover seven species and over 90 percent of the total landings (Table 6) [39, 79]. Two ROPs cover specific areas: Tumbes and the Amazon. The majority of species for human consumption (and landed by the artisanal fleet) are not managed via ROPs. A recent review by the Nature Conservancy revealed that both information and management measures are lacking for the majority of Peru's commercial species. Out of 150 species reviewed, information was insufficient for even minimal management for 73 percent of finfish and 45 percent of invertebrate species. Of the 72 most important commercial species, 35 percent are not subject to any management regulations, 35 percent are subject to a minimum catch size regulations, 20 percent are subject to two management measures (minimum size and gear-use control), and just 10 percent (7 species) have more than these two management measures in place [42].

Table 6. Species with *Reglamentos de Ordenamiento Pesquero.* Two ROPs (anchovy and hake) include access regimes with individual catch shares that are assigned per vessel.

Species	Catch shares assigned per vessel
Anchovy and white anchovy	✔
Hake	✔
Jack mackeral and chub mackeral	
Tuna	
Eel	
Jumbo Squid	
Macroalgae	

[20] The latest General Law of Fisheries was approved in 1992 (Decree-Law No. 25977), along with additional regulations approved in 2001.

Industrial Fisheries

Anchovy

The Peruvian anchovy fishery is the largest single species marine fishery in the world, representing around 10 percent of worldwide marine fisheries landings [80]. It is also the must studied and political fishery in Peru [81-89]. By law, all of the industrial fleet's catch must be processed into fishmeal, which feeds into the global food supply chain. In 2010, approximately 60 percent of the world's supply of fishmeal was consumed by the aquaculture sector, followed by pork (30 percent) and poultry production (9 percent) [9]. While global aquaculture production has exploded over the past two decades, its reliance on fishmeal has decreased following a similar temporal pattern as pork production.[21] Peru provides around 23 percent of the global supply of fishmeal [9]. Peru's main fishmeal export countries are China, Germany, and Japan, which made up nearly 70 percent of total exports in 2011 and 2012 (Fig. 13) [8, 90].

Historically, the Peruvian anchovy fishery went through a phase of explosive and uncontrolled growth between the 1950s and early 1970s (Fig. 14). In 1972-73, the anchovy stock collapsed, most likely due to a combination of El Niño and overfishing [86, 87, 91]. Between 1973 and 1984, the anchovy fishery can be characterized as a period of unfavorable warm ocean conditions and low landings. A third phase (1984 to present) has been characterized and broken down into two sub-phases: (a) a controlled growth phase (1985 – 1994) with favorable environmental conditions and improved governance and (b) a sustainable landings phase (1995 – present) with sufficient governance to cope with inter-annual variability, as well as with economic and ecological sustainability [87]. Landings have stabilized between five and nine million tonnes. In fact, Peru was ranked first out of 53 countries for fisheries sustainability, using eight indicators [92]. The sustainability of the anchovy fishery, however, is a topic of lively debate with widely varying opinions.

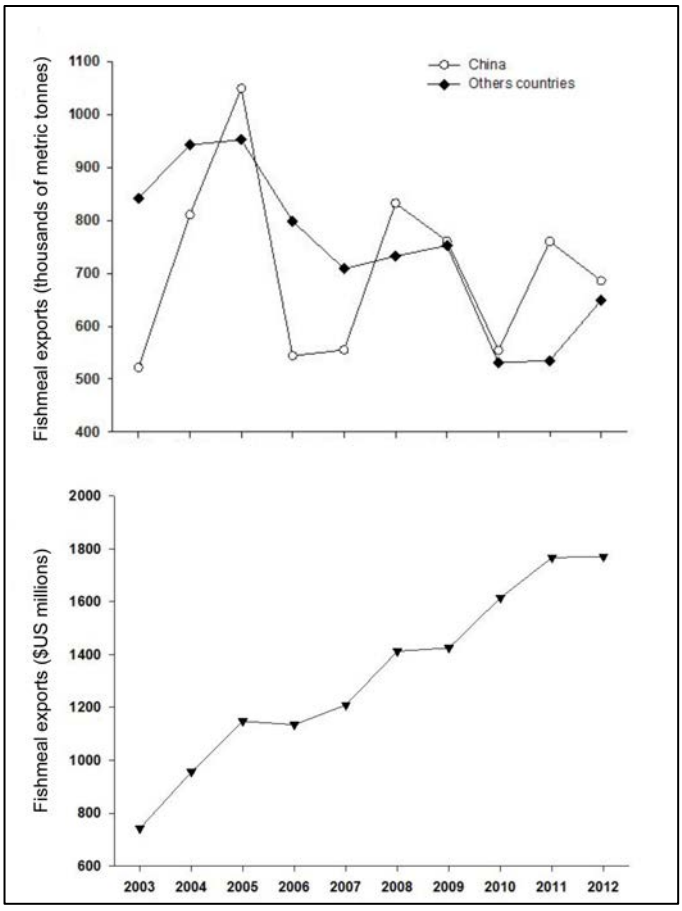

Figure 13. Fishmeal exports to China and other countries (thousands of tonnes) and total export values of fishmeal for Peru (US$). Value has increased steadily over the past decade, while volume has fluctuated.

The anchovy fishery is the most regulated fishery in Peru, and that regulatory system is dynamic. In general, the anchovy fishery as a whole is subject to catch quotas, restricted fishing seasons, gear-type regulations, and overall controlled fishing effort [93]. The fishery is broken down into two stocks: a northern stock (close to the Peruvian-Ecuador border south to 16º S) and the

[21] Aquaculture is the world's fastest growing technology; global production grew from 30 million tonnes to nearly 60 million tonnes between 1998 and 2008. Salmon feed in the 1990s usually contained over 50 percent fishmeal; today it typically contains 15 percent. See Asche et al. 2012.

southern stock (between 16º S and the Peruvian-Chilean border). The northern stock is more abundant and economically important: average biomass generally ranges from 3-16 million tonnes, compared to 3-6 million tonnes for the southern stock [94, 95]. Annual landings over the past twenty years have fluctuated between 3 and 11 million tonnes (Fig. 15). Most of the anchovy landings come from the northern stock. Current management includes an escapement rule that leaves 4-6 million tonnes of spawning stock in the water.

Anchovies are fished exclusively with purse seiners. There are two fleets: a steel fleet (~430 vessels) and a wooden fleet (~650 vessels). The steel fleet holds the majority of capacity (140,000 m^3 versus 41,000 m^3). A typical steel purse seiner will have a hull capacity of 250 m^3 and sophisticated sonar technology. The fleet remains overcapitalized, despite regulatory attempts to make it otherwise; some estimates suggest the industrial fleet possesses three times the optimal capacity [96, 97].

The main regulations and requirements for the industrial anchovy fleet are,

- Operate with a valid fishing license, hold quota, and abide by Legislative Decree 1084 which established quota regulations;
- Operate with a mesh size of ½ inch (13 mm); anchovies that are <12 cm in length are considered juveniles, and their total harvest is limited to 10 percent of landings [98];
- Operate outside of 10 nautical miles from the coast;
- Operate under a 24-hour fishing day (between 8 am and 8 am next day); and
- Operate with the required vessel monitoring system.

Anchovy is one of two Peruvian fisheries that are managed under a non-transferable individual vessel quota system, which was implemented in 2009. Prior to 2008, the total allowable catch (TAC) was the dominant regulatory mechanism for anchovy. In 2008, PRODUCE moved away from an open access regime and enacted individual vessel quotas (*Límite Máximo Total de Captura Permisible*, IVQ) in an effort to improve management and reduce the "race to fish." By 2012, effective fishing days of the anchovy fishery increased, while the number of vessels decreased (Fig. 15) [88]. The non-transferability of the quota system was designed to avoid the potential consolidation of quota. Some consolidation, however, has taken place. As of 2012, 70 percent of the quota belongs to just seven companies, all of which owned industrial vessels prior to 2009. Many of those companies are vertically integrated along the supply chain.

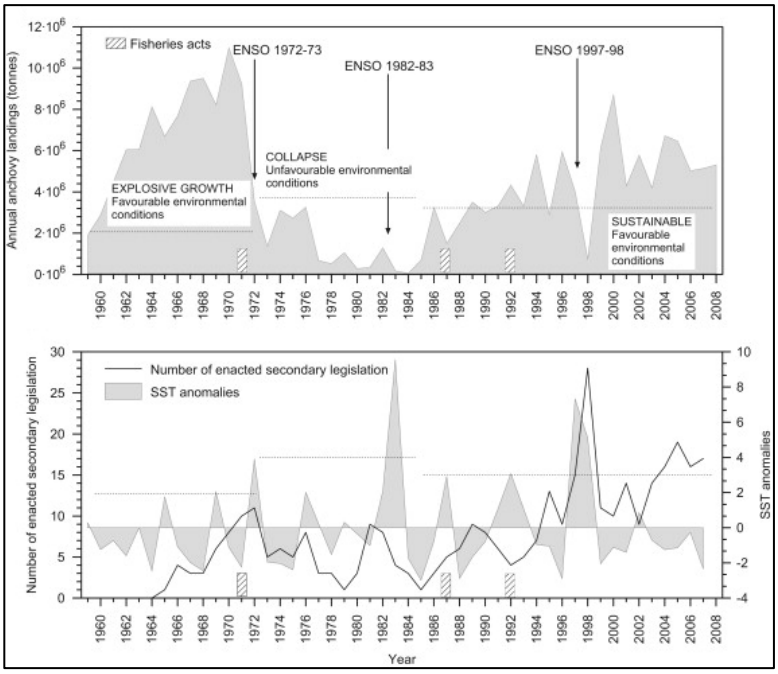

Figure 14. A graphical history of the Peruvian anchovy fishery. The top panel shows annual landings, three general phases, strong ENSO events, and the three main fisheries acts. The bottom panel shows additional fisheries legislation affecting the anchovy fishery and the number of sea surface anomalies (SST), which tend to negatively impact the fishery. From Schreiber 2012.

PRODUCE, in accordance with scientific reports issued by IMARPE,

determine both the fishing seasons and the total allowable catch for the anchovy fishery. Entry to the industrial sector of the anchovy fishery is closed; new vessels can only replace decommissioned vessels. IVQs were originally allocated based on historical fishing records and hull capacity. Third-party operators monitor to verify landing statistics. Misreporting of landings has been documented; one investigative report documented that over 600,000 tonnes had not been reported over the past two and half years [51]

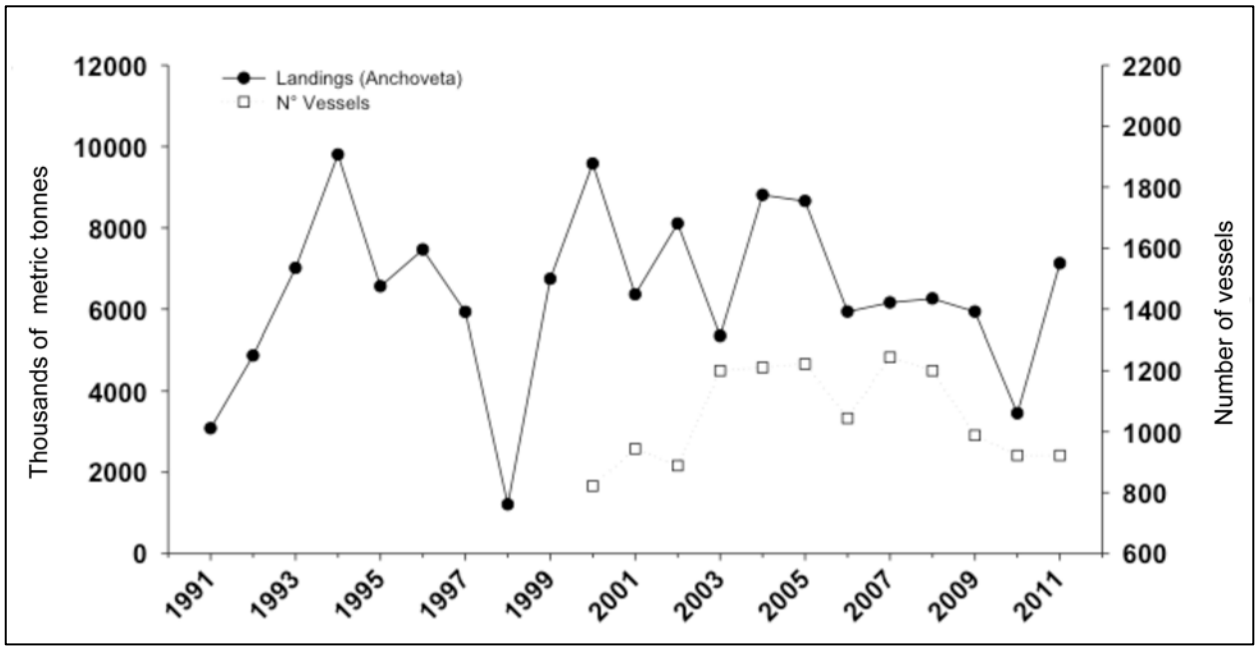

Figure 15. Anchovy landings and number of vessels operating in the industrial fleet over the past 20 years.

Table 7. Major Peruvian anchovy fishing companies, nationality, and their export values (2011 $US).

Company	Nationality	US$	Percentage
TASA	Peru	$434,643,000	31%
Diamante S.A	Peru	$217,834,000	15%
COPEINCA S.A.C.	Peru	$184,167,000	13%
Austral Group S.A.A	Panama	$161,146,000	11%
Exalmar S.A.	Luxembourg	$149,781,000	11%
CFG Investment S.A.C.	Singapore	$140,777,000	10%
Hayduk S.A.	Peru	$136,186,000	10%
Total		$1,424,534,000	

Jack and Chub Mackerel

The industrial fleet fishes three additional species, two pelagic and one demersal species: jack mackerel (jurel, *Trachurus picturatus murphyi*), chub mackerel (caballa, *Scomber japonicus peruanus*), and hake (merluza, *Merluccius gayi peruanus*). In 2002, PRODUCE implemented a Supreme Decree that prohibited the use of jack mackerel and chub mackerel for fishmeal, thus generating the need to develop an industrial fleet that could meet the standards of a human consumption market [83]. This resulted in a fleet reduction since only vessels with cold preservation systems were permitted to fish for mackerel. Currently, there are ~20 purse seiners in the mackerel fleet. For vessels to access the jack and chub fisheries they have to comply with the following conditions:

- Vessels must have on board facilities for freezing and storing fish,
- Vessel must undergo technical-sanitary inspections by PRODUCE,
- Vessels must have vessel monitoring systems,
- Vessels must operate outside of 10 nautical miles,
- Vessels are forbidden to land at fishmeal plants,[22] and
- Landing systems must have weighing and pumping systems to assure fish quality.

Jack and chub mackerel landings peaked in the mid 1990s and early 2000s (Fig. 16). Jack and chub mackerel landings are processed fresh, frozen, and canned. The recent reduction in the catch of jack mackerel and chub mackerel has had a direct and negative effect on canning industry, since both species have represented around half of total landings for that activity. Information on the stock status of jack and chub mackerel is weak and insufficient [96]. The need for more scientific information by IMARPE, in cooperation with fishing firms, is undoubtedly one of the main challenges for the proper management of these fisheries.

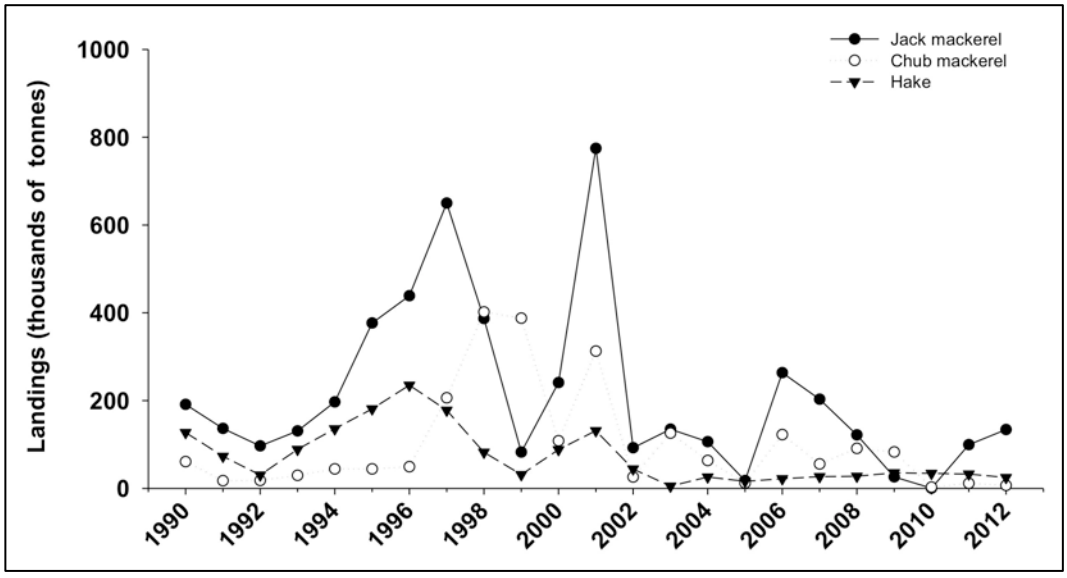

Figure 16. Industrial landings between 1990 and 2012 for jack mackerel, chub mackerel, and hake.

[22] The Supreme Decree states an exception: landing at fishmeal plants is allowable if and only if mackerel is not fit for human consumption.

Hake

There is a small industrial hake fishery for direct human consumption; the trawling fleet operates in the northern Peru. Overfishing and mismanagement occurred in the 1990s [99]. In 2002, a fishery closure was established, and a technical recovery commission was created that carried out stock monitoring. The fishery was reopened in 2004, but recovery has been limited [99]. Fishery capacity was reduced following the 2002 closure, and again in 2006 when the fishery was designated only for direct human consumption. Hake is the only other species in addition to anchovy that is managed under an individual vessel quota system. During the 2000s, the total allowable catch was over allocated [99]. Current landings are around 35,000 tonnes (Fig. 16); the majority is sold as frozen product (~70 percent).

Artisanal Fisheries

Artisanal fisheries are defined on the basis of boat capacity and length: vessel capacity of up to 32.6 m^3 and up to 15 meters long. The artisanal fishery has exclusive fishing rights within five nautical miles of the coast; however, this does not exclude them from fishing beyond the five-mile boundary [100]. Over the past seventeen years, the government has conducted two surveys and one census on the artisanal sector [101-103]. According to this research, between 1997 and 2012 the numbers of artisanal fishers and boats have increased by ~16,000 and ~6,200 respectively (Table 8). Current estimates suggest there are around 44,000 artisanal fishers; the region of Piura has the most fishers and vessels, representing ~30 percent of the total 2013 census. These patterns are consistent with a complementary analysis in the peer-reviewed literature, which relied on the same data along with additional surveys [104]. The changes in artisanal vessel types have differed over time: between 1995 and 2005, purse seiners increased by 18 percent, long liners increased by 357 percent, and gillnets decreased by 15 percent [104].[23]

Table 8. Results of two surveys (by IMARPE in 1997 and 2010) and the First National Census of Artisanal Fisheries in the Marine Area by PRODUCE and the National Institute of Statistics and Informatics in 2012 [65-67]. Adopted from Sueiro & de la Puente 2013.

Region	Number of Artisanal Fishers			Number of Artisanal Boats		
	1997	2010	2012	1997	2010	2012
Tumbes	2,125	2,861	3,447	468	667	1,138
Piura	9,103	13,050	13,248	2,200	2,898	5,566
Lambayeque	2,938	1,422	2,945	285	222	1,301
La Libertad	1,080	1,221	1,223	172	333	517
Ancash	3,033	3,523	3,645	713	1,294	1,868
Lima	3,952	5,613	6,854	1,286	2,178	2,774
Ica	2,372	3,525	5,731	636	784	1,046
Arequipa	2,318	4,172	4,006	260	816	1,102
Moquegua	687	1,640	2,022	126	347	559
Tacna	490	700	1,040	122	128	174
Total	**28,098**	**37,727**	**44,161**	**6,268**	**9,667**	**16,045**

The 2013 census provides insights into the demographics of Peru's artisanal fisheries [103].[24] About half (51 percent) of artisanal fishers are under thirty years of age (born between 1980 and 1999). Sixty-five percent of fishers have more than ten years of fishing experience. Approximately half (52 percent) do not have any accreditation, 80 percent hold fishing licenses, and only 496 have diving permits. The census

[23] Based on surveys from 30 harbors along the entire Peruvian coast.

[24] More information about CENPAR (*Censo Pesca Artesanal*) can be found at http://censos.inei.gob.pe/cenpar

documented 12,398 artisanal boat owners, 46 percent of them located in the northern portion of the country—between Lambayeque and Lima. Seventy-seven percent of artisanal boat owners have only one boat. Approximately 1,300 women (~3 percent) are involved in artisanal fisheries; the majority are associated with intertidal and seaweed harvesting. Women involved in artisanal fishing are mostly located in the south, where they represent up to 8 percent of registered fishers in the census.

Artisanal fishing organizations (*Organizaciones Sociales de Pescadores Artesanales*, OSPA) are common in Peru; however, many, if not most, are considered small, unorganized, and fragmented [105, 106]. Over a thousand have been documented, although many are now defunct (Table 9). The two major OSPAs are the *Federacion de Integración y Unificación de los Pescadores Artesanales del Perú* (FIUPAP) and *Asociación Nacional de Empresas Pesqueras Artesanales de Perú* (ANEPAP). The latter is an association of boat owners who work both with the private and public sectors to leverage investment. They have been successful in accessing microcredit loans for their members. ANEPAP is currently focused on three areas: (a) pollution, in particular they are promoting macroalgae projects to improve water quality; (b) information systems, they are interested in investing in technology to empower fishers, and (c) port management plans, ANEPAP views the ports in Peru as benefiting intermediaries as opposed to fishers [107]. The largest OSPA in Peru, FIUPAP was created in response to the 1991 cholera epidemic which heavily impacted artisanal fishers [108]. It is perhaps the most politically active group, and it is engaged with industry. However, it is also criticized for not representing its constituents and for limited turnover of leadership positions [39, 109].

Table 9. Number of fishing organizations and total number of fishers in organizations for different regions. The data below does not account for organizations that are now defunct. From Sueiro and de la Puente 2013.

Region	Number of Organizations	Number of Associates
Tumbes	30	3,769
Piura	361	5,076
Lambayeque - Lima	429	16,195
Ica - Tacna	214	7,403
Total	**1,034**	**32,443**

The artisanal fishing sector in Peru is informal and diverse, consisting of a wide range of activities, vessels, and seasons. Landings include pelagic finfish, benthic resources, and algae (Table 10). Important species for the artisanal fleets are jumbo squid (*pota*), jack mackerel, anchovy, and mahi mahi (see Table 9 for scientific names). Between 2001 and 2012, jumbo squid contributed 45 percent, on average, to annual artisanal landings, followed by jack mackerel (12 percent), anchovy (8 percent), and mahi mahi (6 percent) (Fig. 17). Jumbo squid landings have increased dramatically over the past 12 years, reaching nearly 600,000 tonnes. Anchovy is one of the main pelagic species for which artisanal landings have increased over the past decade, peaking around 120,000 tonnes (Fig. 17).[25] By law, artisanal landings for anchovy must be for human consumption. Jack mackerel landings are high and variable. Another species that is playing an increasingly important role for artisanal fisheries is scallops.

[25] Illegal anchovy landings by artisanal fishers are considered common; some estimates are up to 1 million tonnes per year.

Table 10. Fish and invertebrate species targeted by artisanal fisheries.

Species group (English)	Species group (Spanish)	Scentific Names
Anchovy	Anchoveta	*Engraulis ringens, Anchoa sp., Anchoa nasus, Cetengraulis mysticetus*
Bonito	Bonito	*Sarda chiliensis chiliensis*
Chub mackerel	Caballa	*Scomber japonicas*
Crab	Cangrejo	*Cancer sp., Platyxanthus sp., Platyxanthus cokeri, Euphylax robustus, Euphylax dovii, Cancer setosus, Platyxanthus orbignyi, Portunus asper, Callinectes toxotes, Cancer porteri, Callinectes arcuatus*
Mahi Mahi (Common dolphin fish)	Perico	*Coryphaena hippurus*
Drum	Lorna	*Sciaena deliciosa*
Grunts	Cabinza	*Isacia conceptionis*
Gurnard	Falso volador	*Prionotus sp., Prionotus stephanophrys*
Jack mackerel	Jurel	*Decapterus macrosoma, Selar crumenophthalmus, Trachurus picturatus murphyi*
Jumbo squid	Pota	*Dosidicus gigas*
Mullet	Lisa	*Mugil curema, Mugil cephalus*
Mussel	Choro	*Aulacomya ater, Choromytilus chorus*
Rock Shell	Caracol	*Stramonita chocolata*
Sardine	Sardina	*Sardinops sagax sagax, Etrumeus teres*
Scallop	Concha abanico	*Argopecten purpuratus*
Sculpin	Camotillo	*Normanichthys croockeri, Diplectrum pacificum*
Peruvian rock seabass	Cabrilla	*Paralabrax humeralis, Paralabrax callaensis*
Skipjack	Barrilete	*Katsuwonus pelamis, Auxis rochei, Euthynnus lineatus*
Snake eel	Anguilas	*Ophichthus pacifici, Ophichthus grandimaculatus*
Squid	Calamar	*Loligo gahi, Lolliguncula panamensis, Lolliguncula spp., Loliolopsis diomedeae*
Silversides	Pejerrey	*Odontesthes regia regia*
Weakfish	Cachema	*Isopisthus remifer, Cynoscion analis*
Largehead hairtail	Pez cinta	*Trichiurus lepturus*
Hake	Merluza	*Merluccius gayi peruanus*
Deepbody thread herring	Machete de hebra	*Opisthonema libertate*

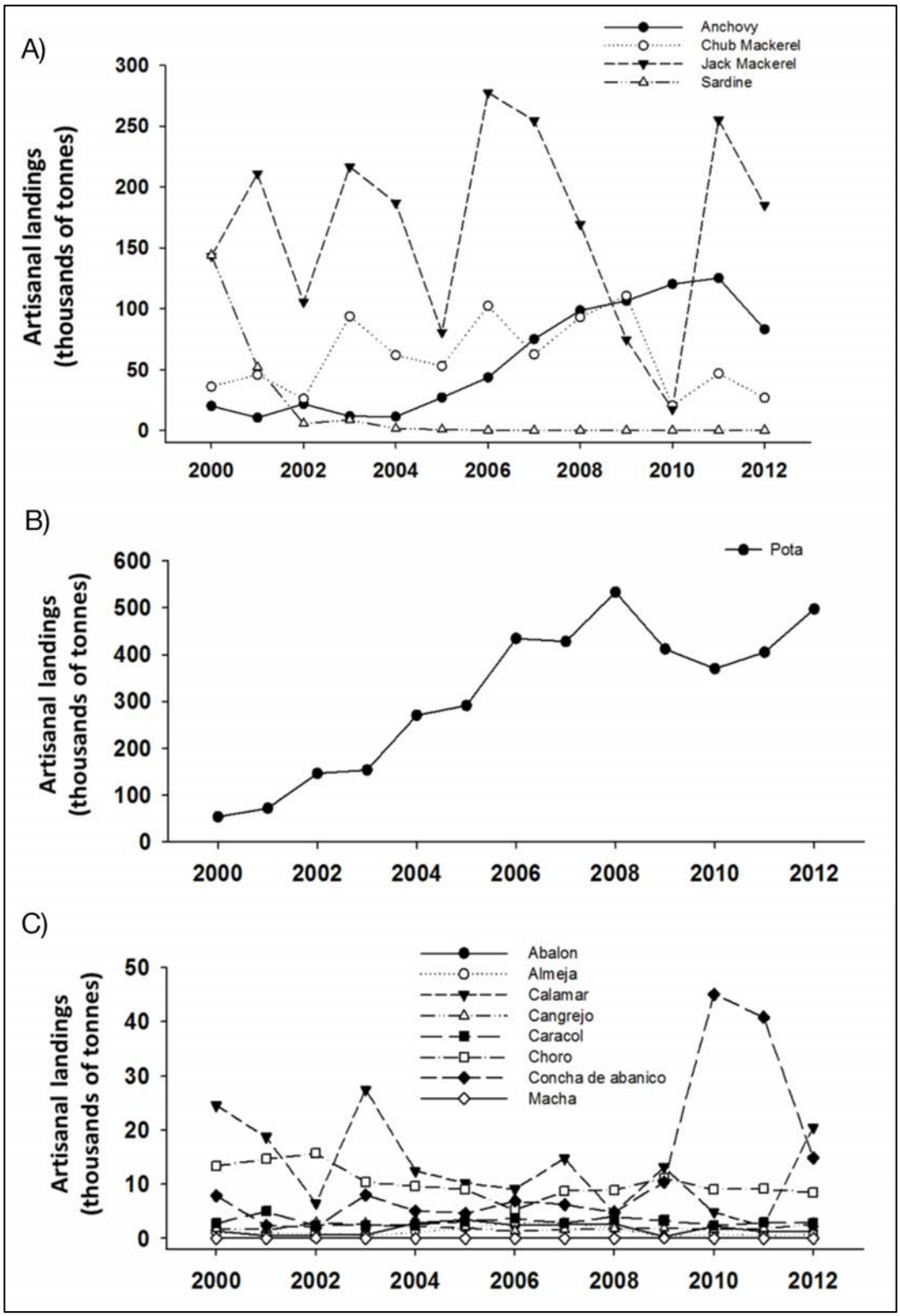

Figure 17. Artisanal landings between 2000 and 2012 for A) pelagics, B) jumbo squid (pota), and C) benthic resources. See Table 10 for common and scientific names.

Geographically, artisanal fisheries landings are heterogeneous. While many species are landed across all regions, the level of landings varies dramatically (Fig. 18). For example, Piura, by far, is responsible for the most artisanal landings, the majority of which is jumbo squid. The pota fishery mainly occurs in the north (i.e., Tumbes and Piura) and the south (i.e., Arequipa). Benthic landings are also concentrated in the north (i.e., Tumbes) and the south, while small pelagic landings occur along the entire coast and peak in Piura, Ancash, and Lima (Fig. 18).

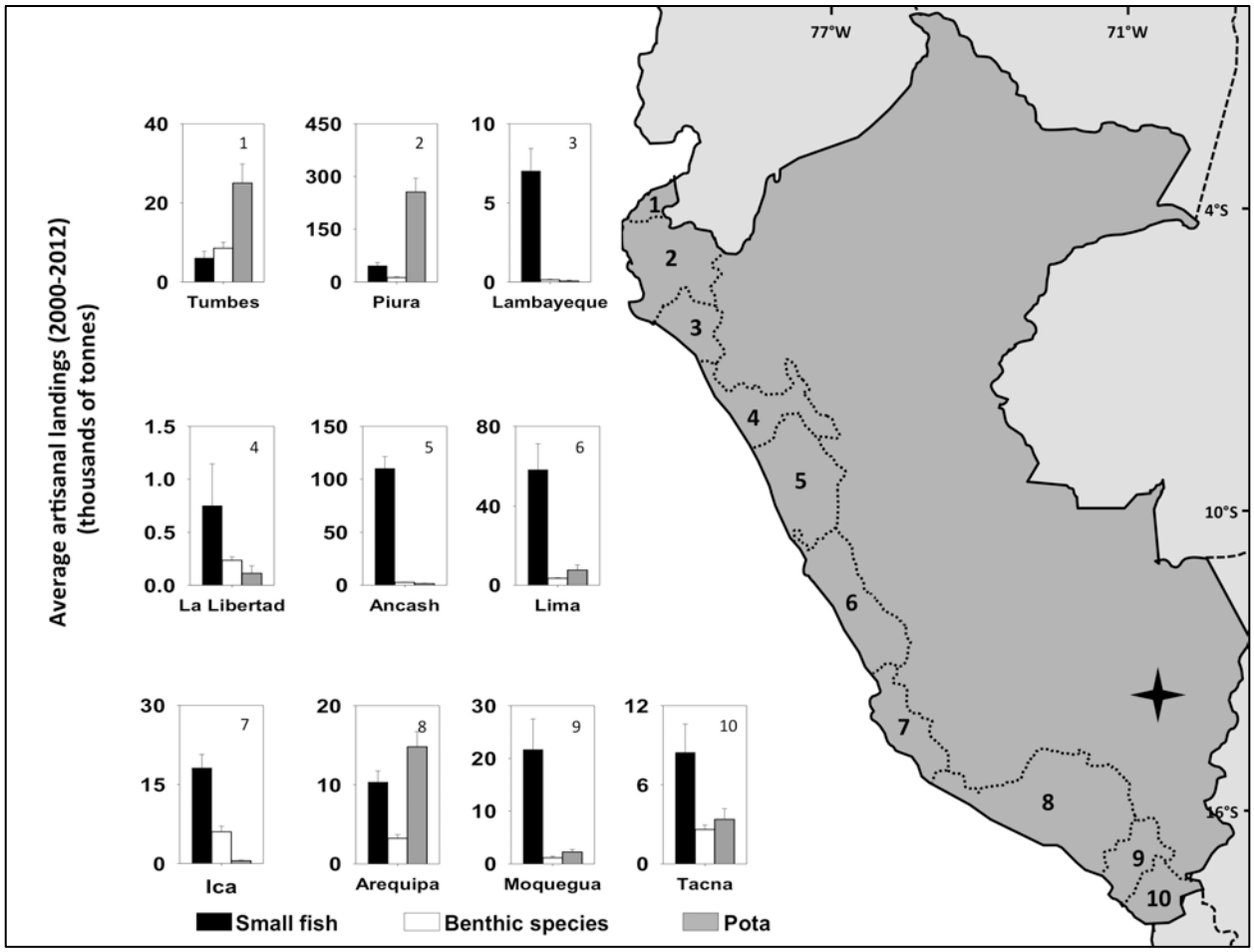

Figure 18. Average landings (2000-2012) of small pelagic fish, benthic species, and jumbo squid (pota) in each region. Biogeographically, Tumbes (1) is tropical, while Piura (2) represents a transition zone. Regions 3-6 are part of the central North Humboldt bioregion, while regions 7-10 are part of the South Humboldt bioregion.

Jumbo Squid (pota, *Dosidicus gigas*) is the largest ommastrephid squid, and occurs within the Eastern Pacific Ocean from northern California to southern Chile [110]. Restricted exclusively to the artisanal fleet, the majority of pota is landed by jigging with the use of lights; a much smaller percentage is landed by gillnets [100]. Pota have a rapid growth rate and life span of 1-2 years; they die after one reproductive event [110]. Spawning occurs throughout the year, with most important spawning peak between October and January [111]. Historically, Peru has sold fishing permits for pota to South Korea and Japan. Since 2002, Pota has rapidly become the most important species for the artisanal fishery. The fishery takes place 10-60 nautical miles offshore. Catches by foreign or national industrial fleets have been closed until a surplus is identified with a stock assessment and a study is conducted to assess potential negative impacts

on the artisanal sector of opening access to industrial fleets. Artisanal fishes strongly oppose loosing their exclusive access.

Globally, Peru has the largest pota fishery in terms of landing, followed by Chile, Japan, and Mexico [112]. Catch is sold frozen; major export countries from Peru include China (36 percent) Spain, (20 percent), and South Korea (15 percent). There some recent industry signals the pota could establish markets in the United States and South Africa [113].

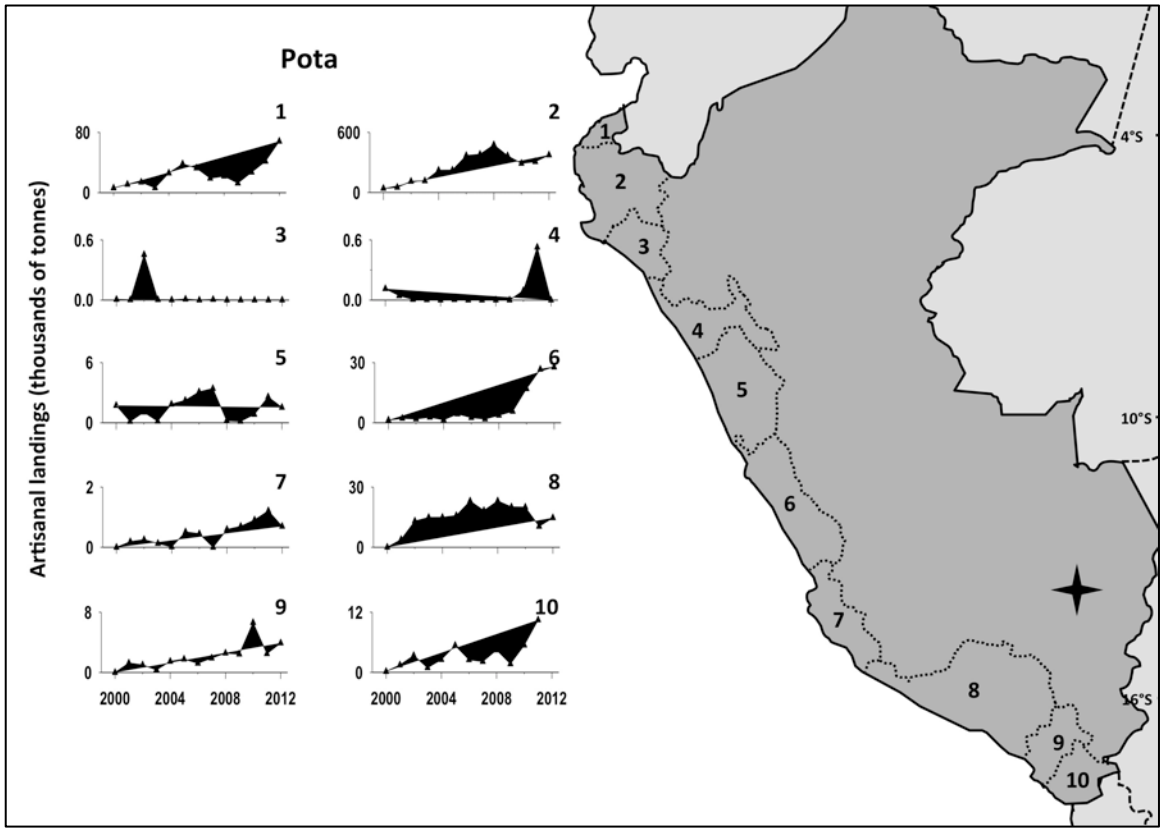

Figure 19. Landings of pota between 2000 and 2012 along the coast of Peru. Piura (2) is responsible for the majority of landings.

Jack mackerel (jurel, *Trachurus murphyi*) has historically been an important artisanal fishery [100]. However, artisanal landings account for a small proportion of total landings due to the large landings by the industrial fleet (>90 percent of total landings). Overall, jack mackerel is considered fully exploited or overexploited throughout its large range within the south Pacific [114]. Its state in Peruvian waters is uncertain, but likely similar. In 2002, the Peruvian Government declared that jack mackerel, chub mackerel, and sardines could only be landed for direct human consumption [78]. The artisanal fleet catches jack mackerel with the use of purse seines, gill nets, or long lines, the latter being a bycatch fishery [100]. In the early 2000s Piura accounted for an important proportion of the landings; however, main landings are now observed in Ancash and Lima (Fig. 20). The majority of jack mackerel is sold and consumed domestically, fresh or frozen [7].

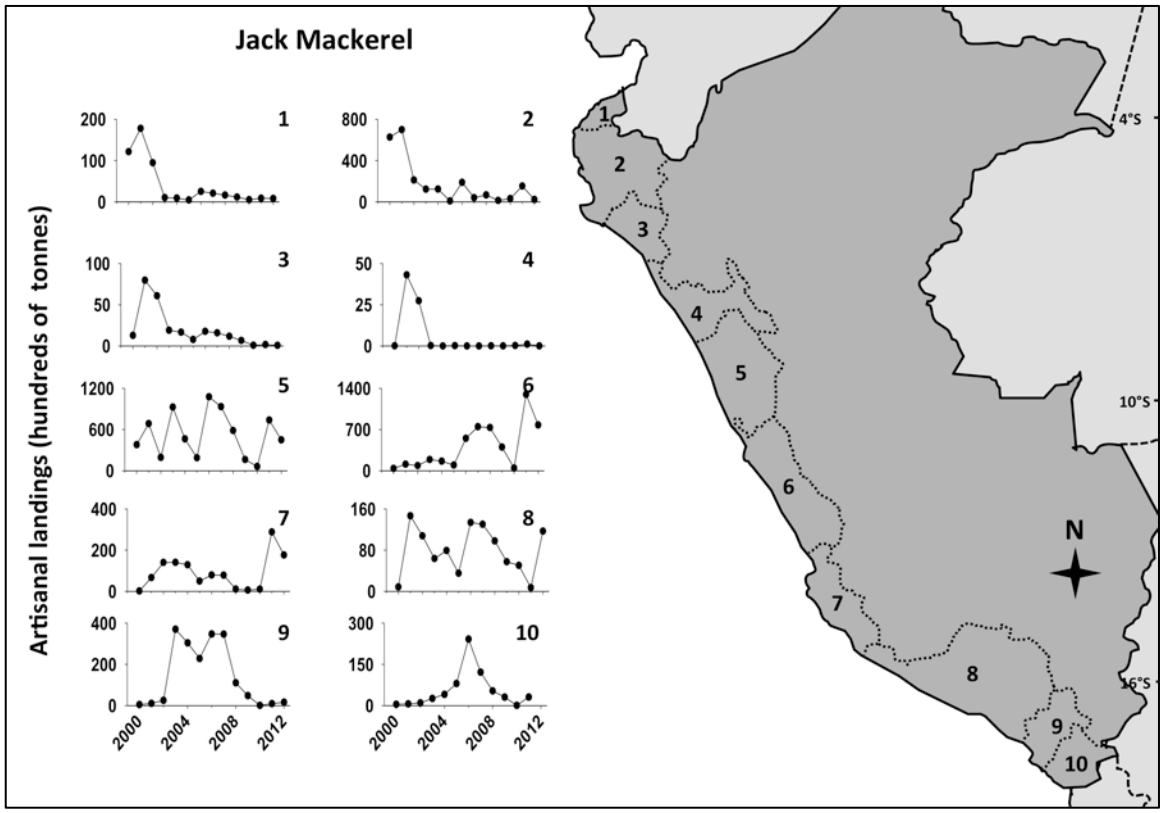

Figure 20. Landings of jack mackerel between 2000 and 2012 along the coast of Peru. Recent landings are highest in Ancash (5) and Lima (6).

Mahi mahi (*perico*, *Coryphaena hippurus*) is a cosmopolitan species found in offshore waters worldwide. They are fast growing, live up to five years, and spawn year round in warm waters [115, 116]. Like pota, this fishery occurs offshore (60 – 120 nautical miles) and is based in the north (Fig. 17) [100]. Landings have increased steadily after the 1997-98 El Niño. In 2000, 28,000 tonnes were landed compared to nearly 59,0000 tonnes in 2012 (Fig. 21).

Table 11. Peru and Ecuador mahi mahi exports to the United States in 2012 (quantity in kilograms, value in US$ millions, and overall market share). Peru controls 38 percent of the frozen mahi mahi market share, while Ecuador controls 27 percent and 42 percent of the frozen and fresh market respectively. Frozen mahi mahi from Peru makes up 30 percent of the total seafood exports to the United States. Data source: NOAA

	Quantity (kg)	Value (US$ mm)	Market share (%)
Peru (Frozen)	7,095,680	72	38
Ecuador (Frozen)	5,004,731	55	27
Ecuador (Fresh)	2,785,453	18	42

Mahi mahi is managed under the Pacific Fishery Management Council for Highly Migratory Species[26], of which Ecuador is a signatory, but not Peru. The Council has authorization to manage mahi mahi; however, no management measures have been implemented. Currently, there is no Regional Fishery Management

[26] Article 64 of the United Nations Convention on the Law of the Sea

Organization in charge of mahi mahi management. Today, Peru is the leading global producer of mahi mahi, accounting for over 60 percent of the total landings [117]. Peru and Ecuador are the main exporters of mahi mahi to the United States: Ecuador exports both fresh and frozen product, while Peru exports only frozen (Table 9). Over 80 percent of all Peruvian mahi mahi is exported to the United States [117]. Quality is a major issue for the Peruvian mahi mahi fleet. In 2010, the US Food and Drug Administration rejected 500 tonnes of Peruvian mahi mahi due to unsafe histamines levels [117]. Since buyers are impacted by such events, this event has created a long-lasting mistrust with some US buyers [118]. Because of a quality gap—which is a consequence of poor handling and infrastructure—Peru is capturing less value for their mahi mahi landings [118].

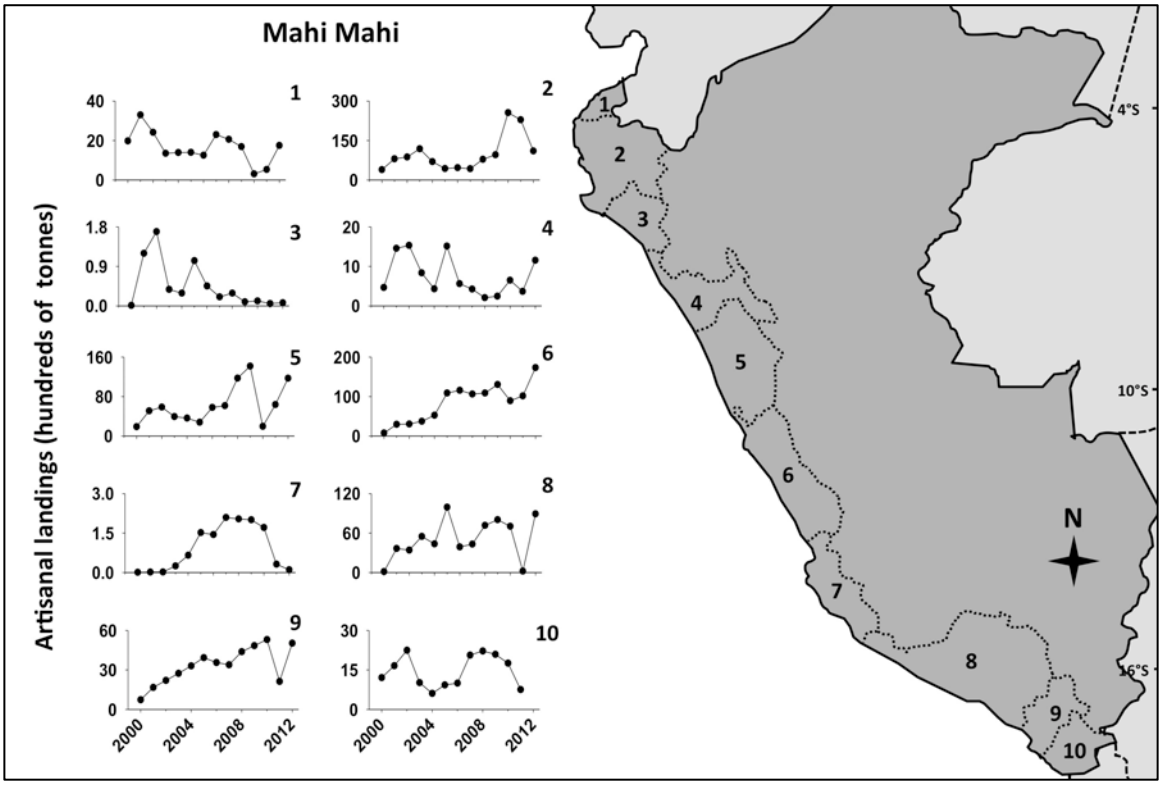

Figure 21. Landings of mahi mahi between 2000 and 2012 along the coast of Peru. The majority of landings are based in Piura (2).

Sharks are explicitly targeted by the artisanal fishing sector. The season is typically April to November (opposite the mahi mahi season), and the main target species include blue (*Prionace glauca*) and shortfin mako sharks (*Isurus oxyrinchus*), but also included porbeagle (*Lamna nasus*) and other Carcharinidae shark species [104]. Bait use for both the shark and mahi mahi fisheries is jumbo squid, mackerel, and flying fish, but also includes small cetaceans (common dolphins *Delphinus spp*. and dusky dolphins *Lagenorhynchus obscurus*) [119].[27] Dolphin meat is desirable bait because of its durability on the hook, and fishers believe it is effective at attracting sharks [119, 120]. Both gillnets and long lines are used to

[27] Historically there was an active dolphin fishery in Peru. Landings are thought to have peaked in the early 1990s with estimates of 15,000 – 20,000 animals per year for both the artisanal and commercial fleets. A series of laws in the mid-1990s prohibited the intentional take, landing, and sale of small cetaceans in Peru. While not 100 percent effective (i.e., a black market exists), intentional take of small cetaceans has decreased drastically. See Van Waerebeek et al. 2002 and Fisheries Bycatch Section for more information.

target sharks. Shark meat is sold to both domestic and international markets. Shark fins are not explicitly targeted; rather, fishers and vessel owners treat them as bonus income [121].

Anchovy landings by the artisanal sector can only be used for direct human consumption. Over the past twenty years, the percentage of total landings used for direct human consumption has varied between 6 and 20 percent. In 2012, management of the direct human consumption anchovy fishery was reorganized: the fishery was divided into two fleets based on size, artisanal with a hull capacity of ≤ 10 m^3 and small-scale with a hull capacity between 10 and 32.5 m^3. Small-scale vessels are permitted to fish exclusively between the first 5 and 10 nautical miles off the coast. The small-scale fleet is regulated by PRODUCE and required to use vessel monitoring systems. There are ~550 artisanal anchovy vessels, which are allowed to fish exclusively within the first 5 nautical miles off the coast. The regional government is charged with managing the artisanal fleet; however, in reality regulation is currently vague in theory and practice. The main direct products for anchovy are frozen and canned products, and to a lesser extent cured and dried products [98]. The majority of small-scale and artisanal landings (~80 percent) go toward canned products.

The majority of the small-scale and artisanal landings are based in Piura, Ancash, and Lima (Fig. 22). A major issue with the small-scale and artisanal fleets is illegal landings for fishmeal, which is driven by higher prices compared to direct human consumption [122]. Some researchers have estimated that up to 80 percent of the small-scale and artisanal anchovy landings are not declared and are processed for fishmeal [123].

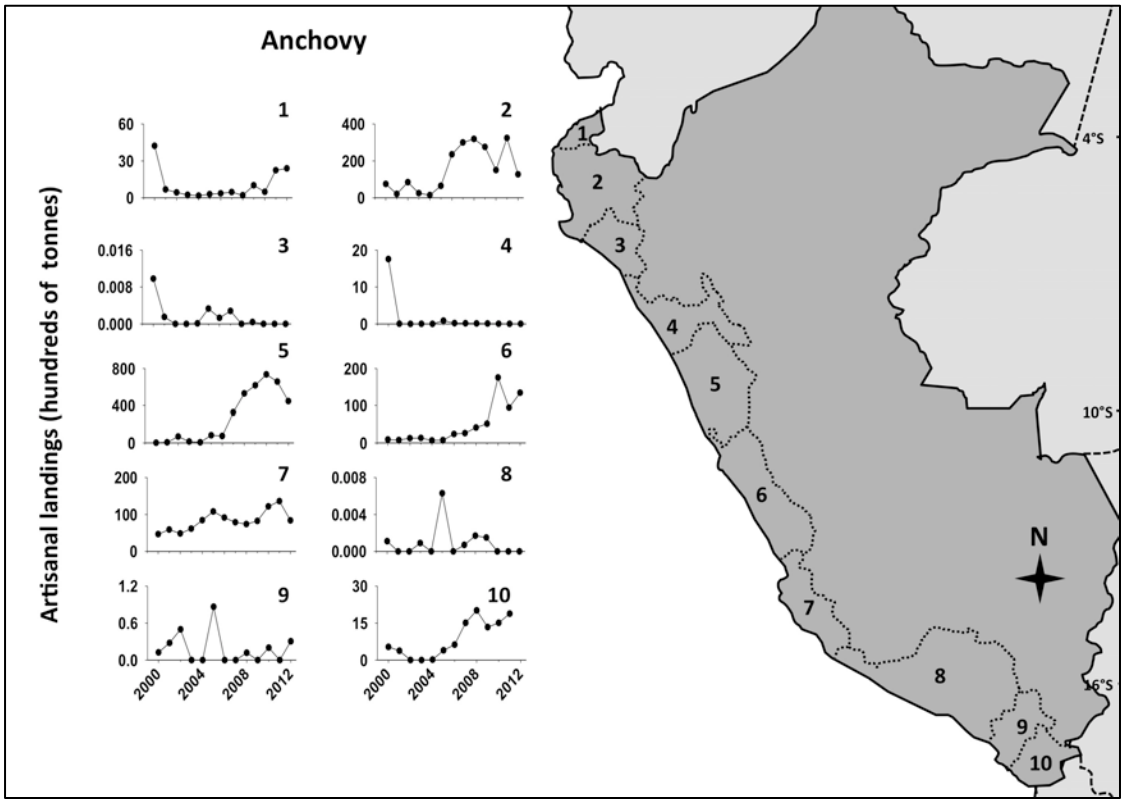

Figure 22. Small-scale and artisanal anchovy landings between 200 and 2012 for different regions of Peru.

What Is Happening Now?

- In July 2014, PRODUCE established a fishing season for mahi mahi: 1 October to 30 April [124]. Fishing mahi mahi during the rest of the year is banned. The fishing season can be modified upon recommendation by IMARPE.

- There is a fisheries improvement project (FIP) underway for Peruvian mahi mahi, as well as Ecuadorian mahi mahi. The FIP was launched in response to the completion of a Marine Stewardship Council (MSC) pre-assessment, which raised a number of issues that would need to be addressed in order to achieve certification [125]. Main issues include a lack of a harvest strategy and stock assessment measures; bycatch impacts on endangered, threatened, and protected species; and an overarching management systems that lacks governance mechanisms and specific short- and long-term objectives [125]. Through a participatory process, WWF-Peru led the development of the FIP action plan, which was finalized in November 2013. The action plan outlines a number of specific objectives and activities through 2017 [126].

- In light of the global decline in shark species and the recent inclusion of additional shark species under CITES, the Peruvian government has recently developed Action Plan for Sharks, Rays, and Related Species. Among other activities, the government presented the plan at an open meeting in October 2014 [127].

- CeDePesca is in the early phases of scoping and assessing a program to work with the pota fishery to improve its management and sustainability. The project's objectives include updating the fisheries management plan, identifying biological reference points, establishing a monitoring program, assessing bycatch, increasing transparency, and increasing access to market information [128].

- In October 2014, the Peruvian government issued a Ministerial Resolution, which calls for the establishment of a Supreme Decree to strengthen and promote the management of the human consumption anchovy fishery.

- In November 2014, the Peruvian government issued a Ministerial Resolution, which calls for the establishment of a Supreme Decree to strengthen the management of the jumbo squid fishery. The goal is to establish new rules and responsibilities around access to the jumbo squid fishery for the artisanal and mid-scale fleets. The Resolution includes issues such as traceability, control measures, and enforcement.

Fisheries Bycatch

Fisheries bycatch is well documented along the Peruvian coast; in particular, research with artisanal fisheries is active [119, 121, 129]. Collectively, the artisanal fishery is having significant impacts on marine megafauna—seabirds, sea turtles, and marine mammals (Table 12).

Table 12. Total estimated annual effort for the entire Peruvian artisanal gillnet and long line fleets. Total effort is equivalent or greater to industrial fleets, including high seas driftnet fleets that are now banned. Source: Alfaro-Shigueto et al. 2010.

Gear Type	Annual effort	Equivalent
Gillnets	>100,000 km	14x the length of the Taiwanese high seas drifnet fleet
Long lines	80 million hooks	1/3 the global industrial swordfish fleet

Small cetacean mortality is a combination of bycatch and direct take for bait (and still human consumption). Gillnets are the main cause of cetacean mortality; species include are common dolphins (*Delphinus* spp.), dusky dolphins (*Lagenorhynchus obscurus*), common bottlenose dolphins (*Tursiops truncatus*), and Burmeister's porpoises (*Phocoena spinipinnis*). Marine mammal bycatch rates for long line vessels are lower; however, these vessels actively target small cetaceans via harpooning for bait [119]. In the port of Salaverry, overall bycatch mortality rates of small cetaceans is estimated to be 2,412 animals a year—approximately an equivalent rate for all recorded fisheries in the United States [119]. The total marine mammal mortality by the artisanal fleet is unknown, but it is likely to be among the highest in the world.

Artisanal fisheries are also having a significant impact on marine turtles: the annual number of interactions is estimated to be in the tens of thousands [121]. Marine turtles primarily use Peruvian waters as fertile feeding grounds, and nest in other localities such as the Galapagos Islands, Mexico, Australia, and New Caledonia. The species most impacted are green (*Chelonia mydas*), loggerhead (*Caretta caretta*), and leatherback turtles (*Dermochelys coriacea*) [121]. Turtle bycatch rates for gillnets in Peru are among the highest documented in the world; long line rates are lower but still significant, especially given the current growth of long line vessels being observed in Peru [121]. At least a portion of turtle bycatch is retained for human consumption, which provides an important source of protein for often impoverished coastal communities [121].

What is happening now?

- In northern Peru, ProDelphinus is working with artisanal fishers to create portfolio of solutions to reduce bycatch of marine megafauna. They have created a high frequency radio communications program that provides local oceanographic and weather information to fishermen in real-time [130]. In exchange for this service, they collect data from vessels via radio communication (in real time) on sea turtle bycatch events, and provide instructions on safe handling and release. ProDelphinus has a number of active observer programs and bycatch mitigation trials. They have documented that acoustic alarms (i.e., pingers) on driftnets reduce dolphin and porpoise bycatch compared to normal driftnets in the artisanal shark fishery [131]. This 37 percent reduction in cetacean bycatch could result in a major reduction in overall annual mortality if the use of pingers can be mainstreamed into artisanal fishery practices. Prodelphins is exploring the use of incentive programs to increase the participation of multi-taxa bycatch reduction programs.

Rights-Based Management and Policy

Over the past decades, there have been on-going discussions about granting territorial use rights in fisheries or similar mechanisms to organized groups of artisanal fishers. However, until today, the government has feared the rejections of such mechanisms by those fishing groups that would be excluded from the designated areas. As discussed earlier, there are currently no legal tools that allow for private individuals or groups to manage a marine area through a concession with the explicit purpose of biodiversity conservation. Three exceptions exist:

1. Civil participation in marine management within existing, formal MPAs (see Marine Protected Areas and Policy Section),
2. Marine concessions granted under the law regulating aquaculture, and
3. A bottom-up approach to rights-based management involving a single demonstration project in *San Juan de Marcona*.

Within the Law for the Promotion and Development of Aquaculture, article 16 states that it is possible to grant area-based management rights to an artisanal fisheries association or an indigenous or rural community for the purposes of aquaculture.[28] To date, this has been interpreted, perhaps narrowly, to only include stocking and re-stocking activities. Article 14 allows PRODUCE to specifically authorize the development of stocking and re-stocking activities for aquaculture over a maximum area of 100 hectares for ten years. Authorizations are renewable if conditions are fulfilled. While this is the most common mechanism utilized by artisanal fishers organizations to secure marine resource access, it does not officially grant exclusive rights.[29] Nonetheless, under existing legislation, this law is the closest in practice to gaining some right to manage a marine area.

Relatedly, Article 14 of the Aquaculture Law also allows PRODUCE to authorize research in an area that focuses on the development of capacity and activities for seed production and cultivation of native marine species. The overarching goal of this legal mechanism is the conservation and sustainable use of native marine species.[30] Research permission is normally granted for two years; however, depending on research objectives, longer time frames can be approved. Artisanal fisher organizations can apply for research authorizations in partnership with universities and other institutions. To date, "stocking" or "research" concessions have not been assessed or developed with the explicit goal of biodiversity benefits or co-benefits (see Aquaculture Section for more discussion).

San Jaun de Marcona Demonstration Project

In 2003, a Special Commission was charged with the assessing and identifying options for a demonstration project to help recover the marine ecosystems and their sustainable use in the Marcona District (Nazca Province of the Ica Region). The focus was on local strategies for increasing the productivity of fisheries and mariculture. The demonstration project was later approved and a Permanent Assessment Commission (*Comisión Asesora Permanente*, CAP) was created. Representing 15 OSPAs (including fishers with and without vessels), the Artisanal Fishers Community of Puerto San Juan de Marcona (*Asociación Comunidad Pesquera Artesanal del Puerto San Juan de Marcona*, COPMAR) was put in charge of implementing the project.[31] Working closely with the Vice-ministry of Fisheries in PRODUCE, The COPMAR and the CAP created an official plan for the project (*Reglamento de gestión del programa piloto demostrativo para la recuperación de ecosistemas acuáticos y usos sostenible de su biodiversidad*).

Important factors that led to the creation of the demonstration project include,

[28] Article 16 of the Regulation of Law 27460
[29] Articles 14.7 and 41. of Law 27460
[30] Article 14 of Law 27460 and Article 3 of the Regulations of Law 27460

[31] Relevant policies: DS 015-2003-PRODUCE, DS 009-2005-PRODUCE, DS 010-2005-PRODUCE, DS 010-2005-PRODUCE

- The main species extracted by the artisanal fisheries were red sea urchin (erizo rojo, *Loxechinus albus*), Chilean abalone (Chanque, *Concholepas concholepas*), thick keyhole limpet (lapa, *Fisurella crassa*), octopus (pulpo, *Octopus mimus*), Magellan mussel (choro, *Aulacomya atra*), kelp (aracanto, *Lessonia* sp.), rock shells (caracol, *Thais chocolata*), and razor clams (navajas, *Tagelus dombeii*). Populations of these species were declining due to overharvesting and overfishing.
- Between 1990 and 2000, OSPAs were created that covered a stretch of coastline approximately 23 kilometers (between Punta San Juan and Yanyarina).
- Every OSPAs assumed responsibility to protect its own territory with the goal of sustainable use and species recovery. However, they encountered challenges with respect to meeting their goals, as well as encroachment from non-members of the OSPAs.

The demonstration project has been underway for nearly a decade, and formal evaluation was conducted. Some of the findings included,

- The regulations of the project, which make up its core strategies, were approved.
- COPMAR has been officially recognized and registered by multiple levels of governments, including PRODUCE,
- Area boundary definitions are being formalized and processed by the government (Presidential Commission of the Council of Ministers)
- While OSPAs recognize and respect areas boundaries, currently there is no legal mechanism that grants territorial use rights for artisanal fisheries (e.g., exclusivity, security, seasonality, and transferability). However, there are legal mechanisms that allow territorial rights for cultivation activities (e.g., restocking areas) via aquaculture laws.[32]
- Within the legal framework of aquaculture, regulations exist with respect to the marine resource use rights of COPMAR. The OSPAs have access to these rights, if they comply with certain requirements. However, the Management Areas established by this law do not grant exclusivity over a geographical area. COPMAR has issued a report that provides local zoning and designation of areas for the sustainable harvesting of benthic resources.

Most recently, COPMAR has taken interest in the sustainable harvest of macroalgae within the project site.[33]

[32] *La Ley General de Promoción y Desarrollo de la Acuicultura y su Reglamento.*

[33] For a short video on COPMAR produced by the Ministry of the Environment, see http://tinyurl.com/mqzevvc

AQUACULTURE

The Peruvian aquaculture sector is small and young compared to other countries with aquaculture (e.g., Chile). Yet, because of desirable conditions, species, and access, the sector is rapidly growing. It is currently dominated by a few species: shrimp (*Penaeus vannamei*), Peruvian scallop (*Argopecten Purpuratus*), trout (*Oncorhynchus* spp.), tilapia (*Oreochromis* spp.) and some Amazonian fish. Undercapitalization has resulted in most enterprises being small-scale, at least for the time being. Nonetheless, there is an increased focus on aquaculture in Peru: the National Plan for Aquaculture Development states a number of goals for 2015, including increasing overall harvest (to 95-110 thousand tonnes), both domestic and export production, private investment, and number of concessions (by 20 percent) [132].

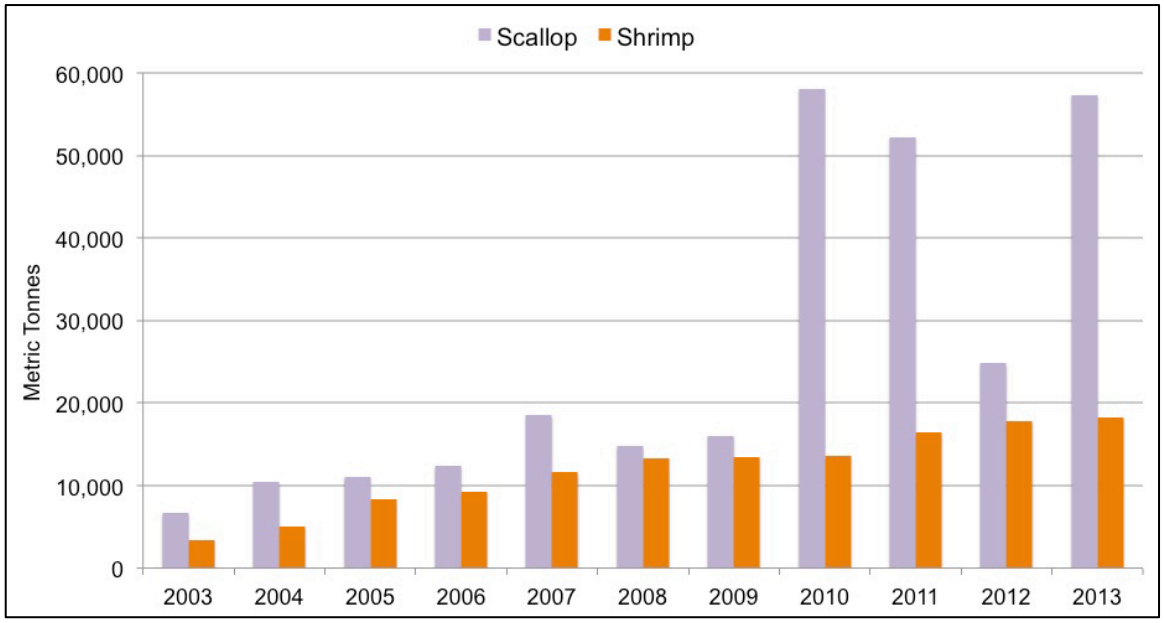

Figure 23. Scallop and shrimp aquaculture production between 2003 and 2013 (2013 figures are not final and subject to revision). Source: PRODUCE

Peruvian Scallop

Peruvian scallop (*canchas de abanico*) occur in South America from Panama south to Coquimbo, Chile. They spawn all year long, with particularly high productivity during El Niño events due to elevated water temperatures [133]. In Peru, the production of scallops includes both wild harvest and aquaculture. Wild harvest comes from the artisanal sector, while there are few larger-scale operators in the aquaculture sector. Aquaculture production is rapidly increasing and becoming an export-oriented industry, while scallops harvested under the fishing sector are mainly for the domestic market.

By volume, scallop is the largest aquaculture activity, followed by shrimp. Production has gone from ~10,000 tonnes in 2003 to over 50,000 tonnes over the past few years (Fig. 23). Most of the production is in Piura, with some activities in in Ancash (Fig. 24). Main export countries are France and the United States, together making up ~70 percent of total exports. In 2012, scallop exports were worth $75 million [90].

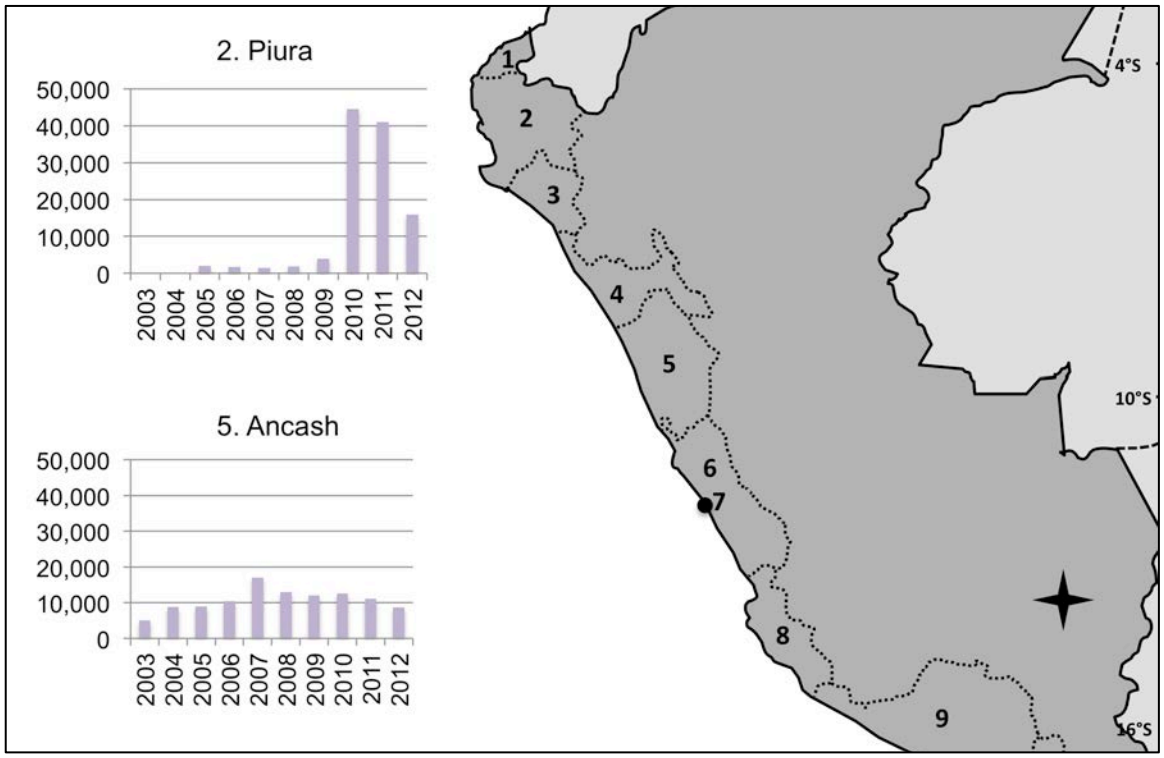

Figure 24. Scallop production by region. Over the past few years, Piura has dominated production, followed by Ancash. There was some production in Lima (6) in the mid-2000s, and small amounts of production (<1,000 tonnes annually) in Ica (7). Currently, there are 155 (9,523 ha) scallop concession in Piura, 15 (92 ha) in Ancash, and 2 (60 ha) in Callao. Source: PRODUCE.

Shrimp

Shrimp is the most developed and capitalized part of the aquaculture sector in Peru. It takes place along the northern coastline, where the climate is suitable; the center of activity is in the Tumbes region. Low land prices and less competition for land-use has also made entering into shrimp aquaculture easier in this region [132]. Using semi-intensive production systems, shrimp is cultivated in ponds in coastal mangrove areas. Relatively few Peruvian producers have laboratories for egg production, so Peru has relied on imports of larvae from Ecuador [132]. Over the past decades, the Peruvian shrimp industry has experienced a number of challenging setbacks. Heavy rains during the 1997-98 El Niño destroyed production facilities and infrastructure, and an outbreak of white spot disease in 1999 further reduced production levels [134]. Many companies went out of business during this period, and the industry went through a period of intensification in the early 2000s. Currently, there are around 50 producers, half of which are small-scale. Most of production is exported; however, ~10 percent remains in country for domestic production. Main export markets are Europe (France and Spain) and the USA. No official statistics exist on employment and income for aquaculture. The shrimp sector is estimated to directly employ somewhere between 1,100 and 4,000 people. Indirect employment is estimated at ~12,000, including a high percentage of women employed at processing plants [132, 135].

What is Happening Now?

- SeaCorp is a family-run scallop aquaculture company that has been operating in Sechura Bay (Piura) since 2003. It currently holds over 200 hectares in aquaculture concessions. A business-to-business company, SeaCorp has combined technology with sustainable practices to deliver reliable, year-round, and safe scallops for export. Current markets are USA, France, and Australia. The company is scoping the possibility of expanding into Asian markets. The company is working with local fishers and families, providing technical training and opportunities to work with SeaCorp in sustainable scallop production. Seacorp is currently in discussions with Acumen, an impact investing NGO, about a ~$1 million investment.

- There is a collaborative research program underway in Sechura Bay that is run by Leibniz Center for Tropical Marine Ecology (Bremen, Germany) and the Universidad Nacional Agraria La Molina (Lima, Peru). The *Sustainability Analysis of Scallop Culture in Sechura Bay* project is focused on research of various aspects of scallop aquaculture, with the aim of providing recommendations on improving long-term sustainability.[34] The program, funded by the German Ministry for Science and Development, is tackling a number of research questions focused on the biology, ecology, and socio-economics of scallop aquaculture in Sechura Bay. This includes research into the potential biodiversity impacts of scallop aquaculture, as well as production-related topics such as carrying capacity and bio-economic modeling.

[34] For more information, see http://sascaperu.wordpress.com

CONCLUSION

In sum, it is our view that momentum is growing for marine and fisheries conservation in Peru, and it is a strategic time to be investing wisely. Investments could leverage other projects and resources that are ramping up in the marine environment. While not as strong as some other Latin American countries, capacity is present in Peru for marine conservation, and is not the limiting factor. Some of the main challenges include weak regulation and enforcement, informal markets and economies, a relatively weak entrepreneurial sector, and lack of information and transparency. Some of the major assets include one of the world's most productive marine ecosystems, marine resource users with major capital, strong demand for seafood, private sector capacity, and a growing younger generation of social entrepreneurs and conservation practitioners.

Based on our experience, below are nine broad areas that will feel fall under the category of strategic opportunities for supporting activities that are likely to produce beneficial outcomes for marine biodiversity conservation and coastal communities in Peru. These opportunities build on current socio-political climate, capacity, and momentum within Peru. This is by no means an exhaustive list of recommendations; rather, we attempt to highlight certain areas or intervention types that are likely to have high impacts with investment and successful execution.

1. Filling information gaps and promoting transparency.
2. Developing policy reforms that support marine spatial planning, rights-based management, and voluntary conservation.
3. Supporting policy reforms and other strategies to improve artisanal fisheries management with leadership capacity building.
4. Improving artisanal seafood markets along the value chain.
5. Developing incentive-based programs for sustainability improvements for artisanal fisheries.
6. Supporting the scoping of Peruvian Scallop aquaculture as a business model with livelihood and biodiversity co-benefits.
7. Supporting pilot projects that test rights-based approaches to incentivize environmental stewardship.
8. Supporting the scoping of a multi-sector artisanal fisheries fund that would provide economic incentives and technical assistance to improve the sustainability, efficiency, and value of artisanal fisheries.
9. Mainstreaming and scaling environmental education.

Most, if not all, of our recommendations will involve regional and local governments in some capacity. In many cases, the decentralization process has resulted in major capacity and resource gaps at these lower levels of governments. It will likely be the case that specific investments targeting our recommendations will need to include support explicitly focused on building capacity within regional and local governments for conservation and management activities, as well as the provision of technical and financial assistance when needed.

INTERVIEW LIST

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