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Identifying Opportunities to Address Issues of Marine Fisheries and Biodiversity Conservation

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Executive Summary

Fisheries are a vital source of food and income, supplying the main animal protein for more than one billion people around the world, jobs for estimated 43.5 million, and with an export value of US$86.4 billion, 50% of which comes from developing countries (FAO, 2009, Kelleher, 2008, World Bank 2008). Even as per capita fisheries consumption is declining in parts of the developing world, people in the developed world are consuming more fish, creating new and expanding global pressures on fisheries resources. According to one fisheries expert, "Virtually every fishery in the world is either over-exploited or recovering from past over-exploitation; there are very few that are under-exploited. In most places, the challenge is recovery, rather than room for expansion."

The aim of this report is to conduct a global assessment of marine fisheries and biodiversity conservation in order to identify opportunities for The MacArthur Foundation to address issues relating to marine fisheries and biodiversity conservation. By looking at 19 Large Marine Ecosystems Currents in five mega-regions of the world – Africa, South and Southeast Asia, Latin America, the Pacific Islands, and the Polar Regions – the report identifies high-priority current and future challenges and changes facing marine fisheries in each of these mega-regions. The report also provides 14 case studies illustrating highly successful solutions strategies and approaches that have proven effective in practice. Two global matrices – one identifying organizations and funders working in the regions, and one identifying 56 successful cases in the marine fisheries sector – are provided to further inform the Foundation as it considers where opportunity and capacity exists for leveraging future support.

The body of the report, Sections 2, 3, and 4, is organized into three main analytical divisions.

Section 2: Methodology presents our approach for conducting this analysis.

Section 3: Current and Future Challenges discusses main current and future issues that are expected to affect marine fisheries resources, biodiversity conservation, and sustainable development, and identifies important regional fisheries in each of the five mega-regions considered. The three main threats currently facing marine fisheries biodiversity and sustainability are: (1) Overfishing, an extensive issue in every sub-region we reviewed, particularly Africa and Asia, compounded by intense overcapacity and by-catch; (2) Habitat Destruction, primarily by destructive fishing practices and gear, as well as coastal development and tourism, particularly in parts of Asia, Latin America, and the Pacific Islands; and (3) Pollution, especially land-based pollution from urbanization and agriculture, but also marine-based pollution, which is amplified in shipping hotspots. The main drivers of these threats include globalization of markets and trade in fisheries, limitations in institutional capacity for fisheries policy, inadequate governance and management, and the socioeconomic pressures of population growth, urbanization, and economic development. Poverty, unemployment, food insecurity, and health risks create additional pressures on fisheries. Together, these forces drive demand for growth in both industrial and small scale fisheries around the world. Section 3 also provides a comparative regional analysis and synthesis of trans-boundary and cross-cutting issues, discussing commonalities and differences across the regions.

Section 4: Current Partners and Projects identifies the institutional landscape of organizations and funders working on fisheries issues in the five mega-regions considered, and highly-effective or innovative approaches to strengthening marine fisheries and enhancing biodiversity. The majority of organizations' and funders' programmatic efforts addressed capacity building, science-based decision-making, policy and governance, and area-based management, with considerably less programmatic support for market-based management, climate change adaptation, technology transfer, rights-based management, and adaptive management approaches.

Within the regions, Latin America has the greatest presence of organizational and funding support, particularly the Caribbean Sea region, followed by the Pacific Islands, Asia, and Africa. Key ingredients for practical success include the need for a sequenced, programmatic, and contextually-grounded approaches, as well as transparent, participatory processes, and accountability in policy and decision-making. Other important factors for success include capacity building for management and governance, strong and informed leadership, multi-scale cooperation and collaboration, market-based solutions and private sector participation, and sustainable, long-term financing.

The report offers high-level suggestions in **Section 5: Solution Strategies and Opportunities** on broad solutions strategies and approaches, and opportunities for working or thinking about marine fisheries issues. Specific funding needs and opportunities we have identified include: (1) Developing market-based solutions to influence fisheries demand and supply, policy, and practice on the water; (2) Building institutional capacity and effective management and governance for fisheries, with particular emphasis on the need for cross-scale capacities that connect internal impacts with external pressures; and (3) Developing political will and support to drive policy and governance reform, behavioral change and compliance.

The report is supported by six appendices: (A) List of Key Informants Interviewed; B) Region and Sub-Regional Definitions; (C) Key Partner Organizations and Index of Projects Working in Marine Fisheries and Biodiversity Conservation by Region; (D) Key Funders Working in Marine Fisheries and Biodiversity; (E) Case Studies of Highly Effective Projects or Innovative Approaches to Marine Fisheries and Biodiversity Conservation; (F) In-Depth Highly-Effective Case Study Tables.

Section 1: Introduction

The aim of this report is to conduct a global assessment of marine fisheries and biodiversity conservation in order to identify opportunities for The MacArthur Foundation to address issues relating to marine fisheries and biodiversity conservation. By looking at 19 Large Marine Ecosystems Currents in five mega-regions of the world – Africa, South and Southeast Asia, Latin America, the Pacific Islands, and the Polar Regions – the report identifies high-priority current and future challenges and changes facing marine fisheries in each of these mega-regions. The report will also provide 14 case studies illustrating highly successful solutions strategies and approaches that have proven effective in practice. Two global matrices – one identifying organizations and funders in each of the five mega-regions, and one identifying successful cases in marine fisheries sector – are provided to further inform the Foundation as it considers where capacity exists for leveraging future support.

The body of the report, Sections 2, 3, and 4, is organized into three main analytical divisions. **Section 2: Methodology** presents our approach for conducting this analysis. **Section 3: Current and Future Challenges** discusses main current and future issues that are expected to affect biodiversity conservation and sustainable development for marine fisheries and identifies endangered regional fisheries in each of the five mega-regions. The section provides a comparative regional analysis and synthesis of trans-boundary and cross-cutting issues, discussing commonalities and differences across the regions, and issues and drivers generated internally and externally, within and across the regions.

Section 4: Current Partners and Projects identifies highly-effective or innovative approaches to strengthening marine fisheries sustainable management and enhancing biodiversity. Working from a select list of case studies, this section identifies and discusses:

- Cross-cutting themes and elements among projects leading to conservation and socioeconomic successes;
- How impact was measured and the effectiveness of measurement;
- The potential for, and experience with project replicability;
- Identification of areas where innovation is needed.

The report offers high-level suggestions in **Section 5: Solution Strategies and Opportunities** we suggest broad solutions strategies and approaches, and opportunities for working or thinking about marine fisheries issues. This includes identifying: solutions strategies; existing knowledge or technical gaps in fisheries management; potential new areas where the Foundation may fill existing, new, or anticipated gaps; opportunities to catalyze additional investment for under-supported issue areas. The report then considers issues of scale of investment, specifically with regard to the scale at which MacArthur is likely to have the greatest impact. Key findings and suggestions are made to guide decision-making and trade-off analysis between a regional approach and a cross-cutting/trans-boundary approach, to aid in fashioning the approach most likely to have the greatest practicable impact for realizing sustainable fisheries.

The report is supported by six appendices: (A) List of Key Informants Interviewed; B) Region and Sub-Regional Definitions; (C) Key Partner Organizations and Index of Projects Working in Marine Fisheries and Biodiversity Conservation by Region; (D) Key Funders Working in Marine Fisheries and Biodiversity;

(E) Case Studies of Highly Effective Projects or Innovative Approaches to Marine Fisheries and Biodiversity Conservation; (F) In-Depth Highly Effective Case Study Tables.

Section 2: Methodology

The information in this report was based on information collected through academic and grey literature, web-based research, key informant interviews, and Blue Earth Consultants' experience and expertise in the field.

Blue Earth Consultants examined 19 large marine ecosystems listed in the table below.

Table 1. Geographic Mega-Regions and Sub-regions of Foundation Interest

Africa	
Somali Coastal Current	Kenya, Somalia, Tanzania
Agulhas Current	Comoros, Madagascar, Mauritius, Mozambique, Seychelles, Swaziland
Canary Current	Morocco, Mauritania, and Senegal, Western Sahara
Guinea Current	Benin, Cameroon, Congo, Equatorial Guinea, Gabon, Ghana , Guinea, Ivory Coast, Nigeria, Togo
Benguela Current	Angola, Namibia
Asia (Southeast and South)	
South China Sea	Brunei Darussalam, Cambodia, Southern China, Northwestern Indonesia, Philippines, Singapore, Malaysia, Vietnam
Sulu-Celebes Sea	Northeastern Indonesia, Malaysia, Philippines
Indonesian Seas	East Timor, Indonesia
Gulf of Thailand	Cambodia, Malaysia, Thailand, Vietnam
Bay of Bengal	Bangladesh, India, Indonesia, Malaysia, Maldives, Myanmar, Sri Lanka, Thailand
Latin America	Countries and Territories Included in Region and Sub-region
Gulf of Mexico	Cuba, Mexico Caribbean
Caribbean Sea	Large and small Caribbean Islands, Central America Caribbean
Eastern Equatorial Current	Pacific Southwest Mexico, Central Equatorial Pacific (Costa Rica, El Salvador, Guatemala, Honduras, Nicaragua, and Panama), Pacific Coast of Colombia, Ecuador
Humboldt Current	Pacific Coast of Peru and Chile
Pacific Islands*	
Melanesia	New Caledonia, Fiji, Papua New Guinea, Solomon Islands, Vanuatu
Micronesia	Commonwealth of Northern Marianas, Federated States of Micronesia, Kiribati, Nauru, Palau
Polynesia	Cook Islands, French Polynesia, Niue, Pitcairn Islands, Samoa, Tokelau, Tonga, Tuvalu
Polar Regions	
Antarctic	Argentina, Australia, Chile, France, New Zealand, Norway, and UK*
Arctic	United States, Canada, Greenland, Norway, Sweden, Finland, Russia*

*The assessment does not take into account U.S. territories, New Zealand, and Australia.
(See map of regions and sub-regions and sources in Appendix B).

Background Issues Research: Background research was conducted to inform the assessment, and its analysis drew on several key approaches discovered in the research efforts. Blue Earth Consultants in-house expertise and publications provided a depth of existing and well-vetted information on marine fisheries issues in Latin America, Asia, and the Pacific Islands. This was supplemented by extensive web-based research, with independent in-house information collection and analysis for each of the 19 sub-regions, as well as the five mega-regions, and marine fisheries biodiversity issues and challenges more broadly. Some of these sources include the Food and Agriculture Organization (FAO), Global International Waters Assessments (GIWA) of the United Nations Environment Program (UNEP) , National Oceanic and Atmospheric Administration (NOAA) Large Marine Ecosystems of the World, the World Resources Institute's (WRI) " Reefs-at-Risk" publications, the Center for Ocean Solutions, as well as a large pool of other international and regional NGOs, IGOs, multi-lateral and bi-lateral funding agencies, Google Scholar, and general issue or region-specific searches.

Key Informant Interviews: We enriched this background work by conducting in-depth interviews with 12 recognized leaders in the field of sustainable fisheries management and biodiversity conservation, representing academia, NGOs, IGOs, foundations, and the private sector (see Appendix A).

Matrices of Key Organizations and Funders and Case Studies: In compiling the matrices of organizations and funders and case studies, we collected information from a variety of sources cited above. In addition to Blue Earth Consultants' in-house expertise and proprietary databases on marine experts and case studies, and recommendations made by our key informant interviews, we consulted online database searches of marine institutions and experts (e.g., the Intergovernmental Oceanographic Commission (IOC) ocean experts database); we also performed database searches of grants from major philanthropic organizations funding work on marine fisheries biodiversity and sustainability (e.g., MacArthur Foundation and Packard Foundation).

Blue Earth Consultants developed systematic, concise, easily-accessible information criteria for each organization, funder and case study included in the matrix to provide a general description of each, enabling a quick sense of whether each would suit MacArthur's funding strategy and criteria.

Section 3: Current and Future Challenges and Changes to Sustainable Fisheries in Africa, Asia, Latin America, Pacific Islands, and Polar Regions

Nearly three-quarters of the Earth's surface is covered by oceans, hosting nearly 250,000 catalogued species, with possibly another 10 million still to be discovered (D'Or, 2003, Sala and Knowlton, 2006). Oceans and their resources provide us with livelihoods, food, and climate security. Marine fisheries employ more than 200 million people around the world; 90% of fishers live in developing countries, 95% of whom are small-scale fishers (Kelleher 2008). More than 1 billion people get their main animal

protein from fish (Kelleher 2008); 2.8 billion people get at least 15% of their average annual intake of protein from this source (FAO 2008). Marine plants in the oceans fix about 50 million tons of carbon each year(roughly equivalent to the amount fixed by terrestrial plants) produce half the oxygen we breathe, and absorb a quarter of the carbon we emit (NRC 2008, IPCC 2007).

These essential services are at risk from a variety of pressures at multiple scales. This section identifies the main commercial fisheries at risk and introduces the critical issues affecting fisheries biodiversity and sustainable development –now and in the coming decades. The three main threats currently facing marine fisheries biodiversity--broadly agreed upon by experts and the literature—are overfishing, habitat destruction, and pollution. In many places, these threats will be intensified in the coming decades by the anticipated impacts of climate change.

Overexploitation: A majority of the fisheries experts we consulted, supported by an extensive literature, identify overfishing as among the greatest current and future threats to marine fisheries resources (FAO 2009, Worm et al.., 2009, Allison et al. 2009, Pauly 2010, Monterey Bay Aquarium 2009, UNEP 2008, Nelleman et al.., 2008, Doak et al. 2007). According to the FAO (2009), 80% of assessed fish stocks (mainly in developed countries) are either fully- or overexploited, or depleted and recovering from overfishing; 63% are in need of rebuilding. Most of the stocks of the top ten commercial capture fisheries are fully-exploited or overexploited. These include anchoveta, Alaskan pollack, Atlantic herring, Japanese anchovy, Chilean jack mackerel, yellowfin tuna, and some stocks of skipjack tuna (FAO 2009).

Today's widespread overfishing in the open ocean is due, in large part, to an overcapitalized industrial-scale fishing fleet: large, mechanized vessels equipped with advanced technology, enabling them to find and catch fish. Fishing capacity is now estimated to be as much as 2.5 times that needed to harvest the sustainable yield catch from the world's fisheries (Nellemann, et al.., 2008). Trans-boundary or migratory stocks are most at risk from the industrial fleets that sweep the oceans of targeted species and by-catch, changing the age structure of fish populations, disrupting food webs, and threatening endangered species. The volumes of by-catch and discards are significant—sometimes consumed, and increasingly used to feed aquaculture, but nearly always representing an enormous loss of potential protein. The global shrimp trawl fishery discards, on average, 1.6 pounds of by-catch for every pound that is landed. Global discards have been estimated to amount to more than seven million metric tons, equating to roughly eight percent of landings (Kelleher 2005). Experts anticipate industrial-scale overfishing, along with its impacts, to continue into the coming decade, mainly in response to continued expansion of global markets and trade (unless rising fuel costs prove unsupportable for industrial fleets) (Pauly 2010).

In contrast to the threat posed to the open ocean stocks by industrial-scale fishing fleets, coastal waters and the more accessible inland fisheries are currently more at risk from small-scale artisanal fishers. According to Pauly (2010), there are more than 12 million small-scale fishers in the world, 25 times more than those working at the industrial scale (Chuenpagdee, 2006). Yet, the annual catch from each is roughly equivalent: about 29 million tons from industrial sector, about 24 million tons from small-scale fishing (Pauly 2010). As coastal artisanal and small-scale fishers exhaust large predator populations, they, too, "fish down the food web, targeting smaller, less valuable species." In a feedback loop of overfishing pressures, as stocks decline artisanal fishers resort to more destructive fishing techniques such as reef bombing or the use of cyanide poison, or the use of trawl nets with a by-catch that is equally as destructive, if differently composed, as that taken in deeper waters. Given anticipated growth

in population, urbanization, limited livelihood alternatives, and growing market integration over the coming decade, small-scale fishing pressures are also expected to intensify.

Habitat destruction or modification: The current destruction or modification of marine fisheries habitat is directly attributable to human activity not only in marine environments, but terrestrial as well. Coastal land reclamation is potentially the greatest cause of marine habitat destruction or fragmentation. This destruction occurs when coastal areas are converted for urbanization, industrial and port development, tourism, or resource extraction, including sand mining for industry and construction. In Southeast Asia, tens of thousands of square kilometers of mangrove forests, which provide critical haven to nursery and spawning stocks, have been lost to the expansion of shrimp and prawn farms for regional and global markets. Mangrove forests have been sacrificed elsewhere to local demand for timber and firewood. In the sea, fisheries habitats are currently destroyed by dredging, trawl nets that scrape the seabed with the equivalent ecosystem effect of clear-cutting a forest, coral mining for lime production, and the rising practice of dynamite fishing, a method that yields a catch suitable for sale in the live-food fish markets and aquarium trade, but also destroys coral reefs. Marine fisheries habitat destruction is also anticipated to continue into the future under pressures from further coastal development, rising populations, pollution from land and sea, as well as the ocean acidification and reef bleaching ancillary to climate change.

Pollution: Land and sea-based pollution is frequently a component of the threats mentioned above, but warrants particular attention given the grave challenges it poses—both now and in the future—t o the resilience of marine fisheries and coastal communities. Urban sewage and solid wastes, as well as agriculture fertilizers increase the risk of eutrophication and expanded incidence of harmful algal blooms, even in open coastal waters. Suspended solids, sedimentation, and other sources of turbidity result from deforestation and other large-scale land use changes, while agricultural and industrial activities generate malignant nutrient and chemical runoff. Hypoxia from nutrient loading in the Gulf of Mexico has resulted in an 8,000 square mile “dead zone” that threatens the region’s US$500 million fishery (Science Daily 2009). Elsewhere, heavily traveled oil and gas shipping routes face particular risks of pollution from oil spills, garbage dumping, and bilge pumping. Growing populations, increasing urbanization and land transformations will continue to create pressures, particularly for coastal marine fisheries resources, into the coming decade.

Climate Change: Climate change has profound future implications for the health of marine ecosystems, fisheries, and dependent coastal fisheries communities. Rising atmospheric temperatures are expected to change ocean temperatures, circulation patterns, the frequency and intensity of storms, ice cover, salinity, and oxygen levels, causing shifts in the range and abundance of marine life and fish migration patterns, and the probable demise of an estimated 80% of the world’s coral reefs (Nellemann et al., 2008, Cochrane et al., 2009, FAO 2008). Organisms that form the base of the food web are threatened by ocean acidification (Jacobson 2005), and in the Antarctic, by the loss of sea ice. Climate impacts will exacerbate the vulnerability of fisheries-dependent developing countries and communities, threatening livelihoods, food security, and infrastructure in places with little capacity for adaptation (Allison, et. Al. 2009). Additional threats to fisheries resources may follow as new areas open to commerce and transportation in the heretofore frozen Polar Regions (Informant interviews, UNEP 2008, FAO 2009, Brander 2007).

Drivers: There have long been threats and challenges to the vitality and integrity of marine fisheries resources, ecosystems, and the livelihoods that they support, however, the majority of our expert

informants argue that the drivers and scale of those threats have changed dramatically in recent decades. The drivers are generated both internally and externally, and are linked across scales. As global drivers increasingly exacerbate local pressures, there is a growing disconnect between the problems and their causes.

- Globalization of markets and trade have combined to create unprecedented demand pressures on fisheries resources, fed by the increasing connectivity and transformative speed of information, money, access, labor, and industrial technologies. Newly emerging global markets can decimate a fishery. The lucrative live food markets in Asia, where species can command up to US$100 per kilogram, drive overfishing at the source. The expansion of markets and trade is expected to continue into the coming decades (Informant interviews, FAO 2009, UNEP 2006, Monterey Bay Aquarium 2009, Worm et. al., 2009).
- Limitations in a country's institutional capacity for fisheries policy and governance are manifested in weak management, monitoring and enforcement, and a lack of coordination across scales and among stakeholders. Inequitable fishing agreements allow developed country fleets to overfish developing country waters, while illegal, unregulated and unreported fishing (IUU) threatens fisheries and community economic stability with relative impunity. A lack of political will to enforce science-based management enables non-compliance on the water. The failures of institutional capacity need not be generated into the future, but likely will be, as the fixes are not quick and require long-term approaches and commitments (Informant interviews, FAO 2009, UNEP 2006, Worm et al., 2009).
- Socioeconomic drivers of increasing populations, urbanization, and economic development on a regional scale join with growing poverty, unemployment, food insecurity, and health risks at the local scale to drive demand for both industrial and small-scale fisheries. In some places, livelihood diversification has fostered a link between fisheries and crime, globalizing the labor force. HIV/AIDSs has become prevalent in vulnerable fisheries communities around the world, threatening 24% of fishers in East Africa (Informant interviews, Kelleher 2008, FAO 2009, UNEP 2006, Allison et al., 2009).

Africa

The fisheries resources in the highly productive marine ecosystems of West and East Africa are fundamental sources of income, protein, and economic development for the countries and coastal communities in the region. Overfishing is a significant problem in the region's largely unregulated offshore fisheries, by overcapitalized fleets from the EU and Asia licensed to take expansive fisheries resources for pennies on the dollar. IUU is has become an intractable problem, with limited country capacity in the region for monitoring and enforcement. Inshore fisheries, mostly targeted by artisanal fishers for local consumption, are at risk from destructive fishing practices and gear. In the coming decade, population growth, urbanization and coastal development is expected to amplify pressures on resources and marine habitats. Eleven countries in this region – Angola, Congo, Ghana, Guinea, Ivory Coast, Morocco, Mauritania, Mozambique, Nigeria, Senegal, and Tanzania – are particularly vulnerable to climate change impacts on fisheries given the important role of fisheries in their diet and economy, and their limited societal capacity for future adaptation (Allison, et al.., 2009).

Table 2. Current and Future Challenges and Changes – Africa Region and Sub-regions

CHALLENGES & CHANGES O = Current ⊙ = Current & Future ⊘ = Future	SOMALI COASTAL CURRENT	AGULHAS CURRENT	CANARY CURRENT	GUINEA CURRENT	BENGUELA CURRENT
OVEREXPLOITATION					
Overfishing	⊙	⊙	⊙	⊙	⊙
Overcapacity	O		O		O
By-catch	O	O	O	O	O
HABITAT DESTRUCTION					
Coastal Development/Tourism	O	⊙	O		
Destructive Fishing Techniques/Gear	⊙	⊙	O		
Urban/Industrial/Port Development	O		O	⊙	⊙
Invasive Species			O		O
LAND-BASED POLLUTION					
Urban Sewage and Solid Waste (Nutrient Loading and Eutrophication)	O	O	O	⊙	
Sedimentation	O				⊙
Pollution/Runoff (Industrial and Agricultural)	O	O	O	⊙	⊙
MARINE-BASED POLLUTION					
Harmful Algal Blooms (HABs)				O	⊙
Ocean/Industrial Activities (Including Shipping, Ballast Water, Marine Mining, Oil and Gas Exploration)	O	O			⊙
Oil Spills	O	O		O	O
Aquaculture		O			⊙
CLIMATE CHANGE					
Sea Level Rise		⊘		⊘	
Changes in Water Temperature	⊘	⊘	⊘	⊘	
Storms/Flooding/ENSO Events	⊘	⊘	⊘	⊘	⊘
Ocean Acidification	⊘	⊘			
MARKETS & TRADE					
Foreign/Distant Water Fleets	O	O	O	O	O
Increased Demand					
Expanding Markets (Local/National/International)					
New Oil and Gas Exploration/Development	O	O			
International Shipping	O	O			
SOCIO-ECONOMICS					
Poverty	⊙	⊙	⊙		⊙
Population Growth/Urbanization	⊙	⊙	⊙	⊙	⊙
Food Insecurity/Health	⊙	⊙	⊙		⊙
Economic Dependence on Fisheries	O	O	⊙	⊙	O
Limited Alternative Livelihoods		O	O		
Political Disputes/Conflict/Instability	⊙		O	⊙	O
POLICY & GOVERNANCE					
IUU	O			O	
Bi-Lateral/Multi-Lateral Agreements	⊙		O		
Limits in Infrastructure and Capacity:					
Policy and Legislation (defined and current)	O	O			
Management	O	O			O
Regulation and Enforcement	O	O			O
Coordination and Participation					
Technical Capacity					O
Knowledge Gaps (Scientific Data/Information)	O	O	O		
Monitoring and Science for Decision Making	O	O	O	O	O
Political Will and Corruption	⊙				O

Somali Coastal Current

Background

The Somali Coastal Current runs along the East coast of Sub-Saharan Africa. It is a highly productive ecosystem with intense nutrient rich upwelling that supports high marine biodiversity and a wealth of marine and coastal resources. The fisheries of the Current are valued at approximately US$50-60 million annually and support about 15 million people in the region (NOAA 2009). Artisanal fisheries tend to operate inshore in low-tech traditional vessels, using gill- and cast-nets, longlines, traps, and handlines (ASCLME). The domestic market commands as much as 70% of the total fish market, with a significant role in food security. However, the market is not well defined or organized.

Key Challenges & Changes

Current

- Overfishing
- Destructive Fishing Practices/Gear
- By-catch and IUU
- Foreign Water Fleets
- Coastal Development and Resource Extraction

Future

- Continued Overfishing and IUU
- Bi-lateral relationships with foreign fleets
- Climate Change Impacts

Key Fisheries at Risk

- Migratory species (e.g. tuna, sharks)
- Crustaceans
- Mackerels, snappers, perch, groupers, dolphin, wahoo, barracuda

Current Challenges

There is limited knowledge of the status of fisheries in this region, but fisheries appear to be heavily exploited or overexploited at all scales. Overfishing is driven by improvements in, and the overcapacity of fishing technology, and made worse by destructive fishing practices both inland and at sea (UNEP 2006). By-catch in the Current also is extreme: the ratio of prawns to by-catch is 1:7 and 1:4 for trawlers. Distant water fleets from Europe and Asia dominate offshore fisheries. These fleets discard such volumes of edible by-catch that when the carcasses are carried shoreward, local fishermen are justifiably moved to protest that foreigners are destroying their fisheries (UNEP 2006, p60). Several foreign industrial fishing companies have been issued licenses to fish in Somalia's Exclusive Economic Zone (EEZ), however, an estimated 700 foreign-owned vessels fish illegally in Somalia's waters (ASCLME Somalia 2010). The local impacts of overfishing – unemployment and communities' inability to meet their basic needs – have been a source of considerable friction between the artisanal and commercial fishers in the region (NOAA 2009).

Recently, in a perverse alignment of forces, pirates off the east coast of Africa have scared away the previously pervasive distant-water fleets, both legal and illegal, reducing overfishing so dramatically that in Kenya and Somalia, there are more fish, across all species, than people can use. As a result, local fishers have seen their incomes and quality of life rise, allowing them to outfit with new boats and better equipment (Straziuso, 2010). Even so, attempts by Kenya and Tanzania to monitor and enforce its extensive coasts within existing legal and institutional frameworks have been relatively unsuccessful (NOAA 2009). Kenya's Ministry of Fisheries Development has identified policy priorities to strengthen all manner of institutional capacity for fisheries management (NOAA2009), though the lack of suitable

fishing vessels to venture into the offshore areas of the EEZ is seen as a major obstacle for the growth of Kenya's marine fisheries (ASCLME 2009).

Future Challenges

In the coming decade, continued overfishing and IUU, bi-lateral relationships with foreign fleets, and climate change impacts are expected to cause the loss of coral reef ecosystems and shifts in species ranges (UNEP 2006). Tanzania is expected to be particularly vulnerable to climate impacts on fisheries given its reliance on fisheries for economic and food security, and the lack of institutional capacity for future adaptation (Allison, et al.., 2009).

Agulhas Current

Background

The Agulhas Current is a moderately productive ecosystem, situated in the Indian Ocean, off the southeastern margin of Africa (NOAA 2008). The region has rich marine fisheries biodiversity supported inshore by mangrove, seagrass, and coral reef habitats. Commercial fisheries include shrimp, prawn, cape hake, blackhand sole, yellowfin and albacore tuna, as well as a significant crustacean fishery (comprising more than 40% of total catch) (NOAA 2008). The fisheries and aquaculture sectors are major economic activities in all countries of the region, supporting more than 100,000 artisanal and industrial fishers (ASCLME 2010). The government of Comoros aims to double fishery production to create new jobs and raise the sector's contribution to GDP to over 13% (ASCLME 2010).

Key Challenges & Changes

Current

- Overfishing
- Destructive Fishing Practices and Gear
- Resource Extraction
- Pollution (Sewage, Waste, Runoff, Oil Spills/Exploration, Shipping)

Future

- Continued Overfishing and Destructive Practices
- Poverty and Food Insecurity
- Climate Change and Sea Level Rise Impacts

Key Fisheries at Risk

- Pelagic migratory fishes
- Shellfish
- Finfish and reef fish

Current Challenges

Most fisheries in the Current are considered fully or overexploited (NOAA 2009). Fisheries for cape anchovy and South American pilchard (forage fish) collapsed in the mid 1970s, though increased annual landings indicate some evidence of recovery. With the introduction of trawlers and more effective fishing methods, greater numbers and variety of fish are being caught, causing stocks to shrink (NOAA 2008), with destructive fishing methods compounding the issue. There is also a significant presence of distant water fleets from the EU and Japan. In Comoros, 60 EU vessels are licensed to fish for tuna until 2010 (ASCLM 2010); Madagascar has licensed EU vessels a take of up to 11,000 tons of tuna and prawn annually (ASCLM 2010). Inland fisheries are less exploited given the limited technology and equipment of the local artisanal fishers.

Several other factors are contributing to fisheries resources and habitat challenges. Mangrove forests are cleared for aquaculture or salt production. Urbanization, tourism, dredging and extraction of reef materials, as well as bleaching from rising sea temperatures threaten coral reefs. Pollution from a multitude of sources is also severe, including sewage and solid waste, industrial effluents, agricultural runoff, polluted ballast water and oil spills from extensive crude oil shipping traffic, as well as oil and gas exploration activities (NOAA 2008).

Many of these islands have limited natural resources at their disposal and suffer significant poverty. Therefore, identifying potential alternative livelihoods to boost income, help alleviate food insecurity, and relieve pressure on the fisheries is crucial. This may also allow for the recovery of crashed forage fisheries, a critical food sources for many of the fishing communities in the Current. Although limits to available data are creating some hindrances, steps to address these challenges are being supported by several MPA efforts, including the first trans-boundary marine reserve, spanning Mozambique and South Africa (WWF 2009). There are significant capacity building efforts in the region, including USAID and WWF work aimed at mitigating conflict over marine resources and addressing fisheries stock decline in Mozambique. There is also support from the Marisla Foundation, multi-lateral organizations, NGOs, IGOs, and private corporations.

Future Challenges

The challenges of reducing poverty and food insecurity will extend into the coming decade. Climate change impacts and sea level rise also pose a particularly urgent threat to these island nations, with warming ocean temperatures expected to place additional stress on coral reefs and fisheries habitat. Mauritius and Mozambique are expected to be particularly vulnerable to climate impacts on fisheries, given their heavy contribution to the economy and food security, and the limitations to institutional capacity for adaptation (Allison, et al.., 2009).

Canary Current

Background

The Canary Current, located along the west coast of Africa, is a highly productive large marine ecosystem with intense seasonal upwelling. It is bordered by eight countries, with more than 56% of the population living in the coastal areas. An estimated 70% of inhabitants are directly dependent on the marine ecosystem as their primary source of protein and livelihoods (NOAA 2009).

Current Challenges

Overexploitation of marine resources is severe. Major commercial species in the Current include

Key Challenges & Changes

Current

- Overcapacity
- Destructive Fishing Practices/Gear
- Foreign Water Fleets
- Poverty and Economic Dependence on Fisheries

Future

- Population Growth in Coastal Areas
- Climate Change and Sea Level Rise Impacts

Key Fisheries at Risk

- Demersal and pelagic species
- Crustaceans and mollusks
- Sardinellas, mackerels and anchovies

sardines, anchovies, pilchards, mackerel and hake (Encyclopedia of Earth 2008-2009a), though about 40% of commercial stocks are overexploited, and an additional 40% are considered collapsed (NOAA 2009). This collapse is primarily due to overcapacity of fishers and vessels. Destructive fishing practices and gear are also a major concern (UNEP 2006). Fishing trawls and artisanal gillnets result in by-catch of sea turtles and marine mammals, though significant knowledge gaps exist with respect to estimates of by-catch and fishing effort along the entire West African coast, for both commercial and artisanal fisheries (Project Global, 2010).

Adjacent to the Guinea Current, and with similar economic dependency by artisanal fishers, overfishing in the Canary Current has led to conflict among user groups, protein deficits among children, and high unemployment in the fisheries sector (80% in the Senegalese fisheries sector) (UNEP 2006). These pressures are exacerbated by the countries' increasing accommodation of highly subsidized large distant water fleets from the EU and Asia pressing for expanded access, particularly in Morocco, Mauritania, and until 2006, Senegal (Project Global, 2010). The countries' lack of financial resources has long been an obstacle to the establishment of an effective monitoring system for the region's fisheries (Encyclopedia of Earth 2008-2009a).

Future Challenges

Major challenges in the coming decade will be driven by climate change impacts and sea level rise. Upwelling intensity and sea surface temperatures are strongly linked, and are expected to affect both the spatial distribution and abundance of fish in the Large Marine Ecosystem (LME) (NOAA 2009). Morocco, Mauritania, and Senegal are expected to be particularly vulnerable to climate impacts on fisheries, given their heavy dependence on fisheries for economic and food security, and the limits to societal institutional capacity for future adaptation (Allison, et al.., 2009). Further, migration to the coastal cities of West Africa has been accelerated by the increasing desertification of the interior, placing additional pressure (e.g. pollution, fish demand) on the coastal areas (Encyclopedia of Earth 2008-2009).

Guinea Current

Background

The Guinea Current runs along the central West African coast. This highly productive ecosystem provides food, employment, and foreign exchange to the people and countries in the region (NOAA 2009). An estimated 300 million people live in the 16 countries that border the Current, with the population expected to double in 20-25 years (NOAA 2009). Nearly half of the inhabitants live within 200 km of the coast, with many of the region's poor crowded in the coastal

Key Challenges & Changes

Current

- Overfishing
- Urban, Industrial and Chemical Pollution
- Foreign Water Fleets and IUU

Future

- Population Growth
- Limited Alternative Livelihoods
- Climate Change and Sea Level Rise Impacts

Key Fisheries at Risk

- Large migratory and small pelagic fishes
- Crustaceans and mollusks
- Demersal fish

areas for subsistence livelihoods such as fishing (NOAA 2009). The area is fished by both small-scale artisanal near shore fishers (about 60% of all landings) and commercial foreign fleets (Japan, Spain, France) targeting offshore migratory stocks. Fisheries landings in 2003 accounted for US$14.5 billion, though IUU landings were estimated to account for an additional US$3.3 billion (about 23% of total landings) (Chukwuonoe et al.. 2009).

Current Challenges

Overfishing has lead to major fluctuations in the spectrum of size, biomass, abundance, and reproductive strategy of commercially valuable fisheries (Ukwe, et al., 2006, UNEP 2006, NOAA 2009). This has created a downturn in fisheries production, increasing unemployment and provoking conflict between artisanal fishers and commercial trawlers (UNEP 2006). Exploited species include small pelagic fishes (sardines, anchovies), large migratory pelagic fishes, such as bigeye and yellowfin tuna and billfish, as well as crustaceans, mollusks, and demersal fish (NOAA 2009). The loss of fisheries livelihoods has pushed people toward agriculture, promoting habitat destruction. Ghana has cleared 55% of the mangroves, as well as significant areas of marshland in the region (UNEP 2006).

Pollution from sewage and solid waste are of significant concern for fisheries ecosystems and habitats, especially near large coastal cities. Eutrophication has created an increase in the occurrence of harmful algal blooms (NOAA 2009), and industrial and chemical pollution is also severe. The LME lies to the east and downwind of the main oil transport route from the Middle East to Europe, thus trans-boundary pollution from spills is significant (Source: NOAA 2009).

Future Challenges

Rapid population growth, movements between rural and urban areas, pollution, and the risks of political instability as governments are pressured to provide alternative livelihoods will continue to create challenges to sustainable use and management of fisheries in the next three to ten years. Climate change impacts in this highly variable upwelling environment are likely to intensify, accelerating habitat modification and loss. This region is also highly vulnerable to sea level rise, which could put approximately 2% of Nigeria's coastal zone (populated by 3.7 million people) at risk of flooding, resulting in a potential loss of up to 3,000 square kilometers of coastal lands (NOAA 2009). Five countries in the current – Congo, Ghana, Guinea, Ivory Coast, and Nigeria – are expected to be particularly vulnerable to climate impacts on fisheries, given their heavy dependence on fisheries for economic and food security, and the limits to socio-institutional capacity for future adaptation (Allison, et al.., 2009).

Benguela Current

Background

The Benguela Current, located on the Atlantic side of Africa's southern cone, is a highly productive ecosystem supporting a wide variety of pelagic and demersal species. Commercial stocks in the region include sardine, anchovy, hake horse mackerel, tuna and sardinella, as well as crustacean fisheries for rock lobster in the south, and deep-sea crab in the north (NOAA 2009). The fisheries sector contributes as much as 10% to GDP in Angola (after oil and diamonds) and Namibia, and is important to artisanal

incomes and food security in all three countries. While the artisanal fishery in Namibia is relatively small, in Angola, as many as 140,000 people engage in coastal artisanal fishing, and an additional 25,000 engage in commercial fishing activities (Cochrane et al. 2009).

Current Challenges

Approximately 60% of commercially exploited species in the LME have collapsed, with an additional 10% overexploited. Though fully exploited stocks account for less than 30% of the stocks, they contribute to 50% of the total catch. Over the past decades, there have also been dramatic declines in catch per unit effort (CPUE) (NOAA 2009). The decline in stocks is a major trans-boundary problem, as most of the LME's major fisheries are shared between bordering countries or migrate across national jurisdictions. By-catch is a moderate problem in the region, largely in large pelagic and demersal fisheries. In Angola and South Africa, purse-seine by-catch is about 10-20% of the total catch.

Key Challenges & Changes

Current

- Overfishing
- Resource Extraction Impacts
- Pollution (Agricultural Runoff and Oil Spills)

Future

- Population Growth and Urbanization
- Pollution (Increased occurrence of HABs)
- Food Insecurity

Key Fisheries at Risk

- Cape rock lobster (verge of collapse)
- Cape of Good Hope squid (verge of collapse)
- Anchovy (fully-exploited, though stocks are *currently* healthy)

Marine- and land-based pollution poses a challenge in the Current. Marine mining (e.g., round the clock diamond mining in Namibia) has proven difficult to regulate, and is a primary cause of suspended solids, impacting water quality in the region. Agricultural runoff (nutrients and pesticides) and harmful algal blooms (HABs) are a widespread occurrence throughout the LME,. Oil spills have also had severe impacts in the Current (UNEP 2006, NOAA 2009).

Agency corruption and lack of infrastructure (especially in Angola) make achieving significant policy changes difficult, compounded by a shortage of skilled personnel for scientific research, management and governance, or institutional capacity for monitoring and enforcement (Mechling 2005, Cochrane et al. 2009).

Future Challenges

Future challenges stem from continued urbanization and associated pollution, with increasing HAB occurrences. A growing vulnerability to income and food insecurity also exists, particularly in Namibia and Angola, as population increases and fisheries continue to be overfished. Beyond 2013, sustaining capacity-building efforts with sufficient financial resources will also become an issue once Global Environmental Facility (GEF) grants run out or are no longer available (Mechling 2005). Angola is expected to be particularly vulnerable to climate change impacts on fisheries, given the country's heavy dependence on fisheries for economic and food security, and the limits to societal institutional capacity for future adaptation (Allison, et al.., 2009).

Table 3. Current and Future Challenges and Changes – Asia Region and Sub-regions

CHALLENGES & CHANGES O = Current ⊙ = Current & Future ⊘ = Future	SOUTH CHINA SEA	SULU-CELEBES SEA	INDONESIAN SEAS	GULF OF THAILAND	BAY OF BENGAL
OVEREXPLOITATION					
Overfishing	⊙	⊘	⊙	⊙	⊙
Overcapacity	O	O	O	O	O
By-catch		O	O	O	O
HABITAT DESTRUCTION					
Coastal Development/Tourism	O	⊘	⊙	O	O
Destructive Fishing Techniques/Gear	O	O	O	O	O
Urban/Industrial/Port Development				O	
Invasive Species	⊙			⊙	
LAND-BASED POLLUTION					
Urban Sewage and Solid Waste (Nutrient Loading and Eutrophication)	O	O	⊙	⊙	O
Sedimentation	O		O	⊙	O
Pollution/Runoff (Industrial and Agricultural)	O	O	⊙	⊙	O
MARINE-BASED POLLUTION					
Harmful Algal Blooms (HABs)	O			⊙	
Ocean/Industrial Activities (Including Shipping, Ballast Water, Marine Mining, Oil and Gas Exploration)	O	⊙			⊙
Oil Spills	⊘		O		⊙
Aquaculture		⊙		⊙	⊙
CLIMATE CHANGE					
Sea Level Rise				⊙	⊙
Changes in Water Temperature		⊘	⊘		
Storms/Flooding/ENSO Events				⊘	⊙
Ocean Acidification	⊘	⊘	⊘	⊘	
MARKETS & TRADE					
Foreign/Distant Water Fleets	O	O	O		⊙
Increased Demand	O	O	O	⊙	⊙
Expanding Markets (Local/National/International)	O	O		⊙	⊙
New Oil and Gas Exploration/Development	⊘		O		
International Shipping				O	⊙
SOCIO-ECONOMICS					
Poverty	⊙	⊙			⊙
Population Growth/Urbanization	⊙	⊙	⊙	⊙	⊙
Food Insecurity/Health	⊙	O		O	⊙
Economic Dependence on Fisheries	⊙	O	O	O	⊙
Limited Alternative Livelihoods	⊙		O	O	⊙
Political Disputes/Conflict/Instability	⊙				⊙
POLICY & GOVERNANCE					
IUU	O	O			
Bi-Lateral/Multi-Lateral Agreements					
Limits in Infrastructure and Capacity:					
Policy and Legislation (defined and current)	O			O	O
Management	O	O			O
Regulation and Enforcement	O	O			O
Coordination and Participation	O			O	
Technical Capacity					O
Knowledge Gaps (Scientific Data/Information)	O	O	O	O	O
Monitoring and Science for Decision Making	O				O
Political Will and Corruption	O				

Asia (South and Southeast)

The five sub-regions of South and Southeast Asia cover 8.5 million km^2 with a population of 3.4 billion, roughly one-half of the entire world population (CIA 2009). Southeast Asia is home to the most biodiverse marine environments in the world, containing more than one-third of all reefs and home to more than 75% of known coral species (WRI 2009). Three hundred fifty million people in Southeast Asia live within 50km of the coast, many depending heavily on the marine environment as a source of food and income. In the Philippines alone, over 1 million small-scale artisanal fishermen rely directly on reef fish for their livelihood (NOAA 2009). Sustainably managed reef fisheries in this region have an estimated annual worth of about US$2.4 billion (Burke et al.., 2002). Asia also supports an annual live fish and aquarium fish market in excess of US$1 billion (NOAA 2009).

Political will for sustainable management and capacity to implement programs is limited throughout the region. The limited regulation that does exist is rarely enforced. There is a great need for research and data collection to better understand the LME's fish stock status, IUU, by-catch and biomass levels, and local-level fisheries status. Improved data reliability, and standardized collection and reporting methods for shared fisheries among regions are also needed (NOAA 2009, UNEP 2005).

South China Sea

Background

The South China Sea encompasses an area of 3.3 million km^2, including the EEZs of nine countries, and yields approximately six to seven million tons of annual fisheries resources, valued at US$6.5 billion (UNEP 2005). The region is developing rapidly and supports more than 270 million people, many living close to or below poverty levels, and heavily dependent on fish as a main source of animal protein (UNEP 2005). The Sea is largely located within the Indo-Pacific Coral Triangle, which hosts the world's richest coral reef biodiversity, including 75% of all reef-building, hard coral species known to science (COS 2009).

Key Challenges & Changes

Current

- Overfishing
- Destructive Fishing Practices/Gear
- Habitat Destruction
- Pollution (Runoff, Sewage, Aquaculture)

Future

- Continued Overfishing
- Continued Habitat Destruction and Pollution
- Population Growth
- Oil and Gas Exploration/Development Impacts

Key Fisheries at Risk

- Small pelagic species

Current Challenges

Overfishing poses a severe threat to the region's coastal and marine fisheries, of which approximately 40% are overexploited or collapsed (UNEP 2005, 2006). An emphasis on exports rather than local consumption has led to widespread unemployment and loss of incomes, as well as childhood malnutrition (UNEP 2006c, p59). In coastal communities, with few alternative livelihoods, injuries and deaths from blast fishing and reef diving are common. Foreign trawlers and driftnet operators reap the premiums available from international

markets, while declining fish stocks have provoked conflicts between local fishing groups and foreign fishers (UNEP 2006, p59).

Habitat destruction or alteration is the second-most significant threat in the region. In addition to impacts from explosives, trawling, and other destructive practices and gear, 50% of intact mangrove forests have been lost to prawn aquaculture, which occupies an area of 5,000 km^2 in the region (UNEP 2006, p78). Pollution from agriculture runoff, sewage, and nutrient loading from aquaculture has lead to increased frequency of HAB outbreaks within the region (Wang et al., 2008).

Future Challenges

In the coming decade, overexploitation of fisheries and habitat destruction are expected to grow. The primary drivers of this increase are a doubling of coastal populations over the next 30 years (NOAA 2009) and an increase in IUU fishing in the absence of maritime boundaries and fisheries monitoring, control and surveillance (Khemakorn 2006). Pollution will continue to threaten the health of fisheries, increasing incidences of 'red tides', and the spread of diseases in pilchards and from aquaculture farms (Source: UNEP 2005). Oil spills may be a new challenge in the future, as vast offshore oil and gas potential has been discovered recently in the South China Sea, though its extent is not yet known. This discovery has made Indonesia one of the world's leading oil exporting states. Oil and gas exploration may further exacerbate maritime boundary/territorial conflicts, conflicts with fisheries, and pollution. (Wang, Kuan-Hsiung 2001)

Sulu-Celebes Sea

Background

As part of the Coral Triangle, the Sulu-Celebes Sea consists of three nations, and forms part of the Philippine-Malay Archipelago, a region that supports a mega-diversity of fisheries, marine mammals, and other marine life (NOAA 2009). The human population of 34 million is expected to increase to 50 million within the decade, and double by 2035. Fish and other marine organisms are a primary food resource and provide a livelihood for the local community. Coastal prawn trawling also provides a major marine export industry.

Key Challenges & Changes

Current

- Overfishing
- Bi-Catch (from Foreign Water Fleets)
- Destructive Fishing Practices/Gear
- Pollution (Runoff, Sewage, Aquaculture, Shipping)

Future

- Population Growth and Urbanization
- Continued Destructive Fishing Practices/Gear
- Lack of Legislation, Regulation and Enforcement
- Climate Change Impacts

Key Fisheries at Risk

- Trawling and purse-seine fisheries
- Anchovy, sardine, mackerel, shrimp, tuna

Current Challenges

Overfishing and destructive fishing practices have had significant impacts on fisheries, with more than 50% of stocks in the LME collapsed or overexploited (NOAA 2009). Destructive fishing practices pose the greatest threat to the reefs in the sub-region, and also carry tremendous social and economic costs. Blast fishing is expected to cost Indonesia at least US$3 billion over the next 50 years, with cyanide use adding an additional US$50 million (UNEP 2006, p60). In an effort to address these challenges, several

hundred MPAs have been established, though only 7% are effectively managed, with the majority suffering from a lack of management capacity (Burke et al.. 2002). Non-compliance with existing laws and weak institutional capacity for enforcement are also tremendous challenges in this region. Nevertheless, governments continue to take steps toward the creation and implementation of several regional and international fisheries initiatives.

By-catch and discards from foreign water fleets are also an issue, though in virtually all inshore fisheries by-catch is consumed by local fishing populations (NOAA 2009).

Pollution is a severe problem in the Sulu-Celebes Sea, especially near coastal urban centers. The primary sources include agricultural and industrial runoff, urban sewage, aquaculture and shipping. Suspended solids and sedimentation from extensive deforestation is widespread in coastal Philippines. Solid waste pollution is also severe around the region's larger cities, towns and villages where waste management is generally poor or non-existent (NOAA 2009).

Future Challenges

Future challenges to the health and vitality of the coastal and marine systems in the Sea are largely posed by population growth and urbanization in coastal areas, continued use of destructive fishing practices, and lack of effective regulation to curb pollution There is a pressing need for improved management and cooperation between countries to improve conservation and protection in the Sulu-Celebes Sea LME. Increasing surface ocean temperatures are expected to pose significant risks to coral reefs throughout the region, and are estimated to cost the Philippines and Indonesia $2.5 billion annually over the next 20 years (NOAA 2009).

Indonesian Seas

Background

The Indonesian Sea LME consists of approximately 400,000 km^2 situated at the convergence of the Pacific and Indian Oceans. Fisheries stocks include gouramy, carp, milk fish, tilapia, tuna, skipjack tuna, barramundi, anchovy, travelly, mackerel, garfish, shrimp, parrotfish, octopus, squid, crab, and lobster. Ornamental fish species are also harvested and exported to the United States, Japan and Germany. Artisanal fisheries are responsible for the bulk of the catch in this region, though industrial fisheries reap the highest economic benefits, with fishing focused on high value stocks such as tuna (NOAA 2009). Coastal communities in East Timor historically have relied on fishing as a main source of food and income, but violence following the country's independence in 2002 caused serious damage and destruction to nearly 90% of the boats and gear in these communities,

Key Challenges & Changes

Current

- Overfishing
- Destructive Fishing Practices/Gear
- Habitat Destruction
- Pollution (Sewage, Waste, Runoff, Mining)

Future

- Continuation of Current Challenges
- Population Growth and Urbanization
- Climate Change Impacts

Key Fisheries at Risk

- Unknown

and to a significant portion of the onshore processing infrastructure (Guterres, C. 2003), forcing many people to seek out alternative livelihoods.

Current Issues

Overfishing, destructive fishing techniques (explosives and poison) and habitat destruction or modification is devastating fishery productivity and destroying marine ecosystems in the region (Burke et al.,2002). Overfishing in the Indonesian Seas is caused in part by the lack of awareness among fishers of the impact of destructive fishing practices. Many local fishers have only a basic understanding of fish and coral reef ecology, and use destructive techniques rather than traditional fishing method because they yield larger catches for minimal cost and effort, despite the long-term impacts on the productivity of the fisheries (UNEP 2006). Indonesia is the world's largest marine aquarium exporter, and cyanide is used to capture approximately 85% of the aquarium fish traded internationally (Reksodihardjo-Lilley, et al., 2007). The growing and lucrative export market for live seafood in China and other parts of Asia contributes to further depletion of fish stocks (UNEP 2006), as does the capture and sale of wild spawn for aquaculture. Although these practices are illegal, regulations are difficult to enforce, especially in remote areas (NOAA 2009). While the level of by-catch is considered severe, discards are virtually non-existent as by-catch is often consumed (NOAA 2009, UNEP 2006).

Mangrove forests have also been significantly impacted in this region. In the 1990s, governments of the Indonesian Seas allocated approximately 10,000 km^2 of land, mostly mangrove forests, to the shrimp industry. By 2001, about 70% had been abandoned because aquaculture pollution and the creation of acid sulfate soils had rendered them unproductive (UNEP 2006).

Pollution in the region is severe, sourced from the dumping of solid wastes, untreated wastewater and sewage, chemical pollution from agriculture and industry, mercury contamination and toxic waste leached from copper and gold mines (NOAA 2009, UNEP 2006).

Future Challenges

The main challenges to the Indonesian Seas in the coming years are the continuation and exaggeration of current threats. These will all be compounded by a rapidly growing population, which is expected to double to 400 million by 2035. Changes in sea surface temperature will make coral more susceptible to bleaching, and will encourage changes in the structure of coral reef communities (UNEP 2005).

Gulf of Thailand

Background

The fisheries economy in this region is dominated by artisanal and subsistence fishers, who are nutritionally dependent on fish and comprise 40%-60% of the coastal populations in Thailand and Cambodia. Aquaculture and tourism are also important economies activities in the region (De Young 2007, NOAA 2009).

Current Challenges

Over 60% of the fish stocks in the LME are either collapsed or overexploited. Catch per unit effort has declined from 300 kg/hour (1960s) to merely 20-30 kg/hr, forcing fishers to fish "down the food web" for subsistence and livelihood (NOAA 2009). IUU in the region is significant, and by-catch – particularly of sea turtles – from non-selective, small mesh trawl nets is considerable, though non-target species are generally used as aquaculture feed.

Land-based pollution, eutrophication, and hypoxia are severe, as untreated wastewater from tourist destinations and municipal sewage are often discharged into the Gulf, as are agricultural and industrial effluents. Degradation and modification of fisheries habitat is also extreme. Fifty to 80% of mangrove forests along the Gulf have been lost to shrimp aquaculture; Thailand leads the world in farmed shrimp exports. Land conversion from urbanization, port development, and timber harvest further exacerbate these challenges (FAO 2006-2009; Wattayakorn 2006).

Key Challenges & Changes

Current

- Overfishing
- Habitat Destruction (Aquaculture)
- Pollution (Sewage, Waste, Runoff)
- Policy and Governance

Future

- Continuation of Current Challenges
- Population Growth
- Climate Change Impacts

Key Fisheries at Risk

- Sardinella, anchovy, mackerel, scad, big eye
- Crustaceans and mollusks

This area also suffers from policy and governance issues. Most countries of the sub-region lack stock assessments, legislative reviews, and interagency coordination. Implementation and enforcement of existing legislation is often also neglected. Fisheries management in Thailand has been a moderate success. The government manages 67% of commercial fisheries. Recently, increased control measures such as spatial restrictions, fishery conflict-resolution, capacity reductions (e.g. buyouts, shortened seasons) have also been implemented. Despite increased management and budget for implementation and enforcement, however, overfishing and other fisheries issues are still pervasive. Key challenges include funding and personnel support, establishment of effective inter-agency mechanisms, and commitment to more sustainable management approaches (De Young 2007).

Future Challenges

In the coming decade, fisheries overexploitation, habitat destruction, and pollution are expected to increase. Impacts to fisheries and marine ecosystems from climate change will also be significant (NOAA 2009). Because of its elevation and proximity to the sea, the Gulf of Thailand is particularly vulnerable to sea level rise; noticeable impacts are already being identified. Coastal communities will also be susceptible to increased storm and flooding events, and ocean acidification. In Malaysia, rapid industrial development has increasingly absorbed the younger population, causing an increased number of fishers to be recruited from Indonesia, the Philippines, and Thailand, compounding already stressed population sizes (De Young, 2007).

Bay of Bengal

Background

The Bay of Bengal is the largest bay in the world, comprising the northeastern portion of the Indian Ocean, and occupying nearly 2.2 million km^2. The Bay is a highly productive ecosystem with several critically important areas of biodiversity. It is regularly affected by monsoons, storm surges, cyclones, and tsunamis (NOAA 2009). The majority of catches are artisanal and subsistence based; in Bangladesh, industrial fishing comprises only an estimated five percent of total catch (NOAA 2009).

Key Challenges & Changes

Current

- Overfishing
- Destructive Fishing Practices/Gear
- Pollution (Sewage, Sedimentation, Aquaculture, Resource Extraction)

Future

- Population Growth
- Habitat Destruction and Aquaculture
- Artisanal and large-scale fisher conflicts

Key Fisheries at Risk

- Unknown

The fisheries sector is integral to the livelihoods of people in the region, providing full- or part-time employment to more than 14 million people in India and another 14 million in Bangladesh (FAO 2000-2009), and supplying 60% to 80% of animal protein for people throughout the region (NOAA 2009). Most countries in the LME are major producers of farmed fish for export, though the aquaculture industry in the Bay of Bengal has been adversely affected by trans-boundary microbial pollution; the contamination of seafood has resulted in reduced exports (UNEP 2006). In addition to farmed fish, Indonesia, Thailand, and Sri Lanka have recently developed a tuna export fishery (NOAA 2009).

Current Challenges

Overfishing has had significant direct impacts on the millions of people in coastal areas, many of whom are deeply impoverished and depend on fish for income and food. Near-shore stocks are increasingly overexploited by artisanal fishers; over the past 20 years there has been a nearly 300% increase in the number of fishers in India (UNEP 2006, p59). Destructive fishing practices, especially shrimp trawling, are a leading cause of species decline and ecosystem destruction in southern India (Preston 2004). By-catch is also of concern, though most of it is consumed or used as feed for aquaculture (NOAA 2009).

Pollution is a serious concern to the fisheries ecosystems and coastal communities in this region. Sewage and suspended solids are priority issues, as are sedimentation and siltation, coastal aquaculture, and coral mining (Angell 2004). Asian oil demand from Africa and the Middle East creates high levels of shipping traffic through the Straits of Malacca and along the Indian coastline, significantly increasing the risk of oil spills in the Bay (NOAA 2009).

Future Challenges

Over the next decade, fisheries and coastal communities in the Bay will be confronted by challenges from destructive fishing practices, pollution and habitat destruction. Growing coastal populations, weakened common property management, and heightened development of shrimp aquaculture are intensifying pressure on coastal resources (NOAA 2009). Increased competition between artisanal and

large-scale fisherman is already a problem in Bangladesh and India. Larger populations and increased demand for resources may amplify these conflicts (Preston 2004, Bay of Bengal Overview).

Table 4. Current and Future Challenges and Changes – Latin America Region and Sub-regions

CHALLENGES & CHANGES ○ = Current ⊙ = Current & Future ⊘ = Future	GULF OF MEXICO	EASTERN EQUATORIAL	HUMBOLDT CURRENT	CARIBBEAN SEA
OVEREXPLOITATION				
Overfishing	⊙	⊙	⊙	⊙
Overcapacity	○	○	○	⊙
By-catch	○	○	○	
HABITAT DESTRUCTION				
Coastal Development/Tourism	⊙	○	○	○
Destructive Fishing Techniques/Gear	○	○	○	○
Urban/Industrial/Port Development				○
Invasive Species	⊙	⊙		⊘
LAND-BASED POLLUTION				
Urban Sewage and Solid Waste (Nutrient Loading and Eutrophication)	○	⊙	○	○
Sedimentation	○	○	○	○
Pollution/Runoff (Industrial and Agricultural)	○	⊙	○	⊙
MARINE-BASED POLLUTION				
Harmful Algal Blooms (HABs)				○
Ocean/Industrial Activities (Including Shipping, Ballast Water, Marine Mining, Oil and Gas Exploration)	⊙	⊙	⊘	○
Oil Spills		○		○
Aquaculture		○	⊙	
CLIMATE CHANGE				
Sea Level Rise		⊘	⊘	⊘
Changes in Water Temperature	⊘			⊘
Storms/Flooding/ENSO Events	⊘		⊘	⊘
Ocean Acidification	⊘			⊘
MARKETS & TRADE				
Foreign/Distant Water Fleets		⊙	⊘	
Increased Demand				
Expanding Markets (Local/National/International)				
New Oil and Gas Exploration/Development	⊙	⊙		
International Shipping	⊙	⊙		⊙
SOCIO-ECONOMICS				
Poverty		○	○	○
Population Growth/Urbanization	⊘		⊙	○
Food Insecurity/Health	○	○		
Economic Dependence on Fisheries	○	⊘	⊙	○
Limited Alternative Livelihoods		○	○	
Political Disputes/Conflict/Instability				
POLICY & GOVERNANCE				
IUU				
Bi-Lateral/Multi-Lateral Agreements				○
Limits in Infrastructure and Capacity:				
Policy and Legislation (defined and current)	○		○	○
Management	○	○	○	
Regulation and Enforcement	○	○	○	
Coordination and Participation	○			
Technical Capacity	○			
Knowledge Gaps (Scientific Data/Information)	○	○	○	○
Monitoring and Science for Decision Making		○		
Political Will and Corruption				

Latin America

The oceans and coastal systems of Latin American and the Caribbean support a vast and biologically diverse wealth of fisheries resources, from coral reefs and small islands to high seas deep water resources. Some of the fisheries of greatest commercial value in the region are also those facing significant economic, biological, and ecological pressures, particularly straddling and migratory stocks in the high seas, including the tuna fishery in the Eastern Pacific, the Peruvian/Chilean anchoveta fishery in the Humboldt Current, and the southern ocean tooth-fish and squid fisheries (WWF 2009). In the Caribbean, there is marked intersection of EEZs and much stock sharing, as national jurisdictions extend to maritime areas, abutting or overlapping each other. Substantial commercial fisheries here include the queen conch and spiny lobster, as well as a variety of shrimp stocks.

Gulf of Mexico

Background

The Gulf is rich in biodiversity and unique habitats, hosting more than half the world's coral reefs as well as the world's only known nesting beach of the Kemp's Ridley turtle, the world's most endangered sea turtle (UNEP 2008, WRI 2004). Fisheries in the Gulf are multispecies, multigear and multifleet in character, and include artisanal, commercial and recreational fishing. There is enormous economic dependency on the sector in the Gulf, which contributed nearly $50 billion to GDP in 2001 (FAO 2000-2010). The number of registered fishers in the region has increased 400% from 1982 (40,000) to 2000 (200,000).The total number of artisanal vessels has seen the same rate of increase, though total catches have remained the same over the same 18 years (NOAA 2009). Species of economic importance include several species of shrimp, Gulf menhaden, king and Spanish mackerel, red grouper, red snapper, sea trout, tuna, and billfish (NOAA 2009).

Current Challenges

Overfishing and overcapitalization is the primary force driving biomass changes in the LME, as both traditional and emerging fisheries have reached their harvesting limits, driving the shift of fishing to lower trophic levels and smaller sizes of fish (NOAA 2009). Collapsed and overexploited stocks account for over 70% of all commercially exploited stocks in the LME, with overexploited stocks comprising 60% of reported landings (NOAA 2009). Red snapper is considered to be the most severely overexploited in the Gulf, with its recovery deterred by the loss of juveniles in the shrimp trawl by-catch. Heavy sedimentation flowing from the North American continent limits coral reef development, while urban, agricultural, and industrial wastes also carried to the Gulf caused a massive 7,900 square mile dead zone in 2009, threatening the US$500 million fishing industry (Science Daily, 2009). Offshore fisheries are under pressure from artisanal fishers, as well as threats from oil and gas exploration, the associated shipping traffic, and the increasing risk of spills (WRI Caribbean 2004).

Key Challenges & Changes

Current

- Overfishing and Overcapacity
- Destructive Fishing Techniques and Gear
- Pollution (Sedimentation, Sewage, Waste, Runoff)
- Oil and Gas Exploration

Future

- Population Growth and Urbanization
- Climate Change Impacts

Key Fisheries at Risk

- Red Snapper
- Bluefin tuna, swordfish, blue and white marlin

Future Challenges

Climatic variability – warming water and associated upwelling - poses the second greatest threat to biomass change (after overfishing) in the Gulf (NOAA 2009). Communities and infrastructure will become increasingly vulnerable to storm surges, coastal flooding, shoreline erosion, and resulting degradation of critical long-term water supplies (NOAA 2009a). There are insufficient social services and infrastructure to support the increasing needs of the growing population.

Eastern Equatorial Current

Background

The marine fisheries sector in Mexico, Panama, Guatemala, and Costa Rica is comprised of large commercial industrial fishing fleets. The Salvadoran, Honduran, and Nicaraguan fisheries are mainly artisanal and subsistence (De Young 2007). In both, fisheries play a significant economic role in the region, through fishing, aquaculture, substantial export values, tourism, as well as food security.

Current Challenges

Marine-based threats to fisheries include overfishing, by-catch and discards, destructive fishing techniques, and fleet-based pollution. 80 percent of the main commercial species, except tuna, are fully- or overexploited. Shrimp trawling practices are particularly harmful, posing severe by-catch threats to sharks and turtles in Colombia (NOAA 2008). As a result of shrimp overharvest, fisheries in the region are targeting new species, including snapper and grouper (UNEP 2006a). Distant water fleets from Korea, Japan, the U.S., and Venezuela are the primary fishers of offshore tuna. Land-based pollution includes agricultural run-off, untreated domestic and industrial wastewaters, inadequate sanitation and waste treatment systems from growing coastal populations (UNEP 2006).

Key Challenges & Changes

Current

- Overfishing and By-catch
- Destructive Fishing Techniques and Gear
- Coastal Development/Urbanization
- Pollution (Sewage, solid waste, industrial wastes, POPs, heavy metals, nutrient loading)
- Aquaculture (disease, waste)

Future

- Climate Change Impacts
- Population Growth and Urbanization

Key Fisheries at Risk

- Swordfish, marlin, mahi-mahi, shark
- Shrimp

Future Challenges

Growing population, urbanization, and overfishing will continue to pose threats to marine environments and coastal communities into the coming decade. Rising sea surface temperatures and decreasing rainfall under climate change are expected to disproportionately affect the Pacific side of Central America. Coastal communities will be vulnerable to rising sea levels, where a one meter rise in sea level is expected to inundate up to 3 km^2, flooding 90% of the urban area, with severe impacts on coastal infrastructure and economic activities (UNEP 2006).

Humboldt Current

Background

The Humboldt Current produces more than 20% of the world's total fisheries output (UNEP 2006). Of this, the Peruvian anchoveta accounts for the vast majority of commercial fishing production and value, currently dedicated mainly toward the production of fishmeal (Sea Around Us 2010, UNEP 2006b). Aquaculture production in Chile is growing rapidly, producing more than 630,000 tons in 2001, a 600% increase over 1991 levels, farming shrimp, salmonoids, and to some degree, mollusks and algae (UNEP 2006).

Key Challenges & Changes

Current

- Overfishing
- Destructive Fishing Techniques and Gear
- Coastal Development/Tourism
- Sedimentation and Pollution

Future

- Climate Change Impacts (Extremely Susceptible)
- Intensity and Frequency of Storm Events

Key Fisheries at Risk

- Tuna (skipjack, yellowfin, bigeye, albacore
- High-value Invertebrates
- Giant clams, beche-de-mer, mangrove crab, lobsters, sea cucumber

Current Challenges

Overfishing is a major concern, with some fisheries operating 15-22 days a month, 10 months a year (UNEP 2006). The constant pressure combined with destructive fishing gear is reflected in the 80% of commercial/industrial fisheries that are overexploited or have collapsed (NOAA 2008). Excessive by-catch in the anchovy and sardine fisheries generates several hundred thousand tons of discards.

Pollution is a serious ongoing threat, as increasing development and urbanization lead to increases in sewage, solid waste, and industrial waste; over 80% of wastewater from Peru, Ecuador and Chile is discharged without treatment (UNEP 2006c). Other pollutants include nutrient loading, persistent organic pollutants (POPs), heavy metals, as well as heat pollution from thermoelectric plants, and additional impacts on health, tourism, and coastal marine resources from petroleum exploitation (UNEP 2006). Aquaculture poses growing threats to fisheries: outbreaks of disease from shrimp farms have cost US$600 million each year, excluding the subsequent economic impact on wild stocks. (UNEP 2006), while Chilean salmon farms produce volumes of waste comparable to that generated by a city of over 2 million inhabitants (UNEP 2006).

Future Challenges

Climate change impacts will be among the main challenges in the coming decade. Warming waters in Chile are expected to enable the invasion of tropical species and probable changes in the food web. The anchovy fishery in Peru, and perhaps sardines, too, will move southward or downwards to colder water. The change in the distribution of targeted species will particularly affect artisanal fishers in the south-central region, likely prompting a migration of the fisher population and change in the labor structure via employment substitution. Crowded coastal urban areas will become vulnerable to flooding and wave effects. In coastal areas, the occlusion of draining systems is expected, with resulting sanitation problems. Additional future challenges may develop from conflicts provoked as industrial fishing vessels invade fishing areas assigned to artisanal fisheries, as well as the increased use of explosives in both industrial and artisanal fisheries (UNEP 2006).

Caribbean Sea

Background

In the Bahamas and throughout the Caribbean, fisheries resources are critical for economic development, tourism, and food security; coral reefs provide an estimated annual net economic value of US$3.1 billion, with an additional US$4.6 billion from fisheries, dive tourism, and shoreline protection services (WRI 2004).

Key Challenges & Changes

Current

- Overfishing and By-catch
- Destructive Fishing Techniques and Gear
- Habitat Destruction
- Coastal Development/Urbanization
- Pollution (Sedimentation, sewage, nutrient loading, shipping)
- Population Growth

Future

- Climate Change Impacts
- Population Growth and Urbanization

Key Fisheries at Risk

- Unknown

Current Challenges

Overfishing in the small islands region of the sea has escalated to unsustainable levels, expanding from a catch of 9,000 tons in 1950 to 60,000 tons in 2000, putting many commercial species at risk (UNEP 2006). Fisheries habitat is being lost through the destruction or alteration of the coral reef systems, seagrass meadows, and mangrove forests, driven by development along the coast, and the pressures associated with growing populations. Land-based sedimentation and pollution come from deforestation and poor agricultural practices, and nutrient loading from sewage (UNEP 2006). Marine-based pollution includes predation of alien species (from aquaculture) and pollution from trans-boundary and extra-regional shipping through the region, with garbage and waste dumping and bilge pumping into the sea (UNEP 2001, WRI 2004). In the Caribbean Islands, there are no economic incentives to prevent cruise line operators from dumping wastes at sea, and the countries of the region are reluctant to penalize them, given their dependence on foreign exchange from tourism (UNEP 2006).

Future Challenges

In the coming decades, climate change impacts on fisheries will include changes to the migratory patterns and the invasion of marine species previously unknown in regional waters (Caribbean press release 2009). Rising sea level and warmer waters, as well as storm surges and increased incidence of hurricanes could have significant ecological impacts on coral reef productivity, as well as socioeconomic impacts on small scale fishers with little institutional support for recovery in the aftermath of extreme events. Reef-associated fisheries could lose an estimated US$95 million to US$140 million per year, by 2015 (WRI 2004).

Table 5. Current and Future Challenges and Changes – Pacific Islands Region and Sub-regions

CHALLENGES & CHANGES O = Current ⊙ = Current & Future ⊘ = Future	MELANESIA	MICRONESIA	POLYNESIA
OVEREXPLOITATION			
Overfishing	⊙	⊙	⊙
Overcapacity	O		
By-catch			O
HABITAT DESTRUCTION			
Coastal Development/Tourism	O	O	O
Destructive Fishing Techniques/Gear	O	O	O
Urban/Industrial/Port Development		O	O
Invasive Species			O
LAND-BASED POLLUTION			
Urban Sewage and Solid Waste (Nutrient Loading and Eutrophication)	O	O	O
Sedimentation	O	O	O
Pollution/Runoff (Industrial and Agricultural)	O	O	O
MARINE-BASED POLLUTION			
Harmful Algal Blooms (HABs)			
Ocean/Industrial Activities (Including Shipping, Ballast Water, Marine Mining, Oil and Gas Exploration)			
Oil Spills	O		
Aquaculture			
CLIMATE CHANGE			
Sea Level Rise	⊘	⊘	⊘
Changes in Water Temperature	⊘	⊘	⊘
Storms/Flooding/ENSO Events	⊘	⊘	⊘
Ocean Acidification	⊘	⊘	⊘
MARKETS & TRADE			
Foreign/Distant Water Fleets		O	O
Increased Demand		O	
Expanding Markets (Local/National/International)	O	O	O
New Oil and Gas Exploration/Development			
International Shipping			
SOCIO-ECONOMICS			
Poverty		O	
Population Growth/Urbanization	⊙	⊙	⊙
Food Insecurity/Health	⊙	⊙	
Economic Dependence on Fisheries	O	O	O
Limited Alternative Livelihoods	O		
Political Disputes/Conflict/Instability	O		
POLICY & GOVERNANCE			
IUU	O	O	O
Bi-Lateral/Multi-Lateral Agreements	O	O	O
Limits in Infrastructure and Capacity:			
Policy and Legislation (defined and current)			
Management			
Regulation and Enforcement		O	O
Coordination and Participation			O
Technical Capacity	O		
Knowledge Gaps (Scientific Data/Information)			
Monitoring and Science for Decision Making			
Political Will and Corruption	O		

Pacific Islands

The Pacific Islands region includes all of the 23 island nations or territories of the tropical Pacific Ocean northeast of Australia and New Zealand, some of which have been inhabited by fisheries-dependent peoples for as long as 3,500 years. Total coastal fisheries production in the region is more than 100,000 tons per year, valued at more than US$260 million. About 70% of total harvest comes from coastal areas, with as much as 80% of the coastal catch from the subsistence sector (UNEP 2004). Nearly all offshore commercial fishing is done by foreign fleets; 14 countries in the Pacific Island have bi-lateral agreements with foreign fleets (primarily for rights to fish tuna) including the US, Japan, China, Korea, Taiwan and the EU, whose licensing fees comprise a substantial portion of regional government revenues (WCPFC 2002, CDPR 2009). Nevertheless, The Forum Fisheries Agency estimated that of the nearly 950 foreign vessels licensed to fish in the region in 2000, only 5% of the wealth generated was captured by the Islands (Pacific Expert Group on Climate Change). Tuna (skipjack, yellowfin, bigeye, and albacore), though fully- or over-exploited, is the main targeted commercial species, with a 2007 catch of approximately 2.4 million tons, valued at US$3.8 billion in the Western and Central Pacific Ocean Stocks, an all-time record representing 55% of global tuna production (Gillett 2002). Marlins, sailfish, mahi-mahi, wahoo, and sharks are significant by-catch from the commercial fisheries (FAO 2003). Additional export markets include the Asian aquarium and live-food fish trade.

Inshore, fisheries play a significant role in staving off rural poverty in small coastal communities, providing as much as 70% of dietary protein in many Pacific Island countries (SPC 2009). In the coming decade, population growth, urbanization, coastal development, and increased external demand (particularly from Asia), will drive increases in the value and volume of fisheries exports. This will place additional pressures on the ecosystem, likely leading to the persistence of overfishing, habitat destruction, pollution, and increased vulnerability of fisheries and the communities that depend upon them. Rising sea levels and warming surface temperatures will exacerbate existing pressures and create new challenges for the countries and territories of the region.

Melanesia

Background

The island countries and territories of Melanesia provide a wealth of marine resources, and are exceptionally diverse – with both rural, sparsely populated islands, and densely populated urban areas. Fiji is a major tourist destination whose 10,000 km^2 of reefs attracted more than 430,000 tourists in 2004. The reefs also provide a major source of food for local people (COS 2009).

Current Challenges

Overfishing by offshore commercial and artisanal/subsistence fishers poses significant threats to fisheries biodiversity and resources. Increased fishing efforts and new technology appear to be depleting offshore tuna species (Hunt 2003). The growing aquarium and ornamental coral trade in Fiji, the Solomon Islands, and Vanuatu, has intensified negative impact on coral reef ecosystem health (Guillaume, 2004). In response to these declines, the governments of Vanuatu and Solomon Islands have recently closed a number of lucrative export fisheries, most notably beche-de-mer; Papua New Guinea is expected to do the same in the near future (Foale 2008). Tenure and ownership of the reefs by indigenous peoples throughout Melanesia has been an important means for preservation and sustainable harvest. Unfortunately, this form of stewardship is slowly disintegrating (Oreihaka and Ramohia 1994).

Other fisheries threats include pollution from agricultural and industrial runoff, sewage, waste disposal, and oil spills as well as the erosion and sedimentation exacerbated by resource extraction and coastal development.

Future Challenges

In the coming decade, food insecurity will become a primary concern in Melanesia. Population growth and urbanization will create additional pressures on the export market, yet limits in existing capacity to meet this demand and growing rural populations may force a reduction in per capita fish consumption, driving up rural poverty and food insecurity (SPC 2009). Climate change impacts, such as sea level rise and warming surface temperatures, pose additional long-term and trans-boundary threats to both fisheries resources and dependent communities. Increased frequency of storms, flooding, coastal erosion, and saline intrusion will worsen, along with threats to built infrastructure, water quality, and increased losses of settled and agricultural lands (COS 2009).

Micronesia

Background

Micronesia comprises hundreds of islands spread over a large area of the western Pacific, and, compared to other regions of the world its marine systems are in good to excellent condition. The region supports some of the highest marine biodiversity in the world, containing 60% of all known corals species. Its high endemism harbors endangered and vulnerable species, including saltwater crocodiles, sea turtles, giant clams, and the world's most isolated population of dugong – a relative of the manatee (The Nature Conservancy 2008, in COS 2009). The region's fisheries and other marine resources are critical for the economic well being of Micronesia, since limited agricultural opportunities exist on many of the islands (i.e. Kiribati).

Key Challenges & Changes

Current

- Overfishing
- Destructive Fishing Techniques and Gear
- Coastal Development/Tourism
- Pollution (Sewage, Waste, Runoff)

Future

- Population Growth and Urbanization
- Economic Dependence on Fisheries
- Climate Change Impacts (Extremely Susceptible)

Key Fisheries at Risk

- Tuna (skipjack, yellowfin, bigeye, albacore
- High-value Invertebrates
- Giant clams, beche-de-mer, mangrove crab, lobsters, sea cucumber

Fisheries are valued at approximately US$4 million per year (van Beukering, Haider et al., 2007). In Nauru, the revenue from fisheries now accounts for about 30% of GDP, with a significant portion coming from licensing fees paid by foreign water fleets (Peter 2000). Tourism is also a major industry for some islands: Guam's reefs are valued at USD $127.3 million per year, with tourism accounting for 75% of this value (COS 2009).

Current Challenges

Overfishing by commercial fleets has caused ecological shifts, reducing stocks and biodiversity in marine areas across Micronesia. This has lead to economic losses and threatened food security (COS 2009, Goldberg et al. 2008). In Nauru, overfishing by artisanal/recreational/subsistence fishers has magnified these impacts, forcing a shift in target species from coastal to pelagic and deep ocean species (SPS

2005). The use of destructive techniques (poisons and bleaches) and gear (bottom trawls, dredges, gillnets, and longlines) has also had profound impacts on the ecosystem (COS 2009). Coastal development and associated land-based pollution (solid waste, sewage, agricultural runoff) are localized problems on many of the islands (Spalding et al.. 2001), while the construction of causeways, such as those in Kiribati, alter water circulation in lagoons and interrupt migration patterns of spawning fish (Spaulding et al.. 2001).

Future Challenges

In the coming decade, population growth and urbanization will compound pressures on fisheries resources. On Nauru, phosphate reserves are expected to be exhausted in the near future, ending 80 years of export revenues, and leaving fishing as the only economic fallback for people in the region (WHO 2008). The impacts of climate change are already evident in many of the Micronesian islands (i.e. coral bleaching and flooding), but future transformations pose critical challenges to the long-term environmental, social and economic integrity of the Micronesian islands. The environmental implications of warming waters and rising sea levels under climate change include acidification, intensified frequency and severity of storms and typhoons, salt water intrusion into freshwater supplies, and shifts in species composition (Gaffin and Oneil 1977, IPCC 2007, in COS 2009). Sea level rise could also seriously threaten social and economic infrastructure in many part of Micronesia; an 80 centimeter rise in sea level would inundate two-thirds of Kiribati, threatening its entire human population (IPCC 2007, in COS 2009).

Polynesia

Background

Polynesia consists of more than 1,000 island countries and territories, ranging from very large, high continental islands, to offshore islands, coral limestone islands, and numerous atolls. A network of more than 6,700 km^2 of coral reefs support fishing, tourism, and the black pearl industry, the latter worth US$150 million in annual exports (Adams, Bell et al., 2001). Subsistence and commercial (coastal and offshore) fishing are conducted in approximately equal measure (Gillett 2007), with reef fish and coastal pelagic fish being the most commonly harvested species throughout the region (COS 2009).

Key Challenges & Changes

Current

- Overfishing
- Destructive Fishing Techniques and Gear
- Coastal Development/Tourism
- Sedimentation and Pollution

Future

- Climate Change Impacts (Extremely Susceptible)
- Intensity and Frequency of Storm Events

Key Fisheries at Risk

- Tuna (skipjack, yellowfin, bigeye, albacore
- High-value Invertebrates
- Giant clams, beche-de-mer, mangrove crab, lobsters, sea cucumber

Current Challenges

Subsistence-based and small-scale commercial operations harvest inshore fisheries heavily and show signs of overexploitation. Shallow fisheries are intensely overfished and commercial fishing has had a severe impact in the Hawaiian Islands, Samoa, Tuvalu, and Tonga (COS 2009, FAO 2003). The marine ecosystem is also stressed from the use of destructive fishing practices and gear by

commercial fisheries, and explosives in inland reef fisheries. Land based-threats include habitat destruction and shoreline modification from coastal tourism development, sedimentation, coral sand mining, dredging, and ocean reclamation. Nutrient and chemical pollution from agriculture, sewage, waste disposal, and industry is pervasive. Rapid population growth and increases in exports have also contributed to overexploitation of fisheries resources in the region.

Future Challenges

Climate change-related sea level rise and warming surface waters comprise the major long-term threat to Polynesian fisheries resources. The frequency and intensity of storms and cyclones are expected to escalate, heightening the potential for damage to fisheries habitats, such as shallow reefs, seagrass beds, and mangroves, and risking increased occurrence of coral bleaching and potential shifts in species composition. Rarely rising more than three meters above sea level, Tonga, Tuvalu, and the Cook Islands, are at risk of total inundation from sea level rise (COS 2009). Socioeconomic costs include changes in water quality from saltwater intrusion, losses from tourism, agriculture, and reduction of land area suitable for human settlements resulting from inundation.

Table 6: Current and Future Challenges and Changes – Polar Regions

CHALLENGES & CHANGES O = Current ⊙ = Current & Future ⊘ = Future	ARCTIC	ANTARCTICA
OVEREXPLOITATION		
Overfishing	⊙	⊙
Overcapacity	⊘	
By-catch	⊙	
HABITAT DESTRUCTION		
Coastal Development/Tourism	⊙	
Destructive Fishing Techniques/Gear	⊙	⊘
Urban/Industrial/Port Development		
Invasive Species	⊘	
LAND-BASED POLLUTION		
Urban Sewage and Solid Waste (Nutrient Loading and Eutrophication)		
Sedimentation	O	
Pollution/Runoff (Industrial and Agricultural)	⊘	
MARINE-BASED POLLUTION		
Harmful Algal Blooms (HABs)		
Ocean/Industrial Activities (Including Shipping, Ballast Water, Marine Mining, Oil and Gas Exploration)	⊙	
Oil Spills	⊙	
Aquaculture		
CLIMATE CHANGE		
Sea Level Rise		
Changes in Water Temperature	⊘ (Melting Sea Ice)	⊙ (Melting Sea Ice)
Storms/Flooding/ENSO Events		
Ocean Acidification	⊘	⊘
MARKETS & TRADE		
Foreign/Distant Water Fleets	⊙	
Increased Demand		
Expanding Markets (Local/National/International)	⊙	⊙
New Oil and Gas Exploration/Development	⊘	
International Shipping	⊘	
SOCIO-ECONOMICS		
Poverty		
Population Growth/Urbanization		
Food Insecurity/Health		
Economic Dependence on Fisheries	⊙	
Limited Alternative Livelihoods	⊘	
Political Disputes/Conflict/Instability	⊘	
POLICY & GOVERNANCE		
IUU		⊙
Bi-Lateral/Multi-Lateral Agreements		
Limits in Infrastructure and Capacity:		
Policy and Legislation (defined and current)	⊙	⊙
Management		
Regulation and Enforcement	⊙	⊙
Coordination and Participation	⊙	⊙
Technical Capacity		
Knowledge Gaps (Scientific Data/Information)	⊙	⊙
Monitoring and Science for Decision Making	⊙	⊙
Political Will and Corruption		

Polar Regions

The polar regions of the Arctic and Antarctica are characterized by an extreme photoperiod, low temperatures, and snow and ice. Though these regions have seen their marine environment disturbed by fishing activities, many areas remain among the most pristine in the world. The challenges of IUU and sustainable fisheries management are of relatively greater importance to the Antarctic region., however, the capacity of marine ecosystems to withstand the cumulative impact of multiple pressures is of concern to both regions (Clark and Harris 2003). Climate change impacts present serious threat in the future to both regions; however, it may be more critical to the Arctic region in the immediate near term, poses a serious threat to both regions in the long term.

Arctic

Background

The Arctic Ocean is a bordered by continental landmasses of Eurasia, North America, and Greenland, and influenced by surrounding populations and industrial and fishing activities. Nearly 70 percent of the world's white fish supply originates in the Arctic, including Russian Alaska Pollack and Barents Sea cod, both at risk and the object of heavy illegal fishing. Because few species dominate in the region, there is virtually no by-catch, though overfishing can have significant effects. Countries need to fill gaps in policy and knowledge to address climate impacts, and to reaffirm agreed norms and standards for governance of the territory, as changing stock distribution may change the basis for allocation among states.

Key Challenges & Changes

Current

- Overfishing
- Ocean/Industrial Activities
- Pollution
- Scientific Data and Information

Future

- Climate Change Impacts
- New Oil and Gas Exploration
- International Shipping
- Overfishing

Key Fisheries at Risk

- Atlantic Cod
- Whales because of increase in Krill (Eastern Bowhead, beluga, and narwhale)

Current Challenges

In addition to IUU, oil and gas extraction in the Arctic region poses significant localized risks from oil spills, infrastructure leakages, and operational issues such as noise, physical disturbance from construction, and waste discharge (Clark and Harris 2003). Contaminants such as POPs and heavy metals can interfere with reproduction, immune/neurological functions, as well as cellular and subcellular biological functions. Growth in tourism and the development of the International Northern Sea Route is expected to create increased potential for pollution and accidental spills, with attendant impacts on fisheries.

Future Challenges

The ecological impacts of climate change pose a great concern for the Arctic. Reductions in sea ice, with longer periods of open water and warmer water temperatures have direct implications for ice-dependent species, primary productivity within the food web, species distribution, and the prevalence and spread of disease. Sinks of pollutants (mercury, PCBs, cadmium), currently stored in the Ice Cap, will be released into ocean surface waters and eventually the food chain. New areas will be open to fishing, and the Northern Sea Route (Russian Arctic) and the

Northwest Passage (Canadian Arctic) will open to shipping traffic and industrial development, adding pressures from wastes, noise, spills, and accidents (Clarke and Harris, 2003). The US closed its Arctic waters to industrial fishing in December 2009 to establish a science-based, decision-making process (Pemberton 2009). Indigenous people of the Arctic are particularly ill-equipped to accommodate the impacts of climate change on fisheries resources, their communities and traditional lifestyles.

Antarctica (Southern Ocean)

Background

The Southern Ocean is remote from major population centers and sources of pollution, but incorporates sovereignty claims from seven countries. (Under the Atlantic Treaty (1959), 21 of the 28 consultative nations agreed to make no claims to Antarctica, and do not recognize the claims of the other nations) (Norwegian Polar Institute) Because of its remoteness, there are exceptionally low levels of pollutants and contaminants, and relatively little oil and gas exploration. Cruise ships bring 10,000 to 15,000tourists each year, augmenting the small summer population of scientists and researchers. Main commercial fisheries include crab and krill (NOAA 2009).

Key Challenges & Changes

Current

- IUU

Future

- Climate Change Impacts

Key Fisheries at Risk

- Patagonian Toothfish (Chilean Seabass)
- Krill

Current Challenges

IUU is said to account for five to six times reported catch data in the region (NOAA 2009) and has pushed the Patagonian toothfish (Chilean Sea Bass) to the verge of collapse. Expansion of the krill industry to meet international demand for aquaculture feed and the pharmaceutical industry--exacerbated by new technology and continued IUU in the region —threatens the base of the food web in the region, with significant implications for fisheries and dependent communities beyond (Owen 2003).

Future Challenges

Climate change presents the greatest long-term threat to the region (Clarke and Harris 2003). Warming waters will enable predatory species to return to the region for the first time in millions of years, fundamentally altering ecological relationships in the system (Science Daily, 2008), and are believed to have caused the disintegration of seven ice shelves during the past 50 years. Increases in UV radiation from the ozone hole may cause changes to phytoplankton communities, and the food chain, in turn. Shrinking sea ice will reduce krill habitat, and increase the rate at which icebergs scour the seabed, threatening damage to marine fisheries habitat (Telegraph 2008).

Comparative Regional Analysis and Synthesis of Cross-Cutting Issue Areas

Table 7. Primary Issues of Concern by Region

PRIMARY ISSUES CONCERNS ■ = Significant ■ = Most Severe	AFRICA	ASIA	LATIN AMERICA	PACIFIC ISLANDS	POLAR REGIONS
CURRENT & FUTURE CHALLENGES					
Overfishing	■	■	■	■	■
Overcapacity & Bi-catch	■	■	■	■	■
Destructive Fishing Techniques/Gear	■	■	■	■	■
Coastal Development/Tourism		■	■	■	
Land-Based Pollution	■	■	■	■	
Shipping Impacts (Oil Spills, Invasive Species)	■	■	■		
FUTURE CHALLENGES					
Changes in Water Temperature	■	■	■	■	■
Storms/Flooding/ENSO Events	■		■	■	
Ocean Acidification	■	■	■	■	■
DRIVERS					
Poverty	■	■	■		
Population Growth/Urbanization	■	■	■	■	
Food Insecurity/Health	■	■	■	■	
Economic Dependence on Fisheries	■	■	■	■	■
Limited Alternative Livelihoods	■	■	■	■	■
Limits in Infrastructure and Capacity	■	■	■	■	■

In all five regions, fisheries resources and biodiversity are challenged by a number of issues, generated by a variety of interdependent drivers behind them. The table above provides an overview of the significant and most severe challenges and changes.

Fisheries Trends

Following is a summary of common trends we identified in the literature across the regions and sub-regions:

- "Fishing down the food chain" is occurring in all regions of the world's oceans;
- Highly migratory species, such as tuna and shark are overfished in all regions except the Polar regions, where tuna and commercial shark species do not currently choose to live;
- High-value invertebrates being sold to foreign markets – lobster, crab, giant clam, beche-de-mer, shellfish, and conch – are overfished in Pacific Islands, Latin America, and Asia;
- Small pelagic species, such as anchovy, pilchard, mackerel, sardines, and others are used for fish farming and aquaculture and are at risk in all regions outside of the Poles, though krill are being exploited on an ever-increasing scale in these areas;

- Top predatory reef species, such as grouper and snapper, are overfished in Latin America, Africa, and the Pacific Islands. The impacts of diminishing populations are of particular importance to these species because they are aggregating spawners;
- Africa has more incidence of exploitation in all fisheries than any other region – inshore, nearshore, pelagic, migratory, demersal, and benthic. With the exception of South African waters, this overexploitation is being caused by foreign fleet takes;
- Reliable fisheries data is extremely limited for Asia. Thus, the current state of the fisheries in this region is largely unknown. Old and limited data exists in many other regions as well.

Current Global Challenges

Many of the challenges facing deep-water and coastal fisheries today will likely extend into the coming decade, as the entrenched institutional drivers and relationships behind these pressures on fisheries resist easy resolution. Literature and experts identified these issues as current areas of common concern: overfishing, habitat destruction, pollution, and socio-economic considerations pose the most significant global threats to marine fisheries biodiversity and resources.

Overfishing is an extensive issue in essentially every sub-region reviewed, though it is most severe in Africa and Asia. Overcapacity and by-catch are present in all regions of the world, though much more intense in Africa, Asia and Latin America.

The most predominant source of habitat destruction is the use of destructive fishing practices and gear. This is an enormous problem in all regions; there is a critical need for the creation of innovative and less-destructive fishing gear, and effective channels for technology sharing and transfer. Coastal development and tourism impacts are also on the rise, with significant destructive effects from this source already evident in Asia, Latin America and the Pacific Islands.

Land-based pollution sources are an issue of grave concern in all regions outside the Polar areas, where small populations yield far less relative contamination. Marine-based pollution is also present everywhere, but less severe, the sources of most concern being oil spills, transport and industrial activities. Shipping hotspots, such as the South China Sea, Canary Current, and the Eastern Equatorial Current/Caribbean Sea (Panama Canal), pose significant marine pollution problems and are enabling increased transfer of invasive species.

Future Global Challenges

Climate change impacts are of increasing concern, and are expected to add new sources of pressure to global fisheries and coastal communities. Each of the five sub-regional African currents is particularly vulnerable to the climate impacts on fisheries, given their heavy dependence on fish for food and economy, and the limits to societal capacity for adaptation (Allison, et al.., 2009). Vietnam, Cambodia, and Bangladesh, in South and Southeast Asia, are similarly vulnerable to fisheries impacts, as are Peru and Columbia in Latin America (Allison, et al.., 2009). Changes in water temperature will lead to a shift in species composition and population sizes in all regions. Ocean acidification will impact all regions as well, though the impacts will be more severe in the Pacific Islands and Polar regions. The Bay of Bengal,

Somali Coastal Current, Sulu-Celebes, and Indonesian Seas are home to some of the most biodiverse coral reefs in the world, and are also at the greatest risk to climate change impacts due to their limited capacities to adapt. Africa, Latin America and the Pacific Islands are particularly vulnerable to increased storm events, flooding, and the impacts of the El Niño Southern Oscillation (ENSO).

In response to growing populations and increased demand, continued expansion of marine aquaculture is expected. However, without sufficient scientific data and management capacity, aquaculture places significant additional pressures on fisheries resources and biodiversity, via escapes and disease, increased biomass demands to feed carnivorous stocks, and habitat destruction to accommodate farms.

Current and Future Drivers

Population growth, economic dependence on fisheries, and limited alternative livelihoods are the biggest socio-economic challenges placing pressures on global fisheries. Countries of South and Southeast Asia, , and the countries of East and West Africa suffer particular poverty that drives subsistence and small-scale fishing as a primary means of protein and livelihood.

Even the most remote areas (i.e. Polar, Pacific Islands) are at risk of increased overfishing from expanding markets and nutritional demands of growing global populations. Food insecurity and health are already of great concern in all regions except Polar, and are expected to intensify in the future. The development and implementation of programs that effectively address alternative livelihood training and offer strategies for increasing food security are greatly needed throughout world. Political disputes, conflict or instability is also present in most regions. IUU is also an issue almost everywhere, except Latin America. Foreign water fishing fleets are responsible for IUU fishing in all regions.

Limits to infrastructure and the capacity to create, implement and enforce more sustainable fisheries practices are significant in all regions, though the specific challenges and most pervasive limits vary greatly by region. Nevertheless, all regions would benefit from increased coordination, technical capacity-sharing, and better monitoring and enforcement programs.

Section 4: Current Partners and Projects and Examples of Success in the Regions

A question central to marine fisheries and biodiversity conservation is how to transform fisheries management regimes in a way that reduces pressure on marine resources, while still enabling countries to feed their people, and realizing both in a sustainable way. The answer is different for different places, contexts, scale, and objectives. Biodiversity conservation is a focus of paramount concern for coral reef fisheries around the world. Reduction of poverty and malnutrition assume primacy of place in Bangladesh, and the East and West coasts of Africa. Challenges on the equitable and sustainable distribution of resource supply and consumption leads to questions about the terms of bi-lateral fishing agreements and the prevalence of IUU. Several experts (Worm et al.. (2009), Allison et al. (2009), Collier (2007), among others) emphasize that the feasibility and value of different management tools and approaches depend heavily on locally-specific characteristics of the fisheries, ecosystem, and governance systems.

Below is a discussion of the current institutional landscape of organizations and funders that are working in support of marine fisheries, in relation to biodiversity conservation and sustainable development. The section

continues with a review of successful and innovative approaches, cross-cutting themes and ingredients for success, potential for measurement and replicability, and some areas where innovation is still needed achieve long-term sustainability in marine fisheries and their associated communities.

Institutional Landscape of Organizations and Funders Working on Fisheries

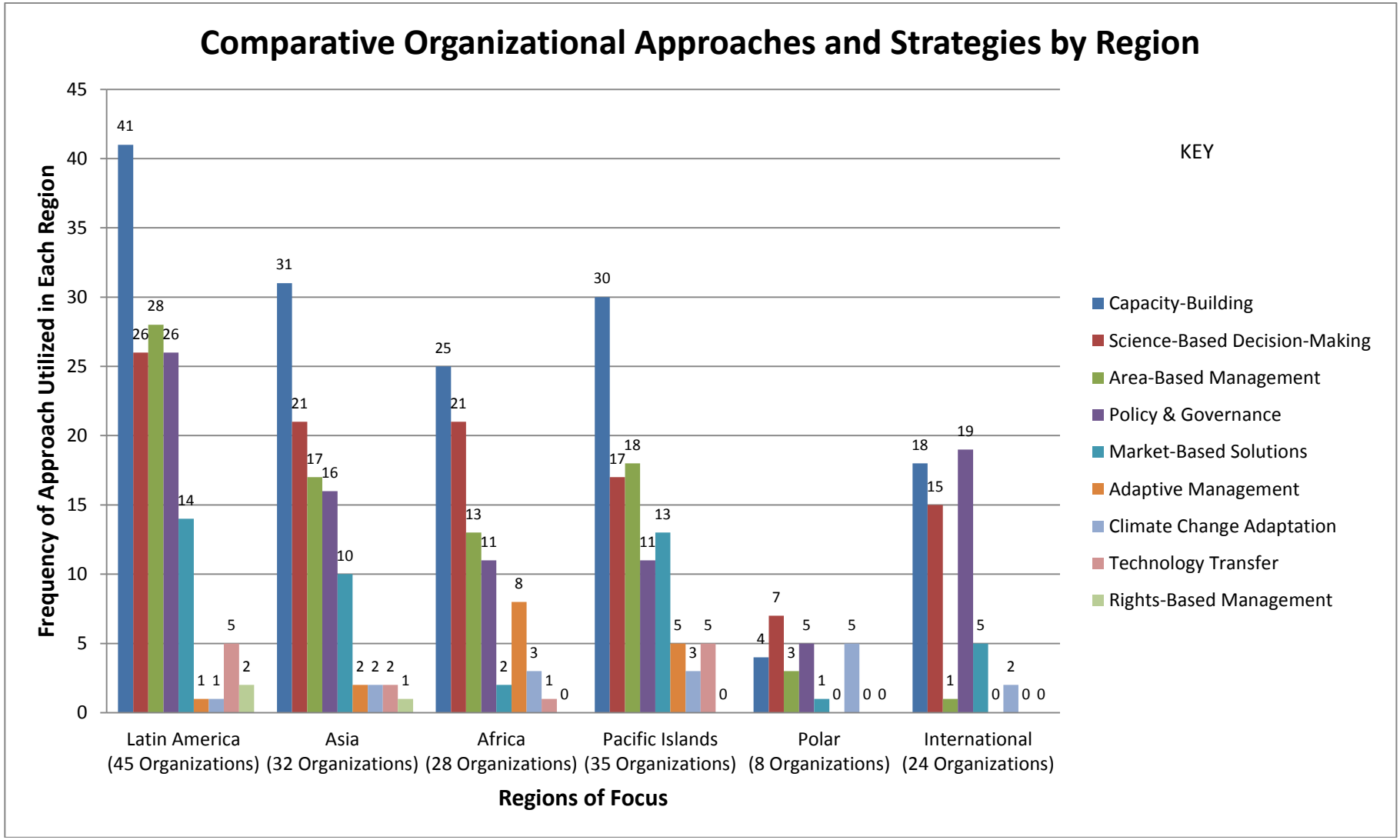
There is a deep institutional landscape of organizations and funders working on marine fisheries biodiversity conservation, restoration, sustainable management and development in the five regions of focus.

Through informants, our own expertise, and web-based research, we identified 172 NGOs, IGOs, governmental, or other types of organizations working in Latin America, South and Southeast Asia, Africa, the Pacific Islands, and the Polar regions, and worldwide, employing nine distinct categories of approaches to marine fisheries resources[1]. Capacity-building efforts (87%), science-based decision-making (62%), policy and governance (51%), and area-based management (47%) are the most common approaches being utilized across all approach categories and regions by implementing organizations. Market-based solutions comprise 26% of approaches, with efforts at climate change adaptation, technology transfer, rights-based and adaptive management each representing 3% or less of the efforts in practice.(See Appendix B for definitions of the various approaches, and for Figure 1, Comparable Organizational Approach and Strategies by Region).

We found that there are slightly more organizations working in Latin America than in any of the other regions (45 organizations, 26% of the total), with the greatest emphasis on efforts toward capacity-building, followed by science-based decision-making, policy and governance, and area-based management. Figure 1 illustrates existing organizational capacity by region and approach implemented in the five regions studied. The Pacific Islands, South and Southeast Asia, and Africa have comparable organizational representation, with 35 (20%), 32 (19%), and 28 (16%) active organizations respectively. The approaches taken in these three regions follow the same hierarchy as in Latin America, with capacity-building as the most common organization practice. Efforts to establish area-based management approaches take precedence in Asia and the Pacific Islands, which is natural, given the prevalence of small-scale fisheries, national jurisdiction over occasionally enormous and remote marine areas rich in biodiversity, and the level of support from private foundations for these efforts. Science-based management efforts are more prevalent in Asia and Africa. Efforts to address policy and governance issues are relatively few in Africa (less than half of the organizations are utilizing this approach there), which is hardly surprising, considering the much-recognized absence of governance capacity in the region.

[1] Many of these organizations have programs in more than one region and therefore are listed more than time.

Figure 1 – Graphic of Comparative Organizational Approaches and Strategies by Region[2].



[2] We assessed categories based on available information.

There is equal effort in place from organizations working on technology transfer (i.e. improvements in gear) and market-based solutions (i.e. certification, improving practices along the supply chain, payments for ecosystem services) in Latin America and the Pacific Islands. Across Latin America, Asia, Africa and the Pacific Islands, there are marginal efforts organized around rights-based (i.e. catch-shares, quotes, and coops) and adaptive management (i.e. monitoring, evaluating and testing management tools to improve and change tools and practice over time). It is notable that Africa has more organizations working adaptive management than other regions, with 8 organizations implementing this approach as a key strategy. No region has more than a few organizations focused on climate change adaptation, even though this area of concern is expected to pose a significant challenge in Asia, Africa, and the Pacific Islands in the coming decades. With their unique environments, history of exploration, and future challenges, the Polar Regions enjoy the attentions of only eight organizations, employing nearly equal emphasis on science-based management, climate change adaptation, policy and governance, and capacity building. Their work naturally crosses boundaries and requires collaborative efforts to address the challenges facing fisheries and biodiversity in the northern and southern oceans. Efforts to establish area-based management appear to be increasing, as the Polar regions open up to more commercial fishing and shipping traffic under climate change, and sovereign nations consider new ways to protect the waters under their jurisdictions.

Funding Capacity Supporting Efforts on Fisheries Biodiversity and Sustainability

We identified 84 bi-lateral, multi-lateral, government, or private funders supporting fisheries, organized around seven different types of program focus, and funding nine different approaches, or strategies. Across all of the regions, 60 funders finance marine fisheries management (71 %), 48 funders support marine fisheries conservation (57%), and 41 are supporting sustainable fisheries development (49%) as main areas of programmatic focus (See figure 2 below). The distribution of funders' approaches mirrors that found in the regional organizations cited above, with capacity-building the most frequent approach, funded by 77 (92%) , followed by 47 funding policy and governance(56%), then area-based management in 43 instances (51%), and science-based decision-making in 40 instances (48%). See Appendix B for definitions of the various types of funders, Figure 2for Comparative Funding Capacity by Programmatic Focus, and Figure 3 for Approaches Funded for Marine Fisheries by Region.

Latin America and the Pacific Islands have the highest number of funders (28% and 21%, respectively), followed by Asia (12%). Marine fisheries management is the primary programmatic focus across all five regions, followed by fisheries conservation in Latin America, Asia, the Pacific Islands, and the Polar regions. In Africa, sustainable development was the second most common focus, after management. Marine fisheries restoration represents only 18% of programmatic support from funders, with equal numbers of programs s in Latin America, Asia, and the Pacific Islands (4 programs each). Programmatic support for ecosystem conservation and research was fairly minimal in each of the regions, with the exception of the Pacific Islands and funders working internationally, where a quarter of funders in the Pacific Islands support restoration(4 programs) and 5 programs finance research. Programs with cross-cutting focus were funded in all of the regions. Internationally, funders spread out their support more evenly, with at least 20% of the 9 major funders giving to restoration, conservation, and cross-cutting issues each.

Figure 2. Comparative Funding by Programmatic Focus, by Region

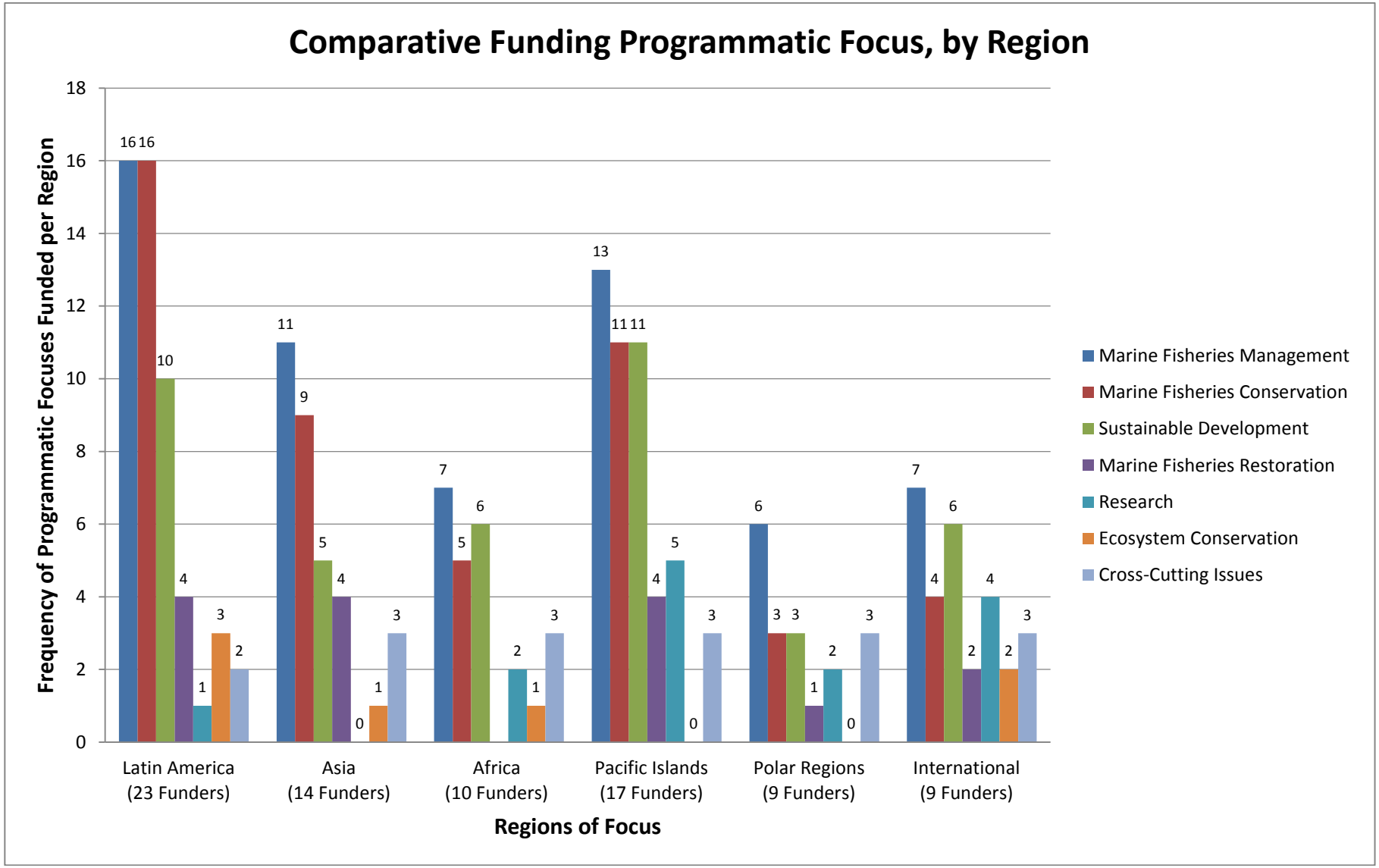
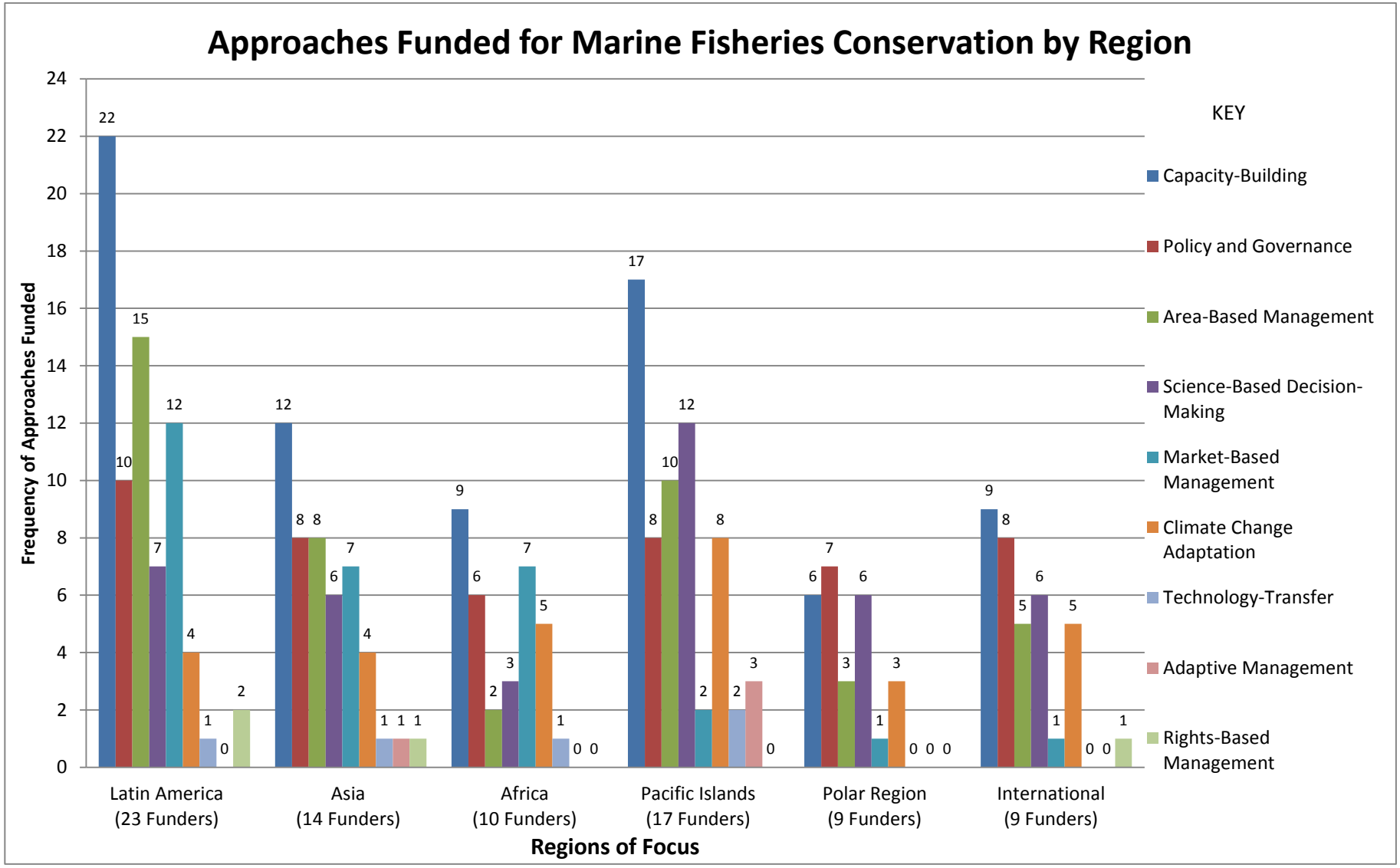


Figure 3. Comparative Funding by Approach, by Region



Highly Effective or Innovative Approaches to Sustainable Marine Fisheries and Biodiversity Conservation

In the course of our analysis of the institutional landscape of organizations and funders working on fisheries issues, we identified 56 case studies (Appendix E) that represent examples of successful or innovative approaches to sustainable fisheries and associated communities. As shown in Table 8, the majority of projects or programs were either local (41%) or transboundary (30%), with more than one third implemented by a partnership among different types of organizations. Overfishing and IUU fishing were the overwhelming threats being addressed (52% and 48%, respectively), with gaps in knowledge and by-catch at 36% and 30%, respectively. Community-based management was the primary approach taken in 36% of the cases, with MPAs the second most-used approach in 11 cases (20%)

Table 8. Highly Effective or Innovative Cases Studies – Pool of 56 Case Studies

Project/Program Implementation Scale	Type of Implementing Organization	Threats Addressed	Approach/Strategy	Measures of Success
• Local 41% (23) • Transboundary 30% (17) • Regional 14% (8) • State 14% (8)	• Mixed 36% (20) • Government 21% (12) • IGO 20% (11) • NGO 16% (9) • Other 7% (4)	• Overfishing 52% (29) • IUU fishing 48% (27) • Gaps in Knowledge 36% (20) • By-catch 30% (17) • Land-based Pollution 25% (14) • Destructive Fishing 20% (11) • Lack of Monitoring/ • Enforcement 20% (11) • Coastal Development 11% (6) • Climate Change 9% (5) • Increasing Demand on • Fishery 5% (3) • Marine Pollution 4% (2)	• Community-based Management 36% (20) • MPAs 20% (11) • Education 19% (10) • Exclusive Access to Fishery 9% (6) • Alternative Livelihood Training 9% (5) • Sustainable Tourism 9% (5) • Individual Transferable Quota (ITQ) 4% (2)	• No measure/Not known 53% (30) • 48% addressed Biological Factors (27) • 43% addressed Socio-economic Factors (24) • 41% Addressed Governance Factors (23) • 16% Addressed Socio-cultural Factors (9) • 7 % Addressed Economic Factors (7)

Table 9 Highly Effective/Innovative Case Studies – 14 Best Cases

Implementation	Type of Organization	Threats Addressed	Approach/Strategy	Measure of Success
• Local (7) • State (3) • Trans-boundary (2) • Regional (2)	• Mixed (5) • Government (4) • NGO (3) • IGO (1) • Other (Private) (1)	• 93% Overfishing (13) • 50% IUU fishing (7) • 36% Lack of Monitoring/ • Enforcement (5) • 36% Gaps in Knowledge (5) • 29% Destructive Fishing Practices (4) • 29% Land-based Pollution (4) • 21 Increasing Demand on Fishery (3) • 14% By-catch (2) • 7% Climate Change (7) • 7% Coastal Development (7)	• Education/Outreach 64% (9) • MPA 36% (5) • Sust. Dev 36% (5) • Co-Mgt 36% (5) • M&E 36% (5) • No-take Zones 36% (5) • PES 21% (3) • Controlled Access 21% (3) • Cross-cutting 14% (2) • Gear Exchange 14% (2) • Concession 14% (2) • Certification (1) • Non-transferable User Rights (1) • Sust. Tourism (1) • Alternative Livelihood Training (1)	• 100% Measures of Success • 100% Addressed Biological Factors (14) • 86% Addressed Socio-economic Factors (12) • 71% Addressed Governance Factors (10) • 50% Addressed Economic Factors (7) • 50% Addressed Socio-Cultural factors (7)

Highly Successful or Innovative Case Studies

From these 56, we selected 14 cases (Appendix E) that illustrate highly effective or innovative approaches to fisheries biodiversity conservation and restoration, effective management, and sustainable development. This subset of cases were selected based on recommendations by expert informants, the availability of measurable impacts on fisheries and community resiliency, potential for replicability in developing countries, the depth of literature, the longevity of the project or program, and Blue Earth Consultants' in-house expertise and resources. The majority reflect collaborative partnership efforts, with half working at the local level, and taking a wide variety of approaches. Some of these 14, as well as some in the larger pool of 56, require more institutional infrastructure, and governance capacity than is common in many developing countries, but given the cases' success and innovation, and the potential lessons that may be scaled for application elsewhere, we include them here for consideration.

The case studies each present a variety of attributes that have proven successful or innovative in supporting fisheries and biodiversity, while also supporting communities and economies that rely on the fisheries for livelihoods, food security, and economic development. The 14 highly-effective case studies are presented in Appendix F. The case studies were selected based on depth of available information, potential for replication, and overall impact.

Engaging Stakeholders, Cross-cutting Collaboration, and Development of Alternative Livelihood:
The most common attribute of the highly successful cases we examined is the breadth of stakeholder participation in the process of identifying the problem, and deriving and implementing the solutions. The success of one small-scale integrated management scheme in Kenya was indicative of many. Small-scale fishers who were educated on the data of their overexploited reef fisheries, and brought into the process to derive and implement solutions, made the decisions to close some areas to fishing and to discontinue use of particularly harmful gear – small-mesh nets and harpoon fishing. The result has been measureable increases in catch per unit effort (CPUE), increased species abundance on the reef, overall ecosystem health, and better locally-managed fisheries (Case #1). Such cross-cutting stakeholder collaboration and engagement was also instrumental in five other highly successful cases: drafting legislation for community enforcement of MPA rules in the Coral Triangle, unique in its explicit focus on climate resiliency as a goal (Case #4); drafting terms for bio-prospecting agreements with pharmaceutical interests for more than 300 local communities, which now fund marine conservation and management in Fiji and has fostered the development of alternative livelihoods (Case #6); the organization of 23 community-based, no-take octopus protected areas in Madagascar have resulted in measurable increases in size and abundance of the octopus, and improved understanding of food security and management issues by fisheries managers in the area (Case #10); the establishment of Non-Transferrable Individual Quotas (NTIQs) and co-management of the *loco* (false abalone) resource in Chile, (Case #13); the establishment of management and use rights, research and monitoring mechanisms, and Individual Vessel Quotas (IVQs) for the geoduck resource in British Columbia, (Case #9).

Stakeholder-driven Solutions.
One winning design in the World Wildlife Fund's International SmartGear competitions – challenging fishermen, fishing groups, universities, and others to improve on fishing gear to reduce by-catch -- was the turtle exclusion devices (TEDs) now required by law in Mozambique to prevent sea turtle by-catch in the country's fishing industry (Case #2). On the southwest coast of Africa, the national marine institutions of Namibia, Angola, and South Africa share information, science, management technologies and research capabilities under the BENEFIT program, which has resulted in coordinated IUU monitoring efforts among them (Case #8). Similarly, in the

Antarctic, the Convention on the Conservation of Antarctic Marine Living Resources (CCAMLR) created a Catch Documentation Scheme that has enabled international collaboration among the 25 countries of the Southern Ocean, and has resulted in greater monitoring and enforcement capacity against IUU in the krill and Patagonian toothfish fishery, as well as collaborative data collection and scientific research (Case #14). Private industry stakeholders along the supply chain are also increasingly driving sustainable solutions, as unsustainable harvest and IUU threatens to drive them out of business. In the Barents Sea Cod fishery, processors used their political and economic clout to successfully advocate for catch limits on the fishery, and push the government to step up monitoring and enforcement, as a way to protect the resource and their livelihood from over-exploitation. Subsequent illegal landings in 2009 were down by more than 80% from 2005 levels, and in 2009, the Norwegian government revised the 2010 quota to within precautionary limits (Case #3). In another example of stakeholder pressure influencing changes in policy, though at a much higher scale, NGOs (Longitude 181 Nature, and all 70 members of the Shark Alliance) pressured the EU Council of Fisheries Ministries to officially adopt the European Commission's Plan of Action for Sharks (Longitude 181 Nature, 2009).

Area closures, Marine Protected Areas (MPAs), Non-Transferrable Individual Quotas (NTIQs), and Individual Transferrable Quotas (ITQs)

Limited access, marine protected areas, and rights-based fishing can also be effective approaches to safeguarding fisheries resources and the communities that depend upon them. Eight of the 14 examples of highly effective cases here included some component of closure and exclusive rights fisheries, with resultant improvements in the size and abundance of the fisheries resource and ecosystem conditions, local or regional economic returns, and the development of community-based management capacity. There are many more examples of area –based closures that are well documented in the list of 56 case studies such as Apo, Chumbe Island, Cook Island, Komodo Island, Bahía Magdelena, and Bolama-Bijagos, among others. Area closures in the Kenyan coral reef fisheries (Case #1) reduced exploitation levels and enabled regeneration of the fishery, as in the British Columbia geoduck fishery (Case #9) and the FEDECOOP MPA (Case #12), now an MSC-certified sustainable fishery in Mexico, and the no-take zones for the Chilean *loco* fishery (Case#13). In Kenya, as in the network of MPAs established in the Pacific Islands' Coral Triangle (Case #4), the MPAs are intended to enable greater reef resiliency to withstand future impacts from climate change. In some cases, very large (EEZ-scale) protected areas are emerging as a new and major conservation tool to protect against overexploitation by distant water fleets. The South Pacific Phoenix Islands (PIPA) MPA was created to safeguard the ecosystem from IUU fishing by international fleets, and is now the largest MPA in the world at more than 400,000 square kilometers, now under extensive scientific research on the implications for ecosystem, reef, and fisheries health (Case #5). In Palau, the government has created the world's first shark sanctuary, of 621,600 sq km^2, including its EEZ, and may become a "no-take" region in the future, though enforcement may prove challenging (Heilprin, 2009, Informant interview).

Smarter Fishing through Innovations in Gear Technology and Marine Spatial Management

In addition to the Smart Gear competition (Case #2), Canadian efforts to lessen the impact of gear on by-catch includes the collaborative work of the Ecology Action Center and Marine Conservation Biology Institute to gather gear-impact data in Atlantic Canada. In Case #1, Kenyan managers utilized a small mesh net and harpoon gun gear exchange with artisanal fishermen to allow reef fish to reach spawning size before being captured.

Financial Support to Implement Change

Successful and innovative efforts to protect marine fisheries resources and ecosystems follow creative funding efforts and mechanisms. The Smart Gear competitions incentivize innovation and disseminates information and new technology through $50,000 prizes(Case #2); the PIPA MPA is funded by "reverse fishing licenses" paid to the government, equal in amount to that which would have otherwise been collected from license sales (Case

#5); and a foundation fund, comprised of reef bio-prospecting royalty fees, finances marine conservation and local marine management in Fiji (Case #6). Further, in the Philippines, the government made tax-exempt lands available for lease to community development organizations that agreed to protect mangroves in the course of their development plans. As a result, more than 5,500 hectares of mangroves have been protected as a condition of 62 community-based Forestry Management Agreements (Case #11). Sustainable financing mechanism is also helping to support the Komodo Island Marine Reserve in Indonesia.

Market- and Industry-based Approaches: Sustainable Supply Chain and Payments for Ecosystem Services (PES)
Increasingly, markets for sustainable seafood supply are driving changes in behavior on the water, in the ports, and in Western supermarkets and restaurants. In the Barents Sea, fisheries processors used their political capital to convince Norwegian government ministers to institute catch limits and bolster monitoring and enforcement of IUU, creating a political counterweight to vested interests to keep open access (Case #3). Also in the Barents Sea, in response to high IUU in the cod fishery, 85% of the major European importers agreed to a common contract requiring legal verification of the catch by the suppliers, with verification by independent third-party auditors: those suppliers without verification could not sell to any of the participating buyers or land their catch in the ports of complying countries. In differently remote places, sorting out the requirements of the supply chain for the aquarium trade (storage, packing, transport, and links to export market), has enabled the development of a highly successful trade in the Solomon Islands in the cultivation of coral buds and cleaner shrimp for the western market aquarium trade, likewise for the sponge culture in Australia, seaweed and sea cucumber culture elsewhere in the Pacific Islands (Informant interview).

There are some good examples of effective Payments for Ecosystem Services (PES) in a marine environment. Fees for access and use of marine resources is not a new concept, but oftentimes the fees or permits for access are not priced for the true value of the ecosystem service and the fees received do not go towards the management of marine ecosystem. In Vietnam, the government imposed visitor- and user-fees for the Bay's storm-protection and tourism services. Despite low fees, sightseeing, and swimming and diving have generated more than US$100,000 and US$50,000 per year toward sustainable financing of the MPA, with 12% dedicated to local community development around the Bay (Case #7). While the PES model has potential application in many maritime systems, some experts advise caution, warning that effective PES regimes require monitoring and enforcement infrastructure and capacity, and unless carefully crafted, may have little direct return for small-scale development and local stakeholders.

Research, Information Sharing, Education
The trans-boundary nature of fisheries resources and integrated ecosystems that cross governance jurisidictions means that effective efforts for sustainable fisheries must be cross-cutting and collaborative as well. CCAMLR's Catch Documentation (Case #14), and the BENEFIT program on the southwest coast of Africa (Case #8) both represent highly effective examples of trans-boundary collaborative research and management efforts. Other effective educational efforts derive from developed countries, including consumer awareness programs that advocate sustainable fishing practices and educate consumers to make informed decisions about seafood consumption. In a survey by the Ocean Project, they found growing consumer awareness in the United States that individual seafood purchasing decisions impact ocean health, and people are willing to buy and pay more for seafood that is healthy and sustainable (Monterey Bay Aquarium, 2009). Consumer awareness, in the form of a 100,000-signature petition, was instrumental in the EU's Council of Fisheries Ministers decision to ban destructive practices such as shark finning (Longitude 181 Nature).

Ingredients for Success: Cross-cutting themes and elements of highly successful or innovative approaches

Some common themes and cross-cutting ingredients for success can be drawn from these cases, our conversations with expert informants, and additional research conducted in the course of the study, and drawing on in-house expertise.

Ingredient 1: Approach

- ***Sequencing:*** Improving the effectiveness of fisheries governance fares better under a sequenced approach of three major intervention points, beginning with strengthening institutions of governance, strengthening and defining stakeholder rights, and setting up institutions (including markets) that reflect local realities. Several expert informants argue that, where capacity building is done out of turn, e.g., linking isolated villages with external markets first, before fishing rights and management regimes are established, resources can be quickly degraded by easy and early access of powerful external players, with limited recourse by locally-effected economies and communities.

- ***Take a programmatic rather than project approach:*** Most of the experts consulted, and many of the highly successful case studies emphasized that durable impact in sustainable fisheries biodiversity and sustainable communities requires a strategic, long-term investment and vision, build upon relationships of trust and respect among stakeholders.

- ***Map the site specific complexities and context, including the political economy of decision-making and cultural context for the design of appropriate and sustainable solutions:*** The majority of experts consulted emphasized the need for contextually-specific, diagnostic, analytical approaches that identify drivers, stakeholder interests and relationship, and ecological elements that characterize a particular challenge and in turn, help to define potential solutions. This includes selection of locations that suit project or program objectives. According to one informant: "If you are conserving coral reefs by paying people not to damage them, or to provide alternative livelihoods, it makes more sense to work in Tuvalu, where there is a small population, 400 miles from the next country, which has national jurisdiction over everything out to 200 miles from land."

Ingredient 2: Process and Accountability

- ***Transparency, participation, and legitimacy in the policymaking process improve chances for sustainable fisheries management and builds socioeconomic capacity.*** Mora et al.. (2009) surveyed nearly 1,200 fisheries experts in 236 EEZs around the world, and found that where all parties are consulted and considered, and scientific advice is considered and followed, the probability of fisheries sustainability is significantly increased. A high level of community engagement with the resource users is key, particularly in the developing world where national and regional governance capacity is weak. This has been corroborated in practice countless times, in all the regions considered, from local, community-based co-management up through transboundary collaborative efforts on IUU in the Southern Ocean. Corruption and external economic pressures (subsidies, or as one person said "payments for environmental destruction"), however, can undermine engagement where there is not the institutional capacity and political will for sustainable resource use.

- ***Implement a Strong Monitoring and Evaluation Plan, with Adaptive Management.*** Identifying the impacts and measuring the results of a program is essential for increasing the likelihood of success. The measurement strategy should be scientific – both natural and social – and be incorporated at the

beginning of management tool or program implementation. The collected data should be aimed at identifying adaptive management strategies, informing decision-makers, managers and stakeholders on how to improve and modify management and conservation approaches in the future. It can also be used to evaluate the performance of policy and practice, and show the progress of management and conservation efforts.

Including local community members into the monitoring and evaluation process is critical. This ensures that resource users have an understanding of marine resource management and provides them with an opportunity for ownership over the process. Goals and objectives must first be identified, and then indicators to measure progress and evaluate performance must be determined. As discussed above in "Ingredient 2: Develop a transparent process with extensive community engagement," engaging communities in the management of marine resources can have a positive impact on success. Both *Guidelines for establishing marine protected areas* (Kelleher and Kensington 1992) and *Changing views on change: participatory approaches to monitoring the environment (*Abbot and Guijt 1998) site community monitoring as an important ingredient to developing effective conservation programs.

Ingredient 3: Capacity Building

- ***Improving governance***. According to the World Bank's recent report, The Sunken Billions (2008), improving governance would allow society to capture a substantial part of the $50 billion difference between potential and actual net economic benefits from marine fisheries. "Through comprehensive reform the fisheries sector could be a basis for economic growth and the creation of alternative livelihoods in many countries. At the same time, a nation's natural capital in the form of fish stocks could be greatly increased and the negative impacts of the fisheries on the marine environment reduced."

- ***Community-based co-management is essential to local capacity building efforts and small-scale fisheries revitalization*** (Worm et al.., 2009). Most efforts usually work well on a very small scale, where solutions are derived through education, collaboration, and communication, and where the people working on the issues with the individuals/communities are dedicated and long term. These efforts are most successful when they include program elements that build fishers' understanding and capacity for sustainable management. Providing resources and training that help teach these communities to self organize, gain management skills and obtain permits or concessions is essential. Through these avenues, fishers are more likely to understand and realize the value in sustainable management. Successful forms of governance most often involve local communities in a co-management arrangement with government, local NGO, or regional fishery cooperatives.

- ***A combination of diverse management tools are needed to meet both fisheries and conservation objectives.*** The most frequently used management tools are used in combination Among those methods successfully mixed are gear restrictions, closed areas, reduction of fishing capacity, followed by reductions in total allowable catch and catch shares. Closed areas can initiate recovery by providing refuge for overfished stocks, restoring community structure and biodiversity, protecting important habitat features and increasing ecosystem resilience (Worm et al., 2009). As elsewhere, the potential of lessons from the industrialized world for developed countries depends in some part on localized capacity for implementation, monitoring and enforcement.

- ***Assigning dedicated access privileges, such as catch shares or territorial fishing rights, to individual fishers or fishing communities can provide economic incentives to reduce effort and exploitation rates***

and may also improve compliance and participation in the management process. Some rights-based regimes enable more flexibility than others to work on scales appropriate to the fisheries users.

- ***Realigning economic incentives with resource conservation (rather than overexploitation) is increasingly recognized as a critical component of successful rebuilding efforts*** (Worm et al.., 2009). Subsidies drive over-fishing and over-capitalization in waters that would otherwise not be economic to fish; eliminating subsidies and reorienting economic incentives toward certification, or sustainable supply, for instance, could create economic incentives for sustainable management and exploitation. Multiple incentives, such as economic rewards, training, new gear, and low interest loans should be used to motivate behavior change.

Ingredient 4: International Fisheries Management Policy

- The three pillars of the 1995 UN Fishstock Agreement ***-- (i) collection and analysis of needed information, (ii) application of the science to inform and set sustainable fishing rules, and (iii) capacity for monitoring, compliance, and enforcement --*** have served as a standard and model of fisheries agreements, and for the revision of existing conventions, since it was negotiated in 1995. The potential for developing countries is, as elsewhere, contingent upon institutional capacity for science-based decision making, monitoring, compliance, and enforcement.

Ingredient 5: Strong and Informed Leadership

- ***Political will often follows when leaders have an informed awareness of ecological dependency.*** Where leaders in local government and in co-management roles are educated about, and advocating for, environmentally sound approaches on behalf of the local interest, the likelihood of effective governance for sustainable fisheries is greatly improved. The effect of informed and dedicated leadership is equally powerful at a higher scale, particularly when in concert with cooperation of transboundary counterparts, as in the Southern Ocean or the western coast of Africa BENEFIT program.

Ingredient 6: Cooperation and Collaboration

- ***At all scales partnership across sectors is essential for success***: In the majority of case studies, having a collaborative approach, and developing programs where multiple sectors are participating and partnering in the process, is essential. The involvement and buy-in of the private sector, specifically resource users, is particularly important when developing marine fisheries management and conservation programs. Where there are overlapping jurisdictions or migratory stocks, effective sustainable fisheries management requires cooperation and coordination of countries' national management authorities and implementation at the national level.

Ingredient 7: Market-based Solutions and Private Sector Participation

- ***For commercial supply chain: Work with seafood importers and large commercial buyers to establish a market for sustainable seafood, requiring verification of sustainable sources from suppliers.*** This approach works best in developed commercial fisheries where a strong majority of the catch is going to markets sensitive to sustainability (e.g. the EU and the US), and where there is supporting policy, legislation, and capacity to ensure realization.

Ingredient 8: Sustainable Financing

- ***Dedicated, long-term financing is essential for durable outcomes.*** As discussed above, designing and implementing an effective program requires dedicated, skilled people and resources for execution, science, monitoring and adaptive management, coordination and collaboration, and enforcement. Projects with long-term, stable funding enable programs and project leaders to stay focused on implementation and improvement over-time.

Measures of Success

Nearly unanimous sentiment among our expert informants was the express need for effective long-term monitoring and evaluation to assess the impact and performance of models, projects, programs, and approaches, so the lessons of the past can inform current and future efforts. The key to effective monitoring and evaluation, however, must be built into the structure of projects and programs from the beginning, such that a later assessment has a baseline for measurement. The case studies present a variety of approaches to sustainable fisheries and the measures of more immediate project outcomes, where available, are represented as improvements in biological measures, governance capacity, social/cultural capacity, and reductions in socioeconomic and economic vulnerability (Definitions are presented in Appendix C). More than half of the 56 case studies did not have measures of success in place, though all the 14 highly effective case studies had such a system in place.

In the case of area closures and protected areas, some of the outcomes were measured in quantitative and biological terms of reduced catch per unit effort, increased species size and abundance, and restoration or overall improvements in ecosystem health (Kenya, British Columbia, Chile, Baja, Philippines, Madagascar).

The development of governance, social/cultural and socioeconomic community capacity for fisheries management is more difficult to quantify, but is a qualitative measure of success that is as important to long term sustainability of fisheries resources as the physical health of stocks and ecosystems. Institutional governance capacity developed as communities became instrumental in drafting legislation, providing the authority to enforce MPA status (Papua New Guinea) and crafting equitable royalty terms for bio-prospecting on their reefs (Fiji).

Economic measures of success are found in the creation of long-term sustainable financing mechanisms supporting protected areas, conservation efforts, and local management (Fiji, Papua New Guinea, Philippines, Vietnam). Successful social/cultural project outcomes are found in the recognition of others, such as by Marine Stewardship Council certification (Baja) or the UNDP Equator Prize for poverty reduction and biodiversity conservation (Madagascar).

Replicability

“Where there’s good governance, honest players, and the scale is not too big, things work well, no matter what you do.” Many of our experts agree that the prospects for project replicability are generally improved when small scale efforts remain small, where relationships are among individuals, resources are relatively limited, with bottom-up approaches in response to local pressures (Worm et al.., 2009). Challenges that manifest on a larger scale need to be addressed through regional or international bodies and negotiations, and require different capacity, resources, skills, and timeframes. Learning to scale up, however, is essential for capacity-building in fisheries management and conservation efforts. Of the highly effective case studies examined here, half are implemented on a local scale with easily replicable components including community participation in decision-making processes (Kenya, Case #1), a small-scale community (Fiji), and community-based conservation measures

(Madagascar). Three of the cases incorporate research partnerships with local groups (Kenya, British Columbia, Madagascar), and two address the need for community outreach, and payments for tourism and ecosystem services, with direct community benefits (Fiji, Vietnam). On an international level both the BENEFIT and CCAMLR programs require political will and capacity to coordinate with neighboring countries, a process more replicable if led by consensus and strengthened by individual relationships. In many instances, however, replicability depends on the ripeness of the situation for change and a confluence of factors and capacities. For instance, seven of the 14 highly-effective cases (Barents, Coral Triangle, British Columbia, FEDECOOP, Chile, Smart Gear competitions, Philippines) benefitted from some measure of institutional capacity in effective monitoring and enforcement, sustainable or significant financing, strong governance structures to oversee the administration of laws and regulations, or were driven by individuals or organizational structures and partnerships in positions of leadership. None of these characteristics may be independently sufficient, but the combination can create a mutually supportive environment for innovation and improvement.

Where is Innovation Needed?

Ten main areas of opportunity that are ripe for innovation in sustainable marine fisheries and biodiversity conservation include rethinking over-arching objectives and approaches, ways to bolster effective policy and governance and institutional capacity building, expanding the potential of market-based solutions and rights-based management, rethinking aquaculture for sustainability, helping build fisheries and community resilience to adapt to expected climate change impacts, raising awareness and strengthening education of stakeholders, consumers, and decision-makers, improving knowledge and scientific data, and developing long-term financing mechanisms for sustainable management.

- **Approaches and Objectives**

***Building resilience into practice and cross-scale linkages*:** Among the biggest challenges facing the realization of fisheries resilience is strengthening community resilience in practice, and linking small scale needs and capacities into larger scale responses. An enormous amount of learning needs to be accomplished over the coming five to ten years to understand how to build resilience into practice, what does it mean, what does it look like, how does it work? There is a need for diagnostic approaches to systematically identify and understand approaches toward practice, identify the biggest threat, how to respond to it, and who should be the management constituent. The next question is how to build governance capacity, national vision, and coordination and support across scales, in order to take pressure off the resources. Essential in this is building connections between the local, regional, and national, and the integration of diagnosis, analysis and response across these same scales. Per one expert, "There is a huge toolbox out there. What is missing is the capacity for people in fisheries and fisheries management to make those cross-scale and multi-sectoral diagnoses.

Socioeconomic dynamic of fisheries: Much is understood about fisheries resources, about markets in the aggregate and at different scales, but very little is understood about the people, the dynamics, and about the flows of capital and labor in fisheries. There has been emphasis on community-based management, but there has been little done to understand what are people's incentives and circumstances. Per one expert: "We are trying to involve people in conserving one of the most threatened sources of biodiversity on the planet, but we don't know anything about our partners."

- **Policy and Governance**

International bi-lateral agreements: Overcapitalization of industrialized country fishing fleets have led to fishing in places that are largely unregulated. West Africa, in particular, has become the fish basket for Western Europe, Russia and China with a 650% increase in marine fish landings over the past 50 years (600,000

to 4.5 million tons in 2000) (Adler and Sumalia 2004). Much of this distant water fishing is conducted under the aegis of bi-lateral agreements, with Northern fleets negotiating access to Southern resources for pennies on the dollar. There remains an enormous need to strengthen these fisheries agreements and level the playing field, whether disciplining subsidies for foreign fleets, or by collective bargaining through regional bodies.

IUU, Monitoring, and Enforcement. Illegal, unregulated, and unreported (IUU) fishing poses a significant and expanding threat to global fish stocks and marine ecosystems across all scales, as well as the economic livelihoods of people and communities who make their living from the fisheries resources. In recent years, the capacity for IUU has grown, driven by increased flows of information, ease of transport, communication, and money, making responses to IUU all the more difficult. There remains a lack of systematic and comprehensive information on the extent of IUU operations and impacts, the diversity of actors involved, trade tracking, and knowledge about the socio-economic links "upstream and downstream" that define the nature and scope of IUU (OECD 2004).

- **Institutional Capacity Building:**

Cross-scale policy, practice, and implementing capacity: Institutional capacity for cross-scale dialogue, collaboration, and implementation is necessary for effective policy and decision-making for sustainable fisheries. At a local level, this requires enabling marginalized stakeholders to participate at appropriate levels of policy-making. Governments must develop the capacity to work across multiple scales, especially as national administrative responsibility is decentralized. Regional and national extension services also need to be provided parallel resources to implement their newly inherited responsibilities. Further, the nature of fisheries resources, governance demarcations, and fleet movements make transboundary approaches, dialogue, and collaboration similarly essential across regional, national, and international levels. Key to this is the ability to link national strategies to practice across scales.

Long-term monitoring and evaluation: There is a widely-recognized absence of monitoring and evaluation to assess performance and impact of management measures and lessons from past experience: "The evaluation of fisheries management is almost nonexistent. No baseline has been done," per one expert informant. There is a critical need for quantified assessments of reduced pressures and impacts on fisheries, systematic identification of lessons learned, and the political economic analysis of fisheries, re: what has worked and what hasn't, and why?

- **Market-Based Solutions**

Fisheries Supply Chain: Despite best efforts, international treaties, laws, and fisheries science have not worked well to change fisheries practice. Efforts are being made to change the economics and market demand of fisheries by bringing in large private sector players to create a powerful commercial constituency for sustainability. Industry has a deep understanding of fisheries issues, and sustainability may be effectively realized by working through industry. Work needs to be done, however, with fisheries suppliers and retailers along the supply chain of emerging markets for sustainable seafood, on how best to engage and educate companies to encourage sustainable supplies. Need to also connect capacities and common cause of fisheries experts, suppliers, and development agencies.

Enabling market access to small-scale participants: Sorting out the supply chain (e.g., storage, transport, export links) is key to linking remote, small-scale coastal aquaculture into export markets. But establishing market connectivity has proved particularly difficult in some small island nations, such as in the Solomon Islands which are separated from one another by at least 1 hour by boat. Similarly, increasingly stringent requirements on hygiene (e.g., clean ice and water for storage and transport) and traceability,

especially in the European Union, make it difficult for small-scale artisanal fisheries to participate in international markets.

***Certification**:* There is a growing demand for certified seafood products, especially in Europe and by large commercial buyers (Walmart); the Marine Stewardship Council has certified 51 fisheries representing more than 3.8 million tons of seafood (Turning the Tide, 2009). Some experts question, however, whether certification was the most appropriate mechanism for small-scale fisheries and developing countries. Some believe that certain fisheries should not have received certification, and there are also concerns about effort shift. The MSC process is recognized as scientifically rigorous, but the information for certification is often not available, the process is generally slow and expensive, and there are increasing numbers of competing certification agencies and processes, which can result in confusing the customer. There has been resistance to certification among some small-scale fishers (Vietnam) because it is seen as favoring global markets over local ones, opening local fisheries to larger interests, and is focused global value chains instead of local ones. Work needs to be done to determine the viability, efficacy, and impact of certification of fisheries resources.

Payments for ecosystem services (PES): There is an opportunity to design and develop innovative, comprehensive marine PES programs, including developing markets for blue carbon credits. Users believe that marine spatial planning could be a framework to inform this paradigm shift, especially if comprehensive economic data places a value on the services and all users are brought to the table for designing solutions. Reservations about the viability of marine PES in developing countries usually center on the absence of governance, management, measurement and accounting, and enforcement capacities more common in developed countries. In the industrialized countries many sectors already, from their perspective, make PES for access privileges through fees for permits and leases. The opportunity is to increase fees for real cost of management and services and fees for all types of users.

Smarter Fishing: There have been some successful gear shift programs and there is an opportunity to replicate them and also continue to develop new solutions. Competitions for industry and load programs have been successful in many places throughout the world. Similarly, enabling gear modifications or replacement for small- and large-scale fleets will enable their participation in competitive markets for sustainable seafood, with potentially dramatic reductions in destructive open-water and coastal by-catch.

- **Rights-based Management**

Catch Shares: Some experts strongly encourage a move toward the establishment of catch shares. Reservations about privatization of fisheries, however, are based in the need for functioning institutions of governance, management, enforcement, and measurement of resources; capacities generally more characteristic of developed countries. Work needs to be done to devise catch share mechanisms appropriate to developing country capacities.

Community-based Quotas: Some experts argue for the community-based quotas in lieu of individual-based quotas, in the context of indigenous communities seeking fisheries rights.

- **Aquaculture**

Realizing Sustainability: Aquaculture is certain to supply increasing amounts of the world's food supply and there is great need and opportunity for doing so sustainably. Some of the questions center on the environmental ethics of feeding fish to fish rather than to hungry people. There are also questions about how to realize sustainability across several measures, including choice of species farmed (e.g., carnivores vs. omnivores), sustainability of feed sources (e.g., creating a market for by-catch and "trash fish"), protection of

genetic wild stocks and prevention of disease, the benefits of onshore vs. offshore, and the beneficial potential for aquaculture to enable fisheries adaptation to climate change impacts. Throughout, there is associated need to strengthen the science and develop standards and regulation of sustainable aquaculture, with careful consideration of the risks involved, inputs required, limited returns for food security and livelihood for vulnerable communities, among other impacts.

Avoiding a "Blue Revolution" As fisheries shift from wild capture to farming, there is a generally agreed need to avoid replication of the enormous environmental fallout of a "green revolution" in the oceans.

- **Climate Change**

Climate impacts on small-scale fishers: Climate change impacts on fisheries are expected to have potentially significant impacts for the millions of small-scale fishers, processors, traders, and ancillary workers in the developing world who are among the most vulnerable to climate change. Informed predictions at these scales are urgently needed. Similarly, policy makers need information and analysis to guide investments and initiatives for mitigation and adaptation.

Protection of Blue Carbon Sinks: Protection of seagrass beds and mangrove forests, offer climate mitigation strategies that also serve to protect critical marine fisheries habitats.

- **Raising Awareness and Strengthening Education**

Diversifying Livelihoods: Community support, job training in non-resource-dependent sectors, and education for today's children living in coastal fisheries communities are necessary if local, regional, or national strategies aiming to reduce overcapacity are able to steer people away from fisheries into alternative livelihoods. Inclusive efforts to rethink the development of alternative livelihoods requires a more concerted analysis of the expanded linkages between fisheries and crime, and the diversification of fisheries livelihoods into IUU.

Consumer Awareness: A recent survey by the Ocean Project (2009) found that Americans believe their seafood purchase decisions impact ocean health and they are willing to buy and pay more for seafood that is healthy and sustainable (Monterey Bay Aquarium, 2009). Increasing consumer awareness, particularly Europe, the United States, and Japan and other parts of Asia can translate into practical impact at the grocery store, in restaurants, or in political fora, with direct influence on policy and practice on the water.

Political Will: Creating support and obtaining political will for sustainable fisheries management takes time. It can be done and is happening slowly. The challenge, however, is to obtain political will before there is a crisis. Private sector support, as well as strong voice from civil society and funders can create change opportunities for shifts in political support. We have seen this in key targeted locations like Gulf of California and Mexico recently, and in the EU Council of Fisheries Ministry.

- **Knowledge/Scientific Data**

Informed fisheries management systems are among the key criteria for maintaining the long term productivity and stability of marine fisheries resources. The availability and quality of science and data on fisheries in developing counties varies across region and country, but there is wide agreement on the general need for more information on fisheries stocks, exploitation efforts and impacts, the extent of IUU, subsistence/artisanal fisheries, impacts of land-based pollution, and aquaculture, and ecological

relationships among species. As marine spatial planning moves forward in many regions, comprehensive data and information sharing platforms are needed to understand tradeoffs.

- **Long-term Financing Mechanisms for Sustainable Fisheries Management and Biodiversity Conservation**

There is much opportunity to develop long term financing mechanisms and new revenue streams (PES) for sustainable marine fisheries management. There are also innovations and lessons from public/private partnerships in other sectors as well as the marine realm to share. Finally, there are many opportunities to leverage the knowledge and expertise of fishermen and engage them as partners in management - enforcement and monitoring or collaborative research, etc.

Section 5: Solution Strategies and Opportunities

In this section we provide high level suggestions for the Foundation to consider as it moves forward in deciding whether to invest in developing a cross-cutting or regional specific sustainable marine fisheries and biodiversity conservation initiative. First, we will discuss solution strategies and existing gaps for marine fisheries and biodiversity conservation. We will then present a brief discussion on appropriate scales of investment and potentially appropriate approaches for MacArthur to consider.

Fisheries Funding Priorities

Funding in fisheries is small, but growing. Since the mid-1990s, there has been a concerted effort to encourage fisheries sustainability by targeting large-scale, high-catch fisheries and by raising consumer awareness. Though small-scale fisheries catch nearly the same volumes as large-scale fisheries, and are in many cases more sustainable, they are more difficult to work with; thus they have not seen the same levels of investment (Jacquet and Pauley, 2008). Several large private foundations, including the Walton Family Foundation and David and Lucille Packard Foundation, have specific strategies for funding fisheries initiatives. Others with fewer funds and less focus include the Oak Foundation, the Gordon and Betty Moore Foundation (primarily domestic), the Marisla Foundation, Kerzner Marine Foundation, Munson Foundation, as well as the Kaplan Foundation, the Arctic Funders Group, among others.

Bi-laterals and multi-laterals have been and will continue to work on building governance structures and capacity for fisheries management. This is at times framed around ecosystem-based management, marine protected areas, and increasingly, marine spatial planning. Among the 11 bi-lateral and multi-lateral development organizations we identified are the World Bank, the Global Environment Facility, the African Development Bank and the Interamerican Development Bank, as well as national development agencies in the US (USAID), Canada (CIDA), Asia (ADB), Japan (JICA), New Zealand (NZAID), the Netherlands, and Australia (AUSAID).

There is a well of existing funding and organizational programmatic support for sustainable fisheries resources and biodiversity. Of the 84 funders we identified working on fisheries, 27 private foundations comprised 32% of the total, with bi-lateral (18, 21%), multi-lateral (14, 17%), and IGOs (12, 14%) having the next-greatest representation. Relatively small amounts of additional funding comes from NGOs (5, 6%), government (6, 7%), and conservation trusts (2, 2%). Of the total community of 84 funders, about 27% had a programmatic focus in Latin America, 23% in the Pacific Islands, and 18% in Asia, with somewhat less programmatic attention in Africa (12%) and the Polar Regions (10%).

As presented in Section 4, we identified four main strategies that receive the majority of the support from identified donors – capacity building, science-based decision-making, policy and governance, and area- based management, primarily MPAs. Within this, there exists a wealth of small-scale efforts to address local challenges in all the regions; and there are growing efforts, and successes, to work at a national scale and on international transboundary challenges. In the past few years, there has been an increased interest by bi-laterals and multi-laterals to work on some of these challenges at the national and LME scale. These efforts are realized, for example, in the Coral Triangle, Tanzania, and are being developed in Kenya. There are large gaps in funding for rights-based management solutions, adaptive management, and smaller gaps for market-based solutions and climate change adaptation approaches.

Table 10. Review of Funder Priorities

FUNDERS - APPROACHES FUNDED	Capacity-Building	Policy & Gov.	Area-Based Man't	Science-Based Decision-Making	Market-Based Man't	Climate Change Adaptation	Technology -Transfer	Adaptive Man't	Rights-Based Man't
Latin America (23 Funders)	22	10	15	7	12	4	1	0	2
Asia (14 Funders)	12	8	8	6	7	4	1	1	1
Africa (10 Funders)	9	6	2	3	7	5	1	0	0
Pacific Islands (17 Funders)	17	8	10	12	2	8	2	3	0
Polar Region (9 Funders)	6	7	3	6	1	3	0	0	0

Key Finding: There are gaps across regions in funding in the approaches, solutions strategies for technology transfer, rights-based management, adaptive management, market-based solutions, and climate change adaptations. Key geographies needing support across approaches include the Polar and Africa regions.

Solution Strategies and Opportunities for MacArthur to Consider

Highlighted below are three main themes we identified through this research where there are needs and opportunities to fund solutions strategies. Some of these opportunities build upon existing strategies to make them more comprehensive and robust solutions, while others present new opportunities for funding.

Theme 1: Specific Needs and Funding Opportunities to Develop Market-Based Solutions

The absence of institutional capacity for management and governance has long slowed headway towards sustainable fisheries, and there is growing attention to market-based solutions**.** In some cases, they are tried-and-true, with continued effectiveness, others build on successful terrestrially-based models, and still others are breaking new ground. Over the long-term, working with resource users is critical to change policy and practice, supporting the development of durable long-term solutions.

Market-Based Solution Opportunities

Subsidies: It is commonly held that fisheries sector subsidies distort the conditions of trade, favor subsidized fleets over those that are not, and drive overcapacity and overfishing that would otherwise be uneconomical. As the WTO Negotiating Group on Rules considers limits on subsidies that contribute to overfishing and overcapacity (FAO 2005), there may be an opportunity to rethink the use of subsidies in support of small-scale fishing communities, if designed to minimize overfishing and maximize livelihoods and food security. The UN, OECD and WWF are among organizations working on these issues at the international and country levels.

Sustainable Aquaculture: Aquaculture provided 43 million tons (33%) of fisheries catch in 2005; it is expected to continue growing at 8-9% per year (Kelleher 2008). To realize the promise of poverty alleviation and food security, aquaculture must be made sustainable through a number of actions, including:

Develop Market-Based Solutions

Example Outcomes

- Sustain and restore fisheries
- Maintain or increase food security

Example Solution Strategies

- Decrease capacity and take in fisheries while increasing or maintaining economic prosperity
- Increase sustainable practices by industry throughout the supply chain
- Develop sustainable aquaculture industry
- Users of ecosystem services support the sustainable management and conservation of it through PES

- Create a viable international certification scheme for sustainable aquaculture.[3] The standards that the industry has created for itself, thus far, are relatively weak and there is a need for investment capital to support development innovations. The World Wildlife Fund is working to further develop the Aquaculture Stewardship Council, though at present, there is no accepted, standardized certification in place;
- Develop a non-carnivorous aquaculture fishery to help resolve the problem of catching fish to feed fish;
- Identify microfinance funds and mechanisms for small-scale aquaculture infrastructure investment to enable small-scale participation in growing export markets.

Additional other organizations working on sustainable aquaculture include the Sustainable Fisheries Partnership, the Global Aquaculture Alliance, as well as the Southeast Asian Fisheries Development Center (SEAFDEC) among others.

Fisheries Co-operatives: Co-operatives create a forum for transparent, collaborative initiatives and decision-making, building local leadership and capacity, while working closely with stakeholder communities on a small-scale. FEDECOOP in Mexico offers a strong example of reduced vulnerability for both the fisheries and communities. EDF and Rare are examples of a groups working with cooperatives

[3] The Packard Foundation had developed a long-term strategy for aquaculture certification, but the multi-year program was cut in the course of downsizing in 2009.

in Latin America, as well as collaborative efforts between Universidad Catolica (Chile) and University of California, San Diego.

Marine Payments for Ecosystem Services: Payments for marine ecosystem services have significant promise, but are nascent and challenging in developing countries given limits to data, infrastructure, and institutional and enforcement capacity, despite examples of success on the ground (e.g., Vietnam concessions). Markets for carbon credits are also on the horizon, though much intellectual work remains to be done. As with marine certification, some experts expressed reservations about the equity of returns on PES and the need to ensure that the economic benefits return to the community economy rather than largely to the concessionaire. The Center of Ocean Solutions and the Marine Natural Capital Program at Stanford, Forest-Trends, as well as IUCN are among the organizations working on marine PES. In certain geographies, the private sector may be more willing to participate and engage in PES, but they often require comprehensive data on ecosystem services and participation by all ocean users.

Smarter Fishing through Gear Improvements/Reform**:** As markets for sustainable seafood continue to expand, and sustainable fisheries certification gets off the ground, small- and large-scale fisheries will need to modify or improve their gear to participate in markets for sustainable seafood. Modifying or replacing gear on all the long line boats in US and Japan, for instance, would dramatically reduce turtle and shark mortality, as would modifications to bottom-fishing trawls, among others. Some organizations working on smarter fishing and gear reform include Grupo Tortugo and PRETOMA in Costa Rica, WWF, the Ecology Action Center and Marine Conservation Biology Institute (Canadian Atlantic Ocean), and the Wildlife Conservation Society.

Sustainable Seafood Supply Chain: The Packard Foundation has provided strong support for developing sustainable seafood demand in the consumer and restaurant markets of the developed world. They also developed the Sea Change Investment Fund for the developed world to loan funds to fisherman to support sustainable business practices; there is opportunity and need for a complement in the developing world. For example:

- There remain significant potential supply chain strategies to approach this market, such as educating major fisheries buyers (e.g. Walmart) on the need for sustainable supplies;
- Support the formation of international/regional market associations and partnerships for sustainable fisheries. Working with major buyers in Europe, North America, and Japan to form industry associations can drive improvements in fisheries via their purchasing decisions and political voice;
- Identify how buyers can help suppliers make improvements, such as buy or subsidize suppliers' low-impact gear. Or, engage industry to connect suppliers, fisheries experts, and the development community to integrate approaches and share knowledge on how to fish more sustainably.

The Sustainable Fisheries Partnership, including its Fish Source program on fisheries science and technology, has pioneered many of these and is working to replicate their successes in China, the Western Central Pacific, Mediterranean, British Columbia, and Gulf of California. The EU Fish Processors Association (AIPCE) has done work on legal verification of supplies.

Theme 2: Specific Funding Needs and Opportunities to Build Capacity and Effective Management and Governance for Fisheries

The need for institutional capacity-building has long defined economic development efforts, and the marine fisheries sector is no exception. There are opportunities everywhere, but capacity needs to exist at all levels. There is general agreement that capacity building at a small-scale is more manageable, more replicable, and offers better results. Yet different pressures manifest at different scales, and small pilots may not be economical to replicate or be capable of addressing larger-scale problems. Further, there is a critical and near-universal gap in developing-country capacity that links the small-scale and the national, trans-boundary, or international scales. There can also be a similar disconnect between governmental, intergovernmental, and NGO sector working on the ground. The main questions for capacity building are: 1) how to scale up, and 2) how to build the linking mid-level capacity to support integrated, multi-scale approaches for marine fisheries management and biodiversity conservation. Some of the primary gaps and potential opportunities are presented below.

Build Capacity and Effective Management and Governance for Fisheries

Example Outcomes

- Build resilient fisheries against climate change
- Effective governance and management to sustain, protect and restore fisheries

Example Solution Strategies

- Implement multiple management tools taking a long-term perspective with adequate human and financial resources
- Develop and implement strong, transparent governance structures and stakeholder processes
- Science, social and natural, data and information to inform policy and management
- Develop governance structures with accountability

Fisheries Management Strategies and Approaches: There is need for fisheries management approaches that can work across time and scale, and manage for the many services and uses the fisheries provide.

- *Long-term national fisheries management strategies* need to be developed and internally supported such that they can withstand and adjust to changes in economy and political administrations, and provide continuity of management and approach over 10-20 year timeframe.
- *Marine Spatial Planning (MSP) and Management* is a participatory approach for establishing rational multiple use of marine spaces to realize multiple objectives – social, ecological, and economic. The process is fairly new in developing countries and support is needed to create capacity at the national and regional levels for MSP design, planning, and implementation.

- *Area-based Management (*e.g., marine-protected areas (MPAs), multi-use MPAs, no-take, and marine reserves) provides proven effective tools. Unfortunately, many are "paper parks" and is still support needed for others that could be (i) managed effectively, and (ii) designated.
- *Rights-Based Management* – individual transferrable quotas (ITQ), individual non-transferrable quotas (INTQ), territorial use rights (TURF), community development quotas (CDQ) – works by limiting entry, access, input or output rights to fisheries resources. Support is needed to identify where rights-based approaches are most suited to a site's institutional and cultural context and need, and how to design allocation mechanisms that allow for flexibility of community relations and ensures equitability in benefits.

The Universidad Catolica is working closely with the University of San Diego on community-based approaches, cooperatives, and TURFs; Foundations and Manta Consulting have initiated a collaborative effort among academics and NGOs to establish four sites in Latin America merging TURFs with MPAs; and the NGO, International Collective in Support of Fish Workers, works on rights-based approaches for sustainability in the small-scale artisanal fishing sector. The Partnership for Interdisciplinary Studies of Coastal Oceans (PISCO) and the Marviva Foundation in Costa Rica are additional organizations working on MPAs.

Cross-Scale Linkages: In addition to specific capacity at the local and transboundary levels, countries also need the regional and national-level capacity to link the two. Without the scientific data, technical skill, managerial know-how, institutional relationships and mechanisms and capacity for communication and collaboration across and among scales, the local and internally-generated problems and solutions will continue to be affected by larger external pressures.

Technical Capacity and Education for Fisheries Managers, Decision-Makers, and Stakeholders: Many funders do not want to fund education for targeted audiences like decision-makers, in part because it is difficult to measure impacts and success. Yet, decision-makers, as well as managers and stakeholders, need to have the education and skills to make informed decisions for long-term sustainable fisheries use, management, and conservation, to realize effective practices and mechanisms for going forward. Strategies include:

- *Cultivate a skilled technical workforce*: Support is needed to rebuild the Regional Fisheries Management Agencies, and incentives put in place to keep skilled managers and technical staff in public service rather than leaving for private sector opportunities. The Southeast Asian Fisheries Development Center (SEAFDEC) is just one of many regional organizations that provide training, research and other capacity building activities.
- *Education and training for decision-makers*: Support is needed to develop leaders and replicate training programs that were successful in Micronesia. Training in marine ecology, economics, and policy, such as those US-based programs at COS/Duke/and EDF, the University of California, Davis, and COMPASS, are aimed at the next generation of researchers, policy- and decision-makers. These programs can make significant contributions to effective management and conservation of marine ecosystems in the future, via policy and informed pressure for political reform, and could be replicated in the developing world.
- *Stakeholder education:* Technical assistance and services for fishermen and communities informs key stakeholders of the threats to their livelihoods, and provides them the tools and knowledge to make decisions to support the resource over the long term. Rare, for example, is

piloting the Fisheries Fellows Program in the Gulf of California; this model could also be replicated in other geographies.

***Developing processes for transparent policy-making including cross-cutting stakeholder participation in policy and decision-making*:** Worldwide, only 7% of coastal governments employ rigorous scientific assessments as the basis for their fishery management policies. Only 1.4% of coastal governments use a transparent process to convert scientific recommendations into policy, and less than 1% provide for robust engagement of fisheries regulations (Mora et al., 2009). Improving stakeholder participation and communication in policy and decision-making processes improves the chances for sustainable solutions to resource challenges in practice. The Wildlife Conservation Society, WWF, and IUCN are some of the organizations working in this area. Several regional fisheries have conducted internal performance assessments including North East Atlantic Fisheries Commission (NEAFC), the North Pacific Fisheries Observer Training Center (OTC), International Commission for the Conservation of Atlantic Tunas (ICCAT), and Commission for the Conservation of Southern Bluefin Tuna (CCSBT), and it would be interesting to assess the effectiveness of these assessment and the ability for these organizations to implement changes to improve performance.

Strengthen Science and Science Integration: There is a need for greater and better information on economic valuations and ecosystem services, as well as basic data on stocks, catch and by-catch, small-scale fisheries, and ecosystem health. Parallel is the need for monitoring and evaluation, and interpretation of the data for decision-making. Following strengthened science and management regimes, fisheries institutions need the capacity to then integrate the science (natural and social) into policy and management. Organizations like WCS and Worldfish are working on these efforts, but there are models of best practices in United States to examine, such as the California Ocean Science Trust's MPA Monitoring Enterprise.

Enforcement and compliance: In developed countries, science is often overruled in the interests of industry; in developing countries the capacity for both enforcement and compliance needs to be developed.

Managing the Impact of Distant Water Fleets: There is a complex network of binding and non-binding agreements which form a solid basis of international law for promoting the development of sustainable fisheries and for preventing or eliminating IUU fishing. In some cases, fisheries agreements are significantly inequitable, and elsewhere, loopholes enable the continued and growing pressure from illegal fishing. Opportunities for supporting remedies might include:

- *Negotiating or re-negotiating bi-lateral fishing agreements:* At least 10 bi-lateral fisheries partnership agreements between the EU and developing countries are due to expire in the next few years (Comoros, Ivory Coast, Gabon, Guinea, Kiribati, Madagascar, Mauritania, Micronesia, Mozambique, Seychelles); Some countries have no protocol (Angola, Senegal) (European Commission, 2009). Most were reformed in 2002 under the EU's Common Fisheries Policy, aiming for a more balanced return on the agreements. Expiration of the protocols, and their renegotiation, presents an opportunity to support developing countries in strengthening their position for economic benefits and better fisheries management.
- *Illegal, unauthorized, and unregulated fishing (IUU):* Supporting efforts to reduce IUU by closing existing loopholes in international law and country- or cross-country-level practice could focus

on: (1) efforts to discontinue the allocation of flags of convenience, (2) strengthening international coordination of monitoring, control, and surveillance on the water and in the harbors; (3) strengthen comprehensive high-seas management agreements and capacity. The International Monitoring and Control Surveillance Network works to link fisheries enforcement agencies from around the world and increase information and communication in efforts against IUU. CCAMLAR in the Antarctic, the Coalition of Legal Toothfish Operators (COLTO) and the Forum Fisheries Agency in the Pacific Islands are three other examples of organizations working to reduce IUU.

- *International Fleet Migration:* The rapid development of new markets and speed of resource exploitation has overwhelmed the ability of many developing-country institutions to respond. Some fisheries experts anticipate the arrival of industrial fleets in the Polar Regions, as melting sea ice opens fisheries and petroleum resources to commercial exploitation. Efforts to limit the potential impacts of continued fleet migration could include support to multi-level governance institutions to: (1) establish effective monitoring and enforcement strategies before fisheries become at risk from overexploitation; (2) support capacity to track trade and resource trends, and disseminate information to inform bi-lateral fisheries agreements; and (3) create incentives for local conservation by developing resource-rights that align local/regional self-interest with long-term fisheries health (Berke, et al., 2006).

Climate Change Planning: Climate change promises potentially drastic impacts on fisheries and reef habitats around the world. Many of the fisheries-dependent communities in the developing world do not have the capacity or alternatives to adapt to these changes. There is a great need to initiate efforts to strengthen coastal fisheries' resilience to withstand the impacts of climate change, and long-term planning and adaptation to help prepare dependent communities to adapt to the socioeconomic implications. Actions need to be taken to: 1) Protect locally important fisheries; 2) Reduce pressures from overcapacity; and 3) Assist communities in the transition to alternative livelihoods. Ecoadapt, TNC, IUCN, the World Bank, and the Global Environment Facility are leading efforts in this arena.

Theme 3: Specific Needs and Funding Opportunities to Develop Political Will and Support

Where you have an informed and strong public, stakeholders, managers, and decision-makers, chances are improved that political will follow.

Building on Section 4, below are some more specific strategies that could be deployed in key geographies

Proper valuation of fisheries and ecosystem services: Making environmental costs and benefits of marine fisheries and ecosystem services explicit in accounting systems and fees for service can create the basis for political support. Proper valuation of ecosystem services is also central to effective initiatives in marine PES, as discussed above. Currently, these efforts are being lead by WRI and academic institutions.

Strengthen consumer awareness and education: The Ocean Project (2008) and Edge Research (2006) have found that informed American consumers are more likely to buy and pay higher prices for seafood that is healthy and sustainable. Seafood Choices, funded by $37 million from the Packard Foundation, and the Seafood Watch pocket guides, out of the Monterey Bay Aquarium, have effectively promoted market-based sustainable seafood in the US. Developing the same consumer awareness in Japan and Europe, and possibly other parts of Asia, could have a significant impact on global demand for sustainable seafood. Creating consumer demand for sustainable seafood is a necessary complement to efforts for sustainability in the supply chain discussed above. Organizations like the Monterey Bay Aquarium could be poised to support or collaborate with an organization in Asia to launch similar campaigns.

Develop Political Will and Support

Example Outcomes

- Reduce demand for endangered species
- Increase demand and implementation of robust policies and management for sustaining, protecting, and restoring fisheries
- Increase demand and price for sustainably harvested and farmed fish

Example Solution Strategies

- Decision-makers in e.g. Latin America and Africa understand true values and tradeoffs of fisheries and ecosystem services and design and implement policies and funding to sustain, protect, and restore these services.
- Campaign and educate consumers, creating demand in Asia for sustainably certified products.

Campaigns and Boycotts: Developing and implementing political strategies to place leaders, create policy, and allocate funding is critical. Campaigns and boycotts have long been effective in raising consumer awareness and arresting harmful activities. As sustainability becomes a growing demand criterion in the global seafood industry, targeted national and international campaigns can have a powerful influence on changing unsustainable behavior. Organizations like Oceana, Greenpeace, and Longitude 181 Nature have experience in this arena.

Region-Specific Support and Needs, and Identification of Specific Opportunities in MacArthur Geographies

The regions have comparative strengths and weaknesses across a wide set of measures, including institutional capacity, political will and leadership, degrees of corruption, as well as additional layers of risk from pollution, climate change, IUU, etc. The section below briefly presents some of the existing regional capacity and support, as well as identifies region-specific needs.

Africa

The countries of Africa suffer from a lack of capacity at many levels, and programmatic support from organizations and funders here is less than in the other regions, except for the Polar regions. As elsewhere, capacity building and policy and governance receive the most external institutional support, but unlike the other regions, market-based solutions receive more support than area-based management or science-based decision-making. Organizations work fairly evenly across the five sub-regions, though with a lighter programmatic presence in the Canary Current (Morocco, Mauritania, and Senegal), despite the fact that each of these countries are expected to be particularly vulnerable to climate impacts on fisheries in the future. There is ongoing GEF-funded work to build transboundary capacity and regional cooperation in the Benguela, Canary and Guinea Current countries. The GEF, with others, also funds the Sustainable Fisheries Partnership Program, BENEFIT Program, and an integrated marine capacity building program in Namibia, Angola, and South Africa.

Africa

Example Outcomes

- Build resilient fisheries against climate change
- Maintain or increase food security
- Protect against habitat destruction, overexploitation, IUU and by-catch
- Inform policy needs and regulation
- Reduce political instability

Example Solution Strategies

- Internal
  - Climate adaptation strategies
  - Coordination for increased political infrastructure and capacity
  - Collection of reliable fisheries data and science-based decision-making
- External
  - Inter-agency cooperation to address transboundary monitoring and enforcement issues
  - Technology transfer

Efforts in the African regions are compromised by limitations in inter-agency (or inter-ministerial) frameworks for addressing transboundary problems, and laws can be regionally incompatible, with few environmental regulations. There is a deep need for scientific data and information on fisheries and by-catch for the whole of the West African coast. Pockets of political instability and widespread corruption, IUU, deep poverty and a heavy dependence on fisheries for food and livelihoods undermine best efforts for sustainable fisheries management where there are limited alternatives.

Madagascar:

Madagascar has specific needs that must be addressed to realize sustainable fisheries. There is a strong need for diversification of economic and food dependency on the coastal fisheries. Land-based pollution, such as runoff from agriculture, industry, and human waste must be controlled as well. Levels of marine-based pollution, such as oil spills, invasive species, and marine debris need to be reduced, and further support for building capacity in science-based decision-making is necessary. The protection of mangrove forest is also key for improving fisheries resilience and reducing the vulnerability of coastal infrastructure to future impacts of climate change in Madagascar.

There are multiple strategies that could be employed in Madagascar to address these needs. Alternative livelihood training could be offered to users of the coastal fisheries in order to support the rapidly expanding tourism industry there. With increases in support for Madagascar's Marine Institute, there could be capacity built for marine spatial planning (MSP) for their extensiveoastline and Exclusive Economic Zone (EEZ) waters. Rights-based management and Payments for Ecosystem Services (PES) approaches could be utilized to create incentives for protection of near-shore environments, such as mangroves, to strengthen climate change resiliency. Also, technology transfer could be used to support the Malagasy government in controlling land-based pollution, e.g., waste water treatment; catalyzing industrial engagement in policy and technology transfer could help shipping companies in the Agulhas Current to adopt stricter marine pollution policies.

Potential Outcomes: Some implications of these strategies would be resiliency to climate change impacts through better governance, increased capacity to adapt, and better management of coastal resources. Also, through reduced land-based pollution, there would be healthier fisheries resources for artisanal fishers and other coastal resource-users, which addresses important food quality and security issues. Finally, bolstering the scientific expertise of Madagascar's Marine Institute would allow collection of much-needed marine resources data, which would inform scientifically-based decisions.

Asia (South and Southeast)

Asia has a depth of institutional support from funders and organizations, working fairly evenly across four of the five sub-regions, though the Gulf of Thailand (Cambodia, Malaysia, Thailand, Vietnam) has only about half the representation of the other sub-regions. The bulk of support focuses on capacity building, science-based decision-making, policy and governance, and area-based management. There is strong governmental commitment to sustainable fisheries and environment in the Indonesian Sea, as in the Gulf of Thailand, where the government is implementing policies and programs building artificial reefs and establishing fishing zones and seasons limiting the use destructive gear. In the South China Sea, where there are competing claims on minerals, oil, and gas resources, seven countries have agreed to a collaborate on a ecosystem-based regional management plan, including nine pilot projects for sustainable transboundary development, supported by US$16 million GEF funding.

Asia

Example Outcomes

- Inform policy and regulation
- Reduce political instability
- Protect against overexploitation, IUU and by-catch
- Maintain or increase food security

Example Solution Strategies

- Internal
  - Coordination for increased political infrastructure and capacity
  - Collection of reliable fisheries data and science-based decision-making
  - Market-based solutions
- External
  - Transboundary cooperation and partnerships for more effective regulation, monitoring, and enforcement, and management.
  - Technology transfer

There remain gaps, however. As elsewhere, there is minimal support for technology transfer and rights-based management approaches. In the Bay of Bengal, there is a multitude of international, regional, and sub-regional institutions, many of which have similar mandates, resulting in overlap and duplication. Here, and across the rest of the Indian Ocean, there is a significant compliance gap in the tuna fisheries, with illegal fisheries, weak management, inadequate compliance, and lack of political will. Broadly speaking, there is a need for improved transboundary management and country cooperation for conserving and protecting the region's marine fisheries, including collaborative monitoring and enforcement efforts against IUU.

Lower Mekong

The Lower Mekong region lies in the Gulf of Thailand sub-region and has specific needs. Large coastal populations rely heavily on small-scale fisheries for food and livelihoods and need alternatives and training to take pressure off their over-exploited fisheries. Incentives to halt the destruction of mangrove forests for shrimp aquaculture production, or to create certified, sustainable aquaculture in those areas are needed. Also, as elsewhere, control of land-based pollution in this large delta region is critical. Finally, international fishing pressure from foreign fleets needs to be reduced to enable sustainable management of this highly productive fishery that so many rely on locally for food.

There are solutions to these myriad problems. First, alternative livelihoods and training must be offered to coastal populations that rely heavily on local fisheries. Certification of sustainable aquaculture could be utilized to dovetail with increasing demand for sustainably-harvested seafood and to address the explosive expansion of aquaculture in the region. Technology transfer could further allow shifts to better management of mangrove areas and expansion of fish farming and aquaculture as well. Developing management capacity to help equip coastal communities that are at high risk from storms, flooding, and other climate impacts are critical, especially in the low-lying region surrounding the Mekong River Delta. Also, government capacity to utilize rights-based approaches , could incentivize better monitoring and enforcement and help ensure long-term sustainability in the region's fisheries. Market-based approaches such as (PES) could also be utilized to create demand for well-managed and healthy mangrove forests. Finally, transboundary cooperation in management techniques between Cambodia, Vietnam, and Thailand could bolster regulation and enforcement of management.

Potential Outcomes*:* These possible solutions could lead to better resiliency to climate change impacts from mangrove and coastal protection, better incentives to expand aquaculture sustainably, decreased coastal population reliance on depleted fisheries, and greater ability to manage the region's fisheries collaboratively at a transboundary scale through mutual participation and effort.

Latin America

Of the five regions that we examined, Latin America received the most support for fisheries management and biodiversity conservation by both funders and organizations, with twice as many organizations working in the Caribbean as elsewhere in the region. The support trends heavily toward capacity building, policy and governance, area-based management approaches, and science-based decision-making. The Gulf of Mexico has developed a strong dynamic between fishers and conservationists, and Peru and Chile have well-established regional cooperation for fisheries management and strong scientific and management capacity and data. Chile is also known to be a leader in territorial use rights fisheries (TURFS), transferring specific waters to fisheries co-operatives. The risks from corruption are likely less here, relatively speaking, than in some of the other mega-

regions considered, though land-based pollution in the Gulf of Mexico is a growing threat to fisheries resources.

We identified minimal support for technology transfer such as gear reform and there are few organizations working on climate change issues in the region, which is expected to have significant potential impacts in the Gulf of Mexico and the Caribbean. Institutional gaps in the region include the need for transboundary knowledge sharing and coordinated support for monitoring, management and enforcement, and improved public awareness of fisheries issues, especially in the Caribbean region. In Ecuador, the government initiated a process of legal fisheries reform, but has yet to complete it. There is also a need to better understand the biophysical, social, economic, and political drivers affecting the fisheries in order to develop capacity and harmonize efforts.

Latin America

Example Outcomes

- Build resilient fisheries against climate change
- Protect against habitat destruction and pollution
- Expand existing scientific and governmental capacity for improved management and enforcement

Example Solution Strategies

- Internal
  - Climate adaptation strategies
  - Science-based decision-making
  - Rights-based management
  - Increase public awareness of importance of sustainable practices and training programs
- External
  - Transboundary knowledge sharing and coordination for improved management, monitoring, enforcement and awareness
  - Technology transfer

Humboldt Current

In the Humboldt Current, only the tuna fisheries are required to record by-catch, though there is an equally pressing need to account for and reduce excessive by-catch impacts in the sardine and anchoveta fisheries. Land-based pollution from coastal development and urbanization (among other sources) needs to be monitored and brought under control to limit impacts on fisheries, marine habitat, and human health. There is also an immediate and pressing need to get Chile's aquacultural sector on a sustainable track, given current risks from waste, disease, and escapes. Further, alternative employment options in fisheries communities will become a necessity, as half of Chile's artisanal fishers, especially in the south-central region, will be affected by changes in the distribution and composition of targeted fisheries under climate change, likely prompting a migration of fisher population and change in the labor structure via employment substitution.

Several opportunities for solutions strategies exist in the Humboldt. Internally, market-based approaches of microfinance for sustainable aquaculture and subsequent certification would provide sustainable livelihood alternatives to artisanal fishers in the region, though these would necessitate technology transfer and education to enable them to transition into aquaculture. Also internally, there is significant opportunity for capacity building and technology transfer for wastewater treatment, solid waste management, and rethinking approaches to housing and tourism development in flood/storm

prone areas and near important marine habitat. Given that institutions already exist to monitor tuna fisheries by-catch in the region, there is an important opportunity for larger-scale external impacts by extending this capacity to the sardine and anchoveta fisheries, combined with support to swap destructive fishing gear for more sustainable alternatives.

Potential Outcomes: These opportunities - supporting alternative livelihoods and reducing community and fisheries risks from land-based pollution and unsustainable coastal development – can help to reduce pressure on fisheries and also greatly increase resiliency of both human and marine communities to withstand future impacts from climate change. Transforming fishing technology to reduce by-catch will further strengthen the integrity of transboundary fisheries resources to rebound from overfishing in the current.

Insular Caribbean

There are more than 30 organizations and 17 funders working in the Caribbean region; nearly twice as many as are working elsewhere in Latin America. There remain, however, significant challenges to sustainable fisheries resources and biodiversity that need to be addressed, including overfishing, land- and marine-based pollution and coastal zone development and habitat destruction. In particular, the multi-billion dollar fisheries- and reef –dependent economy needs to be protected, and fisheries-based livelihoods need to be diversified to reduce vulnerability to overfishing and potential future climate impacts. There is also pressing need to strengthen the institutional capacity and mechanisms for cross-country cooperation and collaboration among the 36 Caribbean nations, given the transboundary nature of resources and stresses upon them. There are multiple region-wide efforts underway, however, so we have suggested additional areas of opportunity that offer solutions strategies for both internal and external pressures on fisheries and dependent communities.

Among the other areas of internal opportunities, local and regional capacity building for wastewater treatment, sewerage and sanitation infrastructure, and solid waste management would go a long way to reducing land-based pollution impacts (including eutrophication) that can be devastating for fisheries and human health. Capacity building for new, more integrated and science-based approaches to coastal zone development for housing and tourism will enable more sustainable and integrated resource-based economic development. Market-based approaches, such as rights-based management and PES, can instill economic incentives for localized protection and management of fisheries and reefs. Similarly, supporting sustainable aquaculture can reduce pressures on fisheries and provide alternative livelihoods, via certification and microfinance to provide the skills, technology, and infrastructure necessary to access and participate in growing export markets. Externally, there is significant opportunity to build on the awareness borne of consumer campaigns for sustainable seafood in developed country markets. Supporting similar consumer campaigns can create market demand for sustainable tourism and drive improvements in the environmental performance of international cruise lines, dive tours, and tourist resorts that are economically fundamental to many Caribbean nations. Finally, given the high numbers of organizations and funders working in the region, enabling fora for communication, collaboration, leveraging capacities, and sharing lessons learned could reduce duplication and improve effectiveness and efficiency of efforts in the region.

Potential Outcomes: Possible outcomes from these internal and external solutions include better management of coastal fisheries and increased food security for artisanal fishers. More integrated management of coastal tourism impacts and fisheries could result in more sustainable development of coastal areas and better outcomes for fishers engaging in alternative livelihoods. Strengthening

transboundary management of marine resources here is especially important here, with multiple countries and territories competing for use of limited resources. Addressing needs for collaboration would enable better management of marine resources across jurisdictions, and allow the Caribbean to further develop its important tourism industry in a more sustainable way.

Pacific Islands

The Pacific Islands received programmatic support from about 23% of the funders and 20% of the organizations that we examined, with a main emphasis on capacity building and science-based decision-making. Area-based management approaches, climate change adaptation and planning, and policy and governance received second-tier support. In 2006, the government of Micronesia launched the Micronesia Challenge to increase coordination and cooperation among the five political entities of the region. The past decade the capacity of many key IGOs in the region has increased, such as the Secretariat of the Pacific Community (SPC), the Forum Fisheries Agency (FFA), the South Pacific Regional Environment Programme (SPREP), as well as regional programs dedicated to fisheries at the University of the South Pacific (USP). Key funders in the region include The Packard Foundation, NOAA, AUSAID, the World Bank/GEF, FAO, among others.

Pacific Islands

Example Outcomes

- Build resilient fisheries against climate change
- Increase or maintain food security
- Environmental and economic protection against exploitation by foreign/distant fleets

Example Solution Strategies

- Internal
  - Climate adaptation strategies
  - Payment for ecosystem services
  - Area-based management
- External
  - Partnerships and coordination for improved enforcement
  - Technology transfer

There is significant opportunity for cooperative area-based management and enforcement efforts among the Pacific Island nations, given the large open water jurisdictions and the depth of organizational regional capacity. The successful protection of vast areas of reefs and ocean waters will create a safe haven for biodiverse fisheries, reducing environmental and economic vulnerabilities, and supporting food security for the communities who depend on them.

Melanesia

Melanesia's main needs include increased infrastructure and support for reef ownership by local communities. This form of stewardship has historically been used as an effective means for preserving fisheries, but is currently becoming more fragmented. Programs aimed at increasing food security are also becoming increasingly important, as are channels for advancing transboundary cooperation. Bolstering infrastructure to increase social resiliency from the impacts of climate change will also become significant in the future.

Several opportunities exist in responding to Melanesia's internal and external needs. Rights-based management effort may help to encourage sustainable harvest and preservation. Tenure by local communities has been an effective small-scale management strategy. This is an extremely under-funded opportunity in the Pacific Islands, one that could benefit from support to expand these methods to a national scale. Climate change adaptation is another area that could provide enormous benefits. In spite of being a currently highly visible global issue, surprisingly few organizations are providing funding to help coastal communities prepare for these impacts. Other areas of opportunity include offering support for strengthening transboundary agreements and management and the creation of market-based solutions. Implementation of incentives, paying for ecosystem services, and identification of alternative livelihoods/income generation options can help to lessen anticipated food insecurity issues.

***Potential outcomes*:** Rights-based management on local and national scales, combined with stronger transboundary agreements, can increase fisheries protection and sustainable harvest. Greater transboundary cooperation can increase integrated management capacity for sustainable fisheries and biodiversity conservation, and reduce economic vulnerability to overfishing; both of which could have positive impacts on food security. Climate change adaptation measures may reduce impacts to coastal communities from storms, flooding, sea level rise, etc., and help prepare communities for identifying alternative livelihoods.

Polar Regions

The Polar regions received the least funding and organizational support among the regions considered, due to the relatively limited number of pressures and commercial fisheries. There is strong basis for management and international cooperation in the Antarctic, due to the long-standing Antarctic Treaty and the Convention on the Conservation of Antarctic Marine Living Resources (CCAMLR), recognized for its international and ecosystems approach as a milestone in the conservation and management of living marine resources. Most of the funding and operational support in the Polar regions is focused on policy and governance, given the expected politics of access following changes in open water systems under climate change, as well as capacity building and science-based decision-making.

Polar Regions

Example Outcomes

- Build resilient fisheries against climate change
- Reduce ecosystem destruction and food web interference from increased commercial activity

Example Solution Strategies

- Internal
  - Climate change adaptation strategies
  - Science-based decision-making and adaptive management practices
- External
  - Transboundary capacity building
  - Bi- and multi-lateral agreements for sustainable fisheries and resource extraction plans
  - Cooperative approaches for enforcement

The gaps in the Polar regions will become more apparent in the future, as the impacts of climate change are realized. Unlike in the Southern Ocean, the Arctic, has limited transboundary institutional capacity to address growing competition and claims to vast fisheries and petroleum resources. And there is pressing need to understand the potential chain of ecosystem and food web impacts from climate change in both regions, and to integrate.

Opportunities for Greatest Impact: Key Findings for MacArthur to Consider and Possible Next Steps

The priority issues challenging sustainable fisheries resources and biodiversity are overcapacity in both deep and coastal waters, driven by a variety of pressures across different scales. Inequitable bi-lateral agreements are a key in many developing countries, as is IUU. The explosive expansion of aquaculture, and expectations of 8-9% growth per year, demands concerted efforts to make it sustainable. Stakeholder education and participation are key to effective policy and practice, as is the collection and integration of scientific data, bolstered capacity for compliance and enforcement, and the political will to make it happen. There is also need to test the efficacy of different management tools, including rights-based approaches such as individual transferrable quotas (ITQs), transferrable use rights (TURFs), etc. as well as assessment of the socioeconomic impacts. And finally, organizations and funders need to understand and assess the impacts of what has been done to date, with explicit measures of success, and identify lessons learned in order to go forward with improved effect.

Historically MacArthur has focused on direct biodiversity conservation and conserving the most biodiverse habitats, looking at markets as a way of leveraging change. In fisheries, as on land, protecting biodiversity takes place by working through the institutional context of pressures and drivers.

Below we present high level recommendation for MacArthur to consider to fill existing and anticipated gaps, and to catalyze additional investment and support for under-supported issue areas, and potential next steps.

Catalyze Funding

Building on MacArthur successes of the past to catalyze bi-lateral and multi-lateral funding, we believe there is a need and opportunity to seek greater investment for sustainable fisheries management and conservation. Specifically, our findings show an opportunity for MacArthur to seed and catalyze project planning and pilot new approaches in the following areas: climate change adaptation and planning for fisheries management; create and support environment of engagement for cross-scale linkages for effective governance and management; and microfinance to support development of alternative livelihoods.

> ***Key Finding: There are opportunities to catalyze funding from bi-laterals and multi-laterals in the following areas: climate change, national and regional governance and management, and alternative livelihood development.***

Leverage Success in Key Geographies to Address External Issues

MacArthur could build on existing geographies and approaches where there is existing capacity and infrastructure and a proven track record to restore and protect fisheries from external factors. For example, MacArthur could consider addressing some of the large-scale national, multi-country efforts for transboundary cooperation in the Pacific to direct focused support to improve governance and management effectiveness and reduce IUU fishing, and impact of distance water fleets or invest in supporting the development of larger networks and multi-use areas that link conservation and fisheries management more effectively in areas where IUUs and distant water industrial fleet activity is present and increasing. The Polar Regions present another area defined by long-standing transboundary collaboration and capacity, and which are now coming under threat as climate change promises greater and more economic access to the fisheries resources and newly accessible international sea routes.

> ***Key Finding: Addressing external factors requires a level of national and regional capacity in place.***

Planning Ahead for Global Fleet Migration

International fishing fleets relocated to developing country waters once the "northern" waters were too overfished to be economically sustainable, in preparation for the future MacArthur might consider how and where the international fleet may migrate as the "south" gets overfished and the impacts of climate change alter stock distribution and composition, and open historically uneconomic fisheries to industrial commercial exploitation (e.g., the Polar regions). The Foundation could support efforts to match modeled expectations of the global stock dynamics and trade, with multi-level governance institutions to set up the institutional infrastructure and capacity in response to the migration of exploitation.

> ***Key Finding: There is a need and opportunity to model fisheries and plan for climate change impacts in relations to global fleet migration.***

Implement Best Practice Models, Develop and Pilot Next Practices

There is much room for honing and developing best of practice models as well as the innovation and piloting of new approaches and next practices, especially for market-based solutions. The Foundation could focus on place-based work and develop models of excellence for science integration, compliance, and enforcement – sharing lessons or support the development of new tools and solutions in areas such as sustainable supply chain efforts, technology transfer, sustainable aquaculture, PES, and blue carbon.

> ***Key Finding: The role of a Foundation can be to support best practices as well as support of innovation to develop sustainable next practices***

Partnership

Partnerships take both financial and human resources. Foundations have an opportunity to facilitate and convene groups and partnerships across scales as well as sectors. Partnerships are not just for planning and implementation, but more and more public and private partnerships need to be established to support and fund management and conservation.

> ***Key Finding: There is an opportunity to catalyze and support nascent partnerships, especially those that will lead to joint funding initiatives. This also includes funding partners.***

Science, Evaluating Performance, and Learning

It is clear that bolstering fisheries science data and information, and building the technical and management capacity for its integration into policy and management is essential for fisheries management. This includes developing consistent frameworks for monitoring and evaluation for adaptive management and performance evaluation. It may not be realistic, however, for a Foundation to support science, but it could support key pieces of research or analysis for decision-making or develop of institutions or processes to support science. MacArthur can establish a learning platform and system at the inception of the program to share performance and lessons.

> ***Key Finding: Build into the Foundation's funding strategy programs to monitor performance to share and learn from initiative with other funders as well as practitioners.***

Scale

The issue of scale in marine systems is complex because of the vastness of marine space and the upstream and downstream connections that impact ecosystem health, both physically and socioeconomically. When fisheries solutions are designed and implemented at only one scale, they can result in, for example, a community developing and implementing a successful site-based program whose success may be comprised or limited by external factors, such as IUU fishing, overcapacity of the industrial fleet, or agro-industry or urban land-based pollutants influencing the health of the system.

There have been many programs and projects funded the past decade by private foundations supporting small-scale, community, site-based efforts. Bi-lateral and multi-lateral organizations have started to fund science and governance capacity building at the LME scale in select regions, as well as some national scale efforts, though they are few and far between.

We suggest that the Foundation consider investments and support efforts across scales.

> ***Key Finding: Small-scale efforts may be easier to implement and show success, but result in small- scale outcomes. There is a need to bolster and support efforts to work across scales, connecting the local to the national and regional for greater impact. Most regions need to focus on local, sub-regional and national efforts.***

Next Steps for MacArthur to Consider

As MacArthur explores new opportunities for future investment over the coming year it will be important to consider taking the following next steps:

1. Determining Priorities and Setting Goals: There are many needs and opportunities for impact in the arena of sustainable marine fisheries and biodiversity conservation. In order for MacArthur to select an appropriate strategy, the Foundation needs to decide what are the main goals driving the investment. Does MacArthur weigh equally, for example, maintaining or developing food security and biodiversity conservation? Or is biodiversity

conservation and fisheries restoration of greater value. If the former, the strategy could focus on market-based solutions and policy development for sustainable aquaculture in the African regions. However, if the latter is a goal, the Foundation may choose to invest in restoration and management in Asia and Latin America and protection efforts in the Pacific and Polar regions.

2. Assessing the Foundations Level of Risk Tolerance: The Foundation stated it would like incremental change. However, in order for the Foundation to move forward on selecting an effective strategy and approach, e.g. regional and/or cross-cutting, based on priorities it outlines, we believe the Foundation needs to determine its risk tolerance threshold for achieving results. As elsewhere in the Foundation's work, strategies with very high likelihood of achieving proposed goals may have less impact than those taking higher risks; e.g., working in Africa could have significant impacts, but the institutional challenges are great. On the other hand, supporting small, well-established groups on the ground may not break new ground, but much can be done with every marginal dollar. We believe that working on emerging issues with new solutions could have higher risk than approaches and geographies that have the building blocks for further results.

3. Deeper Scoping and Analysis for Strategy Development**:** This report is a global survey. We suggest the Foundation select a few solution strategies and geographies, and then drill down and scope out more specific strategies and potential opportunities, based on priorities, goals, and risk tolerance. It will be important to take the time to assess the political and economic context before investing in any particular geography. Taking the time to assess opportunities that are "ripe" with some capacity to build on, leadership, and political will be essential for success.

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