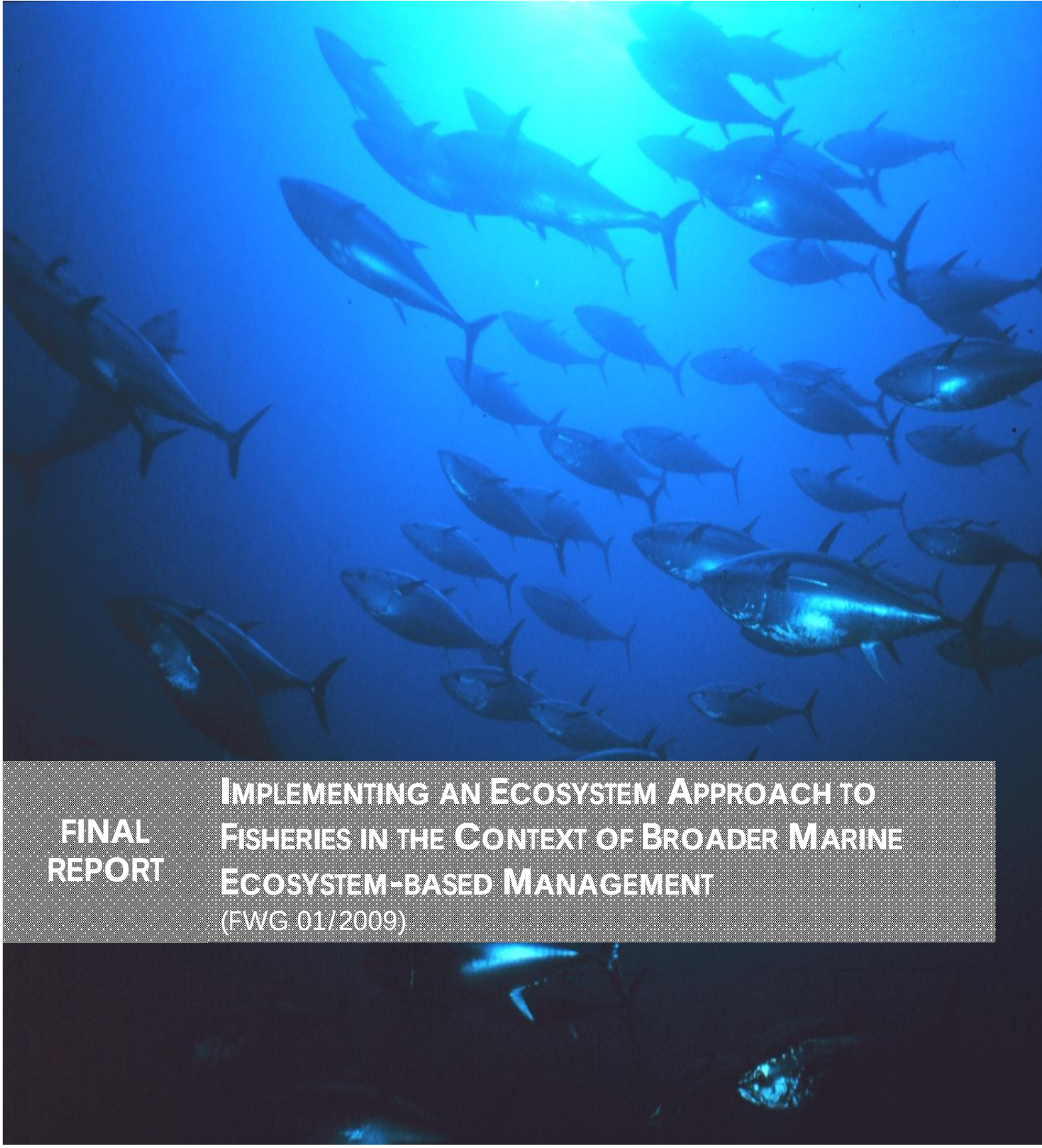

FINAL REPORT

Implementing an Ecosystem Approach to Fisheries in the Context of Broader Marine Ecosystem-based Management

(FWG 01/2009)

Asia-Pacific Economic Cooperation

Publication No.: APEC#210-FS-01.2

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ABBREVIATIONS

ADB	Asian Development Bank
AFT	Atlantic Fisheries Technological Society
APEC	Asia Pacific Economic Cooperation
ASEAN	Association of Southeast Asian Nations
BIMSTEC	Bay of Bengal Initiative for Multi sect oral Technical and Economic Cooperation
BOBLME	Bay of Bengal large Marine Ecosystem
BPA	Bali Plan of Action
CCAMLR	Convention on the Conservation of Antarctic Marine Living Resources
CCRF	FAO Code of Conduct for Responsible Fisheries
CCSBT	Conservation of Southern Bluefin Tuna
CITES	Convention on International Trade in Endangered Species
COMDA	Centre of Ocean Modelling Development and Application
CONCEPTS	Operational Network of Coupled Environmental PredicTion Systems
CSIRO	Commonwealth Scientific and Industrial Research Organisation
CTAM	Coastal Transects Analysis Model
CTI-CFF	Coral Triangle Initiative for Coral Reefs, Fisheries and Food Security
DEVFISH	Development of Tuna Fisheries in the Pacific ACP Countries Project
EAF	Ecosystem Approach to Fisheries
EAFM	Ecosystem Approach to Fisheries Management
EBM	Ecosystem-Based Management
EBSA	Ecologically and Biologically Sensitive Areas
EEZ	Exclusive Economic Zone
EHMP	Ecosystem Health Monitoring Program
EIA	Environmental Impact Assessment
ERA	Ecological Risk Assessment
ERI	Ecosystem Risk Index
ERM	Ecological Risk Management
FAO	Food and Agriculture Organisation
FARMCS	Fisheries and Aquatic Resource Management Council
FEP	Fishery Ecosystem Plan
FMP	Fisheries Management Plans
FRI	Fishery Risk Index
GEF	Global Environment Facility
GIS	Geographic Information System
GPA	Global Programme of Action of the Marine Environment from Land-based activities
IATTC	Inter-American Tropical Tuna Commission
IBM	Individual-Based Models
ICCAT	the International Commission for the Conservation of Atlantic Tunas
ICRAN	International Coral Reef Action Network
ICRI	International Coral Reef Initiative
IGO	Intergovernmental Organisation
IOC	Intergovernmental Oceanographic Commission
IODE	International Oceanographic Data and Information Exchange
IOTC	Indian Ocean Tuna Commission
IPOA	International Plan of Action
IPOA-IUU	International Plan of Action to Prevent, Deter and Eliminate Illegal, Unreported and Unregulated Fishing
ITQ	Individual Transferable Quota

IUCN	International Union for Conservation of Nature
IUU	Illegal, Unreported and Unregulated
JNCC	Joint Nature Conservation Committee
JTED	Juvenile and Trash Excluder Devices
LME	Large Marine Ecosystem
LOMA	Large Ocean management Areas
MCS	Monitoring, Control and Surveillance
MPA	Marine Protected Area
MSFOR	Multi-Species Forward Projection
MSM	Multi-Species Statistical Model
MSVPA	Multispecies Virtual Population Analysis
MSY	Maximum Sustainable Yield
NABIS	National Aquatic Biodiversity Information System
NACA	Network of Aquaculture Centres in Asia-Pacific
NGO	Non-Governmental Organisation
NODC	National Oceanographic Data Centres
NPAFC	North Pacific Anadromous Fish Commission
ODP	Ocean Data Portal
ORI	Objectives Risk Index
PICES	North Pacific Marine Science Organisation
PPGIS	Public Participation Geographic Information System
PPP	Public-Private Partnership
RFMO	Regional Fisheries Management Organisations
ROE	Rate of Effort
SEAFDEC	Southeast Asian Fisheries Development Center
SMA	Salmon Management Area
SRI	Species Risk Index
TED	Turtle Excluder Device
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFA	United Nations Fish Stocks Agreement
VMS	Vessel Monitoring Systems
WCPA	World Commission on Protected Areas
WCPFC	Western and Central Pacific Fisheries Commission
WWF	World Wildlife Fund

EXECUTIVE SUMMARY

The objectives of the project include an assessment of overall progress and readiness of APEC Economies in implementing marine ecosystem-based management (EBM) and ecosystem approach to fisheries management (EAF), and identification of any challenges in implementation. The project serves to improve understanding of the range, nature, degree and complexity of marine EBM/EAF practice amongst APEC as a whole.

This Final Report describes a range of marine EBM/EAF activities, practices and programs currently being undertaken by APEC Economies, and identifies some elements of practice in this regard. The findings are based on the results of secondary research and findings of an APEC Economy Survey led by the APEC Fisheries Working Group & Marine Resources Conservation Working Group under APEC Project No: FWG 01/2009. A total of 14 out of 21 APEC Economies returned the survey questionnaire. The results and specific examples presented in this Report are not intended to be all inclusive; rather, they provide a context within which APEC Economies may undertake benchmarking to aid progress in their implementation of marine EBM and EAF.

The identification and understanding of ecosystems, and the opportunity to provide for the needs of interdependent user-groups is essential for sustainable coastal and oceans management. However, the principles of EBM are often not easily translated into operationally-meaningful terms because of the challenges in moving from broad objectives to practical applications at the management or industry level(s).

A total of 20 conditions have been identified in this Report to indicate that marine EBM has been adopted by an APEC Economy, and a further 23 conditions to indicate an EAF. For EBM, these are discussed under the thematic headings of: Policy and Law; Science and Data; Stakeholder Participation and Awareness; Finance; and Capacity. For EAF, they are discussed under the thematic headings of: Fish-stock Management; Non-target Species and Habitats; Industry Management; and Fisherfolk and Stakeholders.

The findings from the returned surveys and literature review are that awareness of EBM and EAF is growing amongst APEC Economies, and that many of these Economies have embraced these concepts in Government rhetoric and even in policy articulation. However, there would appear to be more to be done in translating such declared intentions into practical management outcomes,

i.e. through legislative amendments, improved science and technology effort, determination and monitoring of performance indicators, allocation of sustained funding and much more. Many early initiatives have also tended to take place within the boundaries of marine protected areas.

1.0 INTRODUCTION

Ecosystem-Based Management (EBM) entails a broad approach to the management of human activities that impact on living resources and the habitats on which they depend. EBM represents a shift from a focus on single-species to a more holistic perspective that considers and manages all interactions and linkages within an ecosystem, maintains its structure and function, recognises that humans and ecosystems are interdependent, and considers ecological, social and cultural aspirations.[1]

Within the context of EBM, an Ecosystem Approach to Fisheries (EAF) aims to balance development goals, knowledge of marine ecosystem functions, and interactions amongst species in order to sustain fisheries, protect and restore ecosystems, and provide for food security. EAF strives to "balance diverse societal objectives, by taking account of the knowledge and uncertainties about biotic, abiotic and human components of ecosystems and their interactions and applying an integrated approach to fisheries within ecologically meaningful boundaries".[2] Thus, EAF is a way of implementing many of the provisions of the FAO Code of Conduct for Responsible Fisheries, and achieving sustainable development in a fisheries context.[3]

The primary goal of EBM is to maintain overall ecosystem health and sustainability in the context of multiple-use management to achieve the needs of societies without jeopardising the option for future generations to benefit from the full range of goods and services provided by marine ecosystems. EBM is now a high priority for many scientists and marine resource managers. EBM involves recognizing and addressing interactions across different spatial and temporal scales, between different ecological and social systems, and among various stakeholder groups and communities interested in the health of coastal and marine areas. The identification and understanding of ecosystems, and the opportunity to provide for the needs of interdependent user-groups is essential for sustainable coastal and oceans management. However, the principles of EBM are often not easily translated into operationally-meaningful terms because of the challenges in moving from broad objectives to practical applications at the management or industry level(s).

[1] The Nature Conservancy, 2007.
[2] FAO, 2003a. Fisheries Management - 2. 'The Ecosystem Approach to Fisheries. FAO Technical Guidelines for Responsible Fisheries.' Publication # 4, Supplement 2. Food and Agriculture Organization of the United Nations, Rome.
[3] http://www.fao.org/docrep/005/v9878e/v9878e00.HTM

Within this context, EAF moves beyond the narrower aspirations of single-species fishery sustainability. EAF aims to conserve the structure and function of marine ecosystems, whilst conserving fishery resources. Therefore, EAF complements and enhances existing fisheries management practices. For EAF, fishery managers need to understand the complexity of marine ecology and the socio-economic environment in which they operate, along with the effects of interventions upon ecosystems and the fisheries themselves.

1.1 PROJECT BACKGROUND

This report describes a range of marine EBM/EAF activities, practices and programs currently being undertaken by APEC Economies, and identifies some elements of practice in this regard. The findings are based on the results of secondary research and an APEC Economy Survey led by the APEC Fisheries Working Group & Marine Resources Conservation Working Group under APEC Project No: FWG 01/2009. The results and specific examples presented are not intended to be all inclusive; rather, they provide a context within which APEC Economies may undertake benchmarking to aid progress in their implementation of marine EBM and EAF.

The objectives of the project includes an assessment of overall progress and readiness of APEC Economies in implementing marine EBM and EAF, and identification of any challenges in implementation. The project serves to improve understanding of the range, nature, degree and complexity of marine EBM/EAF practice amongst APEC as a whole.

This report builds upon the findings of a 2008 stock-take survey of APEC implementation of the Bali Plan of Action (BPA), and a number of other past initiatives, such as APEC Project FWG02/2005, a PICES Study on 'Ecosystem-based Management Science and Application in the North Pacific', and the 'Eastern Scotian Shelf Integrated Management (ESSIM) Initiative: Ocean and Coastal Management Report 2005-09', and others.

1.2 ECOSYSTEM-BASED MANAGEMENT (EBM) PRACTICE

EBM integrates ecological, social, and economic goals and recognises humans as a key component of ecosystems. It considers both ecological and political boundaries, and addresses the complexity of natural processes and social systems.[4] EBM aims to manage the effects of human activity upon habitats and ecosystems, whilst providing for current and future economic, social and cultural needs. In the marine context, EBM recognises fisheries as one of the influencing factors of EBM, but there are numerous others, such as shipping, tourism, recreation, industrial development, and hydrocarbon extraction etc. An EBM regime considers the cumulative impacts of each of these activities, and works towards maintaining ecosystem services.

The following actions are consistent with EBM:[5]

- Protect and restore marine ecosystems and all their services as the primary focus, even above short-term economic or social goals for single services.
- Consider cumulative effects of different activities on the diversity and interactions of species, and keep any negative effects to a minimum.
- Facilitate connectivity among and within marine ecosystems by accounting for the import and export of larvae, nutrients, and food.
- Incorporate measures that acknowledge the inherent uncertainties in ecosystem-based management and account for dynamic changes in ecosystems, for example as a result of natural oscillations in ocean state or shifts in the frequency or intensity of storms.
- Create complementary and coordinated policies at global, international, national, regional, and local scales, including between coasts and watersheds.
- Maintain historical levels of native biodiversity in ecosystems to provide resilience both to natural and human-induced changes.
- Require evidence that an action will not cause undue harm to ecosystem function before allowing that action to proceed.
- Develop multiple indicators to measure the status of ecosystem function, service provision and effectiveness of management efforts.
- Involve all stakeholders through participatory governance that accounts for both local interests and those of the wider public.

[4] The COMPASS Scientific Consensus Statement on Marine Ecosystem-Based Management recognises that solutions based on an integrated ecosystem approach hold the greatest promise for delivering desired results and that from a scientific perspective, there is sufficient knowledge to improve dramatically the conservation and management of marine systems through the implementation of ecosystem-based approaches.
http://www.compassonline.org/pdf_files/EBM_Consensus_Statement_v12.pdf

[5] McLeod, K.L., J. Lubchenco, S.R. Palumbi, and A.A. Rosenberg. 2005. Scientific Consensus Statement on Marine Ecosystem-Based Management. Signed by 217 academic scientists and policy experts with relevant expertise and published by the Communication Partnership for Science and the Sea at http://compassonline.org/?q=EBM; along with U.S. Commission on Ocean Policy and the Pew Oceans Commission.

Within the framework of the above actions, the following implementation initiatives are indicative of sound marine EBM practice:[6]

- Initiate ecosystem-level planning that involves multiple stakeholders and takes into account the cumulative impacts of multiple important human activities on ecosystems, as well as the effects of long-term environmental changes.
- Establish management goals through formal agreements and mechanisms across local, state, national and tribal authorities and jurisdictions. Goals within ecosystem-based management should reflect interagency management at all levels, as opposed to focusing on specific jurisdictions within an ecosystem (for example, parks, refuges, and sanctuaries).
- Initiate zoning of marine space, for example LMEs, by designating areas for particular allowable uses in both space and time, including networks of fully protected marine reserves and other types of marine protected areas. Zoning that reduces conflict among users of different services should account for and integrate the effects of key activities. This regional planning should be carried out in a comprehensive manner. Area-based management approaches are valuable tools for coordinating the management of multiple uses within the larger land- or seascape context. Networks of marine reserves are uniquely capable of protecting biodiversity and habitats, producing the large-bodied individuals who contribute disproportionately to reproductive output, providing insurance against management uncertainties, and providing a benchmark for evaluation of the effects of activities outside of reserves.
- Expand and improve the coordination of habitat restoration in coastal ecosystems such as wetlands, sea-grass beds, and kelp and mangrove forests where habitats have been lost or ecosystem functioning has been diminished. These activities, should be coordinated in a comprehensive manner that considers their cumulative effects on ocean and coastal ecosystems and includes a rigorous program of research, monitoring and evaluation.
- Adopt co-management strategies in which governments (national, state, local, and tribal) and diverse stakeholders (local resource users, academic and research scientists, conservation interests, community members with traditional knowledge, and other stakeholders) share responsibility for management and stewardship. Potential advantages include decision-making that is better informed, more flexible, and incorporates local ecological knowledge.
- Incorporate adaptive management into ecosystem plans as an approach to learning from management actions that allows for scientifically based evaluation, testing of alternate management approaches, and readjustment as new information becomes available from carefully designed monitoring programs. Management should explicitly acknowledge that our current understanding is incomplete and will continue to improve. Likewise, institutions must be adaptable when ecosystems or knowledge change.
- Establish long-term ocean and coastal observation, monitoring and research programs to collect continuously and integrate relevant bio-geophysical, social, and economic data. These programs are needed to understand better the workings of marine ecosystems, changes in ocean dynamics, and the effectiveness of management decisions.

[6] *Loc. Cit.*

A 2005 review of progress in implementation of EBM looked at the development of objectives and indicators (i.e. the targets set, and how progress towards them was measured), and noted that "of the 23 marine EBM initiatives identified [in that review], only nine [had] developed objectives and/or indicators and none [had] yet achieved full implementation".[7] That is, out of a broad suite of EBM initiatives, very few had articulated measurable targets, nor described how progress would be measured. Currently, there is a lack of understanding on how to determine effective objectives and indicators. For instance, whilst the need to ensure that pressures on one resource (e.g. a fishery) do not have deleterious impacts on other resources (e.g. endangered species, or a key forage species for another fishery resource) is well understood, the problem in many cases is that science is yet to determine the precise nature of these linkages. Therefore, setting targets becomes problematic. Complicating matters even further are the unmeasured impacts of other ocean uses, such as shipping and tourism, or even pollution and land-based impacts such as runoff. Some APEC Economies have made progress in addressing multiple-use impacts on marine ecosystems, but there is still insufficient cross-cutting management of the varied impact areas.

[7] Walmsley, J., 2005. Developing Objectives and Indicators for Marine Ecosystem-Based Management: International Review of Marine Ecosystem-Based Management Initiatives Throughout the World. Fisheries and Oceans Canada, Nova Scotia.

2.0 ELEMENTS OF ECOSYSTEM-BASED MANAGEMENT (EBM)

A total of 20 conditions have been identified in this report to indicate that marine EBM has been adopted by an APEC Economy, and these are discussed below under the thematic headings of: Policy and Law; Science and Data; Stakeholder Participation and Awareness; Finance; and Capacity.

2.1 POLICY & LAW

Human activities at sea are managed through a combination of regulations and enforcement, incentives, and awareness and education. The balance of emphasis between these different management tools and the form they take is governed by the overall vision, goals and principles adopted by each Economy, which may or may not be articulated formally in public policy. Thus, in the area of policy and law, the following factors are indicators of the extent to which an Economy practices marine EBM:

- The Economy has made commitments (i.e. signature, ratification, or accession) to implement international agreements that embody EBM principles and practices;
- The Economy implements management approaches that are consistent with EBM;
- There is formal policy articulation of coastal or ocean policy that reflects EBM;
- Management objectives, targets, indicators and / or permits are determined consistently with the goal of maintaining ecosystem health;
- The principles of EBM are reflected in national legislation;
- Laws, vision, goals, objectives, guiding principles, indicators and management practice are harmonised across political boundaries;
- Management area boundaries are determined by ecological parameters, and marine space planning and management is practiced; and
- Indigenous and traditional property and user-rights are respected.

The survey and research on current practice by APEC Economies canvassed these aspects, and each is discussed in turn below.

2.1.1 Relevant International Instruments & EBM practiced

Influence of International Instruments

The survey questionnaire explored the extent to which certain legal instruments have been "particularly influential" in encouraging economies to practice EBM. The following nine instruments were cited as being particularly influential by at least half of respondents:

- United Nations Convention on the Law of the Sea, 1982;
- The United Nations Agreement for the Implementation of the Provisions of the United Nations Convention on the Law of the Sea of 10 December 1982 relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks, 1995 (UNFSA);
- Convention on International Trade in Endangered Species of Wild Flora and Fauna, 1973 (CITES);
- United Nations Convention on Biological Diversity, 1992;
- FAO Code of Conduct for Responsible Fisheries, 1995;
- International Plan of Action to Prevent, Deter and Eliminate Illegal, Unreported and Unregulated Fishing (IPOA-IUU);
- International Plan of Action for the Conservation and Management of Sharks (IPOA-Sharks);
- APEC Bali Plan of Action; and
- National Legislation

Of these, the *United Nations Convention on the Law of the Sea* (LOSC) 1982, and FAO Code of Conduct for Responsible Fisheries were identified by the most Economies (71% and 64% respectively) as being particularly influential. Inclusion of the LOSC so prominently in this list perhaps reflects mainly the role of that treaty in raising awareness in coastal States of their rights and duties with regard to the sea. The treaty itself generally is silent on the question of ecosystems and reflects a focus on species preservation that was prevalent in the era when the treaty was done. Indeed, the 'Preface' to the FAO Code of Conduct for Responsible Fisheries says of the extended sovereign rights and jurisdiction established by the LOSC, that "Such extended national jurisdiction was a necessary but insufficient step toward the efficient management and sustainable development of fisheries."

The FAO Code of Conduct for Responsible Fisheries purposely moves beyond questions of sovereignty, sovereign rights and jurisdiction, noting that its first objective is to "establish principles, in accordance with the relevant rules of international law, for responsible fishing and fisheries activities, taking into account all their relevant biological, technological, economic, social, environmental and commercial aspects". Elaboration of this principle in Section Six of the Code observes that "States and users of living aquatic resources should conserve aquatic ecosystems. The right to fish carries with it the obligation to do so in a responsible manner so as to ensure effective conservation and management of the living aquatic resources". In this regard, acknowledgement by APEC Economies of a particularly influential role for the FAO Code of Conduct for Responsible Fisheries in encouraging EBM is perhaps to be expected.

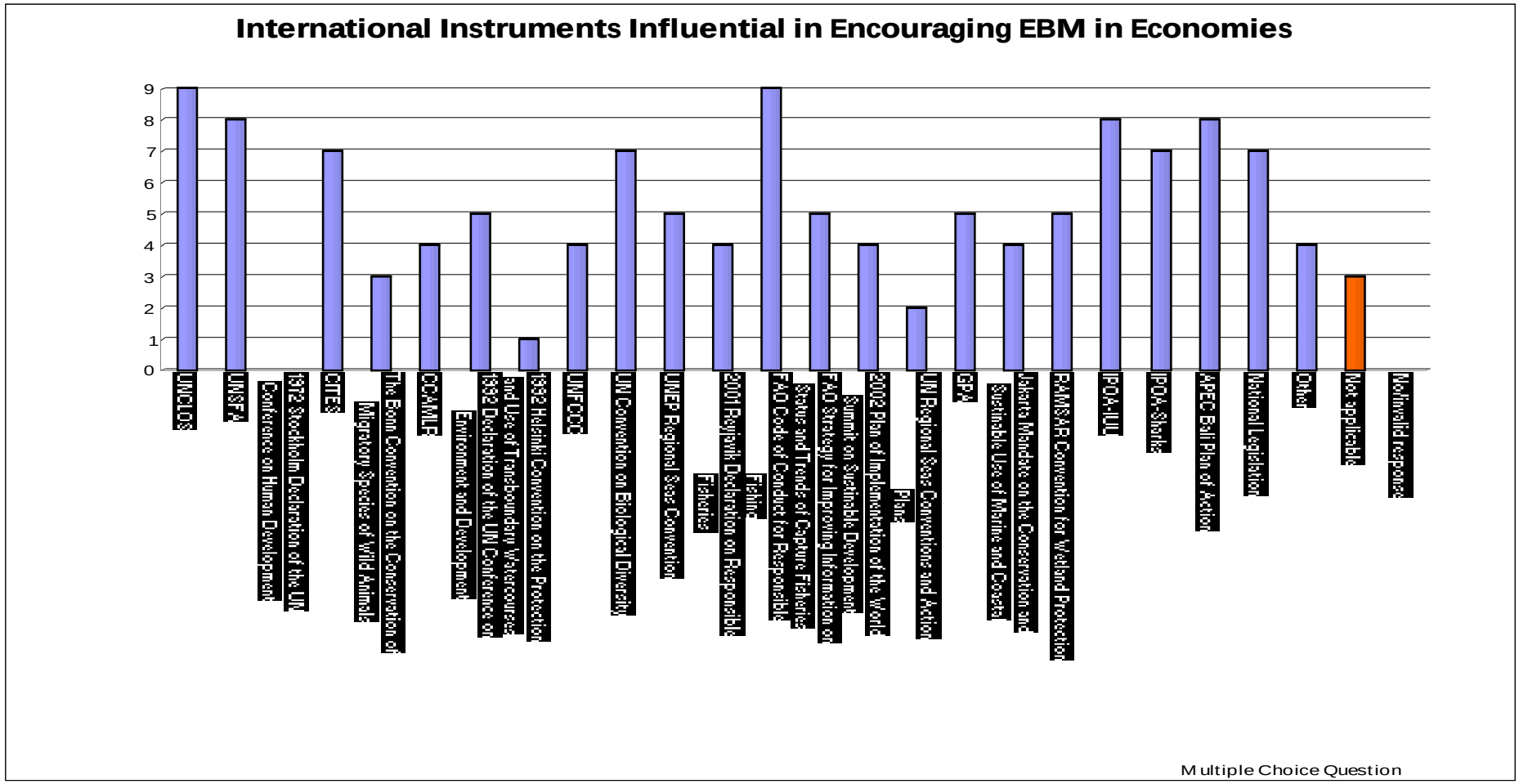
However, interestingly, of the nine instruments identified by at least half of the responding Economies as encouraging EBM practice, four are non-binding instruments (**see Figure 1**). This illustrates that principles and practices need not be embodied in binding international law in order to be influential on State practice. Finally, the survey question highlights that instruments concerned with fishing practice feature strongly amongst those that have been particularly influential in encouraging EBM.

Remarkably, one Economy declared that no international instruments have been particularly influential in encouraging EBM.

EBM Practice

Adaptive Management. Essentially, adaptive management entails monitoring, evaluation, reporting and improvement. It is an ongoing cycle in which lessons learnt are 'reinvested' in environmental management practices. A number of APEC Economies have moved toward adaptive management practices with regard to the marine environment, but this is a slow evolutionary process.

Figure 1: **International instruments influential in encouraging EBM in Economies**



Taken at the wider ecosystem level, which incorporates multiple impacts, there has been limited application of adaptive management. Most adaptive management frameworks are piecemeal. In many Economies, initiatives taken in one sector are executed independently from management initiatives in other sectors. Notably, some Southeast Asian Economies have investigated adaptive fishery co-management structures that bring together different stakeholders; however, such co-management and adaptation appears to have been motivated more by a desire to protect fishery resources from outside exploitation than by conservation.[8]

Initiatives taken on behalf of a very substantial marine protected area in one developed Economy provide good examples of cross-cutting adaptive management. Officials of that Economy publicly acknowledge that the MPA is not static, i.e. "Use patterns and technology are constantly changing and the marine environment itself is dynamic - subject to both human use and natural impacts". That particular Authority has channels of liaison with more than ten key government agencies and numerous other stakeholders in implementing management initiatives. It has an annual review of both resource management and fiscal performance, and a process whereby legislation can be amended, revoked, or introduced so that laws are not static and remain aligned with government policy and priorities.[9]

Building on an adaptive framework, a developed Economy also implements an 'Environment Protection and Biodiversity Conservation Act', which allows the government, *inter alia*, to assess the environmental performance of fisheries and promote ecologically sustainable management. Along with this, catchment-based adaptive management programs are also in place to consider runoff and land-based pollution of downstream (marine) habitats. Moreover, the Economy has a continual process to re-evaluate the listing of threatened and endangered species in order to reflect the most current status of each population.

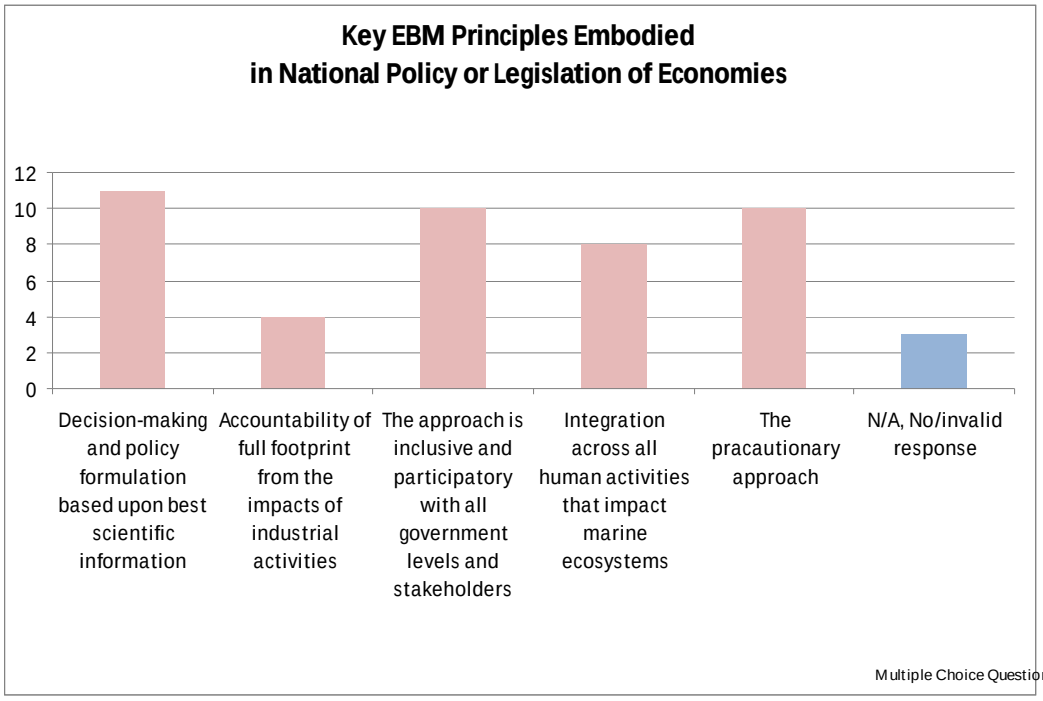
A natural heritage site in another developed Economy provides a further example of adaptive marine ecosystem management and co-management of coastal fisheries.[10] The management plan describes which species and factors are to be monitored, how these data are evaluated, and how

[8] Wilson, D.C., M. Ahmed, S.V. Siarb and U. Kanagaratnamb, 2005. Cross-scale linkages and adaptive management: Fisheries co-management in Asia. *Marine Policy* 30 (5): 523-533, discuss also the potential for adaptive processes to be enabled between varying stakeholder groups as part of a worldwide collaborative research project on fisheries co-management.
[9] http://www.gbrmpa.gov.au/__data/assets/pdf_file/0003/8076/GBRMPA_Submission_Part_A.pdf
[10] Matsudaa, H., M. Makinob and Y. Sakuraic, 2009. Development of an adaptive marine ecosystem management and co-management plan at the Shiretoko World Natural Heritage Site. *Biological Conservation* 142(9): 1937-1942.

the benchmarks specified by ecosystem management are to be determined. The plan provides a good example of 'environment-friendly fisheries' because it includes voluntary activities by resource users that are: suitable for use in a local context; flexible to ecological and social fluctuations; and efficiently implemented through increased legitimacy and compliance.

Integrated Management. More than half of the survey respondents reported that marine management in their economy is integrated through policy or legislation across all human activities that impact on the marine environment. Two-thirds also claim that their approach is inclusive and participatory with representation by all levels of government and stakeholders (**see Figure 2**).

Figure 2: Key EBM principles embodied in national policy or legislation



A number of APEC Economies have developed ICM plans to address multiple impacts including: land-based pollution and runoff; land reclamation and dredging; shipping; tourism and recreation, and more. An emerging APEC Economy identified a demonstration site that was suffering from marine pollution and the impacts of rapid development, for implementation of an integrated coastal management (ICM) project. The project was reported to have achieved success in strengthening relevant institutions, and establishing decision-making mechanisms based on consensus building among stakeholders and inputs from science and technology.

In particular, another developing APEC Economy with extensive and diverse marine and coastal resources has substantially embraced the concept of ICM. This Economy is characterized by a multi-level, decentralized governance system incorporating national, provincial, city, municipality and village levels. Its widespread adoption of ICM principles is facilitated by a process of decentralization, through which local government units (LGUs) are empowered to manage natural resources as they see fit. In response to significant national and international funding investment, many of the LGUs have adopted integrated practices. Nevertheless, although these initiatives and programs are arguably some of the most advanced in the Economy's region[11], reportedly, there remain a number of issues to resolve such as coastal resources degradation, conflicts of interest and jurisdiction, and impractical marine and coastal policies.

Precautionary Approach. To varying degrees APEC Economies are also adopting a precautionary approach.[12] Two-thirds of survey respondents stated that the precautionary approach is reflected in national policy or legislation.

In one developed Economy, the Minister responsible for the environment is required by law to adopt a precautionary approach, and under specific subsidiary regulations, decision-making must be consistent with the precautionary principle. The largest MPA in that Economy is also required to have regard for the precautionary principle in developing management plans, and, under Natural Heritage legislation, if there are threats of serious or irreversible environmental damage, lack of full scientific certainty cannot be used as a reason for postponing measures to prevent environmental degradation.

In another developed Economy, there is a requirement to adopt a precautionary approach in the assessment of coastal hazard risk and in the assessment of potential risks for coastal permit applications. That economy has also already adopted a precautionary approach to fisheries management, and has stated that it intends to amend fisheries legislation to reflect the internationally-accepted precautionary approach. Another Economy reported an explicit

[11] In 2007, an informative comparison of ICM adoption was developed under the auspices of the UN Nippon Foundation Fellowship program by Hendra Yusran Siry. This report details the successes, failures and mechanisms for adoption of ICM in SE Asia. http://www.un.org/Depts/los/nippon/unnff_programme_home/fellows_pages/fellows_papers/siry_0607_indonesia.pdf

[12] Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation.' See: *Agenda 21* – preventative and precautionary approach (para 17.5[d], Chap 17 Programs A, B); *Convention on Biological Diversity* – (Preamble); *Jakarta Mandate, Convention on Biological Diversity* – (COP Decision II/10 Annex II para 3[a]; Decision IV/5 Annex B para 4); *Rio Declaration* – (Principle 15

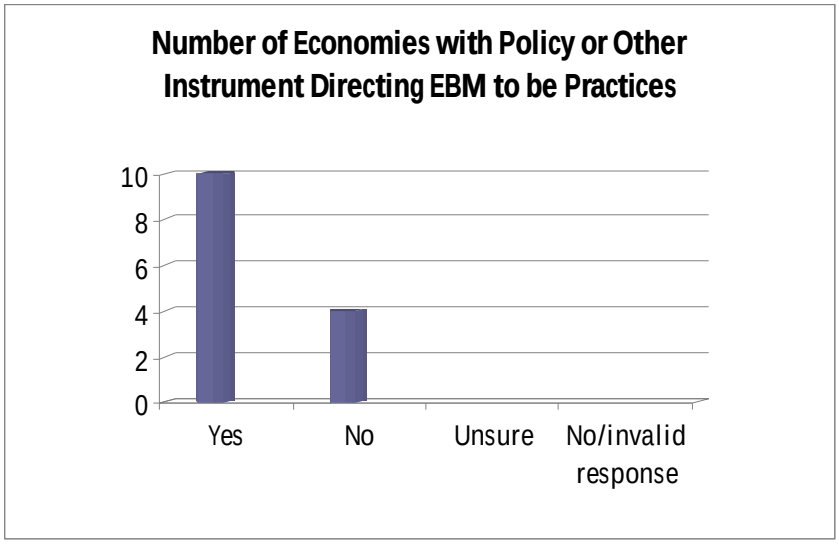
requirement for the precautionary approach to be respected in Dumping at Sea Ordinance and Water Pollution Control Ordinance.

Use of Best Science. Remarkably, three-quarters of responding Economies said that there is a requirement in national policy or legislation for decision-making and policy formulation to be based upon best scientific information. However, none of the survey responses offered examples of such legislation or policy. A review of published ocean policy in a number of APEC Economies does reveal strong recognition of the need for best scientific information; however, examples of such a legislative requirement are not as readily apparent.

2.1.2 Promulgated official commitment to EBM

Seventy one per cent of responding Economies reported that they do have either an official policy or other instrument directing that EBM be practiced. Although this evidence would appear to suggest that Economies are embracing the concept of EBM, the practice is yet to be applied universally. For example, one Economy noted that a 'Coastal Act' is currently under review by its National Legislature but stressed that the new Act does not call for EBM. Another developed Economy responded "No" to the question and explained that the concept is "not applicable" to its circumstances (**see Figure 3**).

Figure 3: Number of Economies with policy or other instrument directing EBM to be practiced



However, some of the Economies that provided qualitative amplification for the question cited examples of legislation or policy that do embrace EBM. Most of these examples related to fisheries management, but a developing Economy also highlighted the requirement for EBM in a draft 'National Maritime Act' that aims to "address gaps in ocean-related legislation". Other examples cited of multi-sectoral instruments to direct the practice of EBM include the establishment of a 'Climate Change Commission' and a 'National Agenda 21'. One developed Economy stated that its Oceans Policy "recognises that ocean ecosystem health and integrity is fundamental to ecologically sustainable development". It also stated that marine bioregional plans- currently being prepared for its five marine regions will provide for the conservation and sustainable management of the Economy's marine environment. This process aims to achieve ecologically sustainable development (ESD) and to integrate short and long-term economic, social and environmental aspects across a broad range of activities. The declared overall goals for ESD by that Economy are to: protect biodiversity and maintain essential ecological processes; provide effective legal, institutional and economic frameworks; and enhance individual and community well-being by following a path of economic development that safeguards the welfare of current and future generations.[13]

At the greater ecosystem level, a 'Strategy for Managing the Environmental Effects of Fishing' of another developing Economy is a good example of formally promulgated EBM, which links land-based activities with fishery management. The strategy recognises that inputs into the sea from influences such as urban development, catchment deforestation, agriculture and road development have potential deleterious impacts on the marine environment. The Strategy has already demonstrated that impacts from these influences have caused shrinkage of shellfish nursery areas and contaminated shellfish stocks.

Of similar success is an initiative taken by a developed Economy in implementation of a national Oceans Act. A pilot project was established for the integrated management of a prominent part of the continental shelf. The aim of the project is to explore governance frameworks and develop conceptual and operational ecosystem objectives.[14] The area concerned is home to a wide array of living and non-living marine resources, significant areas of high biological diversity and productivity, and increasing levels of multiple-use and competition for ocean space and resources.

[13] Walmsley, *op. cit.,* 2005

[14] O'Boyle, R. and T. Worcester, 2006. Eastern Canada – Ecosystem approach to fisheries in DFO Maritimes Region. In Kruse, G.H., P. Livingston, J.E. Overland, G.S. Jamieson, S. McKinnell, and R.I. Perry (Eds.) pp. 63-64. *Report of the PICES/NPRB Workshop on Integration of Ecological Indicators of the North Pacific with Emphasis on the Bering Sea*. PICES Sci. Rep. No. 33.

Given competing use pressures within the area (fisheries, oil and gas, shipping, defense, research, recreation and tourism, amongst others), the Initiative was developed as a multi-year, strategic level plan to provide long-term direction and a common basis for integrated, ecosystem-based and adaptive ocean management. The planning process for this initiative involves a broad range of interests, including government, aboriginal groups, ocean industry and resource users, environmental conservation groups, coastal communities, and university researchers. The project is a collaborative process being facilitated by the lead Government agency for ocean and coastal management. Under the program, decisions are based on shared information where those with the decision-making authority and those affected by the decision jointly seek outcomes that meet the needs and interests of all parties to the greatest possible degree. The management arrangements are hierarchical, with overarching ecosystem objectives, followed by conceptual and operational objectives, and finally ocean sector operational objectives.[15] In other words, the initiative looks first at the broader picture and sets goals for overall environmental sustainability. It then addresses key process requirements, and finally how to achieve those. This project, with its zoning processes, inclusion of stakeholders, use of science and ecological indicators, addresses a number of the key requirements for successful ecosystem-based management of maritime areas.

The same developed economy offers another good example of marine EBM for a complex ocean area. The area in question encompasses 88,000 km^2 and is of immense value for its array of marine biodiversity (fish, deep sea creatures, tidal life, porpoises and whales), and because it is the livelihood backbone for more than 35,000 people. The area supports many uses and interests, including fisheries, tourism, protected areas, harbours and shipping lanes, shellfish harvesting, transportation, aquaculture, scientific research and wildlife habitat. When the Oceans Act came into effect, there were piecemeal management initiatives across the project area. The development of an improved, comprehensive approach was not easy, and after a number of failed initiatives, the process had not advanced far. Then, in 2008, a formal governance agreement between local coastal communities and the relevant national government ministry was signed. This agreement initiated a planning process that engaged local people who now provide meaningful input into the management of the ocean resources upon which they rely. The planning process, which encompasses both the continental shelf and the coastal watersheds, is

[15] O'Boyle, R., M. Sinclair, P. Keizer, K. Lee, D. Ricard, D. and P. Yeats, 2005. Indicators for ecosystem based management on the Scotian Shelf: bridging the gap between theory and practice. *ICES Journal of Marine Science* 62: 598 – 605; & O'Boyle, R. and G Jamieson, 2006. Observations on the implementation of ecosystem-based management: experiences on Canada's East and West Coasts. *Fish. Res.* 79: 1–12.

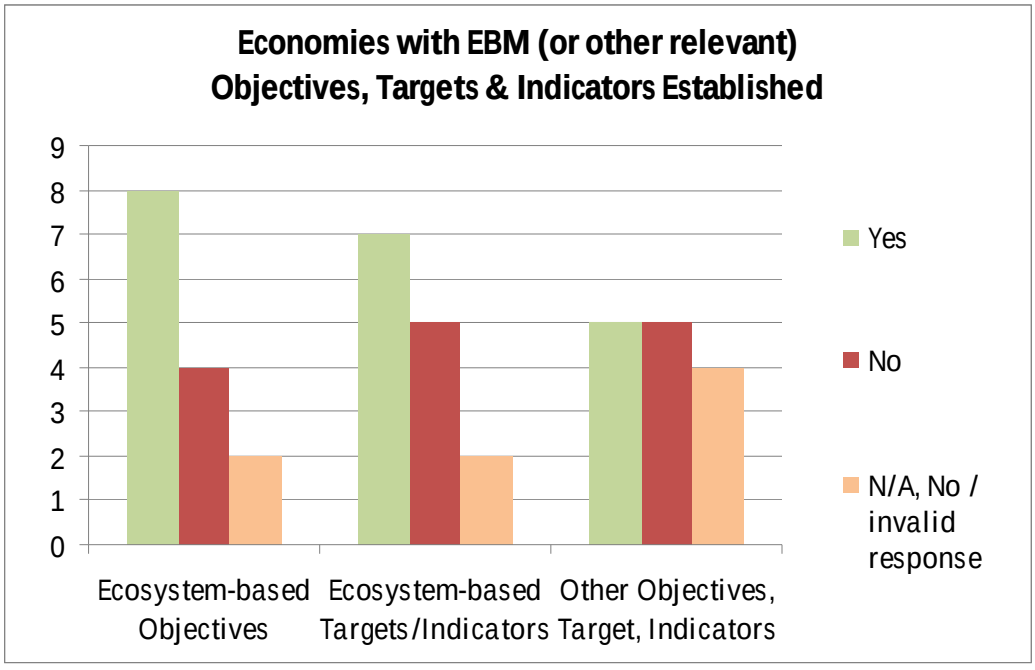
now developing an integrated approach to managing the ecology and economy, and establishing a network of marine protected areas to act as reservoirs for marine productivity.

2.1.3 Marine management objectives, targets and indicators and permits are guided by the goal of ecosystem health

The development of objectives and indicators are key requirements for effective EBM implementation. Decision-makers need a clear idea of what the targets are, and whether or not these targets are being met. However, only eight of the responding APEC Economies reported that they have established ecosystem-based objectives and seven of them have translated these objectives into targets.

One developed Economy has developed seven high-level Key Performance Indices (KPIs) for the management of a large coral-reef marine protected area. The KPIs indicate performance against the main foci of the reef, namely reef health, pollution from land-based sources, fisheries, park management, information management, tourism and community participation. The Economy also publishes a State of the Reef report as a living document that is published on the Internet and regularly reviewed and updated.

Figure 4: Economies with EBM (or other relevant) objectives, targets & indicators established



Since 1992, ESD has become a major objective of fisheries legislation in one developed APEC Economy, and management agencies are accountable for achieving this objective. An important component of such accountability is the measurement and reporting of progress against the ESD targets, which is not yet apparent across many APEC Economies.[16]

One developed Economy stated that Integrated Management Plans and Large Ocean Management Areas have been established to address and manage EBM, while another developed Economy stated that its Government is in the process of determining ecosystem-based objectives/targets and indicators through the marine bioregional planning process and the CERF Marine Indicators project. These indicators will assist in State of the Environment (SoE) Reporting. The bioregional plans for the Economy's five marine regions are scheduled to be completed during 2010, where each plan is expected to identify key habitats, flora and fauna, natural processes, human uses and benefits, and threats to the long-term ecological sustainability of a region. The plans are envisioned to provide: 1) greater certainty and understanding on how the marine environment is protected under legislation; and 2) details on: conservation priorities at the regional level; the various statutory obligations under the relevant legislation; the range of conservation measures that already exist or are to be applied.

This Economy also undertakes a Reef Research Centre program that aims to generate critical information, relevant products and useful advice that will assist users, interested members of the public, industry operators, and natural resource managers to know the status and trends of marine ecosystems within the relevant areas, through development of benchmarks and performance indicators.

2.1.4 Principles of EBM reflected in legislation

One indicator of the extent to which the principles of EBM are reflected in legislation is the use of appropriate language in regulatory instruments. The survey indicates that more than half of APEC Economies have included the following EBM-related terminology in legislation (**see Figure 5**):

- 'Sustainable resource management' (cited by 71% of respondents);
- 'Threatened species management';

[16] Walmsley, *op.cit*., 2005

- 'Environmental Impact Assessment / Social Impact Assessment';
- 'Invasive species'; and
- 'Habitat'.

Perhaps equally telling is that, of the examples offered in the survey, apart from the specific term of 'Ecosystem-based Management' (reported to be used in legislation by one-third of responses), terminology that includes the word "ecosystem" scored lowest. Generally, only one or two Economies suggested that the word is captured in legislation, i.e.

- 'Ecosystem threshold / vulnerability' (two Economies);
- 'Ecological integrity' (three Economies);
- 'Ecosystem interaction' (two Economies);
- 'Connectivity' (three Economies).

Nevertheless, such a low reported rate of legislative inclusion for the term 'ecosystem' could reflect an inherent inertia of legislative processes and a tendency to use conservative language in legal instruments, rather than a reluctance to embrace the concept of EBM. Responding Economies do suggest this to be the case with two-thirds reporting that EBM-relevant terminology is captured in legislation in an implied or tacit manner (**see Figure 6**).

Figure 5: EBM-related terminology included in Economy legislative framework

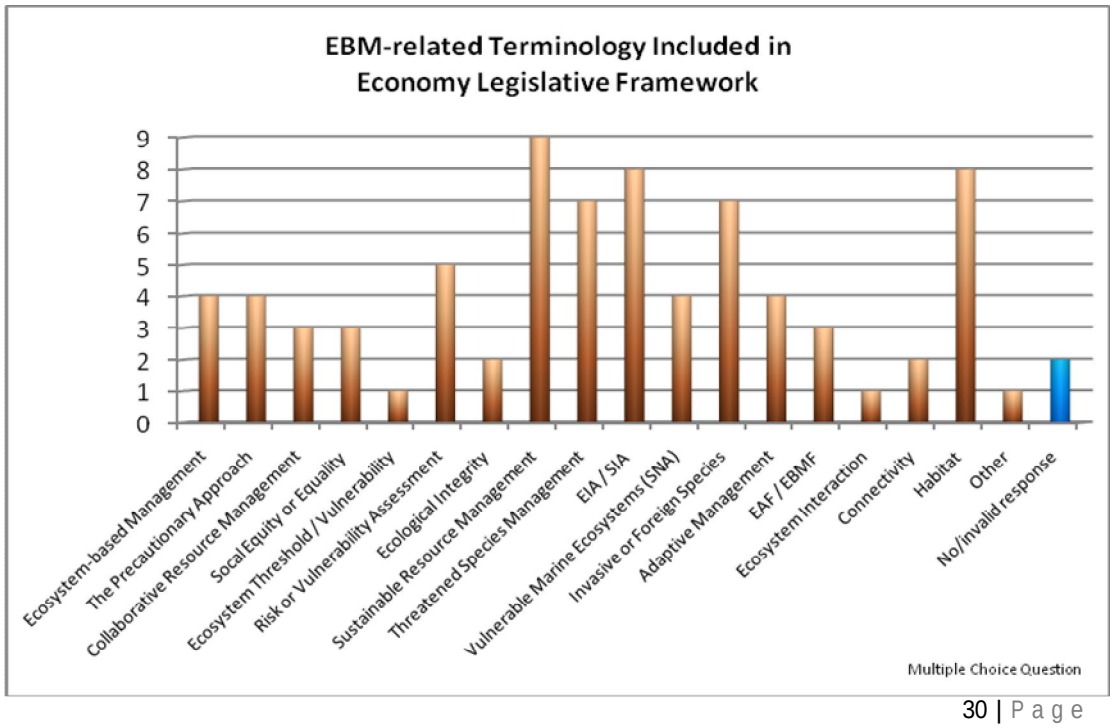
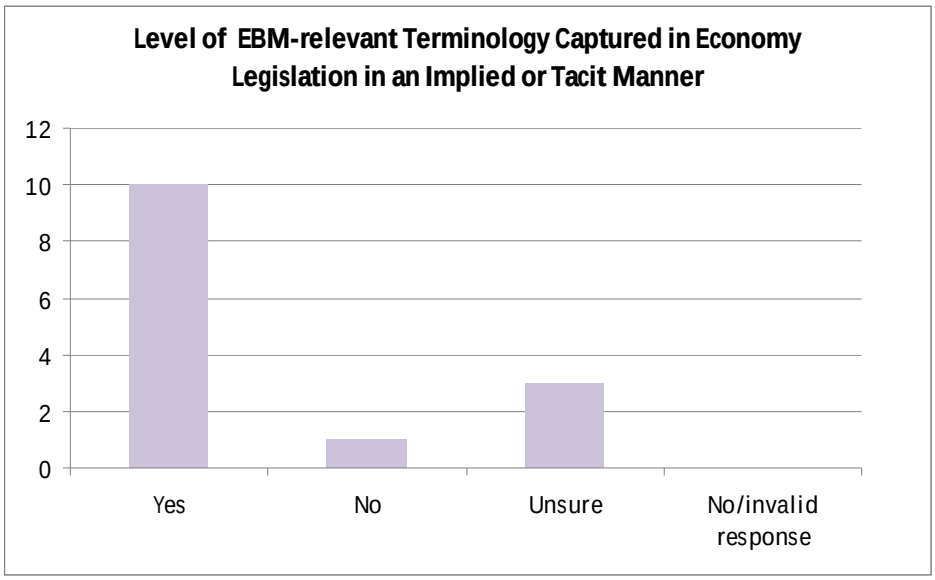


Figure 6: Level of EBM-relevant terminology captured in Economy legislation in an implied or tacit manner

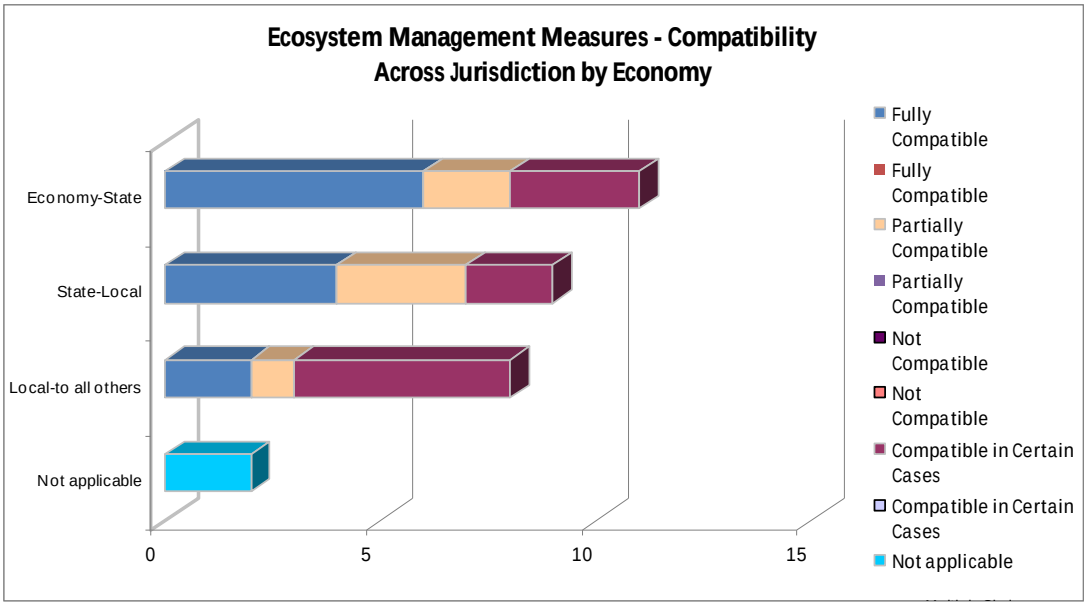


2.1.5 Laws, policies and practice are harmonized across political boundaries

The survey questionnaire explored the extent to which laws, policies and practices for EBM within an Economy are compatible between the national and state levels, state and local levels, and between local administrative areas.

Half of the responding Economies reported that EBM laws, policies and practice are compatible between the national and state levels, with a further two noting that they are partially compatible. However, at the lower hierarchical level between state and local administrations, the degree of reported compatibility fell, with only one third of Economies reporting that EBM laws, policies and practice are compatible. The level of compatibility between local administrations was reported to be least of all, with one quarter of all respondents suggesting that compatibility varies on a case-by-case basis (**see Figure 7**).

Figure 7: Ecosystem management measures – compatibility across jurisdictions by Economy



Two emerging Economies reported collaboration on integrated management within a regional Large Marine Ecosystem. The first phase of the project started in July 2002. The primary tasks during the first year were to define key problems, issues and threats, and to identify priorities, options and alternatives. In addition, the collaborative effort included a Trans-boundary Diagnostic Analysis and Strategic Action Program.[17]

Another successful model exemplifying many of the requirements for transboundary EBM has involved the planning and management by a developed Economy for marine-based industries (shipping, ports, petroleum, tourism, aquaculture, and fisheries) in marine space that extends across four state jurisdictions (i.e. provincial equivalent). The initiative was developed in consultation with state governments, industry representatives, indigenous groups, marine communities and others with an interest in the marine environment. The plan outlines actions needed to strengthen oceans management and achieve ecologically sustainable development. Key amongst these are: the development of a system of representative marine protected areas (MPAs); improved knowledge of marine ecosystems, including better mapping of the seafloor and its habitats; a reduction or elimination of key threats to marine biodiversity (such as declining water quality or marine invasive species); the establishment of a monitoring and reporting regime to determine the ecological, social and economic health of the region; and risk assessments to

[17] http://www.imarpe.gob.pe/imarpe/proyecto.php

identify the combined effects of fishery and other activities. A performance assessment system was also developed to monitor and review management arrangements and actions to determine whether they are achieving the intended goals. In addition to broad-scale policy and management arrangements, other management tools that contribute to environmental health include fishery closures, marine reserves and marine protected areas, along with threatened species planning, environmental management plans, quotas, catch limits, permits and licenses. Similarly, another developed Economy briefly stated that it works through Integrated Ocean Management Plans to ensure that EBM measures across various jurisdictions are supported and implemented.

2.1.6 Boundaries based on ecological parameters with marine space planning and management practiced

The use of Large Marine Ecosystems or Eco-regions (LME) has provided a starting point for many Economies to address impacts at spatial and temporal levels greater than traditional single-sector management approaches. LMEs are relatively large regions characterized by distinct bathymetry, hydrography, productivity, and tropically dependent populations. Currently, there are over 60 LMEs recognised worldwide.

Three developing APEC Economies share a transboundary seascape that is home to coral reefs, seagrass meadows and mangrove forests, which in turn support fish, sea turtles, dolphins, whales, sharks, rays, and other lesser-known but important marine flora and fauna. To help manage the area effectively, a Tri-National Committee was mobilized through inter-governmental partnerships. Regional collaboration on behalf of that seascape has included the formation of sub-committees on fisheries, marine protected areas and species.[18] The Initiative integrates enforcement, fisheries, communities and livelihoods, endangered species, food security, and a suite of other issues. Smaller in scale than the LME process, the seascape initiative allows a focused and practical evaluation of inter-linkages, and provides a forum for a smaller range of stakeholders to develop and implement meaningful resource-use and resource-conservation practices.

[18] The SSS regional management initiatives have been catalyzed by the work of Conservation International Philippines in recent years, building on the foundation developed by WWF in the 1990s.
http://www.conservation.org/explore/priority_areas/oceans/Pages/sulusulawesi.aspx

2.1.7 Indigenous and traditional property and user-rights respected

Over the last two decades, in many parts of the world, access rights have been recognised for fisheries under national jurisdiction.[19] Today, a common practice for allocating traditional user rights is to assign catch quotas to an individual. These rights are commonly known as Individual Transferable Quotas (ITQs).

In those APEC Economies where traditional resource ownership and knowledge is formally acknowledged, traditional rights and properties are generally well entrenched in local policy and governing processes. For example, in one developed Economy, traditional rights are embedded in the framework of a Fisheries Act. That Economy purchased 10 percent of the quota shares it had given out to commercial fishers under an earlier quota system and gave them to an indigenous Fisheries Commission. In 1998, provincial fisheries regulations also strengthened the rights of traditional owners to manage non-commercial fishing. A suite of other initiatives have been developed to promote indigenous access and resource management, including fishing for traditional uses but also traditional closures. Today, representatives of the local communities also advise the Minister of Fisheries on how best to manage and protect certain fisheries based on traditional practices.

In another developing Economy, local communities are the traditional owners of natural resources including fisheries. Fisheries management at a national level is carried out by the National Fisheries Authority (NFA)[20], which is a non-commercial statutory authority established and operated under a Fisheries Management Act. The NFA's stated objectives are "ensuring that fisheries of national or community significance are managed to obtain maximum benefit on a sustainable basis. This must take into account balanced views of fisheries science, environmental impact, social factors and economic development". Under these arrangements, community links and societal impacts are addressed through a consultative process with provinces and local groups. More recently, customary marine tenure systems have improved the management of local fisheries resources.[21]

[19] FAO – Legislating for property rights in fisheries http://www.fao.org/docrep/007/y5672e/y5672e03.htm
[20] http://www.fisheries.gov.pg/about_goals.htm
[21] The Live Reef Food Fish trade is a good example of how this traditional management of marine resources works. The LRFF industry was halted through requests by traditional owners to the NFA for a moratorium on the industry See http://wwwx.spc.int/coastfish/sections/reef/Library/InfoBull/LRF/8/LRF8-3-Gis.pdf

Other Economies have also made headway in this regard. One developed APEC Economy has introduced traditional fishery management rights under fisheries management plans and quota management systems. In another developed Economy, individual transferable quotas have evolved in both national and provincial legal systems in response to the demands of industry, rather than as a legislation-led initiative. However, across the APEC region, while traditional heritage of natural resources is often articulated, the role that traditional owners play in decision-making is not clear.

2.2 SCIENCE & DATA

Historically, scientific programs are conducted to investigate a single focused aspect of a marine ecosystem and its interactions with human activities. However, the full complexity of a marine ecosystem cannot be understood through the examination of only a single aspect of that ecosystem. The data (historical and current) required to understand the complexity of various ecosystems draws upon a range disciplines such as marine biology, ecology, chemistry, physical dynamics, economics, political science, and sociology. Many APEC Economies have listed a lack of knowledge and understanding of ecosystem structure and function as key limiting factors for effective implementation of the EBM approach and EAF.[22]

In recent years, the EBM approach has been widely accepted as an integrated management approach. One of the essential elements for effective and successful implementation of EBM is the availability of adequate science and data. Scientific communities, policy-makers and other stakeholders have, in various conferences and working groups, agreed and strongly recommended the integration of science into policy and management decisions. They have acknowledged a need to develop practical approaches and methodologies for the implementation of EBM and recognised the importance of a collaborative network for knowledge transfer and communication.

This section examines the various elements of science and data for EBM, and current practices and degree of implementation within APEC Economies.

[22] Arancibia, H. and H. Muñoz, 2006. Ecosystem-based approach: a comparative assessment of the institutional response in fisheries management within APEC economies: the case of demersal fisheries (Phase I). Final Report. Project APEC FWG 02/2005, Universidad de Conception (Chile), 68 pp.

2.2.1 Comprehensive, on-going marine science, oceanography and environmental health monitoring research programs are in place

Successful implementation of EBM requires an understanding of the diversity, functions and interactions (including impacts from human activities) within species, between species and of ecosystems. Therefore, many developed APEC Economies have in place on-going oceanographic and marine research and monitoring programs that are adequately equipped and funded. However, some developing APEC Economies experience difficulties in allocating sufficient resources for such programs. Thus, developing and emerging APEC Economies have, to a varying degree, tended to establish marine monitoring programs targeted at specific focal areas. Nevertheless, there are many examples of APEC Economies taking initiatives to strengthen their marine science, oceanography and monitoring capabilities.

In September 2008, an APEC survey on implementation progress for the APEC Bali Plan of Action for Coasts and Seas 2005, found that monitoring and research programs are often carried out within marine parks or reserves, or to monitor specific ecosystems, such as coral reefs, sea-grasses, mangroves, and wetlands.[23] Other monitoring programs conducted in marine parks and reserves usually focused on water quality. Another common approach for monitoring marine ecosystems has been to undertake ad hoc sampling, usually to determine baseline data prior to development of some kind, e.g., an oil and gas or agricultural activity.

Specifically, in 2000, a developed APEC Economy commenced an 'Ecosystem Health Monitoring Program (EHMP)', which entails marine, estuarine and freshwater monitoring activities. The program delivers an assessment of the ambient ecosystem health for each of the identified catchment areas, river estuaries and a bay using a broad range of biological, physical and chemical indicators to monitor responses to human activities. Results are used to advise councils and land managers on areas of declining health, report the effects of different land uses, and evaluate the effectiveness of management actions aimed at improving and protecting aquatic ecosystems.[24] The program is managed by a partnership of members from the public sector, universities and a research organisation.

[23] Implementation of the Bali Plan of Action: Regional Stock-take (Gap Analysis) of the Current Situation in the Asia-Pacific Region compared with Ministers' Objectives – A Foundation Assessment (APEC FWG 01/2007), Final Report, September 2008, Asia Pacific Economic Cooperation, pg. 96

[24] Ecosystem Health Monitoring Program, Healthy Waterways, accessed on 29 January 2010, source: http://www.healthywaterways.org/ehmphome.aspx

In 2009, one emerging APEC Economy undertook an oceanography research cruise within its 'territorial waters' with the support of the Navy, research institutions and government agencies. The main objectives of the cruise were to undertake research and mapping of marine biodiversity, and produce new and up-to-date data in the areas of physical, chemical, biological, and geological oceanography.[25] An overall goal of the oceanography research cruise was to develop a foundation for more integrated and on-going marine research programs.

Another developed APEC Economy has advocated the incorporation of an EBM approach in their 2007 'Health of the Ocean Initiative'. Among other activities, the Initiative included the implementation of marine health monitoring programs to identify the causes and effects of human activities on selected ecosystems. The outcomes of the research were reported in Ecosystem Overviews and Integrated Ecosystem Assessment documents for each of the identified ecosystems.[26] This Initiative was designed to inform decision-makers in their subsequent establishment and management of five (5) Large Ocean Management Areas (LOMAs), each of which required the development of a sustainable marine environmental health monitoring program.

Another example of a suite of marine research programs included a research institute focused on maritime and fisheries technology within a newly emerging Economy. Also within that APEC Economy, universities have focused on maritime issues, which have broadened the Economy's understanding of the marine environment and the contribution of fisheries in an ecosystem context.[27]

In 2002, one developing APEC Economy organised a coalition of volunteers from industries, academic communities, local governments, NGOs, and public and private organisations to form a council to undertake scientific assessments and monitoring of a maritime area.[28] The objective of the assessment was to produce environmental profiles in one of the most human-impacted water

[25] Ekspedisi Pelayaran Sains Perdana (EPSP09), Kementerian Sains, Teknologi dan Inovasi (MOSTI), accessed on 29 January 2010, source: http://www.mosti.gov.my/mosti/index.php?option=com_content&task=view&id=1397.
[26] Oceans Management Approach, Fisheries and Oceans Canada, accessed on 29 January 2010. source: http://www.dfo-mpo.gc.ca/oceans/management-gestion/index-eng.htm.
[27] www.nfrdi.re.kr
[28] Mactan Channel Environmental Monitoring: Insights from a Multisectoral Stakeholder Participative Approach Towards An Effective Management, accessed on 31 January 2010, source: www.itmems.org/itmems2/.../MactanChannel_DLargoT5.doc

bodies of that Economy. This program, whilst limited in funding, reportedly generated primary scientific data, through the cooperation and support of the council members, on a monthly basis. The primary data collected were on species richness and abundance (biodiversity) that included taxonomic groups of marine algae, phyto- and zoo-plankton, sea-grasses, mangroves, corals, invertebrates, and fishes. Parallel to these biological components was the monitoring of water quality for nutrients (nitrates, nitrites, ammonia, and phosphates), heavy metals (cadmium, chromium, lead, nickel, copper, and zinc), salinity, temperature, pH, dissolved oxygen, water transparency and surface water circulation patterns.

Element Summary

There appears to be only isolated (in the context of APEC's total geographic expanse) examples of extensive, comprehensive, on-going marine science, oceanography and environmental health monitoring programs outside of the borders of marine parks, reserves and other spatially delineated areas. Furthermore, most marine environmental health monitoring programs appear to be done on an ad-hoc basis, possibly due to insufficient funding.

However, there is evidence of an awareness and understanding amongst APEC Economies of the need for marine environmental health monitoring programs as a component of effective EBM implementation. In the context of the multitude of international instruments desiring sustainable marine resource management, decision-makers are being increasingly obliged to re-evaluate the effectiveness of current practices, and more importantly to address existing barriers (e.g. insufficient funding, limitation in human resources, application of state-of-the-art technology, etc) towards the implementation of more comprehensive and sustainable environmental and marine status monitoring and management programs.

2.2.2 Detailed, up-to-date data on marine resources, environment, ocean processes and ecosystem uses readily available

Ocean and coastal data are essential for understanding ocean processes to measure changes of marine resources and how ecosystems operate, and for predicting how a change in environmental conditions might affect ecosystem interactions. These data sources are the foundation for science-based information on which decision-makers depend for effective

implementation of EBM. Other users range from scientists, the general public, commercial parties and educators, each with their own needs and purposes.

One method of accessing data and ensuring its availability is through the installation and operation of a reliable data centre. To varying degrees, some APEC Economies have been collecting and analysing data from multiple data centres. However, these data centres often operate in isolation and are not always kept up-to-date. There are two main challenges facing data managers today: (1) the exponentially growing volume of data; and (2) the need for timely accessibility of these data to be made available to the user-community in a variety of useful formats.[29] As an example, in 2001, one developed APEC Economy recorded on-line 6 million data requests (average 16,000 requests per day). Although many data users are increasingly dependent on electronic access, only 4% of that APEC Economy's digital data archive is available on-line, and many historical data sets have yet to be converted to digital form.[30]

In an effort to establish, an integrated system for data management, several developed and developing APEC Economies have in place, or are in the development phase, to establish centralised national oceanographic data centres (NODCs). The Intergovernmental Oceanographic Commission (IOC) of UNESCO has, through its International Oceanographic Data and Information Exchange (IODE) program, developed on 'Ocean Data Portal' (ODP) to merge these NODCs into a single portal with the aim to provide seamless access to collections and to catalogue marine data. The ODP allows for the discovery, evaluation (through visualization and metadata review) and access to data via web services.[31]

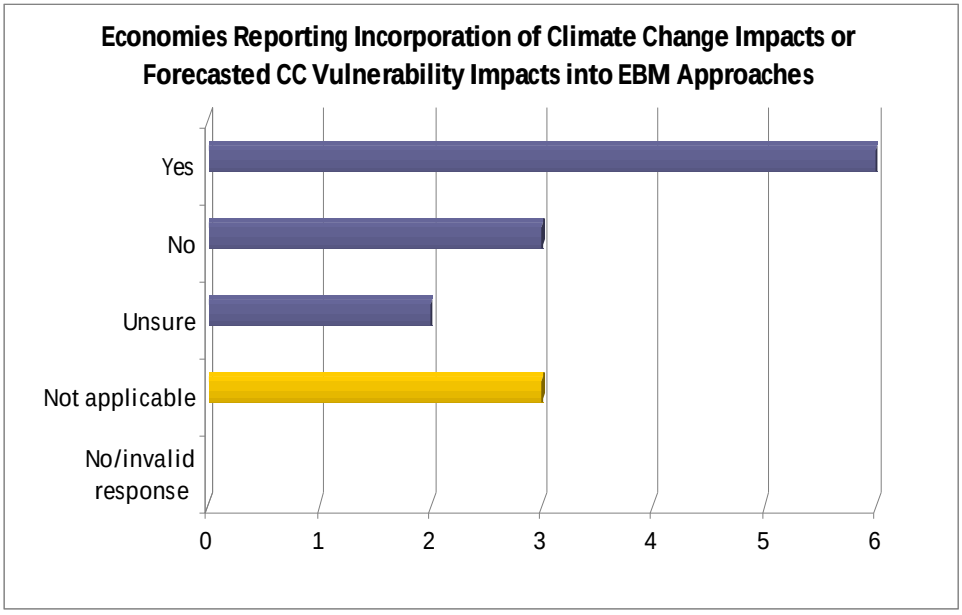
As climate change issues and initiatives are becoming increasingly critical, data and information on climate change (including adaptation and mitigation measures), and its impact on, marine ecosystems and marine biodiversity are also being addressed much more significantly and spatially.

[29] Modernizing Ocean Data and Information Systems, United States Commission on Ocean Policy, accessed on 1 February 2010, http://oceancommission.gov/documents/prelimreport/chapter28.pdf
[30] Ibid
[31] International Oceanographic Data and Information Exchange (IODE), Data Access, accessed on 1 February 2010, source: http://www.iode.org/index.php?option=com_content&task=view&id=178&Itemid=141,

In this context, quantitative responses from the APEC Economy EBM/EAF implementation survey, as indicated in **Figure 8,** emphasise that a majority of APEC Economies have already taken into consideration or incorporated elements of climate change vulnerabilities into their EBM approaches.

Some developing APEC Economies reported that most of their climate change impacts and / or vulnerability assessment programs are implemented primarily in coastal areas, with a focus the ability to adapt to climate change impacts, both physically and socially. One developed APEC Economy cited a consultancy study on climate change, part of which included an assessment of the economic impacts of climate change. This consultancy study also provided recommendations for the implementation of appropriate climate change adaptation and mitigation measures.

Figure 8: Economies reporting incorporation of climate change impacts or forecasted climate change vulnerability impacts into EBM approaches



An APEC report commissioned in September 2008 found that there were relatively high levels of climate change-related activities by APEC Economies for improving the exchange of observational data on predictions, forecasting and warnings. Several APEC Economies also cited that the exchange of climate change data for the purposes of 'watching and warnings' was somewhat less

than that for predictions, and possibly even lesser than for forecasting.[32] One APEC Economy reported that there were provisions for a more open, free and unrestricted access to real-time observational oceanographic data and analysis results associated with climate change. A majority of APEC Economies indicated that new initiatives utilising innovative technologies had been undertaken at the national level, with the data shared openly via the internet.[33] Also stated in the same report, a developing APEC Economy noted that it had already produced several guidelines on mitigation and adaptation measures for marine disasters and sea level rise, besides having organised annual workshops on the 'Management of Potential Conflicts in the South China Sea', an activity that another APEC Economy had cited as a platform for the exchange of information on the effects of climate change.

Element Summary

Generally, most APEC Economies collect and analyse data from multiple data centres. However, development of a data-sharing mechanism has proven to be a problem within the economies, and most do not have an integrated online data exchange portal. The majority of APEC Economies reported that they take into consideration or incorporate elements of climate change vulnerabilities into their EBM approaches.

[32] Implementation of the Bali Plan of Action: Regional Stock-take (Gap Analysis) of the Current Situation in the Asia-Pacific Region compared with Ministers' Objectives – A Foundation Assessment (APEC FWG 01/2007), Final Report, September 2008, Asia Pacific Economic Cooperation, pg. 36.
[33] Ibid

2.2.3 Best available science informs decision-making and is applied to identify, describe and understand marine ecosystems and threats, and ecosystem interactions taking into account the cumulative impacts of multiple human activities as well as the effects of long-term changes

Best available science is necessary for the wise management of marine resources and environmental issues so that fully informed decisions are feasible. However, scientists, policy-makers, and the public need to be aware of the factors affecting both the development of science and its application.[34] For science to qualify as "sound science", it must adhere to a generally accepted standard set of scientific principles and processes, which include the following elements:

- a clear statement of objectives;
- a conceptual framework model for characterising systems, making predictions, and testing hypotheses;
- an appropriate experimental design and methodology for data collection;
- statistically and logically rigorous approaches for analysis and interpretation;
- a suitable documentation of methodologies, results and conclusions; and
- avenues for peer review.[35]

EBM is an effective tool that entails the application of best available and practical science to generate data and information (both the natural and social sciences) the sustainable management of marine and coastal resources.

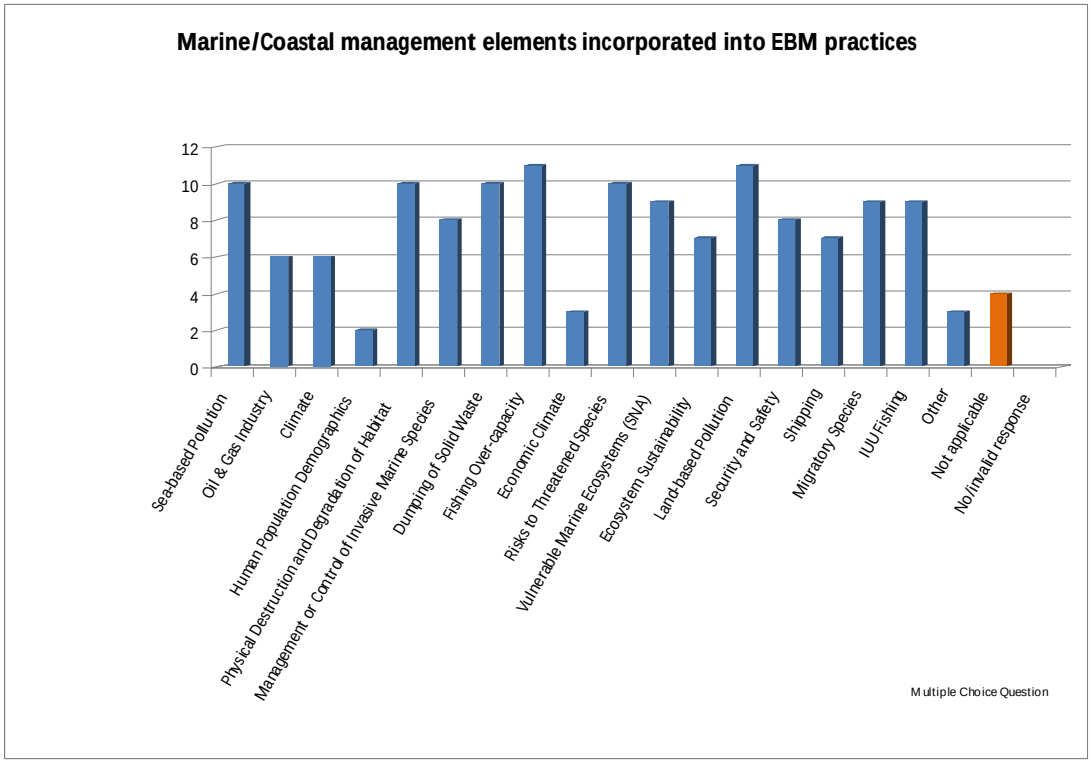
At first glance, **Figure 9** could tend to imply a rather wide acceptance and implementation of EBM by APEC Economies. However, **Figure 9** could also be alternatively interpreted in the following manner: viz. with 79% of the APEC Economies addressing 'over-fishing' and 'land-based pollution' within their EBMs; with 71% of the APEC Economies addressing 'sea-based pollution', 'habitat degradation and physical destruction', 'solid waste dumping' and 'risk assessments of threatened species' within their EBMs; and with only two of the 14 APEC Economies addressing 'human population demographics' within their EBMs.

Further, yet another interpretation of **Figure 9** could also suggest that only a small number of the APEC Economies are actually practising comprehensive EBMs, with the majority of them

[34] Defining and Implementing Best Available Science for Fisheries and Environmental Science, Policy and Management, American Fisheries Society / Estuarine Research Federation, 2006, accessed on 2 February 2010, http://www.co.san-juan.wa.us/cdp/docs/CAO/ImplementingBAS.pdf
[35] Ibid

(according to the trends depicted in Figure 2) in fact seen to be practising lesser forms of EBMs, perhaps by way of a sectorally-based management framework, with limitations in their inter-departmental integration or collaboration. In this context, only two APEC Economies (through an aggregated assessment of the data in **Figure 9**) seems to be considering all of the elements, activities or environmental factors highlighted; with only two to four of the 14 APEC Economies incorporating 70-90% of the items indicated in **Figure 9**, thereby signifying a slightly lesser (but yet no less impressive) holistic and comprehensive implementation of EBMs.

Figure 9: Marine / Coastal management elements incorporated into EBM practices



Additionally, as expressed in **Figure 9**, one developing APEC Economy had stated that its EBM approach also included "land-use planning", while another APEC Economy noted that public-private partnership (PPP) initiatives were a key requirement in EBMs (but with the latter response being difficult to interpret in terms of its relevance to the subject matter). Another developed Economy listed climate change; nuclear actions; World Heritage; National Heritage places; Native Title rights; Bilateral Agreements; and Biosphere Reserves as the elements incorporated into its EBM practices.

Two APEC Economies (as depicted in **Figure 9**) reported that they did not practice EBM, i.e., the question was irrelevant. These responses indicate that the Economies do not believe that EBM is not an easily achievable management approach. Likewise, 75% of the responding APEC Economies reported that decision-making and policy-formulation are based on the best available scientific information. No Economy provided further elaboration on the methodology and processes involved for purposes of validating the data and information necessary for their decision-making.

An earlier study by APEC in September 2008 (i.e. Implementation of the Bali Plan of Action) found that a significant majority of the APEC Economies surveyed had increased the sharing of best practices on the roles and functions with the private sector and communities in maintaining the sustainability of the marine environment. Efforts in promoting the involvement of these stakeholders were also enhanced. The mechanisms used towards the achievement of the outcomes included, inter alia, liaison with NGOs; establishment of consultative committees; funding of community projects; and the participation of entrepreneurs in environmental inspections. Further, only two out of the 16 APEC Economies surveyed in the study had reported that they had not taken any actions to improve their understanding and management of human impacts on the coastal and ocean environments.[36] The same APEC study revealed that 14 out of 16 (88%) of the APEC Economies had identified 'Ecologically and Biologically Sensitive Areas' (EBSAs) and had established area-based management measures for protecting the EBSAs. However, five out of the 16 (31%) APEC Economies surveyed had declared that their area-based management initiatives were either not based on the best available sciences or were not consistent with international laws. Qualitative data for the situation could possibly reinforce a conclusion that the relevant scientific/legal foundations for some of the area-based mechanisms may not be sufficiently robust. While some APEC Economies offered examples of measures and techniques adopted for the collection and examination of scientific data and information, other Economies provided only general statements on the importance of respecting and adhering to best available scientific and international legal frameworks[37] for the management of marine areas and resources.

[36] Implementation of the Bali Plan of Action: Regional Stock-take (Gap Analysis) of the Current Situation in the Asia-Pacific Region compared with Ministers' Objectives – A Foundation Assessment (APEC FWG 01/2007), Final Report, September 2008, Asia Pacific Economic Cooperation.
[37] Ibid, page 64.

Evidence of effective interventions and appropriate outcomes in the utilization of the best available science includes the systematic and the strategic application and assessment of environmental and socio-economic modelling. For instance, in one reported case, the merging of a comparative economic analysis with similarities and disparities in ecosystem structures and the functions, via the Ecopath modelling software,[38] succeeded in highlighting food web connectivity measured in terms of the number of trophic levels, from primary producers to apex predators.[39]

Element Summary

Although there have been several marine and ocean ecosystem-related programs undertaken within the APEC region at various levels (district, state, national, regional and international, etc), there has been little indication that best available science has been comprehensively incorporated into decision-making processes.

2.2.4 Marine-science collaborative networks are active and effective

Marine and ocean science monitoring programs often face challenges in maintaining their long-term *in-situ* ocean monitoring devices, which are frequently located in inaccessible and harsh ocean places and conditions. Further, there is the need to link existing data flows from public and private observations (e.g. from research vessels, data buoys, satellites, oil rigs and other coastal and offshore structures) in order to maximise their use and benefits. Efforts to address critical issues, such as the implications of climate change, and the implementation of EBM also benefit from such long-term datasets. There remains a need for national governments and private-sector funding bodies to recognize the critical need for such data and data collection facilities. Thus, in a 2008 APEC survey,[40] under Goal 1 of the Bali Plan of Action, there was strong reiteration of the need to establish robust scientific networks and their associated data along with information collection and exchange systems.

[38] *Ecopath* modelling software for which it takes a static, mass-balanced snapshot of the system. The Ecopath software package can be used to address ecological questions, evaluate ecosystem effects of fishing, explore management policy options, analyze impact and placement of marine protected areas, and predict movement and accumulation of contaminants and tracers (Ecotracer), and model effect of environmental changes.
[39] Zhang, C.I., J.B. Lee and S.K. Lee, 2007, Structure and function of three marine ecosystems in Korea: A comparative study, In Proceedings of the 2007 Annual Science Conference, 17–21 September 2007, Helsinki, Finland.
[40] Implementation of the Bali Plan of Action: Regional Stock-take (Gap Analysis) of the Current Situation in the Asia-Pacific Region compared with Ministers' Objectives – A Foundation Assessment (APEC FWG 01/2007), Final Report, September 2008, Asia Pacific Economic Cooperation

International networks

Two examples of quantitative information and data management that have benefited APEC Economies are the 'International Coral Reef Initiative' (ICRI) and the 'International Coral Reef Action Network' (ICRAN).[41] These initiatives appear to have enjoyed funding, active networking, and collaboration at all levels.

One APEC Economy reported that it has developed national guidelines under the *International Convention for the Control and Management of Ships' Ballast Water and Sediments*. The same Economy has also encouraged other APEC Economies to familiarise themselves with the *GloBallast* partnership.[42]

An emerging APEC Economy noted its participation outside of the APEC framework in an international network of scientific support, 'The EUR-OCEANS Working Group 6, *EAF Indicators: A Comparative Approach across Ecosystems*' through its 'Network of Excellence'.[43] The goal of the network is to gather and share relevant indicators between experts across marine ecosystems and member institutions. One primary output of the network has included the formulation of a website to inform the public, and another website intended for experts, on the state of the world's marine ecosystems from fishing pressures.

Further, an intergovernmental scientific organisation, The North Pacific Marine Science Organisation (PICES) was established in 1992 with the aim of promoting and coordinating marine research in the Northern North Pacific and adjacent areas. All six of its members are APEC Economies. One of its highest priority programs is the FUTURE Scientific Program (Forecasting and Understanding Trends, Uncertainty and Responses of the North Pacific Marine Ecosystems), which started in mid-2009. It is an integrated program, undertaken by member countries and affiliates, in order to understand the response of marine ecosystems in the North Pacific to climate change and human activities, to forecast the status of ecosystems, and to communicate new findings to its members, governments and the public.

[41] Ibid, pg. 100
[42] Ibid, pg. 92
[43] Ibid, pg. 127

Regional networks/initiatives

In 2007, efforts were commenced to establish the Coral Triangle Initiative for Coral Reefs, Fisheries and Food Security (CTI-CFF). All but two of its six member countries (in the CT6) are APEC Economies. Further, another emerging APEC Economy has also since applied to be part of the CTI-CFF membership, demonstrating the CTI-CFF's perceived significance as a vehicle for the future security and well-being of marine biodiversity in the region. The CTI-CFF is also supported by two developed APEC Economies as partners of the CTI-CFF. The goals of the CTI-CFF encompass priority seascapes; ecosystem approaches to managing fisheries and other marine resources; conservation of marine protected areas and threatened species; and adaptation to climate change. One of the targets of the CTI-CFF is to provide for "*Networked National Centers of Excellence on Climate Change Adaptation for Marine and Coastal Environments*". The network is aimed at improving the understanding of future climate change impacts and related issues; and also to support implementation of comprehensive and effective adaptation measures for mitigating the impacts.[44] However, the network has yet to materialise, pending the full operation of its Regional Secretariat, its financial mechanisms and other necessary institutional arrangements.

Another regional network, the *UNESCO-IOC Regional Network of Training and Research Centers on Oceanography in the Western Pacific,* aims to improve regional capabilities in marine sciences between the various national oceanographic institutes, universities and research institutions within the Western Pacific region.[45] Fifty seven percent (57%) of the APEC Economies are members of the IOC-WESTPAC, thereby representing a mix of developed, emerging and developing APEC Economies.

National / domestic network

One developed APEC Economy has established a *Centre of Ocean Modelling Development and Application (COMDA),* to provide guidance for the distributed expertise and requirements of ocean model applications. In 2007, the same APEC Economy designed an '*Operational Network of Coupled Environmental PredicTion Systems'*, which is often known by its acronym 'CONCEPTS'.[46]

[44] Regional Plan of Action – Coral Triangle Initiative on Coral Reefs, Fisheries and Food Security (CTI-CFF), Coral Triangle Initiative, 2008, pg.38
[45] Guidelines and Procedures for the UNESCO-IOC Regional Network of Training and Research Centers on Oceanography in Western Pacific, United Nations Educational, Scientific, and Cultural Organisation, accessed on 4 February 2010, source: http://www.unescobkk.org/special-programmes/westpac/westpac-activities/capacity-development/unescoioc-regional-network-of-training-and-research-centres-on-oceanography-in-the-western-pacific/annex-to-sc-westpac-vii3/
[46] Ibid, pg. 41

The operational network between the three governmental agencies (environment, fisheries and defence) was promulgated to develop operational oceanographic products that could be made available by an operational global-coupled atmosphere-ocean-ice data assimilation and prediction system. The APEC Economy concerned cooperates with a European country to adopt, import and participate in its Operational Ocean Data Assimilation and Modelling System, and is currently active in various activities to complete and sustain the system.

Additionally, an emerging APEC Economy has reported an initiative to establish a '*Network for Deep Sea Fisheries'* to exchange information and strengthening coordination and cooperation amongst the member APEC Economies.

In the 2008 APEC survey report, criticism made by member APEC Economies on the low efficacy of information exchange at the APEC level, primarily appears to be oriented towards two points: firstly, that communication between the APEC Economies on ecosystem-based management is rather poor; and secondly, that there is no comprehensive framework for facilitating such communication dissemination and purposeful liaison the APEC Economies. One of the survey respondents emphasised the contributions made by the RFMOs in facilitating information exchange; however, another survey respondent cited a 2006 conclusion by the tuna-related regional RFMOs that the exchange of information from APEC Economies to the RFMOs, and between the RFMOs, needed to be strengthened. Such unclear qualitative comments are once again consistent with that of the quantitative data that revealed evenly split opinions by Economies on the adequacy of the exchange of research and information on ecosystems to ensure their conservation, sustainable use and management.

In general, most APEC Economy survey respondents acknowledged that issues relating to the maintenance of active and effective networking of information and data systems are technical and financial. Therefore, developed APEC Economies have been relatively successful in their ability to maintain active and effective networks of data and information sharing, but not without challenges. However, there are still some positive initiatives that could be pursued by several emerging and developing APEC Economies to strengthen new data and information exchange networking approaches, including for them to become partners in existing systems through the provision of scientific and technical assistance and expertise.

Element Summary

A wide range of collaborative networks on marine science do exist within the APEC community for the purpose of improving information and data collection and exchange. However, there remain several challenges to be addressed and overcome, especially by developing APEC Economies, before they can be deemed to be equipped sufficiently to undertake effective and efficient data and information collection, analysis and dissemination.

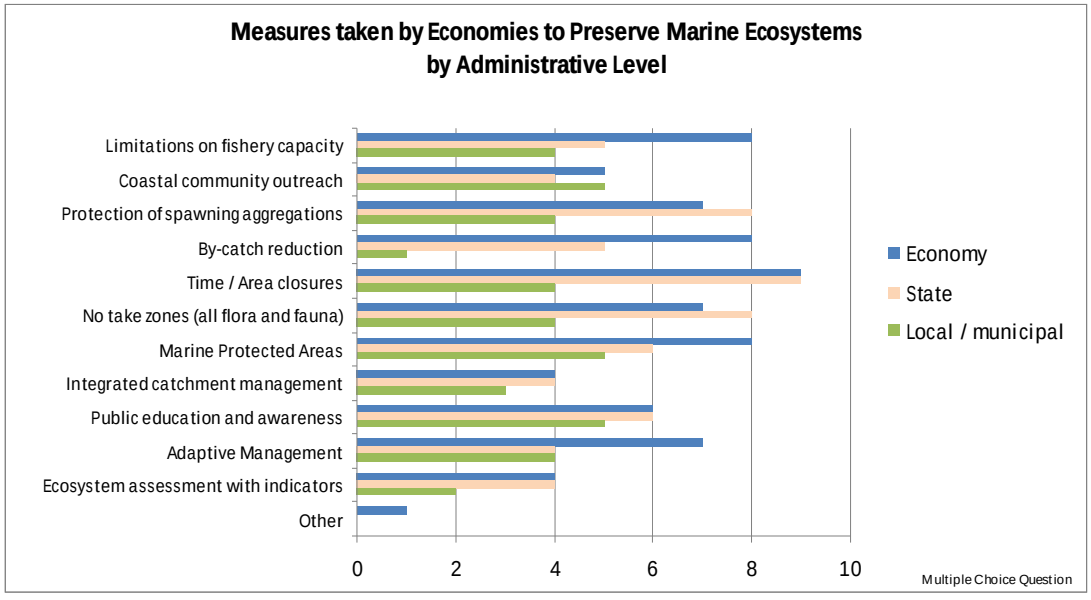
2.3 STAKEHOLDER PARTICIPATION & AWARENESS

2.3.1 Information, training and education programs provided for awareness-building

The creation of the necessary support for EBM and effectively reaching out to a sufficiently large audience the awareness-building is critical to successful outcomes.

In 2008, a survey indicated that the extent of activities undertaken by APEC Economies to promote coral reef conservation and to raise public understanding on the importance of coral reefs, sea-grass beds, and mangroves to the overall management of marine ecosystems were from moderate to strong. The same study of APEC Economies also demonstrated strong support for international and regional efforts to promote wetlands awareness and the protection of wetlands.[47]

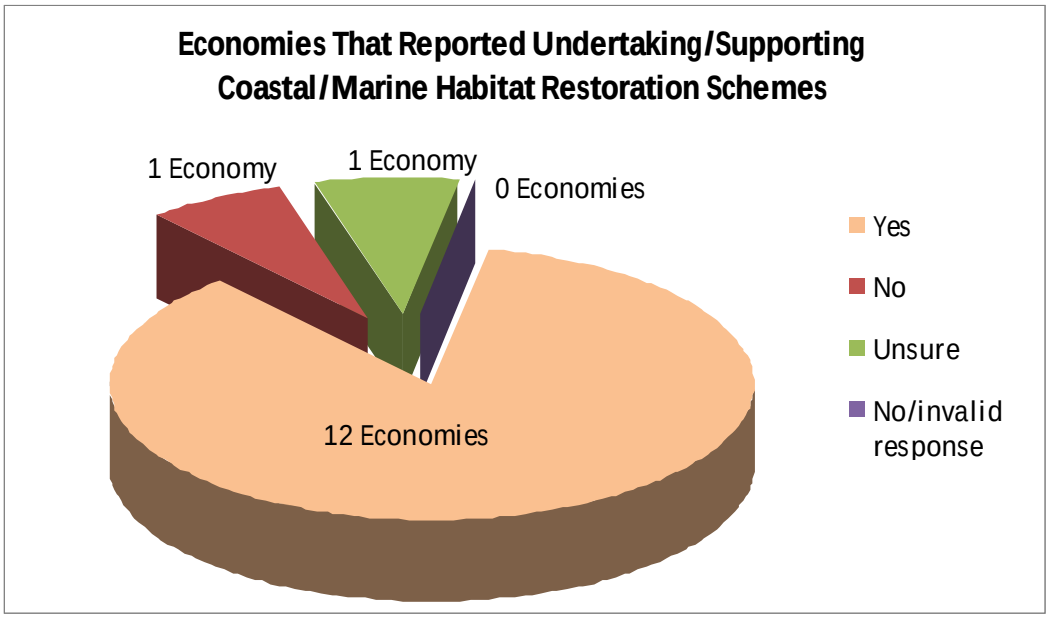
Figure 10: Measures taken by Economies to preserve marine ecosystems by administrative level



[47] Asia Pacific Economic Cooperation, 2008. Implementation of the Bali Plan of Action: APEC Bali Plan of Action Economy Survey Analysis Final Report. APEC Publication Number: APEC#208-FS-01.2, Singapore, 325 pp.

Based on the responses received from the current survey (as indicated in **Figure 10**), a majority of the responding APEC Economies do already have in place a number of similar approaches, such as those on coastal community outreach and public education, and on awareness raising programs, at various administrative levels. Further, five of the APEC Economies that had responded to the current survey have also been implementing such outreach programs at the coastal community level, at the local/municipal level and at the State level. With regard to the status of the public education and the awareness raising programs, 43% of the APEC Economies who responded to the current survey had indicated that their corresponding programs were being implemented at the State level.

Figure 11: Economies that reported undertaking / supporting coastal and marine habitat restoration schemes



According to **Figure 11,** 86% of the total APEC Economies who had responded to the survey reported having undertaken and supporting habitat restorations schemes for the marine and coastal environment. Further elaboration of the responding APEC Economies surveyed revealed several other common programs, such as mangrove restoration programs (e.g. replanting programs) and also coral reef restoration and protection programs (e.g. artificial reefs programs). Other programs, including the establishment of no-take zones and marine protected areas, besides the imposition of time limits for fishing activities have also been undertaken with the participation of various stakeholders at the local level. More focussed plans for habitat restoration include the development and restoration of seaweed fields, establishment of fish

sanctuaries and fish refugias with the support for more research and technology transfer in selected areas, etc. Their ensuing research findings are to be subsequently utilised for community programs which are aimed at the restoration and preservation of marine and coastal ecosystems and habitats. One developed Economy mentioned that the Commonwealth and State Governments fund community organisations, research institutions and local government to implement habitat restoration programs across the Economy. This Economy has also established a community program to rehabilitate coastal habitats.

Element Summary

As per the current survey results and those from secondary research, most APEC Economies are and/or have been, giving attention towards awareness-building programs for the preservation and restoration of the marine and coastal ecosystems and habitats. Most coastal community outreach programs are implemented at the Economy and local level, while majority of public education and awareness initiatives are undertaken at the Economy and state level. The strong support of the APEC Economies are evidenced by the plans and programs implemented under the various conservation and restoration efforts for mangroves, coral reefs and fisheries, which include the participation of stakeholders, and especially of communities using the knowledge from the research programs at the said areas. However, details on the scale and frequency of stakeholder involvements were not discernible from the current survey responses or from any other sources. Nevertheless, the financial allocations for this particular element of the EBM would invariably be an important factor.

2.3.2 Current and future economic, cultural and social needs to be addressed

The ecosystem-based approach recognises the inter-relationships between the ecological, economical and social factors to maintain and to improve the quality of the marine environment for the society's present and future needs. Thus, in practice, it should provide a framework for the integration of knowledge and perspectives of the natural and social sciences with those of policy, planning and decision-making.

Based on the current survey results, it can be assumed that the economical, cultural and social needs are addressed, to some extent, in the activities undertaken by the APEC Economies within the EBM and/or EAF context. For example, the identification of adverse effects on the marine

ecosystems from fisheries, the implementation of research projects on marine ecosystem structures and functions, the identification of impacts, the inter-connectivity amongst ecosystems in relation to fisheries management, etc., would require a consideration of the economic, cultural and social needs to varying degrees, etc. The findings from such activities can be used to evaluate not only the environmental needs (i.e. scientific data and analysis), but also to identify and evaluate other current and future economic, social and cultural needs. However, the current survey responses did not provide any further information for the economic, cultural and social need assessments in the respective APEC Economies.

Element Summary

Economical, cultural and social needs are addressed, to some extent, in the activities undertaken by the APEC Economies within the EBM and/or EAF context; however no detailed information is available on these elements.

2.3.3 Representative stakeholders participate in EBM

EBM approach ideally requires the inclusion of "*...stakeholders, social and political scientists, economists, lawyers, political lobbyists, educators, journalists, civil engineers, ecologists, fishery scientists and oceanographers, all operating in a conciliatory and integrative environment*".[48]

Adequate and representative stakeholder participation would ensure that the parties involved are accorded the opportunity to participate in the process, and also to be updated on the latest developments. Active participation by the stakeholders would further increase the awareness, support and dedication for a more successful implementation of EBM.

An indicative level of the participation of stakeholders in EBM is represented in another APEC report,[49] which illustrated that a high majority of responding APEC Economies had indicated their satisfactory to higher rating in the creation of awareness and in the engagement of coastal communities in the monitoring and conserving of the coastal environment. In the same APEC

[48] Browman, H.I. and K.I. Stergiou, 2004. Perspectives on ecosystem-based approaches to the management of marine resources. Marine Ecology Progress Series 274: 269-303.
[49] Implementation of the Bali Plan of Action: Regional Stock-take (Gap Analysis) of the Current Situation in the Asia-Pacific Region compared with Ministers' Objectives – A Foundation Assessment (APEC FWG 01/2007), Final Report, September 2008, Asia Pacific Economic Cooperation, pg. 18

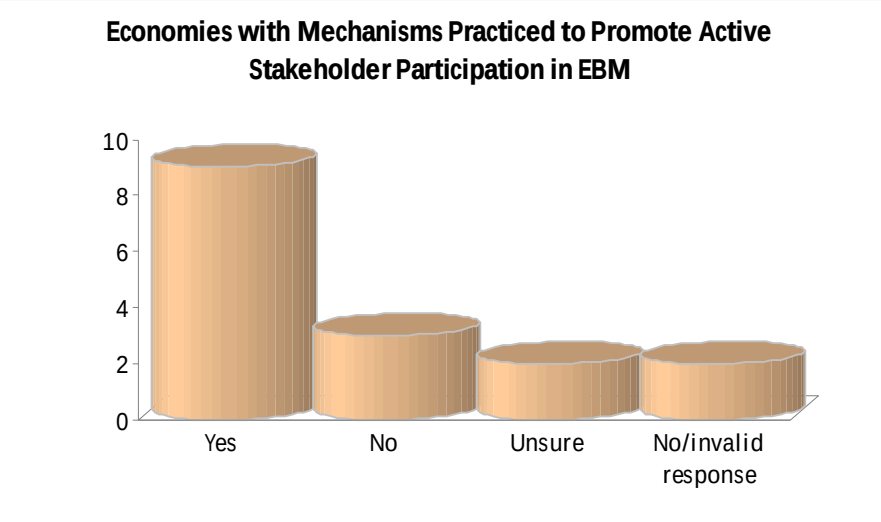
report, half of the participating APEC Economies had rated themselves to be above satisfactory in identifying the roles of fishing communities (including those of women) in marine conservation and restoration efforts.

In the current survey, approximately 64% (9 out of 14) of the total responding APEC Economies had mechanisms in place to promote active stakeholder participation in EBMs **(see Figure 12)**. Three of the APEC Economies did not have such mechanisms in place. Most of the responding APEC Economies had implemented various types of consultative processes, including: liaison meetings; public consultations; and cross-boundary collaboration for the formulation and implementation of any policies and regulations; management and development of marine parks; and planning and evaluation of projects. Two of the responding APEC Economies were unsure if such mechanisms were practiced in their respective countries.

Three of the emerging APEC Economies indicated that stakeholders' consultations had been undertaken within several programs or activities, including prior to the implementation of any regulations, in the planning and evaluation of fisheries-related programs, and in one particular emerging APEC Economy, prior to the establishment of the Fisheries and Aquatic Resource Management Council (FARMCS) at the national and district level. Similarly, one developed Economy mentioned that it has a Regional Committee on Ocean Management that involves stakeholder participation.

One developed APEC Economy had indicated the extent of stakeholders' participation in Environmental Impact Assessment (EIA) processes; in liaison meetings for soliciting views from stakeholders in the management and development of marine parks; in formulating policies and programs for water quality management; and in promoting cross-boundary collaboration for regional water quality management and in controlling cross-boundary water pollution. Another developed Economy stated that it undertakes Marine NGO roundtables; Marine and Coastal Committee Biodiversity Working Group (a national group), EBFM subcommittee of the Economy's Fisheries Management Forum (a national group), industry consultation, community education, and Caring for Country grants program.

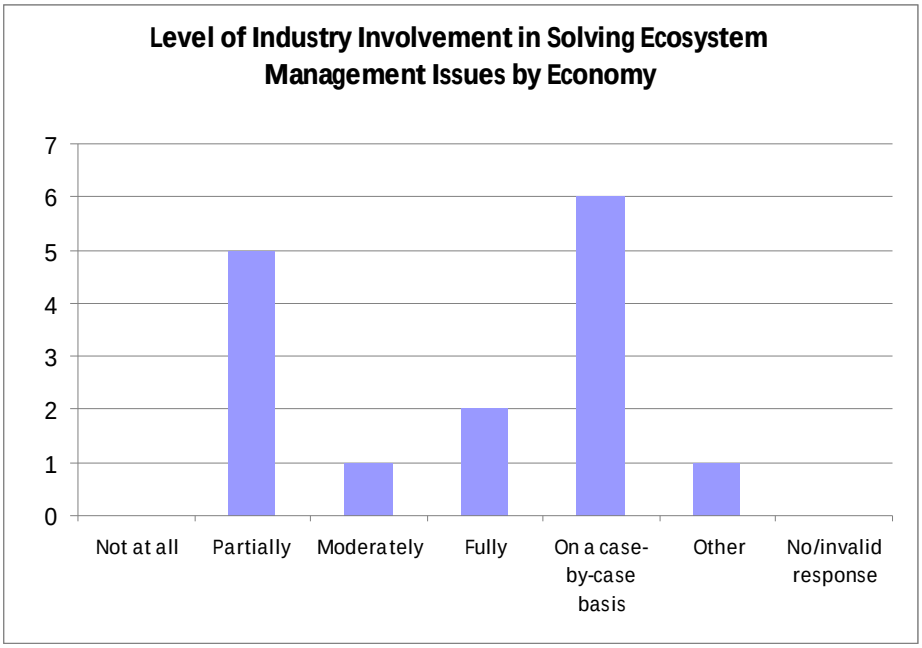
Figure 12: Economies with mechanisms practiced to promote active stakeholder participation in EBM



As expressed in **Figure 13** below**,** all of the responding 14 APEC Economies had the involvement of industries to varying degrees and circumstances. Majority of the responding APEC Economies included industries which addressed ecosystem management issues and initiatives on a case-by-case basis. Five APEC Economies had partial industry involvement, when compared to two other APEC Economies that had full industry participation. One developing APEC Economy described that its industry involvement in ecosystem management was through the funding of education and campaigns. Another developed Economy responded that its navy are also involved via enforcement of Acts and regulations in marine protected areas.

Funding for research in support of marine and coastal EBM was also considered to be another important indicator of stakeholder participation in EBM programs. (For more detailed discussions on such funding, please refer to **Section 2.4** on Finance).

Figure 13: Level of industry involvement in solving ecosystem management issues by Economy



Element Summary

Most APEC Economies have indicated a fair representation of stakeholders' participation in EBM programs through some degree of industry involvement, community participation and support from the government in the form of finance and regulatory support. However, according to the APEC Economies, most industry involvement is often done on case-by-case basis, and is thus unable to provide support in a more sustainable manner.

2.4 FINANCE

Ocean and coastal ecosystem management regimes are increasingly subject to competing demands from users. Regulations and other management instruments must not only address fishing, recreation, and shipping, but also a suite of various other impacts, such as mining, oil and gas, offshore wind and tidal energy facilities, aquaculture, industrial plants, etc. With such a vast array of pressures and resulting impacts on ecosystem functions, the question of ecosystem financial values has increasingly influenced contemporary management.

Effective implementation of EBM and EAF invariably relies on good scientific knowledge of the structures and functions of ecosystems, especially under the influence of external forces and

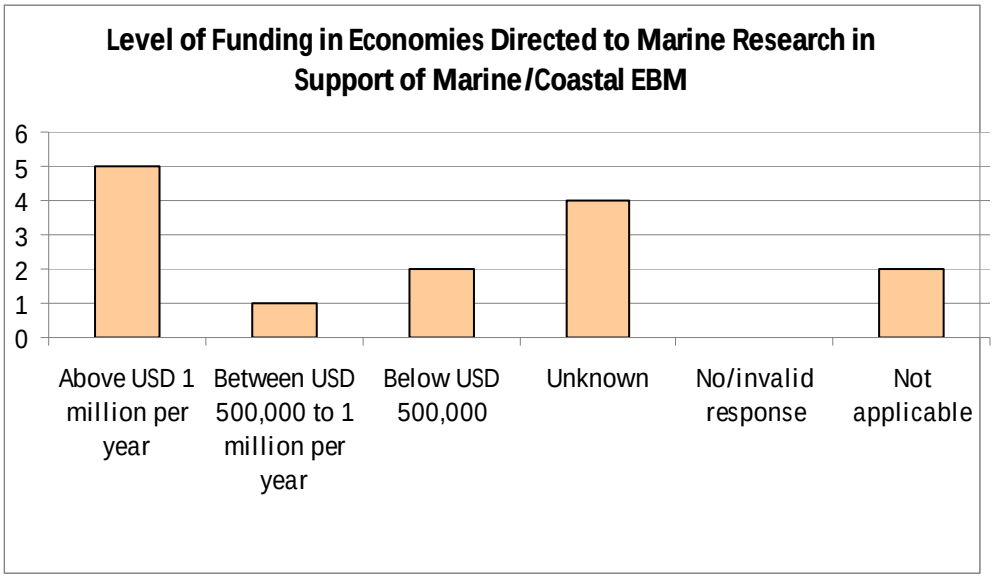
pressures.[50] From this perspective, the availability of adequate and sustainable funding plays a crucial role in enabling research programs to generate the knowledge required for wise marine management decision-making.

2.4.1 Sufficient finances are allocated

The level of funding directed towards marine research in support of marine/coastal EBM tends to vary, possibly dictated by the financial situation of the different APEC Economies (see **Figure 14**). Five APEC Economies, comprising three developed APEC Economy and two emerging APEC Economies stated that more than USD one million is allocated towards marine research in support of marine/coastal EBM each year. One developing APEC Economy responded that between USD 500,000 to USD 1 million is allocated each year, while two other APEC Economies indicated funding levels below USD 500,000 each year for marine/coastal EBM research. Four APEC Economies, including one developed APEC Economy, had responded that the level of funding is unknown. It is noteworthy that two APEC Economies (comprising of one developed and another developing APEC Economy) chose the 'not applicable' option, which might indicate the fact that research activities in relation to marine/coastal EBM are not being carried out or have not yet been commenced by those APEC Economies. In general, both the developed and developing APEC economies have a stake in moving towards the use of sustainable ecosystem resources. The absence of funding towards EBM research in these two APEC Economies might signal a need to encourage and to support capacity building in such APEC Economies, including their participation in developing ecosystem-based maritime regimes and also in supporting marine/coastal EBM research programs towards protecting and conserving the natural resources in the marine environment.

[50] Kononen, K. 2008. Marine science contribution to the ecosystem-based management of Baltic Sea. US/EU-Baltic International Symposium, 2008 IEEE/OES.

Figure 14: Level of funding in economies directed to marine research in support of marine / coastal EBM



Mostly, the funding for marine research in support of EBM is provided by the APEC Economies themselves, while the rest depend on additional funding from IGOs and NGOs (see **Figure 15)**. The survey response shows that, five APEC Economies, which includes three newly emerging Economies, provide their own funding for marine/coastal EBM research. Six other APEC Economies including three developed Economy responded that funding is also provided by IGOs and NGOs likewise.

A total of ten APEC Economies stated that they allocate funding to promote EAF management, whereas two Economies comprising of one emerging and one developed Economy stated that no funding has been allocated (see **Figure 16**). One emerging Economy and two developed Economies stated that above one million USD per year is directed towards marine research in support of EAF, while another developing Economy responded that a sum between 500,000 to one million USD is allocated per year (see **Figure 17**). Two Economies stated that below 500,000 USD is allocated per year. Survey response from three other Economies revealed that although funding is allocated to promote EAF management, the amount of allocation available for EAF research is unknown. It is also worth mentioning that one Economy which previously stated that it allocates funding to promote EAF management responded that the level of funding directed towards EAF research is not applicable, rising some concern over the accuracy of information that have been provided. Or it might also indicate that the Economy utilises the funding to promote

EAF management through initiatives other than research, e.g. enhance monitoring, control and surveillance; educate and train stakeholders, etc.

Figure 15: Sourcing of funding for research in support of marine / coastal EBM

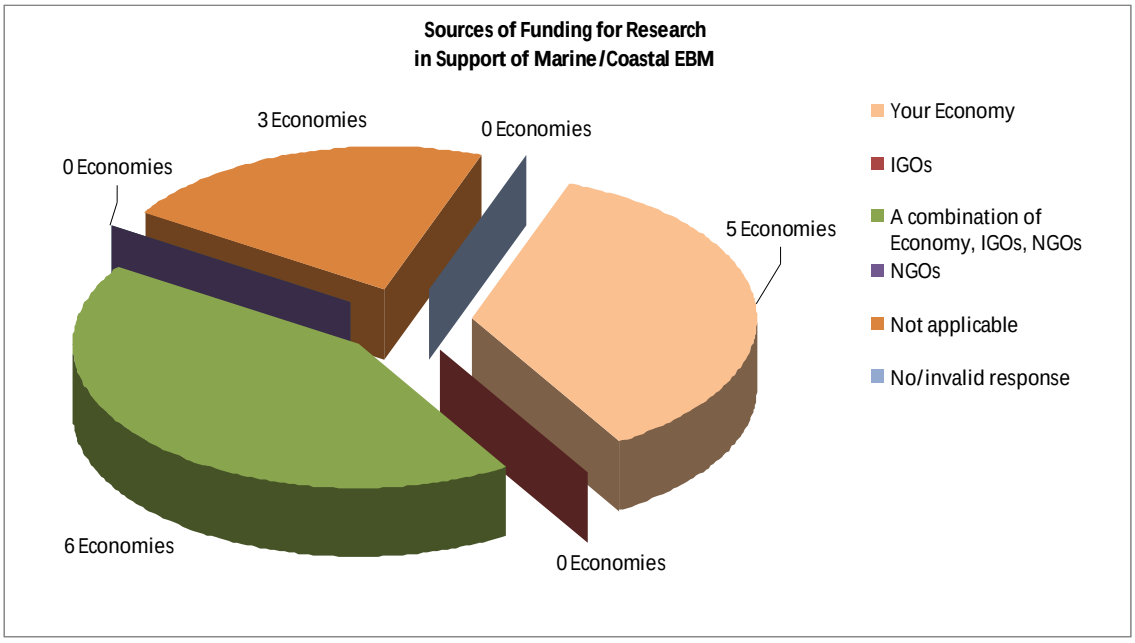


Figure 16: Economies that allocate funding to promote EAF management approach

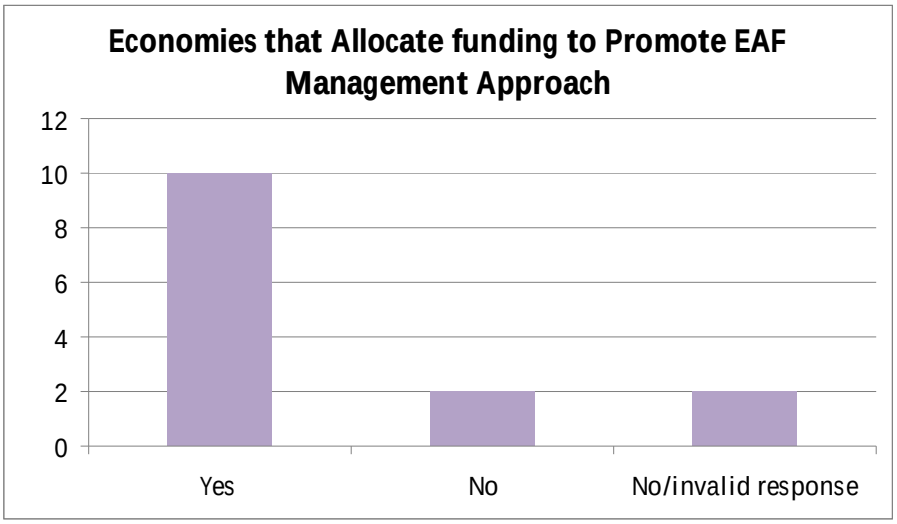
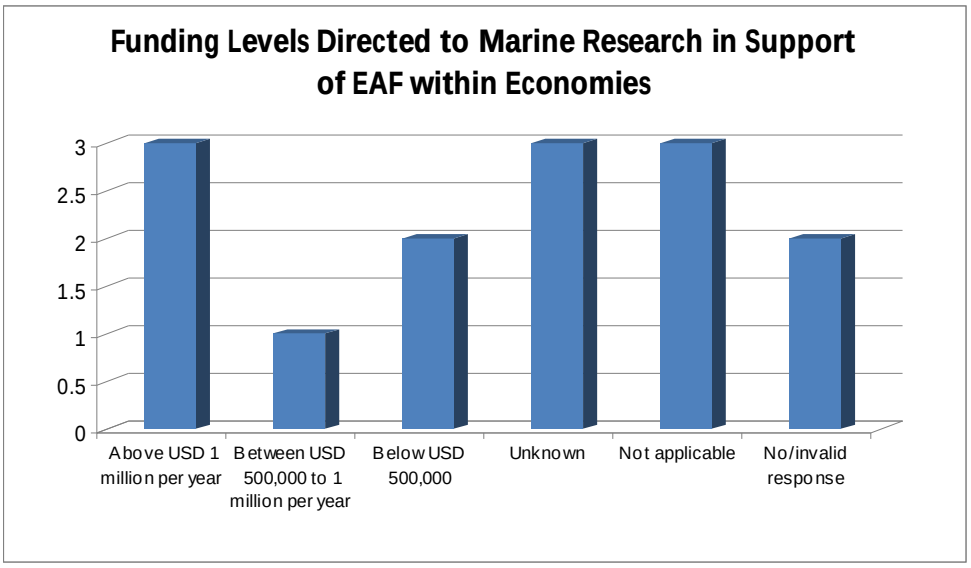


Figure 17: Funding levels directed to marine research in support of EAF within Economies



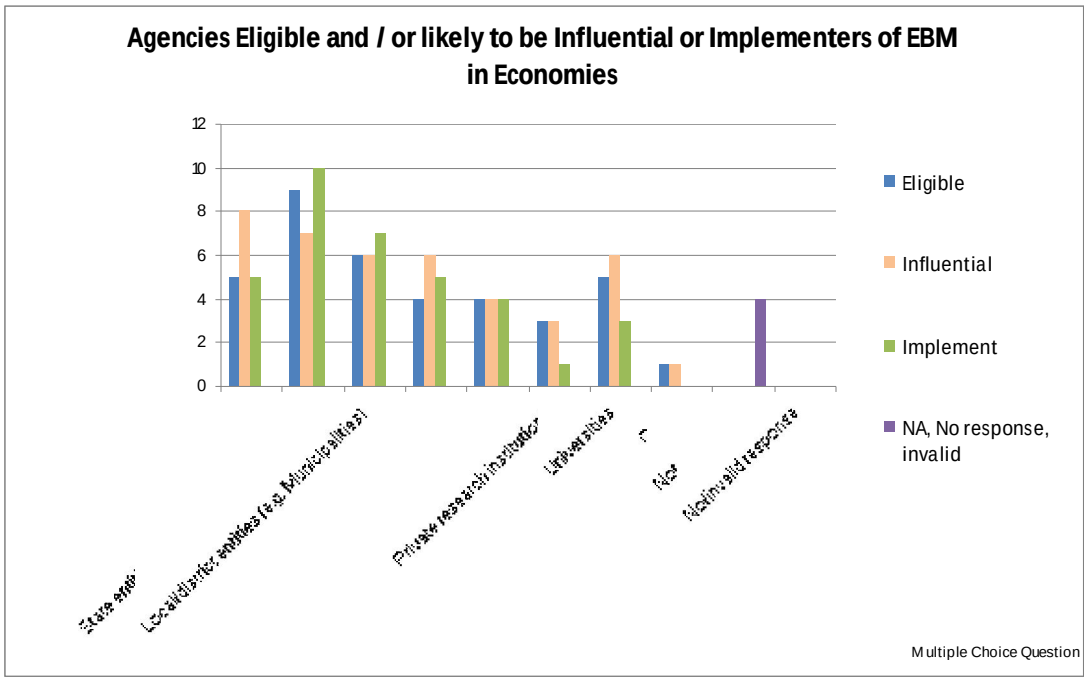
In responding to the query on agencies eligible for funding and/or likely to be influential or implementers of EAF in Economies, six APEC Economies including two developed Economies stated that Economy-level agencies are more influential in terms of policy-making with regard to EAF (see **Figure 18**). One developing Economy stated that 'the Ministries are more influential in policy and legislative aspects while implementation agencies basically are state agencies, NGO and research institutes'. The survey response also indicates that State entities are mostly the implementers of EAF and more likely eligible for funding. IGOs, NGOs, private research institutions and universities are generally found to be influential towards EAF, but less eligible for funding and less likely to be the implementers of EAF within the Economies.

Funding schemes are essential to provide the necessary financial assistance to promote and implement EBM and EAF. Funding schemes that exist within an Economy are usually provided by the government and to a lesser extent by the private bodies. One developing Economy listed DEVFISH[51], AFT (Atlantic Fisheries Technological Society), and CTI-CFF (Coral Triangle Initiative) as the significant funding schemes that exist at the Economy to enable EAF. However, all three above are regional projects and not ones initiated by the Economy itself. Three Economies stated that funding for EAF is mandated in the legislation of their respective Economy. In light of that, one developing Economy stated that funding schemes are provided through the General Appropriations Act of the Economy, while another developed Economy stated that EAF-related

[51] Development of Tuna Fisheries in the Pacific ACP Countries Project (DEVFISH) is a European Union funded regional project, which encourages governments to make policy changes that can make it easier for local Pacific fishing industries to grow and profit. Source: Forum Fisheries Agency (FFA).

budgets are 'approved by the parliament'. One more emerging Economy responded that initiatives with regard to EAF, such as establishment of MPA/marine reserve have been imparted in the 5-year development plan as mandated by the Fisheries Order 2009 of the Economy. An emerging Economy responded that funds are provided for research in support of EAF through a governmental agency (Fisheries Research Fund) under the Ministry of Economy. One developed Economy listed 'The Fisheries Development Loan Fund' and 'The Environment and Conservation Fund' as the significant funding schemes to enable EAF in the economy, while another emerging Economy simply listed the National Development Fund.

Figure 18: Agencies eligible for funding and / or likely to be influential or implementers of EAF in Economies



Element Summary

Generally, most of the APEC Economies allocate funding to promote EBM and EAF in their respective Economies. However, it is notable that there is absence of funding for EBM and EAF research in one developed Economy and another developing Economy. The level of funding provided does not necessarily correlate with the status of the Economy, where some emerging Economies have allocated higher amount of funding compared to developed and developing Economies. Funding for EBM and EAF initiatives are generally mandated in the legislation of some Economies while others have set up separate finance schemes for this purpose.

2.4.2 Economic incentives utilized

Short-term gains incentives provided by some Economies to boost local productivity create financial scenarios in which user-groups are encouraged to develop a resource which cannot [biologically] support long term extraction. As the Joint Nature Conservation Committee (JNCC) notes, *"incentives should be realigned to support the aims of the ecosystem based approach… and …there needs to be a re-direction of incentives and financial support mechanisms from those aimed at increasing fishing efficiency to ones which promote the restoration of fish stocks to optimal levels of yield, and which support responsible fishing practice in sensitive marine areas, e.g. reducing the by-catch of target and non-target species".*[52]

FAO highlights the need to allocate user rights in fisheries as part of its Ecosystem Approach to Fisheries.[53] The need to allocate user rights against some form of payment however (for example, to capture economic rent or pay for management costs), continues to be a stumbling block. The "user-pays principle" states that "*all resource users should pay for the full long-term marginal social cost of the use of a resource and related services including any associated treatment cost".* That is, authorized users should pay for the exclusive privilege granted to them to use a public resource. The principle might be implemented through payments for licenses or quotas, or though taxes.

In relation to funding though, the issues of impact costs and benefit costs are far outweighed by the sheer cost of evolving into ecosystem-based approaches. As FAO (2002) noted, "*The challenge to implement improved fisheries management is stretching national systems and capacity in most countries, and especially in the developing world. Implementing EAF could add a significant additional burden, and the challenge may be particularly formidable in small-scale fisheries, where the difficulty and costs of the transition to effective management may outweigh the available capacity and short-term economic benefits derived from it"*. Indeed, the financial burden of the EAF/EBM evolution is acknowledged as a key hurdle. Across the board within the region, it appears insufficient funding is being devoted (or is made available) to ensuring APEC Economy ocean areas continue to be productive. Management authorities need to mobilize greater funding

[52] See the JNCC's identification of key issues related to the Ecosystem Approach http://www.jncc.gov.uk/page-2518
[53] FAO's *Ecosystem Approach to Fisheries* http://www.fao.org/docrep/005/Y4470E/y4470e0d.htm Annex 2. Principles of relevance to an ecosystem approach to fisheries (EAF).

resources now to safeguard the future. “One has to invest something to get returns” has never been more applicable than in the current transition phase from single-species fisheries to ecosystem approaches. Acknowledging the fact that government’s spending is implemented on a priority basis, the need is thus to highlight the relative priority of ocean-level management over other spending areas, making prominent the sheer range of stakeholders who stand to benefit – not simply fishing communities. The environmental costs associated with the 2004 tsunami make a great case for investing in ecosystem integrity.

Element Summary

Throughout APEC Economies, the issues related to costs-sharing for ecosystem impacts are largely lacking. Most Economies have in place penalties for polluters, but these are rarely related to ecosystem function nor linked to fisheries productivity. There is a need to clearly articulate ecosystem function costs as a function of impacts to the environment in such a way as they are transparent and easily accepted, understood and implemented by governing authorities.

2.5 CAPACITY

Capacity to develop and implement an EBM approach for marine ecosystem and habitat management requires a number of fundamental ingredients; for example, institutional, personnel, tool use and development, enforcement capability, and assessment frameworks. The following outlines the general status of these fundamentals as reported in the Economy Survey and secondary sources.

2.5.1 Relevant institutions committed to EBM & adequately resourced

Institutional capacity and resourcing are essential for the implementation of EBM. Furthermore, in order to promote uptake of EBM and EAF principles, science must link ecological processes to ecosystem-level patterns, so that managing authorities are able to recognize and understand ecological limits to avoid the loss of ecosystem integrity, and maintain healthy marine ecosystems and habitat, including fisheries in viable state.[54] Affecting capacity is the current knowledge gaps in ecosystem function and structure that appear to arise primarily from insufficient funding and political will to divert funding toward the key activities.

Some developed APEC Economies have a broad range of science and research capacity. As an example, one Economy has a dedicated office of Science and Technology to provide scientific data for fishery research and resource conservation programs. Principal work of this office entails a core information and statistics program, status assessments for living marine resources and their habitats, and strategic research aimed at satisfying the near-term and long-range fishery

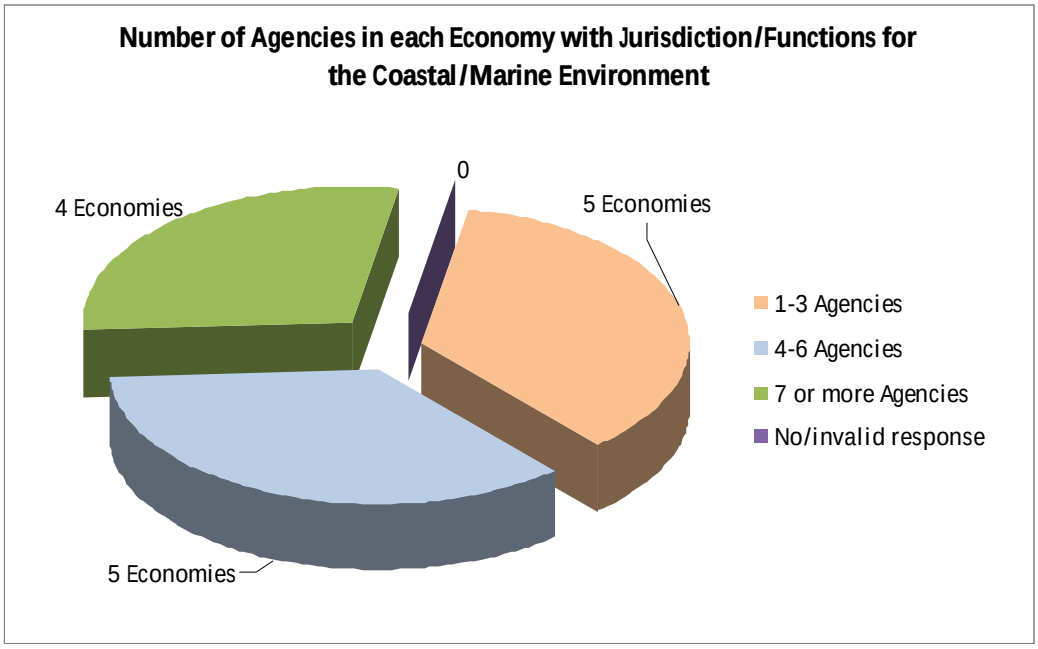
[54] Fowler C.W., and L. Hobbs, 2002. Limits to natural variation: Implications for systemic management. Animal Biodiversity Conservation 25: 7–45. & Mullon C., P. Cury and L. Shannon, 2004. Viability model of trophic interactions in marine ecosystems. Natural Resource Modelling 17: 27–58.

management goals of the agency charged with fisheries management.[55] This economy also has a Pelagic Fisheries Research Program, established under joint efforts in 1992 to provide scientific information on pelagic fisheries to the Western Pacific Regional Fisheries Management Council of use in development of fisheries management policies.[56] Another developed Economy takes a slightly different approach through collaboration with a university-based fisheries research centre,[57] with emphasis on a fisheries policy and restoration program that focuses on modelling and evaluation in support of Economy policy goals that reconcile the preservation of biodiversity and services with sustainable and responsible fisheries practice. Within this university-based research centre, the Fisheries Economics Research Unit studies the economics of capture and aquaculture fishery resources, while the Marine Mammal Research Unit conducts multidisciplinary research on marine mammals in the field, in captivity and in the laboratory. There are also programs to document large-scale fishing impacts on marine ecosystems and find solutions to challenges; and to develop mathematical models to help fish biologists and resource managers adapt in the face of the extreme uncertainty that characterizes many marine ecosystems.

Economy survey responses highlight a spread in the number of agencies with responsibility and jurisdiction for the management of coastal and marine environments. Five APEC Economies reported to having 1-3 agencies with such responsibility, while five other Economies indicated the existence of 4-6 agencies. Four Economies reported having a higher number (7 or more agencies) with responsibility and jurisdiction for coastal/marine management (see **Figure 19**). It is likely that a high number of agencies with responsibility and jurisdiction for the coastal/marine environment may result in a higher occurrence of jurisdictional and program overlap. In the main, there appears to be movement from a multiple agency approach to a single management where agency rationalisation is occurring, and this should provide a more stable basis for marine EBM implementation.

[55] The NOAA Fisheries research program is one of the most comprehensive efforts demonstrated across the region. Their work entails careful monitoring and documentation processes, ecosystem-level research, and a the provision of a suite of recommendations to the government for effective fisheries management http://www.st.nmfs.noaa.gov/
[56] http://www.soest.hawaii.edu/PFRP/overview.html
[57] http://www.fisheries.ubc.ca/

Figure 19: Number of agencies in each Economy with jurisdiction / functions for the coastal / marine environment



Elaboration by Economies generally named specific Ministries or Departments with Jurisdiction and/or Functions for Coastal and Marine Environments; however, one emerging Economy noted the distinct division of responsibility between Economy, State, and Municipal levels noting the executive, implementing, local management, and monitoring hierarchies. A further observation from the elaboration is that in most instances, coastal and marine management responsibility is organised into functional sectors, i.e. transportation & navigation, enforcement, fisheries, tourism, environment/conservation, planning etc. This may not provide an ideal platform for integrated EBM implementation unless all functional agencies have a mandate to implement EBM, and work together towards shared objectives (**see Figure 20**).

When asked to identify at what level within the Economies lies the jurisdictional responsibility for implementing EBM, several Economies responded with multiple answers. For example, some Economies observed that agencies implementing EBM may be at the Economy-level, State-level, and in some cases local-level simultaneously. Economies that selected more than one option (e.g. Economy, State, Local level etc) signify EBM practice and implementation devolved through each level. Thus it can be implied that capacity to implement EBM in these Economies does not lie with the top level of government alone, and through devolution of functions and responsibility practical EBM implementation on the ground may be enabled over time.

Of interest, was the response by three Economies, which indicated that EBM was either not practised or that the question was not applicable to them (suggesting the same outcome). Qualifying this outcome is the point made by two of these Economies that although they selected this option, some aspects of EBM were being put into practice (also signifying these Economies' awareness of what full EBM implementation may require) and that in large, many of the principles although not included within their respective Economies legislation, the agencies charged with coastal and marine resource management were non-the-less implementing EBM progressively.

NGO, IGO and Universities also appear to play a central role in some Economies, with seven economies acknowledging the role of NGOs and three Economies noting the role that IGOs and universities in the implementation of EBM.

Figure 20: Types of agencies within Economies involved in implementing EBM

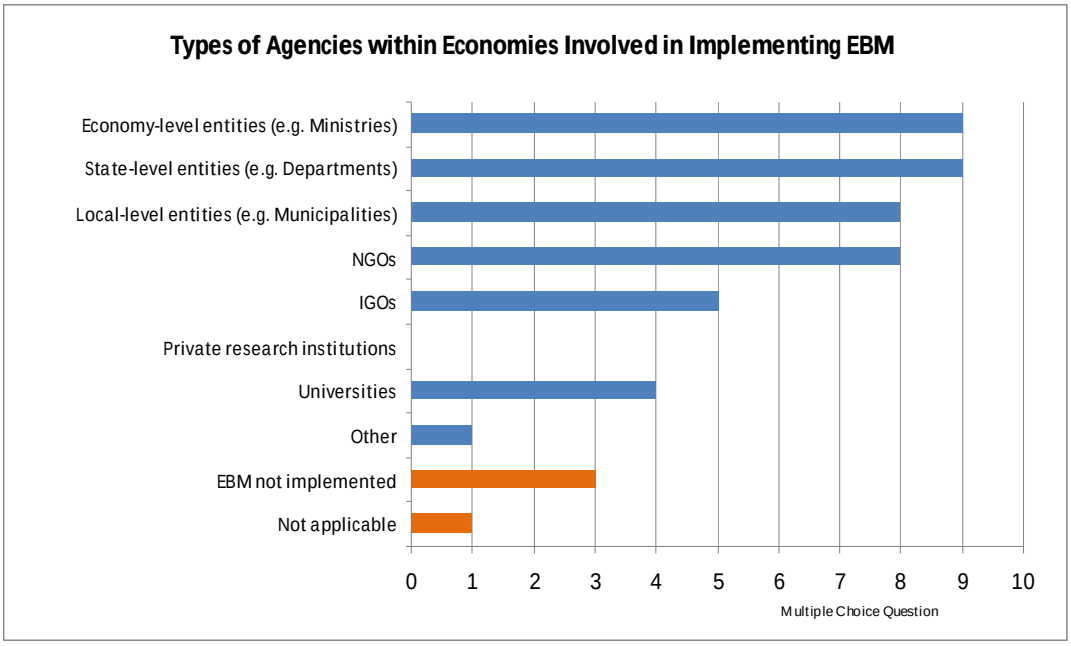
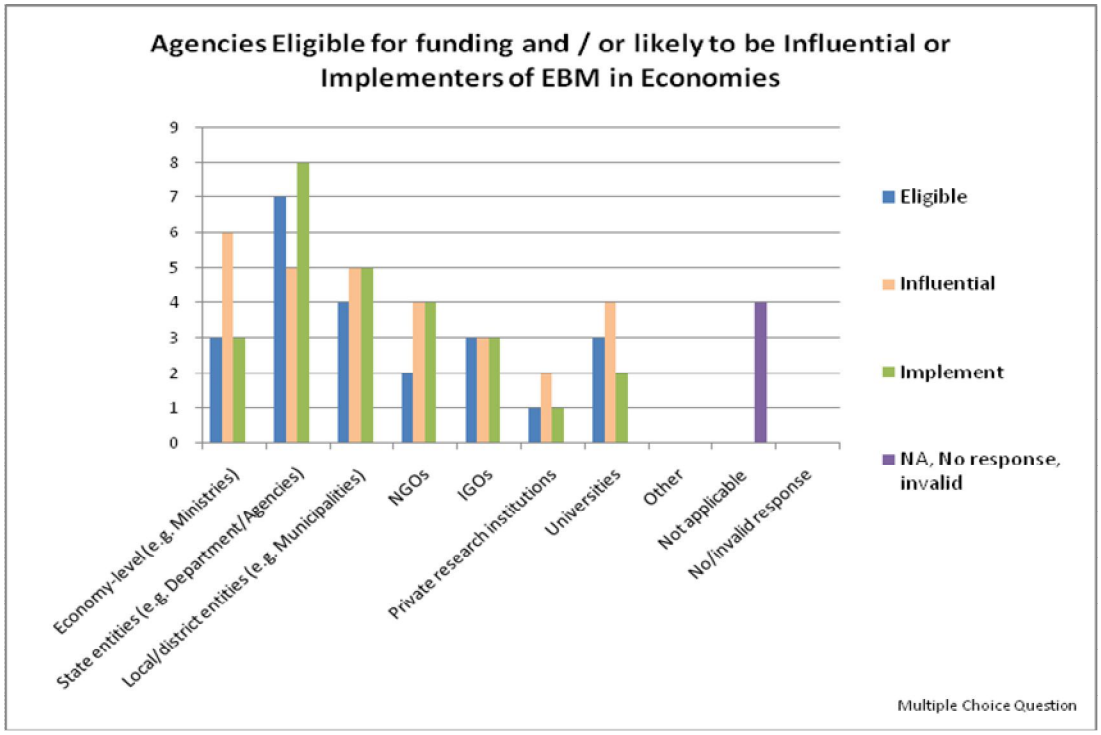


Figure 21 outlines those agencies eligible within APEC Economies for funding to implement EBM; those agencies likely to be influential in implementing EBM; and agencies likely to implement EBM within APEC Economies. From the survey responses, Economies generally reported that agencies eligible for funding were mostly at the Economy, State, or municipal levels, and indeed some Economies selected two or three of these options further indicating devolved EBM capacity

through the various levels of government. However, of possible significance was the moderate level of Economies noting IGO and Universities as eligible agencies for funding (four and five Economies for each respectively). Influence to affect (drive) EBM within Economies was spread across the various options with the Economy-level rating the highest (eight Economies). While EBM implementation was observed to be most undertaken at the State and municipal levels, with ten and seven Economies respectively nominating this option (**Figure 21**). Furthermore, Economies also reported moderate NGO and IGO EBM implementation.[58]

Figure 21: Agencies eligible for funding and / or likely to be influential or implementers of EBM in Economies



One emerging Economy distinguished by way of elaboration to the survey that, *"...NGOs and IGOs source their funds from International NGOs or foreign establishments linked to government [while] government funds are generally from Ministries..."* [and therefore utilised by government agencies]; while a developing Economy reported that, "*when funding is available, government agencies and private research institutes and NGOs work together to implement the program [and that] the government is influential in making decisions and providing funding and making laws*".

[58] Survey responses indicate that funding for NGO EBM implementation would partly rest with external sources, and not directly from Economies themselves.

These statements acknowledge the various roles and levels of external influence upon Economies, where outside influence may or may not be perceived to impact State sovereignty.

Element Summary

Institutional commitment and resourcing indicators discussed above suggest some progress to enable EBM implementation at the Economy level. However, secondary and survey data suggest that the administrative structure within Economies may hinder integrated and thorough EBM implementation, particularly for those Economies with numerous agencies (sectorally focused) with jurisdiction for coastal and marine management (e.g. nine APEC Economies with four or more agencies with jurisdiction and function in the coastal and marine environment). Interestingly, the survey response from three Economies reported that they are not implementing EBM, although they acknowledged that aspects of EBM were being incrementally implemented. Perhaps such a response signifies an appreciation for the sheer scope of activity required to fully implement EBM. Finally, institutional commitment and capacity to implement EBM was not the sole domain of Economy administrative agencies, but is shared to a varying degree with IGOs, NGO and academia throughout the responding surveyed Economies.

2.5.2 An adequate number of marine & coastal management personnel qualified and experienced in EBM

In general, there is no shortage of qualified scientists, modellers, oceanographic institutions and ecological research programs which would limit understanding of ecosystem structure and function across APEC Economies, but there is a need for constant collaborative effort where technical, institutional and human resources are constrained. Furthermore, general observations seem to support the need to continue to promote EBM as the guiding agenda to focus this apparently large number of experts. Without this focus (ecosystem health), research direction and purpose, and thereby the use of limited resources will continue to constrain the adoption of EBM. Nearly every APEC Economy has demonstrated substantial advances in scientific research in recent years, funding limitations notwithstanding.

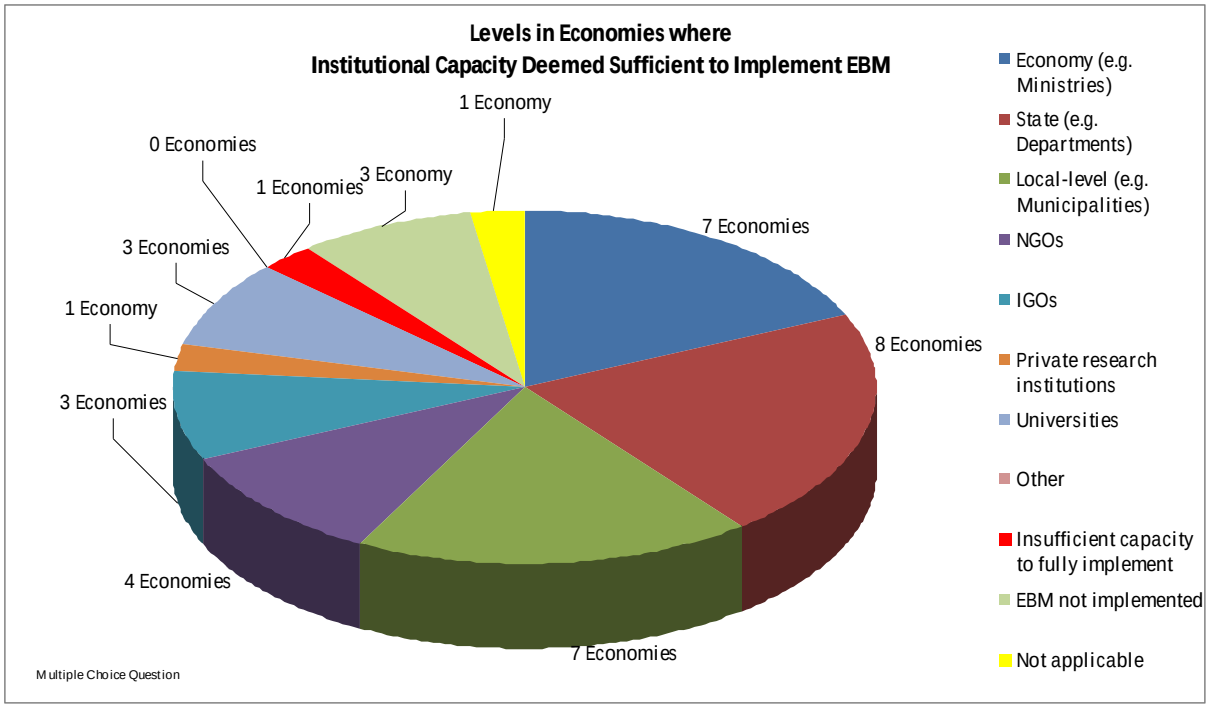
Economy survey responses provided a mixed range of response on the level at which Economies deemed institutional capacity (mentioned here as a measure of adequate personnel levels) to be sufficient to implement EBM (**Figure 22**). For example, seven Economies reported adequate institutional capacity at the ministry and local government levels, while seven Economies

reported sufficient capacity at the State level. Conversely, three Economies (as previously indicated by these Economies) reported that EBM is not implemented and one Economy responded that the question was not applicable.

Upon reflection, these responses do not provide more than a subjective assessment by Economies, as no basis or explanation was provided in the survey as to the meaning and understanding of the term 'adequate capacity'. The response therefore, would depend upon each Economy's expectation of adequacy to implement varying standards and programs considered to reflect EBM.

As the question was multi-choice, some Economies reported capacity at a number of levels including within locally-based NGOs, IGOs or Universities. One Economy further noted that; "as this is rather new [to the economy], there is insufficient institutional capacity to fully implement EBM". Such a response demonstrates once again that at least this Economy considers EBM to be an all-encompassing approach to marine resource management requiring very significant expertise, science, funding and will.

Figure 22: Levels in Economies where institutional capacity deemed sufficient to implement EBM



Element Summary

Even within the three Economies who once again signified that EBM was not being implemented in the true breadth of the approach, it is likely that there is a significant population of marine and coastal management personnel qualified to implement EBM, although the drive and direction to focus efforts within an EBM framework may still require further endeavours.

2.5.3 Marine-space management tools applied

There are numerous tools and strategies available through which Economies can meet the aspirations and requirements of EBM and EAF. Ecosystem-Based Management tools include data collection and management tools; data processing tools; conceptual modelling tools; modelling and analysis tools (such as watershed models, marine ecosystem models, dispersal models, habitat models, socioeconomic models, and model development tools); scenario visualization tools; decision support tools (such as coastal zone management tools, fisheries management tools, conservation and restoration site selection tools, land use planning tools, and hazard

assessment and resilience planning tools); project management tools; stakeholder communication and engagement tools; and monitoring and assessment tools.[59]

While mapping of marine resources is an ongoing activity, there remain substantial gaps in knowledge on the spatial distribution of marine species (including target and non-target species) and habitats. With current satellite technology, there is ample access to spatial climate-related data, such as sea surface temperatures, predominant currents, and even chlorophyll densities. Unfortunately, this technology is not suited to mapping the distribution of key marine species. Mapping technology involves the use of sophisticated spatial software coupled with reports of known distribution of a species. The problem is the latter half of this work is more often than not seen as purely academic exercises and therefore does not always get the funding resources allocated to it as Economies would like. Frequently these studies involve extensive oceanographic vessel time, satellite tracking, data logging and other specialized technology, which can be prohibitively expensive, as well as logistically and technically complex.

GIS mapping and information systems are extremely powerful tools for understanding spatial relationships, overlaps between pressures and resources, and in delineating key management areas. As an example, one developed Economy has produced a National Aquatic Biodiversity Information System (NABIS)[60], which is a web-based mapping tool that allows users to access a wide range of information related to fisheries management areas; marine species distribution; the coastline and marine environment; bathymetry; marine reserves; customary areas; and restricted fishing areas. Another Economy provides a comprehensive inventory of GIS-based decision-making tools to support the MPA establishment process.[61]

A case study-based toolkit developed by WWF for the application of EBM to fisheries outlines twelve key Eco-regions that were used as reference material, drawing on the twelve steps toward EBM adoption described in the WWF EBM framework.[62] The toolkit uses each of the case studies to highlight one of the 12 key EBM steps, and highlights extensively the lessons learnt through the 12 Eco-regions as determined through an extensive research process. “The concept of EBM is

[59] See the Ecosystem Based Management Tools Network for additional reference material http://www.ebmtools.org/
[60] NABIS is an interactive web-based mapping tool with which users can map and display information about New Zealand's marine environment, species distributions and fisheries management, provided by the New Zealand Ministry of Fisheries. http://www.nabis.govt.nz/Pages/default.aspx
[61] An Inventory of GIS-Based Decision-Support Tools for MPAs. US National Oceanic and Atmospheric Administration http://mpa.gov/pdf/publications/FINAL_Decision%20Sup%20Rpt.pdf
[62] Grieve C. and K. Short, 2007. Ecosystem-Based Implementation of Management in Marine Capture Fisheries - Case studies from WWF's Marine Ecoregions. WWF International, Global Marine Programme. Gland, Switzerland. 76 pp, and Ward T., D. Tarte, E. Hegerl and K. Short, 2002. Ecosystem-based management of marine capture fisheries. World Wide Fund for Nature, Australia. 80 pp.

hierarchical, where the operational aspects should be guided by and nested within the terms of EBM principles [and] operational elements, as set out in the framework's steps, do not need to be followed sequentially or rigidly"; noteworthy here again is the reference to the evolutionary nature of EBM adoption.[63]

Similar to this, another toolkit entitled "Advancing Ecosystem-Based Management: a decision support toolkit for marine managers", was developed by a consortium of marine conservation groups to guide managers and practitioners in the use of common tools for regional planning and to illustrate through case studies approaches to advance ecosystem-based management by jointly addressing multiple objectives in conservation, fisheries and coastal hazards.[64]

The Landscape Value and Special Place Mapping Website[65] is an interesting planning technique for sustainable land use and environmental protection, meaningful public participation, and the inclusion of multiple values in land-use decision-making. Landscape value and special place mapping is a type of Public Participation Geographic Information System or (PPGIS) used to support land-use planning efforts at multiple scales ranging from local, to national and regional scales. While primarily terrestrial, the website provides examples of applications, methods, and tools for mapping and analyzing landscape values and special places and resources that could be used for a variety of planning applications, including the marine environment.

Models are also available for assessing the impacts of direct ecological interactions between species and fisheries; and the implications that these have on fisheries management. Dynamic multi-species models (or Minimum Realistic Models) are those used to show how a limited number of species are most likely to have important interactions with a target species of interest. Other models include Multispecies Virtual Population Analysis (MSVPA) and MSFOR; CCAMLR's predator-prey models, Individual-Based Models (IBM) and MSM (Multi-species Statistical Models). Dynamic System Models attempt to represent both bottom-up (physical) and top-down (biological) forces interacting in ecosystems, and include a wide range of variants: Individual-Based Models (IBM), OSMOSE (Object-oriented Simulator of Marine ecosystem Exploitation), INVITRO, biogeochemical models e.g. IGBEM (Integrated Generic Bay Ecosystem Model);

[63] Grieve C. and K. Short, 2007. Ecosystem-Based Implementation of Management in Marine Capture Fisheries - Case studies from WWF's Marine Ecoregions. WWF International, Global Marine Programme. Gland, Switzerland. 76 pp.
[64] Advancing ecosystem-based Management: a decision-support toolkit for marine managers, The Nature Conservancy, 2007: http://marineplanning.org/.
[65] The website is supported by the Landscape Values Institute, a non-profit consortium of international researchers and planners interested in advancing knowledge about landscape values to improve land allocation and management. http://www.landscapevalues.org/

ATLANTIS and SEPODYM/SEAPODYM (Spatial Environmental Population Dynamics Model). All these models help managers predict the responses of ecosystems and ecosystem components to a suite of external pressures, and are becoming fundamental aspects of ecosystem-based management approaches.

Currently the most widely used modelling approach is Ecopath with Ecosim[66], an ecological software suite that uses biomass, production / biomass ratio (or total mortality), consumption / biomass ratio, and ecotrophic efficiency for each of the functional groups in a model. Ecopath with Ecosim is a free suite of ecosystem modelling tools that can be used to evaluate the ecosystem effects of fishing and explore management policy options. It is one of the most user-friendly and least data-intensive of the whole-ecosystem models (models that represent all trophic levels) but still requires data that may be difficult to obtain in data-poor areas (e.g. species abundance estimates). Ecopath with Ecosim is likely to remain a forerunner given the user friendly interface and on-going improvements to the software, as the software package can be used to address ecological questions evaluate ecosystem effects of fishing, explore management policy options, evaluate impact and placement of marine protected areas, and also evaluate effect of environmental changes.

The Coastal Transects Analysis Model[67] (CTAM) is a free, on-line visualization and decision-support tool for describing and analyzing interactions between natural and human systems, with an emphasis on fisheries and aquatic resources. It is available in two forms: 1) a basic model that utilizes descriptive information about a coastal area and is appropriate for data-poor areas; and 2) an advanced model for users with detailed information about their coastal area. The CTAM is a simple tool that can assist coastal managers, practitioners, policy-makers, coastal communities and other coastal stakeholders in addressing multiple present and future demands in coastal areas. CTAM analyzes interactions and flows between natural and human systems, with current emphasis on fisheries and aquatic resources, using information provided by users, coupled with literature and experts' judgment.

Similarly, Atlantis[68] is another free whole-ecosystem model available through the CSIRO and intended for use in management strategy evaluation. It incorporates sub-models for the marine

[66] http://www.ecopath.org/
[67] http://fishbase.sinica.edu.tw/report/t/home.htm
[68] http://www.csiro.au/science/ps3i4.html

environment (physical and biological components), industry (including pollution, climate change, and fishing fleet dynamics), and management actions (including gear restrictions, days at sea, quotas, spatial and temporal zoning, discard restrictions, size limits, and by-catch mitigation). Reportedly, calibration and use of Atlantis can be time- and data-intensive, and it is generally not suitable for data-poor areas, but it may be a suitable tool for more advanced forms of EBM applications. The Atlantis model has already been applied to more than 15 ecosystems, primarily in temperate regions of some Economies to investigate appropriate strategic management options for regional fisheries, the effects of complexity on model performance, robust indicators of the ecological impacts of fisheries, regional marine planning, and spatial management to meet conservation goals.

Commentators acknowledge that definitive conclusions cannot be drawn from a single model structure, given the incomplete knowledge of ecosystem functioning, but highlights that there have been increasing efforts to modularize models so that different components can be easily substituted, making them more realistic and relevant to ecosystem processes.[69]

Marine Protected Areas are yet another tool to manage ecosystems in a wider context. They need not be exclusionary, and indeed, as highlighted by the IUCN Categories (IUCN 1994) can have multiple uses and still be protected; and act as ideal avenues for managing use and preserving ecosystem function. MPAs can include fisheries management, and also act as larval and brood stock refuges to nearby areas. MPAs can be home to people, and to numerous industries. They can be on the high seas, or coastal. They can be large or small, and can accommodate a broad range of management regimes. In 2000, the IUCN World Commission on Protected Areas (WCPA Marine) and WWF formed the MPA Management Effectiveness Initiative to develop a guidebook for assessing MPA management effectiveness, based on MPA objectives and indicators (Pomeroy et al. 2004). MPAs provide a platform for addressing conservation of the complex marine environment, and are a key building block for a number of APEC Economies EAF and EBM initiatives.

As an example, one developed Economy has a number of marine protected areas designated under an Oceans Act and areas of interest at various stages of progress towards designation. These areas are ecologically significant, with species and/or properties that require special

[69] Plagányi, E.E., 2007. Models for an ecosystem approach to fisheries. FAO Fisheries Technical Paper No. 477. Rome, FAO. 2007. 126 pp.

consideration. Marine protected areas are one among other management tools that this Economy uses to contribute to the improved health, integrity and productivity of their marine ecosystems; and help advance integrated ocean management. These areas are part of that Economy's network of MPAs and are established following a systematic and collaborative approach under a Federal Marine Protected Areas Strategy.[70]

One developed Economy has an extensive reef multi-use MPA.[71] The Parks' objectives are to provide for the long-term protection; ecologically sustainable use; and understanding and enjoyment of the park through the care and development of the MPA. Some of the key principles that identify the Park as one with a greater ecosystem-based approach to management are: the Park is managed in accordance with the principles of ecologically sustainable development; the community is meaningfully involved in the management of the Park; and continuous research is conducted including disseminating up-to-date information. The Park also seeks improvements in coordinated management and works with the indigenous people in a way that takes account of traditional affiliations, culture and rights.

Another example of marine area management is demonstrated by an emerging Economy that has developed a network of protected areas which serve various functions, from protecting endangered species such as marine turtles to serving as larval sources for commercial and artisanal fisheries. The Parks, administered through two levels of government, have stated objectives to conserve and protect the biological diversity of the marine community and its habitats; upgrade and conserve the natural habitats of endangered aquatic species; establish management zones for the conservation of aquatic flora and fauna; establish zones of recreational use consistent with its carrying capacity; and to manage and develop capacity building in public awareness programs. These habitats are set aside to afford special protection to aquatic flora and fauna, and to protect, preserve and manage the natural breeding grounds and habitat of aquatic life with particular regard to species that are rare or endangered. In keeping with broader EBM principles, the Parks are also designed to allow for the natural regeneration of aquatic life where such life has been depleted; and promote scientific study and research.[72]

[70] http://www.dfo-mpo.gc.ca/oceans/marineareas-zonesmarines/mpa-zpm/index-eng.htm
[71] http://www.gbrmpa.gov.au/
[72] Many of these parks are administered at the federal level, whilst other are administered at the state government level. http://www.dmpm.nre.gov.my/main.php?lang=1, www.sabahparks.org.my/ www.forestry.sarawak.gov.my/forweb/np/np/np.htm .

Risk-based assessments are among the tools that exist for management authorities to better predict environmental consequences, but few APEC Economies adequately implement risk-based approaches to ecosystem management. In the absence of sufficient quantitative data, risk-based assessments allow the use of a structured framework to assess the risk to an ecosystem, for example, to assess if a fishery is operating unsustainably with regard to target, by-catch and retained species, and habitats and ecosystems.[73] Risk assessments can assist in prioritising and guiding research, data collection, monitoring, and future management decisions. In 2009, an early effort to test a risk-based fisheries assessment framework (based upon the Marine Stewardship Council Approach) on a data-deficient fishery was conducted. This effort was applied to a fishery within an emerging Economy, with early results demonstrating proven usefulness of a practical tool, flexible enough to be considered appropriate to a wide range of fishery types.[74]

As in indicator of possible tools in use by APEC Economies, **Figure 23** shows that Economies apply a range of measures from the protection of spawning aggregations to integrated catchment management to preserve marine ecosystems. Eight responding Economies (from 14 returned surveys) observed that MPAs are administrated from the Economy level, while six and five Economies reported MPA administration at the State and local levels respectively. At the Economy level, eight of the respondent Economies selected 'limitations on fishery capacity' and nine selected 'time/area closures', while 'no takes zones' were reported to occur within seven Economies at the Economy level (**Figure 23**). 'By-catch reduction' was selected by eight of the 14 responding Economies at the Economy level, with five Economies reporting its use at the State level and one at the local level. Such a response suggests a high level of importance placed on this mechanism with 100% of respondent Economies selecting this marine preservation measure.

The least applied measure was 'ecosystem assessment with indicators', where one Economy noted its application at the local level, four Economies at the Economy level and State levels. Integrated catchment management was also only nominally selected by the Economies as a measure to preserve marine ecosystems. The results show a somewhat sectoral management approach being implemented in the main, with fisheries and MPA associated measures forming the majority of action. Due to the multiple choice nature of the question, some Economies noted the use of MPA and other marine ecosystem preservation measures at multiple jurisdictional levels; however, a further question posed in the survey specific to fisheries and EAF saw ten

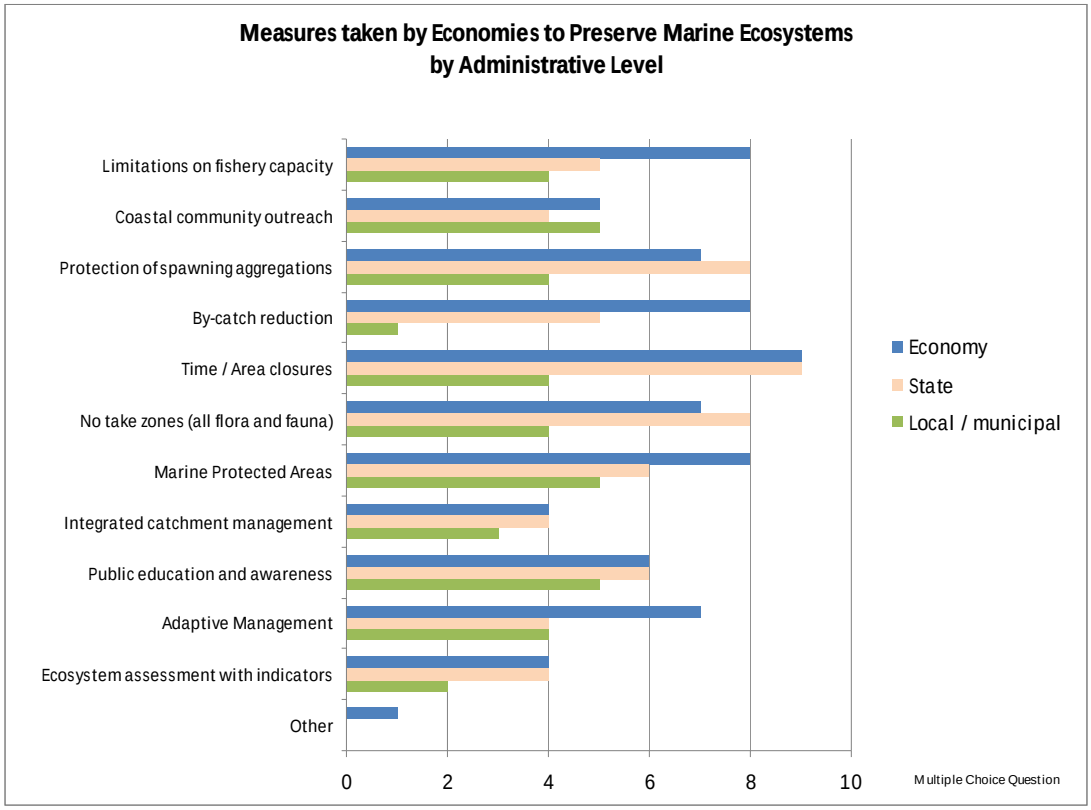
[73] Marine Stewardship Council's Risk-Based Framework (http://www.msc.org/about-us/standards/methodologies/fam)
[74] The case study used to test the risk-based fisheries assessment methodology will be concluded in early 2010.

Economies selecting MPA implementation as a measure taken specifically to manage fisheries pressure (see **Section 3** for further detail).

Three of the 14 respondent Economies provided elaboration to this question. A developed Economy stated that the MPAs established within the Economy are not only used to address fishing but also for variety of purposes. One economy reported as an additional measure "prohibiting fishing gear", while the other noted the "protection of marine mammals, birds and turtles and fishing gear regulations" as other measures taken to preserve marine ecosystems.[75] One developed Economy responded that fisheries management range from large complex multi-species fisheries with full individual transferable quota systems, to small single species operations managed purely by input controls.

[75] Data relating to fishing gear selectivity was captured within the response to a specific question under the EAF component of the Economy survey.

Figure 23: Measures taken by Economies to preserve marine ecosystems by administrative level



Element Summary

It is evident that a broad range of tools exist to help advance implementation of the complex EAF and EBM principles. Not all need to be used at once, and indeed there are likely a suite of constraints, practical, logistical and financial, which attempting this might be counterproductive. As noted above, EAF and EBM will need to evolve, and adoption of the different mechanisms will vary based on an Economy's needs, priorities, and aspirations. The discussion above emphasises broad application of marine-space management tools by Economies, with a pattern of higher levels of tool implementation amongst developed Economies in general.

2.5.4 National & collaborative enforcement is effective throughout the geographic expanse of identified ecosystems

As an element of EBM, effective enforcement throughout the geographic area of identified ecosystems is a necessary requirement. Enforcement will apply both to national territory and in some cases (where cooperation occurs) at the trans-boundary level. The rate and frequency of

enforcement activity is likely to be influenced by a number of factors including: number and capacity of personnel, asset and technology capability, mandate, financial support (budget), participation in and maintenance of MCS Networks (national & cross-jurisdictional), the nature of the marine area under management, and the patterns of pressures on marine ecosystems and habitats due to human activity.

Economies undertake a range of enforcement activities and programs, including setting-up of specific task forces and participating in MCS networks. Some Economies demonstrate enforcement arrangements that are sectoral in focus, while others take on a holistic and/or integrated form with regard to the range of activities that are controlled. To demonstrate the range of Economy activity related to national and collaborative enforcement, an extract taken from the Bali Plan of Action Economy Implementation Review is provided below.

Extracts from BPA Economy Implementation Study: Final Report 2008[76]

Marine Environment

All but one participating Economy [15 Economies] reported enhanced management or enforcement to control activities that have a destructive impact [on the marine environment]. Thirteen Economies observed that actions to reduce destructive impacts were based upon best available scientific information, while fourteen Economies (87%) also reported enhancement in monitoring and research. Approximately 70% of respondent Economies declared that they [had] enhanced local management to maintain environmental and economic benefits (pg 13). A developed Economy reported that assistance [was] provided in the course of implementing the High Seas Task Force proposals to combat IUU fishing. This Economy observed that monitoring, control and surveillance (MCS) networks [could] be strengthened through improved access to information and analysis capability (pg 24). Another developed Economy noted that a sum of $500,000 has been provided to the UN Fish Stocks Agreement (UNFSA) Part VII Assistance Fund. The funding [was] to help developing countries who are Parties to the UNFSA build enforcement capacity, undertake scientific research and participate more actively in the meetings and activities of RFMOs. At the BPA Implementation Workshop at Manado in November 2007, participants observed that domestic efforts to address land-based sources of pollution, particularly the problem of sewage, continued to be challenged by weaknesses in regulations, problems in jurisdiction, inadequate enforcement, lack of financial capacity, and a lack of understanding on how to use appropriate technology. Several measures were proposed to address these inadequacies, such as focusing on technology transfer, improvement of regulatory frameworks, encouraging investment through the private sector, and development of common criteria to facilitate implementation (e.g. water quality discharge standards for aquaculture) (pg 70). A developed Economy cited comprehensive actions in fisheries management, and coastal zone management through plans; decisions by councils; ensuring regulations and fisheries closures; as well as increasing enforceability through international MSC initiatives and continued use of observer programs, while a further stated that "impact studies on biodiversity are implemented, where necessary, in coastal and marine developments", and that an "…environmental management and monitoring program (EMMP) is usually also implemented to monitor and control impacts from development". The establishment of 40 MPA island areas, legislation prohibiting destructive fishing methods, and regular enforcement by fisheries officers were actions reported to be taken by an emerging Economy to improve conservation of marine resources (pg 95).

[76] Asia Pacific Economic Cooperation, 2008. Implementation of the Bali Plan of Action: APEC Bali Plan of Action Economy Survey Analysis Final Report. APEC Publication Number: APEC#208-FS-01.2, Singapore, 325 pp

IUU-Fishing

Six respondent Economies reported that they implemented the IPOA-IUU before September 2005. Some of the measures adopted by these Economies to implement the IPOA-IUU and address IUU fishing [included]:

- provision of additional budget to increase enforcement capacity;
- improvement of coordination and cooperation in operational activities to deter illegal fishing;
- introduction of amendments to legislation to include significant custodial penalties for foreign fishing offences;
- conduct of joint patrols with neighbouring States;
- participation in international and regional efforts to address IUU fishing;
- maintenance of a cadre of professional, well-trained and well-equipped fishery officers with authority to inspect, search, seize and arrest fishery violators;
- implementation of fisheries laws, including regulations of fishing efforts and promoting rights-based fisheries to replace open access regimes;
- implementation of observer programmes and dockside monitoring programmes;
- improvement of MCS systems involving local communities;
- involvement in the International MCS Network; and more…[see pg 117 of BPA Final Report].

Two Economies have reported that they [were as at 2008] in the process of adopting an NPOA-IUU while two others stated that they [did] not implement the IPOA-IUU but have been monitoring IUU fishing by foreign fishing vessels (pg 117).

Marine Pollution

A developed Economy maintained that it enforces IMO Safety and Environmental Conventions. The Economy stated that it [had] developed guidelines and educational materials dealing with marine pollution, along with a program specifically to address marine debris (pg 78). Another developed Economy declared that it has had Ballast Water regulations since 2006, and that recent funding will enhance enforcement of the regulations to prevent the introduction of marine invasive species (pg 90). A developed Economy stated that it has trained marine inspectors who are now implementing enforcement aspects of domestic Ballast Water Control and Management Regulations. Another Economy reported that it regularly trains quarantine officers for inspection of ship ballast water and hulls (bio-fouling) (pg 91).

MCS

Progress towards receiving six new patrol boats was cited by one developed Economy as a means to improve fisheries surveillance and monitoring within its EEZ. The Economy also stated that the new vessels [would] be accompanied by aerial surveillance and an inspection regime "…as part of a comprehensive, integrated MCS program". This program [was] being managed through an inter-agency centre. This Economy stated that the challenge of implementing the enhanced program is one where a transition from shore-based enforcement to a more comprehensive system [was] to be achieved. Another developed Economy reported that it [had] accelerated efforts to modernise and redefine a compliance and enforcement program. Some of the main drivers of the review were reported as: an expanding range of regulatory responsibilities including fisheries, habitat, species at risk, marine security etc; a more complex management regime requiring improved coordination and integration of compliance management; an increasingly challenging legal environment; increased conservation concerns and greater awareness by stakeholders requiring compliance of third parties in compliance and monitoring; and the generation of more data through new technology and the need for enhanced analysis. The Economy stated that under the compliance review it [was going to] focus on three areas, integrated risk management, operational planning and budgeting, and performance measures. Under these focus areas, the Economy stated that it will make further advances in integrating new technologies and strategies, enhance integration of VMS and the at-sea observer program, undertake closer monitoring of the dockside monitoring program, and aim for a more strategic response to activities that have impacts on habitats. An emerging Economy stated that it "…has made progress inventorying its fishing fleet and operates a program to equip its deep-sea fleet with GPS". Another

emerging Economy declared that it [had] good MCS in place and that a vessel monitoring system is compulsory for deep-sea fishing vessels. It also noted that enforcement practices [were] upgraded... An emerging Economy reported that it has made significant effort to eliminate IUU fishing and that it "…has strengthened control and surveillance domestically". This Economy also reported that it [was] enhancing [a] vessel monitoring system (VMS) through increasing the number of fisheries guidance vessels and mandating installation of VMS; and that following RFMO agreement, VMS [was] being installed on deep-sea vessels. This Economy [was] also running an international observer program on a trial basis, which it said [was] likely to expand. A developing Economy reported monitoring the EEZ although it [had] no proper training for enforcement staff. An interesting approach to MCS was cited by two developing Economies, which reported that local communities participate in formulating fisheries management and conflict resolution. [one of these Economies] also reported that it [had] established a local MCS network and [had] applied a simplified MCS system for small-fisheries including conducting training through workshops under a recent project. [One] Economy also reported a fisheries legislation amendment that came into force in 2007, which has strengthened forfeiture provisions, and surveillance and enforcement powers. A hindrance to effective sanctions reported by a developing Economy, was that they [had] difficulty coordinating fisheries and environmental monitoring bodies. Another developing Economy reported that under legislation, the captain is liable to a fine of not more than USD$743,000 equivalent. [Another] Economy reported that legislation on fisheries violations provided for up to two years imprisonment or a fine of up to USD$5,000 equivalent. [While] another Economy reported that current legislation is under revision. Whereas a developing Economy reported that under legislation they have established a fisheries tribunal. Four Economies did not respond to this part of the question, two Economies stated that it was not applicable, and four Economies did not elaborate to support the ranked quantitative response given (pg 125-126). One Economy noted that it has a small fishing fleet only of less than 20 vessels, all under 50 metres in length. Two developed Economies reported that they [were] proponents of MCS regimes, with one claiming that it seeks to utilise its MCS network at every opportunity to share information. The second of these two Economies also reported that it has hosted MCS Network meetings and [had] pledged financial support for ongoing work. In addition, one of these Economies reported that it also participates in RFMOs, and through these mechanisms, "champions" enhancements to enforcement measures to help combat IUU activity, in addition to providing enforcement resources. An Economy reported that USD 553 million equivalent [had] been budgeted for armed patrols and an enhanced ability to respond to IUU fishing. Additionally, this Economy noted that it [had] a joint-patrol program with another country based on a cooperation treaty, where regular joint patrols are conducted. Finally, this Economy also cited an educational program occurring in a neighbouring country to educate fishers on the consequences of IUU fishing and alternative livelihoods. A developing Economy observed that it has attended workshops on the International MCS Network, and although it has yet to participate in the Network, it intends to do so. A developed Economy cited the provision of information to RFMOs and Economies on the movements of suspected IUU cargo vessels. An impediment noted by a developing Economy was that it is not a member of the MCS Network. Also, an emerging Economy reported that it is not a member of the MSC Network; however, it observed that it has undertaken the following measures: fishing vessels larger than 100 tonnes have been installed with VMS in accordance with RFMO resolutions, and small tuna long-liners are also scheduled to have VMS installed; patrol vessels are despatched to the Pacific and Atlantic to monitor its flag vessels; a scientific observer program has been ongoing for many years; and no tuna vessel listed on a negative list held by an RFMO is allowed to enter its ports. Another emerging Economy reported that it [had] expended strong efforts for MCS with regard to pelagic fisheries, including: a VMS on commercial vessels, on-board observers including for bird and mammal observations. Additionally, the Economy stated that it developed a satellite surveillance system for a squid fishery, and that quota management applies to other fisheries (pg 134).

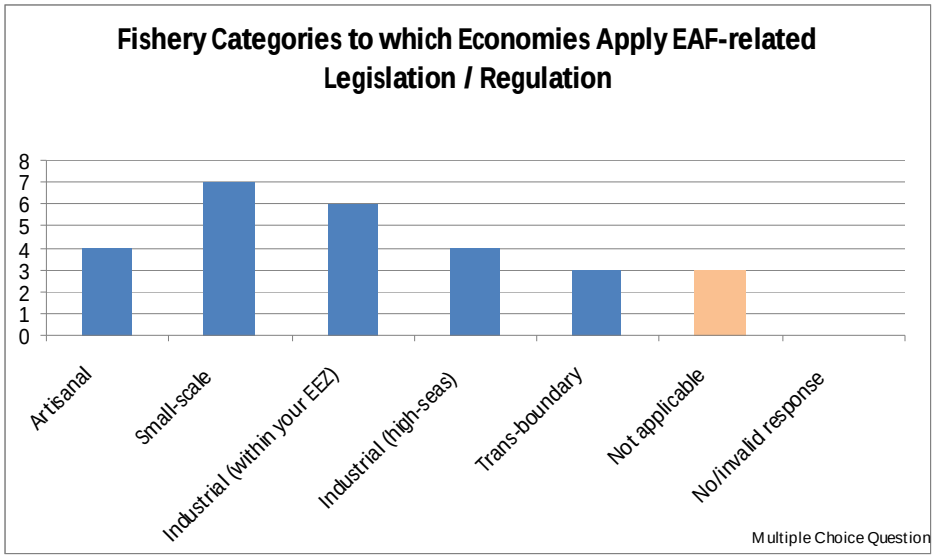
Use of at-sea, port-state and trade-related measures

One developed Economy reported that it resumed recruiting enforcement officers in 2005-06, and that 85 officers [had] graduated [as of 2007] with another 50 officers reported to be scheduled to graduate in early 2008. The Economy reported that with the new officers, and an already effective dockside monitoring program, it continues to take steps to address IUU activity. As previously reported, a developed Economy, is in the process "…of significantly increasing its ability to combat IUU fishing at

> sea through the [deployment] of six new patrol vessels and aerial surveillance…, [which] will allow…[the Economy]…to conduct boarding and inspections in its EEZ and on the high seas to support the objectives of relevant regional and sub-regional arrangement [that it] is a party to". This Economy also stated that fishing vessels wishing to enter ports are subject to inspection in accordance with the FAO Model Scheme. Vessels wishing to land fish were said to require prior approval and prove that the fish are from authorised activities, which are then subject to observer monitoring (pg 132). One Economy emphasised the importance of discussions with coastal States to encourage them to take more effective enforcement measures to protect their own marine resources. Another developed Economy said that it "…provides information on the movement of suspected IUU cargo vessels and their cargo upon request from [any] Member Economy or RFMO". An emerging Economy reported that it [was] enacting new legislation for 'Distant Water Fisheries', that include[d] port-State provisions to promote compliance with RFMO conservation measures, such as, a port inspection scheme, and restrictions on landings and transhipment of IUU catches (pg 133).

An indirect but relevant indicator of the effectiveness of enforcement regimes is the range of fisheries (scale) at which EAF-related legislation and regulation applies. **Figure 24** provides responses from 14 Economies to this question. The question sought to asses if EAF-related legislation/regulation was in place, and what form or scales of fisheries did it apply to, e.g. within an Economies EEZ or further afield. The results show that of the 14 Economy responses, four apply EAF-related legislation/regulation to artisanal fisheries, seven to small-scale fisheries, and six to industrial fisheries within their EEZ. Only three Economies indicated EAF-related legislation/regulation applying to 'transboundary fisheries'. Clearly, this shows that Economies manage and therefore can regulate fisheries with more ease within their respective EEZ, than on transboundary issues. However, as discussed above, some Economies have and are able to apply port-state and at-sea measures to industrial fisheries that operate in this region.

Figure 24: Fishery categories to which Economies apply EAF-related legislation / regulation



Finally, three Economies reported that EAF-related legislation or regulation was not applicable to their Economies, which is consistent with earlier comments made by these Economies who nevertheless, do practice aspects of EBM and EAF at varying levels.

Element Summary

The secondary source information for which informed a large part of the discussion above did not serve to identify and describe whether enforcement efforts by Economies fully covered the geographic expanse of identified Ecosystems for which EBM should be applied. Most likely the geographic scale is based upon maritime jurisdictional zones. The discussion above does however, describe with some detail a raft of Economy activity in support of national and to a lesser extent collaborative enforcement efforts, implying a fair level (although no doubt variable) of effectiveness throughout APEC.

3.0 ELEMENTS OF AN ECOSYSTEM APPROACH TO FISHERIES (EAF)

There are a number of key initiatives underway within APEC Economies that address the issue of the wider ecosystem in fisheries management. Some examples have been listed here to provide guidance and a summary of the current approaches. While an exhaustive list of what each and every Economy is doing, which in any way relates to fisheries and ecosystems is beyond the scope of this report, it is encouraging that many are indeed underway, and a summary of these include, amongst others, development of policies and frameworks for adoption of ecosystem principles, development of management plans that address wider issues than just fisheries, development of plans of action for other impacted species, and formulation of MPA strategies. The following discussion on EAF is divided in to four broad themes: i.e. Fish Stock Management; Non-target Species & Habitat; Industry Management; and Fishers & Stakeholders.

APEC Economies have diverse and comprehensive fishery regulations, with a substantial range of regulatory measures in place to cater to a single and less frequently multiple-species management. However, these regulations are mostly historical as not all Economies have revised their regulations to adapt to ecosystem-based approaches to fishery management. Concepts such as co-management have been more widely accepted and included within APEC Economy regulatory systems, in part due to a longer history of this approach.[77] Some positive steps being taken in the APEC region include the development and integration into fishery regulations of wider concerns, such as through the Ecologically Sustainable Development of Fisheries (ESD) concept, which integrates the short and long-term economic, social and environmental aspects of activities into fishery regulations.

Conflicts over fishery resources today are much more complex than those of yesteryear. Today conflicts arise not just between fishing operations and depletion of stocks, but through the complex inter-linkages within ecosystems, and the effect that multiple activities may have on marine systems. Over-harvesting a fish species that is a foraging resource for a bird in a different country is one such example. Another more complex one could be the decrease in small pelagics due to an increase in sea jellies. The reduction in the number of turtles as a result of excessive entanglement in high seas long-line operations has more or less removed one of the main

[77] Publication Pending (Draft), Meryl J Williams and Derek Staples, *Handbook of Marine Fisheries and Conservation: Section III: Case Studies in Governance-24. Southeast Asian Fisheries*.

predators of the sea jellies, assisting the latter to thrive. Adopting an ecosystem approach to understanding and managing fisheries is a load-bearing pillar in the move towards sustainability.

The adoption of an Ecosystem Approach to Fisheries (EAF) is an evolutionary and, not a revolutionary one.[78] Small, incremental steps have transformed simple extractive fisheries activity to fisheries conducted within ecological bounds, where no country has yet developed and implemented a full and comprehensive EAF. Perhaps this is the greatest lesson of all in the quest for sustainable fisheries, insofar as how fishery management agencies, regional fishery management organizations and intergovernmental panels facilitate a more spatially-comprehensive adoption of ecosystem-based principles in fisheries management.

None of the principles that underlie EAF are novel and most are contained or addressed in one form or another in earlier instruments, agreements, or declarations, such as the *FAO Code of Conduct for Responsible Fisheries*.[79] However, complete implementation of these principles is hindered mostly due to the complexity of the issues (and often a lack of understanding of the issues), the costs involved, and the sheer range and number of ecosystems, species and stakeholders involved. While this strikes a negative chord, the emergence within APEC Economies of more fishery management practices that are based on ecosystem approaches rather than single-species management regimes is encouraging.

In an effort to Institutionalise EAF, one developed Economy undertook a strategic planning exercise to identify issues that must be addressed before meaningful ecosystem-based fisheries management would be feasible. The resultant strategy was centred on the setting of goals and objectives as targets in management.[80] Through this strategic approach, commentators note that Ecosystem-based Fisheries Management has been articulated to encompass a process where "personal, social, political, and management decisions are made considering ecological information", with acknowledgement that an ecosystem-based approach requires attention to ecosystem integrity, interagency cooperation, spatially explicit management measures, and time-series data for multiple species and habitats.

[78] Grønnevet, L., 2009. Effective collaboration between scientists, managers and policy makers. Paper presented at the APEC Ecosystem-based Workshop, 28-29 May 2009, Vancouver, Canada.
[79] FAO, 1995. Code of Conduct for Responsible Fisheries. Rome, FAO. 1995. 41 pp.
[80] Busch, W.D.N., B.L. Brown and G.F. Mayer (Eds). 2003. Strategic Guidance for Implementing an Ecosystem-based Approach to Fisheries Management. United States Department of Commerce, National Oceanic and Atmospheric Administration, NMFS, Silver Spring, MD 62p.

Accordingly, key activities prescribed through the analysis include:

- Identifying and setting goals with reference to the larger environment, including ecosystem parameters or environmental conditions that limit fishery management options;
- Focusing on interactions among constituents, team building, and trust;
- Emphasizing "coordination and cooperation" as opposed to "control";
- Accessing and incorporating local and regional expertise;
- Categorizing current and proposed ocean zoning measures according to ecosystem relevance;
- Reporting on efforts to ensure compliance with environmental regulators, and determine what, if any, additional action is needed to foster an ecosystem-based approach;
- Match elements of current fishery management plans to the suggested elements of fishery ecosystem plans to identify missing elements and to determine if objectives and indicators are aligned;
- Examining current efforts to apply an ecosystem-based approach to determine coverage of suggested fishery ecosystem plans;
- Undertaking limited scale pilot projects; and
- Promoting development of graduate level curricula in support of ecosystem-based approach to fisheries management and implementing this through scholarship incentives[81].

In many ways the this Economy's analysis reflects a standard approach for evolving from fishery dependent plans to ecosystem dependent plans, proving a useful starting point to address many of the key requirements for EAF to become operational: i.e. enhanced communication, broad stakeholder participation, zoning, reporting, and the use of pilot projects to test the process.

A more recent study[82] investigated 53 counties and their progress in implementing the FAO Code and comparing this to the ecosystem approach to fisheries – viewed by many as a definitive and model approach to EAF – by reviewing each country's reports to FAO and through extensive communication with researchers, analysts and government agencies in each country. A more focused version of this document was published subsequently,[83] which was aimed at evaluating further each country's performance against EBM principles, objectives and performance, distilled from the extensive data accumulated during the first study. A study in 2009 evaluated fisheries management for 219 EEZs via a web-based survey and assigned scores to each country based on six key performance categories. These included: (1) robust scientific basis for management

[81] Busch, W.D.N., B.L. Brown and G.F. Mayer (Eds). 2003. Strategic Guidance for Implementing an Ecosystem-based Approach to Fisheries Management. United States Department of Commerce, National Oceanic and Atmospheric Administration, NMFS, Silver Spring, MD 62p.
[82] Pitcher, T., D. Kalikoski, G. Pramod and K. Short, 2008a. Safe conduct? Twelve years fishing under the UN code. WWF-International / Fisheries Ecosystem Restoration Research, University of British Columbia. Vancouver, Canada. 63 pp.
[83] Pitcher, T.J., D. Kalikoski, K. Short, D. Varkey and G Pramoda, 2008b. An evaluation of progress in implementing ecosystem-based management of fisheries in 33 countries. Marine Policy 33: 223-232.

recommendations, (2) transparency in turning recommendations into policy, (3) capacity to enforce and ensure compliance with regulations, and minimizing the extent of (4) subsidies, (5) fishing overcapacity, and (6) foreign fishing in the form of fisheries agreements. Their project was designed to the effectiveness with which fisheries are being managed, and related those results to an index of the probable sustainability of reported catches. The study found that that the management of fisheries worldwide "*is lagging far behind international guidelines recommended to minimize the effects of overexploitation*" and that "*only a handful of countries have a robust scientific basis for management recommendations, and transparent and participatory processes to convert those recommendations into policy while also ensuring compliance with regulations*". The study also highlighted how the conversion of scientific advice into policy, through a participatory and transparent process, was at the core of achieving fisheries sustainability. Subsequently, a Pew Foundation-commissioned report (2008) ranked the management of fisheries in 53 countries while addressing indicators related to biodiversity, fishery values, and socioeconomic aspects of the fisheries[84].

The key findings from the above analyses are indicative of progress amongst APEC Economies in implementing EBM and EAF principles. Irrespective of the methods used above, not one country scored an 'excellent' pass grade overall. A handful of countries (six) measured up sufficiently to be awarded 'good' grades, amongst these a couple of APEC Economies, and a disturbing >50% of countries rated 'fail' grades. Noteworthy then were the balance ~40-45% of countries that did not fail but neither had they rated 'good' performance overall. Of alarm also was that there was a negative relationship between marine biodiversity and ecosystem-based implementation of fisheries management, highlighting the situation in a major APEC sub-region.

The above analyses did not reveal any major trend with regard to UN Development Index, and indeed found that a number of developed Economies lagged far behind developing Economies in the implementation of EBM and EAF principles. However, there are certain of caveats to this point: First, a number of countries may be partially implementing the provisions of the Code, but not fully, and the above analyses often were not sufficiently descriptive to provide this level of detail. Secondly, some aspects of the Code might be of negligible consequence to some developed economies for which they would score a lower grade, and yet overall their

[84] Alder, J. and D. Pauly. 2008. A Comparative Assessment of Biodiversity, Fisheries, and Aquaculture in 53 Countries' Exclusive Economic Zones. Fisheries Centre Research Reports 16(7). The Fisheries Centre, University of British Columbia Vancouver, B.C., Canada. 90 pp.

performance could be considered much better. Additionally, how performance of an Economy's attention to one fishery sector is weighted against performance in another can have dramatic influences on overall scores.

For instance, seabird by-catch might be an issue in a southern ocean Economy, but of negligible impact in a Southeast Asian Economy. Thus a country might score poorly on addressing seabird by-catch when it was not an issue for them to start with. Similarly, small scale, artisanal fisheries are of huge importance to several Southeast Asian Economies, but of little consequence in some larger Economies. Again, an Economy could score poorly for something which was not of direct consequence. If the value of these two issues were weighted similarly, this might have substantial impacts on overall scores. If by-catch were considered less important than artisanal fisheries, the results may not be representative of the real issues affecting individual Economies. The analyses do, however, provide a starting point for self-evaluation and determining areas for improvement.

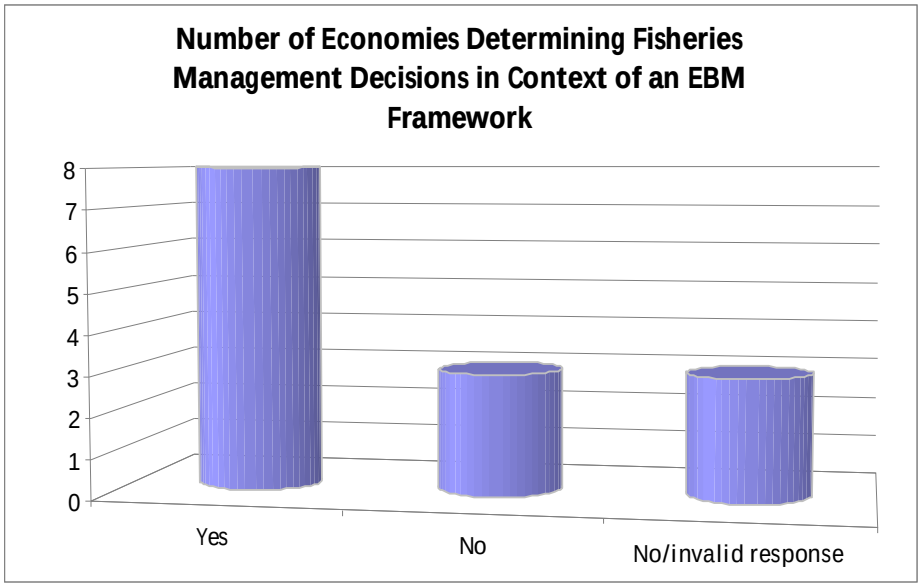
In many ways, analytical studies such as those described above would need to be more thorough on explaining how they weigh different values against each other, and likely need further refinement to paint a realistic picture of the status of implementation of EBM and EAF (see Langley 2009). Irrespective, however, is the fact that many countries received overall 'fail' grades and that a significant proportion of countries barely scored as 'adequate'. If nothing else, this is a worthwhile starting point for where Economies need to go from here. These analysis provide a snapshot 'stock-take' of the state of EBM and EAF implementation, and while slightly out of focus, the picture does show that APEC Economies could do a lot more to adopt and implement fully the FAO CCRF and thus meet the objectives of EAF and EBM.

3.1 FISH STOCK MANAGEMENT

Fish stock management within an EAF approach should have a number of elements, including: official commitment to EAF (policies and guidelines); adoption of international practices and instruments; fishery surveys and mapping that are kept up to date; management tools such as quotas, the development of indicators and objectives guided by the goal of ecosystem health; comprehensive accurate rate-of-effort and landings data; and participation in and the maintenance of fisheries data-sharing and collaborative scientific networks. Each of these elements is further considered below in the context of good practice examples demonstrated by various APEC Economies.

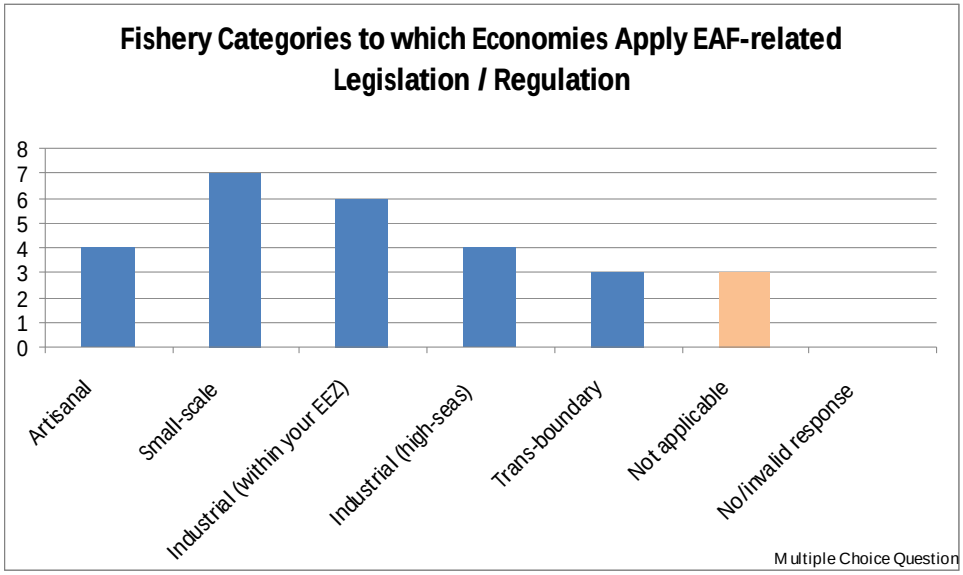
APEC Economies responses to the project survey reveals that of the 14 responding Economies, eight acknowledged fisheries management decisions being made in the context of an EBM framework. Interestingly, three Economies responded that they do not yet determine fisheries management decisions in the context of an EBM framework (**Figure 25**).

Figure 25: Number of Economies determining fisheries management decisions in context of an EBM framework



In **Figure 26**, when asked to respond on EAF-related legislation and /or regulations, six Economies reported that such legislation / regulation applies to small-scale fisheries, three in artisanal fisheries, and five in industrial fisheries within respective EEZs. Only three of the 14 Economies reported coverage by EAF-related legislation and / or regulation for high seas fisheries, with only one Economy noting application to transboundary fisheries. Three Economies noted no such EAF-related legislation or regulation being applied to fisheries at any scale.

Figure 26: Fishery categories to which Economies apply EAF-related legislation / regulation



3.1.1 Promulgated official commitment to EAF and sustainability

Promulgated official commitments to EAF are manifested by Economies in a number of ways, such as through regional agreements, legislations, policies, strategies, frameworks and / or guidelines. These approaches may or may not be comprehensive and holistic (e.g. species or fishery or ecosystem-specific). Nevertheless, the varying levels of EAF incorporation demonstrate the evolution and development of mechanisms being introduced to demonstrate official commitment to EAF and sustainability. Examples of official commitment are provided in the following.

Although species-specific, one developed Economy has established a policy for conservation of wild Atlantic salmon that adopts a precautionary approach to conserving Atlantic salmon, their habitat, and dependent ecosystems. The policy aims to maintain and improve Atlantic salmon diversity through the protection of Salmon Management Area (SMA) populations but also recognizes there will be exceptional circumstances where it is neither feasible nor reasonable to fully address all risks[85]. This Economy has also developed an Oceans Strategy along with an Oceans Act signifying high level of commitment to managing marine ecosystems and habitat from an EBM perspective.

[85] http://www.dfo-mpo.gc.ca/fm-gp/policies-politiques/wasp-pss/wasp-psas-2009-eng.htm

In the eastern Pacific, two Economies along with two neighbouring countries signed what is known as the *Galapagos Agreement* in August of 2000 establishing the general framework for the creation of a Regional Fisheries Body (*Comision Permanente del Pacífico Sur*[86]) that is responsible for regulating the use of straddling and highly-migratory stocks exploited by the four countries and other States in the Southeast Pacific. The *Galapagos Agreement* mirrors many of the principles established in the *UN Fish Stocks Agreement*, including the application of a precautionary approach and inclusion of ecosystem considerations, in addition to listing types of measures for regulating, controlling and surveillance of fisheries in the area.

Another developed Economy has developed a 'Strategy for Managing the Environmental Effects of Fishing'[87] that reflects yet another positive example of an evolution towards the implementation of EAF. Also, this Economy addresses regional aspects of fisheries through Fishery Management Areas mechanism that are managed regionally, taking into account differences in fish numbers and types of fishing.[88] Within this Economy, fisheries management approaches to indigenous rights claims are also addressed through the recognition of customary fishing rights and the establishment of indigenous fisheries areas, where profits from species brought into the fisheries are shared with local communities. Customary fishing regulations also formally recognise the special relationship between fisheries, local communities and places of spiritual and cultural importance. For instance, this Economy has fisheries legislation that supports traditional closures through regulated temporary (temporal) closures, as well as fishing method restrictions or prohibitions.[89] This Economy has also taken steps to minimise fishery industry footprint on marine ecosystems, including managing target fish stocks sustainably, closing areas to protect seabed communities, requiring seabird mitigation devices and techniques to be used in some fisheries, and imposing by-catch limits in others.[90]

Another example of official promulgation of EAF is undertaken by one developed Economy through the implementation of a "Sustainable Fisheries Framework", that provides a robust foundation for implementing an ecosystem approach in the management of its fisheries. The Framework includes using new policies and tools to implement the precautionary approach to

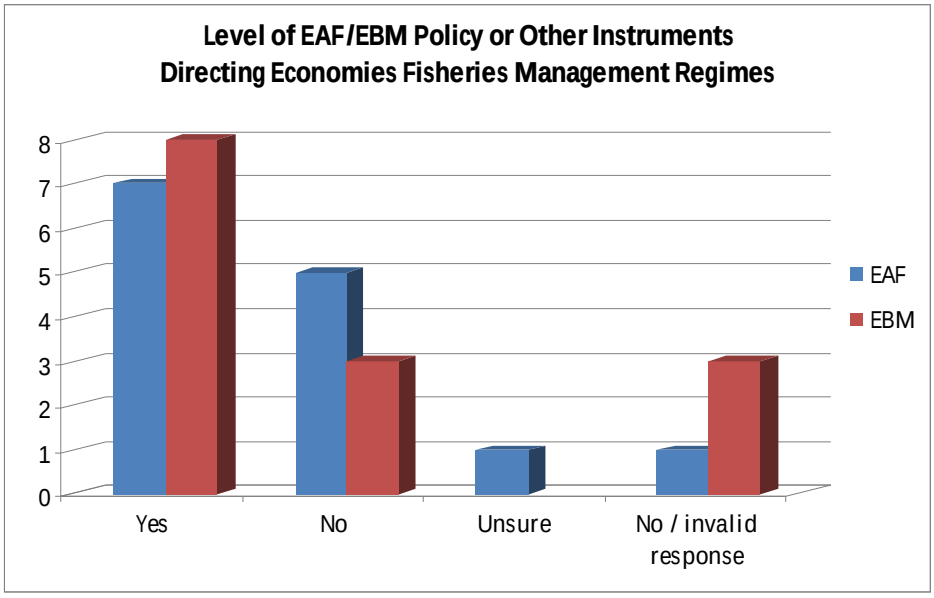
[86] http://www.cpps-int.org/
[87] New Zealand Ministry of Fisheries, 2005. Strategy for Managing the Environmental Effects of Fishing. New Zealand Ministry of Fisheries, Wellington, New Zealand 26 pp.
[88] New Zealand Ministry of Fisheries, 2008. The State of Our Fisheries 2008. New Zealand Ministry of Fisheries, Wellington, New Zealand 52 pp.
[89] New Zealand Ministry of Fisheries, 2005. Strategy for Managing the Environmental Effects of Fishing. New Zealand Ministry of Fisheries, Wellington, New Zealand 26 pp.
[90] New Zealand Ministry of Fisheries, 2005. Strategy for Managing the Environmental Effects of Fishing. New Zealand Ministry of Fisheries, Wellington, New Zealand 26 pp.

fisheries management decision-making, and to manage the impacts of these fisheries on sensitive benthic areas and forage species. Over time, new national policies on other aspects of ecosystem management, such as the management of by-catch species, will be incorporated into this Framework[91].

Consistent with previous Economy survey response in **Figure 27**, seven and eight Economies reported the existence of EAF and EBM policy respectively to direct fisheries management regimes. Five Economies noted no such EAF policy while three noted a lack of EBM policy directing fisheries management.

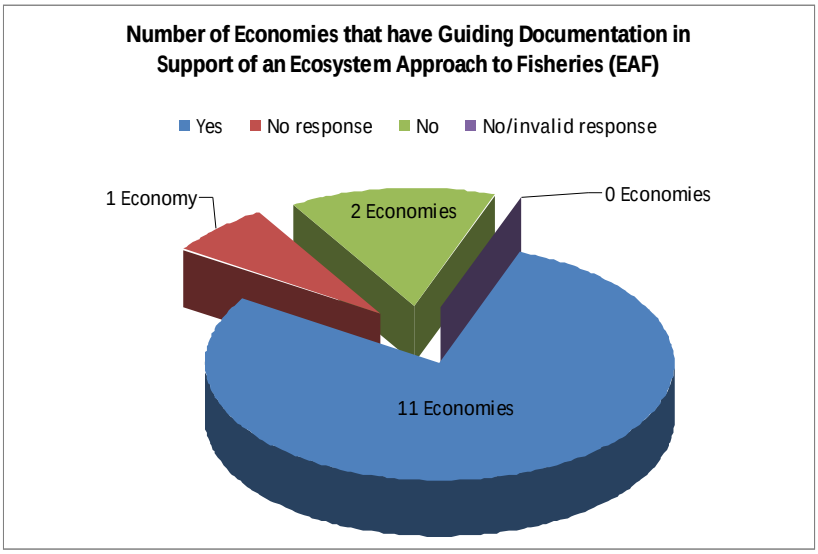
While approximately half of responding Economies noted not having EAF/EBM policy frameworks to direct fisheries management, many more (a total of 11 from 14 Economies) reported the existence of 'guiding documentation' in support of an EAF for their Economies (**Figure 28**). The results of this question in contrast with the previous one on policy indicate that Economies may and are likely to implement EAF and EBM even if the policy framework is not yet established. Additionally, the term 'guiding documentation' may be defined broadly by Economies.

Figure 27: Level of EAF / EBM policy or other instruments directing economies in fisheries management regimes



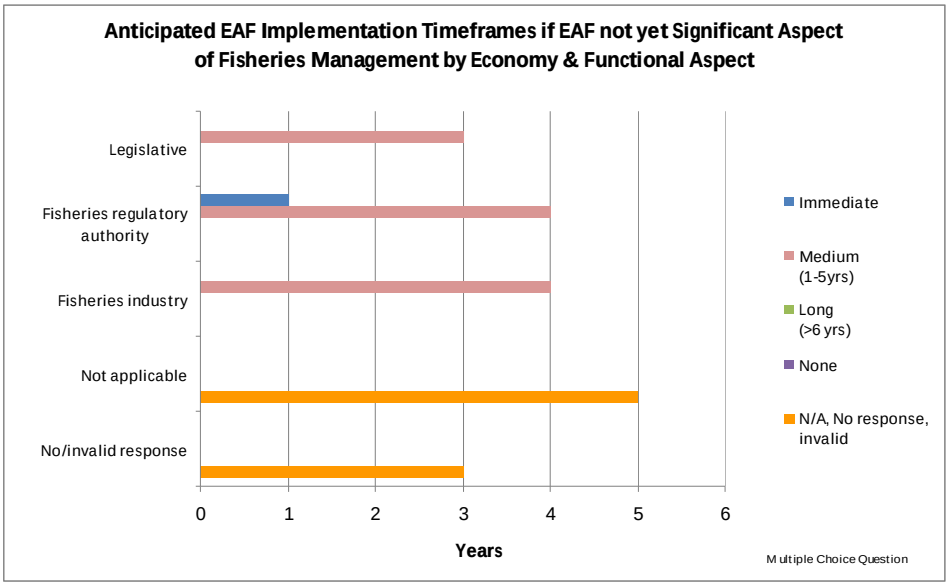
[91] DEWHA, 2009. Australia Department of Environment, Water, Health and Arts Website. http://www.environment.gov.au/coasts/fisheries/index.html. Accessed 28 Dec 2009.

Figure 28: Number of Economies that have guiding documentation in support of an Ecosystem Approach to Fisheries



Furthermore, although roughly half of responding Economies acknowledged not yet having comprehensive EAF policy guidance or frameworks, several Economies did indicate their intention to begin the process in institutionalising EAF within fisheries management (**Figure 29**). Hence, four Economies responded that EAF Implementation was planned within the regulatory authority and within the fisheries industry in the medium term (within 5 years), and three Economies noted plans for EAF-related legislation in the medium term, while only one Economy reported plans for EAF implementation within the regulatory authority immediately. Five Economies responded that the question was not applicable. The assumption here may be that these Economies already consider EAF implementation is well in hand.

Figure 29: Anticipated EAF implementation timeframe



Element Summary

Evidence of official commitment to EAF and fisheries sustainability has been demonstrated by some Economies through examples such as: development of Ocean Policy with an EAF component; transboundary regional fisheries agreement; national-level strategies and frameworks requiring either the assessment of environmental effects and protection of sensitive marine environments, species and habitat; and the adoption of the precautionary approach or co-management (including recognition of indigenous fisheries rights in some cases). Economy survey results suggested on average that around 50% of Economies have in place policy in support of an EBM or EAF framework, while those Economies (about 30% of respondents) that do not yet have such policy frameworks plans on doing so (through legislation and/or institutional development) in the near or medium-term. Finally, the primary observation is that developed Economies have in general travelled further down the path towards institutionalising official commitment to EAF and fisheries sustainability within policy, legislation and institutions.

3.1.2 Relevant international fisheries instruments and practices accepted and implemented

The broad principles and approach for effective and responsible fisheries management are contained in the *FAO Code of Conduct for Responsible Fisheries* (CCRF), many of which relate to an

ecosystem approach to fisheries (EAF). FAO's definition of EAF is, "An Ecosystem Approach to Fisheries [that] strives to balance diverse societal objectives, by taking account of the knowledge and uncertainties about biotic, abiotic and human components of ecosystems and their interactions...applying an integrated approach to fisheries within ecologically meaningful boundaries"[92]. Further, FAO has summarized the development and implementation of the EAF process in a short series of steps as follows:

1) Initiation / Preparation to gather initial information and plan a participatory process consistent with the context (cultural, resources available, type of fisheries, etc.).
2) Definition of the scope of the EAF process. This step defines the scope of the social, economic and ecological system and develops a shared understanding of the status and trends and of potential issues.
3) Identification of issues and, amongst them, those that need to be managed. This step defines the scope and priority of issues to be managed within the context of the EAF plan and provides avenues to pursue those that cannot be managed within the scope of the EAF process.
4) Development of operational objectives. This step defines and prioritizes the ecological, social, economic and institutional objectives to be pursued in the EAF process.
5) Identification of indicators and the choice of performance limits. This step defines the ecological, social, economic and institutional indicators that will be used to gauge the success of the EAF process.
6) Implementation of the EAF - the development and evaluation of the management options. This step identifies portfolios of management measures and evaluates their usefulness to achieve the ecological, social, economic and institutional objectives pursued by the EAF process.
7) Formalizing the management system. This final step defines in detail what needs to be done by whom how and where in order to implement the EAF process.

Individual APEC Economies are variously at different stages in this process. Some Economies are progressing well, while others have only recently begun. This is particularly noteworthy as we enter 2010, the target year for adopting ecosystem approaches set by the World Summit on Sustainable Development. It is also noteworthy that the limited (in some cases) progression along this path is not necessarily directly linked to Economies' UN Development Index. A past EAF implementation review found that funding and development status were not the drivers behind adoption of ecosystem approaches to fisheries.[93] In an overall assessment of how countries scored for implementing an ecosystem approach to fisheries, this past review reported that only two countries were considered 'good' while another four were 'adequate', and only three of the six top scorers were APEC Economies.[94] Significant in the study was that most countries scored better on Principles than on Indicators. This suggests many countries were committed to adopting EAF as a process, but had not yet actually done so, or were in the process of doing so. This

[92] FAO, 2003a. Fisheries Management - 2. The Ecosystem Approach to Fisheries. FAO Technical Guidelines for Responsible Fisheries. Publication # 4 Supplement 2. Food and Agriculture Organization of the United Nations, Rome. 121 pp.
[93] Pitcher, T.J., D. Kalikoski, K. Short, D. Varkey and G Pramoda, 2008b. An evaluation of progress in implementing ecosystem-based management of fisheries in 33 countries. Marine Policy 33: 223-232.
[94] *Ibid*.

outcome also reflects of the relative young age of the EAF framework where much of the drive behind the adoption of EAF comes directly from the 2005 APEC Bali Plan of Action. In an evolutionary sense for fisheries, the interim period 2005 to 2010 is simply too short to see full implementation of all possible approaches that could be considered reflective of EAF. These outcomes on the status of EAF implementation (at the strategic and operational levels) appear to be further supported by the Economy survey responses when considered in their entirety.

A number of international agreements exist which promote wider environmental-based approaches to oceans management. Key amongst these is the *UN Convention on the Law of the Sea* and the *FAO Code of Conduct for Responsible Fishing* (CCRF).

All but five Economies are signatories to the *UN Convention on the Law of the Sea*, and when requested to nominate which international instruments instrumental in encouraging Economies to incorporate EAF into their fisheries management regime, ten Economies noted this convention as being particularly influential (**Figure 30**). Notably, the Code of Conduct for Responsible Fisheries was unanimously adopted in 1995 by all 170 member Governments of the FAO Conference. This outcome was consistent with survey responses by the Economies, where ten of the 14 Economies acknowledged the CCRF as one of the international instruments influential in encouraging EAF implementation.

Spearheaded by the FAO, many of these international agreements address fishery issues that cannot be dealt with by countries acting independently (e.g. straddling and highly migratory fish stocks). The F*AO Compliance Agreement*[95] is one of these, developed to improve the regulation of fishing vessels on the high seas by strengthening 'flag-state responsibility'. Parties to the Agreement must ensure that they maintain an authorisation and recording system for high seas fishing vessels and that these vessels do not undermine international conservation and management measures. The agreement also makes provisions for international cooperation and exchange of information in implementing the Agreement, particularly through the FAO. However, only a handful of APEC members are signatories to the Compliance Agreement.

[95] The Agreement to Promote Compliance with International Conservation and Management Measures by Fishing Vessels on the High Seas. http://www.fao.org/legal/treaties/012T-e.htm

A number of Economies are parties to the *UN Fish Stocks Agreement* (UNFSA),[96] which was developed to ensure the long-term conservation and sustainable use of straddling and highly migratory fish stocks. The Agreement elaborates upon provisions of the *UN Convention on the Law of the Sea* with the intent to improve international management of fishing on the high seas. The UNFSA strengthens the legal regime for conservation and management of highly migratory and straddling fish stocks implemented through global, regional and sub-regional fisheries management organisations (RFMOs). While more widely embraced than the Compliance Agreement, less than half of APEC Economies are signatories to the UNFA. Consistent with this outcome was the fact that only 57% (eight Economies) acknowledged that this instrument was influential in encouraging their respective Economies to implement the EAF (**Figure 30**).

There are also a number of existing international plans of action (IPOAs) in which a number of Economies participate, and which address the wider impacts of fishery activities. These include the IPOA to prevent, deter and eliminate illegal, unreported and unregulated (IUU) fishing (nine Economies noted this instrument as influential in encouraging EAF implementation [**Figure 30**]), the *IPOA for Reducing Incidental Catch of Seabirds in Long-line Fisheries*, the *IPOA for the Conservation and Management of Sharks* (eight Economies observed this instrument as influential in encouraging EAF implementation [**Figure 30**]), and the *IPOA for the Management of Fishing Capacity*. Sharks and IUU fishing are more widely recognized by APEC Economies as relevant, with only a few becoming parties to the Seabirds IPOA (possibly because seabird by-catch is not relevant to all Economies) and even fewer to the Management of Fishing Capacity IPOA.

In addition to the International and National Plans of Action, APEC Economies also share/participate in a number of regional agreements which address multiple-scale management initiatives. There are a number of international agreements to prevent seabird mortality in long-line fisheries, for instance. The *Convention for the Conservation of Antarctic Marine Living Resources* (CCAMLR)[97] enacted strict regulations in 1992 requiring all long-line vessels in CCAMLAR waters to use a series of avoidance measures. Under the guidance of the Commission for the Conservation of Southern Bluefin Tuna (CCSBT),[98] three Economies have taken seabird mitigation measures in their southern bluefin tuna long-line fishery and made the use of bird scaring lines mandatory in their fisheries since 1992. In October 1996, the World Conservation

[96] The Agreement for the Implementation of the United Nations Convention on the Law of the Sea relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks
http://www.un.org/Depts/los/convention_agreements/texts/fish_stocks_agreement/CONF164_37.htm
[97] http://www.ccamlr.org/
[98] http://www.ccsbt.org/

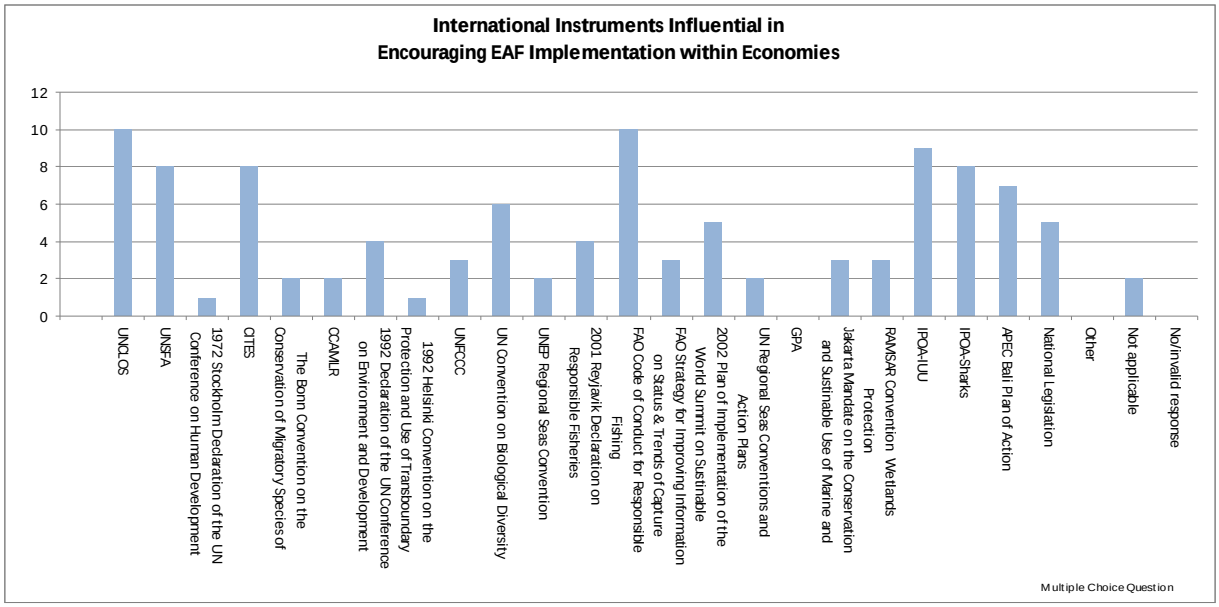
Union (IUCN) adopted a resolution urging nations to "adopt the goal of eliminating seabird by-catch within long-line fisheries" and "...implement seabird by-catch reduction measures immediately within long-line fisheries." In 1997, all of the world's albatross species were added as protected species under the Bonn Convention. Interestingly, only two Economies noted the Bonn Convention as being particularly influential in promoting EAF implementation in that Economy (**Figure 30)**. There are also marine turtle conservation agreements[99] to which a number of APEC Economies are party, along with a recently-developed range-state Dugong (*Dugong dugon*) agreement.[100] Dugongs, like most turtles, are classified as vulnerable to extinction under the 2009 World Conservation Union (IUCN) Red List of Threatened Species, which indicates that they face a high-risk of extinction in the wild in the medium-term future.

Aggregated results from the Economy survey suggests that although there are a number of relevant international instruments, whether treaties or soft instruments, only a handful (enquired about) were recognised as being particularly influential in setting the stage for EAF implementation by APEC Economies (**Figure 30**). Furthermore, and possibly of concern, was the outcome that no Economy (from the 14 that responded) acknowledged the 'Global Programme of Action for the Protection of the Marine Environment from Land-based Activities' (GPA) as being particularly influential in encouraging the implementation of EAF. This implies a disconnect, or lower level of importance placed upon the GPA. However, the GPA was acknowledged by five Economies as being particularly influential in encouraging the implementation of the broader concept of EBM.

[99] In the western Pacific most countries are signatories to the IOSEA Marine Turtle Memorandum of Understanding (http://www.ioseaturtles.org/) which aims to protect, conserve, replenish and recover marine turtles and their habitats of the Indian Ocean and South-East Asian region, working in partnership with other relevant actors and organizations. In the Eastern Pacific, a number of Economies are signatories to the Inter-American Convention for the Protection and Conservation of Sea Turtles www.seaturtle.org/iac/. Countries joining the agreement must prohibit the intentional capture or killing of sea turtles, protect sea turtle habitat and nesting areas, and reduce, to the greatest extent practicable, accidental harm to sea turtles in the course of fishing activities.

[100] The MoU is designed to facilitate national level and transboundary actions that will lead to the conservation of dugong populations and their habitats. The CMP provides the basis for focused species and habitat-specific activities, coordinated across the Dugong's migratory range http://www.cms.int/species/dugong/index.htm.

Figure 30: International instruments influential in encouraging EAF implementation within Economies



The influence and subsequent acceptance by Economies of international instruments to encourage EAF implementation carry spatial implications for EAF practice by Economies. **Figure 31** (the aggregated response from 14 Economies) demonstrates that the spatial implementation of EAF by Economies is most common within their respective maritime zones. Notably only four Economies observed the application of EAF to transboundary stocks.

Consistent with other findings on the state of EAF implementation in the context of international instrument influence upon an Economies fisheries management regime, **Figure 32** reinforces that on the whole EAF is still being incrementally established within the fisheries management frameworks of Economies, where EAF is often still at a conceptual level (yet to be operational). Of the 14 Economy responses, four Economies have included the EAF within the legislative framework, and five within their regulatory authority and fisheries industries. This implies perhaps some progress in recent years (since the development of the BPA); however, it also emphasises the need for further progress by APEC in EAF acceptance and subsequent implementation.

Figure 31: Spatial scale at which EAF is implemented by Economies

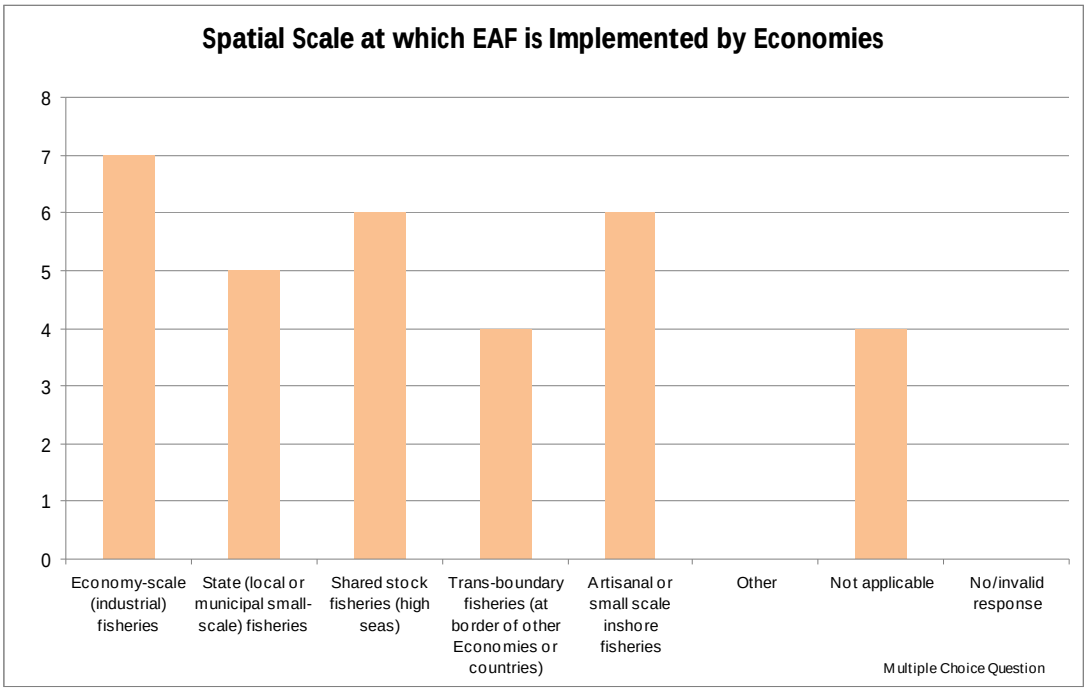
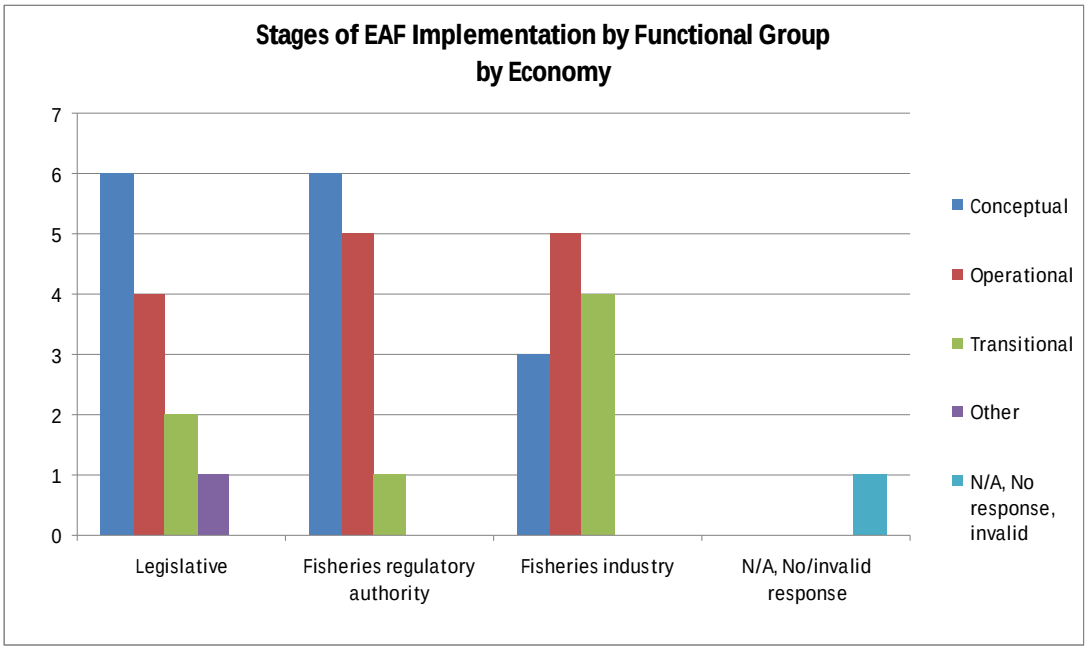


Figure 32: Stages of EAF implementation by functional aspects



Element Summary

Although there is widespread intent and agreement on the need for an ecosystem-based approach to fisheries and oceans management, comprehensive EAF institutionalisation and practice by APEC Economies is yet to be realised. Fifteen years after the adoption of the FAO CCRF, Economies remain on the doorstep of the deadline for inclusion of ecosystem principles in fishery management set forth in the World Summit on Sustainable Development. The results from secondary sources and Economy surveys imply that this deadline will not be achieved within the APEC region.

Commentators have also noted that for one particular segment of APEC, i.e., Southeast Asia, regional efforts to apply the ecosystem approach to fisheries have been found to be mostly ineffective due to insufficient environmental planning and management at national and local levels, coupled with policy, institutional and enforcement failures.[101] Other critiques have reported that within the same general group of Economies, there has been a lack of integrated management capacity at the local levels to plan and manage the use of natural marine resources, compounded by insufficient ability to link economic and social benefits to environmental management.[102] Therefore, although Economies recognised the importance and likely influence of international instrument that encourage EAF implementation, evidence at this juncture suggests a need for further acceptance and implementation of rights and obligations contained in these various international instruments as they pertain to an EAF.

3.1.3 Fishery survey assessments and mapping are done and up-to-date

In the Pacific, one developed Economy has developed a 'Pacific Pelagic Fishery Ecosystem Plan' to regulate harvests of pelagic species by vessels flagged to this Economy, and also 'Fishery Ecosystem Plans' for Pacific Islands linked to this Economy. These management approaches are adaptive and take into account ecosystem knowledge and uncertainties, external influences and societal needs.[103] In recognition of the fact that comprehensive ecosystem approaches to fisheries management need to evolve to account of the greater ecosystem and fishers within which it

[101] Pitcher, T.J., D. Kalikoski, K. Short, D. Varkey and G Pramoda, 2008b. An evaluation of progress in implementing ecosystem-based management of fisheries in 33 countries. Marine Policy 33: 223-232.
[102] Chua T.E., H. Yu and C. Guoqiang, 1997. From sectoral to integrated coastal management: a case in Xiamen, China. Ocean & Coastal Management 37(2): 233-251.
[103] WPRFMC, 2009. Fishery Ecosystem Plan for the Pacific Remote Island Areas Western Pacific Regional Fishery Management Council, Honolulu, Hawaii. 211 pp

interacts, this Economy's fishery management body (a Council) is restructuring its activities towards an ecosystem-based approach to fisheries management and is shifting its management framework from species-based Fishery Management Plans (FMPs) to place-based Fishery Ecosystem Plans (FEPs).

Another developed Economy has also developed a research agenda that focuses on research priority areas related to fishery management. These are strongly influenced by the 'New Ecosystem Science Framework in Support of Integrated Management'[104] and highlight basic and applied research needed for developing new knowledge and improving the use of existing knowledge in ecosystem-based management.

Some Economies have incorporated within their management approaches modelling of ecosystem interactions such as the likely effect of predation in a system. For example, one emerging Economy models the effect of squid predation on its Hake fishery to determine if collapses in stocks and the reduction of the TAC directly attributed to intra-specific predation. The model concluded that the squid were not the only factor in Hake biomass health, but highlighted that the study demonstrated the need to better understand ecosystem processes when managing fisheries.[105] Further highlighting ecosystem modelling and research was another study conducted within this Economy fishery resource (the squat lobster) to highlight how considerations of predation on target species are required to understand the interconnectivity of species in an ecosystem context.[106]

Another Economy conducted investigations into the effects of fishing on the marine environment, including plankton, to understand how marine ecosystems are structured and to minimise the impact of fishing on by-catch, taking into account a suite of variables, from ocean temperatures to trophic level impacts.[107] This Economy has also investigated the effects of dumping, burst bags and the discard of frames and heads on water quality within the west coast spawning ground, and

[104] Canada's Ecosystem Science Framework in Support of Integrated Management provides the rationale for an ecosystem science approach and describes the proposed framework for realigning the DFO Science program to support an ecosystem approach to management and better reflect an ecosystem science program.
http://www.dfo-mpo.gc.ca/science/publications/ecosystem/index-eng.htm#a1
[105] Arancibia, H. and S. Neira, 2005a. Predation on common hake (*Merluccius gayi*) by jumbo squid (*Dosidicus gigas*) in central Chile (33°– 39°S). *In* Proceedings of the ICES Conference, 20–24 September 2005, Aberdeen Scotland. pp. 293.
[106] Arancibia, H. and S. Neira, 2005b. Role of predation in the collapse and recovery of two Galatheid crustaceans in central Chile (33°–39°S). *In* Proceedings of the ICES Conference, 20–24 September 2005, Aberdeen Scotland. pp. 293.
[107] New Zealand Ministry of Fisheries, 2008. The State of Our Fisheries 2008. New Zealand Ministry of Fisheries, Wellington, New Zealand 52 pp.

conducted modelling studies to compare the effects of mincing fish waste rather than dumping the waste whole, which ascertained little would be gained by this practice.[108]

Another Economy development of a large marine eco-region (LME) demonstrates a move away from single-species management approaches to an ecosystem approach to fisheries that recognises the benefit from the use of science and research as it evolved from single-species to multi-species and finally ecosystem approaches. In the 1970s, the fishery management was basically single-tiered, but has adapted to changes in target stocks, fluctuations in catches, introduction of new protected species listings and a suite of conflicts amongst fisher groups[109]. Today, the fishery is benefiting from investigations into multi-species production, energy budgets, guild/functional group-based management, and total allowable catch, all of which constitute approaches to ecosystem based management[110].

The collated responses to the survey found that eight Economies acknowledged the use of fisheries modelling as a component of EAF, while four Economies reported not undertaking fisheries modelling as a component of EAF (**Figure 33**). The second outcome (four Economies responding in the negative), may not necessarily be interpreted to mean that no modelling takes place, modelling may be conducted but not in the context of EAF.

Although EAF in broad terms is not yet fully implemented, Economies have recognised that importance is developing a better understanding of ecosystem form, function and connectivity. For example, 12 of the 14 Economy responded that they do conduct research to enhance understanding of marine ecosystems, while one Economy indicated no such research objective, and one Economy did not respond (**Figure 34**).

[108] Rutherford JC., Roper DS., Nagels JW., 1988. A preliminary study of the dispersion of hoki wastes and potential oxygen depletion off the west coast South Island. Unpublished Report prepared for Fisheries Research Division, MAFFISH, Wellington, by the Ministry of Works Water Quality Centre, Hamilton. 36p.
[109] Link, J., M. Fogarty, J. Brodziak, W. Overholtz, T. Noji, S. Murawski, and F. Serchuk, 2005. A case history of ecosystem considerations for science supporting fishery management in the Northeast US. *In* Proceedings of the ICES Conference, 20–24 September 2005, Aberdeen Scotland. pp. 288.
[110] *Ibid*.

Figure 33: Number of Economies conducting fisheries modelling as a component of EAF

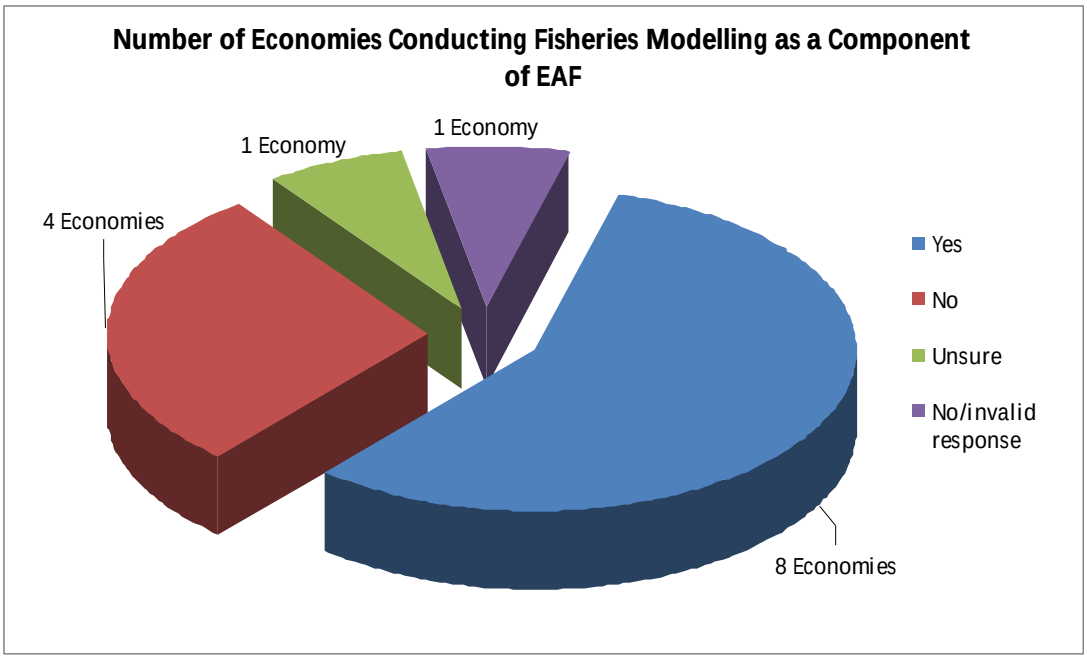
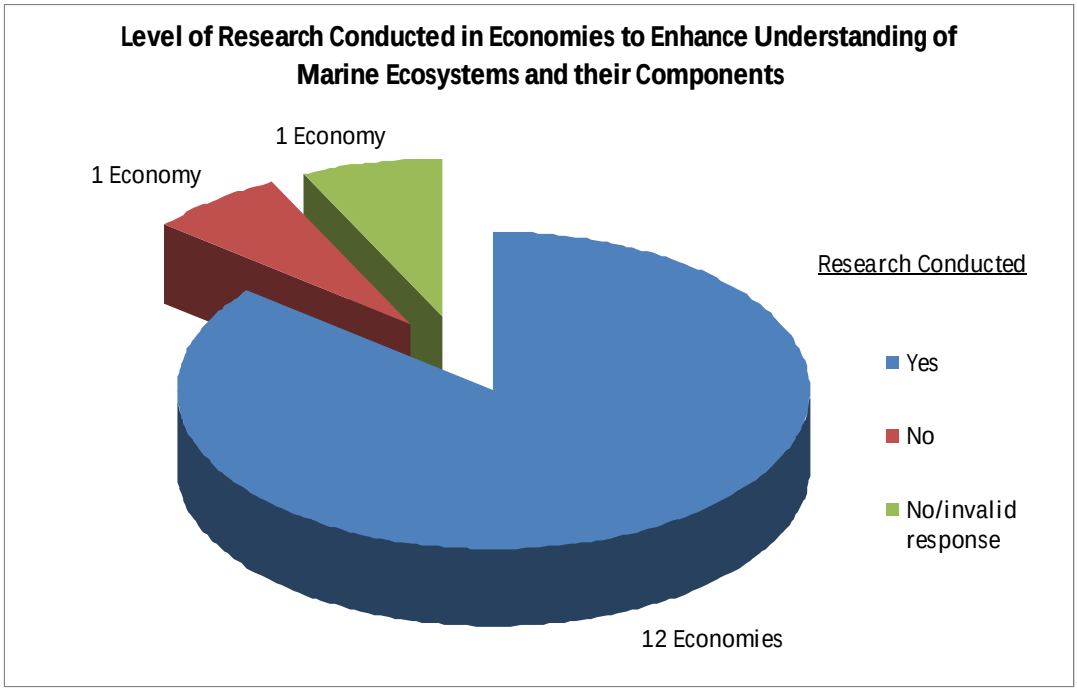


Figure 34: Level of research conducted in Economies to enhance understanding of marine ecosystems and their components



Consistent with the Economy responses shown in **Figure 35** of Economies conducting fisheries modelling as component of EAF, nine Economies have reported to conduct research on adverse effects to marine ecosystem from fisheries; and information systems; while eight Economies stated that they conduct research on: marine ecosystem structures / functions in the context of fisheries monitoring / management. Consequently, six of these same Economies reported conducting mapping of Eco-regions and habitat. This outcome implies that almost half (43%) of Economies have reached the level of marine ecosystem research adequate enough to undertake mapping exercises of marine habitat and ecosystems.

Specific fisheries biology studies are incorporated into fisheries management decision-making processes by 12 of the 14 responding Economies (**Figure 36**). However, this result does not imply that the same economies are managing their fisheries from an EAF approach yet, as support by previous data above. In response to the frequency of fisheries biology studies, the range of Economy observations highlight that this is a matter relevant to the nature of the fishery, specific management frameworks, and resources available. For example, the temporal range of fishery biology studies conducted within Economies ranges from monthly through to yearly or every four to five years (as shown at **Figure 37**). Some Economies reported that the frequency of studies is dependent on the nature of specific fisheries. Of interest was that two Economies reported not updating their fisheries biology studies (**Figure 37**).

Figure 35: EAF-related activities conducted or in development by Economies

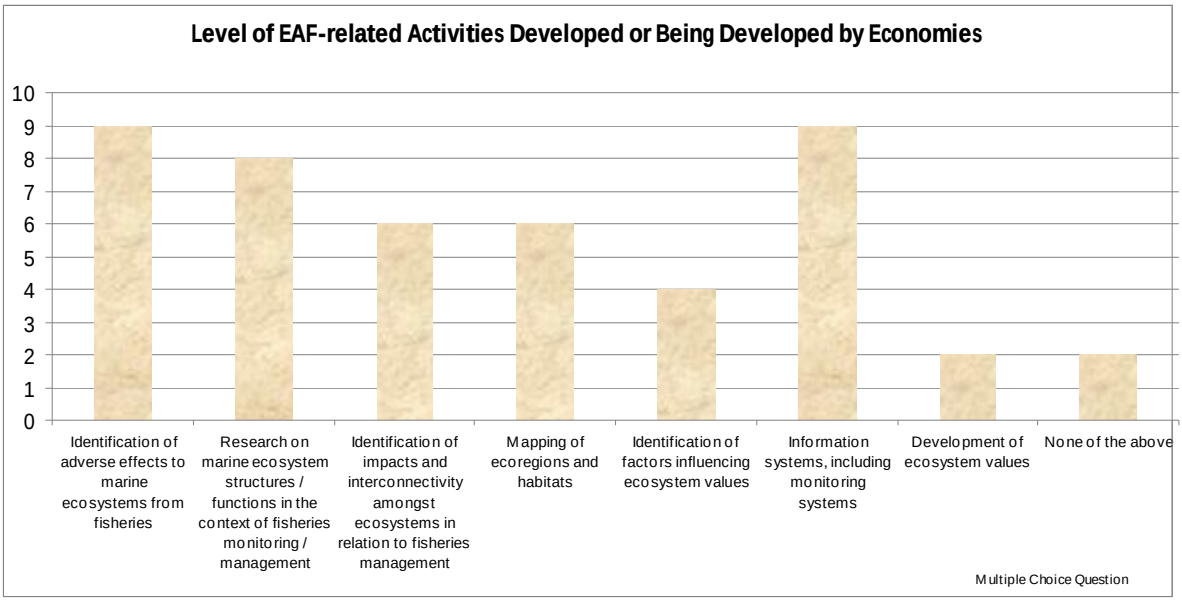


Figure 36: Economies that incorporate findings from fish biology studies into fisheries management decision-making processes

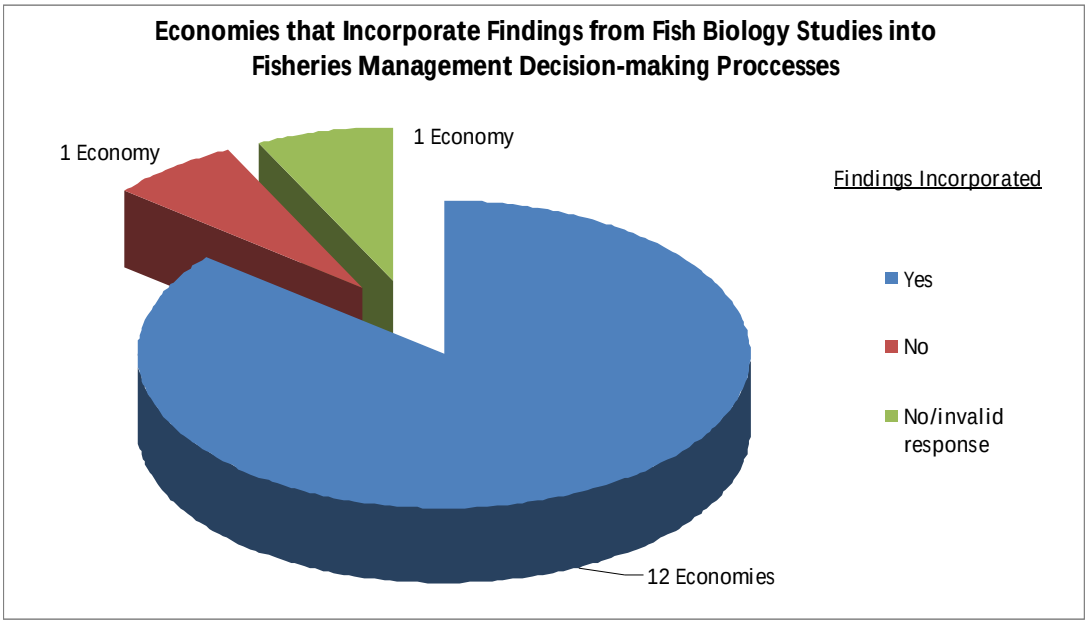
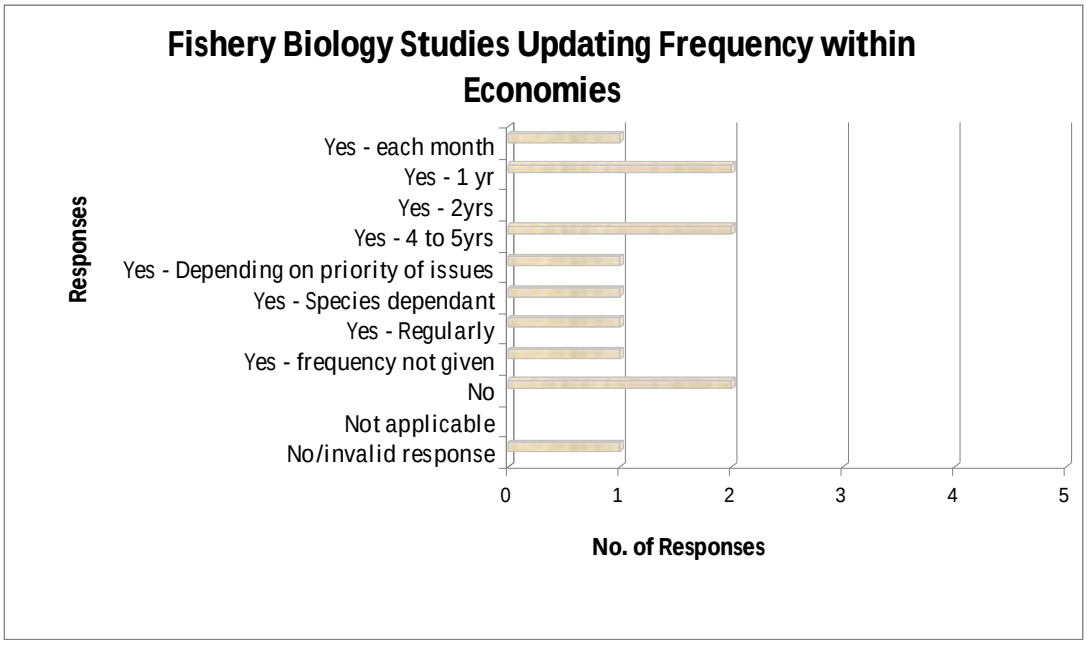


Figure 37: Fishery biology studies updating frequency within Economies



Element Summary

The survey results show that four Economies acknowledged conducting specific mapping of habitat and eco-regions, while the majority (12 of 14 Economies) incorporate findings from fish biology studies in fisheries management decision-making processes. Secondary sources allude to the point that there are a number of Economies that have identified LMEs, and that these LMEs require extensive research programs. The process (the identification of LMEs) requires extensive mapping and habitat surveys. As elements of EAF, these efforts support the fact that this element of EAF is being practiced by at least a select few Economies. The key challenge in achieving mapping of habitat and fishery assessment surveys, are that both these activities require extensive resources, time and specialised skill-sets, all of which pose significant challenge to all APEC Economies.

3.1.4 Fishery quota, objectives and indicators are guided by the goal of ecosystem health (including trans-boundary impacts)

A number of Economies are yet to clearly identify and articulate the objectives of their EAF implementation program, and the indicators with which they aim to measure performance.[111] Past review of EAF programs found that many had not reached the stage of identifying objectives and indicators, with only nine out of the 23 ongoing programs examined clearly articulating these objectives and indicators.[112] A number of National Plans of Action are being drawn up across the region, which make reference to specific actions, and these will need translating into measurable outputs that consider the wider scope of impacts to ecosystems through fishery activity. *"Objectives-based management is not a new concept in management circles. However, its application to marine systems provides challenges as… marine ecosystems are highly complex and many of the functions and processes are not fully understood[113]. This is further complicated by economic and social requirements of people who use the resources of the oceans. Developing objectives in an environment of inherent complexity is demanding and requires a high level of commitment on the part of resource managers. … [as of 2005] none of the initiatives implemented the objectives or the indicator reporting systems. Until such time as they (ongoing EAF EBM*

[111] Walmsley, J., 2005. Developing Objectives and Indicators for Marine Ecosystem-Based Management: International Review of Marine Ecosystem-Based Management Initiatives Throughout the World. Fisheries and Oceans Canada, Nova Scotia. 63pp
[112] Walmsley, J., 2005. Developing Objectives and Indicators for Marine Ecosystem-Based Management: International Review of Marine Ecosystem-Based Management Initiatives Throughout the World. Fisheries and Oceans Canada, Nova Scotia. 63pp
[113] *Ibid*.

efforts) do, the value of the objectives-based management approach to marine systems will remain unknown."[114] Importantly, this earlier review found that marine ecosystem management approaches usually focus on fisheries alone.

One developed Economy approach to fisheries dates back to the implementation of their Quota Management System in 1986, and is regarded as a benchmark example for fisheries management. This Economy noted that "*There is still much to learn about our fisheries, particularly the environmental effects of fishing*"[115]. With some 130 species fished commercially in this Economy's waters at a market value of some $2.7 billion to $3.8 billion, effective management of the fisheries is crucial to continue to maintain a sustainable fishery industry. Significant among Economies approach has been to develop government-set standards for managing fisheries which limit biomass targets, harvest rates, and by-catch, and limit ways in which fisheries activities disturb the seabed, prescribing standards for consultation and research, so that fisheries management decisions are appropriate.

In another developed Economy, fisheries management within a World Natural Heritage Area has evolved into an ecosystem-based management practice in which the fisheries sector plays an essential role[116]. A marine management plan was developed to define management objectives, strategies to preserve major species, and methods for ecosystem monitoring. A network of coordinating organizations from a wide range of sectors was established to integrate policy measures. Worthy of consideration amongst developing APEC Economies, the experiences from this process could be used as a case study for ecosystem-based management efforts where large numbers of small-scale fishers took a wide range of species under this co-management regime.

In the context of international best practice under the FAO CCRF, only six of the 14 respondent Economies reported the existence of 'Ecosystem Targets and Indicators' within their official fisheries management instruments (**Figure 38**). Seven Economies acknowledged the absence of these essential elements. Corresponding to this, only six Economies reported that strategies had been developed to achieve identified target and indicator (**Figure 39**). Furthermore, five of these six Economies were the only Economies to observe the existence in their fisheries management systems of 'Conceptual or Operational Objectives'. No differentiation is made whether the

[114] *Ibid*.
[115] New Zealand Ministry of Fisheries, 2008. The State of Our Fisheries 2008. New Zealand Ministry of Fisheries, Wellington, New Zealand 52 pp.
[116] Makinoa, M., H. Matsudab and Y. Sakuraic, 2009. Expanding fisheries co-management to ecosystem-based management: A case in the Shiretoko World Natural Heritage area, Japan. Marine Policy 33(2), 207-214.

objectives are conceptual or operational. There is limited progress in setting EAF targets, indicators and in objectives development.

Figure 38: Number of Economies citing existence of ecosystem targets & indicators in official instruments for fisheries management

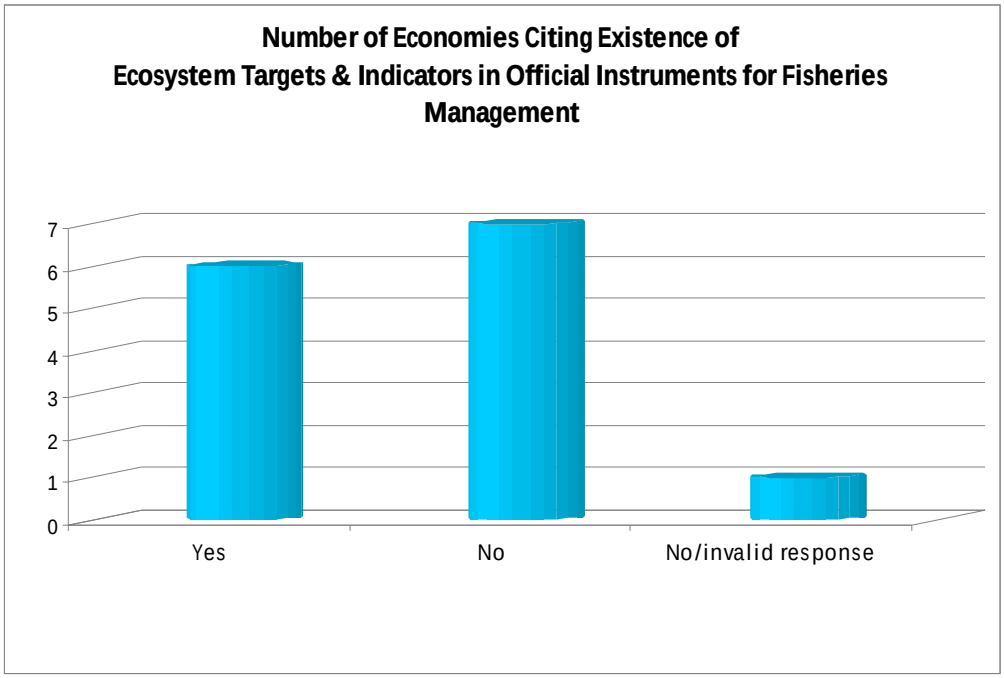


Figure 39: Number of economies citing development of strategies to achieve identified targets and indicators

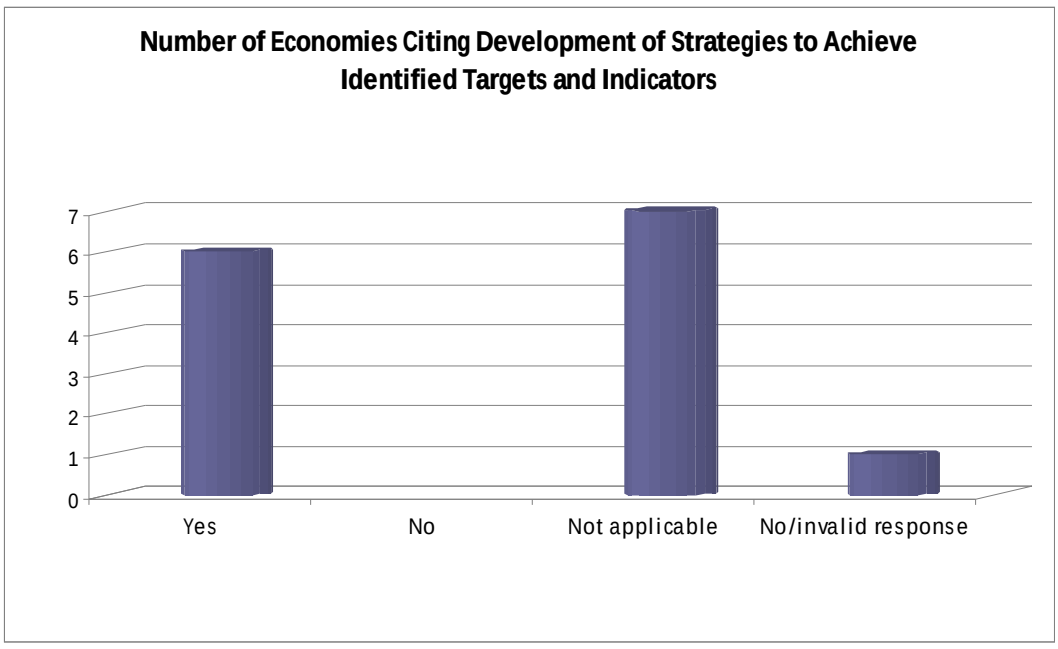
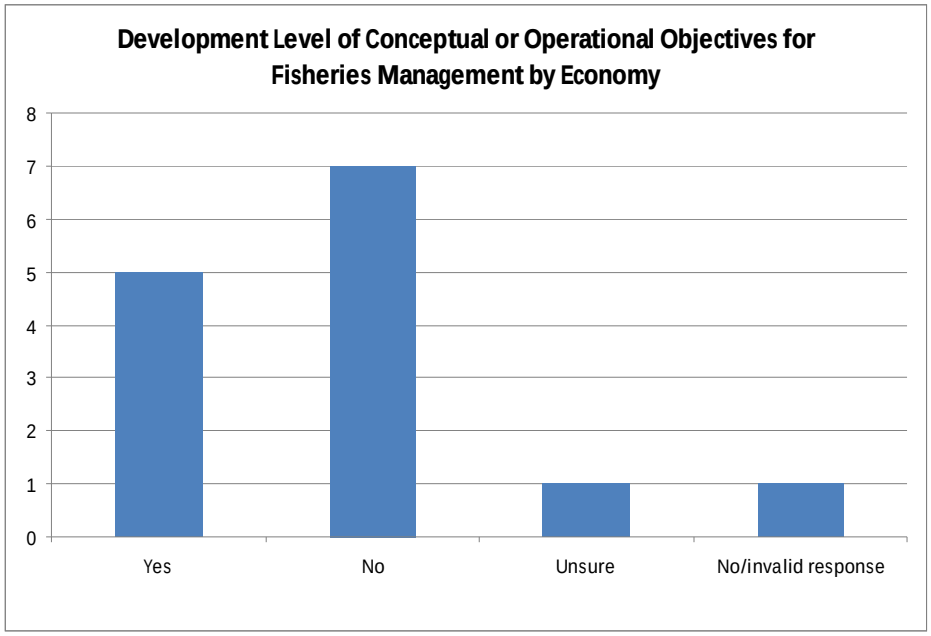


Figure 40: Development level of conceptual or operational objectives for fisheries management by Economy



If fisheries management is to be conducted within the EAF framework, the development of fishery quota, objectives and indicators should ideally be seated within or supported by identified and articulated long term goals for fisheries management at an ecosystem level. Qualitative Economy survey responses describing long-term goals for fisheries management at the ecosystem level varied widely. Notably, amongst the responses three of the 14 Economies either replied 'nil' or did not provide any description of long-term goals (non-response to the question). A verbatim reproduction of the remaining Economy responses (eight Economies) is shown at **Table 1**[117]. However, these responses do not provide any indication on the level of actual achievements at the operational levels. Nevertheless, long-term goals seated within EAF are essential to inculcate the EAF.

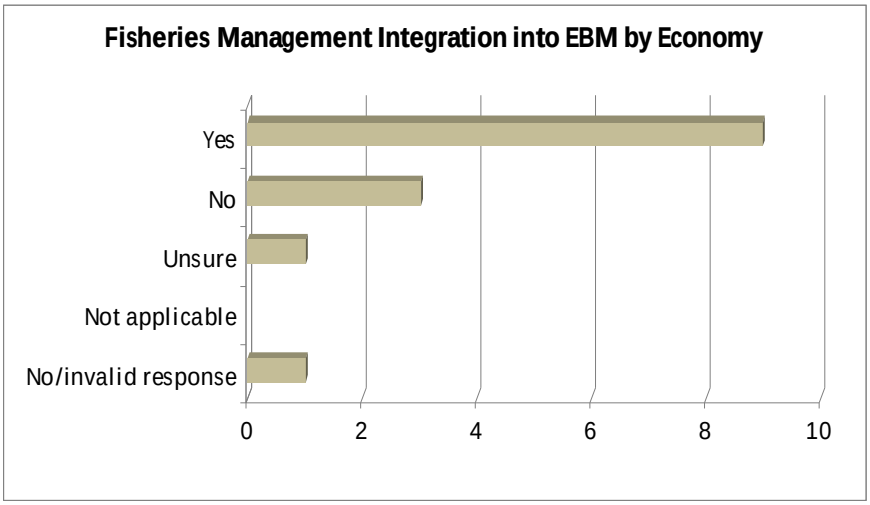
Interestingly, **Figure 41** reveals that nine Economies indicated some level of fisheries management elements are being planned to integrate EBM into its management regime.

[117] Economy specific identifying factors have been removed from the statements.

Table 1: **Qualitative Economy survey responses describing long-term goals for fisheries management at the ecosystem level**

Economy	*Question: Please describe any long-term goals for fishery management at an ecosystem-level and list any relevant action plans developed to reach such goals.*
1	The Master Plan of Marine Fisheries Management [ ] was established in 2009 with action plans to manage all activities pertaining to resource use, rehabilitation, maintenance and protection of the marine environment to ensure its high productivity under the current socio-economic reality, conflict resolution and the state of the marine resources and ecosystem.
2	The government is determined to assist fishermen [sic] to switch to sustainable practices and to protect, conserve and rehabilitate the marine ecosystems and fisheries resources.
3	[ ] national fisheries authority is a leader in sustainable fisheries management in the region. The authority is in the process of developing a national fisheries development and management policy to complement what measures it already has like the legislation and the management plans.
4	[ ] has already produced NPOA sharks, NPOA Fishing Capacity, Action Plan for the Conservation and sustainable use of fishery resources, Action Plan for the Biological Diversity of [ ]. NPOA Shark: objective 2: Assess threats to sharks and ray populations, determine and protect critical habitats and implement harvesting strategies consistent with the principles of biological sustainability and rational long-term economic use. NPO[A] Fishing Capacity: 1. Control the number of fishing effort at MSY levels. 2. Eliminate illegal fishing vessels. 3. Improve existing fishing methods to become environmental friendly. Action Plan for Biological Diversity of [ ]: 1. Reduce loss of biological diversity. 2. Control and manage invasive species.
5	Sustainable resources through ecosystem approach to fisheries and protection of the marine environment as indicated in the Fisheries [ ] and action plan[;] includes preliminary biodiversity and MPA studies that has been initiated towards a more comprehensive assessment.
6	Poverty alleviation and coastal habitat protection.
7	[ ] Constitution, General fisheries law, and Fisheries Management Plans explicitly consider the sustainable use of fishing resources. However, there is no management plan for artisanal fisheries.
8	Cabinet approved program entitled "reinforcing [ ] Deep Sea Fisheries management and Industry Adjustment" is in place. This program covers the period of [ ] years from 2006 to [ ]. There are two categories of work to be fulfilled for this program, which are adjustment of fishing capacity and reinforcing fisheries management. (1) for adjustment of fishing capacity, the major work item will be: (A) reducing large-scale tuna [ ] fleet as necessary; (B) evaluating the fishing capacity of small-scale [ ] and reducing the fleet as necessary; and (C) evaluating the fishing capacity of trawlers and reducing the fleet as necessary. (2) For reinforcing fisheries management, the major work items will be: (A) reinforcing laws and regulations to deter IUU fishing activities (B) strengthening enforcement which includes strengthening management of small-scale vessels, compliance and scientific observer onboard, extending VMS installation and monitoring, deployment of patrol boats, port inspection at foreign bases, and enhancing scientific research. (C) Intensifying training personnel and recruitment of experts for international affairs; and (D) promoting bilateral and multi-lateral cooperation.
9	As part of its Plan for Sustainable Fisheries, the Government of [ ] will ensure the long-term sustainable management of marine and freshwater fisheries resources.
10	[ ] recently adopted Sustainable Fisheries Framework (SFF) has as a goal "…to ensure that its fisheries are environmentally sustainable, while supporting economic prosperity. This means maintaining a balance between healthy fish stocks and marine environments, while allowing for prosperous fisheries; a balance known as 'sustainable development."' Several components of the SFF relate to specific aspects of EAF, including: the Fishery Decision-Making Framework Incorporating the Precautionary Approach; the Policy on Managing Impacts of Fishing on Sensitive Benthic Areas; and the Policy on New Fisheries for Forage Species. The SFF and its component policies are being implemented progressively over time.

Figure 41: Fisheries management integration into EBM by Economy



Element Summary

Fishery quota, objectives and indicators guided by the goal of ecosystem health as an element of EAF implementation do not appear to be widely provided for within APEC fisheries management approaches based upon current secondary and survey results. Both secondary and survey results support the conclusion that this element is not strongly emphasised within fisheries management frameworks within APEC as a whole. However, this is not surprising given the relatively new approach for EAF as a tool in fisheries management.

3.1.5 Landings and rate-of-effort data are comprehensive and accurate

Accurate and comprehensive fisheries landings and rate-of-effort data are essential elements of EAF. Seventy six percent (16) of Economies reported that fisheries data collection methods conform to the FAO Strategy for Fisheries and Trends Reports[118]. However, "*very few [Economies] elaborated to explain how their methods ensure that fisheries data is based on best scientific evidence are objective and transparent, participatory, timely, and flexible*"[119]. Four Economies reported compiled fisheries data from logbooks (including e-logs), catch returns, quota monitoring, sampling, surveys, observers, and VMS. Within APEC, developing and emerging

[118] Implementation of the Bali Plan of Action: Regional Stock-take (Gap Analysis) of the Current Situation in the Asia-Pacific Region compared with Ministers' Objectives – A Foundation Assessment (APEC FWG 01/2007), Final Report, September 2008, Asia Pacific Economic Cooperation, pg 20.
[119] *Ibid.*

Economies rely mainly on fish-landing data, categorised by species, with estimates of rate of effort (ROE) based upon industry feedback and logbooks. Challenges in obtaining reliable information were observed by some Economies, particularly for coastal and small-scale fisheries sectors, which may in part be unregulated (sometimes referred to as part time fisheries).[120]

Only a small number (25%) of Economies noted having a broad range of sources and methods of data collection for fisheries landings and rate of effort. In each case, these were developed Economies. Notably, the research also indicated that Inter-governmental (including Regional Fisheries management organisations: RFMOs) and Non-governmental organisations provided assistance in fisheries data collection program development, including the advancing a tuna fishery and reef fisheries database. Lastly, four Economies reported fisheries sustainability certification for specific fisheries in their Economies.[121] Such certification is only possible where fisheries data is comprehensive, accurate, and complimented with other data types, such as by-catch, habitat and ecosystem data, along with a range of measures to enhance sustainability.

Element Summary

Comprehensive and accurate landings and rate of effort data achievement within APEC likely require further effort, capacity building and political will in order to meet this element requirement for EAF implementation. The research implies that developed Economies are more likely to meet this requirement than emerging or developing Economies at present.

3.1.6 Active and effective fisheries data-sharing and scientific collaboration

As discussed prior in **Section 3.1.2** of this report, six Economies reported applying EAF to shared-stock fisheries, while four of the 14 respondent Economies recognised application of EAF to trans-boundary fisheries by their Economies. A pre-requisite to apply EAF at these spatial scales, is the requirement for a fair level of fisheries data-sharing and scientific collaboration to occur. Without such an outcome (e.g. effective fisheries data-sharing and scientific collaboration) EAF would not be likely successful for these fisheries.

[120] *Ibid*.
[121] *Op Cite*. Pg 21.

There are a number of scientific and fisheries data-sharing networks and institutions that promote collaboration within defined geographic locations, of which many APEC Economies participate, including within RMFOs. However, popular press suggests that at least some of the processes and management outcomes from RFMOs may not yield sustainable marine ecosystems and fisheries management outcomes.

> "At the BPA Implementation Workshop held in association with this [past BPA implementation review] survey at Monado (Indonesia), in November 2007, participants noted a lack of awareness on capacity building opportunities afforded by FAO and other organisations, and the existence of trust funds and grants designed to support implementation of the Strategy [FAO Strategy for Fisheries and trends reports]. Participants also expressed concern regarding the data submission criteria of FAO, citing challenges associated with: maintaining and/or improving data quality; FAO-inconsistent data formats with national fisheries data collection programs; domestic institutional changes and reporting time lags that disrupt flow and negatively affect accuracy; lack of national laws (and sometimes political will) to implement the Strategy and other international instruments; and lack of consistency between RFMO statistical document formats and FAO submission criteria. Additionally, participants expressed concern over instances when reported data did not appear to be accurately reflected in subsequent FAO reporting.

Element Summary

For the purpose of this report the discussion above merely highlights some of the challenges facing Economies with regard to data-sharing and scientific collaboration, but should not be construed as an option not to pursue these key elements of EAF.

3.2 NON-TARGET SPECIES & HABITAT

Fishing activities can impose a great level of ecological disturbance to marine lives. Previously, the main issue of interest has been the direct effects of fishing on target species. However, the focus has since shifted towards the wider effects of fishing activities on marine lives and habitat. This includes physical effects of fishing gears on the seabed; distribution of, and trends in fishing effort; ecological effects on benthic fauna; long-term community changes; the effects of food subsidies in the marine environment; interactions between fisheries and marine mammals; technical measures to reduce impacts of fisheries; conservation issues and priorities; socio-economic implications of wider fisheries impacts.[122] The following sections concentrate on the commitments of APEC economies in handling issues with regard to effects of fishing on non-target species and habitat.

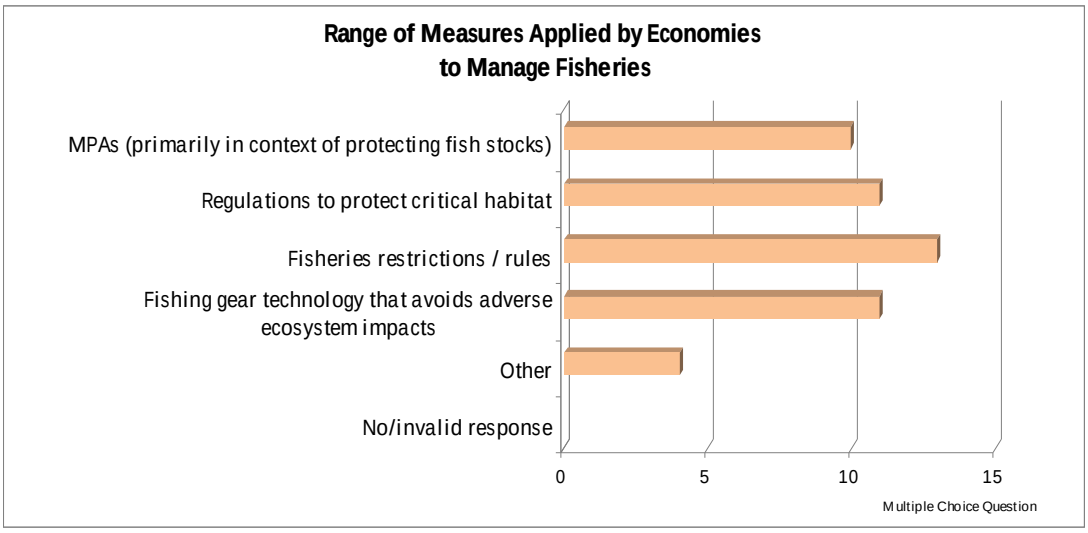
3.2.1 Fishery regulations and practice maximise gear selectivity

The survey response indicates that generally all the respondent Economies (except one emerging Economy, which did not respond) practice at least one fishery management measure (see **Figure 42**). A total of ten Economies responded that they implement all the fishery management measures stated in the questionnaire, i.e. MPAs, regulations to protect critical habitat, and fishing gear technology that avoids adverse ecosystem impacts. One emerging Economy added that it also imposes 'catch limit for bycatch'. Fisheries regulations for bycatch generally requires that bycatch from fishing operations do not exceed specified levels, and that bycatch be brought ashore. In some instances, the fishing industry may also exert self regulation by penalising fishing captains and skippers who do not follow the rules.[123] This Economy exerts mitigation efforts to reduce bycatch through two important plans of action: one for sharks and rays, as incidental fauna in the industrial long-line fishery mainly targeting sword fish; and another for marine birds, whose incidental deaths are recorded in the industrial long-line fishery targeting hake.[124]

[122] Kaiser, M.J., and DeGroot, S.J. 2000. Effects of Fishing on Non-Target Species and Habitats: Biological, Conservation and Socio-economic Issues. Wiley-Blackwell.
[123] Avoiding and eliminationg by bycatch; Fisheries Council of Canada, http://www.fisheriescouncil.ca/pdf/FCCAvoiding5.pdf
[124] Cristian M. Canales "Ecosystem approach in the research and management of the Chilean fisheries" unpublished report.

A developing Economy stated that apart from exerting fisheries restrictions and regulations to protect critical habitat, it also enforces 'prohibition on certain gears with low selectivity', while one developed Economy responded to be only implementing fisheries regulations. Another emerging Economy responded that it implements MPAs, fishing restrictions, and fishing gear technology. This Economy has also drafted National Plans of Action for sharks, dugong, and marine turtles, and many aspects of these are already being implemented.

Figure 42: Range of measures applied by Economies to manage fisheries



Another APEC Economy (not included in the survey response) undertake measures such as designation of seventeen *Benthic Protection Areas* covering some 1.2 million sq km within its Exclusive Economic Zone, with regulations prohibiting bottom trawling and dredging to protect the seabed from fishing impacts. [125]

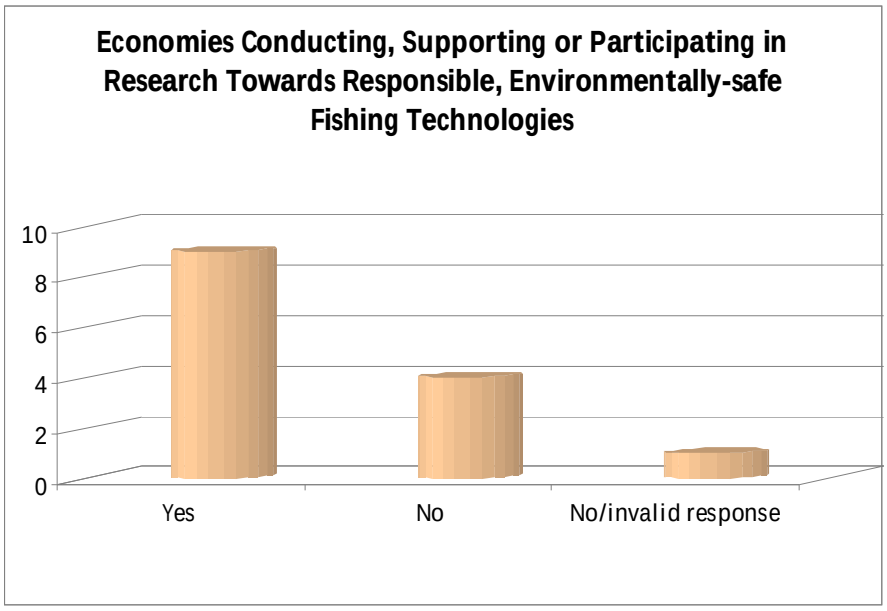
A total of nine Economies responded that they conduct, support or participate in any research towards responsible / environmentally-safe fishing technologies (see **Figure 43**). A developed Economy listed 'development of by-catch reduction systems such as a tori-line' as an example of research being conducted towards responsible fishing technologies, while another developed Economy responded that it conducted a research entitled "The studies on distant-water longline fishery used with circle hooks" and the results obtained from the two-year practical experiments of tuna long line boats on east Pacific indicated that *'…using circle hooks would not affect the*

[125] Ministry of Fisheries. 2008. *National Aquatic Biodiversity Information System*

catch rate and their hooked positions frequently found in the jaws of tunas. Meanwhile, it could increase the survival rate by using this type of hook.' These advantages are said to not only improve the freshness of catches, but also increase the chances of releasing bycatch species. Another developed Economy briefly stated that its fishery management agencies support research into improving sustainable management, for example through investigating (developing and trialling) measures to mitigate against the take of bycatch, including protected species. One developed Economy provided an example of a research that was being carried out to develop and commercialize innovative fishing systems capable of catching commercial quantities of finfish and shellfish, but with reduced seabed contact compared to traditional systems. Another example given was the Pacific Salmon Selective Fishing Program, which in 1998-2002 encouraged commercial and First Nations harvesters, and recreational anglers to develop selective fishing gear and methods, and participate in experiments and research projects.

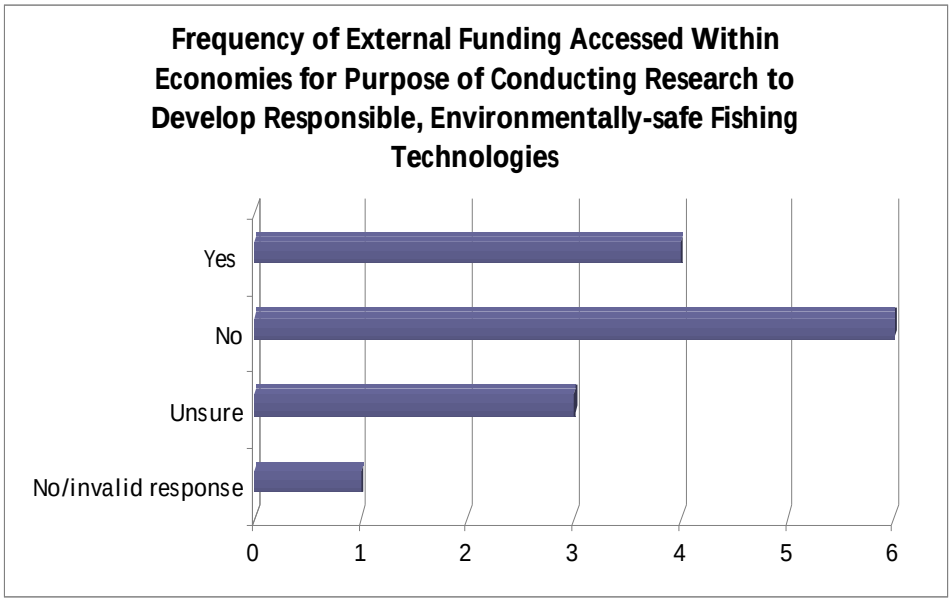
An emerging Economy responded that it is indirectly involved in research undertaken by SEAFDEC on Juvenile and Trash Excluder Devices (JTED) and Turtle Excluder Device (TED) in collaboration with its Department of Fisheries, while another similar Economy reported that it conducts study on fish biology to provide growth, mortality and recruitment parameters that are used for assessment of stocks. It also mentioned that the status of stocks form the basis for fisheries management policies within the Economy. Another emerging Economy stated that they have recently concluded a four-year research at its national university aimed at designing and testing a new bottom trawling net. This new net is said to be an 'environmentally-friendly fishing gear' and will be utilised in the demersal crustacean fishery. One developing Economy provided a brief response that it undertook some research in collaboration with some ASEAN countries with funding from ADB.

Figure 43: Economies conducting, supporting or participating in research towards responsible, environmentally-safe fishing technologies



With regard to research funds, most of the Economies have not accessed external (non-State) funds for the purpose of conducting research towards developing responsible/environmentally-safe fishing technologies (**Figure 44**). Only four out of 14 Economies, reported to have accessed external funds, where one developed Economy noted that it is currently undertaking a project for APEC FWG entitled "*Development of hydrographic forecasting model for preventing fisheries disaster induced by ENSO events*". One developing Economy listed funds from SEAFDEC, while another Economy added Bay of Bengal Initiative for Multi-Sectoral Technical and Economic Cooperation (BIMSTEC), Bay Of Bengal Large Marine Ecosystem (BOBLME) and Global Environment Facility (GEF) as the sources of external funds accessed.

Figure 44: Frequency of external funding accessed within Economies for purpose of conducting research to develop responsible, environmentally-safe fishing technologies



Element Summary

Generally, most of the Economies practise at least one of the fishery management measures such as MPAs, regulations to protect critical habitat, fisheries restrictions/rules, and fishing gear technology that avoids adverse ecosystem impacts. These Economies also conduct research towards responsible / environmentally-safe fishing technologies emphasizing on efforts to reduce by-catch.

3.2.2 The impacts of fishing on ecosystems are described and understood

There has been an increase in by-catch and habitat destruction worldwide due to unsustainable fishing activities and a single species approach to fisheries management is no longer considered effective.[126] This has caused management approaches to shift from its traditional focus on maximizing the yield of individual resources towards broader considerations of direct and indirect impacts of fishing on ecosystems as a whole[127]. A total of 11 out of 14 Economies have reported

[126] Tegner,M.J. and Dayton, P.K. 1999. Ecosystem effects of fishing. Trends in Ecology and Evolution, *Vol 14, Issue 7*.
[127] *Ibid*.

to consider the impacts of fisheries on non-target stocks and the environment in a broader marine ecosystem management approach (see **Figure 45**). One developed Economy stated that it has established national plans of action for conservation and management of sharks and seabirds. Another developed Economy has also undertaken similar approaches such as conservation of sharks, sea turtles, and sea birds in accordance with decisions made by regional fisheries management organizations. This includes '*requirements in regulations for releasing cetaceans, whale sharks, sea turtles, and sea birds which are incidentally caught'*. One developed Economy mentioned that it has an Act for Environment Protection and Biodiversity Conservation, which is measured against Guidelines for the Ecologically Sustainable Management of Fisheries. Based on these guidelines, a fishery is assessed as a whole, rather than a focus on individual species within a fishery, including on target, by-product, by-catch (including protected species) and broader ecosystem impacts. One such guideline states that "Fishing operations should be managed to minimise their impact on the structure, productivity, function and biological diversity of the ecosystem." Similarly, another developed Economy stated that it has a Sustainable Fisheries Framework (SFF) and Integrated Fisheries Management Plans (IFMPs), which consider impacts of fisheries.

Another developing Economy also shares similar steps where it has management schemes that include control on by-catch and discards, and taking into account environmental considerations for the major fisheries. One emerging Economy responded that the '*protection of turtles, dugongs and lobsters are included in the Order*' of its legislation, while another emerging Economy listed mesh-size regulation, introduction of JTED, zoning systems (for trawl fishery), no-take zones in MPAs, and ban on destructive fishing gears as some of the broader marine ecosystem management approaches being undertaken. A developing Economy elaborated that due to multi-species stock characteristic and multi-gear operation, it has been studying the interaction and impact from fishing gears on all species of catches.

In responding to a specific query on whether data collection programs exist for by-catch and fishery by products, a total of ten Economies acknowledged to having such data collection programs in place for commercial offshore fisheries, eight Economies for inshore/near-shore artisanal fisheries, and eight for high-seas fisheries (see **Figure 46**). However two developed Economies stated that they do not have data collection programs for any of the fisheries above, while one emerging Economy responded that it does not have data collection programs and fisheries management is mainly based on target catch. All the Economies that conduct data

collection programs have responded that they utilise the by-catch and by-product data for fisheries management (see **Figure 47**). However, one developed Economy responded that '*management measures are considered based on best scientific information available'*, which indicates that this Economy might also be using other sources of data for fisheries management, while another emerging Economy said that presently, '*the data is only partially applied to management (mainly in what refers to the setting of catch limits for the associated species).*' One emerging Economy reiterated that the amount of by-catch provides the basis for mesh size regulation and also establishing limits for the fishing capacity or fishing licenses issued among trawlers and purse seiners. A developing Economy briefly responded that the data is applied '*in the sense for improving fish stocks and economical use*', while another similar Economy acknowledged some limitations faced in data collection where it reported to have limited reference points of by-catch used in the management schemes of main fisheries.

A developed Economy responded that fisheries management agencies, through the fisheries assessment process, are encouraged to take into account all sources of mortality when setting total allowable catch limits, for fisheries that have catch limits.

Figure 45: Consideration of fisheries impacts upon non-target stock & environment in broader EBM approach by Economy

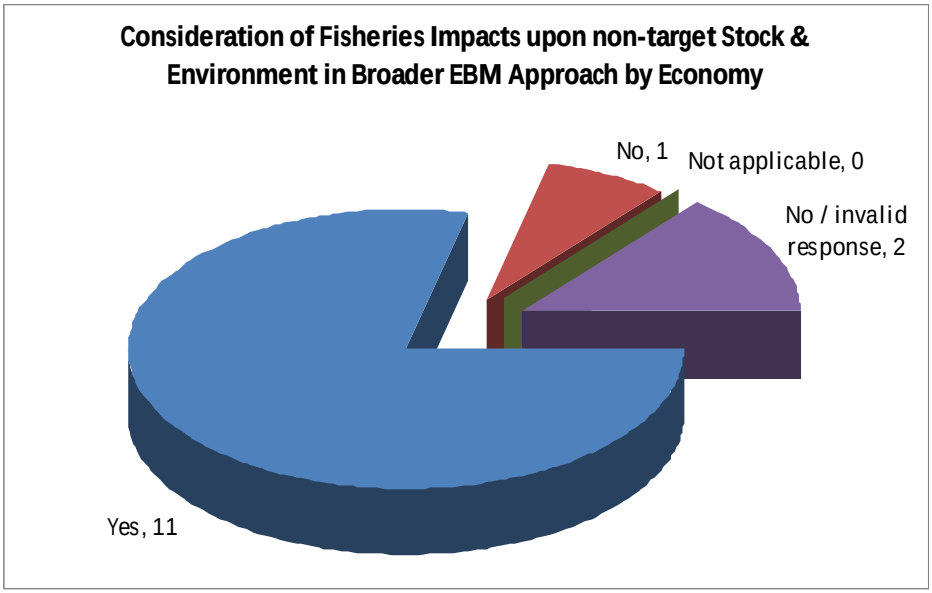


Figure 46: Number of Economies with fisheries by-catch & by-product data collection programs by fishery scale

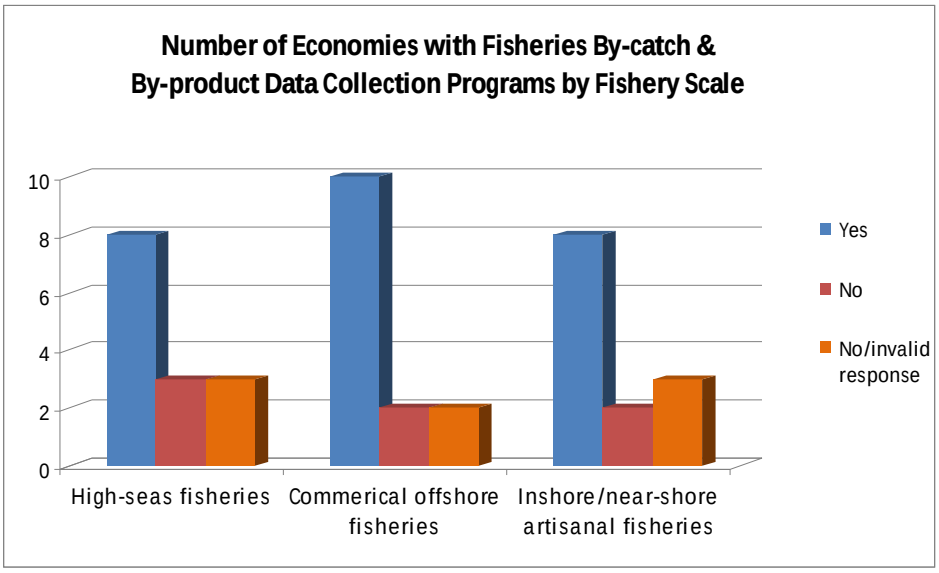
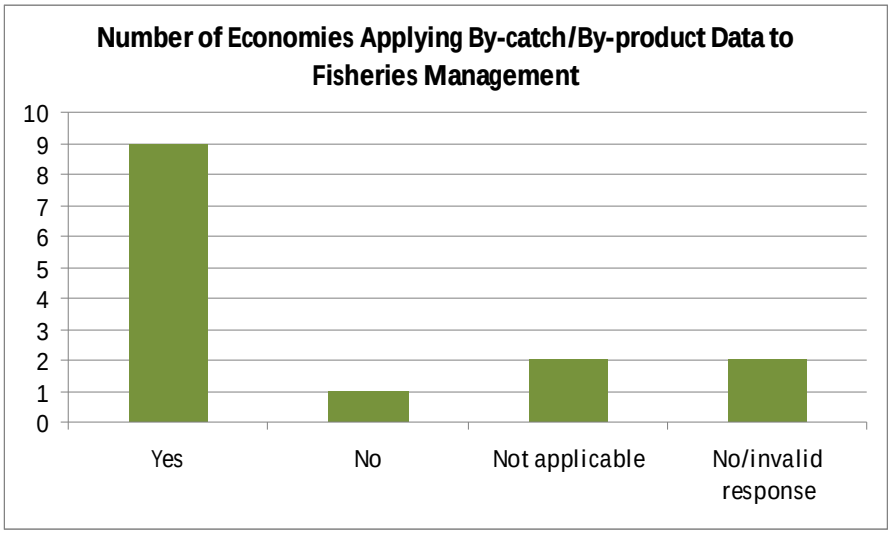


Figure 47: Number of Economies applying by-catch / by-product data to fisheries management

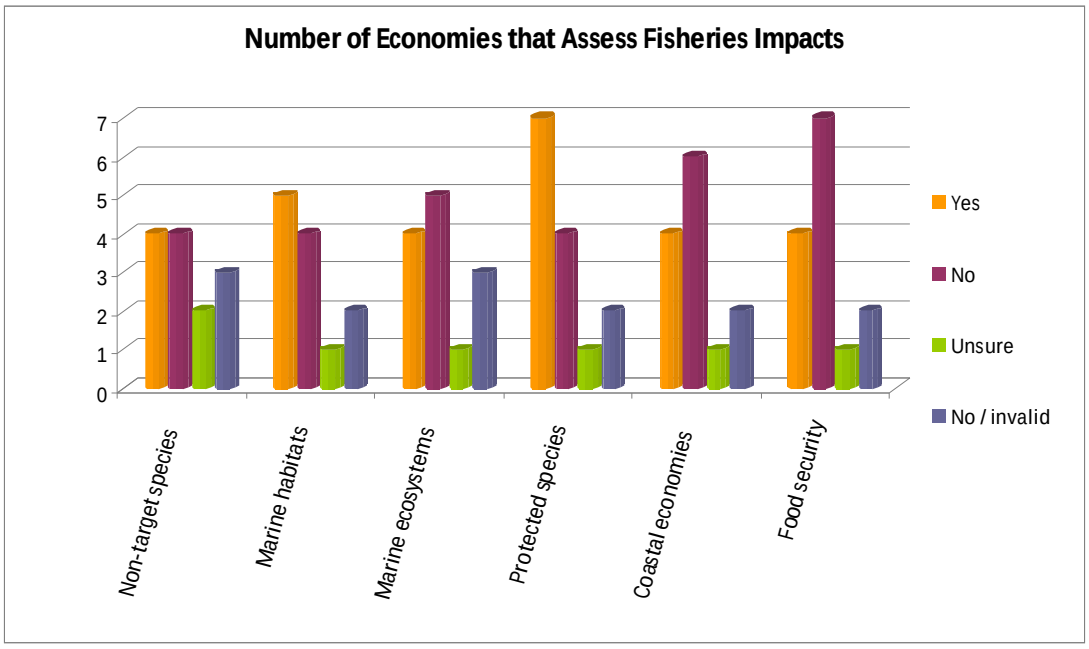


Most of the Economies responded that they require the assessment of impacts from fisheries upon marine habitats, protective species, coastal economies and food security (see **Figure 48**). A total of six Economies stated that they assess the environmental impacts from fisheries exploitation as a standard fisheries management practice and apply adaptive management when necessary (**see Figure 49**). Amongst the adaptive management measures practised by one emerging Economy to abate the negative impacts of fishing on the environment are: mesh size

regulation and establishment of fishing zones. One developing Economy responded that it conducts the assessment through its National Stock Assessment Program, while a developed Economy is said to conduct '*domestic and international assessments within RFMOs'*. It responded that adaptive management is then applied in accordance with the decisions made by domestic authority and RFMOs based on the findings of the assessment. Six Economies responded that they do not assess the environmental impacts from fisheries exploitation as a standard fisheries management practice, and one Economy among them stated that although it does not carry out environmental assessments, impact assessments of bottom fisheries were implemented in accordance with UN resolution 61/105.

One developed Economy stated that fisheries environmental impacts assessment is done through an Ecological Risk Management Framework, which is informed by, among other things, information which is collected on fisheries by-catch, fishery interactions with protected species, and other fishery environmental interactions. Another developed Economy responded that development of such assessments are in progress within the context of the Policy for Managing the Impacts of Fishing on Sensitive Benthic Areas and the New Emerging Fisheries Policy formulated within the Economy.

Figure 48: Number of Economies that assess fisheries impacts



Although many Economies are reportedly committed to apply precautionary ecosystem approaches to minimize fisheries impacts on the environment; putting these concepts into practice in effective ways have proven to be a struggle for many.[128] The usage of pre-determined decision rules, linked to target and limit reference points, is essential to implement these approaches within fisheries management in order to monitor and protect key fishery stocks.[129] However, reference points and decision rules are generally set at levels that rest on the short-term interest of fishers rather than precaution. In light of this, the ecological risk assessment (ERA) approach is believed to be able to assist in establishing a regime of reference points and decision rules based on precautionary defaults.[130] Nevertheless, only three out of 14 Economies have reported to conduct ERA on key fishery stocks (**see Figure 50**). This indicates that the ERA approach is not widely practised in most of the APEC economies. One developed Economy stated that it '*shares concern and participates'* in ERA works carried out by relevant RFMOs. In addition, it '*delegates experts to conduct researches to assess the ecology and major fishery resources such as trawl fishery, flying fish roe fishery, and larval anchovy fishery*'. Another developed Economy responded that its Commonwealth Fisheries Management Authority has conducted ERAs for all Commonwealth-managed fisheries, excluding two fisheries, to quantify the level of risk that each Commonwealth fishery poses to the ecological sustainability of the marine environment. Target, by-product and by-catch species have been assessed in each the ERA. One developing Economy responded that its National Fisheries Authority '*has conducted some assessment on sea cucumber*'.

[128] Nevill, J. 2006. The application of ecological risk assessment to precautionary reference points and decision rules in fisheries management.
[129] Ibid.
[130] Ibid.

Figure 49: Number of Economies applying adaptive management as a result of fisheries environmental impact assessments

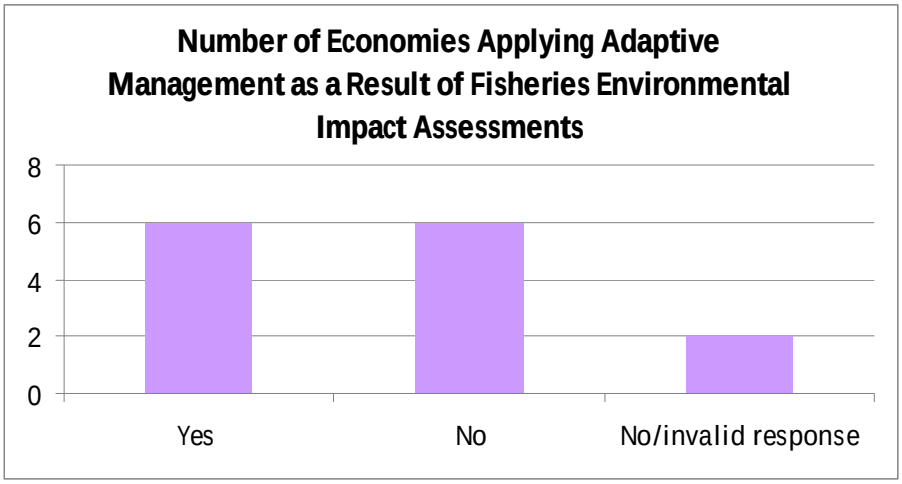
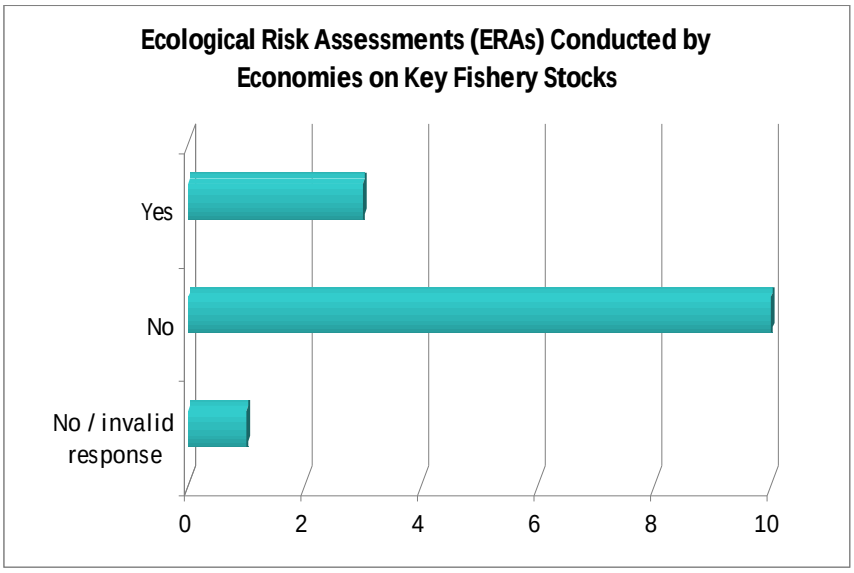


Figure 50: Ecological risk assessment (ERAs) conducted by Economies on key fishery stocks



Within one APEC Economy (not included in the survey), risk assessments are used to prioritise vulnerability of species and annual catch limits – i.e. to assess stocks in terms of the probability of overfishing and consequences of overfishing, through the Western Pacific Regional Fishery Management Council[131] for fisheries in the Western Pacific. These risk assessments are reviewed regularly and revised as needed, and address cultural and economic importance of the species to

[131] http://www.wpcouncil.org/about/

local / regional markets and non-market fish distribution channels. Another Economy (also not included in survey) developed risk-based approach to assess fisheries resources in its waters involving three management objectives: sustainability, biodiversity, and habitat quality. The assessment design allowed for situations where sufficient information was available to allow for a quantitative evaluation of the status of the system, but also for situations where available information necessitated a semi-quantitative or qualitative assessment. In this example, nested risk indices, such as objectives risk index (ORI), species risk index (SRI), fishery risk index (FRI), and ecosystem risk index (ERI), were developed to assess the ecosystem status at the management unit level. The process was found useful in comparing the status of species, fisheries and ecosystems spatially and temporally using an ecosystem perspective.

Most of the Economies seem to be committed in undertaking EAF-related activities in order to protect their marine environment (See **Figure 51**). Majority of the Economies who responded (nine in total) have reported to have information systems, including monitoring systems in place; and also identification measures to determine the adverse effects of fisheries to the marine ecosystem. Six Economies undertake identification of impacts and interconnectivity amongst ecosystem in relation to fisheries management. Other activities such as identification of factors influencing ecosystem values are not undertaken by many Economies. Survey response from one developed Economy and another developing Economy revealed that none of the EAF-related activities mentioned in the questionnaire are being implemented in their Economy. However, it remains unclear if other forms of EAF activities are being carried out in those Economies.

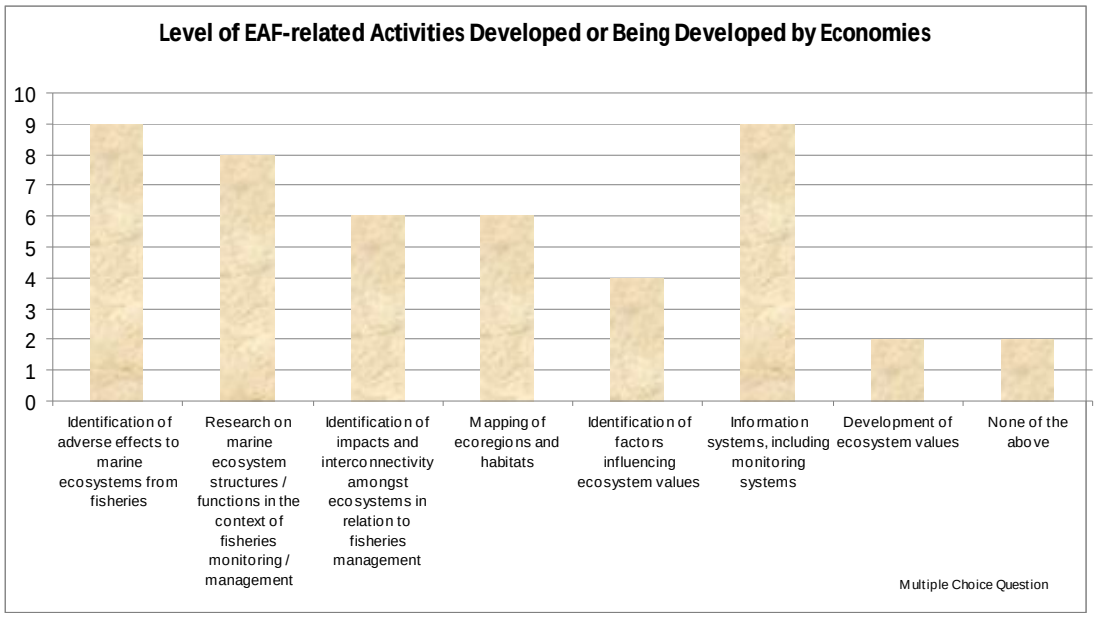
Another model approach in the Pacific was the development of a guide to implementing an Ecosystem Approach to Fisheries Management (EAFM) for the tuna fisheries of the Western and Central Pacific Fisheries Commission (WCPFC).[132] The EAFM approach was designed to ensure communities in the Pacific region would benefit from optimal utilisation of fishery resources by (1) developing a clear description of what is being managed / assessed along with relevant societal values; (2) identifying issues across all five EAFM components (target species, non target species, the ecosystem, community outcomes and fishery administration); (3) prioritising issues using some form of risk assessment and the precautionary approach; (4) developing management systems that include operational objectives and the ability to assess performance; and (5)

[132] Fletcher, W.J., 2008. A Guide to Implementing an Ecosystem Approach to Fisheries Management (EAFM) for the tuna fisheries of the Western and Central Pacific Region. Forum Fisheries Agency, Honiara, Solomon Islands. Version 5 March 2008. 70pp.

developing operational plans that outline the specific activities that will need to be done by all parties to deliver the outcomes needed for EAFM[133].

The EAFM approach covers issues related to target species, non target species, other dependent species within the ecosystem, minimising waste and pollution, endangered species, biodiversity, optimum utilisation, the welfare of the various states involved including the interests of artisanal and subsistence fishers[134]. The process utilizes a suite of risk assessment approaches to prioritise issues, and describes the process of developing objectives for and indicators to sustainable fishery practices.

Figure 51: Level of EAF-related activities developed or being developed by Economies



In one developed Economy, a key initiative driving the implementation of ecosystem based fisheries management is the implementation of an ecological risk management (ERM) framework which details a process for assessing and progressively addressing the impacts that fisheries' activities have on five aspects of the marine ecosystem including target species, by-catch and by-product species, threatened, endangered and protected species, habitats, and communities[135]. This Economy has developed the National and Commonwealth by-catch policies, which demonstrates a commitment to ensure fisheries are ecologically sustainable through by-catch

[133] *Ibid*.
[134] *Ibid*.
[135] http://www.afma.gov.au/environment/eco_based/eras/default.htm

reduction, improved protection for vulnerable/ threatened species and minimising adverse impacts of fishing on the marine environment, addressing also marine protected areas and climate change.

Element Summary

Most of the Economies seemed to consider the impacts of fisheries on non-target stocks and the environment in a broader marine ecosystem management approach. These Economies have management schemes in place to control by-catch and discards, and take into account environmental considerations for the major fisheries. Majority of the Economies also undertake data collection programs for by-catch and fishery by products, commercial offshore fisheries, inshore/near-shore artisanal fisheries, and high-seas fisheries; and these data are utilized for fisheries management. A few Economies that do not have data collection programs reported to manage their fisheries based on target catch and best scientific information available. Only a handful of Economies assess environmental impacts from fisheries exploitation as a standard fisheries management practice and apply adaptive management when necessary. This indicates a lack of commitment among many Economies towards implementing assessment of environmental impacts from fisheries exploitation as a compulsory management practice. The Ecological Risk Assessment approach is also not widely practised in most of the APEC economies. Only three Economies (two developed and another developing Economy) are currently implementing this approach for their key fishery stock. EAF-related activities are undertaken in many Economies with the aim to protect their marine environment. Majority of the Economies reported to have information systems, including monitoring systems in place; and also identification measures to determine the adverse effects of fisheries to the marine ecosystem. Some also conduct research on: marine ecosystem structures / functions in the context of fisheries monitoring / management; and undertake identification of impacts and interconnectivity amongst ecosystem in relation to fisheries management.

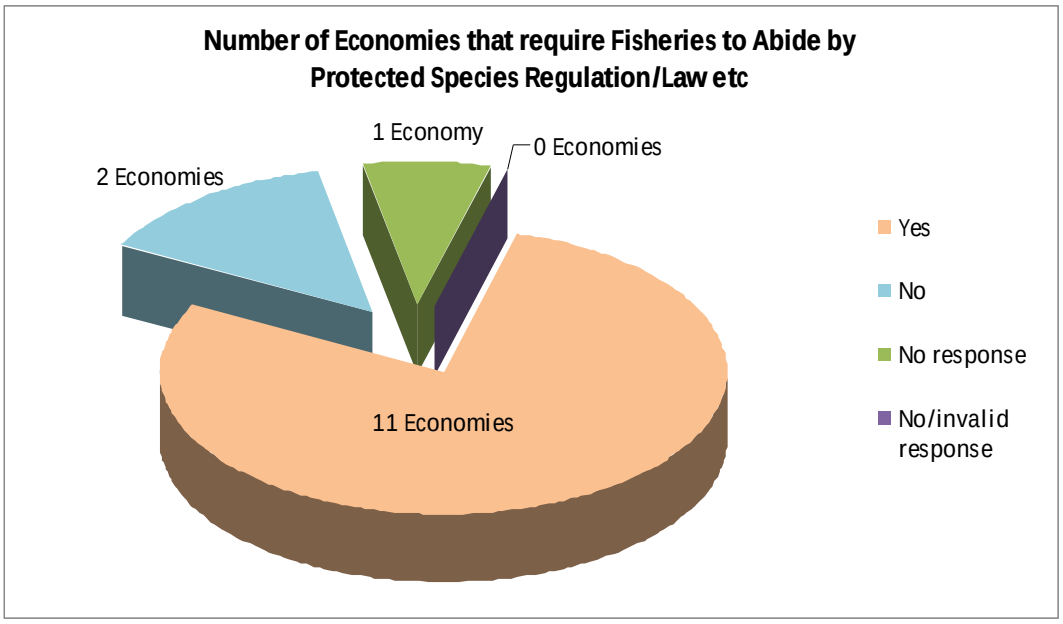
3.2.3 The status of threatened & endangered species known, and detrimental impacts from fishing minimised

Higher demand for seafood has resulted in 77% of global fish stocks being fished to maximum at unsustainable levels.[136] At times, up to a quarter of marine resources caught are discarded as by-catch, including endangered species such as sea birds, turtles and sharks.[137] Unfortunately, many of these by-catch species belong to the top predators group that grow and reproduce at a slow rate. The mortality of these species, although small in number, can cause a significant imbalance in the marine ecosystem.

A total of 11 Economies acknowledged that fisheries activities in their Economy are required to abide by some level of endangered species protective constraints (see **Figure 52**). Four Economies (which includes one developed, two developing and one emerging Economies) responded that they comply with CITES licensing system, which regulates international trade to ensure sustainability of species listed on CITES appendices. One developing Economy among them also stated that it has a National Wildlife Act. Other Economies have listed Economy-level laws that have been enacted to ensure protection of endangered marine species against fisheries impacts, such as the Wildlife Protection Act 2007, Wildlife Conservation Law, National Wildlife Act, Species at Risk Act, and Convention on Migratory Species.

[136] Impacts of Fishing, WWF Responsible fisheries programme; *rfp.wwf.org.za/?m=3&s=3*
[137] *Ibid*.

Figure 52: Number of Economies that require fisheries to abide by protected species regulation / laws



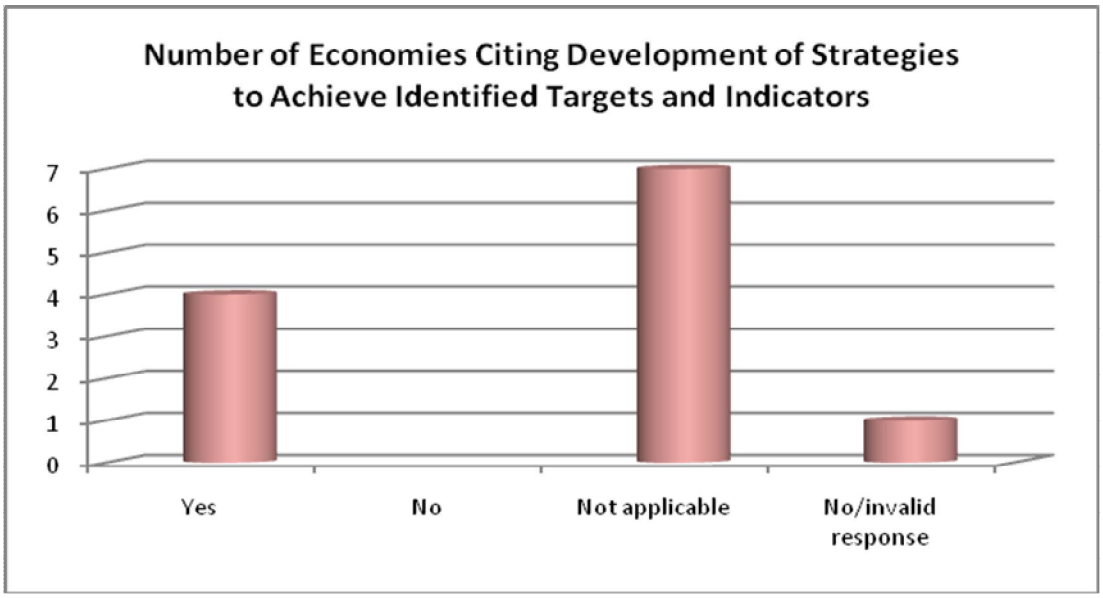
Element Summary

As discussed in the previous section, most of the Economies have data collection programs through which they assess the status of threatened and endangered species. Equipped with this information, the Economies are able to minimise the detrimental effects from fishing through compliance with certain endangered species protective constraints that are imposed either internationally or within the Economies itself. About four Economies comply with CITES licensing system that encourages sustainability of species while others have Economy-level laws to ensure protection of endangered marine species. This indicates that almost all the Economies that responded are committed towards minimizing impacts of fishing towards endangered species.

3.2.4 Initiative taken to rebuild depleted stocks and re-establish degraded habitat

Four Economies responded that they have developed strategies to achieve ecosystem protection-related targets or indicators in relation to fisheries (see **Figure 53**). One emerging Economy stated that it has initiated studies on biodiversity and the establishment of MPA is being carried out. Another emerging Economy responded that it maintains fishing capacity at an optimum level. However, this Economy did not provide a clear explanation on what strategies are being utilised to maintain fishing capacity at optimum level, or how the effort has affected the ecosystem protection progress. One developing Economy stated that it applies seasonal closures to areas in which stock depletion occurs rapidly. Seven Economies did not provide any strategies as they have not developed any ecosystem targets or indicators to measure ecosystem protection progress.

Figure 53: Number of Economies citing development of strategies to achieve identified targets and indicators

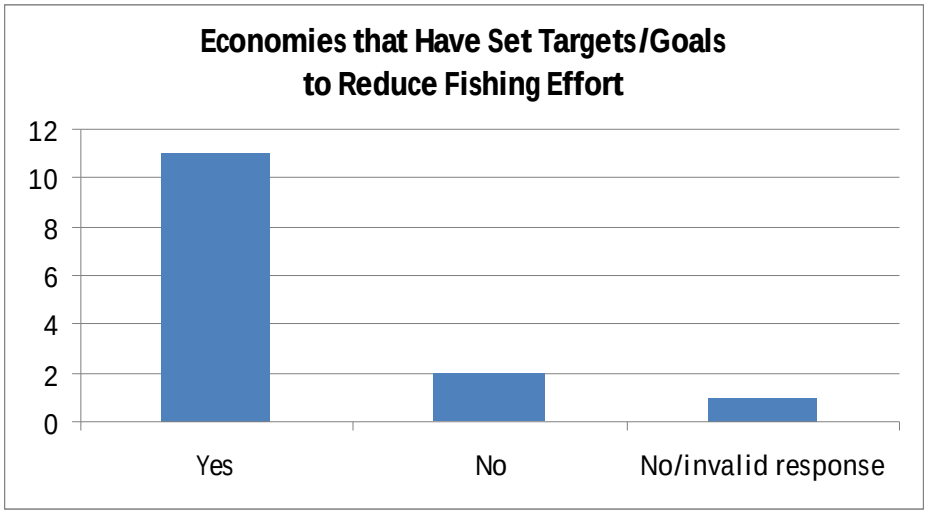


The survey responses illustrate that majority of the Economies are committed towards ensuring sustainable fishing practices. A total of 11 Economies responded that they have set targets / goals to reduce fishing effort to enhance the sustainability of fisheries (see **Figure 54**). A developed Economy stated that capacity reduction program has been introduced to reduce fishing effort but did not elaborate on which fishery it applies to or how the capacity reduction program is expected to enhance sustainable fisheries. Another developed Economy responded that targets are set to reduce fishing efforts where fish stocks are being re-built. One emerging Economy responded

that '*the current moratorium on certain gears operating in certain areas'* aim to reduce excessive fishing practices. A developing Economy elaborated that it has a measure named *maximum catch limit per shipowner*, established in Law N° 19.713 as of 2001, which resulted in a significant reduction of fishing capacity in the main industrial fisheries. This measure represented the final step of a series of actions/regulations implemented since 1986 with the aim to reduce the fishing effort. Another developing Economy mentioned a 'Master Plan' that aims to '*manage the fishing capacity in commensuration with the prevailing conditions of fish stocks'*; while one more similar Economy stated that it has '*Individual Quotas System'* in place for its fisheries. One developed Economy listed the following: Fishing Vessels Buy-back Program; Reward for Closing Fishery Season; Fishing Vessel Reduction Program; Total Allowable Catch; and Closure of Fishing Areas and Fishing Season as the targets set to reduce fishing effort.

One developed Economy stated that there are specific targets or goals but fisheries management agencies address excess fishing effort/capacity on a fishery by fishery basis. The Economy also announced the 'Securing our Fishing Future' package in 2005 to provide for profitable and sustainable Commonwealth fisheries for the future. Implementation of the package was completed in 2009.

Figure 54: Economies that have set targets / goals to reduce fishing effort



As stated previously, most of the Economies conduct assessment of impacts from fisheries upon marine habitats, protective species, coastal economies and food security. However, the respondents did not provide detailed description on processes that applies for the recovery of

each impacted factor. Most have listed initiatives that have been previously cited for other queries, e.g. research projects, regulation on fishing gears and areas, MPA, fishing zonation, moratoriums on fishing, etc.

Element Summary

In general, most of the Economies are committed towards ensuring sustainable fishing practices. These Economies have set targets / goals to reduce fishing effort to enhance the sustainability of their fisheries. Among the efforts taken are: fishing capacity reduction programs, moratorium on gears, measures such as *maximum catch limit per shipowner*, fishing quota system, Fishing Vessels Buy-back Program; Reward for Closing Fishery Season; and Fishing Vessel Reduction Program.

3.3 INDUSTRY MANAGEMENT

3.3.1 Fisheries are assessed and certified for sustainability

One of the elements of an ecosystem-approach to Fisheries (EAF) is the implementation of fisheries management tools such as product certification and eco-labelling. Product certification is a measure mandated by governments, often through mutual agreement by regional fisheries management organisations (RFMOs), in order to ensure that only legally harvested and reported fish landings can be traded in domestic and international markets. The principal objective of product certification (and catch documentation) is to prevent, deter and eliminate illegal, unreported and unregulated fishing in accordance with the 2001 FAO International Plan of Action[138]. Product certification does not necessarily involve a product label at the retail level, and where product certification comes with a label to inform consumers, it can influence consumers' choices similar to a voluntary eco-labelling program.

Product labels can be mandatory or voluntary and refers to a variety of product characteristics or attributes including the product's composition or content, product quality, as well as environmental or social aspects of the product's production process or method. The goal of eco-labelling programs is to create market-based incentives for better management of fisheries

[138] Wessells, C.R., Cochrane, K., Food and Agriculture Organisation (FAO), Product Certification and Ecolabelling for Fisheries Sustainability, FAO Fisheries Technical Paper no. 442, accessed on 5 February 2010, source: http://www.fao.org/docrep/005/Y2789E/y2789e00.htm

through the creation of healthy consumer demand for seafood products from well-managed stocks[139].

Realistically, based on a 2004 publication reveals that domestic markets in developing countries (some are APEC Economies) are more sensitive to price than to environmental considerations. They may not support price premiums, or only certain sectors of the domestic market would show willingness or have the capacity to pay if costs were translated into increased prices. This could exacerbate trends by which products (in some cases the "national fish" e.g. *kurau* in an emerging Economy, tuna in the southern parts of a developing economy) become unaffordable in the local market or to some sectors of consumers[140].

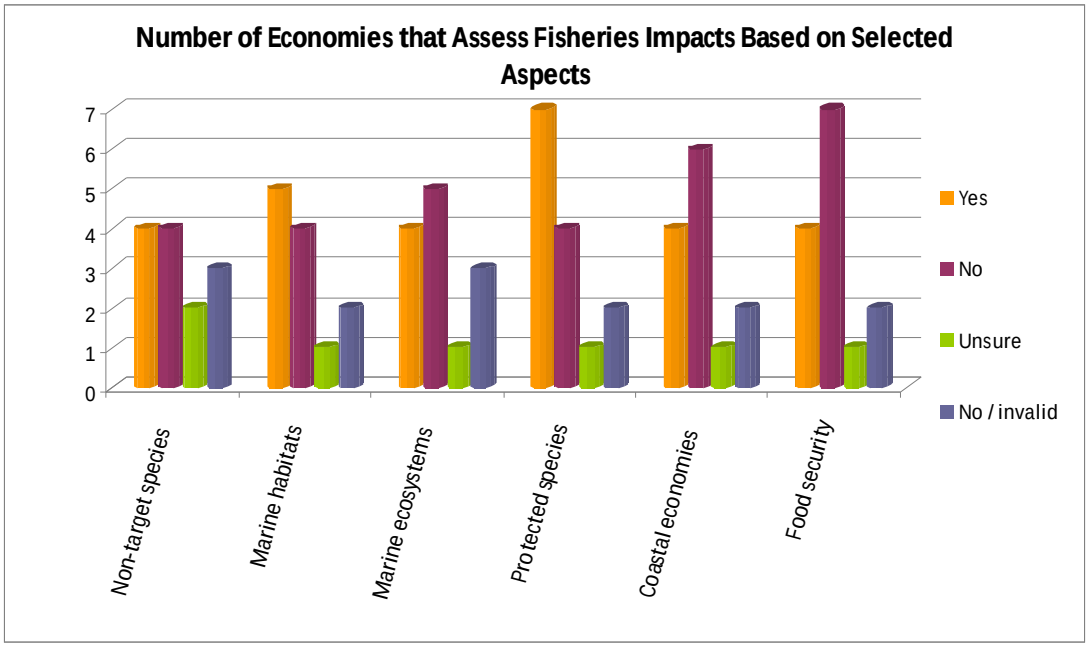
To support this, in 2006, a regional study by researchers from ASEAN research institutions and organizations on the eco-labelling of aquatic products found that many countries within the ASEAN region view eco-labelling as a potential barrier to trade for ASEAN products[141]. Also, there is concern about the feasibility of applying eco-labelling to multi-species fisheries and aquaculture in the region and issues of certification costs, especially to small-scale producers. In addition, the study found that national eco-labelling schemes exist in some ASEAN countries that could be adopted or adjusted to fisheries and aquaculture products.

> *Most ASEAN countries indicate a cautious attitude towards eco-labelling whose promotion would depend on future market developments. When and where implementation is considered, capacity building and technical and financial assistance will be required. Regional and international institutions, including SEAFDEC, FAO, and the Network of Aquaculture Centres in Asia-Pacific (NACA), could play a role in this regard and assist in various ways, including in the setting-up of pilot projects, awareness raising and market identification and development*[142].

[139] Ibid
[140] Gardiner, P.R., Viswanathan, K.K., Ecolabelling and Fisheries Management, WorldFish Centre, accessed on 1 March 2010, source: http://www.blueyou.com/pdf_knowledgebase/B%20Fisheries/Ecolabelling%20and%20Fisheries%20Management.pdf , pg. 36
[141] Subasinghe, S., *Emerging issues and requirements relating to food safety and trade*, APFIC Regional Consultative Forum Meeting - "Reforming fisheries and aquaculture in the Asia-Pacific", INFOFISH, FAO, accessed on 5 February 2010, source: http://www.fao.org/docrep/009/ag111e/AG111E08.htm
[142] Ibid

One of the objectives of EAF is to certify fisheries and not single species. However, it has to consider existing issues with the current practices of eco-labelling for one species, other technical and market issues for multi-species fisheries if eco-labelling are to be successful. One of the important criteria for sustainability certification is the assessment of the status of resources and ecosystem. Based on the survey result, **Figure 55** demonstrates the number of Economies which imposes fisheries impacts assessments to be conducted based on six (6) criteria; i.e. non-target species, marine habitats, marine ecosystems, protected species, coastal Economies and food security. Fisheries impact assessments are reported to be required by five of 14 reporting Economies for marine habitats and seven Economies for protected species. A small percentage of between 8% and 17% are unsure of such assessments. There is no indication if the assessments consider multi-species techniques and management regimes as expected in an ecosystem approach to fisheries management.

Figure 55: Number of Economies which assesses fisheries impacts based on selected aspects



Element summary

Based on survey results and secondary research, it can be construed that current fisheries assessments and sustainability certification practices are focused on a single-species fisheries management and there is no indication of moving towards multiple-species fisheries

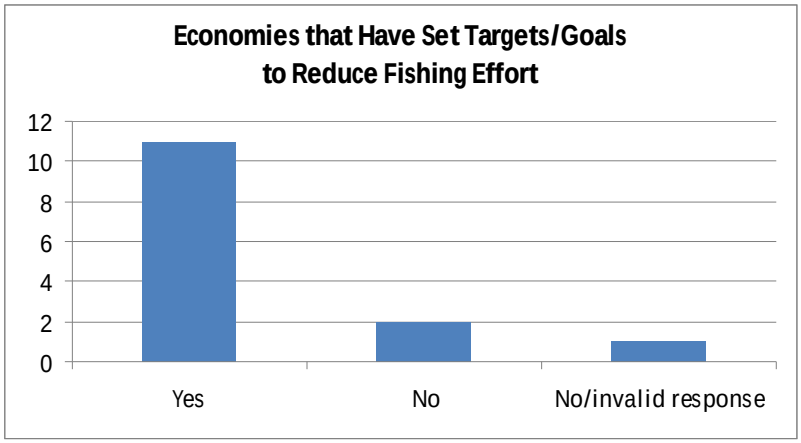
management amongst developed Economies. In addition, even with the current single-species fisheries management, most developing and emerging Economies continues to debate issues over the practice and implementation of fisheries product certification methods due to price sensitivities over environmental considerations, i.e. lack of awareness with regards to the importance of sustainable fisheries management over short-term gains.

3.3.2 Industry rate of effort controlled to achieve sustainability

The fisheries communities are beginning to recognise the shortcomings of the traditional single-species fisheries management and advocate a move towards an ecosystem approach to fisheries (EAF) practices. A sustainable fish stock is now a minimum criterion for fisheries management. However, equally important is to maintain the overall quality of the ecosystem which supports the stock to be both productive and robust. Strategies and techniques for sustainable fisheries involves a combination of theoretical disciplines of fisheries population dynamics with practical strategies; e.g. reduce overfishing through various practices such as the imposition of fishing quotas, reduction of IUU fishing practices and setting up protected areas.

More importantly, some Economies recognise the real economic gain of practicing sustainable fishing practices and have taken measures to ensure that the resources are well-managed. This can be substantiated through the survey result which indicates that 79% of responding Economies have verified that targets / goals have been set to reduce fishing efforts in order to enhance the sustainability of fisheries and only one Economy do not (see **Figure 56**).

Figure 56: Economies that have set targets / goals to reduce fishing effort



One developed Economy has introduced measures for its two *Hoki* fishery to address the ecological impacts of fish removal. Fisheries in each of its *Hoki* stocks are managed under separate catch limits, based on scientific assessments, reviewed annually and with adjustments to catch limits to ensure sustainability. In addition, the Economy adopted a Code of Practice for trawling in 2001, with the aim to protect smaller fish (<60cm). More recently, the Code was extended to include seasonal and area closures in spawning fisheries. Consequently, after going through the painful process of the implementation of catch limits by all quota owners, at the beginning of the 2009/2010 fishing year (1 October 2009), the Total Allowable Commercial Catch (TACC) of the Economy's two *Hoki* fisheries for the upcoming fishing year (2009/2010) has increased by 20,000 tonnes - more than a 20 percent increase over the previous year. This marks the successful rebuilding of the Western stock.

As part of setting catch limits processes, environmental impact assessments for fisheries exploitation are needed. However, in the same survey only 43% of total responding Economies reveals that such assessments are undertaken as a standard fisheries management practice and apply adaptive management when necessary (please refer to **Section 3.2.2**).

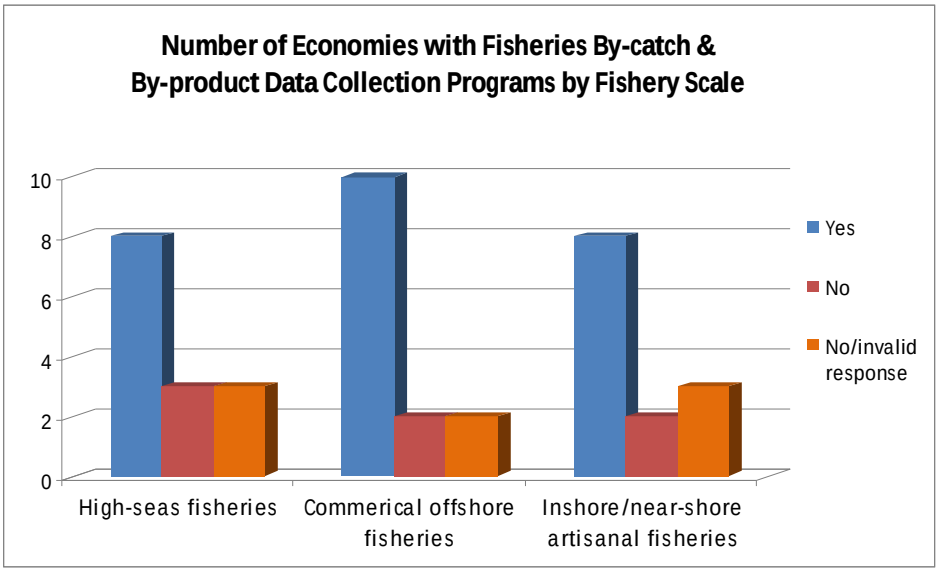
The management of 'by-catch' in marine capture fisheries is also an integral component in the implementation of the ecosystem approach to fisheries management. Unsustainable by-catch management causes negative socioeconomic consequences for fishing communities as it is an important income source and food supply in some fisheries and countries. Overexploitation of commercially important non-target by-catch species, including juveniles or commercial species, will adversely affect future catch levels.

Many countries have yet to implement comprehensive programs for by-catch management and reducing discards[143]. In 2004, FAO reported that while discards had declined, retention of by-catch had increased[144]. Although the extent of by-catch and discards has not been comprehensively quantified, it may be more than 20 million tonnes. Pre-catch losses for some gear types such as trawls[145], pots and gillnets[146] represent an additional source of fishing mortality.

[143] FAO, Committee on Fisheries, Twenty-Eighth session, *Combatting illegal, unreported and unregulated fishing, including through legally binding instrument on port state measures and the establishment of a global record of fishing vessels*, Rome, 2-6 March 2009, pg.9.
[144] FAO. 2004. *The State of World Fisheries and Aquaculture* (SOFIA) 2004. Rome.
[145] FAO. 2005. Mortality of fish escaping trawl gears. *FAO Fisheries Technical Paper*. No. 478. FAO, Rome. 2005. pg.72

One of the pre-requisite to good by-catch management is reliable data collection programs. Analysis in **Figure 57** indicates that an average percentage of between 57% and 71% of total responding Economies does have data collection programs for by-catch and fishery by-products in high-sea fisheries (57%), commercial offshore fisheries (71%) and in-shore / near-shore artisanal fisheries (57%).

Figure 57: Number of Economies with fisheries by-catch & by-product data collection programs by fishery scale

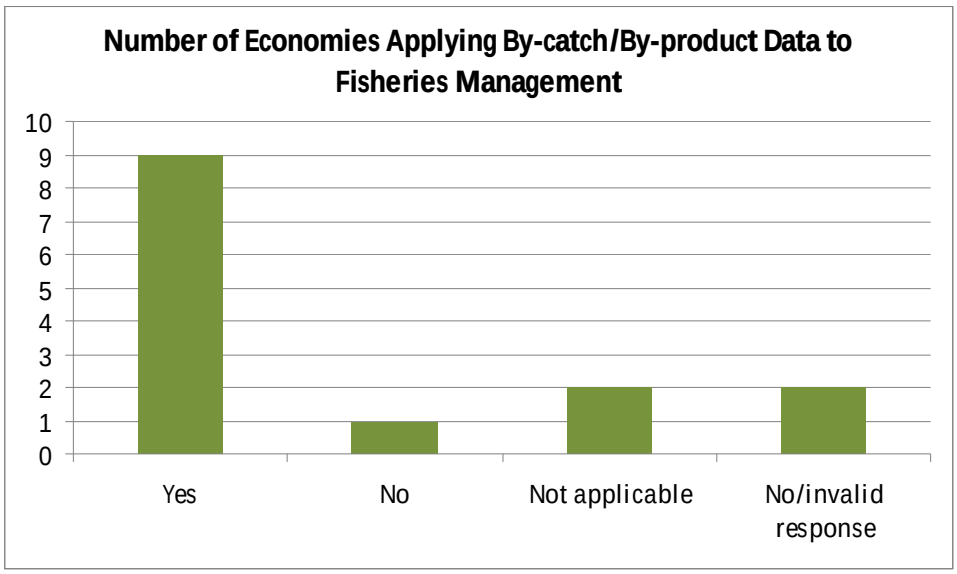


Following that, 64% of responding Economies indicated that by-catch and by-product data are utilised and applied into their fisheries management programs (**see Figure 58**). One developing Economy disclosed that there is limited reference point for by-catch data in their main fisheries management scheme. However, another developing Economy does have catch data in their fisheries management system but did not state if it is on targeted or by-catch fisheries. In addition, one emerging Economy states that their fisheries management program are mainly based on target catch and thus no by-catch data are collected. One developed and developing Economies have in place fisheries management program which includes by-catch and by-product data which is based on best scientific information available and aimed to improve fish stocks and its economic value. One emerging Economy clarifies that the by-catch and by-product data is applied partially in the fisheries management program mainly to set catch limits for specific

[146] James Brown, Graeme Macfadyen, Ghost fishing in European waters: Impacts and management responses, MarinePolicy. Volume 31, Issue 4, July 2007, pg. 488-504.

species. Another emerging Economy utilises by-catch data as a basis to develop regulations on mesh size and set catch limits through issuance of fishing licenses for trawlers and purse seiners. One developed Economy requires the use of *tori* lines for tuna long-liners operating in waters southward of 28°S. Also, the Economy collects by-catch data of coastal larval anchovy and from trawl fisheries as part of the fisheries management program. Another developed Economy responded that fisheries management agencies, through fisheries assessment process are encouraged to take into account all sources of mortality when setting total allowable catch limits, for fisheries that have catch limits. By-catch and by-product catch limits (single species or multi-species) are also applied widely.

Figure 58: Number of Economies applying by-catch / by-product data to fisheries management



The maximum sustainable yield (MSY) concept is extensively used in many countries including member Economies as one of the tool for fisheries management. The survey found that eight Economies does have fishery stock assessments programs to support the implementation of maximum sustainable yield (MSY) at the national level, one Economy at the state level and three Economies have applied MSY at selected areas. There is no elaboration as to the type of fishery that has been assessed; however one developed Economy provided the table below as an example of fishery stock assessment that is being carried out.

Table 2: Fishery Assessment to Support Maximum Sustainable Yield – as provided by a developing Economy

Species/stock	Level of management	Are quant. stock assessments conducted?	How often?
Lobster			
Lobster Fishing Areas 1 – 14	National	yes	every 3 years
Lobster Fishing Areas 15 – 18	National	yes	every 3 years
Lobster Fishing Areas 19 – 21	National	yes	every 3 years
Lobster Fishing Area 22	National	yes	every 3 years
Lobster Fishing Areas 23 – 26	National	yes	last assessed in 2007
Lobster Fishing Areas 27 – 30	National	yes	last assessed in 2004
Lobster Fishing Areas 31A, 31B, 32	National	yes	last assessed in 2004
Lobster Fishing Area 33	National	yes	last assessed in 2004
Lobster Fishing Area 34	National	yes	last assessed in 2005
Lobster Fishing Areas 35, 36, 38	National	yes	last assessed in 2007
Lobster Fishing Area 41	National	yes	last assessed in 2009
Queen-Snow Crab			
Areas 12, 19, E, F	National	yes	annually
Areas 13 - 17, 12A, 12B, 12C, 16A	National	yes	annually
Areas 2H, 2J, 3K, 3L, 3N), 3Ps, 4R	National	yes	annually
Area 4VwX	National	yes	annually
Pandalus Borealis Shrimp			
Shrimp Fishing Areas 0, 2 and 3	National	yes but with indices only	biennially
Shrimp Fishing Areas 2G - 3K	National	yes but with indices only	biennially
Shrimp Fishing Areas 13 – 15	National	yes but with indices only	yearly
Estuary and Gulf of St. Lawrence	National	yes but with indices only	yearly
Sea Scallops			
Scallop Fishing Areas 1 - 6 (Bay of Fundy)	National	yes	annually
Georges Bank	National	yes	annually
Scallop Fishing Area 29	National	yes	annually
Inshore waters of Quebec	National	yes	every three years
Cod			
Divisions 3Pn, 4Rs	National	yes	every year
Divisions 4T, 4Vn, 4Vs	National	yes	every year
Divisions 2J3KI	National	yes	every year
Divisions 4X / 5Y	National	yes	every 3 years
Divisions 3Ps	National	yes	every 2 years
Herring			
Divisions 4T	National	yes	annually
Divisions 4VWX	National	yes	annually
Newfoundland East and South Coast	National	yes	annually
Divisions 4S	National	yes - autumn acoustic survey (6 times during 1991-2002); bottom trawl "probability of catching herring 1990-present	Irregular assessments, Acoustic survey conducted in 2009-10 with the previous in 2006

Species/stock	Level of management	Are quant. stock assessments conducted?	How often?
Divisions 4R	National	yes - autumn acoustic survey (6 times during 1991-2002); bottom trawl "probability of catching herring 1990-present	Irregular assessments, Acoustic survey conducted in 2009-10 with the previous in 2006
Stimpsons Surf Clams	National	yes	every three years
Haddock			
Divisions 4X / 5Y	National	yes	every 4 years
Eastern Georges Bank	National	yes	not assessed since 2003
Divisions 4TVW	National	yes	not assessed since 2002
Divisions 3Ps	National	yes	not assessed since 2001
Divisions 3LNO	National	yes	not assessed since 2001
Turbot-Greenland Flounder			
Divisions 4RST	National	yes	every year
Cumberland Sound (Inshore)	National	yes	assessed 2008 only
Atlantic Halibut			
Divisions 4RST	National	yes	every 2 years
Divisions 3NOPs, 4VWX, 5Zc	National	yes	every 3-5 years
Bluefin Tuna	RFMO (ICCAT)	yes	every 2 years
Mackerel			
Divisions 4RST (Subareas 3 and 4)	National	yes	annually
Capelin			
Divisions 4RST	National	yes indirectly based on catch distribution and dispersion index and landings; however no directed capelin abundance survey so it is impossible to calculate biomass, TACs, etc.	Fairly regular assessments 2005, 2006, and 2008
Subarea 2 + Division 3KL	National	yes - however no recent abundance available for the entire stock	Fairly regular assessments (annually) - abundance estimates, egg deposition and larval emergence indices, trawlable biomass estimates, and probability occurrence indices
Silver Hake			
Divisions 4VWX	National	yes	every 3-5 years
Swordfish	RFMO (ICCAT)	yes	every 3 years
Whelks			
Quebec coastal waters	National	yes	every three years

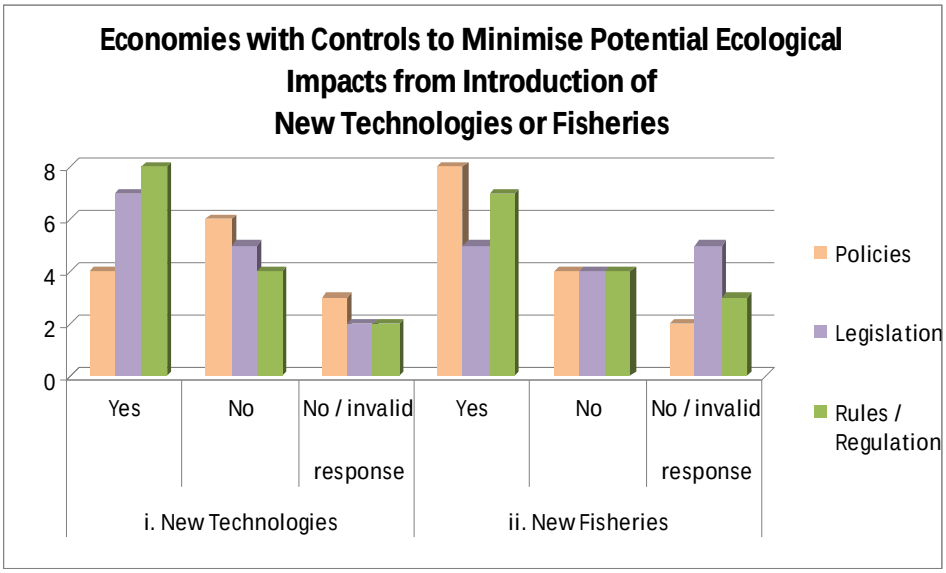
PACIFIC COAST FISHERIES

Crab	National	yes	Last done 2000
Halibut	RFMO (IPHC)	yes	annual
Geoduck	National	yes	Last done 2000

Species/stock	Level of management	Are quant. stock assessments conducted?	How often?
Sablefish	National	yes	Last done 2005
Rockfish	National	yes	Last done 2000
Prawn	National	yes	Last done 2008
Hake	National, Treaty w/USA	yes	every three years
Roe Herring		yes	annual
Queen Charlotte Islands	National	yes	Last done 2009
Prince Rupert	National	yes	Last done 2009
Central Coast	National	yes	Last done 2009
Strait of Georgia	National	yes	Last done 2009
West Coast Vancouver Island	National	yes	Last done 2009
Tuna	RFMO (WCPFC and IATTC)		
Chinook salmon	National, RFMO (PSC)		
Sockeye salmon	National, RFMO (PSC)	yes	Last done 2008
Pacific Ocean Perch	National	yes	Last done 1999
Rock Sole	National	yes	Last done 1999
Dover Sole	National	yes	Last done 1999
English Sole	National	yes	Last done 1999
Petrale Sole	National	yes	Last done 1999
Lingcod	National	yes	Last done 2004
Chum salmon	National, RFMO (PSC)		
Sea Cucumber	National	yes	Last done 2002
Coho salmon	National	yes	Last done 2008
Pink salmon	National, RFMO (PSC)	yes	annual

In response to the introduction of new technologies in existing fisheries and emergence of new fisheries, the survey queried member Economies of any controls to minimise potential marine ecological impacts through implementation of new policies, legislations and / or rules and regulations (**see Figure 59**). Interestingly, 57% of the responding Economies impose rules and regulations to control and minimise potential marine ecological impacts from the introduction of new technologies whilst a fair distribution of responding Economies indicates that control at the policy and legislation level are not desirable. On the other hand, the situation is reversed for the introduction of new fisheries where slightly more than\ 50% of total responding Economies introduced new policies for new and emerging fisheries complemented by compulsory rules and regulations in efforts to limit marine ecological impacts from its activities.

Figure 59: Economies with controls to minimise potential ecological impacts from introduction of new technologies and new fisheries



Element summary

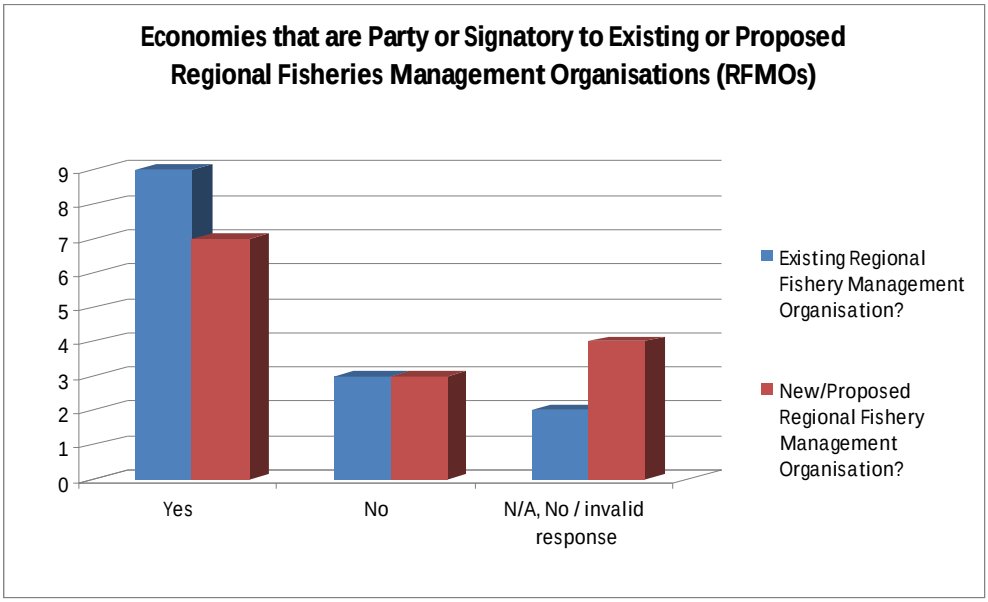
On the whole, many Economies have yet to have comprehensive and effective programs to control industry rate of effort to achieve sustainability, for example – by-catch programs and to minimise overall catch volume in line with the FAO Code of Conduct for Responsible Fisheries (CCRF) limit reference point. However, efforts have been taken by some Economies such as by-catch data collection schemes and its application to fisheries management programs. Also, majority of responding Economies practices the application of the maximum sustainable yield (MSY) for selected fisheries in efforts to ensure overall sustainable fisheries management. With the advent introduction of new technologies, most responding Economies impose rules and regulations to control potential detrimental effects on marine ecology and habitats. However, the introduction of new fisheries requires majority of responding Economies to set new policies complemented by rules and regulations with the same goal.

3.3.3 Government & industry participate in RFMOs and satisfy relevant reporting and documentation standards

Regional Fisheries Management Organisations (RFMOs) are established through international agreements to provide a framework within which representatives of governments agree on mechanisms for fishery resources management in the high seas. The RFMOs plays a key role in combating illegal, unreported and unregulated fishing (IUU) and destructive fishing practices and in doing so offer recommendations on management and conservation measures based on best scientific information available.

As illustrated in **Figure 60**, majority of responding Economies (58%) have indicated that they are party to existing RFMOs and a fair number of Economies indicate that they are party to new RFMOs.

Figure 60: Economies that are Party or Signatory to existing or proposed Regional Fisheries Management Organisations (RFMOs)



A new RFMO of the South Pacific Regional Fisheries Management Organisation (SPRFMO) was recently formed in November 2009 with the adoption of the Convention on the Conservation and Management of the High Seas Fishery Resources of the South Pacific Ocean. Four Economies (one from developing, one emerging and two developed Economy) are parties to the Convention.

Another RFMO, the Western Pacific Fisheries Commission (WCPFC) which was established in 2004 by the Convention for the Conservation and Management of Highly Migratory Fish Stocks in the Western and Central Pacific Ocean includes six (eight) developed Economies, two (2) emerging Economies and two (2) developing Economies. In addition, three (3) Economies are co-operating non-members of the Commission.

The Indian Ocean Tuna Commission (IOTC) is an intergovernmental organisation established under Article XIV of the FAO Constitution mandated to manage tuna and tuna-like species in the Indian Ocean and adjacent seas. Four (4) developing Economies are members to the Commission and so do three (3) emerging Economies and two (2) developed Economies.

One developed Economy indicated that they are members to all tuna related RFMOs and several RFMOs for bottom fisheries. It is also a member of the North Pacific Anadromous Fish Commission (NPAFC) together with two (2) other developed Economies and two (2) developing Economies.

Membership under the Conservation of Southern Bluefin Tuna (CCSBT) includes one from developing Economy, one from an emerging Economy and four developed Economies and one Economy as a cooperating non-member.

The Inter-American Tropical Tuna Commission (IATTC), which was established in 1950, is responsible for the conservation and management of fisheries for tunas and other species in the eastern Pacific Ocean. Its membership includes two emerging Economies, as well as two developed Economies and one developing Economy. One developed Economy has joined the Commission as a cooperating fishing entity and two other Economies as cooperating non-party member.

Eight of the twenty-one Economies are members of the International Commission for the Conservation of Atlantic Tunas (ICCAT), four are from emerging Economies, one from developing Economy and three from developed Economy. Based on best available science, the Commission compiles fishery statistics from its members, coordinates research and on behalf of its members, develops scientific-based management measures.

One emerging Economy is currently not a member of any RFMOs, however, is a member of several regional organisations for fishery-related policy development and promotion of sustainable fisheries management such as the Southeast Asian Fisheries Development Centre (SEAFDEC), the Association of Southeast Asian Nations (ASEAN) and APEC. One developed Economy added that it is taking the lead with another emerging Economy on implementing a Regional Plan of Action (RPOA) to Promote Responsible Fishing Practices Including Combating Illegal, Unregulated and Unreported Fishing in the South East Asia Region. Fisheries Ministers from 11 countries in the region have signed onto the RPOA.

In a 2008 APEC report, most Economies indicated that they provide comprehensive fisheries data to RFMOs, and half of them claim to publish fisheries data on the internet. The survey illustrates that over half of the respondent Economies have become parties or cooperating non-members to existing or newly-formed RFMOs since September 2005. Furthermore, Economy surveys have identified endeavours by Economies to address gaps in fisheries governance by establishing new regional organisations to manage fisheries and areas where no measures exist at that time as validated by recent survey responses.[147]

Element summary

Based on survey results, a fair majority of responding Economies are members of various RFMOs. However, there is no indication if these Economies *satisfy* reporting and documentation standards required from these RFMOs. However, those Economies which are not part of any RFMOs are part of several regional organisations for fishery-related policy development and promotion of sustainable fisheries management.

[147] Implementation of the Bali Plan of Action: Regional Stock-take (Gap Analysis) of the Current Situation in the Asia-Pacific Region compared with Ministers' Objectives – A Foundation Assessment (APEC FWG 01/2007), Final Report, September 2008, Asia Pacific Economic Cooperation.

3.3.4 Principles of EAF reflected in fisheries legislation

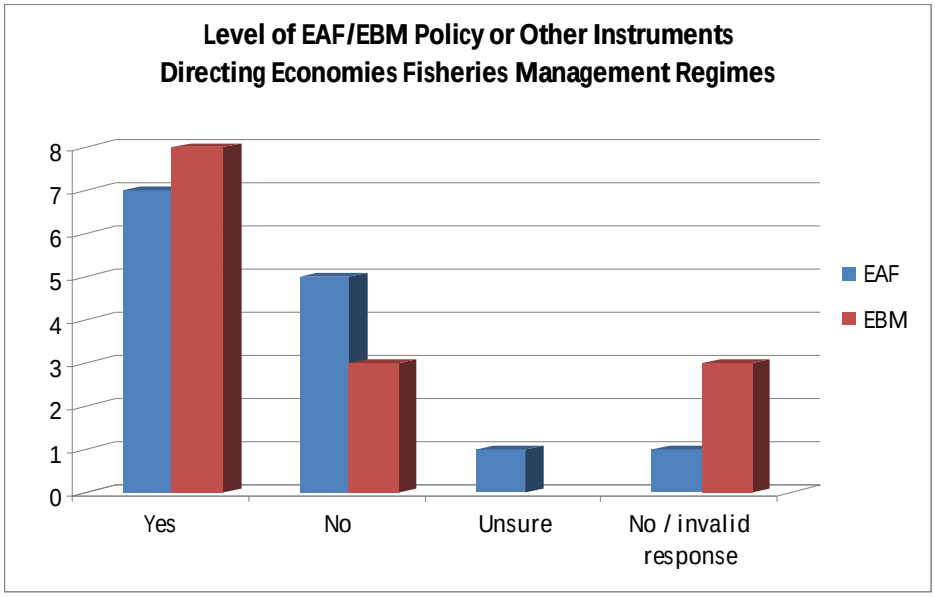
Consideration for international instruments to be included in EAF implementation within national legislation and all associated fisheries regulations and practices are desirable but have not necessarily received the attention that they deserve. At the international level, EAF is reflected mainly in voluntary instruments such as the Rio Declaration, Agenda 21, the FAO Code of Conduct for Responsible Fisheries, the Reykjavik Declaration and the 2002 Plan of Implementation of the World Summit on Sustainable Development.[148] Due to the voluntary nature of the instruments, few RFMOs make explicit recognition of EAF in fisheries management practices. Whilst EAF is not frequently an integral part of national fisheries policy and legislation, Economies experience several gaps and shortcomings in fishery management regimes, e.g. insufficient cross-sectoral consultation and cooperation with stakeholders; and legal inabilities to take action on external influences such as land-based pollution and causes of habitat deterioration.

EAF requires existing legal instruments and the practices of other related sectors to be considered and adjustments made where necessary. Implementation of EAF requires more complex set of legislation that recognises the impacts of fisheries on other sectors and vice versa. It is desirable to regulate the inter-sectoral interactions through primary legislation.

The current survey shows that almost half of total responding Economies have a stated policy and/or official instrument to apply ecosystem-based management (50% of responding Economies) and EAF (57% of responding Economies) in fisheries management practices (see **Figure 61**). One Economy reported that it does not have policy instruments for the inclusion of EBM and/or EAF but practices selected elements in marine resources management. Another Economy reported that although it does not apply EBM and / or EAF in its official instruments, it is an advocate of EAF. Specifically, eleven Economies are required at various levels (Economy, State or local) to abide by endangered species protective constraints such as the Endangered Species Act 1973. Please refer to **Section 3.2.3** for further discussion.

[148] FAO, *Putting into practice the ecosystem approach to fisheries: What are the legal and institutional aspects of EAF?*, Food and Aquaculture Department, Food and Agriculture Organisation of the United Nations, Rome, 2005, accessed on 22 March 2010, source: http://www.fao.org/docrep/009/a0191e/A0191E00.htm#TOC

Figure 61: Level of EAF/EBM policy or other instruments directing economies' fisheries management regimes



Additionally, as discussed in **Section 3.3.2**, seven Economies indicate that they impose legislative control over the minimisation of potential marine ecological impacts from the introduction of new fisheries related technologies but five Economies do not.

Element summary

Survey results indicated that more than half of total responding Economies have stated policies and / or official instruments for implementation of ecosystem-based management (EBM) and EAF in its fisheries management practices. However, there is no evidence to suggest that responding Economies have taken the principles of EAF into its respective fisheries legislations in totality.

3.3.5 Transferable, resource-use rights are a tool of fisheries management

All fisheries, traditional or modern, have been operating under some form of use right based on the right of access to fishery resources in a particular area under various conditions. The 'right' can be as general (as the right to harvest high seas resources provided in the 1982 Law of the Sea Convention) or specific (as to the right to harvest a certain amount of fish of a particular species in

a particular area in a given period of time)[149]. The specific right are usually termed as 'property right' and is implemented in Exclusive Economic Zones (EEZs). The right to transfer or sell these rights depends on respective countries.

According to the Food and Agriculture Organisation of the United Nations (FAO), property rights in fisheries can consist of all or some of the characteristics (to some degree) described below[150]:

- *Durability* - the time, period or duration of the right that is held, e.g. it might be an annual licence or one held, in the limit, in perpetuity unless transferred in some manner.
- *Exclusivity* - the degree to which the resource that is the specified by the right is shared with other participants who are not bound by the same rules of ownership - e.g. recreational fishers or those with traditional rights of exploitation of stocks taken by commercial fisheries operating under a different rights-based regime.
- *Security of title* - that is, its strength as a constitutional or legislated right; a civil agreement; or simply common accepted practice. Fisheries rights may, e.g. be securitized; claimed in a divorce disagreement or attached in some other manner.
- *Transferability* - of the right, either in part, i.e. is it divisible so that part of the right can be sold, or in whole. Degrees of transferability exist as there may be constraints as to whom the fishing rights may be transferred.
- *Property in fisheries* - that has strong rights implies that they are durable, i.e. have long tenure; provide exclusivity of use, cannot be arbitrarily removed or diluted; and that there are rights of transfer.

One developed Economy has, in 1983 implemented a limited individual transferable quota system to protect the deepwater trawl fishery. Total allowable catches are set for seven (7) basic species divided into individual transferable quotas and allocated to existing firms on the basis of investment in harvesting equipments, investment in onshore production equipment, and recent onshore production. This right to harvest were granted for a 10-year period but changed to quotas in perpetuity in 1985. At the same time, the inshore fishery began to face problems with dwindling stocks especially snappers. It was estimated that in 1984, over-capitalisation in the areas where inshore fisheries were most concentrated had reached about 44% of the existing

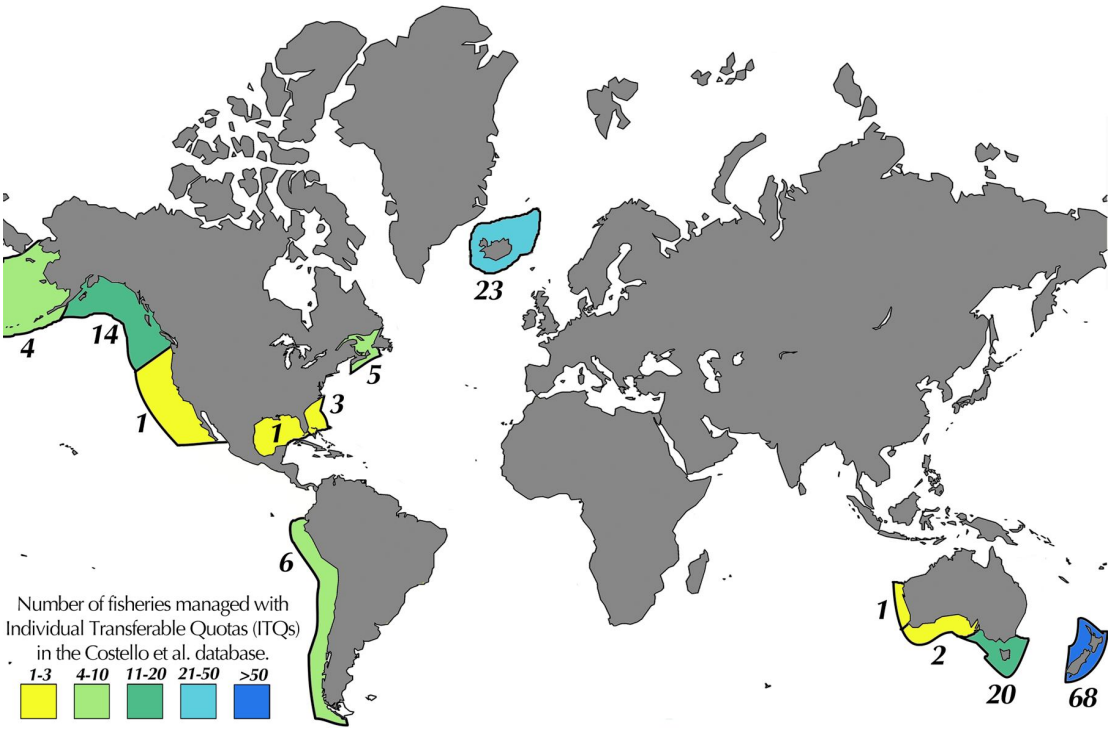
[149] FAO, The Use of Property Rights in Fisheries Management, Food and Aquaculture Department, Food and Agriculture Organisation of the United Nations, accessed on 21 April 2010, source: http://www.fao.org/fishery/topic/3281/en
[150] Ibid

fishing capacity[151]. To manage the inshore fisheries, the Economy implemented a rent-oriented management system based on individual transferable quotas (ITQs) in perpetuity. However, this is not imposed on recreational and part-time fishers (although there is a set bag limit for major species). After an intensive consultative process with the stakeholders, it was agreed that quotas were allocated on the basis of historical catch and resource rentals to be charged. An Appeal Court was set up for fishers to appeal their quota and the total sum of the ITQs was high, for some species much higher than the estimated sustainable yield. The resource rental was used by the Economy to buy-back quotas as a means to ensure that the total quota is at a sustainable catch level. Quotas can be sold on voluntary basis and the Economy has had several tendering rounds for fishers to offer their quotas to the government at an agreed price. The Economy ended up with 15,800 tonnes of quota buy-back at a cost of $NZ45 million[152]. Initially, the ITQ management was established for 29 species to include 21 inshore and eight (8) deepwater species. Since then, there are now 68 fisheries managed under ITQs[153]. This represents approximately 85% of the Economy total commercial catch from its EEZ area. The 1996 Fisheries Act provides for additional commercial species to be managed under the ITQs system.

Another developed Economy has adopted the ITQ system for its southern bluefin tuna fishery. The implementation of this system has led to a rapid reduction of the fishery with two thirds of the boats receiving quota leaving the fishery within two years. Although fish landings were reduced by more than a quarter, those remaining in the fishery enjoyed increased returns and continued to increase in spite of further reductions in allowable catch[154]. In addition, the use of the ITQs has created an institutional structure through which another developed Economy gained access to the ITQs through a series of joint ventures. This resulted in the exchange of technologies between these Economies and increased profitability.

[151] Food and Agricultural Organization (FAO) 1999. *The State of the World Fisheries and Aquaculture 1998* FAO code: 43 AGRIS:M11; M12. FAO, Rome. Holland, D.S. 1995. "Managing of Artisanal Fisheries: The role of marine fishery reserves." Policy Brief No. 11. Department of Resource Economics, University of Rhode Island, Kingston, USA.
[152] Ibid
[153] Fisheries are as defined by the Sea Around Us Project 2007 database on large marine ecosystems. Source: http://fiesta.bren.ucsb.edu/~costello/research/CatchShares/
[154] Campbell, D., Brown, D., Battaglene, T., *Individual Transferable Catch Quotas: Australian Experience in the Southern Bluefin Tuna Fishery,* Marine Policy, Volume 24, Issue 2, March 2000, pg 109-117.

Figure 62: There are 148 fisheries that are managed under the Individual Transferable Quotas (ITQs)[155]



Where ITQs are practiced, the value of shares increases as a result of a well-managed fishery and increases the fish population. Based on the map above, there are 148 fisheries that are managed under variations of management scheme that includes ITQs. Twenty-four (24) fisheries along the West and East Coasts of North America are managed under ITQs of which includes two developed member Economies. ITQs are also practiced within the Humboldt Current Large Marine Ecosystems (LME) that includes one emerging Economy and one developing Economy. A large percentage of member Economies have and are not practicing ITQs.

Element Summary

In a nutshell, where ITQs are practiced, there are reports to note the increase in returns and it continues to increase in spite of further reductions in allowable catch. Also, this has helped with the restoration of previously overfished fishery in terms of promoting healthy fish population.

[155] Costello, C., Gaines, S.D., Lynham, J., *Can Catch Shares Prevent Fisheries Collapse?,* Science, Sept 19, 2008, accessed on 21 April 2010, source: http://fiesta.bren.ucsb.edu/~costello/research/CatchShares/

3.3.6 Monitoring, Control and Surveillance (MCS) programs are comprehensive and effective

Majority of Economies have reported strong performance in enhancing MCS programs in the previous stock-take.[156] This might serve as an indicator that comprehensive MCS programs are being conducted among the Economies. Examples of enhancements carried out in MCS programs by member Economies as cited in the Final Report of Implementation of the Bali Plan of Action: Regional Stock-take (Gap Analysis) of the Current Situation in the Asia-Pacific Region compared with Ministers' Objectives are listed below:

- Acquisition of new patrol boats accompanied by aerial surveillance and an inspection regime "…as part of a comprehensive, integrated MCS program".
- Advocating world's best practice in the adoption of effective MCS measures and their implementation in RFMOs, such as VMS, catch documentation schemes, boarding and inspection schemes, and positive and negative vessel lists.
- Modernisation and redefinition of a compliance and enforcement program. The main drivers of the review were reported as: an expanding range of regulatory responsibilities including fisheries, habitat, species at risk, marine security etc; a more complex management regime requiring improved coordination and integration of compliance management; an increasingly challenging legal environment; increased conservation concerns and greater awareness by stakeholders requiring compliance of third parties in compliance and monitoring; and the generation of more data through new technology and the need for enhanced analysis.
- Inventorisation of fishing fleet and equipping deep-sea fleet with GPS.
- Enhancement of VMS through increasing the number of fisheries guidance vessels and mandating installation of VMS; and that following RFMO agreement, VMS is being installed on deep-sea vessels.

Element Summary

[156] Implementation of the Bali Plan of Action: Regional Stock-take (Gap Analysis) of the Current Situation in the Asia-Pacific Region compared with Ministers' Objectives – A Foundation Assessment (APEC FWG 01/2007), Final Report, September 2008, Asia Pacific Economic Cooperation.

Most of the members Economies have undertaken at least one type of MCS effort/program. Some Economies seem to have more comprehensive MCS programs than others. For instance, a few Economies have just noted installation of VMS on fishing vessels as their MCS effort, while some have reported a broad range of programs such as: fishing vessels larger than 100 tonnes installed with VMS in accordance with RFMO resolutions, patrol vessels despatched to the Pacific and Atlantic to monitor flag vessels; on-board observers including for bird and mammal observations; satellite surveillance system for a squid fishery; etc.

3.3.7 Effective enforcement against IUU fishing throughout the national jurisdiction

Findings of the APEC BPA report suggested that majority of the Economies had enforcement activities carried out to keep IUU fishing at bay. Among the initiatives that were reportedly taken by the Economies against IUU fishing is implementation of IPOA-IUU, which includes measures such as:

- provision of additional budget to increase enforcement capacity;
- improvement of coordination and cooperation in operational activities to deter illegal fishing;
- introduction of amendments to legislation to include significant custodial penalties for foreign fishing offences;
- conduct of joint patrols with neighbouring States;
- participation in international and regional efforts to address IUU fishing;
- maintenance of a cadre of professional, well-trained and well-equipped fishery officers with
- authority to inspect, search, seize and arrest fishery violators;
- implementation of fisheries laws, including regulations of fishing efforts and promoting rights-based fisheries to replace open access regimes;
- implementation of observer programmes and dockside monitoring programmes;
- improvement of MCS systems, involving local communities;
- involvement in the International MCS Network
- implementation of a registration and licensing system for fisheries
- implementation of port State control measures such as the requirement to provide reasonable advanced notice and information prior to entry into port, undergo port

inspections, and the application of port enforcement measures against IUU vessels such as the prohibition of landing and transhipment;

- implementation of boarding and inspection schemes;
- application of rules to prevent nationals from engaging in IUU fishing;
- cooperation with neighbouring States to address IUU fishing;
- decommissioning of vessels engaged in IUU fishing;
- collection of fisheries information from local and foreign fishing vessels; and
- certification of fish and fishery products for trade.

Apart from implementing the IPOA-IUU, one developed Economy reported that it had effective dockside monitoring program to address IUU activity. Another developed Economy stated that it was in the process *"…of significantly increasing its ability to combat IUU fishing at sea through the [deployment] of six new patrol vessels and aerial surveillance…, [which] would allow…[the Economy]…to conduct boarding and inspections in its EEZ and on the high seas to support the objectives of relevant regional and sub-regional arrangement [that it] is a party to*". This Economy also stated that fishing vessels wishing to enter ports were subjected to inspection in accordance with the FAO Model Scheme. Vessels wishing to land fish were said to require prior approval and prove that the fish are from authorised activities, which are then subject to observer monitoring.

Another developed Economy reported that the importation of tuna and tuna-like species from vessels that are not on positive lists, in accordance with *"…relevant RFMO…"* decisions were prohibited. Another developed Economy highlighted that the main emphasis to combat IUU fishing has been in regard to strengthening at-sea surveillance and enforcement measures in its northern waters. In response to a sharp rise in IUU fishing in 2005, that Economy "…bolstered [efforts] significantly [through] the following measures: deployment of customs and defence patrol boats and surveillance flights in northern waters; and increased capacity of [the fisheries authority] to conduct investigations into foreign fishing offences". The Economy also reported: the establishment of detainee and apprehended vessels facilities; the appointment and posting of customs officials in another country to progress cooperative measures and ongoing delivering of information on the penalties of IUU fishing to discourage foreign IUU fishing; co-hosting a regional initiative to develop actions to combat IUU fishing practices in Southeast Asia; and enhancing biosecurity surveillance and response in remote areas. The Economy also stated that there had been amendments to fisheries legislation since September 2005, for example, vessels were

forfeited if they were caught twice within a two-year timeframe, and all things found on board seized vessels, were also forfeited including any fish.

An emerging Economy reported that it was in the process of enacting new legislation for 'Distant Water Fisheries', that included port-State provisions to promote compliance with RFMO conservation measures, such as, a port inspection scheme, and restrictions on landings and transhipment of IUU catches. One developing Economy highlighted that its Navy carried out surveillance and enforcement actions to monitor fishing activities, while another stated that it had prohibited IUU vessels from entering its ports.

An Economy reported that USD 553 million had been budgeted for armed patrols and an enhanced ability to respond to IUU fishing. One Economy reported having a fish marketing organisation to ensure orderly marketing of fresh marine fish and to provide a fair trade platform. It also claimed to have undertaken enforcement actions against illegal marine fish marketing.

Element Summary

In general, most of the Economies, in one way or another has undertaken measures towards effective enforcement against IUU throughout their national jurisdiction. Means of enforcement undertaken by the Economies among others include implementation of IPOA-IUU, dock-side monitoring programme, deployment of patrol vessels and aerial surveillance, inspection in accordance with the FAO Model Scheme, increased capacity of fisheries authority to conduct investigations into foreign fishing offences, the establishment of detainee and apprehended vessels facilities, and amendments to national fisheries legislation.

3.3.8 Active MCS collaboration with neighbouring States

Findings of the APEC BPA report indicated that most of the Economies conduct joint patrol with neighbouring countries to curb IUU fishing. Elaboration in the report provided by a developed Economy stated that the Economy had a lead role in the International MCS Network; had been working to encourage neighbouring countries to participate to deter illegal activities; and had provided funding to the network. Additionally, the Economy said it had expanded MCS operations in northern waters by opening up a regional office staffed with fisheries officers who

patrol in conjunction with other agencies to detect, apprehend and prosecute illegal foreign fishers, which had resulted in a significant reduction in illegal fishing. Southern water patrols were reported also to occur regularly with authorities of another country under a convention for these waters.

Element Summary

Most Economies are involved in conducting joint patrol with neighbouring countries to curb IUU fishing. There are not many examples available on the other types of MSC collaborations that are undertaken among the Economies with their neighbouring States.

3.4 FISHERFOLK & STAKEHOLDERS

Stakeholder participation is widely recognised as one of the key elements for ecosystem approach to fisheries practices. It brings together stakeholders' perspectives, which represent diverse uses, values and concerns. In theory, stakeholder participation provides a comprehensive understanding of situations and collaborative decision-making processes and decisions.

Stakeholders, amongst others include the government, industry players and resource users. Survey results reveals that five Economies indicates that the most probable agencies to be able to influence policy decisions are at the Economy level[157] closely followed by four other entity, i.e. state entities, NGOs, IGOs and universities. However, funding eligibility[158] are strongest at the state agencies compared to Economy level, in addition to being the implementing entities for policy decisions. Hence, there is a strong need to have cooperation between these stakeholders to ensure successful EAF implementation at the policy (Economy), funding and implementation (State) levels.

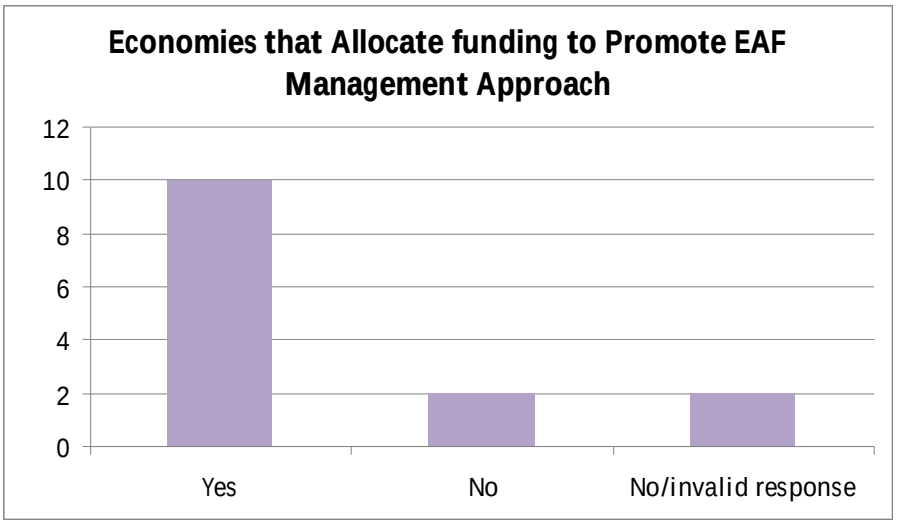
[157] Refer Section 2.3 for further detail.
[158] Refer Section 2.4.

3.4.1 EBM awareness and education programs conducted for fishers, fishing communities and other stakeholders

In a 2009 report by APFIC / FAO[159], awareness-building and communication are recognised as one of the essential elements towards a successful implementation of EBM. However, it requires the following issues to be resolved and actions to be undertaken. It includes development of EAF materials and its dissemination in local languages; capacity building programs which includes monitoring and evaluation programs; community-level meetings, training courses and workshops; education and awareness programs for decision-makers at all levels; and public awareness-building programs.

As discussed in **Section 2.3**, almost half of the responding Economies have in place, public education and awareness programs to preserve marine ecosystem. As illustrated in **Figure 63**, 71% of the responding Economies reported that funding is allocated in their respective Economy to promote EAF management. However, two Economies (each from an emerging and developing Economy) do not have funding allocated to promote EAF management approach.

Figure 63: Economies that allocate funding to promote EAF management approach



[159] APFIC. 2009. APFIC/FAO Regional consultative workshop "Practical implementation of the ecosystem approach to fisheries and aquaculture", 18–22 May 2009, Colombo, Sri Lanka. FAO Regional Office for Asia and the Pacific, Bangkok, Thailand. RAP Publication 2009/10, 96 pp.

Secondary research indicated that different Economies have a variety of awareness and education programs in place. This includes turtle conservation programs[160], invading species awareness programs[161], sustainable fishing programs[162], certification of fisheries[163], stock management[164] and active sea patrols to inform fishermen working in remote places of fisheries rules and regulations[165].

From a larger scale of marine ecosystem management, three Economies are involved in the Bay of Bengal Large Marine Ecosystem (BOBLME) Project. Its core objectives are to increase awareness and knowledge of the needs, benefits and practices of coastal fisheries management; enhance skills through training and education; transfer appropriate technologies and techniques for development of small-scale fisheries; establish a regional information network; and promote women's participation in coastal fisheries development at all levels.

A regional initiative recently formalised in 2009 is the Coral Triangle Initiative on Coral Reefs, Fisheries and Food Security (CTI-CFF). Five of its members also are member Economies in various stages of development. A Regional Plan of Action (RPOA) is in place with five goals; (1) Priority seascapes designated and effectively managed; (2) Ecosystem approach to management of fisheries (EAFM) and other marine resources fully applied; (3) Marine protected areas (MPAs) established and effectively managed; (4) Climate change adaptation measures achieved; and (5) Threatened species status improving[166]. One of the targets under Goal 2 is to "*improve income, livelihoods and food security in an increasingly significant number of coastal communities across the region through a new sustainable coastal fisheries and poverty reduction initiative ('COASTFISH')".* This target is to be met through close collaboration with all stakeholders; various level of government entities, NGOs fishing industries, consumer organisations and communities.

[160] Asia Pacific Economic Cooperation, 2008. Implementation of the Bali Plan of Action: APEC Bali Plan of Action Economy Survey Analysis Final Report. APEC Publication Number: APEC#208-FS-01.2, Singapore, 174 pp.
[161] Great Lakes Panel on Aquatic Nuisance Species,, 2007, *The Invading Species Awareness Program for Ontario*, accessed 11.02.10 http://www.glc.org/ans/documents/MacDonald-GLP-Meet-Nov-07.pdf
[162] WWF, March 2009, 2nd Edition. *Implementation of Ecosystem-based Management in Marine Capture Fisheries*, 70 pp.
[163] Ibid.
[164] Ibid.
[165] Ministry of Marine Affairs and Fisheries, 2009, *Ministry of Marine Affairs and Fisheries Papua Province Trigger Fishermen Awareness in Sea Supervision*, accessed 11.02.10 http://www.dkp.go.id/dkp5en/index.php/ind/news/1544/ministry-of-marine-affairs-and-fisheries-papua-province-trigger-fishermen-awareness-in-sea-supervision

[166] Source: http://www.cti-secretariat.net/

Element Summary

However, there are implementation issues and challenges in particular to gain stakeholders' understanding of the significance of EAF. These issues include lack of awareness of current data and information on stocks, current fisheries management efforts, and the various inter-agency relationships and mandates[167]. Hence, EBM awareness and education programs especially for fishers, fishing communities and other stakeholders is an important element of EBM and especially for EAF, thus require adequate attention to address the issues and challenges in addition to current programs undertaken in respective Economies.

3.4.2 Fisheries management initiatives consider the socio-economic impact on fishers and their activities, and mitigation measures taken to minimise or compensate for detrimental impact

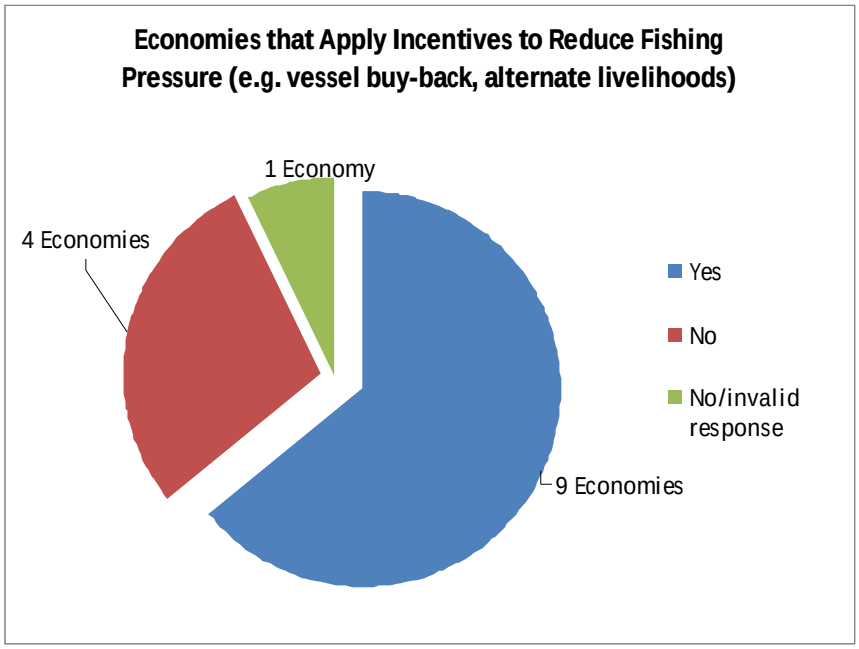
The ecosystem approach to fisheries (EAF) not only benefits ecosystem health, biodiversity conservation and sustainable natural resource use efforts, but specifically, has the potential to benefit those relating to human considerations, such as greater employment and income generation as a result of rehabilitated ecosystems, reduction in the risk of fishery collapse, aesthetic benefits, etc[168].

Based on survey findings (please see **Figure 64**), nine of the 14 responding Economies have set in place, programs to reduce fishing pressure. Four of the responding Economies reported that no such incentives are in place. One emerging Economy which has no such incentives, did inform of new measures which have been put in place as a result of declining fish stocks such as the provision of special aid and benefits such as bonuses, scholarships and retraining programs. Another emerging Economy, although has no incentives to reduce fishing pressure is now considering such incentives in their fishery management plans.

[167] Sauni, S., *Ecosystem Approach to Fisheries Management: Implementation Issues and Challenges for the Pacific Island States*, accessed on 8 March 2010, source: http://www.ancors.uow.edu.au/images/publications/Navigating%20Pacific%20Fisheries%20Ebook/Chapter_13_Navigating_Pacific_Fisheries.pdf

[168] Young, C.D, Charles, A., Hjort, A., Human dimensions of the ecosystem approach to fisheries: an overview of context, concepts, tools and methods, FAO Fisheries Technical Paper No. 489, 2008, pg 35, source: http://www.fao.org/docrep/010/i0163e/i0163e00.HTM

Figure 64: Economies that apply incentives to reduce fishing pressure (e.g. vessel buy-back, alternate livelihood)



A further elaboration from four responding Economies indicates a common measure to implement alternative livelihood and retraining programs for fishing communities through the provision of technical and financial assistance. Specifically, one developing Economy provides alternative livelihood programs for the anchovy fishing communities. Another common incentive is the vessel buy-back schemes practiced by three Economies. A separate, frequently mentioned measure was the fishery season closure. One developing Economy has in addition to its season closures, has a domestication policy (no explanation were given). Another developed Economy reveals that rewards are given to those who adhere to the season closure ruling (no further detail were provided).

A developing Economy reports improved efficiency in the issuance and renewals of fishing licences and the prescription of a justifiable fee for the resource rent. Other measures taken are the determination of the number of fishing vessel and their gears and assess if it supports sustainable fish stocks management. Also, the Economy has prescribed measures and coordinates with relevant agencies to minimise fishing capacity (including production of new fishing boats).

An emerging Economy reports that an exit plan is in place for trawlers fishing in Zone B (between 5 to 12nm). Additionally, the Economy has stopped the issuance of licenses for coastal fisheries and limited entry by way of fishing licences for deep sea and tuna fishery.

One emerging Economy has a pilot project off the coast of one of its islands where an ecosystem approach to fisheries management is practiced. The project provides technical assistance for the sustainable development of the coastal fishery communities, and is introducing a community-based resource management scheme for coastal fisheries. The project aimed to enhance understanding and awareness of fisheries management in the context of EAF amongst communities and Department of Fisheries officials, and to develop capacity amongst local people to manage maritime resources and sustain development under a voluntary adoption scheme. Within the local community participation, a broad range of initiatives are set in place to create job opportunities and promote new local businesses, thus increase income level and alleviate poverty and develop the economy base at the community level.[169]

Following the discussion in **Section 3.3.1**, seven of the total responding Economies, do not require assessment of fishery-based activities impacts on the coastal economies and food security. Four Economies does require such assessments to be done and one Economy is unsure of such requirements.

Element Summary

There are fair amount of evidence that fisheries management initiatives within the APEC region does consider the socio-economic impact on fishers and their activities and to some extent implementation measures for mitigation to minimise detrimental impacts. However, there are insufficient indications to suggest that if these measures have been successful in the long-term, for example, the success of the retraining programs for fishing communities.

[169] Ahmad, A.A., I. bin Ishak, N.H. bt Yahya, 2009. Ecosystem approach to fisheries and aquaculture in Malaysia. Paper presented at the Regional Workshop on EAF/EAA, 18-22 May 2009, Colombo, Sri Lanka.

4.0 CHALLENGES & OPPORTUNITIES

A number of APEC Economies have good national policy documents that support some elements of EBM/EAF, and many of these policies have been incorporated into national plans that are linked to budget allocations.[170] However, Economies remain challenged by factors that can influence the success of implementation, including, amongst many others: (i) awareness and education; (ii) government and NGO partnership; (iii) stakeholder engagement; (iv) stakeholder empowerment to co-manage; (iv) planning for common goals; (v) demonstrated results; and (vi) monitoring and evaluation.[171]

4.1.1 A common language, terminology and communication of the concepts of EBM and EAF

In any public policy realm, the existence of a 'policy language' that includes specialised terms, common acronyms, preferred words and phrases, and which reflects agreed values is actually a good indicator of those people and institutions who constitute the 'policy actors' for that particular policy realm. Indeed, often, people from outside of a certain policy realm, i.e. the uninitiated, may even have difficulty understanding a policy-related discussion. As a further complication, the language used in a policy realm is dynamic and will often evolve as different terms come in and out of vogue.

Such is certainly the case for the ocean policy realm and more particularly for marine EBM and EAF. However, because EBM and EAF are essentially cross-cutting approaches to marine management, there may not always be clear understanding of language, terms and concepts across distinct marine sectors that in themselves may constitute a policy realm, e.g. maritime transport, offshore energy, fisheries, defence etc.

For example, the term 'marine protected area' need not necessarily mean a total fishing no-take zone, and there are many examples of multiple-use MPAs around the world that cater to a degree of marine living resource exploitation. However, a policy actor from the fishery policy realm (e.g.

[170] Staples, D. and S. Funge-Smith, 2009. Ecosystem approach to fisheries and aquaculture: *Implementing the FAO Code of Conduct for Responsible Fisheries*. FAO Regional Office for Asia and the Pacific, Bangkok, Thailand. RAP Publication 2009/11, 48 pp.
[171] *Loc. Cit.*

fish workers association representatives, or fishing boat owners association etc.) may not understand this, and could oppose or undermine a useful, sensible and desirable MPA initiative on the mistaken grounds that it will totally prohibit fishing and hurt stakeholder interest. To take this example further, there is a growing body of evidence of the beneficial impact that MPAs located at fish breeding grounds can have on the overall viability of a fishery, but this again may not be understood by interests who are outside of the 'marine science' or 'fishery science' policy realm.

Thus, a challenge for marine managers is to strengthen education and build awareness to ensure that stakeholders are able to engage in meaningful discussion that does not flounder or descend into conflict through misunderstanding of language. Of course, this challenge increases in complexity when EBM/EAF is to take place across jurisdictional, language or cultural boundaries.

4.1.2 Funding for science and implementation

Based on the survey findings, extensive, comprehensive and on-going marine science, oceanography and environmental-health monitoring programs are required for good marine EBM/EAF decision-making and practice. However, such research often is not done beyond the boundaries of marine parks, reserves and other spatially delineated areas. Much scientific research remains ad hoc due to insufficient funding for the development of long-term, goal-orientated research programs.

However, some APEC Economies have risen to this challenge and do provide comprehensive funding in support of EBM and EAF implementation. Generally, sustained marine research funding is allocated through legislation; however, some Economies have set up specialised finance schemes. Generally, effective EBM and EAF will be achieved across the APEC region only when all Economies follow such examples.

4.1.3 Political will and marine industry acceptance

In general, political acknowledgement of the desirability of EBM/EAF is nearly universal. The objectives of EBM/EAF formalise political and societal expectations on the state of the environment, usually reflecting the outcome of complex negotiations that take account of short

and long-term economic, social and environmental interests.[172] Therefore, the development high level objectives that can be translated into operational outcomes is essential. With regard to EAF, globally, there has been limited political commitment to bear the high short-term costs associated with achieving sustainable fisheries. At present, the main issues to be addressed when moving towards an EAF are the need to remove excessive fishing capacity and to develop technical mitigation measures and incentives to reduce the environmental impacts of fishing.

From the survey results, there appears to be a reasonably wide reflection of EBM, and to a lesser extent EAF, at the policy level. However, there is yet to be a corresponding level of commitment embodied in legislation or implementation practice. Such a dichotomy of content between the levels of policy and practice could reflect either that the concepts of EBM/EAF are still at an early developmental stage, or that EBM/EAF are seen more as rhetorical tools with no political will to effect true implementation. Further monitoring of EBM/EAF implementation by APEC Economies will be needed over a longer duration to determine confidently which is the case.

Industry acceptance

One indication of marine industry acceptance of EBM and EAF are the practices currently used for certification of resource-use sustainability and assessment of environmental responsibility. For example, although EAF advocates multiple-species management, current practices still focus on single-species fisheries management. There has been limited take-up of non-government fishery sustainability certification, and such certification that has been done has involved mostly industries in developed Economies. There is little indication that Economies or industries are moving towards multiple-species fisheries management, and less that broader ecosystem factors are influencing management decisions. Indeed, even current single-species fisheries management is weakened by compromises between the need for wealth generation and long-term sustainability.

Effective EBM and EAF cannot be achieved through regulatory compulsion alone. Stakeholders and key decision makers must share in a conviction that the best interests of all concerned can be met equitably only through the management of sustainable ecosystems, and that this is especially so with regard to fisheries.

[172] Jennings,S., Towards an ecosystem approach to fisheries, El Anzuelo: European Newsletter on Fisheries and the Environment, Vol.18, 2007, pp.5

Apart from the challenges addressed above, there are some other challenges faced in implementing EBM and EAF among APEC Economies. One such challenge is the lack of comprehensive EAF institutionalisation and practice among Economies. There is a need for further acceptance and implementation of rights and obligations contained in various international instruments. Secondly, there is a lack of data collection programs to manage fisheries based on target catch and best scientific information available. Very few Economies also observe the environmental impacts from fisheries exploitation as standard management practice and apply adaptive management when necessary. Same scenario is observed in the adoption of ERA approach.

5.0 CONCLUSION

The identification and understanding of ecosystems, and the opportunity to provide for the needs of interdependent user-groups is essential for sustainable coastal and oceans management. However, the principles of EBM are often not easily translated into operationally-meaningful terms because of the challenges in moving from broad objectives to practical applications at the management or industry level(s). The following discussion is based on an overall analysis of survey results from 14 APEC Economies.

In general, most of the APEC Economies are embracing EBM and EAF where majority of the Economies have an official policy/instrument directing the practice of EBM and EAF. However, these laws, policies and practices are seen as compatible between the national and state level among only half of the Economies. Most of the Economies also have in place ecosystem-based objectives, targets and indicators to ensure effective EBM-EAF implementation. Although EBM seems to be widely practised among the respondent Economies, only a small number (two Economies) are practising comprehensive EBMs addressing most of the coastal/marine management elements (i.e. seabed pollution, oil and gas industry, climate, human population and demographics, physical destruction and many more), while majority of Economies are practising lesser forms of EBMs perhaps through a sectorally-based framework.

Majority of the APEC Economies are undertaking on-going oceanographic, and marine research and monitoring programs and many Economies to varying degree have taken up measures to produce data on ecosystem. However, data-sharing mechanism has proven to pose some difficulty within the Economies where most do not have an integrated online data exchange portal. There is a wide range of cooperative and collaborative networks on marine science for the purpose of improving information, and data collection and exchange, that can be implemented by APEC Economies; and this would not pose a limitation to developed Economies but developing Economies might need to address and overcome several challenges (mainly with regard to funds, time and expertise) before being able to undertake effective and efficient data/information collection, analysis and dissemination.

Most Economies have been undertaking a variety of measures to preserve marine ecosystem and many have emphasized on awareness building programs where majority of such programs are

carried out at the Economy and state level. A large number of Economies undertake a range of plans and programs under the various conservation and restoration efforts that involves the participation of stakeholders. However, many Economies face challenges in gaining stakeholders' understanding of the significance of EAF and EBM. These issues include lack of awareness of current data and information on stocks, current fisheries management efforts, and the various inter-agency relationships and mandates.

A high number of Economies allocate funding to promote EBM and EAF in their Economies and the fundings are generally mandated in the legislation of some Economies while others have set up separate financial schemes for this purpose. Economies are also seen utilising a broad range of tools to assist in the implementation of EAF and EBM. The needs, priorities and aspirations of different Economies with regard to EBM and EAF influence the adoption of different mechanisms and approaches. However, it can be generally observed that higher level of tool utilisation prevails amongst developed Economies compared to developing or emerging Economies.

Decision making processes in majority of the Economies with regard to EAF incorporate findings from fish biology studies in fisheries management. Nonetheless, mapping of habitat and eco-region, which is an important approach to EAF is not widely practised among Economies. This might be due to the challenges in achieving mapping of habitat and fishery assessment survey arising from lack of extensive resource, time and specialised skill-sets among almost all the APEC Economies. Similarly, fishery quota, objectives and indicators are not widely provided for within APEC fisheries management approaches. Other downfalls of fish stock management include lack of comprehensive and accurate data on landings and rate of effort within APEC Economies.

Generally, most of the APEC Economies practise fishery management measures to avoid adverse ecosystem impacts and reduce by-catch. There is also a high level of commitment among Economies towards ensuring sustainable fishing practices. However, these Economies are yet to implement comprehensive and sustainable programs to achieve this. Most of the fishery assessments and sustainability of certification processes are however focussed on single species fisheries management and the move towards multiple species fisheries management is yet to be realised.

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