GLOBE Action Plan for Coral Reefs

GLOBE INTERNATIONAL

International Commission on Land Use Change and Ecosystems

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GLOBE Action Plan for Coral Reefs

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Top: GLOBE delegates in Copenhagen, 2009 © GLOBE International
Middle: Multi-coloured corals in Papua New Guinea, 2004 © Mila Zinkova
Bottom: Beach-seine artisanal fishing in India, 2010 © Simon Harding

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Executive Summary

I. Coral reefs are one of the world's most threatened ecosystems, with the effects of global climate change and direct human impacts threatening to alter them irrecoverably. The most effective management approach to safeguard these ecosystems is to significantly reduce all direct human impacts on them in order to build their resilience to the long-term effects of climate change, as well as joining the international calls to significantly reduce 'greenhouse gas' emissions and stabilising atmospheric CO_2 concentrations at a safe level for coral reefs.

This action plan provides international legislators and policymakers with clear and targeted actions to build resilience in tropical shallow-water coral reef ecosystems and in the people that rely on them.

II. The Global Legislators Organization for a Balanced Environment (GLOBE International), in collaboration with the Zoological Society of London (ZSL) and in consultation with the wider coral reef conservation community, has developed a range of recommendations to guide legislators and policy makers in creating and implementing environmental policy for coral reef ecosystems. GLOBE serves as a direct channel for communication between scientists, the conservation community and policymakers, and works with legislators to implement recommended legislation and policies in their countries.

III. A key aim of the initiative is to promote 'win-win' policies that increase the ecological resilience of coral reefs while boosting the social resilience of the communities and stakeholders that depend on them.

IV. The introduction section explains current scientific understanding of why there is a coral reef crisis, the social and economic importance of saving coral reefs, and **the urgent need for political action**.

V. **Part One** of the coral reef action plan lays out measures to address **direct human pressures** on the coral reef environment through legislation, policies and implementation. It contains 3 main objectives, to: (1) Sustainably manage fishing; (2) Manage watersheds and water quality to reduce pollution; and (3) Increase marine protected area coverage and effectiveness.

VI. **Part Two** of the action plan proposes measures to **increase governance, management capacity and awareness**, all fundamental requirements for effective implementation of the measures in part one. There are two main objectives, to: (1) Increase effective management and governance; and (2) Increase environmental education and awareness.

VII. **Part Three** suggests ways to **finance and coordinate** the GLOBE action plan for coral reefs, recommending current and emerging funding mechanisms and providing suggestions on how best to coordinate action at the national and regional level

VIII. GLOBE International's action plan for coral reefs provides a framework for smart investment in coral reefs and associated coastal ecosystems by adopting an ecosystem-based adaptation approach that encompasses both social and ecological aspects of the tropical marine and coastal environment. By acting now to reduce our impacts and dependence on coral reef ecosystems we can provide a buffer to some of the long-term effects of climate change, reduce adaptation costs and contribute to achieving poverty reduction and sustainable development goals.

1 Introduction

This action plan provides international legislators and policymakers with clear and targeted actions to build resilience in tropical shallow-water coral reef ecosystems and in the people that rely on them. The recommendations have been produced in close consultation with the coral reef scientific and conservation community to ensure the latest research and understanding of the coral reef crisis and the requirements to effectively address it are taken into account.

1.1 Coral reefs in crisis

Tropical shallow-water coral reefs are critically threatened by the synergistic effects of climate change and direct human impacts. Climate change is recognised as the most serious long-term threat to coral reefs[1]. Current atmospheric carbon dioxide (CO_2) concentrations and global temperature changes have already considerably damaged coral reefs globally, and these negative impacts are rapidly escalating as CO_2 emissions rise. Temperature induced mass coral bleaching started when atmospheric CO_2 levels exceeded 320 ppm[2], and the process of ocean acidification has already begun to affect marine life especially in the deep ocean[3] and in polar waters[4]. When the global average temperature rise exceeds 2°C (expected to occur when CO_2 concentrations reach 450 ppm), mass coral bleaching events will become unsustainably severe and frequent, putting coral reefs at increased risk of widespread mortality[2,5,6]. If atmospheric CO_2 levels reach 500 ppm, ocean acidification will severely reduce the calcification rates of tropical corals and coral reefs will start to structurally collapse as reef erosion exceeds growth[5]. A CO_2 concentration of **450 ppm is regarded as a critical threshold, beyond which corals will not have the ability to maintain the complex structures we know today as coral reefs**. The majority of coral reef experts consider this is the point of no return for coral reef ecosystems. For coral reefs to survive as a functioning ecosystem, CO_2 levels must peak at or below 450 ppm and then be reduced over time to less than 350 ppm, regarded as a safe level for coral reefs[2,6]. **A peak at or below 450 ppm is still technically and politically achievable**.

The coral reef crisis is also a crisis of governance[7]. Unfortunately, all but the most remote coral reefs have been heavily impacted by direct human pressures (Box 1). An estimated 19% of the world's reefs have already been lost through the human actions, with a further 35% predicted to be lost in the next 20 to 40 years if such pressures continue unabated[8]. In some regions, such as south-east Asia and the Western Pacific, the amount of coral lost over the past 40 years may be even greater (30-50%)[9]. Overfishing, destructive fishing practices, coastal pollution and coastal development account for most of these direct impacts, which not only destroy and degrade coral reefs but also considerably reduce their resilience to the impacts of climate change. Resilience refers to the ability of an ecosystem to absorb, resist or recover from disturbances while maintaining key functions and processes[10]. A degraded environment, whether natural or human-induced, has a strong influence on reef resilience[2]. **If these direct human impacts are not significantly reduced on a global scale, the continued loss of ecosystem resilience will create a much greater risk of ecosystem collapse even before the 450 ppm climate-based tipping point is reached.**

At current emission rates, 450 ppm CO_2 will be reached between 2030 and 2040. If emissions are successfully reduced so that CO_2 levels peak at or below 450 ppm and ecosystem resilience is enhanced, coral reef ecosystems may persist (although in many areas they would be degraded and highly vulnerable) and still be able to support a reduced level of sustainable use. Alternatively, if emissions are not reduced and the 450 ppm threshold is exceeded, coral reef ecosystems will be committed to eventual collapse over the next 30-50 years. In this scenario, drastic reduction of direct human impacts will act as a buffer to climate change effects, slowing coral reef degradation and buying crucial time for reef-dependent communities to adapt. Both situations demand critical action now to increase coral reef resilience to the effects of climate change by significantly reducing direct human impacts.

It is clear that coral reefs are in crisis, and saving them will require dramatic reduction of direct human impacts over the next decade, to increase their resilience to the effects of climate change in the 21st century. If we take this choice it will be a significant step to saving coral reefs and providing a chance for ecosystem

recovery next century. This step should also go hand-in-hand with mitigation measures to significantly reduce emissions and stabilise atmospheric CO_2 concentrations to a safe level for coral reefs.

Box 1: Direct Human Impacts on Coral Reefs

Overfishing is the harvesting of fishes and invertebrates beyond sustainable yields and the use of damaging practices (e.g. blast and cyanide fishing). Many coral reefs are now overexploited. Overfishing can remove the herbivorous fish critically needed to prevent algae outcompeting corals, which can lead to phase shifts as well as limiting reef recovery after bleaching events.

Sediment pollution results from poor land use practises, deforestation, and dredging. The rate of sediment release is increasing with growing urban populations, agriculture and aquaculture. Sediments can reduce light availability to photosynthetic corals and increase disease rates, limiting coral growth and reef recovery rates.

Nutrient and chemical pollution results from organic and inorganic chemicals carried with sediments, in untreated sewage, and waste from agriculture and industry, including complex organics and heavy metals. Excess nutrients favour the growth of microorganisms and algae, particularly when herbivorous fish populations are reduced by overfishing.

Development of coastal areas for urban, industrial, transport and tourism use, including land reclamation and the unsustainable mining of coral reef rock and sand, often causes extreme modification or direct destruction of coral reefs. These processes destroy or significantly degrade coral reef habitats.

(Adapted from the top ten threats and stresses to coral reefs in Wilkinson et al. (2004)[11])

1.2 The value of coral reefs to humanity

Tropical coral reef ecosystems represent just 0.2% of the oceans in area but are **the world's most diverse marine ecosystems**, harbouring an estimated 1-3 million species, including one third of all described marine species[12,13] and more than a quarter of all marine fish species[14]. Coral reefs are also critically connected to other coastal and marine ecosystems such as mangroves and seagrass beds, which provide nursery grounds for many marine species, nutrient cycling, and the removal or storage of wastes from human activities[15].

More than 100 countries have coastlines with coral reefs[15] and half a billion people depend to some degree on the goods and services provided by them[8]. Coral reefs have an estimated value of **US$172-375 billion** per annum[16,17,18,19]. They provide food and raw materials, a physical barrier to protect coasts from extreme weather events, help to regulate climate and generate substantial tourism revenue (Table 1, TEEB, 2009). It should be noted that the estimates provided in Table 1 are average values with wide variation according to factors such as remoteness, reef productivity and existing infrastructure, and should not be extrapolated to estimate a national value according to total reef area.

Although it will take significant economic investment to maintain these benefits for humanity over the next fifty years, the costs of inaction are likely to be substantially greater. Annual economic losses in fisheries, tourism and shoreline protection resulting from direct human impacts in the Caribbean alone are projected to reach US $350-870 million each year by 2015[20]. The global 1998 bleaching event caused losses of up to $8 billion in the Indian Ocean alone[21], while the total cost of coral bleaching to 2050 is projected to be more than $100 billion worldwide[22]. The economic cost of ocean acidification is estimated to reach $870 billon annually by 2100 if emissions are not stabilized[23].

Table 1: The value of coral reef ecosystem goods and services

Adapted from TEEB (2009) Climate Issues Update

Coral Reef Ecosystem Services	Value (in US$/ha/year)
Provisioning Services	
Food	**470**
Raw materials	**400**
Ornamental resources	**264**
Regulating services	
Climate regulations	**648**
Moderation of extreme events	**25,200**
Waste treatment / water purification	**42**
Biological control	**4**
Cultural Services	
Aesthetic information	**7,425**
Recreation and tourism	**79,099**
Information for cognitive development	**2,154**

The consequences of inaction for food security, human health and well-being will be immense. For example, in the Coral Triangle region of the Indo-Pacific, failure to address climate change and direct impacts is projected to increase human vulnerability, decrease food security, cause social disruption and threaten security[24]. Damage to coastal community infrastructure caused by decreased coastal protection, a 50% decline in fish provision, subsequent migration inland and loss of livelihoods all threaten to destabilize the Coral Triangle region by mid-century[24]. **At least 30 million of the world's poorest and most vulnerable people in coastal communities are completely dependent on coral reefs** as their primary means of food production, income and livelihood[8]. For these people, coral reef ecosystem collapse will be truly catastrophic for their way of life unless action is taken to reduce their dependence and build their capacity to adapt to reef loss.

1.3 The benefits of action now to increase resilience

To continue to benefit from the essential ecosystem services that coral reefs provide we must invest now in significant measures to enhance reef resilience to climate change. Without action, the cumulative and synergistic effects of climate change and direct human impacts will drive coral reef ecosystems into a highly degraded state. These shifts have already occurred on coral reefs exposed to chronically high levels of human pressure[11,25,26]. However, there is evidence that reducing the effects of overfishing and pollution can prevent this shift and **reefs with fewer direct threats are more able to cope with the effects of climate change[27]**. For example, research has shown that coral reefs with healthy fish communities have significantly better rates of coral recovery after bleaching events[28]. Water quality along coastlines is also a critical factor in coral recovery[11]. Specific measures to improve coral reef resilience must address governance, awareness and political will as well as direct human pressures[11]. Sufficient and appropriate management is lacking in many coral reef nations, making it imperative to build capacity to implement the management interventions required[11]. Existing national plans for coral reef and coastal zone management need to be supported to enable effective implementation involving all relevant government departments. Where these plans are inadequate, emphasis must be put on revising and updating them to take into account the urgent need for action. The importance of local plans to improve management must also be fully recognised and supported at the sub-national or national level.

Investment now to increase coral reef resilience will provide long-term benefits to society through the continued provision of marine resources and ecosystem services in perpetuity. Communities most vulnerable to climate change impacts are those whose livelihoods, well-being and survival depend on the integrity of marine and coastal ecosystems. Coastal ecosystems, including tropical coral reefs, protect coastal communities from extreme natural events such as storms and tsunamis and provide communities with critical resources for livelihoods, income and food. Effective management of coastal ecosystems will slow and minimize the decline of these resources resulting from climate change impacts[24]. Long-term

investment for integrated programmes that address human impacts on coral reefs and their drivers using a range of measures is critical.

The long-term benefits provided by safeguarding coral reef ecosystem services will be complemented by investing in win-win social adaptation measures to reduce both dependence and impacts. For example, **developing appropriate alternative livelihoods and food sources will help reduce dependence on coral reefs while simultaneously reducing human pressure on reefs.** Alternative food sources from sustainable agriculture and aquaculture practises to relieve fishing pressure plus a diversification of livelihoods including the use of sustainable tourism where viable all require further investigation at the local and national level. Substantially increasing coral reef resilience coupled with reducing emissions will have profound social benefits such as stabilized food security, fewer social challenges and strengthened regional security[24]. **As climate change threatens to undermine development progress, effectively managed coral reef ecosystems will be essential to attaining agreed poverty reduction and sustainable development goals.**

1.4 Current initiatives and programmes addressing the crisis

The great biological, social and economic value of coral reefs has ensured that they have already received considerable attention from governments, inter-governmental and non-governmental organizations (NGOs). Local, regional and major international NGOs have implemented comprehensive assessment, communication and action programmes to improve coral reef conservation and management. Global networks and regional initiatives have been established to coordinate, fund and implement conservation measures. Key international environmental law, such as the Convention on Biological Diversity (CBD), is incorporating coral reef resilience as a fundamental aspect that needs to be considered as integral to successful ecosystem conservation and management. A number of national and local governments and also local communities have implemented exemplary coastal and coral reef management (see case studies in Appendix 1) and legislation (case studies in Appendix 2). While these successful programmes have achieved much, they are the rare exception on the whole and such initiatives need to be drastically scaled up to fill the gaps in management and governance. **By engaging with and encouraging support for the existing programmes and initiatives** (see below), **GLOBE legislators can make a highly significant contribution to the protection of coral reef ecosystems and the services they provide for humanity**.

The management of tropical coral reefs are addressed in several areas within the CBD. Within the Programme of Work on Marine and Coastal Biodiversity, there is a detailed Specific Work Plan on Coral Bleaching, which was agreed at CBD COP7 in 2004. The 2010 review of the implementation of the Programme of Work on Marine and Coastal Biodiversity noted the threat posed to the survival of coral reefs by climate change, ocean acidification, and degradation. Another major relevant Programme of Work is that on Island Biodiversity, which was adopted in 2006. Implementation activities for this programme are channelled primarily through the Global Island Partnership (GLISPA). Two further work programmes are also relevant, namely Protected Areas and Biodiversity and Climate Change. The next Strategic Plan for the CBD, which will be agreed at CBD COP10, includes coral reefs under Target 10: "By [2020][2015], to have minimized the multiple pressures on coral reefs, and other vulnerable ecosystems impacted by climate change or ocean acidification, so as to maintain their integrity and functioning". Appendix 3 provides further detail on CBD decisions relating to coral reefs.

Founded at the CBD First Conference of the Parties in 1994, **the International Coral Reef Initiative (ICRI) is an informal partnership** among governments, international organizations, and NGOs which promotes implementation of relevant international conventions and agreements and mobilizes governments **to improve management, capacity and political support.** Two ICRI subsidiary organizations, the Global Coral Reef Monitoring Network (GCRMN) and the International Coral Reef Action Network (ICRAN), provide further support for specific activities, namely reporting on the status of coral reefs and enabling action to effectively manage them. ICRI is currently updating its Framework for Action as a basis to achieve the sustainable management of coral reefs and associated ecosystems. The recommendations provided by the

ICRI Call to Action and Framework for Action provide a sound platform that the current initiative looks to build on and is a key part of national and regional actions that legislators should support.

Major international organisations (e.g. The Nature Conservancy, Conservation International, WWF, Wildlife Conservation Society, World Resources Institute, WorldFish Center) regional marine NGOs (e.g., Coastal Oceans Research and Development in the Indian Ocean (CORDIO)) and smaller mainly coral reef-focused NGOs (e.g. Coral Cay Conservation, Blue Ventures, Coral Reef Alliance, Locally Managed Marine Area (LMMA) networks, Project Seahorse) are engaged in a wide range of coral reef research and management activities such as the designation and implementation of marine protected area (MPA) networks, long-term monitoring, research-for-development, and community-based natural resource management. **These organizations are pioneering conservation and management measures to improve coral reef resilience to climate change.**

A number of global and regional initiatives (e.g. GEF/World Bank Coral Reef Targeted Research and Capacity Building for Management Programme (CRTR), the Global Islands Partnership (GLISPA), ReefBase, Coral Reef Initiatives for the Pacific (CRISP) and the UNEP Regional Seas Programme) promote critical research, communication, capacity-building, and coordination activities in coral reef countries. **Partnerships between governments and NGOs have prompted significant commitments to regional coral reef conservation initiatives**, namely the Micronesia Challenge, Caribbean Challenge, Coral Triangle Initiative and Western Indian Ocean Challenge.

Research to improve the understanding and management of coral reefs is conducted at many universities and institutes around the world. The principle conduit for the dissemination of this information to the public is through the International Society for Reef Studies (ISRS). The Society also produces expert briefing papers on relevant topics that provide a useful synopsis of current understanding and recommendations for management.

Despite these extensive efforts, there are still significant gaps in coral reef knowledge, monitoring and management (summarised in Appendix 4). There is a particular need for better measurement and reporting of management success, particularly through long-term environmental and socio-economic monitoring programmes. Technical and logistical capacity for effective management is severely lacking in many coral reef countries, and long-term financing to build and maintain adequate capacity is critical to success. A detailed overview of current legislation in twelve major coral reef nations highlighting both legislative gaps and best practise is provided in Appendix 5.

1.5 The urgent need for political action

Coral reefs are in crisis, and ensuring their survival within this century will require dramatic and bold steps and strong political leadership. The benefits of swift and effective action now to increase coral reef resilience to climate change are clear and significant steps have already been taken, but major barriers to successful ecosystem management still remain. Legislators have a crucial role to play in removing these barriers, catalysing fast action and ensuring that coral reefs remain for the use of future generations.

Although the initiatives and programmes summarized above have made significant efforts towards protecting coral reef ecosystems from direct human impacts, there are still major barriers to further success at the highest political levels. For example, establishment of national level funding for one of the regional initiatives has been hindered by the need for the introduction of strong legislation to establish sustainable financing mechanisms. Although healthy coral reefs are vital to the economies of many coral reef nations through fisheries and tourism, political commitment to protecting coral reefs is often weak. This is partly due to a lack of recognition within many levels of government of the crucial importance of coral reef ecosystems in providing both social and economic benefits. In addition, major capacity gaps in government departments, particularly those dealing with the environment or fisheries, often means that right advice is not reaching the decision makers.

Legislators have the power to effect real change for the future of coral reefs:

Legislation must be reformed and rationalised for effective management of coral reefs. Lack of communication between government departments and a fragmented approach to policy-making for the coastal zone have lead to both gaps and overlaps in legislation, inefficiencies and conflicting priorities. For example, in some cases, fishing licences are granted at the national level that allows fishing in community-based marine reserves which are covered by local legislation. A more integrated approach to coastal zone management is required which will establish robust and ambitious policies and rationalise existing and new legislation.

Coral reef ecosystem-based management must be a top priority within government. At present the real social and economic value of coral reef ecosystems is not adequately integrated into government decision-making procedures meaning that there is often a perceived conflict between development needs and sustainable ecosystems management. Ecosystem-based management of coral reefs and closely associated ecosystems must be made a higher priority within government, and funding for sustainable, reef resilience-boosting measures for coral reefs must be dramatically increased.

Swift strategic political action is urgently required at all levels of government. National parliaments must act now to introduce legislation that fills existing gaps in coral reef management requirements and to ensure that government implementation of existing legislation is effective and comprehensive. Governments should also recognise that they may not initially have the human capacity required for comprehensive implementation and a more strategic and integrated management approach may be necessary according to national coral reef priorities.

A strong mandate for reform and greater scrutiny of government implementation is required. Many coral reef countries will require significant investment to build capacity and improve governance in order to ensure that legislation on specific coral reef management issues is effectively implemented. It is the responsibility of legislators to provide government agencies with the mandate and the resources to protect coral reef ecosystems within their jurisdiction and the communities which depend on them.

Greater cooperation is required between coral reef nations to build capacity and coordinate effective and efficient management. International collaboration between coral reef nations, neighbouring countries, and the international community is essential for funding, capacity building, knowledge dissemination and coordination of management activities. Parliaments must ratify and adopt robust implementing legislation for all international and regional agreements relating to coral reef ecosystem conservation and management and hold governments to account for international commitments.

Legislators must provide the political leadership necessary for coral reefs and support governments in taking ambitious action to ensure ecological and social resilience for the future. Policymakers must begin planning now for social adaptation to climate change, particularly through win-win measures that reduce both human dependence and impacts on coral reef ecosystems. Our planet is on an irreversible path to a high level of climate change impacts on coral reefs which will have serious consequences for the ecosystem and the services it provides for humanity, irrespective of future emission levels. The full socio-economic consequences of these impacts (e.g. health, food security, poverty and migration) will need further consideration and fall outside of the remit of this initiative. However, we can ensure that coral reefs are in the healthiest, most resilient condition possible to face the effects of climate change by following the course of action laid out in this document.

An increase in policymakers', engagement and support for effective coral reef conservation and management will be critical for financing and implementing the measures required to save coral reefs. **Legislators have a key role in supporting and expanding efforts to reduce direct human impacts on coral reefs to make them – and humanity – more resilient to the impacts of global climate change.**

2 Action Plan for Coral Reefs

This section provides specific policy recommendations that will collectively act to reduce direct impacts on coral reef ecosystems. The recommendations are focussed on five core objectives to increase coral reef resilience: sustainable fishing, managing land-based activities to reduce coastal pollution and habitat loss, increasing the coverage and effectiveness of marine protected areas, improving coral reef management and governance and increasing environmental education and awareness of coral reefs.

The first part (2.1) of the action plan lays out measures to address direct human pressures on the coral reef environment through legislation, policies and implementation. Part two (2.2) proposes measures to increase governance, management capacity and awareness, all fundamental for the effective implementation of measures in part one. Part three (2.3) suggests ways to finance and coordinate the coral reef action plan.

Policy and implementation recommendations are categorised according to a phased approach over the ten year period (2011-2020). In addition the first two years should be regarded as a preparatory phase for particular aspects of the strategy that require assessment at the national and regional level prior to implementation. The recommendations are also provided as a strategic plan (Appendix 5) with specific actions alongside suggested indicators of success for each action.

The recommendations provide a global list of required actions and do not necessarily apply to all nations containing coral reefs. We encourage nations currently lacking comprehensive management plans for their coral reefs to use the strategic plan in Appendix 5 as a template to produce an appropriate national action plan to meet their requirements. The phased approach also enables nations to pick up policy recommendations at different stages depending on existing national progress.

Most of the recommendations can also be regarded as part of a coastal ecosystem-based adaptation approach to climate change, which integrates both biological and social resilience. This is achieved by managing and protecting ecosystems such as coral reefs so that they continue to provide both livelihood resources and protection from extreme events for coastal communities and stakeholders. There is growing evidence that ecosystem-based adaptation (EBA) may be a cost-effective method for climate change adaptation[29,30]. The use of frameworks for assessing ecological[1] and social[31] systems and their resilience will form a key part of any EBA approach.

An Assessment of Global Priorities

At the global level there are number of reef types, regions and scenarios that are considered to be key priorities for effective coral reef conservation and management. These should be prioritised for action within each national or regional plan:

- Source reefs important for re-populating ‘downstream’ reef systems, especially major reef fish spawning aggregation sites;
- Resilient reefs with highest ecological functionality or value of ecosystem services;
- Uninhabited/remote (near pristine) islands and atolls – important refuges from human impacts and control sites for research;
- Reefs on the edges of their geographic or biological range – most able to adapt to new conditions;
- Areas or communities particularly vulnerable to climate change effects such as rising sea levels or temperatures or increased storm damage;
- Regions with high predicted coastal population growth and reef dependence combined with poor management and low adaptive capacity;
- Areas of limited habitat associated with specific ecological communities. These include outer reef/shelf drop-off areas, home to unique deepwater fish assemblages and increasingly exploited as shallow waters become overfished.

2.1 Addressing Direct Human Pressures

Key policy recommendations required to increase coral reef resilience to climate change through reducing direct impacts are provided by the first three objectives. There are linkages between many direct impacts that can have a combined or even synergistic effect on reef condition. For example, overfishing of herbivorous fish coupled with eutrophication of coastal waters provides ideal conditions for algae to outcompete and smother corals on reefs. It is therefore critical that all three objectives are tackled for each coral reef region or nation. It is also important to tackle these impacts both at the local, sub-national and national level, but particularly through community-based management approaches with stakeholder buy-in. The targets set for each objective are ambitious but necessary given the short time available before the 450 ppm threshold is reached.

Objective 1: Sustainably Manage Fishing

Target: By 2020 half of all fishing / resource extraction on coral reefs is conducted at biologically sustainable levels based on clearly defined indicators and with regular monitoring of key target commercial species.

Policy Recommendations:

Phase 1:

- Increase enforcement capacity to implement existing bans on destructive fishing practices;
- Implement national stock assessments of keystone species and key reef fish and invertebrate species targeted by commercial and artisanal fisheries, and by the aquarium and curio trades;
- Remove harmful subsidies to fisheries and reduce fishing effort on over-exploited stocks;
- Adopt and implement the FAO Code of Conduct for Responsible Fisheries at the national level;
- Conduct socio-economic analyses to determine the value of commercial and artisanal reef fisheries and aquaculture to local economies and society as well as wider stakeholders;
- Conduct vulnerability assessments to identify vulnerable groups and underlying social and economic drivers of overfishing;
- Identify viable and appropriate options for sustainable livelihood activities in reef dependent regions.

Phase 2:

- Ban all destructive fishing practices and ensure there is sufficient management capacity to effectively enforce bans through local and national legislation;
- Revise existing or develop new regulations to implement sustainable ecosystem-based fisheries management plans locally (using community-based approaches) and nationally (following FAO guidelines[32]) with effective enforcement;
- Develop and implement regulations for threatened species of fishes and invertebrates and plan for their recovery using species-specific national action plans;
- Adopt sustainable ecosystem-based management approaches, including setting targets and identifying indicators for sustainable fishery operations, and monitor these targets;
- Implement programmes to diversify and enhance livelihoods in reef dependent regions, based on sustainable (ecologically, socially, economically) activities (both reef-based and other alternatives) supported through microfinance and capacity building;
- Where necessary, implement policies to support local reef fish food security through market and trade measures.

Objective 2: Manage Watersheds, Water Quality and Reduce Pollution

Target: Comprehensive watershed and coastal water quality management plans that reduce pollution to half of 2010 levels by 2020 are implemented for all major pollutants, especially those that cause eutrophication, have sublethal effects on corals (e.g. affect reproduction), lower seawater pH or have other negative impacts (including Persistent Organic Pollutants).

Policy Recommendations:

Phase 1:

- For all major watersheds linked to coral reefs identify the level of management required to draw up integrated watershed management policies;
- Identify natural and legal watershed boundaries and determine what nations, sectors or communities have legal jurisdiction over these areas;
- Identify the main point and diffuse sources of all pollutants on coral reefs;
- Develop legislation to reduce the levels of all major pollutants to at least half of 2010 levels by 2020;
- Set up comprehensive national monitoring programmes for riverine and coastal water quality;
- Redefine international shipping lanes to avoid coral reef areas and improve the monitoring of merchant vessels in national waters;
- Develop national management strategies for large-scale marine pollution incidents such as oil leaks;
- Support the establishment and implementation of polluter pays legislation for coral reefs;
- Establish best practice standards for mariculture operations conducted in or adjacent to coral reefs;
- Ratify and adopt robust implementing legislation for the Stockholm Convention on Persistent Organic Pollutants, the Global Program of Action for the Protection of the Marine Environment from Land-based Activities (non-binding global agreement), and the International Convention for the Prevention of Marine Pollution from Ships (MARPOL);
- Ratify regional Conventions and Protocols for the protection of the marine environment against land-based pollution.

Phase 2:

- Implement watershed management policies involving afforestation, runoff-reduction, sustainable agriculture methods, reduction of pesticide, herbicide, fertiliser and other agrochemical use;
- Set up trans-boundary watershed management bodies;
- Declare, through the International Maritime Organisation, coral reef regions of outstanding ecological value as Specially Sensitive Areas, prohibiting transport of hazardous cargo through these waters;
- Encourage all coral reef states to ratify and implement the IMO Ballast Water Convention with support from the GloBallast Partnership;
- Implement national management strategies for large-scale marine pollution incidents;
- Implement best practice standards for mariculture operations conducted in coral reef or adjacent environments;
- Ensure that water quality control and coastal zone building and industry regulation are integral parts of sustainable coastal planning legislation both locally and nationally that require Environmental Impact Assessments (EIAs) which are:
    - Conducted for all coastal development with a full peer-review;
    - Followed through so that all development projects identified by EIAs to have a negative impact on coral reefs are refused planning permission, relocated, or provide sufficient mitigation for any environmental damage caused.

Objective 3: Increase Marine Protected Areas Coverage and Effectiveness

Target: 30% of the world's coral reefs are under effective management in no-take marine protected areas by 2020 using a range of management approaches.

Policy Recommendations:

Phase 1:

- Conduct national and regional assessments of tropical MPA management effectiveness, coordinated through existing projects and in areas that are currently unmonitored;
- Implement existing national legislation that support MPAs, including locally managed marine areas (LMMAs), and improve MPA management so that marine paper parks are converted into effective MPAs that meet their management and broader ecological objectives;
- Identify the increase in MPA coverage required at the national level to meet the 30% target;
- Ratify regional Conventions and Protocols concerning protected areas and protection of marine natural resources;
- Ensure existing legislation that supports MPAs is understood and supported by user communities and stakeholders.

Phase 2:

- Support collaboration between existing regional coral reef initiatives to help meet the 30% target;
- Implement national plans to increase no-take MPA coverage to 30% of coral reef area;
- Ensure MPAs and MPA Networks protect biologically meaningful regions of known value to fisheries (such as spawning aggregation sites), conservation and communities;
- Integrate ecological and social resilience factors into MPA network designation and management to help 'future proof' them against climate change effects;
- Ensure that national legislative frameworks recognise the legitimacy of community-based marine protected areas and their management systems and devolve sufficient authority for effective community co-management of resources;
- Increase coverage of no-entry MPAs at the national level to 10% of coral reef area.

2.2 Increasing Governance and Management Capacity

There is a clear and pressing need in many coral reef nations to significantly build capacity, strengthen governance and increase environmental awareness at all levels. In particular, community-based management at the local level must play a key role in enabling the first three objectives to be met, and this needs to be officially recognised both at the sub-national and national level.

Objective 4: Increase Effective Management and Governance

Target: Effective management strategies for coral reef governance and enforcement are designed and implemented at the national and regional level by 2020.

Policy Recommendations for Building Capacity:

Phase 1:

- Synthesise existing knowledge to complete an assessment of current national capacity and the increase in logistical and technical capacity required for the level of management and enforcement needed to achieve objectives 1-3;
- Review existing national management structures for fisheries and conservation management to identify areas where management could be improved;

- Compile existing training manuals, guidance materials and other "how to" knowledge products addressing priority management issues through a 'one-stop shop' website for coral reef management agencies (e.g. ICRI Forum, ICRAN, or Reef Resilience) and disseminate hard copies to those without web access;
- Initiate and support efforts to translate key coral reef management training literature into 9 languages to increase accessibility to local resource managers and government agencies (English, French, Spanish, Portuguese, Chinese Mandarin, Filipino (Tagalog), Indonesian, Thai, Arabic);
- Provide and increase support to existing national, regional and international networks and mechanisms for knowledge management and information exchange for improved intra-national and trans-boundary cooperation.

Phase 2:

- Implement an international training programme in priority management tools and interventions, incorporating existing regional or international initiatives, that will conduct regional workshops biannually in regional nodes and train enough local resource managers by 2020 to meet the management and enforcement needs of each region;
- Increase national technical capacity to manage coral reefs through degree level training in multidisciplinary studies (e.g., ecosystem-based management, marine and social sciences) and the recruitment of matriculated staff into management positions with on the job training;
- Develop mechanisms to feed science into management including scientific advisory committees with accessible experts, identification of priority information needs for management, regular policy briefs with management recommendations and newsletters with the latest learning, facilitated discussions between scientists and decision makers;
- Increase logistical capacity (monitoring and communication infrastructure, equipment, etc.) to meet national needs for required types of management and enforcement (top-down or bottom-up);
- Scale up, support and build upon programmes of regional cross-visits for local resource managers and government agencies;
- Facilitate the participation of resource and conservation managers in cross-discipline training at the local and national level;
- Enable and increase levels of community-based management in areas with minimal capacity and infrastructure, backed by co-management agreements with local government and NGOs to set up community-led management and enforcement programmes with appropriate training and support.

Policy Recommendations for Improving Governance:

- Implement effective enforcement systems for MPA and fisheries management locally, nationally and regionally with appropriate penalties to deter further infringements and full stakeholder involvement at the local level to ensure community support and ownership. Ensure all enforcement chain components are strong (detection, arrest, prosecution and sanctions), that there is a sound regulatory framework and sufficient stakeholder awareness efforts regarding regulations;
- Establish international collaboration and regional agreements to reduce IUU fishing in the Exclusive Economic Zones of coral reef nations by:
    - eliminating markets for illegally caught fish through strengthening market-based measures to effectively control the trans-boundary movement of products;
    - coordinating MCS and enforcement activities including intelligence gathering on illegal fishers (also see GLOBE Marine Ecosystems Recovery Strategy Part I: Marine Fisheries);
- Establish personnel and review mechanisms within government agencies that have coral reef and fisheries specific mandates, in order to eliminate barriers to progression;

- Hold local, provincial and national, governments or leaders accountable for commitments to local, regional and global initiatives;
- Support the establishment of regional web-based monitoring and reporting systems to assess coral reef ecosystem health and make governance more accountable;
- Increase devolution of management responsibility to local communities using existing or new local legislation, particularly for fisheries and MPAs, especially for remote regions and where capacity is low, within national guidelines and under national supervision.
- Increase federal cohesion for fragmented nation states (politically and geographically) to facilitate the development of national management plans;
- Establish regional commissions to support management of discrete but trans-boundary coral reef ecosystems;
- Clarify legislation and responsibilities for management of marine resources and MPAs between different sectors and levels of government to avoid overlaps and inter-sectoral disputes.

Objective 5: Increase environmental education and awareness

Target: Environmental education and awareness programmes are implemented within both national education systems and through outreach programmes for all coral reef nations by 2020.

Policy Recommendations:

Phase 1:

- Identify and fill gaps in environmental educational materials - develop an international meta database of existing coral reef education materials and awareness raising material;
- Assess local knowledge and levels of school attendance and completion prior to development of environmental education and awareness programmes;
- Develop and implement teacher training programmes to ensure the delivery of the revised curricula;
- Investigate ways to increase the uptake of national curricula for children of tropical coastal communities e.g. subsidising education for the poorest members of society.

Phase 2:

- Integrate information about coral reefs, environmental conservation and sustainable ecosystem-based management into existing curricula at all levels of national education systems;
- Ensure universities and research institutes in coral reef nations offer undergraduate courses in tropical marine biology and conservation and fisheries management;
- Establish national scholarships for students to pursue undergraduate degrees or shorter applied training courses in tropical marine biology, and conservation and fisheries management;
- Develop and implement targeted education and awareness campaigns for both children and adults on how communities and stakeholders can increase coral reef resilience by reducing direct threats.

2.3 Finance and Coordination

Securing Long-term Funding

Securing long-term funding for national or regional action is crucial if countries are to effectively reduce direct human impacts on coral reef ecosystems. National level funding needs to meet the five key objectives above will vary greatly between coral reef nations depending on their specific requirements. We recommend that these financial needs are estimated by governments within the preparatory phase of the action plan whilst suitable funds and financing mechanisms are simultaneously explored and identified. A large range of funding sources is potentially available to coral reef countries which can be split into two main categories; Donor-based funding and Innovative and Market-based funding:

1. **Donor-based Funding Sources**

- **Climate change related** (Also see Table 6.4 in the 2010 World Development Report[33])
  Examples include the UNFCCC Adaptation Fund, the German Government's International Climate Initiative (ICI), the World Bank's Climate Investment Fund's Pilot Programme for Climate Resilience (PPCR) and the European Union's Global Climate Change Alliance (GCCA).
  Funding from the Global Environment Facility, namely the GEF Small Grants Programme (SGP), which is part of the Strategic Priority on Adaptation (SPA). This supports community-based adaptation (CBA) interventions that increase resilience to the adverse impacts of climate change of vulnerable countries, sectors, and communities. CBA interventions are also funded by the two funds managed by GEF that are part of the UNFCCC — the Least Developed Countries Fund and the Special Climate Change Fund.
- **Watershed management and pollution related** - The GEF International Waters programme provides funding to improve the management of trans-boundary water systems and increase multistate cooperation in reducing coastal pollution (and rebuild marine fisheries). Another GEF programme, the Land Degradation Strategy, can also contribute to improving coral reef ecosystems through the management of land-use practices and watersheds.
- **Biodiversity-related funding** - The GEF is one of the main sources of explicit biodiversity funding, for the conservation and sustainable use of biodiversity and the maintenance of ecosystem goods and services both within and outside of (marine) protected areas. This funding is also available to strengthen management and capacity building related to ecosystem conservation.
- **Development-related funding** – available from a mix of bilateral aid agencies and multilateral agencies including the World Bank. Such funding is suitable for capacity building and environmental education needs in national and regional action plans for coral reefs but also qualifies for use as part of coastal management programmes within agreed development plans. Protection of coral reef ecosystems should be written into the national development plans of coral reef nations.

2. Innovative and Market-based funding sources:

- Payments for ecosystem services (PES) schemes for tropical coastal ecosystems including REDD-type approaches for coastal carbon sink ecosystems associated with coral reefs such as mangrove forests and sea-grass beds (blue carbon initiatives);
- Establishment of dedicated national level Trust Funds for protected area management, enabled through legislation to generate revenue from various economic instruments and from trust fund financing from donors to launch the fund and then supplemented through other mechanisms including those below:
- Revenue through direct user fees for access to on-site benefits in marine parks and reserves or through stakeholder taxes for coastal zone access;
- The use of environmental bonds for climate resilience and adaptation projects such as the World Bank Green Bond or the Great Barrier Reef Foundation's Coral Reef Bond;
- Private sector partnerships such as Marine Conservation Agreements (MCAs) including private marine parks that may involve compensation for local resource users, or self-financing Marine Protected Areas;
- Polluter pays principle (PPP) for both chronic and acute pollution of coral reef ecosystems, incorporating upstream polluters in watersheds or in neighbouring coastal countries;
- Other fees or green taxes that would specifically generate money to capitalise the funds

Of the above categories the climate change adaptation funds will be a key target for enhancing coral reef resilience and enabling social adaptation over the long-term. Other forms of funding which are more market-based, such as PES or blue carbon schemes are currently in their infancy but are also expected to provide significant funding within the next decade.

New, dynamic and innovative funding mechanisms will also be needed to ensure sufficient funds are available to meet the scale of the proposed action. An area to be further explored is the involvement of the private sector in tropical coastal ecosystem management through direct funds, incentives, compensation payments or user fees, particularly tourism but also other marine resource extraction industries such as fishing, oil and gas or mining. Setting up new mechanisms will however be dependent on the existing available infrastructure and institutional capacity. Bilateral or unilateral funding mechanisms are also options for raising revenue through 'green taxes' for sustainable development and adaptation linked to tropical coastal zone management. One example could be an increased use of ticket levies on national-bound air tickets to specifically finance coral reef ecosystem-based adaptation programmes.

A recent initiative is one currently being planned to set up national level Trust Funds for Protected Area Management in the Organisation of Eastern Caribbean States (OECS) countries with donor support to a regional endowment with national level sub-accounts. Once legislated, these national level PA accounts can generate revenues from domestic sources to match regional funding and build up an endowment for sustainable financing of Marine and other Protected Area Networks. Without legislation to support the necessary legal and institutional financial framework these challenge grants will be ineffective.
Creativity as well as political will is required to determine opportunities to generate sustainable financing in support of coral reef conservation. Developing long-term business plans that identify the funding required and the specific strategies to raise those funds which can be realistically implemented are needed. Further information and advice on sustainable and innovative conservation financing is available from the Conservation Finance Alliance.

Existing bottlenecks to funding including institutional, governance, economic challenges must be removed to ensure funds reach their target user groups in a timely manner. Many of these bottlenecks will be addressed through capacity building within national government departments but assistance from external partners such as NGOs may be required in the initial stages to ensure funding is firstly secured and then maintained through adequate reporting and administration in country. Existing finance instruments will also need to be reformed to increase their efficiency and cope with the required scale-up. Securing 'matching funds' in country to meet a particular donor's criteria can also be an issue for developing countries that delays action.

Recommendations:

- Establish a cross-cutting working group involving government departments (including fisheries, environment, development and finance) to estimate the cost of the action plan at the national level;
- Ensure all coral reef states have the technical and logistical capacity to secure and maintain long-term sources of funding such as climate change adaptation funds;
- Strongly support the implementation of comprehensive and diverse financing schemes for coral reefs. Explore opportunities for innovative financing such as the use of environmental bonds linked to PES initiatives, creation of trust funds, development of biodiversity offsets and compensation, green taxes and fees and new market mechanisms to ensure adequate annual cash flow to meet conservation needs effectively and maintain investments into the future;
- Remove key bottlenecks and improve access to funding throughout the length of the action plan through capacity building and streamlining of funding processes;
- Encourage smaller states to join forces in regional initiatives to seek funds and implement management projects;
- Demonstrate the economic importance of coastal fisheries to communities and government and work towards encouraging countries to recognize the high value of their marine resources to the local economy and local population;
- Improve the communications and management capability of government departments to ensure funding timelines are followed and deadlines are met.

Coordination of Coral Reef Management

The coordination and implementation of national and regional action should be responsive to emerging science and follow the principles of adaptive management and the Precautionary Approach within an Ecosystem-based Adaptation framework with continued review, joint learning and exchange of ideas between science, policy and management. Setting up of national and regional systems for information exchange and timely reporting is a key aspect to ensure plans are working well and that targets can be met.

Target: Effective coordination for coral reef management is in place at the national and regional level by 2020.

Recommendations:

- Integrate national coral reef management plans into existing national mechanisms such as National Adaption Programmes of Action (NAPAs), National Biodiversity Strategies and Action Plans (NBSAPs) and broader national priorities such as poverty reduction and sustainable development strategies (including those for population and health, coastal development and food security). For example, NBSAPs should include coral reef plans with specific targets and be more legally binding;
- Increase national representation and participation of coral reef countries in the UNEP Regional Seas Programme and in ICRI so that all nations are ICRI members and take an active role;
- Use existing international and regional conservation programmes and initiatives to implement the action plan where cross-over occurs;
- Ratify all relevant regional Conventions and Protocols related to the protection of the marine environment. For most coral reef regions there are a number of Conventions and Protocols related to environmental protection, pollution (including land-based sources), protected areas and wildlife;
- Review fishery management plans, identify where shortfalls could be addressed and why fishery regulations are often ignored or poorly implemented;
- Identify parts of the action plan that are not currently covered by ongoing conservation programmes and initiate new collaborative projects to address or incorporate them into existing programmes;
- Designate an organisation, initiative or new steering group to provide technical support to national focal points to integrate the GLOBE recommendations into existing or new national coral reef management plans as appropriate, and to provide global coordination support to manage and track the process from 2011;
- Establish strong networks to share best practise at a range of scales between large-scale regional initiatives and between different disciplines in research, management and policy;
- Develop a clustered approach to co-ordination for implementation and management involving governments, all relevant regional management bodies and main research and management organisations involved in coral reef conservation;
- For each coral reef nation and region identify and prioritise the actions needed to meet the objectives and targets by the end of 2012;
- Provide sufficient support to ensure national, and later, regional coral reef task forces are in place and are maintained subsequently;
- Support the World Commission on Protected Areas to record all MPAs and their effectiveness in Google Oceans;
- Establish national and regional reporting programmes, with accessible information storage mechanisms, for the exchange of coral reef datasets to encourage timely reporting to key global assessment processes supported by international conventions.

References

(1) Maynard, J.A., P.A Marshall, J.E. Johnson, & S. Harman (2010) *Building resilience into practical conservation: identifying local management responses to global climate change in the southern Great Barrier Reef*. Coral Reefs 29: 381-391.

(2) Veron, J.E.N., O. Hoegh-Guldberg, T.M. Lenton, J.M. Lough, D.O. Obura, P. Pearce-Kelly, C.R.C. Sheppard, M. Spalding, M.G. Stafford-Smith, & A.D. Rogers (2009) *The coral reef crisis: The critical importance of <350 ppm CO_2*. Marine Pollution Bulletin (58).

(3) Olafsson, J., S.R Olafsdottir, A. Benoit-Cattin, M. Danielson, & T. Takahashi (2008). *Current rates of change in pH and calcium carbonate saturation in the high latitude North Atlantic Ocean.* Presented at the Second International Symposium on the Ocean in a High-CO_2 World, Monaco, October 2008.

(4) Mayewski, P.A. et al. (2009). *State of the Antarctic and Southern Ocean climate system*. Reviews of Geophysics 47.

(5) Hoegh-Guldberg, O., P.J. Mumby, A.J. Hooten, R.S. Steneck, P. Greenfield, E. Gomez, C.D. Harvell, P. F. Sale, A.J. Edwards, K. Caldeira, N. Knowlton, C.M. Eakin, R. Iglesias-Prieto, N. Muthiga, R.H. Bradbury, A. Dubi, and M.E. Hatziolos (2007) *Coral reefs under rapid climate change and ocean acidification*. Science 318: 1737-1742.

(6) Hoegh-Guldberg, O. and J.F. Bruno (2010) *The Impact of Climate Change on the World's Marine Ecosystems*. Science 328: 1523-1528.

(7) Hughes, T.P., N.J. Graham, J.B.C. Jackson, P.J. Mumby & R.S. Steneck (2010) *Rising to the challenge of sustaining coral reef resilience*. Trends in Ecology and Evolution 1282: 8 pp. (in press)

(8) Wilkinson, C. (2008) *Status of coral reefs of the world: 2008*. Global Coral Reef Monitoring Network and Reef and Rainforest Research Centre, Townsville, Australia, 296 p.

(9) Bruno, J.F. and E.R. Selig (2007) *Regional decline of coral cover in the Indo-Pacific: timing, extent, and sub-regional comparisons*. PLoS ONE 2(8).

(10) Nyström, M. & C. Folke (2001) *Spatial resilience of coral reefs*. Ecosystems 4: 406–417.

(11) Wilkinson, C. (2004) *Status of Coral Reefs of the World: 2004.* Australian Institute of Marine Science, Townsville, Australia.

(12) Reaka-Kudla, M.L. (1997) *Global biodiversity of coral reefs: a comparison with rainforests*. In: Reaka-Kudla, M.L., Wilson, D.E. (eds.) *Biodiversity II: Understanding and Protecting Our Biological Resources*. Joseph Henry Press

(13) Reaka-Kudla, M.L. (2001) *Known and unknown biodiversity, risk of extinction and conservation strategy in the sea*. Waters in Peril, 19–33.

(14) Allsopp, M. et al. (2009) *State of the World's Oceans*. Springer, Dordrecht.

(15) Moberg, F. and C. Folke (1999) *Ecological goods and services of coral reef ecosystems*. Ecological Economics 29(2):215-33.

(16) Moore, F. & B. Best (2001) *Coral reef crisis: causes and consequences*. In: Best, B., Bornbush, A. (Eds.) *Global Trade and Consumer Choices: Coral Reefs in Crisis.* American Association for the Advancement of Science (AAAS), New York. p. 5-9

(17) Fischlin, A. et al. (2007) *Ecosystems, their properties, goods and services*. In: Parry, M.L. et al. (eds.) *Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel of Climate Change (IPCC)*. Cambridge University Press, Cambridge, UK, pp. 211-272.

(18) Martínez, M.L. et al. (2007) *The coasts of our world: Ecological, economic and social importance*. Ecological Economics 63: 254-272.

(19) Conservation International (2008) *Economic Values of Coral Reefs, Mangroves, and Seagrasses: A Global Compilation*. Conservation International, Arlington.

(20) Burke, L. & J. Maidens (2004). *Reefs at risk in the Caribbean*. World Resources Institute.

(21) Cesar, H. & C.K. Chong (2005). *Economic Valuation and Socioeconomics of Coral Reefs: Methodological Issues and Three Case Studies*. In Ahmed, M., C.K. Chong and H. Cesar (eds). (2005). *Economic Valuation and Policy Priorities for Sustainable Management of Coral Reefs*. Second Edition. WorldFish Center Conference Proceedings 70.

(22) Cesar, H., L. Burke & L. Pet-Soede. (2003) *The economics of worldwide coral reef degradation*. Cesar Environmental Economics Consulting (CEEC).

(23) L.M. Brander, K. Rehdanz, R.S.J. Tol, & P.J.H. van Beukering (2009) *The economic impact of ocean acidification on coral reefs*. The Economic and Social Research Institute (ESRI) Working Paper No. 282.

(24) Hoegh-Guldberg, O., Hoegh-Guldberg, H., Veron, J.E.N., Green, A., Gomez, E. D., Lough, J., King, M., Ambariyanto, Hansen, L., Cinner, J., Dews, G., Russ, G., Schuttenberg, H. Z., Peñaflor, E.L., Eakin, C. M., Christensen, T. R. L., Abbey, M., Areki, F., Kosaka, R. A., Tewfik, A., & Oliver, J. (2009) *The Coral Triangle and Climate Change: Ecosystems, People and Societies at Risk*. WWF Australia, Brisbane, 276 pp.

(25) Hughes, T.P., Baird, A.H., Bellwood, D.R., Card, M., Connolly, S.R., Folke, C., Grosberg, R., Hoegh-Guldberg, O., Jackson, J.B., Kleypas, J., et al. (2003) *Climate change, human impacts, and the resilience of coral reefs*. Science 301, 929–933.

(26) Bellwood, D.R., Hughes, T.P., Folke, C., and Nystrom, M. (2004) *Confronting the coral reef crisis*. Nature 429, 827–833.

(27) Sheppard, C., A. Harris & A. Sheppard (2008) *Archipelago-wide coral recovery patterns since 1998 in the Chagos Archipelago, central Indian Ocean*. Marine Ecology Progress Series 362, 109-117.

(28) Hughes, T.P., M.J. Rodrigues, D.R. Bellwood, D. Ceccarelli, O. Hoegh-Guldberg, L. McCook, N. Moltschaniskyj, M.S. Pratchett, R.S. Steneck, & B. Willis (2007) *Phase shifts, herbivory, and the resilience of coral reefs to climate change*. Current Biology 17: 1-6.

(29) Hale, L. et al. (2009) *Ecosystem-based Adaptation in Marine and Coastal Ecosystems*. Renewable Resources Journal 25: 21-28.

(30) The World Bank (2010) *The Economics of Adaptation to Climate Change*. Final Synthesis Report – Final Consultation Draft. August 2010. The World Bank, Washington DC. 79 pp.

(31) Marshall, N.A., Marshall, P.A., Tamelander, J., Obura, D., Malleret-King, D. and Cinner, J. (2009) *A Framework for Social Adaptation to Climate Change: Sustaining Tropical Coastal Communities and Industries*. IUCN, Gland, Switzerland. 36 pp.

(32) FAO (2003) *FAO Technical Guidelines for Responsible Fisheries*. 4 Suppl. 2. Fisheries Management: The ecosystem approach to fisheries. FAO, Rome 112 pp.

(33) The World Bank (2010) *World Development Report 2010*. Development and Climate Change. The World Bank, Washington DC, 417 pp.

Appendix 1: Best Practice Case Studies – Management

National Level Resilience: Great Barrier Reef, Australia

National parliaments have an important role to play in investing in coral reef resilience. In 2004, the Parliament of Australia declared highly protected status for 33% of the Great Barrier Reef, and this protected area network is now recognized as the world's best practice in coral reef management. Implementation of the protected areas has already shown significant ecosystem benefits, with good recovery from disturbances indicating strong biological resilience. Prior to the establishment of highly protected areas, multiple-use pressures were resulting in major population declines of key protected and commercial marine species. The new marine protected area system was designed to preserve the biodiversity of the entire coastal zone including seagrass beds, sandy and muddy bottoms, and deep continental shelf slopes in addition to the coral reefs. The zoning process included comprehensive environmental assessment and stakeholder involvement, and the government is providing assistance for commercial fishers affected by the increase in areas closed to fishing. Management activities are supported by good central planning, legislation, enforcement, and research and monitoring. However, although this is the best coral reef protected area network in the world, some areas of the Great Barrier Reef still show signs of decline and decreased resilience mainly due to land-based activities leading to sediment, nutrient and other chemical pollution.

Wilkinson, C. (2008). *Status of coral reefs of the world: 2008*. Global Coral Reef Monitoring Network and Reef and Rainforest Research Centre, Townsville, Australia, 296 p.

Local Level Resilience: Kimbe Bay, Papua New Guinea

The Protected Area Network of Kimbe Bay, Papua New Guinea, is the first in the world to incorporate both human needs and the principles of coral reef resilience to withstand impacts from climate change. The incredible biodiversity and ecosystem services of Kimbe Bay are threatened by climate change and direct impacts (mainly forest and mangrove clearance for plantation agriculture, which results in chemical and sediment runoff pollution). 100,000 people live in the Kimbe Bay watershed and these coastal communities rely on both land and marine resources to meet subsistence and income needs. An international NGO, The Nature Conservancy (TNC), is working with local communities and government to reduce the direct impacts and implement a marine protected area network designed for climate change resilience. The scientific design of the network was based on the principles of resilience:

- Spreading the risk through representation and replication of major habitats;
- Protecting critical habitats, particularly those more resilient to climate change;
- Connectivity to ensure coral larvae from healthy reefs can replenish those affected by bleaching;
- Reducing other threats and implementing effective management.

A community-based planning process is now underway with the local communities that own and manage the Kimbe Bay resources. These local communities will manage the Protected Area Network through legally-binding Locally Managed Marine Areas. (Green et al. 2009)

Green, A., S.E. Smith, G. Lipsett-Moore, C. Groves, N. Peterson, S. Sheppard, P. Lokani, R. Hamilton, J. Almany, J. Aitsi, and L. Bualia. (2009). *Designing a resilient network of marine protected areas for Kimbe Bay, Papua New Guinea*. Oryx 43(4): 488-498.

Appendix 2: Best Practice Case Studies – Legislation

Coral Reef Conservation Act 2000 (USA)

This legislation exists to provide co-ordinated funding for coral reef conservation projects and emergency assistance to state and local governments managing coral reef ecosystems. Through this Act, four major national programs have been established to address coral reef conservation and management. The Act requires the submission of an 'effectiveness report' every two years to analyse the progress made and if necessary, feed back into its objectives. Achievements of this legislation includes awareness raising of American citizens regarding the coral reef crisis, research conducted documenting the threats to coral reefs and large areas such as the Northwest Hawaiian Islands have been protected under this Act.

ICRAN Recommendations for Coral Reef Conservation to the Obama Administration and the 111th Congress [Online] available: www.icran.org/pdf/Coral%20Recommendations.pdf [Accessed: 01/10/10]

NOAA (2000) National Coral Reef Action Strategy: Coral Reef Conservation Act of 2000 [Online] available: www.response.restoration.noaa.gov/book_shelf/146_coral_consv_act_2000.pdf [Accessed: 01/10/10]

Oceana (no date specified) Laws Protecting the Oceans: Coral Reef Conservation Act (CRCA) [Online] available: http://na.oceana.org/en/policy/laws-protecting-the-oceans [Accessed: 01/10/10]

The Coastal Zone Management Act (USA)

This Act enhanced and empowered the National Coastal Zone Management Program and National Estuary Research Reserves through a federal-state partnership to restore economically important coastal areas. A unique feature of this Act is that participation by states is voluntary, however, monetary incentives including financial and technical assistance are provided through federal funding for those states that develop and implement a comprehensive coastal management program (CMP). In response to this, 34 out of 35 coastal states have implemented CMPs, through methods including Integrated Coastal Zone Management legislation, framework acts and non-statutory co-ordination schemes. This empowerment of states has resulted in strong local participation and compliance in addition to affording coastal states the opportunity to tailor individual programs that address their own specific needs. Furthermore, the inclusion of a Performance Measurement System is used to monitor the success of the management programmes at a national level. However there is no widely accepted method to measure coastal resilience and this may require further co-ordination to establish suitable criteria.

Collini, K. (2008) Coastal Community Resilience: An Evaluation of Resilience as a Potential Performance Measure of the Coastal Zone Management Act. Coastal States Organisation.

Davis, B. (2004) Regional planning in the US coastal zone: A comparative analysis of 15 special area plans. *Ocean and Coastal Management.* **47** (1-2): 79-94.

National Governors Association (2009) Ocean and Coastal Zone Management. [Online] available:

http://www.nga.org/portal/site/nga/menuitem.8358ec82f5b198d18a278110501010a0/?vgnextoid=2a0b9e2f1b091010VgnVCM1000001a01010aRCRD [Accessed: 01/10/10]

United States Environmental Protection Agency (2007) Summary of Coastal Zone Management Act and Amendments. [Online] available: http://www.epa.gov/agriculture/lzma.html [Accessed: 31/09/10]

Protected Areas Network Act 2003 (Palau)

This legislation provided a comprehensive framework for Palau's national and State governments to collaborate with non-governmental organisations to build upon the existing suite of protected areas and establish a nationwide network of MPAs. The legislation places a strong emphasis on biophysical criteria, incorporating ecosystem based principles into its designation process. To date, 28 MPAs have been designated, 24 of which contain coral reefs. The success of this Act has not yet been documented through scientific analysis, due to the recent establishment of many of the MPAs; however, it has provided a model for other island nations to pursue through its strong political support, ranging from indigenous communities to the highest level of national government in addition to stakeholder involvement and flexibility within its

planning process. This legislation has fuelled commitments by several other Micronesian governments including the Federated States of Micronesia, the Republic of the Marshall Islands, the U.S. Territory of Guam and the Commonwealth of the Northern Mariana Islands, to protect their own resources through the establishment of the Micronesia Challenge, launched in 2006. This project covers 5% of the Pacific Ocean and 61% of the world's coral species.

Hinchley, D., Lipsett-Moore, G., Sheppard, S., Sengebau, U., Verheij, E., Austin, S. (2007) Biodiversity Planning for Palau's Protected *Areas* Network*:* An Ecoregional. Assessment TNC Pacific Island Countries Report No. 1/07

IUCN World Commission on Protected Areas (IUCN-WCPA) (2008) Establishing Resilient Marine Protected Area Networks – Making it Happen. Washington, DC. IUCN-WCPA, National Oceanic and Atmospheric Administration and The Nature Conservancy. 118p.

Lutchman, I., Aalbersberg, B., Hinchley, D., Miles, G., Tiraa, A., Wells, S. (2005) Marine Protected Areas: Benefits and Costs for Islands. WWF The Netherlands.

Great Barrier Reef Marine Park Act 1975 (Australia)

Australia is recognised as a world leader in coral reef management through its Great Barrier Reef Marine Park. This Act provides important management tools including zoning plans, permits, education and management plans to regulate access and control and mitigate impacts associated with human uses of the GBR. Significantly, a single organisation has the principal authority over the entire Marine Park, therefore reducing conflicting interests from multiple governing agencies as has often been the case in many other countries. The establishment of the Great Barrier Reef Marine Park Authority has provided important leadership in its protection. Additionally, there have been dramatic improvements in the development of the catchment, since the Acts implementation, including improved agricultural practices, which has reduced the level of ex situ threats from terrestrial land uses.

The variety of zones set within a multiple use framework such as in the GBR allows a range of reasonable uses to occur in a co-ordinated way and provides for a broad scale integrated approach to management. The most noteworthy success of this legislation in relation to the establishment of the GBR Marine Park was the level of public consultation and support for its implementation. Initially resource intensive and time consuming, this planning process was considered worthwhile and cost effective in the long term. By allowing for alterations in zoning plans provides an adaptive and flexible management regime and this has been primarily responsible for the increase in no-take zones from 4.5% to 33% after re-zoning occurred in 2004. Each zone has a specific written objective clarifying its purpose and in all cases, each zone has 'conservation' or 'protection' as an overriding aspect. A review of the Act in 2006 provided significant amendments to better integrate other legislation to provide an effective framework for the protection and management of the GBR.

Day, JC. (2002). Zoning – lessons from the Great Barrier Reef Marine Park. *Ocean and Coastal Management* **45**: 139-156.

Fernandes, L., Day, J., Lewis, A., Slegers, S., Kerrigan, B., Breen, D., Cameron, D., Jago, B., Hall, Lowe, D., Innes, J., Tanzer, J., Chadwick, V., Thompson, L., Gorman, K., Simmons, M., Barnett, B., Sampson, K., De'ath, G., Mapstone, B., Marsh, H., Possingham, H., Ball, I., Ward, T., Dobbs, K., Aumens, J., Slater, D., Stapleton, K. (2005) Establishing representative no-take areas in the Great Barrier Reef: Large scale implementation of theory on marine protected areas. *Conservation Biology* **19**: 1733-1744.

Great Barrier Reef Marine Park Authority (no date specified) Legislation and Regulations [Online] available at: http://www.gbrmpa.gov.au/corp_site/about_us/legislation_regulations [Accessed: 01/10/10]

McCook, L., Ayling, T., Cappo, M., Choat, H., Evans, R., Freitas, D., Heupel, M., Hughes, T., Jones, G., Mapstone, B., Marsh, H., Mills, Molloy, F., Pitcher, C., Pressey, R., Russ, G., Sutton, S., Sweatman, H., Tobin, R., Wachenfeld, D., Williamson, D. (2009) Adaptive Management of the Great Barrier Reef: A Globally Significant Demonstration of the Benefits of Networks of Marine Reserves*. Proceedings of the National Academy of Sciences.*

Olsson, P., Folke, C, and Hughes, T. (2008) Navigating the transition to ecosystem-based management of the Great Barrier Reef, Australia. *Proceedings of the National Academy of Sciences.* **105**: 9489-94.

Appendix 3: Reference to Coral Reefs in the Convention on Biological Diversity

Convention on Biological Diversity Coral Reef Decisions

Table 1: Explicit Coral Reef Decisions

This table outlines the CBD Decisions that deal explicitly with coral reefs. Organized by Programme of Work, the table provides information about the meeting and year of the decision, the decision code, decision name, and the section of the decision in which coral reefs are addressed.

Programme of Work	Meeting	Year	Decision code	Decision name	Coral reef sections
Island Biodiversity	COP-9	2008	COP Decision IX/21	Island Biodiversity	Paragraph 2
Island Biodiversity	COP-8	2006	COP Decision VIII/1, Annex A	Programme of Work on Island Biodiversity	Paragraph 4
					Paragraph 6
					Paragraph 7
Island Biodiversity	COP-8	2006	COP Decision VIII/1, Appendix	Programme of Work on Island Biodiversity: List of suggested supporting actions for parties	Priority action 1.2.2.4.
					Priority action 1.1.3.4.
					Priority action 2.2.1.11.
					Priority action 5.1.1.6.
					Priority action 7.1.1.6.
					Priority action 7.1.1.7.
					Priority action 8.1.1.2.
Island Biodiversity	SBSTTA-10	2005	SBSTTA Recommendation X/I	Island Biodiversity, Annex A	Paragraph 4
Marine and Coastal Biodiversity	COP-2	1995	Decision II/10 B	Conservation and sustainable use of marine and coastal biological diversity	Paragraph 5
					Paragraph 13
Marine and Coastal Biodiversity	COP-4	1998	Decision IV/5	Conservation and sustainable use of marine and coastal biological diversity, including a programme of work	Section II: Coral Reefs
					Programme element - operational objective 1.3
Marine and Coastal Biodiversity	COP-5	2000	Decision V/3 Implementation of decision IV/5	Progress report on the implementation of the programme of work on marine and coastal biological diversity	Paragraph 1
					Paragraph 2
					Paragraph 3

				(implementation of decision IV/5)	Paragraph 4
					Paragraph 5
					Paragraph 6
					Paragraph 7
					Paragraph 8: Priority Areas for Coral Bleaching
Marine and Coastal Biodiversity	COP-6	2002	Decision VI/3	Marine and coastal biological diversity	Paragraph 1
					Paragraph 2
					Paragraph 3
					Paragraph 5
Marine and Coastal Biodiversity	COP-7	2004	Decision VII/5	Marine and coastal biodiversity	Paragraph 8
					Paragraph 15
Marine and Coastal Biodiversity	COP-7	2004	Decision VII/5	Marine and coastal biodiversity	Appendix 1 SPECIFIC WORK PLAN ON CORAL BLEACHING
					Appendix 2 ELEMENTS OF A WORK PLAN ON PHYSICAL DEGRADATION AND DESTRUCTION OF CORAL REEFS, INCLUDING COLD WATER CORALS
					Appendix 3 ELEMENTS OF A MARINE AND COASTAL BIODIVERSITY MANAGEMENT FRAMEWORK
					Annex III IMPROVEMENT OF AVAILABLE DATA FOR ASSESSMENT OF PROGRESS TOWARDS THE GLOBAL GOAL
Biodiversity and climate change	COP-5	2002	Decision V/3	Risks, in particular, to coral reefs	Paragraphs 4, 5, Annex Paragraph A, C

Table 2: Implicit Coral Reef Decisions

This table outlines the CBD Decisions that would necessarily relate to coral reefs in their implementation but which do not mention coral reefs in the text directly. Organized by Programme of Work, the table provides information about the meeting and year of the decision, the decision code, and decision name.

Programme of Work	Meeting	Year	Decision code	Decision name
Island Biodiversity	COP-8	2006	COP Decision VIII/1	Programme of Work on Island Biodiversity
Island Biodiversity	COP-8	2006	COP Decision VIII/1, Annex E	Programme of Work on Island Biodiversity: E. Goals, targets and timeframes
Island Biodiversity	COP-8	2006	COP Decision VII/31	Request to develop a preparatory process for the work of the SBSTTA on island biodiversity / Decision to establish a new thematic programme of work on island biodiversity
Island Biodiversity	COP-8	2006	COP Decision VII/31, Annex II	Terms of reference of the Ad Hoc Technical Expert Group on Island Biodiversity
Marine and Coastal Biodiversity	COP-8	2006	Decision VIII/22	Marine and coastal biological diversity: enhancing the implementation of integrated marine and coastal area management
Marine and Coastal Biodiversity	COP-9	2008	Decision IX/20	Marine and coastal biodiversity
Protected Areas	COP-9	2008	Decision IX/18	Protected areas
Protected Areas	COP-8	2006	Decision VIII/24	Protected areas
Protected Areas	COP-7	2004	Decision VII/28	Protected Areas (Articles 8 (A) to (E))
Protected Areas	COP-3	1996	Decision III/9	Implementation of Articles 6 and 8 of the Convention
Protected Areas	COP-2	1995	Decision II/7	Consideration of Articles 6 and 8 of the Convention
Protected Areas	COP-2	1995	Decision II/8	Preliminary consideration of components of biological diversity particularly under threat and action which could be taken under the Convention
Biodiversity and climate change	COP-7	2004	Decision VII/15	Measures to manage ecosystems to maintain their resilience to extreme climate events and help mitigate and adapt to climate change
Biodiversity and climate change	COP-8	2006	Decision VIII/30	Importance of integrating biodiversity considerations into all relevant national policies, programmes and plans, in response to climate change, and need to identify mutually supportive activities to be conducted by the secretariats of the three Rio Conventions (UNFCCC, UNCCD, CBD), parties and relevant organizations
Biodiversity and climate change	COP-9	2008	Decision IX/16	Biodiversity and Climate Change

Appendix 4: Major Gaps in Coral Reef Management

Gaps in our understanding of coral reef ecosystems and communities

Socioeconomic Knowledge Gaps

- Artisanal and subsistence fisheries: levels and importance of employment
- Nutrition: levels and importance of consumption of reef-derived foods
- Effective alternative livelihoods: which can reduce reef dependence and benefit communities
- Socioeconomic drivers of coral reef degradation, both local and global scale: community dependence on reefs, drivers of effects originating far from reefs such as conflicts with other resource users, poverty, governance issues and the political economy
- Socio-economic effects of direct impacts and climate change: food security, poverty, health, migration, conflict, markets and trade

Ecological Knowledge Gaps

- Artisanal and subsistence fisheries: sustainability of catches and stock status
- Effects of MPAs (including LMMAs) on ecological communities and fisheries yields
- Effects of resource overexploitation on coral reef ecosystems
- Effects of climate change and ocean acidification on coral reef organisms, biodiversity and ecosystem functioning

Gaps in measuring the impacts of our actions / assessment

Long term monitoring programmes

- Environmental variables such as watershed and coastal zone pollutants, bleaching events and other effects of climate change
- Socioeconomic variables such as the effects of coral reef degradation and conservation measures on local communities and societies

Other types of monitoring

- Effectiveness of conservation measures such as MPAs, fisheries management, and uptake of alternative livelihoods
- Meta-monitoring: spatial and temporal coverage of monitoring programmes
- Communication and coordination of information obtained through monitoring: making the data available and comparable

Management gaps

- Technical and logistical capacity for coral reef monitoring and enforcement of conservation measures
- Long-term consistency of management approaches at each spatial scale
- Environmental education and awareness (formal and informal education)
- Understanding the needs of local communities
- Use of and access to ecosystem-based management approaches
- Effective management of Marine Protected Areas especially raising awareness of designated MPAs and the management plans and the willingness and capacity to enforce MPA rules
- Efficiency of standard fisheries management

Legislative Gaps

Coral Reef Fisheries Management

- Much of the legislation in relation to fisheries is contained within vintage Acts and should be updated or suitably amended to reflect the threats of modern times.
- Fisheries laws tend to provide the main legislative framework for marine management, however, the focus shifts predominantly towards the management of harvesting activities in addition to single species protection and away from ecosystem based approaches.

Marine Conservation Measures

- Few laws exist for the sole purpose of coral reef conservation and management.
- Monitoring procedures to ensure the effective implementation of Marine Protected Areas is not a strict requirement under most laws.
- Legislation to protect coral reefs is often fragmented over various policies and administrative bodies causing confusion in its interpretation and enforcement.
- Community-based management of MPAs is not an integrated part of legislation. In addition, many MPAs are established without prior public consultation and participation, result in non-compliance and consequently, ineffective protection. Legislative mechanisms need to be identified in order to meet protected area management whilst also meeting the needs of indigenous people.
- Much of the existing legislation is reactive, in response to natural and anthropogenic pressures on coral reefs. However, management needs to be more proactive by adopting the precautionary principle to ensure effective mechanisms are in place to adjust to changing pressures or level of threat.
- Legislative and policy fragmentation exists, where MPAs should be integrated with policies for integrated land and marine resource management.
- Many national laws tend to be a centralised approach for resource management and discourage any existing community based systems, however an increasing number of new laws have been designed to be more supportive of community initiatives.

Coastal Zone Planning and Development

Integrated Coastal Zone Management which seeks to ensure sustainable coastal development is not incorporated into national legislation, even though the most of the population of these countries is in coastal communities.

Pollution Control

- Many small island nations are not a party to MARPOL, and so cannot benefit from the financial assistance provided by the IMO in relation to marine pollution.
- A lack of national legislation currently exists to address marine litter (only the Wider Caribbean and Northwest Pacific Regions have legislation implemented).
- Inadequate regulations exist to address the issue of cruise ship pollution (in one week, a 3,000 passenger ship can release 210,000 gallons of raw sewage into coastal waters).

Integrated land/ocean/watershed management

- Much of the current conservation of adjacent land and sea areas remains under the control of uncoordinated government agencies with conflicting priorities. Coral reefs extend into adjacent watersheds and should be managed as an integrated component.
- There is a lack of explicit legislative definitions for coral, coral reefs and coral reef ecosystems which limits the capacity of environmental legislation to support important conservation efforts.
- Within many countries there is a critical lack of data management systems and coral reef data storage capacity which would help coordinate and monitor the status of coral reef ecosystems which could further influence future legislative proposals.

Appendix 5: Legislative Mapping of Major Coral Reef Nations

This document outlines the current legislative landscape which pertains to the conservation and management of tropical coral reef ecosystems in twelve major coral reef nations (India, U.S.A., Australia, Palau, Japan, Mexico, Cuba, The Philippines, Indonesia, China, Kenya and French Polynesia). This analysis was undertaken using a combination of both primary research and communication with relevant experts in the field. The underlying purpose of the report is not only to serve as a useful resource to share examples of legislative best practice among parliaments, but also to identify policy gaps to address, that adequately address the plethora of anthropogenic activities that are well-recognised as contributing factors to the extensive degradation of these fragile ecosystems.

This overview describes the situation in each country regarding the current level of legislation and its subsequent implementation. This is followed by a set of sub-headings that address the primary areas that relate to, or affect the tropical coastal marine environment. These headings were specifically chosen to reflect the recommendations outlined in the action plan, by addressing the laws that currently exist, that may serve as a tool for coral reef conservation and management and acts as a basis to determine where further action should be concentrated. The structure is of this document for each country is as follows:

Overview:
(General background regarding current legal mechanisms)

Existing legislation to ensure sustainable fisheries exploitation in coral ecosystems:
Relevant Action Plan Recommendation: *'Ban all destructive fishing practices and ensure there is sufficient management capacity to effectively implement bans'*

Legislation relating to Marine Conservation Measures:
Relevant Action Plan Recommendation: *'Implement existing national legislation that supports MPAs'*

Legislation relating to Coastal Zone Planning and Development:
Relevant Action Plan Recommendation: *'Ensure that regulation of building and industry in the coastal zone are integral parts of sustainable coastal planning legislation'*

Legislation relating to Pollution Control:
Relevant Action Plan Recommendation: *'Develop legislation to reduce the levels of all major pollutants'*

Integrated Watershed Management Policy Approaches:
Relevant Action Plan Recommendation: *'Identify management needs to draw up watershed management policies'*

Priorities for Legislative Action
(A list of country-specific recommended policy actions to provide comprehensive protection for the conservation and management of coral reefs)

Background Literature
(Provided as a source for further information related to legislation contained in the main body of text)

This report reviews only national legislation and does not include regional or international agreements and initiatives that these countries may be a contracting party to. It is anticipated that this analysis will offer a useful insight into existing efforts and provide a resource to help achieve the ultimate goal of comprehensive and proactive legislation that enables appropriate management to restore the long term integrity and resilience of coral reef ecosystems.

National Legislation: India

Overview:

Much of India's national legislation focuses on restricting destructive activities including construction and resource extraction. Fishing regulations are enforced to protect coral reef fisheries from over exploitation through prohibitions on fishing methods and gear type. The Ministry of Environment and Forests holds responsibility for the tasks of monitoring, conservation and management of coral reefs in India, having constituted a National Committee on Mangroves and Coral Reefs to oversee their protection. The major threats to the coral reefs in coastal India include high levels of destructive fishing, industrial, agricultural and domestic pollution, sedimentation and coral mining. This, combined with increased industrial development poses a major risk to coastal ecosystems.

Existing legislation to ensure sustainable fisheries exploitation in coral ecosystems:

The Marine Fishing Regulation Acts 1978 provide guidelines for maritime states to enact laws. Regulatory measures include restrictions on mesh size and gear type, in addition to declarations of closed seasons during fish breeding. The Indian Fisheries Act 1897 offers protection to fisheries against explosives or dynamites by prohibiting the use of explosives and restricting gear type and size of target fish species. However, in light of species declines since the vintage Act was introduced, this legislation should be updated to suit modern requirements and changes in fishing patterns. A Comprehensive Fisheries Policy imposes a strict ban on all types of destructive fishing gear however these 'types' are not defined and are open to interpretation by the State authority.

Legislation to increase marine protected areas coverage and effectiveness:

The Wildlife Protection Act 1972 provides the primary framework for MPAs in India, although MPAs they can also be declared under the fisheries legislation. Schedule I Part IVA contains provisions prohibiting industry overuse and exploitation of coral reef as well as other marine species that share a close interdependence with the reef. The WLPA provides two kinds of protection endangered species protection regardless of location and protection of all species in designated MPAs. The Biological Diversity Act 2002 was implemented under India's commitments to the Convention on Biological Diversity through which a State Biodiversity Fund was established for the purposes of management and conservation of biodiversity heritage sites. Importantly, MPAs in India are designated for conservation and ecosystem preservation and are monitored and managed under the Ministry of Environment and Forests.

Legislation relating to Coastal Zone Planning and Development:

The Coastal Regulation Zone Notification 1991 (developed under the EPA 1986) is currently the primary legislation to regulate coastal development. This law prohibits the construction of beach resorts in ecologically sensitive areas including coral reefs and is the only law that explicitly outlaws coral mining. These and other prohibitions have been acknowledged as essential to coral reef conservation and as such it is recommended that this law be extended elsewhere as current enforcement is restricted to Andaman, Lakshadweep and Nicobar. Of additional importance is the Environmental Impact Assessment, implemented since 1994 and through which it provides an important mechanism to incorporate environmental considerations into the planning process. However, under Annex I, some major developmental projects are exempt from undertaking an EIA, which could lead to serious negative impacts.

Legislation relating to Pollution Control:

India's main legislative framework for controlling marine pollution is contained within the Territorial Waters, Continental Shelf, EEZ and Other Maritime Zones Act of 1976. The Act transfers exclusive jurisdiction to the

Central Government to preserve and protect the marine environment and to prevent and control marine pollution. However, there is no mention of fisheries conservation and management.

Integrated Watershed Management Policy Approaches:

The Environment Protection Act 1986 provides an integrated policy connecting issues in relation to water, air and land by addressing the inter-relationship between them. This legislation provides a framework for central government to co-ordinate activities of various authorities and enables sectoral agencies to collaborate effectively. The implementation of the Forest Conservation Act 1980 has achieved a decline in the diversion of forest land for alternative use, but there is currently a lack of incentives for local people to participate in conservation.

Priorities for Legislative Action:

- Give coral reefs separate legal status under the Wildlife Protection Act.
- Current legislation should be amended to distinguish coral reef areas from islands, coastal and marine areas.
- Implement positive protection of coral reefs into legislation, such as regeneration and coastal bioshields.
- Harmonisation is required between the WLPA, fisheries legislation and implementing regulations.
- Current protected area legislation is orientated towards a terrestrial approach and needs to be amended in order to fully address the needs of the MPA.
- Amend the Environmental Impact Assessment Act 1994 to require an evaluation for all developments regarding the effectiveness following implementation of mitigation measures.
- Coastal Regulation Zone Notification 1991 should be implemented on a national basis as it is currently only enforced on Andaman, Lakshadweep and Nicobar.
- India's vintage Fisheries Act 1897 should be suitably amended to control fishing and reflect the threats of modern times including dynamite and trawler fishing as well as coral mining, all of which should be under stringent regulation.

Background Literature:

Government of India (No date supplied) *Environment Protection* [Online] available: http://moef.nic.in/modules/rules-and-regulations/environment-protction/

Panini, D (1997) Law and Policy for Conservation and Management of Coral Reef Areas in India. In (ed.) Regional Workshop on the Conservation and Sustainable Management of Coral Reefs. Fisheries and Aquaculture Department of the Food and Agriculture Organisation.

Sehgal, R. (2006) 'Legal Regime Towards Protecting Coral Reefs: An International Perspective and Indian Scenario' 2/2 Law. *Environment and Development Journal*, p.183.

Rajagopalan, R. (2008). *Marine Protected areas in India*. Samudra Monograph, 69 pp, Chennai: ICSF.

Rajasuriya, A., H. Zahir, E.V. Muely, B.R. Subramanian, K. Venkataraman, M.V.M. Wafar, S.M. Munjurul Hannan Khan and E. Whittingham. (2000) Status of coral reefs in South Asia: Bangladesh, India, Maldives and Sri Lanka. *In:* Wilkinson, C. (ed). *Status of Coral Reefs of the World: 2000.* Australian Institute of Marine Science. pp 95-116.

Srivastava, N, (2005) *Protecting Coral Reef: Legal Perspective in India*. Panda, WWF India Newsletter, pp. 5-6.

National Legislation: United States of America

Overview:

In most regions of the U.S. the management of coral reef resources is undertaken through a joint partnership of local and Federal agencies with the U.S. Coral Reef Task Force as the central body that co-ordinates and over-see's implementation of relevant legislation. A comprehensive network of legal instruments exists regarding the management of coastal and marine resources in addition to legislation enacted for the specific purpose of coral reef protection. Significantly, Americas new National Oceans Policy 2010 albeit still in its infancy, incorporates an integrated and proactive approach to management within national jurisdiction with a distinct ecosystem focus and builds upon existing legislation regarding marine spatial planning. This combined legislative effort serves as a model in reducing the threat of anthropogenic stresses that are degrading coastal and marine ecosystems worldwide.

Existing legislation to ensure sustainable fisheries exploitation in coral ecosystems:

The U.S. does not currently have legislation specific to coral reef fisheries, although The Magnuson-Stevens Fishery Conservation and Management Act 2007 is the primary law that governs fisheries within its Exclusive Economic Zone. This Act incorporates the ecosystem-based approach to fisheries management, rather than traditional species-specific management. However, the jurisdiction under which this act is implemented only begins at 3nm and as such, does not cover coastal waters up to the shoreline.

Legislation relating to Marine Conservation Measures:

The Coral Reef Conservation Act 2000 is specific legislation that has established four major national programmes to address coral reef conservation and management through which provision of financial assistance for coral reef projects is coordinated. This legislation has increased national awareness regarding the coral reef crisis in addition to the establishment of an MPA network on the western shore of the Hawaiian Islands, closing 35% of the coastline to aquarium fish harvest. Furthermore, the Marine Managed Areas Improvement Act 2000 created a unified marine managed areas classification system, reducing an initially confusing 18 classifications for MPAs into 6, each with its own specific designation process.

Legislation relating to Coastal Zone Planning and Development:

The Coastal Zone Management Act contains a National Coastal Zone Management Program under which 34 out of 35 states have implemented coastal programs, governed through a federal and state government partnership, to balance competing land and water issues in the coastal zone. A unique feature of this legislation is that participation by states is voluntary; however, the act provides federal financial incentives to develop and implement a comprehensive management program. The success of this legislation is attributed to its holistic approach to problem solving including a Performance Development System to track indicators at the national level. The National Environmental Policy Act 1969 (NEPA) requires federal agencies to consider the environmental impacts of major actions such as coastal development or significant changes to a fishery management plan by undertaking an environmental assessment. Success of this Act includes the collaboration of different interest groups in the decision-making process; however, an effectiveness study found that many agencies misinterpret the purpose of NEPA.

Legislation relating to Pollution Control:

Four Congressional Acts regulate both point and non-point pollution sources in U.S. waters;
The Clean Water Act focuses on point sources of pollution through which permits are required, subject to meeting water quality standards. Non-point sources are exempt from the permit programme, notably agricultural discharge, although Congress provides financial assistance to improve run-off management from

agricultural practices. The Ocean Dumping Act is a comprehensive waste management law that prohibits all ocean disposal except that allowed by its permit system. The law provides for research concerning ocean disposal in addition to coastal water quality monitoring. There is some overlap with the Clean Water Act, however, the Environmental Protection Agency provides a uniform set of standards to eliminate confusion and interpretation issues. The Oil Pollution Prevention, Response, Liability, and Compensation Act imposes strict liability on vessel owners for clean up costs and damage corresponding to oil spills. The law promotes effective prevention measures and established a federal superfund to clean up emergency releases of pollutants into the marine environment. Under the Coastal Zone Management Act, coastal states must manage non-point pollution sources through financial assistance provided by federal funding, to establish pollution management programmes and identify land use that is potentially harmful to coastal waters. Noteable achievements of this legislation include implementation level within 97% of the total U.S shoreline. This law is a good example of an effective integrated approach to land and marine pollution control.

Integrated Watershed Management Policy Approaches:

The Watershed Protection and Flood Prevention Act 1954 provides an integrated program of soil and water conservation on all fields and forests in a watershed and has been amended in light of changing national priorities. This law adopts a project type approach with technical and financial assistance provided by the Department of Agriculture to encourage local organisations to take responsibility. Under the Clean Water Act Amendments 1987, the National Estuary Program was established as a community-based program designed to improve water quality and ecological integrity of estuaries of national importance. This was achieved through a watershed based approach to connect upstream pollution sources with downstream impacts on coastal ecosystems.

Priorities for Legislative Action:

- US federal legislation should explicitly state that it is illegal to kill corals or damage coral reefs.
- Legislation should be enacted that prohibits the discharge of waste from cruise ships in coastal waters.
- Implement legislation that pertains to the specific management of coral reef fisheries.
- To establish adequate MPA networks in areas where there are coral reefs present such as Florida, based on the success of the MPA network along Hawaii's western shoreline.

Background Literature:

Collini, K. (2008) *Coastal Community Resilience: An Evaluation of Resilience as a Potential Performance Measure of the Coastal Zone Management Act.* Coastal States Organisation.

Davis, B. (2004) Regional planning in the US coastal zone: A comparative analysis of 15 special area plans. *Ocean and Coastal Management.* **47** (1-2): 79-94.

Gleason, M., McCreary, S., Miller-Henson, M., Ugoretz, J., Fox, E., Merrifield, M., McClintock, W., Serpa, P., Hoffman, K. (2010) Science-based and stakeholder-driven marine protected area network planning: A successful case study from north central California. *Ocean and Coastal management* 1-17.

IUCN (2009). Marine Protected Area Network: Hawaii's western shore, USA. International Union for the Conservation of Nature.

National Governors Association (2009) *Ocean and Coastal Zone Management.* [Online] available: http://www.nga.org/portal/site/nga/menuitem.8358ec82f5b198d18a278110501010a0/?vgnextoid=2a0b9e2f1b091010VgnVCM1000001a01010aRCRD

National Oceanic and Atmospheric Administration (2002). *Coral Reef Conservation Act of 2000.* NOAA National Coral Reef Action Strategy, p.112.

Rogers, Z. Hillis-Starr, R. Nemeth, M. Taylor, G.P. Schmahl, M.W. Miller, D.A. Gulko, J.E. Maragos, A.M. Friedlander, C.L. Hunter, R.S. Brainard, P. Craig, R.H. Richond, G. Davis, J. Starmer, M. Trianni, P. Houk, C.E. Birkeland, A. Edward, Y. Golbuu, J. Gutierrez, N. Idechong, G. Paulay, A. Tafileichig, and N. Vander Velde. (2002). *The State of Coral Reef Ecosystems of the United States and Pacific Freely Associated States.* National Oceanic and Atmospheric Administration/National Ocean Service/National Centers for Coastal Ocean Science, Silver Spring, MD. 265 pp.

United States Environmental Protection Agency (2009) *Coastal Zone Act Reauthorization Amendments* [Online] available: http://water.epa.gov/polwaste/nps/czara/ch1-1.cfm

National Legislation: Australia

Overview:

In Australia, there are specific laws and legislation aimed at managing coral reefs and endangered species and limiting by-catch, with a single organisation having authority over the entire Great Barrier Reef (GBR) in association with the Queensland State Government. The establishment of effective management tools, including multiple-use planning through zoning on a large spatial scale and statutory conservation plans for species and ecosystems in the GBR Marine Park, has established Australia as a world leader in proactive coral reef management. Much legislation focuses on the East coast in which the world's largest reef - the GBR - is situated in close proximity to coastal communities and multiple human pressures. In contrast, Western Australia's coral reef system is located away from urban centres; therefore fewer anthropogenic pressures contribute to its decline.

Legislation relating to Coral Reef Fisheries Management:

Fisheries resource management in Australia involves a complex mix of Commonwealth and State/Territory legislation, with the States or Territories responsible out to 3 nm and the Commonwealth managing fisheries beyond that to 200nm. Increasingly, the management focus for coral reef fisheries has moved from considering the fishing impacts on target species to consideration of non-target species and the ecosystem, especially the effects of trawling on benthic habitats. Under the Fisheries Management Act 1995 a Fisheries (Coral Reef Fin Fish) Management Plan was enacted as Queensland legislation in 2003. The plan contains provisions for the long term sustainable management of coral reef fin fish stocks based on scientific advice, via a system of tradable quotas for Total Allowable Catch, issuing a limited number of fishing licences, legal catch size limits and no-take species. The Environment Protection and Biodiversity Conservation Act 1999 is also important for the management of coral reef fisheries within the GBR through the provision of an assessment and approval process for activities likely to have significant impacts on the marine environment.

Legislation relating to Marine Conservation Measures:

Much of the success of Australia's legislation is achieved through its approach to collaboration between science and public consultation, providing transparency throughout the process of designating MPAs. This is highlighted in the Great Barrier Reef Re-zoning Plan 2004 which was initiated in response to scientific evidence that reflected the inadequacy of existing zoning arrangements. This led to increased coverage of no-take zones from 4.5% to 33%. The Environment Protection and Biodiversity Conservation (EPBC) Act 1999 is the key legislation for establishing and managing a system of MPAs, however, other legislation exists for the implementation of MPAs at the state and territorial level. The EPBC Act requires all marine reserves to include management plans with the exception of the Great Barrier Reef Marine Park, which is governed under the Great Barrier Reef Marine Park Act 1975. Furthermore, this Commonwealth legislation contains offences for injuring and killing a listed marine species which is a significant legal success.

Legislation relating to Coastal Zone Planning and Development:

Integrated coastal zone management in Australia is conducted at federal, state and local levels, however, its adoption and level of implementation varies between states. There are a large number of agencies involved in the coastal management and therefore appropriate coordination is required. The Sustainable Planning Act is the principal legislation to regulate activities within the coastal zone. It has a strong focus on ecological sustainability and contains important considerations regarding the impact of climate change, a significant threat to the long term integrity of coral ecosystems. Section 110 of the Coastal Protection and Management Act 1995 has proven to be a successful management tool ensuring development does not occur in areas prone to sea erosion and which could potentially lead to sedimentation of coral reefs.

Legislation relating to Pollution Control:

The Australian Maritime Safety Authority is responsible for the enforcement of marine pollution legislation in Australian coastal waters. Under UNCLOS commitments, the Australian Government established National Programmes of Action for the Protection of the Marine Environment from Land-based Activities through specific legislation at the state level, therefore objectives and actions varies spatially, depending on the situation in that location. The focus of this legislation is mainly point source pollution and functions primarily through the enforcement of offence and penalty provisions. Notably, state level pollution control is linked to planning legislation; examples include Queensland's Sustainable Planning Act 2009. The Protection of the Sea (Prevention of Pollution from Ships) Act implements provisions under the MARPOL commitment. However, the absence of high-level coordination for monitoring initiatives aimed at both point and diffuse sources of marine pollution represents a gap in the approach to alleviating marine pollution.

Integrated Watershed Management Policy Approaches:

The Australia's Oceans Policy 1998 enjoyed bipartisan political support through its non-legislative, co-operative approach but currently remains binding only at the Commonwealth level, since state and territory governments chose not to sign the policy. However, the Commonwealth is to attempt to engage their cooperation through a Memoranda of Understanding. This umbrella policy is designed to coordinate existing mechanisms through ecosystem-based allocation, without adding further management arrangements. To become a truly integrated policy, the government may have to resort to legislation to ensure an integrated oceans policy is in practice. The recently enacted Great Barrier Reef Protection Amendment Act 2009 aims to halt the decline in water quality on the reef through the application of targets for commercial sugar cane growers and beef cattle grazing operations throughout the catchment area, in order to reduce the levels of pollutants from these agricultural practices.

Priorities for Legislative Action:

- Implement legislation that corresponds to integrated watershed management.
- Like the Great Barrier Reef, establish a single authority to manage coral reefs in Western Australia.
- The representative areas program (re-zoning initiative) is only established in the Great Barrier Reef and should be extended to other coral reef locations across Australia.
- The Oceans Policy should be implemented as national legislation (it is currently only binding at the Commonwealth level).

Background Literature:

Akwilapo, F. (2007). *A Comparative Study on Marine Protected Areas Between Australia and Tanzania.* United Nations – The Nippon Foundation Fellow.

Fernandes, L., and 27 others. (2005) Establishing representative no take areas in the Great Barrier Reef: Large scale implementation of theory on marine protected areas. *Conservation Biology* 19: 1733-1744.

Great Barrier Reef Marine Park Authority (no date specified) Legislation and Regulations [Online] available at:http://www.gbrmpa.gov.au/corp_site/about_us/legislation_regulations
Day, JC. (2002). Zoning – lessons from the Great Barrier Reef Marine Park. *Ocean and Coastal Management* 45: 139-156.

McCook, L. and 20 others. (2009) Adaptive Management of the Great Barrier Reef: A Globally Significant Demonstration of the Benefits of Networks of Marine Reserves. *Proceedings of the National Academy of Sciences.*

Olsson, P., Folke, C, and Hughes, T. (2008) Navigating the transition to ecosystem-based management of the Great Barrier Reef, Australia. *Proceedings of the National Academy of Sciences.* 105: 9489-94.

Sweatman, H., K. Osborne, L. Smith, T. Grubba, J. Kinch, G. Jones and V. Rai , 2002 , Status of Coral Reefs of Australasia: Australia and Papua New Guinea. . In: C.R. Wilkinson (ed.), *Status of coral reefs of the world: 2002.* GCRMN Report, Australian Institute of Marine Science, Townsville. Chapter 9, pp 163-180.

National Legislation: Republic of Palau

Overview:

The Republic of Palau has the most diverse coral reef ecosystems of Micronesia and is comparable to those found in Indonesia, Australia and the Philippines. Palau has done a great deal towards limiting the impacts of tourism on reef resources. The management of marine resources in the Republic of Palau is administered and managed at the state level. The major anthropogenic threats to Palau's coral reef ecosystems include point source pollution from coastal development and run-off, lack of adequate sewerage infrastructure and marine debris, predominantly through the importation of goods from neighbouring countries. However, Palau was one of the world's first nations to formalise, through a national law, a national protected area network, which fully integrates the model of coral reef resilience and effective management.

Legislation relating to Coral Reef Fisheries Management:

The main fisheries legislation is contained in the Constitution and in the Palau National Code which deals with fisheries management and environmental protection. The most noteworthy law in relation to coral reef fisheries is the 1994 Marine Protection Act, implemented to better manage local fishery resources through the designation of no-take zones. This comprehensive species-focussed legislation has been argued as Palau's most successful management intervention to date and is viewed as model legislation that highlights the importance of traditional knowledge of spawning sites and methods in fishery resource management.

Legislation relating to Marine Conservation Measures:

Palau has been a leader in establishing a network of marine and terrestrial protected areas that provide a complementary approach in reducing anthropogenic impacts. The Protected Areas Network Act 2003 is Palau's landmark legislation governing resource management and biodiversity protection and promotes collaboration between Palau's national and state governments to create a nationwide network of protected areas through stakeholder involvement. This legislation reflects Palau's commitments to ensuring ecosystem integrity through addressing sedimentation in the designation of terrestrial protected areas; currently recognised as the dominating threat to Palau's coral reefs. This piece of legislation serves as an inspirational model for other small island developing nations and as such, has fuelled commitments by other Micronesian governments to protect their marine resources, through the establishment of the Micronesia Challenge 2006 encompassing 61% worlds coral species. More recently, the implementation of the $15 'Green Fee' as part of the revised PAN Act in 2008, aimed at raising funds to help support Palau's natural resource conservation efforts, commenced and has, to date, collected over a million dollars towards the PAN program. The money is to be managed by the PAN Fund and it is anticipated that the actual program for funding to PAN will become operational by the end of 2010.

Legislation relating to Coastal Zone Planning and Development:

Palau has no specific law regarding coastal zone planning and development; however, all development projects require a permit through the Environmental Quality Protection Board earthmoving regulations. Through this process, Environmental Impact Assessment is required for large scale developments that would result in a significant impact, therefore developers must submit an Environmental Impact Statement outlining proposed mitigation strategies to reduce or eliminate these adverse impacts. Additionally, several municipal governments within Palau have master development plans and State Planning Commissions that regulates building and zoning codes in the municipality.

Legislation relating to Pollution Control:

The Environmental Quality Protection Act established the Environmental Quality Protection Board (EQPB) to coordinate with the Bureau of Public Safety Division of Marine Law Enforcement (MLE) for inshore marine pollution and the EQPB established a permit system for any discharge into the marine and freshwater environment. The general marine pollution regulations are reactive in nature and evolve as new issues arise however, adopting the precautionary approach would allow agencies to plan for unknown future issues in the absence of scientific evidence. This Act provides for various offences related to the discharge of sewage and debris into port waters. However, there is currently no specific legislation concerning inshore marine pollution and this is essential to alleviate the multiple pollution sources that present a major threat to coral ecosystems. Although Palau is not a member of MARPOL, compatible national legislation is in place through EQPB regulations and there are a series of codes within these regulations addressing specific issues including marine pollution. Becoming a party under MARPOL will enable Palau to draw upon the technical assistance available from the IMO.

Integrated Watershed Management Policy Approaches:

The Republic of Palau has not implemented any formal national legislation promoting the integrated watershed management approach. However, at the State level, there is local legislation to designate critical watershed areas for protection. A local initiative called Babeldaob Watershed Alliance is working to protect, conserve and restore the water and terrestrial resources of Babeldaob through collaborative outreach, education, science, information sharing and technical assistance via community effort. The Alliance has also helped several states pass buffer zone legislation to protect riparian areas. Legislation such as this has been critical to reducing the sedimentation of waterways.

Priorities for Legislative Action:

- Fishing restrictions under the Marine Protection Act 1994 should integrate the adaptive management approach.
- To enact legislation that provides for coastal zone management.
- Palau's shallow water coral reef and associated benthic habitats need to be mapped.
- Although legislation exists at the State level, Palau legislation requires strong land use regulations and integrated watershed management to effectively prevent degradation of its coral reefs through sedimentation - argued as the dominant threat to Palau's coral reef ecosystems.
- To establish a national water committee to coordinate efforts under under current legislation.
- Enact legislation to control inshore marine pollution from point and diffuse sources.

Background Literature:

Golbuu, Y. (2000). *The Status of Coral Reefs in Palau*. Global Coral Reef Monitoring Network (GCRMN) Report.

Hinchley, D., Lipsett-Moore, G., Sheppard, S., Sengebau, F.U., Verheij, E., and Austin S. (2007) *Biodiversity Planning for Palau's Protected Areas Network: An Ecoregional Assessment.* TNC Pacific Island Countries Report No. 1/07.

Lutchman, I., Aalbersberg, B., Hinchley, D., Miles, G., Tiraa, A., Wells, S. (2005) *Marine Protected Areas: Benefits and Costs for Islands*. WWF the Netherlands.

Marino, S., Bauman, A., Miles, J., Kitalong, A., Bukurou, A., Mersai1, C., Verheij, E., Olkeriil, I., Basilius, K., Colin, P., et al. (2008) The State of Coral Reef Ecosystems of Palau. *In* (eds) *The State of Coral Reef Ecosystems of the United States and Pacific Freely Associated States: 2008* pp. 511–539. NOAA Technical Memorandum. Centre for Coastal Monitoring and Assessment's Biogeography Team.

Richmond, R., Rongo, T., Golbuu, Y., Victor, S., Idechong, N., Davis, G., Kostka, W., Neth, L., Hamnett, M., Wolanski, E. (2007) Watersheds and coral reefs: Conservation science, policy and implementation. *BioScience* 57, 598-607.

South Pacific Regional Environment Programme (2002) Palau. SPREP Publication.

National Legislation: Japan

Overview:

Currently, a diversity of laws exists to conserve coral reef ecosystems in Japan, implemented primarily on a sectoral basis. These laws relate to conservation and fisheries management, restricting extractive activities that contribute to the preservation of coral reef ecosystems. However, in 2007 Japan enacted the Basic Act on Ocean Policy to implement measures with regard to the first comprehensive and systematic management of its marine waters. Of further importance is the style of MPA governance adopted in Japan, incorporating a distinctive community-based self-management approach to designation and compliance. Coral reef restoration projects are now underway, since the Law for the Promotion of Nature Restoration was enacted in 2003.

Legislation relating to Coral Reef Fisheries Management:

Coral reef fisheries in Japan are controlled primarily through the following national, prefectural and Fisheries Cooperative Associations' (FCA) regulations Act on the Protection of Fisheries Resources which prohibits destructive fishing practices such as bomb and poison fishing and allows prefectural authorities, if needed, to designate specific areas where coral reef are protected.. In addition, coral reef fisheries are effectively controlled according to the local circumstances by FCAs. Territorial fishing rights, which are issued by the prefectural governments and allow non-transferable exclusive access to fishery resources to FCAs, are required to establish their own regulations (stricter than the official prefectural regulations) for resource conservation and sustainable utilization. According to the Fisheries Law, each prefectural government can also establish official regulations which are applied in the respective coastal areas based on its own situation, which enables flexibility regarding coastal resource extraction.

Legislation relating to Marine Conservation Measures:

In Japan, both the Natural Parks Law and Nature Conservation Law are main national legislation responsible for the establishment of protected areas within Japan. The Natural Parks Law is the principal law that allows for the establishment and monitoring of Marine Park Zones. Furthermore, the Law for the Promotion of Nature Restoration 2003 was enacted to promote nature restoration. Under this Law, several projects have been promoted in national parks with a purpose to revitalise coral reefs. Through this Law, restoration is conducted among various stakeholders, reducing the likelihood of conflicting interests and non-compliance. Japan has 616 legally binding no-take zones, in addition to approximately 600 voluntary no-fishing areas, designated through a community-based approach, primarily by the fishers themselves. However, fishermen bear both the costs of conservation and receive the benefits from management inside their local waters which highlights this strategy as an effective management option. Additionally, the government imposes and strictly maintains a limited entry system for coastal fisheries under the fishery rights regime and this provides an efficient regulatory mechanism.

Legislation relating to Coastal Zone Planning and Development:

Japans coastal zone is classified into harbours, fishing ports and reclaimed agricultural lands with separate laws for each zone and its subsequent management provided by different ministries. Importantly, Japan has incorporated Integrated Coastal Zone Management in its new Basic Act on Oceans Policy for maintaining the integrity of its coastal zone but due to the infancy of this law, it may take some time to determine the level of success and implementation. Additionally, the Environmental Impact Assessment Law 1999 provides an important planning tool for coastal development by requiring the proponents of large developments to incorporate environmental considerations in the planning process.

Legislation relating to Pollution Control:

Japan's legislation regarding pollution control is fragmented over 20 different laws. However, the major acts of legislation include the Water Quality Pollution Law, the Basic Environmental Law and the Law relating to the Prevention of Marine Pollution and Marine Disasters. The establishment of effluent standards to control pollution concentration in each water body are provided under both the Water Quality Pollution Law and Basic Environmental Law. The Law relating to the Prevention of Marine Pollution and Marine Disasters regulates the ocean dumping of waste through an approval system. Additionally, waste generating companies are obliged to perform prior assessments of impacts of ocean dumping, therefore making it less likely that significant pollution will arise in the future. The Law for the Promotion of Marine Litter Disposal was established in 2009 and responsibility for appropriate marine litter disposal of relevant bodies was clarified. This Law includes a campaign process incorporating both private and public sectors to collaborate and implement strategies to reduce marine litter.

Integrated Watershed Management Policy Approaches:

Japan does not have a specific policy to regulate watersheds; however several policies have an impact upon various anthropogenic activities. Red-Silt and Other Soil Particles Outflow Prevention Ordinance 1995 is a local ordinance that prevents contamination of public waters by controlling soil outflow from developmental works of 1000m ^{2} or more, requiring developers to implement measures to prevent soil run-off. However, farmlands are not obliged to take measures, preventing notable improvements. Japan implemented the Agricultural Chemicals Regulation Law under its commitments to the Stockholm Convention on Persistent Organic Pollution and through this has prohibited 14 such chemicals previously used in agriculture which has led to improvements in the environmental indicators of rivers, lakes and reservoirs.

Priorities for Legislative Action:

- Co-ordinated conservation of adjacent land and sea areas is required to address the issues of land-based sources of pollution and watershed management. Specifically, farmlands should be required to implement measures to reduce red soil erosion.
- Japan should implement Integrated Coastal Zone Management legislation that is specifically focussed on coastal marine resources.
- When designating a national park on private land, stakeholder/owner consultation should be mandatory.
- An integrated information database of domestic MPAs should be established to provide for effective management.
- Information on the size of no-take zones in Japan should be readily available through the prefectural governments.
- Current law affects the conservation and restoration of coral reefs on a sectoral basis; however comprehensive legislation should be designed to focus specifically on these ecosystems and incorporate the multiple pressures that threaten their integrity.
- Implement the Law for the Promotion of Marine Litter Disposal in all coastal prefectural governments.

Background Literature:

Fujiwara, S., Shibuno, T., Mito, K., Nakai, T., Sasaki, Y, Dai, C and Chen, G (2000). Status of Coral Reefs of East and North Asia: China, Japan and Taiwan. In: Wilkinson, C. (ed.) *Status of Coral Reefs of the World: 2000.* Australian Institute for Marine Science, Australia. pp 131-140.

Government of Japan (no date supplied) *Conservation of Marine Environment* [Online] available: http://www.env.go.jp/en/earth/marine/conservation.html

Kimura, T., C.F. Dai, H-S. Park, H. Hui and P.O. Ang. , 2008 , Status of Coral Reef Resources in East and North Asia (China, Hong Kong, Taiwan, South Korea and Japan) . In: Wilkinson, C. (ed.). *Status of Coral Reefs of the World: 2008*. Global Coral Reef Monitoring Network and Reef and Rainforest Research Center, Townsville, Australia. p145-158

Tsuchiya, M., Nadaoka, K., Kayanne, H., Yamano, H. (2006). *Coral Reefs of Japan*. Ministry of the Environment.

Yagi, N., Takagi, A., Takada, Y and Kurokura, H. (2010) Marine protected areas in Japan: Institutional background and management framework. *Marine Policy*, Vol. 34, Issue 6, pp. 1300-1306.

National Legislation: Mexico

Overview:

Mexico has extensive legislation and is developing capacity to manage natural resources, with an effective protected areas programme containing numerous ecological zoning initiatives responsible for regulating coastal activities. Significantly, all 31 Mexican states have their own environmental legal regimes; however legislation regulating access to coastal resources remains fragmented and sometimes inconsistent because it is based on mechanisms implemented in a sectoral manner. Land-related jurisdictions belong to the states and municipalities, whereas coastal and marine areas remain primarily under federal jurisdiction. Therefore coordination among the three levels of government is imperative for an effective legal framework for integrated management. The dominating human threats to the health of the coral reefs in Mexico stem from tourism development, overfishing, land conversion and agricultural activities.

Legislation relating to Coral Reef Fisheries Management:

Mexican fisheries policy has always been a top down affair based on centralised government institutions. The General Law of Ecological Balance and Environmental Protection 1988 (Ecology Law) contains protected area regulations which specify that fisheries by catch within them can not exceed the volume of the target species, a provision intended to increase sustainability of fisheries but may still result in excessive levels of bycatch. Mexico's Penal Code contains chapters with important regulations meant to protect marine life. Importantly, there exists no documentation pertaining to coral reef fisheries due to the absence of a national data information system. The Federal Fisheries Law 1992 is a specific instrument of Mexico's fisheries legislation however; the management objectives remain somewhat vague.

Legislation relating to Marine Conservation Measures:

Coral reefs in Mexico are protected either as biosphere reserves or as national parks under the Ecology Law. Current MPAs have incorporated interagency and stakeholder involvement within its planning and implementation process. Significantly, Mexico's first National Marine Park initiated by a local community was recognised by the federal government in 2000 and was an important step in the adoption of a nationwide community-based management approach to coral reef conservation. The Ecology Law is the principle law governing protected areas and requires an establishment decree and management plan in each MPA. The legal basis for employing charging fees in protected areas is addressed in the Federal Law of Rights which specifies the amount that may be charged in a specific situation.

Legislation relating to Coastal Zone Planning and Development:

To date, no explicit integrated coastal zone management policy has been formally implemented to manage coastal and marine issues in Mexico; however it has been argued that environmental policy tools such as ecological zoning programmes and MPAs could provide a baseline for future integrated coastal zone management in Mexico.

Legislation relating to Pollution Control:

The Ecology Law establishes general provisions attributing to the prevention and control of water pollution that applies to aquatic ecosystems including marine waters. Mexican Official Standards is a comprehensive environmental statute which addresses water, air and ground pollution, resource conservation and environmental enforcement. Specifically, NOM-001-SEMARNAT-1996 contains maximum contaminant limits for wastewater discharges into marine waters. The National Waters Law 1992 establishes a comprehensive legal regime for the management of water resources in Mexico. Through this legislation, the Government introduced a Water Financing System – a regulatory framework that seeks to encourage greater efficiency

with permits for wastewater discharges. Regulations under this law include all 'marine zones' in its definition of a wastewater receiving body. The National Waters Commission is the governing body in charge of regulating wastewater discharges into all marine zones. Contraventions of the National Waters Law may incur fines with permits revoked, required cessation of activities causing the discharge or even facility closure.

Integrated Watershed Management Policy Approaches:

In 1992, Mexico modified its National Waters Law and introduced a basin-orientated management approach, effectively incorporating the Polluter Pays Principle into its enforcement regime. Under this law, a tax is imposed on both the use of the water resource and its disposal. This revenue is then used to support the management of water sources while simultaneously providing a disincentive for polluters and encouraging efficiency of water use. River Basin Councils were established under this law and constitute as the primary tool for integrated water resource management and focus their attention on issues relevant to each individual River Basin, however, there is a need to incorporate indicators to signal the extent of progress.

Priorities for Legislative Action:

- Mexico's Coastal and marine legal framework should be contained under a single comprehensive law to eliminate fragmented and overlapping legislation and regulations.
- There should be a single government institution that holds jurisdiction over coastal and marine issues and which integrates community-based management of MPA's (currently 33 coastal and marine protected areas are managed by 24 administrative bodies).
- Integrated Coastal Zone Management legislation is urgently required.
- To include the use of indicators as a tool to evaluate the level of progress with regards to watershed management.

Background Literature:

Almada-Villela, P., Mcfield, M., Kramer, P., and Arias-Gonzalez, E (2002) Status of Coral Reefs of Mesoamerica - Mexico, Belize, Guatemala, Honduras, Nicaragua, and El Salvador. *In* C.R. Wilkinson (ed.) Status of coral reefs of the world: 2002. GCRMN Report, Australian Institute of Marine Science, Townsville. Chapter 16, pp 303-324.

Bezaury-Creel, J. (2005). Protected areas and coastal and ocean management in Mexico. *Ocean and Coastal Management* 48, 1016-1046.

Cruz, I., and McLaughlin, R. (2008) Contrasting marine policies in the United States, Mexico, Cuba and the European Union: Searching for an integrated strategy for the Gulf of Mexico region. *Ocean and Coastal Management.* Vol. 51, Issue 12, pp. 826-838.

Fraga, J. and Jesus, A. (2008). *Coastal and Marine Protected Areas in Mexico*. International Collective in Support of Fishworkers, India.

Fraga, J., Arias, Y and Angulo, J (2006). Communities and stakeholders in marine protected areas of Mexico, Dominican Republic and Cuba. *In* (ed.) *Coastal Resource Management in the Wider Caribbean, Resilience, Adaptation, and Community Diversity*.

Spreij, M (2005) National Aquaculture Legislation Overview. Mexico. In: *FAO Fisheries and Aquaculture Department* [Online] available: http://www.fao.org/fishery/legalframework/nalo_mexico/en

U.S. Coral Reef Task Force (2001) *FY2000 Accomplishments and Future Activities* [Online] available: *www*.coralreef.gov/about/2000_Accomplishments.pdf

National Legislation: Cuba

Overview:

Cuba is the most ecologically diverse island in the Caribbean and contains over 3000 miles of coastline, much of which remains undeveloped. The main human-induced threats to coral reefs in Cuban waters are derived primarily from land-based sources of sewage and agricultural run-off occurring near coastal population centres. However, due to only short stretches of urbanised coastline, these impacts are localised. The establishment of MPAs is a relatively modern concept in Cuba, with many established in 2000. Currently conservation of terrestrial protected areas take precedence over marine ecosystems however, the Cuban Government has set an ambitious goal to protect 22% of the marine shelf. Much of the environmental management in Cuba is centralised and therefore community-based management is not readily incorporated into national legislation.

Legislation relating to Coral Reef Fisheries Management:

The main legislative framework governing fisheries management is Decree Law 164 (1996) which contains regulatory measures including gear restrictions, seasonal closures, total allowable catch and the provision of fishing licences, all of which have had a significant effect on fish stocks. The Ministry of Fishing Industries has controlled and regulated access to the nation's fisheries resources through a single, sectoral approach to marine conservation however, integrated management and stakeholder involvement could be a more effective and efficient method as has been witnessed in other coral reef nations. Importantly, an official resolution of the Fisheries Ministry in 2004 banned the use of trawl nets and set nets in Cuban waters. Additionally, a Joint Resolution of MIP-CITMA No. 1/97 establishes key regulations for the protection and sustainable use of coral reefs, through prohibitions relating to certain harmful practices. Environmental Law 81, used as a comprehensive fisheries management tool, considers endangered species (as listed under CITES), the environmental impact of fisheries projects and marine pollution from unregulated activities.

Legislation relating to Marine Conservation Measures:

Establishing a network of MPAs in Cuba has historically been a top-down affair. Decree Law 201 (1999) contains provisions for a National System of Protected Areas through formally defined protected area categories, administrative formulations, mechanisms for proposals and approvals and guidance for participatory area planning. To date, twenty one coastal and marine protected areas have already been legally declared, with thirteen more in final approval process. Currently, eight categories of protected areas exist based on the level of management and human activity allowed within its boundaries which could lead to confusion unless communicated effectively. Notably, Law 201 authorises the establishment of buffer zones around protected areas in all categories. Environmental Law 81 is the framework law for environmental management. Although, a lack of funding is a significant limitation in Cuba, Law 81 authorises some economic tools for environmental management purposes for example Resolution 60/2000 allows tariffs and green credits, as revenues generated from environmental license fees, to finance environmental projects although Cuba has not experimented much with these user fees.

Legislation relating to Coastal Zone Planning and Development:

Cuba has a centralised system of land use planning in the coastal zone. Specifically, the Decree Law 212 (2000) aims to delineate the extent of the coastal zone and regulate activities within it to ensure its protection and sustainable use, in light of the principles of integrated coastal zone management and as a result of this, new or expanded construction is prohibited. The Decree is premised upon the most current and up-to-date environmental principles including Environmental Impact Assessment, through which treatment for sewage generated by all tourism developments has been compulsory. Under this Law, in certain coastal areas, new construction is prohibited unless justified for public utility or social interests. Furthermore, all new

construction projects are subject to a series of licensing requirements. This has led to a successful moratorium on the anthropogenic destruction of mangroves.

Legislation relating to Pollution Control:

In Cuba, Environmental Law 81 provides tools for environmental management and requires all waste disposal into the marine environment to obtain prior consent from the Ministry of Science, Technology and the Environment. Pollution control management is controlled through ambient standards, an approach that has largely failed in other countries including the U.S. who now adopts standards based on best available technology. Agriculture and mining industries are major sources of diffuse pollution which is difficult to measure and emphasises the case-by-case approach to pollution control in Cuba. Furthermore, an estimated 70% of Cuba's domestic wastewater is untreated/receives primary treatment before being discharged into coastal waters presenting a need for improved sewage treatment facilities.

Integrated Watershed Management Policy Approaches:

Environmental Law 81 defines the objectives of integrated watershed management in Cuba and is coordinated primarily by National Watershed Councils in collaboration with the central administration of the state, allowing for the benefits of an inter-sectoral cross cutting approach. Subsequently, eight watersheds have been identified as 'highest priority', based on their economic, social and environmental complexity. The National Watershed Councils conduct in situ monitoring to assess the extent of compliance, in addition to assessment of the coastal zone, recognising the connectivity of the watershed and coastal environment.

Priorities for Legislative Action:

- To incorporate community-based management approaches into marine resource management.
- The term coral reef should be expressed in Environmental Impact Assessment; it is currently included in the generic concept of fragile ecosystems.
- More than 12% of Cuba's terrestrial land is under various forms of protection compared to just 3.5% of the Cuban shelf – this should be increased to safeguard ecosystem resilience and integrity.
- A specific law incorporating Integrated Coastal Zone Management is required to harmonise the growing tourism base with the sustainable use of coastal and marine resources.
- To increase focus on ecological interactions and ecosystem-based management.
- Regulations for the protection of coral reefs directed at both tourists/tour guides should be enforced.
- Ambient standards are seen as ineffective in controlling pollution levels; this should instead be premised upon best available technology.

Background Literature:

Alcolado, P., Claro-Madruga, R and Estrada, R (2000) *Status and Prospectives of Coral Reef Management in Cuba.* Proceedings of the Ninth International Coral Reef Symposium, Bali, Indonesia.

Barba, B and Avella, A. (1995) *Cuba's Environmental Law.* Assoc. for the Study of the Cuban Economy Newsletter, Winter, pp.35-36.

Cruz, I., and McLaughlin, R. (2008) Contrasting marine policies in the United States, Mexico, Cuba and the European Union: Searching for an integrated strategy for the Gulf of Mexico region. *Ocean and Coastal Management* Vol. 51, Issue 12, pp. 826-838.

Estrada, R., Avila, A., Muro, J., Zorrilla, A., Leon, M., Izquierdo, M., Lindeman, K. (2004). *The National System of Marine Protected Areas in Cuba.* National Centre of Protected Areas.

Houck, O. (2000) Environmental Law in Cuba. *Journal of Land Use and Environmental Law*. 1, 5, 41.

Jones, L., *et al* (2004). Status Of Coral Reefs In The Northern Caribbean And Western Atlantic Node Of The GCRMN. pp. 451-470. *In* C. Wilkinson (ed.). *Status of coral reefs of the world: 2004. Vol. 2.* Australian Institute of Marine Science, Townsville, Australia. p. 557.

Whittle, D., Lindeman, K. (no date supplied) *Protecting Coastal Resources in Cuba: A Look at Current Laws and Institutions.* [Online] available: www.nsgd.gso.uri.edu/riu/riuc04001/riuc04001_part3.pdf

Whittle, D., Lindeman, K., Tripp, J. (2003) International Tourism and Protection of Cuba's Coastal and Marine Environments, 16 *Tulane Environmental Law Journal.* 533, 534.

National Legislation: Philippines

Overview:

The legal framework for the management of marine coastal resources in the Philippines is strong, incorporating an effective community-based management approach of noteworthy achievement. In 1991, resource management in the Philippines was decentralised to the local government, with an aim to establish self-reliant communities through which a wave of MPAs were established, among other coastal resource management initiatives. Significantly, law enforcement is not the sole responsibility of government agencies and regular citizens can become designated as fish wardens in the enforcement of fisheries laws. The dominant threat to the Philippines coral reef ecosystems includes the over-exploitation of fisheries as well as the use of destructive fishing methods.

Legislation relating to Coral Reef Fisheries Management:

The Philippine Fisheries Code 1998 contributed to the devolution of primary responsibility for coastal resources to the local government and is a legislative landmark associated with the management of corals and coral reefs through prohibiting the gathering, possession, exploitation and exportation of scleractinian corals. The Code enhanced the biophysical quality of coral reefs that has translated into improved fish catch, as documented inside and outside marine sanctuaries therefore providing a useful tool to encourage local participation in sustainable management. Another law, the Agriculture and Fisheries Modernisation Act of 1997, implements fisheries management by delineating strategic fisheries development zones. Both these laws are important to fisheries management because they clearly emphasise the conservation, protection and sustainable management of marine and coastal resources as a major objective.

Legislation relating to Marine Conservation Measures:

The Philippines have implemented appropriate laws for the establishment of MPAs. Community-based MPAs are among the most successfully managed in the country as it is they who decide on management of MPAs such as designation of zones in addition to open/closed seasons. The National Integrated Protected Areas System (NIPAS) Act of 1992 (a direct result of the 1992 Convention on Biological Diversity) provides the framework to designate MPAs by integrating ecosystem management from watershed to reef slope. The establishment of MPAs heavily involves stakeholder consultation in addition to management through a multi-sectoral management board (also the decision making body) which typically comprises both local communities and local government units. Under the Local Government Code of 1991, coastal municipalities have been able to establish sanctuaries in their municipal waters through the issuance of municipal ordinances. The management of natural resources became the shared responsibility of the Local Government Units and the National Government and consequently coastal local governments became the primary coastal resource managers.

Legislation relating to Coastal Zone Planning and Development:

The Philippines is argued as having one of the most advanced coastal zone management systems in the Southeast Asian Region. The Local Government Code 1991 and Fisheries Code 1998 provides the main elements of legal framework for decentralised coastal zone management in the Philippines with an emphasis on local community participation in the management of coastal resources. The Local Government Code 1991 provides a decentralised legal framework for certain government functions including marine, coastal and fisheries management. This has consequently led to an integrated, multi sector and ecosystem-based management approach.

Legislation relating to Pollution Control:

Under the Marine Pollution Decree of 1976, the National Pollution Control Commission has the primary responsibility to promote national rules and policies governing marine pollution. The decree also gives the Philippine Coast Guard responsibility for controlling, containing and preventing marine pollution of the seas and other bodies of water within the territorial jurisdiction. Under the Clean Water Act 2004, penalties exist for those who commit prohibited acts, demonstrating the adoption of the Polluter Pays Principle as a deterrent into national legislation. This legislation applies to water quality management in all water bodies however; it primarily applies to the abatement of pollution from land-based sources.

Integrated Watershed Management Policy Approaches:

The policy and institutional landscape regarding watershed management is generally established and is typically sectoral in its approach, based upon the principles of ecosystem-based management. The Local Government Code 1991 provides the legal basis for governance of the country's natural resources, including its watershed and hence transferred certain responsibilities relating to environmental management to local government units (LGU). The LGU developed a Natural Resource Management and Development Plan through a stakeholder planning process. A key feature of this Plan is a Landcare Program, a grassroots community-based approach for rapid and inexpensive distribution of agro-forestry and conservation practices. The NIPAS Act led to a multi-sectoral Protected Area Management Board, to manage coastal, marine and terrestrial protected areas

Priorities for Legislative Action:

- To resolve the issue regarding which government institution should manage CITES protected species in the marine environment.
- The National Integrated Protected Areas System Act of 1992 should provide a separate category for marine areas.
- There exists a plethora of agencies with fisheries related responsibilities which leads to jurisdictional overlap, contradictory mandates and duplication of effort; instead, an interagency partnership should be established which incorporates clearly defined objectives and responsibilities.

Background Literature:

Alcala, A and Russ, G. (2002) Status of Philippine Coral Reef Fisheries. *Asian Fisheries Science* 15, pp. 177-192.

Alino, P. (2001*) An overview of the Philippines fisheries.* Fisheries Training Programme. United Nations University, Iceland.

Alino, P. (No date supplied) *Philippine Coral Reef Fisheries – Challenges and Frustrations*. The Marine Science Institute, University of the Philippines.

Chou, L. M., Tuan, V., Philreefs, T. Yeemin, A. Cabanban, Suharsono and Kessna, I. (2002). Status of Southeast Asia Coral Reefs. In: C.R. Wilkinson (ed.) *Status of coral reefs of the world 2002.* Australian Institute of Marine Science, Townsville. pp 123-152.

Dalby, J., and Sorensen, T. (2002). *Coral Reef Resource Management in the Philippines – with focus on Marine Protected Areas as a Management Tool*. University of Copenhagen.

Environmental Law [Online] available: www.aseanlawassociation.org/papers/phil_chp11.pdf

Licuanan, W and Gomez, E. (2000). *Philippine Coral Reefs, Reef Fishes, and Associated Fisheries: Status and Recommendations to Improve Their Management.* Global Coral Reef Monitoring Network (GCRMN) Report.

Philippine Clearing House Mechanism for Biodiversity (2009). *National Integrated Protected Areas System (NIPAS)* [Online] available: http://www.chm.ph/index.php?option=com_content&view=article&id=104:nipas&catid=40&Itemid=73&el_mcal_month=5&el_mcal_year=2010

White, A., Deguit, E., Jatulan, W. and Eisma-Osorio, L. (2006). Integrated coastal management in Philippines local governance: Evolution and benefits. *Coastal Management* 34, pp. 287-302.

National Legislation: Indonesia

Overview:

Indonesian coastal waters contain the greatest proportion of the world's coral reefs and are managed on both a national and local community basis. The main causes of coral reef degradation are destructive fishing methods and agricultural practices, in addition to sewage and industrial pollution from rapid coastal development. Comprehensive legislative efforts are required in order to address these multiple issues. Significantly, land-based pollutants are not controlled, which further exacerbates the problem. In 1999, decentralisation gave inexperienced local governments the authority to manage complex coastal and ocean issues such as coastal zone management and this required a transfer of knowledge and technology. The protection of Indonesia's coastal resources remains sectoral in its implementation; however, the complex set of legislation that currently exists could be adequate if implementation was strengthened and incentives for compliance were included.

Legislation relating to Coral Reef Fisheries Management:

The Fisheries Act 2004 is the legal basis for fisheries management and prohibits the use of illegal fishing equipment that pollutes and degrades the associated ecosystems with fines and penalties imposed. Furthermore, the Act authorises the government to protect a fishery zone or preservation area. Regulations including the Agriculture Ministry Decree No. 607 of 1976 are provided to regulate the size of the fishing gear and MSY of the fish species. Coral reefs are categorised as a fishery resource under this Act. This legislation has had the greatest impact on the management of coral reefs and their ecosystems in Indonesia, however, the zonation system only restricts larger vessels from fishing near the shore and therefore does not provide complete protection against over fishing – additionally, the license system only applies to boats heavier than 3 tons which limits the effectiveness of inshore fisheries management.

Legislation relating to Marine Conservation Measures:

The decentralisation of marine management contributed to the establishment of small scale community-based MPAs. The Biological Resources Act 1990 influences the use and management of coral reefs in Indonesia. The law promotes two types of 'Nature protection areas' as nature reserve areas and nature sustainable areas. In addition, Presidential Decree No. 32 1990 delegates the regional government to determine the protected area, but not to manage them. This Decree allows conservation as the only choice of protection, which can hinder consensus on the most appropriate method of management. Furthermore, the Decree does not contain provisions for areas that, through exploitation, no longer contain mangroves, widely recognised as an essential buffer to the effects of siltation on coral reefs. Significantly, no MPAs are completely closed to fishing activities which limits their ability to provide a sanctuary against the effects of over fishing. The recently enacted Mining Law 2009 provides a licensing system for certain types of mining and coal companies; however, this does not include tin mining of which Indonesia is a primary exporter and this activity is attributed to coastline erosion and destruction of coral reefs.

Legislation relating to Coastal Zone Planning and Development:

No national and policy framework on coastal zone management existed before 2007 and as such is still in its infancy in Indonesia. However, it is anticipated to have a significant impact on future coastal and ocean management. Under Act No. 27/2007, article 9 includes provisions for marine zoning which creates an obligation to provide access for local communities and in turn strengthens the local community role in coastal resource management. The Spatial Use Management Act 1992 is a general law with the purpose to manage the marine and coastal resources. Coral reef management is not directly addressed in this law; however, the obligations to manage marine and coastal areas are clearly relevant to coral reefs. Under the Environmental

Management Act an EIA is a required for activities that have a major impact on the environment however, the official guidance is ambiguous and is open to interpretation.

Pollution Control:

The Continental Shelf Act 1973 contains provisions which specifically cover the prevention of pollution by activities on adjacent waters and affects the use of coral reefs in maritime jurisdiction by restricting activities including gas and mineral mining. Additionally, the Shipping Act of 1992 contains provisions governing pollution generated from ship operations which provides for coral reef management. There is a complementary relationship between the continental shelf law, the basic mining law, and government regulations on the supervision of offshore oil exploration and exploitation. However, legislation is required that addresses land-based pollutants, identified as a major threat to the integrity of Indonesia's marine and coastal ecosystems.

Integrated Watershed Management Policy Approaches:

The Environmental Management Act 1997 is a comprehensive law that provides regulations associated with the preservation of plants and animals as well as the standardisation of water quality. The Act provides a set of rules to develop a financing system for environmental conservation programmes. In addition, Act No. 7/2004 on Water Resources is based on two important principles: water resource management as an integrated approach: and an emphasis on conservation, linking water use with water supply. This Act provides a licensing system for those who require water beyond their personal needs and for undertaking construction works affecting water resources which provides an effective regulatory mechanism.

Priorities for Legislative Action:

- Indonesia should implement a national marine policy to provide a holistic approach to managing its marine resource base and which integrates all major anthropogenic pressures on coral reefs.
- There is a need to incorporate community-based participation into legislation in order to achieve greater compliance and support at the public level through co-management. Traditional community rights should be recognised in natural resource management laws.
- Marine Protected Areas should be closed or partially closed to fishery activities.
- The Mining Law 2009 should include tin mining in its licensing system.
- To implement local regulations for coastal and marine spatial planning in order to reduce user conflict in the jurisdiction regarding fishing and conservation areas.
- The definition of conservation should be standardised in all laws relating to natural resource management.
- Stronger and more specific EIA rules.

Background Literature:

Dirhamsyah, D. (2005) Indonesian legislative framework for coastal resources management: A critical review and recommendation. *Ocean and Coastal Management* 49, 68-92.

Fristikawati, Y. (2009) *Legal Protection of Indonesian Coral Reefs in Papau Province*. University of Indonesia.

Hopley, D. and Suharsono (2000*). The Status of Coral Reefs in Eastern Indonesia* . Global Coral Reef Monitoring Network (GCRMN).

Nurhidayah, L. (2010) *Towards Integrated Coastal Zone Management in Indonesia: Framework Assessment and Comparative Analysis*. Indonesian Institute of Sciences.

Ryan, J. (2001) Indonesia's Coral Reefs on the Line. *In* World Watch Magazine, May/June 2001 Volume 14, No. 3.

Tun, K., L. M. Chou, A. Cabanban, V. S. Tuan, Philreefs, T. Yeemin, Suharsono, K. Sour and D. Lane , 2004 , Status of Coral Reefs, Coral Reef Monitoring and Management in Southeast Asia, 2004. p. 235-276. In C. Wilkinson (ed.) *Status of coral reefs of the world: 2004. Vol. 1.* Australian Institute of Marine Science, Townsville, Queensland, Australia. p. 301.

National Legislation: China

Overview:

Coral reefs play an important role in providing marine resources and biodiversity in China. However, the economic and population growths are contributing to the long term degradation of coral reef ecosystems. The Chinese government has promulgated a series of laws and regulations that relate to the management and protection of coral reefs with the Precautionary Approach taking precedence through the dominance of fully-protected marine nature reserves. However, there is a need to implement legislation that incorporates both the growing maritime sector (fishing, aquaculture and tourism) that reaps short-term economic benefits and the addition to protection of its coral reef resources in a way that sustains its value and ensures the long term ecosystem integrity. The major human-induced threats to China's coral reefs include poor land management practices resulting in sedimentation, freshwater incursion and sewage outflow in addition to increasing coastal development.

Legislation relating to Coral Reef Fisheries Management:

There currently exists no specific law pertaining to the management of coral reef fisheries; however fisheries in China are regulated under the Fishery Law of China which contains provisions for fishery resource conservation.

Legislation relating to Marine Conservation Measures:

China's MPA system operates at national, local and site levels with various policies and regulations to provide for the establishment and management of MPAs which follows a zoning scheme. The designation process is decentralised, with responsibility concentrated on local governments. Significantly, no-take zones amount to 94.4% of China's total MPA system, whereas on a global scale no-take zones only represent a tiny fraction of the total area. This reflects a precautionary approach to ecosystem management. However, few designated MPAs have a long term monitoring program to evaluate their effectiveness. Hainan Province Regulation of Coral Reef Protection 1998 is state legislation that prohibits coral mining for building materials and limestone, blast fishing and cyanide fishing, coral and shell collection and the establishment of waste outfalls into coral reef marine reserves. The State Law of Marine Environment Protection and the State Management Regulation Preventing Coastal Engineering Projects from Marine Environmental Damage and Pollution strictly prohibit coral destruction by any coastal engineering activities. The former was revised in 2000, placing more emphasis on coral reef protection, restoration of damaged reefs and the establishment of marine reserves.

Legislation relating to Coastal Zone Planning and Development:

Planning in China has traditionally been conducted as a top-down affair. The Law on the Management of Sea Use 2002 is the foundation for marine development and management, under which the sea is divided into various functional zones. A user-fee system is imposed, which requires any entity or individual who uses the sea to pay a fee. According to the Law, 70% of the fees collected will rest with the local government and the remaining 30% will go directly to state revenue for marine development, protection and management. The Marine Environmental Protection Law of the People's Republic of China 1983 seeks to strengthen integrated coastal zone management (including construction projects, vessel pollution and oil exploration) and promotes improved coordination between agencies to implement and monitor integrated coastal management and protection efforts. Significantly, China's Law on Environmental Impact assessment made public consultation and access to information a requirement for all EIAs in China however, enforcement mechanisms are weak in comparison to other countries and has led to widespread non-compliance.

Legislation relating to Pollution Control:

China recently implemented its first comprehensive anti-marine pollution regime through the Regulations on the Prevention and Control of Ship Induced Pollution of the Marine Environment 2010. The Maritime Safety Authority (MSA) was delegated as the government body to administer the regime for pollution control. The MSA can take removal measures and recover costs from the liable party, illustrating effective implementation of polluter pays legislation. The Regulations require ship owners to prepare an emergency response plan for the prevention and control of marine pollution. Because China is not a party to the IMO Fund convention, these regulations establish a domestic fund in which receivers of regular oil cargoes must contribute to and is used as compensation for ship induced pollution. Penalties in the form of fines are imposed and vary depending on the level of the incident.

Integrated Watershed Management Policy Approaches:

To date, there exists no comprehensive policy on integrated watershed management in China. However, The Law on Water and Soil Conservation 1991 requires the conservation of these components while starting construction projects to prevent the destruction of vegetation, thereby decreasing the sediment flow into the rivers and coastal waters. Through implementation of this Law, the soil and water conservation consciousness of the public has been improved.

Priorities for Legislative Action:

- The management scheme of the coastal zone in China still remains sectoral leading to interagency conflicts through overlapping jurisdiction. Effective co-ordination among related agencies is necessary.
- To include a campaign and educational program to increase environmental awareness among the general public.
- To create a national database to monitor changes in fish abundance at the species level.
- To implement regulations specific to coral reef fisheries and destructive fishing activities.
- Legislation should include an obligation to monitor the long term effectiveness of MPAs.
- The maximum possible fine for failing to complete an Environmental Impact assessment is capped at US$25,000, a fraction of the total cost of development - penalties should be more stringent, to deter non-compliance.
- Integrated watershed management legislation should be introduced in China.

Background Literature:

Beyer, S. (2006) 'Environmental Law and Policy in the People's Republic of China' *Chinese Journal of International Law.* Vol. 5, No. 1, 185-211.

Kimrua, T., Chang, S., Pae, H., Hui, H., Ang, O.,Je, J and Choi, C. (2004) Status of Coral Reefs in East and North Asia: China, Hong Kong, Taiwan, Korea and Japan p. 277-301. In C. Wilkinson (ed.). *Status of coral reefs of the world: 2004*. *Vol 1*. Australian Institute of Marine Science, Townsville, Queensland, Australia. p. 301.

Kimura, T., C.F. Dai, H-S. Park, H. Hui and P.O. Ang. (2008) Status of Coral Reef Resources in East and North Asia (China, Hong Kong, Taiwan, South Korea and Japan). In: Wilkinson, C. (ed.). *Status of Coral Reefs of the World: 2008.* Global Coral Reef Monitoring Network and Reef and Rainforest Research Center, Townsville, Australia. p145-158.

Qui, W., Wang, B., Jones, P., Axmacher, J. (2008). Challenges in developing China's marine protected area system. *Marine Policy* 33, 599-605.

Zhang Q M. Coral reefs conservation and management in China. In: Ahmed M, Chong C K, Cesar H, eds. *Economic Valuation and Policy Priorities for Sustainable Management of Coral Reefs*. WorldFish Center Conference Proceedings 70. Penang Malaysia: WorldFish Center, 2004. 198–202.

National Legislation: Kenya

Overview:

Kenya has shown a strong commitment to the protection of wildlife and natural habitats with protection of the marine environment going back several decades and currently has more than 77 statutes for the conservation and management of the marine environment. Most laws address the need to conserve and develop the resources of the coastal and marine areas, however; they do not clearly address the management that sustains these resources. There is no single authority/institution responsible for all aspects of marine affairs as coral reef associated ecosystems fall under the jurisdiction of several government agencies. The fisheries department has control over fishing activities; the forestry department has jurisdiction over the mangrove resources, while the tourism department licenses tourism activities. This overlapping responsibility requires sufficient consultation between these government agencies in order to minimise the risks of user conflict within the MPAs. Land-use change and physical alteration have led to widespread erosion and sedimentation which have severely degraded coral reefs. These threats have been exacerbated further by destructive fishing and marine pollution from various point and diffuse sources.

Legislation relating to Coral Reef Fisheries Management:

Kenya employs a sectoral approach to coral reef fisheries management. The Fish Industry Act 1991 was established to provide for the reorganisation, development and regulation of the fish industry and to make provision for the protection of fish. The Fisheries Department (FiD) was created in cooperation with other departments of Government. Legislative measures enforced by the FiD includes gear restrictions (seine nets and spear guns are illegal), closed seasons, limits to the amount, size, species or ages of fish caught. Kenya's regulations have included the protection of near shore fishery resources from large scale commercial exploitation; although these regulations also prohibit coral mining, no formal management plan is in place to implement the mining ban.

Legislation relating to Marine Conservation Measures:

Coral reefs in Kenya are managed as Marine Protected Areas under the Wildlife Conservation and Management Act 1976. Six marine reserves and four marine parks have been designated and are managed by the Kenyan Wildlife Service. Coral reef fisheries outside of protected areas are under the jurisdictions of the Fisheries Department. The Act allows some extractive activities such as fishing using traditional methods in marine reserves, while it prohibits others, such as drilling for oil and gas. Marine Parks (no-take areas) are completely protected from all extractive activities. Under the Act, all biological resources within a park are protected through application of the ecosystem approach and no removal of biotic or abiotic components is permitted. The enforcement of MPA regulations includes daily patrols which have been effective in reducing human disturbance within MPAs, leading to increases in abundance, diversity, and productivity of marine organisms. This Act has led to the recognition of the value of coral reefs.

Legislation relating to Coastal Zone Planning and Development:

The Land Planning Act 1970 is implemented through the Ministry of Lands and Settlement. The Act therefore determines the extent and development of land in the coastal zone of Kenya. In addition, the Coast Development Authority Act 1990 established the Coast Development Authority (the leading coastal planning agency in Kenya) which has been a major step in Kenya's commitment to coastal issues. Furthermore, the Environmental Management and Coordination Act recognises the coastal zone for planning and development purposes: however, there is no specific legislation in place to implement a strategy for this.

Legislation relating to Pollution Control:

The Agriculture Act 1963 relates to land-based sources of coastal and marine pollution and degradation. It is the principle land use statute covering soil conservation and agricultural land use in general. The Acts long term objective is to ensure the development of arable land in accordance with the practice of good land use.

Integrated Watershed Management Policy Approaches:

The Forest Act 2005 provides for higher penalties to deter those who engage in activities that are harmful to forests. The Act contains provisions including a strong emphasis on community engagement and partnerships and provides an orderly system for the protection of forests as well as rational exploitation of coastal forest resources. Although the Land Act states that the riparian zone along rivers belongs to the government and must be left intact, the official size of the strip is not standardised but instead is determined by the width of the river. This has led to confusion and differences in interpretation by individuals, creating problems in relation to enforcement and management with many landowners clearing vegetation for land use right up to the river edge.

Priorities for Legislative Action:

- Many fishers do not know if spear fishing is illegal – this must be explicitly stated in the Fisheries Act.
- A legislative framework for fisheries management exists, however adequate funding and institutional capacity is required to enhance its implementation.
- Kenya needs to increase its network of marine parks to include a substantial portion of its reef system.
- Reef fisheries management requires a comprehensive rather than sectoral approach to avoid overlapping mandates.
- MPAs require specific regulations to ensure compliance.
- Suitable incentives are required to reduce the use of destructive fishing gear which could lead to the recovery and sustainability of these resources within the marine reserve.
- Kenya should implement a national Integrated Coastal Zone Management policy.
- The Land Act must stipulate the official size of the riparian zone along the rivers to prevent differences in interpretation and difficulties in enforcement.
- Kenya's legal framework for coastal resource management should refer specifically to coral reefs and marine life management.

Background Literature:

Frontani, H., and Hopkins, A. (2008). *Managing Coral Reef Fisheries.* The Encyclopedia of Earth [Online] available: http://www.eoearth.org/article/Managing_coral_reef_fisheries#gen4

Government of Kenya (2009*) State of the Coast Report: Towards Integrated Management of Coastal and Marine Resources in Kenya*. National Environment Management Authority, Nairobi. 88 pp.

Mangi, S., Roberts, C., and Rodwell, L (2007) Reef fisheries management in Kenya: Preliminary approach using the driver-pressure-state-impacts-response (DPSIR) scheme of indicators. *Ocean and Coastal Management*, 50: 463-480.

Obura, D., M. Suleiman, H. Motta and M. Schleyer (2000) Status of Coral Reefs in East Africa: Kenya, Mozambique, South Africa and Tanzania. In: Wilkinson, C. (ed.). *Status of Coral Reefs of the World: 2000*. Australian Institute for Marine Science, Australia. p. 65-76.

Obura, D., Church, J., Daniels, C., Kalombo, H., Schleyer, M. and Suleiman, M. (2004) Status of Coral Reefs in East Africa 2004: Kenya, Tanzania, Mozambique and South Africa. In: Wilkinson, C. (ed.) *Status of coral reefs of the world: 2004. Vol. 1*. Australian Institute for Marine Science, Townsville, Queensland, Australia. pp. 171-188.

Weru, S. (2004) .Policy Implications in the Management of Kenya's Marine Protected Areas. *In* these Proceedings.

National Legislation: French Polynesia

Overview:

French Polynesia has complete autonomy over its environmental protection. Most international conventions ratified by France apply to the region, but in some instances the procedures for implementing these agreements have not been taken. Two territorial organisations are in charge of the marine resources – Service de la Mer et de l'Aquaculture – involved in the management of marine heritage, and the Establissment pour la Valorisation des Activities Aquacoles et Maritimes – involved in scientific and applied research. Currently there are about 15 associations that have formed a federation and are involved with the protection of the environment; this federation plays an important role in decision making processes and the implementation of environmental measures. Coral reefs are well covered through legislation however; there is some inconsistency with the reality of its implementation.

Legislation relating to Coral Reef Fisheries Management:

Decision no. 88-183/AT of 8.12.88 prohibits use of scuba equipment for all fishing or collection of marine mammals, prohibits the use of certain toxic substances for fishing and defines the limits to the use of meshed nets. Foreign vessels are not licensed to fish inside the EEZ since 2000. French Polynesia has internal management autonomy from France on several issues including the regulation of maritime resource exploration and exploitation. There is not a separate law providing for coral reef fisheries as all legislation for fisheries management is generally modelled upon the European approach, however, there is limited scope for the preservation of coral reefs due to the absence of these tropical ecosystems in European waters and subsequent legislation.

Legislation relating to Marine Conservation Measures:

The Marine Space Management Plan (PGEM) provides the legal basis for the creation of no-take zones and fishing regulations and is based on government policy in the public domain, although the sanctions regime is currently inefficient. The Plan is part of municipal constituencies who are co-responsible for developing their own PGEM, however to date there exists only 2 management plans of this kind. Additionally the Protection of Nature (1995) allows the establishment of various types of protected areas as well as the protection of flora and fauna.

Legislation relating to Coastal Zone Planning and Development:

There is no specific legislation providing for integrated coastal zone development, however, the Planning Code of French Polynesia was revised in 1992 to encompass an integrated approach to coastal zone management by considering both the reef and terrestrial environments. Generally it is under a combination of powers of the Polynesian Government in the field of fisheries, state ownership, environment and urban planning with the management shared between the municipalities concerned. They can be initiated and implemented with the consent of the local government, implying a protection agreement on a case by case basis. Increasingly, Environmental Impact Assessments are being undertaken, although they are not always taken into account when making final determinations regarding the development.

Legislation relating to Pollution Control:

The French Environment Code contains provisions relating to the prevention of marine pollution in oversees territories including French Polynesia. However, on a national basis, pollution is controlled under the Government of French Polynesia Code of Planning, which is premised upon that of French Law. The proposal to develop a specification by activity type has not yet been followed and all actions are limited in light of current and emerging issues including wastewater treatment and sewage disposal.

Integrated Watershed Management Policy Approaches:

The Urban Planning Code provides for the establishment of terrestrial management areas, which employs an effective community and government co-management approach. However, land management requires further integrated legislation that establishes a comprehensive regime incorporating agriculture and other industries with specific water quality standards that must be met with stringent sanctions to deter non-compliance.

Priorities for Legislative Action:

- Need to integrate watersheds in the coastal management of populated islands because main sources of degradation come from land-based sources.
- Administrative capacity needs to be sufficient for coral reefs scattered over a large spatial area.
- The sanction regime for MPAs in French Polynesia needs to be more stringent.
- The Government of French Polynesia requires administrative means to carry out policies that incorporate community empowerment.
- Legislation is required to provide specific protection for coral reef fisheries as current laws are inefficient, since they are premised upon European law.

Background Literature:

Cazalet, B (2008). *Droit Des Lagons De Polynesie Francais*. Universite de Perpignan.

Hutchings, P., Payri, C., and Gabrie, C. (1994). The Current Status of Coral Reef Management in French Polynesia. *Marine Pollution Bulletin* Vol. 29, No. 1-3, pp. 26-33.

Payri, C., and Bourdelin, F. (No date supplied) *Status of Coral Reefs in French Polynesia*. Laboratoire d'Ecologie Marine Universite Francaise du Pacifique, Tahiti.

Salvat, B., Aubanel, A., Adjeroud, M., Bouisset, P., Dominique, C., Chancerelle, Y., Cochennec, N., Davies, N., Fougerousse, A., Galzin, R., Lagouy, E., Lo, C., Monier, C., Ponsonnet, C., Remoissenet, G., Schneider, D., Stein, A., Tatarata, M. and Villiers, L. (2008) 'Le Suivi De L'Etat Des Recifs Coralliens De Polynesie Francais et Leur Recente. *Evolution' Annual Review of Ecology*, Vol. 63, Issue 1-2, pp. 145-177.

Vieux, C., Salvat, B., Chancerelle, Y., Kirata, T., Rongo, T., Cameron, E., Samoa, E. (2008) *Status of Coral Reefs of the World: Status of Coral Reefs in Polynesia Mana Node Countries: Cook Islands, French Polynesia, Niue, Kiribati, Tonga, Tokelau and Wallis and Futuna.* Global Coral Reef Monitoring Network.

Appendix 6: Strategic Plan for Coral Reefs 2011 – 2020

Five core objectives to increase coral reef resilience with targets, activities and indicators of success

OBJECTIVE 1: Sustainably Manage Fishing

Target: **By 2020 half of all fishing / resource extraction on coral reefs is conducted at biologically sustainable levels based on clearly defined indicators and with regular monitoring of key target commercial species**

Activities	Indicators
Phase 1	
Increase enforcement levels to implement existing bans on destructive fishing practises	• Enforcement levels meet agreed new standards • Destructive fishing infringements are significantly reduced or eliminated
Implement national stock assessments of keystone species and for key reef fish and invertebrate species targeted by commercial and artisanal fisheries and by the aquarium and curio trades	• Species data for commercial and artisanal fisheries – biometrics, maturity, independent CPUE • Species data for aquarium and curio trade export volumes
Remove harmful subsidies to fisheries and reduce fishing effort on overexploited stocks.	• (reduction in the) number of fishers and total number of fishing gears • (decreasing) catch per unit effort/landings over time
Adopt and implement the FAO Code of Conduct for Sustainable Fisheries at the national level.	• Number of countries following FAO Code of Conduct • Degree to which the FAO code is followed
Conduct socio-economic analyses to determine the value of commercial and artisanal reef fisheries and aquaculture to local economies and society	• Contribution of fisheries and aquaculture to local income and expenditure • Contribution of marine-based activities to overall livelihoods
Conduct vulnerability assessments to identify vulnerable groups and underlying social and economic drivers of overfishing.	• Number of vulnerability assessments completed for each region • Number of social and economic drivers identified for each community
Revise/develop national legislation for sustainable fisheries and good aquaculture practices	• National and local legislation revised or put in place
Phase 2	
Ban all destructive fishing practises and ensure there is sufficient management capacity to effectively implement bans.	• National and local legislation put in place • MCS reports on destructive fishing practises / infringements • Habitat complexity and benthic (coral) cover
Revise existing or develop new regulations to implement sustainable ecosystem-based fisheries management plans nationally following FAO guidelines.	• Finalised Plans are in place for coral reef ecosystems • Commercial species stock assessments - CPUE values, fish biometrics • Management effectiveness – quotas, enforcement
Develop and implement regulations to enable the recovery of threatened species of fishes and invertebrates	• Regulations at the sub-national and national level • (increase) in population size of threatened spp.
As part of sustainable ecosystem-based management, set targets and identify	• National and local legislation put in place

indicators for sustainable fishery operations, and establish a monitoring programme to track fishery condition and management outcomes with reference to these targets.	• Recorded catches of large predatory and key herbivorous reef fish • Abundance of large reef predatory and key herbivorous reef fish • Catch levels of other important local reef fish or invertebrate species • Level of management effectiveness compared to minimum standards
Implement sustainable (ecologically, socially, economically) livelihoods (both reef-based and other alternatives) in reef dependent regions through microfinance and capacity building.	• Socio-economic status – household income / expenditure and occupational structure • Number of cross visits, micro-finance loans, • Number of training courses and their effectiveness
Where necessary, implement policies to support local reef fish food security through market and trade measures.	• Commercial species stock assessments • Loss of value / benefits to local economies and communities

OBJECTIVE 2: Manage watersheds, water quality and reduce pollution

Target: **Implement comprehensive watershed and coastal water quality management plans that reduce pollution to half of 2010 levels by 2020 for all major pollutants, especially those that cause eutrophication, have sublethal effects on corals (e.g. affect reproduction), lower seawater pH or have other negative impacts (including Persistent Organic Pollutants)..**

Targets / Activities	**Indicators**
Phase 1	
Identify management needs for all major watersheds linked to coral reefs to draw up integrated watershed management policies	Proportion of major watersheds with identified management needs
Identify natural and legal watershed boundaries and determine what nations, sectors or communities have legal jurisdiction over these areas	• Proportion of watersheds with boundaries clearly determined • Proportion of watersheds with legal jurisdiction clearly defined
Identify the main sources of all main point source and diffuse pollutants on coral reefs; Develop legislation to reduce pollution levels to at least 50% of 2010 levels by 2020	• Legislation in place and enforced • Level of compliance with legislation (prosecutions / fines for pollution) • Water quality data and recorded reduction in pollutant levels
Set up comprehensive national monitoring programmes for water quality	• Number of national monitoring programmes in place and operating • Water quality data-sets from national programmes
Redefine international shipping lanes to avoid coral reef areas and improve the monitoring of merchant vessels in national waters	• Number of countries that have redefined shipping lanes near coral reefs • Number of vessel groundings on coral reefs • Monitoring records for merchant vessels around coral reefs
Develop, implement or improve national management strategies for large-scale marine pollution incidents such as oil leaks	Number of nations with appropriate strategies in place and functional
Establish best practice for mariculture operations conducted in or adjacent to coral reefs	• National regulations for good practise mariculture in place and effective • Water quality assessments

Ratify and adopt robust implementing legislation for the Stockholm Convention on Persistent Organic Pollutants, the Global Program of Action for the Protection of the Marine Environment from Land-based Activities (non-binding global agreement), and the International Convention for the Prevention of Marine Pollution from Ships (MARPOL)	• All conventions are ratified and robust legislation is in place • Effectiveness of legislation in meeting the conventions targets
Ratify regional Conventions and Protocols for the protection of the marine environment against land-based pollution	• All regional conventions and protocols are ratified and robust legislation is in place • Effectiveness of legislation in meeting the regional convention and protocol targets
Phase 2	
Implement watershed management policies involving afforestation, runoff-reduction, sustainable agriculture methods, reduction of pesticides, herbicides, fertiliser and other agrochemical use	• Number of integrated watershed management policies in place • Scope of each policy to tackle all management needs for major watersheds
Set up trans-boundary watershed management bodies	• Number of trans-boundary bodies in place and active
Ensure that water quality control and the regulation of building and industry in the coastal zone integral parts of sustainable coastal planning legislation	• Number of sustainable coastal planning policies enacted • Effectiveness of legislation in regulating water quality and building in the coastal zone
Ensure Environmental Impact Assessments (EIAs) are conducted for all coastal development with a full peer-review and complied with.	• Levels of compliance with EIA recommendations • Proportion of approved and unapproved developments completed in the coastal zone
Establish and implement polluter pays legislation for coral reefs	Legislation in place and successfully implemented
Declare, through the IMO, coral reef ecoregions of outstanding ecological value as Specially Sensitive Areas, prohibiting transport of hazardous cargo through these waters.	• Number and coverage of Specially Sensitive Areas declared • Effectiveness of SSAs – number of infringements for each one declared
Encourage all coral reef states to ratify and implement the IMO Ballast Water Convention with support from the GloBallast Partnership	• Number of coral reef states that have ratified and implemented the Ballast Water Convention • Number of states with national legislation specifically for ballast water management • Number of recorded invasive species attributable to ballast water
Implement national management strategies for large-scale marine pollution incidents	Number of national management strategies in place and operational
Implement best practice standards for mariculture operations conducted in coral reef or adjacent environments	Number of mariculture standards in place and operational

OBJECTIVE 3: Increase marine protected areas coverage and effectiveness

Target: **30% of the world's coral reefs are effectively managed in no-take marine protected areas by 2020 using a range of management approaches**

Targets / Activities	Indicators
Phase 1	
Implement a global assessment of tropical MPA management effectiveness, coordinated through existing projects and in areas that are currently unmonitored	• Proportion of MPA assessed for effectiveness at the national level • Number of nations with effectiveness assessments completed
Implement existing national legislation that support MPAs, including locally managed marine areas (LMMAs), and improve MPA management so that marine paper parks are converted into effective MPAs that meet their management and broader ecological objectives	• Proportion of coral reefs covered by existing legislation • Effectiveness of legislation in supporting MPAs: • Proportion of MPAs meeting their objectives
Identify the increase in MPA coverage required at the national level to meet the 30% target	% coverage of no-take MPAs at the national and regional level
Ratify regional Conventions and Protocols concerning protected areas and protection of marine natural resources	Number of regional conventions and protocols ratified and adhered to
Ensure existing legislation that supports MPAs is understood and supported by user communities and stakeholders	• Number of communication/training programmes for MPA legislation • Level of understanding of legislation by user communities and stakeholders
Phase 2	
Support collaboration between existing regional coral reef initiatives to increase MPA coverage to help meet the 30% target	Measures of collaboration – inter-initiative meetings; formation of an inter-regional initiative working group / committee
Implement national and sub-national plans to increase MPA coverage to 30% of coral reef area	% coverage of no-take MPAs at the sub-national and national level
Ensure MPAs and MPA Networks protect biologically meaningful regions of known value to fisheries, conservation and communities	Presence of biologically valuable regions in MPA networks
Integrate ecological and social resilience factors into MPA network designation and management to help 'future proof' them against climate change effects	Number of MPA networks designed according to resilience criteria
Ensure that national legislative frameworks recognise the legitimacy of community-based marine protected areas and their management systems	Inclusion of community-based management systems in existing or new legislation
Increase coverage of no-entry and no-take MPAs globally to meet national targets	Number of national targets met for no-take and/or no-entry MPAs
Ensure there is consistency between national legislative frameworks so that loopholes are closed regarding infringements in MPAs	• Number of reports of infringements directly linked to legislative loopholes • Number of loopholes remaining
Continue to improve MPA management so that marine paper parks are converted into effective MPAs	• Standard measures of MPA management effectiveness • Proportion of MPAs meeting their objectives

OBJECTIVE 4: Increasing Governance and Management Capacity

Target: **Effective management strategies for coral reef governance and enforcement are designed and implemented at the national and regional level by 2020.**

Targets / Activities	**Indicators**
Phase 1	
Synthesise existing knowledge to complete an assessment of current national capacity and the increase in logistical and technical capacity required for effective management and enforcement that will achieve objectives 1-3.	• National capacity assessment completed • Increase in capacity identified
Review existing national management structures for fisheries and conservation management to identify areas where management could be improved	Reviews of management structures completed and areas for improvement identified
Compile and disseminate existing training manuals, guidance materials and other "how to" knowledge products addressing priority management issues through a 'one-stop shop' website for coral reef management agencies	• Educational materials available through a designated website and as hard copies • Proportion of local managers with access to electronic or paper copies
Initiate and support efforts to translate key coral reef management training literature into 9 languages to increase accessibility to local resource managers and government agencies (English, French, Spanish, Portuguese, Chinese Mandarin, Philippine, Indonesian, Thai, Arabic)	National targets for translation and distribution – number of key training documents translated and at the local level
Provide and increase support to existing national, regional and international networks and mechanisms for knowledge management and information exchange for improved intra-national and trans-boundary cooperation	Sub-national, national and regional networks in place and operating
National technical capacity to manage coral reefs is increased through recruitment and training	Number of national capacity building targets met – recruitment,/staff levels, training programmes (success of training)
Phase 2	
.Implement an international training programme in priority management tools and interventions, incorporating existing regional or international initiatives, that conducts workshops biannually in regional nodes and trains enough local resource managers by 2020 to meet the management and enforcement needs of each region	• Number of regional targets for workshops and training programmes achieved • Number of local managers trained and the effectiveness of training
Increase national technical capacity to manage coral reefs through degree level training in multidisciplinary studies (e.g., ecosystem-based management, marine and social sciences) and, recruitment of matriculated staff into management positions and on the job training.	• National targets for capacity building achieved • Departmental recruitment targets achieved • Proportion of managers receiving on the job training • Success of new managers in meeting conservation and management objectives
Increase logistical capacity (infrastructure etc.) to meet national needs and the type of management required (top-down or bottom-up)	Number of logisitical targets met (sub-nationally / nationally) – infrastructure in place and working
Scale up, support and build upon programmes of regional cross-visits for local	Regional targets for cross-visits achieved

resource managers and government agencies.	
Facilitate the participation of resource and conservation managers in cross-discipline training at the local and national level	Proportion of sub-national and national targets for cross-discipline training achieved
Enable and increase levels of community-based management (CBM) in areas with minimal capacity and infrastructure, backed by co-management agreements with local government and NGOs to set up community-led management and enforcement programmes with appropriate training	• Number of CBM programmes in place • Measures of CBM effectiveness • Number of co-management agreements and their effectiveness • Proportion of communities with effective CBM in place
Governance Focus	
Implement effective enforcement systems for MPA and fisheries management locally, nationally and regionally with appropriate penalties to deter infringements and full stakeholder involvement at the local level to ensure community support and ownership	• Local, National and Regional enforcement systems in place and operational • Reduced number of infringements • Increased levels of community buy-in
Establish international collaboration and regional agreements to reduce IUU fishing in the EEZs of coral reef nations by: o eliminating markets for illegally caught fish by strengthening market-based measures to effectively control the trans-boundary movement of products o coordinating MCS and enforcement activities including intelligence gathering on illegal fishers	• Number of regional agreements and level of collaboration in place • Market-based measures operating and effective • Trans-boundary MCS and enforcement occurring
Establish personnel and review mechanisms within government agencies with coral reef and fisheries specific mandates, to eliminate barriers to progression	Review process reports – staff assessments
Hold national and provincial and local governments or leaders accountable for commitments to local, regional and global initiatives	Number of commitments met by leaders for initiatives at their level of governance/responsibility
Support the establishment of regional web-based monitoring and reporting systems to assess coral reef ecosystem health and make governance more accountable	Regional monitoring and reporting systems in place and functional
Increase devolution of management responsibility to local communities using existing or new local legislation, especially for remote regions and where capacity is low	Number of local laws in place and number of remaining legislative gaps Measure of community buy-in to local laws
Increase federal cohesion for fragmented nation states (politically and geographically) to allow national plans to be developed	Targets for improved federal cohesion met
Establish regional commissions to support management of discrete but trans-boundary coral reef ecosystems	Regional trans-boundary commissions in place and operational
Clarify legislation and responsibilities for management of marine resources and MPAs between different sectors and levels of government to avoid overlaps and inter-sectoral disputes	Number of overlaps in legislation and management responsibilities remaining Number of inter-sectoral disputes

OBJECTIVE 5: Increase environmental education and awareness

Target: **Environmental education and awareness programmes are implemented within both national education systems and through outreach programmes for all coral reef nations by 2020.**

Targets / Activities	**Indicators**
Phase 1	
Identify and fill gaps in environmental educational and awareness materials – develop an international meta-database of existing materials	• Meta-database in place and operational • Number of gaps remaining for materials
Assess local knowledge and levels of school attendance prior to development of environmental education and awareness programmes	Proportion of the coastal population with levels of local knowledge and school attendance assessed
Develop and implement teaching training programmes to ensure practioners are able to deliver the revised curricula	• National targets for teacher training programmes
Investigate ways to increase the take up of national curricula for children of tropical coastal communities	10 news ways to increase curricula use recommended
Phase 2	
Integrate information about coral reefs, environmental conservation and sustainable ecosystem-based management into existing curricula at all levels of national education systems	National targets for education systems – presence of coastal ecosystems conservation and management in curricula
Ensure universities and research institutes in coral reef nations offer undergraduate and postgraduate courses in tropical marine biology and conservation and fisheries management	• Number of courses available at the national and regional level for each discipline
Establish national scholarships for students to pursue undergraduate degrees in tropical marine biology and conservation and fisheries management	• National scholarship programmes – in place and operating • Number of scholars who graduate • Number of scholars employed in management/conservation posts (post 2020)
Develop and implement targeted adult education and awareness campaigns about how communities and stakeholders can increase coral reef resilience by reducing direct threats	• Number of EEA campaigns completed at the sub-national / national level • Proportion of communities / stakeholder groups involved in the EEA campaigns • Record of local efforts to reduce impacts – e.g. pollution / coastal development