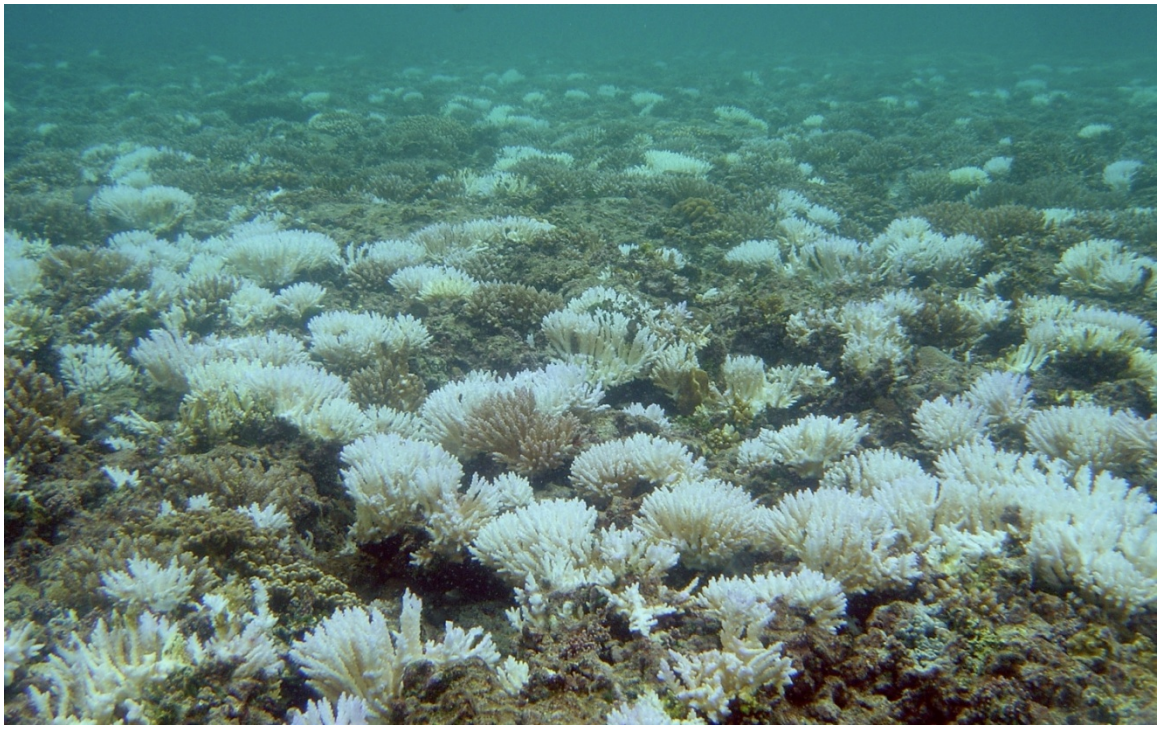
Management Report for 82 Corals Status Review under the Endangered Species Act:

Existing Regulatory Mechanisms
(per Endangered Species Act § 4(a)(1)(D), 16 U.S.C. § 1533(a)(1)(D))
and Conservation Efforts
(per Endangered Species Act § 4(b)(1)(A), 16 U.S.C. § 1533(b)(1)(A))

November 2012



Coral bleaching, Guam
By David Burdick, NOAA Photo Library

Pacific Islands Regional Office
National Marine Fisheries Service
National Oceanic and Atmospheric Administration
Department of Commerce

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1. Introduction

On October 20, 2009, the National Marine Fisheries Service (NMFS) received a petition from the Center for Biological Diversity (CBD) to list 83 species of coral as either threatened or endangered under the Endangered Species Act (ESA). In response, NMFS issued a 90-day finding (75 FR 6616, February 10, 2010), wherein the petition was determined to contain substantial information indicating listing may be warranted for all of the petitioned species except *Oculina varicosa* (see the 90-day finding for information included in the petition). Thus, NMFS initiated a status review of the remaining 82 species of corals; *O. varicosa* will not be considered further. NMFS convened a Coral Biological Review Team (BRT) to assess the biological status of each of the 82 corals, and threats to these species with regard to the factors listed under section 4(a)(1) of the ESA. The BRT's Status Review Report (hereafter "BRT Report", cited as Brainard *et al.* 2011) evaluated the status of these species and the risk of extinction faced by each using the best available scientific and commercial data and analyses, including the best available climate change and ocean acidification scenarios. In addition, the Pacific Islands Regional Office (PIRO) staff developed this report on management actions relevant to the species across their range, including existing regulatory mechanisms and conservation efforts (hereafter "Management Report"). Finally, as a result of a unique public engagement process over the summer of 2012, in which additional scientific and management information was sought, both PIRO and the Southeast Regional Office (SERO) developed a Supplemental Information Report (SIR) based on new information since the BRT's report was published in 2011. Thus, the BRT Report, the Supplemental Information Report, and this Management Report together constitute the comprehensive status review for the 82 coral species.

> The purposes of . . . [the ESA] are to provide a means whereby the ecosystems upon which endangered species and threatened species depend may be conserved, to provide a program for the conservation of such endangered species and threatened species, and to take such steps as may be appropriate to achieve the purposes of the treaties and conventions set forth in subsection (a) of . . . [Section 2 of the ESA, 16 U.S.C. § 1531(a)], 16 U.S.C. § 1531(b). The U.S. Fish and Wildlife Service (USFWS) and NMFS share responsibility for administering the ESA; NMFS is responsible for determining whether marine, estuarine or anadromous species, subspecies, or distinct population segments are threatened or endangered under the ESA. : *"The term* 'species' *includes any subspecies of fish or wildlife or plants, and any distinct population segment of any species of vertebrate fish or wildlife which interbreeds when mature." 16 U.S.C. § 1532(16). "The term* 'endangered species' *means any species which is in danger of extinction throughout all or a significant portion of its range other than a species of the Class Insecta determined by the Secretary to constitute a pest whose protection under the provisions of this Act would present an overwhelming and overriding risk to man." 16 U.S.C. § 1532(6). "The term* 'threatened species' *means any species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range. 16 U.S.C. § 1532(20).*

The process for determining whether a species should be listed as threatened or endangered is based upon "the best scientific and commercial data available . . . ." 16 U.S.C. § 1533(b)(1)(A). Section 4(a)(1) of the ESA states that:

> [t]he Secretary shall . . . determine whether any species is an endangered species or a threatened species because of any of the following factors:
>
> (A) the present or threatened destruction, modification, or curtailment of its habitat or range;
>
> (B) overutilization for commercial, recreational, scientific, or educational purposes;
>
> (C) disease or predation;
>
> (D) the inadequacy of existing regulatory mechanisms; or
>
> (E) other natural or manmade factors affecting its continued existence.

16 U.S.C. § 1533(a)(1). In addition, Section 4(b)(1)(A) of the ESA requires NMFS to take into account conservation efforts being made to protect a species that has been petitioned for listing. § 1533(b)(1)(A). Factors A, B, C, and E above were considered in the BRT Report (Brainard *et al.* 2011). Factor D, and conservation efforts were not considered by the BRT in its report, because a determination whether a species warrants listing under the ESA is the ultimate determination that involves applying the management judgment of the agency (including legal and policy dimensions) to the best available science. Thus, these factors are identified and summarized in this Management Report. Therefore, this report covers existing regulatory mechanisms (factor D) and conservation efforts (section 4(b)(1)(A)).

Existing regulatory mechanisms summarized in this Management Report include international treaties, laws, decrees, executive orders, rules and/or regulations enacted and being implemented by some governing body or official, whether they are international organizations, national governments, state and local authorities, heads-of-state, or other so empowered official, affecting the status of the 82 coral species. Conservation efforts summarized in this report include actions, activities, and programs undertaken by both governmental and non-governmental organizations ("NGOs," e.g., conservation groups, private companies, academia, etc.) that may eliminate or reduce threats or otherwise improve the status of the 82 coral species identified by the BRT Report.

The first purpose of this report is to identify existing regulatory mechanisms as per ESA Section 4(a)(1)(D) that are or may be affecting the threats contributing to extinction risk for the 82 coral species, to determine whether regulatory mechanisms themselves are inadequate such that they are contributing to the species' endangerment. This is accomplished by: (1) identification of existing regulatory mechanisms directly or indirectly addressing the most important threats to the 82 species in general; and (2) identification of existing regulatory mechanisms directly or indirectly addressing the local threats to the 82 species in general. The second purpose of this report is to identify conservation efforts with regard to the status of the 82 coral species as per ESA Section 4(b).

1.1 Current Ranges of the 82 Species: Caribbean vs. Indo-Pacific

Of the 82 coral species included in the status review, 7 are located in the Caribbean region while the remaining 75 are located in the Indo-Pacific region. The collective ranges of the 82 species occur in 84 countries (Figure 1, Table 1). The Caribbean and Indo-Pacific regions are highly dissimilar in their physical and geographical characteristics; however, they are both comprised primarily of developing countries (many of them small island developing states (SIDS)) and therefore have socio-economic and political commonalities. Additionally, both regions are vulnerable to the effects of global climate change, particularly coral bleaching events and sea-level rise which are likely to detrimentally affect the regions' natural resources and economies.

For the purposes of this report, the Caribbean region includes the reef tract of south Florida and the Florida Keys, Puerto Rico, the U.S. Virgin Islands (USVI) and all the islands of the wider Caribbean region. The Caribbean is a relatively small and somewhat closed system in comparison to the Indo-Pacific. Comprised mostly of SIDS, the Caribbean is the most tourism-dependent region in the world (Niles 2010). Relatively high human population densities and a long history of pervasive human impacts to coral reef systems exist across the region. The World Resource Institute conducted a study to assess the status of coral reefs within the wider Caribbean Region and determined that nearly two-thirds of Caribbean coral reefs are threatened by at least one form of human activity, with continuing threats of region-wide damage due to rising sea temperatures and disease (Burke and Maidens 2004). Additionally, none of the Caribbean's three keystone species indicative of reef health (the corals *Acropora palmata* and *A. cervicornis*, and the urchin *Diadema antillarum*) have shown significant recovery over decadal time scales (Brainard *et al.* 2011). The region is also susceptible to strengthening storms and hurricanes and has suffered mass bleaching events, hampering ecosystem recovery.

In contrast with the Caribbean, the Indo-Pacific is an enormous region including both the Indian and Pacific Ocean basins. About 80 percent of the world's coral reefs are in the Indo-Pacific, with over half found in five countries or their territories (Indonesia, Australia, Philippines, France, and Papua New Guinea; World Atlas of Coral Reefs). This region hosts a much larger amount of coral diversity than the Caribbean: the Indo-Pacific is home to 700 species, compared to 65 species in the Caribbean. The sheer size and amount of diversity of the Indo-Pacific, combined with vast expanses of ocean has provided a substantial buffer to Indo-Pacific corals from the human induced influences and declines that have manifested across the Caribbean (Brainard *et al.* 2011). Additionally, increased rates of CO_2 uptake in the Northern Atlantic Ocean have caused a decrease in resiliency of corals in the wider Caribbean, while corals in the Pacific have maintained resilience despite major bleaching events. Moreover, the Indo-Pacific's Coral Triangle is the epicenter of coral biodiversity, containing the greatest number of endemic scleractinian species, while the highest proportions of endemic scleractinians are found in the more remote Indo-Pacific archipelagoes (e.g., 20 percent of Hawaiian scleractinian species are endemic). The Indo-Pacific also has greater coral cover on mesophotic reefs in the Indo-Pacific than in the Caribbean, which presents more potential for deep refugia (Roff & Mumby 2012). However, consensus is building that these buffering factors have simply put the Indo-Pacific on a slower journey down a similar road of decline as the Caribbean, rather than a qualitatively different trajectory (Brainard *et al.* 2011).

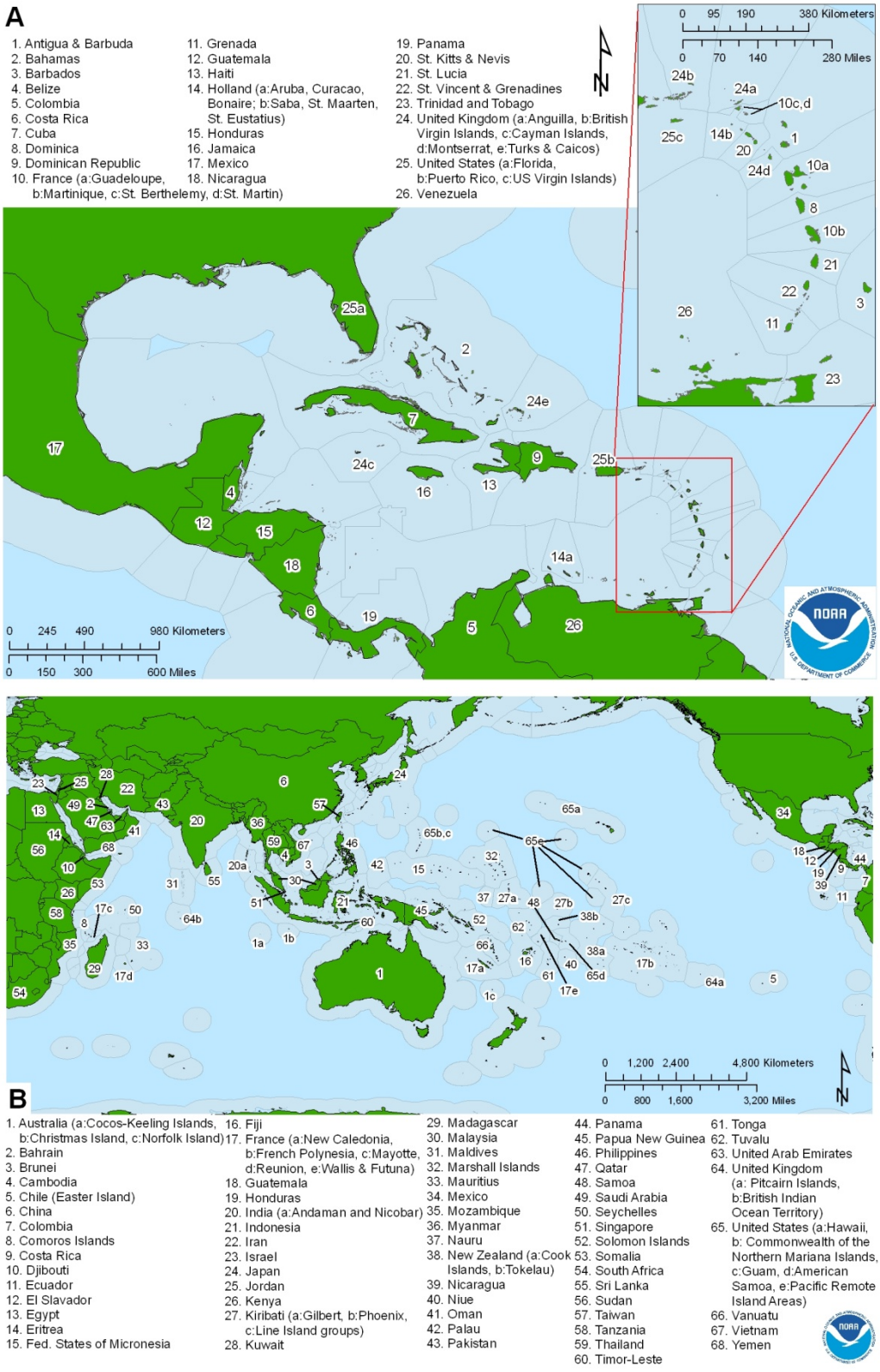

Figure 1. The 84 countries within ranges of the 82 coral species in A. Caribbean Region (26 countries), and B. Indo-Pacific Region (68 countries). Ten countries include areas in both regions (Colombia, Costa Rica, France, Guatemala, Honduras, Mexico, Nicaragua, Panama, U.K., and U.S.).

Table 1. The 84 countries within ranges of the 82 coral species in A. Caribbean Region (26 countries), and B. Indo-Pacific Region (68 countries). Ten countries include areas in both regions (Colombia, Costa Rica, France, Guatemala, Honduras, Mexico, Nicaragua, Panama, U.K., and U.S.).

A. Caribbean Region	B. Indo-Pacific Region	
Antigua & Barbuda	Australia[1]	Mozambique
Bahamas	Bahrain	Myanmar
Barbados	Brunei	Nauru
Belize	Cambodia	New Zealand[2]
Colombia	Chile (Easter Island)	Nicaragua
Costa Rica	China	Niue
Cuba	Colombia	Oman
Dominica	Comoros Islands	Palau
Dominican Republic	Costa Rica	Pakistan
France[3]	Djibouti	Panama
Grenada	Ecuador	Papua New Guinea
Guatemala	El Salvador	Philippines
Haiti	Egypt	Qatar
Holland[4]	Eritrea	Samoa
Honduras	Fed. States of Micronesia	Saudi Arabia
Jamaica	Fiji	Seychelles
Mexico	France[5]	Singapore
Nicaragua	Guatemala	Solomon Islands
Panama	Honduras	Somalia
St. Kitts & Nevis	India	South Africa
St. Lucia	Indonesia	Sri Lanka
St. Vincent & Grenadines	Iran	Sudan
Trinidad & Tobago	Israel	Taiwan
United Kingdom[6]	Japan	Tanzania
United States[7]	Jordan	Thailand
Venezuela	Kenya	Timor-Leste
	Kiribati	Tonga
	Kuwait	Tuvalu
	Madagascar	United Arab Emirates
	Malaysia	United Kingdom[8]
	Maldives	United States[9]
	Marshall Islands	Vanuatu
	Mauritius	Vietnam
	Mexico	Yemen

[1] Includes Australia colonies of Cocos-Keeling Islands, Christmas Island, and Norfolk Island.
[2] Includes New Zealand colonies of Cook Islands and Tokelau.
[3] Includes French territories of Guadeloupe, Martinique, St. Barthelemy, St. Martin.
[4] Includes Dutch territories of Aruba and Netherlands Antilles.
[5] Includes the French territories of New Caledonia, French Polynesia, Mayotte, Reunion, Wallis and Futuna
[6] Includes British territories of Anguilla, British Virgin Islands, Cayman Islands, Montserrat, and Turks & Caicos Islands.
[7] Includes Florida and U.S. territories of Puerto Rico, Navassa, and U.S. Virgin Islands
[8] Includes British colonies of Pitcairn Islands and British Indian Ocean Territory
[9] Includes Hawaii, Commonwealth of the Northern Mariana Islands, Territories of Guam and American Samoa, and the US Pacific Island Remote Area

1.2 Threats to the 82 Species

The Coral BRT identified 19 threats to reef-building corals in general, including the 82 coral species (Table 2). Each threat was given a ranking of high, medium, low or negligible (or combinations of two, i.e. "low-medium") in terms of the overall importance of the threat to the 82 coral species. That is, rankings were dependent on each threat's perceived significance in terms of posing extinction risk to the 82 coral species collectively across their ranges (Table 2). Ocean warming, disease, and ocean acidification were the highest ranked threats. The detrimental trophic effects of fishing (i.e., over-fishing) received a medium ranking, and land-based sources of pollution (sedimentation and nutrients) and sea-level rise received rankings of low-medium. All of the remaining threats received rankings of low or negligible (Brainard *et al.* 2011).

Table 2. Threats considered by the BRT in assessing extinction risks to the 82 coral species, including the BRT's estimate of each threat's relative importance (Brainard *et al.* 2011).

Threat	Importance
Ocean Warming	High
Disease	High
Ocean Acidification	Med-High
Reef Fishing – Trophic Effects	Medium
Sedimentation	Low-Medium
Nutrients	Low-Medium
Sea-Level Rise	Low-Medium
Toxins	Low
Changing Ocean Circulation	Low
Changing Storm Tracks/Intensities	Low
Predation	Low
Reef Fishing – Habitat Impacts /Destructive Fishing Practices	Low
Ornamental Trade	Low
Natural Physical Damage	Low
Human-induced Physical Damage	Negligible-Low
Aquatic Invasive Species	Negligible-Low
Salinity	Negligible
African/Asian Dust	Negligible
Changes in Insolation	Probably Negligible

The threats identified above in Table 2 and summarized below in Section 1.2.1 are generalized for all reef-building corals, including the 82 coral species, based on the "Threats to Coral Species" section of the BRT Report (Chapter 3, Brainard *et al*., 2011). This generalized description of threats to reef-building corals does not necessarily account for variation in the importance of threats to each of the 82 coral species. As described in Section 1.2.2 below, the "Individual Species Accounts" sections of the BRT Report provide evaluations of the most important threats for each of the 82 species (Chapter 6 for Caribbean species, Chapter 7 for Indo-Pacific species, Brainard *et al*., 2011).

1.2.1 Threats Affecting Coral Species Generally

The threats listed in Table 2 can be divided into threats related to greenhouse gas emissions, and threats related to a variety of more localized human activities.

1.2.1.1 Threats Related to Greenhouse Gas Emissions

Ocean warming, coral disease, and ocean acidification were rated by the BRT as the highest importance threats to the 82 coral species (Table 2). The BRT Report (Brainard et al., 2011) concluded that "the threat posed by the most optimistic scenarios of emissions in the 21st century and even the threat posed by committed warming and other climatic changes represent a plausible extinction risk to the 82 candidate coral species." This conclusion is based on climate projections provided in the Intergovernmental Panel on Climate Change Fourth Assessment Report (IPCC AR4) completed in 2007, which the BRT Report (Brainard et al., 2011) acknowledged was already outdated. Climate projections in the AR4 were based on a now 12-year old Special Report on Emissions Scenarios (SRES; IPCC 2000), which is now known to have underestimated projected emissions. IPCC AR4 will be updated by IPCC AR5 in 2013 and climate projections in AR5 will be based on a new set of four scenarios (the Representative Concentration Pathways or RCPs; Moss et al. 2010; van Vuuren et al. 2011). Despite uncertainties regarding specific impacts, climate changes are occurring at a quicker pace than previously estimated and predicted (Blunden and Arndt 2012, Meissner et al. 2012, NOAA 2012, Yammoto et al. 2012).

As a result of increasing anthropogenic greenhouse gases (GHGs) in the atmosphere since the Industrial Revolution, sea surface temperatures are rising, including in waters around many coral reefs (i.e., ocean warming). Ocean warming is a primary driver of coral bleaching and disease. Also as a result of increasing atmospheric GHGs, specifically the increasing concentrations of CO2 in the atmosphere, a corresponding change has occurred in the partial pressures of CO2 in the surface ocean, resulting in reduced pH (i.e., ocean acidification). The relationship of GHGs to ocean warming and ocean acidification is described in detail in the BRT Report (Brainard et al., 2011).

Ocean warming results in bleaching of adult coral colonies, wherein corals expel their symbiotic zooxanthellae in response to stress. Corals can withstand mild to moderate bleaching; however, severe, repeated, or prolonged bleaching can lead to colony death. Ocean warming is also a primary cause of increased prevalence and severity of coral diseases, for example by causing pathogens to grow faster and be more virulent. Ocean acidification may reduce coral calcification, leading to reduced coral growth rates and increased mortality, among many other detrimental effects. The effects of ocean warming, disease, and ocean acidification on corals can occur together, compounding their overall effects. These three high importance threats are described in detail in the BRT Report (Brainard et al., 2011).

1.2.1.2 Local Threats Affecting Coral Species Generally

Threats to corals from more localized human activities were also identified by the BRT: reef fishing (trophic effects, habitat impacts), land-based sources of pollution (sedimentation, nutrients, toxins, and salinity), predation, ornamental trade, physical damage, aquatic invasive species, and African/Asian dust (Table 2), and described in detail in the BRT Report (Brainard *et*

al., 2011). Only three of these local threats were rated by the BRT as up to medium in importance: The trophic effects of reef fishing, and two types of land-based pollution (sedimentation and nutrients; Table 2). Trophic effects of fishing occur when herbivorous reef fish, such as parrotfish, are heavily fished down to the point where the absence of their grazing pressure allows algae to outcompete and exclude coral settlement and even overgrowth of corals. Sedimentation and nutrients are land-based pollutants: Human activities in coastal watersheds introduce sediment and nutrients into the ocean by a variety of mechanisms, including river discharge, surface runoff, groundwater seeps, and atmospheric deposition (Brainard *et al*., 2011). Other local threats were rated as low or negligible in importance to the 82 coral species (Table 2), including other types of land-based sources of pollution (toxins, salinity), ecological processes (predation, invasive species), reef fishing (habitat damage), ornamental trade, and physical damage (natural and human) (Brainard *et al*., 2011).

1.2.2 Individual Threats to Each of the 82 Species

Within the context of the general threats summary (Chapter 3 of BRT Report; Brainard *et al*., 2011), the BRT evaluated threats to each of the 82 species (Chapter 6 and 7 of BRT Report; Brainard *et al*., 2011). Information was not available to determine the relative importance of all 19 general threats (Table 2) to each of the 82 species. However, the BRT used the best available information to describe the susceptibility of each species to the three most important general threats (bleaching from ocean warming, coral disease, ocean acidification), as well as the susceptibility of each species to as many of the local threats for which information was available.

1.2.3 Conservation Efforts

This Management Report also identifies the conservation efforts that may contribute to making the listing of the 82 corals under the ESA unnecessary, in accordance with section 4(b)(1) of the ESA. For purposes of this report, conservation efforts include conservation actions other than regulatory mechanisms undertaken by both governmental and non-governmental organizations ("NGOs," e.g., conservation groups, private companies, and academia) intended to address any of the threats to the 82 coral species identified by the BRT Report.

2. Existing Regulatory Mechanisms

2.1 Regulatory Mechanisms Addressing GHG Emissions

The two major types of existing regulatory mechanisms addressing GHG emissions are international treaties and conventions (Section 2.1.1), and national laws and regulations. For the latter, national laws and regulations are described for the top 25 GHG emitting countries in the world (Section 2.1.2).

2.1.1 International Regulatory Mechanisms Addressing GHG Emissions

2.1.1.1 Background

The First World Climate Conference was held from February 12-23, 1979 in Geneva and sponsored by the World Meteorological Organization (WMO). As one of the first major international meetings on climate change, it was essentially a scientific conference attended by scientists from a wide range of disciplines. In addition to the main plenary sessions, the conference organized four working groups to look into climate data, the identification of climate topics, integrated impact studies, and research on climate variability and change. The

Conference led to the establishment of the World Climate Program and to the creation of the Intergovernmental Panel on Climate Change (IPCC) by WMO and the United Nations Environment Program (UNEP) in 1988. The World Climate Program facilitates, among other things, the effective collection and management of climate data and the monitoring of the global climate system, including the detection and assessment of climate variability and changes. The IPCC, on the other hand, does not conduct scientific research on various aspects of climate change; rather they compile, review, and summarize all relevant scientific literature that will help inform policy makers dealing with climate change mitigation and adaptation. The IPCC and the UNEP are both scientific bodies that were created to fulfill a global need for a clear, broad, and balanced scientific view of what is happening to the world's climate.

The initial task for the IPCC as outlined in the UN General Assembly Resolution 43/53 of 6 December 1988 was to prepare a comprehensive review and recommendations with respect to the state of knowledge of the science of climate change; social and economic impact of climate change, possible response strategies, and elements for inclusion in a possible future international convention on climate. The scientific evidence summarized in the first IPCC Assessment Report (1990) succeeded in bringing climate change and its potential consequences to the forefront as an important topic for countries to address, as evidenced by the continued international efforts and actions described below.

The Second World Climate Conference was held again in Geneva from October 29 to November 7, 1990, and represented an important step towards a global climate treaty. Eventually, developments at this Second World Climate Conference led to the establishment of the United Nations Framework Convention on Climate Change (UNFCCC) that was finalized and opened for signature at the Earth Summit in Rio in 1992. World Climate Conference-3 (WCC-3) was held in Geneva, Switzerland, August 31 to September 4, 2009. Its focus was again firmly rooted in science, primarily on climate predictions and information for decision-making at seasonal to multi-decadal timescales. The goal was to create a global framework that will link scientific advances in these climate predictions and the needs of their users for decision-making to better cope with changing conditions.

2.1.1.2 International Treaties and Conventions

2.1.1.2.1 Montreal Protocol, 1987

In 1974, Molina and Rowland provided an early warning of the potential for chlorofluorocarbons (CFCs) to deplete stratospheric ozone. The warning led to national actions and regulations to reduce ozone depleting substance (ODS) emissions (UNEP 2003). Ten years later, the ozone hole was discovered over Antarctica (Farman *et al.* 1985) and ODSs were identified as the cause (Solomon *et al.* 1986; WMO 1988) which prompted heightened concern and global action. The Montreal Protocol on Substances that Deplete the Ozone Layer (MP), a protocol to the Vienna Convention for the Protection of the Ozone Layer, is an international treaty designed to protect the ozone layer by phasing out the production of numerous substances believed to be responsible for ozone depletion including CFCs and hydrochlorofluorocarbons (HCFCs). It was opened for signature in 1987 and entered into force in 1989. The MP has been ratified by 196 states and is generally considered "perhaps the single most successful international agreement to date," as stated by Kofi Annan, Former Secretary General of the United Nations. Although there are no formal climate considerations in the MP, ODSs addressed within it are also greenhouse gases

that contribute to radiative forcing of climate (Wigley 1988; Ko *et al.* 1993). As such, even though it does not contain specific climate related intentions, the MP is one of the first international agreements to address emissions of certain greenhouse gases having consequences for climate warming.

2.1.1.2.2 United Nations Framework Convention on Climate Change, 1992

As stated in the previous section, the first IPCC Assessment Report prompted an international effort to address climate change more specifically. The United Nations Conference on Environment and Development (UNCED; known by its popular title, the Earth Summit) was held in Rio de Janeiro from June 3 – 14, 1992. It is generally considered the first global initiative to take action to slow or reverse human induced climate change. One of the primary outcomes of the Earth Summit was the opening of the UNFCCC for signature. Upon ratification, the UNFCCC committed signatories' governments to a voluntary, non-binding aim to reduce atmospheric concentrations of greenhouse gases with the goal of "preventing dangerous anthropogenic interference with Earth's climate system" (United Nations 1992). These actions were aimed primarily at industrialized countries, with the intention of stabilizing their emissions of GHGs (specifically those not covered by the Montreal Protocol) at 1990 levels by the year 2000. On June 12, 1992, 154 nations signed the UNFCCC. The parties agreed in general that they would recognize "common but differentiated responsibilities," with greater responsibility for reducing GHG emissions in the near term on the part of developed/industrialized countries, which were listed and identified in Annex I of the UNFCCC. With over 50 countries' instruments of ratification, the UNFCCC entered into force on March 21, 1994. As of November 2012, UNFCCC has 195 parties, including the United States.

One of the first tasks of the UNFCCC was to establish national greenhouse gas inventories of emissions by sources and removals by sinks using methodologies and guidelines prepared by the IPCC. These inventories were used to create the 1990 benchmark levels for accession of Annex I countries to the Kyoto Protocol (see below) and for the commitment of those countries to GHG reduction targets. Updated inventories must be submitted annually by Annex I countries. Since the UNFCCC entered into force, the parties have been meeting annually in Conferences of the Parties (COP) to assess progress in dealing with climate change, and beginning in the mid-1990s, to negotiate the Kyoto Protocol to establish legally binding[10] obligations for developed countries to reduce their GHG emissions.

2.1.1.2.3 Kyoto Protocol, 1997

COP 3 for the UNFCCC took place from December 1 – 11, 1997 in Kyoto, Japan. The objective of the Kyoto climate change conference was to establish a legally binding international agreement, whereby all the participating nations commit themselves to addressing the issue of global warming and GHG emissions. After intensive negotiations, parties adopted the Kyoto

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[10] The Kyoto Protocol is considered legally binding in that there are consequences outlined in the agreement for those countries that fail to meet the GHG emission reduction commitments they pledged. If the enforcement branch determines that an Annex I country is not in compliance with its emissions limitation, the Party is then required to make up the difference between its emissions and its assigned amount during the second commitment period, plus an additional reduction of 30%. In addition that country would be suspended from making transfers under an emissions trading program (United Nations 1998).

Protocol to the Convention, which outlined GHG emissions reduction obligations for participating Annex I countries, along with what came to be known as Kyoto mechanisms[11] (United Nations 1998). These are market based mechanisms that can be used in addition to national measures as a means of meeting targets and include emissions trading, the clean development mechanism, and joint implementation. The IPCC Second Assessment Report (1995) provided key input for the formation and adoption of the Kyoto Protocol. Most industrialized countries and some central European countries with economies in transition agreed to legally binding reductions in GHG emissions of an average of 6 to 8% below 1990 levels between the years 2008-2012, defined as the first emissions budget period. Under the terms of Kyoto, the U. S. would have been required to reduce its total emissions an average of 7% below 1990 levels. However, neither the Clinton administration nor the Bush administration sent the protocol to Congress for ratification. The Bush administration rejected the protocol in 2001 acknowledging that one condition included in a resolution passed by the U.S. Senate (S. Res. 98, 1997) mandating meaningful participation by developing countries in binding commitments limiting greenhouse gases, had not been met and that climate policy in the U.S. would instead remain focused on domestic voluntary and market-based approaches to reducing GHG emissions(CRS 2006).

UNFCCC COP 11/Meeting of the Parties 1 (COP 11/MOP 1) took place between November 28 and December 9, 2005, in Montreal, Quebec, Canada. COP 11 was also the first MOP to the Kyoto Protocol since their initial meeting in Kyoto in 1997. It was therefore one of the largest intergovernmental conferences on climate change ever and marked the entry into force of the Kyoto Protocol (February 16, 2005). As of September 2011, 192 parties have signed and ratified the Protocol. The U.S. signed in 1998 but did not ratify the Protocol, meaning the U.S. has not committed to a legally binding GHG emissions reduction target by 2012 via this agreement. In 1998 when the U.S. signed the Protocol, the U.S. did pledge to work voluntarily toward reducing emissions 7% below 1990 levels by 2012.

2.1.1.2.4 Bali Roadmap, 2007

In December 2007, the Parties met for the thirteenth session of the Conference of the Parties and the third session of the Meeting of the Parties to the Kyoto Protocol in Bali, Indonesia. At the United Nations Climate Change Conference in Bali, Indonesia, the participating nations adopted the Bali Road Map as a two-year process to finalizing a binding agreement in 2009 in Copenhagen. The Bali Conference encompassed meetings of several bodies, including the UNFCCC COP 13 and Kyoto Protocol MOP 3. The Bali Road Map includes the Bali Action Plan (UNDP 2007), which charts the course for a new negotiating process designed to tackle climate change, with the aim of completing this process by 2009. The Bali Conference decided to establish subsidiary bodies under the Convention to conduct the process -- the Ad Hoc Working Group on Long-term Cooperative Action and the Ad Hoc Working Group on Further

[11] The Kyoto mechanisms stimulate sustainable development through technology transfer and investment, help countries with Kyoto commitments to meet their targets by reducing emissions or removing carbon from the atmosphere in other countries in a cost-effective way, and encourage the private sector and developing countries to contribute to emission reduction efforts. Joint Implementation enables industrialized countries to carry out joint projects with other developed countries, while the Clean Development Mechanism provides for investment in sustainable development projects that reduce emissions in developing countries.

Commitments for Annex I Parties under the Kyoto Protocol -- that were to complete their work in 2009 and present the outcome to the COP15/MOP 5. The process also included the launch of the Adaptation Fund, the scope and content of the Article 9 review of the Kyoto Protocol, as well as decisions on technology transfer and on reducing emissions from deforestation.

2.1.1.2.5 Copenhagen Accord, 2009

With the impending expiration of the Kyoto Protocol in 2012, a Climate Conference was held in Copenhagen from December 6 – 18, 2009. It included the COP 15 for UNFCCC members and MOP 5 for signatories to the Kyoto Protocol. Known as the Copenhagen Summit, this conference's goal was to produce a new protocol to address climate change on a global level after the existing Kyoto treaty expires in 2012, as was outlined in the Bali Road Map. The Copenhagen Summit did not result in a binding agreement. The Copenhagen Accord was drafted by the U.S., China, India, Brazil and South Africa on December 18, 2009, but was not passed unanimously. The Accord recognizes that climate change is one of the greatest challenges of the present day and that actions should be taken to keep any further global temperature increase to below 2°C (United Nations 2010), but does not contain commitments for reduced emissions that would be necessary to achieve that aim. Many countries and non-governmental organizations were opposed to this Accord and the way it was reached (negotiated by only five countries). Nevertheless, as of January, 2010, 138 countries have signed the Accord. To date, countries representing over 80% of global emissions have engaged with the Copenhagen Accord in some form or other (see Table 3 in Section 2.1.3 below for GHG emissions reduction commitments of the top 25 emitting countries). Participating countries have established an unconditional (or "low") pledge that they commit to regardless of other pledges, and a more ambitious "high" pledge that is conditional on whether or not other countries make similar commitments. These pledges under the Copenhagen Accord are for emissions reductions by 2020 from base year levels. The U.S. pledged to reduce GHG emissions to 17% below 2005 levels by 2020 under the Copenhagen Accord.

2.1.1.2.6 Cancun Accords, 2010

COP 16/MOP 6 was held in Cancun, Mexico November 29 – December 10, 2010. The Cancun Accords are a series of documents that resulted from international negotiations that ensued there. At Cancun, there was formal agreement on a number of matters including acknowledgement that emissions cuts need to be in line with scientific estimates of 25 to 40% cuts by 2020, and the global temperature rise target should be kept below 2°C instead of at 2°C as stated in the Copenhagen Accord. Most notably, a Green Climate Fund that was first mentioned in the Copenhagen Accord has been established and it was agreed that developing countries will receive 300 billion U.S. dollars in short-term funding to address climate change in 2010-2012 from industrialized countries, and after 2020 they will be funded 100 billion U.S. dollars per year. However, the agreement establishing the fund does not specify how the funding will be raised, confirming only that parties remained committed to providing $100 billion a year of climate funding from 2020 on that will be generated from a "wide variety of sources, public and private, bilateral and multilateral, including alternative sources" (UNFCCC 2010). The intent was to secure the design of the fund from March – November 2011 and seek approval to begin the fund at COP 17 in Durban, South Africa (see below).

At Cancun, Japan, Canada, the U. S., and Russia opposed a binding agreement on how to reach

reduction targets and, instead, moved to replace the Kyoto Protocol with a pledge and review system as proposed in the Copenhagen Accord.

2.1.1.2.7 Durban Agreement, 2011

The UNFCCC held its COP17 in Durban, South Africa from November 28 through December 9, 2011. Overall, these meetings have been reported as achieving more consensus on measures than the two previous meetings in Cancun and Copenhagen. One notable decision was agreement among the Parties on the design of the "Green Climate Fund", first mentioned in the Copenhagen Accord, to provide up to $100 billion U.S. dollars per year to poor nations, although little was achieved on establishing where the money would come from (UNFCCC 2011a). More importantly, all Parties including developed and developing nations agreed to a process to develop a "new protocol, another legal instrument, or agreed outcome with legal force that will be applicable to all Parties to the UN climate convention" (UNFCCC 2011b). This new legal instrument is to be developed no later than 2015 and take effect by 2020. This is the first consensus agreement in which all countries, regardless of their state of development, will be held accountable to an agreement to reduce GHG emissions. However, given the extended timeline of the new process, in the short term the work of reducing emissions will fall to individual nations to implement their own initiatives.

2.1.2 National Regulatory Mechanisms Addressing GHG Emissions (top 25)

The 25 countries responsible for the highest percentages of global GHG emissions account for approximately 85% of global emissions. Twelve of these countries are Annex I countries that have signed and ratified the Kyoto Protocol and have therefore committed to GHG emission reductions by 2012. Those 12 countries account for ~24% of global emissions. In addition, the U.S. (an Annex I country that has not signed and ratified the Kyoto Protocol) accounts for ~20% of global emissions. The aggregated reduction target by 2020 of the Annex I pledges from all 13 of these countries under the Copenhagen Accord ranges from 12 to 18% relative to the 1990 level (den Elzen and Höhne 2008) (see Table 3 in Section 2.1.3 below).

The remaining 12 countries in the top 25 emitters are non-Annex I countries and therefore are not obligated to establish reduction targets under the Kyoto Protocol. They account for approximately 41% of global emissions. In contrast to the relatively precise pledges of developed countries under the Copenhagen Accord, developing countries specify their mitigation actions, labeled as Nationally Appropriate Mitigation Actions (NAMAs), in a variety of ways, making it difficult to determine an aggregate level of reduction expected for this group (Rogelj *et al.* 2010) (see Table 3 in Section 2.1.3 below).

This section briefly describes, for each of the top 25 emitting countries, commitments made via the Kyoto and Copenhagen agreements, GHG emissions trends from 1990 to the most recent year available[12], and regulatory mechanisms or initiatives in place at the national level to reduce GHG emissions. Numbers in parentheses in each heading are the approximate percentage of total global carbon dioxide emissions produced by each country in 2008 (excluding land use,

[12] Estimates for Annex I countries are in terms of total GHG emissions. Source: UNFCCC Summaries of GHG Emissions for each country prepared using information submitted via National 2010 Annual GHG Inventories (1990 – 2008). Estimates for Non-Annex I countries are in terms of CO_2 emissions from the burning of fossil fuels. Source: World Bank via Google Public Data (http://www.google.com/publicdata/overview?ds=d5bncppjof8f9_)

land use change, and forestry sector (LULUCF)). Except where noted (for Indonesia and Brazil), figures for CO_2 and GHG emissions and emissions trends are reported excluding contributions from LULUCF. Because of large uncertainty and a lack of consistent reliable data globally for LULUCF, emissions estimates and projections are often given in two forms: including LULUCF and excluding LULUCF. If one form is reported, it is typically excluding LULUCF for the reasons described. For most countries, the burning of fossil fuels in the energy sector is the primary source of CO_2 and overall GHG emissions and LULUCF do not contribute a significant portion. For some, however, LULUCF contributes substantially and including estimates from this sector in an assessment dramatically changes the proportion of global GHG emitted. This is the case for Brazil and Indonesia as described in more detail below. In 2010, emissions from LULUCF have dropped globally and so has the proportion of global emissions that are related to LULUCF to ~10% (Houghton 2010).

2.1.2.1 UNFCCC Annex I Countries

2.1.2.1.1 The United States (18.3%)

The United States is currently the 2nd highest emitter of GHGs in the world, after China. The U.S. signed the Kyoto Protocol in 1998 but did not ratify the Protocol.
However, at the time of signing in 1998, the U.S. pledged to voluntarily reduce GHG emissions 7% below 1990 levels by the year 2012. In 2009, the U.S. pledged to reduce GHG emissions to 17% below 2005 levels by 2020 under the Copenhagen Accord.

According to the Environmental Protection Agency's (EPA) 2010 National Greenhouse Gas Inventory Report, total U.S. GHG emissions have risen by approximately 16.5% from 1990 to 2008 (EPA 2010). Although U.S. emissions dropped by around 3 percent from 2007 to 2008, this reduction is attributed to lower fuel and electricity consumption as a result of high fuel prices (EPA 2010). This reduction in emissions was expected to be temporary and emissions are likely to grow to equal and surpass previous levels with the recovery from the 2008 recession and increase of economic activity. According to the 2011 Climate Change Performance Index which ranks the top 60 emitting countries in various factors including emissions level, emissions trend, and climate change policy, the U.S. is ranked 54th overall with a performance rating of 'very poor' (1 being the best performance to address GHG emissions, 60 being the worst) (Burck *et al.* 2010).

The U.S. has taken a range of actions toward meeting its pledge under the 2009 Copenhagen Accord of reducing greenhouse gas emissions in the range of 17 percent below 2005 levels by 2020. In addition, under the 2011 Durban Agreement, the U.S. and other countries agreed to a process to develop a "new protocol, another legal instrument, or agreed outcome with legal force that will be applicable to all Parties to the UN climate convention" (UNFCCC 2011b). As noted above, this new legal instrument is to be developed no later than 2015 and take effect by 2020.

The EPA is the regulatory agency primarily responsible for issuing and implementing regulations predominantly under the Clean Air Act (CAA), and also other statutory authorities, to address climate change. In April 2007, the Supreme Court in *Massachusetts v. EPA*, 127 S. Ct. 1438 (2007) held that the EPA was required to determine whether or not emissions of GHGs from new motor vehicles cause or contribute to air pollution which may reasonably be anticipated to endanger public health or welfare, or whether the science is too

uncertain to make a reasoned decision. In response, in December 2009 EPA issued a final finding that emission of 6 key greenhouse gases constitutes a threat to the public health or welfare, and that EPA has authority under the Clean Air Act to regulate tailpipe emissions of GHGs. This determination was challenged but upheld in its entirety by the U.S. Court of Appeals for the D.C. Circuit in June 2012.

In May of 2010, EPA and the Department of Transportation's National Highway Traffic Safety Administration (NHTSA) issued the first national rule limiting GHG emissions from cars and light trucks (light duty vehicles) model years 2012 through 2016 (75 FR 25324, May 7, 2010). The requirements of the GHG light duty vehicle rule took effect on January 2, 2011, the date when 2012 vehicles meeting the standards can be sold in the United States. On December 1, 2011, EPA and NHTSA issued their joint rule to extend the National Program of harmonized greenhouse gas and fuel economy standards to model year 2017 through 2025 light duty passenger vehicles (76 FR 74854). On Sept. 15, 2011, EPA and NHTSA jointly published a final rule to establish Greenhouse Gas Emissions Standards and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles (76 FR 57106).

The EPA also regulates pollutants from large stationary sources through the New Source Review Prevention of Significant Deterioration (PSD) and Title V Operating Permit programs of the Clean Air Act. If a facility meets certain emissions thresholds, it is required to obtain a permit that requires the application of Best Available Control Technology (BACT), which is determined on a case by case basis taking into account, among other factors, the cost and effectiveness of the control. The CAA permitting program emissions thresholds for criteria pollutants such as lead, sulfur dioxide, and nitrogen dioxide are 100 and 250 tons per year (tpy). While these thresholds are appropriate for criteria pollutants, they are not feasible for GHGs because GHGs are emitted in much higher volumes. To address GHG emissions from stationary sources, in 2009 EPA proposed the Prevention of Significant Deterioration and Title V Greenhouse Gas Tailoring Rule, which focuses on setting new thresholds for GHG emissions from large facilities that will trigger PSD permit requirements, specifically facilities emitting over 25,000 tons of GHG each year. The proposed thresholds that define when PSD permits are required would be limited to large facilities such as power plants, oil refineries and cement production facilities, but would cover nearly 70% of national GHG emissions from stationary sources. The final rule was published June 3, 2010 (75 FR 31514), became effective as of August 2, 2010, and requirements have since been implemented in phases, starting January 2, 2011. In June 2012, the U.S. Court of Appeals for the District of Columbia Circuit ruled in EPA's favor against challenges to these rules. Currently (July 1, 2011 to June 30, 2013), the new permitting requirements apply to new construction projects that emit 100,000 tons per year of GHG, even if they do not exceed permitting thresholds for any other pollutant. Modifications at existing facilities that increase GHG emissions by at least 75,000 tons per year will be subject to permitting requirements, even if they do not significantly increase emissions of any other pollutant. These thresholds simply trigger the requirement to obtain a permit under the CAA and to implement BACT. The next phase of implementation was intended to include smaller sources of GHG emissions. However, on July 3, 2012, EPA issued a final rule to keep GHG permitting thresholds at current levels established under the GHG Tailoring Rule (77 FR 41051). After evaluating the progress of GHG

permitting so far, EPA found that state permitting authorities have not had sufficient time to develop necessary program infrastructure, and to increase their GHG permitting expertise, to make it administratively feasible to apply PSD and title V permitting requirements to smaller sources of GHG emissions.

For new stationary sources of GHGs, EPA proposed new source performance standards for emissions of carbon dioxide (CO2) for new affected fossil fuel-fired electric utility generating units (EGUs) (77 FR 22392; April 13, 2012). The EPA did not propose standards of performance for existing EGUs whose CO2 emissions increase as a result of installation of pollution controls for conventional pollutants, or for proposed EGUs (referred to as "transitional sources") that have acquired a complete preconstruction permit by the time of the proposed rule and that commence construction within 12 months of the proposed rule.

In addition to creating regulations to control GHG emissions, the EPA has many current and near-term initiatives that encourage voluntary reductions from a variety of stakeholders. Initiatives such as Energy Star, Climate Leaders, and Methane Voluntary Programs encourage emissions reductions from large corporations, consumers, industrial and commercial buildings, and many major industrial sectors.

In addition to these federal regulatory efforts, several states have undertaken various efforts to address GHG emissions, described more fully in Section 3.1 below. These efforts include the Midwest Greenhouse Gas Reduction Accord, the Regional Greenhouse Gas Initiative, and the Transportation and Climate Initiative.

2.1.2.1.2 Russian Federation (5.7%)

Russia's carbon emissions are now the 4th highest in the world, behind China and the United States. Its original commitment under the Kyoto Protocol was to maintain emissions at 1990 levels by 2012. Since 1992, fossil-fuel CO_2 emissions from Russia have dropped 25.9% (Boden *et al.* 2010) and total GHG emissions have dropped to 34.1% below 1990 levels as of 2008. The country's overall GHG emissions dropped far below the baseline level established by the Kyoto Protocol throughout the 1990s due to economic collapse; an increasing trend began to return around 1998 (WRI 2010). In association with the Copenhagen Accord, Russia has committed to a 15 to 25% reduction in emissions by 2020 based on 1990 levels. However, regulatory mechanisms have not been enacted to achieve these goals. According to the 2011 Climate Change Performance Index, which ranks the top 60 emitting countries in various factors including emissions level, emissions trend, and climate change policy, the Russian Federation is ranked 48th overall with a performance rating of 'very poor' (Burck *et al.* 2010).

In 2009, President Dmitry Medvedev released the Climate Doctrine of the Russian Federation (IEA 2009). The Doctrine represents a blueprint to harmonize domestic climate-related legislation with international standards, improve climate monitoring, stimulate the adoption of stronger environmental standards, the adoption of energy-efficiency and energy-saving measures, as well as greater use of alternative (including renewable) energy sources. In regards to mitigation of climate change, the Doctrine outlines measures to be developed and implemented including enhanced energy efficiency in all economy sectors, expanded renewable and alternative energy use, reduced market disproportions, implementation of financial and tax policy measures stimulating the reduction of anthropogenic greenhouse gas emissions, protection

and improvement of carbon sinks and receivers including sustainable forest management, deforestation and reforestation on a sustainable basis, and expansion of research and development in energy efficiency, renewable energy, and environmentally friendly technology and GHG sink technologies.

While the plan does not adopt any firm position in terms of CO_2 reduction targets, President Medvedev announced at the 2009 G8 Summit that Russia will try to reduce GHG emissions levels by 10-15% below 1990 in 2020 and by 50% below 1990 levels by 2050 (RIA Novosti 2009a). Although it appears possible for Russia to cut GHG emissions by 20-30% by 2030, this reduction goal is not currently backed by any legal regulatory framework (RIA Novosti 2009b). The only recent relevant regulatory mechanism enacted in Russia is the 2009 State Policy Guidelines for Promoting Renewable Energy in the Power Sector. The guidelines establish targets for the share of electricity generation from renewable energy sources up to 2020. The targets are 1.5% in 2010, 2.5% in 2015 and 4.5% in 2020. At the time the policy passed, less than 1% of total electricity generation came from renewable energy sources, excluding large hydro (IEA 2009).

2.1.2.1.3 Japan (4.0%)

Japan currently ranks 5th in overall GHG emissions. Japan's original commitment under the Kyoto Protocol was to reduce GHG emissions by 6% below 1990 levels by 2012. According to Japan's 2010 National GHG Inventory Report submission to the UNFCCC, Japan's total GHG emissions have increased 1% between 1990 and 2008. In association with the Copenhagen Accord, Japan set an additional target of reducing GHG emissions to 25% below 1990 levels by 2020. According to the 2011 Climate Change Performance Index which ranks the top 60 emitting countries in various factors including emissions level, emissions trend, and climate change policy, Japan is ranked 38th overall with a performance rating of 'poor' (Burck *et al.* 2010).

In 1998, Japan enacted the Act on Promotion of Global Warming Countermeasures: Act No. 117 (Government of Japan 2005a), which came into force in 1999 and was revised in 2002 and 2005. The purpose of this law is to: "…promote global warming countermeasures by formulating a plan for attaining targets under the Kyoto Protocol and taking measures to promote the control of greenhouse gas emissions due to social, economic, and other activities, thereby contributing to the health and cultural life of the Japanese people, both now and in the future, as well as contributing to the wellbeing of all humankind" (Government of Japan 2005a). The Act calls for the establishment of a Council of Ministers for Global Environmental Conservation, development of the Kyoto Achievement Plan, and establishment and implementation of countermeasures by local governments. With the 2002 revision, the Government's New Climate Change Program was adopted. The program intensifies previous guidelines concerning basic measures that should be taken by every sector of society to reduce GHG emissions in line with Japan's Kyoto commitment. The program introduced 45 new approaches including further promotion of renewable energy, energy conservation, and energy efficiency, giving a total of more than 100 approaches to climate change policy. Reduction goals to be imposed on each sector were proposed for the first time.

The Act on the Rational Use of Energy: Act No. 49 (Energy Conservation Act) (Government of Japan 2005b) was passed in 1979 and revised in 1993, 1998, 2002, and 2005. The 1993

revisions strengthened the quantitative goals, reporting requirements, and non-compliance penalties for designated energy management factories. They also established a new enforcement authority concerning display requirements for energy efficiency and other information. Standards for cooling-only air conditioners and passenger cars were strengthened, and new standards issued for: Heat pump air conditioners (dual use, heating and cooling); fluorescent lamps; televisions; photocopiers; computers; and magnetic hard-disk drives. The 2008 revisions strengthen measures to enhance energy efficiency, including those for the commercial sector. Also in this revision, sectoral approaches used in domestic regulation were introduced, to be implemented as of April 2009.

While the Acts described above are its primary climate change-related legislation, Japan has a number of other regulatory programs regarding fuel efficiency standards for passenger vehicles, housing energy efficiency standards, strategies to reduce transport emissions, among others.

2.1.2.1.4 Germany (2.6%)

Germany currently ranks 6th in overall GHG emissions. Germany's original commitment under the Kyoto Protocol (and the European Union's (EU) Burden Sharing Agreement[13]) was to reduce GHG emissions by 21% below 1990 levels by 2012. Between 1990 and 2008, Germany's GHG emissions have declined 21.4%. Germany's ultimate goal is to become one of the most energy-efficient and greenest economies in the world (Federal Ministry of Technology and Economics 2010) by setting ambitious GHG reduction targets and utilizing renewable energies. Under the Copenhagen Accord, the EU has pledged an overall reduction of 20-30% below 1990 levels by 2020, which Germany will contribute to in some proportion. According to the 2011 Climate Change Performance Index which ranks the top 60 emitting countries in various factors including emissions level, emissions trend, and climate change policy, Germany is ranked 7th overall with a performance rating of 'good' (Burck *et al.* 2010). It is also highlighted as having one of the best rankings for emissions trend, although the report points out that even these countries are not on track to prevent dangerous climate change.

In October of 2003, the European Parliament and Council of the European Union (of which Germany is a member) adopted a Directive for establishing an emissions trading scheme in Europe. The Directive applies to energy-intensive installations that fall within activities specified in Annex I of the Kyoto Protocol (Federal Ministry for the Environment, Nature Conservation and Nuclear Safety 2004). In response, Germany enacted the 2003 Greenhouse Gas Emission Trading Act, which established the German Federal Environment Agency as the enforcing agency in the field of climate protection (GETA 2007). To meet the new demands set forth by the EU, Germany founded the German Emissions Trading Authority (Deutsche Emissionshandelsstelle; GETA) which verifies information submitted by companies that wish to obtain emissions allowances, evaluates and corrects the information where necessary and issues emission certificates (GETA 2007). Germany released its National Allocation Plan for emissions allowances in 2004.

[13] The EU as a whole is committed to reducing its emissions by 8% during the period 2008-2012 compared with 1990 levels. For the EU to reach its reduction targets, in 1998 a political agreement was reached to divide the burden of achieving this target unequally amongst member states. This method takes into account: national conditions, including current greenhouse gas emissions; the opportunities for reducing them; and the level of economic development.

In 2010, Germany passed the Ordinance on the Auctioning of Emission Allowances in accordance with the Allocation Act 2012 of 2007. The Ordinance provides for the auctioning of emissions allowances and sets regulations regarding auction procedure, the number of allowances that can be traded, and several other guidelines.

Most recently, in September 2010, the Federal Ministry of Technology and Economics along with the Federal Ministry for the Environment, Nature Conservation, and Nuclear Safety released Germany's Energy Concept for an Environmentally Sound, Reliable and Affordable Energy Supply. The Energy Concept establishes Germany's targets of cutting GHG emissions by 55% by 2030, 70% by 2040 and an 80-95% reduction by 2050, with 1990 as the base year. This plan came out even after Germany reached its GHG reduction targets set under Kyoto in 2009 (3 years in advance) by reducing GHG emissions by approximately 23% since 1990.

Descriptions of all of Germany's programs and initiatives for reducing GHG emissions and utilizing renewable energy can be found in English at http://www.bmu.de/english/climate_energy/doc/41327.php.

2.1.2.1.5 Canada (1.8%)

Currently, Canada ranks 7th in overall GHG emissions. Canada's original commitment under the Kyoto Protocol was to reduce GHG emissions by 6% below 1990 levels by 2012. Between 1990 and 2008, Canada's total GHG emissions have increased approximately 24.1%. Canada's 2008 GHG emissions decreased 2.1% from 2007 levels, attributed partly to a slowdown in economic growth which began in 2008, and to increased use of hydropower for electricity generation. Although emissions rose 24.1% between 1990 and 2008, the overall emissions growth trend has slowed slightly in recent years and emissions since 2003 have decreased by 0.8% (Environment Canada 2010).

Under the Copenhagen Accord, the Government of Canada has committed to reducing total greenhouse gas emissions by 17% from 2005 levels by 2020, in alignment with the final economy-wide emissions target of the United States in enacted legislation. According to the 2011 Climate Change Performance Index which ranks the top 60 emitting countries in various factors including emissions level, emissions trend, and climate change policy, Canada is ranked 57th overall with a performance rating of 'very poor' (Burck *et al.* 2010). It fell eight ranks from last year's performance index with respect to emissions levels because of it high emissions trend.

In April 2007, the Government of Canada announced released "Turning the Corner: An Action Plan to Reduce Greenhouse Gases and Air Pollution" (Environment Canada 2008), which provided the ground work for Canada's approach to tackling climate change. This plan set out an approach for reducing GHG and air pollution emissions from the industry and transportation sectors, as well as actions on consumer and commercial products, and actions to improve indoor air quality. In December 2007, the Government of Canada formally required industry to provide information about their emissions of air pollutants and GHG which is used to report facility level emissions, which Environment Canada publishes every fall as part of its Greenhouse Gas Emissions Reporting Program. The Action Plan requires big companies to reduce their emission intensity by 18% below 2006 levels by 2010. For each year thereafter, industry will have to reduce its emission intensity by a further 2%.

Most recently, the Canadian Government sought to pass legislation in the form of Bill C-311, the Climate Change Accountability Act. This Act, Canada's only climate change-specific legislation, would have committed Canada to a 25% reduction of emissions below 1990 levels by 2020, and 80% reduction by 2050, with progress reports due every 5 years. While the bill had passed the House of Commons, a majority of the Senate took action to block its passage (Levangie 2010).

2.1.2.1.6 United Kingdom (1.8%)

Currently, the UK ranks 8th in overall GHG emissions. The UK's original commitment under the Kyoto Protocol was to reduce GHG emissions by 12.5% below 1990 levels by 2012. From 1990 through 2008, total GHG emissions in the UK have decreased by almost 17%. Under the Copenhagen Accord, the EU has pledged an overall reduction of 20-30% below 1990 levels by 2020, to which the UK will contribute in some proportion. According to the 2011 Climate Change Performance Index which ranks the top 60 emitting countries in various factors including emissions level, emissions trend, and climate change policy, the UK is ranked 8th overall with a performance rating of 'good' (Burck *et al.* 2010). It is also highlighted as having one of the best rankings for emissions trend, although the report points out that even these countries are not on track to prevent dangerous climate change.

The Department of Energy and Climate Change[14] is the regulatory agency that aims to bring together energy policy and climate change mitigation policy. The Department of Energy and Climate Change's goal is to ensure the right legislative framework is in place to meet policy objectives including reducing GHG emissions in the UK, confirming global commitments to tackle climate change, and ensuring secure, affordable energy supplies (Department of Energy and Climate Change 2010). The Climate Change Act of 2008 introduced a new, more ambitious, and legally binding target for the UK to reduce GHG emissions to 80% below base year levels by 2050, with legally binding five year GHG budgets. Other provisions of the Act include developing a carbon budgeting system which caps emissions over five-year periods, creation of the Climate Change Committee, inclusion of aviation and shipping emissions, and implementation of a domestic trading scheme, among others (Department of Energy and Climate Change 2010).

Other key pieces of legislation include the Energy Acts of 2008 and 2010 which include provisions for carbon capture and storage, renewable energy, decommissioning of offshore renewables, offshore electricity transmissions, renewable heat incentives, etc. Enacted in 2008, the Planning and Energy Act enables local planning authorities in England and Wales to set requirements for energy use and energy efficiency in local plans. Additionally, the recent Carbon Reduction Commitment Energy Efficiency Scheme targets large private and public sector organizations and aims to improve energy efficiency and energy savings, reduce GHG emissions, and help large organizations generate cost savings through reduced energy expenditure (Department of Energy and Climate Change 2010)

Most recently, the UK outlined its "Green Deal" in the Energy Bill 2010-2011. This Bill is predominantly intended to enhance energy efficiency for homes and businesses, as 25% of the

[14] http://www.decc.gov.uk/default.aspx

UK's CO_2 emissions come from the energy used to heat homes due to old, inefficient housing (Department of Energy and Climate Change 2010). In summary, the Green Deal is the UK Government "establishing a framework to enable private firms to offer consumers energy efficiency improvements to their homes, community spaces and businesses at no upfront cost, and recoup payments through a charge in installments on the energy bill" (Department of Energy and Climate Change 2010).

Building efficiency regulations, incentives for renewable energy use, as well as vehicle excise taxes according to emissions level are all additional regulatory and incentive tools implemented by the UK government.

2.1.2.1.7 Italy (1.5%)

Italy currently ranks 12th in overall GHG emissions. Italy's original commitment under the Kyoto protocol was to reduce GHG emissions by 6.5% below 1990 levels by 2020. As of 2008, Italy's GHG emissions had increased approximately 6.9% from the base year of 1990. It is estimated that Italy will not reach its Kyoto target of -6.5%, even with current and additional regulatory mechanisms (Europe Environment Agency 2007a). Between 2004 and 2008, however, Italy's emissions have shown a steep downward trend (WRI 2010). Under the Copenhagen Accord, the EU has pledged an overall reduction of 20-30% below 1990 levels, to which Italy will contribute in some proportion. According to the 2011 Climate Change Performance Index which ranks the top 60 emitting countries in various factors including emissions level, emissions trend, and climate change policy, Italy is ranked 41st overall with a performance rating of 'poor' (Burck *et al.* 2010).

Italy has planned and implemented numerous initiatives to ensure their compliance under the Kyoto Protocol. In June 2007, the Italian Parliament's environment committee set out a comprehensive Climate Change Action Plan, aimed at helping Italy achieve its GHG emissions reduction targets under Kyoto. The plan includes a ban on the sale of household appliances ranked below A on the EU energy efficiency labeling scale. Additionally, these appliances will be removed from sale by 2010, and low efficiency incandescent light bulbs will be banned by 2012. The industrial sector is encouraged to switch to low energy devices and install more efficient engines and motors. These provisions target small and medium sized firms. Energy saving is encouraged through various incentives aimed at industrial and domestic consumers. Under a new system of energy tariffs, heavy users and daytime users will pay more per unit of energy. The committee also proposed a 10% increase in waste recycling and says this could prevent four million tons of CO_2 emissions annually. It further sought a shift in goods transport to rail from road, which currently carries 85% of goods traffic. The plan was endorsed by the lower house, but has yet to be implemented by the government as national policy.

Italy also implements policies and regulations set by the EU, such as the EU Emissions Trading Scheme and EU Energy Performance of Buildings Directive. Italy passed Legislative Decree n. 115 of 30 May 2008 set to implement into domestic legislation the EU Energy Services Directive (2006/32/EC), creating a legal framework for greater efforts to improve energy efficiency and addressing a spectrum of activities in the energy sector. Italy released its National Energy Efficiency Action Plan in July 2007.The plan considers measures already undertaken under the budgetary law of 2007 (which provides for various fiscal incentives and financial measures to improve energy efficiency and to abate emissions) and other measures, such as application of

energy efficiency standards in buildings. The proposed measures aim to achieve an energy saving target of 9.6% by 2016. Sectors addressed in the Plan include industrial, residential, tertiary and transport sectors.

Italy has also implemented a number of regulatory and incentive programs to reduce emissions from vehicles, buildings and appliances.

2.1.2.1.8 Australia (1.3%)

Australia currently ranks 16th in overall GHG emissions. Australia's original commitment under the Kyoto Protocol was to limit GHG emissions to 8% above 1990 levels by 2012. According to their 2010 National Inventory submission, as of 2008, Australia's GHG emissions have increased approximately 29.4% above 1990 levels. Under the Copenhagen Accord, the Government has committed to reduce Australia's GHG emissions at minimum to 25% below 2000 levels by 2020 if the world agrees to an ambitious global deal to stabilize levels of GHGs in the atmosphere at 450 parts per million CO_2 equivalent or lower. If the other countries fail to reach the agreement of the 450 parts per million target, Australia will only commit to reducing its emissions by between 5 and 15% below 2000 levels by 2020. According to the 2011 Climate Change Performance Index which ranks the top 60 emitting countries in various factors including emissions level, emissions trend, and climate change policy, Australia is ranked near the bottom at 58th overall with a performance rating of 'very poor' (Burck *et al.* 2010).

Australia's Department of Climate Change and Energy Efficiency is the lead agency responsible for creating and implementing the regulatory framework for dealing with issues related to climate change. The driving legislation to curb Australia's GHG emissions is the Carbon Pollution Reduction Scheme; it was designed to guide the country in reaching its goal of 25% below 2000 levels by 2020. However, due to a lack of bipartisan support for the Carbon Pollution Reduction Scheme and slow progress on reaching a credible global agreement to limit carbon emissions, the Government has delayed the introduction of the Carbon Pollution Reduction Scheme. Emissions projections released in August 2009 showed that in the absence of the Carbon Pollution Reduction Scheme, Australia's GHG emissions are projected to rise to 20% above 2000 levels. Australia has numerous voluntary and incentive programs and initiatives to help abate GHG emissions. A comprehensive list of these can be found at http://www.climatechange.gov.au/government/initiatives.aspx. Without a clear consensus on the Carbon Pollution Reduction Scheme, it is unclear whether or not Australia will meet its reduction goals under Kyoto.

2.1.2.1.9 France (1.3%)

France currently ranks 17th in overall GHG emissions. France's original commitment under the Kyoto Protocol (and the EU Burden Sharing Agreement) was to stabilize emissions at 1990 levels. Between 1990 and 2008, France's GHG emissions (excluding LULUCF and emission credits) decreased 5.6%. More recently, in association with the Copenhagen Accord, the EU has committed to reducing overall GHG emissions by 20-30% by 2020, to which France will contribute in some proportion. France is also one of the G8 countries who have agreed to cut their emissions by 80 percent by 2050 (Serre 2010). According to the 2011 Climate Change Performance Index which ranks the top 60 emitting countries in various factors including emissions level, emissions trend, and climate change policy, France is ranked 9th overall with a performance rating of 'good' (Burck *et al.* 2010).

Domestically, under the Energy Strategic Law of 2005, France has committed to average yearly reductions of 3% resulting in a projected division of emissions by four by 2050 - so called "Factor 4" (Serre 2010). Most recently, France passed a major new bill that will likely transform environmental law in the country, including its approach to climate change. The Grenelle 2 bill includes various measures that aim to reduce GHG emissions. The bill contains incentives to embed sustainability into French urban planning; "urban master plans" (Schéma de Cohérence Territoriale) will be finalized before 2017 to enhance policy coherence between urban, industrial, farming, tourism, and natural zones, and also to help tackle urban sprawl. Grenelle 2 also allows for a possible exception for energy-efficient buildings to the Building Density Limit, which specifies the maximum building density of a landed property allowed, by acreage. In general, Grenelle 2 makes great improvements regarding the energy efficiency of buildings which account for around 18% of France's GHG emissions. The new law sets a target of reducing the average energy consumption of buildings nearly 40% by 2020, and puts a focus on advanced energy performance for both old and new buildings (Serre 2010).

France has already reached (and surpassed) its GHG reduction goals under Kyoto, and is likely they will also reach their current domestic reduction goals as well.

2.1.2.1.10 Spain (1.1%)

Spain currently ranks 19th in overall GHG emissions. Spain's original commitment under the Kyoto Protocol (and the EU Burden Sharing Agreement) was to cap increasing emissions at 15% above 1990 levels by 2012. However, between 1990 and 2008, Spain's GHG emissions increased by 42.5%. Despite these policy and regulatory implementations, Spain is not estimated to reach its Kyoto target with current measures. Even with the use of Kyoto Mechanisms and carbon sinks, a gap to the Kyoto target of about 14 percentage points remains (Europe Environment Agency 2007b). Under the Copenhagen Accord, the EU has pledged an overall reduction of 20-30% below 1990 levels by 2020, to which Spain will contribute in some proportion. According to the 2011 Climate Change Performance Index which ranks the top 60 emitting countries in various factors including emissions level, emissions trend, and climate change policy, Spain is ranked 35th overall with a performance rating of 'poor' (Burck *et al.* 2010).

In efforts to reach their GHG reduction goals under Kyoto, the Spanish Government developed the Spanish Climate Change and Clean Energy Strategy in 2007 (Government of Spain 2007). This Strategy includes provisions for clean energy, energy efficiency, and renewable energy. Examples of specific measures targeting the transport sector include better infrastructure and territorial planning and modal change. In addition, efficient building and power generation technologies and renewable energy sources are to be used when developing transport facilities. Other efficiency measures include eco-driving programs, improved energy labels for vehicles, and integration of energy efficiency criteria in administrative contracts to increase the number of clean-air vehicles in the public vehicle fleet. In the residential, commercial and institutional sectors, most measures concentrate new buildings through strengthening thermal building code requirements and promoting energy performance certificates and existing buildings through incentives for renovation. Measures also encourage the use of efficient appliances, heating equipment and light bulbs. Regarding renewable energy, proposed measures extend the use of solar thermal panels in new housing projects as well as non-residential buildings and public

facilities. In addition, the use of wood as heating fuel is promoted.

In 2008 the Spanish government approved the Spanish Industry Minister's 2008-2011 Energy Saving and Efficiency Plan. The plan contains 31 recommendations aimed at reducing CO_2 emissions. The new plan will cover the transport, industrial, residential, tertiary and agricultural sectors. Measures follow four lines of action: transversal measures, mobility, buildings and energy savings.

More recently, the Spanish Government drafted the Sustainable Economy Law in 2010. The Draft Bill for the Sustainable Economy Law has been drawn up as the cornerstone of the Spanish government's strategy to define the new growth model for the Spanish economy. It is formulated around three central themes: improvements to the economic environment, the promotion of competitiveness and the development of sectors working in the fight against climate change. As such, the law will contain specific measures that will benefit companies in renewable energy, and other climate change mitigation sectors, including energy efficiency and savings. The Sustainable Economy Law sets national targets in accordance with European objectives in renewable energy including a 20% share of renewable sources in energy consumption, with at least 10% of renewable sources in the transport sector.

2.1.2.1.11 Ukraine (1.1%)

Ukraine currently ranks 20th in overall GHG emissions. Ukraine's commitment under the Kyoto Protocol was to ensure that its annual GHG emissions during the period 2008-2012 do not exceed the 1990 level. According to the Ukraine's 2010 national inventory report submission to the UNFCC, total GHG emissions decreased by 53.9% between 1990 and 2008. Under the Copenhagen Accord, the Government of Ukraine plans to keep GHG emissions 20% and 50% below 1990 levels by 2020 and 2050, respectively. The latter target would require maintaining the GHG emissions in 2050 to roughly today's levels, implying a net zero growth in emissions between now and 2050 despite an expected strong economic growth (NEIAU 2010). Projections for Ukrainian total GHG emissions in 2012 and 2020 are estimated to remain well below 1990 levels (NEIAU 2010). According to the 2011 Climate Change Performance Index which ranks the top 60 emitting countries in various factors including emissions level, emissions trend, and climate change policy, Ukraine is ranked 36th overall with a performance rating of 'poor' (Burck *et al.* 2010). Despite being ranked as one of the highest for emissions trend, Ukraine's low ranks for climate policy and emission level brought down its overall score.

In 2007, the Ukraine passed Regulation #977 establishing the National Environmental Investment Agency of Ukraine[15] (SEIAU). Within this regulation, responsibilities of financing and implementing mechanisms to mitigate climate change and reduce emissions were delegated to the Agency. The Agency is also responsible for executing the requirements under the UNFCCC and implementing the mechanisms of the Kyoto Protocol, including completing the annual inventories of anthropogenic GHG emissions as well as providing the National communications on climate change to the UNFCCC.

Ukraine's primary energy policy and priorities are defined in its Energy Strategy to 2030

[15] http://www.neia.gov.ua/nature/control/en/publish/category?cat_id=80484

(Government of Ukraine 2006)[16], which was approved by the Cabinet of Ministers in 2006. The overriding objectives the Strategy are to ensure its energy security and status as a significant transit country. Priorities include increasing transit volumes, reducing the economy's energy intensity, improving its energy efficiency, integrating with the European energy system and expanding domestic energy production. In order to meet these objectives and priorities a set of policy measures is specified, which includes modernizing and rehabilitating infrastructure that transports hydrocarbons, diversifying supplies and routes, increasing domestic production of coal and nuclear energy, implementing broad-ranging energy efficiency measures, adopting relevant EU laws and undertaking pricing reform.

2.1.2.1.12 Poland (1.1%)

Poland currently ranks 21st in overall GHG emissions. Poland's original commitment under the Kyoto Protocol was to reduce GHG emissions by 6% below 1988 levels[17]. As of 2008, Poland's total GHG emissions decreased by 29.6% from 1988 levels. Under the Copenhagen Accord, the EU has pledged an overall reduction of 20-30% below 1990 levels, to which Poland will contribute in some proportion. According to the 2011 Climate Change Performance Index which ranks the top 60 emitting countries in various factors including emissions level, emissions trend, and climate change policy, Poland is ranked 55th overall with a performance rating of 'very poor' (Burck *et al.* 2010).

The regulatory agency in Poland responsible for implementing policies and regulations related to climate change is the Poland Ministry of the Environment and its Department of Climate Change and Atmosphere Protection. As of April 29, 2008 Poland met specific criteria and became eligible to engage in international emissions trading (Article 17 of the Kyoto Protocol) including trading of Assigned Amount Units (Poland Ministry of Economy 2009). In 2009, Poland enacted the System to Manage the Emissions of Greenhouse Gases and Other Substances, which provides the legal framework for Poland's Green Investment Scheme. The System allows the profits generated from trade of Assigned Amount Units to be used for various programs and projects including improving energy efficiency, clean coal technologies, fuel replacement with low-emission alternatives, renewable energy, GHG sequestration, among others. The operating entity for the National Green Investment Scheme is the National Fund for Environmental Protection and Water Management.

Also in 2009, the Council of Ministers adopted the Energy Policy of Poland until 2030. Prepared within the Ministry of Economy, it includes a long-term strategy for the energy sector, fuel and energy demand forecasts, and an implementation program of policies and measures until 2012. The policy specifies six basic directions for the development of the Polish energy sector including improvement of energy efficiency, enhancement of fuel and energy supply security, diversification of electricity generation mix by introducing nuclear energy, use of renewable energy sources including biofuels, development of competitive fuel and energy markets, and reduction of the environmental impact of the power industry. In order to reduce GHG and other

[16] http://www.esbs.kiev.ua/en/energy-sector-cooperation-and-reforms/ukraine-s-energy-strategy-to-2030

[17] The economies in transition were granted the right to choose a different base year than 1990. Poland adopted 1988 as its base year. It was the last year before the crisis when its economy functioned in a relatively normal manner and when the greenhouse emissions were highest in the decade.

industrial emissions, the Energy Policy outlines a system of national ceilings on emissions of GHGs and other substances, along with admissible product-specific emission indicators (Poland Ministry of the Environment 2009).

There have been several other regulatory instruments and policies enacted in Poland to continue on the track of their long-term emission goals. These include the Act on electricity production from cogeneration, the Regulation for Obligation for Power Purchase from Renewable Sources, and the Long-term Program for Promotion of Biofuels or Other Renewable Fuels among others. More details on these and other regulatory measures in Poland and elsewhere can be found via the International Energy Agency's Climate Change Policies and Measures Database[18].

2.1.2.1.13 Turkey (1.0%)

Turkey currently ranks 22nd in overall GHG emissions. Turkey was not yet a UNFCCC Party at the time of signing the Kyoto Protocol and therefore has no reduction commitment assigned under it. Between 1990 and 2008, Turkey's GHG emissions increased 103.2%. Turkey has not yet made an emissions reduction pledge under the Copenhagen Accord. According to the 2011 Climate Change Performance Index which ranks the top 60 emitting countries in various factors including emissions level, emissions trend, and climate change policy, Turkey is ranked 50th overall with a performance rating of 'very poor' (Burck *et al.* 2010).

In 2004, the Coordination Board on Climate Change was established under the Chairmanship of the Ministry of Environment and Forestry to determine the policies to be followed, measures to be taken and activities to be conducted by Turkey in the field of climate change. The Energy Efficiency Law is the primary legislation that aims to increase the efficient use of energy and energy resources for reducing the burden of energy costs on the economy and protecting the environment. This law includes the organization, principals, and procedures for increasing energy efficiency in industry, electrical power plants, transmission and distribution systems, building, service, and transport sectors. The Energy Efficiency Law also amended Law no.5346 dated.2005 on Utilization of Renewable Energy Sources for the Purpose of Generating Electrical Energy. Renewable electricity receives a fixed purchase price of between EUR cents 5 and 5.5/kWh for 10 years. The price is valid for plants installed until end of 2011, though the government can extend this date for two years. The Electricity Market Law of 2001 was also modified by the Energy Efficiency Law, exempting certain categories of power plants from the obligation to obtain licenses and establish companies. The exemption applies to: renewable energy plants with installed capacity of maximum 500kW; cogeneration plants with at least 80% overall efficiency; micro cogeneration plants with 50 kW installed capacity (IEA 2009b).

In Turkey's initial communication to the UNFCCC in 2007, Turkey noted that it was in the process of seeking to establish a National Action Plan on Climate Change. As of the end of 2010, an initial Climate Change Strategy paper has been completed but a comprehensive National Plan has not yet been developed. Additional regulations in Turkey include laws regarding labeling appliances and passenger vehicles for energy use and fuel efficiency, efficient outdoor lighting, renewable energy use, regulations on heat insulation for new buildings, and

[18] http://www.iea.org/textbase/pm/?mode=cc

several others. More detail can be found here: http://www.iea.org/textbase/pm/?mode=cc&action=view&country=Turkey.

2.1.2.2 UNFCCC Non-Annex I Countries

2.1.2.2.1 China (23.5%)

China surpassed the U.S. sometime around 2006/2007 to become the world's largest emitter of greenhouse gases[19] (Netherlands Environmental Assessment Agency 2007, 2008; Rosenthal 2008). As a non-Annex I country, China made no commitment under the Kyoto Protocol to reduce GHG emissions below 1990 levels by the year 2012. It has submitted only one GHG Inventory to the UNFCCC in 1994. China has opposed numerous proposals by UNFCCC parties that would require non-Annex I countries to submit GHG Inventories on a regular basis. Between 1990 and 2007, CO_2 emissions in China from the burning of fossil fuels increased 165%. Since 2000, total GHG emissions in China have more than doubled and in 2009, they grew by 9% over the previous year (Olivier and Peters 2010). As one of the primary parties that negotiated the Copenhagen Accord in 2009, it has pledged to reduce carbon dioxide emissions intensity[20] (emissions per unit of GDP) 40-45% by 2020 compared to 2005, increase the share of non-fossil fuels in primary energy consumption to around 15% by 2020 and increase forest coverage by 40 million hectares and forest stock volume by 1.3 billion cubic meters by 2020 from the 2005 levels (Government of China 2010). It is uncertain whether these goals are realistic or achievable as they would put great pressure on China's continued development. According to a researcher at the Chinese Academy of Social Sciences, "In 2020, the country's GDP will at least double that of now, so will the emissions of greenhouse gases. But the required reduction of emissions intensity by 40 to 45 percent in 2020 compared with the level of 2005 means the emissions of greenhouse gases in 2020 has to be roughly the same as emissions now." (Government of China 2009). Stern and Jotzo (2010) state that while China's targeted reductions in terms of emissions intensity are on par with those implicit in the U.S. and EU targets (which are framed in terms of absolute reductions of carbon emissions and not emissions intensity), the Chinese government will have to adopt ambitious carbon mitigation policies in order to achieve this target. According to the 2011 Climate Change Performance Index which ranks the top 60 emitting countries in various factors including emissions level, emissions trend, and climate change policy, China is ranked 56th (down from 52nd in 2010) and in the 'very poor' performance category (Burck *et al.* 2010). China is ranked the highest for emissions trend.

The National Development and Reform Commission Department of Climate Change takes the lead for domestic climate change activities and the Ministry of Foreign Affairs leads on international climate change issues in China. Domestically, as a developing country, China's focus remains on developing their economy and eradicating poverty more so than environmental issues including climate change. In the international climate change arena, it abides by the

[19] Even though it has been widely accepted outside of China that it became the world's top GHG emitter sometime around 2006/2007, China itself has acknowledged this position as of November 2010 (Samuelsohn 2010).

[20] Framing reduction targets in emissions intensity has been criticized because a targeted reduction in intensity can mean continued increase in absolute levels, but they have valuable properties in managing economic uncertainty and focus the target formulation on structural and technological change rather than GDP growth which is not a policy variable (Jotzo and Pezzey 2007).

notion of "common but differentiated responsibilities" as described in the UNFCCC and argues that industrialized countries are responsible for the historical accumulation of GHG in the atmosphere and should therefore lead the way in mitigating emissions. The former head of China's National Development and Reform Commission, Ma Kai, said "Our general stance is that China will not commit to any quantified emissions reduction targets, but that does not mean we will not assume responsibilities in responding to climate change" (China Department of Climate Change 2009).

In 2007 China released its National Climate Change Program outlining domestic policies and actions to be implemented to improve energy efficiency and expand low-carbon energy supply. Out of the 52 policies and measures stated in the National Climate Change Program, ten of them are quantitatively described in terms of how much of a GHG emissions reduction will result, many of them estimated by 2010 (See Table A-1 in the Appendix of Leggett *et al.* 2008 for a summary of measures, expected emissions reduction, and progress as of 2008). The primary domestic policies and programs of note are described briefly in the Appendix (also see Leggett *et al.* 2008 and China's National Climate Change Program for more detailed information). In General, they include renewable energy laws, increased efficiency targets, promotion of nuclear power, and updated building codes and vehicle fuel economy standards, among others. While several of these policies and programs have shown measurable progress toward their stated goals and were on track to meet or surpass them as of 2008 (see Leggett *et al.* 2008), China's overall emissions have continued to increase.

2.1.2.2.2 India (5.8%)

India currently ranks (a distant) third in its contribution to global greenhouse gases behind China and the U.S. at around five percent of the global total. It has submitted only one GHG inventory to the UNFCCC in 1994. As a non-Annex I country, India made no commitment under the Kyoto Protocol to reduce GHG emissions below 1990 levels by the year 2012. Between 1990 and 2007, India's CO_2 emissions from the burning of fossil fuels increased 133%. India's pledge to the UNFCCC under the Copenhagen Accord is to reduce their emissions intensity per unit of GDP by 20-25% by 2020 in comparison to 2005 levels (Government of India 2010a). According to Stern and Jotzo (2010), this target is not comparable to targets set by the U.S. and E.U. for absolute reductions in carbon emissions and might be met with only limited or even no dedicated mitigation policies. Despite their on-going policies and initiatives, India's CO_2 emissions in 2009 increased 6% over the previous year. Together with China's 9% increase, this was enough to nullify the overall decrease in GHG emissions of most Annex I countries that year (Olivier and Peters 2010). According to the 2011 Climate Change Performance Index which ranks the top 60 emitting countries in various factors including emissions level, emissions trend, and climate change policy, India is ranked 10th overall with a performance rating of 'good' (Burck *et al.* 2010). Out of the top 10 emitters, India ranks third in overall climate change performance.

India has numerous policies in place that are not necessarily driven by climate concerns but contribute to reducing or avoiding GHG emissions. Many of the policies are contained within the Five Year Plans to guide economic policy in India (the 11th Five Year Plan covers 2007-

2012[21]) prepared by the Planning Commission and some are found in the Integrated Energy Policy from 2006. The government is mandating the retirement of inefficient coal-fired power plants and supporting the research and development of alternative technologies. Under the Electricity Act 2003 and the National Tariff Policy 2006, the central and state electricity regulatory commissions must purchase a certain percentage of grid-based power from renewable sources. Under the Energy Conservation Act 2001, large energy consuming industries are required to undertake energy audits and an energy labeling program for appliances has been introduced (Government of India 2008; see Pew Center for Global Climate Change 2008a for summary). On June 30, 2008, India released its first National Action Plan on Climate Change outlining existing and future policies and programs addressing climate mitigation and adaptation. The plan identifies eight core "national missions" running through 2017, four of which are in some way related to reducing GHG emissions. These missions include activities like making solar power competitive with fossil-fuel based energy sources, increasing energy efficiency, extending the existing Energy Conservation Building Code, enforcing fuel economy standards and providing incentives for fuel-efficient vehicle purchasing, afforestation of six million hectares of degraded forest lands and expanding forest cover from 23% to 33% of India's territory, and a whole separate National Mission to facilitate science and research on climate change (Government of India 2008; see Pew Center for Global Climate Change 2008a for summary). Other on-going initiatives and regulations for adaptation to climate change are also described in the National Action Plan on Climate Change. Specific estimates of the emission impacts of most of these policies are not available but an analysis prepared for the Ministry of Environment and Forests in 2005 concluded that in the absence of several energy policies being implemented at the time, CO_2 emissions would likely be ~20% higher compared to business as usual scenarios in both 2021 and 2031 (Pew Center for Global Climate Change 2008b).

In October of 2009, the government of India launched the Indian Network of Climate Change Assessment[22] within the Ministry of Environment and Forests in an effort to research and produce updated reports on GHG emissions. The first Indian Network of Climate Change Assessment report from 2010 provides updated emissions estimates for 2007. According to their report, total GHG emissions without LULUCF grew 52% between 1994 and 2007 at a compounded annual growth rate of 3.3%; with LULUCF the compounded annual growth rate is 2.9%, although emissions intensity of India's GDP declined by more than 30% during the period 1994-2007 (Government of India 2010b). At that time, India ranked fifth in total emissions.

2.1.2.2.3 Iran (1.8%)

Iran currently ranks 10th in overall GHG emissions. As a non-Annex I country, Iran made no commitment under the Kyoto Protocol to reduce GHG emissions below 1990 levels by the year 2012. Iran submitted a GHG Inventory for the year 1994 in 2003 (Government of Iran 2003). In 2003, the amount of total GHG emissions in all sectors in Iran was predicted to increase 80% between 1994 and 2010. Between 1990 and 2007, Iran's CO_2 emissions from the burning of fossil fuels increased 118%. As of Jan. 2011, Iran has not submitted a reduction target pledge under the Copenhagen Accord. According to the 2011 Climate Change Performance Index which ranks the top 60 emitting countries in various factors including emissions level, emissions

[21] http://planningcommission.gov.in/plans/planrel/11thf.htm
[22] http://moef.nic.in/modules/others/?f=event

trend, and climate change policy, Iran is ranked 52nd overall with a performance rating of 'very poor' and is in the bottom three in emissions trends over the last five years (Burck *et al.* 2010).

National Policy measures proposed for reduction of GHGs in Iran, known as Mitigation Scenarios, were included in Iran's Third Five Year Development Plan which covers 2001 - 2005. The fourth Five Year Development Plan was ratified in 2005 (2006 – 2010) and the Fifth was announced in 2010 and will cover 2011-2015. According to Iran's Initial Communication to the UNFCCC in 2003, domestic policies addressing climate change apply primarily to the energy sector (which accounted for 83% of GHG emissions in 1994). These include clean and efficient power generation, environmentally friendly refineries, improved vehicle and public transport and energy-efficient buildings and appliances. In the non-energy sector, policies and reduction strategies include modern farm and livestock management, protection of forestlands and other natural resources, control and treatment of wastewater, disposal management, and recycling of solid wastes. Iran's fifth Five-Year Plan drew internal criticism as it moved through the legislative process. Critics of the plan claim it is more of an "essay" or "collection of wishes" lacking specific objectives and ways to reach them, it is not well structured and lacks both quantitative indices and transparency regarding sources of revenue. Some critics claim it conflicts with other legislation and even the constitution (Farhi 2010). Iran's renewable energy consumption is low. With 9% of the world's oil reserves and 15% of its natural gas reserves (80% of which have not been developed), Iran has an abundant supply of fossil fuel resources, which tends to discourage the pursuit of alternative, renewable energy sources (Mostafaeipour and Mostafaeipour 2009).

2.1.2.2.4 South Korea (1.7%)

South Korea currently ranks 9th in overall GHG emissions. As a non-Annex I country, South Korea made no commitment under the Kyoto Protocol to reduce GHG emissions below 1990 levels by the year 2012. Total GHG emissions in South Korea increased 98% between 1990 and 2005 and the primary source of CO_2 emissions is the energy sector (Jick Yoo 2008). Emissions of CO_2 from the burning of fossil fuels increased 108% between 1990 and 2007. Emissions are estimated to continue to grow at a rate of ~2.2% through 2020 for an overall continued increase of 37.7% without mitigation actions (Jick Yoo 2008). Under the Copenhagen Accord, South Korea has pledged to reduce national GHG emissions by 30% from business as usual emissions by 2020 (Republic of Korea 2010) which allows for further increase over 2005 levels of only 7.7%. According to Energy Information Administration (EIA) data, CO_2 emissions from consumption of fossil fuels in South Korea increased over 9% between 2005 and 2008 (EIA 2010b). According to the 2011 Climate Change Performance Index which ranks the top 60 emitting countries in various factors including emissions level, emissions trend, and climate change policy, Korea is ranked 34th overall with a performance rating of 'poor' (Burck *et al.* 2010). This is an improvement over their previous ranking of 41st due mostly to recent improvement in climate policy.

The Government of South Korea established a Climate Change Committee in 1998 to create a National Action Plan. A Special Committee for Climate Change was also established in the National Assembly in 2001. A Task Force was formed in 2004 to help energy intensive industries lower their GHG emissions. A National GHG Inventory System was established in 2006 and a National Registry established to provide incentives and record voluntary reductions of GHG emissions by registered firms and businesses.

In August of 2008, President Lee Myung-bak proclaimed "Low carbon, Green Growth" as Korea's new national vision for the next 60 years. As such, the Presidential Committee on Green Growth was established in 2009 and they have developed 27 national strategies for Green IT, finalized the Five-Year National Plan for Green Growth (2009-2013), confirmed a 30% target reduction of national GHG emissions below business as usual by 2020, announced the enforcement of a 'Framework Act on Low Carbon, Green Growth', and launched the Global Green Growth Institute. The National Strategy for Green Growth has both mid- (2009 – 2013) and long-term (2009 – 2050) objectives and describes ten policy directions to be implemented, including the effective reduction of GHG emissions (Jung and Ahn 2010). The Five-Year National Plan represents a significant investment as US$83.6 billion has been dedicated to mitigation and adaptation to climate change (that is equal to ~2% of GDP). The new National Energy Plan includes a renewable energy target of 11% by 2020 which means reducing the use of fossil fuels. According to an analysis by UNEP, several of the targets Korea has set forth under this new Green initiative are modest compared to those of other countries; however they will still require a rapid pace of change since little has taken place since the early 2000s (UNEP 2010a).

2.1.2.2.5 Mexico (1.6%)

Mexico currently ranks 11th in overall GHG emissions. As a non-Annex I country, Mexico made no commitment under the Kyoto Protocol to reduce GHG emissions below 1990 levels by the year 2012. Between 1990 and 2007, Mexico's CO_2 emissions from the burning of fossil fuels increased 32%. Under the Copenhagen Accord, Mexico has pledged to reduce its GHG emissions up to 30% with respect to the business as usual scenario by 2020 (Government of Mexico 2010). According to the 2011 Climate Change Performance Index which ranks the top 60 emitting countries in various factors including emissions level, emissions trend, and climate change policy, Mexico is ranked 11th overall with a performance rating of 'good' (Burck *et al.* 2010). Mexico is one of the developing nations considered to have taken a leadership role in domestic greenhouse gas mitigation policy and international climate change negotiations (WWF 2010).

When President Felipe Calderón took office in 2006, climate change became an integral part of his administration's agenda. The president's Special Climate Change Program (2009 – 2012)[23] has been developed and builds on elements contained in the National Climate Change Strategy completed in 2007. Although the program is specific to objectives intended to meet goals by 2012, it also includes intermediate aspirational targets for 2020 and 2030 with the ultimate target of reducing GHG emissions by 50% by 2050 as compared to 2000 levels, although it is noted that this target will only be met with financial and technological support mechanisms from developed countries. A portion of the government's Climate Change Program focuses on raising energy efficiency standards while helping Mexicans replace out-of-date refrigerators and air conditioning units and enforcing mandatory emissions controls for vehicles. A program providing tax credits to home owners who install solar panels and other environmentally friendly fixtures is also included. Sustainable forest management, renewable energy, incandescent bulb

[23] http://www.cop16.mx/en/climate-change/executive-summary-special-climate-change-program-20092012-mexico/index.htm

replacement, increased use of rail for freight, green buildings and wind generation, among others, are all included as mitigation targets to be implemented via policies and incentive programs.

2.1.2.2.6 South Africa (1.5%)

South Africa currently ranks 13th in overall GHG emissions. As a non-Annex I country, South Africa made no commitment under the Kyoto Protocol to reduce GHG emissions below 1990 levels by the year 2012. Between 1990 and 2007, South Africa's CO_2 emissions from the burning of fossil fuels have increased 30%. Prior to the Climate Talks in Copenhagen in 2009, South Africa announced a voluntary commitment to reduce emissions by 34% below business as usual levels by 2020. This reduction is, however, conditional upon international support that is not certain to materialize. According to the 2011 Climate Change Performance Index which ranks the top 60 emitting countries in various factors including emissions level, emissions trend, and climate change policy, South Africa is ranked 29th overall with a performance rating of 'moderate' (Burck *et al.* 2010).

South Africa provided its Initial National Communication to the UNFCCC in 2000 which includes GHG inventories for 1990 and 1994. The second National Communication was submitted in 2009 and included an additional GHG inventory for the year 2000. The proportion of emissions from the energy sector increased from 75% in 1990 to 78% in 1994 while emissions from agriculture, industry, and waste all fell slightly between 1990 and 1994 (Government of Republic of South Africa 2000). The year 2000 showed further increase in overall emissions (Government of Republic of South Africa 2010a). As development continues, GHG emissions under business as usual terms are expected to rise steeply through 2050 (Letete *et al.* 2009).

South Africa is in the early stages of climate change mitigation policy, with policy intentions and directions existing at this stage (Tyler 2009). The National Committee on Climate Change was established in 1994 to act as an advisory body to the Minister of Environmental Affairs and Tourism. South Africa released a National Climate Change Response Strategy in 2004. In 2005, a South African Country Study on Climate Change was completed, a Climate Change Conference was held, and in 2007, a resolution on climate change was adopted at the African National Congress. The resolution resolves to set a GHG mitigation target for the future and to emphasize wind and solar energies over the use of coal. The Long Term Mitigation Scenarios process was undertaken by the Cabinet in 2007 to determine what trajectory their targets need to take and how ambitious policies need to be to achieve them. Comparing 'Growth without Constraint' and 'Required by Science' scenarios, they determined that a Required By Science scenario could not be met with the implementation of current existing mitigation policies and the use of new and as of yet unidentified technologies and behavioral change would be required to achieve a reasonable mitigation trajectory (Energy Research Centre 2008).

Despite good climate change mitigation policy intentions, it has been a slow process for South Africa to actually develop its policies. As of December 2010, a draft 'green paper' of South Africa's climate change mitigation policy[24] has been released for public comment and the final is expected in mid-2011 (van der Murwe 2010). The paper describes general strategies in various

[24] http://www.environment.gov.za/HotIssues/2010/cgreenpaper.pdf

mitigation sectors including energy, industry, and transport and describes intended policies including fuel standards, renewable energy requirements, and financial incentives to encourage behavior change (Government of Republic of South Africa 2010b). Although considered a step in the right direction, the green paper is seen by some as not specifying intended rules or specific policies, but rather defining an ultimate policy objective and identifying principles and strategies to be used to achieve the objective (van der Murwe 2010).

2.1.2.2.7 Saudi Arabia (1.5%)

Saudi Arabia currently ranks 14th in overall GHG emissions. As a non-Annex I country, Saudi Arabia made no commitment under the Kyoto Protocol to reduce GHG emissions below 1990 levels by the year 2012. Between 1990 and 2007, Saudi Arabia's CO_2 emissions from the burning of fossil fuels increased 87%. Saudi Arabia submitted its initial National Communication to the UNFCCC in 2005[25] and provided a GHG inventory for the base year 1990. Saudi Arabia has yet to make any pledge under the Copenhagen Accord. According to the 2011 Climate Change Performance Index which ranks the top 60 emitting countries in various factors including emissions level, emissions trend, and climate change policy, Saudi Arabia is ranked last in 60th place overall with a performance rating of 'very poor' (Burck *et al.* 2010). Within the three categories of index variables, Saudi Arabia was among the lowest scorers in relative emissions levels and emissions trend and it ranked lowest out of all the countries in climate policy.

Saudi Arabia is the world's largest exporter of oil; 75% of Saudi Arabia's budget revenues and 45% of GDP is accounted for by the country's petroleum sector (OPEC 2011). It has done little to diversify its economy despite large potential for renewable energy sources like solar power. In international climate negotiations, Saudi Arabia has opposed measures, like taxing oil supplying nations and others, that encourage use of alternatives to fossil fuels, the exportation of which is a large component of their economy. A vulnerability assessment and list of adaptation measures are included in Saudi Arabia's initial National Communication to the UNFCCC; however, mitigation in the form of GHG reduction policies or initiatives is not discussed. At the UN climate talks in Bangkok in October of 2009, Saudi Arabia initiated negotiations requesting financial assistance for oil producing countries that would be adversely affected by any resulting climate change agreement (Associated Press 2009). The Saudi delegate held this position despite an International Energy Agency (IEA) report released the same week showing that revenues for the Organization of Petroleum Exporting Countries (OPEC) members would still increase $23 trillion between 2008 and 2030 — a fourfold increase compared to the period from 1985 to 2007 — even if countries agree to significantly reduce emissions and thereby cut their use of oil (Whittington 2009).

2.1.2.2.8 Indonesia (1.4%)

Currently,Indonesia ranks 15th in overall GHG emissions. It is important to note, however, that Indonesia's estimated percentage of global GHG emissions and resulting rank reported here do not incorporate CO_2 emissions from LULUCF, for the sake of consistency. For most other countries, fossil fuel consumption in the energy sector is the primary source of CO_2 emissions. Because of the high uncertainty and lack of reliable data globally regarding CO_2 emissions from

[25] http://unfccc.int/resource/docs/natc/saunc1.pdf

LULUCF and because it is not the primary source of CO_2 emissions for most countries, it is often not excluded from assessments of the relative contributions of nations to global emissions. In Indonesia, however, LULUCF and peat fire contributions to CO_2 emissions are highly variable on an annual basis but typically represent more than 50% of total emissions. In 2005, LULUCF and peatland degradation contributed almost 80% of Indonesia's CO_2 emissions. Incorporating these sectors, Indonesia has been estimated to contribute a much higher percentage to global GHG emissions of around 5% (bringing their rank among the top 25 emitters closer to 4th overall) which is predicted to remain consistent through 2030 (DNPI 2010a).

As a non-Annex I country, Indonesia made no commitment under the Kyoto Protocol to reduce GHG emissions below 1990 levels by the year 2012. Between 1990 and 2007, Indonesia's CO_2 emissions from the burning of fossil fuels increased 166%. Under the Copenhagen Accord, Indonesia has pledged to reduce GHG emissions by 26% below business as usual by 2020. According to the 2011 Climate Change Performance Index which ranks the top 60 emitting countries in various factors including emissions level, emissions trend, and climate change policy, Indonesia is ranked 21st overall with a performance rating of 'moderate' (Burck *et al.* 2010). Of note, however, is that deforestation and land use, making up around 20% of global GHGs, are not included in the index either due to lack of consistent available data globally.

In 2008 via Presidential Regulation, the National Council on Climate Change (DNPI) was established to formulate national policies, strategies, programs and activities on climate change control[26]. In November 2007, the Indonesian Government published a National Action Plan on Climate Change which contains initial guidance and multi-sectoral coordination efforts to address mitigation and adaptation to climate change. In December, 2007, Bappenas (National Development Planning Agency) published a document entitled National Development Planning: Indonesia Responses to Climate Change which was revised in July 2008. In 2009, the Indonesia Climate Change Sectoral Roadmap[27] was released as a summary and synthesis of previous documents as well as a guide for future policy actions through 2029. The roadmap highlights specific policy and regulatory initiatives for both sink enhancements and emissions reduction in the transportation, energy, forestry, industry, and waste sectors.

Indonesia proposes to meet their commitment under the Copenhagen Accord via sustainable peat land management, reductions in deforestation and land degradation, carbon sequestration projects in forestry and agriculture, energy efficiency, alternative and renewable energy sources, reductions in solid and liquid waste, and shifting to low-emission transportation options (DNPI 2010b). A DNPI study has analyzed emissions and reduction potential in six sectors; it estimates Indonesia's annual GHG emissions in 2005 at 2.3 Giga tons, projects that emissions will increase an estimated 57% by 2030 if there are no changes in the way several sectors are managed, and claims that Indonesia has the potential to reduce its GHG emissions by as much as 46% below 2005 levels by 2030, with the right mixture of domestic policies and international support. This would reportedly accomplish 7% of the overall global reduction estimated to be necessary to prevent surpassing the 2°C additional warming target (DNPI 2010a).

At the September 2009 G-20 meeting in Pittsburgh, President Susilo Bambang Yudhoyono laid

[26] http://adaptasi.dnpi.go.id/index.php/main/contents/54
[27] http://csoforum.net/attachments/Synthesis%20Roadmap%20Dec09.pdf

out a vision where significant reductions would be achieved through land use, land use change and forestry (LULUCF), primarily through a 'reforestation rather than a deforestation reduction approach'. However, attempts to achieve significant emissions reductions through a plantation expansion program alone would not be feasible, as planting the number of trees needed to fully achieve emissions reduction targets would require a land area twice the size of Indonesia, even if planted on degraded lands (Verchot *et al.* 2010).

2.1.2.2.9 Brazil (1.3%)

Excluding emissions from LULUCF, Brazil currently ranks 18th in overall GHG emissions. Important to note, however, is that Brazil's estimated percentage of global GHG emissions and resulting rank reported here do not incorporate CO_2 emissions from LULUCF, for the sake of consistency. For most other countries, fossil fuel consumption in the energy sector is the primary source of CO_2 emissions. Because of the high uncertainty and lack of reliable data globally regarding CO_2 emissions from LULUCF and because it is not the primary source of CO_2 emissions for most countries, it is often excluded from assessments of contributions of individual nations to global emissions. In Brazil, however, LULUCF (primarily deforestation) contributions typically represent more than 50% of total CO_2 emissions. According to Brazil's initial National Communication to the UNFCCC, in 1994, LULUCF contributed 75% of Indonesia's CO_2 emissions and 55% of overall GHG emissions (Ministry of Science and Technology 2004). More recently, those estimates still hold true for 2005 (Cerri *et al.* 2009). Incorporating these sectors, Brazil has been estimated to contribute a much higher percentage to global emissions of around 3% (bringing their rank among the top 25 emitters closer to 7th overall).

As a non-Annex I country, Brazil made no commitment under the Kyoto Protocol to reduce GHG emissions below 1990 levels by the year 2012. Between 1990 and 2007, CO_2 emissions from the burning of fossil fuels in Brazil increased 76%. Total GHG emissions from LULUCF in Brazil are estimated to have increased 11% between 1990 and 2005. Under the Copenhagen Accord, Brazil has pledged a variety of quantified targets in various sectors that will ultimately result in an estimated reduction in GHG emissions of 36.1 to 38.9% by 2020. In 2009, Brazil announced that it had already met its target for reducing deforestation originally set for 2013 (Pimm 2009). According to the Brazilian government, after implementing the National Climate Change Action Plan, they have met their 2020 goals as of late 2010, primarily through increased enforcement leading to a large reduction in deforestation. In 2009, Brazil reduced its GHG emissions 33.6% below 2004 levels. At the U.N. climate conference in Copenhagen last year Brazil had pledged to reduce its emissions a further 5% from 2009 levels by 2020 (Colitt 2010). According to the 2011 Climate Change Performance Index which ranks the top 60 emitting countries in various factors including emissions level, emissions trend, and climate change policy, Brazil is ranked fourth overall with a performance rating of 'good'. This actually equates to the top spot out of all countries because the first three ranks are reserved for countries doing enough to reduce their GHG emissions per capita enough to meet the requirements for keeping further global temperature increase to below 2° C and no countries meet those criteria (Burck *et al.* 2010). Of note, however, is that deforestation and land use, making up around 20% of global GHGs, are also not included in the index due to lack of consistent available data globally.

Brazil released its National Climate Change Action Plan in 2008 (Government of Brazil 2008), to be implemented by the Interministerial Committee on Climate Change and its Executive

Group, established a year earlier, in collaboration with other fora and institutions such as the Brazilian Forum on Climate Change, Interministerial Commission on Global Climate Change, the III National Conference on the Environment and the State Fora on Climate Change, and civil society organizations. One of the primary objectives outlined in the plan is increasing energy efficiency. The National Energy Efficiency Policy will represent a reduction in electricity consumption of around 10% in 2030, which can avoid emissions of 30 million tons of CO_2 the same year, through increased use of solar heating, replacement of old refrigerators, replacing coal with charcoal, increasing recycling, and other agricultural projects. Renewable energy already represents a large proportion of Brazil's energy source (45.8% as of 2008) so maintaining that position is another plan objective. The plan also calls for increased use of biofuels, reduced deforestation, and dedicated scientific research on climate change and its impacts.

2.1.2.2.10 Taiwan (1.0%)

Taiwan currently ranks 23rd in overall GHG emissions. Taiwan is included in the list of top 25 GHG emitting countries, but because Taiwan lacks UN membership (due to its political relationship with mainland China), Taiwan is not a signatory party to the UNFCCC or its Kyoto protocol, and thus cannot be formally represented at the UN's annual climate conference (EPA Taiwan 2009a). However, Taiwan has and continues to show a desire and willingness to be included as a member in the UNFCCC. GHG emissions in Taiwan increased by 122% from 1990 to 2008 (EPA Taiwan 2009b). While its GHG emissions decreased for the first time between 2007 and 2008, outside factors such as the economic recession and decrease of energy consumption due to oil and electricity prices were the main factors in GHG reduction (EPA Taiwan 2007). Again, as a non-member of the UN, they are also unable to make a pledge under the Copenhagen Accord. In 2008, however, newly-elected President Ma Ying-jeou laid out an ambitious plan to cut GHG emissions, and established targets to keep emissions to the 2008 level by 2020, reducing to the 2000 level by 2025, and then to half the 2000 level by 2050 (EPA Taiwan 2009c). According to the 2011 Climate Change Performance Index which ranks the top 60 emitting countries in various factors including emissions level, emissions trend, and climate change policy, Taiwan (Chinese Taipei) is ranked 47th overall with a performance rating of 'poor' (Burck *et al.* 2010).

Taiwan's Environmental Protection Administration has been implementing a GHG inventory project since 2004. Taiwan has implemented a number of laws and actions related to GHG emission reductions[28]. In 2008, the Executive Yuan (the executive branch of the Republic of China Government) passed the draft Greenhouse Gas Reduction Act, which was then submitted to the Legislative Yuan for deliberation. Jointly developed by the government and the private sector, the Act establishes a framework to regulate GHG emissions based on emission efficiencies and new-source emissions, as well as penalties for non-compliance. The Act serves as the legal basis for developing and implementing domestic GHG emission reduction measures,. The legislative process for this Act is still in progress as of January 2011. When the Act becomes effective, an emissions permit system, inventory verification and reporting, and emission performance standards will be enforced. In 2009, Taiwan passed the Renewable Energy Act, establishing a foundation for long-term renewable energy development. This Act

[28] http://estc10.estc.tw/ghgenglish/Reduction_GHG.asp

intends to reduce GHG emissions by enhancing energy efficiency, scaling up the total amount of renewable energy over the next 20 years, and using an incentive-based purchasing mechanism to encourage renewable energy use. In addition, Taiwan's Ministry of Economic Affairs developed a Sustainable Energy Policy, which targets energy, the economy and the environment and has three specific objectives listed. Objectives include improving energy efficiency by more than 2% per annum, so that when compared with the level in 2005, energy intensity will decrease 20% by 2015, developing clean energy by increasing the share of low carbon energy in electricity generation systems from the current 40% to 55% in 2025, and building a stable energy supply system to meet economic development goals, such as 6% annual economic growth rate from 2008 to 2012, and US$30,000 per capita income by 2015.

2.1.2.2.11 Thailand (1.0%)

Currently, Thailand ranks 24th in overall GHG emissions. As a non-Annex I country, Thailand made no commitment under the Kyoto Protocol to reduce GHG emissions below 1990 levels by the year 2012. As in other parts of Asia, Thailand's CO_2 emissions per capita per year have increased in recent decades, rising approximately 170% between 1990 and 2004. Although emissions dropped following the 1997-1998 financial crisis, they continued to increase from 1999 through 2007 (Bangkok Metropolitan Administration 2010). Overall, between 1990 and 2007, Thailand's CO_2 emissions from the burning of fossil fuels increased 190%. Thailand has yet to make an official commitment under the Copenhagen Accord. According to the 2011 Climate Change Performance Index which ranks the top 60 emitting countries in various factors including emissions level, emissions trend, and climate change policy, Thailand is ranked 19th overall with a performance rating of 'moderate' (Burck *et al.* 2010).

Thailand's climate strategy includes taking advantage of the Clean Development Mechanism under the Kyoto Protocol (Ministry of the Environment, Japan 2006). In 2003, the Ministry of Natural Resources and Environment was named the designated national authority in matters pertaining to Clean Development Mechanism projects. The Office of Natural Resources and Environmental Policy[29] is the designated national authority Secretariat and the national focal point for UNFCCC. The National Climate Committee provides overall policy direction. The Office of Natural Resources and Environmental Policy has drawn up the national sustainable development criteria and indicators and Clean Development Mechanism approval procedures. Thailand has already registered 17 Clean Development Mechanism projects. In August 2006, the Government of Thailand set up a National Board on Climate Change Policy, Climate Change Coordinating Office under the Office of Natural Resources and Environment, and Thailand Greenhouse Gas Management Organization[30] to supervise Clean Development Mechanism implementation in Thailand (Ministry of the Environment, Japan 2006).

The government also developed various Action Plans and strategies to deal with climate change in different sectors of the government. Its first National Strategy on Climate Change (2008-2012) was released in 2006. Thailand's 10th five year economic development plan (2007-2011) focuses on the "self-sufficiency economy" and briefly incorporates the National Climate Action Plan which sets a target of CO_2 emissions reduction of 5% from 2003. Thailand presented its

[29] http://www.onep.go.th/cdm/
[30] http://www.tgo.or.th/english/index.php?option=com_content&task=section&id=6&Itemid=30

Initial National Communication to the UNFCCC in 2000 which summarized available mitigation options including improvement of energy efficiency, renewable energy sources, reforestation, and agriculture waste treatment (Office of Environmental Planning and Policy 2000). The Bangkok Metropolitan Administration developed an Action Plan on Global Warming Mitigation 2007 – 2012 which is intended to reduce GHG emissions by at least 15% of those anticipated in the year 2012 under a business as usual scenario. The Ministry of Energy developed an Alternative Energy Development Plan (2008 – 2022) to serve as a roadmap to promote alternative energy use by increasing the share of commercial alternative energy from 0.5% in the year 2003 to 20% of total country final energy demand in the year 2022. For the most part, these plans focus on promotion of renewable energy and energy conservation as important strategies that will enable the country to achieve its aim of energy security and reduction of dependence on imported fuels. Because the highest GHG emitting sector is the electricity sector (Limmeechokchai and Suksuntornsiri 2006), principle mitigation strategies include energy efficiency, renewable energy and cleaner technology, urban green space, eco-buildings, mass transport infrastructure, and reduced emissions from industrial processes. Goals for institutional capacity building and international cooperation are also commonly included.

In April 2008 the Government announced new energy conservation measures aimed at saving around $50 billion per year in energy bills including things like interest free household loans for energy saving appliances, incentives to retrofit industry for energy conservation, mandatory power usage labeling for manufacturers of electric and electronic appliances, compulsory energy saving features to be included in design of new buildings, and energy standards for commerce and industry.

After the 2009 climate talks in Copenhagen, the Royal Thai Government, in partnership with the Thai Working Group for Climate Justice and the United Nations in Thailand, held a major development cooperation seminar entitled “Beyond Copenhagen: Implementing Thailand’s Climate Change Strategy.” Over 150 representatives from government, civil society, local communities, international organizations, academia, the private sector and the media, came together to debate the outcome of the COP 15 Conference and its implications for Thailand, and how best to ensure that the general public is better informed and more closely involved in future climate change policy planning and implementation (IANS 2010).

2.1.2.2.12 Kazakhstan (0.8%)

Currently, Kazakhstan ranks 25th in overall GHG emissions. Kazakhstan’s first National Communication to the UNFCC (1998) announced that it was prepared to join Annex I and take on a quantified GHG emissions reduction target. Upon entry into force of the Kyoto Protocol, it became an Annex I Party under the Protocol, although remains a non-Annex I party under the UNFCCC. As this declaration had not been made when the Protocol was adopted, Kazakhstan does not have an established emissions reduction target under the Kyoto agreement. Nevertheless, in its Second National Communication to the UNFCCC in 2009, Kazakhstan notes that it has undertaken annual GHG inventories since 2001 and analyzes emissions from 1990, 1992, 1994, and 1998 – 2005 and states it is working toward a voluntary target of 15% below 1992 levels of GHG emissions under the Copenhagen Accord. Kazakhstan’s GHG emissions showed a steady decline through the 1990s due to the reduction of livestock animals, size of agricultural lands and amount of mineral fertilizers. This trend changed following the reorganization of the agricultural sector in 2000, with GHG emissions in 2005 exceeding the

2000 level by one third (Government of Kazakhstan 2009)[31]. Despite annual growth in GHG emissions since 1999, emissions through 2005 still remained below the 1992 Kyoto baseline year levels. Overall, between 1990 and 2007, Kazakhstan's CO_2 emissions from the burning of fossil fuels have dropped 23% (down 13% from their base year 1992 levels). According to the 2011 Climate Change Performance Index which ranks the top 60 emitting countries in various factors including emissions level, emissions trend, and climate change policy, Kazakhstan is ranked 59th overall, ahead only of Saudi Arabia, with a performance rating of 'very poor,' primarily due to its high relative emissions level (Burck *et al.* 2010).

In Kazakhstan, the Ministry of Natural Resources and Environment is the lead on climate issues and the Climate Change Coordination Center is a quasi-governmental institute under its auspices. The Interagency Commission on Ratification of the Kyoto Protocol and Implementation of obligations under the UNFCCC was established in 2000 and oversees climate policies in the context of international agreements. Thirteen key sources of emissions were identified in 2009, seven of which comprise the 'energy activity' category. A primary source of GHG emissions is energy (fuel combustion) amounting for 72% in 2005. The second contributor is agriculture, the proportion of which has reduced from 15% in 1990 to 9% in 2005 (Government of Kazakhstan 2009). As such, Kazakhstan's primary climate change related policies are geared toward the energy sector and increasing energy efficiency. Its main policy came into effect in 1997 and more recently the government is focusing on an energy saving program for 2005-2015. In particular, they plan to focus on increasing renewable energy sources like wind, hydroelectric, solar, and geothermal power. As of 2009, three projects to restore or build new hydroelectric power stations were underway. Wind electrical station legislation is being coordinated which, along with hydro-power, is expected to increase electrical energy output from renewable sources to 5% by 2024. It is also acknowledged that to reduce GHG emissions, the country will have to move away from a large emphasis on agriculture and toward a more modernized industry.

Kazakhstan estimates that, if renewable energy policies and measures are implemented effectively, the total reduction of GHG emissions relative to the baseline scenario could amount to more than 31 million tons of CO_2 by 2016 and 72 million tons by 2024 (Government of Kazakhstan 2009). They acknowledge, however, that the future scenario including increased use of renewable energy sources will require substantial financial investment, a source for which they have yet to identify.

2.1.3 Summary of Regulatory Mechanisms Addressing GHG Emissions

The Montreal Protocol has been contributing to the reduction of global GHG emissions since 1989. By phasing out ozone depleting substances (ODS), the world has avoided the equivalent of 135 Gt CO_2 between 1990 and 2010, and that is thought to have effectively slowed the rate of warming and other climate change impacts by 7 to 12 years, as compared to what would have happened under the continued use of ODS. As of 2010, net emissions reductions from ODSs are ~11 Gt CO_2 eq. per year, and that is 5-6 times the reduction target of the first commitment period of the Kyoto Protocol (2 Gt CO_2 eq. per year) (Velders *et al.* 2007; see Figure 2). This progress, however, is threatened by the rapidly increasing use of hydrofluorocarbons (HFCs) and continued use of HCFCs as replacements for the ODSs that have been phased out. The Protocol

[31] Although EIA estimates 2005 levels are 17.5% higher than 2000 and 2006 levels are closer to one third higher at a 28% increase (EIA 2009).

recognizes HCFCs as transitional substitutes for CFCs being phased out that will eventually be phased out. In September 2007, the parties agreed to an accelerated phase-out of HCFCs under the Montreal Protocol (UNEP 2007).

HFCs, commonly used to replace CFCs, are not covered by the Montreal Protocol as they are not ozone depleting substances and their consumption is projected to increase rapidly over the next few decades without regulation, particularly in developing countries (Velders *et al.* 2009). HFCs range from 140 to over 11,000 in global warming potential (GWP)[32] and so are considered a suite of "super" greenhouse gases. While HFCs are included under the Kyoto Protocol, the issue remains that the rapid growth in HFC consumption in non-Annex I countries will not be addressed via Kyoto because non-Annex I Parties do not have emissions reduction targets. Recent developments among parties to the Montreal Protocol have included discussions of expanding its scope to incorporate more of a climate related purpose and negotiating agreements to phase-out the use of HFCs (Sustainable Business.com News 2010; Broder 2010). The Federated States of Micronesia has been promoting this approach for the past four years. In 2010, the U.S., Canada, and Mexico showed support by submitting a proposal to the rest of the Parties proposing a phase-out schedule for HFCs by which developed countries would reduce production and consumption to 15% of current levels before 2035 and developing countries would match that reduction by 2045 (UNEP 2010b). The EPA estimates adopting this phase out schedule could eliminate 3.1 Gt CO_2 eq. by 2020 and 88 Gt CO_2 eq by 2050, and slow global warming by another decade. Velders *et al.* (2009) propose an estimate of direct effect in the range of 110 – 170 Gt CO_2 eq. by 2050 (see Figure 2). The 22nd meeting of the Parties to the Montreal Protocol took place in Bangkok, Thailand, November 8-12, 2010. During discussions of the proposal to include HFC phase-out under the Montreal Protocol, Brazil, India and China voiced their opposition, stating that HFCs are not ODSs and are therefore outside the purview of the Protocol. Other Parties were also hesitant to make decisions on a GHG at these talks and suggested tabling the issue as it would be addressed in December 2010 in Cancun, Mexico at the next round of UNFCCC climate talks (IISD 2010). No formal decision was adopted by the Meeting of the Parties.

[32] The concept of a global warming potential (GWP) was developed to compare the ability of each greenhouse gas to trap heat in the atmosphere relative to another gas. The definition of a GWP for a particular greenhouse gas is the ratio of heat trapped by one unit mass of the greenhouse gas to that of one unit mass of CO_2 over a specified time period; typically 100 years is used. (http://www.epa.gov/highgwp1/scientific.html)

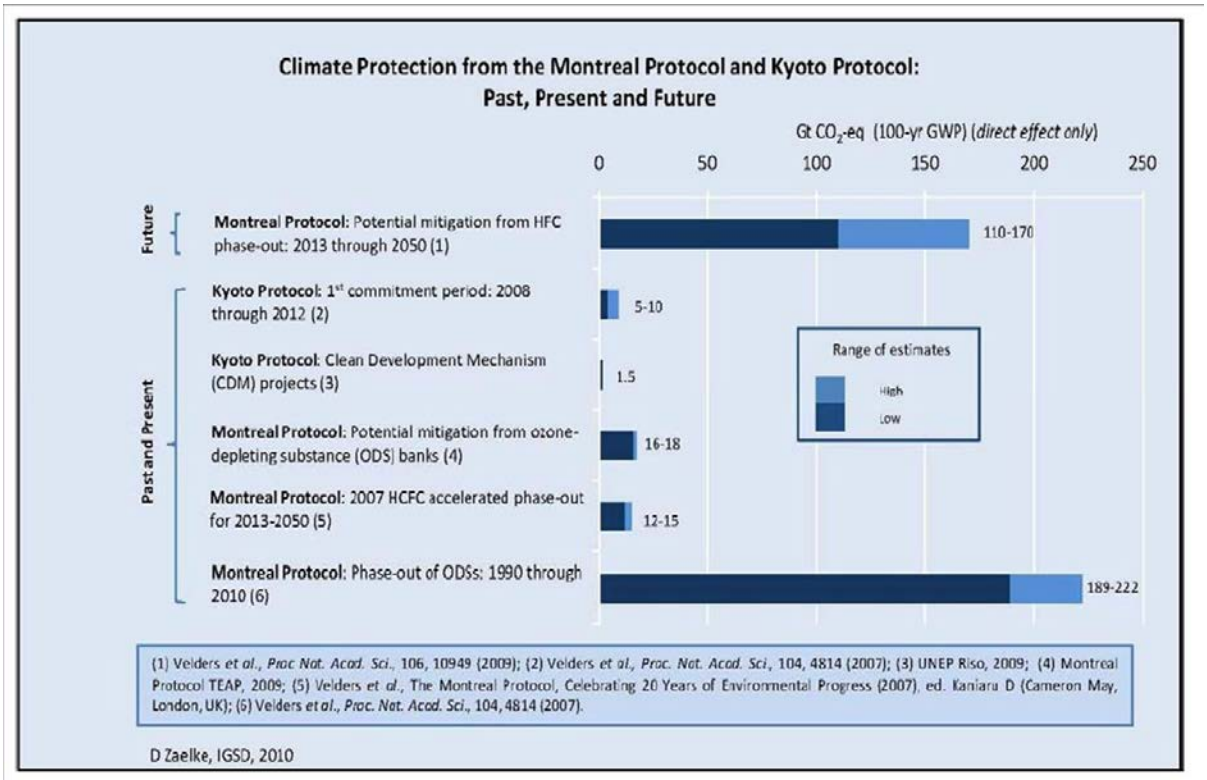

Figure 2. From: Summary of Federated States of Micronesia 2010 Proposal to Strengthen Climate Protection Under the Montreal Protocol presented to the 22nd Meeting of the Parties (MOP-22) of the Montreal Protocol in Bangkok, Thailand November 2010.

Although the UNFCCC was a widely supported effort with a large number of signatories, the Convention originally called for voluntary action to reduce emissions of GHG to 1990 levels by 2000. Although many Annex I countries met this goal individually, globally, GHG emissions grew well above 1990 levels by 2000. In 2009, global GHG emissions had increased 25% since 2000 and almost 40% since 1990 (Olivier and Peters 2010; Global Carbon Project 2010a) (See Table 3). Without the introduction of new laws and policies to reduce GHG emissions or changes to the existing ones, total world GHG emissions are projected to increase to 97% above 1990 levels by 2035 (EIA 2010).

The Kyoto Protocol to the Convention is the first legally binding agreement intended to continue global progress in reducing GHG emissions. It is stronger than the original terms of the UNFCCC in that it is a legally binding agreement that sets specific ceilings on GHG emissions for individual countries. However, the top three contributors to global GHG emissions (China, the U.S., and India; accounting for ~ 48% of global GHG emissions) have not established official reduction targets under Kyoto. The United States has signed but has not ratified the Protocol. Instead, when they signed the Protocol in 1998, the U.S. pledged a voluntary GHG emission reduction target of 7% below 1990 levels by 2012, although as of 2010, emissions have grown in the U.S. to 10.5% above 1990 levels. India and China are non-Annex I countries and are not required to establish reduction targets under Kyoto. Collectively, participating Annex I countries reduced CO_2 emissions in 2009 by about 7%. Assuming that the non-CO_2 greenhouse gas emissions show a similar trend, total 2009 emissions of Annex I countries are about 6% lower than in 1990 (10% lower including LULUCF), the base year for the Protocol (Olivier and Peters,

2010), indicating the world is on track to meet the individual obligations at the national level set forth under Kyoto. However, this recent trend in CO_2 emission reductions for Annex I countries does not necessarily translate into a reduction of the rate of global warming or in overall global emissions for several reasons. First, in many cases, the driver of reduced GHG emissions has not been policy change for long-term stability or infrastructure changes including conversion to cleaner energy sources; rather, a large part of the decrease is due to a freeze or drop in economic activity in response to the recent global economic recession and the associated unavailability of credit. Greenhouse gas emissions could rapidly increase toward pre-recession levels as industrialized countries grow out of recession (Olivier and Peters, 2010). Secondly, overall there was no reduction in global GHG emissions in 2009 because emissions in India and China increased at a high enough rate (6% and 9% respectively) to nullify reductions made by Annex I countries (Olivier and Peters 2010). While the targets outlined in Kyoto provided a good foundation for future negotiations for further reductions in GHG emissions, not including commitments for non-Annex I countries that contribute a large portion of global emissions limited the potential effectiveness of the Kyoto Protocol in actually reducing the rate of global climate warming. .

The Copenhagen Summit was expected to produce a subsequent agreement to the Kyoto Protocol defining GHG emissions reduction targets beyond 2012. While no agreement was universally adopted, the Copenhagen Accord was developed and recognized the importance of keeping global warming capped at a 2°C increase above pre-industrial levels. There has been widespread participation by countries making pledges for GHG emissions reduction targets under the Copenhagen Accord, which are intended to meet the 2°C target in aggregate. The 2°C target is described as the maximum allowable warming to avoid dangerous anthropogenic interference in the climate in terms of disruptions in economic, social, political, and biological systems on a global scale. The target has both supporters and critics who argue that it is infeasible, expensive, and an inappropriate way to frame climate policy (Randalls 2010). Nevertheless, UNFCCC member countries have agreed upon this target.

Table 3. Summary of Top 25 GHG emitters: Emissions reduction commitments, progress, and emissions trends since 1990.

Country	% of Total Global Emissions (in 2007, ex. LULUCF)[1]	Kyoto Commitment (change relative to 1990 levels by 2012)	Change in GHG emissions 1990-(most recent year available) (ex. LULUCF)[2]	Copenhagen Commitment (change by 2020 relative to (base year))
Annex I:				
U.S.	19.9%	-7%[3]	+10.5% (2010)	-17% (2005)
Russian Fed.	5.2%	0%	-34.1% (2008)	-15 – 25% (1990)
Japan	4.3%	-6%	+1% (2008)	-25% (1990)
Germany	2.7%	-21%	-21.4% (2008)	-20 – 30% (1990)[4]
Canada	1.9%	-6%	+24.1% (2008)	-17% (2005)
U.K.	1.8%	-12.5%	-16.9% (2008)	-20 – 30% (1990)[4]
Italy	1.6%	-6.5%	+6.9% (2008)	-20 – 30% (1990)[4]
Australia	1.3%	+8%	+29.4% (2008)	-5% - 25% (2000)
France	1.3%	0%	-5.6% (2008)	-20 – 30% (1990)[4]
Spain	1.2%	+15%	+42.5% (2008)	-20 – 30% (1990)[4]
Ukraine	1.1%	0%	-53.9% (2008)	-20% (1990)
Poland	1.1%	-6%	-29.6% (2008)	-20 – 30% (1990)[4]
Turkey	1.0%	none yet[5]	+103.2% (2008)	none
	Total: 44.4%	**Average Commitment: -7%**	**-6.1% [ex. LULUCF] (2008)[6]**	**Aggregate: -12 - 18% (1990)[7]**
Non-Annex I:				
China	22.3%	N/A	+ 165% (2007)	-40 - 45% (2005)[8]
India	5.5%	N/A	+133% (2007)	-20 – 25% (2005)[8]
Iran	1.7%	N/A	+118% (2007)	none
South Korea	1.7%	N/A	+108% (2007)	-30% (BAU)[9]
Mexico	1.6%	N/A	+32% (2007)	-30% (BAU)[9]
South Africa	1.5%	N/A	+30% (2007)	-34% (BAU)[9]
Saudi Arabia	1.4%	N/A	+87% (2007)	none
Indonesia	1.4% (~5%)[10]	N/A	+166% (2007)	-26% (BAU)[9]
Brazil	1.3% (~3%)[10]	N/A	+76% (2007)	-36 - 39% (BAU)[9]
Taiwan[11]	1.1%	N/A	N/A	N/A
Thailand	1.0%	N/A	+190% (2007)	none
Kazakhstan	0.8%	N/A[12]	-23% (2007)	-15% (1992)
	Total: 41.3%	N/A		N/A[14]
Global Totals:	**85.7%**		**World: +49% (2010)[13]**	

[1] Data from World Bank via Google Public Data. http://www.google.com/publicdata/overview?ds=d5bncppjof8f9_.
[2] Data for Annex I countries are from their 2010 Annual GHG Inventory submissions to UNFCCC, except the U.S. which came from the EPA: http://www.epa.gov/climatechange/ghgemissions/usinventoryreport.html. Data for Non-Annex I countries are from World Bank via Google Public Data.
[3] The US is a signatory to Kyoto but has not ratified therefore has made no official pledge under the Protocol. The US instead made a voluntary pledge to reduce GHG emissions to 7% below 1990 levels by 2000.

[4] The European Union as a whole has pledged a 20-30% reduction below 1990 levels, to be accomplished by varied reductions among different member countries.
[5] Annex I countries that were not UNFCCC parties at the time of signing the Kyoto Protocol have no reduction target assigned.
[6] Source: http://unfccc.int/resource/docs/2010/sbi/eng/18.pdf.
[7] Source: den Elzen and Hohne 2008.
[8] Reductions in Emissions Intensity (emissions per unit of GDP), not overall emissions.
[9] Expected reduction below projected 2020 emissions under the "Business As Usual" (BAU) scenario.
[10] Because the majority of GHG emissions in Brazil and Indonesia are from the LULUCF sector which contributes minimally to most other countries, including these data for Brazil and Indonesia substantially changes their overall % contributions to global emissions and rank within the top 25 emitters.
[11] Although Taiwan wants to become a UNFCCC Party, they have thus far been precluded from doing so because of their political relationship with China. Therefore, emissions estimates are unavailable and pledges cannot be made under Kyoto or Copenhagen.
[12]Kazakhstan is a Party included in Annex I for the purposes of the Kyoto Protocol in accordance with Article 1, paragraph 7, of the Protocol, but Kazakhstan is not a Party included in Annex I for the purposes of the Convention
[13] Sources: Global Carbon Project Carbon Budget 2010. Released Dec. 5 2011 (http://www.globalcarbonproject.org/carbonbudget/index.htm).
[14]In contrast to the relatively precise pledges of developed countries under the Copenhagen Accord, developing countries specify their mitigation actions, labeled as Nationally Appropriate Mitigation Actions (NAMAs), in a variety of ways, making it difficult to determine an aggregate reduction target for this group (Rogelj *et al.* 2010).

The Climate Change Performance Index (Burck *et al.* 2010) evaluates and compares the climate protection performance of the top 60 GHG emitting countries that are together responsible for more than 90% of global energy-related CO_2 emissions. Performance rankings are based on an index including emissions level, emissions trend, and national and international climate change policy in each country. Each year, the top three ranks are reserved for countries that have reduced per capita emissions enough to meet the requirements to keep the increase in global temperature below 2°C. According to the 2011 report, no countries are meeting those criteria. Importantly, the performance of the top 10 emitters that account for over 60% of global emissions is of particular concern as all but three of them are ranked as either 'poor' or 'very poor' in overall performance (Burck *et al.* 2010). Among participants in the Copenhagen agreement, a common theme among non-Annex I party pledges is that they contain ambitious goals but are dependent upon external funding and contingent upon what developed countries pledge to accomplish. In particular, the U.S. and China both contribute the largest proportions to global emissions and both have 'very poor' ranks in the 2011 Climate Change Performance Index (See Figure 4).

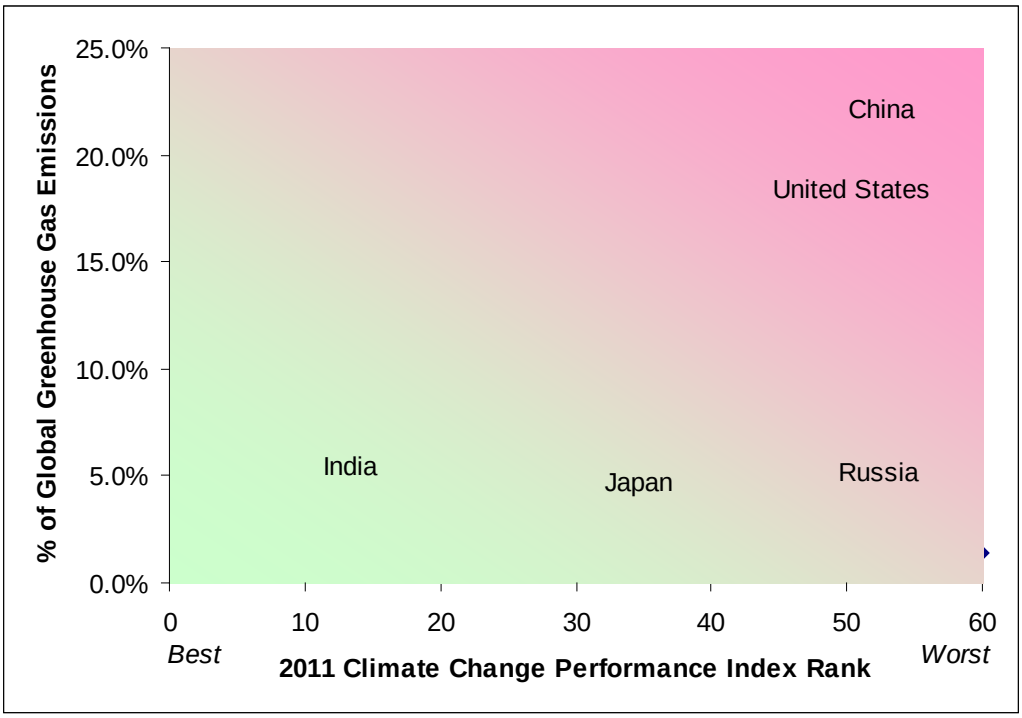

Figure 4. This figure is a qualitative illustration of which countries have the most potential to increase their positive impact on GHG reduction globally. The Climate Change Performance Index ranks the top 60 emitting countries in various factors including emissions level, emissions trend, and climate change policy annually. The United States and China are the top two GHG emitters and were both ranked in the 'very poor' category in the 2011 CCPI.

2.2 Regulatory Mechanisms Addressing Local threats

As described in the BRT Report and summarized in Section 1.2.1.2, local threats to the 82 corals in general include the trophic effects of fishing (i.e., herbivore removal), land-based pollutants (especially sediments and nutrients), sea-level rise, and a wide variety of local threats. These local threats are typically addressed directly or indirectly by existing regulatory mechanisms at the national level such as national fisheries, coastal, and watershed management laws and regulations. Thus, existing regulatory mechanisms addressing the local threats are assessed below at the national level for the 84 countries across which the 82 candidate coral species occur, first in the Caribbean (Section 2.2.1), then in the Indo-Pacific (Section 2.2.2). Relevant international regulatory mechanisms, such as international conventions to protect coral reefs, are also described (Section 2.2.3).

2.2.1 National Regulatory Mechanisms - Caribbean (26 countries)

Of the 82 coral species, 7 species occur in the Caribbean. These 7 species are found in the waters of 26 countries (Figure 1, Table 1). Within this region, the Bahamas and Cuba have the largest reef areas (each with about 1 percent of the world's total), according to the 2001 Coral Reef Atlas's Coral Reef Area Statistics[33]. For each of the countries within the Caribbean, environmental laws that regulate fishing of reef fish, coastal development, land use (to control sedimentation onto reefs), and/or that protect corals and coral reefs in other various ways were

[33] http://coral.unep.ch/atlaspr.htm

summarized and described if available. Descriptions of relevant marine protected areas (MPAs) that may include and/or benefit corals and coral reefs are also included in each country account if present. Ten of the Caribbean countries described in the following section have Pacific coastlines and thus will also be included in the Indo-Pacific countries section.

There is considerable variation in relevant management actions throughout the 26 countries within the Caribbean region. While many Caribbean countries have enacted some sort of coral conservation program/regulation, most proactive coral initiatives/efforts in the region are small-scale with, at best, localized effects. Further, many of these efforts are ongoing only at specific locations and are thus not being implemented nation-wide (*Acropora* Biological Review Team 2005).

2.2.1.1 Antigua and Barbuda

Antigua and Barbuda's coastal areas are home to large bank reefs, patch reefs and fringing reefs totaling approximately 180 sq km. The biggest threats to the reefs of Antigua and Barbuda include over-fishing, coastal development, marine-based pollution, sedimentation, and natural disasters such as hurricanes (Burke and Maidens 2004). In 2004, the government drafted the Fisheries Act which promotes sustainable development and responsible management of fisheries and aquaculture activities under the premise of the "precautionary principle." Corals are protected under this law under the definition of "fisheries." Within the fisheries regulations, taking of any corals requires written permission from the Chief Fisheries Officer (Antigua and Barbuda Fisheries Regulations 2004). There are 3 established marine reserves including Cades Bay Marine Reserve est. 1999, Diamond Reef Marine Park est. 1973, and Palaster Reef Marine Park est. 1973. While these marine reserves are nationally recognized and fall under the responsibility of the Fisheries Division, marine reserves of Antigua and Barbuda are not actively managed, nor do they have any management objectives or plans (Geoghegan et al. 2001).

2.2.1.2 Bahamas

The islands of the Bahamas consist of over 700 low-lying islands extending 50 miles east of Florida and 50 miles northeast of Cuba. The Bahamas have extensive fringing reefs on the windward side of the islands as well as patch reefs. Providing the largest body of coral reef in the Atlantic/Caribbean region, the Bahamas' reefs cover an estimated area of 10,000 sq km. The Bahamas's reefs are some of the least threatened in the Caribbean region, with approximately 30% of sub-regions threatened by overfishing (the only identified threat for most regions) (Burke and Maidens 2004). Corals within Bahamian waters are protected under 2 main pieces of legislation. The Fisheries Resources Regulations of 1986 bans the collection of corals as well as the exportation of marine products by non-Bahamians. Additionally, they prohibit destructive fishing practices such as the use of bleach, poisons or explosives. The Bahamas National Trust Act of 1959 bans take of fish, turtle, crawfish, conch, and welks in national parks; or destruction or removal of any animals, including coral, and bans removal of sand in national parks.

In 1958 the Exuma Cays Land and Sea Park was established. It is composed of 45,584 ha of small islands and marine areas in the central Bahamas. The park encompasses a 35-km long section of the northern Exuma Cays and was designated a no-fishing zone in 1986, making it the first no-take marine reserve in the wider Caribbean. Coral damage is reported from diving and fishing activities, as well as the use of chlorine bleach for fish collecting. Mooring buoys have

been installed at some of the more popular dive sites to minimize anchor damage both inside and outside of the park (Acropora Biological Review Team 2005).

In 2000, The Bahamian government made a policy decision to protect 20 percent of the Bahamian marine ecosystem, which led to the creation of 10 new national parks in 2002. Strong management of national parks falls under the Bahamas National Trust; however adequate funding, staffing and equipment remain an issue.

2.2.1.3 Barbados

Barbados is the most easterly island in the Eastern Caribbean and has a approximately 90 km² total reef area. The highest estimated threats to corals in Barbados are coastal development and fishing pressure. There is currently only 1 legislated marine reserve on the island: the Barbados Folkestone Park and Marine Reserve[34], although it is estimated that only 6% of Barbados reefs are within the Reserve (Burke and Maidens 2004). The reserve was established in 1981 via the Designation of Restricted Areas Order and the Marine Areas under the Preservation and Enhancement Act of 1976[35] (the Barbados Marine Reserve Regulation). The reserve is a no-take zone that covers approximately 11% of the west coast of Barbados (2.1 sq km) and has 4 different zoning designations (scientific, northern water sports zone, recreational, southern water sports zone). The reserve is actively managed by the National Conservation Commission with enforcement support from the Marine Police and Coast Guard (National Conservation Commission 2011).

Important legislation directly affecting Barbados' coral reefs also includes the Coastal Management Act of 1998, the Marine Pollution Control Act of 2000, and the Fisheries Act of 1995. The Marine Areas (Preservation and Enhancement Act) defines management of marine reserves and establishes the Folkestone Park & Marine Reserve in 1981. The Coastal Management Act provides for the establishment of restricted marine areas, their standards for management, as well as standards for water quality and activities that may affect marine habitats. The Marine Pollution Control Act aims to prevent, reduce and control pollution of the marine environment of Barbados by prohibiting the release of any pollutants into the waters. Finally, the Fisheries Act establishes development and management regulations for all fisheries (including corals) (Coastal Zone Management Unit of Barbados 2011).

2.2.1.4 Belize

The largest continuous reef system in the western Atlantic extends 250 km along the entire length of the Belizean coast. The biggest identified threats to Belize's reefs are sedimentation and pollution from land-based sources (Burke and Maidens 2004).

The Belize Barrier Reef Reserve System is composed of seven marine reserves, national monuments and national parks, all established between 1977 and 1996. They include Bacalar Chico National Park and Marine Reserve (10,700 ha), Blue Hole Natural Monument (4,100ha), Half Moon Caye Natural Monument (3,900 ha), South Water Caye Marine Reserve (29,800 ha), Glover's Reef Marine Reserve (30,800 ha), Laughing Bird Caye National Park (4,300 ha), and

[34] http://www.coastal.gov.bb/pageselect.cfm?page=17
[35] http://www.coastal.gov.bb/category.cfm?category=5

Sapodilla Cays Marine Reserve (12,700 ha). The Reserve System is located within the Belize Barrier Reef Complex, which is located only a few hundred meters offshore in northern Ambergris Caye, to about 40 km offshore in the south. The barrier reef presents a zonation pattern which seems to be similar to that described for other reefs in the Caribbean. In the north, the barrier reef touches the shoreline at Rocky Point, maybe one of the few sites in the world where a major barrier reef meets a coast. Outside the barrier reef, there are three large atolls: Turneffe Islands (33,000 ha), Lighthouse (12,600 ha) and Glover's Reef (13,200 ha). These areas are moderately protected under the National Protected Areas System Plan Program for Belize (1995) (Acropora Biological Review Team 2005).

Hol Chan Marine Park (ca. 1986) is a managed nature reserve located on the south tip of Ambergris Cay, Belize. The park is a 311 ha reef area with associated seagrass beds, and approximately 100 ha of mangrove cays. The site covers a continuum of environments from mangrove cays to lagoon through the Hol Chan Channel, then over the back reef to the reef crest, and then for 1.2km out past the fore reef towards the deep sea. Fisheries Ordinance Section 9 (A) (1977) and the Wildlife Protection Act (No. 4 1981) relate to this area. Designation has been proposed to prevent overfishing in the area and to help maintain the coral reef ecosystem and enhance tourist attraction (Acropora Biological Review Team 2005).

2.2.1.5 Colombia

Caribbean Colombia has approximately 2,000 sq km of reef area of which approximately two thirds is located in the San Andres and Providencia Archipelago (which is located more than 700 km from the Colombian coast). According to the Reefs at Risk Caribbean analysis, sedimentation is a prevalent stressor to coral reefs in Colombia, threatening all but a few reefs around some small coastal islands. This is predominantly due to extensive deforestation and poor agricultural practices in inland watersheds increasing runoff and erosion. Additionally, on populated islands, overfishing and coastal development are the main threats to reefs (Burke and Maidens 2004). The Indo-Pacific portion of Colombia is covered in Section 2.2.2.

CORALINA is a public cooperation that was established under Article 37. CORALINA has its own autonomy for administration and its jurisdiction totally encompasses the archipelago of San Andres, Providencia and Santa Catalina in the southwestern part of the Caribbean, off the continental shelf of Nicaragua and Honduras. The mission of CORALINA is to protect and recover natural resources by applying appropriate technologies and furthering community involvement in coastal development. CORALINA used its authorities to establish the Seaflower Biosphere Reserve.

Seaflower Biosphere Reserve (2000) is approximately 300,000 km2 of marine area and includes offshore islands of the archipelagos of San Bernardo and Rosario and the oceanic archipelago of San Andrés and Providencia. Tayrona National Natural Park, in the central part of the northern coast of Colombia provides limited protection for corals (Acropora Biological Review Team 2005).

2.2.1.6 Costa Rica

Costa Rica contains approximately 30 sq km of coral reefs that are situated along the southern region of Costa Rica's Caribbean coast (the Indo-Pacific portion of Costa Rica is covered in Section 2.2.2). The biggest threat to Costa Rica's reefs is sedimentation and pollution from

inland sources (Burke and Maidens 2004). The Costa Rican government lacks any specific policy regarding coral reefs (Cajiao- Jiménez 2003 in Cortes et al. 2009). Costa Rican law prohibits collection of corals or live rock within protected areas; however, artisanal fishing is still active in some cases due to local social problems, and in others due to lack of control. Tourism activities are regulated at Parque Nacional Cahuita, but not in other areas (Cortes et al. 2009). There are two protected areas of reef on the Caribbean coast of Costa Rica. Gandoca-Manzanillo Ramsar Site (1995) contains approximately 4,436 ha of marine habitats, including well-developed and relatively undisturbed coral reefs. These reefs have higher coral species diversity than other Costa Rican reefs. Management recommendations for this site include a ban on coral extraction and stringent fishing regulations. In addition, Cahuita National Park was established in 1970 to protect one of Costa Rica's only coral reefs on the Caribbean coast; this park includes beaches, mangroves, forests, marsh and 240 ha of adjacent coral reef (Acropora Biological Review Team 2005). "A decree banning the extraction of corals and other reef organisms in Costa Rican waters was drafted and submitted in September 2005 but has not yet been signed" (Cortes et al. 2009).

2.2.1.7 Cuba

Cuba has about 1 percent of the world's total coral reef area. In the Reefs at Risk Caribbean analysis, more than two-thirds of Cuba's reefs were ranked as threatened, with over 35 percent at high threat. The main threat to Cuba's reefs is overfishing, with over 65 percent of the reefs considered to be threatened (Burke and Maidens 2004). Information on Cuban environmental laws that regulate fishing of reef fish, land use (to control sedimentation onto reefs), and/or that protect corals and coral reefs in other various ways is not readily available. However, Cuba has large MPAs with significant coral reef resources: Buenavista Biosphere Reserve (2000) in north central Cuba covers 313,502 ha (58,099 ha core marine area), and is made up of 11 core areas including National Parks, Ecological Reserves, Outstanding Natural Elements, Faunal Refuges, and Protected Areas. Protection for corals varies by protected area status and mandate. The Cienaga de Zapata Biosphere Reserve (2000) in southwestern Cuba is 624,354 ha (28,700 ha core marine area) and contains some of the best-preserved coral reefs in Cuba. The Cuchillas del Toa Biosphere Reserve (1987) in northeastern Cuba is 208,305 ha in area and has a marine core area of 2,642 ha that includes coral reefs, although with high rainfall and many rivers, they are of doubtful significance to corals. The Peninsula de Guanahacabibes Biosphere Reserve (1987) at the west end of Cuba (119,189 ha, 16,400 ha core marine area) contains some of the best-conserved coral reefs in Cuba. All of the biosphere reserves in Cuba have management programs in place to preserve natural resources. Most marine portions of these reserves are located in the core areas, which provides them with the highest level of protection found in a biosphere reserve. However, the degree of protection depends on human resources that are extremely variable across the country (Acropora Biological Review Team 2005).

2.2.1.8 Dominica

Reef development on the island of Dominica is limited; however, in a few locations, coral veneers on rocks are highly developed and provide desirable dive sites. Approximately all 70 sq km of the coral reefs in Dominica are threatened by human activities: particularly overfishing, coastal development, and sedimentation and pollution from land-based sources (Burke and Maidens 2004).

There are a total of 3 marine reserves in Dominica, only 2 of which are legislated. Marine reserves established under the Fisheries Act are meant to be "no take" zones where fishing and/or taking or destruction of any marine flora/fauna is strictly prohibited (Dominica Fisheries Act 1987).

The Soufriere Scott's Head Marine Reserve was established in 2000/2001 via Fisheries Act #11 of 1987 and the Statutory Rules and Orders (SRO) #18 of 1998. The reserve is actively managed by the Local Area Management Authority with funding from the implementation of user fees. Management mechanisms include permanent mooring buoy systems and zoning plans. Prohibited activities in the marine reserve include:

- Spear-fishing
- Jet skiing/water skiing in reserve
- Undertake scuba diving or snorkeling without special permit issued by Chief Fisheries Officer
- Moor, anchor or take any vessel into the reserve without permission to do so
- Dispose of or dump any debris or pollutants into reserve
- Cause any pollutant to be released in the reserve (Dominica Fisheries (Marine Reserve) Regulations 2001).

Cabrits Marine Reserve was established in 1987 via the National Parks and Protected Areas Act of 1975. Management of the Cabrits Marine Reserve falls under the Forestry Department with objectives of conserving and protecting marine resources (including corals). The Cabrits Marine Reserve is not actively managed (Geoghegan *et al.* 2001) (with the exception of the permanent mooring system for yachts).

2.2.1.9 Dominican Republic

The Dominican Republic makes up the eastern half of the island of Hispaniola and has fringing and barrier reefs scattered along 170 km of its coastline. The reefs of the Dominican Republic are relied heavily upon for sustenance due to widespread unemployment, densely populated coastal zones, and easy access (Burke and Maidens 2004).

Most of the activities related to non-sustainable fishing practices, as well as industrial, agricultural and rural development, have been either prohibited or regulated by the recently promulgated Environmental Law 64/00 and several Presidential Decrees. Nevertheless the marine ecosystems management is not receiving the sufficient financial and political support needed to support and implement the mandates, policies, enforcement and education. Marine areas under national protection found in the Dominican Republic include Parque Nacional Montecristi, Parque Nacional del Este, and Parque Nacional Jaragua (Acropora Biological Review Team 2005).

2.2.1.10 France

The following group of Caribbean French colonies is commonly referred to as the French West Indies or French Antilles, and includes Guadeloupe, Martinique, St. Barthelemy, and St. Martin (French territories in the Indo-Pacific are covered in Section 2.2.2). Under French law, leatherback turtles, lobsters and corals are all protected under legislation no. 79-6, AD/3/3 of April 1979.

Guadeloupe[36]. Guadalupe has approximately 400 km² of total reef area, with an estimated 84% either highly or very highly threatened. Fishing pressure and coastal development are the most prevalent threats to Guadeloupe's reefs (Burke and Maidens 2004). The Archipel de la Guadeloupe Biosphere Reserve was created in 1992 and is managed by the National Park of Guadeloupe. The marine portion of the Biosphere Reserve is the Grand Cul-de-sac Marin, 15,000 ha (marine) in size, containing many coral reefs. A management plan was completed in 1998 that directs activities to maintain biodiversity and water quality.

St. Barthélemy. The decree of creation of St. Barths' Marine Reserve was signed, in Paris, on October 10, 1996 by the Prime Minister of France and the French Minister of Environment, making it the 132nd natural reserve of France. The Marine Reserve was established to protect coral, sea life and fisheries. The taking of any corals is strictly prohibited.

St. Martin. Organic Law of 22 February 2007 confirms the ecological value of protected areas in St. Martin and sets up the management responsibilities of the Nature Reserve. La Reserve Naturelle Nationale De Saint-Martin (National Nature Reserve) which includes corals reefs, strictly prohibits any disruption or disturbance of any flora or fauna within the reserve.

Martinique. Martinique is home to approximately 260 km² of total reef area, representing approximately 1% of the reef area in the Caribbean. It is estimated that 65% of Martinique's reef resources are under threat, The island of Martinique was established as a 70,150 ha regional nature park in 1975 under the French Decree of 24 October 1975 and subsequent Ministerial Act of 24 August 1976. While no specific regulations for corals in Martinique could be found, under Decree 67-158 of 1967, regional nature parks are managed for environmental protection, recreation and research. The regional nature park of Martinique includes its coral reef resources.

2.2.1.11 Grenada

Grenada is the most southerly island in the Eastern Caribbean with fringing and patch reefs found on the east and south coasts. The most pervasive threats to Grenada's 160 sq km of coral reefs include overfishing and coastal development (Burke and Maidens 2004). Grenada's coral reefs are mostly protected by the presence of National Parks which are overseen by the Ministry of Agriculture and Tourism. There are only two areas deemed "protected areas" by the Fisheries Division via the Fisheries Act in 2001 which covers about 500 hectares of marine environment.

Both The Molinere Reef/Beausejour and Woburn/Clarks Court Bay protected areas were legally established in 1999 (Geoghegan et al. 2001) via the Fisheries (Amendment) Act of 1998. They have been actively managed since January 2001. Together these two protected areas cover a combined area of approximately 610 ha and fall under the management of the Fisheries Division. Management committees include members of government, NGOs, stakeholders and community members. Management programs include zoning, stakeholder consultation and solid waste control. At the 2006 8th Meeting of the Conference of Parties to the Convention on Biological

[36] Guadeloupe includes the French islands of St. Barthélemy and St. Martin.

Diversity, the Grenada Declaration was made to effectively conserve at least 25% of its near shore marine area by 2020.

2.2.1.12 Guatemala

The Caribbean coast of Guatemala is reported to have 0 km of reef area (Burke and Maidens 2004). However, Guatemala shares coastline boundaries and coastal waters with Belize and Honduras. The Ley General de Pesca y Acuicultura promotes environmentally safe fishing gear and practices. It is prohibited to pollute aquatic ecosystems with any kind of waste that threatens aquatic resources (including chemical or biological, solid or liquid). Decreto Numero 4-89, the Protected Areas Act, includes guidelines for establishing protected areas, including marine parks. There are also protections for endangered species listed and it is forbidden to hunt or gather dead or alive plants or animals in protected areas (El Congreso de la República de Guatemala, 1989).

2.2.1.13 Haiti

Haiti has approximately 1,260 km² total reef area. As one of the most densely populated and poorest countries in the Western hemisphere, all coastal resources of Haiti are threatened by destructive uses, overexploitation, pollution, and poor management practices. Coral reefs in Haiti are particularly threatened by high sedimentation due to deforestation activities and land-clearing, as well as high levels of pollution due to a lack of sewage treatment and finally, overfishing and destructive fishing practices. Currently, no existing natural resource management plans or marine reserves exist. Sewage treatment is also non-existent in Haiti (Burke and Maidens 2004).

2.2.1.14 Holland

The following descriptions are of the Caribbean Dutch colonies, including Aruba and the former Netherland Antilles. Aruba seceded as a separate country within the Kingdom of the Netherlands in 1986. Additionally, while the Netherland Antilles was an autonomous Caribbean country within the Kingdom of the Netherlands, in October 2010 the Netherland Antilles dissolved, resulting in two new constituent countries (Curacao and St. Maarten) while the rest of the islands joined the Netherlands as special municipalities (Bonaire, Klein Bonaire, Saba, St. Eustatius).

Aruba. Aruba is a sovereign state within the Kingdom of the Netherlands and is situated in the southern Caribbean. Aruba lacks the extensive reef development of its fellow ABC islands (Bonaire & Curacao) because of its position on the continental shelf. Aruba has a total of approximately 25 sq km of reef and currently has no marine protected areas (legislated or voluntary). The reefs are under threat from over-fishing and coastal development, as well as recreational use impacts (Burke and Maidens 2004). Currently there is no legislated protection of coral reefs directly; however, in 2001 Aruba adopted a multi-year policy plan with the following projects proposed: waste water treatment plans, development of a solid waste management facility, implementation of air and water quality monitoring program, and a beach improvement and coastal zone management institution and awareness program (which aims to legislate the Aruba Marine Park and establish a coastal zone management unit to manage the park). Currently the legislation of the Aruba Marine Park is underway.

Curacao. Curacao is completely surrounded by fringing reefs making a total area of 127 sq km. Curacao's reefs are threatened by heavy fishing, massive coastal development (related to

tourism) sedimentation due to deforestation, and oil pollution due to large oil refineries on the island (Burke and Maidens 2004). The Curacao Underwater Park[37] was legally established in 1983 and covers 600 ha of coral reef. The Curacao Underwater Park is managed by CARAMBI (Caribbean Research & Management of Biodiversity) however; there is currently no legislative support or legal protection for the park. New legislation will establish an official marine park with the same model as the Bonaire National Marine Park.

St. Maarten (Dutch side). St. Maarten sits on the Anguilla Bank with spur and groove structures concentrated on the east and southeastern part of the island from 8 to 18 m depth. Threats to St. Maarten's coral reefs include overfishing, rapid population growth and tourism, pollution, siltation, and eutrophication from high sewage output (Burke and Maidens 2004). The St. Maarten Marine Park was voluntarily established in 1997 and encompasses approximately 5128 ha surrounding the entire Dutch coast of St. Maarten out to the 200-meter depth range. The park has been actively managed by the St. Maarten Nature Foundation since 1997 with the primary purpose of providing a sustainable source of nature conservation, while concurrently guaranteeing a continuation of the local population's traditional use of the area. Management features include a zoning plan with designated fishing areas, scuba sites and anchoring/shipping zones. Most recently, the government of St. Maarten announced its first legislated marine park: The "Man of War Shoal Marine Park" and includes the island's most ecologically and economically important marine habitat (including extensive coral reefs and seagrass beds (St. Maarten Ministry of Tourism and Economic Affairs 2011)

Netherland Special Municipalities:

Bonaire (and Klein Bonaire). Bonaire is home to some of the healthiest reefs in the Caribbean and contains 2700 ha of coral reef, seagrass, and mangrove ecosystems. The Bonaire National Marine Park was established in 1979 and declared a National Park in 1999 under the Marine Environment Ordinance (A.B 1991 No. 8). The Bonaire National Marine Park surrounds the entire coastline up to a depth of 60 m (Burke and Maidens 2004). It also includes Klein Bonaire (a Ramsar Convention Site (1980) of less than 100 ha (marine)). Klein Bonaire is ringed by fringing reefs. No anchoring or taking of corals is permitted. The greatest threat to this site is the approximate 100,000 divers that visit each year (*Acropora* Biological Review Team 2005). The Bonaire National Marine Park features permanent moorings for boats/divers and is actively managed on a daily basis by STINAPA (the National Parks Foundation) park rangers.

Saba. Saba Marine Park was legally established in 1987 under the Marine Environment Ordinance (1987) and surrounds the entire coast of the island from the high water mark down to the 61 m (200 ft) isobath. The island is an inactive volcano, which rises steeply from the sea. There is a near shore submarine plateau to which coral is restricted, giving way to deep water (Burke and Maidens 2004). The 61 m (200 ft) isobath is never more than 900 m from the shore and is as close as 250 m to the west and east coasts. The aim of the marine park is to ensure conservation of marine resources whilst developing a sustainable tourism industry. The Saba Marine Park is actively managed by the Saba Conservation Foundation and is visited by 7,000 divers and 6,000 sailors per year. Management mechanisms include restrictions on fishing and anchoring. The park also features a permanent mooring system (color coded for different user

[37] http://www.carmabi.org/nature-management/curacao-marine-park

groups) and two designated anchoring sections. Finally, extensive diver education regarding rules and regulations of the park is mandatory prior to diving (*Acropora* Biological Review Team 2005).

St. Eustatius. St. Eustatius is a volcanic island with offshore coral reefs beginning at 25 m depth and extending to 60 m deep. Coral reefs of St. Eustatius are threatened by overfishing (evidenced by a lack of large predatory fish such as grouper and snapper) and sedimentation due to deforestation activities (Burke and Maidens 2004). Statia National Marine Park[38] was legally established in 1996 under the Marine Environment Ordinance (A.B. Nr. 3) and has been actively managed since 1998 by STENAPA (St. Eustatius National Park Foundation). The marine park encompasses the entire coastline of St. Eustatius from the high water mark to the 30 meter depth contour. The park includes 32 dive-site moorings and 12 yacht moorings, regular patrolling of marine reserves, research and monitoring as well as education and outreach. The park is visited by approximately 1600 divers per year.

2.2.1.15 Honduras

The Caribbean coastline of Honduras can be divided into three groups within a highly developed small island reef system: the Bay Islands, Cayos Cochinos archipelago, and Cayos Mosquitos. The healthiest reefs in Honduras can be found in both the Bay Islands group (Roatan, Guanaja and Utila) as well as Cayos Cochinos. The most pervasive threat to corals in Honduras is overfishing and coastal development, threatening approximately 30% and 25% of reefs respectively (Burke and Maidens 2004).

Overall, there are few laws regarding coral reef resources in Honduras. As of 2006, there were 12 declared MPAs in Honduras covering a total area of 1,054,976 ha with an additional 14 MPAs proposed, for a total area of 1,339,591 ha. Most of the 12 declared MPAs in Honduras are managed by NGOs; however the level of enforcement is unclear. The Ministry of Tourism, with funding from the Inter-American Development Bank, developed the Bay Islands Environmental Management Project which anticipates bringing an estimated 210 sq km of marine ecosystems (including coral reefs) under a comprehensive management regime (Burke and Maidens 2004).

The Refugio de Vida Silvestre Punta Izopo is a Ramsar Convention Site (1977). The marine portion of this site contains coral reefs, but no information is available on their status or composition. A management plan was prepared for this Site but appears to be lacking any specific measures for corals.

Cayos Cochinos are a group of two small islands (Cayo Menor and Cayo Grande) and 13 small coral cays lying 19 miles northeast of La Ceiba on the northern Honduran coast. In 1993 a team of business leaders concerned with the conservation of the Honduran coast and its wildlife, together with the Swiss conservation foundation called AVINA, formed the Honduran Coral Reef Foundation (HCRF) that lobbied the Honduran Government to obtain protection for these islands and surrounding waters. In November 1993 Presidential Decree No.1928-93 designated the Cayos Cochinos as a Natural Protected Area and the HCRF as the managing agency responsible for the conservation of the islands. In August 1994 a second Presidential Decree

[38] http://www.statiapark.org/parks/marine/index.html

(No. 1704-94) confirmed the protected status of the islands. The protected area covers 460 km2 and HCRF are responsible for the management of the area. The Cayos Cochinos form part of the second largest barrier reef system in the World known as the Meso-American Barrier reef system and have been identified by the Smithsonian Institution, The Nature Conservancy, World Wildlife Fund, and the World Bank as one of the key sections of the Barrier Reef to preserve. The reefs are the least disturbed ecosystems in the Bay Islands complex and have had a strong and active non-governmental organization (NGO) working with local communities, private sector bodies, and government organizations to help manage the reefs and their fisheries during the last 10 years (Acropora Biological Review Team 2005).

Cayos Cochinos provide a good example of coral reef habitats in the Caribbean and are considered to be less damaged than most Caribbean reefs. However, some reefs have been seriously impacted by bleaching, hurricanes, and the impacts of human activity, especially over-fishing. As a result, the local fishing committee has agreed to limit fishing within the protected area to only line fishing and trapping for lobsters within the legal season. Few other protection measures exist (Acropora Biological Review Team 2005).

2.2.1.16 Jamaica

Jamaica, the third largest island in the Caribbean, has some of best studied reefs in the world. Fringing reefs occur on the northern coast and also grow sporadically along the south coast. Reefs can also be found on the neighboring banks of the Pedro Cays and Morant Cays. The biggest threats to Jamaica's reefs are overfishing pressures, coastal development, and marine-based sources (Burke and Maidens 2004).

There are a few different laws in Jamaica that specifically protect coral reefs. The Natural Resource Conservation Authority (NRCA) Act (1991) provides for the establishment of protected areas including marine parks under the Natural Resources (Marine Parks) Regulations 1992. The Montego Bay Marine Park, the Negril Marine Park and the Ocho Rios Marine Park are the three marine parks to which these regulations apply. Marine Protected Areas are also covered in the Beach Control Act; however this Act does not provide any specific definitions and is superseded by the NRCA Act. A draft policy/regulation document also exists for the specific protection and preservation of coral reefs in Jamaica: the Coral Reef Protection and Preservation Policy and Regulation, October 1997. Additional indirect protection for coral reefs is provided in the Fishing Industry Act which establishes Fish Sanctuaries (no-take zones).

Pedro Bank and Cays Management Area (1907/1975). The Pedro Bank is roughly triangular in outline, 70 km in its long axis (east-west) and about 43 km in width at the western end. The total shelf area less than 50 m deep is about 8000 km^2, and that less than 20 m deep is about 2400 km^2. The total land area is about 27 ha. The submarine topography is fairly flat, the bottom covered with coral rubble, sand and silt, with patches of scattered corals and algae increasing to the southeast where the cays and reefs and shoals are situated. Little information is available on protection of corals for this area (*Acropora* Biological Review Team 2005).

2.2.1.17 Mexico

Mexico is the 12th largest country in the world, with a coastline that extends 11,500 km (Fraga and Jesus 2008). In Mexico's Atlantic region (Mexico's Pacific coast is covered in Section 2.2.2), coral reefs occur in three major areas: the southwest Gulf of Mexico, Campeche Bank,

and the Caribbean coast of the Yucatan peninsula (Burke and Maidens 2004). Human threats to some reefs off the coast of Mexico were rated lower in comparison to other areas in the region. Over-fishing is identified as the most pervasive threat to the Mesoamerican reef system (Burke and Maidens 2004). Management of coastal resources is centralized, and is delegated to the state and/or municipalities only for specific purposes; however most of the 31 Mexican states have their own regulatory instruments (Fraga and Jesus 2008). Perhaps the most important law related to the regulation of access and use of natural resources in Mexico is the General Law for Ecological Equilibrium and Environmental Protection. Additionally, in Mexico's Penal Code, there are chapters that provide important regulations for the protection of marine life. Penalties imposed include up to 10 years in prison for the capture or harm of marine turtles, marine mammals, coral reefs and any aquatic species during periods when fishing is banned. The same penalty applies to those who reclaim wetlands, mangrove areas, lagoons or marshes. An additional penalty exists of up to three years in prison if the offence is committed in a protected area or detrimentally affects one (Fraga and Jesus 2008).

Within the Atlantic margin of Mexico, there are nine protected natural areas that include coral reefs, two of them are biosphere reserves and the remaining 7 are national parks (Burke and Maidens 2004). The following descriptions of marine reserves are just a sample of the protected areas in Mexico's Atlantic waters.

Sian Ka'an Biosphere Reserve Coral Reef System, Yucatan Peninsula (1986). Marine portions (120,000 ha) of this reserve contain a wide variety of reef types. Sixteen management zones are identified for this area, with objectives including protection, resource management, monitoring and restoration.

The Banco Chincorro Biosphere Reserve (1996) includes 144,360 ha of atoll and platform reef formations. As part of the Mesoamerican Reef System, it is located off the coast of Quintana Roo, eastern Mexico and is reported to contain significant reefs. The remote location of this area has provided some protection; however, management objectives are more oriented towards determining the state of the reefs than protection measures at this time (Acropora Biological Review Team 2005).

Veracruz Coral Reef System National Park- On August 24, 1992, then President Carlos Salinas de Gortari decreed the reef system surrounding Veracruz as a National Sea Park. The Veracruz Coral Reef System National Park surrounds the port city of Veracruz Mexico and encompasses 52,000 ha (128,000 acres). The reef ecosystem lies very close to the shores of the rapidly growing city, which helps make it one of the highest risk reefs in the Gulf. Although the declaration of the National Sea Park helps prevent over-exploitation of the area, the reefs are still threatened by substantial fresh water run-off (producing heavy sediment and agricultural nutrient loading) as well as non-regulated point-source industrial and sewage discharges (*Acropora* Biological Review Team 2005).

2.2.1.18 Nicaragua

Nicaragua is home to approximately 870 km² of total reef area as well as the broadest continental shelf in the Caribbean. While overfishing was ranked as the predominant threat to Nicaragua's reefs (about 15 percent identified as threatened) threats to reefs from land-based sources and marine-based sources were ranked low (Burke and Maidens 2004). Little information was found

on Nicaragua's fisheries and coastal management laws and regulations, although there are some MPAs with considerable coral resources (approximately 68% of total reefs). Cayos Miskitos y Franja Costera Immediata is a Ramsar Convention Site (2001). It contains the Cayos Miskitos Reserve, which is comprised of many small cays, and extensive seagrass intermingled with coral reefs. The site has been designated a Marine Biological Reserve and Protected Area in the Presidential Decree 43-91. The management plan prohibits the take of any species listed as vulnerable or endangered under CITES (Acropora Biological Review Team 2005).

2.2.1.19 Panama

Panama has an estimated 1,600 sq km of coral reefs spread along the majority of its Caribbean coast (Panama's Pacific coast is covered in Section 2.2.2). The major Caribbean reef areas are Bocas del Toro, Colon-Isla Grande and San Blas (or Kuna-Yala) (Burke and Maidens 2004). Marine protected areas along the Caribbean coast of Panama include: Isla Bastimentos National Marine Park (132 km^2, established 1988) in the region of Bocas del Toro, Isla Galeta Protected Area just east of the city of Colon, and Portobelo National Park (359 km^2, established 1976) that includes Portobelo Bay and 70 km of shoreline and coastal waters) east of Isla Galeta (Spalding 2004). The most extensive reefs occur in the San Blas Archipelago, which is controlled by the Kuna people. The presence of the Kuna has protected the San Blas region from extensive development, sedimentation, and land-based sources of pollution, but there has been extensive mining of live corals to enlarge islands (Guzman et al. 2003). Additionally, due to a lack of waste management and sewage treatment, most (if not all) waste produced by the Kuna-Yala Comarca ends up in their Caribbean coastal waters. Large amounts of plastic and human waste are dumped into the ocean every day. Further, fishing with chlorine bleach is a common practice, shifting their local reefs to algal-dominated systems and killing much of the live coral. The first MPA in the Kuna-Yala Comarca was established on the island of Niadup in response to the evident decline in large predatory fish (Young Pers. Comm. 2010). Overall, Panama lacks national laws enacting reef conservation efforts (Burke and Maidens 2004).

2.2.1.20 St. Kitts and Nevis

St. Kitts & Nevis are two volcanic islands with fringing reefs surrounding much of their coastlines. St. Kitts & Nevis have a combined total of approximately 160 sq km of coral reefs, of which all are threatened by overfishing, coastal development, and sedimentation (given the steep topography of the islands) (Burke and Maidens 2004). The National Conservation and Environment Protection Act No.5 of 1987 covers the establishment and development of national parks and protected areas; however, currently there are no legally established marine protected areas or parks, and regular reef management and monitoring is lacking. Additionally, the Fisheries Act No.4 of 1984 provides for the establishment of fishing priority areas and marine reserves but no proposals of implementation have been declared[39].

2.2.1.21 St. Lucia

The majority of St. Lucia's 90 sq km of coral reefs are narrow fringing reefs lying in close proximity to the shore. Overfishing, coastal development, sedimentation, and more recently, tropical storms remain the biggest threats to St. Lucia's coral reef ecosystems. On the west

[39] http://www.oas.org/dsd/fida/laws/legislation/st_kitts_&_nevis/st_kitts_&_nevis.pdf accessed 2010

coast of St. Lucia, population increases along the coast and tourism development have resulted in user conflicts between fishermen and divers, as well as fishermen and yachts. As a result, the Soufriere Marine Management Area was legally established in 1994 (Burke and Maidens 2004) under the 1984 Fisheries Act and the Parks and Beaches Commission Act, 1984 (after an 18 month-long process of participatory planning and stakeholder consultations). The Fisheries Act No. 10, 1984 provides for the creation of marine reserves and fisheries priority areas. Other legislation affecting reefs in St. Lucia includes provisions of the Water and Sewerage Act, 1984, which may request that the Chief Forest Officer take action to protect any catchment area threatened by deforestation (CEP 1996).

The Soufriere Marine Management Area covers 11 km of coastline and encompasses a variety of near-shore coastal environments (including coral reefs). Regulations within the Soufriere Marine Management Area include user fees, mooring and demarcation buoys, signs, and enforcement by 4 wardens. Approximately one-third of the entire area is zoned as Marine Reserve, where no fishing or other take is allowed. Anchoring is restricted to sand bottom and it is illegal to take, purchase, sell or possess corals in St. Lucia. The primary objectives of the Soufriere Marine Management Area are to solve user conflicts while ensuring economic prosperity and sustainability of St. Lucia's coastal environment and marine resources[40].

2.2.1.22 St. Vincent and The Grenadines

St. Vincent is a relatively young volcanic island, with the chain of the Grenadines running south from the main island. There are approximately 140 sq km of coral reef in the waters of St. Vincent and the Grenadines, all of which are threatened by overfishing, coastal development, sedimentation and marine-based pollution (Burke and Maidens 2004). There are 10 conservation areas within the territorial waters that were designated under the 1987 Fisheries Conservation Act. One of these areas, the Tobago Cays, has been legally designated as the Tobago Cays Marine Park. The Tobago Cays Marine Park covers 50 sq km and 4 small islands. The Marine Parks Act of 1997 established a Marine Parks Board to oversee and conduct the day-to-day management of the Tobago Cays Marine Park and any future designated marine parks. The 1998 Marine Park (Tobago Cays) Regulation established user fees and other rules and regulations that prohibit any touching or taking of corals (or any other animals in the park) as well as anchoring in close proximity to the reef[41]. An official management plan was submitted to the Marine Parks Board in 1998 (Cordice 2008) to combat continuing threats to the park, including:

- Overfishing (particularly spear fishing)
- Physical damage from yachts anchoring/running aground (No mooring system in place)
- Bilge and wastewater dumping by yachts
- Controlling large volume of visitation
- Visitation by cruise ships (10,000 visitors per year to the Cays) and estimated 3,000 yachts anchor in lagoon each year.

2.2.1.23 Trinidad and Tobago

Trinidad and Tobago lie on the edge of the South American shelf, with 1 fringing reef on the northeast coast of Trinidad, and several patch reefs near the offshore islands (especially around

[40] http://www.smma.org.lc/index.php 2010
[41] http://www.tobagocays.com/fees.html

Tobago). Trinidad and Tobago have a combined 40 sq km of coral reefs in their waters, all of which are threatened by overfishing, coastal development, and land pollution in the form of poorly treated sewage, domestic gray water, and agricultural run-off (Burke and Maidens 2004). The only legislated marine reserve in Trinidad and Tobago is the Buccoo Reef Marine Reserve, legally established in 1973 under the Marine Area Order of the Marine Area (Preservation and Enhancement) Act of 1970 (Republic of Trinidad and Tobago Ministry of Legal Affairs http://rgd.legalaffairs.gov.tt/Laws2/Alphabetical_List/Alphabetical_List.htm). The Buccoo Reef Marine Reserve covers 650 ha and is intended to preserve and enhance the natural beauty of the area, protect flora and fauna (including corals), promote public enjoyment of the area, and promote scientific study and research. Management plans have been formulated but not implemented for the reserve (Burke and Maidens 2004). Enforcement of the marine reserve is present, but adequacy is undetermined. The Buccoo Reef Marine Park still suffers from adverse effects from high volumes of tourist activity and pollutant discharges from the islands.

2.2.1.24 United Kingdom

The following U.K. Territories within the Caribbean region are included in this section (U.K. Territories in the Indo-Pacific are covered in Section 2.2.2): Anguilla, British Virgin Islands (BVI), Cayman Islands, Montserrat, and the Turks and Caicos.

Anguilla. Anguilla is a flat low-lying island in the Caribbean Sea and an internally self-governing overseas territory of the United Kingdom. Extensive reefs shelter the north coast of Anguilla, while fringing reefs occur on the southern coast. The most pervasive threats to Anguilla's coral reefs are over-fishing and coastal development as well as local threats such as hurricanes and physical damage and breakage due to tourism impacts (anchoring, divers). Marine-based pollution and sedimentation are not considered threats. Subsistence fishing pressures are not prevalent due to the relative wealth of the island (Burke and Maidens 2004). Anguilla has 5 legislated marine reserves totaling 6,800 ha: Dog Island, Prickly Pear Cays, Little Bay, Shoal Bay/Island Harbour, and Sandy Island. These marine reserves were established under the Marine Parks Ordinance in 1982, but were not managed until the Marine Parks Regulations came into force in December 1993. Management responsibility for the MPAs falls under the jurisdiction of the Department of Fisheries and Marine Resources in the Chief Minister's Office (Homer 2004). Dog Island is considered a relatively pristine area and visitation to this site is discouraged by Anguilla's Department of Fisheries. The other marine reserves were established with the development of tourism in mind.

British Virgin Islands (BVI). The British Virgin Islands is an overseas territory of the United Kingdom. An archipelago of 60 islands and cays, the BVI has approximately 380 sq km of reef area. The most extensive reef in the BVI is Horseshoe reef, which covers an area of 77 sq km and is a protected area. The most pervasive anthropogenic threat to the BVI's reefs is pollution: sewage from land, pollution from boats, lack of regulations on sewage holding tanks within marinas, as well as pumping of boat bilges and disposal of engine oil all present major threats to the health of coral reefs in the BVI (Burke and Maidens 2004).

Legislation affecting BVI coral reefs include the Marine Parks and Protected Areas ordinance of 1979 which provided the basis for the 1980 declaration of the Wreck of the Rhone Marine Park. The Wreck of the Rhone Marine Park forms a protected area totaling 798 acres and is managed by the National Parks Trust. A mooring buoy system was established under the 1991 regulations

governing the marine park and prohibits activities such as anchoring without a permit and speeding in the park. Additionally, mandatory permits and fees are enforced for use of mooring buoys. Additional legislation includes the 1990 Fisheries Ordinance which establishes marine reserves as either fisheries protected areas or marine protected areas in which activities such as harvesting any marine animals or marine life, anchoring, and conducting development projects, are prohibited without a permit.

In 2008, a proposed network of marine protected areas was approved by the government Cabinet in efforts to protect 30% of BVI's important biological habitats (including coral reefs, mangroves, seagrasses, etc). This network of MPAs will have designated zones marked by mooring buoys to ensure resiliency of important marine habitats across the BVI.

Cayman Islands. The Cayman Islands are an overseas colony of the British Crown and consist of 3 small low islands known as Grand Cayman, Little Cayman, and Cayman Brac. The islands are surrounded by well-developed fringing reefs situated on narrow insular shelves. Marine conservation laws are strict and highly enforced (WRI, 2004). All corals are protected under the Marine Conservation Law of 1978. The Cayman Islands Marine Parks are comprised of Marine Park Zones, Environmental Zones, and Replenishment Zones, as well as Designated Grouper Spawning Areas. These zones are scattered around the perimeter of Grand Cayman, Cayman Brac, and Little Cayman. Marine Park and Environmental zones have prohibitions on the taking of any marine life, anchoring is prohibited in any hard bottom habitats, and fish pots, nets and spearguns are prohibited in all zones. These regulations are administered by the Department of Environmental Protection and Conservation Unit (*Acropora* Biological Review Team 2005).

Montserrat. Montserrat is an overseas territory of the United Kingdom and became approximately 50% uninhabitable due to a volcanic eruption in 1995. Significant plumes of sediment found their way into the sea at several locations around the island and severely affected the health of the local reefs. In addition to volcanic activity, coral reefs of Montserrat are also threatened by overfishing and additional sedimentation due to the precipitous volcanic slopes of the island. Reef growth is also limited due to a lack of hard substrate. Despite the negative effects from the sedimentation caused by volcanic activity, the eruption of 1995 also deposited many hard rocky boulders into the sea, providing new substrate for corals to settle. Reefs appear to have recovered somewhat in the last 15 years since the eruption; however, there is currently no solid legislation for the protection of corals (Burke and Maidens 2004).

Turks and Caicos. The Turks and Caicos Islands (TCI) are an overseas territory of the United Kingdom, and contain 19 marine protected areas. Some include both marine and terrestrial resources. Marine protected areas are classified as National Parks, Nature Reserves or Historical Sites and all prohibit the take of any marine animal or plant. Of the 19 protected areas that could benefit corals, ten are entirely marine and nine have both marine and terrestrial components. Strictly marine protected areas range in size from the one-acre Molasses Reef Wreck Area to the 6,532 acre Princess Alexandra Land and Sea National Park. Marine/terrestrial protected areas range in size from the 33 acre Three Marys Cays Sanctuary to the 210 square mile North, Middle and East Caicos Reserve (Ramsar Site). Effectiveness of the different reserves in TCI depends upon the particular reserve; for example, Princess Alexandra National Park is very well enforced since it is in the area where most of the all-inclusive hotels are located. Overall, human impacts to corals are relatively low in TCI (e.g. little sediment runoff or eutrophication); however two

recent boat groundings that damaged *A. palmata* resulted in large fines suggesting that the TCI does place significant value on their reefs (*Acropora* Biological Review Team 2005).

2.2.1.25 United States

The collective range of the seven Caribbean species within the US includes Florida and the Territories of Puerto Rico and the US Virgin Islands (US possessions in the Indo-Pacific are covered in Section 2.2.2). Existing regulatory mechanisms in the US Caribbean most relevant to addressing local threats to corals are: (1) fisheries and coastal management; (2) MPA management. These two categories of regulatory mechanisms are described for the federal (national) level, and for the non-federal (State and Territorial) level. This US section is a summary based on the information in Appendix A to this report.

2.2.1.25.1 Federal

Within US waters, federal fisheries and coastal management are dictated by numerous federal statutes and Executive Orders: Clean Water Act, Coastal Zone Management Act, Outer Continental Shelf Lands Act, Coral Reef Conservation Act, Endangered Species Act, Magnuson-Stevens Fishery Conservation and Management Act, National Marine Sanctuaries Act, Rivers and Harbors Act, Act to Prevent Pollution From Ships, National Environmental Policy Act (NEPA), National Park Service Organic Act, National Wildlife Refuge System Administration Act, Ocean Dumping Ban Act, Refuge Recreation Act, The Lacey Act, The Sikes Act, and Water Resources Development Act. The most relevant Executive Orders (EOs) include EO 12962 on recreational fishing, EO 12996 on the National Wildlife Refuge System, and EO 13158 on Marine Protected Areas. These federal laws and Executive Orders are described in detail in Section 1.1 of Appendix A.

Federally-managed MPAs within the US Caribbean that protect corals and coral reefs include Dry Tortugas National Park, Biscayne National Park, Dry Tortugas National Park, Fort Jefferson National Monument, Everglades National Park, Key Largo National Marine Sanctuary, Looe Key National Marine Sanctuary, Buck Island Reef National Monument, Virgin Islands National Park, Virgin Islands Coral Reef National Monument, Navassa Island, and Flower Garden Banks National Marine Sanctuary. These federally-managed MPAs are described in detail in Section 2.1 of Appendix A.

2.2.1.25.2 Florida

Within Florida waters, fisheries and coastal management are dictated by numerous non-federal laws and regulations. In addition, many of Florida's over 400 MPAs are managed non-federally by the State or Counties. These non-federal laws and regulations, and non-federal MPAs, are described in detail in Sections 1.2.1 and 2.2.1 of Appendix A.

2.2.1.25.3 Puerto Rico

Within Puerto Rico waters, fisheries and coastal management are dictated by numerous non-federal laws and regulations. In addition, many of Puerto Rico MPAs are managed non-federally. These non-federal laws and regulations, and non-federal MPAs, are described in detail in Sections 1.2.2 and 2.2.2 of Appendix A.

2.2.1.25.4 U.S. Virgin Islands

Within USVI waters, fisheries and coastal management are dictated by numerous non-federal laws and regulations. In addition, many of USVI's MPAs are managed non-federally. These non-federal laws and regulations, and non-federal MPAs, are described in detail in Sections 1.2.3 and 2.2.3 of Appendix A.

2.2.1.26 Venezuela

Venezuela has approximately 230 km² of total reef area. According to the Reefs at Risk Caribbean analysis, "Reefs along the continental Venezuelan coast are subject to pressure from overfishing, coastal development, and some port facilities. Deforestation has increased sediment loads to coastal waters, and all reefs along the continental coast were identified as under high threat from land-based sources. Although most Venezuelan coastal coral reefs are located within national parks with protective regulations, inadequate staffing as well as logistical and financial capacity prevent full enforcement" (Burke and Maidens 2004).

Little information was found on Venezuela's fisheries and coastal management laws and regulations, although there are some MPAs with considerable coral resources. Archipelago de Los Roques is a Ramsar Convention Site (1996) and is located approximately 180 km offshore of Venezuela. It is comprised of 213,220 ha of shallow waters around the atoll and contains many coral reefs. Management plans call for regulation of small-scale fishing and the harvest of certain species is prohibited. Cuare is another Ramsar Convention Site (1988) in Venezuela, including the Golfete de Cuare, a semi-enclosed body of water. The site contains coral reefs and coral keys, but is significantly impacted by runoff and poor oceanic circulation. The site is managed and protected through PROFAUNA, an autonomous service of the Ministry of Environment and Renewable Natural Resources (Acropora Biological Review Team 2005).

National Regulatory Mechanisms - Indo-Pacific (68 countries)

Of the 82 coral species petitioned for listing, 75 species occur in the Indo-Pacific. These 75 species are found in the waters of 68 countries (Figure 1, Table 1). The Indo-Pacific region contains about 80 percent of all coral reefs in the world. For each of the 68 countries within the Indo-Pacific, environmental laws that regulate fishing of reef fish, coastal development, land use (to control sedimentation onto reefs), and/or that protect corals and coral reefs in other various ways were summarized and described if available. Descriptions of relevant MPAs that may include and/or benefit corals and coral reefs are also included in each country account if present. Ten of the Indo-Pacific countries described in the following section have Caribbean coastlines and thus were also included in the Caribbean section (2.2.1).

Of the 68 countries within the Indo-Pacific region, Australia, France, Indonesia, Papua New Guinea, and Philippines have the largest coral reef areas. Together these make up over half of the world's coral reef areas, according to the 2001 Coral Reef Atlas's Coral Reef Area Statistics (in contrast, the US has <2% of the world's coral reefs[42]).

[42] http://coral.unep.ch/atlaspr.htm

2.2.1.27 Australia

Australia is home to the largest coral reef system in the world: the Great Barrier Reef. The Great Barrier Reef is composed of 2,900 individual reefs and 900 islands stretching for over 2,600 km. The reef areas in Australia alone comprise approximately 17 percent of the total coral reef area in the world according to the 2001 Coral Reef Atlas's Coral Reef Area Statistics. It is the world's largest cluster of corals and other exotic marine life. According to the Reefs at Risk Revisited analysis: "Australia's reefs are the world's least threatened, with an estimated 14 percent threatened by local activities and just over 1 percent at high or very high threat. Our analysis identifies both marine-based pollution and watershed-based pollution as the dominant threats, but vast areas of reef are remote from such impacts" (Burke et al. 2011).

Australia hosts a total of 200 marine protected areas, covering 64.8 million hectares. They range from Commonwealth Reserves, such as the Great Barrier Reef Marine Park, to fish habitat reserves, fish sanctuaries, aquatic reserves, conservation areas, marine parks and marine and coastal parks. The Director carries out the responsibilities of the office with the primary assistance of Parks Australia, a division of the Department of the Environment, Water, Heritage and the Arts. The Marine and Biodiversity Division of the Department is responsible for the management of Commonwealth marine reserves on behalf of the Director of National Parks.

Among the most notable MPAs in the world, the Great Barrier Reef Marine Park covers an expansive 345,400 km² area and protects a large part of Australia's Great Barrier Reef from damaging activities. Fishing and the removal of artifacts or wildlife (fish, coral, sea shells etc.) is strictly regulated, and commercial shipping traffic must stick to certain specific defined shipping routes that avoid the most sensitive areas of the park. The Great Barrier Reef Marine Park Authority (GBRMPA) is the administrator of the park. They issue permits for various forms of use of the marine park and monitor usage in the park to ensure compliance with park management. The GBRMPA is funded by Commonwealth Government Appropriations that includes an environmental management charge levied on the permit-holders passengers. Some international conventions that the Great Barrier Reef Marine Park must follow are: the Bonn Convention, Ramsar Convention (for the Bowling Green Bay National Park site), CITES, JAMBA and CAMBA. Some national legislation that the Park must follow include: the Great Barrier Reef Marine Park Act 1975, the Environment Protection and Biodiversity Conservation Act 1999, the National Strategy for Ecologically Sustainable Development, National Strategy for the Conservation of Australia's Biological Diversity, Australia's Oceans Policy, and the National Strategy for the Conservation of Australian Species and Communities Threatened with Extinction. Some state legislation that the Park must follow includes the Nature Conservation Act of 1992, the Marine Parks Act of 1982, the Fisheries Act of 1994, and the Queensland Nature Conservation (Wildlife) Regulation 1994.

When the GBRMP was first established in 1975, there was a strong emphasis on education rather than enforcement of regulations because education was seen as the most effective compliance tool. As an enforcement tool, officers developed a compliance risk assessment matrix that scored illegal activity for probability of occurring, level of impact, and priority of enforcement. By prioritizing threats, there has been a 42 percent increase in the number of prosecutions from 1999/2000 when first implemented (Skeat et al., 2000).

Following are brief descriptions of important legislation in Australia regarding the marine environment and coral reefs.

Environment Protection and Biodiversity Conservation Act 1999[43]. This act ensures the protection of places of national significance, ecologically sustainable development, and conservation and biodiversity across Australia. Under this act, native species are protected, reserves can be established, plans are made for the wise-use of Ramsar wetlands, and places are identified for National Heritage and Commonwealth Heritage. Under the Environment Protection and Biodiversity Conservation Act, the Australian Government manages an estate of MPAs that are Commonwealth reserves. The GBRMP is one of 15 Commonwealth Reserves. The Director of National Parks is the Statutory Authority directly responsible for managing all Commonwealth reserves (including marine protected areas) as specified by the Environment Protection and Biodiversity Conservation Act.

Conservation and Land Management Act of 1984[44]. This act establishes authorities that protect and manage certain public lands and waters, including flora and fauna in Western Australia. Marine nature reserves and marine parks are applicable to lands and waters covered in this act.

Fish Resources Management Act 1994[45]. This act pertains to managing fish and fishing areas in Western Australia. It provides guidelines for fishing activities and management plans.

Marine Parks Act 1997[46]. This act provides authority to declare marine parks in New South Wales.

Marine Parks Reserve Authority[47]. This agency manages marine protected areas in Western Australia under the Conservation and Land Management Act.

National Parks and Wildlife Conservation Act 1975[48]. Establish national parks and other parks and reserves for the protection and conservation of wildlife across Australia.

The Wildlife Protection Act of 1982[49]. This act prohibits the export and import of certain reef species without a permit. A permit cannot be granted by the Australian Minister unless he makes certain determinations depending on the species.

Queensland Fisheries Regulation 2008[50]. Corals are also regulated under the Queensland Fisheries Regulation of 2008. The regulation defines and contains provisions for the "coral fishery." Corals included in this fishery that may be taken with a license are of the class Anthozoa or Hydrozoa, including its uncompacted skeletons. Additionally any marine organism

[43] http://www.environment.gov.au/epbc/index.html
[44] http://www.austlii.edu.au/au/legis/wa/consol_act/calma1984290/
[45] http://www.austlii.edu.au/au/legis/wa/consol_act/frma1994256/
[46] http://www.austlii.edu.au/au/legis/nsw/consol_act/mpa1997135/sch4.html
[47] http://www.dec.wa.gov.au/content/section/22/1355/
[48] http://www.austlii.edu.au/au/legis/cth/num_act/npawca1975390/s1.html
[49] http://www.austlii.edu.au/au/legis/cth/num_act/wpoeaia1982578/
[50] http://www.legislation.qld.gov.au/SL_AsMade/SL_AsMade_NUM_2008.htm

living in or on corals mentioned previously, other than a marine organism that is a regulated fish, as well as coral sand consisting of fine remnants of coral, may be taken with a license.

There are 3 coral fisheries in Australia: WA Marine Aquarium Fish Managed Fishery, Queensland Coral Fishery and Northern Territory Marine Aquarium Fish Fishery. These commercial fisheries operate in accordance with the Fisheries Act 1994 and the regulations set out in the Fisheries Regulation 2008, the Policy for the Management of the Coral Fishery 2009 and/or State and Australian federal government marine parks legislation (e.g., the Great Barrier Reef Marine Park Act 1975).

The Queensland Coral Fishery is a low volume, high value fishery operating primarily within the Great Barrier Reef Marine Park. Participation in this fishery is limited to 59 licenses, which are operated by 24 businesses. Currently, no additional licenses can be issued for this fishery. There are limits on the number of collectors that can operate under each license and restrictions of gear used for collecting corals. Harvest levels are limited to an annual Total Allowable Catch (TAC) of 200 tons. Within the overall TAC limit of 200 tons a maximum of 60 tons of living coral and 140 tons dead coral (mostly live rock) can be harvested. A system of Individual Transferable Quota (ITQs) applies with the harvest tracked through a quota monitoring system that is run by Fisheries Queensland. The primary resource sustainability assessment tool for the fishery is an Ecological Risk Assessment (ERA) based upon the AS/NZ Standard. Coral taxa from over 36 families are harvested. The current ERA identified 12 coral taxa and two live rock collection areas that were at low risk from the fishery. In addition, the aquarium supply industry has implemented a Stewardship Action Plan that defines collection standards that specifically address the species identified in the ERA in order to mitigate risk. The outcomes of the ERA are used to focus monitoring of the fishery through a Performance Measurement System (PMS). The PMS measures the fishery's performance against defined ecological, economic and social management objectives with response action required if performance falls outside of defined acceptable ranges.

Corals are only allowed to be exported from Australia if the fishery harvesting the coral specimens is considered to be sustainable or not causing detriment to the species in the wild, as required by CITES. Both the WA Marine Aquarium Fish Managed Fishery and Queensland Coral Fishery recently were re-evaluated, and associated non-detriment findings were developed. For most species of coral, the CITES Scientific Authority has found that due, in part, to their similarity in appearance and ecology, it is difficult to manage most corals at a species level. Therefore, these fisheries also are subject to a series of stringent monitoring requirements. Of the 82 corals listed, 51 occur in Australian waters and are subject to the CITES Non-Detriment Finding (NDF) process, prior to any export approval being granted. CITES recognizes the difficulty associated with being able to correctly identify coral species, by allowing some species to be listed on export permits at the higher taxonomic level of genus (when identification to species is not feasible) instead of the normal requirement to label to species level.

Sea Dumping Act 1981[51]. Australia regulates the loading and dumping of waste at sea under the Sea Dumping Act. Under this Act, the Commonwealth aims to minimize pollution threats by

[51] http://www.environment.gov.au/coasts/pollution/dumping/act.html

prohibiting ocean disposal of waste considered too harmful to be released in the marine environment and regulating permitted waste disposal to ensure environmental impacts are minimized. The Sea Dumping Act applies to all vessels, aircraft and platforms in Australian waters and to all Australian vessels and aircrafts in any part of the sea. Permits are required for all sea dumping operations. Permits are most commonly issued for dredging operations and the creation of artificial reefs. Permits have also been issued for dumping of vessels, platforms or other man-made structures and for burials at sea.

The following islands are overseas territories of Australia and fall under the jurisdiction of the Commonwealth laws.

Christmas Island[52]. Christmas Island is a territory of Australia in the Indian Ocean. Currently, 63 percent of the island's 135 square kilometers is now protected under the Christmas Island National Park. Parks Australia, within the Australian Government Department of Environment and Water Resources is responsible for administering the Environmental Protection and Biodiversity Conservation Act 1999 on Christmas Island and managing the park for the Director of National Parks in accordance with the Act and the park Management Plan.

The park includes a marine area extending 50 m seaward of the low water mark where terrestrial areas of the park include the coastline. This marine area incorporates approximately 46 km (63 percent) of the island's 73 km of coastline. Shoreline platforms descend directly to a narrow band of shallow coral reefs with no intervening sandy, shallow reef flats. The shallow reefs drop off steeply so that there is little deep reef habitat before abyssal depths are reached. Management objectives of the park include protecting all marine organisms and habitats in as near a natural state as possible, allowing recreational fishing subject to specified conditions, and managing recreational activities, particularly fishing, boating and diving, so as to minimize physical or biological damage to habitats and wildlife, and physical damage to wrecks or other artifacts. Regulations within the park prohibit commercial fishing or the taking of any organism or object for sale or barter. The park also installed mooring buoys for the use of boat operators. There is also one marine and terrestrial Ramsar site called Hosnie's Spring[53] on Christmas Island.

Cocos-Keeling Islands[54]. The Territory of Cocos (Keeling) Islands, also called Cocos Islands and Keeling Islands, is a territory of Australia. There are two atolls and twenty-seven coral islands in the group. The islands are located in the Indian Ocean, approximately midway between Australia and Sri Lanka. The conservation significance of North Keeling was clearly recognized when the island was recommended to become a national park or nature reserve by two House of Representative committees in 1990 and 1991, following its listing on the Register of the National Estate in 1990. In 1993, the Cocos (Keeling) Islands Shire Council resolved in principle to lease North Keeling Island to the Commonwealth for the creation of a national park. The lease was finalized in 1995 and stipulated that the Island must be developed as a national park of world standard. Proclamation of Pulu Keeling National Park in December 1995 aims to ensure the long-term conservation of the island's unique biodiversity and safeguards its natural and historical attributes for the benefit of the local, national and international communities.

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[52] http://www.environment.gov.au/parks/christmas/index.html
[53] http://www.wdpa.org
[54] http://www.ag.gov.au/www/agd/agd.nsf/Page/Territories_of_AustraliaCocos_(Keeling)_Islands

According to the Pulu Keeling National Park Management Plan, the park includes North Keeling Island and the marine area extending 1.5 km from the shore. The marine zone is designated as IUCN "national park" while the lagoon and terrestrial environments are designated "strict nature reserve."[55] Reef check sites will be monitored to detect changes in coral reef status and the effects of anchors are monitored. Patrols take place throughout the marine zone. The park includes the central sandy-bottom seagrass lagoon on North Keeling Island, and island itself is surrounded by fringing reef. There are two other MPAs called Emden and Historic Shipwreck[56].

As of July 2000, wildlife protection and management and national park management in the Territory is carried out under the Australian Environment Protection and Biodiversity Conservation Act 1999 and Regulations. The Director of National Parks, assisted by Parks Australia within the Australian Government Department of Sustainability, Environment, Water, Population and Communities is responsible for managing the park in accordance with the Management Plan. Corals are afforded protection under the laws of Australia's National Parks. Commercial fishing is also prohibited in the park.

Norfolk Island. Norfolk Island is a small island in the Pacific Ocean located between Australia, New Zealand and New Caledonia. The island is part of the Commonwealth of Australia, but unlike other Australian territories, Norfolk Island enjoys a large degree of self-governance. The Environment Act of 1990 addresses promoting the conservation of the natural environment and landscape beauty of Norfolk Island by preventing degradation. Norfolk Island is also subject to Commonwealth laws of Australia.

2.2.1.28 Bahrain

The Kingdom of Bahrain has about 126 km of coastline and 8,000 km² of marine area with more than 90% of the total population living immediately along the coast or in very close proximity to it. The only live coral reef surviving in Bahrain is on Abul Thama, a small raised area surrounded by 50m deep water about 72km north of the main island. Bahrain is at risk of losing all of its coral reef resources due to the extensive engineering and land reclamation projects within coastal waters (Maghsoudlou *et al.* 2008). In addition to land reclamation and coastal engineering projects, anchor damage, over-fishing, spear fishing, solid wastes, oil pollution, trawling nets, and sedimentation threaten Bahrain's reefs.

The first and only comprehensive law concerning the Environment was passed in 1996 by virtue of Law Decree No. 21 (1996). Biodiversity protection has been given considerable attention at the National level in the form of issuing regulations and informing institutions that are responsible for these issues. Bahrain's sustainable development policy includes six main priority issues, one of which is Biodiversity (United Nations Country Profile 2002- Bahrain). Government regulations regarding land reclamation exist, but there is little enforcement or compliance of these regulations evidenced by completed projects lacking government approval (Pilcher *et al.* 2000). Finally, a committee for the Protection of the Marine Environment was formed with members from various NGOs and government agencies. The main tasks of the committee includes: (1) prepare guidelines to protect coastal zones, (2) prepare an action plan to protect nationally and internationally important marine resources, (3) study the effects of sea

[55] http://www.environment.gov.au/parks/publications/cocos/management-plan.html
[56] http://www.wdpa.org

level rise due to climate change on coastal areas, and (4) prepare a plan to encourage research related to marine environment and effecting factors (United Nations Country Profile 2002-Bahrain).

2.2.1.29 Brunei

The only two oceanic islands of Brunei, Pelong Rocks and Pulau Punyit, are fringed with corals. Due to high turbidity caused by runoff from four major rivers and coastal development projects, coral reefs are not well developed in Brunei. The total known reef area is approximately 45 km^2 and is mostly confined to five areas far from the shore on offshore islands and shoals (ASEAN Regional Centre for Biodiversity Conservation 2002). The government agency responsible for the management of coral reefs in Brunei is the Department of Fisheries in the Ministry of Industry and Primary Resources (Burke *et al.* 2002). Legislation affecting coral reefs in Brunei includes the 1972 Fisheries Enactment which provides for the establishment of closed areas to fishing and the 1978 (revised 1984) Wildlife Protection Act which provides for the establishment of wildlife sanctuaries. Most recently, the Fisheries Order of 2009 provides for the establishment of marine reserves to afford special protection to the aquatic flora and fauna and to protect, preserve and manage the natural breeding grounds and habitat of aquatic life, with particular regard to the species of rare or endangered flora and fauna. Marine reserves are also intended to allow for the natural regeneration of aquatic life where such life has been depleted, promote scientific study and research, and preserve and enhance the pristine state and productivity of the area.

Activities prohibited in marine reserves include fishing (or attempting to fish), taking or removing of any organisms (alive or dead), collection, possession or destruction of coral, sand, and gravel, discharging any pollutant, alteration or destruction of the natural breeding ground of aquatic life or destroying any aquatic life. Additionally, anchoring a vessel to any coral, rock or other object within the marine reserve is prohibited. Two small marine wildlife sanctuaries (islands) with coral reefs, Pelong Rocks (2 ha.) and Pulau Punyit (8 ha.), have been protected as historical sites through the Antiquities and Treasure Trove Enactment (1967), with a view of protecting their fauna and flora. Finally, logging as an industry and export-earner has been stopped, with the remaining rainforests protected by law (ASEAN Regional Centre for Biodiversity Conservation 2002).

2.2.1.30 Cambodia

Cambodia's coastline contains sandy beaches, muddy and rocky shores that are fringed by seagrass beds and coral reefs. There are 52 offshore islands along Cambodia's coast. Coral reefs in Cambodia are subject to threats such as blast fishing, cyanide and coral collection, trawling and sewage run-off. Blast fishing and extensive coral collection in particular seem to be the most widespread threats to Cambodia's reefs, and have extensively damaged many areas. Overfishing is also prevalent (Burke *et al.* 2002).

Management for the conservation of coral reefs is still relatively basic, with most legislation relating to the protection of fisheries (Burke *et al.* 2002). However, in November of 1993, a Royal Decree was issued: "Creation and Designation of Protected Areas" designating 23 areas, covering some 3.3 million hectares or almost 19% of Cambodia's total land area, as National Parks, Wildlife Sanctuaries, Protected Landscapes, and Multiple Use Areas. It should be noted that all the Coastal Protected Areas are part of the National Protected Area System.

The present system of coastal and marine protected areas in Cambodia comprises six reserves, including two that are entirely terrestrial. The four other reserves containing marine components are Botum Sakor National Park (171,250 ha, including terrestrial areas), Preah Sihanouk (Ream) National Park (21,000 ha, including offshore islands and surrounding waters), Dong Peng Multiple Use Area (27,700 ha), and Peam Krasop Wildlife Sanctuary (23,750 ha, including terrestrial areas).

Other major environmental legislation affecting corals includes the Law on Environmental Protection and Natural Resource Management (1996), Praka No. 1033 on the Protection of Natural Areas (3 June 1994), Decree No. 33 on Fishery Management and Administration, Royal Kram NS/RKM/0506/011 on Promulgation of the Fisheries Law, 2006 (provides for the classification of Protected and Conservation Areas of Fishery Resources important for the sustainability of fishery resources; corals specifically included in fishery resources). Additionally, community fisheries are in charge of managing and conserving fisheries resources and establishing conservation areas (Penh 2005).

2.2.1.31 Chile

Easter Island, (traditionally known as Rapa Nui) and Sala y Gómez Island are the only sub-tropical environments that support reef-building corals in Chile. Information on the coral resources in Chile has grown slowly. To date, only 11 species of zooxanthellate corals are known. Easter Island is a self-governing territory of Chile. In January 1935 the Government of Chile declared the whole island to be a National Park in order to protect natural and archaeological resources, including coral reefs. However, specific regulations could not be found for corals or coral reefs for the island. No permits are required to extract corals and there are no enforced limits on the numbers or sizes of corals or fishes taken. Currently there is no formulation of a management plan for the coral resources of Chile (Glynn, et al. 2003 in Cortes (Ed.) Latin American Coral Reefs 2003).

2.2.1.32 China

Typical coral reefs in China include fringing reefs along the southern coastal waters of the continent and offshore islands and atolls of the South China Sea Islands. Fringing reefs occur mainly on parts of the coasts of Hainan Island and Taiwan Island. Both rapid economic development and population growth have resulted in serious damage and degradation of many of China's coral reefs (Zhang 2001). China's reefs have also been particularly targeted for valuable edible fish and other various species. As a result, areas around Hong Kong and the Xisha Islands have been significantly damaged due to overfishing and destructive fishing practices. Around Hainan Island, illegal fishing activities and the sale of living corals for the aquarium trade also occur. Finally, sedimentation, freshwater incursion, and sewage outflows have also negatively impacted China's reefs (Hui, 2004).

There are a series laws or regulations regarding coral reef protection and management. For example, 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 (Zhang 2004). Articles 32 to 37 are regulations to disclose the type and amount of industrial pollution, pesticides, medical waste and rules for pollution discharging facilities. In 2000, the State Management Regulation

was revised, putting more emphasis on coral reef protection, restoration of damaged reefs and establishment of marine reserves. In addition, the Hainan Province Regulation of Coral Reef Protection issued in 1998 prohibits coral mining for building materials and limestone; blast fishing and cyanide fishing; coral and shell collection for the curio trade; and the establishment of waste outfalls into coral reef marine reserves. Also, Chapter IV, article 30 of the Fisheries Law of the People's Republic of China 2004 bans the use of poisons and explosives. Finally, the State Law of Ocean Use Management issued in 2001 demands that all coastal development programs be in accordance with the Division of Marine Functional Zonation made by government.

The World Database on Protected Areas[57] shows over 40 marine and terrestrial sites and eight marine sites in China. There are six marine RAMSAR sites and three marine and terrestrial Ramsar sites. Yancheng National Nature Reserves is a marine and terrestrial Ramsar site and a marine UNESCO-Man and the Biosphere site. There are two marine and terrestrial UNESCO-Man and the Biosphere sites. However, as of 2004, only 3 Marine Coral Reef Reserves exist. These Coral Reef Reserves are strictly "no-take" areas where only scientific research is permitted and include Sanya National Coral Reefs Reserve (the only national coral reef reserve in China), the Dongshan Bay Provincial Coral Reefs Nature Reserve, and the Dengloujiao Provincial Coral Reefs Nature Reserve in Guangdong Province (Hui 2004). The implemented policies of the reserves include prioritizing conservation, appropriate utilization, and sustainable development (Zhang 2004). In addition, since 1996, several marine parks in Hong Kong have been established with the sole aim of conserving coral reefs.

The high value of reef resources in China encourages fishing effort throughout Asia and the Pacific even after targeted species are considered rare (Gillett, 2010). Live reef fish are culturally popular and mainland China is vying with Hong Kong as the biggest importer of live reef fish in the world (Johannes, 1997). Through fishing and live reef fish collection, 80 percent of the reefs off the coast of Hainan Island are damaged or degraded (Zhang, 2004).

Paracel (Xisha) Islands. The Paracel Islands in the South China Sea are composed of 130 small coral islands and reefs divided into the northeast Amphitrite Group and the western Crescent Group. China has occupied the Paracel Islands since 1974, although claims of territory have been made by other countries. Due to jurisdictional disputes and long-standing conflicts over sovereignty of the islands, the South China Sea is being over-exploited and degraded on a daily basis. This region is considered under high threat from destructive fishing (Bryant *et al*., 1998).

Spratly (Nansha) Islands. The Spratly Islands are a group of more than 750 reefs, islets, atolls, cays and islands in the South China Sea between Vietnam, the Philippines, China, Malaysia, and Brunei. Coral reefs are the predominant structure of these islands. The Spratly group contains over 600 coral reefs in total. These islands are claimed by 6 different countries, with 1 EEZ claimed by Brunei (which encompasses only one area of the islands) therefore making regulations of these islands nearly impossible to enforce. The Pratas Islands (Dungsha) Group within the Spratly Islands was successfully established as a Taiwanese National Marine Park in 2007, however most regulations that out-law activities in other areas of the region (such as dynamite and cyanide fishing) are not implemented or enforced in the waters of the South China

[57] http://www.wdpa.org/

Sea. A proposal to create an international marine peace park has been examined by claimant nations in a series of workshops. In the meantime, the area of the South China Sea remains susceptible to unsustainable commercial fishing and destructive fishing practice (Burke *et al.* 2002). Bryant *et al.* (1998) consider the reefs at low risk, due to location, but state that unclear ownership and exploitation of resources can exacerbate threats from destructive fishing.

2.2.1.33 Colombia

Colombia's Pacific coast extends for 1,300 km (Colombia's Caribbean coast is covered in Section 2.2.1). Reef development on Colombia's Pacific coast is sparse in comparison to Colombia's Caribbean coral reefs, with Gorgona Island being the only place that exhibits extensive coral formations. Coral reef decline has been significant in Colombia in the last 3 decades due to both natural and anthropogenic threats such as overfishing and significant deforestation. There are 3 MPAs in Colombia's Pacific Waters, all of which are National Parks. The Island of Gorgona and its surrounding waters were designated the Gorgona National Nature Park in 1984. The only inhabitants on the island are the Park Guides which are required to accompany tourists while on the island. Within protected areas, taking of corals and other extractive and/or disturbance activities are regulated. The Pacific reserves, although smaller than their Caribbean counterparts, have seemingly fewer management problems and are better conserved (Garzón-Ferreira and Rodríguez-Ramírez 2010).

2.2.1.34 Comoros Islands

The Comoros Archipelago is situated in the Mozambique Channel between Madagascar and the East African coast. The Comoros Islands suffer from threats to biodiversity from unplanned development, overexploitation of marine resources, and overpopulation. The Comoros Islands has 430 km² of reef. Threats to corals include overfishing, coral mining and dynamite fishing.

The management of marine and coastal resources is not the responsibility of any single institution. Decree no 93-115/PR if 31 July 1993 establishes the mission, organization and Assignments of the Directorate of the Environment. The 1994 framework law for environment regulates activities relating to the protection of the national heritage and the creation of protected areas. Decree No 93-114/PR of 31 July sets out the mission for the Directorate of Fisheries (Abdoulhalik 1997). Throughout the Comoros, it is prohibited to fish with dynamite or poisons, while in some villages they banned the use of fishing nets, traps, and underwater spearguns (Project GloBAL, n.d).

Currently, the Comoros Islands has only 1 legislated marine protected area: Mohéli Marine Park. The park covers 404 km² and was initially funded by the Global Environment Facility and the United Nations Development Program. Currently, the park is funded by park entrance fees and is managed and enforced by local village-nominated "eco-guards." The eco-guards of the Mohéli Marine Park monitor sea turtle nesting beaches, reef health and fisheries. The park seems to be showing evidence of increased coral coverage and re-growth, as well as increased fish diversity and abundance (Granek and Brown 2005), which is likely due to local participatory management. The Comoros Islands are signatories to the Regional Convention for the Protection, Management, and Development of the Marine & Coastal Environment of Eastern Africa which specifically recognizes the value and threats to marine ecosystems.

2.2.1.35 Costa Rica

The Pacific coast of Costa Rica is 1,160 km long and has coral reefs along the coast and around off-shore islands (Costa Rica's Caribbean coast is covered in Section 2.2.1). The Costa Rican government lacks any specific policy regarding coral reefs (Cajiao- Jiménez 2003 in Cortes *et al.* 2009). The Pacific coast of Costa Rico has only three protected areas that focus on protection of the marine environment. These include: Parque Nacional Marino Las Baulas (Las Baulas National Marine Park), Parque Nacional Marino Ballena (Ballena National Marine Park) and Área de Conservación Marina Isla del Coco (Isla del Coco Marine Conservation Area). Extraction of corals and/or live rock is prohibited within protected areas; however reef fish extraction still takes place in some areas. In most parks, commercial fishing has been controlled, but it is still known to occur within the outer limits of the protected areas. Tourism is only being regulated at two specific islands, but not in other areas. Finally, "a decree banning the extraction of corals and other reef organisms in Costa Rican waters was drafted and submitted in September 2005 but has not yet been signed" (Cortes *et al.* 2009).

2.2.1.36 Djibuoti

Djibouti lies at the junction of the Red Sea and the Gulf of Aden, with most of its coastline lying along the narrow Gulf of Tadjourah. Djibouti comprises a rich marine biodiversity and has 370 km of coastal area (and 4 principal islands). Generally, the reefs of Djibouti experience high turbidity, limiting coral growth to depths between 15 and 25 meters (although corals have been reported at depths below 35 m) (PERSGA 2001).

Djibouti has numerous laws at the national level for the protection of the marine environment and includes provisions on marine pollution, protection of endangered species and the creation of protected areas. Djibouti has two marine protected areas: the Territorial Park of Musha (est. 1972) and the Integral Reserve of South Maskali (est. 1980). The Park of Musha was first established by Order 72-1363/SG/CG of 20 September 1972, which prohibits the collection of corals and mollusks. Subsequently, Decree 80/062/PR/MCTT of 25 May 1980 extended the protection to the Maskali Reserve (PERSGA 2001). Fisheries regulations prohibit certain fishing techniques, such as the use of explosives and poisons as well as the export of reef fish. Underwater hunting is also prohibited: only artisanal fishing of edible species is allowed in the marine protected areas.

2.2.1.37 Ecuador

Overall, Ecuador is home to less than 50 km² total reef area with only approximately 16% at risk. There are few coral reefs developed on the mainland of Ecuador; however, it is in the Galapagos Islands where the reefs are best developed. Increasing fishing pressure is estimated to be the most pressing threat to reefs in Ecuador (Spalding 2001). Specific federal regulations for coral in Ecuador could not be found. A ministerial agreement states that the first 8 nautical miles adjacent to the coast are for the exclusive use by artisanal fishermen. Additionally, the fisheries law states that no harm may be caused to areas that are declared protected, with corals included under those protections[58]. Ecuador's Ley de Gestion Ambiental (Law of Environmental Management) establishes principles and directives for environmental management, land-use planning, zoning, sustainable use, and natural heritage conservation.

[58] http://www.mcatoolkit.org/Field_Projects/Field_Projects_Ecuador.html

Galapagos National Park and Marine Reserve. In 1959, the Ecuadorian government set aside 1,714,000 acres (693,700 ha), 90% of the Galapagos Islands as a National Park. The Galapagos Marine Reserve Law created the Galapagos Marine Reserve in 1998 and incorporated the Reserve into the National Park. Ley Especial de la Provincia de Galapagos (Special Law for the Province of the Galapagos) states: The Marine Reserve is a multiple use and integrated management area extending 40 nautical miles from the baselines of the archipelago and inland waters out toward the sea. Article 40 defines the Management Plan for the Marine Reserve of the Galapagos and defines zoning used and fishing activities allowed to protect vulnerable species and fragile island ecosystems ensuring ecosystem conservation.

The Marine Reserve Law also established the Galapagos National Park Service as the authority in charge of administration, management and control of the marine reserve, as well as coordinating control with the fisheries ministry and the navy. Additionally, the law established a multi-sector management board consisting of the Galapagos National Park Service and the users of the Galapagos Marine Reserve. The Park Rules prohibits removing or disturbing any plant, animal, or remains of such (including shells, bones, and pieces of wood), or other natural objects.

2.2.1.38 El Salvador

As with the neighboring countries, El Salvador's coast is dominated by mangroves and swamplands, thus corals are uncommon, although at least one major reef is found in El Salvador's waters. The Ley de Medio Ambiente (Environmental Law) of 1998, article 74 states that it is prohibited to alter coral in an ecological reserve. The Ley de Areas Naturales Protegidas (Law of Natural Protected Areas) of 2005 says it is forbidden to destroy or damage natural resources or make changes to environments that cause harm to biodiversity or landscapes. No specific regulatory mechanisms for corals could be found.

2.2.1.39 Egypt

The coastline of Egypt has fringing coral reefs throughout both the Gulf of Suez and Gulf of Aqaba. Coral reefs tend to be patchy within the Gulf of Suez while vertical drop-offs are common in the Gulf of Aqaba. Continuous fringing coral reefs extend along the coastal regions outside of the two gulfs through to the border of Sudan. Coral reefs in Egypt experience restricted growth due to a number of factors including: water temperature, sediment load, salinity and light intensity. For these reasons, reef growth is more prevalent in the Gulf of Aqaba. Coral reefs in Egypt are threatened by pollution such as sewage and garbage from urban and recreational contributions, as well as rapid, uncontrolled coastal development and tourism impacts (Cesar, 2003). Most notably, physical breakage of corals from divers and anchors as well as coral species collection have all led to the rapid deterioration of coral reefs in Egypt.

In 1983, the Egyptian Conservation Law No. 102 set up the legislative framework for the establishment of protectorates. Specifically, this law prohibits any action that may damage or alter any organism, habitat, or living resource of the marine protectorate. It also prohibits the introduction of exotic species and the taking of any organisms or materials (Shehata 1998). The Law of the Environment (Law No. 4 for the year 1994) established the Egyptian Environmental Affairs Agency (EEAA) which is the administrative body that formulates policies and plans for the protection and promotion of the environment (PERSGA 2001). In 1996, the EEAA released guidelines for the development of coastal areas, establishing rules and regulations for the

following: mooring and anchoring in the Red Sea, diving and other water sports, hotel ships, establishment of marinas, embankments, and jetties, etc.

Egypt has a total of 6 marine reserves that include protection for coral reefs. The Ras Mohamed Marine Park (established in 1983 but not actively managed until 1988) covers 210 km² and was declared Egypt's first National Park in 1989. In 1992, two additional marine Protectorates in the Gulf of Aqaba were declared (Nabq and Abu Galum Managed Resource Protected Areas). In 1994, Napq and Abu Galum Managed Resource Protected Areas were linked with the Ras Mohamed Marine Park to form the Ras Mohamed National Park Sector which covers 1470 km² and 52% of Egypt's littoral on the Gulf of Aqaba. The success of the EEAA's actions on the Gulf of Aqaba (with strong support from stakeholders) led to the declaration of the remainder of Egypt's littoral as protected (Shehata 1998). Current regulations to protect reefs within protectorates include:

- Strictly implemented dive site management plan regulating the number of boats and divers/snorkelers that can access main dive areas
- Scientific reserve areas
- Rehabilitation areas (for heavily used sites)
- The use of anchors is prohibited to minimize physical damage to coral reefs
- Installation of mooring buoys
- Fish feeding (which affects fish behavior and upsets the ecological balance on the reef) is prohibited.
- The collection of coral, shells or any natural marine element is strictly prohibited.

2.2.1.40 Eritrea

Eritrea is located in the northeastern corner of the Horn of Africa and has approximately 1,200 km of coastline along the Red Sea. Eritrea's coastline includes over 350 islands, with approximately 210 islands in the Dahlak Archipelago (Pilcher and Alsuhaibany 2000). The coral reefs of Eritrea are reported to be in pristine condition and a global "hot spot" of marine biodiversity, supporting over 600 species of fish and 220 species of corals. Eritrea has remained isolated over many years due to wars with neighbor Ethiopia, and has very little tourism development; as a result, the coral reef ecosystems remain relatively untouched (Martell 2008). Additionally, Eritrean corals are uniquely tolerant of elevated sea surface temperatures. The average surface water temperature in the summer is 32.5 C. Corals elsewhere around the world would normally experience bleaching at these levels, whereas Eritrean corals are temperature resistant (Martell 2008).

The 1998 Eritrean Fisheries Proclamation No. 104/1998 prohibits direct harvest and domestic trade of endangered and protected species. Eritrea aims to become the first country in the world to turn its entire coast into an environmentally protected zone to ensure balanced and sustainable development. The State intends to protect its 1,350-kilometer coastline, along with another 1,950 kilometers of coast around its more than 350 islands, according to the draft coastal policy document.

Currently there are no legally established areas of protection in Eritrea; however, laws in the previous Fisheries Proclamations include a number of initiated articles relevant to the protection and conservation of marine resources, including the establishment of marine protected areas. A

National Protected Areas Network aiming at maintaining the diversity and viability of the various components of Eritrean's natural heritage, and to insure the sustainable utilization of the natural resources within them, has been planned by the Eritrean government (Pilcher and Alsuhaibany 2000).

2.2.1.41 Federated States of Micronesia

The Federated States of Micronesia (FSM) is comprised of 607 islands found within four states. From east to west, Kosrae, Pohnpei, Chuuk and Yap span 1.6 million km2 of the western Pacific Ocean. Each island or group has its own language, customs, local government and traditional system for managing marine resources. The FSM has a total landmass of 702 km² comprised of both high islands and atolls, with land elevation ranging from sea level to about 760 m according to the FSM National Biodiversity Strategic Action Plan (NBSAP), 2003 (George *et al.* 2008 in J.E. Waddell and A.M. Clarke (eds) 2008).

Among numerous natural and anthropogenic threats to Micronesia's coral reefs, overfishing has been identified as the most urgent and critical threat across biologically significant marine areas in all states (TNC 2003). The breakdown of traditional management systems throughout Micronesia has contributed to overharvesting. The Title 24 of the Code of the Federated States of Micronesia prohibits catching of marine life through explosives, poisons, chemicals, or other substances with intent to kill marine life. There are also seasonal closures and size restrictions of some marine species.

Each state in the FSM has two government regulatory agencies that manage coral reef ecosystems: Marine Resources Divisions (MRD) and Environmental Protection Agencies (EPA). There are protected areas established within FSM that encompass coral reefs and are managed either nationally or by community stakeholders. Historically, the national government was not very involved in establishing MPAs, but with the establishment of the FSM Protected Areas Network, they have become a higher priority in the NBSAP under the goal of preserving "a full representation of the FSM's marine, freshwater, and terrestrial ecosystems." The NBSAP sets a clear conservation objective under the major theme of ecosystem management. Pohnpei has established 11 legal marine sanctuaries and a central Watershed Forest Reserve. The five MPAs in Kosrae are co-managed at the local and state level. Traditional management is common throughout Chuuk. Yap State had created one MPA that is a Locally Managed Marine Area (George et al., 2008). Throughout FSM, there are marine reserves with no-take zones for both fishing and mangrove harvest[59].

Also, by supporting the Micronesia Challenge, government officials have gained financial, technical, and community support for establishing the FSM Protected Areas Network. The most effective forms of fisheries management in Micronesia are from traditional systems where community-based (Yap, for example) or participatory approach (used in Kosrae) is used. Traditional systems are enforced by community leaders and often do not involve economic incentives (FAO, 2002).

59 http://www.seacology.org/projects/micronesia_projects.htm

2.2.1.42 Fiji

Scattered across roughly 1.3 million square kilometers of the South Pacific, the Fijian Archipelago encompasses one of the most extensive coral reef systems in the world. While Fiji's insular shelf is relatively narrow, extensive reef formation has occurred around all islands. There is no systematic establishment of protected areas in Fiji and no formally designated Marine Protected Areas. Legislative and institutional responsibilities are ill-defined, with the Departments of Environment, Fisheries and Forestry and the National Trust for Fiji all having some legislative responsibilities for the management of the protected areas in Fiji.

The most recent and comprehensive piece of environmental legislation in Fiji is the Sustainable Development Bill, drafted in 1998. This Bill is to update and replace all existing environmental, resource management and conservation legislation. One of the main objectives of this Bill is to create new legal frameworks and effective administrative mechanisms for environmental impact assessments, pollution and waste management, integrated natural resource management, biodiversity conservation, and national parks management (Fiji Department of Environment 1997). Coral reef loss was identified as a key environmental issue. Other legislation affecting the conservation of the marine environment in Fiji includes the Environment Management Act of 2005, which provides regulations concerning pollution and waste management as well as requiring EIAs for development projects. The Fisheries Act of 1941 and Fisheries Regulations of 1961 prohibits fishing methods such as the use of dynamite and poison, and requires a license to fish (Fiji Department of Environment 1997). Regarding other issues (the protection of certain species, creation of marine reserves, fishing with self-contained underwater diving equipment, ornamental fishing etc.), most respective laws only authorize the minister to regulate them *via* specific regulations. The Endangered Species Act of 2002 and subsequent regulations of 2003 regulates trade of endangered species according to CITES. However, coral species are not listed under this Act or under Fiji's species of concern list.

2.2.1.43 France

French overseas territories in the Indo-Pacific region include French Polynesia, La Reunion, Mayotte, New Caledonia, and the islands of Wallis and Futuna. Collectively, these French colonies have about 4 percent of the coral reef area in the world. Under French law, leatherback turtles, lobsters and corals are all protected under legislation no. 79-6, AD/3/3 of April 1979. In 2009, French President Sarkozy announced that by 2012, 10 percent of France's maritime space will be protected, with 50 percent of the area within reserves and no take zones. This plan to upscale France's MPAs includes overseas territories of French Polynesia and New Caledonia (IUCN 2009).

French Polynesia. Governing with a status of autonomy, French Polynesia is a French overseas territory in the southern Pacific made up of several groups of Polynesian islands, the most famous island being Tahiti in the Society Islands group. French Polynesia has about 12,800 km^2 of total reef area, with all reef types represented. French Polynesian reefs are threatened by both natural and anthropogenic threats. Human-induced threats include extraction and mining, over-fishing, tourism activities, black pearl culture etc (Salvat *et al.* 2001).

Marine nature reserves have been declared in various areas of French Polynesia; however these reserves represent only about 1 percent of French Polynesian Reefs. In order to resolve user conflicts, the French Polynesia government is setting up Management Plans of Marine Areas

which restricts activities within lagoons and reef areas (Salvat *et al.* 2001). The Management Plan Maritime Spaces (PGEM) sets guidelines for the protection, exploitation and management of lagoons and the Minister for the Environment is responsible for managing coral reefs. The overseas committee of the French Initiative for coral reefs (IFRECOR) was established via the Decree of July 7, 2000 by the Minister. IFRECOR is responsible for a developing strategy and national action plan for coral reefs, as well as making recommendations and ensuring the protection and sustainable management of these reefs in order to develop the information for the public on coral reefs and coastal zone management. Deliberation on the Protection of Nature was adopted in 1995 (Decision No. 1995-257/AT of December 14, 1995 on the protection of nature, JOPF of December 28, 1995) and represents new principles for the regulation of the protection of nature, calling for the precautionary principle and individual and collective responsibility. It addresses natural protected areas, protection of fauna and flora species, and threatened biodiversity.

There are seven MPAs established in 1971 in French Polynesia according to the Environmental Code. Four are IUCN category IV, two are IUCN category I and one is not categorized. PGEM island of Moorea and seven atolls comprising Fakarava were established as MPAs in 2000 (Verducci 2007).

La Réunion. Approximately 40 percent of the island of Réunion is part of a France's 9th national park, called La Réunion National Park and was created in 2007. It is one of the protected natural environments in France's Overseas Departments. To combat coral reef degradation, Réunion has also funded a National Natural Marine Reserve with an area of 35 km², encompassing 80% of the island's coral reefs. Under the name of Villages Créoles, there is a network of fifteen communities that are engaged in a quality, responsible approach. Within the reserve, there are three levels of protection: **level 1**, restricts certain uses; **level 2**, allows commercial fishing in 20 percent of this area and traditional fishing in certain places; and **level 3** prohibits all activities including work, traffic, and moorings, but permits may be obtained for scientific purposes. There are a few fishing restrictions in the reserve, including no night fishing and no recreational fishing, net fishing, or spearfishing in enhanced protection zones[60]. The network's goal is to participate in the development of populations and areas, and to contribute to the preservation of the environment, natural resources, and biodiversity. In 2007, the Réunion National Natural Marine Reservewon an award in the Culture and Heritage category at the Responsible Tourism Awards.

Mayotte. Mayotte is situated in the northern Mozambique Channel, between Madagascar and the African mainland, and is part of the Comoros archipelago. Mayotte is almost entirely surrounded by a 197 km long barrier reef, with a second double-barrier in the southwest and the immerged reef complex of Iris, in the northwest, which has an area of 40km².

Various government decrees have been established to regulate fishing in Mayotte. The Decree No. 90-618 of 11 July 1990 Article 4 prohibits spearfishing on compressed air or using chemicals while spearfishing. There is no underwater fishing with a spear between sunset and sunrise and it is forbidden to use a light while spearfishing. Also, it is prohibited to use dynamite or spear guns in lagoons. Article 5 prevents the degradation of fisheries resources, establishes

[60] www.reunion.ecologie.gouv.fr

protection zones around aquaculture facilities, and limits the type of fish gear used and species taken (Pusineri and Quillard 2008).

There are three marine protected areas, one IUCN category IV MPA, protected area managed mainly for conservation through management intervention, Passe de Longogori Strict Fishing Reserve; one IUCN category II MPA, protected area managed mainly for ecosystem protection and recreation, Saziley Parc Marin; and a no category MPA. These areas contain mangroves and/or coral reef habitat[61].

New Caledonia. New Caledonia is an overseas Department of France in the Southwest Pacific. New Caledonia contains one of the world's largest lagoon systems, encompassing 10 million acres (44,000 km²). In July 2008 the World Heritage Commission listed the lagoons as containing 15,743 km2 of coral reefs, or 60% of the total reef area. The location of the reefs has largely protected them from recent massive coral bleaching events that have had profound impacts on the reefs of neighboring countries. The Commission acknowledged that these reefs were of global significance, noting the large numbers of species, including many found nowhere else on earth.

New Caledonia addresses land use and coral extraction through a few pieces of legislation. The World Heritage implementation is supported by specific legislation on fisheries, land and water use planning, urban development and mining (Morris and Mackay 2008). The Memento Sur La Reglementation des Peches Maritimes 2004 prohibits commercial fishing for coral from vessels without a permit, with the exception of coral genera *Acropora* and *Fungia*. The weight of the harvested fragments of the coral genus *Acropora* cannot exceed 300 grams. Also, it establishes a national marine protection zone and multiple marine reserves. There is a protection zone of 1,000 m from the leaves of the highest tides around the islands of Grande Terre, Mare Island, Lifou, Ouvea, Ouen, Tiga, Yande, the Isle of Pines, and the archipelago of Belep. Within this zone, fishers must retain a permit to use nets longer than 100m and coral harvesting allowed for commercial purposes. These regulations establish Yves Merlet reserve, the Bay of Prony reserves, the wreck of Humboldt reserve, l'îlot Ténia marine reserve, Nékoro special reserve, and Ouano special marine reserve all of which include areas of where fishing is prohibited. There are a total of 17 protected areas that have limited or no fishing and coral harvesting restrictions. Another seven are marine and terrestrial protected areas[62].

An important management feature in New Caledonia is the strong customary tenure and practices of the Kanak (Melanesian) people. The Kanak people were involved in developing the management framework in partnership with the French, New Caledonian and Provincial Governments. Approximately 50% of the main island and all the offshore islands are held in customary tenure through local chiefs and villages; whereas individual land ownership is most prevalent around the capital, Noumea, and on the west coast of Grand Terre.

Wallis and Futuna. Wallis and Futuna are an overseas territory of France, consisting of 3 main islands: Wallis, Futuna, and Alofi. Wallis has fringing reefs around most of its coastline and is surrounded further by a barrier reef. Futuna coasts all have narrow fringing reefs, and Alofi has

[61] http://www.wdpa.org
62 http://www.wdpa.org/

few such areas. Fishing is important, although mainly on a subsistence level. Blast/dynamite fishing is still a problem in the islands.

2.2.1.44 Guatemala

The Pacific coast of Guatemala supports few corals and has few if any coral reefs. The Caribbean coast is covered in Section 2.2.2.

2.2.1.45 Honduras

The Pacific coast of Honduras is lined by the Gulf of Fonseca which is dominated by mangroves and swamplands, thus coral reefs are not found in the area. The Caribbean coast of Honduras is covered in Section 2.2.2.

2.2.1.46 India

The following description of India's regulatory mechanisms includes mainland India as well as the Andaman and Nicobar Islands. The law and policy for coral reefs in India is virtually non existent. There are a few laws in the country that can be activated for the protection of coral reef areas such as the Environment (Protection) Act of 1986 and the Coastal Regulation Zone Notification of 1991 issued under the broad EPA, as well as the Wildlife (Protection) Act of 1972, which protects all coral reef areas in India. Other laws that would have a bearing on coral reef areas are the Indian Forest Act of1927, the Forest Conservation Act of 1980, and the Indian Fisheries Act (which is of vintage origin). Various state fisheries acts would also be relevant for conservation and management of coral reef areas. For example, the Comprehensive Marine Fishing Policy bans destructive fishing methods.

There are 31 Marine and Coastal Protected Areas, 18 of which are fully under water and the other 13 being partially on land. There are also 100 wildlife sanctuaries (Pas) that have terrestrial or freshwater ecosystems that border seawater or partially contain coastal and marine environments (Rajagopalan 2008). The Gulf of Mannar is classified as both a regional MPA and a marine and terrestrial UNESCO-MAB Biosphere site. Sunderban (India) and Sundarbans National Park (Bangladesh) are the same area shared between the two countries and are classified as marine and terrestrial World Heritage sites and UNESCO-MAB Biosphere sites. There are four marine Ramsar sites and four marine and terrestrial Ramsar sites[63].

Within the Andaman and Nicobar Islands, there are two marine reserves called Mahatma Gandhi Marine National Park and Rani Jhansi Marine National Park. The government sponsors research on wetlands, coral reefs and mangroves (Rajagopalan 2008). Marine Protected Areas in India. (International Collective in Support of Fishworkers: 87).

Overall, it should be noted that even under the Wildlife Protection Act, coral reef areas possess no separate legal status. The Marine National Parks which have coral reefs fall under the responsibility of the Ministry of Environment and Forests. However, the national laws that are applicable to coral reef areas involve various departments of the government agencies (state forest departments, fisheries departments and most recently the state coastal management

[63] http://www.wdpa.org/

authority at the state level). The laws are not area specific and do not distinguish coral reef areas from other islands, coastal and marine areas.

2.2.1.47 Indonesia

Indonesia has more coral reef areas than any other country in the world, encompassing about 18 percent of the world's total. Comprised of some 17,508 islands (Hopley and Suharsono 2000), the archipelagic state of Indonesia spans a vast area, with 80,791 km of coastline and approximately 42,000 km² of coral reef (Bryant et al., 1998). Coral reefs may be found all around Sulawesi, NusaTenggara, Bali and Maluku; some reefs are also found in West Irian Jaya, islands East and West of Sumatra and East of Kalimantan[64]. According to the World Resource Institute's Reefs at Risk in Southeast Asia project, modeling suggests that human activities threaten over 85 percent of Indonesia's coral reefs, with nearly one half at high threat. Principal threats to Indonesian reefs include overfishing and destructive fishing, which threaten 64 and 53 percent of Indonesia's reefs, respectively (Burke *et al.* 2002).

In 1990, Indonesia passed the "Conservation of Living Natural Resources and their Ecosystem Act" which dealt with the sustainable utilization of resources and ecosystem maintenance. This piece of legislation has become the fundamental regulatory tool for the management of protected areas (ASEAN Regional Centre for Biodiversity Conservation 2002). According to the World Database on Protected Areas[65], there are 316 marine and terrestrial protected areas and 24 MPAs in Indonesia. MPAs are nationally managed by the Ministry of Forestry in Jakarta and provincially managed by Konservasi Sumber Daya Alam (KSDA). Under the Ministry of Forestry, the Spatial Planning Act of 1992 requires MPAs to have a 25-year management plan in addition to short and medium plans for 1 to 5 years (Clifton, 2003). The Spatial Planning Law 26/2007 established under the Spatial Planning Act differentiates the uses of areas within two or more provinces spatially and requires the provinces to determine these areas. MPAs serve as environmental conservation areas under this law[66]. MPAs are also managed nationally by the Ministry of Marine Affairs and Fisheries according to the Fisheries Law 31/2004. Komodo National Park is both a marine and terrestrial World Heritage site and a marine UNESCO-MAB Biosphere site. Lorentz National Park is also a marine and terrestrial World Heritage site. There are two marine and terrestrial RAMSAR sites, Berbak and Wasur National Park. Siberut and Tanjung Putti are marine and terrestrial UNESCO-MAB Biosphere sites. Conservation areas, particularly areas containing mangroves habitat, are designated by the government. Approximately 38,000 km² of mangrove area are protected within marine protected areas[67]. For the majority of MPAs in Indonesia, there are no management activities; only minimal levels of management in the marine national parks and some NGO activities are evident in a few sites. For example, of the six Marine National Parks, only three have management plans being implemented (ASEAN Regional Centre for Biodiversity Conservation 2002).

The Ministry of Marine Affairs was established by Presidential decree No.9 in 2005, and stipulated that the main mission of the Ministry of Marine Affairs is: "To Assist the President (of the Republic of Indonesia) in holding the process of governance in the Marine and Fisheries

64 www.arcbc.org/arcbcweb/publications/mpa.htm

65 http://www.wdpa.org

66 http://indonesiaurbanstudies.blogspot.com/2008/09/historical-overview-of-spatial-planning.html

67 www.arcbc.org/arcbcweb/publications/mpa.htm

sector." The functions of the Ministry of Marine Affairs include formulation of national, implementation, and technical policy in the Marine and Fisheries sector, implementation of governance affairs in the Marine and Fisheries Sector, management of state-owned properties under Ministry of Marine Affairs, supervision of Ministry of Marine Affairs mission implementation, and delivery of report to the President on the account of evaluations, suggestions and consideration on Ministry of Marine Affairs mission and Function.

Under the MMAF, fishing regulations are established that impact coral reef areas. The Fisheries Law 31/2004 prohibits the use of chemicals and explosives. Clarification of the Act of the Republic of Indonesia No. 9 of 1985, article 6 prohibits catching or cultivating fish using materials or tools that may endanger or cause pollution to the fishery resource and its environment. This act also prohibits the use of explosives, but states an exception for scientific research. The Decree of the Minister for Agriculture N°609/Kpts/Um/9/1976 on the Fishing Areas for sea-bed trawlers delineates certain areas in Sumata, Java, the Nusa Tenggara Islands, Malacca, Borneo, Karimata, and Macassar where vessels are permitted to use sea-bed trawls, thus impacting coral reefs where sea-bed trawlers are permitted. Regulation of the Minister of Marine and Fishery No. PER.06/MEN/2008 from February 26, 2008 allows trawlers to fish in the Northern Part of East Kalimantan, subject to size and weight of the trawler. Additionally, the Indonesian Act No. 9/1985 on Fishery, Articles 6 and 7 prohibit the export of recently dead coral.

The Fisheries Law 31/2004 also provides provisions for mangrove habitat and emphasizes the sustainable use of aquatic resources in developing capture and aquaculture fisheries. Development of aquaculture is a major threat to mangrove habitat in this area. Licenses and EIAs are required for shrimp and fish breeders operating facilities larger than 50 ha. Small scale fishers and breeders are not required to get a license, though. Indonesia is also part of ASEAN, which mandates good shrimp farming management practices (FAO 2010). In 2007, Indonesia enacted Act No 27/2007 on management of coastal zone and small islands, regarded as ICZM policy framework, with the Ministry of Marine Affairs and Fisheries appointed as leading agency. ICZM in Indonesia, however, remains in its infancy due to a lack of cooperation and coordination between the central and local governments, inconsistency of laws, and inconsistency of zoning laws.

2.2.1.48 Iran

The coastline of Iran is approximately 2000 km along the Persian Gulf and the Gulf of Oman. Corals are mostly restricted to the offshore islands on the Gulf coast of Iran that are often protected passively by military bases. This also restricts access to these islands for scientific work, such that many of the important coral areas in Iran remain un-surveyed. Threats to coral reefs in Iran include: oil production and pollution, temperature fluctuations, breakwater construction, sedimentation during land reclamation, dredging, depletion of corals by local people, fishing for aquarium trade, extensive anchor damage, discharge of nutrients and sewage (Maghsoudlou *et al.* 2008).

Goals of Iran's Department of Environment include (translated from http://epo.ir/Portal/home/default.aspx):

- Protect the environment and ensure the correct utilization in line with environment and sustainable development

- Use of environmentally friendly technologies while providing environmental guidelines for site location of large industrial locations, agricultural and human settlements.
- Identification and critical habitats of high value
- Develop regional and international cooperation in environment
- Preparing environmental regulations and standards for management and utilization of water resources, soil, air, waste and solid waste management in urban, rural, industrial and agricultural ecosystems by controlling interference in their normal capacities
- Develop environmental awareness
- Collection, preservation and display of plant and animal species through the creation of museums and exhibitions
- Supervision and legal intervention to prevent and prohibit entry to the sources of environmental pollutants

Laws that may indirectly protect coral reefs include the Environmental Protection and Enhancement Act (1974) the Prevention of Water Pollution Regulation (1994); however, no legislation pertaining specifically to corals could be found.

2.2.1.49 Israel

The coral reefs of Israel are found in the Gulf of Eilat (Aqaba) a semi-enclosed basin that stems from the Red Sea. These reefs represent some of the northern most reefs in the world and have high levels of biodiversity. According to the Reefs at Risk Revisited analysis, 60% of reefs in the Red Sea region are threatened (Burke et al. 2011). Along the Israeli coast, pollution, coastal development, and fishing represent the most pervasive threats to coral reefs. The Israel Ministry of the Environment is the main governing body with management authority of the marine environment. Legislation that protects coral reefs from threats of land-based sources, oil pollution, and local threats are described below:

Protection of the Coastal Environment Law, 2004. The stated aims of this law, which came into force on November 15, 2004, are:

- To protect the coastal environment, its natural and heritage assets, to restore and preserve them as a resource of unique value, and to prevent and reduce as far as possible any damage to them;
- To preserve the coastal environment and the coastal sand for the benefit and enjoyment of the public, for present and future generations;
- To establish principles and limitations for the sustainable management, development and use of the coastal environment.

Prevention of Sea Pollution from Land-Based Sources Regulations, 1990- These regulations relate to permits for the discharge of waste or sewage into the sea from a land-based source which may or may not be granted by the Permits Issue Committee. The committee decides whether a permit is warranted, and if so under what conditions and for how long a time. Permits are only issued under special conditions when the waste or wastewater does not contain toxic materials harmful to the marine environment, as specified in the annexes to the regulations.

Prevention of Sea Water Pollution by Oil Regulations (Marine Environment Protection Fee), 1983- These regulations set a fee on the owners of vessels and tankers calling at Israeli ports and

on coastal installations handling oil. Different fees are set for vessels, depending on size and purpose, and for tankers and terminals. The collected fees are paid into the Marine Pollution Prevention Fund.

Declaration on National Parks, Nature Reserves, National Sites and Memorial Sites (Protected Natural Assets), 2005- Israel's National Parks, Nature Reserves, Memorial Sites and National Sites Law of 1992 relates, inter alia, to the declaration of "protected natural assets," defined as flora, fauna or minerals, which, in the opinion of the Minister of Environmental Protection, are valuable for protection and are at risk of extinction. The law prohibits destroying, possessing or trading in these protected natural assets. The Red Sea Marine Peace Park between Israel and Jordan was launched in September 1999 to protect the coral reefs shared between the two nations.

2.2.1.50 Japan

Japan's coral reefs are mostly of the fringing type, and are restricted mainly to the Ryukyu Islands and the Ogasawara Islands, which represent the northern limit of the world's coral reef distribution. Reefs in Japan are threatened by coastal reclamation activities and coastal construction, as well as sedimentation and outbreaks of crown-of-thorns starfish (*Acanthaster planci*).

Currently, Japan's coastal management is enforced through three separate laws: the Fishery Act, which affects marine industries, the Harbor Act, and the Coast Act for coastal disaster prevention. Local ordinances are similarly divided, and government agencies in charge of coastal management are separate from each other. Therefore, even though development laws are beginning to include conservation measures and conservation projects are happening in some areas, legal plans or institutions to effectively control them do not exist. Japan has a total of 13 marine parks containing coral reefs that were established under the Natural Parks Law. However, these parks are extremely small and the boundaries have not been defined with any consideration for the regional ecosystem.

The Nature Conservation Law provides for the establishment of Nature Conservation Areas (areas worthy of protection for both environmental and social reasons). The law states that Natural Conservation Areas should include 'areas that sustain well-preserved nature including native fauna and flora, e.g. tropical fishes, corals, and seaweeds. It also provides for the establishment of Marine Special Areas where the collection of marine fauna and flora, reclamation, and dredging are prohibited.

The Natural Parks Law provides for the establishment of Marine Park Zones. Activities such as collection of marine fauna and flora (specified by the Minister of the Environment), reclamation, and dredging are regulated inside Marine Park Zones

Coral reef organisms (including hermatypic corals) are also protected by regulations in Japan, including:

- The Living Aquatic Resources Protection Law- Aims to protect and sustain fisheries resources, and governs procedures for mariculture and aquaculture. The law prohibits destructive fishing methods such as blast fishing and poisoning. This law also promotes sustainable fisheries and establishes the protected waters.

- Fishery Adjustment Rule – established by the governor, regulates the collection of biota, as well as the permissibility of particular fishing gears and boats. Collection of hermatypic corals is completely prohibited in Okinawa and Ogasawara Islands.

Information summarized and adapted from Coral Reefs of Japan (Ministry of the Environment and the Japanese Coral Reef Society 2004).

2.2.1.51 Jordan

Jordan's only coastline lies along the Gulf of Aqaba and is 26.5 km in length. This stretch of coastline is Jordan's only maritime access and has become a major shipping center. As a result, ship traffic in the gulf poses a major threat to coral reefs in the area due to oil pollution. Development from tourism also poses a direct threat to Jordan's coral reefs in the form of coastal sewage pollution and direct physical damage (PERSGA 2001).

In 1995, the Jordanian Parliament passed the Law of Environmental Protection No. 12 with the purpose of establishing a national framework for environmental policy. Article 25 provides explicit protection for corals by banning harm to or removal of coral or shellfish from the Gulf of Aqaba. Article 25 also specifies fines and prison terms for violators Additional protection of fisheries and coral reefs is provided under Agriculture Law No. 20 (1973) which provides for the issuance of fishing licenses and prohibits damage to or removal of corals. Jordan also has a number of laws regarding marine-based pollution. Shipping Law No. 51 (1961) bans ships from dumping soil, stones, sand, scum, toxic and chemical waste, or any other material on land or water. Additionally, Law No. 32 (1972) bans the discharge of ship based pollution, including bilge water (PERSGA 2001).

Jordan established a marine park off the shores of Aqaba and designated a protected coral reef strip stretching seven kilometers on the eastern side of the northern Gulf of Aqaba. Israel has set aside the southern part of the Eilat coast for nature conservation. A four-kilometer 'marine protected belt' lies in the sea, approximately parallel to two on-shore nature reserves which stretch from the southern end of the city of Eilat to the border crossing to Egypt at Taba. There is a cross-boundary cooperative research, monitoring and management program that is assisted by the National Oceanographic and Atmospheric Administration and US-AID.

2.2.1.52 Kenya

Kenya's reefs are extensive and cover almost 240 square miles along the coast, with an estimated total coral reef area estimated at 50,000 ha. These reefs are some of the largest coastal reefs along the shores of the continent of Africa. Two pieces of legislation affecting the establishment of MPAs in coral reef areas in Kenya are the Fish Industry Act of 1968 and the Wildlife (Conservation and Management) Act of 1976. Although neither of these policies specifically mentions coral reefs, through the powers vested in the Kenya Wildlife Service, an agency established by the Wildlife Act, coral reefs are now recognized as valuable ecosystems. Coral reef management in Kenya can be categorized into 3 different management regimes: fully protected, partially protected, or areas offering no protection. As a result, 4 fully protected marine areas (Marine National Parks) and an additional 6 partially protected marine areas (Marine National Reserves) were established. Full protection of a marine area prohibits any extractive use (with or without a license) with the exception of samples for research. This may only be done with the authority of the Office of the President in collaboration with the Kenya

Wildlife Service. Partially protected areas (marine reserves) are reef areas used as buffer zones into the marine parks as well as multiple use areas.

Harvesting of fish and other marine organisms is permitted with a license from the Fisheries Department; however, only traditional fishing techniques and universal hook-and-line is permitted. Destructive fishing techniques such as dynamite fishing, seine netting, and coral mining are prohibited. Non-destructive tourism activities such as scuba diving and water sports are permitted via a nominal fee. Coral reefs outside of designated marine reserves and marine parks have virtually no protection; however the Fish Industry Act prohibits dynamite fishing and coral mining in these areas as well and may elicit enforcement assistance from the police and/or Kenyan navy. Kenya currently has a total area of 956 km² with partial protection under marine reserves, and 54 km² with full protection under marine national parks. Enforcement in certain areas is difficult due to a proximity to neighboring countries (such as Somalia) and remoteness of other areas (Information summarized and adapted from Sam Weru in Ahmed *et al.* 2005).

2.2.1.53 Kiribati

The Republic of Kiribati spans 4200 km of the Central Pacific Ocean, straddling the equator. Kiribati is comprised of 3 different island groups: the Gilbert, Pheonix, and Line Islands. These island groups are scattered over 5,000,000 km² of ocean on either side of the equator and the International Date Line. Kiribati is comprised entirely of coral reefs perched on submerged seamounts and is synonymous with the atoll environment, in which all coral reef forms exist. Kiribati's coral reefs have been subject to numerous anthropogenic stressors, including military bombing, over- harvest, coastal construction, sewage nutrient pollution, oil spills and vessel groundings, solid waste disposal, mangrove clearing and new settlements (Lovell *et al.* 2000). Kiribati has nine protected areas which are wildlife sanctuaries for the protection of seabird breeding areas. Most of these do not include the marine environment, though wildlife reserves can be considered to protect the coral reef ecosystem. However, by establishing the world's largest MPA (410,500 km²) Kiribati has emerged as a global leader in conservation. The Phoenix Islands Protected Area (PIPA) conserves one of the world's last intact oceanic coral archipelago ecosystems, consisting of 8 coral atolls and 2 submerged reef systems in a nearly uninhabited region, with abundant marine and bird life (Vieux *et al.* 2008).

The main piece of legislation relating to the marine environment is the Kiribati Environment Act of 1999. This law lays the legislative framework for environmental protection in Kiribati and deals with conducting environmental impact assessments, managing ozone-depleting substances, marine pollution and waste management which includes an oil spill response, dumping of wastes by vessels, prevention of marine pollution from land-based sources, management of hazardous substances, integrated resource management, fisheries conservation and management, as well as biodiversity, conservation and national parks management (Lovell *et al.* 2000). The Kiribati National Environment Management Strategy (1994) has been developed with the assistance of the South Pacific Regional Environment Programme. They have been involved with many projects which help safeguard the marine environment. The focus of this strategy has been on the formation of many polices concerning sustainable and economical development of the marine resource (Lovell *et al.* 2000). The Fisheries Ordinance 1957 is the main body of regulations that prohibits fishing with explosives or poisons.

2.2.1.54 Kuwait

The most northerly reefs in the Gulf lie around the southern islands, particularly the islands of Kubbar, Qaru and Um Al-Maradim, where they occur in extreme oceanographic conditions with relatively high sediment loading. In this extreme environment, species diversity is relatively low (35 species). Law No. 21 of 1995 & Law No. 16 of 1996 established the "Environment Public Authority (EPA)." These laws included specific regard to Coral Islands and Coral Reefs with objectives to develop coral islands and exploit them as natural reserves, recreational facilities and as fish resources. Also, these laws aim to conserve the coral reefs around coral islands and submerged reefs, and declare them as protected areas to conserve fish breeding sites.

Additionally, Decision No. 210 / 2001, regarding the executive law of the establishment of the EPA, states in article (81) that: it is prohibited to hunt, kill, catch, gather or harm all marine and terrestrial wildlife species or to temper with its young, eggs, nests or refuges to the duration of two years starting at the date of issuance. It is conclusively prohibited to pluck, remove or harm corals or any other coral reef organisms. EPA has two committees related to coral reefs: the National Committee for Biodiversity and the National committee for Trade in Endangered Species. The National Committee for Biodiversity proposed a law for the establishment of protected areas (land and marine) in 1997. In this law, all coral reef areas were recommended to be protected. Under the National Committee for Trade in Endangered Species, Resolution No. 93/2003 regarding the regulation of sale and trade in endangered wildlife species prohibits the exchange, sell or trade in endangered wild life species or in their parts and products, listed in the Appendices of the resolution (coral is listed in these Appendices), in local markets or in private farms, without obtaining required permits and adhering to the conditions listed in the above resolution (Information summarized and adapted from Alsaffar and Al-Tamimi 2006).

2.2.1.55 Madagascar

Madagascar, one of the largest islands in the world, is home to 3300 types of hard corals. Madagascar's coral reefs are threatened by uncontrolled industrial fishing, sedimentation, user conflict over resources and a lack of adequate protection.

The 1990 Charter of the Environment states that any project that might damage the environment must be subject to an Environmental Impact Assessment. It has been supplemented by further decrees that projects in mangrove areas are to be covered under this law as well (Percy and Hishamunda 2001).

Throughout the country, there are multiple parks and reserves that protect coral reef areas. Most notably, there are two marine and terrestrial UNESCO-MAB Biosphere sites called Mananara Nord and Sahamalaza – Iles Radama[68]. The country's northeastern coast features the Mananara Nord National Park and Biosphere Reserve Complex: a major protected underwater refuge with coral reefs that covers 2,000 acres of marine habitat. Additionally, the Sahamalaza/Radama Marine Biosphere Reserve is on the northwest coast. This new protected area, which contains important coral, mangrove, and forest ecosystems, is used by local people for fishing crab and shrimp.

[68] http://www.wdpa.org

Masoala National Park, comprised of both terrestrial and marine ecosystems, features 164 species of reef-building corals. Masoala National Park features three marine parks that protect over 10,000 ha of coral reefs and mangroves (Tajona, Tampolo, and Cap Masoala). In each marine park, no-take zones are present in which only local residents can use the multiple-use zones. The total area of no-take zones in Madagascar's marine parks is approximately 10 km^2 (Cinner *et al.* 2009). Other examples of protected areas include Grand Recif Marine National Park, which is a proposed marine park; Nosy Tanikely, which contains a no fishing zone; and Nosy Ve, which has a community-based marine management area.

2.2.1.56 Malaysia

Malaysia is a federation of 13 states and two federal territories with an estimated coral reef area of 4,000 km^2. Coral reefs in Malaysia may be found around the islands off the coast of East and Northeast Peninsular Malaysia and less so in areas fringing East Peninsular Malaysia and in small patches fringing West Peninsular Malaysia. However, a majority of Malaysia's coral reefs are found in the North peak and Southeast of Sabah (UP-MSI *et al*., 2002). Coral reefs around Semporna and Sipadan Islands in Southeast Sabah are the most developed due to very clear waters and the oceanic influence from the deep sea in the east. Fringing reefs are the most common but patch and barrier reefs are also present. The only coral atoll is Pulau Layang-Layang among the Spratly Archipelago far north from Sabah (ASEAN Regional Centre for Biodiversity Conservation 2002). Threats to Malaysia's reefs vary in different areas; however, coastal development and marine-based pollution seem to be the two highest threats (Burke *et al.* 2002).

The Department of Fisheries of the Ministry of Agriculture is the federal government agency tasked with the protection of marine resources, including marine parks. The Fisheries Act of 1985 mandates for the establishment of marine parks to protect aquatic flora and fauna for natural regeneration, scientific study, to preserve and enhance the pristine state of a system, or to regulate recreational activities. The National Advisory Council for Marine Park and Marine Reserve determines the protection, conservation, utilization, control, management, and progress guidelines for marine parks and marine reserves. According to the Fisheries Act of 1985, there is a moratorium on the issuance of new or additional fishing licenses for vessels in coastal waters. A license is needed for fishing stakes, fish appliances, and fish-aggregation devices from the Director-General. It is prohibited to use explosives, poisons, pollutants, or any apparatus utilizing electric currents. Further, all fishing and extractive activities are prohibited within two nautical miles around islands declared as marine parks. Environmental pollution protection and waste management in both mangrove and coral reef areas are managed by the Department of Environment of the Ministry of Science, Technology and Environment (UP-MSI *et al*., 2002). The MPA system in Malaysia is relatively well developed with MPAs in most areas of the country. Taking of coral and anchoring within a marine park is prohibited. As of 2002, about 40 Marine Parks were being managed by the federal Department of Fisheries (all rated well-managed "A"). In addition, there are three State Parks on Sabah and three Fisheries Prohibited Areas (established under the Fisheries (Prohibited Areas) Regulations of 1994) on Sarawak. Additionally, Malaysia has 4 RAMSAR sites including Kuching Wetlands National Park (which is a marine and terrestrial RAMSAR site) as well as three other marine RAMSAR sites. MPA management effectiveness is variable (Burke *et al.* 2002).

Wildlife sanctuaries and national parks are created by the Department of Wildlife and National Parks of the Ministry of Science, Technology and Environment, which is the federal government agency tasked with the implementation of the Protection of Wildlife Act 1972 and National Parks Act 1980. The Protection of Wildlife (Amendment) Act 1988 prohibits the established Wildlife sanctuaries where it is prohibited to shoot, kill or disturb any animal, or disturb or remove any vegetation. States also have control over their coastal waters and can mandate protected areas as well (UP-MSI et al., 2002). The National Parks Act 1980 governs the creation and maintenance of national parks[69].

2.2.1.57 Maldive Islands

The Maldives is an archipelagic nation of approximately 1,190 small low-lying coral islands scattered across the Indian Ocean. Most of the islands are just a meter above sea level. These islands stretch more than 800 km from north to south covering a total area of about 90,000 km^2, of which about 99 percent is water. With a total area of 8,920 km^2, the coral reefs of the Maldives are the seventh largest in the world and represent as much as five percent of the world's reef area (Spalding, et al., 2001).

Coral reef systems provide natural protection for the islands while serving the needs of the two major economic driving forces of the country – tourism and fisheries. Most reefs of the Maldives are in better condition in comparison to other south Asian reefs due to their relative isolation; however, threats to Maldivian reefs include coral mining, pollution, dredging, etc. due to development (Rajasuriya *et al.* 2000).

The main regulatory authority in the Maldives, responsible for the management of all issues and activities related to living marine resources, is the Ministry of Fisheries and Agriculture. Management of all fisheries activities is governed by the Fisheries Law (Law No. 5/87, 24-08-87). Under this law, the Fisheries Regulations of 1997 bans specific destructive fishing practices such as:

- Use of dynamite or explosives
- Use of guns or such devices to catch fish
- Use of any chemical to collect or catch fish
- Use of scuba gear to collect sea cucumber and lobsters

Special areas or species can be protected from exploitation and/or export under the Fisheries Law as well. As a step towards conserving and managing the marine environment and coral reefs, information on protected marine species in the Maldives can be found in the Fisheries Regulations. All corals (with the exception of the Organ coral) are listed under these regulations as protected from exploitation and export. In addition, regulations established in 1992 prohibit coral mining on island house reefs, atoll rim reefs, and common bait fishing reefs. These regulations also require a permit for any coral mining and require islands to maintain logbooks of the amount of coral that is mined (Naseer 1997 in Hoon V. (ed.)).

69 http://en.wikipedia.org/wiki/National_Parks_Act_1980_%28Malaysia%29

In 1993 the People's Majlis, the main legislative body in the Maldives, adopted the Environment Protection and Preservation Act (EPPA). The EPPA serves as the foundation for national environmental law and emphasizes the preservation of land and water resources, flora and fauna extending protections to beaches, reefs, lagoons, and all natural habitats. It sets out guidelines for the management of the environment, including nonhazardous waste disposal and oil, poisonous substances, and hazardous/toxic or nuclear waste handling and disposal; establishment of protected areas and natural reserves; and mandates for performing environment impact assessments (EIA). One of the key elements of the Environment Law include the mandatory requirement of an EIA to be submitted to the Ministry of Planning Human Resources and Environment prior to the implementation of any developmental project that may affect the environment (including coral reefs). The law also prohibits disposal of wastes, oil, poisonous chemicals or environmentally harmful substances within the territory of Maldives (Naseer 1997 in Hoon V. (ed.)). As of 2000 there were a total of 25 MPAs established under the Environment Act. There are few activities permitted in these MPAs; however, the level of actual management and protection of these MPAs is questionable (Rajasuriya *et al.* 2000).

2.2.1.58 Marshall Islands

Located in the central Pacific Ocean and spanning more than 5,025,000 km^2 (1,940,000 mi^2), the Republic of the Marshall Islands is comprised of 1,225 islands and islets including 29 atolls and five solitary, low coral islands. Some of the most pressing threats to coral reef ecosystems of the Marshall Islands include: sedimentation, pollution from big oil stocking tankers and foreign fishing vessels, solid waste and sewage disposal, dredging, overexploitation of the marine biological resources for the live fish industry and aquarium trade and extraction for local use (fish, clams and turtles).The primary agencies involved in protecting coral reef ecosystems are the Office of Environmental Planning and Policy Coordination Marshall Islands**,** the Marine Resources Authority and the Marshall Islands Environmental Protection Authority. Marine reserves and other management measures are still in their infancy, but several atolls (Jaluit, Arno, Likiep, Mili, and Rongelap) are spearheading this effort. Traditionally, communities would establish a "mo," a management tool that instituted taboos of fishing in particular areas to conserve marine resources. These traditional mo's are still evident and respected in some areas. In 2000, the National Biodiversity Strategy and Action Plan and the National Biodiversity Report addressed the need for conservation and management of natural resources. Under the Micronesia Challenge, the Marshall Islands has agreed to have 30% of nearshore marine resources and 20% of terrestrial resources under "effective conservation" (Beger et al. in J.E. Waddell and A.M. Clarke (eds.) 2008).

2.2.1.59 Mauritius

Mauritius is a volcanic island that was formed approximately 8-12 million years ago and is surrounded by fringing reefs that cover 150 km around the coast. Threats to Mauritian coral reefs include chronic sedimentation due to a number of factors, including: clearing of native forests, land clearing for sugar plantations, and coral sand extraction. Additionally, uncontrolled coastal and industrial development coupled with increased tourism pressure has led to the decline of coral reefs in Mauritius. Finally, destructive fishing practices such as seine net and dynamite fishing have also led to the degradation of reefs in Mauritian waters.

Laws addressing these issues include the Fisheries and Marine Resource Act (updated in 2007) that includes the 2006 Fisheries and Marine Resources Regulations prohibiting the removal of

coral and seashells. There are also provisions for the protection of marine areas/habitats and an establishment of the Marine Protected Area Fund. Marine Protected Areas are defined in the Wildlife and National Parks Act of 1993. Mauritius currently has 9 marine protected areas covering 75 km². MPAs in Mauritius are divided into three categories: fisheries reserves, marine parks, and estuary reserves.

Other regulations now prohibit the extraction of sand (although sand extraction is still known to occur) and establish the placement of fixed mooring buoys at popular dive sites. While coral collection and trade is prohibited, Mauritius still permits the import of corals and seashells, making it impossible to enforce the local law which in turn displaces the problem to nearby countries such as Madagascar, Philippines and Indonesia (Reef Conservation Mauritius[70] 2011).

2.2.1.60 Mexico

Mexico's Pacific coast is home to the northernmost coral reef in the eastern Pacific. The corals on Mexico's Pacific coast are subject to pressures from commercial fishing and abuse from visitors that are simply unaware or uneducated. In order to protect marine resources and coral reefs found here, the Mexican Government established the Cabo Pulmo National Marine Park[71] in 1995. Prohibited activities in the park include: commercial and recreational fishing, extractive activities, anchoring in reef areas, use of explosives, etc. See the description of Mexico's laws and regulations related to coral reefs in the Caribbean section 2.2.1.

2.2.1.61 Mozambique

Mozambique's coastline stretches approximately 2700 km with the main reef system extending 770 km. Artisanal and commercial fishing and tourism are the main uses coral reefs, and the major threats to Mozambique's coral reefs include destructive fishing practices and illegal fishing by international boats within Mozambique's coastal waters. Mozambique's reefs are also threatened by physical impacts via tropical cyclones.

There are four marine and terrestrial national parks including Bazaruto Archipelago National Park and Quirimbas National Park. In Bazaruto Archipelago National Park, there is industrial fishing by foreign vessels even though it is not permitted. Also, the communities living in and around the park participate in management activities (Cunliffe *et al.* 2005). In Quirimbas National Park, fishing by local residents using traditional techniques is permitted. There is no fishing in 30 percent of the national park. In certain zones within the park, it is prohibited to damage coral; take live fish for sale; use gillnets, spearguns, or harpoons; or to kill fish using chemicals, poisons, or explosives. It is also forbidden to sell mangrove cuttings and mine for coral. Tourists are not permitted to fish at night. The marine and terrestrial Ramsar site is Marromeu Complex. These areas include lagoon and/or coral reef habitat[72].

Another protected site is Marromeu Complex, the only marine and terrestrial RAMSAR site. As for future MPAs, the national government has been working on developing a 1.7 million ha MPA in the Primeiras and Segundas Archipelago off the northern coast, since 2004. Regulations

[70] http://www.reef-mauritius.com/index.php
[71] http://www.cabopulmopark.com/thepark.html
[72] http://www.wdpa.org

specific to corals in Mozambique include the prohibition of harvesting and exportation of live and dead corals.

2.2.1.62 Myanmar

Myanmar contains a considerable amount of coastal wetland diversity within its coastline that spans approximately 2,278 km (UP-MSI et al., 2002). Estimates made by WRI (2002) suggest Myanmar has 1,686 km^2 of coral reef area which is about 1.7 percent of the total coral reef area in Asia-Pacific region. Generally, coral reefs are only found away from river deltas and mainly around islands along the southern coast, particularly in the Mergui Archipelago, and around the Coco Islands north of the Andaman Islands of India. Overfishing is the primary threat to nearly one half of Myanmar's reefs, with destructive fishing, coastal development, and sedimentation threatening an estimated 10 percent. Marine-based pollution impacts only three percent of reefs (Burke *et al.* 2002).

Very few management initiatives have been taken for coral reefs in Myanmar thus far. National regulations do not currently exist for establishing MPAs within Myanmar, though protected areas do exist. There are approximately 4,219 km^2 of mangrove area that are protected, and an estimated 387.5 km^2 of coral reefs protected. MPAs exist within national parks, marine national parks, wildlife sanctuaries, and protected areas (UP-MSI et al., 2002) however, according to WRI's 2002 Reefs at Risk analysis, MPAs cover only 2% of Myanmar's reefs. The Myanmar Fisheries Law in 1990 does prohibit the use of explosives, poisons and toxic chemicals, harmful agents and damaging gears, and thus prohibits fisheries that can destroy coral reefs.

2.2.1.63 Nauru

Nauru is a raised coralline island, with a total land area of only 21 km^2. The reefs are fringing, and are often exposed during low tides. The main threat to coral reefs and marine resources are human-induced such as overfishing, pollution, reef blasting and mining. While the biodiversity of Nauru's reefs are highly unknown, it is estimated that the dominant coral species, covering approximately 80% of the coral reefs, belong to the genera *Pocillopora*, *Monitipora* and *Acropora.* Climate change impacts are of concern to the people of Nauru, especially due to sea level rise threats to communities located in low-lying areas. There are no marine protected areas in Nauru, although the Anibare Bay has been suggested as a possible candidate site. The Nauru Fisheries and Marine Resources Authority Act 1997 calls for the Authority to manage and sustainably utilize the fisheries and marine resources of Nauru. The Nauru Fisheries Act 1997 calls for the management, development, protection and conservation of the fisheries and marine resources of Nauru. (Information summarized and adapted from Jacob, P. of Nauru Fisheries & Marine Resources Authority, date unknown).

2.2.1.64 New Zealand

While coral reefs do not occur in the territorial waters of New Zealand, there are two New Zealand dependencies that have coral reefs -- the Cook Islands and Tokelau. The Department of Conservation (DOC) is the government entity charged with conserving New Zealand's natural and historic heritage for all to enjoy now and in the future. The Department was formed in 1987 when the Conservation Act was passed to integrate conservation management functions. This Act sets out the majority of the Department's responsibilities and roles and includes specific legislation for such things as wildlife, reserves and national parks. New Zealand has 14 national parks and more than five million hectares - a third of New Zealand - protected in parks and

reserves (several of which occur in the following described territories) (http://www.parks.it/world/NZ/Eindex.html 2011).

Cook Islands. The Cook Islands is a self-governing, freely associated state of New Zealand. The main government regulatory agency charged with protecting, managing and conserving the marine environment of the Cook Islands is the Cook Islands National Environment Service (established under the Environment Act 2003). The national goal of the Service is geared towards building a more sustainable future in the environment. Increasing environmental concerns in the Cook Islands include global warming and sea level rise, erosion and sand mining, biodiversity and habitat loss, coral bleaching and coral death, pollution, waste management and recycling. The government of the Cook Islands recognizes the need to require urgent responses from government and the public for sustainable development as an overall national goal to be realized. The National Environment Service also specifically protects corals through the implementation of CITES. Suwarrow Atoll was the first area to be formally established as a National Park in the Cook Islands since 1978 for the protection of the wildlife and the marine resources that it possesses. In 2000 the Nikao Social Centre was declared a National Park under the protection of the Environment Act. Other protected areas include a Raui system (a traditional system whereby access to a particular resource or area is forbidden for a given period) which is still in practice in the Islands, and reserves.

Tokelau. Tokelau is an island territory under New Zealand administration. It comprises three small atolls, Atafu (3.5 sq.km), Nukunonu (4.7 sq.km) and Fakaofo (4.0 sq.km), each consisting of a number of low-lying, scrub-covered islets surrounded by reefs and encircling a large central lagoon up to 400 fathoms in depth. Legislation concerning conservation of habitats and/or species or the establishment of protected areas is lacking in Tokelau. Rather, for the most part, conservation of Tokelau's natural resources has been accomplished via traditional practices such as the "lafu" system which prohibits harvesting or disturbance of particular land or marine resources. New Zealand acts for Tokelau in international agreements. The Government of New Zealand is party to the Ramsar Convention, World Heritage Convention and Convention for the Protection of the Natural Resources and Environment of the South Pacific Region (SPREP Convention), but it is not clear if this places any obligations upon Tokelau itself (IUCN, 1991; http://ramsar.wetlands.org/portals/15/tokelau.pdf).

2.2.1.65 Nicaragua

Coral reefs on Nicaragua's Pacific coast are very limited in comparison to the coral reefs of its Caribbean coast. The corals in Nicaragua's Pacific waters are only small patches of individual pocilloporids and octocorals. In general, coral formations on the Pacific continental shelf are considered uncommon. See Nicaragua's Caribbean description in section 2.2.2 for laws and regulations concerning coral reefs.

2.2.1.66 Niue

Niue is the largest raised coral atoll in the world with a total land area of 261 km². It is an isolated island situated approximately 480 km east of Tonga and 560 km southeast of Samoa. The Environment Act 2003 marked a milestone in the government's commitment to the environment of Niue. The Act established the Department of Environment as well as a national council for sustainable development. Fisheries in Niue are regulated by the Domestic Fishing Act 1995, Domestic Fishing Regulations 1996, and the Territorial Sea and Exclusive Economic

Zone Act 1997. Domestic Fishing Act 1995 covers the protection of fish and established regulations for: prohibiting use of illegal fishing means, establishing marine reserves, restrictions on taking of certain species, prohibited exports, and catch/size limits. The Domestic Fisheries Regulations of 1996 provides specific protection for all coral species, and prohibits interfering with, taking, killing, or bringing ashore any live coral (Niue Domestic Fisheries Regulations 1996).

2.2.1.67 Oman

Major coral growth occurs in four regions along the varied shores of Oman's 1700 km coastline: the Musandam Peninsula; the Capital Area coast, including the Daymaniyat Islands; the Gulf of Masirah; and the Dhofar coast from the Al Hallaniyat Islands to Mirbat. Threats to Oman's reefs identified by the Status of the Regional Organization for the Protection of the Marine Environment (ROPME) Region Reefs 2008 report include: coastal development, destructive fishing, hazardous/solid waste, over-fishing, depletion of rare species, oil pollution, trampling, eutrophication and siltation due to coastal development (Maghsoudlou et al. 2008).

The main piece of environmental legislation in Oman that affects the marine environment is the Law on Conservation of the Environment and Prevention of Pollution established by Royal Decree No. 114/2001. Oman also has a National Coral Reef Management Plan (1996), and National Biodiversity Strategy and Action Plan (2000); these plans were developed to manage natural resources (Rezai *et al.* 2004). The National Biodiversity Strategy and Action Plan established the political directions, basic rules, principles and guidelines for a sustainable development process and the preservation of biodiversity, including plans for corals.

Threats to Oman's coral reefs are being tackled with the launch of the Coral Reef Management Plan. To protect this unique natural heritage, the government of Oman through Ministry of Environment and Climate Affairs has declared 12 marine protected areas including the Daymaniyat Islands Nature Reserve for the protection of coral reefs. The ministry has also deployed a number of mooring buoys in Muscat and Musandum.

2.2.1.68 Palau

The Republic of Palau, part of the Caroline Islands group, is the westernmost archipelago in Oceania. Palau hosts numerous island and reef types, including volcanic islands, atolls, raised limestone islands, and low coral islands. A barrier reef also surrounds much of the main island.

The Palau Ministry of Resources and Development has overlapping jurisdiction with each of Palau's 16 state governments for all marine areas within 12 nm of the hightide watermark. The Protected Areas Network Act of 2003 aims to support Palauan state government efforts directed at protecting marine resources. MPAs have been established throughout Palau to provide measures of protection for marine resources. There are 15 protected areas with marine and terrestrial habitat and 16 with marine habitat only that are part of the Palau Protected Areas Network. The Ngerukewid Islands Wildlife Preserve is a no take and no fishing preserve under Title 24, Division 3 of the Palau National Code. Most of Palau's MPAs have been designated by the states and management of these areas falls under the authority of the local governments. In addition, there are MPAs designated by the national government for the purpose of protecting biodiversity and significant habitats (Marino et al. 2008 in J.E. Waddell and A.M. Clarke (eds.) 2008).

Outside the MPAs and other managed areas with very specific regulations, fishing is nationally regulated under Title 24 of the Palau National Code, which prohibits the commercial export of reef fishes. Chapter 31 prohibits catching and selling marine life caught with explosives, poisons, chemicals or other substances that kill marine life. The Ngerumekaol Spawning Area, also designated in this act, is a no take zone in this area between April 1 and July 31 every year. Title 24 of the Palau National Code also prohibits the export of sponges and marine rocks, including four types of hard corals (Maibrel 2010).

As a result of national and local regulations, increased patrolling and outreach to remote villages has increased Division of Fish and Wildlife Protection citations by 100 percent and four additional states within Palau have initiated conservation law enforcement programs (Birkeland, 1997).

2.2.1.69 Pakistan

Coral reefs were recently discovered along the coastal belt of Baluchistan. While Pakistan is already a member of the International Coral Reef Task Force, the government has yet to declare the reefs as endangered and protected wildlife. There is potential legislation to conserve coral reefs and marine life (Biodiversity Action Plan 1997, Environmental Protection Ordinance 1983, the Wildlife Protection Ordinance 1972 and the Pakistan Environmental Protection Act 1995), but these laws have yet to be activated for this purpose. However, there are plans to recommend to the federal government to legislate and declare these coral reefs as endangered wildlife.

2.2.1.70 Panama

Panama's Pacific coast coral reefs are much smaller and less diverse than on the county's Caribbean coast (see Section 2.2.2). The reefs are also under very high pressure from natural impacts (e.g., COTS) and increasing human activities (e.g. increasing sedimentation and pollution due to poor land-use practices) (Cortes and Hatziolos 1998). While there are no national laws in Panama for coral reef protection, the second largest coral reef in the eastern Pacific (Bahia Damas) is fully protected within the Coiba National Park which houses the Gulf of Chiriqui Marine National Park. Coiba National Park is a group of 38 islands including Coiba Island (Isla Coiba) and the waters surrounding them. The Park covers 430,825 acres and was identified by UNESCO as a World Heritage Site in 2005. The Park is managed by the National Authority of the Environment and is accessible only via permit.

2.2.1.71 Papua New Guinea

Located on the eastern half of the island of New Guinea between the Coral Sea and the South Pacific Ocean, Papua New Guinea (PNG) is one of the world's major coral reef nations with an estimated 40,000 km² of coral reefs, sea grass beds, and mangrove forests. This accounts for approximately 5 percent of the world's coral reef areas. The biggest threats to Papua New Guinea's coral reef resources include sedimentation and pollution from inland sources (e.g., forest clearance and erosion) and overfishing (Burke et al. 2011).

According to the Fisheries Act of 1994, there are limits on the size and exceptions for equipment used in catching certain fish. The Fisheries Management Act of 1998 requires fishers to get a license and no poisons or explosives can be used for fishing. It also provides guidelines for developing fisheries management plans. The Fisheries Management Regulation 2000 requires

that commercial and foreign fishing vessels get licenses specific to the fish type and/or for specific water ways within the EEZ. Ecosystem-based management regimes are in place for Manus Province, New Ireland Province, and Milne Bay Province according to the Coral Triangle Support Partnership.

MPAs and reserves can be declared under three different acts. Mainly, the Fauna (Protection and Control) Act 1966 is used to allow the Minister to declare sanctuaries, protected areas, and wildlife management areas (WMA). Sanctuaries offer the most protection stating that fauna may not be taken or killed within a sanctuary. Within protected areas, specific fauna may not be taken. WMAs are managed at the local level, often by a committee of members that have traditional rights to land and natural resources[73], and licenses may be obtained to harvest animals within a WMA.

The Conservation Areas Act 1978 promotes delineating conservation lands with a Conservation Management Committee made up of land owners and provincial or local governments. Development is not allowed in conservation areas. The National Parks Act 1982 ensures the conservation of sites and areas with biological, topographical, geological, historical, scientific, or social importance. Customary sea tenure is also part of locally adapted management strategies (Aswani and Hamilton 2004).

The World Database on Protected Areas[74] lists 19 protected areas containing marine habitat. Maza Wildlife Management Area is the only MPA listed and is managed specifically for the harvest of dugongs by the Fauna (Protection and Control) Maza Wildlife Management Area Rules, 1979. Another example is the Sinub Wildlife Management Area. Regulations include banning the use of dynamite, hand lines, spear guns, traps, and nets for fishing. All night fishing is banned and it is prohibited to collect reef life (Jenkins, 2002). There are 18 other marine and terrestrial protected areas. Tonda Wildlife Management Area is a marine and terrestrial RAMSAR site. There are 64 additional proposed Marine Parks listed on MPA Global[75]. Most legislation does not specifically refer to marine systems, which has generated some uncertainty as to how it should be applied to coral reefs. Also, the laws relevant to different sectors (e.g. fisheries, mining, environmental protection) are not fully integrated which has led to confusion over which laws have priority, who is responsible for management, and the rights of the various interest groups.

2.2.1.72 Philippines

Located entirely in the tropics of the western Pacific Ocean, The Philippines is an archipelago consisting of over 7,100 islands, including an estimated reef area of 26,000 km² (Burke *et al.* 2002). With the second largest amount of reef area in Southeast Asia, the Philippines have approximately 9 percent of the world's total (almost 10% of the total land area). Coral reefs are widespread, and may be found around almost the entire archipelago except perhaps in some portions of north and south central Mindanao and east of northern Luzon. (ASEAN Regional Centre for Biodiversity Conservation 2002). The Philippine's reefs are the second highest threatened reefs in the Southeast Asia region. Threats from overfishing and destructive fishing

[73] http://www.worldwildlife.org/wildplaces/ng/pubs/PNG_Largest_Protected_Area.pdf
[74] http://www.wdpa.org/

[75] http://mpaglobal.org/index.php?action=search

practices drive much of the threat in this region, followed by watershed-based pollution and coastal development (Burke et al. 2011).

The two government agencies mainly responsible for the national planning, policies, and evaluation of the Philippine marine environment are the Department of Environment and Natural Resources and the Department of Agriculture's Bureau of Fisheries and Aquatic Resources. The Department of Environment and Natural Resources' Protected Areas and Wildlife Bureau in particular is responsible for marine protected areas and wildlife; the Department of Environment and Natural Resources' Coastal Environment Project, for coastal monitoring and evaluation, and the Department of Environment and Natural Resources' Environmental Management Bureau, for pollution management. However, much of the actual management authority and implementation has been decentralized to the local government units (especially the Municipal level) after the ratification of the Local Government Code of 1991 (ASEAN Regional Centre for Biodiversity Conservation 2002).

MPAs and reserves are established via several regulations managed by the PAWB that include designations for mangrove habitat, lagoons, and coral reefs. Introduced in 1992, the Republic Act 7586 provided for the establishment of a National Integrated Protected Areas System (NIPAS) to aid in developing effective protection and management of habitats throughout the Philippines, including a few marine areas[76]. Among the Southeast Asian countries, the Philippines have the most number of marine protected areas. There are 985 community managed MPAs around the Philippines, with 942 of them containing a no-take area. The total amount of coastal municipal water that is protected through MPA status adds up to 4.9%, while strictly no-take areas are 0.5% (Weeks *et al.* 2010). An example of a nationally managed MPA is Tubbataha Reefs National Marine Park, classified as both a marine RAMSAR site and a marine World Heritage site. Olango Island is also a marine RAMSAR site. Puerto-Princesa Subterranean River National Park is a marine UNESCO-MAB Biosphere site. There are two marine and terrestrial UNESCO-MAB sites, Palawan and Puerto Galera[77].

In addition to laws establishing protected areas, the Philippine Fisheries Code of 1998 prohibits the use of explosives, noxious, or poisonous substances for fishing. The Official Gazette volume 71, no. 28 of July 14, chapter VI section 33 states that it is prohibited to use these substances but allows them if the user is permitted for scientific, research or educational purposes. The code also establishes a fixed mesh width (exact dimensions not given) stating it is unlawful to use a smaller size. Presidential Decree 1219 of 1977 prohibits the collection, sale and export of coral, permitting it only for scientific research. It is unlawful to use fishing gear that destroys coral reefs, seagrass beds, or other marine habitat. In 1992, the Republic Act 7586 provided for the establishment and management of a National Integrated Protected Areas System (NIPAS). The Fisheries Code of 1998 (Republic Act 8550) mandates in Section 80 the setting aside of 15% of municipal waters for fish sanctuaries and allows 25-40% of fishing grounds beyond municipal waters for fish sanctuaries or mangrove reserves. The Fisheries Code of 1998 includes corals under the provision for aquatic resources.

[76] http://www.iapad.org/pa/about_nipap.htm
77 http://www.wdpa.org/

Finally, laws in the Philippines prohibit the conversion of mangrove habitat to fishponds. Fisheries reservations can be established 15 km from the shoreline. The Presidential Decree No. 705 states that 20 seed trees per ha must be retained in a mangrove forest. There is a 50 year rotation and regulation of annual allowable cut (Choudhury 1997).

The Philippines' environmental legislation is probably one of the most advanced in the region (Tan 2000; Jacinto *et al.* 2000). However, threats to the successful implementation of MPAs in the Philippines include rapid population growth, high demand for marine products, lack of employment (other than marine resource extraction), law enforcement constraints, and poverty (ASEAN Regional Centre for Biodiversity Conservation 2002).

2.2.1.73 Qatar

Qatar's reefs are of the fringing type and occur along the north and east coasts, with generally high coral cover but low species diversity. Threats to Qatar's reefs include coastal development, bleaching, local fishing, boat anchors, and oil pollution (Maghsoudlou et al. 2008). Law No. 11 of 2000 established the Supreme Council for Environment and Nature Reserves, and was the major step forward towards regulation of environmental management and protection. The Supreme Council is the principle regulatory agency of the State for all matters concerning the environment. The Supreme Council, inter alia, augments and protects endangered wildlife and natural habitats; formulates policies that aim to protect the environment and ensure sustainable development (El- Meniawy and Fouad 2010). The exploitation of marine resources in Qatar is addressed under Law No. 4 of 1983 (Utilization and Protection of Aquatic Resources) and executive regulations issued thereunder. Ministerial Decree No. 54 of 1997 limits the volume of fishing in Qatar's waters. The Emiri decree No. 4 for 2002 regulates the hunting of animals, birds, wild reptiles, and bans hunting inside islands, subsequently establishing them as natural reserves (Abdel-Moati 2008).

2.2.1.74 Samoa

Marine resource management in Samoa is a joint effort between the government of Samoa and the coastal villages and their *fonos* (councils). When the Fisheries Act was formulated in 1988, the Fisheries Division made sure that the rules set by the village *fono* were given legal recognition. To this end, the Fisheries Act was specifically designed to include provisions dealing with procedures whereby a village *fono* could declare its own rules as by-laws. These by-laws, in essence, are village rules that have legal recognition; hence the inception of village fisheries by-laws. Common fisheries by-laws (or regulations) include banning the use of chemicals and dynamite to kill fish and the use of traditional plant-derived fish poisons, which occur in 100% of villages. Establishing small protected areas in which fishing is banned and banning other traditional destructive fishing methods (e.g., smashing coral) occur in 86% and 80% of villages, respectively. However, less than 10% of villages implement regulations to protect corals from harvest for the international aquarium trade or the coral-damaging collection of edible anemones (Ueta Fa'asili & Iuliaa Kelekolo 1999).

2.2.1.75 Saudi Arabia

The Saudi Arabian coastline is approximately 1840 km in length, accounting for 79% of the eastern seaboard of the Red Sea. According to the Reefs at Risk Revisited analysis, Saudi Arabia has approximately 5,273 km² of total reef area, with an estimated 61% under threat (Burke et al. 2011). Rapid development in coastal areas due to population and economic

expansion has affected Saudi Arabia's near shore marine environments. In addition, land filling, sewerage, water use, maritime risks, etc. all poses threats to Saudi Arabia's reefs. The central environmental agency for coastal management in Saudi Arabia is the Meteorological and Environmental Protection Administration; however, numerous agencies operate under individual mandates which arise in frequent overlaps and jurisdictional issues (PERSGA 2001).

Saudi Arabia is one of two countries in the region that has framework legislation for the establishment of protected areas. The Royal Decree M/12 of 1995 enacted the Protected Areas Act, which establishes the requirement for a network of protected areas to be established and managed, and lays out the range of activities prohibited within all protected areas (Gladstone *et al.* 2003). Overall, Saudi Arabia has a number of extensive terrestrial protected areas, but lags behind in the development and implementation of marine protected areas. Numerous proposed and suggested MPAs date back to the 1980's; however, only two MPAs have been legally established and implemented, including the Farasan islands (protected in 1996), and the Umm al-Qamari MPA, established in 1977 (Gladstone *et al.* 2003). With the resurgence of PERSGA and its Strategic Action Plan (including a Regional MPA Network), the number of MPAs in Saudi Arabia is expected to increase, with up to 32 proposals for protected areas being put forward for the Red Sea alone.

2.2.1.76 Seychelles Islands

The Seychelles is a large archipelagic nation comprised of approximately 115 islands and surrounded by approximately 1690 km² of coral reef. The biggest concern regarding coastal resources in the Seychelles is rapid development in a narrow belt of coastal lowlands and reclaimed land. Efforts to promote biodiversity and sustainability are evident from numerous decrees dating back to the 1700s. Recognizing the imperatives of environmental protection and sustainable use of natural resources, the Seychelles government developed the Environmental Management Plan of Seychelles (2000-2010), which addresses coastal zone management, involvement of communities, and partnerships with the private sector.

The Seychelles has at least 14 areas that can be divided into 5 different categories of MPA's: marine national parks, shell (mollusk) reserves, special reserves, protected areas, and strict natural reserves. The management of these MPAs falls under the jurisdiction of 6 different agencies. There are extensive laws that provide the framework for the establishment of MPAs in the Seychelles, including but not limited to: Environment Protection Act 1994 (which established the management agency called the Marine Parks Authority); Environment Protection (Marine Parks Authority) Order, 1996; Fisheries Act -Chapter 82 (1986) including Fisheries Regulations (1987) and others.

With the designation of the St. Anne Marine National Park in 1973, the Seychelles became recognized as the first country in the East African region to create an MPA. The creation of the Ste. Anne National Marine Park was an explicit conservation measure to address the over-exploitation of shells, corals, and fish. Regulations for the park prohibit touching, taking, and/or disturbing any shells, corals, or fish. Another protected area within the Seychelles is the Aldabra Atoll, which is also a UNESCO World Heritage Site. Marine parks in the Seychelles have mooring systems as well as entry fees to support management and enforcement (Information summarized and adapted from (Domingue *et al.* 2009).

2.2.1.77 Singapore

Singapore is an island nation with a total land area of 700 km², a coastline of approximately 193 km, and a total reef area of only 1,000 ha (ASEAN Regional Centre for Biodiversity Conservation 2002; Goh 2008). Both fringing and patch reefs grow around the main island and more than 60 offshore islands. Singapore's reefs are not subject to the pervasive threat of overfishing that impacts the rest of the region; however, extensive land reclamation for coastal development projects has resulted in the loss of approximately 60 percent of total coral reef area (Burke *et al.* 2002). Singapore's only significant policy for environmental management is the national concept plan "Living the Next Lap" or "Green Plan" of 1991. This plan mandates that 5 percent of Singapore's total land area be protected for the purpose of nature conservation. In 1993, an Action Plan under the "Green Plan" was passed that protected 4 coral reef areas from commercial harvest (ASEAN Regional Centre for Biodiversity Conservation 2002).

There are two areas in Singapore that are considered to be MPAs. The first is the 87-ha Sungei Buloh Nature Park located along the northern coast of the mainland, which is a coastal mangrove habitat. The second is a group of southern offshore islands (St. John's, Kusu, Lazarus and Sister's) designated as a Marine Nature Area in 1996. These extend to about 500 ha. A management imperative in Singapore is to minimize the loss of living corals from any development project by complying with environmental quality objectives (Goh 2008).

2.2.1.78 Solomon Islands

The Solomon Islands consist of over 900 islands widely distributed in the Western Pacific. Coral reefs are widespread throughout the country, with several atolls and fringing reefs around most of the islands. The Solomon Islands has one of the highest diversities of corals anywhere in the world, with a recorded 494 species as of 2006. Threats to the Solomon's reefs include overfishing of commercially important species and poor land use practices, although overall threats are considered to be low (TNC 2006). Traditional management systems are still considerably important in the Solomon Islands, with all reefs being "owned" by particular groups with fishing rights under customary marine tenure. It is common for taboos to be placed on particular reefs for restricted periods of time by Christian leaders, traditional kastom men, or even local villagers (Spalding et al. 2001).

There are 11 Community Marine Conservation Areas that use customary sea tenure in locally adapted management strategies. The most successful marine conservation area is the Arnavon marine conservation area. First established in 1975, there have been a number of disputes and problems, but in 1992 the site was revived and a community-based management committee established. The eastern third of Rennell Island was declared a World Heritage Site in 1998, with boundaries extending seawards for 3 nautical miles. According to the World Database on Protected Areas (http://www.wdpa.org/), there are also five other marine and terrestrial protected areas throughout the country.

The Fisheries Act of 1998 states that marine biodiversity, coastal and aquatic environments of Solomon Islands shall be protected and managed in a sustainable manner and calls for the application of the precautionary approach to the conservation, management and exploitation of fisheries resources in order to protect fisheries resources and preserve the marine environment (Solomon Islands Government 1998). The Act also provides Provincial Governments with the ability to establish marine reserves; however, all of the Marine Conservation Areas have yet to

be established (Green et al. 2006). The Act prohibits fishing with explosives or noxious materials, although these methods are still known to occur.

2.2.1.79 Somalia

Somalia's coastline stretches approximately 3300 km, with 1300 km facing the Gulf of Aden, and the remaining coastline facing the Indian Ocean. Coral reefs in Somalia are threatened by bleaching, but local human impacts are relatively minimal. Fishing in Somalia is very limited and is nearly entirely artisanal in nature. There are a total of three proposed areas of protection in Somalia along the north coast, only one of which contains coral reefs (the Aibat, Saad ad-Din and Saba Wanak area); however, no MPAs have been legally declared. Protection of coral reefs in Somalia is of low priority in comparison to rebuilding the country and eradicating poverty. Additionally, while Somalia is a signatory to many international agreements and Protocols, political unrest and a virtual lack of national legislation extremely limit the effective implementation of any stipulations (Pilcher & Krupp 2000).

2.2.1.80 South Africa

South Africa has very few "true" reefs with a total of only 40 km² found in a World Heritage Site (IsiMangaliso Wetland Park) in the Delagoa Bioregion. While the coral communities do not form true coral reefs (rather they grow as a veneer on sandstone reefs) they are rich in biodiversity. Corals in South Africa can be found between 8 and 27 meters depth and are dominated primarily by soft corals. The IsiMangaliso Wetland Park was zoned for recreational use only, for the explicit protection of the coral communities in this area, as they are highly sensitive to damage (Obura *et al.* 2000).

2.2.1.81 Sri Lanka

Sri Lanka is an island nation of approximately 65,000 km² located off the southern coast of India, and has a coastline of 1585 km. Nearshore fringing reefs can be found along approximately 2 percent of the coast (Rajasuriya 1997). Among the foremost destructive practices directly and adversely impacting the physical structure of the reef are the removals of coral for conversion into wall plastering material, reef organisms for the export aquarium industry, sedimentation due to poor land use practices, pollution, tourism related activities, as well as fishing practices that employ explosives and indiscriminate use of fishing nets (Perera *et al.* 2002).

Sri Lanka's Coastal Zone Management Plan, the National Environmental Act, the Fisheries Ordinance and the Fauna and Flora Protection Ordinance provides the necessary guidelines and regulations for the use and protection of the marine environment in general and sensitive marine ecosystems in particular. The Fisheries and Aquatic Resources Act requires fishers to obtain a license to fish. Along with the Fisheries Amendments Law 20 of 1973, this act also prohibits the use of poisons or explosives and fish caught this way cannot be bought, sold, possessed, or transported. The Minister declares when fishing season is open or closed, and if a fisheries reserve offers protection to a species in danger of extinction or promotes regeneration of aquatic life. There is no fishing in a reserve except by permit.

Sixteen marine and terrestrial sites are protected areas according to the World Database on Protected Areas (http://www.wdpa.org/). Annaiwilundawa Tanks Sanctuary is a marine Ramsar site. Bundala and Maduganga are both marine and terrestrial Ramsar sites. However, reef sites

at Hikkaduwa and Bar Reef constitute the only 2 legally-protected Marine Sanctuaries in Sri Lanka, the former having been given Sanctuary status in 1979 and the latter in 1992 (Pernetta 1993). Legal enactments for reef and reef-related protection are well in place; however, implementation and monitoring are considered to be lacking (Ekaratne 1995).

Protection has also been given to selected marine species listed under the Fisheries ordinance as well as the Fauna and Flora protection Ordinance of the (Department of Wild Life Conservation (Wood and Rajasuriya 1996). For example, in 1993 and 1994 the QCD implemented the ban on operation of lime kilns within the coastal zone.

The following excerpt from the Status of the Reefs in South Asia Report described the status of management in Sri Lanka: "Many reefs in Sri Lanka lack effective management with many illegal activities, such as live coral mining and fishing using unsustainable gear and dynamite. MPAs remain poorly managed and compliance with regulations is low with the possible exception of Hikkaduwa. The escalation of internal conflict in the country prevents active work in the northern and eastern parts of the country" (Tamelander and Rajasuriya 2008).

2.2.1.82 Sudan

The Red Sea coast of Sudan is approximately 750 km long inclusive of bays and inlets, and extends from the Eritrean border to the Egyptian border. Three primary coral habitats occur along the Sudanese coastline: barrier reefs, fringing reefs and Sanganeb, an oceanic atoll. The main threats to Sudanese coral reefs include maritime shipping and dredging (Pilcher & Nasr 2000).

The only marine protected area in Sudan is the Sanganeb Marine National Park (est.1990) which encompasses Sanganeb, the12 km² atoll with highly diverse and complex coral reefs. The park is managed by the African Parks Network in partnership with the Sudanese Wildlife Administration. Management plans for the park were developed by PERSGA in 2003. With the exception of the Sanganeb Marine National Park, coral reefs are only indirectly managed through government institutions and regulations (Pilcher & Nasr 2000).

While Sudan does not have any specific legislation that addresses coral reefs specifically, there are numerous national laws in place that protect reefs indirectly. The Sudanese Fishery Ordinances and Regulations prohibit overfishing, dumping of refuse (including oil) into the sea, and the collection of corals, shells and aquarium fish. The Environmental Health Act (1975) prohibits dumping any item that is harmful to humans or animals into the sea. The Marine Fisheries Ordinance gives police, customs officers, and local authorities the right to board and search a vessel, and detain any craft accused of violating the above regulations. Additionally, the Maritime Law, drafted by the Maritime Administration, is awaiting approval and implementation. Finally, the Comprehensive National Strategy states that Sudan has committed to the pursuit of sustainable development and environmentally sound resource management (Pilcher & Nasr 2000).

2.2.1.83 Taiwan

Coral reefs can be found in all coastal waters around Taiwan with the exception of a sandy area on the west coast. Coral reefs can also be found in the waters surrounding offshore islands. Taiwan's reefs face intense pressure from overfishing and destructive fishing, pollution and

nutrient enrichment from terrestrial sedimentation, and marine recreational activities. Most of Taiwan's coral reef resources are within the boundaries of National Parks or National Scenic Areas. These include: Kenting National Park in south Taiwan; the Northeastern Coast National Scenic Area; the East Coast National Scenic Area; Tapengwan National Scenic Area; and Penghu National Scenic Area (Dai *et al.* 2005).

Overall, coastal resources are protected under the National Park Law and the Coastal Environmental Protection Plan which are both administered by the National Park Department within the Ministry of Interior. The National Park Law of 1972 ensures the preservation of "unique natural scenery," flora and fauna, public recreation areas, and scientific research areas. There is no fishing or altering of the landscape in national parks and cultural and recreation areas, without permission. The Taiwan Fishery Law (Article 48) prohibits the use of poisons, dynamite and other explosives, electric shocks or anesthetic agents for fishing. Finally, the Wildlife Conservation Law of 1989 (amended in 1994) conserves and protects wildlife, including fish, and associated habitat (Dai *et al.* 2005).

2.2.1.84 Tanzania

Numerous fringing and patch reefs are located along about two-thirds of Tanzania's 1,000 km coastline. The reefs of Tanzania have been moderately to severely degraded as a result of destructive fishing practices such as the use of explosives and seine netting. Tanzania has a well-developed policy and institutional framework to oversee the development and administration of MPAs. There are 2 types of MPAs in Tanzania: marine parks and marine reserves. Tanzania has only 1 national MPA, Mafia Island Marine Park, which is managed through the Tanzania Marine Parks and Reserves Board of Trustees, and has technical assistance from WWF (Obura *et al.* 2008). In total, mainland Tanzania has a total of 13 MPAs: 11 marine reserves and 2 marine parks. The island of Zanzibar has 4 conservation areas. The difference in MPAs between mainland Tanzania and Zanzibar is their management. MPAs on mainland Tanzania are administered by the government, whereas MPAs on Zanzibar are managed by the private sector and/or NGOs. Those in mainland Tanzania are established under the Marine Parks and Reserves Act No. 29 of 1994. This Act has two over-riding principles:

- To protect, conserve and restore the species and genetic diversity of living and non living marine resources as well as the ecosystem processes of marine coastal areas; and
- To ensure that communities and local users of resources are facilitated to engage (through education and information sharing) in the planning, development and management of an MPA, and that they share in the benefits of the operation of the PA, and have priority in the resource use and economic opportunities afforded by the establishment of the marine park or reserve (Mwaipopo 2008).

Combined, the Marine Parks and Reserve Act No. 29 of 1994, and the Marine Parks and Reserves (Declaration) Regulations of 1999 represent the basic legislation that guides operations of MPAs in Tanzania. In addition, the Fisheries Act of 2003 is another main piece of legislation that guides the fisheries industry and MPAs. The latter act provides regulations for the general purposes of protecting, conserving, developing, regulating or controlling the capture, collection, gathering, manufacture, storage or marketing of fish, fish products and aquatic flora. Other legislation includes the National Integrated Coastal Management Strategy (2003) which outlines

a general framework on sensitivity to the coastal environment, and sustainable use and development of resources in relation to economic growth (Mwaipopo 2008).

The Chumbe Island Coral Park in Tanzania (Zanzibar) is a unique privately managed nature reserve developed and managed by the Chumbe Island Coral Park Ltd. (CHICOP). The reserve includes a reef sanctuary, which has become the first gazetted marine park in Tanzania, and a forest reserve. CHICOP has over the years conducted school excursions for secondary students and their teachers to Chumbe Island. Guided by park rangers along the nature trails in the reef and the forest, the participating children benefit greatly from the insight they gain in Marine biology, Forest ecology and Environmental protection. In 2001, the Chumbe Education Program developed to the extent that a module on "The Coral Reef", produced by CHICOP, was recognized by the Ministry of Education as an official teaching aid. The program was expanded to encompass Teacher Training workshops and evaluation seminars, where teachers were trained to link learning experiences with the Science syllabi in particular.

2.2.1.85 Thailand

The coastline of Thailand is influenced by both the Pacific and Indian oceans. The coral reefs, which are mostly small fringing reefs, are found both in the Gulf of Thailand (74.8 km²) and the Andaman Sea (78.56 km²) making up approximately 1800 km2 of reef area (Burke *et al.* 2002). Major threats to the reefs of Thailand include sedimentation, nutrient pollution from development on the land, and overfishing. Additionally, destructive methods using dynamite, poison, traps and spear guns are also a problem, particularly on the west coast of the Gulf of Thailand. Moreover, 60% of the reefs are estimated to have less than 50% live coral cover (ASEAN Regional Centre for Biodiversity Conservation 2002).

The agencies responsible for enforcing coral reef protection regulations are the Department of Fisheries and the Royal Thai Forestry Department. In 1993, the Department of Fisheries initiated a program for marine and fisheries protected areas to enhance the protection and conservation of breeding grounds in the Gulf of Thailand (Agenda 21). The National Park Act of 1961 and the Fisheries Law of 1947 provides for the establishment of national parks and fish sanctuaries. Additionally, certain areas can be declared as “areas under protection” under the National Environment Quality Act, and any measures deemed necessary can be imposed. There are five different categories of protected areas in Thailand, including: national parks, national marine parks, wildlife sanctuaries (in some translations, “wildlife conservation areas”), forest parks and non-hunting areas. The primary purpose of National marine parks is to protect areas of coastal habitat and islands, and appear to have little relevance to watershed management; some, however, extend inland to include even mountainous terrain (from Clarke 1999). The National Park Act of 1961 states that a national park is to be, ‘preserved in its natural state for the public’s education and enjoyment’. National marine parks have similar functions. Most are former national parks that have been reclassified, although the National Park Act lacks specific provisions for marine areas. The Wildlife Protection and Preservation Act of 1960 states that wildlife sanctuaries are areas for, ‘the conservation of wildlife habitat so that wildlife can freely breed and increase their populations in the natural environment’ (ASEAN Regional Centre for Biodiversity Conservation 2002).

A total of 21 National Marine Parks have been declared, with two other MPAs designated as non-hunting areas that also encompass coral and mangrove habitats. 13 of the 21 National parks

include coral reef areas, most of which are located in the Andaman Sea and only five are located in the Gulf of Thailand. Approximately 60% of the coral reef area is included within a protected area (ASEAN Regional Centre for Biodiversity Conservation 2002).

2.2.1.86 Timor Leste

Timor-Leste has a coastline of approximately 700 kilometers in length with varying habitats along the coast. There are a few, small patches of coral reef on the north coast of Timor-Leste (Uniquest PTY LTD 2010). Marine fisheries in Timor-Leste are regulated by various government decrees. The Government Decree-Law No. 6/2004 of 21 April 2004 General Bases of the Legal Regime for the Management and Regulation of Fisheries and Aquaculture states that fishing gear that adversely affects the seabed in national maritime waters is banned and fishing in coral reefs is prohibited. The introduction of poisons that destroy fishing resources in the aquatic environment is prohibited. Additionally, using explosives, electrocution, or toxic products for fishing is prohibited. National parks can be established by the Minister of Agriculture, Forestry, and Fisheries and the Minister for Environment can prohibit fishing within national parks. Corals cannot be removed, collected, or destroyed. Currently, there is only one known MPA in Timor-Leste that contains coral reefs, although management effectiveness is unknown (Tun *et al.* 2008).

2.2.1.87 Tonga

The Kingdom of Tonga is an archipelago in the South Pacific Ocean, comprising 169 islands, 36 of them inhabited (http://www.e-pic.info/countries/pic/tonga). Tonga is home to approximately 1500 km² of total reef area, with about 46% at risk from various threats such as overfishing, tourism impacts, and eutrophication in some areas (Spalding 2001). Tonga's National Tourism Plan identifies coral reefs as the main tourism attraction for Tonga and describes them as environmentally sensitive. It identifies physical disturbances, nutrients and pollutants, waste disposal, breakage of corals, effects of fishing, and sea-level rise as threats to Tonga's corals. Tonga's Environmental Management Plan of 1990 provides the following legislative responsibilities for management of the marine environment:

- The Parks and Reserves Act of 1976 established the Parks and Reserves Authority to protect, manage and develop natural areas in the Kingdom (this includes marine reserves)
- The Fisheries Act of 1988 provides for the management and development of fisheries on Tonga
- The Fisheries Regulation Act provides for the licensing of fishing apparatus, protection of whales, net sizes, and prohibits the use of poisons or explosives (except for aukava) for fishing.
- The Tourist Act 1976 Regulates and controls tourism through the Tonga Visitors Bureau and established a licensing system for tourist facilities (Tonga Environmental Management Plan 1990).

The Parks and Reserves Act (1976) govern the establishment of protected areas within the Kingdom, but also by regional and international frameworks. Tonga was the first Pacific island country to create marine parks or sanctuaries. According to the Secretariat of the Convention on Biological Diversity[78], there are 9 established MPAs in Tonga's waters.

[78] https://www.cbd.int/countries/?country=to

2.2.1.88 Tuvalu

Tuvalu is a small independent nation made up of a chain of nine reefs and atolls in the Polynesian region of the South Pacific. The islands are the result of coral reefs which have formed around the peaks of a series of underwater mountains created by volcanic eruptions. Tuvalu has approximately 710 km of total reef area, with only about 15% at risk of threats. There are no significant commercial fishing or tourism industries (Spalding 2001). Tuvalu has 6 marine conservation areas belonging to community groups (or Island Councils) who decide when and where harvesting may take place. Both the Minister of Fisheries and Island Councils are granted relevant authority within the Conservation Areas Act, the Marine Resources Act and the recently established Environment Act. However, there are some clauses in the Marine Resources Act which allow the Minister for Natural Resources and Environment to overrule an Island Council (Vierros *et al.* 2010). The Marine Resources Act of 2006 deals predominantly with fisheries and does not specifically provide protection for corals; however, it does call for the conservation of marine ecosystems and biodiversity essential to fisheries sustainability.

The Funafuti Conservation Area[79] covers 33 square kilometers of water and land on the western side of the Atoll. This area includes reef, lagoon, channel, ocean and islands habitats. The Falekaupule (the people who own the land within the Conservation Area), together with the Funafuti Town Council and the Government of Tuvalu have agreed to protect the natural resources within the Conservation Area. The objectives of this Area are to allow the populations of animals to increase and contribute to the biodiversity of Funafuti atoll. The management process includes the following stipulations:

- Fishing, hunting and collecting of animals and marine plants and destruction of habitats by any people is prohibited with the Conservation Area at the present time. This is enforced under the Tuvalu Conservation Areas Act and the Funafuti Conservation Area By-Laws.
- Baseline surveys and monitoring programs will be initiated in order to keep watch on the resources and assess their status so that this information can be used for making management decisions; and
- A Management plan will be developed by the Conservation Area Project Officer together with the people of Funafuti (see information sheet 2). This plan will provide information on what activities are allowed in the area and how income generating activities and sustainable use of the area are to be implemented and managed.

2.2.1.89 United Arab Emirates

The United Arab Emirates (UAE) has an extensive coastline of about 700 km facing the Arabian Gulf on the west and the Gulf of Oman on the east. The UAE has approximately 1,190 km² of total coral reef area (although diversity in the area is relatively low) with about 65% at risk from various threats such as development of numerous oil platforms and pollution from oil spillage in coastal waters (Spalding 2001). The Ministry of Agriculture and Fisheries (MAF) is the main governing body responsible for maintaining healthy, sustainable fisheries and keeping the marine environment free from all pollution. Marine reserves are covered in federal legislation, but the establishment of marine reserves is predominantly left up to the individual Emirates.

[79] http://www.timelesstuvalu.com/tuvalu/export/sites/TTO/Attractions/funafuti_conservation_area.html

Federal Law No. (7) of 1993 for the establishment of the Federal Environment Agency- The objectives for establishing the Agency shall be: to protect and develop the environment within the State; to determine the necessary plans and policies to safeguard it from damaging activities, particularly those affecting human health, agricultural crops, wildlife, marine life, other natural resources and atmosphere; to implement such plans and policies; to take all suitable measures and actions to prevent deterioration of the environment, to combat environmental pollution of all kinds, and to minimize effects of pollution for the welfare of both present and future generations. The Federal Law provides for the establishment of protected areas and monitoring and studies of the marine environment.

Federal Law No. (24) of 1999 for Protection and Development of the Environment- Drafted by the FEA, this law, which carries 101 articles, is particularly strong in respect of the marine environment, with over 40 articles concerning 297 marine transportation and pollution and the respective penalties applicable to a vessel found in breach of any specified offence.

Federal Law No. (23) of 1999 for Protection of the Marine Environment- governs the exploitation, protection and development of marine biological resources. This law predominantly deals with fisheries and does not provide any specific protections for corals. Fishing methods are considered, with bans on the use of certain equipment or particular methods – nylon nets, drift nets, bottom trawling and the use of poisons and explosives. Protection of restricted areas is also covered again in the Federal Law No. 23 (information summarized from Aspinall, Simon 2001).

2.2.1.90 United Kingdom

The United Kingdom has two overseas territories in the Indo-Pacific region; the Pitcairn Islands and the British Indian Ocean Territory (BIOT). The BIOT includes the Chagos Archipelago and Diego Garcia (the UK's Caribbean territories are covered in Section 2.2.1).

Pitcairn Islands. The Pitcairn Islands form a group of four volcanic islands in the southern Pacific Ocean. The islands are a British overseas territory (formerly a British colony), the last remaining in the Pacific. The four islands – named Pitcairn, Henderson, Ducie, and Oeno – are spread over several hundred miles of ocean and have a total area of about 18 square miles (47 km2). Only Pitcairn, the second largest and measuring about 2 miles (3.2 km) across, is inhabited with a population of approximately 50 people (as of 2008). There is no specific conservation policy for the islands, and there appears to be no specific legislation covering the protection of sites for conservation purposes. The Ordinances (Local Government Regulations, 1971) cover wildlife protection and fisheries management. Additionally, no protected areas have been established in the islands, but the extreme isolation of Henderson, Oeno and Ducie affords these uninhabited islands a considerable degree of protection.

British Indian Ocean Territory (BIOT). The British Indian Ocean Territory (BIOT) covers a very large area of reefs and islands, also known as the Chagos Archipelago. There are some 50 islands and islets and, although the total land area is only 60 km², there is a vast area of reefs, including five true atolls: Blenheim Reef, Diego Garcia, Egmont, Peros Banhos and Salomon.

- Chagos Archipelago: Located in the center of the Indian Ocean, the Chagos contain the world's largest coral atoll and the greatest marine biodiversity in the UK by far. It

also has one of the healthiest reef systems in the cleanest waters in the world, supporting half the total area of good quality reefs in the Indian Ocean. The UK is committed to protecting marine biodiversity, both through its own Marine Access Bill and also through numerous EU and international agreements. The declaration of the Chagos Marine Protected Area will make it the largest marine protected area in the world, totaling more than 210,000 square miles (544,000 square kilometers), an area twice the size of the UK. The Chagos MPA will include a "no-take" marine reserve where commercial fishing will be banned.

- Diego Garcia: The coral atoll of Diego Garcia (Chagos Archipelago), strategically situated in the middle of the Indian Ocean, is part of the British Indian Ocean Territory (BIOT) established by Order-in-Council on November 8, 1965. In September of 2003, the UK proclaimed a 200-mile 'Environment (Protection and Preservation) Zone' around BIOT, under Article 75 of UNCLOS, with geographical boundaries identical to those of a BIOT 'Fisheries Conservation and Management Zone' declared in 1991. Ordinance No. 12 of 1984 (The Protection and Preservation of Wild Life) Amendment deals with the protection and preservation of wildlife. This ordinance amends Statutory Instrument No. 6 of 1984 "The Wild Life Protection Regulations of 1984" and forbids the taking, possession, killing, or injury of any animal, including live seashells, corals, and turtle eggs. Exceptions are made for any fish or marine product lawfully taken in accordance with the Fisheries Ordinance, 1991 (Diego Garcia Integrated Natural Resources Management Plan, September 2005 Appendix B. BIOT Policies B-3).

2.2.1.91 United States

The collective range of the 75 Indo-Pacific species within the US includes Hawaii, the Territories of American Samoa and Guam, the Commonwealth of the Northern Mariana Islands, and the Pacific Remote Islands Area (PRIA; The US Caribbean areas are covered in Section 2.2.1). Existing regulatory mechanisms in the US Pacific Islands most relevant to addressing local threats to corals are: (1) fisheries and coastal management, and (2) MPA management. These two categories of regulatory mechanisms are described for the federal (national) level, and for the non-federal (State and Territorial) level. PRIA is entirely federally managed, so it does not appear in the non-federal section. This US section is a summary based on the information in Appendix A to this report.

2.2.1.91.1 Federal

Within US waters, federal fisheries and coastal management are dictated by numerous federal statutes and Executive Orders: Clean Water Act, Coastal Zone Management Act, Outer Continental Shelf Lands Act, Coral Reef Conservation Act, Endangered Species Act, Magnuson-Stevens Fishery Conservation and Management Act, National Marine Sanctuaries Act, Rivers and Harbors Act, Act to Prevent Pollution From Ships, National Environmental Policy Act (NEPA), National Park Service Organic Act, National Wildlife Refuge System Administration Act, Ocean Dumping Ban Act, Refuge Recreation Act, The Lacey Act, The Sikes Act, and Water Resources Development Act. The most relevant Executive Orders (EOs) include EO 12962 on recreational fishing, EO 12996 on the National Wildlife Refuge System, and EO 13158 on Marine Protected Areas. These federal laws and Executive Orders are described in detail in Section 1.1 of Appendix A.

Major federally-managed MPAs within the US Pacific Islands that protect corals and coral reefs include Pacific Remote Islands National Wildlife Refuge Complex, Papahanaumokuakea Marine National Monument, Hawaii Humpback Whale National Marine Sanctuary, Kalaupapa National Historic Park, Fagatele Bay National Marine Sanctuary, National Park of American Samoa, Rose Atoll Marine National Monument, Guam National Wildlife Refuge, Marianas Trench Marine National Monument, and Pacific Remote Islands National Marine Monument. These and other federally-managed MPAs are described in detail in Section 2.1 of Appendix A.

2.2.1.91.2 Hawaii

Within Hawaii waters, fisheries and coastal management are dictated by numerous non-federal laws and regulations. In addition, many of Hawaii's MPAs are managed non-federally. These non-federal laws and regulations, and non-federal MPAs, are described in detail in Sections 1.3.1 and 2.3.1 of Appendix A.

2.2.1.91.3 American Samoa

Within American Samoa waters, fisheries and coastal management are dictated by numerous non-federal laws and regulations. In addition, many of American Samoa's MPAs are managed non-federally. These non-federal laws and regulations, and non-federal MPAs, are described in detail in Sections 1.3.2 and 2.3.2 of Appendix A.

2.2.1.91.4 Guam

Within Guam waters, fisheries and coastal management are dictated by numerous non-federal laws and regulations. In addition, many of Guam's MPAs are managed non-federally. These non-federal laws and regulations, and non-federal MPAs, are described in detail in Sections 1.3.3 and 2.3.3 of Appendix A.

2.2.1.91.5 Northern Mariana Islands

Within Northern Mariana Islands waters, fisheries and coastal management are dictated by numerous non-federal laws and regulations. In addition, many of Northern Mariana Islands's MPAs are managed non-federally. These non-federal laws and regulations, and non-federal MPAs, are described in detail in Sections 1.3.4 and 2.3.4 of Appendix A.

2.2.1.92 Vanuatu

Vanuatu is an archipelago that stretches for 1,300 km and is comprised of more than 80 islands. The coral reef areas of Vanuatu make up a total area of approximately 408 km² and are relied upon heavily by the people of Vanuatu. Anthropogenic threats to Vanuatu's coral reefs include: coastal construction, land reclamation, waste disposal, livestock farming, logging, soil erosion and effluent from septic tanks.

Each cultural group in Vanuatu has its own traditional approaches to management, which may include the establishment of MPAs. Simple management tools are implemented such as monitoring size of resource, abundance, etc. Some cultural groups also place taboos on different areas as a management tool, but often these taboos are not adhered to by neighboring villages. These traditional management schemes have been supplemented by various government

administered legislation. Key legislation affecting the marine environment and coral reefs in Vanuatu include the following Acts and Regulations:

- Marine Zones Act, CAP 138 of 1982 Delimits archipelagic zones to define territorial sea and other maritime zones
- Fisheries Act, CAP 158 of 1982 Development and management of fisheries including provisions to prohibit the use of explosives, poisons and noxious substances for fishing
- Fisheries Regulations Order No 49 of 1983- Conservation and regulation of fisheries including aquarium fish and coral.
- Foreshore Development Act CAP 90 Regulates foreshore works.

The primary related responsibility for marine and coastal resource management in Vanuatu rests jointly between the Department of Fisheries within the Ministry of Agriculture, Quarantine, Forestry and Fisheries and the Environment Unit within the Ministry of Lands and Natural Resources (Naviti and Aston 2000).

2.2.1.93 Vietnam

Vietnam's coastline extends for approximately 3,260 km and encompasses more than 3,000 inshore and offshore islands and islets that extend to claims covering the Spratly and Paracel Islands. Vietnam has an estimated 1,100 km² of reef area, with the most diverse reefs being in the south (Burke *et al.* 2002). According to the Reefs at Risk in Southeast Asia model, approximately 96 percent of Vietnams' coral reefs are threatened by human activities, with nearly 75 percent at high or very high threat. The most pervasive and significant threat is destructive fishing practices, with approximately 85 percent of reefs at medium or high risk of this activity. Additionally, overfishing threatens an estimated 60+ percent of Vietnam's reefs, and sediment from upland sources threatens an estimated 50 percent of the country's reefs (Burke *et al.* 2002).

Vietnam's broad and basic framework for environmental protection policy is established by the Law on Environmental Protection, which was passed by the National Assembly on 27 December 1993. Chapter II of this legislation focuses on prevention and mitigation of environmental degradation and pollution incidents. The specific protection of marine resources falls under the jurisdiction of 2 separate government ministries: The Ministry of Fisheries and the Ministry of Forestry. The Ordinance on Fisheries Resource Protection contains specific regulations on fish catch, methods, seasons, etc. that are being enforced by the Department of Fisheries Resources Protection, which was established in 1993 under the Ministry of Fisheries (ASEAN Regional Centre for Biodiversity Conservation 2002). The Law of Conservation and Management of Living Aquatic Resources (2005), article 8, prohibits using toxic and harmful substances, explosives, gun powder, or electric currents to kill fish. The Fisheries Law of 2005 mandates the creation of marine protected areas where there are fauna and flora of significance either nationally or internationally.

As of 2002, of the 31 existing protected areas, only Cat Ba and Con Dao National Parks and Halong Bay World Heritage contain marine areas. Most of the existing areas focus on terrestrial biodiversity conservation (ASEAN Regional Centre for Biodiversity Conservation 2002).

Currently, only a small proportion (approximately 11 percent) of Vietnam's coral reef resources is protected within MPAs (Burke *et al.* 2002).

2.2.1.94 Yemen

Yemen is located in the southeastern part of the Arabian Peninsula and has three main coastal regions: the Red Sea, the Gulf of Aden and the Arabian Sea. The Red Sea and Gulf of Aden areas contain Yemen's complex and unique marine ecosystems. Yemen has established a number of national laws that related directly and indirectly to the marine environment. Some of the laws more pertinent to coral reefs are described below.

Law No. 26 of 1995 was established with the aim of fulfilling international commitments with respect to protecting the environment and combating pollution. It places the responsibility of protecting the environment and its natural resources, combating pollution, and protecting terrestrial and marine wildlife on formal government authorities, public and private institutions, and the individuals.

Law No. 11 of 1993 was established for the protection of sea from pollution, mainly concerned with pollution by oil and passing ships. The law lays out procedures for prosecuting, penalizing and requesting compensation from ships that violate the law. It gives the Public Corporation for Maritime Affairs the legislative power to deal with oil pollution at sea. Article No. 35 prohibits any form of discharge of pollutants of any kind and from any source into the sea without prior treatment.

Law No. 42 of 1991 provides the main legal framework for organization, exploitation and protection of fishing and aquatic resources. This law deals with the protection of fisheries resources and regulation of fishing activities by prohibiting the use of destructive fishing methods such as poisons, chemicals, etc. In 1997, the law was amended according to the Presidential Resolution No. 43 of 1997 to also prohibit the plucking and cutting of seaweed and sea grasses or coral reefs except in exceptional cases and after securing prior permission from the responsible Ministry.

Presidential Decree No. 275 of 2000 established the Conservation Zoning Plan of Socotra Islands and includes a marine conservation zoning plan covering resource use reserves, general use zones, national parks and nature sanctuaries. The Socotra Islands is also a candidate to be declared a World Heritage Site by UNESCO. The Socotra Islands contains some of the most diverse coral reefs in the region. The Ministry of Water and Environment and Environment Protection Authority also established Yemen's National Programme of Action for the Protection of the Marine Environment from Land-Based Sources (Information summarized and adapted from Republic of Yemen's Ministry of Water and Environment; Environmental Protection Authority 2003).).

2.2.2 International Regulatory Mechanisms Addressing Local threats

Convention on International Trade in Endangered Species[80]. The Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES) is a treaty that pertains only to

[80] http://www.cites.org/

international trade. Species are proposed and, if accepted by the Conference of Parties, are included in one of several Appendix listings based on extinction risk. Species in Appendix I are considered to be threatened with extinction and all commercial international trade of these species is permitted only under specific circumstances. Species in Appendix II are not considered threatened with extinction, but regulation of international trade is necessary to prevent endangerment. Appendix III contains species protected in countries that have asked the CITES Parties for assistance in controlling their trade. Trade of species listed in the three Appendices requires all specimens to be legally obtained, and, if alive, be treated in a way that minimizes risk to the species in transport. To import any of these species listed in Appendix I, permits are required which indicate either the specimen will not be used for commercial purposes or its take is not detrimental to the species. No importing permits are required for species listed in Appendix II or III. Exporting permits are required from all species listed in all three Appendices from the country of export. Permitting is essential because it allows for the collection of data on international trade that is often useful in evaluating the degree of threat and such data are generally not otherwise available. Section 9(c) of the ESA prohibits any person subject to the jurisdiction of the U.S. from engaging in any trade in any specimens contrary to the provisions of CITES or to possess any specimens traded contrary to the provisions of CITES (16 USC §1538(c)). Most reef-building corals are listed under CITES (all scleractinian corals are included in Appendix II). Of the 82 candidate coral species, all are listed on CITES. CITES allows some species to be listed on export permits at the higher taxonomic level of genus (when identification to species is not feasible) instead of the normal requirement to label to species level because of the recognized difficulty associated with correctly identifying corals at the species level.

Convention on Biological Diversity[81]. The Convention on Biological Diversity (CBD) was signed at the 1992 Rio Earth Summit by 150 governmental leaders to promote sustainable development. Its three main objectives include conserving biological diversity, sustainably using components of biological diversity (recognizing the sovereign use of resources with a State), and establishing equal sharing from using genetic resources. Most countries participating in the CBD develop a National Biodiversity Strategy and Action Plan to implement the convention. The most recent convention in 2010 focused on biodiversity, establishing the Strategic Plan 2011-2020 which includes global biodiversity targets for ecosystem resilience.

Jakarta Mandate on Marine and Coastal Biological Diversity (Jakarta Mandate) (1995, established in 1998): This multi-year program is part of the Convention on Biological Diversity (CBD) and has the broad goal of conservation and sustainable use of marine and coastal biological diversity. It has five parts, including: integrated marine and coastal area management, sustainable use of marine and coastal living resources, establishment and maintenance of marine and coastal protected areas, mariculture, and alien species control (Secretariat of the Convention on Biological Diversity, 1995).

International Convention for Prevention of Pollution from Ships. The International Convention for the Prevention of Pollution from Ships (MARPOL) was adopted in 1973. This Convention was subsequently modified by the Protocol 1978 that introduced stricter regulations for the survey and certification of ships. Together the Convention and Protocol are to be read as one

[81] http://www.cbd.int/

instrument and is usually referred to as MARPOL 73/78. MARPOL prevents pollution by governing the design and equipment of ships with an established system of certificates and inspections. It requires states to provide reception facilities for the disposal of oily waste and chemicals. MARPOL covers all the technical aspects of pollution from ships, except the disposal of waste into the sea by dumping; it applies to all ships of all types but does not apply to pollution arising out of the exploration of seabeds.

Regulations covering the various sources of ship-generated pollution are contained in six Annexes of the London Convention and are updated regularly. Annexes I and II are compulsory and govern oil and chemicals; Annexes III – VI govern packaged materials, sewage, garbage, and air pollution and are optional. Under the Convention, "special areas" are provided with a higher level of protection than other areas of the sea. The term "special areas" is defined as "a sea area where for recognized technical reasons in relation to its oceanographical and ecological conditions and to the particular character of its traffic, the adoption of special mandatory methods for the prevention of sea pollution by oil, noxious liquid substances, or garbage, as applicable, is required."

Ramsar Convention[82]. The Convention on Wetlands of International Importance, called the Ramsar Convention, is an intergovernmental treaty that provides the framework for national action and international cooperation for the conservation and wise use of wetlands and their resources. The Convention's mission is "the conservation and wise use of all wetlands through local and national actions and international cooperation, as a contribution towards achieving sustainable development throughout the world". The Convention uses a broad definition of the types of wetlands covered in its mission, including lakes and rivers, swamps and marshes, wet grasslands and peatlands, oases, estuaries, deltas and tidal flats, near-shore marine areas, mangroves and coral reefs, and human-made sites such as fish ponds, rice paddies, reservoirs, and salt pans. Currently there are 160 Contracting Parties with a total of 1,897 sites designated for the Ramsar list covering a total surface area of 185,621,539 hectares (ha).

United Nations Convention on the Law of the Sea. The United Nations Convention on the Law of the Sea (UNCLOS) is the international agreement that resulted from the third United Nations Conference on the Law of the Sea (UNCLOS III), which took place from 1973 through 1982. The Law of the Sea Convention defines the rights and responsibilities of nations in their use of the world's oceans, establishing guidelines for businesses, the environment, and the management of marine natural resources. The Convention, concluded in 1982, replaced four 1958 treaties. UNCLOS came into force in 1994, a year after Guyana became the 60th state to sign the treaty. To date, 158 countries and the European Community have joined in the Convention. However, it is uncertain as to what extent the Convention codifies customary international law (*Acropora* Biological Review Team 2005).

3. Conservation Efforts

As mentioned in the Introduction, one of the purposes of this Management Report is to identify and summarize conservation efforts pursuant to ESA section 4(b)(1). For this report, conservation efforts included non-regulatory conservation actions undertaken by both governmental and non-governmental organizations (NGOs, conservation groups, private

[82] http://www.ramsar.org/cda/en/ramsar-home/main/ramsar/1_4000_0__

companies, academia, etc) that may address threats identified by the BRT Report (Brainard et al. 2011) or otherwise protect coral resources. Conservation efforts with the potential to address the threats to the 82 corals include a vast array of coral reef-oriented agreements, organizations, management plans, monitoring efforts, research, education and/or outreach, marine debris removal projects, restoration programs, etc. These conservation efforts are often conducted by countries, states, local governments, individuals, NGOs, academic institutions, private companies, etc. They also include global conservation organizations that conduct coral reef and/or marine environment conservation projects, global coral reef monitoring networks and research projects, regional or global conventions, and education and outreach projects throughout the range of 82 species.

3.1 Conservation Efforts Addressing GHG Emissions

Global Carbon Project[83]. The Global Carbon Project (GCP) was formed in 2001 to assist the international scientific community in establishing a common, mutually agreed upon knowledge-base that would support policy debate and action to slow the increasing rate of GHG emissions into the atmosphere. The scientific goal of the project is to develop a complete picture of the global carbon cycle, including both its biophysical and human dimensions together with the interactions and feedbacks between them. The GCP is responding to this challenge through a shared partnership between the International Geosphere-Biosphere Programme, the International Human Dimensions Programme on Global Environmental Change, the World Climate Research Programme and Diversitas. This partnership constitutes the Earth Systems Science Partnership. The GCP has published the state of global carbon cycle annually since 2007. For a summary of accomplishments and scientific findings over the past 10 years, see http://www.globalcarbonproject.org/global/ppt/GCP_10years_med_res.pdf.

Global Methane Initiative[84]. The Global Methane Initiative is an action-oriented international initiative to reduce global methane emissions, enhance economic growth, promote energy security, improve the environment and reduce greenhouse gas emissions. It was launched as the Methane to Markets Partnership in 2004 with participation from the Departments of State, Energy, and Agriculture, and from the U.S. Trade and Development Agency and the Agency for International Development. The Global Methane Initiative targets three major methane sources: landfills, underground coal mines and natural gas and oil systems. The Initiative focuses on the development of strategies and markets for the recovery and use of methane through: technology development, demonstration, deployment and diffusion; implementation of effective policy frameworks; identification of ways and means to support investment; and removal of barriers to collaborative project development and implementation. Member countries will work in collaboration with the private sector, multilateral development banks, and other governmental and non-governmental organizations to achieve these objectives. More information can be found at EPA's Global Methane Initiative Site and the Global Methane Initiative Site.

Intergovernmental Panel on Climate Change[85]. The Intergovernmental Panel on Climate Change (IPCC) is a leading international body for the assessment of climate change established by the United Nations Environment Program and the World Meteorological Organization in 1988. The

[83] http://www.globalcarbonproject.org/
[84] http://epa.gov/climatechange/policy/international_multilateral.html
[85] http://www.ipcc.ch/

goal of the IPCC is to provide the world with a clear scientific view on the current state of knowledge in climate change and its potential environmental and socio-economic impacts. The IPCC is a scientific body that does not perform scientific research; rather, it reviews and assesses the most recent scientific, technical and socio-economic information produced worldwide relevant to the understanding of climate change. Thousands of scientists from all over the world contribute to the IPCC on a voluntary basis. It is an intergovernmental body open to all member Countries of the United Nations and World Meteorological Organization. The work of the organization aims to be policy-relevant and yet policy-neutral, never policy-prescriptive. The IPCC has released four major publications to date known as the IPCC Assessment Reports (1990, 1995, 2001, 2007) as well as many other publications and reports. Information summarized and released in the assessment reports has been integral in informing major international negotiations and treaties to address climate change including the UNFCCC, Kyoto Protocol, and Copenhagen Accord.

International Energy Agency[86]. The International Energy Agency (IEA) is an intergovernmental organization which acts as an energy policy advisor to 28 member countries in their efforts to ensure reliable, affordable, and clean energy for their citizens. Founded during the oil crisis of 1973-74, the IEA's initial role was to coordinate measures in times of oil supply emergencies. Energy security remains a key priority, but IEA's focus has expanded beyond concerns about oil supplies to include natural gas and electricity. The Agency's mandate has also broadened to incorporate the "Three E's" of balanced energy policy making: energy security, economic development, and environmental protection. Current work focuses on diversification of energy sources, renewable energy, climate change policies, market reform, energy efficiency, development and deployment of clean energy technologies, energy technology collaboration and outreach to the rest of the world, especially major consumers and producers of energy like China, India, Russia and the OPEC countries. The most recent meeting of the Governing Board of IEA member countries at Ministerial level was held on 14-15 October 2009 in Paris. With a staff of around 250, mainly energy experts and statisticians from its 28 member countries, the IEA conducts a broad program of energy research, data compilation, publications and public dissemination of the latest energy policy analysis and recommendations on good practices.

International Renewable Energy Agency[87]. The International Renewable Energy Agency (IRENA) was officially established in January 2009. To date, 148 states and the European Union have signed the Statute of the Agency including 48 African, 38 European, 35 Asian, 17 American and 10 Australia/Oceania States. Mandated by these governments worldwide, IRENA's mission is to promote the widespread and increased adoption and sustainable use of all forms of renewable energy. Acting as the global voice for renewable energies, IRENA will facilitate access to renewable energy information including technical data and renewable resource potential data, and will share experiences on best practices and lessons learned regarding policy frameworks, capacity-building projects, available finance mechanisms and renewable energy related energy efficiency measures. A Preparatory Commission was established to act as an interim body until the Statute entered into force with the 25th ratification

[86] www.iea.org

[87] http://www.irena.org/

instrument which occurred on June 8, 2010. They are currently in the process of establishing member representatives to form a Council to implement the 2010 Work Program[88].

Asia-Pacific Partnership on Clean Development and Climate[89]. The Asia-Pacific Partnership on Clean Development and Climate is an innovative new effort to accelerate the development and deployment of clean energy technologies. Participating countries include: Australia, Canada, China, India, Japan, Korea, and the United States. The seven partner countries collectively account for more than half of the world's economy, population and energy use, and they produce about 65 percent of the world's coal, 62 percent of the world's cement, 52 percent of world's aluminum, and more than 60 percent of the world's steel. These countries have agreed to work together and with private sector partners to meet goals for energy security, national air pollution reduction, and climate change in ways that promote sustainable economic growth and poverty reduction. The Partnership focuses on expanding investment and trade in cleaner energy technologies, goods and services in key market sectors. The Partners have approved eight public-private sector task forces for Aluminum, Buildings and Appliances, Cement, Cleaner Fossil Energy, Coal Mining, Power Generation and Transmission, Renewable Energy and Distributed Generation, and Steel.

Australia's Bilateral Climate Change Partnership Program[90]. Under Australia's Bilateral Climate Change Partnership Program, Australia maintains partnerships with China, South Africa, New Zealand, the European Union, the United Kingdom, Japan, and the United States. These partnerships provide opportunities for building stronger political relationships and influencing other countries' climate change policies at the highest level. Through these partnerships, Australia supports practical activities that address climate change issues of mutual concern. The partnerships with developing countries aim to build their capacity to tackle climate change alongside sustainable development. Examples include collaboration with China and South Africa on projects involving capacity building on emissions reporting, renewable energy technology, energy efficiency, capture and use of methane, climate change and agriculture, climate change and biodiversity, land use, land use change and forestry, and adaptation and climate change science.

Australia-China Bilateral Cooperation on Climate Change. In 2003, officials from Australia and China agreed on a joint declaration of the Australia-China Bilateral Cooperation on Climate Change (Government of Australia 2003). This Memorandum of Understanding (MOU) between the two countries is a cooperative effort to combat climate change, focusing on several key themes including climate change policies, climate change impacts and adaptation, national communications (greenhouse gas inventories and projections), technology cooperation, and capacity building and public awareness. The MOU between Australia and China is expected to open up trade benefits in greenhouse technologies as well as exemplify both countries' willingness to cooperate on bilateral, multilateral, regional, and domestic levels in regards to the global issue of climate change (Government of Australia 2003).

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[88] http://www.irena.org/pdf/IRENA_Work_Programme_2010.pdf
[89] http://www.asiapacificpartnership.org/english/default.aspx

[90] http://www.climatechange.gov.au/government/initiatives/bilateral-cc-partnership-program.aspx

Carbon Sequestration Leadership Forum. The Carbon Sequestration Leadership Forum seeks to develop cost-effective technologies for the separation and capture of carbon dioxide for its transport and long-term storage. The purpose of the Carbon Sequestration Leadership Forum is to make these technologies available internationally, and to identify and address wider issues relating to carbon capture and storage. The forum, which now includes 21 countries as well as the European Commission, has approved 17 capture and storage projects as well as a Technology Roadmap to provide future directions for international cooperation (info and summary adapted from http://www.pi.energy.gov/usa_china_energy_cooperation.htm and http://www.cslforum.org/).

Caribbean Community (CARICOM) Climate Projects[91]. CARICOM climate projects include the Caribbean Renewable Energy Development Programme and the Mainstreaming Adaptation to Climate Change. The mission of Caribbean Renewable Energy Development Programme is "to reduce barriers to the increased use of renewable energy thus reducing the dependence on fossil fuels while contributing to the reduction of greenhouse gas emissions." Caribbean Renewable Energy Development Programme is an initiative of the Energy Ministers of the Caribbean Community region established to change the market environment for Renewable Energy in the Region. Currently 13 Caribbean countries are participating, with another 4 countries pending.

Mainstreaming Adaptation to Climate Change[92] is a program by CARICOM, and implemented by the World Bank with funding of $5 million from the Global Environment Fund. The executing agency is the CARICOM Secretariat. The project's main objective is to incorporate mainstream climate change adaptation strategies into the sustainable development agendas of the Small Island and low-lying states of CARICOM. This program is comprised of 5 components, including: building capacity to identify climate change risks, reduce vulnerability to climate change, effectively access and utilize resources to minimize the costs of climate change, increase public education and awareness, and finally, project management. The participating countries include: Antigua and Barbuda, the Bahamas, Barbados, Belize, Dominica, Grenada, Guyana, Jamaica, Saint Lucia, St. Kitts and Nevis, St. Vincent, and Trinidad and Tobago.

Caribbean Community Climate Change Center[93] coordinates the Caribbean region's response to climate change. Officially opened in August 2005, the Centre is the key node for information on climate change issues as well as the region's response to managing and adapting to climate change in the Caribbean. It is the official repository and clearing house for regional climate change data, providing climate change-related policy advice and guidelines to the CARICOM Member States through the CARICOM Secretariat. In this role, the Centre is recognized by the UNFCCC, UNEP, and other international agencies as the focal point for climate change issues in the Caribbean.

China-EU Climate Change Rolling Work Plan. China and the EU issued the Joint Declaration on Climate Change which established the bilateral Partnership on Climate Change at the EU-China Summit in Beijing on 5 September 2005. The Partnership is to provide a mechanism for

[91] http://www.caricom.org/jsp/projects/macc%20project/cpacc.jsp
[92] http://www.caricom.org/jsp/projects/macc%20project/macc.jsp
[93] http://www.caricom.org/jsp/community/ccccc.jsp?menu=community

the EU and China to take a strategic view of shared climate change objectives, and to take an overview of, give direction to and develop bilateral cooperation activities that contribute to these objectives. Delegations have met at regular intervals since 2005 to exchange information and discuss ways to jointly address the sources and impacts of climate change (For more information see the following links: http://www.mfa.gov.cn/eng/wjb/zzjg/tyfls/tfsxw/t283051.htm, http://ec.europa.eu/clima/documentation/international/docs/minutes_6_meeting.pdf)

Energy Star[94]. Energy Star is a joint program of the U.S. Environmental Protection Agency and the U.S. Department of Energy to help save consumers money and reduce greenhouse gas emissions through energy efficient products and practices. EPA has entered into agreements with the following foreign governments of Australia, Canada, European Union, European Free Trade Association, Japan, New Zealand, Switzerland, and Taiwan to promote specific Energy Star qualified products. These partnerships are intended to unify voluntary energy-efficiency labeling programs in major global markets and make it easier for partners to participate. These countries are using Energy Star products for offices, consumer electronic products, and home appliances.

India-China Bilateral Agreement on Climate. In 2009, one month prior to high-profile climate talks in Copenhagen, India and China signed a bilateral agreement pledging partnership to tackle climate change (ICTSD[95] 2009). The memorandum of understanding was signed by India's environment minister, Jairam Ramesh, and minister and vice-chairman of China's National Development and Reform Commission, Xie Zhenhua. The agreement promises of continued cooperation on climate at the international level, and "seeks to broaden joint research and development into emissions-reducing technologies, in areas such as wind, solar, forestry and even 'clean coal.'" Considering half of the world's population resides in one of these two countries, both India and China need to be on board to make any climate actions successful.

International Partnership for a Hydrogen Economy. Established in 2003, the International Partnership for a Hydrogen Economy is comprised of 17 member countries and the European Union, in a partnership to foster international cooperation on research, development and demonstration programs that advance the transition to a global hydrogen economy. The Partnership for a Hydrogen Economy organizes and coordinates national strategies for hydrogen and fuel cell research and development (info and summary adapted from http://www.iphe.net/ and http://www.pi.energy.gov/usa_china_energy_cooperation.htm).

International Thermonuclear Experimental Reactor. The International Thermonuclear Experimental Reactor is an international research and development project that aims to demonstrate the scientific and technical feasibility of fusion power. The project's partners are the United States, China, Japan, India, Russia, the Republic of Korea, and the European Union (represented by EURATOM). The experimental fusion reactor will be constructed at Cadarache, France and is expected to be completed in 2015 (info and summary adapted from http://www.iter.org/default.aspx and http://www.pi.energy.gov/usa_china_energy_cooperation.htm).

[94] http://www.energystar.gov/index.cfm?c=about.ab_index
[95] ICTSD stands for International Centre for Trade and Sustainable Development

Midwest Greenhouse Gas Reduction Accord[96] The North American Midwest has intensive manufacturing and agriculture sectors, making it the most coal-dependent region in North America. Realizing the unique and major impact that the Midwestern states plain the emissions of carbon, nine Midwestern governors and two Canadian premiers have signed on to participate or observe in the Midwestern Greenhouse Gas Reduction Accord (Accord). Through the Accord, these governors agreed to establish a Midwestern greenhouse gas reduction program to reduce greenhouse gas emissions in their states, as well as a working group to provide recommendations regarding the implementation of the Accord. The participating Midwestern states and Canadian provinces include: Iowa, Illinois, Kansas, Manitoba, Michigan, Minnesota and Wisconsin. Observing parties of the Accord include Indiana, Ohio, Ontario and South Dakota.

North American Declaration on Climate Change and Clean Energy[97]. Leaders from the North American countries (U.S., Canada, and Mexico) made a Declaration on Climate Change and Clean Energy in August 2010. In the Declaration, the North American Leaders state their recognition of the broad scientific view that the increase in global average temperature above pre-industrial levels ought not to exceed 2 degrees C. Additionally, they declare their support of a global goal of reducing global emissions by at least 50% compared to 1990 or more recent years by 2050, with developed countries reducing emissions by at least 80% compared to 1990 or more recent years by 2050.The Declaration states the Parties' goals of working together to reduce GHG emissions from transport and oil and gas sectors, pursue a framework to align energy efficiency standards in the three countries, develop comparable approaches to measuring, reporting, and verifying emissions reductions, and collaborate on climate friendly and low-carbon technologies, among others. In order to facilitate these actions, the North American leaders aim to work cooperatively to develop and follow up on a Trilateral Working Plan and submit a report of results at the next North American Leaders Summit.

Regional Greenhouse Gas Initiative[98]. The Regional Greenhouse Gas Initiative is the first greenhouse gas emissions reduction effort by the United States that is market-based and mandatory. This Initiative is represented by ten Northeastern and Mid-Atlantic States that have capped, and will continue to reduce CO_2 emissions from the power sector by 10% by 2018. In order to accomplish this goal, states sell nearly all emission allowances through auctions and invest proceeds in consumer benefits such as energy efficiency, renewable energy, and other clean energy technologies. The Regional Greenhouse Gas Initiative is thus able to spur innovation in the clean energy economy and create green jobs in each state. Participating states in the Regional Greenhouse Gas Initiative include: Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Rhode Island and Vermont.

Transportation and Climate Initiative[99]. Eleven Mid-Atlantic and Northeastern states, as well as the District of Columbia, announced a Declaration of Intent for the Transportation and Climate Initiative on June 16, 2010. The main goals of the Transportation and Climate Initiative include: reducing greenhouse gas emissions, minimizing the transportation system's reliance on high-

[96] http://www.midwesternaccord.org/midwesterngreenhousegasreductionaccord.pdf
[97] http://www.whitehouse.gov/the_press_office/North-American-Leaders-Declaration-on-Climate-Change-and-Clean-Energy/
[98] http://www.rggi.org/home
[99] http://climatechange.transportation.org/pdf/markstout_trclimateinit.pdf

carbon fuels, promoting sustainable growth, addressing the challenges of vehicle-miles traveled, and helping to build the clean energy economy. Included in this initiative are the ten Regional Greenhouse Gas Initiative members (Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Rhode Island, and Vermont), Pennsylvania, and the District of Columbia. Currently, transportation accounts for a total of 30 percent of greenhouse gas emissions in the Mid-Atlantic and Northeastern U.S. The states involved with the Transportation and Climate Initiative will establish and fund the Transportation, Energy, and Environment Staff Working Group to direct the initiative's planning and seek public and private funding for projects.

US-China Oil and Gas Industry Forum. Launched in 1998, this bilateral forum provides opportunities for U.S. and Chinese government and industry leaders to conduct open discussions about their respective ventures in the oil and gas sector. The Departments of Energy and Commerce co-host the forum on the U.S. side and the National Development and Reform Commission is the lead agency for China. Additionally, a variety of industry representatives play an active role in formulating meeting agendas and delivering timely and informative presentations on private sector opportunities and issues **(**info and summary adapted from http://www.pi.energy.gov/usa_china_energy_cooperation.htm and http://www.uschinaogf.org/).

US-China Strategy for Clean Air and Energy Cooperation[100]. The goal of the joint US-China Strategy for Clean Air and Energy Cooperation is to enhance the effectiveness of collaborative efforts to reduce the emissions intensity (air pollution and greenhouse gases) of China's rapidly growing economy. To achieve this goal, the U.S. EPA and the State Environmental Protection Agency of China plan to develop and implement a coordinated strategic framework for cooperation on matters related to air quality management, public health, clean energy and transportation.

US-India Green Partnership[101]. In November 2009, President Barack Obama and Indian Prime Minister Manmohan Singh launched a "Green Partnership to Address Energy Security, Climate Change, and Food Security," reaffirming their countries' strong commitment to taking vigorous action to combat climate change, ensuring their mutual energy security, working towards global food security, and building a clean energy economy that will drive investment, job creation, and economic growth throughout the 21st century. Toward that end, Prime Minister Singh and President Obama agreed to strengthen U.S.-India cooperation on clean energy, climate change, and food security by launching various initiatives.

US-Indonesia Partnership on Climate Change and Clean Energy[102]. In 2009, President Obama and Indonesian President Yudhoyono committed to making combating climate change, including improved cooperation on clean energy, a key element of the new U.S.-Indonesia Comprehensive Partnership. Emphasis was placed on efforts to implement two major international climate and

[100] http://www.epa.gov/oia/regions/Asia/china/2004_sca_eng.pdf
[101] http://www.america.gov/st/texttrans-english/2009/November/20091124173218eaifas0.8567425.html#ixzz1823kF2JM
[102] http://www.america.gov/st/texttrans-english/2010/November/20101109180315su0.9502614.html#ixzz1827gyDGh

energy agreements: the Copenhagen Accord's call to reduce global emissions and the G-20 Leaders' commitment to phase out inefficient fossil fuel subsidies while promoting renewable energy and improving energy efficiency.

US-Korea Climate Technology Partnership. To accelerate the implementation of methane recovery technologies in Korea, it was determined in 2001 by the Korean and U.S. governments that a new program approach was needed. This is when the Climate Technology Partnership was developed with considerable consultation among the U.S. Agency for International Development, the U.S. Environmental Protection Agency, the Department of Energy, and the National Renewable Energy Laboratory. Climate Technology Partnership is a follow-on from the Technology Cooperation Agreement Pilot Project which started in 1997 with the goal of developing an international process that assesses needs and fosters private sector development of climate friendly technologies in developing nations. In 1999 Korea joined Technology Cooperation Agreement Pilot Project and an assessment of technologies with market-based status, applicable developing country-driven strategy, and available resources was done. To better focus resources under Climate Technology Partnership Korea, two of the three priority technologies that were identified by Technology Cooperation Agreement Pilot Project – energy management and methane recovery – were selected for further development. Climate Technology Partnership differed from Technology Cooperation Agreement Pilot Project in that it had the added feature of strategic activity to complement project activity. This bifurcation of tasks between strategic and project objectives sought to create a suitable environment for the formation of active new markets in energy service companies and landfill gas (LFG) development (summary and info adapted from Larney *et al.* 2006).

Western Climate Initiative[103]. The Western Climate Initiative is a collaborative effort to reduce greenhouse gas emissions while spurring investment into clean-energy technologies that create green jobs and help to reduce dependence on foreign oil. This initiative represents numerous independent jurisdictions that are working together to identify, evaluate, and implement policies to tackle climate change at a regional level. Regional partners include Arizona, British Colombia, California, Manitoba, Montana, New Mexico, Ontario, Oregon, Quebec, Utah, and Washington. Observers of the Initiative include: Alaska, Colorado, Kansas, Nevada, Idaho, Wyoming, Saskatchewan, New Brunswick, Nova Scotia, Yukon, and several Mexican states.

IUCN Climate Change and Coral Reefs Marine Working Group (CCCR)[104]. The main objective of the Working Group is to form a bridge between theoretical science and management in coral reef ecosystems. They address this by identifying information gaps and issues through workshops and research tracks to synthesis the most recent and relevant information, especially that pertaining to coral reefs and climate change. Projects under implementation of the CCCR include measuring resilience in coral reef monitoring programs and rapid resilience assessments of coral reefs around the world, improving bleaching early warning and response plans, measuring herbivory, and creating a resilience bibliography and coral reef resilience and resistance DVD.

[103] http://www.westernclimateinitiative.org/
[104] http://www.iucn.org/cccr/

3.2 Conservation Efforts Addressing Local threats

Many international and national programs exist to conserve corals and coral reef habitat through addressing localized threats such as fishing, land-based sources of pollution, physical damage, and local threats. Also, numerous international and multinational agreements and conventions on coral reef conservation are also aimed at reducing such threats. Likewise, numerous non-governmental organizations (NGO) support coral research, monitoring, restoration and protection, thereby addressing such threats in various ways. For a relatively exhaustive list of coral-centric NGOs visit the International Coral Reef Information Network (ICRIN) website[105].

Conservation International (CI)[106]. CI is an NGO whose mission is to assist communities to responsibly and sustainably care for nature, biodiversity, and humanity. CI is staffed with scientists, managers, and policy analysts all working to provide current information used by governments and international organizations in policy making decisions. One example of a project CI is working is the Oceanscapes Initiative, which works closely with the heads of state and six governments in the Coral Triangle[107] region. Also through Oceanscape, CI is working closely with the government of Kiribati to launch a multi-governmental effort to improve ocean health.

Global Coral Reef Monitoring Network (GCRMN)[108]. The objectives of the GCRMN are to connect and train people and organizations in monitoring ecological, social, cultural, and economic aspects of coral reefs by providing a monitoring program framework; and to enable people at the local, regional, and global level to disseminate information on the sustainable use and conservation of coral reefs. Monitoring experts in each of these fields train trainers in participating countries and information on coral reef status is gathered into databases within the GCRMN. For example, experts from Reef Check train people in ecological monitoring and the Socioeconomic Manual for Coral Reef Management is used to train people in socioeconomic monitoring. All these data are gathered into ReefBase so that researchers around the world can access it.

The Global Programme of Action (GPA)[109]. The GPA for the Protection of the Marine Environment from Land-Based Activities was adopted in 1995 and is designed to be a source of conceptual and practical guidance to national and/or regional authorities for devising and implementing that prevents, reduces, controls, and/or eliminate marine degradation from land-based activities. More specifically, it is recommended that States identify and assess problems related to food security, poverty alleviation, public health, coastal and marine resources, ecosystem health, economic and social benefits, cultural values, impacts of contaminants, physical alteration and degradation of habitat, and affected or vulnerable areas of concern.

International Coral Reef Initiative[110]. The International Coral Reef Initiative (ICRI) was originally initiated by the governments of Australia, France, Japan, Jamaica, the Philippines,

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105 http://www.coralreef.org

106 http://www.conservation.org/Pages/default.aspx

107 http://www.conservation.org/sites/marine/initiatives/oceanscapes/cti/Pages/overview.aspx

108 http://www.gcrmn.org/

109 http://www.seafriends.org.nz/issues/cons/gpa.htm

110 http://www.icriforum.org/

Sweden, the United Kingdom, and the United States in recognition that tropical and sub-tropical coral reefs are facing serious degradation. Additional partners from governments, United Nations organizations, multilateral development banks, environmental and developmental NGOs, and the private sector have subsequently joined the partnership and are currently collaborating in the ICRI. The partnership strives to protect and preserve coral reefs and their related ecosystems by calling on states to: "identify marine ecosystems exhibiting high levels of biodiversity and productivity and other critical habitat areas and should provide necessary limitations on use of these areas, through, inter alia, designation of protected areas" (Chapter 17, Section 17. 86, ICRI). ICRI objectives call for governments and international organizations to strengthen their commitments to programs at the local, national, regional, and international levels to conserve, restore, and promote sustainable use of coral reefs and associated environments. Objectives also include development of management provisions for protection, restoration, and sustainable use of coral reefs and associated environments, strengthening capacity for development and implementation of policies, management, research, and monitoring of coral reefs and associated environments, and establishment or maintenance of international, regional and national research and monitoring programs to ensure efficient use of scarce resources and a flow of information relevant to management of coral reefs and associated environments.

International Coral Reef Action Network (ICRAN)[111]. ICRAN was established in 2000 with a historic grant from the United Nations Foundation (UNF). It was formed in response to a Call to Action by the International Coral Reef Initiative (ICRI), ICRAN supports the implementation and regular review of ICRI's Framework for Action. The main objectives of ICRAN are to link scientific monitoring and management activities in coral reefs systems across local, national, and global scales. Traditional knowledge, training, and information about alternative livelihoods are shared within ICRAN.

International Union for Conservation of Nature (IUCN). Also known as the World Conservation Union, IUCN helps the world find pragmatic solutions to our most pressing environment and development challenges. It supports scientific research, manages field projects all over the world and brings governments, non-government organizations, United Nations agencies, companies and local communities together to develop and implement policy, laws and best practices.

IUCN Marine Programme[112]. The IUCN's Marine Programme is broken down into 8 separate themes: Climate Change Mitigation & Adaptation, Conserving Threatened Species, Energy & Industry, Fisheries & Aquaculture, Managing Marine Invasive Species, Marine Protected Areas, and Ocean Governance. Under the Climate Change Mitigation & Adaptation theme, the IUCN conducts work in the areas of coral reef monitoring, research, resilience, and ocean fertilization and other geo-engineering issues.

IUCN Red List of Threatened Species[113]. The main objective of the IUCN Red List is to organize and evaluate the conservation status of plant and animal species around the world. Many government institutions and NGOs refer to this list to help in conservation decisions.

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[111] http://www.icran.org/
[112] http://www.iucn.org/about/work/programmes/marine/
[113] http://www.iucnredlist.org/about/red-list-overview#introduction

Man and the Biosphere Programme (MAB)[114]. The MAB, started in the early 1970s, proposes an interdisciplinary research agenda and capacity building aiming to improve the relationship of people with their environment globally. It notably targets the ecological, social and economic dimensions of biodiversity loss and the reduction of this loss. It uses its World Network of Biosphere Reserves as vehicles for knowledge-sharing, research and monitoring, education and training, and participatory decision-making. Coastal marine biosphere reserves are reference sites for monitoring coastal and marine biodiversity. Marine protected areas are essential for observing and measuring human impacts on the coastal/marine habitats and developing more rigorous and innovative guidelines for their conservation and sustainable management. Biosphere reserves are sites of excellence recognized under UNESCO's Man and the Biosphere Programme. They offer privileged arenas for melding science and society. Their system of zoning allows targeted management, with different requirements for protection, scientific research, and human use; a great number of these requirements encompass coastal and marine areas.

The Nature Conservancy (TNC)[115]. TNC is an NGO with marine conservation staff and projects in more than 33 countries and all coastal U.S. states and territories, The Nature Conservancy works with partners to create lasting conservation results that benefit marine life, local communities and economies. TNC's Marine Conservation Initiative is working toward a future of healthy oceans that support plants, animals and people for generations. Their work is focused on restoring coastal habitats, helping people and marine life adapt to climate change, developing better approaches for fisheries, and expanding ocean protection and improving management. The Nature Conservancy also works to create networks of protected areas, in order to help nearby degraded marine habitats recover and rebuild. TNC also works with local communities to provide managers with tools and training to help make their reefs stronger in the face of climate change and are currently partnering with NOAA to advance coral reef conservation efforts in seven United States coral reef jurisdictions. TNC, along with partners like NOAA, offer reef resilience training to coral reef managers around the world to implement strategies that address the effects of climate change.

Regional seas partnership on marine and coastal protected areas (UNESCO-UNEP (United Nations Environment Programme) Regional Seas- CBD (Convention on Biological Diversity))[116]. This is a partnership on Marine and Coastal Protected Areas. It is designed to coordinate information related to marine and coastal protected areas in United Nations and other international processes. The aim is to contribute to establishing representative networks of marine protected areas by 2012, as agreed at the World Summit on Sustainable Development.

Reef Check Foundation[117]. Reef Check is a global NGO established to facilitate community education, monitoring and management of coral reefs. Reef Check is active in more than 70 coral reef countries and territories, where it seeks to: educate the public about the coral reef

[114] http://www.unesco.org/new/en/natural-sciences/environment/ecological-sciences/man-and-biosphere-programme/
[115] http://www.nature.org/
[116] http://www.unesco.org/new/en/natural-sciences/environment/ecological-sciences/specific-ecosystems/island-and-coastal-areas/
[117] http://www.reefcheck.org/

crisis and how to prevent it; create a global network of volunteer teams that regularly monitor and report on reef health under the supervision of scientists; scientifically investigate coral reef processes; facilitate collaboration among academics, NGOs, governments and the private sector to solve coral reef problems; and stimulate community action to protect remaining pristine reefs and rehabilitate damaged reefs worldwide using ecologically sound and economically sustainable solutions. Under the ICRI framework, Reef Check is a primary GCRMN partner and coordinates GCRMN training programs in ecological and socio-economic monitoring, and coral reef management throughout the world.

Territorial Use Rights in Fisheries (TURFs). TURFs are community-controlled fishing areas established around the world. They can managed either by traditional or modern methods by under legal or illegal terms (Christy, 1982).

United Nations Environment Programme (UNEP)[118]. The UNEP was established in 1972 to address environmental issues within the United Nations system. UNEP's mission is to "provide leadership and encourage partnering in caring for the environment by inspiring, informing, and enabling nations and peoples to improve their quality of life without compromising that of future generations." UNEP promotes conservation and sustainable development at the global scale through partnerships and programs around the world. It often acts as a catalyst, advocate, educator, and facilitator to other United Nations entities, international organizations, and private businesses. UNEP's work encompasses assessing global, regional and national environmental conditions and trends; developing international and national environmental instruments; strengthening institutions for the wise management of the environment; facilitating the transfer of knowledge and technology for sustainable development; and encouraging new partnerships and mind-sets within civil society and the private sector.

UNEP's Regional Seas Programme[119]. UNEP's Regional Seas Programme was launched in 1974 after the 1972 United Nations Conference on the Human Environment held in Stockholm to address the "accelerating degradation of the world's oceans and coastal areas." The Regional Seas Programme seeks to accomplish this through the sustainable management and use of the marine and coastal environment, by engaging neighboring countries in comprehensive, and though specific actions to protect their shared marine environment. It has accomplished this by stimulating the creation of Regional Seas programmes prescriptions for sound environmental management to be coordinated and implemented by countries sharing a common body of water. There are more than 140 countries participate in 13 Regional Seas programmes established under the auspices of UNEP.

UNESCO's Programs. The United Nations Educational, Scientific, and Cultural Organization (UNESCO) has several major programs aimed at conservation of corals and coral reefs, including the World Heritage Convention, the Man and Biosphere Program, and the Regional Seas Partnership on Marine and Coastal Protected Areas.

[118] http://www.unep.org/
[119] http://www.unep.org/regionalseas/about/default.asp

World Heritage Convention[120]. The World Heritage Convention defines the kind of natural or cultural sites which can be considered for inscription on the World Heritage List. The Convention sets out the duties of States Parties in identifying potential sites and their role in protecting and preserving them. By signing the Convention, each country pledges to conserve not only the World Heritage sites situated on its territory, but also to protect its national heritage. The States Parties are encouraged to integrate the protection of the cultural and natural heritage into regional planning programs, set up staff and services at their sites, undertake scientific and technical conservation research and adopt measures which give this heritage a function in the day-to-day life of the community.

Barbados Programme of Action[121]. The Barbados Programme of Action was established in April 1994 during a global conference held in Barbados, to address how small island States could rise to meet their unique challenges. The Global Conference on the Sustainable Development of Small Island Developing States identified sustainable development as the most reasonable solution. Thus, the Barbados Programme of Action GPA for the Sustainable Development of Small Island Developing States was adopted. The Small Islands Developing States Programme of Action specifically identifies coastal and marine resources as an area that requires imperative action. In addition, it asks for the establishment and/or strengthening of programs within the framework of the Programme of Action and the Regional Seas programs, to evaluate the impacts of planning and development on areas including: coastal communities, wetlands, coral reefs habitats and other areas.

Action Plan for the Protection and Development of the Marine and Coastal Areas of the East Asian Region (1981)[122]. This is a plan steered by the Coordinating Body on the Seas of East Asia (COBSEA) made up of the countries of Australia, Cambodia, the People's Republic of China, Indonesia, the Republic of Korea, Malaysia, the Philippines, Singapore, Thailand, and Vietnam. Under this plan, COBSEA assesses the effects of human activities on the marine environment; controls of coastal pollution; protection of mangroves, seagrass and coral reefs; and wastewater management.

The Action Strategy for Nature Conservation in the Pacific Islands Region[123]. Developed through the cooperation of countries within the Roundtable for Nature Conservation, this strategy addresses issues concerning nature conservation in the Pacific Islands. The Roundtable had its first meeting in 1997. More recently, each meeting includes representatives from national governments, donors, NGOs, and regional organizations, and produces an action strategy that is updated every five years. In 2007, the Action Strategy for Nature Conservation 2008-2012 was drafted and it links national biodiversity strategies and action plans (NBSAPs) to the regional strategy of nature conservation. Notably, it also suggests that countries within the Roundtable recognize community involvement, traditional rights over natural resources, and sustainable use of resources.

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[120] http://whc.unesco.org/en/conventiontext
[121] http://www.unep.ch/regionalseas/partners/sids.htm
[122] http://www.cobsea.org/
[123] http://www.sprep.org/Roundtable/

Apia Convention (1976, in force in 1990)[124]. This is an agreement between Australia, the Cook Islands, Fiji, France, and Samoa that seeks to preserve unique natural ecosystems across the South Pacific. These can include superlative scenery; striking geological formations; or regions and objects of aesthetic interest or historic, cultural, or scientific value.

Association of the Southeast Asian Nations (ASEAN) Heritage sites[125]. ASEAN is an economic and geo-political organization of Indonesia, Malaysia, the Philippines, Singapore, Thailand, Brunei, Burma (Myanmar), Cambodia, Laos, and Vietnam. A list of nature parks, called ASEAN Heritage Parks, was started in 1984 and relaunched in 2004 to protect the natural and cultural sites in this region.

ASEAN Policy Framework for Forestry Cooperation[126]. ASEAN countries participate in a Strategic Plan of Action on Forestry with goals to conserve biological diversity, promote sustainable forest management, and eradicate unsustainable practices namely illegal logging and associated trade.

Bay of Bengal Large Marine Ecosystem Project (BOBLME)[127]. This project involves the countries of Bangladesh, India, Indonesia, Malaysia, Maldives, Myanmar, Sri Lanka, and Thailand. It is broken into five parts: the Strategic Action Programme; coastal/marine national resources management and sustainability use; improved understanding and predictability of the BOBLME environment (including MPAs); maintenance of ecosystem health and management of pollution; and project management, monitoring and evaluation, and knowledge management.

Coral Reef Initiative for the South Pacific (CRISP)[128]. This initiative is sponsored by France and was prepared by the French Development Agency (AFD) as part of an inter-ministerial project started in 2002. The Secretariat of the Pacific Community (SPC) is also involved in CRISP which aims to develop a vision for the future of these unique ecosystems and the communities that depend on them and to introduce strategies and projects to conserve their biodiversity, while developing the economic and environmental services that they provide both locally and globally. Also, it is designed as a factor for integration between developed countries (Australia, New Zealand, Japan and US), French overseas territories and Pacific Island developing countries. CRISP has 3 main components:
1) Integrated Coastal Management and Watershed Management (marine biodiversity conservation planning, marine protected areas (MPAs), institutional strengthening and networking, integrated coastal reef zone and watershed management).
2) Development of Coral Ecosystems (knowledge, beneficial use and management of coral ecosystems, reef rehabilitation, development of active marine substances, development of regional data base (ReefBase Pacific)).

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[124] http://www.sprep.org/Factsheets/pdfs/Archive/The%20Apia%20Convention.%20Fact%20sheet%2012-5-Reduced.pdf
[125] http://www.asean.org/15524.htm
126 http://www.aseanforest-chm.org/issue_pages/about/asean_policy_framework_for_forestry_cooperation.html

127 http://www.boblme.org/

[128] http://www.icran.org/action-crisp.html

3) Programme Coordination and Development (capitalization, value-adding and extension of CRISP Programme activities, coordination, promotion and development of CRISP Programme, support to alternative livelihoods, vulnerability of ecosystems and species, economic task force).

Coral Triangle Initiative[129]. This agreement between Indonesia, the Philippines, Malaysia, Timor-Leste, Papua New Guinea, and the Solomon Islands states that each country will develop an action plan to implement four objectives: sea conservation, sustainable marine resource management, protection of endangered species, and adapting to climate change. Partner nations in this initiative include Australia, France, Germany and the United States. Partnering organizations (and sources of funding) include the World Wildlife Fund, Conservation International, and The Nature Conservancy. Destructive fishing is practiced in this region and this initiative is developed to help curtail this practice. This initiative developed a plan for the region entitled "CTI Plan of Action" with the objectives of conducting meetings and working groups, researching topics of interest to the region, promoting the World Ocean Conference, developing a network of MPAs, and establishing an alternative livelihood program.

Eastern and Southern Africa (ESA) Workshop: This workshop was organized by the ICSF and International Ocean Institute (IO) to bring together fishworker organizations, NGOs, research institutions, universities, and policy makers from Kenya, Tanzania, Mozambique, South Africa, the Seychelles, and seven other countries bordering the Indian Ocean. It was meant to identify fisheries issues in this area and discuss policies for sustainable fisheries development. To date, two workshops have taken place, one in 2006 and the second in 2008. Among the main issues are human rights, biodiversity and fisheries management strategies that incorporate traditional fishing techniques[130].

Indian Ocean Commission (IOC)[131]. This organization composed of the Comoros, Madagascar, Mauritius, the Seychelles, and France promotes sustainable development through diplomacy, the economy, trade, agriculture, fishing, the conservation of resources and ecosystems, culture, science, and education. The IOC regulates illegal fishing as well, mostly tuna and tuna-related fisheries.

Regional Convention for the Conservation of the Red Sea and Gulf of Aden Environment (The Jeddah Convention (established in 1982)[132]. This convention was the result of a Regional Intergovernmental Conference and supported by UNEP. It provides an important basis for environmental cooperation in the Region. The Regional Intergovernmental Conference also adopted a "Programme for the Environment of the Red Sea and Gulf of Aden (PERSGA)," and established a Secretariat for the Programme in Jeddah. Additionally, the Conference produced two important tools: (a) an "Action Plan for the Conservation of the Marine Environment and Coastal Areas in the Red Sea and Gulf of Aden"; and (b) a "Protocol Concerning Regional Cooperation in Combating Pollution by Oil and Other Harmful Substances in Cases of Emergency." These provisions are complemented by those of MARPOL and the Basel Conventions. Participating Parties to the Jeddah Convention include: Djibouti, Egypt, Jordan,

[129] http://www.cti-secretariat.net/
[130] http://www.icsf.net/icsf2006/jspFiles/eastAfrica/statement/english/statement_2008.jsp
[131] http://www.fao.org/newsroom/en/news/2007/1000608/index.html
[132] http://www.persga.org/inner.php?id=61

Palestine, Saudi Arabia, Somalia, Sudan and Yemen. In addition to the Convention, the Conference produced and signed another important instrument, which is also legally binding: the "Action Plan for the Conservation of the Marine Environment and Coastal Areas in the Red Sea and Gulf of Aden." While, as the case in all international and regional conventions, the Jeddah Convention is a legally binding document, it does not include specific control measurements and actions. Hence, the mechanisms of developing associated protocols allow countries for a wide range of actions to be agreed upon on specific problems.

The Kuwait Regional Convention for the Co-operation on the Protection of the Marine Environment against Pollution from Land-Based Sources , 1978 (Kuwait Convention)[133]. Through this convention, the governments of Bahrain, Iran, Iraq, Kuwait, Oman, Qatar, Saudi Arabia, and the United Arab Emirates agree to coordinate efforts to protect the marine environment. The Convention was adopted with the objective to ensure that development projects and other human activities do not in any way cause damage to the marine environment, jeopardize its living resources or create hazards to human health. Another objective of the Convention was the development of an integrated management approach to the use of the marine environment and the coastal areas in a sustainable way which will allow the achievement of environmental and developmental goals.

The Protocol for the Protection of the Marine and Coastal Environment of the Western Indian Ocean from Land Based Sources and Activities (LBSA Protocol)[134]. The LBSA Protocol was added to the Nairobi Convention by the UNEP in 2010. It applies to activities that cause pollution in ports and harbors that contribute to marine and coastal pollution and degradation. These can be point-sources, diffuse sources, and transboundary sources of pollution and harmful activities. Countries under this agreement have yet to ratify the instrument, however, there are present efforts both to ratify and implement the Protocol. It is expected that the LBSA Protocol will contribute to the regional and global efforts to protect the marine and coastal environment of the WIO region from land based sources and activities causing pollution and degradation.

Locally Managed Marine Areas[135]. Locally managed marine areas (LMMAs) are marine areas that are managed at a local level by the coastal communities, landowning groups, partner organizations, and/or collaborative government representatives for sustainable use. The way in which LMMAs are managed is extremely variable, and many of the more formally regulated LMMAs belong in the regulatory mechanism section of this report. However, less formally regulated, and/or less known LMMAs, may be considered a type of conservation effort, thus are included in the Conservation Effort portion of this report. Most LMMAs restrict resource use, and many contain permanent, temporary, or seasonal fishery closures as well as other fisheries controls. In the Indo-Pacific, LMMAs are prevalent in parts of Melanesia, including Fiji, the Solomon Islands, and Vanuatu, and appear to be effective at controlling overfishing. An additional advantage of such local management is that the concept can be rapidly transmitted between neighboring communities and islands (Burke et al., 2011).

[133] http://maritimesafety.pmo.ir/marineenvironmentprotection-regionaltreaties-kuwaitconvention-en.html
[134] http://www.unep.org/NairobiConvention/LBSA_NCText_SAP_Workshop/index.asp
[135] http://www.lmmanetwork.org/

Mangroves for the Future[136]. This is a regional initiative coordinated between the UNDP and IUCN and local governments, non-governmental organizations, and community-based organizations in India, the Maldives, Indonesia, Sri Lanka, Seychelles, and Thailand promotes coastal ecosystem management of mangrove habitat, lagoons, estuary, and seagrass systems.

The Micronesia Challenge (launched in 2006)[137]. This initiative is a commitment between Micronesian governments to balance the need to use their natural resources today between the need to sustain those resources for future generations. The five Micronesian governments of the Republic of Palau, 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 all committed to "effectively conserve at least 30 percent of the near-shore marine resources and 20 percent of the terrestrial resources across Micronesia by 2020." It is supported by a number of nationally and internationally recognized organizations including TNC, CI, MCT, NOAA, DOI, SPREP, SPC, USFWS, USFS, CCN, LMMA, RARE, SOPAC, and FORUM.

The Middle East Peace Park[138]. This park originated from a special Research and Monitoring Workshop, hosted by the Aqaba Regional Authority and funded by the Middle East Regional Cooperation Program (MERC), held in Aqaba in December 1996. As a result of this workshop, Israel and Jordan have developed a project for coordinated management and monitoring of a Bi-national Marine Peace Park in the Gulf of Aqaba. This project involves collaboration between the Aqaba Regional Authority (ARA) and the Israel Nature Reserves Authority (NRA) with the participation of the Marine Science Station (MSS) in Aqaba and Israel's Inter-university Institute (IUI) as research agencies. Two million dollars for this three-year program is being provided by MERC with contributions in kind from Israel and Jordan, and additional funding by the Jordan Global Environmental Facility sponsored by the World Bank. The project is being coordinated by the NOAA. Both Israel and Jordan look at this program as the basis for longer term collaboration in the future.

The Mtwara-Quirimbas Complex[139]. A shared park between Tanzania and Mozambique was created to reduce pressure on near-shore fisheries and to assess, monitor, conserve and restore coral reefs, mangroves, and seagrass beds.

The Nairobi Convention for the Protection, Management and Development of the Marine and Coastal Environment of the Eastern African Region (The Nairobi Convention) (signed in 1985; came into force in 1996; amended in 2010)[140]. All ten Eastern African countries have ratified the convention and include: Comoros, France, Kenya, Madagascar, Mauritius, Mozambique, Seychelles, Somalia, Tanzania, and the Republic of South Africa (Contracting Parties). The convention provides a mechanism for regional cooperation, coordination and collaborative actions, and enables the Contracting Parties to harness resources and expertise from a wide range of stakeholders and interest groups towards solving interlinked problems of the coastal and marine environment. Activities set out by the Nairobi Convention include: assessing pollution

136 http://www.mangrovesforthefuture.org/index.html

137 http://www.micronesiachallenge.org/

138 http://celebrating200years.noaa.gov/magazine/mideast_peace_park/welcome.html

139 http://eame.wiomsa.org/tanzania.html

140 http://www.unep.org/nairobiconvention/

loads affecting the marine environment, and their harmful effects; setting up monitoring programs and development strategies; preparing and implementing a regional action plan; and strengthening capacity of coastal States to intervene in case of accidents and emergencies.

The Nature Conservancy's (TNC) Improving Resiliency to Climate Change project in Mozambique[141]. This project is providing climate change technical assistance to partners in Mozambique by identifying coral reef communities that are more naturally resistant to bleaching events and stresses. The main goal of this project is that by intentionally identifying and protecting these species, the entire reef community has an increased ability to adapt to climate change, and continues to support spawning grounds for a fishery that feeds thousands of artisanal fishers.

Northwest Pacific Action Plan (NOWPAP)[142]. This plan was adopted in 1994 by the four Member States, namely the People's Republic of China, Japan, the Republic of Korea and the Russian Federation as a part of the UNEP Regional Seas Programme. The origin of the Action Plan dates back to 1991 when a regional meeting of experts and national representatives from the four countries was held in Vladivostok to develop a regional seas action plan. The implementation of NOWPAP is financed mainly by contributions from the Members. Implemented activities of NOWPAP affecting coral reefs include long term biodiversity assessments, a review report for the state of the marine environment in the region, development of a regional action plan on marine litter and an overview of the protection and management of the marine and coastal environment of the Northwest Pacific Region.

The Convention for the Protection of Natural Resources and Environment of the South Pacific Region, 1986 (Noumea Convention)[143]. This convention provides a broad framework for co-operation in preventing pollution of the marine and coastal environments. Each Party is committed to endeavor to participate in bilateral or multilateral agreements that protect, develop and manage the marine and coastal environments of the Convention Area. SPREP is the Secretariat for this convention. It carries out institutional arrangements, calls meetings of Parties, and acts as an information clearing-house.

The Pacific Oceanscape Initiative. This is a multi-national agreement to address all ocean issues from governance to climate change. It effectively represents the largest marine conservation initiative in history. This agreement specifically covers the management and conservation of coral reefs via addressing threats from climate change and the establishment of multiple use marine protected areas. The participating countries include: Australia, Cook Islands, Federated States of Micronesia, Republic of Kiribati, Nauru, New Zealand, Niue, Palau, Papua New Guinea, the Republic of the Marshall Islands, Samoa, Solomon Islands, Tonga, Tuvalu, and Vanuatu (Pratt and Govan, 2010).

Regional Organization for the Conservation of the Environment of the Red Sea and Gulf of Aden (PERSGA)[144]. This is an intergovernmental body dedicated to the conservation of coastal and

[141] http://www.nature.org/ourinitiatives/regions/africa/wherewework/mozambique.xml
[142] http://www.nowpap.org/
[143] http://seanet.org.nz/index.php?option=com_content&task=view&id=177&Itemid=75
[144] http://www.persga.org/index.php

marine environments of the Red Sea, Gulf of Aqaba, Gulf of Suez, Suez Canal, and Gulf of Aden surrounding the Socotra archipelago. Countries that have joined PERSGA include Djibouti, Egypt, Jordan, Saudi Arabia, Somalia, Sudan, and Yemen. The mission of PERSGA is as follows: to perform the functions necessary for the implementation of the Jeddah Convention on a sustained and cost effective basis, aiming at rational use of living and non-living marine and coastal resources in a manner ensuring optimum benefit for the present generation while maintaining the potential of that environment to satisfy the needs and aspirations of future generations. PERSGA seeks to remedy destructive fishing practices and over-exploitation of fishery resources by implementing various management plans. Some applicable programs included in these plans are monitoring ornamental fish trade and conducting creel surveys. Parrotfish are specifically mentioned in creel surveys from the "Status of the Living Marine Resources in the Red Sea and Gulf of Aden and Their Management." A program instituted by this organization ameliorates the impacts on coastlines and mangrove areas from future development of shrimp and fish farms.

The Red Sea Regional Coral Nursery. This nursery is managing reef restoration through the Gardening Concept. Due to many coral species' ability to reproduce via fragmentation, creating coral nurseries for the purpose of restoring degraded reefs has become a popular rehabilitation tool. In this project, large pools of farmed corals and spats are constructed within specially designed underwater coral nurseries. These nurseries are installed in sheltered zones where the different types of coral recruits are maricultured to sizes suitable for transplantation. This practice also makes use of minute size coral fragments that would have died in direct transplantation. Then, nursery-grown coral colonies, in different size and species combinations, are transplanted to degraded reef sites. Various coral nurseries are now being used in numerous countries around the world to help restore coral reefs (Rinkevich, 2007).

Reef Check Australia[145]. This is a not-for-profit environmental organization that engages the Australian community in coral reef conservation. Reef Check Australia recruits a global network of volunteers to regularly monitor and report on reef health. The aims of this organization are to protect and help to rehabilitate Australia's coral reefs through combination of community education, to raise awareness of the key issues, and scientific research, to collect data that contributes to solutions. Reef Check Australia runs a number of conservation programs and projects including educational activities and monitoring programs. The Coral Trout Search program enables both recreational and commercial fishers, as well as snorkelers, to help monitor the populations of vital fish stocks that are essential to the sustainability of the reef. The EcoAction program includes material to help snorkelers and new divers, as well as casual reef visitors, to identify some of the vital species that find a home in our coral reefs. Reef Check Australia has a unique way of involving the general public in coral reef conservation via Scuba Monitoring Programs. Their volunteers are recreational scuba divers who monitor the health of reefs around Queensland (with future plans to spread the network to wider Australia and the Indo-Pacific). All volunteers complete one of PADI's accredited Training courses to qualify as Coral Reef Surveyors. The Great Barrier Reef Project is run with support of dive operators in Cairns, Port Douglas and Airlie Beach, conducts at least annual surveys at over 25 selected sites.

[145] http://www.reefcheckaustralia.org/

Regional Coastal Management Programme of Indian Ocean Countries (ReCoMap)[146]. An agreement that came out of the Nairobi Convention between the Comoros, Madagascar, Mauritius, Kenya, the Seychelles, Somalia, and Tanzania that promotes sustainable use of marine and coastal resources with the goal of reducing the toll on coastal and marine resources. It also involves finding ways to adapt and implement national plans for Integrated Coastal Zone Management (ICZM).

Regional Commission for Fisheries (RECOFI) (1999)[147]. This commission includes Bahrain, Iran, Kuwait, Oman, Qatar, Saudi Arabia, and United Arab Emirates and its purpose is to promote the development, conservation, management, and best utilization of living marine resources and the development of aquaculture in the region. They also combat illegal, unreported, and unregulated (IUU) fishing.

Regional Organization for the Protection of the Marine Environment (ROPME)[148]. The ROPME Sea Area covers eight states that joined forces in 1978 to adopt the Kuwait Regional Convention for Cooperation on the Protection of the Marine Environment from Pollution, otherwise known as the Kuwait Convention and four associated Protocols. These eight states include Bahrain, Iran, Iraq, Kuwait, Oman, Qatar, Saudi Arabia, and the United Arab Emirates. In the same year, an Action Plan for the region was adopted to address activities relating to oil pollution, industrial wastes, sewage and marine resources. Projects under the Action Plan include coastal area management, fisheries, public health, land-based activities, sea-based pollution, biodiversity, oceanography, marine emergencies, GIS and remote sensing to environmental awareness and capacity building. The ROPME became the secretariat for the Kuwait Convention and Action Plan in 1982.

Secretariat of the Pacific Community (SPC)[149]. The SPC provides technical and policy advice and assistance, training, and research services to 26 member countries in the Pacific. The member islands territories and countries are: American Samoa, Cook Islands, Federated States of Micronesia, Fiji Islands, French Polynesia, Guam, Kiribati, Marshall Islands, Nauru, New Caledonia, Niue, Northern Mariana Islands, Palau, Papua New Guinea, Pitcairn Islands, Samoa, Solomon Islands, Tokelau, Tonga, Tuvalu, Vanuatu, Wallis and Futuna, Australia, France, New Zealand, and the United States of America. There are six technical divisions within the SPC that strive to help the Pacific community sustainably manage its resources. The SPC contains an Education, Training and Human Development Division; a Public Health Division; a Fisheries, Aquaculture and Marine Ecosystems Division; a Land Resources Division; an Economic Development Division; and an Applied Geoscience and Technology (SOPAC) Division. Other services the SPC provides are through the Strategic Engagement, Policy and Planning Facility and the Statistics for Development Programme. The Coastal Fisheries Programme within the Fisheries, Aquaculture and Marine Ecosystems Division ensures coastal fisheries, nearshore fisheries and aquaculture are managed and developed sustainably. They conduct workshops and produce media information available to fishers and managers. Coral Reef Initiative for the South Pacific (CRISP) (see above for more information) is hosted by the SPC.

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146 http://www.recomap-io.org/

147 http://www.fao.org/world/regional/rne/statut/region/page57/page57_en.htm

148 http://www.ropme.com/

149 http://www.spc.int/

South Asia Cooperative Environmental Programme (SACEP)[150]. This organization is a coordinated program between Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan, and Sri Lanka that is aimed protecting and managing the marine environment and related coastal ecosystems.

South Asia Seas Action Plan (SASP) (1995). A plan developed for Bangladesh, India, Maldives, Pakistan, and Sri Lanka to protect and manage the marine environment and related coastal ecosystems of the region, mainly focused on coral reef management. This plan includes integrated coastal zone management, developing national and regional oil spill contingency plans, human resources development, and protection of the marine environment from land based sources of marine pollution (SACEP, 1983).

South Pacific Biodiversity Conservation Programme. This program ran from 1992 to 2001 and was funded by the Global Environment Facility and the Australian Agency for International Development, and managed by the South Pacific Regional Environmental Programme and the United Nations Development Programme. It was designed help develop strategies for the conservation of biodiversity using the principle of sustainable use in the South Pacific. The program identified and initiated a series of strategic conservation projects in fourteen South Pacific countries. The implementing agency was the South Pacific Regional Environmental Programme, an independent, intergovernmental environmental agency. Specific objectives include establishing a series of conservation areas, protecting terrestrial and marine species that are threatened or endangered in the Pacific region, identifying new areas important to biodiversity conservation, improving awareness in Pacific Island countries of the importance of conserving biodiversity, and improving capabilities and cooperation among different sectors of society in the Pacific Islands (Baines et al., 2002).

South Pacific Regional Environment Programme (SPREP)[151]. This regional organization was established by the governments and administrations of the Pacific region to serve as a conduit for environmental interests in this area. The SPBCP (see above) is funded through the SPREP. Other notable projects the SPREP is involved in include Climate Change, Coastal Management Programme, Coastal Systems Living Resources, Conservation Area Training, Community-based Conservation, Coral Reef Initiative, Mangrove Task Force, Marine Pollution, National Biodiversity Action Plans, and Wetlands Management.

US Coral Reef and Reef Fisheries Conservation Efforts. As described in the Conservation Efforts portion of Appendix A, in the US there are numerous federal and non-federal government programs intended to address conservation of US coral reefs. Some of the non-federal programs also address management of coral reef fisheries.

World Wildlife Fund (WWF) Coastal East Africa Eco-region[152]. This is one of the WWF's largest and most ambitious marine conservation initiatives covering the countries from Somalia to South Africa. Projects in this region focus on conservation to improve socioeconomic status,

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150 http://www.sacep.org/

151 http://www.sprep.org/sprep/about.htm

152 http://www.worldwildlife.org/what/wherewework/coastaleastafrica/projects.html

empowering local communities, creating sustainable fisheries, and protecting coastal forests. WWF and its partners work with communities to tackle illegal fishing, establish new national parks, educate children and others about conservation, and manage tourism to benefit communities and protect the resources upon which they rely.

World Wildlife Fund (WWF) Conservation of Coral Reefs in the Persian Gulf project[153]. The aim of the project is to assist regional governments and NGOs in the development and implementation of a comprehensive conservation strategy for coral reefs in the Persian Gulf that takes into account the unique habitat and biodiversity and the, local community in this area. It also aims to increase regional awareness of the importance and uniqueness of coral reef habitats for this region. The project includes the development of published materials on coral reef habitat, distribution, and identification in the region. Additional objectives include mapping and inventorying reef habitats, investigating diversity, assessing reef fish and benthic life status, evaluating approaches to reef rehabilitation, building capacity for national research personnel, and increasing stakeholder awareness in the Persian Gulf.

World Wildlife Fund (WWF) Mafia-Kilwa-Rufiji Seascape Programme[154]. The Mafia-Kilwa-Rufiji Seascape Programme promotes improved socio-economic well-being of coastal communities in Rufiji, Mafia, and Kilwa communities in Tanzania through sustainable fishing practices, protecting threatened habitats and species, and natural resource management of marine and coastal resources.

[153] http://wwf.panda.org/who_we_are/wwf_offices/united_arab_emirates/?uProjectID=AE0007
[154] http://wwf.panda.org/what_we_do/where_we_work/east_african_coast/publications/?21998/Rufiji-Mafia-Kilwa-Seascape-Programme-Tanzania

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Appendix A – United States Regulatory Mechanisms and Conservation Efforts Potentially Relevant to Addressing Local Threats Within the Ranges of the 82 Candidate Coral Species

Existing Regulatory Mechanisms

Within the U.S., the collective ranges of the 82 coral species are split between the Caribbean (seven species) and the Indo-Pacific (75 species). In the Caribbean, the seven species are collectively found in Florida and the US Territories of Puerto Rico and the US Virgin Islands (USVI). In the Indo-Pacific, the 75 species are collectively found in Hawaii, the US Territories of American Samoa and Guam, the Commonwealth of the Northern Mariana Islands (CNMI), and Pacific Remote Island Areas (PRIA). In Florida, Puerto Rico, USVI, Hawaii, American Samoa, and Guam, the States and Territories have jurisdiction from the shoreline to 3 nautical miles (nm) from shore, and the federal government generally has management authority over fishery resources between 3 and 200 nm from shore. In CNMI and PRIA, federal jurisdiction extends from the shoreline to 200 nautical miles seaward. However, under the Fishery Ecosystem Plan for the Marianas Archipelago, fisheries management in waters 0-3 nautical miles of the CNMI is generally left to the CNMI government. In PRIA, the federal government exercises exclusive jurisdiction.

Existing federal regulatory mechanisms that provide the most benefits to corals are focused on addressing physical impacts, including damage from fishing gear, anchoring, and vessel groundings. Most of these mechanisms are relevant to the threats that the BRT identified as either low or negligible, with the exception of trophic effects of over-fishing, ranked as a medium threat.

The following section describes US regulatory mechanisms by region (Caribbean vs. Indo-Pacific) and includes: Federal statutes, Federal executive orders, Federal marine protected areas (MPAs), State statutes, State regulatory programs, State MPAs, County statutes, Territorial statutes, Territorial MPAs, Commonwealth statutes, and Commonwealth MPAs. The organization of this section is as follows:

1. Fisheries and Coastal Management Regulatory Mechanisms (description of relevant federal and non-federal regulatory mechanisms).
    - 1.1. Federal
        - 1.1.1. Federal Laws
        - 1.1.2. Federal Executive Orders
    - 1.2. Non-federal Caribbean
        - 1.2.1. Florida
        - 1.2.2. Puerto Rico
        - 1.2.3. US Virgin Islands
    - 1.3. Non-federal Indo-Pacific
        - 1.3.1. Hawaii
        - 1.3.2. American Samoa
        - 1.3.3. Guam
        - 1.3.4. CNMI

2. MPA Regulations (description of federal and non-federal MPAs and other relevant protected areas).
   2.1. Federal
   2.2. Non-federal Caribbean
      2.2.1. Florida
      2.2.2. Puerto Rico
      2.2.3. US Virgin Islands
   2.3. Non-federal Indo-Pacific
      2.3.1. Hawaii
      2.3.2. American Samoa
      2.3.3. Guam
      2.3.4. CNMI
3. Conservation Efforts
   3.1. Federal
   3.2. Non-federal Caribbean
      3.2.1. Florida
      3.2.2. Puerto Rico
      3.2.3. USVI
   3.3. Non-federal Indo-Pacific
      3.3.1. Hawaii
      3.3.2. American Samoa
      3.3.3. Guam
      3.3.4. CNMI

1. Fisheries and Coastal Management Regulatory Mechanisms

1.1 Federal

This section describes federal laws, federal executive orders, and federal MPAs that may have an effect on the status of the 82 coral species, and covers the Caribbean region (Florida, Puerto Rico, U.S.Virgin Islands (USVI)) and the Indo-Pacific region (Hawaii, American Samoa, Guam, Commonwealth of Northern Marianas Islands (CNMI)), and the Pacific Remote Island Areas (PRIA), consisting of Jarvis Atoll, Wake Island, Palmyra Atoll, and Howland and Baker Islands.

1.1.1 Federal Laws

Clean Water Act[1]. The 1977 amendments to the Federal Water Pollution Control Act of 1948 and 1972 (PL 92-500) are commonly known as the Clean Water Act (CWA), due to a parenthetical revision in Section 518. Congress stated that the objective of the CWA was to "restore and maintain the chemical, physical, and biological integrity of the Nation's waters" (33 U.S.C. §1251(A)).

Clean Water Act of 1987 Section 404 Program. Section 404 (a) of the CWA gives the authority to the Secretary of the Army (through the Corps of Engineers; "Corps") to issue permits, after notice and opportunity for public hearings, for the discharge of dredged or fill material. Section 404 (b) states that disposal sites shall be specified through the application of guidelines

[1] http://cfpub.epa.gov/npdes/cwa.cfm?program_id=45

developed by the Administrator of the U.S. Environmental Protection Agency (USEPA), in conjunction with the Secretary. These "Guidelines for Specification of Disposal Sites for Dredged or Fill Material" (40 CFR 230) have become known as the "Section 404 (b)(1) Guidelines" (Guidelines); these were finalized on December 24, 1980, and remain in effect. Section 404 (c) authorizes the USEPA to prohibit, restrict, or deny (veto) any defined areas as a disposal site if it is determined that discharges of materials into such areas will have "an unacceptable adverse effect on municipal water supplies, shellfish beds and fisheries areas (including spawning and breeding areas), wildlife, or recreational areas." Issuance of a Section 404 permit requires water quality certification by the appropriate state agency (33 U.S.C.1341, Section 401).

The above-described protections apply to "navigable waters," which are defined as "waters of the United States" (33 U.S.C. §1362(7)). The Corps' regulations (33 CFR 328 (a)) and the Section 404 (b)(1) Guidelines (40 CFR 230.3 (s)) define "waters of the United States to include seven categories:

- All waters which are currently used, or were used in the past, or may be susceptible to use in interstate or foreign commerce, including all waters which are subject to the ebb and flow of the tide;
- All interstate waters including interstate wetlands;
- All other waters such as intrastate lakes, rivers, streams (including intermittent streams), mudflats, sandflats, wetlands, slough, prairie potholes, wet meadows, playa lakes, or natural ponds, the use, degradation or destruction of which could affect interstate or foreign commerce including and such waters:
    - which are or could be used by interstate of foreign travelers for recreational or other purposes; or
    - which fish or shellfish are or could be taken and sold in interstate or foreign commerce; or
    - which are used or could be used for industrial purpose by industries in interstate commerce.
- All impoundments of waters otherwise defined as waters of the United States under the definition;
- Tributaries of waters identified in paragraphs 1-4 of this section;
    - The territorial sea;
    - Wetlands adjacent to waters (other than waters that are themselves wetlands) identified in paragraphs 1-6 of this section; waste treatment systems, including treatment ponds or lagoons designed to meet the requirements of CWA (other than cooling ponds as defined in 40 CFR §423.11(m)) which also meet the criteria of this definition) are not waters of the United States.

The purpose of the Section 404 (b)(1) Guidelines is to restore and maintain the chemical, physical, and biological integrity of waters of the U.S. through the control of discharges of dredged or fill material (40 CFR 230.1). Fundamental to the Guidelines is the precept that dredged or fill material should not be discharged into the aquatic ecosystem, "unless it can be demonstrated that such a discharge will not have an unacceptable adverse impact either individually or in combination with known and/or probable impacts of other activities affecting

the ecosystems of concern." The Guidelines further state that: "From a national perspective, the degradation or destruction of special aquatic sites, such as filling operations in wetlands, is considered to be among the most severe environmental impacts covered by these Guidelines. The guiding principle should be that degradation or destruction of special sites may represent an irreversible loss of valuable aquatic resources."

Special aquatic sites are defined as geographical areas, large or small, possessing special ecological characteristics of productivity, habitat, wildlife protection, or other important and easily disrupted ecological values. 40 CFR § 230.3(q-1). These areas are generally recognized as significantly influencing or positively contributing to the general overall environmental health or vitality of the entire ecosystem of a region. The Guidelines lists the following communities to represent "Special Aquatic Sites": sanctuaries and refuges; wetlands; mudflats; vegetated shallows; coral reefs; riffle and pool complexes. Thus, coral reefs are afforded special protection under the Guidelines.

Dredging and filling activities can adversely affect colonies of reef-building organisms by burying them, by releasing contaminants such as hydrocarbons into the water column, by reducing light penetration through the water, and by increasing the level of suspended particles in the water column. The Guidelines recognize that coral organisms are "extremely sensitive to even slight reductions in light penetration or increases in suspended particulates." These adverse effects will cause a loss of productive colonies that in turn provide habitat for many species of highly specialized aquatic organisms.

Advanced Identification of Disposal Areas Under Section 404. A potential mechanism for providing additional protection to coral communities is through the use of Advanced Identification of Disposal Areas (ADID) (40 CFR 230.80). Under this action, the USEPA and the permitting authority, (e.g., the Corps or State in the case of a state-delegated program) on their own initiative or at the request of any other party after consultation with any affected State that is not the permitting authority, may identify sites which are considered as:

- Possible future disposal sites, including existing disposal sites and non-sensitive areas; or
- Areas generally unsuitable for disposal site specification.

To provide the basis for ADID of disposal areas and areas unsuitable for disposal, the USEPA and the permitting authority shall consider the likelihood that use of the area in question for dredge or fill material disposal will comply with the Guidelines. Thus, it is possible that coral reef sites may be determined through the ADID process as areas generally unsuitable for disposal of dredged or fill material.

<u>Natural Resource Damages - Clean Water Act; Comprehensive Environmental Response, Compensation, and Liability Act and Oil Pollution Act of 1990</u>. The CWA, as amended by the Oil Pollution Act of 1990 (33 USC §§ 2701 et seq.), and the Comprehensive Environmental Response, Compensation, and Liability Act (42 USC §§ 9601 et seq.), mandate that parties that release oil or hazardous substances, pollutants, or contaminants into the environment are responsible not only for the cost of removing (cleaning up) the release, but they are also responsible for restoring, replacing or acquiring the equivalent of any natural resources injured,

lost or destroyed as a result of an actual or threatened release of oil. These provisions are applied by state and federal resource agencies acting as natural resource trustees to address impacts to coral reefs under their jurisdictions from release incidents.

Coastal Zone Management Act[2]. The Federal Coastal Zone Management Act (CZMA) of 1972 encourages coastal states to develop comprehensive management programs that ensure the beneficial use, protection and management of the Nation's coastal resources. To encourage the adoption and implementation of these management programs, coastal states whose programs receive approval from the U.S. Department of Commerce, NOAA, are empowered to review federal activities that affect coastal zone resources and uses covered by the state's approved management program. Federal agencies implementing any of the following activities that may affect a state's coastal zone are required to determine whether the action is consistent with the state's approved management program and seek the state's concurrence with the determination:

- Activities conducted by or on behalf of a federal government agency;
- Federally funded activities;
- Activities that require a federal license or permit; and
- Activities conducted pursuant to the Outer Continental Shelf Lands Act minerals exploration plan or lease.

If a state with an approved management program objects to a consistency determination on the basis that the proposed federal activity is "inconsistent" with the requirements of the state's approved program, the state may request mediation through NOAA's Office of Ocean and Coastal Resource Management, and may appeal the determination to the Secretary of Commerce. As a general matter, state coastal management plans for areas that include coral reefs include specific provisions to ensure that these valuable ecosystems are not harmed. Consistent with the provisions of the CZMA, the ACOE will not issue any permits or authorizations under CWA Section 404, MPRSA Section 103, or RHA Section 10 that do not have a State CZMA consistency determination. Similarly, EPA will not designate an ocean dumping site under MPRSA Section 102 without meeting the requirements of the CZMA.

2 http://coastalmanagement.noaa.gov/czm/czm act.html

Table 1. Summary of US states, territories and commonwealths with federally-approved Coastal Management Programs (CMP) enacted pursuant to the Coastal Zone Management Act.

State/ Territory	Year CMP approved	URL
American Samoa	1980	http://coastalmanagement.noaa.gov/mystate/american_samoa.html
CNMI	1980	http://www.crm.gov.mp/
Guam	1979	http://www.bsp.guam.gov/content/category/6/15/37/
Florida	1981	www.dep.state.fl.us/cmp
Hawaii	1977	http://hawaii.gov/dbedt/czm/
Puerto Rico	1978	www.coralpr.net www.gobierno.or/drna
USVI	1976	www.viczmp.com

In an effort to develop a more comprehensive solution to the problem of polluted runoff in coastal areas, the U.S. Congress expanded the CZMA in 1990 to include a new section 6217 entitled "Protecting Coastal Waters." Section 6217 requires that states with approved coastal zone management programs develop Coastal Nonpoint Pollution Programs wherein state programs incorporate management measures to address land-based sources of run-off from agriculture, forestry, urban development, marinas, hydromodification (e.g., stream channelization), and the loss of wetlands and riparian areas. In keeping with the successful state-federal partnership to manage and protect coastal resources achieved by the CZMA, section 6217 envisioned that nonpoint source programs developed under section 319 of the Clean Water Act (CWA) would be combined with existing coastal management programs. By combining the water quality expertise of state agencies with the land management expertise of coastal zone agencies, section 6217 was designed to more effectively manage nonpoint source pollution in coastal areas. To facilitate development of state coastal nonpoint programs and ensure coordination between states, administration of section 6217 at the federal level was assigned to NOAA and the Environmental Protection Agency.

Continental Shelf Act. Outer Continental Shelf Lands Act of 1953 (43 U.S.C. 1331 - 1356, P.L. 212, Ch. 345, August 7, 1953, 67 Stat. 462) as amended by P.L. 93-627, January 3, 1975, 88 Stat. 2130; P.L. 95-372, September 18, 1978, 92 Stat. 629; and P.L. 98-498, October 19, 1984, 98 Stat. 2296.

The 1953 statute defines the Outer Continental Shelf (OCS) as all submerged lands lying seaward of State coastal waters (3 miles offshore) which are under U.S. jurisdiction. The statute authorized the Secretary of Interior to promulgate regulations to lease the OCS in an effort to prevent waste and conserve natural resources, as well as to grant leases to the highest responsible qualified bidder as determined by competitive bidding procedures.

Title II of the Outer Continental Shelf Lands Act Amendments of 1978 (P.L. 95-372) provides for the cancellation of leases or permits if continued activity is likely to cause serious harm to life, including fish and other aquatic life. It also stipulates that economic, social, and environmental values of the renewable and nonrenewable resources are to be considered in management of the OCS. The timing and location of leasing activities are to be based on several factors, including the relative environmental sensitivity and marine productivity of different areas of the OCS. An environmental studies program is authorized and the Secretary of the Interior is required to study any region included in a lease sale in order to assess and manage environmental impacts on the OCS (*Acropora* Biological Review Team 2005).

Coral Reef Conservation Act[3]. The Coral Reef Conservation Act (CRCCA) (16 U.S.C. 6401 et seq.) was passed in 2000. The CRCCA recognizes the unique nature of coral reef communities and has three main goals:

- The creation of a National Coral Reef Action Strategy;
- The financial promotion of governmental, educational, and non-governmental conservation programs; and
- Granting of additional power to the Secretary of Commerce to protect coral reef ecosystems.

The CRCCA charges NOAA with the development and periodic review of a National Coral Reef Action Strategy that addresses sustainable uses, monitoring, mapping, and public education of coral reef resources. Under the CRCCA, NOAA can provide grants to governmental, education, and non-governmental entities with expertise in coral reef conservation, and to fund monitoring, mapping, and education programs of coral reefs.

Endangered Species Act[4]. The Endangered Species Act (ESA)(16 U.S.C. § 1531, et.seq.) provides a program for the conservation of threatened and endangered plants and animals and the habitats in which they are found. The lead federal agencies for implementing ESA are the U.S. Fish and Wildlife Service (FWS) and the U.S. National Oceanic and Atmospheric Administration (NOAA) Fisheries Service. Section 7 of the Act requires federal agencies, in consultation with the U.S. Fish and Wildlife Service and/or the NOAA Fisheries Service, to ensure that actions they authorize, fund, or carry out are not likely to jeopardize the continued existence of any listed species or result in the destruction or adverse modification of designated critical habitat of such species. "Action," in this case, is defined broadly to include federal grants, permitting, licensing, or other regulatory actions (16 USC 1536(a)(2)). In general, if a listed species may be present in an action area, the Federal action agency must conduct a biological assessment (or evaluation) to determine whether the proposed action may affect listed

[3] http://coris.noaa.gov/activities/actionstrategy/08_cons_act.pdf
[4] http://www.nmfs.noaa.gov/pr/laws/esa/

species. If a jeopardy or adverse modification determination is made, the biological opinion must identify reasonable and prudent alternatives (RPAs), if any, that would not jeopardize the continued existence of the listed species or adversely modify designated critical habitat and are economically and technologically feasible. If the activity will not jeopardize listed species or destroy or adversely modify critical habitat, the biological opinion includes an incidental take statement (ITS) to authorize take resulting from the action. The ITS also specifies reasonable and prudent measures (RPMs) considered necessary or appropriate to minimize the impact of the anticipated incidental take on the species.

The ESA also prohibits any action that causes an unauthorized "taking" of any listed species of endangered fish or wildlife. Likewise, import, export, interstate, and foreign commerce of listed species are all generally prohibited.

Magnuson-Stevens Act[5] (MSA). The Magnuson-Stevens Fishery Conservation and Management Act (16 U.S.C. § 1801 et.seq.) is the primary law governing marine fisheries conservation and management in waters under U.S. jurisdiction. The Act was first enacted in 1976, amended in 1996, and reauthorized by the Magnuson-Stevens Fishery Conservation and Management Reauthorization Act of 2006 on January 12, 2007. Eight regional fishery management councils were created under the MSA to manage fisheries and promote conservation. Among the goals of the MSA are to: achieve optimum yield in each U.S. fishery while preventing overfishing, rebuild overfished stocks, minimize bycatch and bycatch mortality, promote the safety of human life at sea, promote market-based management approaches, improve data collection and processing (including improvements in recreational data collection) giving it a larger role in the decision-making process, and enhance international cooperation by addressing IUU fishing and bycatch of protected living marine resources (NOAA, 2007). Corals are defined as “fish” for purposes of the MSA, as discussed below.

One provision established under the MSA is to establish and maintain essential fish habitat (EFH). EFH is defined as “those waters and substrate necessary to fish for spawning, breeding, feeding or growth to maturity” (16 USC § 1802(10)). MSA requires that EFH be identified for all species which are federally managed. NMFS has designated coral substrate as EFH. MSA requires any Federal agency to consult with NMFS with respect to any action authorized, funded or undertaken, or proposed to be authorized, funded or undertaken by such agency that may adversely affect EFH. After receipt of a completed EFH Assessment, NMFS will provide EFH Conservation Recommendations to the federal agency detailing measures that can be taken by that agency to conserve EFH. Within 30 days of receiving NMFS recommendations, the federal agency must provide a detailed written response to NMFS. The response must include a description of measures proposed by the agency for avoiding, mitigating, or offsetting the impact of the activity on EFH. In the case where a response is inconsistent with NMFS recommendations, the federal agency must explain its reasons for not following the recommendations, including the scientific justification for any disagreements with NMFS over the anticipated effects of the proposed action and the measures needed to minimize, mitigate or offset such effects.

[5] http://www.nmfs.noaa.gov/msa2005/

MSA: Fishery Management Councils in US Coral Reef Areas.

Within US coral reef areas, there are four regional fishery management councils: the Caribbean, Gulf of Mexico, and South Atlantic Fishery Management Councils in the Caribbean, and the Western Pacific Fishery Management Council in the Pacific.

The Caribbean Fishery Management Council developed a FMP, Regulatory Impact Review, and Final EIS for corals and reef-associated plants and invertebrates of Puerto Rico and the U.S. Virgin Islands (USVI) in 1994. This FMP provides protection in the form of no-harvest for EEZ portions of the insular shelves of Puerto Rico and the USVI for all coral species. This alternative was selected due to the lack of biological information necessary to estimate a Maximum Sustainable Yield for the species, coupled with the extremely slow growth rates for most corals. In the case of the USVI, the EEZ starts at 3.0 nautical miles (nmi) from shore and in Puerto Rico, the EEZ starts at 10.2 nmi (*Acropora* Biological Review Team, 2005).

The Gulf of Mexico Fishery Management Council includes federal waters from Texas to the west coast of Florida. The Coral-Coral Reef FMP was developed by the Gulf of Mexico and the South Atlantic Fishery Management Councils and enacted in April 1982. The FMP identified the problems with corals conservation as: degradation from natural and man-made impacts; limited information on many of the species; susceptibility to stresses due to the northern location of the resources; complex and contradictory management objectives; poor public knowledge of the importance of corals and reefs; and poor enforcement of existing laws and regulations. All of the stony corals (Scleractinia, Milleporina) and the gorgonian sea fan (*Gorgonia*) are protected from harvest, sale, and destruction on the seabed in U.S. Federal waters. Note that the Coral-Coral Reef FMP can only regulate fishing related activities: a non-fishing activity that destroys corals is exempt from coral FMP regulation. Coral Habitat Areas of Particular Concern (HAPC) were established on the Florida Middle Grounds, East and West Flower Garden Banks, Gray's Reef, and the Oculina Banks off central eastern Florida. Subsequently, other HAPCs have been recommended by the Gulf of Mexico Fishery FMC to NOAA for approval, including Pulley Ridge off southwest Florida and the Stetson, McGrail, Bright, Geyer, and Sonnier Banks in the northwestern Gulf of Mexico (*Acropora* Biological Review Team, 2005).

The jurisdiction of the South Atlantic Fishery Management Council includes federal waters off the states of North Carolina, South Carolina, Georgia, and Florida. As with some other Fishery Management Councils, the South Atlantic Fishery Management Council is in the process of developing ecosystem-based management in lieu of individual single-species or multispecies FMPs. It released a South Atlantic Fishery Ecosystem Plan (FEP) in 2009 that replaces a previous Habitat Plan and supplements pre-existing FMPs. This effort aims at providing the South Atlantic Fishery Management Council with a foundation from which to attain a more comprehensive understanding of habitat and biology of species, fishery information, social and economic impacts of management, and ecological consequences of conservation and management. The 2009 FEP is comprised of six volumes, and several amendments including the establishment of coral HAPCs[6].

[6] http://www.safmc.net/ecosystem/Home/EcosystemHome/tabid/435/Default.aspx

The Western Pacific Fishery Management Council (WPFMC), established under the Magnuson-Stevens Act, manages the U.S. EEZ waters of Hawaii, the American Samoa Archipelago, the Mariana Archipelago (Guam and CNMI), and the Pacific Remote Islands Areas (PRIA). In 2010, the WPFMC replaced its Fishery Management Plans (FMPs) with four archipelagic Fishery Ecosystem Plans (FEPs) for American Samoa, Hawaii, Mariana Islands, and PRIA to guide ecosystem-based approaches for fishery management in the US Western Pacific region. The FMPs had been used since 1980 to govern commercial fishing throughout the region's EEZ, regulate harvests by annual catch quotas, close seasonal fisheries, place restrictions on gear, and establish minimum catch sizes, all based on species-level management. The new FEPs, on the other hand, restructure fishery management using a place-based ecosystem approach. Around CNMI and the PRIA, these boundaries extend from the shoreline to 200 nautical miles seaward (although CNMI generally manages fisheries conducted by its citizens within 3 nautical miles). The Territories of Guam and American Samoa manage fisheries from the shoreline to three nautical miles seaward. The remaining waters within their EEZs are managed under FEPs to 200 nautical miles seaward (71 FR 53605).

MSA: Federal Coral and Coral Reef Fisheries Management.
In the Caribbean, NMFS defines "prohibited coral" to include all coral belonging to the orders Gorgonacea, Scleractinia (stony corals), and Antipatharia (black corals) or of the Class Hydrozoa (fire corals and hydrocorals) (50 CFR 622.2). No person may fish for, harvest, or possess such prohibited coral without a Federal permit in the Caribbean U.S. EEZs. Moreover, no person may sell or purchase Scleractinia corals if taken from the EEZs; and if the corals are sold in Puerto Rico or U.S.V.I., it is presumed to have been harvested in the EEZs unless it is accompanied by documentation showing that it was harvested elsewhere (50 CFR 622.45(a)). A person harvesting live rock under a Federal permit is exempt from the prohibition on taking prohibited coral, however, if such coral settles on live rock (50 CFR 622.41(a)(1)). Coral fisheries in the Caribbean are managed under the FMPs described above administered by the Caribbean, Gulf of Mexico, and South Atlantic Fishery Management Councils.

In the Western Pacific, NMFS defines precious coral management unit species as any coral of the genus *Corallium* in addition to pink (aka red), gold, black, and bamboo corals, in the US EEZs (American Samoa, Hawaii, Mariana Islands, and PRIA; 50 CFR 665.161, 665.261, 665.461, and 665.661). Federal regulations in 50 CFR 665 also set forth specific prohibitions and regulations for the permitting and take of precious coral management unit species within US jurisdiction in the Western Pacific. Coral management began in 1983 when the Western Pacific Fishery Management Council established the Precious Corals FMP banning bottom trawling and other potentially destructive and non-selective gear in the federally managed EEZ around Hawaii, American Samoa, the Mariana Islands, and the PRIA. The FMP also established minimum sizes and quotas as well as no-take MPAs in the PRIAs. The FMP was amended several times to include certain species of coral as Management Unit Species. As described above, in 2010, the Council replaced the Precious Corals FMP and other FMPs with four archipelagic FEPs for American Samoa, Hawaii, Mariana Islands, and PRIA. Thus, rather than precious corals in the region being managed under a Precious Corals FMP, now precious corals

in each archipelago are managed as a "Management Program for Precious Corals Fisheries" under the FEP for that archipelago[7].

In addition to the management of precious corals as its archipelagic FEPs, the Western Pacific Fishery Management Council also manages coral reef fish species as a "Management Program for Coral Reef Ecosystem Fisheries" under the FEP for each archipelago. These archipelagic management programs include coral reef herbivorous fishes. This is important due to the role that herbivorous fish (e.g., parrotfish) have on reef ecosystem health and resilience. Herbivorous fish graze on algae which compete with corals for space. Healthy populations of herbivorous grazers maintain a balance within reef ecosystems between live coral cover and algae. If herbivorous fish populations are heavily fished and high mortality of coral colonies occurs, then algae can grow rapidly and inhibit the replenishment of coral populations (Brainard et al. 2011).

By establishing and implementing a number of management measures, these coral reef fisheries management programs aim to ensure sustainable coral reef fisheries while also preventing any negative impacts to stocks, habitat, protected species, or the ecosystem itself. Management measures in the coral reef fisheries management programs include the establishment of MPAs with zoning mechanisms, permits, monitoring, and restrictions on gear use and fishing methodologies. For example, within the FEPs for Hawaii, American Samoa, the Mariana Islands, and the PRIAs, certain gears are strictly prohibited for coral reef management unit species (including all important coral reef herbivores such as parrotfish, wrasses, sturgeonfish, etc.), including: gillnets, trawls, dredges, longlines, explosives, and poisons (WPRFMC 2009a, 2009b, 2009c, 2009d). Additionally, harvest using scuba-assisted spearfishing is prohibited at night in the PRIAs and northwestern Hawaiian Islands. Federal regulations for specific gear requirements in American Samoa, the Marianas, and PRIA are set forth in 50 CFR 665.127, 665.427, and 665.627. See sections on Federal MPAs, American Samoa Territorial Laws, and Guam Territorial Laws for further details within each area.

National Marine Sanctuaries Act[8]. The National Marine Sanctuaries Act of 1972 authorizes the Secretary of Commerce, with significant public input, to designate and manage national marine sanctuaries based on specific standards. It provides for supervision by the Secretary over any permitted private or federal action that is likely to destroy or injure a sanctuary resource, and requires periodic evaluation of implementation of management plans and goals for each sanctuary. The Act also specifies prohibited activities, penalties and enforcement.

The Act prohibits the following activities: destroying, causing the loss of, injuring a sanctuary resource managed under law or regulations for that sanctuary; possessing, selling, delivering, carrying, transporting, or shipping a sanctuary resource taken in violation of the Act; interfering with enforcement of the Act; and violating a provision of the Act or regulations of permits issued under it. Furthermore, the Secretary must conduct enforcement activities to carry out the Act. A person authorized to enforce the Act may board, search, inspect or seize a vessel, equipment, stores and cargo suspected of being used to violate the Act, and seize unlawfully taken sanctuary resources. The Act requires the Secretary to promote the use of national marine sanctuaries for

[7] http://wpcouncil.org/hot/
[8] http://sanctuaries.noaa.gov/about/legislation/

research, monitoring, evaluation and educational programs as are necessary and reasonable to carryout the purposes and policies of the Act.

Rivers and Harbors Act[9]. The main purpose of the Rivers and Harbors Act (RHA) is to maintain navigation and prevent the obstruction or alteration of navigable waters of the U.S including its Territories and possessions (RHA; 33 USC §§ 401 et seq.). The RHA authorizes the U.S. Army Corps of Engineers (USACE) to issue permits to perform a variety of activities, including dredging, filling, or placement of structures in navigable waters. Section 9 prohibits the construction of bridges, causeways, dams, or dikes over any navigable water of the United States without the consent of Congress. In addition, a permit must be obtained from the U.S. Coast Guard for bridges and causeways, and from the Corps for dams and dikes (bridges and causeways 33 C.F.R. §114.01 *et seq.*; dams and dikes (33 C.F.R. §321 *et seq.*).

Section 10 of the RHA prohibits any unauthorized obstruction of the navigability of any waters of the U.S. and prohibits dredging or filling in navigable waters without the approval of the Corps. Permits are required under this section for wharfs, piers, breakwaters, jetties, and other obstructions to the "navigable capacity" of waters, and for activities that may "alter or modify the course, location, condition, or capacity" of any navigable water. Section 10 has consistently been given a broad interpretation by the Courts. Two examples of court rulings that show broad interpretation of what constitutes a dredging and/or filling activity include:

- United States v. M.C.C. of Florida, Inc. (772 F.2d 1501 (11th Cir. 1985)) found that repeatedly going back and forth across the same waters with tug equipment that is dredging a channel and dumping the spoil on the adjacent sea grass beds is illegal dredging and filling under Section 10.

- United States v. Republic Steel Corp. (362 U.S. 432 (1960) determined that discharges of solid industrial wastes that progressively decreased the depth of a water body constituted prohibited obstruction covered by Section 10.

In issuing RHA permits, the USACE conducts a "public interest balancing," which can include evaluation of benefits and detriments of a project to fish and wildlife values, such as corals. As a general matter, adverse impacts to coral reefs and coral reef systems are considered to be detrimental to the public interest, and the USACE findings for Section 10 permits should document how these impacts have been avoided. Through this evaluation, USACE requires applicants to avoid and minimize impacts to corals by altering the design of a project or by imposing mitigation actions (e.g., relocation and monitoring of corals).

Under 14 USC § 81, the USCG is charged with establishing, maintaining, and operating aids to navigation to serve the needs of U.S. armed forces and maritime commerce, and when those aids are electronic, air commerce as well when requested by the Federal Aviation Administration. Some of these aids to navigation are found in areas where scleractinian corals occur. For example, the USCG maintains navigational aids in the Florida Keys National Marine Sanctuary (FKNMS) that are intended to help ships avoid grounding on coral reefs.

[9] http://www.fws.gov/laws/lawsdigest/riv1899.html

Act to Prevent Pollution From Ships (APPS) As Amended by the Marine Plastic Pollution Research and Control Act (MPPRCA)[10]. The APPS, as amended by the MPPRCA, protects coral reefs by requiring all U.S. ships and all ships in U.S. navigable waters or the EEZ to comply with the International Convention for the Prevention of Pollution from Ships (33 USC §§ 1901 et seq.). Under the regulations implementing APPS as amended by MPPRCA, the discharge of plastics, including synthetic ropes, fishing nets, plastic bags, and biodegradable plastic into the water is prohibited. Discharge of floating dunnage, lining, and packing materials is prohibited in the navigable waters, and in areas offshore less than 25 nautical miles from the nearest land. Finally, food waste or paper, rags, glass, metal, bottles, crockery and similar refuse cannot be discharged in the navigable waters or in waters offshore inside 12 nautical miles from the nearest land. USCG has the primary responsibility of enforcing regulations under the APPS, and the APPS applies to all vessels, including cruise ships, regardless of flag, operating in U.S. navigable waters and the EEZ.

International Convention for the Prevention of Pollution from Ships (MARPOL)[11]. The MARPOL Convention is the main international convention covering prevention of pollution of the marine environment by ships from operational or accidental causes. It combines two treaties adopted in 1973 and 1978 respectively and includes the Protocol of 1997 (outlined in Annex VI).The Convention currently includes a total of six technical Annexes described below:

- Annex I are the Regulations for the Prevention of Pollution by Oil (entered into force 2 October 1983). It covers the prevention of pollution by oil from operational measures and accidental discharges. Amendments to Annex I in 1992 made it mandatory for new oil tankers to have double hulls and bringing in measures for existing tankers to be fit with double hulls. Annex I was subsequently revised again in 2001 and 2003.
- Annex II are the Regulations for the Control of Pollution by Noxious Liquid Substances in Bulk (entered into force 2 October 1983). Annex II outlines the discharge criteria and measures for the control of pollution by noxious liquid substances carried in bulk. There are 250 substances evaluated and included in the list appended to the Convention. The discharge of their residues is allowed only to reception facilities until certain concentrations and conditions (which vary with the category of substances) are complied with. In any case, no discharge of residues containing noxious substances is permitted within 12 miles of the nearest land.
- Annex III is the Prevention of Pollution by Harmful Substances Carried by Sea in Packaged Form (entered into force 1 July 1992). Annex III contains general requirements for standards on packing, marking, labeling, documentation, stowage, quantity limitations, exceptions and notifications for preventing pollution by harmful substances. Since 1991, the International Maritime Dangerous Goods (IMDG) Code has also included marine pollutants.
- Annex IV is the Prevention of Pollution by Sewage from Ships (entered into force 27 September 2003). It contains requires to control pollution of the sea by sewage.
- Annex V is the Prevention of Pollution by Garbage from Ships (entered into force 31 December 1988). It specifies the distance from land, manner of disposal, and type of garbage

[10] http://wildlifelaw.unm.edu/fedbook/shippoll.html
[11] http://www.imo.org/about/conventions/listofconventions/pages/international-convention-for-the-prevention-of-pollution-from-ships-(marpol).aspx

allowed to be disposed of at sea. The requirements are much stricter in a number of "special areas" but perhaps the most important feature of this Annex is the complete ban on dumping all forms of plastic into the sea.

- Annex VI is the Prevention of Air Pollution from Ships (entered into force 19 May 2005). The regulations in this annex set limits on sulphur oxide and nitrogen oxide emissions from ship exhausts as well as particulate matter and prohibit deliberate emissions of ozone depleting substances

Antiquities Act[12]. The Antiquities Act authorizes the President of the United States to withdraw lands in order to provide for the "proper care and management" of "historic landmarks, historic and prehistoric structures, and other objects of historic or scientific interest." 16 U.S.C. § 431. Many National Monuments are established under the authority of the Antiquities Act, including the Papahānaumokuākea Marine National Monument established in 2006 to protect extensive coral reef ecosystems in the Pacific Ocean. The Antiquities Act establishes penalties for destroying, injuring, removing, or excavating any historic or prehistoric object of antiquity or object of scientific interest located on federal lands identified for protection within the monument. Reference in the Act to objects of "scientific interest" has resulted in the identification of natural geological features and wildlife for protection within monument boundaries.

National Environmental Policy Act (NEPA)[13]. Title I contains the Declaration of National Environmental Policy requiring the federal government to "use all practicable means to create and maintain conditions under which man and nature can exist in productive harmony". Section 102 requires all federal agencies to incorporate environmental considerations in planning and decision-making. Under this act, the impacts of federal actions on the quality of the human environment, including on natural resources, must be considered by conducting an appropriate environmental analysis, which may consist of an Environmental Assessment (EA) or Environmental Impact Statement (EIS). Federal agencies are also required to lend appropriate support to initiatives and programs designed to "anticipate and prevent a decline in the quality of mankind's world environment". Title II established the Council on Environmental Quality to oversee NEPA by gathering information on conditions and trends in environmental quality; evaluating federal programs with respect to the goals of Title I, develop and promote national policies to improve environmental quality; and conduct studies, surveys, research, and analyses related to the ecosystems and environmental quality. Though NEPA is considered a procedural rather than a substantive statute, lawsuits may be brought under the APA to challenge the sufficiency of the environmental analyses for proposed federal actions.

National Park Service Organic Act[14] of 1916. The National Park Service Organic Act, or the Organic Act, establishes the National Park Service within the Department of the Interior. The Organic Act promotes and regulates the use of national parks, monuments, and reservations "to conserve the scenery and the natural and historic objects and the wildlife therein, and to provide for the enjoyment…leaving them unimpaired for the enjoyment of future generations. This Act

[12] http://www.cr.nps.gov/history/hisnps/npshistory/antiq.htm
13 http://www.epa.gov/compliance/nepa/

[14] http://www.nps.gov/dena/upload/NPS%20Organic%20Act.pdf

also contains a natural resource damages and restoration provision, similar to those in the oil pollution statutes and the sanctuaries act. Several national parks have been established for the protection of resources including coral reef ecosystems, such as Biscayne National Park.

National Wildlife Refuge System Administration Act of 1966[15]. The purpose of the National Wildlife Refuge System is "to administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans." 16 U.S.C. § 668dd(a)(2). The law also provides that compatible wildlife-dependent recreational uses are allowable activities on refuges. According to the Act, "no person shall knowingly disturb, injure, cut, burn, remove, destroy, or possess any real or personal property of the United States, including natural growth, in any area of the System; or take or possess any fish, bird, mammal, or other wild *vertebrate* or *invertebrate animals* or part or nest or egg thereof within any such area; or enter, use, or otherwise occupy any such area for any purpose; unless such activities are performed by persons authorized to manage such area, or unless such activities are permitted". Accordingly, vertebrate and invertebrate species (i.e., corals) are protected within National Wildlife Refuges.

Refuge Recreation Act[16]. The Refuge Recreation Act was passed in recognition of mounting public demands for recreational opportunities on areas within the National Wildlife Refuge System, national fish hatcheries, and other conservation areas administered by the Secretary of the Interior for fish and wildlife purposes. Additionally, this act is instituted to assure that any present or future recreational use will be compatible with the primary purposes for which the conservation areas were acquired or established.Ocean Dumping Ban Act[17]. The Ocean Dumping Ban Act of 1988 (also called the Ocean Dumping Act; formerly called the Marine Protection, Research, and Sanctuaries Act) prohibits any person from dumping, or transporting for the purpose of dumping, sewage sludge, medical or industrial waste into ocean waters without a permit after December 31, 1991 (16 USC §1411b). Permits cannot be issued to dump radiological, chemical, and biological warfare agents, high-level radioactive waste, and medical waste (16 USC §1412). The EPA has responsibility for regulating the dumping of all material except dredged material.

The Lacey Act[18]. The Lacey Act, as amended in 1981 (16 USC §§ 3372 et seq.), prohibits the trade of fish, wildlife, or plants taken in violation of any foreign, state, tribal or other U.S. law.

The Sikes Act[19]. The Sikes Act (16 U.S.C. § 670), requires the U.S. Department of Defense to provide for conservation and rehabilitation of natural resources on military installations, which in some locations include corals.

Water Resources Development Act[20]. The Water Resources Development Act (33 USC §§ 2201 et seq.) authorizes the construction or study of United States Army Corps of Engineers (USACE)

[15] http://www.fws.gov/laws/lawsdigest/nwrsact.html
[16] http://www.fws.gov/laws/lawsdigest/refrecr.html
[17] http://www.epa.gov/history/topics/mprsa/02.htm
[18] http://www.fws.gov/le/pdffiles/lacey.pdf
[19] http://www.fws.gov/endangered/esa-library/pdf/2004SikesAct%20NMFWA.pdf

projects and applies to all features of water resources development and planning, including environmental assessment and mitigation requirements.

1.1.2 Federal Executive Orders

Following are descriptions of US Executive Orders that are relevant to protection of corals and coral reefs in the Caribbean and Indo-Pacific.

Executive Order 12962[21]. This Executive Order mandates that Federal agencies, to the extent permitted by law and where practicable, improve the quality, function, and sustainable productivity and distribution of U.S. aquatic resources for increased recreational fishing opportunities. It also established the National Recreational Fisheries Coordination Council. This order is applicable in the Pacific Remote Island Area National Monument (Proclamation No. 8336). The main provisions of this Executive Order are:

- Federal Agencies shall, to the extent permitted by law and where practicable, and in cooperation with States and Tribes, improve the quantity, function, sustainable productivity, and distribution of U.S. aquatic resources for increased recreational fishing opportunities.
- A National Recreational Fisheries Coordination Council is established, consisting of seven members from the Departments of the Interior, Commerce, Agriculture, Energy, Transportation and Defense and the Environmental Protection Agency. The representatives from the Departments of Commerce and the Interior will co-chair the Coordination Council.
- The Coordination Council, in cooperation and consultation with others, will develop a comprehensive Recreational Fishery Resources Conservation Plan setting forth a 5-year agenda for Federal agencies.
- All Federal agencies will aggressively work to identify and minimize conflicts between recreational fisheries and their respective responsibilities under the Endangered Species Act. The Fish and Wildlife Service and the National Marine Fisheries Service will develop a joint agency policy towards this end.
- The role of the Sport Fishing and Boating Partnership Council will be expanded to assist in the implementation of the Order.

Executive Order 12996[22]. Executive Order 12996 for "Management and General Public Use of the National Wildlife Refuge System" declares the National Wildlife Refuge System main purposes are to "preserve a national network of lands and waters for the conservation and management of fish, wildlife, and plant resources of the United States for the benefit of present and future generations". The Order also defines six compatible wildlife-dependent recreational activities (involving fishing, hunting, wildlife observation and photography, and environmental education and interpretation); defines four guiding principles for management; directs the Secretary to undertake several actions in support of management and public use; directs the Secretary to ensure the maintenance of the biological integrity and environmental health; and provides for the identification of existing wildlife-dependent uses that will continue to occur as lands are added.

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[20] http://www.fas.org/sgp/crs/natsec/IB10133.pdf

21 http://www.fedcenter.gov/Bookmarks/index.cfm?id=691

[22] http://teeic.anl.gov/lr/dsp_statute.cfm?topic=3&statute=149

Executive Order 13089[23]. Executive Order 13089, "Coral Reef Protection", issued by President William J. Clinton on 11 June 1998, established the U.S. Coral Reef Task Force (USCRTF) with a central goal of preserving and protecting the biodiversity, health, heritage, and social and economic value of U.S. coral reef ecosystems and the marine environment. In 2000, the USCRTF published "The National Action Plan to Conserve Coral Reefs[24]" identifying two fundamental themes for immediate and sustained national action. These include: 1) understanding coral reef ecosystems and the natural and anthropogenic processes that determine their health and viability and 2) quickly reducing the adverse impacts of human activities on coral reefs and associated ecosystems. The action plan also identified marine protected areas (MPAs) as a promising conservation tool and proposed critical conservation goals. The goals were to 1) strengthen protection within existing MPAs; 2) establish no-take ecological reserves in 20 percent of all representative U.S. coral reefs and associated habitats by 2010; 3) conduct a national assessment of the remaining gaps in coverage; and 4) strengthen support for international cooperation to conserve global biodiversity.

Executive Order 13158[25]. President Clinton issued Executive Order 13158 on Marine Protected Areas on May 26, 2000 to strengthen the management, protection, and conservation of existing marine protected areas and establish new or expanded MPAs; to develop a scientifically based, comprehensive national system of MPAs representing diverse U.S. marine ecosystems, and the Nation's natural and cultural resources; and to avoid causing harm to MPAs through federally conducted, approved, or funded activities (65 FR 34909). The Department of Commerce and the Department of the Interior are the lead agencies charged with carrying out the Executive Order; however, other pertinent agencies must be consulted to develop the national system of MPAs, ensuring agencies coordinate and share information, tools, and strategies. To aid in coordination effors, the Order called for the creation of a MPA Center within NOAA. Furthermore, a Federal Advisory Committee, consisting of non-Federal scientists, resource managers, and other interested persons, was established to provide advice and guidance for developing the national system of MPAs.

1.2 Non-Federal Caribbean

1.2.1 Florida

Florida statutes and rules protect all of the Scleractinia and Milleporina corals from collection, commercial exploitation, and injury/destruction on the sea floor (FS 253.001, 253.04, Chapter 68B-42.008 and 68B-42.009). Additionally, Florida has a comprehensive state regulatory program that regulates most land, including upland, wetland, and surface water alterations throughout the state. The comprehensive nature of the state program is broader than the federal program in that it also regulates alterations of uplands that may affect surface water flows. This regulatory program also includes a Federal-State Programmatic General Permit and implementation of a state-wide National Pollutant Discharge Elimination System (NPDES) program. In addition, activities located on or using State-owned sovereign submerged lands also require applicable proprietary authorizations, including consent agreements, leases, and

23 http://www.coralreef.gov/execorder.cfm

24 http://www.coralreef.gov/CRTFAxnPlan9.pdf

25 http://www.mpa.gov

easements. *The John Pennekamp Coral Reef State Park* was established in 1960 as the first coral reef MPA worldwide (*Acropora* Biological Review Team 2005).

Florida statute 253.001 - Board of Trustees of the Internal Improvement Trust Fund; duty to hold lands in trust

The existence of the Board of Trustees of the Internal Improvement Trust Fund is reaffirmed. All lands held in the name of the board of trustees shall continue to be held in trust for the use and benefit of the people of the state pursuant to s. 7, Art. II, and s. 11, Art. X of the State Constitution

Florida Statute 253.04 - Duty of board to protect, etc., state lands; state may join in any action brought

(1) The Board of Trustees of the Internal Improvement Trust Fund may police; protect; conserve; improve; and prevent trespass, damage, or depredation upon the lands and the products thereof, on or under the same, owned by the state as set forth in s. 253.03. The board may bring in the name of the board all suits in ejectment, suits for damage, and suits in trespass which in the judgment of the board may be necessary to the full protection and conservation of such lands, or it may take such other action or do such other things as may in its judgment be necessary for the full protection and conservation of such lands; and the state may join with the board in any action or suit, or take part in any proceeding, when it may deem necessary, in the name of this state through the Department of Legal Affairs.

(2) In lieu of seeking monetary damages pursuant to subsection (1) against any person or the agent of any person who has been found to have willfully damaged lands of the state, the ownership or boundaries of which have been established by the state, to have willfully damaged or removed products thereof in violation of state or federal law, to have knowingly refused to comply with or willfully violated the provisions of this chapter, or to have failed to comply with an order of the board to remove or alter any structure or vessel that is not in compliance with applicable rules or with conditions of authorization to locate such a structure or vessel on state-owned land, the board may impose a fine for each offense in an amount up to $10,000 to be fixed by rule and imposed and collected by the board in accordance with the provisions of chapter 120. Each day during any portion of which such violation occurs constitutes a separate offense. This subsection does not apply to any act or omission which is currently subject to litigation wherein the state or any agency of the state is a party as of October 1, 1984, or to any person who holds such lands under color of title. Nothing contained herein impairs the rights of any person to obtain a judicial determination in a court of competent jurisdiction of such person's interest in lands that are the subject of a claim or proceeding by the department under this subsection.

(3) The Department of Environmental Protection is authorized to develop by rule a schedule for the assessment of civil penalties for damage to coral reefs in state waters. The highest penalty shall not exceed $1,000 per square meter of reef area damaged. The schedule may include additional penalties for aggravating circumstances, not to exceed $250,000 per occurrence. Penalties assessed according to this section may be doubled for damage to coral reefs located within the boundaries of John Pennekamp Coral Reef State Park. (*Acropora* Biological Review Team, 2005)

68B-42.009 Prohibition on the Taking, Destruction, or Sale of Marine Corals and Sea Fans; Exception; Repeal of Section 370.114, Florida Statutes

(1) Except as provided in subsection (2), no person shall take, attempt to take, or otherwise destroy, or sell, or attempt to sell, any sea fan of the species *Gorgonia flabellum* or of the species *Gorgonia ventalina*, or any hard or stony coral (Order Scleractinia) or any fire coral (Genus *Millepora*). No person shall possess any such fresh, uncleaned, or uncured sea fan, hard or stony coral, or fire coral.

The prohibitions of this provision do not apply to sea fans, hard or stony corals, or fire corals legally harvested outside of state waters or federal EEZ waters adjacent to state waters and entering Florida in interstate or international commerce. The prohibitions also do not apply to any sea fan, hard or stony coral, or fire coral harvested and possessed pursuant to state permit for scientific or educational purposes. Last, the prohibitions are not applicable to any sea fan, hard or stony coral, or fire coral harvested and possessed pursuant to the aquacultured live rock provisions of Florida Statutes, or pursuant to a Live Rock Aquaculture Permit issued by the National Marine Fisheries Service under 50 C.F.R. Part 638 (*Acropora* Biological Review Team 2005).

House Bill 1423- Coral Reef Protection Act 2009

In 2009, the Florida Legislature passed the Coral Reef Protection Act to increase protection of coral reef resources on sovereign submerged lands off the coasts of Martin, Palm Beach, Broward, Miami-Dade, and Monroe counties. This law will increase the protection of Florida's endangered coral reefs by helping raise awareness of the damages associated with vessel groundings and anchoring on coral reefs off the coasts of Broward, Martin, Miami-Dade, Monroe, and Palm Beach counties. The law also authorizes penalties for the destruction of reef resources and provides for efficient repair and mitigation of reef injuries. The new law will allow the Department of Environmental Protection to restore coral reefs by ensuring that those responsible for damaging coral reefs can face fines and penalties to help restore the damage. The law also allows the state to issue "first time" warnings in lieu of a fine to recreational boaters in certain instances, and specifies higher penalties for repeat offenders and for injuries which occur within a state park or aquatic preserve. The law allows the Department of Environmental Protection to delegate authority through agreements with the Florida Fish and Wildlife Conservation Commission, coastal counties and other local governments to investigate reef damages, recover costs, provide restoration and seek compensatory mitigation (*Acropora* Biological Review Team 2005).

Florida Endangered Species Act

Only one of the 82 coral species, *Dendrogyra cylindrus* (pillar coral), is listed as an imperiled species under the Florida Endangered Species Act. FL Fish and Wildlife Commission 2008. Because it was designated prior to June 23, 1999, *Dendrogyra cylindrus* is afforded the protections of Chapter 68A-27.003 of the Florida Endangered Species Act which prohibits take, including harm, of protected species without a permit (*Acropora* Biological Review Team 2005).

Chapter 18-20 Florida Administrative Code – Florida Aquatic Preserves

All sovereignty lands within a preserve shall be managed primarily for the maintenance of essentially natural conditions, the propagation of fish and wildlife, and public recreation,

including hunting and fishing where deemed appropriate. Aquatic preserves which are described in Part II of Chapter 258, Florida Statutes, were established for the purpose of being preserved in an essentially natural or existing condition so that their aesthetic, biological and scientific values may endure for the enjoyment of future generations. Preserves were established to preserve, promote, and utilize indigenous life forms and habitats, including but not limited to: sponges, soft coral, hard corals, submerged grasses, mangroves, salt water marshes, fresh water marshes, mud flats, estuarine, aquatic, and marine reptiles, game and non-game fish species, estuarine, aquatic and marine invertebrates, estuarine, aquatic and marine mammals, birds, shellfish and mollusks (*Acropora* Biological Review Team 2005).

State of Florida Clean Vessel Act and Designation of Waters of the State Surrounding the Florida Keys as a No Discharge Zone

The State of Florida's Clean Vessel Act of 1994 requires houseboats to store sewage in holding tanks (Type III Marine Sanitation Device) that must be pumped out and disposed at approved facilities. However, vessels other than houseboats could legally discharge wastewater from Type I or Type II Marine Sanitation Device that disinfect the wastewater but do not remove nutrients. For that reason, on July 26, 2001, the USEPA, under authority of Section 312 of the CWA, published a proposed rule to establish a No Discharge Zone in State of Florida waters within the boundaries of the FKNMS. That action was taken at the request of the Governor of Florida, with support by the Monroe County Board of County Commissioners and the FKNMS Water Quality Steering Committee. The rule became effective in June 2002 and makes it illegal to dump sewage, whether treated or not, into State waters. NOAA is pursuing establishment of a No Discharge Zone in federal waters of the FKNMS. The Clean Vessel Act administers a grant program to fund construction of vessel sewage pump out facilities and toilet dump stations at marinas (*Acropora* Biological Review Team 2005).

Chapter 99-395, Laws of Florida

In 1999, the Florida State Legislature approved Chapter 99-395 that was adopted as a Law of Florida. This law prohibits new surface water wastewater discharges, requires existing wastewater facilities discharging to cease surface water disposal by 2006, and requires all other discharges to meet specific treatment and disposal standards by July 1, 2010. Facilities with flows greater than or equal to 100,000 gallons per day are required to provide basic disinfection and produce advanced water treatment effluent. Facilities with flows less than 100,000 gallons per day and onsite systems (e.g., septic tanks) are required to provide disinfection and produce an effluent that meets best available technology requirements. Facilities with a wastewater flow of 1 million gallons per day or greater must use a deep injection well for disposal, while facilities with flows less than 1 million gallons per day must discharge to a shallow injection well (*Acropora* Biological Review Team 2005).

Oceans and Coastal Resources Act

The Oceans and Coastal Resources Act states that the coral reefs of southeast Florida and the barrier reef of the Florida Keys are a national treasure and must continue to be protected (Florida Statute §161.72(e)). Both the FDEP and Florida Fish & Wildlife Conservation Commission (FWC) are authorized to promulgate regulations under this act (Florida Statute §161.75). Florida law prohibits taking, attempting to take, or otherwise destroy, or sell or attempt to sell any hard or stony coral (Order Scleractinia) in state waters, with exceptions for permitted scientific

research, educational purposes and aquaculture (Chapter 68B-42.009 of the Florida Administrative Code; http://fac.dos.state.fl.us/faconline/chapter68.pdf). The Act also prohibits possession of such fresh, uncleaned or uncured coral. Any person who willfully violates the above prohibitions is subject to fines (section 253.04 of Florida Statutes). Any person in possession of elkhorn or staghorn coral legally harvested outside of Florida waters or the U.S. EEZ adjacent to state waters and entering Florida in interstate or international commerce must establish the chain of possession from the initial transaction after harvest, by appropriate receipt(s), bill(s) of sale, or bill(s) of lading, and any customs receipts, and to show that such species originated from a point outside Florida waters or the U.S. EEZ adjacent to state waters and entered the state in interstate or international commerce (68B-42.009(2)(a)) (*Acropora* Biological Review Team 2005).

The Florida Aquatic Preserve Act

One of the goals of the Florida Aquatic Preserves Act (18 Florida Administrative Code 258) is to preserve, promote, and utilize indigenous life forms and habitats, including hard corals. The Florida Aquatic Preserve Act implemented a system of protected areas within Florida, such as Biscayne Bay Aquatic Preserve. Biscayne Bay Aquatic Preserve was established in 1974 and it encompasses 69,000 acres of State submerged lands. The preserve extends from Miami-Dade County to Monroe County. The Act establishing Biscayne Bay Aquatic Preserve restricts dredge and fill activities and alteration of physical conditions, and discharge of wastes that substantially inhibit the purposes of the preserve. Coupon Bight Aquatic Preserve is the southern most aquatic preserve located in the lower half of the Florida Keys. It is a shallow semi-enclosed basin approximately 3.5 kilometers (2.2 miles) long and 2.5 kilometers (1.6 miles) wide with an average depth near the center of 1.8 meters (6 feet). Its waters have been designated as Outstanding Florida Waters, and as such, the FDEP cannot issue permits for direct pollutant discharges, which would lower existing water quality, and indirect discharges, which would significantly degrade that water body (*Acropora* Biological Review Team 2005).

Outstanding Florida Waters

Marine waters surrounding the Florida Keys have been declared as "Outstanding Florida Waters" by the State of Florida (FDEP, 1985). By regulation, input of materials that could be considered pollutants to open surface waters cannot exceed the concentration of those materials that naturally occur in the waters. Because of Outstanding Florida Waters designation, direct surface water discharges of pollutants have been eliminated or are being phased out in the Florida Keys. The Florida Keys have also been designated a region of "critical State concern" which requires the development and approval by the Florida Department of Community Affairs a "Monroe County Comprehensive Plan" that addresses elimination of sources of pollution and land-management options (*Acropora* Biological Review Team 2005).

Environmental Resource Permitting and Wetland Resource Permit

The Environmental Resource Permit Program is an independent State permit program that operates in addition to the federal dredge and fill program. The Environmental Resource Permit Program regulates activities involving the alteration of surface water flows. This includes new activities in uplands that generate stormwater runoff from upland construction, as well as dredging and filling in wetlands and other surface waters. Environmental Resource Permit applications are processed by either the Florida Department of Environmental Protection (FDEP)

or one of the State's water management districts, in accordance with the division of responsibilities specified in operating agreements. The Environmental Resource Permit Program is in effect throughout the State except for the Florida Panhandle (Northwest Florida Water Management District).

In northwest Florida, a Wetland Resource Permit (Chapter 62-312 F.A.C.) is required for any dredging, filling or construction in, on, or over waters that are connected (naturally or artificially) to "named waters." Named waters include the Gulf of Mexico, bays, bayous, sounds, estuaries, lagoons, river, streams, and natural lakes that are not wholly owned by one person other than the State. This permitting system does not regulate dredging or filling in isolated wetlands and is implemented solely by the FDEP. In peninsular Florida, the Environmental Resource Permit Program regulates virtually all alterations to the landscape, including all tidal and freshwater wetlands and other surface waters, as well as storm water runoff quality and quantity. This program regulates everything from construction of single family residences in wetlands, convenience stores in uplands, dredging and filling for any purpose in wetlands and other surface waters, construction of roads, and agricultural alterations that impede or divert the flow of surface waters. Application of this permitting program ensures that water quality is not degraded, and that wetlands and other surface waters continue to provide productive habitat for fish and wildlife, including corals. Issuance of an Environmental Resource Permit constitutes water quality certification or waiver thereto under Section 401 of the CWA (33 U.S.C. 1341). Finally, issuance of an Environmental Resource Permit in coastal counties constitutes a finding of consistency under the Florida Coastal Zone Management Program (Section 301 Coastal Zone Management Act) (*Acropora* Biological Review Team 2005).

Submerged Lands Authorization

In addition to the above regulatory program, Submerged Land Authorization is required for any construction on or use of submerged lands owned by the State (sovereign submerged lands) (F.S. Chapter 253). Such lands generally extend waterward from the mean high water line of tidal waters, or the ordinary high water line of freshwaters, out to the State's territorial limit. The State's territorial limit is approximately 3 miles into the Atlantic Ocean and nine miles into the Gulf of Mexico. If such lands are located within certain designated Aquatic Preserves, the authorization must also meet the requirements of Chapter 258 of Florida Statutes. Such authorization considers issues such as riparian rights, impacts to submerged land resources, and preemption of other uses of the water by the public. Authorizations typically are in the form of consent of use, easements, and leases. This program is implemented jointly by the FDEP and four (of five) of the State's water management districts in accordance with the same operating agreement that governs the Environmental Resource Permit Program. The program is structured so that applicants who do not qualify at the time of the permit application for both the regulatory permit and the propriety authorization cannot receive either permit or authorization (*Acropora* Biological Review Team 2005).

National Pollution Discharge Elimination System

In addition to the State regulatory program, Florida has statewide authorization to implement the Federal NPDES permit program for stormwater. Areas of regulation include municipal separate storm sewer systems, certain industrial activities, and construction activities. New construction may require a stormwater permit if the clearing, grading, or excavation work disturbs five or

more acres of land and discharges to either surface waters of the State or to a Municipal Separate Storm Sewer System (*Acropora* Biological Review Team 2005).

Florida Administrative Code, Chapter 18-21

Chapter 18-21 of the Florida Administrative Code prohibits installation of telecommunication lines that originate from or extend into federal waters on or under submerged lands within Biscayne Bay Aquatic Preserve, Biscayne Bay National Park, and Monroe County. Moreover, the law requires conduits for telecommunication lines to be directionally drilled under nearshore benthic resources, including the first reef and any other more inshore reefs off Southeast Florida, to the maximum extent practicable and to punch out in a location that avoids or minimizes the impacts to benthic resources such as seagrasses and live bottom communities including corals and sponges. The same chapter also requires that activities on submerged sovereignty lands be designed to minimize or eliminate any adverse impacts on fish and wildlife habitat, and other natural or cultural resources, with special attention and consideration given to endangered and threatened species habitat (*Acropora* Biological Review Team 2005).

Florida's Coastal Zone Management Act of 1978

Florida's Coastal Zone Management Act of 1978 authorized the development of a comprehensive state Coastal Management Program (CMP) based on existing Florida Statutes and regulations. Florida's CMP is comprised of 23 statutes, which are administered by nine State agencies and five water Districts. The Federal CZMA and Florida law requires Federal agencies and applicants to provide a detailed description of proposed Federal activities that may affect the State's coastal resources, and the State's Department of Community Affairs coordinates the review of such activities to ensure that they are consistent with the State's CMP and Coastal Zone Management Act.

Section 403.061 of the Florida Statutes is part of the State's CMP and it authorizes FDEP to identify "Outstanding Florida Waters", and the designation is intended to protect existing good water quality. FDEP cannot issue permits for direct pollutant discharges to Outstanding Florida Waters, which would lower existing water quality, and indirect discharges, which would significantly degrade that water body. Waters with the Outstanding Florida Water designation in which elkhorn and staghorn corals occur are: (a) in Palm Beach County: John D. MacArthur Beach State Park; (b) in Broward County: John U. Lloyd Beach State Recreation Area, and North Beach; (c) in Miami-Dade County: Biscayne National Park, ITT/Hammock, and Biscayne Bay; (d) in Monroe County: Dry Tortugas National Park, Key West National Wildlife Refuge, National Key Deer National Wildlife Refuge, Bahia Honda State Park, Bill Baggs Cape Florida State Recreation Area, Hugh Taylor Birch State Recreation Area, Long Key State Recreation Area, Fort Zachary Taylor Historic Site, Indian Key State Historic Site, Indian Key State Historic Site, Key Largo Hammock State Botanical Site, Windley Key Fossil Reef State Geological Site, San Pedro Underwater Archaeological Preserve, Coupon Bight, Curry Hammock, North Key Largo Hammock, Port Bougainville, and Biscayne Bay.

FDEP regulates activities that involve alteration of surface water flows through the Environmental Resource Permit Program. The purpose of the Environmental Resource Permit Program is to ensure that construction activities do not degrade water quality, cause flooding, or degrade habitat for aquatic or wetland dependent wildlife. Activities requiring permits involve, but are not limited to involving, the following: 1) solid waste, hazardous waste, domestic waste,

and industrial waste facilities; 2) mining; 3) docking facilities and attendant structures and dredging that are not part of a larger plan of residential or commercial development; navigational dredging conducted by government entities, except when part of a larger project that a Water Management District has the responsibility to permit; systems located in whole or in part seaward of the coastal construction control line; seaports; and smaller, separate water-related activities not part of a larger plan of development, such as boat ramps, mooring buoys, and artificial reefs. Similar to the process described under the Federal RHA, the state of Florida requires project modifications and mitigation measures for corals through the Environmental Resource Permit review process (*Acropora* Biological Review Team 2005).

Pollution Discharge Prevention and Control Act

The Pollution Discharge Prevention and Control Act (28 Florida Statutes §§ 376.011 et seq.) prohibits the discharge of pollutants into or upon any coastal waters, estuaries, tidal flats, beaches, or lands adjoining the seacoast of the state. Pollution is defined as the presence in the outdoor atmosphere or waters of the state any one or more substances or pollutants in quantities which are or may be potentially harmful or injurious to human health or welfare, animal or plant life, or property or which may unreasonably interfere with the enjoyment of life or property, including outdoor recreation (*Acropora* Biological Review Team 2005).

Florida and Cruise Ship Industry MOU

In 2001, the State of Florida entered into a Memorandum of Understanding (MOU) with the cruise ship industry through the International Council of Cruise Lines and related organizations. Under the MOU, cruise lines must eliminate wastewater discharges in Florida waters within 4 nautical miles of the State's coast, report hazardous waste off-loaded in the U.S. by each vessel on an annual basis, and submit to environmental inspections by USCG (Congressional Research Service 2005; *Acropora* Biological Review Team 2005).

Monroe County Code of Ordinances.

The Monroe County Code of Ordinances does not permit dredging of hard bottom communities to construct a boat ramp (section 9.5-349(l)(7)). Docking facilities may be permitted which terminate over hardbottom communities where the water depth at the terminal platform is at least 4 feet above the top of all corals at mean low water and access to open water is continuous (section 9.5-349(m)(5)). Water access walkways are not permitted when designed to terminate over hardbottom communities (section 9.5-349(n)(1)(f)) (*Acropora* Biological Review Team 2005).

Phosphate Detergent Ban in Monroe County, Florida.

The Monroe County Board of County Commissioners (Florida Keys) (MCBCC) recognized that phosphate-laden detergents are a significant source of phosphate pollution of canals and other near shore waters of the Florida Keys. The board also recognized that phosphate enrichment of near shore waters can result in the growth of nuisance algae and can alter ecosystem structure and function, including coral reefs. The MCBCC passed Monroe County Ordinance 029-1989 in October 1989 making it unlawful for any person, firm, or corporation to sell, offer to expose for sale, give or furnish any detergent containing more than 0% to 0.5% phosphorus by weight within unincorporated and incorporated areas of Monroe County. An exemption is given for

detergents used in machine dishwashing that contain 0% to 5.9% phosphorus by weight (*Acropora* Biological Review Team 2005).

1.2.2 Puerto Rico

Law for the Protection, Conservation, and Management of Coral Reefs in Puerto Rico, Law 147

This law explicitly mandates the conservation and management of coral reefs in order to protect their functions and values. The Department of Natural and Environmental Resources (DNER) is in charge of implementing the law. Law 147 provides for the creation of zoned areas in order to mitigate impacts from human activities, including (1) Reef Recuperation Areas and (2) Ecologically Sensitive Areas. These zones will facilitate the DNER in controlling human activity that can directly impact coral species such as anchoring. Law 147 also directs the DNER to identify and mitigate threats to coral reefs from degraded water quality due to pollution, and additionally requires an EIS for projects or activities that can negatively affect coral reefs. Additionally, the law directs the DNER to designate priority areas as marine reserves, including a minimum of 3% of the insular platform within three years (2003). Marine reserves are defined as areas where all extractive activities are prohibited in order to help recover depleted fishery resources and protect biodiversity, and can protect corals by preventing impacts from fishery gear. There are currently an additional 13 natural reserves in Puerto Rico that have coral reefs within their boundaries, all of which are located on all coasts and offshore islands. This spatial distribution of protected areas provides an infrastructure for management measures to protect coral populations (*Acropora* Biological Review Team 2005).

Fishery Law 83 of 1936

Fishery Law 83 of 1936 prohibits harvest or take of corals or live rock for commercial purposes (except under permit) and use of poisonous substances when fishing. The territory prohibits fishing by means of explosives in its maritime waters (12 LPRA §57), and it is illegal to transport or sell articles derived from rare or endangered species as designated by the DNER (12 LPRA §107d; *Acropora* Biological Review Team 2005).

Law 430 of 2000 Navigation and Aquatic Safety Law

The Navigation and Aquatic Safety Law and its associated Regulation 6979 of 2005, establish measures to protect the marine flora and fauna from recreational and other human activities. For instance, Article 24 of Regulation 6979 prohibits the mooring of any vessel in mangroves, coral reefs, or seagrass beds. The fine for violating this regulation is $250 and can be issued in the form of a ticket by any enforcement official (Article 35). The regulation also contains requirements related to the reporting of groundings. DNER is working to become more active in the documenting of recreational vessel groundings in order to characterize the cumulative impacts of these accidents on the coral reef ecosystem (Lilyestrom, pers obs. in *Acropora* Biological Review Team 2005).

1.2.3 U.S. Virgin Islands

U.S.V.I. Coastal Zone Management Act of 1978 (12 VIC § 906)

This statute provides provisions for development activities conducted near the coastal zone. Provisions in this statute include considerations and protections for significant natural areas for their contributions to marine productivity and value as habitats for endangered species and other wildlife. Also included are provisions to protect complexes of marine resource systems of unique

productivity, including reefs, marine meadows, salt ponds, mangroves and other natural systems, and assure that activities in or adjacent to such complexes are designed and carried out so as to minimize adverse effects on marine productivity, habitat value, storm buffering capabilities, and water quality of the entire complex. The U.S.V.I CZMA states that sand, rock, mineral, marine growth and coral, natural materials or other natural products of the sea, excepting fish and wildlife, shall not be taken from the shoreline without first obtaining a coastal zone permit, and no permit shall be granted unless it is established that such materials or products are not otherwise obtainable at reasonable cost, and that the removal of such materials or products will not significantly alter the physical characteristics of the area or adjacent areas on an immediate or long-term basis. This law is generally used to prevent the taking of coral anywhere in the U.S.V.I (*Acropora* Biological Review Team 2005).

Chapter 1 Wildlife. Subchapter VII Wildlife and Marine Sanctuaries § 97. Establishment of wildlife or marine sanctuaries. This statute provides for the establishment of wildlife or marine sanctuaries for the purpose of propagating, feeding, and protecting birds, fish and other wildlife. This statute provides the legal basis for the establishment of the St. Croix East End Marine Park.

*Chapter 1 Wildlife. Subchapter VII Wildlife and Marine Sanctuaries § 98***.** This statute legally established the St. Croix East End Marine Park to protect territorially significant marine resources, promote sustainability of marine ecosystems, including coral reefs, sea grass beds, wildlife habitats and other resources and to conserve and preserve significant natural areas for the use and benefit of future generations.

Indigenous and Endangered Species Act of 1990
Virgin Islands Law VIC, T. 12, Ch. 2, Section 103 (a), also known as the Indigenous and Endangered Species Act of 1990: states that "No person may take, catch, possess… any indigenous species, including live rock (includes coral)… without a valid scientific or aquarium collecting permit, or indigenous species retention permit…" Aquarium permits have not been issued except for private aquarists; and no permits for coral collections are approved (*Acropora* Biological Review Team 2005).

1.3 Non-Federal Indo-Pacific

The following subsections describe non-federal existing regulatory mechanisms for the states, territories, and commonwealths that have local governments (Hawaii, American Samoa, Guam, CNMI) within the range of the 75 Indo-Pacific coral species. Some coral species also occur on Jarvis Atoll, Wake Island, Palmyra Atoll, and Howland and Baker Islands of the Pacific Remote Island Areas (PRIA). However, PRIA does not have a local government, and is thus controlled entirely by the federal government. Therefore, there are no non-federal regulatory mechanisms in PRIA.

1.3.1 Hawaii

The management of coastal and marine areas in Hawaii occurs through various statutes. Application of these laws is commonly undertaken through administrative regulations promulgated for specific areas. A primary focus of marine regulation in Hawaii is the control of "fishing" and the prohibition or restriction of marine organism collection. The underlying motivation for the regulatory system is the maintenance and (if necessary) restoration of marine

ecosystems and/or the reduction of user conflicts. Most of Hawaii's coral ecosystems lie in State-regulated waters. The Department of Land and Natural Resources (DLNR) and Division of Aquatic Resources (DAR) have identified critical coral ecosystems and, using statutory authority, identified various Marine Management Areas. All corals belonging to the order *Scleractinia* are protected under Hawaii's Administrative Code Title §13-95-1.1.

Hawaii Administrative Rules Title 13.

HAR Title 13 Department of Land and Natural Resources Sub-Title 10 Land Management Chapter 221 Unencumbered Public Lands
The purpose of this chapter is to control public activities on unencumbered public lands. Unencumbered public lands include, but are not limited to, beach and coastal areas, submerged lands, and mountainous non-forest reserve, wildlife, or park areas. Provisions that affect the coastal marine environment are described below.

§13-221-23 Geological features
No person shall destroy, disturb, or mutilate any geological features or dig, or remove sand, earth, gravel, minerals, rocks, fossils, coral or any other substance on the premises. No person shall excavate or quarry any stone, or lay, set, or cause any blast or explosion, or assist in these acts within the premises, except as provided by law or with the written permission of the board or its authorized representative.

§13-221-34 Wildlife
No person shall molest, disturb, injure, trap, take, catch, possess, poison, or kill any wild bird or mammal, or disturb their habitat within the premises, except when otherwise authorized by all applicable federal, state and county laws and rules. [Eff FEB 06 1988] (Auth: HRS §171-6) (Imp: HRS §171-6)

§13-5-1 "Conservation Districts"
The purpose of this chapter is to regulate land-use in the conservation district for the purpose of conserving, protecting, and preserving the important natural resources of the State through appropriate management and use to promote their long-term sustainability and the public health, safety, and welfare. [Eff DEC 12 1994] (Auth: HRS §183c03) (Imp: HRS §183c-1)
"Conservation district" means those lands within the various countries of the State and state marine waters bounded by the conservation district line, as established under the provisions of Act 187, Session Laws of Hawaii 1961, and Act 205, Session Laws of Hawaii 1963, or future amendments thereto.

§225M-2 Office of planning, establishment; responsibilities
There is established within the department of business, economic development, and tourism an office of planning. The office of planning shall gather, analyze, and provide information to the governor to assist in the overall analysis and formulation of state policies and strategies to provide central direction and cohesion in the allocation of resources and effectuation of state activities and programs and effectively address current or emerging issues and opportunities. More specifically, the office shall engage in the following activities:

- Coastal and ocean policy management

- Carry out the lead agency responsibilities for the Hawaii coastal zone management program, as specified in chapter 205A.
- Develop and maintain an ocean and coastal resources information, planning, and management system
- Further develop and coordinate implementation of the ocean resources management plan
- Formulate ocean policies with respect to the exclusive economic zone, coral reefs, and national marine sanctuaries

§190-3 Rules
The Department of Land and Natural Resources pursuant to chapter 91, shall adopt rules governing the taking or conservation of fish, crustacean, mollusk, live coral, algae, or other marine life as it determines will further the state policy of conserving, supplementing and increasing the State's marine resources. The rules may prohibit activities that may disturb, degrade, or alter the marine environment, establish open and closed seasons, designate areas in which all or any one or more of certain species of fish or marine life may not be taken, prescribe and limit the methods of fishing, including the type and mesh and other description of nets, traps, and appliances, and otherwise regulate the fishing and taking of marine life either generally throughout the State or in specified districts or areas.

§171-58.5 Prohibitions
The mining or taking of sand, dead coral or coral rubble, rocks, soil, or other marine deposits seaward from the shoreline is prohibited.

§190-1 Conservation area; administration
All marine waters of the State are hereby constituted a marine life conservation area to be administered by the department of land and natural resources subject to this chapter and any other applicable laws not inconsistent herewith or with any rules adopted pursuant hereto. No person shall fish for or take any fish, crustacean, mollusk, live coral, algae or other marine life, or take or alter any rock, coral, sand or other geological feature within any conservation district established.

§188-68
Permits for coral and rock with marine life attached. The department may issue permits, as authorized by this section, section 187A-6, chapter 183C, or under rules adopted pursuant to chapter 91 necessary for collecting live stony corals or marine life visibly attached to rocks placed in the water for a commercial purpose.

[§188F-3] West Hawaii regional fishery management area; purpose: The purpose of the West Hawaii regional fishery management area shall be to:
- Ensure the sustainability of the State's nearshore ocean resources;
- Identify areas with resource and use conflicts;
- Provide management plans as well as implementing regulations for minimizing user conflicts and resource depletion, through the designation of sections of coastal waters in the West Hawaii regional fishery management area as fish replenishment areas where

certain specified fish harvesting activities are prohibited, and other areas where anchoring and ocean recreation activities are restricted;
- Establish a system of day-use mooring buoys in high-use coral reef areas and limit anchoring in some of these areas to prevent anchor damage to corals;
- Identify areas and resources of statewide significance for protection;
- Carry out scientific research and monitoring of the nearshore resources and environment; and
- Provide for substantive involvement of the community in resource management decisions for this area through facilitated dialogues with community residents and resource users. [L 1998, c 306, pt of §2]

Hawaii Coral & Live Rock Statutes

"Stony coral" means any of a variety of invertebrate species belonging to the order Scleractinia characterized by having a hard, calcareous skeleton that are native to the Hawaiian Islands.

§13-95-70 Stony corals.

(a) It is unlawful for any person to take stony coral, or to break or damage any stony coral with a crowbar, chisel, hammer, or any other implement. (b) It is unlawful for any person to sell any stony coral; except that stony coral rubble pieces or fragments imported for the manufacture and sale of coral jewelry or stony coral obtained through legal dredging operations in Hawaii for agricultural or other industrial uses may be sold. [Eff 12/03/98; am Dec 9 2002] (Auth: HRS §187A-5) (Imp: HRS §187A-5)

§13-95-71 Live rocks

(a) It is unlawful for any person to take live rock, or to break or damage with crowbar, chisel, or any other implement, any rock or coral to which marine life is visibly attached or affixed. (b) It is unlawful for any person to sell any rock or coral to which marine life is visibly attached or affixed. [Eff 12/03/98; am Dec 9 2002] (Auth: HRS §§187A-5, 189-6) (Imp: HRS §§187A-5, 189-6)

1.3.2 American Samoa

American Samoa Code Annotated Title 24 Ecosystem Protection and Development[26]

Chapter 1 Environmental Quality Act (A.S.C.A. §§ 24.0101 et seq). The two main objectives of this Act are: (a) to achieve and maintain levels of air and water quality as will protect human health and safety, prevent injury to plant and animal life and property, foster the comfort and convenience of the people, promote the economic and social development, and facilitate the enjoyment of the natural attractions; and (b) to provide for a coordinated Territory-wide program of air and water pollution prevention, abatement, and control; and provide a framework within which all values may be balanced in the public interest.

The Act defines "water pollution" as "the presence in the water of visible floating materials, oil, grease, scum, foam or other materials which produce visible turbidity or settle to form deposits; or materials which produce color, odor or taste, either of themselves or in combination, or in the

[26] http://www.asbar.org/

biota; or materials which induce undesirable aquatic life; or materials which are toxic or an irritant to humans, animals, plants, or aquatic life". The Act pertains to all "waters of American Samoa" of which include all streams, lakes, ponds, rivers, bays, lagoons, navigable water, groundwaters, underground waters, and coastal waters.

Chapter 2 Water Quality Standards (A.S.C.A. §§ 24.0201 et seq). This chapter agrees with the Federal Water Pollution Control Act and asserts that existing water uses and water quality standards must be maintained in such as way as is consistent with the Clean Water Act.

Chapter 9 Fishing (A.S.C.A. §§ 24.0901 et seq). Section 24.0907 of these regulations outlines activities regulated in Fagatele Bay National Marine Sanctuary. In zones A and B, it is prohibited to gather, take, break, cut, damage, destroy, or possess any invert, shellfish, coral, bottom formation, or marine plant; prohibited to possess or use spearguns (Hawaiian slings, pole slings, arbalettes, pneumatic and spring loaded spearguns), blow and arrows, bang sticks, or similar taking device; no person shall possess seines, trammel nets, or any fixed net; no vessel anchor in living coral or anchor in any manner that causes damage to living coral; and no vessel shall discharge, or cause to be discharged, in the marine environment any substance that may damage fish habitat (this includes but is not limited to garbage, human waste, or oily bilge). Within subzone A no person shall possess or use fishing poles, hand lines, or trawls and commercial fishing is prohibited.

Section 24.0909 of these regulations describes activities regulated at Rose Atoll National Wildlife Refuge (operates in conjunction with federal regulations). The boundaries include all lands within extreme low water line of the outside perimeter reef except at the entrance to the channel where the boundary line is a line extended between extreme low waterlines on each side of the entrance channel. It is prohibited to gather, take, break, cut, damage, destroy, or possess any invert, shellfish, coral, bottom formation, or marine plant; prohibited to take or attempt to take fish; and no person shall enter without a special use permit from DMWR.

Section 24.0910 states it is unlawful to use or possess in a fishing area any gear prohibited by annual proclamation.

Section 24.0911 states it is unlawful to take or attempt to take fish or shellfish with dynamite or any explosive.

Section 24.0912 states it is unlawful to place or explode dynamite or any explosive, or cause to be placed or explode dynamite or any explosive in the waters of American Samoa for any reason except as may be authorized by the American Samoa Government pursuant to all applicable regulations and permits

Section 24.0913 states it is unlawful to take or attempt to take fish or shellfish using any substance that has a poisonous or intoxicating effect on fish or shellfish. Includes bleach, quinaldine, insecticides, herbicides, and traditional fish poisons derived from plant and animal materials such as Barrintonia (futu) and Derris (Ava niu kini).

Section 24.0915 states it is unlawful to take, attempt to take, or assist in taking fish or shellfish (or both) using SCUBA or any underwater breathing apparatus, except with a permit issued by the director under 24.0938.

Section 24.0916 states it is unlawful to possess SCUBA or any underwater breathing apparatus and spear on any vehicle, vessel, or along the shoreline, unless the person in possession holds a permit issued by the director under 24.0938.

Section 24.0917 states it is unlawful to be in possession of explosives, poisonous substances, or electrical devices.

Section 24.0926 states it is unlawful to willfully damage coral during fishing operations.

Section 24.0927 states it is unlawful to willfully damage or destroy fish habitat at any time unless authorized by the American Samoan Government pursuant to all applicable permits and regulations.

Section 24.0929 states it is unlawful to collect any living coral in water less than 60 feet deep. No commercial harvest of coral is permitted without a valid permit from the department.

Section 24.0937 states a permit is needed to collect aquarium fish, for coral harvesting, or for scientific collection.

Section 24.0938 states a license is needed for commercial fishing. Applicants must be a resident of American Samoa for one year to obtain a license.

Section 24.0943 states laws are fully enforceable by ASG department of Public Safety Officers and other authorized persons. Primary enforcement is from agents of the DMWR staff.

Chapter 10 Community-Based Fisheries Management Program (A.S.C.A. §§ 24.1001 et seq.). These regulations govern the Community-based Fisheries Management Program in an effort to protect traditionally valuable resources; such as traditional fishing gear, fishing methods, and Village Marine Protected Areas; in the waters surrounding American Samoa. Designation of Village Marine Protected Areas and Village Bylaws are recognized under Sections 24.1005 and 24.1006. According to Section 24.1009, prohibits the use of poisons, explosives, and other noxious substances.

Section 24.1008 addresses Fishing or Taking Fish in a Village Marine Protected Area. The following methods are approved within Village Marine Protected Areas: rod and reel, bamboo pole, hand line, Gleaning, hand thrown pole spear, throw net, Fish or Shellfish Trap, traditional use of Lau and the enu and spear, and spear gun. All other methods are illegal. The village has the right to ban certain types of fishing gear, methods, or declare no take areas within the Village Marine Protected Area.

American Samoa Code Annotated Title 26 Environmental Safety and Land Management[27]

Chapter 2 Coastal Management (A.S.C.A. §§ 26.0201 et seq.). The American Samoa Coastal Management Program Administrative Rules were adopted from the American Samoa Coastal Management Act of 1990 with the purpose of establishing a system of environmental review that includes economic and technical guidance for land-use decisions. These regulations develop standards, procedures for designating, planning, and managing Special Management Areas that are consistent with the Coastal Zone Management Act of 1972. Some specific regulations within this chapter are described below.

Section 26.0221 declares Special Management Areas in mangrove habitat that are "unique and irreplaceable habitat". The two areas specifically mentioned are Leone Pala Lagoon and Nuuuli Pala Lagoon.

Section 26.0222 states that wetlands management must include delineation of boundaries, policy, jurisdictional limits, buffer zones, permitted and prohibited activities, and permissible uses and violations.

American Samoa Coastal Management Program Administrative Rules 1997[28]. These rules developed the Project Notification and Review System, which is a system of environmental review used when making land-use decisions.

1.3.3 Guam

Guam Code Annotated (GCA), Organic Act of Guam[29],

Title 5 Government Operations, Chapter 63 (Fish, Game, Forestry, and Conservation). Take and harvesting of coral is regulated and coral reefs in general are protected under this act. Article 1 (Game and Fish).

Section 63104 states it is unlawful to take any fish using dynamite or explosive.

Section 63105 states it is unlawful for explosives to be thrown, dropped, or exploded in any waters of the Territory of Guam.

Section 63106 states taking fish by means of poisons or intoxicant substances is unlawful.

Section 63107 states the use of poison or intoxicant substances is unlawful.

Section 63108 states the use of electric devices is unlawful.

Section 63113 states it is unlawful to willfully destroy coral for purposes of flushing fish from their habitat or for clearing an area for net fishing.

[27] http://www.asbar.org/
[28] http://www.asbar.org/Regs/asac26_02.htm
[29] http://www.justice.gov.gu/compileroflaws/GCA/title5.html

Section 63116.1 states the purpose of marine preserves is to protect, preserve, manage and conserve aquatic life, habitat, and marine communities and ecosystems. Ensure the health, welfare and integrity of marine resources and qualities for current and future generations by managing, regulating, restricting or prohibiting activities to include but not limited to fishing, development, or human uses (Amended by Bill 228, in 2005).

Section 63116.2 gives information related to activities within marine preserves. All forms of fishing and the taking or altering of aquatic life including living or dead coral is unlawful except as specifically identified as allowable by the Department of Agriculture through regulations (Amended by Bill 228, in 2005).

Section 63129 states anyone violating sections 63104, 63105, 63106, 63107, or 63108 is guilty of felony punishable by imprisonment or fine (Amended by Bill 228, in 2005).

Article 4 (Conservation Reserves). The Department of Agriculture, Department of Parks and Recreation, and other agencies of the government of Guam are in charge of managing land and waters set aside as Conservation Reserves.

Article 6 (Live Coral and Fish Nets)Section 63601 states it is unlawful to remove coral from the area surrounding the Island of Guam extending ten meters inland from the main high tide line then seaward within the waters of Guam, except in accordance with the Article (Amended by Bill 228, in 2005).

Section 63602 and 63603 regulate harvesting of coral. A license is required for commercial harvest. The Director of Agriculture can limit the maximum time of the license to 5 days and may restrict the amount of coral taken to insure conservation.

Section 63609 authorizes the use of poisons, electric devices, and mesh nets for scientific purposes. Permits are issued by the Department of Agriculture for bona fide scientific research.

Article 9 (The Guam Coral Reef Protection Act). Under the Coral Reef Protection Act, the responsible party that has run aground, struck, released pollutants, or otherwise damaged coral reefs must notify the Department of Agriculture 24 hours after the occurrence. They are responsible for a damage assessment and primary restoration in a timely fashion. The vessel must be removed, without causing additional damage, within 72 hours of the initial grounding, weather permitting. If there is a pollutant release, clean-up must begin within 72 hours. The responsible party is financially responsible up to 3 years after the incident and fines vary with the size of the site impacted. The Act also creates the Coral Reef Restoration Fund used exclusively for purposes of this Article and proceeds from fines are added to the fund (Cruz, 2010).

Title 10 Health and Safety, Chapter 45 (Guam Environmental Protection Agency Act)[30]. The purpose of this Act is to "provide a united, integrated and comprehensive territory-wide program of environmental protection and to provide a framework to fulfill that task". The Guam Environmental Protection Agency is responsible for implementing the Water Resources

[30] http://www.guamcourts.org/CompilerofLaws/GCA/title10.html

Conservation Act, the Water Pollution Control Act, Toilet Facilities and Sewage Disposal Act, the Air Pollution Control Act, the Guam Pesticides Act, and Solid Waste regulations.

Bill 397 (proposed in 2009): The Prohibition of Spearfishing with the use of a Self Contained Underwater Breathing Apparatus (SCUBA). This bill proposes a ban on the use of SCUBA spearfishing in Guam waters or in any vessel Guam waters Chapter 63 of Title 5 Guam Code Annotated (§ 63116.3). It recognizes that despite the establishment of marine preserves, the fishing stocks of certain species are declining in Guam waters. The authors acknowledge that fish stocks within marine preserves thrive with continued sediment and pollution into these areas. Declining populations are due to SCUBA fishing. A ban on SCUBA spearfishing is proposed to allow for repopulation of herbivorous fish species, revitalize dive tourism, enable residents to see a fish that once thrived in Guam waters, and preserve vital marine resources for future generations. It would be unlawful to take any fish with a spear or other device while using SCUBA within Guam waters.

Guam Comprehensive Planning Enabling legislation (1989). These laws govern land-use planning, zoning, and adapting and planning for growth.

Guam Seashore Protection Act of 1974. The Seashore Reserve is the land and water area of Guam extending seaward to the 10 fathom contour line, including all islands within government jurisdiction except Cabras Island and those Villages where residences are constructed on the shoreline prior to the effective date of this act. The Guam Territorial Seashore Reserve is seen as a distinct and valuable resource and must be preserved and protected for the resources of the shoreline. Under this act, this area can be studied and development must be consistent with the objectives of this chapter.

Guam Coastal Zone Management Program (1979)[31]. This program guides the use, protection, and development of land and ocean resources within Guam's coastal zone, which is the entire Territory of Guam. The program was developed under the Federal Coastal Zone Management Act of 1972 and is overseen by the Bureau of Statistics.

Guam's Comprehensive Development Plan and Master Plan. The Bureau of Statistics and Plans is comprised of the Administrative Office of the Director, the Guam Coastal Management Program, the Socio-Economic Planning Program, the Business and Economic Statistics Program, the Planning Information Program and Land Use Planning, and has the authority to oversee this plan. This plan takes into account proposed future military expansion, federal regulations, and environmental impacts while focusing on sustainable and well-planned development efforts.

Guam Compensatory Mitigation Policy (revised in 2010) provides guidance for developing and evaluating aquatic and terrestrial compensatory mitigation proposals. The goal is to have no net loss of habitat function by offsetting losses at the impact site though gains in other locations. This policy will assist Guam in issuing permits or reviewing actions under Section 401 of the Clean Water Act; Guam Coastal Management Program Federal Consistency review; Seashore

[31] http://coastalmanagement.noaa.gov/mystate/guam.html

Protection Act of 1974; Water Pollution Control Act; Fish, Game, Forestry, and Conservation (5 GCA Ch 63); and Wetland Areas.

Guam Comprehensive Wildlife Conservation Strategy (2006). Under Guam's Comprehensive Wildlife Conservation Strategy, hard corals are considered species of concern. Threats identified by the Strategy include pollution, development, sedimentation, and climate change. Some abatement measures given in the plan are to assess the current population structure and size by the in situ surveys by determining the percent cover and species; to protect the habitat by restoring vegetation in watersheds and monitoring water quality; and to reduce take by educating local residents and outreach to recreational users (GDAWR, 2006).

Public Law 24-87. Public Law 24-87 ensures that Guam's marine preserves are protected from recreational/commercial activities that may prove detrimental to the fragile ecosystem. Currently, there are draft rules and regulations from Public Law 24-87 and a management plan.

1.3.4 CNMI

Fish, Game, and Endangered Species Act. The Fish, Game, and Endangered Species Act vests the power and duty to protect fish, game, and endangered and threatened species in the Department of Lands and Natural Resources. Under the act, the Secretary of Lands and Natural Resources "shall, by regulation, determine whether any species should be designated as an endangered species or a threatened species, taking into consideration the status of its habitat or range, its utilization by man for various purposes, diseases or predators, other natural or manmade factors affecting its continued existence, and the need for adequate regulation or management" and shall also designate critical habitats for species so designated as endangered or threatened (2 CMC § 5108(a).). Conservation officers of the Division of Fish and Wildlife have the power of law enforcement officers and can make arrests for violations of the act and regulations promulgated under the authority of the act (2 CMC § 5103(b)). Violations of the act and its regulations carry a range of civil and criminal penalties, including imprisonment (2 CMC § 5109.) Furthermore, any governmental entity or instrumentality that plans to conduct, permit, or license an activity that may adversely affect an endangered or threatened species must first consult with the Secretary of Lands and Natural Resources.

Earthmoving and Erosion Control. A person wishing to engage in an earthmoving activity that may cause erosion of soil must obtain a permit from the Department of Environmental Quality before engaging in such activity (NMIAC §§ 65-30-015, 65-30-105(a)). As relevant to the conservation of coral, all earthmoving activities are strictly prohibited and must cease during the annual coral spawning period and extra measures and precautions must be taken during this period (NMIAC § 65-30-315).

The Commonwealth's Anti-degradation Policy sets forth the water quality standards for the Commonwealth and provides that "[t]he protection, maintenance, conservation, and improvement of the quality of the waters for the growth and propagation of aquatic life, for marine research and for the conservation of coral reefs and wilderness areas, . . . are an historic and legal right of the people of the Northern Mariana Islands." (NMIAC § 65-130-010). There are two classes of marine waters—Class AA and Class A (See NMIAC § 65-130-101). Class AA waters are to remain as close to their natural pristine as possible, and the use of such waters are

limited to “the support and propagation of shellfish and other marine life, conservation of coral reefs and wilderness areas, oceanographic research, and aesthetic enjoyment and compatible recreation with risk of water ingestion by either children or adults.” (NMIAC § 65-130-101(a)(1)–(2)). The water quality standards also require a 21-day suspension of “activities which have the potential to adversely affect coral reproduction” during the primary coral spawning event of the summer, in either May or June, as determined by DEQ (NMIAC § 65-130-530(b)(3)(iii)). This requirement would apply to most dredging activities (id.). DEQ also has regulations regarding solid waste, hazardous waste, used oil, above-ground and underground storage tanks, pesticides, air pollution, underground injection wells and wastewater that serve to protect corals (See NMIAC Title 65).

Commonwealth Ports Authority (CPA) Regulations. It is the general environmental policy of CPA “that the air, land, and water environment of the ports and harbors of the Commonwealth shall be preserved, to the maximum extent possible.”(NMIAC § 15-20.1-155). A person who violates a regulation that is designed to carry this policy shall be subject to civil and criminal penalties (Id). CPA limits the type and amount of explosives that may enter the Commonwealth harbors: “No vessel containing more than 25 short tons of class A, 25 short tons of class B, and an unlimited amount of class C explosives (net explosive content) shall enter or be loaded in Commonwealth harbors except on written permission of the Executive Director.” (NMIAC § 40-20.1-202). CPA also regulates the manner in which explosives should be handled: “All handling and loading or unloading of explosives shall be done in a safe and careful manner and shall be in accordance with federal regulations pertinent thereto in force at the time.”(NMIAC § 40-20.1-204). Additionally, CPA regulates the manner in which explosives should be hauled: “All hauling of explosives away from or to the pier shall be done in a safe and careful manner and shall be in accordance with regulations of the Department of Public Safety.”(NMIAC § 40-20.1-206). CPA prohibits the use of explosives on property that is under its control as well as in the waters in the immediate vicinity of such property, unless permission is obtained from the Executive Director (NMIAC § 40-20.1-224). CPA prohibits the delivery of leaky containers holding gasoline, distillate, kerosene, benzene, naphtha, turpentine, paints, oils or other flammable substances onto any wharf under its control (NMIAC § 40-20.1-212). If any of the listed substances are delivered in what is determined to be a leaky container, the container must be removed immediately.

Division of Fish and Wildlife, Northern Mariana Islands Administrative Codes, Title 85:

§ 85-30.1-201 (2004) states a license is required to take regulated fish species. Unprotected wildlife may be taken year-round without a license. Precious corals (Corallium spp., hermatypic and other hard corals, soft corals and stony hydrozoans) are regulated. Also, any species of fish or marine invertebrate taken by a method or for a purpose is regulated by part 400.

§ 85-30.1-401 (2004) prohibits the use of explosives, poisons, electric shocking devices, SCUBA or hookah and use of certain nets, including drag nets/beach seines (Chenchulun and lagua), trap net (Chenchulun managam), surround nets (Chenchulun umesugon) or gill nets (Tekken). Use of explosives, poisons, electric shocking devices, SCUBA or hookah by Division employee for scientific collection is allowed with a permit.

§ 85-30.1-410 (2004) states collection and/or removal from the water of CNMI of any and all species of hard Hermatypic reef building corals, soft corals, or stony hydrozoans is prohibited, but an exception can be granted and a license issued by the Director for the collection of dead coral from the beach above the lower low water mark for the purpose of manufacturing "afuk" (calcium carbonate).

§ 85-30.1-445 (2004) prohibits the sale or export of marine aquarium fish. A license is required by any person who captures aquarium fish for personal use or enjoyment. No poisons may be used to collect aquarium fish, except for scientific research.

§ 85-30.1-450 (2004) states the Director may acquire and designate aquatic habitats or easements as marine reserves, which are created to protect important fish and aquatic species populations and their habitats. The marine reserves managed by the department are Sasanhaya Fish Reserve and Managaha Conservation Area. It is prohibited to kill or remove, or attempt to kill or remove, any marine animal or plants, including but not limited to any fishes, coral (live or dead), lobster, shellfish, clams, or octopus. It is prohibited to anchor unless for an emergency or for scientific research. Also, it is prohibited to dump or deposit rubbish, waste material or substance that would degrade or alter the quality of the environment.

The Commonwealth Constitution[32]

Article XIV: Natural Resources. The waters off the coast of the CNMI are managed by the local government and have jurisdiction under United States law to be managed, controlled, protected, and preserved by the legislature for the people. The islands of Managaha, Maug, Uracas, Asuncion, and Guguan are maintained as uninhabited places for either cultural or recreational purposes or for the preservation and protection of natural resources.

Submerged Lands Act (Public Law No. 1-23 as amended by Public Law No. 6-13, codified at 2 CMC §§ 1211–1231). The Submerged Lands Act sets forth the management guidelines for Commonwealth submerged lands[33] and includes "[e]nsuring environmental protection" as one of the guidelines. The act further provides that the Department of Lands and Natural Resources shall not grant, lease, or otherwise permit the use of submerged lands if doing so "would adversely affect the protection and preservation of marine resources." (2 CMC § 1212(c)). Furthermore, a person or entity seeking to explore, develop, or extract petroleum or mineral deposits on or from submerged lands or develop submerged lands for other uses must finance the cost of an environmental protection plan and a coastal engineering plan (2 CMC § 1221(f); see also § 1213(a)).

[32] http://www.cnmilaw.org/constitution_article14.htm

[33] The Submerged Lands Act defines "submerged lands" as "all lands below the ordinary high water mark extending seaward to the outer limit of the exclusive economic zone." However, this definition was declared preempted, and the Commonwealth's submerged lands are limited to those under its internal waters. See N. Mariana Islands v. United States, 399 F.3d 1057, 1060 n.2 (9th Cir. 2005); see also In Re: The CNMI's Rights Over its Submerged Lands, CNMI Attorney Gen. Op. 07-01 (Apr. 2007) explaining the extent of the Commonwealth's jurisdiction over submerged lands.

Public Law No. 3-23 Commonwealth Environmental Protection Act. Some of the objectives of this Act affecting the marine environment and coral reefs include:

- Establishing and enforcing environmental standards to protect and preserve the marine resources, in implementation of Section 1 of Article XIV of the Constitution;
- Protecting vigorously the environment of uninhabited islands, thus furthering the purpose of Section 2, Article XIV of the Constitution, which requires that they be maintained as uninhabited places and used for cultural and recreational purposes, and for preservation of bird, fish, wildlife, and plant species;
- Affording special consideration to the environmental quality of places and things of cultural and historical significance to contribute to the protection and preservation thereof, in implementation of Section 3 of Article XIV of the Constitution;
- Maintaining optimal levels of air, land, and water quality in order to protect and preserve the public health and general welfare;
- Assuring that necessary or desirable economic and social development proceeds in an environmentally responsible manner in order to promote the highest attainable quality of life for present and future generations; and
- Preserving, protecting, and improving the aesthetic quality of the land, water, and natural resources in order to promote the beauty of the CNMI for the enjoyment of its residents and visitors.

The provisions of this Act and regulations issued pursuant to this Act shall apply to the air, land, water, wetlands, and submerged lands, including the Exclusive Economic Zone and other areas established by the Marine Sovereignty Act of 1980 (P.L. 2-7).

Public Law No. 3-47 Coastal Resources Management Act 1983. This Act establishes the Coastal Resources Management (CRM) Program and Policy. The CRM Program was established on February 11, 1983, with the implementation of Public Law 3-47 within the Office of the Governor. It was established in order to promote the conservation and wise development of coastal resources. The goals of the Coastal Resources Management Policy are to:

- Encourage land-use master planning, floodplain management, and the development of zoning and building code legislation;
- Promote, through a program of public education and public participation, concepts of resource management, conservation and wise development of coastal resources;
- Promote more efficient resources management through the coordination and development of resource management laws and regulations into a readily identifiable program by revising existing unclear laws and regulations, improving coordination among local agencies, improving coordination between local and federal agencies, and establish of educational and training programs for local government personnel and refinement of supporting technical data;
- Plan for and manage any use or activity with the potential for causing a direct and significant impact on coastal, significant adverse impacts shall be mitigated to the extent practicable;
- Give priority for water-dependent development and consider the need for water-related and water-oriented locations in its siting decisions;

- Provide for adequate consideration of the national interest, including that involved in planning for, and in the siting of, facilities(including energy facilities in, or which significantly affect, the coastal zone) which are necessary to meet requirements which are other than local in nature;
- Not to permit to the extent practicable, development of identifiable hazardous lands, including floodplains, erosion-prone areas, storm wave inundation areas, air installation crash and sound zones and major fault lines, unless it can be demonstrated that such development does not pose unreasonable risks to the health, safety or welfare of the people, and complies with applicable laws;
- Mitigate, to the extent practicable adverse environmental impacts, including those aquifers, beaches, estuaries and other coastal resources while developing an efficient and safe transportation system;
- Require any development to strictly comply with erosion, sedimentation, and related land and water use districting guidelines, as well as other related land and water use policies for such areas;
- Maintain or improve coastal water quality through control of erosion, sedimentation, runoff, siltation, sewage and other discharges;
- Recognize and respect locations and properties of historical significance, and ensure that development which would disrupt, alter, or destroy these, is subject to local laws and regulations;
- Recognize areas of cultural significance, the development which would disrupt the cultural practices associated with such areas, which shall be subject to a consultation process with concerned ethnic groups and any applicable laws and regulations;
- Require compliance with all local air and water quality laws and regulations and any applicable federal air and water quality standards;
- Not permit, to the extent practicable, development with the potential for causing significant adverse impact in fragile areas such as designated and potential historic and archaeological sites, critical wildlife habitats, beaches, designated and potential pristine marine and terrestrial communities, limestone and volcanic forests, designated and potential mangrove stands and other wetlands;
- Manage ecologically significant resource areas for their contribution to marine productivity and value as wildlife habitats, and preserve the functions and integrity of reefs, marine meadows, salt ponds, mangroves and other significant natural areas;
- Manage the development of the local subsistence, sport and commercial fisheries, consistent with other policies;
- Protect all coastal resources, particularly sand, coral and fish from taking beyond sustainable levels and in the case of marine mammals and any species on the CNMI Endangered Species List, from any taking whatsoever;
- Encourage preservation and enhancement of and respect for scenic resources through the development of, increased enforcement of, and compliance with, sign, litter, zoning, building codes, and related land use laws;
- Discourage, to the maximum extent practicable, visually objectionable uses so as not to significantly degrade scenic views;
- Encourage the development of recreation facilities which are compatible with the surrounding environment and land uses;

- Encourage the preservation of traditional rights of public access to and along the shorelines consistent with the rights of private property owners;
- Pursue agreements for the acquisition of use of any lands necessary to guarantee traditional public access to and along the shorelines; and
- Encourage agricultural development and the preservation and maintenance of critical agricultural lands for agricultural uses.

Coastal Resources Management ("CRM") Regulations define Areas of Particular Concern:

> *An "area of particular concern (APC)" is a delineated area that is subject to special management standards (NMIAC §§ 15-10-020(f)(1), 15-10-310).*

Before issuing a permit for a project in an APC, CRM must consider APC-specific criteria and use priorities (See NMIAC § 15-10-310). As relevant here, the Lagoon and Reef APC includes all "partially enclosed bod[ies] of water formed by sand spits, baymouth bars, barrier beaches or coral reefs, of the Northern Mariana Islands chain" (NMIAC § 15-10-020(hh)). The management standards for the Lagoon and Reef APC provide that "[s]ignificant adverse impacts to reefs and corals shall be prevented" (NMIAC § 15-10-310(a)(3)). The highest use priorities for coral reefs are uses that maintain the highest levels of primary productivity and uses that create underwater preserves in pristine areas, while the lowest use priorities are uses involving the taking of coral for cultural uses (NMIAC § 15-10-310(b)(4)(i), (iii)). Additionally, unacceptable uses include the "[d]estruction of reefs and corals not associated with permitted projects" and "[t]aking of corals for [reasons] other than [for] scientific study."(NMIAC § 15-10-310(b)(4)(iv)).

Public Law No. 11-112 H. B. No. 11-492 Cyanide Fishing Act of 1999. The Cyanide Fishing Act prohibits use of cyanide in water of CNMI and defines Cyanide Fishing as: "… a method in which fishermen harvest marine life by spraying such poisonous material into the coral reefs to stunt fishes and crustaceans, extract them by breaking apart the coral rocks, and finally, selling them in aquarium and live food markets around world. Although cyanide does not kill the marine life harvested, it kills and destroys the other life forms that inhabit and make up the coral reef." This Act designates the Division of Fish and Wildlife to promulgate rules and regulations to enforce its intent.

Public Law No. 12-87 (2001). It is unlawful for any commercial or non-commercial fisherman to use explosives, poison, or electric shocking devices when fishing for reef fish and harvesting other marine life within the waters of the CNMI. It is also unlawful to for any commercial or non-commercial fisherman to fish with SCUBA or hookah within the lagoon or reef or outside the lagoon or reef on the coastal waters of Saipan from Puntan Agingan to Puntan Sabaneta. Fishing with SCUBA or hookah by commercial or non-commercial fisherman in the First and Second Senatorial Districts is defined as a subject of local law as permitted by Article II, Section 6 of NMI Constitution, may enact laws prohibiting fishing with SCUBA or hookah within the lagoon or reef or outside the lagoon or reef on the coastal waters of their respective districts.

Public Law No. 12-66 (Phosphate Detergent Ban). The Legislature finds that detergent products containing phosphates are causing nutrient overloading, leading to potential eutrophication of the coastal waters of the CNMI, which in turn leads to destruction of the coral reefs and the habitat they provide for many marine organisms. Public Law 12-66 is an act prohibiting the sale, manufacturing, distribution or use of certain cleaning agents containing phosphates; conferring

powers and duties on the Division of Environmental Quality; and providing penalties; and for other purposes.

Public Law No. 15-90 An Act To Create A Marine Reserve Area On Tinian From Southwest Carolinas Point And to Puntan Diablo, And For Other Purposes. This Act created a marine reserve area, located from the Southwest Carolinas Point to Puntan Diablo Point, specifically encompassing all the areas from Tachogna Beach, Taga Beach, YCC Beach, Kammer Beach, Tinian Harbor, Breakwater area to Leprosarium Beach (aka Nasarinu) and Barcinas Bay, from the high-tide mark on shore to one-half mile out to the reef. The Department of Lands and Natural Resources, in consultation with the Tinian Resident Director of the Department of Lands and Natural Resources, were the designated authorities to delineate the boundaries of said areas by installing buoys to ensure that the boundaries are visible to the general public. Regulations of the Reserve Area are as follows:

- The removal, disturbance, damage, or destruction of any marine life or habitat, including any fish, coral, lobster, shellfish, clams, octopus or any shellfish, shall be prohibited within the Marine Reserve Area, except that seasonal fish may be removed only during their respective seasons.

- Any other activities which are exploitative or destructive to the marine life or to any historical value of this Area are strictly prohibited, except that aquaculture and marine studies conducted in the area shall not be considered a violation of this Act.

Public Law No. 17-13 (2010). It is unlawful for any commercial and non-commercial fishermen to use explosives, poisons, electric shocking devices, scuba tank or hookah when fishing for reef fish and harvesting other marine life within water of the CNMI. The use of throw nets (talaya) or the use of the following types of nets must have mesh sizes no smaller than two inches, drag nets (chenchulun lagua), surround nets (chenchulun umesugon) or trap nets (chenchulun managam), shall be legal in waters surrounding the First Senatorial District when used for non-commercial purposes only.

Executive Orders

Executive Directive 235[34]. This directive established CNMI's Coral Reef Initiative Program under the Office of the Governor, with an interagency structure to coordinate coral reef issues. The Coral Reef Initiate Program includes the following agencies: the Coastal Resources Management Office, the Division of Fish and Wildlife and the Division of Environmental Quality. The interagency group is tasked with protecting coral reefs and implementation of Local Action Strategies projects.

Local Laws[35]

Saipan Local Law No. 13-13 (2002). It is unlawful for any commercial or non-commercial fishermen to use SCUBA and other related devices when fishing for reef fish, other types of fish,

[34] http://www.deq.gov.mp/section.aspx?secID=9
[35] http://www.cnmilaw.org/publicandlocallaws.htm

or harvesting other marine life within the lagoon and coastal waters of the island of Saipan and the Northern Islands. Enforcement is the responsibility of the Secretary of the Department of Lands and Natural Resources in consultation with the Director of Fish and Wildlife.

Tinian Local Law No. 13-1 (2002). It is unlawful for any commercial or non-commercial fisherman to use scuba tanks and other related device when fishing for reef fish and harvesting other marine life within the lagoon and coastal waters of the municipality of Tinian and Aguiguan.

2. MPA Regulations

2.1 Federal

One of the most common mechanisms implemented to help regulate activities on and around coral reefs is the establishment of marine protected areas (MPAs). Depending on the specifics of zoning plans and regulations, MPAs can help prevent damage from collection, fishing gear, groundings and anchoring. Because all corals are susceptible to such impacts, MPAs can afford some immediate protection from this type of damage. This section provides descriptions of U.S. Federal MPAs that protect corals and coral reefs in the Caribbean and Indo-Pacific Regions. Some of these MPAs were implemented through regulatory mechanisms discussed above.

Three National Parks have been designated in the south Florida marine environments. Two of these, Dry Tortugas National Park (1992) and Biscayne National Parks (1980) include significant coral reefs. In addition, Everglades National Park (1947) includes much of Florida Bay, an important subtropical lagoon with vital ecological connections with the Florida Reef Tract (*Acropora* Biological Review Team 2005).

The National Marine Sanctuary Program (NOAA) has managed segments of the Florida Reef Tract since 1975. *The Key Largo National Marine Sanctuary* (1975) was established to protect 353 km^2 (103 nmi^2) of coral reef habitat offshore of the upper Florida Keys adjacent to John Pennekamp Coral Reef State Park. In 1981, the 18-km^2 (5.3-nm^2) *Looe Key National Marine Sanctuary* was established to protect the heavily used Looe Key Reef in the lower Florida Keys. By the late 1980s it had become evident that a broader, more holistic approach to protecting and conserving the health of coral reef resources in the Florida Keys had to be implemented. Irrespective of the intense management of small areas of the Florida reef tract, sanctuary managers were witnessing declines in water quality and the health of corals that apparently had a wide range of sources. In November 1990, President G.H.W. Bush signed into law the Florida Keys National Marine Sanctuary and Protection Act (FKNMS Act). The FKNMS Act designated 9,515 km^2 (2,774 nm^2) of coastal waters surrounding the Florida Keys as the *Florida Keys National Marine Sanctuary* and addressed two major concerns. First, there was an immediate prohibition on oil drilling, including mineral and hydrocarbon leasing, exploration, development, or production within the Sanctuary. In addition, the legislation prohibited the operation of vessels longer than 50 m (164 ft) in an internationally recognized "Area to Be Avoided" within and near the boundary of the Sanctuary. Activities prohibited in the FKNMS include:

- Mineral and hydrocarbon exploration, development and production;

- Removal of, or injury to, or possession of coral or live rock;
- Alteration or, or construction on the seabed, except as an incidental result of anchoring, traditional fishing activities not prohibited, installation and maintenance of navigational aids, harbor maintenance, and construction, repair, replacement, or rehabilitation of docks, seawalls, breakwaters, piers, or marinas with less than ten slips that receive valid leases or permits;
- Discharging or depositing of materials or other matter;
- Operating a vessel in such a manner as to strike or otherwise injure coral, seagrass, or any other immobile organism attached to the seabed;
- Diving or snorkeling without a flag;
- The release of exotic species;
- Damaging or removing markers;
- Movement of, removal of, or injury to, or possession of Sanctuary historical resources;
- Taking or possessing protected wildlife;
- Possession or use of explosives of electrical charges;
- Harvesting or possessing any marine life species, or part thereof, except in accordance with pertinent regulations of the Florida Administrative Code (46-42.001 through 46-42.003, 46-42.0035, 46-42.004 through 46-42.007, and 46-42.009), and
- Interference with law enforcement

Additionally, the sea around the Florida Keys is one of seven Particularly Sensitive Sea Areas (PSSA) that has been designated by the International Maritime Organization. A major benefit of this designation, which became official in December 2002, is that it provides international recognition of the ATBAs and no-anchoring zones on the Tortugas Bank.
The FKNMS Waterway Management Program includes a comprehensive and effective waterway marking and management system for boaters within the sanctuary. In addition to markers, this program incorporates several surveys and databases that aid in waterway management. The databases include several studies of propeller scar data, the location of existing markers (permitted and unpermitted), the location and function of marine facilities, depth of entrance and exit channels from subdivisions throughout the Keys, and a vessel grounding database (*Acropora* Biological Review Team 2005).

Corals in general are afforded a number of mechanisms of protection under the various Action Plans that comprise the FKNMS Management Plan. One management mechanism of great importance is the comprehensive zoning action plan of the FKNMS.

Buck Island Reef National Monuent (BIRNM) was expanded to approximately 18,000 acres through Presidential Proclamation under the Antiquities Act on 17 January 2001. The proclamation and draft interim regulations prohibit anchoring, except in an area of deep sand off the west end of the island, and the harvest of any marine life. The expanded BIRNM protects approximately 7% of the St. Croix insular shelf above 100 fathoms (600 ft) in depth (*Acropora* Biological Review Team 2005).

Virgin Islands National Park (VINP) was established on St. John, U.S. Virgin Islands in 1956 (16 USC Sec. 398). Marine portions surrounding St. John were added in 1962 (76 Stat. 746) and include 5,650 acres of water. Interpretation of recent aerial photographs (1999) shows the VINP marine environment consist of 28% unknown (areas deeper than 20 m), 34% coral reef and colonized hard-bottom, 20% submerged aquatic vegetation, and 17% sand (NOAA 2001). Numerous reefs occur in the park with regulations prohibiting the taking or harming of any corals. Moorings are provided for vessels to prevent damage to coral reef and hard-bottom habitats (*Acropora* Biological Review Team 2005).

Virgin Islands Coral Reef National Monument was created by Presidential Proclamation under the Antiquities Act on 17 January 2001. It includes approximately 12,708 acres of submerged lands. The proclamation and draft interim regulations prohibit anchoring, except under emergency situations, and the harvest of any marine life with the exception of Blue Runner (a migratory coastal pelagic fish) off the southern coast of St. John and baitfish in Hurricane Hole. Virgin Islands Coral Reef National Monument effectively protects approximately 3% of the St. Thomas/St. John insular shelf above 100 fathoms (600 ft) in depth (*Acropora* Biological Review Team 2005).

Navassa Island[36].

Navassa Island is an uninhabited, unincorporated, and unorganized insular territory of the U.S. It is a National Wildlife Refuge that was legally established in 1999, the main purpose of which is to protect and preserve coral reefs. The area is closed to the public; however there is no active protection, management or enforcement of the refuge. Due to the remoteness of the refuge, the reefs are still generally healthy and not subject to the pressures of the aquarium trade or threats of invasive species. The biggest threats to the reefs of Navassa Island include subsistence fishing by transient Haitian fishers. There are some signs of change in the composition of fisheries due to serial fishing (fishing down the food chain), increase in aggressive fishing techniques, and a complete lack of fishing management. Additionally, the extent of commercial fishing in Navassa waters is unknown.

Flower Garden Banks National Marine Sanctuary[37].

The Flower Garden Banks is the only designated National Marine Sanctuary in the Gulf of Mexico and is located approximately 70-115 miles off the coasts of Texas and Louisiana. Fishermen discovered the Banks in the late 1800's and subsequently named them after the brightly colored sponges, plants, and other marine life they sometimes snagged and brought to the surface. In the late 1960's, Robert Alderdice and James Covington established the Flower Gardens Ocean Research Center, which brought about a period of intense multi-agency, interdisciplinary research, which continues today. Results of this on-going research prompted government agencies to begin discussing the need to protect the banks from increasing human activities, including oil and gas extraction, anchoring on the reefs and harvesting fish, corals and other invertebrates. With passage of the Marine Research and Sanctuaries Act in 1972, researchers began discussing the Flower Garden Banks as a candidate for designation as a National Marine Sanctuary.

Continued interest in the biological diversity and beauty of the reefs at East and West Flower Garden Banks led to their designation as a sanctuary under the National Marine Sanctuary Act

[36] http://www.fws.gov/caribbean/refuges/PDF/navassa.pdf
[37] http://flowergarden.noaa.gov/about/about.html

(NMSA) in 1992. The coral-sponge communities of Stetson Bank were added to the sanctuary in 1996.

The sanctuary actually protects three separate areas: East Flower Garden Bank, West Flower Garden Bank, and Stetson Bank. These banks are separated from each other by miles of open ocean ranging from 200 to 400 feet (61-122 meters) deep, and each bank has its own set of boundaries.
Activities that are prohibited in the Sanctuary include:

- Anchoring any vessel within the sanctuary
- Mooring a vessel over 100 feet in registered length on a sanctuary mooring buoy
- Injuring or removing, or attempting to injure or remove, any coral or other bottom formation, coralline algae or other plant, marine invertebrate (e.g., spiny lobster, queen conch, shell, sea urchin), brine-http://flowergarden.noaa.gov/image_library/reef/coralcutout.jpgseep biota or carbonate rock within the sanctuary.
- Possessing within the sanctuary (regardless of where collected, caught, harvested or removed), any carbonate rock, coral or other bottom formation, coralline algae or other plant, or fish (except for fish caught by use of conventional hook and line gear).
- Drilling into, dredging or otherwise altering the seabed of the sanctuary; or constructing, placing or abandoning any structure, material or other matter on the seabed of the sanctuary.

Enforcement at Flower Garden Banks National Marine Sanctuary is difficult, at best, given the sanctuary's remote location. The sanctuary lacks resources to maintain a physical presence on-site, and instead, relies on fisherman and dive operators as well as patrolling efforts by the U.S. Coastguard.

The Hawaiian Islands National Wildlife Refuge [38] is part of the Pacific Remote Islands National Wildlife Refuge Complex. Established in 1909 by Theodore Roosevelt's Executive Order 1019, the refuge covers the northwestern Hawaiian Islands, with the exception of Midway and Kure Atolls. The Refuge consists of a chain of islands, reefs, and atolls, including Nihoa, Necker, French Frigate Shoals, Gardner Pinnacles, Maro Reef, Laysan Island, Lisianski Island, and Pearl and Hermes Reef. These remote islands extend about 800 miles northwest of the main Hawaiian Islands. The many small islands provide bare rocky, lowland shrub and grass, sand, and wetland habitat for over 30 species and 14 million breeding sea birds, wintering shorebirds, and endangered endemic songbirds and waterfowl. These islands and reefs also provide breeding and foraging habitat for the endangered Hawaiian monk seal and the threatened Hawaiian green turtle. The over 1,805,403 acres of submerged coral reefs are home to over 7,000 species of coral, algae, mollusks, fish, crustaceans, and other marine vertebrates and invertebrates. Visitation to the refuge is by special use permit only.

[38] http://www.fws.gov/hawaiianislands/

Midway Atoll National Wildlife Refuge[39] includes nearly 300,000 acres of lagoon and surrounding nearshore waters. Over 250 species of fish and a huge diversity of marine invertebrates inhabit the lagoon and surrounding waters. It is now part of the Papahanaumokuakea Marine National Monument, described below.

Papahānaumokuākea Marine National Monument[40] was established on June 15, 2006, by President George W. Bush. The Papahānaumokuākea Marine National Monument is the single largest conservation area under U.S. jurisdiction, spanning 139,797 square miles. The extensive coral reefs found in the Monument are home to over 7,000 marine species including rare species such as the threatened green sea turtle and the endangered Hawaiian monk seal.

About 132,000 square miles (340,000 km^2) of the monument were already part of the Northwestern Hawaiian Islands Coral Reef Ecosystem Reserve, which was designated in 2000. The monument also includes the Midway Atoll National Wildlife Refuge (590,991.50 acres (2,391.7 km^2) and Battle of Midway National Memorial, the Hawaii State Seabird Sanctuary at Kure Atoll, the Northwestern Hawaiian Islands State Marine Refuge, and the Hawaiian Islands National Wildlife Refuge. The mission of the Monument is to implement seamless integrated management to ensure ecological integrity and achieve strong, long-term protection and perpetuation of NWHI ecosystems, Native Hawaiian culture, and heritage resources for current and future generations. Management of the Monument is the responsibility of three Co-Trustees: the State of Hawaii via the Department of Land and Natural Resources (DLNR); the U.S. Department of the Interior (DOI), through the FWS; and the U.S. Department of Commerce (DOC), through NOAA. The Co-Trustees are committed to preserving the ecological integrity of the Monument and perpetuation of the NWHI ecosystems, Native Hawaiian culture, and historic resources. NOAA and FWS promulgated final regulations for the Monument under Title 50 Code of Federal Regulations (CFR) Part 404 on August 29, 2006. These regulations codify the scope and purpose, boundary, definitions, prohibitions, and regulated activities for managing the Monument.

Monument regulations include:

- Prohibit unauthorized access to the Monument;
- Provide for carefully regulated educational and scientific activities;
- Preserve access for Native Hawaiian cultural activities;
- Establish marine zones to manage human activities;
- Provide for visitation in a special area around Midway Atoll;
- Phase out commercial fishing over a 5-year period;
- Ban exploring for, developing, or producing oil, gas, or minerals and using or attempting to use poisons, electrical charges, or explosives in the collection or harvest of Monument resources;
- Prohibit introducing alien species from within or into the Monument; and
- Prohibit anchoring on corals.

[39] http://www.fws.gov/midway/
[40] http://www.papahanaumokuakea.gov/

Monument regulations also define three types of marine zones to manage activities. The zones are: Special Preservation Areas, Ecological Reserves, and the Midway Atoll Special Management Area. Each zone addresses protection of habitat and foraging areas of threatened and endangered species; inclusion of a representative range of the diverse array of marine habitats, including shallow coral reef environments, as well as deepwater slopes, banks, and seamounts; and minimization of risks associated with specific activities such as fishing and recreational activities. Zones also protect the ecological linkages between habitats. While the remote location of the NWHI has helped to protect them, it also provides a potential source of cover for those interested in exploiting the area illegally. Illegal access to the monument, discharge, dumping, and poaching are particular causes of concern. While the establishment of the monument provides an additional layer of protection to the area, protections remain difficult to enforce. Historically, enforcement has relied on occasional USCG over-flights and vessel patrols, as well as reports passed along by fishermen, researchers, and agency personnel working in the area. Now the monument co-trustees plan to use remote surveillance (satellites, radar, vessel monitoring systems) to inform on-the-water law enforcement officers of potential violations as well.

Hawaii Humpback Whale National Marine Sanctuary[41]
Established by Congress in 1992, the Hawaiian Islands Humpback Whale National Marine Sanctuary is the nation's 12th established marine sanctuary. It protects the winter breeding, calving and nursing range of the largest Pacific population of the endangered humpback whale (*Megaptera novaeangliae*). The boundary of the sanctuary encompasses approximately 1,218 square nautical miles of coastal and ocean waters (including coral reefs) around the main Hawaiian Islands. The sanctuary extends seaward from the shoreline to the 100-fathom isobath. It includes areas around the islands of Maui, Lanai, and Molokai, and parts of Oahu, Kauai and Hawaii. The sanctuary is jointly managed via a cooperative federal-state partnership between NOAA and the State of Hawaii. Regulations within this sanctuary are mainly focused on protecting Hawaiian humpback whales; however, one provision prohibits discharging or depositing any material or other matter in the Sanctuary; altering the seabed of the Sanctuary, or discharging or depositing any material or other matter outside the Sanctuary if the discharge or deposit subsequently enters.

Hawaii National Parks
There are 4 national parks in Hawaii that contain coral reef environments, and include at least 1 of the 82 candidate species of coral:

- Kaloko-Honokōhau National Historic Park, Hawai'i
- Puukoholā Heiau National Historic Site, Hawai'i
- Puuhonua o Hōnaunau National Historic Park, Hawai'i
- Kalaupapa National Historic Park, Moloka'i

These parks are accessible by the public in exchange for an entrance fee. The purpose of these parks is to preserve and perpetuate Hawaiian cultural heritage. Recreational activities, as well as fishing, are permitted unless the activities contradict the purpose of the parks.

[41] http://hawaiihumpbackwhale.noaa.gov/welcome.html

Fagatele Bay National Marine Sanctuary[42] in American Samoa was designated in 1986 in response to a proposal from the American Samoa Government. The Fagatele Bay National Marine Sanctuary (FBNMS) is located in an eroded volcanic crater on the island of Tutuila. and encompasses the 0.25 square miles of the bay. Prohibited or otherwise regulated activities within the FBNMS can be found in Sec. 922.102 of 15 CFR Part 222, Subpart J--Fagatele Bay National Marine Sanctuary, and includes the following provisions:

"Except as may be necessary for national defense or to respond to an emergency threatening life, property, or the environment, or as may be permitted by the Director in accordance with Sec. 922.48 and Sec. 922.104, the following activities are prohibited and thus are unlawful for any person to conduct or to cause to be conducted within the Sanctuary:

- Gathering, taking, breaking, cutting, damaging, destroying, or possessing any invertebrate, coral, bottom formation, or marine plant.
- Taking, gathering, cutting, damaging, destroying, or possessing any crown-of-thorns starfish (Acanthaster planci).
- Possessing or using poisons, electrical charges, explosives, or similar environmentally destructive methods.
- Possessing or using spearguns, including such devices known as Hawaiian slings, pole spears, arbalettes, pneumatic and spring-loaded spearguns, bows and arrows, bang sticks, or any similar taking device.
- Possessing or using a seine, trammel net, or any type of fixed net.
- There shall be a rebuttable presumption that any items listed above found in the possession of a person within the Sanctuary have been used, collected, or removed within or from the Sanctuary.
- Operating a vessel in a manner which causes the vessel to strike or otherwise cause damage to the natural features of the Sanctuary.
- Littering, depositing, or discharging, into the waters of the Sanctuary, any material or other matter.
- Disturbing the benthic community by dredging, filling, dynamiting, bottom trawling, or otherwise altering the seabed.
- Removing, damaging, or tampering with any historical or cultural resource within the boundary of the Sanctuary.
- Ensnaring, entrapping, or fishing for any sea turtle listed as a threatened or endangered species under the Endangered Species Act of 1973, as amended, 16 U.S.C. 1531 et seq.
- Except for law enforcement purposes, using or discharging explosives or weapons of any description. Distress signaling devices, necessary and proper for safe vessel operation, and knives generally used by fishermen and swimmers shall not be considered weapons for purposes of this section.
- Marking, defacing, or damaging in any way, or displacing or removing or tampering with any signs, notices, or placards, whether temporary or permanent, or with any monuments, stakes, posts, or other boundary markers related to the Sanctuary.
- In addition to those activities prohibited or otherwise regulated under paragraph (a) of this section, the following activities are prohibited and thus are unlawful for any person to

42 http://fagatelebay.noaa.gov/

conduct or to cause to be conducted landward of the straight line connecting Fagatele Point (14 deg.22'15" S, 170 deg.46'5" W) and Matautuloa Benchmark (14 deg.22'18" S, 170 deg.45'35" W).

- Possessing or using fishing poles, handlines, or trawls.
- Fishing commercially."

The National Park of American Samoa[43] was established by Congress "to preserve and protect the tropical forest and archeological and cultural resources of American Samoa, and of associated reefs, to maintain the habitat of flying foxes, preserve the ecological balance of the Samoan tropical forest, and, consistent with the preservation of these resources, to provide for the enjoyment of the unique resources of the Samoan tropical forest by visitors from around the world" (**16 USC 410qq).** The National Park of American Samoa has jurisdiction over 2,550 acres of coral reefs along 17 miles of coastline within park units on Tutuila, Ofu, and Ta'u Islands in American Samoa. **The park is part of the Pacific West Region of the National Park Service and allows fis**hing or gathering for subsistence purposes only in the marine areas of the park. Traditional agriculture is also permitted.

Rose Atoll is located approximately 130 nautical miles east-southeast of Pago Pago Harbor, American Samoa, is the easternmost Samoan island, and the only atoll in the Samoan Archipelago. It is part of the Territory of American Samoa and is both a National Wildlife Refuge and part of a Marine National Monument. The National Wildlife Refuge was established by cooperative agreement between the Government of American Samoa and the Bureau of Sport Fisheries and Wildlife (a predecessor of the U.S. Fish & Wildlife Service) on August 24, 1973. Rose Atoll National Wildlife Refuge[44] managed by the U.S. Fish and Wildlife Service and is the southernmost unit of the National Wildlife Refuge System sharing the distinction of being the only National Wildlife Refuges located south of the equator with Jarvis Island. The Wildlife Refuge includes Rose Atoll itself which is about 1 mile in length and consists of two low sandy islets, Rose and Sand Islands, each covering areas of about 14 and 7 acres, respectively. A coralline algal reef rim encloses the lagoon within Rose Atoll. A single, natural pass with a minimum depth of 8 to 48 feet deep links the lagoon to the sea. The lagoon is a maximum of 1.2 miles wide and up to about 65 feet deep, and includes 1,575 acres.

On January 6, 2009, President George W. Bush established Rose Atoll Marine National Monument[45] under the authority of the Antiquities Act of 1906 by Presidential Proclamation 8337 (74 FR 1577, 12 January 2009). The Marine National Monument surrounds Rose Atoll National Wildlife Refuge extending from the mean low water line of Rose Atoll out 50 nautical miles. The Fish & Wildlife Service has management responsibility for the Monument, including Rose Atoll National Wildlife Refuge, in consultation with the Secretary of Commerce, except that NOAA has primary management authority over fishery related activities seaward of the mean low water mark. The total area of the Marine National Monument is approximately 13,451 square miles. Within the Marine National Monument, all commercial fishing is prohibited. The Secretaries may permit non-commercial and sustenance fishing, and after consultation with the

43 http://www.nps.gov/npsa/naturescience/coral-reef-studies-and-products.htm

44 http://www.fws.gov/roseatoll/

45 http://www.fws.gov/roseatollmarinemonument/

American Samoa government, traditional indigenous fishing as sustainable activities. The Western Pacific Fishery Management Council also has taken action to recommend the establishment of no-take zones from 0-12 nautical miles around Rose Atoll. Consistent with the Proclamation, NOAA has initiated the process to add the marine areas of the monument to the Fagatele Bay National Marine Sanctuary in accordance with the National Marine Sanctuaries Act.

Guam National Wildlife Refuge[46] was established in 1993, to protect and recover endangered and threatened species, protect habitat, control non-native species, protect cultural resources, and provide recreational and educational opportunities to the public. The refuge is composed of 1,203 acres (371 acres of coral reefs and 832 acres of terrestrial habitat) owned by the U.S. Fish and Wildlife Service, and 22,456 acres (mostly forest) of refuge overlay owned by the Department of Defense in Air Force and Navy installations. According to the Guam National Wildlife Refuge Comprehensive Conservation Plan (2009), recreational fishing, including using gears such as rod-and-reel, throw net, hand spears and Hawaiian slings are allowed within the boundaries.

The War in the Pacific National Historical Park[47], authorized on August 18, 1978, was established to commemorate those participating in the campaigns of the Pacific Theater of World War II, and to conserve and interpret outstanding natural, scenic, and historic values and objects on the Island of Guam. The park itself has seven separate units located in or near the villages of Asan, Piti, and Agat, on the west side of the island facing the Philippine Sea. The park contains over 3,500 marine species and 200 species of coral. Scientific activities within the park include inventories of flora and fauna and long-term monitoring of the coral reefs. It is unlawful to disturb or remove artifacts from public lands; therefore, underwater natural objects (such as corals) are protected within the park.

Marianas Trench Marine National Monument. On January 6, 2009, President George W. Bush established the Marianas Trench Marine National Monument under the authority of the Antiquities Act of 1906 by Presidental Proclamation 8335 (74 FR 1557, 12 January 2009). The Marianas Trench Marine National Monument (Northern Mariana Islands and Guam)[48] is approximately 940 nautical miles long and 38 nautical miles wide within the United States Exclusive Economic Zone and incorporates waters below the mean low water line of three islands of the Mariana Archipelago, Farallon de Pajaros or Uracas, Maug, and Asuncion. The waters of the archipelago's northern islands are biologically diverse surrounded by coral reef ecosystems and the deep waters are inhabited by seamount and hydrothermal communities. The monument consists of two units the Mariana Trench and the Volcanic Unit. The Mariana Trench Unit is almost 1,100 miles long and 44 miles wide and includes only the submerged lands. The Volcanic Unit consists of small circles (2.3 miles in diameter) around 21 undersea mud volcanoes and thermal vents along the Mariana Arc, again only the submerged lands. Fisheries related activities are managed by the National Oceanic and Atmospheric Administration, in consultation with the Fish & Wildlife Service. Commercial fishing is prohibited within the

46 http://www.fws.gov/refuges/profiles/index.cfm?id=12518

47 http://www.nps.gov/wapa/index.htm

48 http://www.fws.gov/marianastrenchmarinemonument/

waters around the islands, but subsistence, recreational, and traditional fishing are allowed under sustainable management via Executive Order 12962 for recreational fisheries. Other agencies involved with management activities within the monument are the Secretary of Defense, the U.S. Coast Guard, and the Government of the Commonwealth of the Northern Mariana Islands. The U.S. Fish and Wildlife Service also has management responsibilities with the Mariana Trench and Volcanic Units as they are within the Mariana Trench and Mariana Arc of Fire National Wildlife Refuges.

Pacific Remote Island Area. The U.S. Pacific Remote Island Area (PRIA) includes seven islands, atolls and reefs in the Central Pacific that are under the jurisdiction of the United States. Baker, Howland, and Jarvis Islands; Johnston and Palmyra Atolls; and Kingman Reef all lie between Hawaii and American Samoa. Wake Island is located between the Northwestern Hawaiian Islands and Guam. Terrestrial activities on each of the islands are managed by different agencies. All islands expect Wake Island and Johnston Atoll are managed by the U.S. Fish and Wildlife Service. Johnston Atoll is managed by the Department of Defense (DOD). Also, both Johnston and Palmyra are owned by the Nature Conservancy. Wake Island is an unincorporated territory of the U.S. that is administered by the DOI and the U.S. Air Force (part of the DOD). Inland waters surrounding the islands are administered by the U.S. Fish and Wildlife Service as the Pacific Remote Islands National Wildlife Refuge Complex[49].

The Pacific Remote Islands National Marine Monument[50] was established by President George W. Bush on January 6, 2009 under the authority of the Antiquities Act of 1906 by Presidential Proclamation 8336 (74 fr 1565; 12 January 2009). The Monument includes the waters and submerged and emergent lands of the Pacific Remote Islands from the mean low water lines of Wake, Baker, Howland, and Jarvis Islands, Johnston Atoll, Kingman Reef, and Palmyra Atoll seaward to approximately 50 nautical miles. The National Oceanic and Atmospheric Administration has primary management authority over fishery-related activities. Resource destruction or extraction, waste dumping, and commercial fishing are prohibited in the PRIA. Scientific research, innocent passage, and recreational fishing on a sustainable basis are allowed.

WPFMC-developed no-take MPAs within the PRIA include Baker, Howland, and Jarvis Islands, and Kingman Reef from 0 to 50 fathoms (fm); and low-use MPAs are Johnston and Palmyra Atolls, and Wake Island from 0 to 50 fm. 50 C.F.R. § 665.599. Fishers may not fish within a low-use MPA without a special permit. 50 C.F.R. § 665.625. Poisons, explosives, or intoxicating substances may not be used to harvest this species. 50 C.F.R. § 665.605. At Wake, Howland, Baker, and Jarvis Islands, and at Johnston and Palmyra Atolls, there is no SCUBA spearfishing from 6pm to 6am in the EEZ (WPRFMC, 2005; NOAA, 2009). Within Palmyra Atoll National Wildlife Refuge, the Secretary shall ensure that recreational fishing is managed sustainably in accordance with the purposes of the monument (Executive Order 12962)[51].

49 http://www.fws.gov/pacificislandsrefuges/

50 http://www.fws.gov/pacificremoteislandsmarinemonument/

51 http://www.fws.gov/pacificremoteislandsmarinemonument/PP%20PRIMNM.pdf

2.2 Non-Federal Caribbean

2.2.1 Florida

Florida has over 400 MPAs, which is more than any other state[52]. John Pennekamp Coral Reef State Park in Monroe County encompasses 178 nautical square miles of coral reefs, seagrass beds, and mangrove swamps and is contained within the FKNMS. Florida Statute §258.083 states it is unlawful for any person, firm, or corporation to (1) bring into or transport through any part of the state, including its waters, any coral or other material taken from the subsoil or seabed of any portion of the John Pennekamp Coral Reef State Park adjacent to or in the vicinity of the state which has been taken in violation of any law or regulation of the Federal Government, or (2) destroy, damage, remove, deface, or take away any coral, rock or other formation or any part thereof, of any portion of the John Pennekamp Coral Reef State Park adjacent to or in the vicinity of the state in which such action is in violation of any law or regulation of the Federal Government. The Park's management plan requires protection of the park's marine resources from among other things, all dredging, filling, and other construction activity by outside sources, and requires installation and maintenance of channel markers and mooring buoys to reduce anchor and boating impacts (*Acropora* Biological Review Team 2005).

2.2.2 Puerto Rico

The Island Government (DNER) and the Caribbean Fisheries Management Council share responsibility for managing 24 MPAs, with most sites having some year-round protection (Wilkinson, 2004). Law 137 (2000) directs the DNER to designate priority areas as marine reserves, including a minimum of 3% of the insular platform within three years (2003). Marine reserves are defined as areas where all extractive activities are prohibited in order to help recover depleted fishery resources and protect biodiversity; such reserves can protect corals by preventing impacts from fishery gear.

To date, four marine reserves have been established: Luis Peña Channel Reserve in Culebra (1999), Desecheo Island Reserve (2000), Mona Island, Monito Island Reserve (2004), and Tres Palmas Reserve in Rincon (2003). With the exception of Tres Palmas, the marine reserves are all no-take and all have mooring buoys to protect benthic habitats. There are currently an additional 13 natural reserves in Puerto Rico that have coral reefs within their boundaries. These are managed by the DNER and are located on all coasts and offshore islands thus providing an infrastructure for management measures to protect coral reefs. The DNER has been utilizing mooring buoys since 1990, principally in the Natural Reserves in Fajardo, Culebra, Guánica, and La Parguera. It should be noted that natural reserves probably have minimal success in preventing impacts to coral reefs from degraded water quality because reserve boundaries do not prevent these impacts.

Enforcement of marine protected areas in Puerto Rico is patchy due to limited numbers of officers and patrol vessels. As elsewhere, DNER officers are responsible for enforcing a wide variety of marine and terrestrial environmental regulations and are therefore unable to devote sufficient time to patrolling marine protected areas (*Acropora* Biological Review Team, 2005).

[52] http://www.mpa.gov/pdf/helpful-resources/us_mpas_snapshot.pdf

2.2.3 USVI

Virgin Islands law (VIC, T. 12, Ch. 1, Section 97) provides for the establishment of wildlife or marine sanctuaries for the purpose of propagating, feeding and protecting birds, fish and other wildlife (which includes coral). Marine sanctuaries established under this law include:

- Cas Cay/Mangrove Lagoon Marine Reserve and Wildlife Sanctuary, St. Thomas (1994). This sanctuary includes many acres of mangrove wetlands, shallow seagrass beds and coral reefs. The taking of any living organism or part thereof from this area is prohibited.
- St. James Marine Reserve and Wildlife Sanctuary, St. Thomas (1994). This sanctuary includes many acres of shallow seagrass beds, coral reefs and some algal plain. The taking of any living organism is prohibited except with a valid scientific collecting permit.
- Salt River Bay Marine Reserve and Wildlife Sanctuary, St. Croix (1995). This site includes many acres of mangrove wetlands, shallow seagrass beds and coral reefs.
- St. Croix East End Marine Park (2002). This site includes many acres of shallow back-reef habitats, seagrass beds and fringing and deeper coral reefs (see below for more information and regulations).

In 2002 the Virgin Islands Legislature passed Bill 12 that approved the establishment of additional large marine park on the eastern end of St. Croix (St. Croix East End Marine Park). The U.S.V.I. established the St. Croix East End Marine Park in 2002 to protect territorially significant marine resources, promote sustainability of marine ecosystems, including coral reefs, and to conserve and preserve significant natural areas for the use and benefit of future generations.

The park surrounds the entire east end of St. Croix and encircles Buck Island Reef National Monument and is managed by the Virgin Islands Department of Planning and Natural Resources. The park encompasses an area of approximately 60 square miles (155 square kilometers). Moving, removing, taking, harvesting, damaging, disturbing, breaking, cutting, or otherwise injuring, or possessing any living or dead coral or coral formation or attempting any of these activities is prohibited throughout the park, except when permitted (Virgin Islands Code, Title 12, Chapter 1, Section 98-4). The following activities are also regulated or prohibited in the St. Croix East End Marine Park (ibid):

- Drilling into, dredging, or otherwise altering the seabed of the Park, or engaging in prop dredging; or constructing, placing or abandoning any structure, material, or other matter on the seabed of the Park, except as an incidental result of otherwise allowed activities.
- Discharging, depositing, placing or abandoning, or allowing the discharge, deposit, placement or abandonment of, any natural or man-made material that a person or vessel has brought into the Park from outside the Park.
- Operating a vessel in such a manner as to strike or otherwise injure coral, seagrass, or any other immobile organism attached to the seabed, including, but not limited to, operating a vessel in such a manner as to cause prop scarring.
- Operating a vessel outside officially marked channels that creates a wake within 100 yards of navigational aids that indicate emergent or shallow reefs or operating in such a manner as to endanger marine resources.

- Anchoring a vessel in hardbottom or coral communities (*Acropora* Biological Review Team, 2005).

2.3 Non-Federal Indo-Pacific

2.3.1 Hawaii

Hawaii's reefs have been valued at over U.S. $10 billion. There are 34 state-managed areas which limit fishing activities in nearshore marine waters: 11 MLCDs (areas designed to conserve and replenish marine life), 20 FMAs (areas designed to resolve conflicts among users, including fishers), and three other marine managed areas: Ahihi-Kinau Natural Area Reserve (NAR), Kahoolawe Island Reserve and Coconut Island Hawaii Marine Laboratory Refuge (HMLR). In addition, members of the public have limited or no access to the shoreline and nearshore waters within and around military or security areas on Oahu and Kauai (Pearl Harbor, Kaneohe Bay Marine Corps Base Hawaii, Barking Sands Pacific Missile Range Facility and Honolulu Reef Runway) or in the Hawaii Volcanoes National Park (Friedlander *et al.* in Waddell and Clarke 2008). The various types of protected areas are described below.

Marine Life Conservation Districts (MLCDs)[53]

Chapter 190 of the Hawaii Revised Statutes gives Hawaii's Department of Land and Natural Resources (DLNR) the authority to establish, modify and adopt rules governing the use of MLCDs. Areas to be included in the MLCD system may be suggested from the State Legislature or the general public. Moreover, the DLNR's Division of Aquatic Resources (DAR) regularly conducts surveys of marine ecosystems throughout the state, and may recommend MLCD status for areas that appear particularly promising.

An area that is recommended for designation as an MLCD is then evaluated in terms of a number of criteria by DAR. These criteria include: public accessibility, marine life and future potential values, safety from a public usage standpoint, compatibility with adjoining area usage, and minimal environmental or ecological changes from the undisturbed natural state. In addition, in the interest of adequate compliance and enforcement, the area should have clearly defined boundaries. Finally, the area must also be of suitable size - large enough so that fish populations can be restored even with ongoing fishing activity outside the MLCD, but small enough so that fishermen are not denied the use of unreasonably vast fishing areas. The main purpose of MLCDs is to protect marine life to the greatest extent possible; thus, the taking of any type of living material (e.g., fishes, eggs, shells, corals, algae, etc.) and non-living habitat material (e.g., sand, rocks, coral skeletons, etc.) is generally restricted, if it is permitted at all. These restrictions encourage non-consumptive uses of the area, such as swimming, snorkeling and diving. There are signs located at each MLCD to indicate the District's boundaries and describe regulations for the area.

Fisheries Management Areas (FMA)

Act 58 of 1953 enabled DLNR to acquire access to fishing rights via agreements with the owners of bodies of freshwater. In 1981, Act 85 expanded this statue to include marine areas, and grant DLRN a broad authority to regulate fish, game, forest and conservation under general policies established by the legislature. Under this authority, DLNR may establish, manage, maintain and

[53] http://hawaii.gov/dlnr/dar/coral/mlcd.html

operate freshwater and marine fishing reserves, refuges and fishing areas to conserve and propagate introduced freshwater fishes and other freshwater and marine life. The main policy goals of these areas are to maintain the resources for economic purposes (such as tourism), as well as for the enjoyment of present residents of Hawaii, and for future generations (Cesar 2004).

Bottomfish Restricted Fishing Areas (BFRFA)

BFRFAs are designed specifically for the conservation and management of the bottomfish resources in the Main Hawaiian Islands. The strategy of BFRFAs is to restrict fishing in certain areas for the purpose of conserving the spawning populations of bottomfish. Created by Administrative Rule in 1998, BFRFAs restrict fishing in about twenty percent of known bottomfish spawning areas. Within the BFRFAs, it is unlawful to take bottomfish with any trap, trawl, bottom fish longline or net, or to possess both bottomfish and any trap trawl, bottom fish longline or net (Cesar 2004).

Natural Area Reserve System (NARS)

The NARS legislation (created by Act 139 of 1970) authorized DLNR to designate and manage reserved areas. The intention of NARS areas is to preserve and protect Hawaii's unique terrestrial and aquatic resources so that present and future generations may be able to learn about and enjoy these natural resource assets. In order for an area to be selected as a NARS, the area should be representative of one or more major, natural and relatively unmodified ecosystems; have significant potential for scientific research or the preservation of genetic material; and be easily identifiable both on maps and on the ground. The legislation includes a provision for the establishment of an advisory commission to set criteria for selecting such areas, and for policies to be placed under their management. The policy goal of these reserves was for the designated NARS areas to provide baselines against which changes in other native ecosystems could be measured (Cesar 2004).

De Facto Protected Areas (around military reserves):

The numerous military areas within Hawaii form de facto protected areas because entry by outsiders for recreational and/or fisheries purposes is strictly prohibited. By being military areas, enforcement of the regulations in these zones is incomparably stricter than in any other protected areas (Cesar 2004).

Overall, only 4.8% of the Main Hawaiian Islands (MHI) nearshore waters are closed, in which all fishing or access is prohibited or heavily restricted. In a study of MPA efficacy in the MHI, results showed that a number of fish assemblage characteristics (e.g., species richness, biomass, diversity) vary among habitat types, but were significantly higher in MLCDs compared with adjacent fished areas across all habitat types. In addition, apex predators and other resource species were more abundant and larger in the MLCDs, illustrating the effectiveness of these closures in conserving fish populations within their boundaries. However, the state of Hawaii is home to approximately 1.2 million residents (over 70% of which live on Oahu) as well as a vacation destination for over seven million tourists each year, resulting in increasing pressure on Hawaii's coral reefs (Friedlander *et al.* in Waddell and Clarke 2008).

2.3.2 American Samoa

American Samoa only has one Territorial MPA. Ofu Vaoto Territorial Marine Park was established in 1994 by Territorial legislation and encompasses a small area (less than one mile in width). The main purpose of establishing the park was to protect unique coral habitats while allowing public access and enjoyment. Only residents of Ofu Island may fish and/or harvest shellfish in the boundaries of the park, while all others are restricted from such activities. The terrestrial part of the park is to remain unimproved[54].

Additionally, within 7 villages, Community-based Fisheries Management Programs are implemented via the Department of Marine and Wildlife Resources. Replenishing resources through no-take areas is the main objective of these programs, where villages manage their own local MPAs.

2.3.3 Guam

In 1997, Public Law 24-21 was implemented creating 5 marine preserves and making changes to Guam's fishing regulations. The names of the preserves are the Pati Point Preserve, the Tumon Bay Preserve, the Piti Bomb Holes Preserve, the Sasa Bay Preserve, and the Achang Reef Flat Preserve. Within a marine preserve, the taking of aquatic animals is restricted. Unless specifically authorized, all types of fishing, shell collecting, the use of gaffs, and the removal of sand and rocks are prohibited in a preserve. Violators of these regulations are subject to fines up to $500 and/or imprisonment up to 90 days. Commonwealth of Northern Mariana Islands MPAs

2.3.4 CNMI

The CNMI has several marine protected areas with varying levels of restricted activities[55]. No-take reserves prohibit the fishing or harvesting of any marine species of plant or animal, including prohibiting the take of coral (live or dead), and ban all exploitive or destructive activities to marine life. In Saipan, there are three no-take reserves. Managaha Marine Conservation Area (Public Law No. 12-12, codified at 2 CMC §§ 1631–1638), which prohibits the harvesting or catching of marine life or natural resources with the designated Managaha Marine Conservation Area, unless otherwise approved for scientific, cultural, traditional, or educational purposes (2 CMC § 1634(a)). . Forbidden Island and Bird Island Marine Sanctuaries (Public Law No. 12-46, codified at 2 CMC §§ 1640–1645), which prohibits the following in the sanctuaries: (1) destruction, harassment, and removal of marine species of any kind; (2) fishing; (3) and walking on exposed sections of the reef (2 CMC § 1644). The island of Rota has a no-take reserve called Sasanhaya Fish Reserve. The island of Tinian has a marine reserve which extends from the Southwest Carolinas Point to Puntan Diablo that is primarily a no-take reserve allowing for the seasonal fishing of atulai, i'i, and ti'ao only and prohibiting destruction of marine habitat (Public Law 15-90).

54 http://faolex.fao.org/cgi-bin/faolex.exe?database=faolex&search_type=query&table=result&query=LEX-FAOC050989&format_name=@ERALL&lang=eng

55 http://www.dfw.gov.mp/Fisheries/Marine%20Protected%20Areas.html

3. Conservation Efforts

The following sections describe U.S. federal and U.S. non-federal conservation efforts that may be relevant to addressing threats to corals and coral reefs or coral conservation. Federal conservation efforts include national programs and initiatives for coral reef conservation while non-federal conservation efforts include State and Territorial conservation programs, initiatives and local action plans.

3.1 U.S. Federal

The United States has numerous federal programs in place aimed at the conservation of coral reefs. Below is a brief description of these different programs and their aims.

FKNMS Education and Outreach Program[56]

In the FKNMS, education and outreach have played a primary role in resource protection. The FKNMS Education and Outreach Program seeks to raise conservation awareness among target audiences, positively affect public attitudes, and increase the value people place on the Florida Keys ecosystem. Some examples of education and outreach activities include Coral Reef Classrooms, reaching 3,314 students in nine years, adult environmental education events, distributing educational materials to businesses, helping to found and lead the statewide Seagrass Outreach Partnership to raise awareness of the significance of seagrass beds, and publishing the Florida Keys Dive and Snorkel User's Guide.

Marine Protected Areas Inventory[57]. This is a geospatial database that catalogs and classifies marine protected areas within U.S. waters.

National Coral Reef Institute (NCRI)[58]. NCRI was initiated in 1998 with the primary goal of protection and preservation of coral reefs through applied and basic research on coral reef assessment, mitigation, monitoring, restoration, and biodiversity, as well as through training and education. This goal is addressed through multidisciplinary scientific research as well as through applied engineering, operations, and public education.

NOAA Species of Concern Program[59]. "Species of Concern" is an initiative implemented under the Endangered Species Act (ESA) that identifies species for which there is concern or uncertainty about their status, but insufficient information to support a determination to add the species to the list of threatened and endangered species. Thus, Species of Concern are not protected by the ESA. As resources permit, NOAA Fisheries conducts a review of the status of each Species of Concern. NOAA Fisheries believes it is important to highlight species for which additional information and management may be warranted so that Federal and state agencies, Native American tribes, and the private sector are aware of which species could benefit from proactive conservation efforts. NOAA has external and internal grant programs to fund such efforts.

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[56] http://floridakeys.noaa.gov/coraleducation.html

57 http://www.mpa.gov/dataanalysis/mpainventory/

[58] http://www.nova.edu/ncri/

[59] http://www.nmfs.noaa.gov/pr/species/concern/

NOAA Coral Reef Conservation Program (CRCP)[60]. The NOAA CRCP is a partnership between the NOAA Line Offices that work on coral reef issues: the National Ocean Service, the National Marine Fisheries Service, the Office of Oceanic and Atmospheric Research, and the National Environmental Satellite, Data and Information Service. The CRCP brings together expertise from across NOAA for a multidisciplinary, ecosystem based approach to managing and understanding coral reef ecosystems. Themes of conservation include: appropriately placed and well managed MPAs; research, restoration, and/or monitoring expeditions; coral reef ecosystem monitoring, mapping and assessment. Conservation methods of CRCP include the following programs:

National Coral Reef Ecosystem Monitoring Program (NCREMP)[61]. In 2000, the Coral Reef Conservation Act authorized and implemented the NCREMP to support local coral reef ecosystem monitoring activities in numerous U.S. coral-bearing jurisdictions. The goal of NCREMP is to provide a long-term monitoring program to: assess the condition of US shallow-water coral reef ecosystems, evaluate the efficacy of coral reef ecosystem management, and communicate progress toward conservation of coral reef ecosystems.

NOAA Coral Reef Watch (CRW)[62]. As part of the Coral Reef Conservation Program, Coral Reef Watch uses satellite sea surface temperature data to alert managers and scientists around the world of the risk of coral bleaching. CRW also recently developed a new system, which uses NOAA experimental sea surface temperature forecasts, to predict coral bleaching events. The prediction system uses forecast models to develop bleaching outlooks up to three months in advance. To continue addressing the threat of coral bleaching, reef managers are provided with tools to understand climate change and coral bleaching and information about how to take action in response to alerts of potential bleaching conditions.

NOAA Coral Reef Management Fellowship Program[63]. In response to the need for additional coral reef management capacity in U.S. Pacific and Caribbean jurisdictions, NOAA established a Coral Reef Management Fellowship Program. The program provides state and territorial coral reef management agencies with candidates whose education and work experience meet each jurisdiction's specific needs. In turn, the fellows receive professional experience in coral reef ecosystem management. Separate Statements of Work are developed for each jurisdiction, containing information on the projects itself, goals and objectives, minimum and desired qualifications, and salary, among other information. The Statements of Work uniquely reflect each jurisdiction's particular needs, while complementing other ongoing local projects and management activities.

NOAA Coral Health and Monitoring Program (CHAMP)[64]. The mission of CHAMP is to provide services to help improve and sustain coral reef health throughout the world.

Long term goals of CHAMP include:

[60] http://coralreef.noaa.gov/
[61] http://ccma.nos.noaa.gov/ecosystems/coralreef/coral_grant.aspx
[62] http://coralreefwatch.noaa.gov/satellite/index.html
[63] http://coralreef.noaa.gov/aboutcrcp/fellowship/
[64] http://www.coral.noaa.gov/

- Establish an international network of coral reef researchers for the purpose of sharing knowledge and information on coral health and monitoring.
- Provide near real-time data products derived from satellite images and monitoring stations at coral reef areas.
- Provide a data repository for historical data collected from coral reef areas.
- Add to the general fund of coral reef knowledge.

NOAA Coral Reef Information System (CoRIS)[65]. NOAA's CoRIS is designed to be a single point of access to NOAA coral reef information and data products, especially those derived from NOAA's Coral Reef Conservation Program. CoRIS is a web-based information portal that provides access to products from NOAA coral reef research, monitoring, and management activities, with emphasis on the U.S. states, territories, and remote island areas. NOAA activities include coral reef mapping, monitoring and assessment; natural and socioeconomic research and modeling; outreach and education; and management and stewardship.

Coral Reef Conservation Fund[66]. Responding to widespread serious declines in both the quantity and productive quality of the world's coral reef ecosystems, the National Fish and Wildlife Foundation partnered with NOAA to establish the Coral Reef Conservation Fund. Through this Fund, the Foundation supports local to ecosystem level projects that restore damaged reef systems and prevent further negative impacts through both on-the-water and up-the-watershed projects by focusing on specific areas of human impact such as anchor damage and sedimentation.

Pacific Reef Assessment and Monitoring Program (Pacific RAMP)[67]. Pacific RAMP institutes principles of ecosystem management through development of an ecosystem observing system to map, assess, and monitor coral reef ecosystems in the Pacific. There are 50 islands and atolls in the Hawaiian and Mariana Archipelagos, American Samoa, and U.S. Line and Phoenix Islands monitored by NOAA's Coral Reef Ecosystem Division (CRED). In 2010, the 5th biennial Pacific RAMP expedition took place in American Samoa. The strategic goal of this research program is to improve scientific understanding of coral reef ecosystems throughout the Pacific, and serve as the basis for improved conservation and resource management.

U.S. Coral Reef Initiative (USCRI)[68]. The United States is one of the first countries with coral reefs to launch a national Coral Reef Initiative. Announced in 1996, the USCRI is designed to be a platform of U.S. support for domestic and international coral conservation efforts. The goal is to strengthen and fill the gaps in existing efforts to conserve and sustainably manage coral reefs and related ecosystems (sea grass beds and mangrove forests) in U.S. waters. USCRI is a partnership of federal, state, territorial and commonwealth governments, the scientific community, the private sector and other organizations. The primary objective of USCRI is to

[65] http://coris.noaa.gov/

[66] http://www.nfwf.org/AM/Template.cfm?Section=Charter_Programs_List&Template=/TaggedPage/TaggedPageDisplay.cfm&TPLID=60&ContentID=18269

[67] http://www.nova.edu/ncri/11icrs/abstract_files/icrs2008-002024.pdf

[68] http://oceanservice.noaa.gov/aa/ia/cri.html

foster innovative partnerships and cross-disciplinary approaches that reduce the threats to U.S. coral ecosystems.

U.S. All Islands Coral Reef Committee (AIC)[69]. The AIC was created in 1999 by governor-appointed Points of Contact (POCs) to represent each coral reef jurisdiction in the United States. The creation of the AIC formally established the Committee consisting of the U.S. island jurisdictions of Guam, American Samoa, Commonwealth of the Northern Marianas, Hawaii, Puerto Rico, and the U.S. Virgin Islands, which had been meeting informally since 1993 after the U.S. Department of State proposed creating the Coral Reef Initiative to ameliorate future global degradation of coral reef ecosystems. The State of Florida became a full member of the Committee in 2007. The Committee works closely with the Coral Reef Conservation Program, NOAA, U.S. Department of Commerce, and the U.S. Department of the Interior, Office of Insular Affairs. The AIC also actively collaborates with other federal agencies who are members of the U.S. Coral Reef Task Force. The AIC is a made up of marine resource managers from state, commonwealth, territorial agencies and freely associated states working collaboratively with federal agencies to conserve and protect coral reefs in the United States.

U.S. Department of Agriculture Coral Reef Initiative[70]. The U.S. Department of Agriculture (USDA) provided $1 million from the Environmental Quality Incentives Program (EQIP) in Fiscal Year 2010 to reduce sediment and nutrient run-off from the watershed to help protect near shore coral reef ecosystems in the Guánica Bay Watershed in southwest Puerto Rico. The pilot project's objective was to protect coastal and stream water quality, improve wildlife habitat, and enhance near shore coastal and coral reef health through land-based management. USDA's Natural Resources Conservation Service (NRCS) assists agricultural producers in voluntarily establishing systems of conservation practices specifically tailored to their operations. These practices aredesigned to avoid, control and trap sediment and nutrient runoff, and include nutrient management, cover crops, grassed waterways, and field borders. The $1 million dedicated to improving coral reef health in the watershed in Fiscal Year 2010 originated from funds NRCS allocated to Puerto Rico. Future projects are planned in Florida, U.S. Virgin Islands, Hawaii and the Pacific Islands..

3.2 US Non-federal Caribbean

For each state/territory, information on state programs for coral reef conservation as well as Coral Reef Local Action Strategies (LASs) is summarized in the following sections. For complete information on each individual LAS, visit (http://www.coralreef.gov/las/). Numerous other projects in each state and territory are conducted every year through grants funded by the Coral Reef Conservation Fund. These projects and their descriptions can be found in the online grants library[71]. It is also recognized that other smaller coral reef conservation

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[69] ftp://ftp.nodc.noaa.gov/pub/data.nodc/coris/library/NOAA/CRCP/project/1204/us_islands_coral_reef_comm_strategic_plan_2008-13.pdf

[70] http://www.coralreef.gov/

[71] http://www.nfwf.org/AM/Template.cfm?Section=Library_Search&Template=/customsource/ProjectSearch/cindex.cfm.

projects conducted by various organizations, academic institutions and/or NGOs are conducted frequently, signifying an increase in public awareness on coral reef issues.

3.2.1 Florida

Summary of Florida Coral Reef Conservation Projects

There are numerous coral reef conservation projects undertaken in Florida's waters every year. These projects range from monitoring programs to education and outreach programs. Monitoring of the Florida Reef Track has taken priority in recent years for bleaching and disease events in order to help managers increase their management capacity. Many of the projects in Florida are multi-faceted and have several different components. Many of Florida's coral reef conservation efforts take place in the Florida Keys National Marine Sanctuary, home of the 3rd largest barrier reef system in the world. These efforts are usually in partnership with NOAA and various NGOs. Coral reef restoration projects and coral nurseries are also increasingly popular reef conservation projects.

Florida Department of Environmental Protection Coral Reef Conservation Program (DEP CRCP)

Through its role in supporting Florida's membership on the U.S. Coral Reef Task Force, and the U.S. All Islands Committee, the CRCP leads the implementation of the Southeast Florida Coral Reef Initiative and contributes to the National Action Plan to conserve coral reefs. The CRCP is also charged with coordinating response to vessel groundings and anchor damage incidents in southeast Florida, and developing strategies to prevent coral reef injuries.

Southeast Florida Coral Reef Initiative (SEFCRI)[72]

The Southeast Florida Coral Reef Initiative (SEFCRI) is a local action strategy for collaborative action among government and non-governmental partners to identify and implement priority actions needed to reduce key threats to coral reef resources in southeast Florida. The targeted area includes Miami-Dade, Broward, Palm Beach and Martin counties.

Southeast Coral Reef Evaluation and Monitoring Project (SECREMP)[73]

SECREMP is a long-term reef monitoring project along Florida's southeast coast (Miami-Dade, Broward, Palm Beach, and Martin Counties). SECREMP is an extension of the Florida Keys Coral Reef Evaluation and Monitoring Project (CREMP), utilizing the same sampling protocols. SECREMP, as an expansion of CREMP ensures that important parameters are being monitored for the full extent of the Florida coral reef ecosystem.

Florida's Coral Reef Local Action Strategy

Led by the Florida Department of Environmental Protection's Coral Reef Conservation Program, and actively engaging over sixty regional agencies, non-governmental organizations, academic institutions and stakeholder organizations, Florida's Local Action Strategy, named the Southeast Florida Coral Reef Initiative, identifies the key threats to the health of southeast Florida's reefs and implements priority actions needed to reduce those threats, including:

[72] http://www.southeastfloridareefs.net/

[73] http://www.nova.edu/ncri/research/a12.html

Public Outreach and Awareness

- Creating and distributing outreach materials including brochures, portable exhibits, websites and signage at boat ramps
- Developing and distributing English and Spanish language public service announcements in print, audio and video formats
- Providing coral reef education kits and teacher training workshops for educators

Fishing, Diving and Other Uses

- Using aerial surveys to determine vessel usage patterns on southeast Florida's coral reefs, and in-water surveys to investigate links between vessel anchoring and reef injuries
- Working with stakeholders to identify concerns and explore options for developing a management plan for the northern third of the Florida reef tract

Land-Based Sources of Pollution and Water Quality

- Mapping the extent of the coral reef tract and characterizing benthic habitats
- Conducting coral reef condition evaluation and monitoring
- Researching the sources and flux of pollution transported to reef communities and the links between pollution and coral reef health

Maritime Industry and Coastal Construction Impacts

- Identifying innovative technologies and establishing best management practices to avoid and minimize impacts to coral reefs associated with coastal construction
- Developing regional standard operating procedures for rapid response to, and restoration of, coral reef injuries

3.2.2 Puerto Rico

Summary of Puerto Rico Coral Reef Conservation Projects

Many of the individual conservation projects in Puerto Rico focus on education of the public with outreach campaigns. A particular focus is educating Puerto Rico's youth about the importance of the ocean and coral reefs. Another common conservation focus of Puerto Rico is coral reef restoration. There are several sites where coral nurseries and coral farms have been implemented to attempt to restore some of Puerto Rico's degraded reef areas. Puerto Rico also has several projects related to its Land-Based Sources of Pollution Local Action Strategy, including the promotion and implementation of integrated watershed and land-use management.

Department of Natural and Environmental Resources Coral Reef Program[74]

The Coral Reef Program has two main categories of tasks for maintaining and improving the integrity of coral reefs:

- Conservation and Management

[74] http://www.drna.gobierno.pr/oficinas/arn/recursosvivientes/costasreservasrefugios/coral/programa-de-conservacion-y-manejo-de-arrecifes-de-coral?set_language=en-us&cl=en-us

The work described in this category focus on local management strategies (i.e., LAS-local action Strategies). These are areas of special interest which cover lack of awareness, overfishing, pollution from diffuse sources, and recreational use (see below).

- Monitoring of Coral Reefs
  A database of characterization and monitoring of reefs and their associated communities is maintained for different areas of PR. Among these are: Desecheo Island, Rincon, Mayaguez, Guanica, Ponce and Caja de Muertos.

Caribbean Coral Reef Institute (CCRI)[75]

The CCRI is a cooperative program between the University of Puerto Rico – Mayagüez (UPRM) and NOAA. The Institute sponsors scientific research and monitoring programs addressing short and long-term management priorities for the U.S. Caribbean coral reef ecosystem. The goals of CCRI include:

- Development, implementation, and administration of research and monitoring activities that improve the management of coral reef ecosystems and build management capability
- Interacting as appropriate with the Federal and Commonwealth agencies as well as other public and private organizations having a demonstrated capacity to assist in the management of coral reef ecosystems
- Fully utilizing the resource base of the region to collaborate and conduct research and monitoring activities on coral reef ecosystems.

Puerto Rico's Local Action Strategy

The Puerto Rico Department of Natural and Environmental Resources (DNER) is the main agency responsible for coral reef management. Puerto Rico's Local Action Strategies (LAS) builds on the experience of many different stakeholders. Coral reef management efforts are strengthened through increased coordination between state and federal partners and local agencies in the following activities:

Public Outreach and Awareness

- Completed an economic valuation study of coral reefs and related resources in Eastern Puerto Rico in December 2007.
- Utilizing an interactive CD on coral reefs as educational material for outreach activities in schools and the community.
- Installing several signs in certain coastal areas to educate users on the different marine ecosystems and ways to protect them.
- Distributing educational information to coastal businesses, navigation course students, and the public about the importance of coral reefs to Puerto Rico's economy. Outreach activities, including user surveys, are conducted.

Land-Based Sources of Pollution

- Increasing public awareness and reaching farmers to encourage them to implement best management practices to reduce pollution from agriculture through an effort made by the

[75] http://ccri.uprm.edu/

DNER, the Natural Resources Conservation Service and the Agricultural Extension Program (NRCS).
- Conducting training workshops for marina operators, the agriculture community and agencies on ways to reduce coastal pollution and promote watershed protection.

Overfishing
- Conducting educational workshops explaining current fisheries regulations to Rangers, fishers and other stakeholders.
- Assessing fishing resources that are of commercial and recreational importance using fishcatch data and reproduction studies taken from the Fisheries Research Laboratory.

Recreational Misuse/Overuse
- Assessing damage by anchoring or trampling at target coral reef and seagrass sites within priority natural reserves around the island.
- Completing and implementing management plans for the Cordillera Reefs, Canal Luis Peña, Tres Palmas, Mosquito Bioluminescent Bay Natural Reserves, La Parguera, Caja de Muertos and Isla de Mona Natural Reserves.
- Installing hundreds of buoys at target sites listed above.

Land-based Sources of Pollution Local Action Strategy

This strategy addresses the impacts to coral reefs caused by erosion and sedimentation transported by runoff, rivers and creeks. The land-based sources of pollution (LBS) planning group based their work plan on the Puerto Rico's Coastal Nonpoint Source Pollution Plan. This document was developed by DNER in coordination with 15 commonwealth agencies and 6 federal advisory agencies and includes information provided by local scientists. This plan considers fine sediments transported by ocean currents (which depend on local patterns of water circulation near the coastal zone) as main pollutants and stressors affecting coral reefs. Agricultural compounds and nutrients were also identified as major stressors to wetlands and coral reefs within the watersheds. In order to address problems affecting corals, key projects were identified that entail the BMP's and MM's by: 1) category type of non point source pollution which include agricultural, urban, marinas, wetlands, etc. 2) inventory of all the non point sources of pollution and 3) training for agronomists and marina operators.

The proposed projects are being implemented in watersheds that are affected by: intensive agricultural activities, urban areas, high number of septic tanks and areas with large land cover removal. These pilot projects are being implemented in the JBNNER watershed and will be subsequently replicated at important watersheds on the island municipality of Culebra, Arrecifes de la Cordillera, Añasco, La Parguera, Guánica and Cabo Rojo as identified by the Coastal Nonpoint Source Pollution– Coral Reef Committee. The group of people working on this strategy includes representatives from state and federal agencies that manage or regulate activities that may impact coral reef ecosystems in close coordination with university and local community representatives.

3.2.3 USVI

Summary of USVI Coral Reef Conservation Projects

Much of the conservation efforts within the USVI focus on activities conducted within St. Croix East End Marine Park. The Park hosts the coral reef monitoring program of USVI as well as the most predominant education/outreach program. The East End Marine Park is also the predominant focus of USVI's LASs, as the initial implementation period of USVI's LASs were conducted entirely within in the Park. Future plans include expanding the LASs to other areas of the islands after the initial implementation period at East End Marine Park.

Virgin Islands Coastal Zone Management Program (VICZMP)

One of VICZMP's goals is to protect, preserve and, where feasible, enhance and restore the overall quality of the environment in the coastal zone. VICZMP works, coordinates and partners with various local and national government agencies to develop and implement a variety of projects and programs, including review, processing and enforcement of minor and major development permits in the first tier of the coastal zone. Major programs managed and administered by Coastal Zone Management include but are not limited to coastal zone permitting, public access, public outreach, Federal consistency, and the St. Croix East End Marine Park (STXEEMP).

St. Croix East End Marine Park (STXEEMP) Programs[76]

- Territorial Coral Reef Monitoring Program

  The main goal of the Territorial Coral Reef Monitoring Program is to document long-term trends in benthic and fishery resources for the USVI. A secondary goal of this program is to document baseline conditions prior to establishing marine reserves. This program utilizes a video methodology that was developed by the US Geological Survey on St. John, and is currently being used in the Virgin Islands National Park, Buck Island Reef National Monument (BIRNM) and the territorial program, thus providing standardized data throughout the territory. Two of the long-term monitoring sites are within the STXEEMP.

- Caribbean Coral Reef Ecosystem Monitoring Program

  In association with NOAA's Biogeography Program and the National Park Service (NPS), STXEEMP staff and local coral reef monitoring partners are working to implement NOAA's protocol within the park. The Biogeography Team and NPS have been using this protocol to monitor marine resources within the BIRNM since 1999. As part of that project, the northern waters of the STXEEMP were also studied, providing important data prior to the establishment of the park. This protocol will be used to complete a comprehensive baseline survey of marine resources within the STXEEMP

St. Croix East End Marine Park Education and Outreach Program[77]

The goals of the St. Croix East End Marine Park education and outreach program are to facilitate environmental education opportunities for community members, promote a holistic view of the park ecosystem as an interrelated and interdependent system of habitats, encourage and promote

[76] http://www.stxeastendmarinepark.org/programs.htm
[77] http://www.stxeastendmarinepark.org/education.htm

a sense of user stewardship regarding the marine environment, and promote the awareness of and support for the St. Croix East End Marine Park. Available education and outreach services provided by this program include presentations on management issues, monitoring results, coral reefs, marine protected areas, and other marine related topics.

Protective Navigational Measures

The Virgin Islands National Park (VINP) maintains a number of navigational aids to prevent vessels from striking underwater objects, including coral reefs. These aids range from boat exclusion buoys around shallow reefs, seagrass areas and beaches, to larger, lighted discretionary buoys around offshore reefs. Buoys have prevented, in many cases, vessels from striking reefs and producing significant damage.

USVI's Local Action Strategy

For the first phase of the Local Action Strategy (LAS) initiative, the U.S. Virgin Islands (USVI) developed action plans to address 4 priority topics and focused implementation of projects within the territory's first marine park, the St. Croix East End Marine Park (STXEEMP). Management of the STXEEMP and coordination of the LAS are led by the Department of Planning and Natural Resources, Division of Coastal Zone Management. Recently, the USVI has begun a process to review, revise and expand the territory's LAS, expanding current strategies territory-wide, and evaluating the adoption of new focal areas including:

Lack of Awareness

- Promoting environmental and cultural education through establishing,(in 2004) and providing leadership for the VI Network of Environmental Educators (VINE). VINE is comprised of St. Croix and St. Thomas/St. John chapters and has a membership that represents 25 territorial agencies including local government, federal government, NGOs and academia. Through collaboration, a sister chapter is being developed in the neighboring British Virgin Islands.
- Providing bayside walking and snorkel tours for thousands of students and community members through STXEEMP Interpretive Program since its inception in Fall 2007.
- Supporting the Park's education and outreach events with the mobile STXEEMP EcoVan using a specialized curriculum developed in collaboration with numerous local partners.

Fishing

- Conducting biological monitoring to provide data on benthic habitats, reef fish, *Acropora* species and spiny lobster populations.
- Hiring Park Interpretive Rangers to support park education and outreach activities and, enforcement efforts, and as a mechanism to provide alternative livelihood opportunities for displaced fishers.
- Installing interpretive signage along roadsides and bayside access points in order to educate the public about the STXEEMP, its management strategies, rules and regulations.

Recreational Use

- Reducing damage to seagrass and coral reef habitats through the installation of a system of daytime use moorings within the park.

- Holding snorkel clinics to teach snorkelers safe, environmentally-friendly practices.

Land-Based Sources of Pollution

- Development of island-specific Best Management Practices to manage land-based sources of pollution within the STXEEMP.
- Using signage installed on roadsides in areas adjacent to the STXEEMP to address pollution impacts from land-based activities.

3.3 U.S. Non-Federal Indo-Pacific

3.3.1 Hawaii

Summary of Hawaii Coral Reef Conservation Projects

Many of the coral reef conservation projects in Hawaii are aimed at increasing management capacity in the form of recovering certain reef areas, mitigating land-based sources of pollution, and implementing invasive species control. Hawaii engages in community based monitoring of its reefs through programs like the Makai Watch Foundation and other foundations throughout the islands. The Coral Reef Alliance also sponsors conservation projects in Hawaii including developing voluntary standards for marine tourism activities, development of an online monitoring portal for reef monitoring volunteers, and the creation of educational "Respect Coral Reefs" signs to educate the public on coral reef ecosystems. Monitoring, education, and mitigation of land-based sources of pollution and invasive species are key components to conservation efforts of Hawaii's reefs.

DLNR Division of Aquatic Resources Coral Reef Monitoring Program[78]

The basic goal of the Division of Aquatic Resources Coral Reef Monitoring Program is to provide the necessary information sufficient for the agency to be able to fulfill its mission to "manage, conserve and restore the state's unique aquatic resources and ecosystems for present and future generations." The two main objectives of this Program include:

- Providing data on the status and trends of key coral reef resources and key components of the ecosystems they are part of. Important resources are identified as fishes of commercial and/or social importance as well as hard corals. Other monitoring foci include grazing and corallivorous invertebrates (sea-urchins and crown of thorns starfish); algae; water quality, and reef structure.
- Providing data sufficient for the Department of Aquatic Resources to be able to assess the effectiveness of marine managed areas. A minimum monitoring goal is to include all MLCDs, the Waikiki Diamond Head FMA, and protected sites within the West Hawaii Regional FMA in routine monitoring, together with a sufficient number of `control' sites.

Monitoring efforts include surveys for disease and bleaching as well as water quality surveys.

Makai Watch Program[79]

[78] http://hawaii.gov/dlnr/dar/coral/coral_monitoring.html
[79] http://hawaii.gov/dlnr/dar/coral/coral_las_makaiwatch.html

The Makai Watch Program was created as a partnership effort by the DLNR and several non-governmental organizations including Community Conservation Network, TNC, Hawai‘i Wildlife Fund, and several community-based organizations. Makai Watch is a coastal education, monitoring and resource protection initiative. Now officially sanctioned by the State of Hawaii, Makai Watch works to restore and sustain Hawaii's coastal resources through community involvement. The three focal points of the Makai Watch Program include:

- *Raising Awareness and Outreach*- Makai Watch volunteers provide ocean users with information about the area's marine ecology, geography, culture, history, regulations, safety, best fishing practices and proper reef etiquette.
- *Observing and Encouraging Compliance*- Makai Watch volunteers observe sites and encourage ocean users to learn and obey regulations. Volunteers are also trained in how to identify illegal activities and collect evidence so that violations can be reported to DOCARE.
- *Biological and Human-Use Monitoring*- Participants collect information on human use as well as biological condition of marine resources. Ongoing monitoring helps to gauge the effectiveness of management efforts, through increased fish counts or improved coral health.

Hawaii's Local Action Strategy

Hawaii used a collaborative planning process to develop local action strategies (LAS) for the six selected focus areas. This process supported and expanded on existing efforts already underway in the State. In cases where coordinating bodies did not already exist, steering committees were formed to facilitate the development and implementation of the particular LAS. These committees include members from state and federal government agencies, non-governmental organizations, academia, industries, and community groups.

The six selected focus areas include:

- Main Hawaiian Island Coral Reef Fisheries Management
- Land-Based Sources of Pollution
- Lack of Public Awareness / Hawaii's Living Reef Program
- Aquatic Invasive Species
- Recreational Overuse
- Climate Change and Marine Disease

Local Action Strategy: Climate Change and Marine Debris

Hawaii and American Samoa are the only states/territories with focal areas of climate change within their LASs. The goal of Hawaii's Climate Change and Marine Debris LAS is to understand and manage impacts to reef ecosystems from climate change and marine disease for increased resistance and resilience. The following objectives are outlined in the LAS:

- To support research that provides a scientific basis for managing impacts to reef ecosystems from climate change and disease.
- To increase public awareness and engage stakeholders in monitoring and reporting bleaching and disease.
- To develop rapid-response contingency plan for events of bleaching and disease.

- To develop proactive and mitigative long-term management strategies to increase resistance and resilience of reef ecosystems to impacts from climate change and marine disease.
- To develop a program to monitor the impacts of climate change and marine disease on the reefs of the Hawaiian archipelago.

3.3.2 American Samoa

Summary of American Samoa Coral Reef Conservation Projects. Conservation of coral reefs in American Samoa is a joint effort of government agencies and community-based management. Like other states and territories, American Samoa's reef conservation efforts include monitoring, education and outreach, as well as community participation in management. The most relevant conservation programs instituted by the local government in American Samoa are summarized below.

American Samoa Coral Reef Initiative (ASCRI)[80]. American Samoa's Coral Reef Initiative is administered by the Governor's Coral Reef Advisory Group (CRAG), an inter-agency task force established to provide the Government of American Samoa with advice, guidance and project management regarding coral reef related issues. Instrumental to its success is the direct and active role that each of the five agencies play in collaborative project development and implementation. Important projects implemented under the ASCRI include:

American Samoa Coral Reef Monitoring Plan. This plan was designed by the Coral Reef Monitoring Coordinator and CRAG Monitoring Working Group to create a management driven program that is achievable with on-island staff and resources and resilient to staff turnover. American Samoa began implementing the integrated coral reef monitoring plan in early 2005. This program consists of 11 core sites, distributed geographically around the island. It will also assist individual agency monitoring efforts, as well as the Community-based Fisheries Management Program at the DMWR. For the first time, the Territory will have a single point of reference and contact for monitoring activities, as well as a centralized database.

Education and Outreach. The main objective of CRAG's Education and Outreach Coordinator is to increase public awareness of issues affecting American Samoa's coral reefs. The Education and Outreach Coordinator conducts regular visits to schools, develops educational equipment, and disseminates information via newspaper articles, slides and brochures relevant to coral reef issues. One notable project is the distribution of grants to teachers in American Samoa through the American Samoa Teachers' Challenge Awards. Le Tausagi, an interagency working group consisting of environmental educators who collaborate on conservation programs and community outreach, administers this program.

American Samoa Marine Protected Area (MPA) Network Strategy. American Samoa has 11 Village Marine Protected Areas which rely on management by the local communities in coordination with local governments. The American Samoa MPA Network Strategy was developed to link the Territory's MPA programs and agencies together to be more effective in protecting and managing the marine resources. The goal of the MPA Network Strategy is to

[80] http://crag.as/?nav=Home&cont=home

effectively coordinate existing and future MPAs to ensure the long-term health and sustainable use of the Territory's coral reef resources. Collaboration and integration among agencies through existing programs in education, research, monitoring, enforcement, and administration are emphasized.

American Samoa's Local Action Strategy[81]. In American Samoa, the Coral Reef Advisory Group (CRAG) is responsible for implementing the Local Action Strategies (LAS) via initiatives developed by the U.S. Coral Reef Task Force. LASs are the result of a continuing process incorporating input from territorial agencies, non-profit groups, interested individuals, stakeholder groups, and federal agency partners. American Samoa has LASs addressing population pressure, overfishing, land-based sources of pollution, public outreach and awareness, and local response to global climate change.

3.3.3 Guam

Summary of Guam's Coral Reef Conservation Efforts. A broad network of agencies, educational/research institutions and non-governmental organizations continue to carry out a range of activities aimed at mitigating the threats to Guam's coral reefs, improving public awareness of coral reef issues and monitoring the vitality of Guam's coral reef resources. Progress towards short- and long-term increases in human capacity to effectively carry out these activities has been made with the establishment of two scholarship programs for graduate study in marine biology/natural resource management, the NOAA Coral Management Fellowship, the Pacific Islands Technical Assistantship program, the NOAA Pacific Islands Regional Office (PIRO) Guam Field Office and various training opportunities for managers, technicians and teachers. Many of the goals and objective of coral reef management projects in Guam are directly linked to the U.S. National Action Plan to Conserve Coral Reefs through Local Action Strategies developed locally (Waddell et al., 2008). The most relevant conservation programs instituted by the government of Guam are summarized below.

Guam Coastal Management Program (GCMP)[82]. The Guam Coastal Management Program, instituted in 1979, is responsible for coordinating and assisting the development and implementation of plans, policies and programs which affect the management, use and preservation of Guam's land and ocean resources. The objectives of the GCMP are to ensure consistency amongst the plans, policies and programs such that Guam's resources are effectively used for the benefit of present and future generations. It is overseen by the Bureau of Statistics and Plans, and guides the use, protection, and development of land and ocean resources within Guam's coastal zone. Because Guam is a small island, the entire land area is included within this coastal zone. The Coastal Program provides overall coordination and direction to a network of government agencies to ensure a balanced approach to coastal management. Some of the most prominent coastal management issues for Guam are coral reef and watershed habitat degradation, water quality degradation, coastal hazards, and cultural and historic resource preservation.

[81] http://www.coralreef.gov/las/lasfactsheets2009/las09/lasas.pdf
[82] http://coastalmanagement.noaa.gov/mystate/guam.html

Guam Coral Reef Initiative (CRI) and Local Action Strategy (LAS)[83]. In 1997, the Government of Guam established the CRI and instituted a LAS to address threats to the reefs via initiatives developed by the U.S. Coral Reef Task Force. The Bureau of Statistics and Plans, Guam Coastal Management Program, Department of Agriculture, Division of Aquatics and Wildlife Resources, and Guam Environmental Protection Agency lead most of the efforts of the CRI. Guam LASs on land-based sources of pollution, fishery management, public outreach and awareness, recreational use and misuse, and coral bleaching and global climate change.

3.3.4 CNMI

Summary of the CNMI Coral Reef Conservation Efforts. Many coral research and monitoring programs funded in recent years by the U.S. Coral Reef Initiative (CRI) have increased the CNMI's capacity to manage its coral reef ecosystem resources. This has assisted the CNMI in assessing and monitoring coral resources, educating the public, and enforcing coral reef management policy through an increase in both personnel and the development of locally applicable management tools (Waddell et al., 2008). The most relevant conservation programs instituted by the government of the CNMI are summarized below.

Coastal Resources Management (CRM) Office Marine Monitoring Program[84]. The CRM Marine Monitoring Program is funded by a grant from NOAA that supports the Coral Reef Ecosystem Monitoring Program in the CNMI. This program is a long-term interagency project between local and national agencies including the CNMI Coastal Resources Management Office, the Division of Environmental Quality, the Division of Fish and Wildlife, NOAA, U.S. EPA, and the USACE. The main goal of this program is to provide the information necessary for effective management of reef resources. It provides a means to document how reef communities change over time in response to natural fluctuations, acute disturbances (e.g. typhoons), and chronic disturbances (e.g. pollution). Documenting changes over time allows for assessing the impacts of land-based pollution and determining if management actions are needed, or working. Monitoring also provides information as to what organisms live on the coral reefs in the CNMI. This provides knowledge of areas that are most precious and endangered so prioritization of limited management resources to these regions can be made.

CNMI's Mooring Buoy Program[85]. In order to protect coral reefs and fisheries habitats from anchor damage at frequently visited sites, while assuring public access to marine resources, CNMI's Coastal Resources Management Office (CRM) and the Northern Mariana Dive Operators Association (NMDOA) worked together to install and maintain public marker and mooring buoys.

CNMI's Nonpoint Source Pollution, Marine Monitoring, and Coral Reef Program[86]. This branch of the Department of Environmental Quality (DEQ) is responsible for keeping CNMI waters clean and healthy for beneficial uses. It was established from the CNMI Coral Reef Initiative. Through this program, the DEQ provides demonstrations for best management practices and

[83] http://www.coralreef.gov/las/lasfactsheets2009/las09/lasguam.pdf
[84] http://www.crm.gov.mp/programs/monitoring/how.asp
[85] http://cnmibouymooring.blogspot.com/
[86] http://www.deq.gov.mp/section.aspx?secID=9

education and outreach campaigns concerning water quality issues through fairs and festivals such as the Environmental Symposium and Expo during Earth Day and the EcoArts Festival.

CNMI's Local Action Strategy[87]. The Local Action Strategies (LAS) the CNMI were developed through a coordinated effort among three natural resources management agencies: **the Coastal Resources Management Office, the Division of Fish and Wildlife and the Division of Environmental Quality**. Stakeholder meetings and input also contributed to the development of the strategies. LAS serve as tools to encourage stewardship towards coastal resource protection and restoration. CNMI has LASs on land- based sources of pollution, fishery management, recreational use, public outreach and awareness, and coral resources management.

CNMI is committed to the Micronesia Challenge, which has an overall goal of effectively conserving at least 30% of nearshore marine resources including coral reefs. Through the Resolution of the 17th Micronesian Chief Executives' Summit to Address the Global Environmental Impact of Climate Changes in Micronesia (See Resolution 17-03, March 15, 2012) the Commonwealth, and other Micronesia Challenge members, would "collaborate with local scientists, community members, educators, leaders and decision-makers in Micronesia to place climate change issues at the forefront of coral reef management through efforts to decrease global contributions to global emissions."

The Commonwealth of the Northern Mariana Islands Climate Change Working Group is a multi-agency climate change working group established in June 2012. The objectives of the working group include the following:

- Identify the communities, livelihoods, and ecosystems in CNMI that are most vulnerable to the impacts of climate change;
- Identify, assess, and prioritize adaptation strategies and policies;
- Identify gaps in knowledge and areas for future research; and
- Build capacity within CNMI departments and agencies to begin dealing with the impacts of climate change .

[87] http://www.coralreef.gov/las/lasfactsheets2009/las09/lascnmi.pdf

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