

Brainard *et al.*, 2011). Information is 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.

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 emitters in the world (Section 2.1.2).

2.1.1 International Regulatory Mechanisms Addressing GHG Emissions

2.1.1.1 Background

The World Meteorological Organization (WMO) held the First World Climate Conference from February 12-23, 1979 in Geneva. 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. They 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 Second Climate Conference was held again in Geneva from October 29 to November 7, and represented an important step towards a global climate treaty. 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. 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 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 UNFCCC, 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. Having received over 50 countries' instruments of ratification, the UNFCCC entered into force March 21, 1994. As of November 2010, UNFCCC has 194 parties.

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 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 Protocol to the Convention, which outlined GHG emissions reduction obligations for participating Annex I countries, along with what came to be known as Kyoto mechanisms¹⁰ (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 economies in transition agreed to legally binding¹¹ 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 outlined by S. Res. 98, passed in mid-1997 — 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 (or COP 11/MOP 1) took place between November 28 and December 9, 2005, in Montreal, Quebec, Canada. COP 11 was also the first Meeting of the Parties (MOP 1) 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 November 2010, 192 parties have signed and

¹⁰ 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 involves investment in sustainable development projects that reduce emissions in developing countries.

¹¹ 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).

ratified the Protocol. The U.S. signed but has yet to ratify the Protocol, meaning the U.S. has not committed to a legally binding GHG emissions reduction target by 2012 via this agreement. However, the U.S. did pledge to voluntarily work toward reducing emissions 7% below 1990 levels by 2012.

2.1.1.2.4 Bali Roadmap, 2007

After the United Nations Climate Change Conference in Bali, Indonesia in December of 2007, the participating nations adopted the Bali Road Map as a two-year process to finalizing a binding agreement in 2009 in Copenhagen. The 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 by 2009. The 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 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. It also includes 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, the goal of this conference was to fulfill the culmination of the Bali Road Map and produce a new protocol to address climate change on a global level after the existing Kyoto treaty expires in 2012. The Copenhagen Summit was generally considered a failure at the time in that no legally binding agreement (i.e. with an established enforcement branch and explicitly stated consequences for non-compliance like the Kyoto Protocol) was reached. The U.S., China, India, Brazil, and South Africa drafted the Copenhagen Accord on December 18, which the U.S. considered a "meaningful agreement." It was "taken note of," but not "adopted," in a debate of all the participating countries the next day, and it was not passed unanimously. The document 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 agreement and the way it was reached (negotiated by only the five countries mentioned above), but, as of January, 2010, 138 countries have signed the agreement. 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 emitters). Participating countries have established an unconditional (or "low") pledge which is what 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. More recently there are varying opinions on the significance of the Accord and some analysts feel it represents progress in climate negotiations by re-engaging the U.S. and provides a solid baseline for future negotiations (Grubb 2010; Light 2010).

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. Some participants agree that objectives set forth in the text of the Cancun Accords are not rigorous enough to reduce global warming but climate talks in Cancun were considered a success by the general media in that they appear to have ‘saved the process’ of international climate negotiations that was badly damaged after the previous year’s COP 15 in Copenhagen (Iqbal and Ghauri 2010). There was formal agreement on a number of issues 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 that will be generated from a "wide variety of sources, public and private, bilateral and multilateral, including alternative sources" (UNFCCC 2010). The intent is to secure the design of the fund from March – November 2011 and approval to begin the fund is expected at COP 17 in Durban, South Africa.

Japan, Canada, the U.S., and Russia successfully opposed a binding agreement on how to reach reduction targets by lobbying to abandon the Kyoto Protocol and replace it with a pledge and review system as proposed in the Copenhagen Accord. The U.S. never ratified the Kyoto Protocol and is opposed to binding GHG emissions reduction commitments extending into a second commitment period under Kyoto (post-2012). Canada, Japan, and Russia have also declared they will not agree to binding commitments for a second Kyoto commitment period. These positions caused some contention since developing countries have long insisted that developed countries should agree to binding reductions under the Kyoto Protocol or a similar agreement.

2.1.1.2.7 Durban Agreement, 2011

The UNFCCC held its COP17 in Durban, South Africa from November 28 through December 9, 2011. 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. In the short term, the work of reducing emissions will fall to individual nations to take the initiative since action is needed sooner rather than later in order to curb continued planet warming.

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 are Annex I countries that signed and ratified the Kyoto Protocol and therefore committed to GHG emission reductions by 2012. Those 12 account for ~24% of global emissions. The U.S. alone accounts for ~20% of global emissions. The aggregated reduction target by 2020 of all Annex I pledges 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 13 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 reduction target for this group (Rogelj *et al.* 2010) (see Table 3 in Section 2.1.3 below).

This section briefly describes commitments made via the Kyoto and Copenhagen agreements, GHG emissions trends from 1990 to the most recent year available¹², and regulatory mechanisms or initiatives in place at the national level to reduce GHG emissions, for each country. Numbers in () in each heading represent the approximate % of total global GHG emissions produced by each country in 2007 (excluding land use, land use change, and forestry sector (LULUCF)). Except where noted (for Indonesia and Brazil), figures for CO₂ 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 CO₂ and overall GHG emissions and LULUCF does 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 (19.9%)

The United States is currently the 2nd highest emitter of GHGs in the world, after China. The U.S. did not ratify the Kyoto Protocol; however, in 1997 the U.S. pledged to voluntarily reduce GHG emissions 7% below 1990 levels by the year 2012. According to the Environmental Protection Agency's (EPA) 2010 National Greenhouse Gas Inventory Report, total U.S. GHG

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 CO₂ emissions from the burning of fossil fuels. Source: World Bank via Google Public Data (http://www.google.com/publicdata/overview?ds=d5bnccppjof8f9_)

emissions increased by approximately 16.5% from 1990 to 2008 (EPA 2010). Although U.S. emissions dropped by approximately 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). 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. ranks 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).

Originally, the U.S. pledged a reduction commitment of 17% relative to 2005 levels under the Copenhagen Accord. However, the Obama Administration has yet to issue regulations to limit GHG emissions in accordance with the U.S.’s pledge under the Copenhagen Accord (Capiello 2010). During the UNFCCC COP16 held in Cancun, Mexico from November 29 – December 10, 2010, the U.S., along with several other developed nations, once again rejected the idea of binding emissions reduction commitments. As a leader in the developed world and one of the top two emitters of GHGs, the U.S.’s approach to international negotiations can have a direct and influential impact on reaching global consensus on an effective path forward to reduce GHG emissions aggressively enough to prevent warming beyond the 2°C target.

The EPA is the regulatory agency responsible for issuing and implementing regulatory initiatives predominantly under the Clean Air Act (CAA), and some other statutory authorities, to address issues related to climate change. In April 2007, the Supreme Court in *Massachusetts v. EPA* (127 S. Ct. 1438 (2007)) found that the EPA is 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. In May of 2010, EPA and the Department of Transportation’s National Highway 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, they are required to obtain a permit which 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. 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 February 24, 2012, EPA issued a proposed rule to keep GHG permitting thresholds at current levels established under the GHG Tailoring Rule (http://www.epa.gov/nsr/ghgdocs/TRStep3_Proposal_FRN.pdf, not yet published in the FR); after evaluating the progress of GHG permitting so far, EPA believes that state permitting authorities lack 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.

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.

2.1.2.1.2 Russian Federation (5.2%)

Russia's carbon emissions represent the 3rd highest in the world, behind China and the United States. Under the Kyoto Protocol, Russia originally committed to maintain emissions at 1990 levels by 2012. Since 1992, fossil-fuel CO₂ emissions from Russia dropped 25.9% (Boden *et al.* 2010) and total GHG emissions 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 committed to a 15 to 25% reduction in emissions by 2020 based on 1990 levels. However, necessary 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 ranks 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 fails to adopt any firm position in terms of CO₂ 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 is an ambitious plan that requires political action and currently lacks support 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 originated from renewable energy sources, excluding large hydro (IEA 2009).

2.1.2.1.3 Japan (4.3%)

Japan currently ranks 5th in overall GHG emissions. Under the Kyoto Protocol, Japan originally committed 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 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 ranks 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), beginning in 1999 and 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 adopted the New Climate Change Program. 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 government of Japan passed the Act on the Rational Use of Energy: Act No. 49 (Energy Conservation Act) in 1969 and subsequently revised it in 1993, 1998, 2002, and 2005. (Government of Japan 2005b) The 1993 revisions strengthen the quantitative goals, reporting requirements, and non-compliance penalties for designated energy management factories. They also establish a new enforcement authority concerning display requirements for energy efficiency and other information. The act also strengthens standards for cooling-only air conditioners and passenger cars, and issues new standards 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 are introduced, and 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 (2.7%)

Germany currently ranks 6th in overall GHG emissions. Under the Kyoto Protocol (and the European Union's (EU) Burden Sharing Agreement¹³), Germany originally committed to reducing GHG emissions by 21% below 1990 levels by 2012. Between 1990 and 2008, Germany's GHG emissions declined 21.4%. Germany aims 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 pledged an overall reduction of 20-30% below 1990 levels by 2020, which Germany contributes 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 ranks 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.

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

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 reaching 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.

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.

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. Germany released this plan even after it 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 (1.9%)

Currently, Canada ranks 7th in overall GHG emissions. Under the Kyoto Protocol, Canada originally committed to reducing GHG emissions by 6% below 1990 levels by 2012. Between 1990 and 2008, Canada's total GHG emissions 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 increased 24.1% between 1990 and 2008, the overall emissions growth trend slowed slightly in recent years and emissions since 2003 decreased by 0.8% (Environment Canada 2010).

Under the Copenhagen Accord, the Government of Canada 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 ranks 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 its high emissions trend.

In April 2007, the Government of Canada released "Turning the Corner: An Action Plan to Reduce Greenhouse Gases and Air Pollution" (Environment Canada 2008) which provides the ground work for Canada's approach to tackling climate change. This plan sets 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, 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 has to reduce its emission intensity by a further 2%.

Most recently, the Canadian Government attempted to pass legislation in the form of Bill C-311, the Climate Change Accountability Act. This Act, Canada's only climate change-specific legislation, 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, for the first time in Canadian history, a bill did not pass the Senate (Levangie 2010).

2.1.2.1.6 United Kingdom (1.8%)

Currently, the UK ranks 8th in overall GHG emissions. Under the Kyoto Protocol, the UK's originally committed to reducing GHG emissions by 12.5% below 1990 levels by 2012. From 1990 through 2008, total GHG emissions in the UK decreased by almost 17%. Under the Copenhagen Accord, the EU pledged an overall reduction of 20-30% below 1990 levels by 2020, to which the UK contributes 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 ranks 8th overall with a performance rating of 'good' (Burck *et al.* 2010). The UK is also recognized for 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 (DECC)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 (DECC 2010). The Climate Change Act of 2008 introduces a new, more ambitious target for the UK to reduce GHG emissions to 80% below base year levels by 2050, with 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 (DECC 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

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

emissions, and help large organizations generate cost savings through reduced energy expenditure (DECC 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 UK’s CO₂ 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 enables the UK Government to establish a framework for 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” (DECC 2010). The UK government implements additional regulatory and incentive tools such as building efficiency regulations, incentives for renewable energy use, as well as vehicle excise taxes according to emissions level.

2.1.2.1.7 Italy (1.6%)

Italy currently ranks 12th in overall GHG emissions. Under the Kyoto Protocol, Italy originally committed to reducing 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 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 CO₂ emissions annually. It further sought a shift in goods transport to rail from road, which currently carries 85% of goods traffic. The lower house endorsed the plan, 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 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. Under the Kyoto Protocol, Australia originally committed to limiting GHG emissions to 8% above 1990 levels by 2012. According to their 2010 National Inventory submission, as of 2008, Australia's GHG emissions increased approximately 29.4% above 1990 levels. Under the Copenhagen Accord, the Government committed to reducing 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 CO₂ 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 ranks 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; the Australian government designed this scheme 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 delayed the introduction of the Carbon Pollution Reduction Scheme. Emissions projections released in August 2009 show that in the absence of the Carbon Pollution Reduction Scheme, Australia's GHG emissions will rise approximately 20% above 2000 levels. Australia implements 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 agreement within Australia's Government regarding 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. Under the Kyoto Protocol (and the EU Burden Sharing Agreement), France originally committed to stabilizing 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 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 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 ranks 9th overall with a performance rating of ‘good’ (Burck *et al.* 2010).

Domestically, under the Energy Strategic Law of 2005, France 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 improves 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).

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

2.1.2.1.10 Spain (1.2%)

Spain currently ranks 19th in overall GHG emissions. Under the Kyoto Protocol (and the EU Burden Sharing Agreement) Spain originally committed to capping 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 expected 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 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 ranks 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 will 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 CO₂ 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 represents 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. Under the Kyoto Protocol Ukraine originally committed to ensuring 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 UNFCCC, 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 (National Environmental Investment Agency of Ukraine (NEIAU)¹⁵ 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, Ukraine passed Regulation #977 establishing the NEIAU. Within this regulation, the government delegated responsibilities of financing and implementing mechanisms to mitigate climate change and reduce emissions 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.

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

Ukraine's primary energy policy and priorities are defined in its Energy Strategy to 2030 (Government of Ukraine 2006)¹⁶, which was approved by the Cabinet of Ministers in 2006. The strategy aims 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. Under the Kyoto Protocol, Poland originally committed to reducing GHG emissions by 6% below 1988 levels¹⁷. As of 2008, Poland's total GHG emissions decreased by 29.6% from 1988 levels. Under the Copenhagen Accord, the EU 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 ranks 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

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.

reduction of the environmental impact of the power industry. In order to reduce GHG and other 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).

Poland enacted several other regulatory instruments and policies 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 Database¹⁸.

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 ranks 50th overall with a performance rating of 'very poor' (Burck *et al.* 2010).

In 2004, the Chairmanship of the Ministry of Environment and Forestry established the Coordination Board on Climate Change to determine policies, strategic measures, and activities for Turkey to adopt 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 Energy Efficiency Law also modified the Electricity Market Law of 2001, 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, Turkey completed an initial Climate Change Strategy paper, but failed to develop a comprehensive National Plan. 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 several others. More

¹⁸ <http://www.iea.org/textbase/pm/?mode=cc>

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 (22.3%)

China surpassed the U.S. sometime around 2006/2007 as the world's largest emitter of greenhouse gases¹⁹ (Netherlands Environmental Assessment Agency 2007, 2008; Rosenthal 2008). As a non-Annex I country, China makes no commitment under the Kyoto Protocol to reduce GHG emissions below 1990 levels by the year 2012. It submitted only one GHG Inventory to the UNFCCC in 1994. China opposes numerous proposals by UNFCCC parties that would require non-Annex I countries to submit GHG Inventories on a regular basis. Between 1990 and 2007, CO₂ emissions in China from the burning of fossil fuels increased 165%. Since 2000, total GHG emissions in China 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 pledged to reduce carbon dioxide emissions intensity²⁰ (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). There is speculation, however, as to whether or not 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) surmise 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 need 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 ranks 56th (down from 52nd in 2010) and in the 'very poor' performance category (Burck *et al.* 2010). China is ranked by far 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

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).

issues including climate change. In the international climate change arena, it abides by the 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).

As such, 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 show measurable progress toward their stated goals and are on track to meet or surpass them as of 2008 (see Leggett *et al.* 2008), China’s overall emissions continue to increase.

2.1.2.2.2 India (5.5%)

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 submitted only one GHG inventory to the UNFCCC in 1994. As a non-Annex I country, India has made no commitment under the Kyoto Protocol to reduce GHG emissions below 1990 levels by the year 2012. Between 1990 and 2007, India’s CO₂ 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). Despite their on-going policies and initiatives, India’s CO₂ 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 ranks 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 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 2007-2012²¹) prepared by the Planning Commission and some are found in the Integrated Energy Policy from 2006. The government is mandating the

²¹ <http://planningcommission.gov.in/plans/planrel/11thf.htm>

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, CO₂ 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 Assessment²² 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 (1.7%)

Iran currently ranks 10th in overall GHG emissions. As a non-Annex I country, Iran has 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 CO₂ 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 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).

²² <http://moef.nic.in/modules/others/?f=event>

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 and its journey through the legislative process highlights tensions within the Iran government. 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 has 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 CO₂ emissions is the energy sector (Jick Yoo 2008). Emissions of CO₂ 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, CO₂ 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, however, 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. South Korea also established a Special Committee for Climate Change in the National Assembly in 2001. A Task Force 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 set forth under this new Green initiative appear modest compared to those of other countries, however they will still require a rapid pace of change since very 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 has made no commitment under the Kyoto Protocol to reduce GHG emissions below 1990 levels by the year 2012. Between 1990 and 2007, Mexico's CO₂ 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).

Since President Felipe Calderón took office in 2006, climate change has been 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 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

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

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 has 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 CO₂ 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 only 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 2007).

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 policy²⁴ 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 mitigation sectors including energy, industry, and transport and describes intended policies including fuel standards, renewable energy requirements, and financial incentives to encourage

²⁴ <http://www.environment.gov.za/HotIssues/2010/cgreenpaper.pdf>

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 (1.4%)

Saudi Arabia currently ranks 14th in overall GHG emissions. As a non-Annex I country, Saudi Arabia has 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 CO₂ emissions from the burning of fossil fuels increased 87%. Saudi Arabia submitted its initial National Communication to the UNFCCC in 2005²⁵ 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 worst 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 other measures that encourage using alternatives to fossil fuels as its economy stands to be severely impacted by such actions in other countries. 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 in the form of a bailout 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 slash emissions and thereby cut their use of oil (Whittington 2009).

2.1.2.2.8 Indonesia (1.4%)

Currently, excluding emissions from LULUCF, Indonesia ranks 15th in overall GHG emissions. Important to note, however, is that Indonesia's estimated percentage of global GHG emissions and resulting rank reported here do not incorporate CO₂ emissions from LULUCF, for the sake of consistency. For most other countries, fossil fuel consumption in the energy sector is the primary source of CO₂ emissions. Because of the high uncertainty and lack of reliable data globally regarding CO₂ emissions from LULUCF and because it is not the primary source of CO₂ emissions for most countries, it is often not excluded from assessments of the relative

²⁵ <http://unfccc.int/resource/docs/natc/saunc1.pdf>

contributions of nations to global emissions. In Indonesia, however, LULUCF and peat fire contributions to CO₂ 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 CO₂ emissions. Incorporating these sectors, Indonesia has been estimated to contribute a much higher percentage to global 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 has made no commitment under the Kyoto Protocol to reduce GHG emissions below 1990 levels by the year 2012. Between 1990 and 2007, Indonesia's CO₂ 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 control²⁶. 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 Roadmap²⁷ 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 out a vision where significant reductions would be achieved through land use, land use change

²⁶ <http://adaptasi.dnpi.go.id/index.php/main/contents/54>

²⁷ <http://csoforum.net/attachments/Synthesis%20Roadmap%20Dec09.pdf>

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 CO₂ emissions from LULUCF, for the sake of consistency. For most other countries, fossil fuel consumption in the energy sector is the primary source of CO₂ emissions. Because of the high uncertainty and lack of reliable data globally regarding CO₂ emissions from LULUCF and because it is not the primary source of CO₂ 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 CO₂ emissions. According to Brazil’s initial National Communication to the UNFCCC, in 1994, LULUCF contributed 75% of Indonesia’s CO₂ 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 has made no commitment under the Kyoto Protocol to reduce GHG emissions below 1990 levels by the year 2012. Between 1990 and 2007, CO₂ 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 successfully 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 CO₂ 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. In order to show the international community their efforts and achievements to gain support for acceptance into the UNFCCC, Taiwan has implemented a number of laws and actions related to GHG emission reductions²⁸. 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. In addition to serving as the legal basis for developing and implementing domestic GHG emission reduction measures, the Act is also expected to demonstrate to the international community Taiwan's willingness to participate in global actions to reduce GHG emissions and to fulfill its responsibilities as a member of the international community. The legislative process

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

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 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 has 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 CO₂ 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 CO₂ 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 Policy²⁹ 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 Organization³⁰ to supervise Clean Development Mechanism implementation in Thailand (Ministry of the Environment, Japan 2006).

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

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 CO₂ emission reduction of 5% from 2003. Thailand presented its 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). The general consensus was that the National Climate Change Strategy is a good one.

2.1.2.2.12 Kazakhstan (0.8%)

Currently, Kazakhstan ranks 25th in overall GHG emissions. Kazakhstan's first National Communication to the UNFCCC (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 CO₂ 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 CO₂ 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 avoided the equivalent of 135 Gt CO₂ between 1990 and 2010, which is thought to effectively slowed the rate of warming

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).

and other climate change impacts by 7 to 12 years, as compared to what would occur under the continued use of ODS. As of 2010, net emissions reductions from ODSs are ~11 Gt CO₂ eq. per year, which is 5-6 times the reduction target of the first commitment period of the Kyoto Protocol (2 Gt CO₂ 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 recognizes HCFCs as transitional substitutes for CFCs phasing out that will eventually phase out as well. 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 thus 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 included discussions of expanding the scope of the Protocol 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). For the past four years, the Federated States of Micronesia promoted this approach. 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 CO₂ eq. by 2020 and 88 Gt CO₂ 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 CO₂ 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 hesitated to make decisions on GHGs 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 CO₂ over a specified time period; typically 100 years is used. (<http://www.epa.gov/highgwp1/scientific.html>)

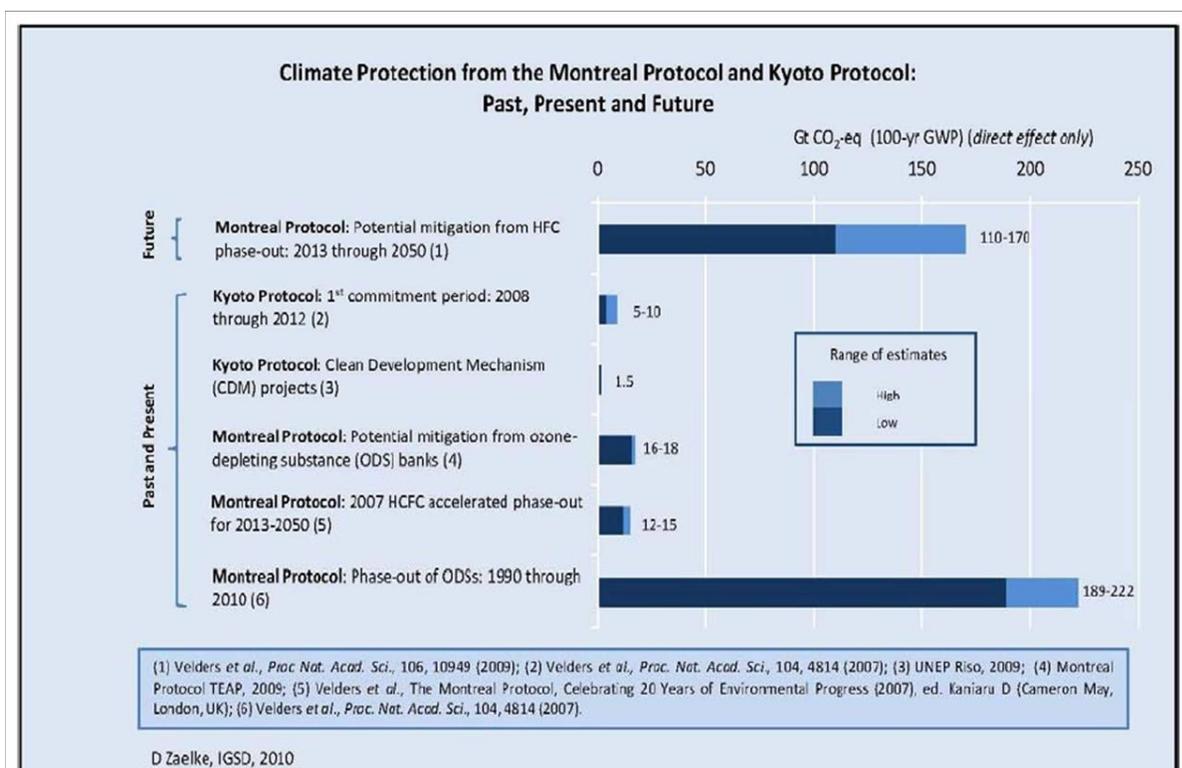


Figure 2. From: Summary of Federated States of Micronesia 2010 Proposal to Strengthen Climate Protection Under the Montreal Protocol presented to the 22nd Meeting of the Parties (MOP-22) of the Montreal Protocol in Bangkok, Thailand November 2010.

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 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 2010a).

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 signed but does not intend to ratify the Protocol as long as non-Annex I countries are not committed to emissions reductions targets alongside Annex I countries (CRS 2006). Instead, the U.S. pledged a voluntary GHG emission reduction target of 7% below 1990 levels by 2012, although as of 2008, emissions have grown in the U.S. to 14% 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 CO₂ emissions in 2009 by about 7%. Assuming that the non-CO₂ 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 does not necessarily translate into a reduction of the rate of global warming or in overall emissions for several reasons. First, in most 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 provide 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 limits the potential effectiveness of the Protocol in actually reducing the rate of global climate warming. Additionally, the Kyoto Protocol and its current requirements expire as of the end of 2012.

The Copenhagen Summit 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 resulted which recognizes the importance of keeping global warming capped at a 2°C increase above pre-industrial levels. There is widespread participation by countries making pledges for GHG emissions reduction targets under the Copenhagen Accord 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 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))
<u>Annex I:</u>				
U.S.	19.9%	-7% ³	+16.5% (2008)	-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. 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 CO₂ 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.

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 largest reef areas occur in the Bahamas and Cuba (each with about 1 percent of the world’s total), according to the 2001 Coral Reef Atlas’s Coral Reef Area Statistics³³. 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 are 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 are also 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 enact some sort of coral conservation program/regulation, most proactive coral initiatives/efforts in the region are small-

³³ [Hhttp://coral.unep.ch/atlaspr.htmH](http://coral.unep.ch/atlaspr.htm)

scale with, at best, localized effects. It is important to note that many of these efforts are ongoing 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 1983, the government passed 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 subsequent fisheries regulations of 1990, taking and/or collection of any corals is prohibited without written permission from the Chief Fisheries Officer (Antigua and Barbuda Fisheries Regulations 1990). 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 (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, it prohibits 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 Bahamian Government established the Exuma Cays Land and Sea Park. 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 are 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 with a total reef area of about 90 km². The Barbados Folkestone Park and Marine Reserve is currently the only legislated marine reserve on the island. The government of Barbados established the reserve in 1981 via the Designation of Restricted Areas Order and the Marine Areas (Preservation and Enhancement Act of 1976) (Barbados Marine Reserve) Regulation (Coastal Zone Management Unit of Barbados 2011). The reserve covers approximately 11 percent of the west coast (2.1 sq km) and is a no-take zone, including 4 different zoning designations (scientific, northern water sports zone, recreational, southern water sports zone). The National Conservation Commission actively manages the reserve with enforcement support from the Marine Police and Coast (National Conservation Commission 2011).

Important legislation directly affecting Barbados' coral reefs includes the Marine Areas (Preservation and Enhancement) Act of 1976, 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. 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 include 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 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 is 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

The Caribbean coast of Colombia boasts approximately 2,000 sq km of reef area of which approximately two thirds in the San Andres and Providencia Archipelago (located more than 700 km from the Colombian coast) (Burke and Maidens 2004). The Indo-Pacific portion of Colombia is covered in Section 2.2.2.

CORALINA is a public cooperation 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 also established the Seaflower Biosphere Reserve.

The 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 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 enforcement. 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). The Costa Rican government submitted a decree for the protection of corals by prohibiting extraction of corals and other organisms, yet failed to sign it (Cortes *et al.* 2009).

2.2.1.7 Cuba

Cuba has about 1 percent of the world's total coral reef area. 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 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 Fisheries Act #11 of 1987 and the Statutory Rules and Orders (SRO) #18 of 1998 established the Soufriere Scott’s Head Marine Reserve in 2000/2001. The Local Area Management Authority actively manages the reserve 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).

The National Parks and Protected Areas Act of 1975 established the Cabrits Marine Reserve. Management of the Cabrits Marine Reserve falls under the Forestry Department to conserve and

protect marine resources (including corals). With the exception of the permanent mooring system for yachts, the Cabrits Marine Reserve lacks active management (Geoghegan *et al.* 2001)

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, are either prohibited or regulated by the recently promulgated Environmental Law 64/00 and several Presidential Decrees. Nevertheless marine ecosystems management is not receiving sufficient financial and political support needed to support and implement 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). French law 79-6, AD/3/3 of April 1979 provides protection of leatherback turtles, lobsters and corals.

Guadalupe. Guadalupe is made up of two separate islands: Basse-Terre and Grand-Terre, whose Caribbean coasts boast diverse coral communities. In 1986, Guadalupe established the Grand Cul-de-sac Marin marine reserve, which covers approximately 37 sq km of coral reef area. Management responsibility of this MPA lies with the Parc National de la Guadeloupe. This MPA is also Man in the Biosphere (MAB) Reserve and a RAMSAR site (Burke and Maidens 2004). A management plan was completed in 1998 that directs activities to maintain biodiversity and water quality.

Martinique. 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 of August 1976. While Martinique lacks specific regulations for corals, Decree 67-158 of 1967, establishes regional nature parks with the purpose of managing for environmental protection, recreation and research. The regional nature park of Martinique includes its coral reef resources.

St. Barthélemy. The Prime Minister of France and the French Minister of the Environment signed a decree of creation, making St. Barths' Marine Reserve the 132nd natural reserve of France. The purpose of the reserve is to protect coral, sea life and fisheries. The taking of any corals is strictly prohibited.

St. Martin. Organic Law of 22 of February 2007 confirms the ecological value of protected areas in St. Martin and sets up the management responsibilities of the Nature Reserve. St.

Martin established La Reserve Naturelle Nationale De Saint-Martin³⁴ (National Nature Reserve) in 1998 which includes corals reefs and a marine park. The reserve strictly prohibits any disruption or disturbance of any flora or fauna within the reserve.

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.

The Fisheries (Amendment) Act of 1998 legally established both Molinere Reef/Beausejour and Woburn/Clarks Court Bay protected areas (Geoghegan et al. 2001). In 2001, the Fisheries Division implemented active management of these two protected areas. Together they cover a combined area of approximately 610 ha. Management committees include members of government, NGOs, stakeholders and community members. Management programs include zoning, stakeholder consultation and solid waste control. The 2006 8th Meeting of the Conference of Parties to the Convention on Biological Diversity resulted in the Grenada Declaration to effectively conserve at least 25% of its near shore marine area by 2020.

2.2.1.12 Guatemala

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

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

³⁴ <http://www.reservenaturelle-saint-martin.com/>

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 lacks marine protected areas (legislated or voluntary). The reefs face threats 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 approximately 127 sq km of fringing reefs.. 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). Curacao established the Curacao Underwater Park³⁵ in 1983 which 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). St. Maarten voluntarily established the St. Maarten Marine Park in 1997; however, the park lacks any legal ramifications. The park encompasses approximately 5128 ha and surrounds the entire Dutch coast of St. Maarten out to the 200-meter depth range. The park is 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 legal 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 (The Daily Herald Online 2011).

Netherlands 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 Marine Environment Ordinance (A.B. 1991 No. 8) legally established the Bonaire National Marine Park

³⁵ <http://www.carmabi.org/nature-management/curacao-marine-park>

in 1979, and later declared it a National Park in 1999. 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's Marine Environment Ordinance of 1987 established the Saba Marine Park. The park 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 precipitously 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 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). St. Eustatius' Marine Environment Ordinance (A.B. Nr. 3) established the Statia National Marine Park in 1996. The park is actively managed by STENAPA (St. Eustatius National Park Foundation) and 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 is 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 are 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. Since 2006, there are 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 it is unclear as to the level of enforcement on the ground. 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 exists 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 (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 are 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. A strong and active NGO works 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 are seriously impacted by bleaching, hurricanes, and the impacts of human activity, especially over-fishing. As a result, the local fishing committee 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 the best studied reefs in the world. Fringing reefs occur on the northern coast and also grow sporadically along the south coast. Reefs are also 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 km², and that less than 20 m deep is about 2400 km². 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). 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 provides 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

Little information exists for Nicaragua's fisheries and coastal management laws and regulations, although there are some MPAs with considerable coral resources. Cayos Miskitos y Franja Costera Inmediata 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 is 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

An estimated 1,600 sq km of coral reefs are spread along the majority of Panama's 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 km², 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 km², established 1976) that includes Portobelo Bay and 70 km of shoreline and coastal waters) east of Isla Galeta (Spalding 2004). These areas are recognized under Panamanian law, but there is little active management on the ground. The most extensive reefs occur in the San Blas Archipelago, which is controlled by the Kuna people. The presence of the Kuna protects the San Blas region from extensive development, sedimentation, and land-based sources of pollution, but extensive mining of live corals to enlarge islands is a problem (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. 2008). 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. Approximately 160 sq km of coral reefs occur in the waters of St. Kitts & Nevis, of which all are threatened by overfishing, coastal development, and sedimentation (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 are declared³⁶.

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 coast of St. Lucia, population increases along the coast and tourism development result in user conflicts between fishermen and divers, as well as fishermen and yachts. Consequently, after an 18 month-long process of participatory planning and stakeholder consultations, St. Lucia legally established the Soufriere Marine Management Area in 1994 under the 1984 Fisheries Act and the Parks and Beaches commission Act (Burke and Maidens 2004). 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 of 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 a 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 resources³⁷.

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 are designated under the 1987 Fisheries Conservation Act. One of these areas, the Tobago Cays, is 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 park and any future designated marine parks. The 1998 Marine Park (Tobago Cays) Regulation establishes 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 reef³⁸. An official management plan submitted to the Marine Parks Board in 1998 (Cordice 2008) aims to combat continuing threats to the park, including:

- Overfishing (particularly spear fishing)

³⁶ http://www.oas.org/dsd/fida/laws/legislation/st_kitts_&_nevis/st_kitts_&_nevis.pdf accessed 2010

³⁷ <http://www.smma.org.lc/index.php> 2010

³⁸ <http://www.tobagocays.com/fees.html>

- 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 Tobago). A combined 40 sq km of coral reefs occur in the waters surrounding Trinidad and Tobago, 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, established in 1973 under the Marine Area Order of the Marine Area (Preservation and Enhancement) Act of 1970 (from the Republic of Trinidad and Tobago Ministry of Legal Affairs³⁹). 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 are 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 include over-fishing and coastal development, as well as local threats such as hurricanes and physical damage due to tourism impacts (anchoring, divers). Marine-based pollution and sedimentation are not considered threats. Additionally, 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. The Marine Parks Ordinance established these marine reserves in 1982; however, the Marine Parks Regulations provided the mechanisms for active management in 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. Anguilla established the other marine reserves with the development of tourism in mind.

³⁹ http://rgd.legalaffairs.gov.tt/Laws2/Alphabetical_List/lawspdfs/37.02.pdf

British Virgin Islands (BVI). The British Virgin Islands is an overseas territory of the United Kingdom. An archipelago of 60 islands and cays, approximately 380 sq km of reef area occurs in the BVI's waters. The most extensive reef in the BVI is Horseshoe reef, a protected area which covers an area of 77 sq km.. 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. Eventually, the Trust established a mooring buoy system under the 1991 regulations governing the marine park which 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, the BVI Government Cabinet approved a proposed network of marine protected areas in efforts to protect 30% of BVI's important biological habitats (including coral reefs, mangroves, seagrasses, etc). This network of MPAs will feature 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 (Burke and Maidens 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 include prohibitions on the taking of any marine life, anchoring in any hard bottom habitats, and fish pots, nets and spearguns 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 lost approximately 50% of its inhabitable land due to a volcanic eruption in 1995. Significant plumes of sediment entered 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 (e.g., 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 (a 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 an area where most of the all-inclusive hotels are located. Overall, human impacts to corals are relatively low in TCI (i.e., little sediment runoff or eutrophication); however two recent boat groundings that damaged *A. palmata* resulted in large fines suggesting that 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 13089 on coral reef protection, 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 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

Little information exists for 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).

2.2.2 National Regulatory Mechanisms - Indo-Pacific (68 countries)

Of the 82 coral species, 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 are 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 are 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 reefs⁴⁰).

2.2.2.1 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.

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 include 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.

The Australian Government established the GBRMP in 1975, and placed a strong emphasis on education rather than enforcement of regulations because education as appeared to be 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, a 42 percent increase in the number of prosecutions occurred from 1999/2000 when first implemented (Skeat et al., 2000).

⁴⁰ [Hhttp://coral.unep.ch/atlaspr.htm](http://coral.unep.ch/atlaspr.htm)

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

Environment Protection and Biodiversity Conservation Act 1999⁴¹. 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 are established, plans are made for the wise-use of Ramsar wetlands, and places are identified for National Heritage and Commonwealth Heritage. Under this 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 1984⁴². 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 1994⁴³. This act pertains to managing fish and fishing areas in Western Australia. It provides guidelines for fishing activities and management plans.

Marine Parks Act 1997⁴⁴. This act provides authority to declare marine parks in New South Wales.

Marine Parks Reserve Authority⁴⁵. This agency manages marine protected areas in Western Australia under the Conservation and Land Management Act.

National Parks and Wildlife Conservation Act 1975⁴⁶. This act establishes national parks and other parks and reserves for the protection and conservation of wildlife across Australia.

The Wildlife Protection Act of 1982⁴⁷. 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 2008⁴⁸. 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 uncompact skeletal skeletons. Additionally any marine organism

⁴¹ <http://www.environment.gov.au/epbc/index.html>

⁴² http://www.austlii.edu.au/au/legis/wa/consol_act/calma1984290/

⁴³ http://www.austlii.edu.au/au/legis/wa/consol_act/frma1994256/

⁴⁴ http://www.austlii.edu.au/au/legis/nsw/consol_act/mpa1997135/sch4.html

⁴⁵ <http://www.dec.wa.gov.au/content/section/22/1355/>

⁴⁶ http://www.austlii.edu.au/au/legis/cth/num_act/npawca1975390/s1.html

⁴⁷ http://www.austlii.edu.au/au/legis/cth/num_act/wpoeaia1982578/

⁴⁸ 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.

The management regime for the Queensland Coral Fishery, in force under the Queensland Fisheries Act 1994 and the Queensland Fisheries Regulation 2008, requires persons engaged in fishing under the management regime to take all reasonable steps to ensure that members of listed threatened species, listed migratory species, cetaceans and listed marine species are not killed or injured as a result of the fishing

Sea Dumping Act 1981⁴⁹. 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 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 Island⁵⁰. 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 Spring⁵¹ on Christmas Island.

⁴⁹ <http://www.environment.gov.au/coasts/pollution/dumping/act.html>

⁵⁰ <http://www.environment.gov.au/parks/christmas/index.html>

⁵¹ <http://www.wdpa.org>

Cocos-Keeling Islands⁵². 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. 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.”⁵³ 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 Shipwreck⁵⁴.

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.

2.2.2.2 Bahrain

The Kingdom of Bahrain possesses about 126 km of coastline and 8,000 km² of marine area. More than 90% of the total population lives 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 extensive engineering and land reclamation projects within coastal waters (Maghsoudlou *et al.* 2008). In addition, anchor damage, over-fishing,

⁵² [http://www.ag.gov.au/www/agd/agd.nsf/Page/Territories_of_AustraliaCocos_\(Keeling\)_Islands](http://www.ag.gov.au/www/agd/agd.nsf/Page/Territories_of_AustraliaCocos_(Keeling)_Islands)

⁵³ <http://www.environment.gov.au/parks/publications/cocos/management-plan.html>

⁵⁴ <http://www.wdpa.org>

spear fishing, solid wastes, oil pollution, trawling nets, and sedimentation threaten Bahrain's reefs.

The first and only comprehensive law concerning the environment passed in 1996 by virtue of Law Decree No. 21 (1996). Biodiversity protection is 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 and Alsuhaibany 2000). Finally, a Committee for the Protection of the Marine Environment 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 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 2002).

2.2.2.3 Brunei

Brunei's two oceanic islands, 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 km² and is mostly confined to five areas far from the shore on offshore islands and shoals (UP-MSI *et al.* 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 Act 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 of the area or part thereof. This Order also provides protection, preservation and management of the natural breeding grounds and habitat of aquatic life, with particular regard to rare species. Marine reserves are also intended to allow for the natural regeneration of aquatic life in the area of part thereof where such life has been depleted, promote scientific study and research in respect of the area or part thereof, and preserve and enhance the pristine state and productivity of the area or part thereof.

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.), are 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 ceased, with the remaining rainforests protected by law (UP-MSI *et al.* 2002).

2.2.2.4 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 extensively damage 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, the government issued a Royal Decree entitled: "Creation and Designation of Protected Areas." This decree designates 23 areas and covers 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).

2.2.2.5 Chile

Easter Island, also known traditionally as Rapa Nui, is a self-governing territory of Chile. In January 1935 the Government of Chile declared the whole island as a National Park in order to protect natural and archaeological resources, including coral reefs. No regulations could be found for corals or coral reefs for the island.

2.2.2.6 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 result in serious damage and degradation of many of China's coral reefs (Zhang 2004). China's reefs are particularly targeted for valuable edible fish and other various species. As a result, areas around Hong Kong and the Xisha Islands are 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 also negatively impact China's reefs (Hui, 2004).

A series of laws and regulations exist in China 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 changed, 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 limestones; 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 2004 Fisheries Law of the People's Republic of China 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 Areas⁵⁵ 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 Reserve 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 Denglujiao 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, Hong Kong established several marine parks with the sole aim of conserving coral reefs.

The high value of reef resources in China encourages 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. Beginning in 1974, China claims territory over the Paracel Islands, although other countries make claims of territory as well. Due to jurisdictional disputes and long-standing conflicts over sovereignty of the islands, no laws or regulations exist in the South China Sea to

⁵⁵ <http://www.wdpa.org/>

protect the area from over-exploitation and degradation. This region is considered under high threat from destructive fishing (i.e., use of explosives) (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. In total, the Spratly group contains over 600 coral reefs. 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. Taiwan successfully established the Pratas Islands (Dungsha) Group within the Spratly Islands 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. Claimant nations examined a proposal to create an international marine peace park in a series of workshops. In the meantime, the area of the South China Sea remains susceptible to unsustainable commercial fishing and destructive fishing practices (Burke *et al.* 2002). Bryant *et al.* (1998) consider the reefs at low risk due to location, but states that unclear ownership and exploitation of resources exacerbates threats from destructive fishing.

2.2.2.7 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 the only place that exhibits extensive coral formations. Colombia's reefs are in decline due to both natural and anthropogenic threats such as overfishing and deforestation practices. There are 3 MPAs in Colombia's Pacific Waters, all of which are National Parks. Colombia designated the Island of Gorgona and its surrounding waters as 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).

2.2.2.8 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. Approximately 430 km² of reef occur in the waters of the Comoros Islands. Threats to corals include overfishing, coral mining and dynamite fishing.

The management of marine and coastal resources is not the responsibility of any sole institution. Decree no 93-115/PR of 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 the use of fishing nets, traps, and underwater spearguns is banned (Project GloBAL, n.d).

Currently, the Mohéli Marine Park is the only legislated marine protected area in the Comoros Islands. Initially funded by the Global Environment Facility and the United Nations Development Program, the park covers 404 km². Currently however, the park receives funds via 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 is 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.

2.2.2.9 Costa Rica

The Pacific coast of Costa Rica is 1,160 km long, with 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). Only three protected areas exist on Costa Rica’s Pacific coast that focuses on protection of the marine environment. These areas 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 is controlled, but it is still known to occur within the outer limits of the protected areas. Tourism is only 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).

2.2.2.10 Djibouti

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 boasts 370 km of coastal area (and 4 principal islands). Generally, the reefs of Djibouti experience high turbidity (i.e., sediment suspended in the water column) which limits 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’s two marine protected areas include the Territorial Park of Musha (est. 1972) and the Integral Reserve of South Maskali (est. 1980). Order 72-1363/SG/CG of September 20, 1972 established the Park of Musha, 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.

2.2.2.11 Ecuador

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 protections⁵⁶. 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.

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 establishes 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 establishes 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.

2.2.2.12 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. Aside from the Environmental Law of 1998, no other regulatory mechanisms could be found specific to coral reef protection

2.2.2.13 Egypt

Fringing reefs occur along the coastline of Egypt 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

⁵⁶ [Hhttp://www.mcatoolkit.org/Field_Projects/Field_Projects_Ecuador.html](http://www.mcatoolkit.org/Field_Projects/Field_Projects_Ecuador.html)

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 continue leading 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.

A total of 6 marine reserves that include protection for coral reefs exist in the coastal waters of Egypt. The Ras Mohamed Marine Park (established in 1983 but not actively managed until 1988) covers 210 km² and represents Egypt's first National Park, declared in 1989. In 1992, Egypt declared two additional marine Protectorates in the Gulf of Aqaba (Nabq and Abu Galum Managed Resource Protected Areas). In 1994, Nabq and Abu Galum Managed Resource Protected Areas combined 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.

2.2.2.14 Eritrea

Eritrea is located in the northeastern corner of the Horn of Africa and boasts 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 remained isolated over many years due to wars with neighbor Ethiopia, resulting in very little tourism development; thus, 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

normally experience bleaching at these levels, whereas Eritrean corals appear 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 established areas of protection by law in Eritrea; however, the capability of establishing protected areas does exist in laws within the previous Fisheries Proclamations, including a number of initiated articles relevant to the protection and conservation of marine resources and 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, is planned by the Eritrean government (Pilcher and Alsuhaibany 2000).

2.2.2.15 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).

Among numerous natural and anthropogenic threats to Micronesia's coral reefs, overfishing is 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 contributes 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). Protected areas established within FSM that encompass coral reefs are managed either nationally or by community stakeholders. Historically, the national government lacked much involvement in establishing MPAs; however, the establishment of the FSM Protected Areas Network resulted in higher priority for protected areas 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 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 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 harvest⁵⁷.

Also, by supporting the Micronesia Challenge, government officials 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).

2.2.2.16 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 occurs 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 carry 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 updates and replaces 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 (Republic of Fiji Department of Environment 1997). Coral reef loss is 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.

2.2.2.17 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 represent 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.

⁵⁷ http://www.seacology.org/projects/micronesia_projects.htm

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 possesses about 12,800 km² 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 are 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 Polynesian government is setting up Management Plans of Marine Areas which restrict 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 Decree of July 7, 2000 set forth by the Minister, established the overseas committee of the French Initiative for coral reefs (IFRECOR). IFRECOR is responsible for developing a 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.

French Polynesia established seven MPAs established in 1971 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. The French Government designated approximately 40 percent of the island of Réunion as part of France's 9th national park, called La Réunion National Park in 2007. It is one of the protected natural environments in France's Overseas Departments. To combat coral reef degradation, Réunion 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 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. A few fishing restrictions exist in the reserve, including no night fishing and no recreational fishing, net fishing, or spearfishing in enhanced protection zones⁵⁸. 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

⁵⁸ [Hwww.reunion.ecologie.gouv.fr](http://www.reunion.ecologie.gouv.fr)

National Natural Marine Reserve won an award in the Culture and Heritage category at the Responsible Tourism Awards.

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

The government of Mayotte established various decrees to regulate fishing.. 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 protection zones around aquaculture facilities, and limits the type of fish gear used and species taken (Pusineri and Quillard 2008).

Three marine protected areas exist in Mayotte: Patte de Longogori Strict Fishing Reserve (an IUCN category IV MPA, protected area managed mainly for conservation through management intervention); Saziley Park Marin (an IUCN category II MPA, protected area managed mainly for ecosystem protection and recreation); and a no category MPA. These areas contain mangroves and/or coral reef habitat⁵⁹.

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, which makes up 60% of the total reef area. The location of the reefs largely protects them from recent massive coral bleaching events that caused profound impacts on the reefs of neighboring countries. The Commission acknowledged that these reefs are 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 to harvest coral for commercial purposes. These regulations establish Yves Merlet reserve, the Bay of Prony reserves, the wreck of Humboldt reserve, l'ilot Ténia marine reserve, Négoro special reserve, and Ouano special marine reserve, all of which include areas where fishing is prohibited. There are a

⁵⁹ <http://www.wdpa.org>

total of 17 protected areas with limited or no fishing and restrictions on coral harvesting. Another seven encompass both marine and terrestrial protected areas⁶⁰.

An important management feature in New Caledonia is the strong customary tenure and practices of the Kanak (Melanesian) people. The Kanak people assisted 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 practice 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. Fringing reefs surround most of Wallis' coastline and are protected further by a barrier reef. Futuna coasts are comprised of narrow fringing reefs, and Alofi has few such areas. Fishing is important, although mainly on a subsistence level. Blast/dynamite fishing is still a problem in the islands.

2.2.2.18 Guatemala

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

2.2.2.19 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.

2.2.2.20 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 nonexistent. There are a few laws in the country that activate 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 affect coral reef areas are the Indian Forest Act of 1927, the Forest Conservation Act of 1980, and the Indian Fisheries Act (which is of vintage origin). Various state fisheries acts may 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 partially on land. There are also 100 wildlife sanctuaries (Pas) with terrestrial or freshwater ecosystems that either 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

⁶⁰ <http://www.wdpa.org/>

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 sites⁶¹.

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 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.

2.2.2.21 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, Nusa Tenggara, Bali and Maluku; some reefs are also found in West Irian Jaya, islands East and West of Sumatra and East of Kalimantan⁶². 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 (UP-MSI *et al.* 2002). According to the World Database on Protected Areas⁶³, 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 law⁶⁴. 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

⁶¹ <http://www.wdpa.org/>

⁶² www.arcbc.org/arcbcweb/publications/mpa.htm

⁶³ <http://www.wdpa.org>

⁶⁴ <http://indonesiurbanstudies.blogspot.com/2008/09/historical-overview-of-spatial-planning.html>

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 areas⁶⁵. 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 (UP-MSI *et al.* 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 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.

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

2.2.2.22 Iran

The coastline of Iran is approximately 2000 km along The 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.

2.2.2.23 Israel

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.

2.2.2.24 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. topical 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).

2.2.2.25 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.

2.2.2.26 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 addition 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).

2.2.2.27 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, Phoenix, 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 policies 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.

2.2.2.28 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).

2.2.2.29 Madagascar

Madagascar, one of the largest islands in the world, is home to 34 species of cetaceans, 5 species of marine turtles, 56 shark species, 300 types of hard corals, and 1,300 kinds of bony fish within its marine environment. 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 Radama⁶⁶. 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.

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 km² (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.

2.2.2.30 Malaysia

Malaysia is a federation of 13 states and two federal territories with an estimated coral reef area of 4,000 km². 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 (UP-MSI *et al.* 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).

⁶⁶ <http://www.wdpa.org>

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 parks⁶⁷.

2.2.2.31 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 km², of which about 99 percent is water. With a total area of 8,920 km², 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.* 1998).

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

⁶⁷ http://en.wikipedia.org/wiki/National_Parks_Act_1980_%28Malaysia%29

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.)).

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).

2.2.2.32 Marshall Islands

Located in the central Pacific Ocean and spanning more than 5,025,000 km² (1,940,000 mi²), 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).

2.2.2.33 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 Mauritius⁶⁸ 2011).

2.2.2.34 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 Park⁶⁹ 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.

2.2.2.35 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 (e.g., use of explosives, chemicals, etc.) 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

⁶⁸ <http://www.reef-mauritius.com/index.php>

⁶⁹ <http://www.cabopulmopark.com/thepark.html>

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 habitat⁷⁰.

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

2.2.2.36 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 km² 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 practices (e.g., use of explosives, chemicals, etc.), coastal development, and sedimentation threatening an estimated 10 percent. Marine-based pollution impacts only three percent of reefs (Burke *et al.* 2002).

Very limited 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 km² of mangrove area that are protected, and an estimated 387.5 km² 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.

2.2.2.37 Nauru

Nauru is a raised coralline island, with a total land area of only 21 km². 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

⁷⁰ <http://www.wdpa.org>

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).

2.2.2.38 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, including the Cook Islands and Tokelau. The Department of Conservation (DOC) is the government department charged with conserving New Zealand's natural and historic heritage for all to enjoy now and in the future. As a government department, the Department of Conservation is subject to laws passed by Parliament. 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 community for sustainable development as an overall national goal to be realized. The National Environment Service also specifically protects corals through the implementation of CITES. Suvarrow 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 Fakaofu (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>).

2.2.2.39 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.

2.2.2.40 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).

2.2.2.41 Oman

Major coral growth occurs in four regions along the varied shores of the 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.

2.2.2.42 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 high tide 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).

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).

2.2.2.43 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.

2.2.2.44 Panama

Panama's Pacific coast coral reefs are much smaller and less diverse than on the county's Caribbean (see Section 2.2.2). The reefs are also under very high pressure from natural impacts and increasing human activities (Cortes and Hatzioles 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.

2.2.2.45 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.

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 resources⁷¹, 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 Areas⁷² 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 Global⁷³.

⁷¹ http://www.worldwildlife.org/wildplaces/ng/pubs/PNG_Largest_Protected_Area.pdf

⁷² <http://www.wdpa.org/>

⁷³ <http://mpaglobal.org/index.php?action=search>

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.

2.2.2.46 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. (UP-MSI *et al.* 2002).

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 (UP-MSI *et al.* 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 areas⁷⁴. 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 Galera⁷⁵.

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

⁷⁴ http://www.iapad.org/pa/about_nipap.htm

⁷⁵ <http://www.wdpa.org/>

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.

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 (UP-MSI *et al.* 2002).

2.2.2.47 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 are dealt with 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).

2.2.2.48 Samoa

Marine resource management in Samoa is a combined 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).

2.2.2.49 Saudi Arabia

The Saudi Arabian coastline is approximately 1840 km in length, accounting for 79% of the eastern seaboard of the Red Sea. 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 established and implemented under the Protected Areas Act, 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.

2.2.2.50 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 including: 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).

2.2.2.51 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 (UP-MSI *et al.* 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 plagues 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 (UP-MSI *et al.* 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).

2.2.2.52 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 enjoys one of the highest levels of coral diversity anywhere in the world, with a recorded 494 species as of 2006. Reef condition is said to be "good" as of 2006, although threats to Solomon's reefs include overfishing of commercially important species and impacts from predatory outbreaks such as Crown of Thorns Starfish (COTS), although human impacts are generally low (Green *et al.* 2006). Traditional management systems are still of considerable importance in the Solomon Islands, with customary tenure allocating ownership of all reefs being "owned" to particular groups with fishing rights. It is common practice for Christian leaders, traditional *kastom* men, or even local villagers to place taboos on particular reefs for restricted periods of time. (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, a number of disputes and problems occurred, but in 1992 the site was revived and a community-based management committee established. The eastern third of Rennell Island is declared a World Heritage Site as of 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 (Government of Solomon Islands 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.

2.2.2.53 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).

2.2.2.54 South Africa

South Africa has very few "true" reefs with a total of 40 km² only 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).

2.2.2.55 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).

2.2.2.56 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, the 12 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. PERSGA developed management plans for the park 2003. With the exception of the Sanganeb Marine National Park, coral reefs only experience indirect management through government institutions and regulations (Pilcher & Nasr 2000).

While Sudan lacks any specific legislation that addresses coral reefs specifically, numerous national laws 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, awaits approval and implementation. Finally, the Comprehensive National Strategy states Sudan's commitment to the pursuit of sustainable development and environmentally sound resource management (Pilcher & Nasr 2000).

2.2.2.57 Taiwan

Coral reefs occur in all coastal waters around Taiwan with the exception of a sandy area on the west coast. Coral reefs are also found in 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, legislation that provides protection of coastal resources includes the National Park Law and the Coastal Environmental Protection Plan, and 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. These laws prohibit 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).

2.2.2.58 Tanzania

Numerous fringing and patch reefs are located along about two-thirds of Tanzania's 1,000 km coastline. The reefs of Tanzania are moderately to severely degraded as a result of destructive fishing practices such as the use of explosives and seine netting; however, increasing live coral cover indicates potential recovery for most of Tanzania's reefs (Muthiga *et al.* 2008). Tanzania's policies and institutional framework to oversee development and administration of MPAs are well-developed (Mwaipopo 2008). Coral reef management in Tanzania is incorporated into their integrated coastal zone management activities under numerous government agencies and stakeholders, including: the Fisheries Division; Environment Division; Marine Parks and Reserves Unit; District Natural Resources offices; Conservation Area authorities; Village Natural Resources Committee; NGOs; hoteliers; dive centres; and fishers (Muthiga *et al.* 2008). Two types of MPAs exist in Tanzania: marine parks and marine reserves. Tanzania's only national MPA, Mafia Island Marine Park, is managed through the Tanzania Marine Parks and Reserves Board of Trustees, with technical assistance from WWF. In total, mainland Tanzania has a total of 13 MPAs: 11 marine reserves and 2 marine parks, and the island of Zanzibar has 4 conservation areas. The difference in MPAs between mainland Tanzania and Zanzibar lies in their management. The government administers MPAs on mainland Tanzania, whereas the private sector and/or NGOs typically manage MPAs in Zanzibar. The Marine Parks and Reserves Act No. 29 of 1994 establishes MPAs on mainland Tanzania. 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).

The National Environmental Policy (1997) sets out the general management of the environment in Tanzania; however, both 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 direct operations of MPAs in Tanzania. In addition, the Fisheries Act of 2003 sets out additional guidelines for the fisheries industry and MPAs, providing regulations for protecting, conserving, developing, regulating or controlling the capture, collection, gathering, manufacture, storage or marketing of fish, fish products and aquatic flora. Other legislation that may affect corals in Tanzania 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.

2.2.2.59 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 (UP-MSI *et al.* 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, the National Environment Quality Act allows for certain areas to be declared as "areas under protection," and any measures deemed necessary can be imposed. The five different categories of protected areas in Thailand, include: 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 (UP-MSI *et al.* 2002). 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’ (UP-MSI *et al.* 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. Thirteen of the 21 National parks include coral reef areas, most of which are located in the Andaman Sea, and only five located in the Gulf of Thailand. Approximately 60% of the coral reef area is included within a protected area (UP-MSI *et al.* 2002).

2.2.2.60 Timor Leste

Timor-Leste’s coastline extends approximately 700 kilometers in length, with varying habitats along the coast. Few, small patches of coral reef occur on the north coast of Timor-Leste (Uniquist PTY LTD 2010). Various government decrees regulate marine fisheries in Timor-Leste. 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 also prohibited. Additionally, using explosives, electrocution, or toxic products for fishing is prohibited. National parks are established by the Minister of Agriculture, Forestry, and Fisheries and the Minister for Environment can prohibit fishing within national parks. Removal, collection, or destruction of is also banned. Currently, there is only one known MPA in Timor-Leste that contains coral reefs, although management effectiveness is unknown (Tun *et al.* 2008).

2.2.2.61 Tonga

The Kingdom of Tonga⁷⁶ is an archipelago in the South Pacific Ocean, comprising 169 islands, with only 36 of them inhabited. 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

⁷⁶ <http://www.e-pic.info/countries/pic/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 Government of Tonga 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. Currently, Tonga has established a total of 9 MPAs (Secretariat of the Convention on Biological Diversity 2006).

2.2.2.62 Tuvalu

Tuvalu is a small independent nation comprised of a chain of nine reefs and atolls in the Polynesian region of the South Pacific. A series of underwater volcanic eruptions resulted in the formation of coral reefs around the peaks, creating the island chain. A number of community groups (or Island Councils) established 6 marine conservation areas belonging to These groups decide when and where harvesting may take place within the conservation areas. 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 calls for the conservation of marine ecosystems and biodiversity essential to fisheries sustainability.

The Funafuti Conservation Area⁷⁷ 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. This area aims to increase populations of animals 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 for use in making management decisions; and
- A Management plan will be developed by the Conservation Area Project Officer together with the people of Funafuti. This plan provides information on permitted activities in the area and how income generating activities and sustainable use of the area are to be implemented and managed.

⁷⁷ http://www.timelesstuvalu.com/tuvalu/export/sites/TTO/Attractions/funafuti_conservation_area.html

2.2.2.63 United Arab Emirates

The United Arab Emirates (UAE) boasts an extensive coastline of about 700 km facing the Arabian Gulf on the west coast, and the Gulf of Oman on the east coast. 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.

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 Aspinal, Simon 2001).

2.2.2.64 United Kingdom

The United Kingdom possesses 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).

2.2.2.65 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; (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.

2.2.2.65.1 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, Papahānaumokuākea 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.

2.2.2.65.2 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.

2.2.2.65.3 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.

2.2.2.65.4 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.

2.2.2.65.5 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.

2.2.2.66 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 upon which the people of Vanuatu rely heavily. Anthropogenic threats to Vanuatu's coral reefs include: coastal

construction, land reclamation, waste disposal, livestock farming, logging, soil erosion and effluent from septic tanks.

Management approaches differ between each cultural group in Vanuatu, 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).

2.2.2.67 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's coastal waters include an estimated 1,100 km² of reef area, with the most diverse reefs located in the south (Burke *et al.* 2002). According to the Reefs at Risk in Southeast Asia model, approximately 96 percent of Vietnam's 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 (e.g., use of explosives, chemicals, etc.), 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, passed by the National Assembly on December 27, 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 enforced by the Department of Fisheries Resources Protection, (established in 1993 under the Ministry of Fisheries) (UP-MSI *et al.* 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 with 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 (UP-MSI *et al.* 2002). Currently, only a small proportion (approximately 11 percent) of Vietnam's coral reef resources is protected within MPAs (Burke *et al.* 2002).

2.2.2.68 Yemen

Yemen is located in the southeastern part of the Arabian Peninsula with three main coastal regions, including: 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 established a number of national laws that relate directly and indirectly to the marine environment. Some of the laws more pertinent to coral reefs are described below.

In 1995, Yemen established Law No. 26 with the aim of fulfilling international commitments regarding environmental protection and combating pollution. This law emphasizes the responsibility of on government authorities, public and private institutions, as well as individuals to protect the environment and its natural resources, combat pollution, and protect terrestrial and marine wildlife.

Law No. 11 of 1993 provides protection of the sea from pollution, mainly concerned with pollution by oil and passing ships. The law sets out procedures for prosecuting, penalizing and requesting compensation from ships that violate the law. It grants the Public Corporation for Maritime Affairs the legislative authority to deal with oil pollution at sea. Article No. 35 of the law 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 Presidential Resolution No. 43 amended the law in 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 for declaration as a World Heritage Site by UNESCO. These islands contain 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).

2.2.3

International Regulatory Mechanisms Addressing Local threats

Convention on International Trade in Endangered Species⁷⁸. The Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES) is a treaty that pertains only to 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).

Convention on Biological Diversity⁷⁹. 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

⁷⁸ <http://www.cites.org/>

⁷⁹ <http://www.cbd.int/>

survey and certification of ships. Together the Convention and Protocol are to be read as one 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 Convention⁸⁰. 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, the purpose of this Management Report is also 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-

⁸⁰ http://www.ramsar.org/cda/en/ramsar-home/main/ramsar/1_4000_0__