

# **Coral Reefs: The Failure to Regulate at the International Level**

*Kristin Kushlan\**

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\* J.D., 2009, University of Baltimore School of Law. The author would like to thank Professor Steve Davison, University of Baltimore School of Law, and Philip Kushlan, University of Miami, for their invaluable advice and guidance.

## INTRODUCTION

Coral reefs are found in warm climates throughout the world and are an essential component of marine ecosystems. Coral reefs must be protected because they are the most diverse ecosystems in the world. Protection of the diversity of coral reefs is vital because the multiplicity of species inhabiting coral reefs provide aesthetic beauty as well as important sources of medical discovery. "Coral reef ecosystems have the largest biodiversity per unit of area on Earth. Although only 93,000 coral reef species have been catalogued, one scientist estimates there are at least 950,000 and possibly up to nine million."<sup>1</sup> Although coral reefs cover less than 0.2% of the ocean floor, they are home to nearly one-quarter of all marine species and recent studies indicate that biodiversity of coral reefs may be even higher than previously estimated.<sup>2</sup> "Despite their limited area, coral reefs may be home to up to twenty-five percent of the fish catch of developing countries or ten percent of the total amount of fish caught globally for human consumption as food."<sup>3</sup> Because coral reefs provide vital habitats to numerous marine organisms, any damage done to either a coral reef—or any species that lives in a reef—seriously harms the delicate balance of the entire reef ecosystem.

Coral reefs worldwide are facing rapid degradation from numerous sources. The primary causes of damage to coral reef ecosystems are water pollution, destructive fishing practices, and climate change.<sup>4</sup> Since most of these threats are the result of human activity, they can and should be regulated at both the local and international levels. Despite the importance of coral reefs and the myriad harms they face, there is no existing international treaty which seeks to protect the world's coral reefs. Some treaties address certain aspects essential to the protection of coral reefs, such as the exportation of coral or reduction of greenhouse gas emissions that cause global warming. All attempts at comprehensive regulation to protect coral reefs presently take place at the domestic level. However, domestic regulation fails to address the overreaching concerns affecting the world's coral reefs. This paper proposes an overarching international treaty that would provide local governments with guidelines for protection of coral reefs and regulation of activities that harm them. Because coral reefs are vital to the health of the world's oceans, the world's nations need to adopt such a treaty to protect coral reefs.

Part I of this paper provides a brief overview of the anatomy and function of

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<sup>1</sup> RADOVLAV S. DIMITROV, SCIENCE & INTERNATIONAL ENVIRONMENTAL POLICY 133 (Rowman & Littlefield Publishers, Inc. 2006).

<sup>2</sup> Odyssey Expeditions, Living Corals, <http://www.marinebiology.org/coralreefs.htm> (last visited Feb. 11, 2010).

<sup>3</sup> *Id.*

<sup>4</sup> DIMITROV, *supra* note 1, at 131.

coral reefs, discussing in particular the sensitive nature of these fragile organisms. It also examines the numerous harms that threaten the reefs. Part II then examines existing international conventions and the present lack of a single convention regulating the multiple threats facing coral reefs. Finally, Part III proposes a new convention that would seek to have nation-states establish new domestic programs to regulate the multitude of activities that threaten coral reefs and to prevent further significant threats to the world's coral reefs.

## I. CORAL REEFS: A BRIEF OVERVIEW

This section briefly discusses what a coral reef is and the threats facing coral reefs. As discussed in more detail below, corals are complex organisms that live in symbiotic association with photosynthetic dinoflagellates (algae).<sup>5</sup> Reefs are created by generations of calcium carbonate deposits. Reefs provide shelter for most marine organisms at some stage of their lives, and are a pivotal component of both inshore and deep ocean ecosystems. "Coral reefs are the ecosystems richest in biological diversity and are considered a focal point of interaction between marine ecology and coastal socioeconomics."<sup>6</sup> Degradation of coral reef systems is caused by numerous sources, both human and natural, and regulating the damage from anthropogenic activities is essential to their survival.

### A. *The Coral Reef*

To understand the nature and biology of a coral reef, one must understand the coral organism. Corals are living animals that are related to sea anemones.<sup>7</sup> An individual "coral" is comprised of colonies of thousands of tiny polyps, which are genetically identical to each other and multiply through asexual budding.<sup>8</sup> A hard, protective limestone skeleton, called a calicle, is found at the base of a coral polyp and helps provide the structure for coral reefs.<sup>9</sup> Corals are classified as either hard or soft depending on their structure.<sup>10</sup> The polyps of hard corals make a sturdy, protective shell out of calcium carbonate, while polyps on soft coral do not build hard skeletons.<sup>11</sup> Common examples of soft coral include sea fans, sea whips, leather corals, and tree corals.<sup>12</sup> The 835 known species of hard

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<sup>5</sup> PetEducation.com, Coral Anatomy and Physiology, <http://www.peteducation.com/article.cfm?c=16&aid=2987> (last visited Feb. 24, 2010).

<sup>6</sup> DIMITROV, *supra* note 1, at 131.

<sup>7</sup> PetEducation.com, *supra* note 5.

<sup>8</sup> Great Barrier Reef, Coral Facts, <http://www.barrierreefaustralia.com/the-great-barrier-reef/coralfacts.htm> (last visited Mar. 9, 2010).

<sup>9</sup> National Geographic, Coral, <http://animals.nationalgeographic.com/animals/invertebrates/coral.html> (last visited Feb. 24, 2010).

<sup>10</sup> PetEducation.com, *supra* note 5.

<sup>11</sup> *Id.*

<sup>12</sup> *Id.*

corals are responsible for building the world's reefs.<sup>13</sup> These corals also help to form the structure of coral reefs. Although both hard and soft corals are usually found in reefs, they can also both live in places other than reefs.<sup>14</sup> "Coral organisms, can live on their own, but are primarily associated with the spectacularly diverse limestone communities, or reefs, they construct."<sup>15</sup>

Though corals appear colorful, the polyps themselves are actually translucent. The colors come from the symbiotic dinoflagellates (algae called zooxanthellae) that live under the skin of the polyps.<sup>16</sup> Corals get most of their nutrition from the products of zooxanthellae photosynthesis, but they also use barbed, venomous tentacles to catch zooplankton and small fish from the water column.<sup>17</sup> Corals that harbor photosynthetic zooxanthellae live close to the surface of ocean waters where they can absorb rays from the sun.<sup>18</sup> "While corals themselves are relatively resilient, the algae [zooxanthellae] on them are sensitive to environmental conditions such as the water temperature and transparency."<sup>19</sup> Accordingly, coral is also susceptible to such external forces.

When corals deposit their skeletons on top of each other, generation after generation, the result is the formation of a reef. There are many definitions of a coral reef, but, "[a]mong biologists, the most widespread definition is a rigid, wave-resistant framework constructed by large skeletal organisms."<sup>20</sup> Reef formations begin when a coral larvae attaches to a hard substrate on the sea floor and divides, or "buds into thousands of clones."<sup>21</sup> The limestone deposits from the calicles of the individual polyps connect to create a colony that acts as a single organism.<sup>22</sup> "As colonies grow over hundreds and thousands of years, they join with other colonies and become reefs. Some of the coral reefs on the planet today began growing over fifty million years ago."<sup>23</sup> Coral reefs can remain living, active ecosystems for extremely long periods of time. A polyp can live from two years to hundreds of years and a reef can exist anywhere from five years to several centuries.<sup>24</sup> "Many reefs are about 8,000 years old . . . and some are as much as 2.5 million years old . . ."<sup>25</sup>

Coral reefs are home to thousands of species of fish. These fish are important

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<sup>13</sup> DIMITROV, *supra* note 1, at 133.

<sup>14</sup> *Id.*

<sup>15</sup> National Geographic, *supra* note 9.

<sup>16</sup> *Id.*

<sup>17</sup> *Id.*

<sup>18</sup> *Id.*

<sup>19</sup> DIMITROV, *supra* note 1, at 133.

<sup>20</sup> *Id.*

<sup>21</sup> National Geographic, *supra* note 9.

<sup>22</sup> *Id.*

<sup>23</sup> *Id.*

<sup>24</sup> *Id.*

<sup>25</sup> DIMITROV, *supra* note 1, at 133.

both to marine ecosystems and humans. Within a reef ecosystem, fish are an important part of the delicate food chain and their depletion throws the entire ecosystem out of balance.<sup>26</sup> In addition, fish that inhabit coral reefs are vital sources of food and livelihood for locals.<sup>27</sup> Coral reefs are also popular with tourists for snorkeling and scuba diving. "More than 500 million people depend upon reef resources, and one billion people worldwide are direct beneficiaries of coral reef-related goods and services."<sup>28</sup> Accordingly, the protection of the world's coral reefs is vital to the health of both the world's economy and the world's oceans.

### B. Threats Facing Coral Reefs

Coral reefs are among the most threatened ecosystems on earth. Human activity has damaged or destroyed them in 93 of the 109 countries in which they are found.<sup>29</sup> "In addition, human impacts may have directly or indirectly caused the death of five to ten percent of the world's living reefs, and if this pace of destruction is maintained, another sixty percent could be lost in the next 20-40 years."<sup>30</sup> As discussed in more detail below, there are numerous sources of disturbance that are causing degradation of coral reefs, including various forms of water pollution, mining, unsustainable or damaging fishing practices, overharvesting for the aquarium trade, and global climate change.<sup>31</sup>

Before 1998, the best available estimates of harm occurring to coral reefs were based on "guesswork...and anecdotal evidence...that ten percent of the world's reefs were dead, and that another thirty percent were likely to die within ten to twenty years."<sup>32</sup> In 1996 the Global Coral Reef Monitoring Network ("GCRMN") was formed. The organization's goal is to collect, synthesize, and disseminate information on coral reef health and help local communities and nation-states develop the capacity for accurate reef assessment.<sup>33</sup> GCRMN employs hundreds of researchers who, in a partnership with Reef Check, engage

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<sup>26</sup> U.S. Env'tl. Prot. Agency, Coral Reef Protection, <http://www.epa.gov/owow/oceans/coral> (last visited Mar. 9, 2010).

<sup>27</sup> NOAA Coral Reef Conservation Program, Fisheries, <http://coralreef.noaa.gov/aboutcorals/values/fisheries/> (last visited Mar. 3, 2010).

<sup>28</sup> The Nature Conservancy, Coral Triangle Center, <http://www.coraltrianglecenter.org> (last visited Feb. 24, 2010).

<sup>29</sup> Odyssey Expeditions, *supra* note 2.

<sup>30</sup> *Id.*

<sup>31</sup> DIMITROV, *supra* note 1, at 131.

<sup>32</sup> *Id.* at 137 (citing DIRK BRYANT ET AL, REEFS AT RISK 7 (World Res. Inst. 1998); Clive Wilkinson, Remarks during Proceedings of the 7th International Coral Reef Symposium, Guam, Micronesia (June 22-27, 1992)).

<sup>33</sup> *Id.* (citing GCRMN, STATUS OF CORAL REEFS OF THE WORLD: 1998 (Clive Wilkinson ed., 1998)).

in global assessments of coral reef distribution in six regions of the world.<sup>34</sup> The organizations also monitor the condition and vulnerability of the world's coral reefs.<sup>35</sup>

One of the first reliable global assessments of coral reef conditions was a report by GCRMN. The report found that "most of the world's reef's corals are in good or excellent condition, because they are either remote from human populations, or under good management."<sup>36</sup> The report stated that only ten percent of the world's coral reefs had been severely degraded and that the damaged reefs had a high chance of recovery.<sup>37</sup> GCRMN's second report concluded that "twenty-seven percent of the world's coral reefs [had been] lost, that in 1998 alone, sixteen percent were destroyed, and that 'probably half of those will never adequately recover.'"<sup>38</sup> The report also predicted that forty percent of the world's coral reefs would be lost by 2010 and another twenty percent would be lost in the following years.<sup>39</sup> GCRMN's 2004 report concluded that twenty percent of the world's coral reefs have been destroyed and that another twenty percent face imminent risk of collapse due to human activities.<sup>40</sup>

There are numerous causes of coral reef degradation. "The factors behind coral reef decline can be grouped into three categories: natural causes, direct human causes, and indirect human causes."<sup>41</sup> Natural causes include "hurricanes, typhoons, underwater earthquakes, seabed volcanoes, disease, and pest outbreaks."<sup>42</sup> Some of these natural phenomena are now thought to be exacerbated by climate change.<sup>43</sup>

Some of the most harmful short-term threats to coral reefs are direct human causes such as "sedimentation (from poor land use such as clear-cutting on steep slopes and other activities such as dredging without silt curtains), eutrophication (over-fertilization caused by excessive fertilizer use and sewage pollution), and overfishing," which destroys the biodiversity of a coral reef ecosystem.<sup>44</sup> Additional commonly-occurring direct human causes of damage to coral reefs

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<sup>34</sup> *Id.*

<sup>35</sup> *Id.*

<sup>36</sup> *Id.* at 138 (citing GCRMN, STATUS OF CORAL REEFS OF THE WORLD: 1998 (Clive Wilkinson ed., 1998)).

<sup>37</sup> *Id.*

<sup>38</sup> *Id.* at 139 (citing GCRMN, STATUS OF CORAL REEFS OF THE WORLD: 2000 I (Clive Wilkinson ed., 2000)).

<sup>39</sup> *Id.*

<sup>40</sup> *Id.* at 135 (citing GCRMN, STATUS OF CORAL REEFS OF THE WORLD: 2004, Executive Summary (Clive Wilkinson ed., 2004)).

<sup>41</sup> *Id.* at 140.

<sup>42</sup> *Id.*

<sup>43</sup> *Id.*

<sup>44</sup> Odyssey Expeditions, *supra* note 2.

include destructive fishing techniques such as the use of fine mesh nets, cyanide poisoning, and the use of dynamite.<sup>45</sup>

Coral reef degradation is also caused by indirect human impacts.<sup>46</sup> Indirect human impacts on coral reefs include global warming, rising sea levels, increased ultraviolet radiation from ozone depletion, and—perhaps of most concern for corals—ocean acidification from carbon dioxide absorption.<sup>47</sup> As the oceans become more acidic, there will be a point at which organisms will stop depositing calcium carbonate and will start dissolving.<sup>48</sup> Accordingly, indirect human impacts on coral reefs need to be addressed at the international level.

Direct human causes of damage to coral reefs, not indirect causes, receive the most international attention. These causes “occur on a relatively small scale and have minor to moderate impact, but because they are wide-spread, chronic and persistent, they lead to the steady decline in the health and distribution of corals.”<sup>49</sup> Reefs at Risk lists four direct human causes of reef degradation: coastal development, overexploitation, inland pollution and erosion, and marine-based pollution.<sup>50</sup> Coastal development affects reefs in a number of ways. Coral is harvested and ground for building material to produce lime that can be used as plaster or as a mix in concrete.<sup>51</sup> Also, development in coastal areas can cause harm to nearby coral reefs through anchoring of vessels directly off-shore, dredging of harbors, and construction occurring in shallow waters.<sup>52</sup>

Overexploitation of coral reefs occurs in many forms. The impact of fishing and harvesting pressure is magnified by the use of fishing practices that are destructive to the greater reef.<sup>53</sup> Blast fishing, where fishermen kill schools of fish with small bombs, destroys corals and other organisms on the reef.<sup>54</sup> Poison fishing, where fishermen squirt cyanide into the water to stun and capture fish,<sup>55</sup> is harmful to coral and reduces biodiversity. This method also

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<sup>45</sup> *Id.*

<sup>46</sup> DIMITROV, *supra* note 1, at 140 (indirect human impacts include any involving speculative human influence).

<sup>47</sup> The Encyclopedia of Earth, Coral Reefs and Climate Change, [http://www.eoearth.org/article/Coral\\_reefs\\_and\\_climate\\_change](http://www.eoearth.org/article/Coral_reefs_and_climate_change) (last visited Mar. 9, 2010).

<sup>48</sup> *Id.*

<sup>49</sup> DIMITROV, *supra* note 1, at 140 (citing Clive Wilkinson & Bernard Salvat, *Global Coral Reef Monitoring Network: Reversing the Decline of the World's Coral Reefs*, in CORAL REEFS: CHALLENGES AND OPPORTUNITIES FOR SUSTAINABLE MANAGEMENT 17 (World Bank 1998)).

<sup>50</sup> DIMITROV, *supra* note 1, at 140.

<sup>51</sup> *Id.* at 141 (citing HERMAN CESAR, ECONOMIC ANALYSIS OF INDONESIAN CORAL REEFS (World Bank 1996)).

<sup>52</sup> *Id.* at 140.

<sup>53</sup> DIMITROV, *supra* note 1, at 141.

<sup>54</sup> *Id.* (citing HERMAN CESAR, ECONOMIC ANALYSIS OF INDONESIAN CORAL REEFS (World Bank 1996)).

<sup>55</sup> *Id.*

directly impacts the coral organism because the cyanide poison kills the coral polyps.<sup>56</sup> When coral fragments are gathered for the aquarium trade, the collection technique is usually no more sophisticated than walking along a shallow reef, dropping a cinder block, and collecting the corals that break off cleanly.<sup>57</sup>

In addition, unregulated tourism can lead to physical damage to coral reefs by scuba divers and tourists. These activities:

would probably be a minor threat if the number of visitors to reefs were limited to moderate levels and if water quality was always high enough to support rapid recovery of corals. However, tourism often results in large numbers of visitors, which leads to extensive physical damage, sewage pollution, and other adverse water quality impacts which slow or eliminate recovery.<sup>58</sup>

All of the aforementioned anthropogenic causes of reef degradation are interconnected and will only become more intense as coastal populations grow. A common result of anthropogenic stress on coral reefs is an increase in nutrient levels and a decrease in herbivorous fish, which in turn allows large algae species to overgrow the corals.<sup>59</sup> This phenomenon is called a "coral-algal phase shift."<sup>60</sup> The end result is the death of the coral and a huge reduction in the diversity of fish and other organisms that call the reef home.

Another effect of anthropogenic pressures on the world's coral reefs is coral bleaching, which is a coral's response to many kinds of stress. At least some corals in every major tropical region of the world were bleached white during the 1980s due to an unusually warm summer.<sup>61</sup> "Bleaching is caused by a variety of factors, including siltation and changes in salinity resulting from poor land use, pollution, and slight increases in temperature."<sup>62</sup> When stressed by any of these factors, corals will "expel" the zooxanthellae and thus lose their supply of nutrients as well as their color.<sup>63</sup> Recent genetic studies have suggested that the bleaching response serves the purpose of allowing the corals to repopulate

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<sup>56</sup> The Destruction of Coral Reefs, <http://plaza.ufl.edu/bettie/coralreef.html> (last visited Feb. 24, 2010).

<sup>57</sup> *Id.*

<sup>58</sup> Odyssey Expeditions, *supra* note 2.

<sup>59</sup> John W. McManus et al., *Coral Reef Fishing and Coral-Algal Phase Shifts: Implications for Global Reef Status*, 57 ICES J. OF MARINE SCI. 572, 572-78 (2000).

<sup>60</sup> *Id.*

<sup>61</sup> Odyssey Expeditions, *supra* note 2.

<sup>62</sup> *Id.*

<sup>63</sup> National Geographic, *supra* note 9.



themselves with a different type of zooxanthellae from the water column, which may be more tolerant to the physical conditions of the coral.<sup>64</sup> However, such an event “can kill the colony [of coral in a reef] if the stress is not mitigated.”<sup>65</sup>

Bleaching depresses coral growth rates, which can lead to mass coral mortality, enormous aquatic population loss, and even to extinction of marine species that rely on the habitat provided by the coral reef.<sup>66</sup> Because algae is expelled from coral reefs as ocean water temperatures rise, “[c]oral reefs may bleach even more extensively if global warming continues unabated.”<sup>67</sup> However, corals can survive without algae for several weeks.<sup>68</sup> Normally the remaining algae still present in a bleached coral reef can repopulate the reef and return color to the coral.<sup>69</sup> Thus, if the rise in water temperatures can be stopped, coral bleaching could be significantly reduced or eliminated.

## II. INTERNATIONAL REGULATION

Coral reefs are found in most oceans in the world, and the protection of the coral organisms that inhabit these reefs is vital to protecting the health of the world’s marine life. Yet no international treaty on coral reefs exists and the matter “is not even on the global political agenda.”<sup>70</sup> “Despite symbolic gestures such as declaring 1997 [and 2008] as the International Year[s] of the Reef, States are unwilling to introduce a formal policy agreement on coral reef management.”<sup>71</sup>

### A. An Essential Lack of Policy

The fact that no international treaty governing the management and protection of coral reefs exists is disturbing considering the relatively limited barriers to creating such a treaty.

“First, there are no interest groups who oppose remedial policy action” to protect coral reefs.<sup>72</sup> “On the contrary, businesses such as pharmaceutical companies and tourist ventures have vested interests in reef preservation, and one would expect them to be active proponents of regulation.”<sup>73</sup> In addition, “policy options for reef preservation have been described as win-win situations

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<sup>64</sup> Andrew C. Baker, *Reef Corals Bleach to Survive Change*, 411 NATURE 765, 765-66 (2001).

<sup>65</sup> National Geographic, *supra* note 9.

<sup>66</sup> Odyssey Expeditions, *supra* note 2.

<sup>67</sup> *Id.*

<sup>68</sup> *Id.*

<sup>69</sup> *Id.*

<sup>70</sup> DIMITROV, *supra* note 1, at 131.

<sup>71</sup> *Id.*

<sup>72</sup> *Id.*

<sup>73</sup> *Id.* at 131-32.

since measures to protect reefs bring additional benefits such as promotion of tourism, reduced water pollution, and health benefits from improved sewage systems.”<sup>74</sup>

Second, “the major superpower, the United States, has taken the political leadership and has been supported by other influential states such as France and Japan in establishing an International Coral Reef Initiative” (“ICRI”).<sup>75</sup> Such support should facilitate the creation of international policy and a new international convention to protect coral reefs—but it has not. The creation of a new international policy and convention to protect coral reefs also should be supported by the fact that while “nearly one hundred countries have coral reefs . . . over half of all coral reefs are under the jurisdiction of six states: Australia, Fiji, Indonesia, the Maldives, Papua New Guinea, and the Philippines.”<sup>76</sup> “[I]t should not be difficult to gain popular support for reef preservation since coral reefs are charismatic ecosystems and their degradation is not an obscure problem known only to scientists.”<sup>77</sup> The scientific community plays an active role in existing efforts to protect coral reefs, and “scientists are the largest and most visible group at international meetings of ICRI.”<sup>78</sup> Lack of opposition, strong leadership, as well as serious economic and social interests make the lack of an international convention or program for international management and protection of the world’s coral reefs particularly troubling.

### B. Existing Policies to Protect Coral Reefs

While there is a significant lack of international policy and agreements for protection of coral reefs, there have been some attempts at the international level to establish a program for management and protection of coral reefs. There has been one attempt at international coral reef regulation (the ICRI, discussed in more detail below) and several attempts to protect coral reefs through regional programs and agreements. Although many have expressed concerns over the state of the world’s coral reefs in various international forums and conferences,<sup>79</sup> “discussions in such institutional settings have not led to collective remedial policy action.”<sup>80</sup>

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<sup>74</sup> *Id.* (citing DIRK BRYANT ET AL., REEFS AT RISK 5 (World Res. Inst. 1998); GCRMN, STATUS OF CORAL REEFS OF THE WORLD: 2000 (Clive Wilkinson ed., 2000)).

<sup>75</sup> *Id.* at 132.

<sup>76</sup> *Id.*

<sup>77</sup> *Id.*

<sup>78</sup> *Id.*

<sup>79</sup> Such discussions occurred at conferences which led to the Convention on Biological Diversity, the Framework Convention on Climate Change, the Convention on International Trade of Endangered Species, and the Global Conference on Sustainable Development of Small Island Developing States. DIMITROV, *supra* note 1, at 134.

<sup>80</sup> *Id.*

The International Coral Reef Symposia is one example of an attempt to protect coral reefs.<sup>81</sup> Every four years, natural scientists, resource managers and users, conservationists, economists, and educators meet at a symposium to advance coral reef science, management, and conservation.<sup>82</sup> In 2004, participants of the Tenth International Society for Reef Studies “declare[d] in the strongest terms that additional destruction of coral reefs must be avoided and more effort is necessary to prevent further reef demise. Conservation and restoration of coral reefs should be made without delay in each nation acting individually and in concert through closer international cooperation.”<sup>83</sup>

The only significant attempt to develop an international policy for coral reef protection is the ICRI. It was launched in 1994 after concerns for the survival of the world’s coral reefs was expressed at a conference of small island states in Barbados in 1993. However, ICRI is neither an international governance structure, nor a policymaking body.<sup>84</sup>

ICRI is an informal network of governments, international development banks, NGOs [non-governmental organizations], scientists, and corporate actors from the private sector who meet annually for nonbinding discussions. It has involved representatives of eighty governments, as well as international organizations such as the World Bank, UNEP, UNDP, UNESCO, and the International Union for the Conservation of Nature.<sup>85</sup>

ICRI’s expressly-defined goal is to “identify and promote needed action without directly engaging in policymaking.”<sup>86</sup> It is an “informal network of interested parties, an open forum for like-minded political actors to discuss coral reef issues, share information, promote research, identify priorities, and facilitate policy action.”<sup>87</sup>

The officials that administer the ICRI regard it as an “advocacy group” and intend for it to remain an informal arrangement.<sup>88</sup> The group does not develop, fund, or implement coral reef policy. ICRI merely identifies policy needs at

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<sup>81</sup> 11th International Coral Reef Symposium, <http://www.nova.edu/ncri/11icrs/> (last visited Feb. 24, 2010).

<sup>82</sup> DIMITROV, *supra* note 1, at 136.

<sup>83</sup> *Id.* at 134.

<sup>84</sup> *Id.* at 135.

<sup>85</sup> *Id.*

<sup>86</sup> *Id.*

<sup>87</sup> *Id.*

<sup>88</sup> *Id.*

local and national levels.<sup>89</sup> ICRI officials and members both wish to keep the organization informal because they believe the group is “more effective in influencing national governments and relevant international institutions if it is a flexible informal mechanism instead of a competing agency.”<sup>90</sup> France is the only country to favor a more formal structure, but even France opposes granting the ICRI the authority to adopt binding obligations.<sup>91</sup>

ICRI has taken a number of actions toward helping the world’s coral reefs. In 1995 it held a four-day international workshop in Dumaguete City, Philippines. Representatives of forty-four nations, intergovernmental organizations, NGOs, the science community, and the private sector attended the workshop.<sup>92</sup> The parties at the conference produced a “Call for Action,” which “recognized that coral reefs are in serious decline due to human activities and urged actors to focus on coastal management, research, and monitoring, and capacity-building.”<sup>93</sup> They also produced a “Framework for Action,” which “outlines activities that governments could undertake to mitigate the plight of coral reefs.”<sup>94</sup> The primary policy recommendations “pertained to integrated coastal management, education, strong environmental laws, ecologically sound land-use practices, sustainable fisheries management, and developing a network of marine protected areas.”<sup>95</sup>

Following the 1994 workshop, the ICRI group met in six different years in regional workshops that focused on coral reefs in the Caribbean, East African seas, South Asian seas, East Asian seas, the Western Indian Ocean, and the Pacific Region.<sup>96</sup> At these workshop conferences, ICRI members attempted to convert the Global Framework for Action into agendas for regional action to protect coral reefs.<sup>97</sup>

Today, the ICRI focuses on generating scientific data about coral reefs. The ICRI established GCRMN to provide the information needed for further discussions related to protection of the world’s coral reefs.<sup>98</sup> The GCRMN network has been a “main operational unit and key component of [ICRI], intended to monitor reef conditions and provide the necessary data for effective

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<sup>89</sup> *Id.*

<sup>90</sup> *Id.* (citing private conversations with Richard Kenchington (Feb. 18, 2001); Jamie Reaser, Assistant Director, U.S. Nat’l Invasive Species Council (Jan. 31, 2001); anonymous U.S. State Department official (Jan. 9, 2001)).

<sup>91</sup> *Id.*

<sup>92</sup> *Id.*

<sup>93</sup> *Id.*

<sup>94</sup> *Id.* at 136.

<sup>95</sup> *Id.*

<sup>96</sup> *Id.*

<sup>97</sup> *Id.*

<sup>98</sup> *Id.*

reef management.”<sup>99</sup> In addition, ICRI partners created the International Coral Reef Action Network (“ICRAN”) “whose mandate is to assist in capacity building for reef management in developing countries.”<sup>100</sup> Thus, the focus of ICRI is the “generation and dissemination of expert information,” not international regulation of human activities that harm coral reefs.<sup>101</sup>

While the ICRI is the only organization that exists solely for the protection of coral reefs, a number of NGOs such as the World Wide Fund, Reef Check, Marine Aquarium Council, and the Coral Reef Alliance spend a great deal of effort and capital on the protection of coral reefs. In addition to these organizations, a few international conventions, including the Convention on Biological Diversity (“CBD”),<sup>102</sup> address some problems facing coral reefs. The CBD’s “objectives are the conservation of biological diversity, the sustainable use of its components and the fair and equitable sharing of the benefits arising out of the utilization of genetic resources.”<sup>103</sup> While the CBD seeks to protect unique ecosystems such as coral reefs, the CBD does not impose any specific obligations upon nation-states with respect to conservation and sustainable use of biodiversity.

One of the most significant conventions concerning coral reefs is the Convention on International Trade in Endangered Species of Wild Fauna and Flora (“CITES”).<sup>104</sup> CITES’s “objectives are to protect wildlife [and plants] against such over-exploitation and to prevent international trade from threatening species with extinction.”<sup>105</sup> This convention “is the only international legal mechanism with the mandate to protect species from overexploitation due to international trade.”<sup>106</sup> CITES places obligations on both exporting and importing parties. “The treaty requires that each signatory nation establish a CITES Management Authority (to issue permits and perform certain other duties) and a CITES Scientific Authority (to monitor biological sustainability of trade).”<sup>107</sup> Appendix II of CITES lists over two thousand species of hard coral (all Scleractinia, organ pipe, fire, and blue coral), ten

<sup>99</sup> *Id.* (citing Clive Wilkinson & Bernard Salvat, *Global Coral Reef Monitoring Network: Reversing the Decline of the World’s Coral Reefs*, in *CORAL REEFS: CHALLENGES AND OPPORTUNITIES FOR SUSTAINABLE MANAGEMENT* 17 (World Bank Publications 1998)).

<sup>100</sup> *Id.*

<sup>101</sup> *Id.*

<sup>102</sup> Convention on Biological Diversity, <http://www.cbd.int/> (last visited Feb. 24, 2010).

<sup>103</sup> The International Coral Reef Initiative, ICRI Core Members and Networks, [http://www.icriforum.org/secretariat/icri\\_members.html](http://www.icriforum.org/secretariat/icri_members.html) (last visited Feb. 24, 2010).

<sup>104</sup> Convention on International Trade in Endangered Species of Wild Fauna and Flora [hereinafter CITES], <http://www.cites.org/eng/disc/what.shtml> (last visited Feb. 24, 2010).

<sup>105</sup> The International Coral Reef Initiative, *supra* note 103.

<sup>106</sup> Susan Lieberman & John Field, *Global Solutions to Global Trade Impacts?*, <http://www.aaas.org/international/africa/coralreefs/ch4.shtml> (last visited Feb. 24, 2010).

<sup>107</sup> *Id.*

species of giant clams (Tridacnidae), one conch species (*Strombus gigas*), and several non-reef-building coral species.<sup>108</sup> However, CITES does not list any species of coral reef fish.<sup>109</sup>

While CBD and CITES address some of the threats facing coral reefs, there is no single convention or international organization that attempts to protect all of the world's coral reefs at an international level from all direct and indirect human threats. The reason for this omission is that the problems facing coral reefs are varied in nature, ranging from global warming to trash dumping. One of the biggest problems facing efforts to draft and adopt a new international convention to protect coral reefs is that the reef characteristics and threats to the reef differ by locality. Consequently, most local environmental groups prefer to keep coral reef conservation efforts within the community near the reef. "Because they are fragmented and local, coral reefs do not tend to have global support. They are seen as a local issue, generally."<sup>110</sup> Unfortunately, there is no way to know if degradation of a particular coral reef will affect another country, making it difficult to create an international program to protect coral reefs. This is because "a state does not have a clear pragmatic interest in protecting other countries' reefs"<sup>111</sup> and the need for local regulation does not necessarily lead to the creation of an international program or policy.

International regulation of coral reefs can be supported by a "common concern" approach. While coral reefs vary by locality, all nation-states have a stake in the health of all of the world's coral reefs. Coral reefs provide a large percentage of the world's fish for consumption, are a vital part of ocean ecosystems, and create international business opportunities by attracting tourists. This local-international dilemma is a significant matter of concern in reef activist circles. Many environmental activists believe that an international coral reef treaty would be ineffective or unable to deal with the wide variety of problems facing the world's varied coral reefs.<sup>112</sup>

Most conservation groups view coral reef conservation as a "bottom-up process driven by local communities."<sup>113</sup> The ICRI's plan for protection of coral reefs places a strong emphasis on regional capacity building, "with the aspiration that sooner or later the international coordination role can be phased down."<sup>114</sup> Recommendations that come from international conferences on coral

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<sup>108</sup> *Id.*

<sup>109</sup> *Id.*

<sup>110</sup> DIMITROV, *supra* note 1, at 149 (internal quotations omitted).

<sup>111</sup> *Id.*

<sup>112</sup> *Id.*

<sup>113</sup> *Id.*

<sup>114</sup> Richard Ketchington, *Status of the International Coral Reef Initiative*, in CORAL REEFS: CHALLENGES AND OPPORTUNITIES FOR SUSTAINABLE MANAGEMENT 17 (World Bank Publications 1998).

reef problems focus on local actions and often there is no mention at these conferences of global or regional policy measures.<sup>115</sup> While it may be difficult to address the multitude of problems threatening the world's coral reefs in one convention, it is worth envisioning what a new international coral reef protection convention would entail. If such a convention were adopted, it would at least provide a framework for local managers to use to ensure the long-term survival of coral reefs.

### III. A PROPOSED NEW CONVENTION TO PROTECT THE WORLD'S CORAL REEFS

As noted earlier, no convention exists at the present time which provides for comprehensive regulation of the multitude of activities which can harm coral reefs, due in part to the myriad problems they face. This paper proposes a new convention for protection of coral reefs that would create an international organization to further the conservation of coral reefs. This proposed convention would seek to address common international threats facing coral reefs, and would put into place a loose framework for implementing local action, sustainable development, and self-regulation to protect coral reefs.

To accomplish these objectives, the proposed new convention would be modeled upon existing conventions that address international environmental problems facing coral reefs. The new convention would mandate the designation of new "marine protected areas" ("MPAs") containing coral reefs and would mandate certain management practices for them. Increased designation of and improved management practices for MPAs would encourage bottom-up, local management of activities that harm coral reefs.

MPAs are defined by the International Union for Conservation of Nature as "clearly defined geographical space, recognized, dedicated, and managed, through legal or effective means, to achieve the long-term conservation of nature with associated ecosystem services and cultural values."<sup>116</sup> MPAs are defined by the CBD as "a geographically defined area, which is designated or regulated and managed to achieve specific conservation objectives."<sup>117</sup> The CBD utilizes a broader term: "Marine and Coastal Protected Area," which the CBD defines as:

Any defined area within or adjacent to the marine environment, together with its overlying water and associated

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<sup>115</sup> M.E. Hatzios, *Summary and Recommendations*, in CORAL REEFS: CHALLENGES AND OPPORTUNITIES FOR SUSTAINABLE MANAGEMENT 17 (World Bank Publications 1998).

<sup>116</sup> Sue Wells, *National and Regional Networks of Marine Protected Areas: A Review of Progress*, UNEP-WCMC Biodiversity Series No. 30, 17 (2008), available at <http://www.unep-wcmc.org/oneocean/pdf/MPA%20report%20FINAL.pdf>.

<sup>117</sup> *Id.*

flora, fauna, historical and cultural features, which has been reserved by legislation or other effective means, including custom, with the effect that its marine and/or coastal biodiversity enjoys a higher level of protection than its surroundings.<sup>118</sup>

The method of management and protection of certain animals, ecosystems, or site can vary by MPA. It would be impractical to attempt to protect all of the world's coral reefs all at once under a new international convention. Instead, the new convention should initially seek to protect only those coral reefs located within already-designated MPAs. The convention should also attempt to extend protection to more coral reefs by encouraging additional designations of MPAs. As of February 2009, approximately 5,000 MPAs existed around the world.<sup>119</sup> Most of these MPAs contain coral reefs, including the entire Great Barrier Reef.<sup>120</sup> However, existing MPAs include only 0.8 of 1% of the world's oceans.<sup>121</sup>

"The establishment of [MPAs] on coral reefs has increasingly been considered a useful option for management of [coral reef] systems."<sup>122</sup> A number of environmental groups have recognized the importance of MPAs, finding that they are "increasingly viewed as an important management tool within a suite of policy alternatives to reduce, prevent and/or reverse, ongoing (and in some cases rapid) declines in marine biodiversity and fisheries."<sup>123</sup> The 2002 Plan of Implementation of the World Summit on Sustainable Development committed to establishment of a representative global network of MPAs by 2012.<sup>124</sup> At the Fifth World Parks Congress in 2003, a recommendation was made to "greatly increase the marine and coastal areas managed in marine protected areas by 2012; these networks should include strictly protected areas

<sup>118</sup> *Id.* at 18.

<sup>119</sup> *World Conservation Congress Brings Many Developments for MPA Practitioners: New Tools, Publications, Principles*, 10 MPA NEWS 1, 2 (2008), available at <http://depts.washington.edu/mpanews/MPA101.pdf>.

<sup>120</sup> Great Barrier Reef Marine Park Authority, Zoning, [http://www.gbrmpa.gov.au/corp\\_site/management/zoning](http://www.gbrmpa.gov.au/corp_site/management/zoning) (last visited Feb. 24, 2010).

<sup>121</sup> Louisa J. Wood et al., *Assessing Progress Towards Global Marine Protection Targets: Shortfalls in Information and Action*, in 42 FAUNA & FLORA INT'L 340 (2008), available at <http://www.seararoundus.org/researcher/dpauly/PDF/2008/JournalArticles/AssessingProgressTowardGlobalMarineProtectionTargets.pdf>.

<sup>122</sup> John R. Clark, Billy Causey & James A. Bohnsack, *Benefits From Coral Reef Protection: Looe Key Reef, Florida*, COASTAL ZONE 3076, 3076-86 (1989).

<sup>123</sup> Wood, *supra* note 121, at 340.

<sup>124</sup> WORLD SUMMIT ON SUSTAINABLE DEVELOPMENT, PLAN OF IMPLEMENTATION 14 (2002), available at [http://ec.europa.eu/environment/wssd/documents/wssd\\_impl\\_plan.pdf](http://ec.europa.eu/environment/wssd/documents/wssd_impl_plan.pdf).



that amount to at least twenty to thirty [percent] of each habitat.”<sup>125</sup>

Most recently, the Eighth Ordinary Conference of the Parties to the CBD in 2006 set a target of having “at least ten [percent] of each of the world’s ecological regions, including marine and coastal, be effectively conserved by 2010.”<sup>126</sup> While MPAs have been included in such targets, no overriding policy pertaining to the management of these areas has been adopted. The new convention would set a specific target that eighty percent of the world’s coral reefs be designated as MPAs by the year 2015. In addition, the new convention would provide a recommended comprehensive plan and guidelines for the management of coral reefs which have been designated as MPAs.

The most important part of the new convention would be the adoption of a comprehensive plan to encourage sustainable development and coral reef protection at the community level. Research is vital to ensuring the future well-being of the world’s coral reefs, so the new convention would mandate that those persons who manage MPAs should provide funding for periodic surveys to track percentages of coral cover,<sup>127</sup> coral disease and bleaching, fish abundance, and estimates of fishing and harvesting in coral reefs. In addition, the new convention would require park managers of MPAs to periodically lobby local governments to designate more coral reefs and wetlands as MPAs.

In order to better manage and monitor the designated MPAs containing coral reefs, this new convention would require that a comprehensive plan be developed that addresses the unique needs and concerns of the individual MPAs. One example is the management plan that was developed for villages in the Philippines in McManus, Ferrer and Campos, 1988.<sup>128</sup> The new convention would require implementation of that plan in all coral reef MPAs. The plan that these three scientists have created is a bottom-up plan that begins with village-based management.<sup>129</sup> They argue that such a plan is more realistic than a broad generic plan due to the individualistic nature of coral reefs.<sup>130</sup> They proposed a “village-based adaptive management system” in which “environmental community organizers are assigned to villages to evaluate the fishery, environmental, sociological, and economic factors, educate villagers in appropriate management options, organize for the formulation of local

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<sup>125</sup> Wood, *supra* note 121, at 340.

<sup>126</sup> *Id.*

<sup>127</sup> Coral cover is “the percentage of a unit area that is occupied by living coral.” University of Puerto Rico, Coral Survey and Monitoring, [http://geology.uprm.edu/Morelock/GEOLOCN/\\_corsurv.htm](http://geology.uprm.edu/Morelock/GEOLOCN/_corsurv.htm) (last visited Feb. 24, 2010).

<sup>128</sup> John W. McManus et al., *A Village-Level Approach to Coastal Adaptive Management and Assessment*, in PROCEEDINGS OF THE 6TH INTERNATIONAL CORAL REEF SYMPOSIUM, VOL. 2: CONTRIBUTED PAPERS 381 (John H. Choat et al. eds., 1988), available at [http://www.reefbase.org/resource\\_center/publication/pub\\_220.aspx](http://www.reefbase.org/resource_center/publication/pub_220.aspx).

<sup>129</sup> *Id.*

<sup>130</sup> *Id.*

regulations, and network with national agencies for assistance with particular problems."<sup>131</sup> This plan has been successfully implemented in numerous villages in the Philippines and Indonesia,<sup>132</sup> and the new convention should require that this plan be put into place in all MPAs.

#### A. *International Issues*

"What makes a problem transnational is defined by its cross-border consequences . . . the formation of common interests that stem from a perceived interdependence is dependent on reliable information about the trans-boundary impact of an alleged problem."<sup>133</sup> The greatest problem facing a proposal for a new international convention on coral reefs is that there is little to no information about the impact that the degradation of any particular coral reef has on the greater ocean ecosystem. However, many threats to coral reefs clearly cross national boundaries and affect all persons who have an interest in the conservation of coral reefs. While a person in Florida may see little need to protect a coral reef in Fiji, many threats to reefs exist in both localities and can be addressed by one comprehensive coral reef protection convention.

The first major cross-boundary threats are the human-induced climate change and oceanic warming that cause coral bleaching. Bleaching occurs in the summer when ocean water is a degree or two warmer than usual for a few weeks. It is called bleaching because the coral appears white after it has expelled its zooxanthellae and only translucent tissue remains.<sup>134</sup> The world's oceans have become warmer because of global warming.<sup>135</sup> Global warming is caused by carbon dioxide, methane, and other greenhouse gases which disperse uniformly throughout the world's atmosphere regardless of where the gases are emitted.<sup>136</sup> While the rise in ocean temperature that has been caused by greenhouse gases appears moderate (about one degree Celsius over the past several decades), this amount of warming is enough to cause mass coral mortality events around the world.<sup>137</sup> For example, in Palau, more than ninety percent of the corals on some reefs have bleached and more than fifty percent of the reefs have died, and in the Maldives, total coral reef coverage has been reduced to only about five percent.<sup>138</sup> During the extremely hot summers experienced over the past ten years, the coral reef mortality rate has increased

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<sup>131</sup> *Id.*

<sup>132</sup> *Id.*

<sup>133</sup> DIMITROV, *supra* note 1, at 150.

<sup>134</sup> The Encyclopedia of Earth, *supra* note 47.

<sup>135</sup> *Id.*

<sup>136</sup> *Id.*

<sup>137</sup> *Id.*

<sup>138</sup> *Id.*

dramatically.<sup>139</sup> In 1998, when El Nino warmed much of the Pacific and Indian Oceans, coral bleaching was widespread.<sup>140</sup> The rise in ocean temperatures is a trend that will not likely be reversed in the near future.

Global warming also kills corals indirectly by magnifying the effects of infectious diseases, which are one of the primary causes of coral mortality, especially in the Caribbean.<sup>141</sup> The number, prevalence, and impacts of diseases in coral reefs have been increasing, in part due to increased ocean temperatures.<sup>142</sup> Higher temperatures can harm corals' immune systems, making them more susceptible to infection and can make bacteria and fungi stronger.<sup>143</sup> Recent studies show a clear correlation between high ocean water temperatures and increases in coral diseases, even when the water temperature has only risen one or two degrees.<sup>144</sup>

The greatest concern for coral reefs in the long term is that global warming will cause the acidification of the ocean (with higher acidity leading to bleaching of coral). When humans burn immense amounts of fossil fuel, they rapidly increase the concentration of carbon dioxide in the earth's atmosphere. In addition, one quarter of the carbon dioxide produced by fossil fuel combustion enters the ocean and reacts with the water to form carbonic acid. Human activity has lowered the current pH balance of the ocean, making ocean waters more acidic.<sup>145</sup> Increased acidification makes it difficult for corals to excrete their calcium carbonate skeletons, which slows coral growth.<sup>146</sup> Increased acidification also reduces the ability of corals to compete with other species, to recover quickly from bleaching and/or disease, and to keep up with high rates of sea level rise.<sup>147</sup>

Global warming is an international issue that is already being addressed by a number of treaties. The Kyoto Protocol sets binding targets for thirty-seven industrialized countries and the European community for reduction of greenhouse gas emissions during the years 2008 to 2012.<sup>148</sup> The Kyoto Protocol's targets seek to lower 1990 emission levels by five percent over the five-year compliance period of 2008-2012.<sup>149</sup> Any new convention that aims to

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<sup>139</sup> *Id.*

<sup>140</sup> *Id.*

<sup>141</sup> Pete Harrison, *Climate Change Blamed for Caribbean Coral Deaths*, REUTERS, June 10, 2009.

<sup>142</sup> The Encyclopedia of Earth, *supra* note 47.

<sup>143</sup> *Id.*

<sup>144</sup> *Id.*

<sup>145</sup> *Id.*

<sup>146</sup> *Id.*

<sup>147</sup> *Id.*

<sup>148</sup> Kyoto Protocol to the United Nations Framework Convention on Climate Change, Dec. 10, 1997, 37 I.L.M. 22.

<sup>149</sup> *Id.* at 24.

protect coral reefs from further degradation will not be successful unless international regulations requiring the reduction of greenhouse gas emissions are successfully implemented.

The other primary issue with respect to coral reef protection that involves a trans-boundary problem is the exportation of endangered species. Many exotic fish found living in coral reefs—and often the colorful reefs themselves—are illegally harvested and sold around the world in pet stores for in-home aquariums. In addition, numerous other international markets exploit coral reefs. Coral reefs are the source of live reef food fish, traditional food fish, curios, traditional medicines, limestone production, and construction materials. One problem is that collectors of tropical fish often use cyanide to stun and capture fish.<sup>150</sup> The cyanide is so poisonous that for every ten fish stunned, only one survives.<sup>151</sup> In addition, removal of fish in large numbers from coral reef habitat can cause extinction of some fish species.<sup>152</sup> Many popular species of fish, including the Banggai Cardinal Fish, the Powder Blue Tang, and the Hawaiian Yellow Tang, are near extinction because they have been over-fished for sale to aquariums.<sup>153</sup>

Fortunately, many of these issues are addressed by the CITES. This treaty is legally binding on the parties, but it does not take the place of domestic laws.<sup>154</sup> As noted earlier, over 2,000 species of hard coral, ten species of giant clams, one conch species, and several non-reef-building coral species are protected from over-exploitation by Appendix II of CITES.<sup>155</sup> This paper's proposed convention would interface with CITES by including all CITES requirements and protections as they apply to coral reefs. CITES remains the only international legal mechanism that obligates nation-states to protect such species from overexploitation.<sup>156</sup> Unfortunately, CITES does not currently list—and therefore does not protect—any coral reef fish.<sup>157</sup> Accordingly, the proposed coral reef convention should include protection for all species of endangered or threatened coral fish. This action would protect these species from over-exploitation, from importation, and from exportation of endangered or threatened coral fish.

The proposed coral reef convention, supplemented by reductions of

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<sup>150</sup> Conservation Sci. Inst., Destructive Fishing Practices, [http://www.conservationinstitute.org/ocean\\_change/Fisheries/destructivefishingpractices.htm](http://www.conservationinstitute.org/ocean_change/Fisheries/destructivefishingpractices.htm) (last visited Mar. 09, 2010).

<sup>151</sup> Tiffany Chaparro, *What Fish Should you Buy?*, SCHOLASTIC NEWS ONLINE, Sept. 23, 2005, <http://www2.scholastic.com/browse/article.jsp?id=10692>.

<sup>152</sup> *Id.*

<sup>153</sup> *Id.*

<sup>154</sup> CITES, *supra* note 104.

<sup>155</sup> Lieberman & Field, *supra* note 106.

<sup>156</sup> *Id.*

<sup>157</sup> *Id.*

greenhouse gas emissions under the Kyoto Protocol regime and by the list of coral species from CITES, would address some of the most important international threats facing coral reefs today. The impact humans have on coral reefs can be reduced by controlling human activities, but more research is needed to find long-term solutions to the threats facing the world's coral reefs.

*B. Addressing Common Local Issues Through Self-Governance*

One of the primary difficulties that could hinder adoption of a new convention to protect coral reefs is that many of the threats to coral reefs, while common to all reefs, vary greatly by location, both ecologically and socially. The primary threats that vary by locality and need to be addressed include destructive fishing practices, marine pollution, runoff from improper land-use practices, overexploitation of ocean fisheries, and coastal development. While it would be impossible for a new coral reef convention to effectively regulate such activities for each locality's coral reefs, the proposed new coral reef convention should set guidelines for regulation and control of harmful local activities threatening coral reefs. The proposed convention would utilize park officials in MPAs to implement and enforce mandated regulations aimed at minimizing harms which are common to all coral reefs.

Destructive fishing practices occur throughout the world, damaging all of the world's coral reefs. Today, over 1.4% of the U.S. fish stocks are overfished, leading to the collapse of some of the most important fishing communities that depend on coral reefs for housing important species of commercial fish.<sup>158</sup> The term "overfished population" necessarily varies by location, number of, and type of fish being caught. The proposed convention could interface with the Straddling Stock Convention, which seeks to protect "overfished" fisheries by establishing maximum sustainable yield harvesting quotas for each region of the world's ocean fisheries.<sup>159</sup> Such percentage limits would be arrived at by initial survey and modeling studies and would be subject to periodic changes in response to new information or changing conditions.<sup>160</sup> The proposed convention would mandate that park officials of all MPAs establish and enforce such quotas for both commercial and local fishermen.

Another destructive practice is the use of drift nets and gill nets, which often results in bycatch: fish, sea turtles, seabirds, and marine mammals that are unintentionally caught and often killed along with the desired fish species.<sup>161</sup>

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<sup>158</sup> NAT'L MARINE FISHERIES SERV., 2003 REPORT TO CONGRESS: THE STATUS OF U.S. FISHERIES (2004), available at [http://www.nmfs.noaa.gov/sfa/statusoffisheries/statusostocks03/Report\\_Text.pdf](http://www.nmfs.noaa.gov/sfa/statusoffisheries/statusostocks03/Report_Text.pdf).

<sup>159</sup> *Id.*

<sup>160</sup> *Id.*

<sup>161</sup> Carmen Sofia Grant, *Deep Sea Corals*, <http://marine->

Long-lining is another practice that often ensnares large numbers of seabirds.<sup>162</sup> Shrimp trawling results, on average, in harvesting of nine pounds of marine life for every pound of shrimp harvested.<sup>163</sup> By depleting the number of marine animals in ocean waters, these practices are extremely damaging to the diverse ecosystem of coral reefs.<sup>164</sup> In addition, in many areas of the world's oceans many types of nets and long lines are dragged along the ocean bottom by heavy weights, which can be caught on coral reefs and seriously harm coral bodies.<sup>165</sup> If trawling is done in the same coral reef area over a period of time, "there is no chance for the coral to recover because of their slow growth patterns,"<sup>166</sup> and the reef will be permanently damaged.

The proposed coral reef convention should ban bottom trawling altogether and set a target goal of reducing the number of drift and gill nets used by at least twenty percent in the next five years. These steps would encourage increased aquaculture projects and the development of new fishing practices.<sup>167</sup> In addition, any fishing operations in MPAs that are home to sea turtles should be required to replace all existing shrimp trawling nets with Turtle Excluder Devices ("TEDs").<sup>168</sup> Turtles, along with other fish that are caught as byproduct by shrimp trawling nets, are vital members of a coral reef ecosystem.<sup>169</sup> By catching and killing endangered or threatened species, these nets deplete marine ecosystems.<sup>170</sup> Switching to TEDs would significantly reduce the harm to marine and coral reef ecosystems because it would protect threatened species whose extinction would greatly reduce the biodiversity of coral reefs.

Another serious threat to coral reefs is marine pollution caused by boats, tourists, and the dumping of waste into the ocean.<sup>171</sup> Trash can kill fish and other marine life, and oils leaked or spilled from motor vehicles (carried as runoff into ocean waters) are deadly to coral organisms.<sup>172</sup> Regulation of trash dumping is difficult to enforce because it is hard to spot each person who may drop a plastic bag or other trash off a boat. Nevertheless, the proposed new convention should mandate that all trash dumping within three miles of MPAs

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conservation.suite101.com/article.cfm/deep\_sea\_corals (last visited Feb. 24, 2010).

<sup>162</sup> *Id.*

<sup>163</sup> *Id.*

<sup>164</sup> *Id.*

<sup>165</sup> Conservation Sci. Inst., *supra* note 150.

<sup>166</sup> Grant, *supra* note 161.

<sup>167</sup> Conservation Sci. Inst., *supra* note 150.

<sup>168</sup> NOAA Fisheries Office of Protected Resources, Turtle Excluder Devices (TEDs), <http://www.nmfs.noaa.gov/pr/species/turtles/teds.htm> (last visited Feb. 24, 2010).

<sup>169</sup> *Id.*

<sup>170</sup> Conservation Sci. Inst., *supra* note 150.

<sup>171</sup> U.S. Env'tl. Prot. Agency, Coral Reefs and Your Coastal Watershed, <http://www.epa.gov/OWOW/oceans/factsheets/fact4.html> (last visited Feb. 24, 2010).

<sup>172</sup> *Id.*

be illegal and should mandate enforcement of this ban by the local park management.

Pollution also occurs when oil and chemicals from boat engines leak into the water. The proposed convention should mandate that each country periodically inspect the engines of all recreational and commercial vessels, to ensure that they are not leaking any oil or chemicals, and to require any such leakage be stopped. The standards of any such inspections would have to be determined by each individual country. Because such inspections and prevention programs might be a costly addition to the infrastructure of an undeveloped country, it may only be feasible to implement them in developed countries.

Another source of pollution harmful to coral reefs is garbage that has been washed from streets on land into storm water drains. Prevention of runoff pollution would be extremely difficult to achieve because every nation has different levels of garbage removal services and storm water infrastructure. While the proposed convention should require developed countries to minimize street runoff pollution and runoff of pollutants into ocean waters from storm water drains, it is unlikely that runoff pollution can be completely prevented. The convention should, however, mandate that each organization managing particular MPAs arrange at least three reef cleanup days (akin to beach cleanup) each year and attempt to recruit volunteers for such cleanups from the local populations.

Runoff of pollutants in coastal areas is another significant threat to coral reefs that exists in all regions of the world. Most of the harmful runoff of pollutants comes from agricultural runoff and sewage, with nutrients in such runoff stimulating the growth of photosynthetic plankton on the surface of coastal waters.<sup>173</sup> As those organisms decay and sink to the bottom, they are decomposed by microbes that consume large amounts of dissolved oxygen.<sup>174</sup> This decomposition causes oxygen levels in ocean waters to drop and creates what are known as dead zones.<sup>175</sup> All bottom-dwelling organisms are killed by the lack of oxygen, completely destroying the food chain of the coral reef.<sup>176</sup> Without the bottom-dwelling organisms, species higher on the food chain are unable to survive and an entire coral reef ecosystem can quickly die.<sup>177</sup>

It is imperative that any country that either borders the ocean or contributes to pollution of coastal waters take a number of steps to prevent runoff of pollutants into coastal waters containing coral reefs. "The global proliferation of dead zones, once mainly a problem of the developed world, has been fueled by

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<sup>173</sup> Bina Venkataraman, *Ocean 'Dead Zones' on the Rise*, N.Y. TIMES, Aug. 14, 2008, available at <http://www.nytimes.com/2008/08/15/science/earth/15oceans.html>.

<sup>174</sup> *Id.*

<sup>175</sup> *Id.*

<sup>176</sup> *Id.*

<sup>177</sup> *Id.*

industrialization, changing eating habits and population growth, which has led to more fertilizer use and more waste in the world's watershed."<sup>178</sup> First, they must reduce the amount of fertilizer used on agricultural land.<sup>179</sup> One method to accomplish this objective is planting winter crops during off-seasons so that spring rains do not cause fertilizer to runoff or leach into ocean waters.<sup>180</sup> While the proposed new convention would not mandate the types or amounts of crops to be grown on a particular parcel of agricultural land, it should mandate implementation by each nation-state of a plan to reduce agricultural runoff pollution into ocean waters containing coral reefs.

In addition, any country whose sewage collection and management system causes runoff of untreated human sewage into coastal waters containing coral reefs should be required under the proposed convention to implement a plan to better manage sewage runoff. The proposed convention should establish uniform minimum standards for municipal and industrial wastewater treatment. Because problems with wastewater treatment vary by the level of development in each country, the first goal would be to bring the water treatment standards of undeveloped countries up to those of developed nations. Accordingly, the proposed convention's minimum treatment standard could follow the guidelines set by the World Health Organization for water sanitation and health.<sup>181</sup> The proposed convention could also set a date by which old sewer system infrastructures must be repaired or replaced to meet these proposed minimum standards. Again, it would be impossible to apply a uniform solution to each country, but mandating a general plan of action would be a productive start toward stemming coastal pollution runoff.

#### CONCLUSION

The complex nature of coral reefs makes protection and conservation on an international level extremely difficult. Some of the problems facing the world's coral reefs, such as rising ocean water temperatures and the exportation of endangered coral reef species, have been addressed by existing conventions aiming to minimize all harms associated with those human-caused problems. However, existing conventions have not addressed these problems solely in the context of coral reef conservation. Problems that affect all coral reefs, but vary by locality, have been addressed only on a piecemeal basis by NGOs and community organizations. A few of these problems, such as wastewater

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<sup>178</sup> *Id.*

<sup>179</sup> *Id.*

<sup>180</sup> *Id.*

<sup>181</sup> World Health Org., Water Sanitation and Health, [http://www.who.int/water\\_sanitation\\_health/dwq/guidelines/en/index.html](http://www.who.int/water_sanitation_health/dwq/guidelines/en/index.html). (last visited Feb. 24, 2010).



management, have been regulated at the national level.

While many local and domestic national regulations have been somewhat effective, coral reefs need recognition and protection at the international level. The problems facing the world's coral reefs are both local and international in nature. Each coral reef ecosystem is similarly affected by the same overriding problems, but they are affected differently depending on the location of a particular coral reef. Therefore, any new convention dealing with coral reefs will have to be both international in scope and local in implementation. While a bottom-up, local approach will be more effective for protection of coral reefs in the long run, creation of a new international organization focusing solely on coral reef protection will help make coral reef protection an international priority. It is imperative that a comprehensive coral reef protection convention be adopted and entered into force as soon as possible. This convention must establish standards and guidelines to address the various challenges facing all coral reefs worldwide, while simultaneously encouraging community interest and participation in local efforts to protect coral reefs.

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