International Control of Marine "Pollution" by Exotic Species

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INTRODUCTION

This article is a case study of how new international environmental threats are identified and addressed. Substantial controversy has arisen concerning the appropriateness of international legal response measures in the face of inconclusive, or even contradictory, scientific evidence on the character and magnitude of newly perceived dangers to the global environment. International efforts to control ozone depletion, tropical deforestation, ocean dumping, global climate change, and the degradation of polar ecosystems have all suffered because of the perception, widely held by policymakers, that international legal action has moved

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too far ahead of international scientific consensus. Too often, a severe manifestation of an environmental hazard—an authentic disaster—must occur before an effective international legal regime is adopted.

The environmental threat posed by exotic species has defied most attempts at sensible definition. Simply defined, exotic species are plants and animals found outside their usual habitats. Exotic species can have either beneficial or hazardous effects on the ecosystems into which they are introduced. Exotic species pollution is largely a man-made problem. Virtually every introduction of an alien species, whether accidental or intentional, can be traced to a human activity of one sort or another. In fact, the phenomenon of nonindigenous species is as ancient as man's propensity to wander. Nonetheless, with the advent of modern transportation and the resulting volume of oceangoing trade, the pace of alien species introductions has increased markedly in the past few decades. This has been especially notable for marine species. Because most of the recent attention to this problem has been focused on its aquatic environmental consequences, this study will concentrate on the issue of exotic species as a form of marine pollution.

Section I of this article will provide a survey of the exotic species problem. A number of significant infestations of exotic species have occurred in the last few years. The most notable of them, the accidental introduction of the zebra mussel into the North American Great Lakes, has resulted in staggering monetary costs and incalculable environmental impact on that region. Other parts of the world have been severely affected by marine exotic species, making this a truly global problem. Yet a significant question remains whether exotic species can be characterized fairly as a form of marine pollution. This problem is more than a semantic concern. Indeed, the characterization fundamentally determines the form that international legal action will take in managing this environmental risk. Although it seems strange to refer to a living organism as pollution, this appears to be the proper way to define the threat. Definition of the threat and assessment of the risks are the first two steps in considering legal management of a global environmental concern.

Section II turns to the problem of fashioning an appropriate legal response to exotic species introductions, first by examining the adequacy of national legal regimes that address the problem. It is predictable that truly international environmental problems are impervious to strictly domestic solutions. This has certainly been the case with exotic species. This section reviews American legislative and regulatory initiatives in the area of exotic species and attempts to account for their lack of success. Judging from the experience of the United States, national efforts to con-

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1. Exotic species are also known as “alien” or “nonindigenous” species, and all of these terms are used synonymously in this article.
control intentional introductions of nonindigenous marine species have only been partially successful, while those limiting accidental infestations have been a complete failure.

Section III discusses the potential for promoting international cooperation in the control and prevention of marine pollution by alien species. This section critically examines the international legal regime in place today. For the most part, general conservation conventions, ocean law codification efforts, and the regional seas treaties negotiated under the auspices of the United Nations Environment Programme have served only to define the problem and to offer hortatory language for its resolution.

Section IV considers the most promising approach to the control of marine exotic species pollution: the establishment of regulations for the handling of ballast water for ships engaged in international trade. Many accidental introductions of alien species have been traced to vessels which have inadvertently taken up these creatures in ballast and later discharged them in a foreign port. The ballast regulation negotiations are still in their early stages. Section IV comments on the international legal implications of these negotiations, and also examines the prospects for effective international coordination between domestic authorities.

This study can hope only to be provisional in its findings concerning the control of exotic species in the marine environment. The object here, however, is to derive some lessons which might be useful in combatting new environmental hazards. International environmental lawyers tend to be practical people. They know the dangers when law and policy outpace the economic and technological parameters of the activities they wish to regulate and the conditions they seek to ameliorate. The fundamental dilemma facing policymakers is whether to act quickly in confronting an environmental hazard and risk the creation of an ineffective (or, worse, counterproductive) legal regime, or to wait until better scientific data becomes available and risk that action be taken too late. This article examines this enduring dilemma in the context of international law and environmental policy.

I

SCOPE AND DEFINITION OF THE EXOTIC SPECIES PROBLEM

The zebra mussel infestation in the Great Lakes has slowly but inexorably been traced back to one source. We do not know the ship's name, but scientists believe that the vessel entered Lake Erie in late 1985 or early 1986 and released its ballast water in Lake St. Clair, not far from Detroit.² The zebra mussel (*Dreissena polymorpha*) is a bivalve of one-

inch diameter with distinctive black and white bands on its shell,\textsuperscript{3} hence its name. It was first found in the Black and Caspian Seas and its range quickly spread to include most European waters.\textsuperscript{4} The zebra mussel is a notorious biofouler, able to attach itself to almost anything.\textsuperscript{5} It is also amazingly prolific. If left unchecked the zebra mussel can propagate at the rate of at least one order of magnitude each year.\textsuperscript{6}

Not surprisingly, in just the few years since its introduction the zebra mussel has wreaked havoc in the Great Lakes. The zebra mussel has no effective natural predators in the Great Lakes, vastly complicating the effort to limit its spread.\textsuperscript{7} In addition, the zebra mussel invasion interferes with human use of the Great Lakes. In particular, zebra mussels clog coastal structures. The cost of unfouling intakes and outfalls of power stations and water treatment plants is expected to run in excess of $5 billion over the next ten years.\textsuperscript{8} In the meantime, zebra mussel infestations have resulted in interruptions of power and water service to coastal communities and have resulted in other substantial economic costs.\textsuperscript{9}

\begin{itemize}
\item \textsuperscript{3} Carolan E. Malia, An Environmental and Ecological Report: The Invasion of the Zebra Mussel and Its Impact on Utilities, PUB. UTIL. FOR., Aug. 2, 1990, at 43, 43.
\item \textsuperscript{4} Zebra Mussels and Exotic Species: Hearings on H.R. 4214 Before the Subcomm. on Oceanography and Great Lakes, the Subcomm. on Fisheries and Wildlife Conservation and the Environment, and the Subcomm. on Coast Guard and Navigation of the House Comm. on Merchant Marine and Fisheries, 101st Cong., 2d Sess. 44-45 (1990) [hereinafter House Hearings] (statement of Alfred M. Beeton, Director, Great Lakes Environmental Research Lab).
\item \textsuperscript{5} Id. at 62 (statement of Wilfred LePage, Water Plant Supervisor, City of Monroe, Mich.).
\item \textsuperscript{6} Hart, supra note 2, at 82. A mature female zebra mussel may lay up to 40,000 eggs during each reproductive season. After fertilization the eggs develop into planktonic larvae (veligers) which currents disperse. The veligers soon must attach themselves to a hard surface to continue their development. They remain there through their adult stage. An individual zebra mussel survives from three to five years. House Hearings, supra note 4, at 44-45 (statement of Alfred M. Beeton, Director, Great Lakes Environmental Research Lab).
\item \textsuperscript{7} See Hart, supra note 2, at 87. A bottom-eating fish known as the drum, which will feed on the zebra mussel, lives in the Great Lakes. However, there is as yet no appreciable commercial demand for drums. Id. Overwintering wildfowl apparently are the zebra mussel's chief predator in Europe. Latest reports indicate that while some native American birds enjoy eating the zebra mussel, these birds are present in insufficient numbers. Id. A Malthusian population collapse could occur in the absence of predation. Even then, alternate collapse and increase would occur until the zebra mussel finds a population level it can sustain. Id.
\item \textsuperscript{9} House Hearings, supra note 4, at 62-63 (statement of Wilfred LePage, Water Plant Supervisor, City of Monroe, Mich.), 71-76 (statement of Vincent J. Tobin, Director of Governmental Relations, N.Y. Power Authority); see also Malia, supra note 3, at 43 (observing that smell of mussels may impact tourism and that pileup of shells on beaches will cause massive litter problem); Hart supra note 2, at 84 (indicating that mussels damage fishing nets, marine engines, and boat hulls). 
\end{itemize}
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The zebra mussel introduction also may have a severe impact on the Great Lakes ecosystem, although these effects are not fully understood and appreciated. Zebra mussels have overrun the spawning reefs of the native walleye, the major sport fish of the Great Lakes.10 Like most mollusks, zebra mussels have an ability to clarify water and purify it of contaminants. This, too, may have an impact on the Great Lakes environment, although it is too early to tell whether the effect would be positive or negative.11 More distressing are the prospects for the future spread of the zebra mussel. Because the Great Lakes are connected to nearly all of the major American river systems east of the Rockies, it is expected that this infestation soon will extend throughout most of the United States.12 The zebra mussel infestation demonstrates that the introduction of an exotic species is usually permanent, often expensive, and potentially devastating to the ecosystem.

The phenomenon of the spread of exotic species has been called the biological "homogenization of the planet—a process both inevitable and inexorable, as species after species casts itself abroad."13 As already suggested, what makes a species "exotic" or "alien" is simply the fact that it has spread beyond its traditional range.14 Sometimes it is difficult to know whether the appearance of a new species is the result of normal propagation and transportation.15 Not all exotic species survive, but a few thrive in their new surroundings. Those which do survive have benefited from an absence of natural enemies in adopted environments. "Without predators or diseases to thin their numbers, they simply crowd-out not-so-fortunate native species."16 This process devastates the biological diversity of ecosystems, producing areas called monocultures in which only one type of vegetation or one kind of animal prospers.17

These problems can be particularly acute for aquatic environments. The common carp is a "prime example of good intentions gone awry."18

10. House Hearings, supra note 4, at 46 (statement of Alfred M. Beeton, Director, Great Lakes Environmental Research Lab); Senate Hearings, supra note 8, at 48 (statement of Michael J. Donahue, Executive Director, Great Lakes Commission); Hart, supra note 2, at 83-84.

11. House Hearings, supra note 4, at 46-47 (statement of Alfred M. Beeton, Director, Great Lakes Environmental Research Lab); Hart, supra note 2, at 84-85.

12. Senate Hearings, supra note 8, at 1 (statement of Sen. Baucus), 5-6 (statement of Sen. Kohl); see also Hart, supra note 2, at 87.

13. Hart, supra note 2, at 86.

14. See supra note 1 and accompanying text.

15. Compare Exotic Species Threaten Parks, CHI. TRIB., Feb. 16, 1988, § 1, at 5 (implying that introduction of gypsy moth into U.S. was part of natural process) with Christopher B. Daly, Gypsy Moth Season is Creeping Up. But Predictions are Mild, BOSTON GLOBE, May 25, 1986, § (Metro), at 30 (stating that gypsy moth was released inadvertently by French scientist seeking to develop a superior earthworm).


17. Id.

18. Juliane Kurdila, Note, The Introduction of Exotic Species into the United States:
Carp were introduced into the United States from Germany in the 1870's, with proponents hailing the fish's promise as an abundant food source. Once adjusted to its new home, the carp displaced native fish species and lost the pleasant taste which had rendered it so attractive.\textsuperscript{19} The brown trout, another exotic introduction, has been known to feed on numerous varieties of native fish.\textsuperscript{20} Alien species may also carry foreign bacteria, viruses, or parasites that can threaten native animals, or even endanger human health. The penaeid shrimp introduced from Panama into Hawaii was later found to be infected with hypodermal and hematopoietic necrosis, a potentially deadly virus.\textsuperscript{21}

Almost all intentional introductions of marine nonindigenous species are motivated by a desire for some perceived benefit.\textsuperscript{22} In many cases, these benefits are realized. Aquatic animals usually are stocked because of a need for a larger number of commercially available species. Another benefit of these introductions is disease prevention. Certain species of fish have been introduced into tropical areas to eat mosquitoes and to arrest the spread of such ailments as malaria.\textsuperscript{23}

Nonetheless, most recent introductions of exotic species have been inadvertent. This was so with the zebra mussel and appears to be the case with other infestations reported in coastal areas of the United States. Infestations such as the alewife,\textsuperscript{24} sea lamprey,\textsuperscript{25} ruffe,\textsuperscript{26} and water flea\textsuperscript{27}


\textsuperscript{19.} \textit{Id.}; see also Jeffrey N. Taylor et al., \textit{Known Impacts of Exotic Fishes in the Continental United States}, in \textit{DISTRIBUTION, BIOLOGY AND MANAGEMENT OF EXOTIC FISHES} 322, 346-49 (Walter R. Courtenay & Jay R. Stauffer eds., 1984); Janet Raloff, \textit{An Exotic Problem}, 117 SCIENCE NEWS 398 (1980).

\textsuperscript{20.} Taylor et al., \textit{supra} note 19, at 343.


\textsuperscript{22.} See Taylor et al., \textit{supra} note 19, at 323 (observing intentional introductions serve four purposes: (1) to provide food for native fish; (2) to control unwanted pests; (3) to promote aesthetic values; and (4) to release unwanted pets). \textit{But see Stein, supra} note 16, § 1, at 18 (describing malicious planting of capeweed near San Francisco).


\textsuperscript{24.} \textit{See Hart, supra} note 2, at 85 (pointing out that alewives initially were viewed as a "plague," but "ultimately turned into a useful forage species for other fish"); \textit{House Hearings, supra} note 4, at 43 (statement of Alfred M. Beeton, Director, Great Lakes Environmental Research Lab) (noting the extensive costs of removing dead alewives littering beaches), 79-80 (statement of Robert E. Malouf, Director, New York Sea Grant Extension Program) (proposing that spread of alewives may have been result of concurrent decline in predator species).

\textsuperscript{25.} \textit{See House Hearings, supra} note 4, at 79 (statement of Robert E. Malouf, Director, New York Sea Grant Extension Program). Prior to the zebra mussel, the sea lamprey was the best known of the Great Lakes' exotic fishes. The sea lamprey is thought to have first established a presence there in the 1930's. \textit{Id.} The sea lamprey preys on a number of other species, and on its own almost destroyed the trout population in the region. \textit{Id.} at 57 (statement of Charles C. Krueger, Chairman, Great Lakes Commission). The damages caused by this intruder have been fixed in excess of tens of millions of dollars. \textit{Id.} at 43 (statement of Alfred M. Beeton, Director, Great Lakes Environmental Research Lab). It has been estimated that the effort to control the sea lamprey has cost the Canadian and American governments $116 mil-
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infestations in the Great Lakes have inflicted substantial environmental damage. That vast body of fresh water seems to be particularly susceptible to alien introductions. In addition to fresh-water environments, estuarine and maritime environments are also at risk. Infestations of exotic species have been reported on the coasts of the United States, as well as in Australia, Europe, and Latin America. In many coastal areas, there have been increased sightings of algal blooms, known as "red" or "brown tides," traced to accidental introductions. These dinoflagellates kill many kinds of fish and marine animals and also can cause paralytic shellfish poisoning in humans. Many of these introductions of marine organisms have been traced to the same "vector," or pathway—introduc-
tion via the ballast water of oceangoing vessels. Ballast water is not bilge water. Ballast water is pumped on board a ship, prior to sailing, to permit the ship to float at its proper height and to provide added stability for the ship during its voyage. Several tons of ballast water are usually required to trim the vessel correctly. Initially, ballast water is pumped from the estuary or port where the vessel is at rest. It is pumped back out when the ship reaches its destination and begins the process of offloading its cargo. The intake of ballast is a routine for ship operators around the globe and is considered absolutely essential to the safe operation of oceangoing vessels.

Ballast water more and more is identified as the vector responsible for the increasing number of introductions of aquatic alien species. One prominent scientist has speculated that [It may be the volume of water transported is greater, that the speeds of the ships are faster and the survival of organisms in the ballast water is higher. It may be that environments that are donating organisms to other areas of the world have changed or that the receiving environments have changed.

Most scientists seem to agree that the process of transporting species in ballast from one part of the globe to another is inherently unpredictable. The odds that a vessel will bring an organism on board during the ballasting process, that the organism will survive the voyage, and that it then successfully will populate a new (and perhaps hostile) environment, are remarkably slim. Most of these organisms do not survive in their new homes. Nonetheless, "[s]ome, like the zebra mussel, step onto the

34. House Hearings, supra note 4, at 86 (statement of James T. Carlton, Maritime Studies Program, Williams College). However, other means of unintentional introduction exist. For example, exotic organisms may imbed themselves on the anchor chains of ships. Senate Hearings, supra note 8, at 21 (statement of Capt. Thomas E. Thompson, U.S. Coast Guard).
35. Senate Hearings, supra note 8, at 86 (statement of James T. Carlton, Maritime Studies Program, Williams College). Bilge water is the stagnant water that collects inside a ship's hull.
36. See Senate Hearings, supra note 8, at 86 (statement of James L. Henry, President, Transportation Institute); House Hearings, supra note 4, at 105 (statement of Joseph Cox, Vice-President, American Institute for Merchant Shipping) ("Ballast is used on all types of ships to achieve satisfactory bending moments, limit shear forces, and control trim and stability. Container ships [also] use ballast . . . to maintain an upright position during asymmetric loading and/or discharge to allow shore cranes to plumb cell guides vertically. On tank vessels, ballast must be discharged before and/or during cargo loading to allow sufficient space/draft for cargo.").
37. See House Hearings, supra note 4, at 162 (statement of Capt. Ivan A. Lantz, Manager, Marine Operations, The Shipping Federation of Canada) (noting that a typical ocean carrier entering the Great Lakes in full ballast would hold from 7000 to 10,000 tons of ballast water).
38. See supra note 36 and accompanying text.
40. See id. at 86.
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biological escalator at precisely the right moment, and ascend to astro-
nomical levels."\textsuperscript{41}

A proposed solution to address this problem is the mandatory reball-
lasting of ships at sea.\textsuperscript{42} The idea seems simple enough. Relative to
coastal and fresh-water organisms, few species reside in the open ocean in
large numbers.\textsuperscript{43} Therefore, it would seem logical to dump into the open
ocean the ballast water collected in port before proceeding to the next
destination. Any fresh-water or estuarine organism should be killed by
the higher salt content of waters beyond the coast, and it is very unlikely
that any coastal marine organism could survive long in a high seas
ecosystem. Conversely, any organisms picked up from the high seas dur-
during reballasting would be unlikely to thrive in coastal waters.\textsuperscript{44}

While plausible in theory, scientists and industry experts disagree
over how workable mandatory reballasting would be in practice. First,
there are concerns about the effectiveness of ballast exchange at sea. It
has been suggested that it is impossible to achieve a complete reballast-
ing.\textsuperscript{45} Some of the estuarine water from the port will be left in the vessel
and some organisms, particularly those accustomed to briny (part fresh,
part salt) water, may survive.\textsuperscript{46} Moreover, many organisms are trans-
ported in the sediment that is brought on board when ballast water is
pumped into the holds of a vessel.\textsuperscript{47} This sediment can be removed only
if the entire ballast of a ship is pumped out, which is a very difficult
operation even in port.\textsuperscript{48} Finally, some of the recent exotic introductions
have been salt-water species, including the Asiatic clam in San Francisco
Bay and dinoflagellates, which cause the deadly red tide, in Australia.\textsuperscript{49}
Reballasting probably would have little effect on these organisms, save

\begin{itemize}
\item \textsuperscript{41} Id.
\item \textsuperscript{42} See, e.g., id. at 58 (statement of Charles C. Krueger, Chairman, Great Lakes Com-
mission) ("[T]o stop irrevocable introductions, ballast exchange must be practiced by every
oceangoing ship inbound to the Great Lakes and connected waters.").
\item \textsuperscript{43} Id. at 87 (statement of James T. Carlton, Maritime Studies Program, Williams
College).
\item \textsuperscript{44} See id. at 87-88. However, a small number of salt-water species have made a success-
ful transition to exotic coastal environments. See infra text accompanying note 49. Further-
more, mandatory reballasting at sea may cause one adverse environmental impact. Such
reballasting will result in the dumping of significant quantities of sea water into harbor ecosys-
tems. If salinity increases too rapidly in an estuarine environment, some salt-sensitive orga-
nisms may die or cease to reproduce. \textit{House Hearings, supra} note 4, at 216 (statement of Great
Lakes Fishery Commission).
\item \textsuperscript{45} See \textit{House Hearings, supra} note 4, at 98-99 (statement of Capt. Thomas E. Thomp-
son, U.S. Coast Guard).
\item \textsuperscript{46} Id. at 177 (statement of James L. Henry, President, Transportation Institute).
\item \textsuperscript{47} Id.
\item \textsuperscript{48} See \textit{id.}; \textit{id.} at 215-16 (statement of Great Lakes Fishery Commission).
\item \textsuperscript{49} Id. at 177 (statement of James L. Henry, President, Transportation Institute); see also
\textit{supra} notes 29-30 and accompanying text.
\end{itemize}
for the obvious benefit of disposing of the creatures on the open sea, rather than in port.  

Quite apart from these biological concerns about the effectiveness of reballasting in preventing exotic introductions, ballast exchanges on the high seas present major safety concerns. The first concern is that a vessel pumping out its ballast on the open ocean runs a great risk of losing its stability and capsizing. Second, reballasting can add to the structural stresses on a vessel and result in a loss of hull integrity. Third, for oil tankers and other bulk chemical carriers there is a possibility that this procedure could cause a spill when a segregated ballast tank's contents are exchanged with a cargo tank. Finally, ballast exchanges also will add to crew fatigue and the costs of operating the ship itself.

Unfortunately, there are few other viable options for averting invasion by ship borne alien species. Methods other than ballast exchange have been proposed, including filtering ballast water, heating it, subjecting it to ultraviolet light or ultrasound, and even treating it with biocides. It appears that additional research is required before any of these suggestions can be converted into treatments. Many may be unavailable due to excessive cost or other considerations. One last possibility is to erect treatment facilities onshore to receive and disinfect

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50. See House Hearings, supra note 4, at 177 (statement of James L. Henry, President, Transportation Institute).
51. See id. ("The emptying of ballast during the exchange process temporarily removes the safety benefits of the ballast. The exchange process simultaneously subjects the vessel to the free surface effect, meaning that during those times that the tanks are partially full there is an additional negative effect on stability from the sloshing of ballast water.").
52. See id. at 177-79 (statement of James L. Henry, President, Transportation Institute), 216 (statement of Charles Krueger, Chairman, Great Lakes Commission).
53. Id. at 177 (statement of James L. Henry, President, Transportation Institute); Senate Hearings, supra note 8, at 42 (statement of Capt. Thomas E. Thompson, U.S. Coast Guard).
54. House Hearings, supra note 4, at 104 (statement of Joseph Cox, Vice-President, American Institute of Merchant Shipping).
55. See Senate Hearings, supra note 8, at 42 (statement of Capt. Thomas E. Thompson, U.S. Coast Guard).
56. Id. at 43 (statement of Capt. Thomas E. Thompson, U.S. Coast Guard); House Hearings, supra note 4, at 178 (statement of James L. Henry, President, Transportation Institute). For a discussion of using electricity to rid ballast water of exotic species, as well as a thorough examination of the other alternatives, see generally James T. Carlton, Preventive Options for the Management and Control of Accidental Intercontinental Transfers of Exotic Organisms by Ballast Water (Mar. 1, 1990) (unpublished manuscript, on file with the Ecology Law Quarterly).
57. See House Hearings, supra note 4, at 178 (statement of James L. Henry, President, Transportation Institute).
58. See id. at 43 (statement of Capt. Thomas E. Thompson, U.S. Coast Guard). See generally Carlton, supra note 56 (discussing feasibility of particular alternatives to ballast water exchange).
ballast water.\textsuperscript{59} This option also is considered to be impractical and costly.\textsuperscript{60}

It seems beyond question that the introduction of aquatic nonindigenous species is a global problem. Infestations of these organisms have plagued a number of coastal nations, ruining delicate ecosystems, imposing substantial economic hardships, and even posing a threat to human health. Although many nations could easily dismiss the risk of exotic species, coastal nations are taking the issue very seriously. With the recognition that these organisms are spread with man’s assistance comes the realization that steps can be taken toward preventing and controlling future introductions.

The ability of the international community to control exotic species introduction largely hinges on whether the problem of alien organisms is considered a manifestation of marine pollution. This exercise of definition is crucial to the process of responding to new environmental threats. Without some generic recognition of a problem, international cooperation is nearly impossible.\textsuperscript{61} As suggested above, the decisive question is the role that humans play in the process of spreading the natural ranges of plant and animal species. This human role is readily apparent in the intentional efforts to introduce a new species into an ecosystem, but the role that humans play becomes more problematic when the introductions are accidental and can only be inconclusively traced to the ballast water vector. A definition of pollution which includes changes to the oceanic environment from natural processes is bound to falter with respect to what the true natural state of a particular ecosystem is supposed to be over time.\textsuperscript{62} The phenomenon of exotic species may be part of a larger process of local ecosystems combining into larger ones with the resulting dispersal of a variety of plant and animal forms.\textsuperscript{63} Then again, it may not. There is simply no way of knowing. But exotic species introduction must be defined as pollution in order to avoid foundering on the determination of an ecosystem’s “natural state.” Exotic species introduction also should be defined as pollution in order to take advantage of existing international pollution control regimes and to sidestep the burden of generating a new set of protocols.

\textsuperscript{59} Carlton, supra note 56, at 12. Ballast water could be pumped onshore into tanks or lagoons where treatment could take place. Ballast water exchange facilities already exist at some petroleum ports; however, these facilities are designed to recover oil from ballast water. \textit{Id.} Presumably separate facilities would be required to treat ballast water for the eradication of exotic species. \textit{See id.}

\textsuperscript{60} \textit{See id.} (discussing expense of constructing new treatment facilities and danger of spilling ballast water into local sewage treatment systems).

\textsuperscript{61} See M. Tomczak, Jr., \textit{Defining Marine Pollution,} 8 \textit{Marine Policy} 311, 311 (1984). Scientists in particular require a common definition of pollution in order to narrow the focus of their research. \textit{Id.}

\textsuperscript{62} \textit{See id.} at 312-13.

\textsuperscript{63} \textit{Sec supra} text accompanying note 13.
The first attempts at defining marine pollution in international legal instruments tended to conceive the problem too narrowly. For example, the 1958 Convention on the Continental Shelf\textsuperscript{64} called upon the signatory nations to “undertake . . . all appropriate measures for the protection of the living resources of the sea from harmful agents.”\textsuperscript{65} No attempt was made to elaborate further on the terms “harmful” and “agent.”\textsuperscript{66} The International Convention for the Prevention of Pollution from Ships of 1973 (MARPOL)\textsuperscript{67} similarly defined “harmful substance” as “any substance which, if introduced into the sea, is liable to create hazards to human health, to harm living resources and marine life, to damage amenities or to interfere with other legitimate uses of the sea, and includes any substance subject to control by the present Convention.”\textsuperscript{68} The approach taken in MARPOL was to describe a pollutant based on its generic effect on the environment. Arguably, an infestation by an exotic species satisfies this formulation since it certainly could degrade the marine ecosystem into which it was introduced. A remaining question then is whether a living organism can be classified as a “substance.”

The most widely accepted definition of marine pollution was put forward by the Joint Group of Experts on the Scientific Aspects of Marine Pollution (GESAMP) in the early 1970’s.\textsuperscript{69} It drew upon language originally drafted by the Scientific Committee of Ocean Research in 1966,\textsuperscript{70} and provided that

\begin{quote}
[p]ollution means the introduction by man, directly or indirectly, of substances or energy into the marine environment (including estuaries) resulting in such deleterious effects as harm to living resources, hazards to human health, hindrance to marine activities including fishing, impairment of quality for use of sea-water, and reduction of amenities.\textsuperscript{71}
\end{quote}

\begin{thebibliography}{9}
\bibitem{66} Tomczak, \textit{supra} note 61, at 314.
\bibitem{68} MARPOL, \textit{supra} note 67, art. 2, para. 2, 12 I.L.M. at 1320.
\bibitem{69} GESAMP is an advisory working group, serving nongovernmental organizations, that is sponsored by eight international organizations. Tomczak, \textit{supra} note 61, at 317-18.
\bibitem{70} Id. at 318.
\bibitem{71} Id.
\end{thebibliography}
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This definition was, in turn, incorporated into the 1982 U.N. Convention on the Law of the Sea,\textsuperscript{72} but with the proviso that the substances or energy introduced by man must "result or [be] likely to result in" the mentioned deleterious effects.\textsuperscript{73} As will be discussed below,\textsuperscript{74} the 1982 Law of the Sea Convention also contains a specific provision dealing with alien or new species. This provision is contained in an article that also calls upon nations to "take all measures necessary to prevent, reduce and control pollution of the marine environment resulting from the use of technologies under their jurisdiction or control."\textsuperscript{75} The combined effect of these provisions suggests, but by no means concludes, that exotic species are to be considered a form of marine pollution.

Only once have international authorities suggested that species should be assimilated to "substances" and "energy," as those terms are used in the GESAMP and Law of the Sea Convention formulations. Special Rapporteur Stephen M. Schwebel made such an assertion in his discussion of the definition of pollution in his 1981 Report on the Law of Non-Navigational Uses of International Watercourses for the International Law Commission of the United Nations.\textsuperscript{76} Later work by Special Rapporteur Stephen M. McCaffrey on this subject alluded to, but did not explicitly link, exotic species and pollution.\textsuperscript{77} Commissioner McCaffrey suggested that "'pollution' means any physical, chemical or biological alteration in the composition or quality of the waters of an international watercourse [system] which results directly or indirectly from human conduct . . . ."\textsuperscript{78} As scientists and international lawyers are becoming


\textsuperscript{73} \textsl{Id.} art. 1, para. 1(4), 21 I.L.M. at 1271; see also Tomczak, \textsl{supra} note 61, at 321-22 (providing further details on the drafting differences between the GESAMP definition and article 1 of the 1982 Law of the Sea Convention).

\textsuperscript{74} See \textsl{infra} notes 154-68 and accompanying text.

\textsuperscript{75} 1982 Law of the Sea Convention, \textit{supra} note 72, art. 196, para. 1, 21 I.L.M. at 1308.


The introduction of various species can, for example, accelerate eutrophication, clog intakes and machinery, damage fisheries and aquacultures, reduce available oxygen, spoil recreation or transmit disease. The effects of such introduction can in some watercourses be as serious as, if not more so than, many contaminating substances (non-living) and be highly difficult to eradicate once introduced and established.


\textsuperscript{78} \textsl{Id.} It is important to note, however, that this language was later dropped in subse-
more sensitive to the notion that exotic species can substantially degrade marine ecosystems, marine pollution increasingly is understood to encompass introduction of nonnative species.

The distinction between accidental and intentional introductions presents another issue for the debate on whether exotic species can be pollution. The strategies for dealing with these distinct facets of the exotic species problem are quite different. Intentional introductions of nonindigenous species ideally should be subject to a rigorous evaluation protocol in which the benefits and risks of a new organism are carefully weighed, preferably with some sort of mechanism for international consultation. A less popular and more cumbersome alternative would be to develop an internationally approved "clean list" specifying which species could be introduced into new environments and under what conditions.79

For accidental infestations of alien organisms, the key element in any successful control effort is to identify those human activities that have a high risk of contributing to the problem.80 The carriage of ballast water is just the first of these leading vectors to be isolated. Others may be observed in the future. Because the problem of exotic species is truly global, measures with international force must be adopted in order to manage these high-risk activities.81

II
DOMESTIC CONTROL EFFORTS: THE U.S. EXPERIENCE

It should come as no surprise, therefore, that domestic efforts have concentrated on the problem of deliberate introductions, while international cooperation has lagged in dealing with inadvertent invasions of nonindigenous species. After all, regulations concerning customs and sanitary protections are the unique province of national governments. In attempting to limit the introduction of harmful species within its territory, the American experience in this area of legislation and regulation has been more or less typical of that of other nations.

79. See House Hearings, supra note 4, at 37 (statement of Constance B. Harriman, Assistant Secretary for Fish and Wildlife and Parks, Department of the Interior).
80. Id.
81. House Hearings, supra note 4, at 37 (statement of Constance B. Harriman, Assistant Secretary for Fish and Wildlife and Parks, Department of the Interior).
EXOTIC MARINE SPECIES

The Lacey Act of 1900 was the first initiative made in United States law to limit harmful introductions. The primary purpose of the bill was to enlarge the powers of the Agriculture Department in order to prohibit the transportation by interstate commerce of game killed in violation of state and local laws. Section 2 of the Act touched on the problem of exotic species by making it "unlawful for any person . . . to import into the United States any foreign wild animal or bird except under special permit . . . ." That section went on to prohibit the introduction of specific species, including the mongoose, fruit bat, English sparrow, and starling, as well as "such other birds or animals as the Secretary of Agriculture may from time to time declare [to be] injurious to the interest of agriculture or horticulture . . . ."

The term "birds or animals," as originally used in the Lacey Act's prohibition of exotic introductions, was interpreted narrowly to extend only to game birds and fur bearing mammals. Congress passed the Black Bass Act in 1926 to protect certain species of fish. Subsequent amendments to that legislation extended the prohibition against delivery or transport, in violation of the laws of a state, to all "game fish," and later to all "fish." The Black Bass Act was finally amended in 1969 to encompass foreign commerce and fish taken, bought, sold, or possessed in violation of foreign law. The Lacey and Black Bass Acts were intended "not as increasing the Federal role in managing wildlife, but as a Federal tool to aid the states in enforcing their own laws concerning wildlife." The Lacey and Black Bass Acts were called "in many ways [the United States'] most important wildlife laws since they affect the thousands of species subject to State and foreign laws."


83. See Kurdila, supra note 18, at 95.


85. Id. § 2, 31 Stat. at 188.

86. Id.


89. Id. § 2, 44 Stat. at 576 (protecting largemouth and smallmouth black bass).


94. Id.
In 1981 these two legislative efforts were consolidated into the Lacey Act Amendments of 1981 (the Amendments),\(^9\) vastly expanding the scope of federal regulation in this area. First, the Amendments apply to all animals and to many plants.\(^9\) The Amendments make it an offense to “import, export, transport, sell, receive, acquire, or purchase” any plant or animal “taken or possessed in violation of any law, treaty, or regulation of the United States or in violation of any Indian tribal law.”\(^9\) The goal of this prohibition was to restrict the trade in wildlife. The idea of controlling introductions of exotic species was only a secondary concern.\(^9\)

Indeed, the enumerated prohibited acts would seem to apply to the problem of exotic introductions only to the extent that a state law specifically prohibits the possession of certain organisms with the intent of introducing them into a new ecosystem.\(^9\) Few states have comprehensive regulatory schemes to control the introduction of exotic species.\(^10\) Consequently, the Act does not result in effective control.

The reference that the Amendments make to treaties,\(^10\) however, would seem to justify some hope for linkage with international control measures. For example, if an international agreement were adopted which imposed regulations for the proper handling of ballast water,\(^10\) a violation of those measures might constitute an offense under the Lacey Act Amendments. Such an offense would be punishable only if the ship operator had not exercised the due care required under the civil penalty provisions\(^10\) or had knowingly engaged in such a violation as required


\(^{96}\) 16 U.S.C. § 3371(a), (f) (1988). The Amendments apply to those plants which are indigenous to any state in the United States and which are either listed in an annex to the Convention on International Trade in Endangered Species of Wild Fauna and Flora, March 3, 1973, 27 U.S.T. 1087, 993 U.N.T.S. 243, or are listed pursuant to any state law which provides for the conservation of species threatened with extinction. 16 U.S.C. § 3371(f) (1988). The Amendments have no impact on the problem of introductions of exotic plant species because these are, obviously, not indigenous to any state.


\(^{98}\) See S. REP. NO. 123, supra note 93, at 1, reprinted in 1981 U.S.C.C.A.N. 1748 (“Imported wildlife carry diseases that can affect poultry, livestock, fish and pets.”). See also Kurdila, supra note 18, at 103-06 (observing that Lacey Act has only indirect effect on exotic introductions).

\(^{99}\) See Kurdila, supra note 18, at 104.

\(^{100}\) See id. at 107-08 (describing various state statutes in effect as of 1984). Interstate introductions present a particularly difficult obstacle to effective state regulation. See id. at 108-11; House Hearings, supra note 4, at 218 (statement of Charles C. Krueger, Chairman, Great Lakes Commission, in response to Committee questions).


\(^{102}\) For more on this possibility, see infra notes 258-59 and accompanying text.

by the criminal provisions of the Amendments. The Lacey Act Amendments do not, therefore, directly address the problem of accidental introductions of nonindigenous species.

The Amendments did leave untouched, however, the specific prohibition in the Lacey Act of 1900 against the importation of certain organisms declared to be injurious to “human beings, to the interests of agriculture, horticulture, forestry or to wildlife or the wildlife resources of the United States.” Pursuant to this criminal provision, a regulatory scheme was developed to identify those species for which importation should be banned. Unfortunately, this scheme operates by blacklisting only those alien species discovered, after the fact, to be dangerous.

A prospective program for evaluating new introductions was adopted in 1977, but it applied only to federal government management of the “natural ecosystems on lands and waters” which the government owns, leases, or holds for purposes of administration. Executive Order Number 11,987, signed by President Carter on May 24, 1977, did allow executive agencies “to the extent they have been authorized by statute to restrict the importation of exotic species, [to] restrict the introduction of exotic species into any natural ecosystem of the United States.” When read together with the remaining criminal provision of the old Lacey Act, the Executive Order offers a comprehensible domestic regime for the prevention of intentional introductions of alien organisms. Unfortunately, the interested federal agencies have not actually implemented a system to consider permits for proposed introductions of exotic species. Instead, the agencies have continued merely to place those species known to be dangerous on the black list in the regulations enforcing the Lacey Act’s criminal penalty provisions.

A potentially effective, albeit presently unexploited, statutory mechanism is thus in place to prevent the introduction of harmful exotic species. Nevertheless, until 1990, virtually no attention was given to the problem of accidental introductions of marine organisms. Regulations

104. Id. § 3373(d)(2).
106. The Department of the Interior deliberated for some years between adopting a “dirty list” approach of banning certain organisms, as opposed to a “clean list” approach prescribing those species that could safely be introduced. The Department finally agreed on the “dirty list” method. See Kurdila, supra note 18, at 104-05; 50 C.F.R. §§ 16.11-16.15 (1990). The general restrictions of the regulations appear to ban all introductions without a permit. See id. § 16.3. However, accompanying provisions make clear that the regulations apply only to particular species. See id. §§ 16.11-16.15.
108. Id. § 2(b).
110. See Kurdila, supra note 18, at 102-03.
issued in 1977 under the authority of the Marine Protection, Research and Sanctuaries Act of 1972\textsuperscript{111} did touch on the problem as an aspect of the larger issue of ocean dumping. Those regulations prohibited the discharge at sea of wastes containing living organisms if they would "endanger human health or that of domestic animals, fish, shellfish and wildlife by [e]xtending the range of biological pests, viruses, pathogenic organisms or other agents . . . [or by] [i]ntroducing viable species not indigenous to an area."\textsuperscript{112} Moreover, the regulations instructed that dumping grounds for such wastes should be selected in order to "prevent or avoid creating [a] habitat conducive to the development of undesirable predators or species which have a competitive edge ecologically over indigenous plants or animals."\textsuperscript{113} These rules were meant only to be advisory in character, and no subsequent attempt has been made to precisely indicate suitable dumping grounds for waste waters containing potentially dangerous plants and animals. Moreover, these regulations did not contemplate the role of ballast water as the major vector for the transport of marine organisms.

The Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990\textsuperscript{114} (the 1990 Act) represents the first direct legislative attention given to the problem of accidental infestations of marine species. Those provisions of the 1990 Act concerning ballast water exchanges will be discussed below,\textsuperscript{115} but other features of this legislation are worth noting here. Aside from a few specific commands, the purpose of this legislation was to establish a sensible national policymaking framework to prevent and control future introductions of marine organisms. A task force was established and given the responsibility of developing a program to identify the pathways by which exotic species are introduced, to implement proposals to close off these vectors, to monitor infestations, and to limit the damage they cause.\textsuperscript{116} The task force will also oversee an ambitious program of research, technical assistance, and public education.\textsuperscript{117} The 1990 Act also calls upon Great Lakes states to coordinate their policies on this issue,\textsuperscript{118} while exhorting states to draft their own aquatic nuisance species management plans.\textsuperscript{119} Finally, and almost as an afterthought, Congress authorized the task force, in consultation with regional, state, and local agencies, to "identify and evaluate approaches

\textsuperscript{112} 40 C.F.R. § 227.7(c) (1991).
\textsuperscript{113} Id. § 230.75(b).
\textsuperscript{115} See infra notes 208-20 and accompanying text.
\textsuperscript{117} Id. § 4722(f)-(h).
\textsuperscript{118} Id. § 4723.
\textsuperscript{119} Id. § 4724.
for reducing the risk of adverse consequences associated with intentional introductions of aquatic organisms."\textsuperscript{120}

It would be easy to criticize the effectiveness of U.S. legislative and regulatory attempts to control both the intentional and accidental introduction of nonindigenous organisms. In part, this is because the legislative efforts have all lacked a cohesive underlying policy. The Lacey and Black Bass Acts were a patchwork effort and the 1981 Lacey Act Amendments only partially filled the gaps. The focus of these enactments was to assist in the enforcement of state game laws and to restrict the interstate and international trade in wildlife. The issue of intentional introductions of exotic species was only a secondary, remote concern.

The only law exclusively directed to the problem of alien organisms was the criminal provision of the Lacey Act proscribing the importation of "injurious" species into the United States.\textsuperscript{121} Because no effort was made to develop a strong federal regulatory scheme for controlling the spread of new species, only weak and sporadic state supervision impeded intentional introductions. It might be that the failure to control intentional introductions is attributable to federalist deference to state regulation in this area.

Accidental infestations have altogether escaped legislative attention until just recently. The 1990 Act seems well designed to set in motion a policymaking process that will address that concern. But it is too early to tell whether the Act will succeed. What is certain is that without the highly publicized zebra mussel infestation, no action would have been taken to adopt a federal policy for combating accidental introductions.

The U.S. experience in controlling exotic introductions illustrates a common tendency in environmental policymaking: little concrete action is taken until the risk is manifest.\textsuperscript{122} Both the 1900 Lacey Act and the 1990 Nonindigenous Aquatic Nuisance Prevention and Control Act were drafted after severe episodes of alien species introductions.\textsuperscript{123} The creation of a unified policy on intentional introductions was frustrated not only by federalism concerns, but also by sparse scientific evidence on the mechanisms by which new organisms were accidentally introduced. Until recently, therefore, the chief conditions for effective environmental policymaking—a perceived need for action coupled with adequate scientific information—were absent.\textsuperscript{124}

\textsuperscript{120.} Id. § 4727.
\textsuperscript{122.} For example, the Oil Pollution Act of 1990 was passed in response to the Exxon Valdez oil spill. Pub. L. No. 101-380, 104 Stat. 484.
\textsuperscript{123.} See Kurdila, supra note 18, at 99-100, 103; House Hearings, supra note 4, at 3 (statement of Rep. Nowak).
\textsuperscript{124.} Australia recently has faced the issue of controlling exotic species, in particular alien plants that have threatened to become unstoppable weeds. For information regarding the Aus-
III
INTERNATIONAL AGREEMENTS AND EXOTIC SPECIES

The threat of exotic species has long been recognized, although not concretely addressed, by international conventions. Ironically, the way in which these international conventions address this issue has been remarkably sensible and supple, if not very precise or authoritative. These treaty regimes express little doubt that the problem of alien organisms is truly global in scope and demands international action. While none of these international agreements attempts to offer a concrete solution that would limit the spread of dangerous forms of animal and plant life, they do succeed in correctly identifying the threat that these organisms pose to vulnerable ecosystems.

A. Conservation Agreements

The network of international wildlife conservation agreements led in the recognition of these threats. The first of these instruments was the 1933 Convention Relative to the Preservation of Fauna and Flora in their Natural State. Negotiated by the European powers holding colonies in Africa, this treaty was intended to apply primarily to that continent. The Convention promoted the establishment of "strict nature reserves" in which, among other things, the contracting parties agreed that "any act likely to harm or disturb the fauna or flora, and the introduction of any species of fauna and flora, whether indigenous or imported, wild or domesticated, shall be strictly forbidden . . . ." The signatories to this agreement also undertook to "give consideration to the desirability of preventing the introduction of exotic trees or plants into national parks or reserves." In 1968, this agreement, including the clauses on exotic species, was renewed virtually in its entirety by the newly independent states of Africa.

126. See id. pmbl., 172 L.N.T.S. at 242, reprinted in 4 RÜSTER & SIMMA, supra note 125, at 1693. The 1933 Convention stated that the Convention "shall not have any application . . . to any metropolitan territory not situated in . . . Africa," unless a signatory makes a declaration of intent to apply the treaty to the other continents. Id. art. I, para. 5, 172 L.N.T.S. at 246, reprinted in 4 RÜSTER & SIMMA, supra note 125, at 1695.
127. Id. art. 2, para. 2, 172 L.N.T.S. at 248, reprinted in 4 RÜSTER & SIMMA, supra note 125, at 1696.
128. Id. art. 7, para. 5, 172 L.N.T.S. at 250, reprinted in 4 RÜSTER & SIMMA, supra note 125, at 1697.
Similar conservation agreements have been adopted for the South Pacific and Europe. These instruments require the signatory states to prevent, by all means at their disposal, the introduction of "non-native" species and are particularly concerned with limiting intentional introductions of alien organisms. The Apia Convention for the South Pacific region requires that "[e]ach Contracting Party shall carefully consider the consequences of a deliberate introduction into ecosystems of species which have not previously occurred therein." The Directive of the Council of the European Economic Communities, adopted April 25, 1979, on the Conservation of Wild Birds, goes so far as to require member states to engage in prior consultation on any proposed introductions of birds which do not occur naturally in the wild. A number of bilateral bird conservation treaties require that steps be taken to ensure that vulnerable habitats are not disrupted by the introduction of exotic species. Some nations, pursuant to these agreements, apparently have taken concrete action to that end.

The most elaborate international regime for the prevention of exotic introductions was adopted by the Antarctic Treaty Consultative Parties (the ATCP's) in 1964. This is not surprising since the problem of...
alien organisms is particularly acute for the pristine ecosystems of Antarctica. The Agreed Measures for the Conservation of Antarctic Fauna and Flora specifically require that participating governments "prohibit the bringing into the Antarctic Treaty Area of any species of animal or plant not indigenous to that Area" unless a permit has been granted after review by that state. Although the Agreed Measures originally contemplated a "clean list" approach in which certain organisms would be allowed to be introduced under permit, the implementing legislation adopted by individual ATCP's has been more permissive, essentially requiring themselves to make a "dirty list" of species or groups of species which are not to be introduced to Antarctica.

While efforts to prevent exotic introductions have been integrated into regional conservation programs, they have also been undertaken in particular global contexts. One of these efforts has concerned the management of highly migratory species, particularly birds. This aspect of the nonindigenous species threat was first noted by nongovernmental or-science series 1987). The original ATCP's are Argentina, Australia, Belgium, Chile, France, Japan, New Zealand, Norway, South Africa, Great Britain, the U.S.S.R., and the U.S. Id. at 140. Poland, Germany, Brazil, China, India, and Uruguay have been recognized as ATCP's due to their research activities in Antarctica. Id. at 141. The ATCP's are the only signatories of the Antarctic Treaty who may wield executive decisionmaking power over the Continent. Id.


140 Id. art. 9, 17 U.S.T. at 1000, reprinted in 5 RÜSTER & SIMMA, supra note 129, at 2410. The Agreed Measures require that permits be narrowly drawn for the introduction of certain, enumerated species. See id. art. 9, para. 2 & annex C, 17 U.S.T. at 1000, 1002, 5 RÜSTER & SIMMA, supra note 129, at 2410, 2412 (permitting sledge dogs, domestic animals and plants, and laboratory animals and plants). Moreover, the Agreed Measures require that adequate safeguards be in place to prevent "any such animal or plant [from causing] harmful interference with the natural system if left unsupervised within the Treaty Area." Id. art. 9, para. 2, 17 U.S.T. at 1000, 5 RÜSTER & SIMMA, supra note 129, at 2410. The Agreed Measures also require that "all reasonable precautions . . . be taken to prevent the accidental introduction of parasites and diseases into the Treaty Area." Id. art. 9, para. 4 & annex D, 17 U.S.T. at 1000, 1003, 5 RÜSTER & SIMMA, supra note 129, at 2410, 2413. New regulations concerning exotic species are now under review by the ATCP's. See supra note 138. These require that all exotic plants and animals be either removed or destroyed by incineration. See Protocol to the Antarctic Treaty on Environmental Protection, ATCP 11th Special Consultative Mtg., Annex on Conservation on Antarctic Fauna and Flora, Apr. 29, 1991 art. 5, para. 4, ATCP Doc. XI/ATSCM/2/WG II/1/Rev. 1 [hereinafter Draft Protocol].

141 See Draft Protocol, supra note 140, art. 9, para. 2 & Annex C.

142 See, e.g., Antarctic Conservation Act of 1978, Pub. L. No. 95-541, 92 Stat. 2048 (codified as amended at 16 U.S.C. §§ 2401-2412 (1988)). The Act makes it an offense to introduce a nonindigenous species to Antarctica. 16 U.S.C. § 2403(a)(1)(c) (1988). The statute also requires the promulgation of regulations to "designate those animals and plants, not indigenous to Antarctica, which either may, or may not, be introduced into Antarctica, and specify those control measures which must be observed with respect to any such animals or plants which are allowed to be so introduced." Id. § 2405 (b)(8). The regulations maintain the "clean list" of the Agreed Measures, while categorically denying a permit to living nonindigenous species of birds. See 45 C.F.R. § 670.41 (1990).
organizations in 1968 when they recommended that "governments prohibit the importation of exotic birds and other animals (including fishes) for purposes of liberation and that restocking with local native species be encouraged."

The 1979 adoption of the Bonn Convention on the Conservation of Migratory Species of Wild Animals was a significant step toward averting introduction of exotic species. The Bonn Convention identifies two classes of migratory species, both of which potentially are threatened by exotic competitors. Signatories attempt to adopt measures to stabilize the populations and preserve the habitats of those species considered endangered. Among these obligations is the duty "to the extent feasible and appropriate, to prevent, reduce or control factors that are endangering or are likely to further endanger the species, including strictly controlling the introduction of, or controlling and eliminating, already introduced exotic species."

The second class of migratory species are those which have an "unfavourable conservation status" and which require international agreements for their future conservation and management. These agreements should provide, among other things, for the "strict control of the introduction of, or control of already introduced, exotic species detrimental to the migratory species."

The emphasis of these conservation conventions is to protect the habitats of endangered species from the depredations of alien organisms. These agreements also tacitly recognize that an introduced species not only can drive an endangered species into extinction, but can wreak havoc with entire ecosystems, thus imperiling the viability of many otherwise nonendangered species. Negotiations are now in progress under the auspices of the United Nations Environment Programme (UNEP) to conclude a Convention on Biological Diversity which, among a number of other issues, will address the threat of nonindigenous spe-

146. Id. art. 3, para. 4(d), 19 I.L.M. at 18-19.
147. Id. art. 4. The Bonn Convention defines a conservation status as unfavorable where its population is unstable in relation with its historic habitat. See id. art. 1, paras. 1(c), (d), 19 I.L.M. at 16-17.
148. See id. art. 4 & app. II, 19 I.L.M. at 19-20, 30-32.
149. Id. art. 5, para. 5(e), 19 I.L.M. at 21. For more on this clause, see also LYSTER, supra note 132, at 285.
150. See supra notes 16-17 and accompanying text.
cies. Suggestions have been made to include language that will impose a duty upon states to "eradicat[e] or control . . . alien species which threaten ecosystems, habitats or species"152 and to initiate programs of research to further study the effects of such introductions.153 Although this Biodiversity Convention project is still in its early stages, it may provide a needed impetus for considering the impact of exotic species on the global environment. It is unlikely, however, that this treaty will add much by way of affirmative obligations on states to undertake ambitious programs of cooperation to limit the spread of alien organisms.

B. International Codification Efforts

Turning now to discussion of the unique threats posed by marine exotic species in international codifications, the leading example of a clause dealing with exotic species can be found in the 1982 Law of the Sea Convention.154 Article 196 provides in full that:

1. States shall take all measures necessary to prevent, reduce and control pollution of the marine environment resulting from the use of technologies under their jurisdiction or control, or the intentional or accidental introduction of species, alien or new, to any particular part of the marine environment, which may cause significant or harmful changes thereto.
2. This article does not affect the application of this Convention regarding the prevention, reduction and control of pollution of the marine environment.155

The travaux préparatoires for this provision began with a Norwegian proposal which covered both accidental and intentional introductions of exotic species.156 The Norwegian draft article required advance consultation on planned releases of new organisms with "interested States and appropriate international organizations."157 It also demanded

153. See Biodiversity Draft Convention, supra note 152, at 41.
154. See 1982 Law of the Sea Convention, supra note 72, art. 196, 21 I.L.M. at 1308.
155. Id.
that states "take appropriate measures" to guard against accidental introductions and to "restore the previously existing state of the marine environment in cases where a disturbance has occurred due to any introduction of alien or new species."\textsuperscript{158}

This language was considered too far-reaching by the Third U.N. Conference on the Law of the Sea and was not adopted. However, the idea of a clause concerning exotic species was included in the Revised Single Negotiating Text of the Convention in 1976,\textsuperscript{159} although it was linked with a parallel provision on preventing pollution from technological activities under a state's control or jurisdiction.\textsuperscript{160} With minor changes, this proposal was included in the final Convention.\textsuperscript{161}

Norway's delegate to the Conference explained that the purpose of the proposed clause was to
draw attention to the problem which arose when human activities disturbed the ecological balance of marine environments, not through pollution but by the introduction of living organisms not previously existing in the seas or by the transfer of a form of marine life to an area where the implications of its existence were unknown.\textsuperscript{162}

The idea of controlling exotic species was considered distinct from the problem of marine pollution, but was part of a state's correlate obligation to "preserve the marine environment"\textsuperscript{163} and to act so "as not to transfer, directly or indirectly, damage or hazards from one area to another or transform one type of pollution into another."\textsuperscript{164} The reason for the second paragraph of article 196, as rendered above, was to reinforce the obligation of states to limit the spread of threats to the marine environment, including the transfer of alien species.\textsuperscript{165}

At least one commentator has suggested that the appearance of a clause on exotic species in the 1982 Law of the Sea Convention represented an innovation in international law.\textsuperscript{166} This is only partially correct. As discussed above, the problem of alien organisms had been addressed in regional and global conventions on wildlife conservation for

\begin{footnotes}
\item[158] \textit{Id.} \S 2.
\item[160] \textit{Revised Text}, \textit{supra} note 159, art. 6.
\item[161] \textit{See} 1982 Law of the Sea Convention, \textit{supra} note 72, art. 196, 21 I.L.M. at 1308; Nordquist, \textit{supra} note 156, at 75.
\item[162] \textit{See} Nordquist, \textit{supra} note 156, at 76 (quoting Norwegian remarks at the 17th meeting of the Third Committee of the U.N. Conference in 1974).
\item[163] 1982 Law of the Sea Convention, \textit{supra} note 72, art. 192, 21 I.L.M. at 1308; \textit{see also} Nordquist, \textit{supra} note 156, at 40-41.
\item[164] 1982 Law of the Sea Convention, \textit{supra} note 72, art. 195, 21 I.L.M. at 1308; \textit{see also} Nordquist, \textit{supra} note 156, at 72.
\item[165] \textit{See} Nordquist, \textit{supra} note 156, at 72, 76.
\item[166] \textit{Id.} at 76.
\end{footnotes}
many years.\textsuperscript{167} It is true, however, that the 1982 Convention marked the first occasion in which the marine environmental consequences of exotic species were considered in an effort to codify the international law dealing with a common resource.

It is easy to criticize article 196 as being only a hortatory call for states to "take all measures necessary" to control accidental or intentional introductions. With the rejection of the earlier Norwegian draft, the article does not speak to the duty of care to be exercised by states, the need for prior consultations before planned introductions, or an affirmative obligation by states to limit known infestations of marine organisms. One commentator has interpreted the phrase "take all measures necessary" to imply a duty of due diligence and to "require . . . states do all that can reasonably be expected to prevent the introduction of alien or new species by public authorities or private persons."\textsuperscript{168} A specific duty to consult with other interested states or relevant international organizations may, as a result, be inferred from this due diligence standard.

The language used in article 196 of the 1982 Law of the Sea Convention has proven durable and has been invoked in other codification efforts, including the International Law Commission's (ILC) ongoing work on the nonnavigational uses of international watercourses.\textsuperscript{169} In a set of articles adopted in 1990, the ILC addressed the problem of exotic species by requiring that "[w]atercourse States shall take all measures necessary to prevent the introduction of species, alien or new, into an international watercourse [system] which may have effects detrimental to the ecosystem of the international watercourse [system] resulting in appreciable harm to other watercourse States."\textsuperscript{170} The Special Rapporteur for this project, Stephen McCaffrey, had previously considered an approach in which watercourse states would have placed exotic species, as well as more conventional substances, on a black list indicating that they were subject to prohibition, limitation, investigation, or monitoring.\textsuperscript{171} This idea was abandoned over a concern whether exotic species could properly be considered a form of pollution\textsuperscript{172} (the conclusion tacitly adopted in the 1982 Law of the Sea Convention) and whether it was workable to

\textsuperscript{167} See supra notes 125-53 and accompanying text.

\textsuperscript{168} McCaffrey, supra note 78, at 938.

\textsuperscript{169} See supra notes 76-78 and accompanying text.

\textsuperscript{170} McCaffrey, supra note 78, at 937 (providing the adopted text of article 24 for a Draft Convention on the Non-Navigational Uses of International Watercourses).

\textsuperscript{171} See ILC Fourth Report, supra note 77, ¶ 89 (discussing art. 16 [17], para. 3 of the Draft Convention).

\textsuperscript{172} Compare ILC Fourth Report, supra note 77, ¶ 89 (categorizing the problem of exotic species as a pollution concern instead of a problem bearing on the protection or preservation of the watercourse environment) with McCaffrey, supra note 78, at 936-37 (dedicating an article to exotic species alone, distinct from provisions dealing with pollution and protection or preservation of the watercourse environment).
identify these dangerous species in the same way as one might blacklist certain chemicals.\textsuperscript{173}

The ILC's formulation is narrower than the approach in the 1982 Law of the Sea Convention in another important respect: the threshold of danger to be tolerated by watercourse states is higher. Article 196 is concerned with alien organisms "which \textit{may} cause significant and harmful changes" to the marine environment,\textsuperscript{174} while the ILC Draft Articles require that the exotic species cause "effects detrimental to the ecosystem of the international watercourse resulting in appreciable harm to other watercourse States."\textsuperscript{175} Assuming that both Conventions impose a duty of due diligence upon states, it will be almost impossible to know in advance whether a particular planned introduction will be detrimental to the ecosystem and also will result in significant harm to other states. If article 196 is interpreted as an implicit demand for prior consultation before a deliberate introduction is made, then the threshold of risk may not really matter. But since the ILC Draft Articles seem to speak only to preventing the introduction of exotic species \textit{into} an international watercourse system, and not to any subsequent measures to control their spread along it, then the need for prior consultation is even more important.

\textbf{C. The United Nations Environment Programme's Regional Seas Programme}

To complete the picture of international legal regimes touching on the problem of exotic species, it is necessary to note UNEP's Regional Seas initiative which has culminated in the negotiation of eight treaties on marine protection in a regional context.\textsuperscript{176} Many of these treaties predated the 1982 Law of the Sea Convention and so did not have the benefit of article 196's language. Yet, some of these instruments did call for establishing mechanisms for environmental assessment of proposed activities which could presumably extend to the intentional introduction of nonindigenous plants and animals.\textsuperscript{177} One of these treaties, the 1981
Lima Convention on the South-East Pacific Environment,\textsuperscript{178} anticipated the 1982 Law of the Sea Convention's prohibition against transferring marine pollution threats.\textsuperscript{179}

The most interesting recent trend in these regional seas treaties has been the movement toward creating specially protected zones in marine areas. Borrowing a page from the regional conservation treaties for terrestrial wildlife,\textsuperscript{180} a number of UNEP conventions call upon signatories to identify ocean regions where stringent measures will be in force to protect and preserve existing habitats.\textsuperscript{181} For the Caribbean and East Africa regions, protocols have been adopted concerning the demarcation of these specially protected areas and the measures that are to be in force inside them.\textsuperscript{182} Both of these protocols contain requirements that accidental or intentional introductions of exotic species be regulated or prohibited altogether.\textsuperscript{183}

\textsuperscript{178} Convention for the Protection of the Marine Environment and Coastal Area of the South-East Pacific (Lima Convention), Nov. 12, 1981, art. 3, para. 5, U.N. Doc. UNEP/CPPS/IG.32/4, reprinted in SAND, supra note 176, at 84 ("The High Contracting Parties shall take all measures necessary to ensure that activities under their jurisdiction are so conducted that they do not cause damage by pollution to others or to their environment, and that pollution arising from incidents or activities under their jurisdiction or control does not, as far as possible, spread beyond the areas where the High Contracting Parties exercise sovereignty and jurisdiction.").

\textsuperscript{179} 1982 Law of the Sea Convention, supra note 72, arts. 192, 195, 21 I.L.M. at 1308; see also Nordquist, supra note 156, at 40-41, 72, 76.

\textsuperscript{180} See supra notes 125-42 and accompanying text.

\textsuperscript{181} See, e.g., Convention for Co-Operation in the Protection and Development of the Marine and Coastal Environment of the West and Central African Region (Abidjan Convention), done Mar. 31, 1981, art. 11, 20 I.L.M. 729 (1981) ("The Contracting Parties shall . . . take all appropriate measures to protect and preserve rare or fragile ecosystems as well as the habitat of depleted, threatened or endangered species and other marine life. [They] shall endeavour to establish protected areas, such as parks and reserves, and to prohibit or control any activity likely to have adverse effects on the species, ecosystems or biological processes in such areas."). For a virtually identical provision, see Convention for the Protection of the Natural Resources and Environment of the South Pacific Region (Noumea Convention), Nov. 24, 1986, art. 14, S. TREATY Doc. No. 21, 101st Cong., 2d Sess. 1 (1990), 26 I.L.M. 38 (1987) (entered into force Aug. 22, 1990).


\textsuperscript{183} 1990 SPAW, supra note 182, art. 12, reprinted in 5 INT'L J. ESTUARINE & COASTAL L. at 376 ("Each Party shall take all appropriate measures to regulate or prohibit intentional or accidental introduction of non-indigenous . . . species . . . that may cause harmful impacts to the natural flora, fauna or other features of the 'Wider Caribbean Region."); 1985 East Africa Protocol, supra note 182, art. 7, 1986 O.J. (C 253) at 11 ("The Contracting Parties shall take all appropriate measures to prohibit the intentional or accidental introduction of alien or new
D. International Approaches to Controlling Exotic Species

This survey of international legal regimes confirms that the global aspects of the problem of exotic species have been recognized for many years. The conventions which address this matter tend to focus on deliberate introductions of alien or nonindigenous species and advance four approaches for its resolution. The first proposed approach, and the one most commonly advocated, is exclusion. This approach encourages states to create wildlife reserves in which the introduction of exotic species is prohibited and the eradication of already prevalent alien organisms is required. Beginning with the 1933 Convention on the Preservation of Fauna and Flora in their Natural State, and ending with the recent UNEP Regional Seas protocols on specially protected marine sanctuaries, this category of agreements has sought to set aside conservation areas. The most ambitious exclusion regime is in force in the Antarctic. Owing to the isolated nature of that ecosystem, and the seeming consensus of the parties to the Agreed Measures, that particular program of excluding the intentional introduction of alien organisms has been successful.

The second approach in this international scheme for the control of exotic species adopts a more general “protection” methodology. The main problem with both this approach and the exclusion approach is the lack of agreement regarding whether it is better to adopt a “clean” or “dirty” list methodology to guide decisionmaking on the introduction of nonindigenous plants and animals. This is a particularly vexing problem for those legal regimes which advocate a more general “protection” methodology. These regimes, including the 1979 Bonn Convention and the proposed Biodiversity Convention, eschew efforts to establish exclusion zones for alien organisms and instead focus efforts on maintaining the integrity of all habitats. It seems to make more sense to advocate a wider protection strategy against incursions of exotic species, as opposed to merely establishing defense perimeters around selected sanctuaries.

This leads to a consideration of the third element, the one most strikingly absent in the international conventions discussed above. This approach would advocate that states consult with their neighbors prior to a planned introduction of an exotic plant or animal. Indeed, only one instrument, the 1979 European Community Directive on Wild Birds species which may cause significant or harmful changes to the Eastern African region.”

184. See supra notes 125-29 and accompanying text.
185. See supra notes 180-83 and accompanying text.
186. See supra notes 138-42 and accompanying text.
187. See supra notes 144-49 and accompanying text.
188. See supra notes 151-53 and accompanying text.
Conservation,\textsuperscript{189} explicitly requires states to engage in consultation. This is especially surprising because this duty has been vigorously promoted in virtually every other facet of international environmental law.\textsuperscript{190} As noted above,\textsuperscript{191} the duty to consult was part of the original Norwegian proposal for an article in the 1982 Law of the Sea Convention, but was later rejected. Yet, an effective system of consultation would obviate the need for either a white or black list of organisms. A by-product of prior consultations would probably be the development, on a regional or bilateral basis, of an agreed methodology for deciding whether a proposed intentional introduction should proceed.

That leads to consideration of the fourth and final element of an international regime for the control and prevention of exotic species. This element is at once the most ambiguous and the most important. It can be called the “risk/duty” factor. “Risk” here means the appreciation given in an international legal instrument to the magnitude of the relevant environmental hazard. “Duty” means the corresponding level of care that a state is expected to exercise in combating that hazard. These are, obviously, interrelated notions and that is how they have been presented in this discussion. They also capture the dual aspect of the problem of exotic species and the differences in strategies used to deal with deliberate introductions and to combat accidental infestations.

The debate over the appreciation of the risk of exotic species is illustrated by the 1982 Law of the Sea Convention and the current work of the International Law Commission on International Watercourses (the ILC). The Law of the Sea Convention apparently takes it as an article of faith that exotic species present a real risk to the marine environment. The language of article 196 is expansive, extending to all plants or animals “which may cause significant and harmful changes” to the aquatic ecosystem.\textsuperscript{192} The ILC’s Draft Convention is rather more circumspect. It demands proof that the effects of an exotic species are “detrimental to the ecosystem of the international watercourse [system] resulting in appreciable harm to other watercourse States.”\textsuperscript{193}

The ILC’s definition is plainly intended as a higher threshold of risk to accommodate a corollary duty of states to undertake “all measures

\textsuperscript{189} See supra notes 134-35 and accompanying text.
\textsuperscript{190} See supra note 157 and accompanying text. See generally Frederick L. Kirgis Jr., Prior Consultation in International Law 16-132 (1983) (describing advent of prior consultation norms with regard to actions affecting international watercourse systems, air basins, partially enclosed seas, and similar resources); ILC Fourth Report, supra note 77, ¶¶ 11-27.
\textsuperscript{191} See supra notes 156-61 and accompanying text.
\textsuperscript{192} 1982 Law of the Sea Convention, supra note 72, art. 196, para. 1, 21 I.L.M. at 1308.
\textsuperscript{193} McCaffrey, supra note 78, at 937 (article 24 of Draft Convention on Non-Navigational Uses of International Watercourses).
necessary" to combat the problem. It is assumed that if states have an obligation to take affirmative action to prevent the introduction of exotic species, or to later see to their elimination, then it is only fair that they be held to this due diligence standard when the risk is real and apparent and has already had an impact on other states. The only difficulty with this logic is that, at least with intentional introductions, the time to weigh the benefits and risks is before the introduction actually occurs. At that point in time it may be impossible to know whether the impact will be "detrimental," resulting in "appreciable harm." And, needless to say, it is much easier to decide not to introduce a species than it is to eradicate it later.

The due diligence standard which is implicit in the language of the Law of the Sea Convention and ILC Draft also places special burdens on states to combat accidental infestations of alien organisms. States have a duty to identify the pathways by which exotic species are transported to new ecosystems and take "all measures necessary" to close them off. So far, one mechanism in particular has been identified for the transmission of aquatic organisms: carriage in the ballast water of vessels. Section IV of this article examines the possibilities for fashioning common rules for ballast exchange, some of the attendant international law issues, and the prospects for successful coordination with domestic control regimes.

IV

THEORY IN PRACTICE: BALLAST EXCHANGE FOR SHIPS

If it is axiomatic that international environmental problems are incapable of strictly domestic solutions, it seems nonetheless true that the key impetus for international regulation is unilateral action which imposes one nation's own solution in the face of a real threat. A handful of nations have already perceived the hazards of inadvertent introductions of exotic species and have proceeded to enact their own programs to combat the problem. Each of these states was galvanized into action by highly publicized infestations of alien aquatic species along their coasts. Nations such as Canada, Australia, and the United States did not have to wait to learn of an authentic disaster involving exotic species. The disasters happened to them. Zebra mussels in the Great Lakes and red-tide-causing dinoflagellates in Tasmania and South Australia were enough to convince the U.S., Canadian, and Australian governments that

194. Id.
195. See supra notes 174-76 and accompanying text. For more on the use of this standard in international environmental law, see also ILC Fourth Report, supra note 77, at ¶¶ 89(6)-(10).
196. See supra notes 2-12 and accompanying text.
197. See supra note 33 and accompanying text.
the time had come for the unilateral implementation of ballast water exchange requirements.

Australia was the first to introduce voluntary restrictions in early 1989 on all vessels entering its ports, whether Australian or foreign-flag ships. These regulations required that a ship's master seeking to discharge ballast must certify either that ballast water was taken from an area free from dinoflagellates or that rebalasting occurred in open tropical waters. The Australian measure was primarily concerned with sediments, taken up in the ballast water, which harbor the toxic dinoflagellates which have so plagued their shores and ports. A vessel which cannot satisfy either certification must submit a health clearance (radio pratique) in order to receive a permit to discharge its ballast water. Before issuing such a permit, the Australian Quarantine and Inspection Service (AQIS) may sample ballast water in order to determine whether it contains any exotic species. By all reports, the Australian measures, which were the product of extensive talks with the shipping industry, have been quite successful.

In April 1989, in response to the zebra mussel explosion in the Great Lakes, the Canadian government, after consultation with the United States, the Great Lakes Fisheries Commission, and representatives of commercial shipping, imposed voluntary guidelines for the discharge of ballast water in the Great Lakes and some parts of their Atlantic seaboard. Under these guidelines, ships entering the Saint Lawrence Seaway bound for any port in the Great Lakes are obliged to complete a ballast water exchange report. The regulations call for ballast exchange on the high seas where the ocean depth exceeds 2000 meters, putting vessels beyond the continental shelf or any fresh-water current effect. A special exemption is given for vessels in transit from another

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198. 1989 Australian Regulations, supra note 33, at 2.
199. Id. at 3-4. The Australian regulations demonstrate a willingness to permit shipmasters to use in-hold water treatment or to pump their ballast water into a treatment facility on shore. Id. at 5. However, the regulations note that these treatment options are not yet available. Id.
200. Id. at 1-4; see also House Hearings, supra note 4, at 94 (statement of Capt. Thomas E. Thompson, U.S. Coast Guard).
201. 1989 Australian Regulations, supra note 33, at 7-13.
202. House Hearings, supra note 4, at 194 (responses of J.D. Hull, Chief, Congressional Affairs Staff, U.S. Coast Guard, to Committee questions), 204-09 (circular letter of Ivan A. Lantz). In a later report, Australia indicated nearly 80% compliance with its regulations and that a majority of vessels chose to reballast on the high seas, with others undertaking not to discharge ballast water in port. A few vessels, operating especially from New Zealand, had provided "clean-water certificates," attesting to the fact that their ballast water was free from dangerous organisms. Virtually no vessels took advantage of proposed alternative measures to prevent exotic introductions. See 1990 Australian Report, supra note 30, at 3 & annexes 2, 3.
203. See House Hearings, supra note 4, at 95 (statement of Capt. Thomas E. Thompson, U.S. Coast Guard), 150-53 (text of Canadian voluntary guidelines).
204. Id. at 150-51 (Canadian voluntary guidelines ¶¶ 1.2, 4.2).
location in North America; they may reballast in the Laurentian Channel leading into the Seaway at a depth exceeding 340 meters. The Guidelines also permit the sampling of ballast water by Canadian Coast Guard officers. It has been estimated that over eighty percent of the vessels entering the Great Lakes have complied with the Canadian regulations.

The United States, the last of these three countries to enter the process of developing ballast water exchange requirements, enthusiastically adopted a ballast exchange program by legislation. The Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990 discussed above requires the Secretary of Transportation (the Federal department in which the Coast Guard is located) to enact regulations on this subject by October 1992. These regulations require that any vessel visiting a port on the Great Lakes, after operating beyond the exclusive economic zones of the United States or Canada, either (1) reballast beyond 200 nautical miles from shore, (2) reballast at safe locations designated by the Task Force established by the Act, or (3) use other acceptable ballast management methods to control the spread of exotic species. These requirements will be mandatory. Any ship not in compliance will be denied access to the Great Lakes and will have its exit clearance withheld or revoked by the Secretary of the Treasury. Finally, the 1990 Act calls for imposition of civil and criminal penalties on any person (or vessel) in violation of the regulations.

Congress intended that ballast exchange would be required only for ships bound to the Great Lakes, and not to other American ports. Although some legislators criticized this result, Congress appeared to lack a consensus on whether a mandatory ballast exchange program was

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205. Id. at 151 (Canadian voluntary guidelines ¶ 4.3). The guidelines apparently are inapplicable to ships calling at the lower Seaway ports of Montreal and Quebec City. See id. at 53 (statement of Charles C. Krueger, Chairman, Great Lakes Commission).

206. See id. at 152 (Canadian voluntary guidelines ¶ 6.1).

207. See id. at 58 (statement of Charles C. Krueger, Chairman, Great Lakes Commission).


209. See supra notes 114-20 and accompanying text.


211. See id. § 4702(6) (describing the United States and Canada as “exclusive economic zone[s]”). The exclusive economic zone (EEZ) is a 200-mile band established from the baselines of the territorial sea, pursuant to the 1982 Law of the Sea Convention, supra note 72, arts. 55-57, 21 I.L.M. at 1280. The United States' EEZ was created by President Reagan's Proclamation of March 10, 1983. Proclamation No. 5030, 3 C.F.R. 22 (1984).


213. Id. § 4711(b)(2)(E), (F); see also 46 App. U.S.C. § 91 (1988) (providing Secretary with authority to grant clearances).


necessary for the entire United States.\textsuperscript{216} The task force established by the 1990 Act will examine this question.\textsuperscript{217} It was certainly intended that the primary means by which vessels would satisfy the requirements of the prospective regulations would be by reballasting on the high seas beyond 200 nautical miles from the coast.\textsuperscript{218} Because of the safety concerns raised by shippers concerning the risks of reballasting so far from shore,\textsuperscript{219} the clause concerning ballast discharges at sites designated by the task force was added.\textsuperscript{220}

The language of the 1990 Act carefully rejects an entirely unilateral approach to ballast exchange requirements. The Coast Guard is encouraged to consult with the Canadian government in order to ensure that the regulations adopted match those currently enforced by that nation's Coast Guard.\textsuperscript{221} Presumably, the chief goal of these consultations will be to encourage the Canadians to make mandatory their hitherto voluntary requirements on ballast control. The 1990 Act also recognizes that it is essential that widespread international cooperation be secured for any global effort to limit introductions of exotic species via ballast water.\textsuperscript{222} Congress realized that the international character of the shipping industry, along with the limits imposed on any one nation's regulation of the vessels of other flag states, necessitates international agreement on ship operation standards.\textsuperscript{223} While the United States could conceivably close its ports and internal waters to foreign ships not complying with our laws, it would be best if a generally binding legal instrument was in force to regulate this matter. The forum for the negotiation of such an agreement will be the International Maritime Organization.

\textsuperscript{216} Id.
\textsuperscript{222} See 16 U.S.C.A. § 4712(d) (West Supp. 1991) (encouraging responsible agencies to consult with IMO); id. §§ 4711(d), 4723(c) (encouraging consultation with Canada in implementing Great Lakes Program); id. § 4726 (encouraging Secretary of State to initiate negotiations with other nations on this subject).
\textsuperscript{223} See, e.g., S. REP. No. 523, supra note 219, at 6 (§ 4726 "acknowledges the international scope of aquatic nuisance species management . . . ")). reprinted in 1990 U.S.C.C.A.N. at 6462. It is a generally accepted principle of international law that a nation may impose on ships visiting its ports those construction, design, safety, and personnel requirements that have been approved by relevant international organizations. See, e.g., 1982 Law of the Sea Convention, supra note 72, art. 211, 21 I.L.M. 1310-11. Pursuant to the 1982 Law of the Sea Convention, the flag state of the vessel maintains at all times the right to regulate activities aboard the ship. Id. art. 94, 21 I.L.M. 1287-88.
(the IMO) in London.\textsuperscript{224} The constituent instrument for this international organization calls for Member States to cooperate in the "field of governmental regulation and practices relating to technical matters of all kinds affecting shipping . . . [and] to encourage the general adoption of the highest practicable standards in matters concerning . . . maritime safety, efficiency of navigation and prevention and control of marine pollution from ships . . . ."\textsuperscript{225} Pursuant to this mandate, the IMO adopted a series of conventions on the subject of marine pollution from vessels,\textsuperscript{226} culminating in the Convention for the Prevention of Pollution from Ships (MARPOL).\textsuperscript{227} Pursuant to MARPOL, a number of annexes have been adopted, covering such pollution problems as oil, packaged hazardous substances, sewage, garbage, and plastics, while establishing regulations for their control.\textsuperscript{228}

One possible way to address the issue of exotic species transfers via ballast water would be to negotiate a new optional annex to MARPOL. One major impediment to this approach is the requirement, within MARPOL itself, that any new optional annex, before it may enter into force, must be ratified by not less than fifteen Member States whose combined merchant fleets constitute not less than fifty percent of the gross tonnage of the world's merchant shipping.\textsuperscript{229} This traditional requirement reflects the concern that no new treaty regime should enter into force until it would operate for most of the world's ships.\textsuperscript{230} This means, of course, that there are often substantial delays as seafaring nations pon-

\textsuperscript{224} For information regarding the IMO's structure and history, see generally Mankabady, \textit{supra} note 30, at 2-19.


\textsuperscript{227} \textit{MARPOL, supra} note 67.


\textsuperscript{229} \textit{MARPOL, supra} note 67, art. 15, para. 1, 12 I.L.M. at 1329.

\textsuperscript{230} For more on this requirement and the membership of the IMO and its organs, see Samir Mankabady, \textit{IMO: Structure, Relationship with other Organisations and Future Development}, in Mankabady, \textit{supra} note 30, at 5-11. \textit{See also Constitution of the Maritime Safety Committee of the Inter-Governmental Marine Consultative Organization, 1960 I.C.J. 150, 165-71 (opinion of June 8) (requiring that membership on IMO organs be allocated in part, to the "largest ship-owning states according to tonnage," based on the state of registry for vessels, and not the states in which the beneficial owners reside).}
order whether to impose new, and sometimes expensive, operating restrictions on their merchant fleets. For example, the coastal states that are most concerned about the impact of such environmental hazards as exotic species may not be the same states in which a majority of ships are registered.231

To date, the Marine Environment Protection Committee (the MEPC) of the IMO has approached the issue of ballast water exchange cautiously. Although the problem of transmission of bacteria and epidemic disease through ballast water had been discussed at the 1973 Conference which negotiated MARPOL,232 the role of ballast water in the introduction of exotic species was first raised at the twenty-ninth session of the MEPC in December 1989. A submission by Australia discussed the difficulties faced by that country in combating recent infestations.233 A discussion group formed at that MEPC session included delegates from Australia, Canada, Denmark, Germany, Japan, Norway, and the United States.234 The discussion group concluded that “[g]iven the international nature of the problem, it was generally agreed that the issue required an international approach, via MEPC,” and that the IMO had the requisite authority to take up this matter.235 The MEPC decided at that session, however, that it was “inappropriate, at this stage, for the Committee to formally request Member States to encourage compliance with ballast exchange guidelines.”236 Instead, the MEPC called for further research and study, and the issue was put on the MEPC’s program of work for subsequent sessions.237

In September 1990, the government of Canada proposed to the MEPC a Draft Resolution containing International Guidelines on ballast exchange.238 The Draft Resolution contemplated that the guidelines

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231. For more on the divisions within the IMO between the shipping and environmental communities, see David J. Bederman, Dead in the Water: International Law, Diplomacy, and Compensation for Chemical Pollution at Sea, 26 VA. J. INT’L L. 485, 507-13 (1986).


233. See 1989 Australian Regulations, supra note 33, at 2.


235. Id. at 2, ¶ 7.


237. Id.; see also Controls on the Discharge of Ballast Water Containing Harmful Marine Organisms, Marine Environment Protection Committee, 31st Sess., Agenda Item 14, at 1 IMO Doc. MEPC 31/14 (Apr. 5, 1991) [hereinafter 1991 Action] (Note by the Secretariat indicating that as a first step voluntary guidelines were preferable).

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would be voluntary for a period of time, and then incorporated into a new technical annex for MARPOL. The Guidelines themselves grant to individual states' port authorities the discretion to select appropriate control measures, which "will depend upon several factors, including the type or types of organisms being targeted, the level of risks involved, the environmental acceptability of some control measures, and the economic and ecological costs involved." Moreover, the Guidelines note that the safety of vessels is of paramount importance, suggesting that "[c]ompulsory regulations are unlikely to prove effective if compliance is wholly dependent upon the acceptance of operating procedures that put a ship or its crew at risk."

The Draft Guidelines call upon ship operators to take care when loading ballast water and to avoid areas where there have been known occurrences of water borne diseases, algal blooms, or dangerous organisms. The Guidelines acknowledge, however, a lack of information as to which method of ballast water management is best to combat the problem of exotic species. The Guidelines do conclude, though, that "[i]n the absence of more positive means of control, exchange of ballast water in deep sea areas currently offers the most reasonable and cost effective means" of controlling the spread of nonindigenous flora and fauna. Ballast exchange "at sea" means at depths of 2000 meters or more and clear of estuarine or fresh-water flows. The Guidelines also suggest some alternatives to this procedure, including certifications of clean ballast, the use of reception facilities on shore, or undertakings not to discharge contaminated ballast water in port. Other methods for killing organisms in ballast water are discussed in the Guidelines but not endorsed. Finally, this draft requires that each ship carry onboard a ballast water management plan, summarizing the procedures adopted.

At the MEPC's thirty-first session, held in London in July 1991, the Guidelines were adopted with only minor technical changes. In response to comments submitted by Japan, a drafting committee sought

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239. See MEPC Draft Proposal, supra note 238, Resolution, para. 4.
240. Id. Guidelines, para. 1.7.
241. Id. para. 3.3.
242. See id. para. 4.0.
243. See id. para. 5.1.2.
244. Id. para. 5.2.1.
245. Id. para. 5.2.6.
246. Id. paras. 5.2.10, 5.2.16, 5.2.17.
247. Id. paras. 5.3, 5.4 (including shore reception facilities, heat treatment, chemical injection, oxygen deprivation control, tank coatings, filters and ultraviolet light disinfection, and ship design measures).
248. Id. paras. 6.4, 6.5.
250. Comments on the Draft International Guidelines for Preventing the Introduction of
to emphasize not only the voluntary character of the ballast control procedures, but also raised concerns about crew safety and the feasibility of conducting ballast exchange in deep ocean areas.\textsuperscript{251} The revised Guidelines also called for further scientific study on the issue of controlling exotic species proliferation via ballast water discharges.\textsuperscript{252}

The MEPC Guidelines follow the regulatory schemes already adopted by Canada and Australia and differ from the U.S. regime in being more flexible.\textsuperscript{253} The Guidelines recognize that solutions to the problem of exotic species introductions are tentative, pending further research and study. Although ballast water exchange appears to be the most promising approach, the Guidelines, as well as the Canadian\textsuperscript{254} and Australian\textsuperscript{255} regulations, are not wedded to that approach and offer a number of alternatives. In contrast, the United States has adopted into law ballast exchange requirements as being the preferred method for controlling the spread of alien organisms. Although the Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990 calls for aggressive study efforts to find alternative means of addressing the problem, the Act chiefly commands that the Coast Guard implement a requirement that vessels bound for United States ports reballast on the high seas beyond 200 nautical miles.\textsuperscript{256} Conceivably, the Coast Guard could adopt the MEPC's Guidelines on this subject and permit reballasting at designated locations within 200 nautical miles from shore, but this decision would require interagency review and perhaps later congressional approval.\textsuperscript{257}

In spite of the differences in the regulatory schemes, the prospects for coordinating domestic and international control efforts for exotic species still appear hopeful. At least for the United States, the 1990 Act encourages international cooperation, while still retaining sufficient flexibility on its own terms. If the MEPC's Guidelines were later to find their way into a MARPOL Annex ratified by the United States, existing legislation would provide the federal government with powerful tools for compliance. As a treaty, the MARPOL Annex would be enforceable under the Lacey Act Amendments of 1981.\textsuperscript{258} A violation of such an


\textsuperscript{252} See id. para. 14.9.

\textsuperscript{253} See supra notes 198-207 and accompanying text.

\textsuperscript{254} See supra notes 203-07 and accompanying text.

\textsuperscript{255} See supra notes 198-202 and accompanying text.

\textsuperscript{256} 16 U.S.C.A. § 4711(b)(2)(B) (West Supp. 1991); see also supra note 218 and accompanying text.

\textsuperscript{257} Congressional approval may be triggered when the Act comes up for reauthorization in 1995. See 16 U.S.C.A. § 4741 (West Supp. 1991).

international standard would probably constitute a prima facie violation of the due care standard under the Amendments and would trigger the civil penalty provisions, as well (perhaps) as its criminal sanctions. In addition, the 1990 Act contains its own criminal and civil penalty clauses for violations of the regulations that are to be promulgated by the Coast Guard.

So far, the developing international consensus on ballast water has avoided the traps and pitfalls into which past efforts to control exotic species have fallen. First, there seems to be no ambivalence in states' appreciation of the risks posed by exotic species. There seems to be little doubt that ballast water is a major vehicle for the transmission of alien organisms, and the IMO's Marine Environment Protection Committee has not questioned this proposition. Moreover, states have conceded that the risk of introducing a new species exists with every vessel that enters a port, thus requiring that ballast control regulations apply to every ship and under all circumstances. The perceived threshold of danger is quite low and, as a consequence, the duty upon states to "take all measures necessary" is that much higher.

Next, there has been little dispute that exotic species are a manifestation of marine pollution. The IMO's consideration of the issue is premised on the implicit notion that it is within its power to adopt regulations preventing marine pollution from ships. With agreement on this point, the focus of international cooperation shifts away from "self-defense" programs (which were featured in the wildlife conservation and regional seas conventions) to affirmative steps to prevent the spread of new flora and fauna by human activities.

Even more encouraging is that international negotiations have not snagged on the need for consultation in adopting a common standard. Although the MEPC is not yet at a stage to adopt binding regulations, participating states have agreed that this is their ultimate goal. As well it must be. The shipping industry depends on coordination between countries on regulations for the clearance of vessels. If each nation had its own particular requirements for construction, design, manning and operation of ships, and enforced those regulations without regard to international standards, ocean trade would become impossible, because ships constantly would be refitting and changing their operating proce-

the Guidelines, decided to take under advisement the issue of whether they should later be incorporated into a MARPOL Annex. See July 1991 MEPC Report, supra note 249, para. 14.10.

260. See 16 U.S.C.A. § 4711(c)-(d) (West Supp. 1991). The 1990 Act also added the zebra mussel to the list of species of which intentional introduction are prohibited under the old Lacey Act. Id. § 4722(i).
261. See supra note 235 and accompanying text.
262. See supra notes 238-41 and accompanying text.
dures from port to port. A state may, as part of its sovereign rights, require a vessel to comply with its laws before the vessel may enter its ports. But as a matter of comity and common sense, these regulations are tempered by international agreement. Ballast exchange requirements are but one part of a larger picture of competing environmental and economic concerns.

V
PRACTICE IN THEORY: SOME CONCLUDING THOUGHTS

The problem of marine exotic species is but one of a host of international environmental disasters waiting to happen. Although the dangers emanating from introductions of alien organisms are not as apocalyptic as those from global warming or ozone depletion, the risk is real and manifest. The challenge is to ascertain the acceptable ways and means to address a problem that admits of no readymade solutions.

This Article has explored one approach: preventing exotic introductions by imposing mandatory reballasting requirements on all oceangoing vessels. Although this measure is certainly more realizable than halting the destruction of the rainforest or limiting the production of chlorofluorocarbons (or other greenhouse gases), it is no less speculative. Scientists are by no means sure that mandatory reballasting at sea will actually result in fewer infestations of new animals or plants in foreign ports and coastal waters. Ballast water is but one possible vehicle for transporting such organisms from one place on the globe to another. Mandatory reballasting only appears to be the most understandable and sensible approach, based on the limited scientific and empirical data. But appearances can be deceiving, and we could be imposing substantial costs on the shipping industry in pursuit of a chimerical goal. That these costs are fairly minor compared with the benefits to be realized does not compensate for the fact that we will never know with certainty how well states are doing in the battle against exotic species. After all, it is hard to count the dangerous pests that are never introduced into a vulnerable ecosystem. As with most environmental initiatives, the costs are palpable while the benefits are largely hidden.

International environmental law has often attempted to reconcile this calculus of benefit and cost. Those solutions which typically gain the greatest international acceptance are those which carefully weigh the costs and benefits of legal rules, distributing incentives and burdens accordingly. But before this process of crafting an international regime may proceed, two steps must be taken. First, states must perceive that action is needed. Most of these revelations come in the wake of an authentic disaster; sometimes they come after long study and vigorous debate. With this perception come attempts by individual states to impose their own solutions. That, in turn, causes conflict. And it is at that stage
where the costs and benefits of a new regime can be most starkly observed. Some states may see no need for action. Others wish to benefit by taking the necessary steps themselves. Still others will benefit by doing nothing. Only when this conflict in environmental policy is resolved will international action be possible.

The United States has been among those nations that have vigorously called for action on the problem of exotic species. It is too early to tell, however, whether those calls were premature and the means adopted by American authorities too stringent. Even though the U.S. laws were not primarily intended to deal with the problem of exotic species, the United States appears well positioned to integrate its domestic laws with an international legal regime. If other states adopt legislation similar to the 1990 Nonindigenous Aquatic Nuisance Prevention and Control Act, it is likely that little time will be wasted standardizing international regulation of ballast water treatment.

Recognizing the hazards posed by exotic species has taken just a few years. What was once an exercise in defining a vague threat has now become a battle to control specific types of dangerous human activities. How exactly the battle against exotic introductions will be waged is not yet known, but the broad contours of the struggle are clear. International environmental law is fundamentally a process of identifying new risks, of calculating costs and benefits, and, ultimately, of grasping opportunities for creating international solutions. International law, like home grown politics, is all about the art of the possible.