

**THE REGULATION OF BIOLOGICAL
POLLUTION:**

**PREVENTING EXOTIC SPECIES INVASIONS
FROM BALLAST WATER DISCHARGED INTO
CALIFORNIA COASTAL WATERS**

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INTRODUCTION

Toward the end of the film *Apollo 13*, which portrays a stricken spacecraft rescued from disaster by American pluck and ingenuity, the returning astronauts are told at the last possible moment that if they don't immediately load more ballast into the re-entry vehicle they'll be bounced back out of the atmosphere to drift through space forever. "Ballast?" ask the incredulous astronauts, who then frantically transfer excess equipment, empty containers and anything else that's not nailed down into the re-entry module to increase its weight.²

Thus, the practice of adjusting a vessel's weight and trim by loading ballast (which is later ejected into the surrounding environment when it is no longer needed) has persisted from the days of sailing ships into the era of starships. Ballast dumping came under regulatory control during the 19th century, as harbor masters barred ships from dumping rock, sand, mud and miscellaneous debris carried as ballast into harbors and channels, to prevent shoaling. In many areas, ballast dumping was banned by statute, both to protect channel depths and, in some cases, to prevent the fouling of waters.³ "Ballast grounds" were set up where ballast could be legally disposed of, and professional "ballast haulers" and guilds of "ballast heavers" serviced the merchant shipping industry.⁴ Even on America's wild frontier, laws and regulations prohibited the dumping of ballast into harbors, although as Richard Henry Dana reported in *Two Years Before the Mast*, ships on the California coast frequently violated them.⁵

Both a physical and socio-economic infrastructure and a regulatory framework were thus created to control ballast dumping. All of that changed, however, toward the end of the 19th century with the advent of steel-hulled ships and steam-driven (and later, diesel-powered) water pumps. These made water a far more convenient and much cheaper substance to use as ballast than solid materials that had to be hauled into and out of ships by gangs of laborers. The regulatory authorities at the time, operating under the erroneous assumption that the water used to ballast ships was harmless, imposed no restrictions on its discharge.

¹ We thank Michael Bean (Environmental Defense Fund), Leora Elazar and Jon Smith (San Francisco Bay Conservation and Development Commission), Tami Grove (California Coastal Commission), Russell Harding (Oregon Department of Environmental Quality), John Lien and Michael Meier (California State Lands Commission), Michael Lozeau (Earthlaw), Steve Moore (San Francisco Bay Regional Water Quality Control Board), Dennis Nixon (University of Rhode Island), Alison Rieser (University of Maine School of Law), Linda Sheehan (Center for Marine Conservation) and Jody Zaitlin (Port of Oakland) for providing information and/or reviewing the manuscript; and thank the Rose Foundation and a Switzer Environmental Leadership Grant provided through the San Francisco Foundation for support of the senior author.

² [CITE?]

³ *United States v. Standard Oil Co.*, 384 U.S. 224, 226-227 (1966), discussing a number of statutes relating to restricting ballast discharges dating back to 1886. Such laws, for example, remain on the books in Oregon, Washington and Alaska. Oregon Rev. Stats. § 783.600 (1995); Washington Code § 88.28.060 (1996) ("Discharging Ballast, When Prohibited"); Alaska Stats. § 30.50.020 (1996) ("Discharging Ballast in Navigable Waters").

⁴ Carlton thesis (1979) at 63-65.

⁵ Dana describes the usual practice for disposing of ballast at Ballast Point in San Diego in 1836 as follows: "[W]e were turned-to, heaving out ballast. A regulation of the port forbids any ballast to be thrown overboard; accordingly, our long-boat was [used]...but where one tub-full went into the boat, twenty went overboard. This is done by every vessel..." Richard Henry Dana (1840) *Two Years Before the Mast*, at Chapter 29.

However we now know, beyond any doubt, that ballast water discharges are not harmless. Ballast water is recognized as a major mechanism for transporting and introducing exotic species⁶ into the world's coastal ecosystems, which may result in severe and irreversible impacts on environmental quality and biological diversity, on economic and recreational activities, and on public health. Thus, as we enter a new century government regulators are beginning to seek means to rectify the errors made since the beginning of the last one, and to at last bring ballast water discharges under appropriate regulatory control. Although several bouts of limited legislative activity during the 1990s have nibbled at this problem, existing state and federal laws offer numerous, generally-unexploited opportunities for managing ballast discharges. Several factors have made California a primary focus of attention and experimentation in ballast water regulation (including a spate of recent marine and freshwater invasions, the publication of some key scientific studies, substantial public and media interest in the phenomenon of invasions, aggressive work by a few environmental organizations, and, possibly, a more activist approach by the government agencies responsible for the protection of natural resources), warranting a close examination of the legal authorities for ballast regulation in California.

In Section I of this article, we describe ballast water's use, its contribution to biological invasions, and the technical approaches that could be used to combat the problem. In Section II we describe opportunities for employing existing laws and regulations to manage ballast discharges in California. We first discuss the limitations of international, federal and state laws that have tried to address ballast discharges of exotic organisms as a shipping issue. We then consider the potential for regulating ballast discharges under federal and state laws aimed at controlling water pollution, protecting wildlife, ensuring the assessment, disclosure and mitigation of environmental impacts, and providing for the planning and management of coastal zone development. While we evaluate these laws in terms of their potential application in California, the federal laws and, in many cases, corresponding state laws could be applied in other coastal regions. We conclude by summarizing how existing regulations may provide a comprehensive overall framework for achieving effective regulation of ballast water discharges.

I. BALLAST WATER DISCHARGES AND BIOLOGICAL INVASIONS

A. THE ROLE OF BALLAST WATER IN SHIPPING

A ship carrying little or no cargo rides high in the water. This may make the ship vulnerable to being knocked over by high waves and winds; increase the potential for "slamming" the bow or stern when riding over waves; or raise the propellor so that it is insufficiently immersed.⁷ At the start of a voyage a ship may take on large quantities of water—of whatever water the ship is floating in, fresh water if in a river port, and salt water if in the sea—in order to lower the ship to a safer and more efficient position in the water. At the end of the voyage the ship will then discharge this ballast

⁶ This article uses the terms "exotic species" or "exotic organism" to refer to a species or organism that has been transported into an ecosystem outside of its historic, natural range. This is similar to the federal statutory definition of nonindigenous species (NIS) as "any species or other biological material that enters an ecosystem beyond its historic range, including any such organism transferred from one country into another" (16 U.S.C. § 4702(11) (Supp. II 1997)). Related terms, some of which have been used interchangeably, include alien, non-native, foreign, immigrant, adventive, introduced, invasive, colonizing, naturalized, escaped, translocated and transfaunated species. Another frequently used term is aquatic nuisance species (ANS), defined in federal statutes as "a nonindigenous species that threatens the diversity or abundance of native species or the ecological stability of infested waters, or commercial, agricultural or recreational activities dependent on such waters" (16 U.S.C. § 4702(1) (Supp. II 1997)), and in slightly different words in California statutes as "a nonindigenous species that threatens the viability or abundance of a native species, the ecological stability of waters inhabited by those species, or the viability of commercial, agricultural, aquacultural, or recreational activities which depend on those waters" (Fish and Game Code § 6431). More-or-less similar terms are injurious, harmful, pest or weed species. Also see Whalin 1998 at 70-77.

⁷ Carlton et al. 1995; Cohen 1998.

water into a new port or coastal region (perhaps thousands of miles from its source) before loading cargo. Ballast water is also loaded or discharged for various other purposes such as adjusting trim, improving maneuverability, increasing propulsion efficiency, reducing hull stress, raising the ship to pass over shallow areas, and lowering it to get under bridges or cranes.⁸

Ballast water enters a ship through intake ports located below the water line. These are typically covered with grates or strainer plates with openings of about half an inch.⁹ The function of the strainer plates is to prevent objects from being drawn in that could damage the ship's pumps, although they incidentally serve to prevent the introduction of large organisms into ballast tanks. Depending on the level of the tank relative to the water surface, water may be taken on or discharged either by pumping or by gravitational flow. Ballast water is generally carried in several different compartments on board ship, often in tanks set aside for that purpose (called "segregated" or "dedicated" ballast tanks), although bulk carriers and tankers may carry ballast water in their cargo holds ("unsegregated tanks"). Some individual ships can carry tens of millions of gallons of ballast water.¹⁰

Sediment sometimes accumulates in the bottom of ballast tanks or ballasted cargo holds.¹¹ This sediment may include mud and small debris pumped in with the ballast water, rust and interior coatings that flake off the inside walls of the tank, and residue from previously carried cargo. Sediment is typically removed from ballast tanks every 3-5 years when a ship is in drydock, and from ballasted cargo holds on every voyage at the cargo-loading port. Sediment from cargo holds, which may amount to 500 gallons or more per ship,¹² is typically shovelled or hosed out and either dumped into port or coastal waters, or retained and disposed of on land or at sea.¹³

B. BIOLOGICAL INVASIONS IN AQUATIC ECOSYSTEMS: HISTORY AND IMPACTS

Recent studies have identified over 230 exotic species that have become established in the San Francisco Estuary.¹⁴ At least another 125 organisms in the estuary are considered to be "cryptogenic," meaning there is inadequate evidence to determine whether they are native or exotic.¹⁵ Exotic species dominate many of the estuary's biotic communities, where they may account for 40% to 100% of the common species, up to 97% of the total number of organisms, and up to 99% of the biomass.¹⁶ Perhaps even more striking than their abundance is the rapidly increasing rate at which new species are arriving and becoming established. Roughly half of the exotic species identified were first observed in the ecosystem within the last 35 years.¹⁷ Overall, the rate of invasions increased from an average of about one new species established every 55 weeks between 1851 and 1960, to one new species every 14 weeks between 1961 and 1995.¹⁸

⁸ Carlton et al. 1995; Cohen 1998.

⁹ Sometimes the openings are larger either because they've been enlarged by corrosion or because the strainer plate has fallen off (Carlton 1985; AQIS 1993a at 20; AQIS 1993b at 25; Carlton et al. 1995; Marine Board 1996).

¹⁰ Carlton et al. 1995; Marine Board 1996; Cohen 1998.

¹¹ Hallegraeff & Bolch 1992. Accumulated sediment may range from negligible to quite substantial amounts. Pollutech 1992, Appendix A at 21 records a foot-thick layer of mud in the ballast tanks of one ship.

¹² Kelly 1993.

¹³ Williams et al. 1988; Hallegraeff et al. 1990; AQIS 1993a at 21; Kelly 1993; Marine Board 1996.

¹⁴ In this study the San Francisco Estuary was defined as all waters in the San Francisco Bay watershed within the reach of the tides, and includes both the salty waters of the Bay and the freshwater inland delta of the Sacramento-San Joaquin rivers (Cohen & Carlton 1998).

¹⁵ Cohen & Carlton 1995. The concept of cryptogenic species is defined and explored in Carlton 1996.

¹⁶ Cohen & Carlton 1995, 1998. Biomass is a measure of the weight of the living organisms present.

¹⁷ Cohen and Carlton 1998.

¹⁸ Cohen and Carlton 1998.

These exotic organisms arrived on the West Coast¹⁹ through a variety of mechanisms. Historically, the most important of these involved organisms that had attached to or bored into the hulls of ships; organisms accidentally transported with oysters from the East Coast or Japan that were planted in the West Coast bays for rearing to market size; and fish imported and stocked to support commercial or recreational fisheries, primarily in fresh water.²⁰ For the last several decades, however, these mechanisms have either not been operating or have declined in importance, while increasing numbers of organisms have been introduced through the discharge of ships' ballast water.²¹ Although a few species may have been introduced by ballast water discharges during the first half of the 20th century,²² substantial numbers began to appear in the 1960s,²³ and by the 1990s between 53 and 88 percent of the exotic species newly found in the San Francisco Estuary had been introduced to the West Coast via ballast water.²⁴

Evidence from other aquatic ecosystems also indicates a high degree of invasion, an accelerating rate of invasion, and an increasing contribution to invasions by ballast water. Within California, at least 81 exotic marine species have become established in southern California between San Diego and Los Angeles,²⁵ 27 species in Morro Bay,²⁶ and 34 species in Humboldt Bay.²⁷ In the freshwater Great Lakes, 139 exotic organisms had become established by the early 1990s.²⁸ Nearly one-third of these arrived between 1960 and 1990,²⁹ coinciding with the opening of the St. Lawrence Seaway in 1959 which resulted in a dramatic increase in the number and size of ocean-going ships entering the Great Lakes and in the volume of ballast water released into the Lakes.³⁰ Invasions due to ballast water discharges first began to appear in the Lakes the 1930s, increased substantially after 1960, and accounted for 82 percent of new invasions in the 1980s.³¹

Biological invasions have the potential to cause substantial damage to ecosystems and to the human activities that depend on them.³² Several recent invasions resulting from ballast water discharges provide noteworthy examples:

A western Atlantic comb jelly,³³ a small, floating organism similar to a jellyfish, was introduced into the Black and Azov Seas by the early 1980s. It became phenomenally abundant and by consuming much of the seas' crustacean zooplankton³⁴ contributed to the decline of the region's already-stressed fisheries, affecting fishing fleets in six nations.³⁵

¹⁹ In this article "West Coast" and "East Coast" refer to the western and eastern coasts of North America.

²⁰ Carlton 1979; Cohen & Carlton 1995.

²¹ Cohen & Carlton 1995; Cohen 1999. The use of ballast water in the shipping industry is decried in section I.A.

²² Cohen 1998, Appendix A.

²³ Cohen 1998, Figure 1 on page 12.

²⁴ Cohen 1999.

²⁵ Andrew N. Cohen, unpublished data.

²⁶ Andrew N. Cohen, unpublished data.

²⁷ James T. Carlton and Andrew N. Cohen, unpublished data.

²⁸ Mills et al. 1993 at page 1.

²⁹ Mills et al. 1993 at pages 1 and 39.

³⁰ Mills et al. 1993 at pages 1 and 4.

³¹ Based on data in Mills et al. 1993 in Tables 3 and 4.

³² OTA 1993; Wilcove et al. 1998. For a discussion of the types of impacts caused by aquatic invasions see Cohen & Carlton 1995 and Cohen 1998b.

³³ *Mnemiopsis leidyi*.

³⁴ Plankton are organisms that drift within the water column, most of which are microscopic or nearly microscopic. Plant and animal plankton are called, respectively, phytoplankton and zooplankton.

³⁵ Shushkina & Musayeva 1990; Travis 1993; Harbison & Volovik 1994.

The European zebra mussel³⁶ was discovered in the Great Lakes in the late 1980s and rapidly proliferated and spread. It caused massive problems by clogging water-delivery pipes; attaching to boat hulls, marine structures and navigational buoys; and accumulating in nuisance quantities on recreational beaches.³⁷ Damages through 1995 were reported at up to \$1.5 million at one factory, \$3.7 million at a water treatment plant, and \$6 million at a power plant, with ten-year costs estimated at \$3.1 billion for the power industry and \$5 billion in all.³⁸ Zebra mussels have also disrupted food webs, promoted blooms of nuisance algae and threatened native species, although some organisms have benefited from the mussel's presence.³⁹ The zebra mussel has now spread across much of North America, from Canada to New Orleans and from the Hudson River to Oklahoma.⁴⁰

In 1986, three specimens of a small Asian clam⁴¹ were found in San Francisco Bay by a college biology class.⁴² Within a year it had become the most abundant clam in the northern part of the bay, and soon spread to the rest of the bay. The clam feeds by filtering small organisms out of the water column, and researchers calculated that virtually the entire volume of water over a large portion of the bay was being filtered through these clams between once and twice a day, dramatically altering the food web. The clam also appears to concentrate the metal selenium in its tissues, directing it into the diets of bottom-feeding fish and birds, which are accumulating selenium at levels known to cause reproductive defects in some species.⁴³

Dinoflagellates are microscopic organisms⁴⁴ that sometimes become so abundant that they color the sea as "red tides." These can kill fish or invertebrates,⁴⁵ and some dinoflagellate species produce neurotoxins which, becoming concentrated in mussels or clams, produce a potentially fatal syndrome known as Paralytic Shellfish Poisoning or PSP when consumed by human beings. In recent decades red tides and PSP outbreaks have been reported more frequently around the world and in areas where they were previously unknown.⁴⁶ Dinoflagellates are common in ballast water and ballast sediments,⁴⁷ and at least some outbreaks (in Australia and Tasmania, and possibly also in New Zealand and Chile⁴⁸) apparently resulted from the introduction of dinoflagellates in ballast discharges.

During the 1991 South American cholera epidemic, the South American cholera strain was discovered in oysters and fish in Mobile Bay, Alabama. The U. S. Food and Drug Administration subsequently found the same strain in 5 out of 15 ships sampled on arrival in the Gulf of Mexico

³⁶ *Dreissena polymorpha*.

³⁷ Nalepa & Schloesser 1993.

³⁸ For reports and estimates of zebra mussel-related costs see: NANPCA 1990; OTA 1993, p. 68; LePage 1993; Glassner-Shwayder 1996; O'Neill 1997.

³⁹ Hushak 1995.

⁴⁰ O'Neill 1997.

⁴¹ *Potamocorbula amurensis*.

⁴² Carlton *et al.* 1990.

⁴³ Carlton *et al.* 1990; Nichols *et al.* 1990; Werner & Hollibaugh 1993; Kimmerer *et al.* 1994; Alpine & Cloern 1992; Luoma & Linville 1997; Thompson 1997. For a personal description of the extent of this invasion, see Cohen & Carlton 1995b.

⁴⁴ Dinoflagellates are single-celled organisms that exhibit features that have been thought characteristic of both plants (photosynthesis) and animals (motility), and have been variously classified. They are found in both fresh and salt water. (Bold & Wynne 1985)

⁴⁵ See, for example, Brian Cole and Andy Cohen, Red Tide in Berkeley Marina raises Concern for Toxic Blooms in Central Bay, *Interagency Ecological Program Newsletter* 11(1): 11-13 (1997).

⁴⁶ Anderson 1989; Smayda 1990; Hallegraeff 1993.

⁴⁷ Hallegraeff *et al.* 1990; Hallegraeff & Bolch 1991, 1992. Also see the studies reported in Cohen 1998, Table 5.

⁴⁸ *Alexandrium catenella*, *Alexandrium minutum* in Australia and *Gymnodinium catenatum* in Tasmania (Hallegraeff *et al.* 1988; Hallegraeff & Bolch 1991, 1992; Hallegraeff 1993); *Gymnodinium breve* in New Zealand (Smith *et al.* 1993); and *Alexandrium catenella* in Chile (G. Lembeje, pers. comm.).

from Latin American ports.⁴⁹ Some medical researchers believe that this epidemic strain had originally been transported from Asia to South America in ballast water.⁵⁰

C. ORGANISMS TRANSPORTED IN BALLAST WATER

It has long been recognized that marine and freshwater organisms can be transported in water carried on ships. As early as 1897 biologists had shown that marine plankton can pass through pumps into a ship's seawater system and survive, and the first scientific report of a ballast water introduction was in 1908.⁵¹ It was not until the 1970s, however, that scientists began directly sampling the organisms carried in ballast water,⁵² with the results of the first substantial studies appearing in the mid-1980s.⁵³ Numerous studies since then have shown that ballast tanks typically contain many species of animals, plants, protozoans, bacteria and viruses, sometimes in considerable abundance.⁵⁴ Well over a thousand different species have been identified from the water and sediment in ballast tanks.⁵⁵ The types of organisms transported in ballast tanks can include organisms that are planktonic for their entire lives; organisms that are planktonic as larvae but settle on the bottom as adults (these include many clams, oysters, mussels, snails, worms, barnacles, crabs, starfish and other common marine organisms); small swimming organisms such as fish or shrimp; parasites of planktonic or swimming organisms; organisms that normally live on the bottom but are stirred up into the water by waves or by ships' propellers; and organisms attached or clinging to bits of wood or other floating debris.⁵⁶

Many planktonic organisms can survive relatively long voyages drifting in the ballast water carried in ships, to be discharged into coastal waters at the end of the voyage.⁵⁷ While several studies have reported dramatic declines in the number and diversity of organisms over the course of a voyage,⁵⁸ some live organisms have been collected from ballast water or sediments after periods of up to a year.⁵⁹ Such long-term survival could be due to the presence of cysts, spores or other resting stages of certain organisms, which may be tolerant of harsh environmental conditions and capable of remaining dormant for many weeks or months,⁶⁰ or to the long-term persistence of biological communities in ballast tank sediments.⁶¹ However, even with large declines, substantial numbers and considerable variety of living organisms may remain in ballast tanks after typical transoceanic voyages of 10-20 days. Densities on the order of 0.1-1 relatively large (>0.003 inch) organisms per gallon, and much greater densities of smaller organisms, have been found in ballast water at the conclusion of transoceanic voyages.⁶² Given the large capacity of ship's ballast water pumps,⁶³ a

⁴⁹ 56(239) Fed. Reg. 64381-64386 (Dec. 12, 1991); 63(69) Fed. Reg. 17782-17791 (Apr. 10, 1998); McCarthy *et al.* 1992; McCarthy & Khambaty 1994.

⁵⁰ Epstein *et al.* 1993; Ditchfield 1993. The South American cholera epidemic resulted in over one million reported cases and over 10,000 deaths (Tauxe 1995).

⁵¹ Carlton 1985.

⁵² Carlton 1985.

⁵³ Carlton 1985; Williams *et al.* 1988; Carlton & Geller 1993.

⁵⁴ Cohen 1998, Tables 4-6.

⁵⁵ Cohen 1998, Tables 4-5.

⁵⁶ Carlton *et al.* 1995; Cohen 1998.

⁵⁷ Cohen 1998, Tables 4, 5 & 8.

⁵⁸ Carlton *et al.* 1992; Cohen 1998, Table 7; Gollasch 1998. The declines may be due to changes in temperature or reductions in dissolved oxygen, or to depletion of food resources since there is no light in ballast tanks that would allow phytoplankton to photosynthesize.

⁵⁹ Cohen, Table 8.

⁶⁰ Carlton 1985; Williams *et al.* 1988; Hallegraef *et al.* 1990; Hallegraef & Bolch, 1992; Galil & Hülsmann 1997. Notable among the cyst-forming organisms are some toxic species of dinoflagellates, whose viable cysts have been found in ballast sediments in enormous numbers.⁶⁰

⁶¹ Smith *et al.* 1996.

⁶² Cohen 1998, Table 6.

single deballasting ship may thus discharge into the environment millions of exotic phytoplankton and zooplankton per hour, and larger numbers of protists, bacteria and viruses.⁶⁴

D. REDUCING THE INTRODUCTION OF ORGANISMS IN BALLAST WATER

The approaches suggested for reducing or eliminating the introduction of harmful organisms in ballast water generally fall into three categories: (1) adjusting where, when or how ballast water is loaded or discharged ("ballast water micromanagement"⁶⁵); (2) exchanging ballast water at some distance from shore ("ballast water exchange"); or (3) treating ballast water to remove or kill the organisms in it ("ballast water treatment"). In addition, the use of a "risk-based decision support system" has been recommended by the Australian government and some shipping industry representatives.⁶⁶ This is not a management action *per se*, but rather a regulatory approach in which regulators would first assess a ship to determine whether its ballast water contained organisms that pose a risk, and then determine what management action would be required.

Due to either intrinsic limitations or practical operational constraints, no approach is likely to be completely effective, and some are certain to fall very short. Combinations of approaches may ultimately be adopted; or different approaches may be used in different areas or by different parts of the industry. For any approach, certain issues must be considered: the safety of the ship and crew; its effectiveness in destroying potential invading organisms; technical feasibility and compatibility with ships' operations; environmental impacts; the ability of regulatory agencies to monitor implementation; and the cost of implementation.⁶⁷

1. Ballast Water Micromanagement

Various actions have been suggested to reduce the number of harmful organisms taken in when loading ballast, or to avoid the discharge of ballast water in sensitive or vulnerable areas. Measures related to the loading of ballast include not loading in areas that are known to contain harmful organisms or phytoplankton blooms, or in areas with local outbreaks of infectious water-borne diseases, or in waters with high sediment loads or where propellers may stir up the sediment, or near dredging operations or in shallow water, or near sewage discharges or in areas with poor tidal flushing.⁶⁸ Other measures include not ballasting at seasons when harmful plankton are abundant, or at night when many types of organisms migrate closer to the surface; or ballasting through intakes located high on the ship's hull when in shallow water, to avoid entraining bottom sediments or organisms living near the bottom; or loading fresh water as ballast when expecting to deballast in salt water; and salt water as ballast when expecting to deballast in fresh water.⁶⁹ Measures related to

⁶³ Typical ships' pumping capacities are 0.3-0.5 million gal/hr for general cargo and container ships, 1.3-2.6 million gal/hr for bulk freighters and ore carriers, and 1.3-5 million gal/hr for tankers (Marine Board 1996 at 37).

⁶⁴ Cohen 1998 at 11.

⁶⁵ The term "ballast water micromanagement" was used by Carlton *et al.* 1995 at 132 to describe types of limitations on where and when ballast water is loaded; as used in this article, the term also includes certain types of limitations on where ballast water is discharged.

⁶⁶ Manning *et al.* 1996 (AQIS #9) at 44-45; Patterson & Colgan 1998 at 13.

⁶⁷ Marine Board 1996 at 47.

⁶⁸ IMO 1991; Bolch & Hallegraef 1994; Carlton *et al.* 1995 at 132-138; Weathers & Reeves 1996 in Table 4 on p. 98; Marine Board 1996 at 50; Reeves 1998 in Table 5 on p. 14; Cohen 1998 at 20-21; 64(94) Fed. Reg. 26672, 26683-26684 (May 17, 1999) [33 C.F.R. 151.2305].

⁶⁹ Carlton *et al.* 1995 at 132-138; Weathers & Reeves 1996 in Table 4 on p. 98; Marine Board 1996 at 50, 56; Reeves 1998 in Table 5 on p. 14; Cohen 1998 at 20-21; 64(94) Fed. Reg. 26672, 26683-26684 (May 17, 1999) [33 C.F.R. 151.2305].

the discharge of ballast include not discharging near aquaculture areas, seafood harvesting areas, marine sanctuaries or parks, coral reefs or other sensitive sites.⁷⁰

While such micromanagement measures could enhance the effectiveness of ballast water exchange or ballast water treatment approaches, they are not a substitute for such approaches, and will not by themselves adequately resolve the problem of introductions in ballast water.⁷¹ In actual practice, ships will be unable to implement most of these measures much of the time, since the time and place of ballasting will to a large degree be constrained by the ship's itinerary, schedule and operational needs.⁷²

2. Ballast Water Exchange

Ballast water exchange is often proposed as a measure for ships arriving from overseas ports. In such cases, an exchange would consist of discharging most of the ballast water that had been loaded in overseas coastal waters and replacing it with ocean water taken on when the ship is some distance from shore or in some minimum depth of water. In this article this is referred to as an open-ocean exchange.⁷³ The majority of existing laws, regulations or guidelines specify that open-ocean exchange is to take place at least 200 miles offshore, or in waters that are at least 2,000 meters (6,560 feet) deep, or both.⁷⁴

The primary purpose of open-ocean exchange is to remove exotic coastal organisms from a ship's ballast tanks, and replace it with water containing only oceanic organisms. On arrival at its destination, the ship would then be discharging only oceanic organisms into coastal waters. These are not expected to survive or thrive in the coastal zone, or to compete effectively with organisms adapted to coastal conditions.⁷⁵ There have been some suggestions that vessels engaged in

⁷⁰ Bolch & Hallegraef 1994; Cohen 1998 at 20-21; 64(94) Fed. Reg. 26672, 26683-26684 (May 17, 1999) [33 C.F.R. 151.2305].

⁷¹ Carlton *et al.* 1995 at 132; Cohen 1998 at 20.

⁷² Cohen 1998 at 20-21. In addition, systematically avoiding sites with unwanted organisms or where blooms of phytoplankton are occurring may be impossible because the system of international sampling programs and notification procedures that would be needed to support such an effort does not exist. Also, avoiding discharging into or near sensitive sites may be of limited value, since exotic species, once established at one site, can sometimes spread rapidly to other sites along the coast. For example, the European green crab, first collected on the West Coast in San Francisco Bay in 1989 or 1990, has since spread northward to Vancouver Island in British Columbia, a distance of about 900 miles.

⁷³ This procedure has also been called a mid-ocean, high seas, at sea or deep water exchange. See Carlton *et al.* 1995 at 154 for a discussion of these terms.

⁷⁴ For most of the U. S. coast, the 2,000 meter depth contour is within 200 miles of shore (Carlton *et al.* 1995 at 161). The specifications for exchange in the International Maritime Organization guidelines, the Canadian guidelines, and the U. S. federal rule for tankers exporting Trans-Alaska Pipeline oil is to conduct the exchange in waters at least 2,000 meters deep (IMO 1991 [MEPC 50(31) § 7.3.2 (p. 8)]); Canada 1989; 61(106) Fed. Reg. 27255-27258 (May 31, 1996); in federal law, at least 200 miles from shore (NANPCA 1990; NISA 1996); in federal regulations and California law, in waters that are both at least 200 miles from shore and at least 2,000 meters deep (58(66) Fed. Reg. 18330-18334 (Apr. 8, 1993); 64(94) Fed. Reg. 26672, 26683-26684 (May 17, 1999) [33 C.F.R. 151.2035]; Pub. Res. Code §§ 71200(e), 71201(b), 71204(a)(1)); in Chilean law, at least 12 miles from shore (Gauthier and Steel 1996); and in Israeli regulations, beyond the continental shelf (Israel 1994).

⁷⁵ Carlton *et al.* 1995 at 153; Reeves 1998 at 5. Similarly, coastal organisms are not expected to do well in the middle of the ocean (Carlton *et al.* 1995 at 153). Coastal waters are characterized by higher turbidity, lower levels of UV radiation, and more variable and generally lower salinities (Locke *et al.* 1993; Carlton *et al.* 1995 at 153; Reeves 1998 at 5). These conditions are thought to make transplants from either environment into the other likely to fail. Higher concentrations of nutrients in coastal waters, different availability of food resources, and different levels of competition and predation may also play a role (Rigby & Hallegraef 1994; Carlton *et al.* 1995; Reeves 1998 at 5). For many coastal organisms that are planktonic only during their larval stages and

coastwise traffic should conduct ballast water exchanges at some lesser distance offshore, but there is no clear consensus on the value of such exchange.

Ballast water exchange may be conducted in two basic ways. In an empty-and-refill exchange,⁷⁶ a ballast tank is pumped as empty as possible⁷⁷ and then refilled. The second approach is to pump water in through one port and allow it to flow out through another, called a flow-through exchange.⁷⁸ An empty-and-refill exchange could potentially make a ship unstable or prone to slamming (by discharging too much ballast for the sea conditions), cause inadequate propellor immersion, or impose unacceptable stresses on the hull (by changing the buoyancy in one section of the vessel relative to another).⁷⁹ In general, stability problems are likelier for smaller ships, and unsafe hull stresses are likelier for larger ships.⁸⁰

Such problems do not occur with flow-through exchange. Because the ballast tanks are never emptied, stability is never compromised and hull stresses are not significantly altered. However, flow-through exchange can be difficult because there is usually only one pipe available for both filling and draining the tank.⁸¹ Flow-through exchange has been conducted by pumping water in through a pipe at the bottom of the tank and overflowing water onto the decks through hatch covers or air ventilators at the top of the tank.⁸² This is generally inefficient, and in some circumstances

must settle on the bottom for the adult stage of their lives, open ocean regions where the bottom is more than 2,000 meters down would provide singularly inhospitable environments.

Two other phenomena that are sometimes cited as the rationale for open-ocean exchange may augment the effectiveness of the exchange process, but are not the primary objectives of the process. The first phenomenon is that higher salinity ocean water may act as a biocide, killing organisms adapted to freshwater or to lower salinity coastal water (Locke *et al.* 1991; Pollutech 1992, Appendix B at 12; Weathers & Reeves 1996; Rigby & Taylor, in press). However, a variety of freshwater organisms have been found to survive open-ocean exchange (Locke *et al.* 1991, 1993; Carlton *et al.* 1995, at 159-162; Reeves 1998 at 5). The second phenomenon is that on transequatorial voyages, the influx of warmer tropical water may kill off temperate species; and the tropical species loaded during exchange would be less likely to survive or thrive when discharged to temperate coasts (Hay *et al.* 1997 at 7). It has also been suggested that exchange will result in fewer organisms being released because lower concentrations or a lower diversity of organisms are found in the open ocean than in coastal waters (e. g. Pollutech 1992, Appendix B at 8; Welch 1996), but this is not necessarily true (Carlton *et al.* 1995 at 155).

⁷⁶ Also called deballast-and-reballast exchange, reballasting, sequential release and replacement, sequential exchange, pumpdown exchange and complete exchange.

⁷⁷ A substantial amount of water, typically on the order of tens of thousands of gallons per ship and often containing a high concentration of sediment and possibly organisms, may remain in the bottom of a ship's ballast tanks after the pumps have lost suction (Carlton *et al.* 1995, page 77 and Appendices D & E; Locke *et al.* 1991). This is known as un-pumpable ballast or dead water.

⁷⁸ Also called flow-through dilution, flushing, continuous flushing, flush-through exchange, continuous exchange, dilution exchange and overflow exchange.

⁷⁹ AQIS 1993b; Woodward *et al.* 1994.

⁸⁰ Hay *et al.* 1997 at 8. A figure that has been repeatedly cited in the ballast exchange literature, but is apparently without data to support it, is that empty-and-refill exchange is unsafe for vessels over 40,000 deadweight tons (Rigby *et al.* 1993; Bolch & Hallegraef 1994; Carlton *et al.* 1995 at 164; Reeves 1998). Pollutech 1992, Appendix B at 23 similarly reports the limit for safe exchange as ships of up to 30,000 tonnes cargo, but without providing any basis or reference for this number. Modelling studies on empty-and-refill exchanges by various ship types and data from strain gauges have provided a more complex picture, with different studies indicating no stability or stress problems on three ship types of 37,700 to 110,000 tons displacement until the seas reached significant wave heights of somewhere between 10 and 20 feet (significant wave heights of 10-20 feet imply occasional waves nearly 40 feet high) (Woodward *et al.* 1994); no stability or stress problems on a bulk carrier of 150,000 deadweight tons when tanks were exchanged in calm sea conditions (Lloyds Registry 1992, in AQIS 1993b at 150-163, and reviewed at 46-48); but unsafe stress conditions for four bulk carriers of 70,000 to 188,000 deadweight tons (Rigby *et al.* 1993; Rigby & Hallegraef 1994; Prior 1995, cited in Weathers & Reeves 1996 at 93-94).

⁸¹ Reeves 1998.

⁸² Rigby & Hallegraef 1994; Hay *et al.* 1997.

may be unsafe.⁸³ Fitting ballast tanks with a second pipe and making some other changes in the tanks could make flow-through exchange safer and easier and somewhat more efficient, even for the largest vessels.⁸⁴

Because of its limited effectiveness and potential safety issues, open-ocean ballast water exchange is generally viewed as an interim measure, that should be replaced or augmented as soon as possible by more effective and safer ballast treatment approaches.⁸⁵

3. Ballast Water Treatment

Many technologies for treating ballast water could potentially be applied either on-board ship or in on-shore facilities,⁸⁶ although a few will be limited to on-shore use due to physical restrictions or safety concerns.⁸⁷ Treatment technologies are generally of two types: technologies designed to remove particles, including both organisms and suspended sediments; and technologies designed to kill living organisms, called disinfection. With most technologies, effective treatment will require both an initial particle removal process and a disinfection process, as discussed below.

Most of the studies and experiments conducted to date have targeted on-board application, and have primarily looked at filtration, chemical biocides and heat treatment. Other methods that have been proposed include ultraviolet (UV) radiation, ultrasound, microwaves, electric pulse and pulse plasma, magnetic treatment, mechanical agitation, and deoxygenation.⁸⁸

a. Particle Removal

Several studies have considered different types of screens, strainers or membrane filters for on-board treatment of ballast water.⁸⁹ In general there are tradeoffs between efficiency, size, complexity and cost: systems that are capable of removing very small organisms⁹⁰ at an acceptable flow rate⁹¹ tend to be large, and shrinking the system tends to make it more complex and more costly. Generally, the preferred arrangement is to filter the ballast water as it is loaded, so that backwash water and material may be discharged back into the source waters, rather than stored for later

⁸³ AQIS 1993b at 61; Hay *et al.* 1997.

⁸⁴ Retrofit costs for this work have been estimated at £170,400 (≈\$280,000) to £528,000 (≈\$860,000) per ship for different ship types and sizes (Weathers and Reeves 1996; Reeves 1996; Armstrong 1997; Reeves 1998). Brazilian researchers have developed a cheaper approach involving deck-mounted pipes, called the "dilution method," which performed well in trials (Report of the Working Group on Ballast Water convened during MEPC 42, MEPC 43/4, 5 January 1999 at 5). In addition, a flow-through exchange requires that more water be pumped into a tank than in an empty-and-refill exchange, typically about three tank volumes to achieve a comparable level of exchange (Rigby & Hallegraef 1994).

⁸⁵ Marine Board 1996 at 53.

⁸⁶ Some studies consider a category of "port treatment" where ballast water is transferred from cargo ships to a treatment plant on a specially-designed vessel floating in the port (AQIS 1993; Greenman *et al.* 1997). In this article this is considered to be a type of on-shore treatment.

⁸⁷ Cohen 1998 at 27.

⁸⁸ Bolch & Hallegraef 1994; Carlton *et al.* 1995; Marine Board 1996; Reeves 1998.

⁸⁹ Pollutech 1992; AQIS 1993a; Carlton *et al.* 1995; Marine Board 1996; Mulvaney 1997; Reeves 1998 at 15, footnote e.

⁹⁰ The size ranges of organisms found in ballast water include invertebrate eggs at 20-100 microns, algal spores and cysts at 5-25 microns, fungi at 1-100 microns, protozoa at 1-80 microns, bacteria at 0.1-100 microns and viruses at 0.01-1 micron (AQIS 1993a; Reeves 1998). A research project on the Great Lakes is testing filters in the 25-250 micron range (Mulvaney 1997).

⁹¹ Typical ballast pumping rates on commercial vessels are on the order of 1,000-20,000 cubic meters per hour (4,400-88,000 gallons per minute) (Marine Board 1996 at 37).

treatment and/or disposal.⁹² Another technology that has been suggested for on-board use is cyclonic separation, which removes particles by centrifugal action.⁹³

While these technologies could be used either on-board or on-shore, there are other, generally cheaper methods for removing organisms and sediment that are only suitable for use on-shore. These include settling tanks and granular filtration, whose requirements for space or still conditions cannot be met on-board.⁹⁴ Whatever technology is used for particle removal, whether employed on-board or on-shore, it is unlikely to be effective at removing the smallest organisms present in ballast water or, in the case of cyclonic separation, to remove organisms with a specific gravity near that of the ballast water. Thus, any particle removal technology will probably need to be followed by additional treatment to kill the remaining organisms, such as biocide application or UV disinfection.⁹⁵

b. Disinfection

Biocides that could potentially be used to disinfect ballast water include chlorine, ozone, hydrogen peroxide, various metal ions, organic acids and glutaraldehyde. In laboratory tests of various commonly-used biocides, extraordinarily high doses were needed to kill dinoflagellate cysts,⁹⁶ which were chosen as test organisms because of their potential harm to shellfisheries and human health, and their resistance to chemical treatment relative to mobile organisms.⁹⁷ These high doses would make use of these biocides prohibitively expensive.⁹⁸ Many biocides may also not be feasible for on-board use because of inadequate storage space on ships, human health hazards, corrosion of ballast tanks or pipes, and concerns about discharging biocides or their residues into the environment.⁹⁹ Many biocides are also much less effective in water containing sediment or

⁹² Marine Board 1996 at 77-79, 87. A disadvantage of in-line filtration during loading is that the system must be large enough to handle the ship's maximum ballast pumping rate (Marine Board 1996 at 70).

⁹³ D. Oemcke, *The Treatment of Ships' Ballast Water*, EcoPorts Monograph Series No. 18, Ports Corporation of Queensland, Brisbane (March 1999), at p. 60.

⁹⁴ One study calculated that a media filtration system (such as is routinely used in water treatment on-shore) which was large enough to handle the ballast pumping rates on a small bulk carrier or tanker would need filters that are 200 square meters in area and 2 meters deep, too large to install on a ship (Marine Board 1996 at 78). Another study calculated that granular filtration in pressure filters would require a footprint of at least 100 square meters to treat a flow of 4,000 cubic meters per hour (AQIS 1993a at 33).

⁹⁵ Pollutech 1992; Carlton *et al.* 1995 at 140; Reeves 1999 at 2. The need to combine on-board filtration with another on-board treatment system tends to make this a relatively expensive approach. For example, one study estimated that filtration to 50 microns would cost about 3-5 times as much per gallon as open-ocean exchange, and that filtration with UV would cost about 200 times as much as open-ocean exchange (Pollutech 1992). Reeves 1998 at 18 noted that current cost estimates suggest that on-board filtration will be prohibitively expensive, and that "one filter breakthrough or failure to religiously maintain and use the system...throughout the voyages around the world...will contaminate the tank and vitiate the protection to be achieved."

⁹⁶ Many types of marine and freshwater organisms can form cysts, spores or other resting life stages, which may be able to survive in environmental conditions that would be harmful to the organism's active life stages (Hallegraeff & Bolch 1992; Carlton 1995 at 162).

⁹⁷ It was felt that biocides capable of killing dinoflagellate cysts would also kill larval zooplankton, copepod eggs and seaweed spores, although possibly not bacterial spores or viral particles (Bolch & Hallegraeff 1993). Chlorine and hydrogen peroxide proved to be effective against some dinoflagellate cysts only at doses that were tens or hundreds of times greater than normal water and wastewater treatment doses (Bolch & Hallegraeff 1993; Rigby *et al.* 1993; Ichikawa *et al.* 1992; Montani *et al.* 1995).

⁹⁸ Bolch & Hallegraeff 1993, 1994; Rigby *et al.* 1993. Some current research efforts in the Great Lakes are investigating the use of glutaraldehyde or organic acids to treat the relatively small amounts of unpumpable ballast remaining in ballast tanks on NOBOB ("no ballast on board") ships, but these chemicals are too expensive for general treatment of ballast water (Reeves 1998 at 19-20).

⁹⁹ Bolch & Hallegraeff 1993; Rigby *et al.* 1993; AQIS 1993a at 38; Carlton *et al.* 1995 at 145-147.

organic material.¹⁰⁰ A prior particle removal process to remove sediments and cysts would reduce the amount of biocide needed for disinfection and could make the use of biocides more feasible.

UV radiation is effective at killing bacteria and other micro-organisms, but may not be as effective for larger organisms, for cysts and spores,¹⁰¹ or for algae and fungi. Its effectiveness is also greatly reduced in water containing suspended sediment. UV radiation is thus considered to be a feasible treatment for ballast water only after a particle removal stage.¹⁰²

Laboratory tests and field trials indicate that on tropical voyages the cooling water from ship's engines can be used to heat ballast water to temperatures that may be high enough to kill dinoflagellates and many other ballast water organisms.¹⁰³ Bacteria and viruses may be unaffected, however,¹⁰⁴ and in many ships it would not be possible to heat the water sufficiently on short voyages or voyages through colder waters.¹⁰⁵

Other suggested technologies are generally considered to be less promising.¹⁰⁶ For example, high intensity ultrasound can kill organisms, but no one frequency is likely to be effective against the range of organisms found in ballast water, the necessary exposure time may be quite long, and the power requirements high.¹⁰⁷ Microwaves appear to be prohibitively expensive and of questionable effectiveness.¹⁰⁸ Electric pulse and pulse plasma technologies, magnetic treatment and mechanical agitation are at experimental or exploratory levels of development, and they may not kill the full range of organisms in ballast water.¹⁰⁹ Ballast water could be deoxygenated by adding certain chemicals, but this would be ineffective against anaerobic bacteria, effectiveness would be compromised by surface reoxygenation, corrosive compounds and hazardous gases would be generated, and there could be environmental impacts from discharging anoxic and possibly sulfur-rich water.¹¹⁰

c. *On-shore vs. On-board Treatment*

Although most of the research conducted to date has focused on on-board ballast water treatment systems, it may be possible to develop treatment systems on-shore more quickly and cheaply, using available technologies that are routinely applied to water and wastewater treatment.¹¹¹ On-shore treatment approaches have several attractive characteristics. They avoid the ship safety and crew safety issues that arise with some ballast exchanges and on-board treatments.¹¹² As noted above, on-shore treatment can use some relatively inexpensive particle removal technologies that would be

¹⁰⁰ Bolch & Hallegraef 1993.

¹⁰¹ Tests have shown substantial germination of dinoflagellate cysts after 2 hours exposure to UV radiation (Rigby & Tayler in press, citing Montani *et al.* 1995).

¹⁰² Pollutech 1992; AQIS 1993a at 36; Carlton *et al.* 1995 at 142; Marine Board 1996 at 85. With regard to the likelihood of effective application on ships, Reeves (1998 at 17) states about the small UV units used on ships to treat sewage that "as a matter of practical experience, we have found that many vessel owners forget to conduct the regular monitoring of the UV penetration necessary to guarantee that their marine sanitation devices are actually treating the sewage adequately."

¹⁰³ Bolch & Hallegraef 1993, 1994; Rigby *et al.* 1997, 1998 (AQIS #11).

¹⁰⁴ Rigby *et al.* 1997 (AQIS #11) at 37.

¹⁰⁵ Rigby *et al.* 1997 (AQIS #11) at 37.

¹⁰⁶ Pollutech 1992; Carlton *et al.* 1995; Marine Board 1996.

¹⁰⁷ Pollutech 1992, Appendix B; Carlton *et al.* 1995 at 143-144; Marine Board 1996 at 85, 130.

¹⁰⁸ Carlton *et al.* 1995 at 150.

¹⁰⁹ Pollutech 1992, Appendix B at 6; Carlton *et al.* 1995 at 141; Marine Board 1996 at 84-85, 127-130.

¹¹⁰ Pollutech 1992, Appendix B at 81-89; AQIS 1993a at 44; Carlton *et al.* 1995 at 150.

¹¹¹ Cohen 1998 at 27-28. Feasibility studies conducted for the Canadian and Australian governments estimated on-shore treatment costs that were generally cheaper than on-board approaches (Pollutech 1992; AQIS 1993a).

¹¹² AQIS 1993a at 13.

impossible on a ship,¹¹³ and some of the least expensive types of biocides that would be too hazardous on a ship.¹¹⁴ Economies of scale would likely result from constructing and operating a smaller number of relatively large on-shore treatment plants, rather than constructing and operating a treatment plant on every single ship.¹¹⁵ In some cases, it may be possible to use existing wastewater treatment facilities.¹¹⁶ Proper maintenance and operation are more likely in on-shore than in on-board treatment plants,¹¹⁷ and it is also likely to be easier to monitor and regulate on-shore than on-board plants.¹¹⁸ Disadvantages of on-shore treatment include the use of land near shore which may be needed for other purposes, possible delays to ships while off-loading ballast water, and the likelihood that in some regions ships will discharge some ballast water before entering port which will not receive treatment.¹¹⁹

4. Risk-based Decision Support System

Various shipping interests and the Australian government have advocated that the required level of ballast management should vary from ship to ship and voyage to voyage based on individual risk assessments. In this approach, the responsible agency would first estimate the level of risk presented by the discharge of a ship's ballast water, and then require a management action appropriate to the level of risk.¹²⁰ The apparent objective is to release a significant number of ships from an otherwise required action, such as exchange or treatment.¹²¹ Two approaches for estimating

¹¹³ AQIS 1993a at 31-34.

¹¹⁴ Such as chlorine gas, probably the most common biocide used in water and wastewater treatment in the United States.

¹¹⁵ Cohen 1998 at 27-28. AQIS 1993a at 86 notes that "clearly the provision of centralised treatment in port or land-based facilities will be more economic in capital cost terms than provision of treatment facilities on board each ship."

¹¹⁶ For example, the volume of wastewater treated in the San Francisco Bay region is several hundred times the amount of overseas ballast water discharged into San Francisco Bay. Thus it may be possible in some cases to mix these relatively small ballast water discharges into the existing large waste streams without unduly altering their physical or chemical characteristics or straining the capacity of the wastewater plants to treat them.

¹¹⁷ For example, AQIS 1993a at 23 (also cited by Reeves 1998) notes that "water treatment equipment would be subject to operation, repair and maintenance by the crew. With the standards of ship maintenance in some cases having slipped badly for both hull and machinery, it may be assumed in these cases that ballast water treatment systems would not be accorded a high priority for maintenance and could be easily by-passed or operated at suboptimal efficiency."

¹¹⁸ AQIS 1993a at 12.

¹¹⁹ Cohen 1998 at 28. Some ships may need to discharge ballast to lessen their draft before crossing a shallow bar or entering a shallow port.

One question that arises with on-shore treatment is who would pay for the construction and operation of treatment facilities, the ships or the ports? If ships were required to treat their ballast water discharges and on-shore treatment was the cheapest approach, either shipping companies, ports or, conceivably, independent entrepreneurs might choose to construct treatment facilities. If ports or independent parties were to do so, they could recover costs and turn a profit by charging ships appropriate fees for receiving and treating their ballast water. A potential advantage to the shipping industry of on-shore treatment is that plant construction costs are more likely to be subsidized by federal or state governments—just as the cost of constructing wastewater treatment plants was subsidized during the implementation of the Clean Water Act—than would the cost of constructing or installing treatment plants on board ships. For example, low-interest or no interest loans are available for the construction of on-shore facilities to treat ballast water in California, through the State Revolving Fund administered by the State Water Resources Control Board, which is a form of subsidy.

¹²⁰ Manning et al. 1996 (AQIS #9) at 44-45; Hayes & Hewitt 1998 at 5. Report of the Working Group on Ballast Water convened during MEPC 42, MEPC 43/4, 5 January 1999, at 7. This strategy was adopted by the Australian government in 1996 (Patterson & Colgan 1998 at 11).

¹²¹ "Based on the "target" organism approach... it is possible that only a relatively small number of ships may need to undertake ballast treatment before discharge, in some areas." Rigby and Taylor 1998 in ICES. See also Manning et al. 1996 (AQIS #9) at 44-45; Hayes & Hewitt 1998 at 2.

risk are "species-specific assessments"¹²² (which estimate the probability that one or more species from a list of harmful organisms could be introduced in the ship's ballast water) and "environmental matching" (which compares the regions where ballast is loaded and discharged and assigns a higher estimate of risk if the regions are similar).¹²³ Thus far there are only rough descriptions of how such approaches might be implemented, but anything more ambitious than very conservative environmental matching (which would probably release few ships from management requirements) would likely prove to be unreliable.¹²⁴

II. REGULATING BALLAST WATER DISCHARGES INTO CALIFORNIA WATERS

Despite the large ecological and economic costs resulting from the release of exotic organisms, there has been little effort to regulate ballast water discharges at the international, federal or state level. Although Congress enacted federal laws as early as 1900 to protect the United States from invasion by exotic species, these statutes have not been applied to transfers of exotic species in ballast water.¹²⁵ Similarly, California laws that prohibit the unauthorized release of exotic species have not been used by California as a method for addressing ballast water-caused invasions.

¹²² Also called a "target organism approach."

¹²³ Hayes & Hewitt 1998. This report actually outlines six levels of assessment of increasing complexity from simple environmental matching (Level 0) to a fully-detailed species-specific assessment (Level 5).

¹²⁴ Species-specific assessments target a group of organisms identified as harmful, and are thus a kind of "dirty list" approach. Such approaches are thought to be ineffective by most regulators and researchers (see discussion and references in II.C.2.b. below). One problem is that we have no tested criteria for predicting which organisms are likely to invade and do harm. For example, Australia currently proposes 13 "invasive" species as targets for management, whose placement on the list is in large part due to their having become established in areas outside of their native ranges (Hayes & Hewitt 1998 at 65). However, 10 of these species were not reported outside of their native ranges until the 1980s or 1990s, so that most of the listed species would not have been selected as management targets even a decade or two ago. This strongly suggests that many of the most harmful invaders of the coming decades would not be included on target lists prepared today. In addition, all but two of the 13 listed species are already established in Australia—consistent with a common complaint regarding dirty list approaches that species are usually listed only after it is too late to prevent their introduction (e. g. Bean 1991 at 45-46).

The value of environmental matching is limited because the ranges of many marine organisms are very poorly known, because the range of environmental conditions in their native habitats may not be good indicators of the environmental limits in which they can establish, and because some aquatic organisms can tolerate or thrive in an extraordinarily broad range of physical and chemical conditions (Hayes & Hewitt 1998 at 16). Examples of aquatic organisms that successfully invaded waters outside of their presumed physical or chemical limits include two diatom species, originally considered to be strictly marine organisms, which became abundant in the Great Lakes (Bioenvironmental Services 1981, Volume 1 at page 18); the tropical green alga *Caulerpa taxifolia* which invaded the Mediterranean (Raloff 1998); and the tropical freshwater weed *Hydrilla verticillata* which became abundant in a New England pond that freezes over in the winter (J. T. Carlton, pers. comm.). Another problem is that many ballast tanks contain a mixture of water from a variety of ports, making it difficult to know the sources of all the ballast water carried (Carlton et al. 1995 at 48; Hayes & Hewitt 1998 at 16).

In commenting on proposed international regulations, the United States noted that risk assessment-based ballast water management could be based on three conditions that theoretically could create a lower risk of invasion: longstanding movement of ballast water along the route in question, absence of target organisms in the ballast water, and different environmental conditions in donor and receiver ports. However, the United States rejected these arguments because many invasions have occurred decades after ballast water movement was begun, because "it is generally impossible to predict which organisms in ballast water will become serious invaders," and because the assumption that organisms introduced from different climate regions will die "is questionable" (Footnote 8 at 8 in Annex 1 to MEPC 43/3, "Proposed Amendments and Comments on the Draft Regulations for the Control and Management of Ships' Ballast Water and Sediments to Minimize the Transfer of Harmful Aquatic Organisms and Pathogens (in the form of an Annex to MARPOL 73/78)").

¹²⁵ 16 U.S.C. §§ 3371-3378.

The few measures that have been taken by California and the federal government to address the discharge of exotic organisms in ballast water have largely treated ballast water releases as a shipping issue. As established exotic species continue to expand their ranges and new invasions threaten ecosystems and economies across the United States, frustration at the slow pace of federal efforts to reform ballast water practices has led a number of organizations and interest groups affected by invasions of exotic species to explore new strategies for regulating ballast water discharges. At the core of these strategies is the recognition that exotic organisms are biological pollutants. In fact, because these biological pollutants can reproduce, expand their range, and fundamentally alter ecosystem processes and biodiversity, many exotic organisms can produce long-term impacts that are far more severe than those of many pollutants categorized as hazardous wastes.

These new strategies have looked to federal and state statutes aimed at controlling water pollution, such as the federal Clean Water Act (CWA),¹²⁶ Ocean Dumping Act¹²⁷ and Rivers and Harbors Act of 1899,¹²⁸ and California's Porter-Cologne Water Quality Control Act (California's equivalent of the CWA),¹²⁹ to regulate ballast water discharges of exotic organisms. Additionally, they have focused attention on how public agencies have failed to assess the indirect effects of ballast water releases associated with the development and operation of shipping facilities and waterways, as is required by the National Environmental Policy Act,¹³⁰ California Environmental Quality Act,¹³¹ and Section 7 of the Endangered Species Act.¹³² In California and elsewhere, groups concerned about the growing environmental and economic effects of exotic organisms are beginning to employ these statutes to hasten reform of ballast water practices.

Applying existing water pollution laws to control ballast water discharges and using existing environmental review statutes to analyze actions (such as port construction or channel deepening projects) that facilitate the release of ballast water provides a framework for regulating ballast water discharges in California and nationwide. Wildlife protection statutes such as the Endangered Species Act¹³³ and the Lacey Act,¹³⁴ and statutes dealing with the management or protection of wetlands, tidelands or coastal lands may provide additional mechanisms for managing ballast discharges. To understand the full framework of potentially applicable regulatory approaches to ballast water, it is important to consider both the inadequacies of current international and domestic efforts that have addressed ballast discharges largely as a shipping issue, as well as the relevance of existing pollution control, environmental review and other laws to ballast releases of exotic organisms.

A. REGULATING BALLAST WATER DISCHARGE AS A SHIPPING ISSUE

1. International Law

Ballast water discharges were first recognized as an international concern in 1973, when the United Nations Conference on Marine Pollution requested the World Health Organization to investigate the potential spread of epidemic disease in ballast water.¹³⁵ As early as 1976, the Tasmania State Government in Australia reportedly required the open-ocean exchange of ballast water for inbound

¹²⁶ 33 U.S.C. §§ 1251-1387.

¹²⁷ 33 U.S.C. §§ 1401-1445.

¹²⁸ 33 U.S.C. §§ 401-426

¹²⁹ Water Code §§ 13000 *et seq.*

¹³⁰ 42 U.S.C. §§ 4331-4370.

¹³¹ Pub. Res. Code §§ 21000 *et seq.*

¹³² 16 U.S.C. § 1536(a)(2).

¹³³ 16 U.S.C. §§ 1536 (a)(2); 1538(a)

¹³⁴ 16 U.S.C. § 3371-3378 ; 18 U.S.C. § 42.

¹³⁵ The requested research was apparently never conducted (Kelly 1992 at 77-78; Welch 1996).

ships,¹³⁶ and in 1982 the Canadian Coast Guard, concerned about the potential for introducing toxic dinoflagellates into local mussel farms, prohibited the discharge of unexchanged ballast water in the vicinity of the Iles-de-la-Madelaine in the Gulf of St. Lawrence.¹³⁷ Between 1989 and 1993 Canada, Australia, New Zealand and the United Nations' International Maritime Organization (IMO) adopted guidelines on ballast water management.¹³⁸ These were in large part spurred by concerns over toxic dinoflagellates, based on studies of their introduction into Australia via ballast discharges.¹³⁹

The IMO Guidelines were adopted by the IMO's Marine Environmental Protection Committee (MEPC) in 1991,¹⁴⁰ and by the IMO as a whole in 1993.¹⁴¹ These guidelines recommend the exchange of coastal ballast water in water at least 2,000 meters deep, along with various operational procedures related to loading and discharging ballast water and sediment. The Guidelines note that Member States or their Port State Authorities may adopt ballast water or sediment management requirements, or may develop shore reception facilities for disposing of ballast water and ballast sediment and implement fees for their use. The Guidelines themselves, however, are entirely voluntary.

In 1994, MEPC established a Working Group on Ballast Water to consider potential ballast water regulations to be proposed as an annex to the Convention on Pollution from Ships (MARPOL).¹⁴² Even if effective regulations should be included in the proposed annex,¹⁴³ it would still take many steps and potentially a very long time before the regulations were adopted and implemented at the national level. First the work on drafting the proposed annex (which has taken five years so far) would need to be completed. Then the MEPC would have to adopt the proposed annex, followed by the IMO as a whole. For the United States, the executive branch of the federal government would decide whether to support the proposed annex at these stages. After adoption by the IMO, the annex would then need to be ratified by IMO member states before it entered into force.¹⁴⁴ Such

¹³⁶ Williams *et al.* 1988.

¹³⁷ Gauthier & Steel 1996, at 5.

¹³⁸ Voluntary Guidelines for the Control of Ballast Water Discharges from Ships Proceeding via the St. Lawrence Seaway to the Great Lakes, adopted by the Canadian Coast Guard on May 1, 1989, reproduced in Locke *et al.* 1991, Appendix A. Voluntary Guidelines for Ballast Water and Sediment Discharge from Overseas Vessels Entering Australian Waters, adopted by the Australian Quarantine and Inspection Service on February 1, 1990, updated in July 1992, reproduced in AQIS 1993b at 114-121. New Zealand Voluntary Guidelines adopted in March 1992. Import Health Standard (Biosecurity Act of 1993) for Ships' Ballast Water from all Countries, New Zealand Ministry of Fisheries, Wellington, 1998.

¹³⁹ Hallegraef *et al.* 1990; Hallegraef & Bolch 1991, 1992; Bolch & Hallegraef 1994.

¹⁴⁰ MEPC Resolution (50)31, adopted July 4, 1991.

¹⁴¹ IMO (Resolution A.774(18), adopted November 4, 1993.

¹⁴² Report of the Working Group on Ballast Water convened during MEPC 42, MEPC 43/4 (Jan. 5, 1999) (hereafter MEPC 43/4). The Convention adopted in 1973, along with the Protocol of 1978, are commonly known as MARPOL. MEPC has also considered proposing ballast water regulations as amendments to an existing annex to MARPOL, or as a new Convention (MEPC 43/4) at 3).

¹⁴³ The current draft of the proposed annex requires open-ocean exchange of ballast water, with treatment of ballast water as an optional alternative (MEPC 43/4). An annex requiring treatment of ballast water appears very unlikely at this time.

¹⁴⁴ The necessary conditions for IMO treaties or annexes to enter into force are set by the Conference convened to adopt the instrument. For example, MARPOL was designed to take effect 12 months after it was ratified by at least 15 member states controlling at least 50% of the world's gross tonnage of merchant shipping. Depending on the treaty, non-ratifying member states may or may not be bound by the treaty provisions (Dennis Nixon, Professor of Maritime Law, University of Rhode Island, pers. comm., Nov. 1999). The current draft of the proposed annex also allows a Port State, or multiple Port States through Regional Agreements, to opt out of adopting and implementing the regulations for waters within their jurisdictions (Regulation 3.2 to Annex 1 ("Proposed Amendments and Comments on the Draft Regulations for the Control and Management of Ships' Ballast Water and Sediments to Minimize the Transfer of Harmful Aquatic Organisms and Pathogens (in the

ratification is often neither prompt nor ultimately assured.¹⁴⁵ For the United States, that decision would be made by the Senate.

Once the annex was in force, any elements of the annex that required implementation by Port States would in practice not go into effect until the Port States drafted, adopted and, finally, implemented appropriate statutes and regulations.¹⁴⁶ Thus, although ideally the transport of exotic organisms in ballast water should ultimately be managed through the development and implementation of comprehensive international regulations, the length of time this is likely to take and the urgency of the problem suggest that national, regional or local regulations may be necessary in the interim.

2. Federal Law

In the United States concern over ballast water arose with the discovery of zebra mussels in the Great Lakes in 1986, which had apparently been introduced through ballast water discharges.¹⁴⁷ The zebra mussel had long been recognized as a nuisance species in Europe, fouling structures and clogging water systems, and its population exploded in the Great Lakes bringing environmental and economic disruption.¹⁴⁸ In November 1990 the Nonindigenous Aquatic Nuisance Prevention and Control Act (NANPCA)¹⁴⁹ was signed into law. NANPCA set voluntary guidelines, modeled on the IMO Guidelines, for ballast water management by ships arriving from outside the Exclusive Economic Zone (EEZ)¹⁵⁰ and entering the Great Lakes. The voluntary guidelines were published on Mar. 15, 1991,¹⁵¹ and became mandatory requirements on May 10, 1993.¹⁵²

These guidelines required ships to exchange their ballast water in the open ocean before discharging it into the Great Lakes, or to conduct alternative treatments that were determined to be as effective.¹⁵³ Additional support for these regulations resulted from the discovery in 1991 that a

form of an Annex to MARPOL 73/78") to MEPC 43/3; and Annex 2 ("Regional Agreements") to MEPC 43/3).

¹⁴⁵ For example, the Convention on the Law of the Sea was adopted by the IMO, with U. S. support and after considerable U. S. input on the language in the Convention, in 1982; but it has not yet been ratified either by the United States or by a sufficient number of IMO member states (D. Nixon, pers. comm., Nov. 1999).

¹⁴⁶ This too may take several years. For example, work on drafting the National Invasive Species Act (described in the next section) was underway at least by the fall of 1995, the bill was introduced in March, 1996 and signed into law in October, 1996, and the implementing regulations were finally published in May, 1999—an elapsed time of over 3.5 years.

¹⁴⁷ NANPCA 1990; OTA 1993.

¹⁴⁸ See section I.B above for more details.

¹⁴⁹ Public Law 101-646, 104 Stat. 4761, adopted on Nov. 29, 1990, codified at 16 U.S.C. § 4701-4751.

¹⁵⁰ The EEZ extends to 200 miles from the U. S. coast.

¹⁵¹ Federal Register (March 15, 1991)

¹⁵² 58(66) Fed. Reg. 18330-18334 (Apr. 8, 1993). NANPCA at § 1101(b) had directed that mandatory regulations be issued within 24 months of enactment of the statute, by November 29, 1992, but they were not published until April 8, 1993 and did not take effect until May 10, 1993. The regulations authorize the Coast Guard to prohibit a vessel's operation on the Great Lakes (33 C.F.R. § 151.1506) or revoke its clearance (33 C.F.R. § 151.1508) if it is not in compliance. Violation of these regulations carries a maximum civil penalty of \$25,000 per day or a criminal charge of a class C felony which carries with it a maximum penalty of 12 years in prison and a \$250,000 fine for an individual or a \$500,000 fine for a company (Weathers and Reeves 1996 at 95).

¹⁵³ NANPCA allows the use of alternative ballast water management methods if the Secretary of Transportation determines that these methods "are as effective as ballast water exchange in preventing and controlling infestations of aquatic nuisance species" (NANPCA § 1101(b)(2)(B)(iii)). There have been no such determinations made or requested. However on four occasions the Coast Guard has allowed ships not in compliance with the regulations to conduct one of the following *ad hoc* alternative treatments: adding salt in the form of liquid sodium chloride (not likely to be allowed again, according to the Coast Guard), adding chlorine as liquid chlorine or sodium hypochlorite, and heating the water (a capability that few vessels possess) (Kabler 1996; Weathers & Reeves 1996; Reeves 1998).

strain of epidemic cholera was being carried in ballast water from South America to the U. S. Gulf Coast, where it was found in oysters and fish.¹⁵⁴ In early 1995, the mandatory ballast water regulations were amended to include ships entering the upper Hudson River.¹⁵⁵

In October 1996, the National Invasive Species Act (NISA)¹⁵⁶ became law. NISA continued the mandatory regulations for the Great Lakes and upper Hudson River, and added similar voluntary guidelines for the rest of the country,¹⁵⁷ along with recordkeeping requirements.¹⁵⁸ However unlike NANPCA, in which the voluntary guidelines for the Great Lakes automatically become mandatory within two years of enactment, under NISA the voluntary guidelines that apply to the rest of the country will remain voluntary unless the Secretary of Transportation determines that they are not being complied with or are ineffective.¹⁵⁹ NISA requires that an initial review and determination regarding compliance and effectiveness be completed within four years of the statute's enactment, but at the current time, three years after enactment, the process is already over a year and a half behind schedule.¹⁶⁰

¹⁵⁴ 56(239) Fed. Reg. 64381-64386 (Dec. 12, 1991); McCarthy *et al.* 1992; McCarthy & Khambaty 1994.

¹⁵⁵ Public Law 102-587, adopted on Nov. 4, 1992, codified at 16 U.S.C. 4701-4751, directed that NANPCA's mandatory requirements be applied to vessels entering the Hudson River north of the George Washington Bridge, which became effective Jan. 30, 1995. The objective was to provide further protection to the Great Lakes, since organisms established in the upper Hudson River could enter the Great Lakes via the Erie Canal (59(250) Fed. Reg. 67632-67634 (Dec. 30, 1994)).

¹⁵⁶ Public Law 104-332, 110 Stat. 4073, adopted on Oct. 26, 1996, codified at 16 U.S.C. § 4701-4751.

¹⁵⁷ In 33 C.F.R. 151.2000 to 151.2050, published as an Interim Rule in 64(94) Fed. Reg. 26672-26690 (May 17, 1999). These guidelines recommend that ships exchange their ballast water outside the EEZ or in other designated areas, or employ alternative ballast water management methods that are determined to be as effective. Passenger vessels with treatment systems designed to kill aquatic organisms in ballast water, and crude oil tankers engaged in coastwise trade were exempted from the guidelines.

¹⁵⁸ Under NANPCA and NISA, the recordkeeping and reporting requirements for ship's ballast water have become more precisely codified over time. In 1991, NANPCA said nothing directly about ships' recordkeeping, but ordered the Secretary of Transportation to "provide for sampling procedures to monitor compliance with the requirements of the regulations" which were to be promulgated for vessels bound for the Great Lakes from overseas (§ 1101(b)(2)(D)). Under this authority, in 1993 these vessels (later including vessels bound for the upper Hudson River) were required to provide, on request of the Coast Guard, information including the volume and salinity of ballast water expected to be discharged into U. S. waters and any ballast water exchange conducted (33 C.F.R. 151.1516). In 1996, NISA required vessels bound for all U. S. waters from overseas to maintain ballast water records on board and make them available for inspection on request (§ 1101(c)(2)(F)). In 1999 these vessels were required to provide somewhat more detailed information to the Coast Guard by a specified point or time before entering port (for ships bound for the Great Lakes or upper Hudson River) or before leaving the first port of call (for vessels entering other waters), and a Ballast Water Reporting Form was provided for this information (33 C.F.R. 151.2040 and 151.2045).

¹⁵⁹ NISA §§ 1101(c) to 1101(f); Whalin 1998 at 123-124.

¹⁶⁰ NISA at § 1101(c)(1) directed that voluntary guidelines were to be issued within 1 year of enactment, or by October 26, 1997; but draft guidelines were not published for public comment until April 10, 1998 (63(69) Fed. Reg. 17782-17791), and the final guidelines were not published (as an Interim Rule) until May 17, 1999 (64(94) Fed. Reg. 26672-26690), almost 19 months after the date mandated by NISA. NISA at § 1101(e)(3) also directed that criteria for determining the adequacy of compliance with and effectiveness of the guidelines were to be submitted to the Secretary of Transportation within 18 months of enactment, or by April 26, 1998; but the committee created to develop recommendations for criteria isn't scheduled to submit these recommendations to the Aquatic Nuisance Species Task Force until May of 2000 (Aquatic Nuisance Species Task Force, "Ballast Water Program Effectiveness and Adequacy Committee: Requirements and Implementation Considerations," April 24, 1999). The Task Force will then decide on the criteria and submit them to the Secretary, but no schedule has yet been set for that (Sharon Gross, USFWS, pers. comm., Sept. 1999).

NISA at §§ 1101(e) and 1101(f) then directs the Secretary of Transportation to determine the adequacy of compliance and effectiveness, within three years of the issuance of guidelines, and within four years of enactment (that is, by October 26, 2000). However, since the guidelines were not issued until May of 1999 it's unlikely that this determination will be made before May of 2002. If the Secretary then determines that either compliance or effectiveness is inadequate, mandatory regulations are to be promulgated promptly.

Furthermore, it appears that the data being collected by the Coast Guard are not adequate to assess either compliance or effectiveness. These data consist of information provided by the ships on Ballast Water Reporting Forms¹⁶¹—in which a ship reports on whether it has conducted an open-ocean exchange—and Coast Guard measurements of the salinity of the ballast water carried by some arriving ships. Although some past reports have based assessments of the rate of compliance on ships' statements about having conducted exchanges,¹⁶² the available evidence indicates that these statements are generally unreliable. For example, an Australian test that checked ships' claims of conducting a full exchange against the ships' electrical records found that 24% of the ships appeared to have done no exchange, another 18% appeared to have done a partial exchange of less than 50%, and only 30% appeared to have done the full exchange that was claimed.¹⁶³

Given the doubtful reliability of ships' statements about ballast exchanges, it is critical that regulators independently test whether exchanges have been conducted. To this end the Coast Guard measures the salinity of ballast water on some arriving ships, but this provides a limited test at best. Open-ocean waters, where ballast exchange is supposed to take place, typically contain about 3.4 to 3.7 percent salt. If a ship arrives in port with ballast water with a substantially different salt content, this would indicate that the ship had not done an adequate ballast exchange. However, this test is most effective when the salinity of the initial ballast water (prior to exchange) is very different from that of the open ocean, and is largely or completely ineffective when the initial salinity is close to that of the open ocean, which will be true for ballast water loaded at many ports. Thus, salinity tests cannot provide a reliable estimate of the rate of compliance; they can at most provide an estimate of the minimum rate of noncompliance.¹⁶⁴

¹⁶¹ 33 C.F.R. 151 Subpart D, Appendix.

¹⁶² E. g. Locke et al. 1991; Gauthier & Steel 1996 at 6, 24, 44.

¹⁶³ Memo from Penny Lockwood, the former manager of Australia's Ballast Water Program, to the Pacific Coast Ballast Water Group, July 4, 1999, summarizing her presentation to the Group's meeting at the Port of Oakland on June 17, 1999. This method of checking ships' ballast reports against electrical records is called the Newcastle method after the Australian port where it was first tried. While some of the inconsistencies between the ships' statements and their electrical records were apparently due to misunderstandings about what constitutes a full ballast exchange, the large number of discrepancies and the number of ships that apparently conducted no exchange at all is consistent with anecdotal and documentary evidence of ships providing false statements about their activities in order to satisfy regulatory requirements. For example, in 1994 a ship entering the Great Lakes reported to the Coast Guard that it had completed a full ballast exchange at sea; however, on inspection the Coast Guard found that it carried freshwater ballast, apparently having arrived from the Congo River without any exchange (Kabler 1996; Weathers & Reeves 1996). In 1996 a ship arriving in San Francisco Bay reported to the Coast Guard that it had treated its ballast water with chlorine to kill the exotic organisms in it, but tests failed to reveal any trace of chlorine in the water (U. S. Coast Guard Marine Safety Office—San Francisco Bay, pers. comm.). In 1997, 59 ships entered the Great Lakes from overseas and reported to the Coast Guard that they had conducted a ballast water exchange as required by NANPCA, but the ballast salinities for at least 13% of the ships were inconsistent with that claim (based on data from Reeves 1998 at 11-12).

¹⁶⁴ While it may be advisable for the Coast Guard to employ the Newcastle method in its monitoring efforts, in the end this also is not an independent test of whether a ship has conducted a ballast water exchange, because a ship's electrical records can be falsified to support such a claim. Thus it is impossible for this method to distinguish between a ship that has conducted an exchange and truthfully reports it, and a ship that falsely claims to have conducted an exchange and consistently falsifies its records in support. Like salinity tests, the Newcastle method can at best provide a minimum estimate of the rate of noncompliance. Independent tests that are based on the analyzing the biota in the ballast water (Badger, Christopher, Harbour Master, Port of Vancouver, "Mandatory Ballast Water Exchange—The Vancouver Solution," Presentation at the Eighth International Zebra Mussel and Aquatic Nuisance Species Conference, March 16-19, 1998, Sacramento, CA) or the chemical and physical characteristics of the ballast water (Deborah Tanis et al., Review and Recommendations of Ballast Water Exchange Verification Technologies and Measurement Techniques, a draft report for U. S. Department of Transportation, U. S. Coast Guard (Oct. 1998)) have been proposed, but are not yet used by the Coast Guard. It is not yet clear whether these types of tests will prove to be any more effective than salinity tests.

With the data now being gathered, the issue of effectiveness will, if anything, be even harder to assess than compliance. Though not defined in the statute, effectiveness presumably refers to the degree to which the voluntary guidelines reduce the release or establishment of exotic species. Since neither the release nor the establishment of these species is being systematically monitored, a direct assessment of effectiveness will be impossible. Theoretically, one could calculate the effectiveness of the guidelines in reducing the rate of release of exotic species by combining data on the effectiveness of individually monitored exchanges with information on the rate of compliance and the volume of shipping—but as noted above, the data needed to assess the rate of compliance are not being gathered.

3. California Law

California's recent legislative involvement with the management of ballast water began with a 1990 State Assembly resolution which found that introductions of exotic organisms in ballast water threatened sport and commercial fisheries and which asked the U. S. Coast Guard to prohibit "the dumping of ballast water originating in foreign ports in any west coast river, estuary, bay or coastal area."¹⁶⁵ In 1992, California passed a bill¹⁶⁶ that also found that fisheries were threatened by ballast water introductions of exotic organisms and that "the people of the state have a primary interest in the regulation of the dumping of ballast water originating in foreign ports in any river, estuary, bay or coastal area of this state."¹⁶⁷ However, the bill contained no mechanisms for regulating ballast water dumping, and merely adopted the voluntary IMO guidelines and directed that ballast management practices be monitored,¹⁶⁸ although the monitoring was never conducted.¹⁶⁹

In 1999, California adopted the first state law in the United States to regulate ballast water discharges specifically in order to prevent the introduction of exotic organisms.¹⁷⁰ Initial versions of the bill regulated ballast water discharges through waste discharge permits in accordance with the state's Porter-Cologne Water Quality Control Act,¹⁷¹ and established an interim period during which open-ocean ballast water exchange or alternative treatment would satisfy permit requirements, followed by the imposition of more stringent standards potentially requiring ballast water treatment or involving a standard of zero discharge of exotic organisms.¹⁷² As passed, however, the law

¹⁶⁵ California Joint Assembly Resolution No. 88—Relative to Ballast Water (filed with the Secretary of State, July 12, 1990). Washington considered and Alaska adopted similar resolutions. Washington Senate Joint Memorial 8002—Requesting that the Coast Guard Prohibit Dumping of Ballast Water in United States Waters (1991, not passed). Alaska Legislative Resolve No. 85, Relating to the Discharge of Ballast Water by Vessels Entering the Waters of Alaska (signed by the Governor, June 8, 1992).

¹⁶⁶ Assembly Bill 3207—The Aquatic Nuisance Species Prevention and Control Act, Chapter 840, Statutes of 1992 (Sept. 22, 1992), Fish and Game Code §§ 6430-6439.

¹⁶⁷ Fish and Game Code § 6430.

¹⁶⁸ It required all operators of vessels carrying ballast water and entering a California port after Jan. 1, 1994 to complete a form describing their ballast water management practices. The Department of Fish and Game was to administer this monitoring program and to report to the Legislature on the rate of compliance with the IMO guidelines by Jan. 1, 1995. O'Shea and Cangelosi's (1996, at 393, 395) description of this statute as *requiring* ballast water exchange was apparently a misreading.

¹⁶⁹ The statute was reportedly regarded as an excessive burden on interstate commerce (see O'Shea and Cangelosi 1996 at 393) and therefore unconstitutional under the dormant commerce clause, although in fact this appears not to be the case (see the discussion in II.A.4 below). Regardless, after five years passed without any monitoring being conducted, the statute was amended in 1997 (Senate Bill 1003, amending Fish and Game Code §§ 6433, 6434 and 6439, Chapter 490, Sept. 25, 1997) to instead allow the Department of Fish and Game to obtain information on ballast management practices from the U. S. Coast Guard, which didn't actually begin collecting such information (under NISA) until mid-1999.

¹⁷⁰ Assembly Bill 703, Chaptered Oct. 10, 1999, Pub. Res. Code §§ 71200-71271.

¹⁷¹ See II.B.2.a. below for a discussion of Porter -Cologne.

¹⁷² Assembly Bill 703 as introduced on Feb. 14, 1999 through amendments made in the Senate on Aug. 17, 1999.

makes no reference to waste discharge permits, providing only for an interim period of required ballast exchange or alternative treatments until Jan. 1, 2004.¹⁷³

The California law largely parallels NISA, but with mandatory rather than voluntary ballast exchange. Its main provisions require vessels that are carrying ballast water into the waters of the state after operating outside the EEZ¹⁷⁴ to retain the water on board, to conduct an open-ocean exchange, or to employ an alternate approved treatment method that is at least as effective as ballast exchange;¹⁷⁵ and to report to the State Lands Commission (SLC) certain information on the ballast water carried and exchanged.¹⁷⁶ As in NISA, there is a safety exemption.¹⁷⁷ The SLC is to monitor compliance¹⁷⁸ and to submit to the Legislature by Sept. 1, 2002 an assessment of the compliance with and the effectiveness of the law, along with recommendations for improvements.¹⁷⁹ In addition, the California Department of Fish and Game (CDFG) is to submit to the Legislature by Dec. 31, 2002 information on "baseline conditions" and on the location and range of exotic organisms in the coastal and estuarine waters of the state, for the purpose, among other things, of determining alternative discharge zones;¹⁸⁰ and the State Water Resources Control Board (SWRCB) is to submit to the Legislature by Dec. 31, 2002 an evaluation of "alternatives for treating and otherwise managing ballast water for the purpose of eliminating the discharge of nonindigenous species into the waters of the state or into waters that impact the waters of the state."¹⁸¹

Noncompliance with reporting requirements could incur penalties of up to \$500 per day, and knowingly filing false reports with the intent to deceive, or other intentional or negligent violations could incur penalties of up to \$5000 per day.¹⁸² It is questionable whether such modest penalties will alter ships' behavior and induce them to exchange or treat their ballast water. Any penalties collected plus fees of up to \$1,000 for each voyage involving transit outside the EEZ are to be deposited in an account and used to implement the law.¹⁸³

This law further directs that "unless required by federal law, a state agency, board, commission, or department shall not, prior to January 1, 2004, impose any requirements that are different from those" specified by it.¹⁸⁴ However, the types of studies and reports mandated by this law suggest that more stringent requirements may likely be imposed by state agencies (including boards, commissions and departments) or by the Legislature after this interim period.¹⁸⁵ For example,

¹⁷³ Pub. Res. Code §§ 71200-71271.

¹⁷⁴ With certain vessels exempted (Pub. Res. Code § 71202).

¹⁷⁵ Pub. Res. Code § 71204.

¹⁷⁶ Pub. Res. Code § 71205. This is the same information required to be reported to the Coast Guard under NISA (see footnote 158) [RECHECK FN #], and is submitted on the same form (Pub. Res. Code § 71205(a)(2)).

¹⁷⁷ Pub. Res. Code § 71203.

¹⁷⁸ Pub. Res. Code § 71206.

¹⁷⁹ Pub. Res. Code § 71212.

¹⁸⁰ Pub. Res. Code § 71211. NISA also anticipates the designation of alternative, backup exchange or discharge zones (NISA § 1002(a)(1)(B), in 16 U.S.C. § 4712), but none have been designated. The scientific review conducted pursuant to NISA indicates that there is no valid scientific basis for designating such zones within protected waters or within the waters of the state (Beeton et al. 1998; Letter from Bill Harvey, Chair, Western Regional Panel to Cathleen Short, Assistant Director—Fisheries, U.S. Fish and Wildlife Service, and Sally. J. Yozell, Deputy Assistant Director for Oceans and Atmosphere, NOAA (May 12, 1999) (on file with author)).

¹⁸¹ Pub. Res. Code § 71210.

¹⁸² Pub. Res. Code § 71216.

¹⁸³ Pub. Res. Code § 71215. The SLC has proposed fees of \$600 per vessel voyage, but shipping industry representatives are protesting these fees, arguing that they should be no more than \$400 per vessel voyage (Marian Ashe, California Department of Fish and Game, pers. comm., Jan. 2000).

¹⁸⁴ Pub. Res. Code § 71207(a).

¹⁸⁵ As noted above, these studies and reports include an assessment by the CDFG of the extent of the exotic species problem in California coastal waters (Pub. Res. Code § 71211), which could justify more vigorous

several possible approaches to regulating ballast water discharges under existing state laws are discussed in the following pages. While implementation of these approaches by state agencies prior to Jan. 1, 2004 is prohibited, it would be fully consistent with the directives and objectives of this bill for agencies to investigate and prepare for implementation of those approaches after that date. In addition, implementation of federal law requirements by authorized state agencies is not restricted during the interim period, nor is there any restriction on the ability of California courts to impose penalties or injunctions based on a finding that discharges are inconsistent with either a state or federal law.¹⁸⁶

4. Constitutional Limitations on State Regulation of Ballast Water Discharges

While states generally have significant discretion in adopting legislation to address the spread of exotic organisms, there are two constitutionally derived limitations on that authority. These limitations restrict state regulation that is preempted by federal law, under the Supremacy Clause of the U.S. Constitution,¹⁸⁷ and prohibit a state from excessively burdening interstate commerce, under the dormant commerce clause.¹⁸⁸ Although there are case precedents upholding a state's right to prevent exotic invasions and regulate ships' discharges, a recent Supreme Court decision suggests the need for a close look at the potential limitations on state regulation of ballast discharges.¹⁸⁹

In deciding *United States v. Locke*, (previously entitled *International Association of Independent Tanker Owners (INTERTANKO) v. Locke*¹⁹⁰) the Supreme Court found that Washington's oil tanker safety regulations relating to general navigation watch procedures, English language skills, training, and casualty reporting on oil tankers were preempted by Title II of the Ports and

regulation of ballast discharges; an assessment and recommendations by SLC regarding compliance with and effectiveness of the current measures (Pub. Res. Code § 71212), which could recommend more aggressive enforcement or a different regulatory approach; an evaluation by SWRCB of ballast water treatment methods (Pub. Res. Code § 71210) and additional research on developing treatment methods to reduce or eliminate the discharge of exotic species (Pub. Res. Code § 71213), which could demonstrate the feasibility of regulations that required treatment or that set higher standards (such as a zero discharge standard) for exotic organisms in ballast discharges. This law thus appears to be an interim measure adopted by the Legislature in order to give the agencies time to determine a more effective approach to be implemented at the end of the interim period.

¹⁸⁶ Other states have also begun to adopt laws that regulate ballast water discharges, inspired in part by the California law, though differing in some important respects. Washington House Bill 2466, signed into law on March 24, 2000, prohibits ships from discharging into state waters any ballast water from outside the coastal region from the Columbia River on Washington's southern border to the north end of the Strait of Georgia in British Columbia, unless the ship has conducted an open-ocean exchange (State of Washington, Substitute House Bill 2466, Sec. 4 [hereafter WA 2466]). There is a safety exemption, but after July 1, 2002 ships invoking the exemption will be required to treat their ballast water to standards that will be set by the state (WA 2466, Sec. 4(2)). Ships will be required to report on their ballast water management, and as in the California law, the information required will likely be the same as that required under NISA and submitted on the same form (though unlike NISA, this reporting will be required of ships traveling to Washington from a U.S. port in Alaska or south of the Columbia River) (WA 2466, Sec. 5(1)). The Washington law is also generally similar to the California law in providing for sampling and monitoring of ballast water (WA 2466, Sec. 5(2) to 5(5)), in requiring certain studies and reports to the legislature (WA 2466, Sec. 6, 7 and 10), and in providing for the same very modest penalties for violations (WA 2466, Sec. 8), but differs in providing no funds to implement the law (WA 2466, Sec. 7). In Michigan, a bill introduced in 2000 would prohibit vessels from operating on state waters if carrying ballast water from outside the state that had not been treated "to destroy or remove all living biological organisms," and would require a permit for discharging any ballast water into state waters (SB-955, "A bill to amend the Natural Resources and Environmental Protection Act").

¹⁸⁷ U.S. Const. art VI, cl. 2.

¹⁸⁸ *Newfound/ Owatonna, Inc. v. Town of Harrison*, 520 U.S. 564, 117 (1997); *Pike v. Bruce Church, Inc.*, 397 U.S. 137, 142 (1970).

¹⁸⁹ *United States v. Locke*, 120 S.Ct. 1135 (1999).

¹⁹⁰ 148 F.3d 1053 (1998)

Waterways Safety Act of 1972 as amended by the Ports and Tanker Safety Act of 1978 (PWSA).¹⁹¹ The Court explained that:

"The state laws now in question bear upon national and international maritime commerce, and in this area there is no beginning assumption that concurrent regulation by the State is a valid exercise of its police powers. Rather, we must ask whether the local laws in question are consistent with the federal statutory structure, which has as one of its objectives a uniformity of regulation for maritime commerce."¹⁹²

PWSA Title II "requires the Coast Guard to issue regulations addressing the design, construction, alteration, repair, maintenance, operation, equipping, personnel qualification and manning" of tanker vessels.¹⁹³ Despite this Title's broad reach and the federal objective of uniform regulation of maritime commerce, the Court nevertheless envisioned the possibility of some state role in regulating tanker vessels. While finding that PWSA Title II or other laws preempted four of Washington's regulations, the Court remanded twelve remaining regulations to the lower courts for further consideration.¹⁹⁴

In a 1984 decision that the Supreme Court declined to review, the Ninth Circuit found that Alaska's requirement that oil tankers discharge oil-tainted ballast water at shore-side treatment plants was consistent with both the Clean Water Act (CWA) and PWSA Title II.¹⁹⁵ In making the latter finding, the Ninth Circuit principally relied on the Supreme Court decision in *Ray v. Atlantic Richfield Co.*, which determined that PWSA Title II had implicitly occupied the field in terms of regulating the design and construction of tanker vessels and therefore states could not require additional or different design or construction.¹⁹⁶ The Ninth Circuit, however, distinguished impermissible design and construction requirements from permissible operational requirements such as de-ballasting at shore-side treatment plants, and upheld Alaska's effort to control discharges of polluted ballast water.¹⁹⁷ The Supreme Court now appears to have undermined this distinction in PWSA Title II when it rejected the Ninth Circuit's similar reasoning in *U.S. v. Locke*.¹⁹⁸

PWSA Title II, however, applies only to tanker vessels and not to all vessels generally,¹⁹⁹ and mandates regulations for the specific purpose of increasing the protection against hazards to life, property and the marine environment, and providing for navigation and vessel safety, that may be necessary in regard to tanker vessels.²⁰⁰ PWSA Title II thus seems unlikely to preempt state regulations regarding the release of exotic organisms in ballast discharges by ships in general.

¹⁹¹ 46 U.S.C. §§ 3702-3719.

¹⁹² *United States v. Locke*, 120 S.Ct. 1135, 1148 (1999).

¹⁹³ *United States v. Locke*, 120 S.Ct. 1135, 1138 (1999).

¹⁹⁴ *United States v. Locke*, 120 S.Ct. 1135, 1150 (1999).

¹⁹⁵ *Chevron v. Hammond*, 726 F.2d 483 (9th Cir 1984). [Please add notation showing *cert. denied* to this cite.]

¹⁹⁶ 435 U.S. 151, 160-161 (1978). Federal law can pre-empt local or state measures either explicitly or implicitly. Although the PWSA did not explicitly restrict state efforts to regulate the design or construction of tankers, the Supreme Court found that in adopting PWSA Congress implicitly intended to foreclose states from requiring different or more stringent requirements on tankers. 435 U.S. 151, 163 (1978). At the same time the Supreme Court overturned two determinations of preemption by the District Court, finding instead that state requirements for pilotage of vessels engaged in foreign trade and for tug escorts of tanker vessels were not preempted by federal law. 435 U.S.C. 151, 152 (1978).

¹⁹⁷ *Chevron v. Hammond*, 726 F.2d 483, 487 (1984).

¹⁹⁸ 120 S.Ct. 1135 (1999).

¹⁹⁹ 46 U.S.C. § 3702. A "tank vessel" is defined as "a vessel that is constructed or adapted to carry, or that carries, oil or hazardous material in bulk as cargo or cargo residue, and that (A) is a vessel of the United States; (B) operates on the navigable waters of the United States; or (C) transfers oil or hazardous material in a port or place subject to the jurisdiction of the United States." 46 U.S.C. § 2101.

²⁰⁰ 46 U.S.C. § 3703(a). These regulations are to apply in addition to regulations prescribed under other laws that may apply to those vessels.

Federal statutes that are more clearly relevant to such state regulation also appear unlikely to impede it. For example, NISA explicitly states that nothing in the statute shall restrict states' authority to control exotic species,²⁰¹ and the Coast Guard emphasized this when issuing regulations.²⁰² Similarly, in adopting the CWA, Congress clearly intended that it serve only as a floor for water quality protection and that states retain the right to require a greater level of protection.²⁰³ The express purpose of these laws was to provide states with significant discretion to adopt standards that are stricter than federal standards without fear that such actions would be preempted.

In considering whether state regulation of ballast discharges would violate the dormant commerce clause, the Supreme Court's decision in *Maine v. Taylor* is likely most relevant.²⁰⁴ In that case, which addressed state regulations prohibiting the importation of exotic bait fish into the state,²⁰⁵ the Supreme Court found that Maine had a legitimate interest in protecting its waters against exotic bait fish and restated the District Court opinion that:

"[T]he constitutional principles underlying the commerce clause cannot be read as requiring the State of Maine to sit idly by and wait until potentially irreversible environmental damage has occurred or until the scientific community agrees on what disease organisms are or are not dangerous before it acts to avoid such consequences."²⁰⁶

Accordingly, despite the recent Supreme Court decision invalidating certain state laws related to the operation of oil tankers,²⁰⁷ which recognized the considerable federal interest in uniform regulation of maritime commerce,²⁰⁸ states nonetheless appear to have significant discretion in adopting measures to control the discharge of exotic organisms in ballast water. Neither the dormant commerce clause nor the Supremacy Clause appear to provide an absolute bar to such measures. In particular the federal statutes that are most clearly relevant to these efforts, NISA and CWA, include strong saving clauses that leave the states substantial discretion to adopt and enforce regulations regarding the release of exotic organisms and pollution standards that are stricter than those adopted by the federal government.

B. REGULATING BALLAST WATER DISCHARGE AS A POLLUTANT DISCHARGE

²⁰¹ "Nothing in this Title shall affect the authority of any State or political subdivision thereof to adopt or enforce control measures for aquatic nuisance species..." (NISA § 1205). NISA goes further, and not only does not restrict state action but rather directs federal agencies to cooperate with states to minimize the risk of unintentional introductions, which are defined to include ballast water introductions (NISA § 1003(17) and § 1202(c)(2)); invites states to develop their own management programs for exotic species, including prevention of introductions (NISA § 1204(a)); and authorizes the granting of federal funds to implement the states' programs, up to 75% of the total cost (NISA § 1204(b)).

²⁰² In adopting the current NISA regulations, the Coast Guard stated that "It has long been the Coast Guard's position that consistent standards of universal application, coupled with Federal initiatives to address unique concerns, are the best means of meeting local and national environmental goals with the least disruption to international maritime commerce...The Coast Guard will try to maintain nationwide consistency in methods for control of invasive species...However, this regulation isn't intended to preempt any State, regional, or local efforts that exceed but do not conflict with the standards set forth in this rule." Federal Register, Vol. 64, 26672, 26674 (May 17, 1999).

²⁰³ 33 U.S.C. § 1370 (stating "Except as expressly provided in this chapter, nothing in this chapter shall (1) preclude or deny the right of any State or political subdivision thereof or Interstate agency to adopt or enforce (A) any standard or limitation respecting discharges of pollutants..."). The relevance of the CWA to the regulation of ballast discharges is discussed in the next section of this article.

²⁰⁴ 477 U.S. 131, 148 (1986).

²⁰⁵ 477 U.S. 131, 148 (1986).

²⁰⁶ 477 U.S. 131, 148 (1986).

²⁰⁷ *United States v. Locke*, 120 S.Ct. 1135 (1999).

²⁰⁸ *United States v. Locke*, 120 S.Ct. 1135, 1148 (1999).

1. Federal Law

a. *The Clean Water Act*

In 1972, Congress passed the Clean Water Act (CWA) with the aggressive goal that "the discharge of pollutants into the navigable waters be eliminated by 1985."²⁰⁹ Although the CWA has hardly eliminated water pollution, it has substantially reduced point source discharges of pollutants into U. S. waters. The CWA is primarily implemented by the U. S. Environmental Protection Agency (EPA), and employs a number of interrelated strategies for restricting water pollution. Several of these are relevant to ballast water discharges of exotic organisms, but have been largely ignored by both federal and state entities.²¹⁰

As in most states, California is authorized by the EPA to issue permits under state water quality laws that satisfy the requirements of the federal CWA. EPA, however, retains authority to veto a state-issued permit that it deems inconsistent with the CWA. In California, waste discharge permits are issued by the State Water Resources Control Board (SWRCB) and nine Regional Water Quality Control Boards (RWQCBs),²¹¹ which are responsible for adopting water quality control plans that will achieve requirements under both the state's Porter-Cologne Water Quality Act and the CWA.²¹²

i. *The Discharge Permit Requirement*

At the heart of the CWA is a prohibition against the discharge of any pollutant into the navigable waters of the United States from a point source absent a CWA permit.²¹³ Several factors indicate that this prohibition applies to the release of exotic organisms in ballast water discharged into either fresh water or nearshore ocean waters. First, the CWA broadly defines "pollutants" as including "biological materials,"²¹⁴ which therefore include exotic organisms, a reading supported by substantial case law.²¹⁵ Second, vessels are statutorily defined as point sources.²¹⁶ Finally, "navigable waters" are broadly defined to include both inland water bodies such as rivers, estuaries and lakes as well as ocean waters extending out to three miles from shore.²¹⁷

²⁰⁹ 33 U.S.C. § 1251(a)(1).

²¹⁰ See Whalin 1998 at 89-101 and Foster 1999 at (draft pages) 16-31 for additional discussion of the application of the CWA to ballast water discharges of exotic organisms.

²¹¹ Seven of the RWQCBs are responsible for coastal or port areas: North Coast RWQCB (Region 1), San Francisco Bay RWQCB (Region 2), Central Coast RWQCB (Region 3), Los Angeles RWQCB (Region 4), Central Valley RWQCB (Region 5), Santa Ana RWQCB (Region 8) and San Diego RWQCB (Region 9).

²¹² Water Code § 13142.

²¹³ 33 U.S.C. § 301(a); 1362 (12).

²¹⁴ 33 U.S.C. § 1362(6).

²¹⁵ *National Wildlife Federation v. Consumers Power*, 862 F.2d 580, at 585 (6th Cir. 1988) (acknowledging that live fish, if added to a water body, would qualify as pollutants under the CWA); *DuBois v. U.S. Dept. of Agriculture*, 102 F.3d 1273, 1299(1st Cir. 1996) (finding that the transferring water from one water body to another constituted a discharge of pollutants that required an NPDES permit because the water being transferred had different biological and chemical components than the receiving waters); *Washington Environmental Consortium v. State of Washington*, May 26, 1997, available in 1997 WL 394651 at 4 (ruling that Atlantic salmon, were biological pollutants under the meaning of the Clean Water Act when released into the waters of the Pacific Northwest). See Whalin 1998 at 90-94 for additional discussion. As noted below in section II.B.1.a.ii., the states of Oregon and California have explicitly recognized that exotic organisms (including those discharged in ballast water) constitute a pollutant within the meaning of the CWA, by listing such organisms as water quality limiting pollutants under CWA §303(d); but EPA Region 9, in reviewing the California listing, stated that exotic species are not a pollutant. See footnote 242. [RECHECK FN #]

²¹⁶ 33 U.S.C. § 1362(14).

²¹⁷ 33 U.S.C. §§ 1362(7),(8); 33 C.F.R. § 328.3.

Congress explicitly recognized that CWA applies to ballast water discharges in 1990 and again in 1996, in language included in NANPCA and NISA.²¹⁸ Yet again, Congress made clear its intent that CWA's permit requirements apply to ballast water discharges when it amended the CWA in 1996 to narrowly exempt ballast water discharges from *Armed Forces vessels* from these requirements, but not ballast water discharges in general.²¹⁹

Although the language of the CWA, case law and legislative history indicate that ballast discharges of exotic organisms require CWA permits, EPA regulations nevertheless purport to exempt ballast discharges from these requirements.²²⁰ However, a group that includes conservationists, water industry associations, Native American tribes, and commercial and sport fishing interests from across the United States has argued that this exemption is illegal in a petition filed under the Administrative Procedures Act.²²¹ In reply, EPA acknowledged that CWA permits could be used to control ballast discharges, and promised a decision on whether to remove the exemption by the spring of 2000.²²²

In deciding how to respond to the petition, EPA will have to consider how the courts would likely rule on a challenge to the current exemption. A similar EPA regulation exempting agricultural return flows from the CWA's permit requirements was roundly rejected by the D. C. Circuit Court. The Court found that "[t]he wording of the statute, legislative history, and precedents are clear: the EPA Administrator does not have the authority to exempt categories of point sources from the permit requirements of § 402."²²³ There is little reason to believe that the exemption for ballast discharges would fare any better.²²⁴

²¹⁸ "The regulations issued under this subsection shall...not affect or supersede any requirements or prohibitions pertaining to the discharge of ballast water into the waters of the United States under the Federal Water Pollution Control Act (33 U.S.C. 1251 et seq)" NANPCA at § 1101(b)(2)(C), NISA at § 1101(b)(2)(C), codified at 16 U.S.C. § 4711(b)(2)(C). Also discussed in Whalin 1998 at 92, 100-101.

²¹⁹ "Uniform National Discharge Standards for Armed Forces Vessels Act" 33 U.S.C. §§ 1322(n), 1362(6)(A). The Senate Report on the bill stated that "[v]essels are sources of pollution under the Clean Water Act. Any discharge from a point source, including a vessel, into the waters of the United States is prohibited unless specifically permitted under section 402 or 404 of the Act." See Craig Johnston letter (Jan. 3, 1999) and Foster 1999 at (draft pages) 20-21 for further discussion.

²²⁰ 40 C.F.R. § 122.3 (a) stating that "The following discharges do not require NPDES permits: (a) Any discharge of sewage from vessels, effluent from properly functioning marine engines, laundry, shower, and galley sink wastes, *or any other discharge incidental to the normal operation of a vessel.*" (emphasis added). The CWA defines "discharge incidental to normal operation of a vessel" to include ballast water. 33 U.S.C. § 1322(a)(12)(A)(i).

²²¹ Craig N. Johnston, Attorney with the Pacific Environmental Advocacy Center, to Carol Browner, U.S. Environmental Protection Agency (Jan. 13, 1999).

²²² J. Charles Fox, Assistant Administrator U.S. EPA, to Craig N. Johnston, Attorney with the Pacific Environmental Advocacy Center (April 6, 1999). The letter stated that EPA would prepare a report on the mechanisms available under the CWA to regulate ballast discharges and a plan for eliminating the exemption of ballast discharge from CWA permit requirements. The report was to be released for public comment by Sept. 1, 1999, but as of this writing in Dec. 1999 had not been released.

Interestingly, some ballast water has been regulated through CWA permits and California water quality law to prevent the release of exotic organisms. Since 1997 the San Francisco Bay RWQCB has issued waste discharge permits to drydocks (under both CWA § 402 and California's Porter-Cologne Water Quality Control Act, discussed below in II.B.2.a.) which prohibit the discharge of ballast water from ships controlled by the drydocks, even before they have entered the drydocks (San Francisco Bay RWQCB "Waste Discharge Requirement for Pegasus Inc., Mare Island, Solano County (Order No. 96-156, NPDES No. CA0030040)" and "Waste Discharge Requirement for Astoria Metal Company, Hunters Point, San Francisco County (Order No. 98-101, NPDES No. CA0028282)"). Ballast water from these ships is pumped directly into sewers and treated at municipal wastewater treatment plants (J. Huang, San Francisco Bay RWQCB, pers. comm. 1998).

²²³ *Natural Resources Defense Council v Costle*, 568 F.2d 1369, 1376 (D.C. Cir 1977). The EPA did not exempt ballast discharges in its initial proposed rule (38(7) Fed. Reg. 1362-1364 (Jan. 11, 1973), but did so in the

If it is established that ballast water discharges are subject to CWA's permit requirements, then prior to making such discharges shippers would be required to obtain a permit under Section 402 of CWA, the National Pollution Discharge Elimination System (NPDES).²²⁵ In order to get an NPDES permit a discharger must meet several criteria. First, the discharge must be consistent with the protection of water quality standards established by states to protect all designated uses²²⁶ of the water body where the discharge would occur.²²⁷ Second, the CWA's anti-degradation policy restricts discharges that would degrade high quality waters even where those waters would still be able to support designated uses.²²⁸ Third, the discharge must be treated to the level that could be achieved with the best available technology.²²⁹ If the discharges were to be made into ocean waters within three miles from shore, the discharge would also have to comply with Section 403 of the CWA, which basically holds NPDES permits to the requirements of the Ocean Dumping Act.²³⁰ Because of these requirements along with the CWA's significant penalties²³¹ and citizen suit provision,²³² the CWA could become a powerful tool for addressing ballast water discharges of exotic organisms.

Because exotic organisms are capable of reproducing and thereby increasing in abundance and expanding in range, the discharge of even a small number of exotic organisms could be inconsistent with the protection of designated uses. Accordingly, the Clean Water Act may actually prohibit the discharge of exotic organisms into aquatic ecosystems entirely. This conclusion becomes difficult to avoid when faced with the challenge of trying to identify a level of discharge of exotic organisms greater than zero that would be consistent with the CWA. In fact, the only governmental body that has attempted to identify a level of exotic species releases that would be consistent with the protection of water quality standards necessary to support designated and existing uses, the San Francisco Bay Regional Water Quality Control Board (RWQCB), appears ready to conclude that no additional input of exotic organisms can be permitted into San Francisco Bay consistent with the CWA.²³³ The requirements in Section 303(d) of the CWA triggered this assessment and are relevant to ballast water-caused biological pollution in a number of respects.

ii. Requirements for Water Quality Limited Waterbodies under Section 303(d)

final rule in order to reduce administrative costs, reasoning that "[t]his type of discharge generally causes little pollution" (38(98) Fed. Reg. 13528-13530 (May 22, 1973)). This exemption was thus adopted more than a quarter-century ago when there was little information available on the harmful effects of ballast discharges, and was based on the erroneous assumption that they are benign. Since there is now substantial scientific evidence of their impacts (see I.B and I.C above, and references therein), and since EPA has concurred that they are the source of a priority pollutant causing impairment of San Francisco Bay (see II.B.1.a.ii. below), there would appear to be no factual basis for maintaining the exemption, even if it were found to be legal.

²²⁴ Brent C. Foster, *Pollutants Without Half-lives: The Role of Federal Environmental Laws in Controlling Ballast Water Discharges of Exotic Species*, 30 ENVTL. L. __ (2000).

²²⁵ 33 U.S.C. §§ 301(a); 1362 (12).

²²⁶ Designated uses are set by states for each waterbody in the state and include uses such as fish and wildlife propagation, domestic water supply, recreation, or shellfish production, but must at least include all existing uses. 40 C.F.R. § 131.11(h)(1).

²²⁷ 33 U.S.C. §§ 301(b)(1)(C), (a)(2).

²²⁸ 40 C.F.R § 131.12(a)(1).

²²⁹ 33 U.S.C. § 1311(b)(2)(A). See discussion at Foster 1999 (draft pages) at 23-25.

²³⁰ See section II.B.1.b. below.

²³¹ 33 U.S.C. § 1319 (c)(2) (providing for civil penalties of up to \$25,000 a day, and larger penalties for knowing violations).

²³² 33 U.S.C. § 1365.

²³³ EPA adds S.F. Bay Dioxins and Other Pollutants and Streams to State's Section 303(d) List, 11(12) California Environmental Insider, (Nov. 17, 1998).

Section 303(d) of the CWA requires states to identify water bodies that are not meeting water quality standards set by the state and approved by EPA.²³⁴ Water quality standard violations may include a violation of specific numeric criteria established to protect existing uses of the waterbody or may be caused by the fact that existing uses, such as fish or wildlife reproduction, are being impaired.²³⁵ If, for example, high water temperatures due to industrial discharges were impairing shellfish production in a given waterbody or simply exceeding a maximum temperature standard set to protect shellfish production then that waterbody should be listed as water quality limited for temperature.

Once a waterbody is identified as not meeting water quality standards, the state must then establish a total maximum daily load (TMDL) for the given pollutant in that waterbody,²³⁶ based on the maximum amount that can be released consistent with the protection of designated uses.²³⁷ Once established, any future NPDES permits must be consistent with the TMDL.²³⁸ Although there have been a number of problems in implementing the TMDL program, it does have the potential to reduce the discharge of specific pollutants.

At least two states have listed exotic organisms as water-quality limiting pollutants under Section 303(d). Oregon listed three exotic plant species in 1996 and 1998.²³⁹ California applied Section 303(d) to ballast water discharges in 1998, when the San Francisco Bay RWQCB listed San Francisco Bay as water quality limited for exotic organisms released in ballast water, designating these pollutants as a high priority for the development of TMDLs,²⁴⁰ which was subsequently approved by the SWRCB.²⁴¹ These state boards, used to setting discharge standards for a range of hazardous pollutants ranging from carcinogens to heavy metals, are now faced with the task of establishing a TMDL for exotic organisms.²⁴²

²³⁴ 33 U.S.C. § 303(d)(1)(A); 40 C.F.R. § 130.7(c).

²³⁵ 40 C.F.R. § 130.2(d); 33 U.S.C. § 1313(c)(2)(A).

²³⁶ 33 U.S.C. § 303(d)(1)(C); 40 C.F.R. § 130.7(c)(1).

²³⁷ 40 C.F.R. § 130.7(c)(1); 40 C.F.R. § 130.2(i).

²³⁸ 33 U.S.C. § 1311(c)(1)(C).

²³⁹ Brazilian waterweed (*Elodea densa*), Eurasian watermilfoil (*Myriophyllum spicatum*) and Fanwort (*Cabomba carolina*) from the southeastern United States were each listed as water quality limiting for one of ten lakes, variously interfering with beneficial uses such as boating and swimming and in some cases requiring the application of herbicides (1994/96 and 1998 303(d)lists, from the Oregon Department of Environmental Quality/Water Quality Limited Streams 303(d) List website at: <http://waterquality.deq.state.or.us/wq/303dlist/303dpage.htm>).

²⁴⁰ The RWQCB's proposed list did not at first include exotic species ("Proposed Revisions to Section 303(d) List and Priorities for Development of Total Maximum Daily Loads (TMDLs) for the San Francisco Bay Region," California Regional Water Quality Control Board, San Francisco Bay Region, Oakland, CA (Jan. 7, 1998)), but were added in response to comments from the San Francisco BayKeeper (Letter from Michael R. Lozeau, San Francisco BayKeeper to Thomas Mumley, Senior Water Resources Control Engineer, California Regional Water Quality Control Board, San Francisco Bay Region (Feb. 2, 1998)). The RWQCB proposed to begin development of a TMDL for exotic species in 1998 and complete it by 2003 ("1998 Water Quality Assessment of Impaired Water Bodies in the San Francisco Bay Region," California Regional Water Quality Control Board, San Francisco Bay Region, Staff Summary Report for meeting date Feb. 18, 1998, Appendix A).

²⁴¹ San Francisco Region Water Quality Control Board Section, 303(d) List of Impaired Water Bodies and Priorities for Development of Total Maximum Daily Loads for the San Francisco Bay Region, Final Staff Report, March 9, 1998; *EPA Adds S.F. Bay Dioxins and Other Pollutants and Streams to State's Section 303(d)*, List, 11(12) CALIFORNIA ENVIRONMENTAL INSIDER, (Nov. 17, 1998).

²⁴² In reviewing the state's 303(d) list, EPA Region 9 stated that exotic species are not a pollutant and that the CWA therefore does not require that TMDLs be developed for them, although the state may do so if it chooses (Review of California's 1998 Section 303(d) List, Staff Report prepared by David Smith and Joe Karkoski (November 3, 1998), Attachment to letter from Alexis Strauss, USEPA to Walter Pettit, SWRCB). However, on January 12, 2000, the San Francisco BayKeeper filed suit to force EPA to develop TMDLs for all pollutants and water bodies listed under 303(d) in California, including exotic species (*San Francisco Baykeeper et al. v. Carol Browner et al.*, Case No. C-00-0132 CAL, filed Jan. 12, 2000, N.D.Cal). As of this date there were 509

Unlike conventional pollutants, however, establishing a TMDL for exotic organisms may be relatively simple given the potential for a discharge of even a small number of organisms to grow into a multi-billion dollar ecological infection. As noted, the San Francisco Bay RWQCB appears poised to set a standard of zero discharge of exotic species into San Francisco Bay.²⁴³ Because designated uses in San Francisco Bay are already severely affected as a result of past invasions and since those effects continue to worsen, it would be difficult to argue that allowing the discharge of additional exotic organisms would be consistent with the CWA's water quality requirements.²⁴⁴

iii. *Dredge and Fill Permitting Under Section 404*

The CWA regulates the discharge of dredged or fill material into U.S. waters under Section 404 instead of through Section 402's NPDES program.²⁴⁵ Section 404 permits are required when private or public entities engage in a number of different activities associated with shipping such as channel deepening for navigational purposes, wetland fills for port expansions, lock construction and maintenance dredging. In order to issue a permit for these activities under Section 404, the U.S. Army Corps of Engineers must insure that the activity 1) will not "cause or contribute to significant degradation of the waters of the United States,"²⁴⁶ 2) will not cause or contribute to a violation of water quality standards, and 3) is in the public interest.²⁴⁷

In evaluating whether a dredge or fill action will cause or contribute to a significant degradation of U. S. waters the Corps must consider the "secondary effects" of a planned fill.²⁴⁸ For example, the secondary effect of a shipping-related project requiring a 404 permit may be to increase shipping traffic and thus increase the volume of ballast water and the quantity of exotic organisms being released in a given water body. If the discharges of exotic organisms associated with the proposed activity would have "significantly adverse" effects on fish, shellfish, plankton, wildlife, or on "aquatic ecosystem diversity, productivity, and stability" then the project would constitute a significant degradation of U. S. waters and could not be approved by the Corps.²⁴⁹ Similarly, if a project's secondary effects would have significantly adverse effects on recreational, aesthetic or economic values this would constitute a significant degradation that could not be permitted.²⁵⁰ Because of the known effects of ballast water-caused invasions of exotic species on these resources and values it is unclear how the Corps could justify a dredge or fill permit where a predictable secondary effect was the release of millions of gallons of untreated ballast.

It would also seem difficult to support a finding that a project that would result in an increased or even a continued release of exotic organisms into a water body would not "cause or contribute to" a

water-quality-limited water bodies and 1471 impairments listed, with the EPA having developed TMDLs for five of these (Michael Lozeau, Earthlaw, pers. comm., Jan. 2000).

As noted above in section II.A.3, while recent legislation bars state agencies from imposing additional requirements on ballast water discharge under *state law* before Jan. 1, 2004, state agencies such as the RWQCB and SWRCB are explicitly not barred from imposing federal law requirements (Pub. Res. Code § 71207(a)).

²⁴³ EPA Adds S.F. Bay Dioxins and Other Pollutants and Streams to State's Section 303(d), List, 11(12) CALIFORNIA ENVIRONMENTAL INSIDER, (Nov. 17, 1998).

²⁴⁴ See Foster 1999 at (draft pages) 28-31 for further discussion.

²⁴⁵ 33 U.S.C. § 404.

²⁴⁶ 40 C.F.R. § 230.10(c).

²⁴⁷ 33 C.F.R. § 320.4(a). Additionally, 404 permit requirements include the need to consider practicable alternatives to the planned dredge or fill activity, potential mitigation measures, and whether the action will jeopardize threatened and endangered species. 40 C.F.R. § 320.10(a); 33 C.F.R. § 320.4(r); 40 C.F.R. § 230.10(b)(3).

²⁴⁸ 40 C.F.R. § 230.10(c).

²⁴⁹ 40 C.F.R. § 230.10(c).

²⁵⁰ 40 C.F.R. § 230.10(c).

water quality violation given the nature of exotic organisms.²⁵¹ If an area is already listed under Section 303(d) as water quality limited for exotic organisms, such as San Francisco Bay, then it is unclear how an activity that would facilitate the continued release of exotic organisms would not at the very least "contribute to" if not "cause" a water quality violation.

Finally, in determining what actions are in the "public interest," in some circumstances the economic, ecological and social costs that are associated with invasions of exotic organisms may outweigh the public benefits associated with the development of additional shipping industry infrastructure. However, in reviewing permit applications for dredge or fill projects the Corps has paid little attention to the cost side of this equation. In assessing the effects of proposed projects in San Francisco Bay, the Columbia River and elsewhere, the Corps has largely ignored the potential role of dredge and fill activities in leading to increased discharges of exotic organisms.²⁵²

These failures could be challenged by a citizen or industry group that would be affected by the release of exotic species. Additionally, Section 401 of the CWA gives states an opportunity to reject an Army Corps-issued 404 permit or to place conditions upon the permit that address the potential threat from exotic species.²⁵³ Section 401, which requires that states certify that a Section 404 permit issued by the Army Corps is consistent with the protection of state water quality standards, is yet another avenue the CWA provides for addressing the discharge of exotic organisms in ballast water as a pollution control issue.²⁵⁴

b. The Ocean Dumping Act

While the CWA regulates discharges within navigable inland waters and out to three miles from shore, the Ocean Dumping Act (ODA) relates to discharges further offshore.²⁵⁵ The ODA prohibits the "dumping" of "any material transported from outside the United States" into the territorial sea or contiguous zone of the U.S. (between three and twelve miles from shore) without a permit.²⁵⁶ The ODA defines "dumping" broadly as a "disposition of material."²⁵⁷ What constitutes a "material" is also broadly defined to include "matter of any kind or description, including but not limited to, dredged material, solid waste, incinerator residue, garbage, sewage..."²⁵⁸ Furthermore, the U.S. Supreme Court, after twice considering the phrase "matter of any kind" in the context of the Rivers and Harbors Act of 1899, strongly supported an expansive reading of its meaning.²⁵⁹ Because exotic organisms taken on in ballast water outside the U.S. likely qualify as "matter of any kind" and de-ballasting is clearly a disposing of that matter into the water, it appears that the ODA requires a permit for such discharges. The U.S. EPA has principal responsibility for enforcing the ODA and issuing dumping permits, but has made no effort to apply the ODA to ballast water discharges of exotic organisms.

²⁵¹ 40 C.F.R. § 230.10(b)(1).

²⁵² PORTLAND DISTRICT, U.S. ARMY CORPS OF ENGINEERS, DREDGED MATERIAL MANAGEMENT PLAN SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT: COLUMBIA RIVER AND LOWER WILLAMETTE RIVER FEDERAL NAVIGATION CHANNEL (1998). ; PORT OF OAKLAND, BERTHS 55-58 PROJECT: DRAFT ENVIRONMENTAL IMPACT REPORT (1999).

²⁵³ 33 U.S.C. § 401.

²⁵⁴ 33 U.S.C. § 401. States can, however, waive this certification if they so choose. 33 U.S.C. § 1341(a)(1).

²⁵⁵ 33 U.S.C. § 1411(b). See Pollutants Without Half-lives *supra* note XX at XX for a more in depth review of the ODA's relevance to ballast discharges.

²⁵⁶ 33 U.S.C. § 1411(b).

²⁵⁷ 33 U.S.C. § 1402(f).

²⁵⁸ 33 U.S.C. § 1402(c).

²⁵⁹ *United States v. Pennsylvania Indust. Chem. Corp.*, 411 U.S. 655, 669 (1973); *United States v. Standard Oil Co.*, 384 U.S. 224, 226-227 (1966).

To issue an ODA permit, EPA must find that the dumping will not "unreasonably degrade or endanger human health, welfare, or amenities, or the marine environment, ecological systems, or economic potentialities."²⁶⁰ EPA is required to consider the need for the proposed dumping and the effect of the dumping on the marine ecosystem (including the effect on everything from plankton to marine mammals).²⁶¹ Specifically, EPA must look at how the requested dumping may change the species diversity and productivity of the marine ecosystems or affect species and community population dynamics, and must evaluate the persistence and permanence of the effects of the dumping.²⁶² EPA must also hold a hearing if any member of the public or an agency requests one²⁶³ and ensure that the dumping will be consistent with relevant water quality standards.²⁶⁴ Because exotic organisms released many miles from shore can be swept into coastal waters and establish themselves, EPA's analysis of a proposed dumping would have to include consideration of on-shore aquatic impacts.²⁶⁵ Discharges in violation of the ODA are subject to penalties of up to \$50,000, and actions for a violation of the ODA can either be brought by the EPA or filed under the ODA's citizen suit provision.²⁶⁶

While statutes such as the National Invasive Species Act and California's AB 703 focus on minimal ballast water operation changes without regard for whether those measures are adequate for the protection of aquatic ecosystems, the ODA's prohibition against dumping that "unreasonably degrades" aquatic resources (like the CWA's restriction of discharges that threaten existing or designated uses) establishes a critical floor of protection against damage to the environment. Due to this substantive bar against unreasonable degradation, it is unlikely that EPA could issue an ODA dumping permit for ballast discharges absent some effective technological treatment to remove exotic organisms. Enforcement of the ODA could therefore serve as an additional mechanism requiring technological treatment of ballast water prior to discharge, and would extend the regulation of ballast water discharges out to twelve miles from shore.

c. The Rivers and Harbors Act of 1899

Another statute that apparently applies to ballast water discharges of exotic organisms is the Rivers and Harbors Act of 1899 (RHA).²⁶⁷ The RHA states that absent a permit "it shall not be lawful to throw, discharge, or deposit, or cause, suffer, or procure to be thrown, discharged or deposited either from or out of any ship, barge, or other floating craft of any kind, ... any refuse matter of any kind or description whatever ... into the navigable water of the United States..."²⁶⁸ Since ballast water is obviously "discharged" from ships into the navigable water of the United States, the only question is whether ballast water containing exotic organisms qualifies as "refuse of any kind or description whatever." Because the U.S. Supreme Court has twice held that the term "refuse" as used in the RHA broadly applies to the release of "all foreign substances and pollutants" the RHA does apply to ballast discharges.²⁶⁹ However, as with the CWA and ODA, the RHA has simply not been applied to ballast water discharges.

²⁶⁰ 33 U.S.C. § 1412(a).

²⁶¹ 33 U.S.C. §§ 1412(a)(A), (C).

²⁶² 33 U.S.C. §§ 1412(a)(D), (E), (D)(iii).

²⁶³ 33 C.F.R. § 222.4(a).

²⁶⁴ 33 U.S.C. § 1412(a).

²⁶⁵ *Stemming the Tide*, supra note XX, at 17.

²⁶⁶ 33 U.S.C. § 1415(g).

²⁶⁷ See *Pollutants Without Half-lives*, supra note XX at XX for a more detailed review of the RHA's applicability to ballast water releases.

²⁶⁸ 33 U.S.C. § 407.

²⁶⁹ *Standard Oil*, 384 U.S. 224,228 (1966); *U.S. Pennsylvania Industrial Chemical Corporation*, 411 U.S. 655, 669 (1973).

With the adoption of the CWA, the procedure for permitting a discharge under the RHA has been replaced by the CWA's NPDES permitting program. Because requirements for obtaining an NPDES permit are substantially stricter than the original requirement for an RHA permit, the RHA has primarily one effect: it increases the potential fines that could be levied against unpermitted discharges from a ship.²⁷⁰ In fact a ship that begins discharging ballast water while more than three miles from shore, where the ODA applies, and then continues de-ballasting while traveling into the three mile coastal zone covered by the CWA and RHA faces federal penalties that could exceed \$100,000.²⁷¹ The Supreme Court may have been correct in referring to the RHA as "almost an insult to the sophisticated wastes of modern technology,"²⁷² but the failure of the EPA to enforce this 100-year-old statute against discharges of exotic organisms in ballast water highlights the need for agencies to recognize and regulate exotic species as a form of biological pollution.

2. California Law

a. *The Porter-Cologne Water Quality Control Act*

California's Porter-Cologne Water Quality Control Act provides an additional basis for regulating ballast water discharges in California.²⁷³ Porter-Cologne's system for regulating pollutant discharges is similar to that of the CWA in that waste discharges must meet water quality standards.²⁷⁴ Unlike the CWA, however, Porter-Cologne is not restricted to the regulation of point source discharges.²⁷⁵

Porter-Cologne uses the term "waste" to describe discharges under its purview, defining waste broadly as "sewage and any or all other waste substances."²⁷⁶ The full definition neither specifically includes nor specifically excludes ballast discharges, but because ballast water is taken on vessels as a necessary substance for maintaining a ship's stability and then discharged when no longer needed, ballast water is consistent with the common definition of waste.²⁷⁷ California courts implementing Porter-Cologne have also construed the term "waste" broadly to essentially cover the same types of pollutants covered under the CWA. Specifically, waste has been found to include silt caused by a

²⁷⁰ Penalties for violation of the RHA are up to \$25,000 a day and/or up to a year in jail. 33 U.S.C. § 411 (1994). *U.S. v. Lambert*, 915 F.Supp 797, 801 (1996) (EPA succeeded in an enforcement action for violations of both the CWA and RHA).

²⁷¹ ODA provides penalties of up to \$50,000 per violation (33 U.S.C §§ 1415(a),(b)) and CWA provides civil penalties of up to \$25,000 per day (33 U.S.C. § 1319(d)). In addition, there could be criminal penalties of up to \$1,000,000 for knowing endangerment by repeat offenders under CWA (33 U.S.C. § 1319(c)(3)(A)) and, as discussed below, state law penalties may also apply. Besides increasing the potential fines, the RHA may act as a legal backstop to the CWA, by remaining applicable to ballast water discharges within three miles of shore even if the EPA's regulatory exemption for ballast water were found to be legal.

²⁷² *United States v. Pennsylvania Indust. Chem. Corp.*, 411 U.S. 655, 669 (1973).

²⁷³ Water Code §§ 13000-13999. As noted above in II.A.3, recent legislation bars state boards from imposing additional requirements on ballast water discharges under Porter-Cologne or other state laws prior to Jan. 1, 2004 (Pub. Res. Code § 71207(a)). However, the SWRCB and RWQCBs could take steps short of imposing requirements, such as developing, proposing and holding hearings on language for permit requirements that would go into effect on or after that date. In addition, the courts may impose penalties or injunctions if they find that discharges of exotic organisms in ballast water violate Porter-Cologne.

²⁷⁴ Water Code § 13263.

²⁷⁵ Water Code § 13263.

²⁷⁶ Water Code § 13050(d).

²⁷⁷ Petition from the San Francisco Baykeeper and DeltaKeeper to the Bay Area Regional Water Quality Control Board and the Central Valley Regional Water Quality Control Board, Seeking Control of Ballast Water Discharges in the Bay-Delta Region, May 21, 1997. In considering whether detritus from construction operations dumped or drained into water could be regulated under Porter-Cologne, the California Attorney General turned to "the New Standard Dictionary, which defines waste as follows: 'Something rejected as worthless or not needed; surplus or useless stuff.'" 16 Ops. Cal. Attny. Gen 125, 132 (1950).

dam,²⁷⁸ runoff from mining and logging operations,²⁷⁹ and agricultural runoff.²⁸⁰ Additionally, Porter-Cologne adopts the same definitions of "pollutants," "discharge" and "point sources" as are used in the CWA.²⁸¹ Thus, there is good support that Porter-Cologne applies to the same substances that would be covered by the CWA, including exotic species discharged in ballast water.²⁸² While Porter-Cologne appears to require regulation of ballast discharges from individual ships, some conservationists have argued that it imposes similar requirements on port facilities where docked vessels commonly release ballast water.²⁸³

Porter-Cologne provides for civil penalties of up to \$25,000 for each day of violation and criminal penalties of up to \$50,000 and up to three years in jail.²⁸⁴ Repeat offenders of Porter-Cologne could face a fine of up to \$100,000 and up to six years in jail.²⁸⁵ The San Francisco Bay RWQCB has made some limited use of Porter-Cologne to regulate ballast water discharges, by prohibiting ballast discharges from ships controlled by drydocks.²⁸⁶ However, in 1997 the San Francisco BayKeeper petitioned the San Francisco Bay and Central Valley RWQCBs to apply Porter-Cologne to all ballast water discharges in the Bay/Delta system.²⁸⁷

b. Fish and Game Code

While Porter-Cologne requires dischargers to apply for a permit before discharging waste, California's Fish and Game Code provides even broader protection. Section 5650 makes it illegal to "deposit in, permit to pass into, or place where it can pass into the waters of this state... [a]ny substance or material deleterious to fish, plant life, or bird life" unless expressly authorized by a permit issued under Porter-Cologne.²⁸⁸ Because exotic organisms can clearly be deleterious to fish, plant and bird life, Section 5650 would appear to apply to ballast water releases of exotic organisms. Violations of Section 5650 are punishable by fines of up to \$25,000 for each violation and are in addition to penalties for violations of any other law such as Porter-Cologne.²⁸⁹ The

²⁷⁸ Lake Madrone Water District v. State Water Resources Control Board, 209 Cal.App.3d 163, 169.

²⁷⁹ People v New Penn Mines, Inc., 212 Cal.App.2d 667, 673. 27 Ops. Cal. Atty. Gen 182 (1956).

²⁸⁰ 27 Ops. Cal. Atty. Gen 182 (1956).

²⁸¹ Water Code § 13373.

²⁸² California's Secretary for Resources and Secretary for Environmental Protection have concluded that the meaning of "waste water discharges" in Porter-Cologne can include ballast water. Report of the Secretary for Resources and Secretary for Environmental Protection to Governor Pete Wilson: An Analysis of Federal Responsibilities Related to Ocean Resource Management in California, Douglas P. Wheeler and Peter M. Rooney, June 1998.

²⁸³ Petition of San Francisco BayKeeper and DeltaKeeper to the Bay Area Regional Water Quality Control Board and the Central Valley Regional Water Quality Control Board, Seeking Control of Ballast Water Discharges in the Bay-Delta Region (May 21, 1997) (on file with author).

²⁸⁴ Water Code §§ 13385(b)(1), 13385(c)(1), 13387(b, c). Additional Porter-Cologne civil penalties may be levied at the rate of up to \$25 per gallon for the volume discharged in excess of 1,000 gallons (Water Code §§ 13385(b)(2), 13385(c)(2)).

²⁸⁵ Water Code § 13387(b, c).

²⁸⁶ See footnote 218. [RECHECK FN #]

²⁸⁷ Petition of San Francisco BayKeeper and DeltaKeeper to the Bay Area Regional Water Quality Control Board and the Central Valley Regional Water Quality Control Board, Seeking Control of Ballast Water Discharges in the Bay-Delta Region (May 21, 1997) (on file with author). Responding to similar questions, the Washington State Attorney General determined that "there is no doubt that water containing exotic microfauna that is potentially harmful to other aquatic life or to public health meets the definition of pollution" in Washington State law, that "ballast water containing harmful microfauna is pollution" under state law, and that "commercially operated vessels are prohibited from discharging waste material—including unwanted ballast waters—into waters of the state, except in accordance with the provisions of a state waste discharge permit" (Washington Attorney General 1993).

²⁸⁸ Fish and Game Code § 5650(a,b).

²⁸⁹ Fish and Game Code §§ 5650.1(a),(b).

California Department of Fish and Game has the authority to bring an action to enforce the requirements of Section 5650,²⁹⁰ but has never used this authority to control ballast water discharges of exotic organisms.

To help enforce this provision, Fish and Game Code Section 12015 places cleanup responsibility directly on the party who has contaminated or polluted state waters.²⁹¹ Fish and Game Code 12016 more broadly "imposes liability on any person who discharges...any substance deleterious to fish, plant, bird or animal life or their habitats, into state waters."²⁹² This section further specifies that the discharger is liable to the state for both actual damages to wildlife and habitats as well as reasonable costs the state incurs in the "clean up and abatement of the effects of the discharge" in addition to any other statutory penalties.²⁹³ While it may be difficult to show that an individual shipper had caused a given invasion, this law does provide a potential avenue for funding exotic species control efforts.

C. Regulating Ballast Water Discharge as a Wildlife Protection Issue

1. International Law

Various current and pending international treaties related to the protection of wildlife or of the natural environment make reference to the prevention and control of exotic species. Although it is possible that these treaties could obligate the signatory nations to take steps to prevent or manage the introduction of exotic species in ballast water, none have yet been used for that purpose.²⁹⁴

For example, the United Nations Convention on the Law of the Sea (not yet ratified) directs signatories to "take all measures necessary to prevent, reduce and control...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."²⁹⁵ It has been argued that this phrase would impose a due diligence standard on the signatories, including a duty to identify the pathways transporting exotic species and "close them off,"²⁹⁶ and that failure to take such measures could make them liable for any damages caused by such introductions.²⁹⁷ The Protocol adopted pursuant to the Convention for the Protection and Development of the Marine Environment of the Wider Caribbean Region directs that "[e]ach 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."²⁹⁸ The Bonn Convention on the Conservation of Migratory Species of Wild Animals obligates signatories to "the extent feasible and appropriate... [to undertake the task of] strictly controlling the introduction of, or controlling and eliminating, already introduced exotic species" that endanger or are likely to further endanger migratory species, or that are detrimental to migratory species in "unfavorable

²⁹⁰ Fish and Game Code § 5651. As noted above in II.A.3, recent legislation bars state departments such as CDFG from imposing additional requirements on ballast water discharges under Section 5650 or other state laws prior to Jan. 1, 2004 (Pub. Res. Code § 71207(a)).

²⁹¹ Fish and Game Code § 12015.

²⁹² Fish and Game Code § 12016.

²⁹³ Fish and Game Code § 12016.

²⁹⁴ For a fuller discussion of the relevance of international treaties to the management of exotic species, both on land and in the sea, see Bederman 1991 at 696-707 and OTA 1993 at 294-298.

²⁹⁵ 1982 Convention on the Law of the Sea, art. 196, 21 I.L.M. at 1308 (Bederman 1991 at 700-707; OTA 1993 at 297; de Klemm 1994). The Convention has not yet been ratified by enough countries to take effect, nor been signed by the United States (OTA 1993).

²⁹⁶ Bederman 1991 at 702 and 707.

²⁹⁷ de Klemm 1994.

²⁹⁸ The Convention was signed by the United States in 1983, while the Protocol Concerning Specially Protected Areas and Wildlife was opened for signature on Jan. 18, 1990 and is not yet in force (Bederman 1991 at 704).

conservation status."²⁹⁹ The Convention Between the United States and Japan on Migratory Birds states that both signatories must attempt to control the importation of organisms that are determined to be hazardous to the birds protected by the treaty, or that could disturb the ecological balance of unique island environments.³⁰⁰ The Convention on Biodiversity requires the signatories, as far as possible and appropriate, to "prevent the introduction of, control or eradicate those alien species which threaten ecosystems, habitats or species."³⁰¹ Thus, if the introduction of exotic organisms in ballast water would endanger migratory animals, harm protected migratory birds, threaten aquatic ecosystems, habitats or species, or cause significant changes to marine or island environments, it is possible that the signatories to these conventions could be obligated to regulate and control ballast discharges.

2. Federal Law

a. *The Endangered Species Act*

Exotic species are the second most common threat to imperiled species³⁰² and endangered fish³⁰³ in the United States, the second most frequent contributing factor to North American fish extinctions,³⁰⁴ and the dominant threat to imperiled aquatic organisms in the West.³⁰⁵ Within California, exotic species may have caused the extinction of three native fish and the eradication of another from its native waters through competition, predation or parasitization,³⁰⁶ and contributed to the decline of the endangered winter-run chinook salmon.³⁰⁷ The Delta smelt, listed as threatened, may be at risk from an exotic predator of its eggs and larvae.³⁰⁸ Among ballast water introductions, zebra mussels are thought to pose a serious threat to many freshwater mussels³⁰⁹ and to chinook salmon if introduced into California.³¹⁰ The shimofuri goby, introduced to California from Japan in ballast water, could have significant impacts on endangered tidewater gobies by preying on juveniles, competing for food and disturbing mating activities.³¹¹ Endangered and threatened

²⁹⁹ Adopted in 1979 (Bederman 1991; de Klemm 1994).

³⁰⁰ Article VI of the Convention (24 UST 3329), which was adopted in 1972 (Peoples et al. 1992). Other bilateral migratory bird protection treaties, with Canada (signed in 1916), Mexico (signed in 1936) and the USSR (signed in 1976), may have similar implications.

³⁰¹ Article 8(h) of the Convention. The Convention was signed by the United States in 1993 but has not yet been ratified by the Senate (OTA 1993; de Klemm 1994). OTA 1993 at 296 described this provision as "vague and probably unenforceable."

³⁰² David S. Wilcove et al., Quantifying Threats to Imperiled Species In the United States, *Bioscience* 48(8): 607-615 (1998).

³⁰³ Aquatic Nuisance Species Task Force, Findings, Conclusions, and Recommendations of the Intentional Introductions Policy Review, A Report to Congress (Mar. 1994), Appendix D.

³⁰⁴ Robert R. Miller, James D. Williams and Jack E. Williams, Extinctions of North American Fishes During the Past century, *Fisheries* 14(6): 22-38 (1989). In these three studies, habitat alteration, degradation or loss was found to be the most common threat or contributing factor.

³⁰⁵ Wilcove et al. 1998 at 612.

³⁰⁶ Miller et al. 1989 at 30; Cohen and Carlton 1995 at 119-22, 125-27, 129, 131, 133, 187.

³⁰⁷ Proposed Recovery Plan for the Sacramento River Winter-run Chinook Salmon, National Marine Fisheries Service, Southwest Region. [at <http://swr.ucsd.edu/hcd/recweb.htm>]

³⁰⁸ Cohen and Carlton 1995 at 129, 187. Proposed Recovery Plan for the Sacramento River Winter-run Chinook Salmon, National Marine Fisheries Service, Southwest Region.

³⁰⁹ Schloesser et al. 1996.

³¹⁰ Proposed Recovery Plan for the Sacramento River Winter-run Chinook Salmon, National Marine Fisheries Service, Southwest Region. [at <http://swr.ucsd.edu/hcd/recweb.htm>]

³¹¹ Swenson and Matern 1995.

salmon, steelhead and Delta smelt may be impacted by changes in their food supply caused by clams and zooplankton introduced via ballast water.³¹²

Several provisions of the federal Endangered Species Act (ESA)³¹³ are relevant to ballast water discharges of exotic organisms and to federal projects that indirectly result in ballast water discharges of exotic organisms. A recent Presidential Executive Order on invasive species³¹⁴ specifically listed the ESA as one source of the federal government's authority to prevent the introduction of invasive species.³¹⁵

For example, Section 7 of the ESA prohibits federal agencies from authorizing, funding or carrying out actions that would jeopardize a listed species or adversely modify the critical habitat of a listed species.³¹⁶ If a federal action "may affect" a listed species or its designated critical habitat, the responsible federal agency must initiate consultation with the U.S. Fish and Wildlife Service (USFWS) (for terrestrial and freshwater species) or the National Marine Fisheries Service (NMFS) (for marine and anadromous³¹⁷ species).³¹⁸ In determining whether a federal action will jeopardize a species or its critical habitat, agencies must consider both direct and indirect effects.³¹⁹ Thus, a federal agency that is engaged in, is authorizing or is funding the construction or expansion of a port or the dredging of a waterway that would indirectly result in the release of ballast water containing exotic organisms must consider the potential effect on listed species or their critical habitat.

Section 9 of the ESA prohibits the taking of an endangered species or its habitat,³²⁰ with "take" meaning to "harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct."³²¹ Under some circumstances, the introduction of exotic organisms can constitute a take under Section 9. For example, the Ninth Circuit, when first affirming that Section 9 protects the habitat of endangered species and not just the species themselves, found that habitat damage caused by the grazing of exotic goats was a take.³²² In addition, NMFS recently adopted a rule specifying that "Releasing non-indigenous or artificially propagated species into a listed species' habitat or where they may access the habitat of listed species..." is a type of habitat

³¹² Proposed Recovery Plan for the Sacramento River Winter-run Chinook Salmon, National Marine Fisheries Service, Southwest Region [at <http://swr.ucsd.edu/hcd/recweb.htm>]. Biological and Conference Opinion for Port of Oakland Berths 55-58 Project, submitted as an attachment to a letter from Rodney R. McInnis, Acting Regional Director, National Marine Fisheries Service, Southwest Region, to Calvin Fong, Chief, Regulatory Section, U. S. Army Corps of Engineers, San Francisco District, November 26, 1999. Dale A. Sweetnum (1999) Delta smelt investigations, IEP Newsletter (California Department of Water Resources) 12(2): 25-29, at p. 28.

³¹³ Since the California Endangered Species Act offers less protection than the federal ESA, it is not analyzed here.

³¹⁴ Executive Order No. 13112, issued February 3, 1999

³¹⁵ Agencies' willingness to use the ESA to regulate ballast water in appropriate circumstances may be encouraged by the order's directives to each federal agency to "use relevant programs and authorities to...prevent the introduction of invasive species" and to "not authorize, fund or carry out actions that it believes are likely to cause or promote the introduction or spread of invasive species in the United States or elsewhere unless, pursuant to guidelines that it has prescribed, the agency has determined and made public its determination that the benefits of such actions clearly outweigh the potential harm caused by invasive species; and that all feasible and prudent measures to minimize the risk of harm will be taken in conjunction with the actions." Executive Order No. 13112, issued February 3, 1999

³¹⁶ 16 U.S.C. § 1536(a)(2).

³¹⁷ Anadromous species, such as salmon, spawn in fresh water and live as adults in salt water,

³¹⁸ 16 U.S.C. § 1536 (a)(3).

³¹⁹ 50 C.F.R. § 402.14(g)(3).

³²⁰ 16 U.S.C. § 1538(a)(1).

³²¹ 16 U.S.C. § 1532(19).

³²² *Palila v. Hawaii Dep't of Land and Natural Resources*, 852 F.2d 1106 (9th Cir. 1988).

modifying activity that may qualify as a take.³²³ In practice, demonstrating a causal link between a given ballast discharge, the release and establishment of an exotic organism, and resulting habitat degradation constituting a take of a listed species may prove to be very difficult. However, when considered in the context of a broader scale challenge to the long-term practice of deballasting exotic species and thereby creating biologically-polluted waters, a Section 9 challenge may be more viable.

In January of 1999, Earthlaw's Environmental Clinic at the Stanford Law School, on behalf of the Center for Marine Conservation and the San Francisco BayKeeper, filed a notice of intent to sue over violations of Section 7 of the ESA in connection with a proposed dredging project at the Port of Oakland.³²⁴ The U.S. Army Corps of Engineers, the federal lead agency for the project, had requested a formal consultation from USFWS in January 1998.³²⁵ The Stanford notice alleged that the Army Corps had failed to comply with its obligations under the ESA in three respects: by preparing an inadequate Biological Assessment that did not address the projects' impacts on endangered and threatened species due to ballast water discharges resulting from the project (violating ESA Section 7(c)); by failing to initiate consultation with USFWS and NMFS regarding those impacts (violating Section 7(a)(2)); and by failing to consult with USFWS and NMFS to develop programs for the conservation of endangered and threatened species that are at risk from exotic species invasions in the project area, largely as a result of ballast discharges (violating Section 7(a)(1)).³²⁶ In response, the Army Corps confirmed that it was requesting consultation on the exotic species issues raised in the notice.³²⁷

In a biological opinion on the dredging project and a related berth expansion project, USFWS found that the Port's proposed ballast water exchange regulation and other measures would adequately minimize the impacts of ballast water discharges, and required the Army Corps to ensure that those measures were implemented.³²⁸ NMFS concluded that the dredging project is not likely to adversely affect listed species,³²⁹ but found that the introduction of exotic organisms resulting from the berth expansion project could result in a take of listed salmon or steelhead.³³⁰ Accordingly, NMFS required the Army Corps to condition the Port's permit to require the Port to

³²³ 64 Fed. Reg. 60727 (1999).

³²⁴ Letter from Deborah A. Sivas, Supervising Attorney, Stanford Environmental Clinic, Stanford Law School, to Lt. Gen. Joe N. Ballard, Chief of Engineers and Commander, U. S. Army Corps of Engineers, and Lt. Col. Peter T. Grass, U. S. Army Corps of Engineers, San Francisco District, January 6, 1999. While the specific project discussed in this letter is the Oakland Harbor Navigation Improvement (-50 Foot) Project (hereafter the "dredging project"), any legal challenge is likely to include related projects such as the Berths 55-58 Project referenced below. The environmental review of these projects is discussed in section II.D.

³²⁵ Letter from Cay C. Goude, Acting Field Supervisor, U.S. Fish and Wildlife Service, Sacramento Field Office, to Peter E. LaCivita, Chief, Environmental Planning Section, U. S. Army Corps of Engineers, San Francisco District, June 29, 1999. The Army Corps also requested consultation from NMFS on the dredging project on March 5, 1999 and on the berth expansion project on September 27, 1999. Biological and Conference Opinion for Port of Oakland Berths 55-58 Project.

³²⁶ Sivas letter.

³²⁷ Michael Lozeau, Staff Attorney, Earthlaw, pers. comm. Jan. 2000

³²⁸ Goude letter.

³²⁹ Letter from Rodney R. McInnis, Acting Regional Director, National Marine Fisheries Service, Southwest Region, to Peter E. LaCivita, Chief, Environmental Planning Section, San Francisco District, U. S. Army Corps of Engineers, August 9, 1999.

³³⁰ In listing the anticipated effects of the project, NMFS wrote: "The introduction of nonindigenous species by ballast water and hull fouling may adversely affect listed salmonids and result in an unknown quantity of take, in the form of mortality, harm, injury, and/or harassing, listed salmonids." Potential impacts include changes in food availability, introduction of pathogens and predators, clogging of fish screens and decreased efficiency of fish salvage facilities, and loss of rearing habitat, which could result in a degradation of a listed species' ability to survive and recover. Biological and Conference Opinion for Port of Oakland Berths 55-58 Project, at pp. 20, 22.

enter into an agreement with NMFS on monitoring and managing the introduction of exotic species, and further required the Army Corps to retain discretion to re-initiate Section 7 consultation with NMFS if the Port failed to fulfill that agreement or if ballast water discharges exceeded the amounts projected by the Port.³³¹

b. The Lacey Act and the Federal Noxious Weed Act

In 1900, Congress passed the Lacey Act with the general purpose of preventing the introduction of animal and bird species injurious to agriculture.³³² As amended, the Lacey Act today prohibits the importation³³³ or interstate shipment of wild mammals, wild birds, reptiles, amphibians, fishes, mollusks or crustaceans, or their offspring or eggs, that are either listed in the Act or are determined by the Secretary of the Interior "to be injurious to human beings, to the interests of agriculture, horticulture, forestry or to wildlife or the wildlife resources of the United States..."³³⁴ The Secretary may only permit the importation of such species for zoological, educational, medicinal or scientific purposes.³³⁵

Additionally, the Lacey Act makes it a violation of federal law to import, export, transport,³³⁶ sell, receive, acquire or purchase in interstate or foreign commerce, or possess within the maritime and territorial jurisdiction of the United States, any fish, wildlife, or plants taken, possessed, transported or sold in violation of any state law or regulation.³³⁷ The implementing regulations deem that "[a]ny importation or transportation of live wildlife"³³⁸ into the United States is injurious or potentially

³³¹ Biological and Conference Opinion for Port of Oakland Berths 55-58 Project, at pp. 23-24.

³³² Act of May 25, 1900, ch. 553, 31 Stat. 187, 188 s 2. Amendments made in 1981 consolidated and partially repealed the 1900 Lacey Act and the 1926 Black Bass Act. Amendments of 1981, Pub. L. No. 97-79, § 9(b)(2), 95 Stat. 1073, 1079 (codified at 16 U.S.C. §§ 3371-3378 and 18 U.S.C. § 42). The Act is generally implemented by the USFWS.

³³³ The Act defines import to mean "to land on, bring into, or introduce into, any place subject to the jurisdiction of the United States, whether or not such landing, bringing, or introduction constitutes an importation within the meaning of the customs laws of the United States" 16 U.S.C. § 3371(b).

³³⁴ 18 U.S.C. § 42(a)(1). Some have read the Lacey Act as only prohibiting transport between the continental United States and its island states, territories and possessions, rather than all interstate transport (e. g. Bean 1991 at 6, Peoples et al. 1992 at 328), but this seems to us to require a rather tortured reading of the admittedly somewhat convoluted text. Specifically, the Act prohibits "shipment between the continental United States, the District of Columbia, Hawaii, the Commonwealth of Puerto Rico, or any possession of the United States" (18 U.S.C. § 42(a)(1)), with the United States defined by applicable regulation to mean "the several States of the United States of America " (50 C.F.R. § 10.12). This passage is thus most sensibly read as prohibiting shipment between the individual states, the District of Columbia, and so forth. This reading is also consistent with the Federal Noxious Weed Act's unambiguous prohibition on interstate transport ("No person shall...move any noxious weed interstate..." (7 U.S.C. § 2803(a)). In contrast, the interpretation that this passage only prohibits shipment between the continental United States as a whole and the other listed entities is severely hampered by the inclusion of the District of Columbia in the list—leading (by this interpretation) to the nonsensical situation where transport of harmful organisms between, for example, Bethesda, Maryland and the adjacent District of Columbia would be prohibited, but transport across the continent from Maryland to California would be allowed.

On the other hand, U. S. Fish and Wildlife Service staff have at times read the Lacey Act as even prohibiting the intrastate transport of proscribed species, although that does not seem to be the Service's current interpretation (Denny Lassuy, U. S. Fish and Wildlife Service to J. A. Kopp, Prince William Sound Regional Citizens Advisory Council, email posted to the Western Regional Panel listserver (July 12, 1999)) (on file with author).

³³⁵ 18 U.S.C. § 42(a)(3).

³³⁶ "Transport" is broadly defined to mean "to move, convey, carry or ship by any means, (or to deliver or receive for the purpose of movement, conveyance, carriage, or shipment" 16 U.S.C. § 3371(j).

³³⁷ 16 U.S.C. § 3372(a).

³³⁸ "Wildlife" is defined to include "any wild animal, whether alive or dead, including without limitation any wild mammal, bird, reptile, amphibian, fish, mollusk, crustacean, arthropod, coelenterate, or other invertebrate,

injurious, and prohibit such importation or interstate transport except as otherwise provided.³³⁹ Further provisions specifically allow for the importing or transporting of fish, mollusks or crustaceans under certain conditions,³⁴⁰ but prohibit their release into the wild without the written permission of the state wildlife conservation agency with jurisdiction over the release site.³⁴¹

The Federal Noxious Weed Act similarly prohibits, except by permit, importing into the United States or the interstate movement of noxious weeds identified by the Secretary of Agriculture.³⁴² "Noxious weeds" are defined as any living stage of a plant that "is of foreign origin, is new to or not widely prevalent in the United States, and can directly or indirectly injure crops, or other useful plants, livestock, or poultry or other interests of agriculture, including irrigation, or navigation or the fish and wildlife resources of the United States or the public health."³⁴³

Because implementation of the Lacey Act and the Noxious Weed Act are each based on the use of a "dirty list" of prohibited species, the statutes are generally applied only to species that have already demonstrated their invasive nature.³⁴⁴ This limits the usefulness of these statutes as a pre-emptive mechanism for preventing invasions before they occur, which is one of several reasons for the oft-noted ineffectiveness of these Acts.³⁴⁵ Various attempts to adopt a "clean list" approach (restricting the import of new species unless it is shown that the species is not a threat) have failed,³⁴⁶ despite substantial support for this approach from the scientific and regulatory community.³⁴⁷

Although these statutes have generally been interpreted as applying only to intentional acts,³⁴⁸ nothing in the language of the statutes or regulations restricts them to intentional acts, and only the

whether or not bred, hatched, or born in captivity, and including any part, product, egg, or offspring thereof" 50 C.F.R. § 10.12.

³³⁹ 50 C.F.R. § 16.3.

³⁴⁰ Fish, mollusks or crustaceans other than a few listed species may be imported or transported without a permit if a written declaration has been filed with the Customs Department (50 C.F.R. § 16.13(a)).

³⁴¹ 50 C.F.R. § 16.13(1).

³⁴² 7 U.S.C. § 2803(a), (b). Noxious weeds identified by the Secretary are listed at 7 C.F.R. § 360.200. The Act is generally implemented by the Animal and Plant Health Inspection Service (APHIS) in the Department of Agriculture.

³⁴³ 7 U.S.C. § 2802(c).

³⁴⁴ Although the broad language of the Lacey Act's regulations at 50 C.F.R. § 16.3 describes a clean act approach, the regulations have never been implemented in that way.

³⁴⁵ Bean 1991 at 5-7, 44-46, 66-68; Bederman 1991 at 693, 695; Peoples at al. 1992 at 332-335; OTA 1993 at 21-30, 173; Dentler 1993 at 210-212; Larsen 1995 at 27-29; Wade at 347-348; Whalin at 104-106. The effectiveness of these Acts is also hindered by inadequate funding for monitoring and enforcement, and by generally lax implementation. In a recent revealing incident, 11,800 bur reed plants (*Sparganium erectum*), an exotic aquatic weed on the federal noxious weed list, were imported from Europe and distributed to Home Depot stores in at least 35 states before the Agriculture Department realized the plant was even in the country, although it was correctly identified on its shipping papers ("Alien Weed Eludes Authorities, Then Turns Up at Home Depot," Wall Street Journal (August 10, 1999); Robert Weller, "Noxious Weed Introduced in US, Sold as Pond Plant," Seattle Daily Journal of Commerce (August 19, 1999)).

³⁴⁶ In 1973 and again in 1975 the USFWS proposed amending the Lacey Act regulations to incorporate a clean list approach (38 Fed. Reg. 34970 (Dec. 20, 1973); 40 Fed. Reg. 7935 (Feb. 24, 1975)), but withdrew the proposals under pressure from pet trade, zoo and scientific interests. Roughly 5,500 comments were received, most of them critical (Bean 1991 at 45-46, 67-68; Peoples et al. 1992 at 333-335; OTA 1993 at 111). In 1995 APHIS attempted unsuccessfully to adopt a partial clean list approach to implementing the Noxious Weed Act (60 Fed. Reg. 5288 (Jan. 26, 1995); 60 Fed. Reg. 31647 (June 16, 1995); The Control of Aquatic Nuisance Species, David Whalin, The Environmental Lawyer vol 5, number 1, 69, 107-114, 1998).

³⁴⁷ OTA 1993 at 109; Letter from Andrew N. Cohen and 106 ecologists and research scientists to Interior Secretary Bruce Babbitt (Oct. 19, 1998), Appendix A in: Sandra M. Keppner, Michael T. Weimer and William J. Troxel, *Caulerpa taxifolia*: A Potential Threat to U. S. Coastal Waters, A Preliminary Report to the Aquatic Nuisance Species Task Force (Nov. 17, 1998).

³⁴⁸ E. g. Wade 1995 at 348.

application of criminal penalties is restricted to knowingly committed acts.³⁴⁹ The appropriate standard for applying civil penalties appears to be one of due care.³⁵⁰ Given the known abundance of certain proscribed species in some port areas, ships discharging ballast water from those areas and which is therefore likely to contain those species may not be exercising due care.³⁵¹ And given the amount of attention that the ballast water issue has received in shipping circles in recent years, and the near-certainty that ballast water contains various types of organisms,³⁵² many ships may be *knowingly* violating the Lacey Act's regulatory prohibitions on importing wildlife without a permit³⁵³ and releasing fish, mollusks or crustaceans into the wild without a permit.³⁵⁴

3. California Law

California has several statutory requirements that generally restrict the release of exotic organisms in California absent a permit. Fish and Game Code Section 6400 makes it unlawful to "place, plant, or cause to be placed or planted, in any of the waters of the State, any live fish, any fresh or salt water animal, or any aquatic plant, whether taken without or within the state, without first submitting it for inspection to, and securing the written permission of, the department [of Fish and Game]." Fish and Game Code Section 2271(a) similarly requires that "[n]o live aquatic plant or animal may be imported into this state without the prior written approval of the department [of Fish and Game]." Additionally, California Code of Regulations Section 671 establishes that "[n]o person shall release in to the wild without written permission of the [Fish and Game] Commission any wild animal...which...is not native to California."³⁵⁵ Pursuant to the above statutes and regulations, California has published two lists of species that may not be imported, transported, possessed or released into the wild without specific authorization, including several that may be found in ballast water.³⁵⁶ The California Department of Fish and Game additionally has the power to destroy any

³⁴⁹ 16 U.S.C. § 3373(d).

³⁵⁰ 16 U.S.C. § 3373(a)(1).

³⁵¹ Crabs in the genus *Eriocheir* (mitten crabs) and the zebra mussel *Dreissena polymorpha* are listed as injurious animals under the Lacey Act (50 C.F.R. § 16.13(a)(2)). Ballast water is thought to be responsible for the introduction of mitten crabs to Europe, for several cases of mitten crab releases into the Great Lakes, New Orleans region and Columbia River, and possibly for their introduction into California. Mitten crabs spawn in estuaries with individual females producing 250,000 to 1 million eggs, which hatch in the late spring or summer and develop over 3-4 months as small, floating larvae. Mitten crabs are common or abundant in many port areas in China, Taiwan, Korea, Japan, Portugal, northern Europe and England, and it is thus likely that many ships taking on ballast water in these countries between late spring and early fall carry mitten crabs (Cohen & Carlton 1997).

Zebra mussels were apparently introduced in ballast water from Europe into the Great Lakes, then spread throughout much of eastern North America causing substantial economic and environmental damage (see I.B above). Zebra mussels spawn from spring to early fall with individual females producing up to 1 million eggs, and the larvae spend up to 33 days in the plankton (Sprung 1993). Thus ships that take on ballast water between spring and fall at freshwater ports in Europe, the Great Lakes, the Saint Lawrence Seaway, the Hudson River or New Orleans are likely to carry zebra mussels.

³⁵² For example, in one study of ships discharging ballast water from Japan into Coos Bay, Oregon, crustaceans were found in the ballast water from at least 98.6 percent of the ships (Carlton & Geller 1993).

³⁵³ 50 C.F.R. § 16.3.

³⁵⁴ 50 C.F.R. § 16.13(1).

³⁵⁵ California Code of Regulations § 671.6. "Wild animal" is defined to include fish, crayfish and gastropods.

³⁵⁶ Fish and Game Code § 2118 makes it "unlawful to import, transport, possess, or release alive into this state, except under a revocable, nontransferable permit" any of a list of species that includes various primarily freshwater fish, three common genera of crayfish, and "all species of slugs." "Transport" is broadly defined to include "to move, convey, carry, or ship by any means" (Fish and Game Code § 2580(a)). California Code of Regulations § 671 makes it "unlawful to import, transport, or possess alive...except under permit issued by the Department of Fish and Game" a somewhat larger list of species that includes all species in the genus *Eriocheir* (mitten crabs) and all species in the genus *Dreissena* (zebra mussels). Species in the latter two groups are believed to have been introduced via ballast discharges into, respectively, northern Europe and eastern North America, and resulted in substantial economic and environmental damage (see footnote 348) [RECHECK FN #]

fish, amphibian, or aquatic plant that it determines is "merely deleterious" to in-state fish, aquatic plants, amphibians or aquatic animal life.³⁵⁷

Despite the broad language in these statutes and regulations, California agencies have failed to apply them to the most important mechanism importing and releasing exotic organisms into state waters: ballast water discharges. That the Legislature intended such statutes to apply to ballast water discharges was made clear by Assembly Bill 1625, passed by the Legislature and signed into law in 1998, which added to the Fish and Game Code three sections related to violations of Section 6400 "through the use of an aquatic nuisance species."³⁵⁸ Section 12023 increased the penalties for violations, Section 12024 made violators "liable for all public and private response, treatment, and remediation efforts resulting from the violation," and Section 12026 provided for rewards to persons providing information leading to the arrest and conviction of violators. Ballast water releases were specifically exempted from the increased penalties of Section 12023,³⁵⁹ but not from the liability or reward provisions, nor from Section 6400 itself or the already established penalties applicable to it.³⁶⁰ In adopting a narrow exemption that applies only to certain penalties for violation of Section 6400 by ballast water discharges, the Legislature implicitly recognized the general applicability to ballast water discharges of Section 6400 and its other penalty provisions.

D. REGULATING BALLAST WATER DISCHARGE THROUGH ENVIRONMENTAL REVIEW

Because of the extensive federal role in the development and maintenance of navigational channels and port and harbor facilities, the National Environmental Policy Act (NEPA) provides an important opportunity to assess and potentially avoid the effects of ballast water transfers on the introduction and spread of exotic species. Although NEPA does not contain substantive protections for the environment³⁶¹ and applies only to federal actions, it does provide an opportunity for both federal agencies and the public to assess and consider the relationship between ballast water practices, invasions of exotic organisms and the resulting ecological, economic and public health impacts. The California Environmental Quality Act (CEQA), which more broadly applies to any discretionary project approved, financed or carried out by a public agency,³⁶² provides a similar opportunity for assessing the effects of non-federal actions, but additionally provides a level of substantive protection that NEPA does not.³⁶³

and discussion of zebra mussels in I.B above). California Code of Regulations § 236 also prohibits importing any of the listed species "unless specifically authorized" by the California Fish and Game Commission.

³⁵⁷ Fish and Game Code § 6303. As noted in II.A.3, recent legislation bars state departments such as CDFG from imposing additional requirements on ballast water discharges under these Fish and Game statutes or other state laws prior to Jan. 1, 2004 (Pub. Res. Code § 71207(a)). However, the courts may impose penalties or injunctions if they find that the importing, transporting or releasing into the wild of exotic organisms in ballast water discharges violates these statutes. In addition, the Lacey Act at 16 U.S.C. § 3372(a) makes it a federal offence to violate a state law, such as Fish and Game Code Section 2271(a), which prohibits the importing of fish, wildlife or plants. In *Maine v. Taylor*, the U. S. Supreme Court upheld the use of the Lacey Act "for federal enforcement of valid state...wildlife laws." 477 U.S. 131, 139-40 (1986).

³⁵⁸ See definition at footnote 6. [\[RECHECK FN #\]](#)

³⁵⁹ Fish and Game Code § 12023(d).

³⁶⁰ These already established penalties are imprisonment for up to a year and /or a fine of up to \$5000 (Fish and Game Code § 12007); Section 12023 increased the penalties, for non-ballast water releases of aquatic nuisance species, to imprisonment for six months to a year and /or a fine of up to \$50,000.

³⁶¹ *Vermont Yankee Nuclear Power Corp. v. Natural Resources Defense Center*, 435 U.S. 519, 558 (1978).

³⁶² Pub. Res. Code §§ 21065, 21063.

³⁶³ Pub. Res. Code §§ 21002, 21081(a).

NEPA, CEQA and their implementing regulations require that decision makers evaluate the potential direct, indirect and cumulative impacts of a given action prior to project approval.³⁶⁴ If a given action may have significant impacts then an Environmental Impact Statement under NEPA, and/or an Environmental Impact Report under CEQA, must be prepared to assess the project's impacts,³⁶⁵ analyze potential alternatives,³⁶⁶ and consider mitigation measures that could reduce significant impacts.³⁶⁷ A single environmental review document can be used to satisfy the requirements of both NEPA and CEQA.³⁶⁸ While NEPA does not actually require an agency to adopt any mitigation measures, CEQA mandates that "[a] public agency should not approve a project as proposed if there are feasible alternatives or mitigation measures available that would substantially lessen any significant effects that the project would have on the environment."³⁶⁹

At least one court has specifically found that under NEPA federal agencies must consider how their actions affect the spread and establishment of exotic species.³⁷⁰ In that case, conservationists successfully challenged an Army Corps environmental review that failed to consider the potential watershed effects of zebra mussel colonization following the construction of a proposed reservoir.³⁷¹

Over the past two years, eight conservation groups submitted a series of comment letters on the NEPA and CEQA documentation for proposed projects at the Port of Oakland, based on impacts related to the discharge of exotic organisms in ballast water. The projects, including a dredging³⁷² and a berth expansion project,³⁷³ would upgrade and expand the Port's facilities. The conservation groups argue that the projects may be expected to lead to an increase in the release or establishment of exotic species transported in ballast water or in other components of ships' seawater systems, or attached to ships' hulls or anchors; that the potential impacts from such exotic species introductions have not been adequately analyzed; and that feasible mitigations have not been adequately or fairly analyzed or adopted.

Among other issues, the conservation groups claim that the projects may lead to larger numbers of exotic organisms being introduced, to exotic organisms from different source regions being introduced, and to exotic organisms arriving from overseas in better condition after more direct and therefore shorter voyages.³⁷⁴ They also argue that the proposed dredging and emplacement of

³⁶⁴ 42 U.S.C. § 4332(2)(C)(i); 40 C.F.R. § 1508.8(b); Pub. Res. Code § 21002.1(a); 14 C.C.R. §§ 15355, 15358(a), 15130.

³⁶⁵ 42 U.S.C. § 4332(2)(C)(i); Pub. Res. Code § 21080(d); 14 C.C.R. § 15064 (a)(1).

³⁶⁶ 42 U.S.C. § 4332(2)(C)(iii); 14 C.C.R. § 15126(d).

³⁶⁷ NEPA MIT ADD, Pub. Res. Code § 15021 (a)(2).

³⁶⁸ See *Village Laguna of Laguna Beach v Bd. of Supervisors of Orange County*, 134 Cal. App. 3d 1022 (1982)

³⁶⁹ Pub. Res. Code § 15021(a)(2).

³⁷⁰ *Hughes River Conservancy v. Glickman*, 81 F.3d 437 (4th Cir. 1996).

³⁷¹ *Hughes River Conservancy v. Glickman*, 81 F.3d 437 (4th Cir. 1996).

³⁷² Oakland Harbor Navigation Improvement (-50 Foot) Project, Final Environmental Impact Statement/Environmental Impact Report, Volume II. U. S. Army Corps of Engineers, San Francisco District and Port of Oakland (May 1998).

³⁷³ Berths 55-58 Project, Draft Environmental Impact Report, Volume 1: Main Text. Port of Oakland (Dec. 11, 1998).

³⁷⁴ Letter from Warner Chabot, Director, Pacific Region, Center for Marine Conservation and seven other organizations to Gail Staba, Environmental Planning Department, Port of Oakland (Mar. 4, 1998) (on file with author), at 3. Letter from Warner Chabot, Director, Pacific Region, Center for Marine Conservation and eight other organizations to Eric Jolliffe, San Francisco District, U. S. Army Corps of Engineers (Mar. 30, 1998) (on file with author), at 11. Letter from Warner Chabot, Director, Pacific Region, Center for Marine Conservation and eight other organizations to Robert McIntyre, Review Manager, Policy Review Branch, Headquarters, U. S. Army Corps of Engineers (June 19, 1998) (on file with author), at 2, 5, 11-12. Letter from Linda Sheehan, Pollution Program Manager, Center for Marine Conservation and seven other organizations to

dredged sediments may lead to an increased rate of establishment of exotic species, by creating disturbed and defaunated (and therefore vulnerable) habitat adjacent to areas where ballast water is released.³⁷⁵ They further suggest that the projects may be inconsistent with various statutes, including CWA sections 303(d), 401 and 402, ESA, the Marine Mammal Protection Act, Porter-Cologne, and sections of the California Fish and Game Code.³⁷⁶ In response, the Port expanded its discussion of the potential impacts from the discharge of exotic organisms in ballast water,³⁷⁷ and adopted mitigations including a mandatory ballast water exchange ordinance for vessels using its facilities.³⁷⁸ The conservation groups, however, do not consider this to be adequate mitigation,³⁷⁹ and could challenge the projects.

While neither NEPA or CEQA can be expected to bear the brunt of ballast water reform, both can provide a much needed opportunity to consider the effects of ballast water discharges of exotic organisms on everything from shellfish production to endangered species.³⁸⁰ CEQA's substantive

Richard Sinkoff, Supervisor, Environmental Planning Department, Port of Oakland (Jan. 28, 1999) (on file with author), at 5, 9-10.

³⁷⁵ Letter from Warner Chabot, Director, Pacific Region, Center for Marine Conservation and eight other organizations to Robert McIntyre, Review Manager, Policy Review Branch, Headquarters, U. S. Army Corps of Engineers (June 19, 1998) (on file with author), at 2, 5, 12. Letter from Linda Sheehan, Pollution Program Manager, Center for Marine Conservation and seven other organizations to Richard Sinkoff, Supervisor, Environmental Planning Department, Port of Oakland (Jan. 28, 1999) (on file with author), at 5, 9. Letter from Linda Sheehan, Pollution Program Manager, Center for Marine Conservation and five other organizations to Jon Amdur, Port of Oakland (Oct. 20, 1999) (on file with author), at 8.

³⁷⁶ Letter from Warner Chabot, Director, Pacific Region, Center for Marine Conservation and eight other organizations to Eric Jolliffe, San Francisco District, U. S. Army Corps of Engineers (Mar. 30, 1998) (on file with author), at 20-23. Letter from Deborah A. Sivas, Stanford Environmental Law Clinic to Lt. General Joe N. Ballard, Chief of Engineers and Commander, U. S. Army Corps of Engineers and Lt. Colonel Peter T. Grass, San Francisco District U. S. Army Corps of Engineers (Jan. 6, 1999) (on file with author). Letter from Linda Sheehan, Pollution Program Manager, Center for Marine Conservation and seven other organizations to Richard Sinkoff, Supervisor, Environmental Planning Department, Port of Oakland (Jan. 28, 1999) (on file with author), at 6, 18-19.

³⁷⁷ Oakland Harbor Navigation Improvement (-50 Foot) Project, Volume V: Final Environmental Impact Statement/Environmental Impact Report, Appendices N through V, and Appendix X: Responses to Comments. U. S. Army Corps of Engineers, San Francisco District and Port of Oakland (May 1998), at X-6 to X-11. Berths 55-58 Project, Draft Environmental Impact Report, Volume 1: Main Text. Port of Oakland (Dec. 11, 1998), at 3.6-14, 3.6-25 to 3.6-28, and 3.6-31 to 3.6-33. Berths 55-58 Project, Draft Environmental Impact Report, Volume 2: Appendices. Port of Oakland (Dec. 11, 1998), at Appendix F1: Ballast Water Management Study. Berths 55-58 Project, Final Environmental Impact Report, Volume 3: Response to Comments. Port of Oakland (Apr. 8, 1999), at 3-67 to 3-78. Oakland Harbor Navigation Improvement (-50 Foot) Project, Revisions to the Final Environmental Impact Report. Port of Oakland (Sept. 1999), at 15-16.

³⁷⁸ Berths 55-58 Project, Draft Environmental Impact Report, Volume 1: Main Text. Port of Oakland (Dec. 11, 1998), at 3.6-31 to 3.6-32. Berths 55-58 Project, Draft Environmental Impact Report, Volume 2: Appendices. Port of Oakland (Dec. 11, 1998), at Appendix F2: Draft Ballast Water Regulation. Berths 55-58 Project, Final Environmental Impact Report, Volume 3: Response to Comments. Port of Oakland (Apr. 8, 1999), at 3-73 to 3-76. Dennis Cuff, *Port Aims to Protect Bay Species*, SAN JOSE MERCURY NEWS, Oct. 6, 1998, at B1.

³⁷⁹ Letter from Linda Sheehan, Pollution Program Manager, Center for Marine Conservation and seven other organizations to Richard Sinkoff, Supervisor, Environmental Planning Department, Port of Oakland (Jan. 28, 1999) (on file with author), at 2-3, 5-6, and 11-18. Letter from Linda Sheehan, Pollution Program Manager, Center for Marine Conservation and five other organizations to Jon Amdur, Port of Oakland (Oct. 20, 1999) (on file with author), at 2 and 9-12. The CEQA documentation for the berth expansion project was certified in April, 1999 and the opportunity to file suit has passed (Jody Zaitlin, Port of Oakland, pers. comm., Dec. 1999). A challenge to this project's environmental documentation under NEPA, or to the dredging project's documentation under NEPA or CEQA, remain possible (Michael Lozeau, Staff Attorney, Earthlaw, pers. comm. Jan. 2000).

³⁸⁰ In Oregon, where the Army Corps has refused to consider the effects of ballast water discharges and the release of exotic organisms that could result from a proposed channel deepening project, NEPA is principally being used to get the Corps to recognize that there is an issue.

requirement to adopt any feasible alternatives or mitigation measures that would substantially lessen the project's significant environmental impacts, and the potential for delay in project implementation under NEPA or CEQA if environment assessment and documentation has to be redone and recirculated for public comment, may lead project proponents to adopt mitigations such as requirements for ballast water exchange or treatment.³⁸¹ Assessing the potentially serious effects of invasions of exotic organisms through the CEQA or NEPA process may also help persuade states or the federal government to require treatment of ballast water—an action that may appear more reasonable when decision makers are forced to balance the economic and environmental risks of invasions against the economic incentives to increase shipping and thus ballast discharges.

E. REGULATING BALLAST WATER DISCHARGE AS A COASTAL ZONE MANAGEMENT ISSUE

In part, California manages activities in the coastal zone by regulating land use and by setting conditions on leases of state-owned tidelands. State statutes and policies direct agencies to manage these uses to support various objectives including the protection of natural resources, native species, water quality and other public benefits. In some cases this may require managing the discharge of ballast water associated with those land uses.

1. The California Coastal Zone

Planning and development within the California coastal zone is managed under the authority of the California Coastal Act,³⁸² which requires proposed developments in the coastal zone to obtain a coastal development permit.³⁸³ The Act created the California Coastal Commission (CCC) to oversee the planning and permitting process.³⁸⁴ In addition, the federal Coastal Zone Management Act (CZMA)³⁸⁵ requires federal actions to be consistent with the policies of the Coastal Act.

The coastal zone is defined on a set of maps, and generally includes the land and water "extending seaward to the state's outer limit of jurisdiction,³⁸⁶ including all offshore islands, and extending inland generally 1,000 yards from the mean high tide line of the sea" (exclusive of the jurisdiction of the San Francisco Bay Conservation and Development Commission, which is described in the next section).³⁸⁷ The coastal zone extends further inland in "significant coastal estuarine, habitat and recreational areas" and less far inland in developed urban areas.³⁸⁸ Within this zone, permits for developments on "tidelands, submerged lands, and public trust lands" are issued by the CCC.³⁸⁹ Permits for developments in specified port areas and other land areas may be issued by,

³⁸¹ As noted above in II.A.3, recent legislation bars state agencies from imposing additional requirements on ballast water discharges prior to Jan. 1, 2004 (Pub. Res. Code § 71207(a)). However, the analysis and disclosure of environmental impacts resulting from a proposed project, including impacts resulting from changes in ballast water discharges caused by a project, would still be required under CEQA. Furthermore, while *state agencies* might be barred from imposing CEQA's substantive mitigation requirement, in practice CEQA's requirements are frequently invoked through lawsuits filed by individuals, non-governmental organizations or local governments. Such actions would not be restricted, nor would the courts be barred from imposing restraining orders or injunctions on projects whose environmental analyses and documentation or whose mitigations with regard to ballast water discharges fail to satisfy CEQA.

³⁸² Pub. Res. Code §§ 30000 et seq.

³⁸³ Pub. Res. Code § 30600.

³⁸⁴ Pub. Res. Code §§ 30300-30344.

³⁸⁵ 16 U.S.C. §§ 1451 et seq.

³⁸⁶ Three miles from shore.

³⁸⁷ Pub. Res. Code § 30103(a).

³⁸⁸ Pub. Res. Code § 30103(a).

³⁸⁹ Pub. Res. Code §§ 30519, 30600.

respectively, the relevant port governing body in conformity with a certified port master plan,³⁹⁰ or the relevant local government in conformity with a certified local coastal program.³⁹¹ Port master plans and local coastal programs are reviewed and certified by the CCC,³⁹² and in the absence of a certified plan or program, coastal development permits are issued by the CCC.³⁹³

The Coastal Act defines developments to include "the placement or erection of any solid material or structure; discharge or disposal of any dredged material or of any gaseous, liquid, solid or thermal waste;...change in the density or intensity of use of land...; change in the intensity of use of water...; [and] construction, reconstruction, demolition, or alteration of the size of any structure..."³⁹⁴ Development permits are to be issued, and port master plans and local coastal programs certified, only if they are consistent with the policies of the Act.³⁹⁵

The Coastal Act's policies state that "[m]arine resources shall be maintained, enhanced, and, where feasible, restored" and that "[u]ses of the marine environment shall be carried out in a manner that will sustain the biological productivity of coastal waters and that will maintain healthy populations of all species of marine organisms adequate for long-term commercial, recreational, scientific, and educational purposes."³⁹⁶ Coastal water quality is also to be maintained or restored to maintain optimum populations of marine organisms and protect human health "through, among other means, minimizing adverse effects of waste water discharges."³⁹⁷ The policies further state that diking, filling, or dredging for new or expanded port facilities or to maintain or restore the depth of navigational channels, turning basins, or vessel berthing and mooring areas shall be permitted "where feasible mitigation measures have been provided to minimize adverse environmental effects."³⁹⁸ Finally, where conflicts arise between different policies in the Act they are to be "resolved in a manner which on balance is the most protective of significant coastal resources."³⁹⁹

Although the Coastal Act does not directly apply to federal agencies, under the CZMA⁴⁰⁰ any federal agency action (which includes activities directly undertaken by federal agencies, including development projects, as well as federal licensing, permitting or funding of activities conducted by others) that affects natural resources within the coastal zone is to be "carried out in a manner which is consistent to the maximum extent practicable with the enforceable policies" of the Coastal Act.⁴⁰¹ Thus, for example, activities undertaken, licensed, permitted or funded by federal agencies in waters outside of the state's jurisdiction but affecting natural resources within the state's jurisdiction are required by the CZMA to be in conformance with the Coastal Act's policies.⁴⁰²

³⁹⁰ Pub. Res. Code §§ 30700-30721. The specified port areas are the Ports of Hueneme, Long Beach, Los Angeles and San Diego.

³⁹¹ Pub. Res. Code §§ 30500-30504.

³⁹² Pub. Res. Code §§ 30512.1, 30514, 30702, 30714, 30716.

³⁹³ Pub. Res. Code §§ 30600, 30715.

³⁹⁴ Pub. Res. Code § 30106.

³⁹⁵ Pub. Res. Code §§ 30200(a), 30512.2, 30714, 30715.5, 30716(c). The policies are described in Chapter 3 of the statute, Pub. Res. Code §§ 30200-30265.5.

³⁹⁶ Pub. Res. Code § 30230.

³⁹⁷ Pub. Res. Code § 30231.

³⁹⁸ Pub. Res. Code § 30233(a).

³⁹⁹ Pub. Res. Code § 30007.5.

⁴⁰⁰ 16 U.S.C. §§ 1451 et seq.

⁴⁰¹ 16 U.S.C. §§ 1456(c), (d). A federal agency undertaking an activity that affects natural resources within the coastal zone is required to provide the State with a consistency determination at least 90 days before final approval of the activity. In addition, any applicant for a required federal license or permit, or using federal funding, to conduct such an activity is required to provide a certification of compliance with the Coastal Act's policies. 16 USC 1456(c)(3)(A).

⁴⁰² 16 U.S.C. §§ 1456(c), (d). T. Grove, Deputy Director, California Coastal Commission, pers. comm. 1999.

Developments resulting in the introduction of exotic organisms into the coastal zone violate the policies of the Coastal Act to the extent that such organisms degrade marine resources; reduce biological productivity; harm populations of marine organisms that are of commercial, recreational, scientific or educational interest; or affect human health. As discussed earlier, exotic organisms introduced in ballast water discharges may have these effects. The CCC has on occasion explicitly recognized that the introduction or persistence of exotic organisms conflicts with the policies of the Act, by including conditions in coastal development permits that restrict plantings to native species or require the removal of exotic plants.⁴⁰³

The Coastal Act establishes the authority for state permitting of ballast water discharges of exotic organisms in two ways. First, coastal development permits are required for port or terminal projects, channel dredging projects and other types of projects that may affect shipping. To the extent that these projects affect the volumes, sources or condition of ballast water discharges, and may increase the number or diversity of exotic organisms released or established, they would conflict with the Act's policies. Permit conditions for such projects may thus require that measures be taken to control ballast discharges.⁴⁰⁴ Second, since ballast water discharges are discharges of a liquid waste, they qualify as a development under the Act's definition,⁴⁰⁵ and require a permit. In addition, under the CZMA's consistency requirements,⁴⁰⁶ actions undertaken, licensed, permitted or funded by federal agencies that would increase the exotic organisms released or established via ballast discharges may require amendment or mitigation.

2. San Francisco Bay Region

The San Francisco Bay Conservation and Development Commission (BCDC) was created by California's McAteer-Petris Act,⁴⁰⁷ and receives its authority from that Act, the Suisun Marsh Preservation Act⁴⁰⁸ and the federal CZMA.⁴⁰⁹ BCDC has permitting authority over dredging, filling and substantial changes in use within its jurisdiction,⁴¹⁰ which includes all of San Francisco Bay within reach of the tides.⁴¹¹ In Suisun Marsh BCDC also has permitting authority over marsh developments as defined within the primary management area, and appeal authority from local government decisions concerning marsh developments within the secondary management area.⁴¹² BCDC's authority applies to both private parties and non-federal agencies.⁴¹³ In addition, under the CZMA any federal agency activity or activity licensed, permitted or funded by a federal agency that

⁴⁰³ T. Grove, Deputy Director, California Coastal Commission, pers. comm. 1999.

⁴⁰⁴ Pub. Res. Code §§ 30200(a), 30233(a), 30714, 30715.5. As noted in II.A.3, recent legislation bars state commissions such as the CCC from imposing additional requirements on ballast water discharges under the Coastal Act or other state laws prior to Jan. 1, 2004 (Pub. Res. Code § 71207(a)). However, the CCC could take steps short of imposing requirements, such as developing, proposing and holding hearings on language for permit requirements that would go into effect on or after that date. In addition, since the federal CZMA requires that projects permitted, funded or undertaken by federal agencies conform with the policies of the Coastal Act, comment or action by the CCC on these projects would not be barred. Penalties may also be imposed by the superior court for violations of the Coastal Act (Pub. Res. Code § 30820).

⁴⁰⁵ Pub. Res. Code § 30106.

⁴⁰⁶ 16 U.S.C. §§ 1456(c), (d).

⁴⁰⁷ Gov. Code §§ 66600-66682.

⁴⁰⁸ Pub. Res. Code §§ 29000-29612.

⁴⁰⁹ 16 U.S.C. §§ 1451 et seq.

⁴¹⁰ Gov. Code § 66632(a).

⁴¹¹ BCDC's jurisdiction consists of all areas subject to tidal action within San Francisco Bay from the Golden Gate to the Sacramento River plus certain tributary creeks and rivers, including all sloughs, marshlands, tidelands and submerged lands up to five feet above mean sea level; plus salt ponds and managed wetlands diked off from the bay and maintained in use during the three years prior to the 1969 amendment of the McAteer-Petris Act; plus a shoreline band within 100 feet landward of the San Francisco Bay shore. Gov. Code § 66610.

⁴¹² Pub. Res. Code § 29000-29612.

⁴¹³ Gov. Code § 66632(a).

affects land or water use or natural resources within BCDC's jurisdiction, and any activity or development project undertaken by a federal agency within BCDC's jurisdiction, must be consistent with BCDC's enforceable policies.⁴¹⁴

BCDC will not issue permits to projects that do not conform with the provisions and policies of the McAteer-Petris Act and the San Francisco Bay Plan.⁴¹⁵ Permits may be granted subject to "reasonable terms and conditions" to meet the purposes of the Act and the Plan.⁴¹⁶ BCDC may issue cease and desist orders to block unpermitted projects or activities inconsistent with an issued permit,⁴¹⁷ may seek enforcement by injunction,⁴¹⁸ and may seek or impose penalties for violations.⁴¹⁹

Projects resulting in the introduction of exotic species into the Bay would likely be inconsistent with the Bay Plan. For example, an objective of the plan is to "protect the Bay as a great natural resource for the benefit of present and future generations."⁴²⁰ If the long-term protection of this resource implies maintaining it in something approximating its natural state, then the establishment or spread of exotic organisms would violate that objective. The Bay Plan's policies state that marshes, mudflats, fish and wildlife benefits, habitats needed to prevent the extinction of any species, and habitats needed to maintain or increase species that provide substantial public benefits are to be protected, maintained or restored.⁴²¹ As exotic species may have harmful impacts on fish and wildlife and may substantially alter marsh, mudflat and other aquatic and wetland habitats, their introduction would violate these policies.

The Bay Plan's policies also state that water pollution should be avoided, that water quality should be maintained in all parts of the bay, and that BCDC's actions with regard to water quality should be based on the "policies, recommendations, decisions, advice and authority" of the State Water Resources Control Board and San Francisco Bay RWQCB.⁴²² Since these agencies have listed the Bay as water-quality limited for exotic species discharged in ballast water,⁴²³ a project that increased the release of exotic species in ballast water would clearly violate the Bay Plan.

Thus, if a project that involved dredging, filling or a substantial change in use can be reasonably expected to contribute to the introduction or spread of an exotic species, BCDC could deny a permit to the project or could require mitigation of that impact as a permit condition.⁴²⁴ These

⁴¹⁴ 16 U.S.C. §§ 1456(c), (d). Consistency determinations or certifications must be provided for relevant activities undertaken, licensed, permitted or funded by federal agencies.

⁴¹⁵ Gov. Code § 66632(f) and San Francisco Bay Plan 1998 at cover letter. The Bay Plan was adopted in 1968 and is currently undergoing its first comprehensive revision. BCDC staff is considering recommending the inclusion of policies on exotic species (Leora Elazar, BCDC Coastal Program Analyst, pers. comm., Sept. 1999). Within the shoreline band, BCDC may deny a permit only for failing to provide adequate public access to the bay and its shoreline (Gov. Code § 66632.4).

⁴¹⁶ Gov. Code § 66632(f).

⁴¹⁷ Gov. Code §§ 66637, 66638.

⁴¹⁸ Gov. Code § 66640.

⁴¹⁹ Gov. Code §§ 66641, 66641.5.

⁴²⁰ San Francisco Bay Plan 1998 at 7.

⁴²¹ San Francisco Bay Plan 1998 at 9-10, 12-13.

⁴²² San Francisco Bay Plan 1998 at 11.

⁴²³ See II.B.1.a.ii. above.

⁴²⁴ As noted in II.A.3, recent legislation bars state commissions such as BCDC from imposing additional requirements on ballast water discharges under McAteer-Petris or under other state laws prior to Jan. 1, 2004 (Pub. Res. Code § 71207(a)). However, BCDC could take steps short of imposing requirements, such as developing, proposing and holding hearings on language for permit requirements that would go into effect on or after that date. In addition, since the federal CZMA requires that projects permitted, funded or undertaken by federal agencies conform with the policies of state law including McAteer-Petris, comment or action by BCDC on these projects would not be barred.

circumstances arise, for example, with a project creating or expanding a marine port or terminal, or dredging a waterway, if the likely result would be an increase in the amount of ballast water discharged into San Francisco Bay, a change in the source of the ballast water, or a decrease in the travel time for the ballast water.⁴²⁵ Appropriate mitigation might involve requiring the exchange or treatment of the ballast water that would arrive at the facility or pass through the dredged waterway, or adopting an exotic species response plan including both a strategy and funding for controlling existing or future invasions.

Violations of the Bay Plan's policies could also arise from projects that alter portions of the San Francisco Bay environment so as to encourage the establishment or spread of exotic organisms. This could occur with projects that dredge or deposit sediment in the bay, to the extent that this creates disturbed habitat or habitat with a depauperate biota, since such habitat may be especially vulnerable to the establishment or spread of exotic species.⁴²⁶ The creation of such readily-invasible habitat may be of particular concern in areas where exotic organisms are regularly released, such as dredging or filling done in or near a port where ballast water is discharged. Appropriate mitigation might involve requiring the exchange or treatment of the ballast water until such time as the disturbed or depauperate habitat has been fully colonized by extant organisms in the bay.

3. State Tidelands Leases and Marine Terminal Regulation

The State Lands Commission (SLC) was established to manage lands owned by the State of California.⁴²⁷ These lands include tidelands and submerged lands from the mean high-tide line to three miles from shore, swamp and overflow lands, and the beds of naturally navigable rivers, streams and lakes.⁴²⁸ Where ports have been constructed on such lands, the land title has been conveyed to the local government managing the port, but about 20 privately-owned marine terminals are constructed in part on land leased from the SLC.⁴²⁹ The SLC holds these lands in trust and has an affirmative duty to manage them in accordance with the public trust doctrine, which includes protecting "the people's common heritage of streams, lakes, marshlands and tidelands."⁴³⁰ The SLC is authorized by statute to include lease terms and conditions that it believes to be in the best interests of the state.⁴³¹

The SLC is also directed by statute to adopt rules, regulations, guidelines and leasing policies addressing "the location, type, character, performance standards, size, and operation of all existing and proposed marine terminals within the state, whether or not on lands leased from the commission[, to] provide the best achievable protection of public health and safety and the environment."⁴³² Marine terminals are required to prepare and submit to the SLC for approval an operations manual describing the equipment and procedures used to achieve these goals.⁴³³ Vessels

⁴²⁵ Since the number and diversity of organisms in a ballast tank generally decreases dramatically over the course of a voyage (as discussed in I.C.), reducing the ballast water's travel time would tend to increase the number and diversity and improve the condition of the organisms released in the discharge.

⁴²⁶ Elton 1958 at 117; Leidy & Fiedler 1985; Nichols et al. 1990 at 100. Essentially, all dredging or filling activities within the Bay would likely leave disturbed and depauperate sediment surfaces vulnerable to colonization by exotic organisms, unless the top surface of the dredged channel or emplaced fill consisted of highly toxic sediments or other material that organisms could not live on.

⁴²⁷ Pub. Res. Code §§ 6001 et seq.

⁴²⁸ State Lands Commission, *Delta-Estuary, California's Inland Coast: A Public Trust Report* (May 1991), at 2, 151.

⁴²⁹ Mark Meier, Attorney, State Lands Commission, pers. comm. 1999.

⁴³⁰ *National Audubon Society v. Superior Court*, 33 Cal.3d 419 (1993)

⁴³¹ Pub. Res. Code § 6501.2.

⁴³² Pub. Res. Code §§ 8755(a), 8756. A marine terminal is defined as "any marine facility used for transferring oil to or from tankers or barges" (Pub. Res. Code § 8750(h)), which includes most shipping terminals in California.

⁴³³ Pub. Res. Code § 8758(a).

docked at the facilities are required to comply with the terms of the manual,⁴³⁴ and the SLC is empowered to inspect and monitor terminals with respect to these goals.⁴³⁵

Thus, when the SLC leases state lands for marine terminals or other navigational improvements, it has the statutory authority and potentially a public trust duty to include terms that protect wildlife and natural resources, and a statutory responsibility to develop leasing policies for marine terminals that protect public health and the environment.⁴³⁶ In addition, the SLC is responsible for developing and monitoring regulatory requirements for all marine terminals, whether or not on land leased from the SLC, that protect public health and the environment.⁴³⁷ So, for activities on land leased from the SLC that involve ballast discharges, or for marine terminals whose operations could result in the release of exotic species in ballast discharges that could in turn affect public trust uses, public health or the environment, the SLC has the authority and possibly the legal obligation to write lease terms and adopt regulations that require ballast water management.⁴³⁸ Inclusion of such terms in marine terminal leases has been considered in a few cases.⁴³⁹ In addition, existing lease terms prohibiting the discharge of pollutants could possibly be applied to ballast discharges of exotic organisms.⁴⁴⁰

CONCLUSION

Until quite recently, policymakers and regulators generally viewed ballast water discharges as harmless. Over the last few decades, however, scientific research and several dramatic ballast water invasions have made it abundantly clear that this view was incorrect. Events have repeatedly demonstrated that ballast water discharges can result in substantial damage to ecosystems, to economic activities, and even to public health. But because of our earlier mistaken view, we approach the close of the twentieth century with virtually no regulation of these potentially harmful discharges. Our review of the facts concerning ballast discharges and the scope of existing laws suggests that the current situation can be summarized as follows:

⁴³⁴ Pub. Res. Code § 8758(g).

⁴³⁵ Pub. Res. Code § 8757(a).

⁴³⁶ Pub. Res. Code § 8755(a). In addition, issuing or renewing such leases is a discretionary action on the part of the SLC, and thus triggers an environmental review under CEQA (John Lien, Environmental Division, State Lands Commission, pers. comm. 1999). Lease terms addressing the management of ballast water discharges could thus be used to satisfy CEQA requirements for mitigation of significant impacts (see II.D above).

⁴³⁷ Pub. Res. Code §§ 8755(a), 8756, 8757(a).

⁴³⁸ As noted above in II.A.3, recent ballast water legislation bars commissions such as SLC from imposing additional requirements on ballast water discharges prior to Jan. 1, 2004 (Pub. Res. Code § 71207(a)). However, SLC could write leases with a "reopener" clause, or could develop leasing policies, that would allow terms requiring ballast water management to be included after that date; and similarly could develop rules, regulations or guidelines related to ballast water management that it would expect to be incorporated into marine terminal operations manuals after that date. In addition, the above-mentioned legislation may not bar SLC from essentially exercising the right of a property owner by offering protective lease terms and conditions, in contrast to adopting a regulatory requirement. Finally, the SLC would not be barred from taking actions compelled by the public trust doctrine.

⁴³⁹ The Environmental Impact Report for an oil terminal in San Francisco Bay proposed that the potential impacts from releasing exotic organisms in ballast water could be mitigated by prohibiting tankers using the terminal from discharging ballast water into the bay and requiring instead that all ballast water (segregated as well as unsegregated) be off-loaded to the terminal's on-shore wastewater treatment facility (Draft Environmental Impact Report for Consideration of a New Lease for the Operation of a Crude Oil and Petroleum Product Marine Terminal on State Tide and Submerged Lands at Unocal's San Francisco Refinery, Oleum, Contra Costa County (March 1994), prepared for State of California State Lands Commission, at 4.4-2 and 4.4-4). This requirement was not included in the terms of the lease, however. In 1997, the environmental review of the lease application for Chevron's Estero Marine Terminal was assessing the release of exotic species in ballast water for potential impacts and mitigation measures when the lease application was withdrawn (John Lien, Environmental Division, State Lands Commission, pers. comm. 1999).

⁴⁴⁰ Mark Meier, Attorney, State Lands Commission, pers. comm. 1999.

Despite the very limited amount of research that has been done on treating ballast water to remove or kill exotic species, it is clear that the basic technology to do so exists. Our long experience as a modern society with disinfecting drinking water supplies and wastewater flows has provided us with a plethora of well-developed tools for killing organisms in large volumes of water; and more recent technologies may eventually provide us with even more efficient approaches. But even applying only those methods that are being used to treat water and wastewater today, it is well within our ability to substantially reduce, if not eliminate, the discharge of exotic organisms in ballast water.

With the recent recognition of the damage that can result from the release of exotic species in ballast water discharges, science indicates and common sense dictates a need for prompt regulatory action. There is, however, a long history of inaction to overcome. This includes a few regulatory missteps—a prime example being the EPA's 1973 adoption of a regulation exempting ballast water discharges from the Clean Water Act's permit requirements. This exemption, though illegal on its face, was adopted only because in the 1970s the EPA believed that ballast water discharges were harmless. Given what is now known about their impacts, if the EPA were to approach the issue anew it clearly would have no basis for adopting such an exemption. Neither does there appear to be any legal or scientific rationale for maintaining it.

On the other hand, the shipping industry has been discharging ballast water without oversight or regulation for over a century, and not surprisingly the industry is now rather resistant to the imposition of regulations. The contrast between the past lack of regulations and the current regulatory need is great, and the resulting potential for conflict is substantial. In these circumstances the legislative response, not surprisingly, has been rather timid, marked more by rhetoric than by action. Thus in 1996 Congress passed a much-publicized national law on ballast water which, when carefully parsed, merely makes it officially voluntary for the shipping industry to do anything about its ballast water discharges.

Fortunately, a substantial body of existing law provides opportunities at both the state and federal level for effective regulation of ballast water discharges. To date, there have been few attempts by regulatory agencies to avail themselves of these opportunities. This could change either through the development of greater awareness and determination by agencies to deal with this major environmental and economic threat, or through agencies responding to public pressure, including citizen-initiated litigation. Although this article focuses on the opportunities to regulate ballast water discharges in California, the same opportunities or parallel opportunities exist in other coastal states.

At the core of the body of relevant law are laws regulating the discharge of pollutants into the nation's and states' waters. Under the usual definitions in these laws, ballast water discharges are waste discharges, and exotic species, which are frequently contained in ballast water, are biological pollutants. These laws generally prohibit such waste discharges without a permit, which set limits on the concentrations or total loads of pollutants that may be discharged. In the case of exotic species, which can reproduce and spread in the environment, the permissible discharge under these laws is likely to be zero.

There are several additional types of laws—pertaining to wildlife protection, the assessment and mitigation of environmental impacts, and coastal zone management—that may in certain circumstances supplement or substitute for the regulation of ballast water by water pollution control statutes. These types of laws usually come into play at the time that proposed projects are adopted, approved or permitted by government agencies; and are applicable to such projects as the development or modification of shipping ports or terminals, navigable waterways, ship locks and navigation aids, harbor improvements, or other projects which may result in changes in the volumes, sources or patterns of ballast water transported and discharged. Challenges are likely to be brought under these laws if adequate and effective regulation of ballast water discharges is not implemented

under water pollution or other laws, and in some cases such challenges are likely to result in delays or denials of permits or approvals for projects.

Although not discussed in this article, a potential additional layer of legal redress exists under the common law theories of liability including tort, nuisance and negligence. If government agencies do not use their available authorities to effectively regulate the release of exotic species in ballast water, we are at some point likely to see lawsuits filed against the shipping industry for recovery of the costs of damages caused by these species and recovery of the costs of containment and eradication. As we have seen from recent invasions in aquatic ecosystems, the costs resulting from the introduction of even a single, particularly harmful organism may amount to several billions of dollars. Thus—besides protecting native ecosystems and public health—implementing technologies to prevent the release of exotic organisms in ballast water could prove to be a wise investment for the shipping industry.