BALLAST WATER AND INTRODUCED SPECIES:
Management Options for Narragansett Bay and Rhode Island

Prepared to fulfill the requirements of Chapter 46-17.3 of the Rhode Island General Laws Related to Ballast Water

by

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INTRODUCTION

This report was developed to meet the requirements of Chapter 46-17.3 of the Rhode Island General Laws relating to ballast water management. It summarizes information from scientific and policy literature, using the most recent reports on the issue of ballast water and its relation to introduced non-native species. Information is presented on the ecological and economic impacts of introduced aquatic species, global and national management initiatives, and technologies under development to treat ballast water. The report also presents possible management options or responses for the State of Rhode Island to address management of ballast water releases and associated introduction of non-native species.

Introduced Species and Ballast Water

Introduced species are a substantial and growing global threat due to the potential for significant economic and ecological harm as well as human health risk. "Every assessment indicates that the rate of marine introductions in U.S. waters has increased exponentially over the past 200 years and there are no signs that these introductions are leveling off. New introductions are occurring regularly on all coasts…." (Carlton, 2001). The actual impact depends on the species of concern and the success it has in establishing a "beachhead" population in new waters. The United States has already been seriously impacted by the introduction of species. From zebra mussels and Eurasian ruffes in the Great Lakes to the completely overturned ecosystem that exists in San Francisco Bay, it is a problem that has accelerated significantly over the last few decades.

Studies conducted in the United States and abroad have show that the single largest transport vector of non-native species for the marine environment is exchange or partial exchange of ballast water from transoceanic vessels as they pass through ports throughout the world (Carlton, 1996; Ruiz et al., 1997). Annually, 21 billion gallons of ballast water are discharged into U.S. waters, containing between 3,000 and 7,000 species. An individual vessel may carry as many as 150,000 metric tons of ballast water, containing sediment and a variety of organisms from varying corners of the globe. A study by the Smithsonian Environmental Research Center of 70 vessels surveyed arriving at Chesapeake Bay ports found that 90% of these vessels carried live organisms in ballast, including clams and mussels, copepods, barnacles, diatoms, and juvenile fish (Chesapeake Bay Commission, 1995).

The scientific consensus is that current ballast water exchange protocols, while a helpful preventative measure, are not a completely effective method of reducing the risk of introduced species. Ship design generally does not allow for complete exchange of ballast; some water and sediments remain that still have the ability to harbor organisms and bacteria. In light of that, current management scenarios, while relying on ballast exchange as a practical immediate step, are concentrating on shipboard treatment of ballast water through a variety of combined technologies. New technologies to treat ballast water are being studied and tested by industry and university researchers (with federal and industry funding) that show promise for effective treatment to remove and destroy microorganisms and bacteria in ballast water.

Management initiatives at the international, national and state level regarding ballast water are in a state of flux, driven by a recognized need to effectively manage ballast water on a broad scale to prevent introductions, and by the development of new ballast treatment technologies. Several states that have experienced impacts from invasive species have, while supporting the passage of national legislation, passed their own ballast water management laws after determining that the existing system of voluntary ballast exchange was not effectively protecting their economic and ecological resources. Industry perspectives on regulatory schemes start with a call for national legislation and include recognition that ballast water treatment standards will be a necessary element of any management scenario.

I. BALLAST WATER: OPERATIONS

Ballast is drawn into a vessel by intake pumps located in the hull, below the waterline. It is taken on to provide stability and maneuverability in rough seas, and is used when the vessel is at less than maximum cargo load, either during a transit to pick up a product, or after dropping off a portion of the cargo before continuing on to the next port. Therefore, ballast waters can often be a mix of waters from many ports (Carlton et al., 1995 in Tzankova, 2000). It is often discharged in order to raise the ship when entering shallower ship channel areas in port.

In earlier centuries, dry ballast consisting of rocks, sand, or other solid materials was used for this purpose. Because of the danger of shifting in heavy seas, such dry ballast materials could cause instability at sea. In addition, loading and unloading ballast was a tedious and time-consuming aspect of shipping. Beginning in the 1880's, with the advent of steel ships capable of watertight containment, water began to be used as ballast. However, it was not until after World War II that water became the most widespread source of ballast weighting (Carlton, 2001; Armstrong, 2001; Tzankova, 2000).

Modern Ballast Procedures

Ballast tanks come in various sizes and shapes, and are located in different areas of the ship, depending on the type of vessel involved (see Tables 1 & 2 and Fig. 1F & 2F, Appendix F). Ballast water normally enters the tanks from below the waterline via one or more intake pumps (Fig. 3F, Appendix F). The water passes through a grate or strainer and reaches the ballast tank or floodable cargo hold. However, these strainers are not meant to remove small organisms and the grates/strainers are often not well maintained, sometimes allowing even sizable aquatic organisms to be introduced to the tanks. For example, a cargo vessel that was bound for Baltimore Harbor from the eastern Mediterranean was found to hold over fifty "actively swimming individuals" of a mullet species, each from twelve to fourteen inches long, contained within the ballast water (National Research Council, 1996. *in* Armstrong, 2001).

In order to decrease the risk of introducing foreign species, a small percentage of ships are now, when feasible and safe, voluntarily exchanging ballast at sea, taking in higher salinity ocean waters (more than 200 miles offshore) on the premises that inshore species won't survive the different offshore environment, and offshore species will be less likely to survive inshore. However, this adds time to the voyage and is therefore a cost to the carrier if undertaken. In addition, the captain always has the right to decide if sea conditions are safe enough for such a procedure.

The volume of ballast normally carried varies, depending on the vessel type. Table 2 of Appendix F (Tzankova, 2000; updated by Tzankova, 2001a) shows typical capacities. When considering introduced species, there is no clear relationship between risk of introduction and volume of ballast water discharged (Carlton, pers. comm., 2001, in Tzankova, 2000). For example, some classes of vessels are considered "NOBOBs" (No Ballast On Board) and have the lowest ballast capacity compared with other vessels, but carry a significant amount of ballast water that cannot be fully pumped out (Carlton et al. 1995; Tzankova, 2000). Due to the lower amount of ballast that is discharged by these vessels, they are not subject to existing ballast water exchange requirements in the Great Lakes and elsewhere. However, studies have shown that the "empty" ballast tanks in NOBOB vessels often contain an un-pumpable residual mixture of water and sediment accumulated from previous ballast operations. When moving between a succession of ports, unloading and loading cargo and maintaining trim to accommodate changes in channel depth and vertical obstruction clearance (e.g., bridges), ballast water is pumped on and off the vessel allowing organisms and bacteria to be discharged (Doblin, et al. 2001; International Joint Commission, 2001). The fact that shipping into the Great Lakes is approximately 80% NOBOB and yet,

according to University of Notre Dame biologist David Lodge, the Great Lakes are "one of the most compelling documented examples of a huge system that has been completely transformed by introduced species" shows that the normally unacknowledged and undeclared small-volume exchanges associated with NOBOBs may carry a significant degree of risk.

In addition, ships carry varying amounts of sediments in their ballast tanks. Deep draft vessels are thought to carry the greatest amount of sediments within the tanks because their ballast intakes are generally closer to the stirred-up estuarine bottom than shallower-draft vessels (National Research Council, 1996 in Tzankova, 2000; Armstrong, 2001). Sediment often harbors large numbers of aquatic species in a resting state. Sediment layers remain in ballast tanks even after pumping and provide a haven to species (or larvae) that can survive the conditions by forming spores or other forms of protection. Some toxic dinoflagellates can take a cyst form that can survive within ballast sediments. As mentioned above, the exchanges, although small-volume, may carry a significant risk due to the organisms associated with re-suspended sediments in the tanks (International Joint Commission, 2001).

II. BALLAST WATER: SPECIES INTRODUCTIONS AND IMPACTS

Non-native species are introduced by transport vectors that allow them to move well beyond their natural range. As they evolve, organisms develop dispersal mechanisms in order to spread and expand their population. Entry of an aquatic species into a new environment is a normal evolutionary process when it takes place through a natural transport such as wind or ocean currents. However, it is becoming increasingly common, as a result of human activity, to have foreign species introduced far beyond their normal geographic ranges. Such introductions may set up circumstances that allow a species population to grow unchecked by their natural predators.

Carlton (2001) and Ruiz et al (1995; 1997) present an extensive historical summary of species introductions worldwide. Prior to 1870, most introduced species arrived as fouling organisms associated with hulls and anchor lines of transoceanic sailing vessels. Fouling organisms on hulls have decreased in numbers due to the use of anti-fouling (toxic) hull paints. Although this has not completely eliminated this vector, it is probably less of a source today than in previous centuries. However, there are plenty of water-holding nooks and crannies in modern vessels that can harbor marine organisms where these paints are not used (e.g., sea chests).

The first recognition that a non-native species was causing a problem occurred in 1903, when an Asian algae, *Odontella sinensis*, exhibited a massive population explosion in the North Sea. The threat caused by such introductions were not acknowledged until a 1973 conference of the International Maritime Organization (IMO), and then only to voice concern over human pathogen transport.

In the late 1980's, serious economic losses due to invasion by the zebra mussel in the Great Lakes region finally forced this issue into the spotlight, highlighting the ecological and economic devastation that can be wrought by rapid unchecked growth of introduced species in an aquatic ecosystem (Carlton, 2000b, Tzankova, 2000). The rapidity and range of the establishment took public officials by surprise; however, it was too late to take any effective measures by the time the invasion was recognized as having occurred.

Problems Associated with Species Introduction via Ballast Water

The following table lists the range of impacts that are associated with aquatic nuisance species (from National Aquatic Nuisance Species Taskforce Website, 2001):

Ecological Effects	*Economic Impacts*	*Public Health Concerns*
Predation	Industrial water users	Cholera risk
Parasitism	Municipal water systems	Paralytic shellfish poisoning
Competition	Nuclear power plants	Harmful algal blooms
Introduction of new pathogens	Other water sports	
Genetic changes	Damage to levees/dams	
Habitat alterations	Commercial and recreational	
Species shifts/loss of biodiversity	fishing	

Ecological Issues

The success of introduced species can depend on several factors including lack of natural predators, abundance of food sources, better tolerance of pollution (or pollution decreases that allow an invader to get a foothold), disease and other stressors, and out-competing a less aggressive species that

currently occupies a biological niche that suits the introduced species. While, as stated above, only a small percentage of introduced species become established in a new ecosystem, that establishment can have powerful and far-reaching consequences.

Introduced species are recognized as the second most significant cause of loss of biodiversity (e.g., loss of species w/in an area) after habitat degradation (Vitousek et al., 1997). In the United States, scientists have demonstrated that of 1,880 U.S. species classified as imperiled, invasive species played a major role in the listing of 49% of these impacted species (Wilgrove et al., 1998). Non-native species, once successfully established, have the potential to cause myriad problems, ranging from parasitising important native species, to out-competing local populations for food, to outright predation on important native species. Such ecological changes to the ecosystem are often significantly disruptive to the normal functioning of that system.

Introductions of exotic species have radically altered the structure and biodiversity of ecosystems around the globe. Europe, Australia, New Zealand, Russia (Black Sea), and the U.S. have all experienced major shifts/losses of local aquatic species, human health risk and economic loss of shellfish due to outbreaks of toxic algal blooms or even human pathogenic organisms (Carlton, 1999; 2001). Although it is considered to be conservatively low, Ruiz et al. (1997) has estimated that at least 400 aquatic nonindigenous species populations had become established in estuaries on US coasts by 1990.

Such introduced species may out-compete and displace commercially important resources for food or space (as in San Francisco Bay with the Asiatic clam and Chinese mitten crab) or harm and feed upon aquaculture stock (as is happening on the U.S. Northwest coast due to recent green crab introduction). Scientists studying Chesapeake Bay have recently seen the introduction of the rapa whelk, a large Asian snail that eats native clams and oysters, threatening an important economic activity. Introduced species can cause unexpected and unpredictable ripple effects within the food web of an ecosystem. The latter happened in the Black Sea, where a comb jelly species from the U.S. (*Mnemiopsis leidyi*) preyed on fish larvae as well as their prey food, essentially wiping out the anchovy fishery there. On the Gulf coast of the U.S., population explosions of the Pacific spotted jellyfish appears to be a major threat to Gulf finfish populations by consuming massive quantities of fish larvae in the water column (Carlton, 2001).

Human Health Issues

Introduction of nonhuman pathogens has been shown to cause extensive ecological and economic damage to industries such as aquaculture and commercial fisheries (Daszak et al., 2000). In addition, the spread of human pathogens to new areas is considered to be a substantial human health risk. Ruiz et al. (2000) measured levels of bacteria, virus-like particles (to mimic viruses which are too difficult to detect), and the bacteria *Vibrio cholerae* (which cause human cholera) in the ballast tanks of vessels entering Chesapeake Bay ports from foreign carriers, and found very high numbers. Their data indicated that viable cell populations of *V. cholerae* can be delivered with some frequency to estuaries by ships coming from foreign ports. They concluded that coastal ecosystems are frequently invaded by microorganisms from ballast water, including species that can form resting stages, waiting out periods until the new environment has the right physical conditions for rapid growth.

Paralytic shellfish poisoning (PSP) results from the consumption of shellfish products contaminated with neurotoxins produced by certain species of phytoplankton (floating microscopic plants) within the group known as dinoflagellates (Hallegraeff and Bolch, 1991; Hallegraeff, 1998, *in* Tzankova, 2000). Several countries around the Pacific Ocean have experienced phenomenal population explosions of a number of toxic dinoflagellates thought to have been transported in an encysted state in

ballast sediments. Such "red tides" (a term linked to coloration of the water by the microscopic toxic plants) make the shellfish in the area unsafe to eat for humans, and can also kill fish and invertebrate (crabs, etc.) in the area (Mlot, 1997). These harmful algal bloom (known as HABs in the scientific community) species have greatly impacted aquaculture operations in Japan and Australia.

In the U.S., an increase in harmful algal blooms between 1972 and 1997 has been at least partially attributed to ballast water transfers (Mlot, 1997, Tzankova, 2000). In Australian ports, the incidence of red tides and PSP was circumstantially linked to the advent of Japanese bulk cargo carriers in the 1960s – 1970s. This concept has been supported by the discovery of toxic dinoflagellates in the ballast of ships arriving from both Korea and Japan (Hallegraeff, 1993; Hallegraeff, 1998). Globally, an increase in the distribution of paralytic shellfish poisoning between 1970 and 1990, is also attributed to introduction of toxic dinoflagellates in ballast water transfers, among other factors such as high nutrient levels that then stimulate growth of the newly introduced organisms.

Exposure to cholera is another potential health-related ballast concern. In 1991 and 1992, *Vibrio cholera*e strain 01 was recovered from ballast, bilge and sewage water from five cargo ships docked in ports on the U.S. Gulf Coast. Four of these ships had taken on ballast water in cholera-infected countries (McCarthy and Khambaty, 1994; Tzankova, 2000). Following this incident, the Food and Drug Administration recommended that the U.S. Coast Guard issue an advisory to shipping agents and captains requesting that ballast water be voluntarily exchanged on the high seas before entry of ships into U.S. ports.

Invasion Detection

Negative impacts are not usually seen in advance prior to introduction, and even the "invasion" itself is not usually detected by scientists, but more often by citizens who work or recreate in the marine environment on a regular basis and recognize some new organism is becoming more common and was never seen by them before (Armstrong, 2001).

Few states monitor marine natural populations outside of the commercially important ones (lobster, certain finfish, etc.), due to the cost, manpower commitment and need for specialists (Carlton, 2001) as well as detection limitations. Introductions of microscopic species (such as toxic dinoflagellates or cholera-linked species) are even more rarely recognized unless monitoring programs are in place to detect them, because they are not visible to the human eye.

It should be noted that because of resting/torpor stages, and the fact that newly-introduced species are not detectable until they reach some advanced level of population growth, the actual ship source is extremely difficult to pinpoint once the impact has occurred - it is usually too late to check an invasive species' growth and too late to identify the specific source.

Increasing Rate of Introductions

As stated above, introductions of species are not new, but what is new is the rate and scale at which they are now occurring. Dr. James T. Carlton, of the Williams College Marine Program, one of the foremost national experts on this issue, recently stated that "…every assessment indicates that the rate of marine introductions in the U.S. has increased exponentially over the past 200 years, and there are no signs that these introductions are leveling off. New introductions are occurring regularly on all coasts, producing immediate damaging impacts, and leading to millions of dollars (annually) in expenditures for research, control, and management efforts." (Carlton, 2001b). In this age of expanding global trade with international shipping being a primary mover of goods, there have been dramatic increases in the volume

and frequency of ballast water discharges as well as an expanded list of donor sites. Currently, there are more than 45,000 commercial cargo-carrying vessels plying international seas (Carlton, 2001b). In terms of U.S. vessel traffic, a Coast Guard source stated that 7,500 vessels enter U. S. waters, making 52,000 stops annually (Adm. G. Naccara, pers. comm., 2002). As an illustration of the rate of increase in shipping, arrivals of seaworthy freight containers at the Port of Los Angeles increased from 20 in 1958 to 3.2 million in 1998 (USDA/APHIS 2000). These ships carry and discharge ballast water among hundreds of bays and estuaries worldwide.

In San Francisco Bay (believed to be one of the most invaded estuaries in the world), the rate of invasions has increased from an average of one species every 55 weeks between 1851-1960, to one new species successfully establishing itself every 14 weeks between 1961-1995. San Francisco now contains over 175 introduced marine species, and many of them have become the dominant organisms in the marine community, displacing the original system residents (Cohen and Carlton, 1998).

Economic Impacts

In addition to ecological impacts, there are clear economic impacts from introduced species. A Congressional report (U.S. Congress, Office of Technology Assessment (OTA), 1993) found that, of 1,300 established nonindigenous species studied in the US, about fifteen percent have caused clear and severe harm to either the local ecosystem and /or the economy. That same Congressional report found that, between 1906 and 1991, 79 nonindigenous species caused documented losses of $97 billion. Another study of the economic impacts of invasive species (aquatic, terrestrial and plant), conducted by Cornell University researchers, updated parts of the OTA report and estimates that the cost of prevention and control of these species approaches $137 billion per year (Pimentel et al, 2000). Invasive species can replace an economically important species or cause costly removal/clean-up to water-linked industries (e.g., zebra mussels, which rapidly clog pipes of cooling intakes of power plants as well as drinking water reservoir pipes). Recent figures from the Great Lakes show that tens of millions of dollars are spent each year on zebra mussel control. Great Lakes area nuclear power plants alone spend an additional $825,000 each annually for zebra mussel control (ANS Task Force, 2001). A 1994 Great Lakes Commission report indicated that, by that year, there were documented cumulative loses to 50% of the Great Lakes' water users totaling $60.2 million (Great Lakes Commission, 1994).

Introduced fish species (sea lamprey, ruffe and round goby) harm native fish populations and threaten a national sport and commercial fishing industry that is valued at almost $4.5 billion annually and supports 81,000 jobs. In Rhode Island, commercial fisheries are valued at $75 million annually and the economic impact of seafood production in Rhode Island is estimated to be $700 million. Recreational fisherman make about 1 million trips annually in Rhode Island waters, valued at approximately $150 million (Fisheries of R.I., Narragansett Bay Summit 2000 White Paper, 2000).

Negative economic impacts include lost revenues from aquatic resource fisheries losses (e.g., fishery value), clearing and removal costs for clogged piping (cooling water intakes, etc.), costs for replacement and repair of docks, etc. from introduced marine wood-borers, damage from shore erosion due to burrowing behavior. In addition, research funding needs (from limited federal government sources in most cases) are significant. The cost of studies of invading species and possible methods to attempt to control them are in the tens of millions at this time; identified research needs will require significant additional funding. Work on just three Pacific coast introduced species alone used up one-third of all available Sea Grant federal research funds over an entire decade for this research area (Carlton, 2001b).

Absolute fact-based estimates of the overall national economic costs of aquatic introduced species are not available. Information is however available on specific species impacts. In a recent study,

Pimentel et al. (2000) estimated annual costs of $44 million per year to the New England shellfishery from impacts of the European green crab, *Carcinus maenus*; the same study found that fouling damage from the Asian clam *Corbicula fluminea* was causing an estimated $1 billion annually. The shipworm, *Teredo navalis*, which entered San Francisco Bay years ago via wooden ships, has continued to cause an estimated $200 million per year for repair to docks and wooden ships since the 1990's.

The only success so far in predictions of impact severity occurs when a " bad actor" species - a particularly rapid colonizing species (e.g., zebra mussels) becomes established. Once the ecological and economic consequences become evident, there will be a high likelihood of the same severe impacts to new areas as it continues to disperse through the new environment.

As Pimentel et al. (2000) notes, these up-front obvious damage and control costs are probably low compared with the actual unpredictable and extensive ecosystem damages already experienced globally from introduced species.

An additional issue associated with ballast-introduced species with potential far-reaching human health and economic impacts is the risk of introduction of pathogenic bacteria and harmful algal blooms. One demonstration of this risk has been the transmission of the cholera bacteria from South American ports to the southern U.S. coast.

III. NEW ENGLAND/NARRAGANSETT BAY: INTRODUCTIONS AND RISKS

Rhode Island has seen a number of recent introductions. The intertidal Asian shore crab, *Hemigrapsus sanguineus*, has migrated along the Rhode Island coast in the late 1990's from an original ballast source in New Jersey. It is now showing rapid growth in the mid-bay areas around Prudence Island. A large nuisance seaweed, *Grateloupia doryphora*, which seems to have come in from a source entering or passing the mouth of Narragansett Bay around 1996 (in the first East coast sighting of this Pacific species), is now found over wide regions of the Bay (Tzankova, 2000; Villalard-Bohnsack and Harlin, 1997, see Fig. 1C, Appendix C). Tables 1C and 3C, Appendix C (from Tzankova, 2000 and R.I. Rapid Assessment Survey Results, unpublished data) provide a list of species known to have been introduced into Rhode Island marine waters.

In relation to New England-wide introductions, at least 13 species are shared with Rhode Island (see Table 2C, Appendix C from Tzankova, 2000). The recent results of the "Rapid Assessment Survey" of fouling communities found on floating docks around Narragansett Bay show a minimum of 24 newly identified clearly foreign-introduced species and at least 17 species termed "cryptogenic", meaning not clearly native or introduced (origin unknown or species was here but never noticed before).

The rate of introductions in the New England area seems to be following global trend of increased invasion. Internationally, there has been a 300% rise in invasive species between the 1980's and 90's in comparison with the 1960's and 70's (Carlton 1999; Carlton, 2000).

Species Risk Predictions

Most experts seem to agree that, at least for the aquatic environment, "predicting which species will arrive…whether they will survive, persist, spread, and proliferate, continue to challenge scientists who study invasion biology" (Carlton, 2001b). Therefore, there is little predictive capability, and it is extremely difficult to develop a "hit list" or "watch list" until the invasion has already begun nearby and one is merely watching the secondary spread of the original population invasion. At this time, quantitative assessments of risk for this ecologically complex problem are not feasible. The major problem with attempting to quantitatively predict risk levels is that the actual successful colonization of the new area is dependent on many factors, all influenced by timing: being in the right place at the opportune moment when the ecosystem receiving the foreign transplant(s) is vulnerable to that particular species (Carlton, 2001; Armstrong, 2001). The complexity of interactions between timing of potential introductions and the numerous environmental factors (e.g., water temperature, nutrient levels, and the extent and nature of pollution) make it extraordinarily difficult to predict what the next invasive species will be or when and where the event will occur. Ruiz et.al (2000a) emphasized the need to establish standardized ecological surveys of non-indigenous species across coastal and estuarine areas. He also noted that, “at present, no program or framework exists to implement such quantitative measures of non-indigenous invasive species.”

As noted above, ballast water is considered the most significant source of foreign introductions (Ruiz et al., 1997). Between three and ten thousand species are estimated to be transported around the globe daily in these tanks, but only one to three percent are estimated to actually end up establishing viable populations in their new homes, and the "winning species" are not predictable in advance (Carlton, 1999; McCarthy & Crowder, 2000). There have been cases where a species is believed to have been released multiple times with no obvious survivors for decades, and then suddenly show explosive growth and strong negative ecological and economic consequences (Carlton, 1996).

Estuaries are considered the most vulnerable areas to such introductions because most ports are located in estuarine environments, allowing organisms released in ballast water to experience conditions that are similar (e.g., salinity and temperature) to the native habitat of the "donor" port increases the probability that they will be capable of surviving in the new "home". From an ecological perspective, the great risk is that a natural predator will not presently exist in the new home, allowing the population to grow unchecked.

It is expected that increases in transoceanic vessel traffic (using current ballast practices) increase the risk, since introductions are likened to "ecological roulette," that is, the greater the number of releases with potential invasive species, the more likely an invading species will successfully colonize and grow in numbers. (Carlton, 2001a and b; Kolar & Lodge, 2001; Tzankova, 2000). It is thought that the origin of transoceanic vessel traffic from known high-risk donor port regions, such as Southeast Asia, Asia and the Mediterranean (also heavily invaded) is likely to also increase the risk

Carlton (1996) identifies a number of major factors as possible influences on the timing and success of a species transfer from donor regions to new locations:

- changes in populations at the donor region (population increases);
- sudden emergence of new donor regions (new shipping transportation patterns);
- changes in the waters of the receiving area (biological, chemical or physical changes helping or hindering new species introductions);
- the opening of “invasion windows” in the recipient region due to changes in the receiving area (the simultaneous occurrence of favorable chemical, physical, biological, or ecological variables); and
- increases in dispersal vectors.

Narragansett Bay/Rhode Island Risk

Present risk to Narragansett Bay appears to be fairly low due to a low frequency of transoceanic vessel arrivals and the fact that the majority of shipping traffic involves non-ballasted towed barges and dry cargo and tank barges (Tables 3F-5F, Appendix F). The traffic either has no ballast at all or comes from geographically local areas and carries only local waters (Nield, 1999; Tzankova, 2000). On average, over the time period 1985-1996, about 75% of all vessel trips on Narragansett Bay are accounted for by non-ballasted towed vessels (Nield, 1999). It should also be noted that, as an area that is a net importer of goods, many of the vessels that do use ballast water systems arrive loaded with goods, taking on ballast here after unloading; that ballast water is then carried to other ports. Though much of the vessel traffic is domestic, the Bay is also visited by commercial vessels that travel directly from dozens of foreign nations (see *Vessel Movements – Port of Providence: Originations & Destinations* Table, Page 12 of this report). While the risk of introductions may currently be assessed as fairly low, it is evident that the risk is certainly above zero since Rhode Island has been identified as the first contact point for the large nuisance red macroalga, *Gratelupia doryphora* (Villalard-Bohnsack and Harlin, 1997).

Tzankova (2000) has reviewed the characterization of risk of introduced aquatic species from present and future vessel traffic in Narragansett Bay. She notes that the risk associated with introductions is related to previous port location and frequency of vessel traffic, but does not have any clear correlation to volume of ballast in the specific vessels in question since low-ballast and No Ballast On Board (NOBOB) vessels often have substantial sediments in their ballast tanks, and often exchange volumes of this water without having to report it since it falls outside the legal definition of a ballast water release (Tzankova, 2000). In terms of expanded port development, Tzankova notes that the proposal for a new container port for Quonset Point projects that, at full development, 728 transoceanic vessels annually

would visit such a port; this represents a 350% increase in the current average number of foreign arrivals. Should this port use become a reality and meet projected traffic volumes, this would present immediate concerns of ballast-mediated non-native species transfer. These concerns are based on characteristics of container vessels. These characteristics include: (1) a frequent pattern of intake and discharge of ballast water in several ports of call; (2) deep-water container ships take on ballast in shallow coastal systems that tend to contain high levels of species-rich sediment; (3) the faster speeds of transit of these newer vessels may increase survival rates for ballast-borne organisms; and (4) the appearance of successful invading species in many donor ports frequented by container ships (Tzankova, 2000).

Vodyanoy (1998) points out that the remaining water and sediments in the bottom of a ballast tank have been shown to contain approximately 25% of the original total of species in the full tank, and any resuspension and pumping of even minor volumes of this water could cause introduction of foreign species. The impact of such mixed sediment releases has already been seen in the Great Lakes, where most of the introductions of exotic species occurred in a situation where 75 to 95% of vessels were NOBOBs (Reeves, 1999).

Based on review of introduced species literature, it is generally accepted in the scientific community that any significant increases in the number of ballast-carrying transoceanic vessels entering American estuaries using current ballast practices (i.e., that do not exchange ballast in deep water and/or are not fitted with effective ballast water treatment technologies) represent an increase in the size and intensity of the ballast transfer vector, increasing the likelihood of new introductions, especially if they emanate from significant donor ports in Europe, Asia and Southeast Asia.

Carlton (1999; 2001b) notes that several invasion myths sometimes cloud discussion of the level of risk involved in this issue. One of the most common is that invasions are a part of nature, and human activity is merely speeding things up. However, Carlton states that species would not be capable of travel between San Francisco and the Black Sea via ocean circulation alone.

A second misconception is that if a vector has already been transporting species from one place to another for many years, every species that could be successfully introduced would have shown itself already. Several examples indicate nature does not follow this logic. Zebra mussels (*Dreissena* spp.), first appeared in the Great Lakes many decades after ballast water had started arriving from Europe. A European sea squirt (*Ascidiella aspersa*) found on ship hulls, anchor chains, etc. appeared in the 1980's in New England - over 400 years after initiation of ship traffic between Europe and the United States (Carlton, 2001b; Tzankova, 2000).

All scientific experts in this area of invasion biology agree that the most important means to avoid such costly losses is to avoid the introduction in the first place. No successful eradication program has been developed so far that can deal with a growing aquatic invasive population once it is established and it usually is well past this stage before the problem becomes evident (Tzankova, 2000).

Vessel Movements - Port of Providence: Trip Originations and Destinations
November 2000 - January 2002

DOMESTIC

From		*To*	
New York	11	New York	13
Baltimore	14	Boston	9
Portland ME	5	Savannah	7
Boston	4	Norfolk	6
Philadelphia	4	Philadelphia	5
Newport RI	4	Baltimore	5
New Haven	4	Newport News	4
Jacksonville	3	New Orleans	4
Wilmington NC	2	Providence	3
Newport News	2	Wilmington DE	3
Norfolk	2	Wilmington NC	2
Savannah	2	Jacksonville	2
Houston	1	Portsmouth NH	2
Portsmouth NH	1	Tampa	2
San Juan	1	Virgin Islands	2
Richmond	1	Chaleston	1
Juneau AK	1	Boston	1
Anchorage AK	1	Puerto Rico	1
Petersburg AK	1	Fall River	1
Anacortes WA	1	Brunswick GA	1
Morehead City SC	1	Lake Charles LA	1
Fall River	1	Bangor ME	1
New Orleans	1	Houston	1
		New Haven	1
		Corpus Christi	1
		Hopewell VA	1
Total	**68**	**Total**	**80**

FOREIGN

From		*To*	
Venezuela	39	Canada	39
Canada	38	Venezuela	26
Colombia	9	Spain	11
Saudi Arabia	5	Aruba	11
Philipines	5	Portugal	5
Bahamas	4	United Kingdom	5
Liberia	4	Mexico	3
Spain	4	Bahamas	3
Mexico	2	Netherlands Antilles	3
Italy	2	Panama	2
Portugal	2	Netherlands Rotterdam	2
Japan	2	Trinidad	2
Bahamas	2	Brazil	1
Belgium	2	Dominican Republic	1
Greece	2	Algeria	1
Grenada	1	Guinea-Bissau	1
Aruba	1	Argentina	1
Algeria	1	Colombia	1
Netherlands	1	Bermuda	1
Argentina	1	South Korea	1
Bermuda	1	Gibraltar	1
Guinea-Bissau	1	Philipines	1
United Kingdom	1	Ireland	1
Nigeria	1	South Africa	1
Turkey	1	Nigeria	1
Dominican Republic	1	Ecuador	1
Iceland	1	Syria	1
Brazil	1		
Thailand	1		
Guatemala	1		
Total	**137**	**Total**	**127**

Source: U.S. Army Corps of Engineers, Navigation Center Data, 2002. *Waterborne Commerce of the U.S*.

IV. INTERNATIONAL AND NATIONAL MANAGEMENT EFFORTS

Due to the fact that ballast water crosses international and national boundaries, the international community, the U.S. government and some state governments have taken some steps to address the introduction of species via ballast discharge.

International Efforts

By the late 1980s, both Australia and Canada had experienced severe bio-invasions by introduced species (Japanese dinoflagellates in Australia; zebra mussels in Canada). Both countries began investigating regulatory means to address these problems and initiated ballast water studies. In 1989, Canada started requesting that vessels entering the St. Lawrence Seaway and the Great Lakes complete a full ballast exchange in ocean waters prior to entrance. Australia developed voluntary exchange guidelines in 1990. In 1991, these nations and others petitioned the United Nations' International Maritime Organization (IMO) to create international guidelines for ballast water. The IMO subsequently issued voluntary **"International Guidelines for Preventing the Introduction of Unwanted Aquatic Organisms and Pathogens from Ships' Ballast Water and Sediment Discharges."** These voluntary measures include:

- Minimizing the uptake of organisms during ballasting by avoiding port areas where harmful organisms are known to occur, in shallow waters and darkness, and when bottom-dwelling organisms might rise in the water column;
- Cleaning ballast tanks and removing sediments that accumulate in ballast tanks on a regular basis;
- Avoiding unnecessary ballast discharges; and
- Initiating ballast water management measures including exchanging ballast while at sea, replacing it with "clean" ballast water; non-release or minimal release of ballast water; and discharge to onshore reception and treatment facilities.

The track record of voluntary exchanges based on these guidelines has shown a pattern of considerable noncompliance. At this time the IMO is considering adopting ballast water management protocols as part of amendments to the International Convention on Marine Pollution (MARPOL). This act would require that all 130 members of IMO follow the ballast exchange guidelines. This addition to MARPOL may not occur for several years and is dependent on broad support by the member nations. The United States, in IMO discussions, has strongly supported the concept of legally binding international regulations on ballast.

The U.S. Federal Role

Problems with invasive species have been with us for some time. In 1899, the Rivers and Harbors Act directed the Army Corps of Engineers to control aquatic invasive plants. Many states have had laws on the books for many decades requiring the eradication or control of invasive weeds. Currently, more than 20 federal agencies have some role in efforts to prevent, control or eradicate invasive species and their impacts. The roles of these agencies include control and prevention, early detection and response, management and restoration, research and monitoring, coordination with international efforts, and information and education. The plethora of agencies involved in this issue presents significant coordination and funding challenges.

The **Nonindigenous Aquatic Nuisance Prevention and Control (NANPCA) Act of 1990** (16 U.S.C. 4701- 4741) was a response to the impacts of invasive species, in particular the Eurasian ruffe and

the zebra mussel. The Act mandated the creation of the Aquatic Nuisance Species Task Force to coordinate actions related to invasive species. Another element of the Act is a call for research in the three major areas:

- assessing the environmental effects of ballast water exchange in the receiving waters of the U.S. and to identify areas, if any, where such exchanges will not introduce or spread nuisance species;
- studying whether aquatic nuisance species threaten the ecological characteristics and economic uses of other water bodies than the Great Lakes; and
- analyzing current shipping practices as vectors of introduced species transmissions and to assess the need for controls on vessels entering waters other than the Great Lakes to reduce the risk of unintentional introductions.

The Act also included a requirement that the U.S. Coast Guard develop guidelines that would eventually become regulations regarding mid-ocean ballast exchange and other control measures for international shipping. The initial guidelines requested that all vessels entering the Great Lakes from outside the U.S. Exclusive Economic Zone (200 miles) exchange their ballast water in the open ocean and provide documentation that this had been done. In May 1993, these guidelines became mandatory and, by the end of that year, were expanded to include all vessels traveling north of the George Washington Bridge on the Hudson River. This represents the only regulatory approach to ballast water management worldwide. A NANPCA Ballast Water and Shipping Committee has been formed to work on solutions to species introduction via ballast water. Other purposes of NANPCA are prevention of intentional introductions, development and implementation of environmentally sound control methods, and the minimization of economic and ecological impacts.

NANPCA was reauthorized in 1996 with a new name – the **National Invasive Species Act (NISA) of 1996**. This reauthorization extended the voluntary ballast water exchange and reporting Act to all U.S. coastal waters (mandatory only for the Great Lakes and Hudson River). It instituted a Ballast Technology Development Program to investigate more effective alternatives to ballast water exchange as a means of reducing risk of invasions. Adding new weight to the legislation was the fact that the International Maritimes Organization was now involved in developing improved guidelines for ballast water.

In 1999, President William Clinton issued **Executive Order 13112 on Invasive Species**. The Order established the National Invasive Species Council, which is co-chaired by the Secretaries of Commerce, Agriculture and the Interior. Also represented on the Council are the Secretaries of State, Treasury, Defense and Transportation as well as the Administrator of the Environmental Protection Agency. The Council is directed to form a non-Federal Invasive Species Advisory Committee to advise the Council in implementing the Order. The Council is required to ensure that: (1) federal initiatives are coordinated and non-duplicative; (2) a mechanism exists for U.S. coordination with international efforts; (3) a network is established to document and monitor invasive species; (4) a web-based information network is created; and (5) a National Invasive Species Management Plan is prepared. This Plan, now completed, contains priority elements needed to address invasive species. These are:

- Leadership and Coordination;
- Prevention;
- Early Detection and Rapid Response;
- Control and Management;
- Restoration;
- International Cooperation;
- Research;

- Information Management; and
- Education and Public Awareness.

The U.S. Navy has adopted procedures designed to minimize the risk of introduced species. These measures are modeled after the IMO guidelines and include ballast exchange and flushing outside of 12 miles offshore, logging of exchanges and adjustments to ballast, and cleaning of sediments and biomass from anchors, chains and appendages.

One caveat to all of the federal activity directed toward ballast water management – the mandated ballast guidelines are voluntary for all U.S. waters with the exception of the Great Lakes and the Hudson River north of the George Washington Bridge. A second shortcoming is the fact that the safety exemption for ballast exchange is left to the discretion of ships' captains with no official oversight. This highlights a serious problem with reliance on ballast water exchange as the only means of management. An additional issue is the fact that the decision to make the voluntary guidelines mandatory is based on an assessment of voluntary compliance. Lack of resources and enforcement capacity makes it difficult to make this assessment accurately. As for compliance performance regarding the current voluntary system, a recent survey revealed an average 20.8 percent compliance rate – a low rate reflecting the lack of any incentives (regulatory or otherwise) to comply with the guidelines.

In March 2002, the U.S. Coast Guard issued an advanced notice of proposed rulemaking (ANPRM) seeking comments on possible standards for treating ballast water to reduce or eliminate invasive species. The Coast Guard is also nearing release of a report that may include a determination on whether the agency will move forward to issue regulations governing ballast water treatment. Under both NANPCA and NISA, the agency is required to issue guidance and regulations for management of ballast water. The ANPRM states that any alternative ballast treatment must be "at least as effective" as deep water exchange in preventing introduced species. The Coast Guard indicated that the lack of a treatment standard is an impediment to the development of alternative treatment technologies. An alternative treatment would be considered effective if it : (a) produces predictable results; (b) removes or inactivates a high percentage of organisms; (c) functions effectively under most operating conditions; and (d) moves toward a goal that meets the congressional intent to eliminate ballast water discharge as a source of harmful invasive species (Inside EPA – Water Policy Report, 2002a).

An unresolved issue for the federal government: can and should the U.S. Environmental Protection Agency regulate ballast water discharges as point sources under the Clean Water Act National Pollution Discharge Elimination System? That issue has been the subject of a legal battle resulting in a federal district court's summary judgment to environmental organizations requiring EPA to issue a decision on whether to regulate ballast water discharges under the Clean Water Act permitting program. EPA downplays that decision, claiming that U.S. courts of appeal have exclusive jurisdiction over petitions that compel final agency action. The federal district court has stayed judgment until it can rule on briefs related to the jurisdiction issue now being prepared for submission by EPA and the lawyers for the environmental organizations involved in the suit (Inside EPA – Water Policy Report, 2002b).

State Ballast Water Management Approaches (refer to Appendix D. for legislation)

Many states have laws on the books preventing discharge of ballast water but only in cases where such water is polluted by oil or other toxic chemicals. Rhode Island has such a law, mainly concerned with the discharge of oil into the waters of the State. However, it does not address the issue of biologically "polluted" discharges from ballast water. Several of the existing state ballast laws are keyed to the current national voluntary provisions. One potential obstacle to the development of state ballast water management laws is the Interstate Commerce clause of the U.S. Constitution which raises the issue

of federal pre-emption of a state law – states would not likely be keen to get involved in possible legal battles with governmental, nongovernmental or private sector entities over this issue in the event that there is a perceived conflict between state and federal law.

California

In 1999, California passed a bill adopting the IMO guidelines as state policy. Development of regulations was initiated but halted in 1994 when legal concerns arose over the constitutionality of state regulation over commerce, which may contravene federal jurisdiction. In 1999, California passed legislation mandating ballast water management for all ships entering state waters. The law applies the federal ballast management guidelines and makes them mandatory for vessels entering California waters. It also narrows the scope of the safety exemption by introducing remedial measures (ballast pipe sealing, non-release, exchange in a state-designated backup zone) in the event a ship arrives without exchanging ballast due to safety concerns.

Key Components California's Ballast Water Management Program:

1. Mandatory mid-ocean exchange or retention of all ballast water for all vessels, United States and foreign, carrying ballast water into the waters of the state after operating outside the EEZ;
2. Mandatory completion and submission of ballast water report form by vessel master, owner, operator, agent or person in charge of vessel;
3. Mandatory compliance with "good housekeeping" practices:
   - Avoid uptake or discharge in or near marine sanctuaries, reserves, parks or coral reefs
   - Minimize or avoid uptake in the following areas or circumstances:
   - Areas of known infestations or pathogens:
     - Near sewage outfalls
     - Near dredging operations
     - Areas with reduced tidal flushing
     - In darkness when bottom-dwelling organisms are active
     - Where propellers may stir up sediment
   - Clean ballast tanks regularly to remove sediment
   - Dispose of sediments in accordance with appropriate laws
   - Minimize discharge amounts
   - Rinse anchors and anchor chains
   - Remove fouling organisms from hull, pipes, etc.
   - Dispose of any removed substance in accordance with laws
4. Maintain a Ballast Water Management Plan prepared specifically for vessel;
5. Training of vessel master, PIC and crew regarding the application of ballast water and sediment management and treatment procedures
6. Mandatory Fee Submission to California's Board of Equalization (916-322-9534) ($400.00 per each vessel that enters a California port).
7. Random Sampling of Vessels for Compliance
8. Civil Penalties for failure to comply with any portion of the Law

Other States Legislation: (refer to Appendix D. for text of state laws and bills)

Washington and Oregon, like California, have determined that, in the absence of federal action to effectively deal with ballast water, state-mandated ballast exchange controls were necessary. Washington's law reflects the ballast exchange requirements promoted under the International Maritimes Organization (relying on deep ocean exchange) but also requires vessels engaged in coastal trade to

exchange ballast at least 50 miles offshore. It also attempts to spur technology development by banning the safety exemption for ballast discharge after a specified time period.

Oregon's legislation, while imposing conditions for ballast water discharge, specifically recognizes that ballast water exchange does not provide the level of protection necessary to protect state ecosystems; ballast exchange controls are considered interim measures until better methods and treatments can be put in place. The Oregon law established a task force to study and make recommendations to the 2003 Oregon Legislature regarding methods and improvements to ballast water management.

The State of Hawaii passed a law designating the Department of Land and Natural Resources as the "lead state agency for preventing the introduction and carrying out the destruction of alien aquatic organisms through the regulation of ballast water discharges and hull fouling organisms." That state has not yet promulgated regulations based on that law.

As mentioned above, the State of Michigan is debating a bill introduced by state legislator Ken Sikkema requiring that any foreign vessel entering state waters must have its ballast water "sterilized" although the law does not define that term. A ballast water management bill has also been discussed but not passed in New York State.

Virginia and Maryland have passed legislation that is essentially equivalent to the U.S. Coast Guard voluntary ballast exchange and reporting provisions with the addition of state reporting requirements.

Call for Federal Legislation for Mandatory Ballast Water Management

The American Association of Port Authorities (AAPA) recently called on the U.S. Congress to pass legislation requiring mandatory ballast water management. AAPA said that this legislation should include treatment standards using demonstrated, effective technologies. A federal law of this nature would pre-empt state laws and would, according to John Jamian of the Detroit/Wayne County Port Authority, help "avoid a crazy quilt work throughout the country" of varying state standards (Bureau of National Affairs, Environmental Reporter, 2001). In recognizing the need for ballast water treatment, Tom Chase, a spokesman for AAPA, stated that, " [AAPA] thinks the solution is……the technology for treating ballast in the vessels" (Donn, J., 2000). AAPA representatives also advocated for standards for ballast water treatment that evolve as technology improves rather than standards that start out too stringent. Enactment of this language may also hinder attempts by environmental groups to force the U.S. Environmental Protection Agency to impose Clean Water Act permitting requirements on ballast water discharges.

The AAPA position on ballast water is stated in the AAPA factsheet, "Prevent the Introduction of Aquatic Nuisance Species from Ballast Water; Replace State and Local Initiatives" (AAPA, 2001). The organization calls for (1) mandatory ballast water management; (2) ballast water management standards to evaluate the effectiveness of ballast water technologies; (3) certification of ballast water technologies and practices; and (4) federal pre-emption of state regulations. The position paper notes that "mid-ocean exchange is widely recognized as only a stop-gap measure to minimize the introduction of nuisance species. There is a great need to develop more effective and efficient approaches to ballast management on ships."

State Regulation of Ballast Water Issues

While ballast water discharges are subject to national and international law, the voluntary nature of ballast water exchange as well as its ineffectiveness to prevent introduced species is insufficient to provide effective protection to coastal and estuarine waters. Industry (as noted in the previous paragraph) and academic researchers (Carlton, 2001b) both have taken a positions that the most effective way of dealing with this issue would be the institution of federal regulations that mandate ballast water management; federal enforcement would be a needed component. It is thought that this approach would provide a consistent and effective management scheme that could reduce the risk of introduced species. Current federal legislation does allow for concurrent action by the states. States interested in pursuing state action can possibly steer clear of the potential federal pre-emption issue and stay within the scope of state powers if they focus ballast water legislation on natural resource protection, and avoid attempts to regulate design, equipment and safety aspects of vessel construction and operation (Tzankova, 2000).

V. BALLAST WATER TREATMENT TECHNOLOGIES

Most of the legislation and initiatives involving ballast water has had a strong focus on promoting research into solutions to species introduction through ballast water treatment, recognizing that ballast water exchange is not a complete solution. Recent research has targeted technologies that treat ballast water to remove or destroy the living organisms being carried. Based on research to date, it appears that a single treatment method would not provide an effective solution; research results point to the use of combinations of technologies (Carlton et. al., 1995. in Tzankova, 2000). The information below regarding the methods available or under study is derived in part from Tzankova, 2001, and Mackey, 2001.

Ballast Water Exchange

The primary standard for ballast water treatment has been the exchange of ballast water. This involves pumping out existing ballast and taking on "fresh" ballast. It takes place in an open ocean environment so that discharged species taken on in bays and estuaries (where ports are located) would find it more difficult to survive. This also helps prevent the spread of non-native species into other bays and estuaries. While it does minimize the uptake of ballast-borne organisms, even pumping out and replacing ballast water does not remove all water or sediments from the tanks thus leaving a viable pathway for the introduction of species. Ballast water exchange is considered a partial solution and some existing ballast water controls imposed by states specifically recognize this fact (refer to Oregon's ballast water management law, Appendix D). Additionally, exchange of ballast water is constrained by sea conditions, vessel routing and scheduling. Federal law provides a safety exemption if a vessel's captain judges that completing a ballast exchange at sea would jeopardize the safety of his crew and ship. While ships and crews need to operate safely, this also means that there will be many instances when ballast cannot be exchanged.

Filtration/Physical Separation

Modern filtration technologies allow separation of organisms above a certain size. This is effective in filtering larger organisms but does not remove smaller microorganisms, bacteria and dinoflagellate cysts from ballast water. When done at the time that ballasting is taken on, the material filtered can be re-deposited in the waters where it originates; this solves the problem of where to dispose such matter. However, secondary treatment will be required to inactivate the bacteria, cysts and viruses. A different method for separating larger particles is the use of cyclonic separators that use centrifugal force to separate organisms from ballast water.

Chemical Biocides

Chemical biocides can work in instances where other options are limited (e.g., no ballast on board vessels with low volumes of ballast). While biocides can be effective, there are issues of cost, need for high doses, and potentially toxic residuals with ballast water discharge. Chlorine is a well-proven disinfectant that has been shown to be effective against most viruses and bacteria as well as dinoflagellate cysts but its reaction to use in seawater is not well known. Also, it is a corrosive chemical and would produce a toxic discharge when the ballast was released.

Ultraviolet Light

Ultraviolet light or UV has proven to be extremely effective and environmentally benign way to destroy microorganisms and bacteria by destroying their DNA. The use of UV in combination with physical separation has been a focus of treatment technology research in recent years. In fact, two of the Princess Cruise Line ships are currently fitted with such combined systems in a pilot demonstration project.

Heat Treatment

It was thought that the heat generated by ship engines could be used in some form to treat ballast water. Experiments with that technology have shown some possibilities but many constraints. One advantage that heat treatment has is that it could be applied in transit and makes use of waste heat. However, the temperatures reached via this technology are not effective against most human pathogens. Also, the increased heat may increase system corrosion and may even promote the growth of heat-loving algae.

Ultrasound

This approach has shown potential to be a very effective secondary treatment technology. It can produce extreme pressure and temperature change to destroy microorganisms and bacteria. However, this is still a new technology and there are potential challenges with large-scale operations related to consistent application, energy requirements and equipment durability. Until further testing and research is completed, its use as a viable secondary treatment is unable to be assessed.

Ozone

Ozone, also used as a disinfectant, is a known technology that has been applied to water treatment on smaller scales. Challenges in using ozone include the fact that it reacts with bromides in seawater, can cause corrosion problems and is not effective against dinoflagellate cysts.

Deoxygenation using nitrogen gas

Researchers in California, with funding and support from government and industry, have tested a technology that not only reduces rust and corrosion caused by sea water in ballast tanks but also kills a significant percentage of organisms being carried in that water (Tamburri, et. al. 2002). Nitrogen gas is bubbled into the ballast water, eliminating oxygen content. Without adequate oxygen, most organisms cannot survive for more than a few days. Tests conducted at the Monterey Aquarium Research Institute showed kill percentages of as much as 80 percent for organisms in the water. An added plus: the process can save shipping companies as much as $100,000 a year in reduced maintenance costs. While not a perfect solution, this technology shows promise and provides a strong economic incentive for industry to comply.

V. OPTIONS FOR THE STATE OF RHODE ISLAND REGARDING BALLAST WATER MANAGEMENT AND INTRODUCED SPECIES

The State of Rhode Island should support the development of national ballast management program that includes mandatory, technology-based regulations on ballast water applicable to all U.S. waters and enforced by the federal government.

A national program of this type should include (from Carlton, J.T., 2001b):

- enhanced funding for U.S. Coast Guard enforcement actions;
- funding for research and development to implement ballast water treatment methods;
- a program to reduce the transport of ship fouling organisms (education and technology);
- procedures to regulate the intentional introduction of live non-native species and the interstate transport of such species;
- a rapid response program to focus on the eradication of marine introductions (with a national early warning invasions network);
- the development of a nationwide research effort to assess introductions through a permanent national marine bioinvasion survey and database;
- an initiative to better assess ecological and economic impacts of invasive species; and
- a national education and public awareness program.

It is clear that significantly more federal funding would be needed to institute these national efforts. Rhode Island's Congressional delegation has proven to be very responsive to providing support at the national level for initiatives that will better protect and preserve the State's ecological systems and economy. If the R.I. Executive and Legislative Branches identify this as a priority concern, our Congressional representatives can lend their voices and influence to Congressional efforts to institute federal regulation of ballast water.

In the absence of federal legislation that effectively protects U.S. waters from the introduction of non-native species and in the instance that the State of Rhode Island determines that State legislation is needed in order to protect the State's environment and economy:

The State of Rhode Island should develop legislation providing effective protection of State waters from ballast-borne introduced species from transoceanic vessels entering State waters.

Elements of such legislation could include:

- Prohibition of any discharges of untreated transoceanic ballast into state waters with an emphasis on prevention rather than after-the-fact penalties;
- Implementation of proven treatment technologies to prevent introduction of species;
- Required ballast exchange outside of the 200-mile U.S. Economic Exclusion Zone;
- Prohibition of discharge of ballast tank sediments into state waters;
- Prohibition of discharge of minor volumes associated including automated trimming of the ship or other operations unless treated with effective technology;
- Encouragement of "good housekeeping" practices by the shipping industry (avoidance of ballasting in global "hot spots", near sewage outfalls, in shallow waters where sediment is likely to be stirred up, and avoidance of night ballasting);
- Requirement that transoceanic vessels provide the State agency in charge of ballast control with a copy of the mandatory ballast reporting form (already required under federal regulation);
- Investigate and report on options for incentive-based programs to achieve ballast management goals;

- Development and implementation of a vessel fee to cover the costs of monitoring and enforcement.

As part of the development of state regulations, the State of Rhode Island should investigate and determine how the federal safety exemption could be modified to better protect the State's waters. This could involve requiring remedial measures such as non-release of ballast while within state waters.

Some states have taken a more cautious approach and have passed legislation that mirrors the existing federal voluntary exchange legislation. Issues to consider in whether State legislation could be effective are capacity to implement, whether other states in the region are enacting controls, and whether there will be significant changes in shipping patterns and intensity, vessel type and trip origin.

The State of Rhode Island should appoint a state agency as lead agency on ballast water management.

Because management of ballast water is a complex issue that involves a variety of organizations and agencies, it would be useful to appoint one state agency as the lead contact on this issue. The lead agency could possibly be responsible for developing and implementing State ballast water controls (if determined to be needed by the State), identifying and addressing research needs, informing key constituencies and the public of introduced species issues, providing technical and administrative support to the Rhode Island Invasive Species Council, participating in the development of an introduced species monitoring framework, and participating in national and regional efforts to control invasive species. While there might be one lead agency for coordination purposes, this should not necessarily prevent other agencies from taking on important roles in addressing this issue.

The State of Rhode Island should coordinate and cooperate with neighboring states on ballast water management.

Rhode Island shares Mt. Hope Bay with the Commonwealth of Massachusetts. At the head of Mt. Hope Bay is the city of Fall River and its regionally important port facility. In order to achieve consistent management of ballast water and to prevent gaps in ecosystem protection, Rhode Island should work with appropriate governmental and nongovernmental parties involved in port and shipping activities in the Massachusetts section of Narragansett Bay. Coordination at the regional level should be encouraged and supported.

The State of Rhode Island should institute a State program to monitor status of introduced species and to identify new invasions, coordinated through the Coastal Institute at the University of Rhode Island.

The State's ability to assess risk from introduced species and to prepare eradication programs will depend on sufficient data on the status of existing introduced species and the identification of new introductions. Continuous monitoring data also will allow the State to evaluate existing and new management actions. This effort could build upon the baseline introduced species data from the 2000 Rapid Assessment Survey. Because the Coastal Institute is engaged in scientific research, ecological monitoring and development of ecological indicators, it is well suited to serve as a coordination center for introduced species monitoring and related research.

The Rhode Island Invasive Species Council should be expanded to include estuarine and marine interests to more effectively address plant, animal, and bacterial introductions into terrestrial and estuarine ecosystems.

The Rhode Island Invasive Species Council was created informally in early 2000 and has been primarily focused on terrestrial and freshwater introduced species. This Council intends to collect and publish a list of invasive plants in Rhode Island. While this is a proactive and needed effort, it should include the broad range of introduced species (plant, freshwater and estuarine/marine) and include representation of the various organizations that deal with this problem.

The State of Rhode Island should consider pursuing the development of options for ballast water controls as well as the larger issue of introduced and invasive species through the Coastal Institute at the University of Rhode Island.

The Rhode Island Invasive Species Council should also be affiliated with an entity that can help support its work. Because the nature of the introduced species problem crosses land, fresh and salt water environments in our coastal watersheds; and because it will require close coordination of management and research entities, the Coastal Institute at the University of Rhode Island could serve a key coordination and support role for efforts to prevent the introduction of non-native species to the State. The Coastal Institute has been proven to be an effective and neutral venue to bring scientists, resource managers and resource users together to help develop solutions for ecological problems.

The State of Rhode Island should ensure that the appropriate representatives from the Rhode Island Invasive Species Council be involved in the Northeast Regional Invasive Species Council and participate in the Panel working committees.

Under the provisions of the National Invasive Species Act (NISA) of 1996, the National Council is creating regional panels to ensure that invasive species activities are coordinated nationwide and that regional perspectives are accounted for. In the last year, a Northeast Panel has been convened and has met twice. The Panel deals with all aspects of invasive species (land, fresh and salt water) including research issues and education/outreach. The Panel has also convened several issue-specific working committees as part of the development of a coordinated action agenda. Rhode Island involvement, covering all aspects of introduced species, in the Panel would ensure that state concerns are addressed in national initiatives and would be a conduit to bring policy and technical information to Rhode Island decision-makers.

The State of Rhode Island should provide or secure funding and resources to develop a State Aquatic Nuisance Species Management Plan.

Federal funds have been made available to the states through the National Invasive Species Council for the development of state aquatic nuisance species (ANS) management plans. Massachusetts (R.I.'s partner on the Narragansett Bay Rapid Assessment Survey for Introduced Species) has completed a draft ANS plan. These plans address all the transport vectors (from research activities, aquaria, plant nurseries, live and processes seafood, aquaculture, and intentional releases) for introduced species including ballast water introductions. The R.I. Invasive Species Council, with the support of the Coastal Institute, could coordinate securing funding and the development of the plan itself. By working through the Northeast Regional Invasive Species Panel, the plan would also be coordinated with plans from the other New England states.

GLOSSARY

Ballast Water: Ballast water is fresh or salt water "placed in a ship to increase the draft, change the trim, regulate the stability, or maintain stress loads within acceptable limits, including sediments which accumulate in ballast tanks and holds." National Research Council, 1996).

Dinoflagellates: Floating microscopic plants which exhibit a great diversity of form. Though not large by human standards, these creatures often have a big impact on the environment around them. The most dramatic effect of dinoflagellates on life around them comes from the coastal marine species which "bloom" during the warm months of summer. These species reproduce in such great numbers that the water may appear golden or red, producing a "red tide". When this happens many kinds of marine life suffer, for the dinoflagellates produce a neurotoxin that affects muscle function in susceptible organisms. Humans may also be affected by eating fish or shellfish containing the toxins. The resulting diseases include ciguatera (from eating affected fish) and paralytic shellfish poisoning, or PSP (from eating affected shellfish, such as clams, mussels, and oysters); they can be serious, causing neurological and other effects, but are not usually fatal.

Fouling Organisms: Animals and plants, such as barnacles, mussels, and seaweeds, that attach to man-made substrates, such as piers, navigation buoys, and the bottoms of ships (Carlton, 2001).

Introduced Species: Nonindigenous (non-native) species that are defined as any species or other viable biological material that, due to human activity, enters an ecosystem beyond its historic range, including any such organism transferred from one country into another (National Research Council, 1996).

Invasive Species: These are subset of introduced species that have the ability to aggressively establish a presence and are "likely to cause economic or environmental harm or harm to human health" (National Invasive Species Council, 1990). It has been estimated that approximately 15% of introduced species to the U.S. fall into the invasive category (U.S. Congress. 1993).

NOBOB (No Ballast On Board): A category of shipping vessel that is considered to have little or no pumpable ballast and therefore exempt from ballast exchange requirements; however, these vessels still have amounts of un-pumpable ballast water in their tanks (remaining ballast water below the intake/discharge pipe opening). When small-volume intakes and discharges take place for ship trim and stability purposes, organisms and bacteria in the remaining sediments and water can be resuspended and discharged.

Rapid Assessment Survey (RAS): As used in this report, a scientific survey that samples numerous sites across a study area to determine the presence, extent and variety of introduced species.

Sea Chest: An opening for supplying seawater to condensers, pumps, etc., and for discharging water from the ship's water systems to the sea. It is a cast or built-up structure located in the hull below the waterline, having means for the attachment of the associated piping. A suction sea chest is fitted with strainers or gratings, and sometimes has a lip that forces water into the sea chest when the ship is underway.

Vector: A variety of human activities that cause species transport including intentional and unintentional introduction via aquaculture (movement of commercial oysters) or aquaria discharge, use of non-native species as bait, attachment to anchor chains, and transport in sea chests (below-the-waterline ship compartments used for intake of water for cooling and sanitary purposes). These pathways are termed vectors for introduced species.

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S T A T E O F R H O D E I S L A N D

IN GENERAL ASSEMBLY

JANUARY SESSION, A.D. 2001

A N A C T

RELATING TO WATERS AND NAVIGATION - BALLAST WATER

Introduced By: Representatives Henseler, Benson, Carter, George and Naughton
Date Introduced: June 14, 2001
Referred To: Jt. Committee on Environment and Energy

It is enacted by the General Assembly as follows:

SECTION 1. Title 46 of the General Laws entitled "Waters and Navigation" is hereby amended by adding thereto the following chapter:

CHAPTER 17.3
BALLAST WATER

46-17.3-1. Legislative findings. -- (a) The General Assembly finds that:

(1) The waters of the state are a precious, irreplaceable resource essential to the environment, commerce, and recreation of citizens and tourists of the state;

(2) Non-indigenous aquatic species introduced into waters of the United States from ballast water have caused tremendous environmental and ecological damage, displacing native species, degrading water quality, and interfering with commerce, including the zebra mussel brought into the Great Lakes and the upper Susquehanna River;

(3) Ballast water practices of commercial shipping vessels may cause irreversible damage to waters of the state; and

(4) Protective measures against the introduction of non-indigenous aquatic species from ballast water are necessary to minimize exposure of the waters of the state to unwanted contamination and damage caused by these species.

46-17.3-2. Purpose. -- (a) The purpose of this act is to commence the process of developing a ballast water management program in Rhode Island by : (1) calling upon the department of

environmental management to investigate and evaluate all relevant state, federal and international laws and policies relating to invasive species management generally and ballast water management specifically; and (2) directing the department of environmental management to report to the general assembly no later than January 15, 2002, regarding the results of said investigation, along with recommended options for establishing a ballast water management program in Rhode Island.

(b) In carrying out the purposes of this chapter, the department of environmental management shall coordinate with all relevant agencies and organizations, including but not limited to: the International Maritime Organization, the U.S. Coast Guard, the U.S. Environmental Protection Agency, the National Oceanographic and Atmosphere Administration, the U.S. Department of Interior, the RI Coastal Resources Management Council, the RI Economic Development Corporation, the University of Rhode Island, commercial shipping interests and environmental organizations.

SECTION 2. This act shall take effect upon passage.

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LC03381/SUB A
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EXPLANATION
BY THE LEGISLATIVE COUNCIL
OF

A N A C T

RELATING TO WATERS AND NAVIGATION - BALLAST WATER

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This act would authorize the department of environmental management to commence the process of developing a ballast water management program for Rhode Island.

This act would take effect upon passage.

APPENDIX C. – NEW ENGLAND AND RHODE ISLAND KNOWN SPECIES INTRODUCTIONS

(From Tzankova 2000 and RI Rapid Assessment Survey results 2001)

Table 1C: Summary of Invasions in New England from 1960 to 1997, By Decade[1]

Praunus flexuosus	1960	
Haplosporidium nelsoni	1967	(Rhode Island presence)
Balanus subalbidus	1972	
Botrylloides diegensis	1972	(Rhode Island presence)
Styela clava	1973	(Rhode Island presence)
Teredo bartschi	1975	
Ostrea edulis	1982	(Rhode Island presence)
Ascidiella aspersa	1985	(Rhode Island presence)
Diplosoma listerianum	1985	(Rhode Island presence)
Antithamnion nipponicum	1986	(Rhode Island presence)
Membranipora membranacea	1987	(Rhode Island presence)
Tritonia plebeia	1987	
Rangia cuneata	1988	
Perkinsus marinus	1990	(Rhode Island presence)
Bonamia ostrea	1991	(Rhode Island presence)
Dreissena polymorpha	1993	
Hemigrapsus sanguineus	1993	(Rhode Island presence)
Bugula neritina	1993	
Grateloupia doryphora	1996	(Rhode Island presence)
Convoluta convoluta	1996	
Palicid crab	1997	(Rhode Island presence)

from Carlton, J. T. 2000. Marine bioinvasions of the Northwest Atlantic Ocean: Bay of Fundy to Long Island Sound. Monograph in preparation.

[1] Entire table from Carlton, 2000b.

Table 2C: Marine and Estuarine Invasions of New England from 1960 through the 1990s (With common names, and arranged chronologically)[2]

Species	Origin	Vector[3]	First New England Record
Praunus flexuosus European opossum shrimp	Europe	BW	1960, Cape Cod
Haplosporidium nelsoni Protist: MSX (oyster disease)	Southern U.S.	COM	1967, Massachusetts
Balanus subalbidus Barnacle	Southern U.S. ?	BW / SF	1972, Charles River, Boston MA
Botrylloides diegensis California Compound Sea Squirt	California	IR	1972, Cape Cod
Styela clava Japanese Stalked Sea Squirt (probably introduced from Europe, where it arrived from Asia in the early 1950s)	Japan	BW / SF	1973, Long Island Sound
Teredo bartschi Shipworm (likely derived from populations in Southern U.S.)	Indo-Pacific	SF	1975, Long Island
Ostrea edulis European flat oyster (IR in Maine in 1940s,but expanding across New England in 1980s-1990s)	Europe	IR?	1982, Rhode Island
Ascidiella aspersa European Recumbent Sea Squirt	Europe	BW / SF	1985, Cape Cod
Diplosoma listerianum Flat Compound Sea Squirt	Europe?	SF	1985, Cape Cod
Antithamnion nipponicum Japanese red alga (probably introduced from Mediterranean, although native to Japan)	Japan	BW / SF	1986, Long Island Sound
Membranipora membranacea Kelp Bryozoan	Europe	BW	1987 Gulf of Maine
Tritonia plebeia European Nudibranch	Europe	BW	1987 Gulf of Maine

[2] Entire table from Carlton, 2000b; cited references: Carlton, J. T. 1993; Carlton, J. T. 1999; Harvey, Alan W. and Christopher B. Boyko. Manuscript; Rivest, Brian, James Coyer and Seth Tyler. 1999.

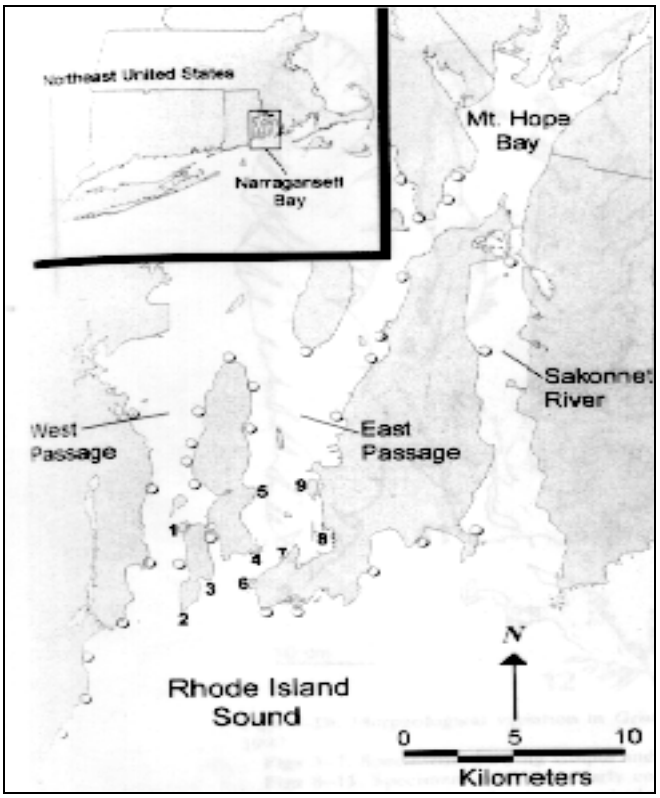
[3] **Vectors**

BW	=	ballast water
SF	=	ship fouling
IR	=	intentional release
COM	=	commercial shellfish movements

Rangia cuneata Atlantic Rangia	South U.S.	BW	1988, Hudson River
Perkinsus marinus Protist: DERMO (oyster disease)	Southern U.S.	COM	1990, Mass.
Bonamia ostrea Protist: BONAMIA (oyster disease)	Southern U.S.	COM	1991, Maine
Dreissena polymorpha Zebra mussel (in oligohaline waters, arriving by dispersal down the Hudson River from the Great Lakes, to where it was introduced by BW in the mid 1980s)	Eurasia	BW	1992, Hudson River
Hemigrapsus sanguineus Japanese Shore Crab (probably by natural larval dispersal from New Jersey, where it was first found in 1988)	Japan	BW	1993, Long Island Sound
Bugula neritina Purple Bryozoan	Europe?	BW / SF	1993, Long Island Sound
Grateloupia doryphora Red Alga	Europe?	BW / SF	1996, Narragansett Bay
Convoluta convoluta European flatworm	Europe	BW	1996, Gulf of Maine
Palicid crab Indo-Pacific crab (established?)	Indo-Pacific	BW	1997, Newport, Rhode Island

From Carlton, J. T. 2000b. Marine bioinvasions of the Northwest Atlantic Ocean: Bay of Fundy to Long Island Sound. Monograph in preparation.

Figure1C: Locations of *Grateloupia doryphora* populations in Narragansett Bay, Rhode Island (July 1996 – March 1997)



From Villalard-Bohnsack, M., and M. Harlin. 1997. The appearance of *Grateloupia doryphora* (Halymeniaceae, Rhodophyta) on the northeast coast of North America. *Phycologia*, **36**: 324-328.

Locations:

Fort Getty (1), Beaver Tail Park (2), Hull Cove (3), Fort Wetherill (4), Taylor Point (5), Castle Hill (6), Fort Adams (7), Goat Island and Newport Harbor (8), Coasters Harbor Island (9);

Table 3C Introduced Species and Approximate Locations
(from unpublished RIRAS data and analyses by Neils Hob)

Species	First Report, Origin	Abundance & Distribution (#sites)
Algae		
Codium fragile tomentosoides	1957, W.Pacific	uncommon- central/lower bay (3)
Grateloupia doryphora	1996, W.Pacific	uncommon- lower bay (1)
Porifera		
Halichondria bowerbankia	1958, Europe	Common- throughout bay (8)
Cnidaria		
Cordylophora caspia	1860, E.Europe	rare- upper bay (1)
Garveia franciscana	1950, E. Pacific	rare- upper bay (1)
Diadumene lineata	1892, probably Asia	Common- throughout bay (7)
With 8 probable cryptogenic spp. In the following genera: *Laomedea, Clytia, Obelia, Gonothyraea, Halecium, Dynamena.*		
Lophophorates (bryozoa, ectoprocta, etc.)		
Bowerbankia sp.	probable	Common- central & lower bay (5)
Bugula neritina	1993, Pacific	uncommon- lower bay (1)
Conopeum sp.	probable	uncommon- upper & central bay (6)
Barentsia sp.	probable	rare- upper bay (1)
With 6 probable cryptogenic spp. in the following genera: *Aeverillia, Bowerbankia, Bugula and Cryptosula*		
Mollusca		
Littorina littorea	1840, Europe, but possibly native before ~1200AD.	Common- throughout bay (7)
Arthropoda		
Chthamalus fragilis	1898, Central Atlantic	uncommon- central bay (1)
Caprella mutica	1990's, Japan	Common- central & lower bay (6)
Corophium spp.	probable (4 spp.*)	uncommon- thoughout bay (7)
Carcinus maenas	1841, Europe	Common- thoughout bay (6)
Hemigrapsus sanguineus	1988, W. Pacific	Common- central & lower bay (8)
Ianiropsis sp.	Recent, Unknown	uncommon- central & lower bay (2)
* atleast one locally found species of *Corophium* is introduced, the others are probably cryptogenic, and two other cryptogenics in *Jassa* and *Paracaprella*		
Ascidiacea		
Botrylloides violaceus	1972, W.Pacific	Common- throughout bay (8)
Botryllus schlosseri	1838, Europe?	uncommon- throughout bay (7)
Diplosoma listerianum	1981, uncertain	rare- lower bay (1)
Ascidiella aspersa	1983, Europe	uncommon- central & lower bay (6)
Molgula manhattensis	1838, Europe	rare- throughout bay (8)
Styela clava	1970, Pacific	uncommon- central & lower bay (6)
Styela canopus	1852, W. Pacific	rare- central bay (2)
With 2 probable cryptogenic species: *Didemnum candidum* and *Ciona intestinalis*		

APPENDIX D. – STATES BALLAST WATER LEGISLATION

State of California

BILL NUMBER: AB 703 CHAPTERED
BILL TEXT

CHAPTER 849
FILED WITH SECRETARY OF STATE OCTOBER 10, 1999
APPROVED BY GOVERNOR OCTOBER 8, 1999
PASSED THE ASSEMBLY SEPTEMBER 9, 1999
PASSED THE SENATE SEPTEMBER 8, 1999
AMENDED IN SENATE SEPTEMBER 7, 1999
AMENDED IN SENATE AUGUST 18, 1999
AMENDED IN SENATE AUGUST 17, 1999
AMENDED IN SENATE JULY 6, 1999
AMENDED IN ASSEMBLY MAY 28, 1999
AMENDED IN ASSEMBLY APRIL 27, 1999
AMENDED IN ASSEMBLY APRIL 5, 1999

INTRODUCED BY Assembly Member Lempert
(Coauthors: Assembly Members Aroner and Corbett)
(Coauthor: Senator Alpert)

FEBRUARY 24, 1999

An act to add and repeal Division 36 (commencing with Section 71200) of the Public Resources Code, relating to ballast water.

LEGISLATIVE COUNSEL'S DIGEST

AB 703, Lempert. Ballast water.

Existing law requires the Department of Fish and Game to adopt the International Maritime Organization's "Guidelines for Preventing the Introduction of Unwanted Aquatic Organisms and Pathogens from Ships' Ballast Water and Sediment Discharges" as the policy of the state to prevent the introduction and spread of aquatic nuisance species into any river, estuary, bay, or coastal area through the exchange of ballast water of vessels prior to entering those waters and to adopt a ballast water control report form to monitor compliance with those guidelines.

This bill, with certain exceptions, would require the master, operator, or person in charge of a vessel to employ prescribed ballast water management practices for ballast water carried into the waters of the state from areas outside the exclusive economic zone, as defined. The bill would require those persons to take certain actions to minimize the uptake and release of nonindigenous species. The bill would require the master, owner, operator, agent, or person in charge of a vessel carrying ballast water into waters of the

state after operating outside the exclusive economic zone to provide the State Lands Commission, and maintain on board the vessel, specified information.

The bill would require the State Lands Commission to take samples of ballast water and sediment and to take other action to assess the compliance of any vessel with prescribed requirements. The bill would prohibit, unless required by federal law, any state agency from imposing requirements different from those contained in the bill relating to the discharge of ballast water for the purpose of limiting the introduction of nonindigenous species prior to January 1, 2004. The bill would, on or before December 1, 2002, require the State Water Resources Control Board to evaluate alternatives for managing ballast water, as specified. The bill would require the Department of Fish and Game to conduct a study relating to resident nonindigenous species populations, as prescribed. The bill would, on or before September 1, 2002, require the State Lands Commission to submit to the Legislature, and make available to the public, a report relating to ballast water. The bill would require the state board, the State Lands Commission, and the Department of Fish and Game to conduct prescribed research.

The bill would subject a person who fails to comply with the ballast water management program required to be undertaken by the bill with prescribed civil penalties. The bill would require the State Lands Commission to establish fees not to exceed $1,000 per vessel, as specified. The bill would require the money generated by the imposition of the fees and the penalties to be deposited in the Exotic Species Control Fund, which the bill would create. The money in the fund, upon appropriation by the Legislature, would be available to carry out the ballast water management program, as described above.

The provisions of this bill would be repealed on January 1, 2004.

THE PEOPLE OF THE STATE OF CALIFORNIA DO ENACT AS FOLLOWS:

SECTION 1. Division 36 (commencing with Section 71200) is added to the Public Resources Code, to read:

DIVISION 36. BALLAST WATER MANAGEMENT FOR CONTROL OF NONINDIGENOUS SPECIES

CHAPTER 1. GENERAL PROVISIONS

71200. Unless the context otherwise requires, the following definitions govern the construction of this division:

(a) "Ballast tank" means any tank or hold on a vessel used for carrying ballast water, whether or not the tank or hold was designed for that purpose.

(b) "Ballast water" means any water and suspended matter taken on board a vessel to control or maintain trim, draft, stability, or stresses of the vessel, without regard to the manner in which it is

carried.

(c) "EEZ" means exclusive economic zone, which extends from the baseline of the territorial sea of the United States seaward 200 miles.

(d) "Exchange" means to replace the water in a ballast tank using either of the following methods:

(1) "Flow through exchange," means to flush out ballast water by pumping in mid-ocean water at the bottom of the tank and continuously overflowing the tank from the top until three full volumes of water have been changed to minimize the number of original organisms remaining in the tank.

(2) "Empty/refill exchange," means to pump out, until the tank is empty or as close to 100 percent as the master or operator determines is safe to do so, the ballast water taken on in ports, or estuarine or territorial waters, then refilling the tank with mid-ocean waters.

(e) "Mid-ocean waters" means waters that are more than 200 nautical miles from land and at least 2,000 meters (6,560 feet, 1,093 fathoms) deep.

(f) "Nonindigenous species" means any species or other viable biological material that enters an ecosystem beyond its historic range, including any such organism transferred from one country into another.

(g) "Person" means any individual, trust, firm, joint stock company, or corporation, including, but not limited to, a government corporation, partnership, or association.

(h) "Sediments" means any matter settled out of ballast water within a vessel.

(i) "Waters of the state" means any surface waters, including saline waters, that are within the boundaries of the state.

(j) "Voyage" means any transit by a vessel destined for any California port from a port or place outside the EEZ, including intermediate stops at a port or place within the EEZ. For the purposes of this division, a transit by a vessel from a United States port to any other United States port, if at any time the vessel operates outside the EEZ or equivalent zone of Canada, is also a voyage.

71201. (a) This division applies to all vessels, United States and foreign, carrying ballast water into the waters of the state after operating outside the EEZ, except those vessels described in Section 71202.

(b) This division applies to all ballast water and associated sediments taken on a vessel in areas less than 200 nautical miles from any shore, or with water that is less than 2,000 meters (6,560 feet, 1,093 fathoms) deep.

71201.5. This division does not authorize the discharge of oil or noxious liquid substances in a manner prohibited by state, federal or international laws or regulations. Ballast water carried in any tank containing a residue of oil, noxious liquid substances, or any other pollutant shall be discharged in accordance with the applicable requirements.

71202. This division does not apply to any of the following vessels:

(a) A crude oil tanker engaged in the coastwise trade, as implemented by the United States Coast Guard in accordance with the National Invasive Species Act of 1996.

(b) A passenger vessel equipped with a functioning treatment system designed to kill nonindigenous species in the ballast water if both of the following apply:

(1) The State Lands Commission has determined that the system is at least as effective as ballast water exchange at reducing the risk of transfer of nonindigenous species in the ballast water of passenger vessels.

(2) The master, operator, or person in charge of the vessel operates, or ensures the operation of, the treatment system as designed.

(c) A vessel of the United States Department of Defense or United States Coast Guard subject to the requirements of Section 1103 of the National Invasive Species Act of 1996, or any vessel of the armed forces, as defined in Section 1322(a)(14) of Title 33 of the United States Code that is subject to the "Uniform National Discharge Standards for Vessels of the Armed Forces" pursuant to Section 1322 (n) of Title 33 of the United States Code.

(d) A vessel that discharges ballast water or sediments only at the location where the ballast water or sediments originated, if the ballast water or sediments do not mix with ballast water or sediments from areas other than mid-ocean waters.

(e) A vessel in innocent passage, which is a foreign vessel merely traversing the territorial sea of the United States and not entering or departing a United States port, or not navigating the internal waters of the United States. However, it is the intent of the Legislature that a vessel described in this subdivision does not discharge ballast water into the waters of the state, or into waters that may impact waters of the state, unless the vessel meets the requirements of Section 71204.

CHAPTER 2. BALLAST WATER MANAGEMENT REQUIREMENTS

71203. (a) The master, operator, or person in charge of a vessel is responsible for the safety of the vessel, its crew, and its passengers.

(b) (1) The master, operator, or person in charge of a vessel is not required by this division to conduct a ballast water management practice, including exchange, if the master determines that the practice would threaten the safety of the vessel, its crew, or its passengers because of adverse weather, vessel design limitations, equipment failure, or any other extraordinary conditions.

(2) If a determination described in paragraph (1) is made, it is the intent of the Legislature that the master, operator, or person in charge of the vessel consider taking all feasible measures that do not compromise the safety of the vessel to minimize the discharge of ballast water containing nonindigenous species into the waters of the

state, or waters that may impact waters of the state.

(c) Nothing in this division relieves the master, operator, or person in charge of a vessel of the responsibility for ensuring the safety and stability of the vessel or the safety of the crew and passengers, or any other responsibility.

71204. (a) Subject to Section 71203, the master, operator, or person in charge of a vessel shall employ at least one of the following ballast water management practices for ballast water carried into the waters of the state from areas outside the EEZ:

(1) Exchange ballast water outside the EEZ, from an area not less than 200 nautical miles from any shore, and in waters more than 2,000 meters (6,560 feet, 1,093 fathoms) deep, before entering the waters of the state.

(2) Retain the ballast water on board the vessel.

(3) Use an alternative environmentally sound method of ballast water management that has been approved by the State Lands Commission before the vessel begins the voyage, and that is at least as effective as ballast water exchange in removing or killing nonindigenous species.

(4) Discharge ballast water to an approved reception facility.

(5) Under extraordinary conditions, conduct a ballast water exchange within an area agreed to by the State Lands Commission at the time of the request.

(b) Subject to Section 71203, the master, owner, operator, or person in charge of all vessels equipped with ballast water tanks that operate in the waters of the state shall do all of the following to minimize the uptake and the release of nonindigenous species:

(1) Avoid the discharge or uptake of ballast water in areas within or that may directly affect marine sanctuaries, marine preserves, marine parks, or coral reefs.

(2) Minimize or avoid uptake of ballast water in all of the following areas and circumstances:

(A) Areas known to have infestations or populations of harmful organisms and pathogens.

(B) Areas near a sewage outfall.

(C) Areas near dredging operations.

(D) Areas where tidal flushing is known to be poor or times when a tidal stream is known to be more turbid.

(E) In darkness when bottom-dwelling organisms may rise up in the water column.

(F) Where propellers may stir up the sediment.

(3) (A) Clean the ballast tanks regularly to remove sediments.

(B) Clean the ballast tanks in mid-ocean waters or under controlled arrangements in port, or at drydock.

(C) Dispose of sediments in accordance with local, state, and federal law.

(4) Discharge only the minimal amount of ballast water essential for vessel operations while in the waters of the state.

(5) Rinse anchors and anchor chains when retrieving the anchor to remove organisms and sediments at their place of origin.

(6) Remove fouling organisms from hull, piping, and tanks on a

regular basis and dispose of any removed substances in accordance with local, state, and federal law.

(7) Maintain a ballast water management plan that was prepared specifically for the vessel.

(8) Train the master, operator, person in charge, and crew, on the application of ballast water and sediment management and treatment procedures.

71205. (a) (1) The master, owner, operator, agent, or person in charge of a vessel carrying ballast water into the waters of the state after operating outside the EEZ shall provide the information described in subdivision (c) in electronic or written form to the State Lands Commission before the vessel departs from the first port of call in California.

(2) The information described in subdivision (c) shall be submitted using the form developed by the United States Coast Guard pursuant to the National Invasive Species Act of 1996.

(b) If the information submitted in accordance with this section changes, an amended form shall be submitted to the State Lands Commission before the vessel departs the waters of the state.

(c) (1) The master, owner, operator, or person in charge of a vessel carrying ballast water into the waters of the state after operating outside the EEZ, shall maintain on board the vessel, in written form, records that include all of the following information:

(A) Vessel information, including all of the following:

(i) Name.

(ii) International Maritime Organization number or official number if the International Maritime Organization number has not been assigned.

(iii) Vessel type.

(iv) Owner or operator.

(v) Gross tonnage.

(vi) Call sign.

(vii) Port of Registry.

(B) Voyage information, including the date and port of arrival, vessel agent, last port and country of call, and next port and country of call.

(C) Ballast water information, including the total ballast water capacity, total volume of ballast water onboard, total number of ballast water tanks, and total number of ballast water tanks in ballast, using units of measurements such as metric tons (MT), cubic meters (m3), long tons (LT), and short tons (ST).

(D) Ballast Water Management, including all of the following information:

(i) The total number of ballast tanks or holds, the contents of which are to be discharged into the waters of the state or to a reception facility.

(ii) If an alternative ballast water management method is used, the number of tanks that were managed using an alternative method, as well as the type of method used.

(iii) Whether the vessel has a ballast water management plan and

International Maritime Organization guidelines on board, and whether the ballast water management plan is used.

(E) Information on ballast water tanks, the contents of which are to be discharged into the waters of the state or to a reception facility, including all of the following:

(i) The origin of ballast water, including the date and location of intake, volume, and temperature. If a tank has been exchanged, the identity of the loading port of the ballast water that was discharged during the exchange.

(ii) The date, location, volume, method, thoroughness measured by percentage exchanged if exchange is conducted, and sea height at time of exchange if exchange conducted, of any ballast water exchanged or otherwise managed.

(iii) The expected date, location, volume, and salinity of any ballast water to be discharged into the waters of the state or a reception facility.

(F) Discharge of sediment and, if sediment is to be discharged within the state, the location of the facility where the disposal will take place.

(G) Certification of accurate information, which shall include the printed name, title, and signature of the master, owner, operator, person in charge, or responsible officer attesting to the accuracy of the information provided and certifying compliance with the requirements of this division.

(H) Changes to previously submitted information.

(2) The master, owner, operator, or person in charge of a vessel subject to this subdivision shall retain a signed copy of the information described in this subdivision on board the vessel for two years.

71206. (a) The State Lands Commission, in coordination with the United States Coast Guard, shall take samples of ballast water and sediment, examine documents, and make other appropriate inquiries to assess the compliance of any vessel subject to this division.

(b) The master, owner, operator, or person in charge of a vessel subject to this division shall make available to the State Lands Commission, upon request of that commission, the records required by Section 71205.

(c) The State Lands Commission, in coordination with the United States Coast Guard, shall compile the information obtained from submitted reports. The information shall be used, in conjunction with existing information relating to the number of vessel arrivals, to assess vessel reporting rates and compliance with the requirements of this division.

71207. (a) This division describes the state program to regulate discharges of ballast water from vessels in order to limit the introduction of nonindigenous species. 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 set forth in this division.

(b) Nothing in this division restricts state agencies from enforcing the provisions of this division.

(c) Any person violating this division is subject to civil liability in accordance with Chapter 5 (commencing with Section 71216).

(e) The State Lands Commission may require any vessel operating in violation of this division to depart the waters of the state and exchange, treat or otherwise manage the ballast water at a location determined by the commission, unless the master determines that the departure or exchange would threaten the safety or stability of the vessel, its crew, or its passengers because of adverse weather, vessel architecture design, equipment failure, or any other extraordinary condition.

CHAPTER 3. RESEARCH AND PROGRAM EVALUATION

71210. (a) The State Water Resources Control Board, in consultation with the Department of Fish and Game, the State Lands Commission, the United States Coast Guard, the regulated industry, and other stakeholders, shall evaluate 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. Whenever possible, the evaluation shall utilize appropriate existing data.

(b) The evaluation shall be completed and submitted to the Legislature and available to the public, on or before December 31, 2002, and shall include, but not be limited to, a description of recommended best available technologies that reflect the greatest degree of reduction in the release of nonindigenous species that is economically feasible, the relative effectiveness of those technologies in minimizing the discharge of nonindigenous species, and the costs of implementing those technologies.

71211. (a) The Department of Fish and Game, in consultation with the State Water Resources Control Board, the State Lands Commission, and the United States Coast Guard, shall conduct a study to establish baseline conditions in the coastal and estuarine waters of the state, which includes an inventory of the location and geographic range of resident nonindigenous species populations. Whenever possible, the study shall utilize appropriate existing data.

(b) The study shall be submitted to the Legislature, and available to the public, on or before December 31, 2002. Information generated by this study shall be of the type and in a format useful for subsequent studies and reports undertaken for any of the following purposes:

(1) The determination of alternative discharge zones.

(2) The identification of environmentally sensitive areas to be avoided for uptake or discharge of ballast water.

(3) The long-term effectiveness of discharge control measures.

(4) The assessment of potential risk zones where uptake shall be prohibited.

71212. Notwithstanding Section 7550.5 of the Government Code, on or before September 1, 2002, the State Lands Commission, in consultation with the State Water Resources Control Board, the

Department of Fish and Game, and the United States Coast Guard, shall submit to the Legislature, and make available to the public, a report that includes, but is not limited to, all of the following:

(a) A summary of the information provided in the ballast water discharge report forms submitted to the State Lands Commission, including the volumes of ballast water exchanged, volumes discharged into state waters, types of ballast water treatment, and locations at which ballast water was loaded and discharged.

(b) Monitoring and inspection information collected by the State Lands Commission pursuant to this division, including a summary of compliance rates, categorized by geographic area and other groupings as information allows.

(c) An analysis of the monitoring and inspection information, including recommendations for actions to be undertaken to improve the effectiveness of the monitoring and inspection program.

(d) An evaluation of the effectiveness of the measures taken to reduce or eliminate the discharge of nonindigenous species from vessels, including recommendations regarding action that should be taken to improve the effectiveness of those measures.

(e) A summary of the research completed during the two-year period that precedes the release of the report, and ongoing research, on the release of nonindigenous species by vessels, including, but not limited to, the research described in Section 71213.

71213. The State Water Resources Control Board, the State Lands Commission, and the Department of Fish and Game shall conduct any research determined necessary to carry out the requirements of this division. The research may relate to the transport and release of nonindigenous species by vessels, the methods of sampling and monitoring of the nonindigenous species transported or released by vessels, the rate or risk of release or establishment of nonindigenous species in the waters of the state and resulting impacts, and the means by which to reduce or eliminate such a release or establishment. The research shall focus on assessing or developing methodologies for treating or otherwise managing ballast water to reduce or eliminate the discharge or establishment of nonindigenous species.

CHAPTER 4. EXOTIC SPECIES CONTROL FUND

71215. (a) The Exotic Species Control Fund is hereby created. The money in the fund, upon appropriation by the Legislature, shall be used to carry out this division.

(b) (1) The State Lands Commission shall establish a reasonable and appropriate fee to carry out this division in an amount not to exceed one thousand dollars ($1,000) per vessel voyage. This amount may be adjusted for inflation every two years.

(2) In establishing fees, the State Lands Commission may establish lower levels of fees and the maximum amount of fees for individual shipping companies or vessels. Any fee schedule established, including the level of fees and the maximum amount of fees, shall take into account the impact of the fees on vessels operating from

California in the Hawaii or Alaska trades, the frequency of calls by particular vessels to California ports within a year, the ballast water practices of the vessels, and other relevant considerations.

(c) The fee shall be collected by the State Board of Equalization from the owner or operator of each vessel that enters a California port with ballast water loaded from outside the EEZ.

(d) Notwithstanding any other provision of law, all fees imposed pursuant to this section shall be deposited into the Exotic Species Control Fund.

(e) Notwithstanding any other provision of law, all penalties and payments collected for violations of any requirements of this division shall be deposited into the Exotic Species Control Fund.

CHAPTER 5. CIVIL PENALTIES

71216. (a) Except as provided in subdivision (b) or (c), any person who intentionally or negligently fails to comply with the requirements of this division may be liable for an administrative civil penalty in an amount which shall not exceed five thousand dollars ($5,000) for each violation. Each day of a continuing violation constitutes a separate violation.

(b) Any person who fails to comply with the reporting requirements set forth in Section 71205 may be liable for an administrative civil penalty in an amount which shall not exceed five hundred dollars ($500) per violation. Each day of a continuing violation constitutes a separate violation.

(c) Any person who, knowingly and with intent to deceive, falsifies a ballast water control report form may be liable for an administrative civil penalty in an amount which shall not exceed five thousand dollars ($5,000) per violation. Each day of a continuing violation constitutes a separate violation.

(d) The employees designated by the Executive Officer of the State Lands Commission may enforce the requirements of this division.

(e) Any violation of this division may be referred by the Executive Officer of the State Lands Commission to the administrator for oil spill response, as appointed by the Governor pursuant to Section 8670.4 of the Government Code, for the purpose of imposing administrative civil penalties.

(f) The administrator may issue a complaint to any person on whom civil liability may be imposed pursuant to this division. Any hearing required shall be conducted pursuant to Section 8670.68 of the Government Code.

CHAPTER 6. REPEAL

71271. This division shall remain in effect only until January 1, 2004, and as of that date is repealed, unless a later enacted statute, that is enacted before January 1, 2004, deletes or extends that date.

State of Washington

Chapter 77.120 RCW
BALLAST WATER MANAGEMENT

SECTIONS

RCW 77.120.005
Findings.

The legislature finds that some nonindigenous species have the potential to cause economic and environmental damage to the state and that current efforts to stop the introduction of nonindigenous species from shipping vessels do not adequately reduce the risk of new introductions into Washington waters.

The legislature recognizes the international ramifications and the rapidly changing dimensions of this issue, and the difficulty that any one state has in either legally or practically managing this issue. Recognizing the possible limits of state jurisdiction over international issues, the state declares its support for the international maritime organization and United States coast guard efforts, and the state intends to complement, to the extent its powers allow it, the United States coast guard's ballast water management program.

[2000 c 108 § 1.]

RCW 77.120.010
Definitions.

The definitions in this section apply throughout this chapter unless the context clearly requires otherwise.

(1) "Ballast tank" means any tank or hold on a vessel used for carrying ballast water, whether or not the tank or hold was designed for that purpose.

(2) "Ballast water" means any water and matter taken on board a vessel to control or maintain trim, draft, stability, or stresses of the vessel, without regard to the manner in which it is carried.

(3) "Empty/refill exchange" means to pump out, until the tank is empty or as close to empty as the master or operator determines is safe, the ballast water taken on in ports, estuarine, or territorial waters, and then refilling the tank with open sea waters.

(4) "Exchange" means to replace the water in a ballast tank using either flow through exchange, empty/refill exchange, or other exchange methodology recommended or required by the United States coast guard.

(5) "Flow through exchange" means to flush out ballast water by pumping in midocean water at the bottom of the tank and continuously overflowing the tank from the top until three full volumes of water have been changed to minimize the number of original organisms remaining in the tank.

(6) "Nonindigenous species" means any species or other viable biological material that enters an ecosystem beyond its natural range.

(7) "Open sea exchange" means an exchange that occurs fifty or more nautical miles offshore. If the United States coast guard requires a vessel to conduct an exchange further offshore, then that distance is the required distance for purposes of compliance with this chapter.

(8) "Recognized marine trade association" means those trade associations in Washington state that promote improved ballast water management practices by educating their members on the provisions of this chapter, participating in regional ballast water coordination through the Pacific ballast water group, assisting the department in the collection of ballast water exchange forms, and the monitoring of ballast water. This includes members of the Puget Sound marine committee for Puget Sound and the Columbia river steamship operators association for the Columbia river.

(9) "Sediments" means any matter settled out of ballast water within a vessel.

(10) "Untreated ballast water" includes exchanged or unexchanged ballast water that has not undergone treatment.

(11) "Vessel" means a self-propelled ship in commerce of three hundred gross tons or more.

(12) "Voyage" means any transit by a vessel destined for any Washington port.

(13) "Waters of the state" means any surface waters, including internal waters contiguous to state shorelines within the boundaries of the state.

[2000 c 108 § 2.]

RCW 77.120.020
Application of chapter.

(1) This chapter applies to all vessels carrying ballast water into the waters of the state from a voyage, except:

(a) A vessel of the United States department of defense or United States coast guard subject to the requirements of section 1103 of the national invasive species act of 1996, or any vessel of the armed forces, as defined in 33 U.S.C. Sec. 1322(a)(14), that is subject to the uniform national discharge standards for vessels of the armed forces under 33 U.S.C. Sec. 1322(n);

(b) A vessel (i) that discharges ballast water or sediments only at the location where the ballast water or sediments originated, if the ballast water or sediments do not mix with ballast water or sediments from areas other than open sea waters; or (ii) that does not discharge ballast water in Washington waters;

(c) A vessel traversing the internal waters of Washington in the Strait of Juan de Fuca, bound for a port in Canada, and not entering or departing a United States port, or a vessel in innocent passage, which is a vessel merely traversing the territorial sea of the United States and not entering or departing a United States port, or not navigating the internal waters of the United States; and

(d) A crude oil tanker that does not exchange or discharge ballast water into the waters of the state.

(2) This chapter does not authorize the discharge of oil or noxious liquid substances in a manner prohibited by state, federal, or international laws or regulations. Ballast water containing oil, noxious liquid substances, or any other pollutant shall be discharged in accordance with the applicable requirements.

(3) The master or operator in charge of a vessel is responsible for the safety of the vessel, its crew, and its passengers. Nothing in this chapter relieves the master or operator in charge of a vessel of the responsibility for ensuring the safety and stability of the vessel or the safety of the crew and passengers.

[2000 c 108 § 3.]

RCW 77.120.030
Authorized ballast water discharge.

The owner or operator in charge of any vessel covered by this chapter is required to ensure that the vessel under their ownership or control does not discharge ballast water into the waters of the state except as authorized by this section.

(1) Discharge into waters of the state is authorized if the vessel has conducted an open sea exchange of ballast water. A vessel is exempt from this requirement if the vessel's master reasonably determines that such a ballast water exchange operation will threaten the safety of the vessel or the vessel's crew, or is not feasible due to vessel design limitations or equipment failure. If a vessel relies on this exemption, then it may discharge ballast water into waters of the state, subject to any requirements of treatment under subsection (2) of this section and subject to RCW 77.120.040.

(2) After July 1, 2002, discharge of ballast water into waters of the state is authorized only if there has been an open sea exchange or if the vessel has treated its ballast water to meet standards set by the department. When weather or extraordinary circumstances make access to treatment unsafe to the vessel or crew, the master of a vessel may delay compliance with any treatment required under this subsection until it is safe to complete the treatment.

(3) The requirements of this section do not apply to a vessel discharging ballast water or sediments that originated solely within the waters of Washington state, the Columbia river system, or the internal waters of British Columbia south of latitude fifty degrees north, including the waters of the Straits of Georgia and Juan de Fuca.

(4) Open sea exchange is an exchange that occurs fifty or more nautical miles offshore. If the United States coast guard requires a vessel to conduct

an exchange further offshore, then that distance is the required distance for purposes of compliance with this chapter.

[2000 c 108 § 4.]

RCW 77.120.040
Reporting and sampling requirements.

The owner or operator in charge of any vessel covered by this chapter is required to ensure that the vessel under their ownership or control complies with the reporting and sampling requirements of this section.

(1) Vessels covered by this chapter must report ballast water management information to the department using ballast water management forms that are acceptable to the United States coast guard. The frequency, manner, and form of such reporting shall be established by the department by rule. Any vessel may rely on a recognized marine trade association to collect and forward this information to the department.

(2) In order to monitor the effectiveness of national and international efforts to prevent the introduction of nonindigenous species, all vessels covered by this chapter must submit nonindigenous species ballast water monitoring data. The monitoring, sampling, testing protocols, and methods of identifying nonindigenous species in ballast water shall be determined by the department by rule. A vessel covered by this chapter may contract with a recognized marine trade association to randomly sample vessels within that association's membership, and provide data to the department.

(3) Vessels that do not belong to a recognized marine trade association must submit individual ballast tank sample data to the department for each voyage.

(4) All data submitted to the department under subsection (2) of this section shall be consistent with sampling and testing protocols as adopted by the department by rule.

(5) The department shall adopt rules to implement this section. The rules and recommendations shall be developed in consultation with advisors from regulated industries and the potentially affected parties, including but not limited to shipping interests, ports, shellfish growers, fisheries, environmental interests, interested citizens who have knowledge of the issues, and appropriate governmental representatives including the United States coast guard.

(a) The department shall set standards for the discharge of treated ballast water into the waters of the state. The rules are intended to ensure that the discharge of treated ballast water poses minimal risk of introducing nonindigenous species. In developing this standard, the department shall consider the extent to which the requirement is technologically and practically feasible. Where practical and appropriate, the standards shall be compatible with standards set by the United States coast guard and shall be developed in consultation with federal and state agencies to ensure consistency with the federal clean water act, 33 U.S.C. Sec. 1251-1387.

(b) The department shall adopt ballast water sampling and testing protocols for monitoring the biological components of ballast water that may be discharged into the waters of the state under this chapter. Monitoring data is intended to assist the department in evaluating the risk of new, nonindigenous species introductions from the discharge of ballast water, and

to evaluate the accuracy of ballast water exchange practices. The sampling and testing protocols must consist of cost-effective, scientifically verifiable methods that, to the extent practical and without compromising the purposes of this chapter, utilize easily measured indices, such as salinity, or check for species that indicate the potential presence of nonindigenous species or pathogenic species. The department shall specify appropriate quality assurance and quality control for the sampling and testing protocols.

[2000 c 108 § 5.]

RCW 77.120.050
Pilot project -- Private sector ballast water treatment operation.

The shipping vessel industry, the public ports, and the department shall promote the creation of a pilot project to establish a private sector ballast water treatment operation that is capable of servicing vessels at all Washington ports. Federal and state agencies and private industries shall be invited to participate. The project will develop equipment or methods to treat ballast water and establish operational methods that do not increase the cost of ballast water treatment at smaller ports. The legislature intends that the cost of treatment required by this chapter is substantially equivalent among large and small ports in Washington.

[2000 c 108 § 6.]

RCW 77.120.060
Report to legislature -- Results of chapter.

The legislature recognizes that international and national laws relating to this chapter are changing and that state law must adapt accordingly. The department shall submit to the legislature, and make available to the public, a report that summarizes the results of this chapter and makes recommendations for improvement to this chapter on or before December 1, 2001, and a second report on or before December 1, 2004. The 2001 report shall describe how the costs of treatment required as of July 1, 2002, will be substantially equivalent among ports where treatment is required. The department shall strive to fund the provisions of this chapter through existing resources, cooperative agreements with the maritime industry, and federal funding sources.

[2000 c 108 § 7.]

RCW 77.120.070
Violation of chapter -- Penalties.

(1) Except as limited by subsection (2) or (3) of this section, the director or the director's designee may impose a civil penalty or warning for a violation of the requirements of this chapter on the owner or operator in charge of a vessel who fails to comply with the requirements imposed under RCW 77.120.030 and 77.120.040. The penalty shall not exceed five thousand dollars for each violation. In determining the amount of a civil penalty, the department shall consider if the violation was intentional, negligent, or without any fault, and shall consider the quality and nature of risks created by the violation. The owner or operator subject to such a penalty may contest the determination by requesting an adjudicative proceeding within twenty days. Any determination not timely contested is final and may be reduced to a judgment enforceable in any court with jurisdiction. If the department prevails using any judicial process to collect a penalty under this section, the department shall also be awarded its costs and reasonable attorneys' fees.

(2) The civil penalty for a violation of reporting requirements of RCW 77.120.040 shall not exceed five hundred dollars per violation.

(3) Any owner or operator who knowingly, and with intent to deceive, falsifies a ballast water management report form is liable for a civil penalty in an amount not to exceed five thousand dollars per violation, in addition to any criminal liability that may attach to the filing of false documents.

(4) The department, in cooperation with the United States coast guard, may enforce the requirements of this chapter.

[2000 c 108 § 8.]

RCW 77.120.080
Legislative review of chapter -- Recommendations.

By December 31, 2005, the natural resources committees of the legislature must review this chapter and its implementation and make recommendations if needed to the 2006 regular session of the legislature.

[2000 c 108 § 9.]

RCW 77.120.900
Severability -- 2000 c 108.

If any provision of this act or its application to any person or circumstance is held invalid, the remainder of the act or the application of the provision to other persons or circumstances is not affected.

State of Oregon – effective January 1, 2002

71st OREGON LEGISLATIVE ASSEMBLY--2001 Regular Session

Enrolled

Senate Bill 895

Sponsored by Senator MESSERLE, Representative KAFOURY; Senators ATKINSON, BROWN, CARTER, DECKERT, GORDLY, SHIELDS, Representatives BECK, BROWN, JENSON, JOHNSON, LEE, MERKLEY, MONNES ANDERSON, VERGER (at the request of Port of Portland, Oregon Ports Group)

CHAPTER .....

AN ACT

Relating to ballast water management; creating new provisions; and amending ORS 783.600.

Whereas the Legislative Assembly finds that aquatic nuisance species have the potential to cause economic and environmental damage to this state and that current national efforts to stop the introduction of aquatic nuisance species through ballast water from shipping vessels do not adequately reduce the risk of new introductions into the waters of this state; and

Whereas the Legislative Assembly finds that no treatment technology currently exists to adequately address the issue of ballast water management and that research into treatment technologies and consistent federal standards must be developed in order to fully address this issue; and

Whereas the Legislative Assembly finds that deep ocean exchange of ballast water is an interim partial solution that is available to ocean-going vessels and has yet to be fully implemented by industry; and

Whereas the Legislative Assembly recognizes the international ramifications and rapidly changing dimensions of this issue and the difficulty that any one state has in legally, cost effectively or practically managing this issue; and

Whereas recognizing the possible limits of state jurisdiction over international issues, the Legislative Assembly declares its support for the efforts of the United Nations International Maritime Organization and the United States Coast Guard; and

Whereas the State of Oregon intends to complement, to the extent practical and cost effective, the United States Coast Guard's ballast water management program and recommend necessary changes and improvements to the United States Coast Guard in the program; and

Whereas the Legislative Assembly recognizes that the State of

Oregon and the State of Washington face certain special legal issues arising from the shared waters of the Columbia River; and

Whereas the Legislative Assembly intends that, when practical and cost effective, implementation of sections 1 to 5 of this 2001 Act shall be coordinated with related rules and regulations adopted by the State of Washington and the State of California; and

Whereas the Legislative Assembly recognizes that ballast water should be managed from the federal level and urges the United States Congress to strengthen the federal ballast water program and, with regional input, apply consistent rules and standards for all waters of the United States; and

Whereas the Legislative Assembly fully intends for this 2001 Act to conform to future federal laws on ballast water management; now, therefore,

Be It Enacted by the People of the State of Oregon:

SECTION 1. { + As used in sections 1 to 5 of this 2001 Act, unless the context requires otherwise:

(1) 'Aquatic nuisance species' means any species or other viable biological material that enters an ecosystem beyond its historic range.

(2) 'Ballast water' means any water and associated sediment used to manipulate the trim and stability of a vessel.

(3) 'Cargo vessel' means a self-propelled ship in commerce, other than a tank vessel or a vessel used solely for commercial fish harvesting, of 300 gross tons or more.

(4) 'Coastal exchange' means replacing the ballast water taken onboard at a North American coastal port in one of the following manners:

(a) For vessels departing from a North American coastal port located south of the parallel 40 degrees north latitude, and traveling northward into the waters of this state, the replacement of ballast water at sea south of the parallel 40 degrees north latitude; or

(b) For vessels departing from a North American coastal port located north of the parallel 50 degrees north latitude, and traveling southward into the waters of this state, the replacement of ballast water at sea north of the parallel 50 degrees north latitude.

(5) 'Department' means the Department of Environmental Quality.

(6) 'Oil' means oil, gasoline, crude oil, fuel oil, diesel oil, lubricating oil, oil sludge, oil refuse and any other petroleum related product.

(7) 'Open sea exchange' means a replacement of ballast water that occurs in an area no less than 200 nautical miles from any shore and where the water depth exceeds 2,000 meters.

(8) 'Passenger vessel' means a ship of 300 gross tons or more carrying passengers for compensation.

(9) 'Sediment' means any matter that settles out of ballast

water.
(10) 'Ship' means any boat, ship, vessel, barge or other floating craft of any kind.
(11) 'Tank vessel' means a ship that is constructed or adapted to carry oil in bulk as cargo or cargo residue other than:
(a) A vessel carrying oil in drums, barrels or other packages;
(b) A vessel carrying oil as fuel or stores for that vessel; or
(c) An oil spill response barge or vessel.
(12) 'Vessel' means a tank vessel, cargo vessel or passenger vessel.
(13) 'Voyage' means any transit by a vessel destined for any Oregon port.
(14) 'Waters of this state' means natural waterways including all tidal and nontidal bays, intermittent streams, constantly flowing streams, lakes, wetlands and other bodies of water in this state, navigable and nonnavigable, including that portion of the Pacific Ocean that is in the boundaries of Oregon. + }

SECTION 2. { + (1) This section and section 3 of this 2001 Act apply to all vessels carrying ballast water into the waters of this state from a voyage, except a vessel that:
(a) Discharges ballast water or sediment only at the location where the ballast water or sediment originated, if the ballast water or sediment are not mixed with ballast water or sediment from areas other than open sea waters;
(b) Does not discharge ballast water in waters of this state;
(c) Traverses only the internal waters of this state;
(d) Traverses only the territorial sea of the United States and does not enter or depart an Oregon port or navigate the waters of this state; or
(e) Discharges ballast water or sediment that originated solely from waters located between the parallel 40 degrees north latitude and the parallel 50 degrees north latitude.
(2) Sections 2 to 4 of this 2001 Act do not authorize the discharge of oil or noxious liquid substances in a manner prohibited by state, federal or international laws or regulations. Ballast water containing oil or noxious liquid substances shall be discharged in accordance with the applicable requirements.
(3) Nothing in this section:
(a) Requires an open sea exchange or coastal exchange if the owner or operator in charge of a vessel determines that performing an open sea exchange or coastal exchange would threaten the safety or stability of the vessel or the safety of the vessel's crew or passengers because of any extraordinary condition, including but not limited to adverse weather, vessel design limitations or equipment failure.
(b) Exempts the owner or operator in charge of a vessel from the reporting requirements under section 4 of this 2001 Act, whether or not ballast water is carried or discharged in the waters of this state. + }

SECTION 3. { + (1) Except as authorized by this section, the discharge of ballast water in the waters of this state is prohibited.

(2) An owner or operator of a vessel may discharge ballast water in the waters of this state:

(a) If the owner or operator has conducted an open sea exchange, or a coastal exchange, if applicable, of ballast water prior to entering the waters of this state; or

(b) Without performing an open sea exchange or a coastal exchange of ballast water if the owner or operator reasonably believes that an exchange would threaten the safety of the vessel or if the exchange is not feasible due to vessel design limitations or equipment failure.

(3) An owner or operator who discharges ballast water in the waters of this state under subsection (2)(b) of this section is subject to the reporting requirements under section 4 of this 2001 Act. + }

SECTION 4. { + (1) Owners or operators of vessels regulated under sections 2 to 4 of this 2001 Act must report ballast water management information to the Department of Environmental Quality at least 24 hours prior to entering the waters of this state. The department may work with maritime associations to establish the manner and form of such reporting.

(2) The department may verify compliance with sections 2 to 4 of this 2001 Act by relying on tests conducted by the United States Coast Guard or on other tests determined to be appropriate by the department. + }

SECTION 5. { + (1) The Director of the Department of Environmental Quality shall establish a task force to study and recommend appropriate changes and additions to sections 2 to 4 of this 2001 Act, including but not limited to changes based upon the following considerations:

(a) Shipping industry compliance with sections 2 to 4 of this 2001 Act;

(b) Practical and cost-effective ballast water treatment technologies;

(c) Appropriate standards for discharge of treated ballast water in waters of this state;

(d) The degree to which open sea exchange and coastal exchange of ballast water decreases the risk of transporting aquatic nuisance species into the waters of Oregon;

(e) The compatibility of sections 2 to 4 of this 2001 Act with new laws enacted by the United States Congress, regulations promulgated by the United States Coast Guard and ballast water management programs established by the States of Washington and California and the Province of British Columbia;

(f) Research requirements for ballast water treatment technology and other areas of concern related to the possible introduction of aquatic nuisance species;

(g) Amendments to the National Invasive Species Act of 1996 (P.L. 104-332) for a single national system of regulation; and

(h) How ballast water management is consistent with and made a part of efforts to eradicate invasive species throughout Oregon.

(2) Subject to available funding from gifts, grants or donations, Portland State University may, from the appropriate department, provide staff and coordination assistance to the task force.

(3) The director shall consider appointing persons to the task force who represent federal, state, State of Washington, maritime, environmental and academic interests.

(4) Two members of the Legislative Assembly appointed jointly by the President of the Senate and the Speaker of the House of Representatives shall act in an advisory capacity to the task force.

(5) The task force shall report its recommendations to the appropriate House of Representatives and Senate committees of the Seventy-second Legislative Assembly by January 2003. + }

SECTION 6. { + The Director of the Department of Environmental Quality shall establish the task force specified in section 5 of this 2001 Act no later than 60 days after the effective date of this 2001 Act. + }

SECTION 7. { + (1) Except as provided in subsection (2) of this section, the Director of the Department of Environmental Quality may impose a civil penalty on the owner or operator of a vessel for failure to comply with the requirements of sections 2 to 4 of this 2001 Act. The penalty imposed under this section may not exceed $5,000 for each violation. In determining the penalty imposed, the director shall consider whether the violation was intentional, negligent or without any fault and shall consider the quality and nature of risks created by the violation. The owner or operator of a vessel subject to such a penalty may contest the determination by requesting a hearing under ORS 183.413 to 183.470.

(2) The civil penalty for a violation of the reporting requirements of section 4 of this 2001 Act may not exceed $500 per violation. + }

SECTION 8. ORS 783.600 is amended to read:

783.600. { - No person, whether an officer of a vessel or not, shall - } { + Except as provided in section 3 of this 2001 Act, a person may not + } discharge the ballast of any vessel into the navigable portions or channels of any of the bays, harbors or rivers of this state, or within the jurisdiction of this state, so as to injuriously affect such portions or channels of such bays, harbors or rivers, or to obstruct navigation thereof.

Passed by Senate May 31, 2001

Passed by House June 7, 2001

State of Michigan (introduced)

SENATE BILL No. 955

Feb. l, 2000, Introduced by Senators SIKKEMA, YOUNG, GOSCHKA, HAMMERSTROM, STILLE, NORTH, GOUGEON, VANREGENMORTER, GAST, BENNET, ROGERS, DUNASKISS, STEIL, MCCOTTER, EMMONS, BULLARD, SCHWARZ, SHUGARS, SCHUETTE, JOHNSON, PETERS and DEBEAUSSAERT and referred to the Committee on Natural Resources and Environmental Affairs.

A bill to amend 1994 PA 451, entitled "Natural resources and environmental protection act," by amending sections 3101 and 3109 (MCL 324.3101 and 324.3109), section 3101 as amended by 1997 PA 29, and by adding sections 3109c and 3109d.

THE PEOPLE OF THE STATE OF MICHIGAN ENACT:

Sec. 3101. As used in this part:

(A) "BALLAST WATER" MEANS WATER AND ASSOCIATED SOLIDS TAKE ON BOARD A VESSEL TO CONTROL OR MAINTAIN TRIM, DRAFT, STABILITY, OR STRESSES ON THE VESSEL, WITHOUT REGARD TO THE MANNER IN WHICH IT IS CARRIED.

(B) "Department" means the department of environmental quality.

(C) "Detroit consumer price index" means the most comprehensive index of consumer prices available for the Detroit area from the United States department of labor, bureau of labor statistics.

(D) "Local unit" means a county, city, village, or township or an agency or instrumentality of any of these entities.

(E) "Municipality" means this state, a county, city, village, or township, or an agency or instrumentality of any of these entities.

(F) "SEDIMENTS" MEANS ANY MATTER SETTLED OUT OF BALLAST WATER WITHIN A VESSEL.

(G) "Sewage sludge" means sewage sludge generated in the treatment of domestic sewage, other than only septage or industrial waste.

(H) "Sewage sludge derivative" means a product for land application derived from sewage sludge that does not include solid waste or other waste regulated under this act.

(I) "Sewage sludge generator" means a person who generates sewage sludge that is applied to land.

(J) "Sewage sludge distributor" means a person who applies, markets, or distributes, except at retail, a sewage sludge derivative.

(K) "STERILIZED" MEANS THE TREATMENT OF BALLAST WATER OR

SEDIMENTS, OR BOTH, BY FILTRATION, THERMAL METHODS, ULTRAVIOLET LIGHT, BIOCIDES, OR OTHER TECHNIQUE APPROVED BY THE DEPARTMENT, TO DESTROY OR REMOVE ALL LIVING BIOLOGICAL ORGANISMS.

(L) "Waters of the state" means groundwaters, lakes, rivers, and streams and all other watercourses and waters within the jurisdiction of this state and also the Great Lakes bordering this state.

Sec. 3109. (1) A person shall not directly or indirectly discharge into the waters of the state a substance that is or may become injurious to any of the following:

(a) To the public health, safety, or welfare.

(b) To domestic, commercial, industrial, agricultural, recreational, or other uses that are being made or may be made of such waters.

(c) To the value or utility of riparian lands.

(d) To livestock, wild animals, birds, fish, aquatic life, or plants, or to the growth , OR propagation OF ANY OF THESE.

(E) TO the value of fish and game.

(2) UNLESS AUTHORIZED BY A PERMIT ISSUED UNDER SECTION 3109C, THE DISCHARGE OF BALLAST WATER OR SEDIMENTS, OR BOTH, DIRECTLY OR INDIRECTLY, INTO ANY OF THE WATERS OF THE STATE SHALL BE CONSIDERED PRIMA FACIE EVIDENCE OF A VIOLATION OF THIS PART AND SUBJECTS THE RESPONSIBLE PERSON TO THE PENALTIES AND REMEDIES PROVIDED IN SECTION 3115.

(3) The discharge of any raw sewage of human origin, directly or indirectly, into any of the waters of the state shall be considered prima facie evidence of a violation of this part by the municipality in which the discharge originated unless the discharge is permitted by A PERMIT OR an order or rule of the department. If the discharge is not the subject of a valid permit issued by the department, a municipality responsible for the discharge may be subject to the PENALTIES AND remedies provided in section 115. If the discharge is the subject of a valid permit issued by the department pursuant to section 3112, and is in violation of that permit, a municipality responsible for the discharge is subject to the penalties AND REMEDIES PROVIDED in section 3115.

(4) Unless authorized by a permit, order, or rule of

the department, the discharge into the waters of this state of any medical waste, as defined in part 138 of the public health 12 code, 1978 PA 14 368, MCL 333.13801 TO 333.13831, is prima facie evidence of a violation of this part and subjects the responsible person to the penalties AND REMEDIES PROVIDED in section 3115.

(5) A violation of this section is prima facie evidence of the existence of a public nuisance and in addition to the PENALTIES AND remedies provided for in this part may be abated according to law in an action brought by the attorney general in a court of competent jurisdiction.

SEC. 3109C. (1) A PERSON SHALL NOT OPERATE A VESSEL ON THE WATERS OF THE STATE THAT CONTAINS BALLAST WATER THAT WAS ACQUIRED OUTSIDE OF THE WATERS OF THE STATE UNLESS THE BALLAST WATER AND ANY SEDIMENTS HAVE BEEN STERILIZED AS REQUIRED BY THE DEPARTMENT.

(2) A PERSON SHALL NOT DISCHARGE BALLAST WATER OR SEDIMENTS, OR BOTH, DIRECTLY OR INDIRECTLY, INTO THE WATERS OF THE STATE UNLESS THE DISCHARGE IS AUTHORIZED BY A PERMIT ISSUED BY THE DEPARTMENT.

(3) AN APPLICATION FOR A PERMIT UNDER THIS SECTION SHALL BE SUBMITTED IN THE MANNER REQUIRED BY THE DEPARTMENT AND SHALL CONTAIN THE INFORMATION REQUIRED BY THE DEPARTMENT AND AN APPLICATION FEE AS PROVIDED IN THIS SECTION.

(4) THE DEPARTMENT SHALL ESTABLISH A BALLAST WATER AND SEDIMENTS INSPECTION PROGRAM THAT ASSURES THAT AQUATIC NUISANCE SPECIES DO NOT ENTER THE WATERS OF THE STATE THROUGH THE DIRECT OR INDIRECT DISCHARGE OF BALLAST WATER OR SEDIMENTS, OR BOTH.

(5) THE DEPARTMENT SHALL ASSESS APPLICATION FEES AND INSPECTION FEES IN AMOUNTS NECESSARY TO IMPLEMENT THIS SECTION. ALL APPLICATION AND INSPECTION FEES RECEIVED BY THE DEPARTMENT UNDER THIS SECTION SHALL BE FORWARDED TO THE STATE TREASURER FOR DEPOSIT INTO THE AQUATIC NUISANCE SPECIES PREVENTION FUND CREATED IN SECTION 3109D.

SEC. 3109D. (1) THE AQUATIC NUISANCE SPECIES PREVENTION FUND IS CREATED WITHIN THE STATE TREASURY.

(2) THE STATE TREASURER MAY RECEIVE MONEY OR OTHER ASSETS FROM ANY SOURCE FOR DEPOSIT INTO THE AQUATIC NUISANCE SPECIES PREVENTION FUND. THE STATE TREASURER SHALL DIRECT THE IN'VESTMENT OF THE AQUATIC NUISANCE SPECIES PREVENTION FUND. THE STATE TREASURER SHALL CREDIT TO THE AQUATIC NUISANCE SPECIES PREVENTION FUND INTEREST AND EARNINGS FROM FUND INVESTMENTS. 4

(3) MONEY IN THE AQUATIC NUISANCE SPECIES PREVENTION FUND AT

THE CLOSE OF THE FISCAL YEAR SHALL REMAIN IN THE FUND AND SHALL NOT LAPSE TO THE GENERAL FUND.

(4) THE DEPARTMENT SHALL EXPEND MONEY FROM THE AQUATIC NUISANCE SPECIES PREVENTION FUND, UPON APPROPRIATION, ONLY TO IMPLEMENT SECTION 3109C

APPENDIX E: RELATED WEB LINKS

Aquatic Plant Management Society, Inc.:	http://www.apms.org
Convention on Biological Diversity:	http://www.biodiv.org
Great Lakes Information Network	http://www.great-lakes.net
Great Lakes Environmental Research Lab	http://www.glerlnoaa.gov
Great Lakes Science Center	http://www.glsc.org
Great Lakes Fisheries Commission	http://www.glfc.org
Great Lakes Panel on Aquatic Nuisance Species	http://www.glc.org/ans/anspanel.html
Nat'l. Aquatic Nuisance Species Clearinghouse	http://www.cce.cornell.edu/aquaticinvaders
Nat'l. Aquatic Nuisance Species Task Force	http://www.anstaskforce.gov
Nat'l. Ballast Water Information Clearinghouse	http://invasions.si.edu/ballast.htm
Nat'l. Invasive Species Council	http://invasivespecies.gov
Pew Oceans Commission Introduced Species in U.S. Coastal Waters Report	http://www.pewoceans.org
Sea Grant Nonindigenous Species Site	http://www.sgnis.org
Smithsonian Environmental Research Center	http://www.serc.si.edu/serc_web_html/research.html
U.S. Army Corps of Engineers Zebra Mussel Research Program	http://www.wes.army.mil/zebra
U.S. Fish & Wildlife Service Invasive Species Program	http://invasives.fws.gov
U.S. Geological Survey – Nonindigenous Aquatic Species	http://nas.er.usgs.gov

APPENDIX F: BALLAST TANK LAYOUT/VOLUMES & RHODE ISLAND SHIPPING DATA

(derived mainly from Tzankova 2000)

Typical vessel types and ballast needs can be classified as shown in Table 1 (From Nat'l. Research Council, 1996).

Table 1F: Typical Vessel Types, Ballast Needs, and Pumping Rates

Ballast Needs[4]	Vessel Types	Typical pumping rates (m^3/h)
Ballast replaces cargo Ballast required in large quantities, primarily for return voyage	Dry bulk carriers	5000 - 10 000
	Ore carriers	10 000
	Tankers	5000 - 20 000
	Liquefied gas carriers	5000 - 10 000
	Oil bulk carriers	10 000 – 15 000
Ballast for vessel control Ballast required in almost all loading conditions to control stability, trim, and heel; For cruise and passenger vessels, ballast also essential in compensating for used fuel and fresh water	Container ships	1000 – 2000
	Ferries	200 - 500
	General cargo vessels	1000 - 2000
	Passenger vessels	200 – 500
	Cruise ships	100 – 300[5]
	Roll-on, Roll-off vessels	1000 – 2000
	Fishing vessels	50
	Fish factory vessels	500
	Military vessels	50 – 100
Ballast for loading and unloading operations Ballast taken on locally in large volumes and discharged in same location	Float-on, Float-off vessels	10 000 – 15 000
	Heavy lift vessels	5000
	Military amphibious assault vessels	5000
	Barge-carrying cargo vessels	1000 - 2000

From National Research Council, 1996. Stemming the tide: controlling introductions of nonindigenous species by ships' ballast water. National Academy Press, Washington, DC. Augmented with additional information from Royal Haskoning, 2001 by Tzankova , 2001.

[4] The three categories of ballast needs are not mutually exclusive, i.e. a vessel in which ballast replaces cargo may also require ballast to control stability.

[5] This information is based on cruise ship ballast data contained in a 2001 report by Royal Haskoning (p. 10), and on a presentation by the California State Lands Commission --http://www.nemw.org/fairfalkner.pdf p. 16. The data is generally consistent with figures generally cited for cruise and passenger vessels in industry reports.

Table 2F: Average ballast capacities, for vessels grouped by major vessel types

Ship type	Average Ballast Capacity	Ballast Range
Bulk carriers	**19 100** MT/ **5 060 000** gallons	**211** MT - **47 000** MT/ **56 000** - **12 400 000** gallons
Tankers	**13 500** MT/ **3 575 000** gallons	**1500** MT - **28 000** MT/ **396 000** - **7 450 000** gallons
Container Ships	**10 600** MT/ **2 800 000** gallons	**3900** MT- **22 200** MT/ **1 020 000** - **5 865 000** gallons
Cruise Ships[6]	**3000** MT / **792 000** gallons	Information not available

Note: Data is from Carlton, J.T., D.Reid, and H. van Leeuwen. 1995, and Royal Haskoning, 2001 as updated by Tzankova, 2001a.

Table 3F. : Vessel traffic data for Narragansett Bay
(Tables 3A-5A from Tzankova, 2000, Appendix 3)

Annual commercial vessel trips on Narragansett Bay, 1985-1996.

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
Freighters	1026	1129	914	828	765	643	1742	304	349	349	1214	557
Tankers	627	729	690	684	661	659	556	522	492	410	380	401
Towing vessels (TV)	3493	4051	3353	3081	3338	3156	2613	2296	1884	2087	2147	1578
Dry Cargo Barges (DCB)	215	259	182	133	868	122	142	169	233	189	151	143
Tank Barges (TB)	1753	1653	1359	1071	1274	1233	909	753	873	791	774	683
TOTAL (all vessel trips)	7114	7821	6498	5797	6906	5813	5962	4044	3831	3826	4666	3362

From Nield, J.A. 1999. Original data from United States Army Corps of Engineers. Annual. *Waterborne Commerce of the U.S. (WCUS) – Vessel Tables.* Navigation Data Center, ACOE. New Orleans, LA.

Table 4F: Towing vessels, dry cargo barges, and tank barges as a percentage of all vessel trips on Narragansett Bay for the period 1985-1996.

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
Towing vessels (TV)	3493	4051	3353	3081	3338	3156	2613	2296	1884	2087	2147	1578
Dry Cargo Barges (DCB)	215	259	182	133	868	122	142	169	233	189	151	143
Tank Barges (TB)	1753	1653	1359	1071	1274	1233	909	753	873	791	774	683
TV+DCB+TB total	5461	5963	4894	4285	5480	4511	3664	3218	2990	3067	3072	2404
All vessel trips - TOTAL	7114	7821	6498	5797	6906	5813	5962	4044	3831	3826	4666	3362
TV+DCB+TB as % of all vessel trips/yr	**77%**	**76%**	**75%**	**74%**	**78%**	**78%**	**61%**	**80%**	**78%**	**80%**	**66%**	**72%**

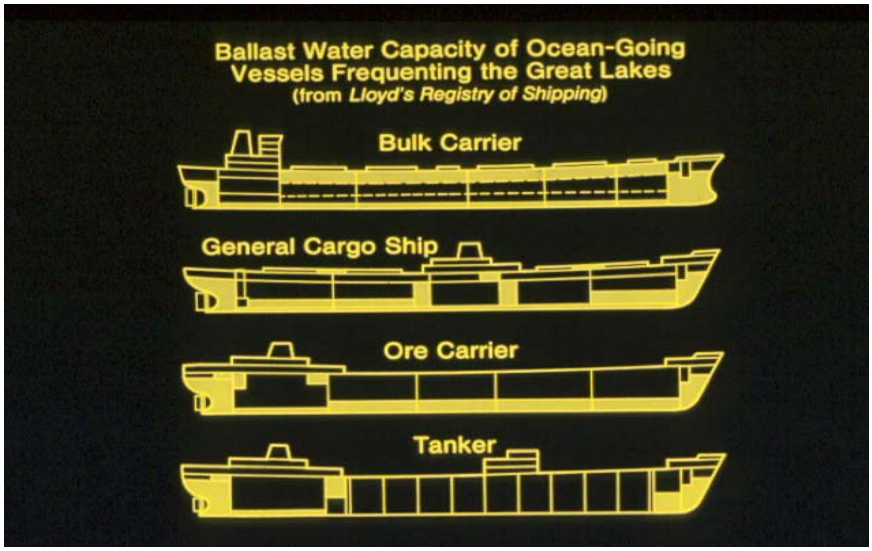
From Nield, J.A. 1999.. Original data from United States Army Corps of Engineers. Annual. *Waterborne Commerce of the U.S. (WCUS) – Vessel Tables.* Navigation Data Center, ACOE. New Orleans, LA.

Table 5F: Number of foreign and domestic vessel arrivals in Narragansett Bay, 1995-1999

	1995	**1996**	**1997**	**1998**	**1999**
# foreign vessel arrivals	185	243	222	202	189
# domestic vessel arrivals	99	127	160	123	94
TOTAL	284	370	382	325	283

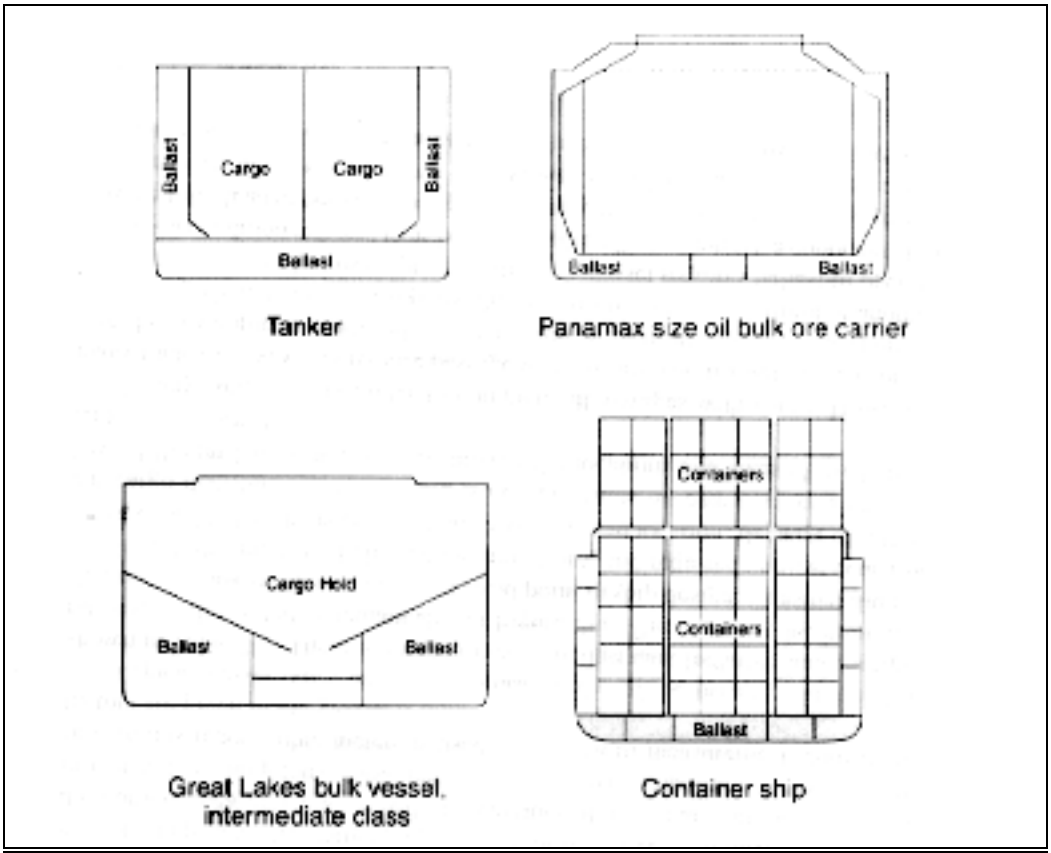
Data from MARAD database, data on vessel arrivals to ports in Narragansett Bay, including Fall River; data provided by Whitman Miller, SERC Ballast Water Clearinghouse on April 4, 2000.

Figure 1F: Ballast water (in white) of various oceangoing vessels



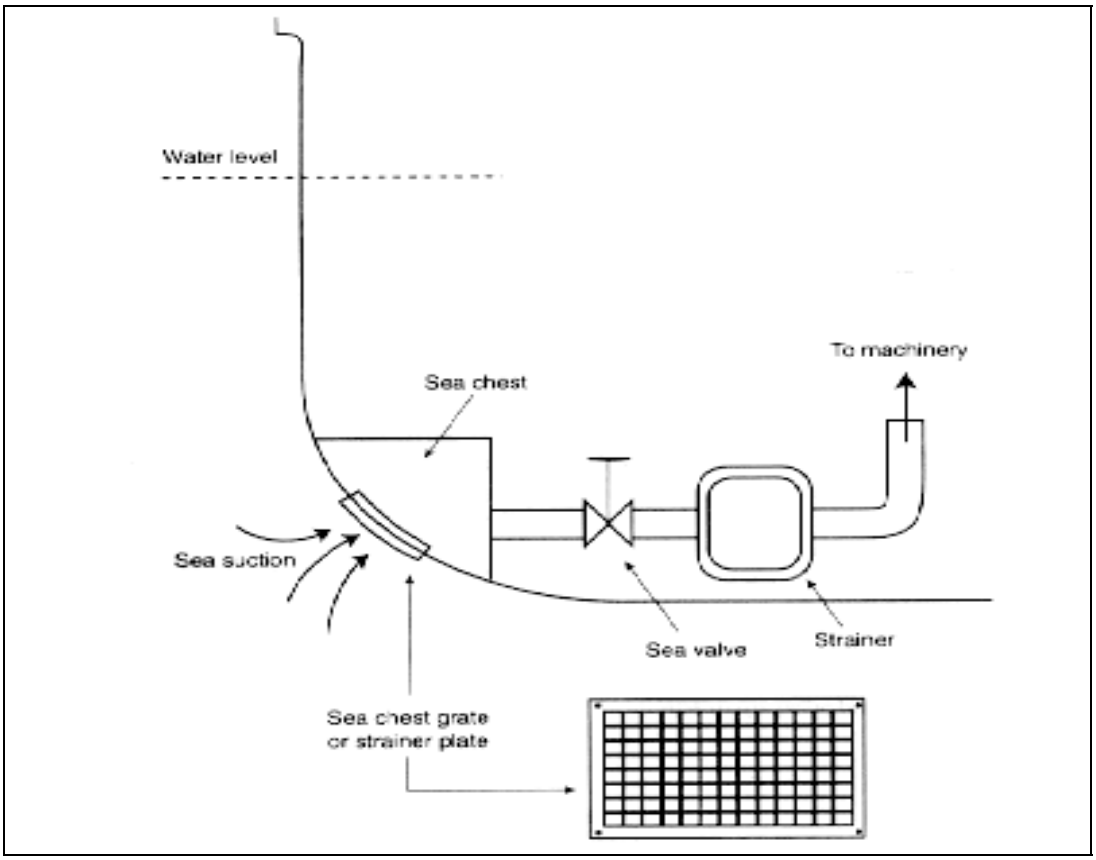
From a slide provided by J.T. Carlton *in* Tzankova, 2000

Figure 2F: Typical ballast tank arrangements for four major types of commercial vessels



From Marine Board, 1996. Stemming the tide: controlling introductions of nonindigenous species by ships' ballast water. National Academy Press, Washington, DC. p. 25. (*in* Tzankova 2000)

Figure 3F: A typical ballast system[7]



From Marine Board, 1996. Stemming the tide: controlling introductions of nonindigenous species by ships' ballast water. National Academy Press, Washington, DC. p. 30. *in* Tzankova, 2000.

[7] Note the sea chest, which has become a source of increasing concern re: its potential to retain and transport aquatic organisms.

APPENDIX F: COMMENTS FROM REVIEWERS OF DRAFT WHITE PAPER

Comments received from:

Dr. Sandra Whitehouse, Consultant to the Office of the Speaker of the House, R.I. General Assembly
Commander Scott Newsham, Chief, Environmental Standards Division, U.S. Coast Guard
Dr. Richard Burroughs, Marine Affairs Program, University of Rhode Island
John Torgan, Narragansett BayKeeper, Save The Bay, Inc.

Comments: Dr. S. Whitehouse

Include more information regarding risks from present and current vessels from Tzankova's masters thesis. Outline the risk factors and probability of introductions. Include information on the origination of vessels visiting Narragansett Bay.

More information from Tzankovas's thesis is included on pages 10 and 11 of the white paper. Tzankova looked at the projected transoceanic ship traffic from the proposed Quonset Point container ship port and described characteristics of containerships that would increase potential introductions from ballast water. A table was included on page 12 displaying data from the U.S. Army Corps of Engineers Navigation Data Center regarding the origin of vessel trips into Narragansett Bay.

Discuss the risk of introductions into Narragansett Bay from drift along the coast. Of the introduced species currently found in the Bay, how many of them are here as a result of shipping or from arriving here on an oceanic current or as a result of a population expansion after being introduced at another location?

There does not exist current information on transport of introduced species, successful invasions and specific sources to assess the risk from either ballast or drift. In terms of drift, nearshore deep currents generally travel north to south across Rhode Island's coastline; however, wind-driven shallower currents can carry plankton from south to north. There has been little or not monitoring of travel of species in this manner and any statements regarding this are further complicated

Provide information on the relative risks of introduced species from the variety of possible vectors (e.g., aquaria, intentional introductions, aquaculture, live seafood, etc.).

Of the two options listed (one – support the development of a national ballast management program; two - creation of State legislation to prevent introductions from ballast), only the first one makes sense. In New England this issue can really only be addressed on a scale that encompasses many states and therefore should be a federal effort.

If legislation is deemed necessary, recommend that we follow Virginia and Maryland legislation – equivalent to the U.S. Coast Guard voluntary ballast exchange with the addition of state reporting requirements.

The State should not get into the business of shipboard ballast monitoring checks. We should not be educating the shipping industry regarding ballast water regulations – this is a federal responsibility. We should cooperate with other states, limited to research and monitoring. The State should institute an introduced species monitoring program. The State should formalize the State Invasive Species Council, requiring that the Council focus on prevention of introductions from all transport vectors, not just ballast water. A State Aquatic Nuisance Species Management Plan should be developed.

The URI Graduate School of Oceanography and Roger Williams University should actively pursue grants to fund research into ballast water treatment technologies.

Comments: Commander S. Newsham

Commander Newsham stated that the Coast Guard's position is that consistent standards of universal application, coupled with Federal initiatives to address unique regional concerns, are the best means of meeting local and national environmental goals with the least disruption to international marine commerce. The Coast Guard is currently developing a ballast water treatment standard to aid in development of effective management practices. The creation of a patchwork of state and regional ballast water legislative actions will confuse mariners as they attempt to manage their ballast water while operating in U.S. waters.

Comments: Dr. R. Burroughs

The report is solid and informative. Can a map be provided to show that there are invasives here in Rhode Island?

Current information on the extent of introduced species in Rhode Island and the Bay is very limited. The 2000

Can information regarding specific damage to Rhode Island from invasive species be included?

Does the Coastal Institute have or can it get the resources necessary to respond effectively?

If resources are projected to remain short, isn't it in our interest to use federal legislation to shift more of the burden back onto the federal government?

Comments: J. Torgan

The report underscores many of the concerns that Save The Bay has expressed in the past with respect to the risks associated with increased transoceanic shipping to Rhode Island waters. The environmental and economic threats posed by invasive species are serious and cannot summarily be dismissed as "manageable."

Save The Bay fully supports the recommendations included in the white paper, particularly those mandating effective treatment systems, monitoring, and public education and outreach.

Despite the thoughtful management strategies discussed and analyzed in the paper, it must be clearly stated and reiterated that none of these techniques is 100% effective at reducing the risk of harmful bioinvasions. An increase in transoceanic traffic, specifically container ships, will necessarily increase these risks, regardless of management efforts.

Save The Bay agrees that we should act now to prevent future bioinvasions by adopting the regulations and management techniques recommended in this white paper. However, taking such actions will not significantly offset the risks posed by a container port. Development of load center port facilities will increase the risks to unacceptable levels.

Refer to the following attached comment letters.