BALLAST WATER ISSUE PAPER

Management
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Shore Based Treatment
Hull Fouling and NOBOBs
Regulations
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I. Introduction

More than 45,000 cargo vessels traverse the world's seas and are responsible for transporting 80 percent of the world's commodities (Globallast 2001). Economical and efficient vessel commerce is critical for the U.S. and the West Coast's economy. For example, cost estimates for a West Coast port closure in October 2002 due to a labor dispute were as high as $2 billion a day (WPPA 2002).

Cargo ship operation requires ballasting, which is done by transferring water in or out of dedicated ballast water tanks, empty cargo and fuel tanks or some combination of the three. Ballasting is required to:

- reduce stresses on the ship hull,
- aid in transverse stability,
- aid propulsion by controlling propeller submergence,
- aid maneuverability by submerging the rudder and reducing hull surface exposure (freeboard or windage), and
- compensate for weight loss from fuel or water consumption.

The discharge of ballast water from commercial vessels is the leading vector for the transfer of potentially harmful aquatic organisms and pathogens around the world. It has been estimated that 21 billion gallons of ballast water are discharged into U.S. ports each year (EPA 2001), and globally, 10,000 organisms or more may be transported around the world daily (Carleton 1999). Ballast water enters the ship through intake valves that are located below the water line. These intakes are usually covered with half-inch or larger grates to screen out materials that could damage the pumps. When ballast water is taken onboard, any organism less than about one centimeter in size near the intake may also be ballasted into the vessel (Carleton and Geller 1993). The maximum size of organisms that can be taken onboard during ballasting operations depends on the method of ballasting and size of intake screens. Fish as large as 14 inches have been reported in ballast tanks (Wonham *et al*. 2000). Following transit, all or part of the ballast water, and any organisms in the ballast water tanks, may be discharged while in port when a ship takes on cargo or fuel.

When long-term records of marine and estuarine biota are available, the data indicate that invasions by new species, many of which are likely ballast water introductions, are increasing at an alarming rate (Cohen and Carleton 1998, Grosholz 2005). This increased rate of introductions probably relates to the development of faster ships, which result in shorter transit times and greater survival of organisms; as well as an overall increase in the size of ships, and increased shipping activity associated with the growth of world trade.

In the 1980s the zebra mussel (*Dreissena polymorpha*), perhaps one of the most damaging aquatic nuisance species (ANS) in the U.S., was introduced into the Great Lakes from the Caspian Sea via veliger-contaminated ballast water. Since then, zebra mussels have spread to 22 states by means of water currents, recreational watercraft, live wells and bait buckets. Ballast water-mediated introduction of zebra mussel veligers to the West Coast is unlikely because of the vessel transit distance and frequency between infected and uninfected areas, *e.g.,* the distance from the Great Lakes to Portland, Oregon.

There are concerns that other organisms, such as the Chinese mitten crab (*Eriocheir spp.),* will be transported from San Francisco Bay northward -- potentially to Coos Bay, the Columbia River and Puget Sound. One study (Culver 2005) suggests that the mitten crab may represent a significant threat to salmonid eggs and larvae by either consuming them or by exposing them to other potential predators and unfavorable conditions. Research indicates that mitten crab larvae can survive voyages in ballast water up the West Coast. However, the viability of the larvae depends on the techniques used in overall ballast management (Hanson and Sytsma 2005). On the West Coast, the Puget Sound and Coos Bay estuaries appear to have the right combination of temperature, salinity and retention time for mitten crab establishment (Hanson and Sytsma 2005).

Ballast water also acts as a vector for human pathogens. The Asian strain of cholera bacterium was likely introduced into South American waters in 1991 through ballast water discharge (Morton 2002). In 1991, a South American strain of the human cholera bacteria, *Vibrio cholerae* O1, was found in ships arriving from South America to the Port of Mobile, Alabama. The bacteria were later found in Mobile Bay seafood, prompting a public health advisory to avoid handling or eating raw seafood (CDC 1993).

II. Ballast Water Management

Preventing or reducing the risk of species transfers and associated invasions through ballast water discharge is a significant challenge. Since nearly all ships conduct ballast water discharges, flushing tanks at sea is one approach that can be implemented to reduce the risk of invasions. Although the long-term goal is to develop treatment technologies to remove organisms, there are currently no treatment methods, either on the ship or shore side that are both universally applicable and proven effective at preventing introductions of organisms[1].

Mid-Ocean Exchange

The U.S. Coast Guard (USCG 2003) currently requires mid-ocean ballast water exchange for transoceanic voyages as the preferred method of ballast water management to reduce invasions. It will likely remain as an important tool for another decade or more until new treatment technologies are developed, tested and installed on the worldwide fleet of cargo vessels. A ballast water exchange routinely removes more than 90% of the original water and a high proportion of the coastal biota (Verling et al. 2004). Mid-ocean water has higher salinity than most coastal waters. The change in salinity that occurs with a mid-ocean ballast water exchange can be lethal to marine organisms that are adapted to lower salinity coastal waters, such as the Columbia River and upper San Francisco Bay. In addition, the exchange physically removes, or flushes, some organisms from the ballast water tanks. Oregon, Washington, and California[2] law require ballast water exchange for certain coastal voyages (inside 200 miles) (**See Table 1**).

[1] The Washington Department of Fish and Wildlife says in their communications with ship captains and companies, that very few have indicated the intent to implement on-board treatment (Smith 2005).
[2] California's coast voyage regulation is expected to take effect in December 2005.

Table 1

State Ballast Water Regulations and Status of State ANS Plans and Programs in Oregon, Washington, Alaska, Idaho and California.

	CA	OR	WA	AK	ID
1. State ANS Plan?	No[1]	Yes	Yes	Yes	No[2]
2. State ANS Plan Drafting Committee/Working Group?	Yes	N/A	N/A	N/A	No
3. Full Time ANS Staff?	Yes	Yes[3]	Yes	Yes	No
4. State Invasive Species Council?	Yes	Yes	No	No	Yes
5 State Ballast Water Management Program?	Yes	Yes[4]	Yes	No	N/A
6. Mandatory Ballast Water Exchange?	Yes	Yes	Yes	No	N/A
7. Mandatory Ballast Water Exchange applicable to domestic intra-basin/ coastal voyages?	Yes[5]	Yes[6]	Yes[7]	No	N/A
8. State Ballast Water Program: Industry Fee Funded?	Yes	No[8]	No	No	N/A
9. Ballast Water Treatment Standard?	No[9]	No	Yes[10]	No	No

[1]The California Department of Fish and Game has been scoping an ANS plan for the past two years.

[2]In February 2004, the Idaho Invasive Species Summit generated recommendations by experts and stakeholders that culminated in the Idaho Invasive Species Action Plan in January 2005. The Idaho Department of Fish and Game has not begun drafting an ANS plan (as of July 2005).

[3] ODFW has an MOA with Portland State University to carry out ANS education, management, and monitoring.

[4] Oregon Department of Environmental Quality is the lead agency under the Oregon Ballast Water Program; however the program has never been funded.

[5] Effective March 2006. Exemption: the San Francisco Bay area east of the Golden Gate bridge including the Ports of Stockton and Sacramento, shall be construed as the same California port or place; and the Ports of Los Angeles, Long Beach and the El Segundo marine terminal shall be construed as the same California port or place.

[6] Ballast water from ports between 40 and 50 degrees north latitude exempt

[7] Ballast Water from ports between Columbia River north to British Columbia (S. of 50^{o} latitude) including the waters of the Straits of Georgia and Juan de Fuca are exempt

[8] Some industry support provided for research and reporting.

[9] In December 2005, the staff of the California State Lands Commission submitted recommendations for ballast water standards.

[10]Ballast water treatment must meet a standard of 95% kill or removal of zooplankton; 99% kill or removal of phytoplankton and bacteria.

Ballast water exchange is not, however, a long term solution to the ballast water problem. The Government Accountability Office (2005) recently testified before the House Subcommittee on Regulatory Affairs on the ballast water - invasive species issue. In the testimony, the GAO pointed out that U.S. waters remain vulnerable to invasive species carried in ballast water and that the current ballast water exchange program is not a viable long-term approach to minimizing the risks posed by ballast water discharges. The primary reasons for this are that:

- many ships are exempt from current ballast water exchange requirements,
- the Coast Guard has not established alternate discharge zones that could be used by ships which are unable to conduct ballast water exchange for various reasons, and
- ballast water exchange is not always effective at removing or killing potentially invasive species.

Although the efficacy of mid-ocean exchange is reported to be highly variable for removing biota and may vary among ship types and organism types, a large amount of the reported variation is due to ballast water sampling methods. There are several constraints with a mid-ocean exchange, including ship safety (not all ships can safely conduct an exchange at all times) and failure to remove many sediment-dwelling organisms in ballast tanks. Effective implementation of ballast water exchange will require enforcement. While at this time there is no reliable method for distinguishing between mid-ocean and coastal water in ballast tanks, the US Coast Guard is testing a Ballast Exchange Assurance Meter, or BEAM[3], for exchange testing.

III. Ballast Water Technologies and Performance Standards

Ballast water exchange will be phased out in favor of on-board treatment (and potentially shore-side treatment) as stricter ballast water regulations are implemented at the international, U.S. federal and state levels. Treatment technology is considered especially critical for coastal shipping where short voyages and proximity to coastal bays make ballast exchange problematic. New shipboard technologies will need to be tested for efficacy and their ability to meet a compliance standard against which the effectiveness of the technologies can be measured. For example, the IMO has set a standard of $\leq$ 10 organisms/cubic meter greater than 50 microns in size (for the complete IMO standard refer to **Appendix 4**) The USCG is in the process of preparing a rulemaking package to establish national standards for ballast water discharges. The proposed regulatory package (environmental impact statement) should be released in the winter of 2006. For a review of current proposed and existing ballast water treatment performance standards for the West Coast, please refer to **Appendix 5.**

There are several federally sponsored ballast water technology programs in the U.S. These include the Shipboard Technology Evaluation Program (STEP), Environmental Technology Verification (ETV) program and the Ballast Water Demonstration Program (See **Appendix 1**).

The USCG will have the responsibility for permitting ballast water treatment systems as these technologies become available for shipboard implementation. Current ballast water treatments that may have potential include **chemical** (chlorine dioxide, ozone and hypochlorite) and **non-chemical** (ultra violet light, filtration, deoxidization, and physical disruption) (Moore 2005a). Please refer to **Table 2** for a review of ballast water technologies. The Prince William Sound

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[3] The BEAM device measures the salinity of and amount of dissolved organic matter in a given water sample, since they are good indicators for discerning the difference between coastal and oceanic source waters. Salinity is measured by refractive index and dissolved organic matter is measured by fluorescence. If a vessel has properly conducted an open ocean ballast water exchange, the refractive index of the sample should be high, and the fluorescence, which indicates dissolved organic matter content, should be relatively low (Moore 2005c)

Regional Citizens' Advisory Council also has fact sheets on ballast water technologies that can be found at http://www.pwsrcac.org/NIS/bwtoptions3.html. Dobbs and Rogerson (2005) conclude that a treatment technology has not yet been developed to where all microorganisms (except viruses) can be killed without making the treated water unsuitable for discharge. However, the use of two treatments in a series (e.g., ultraviolet (UV) and filtration) will likely be the most successful in killing microorganisms (Dobbs and Rogerson 2005).

An additional challenge in the development of ballast water technologies is performance evaluation and the scientific standards used in the evaluation. The growing number of approaches to evaluate ballast treatment technologies makes comparisons across these technologies difficult. The differing approaches result in a lost opportunity to increase the comparative value of ongoing studies. In addition, this creates significant confusion about the criteria needed for evaluation and the approaches to be used to determine compliance with regulatory requirements, yet allowing official approval for particular treatment systems.

To address these issues, in June 2005, an international ballast water workshop, hosted by the PSMFC, Portland State University, Smithsonian Environmental Research Center and others, was held in Portland, Oregon. The purpose of the meeting was to develop consensus recommendations for technical methods, experimental design, and key measures for full-scale, ship-board evaluation of ballast water treatment technology (See **Appendix 2**).

Table 2.
Review of Potential Ballast Water Treatment Technologies
(summarized from Dobbs and Rogerson 2005)

Filtration: Although filtration can effectively remove ichthyoplankton, zooplankton, larger phytoplankton and heterotrophic protists[4], it cannot, at present, reliably reduce the concentration of most microorganisms.

UV Light: Without considering the technical problems inherent in operating a UV reactor on a ship, we believe that this approach is a very effective technology for ballast water treatment.

Biocides (e.g., chlorine dioxide, ozone): Biocides, used to treat drinking water, can effectively kill microorganisms. However, for ballast water treatment, biocides cause ballast tank corrosion and it is difficult to obtain National Pollutant Discharge Elimination System (NPDES) or other permits to discharge the chemicals into coastal or harbor waters.

[4] Protist is a collective term for organisms (with nucleated cells) that are not considered true animals, plants, and fungi; includes algae.

Deoxygenation: This has been shown to kill metazoans[5] (i.e., all animals except protozoans and sponges), but not bacteria or protists.

Thermal Treatment: This treatment has shown some promise but it cannot reach the temperatures needed to effectively kill microorganisms.

Electric Pulse: The electric pulse has been shown to work in the laboratory, but there is no data from larger-scale operations.

Plasma, acoustic, magnetic field technologies: These technologies have been proposed, but no peer-reviewed data exists on their effectiveness.

IV. Shore-Based Treatment

Shore-based ballast water treatment technology has often been discounted because of numerous engineering and environmental issues. Currently, the number of on-shore reception facilities is limited and none have been approved to remove ANS, and this circumstance is likely to remain the same (USCG 2003). Treatment on land is often favored by regulators and managers as the quality of the treatment is often considered more controllable than with any other system (Oemcke 1999). The U.S. Navy is in the preliminary stages of determining the feasibility of using shore-based treatment. Other shore-based treatment facilities are under consideration in the Bosporus and Baltic regions (Helsinki Commission 2004).

Shore-side treatment feasibility studies have also been conducted for the Port of Seattle (Glosten Associates 2002) and public port facilities in California (URS/Dames & Moore 2000). The California State Water Resources Control (2002) also reviewed shore-based treatment in a 2002 report to the legislature. All three of these studies indicate that shore-based treatment is technically feasible. However, retrofitting ships, technological challenges to treating saline water, and developing shore-based ballast treatment facilities likely make this option cost prohibitive at this time.

In Alaska, shore-based ballast water treatment is being discussed. Alaska has a very large ballast water treatment facility; the Valdez Marine Terminal in Prince William Sound. This facility has been in operation for several decades and was designed to remove residual hydrocarbons from unsegregated (dirty) ballast water[6]. The facility is currently not equipped to treat non-hydrocarbon contaminated (i.e. clean) ballast water. According to the Prince William Sound Regional Citizens' Advisory Council (PWSRCAC 2005):

[5] Animals are a major group of organisms, classified as the kingdom Animalia or Metazoa. In general, Metazoa are multicellular, capable of locomotion and responding to its environment, and feed by consuming other organisms.

[6] The Oil Pollution Act of 1990 (OPA 90) made it mandatory for all crude oil tankers calling at U.S. ports to have double hulls and to use dedicated "clean" ballast water tanks. Ballast water in the segregated ballast water tanks is not contaminated with residual hydrocarbons, thus, ANS found in these tanks tend to survive the trip from the West Coast to PWS, Alaska. (PWSRCAC 2005). While tankers are currently exempted under NISA, this may change through reauthorization (See Section VII. Legislation).

The crude oil trade route between the West Coast of the United States and Prince William Sound, Alaska is a predictable route with specific tankers dedicated to the Alaskan crude oil trade. Shore-based treatment may be a viable option for this trade route with the potential solution of a single shore-based treatment plant in Valdez, Alaska at the Valdez Marine Terminal.

However, there are numerous questions as to the feasibility of shore-based treatment, including:

1) If ballast water is treated on-shore at a municipal sewage treatment facility, will the discharge from the facility meet the International Maritime Organization standards and/or U.S. Clean Water Act requirements?
2) Off-loading ballast water to a shore-based system may add to vessel dockage fees. Will the cost be acceptable to the shipping industry or is onboard treatment the preferred and least costly alternative?
3) Who will carry the cost of constructing a shore-based facility?
4) If a municipal sewage treatment facility is proposed, will the municipality consider treating ballast water – even if it results in additional costs to its primary responsibility of waste water treatment?
5) Ships will need to be retrofitted to be able to deliver ballast water to a shore-based facility. What will be the cost to ship owners?

V. Hull Fouling and NOBOBs

Hull fouling and NOBOB are two other ship-related vectors that can transport ANS. A NOBOB is a ship that carries no ballast water onboard.

Hull Fouling, Ship Breaking

Hull fouling is a potent vector for many aquatic organisms. Hull-fouling organisms are historically and contemporaneously important in ANS introductions, yet very little quantitative data exists that rigorously examines the current rates, extent and composition of organism transfers via vessel hulls (Davidson 2005). The evidence for this stems from two broad sources – inventories of ANS from certain bays and estuaries and samples taken directly from hulls. For example, Hewitt *et al*. (2004) suggested that hull fouling was the likely sub-vector for most (>75%) ship-mediated invasions in Port Philip Bay, Australia. They also found that hull fouling was probably responsible for both the first and most recent introductions in the bay, although ballast water was the most likely the vector for a majority of the ANS introduced since 1990. Approximately 212 invasive species are believed to have been introduced into Hawaii via vessel fouling Godwin (2005). Ruiz and Smith (2005) point out that several recent analyses have underscored the potential importance of organism transfer on commercial vessel hulls (Gollasch 2002, Hewitt *et al*. 2004, and Nehring 2001).

Some have suggested that the hull fouling threat may increase rapidly in the near future. It has been argued that faster voyages, regulated changes in antifoulant use (*i.e.* TBT[7]), improved

[7] Tributyltin (TBT) compound, used in marine coatings for the past 40 years, is one of the most toxic chemicals introduced into the environment. It has been linked to abnormal development and reduced reproduction in aquatic

harbor water quality and harbor design which exacerbate hull fouling may all combine to increase the threat of hull fouling transfers (Nehring 2001, Floerl and Inglis 2003, Minchin and Gollasch 2003).

On the West Coast, hull fouling research is being undertaken by Dr. Ian Davidson, Portland State University (PSU), to evaluate the threat of ANS transfers to the lower Columbia River. According to Davidson (2005), preliminary results suggest that although the Columbia River system is not immune to hull-mediated introductions, the threat is lower to it the than for other salt water port systems on the West Coast.

Future research at PSU aims to utilize remote operated vehicle (ROV) technology to provide data for a larger number of vessel hulls that are more representative of the commercial fleet (Davidson 2005). This work will be carried out in conjunction with the California State Lands Commission. A key component of the ROV sampling plan is to ascertain overall hull fouling transfers on the U.S. Pacific coast so that informed management decisions can be made in preparation for the upcoming 2008 worldwide ban on TBT.

The California State Lands Commission has also set up a Vessel Fouling Technical Advisory Group (TAG) which is developing potential management strategies to address hull fouling.

Please refer to **Appendix 3** for a review of existing vessel fouling management practices.

Ship Breaking

Obsolete, deteriorating ships are broken up for scrap metal. There are often environmental concerns associated with ship breaking as the ships can contain oil, asbestos, lead and other toxic chemicals (Talley no date). The spread of ANS via derelict vessels by hull fouling is also a concern if the ship is moved from one port to another. A company named the Bay Bridge Enterprise proposes to bring ships from Suisan Bay, California to Newport, Oregon (or possibly Coos Bay) for deconstruction (Gallob 2005). Since the ships are decades old, it is likely they have a significant amount of hull fouling. Plans to begin the project in February 2006 have been put on hold. It is possible an Environmental Impact Statement will be required, and if so, this will delay the start date of the proposed project.

No Ballast Onboard

Ships that are technically carrying no ballast water are referred to as NOBOBs. A NOBOB can still carry residual ballast water and sediments that cannot be pumped out of the tanks. A possible vector for invasions, the residual water and sediments may contain live aquatic organisms and resting stages of organisms, such as eggs, spores and cysts, accumulated over numerous previous ballasting operations. When a NOBOB vessel takes up ballast water, this water mixes with the residual water and sediments and, if discharged, may provide a mechanism for ANS introduction. Despite this potential vector, NOBOBs have escaped scrutiny under

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life, not to mention its relation to many human health problems. In December 2000, 122 countries signed an international treaty that banned 12 of the most toxic persistent organic pollutants (including TBT). A partial ban on TBT takes effect in 2003, with a complete ban effective 2008.

existing U.S. and Canadian federal, state and provincial laws (Reid 2004). In a recent study, Drake *et al.*, (2005) found that NOBOBs may represent a risk for aquatic invasions to the Chesapeake Bay. NOBOBs appear to pose less of a threat to the West Coast. For example, only 44 out of 609 arrivals (7.2 percent) at Columbia River ports for the first half of 2005 were NOBOB - or at least were reported as having NOBOB (Simkanin 2005).

In January 2005, the USCG requested public comments on the development of management strategies to address the invasion risks posed by NOBOB vessels (USCG 2005a). Subsequently in August, the USCG established best management practices for residual ballast water and sediment management for NOBOB vessels in the Great Lakes as follows (USCG 2005b):

- Conduct mid-ocean ballast water exchange during ballast-laden voyages in an area of 200 nautical miles from any shore and in water 2000 meters deep whenever possible, prior to entering the U.S. EEZ.

- For vessels unable to conduct mid-ocean ballast water exchange, conduct saltwater flushing of their empty ballast water tanks in an area of 200 nautical miles from any shore, whenever possible. Saltwater flushing is the addition of mid-ocean water to empty ballast water tanks; the mixing of the flush water with residual water and sediment through the motion of the vessel; and the discharge of the mixed water, such that the resultant residual water remaining in the tank has as high a salinity as possible, and preferably is greater than 30 parts per thousand (ppt). The vessel should take on as much mid-ocean water into each tank as is safe (for the vessel and crew) in order to conduct saltwater flushing.

- NOBOB vessels that conduct these best management practices should incorporate them into their required ballast water management plan onboard their vessels. The requirements for ballast water management plans are found in 33 Code of Federal Regulations (CFR) § 151.2035(a) (7). Also, NOBOB vessels are reminded that there are required ballast water management practices for vessels equipped with ballast water tanks that operate in U.S. waters regarding avoiding ballasting operations in certain situations, sediment removal, and the cleaning of ballast tanks. These requirements are found in 33 CFR § 151.2035(a).

VI. Ballast Water Regulations

Federal

The National Aquatic Nuisance Prevention and Control Act (NANPCA) and its amending legislation, the National Invasive Species Act of 1996 (NISA), instructed the Secretary of Transportation to develop national guidelines to prevent the introduction and spread of nonindigenous species into U.S. waters via ballast water from commercial vessels. Other regulations that can cover ballast water discharges and treatment include the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA), Federal Hazardous Materials (HAZMAT) Transportation Law (49 CFR), and the Federal Water Pollution Control Act (Clean Water Act).

Please refer to **Table 3** for a U.S. ballast water regulation/litigation timeline and **Appendix 4** for a comparison of ballast water regulations. In 1999, in complying with NISA, the USCG established the voluntary national ballast water management program, but in 2002, the USCG found the voluntary program to be inadequate. As a result, in June 2004, the USCG established a national mandatory ballast water management program for all vessels equipped with ballast water tanks that enter or operate within U.S. waters. This program requires vessels carrying ballast water that was taken on in areas less than 200 nautical miles from any shore into U.S. waters, after operating beyond the Exclusive Economic Zone, to employ at least one of the following ballast water management practices:

(1) Perform a complete ballast water exchange in an area no less than 200 nautical miles from any shore prior to discharging ballast water in U.S. waters;
(2) Retain ballast water onboard the vessel; or
(3) Prior to the vessel entering U.S. waters, use an alternative environmentally sound method of ballast water management (i.e., treatment) that has been approved by the USCG.

Table 3.
Significant Actions Affecting Ballast Water Management

1972	Clean Water Act (CWA) passed - ballast water excluded from National Pollutant Discharge Elimination System (NPDES) regulation
1990	Nonindigenous Aquatic Nuisance Prevention and Control Act (NANCPA) (PL 101-636) passed
1993	Mandatory ballast water management program for Great Lakes established
1996	National Invasive Species Act (P.L. 104-332): Reauthorizes NANCPA, mandates development of voluntary national ballast water program
1999	Voluntary National Ballast Water Management Program established
1999	Pacific Environmental Advocacy Center (PEAC) on behalf of Northwest Environmental Advocates, the Ocean Conservancy, and San Francisco Baykeeper petitions U.S.EPA seeking rescission of regulation exempting ballast water from NPDES
2001	PEAC files suit in U.S. District Court of Northern California to compel EPA to respond to 1999 petition
2001	USCG requests comments on setting ballast water treatment (BWT) performance standard and on experimental BWT installation and testing
2001	EPA and USCG sign Memorandum of Understanding establishing an engineering test program to develop BWT technologies
2002	US District Court orders EPA to respond to PEAC petition, court finds EPA violated Administrative Procedures Act
2002	USCG finds voluntary national ballast water management guidelines inadequate
2003	USCG proposes national mandatory ballast water regulations
2003	EPA and USCG sign MOU outlining their collaborative efforts in drafting the Environmental Impact Statement (EIS) for BWT performance standard
2003	EPA denies petition seeking regulation of ships' ballast water discharges
2003	Petitioners state they "have no recourse other than to look to the courts to force EPA to accept its responsibility under the law"
2004 (June)	The USCG published regulations establishing penalties for ships headed to the U.S. that fail to submit a ballast water management reporting form
2004 (July)	USCG establishes national mandatory ballast water management program. Ships

	entering the U.S. Exclusive Economic Zone (EEZ) must perform complete ballast water exchange, retain ballast water onboard; or use an allowed alternative method of ballast water management
2005 (January)	The USCG requests comments to identify ballast water management strategies for vessels entering the Great Lakes that declare no ballast onboard (NOBOB)
2005 (April)	A federal court rules the EPA must repeal its ballast water exemption under the CWA and that the EPA "acted in excess of its statutory authority" by exempting ballast water discharges from the NPDES permit program
2005 (June)	Federal court grants INTERTANKO's [8] motion to intervene on the court's April 2005 ballast water decision. A hearing is scheduled in federal courts in November 2005
2005 (June)	Michigan enacts law (SB 332) classifying ballast water as point source and requiring a permit for ballast water discharge under NPDES (effective 01/01/07)
2005 (August)	USCG establishes best management practices for ships with no ballast water on board
2005 (November)	INTERTANKO files a remedy brief in the Northern California District Court PEAC/EPA ballast water case

[8] INTERTANKO is the International Association of Independent Tanker Owners. Members include independent tanker owners and operators of oil and chemical tankers, i.e. non-oil companies and non-state controlled tanker owners.

STATE

The states of California, Oregon and Washington have all adopted ballast water regulations (see **Table 1).** Oregon law requires that intracoastal (coastwise) traffic (vessels inside 200 miles) entering state ports from north of Vancouver Island and south of Cape Mendocino (California) exchange ballast water. Washington ballast water law also requires coastwise traffic to exchange ballast water, but exempts coastwise traffic from the Columbia River Basin and British Columbia (south of 50 degrees) from exchanging ballast water before entering a Washington port. In California, mandatory coastwise ballast water regulations are being promulgated and are expected to take effect in December 2005. The State of Alaska has not pursued ballast water regulations.

INTERNATIONAL

In February 2004, the International Maritime Organization (IMO[9]) agreed to language governing ballast water management and ballast water management plans (International Convention for the Control and Management of Ship Ballast Water & Sediments). It will be up to each country to enforce the IMO Convention. U.S.-flagged vessels that call on ratifying nations will likely be subject to the requirements of the Convention whether or not the U.S. ratifies the Convention. U.S. coastwise trade will be unaffected by the Convention.

The Convention will become effective 12 months after ratification by 30 states, representing 35 per cent of world merchant shipping tonnage. Through 2005, the Maldives, Nigeria, St Kitts and Nevis, Spain and Syrian Arab Republic have ratified the Convention. The U.S. has not adopted the Convention, but legislation is being considered that mirrors the IMO standards. Please refer to **Table 4** for some of the highlights of the new convention and **Appendix 3** for an overview and comparison of IMO, U.S. federal and state regulations.

The Convention requires a review to be undertaken no later than three years before the first effective date for compliance set out in the Convention (2009) in order to determine whether appropriate technologies are available to achieve the standard. In July 2005, the Convention's Marine Environment Protection Committee (MEPC-53) met and completed a review of 14 different ballast water management technologies and systems which could meet the ballast water performance standard in the Convention. The group also adopted guidelines for the management and the development of BW management plans, BW exchange, the approval process for BW management systems, and the guidelines for the approval of ballast water management systems that use active substances (such as chemical or biological treatment). It was agreed that the information collected to date on the systems and technologies currently being tested had the potential to meet the criteria, and it was anticipated that final approval of the systems, following testing and evaluation, could be achieved during 2008. A further review of the technologies will again take place at MEPC 55 in October 2006.

[9] The purposes of the IMO is "to provide machinery for cooperation among Governments in the field of governmental regulation and practices relating to technical matters of all kinds affecting shipping engaged in international trade; to encourage and facilitate the general adoption of the highest practicable standards in matters concerning maritime safety, efficiency of navigation and prevention and control of marine pollution from ships".

CANADA

In June 2005, Transport Canada, Canada's ballast water regulatory agency, proposed new mandatory ballast water management requirements for ships entering Canadian waters and waters in their exclusive economic zone (200 miles). The mandatory rules do not apply to coastwise traffic North of Cape Blanco, Oregon. Proposed ballast water management options are: (a) exchange of ballast water; (b) the treatment of ballast water; (c) the discharge of ballast water to a reception facility; and (d) the retention of ballast water on board the ship. Exchange and treatment standards are included (see **Appendix 3**). The next phase of the rulemaking will be a public comment period, in 2006, on the proposed requirements. According to Transport Canada, the regulations are expected to take effect in 2008 and "will be harmonized with international regulations [*i.e.* IMO] that Transport Canada has played a key role in developing."

Table 4
International Convention for the Control and Management of Ships Ballast Water and Sediments Annex
Section B Management and Control Requirements for Ships AND Section D-2 -Ballast Water Performance Standard.

The specific requirements for ballast water management are contained in regulation B-3 *Ballast Water Management for Ships*:

- Ships constructed before 2009, with a ballast water capacity of between 1500 and 5000 cubic metres, must conduct ballast water management that at least meets the ballast water exchange standards or the ballast water performance standards until 2014, after which time it shall at least meet the ballast water performance standard.
- Ships constructed before 2009, with a ballast water capacity of less than 1500 or greater than 5000 cubic metres, must conduct ballast water management that at least meets the ballast water exchange standards or the ballast water performance standards until 2016, after which time it shall at least meet the ballast water performance standard.
- Ships constructed in or after 2009, with a ballast water capacity of less than 5000 cubic metres, must conduct ballast water management that at least meets the ballast water performance standard.
- Ships constructed in or after 2009, but before 2012, with a ballast water capacity of 5000 cubic metres or more, shall conduct ballast water management that at least meets the ballast water performance standard.
- Ships constructed in or after 2012, with a ballast water capacity of 5000 cubic metres or more, shall conduct ballast water management that at least meets the ballast water performance standard. Other methods of ballast water management may also be accepted as alternatives to the ballast water exchange standard and ballast water performance standard, provided that such methods ensure at least the same level of protection to the environment, human health, property or resources, and are approved in principle by IMO's Marine Environment Protection Committee (MEPC).

Under Regulation B-4 *Ballast Water Exchange*, all ships using ballast water exchange should:

- Whenever possible, conduct ballast water exchange at least 200 nautical miles from the nearest land and in water at least 200 metres in depth, taking into account Guidelines developed by IMO.
- In cases where the ship is unable to conduct ballast water exchanges as above, the exchange should be made as far from the nearest land as possible, and in all cases, be at least 50 nautical miles from the nearest land and in water at least 200 metres in depth.
- When these requirements cannot be met, areas may be designated where ships can conduct ballast water exchange.

Regulation B-4 also requires that all ships shall remove and dispose of sediments from spaces designated to carry ballast water in accordance with the provisions of the ships' ballast water management plan.

Regulation D-2 Ballast Water Performance Standard - Ships conducting ballast water management shall discharge less than 10 viable organisms per cubic metre greater than or equal to 50 micrometres in minimum dimension and less than 10 viable organisms per milliliter less than 50 micrometres in minimum dimension and greater than or equal to 10 micrometres in minimum dimension; and discharge of the indicator microbes shall not exceed the specified concentrations.

VII. Legislation

Since 2001, Congress has unsuccessfully tried to reauthorize NISA and its ballast water provisions. Several ballast water management and research related bills have been introduced into the 109th Congress (1st session). In 2006, there will likely be a new bill that combines the ballast water language of S. 363 and S. 770. Ballast water management legislation that is currently before the current Congress is as follows (as of July 2005):

Title (number)	**Sponsor**	**Highlight**
Ballast Water Management Act of 2005 **(S. 363)**	Inouye (D-HI), Stevens (R-AK)	-Preempts state or local ballast water exchange or treatment requirements; -Implementation of ballast water treatment standard starts in 2009; -Tracks IMO standards
National Aquatic Invasive Species Act of 2005 **(S. 770)**	Levin (D-MI)	-Implementation of ballast water treatment standard starts in 2012 -No state or local pre-emption
Aquatic Invasive Species Research Act **(H.R. 1592)**	Ehlers (R-MI)	- ANS ecological and pathway research
National Oceans Protection Act of 2005 **(S.1224)**	Boxer (D-CA)	-Ballast water management provisions in S. 1224 are similar to S. 363

VIII. Remaining Challenges

If the U.S. ratifies the IMO Ballast Water Convention (which is unlikely at this time) or passes the legislation above, ballast water discharge standards will need to be met[10] beginning in 2009 (IMO, S. 1224 or S 363) or 2011 (S. 770). Meeting a new standard will be a challenge because the technology for large scale ballast water treatment has yet to be approved, and rigorous scientific methods to test ballast water treatment effectiveness have yet to be developed (Please see **Appendix 2**). It will be an enormous challenge to develop a relatively inexpensive, reliable and utilitarian ballast water system in five years to meet regulatory guidelines in the next 5 (or 10?) years.

Other ballast water management issues that will need to be resolved include:

- If passed, will federal ballast water regulations pre-empt state regulations?
- Will the U.S. sign the IMO Convention? And if so, how will we integrate U.S. ballast water discharge standards with the IMO standards?
- How will the hull fouling and NOBOB (sediment management) issues be addressed and

[10] There are exceptions to the start date depending on variables including ship size, date built and etc.

will regulations be applied nationally?

- Is shore-based treatment a viable option?
- Will alternative exchange zones be established with the US EEZ?

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Appendix 1: Federally sponsored ballast water technology programs.

Environmental Technology Verification: In 2001, the USCG partnered with the U.S. Environmental Protection Agency's (EPA) Environmental Technology Verification (ETV) Program[11] to independently evaluate the performance of private sector ballast water technologies in controlling invasive species introductions. The EPA, National Science Foundation, Battelle, and the USCG have developed a protocol for verifying the technical performance of commercially available technologies designed to treat ship ballast water for potentially invasive species. Five candidate ballast water technologies have been reviewed for testing at the Naval Research Laboratory in Key West, Florida (Moore 2005b).

Shipboard Technology Evaluation Program (STEP): The purpose of STEP is to facilitate the development of effective ballast water treatment technologies through experimental systems, thus creating more options for vessel owners seeking alternatives to ballast water exchange. The STEP is available to all foreign and domestic vessels subject to the USCG's Ballast Water Management regulations. Technology developers and vessel owners have expressed a need for incentives to encourage development of prototype treatment systems and shipboard testing. However, vessel owners have expressed a reluctance to invest the resources necessary to install and operate an experimental treatment system that might not meet the discharge standards mandated by future regulations. To address this concern, vessels accepted into this program may be granted an exemption[12] to future ballast water discharge standard regulations for up to the life of the vessel or the system with the condition that they operate satisfactorily. As of November 2005, one of the original applicants has resubmitted an application for inclusion in the program (Moore 2005c).

Ballast Water Demonstration Program: This program, led by the National Oceanic and Atmospheric Administration (NOAA), supports projects to develop, test and demonstrate technologies that treat ship ballast water in order to reduce the threat of introducing aquatic invasive species into U.S. waters through ballast water discharge. The U.S. Fish and Wildlife Service and the U.S. Maritime Administration are program partners in this effort.

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[11] Started in 1995, ETV addresses the need for credible environmental technology performance data to help businesses and communities better utilize the environmental technology choices available to them. For further information, go to www.epa.gov/etv.

[12] Note: Even if the approved technology is accepted into the federal program, state regulatory approval may still be needed.

Appendix 2. Summary of the Workshop "Evaluating Ballast Water Treatment Systems Onboard Ships: Technical and Scientific Approaches and Shore-Side Treatment Discussion", held June 14-16, 2005, Portland, Oregon. Hosts: The Pacific States Marine Fisheries Commission, Portland State University, Smithsonian Environmental Research Center, US Coast Guard. Funding Provided by Prince William Sound Regional Citizens' Advisory Council, Alaska Department of Fish and Game NOAA Fisheries and the Pacific States Marine Fisheries Commission.

WORKSHOP SUMMARY

Evaluation of the performance of ballast treatment practices/technologies on board ships, at full scale and under realistic operational regimes, is a common requirement of all ballast management efforts. Such scientific evaluation of treatment systems is challenging and expensive. Various approaches have been proposed that are appropriate to a specific platform (ship), geographic location (environmental conditions), route (voyage duration and operating conditions), and suite of performance measures (biological response variables).

The growing number of approaches to evaluate ballast treatment technologies makes comparisons across these technologies difficult. The differing approaches result in a lost opportunity to increase the comparative value of ongoing studies. In addition, this creates significant confusion about the criteria needed for evaluation and the approaches to be used to determine compliance with regulatory requirements, and allowing official approval for particular treatment systems.

To address these issues, a ballast water workshop was held in Portland Oregon. The purpose of the meeting was to develop consensus recommendations for technical methods, experimental design, and key measures for full-scale, ship-board evaluation of ballast water treatment technology. The workshop included scientists from Japan, Singapore, Great Britain (IMO), and two Canadian provinces. U.S. participants came from across the country including 10 states and Washington, DC.

Workshop presentations and discussion resulted in the following recommendations:

1) **Testing Methodology:** To assess the efficacy of ballast water treatment technologies, researchers need to conduct experiments in a step-wise process starting with small volumes of water in a laboratory setting (i.e. "bench-top"). If the technology proves effective, the volume of water to be tested then needs to be "scaled-up" to a mesocosm size experiment (i.e., swimming pool size), and then ultimately to ship-board trials. The group agreed that development of a common scientific approach and explicit criteria for treatment system evaluation, including scaling-up methodology, was needed.

2) **Testing Robustness:** The group recommended the need to examine the robustness of technologies by testing in different locations, including international locations, using standard practices. The utilization of existing lab facilities to test surrogate organisms and native assemblages will help accelerate this recommendation by keeping costs down.

3) **Viability**: Testing the effectiveness of a technology requires methods to determine the post treatment viability of ballast water organisms. There is a critical need to be able to access the number of viable organisms per unit of volume, based on organism-size criteria.

To address the recommendations set out above, the group will develop a consensus paper on the do's and don'ts of ballast water testing. It is anticipated that this document will be published in a widely circulated periodical, such as the *Marine Pollution Bulletin*. In addition, there will be a larger weightier publication (i.e., minutes) of the workshop which will serve as a resource for those in the field.

These documents will be of value to guide researchers in how they should think about ship-board testing and steps that are needed prior to ship-board testing, including the data quality that will come out of the tests.

SHORE-SIDE TREATMENT

On the third day of the conference, at the request of the Prince William Sound Regional Citizens' Advisory Council, an informal discussion was held on the potential of shore-based ballast water treatment. The Valdez Marine Terminal (VMT) in Prince William Sound (PWS), Alaska has a very large shore-based ballast water treatment facility. The facility has been in operation for several decades and was designed to remove residual hydrocarbons from unsegregated (dirty) ballast water. The PWSRCAC is investigating whether this facility could be equipped to treat ballast water. Attendees included the Naval Facilities Engineering Service Center. The Navy is undertaking a feasibility study on the potential use of shore-based treatment for its fleet.

Barriers to shore-based treatment are substantial and include:

1) If the ballast water is treated on-shore at a municipal sewage treatment facility, will the discharge from the facility meet the IMO (or US) standard for ballast water, even if it met NPDES permit requirements under the Clean Water Act?
2) The off-loading of ballast water to a shore-based system may add dockage fees to a vessel. Will the cost of this delay be unacceptable to the shipping industry? Mandating onboard treatment as the preferred and less costly alternative?
3) Who will carry the cost of constructing a shore-based facility?
4) If a municipal sewage treatment facility is proposed for use, will the municipality consider treating ballast water if it results in additional costs to its primary responsibility of sewage treatment?

The VMT situation may be somewhat unique in that it services a dedicated fleet and there are existing facilities that could be modified to treat segregated ballast water. Other shore-based treatment facilities are under consideration in the Bosporus and Baltic. The Navy and PWSRAC will continue discussion on shore-side treatment.

Appendix 3: Existing Vessel Fouling Management Practices (Source: Lynn Takata, California State Lands Commission 2005).

Country/State	***Practice***	***Details***
New Zealand	Survey	On Ballast Water Declaration Form: ○ When and where was the vessel last dry-docked and cleaned? ○ Has the vessel been laid-up for 3 months or more since it was last dry-docked and cleaned? If YES, state when and where. (Also requests start and end date laid up) ○ Do you intend to clean the hull of the vessel in New Zealand? If YES, state when and where More Information: http://www.fish.govt.nz/sustainability/biosecurity/ballastwater.html
New Zealand	Codes of Practice (Fishing Industry)	○ Chartered foreign owned or sourced fishing vessels must be substantially free from plant or animal growth prior to entering NZ's EEZ. ○ If no assurance, vessel inspected and cleaned before departure. ○ Otherwise inspected in NZ and if necessary, fouling removed so no foreign organisms enter the marine environment
(Formerly) Australia and New Zealand Environmental Conservation Council (Currently the Natural Resource Ministerial Council)	Codes of Practice	(For In-Water Cleaning and Maintenance) ○ No vessels treated with antifoulant can be cleaned in Australian Waters, without permission from administering authority (harbor master, state EPA, etc.) ○ In-water hull cleaning prohibited, except under extraordinary circumstances. ○ Sea-chests, sea suction grids, other hull apertures may be allowed under permit, if removed debris is not allowed to pass to water column or sea bed. ○ Polishing propellers may be allowed under permit. More Information: http://www.deh.gov.au/coasts/pollution/antifouling/code/

Country/State	*Practice*	*Details*
Australia	Regulation (Vessels < 25 m) October 2005	If vessel arrives clean with acceptable documentation, it is in compliance. Before departing your last port for Australia… o Keep ancillary gear and internal seawater systems clean of marine pests and growths, and o Clean hull within one month before arrival OR o Apply antifouling paint within one year before arrival OR o Book vessel for slipping and cleaning within one week of arrival (cleaning should be in a shipway where material removed can be collected and disposed of away from the sea) Voluntary, until review. Thereafter mandatory (on or about Oct. 1, 2006) More Information: http://www.daff.gov.au/content/output.cfm?ObjectID=AC951AF4-6352-4B0E-B453B6576CF0EC5F&contType=outputs
Victoria, Australia (possibly other AU ports?)* (Environment and Natural Resources Committee)	Code of Practice (?) 1997	Bans in-water hull cleaning for vessels over 200 gross tons in Melbourne, Geelong, Hastings and Portland Under permit, allows cleaning of sea chests, sea suction grids and other apertures provided the debris does not enter the water column, and polishing of propellers. More Information: http://www.parliament.vic.gov.au/enrc/inquiries/old/enrc/ballast/default.htm

Hawaii	Risked-Based Framework
	(proposal – not adopted)
	
	See Diagram, next page
		Cooperative interagency monitoring for high-risk vessels that may be investigated
		o Risk evaluated through risk matrix (see diagram, pg. 4)
		o Reactive measures proposed for high risk vessels:
		  o Standard Commercial Vessel: restrict time in port to essential operations
		  o Vessels or platforms intent on long/permanent stay:
		    ▪ Quarantine
		    ▪ Require out-of water cleaning

Country/State	***Practice***	***Details***
U.S. Federal, California	Regulation (embedded in ballast water regulations - no monitoring component)	○ Rinse anchor chains and anchors at place of origin ○ Remove fouling from hull, piping and tanks on a regular basis. Dispose wastes in accordance with local, state, and federal law.

Appendix 4. Ballast water management regulations**:** International Maritime Organization Convention, Canada, U.S. and West Coast state. (**DRAFT).** Sources: Puget Sound Water Quality Authority (Anderson), Portland State University (Flynn), Pacific States Marine Fisheries Commission (Phillips).

	IMO	**U.S.**	**California**	**Oregon**	**Washington**	**Canada** [1]
Enabling Legislation	International Convention adopted by consensus Feb 2004; becomes effective 12 months after ratification by 30 nations	1990: NANPA (PL 101-636) 1996: NISA (P.L. 104-332)	2003: AB 433 (PRC 71200 - 71271)	2001: SB 895 (Chapter 722-2001) 2003: HB 3620 Chapter 692-2003) 2005: HB 2170 ORS 783.625, 630, 635, 640, & 783.992 amended 3/05	2000: SHB 2466 2002: SB 6538 2004: SSB 6329 (RCW 77.120.030; WAC 220.77.090 & 095)	Canada Shipping Act (TP 13617 E)
Implementation	2009-2012 based on capacity & construction date	July 2004	2005 pending rules for coastal voyages	2001	2001 – exchange. 2007 – treatment if not exchanged	2000
General Application	All vessels	Vessels entering U.S. waters from outside the EEZ	Vessels ≥ 300 tons entering CA waters	Vessels ≥ 300 tons entering OR waters	Vessels ≥ 300 tons entering WA waters	All vessels entering Canadian waters from outside the EEZ
Consistency w/ IMO & USCG	N/A	N/A	Yes	Yes	Yes	Yes (guidelines intended to implement IMO guidelines of 1991
Preempts state or provincial programs	No	No	N/A	N/A	N/A	No
Requirements for BW exchange for vessels entering from open ocean outside the EEZ	≥ 200 NM offshore & ≥ 200 m depth w/ exceptions - not yet enforced [2]	≥ 200 NM offshore	> 200 NM offshore & > 2000 m depth	> 200 NM offshore & > 2000 m depth [4]	> 200 NM offshore [5]	Guidelines Only: ≥ 200 NM & ≥ 2000 m; mandatory rule in progress; Required[6]: Port of Vancouver [18]
Management approach	Must meet exchange or treatment standards	Exchange, retain on board or approved alternatives. Treatment standards in consideration	Exchange or retain from outside EEZ, otherwise minimize discharge	Exchange	Exchange or treat	Exchange, non-release of ballast, discharged to reception facilities and treatment
Requirements for BW exchange for vessels operating in coastal	N/A	No	> 50 NM offshore and ≥ 200 m (proposed) [3]	Yes > 50 NM offshore	Yes > 50 NM offshore	Proposed [6]

	IMO	U.S.	California	Oregon	Washington	Canada [1]
waters inside the EEZ						
BW exchange standard	Flow through = 3 times tank volume Empty/refill = 95% volume exchange	Flow through = 3 times tank volume Empty/refill = 100% volume exchange	Flow through = 3 times tank volume Empty/refill = 100% volume exchange	Flow through = 3 times tank volume Empty/refill = 100% volume exchange	Flow through = 3 times tank volume Empty/refill = 100% volume exchange	Flow through = 3 times tank volume Empty/refill = 95% volume exchange
Requires ballast water performance/exchange standard	Yes [7]	No	No	No	No	No
Safety exemptions	Yes	Yes	Yes	Yes	Yes	Yes
Includes fees to support program	N/A	No	$400 per visit	No	No	No
Early compliance for new ships	Yes	Unknown	No	No	No	No
No-ballast uptake areas	Yes	Yes	No	No	No	No
Compensation for delay	Yes	No	No	No	No	No
No-ballast uptake areas	Yes [8]	Yes	No	No	No	No
Compensation for delay	Yes	No	No	No	No	No
Best management practices [9]	Yes	Required for all vessels operating in U.S. waters	Yes	No	No	See IMO
Requires BW management plans [10]	Yes	Yes	Yes	No	No	Yes
Treatment standard	Discharge ≤10 org/m^3 greater than 50 microns; ≤10 org/ ml between 10 to 50 microns, plus human health standards [11]	Three alternatives under consideration	None	None	Being developed, To take effect July 1, 2007	At least as effective as exchange standards, hold ballast on board or discharge to reception facilities
Approval of treatment systems	No – except for biocide/chemical treatment	Proposed	Yes [12]	No	Yes [12]	Yes
Experimental treatment	Yes	Yes [13]	Yes	No	Yes	No
Allows alternative treatment methods (ATM)	Yes if approved by own Nation [14]	Yes	Yes - systems must be approved by CA or USCG	Yes - approved by USCG	Yes, if ATM, must meet standards by 07/01/07	Yes
Offers incentives for alternative treatments	Yes	Yes	Yes	No	Yes	No
Sediment management [15]	Yes	Proposed	Yes	Yes	No	Yes
Sediment reception	Yes	No	No	No	No	Yes

	IMO	U.S.	California	Oregon	Washington	Canada [1]
facilities [16]						
Requires sampled verification of management activity	N/A	Salinity testing	Salinity testing	No	Salinity testing & biological sampling	Salinity testing
Inspections of logs and ballast water sampling	Yes	Yes	Yes	Yes	Yes	Yes
Includes penalty for non-report	No - specific to port state	Yes	Yes	Yes	Yes	Yes
Includes penalties for non- compliance with management	No - specific to port state	Yes	Yes	Yes	Yes	Yes
Penalties	Members develop	Civil penalties up to $27,500/day or Class C Felony charge	$5000/ violation plus misdemeanors	$500 to $5000 per violation	$500 to $5000 per violation	No
Requires BW record book	Yes	Yes	Yes	No	No	Yes (proposed)
Time frame required	N/A	24 hrs prior to arrival at port/destination or prior to departure	Upon departure	24 hrs prior to arrival	24 hrs prior to arrival	Prior to entry into Canadian waters
Required for voyages from outside EEZ	Yes	Yes	Yes	Yes	Yes	Yes
Required for coastal voyages	No	Yes	Yes	Yes	Yes	Yes
Electronic submission of form	N/A	Yes	Yes	Yes	Yes	Accepted with other forms
Maintain log and report ballast operations [17]	Yes	Yes - all vessels entering US ports	Yes	Yes	Yes	Yes
Interim report to show how standards will be met	No	No	No	No	Yes	No

[1] Guidelines for the control of BW discharge from ships in waters under Canadian jurisdiction are developed by Transport Canada and Fisheries and Oceans Canada.

[2] International Maritime Organization: Ballast water exchange should be at least 200 NM from nearest land and in at least 200 m depth; or if unable to meet previous, exchange should be as far from nearest land as possible and at least 50 NM from land and 200 m in depth. Individual nations may impose additional measures on BW and sediments. Implementation of BW regulations vary by ship length. Go To http://globallast.imo.org/

[3] California has proposed coastal exchange requirements for BW exchange to occur at least 200 NM offshore in ≥2000 m depth; some exceptions may apply. This rule is expected to take affect December 2005

[4] Oregon has no offshore distance requirements for coastal exchange. Ballast water exchange is required when taken onboard in North American coastal ports located north 50 degrees N latitude or south of 40 degrees N latitude.

[5] Discharging BW or sediments that originate 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 is allowed. If the USCG requires a vessel to conduct an exchange further offshore, then that distance is the required distance.

[6] In June 2005, Canada's ballast water regulatory agency Transport Canada, proposed new mandatory ballast water management requirements for ships entering Canadian waters, and waters in their exclusive economic zone. The mandatory rules do not apply to coastwise traffic North of Cape Blanco, Oregon. Proposed ballast water management options are: (a) exchange of ballast water; (b) the treatment of ballast water; (c) the discharge of ballast water to a reception facility; and (d) the retention of ballast water on board the ship. For further information: http://www.tc.gc.ca/marinesafety/TP/Tp13617/menu.htm Vessels traveling in coastal waters arriving from ports in British Columbia, Alaska, or the west coast of the U.S. (North of Cape Mendocino) wanting to discharge BW are exempted if the water originated from these waters.

[7] Discharge < 10 viable organisms per cubic meter ≥ 50 micrometers in minimum dimension, and < 10 viable organisms per milliliter < 50 micrometers in minimum dimension and ≥ 10 micrometers in minimum dimension; and discharge of the indicator microbes shall not exceed the specified concentrations

[8] Identify and notify mariners of areas where ballast water should not be taken onboard, including areas with outbreaks and infestations; near sewage outfalls; with poor tidal flushing.

[9] Avoid uptake or discharge in certain areas, clean ballast tanks, clear anchors and chains, clean hull fouling organisms and etc.

[10] Plans developed specifically for a particular vessel that detail actions to implement BW requirements, how sediment must be managed, designates an office in charge and defines reporting requirements.

[11] Discharge less than 250 colony-forming units (cfu) per 100 ml of *E. coli*; and less than 100 cfu per 100 ml of intestinal enterococci.

[12] California and Washington: have treatment incentive programs allowing exceptions to future performance standards if best achievable/available technology is used.

[13] The Coast Guard Shipboard Technology Evaluation Program (STEP), January 2004, facilitates development of ballast water treatment technologies. The STEP allows the Coast Guard to grant equivalencies to vessel owner program participants. Go to http://www.uscg.mil/hq/g-m/mso/step.htm

[14] Ships participating in a program (approved by its nation) to test and evaluate promising BW treatment technologies have a leeway of five years before having to comply with the requirements.

[15] Remove and dispose of sediments according to the ship's ballast water management plan.

[16] Facilities that clean or repair ballast tanks to provide sediment disposal options.

[17] Ballast record book can be electronic, integrated into other record systems and etc. It must be available for inspection anytime. The books must detail ballast practices undertaken.

[18] The Port of Vancouver introduced a mandatory Ballast Water Exchange Program in 1997. This program now also includes the ports of Nanaimo and Fraser River.

NOTE: For further information on state federal, and international programs, please refer to the "Links" and "State Agency Ballast Water Contacts" at http://www.psmfc.org/dataprojects/pbwg.html

List of Acronyms

AB – Assembly Bill
ATM - alternative treatment methods
BW - ballast water
CA - California
EEZ - Economic Exclusion Zone
HB - House Bill
IMO - International Maritime Organization
M - meters
NISA - Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990
NM - nautical miles
OR - Oregon
ORS - Oregon Revised Statues
PL - Public Law
PRC - Public Resources Code
RCW - Revised Code of Washington
SB - Senate Bill
SHB – Substitute House Bill
SSB - Substitute Senate Bill
TP - Transportation Publication
USCG - U.S. Coast Guard
WA -Washington
WAC - Washington Administrative Code

Appendix 5: Proposed and Existing Ballast Water Treatment Performance Standards for the West Coast**.** (Source: Kevin Anderson, Puget Sound Action Team, Olympia, Washington).

Proposed and Existing Ballast Water Treatment Performance Standards for the West Coast

	IMO Regulation D-2 and Transport Canada	**S363 – Ballast Water Management Act Section 1101 (f)[i]**	**California Advisory Committee**		**S 770 National Aquatic Invasive Species Act Section (1101 (b) 3**	**Washington Administrative Code 222-170**
Management approach	Exchange moving towards treatment only	Exchange moving towards treatment only	Exchange moving towards treatment only		Exchange moving towards treatment only	Exchange or treatment
Standard:	**Proposed**	**Proposed**	**Recommended Interim**		**Proposed**	**Adopted Interim:**
1) Organisms greater than 50 microns in minimum dimension:	<10 viable organisms per cubic meter	< 0.1 living organisms per cubic meter	No detectable living organisms		Promulgate numeric discharge standards to ensure that non-native species will not establish in US waters	Technology to inactivate or remove:
2) Organisms 10-50 microns in minimum dimension:	<10 viable organisms per ml	< 0.1 living organisms per ml	$<10^{-2}$ living organisms per ml		When no technology exists to accomplish above standard, treat with best performing treatment technology	95% zooplankton 99% bacteria & phytoplankton
3) Organisms less than 10 microns in minimum dimension:	No standards	No standard	$< 10^{3}$ cfu bacteria/100 ml			
4) Escherichia coli	< 250 cfu[iii]/100 ml	<126 cfu/100 ml	<126 cfu/100 ml		For existing vessels: has a concentration of viable biological material that contains 99 percent fewer near-coastal plankton than the concentration of viable biological material of the intake water of the vessel.	
5) Intestinal Enterococci	<100 cfu/100 ml	< 33 cfu/100 ml	<33 cfu/100 ml			
6) Toxicogenic *Vibrio cholerae* (O1& O139)	<1 cfu/100 ml <1 cfu/gram of wet zooplankton samples	<1 cfu/100 ml <1 cfu/gram of wet weight of zoological samples;	<1 cfu/100 ml < 1 cfu/gram of wet zoological samples $<10^{4}$ viruses/100 ml **Final standards** – no discharge of living organisms		For new vessels: has a concentration of viable biological material that contains 99.9 percent fewer near-coastal plankton than the concentration of viable biological material of the intake water of the vessel	

Proposed implementation schedules:

Proposed by - **International Maritime Organization** - **Senate Bill 363** - **California Advisory Committee**	**Ballast capacity of vessel**	**Applies to vessels in this class if constructed in or after:**	**Applies to all other vessels in this class starting in:**
	<1500 metric tons	2009	2016
	1500-5000 m tons	2009	2014
	>5000 m tons	2012	2016

Proposed in Senate Bill 770	Implement treatment for vessels built on January 1, 2008 or after
	Implement treatment for **all** vessels starting January 1, 2011

Current Washington law	All vessels by June 2007

[i] Also included verbatim in S1224 - National Ocean Protection Act

[ii] Advisory Committee created by the California Lands Commission required by Public Resources code section 71204.9

[iii] cfu = colony forming units