2021 BIENNIAL REPORT

ON THE CALIFORNIA MARINE INVASIVE SPECIES PROGRAM

PRODUCED FOR THE CALIFORNIA STATE LEGISLATURE

CALIFORNIA STATE LANDS COMMISSION

JANUARY 2021

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CALIFORNIA STATE LANDS COMMISSION
JANUARY 2021

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EXECUTIVE SUMMARY

The California State Lands Commission (Commission) prepared this report for the California Legislature pursuant to Public Resources Code sections 71210 and 71212. This is the tenth biennial report to the California Legislature, and it summarizes California Marine Invasive Species Program (MISP) activities from January 1, 2018 through December 31, 2019. This report includes:

- A summary and analysis of vessel arrival patterns at California ports
- A summary of the information provided by the vessels in the Ballast Water Management Report (BWMR) and the Annual Vessel Reporting Form (AVRF)
- An analysis of the ballast water and biofouling management practices used by vessels in California
- An update on the implementation of ballast water discharge performance standards
- A summary of recent research related to nonindigenous species (NIS)
- An evaluation of the MISP accomplishments and recommendations for actions to improve the program

Nonindigenous Species: Impacts and Vectors

Nonindigenous species (NIS) are transported to new environments, both intentionally and unintentionally, through human activities. Once established, NIS pose significant threats to human health, the economy, and the environment. Attempts to eradicate NIS after they become established are often unsuccessful and costly. Hence, prevention of species introductions through vector management is the most effective way to protect California waters.

Shipping is the major pathway by which aquatic NIS are transported around the globe and is responsible for up to 79.5% of established aquatic NIS introductions in North America (Fofonoff et al. 2003). Commercial ships transport organisms through ballast water and vessel biofouling. Ballast water is used by ships to maintain stability at sea. When ballast water is loaded in one port and discharged in another, the entrained organisms are introduced to new regions. Vessel biofouling refers to the attachment or association of an organism or group of organisms to a vessel's submerged and wetted surfaces. Biofouling organisms are introduced to a new environment when they fall off their "host" structure or release larvae in the water as they reproduce.

What is the Marine Invasive Species Program?

In 1999, the California Legislature established the MISP. The MISP is a statewide, multiagency program designed to prevent the introduction of NIS from vessels 300

gross registered tons and above that are capable of carrying ballast water arriving at California ports. The purpose of the MISP is to move the state expeditiously toward elimination of the discharge of NIS into the waters of the state. (Pub. Resources Code, § 71201, subd. (d).)

The MISP consists of four agencies:

- California State Lands Commission: Administers the MISP and develops and implements vessel vector management regulations
- California Department of Fish and Wildlife's Office of Spill and Prevention and Response: Monitors and gathers data on NIS in state waters
- State Water Resources Control Board: Consults with MISP partner agencies on topics related to water quality and toxicity
- California Department of Tax and Fee Administration: Collects a fee from vessel owners and operators of qualifying voyages to California ports

Legislative Evolution of the MISP

In 1999, the initial authorizing legislation for the MISP (Assembly Bill (AB) 703, Chapter 849, Statutes of 1999) focused solely on the management of ballast water from vessels arriving from foreign ports. The MISP was reauthorized and expanded in 2003 with the passage of the Marine Invasive Species Act (MISA; AB 433, Chapter 491, Statutes of 2003) which, among other provisions, directed the Commission to adopt ballast water management regulations for vessels moving coastally between ports on the west coast of the U.S. Since 2003, the MISA has been amended numerous times, most notably to establish California's ballast water discharge performance standards (Senate Bill (SB) 497, Chapter 292, Statutes of 2006) and to authorize the Commission to adopt and implement biofouling management regulations (AB 740, Chapter 370, Statutes of 2007).

Commission staff regularly reviews existing authority under the MISA to assess whether changes are necessary to improve protection of California waters from NIS introductions. Based on recommendations to the Legislature in 2018 (see Commission 2018), the Commission sponsored AB 912 in 2019 (Chapter 433, Statutes of 2019).

AB 912 authorizes the Commission to:

- Adopt and enforce the federal ballast water discharge performance standards set forth in section 151.2030 (a) of Title 33 of the Code of Federal Regulations (see Ballast water discharge performance standards in section 6.5 of this report)
- Delay implementation of the interim and final California ballast water discharge performance standards to 2030 and 2040, respectively, due to a lack of available ballast water treatment technologies to enable vessels to meet the California standards at this time (see Commission 2018 for more detail)

- Sample ballast water and biofouling for research purposes. Prior to AB 912, the Commission could sample only for compliance assessment.
- Change the definition of the Pacific Coast Region (PCR) (see Figure 4-8 for former PCR map and Appendix E for current PCR map)

The Commission is in the process of adopting new and amending existing regulations to implement the requirements of AB 912 (see section 12.1 (2) and (4) of this report for next steps on adopting and implementing federal ballast water discharge performance standards).

Vessel Arrival Patterns

Between 2010-2019, California received an average of 9,848 ± 820 (standard deviation) vessel arrivals per year. During 2018 and 2019, California ports received 10,840 and 11,199 arrivals, respectively. The Los Angeles/Long Beach Port Complex received 40% of all California arrivals during that time. Container and tank vessels combined contributed to more than half of the total arrivals at California ports.

Consistent with the patterns observed in previous years (Scianni et al. 2019), more than half (57%) of the arrivals at southern California ports came from outside the Pacific Coast Region (PCR; see Figure 4-8 for PCR map), while in northern California ports, only 19% of arrivals came from outside the PCR.

Ballast Water Management and Discharge Patterns

Retention of all ballast water on board the vessel (i.e., no discharge) while in California waters continues to be the most common management approach used by vessels. During 2018 and 2019, 85.5% of vessel arrivals reported retaining all ballast water on board. Vessels that do not discharge ballast water present zero risk of ballast water-mediated species introductions.

Of those vessels that reported discharging ballast water in California, bulk and tank vessels reported more ballast water discharge by volume than all other vessel types combined. Ballast water exchange was the most common management method used during the two-year period of this report (69.1% of discharging arrivals). However, the use of alternative methods, specifically the use of ballast water treatment systems (BWTS), is increasing. During the reporting period, 292 unique vessels reported using a BWTS to manage ballast water prior to discharge in California waters (corresponding to 674 arrivals and 5.5 million metric tons of treated water discharged). This represents 24.1% of the total volume discharged in California (22.9 MMT) over that two-year period.

Biofouling Management Practices and Patterns

California's biofouling management regulations were implemented in October 2017 and apply to new vessels delivered into service on or after January 1, 2018 and existing vessels that complete a regularly scheduled out-of-water maintenance (i.e., dry docking) on or after January 1, 2018. The regulations include requirements for biofouling management practices, recordkeeping and reporting, and vessels with extended idle periods. During 2018 and 2019, 3,885 vessel arrivals at California ports were required to comply with the California Biofouling Management Regulations.

The risk of biofouling can be measured using the wetted surface area of a vessel. This is the area of a vessel that is susceptible to biofouling because it is permanently or temporarily submerged in water. During the reporting period, 266 million square meters of cumulative wetted surface area arrived at California ports; this is equivalent to the area of nearly 50,000 American football fields. Container and tank vessels were responsible for 72% of all wetted surface area that arrived at California ports during that time.

Extended idle periods, when vessels sit in one port or place for 10 days or more, increase the risk of biofouling-mediated introductions because biofouling organisms accumulate on wetted surfaces when vessels are not in motion. During 2018 and 2019, 4,637 idle periods of 10 days or greater were reported. Most (80.1%) of these idle periods were between 10 and 19.9 days, but 2.2% of them were greater than 45 days. Commission staff expects to see an increase in the number of vessels reporting extended idle periods due to the COVID-19 pandemic and associated recession.

Field Operations

Commission staff monitors and inspects vessel arrivals throughout California to assess compliance with the Marine Invasive Species Act (MISA) and associated ballast water and biofouling regulations. The MISA mandates that at least 25% of the vessels arriving at California ports be inspected. (Pub. Resources Code, § 71206, subd. (a).)

For the period between 2018 and 2019, staff inspected 20.2% of all vessel arrivals at California ports; however, 15% of arrivals cannot practicably be inspected due to safety and accessibility limitations at certain ports. Removing vessel arrivals that are not practicable to inspect from the total brings the percentage of inspected arrivals up to 23.9%.

The Commission faced challenges meeting the 25% mandate during the two-year reporting period due to staffing shortages. The Commission faces ongoing challenges in recruiting for and filling vacancies in the Marine Safety Specialist series (i.e., vessel inspectors because the classification specifications are outdated. The Commission recognizes the need to cast a wide net with our recruiting processes and has recently reviewed its department-specific classifications through an equity lens in order to

identify opportunities to break down barriers to State employment, such as entry requirements that have not proven to be relevant to staff's performance. Despite these challenges in recruiting, the Commission was able to hire five new Marine Safety Specialists in 2020, and the MISP has already seen an increase in the percent of vessel arrivals inspected.

Partner Agencies Updates

During the reporting period, the **California Department of Fish and Wildlife Office of Spill Prevention and Response** funded and managed new statewide NIS monitoring projects and made improvements to the program's existing efforts. These projects were significantly enhanced by a budget augmentation from the Marine Invasive Species Control Fund in 2017.

The projects include surveys at 10 focal estuaries in California in collaboration with the Smithsonian Environmental Research Center and the Molecular Ecology Laboratory at Moss Landing Marine Laboratories to perform morphological (form and structure) and genetic identification of the species found at these locations. The main objectives of these surveys were to understand:

- The distribution of NIS in state waters
- How NIS are introduced and spread
- How NIS respond to vessel and species management strategies

The **California Department of Tax and Fee Administration** collects a $1,000 fee from the owner or operator of each vessel that arrives at a California port from a port outside of California. (Pub. Resources Code, § 71215.) Between January 1, 2018, and December 31, 2019, an average of 475 vessel arrivals were billed per month. The average collection rate was 98.1%.

MISP Accomplishments 2018-2019

High Compliance Rate: 97.5% of all California arrivals were compliant with both biofouling and ballast water management requirements.

Less than 1% of the reported ballast water discharged in California waters did not meet the ballast water management requirements. Ninety-three percent (126,586 metric tons) of the reported noncompliant ballast water was discharged by bulk and tank vessels. Half of this water was sourced in Mexico and was not exchanged at the required distance from land.

During the reporting period, about 20% of the arrivals subject to the biofouling regulations were inspected, and from those, 33% resulted in violations that required a

60-day grace period. After a follow-up inspection, 96% of the vessels that received a 60-day grace period were found compliant with the biofouling regulations.

Commission staff are seeing a positive shift in the shipping industry biofouling management practices driven by the implementation of the biofouling regulations in California.

2018 Ballast Water Treatment Technology Assessment Report: In response to the recommendations, the Legislature passed AB 912 delaying implementation of the California interim and final ballast water discharge standards to 2030 and 2040, respectively, due to the current lack of available technology capable of meeting those standards. The bill also authorizes the Commission to adopt and implement the federal ballast water discharge standards until the California ballast water discharge standards are implemented.

2019 Biennial Report to the Legislature: On February 4, 2019, the Commission approved a report to the California Legislature summarizing the activities and accomplishments of the California Marine Invasive Species Program during the period from July 1, 2016 through June 30, 2018. The report is available at https://www.slc.ca.gov/wp-content/uploads/2019/02/2019_MISPBiennial_FINAL.pdf.

Update of the Vessel Inspection Training Program: Intensive training and development of improved processes and protocols have had a positive impact in the inspections program. Staff updated and improved the internal vessel inspection documentation process to ensure high quality data collection for analysis and enforcement purposes. Improved processes to prioritize vessels for inspection and targeted inspection and outreach efforts of the highest priority vessel arrivals are reflected in the high compliance rates observed in the past two years and represent the proactive protection of California waters against NIS introductions.

Database improvements: The Commission has improved operations efficiency by developing new processes to enable the automatic import of data into the MISP database from Ballast Water Management Reports submitted via email.

Outreach and Engagement: MISP staff presents at conferences and is involved in workgroups focused on invasive species science and management. Since January 2018, MISP staff has participated in four international meetings and collaborated in at least nine local and national conferences, workshops, and committees.

Peer-Reviewed Scientific Publications: Staff has co-authored four peer-reviewed journal articles during the last two years:

- Non-native species colonization of highly diverse, wave swept outer coast habitats in Central California (Zabin et al. 2018)
- A history of ship specialization and consequences for marine invasions, management, and policy (Davidson et al. 2018)

- Vessel in-water cleaning or treatment: Identification of environmental risks and science needs for evidence-based decision making (Scianni and Georgiades 2019)
- Artificial structure density predicts fouling community diversity on settlement panels (Susick et al. 2019)

The Vessel Incidental Discharge Act

In late 2018, the Vessel Incidental Discharge Act (VIDA), included as Title IX within S.140, the Frank Lobiando Coast Guard Reauthorization Act of 2018, was signed into law. The law:

- Designates the U.S. Environmental Protection Agency (U.S. EPA) as the lead authority to establish national water quality standards for vessel discharges, including ballast water
- Designates the U.S. Coast Guard (USCG) as the lead authority to implement and enforce the national standards set by the U.S. EPA
- Will preempt state authority, once fully implemented, to adopt or implement state-specific management requirements or standards for vessel discharges, including ballast water, that are stricter than the federal standards

Certain provisions were included in VIDA that protect states from some of the impacts to their authority, including:

- Individual states retain authority to inspect vessels and enforce the federal ballast water management requirements
- Individual states retain authority to collect fees (with a cap) and Ballast Water Management Reports from vessels arriving at state ports
- Individual states may, through their governors, petition U.S. EPA for stricter discharge standards

State law is not preempted until U.S. EPA and the USCG adopt regulations to establish discharge standards and implement enforcement procedures. The combined rulemaking process could take four years or more from the time VIDA was signed into law.

Once VIDA is implemented, the California Marine Invasive Species Control Fund (MISCF) is projected to lose between $300,000 and $500,000 in revenue each year due to the cap on vessel arrival fees. This loss of revenue will push the Marine Invasive Species Control Fund towards insolvency by Fiscal Year 2024.

In September 2019, Assembly Member Friedman introduced Assembly Joint Resolution (AJR) 25 to indicate the Legislature's objection to the preemption of state authority under VIDA. AJR 25 did not move forward due to the impacts of the COVID-19 crisis on the legislative session.

Next Steps

Over the next two years, MISP staff will work on high priority actions to improve protection of California waters from the introduction of NIS, including:

Update and improve the Marine Invasive Species Act enforcement process: Amend enforcement regulations (Article 4.9, Marine Invasive Species Act Enforcement and Hearing Process, California Code of Regulations, title 2, section 2299.01 et seq.) to incorporate violations of the biofouling regulations and the ballast water discharge performance standards.

Adopt the federal ballast water discharge performance standards: Adopt regulations to implement the federal ballast water discharge performance standards in accordance with AB 912.

Develop ballast water discharge performance standards compliance assessment protocols: Develop a process to assess vessel compliance with the ballast water discharge performance standards. Ensure performance efficacy of the Ballast Water Treatment Systems that are being used to meet the discharge standards, by assessing operational practices.

Implement a weighted risk assessment: Implement a new pre-arrival risk-based process for identifying high priority vessels for inspection to achieve a more effective and efficient use of available resources. The new approach combines ballast water and vessel biofouling risk factors and relies on data collected via vessel-submitted forms (BWMR and AVRF).

Leverage technology to improve accessibility to vessels for inspections: Evaluate how the Commission can leverage technology to engage in virtual vessel inspections to augment onboard inspections to assess compliance with the MISA. Virtual vessel inspections are particularly important to improve the Commission's ability to inspect vessels that are not accessible due to location at anchorage or that present other logistical or safety challenges (see section 5.2).

Improve the functionality and user experience of the web-based user interface, MISP.IO: Evaluate ways to improve the efficiency and effectiveness of MISP.IO for both Commission staff and external stakeholders:

- Hold town hall events with stakeholders to gather input on the user experience
- Develop a more efficient process to track form submission and to report to responsible parties when forms have not been submitted on time

Implement the recently adopted amendment to the AVRF submission requirements: A proposed regulation amendment to the California Code of Regulations, title 2, section 2298.5 is in progress and is expected to be implemented in 2021. The amendment requires AVRF submission using the Commission's web-based user interface.

Track the arrival of vessels that have been idled during and after the recession caused by the COVID-19 pandemic to assess risk of species introductions: Staff will track vessels during the coming years to assess the risk to California waters and will target applicable vessels for inspection to ensure compliance with California's biofouling regulations.

Actively engage and participate in the process to implement VIDA: Work with the California Department of Justice, the Office of the Governor of California, and state representatives to comment on proposed federal regulations to adopt and implement national standards of performance for discharges incidental to the normal operation of vessels and implement VIDA.

Recommendations

The Commission makes the following recommendations to the Legislature and California state agencies and departments based upon the information and data presented in this report:

1) Support the Commission's efforts to remove recruitment barriers for the Marine Safety series of job classifications to establish a more equitable recruitment process that results in a qualified candidate pool that is larger, more diverse, and maximally inclusive to better reflect the people of California.
2) Support proposed amendments to the Revenue and Taxation Code by the California Department of Tax and Fee Administration to address the difficulties associated with the recent change in the interpretation of section 55381, subsection (b) of the Revenue and Taxation Code. This new interpretation prevents invoices to be sent to vessel agents instead of vessel owners due to a provision relating to disclosure of information, making the fee collection process complicated and difficult.
3) Work collaboratively with all stakeholders and the regulated community to secure ongoing funding for the Marine Invasive Species Control Fund. After the implementation of the Vessel Incidental Discharge Act, the California Marine Invasive Species Control Fund is projected to lose between $300,000 and $500,000 in revenue each year and become insolvent by 2024. In addition, the fund revenue is being critically impacted by the COVID-19 pandemic due to a reduction in shipping traffic and trade.
4) Support the reintroduction and passage of Assembly Joint Resolution 25 in 2021 to signal California's opposition to preemption of state authority to regulate discharges into state waters incidental to the normal operation of a vessel.

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ABBREVIATIONS AND ACRONYMS

µm	micrometers
AB	Assembly Bill
AMS	Alternate Management System
AVRF	Marine Invasive Species Program Annual Vessel Reporting Form
BWMR	Ballast Water Management Report
BWMS	Ballast Water Management System
BWTS	Ballast Water Treatment System
CDFW-MISP	California Department of Fish and Wildlife's Marine Invasive Species Program
CDFW-OSPR	California Department of Fish and Wildlife's Office of Spill Prevention and Response
CDTFA	California Department of Tax and Fee Administration
cfu	colony-forming unit
Commission	California State Lands Commission
eDNA	environmental DNA
ER	Empty-refill exchange
FT	Flow-through exchange
GBRC	Golden Bear Research Center
GIS	Geographic Information Systems
IMO	International Maritime Organization
LPOC	Last Port of Call
m	meter
MEPD	Commission's Marine Environmental Protection Division

MISA	Marine Invasive Species Act
MISCF	Marine Invasive Species Control Fund
MISP	Marine Invasive Species Program
ml	milliliter
MLML	Moss Landing Marine Laboratories
MMT	million metric tons
MT	metric tons
NIS	nonindigenous species
NM	nautical miles
PCR	Pacific Coast Region
Reg. Sess.	Regular Session
SB	Senate Bill
SERC	Smithsonian Environmental Research Center
STEP	USCG Shipboard Technology Evaluation Program
U.S.	United States
USCG	United States Coast Guard
U.S. EPA	United States Environmental Protection Agency
UV	Ultraviolet Irradiation
VIDA	Vessel Incidental Discharge Act
Water Board	State Water Resources Control Board (California)
WSA	wetted surface area

DEFINITIONS AND VOCABULARY

Agent
A vessel's agent acts on behalf of the ship owner and provides information to the vessel crew about local requirements at each port

Antifouling coating
Specialized paint used to prevent biofouling growth on the vessel

Anchorage
Areas suitable for vessels to anchor away from shore while they wait for authorization to berth

Ballast water
Water used by vessels to improve and maintain stability, balance, and trim during cargo operations

Ballast water discharge performance standards
The legal restrictions setting the maximum allowable concentration of living organisms of various types and sizes (i.e., classes) in discharged ballast water

Ballast water exchange
Replacing the water in a ballast water tank with new water

Biocides
Toxic substances that have the potential to kill organisms

Biocidal coating
Antifouling coating containing biocides to prevent the attachment and accumulation of biofouling organisms

Biofouling
Attachment or association of an organism or group of organisms (community) to wetted surfaces (e.g., vessels and docks)

Dry dock
Removal of a vessel from the water for maintenance

Effective lifespan of the antifouling coating
Length of time that an antifouling coating is expected to be effective based on the specific application thickness and design of the coating

Idle period
Period of time where a vessel remains in one place and is not actively moving (also referred to as an "extended residency period")

In-water cleaning
Processes used to remove biofouling from the vessel's wetted surfaces while the vessel is in water (versus out-of-water or "dry dock")

Mid-ocean waters
Ocean water at least 200 nautical miles from any land and having a depth of least 2,000 meters

Nonindigenous species (NIS)
Any species (or biological material capable of reproducing) that has been transferred from its location of origin or historical range into a new location

Out-of-water support strips
Areas on the vessel's hull where the support blocks are placed during dry dock (i.e., out-of-water maintenance) and remain unpainted and unprotected

Phytoplankton
Marine and freshwater microscopic photosynthetic (contain chlorophyll and require sunlight to live) organisms that drift in the water. Also known as microalgae.

Vector
Specific mechanisms that facilitate the movement of NIS

Wetted Surface Area (WSA)
Measurement of all vessel surface area that is temporarily or continuously submerged in water and is susceptible to biofouling accumulation

Zooplankton
Marine or freshwater animals (including immature stages of some animals), often microscopic, that drift with the water currents

1. PURPOSE

The California State Lands Commission (Commission) prepared this report for the California Legislature pursuant to Public Resources Code sections 71210 and 71212. This is the tenth biennial report to the California Legislature; it summarizes California Marine Invasive Species Program (MISP) activities from January 1, 2018, through December 31, 2019.

Per statutory requirements, this report includes:

- A summary and analysis of vessel arrival patterns at California ports, including a summary of compliance rates categorized by geographic area and vessel type
- A summary of the information provided in the Ballast Water Management Reports submitted by vessels to the Commission, including the volumes and method(s) of ballast water management, volumes discharged into state waters, types of ballast water treatment, and locations at which ballast water was loaded and discharged
- An analysis of ballast water management practices and an update on the implementation of ballast water discharge performance standards
- A summary of Commission-sponsored research and programs to evaluate alternatives for treating or otherwise managing ballast water
- A summary and analysis of biofouling management practices reported by vessels arriving at California ports
- A summary of recent research addressing the release of nonindigenous species (NIS) by vessels
- An evaluation of the effectiveness of the MISP and measures taken to reduce or eliminate the discharge of NIS from vessels, including recommendations for actions that should be taken to improve the effectiveness of the MISP

2. INTRODUCTION

2.1 What are Nonindigenous Species?

Nonindigenous species (NIS) are organisms that are intentionally or unintentionally transported through human activities to new habitats, such as California's marine, estuarine, and freshwater environments. NIS pose significant risks to human health, the economy, and the environment. Once a NIS is established in a new geographic location and causes impacts, it is considered an invasive species.

Because attempts to eradicate invasive species are costly and often unsuccessful, the most effective way to address NIS is to prevent species introductions by managing the ways they are moved.

2.2 What are Aquatic Nonindigenous Species and How are they Moved?

Nonindigenous species that are introduced into aquatic habitats (e.g., ocean, estuaries, rivers) are called aquatic NIS. Aquatic NIS are moved around the globe through many pathways, including:

- Aquaculture (Grosholz et al. 2012)
- Aquarium trade (Williams et al. 2012)
- Commercial shipping (Fofonoff et al. 2003)
- Live bait trade (Fowler et al. 2015)
- Live seafood trade (Chapman et al. 2003)
- Marine debris (Barnes 2002)
- Recreational watercraft (Ashton et al. 2012)

Each of these pathways contributes to aquatic NIS movement. However, commercial shipping has been recognized as the major contributor to the transport of these organisms worldwide.

Ballast water and vessel biofouling are vectors, or specific mechanisms, within the shipping pathway that transport aquatic NIS. Ballast water and vessel biofouling have contributed to a large percentage of the established coastal marine aquatic NIS introductions in North America (Ruiz et al. 2015) and in California (Ruiz et al. 2011).

2.2.1 Ballast Water as a Vector

Vessels use ballast water to improve and maintain stability, balance, and trim. Vessels take on, discharge, or redistribute ballast water during cargo loading and unloading as they encounter rough seas or as they transit through shallow coastal waterways. When vessels load ballast water, they take on any organisms that are drawn in with the water. As vessels move around the world, they pick up species in the water from one port and discharge them in different ports. This transfer of ballast water results in the worldwide movement of organisms (Figure 2-1).

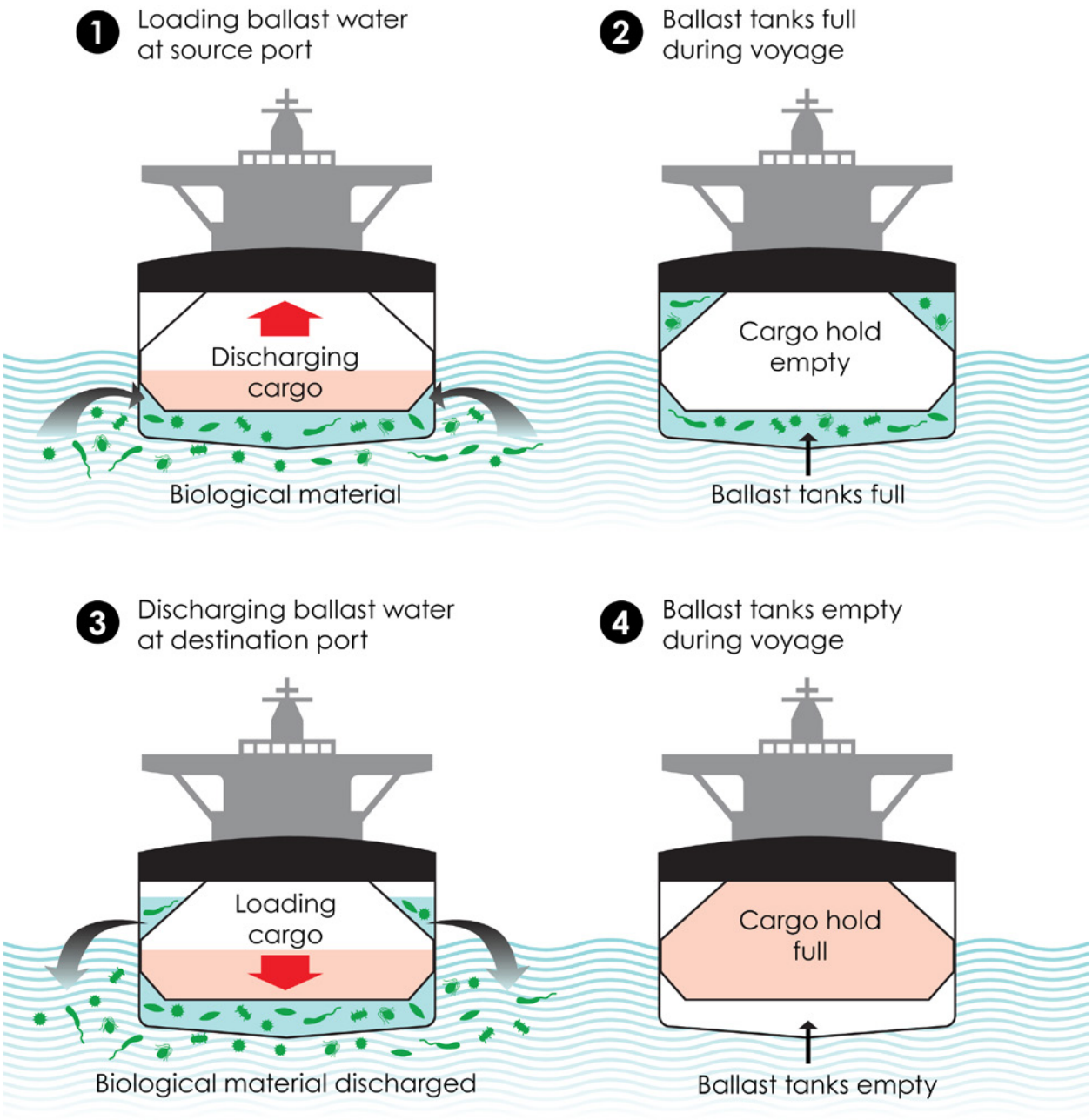


Figure 2-1. Ballast water loading and discharge in relation to vessel cargo operations.

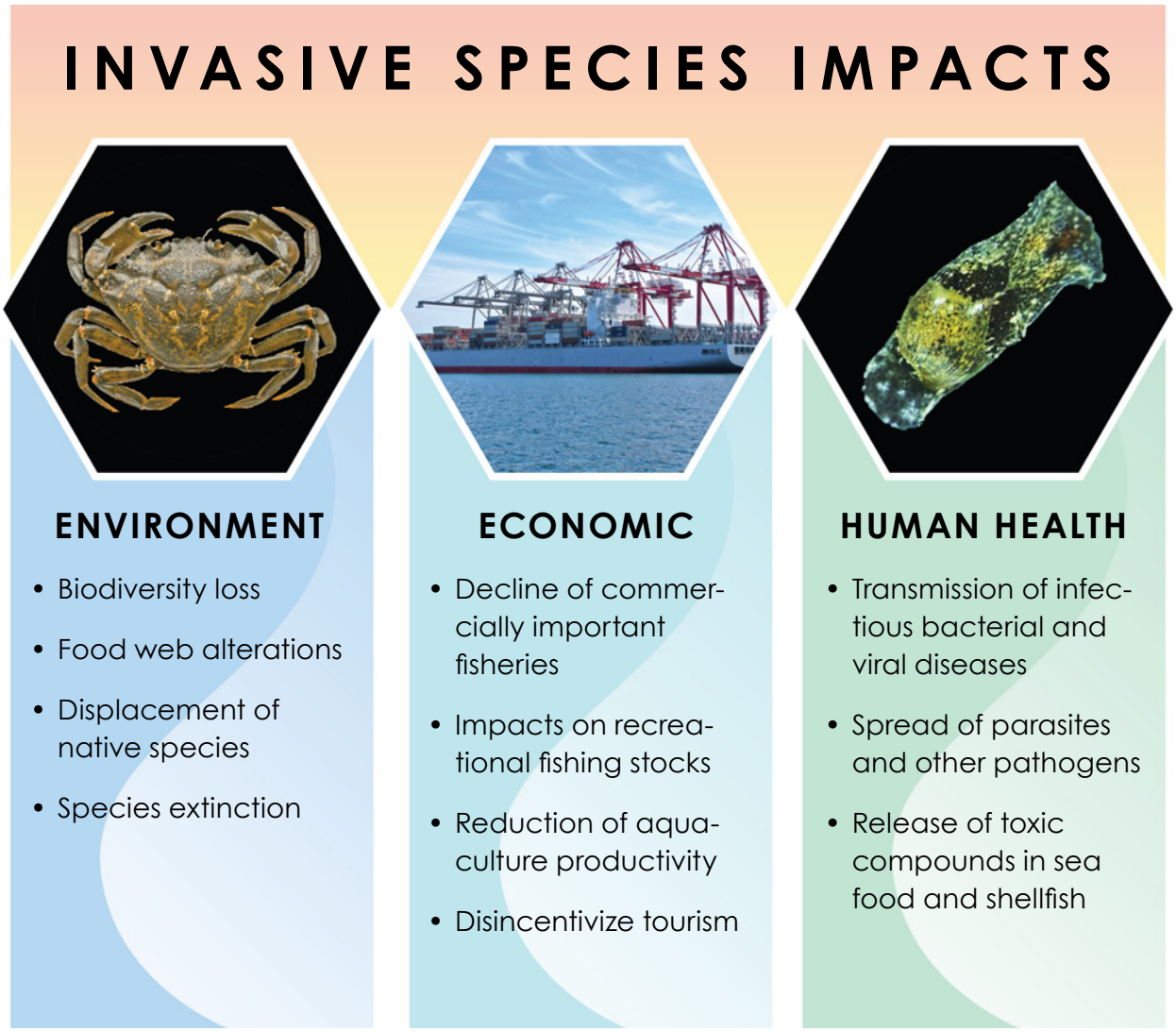
Prior to implementing ballast water management practices in the early 2000s, it was estimated that more than 7,000 aquatic species were moved around the world daily in ballast water (Carlton 1999). The discharge of unmanaged ballast water from a single vessel has the potential to release over 8.9 billion individual zooplankton (microscopic animals that drift or free-float in water) (Minton et al. 2005).

2.2.2 Vessel Biofouling as a Vector

Vessel biofouling refers to the attachment or association of an organism or group of organisms (community) to a vessel's wetted surfaces, which are the areas of the vessel that are permanently or temporarily in contact with ambient water. Vessel biofouling communities consist of both sessile (directly attached to the vessel, e.g., barnacles) and mobile organisms that can survive long voyages and a wide range of environmental conditions. Biofouling communities include fishes, barnacles, algae, mussels, worms, crabs, and other invertebrates.

As vessels transit from port to port, biofouling organisms can drop off or spawn (i.e., reproduce), resulting in aquatic NIS introductions. Vessel biofouling is considered a significant vector for aquatic NIS introductions in several regions including Australia, the North Sea, Hawaii, and California (Ruiz et al. 2000, 2011; Eldredge and Carlton 2002; Gollasch 2002).

2.3 Invasive Species Impacts



2.3.1 Environmental Impacts

NIS significantly impact the ecology of invaded habitats by affecting community structure, food web interactions, resources availability, and biodiversity (Carlton 2001; Grosholz 2002). Worldwide, 42% of threatened or endangered species are listed because of impacts from NIS (Pimentel et al. 2005). Aquatic NIS are commonly found in bays and estuaries (Ruiz et al. 2000b; Ruiz et al. 2009) due to the influence of human-mediated pathways (e.g., shipping and recreational boating) in these areas (Miller et al. 2011). Shipping is the major pathway by which aquatic NIS are transported around the globe and is responsible for up to 79.5% of established aquatic NIS introductions in North America (Fofonoff et al. 2003).

The European Green crab *(Carcinus maenas)* is an invasive species that was first detected in San Francisco Bay in 1989 (Cohen and Carlton 1995). Green crabs negatively impact populations of native California shore crabs (Grosholz et al. 2000) and are also responsible for the loss of eelgrass beds, which are a critical habitat for young fish (Matheson et al. 2016). Since the early 2000s, scientists have been monitoring local populations of the European green crab in California and even attempted an unsuccessful localized eradication (Grosholz et al. in review).

Another example of an aquatic NIS that causes environmental impacts is the overbite clam *(Potamocorbula amurensis)*. Native to estuarine habitats from Russia to southern China, it was first detected in San Francisco Bay in 1986. The clam consumes 80 to 90 percent of the zooplankton from the water column in the shallow portions of the San Francisco Bay (Greene et al. 2011). *P. amurensis* has been associated with the decline of the native delta smelt and other pelagic fishes in the Sacramento-San Joaquin River Delta (Feyrer et al. 2003, Sommer et al. 2007, Mac Nally et al. 2010).

Quagga *(Dreissena bugensis)* and zebra mussels *(Dreissena polymorpha)* were introduced via ballast water to the Great Lakes in the mid-1980s (Carlton 1993) and then moved to California through water deliveries and overland movement of recreational watercraft and equipment. The zebra mussel was first discovered in San Justo Reservoir (San Benito County, California) in 2008 (USGS 2020). Invasive bivalves (such as mussels and clams) filter vast amounts of water, dramatically reducing phytoplankton and zooplankton concentrations (Higgins and Vander Zanden 2010, Vanderploeg et al. 2010), which has been associated with the decline of recreationally valuable fishes (Cohen and Weinstein 1998).

2.3.2 Economic Impacts

In aquatic environments, invasive species threaten aquaculture operations, recreational boating, agriculture, water conveyance, commercial and recreational fishing, marine transportation, and tourism, among other industries — all of which are essential to California's economy. In 2016, California's ocean-based economy employed an estimated 561,777 people and accounted for almost $45 billion of California's total gross domestic product (NOEP 2020).

The European green crab is threatening California's fishing economy by competing for resources with the commercially important Dungeness crab *(Metacarcinus magister)* and other native species. Dungeness crab is one of the most important commercial fisheries in California, accounting for approximately $47 million in revenue in 2017 (NOEP 2020).

The California Department of Fish and Wildlife (CDFW) is working to control the spread of quagga and zebra mussels in California because these mussels threaten water delivery systems (e.g., the California aqueduct) and hydroelectric facilities. Over $29

million has been spent by CDFW since 2008 to control the mussels, and this cost will continue as eradication is not possible (Volkoff, M., *pers. comm.* 2020).

Tens of millions of dollars have been spent on managing and reducing the impact of other aquatic NIS introductions in California, including the following examples:

- Between 2000 and 2006, more than $7 million was spent to eradicate the Mediterranean green seaweed *(Caulerpa taxifolia)* from two small embayments (Agua Hedionda Lagoon and Huntington Harbor) in southern California (Woodfield 2006).
- Since 2000, approximately $34 million has been spent to manage the Atlantic cordgrass *(Spartina alterniflora)* in the San Francisco Bay-Delta (Olofson, P., *pers. comm.* 2018).
- In 2014, the Port of Stockton spent $200,000 to mechanically remove water hyacinth *(Eichhornia crassipes)*, a nonindigenous aquatic plant from surrounding waterways, resulting in an estimated $300,000 loss due to delays in cargo operations (Wingfield, J., *pers. comm.* 2015).

These costs represent only a fraction of the cumulative expenses related to NIS management because eradication is rarely successful and control is an unending process. The environmental damages and losses associated with NIS (aquatic and terrestrial) impacts in the United States have been estimated between $120 to $137 billion per year (Pimentel et al. 2005; Neill 2011).

2.3.3 Human Health Impacts

In addition to economic and ecological impacts, invasive species impact human health by acting as a vector for many human pathogens or by being the pathogens themselves. Some of the best studied epidemics can be traced to biological invasions, including the bubonic plague, which was caused by a bacterium in a flea that infested an invasive rat. Also, a cholera outbreak in South America during the 1990s was likely introduced into port areas through ballast water discharge (Ruiz et al. 2000b, Takahashi et al. 2008, Neill 2011).

Other examples of organisms that are harmful to humans and were introduced by vessel vectors include:

- Human intestinal parasites *(Giardia lamblia, Cryptosporidium parvum, Enterocytozoon bieneusi)* (Johengen et al. 2005, Reid et al. 2007)
- Microorganisms that cause paralytic shellfish poisoning (e.g., *Alexandrium fundyense*) (Hallegraeff 1998)
- Microbial indicators for fecal contamination (*Escherichia coli* and intestinal enterococci) (Reid et al. 2007)

- *Vibrio parahaemolyticus,* which infects shellfish and causes gastrointestinal illness in humans when ingested (Revilla-Castellanos et al. 2015)
- The Japanese sea slug (*Haminoea japonica)*, which serves as a host of the parasitic flatworm that causes cercarial dermatitis (i.e., swimmer's itch) (Brant et al. 2010)

3. CALIFORNIA'S MARINE INVASIVE SPECIES PROGRAM

California has responded aggressively to prevent and manage the vessel-mediated introductions of aquatic nonindigenous species (NIS). In 1999, the California Legislature established the Marine Invasive Species Program (MISP). The MISP is a statewide, multiagency program designed to prevent the introduction of NIS from large vessels arriving at California ports. The mandate of the MISP is to:

> ***"move the state expeditiously toward elimination of the discharge of nonindigenous species into the waters of the state or into waters that may impact the waters of the state, based on the best available technology economically achievable." (Pub. Resources Code, §71201, subd. (d).)***

MISP's Statutory Authority

Through the authority granted by the Marine Invasive Species Act (MISA; Public Resources Code section 71200 et seq.), the four MISP agencies (California State Lands Commission, California Department of Fish and Wildlife, State Water Resources Control Board, and the California Department of Tax and Fee Administration) work collaboratively to address the risk of species introductions from vessel biofouling and ballast water discharge. Vessels subject to the MISA are:

1) 300 gross registered tons or more, and
2) capable of carrying ballast water.

The MISP consists of four agencies:

MISP Agencies

The California State Lands Commission (Commission)

Administers the MISP and is tasked with developing and implementing vessel vector management regulations and funding research.

The California Department of Fish and Wildlife's Office of Spill Prevention and Response (CDFW-OSPR)

Monitors and gathers data on species to maintain an inventory of NIS populations in the coastal and estuarine waters of the state. These data are used to help to assess the effectiveness of the MISP.

The State Water Resources Control Board (Water Board)

Consults with MISP partner agencies on topics related to water quality and toxicity, including the in-water cleaning of vessels and use of ballast water treatment systems.

The California Department of Tax and Fee Administration (CDTFA)

Collects a fee from vessel owners and operators of qualifying voyages to California ports. Fees are deposited into the Marine Invasive Species Control Fund and support all MISP operations. The MISP does not receive any General Fund dollars.

For more details on MISP partner agency activities, see section 9 (Marine Invasive Species Program Partner Agency Updates).

The Commission administers the MISP including policy development, data administration, field operations, and outreach. The Commission is also the fund administrator for the Marine Invasive Species Control Fund.

The Functions of the Commission's MISP are:

Program Management and Science-based Policy Development

- Recommend policy proposals to the Legislature
- Develop and implement regulations
- Review best available science to inform policy decisions
- Manage research contracts
- Analyze data to assess vessel compliance
- Prepare reports for the Legislature
- Pursue enforcement actions for violations of the Marine Invasive Species Act (MISA)

Data Administration

- Input data from ballast water and biofouling reporting forms
- Track form submission and compliance
- Assess quality and accuracy of data entry
- Maintain contact with stakeholders to relay information about MISP requirements

Field Operations

- Vessel inspections
- Disseminate, clarify, and answer questions about MISA requirements during inspections
- Compliance assessment of report submission, recordkeeping, and management requirements. Violations are written on-site when vessels are found noncompliant.

THE SHARED ROLE OF OUTREACH

One of the key components of the success of the MISP is the close communication, coordination, and outreach amongst Commission staff, the maritime industry, and other state, federal, and international agencies. By establishing and maintaining relationships with these diverse groups, MISP staff works towards:

- Improved compliance within the regulated community
- Development of well-informed policy decisions
- Use of management tools and strategies based on the best available science

The MISP management and scientific staff work closely with state, federal, and foreign regulatory agencies/authorities, technical advisory groups, non-governmental organizations, researchers, and the shipping industry. By consulting with other regulatory jurisdictions, the MISP increases its effectiveness in the development of regionally and internationally consistent policies. MISP staff members participate on numerous working groups, advisory panels, and committees including (but not limited to):

- California Agencies Aquatic Invasive Species Team
- Delta Interagency Invasive Species Coordination Team
- Pacific Ballast Water Group
- State of Washington's Ballast Water Working Group
- State of Oregon's Shipping Transport of Aquatic Invasive Species Task Force
- State of Hawaii's Alien Aquatic Organism Taskforce
- Western Regional Panel on Aquatic Nuisance Species (part of the federal Aquatic Nuisance Species Task Force)
- U.S. Coast Guard Vessel Incidental Discharge Act Ballast Water Reporting and Enforcement Data Work Group
- International Maritime Organization: GloFouling Partnership workgroup collaborations

3.1 Legislative Evolution of the MISP

In 1999, the initial authorizing legislation for the MISP (Assembly Bill (AB) 703, Chapter 849, Statutes of 1999) focused solely on the management of ballast water from vessels arriving from foreign ports. The MISP was reauthorized and expanded in 2003 with the passage of the Marine Invasive Species Act (AB 433, Chapter 491, Statutes of 2003) which, among other provisions, directed the Commission to adopt ballast water management regulations for vessels moving coastally between ports on the west coast of the U.S. Since 2003, the MISA has been amended numerous times, most notably to establish California's ballast water discharge performance standards (Senate Bill (SB) 497, Chapter 292, Statutes of 2006) and to authorize the Commission to adopt and implement biofouling management regulations (AB 740, Chapter 370, Statutes of 2007).

The Commission adopts and amends regulations to implement the MISA (Public Resources Code section 71201.7). The ballast water management regulations for coastal vessels were adopted in 2006 (California Code of Regulations, title 2, section 2280 et seq.); ballast water discharge performance standards were codified in 2007 (California Code of Regulations, title 2, section 2291 et seq.); and the biofouling management regulations (the first of their kind in the world, see section 7.1) were

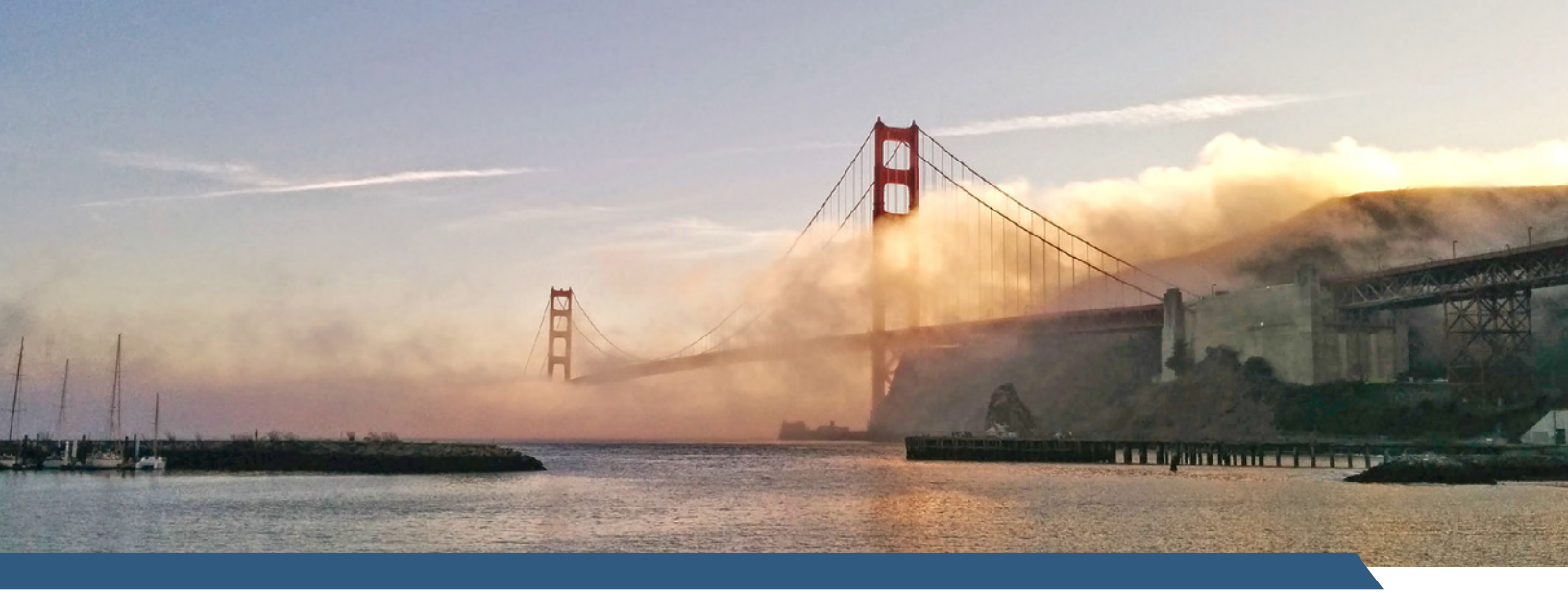
adopted and implemented in 2017 (California Code of Regulations, title 2, section 2298.1 et seq.). These regulations were strengthened through the adoption of enforcement regulations in 2017 (California Code of Regulations, title 2, section 2299.01 et seq.). Adoption of the enforcement regulations was an important step toward holding the shipping industry accountable for violations of the MISA and increasing protection of California waters from species introductions.

Commission staff continues to regularly review existing authority under the MISA to assess whether changes are necessary to improve protection of California waters from NIS introductions. Based on recommendations to the Legislature in 2018 (see Commission 2018), the Commission sponsored AB 912 in 2019 (Chapter 433, Statutes of 2019).

AB 912 authorizes the Commission to:

- Adopt and enforce the federal ballast water discharge performance standards set forth in section 151.2030(a) of Title 33 of the Code of Federal Regulations (see Ballast water discharge performance standards in section 6.5)
- Delay implementation of the interim and final California ballast water discharge performance standards to 2030 and 2040, respectively, due to a lack of available ballast water treatment technologies to enable vessels to meet the California standards at this time (see Commission 2018 for more detail)
- Sample ballast water and biofouling for research purposes. Prior to AB 912, the Commission could sample only for compliance assessment
- Change the definition of the Pacific Coast Region (PCR) (see Figure 4-8 for former PCR map and Appendix E for current PCR map)

The Commission is in the process of adopting new and amending existing regulations to implement the requirements of AB 912 (see section 12.1 (2) and (4) for next steps on adopting and implementing federal ballast water discharge performance standards).



4. VESSEL ARRIVAL PATTERNS IN CALIFORNIA

4.1 Data Collection and Reporting Forms

Commission staff monitors and analyzes vessel arrival patterns at all California ports (Figure 4-1), including ballast water discharges, biofouling and ballast water management strategies, and compliance rates. Staff obtains arrival data from the Marine Exchanges of Southern California and the San Francisco Bay Region and ballast water and biofouling management data from the following vessel-submitted reporting forms:

- **Ballast Water Management Report (BWMR):** The BWMR is a U.S. Coast Guard form that must be submitted by all qualifying vessels at least 24 hours prior to arriving at a California port (Appendix A). The BWMR includes vessel voyage information and ballast water management activities (more information about the data collected in the BWMR can be found in section 6).
- **Marine Invasive Species Program Annual Vessel Reporting Form (AVRF):** The AVRF is a Commission-adopted form that must be submitted at least 24 hours in advance of the first arrival at a California port each calendar year (Appendix B). The AVRF includes information about vessel operational practices and biofouling maintenance and the installation, use, and maintenance of ballast water treatment systems (more information about the data collected in the AVRF can be found in section 7.2).

Commission staff regularly sends emails to vessel owners/operators and agents notifying them of noncompliance with reporting requirements and clarifying form submission laws. Commission staff also analyzes patterns of form submission noncompliance to better target outreach efforts. See Appendix C for penalties associated with violation of reporting form submission requirements.

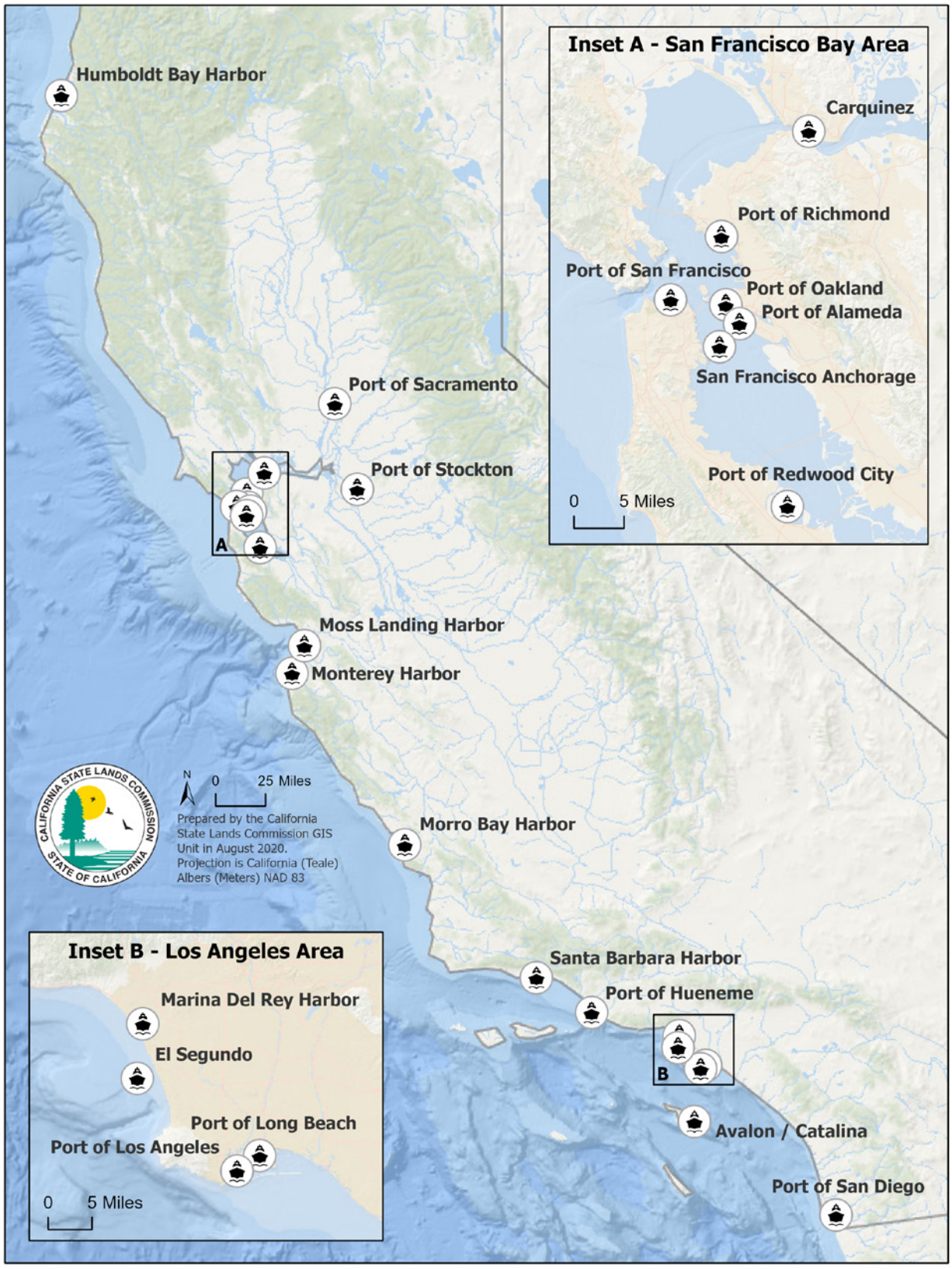


Figure 4-1. Map of California ports recognized by the Marine Invasive Species Program. Inset A: San Francisco Bay Area, Inset B: Los Angeles Area.

4.1.1 Reporting Compliance

Ballast Water Management Report:

Commission staff monitors reporting compliance by reconciling the submitted reports with vessel arrivals. The reporting compliance of the BWMR during 2018 and 2019 was 79%; this includes only the forms that were submitted 24 hours in advance of arrival as required by Public Resources Code section 71205. Receiving the reports in advance enables the early detection of potentially noncompliant discharges and an efficient and effective allocation of resources to vessel inspections. Out of the 21% of vessel arrivals that were noncompliant with the reporting requirement, about half of the reports were received late (12% of total arrivals) (Figure 4-2). When forms are not submitted on time, staff's ability to prevent noncompliant discharges is limited, subjecting the state to an increased risk of species introductions. In the coming year, staff intends to develop and implement an improved process for tracking and enforcing violations of the BWMR submission requirement to improve reporting compliance (see section 12.1 (1)).

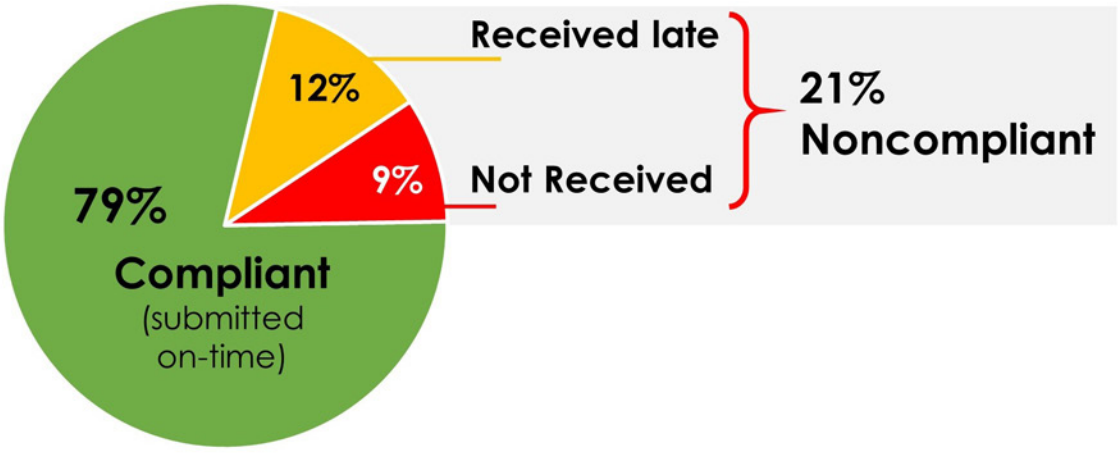


Figure 4-2. Reporting compliance and submission rate (received forms) of the Ballast Water Management Report during 2018 and 2019.

The number of vessels that failed to submit a BWMR increased in the past two years (2018-2019). This increase may be due to a change in the reporting requirements that was initiated in April 2017. As vessels become familiar with the new reporting requirements, staff expects there will be fewer missing BWMRs, enabling a more comprehensive assessment of vessel ballast water management and discharging activities in California (see section 6.3).

Annual Vessel Reporting Form:

Reporting compliance for the AVRF was 77% during 2018 and 2019 (Figure 4-3). From the 23% of vessels that did not submit the AVRF before their first arrival to California as required by California Code of Regulations, title 2, section 2298.5, 11% submitted the report at a later date in response to a letter of noncompliance sent by staff.

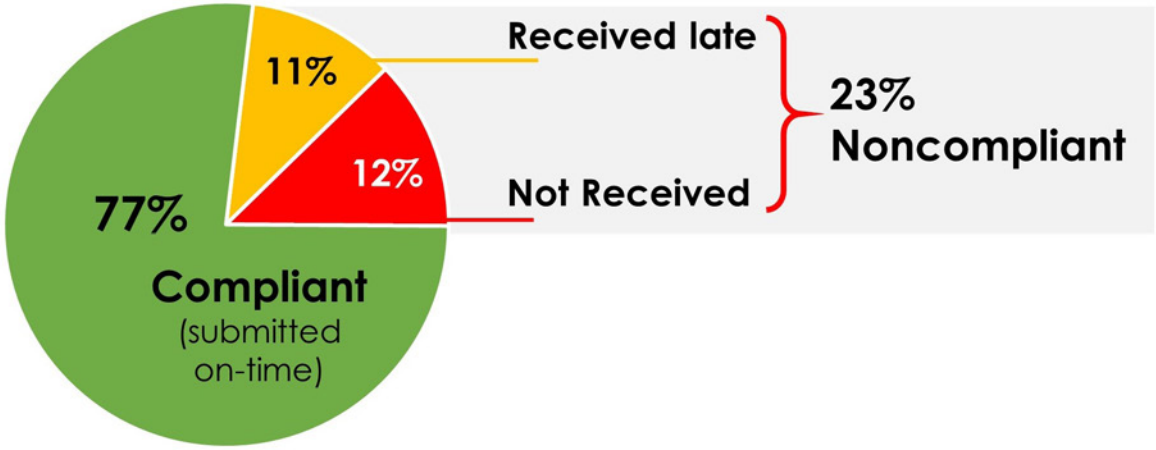


Figure 4-3. Reporting compliance for the Annual Vessel Reporting Form during 2018 and 2019.

The submission rate (including forms submitted on time and those received late) improved from 83% in 2018 (the first full year of required AVRF submission) to 91% in 2019; this increase could be the result of the Commission's outreach efforts, which provided the regulated industry with a better understanding of the AVRF submission requirements.

4.2 Vessel Arrival Patterns

- Since 2010, California received an average of 9,848 ± 820 (standard deviation) vessel arrivals per year.
- During 2018 and 2019:
  - 39% of arrivals came from outside the Pacific Coast Region.
  - The Los Angeles/Long Beach Port Complex received 40% of all California arrivals.
  - Container and tank vessels together contributed to more than half of the total arrivals at California ports.

California has received an average of 9,848 ± 820 (standard deviation) vessel arrivals per year since 2010.

During the period analyzed in this report (2018 and 2019), California ports received 10,840 and 11,199 arrivals, respectively (Figure 4-4). These numbers are about 10% above the 10-year average and are consistent with the trend of increasing number of arrivals since 2015.

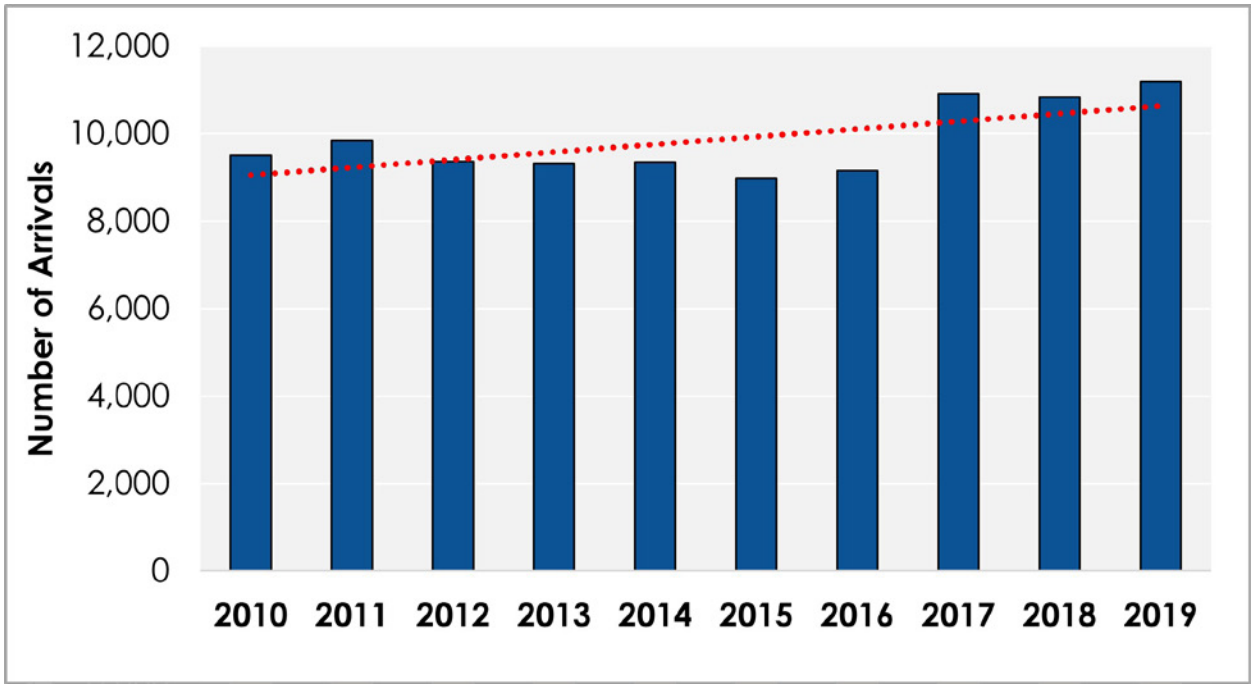
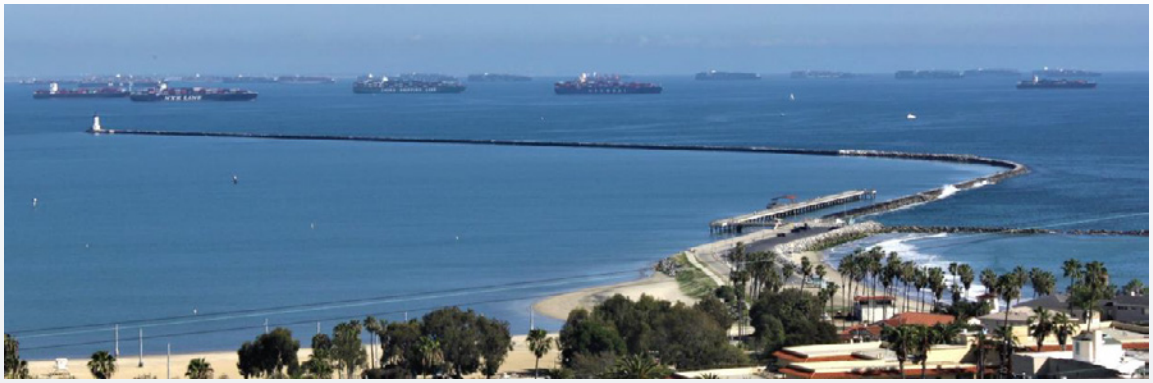


Figure 4-4. Number of vessel arrivals at California ports since 2010. Dotted line represents the trend of increasing arrivals observed over time.

The increase in vessel arrivals observed recently is partially a result of a recent change in Commission staff's interpretation of reporting requirements. Since April 2017, vessel arrivals at anchorages in San Francisco Bay have been required to comply with the reporting requirements to better capture ballast water activities performed while at anchorage. This new interpretation was the result of the need to better capture ballast water management activities from vessels at anchorage, as not all anchorage arrivals eventually move into a shore-side berth at a port.

Anchorage

Areas suitable for vessels to anchor away from shore while they wait for authorization to berth.



4.2.1 Where are the Vessels Arriving?

During the two years analyzed in this report (2018-2019), southern California ports received 52.2% of all state arrivals while northern California received 47.8%. The Los Angeles/Long Beach port complex accounted for more than 40% of all state arrivals and 78% of the southern California arrivals (5,754 average arrivals per year) (Figure 4-5). The Port of Oakland received an average of 1,500 arrivals per year, representing 13.7% of all state arrivals and 29% of northern California arrivals.

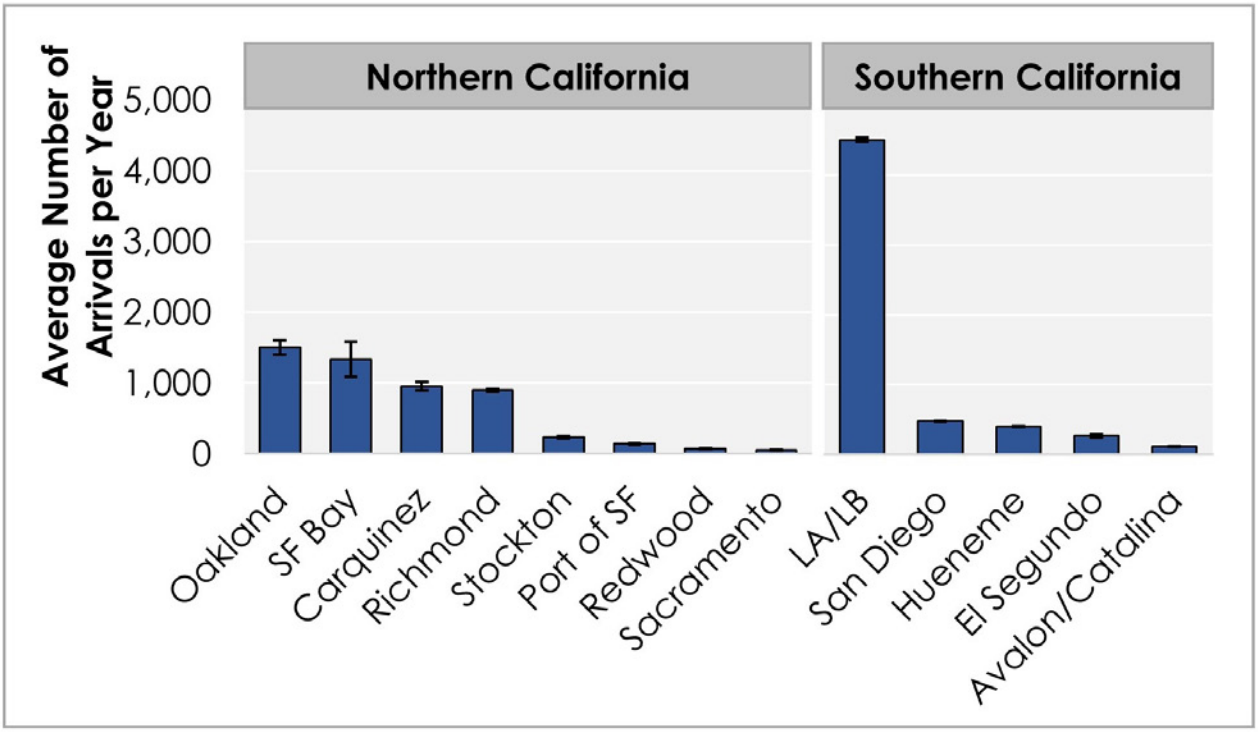


Figure 4-5. Average number of arrivals per year in 2018 and 2019. Note: "SF Bay" includes all anchorage arrivals. Ports with fewer than 50 arrivals per year (Humboldt, Moss Landing, Santa Barbara, Monterey, Marina del Rey, and Morro Bay) were removed from this figure; a complete dataset is presented in Appendix D, Tables D-1 and D-2).

4.2.2 Vessel Type Arrival Patterns

Multiple factors (e.g., local industry, demand, port infrastructure, economy) contribute to differences in the types of vessels arriving at California ports. Container and tank vessels continue to be the most common vessel types arriving at California ports without significant changes between 2018 and 2019. These two vessel types together have consistently contributed to more than half of the total arrivals to the State over the last several years (Figure 4-6).

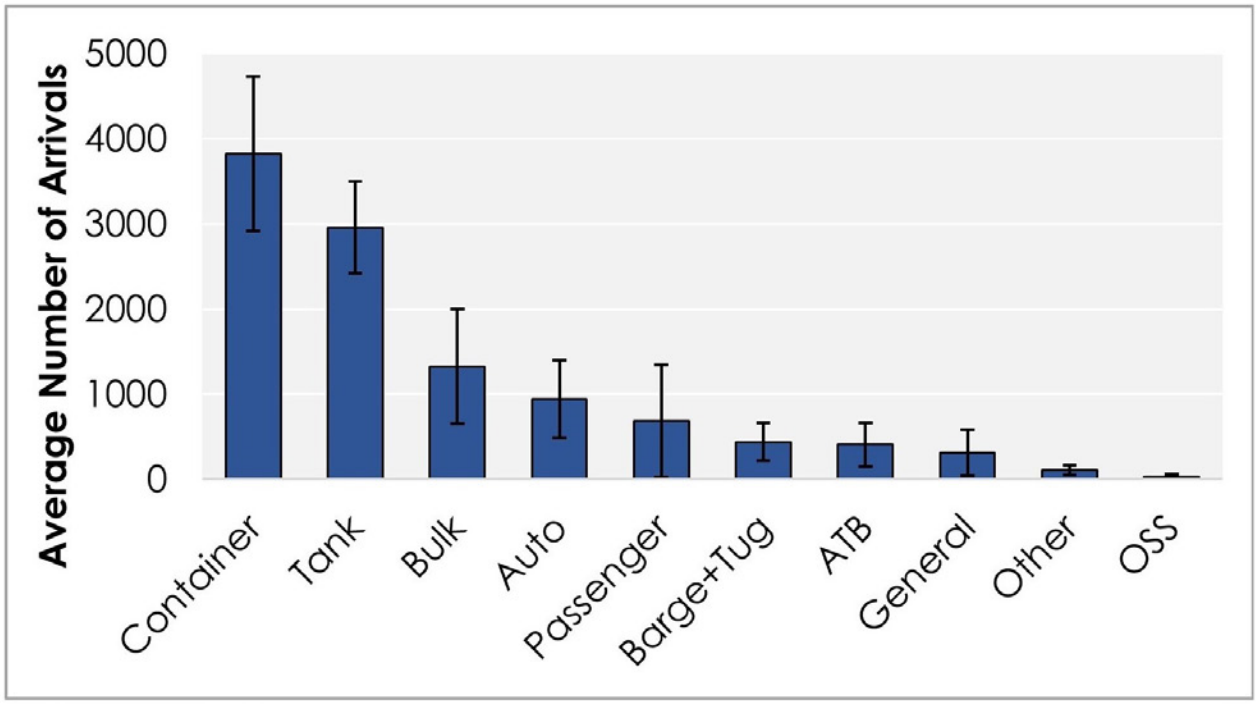


Figure 4-6. Average number of vessel arrivals per year by vessel type at California ports during 2018 and 2019. The description of vessel type categories is presented in Table 4-1. Error bars represent the standard deviation.

Table 4-1. Description of the vessel type categories used in this report

VESSEL TYPE	Description
Auto	Vessels designed to carry wheeled cargo such as cars, trucks, semi-trailer trucks, trailers, and railroad cars, that are driven on and off the ship on their own wheels or using a platform vehicle.
Bulk	Vessels designed to carry large quantities of dry cargo such as grain, coal, and ore.
Container	Cargo vessels that carry all of their load in truck-size intermodal containers in a technique called "containerization."
General	Vessels designed to carry a wide variety of cargo. Cranes and other heavy equipment needed to move, load, and unload cargo are usually on-board.
OSS	Offshore Supply Ships are a vessel category specially designed to supply offshore oil and gas platforms.
Other	Includes fishing, research, and cable laying vessels
Passenger	A vessel whose primary function is to carry passengers on the sea, includes cruise vessels and large yachts.
Tank	Vessels designed to transport or store liquids or gases in bulk. Major types of tankships include oil tankers, chemical tankers, and gas carriers.
ATB	An articulated tug and barge (ATB) combination is a vessel that consists of a barge and a large powerful tug that is positioned in a notch in the stern (rear) of the barge which enables the tug to propel and maneuver the barge.
Barge+Tug	Unmanned flat bottom vessel (barge) that must be tugged or towed by another vessel (tug). In this report, a Barge+Tug is counted as a single unit.

During 2018 and 2019, the contribution of each vessel type to the total number of arrivals per region differed between north and south due to geographic variation in cargo activities. However, in both regions, container and tank vessels dominated the arrivals representing 30% and 32% of northern California arrivals, respectively, and 39% and 22% of southern California arrivals. Passenger vessels accounted for 10% of total arrivals in southern California but only 2% in northern California; this is due to frequent arrivals at the Los Angeles/Long Beach port complex by cruise ships traveling to and from the Mexican Riviera. In contrast, bulk vessels showed the opposite pattern, accounting for 17% of arrivals in northern California and only 7% in southern California (Figure 4-7); this pattern is due to the large number of bulk terminals located in northern California that specialize in the import and export of products such as rice, lumber, and sugar.

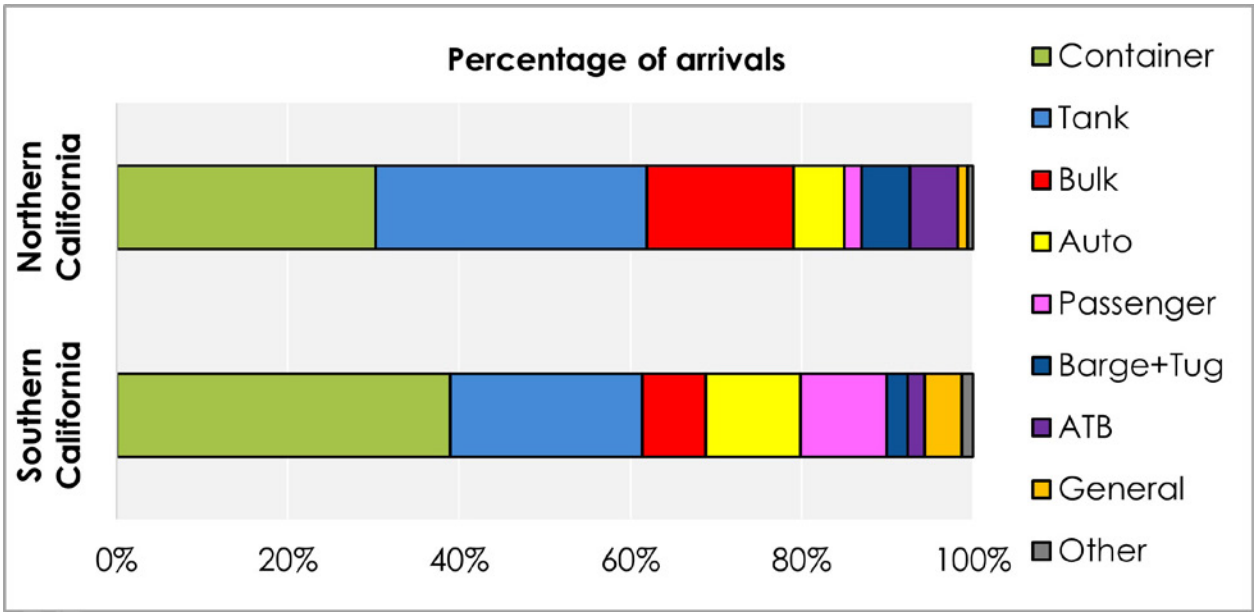


Figure 4-7. Percentage of total arrivals by vessel type at northern and southern California ports during 2018 and 2019. The description of vessel type categories is presented in Table 4-1.

4.2.3 Where are the Vessels Coming From?

Commission staff tracks the Last Port of Call (LPOC) for each vessel arrival because ballast water management requirements depend on whether the vessel is coming from a port within the Pacific Coast Region (PCR, Figure 4-8) and whether the ballast water is sourced within the PCR (see section 6.1 for more information about ballast water requirements).

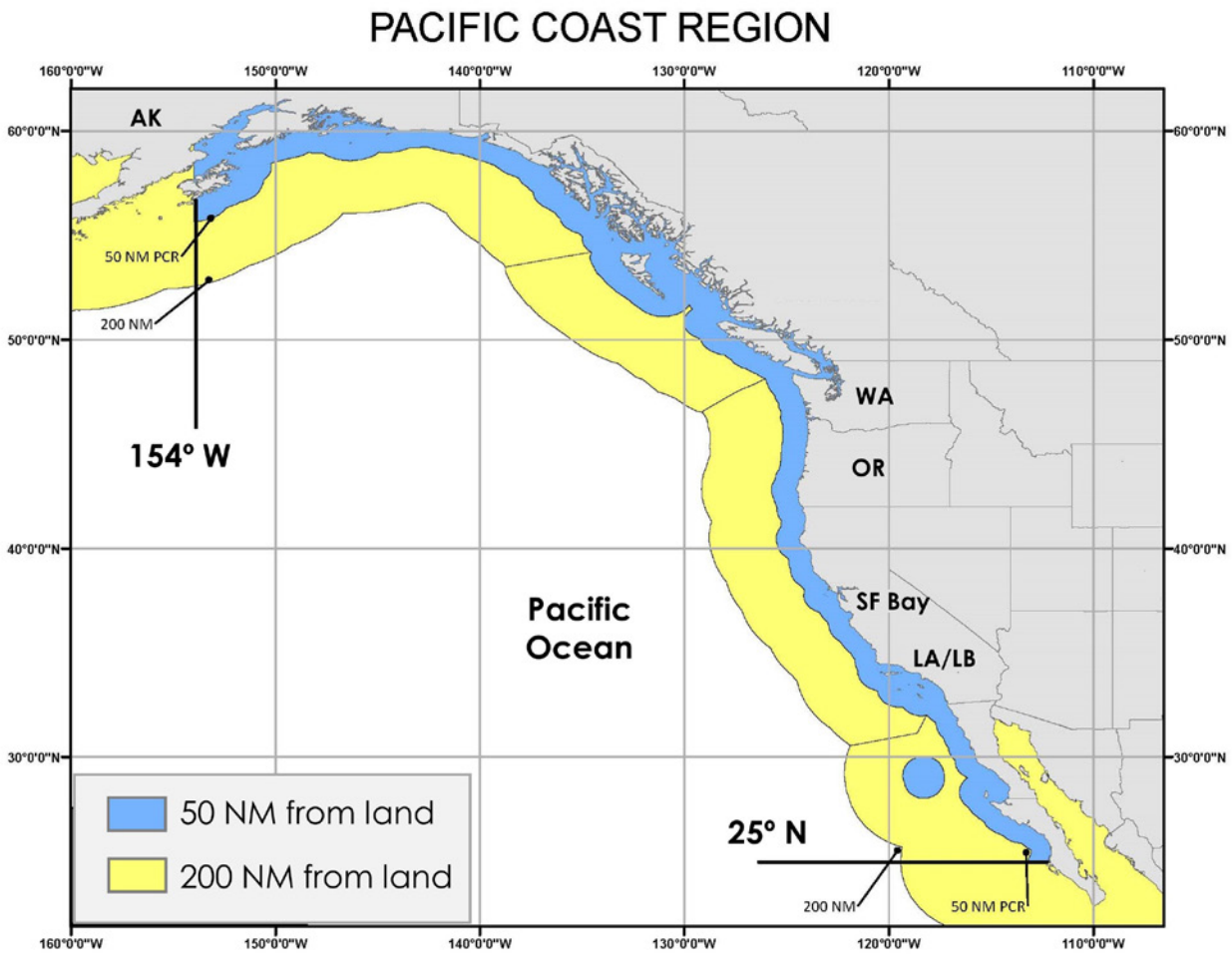


Figure 4-8. Map of the Pacific Coast Region (PCR). For the reporting period (2018-2019) the PCR extended from 25˚ N latitude to 154˚ W longitude, exclusive of the Gulf of California. Note: The PCR definition changed on January 1, 2020, due to AB 912, described in section 3.1 (see Appendix E).

Consistent with the patterns observed in previous years (Scianni et al. 2019), more than half (57%) of the arrivals at southern California ports reported a LPOC outside the PCR. This pattern is driven primarily by arrivals at the Los Angeles/Long Beach port complex, which is often the first point of arrival to the west coast of the United States for many oceangoing vessels arriving from Asia. In northern California ports, only 19% of arrivals were from outside the PCR (Figure 4-9), reflecting an influx of vessel arrivals from southern California ports and a large number of vessels voyages between ports within San Francisco Bay. Other arrivals to California ports that originated within the PCR came from Mexico (5%), Canada (7%), and the U.S. states of Alaska, Washington, and Oregon (11%).

For voyages that originated outside the PCR, Mexico (non-PCR ports, see figure 4-8 PCR map) and China were the most common LPOCs reported, representing 20% and 16% of all California arrivals, respectively.

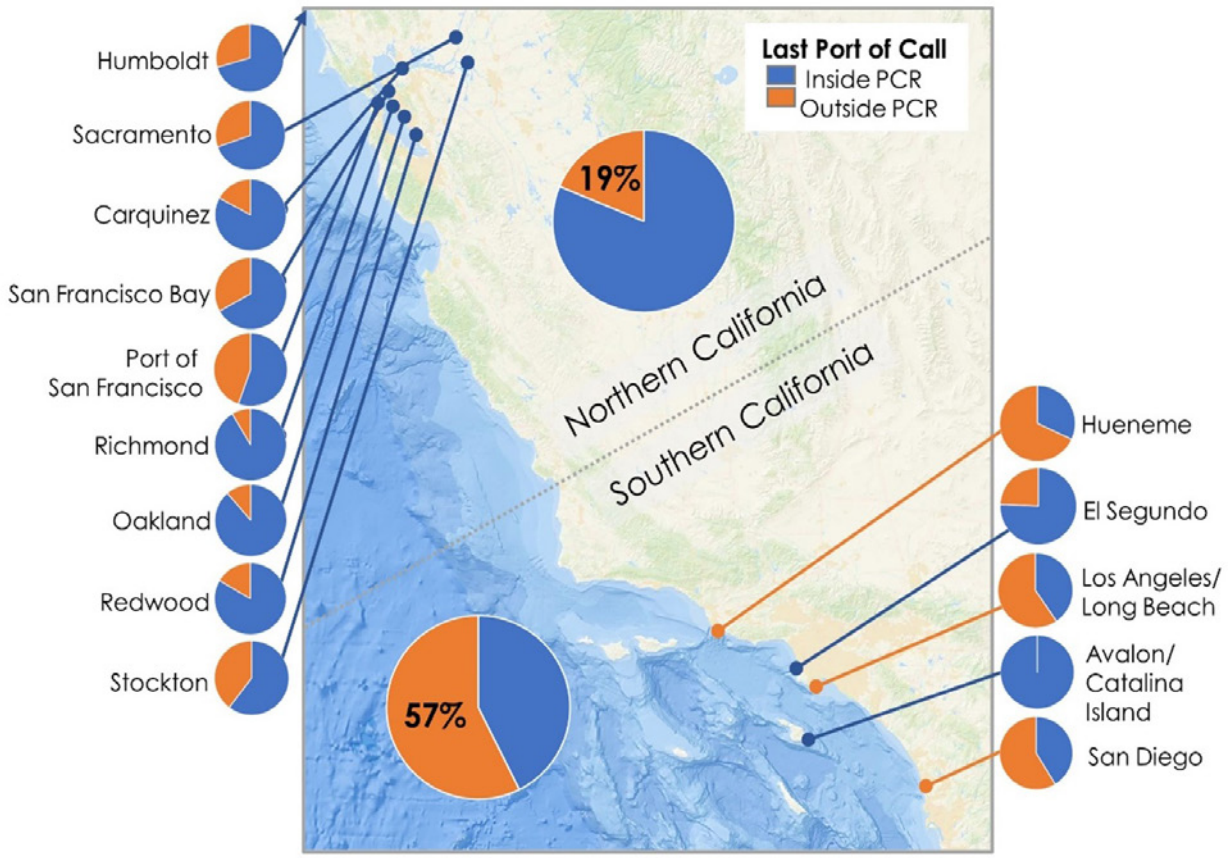
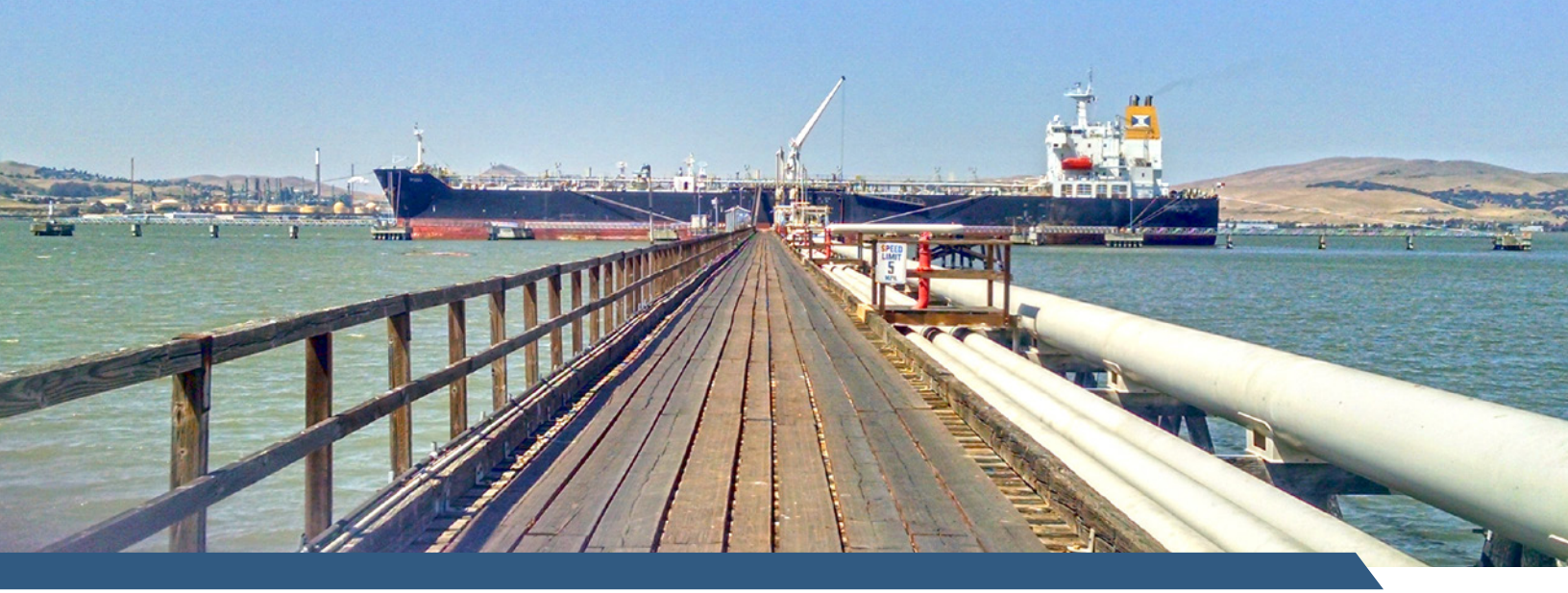


Figure 4-9. Identification of the Last Port of Call as inside or outside of the Pacific Coast Region (PCR) for vessel arrivals at California ports during 2018 and 2019. Ports with less than 50 arrivals in the 2-year period (Moss Landing, Santa Barbara, Monterey, Marina del Rey, and Morro Bay) were removed from this figure. Note: The PCR definition changed in January 2020. However, these changes were not applicable during the focus period of this report and are not represented in this figure.



5. FIELD OPERATIONS

Staff from the Commission's Marine Environmental Protection Division (MEPD) monitors and inspects vessel arrivals throughout California to assess compliance with the MISA and associated ballast water and biofouling regulations. MEPD has two field offices. The Northern California Field Office is located in Hercules, and the Southern California Field Office is located in Long Beach. All vessels that are subject to the MISA may be inspected to assess compliance with California laws and regulations and to provide outreach.

The MISA mandates that at least 25% of the vessels arriving at California ports be inspected. (Pub. Resources Code, § 71206, subd. (a).)

5.1 The Inspection Process

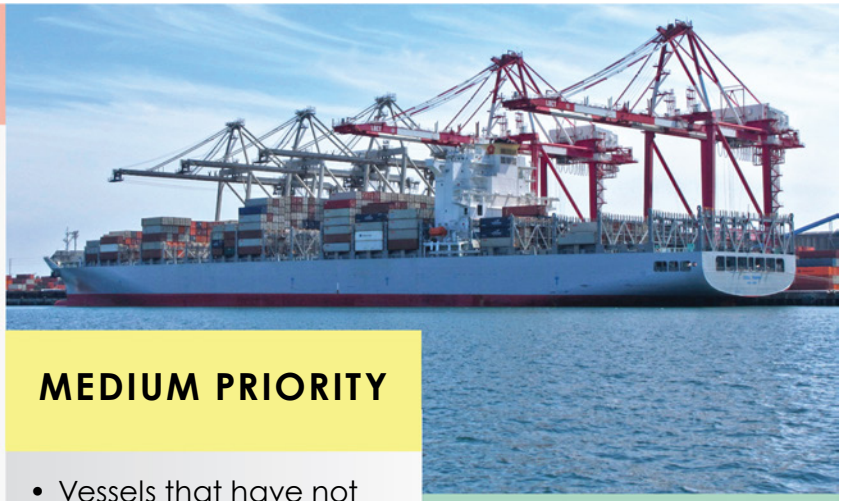
The inspection process has two components: 1) Tracking and prioritizing arrivals for inspection based on the risk of NIS introductions, potential vessel noncompliance, and opportunities to provide outreach and 2) Vessel inspections.

1) Tracking and Prioritizing Arrivals

Vessel arrivals are tracked in the MISP database to understand vessel traffic patterns, prioritize and select arrivals for inspection, and enforce California requirements. Staff uses the information from the regional Marine Exchanges' Advanced Arrival Notifications and enters each arrival into the MISP database vessel schedule. Once an arrival is entered into the vessel schedule, it is assigned an inspection priority level (High, Medium, Low, or not a priority for inspection) using the following criteria:

HIGH PRIORITY

- Vessels that have not been inspected in the past five years or vessels new to California
- Vessels discharging ballast water
- First arrival after becoming subject to the biofouling regulations
- Vessels with an unresolved previous violation
- Vessels that have changed their name
- Vessels with errors in their submitted ballast water and biofouling reporting forms
- Suspicion of improper ballast water or biofouling management



MEDIUM PRIORITY

- Vessels that have not been inspected in the past 12 months
- Vessels with resolved previous violations

LOW PRIORITY

- Vessels that have not been inspected in the past three months
- Vessels with an installed ballast water treatment system that are not discharging ballast water

The Commission is currently working on the development and implementation of a new pre-arrival risk assessment process to improve the current prioritization scheme. The proposed process will be based on a weighted risk assessment combining the effects of ballast water and biofouling risk factors; the goal is to use available resources more efficiently and effectively while targeting the riskiest vessel arrivals (see section 12.1(4)).

2) Vessel Inspections

Vessel inspections include:

- Examining ballast water and biofouling management documents and reporting forms
- Assessing the compliance of ballast water and biofouling management activities
- Examining vessel hulls at the waterline for signs of biofouling
- Delivering outreach on MISP requirements and invasive species (https://www.slc.ca.gov/marine-invasive-species-program/information-for-vessels-arriving-at-california-ports/)
- Answering vessel crew's questions

Failure to comply with any of the management, recordkeeping, or reporting requirements will result in a violation and potential enforcement (See table of Violation Classes and Penalties in Appendix C).

5.2 Inspection Data

During 2018 and 2019, California received an average of 11,020 vessel arrivals per year, which corresponds to about 30 arrivals per day statewide. Using available resources and the prioritizing scheme described above, the Commission strives to meet the mandate to inspect 25% of the annual arrivals.

For the period between 2018 and 2019, Commission staff inspected 20.2% of all vessel arrivals at California ports (Table 5-1); however, 15% (3,306) of arrivals cannot practicably be inspected due to safety and accessibility limitations (e.g., Commission field operations staff do not have access to a boat or other means to inspect vessel arrivals at Avalon/Catalina Island, El Segundo offshore oil marine terminal, and San Francisco Bay anchorages. Removing vessel arrivals that are not practicable to inspect from the total brings the percentage of inspected arrivals up to 23.9%.

Table 5-1. Vessel inspections during 2018 and 2019 at California ports.

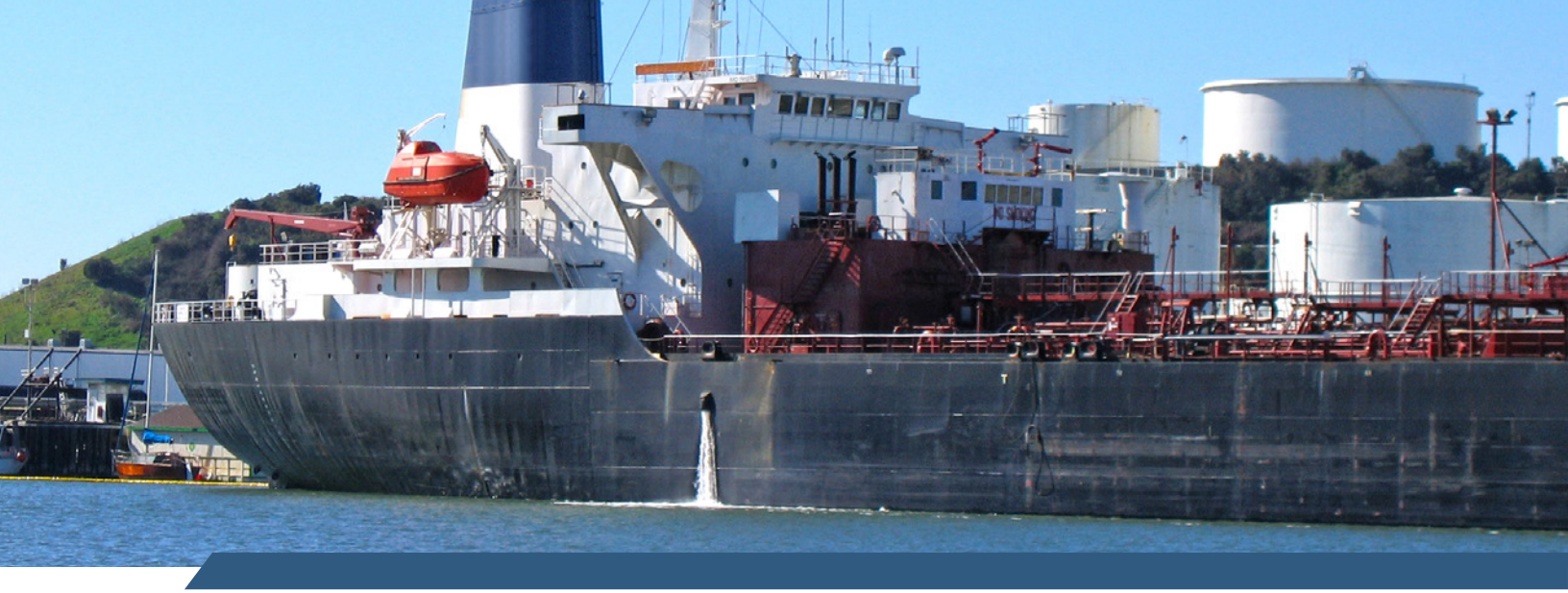
		Total Arrivals	Inspectable Arrivals*	Inspected Arrivals	Percent Inspected (from total arrivals)	Percent Inspected (from inspectable arrivals*)
2018	Northern California	5,122	3,964	1,013	19.8%	25.6%
	Southern California	5,718	5,358	1,281	22.4%	23.9%
2019	Northern California	5,408	3,900	990	18.3%	25.4%
	Southern California	5,791	5,403	1,171	20.2%	21.7%
TOTAL		**22,039**	**18,625**	**4,455**	**20.2%**	**23.9%**

*Inspectable arrivals are those that can be accessed by the Commission Field Operations staff (excludes all arrivals at Avalon/Catalina Island, all anchorage arrivals in San Francisco Bay, and other ports only accessible by boat, like the El Segundo offshore oil marine terminal).

During the years analyzed in this report, 3,641 arrivals (16.5%) were categorized as High Priority for inspection; however, 10.6% of these arrivals (386) were considered "not inspectable" for the reasons explained above. The MISP's goal is to inspect 100% of high priority arrivals due to their increased risk of species introductions. During 2018 and 2019, staff inspected 73.2% of "inspectable" high priority arrivals. The remaining high priority arrivals were not inspected due to personnel shortages.

The Commission faces challenges in recruiting for and filling vacancies in the Marine Safety Specialist series (i.e., vessel inspectors) because the classification specifications are outdated. The existing Marine Safety Specialist I and II specifications require college-level education, which is not necessary for success in those positions. The Commission recognizes the need to cast a wide net with our recruiting processes and has recently reviewed its department-specific classifications through an equity lens to identify opportunities to break down barriers to State employment, such as entry requirements that have not proven to be relevant to staff's performance. (see section 12.2 (1)). The Commission is committed to removing these recruitment barriers. In doing so, the Commission will establish a more equitable recruitment process that results in a qualified candidate pool that is larger, more diverse, and maximally inclusive.

In addition to addressing barriers to the recruitment and hiring of vessel inspection personnel, Commission staff continuously works on improving processes to identify the most efficient use and allocation of resources. Staff is investigating new ways to leverage technology to improve vessel inspection accessibility. Novel approaches may include the use of virtual inspections to augment onboard vessel inspections (see section 12.1 (5)) with the goal of increasing compliance and protecting California waters from new NIS introductions.



6. BALLAST WATER

This section highlights the MISP's statutory and regulatory tools for reducing the risk of nonindigenous species (NIS) introductions via ballast water discharge from vessels arriving at California ports. The MISP's comprehensive ballast water management program includes:

- Ballast water best management practices (see details below)
- Ballast water management requirements (see section 6.1)
- Recordkeeping and reporting requirements (see section 6.1.3)
- Compliance assessment (see section 6.4)
- Ballast water discharge performance standards (see section 6.5)

6.1 Ballast Water Management Requirements in California

All vessels that arrive at California ports must manage their ballast water to minimize the release of NIS into California waters. Retention of all ballast water on board the vessel (i.e., not discharging) is the most effective management strategy to reduce the risk of ballast-mediated NIS introductions. If no ballast water is discharged, no organisms are released into the environment.

Some vessels, however, need to discharge ballast due to their cargo operations (Figure 2-1, Ballast water operations). Any vessel that discharges in California waters must follow best management practices to reduce the likelihood of introducing NIS to California waters.

Ballast Water Best Management Practices

- Discharge only the minimum amount of ballast water essential for operations
- Clean ballast tanks in accordance with applicable laws
- Minimize the discharge of ballast water in:
  - Marine sanctuaries
  - Marine preserves
  - Marine parks
  - Coral reefs
- Minimize the uptake of ballast water in areas that are high risk due to the presence of NIS, such as:
  - Areas known to have infestations or populations of NIS and pathogens
  - Areas near a sewage outfall
  - Areas for which the master, owner, operator, or person in charge of a vessel has been informed of the presence of toxic algal blooms
  - Turbid waters or areas where tidal flushing is known to be poor
  - In darkness when bottom-dwelling organisms may rise in the water column
  - Areas where sediments have been disturbed (e.g., near dredging operations or where propellers may have recently stirred up sediment)

In addition to following best management practices, vessels that intend to discharge ballast water in California waters must employ at least one of the following management methods prior to discharge (Public Resources Code section 71204.3 and California Code of Regulations, title 2, section 2284):

- Exchange ballast water at a minimum specified distance from land prior to discharge (see section 6.1.1)
- Use a Commission-approved alternative management method (e.g., USCG) approved ballast water treatment system (BWTS) or use of freshwater from a Public Water System; see description of Approved Alternative Ballast Water Management Methods within this section for more information)

- Take on and discharge ballast water at the same location (within one nautical mile of each other)
- Discharge to a Commission-approved shore-based reception facility (none currently exist in California; for more information on a Commission-funded study of the feasibility of shore-based treatment in California, see Commission 2018b)
- Under extraordinary circumstances, exchange ballast water within an area agreed to in advance by the Commission in consultation with the USCG

Vessels may forego ballast water management if the practice would threaten the safety of the vessel, its crew, or its passengers. In these instances, the vessel master must notify the Commission on the BWMR and claim a "safety exemption."

Ballast water exchange and the use of alternative management methods are the most common approaches to managing ballast water prior to discharge in California. These two approaches are described in more detail below.

6.1.1 Ballast Water Exchange

Ballast water exchange refers to the process by which the (typically) biologically-rich water that is loaded while a vessel is in port, or near the coast, is exchanged with the comparatively biologically-poor waters of the open ocean. Coastal organisms adapted to the environmental conditions of bays, estuaries, and shallow coasts are not expected to survive or reproduce in the open ocean due to chemical, physical, and biological differences between the two types of habitats. Open ocean organisms are likewise not expected to survive in coastal waters (Cohen 1998).

Most vessels can exchange ballast water, and this management practice typically does not require any special structural modification. However, exchange may pose a risk to vessel stability and safety depending on vessel design, weather conditions, and human factors. A proper exchange can take many hours to complete due to ballast pumping and piping capacities.

Methods of Ballast Water Exchange

Ballast water exchange is defined as, a means to replace the water in a ballast tank using either of the following methods:

- **Flow-through exchange (FT)** – Flushing ballast water by continuously displacing water from the tank with mid-ocean water until at least 300% of the tank volume has been exchanged.
- **Empty-Refill exchange (ER)** – Pumping out each tank's ballast water taken on in ports, or estuarine, or territorial waters until it is empty or as close to 100% empty as is safe to do so, then refilling the tank with mid-ocean waters. (Pub. Resources Code, § 71200, subd. (h).)

Ballast water exchange is intended to reduce the risk of introducing aquatic NIS into California waters. However, its effectiveness varies considerably from vessel to vessel. Ballast water exchange eliminates between 70-99% of the organisms taken into a ballast tank (Parsons 1998, Zhang and Dickman 1999, USCG 2001, Wonham et al. 2001, MacIsaac et al. 2002). Even if a vessel exchanges all its ballast water, living coastal aquatic NIS may remain in the tank after exchange.

The requirements for ballast water exchange vary depending on the vessel's last port of call and the source of the ballast water. Before discharging ballast water, vessels arriving at a California port from a port:

- Outside of the Pacific Coast Region (PCR; Figure 4-8), or carrying ballast water sourced from outside the PCR, are required to complete a mid-ocean ballast water exchange at least 200 nautical miles (NM) from any land, including islands, in water at least 2,000 meters (m) deep (Public Resources Code sections 71200, subdivision (i), and 71204.3, subdivision (c))
- Within the PCR, and with ballast water sourced within the PCR, are required to complete a ballast water exchange in near-coastal waters at least 50 NM from any land, including islands, in water more than 200m deep (California Code of Regulations, title 2, section 2284)

6.1.2 Alternative Ballast Water Management Methods

The Commission has the authority to approve alternative ballast water management methods in lieu of ballast water exchange. The two most commonly approved alternatives are: 1) the use of freshwater from a Public Water System as ballast, which is approved on a case-by-case basis, and 2) the use of Ballast Water Treatment Systems (BWTS). There is a blanket approval for the use of BWTS that meet at least one of the following requirements:

- Type approved by the USCG for use in U.S. waters
- Accepted by the USCG as an Alternate Management System (AMS)
    - AMS are BWTS that have been approved according to international guidelines and may be used in U.S. waters in lieu of ballast water exchange but have not yet been type approved by the USCG
- Installed on a vessel as part of a testing and approval process through the USCG Shipboard Technology Evaluation Program (STEP)

Ballast Water Treatment Systems vs. Ballast Water Management Systems

Ballast Water Treatment Systems (BWTS) and Ballast Water Management Systems (BWMS) are water treatment technologies designed to decrease the number of organisms in ballast water. The terms "BWTS" and "BWMS" are used interchangeably and may be seen on the Ballast Water Management Report, in California ballast water management requirements, and other MISP documents.

6.1.3 Ballast Water Recordkeeping and Reporting Requirements

In addition to managing all ballast water while in California, vessels must also comply with the MISA's reporting and recordkeeping requirements. All vessels that arrive at California ports must:

- Maintain a vessel-specific ballast water management plan that describes the ballast water management strategy employed by the vessel
- Train crew on the application of the management plan and keep proof of that training on board

- Maintain a separate ballast water log that outlines the ballast water management activities for each ballast water tank on board the vessel
- Report their ballast water management practices to the Commission for compliance assessment via the Ballast Water Management Report (Appendix A, section 4.1.1 and 6.2)

6.2 Patterns of Ballast Water Management

Understanding which types of vessels use each of the ballast water management methods and how often they use them is necessary for Commission staff to develop and recommend changes to policies to best protect California waters.

Retention of all ballast water on board the vessel (i.e., no discharge) while in California waters continues to be the most common management approach used by vessels. During 2018 and 2019, 85.5% of vessel arrivals that submitted a BWMR that reported retaining all ballast water.

Of those vessels that reported discharging ballast water in California, ballast water exchange was the most common management method used during 2018 and 2019 (69.1% of discharging arrivals; Figure 6-1). However, the use of ballast water exchange as the sole method of management is declining as the use of alternative methods, specifically ballast water treatment, is increasing.

The reported use of BWTS (exclusively or in combination with another management method) increased by 79.9% from 2018 to 2019, most likely in response to foreign and U.S. federal requirements to install BWTS on board vessels to meet ballast water discharge performance standards (Table 6-1).

The reported use of BWTS in conjunction with ballast water exchange was used by 5.7% of the discharging arrivals in California during 2018 and 2019. The use of this management method also increased from 4.9% in 2018 to 6.6% in 2019. It is unknown why vessels are employing exchange plus treatment because it is not a California ballast water management requirement.

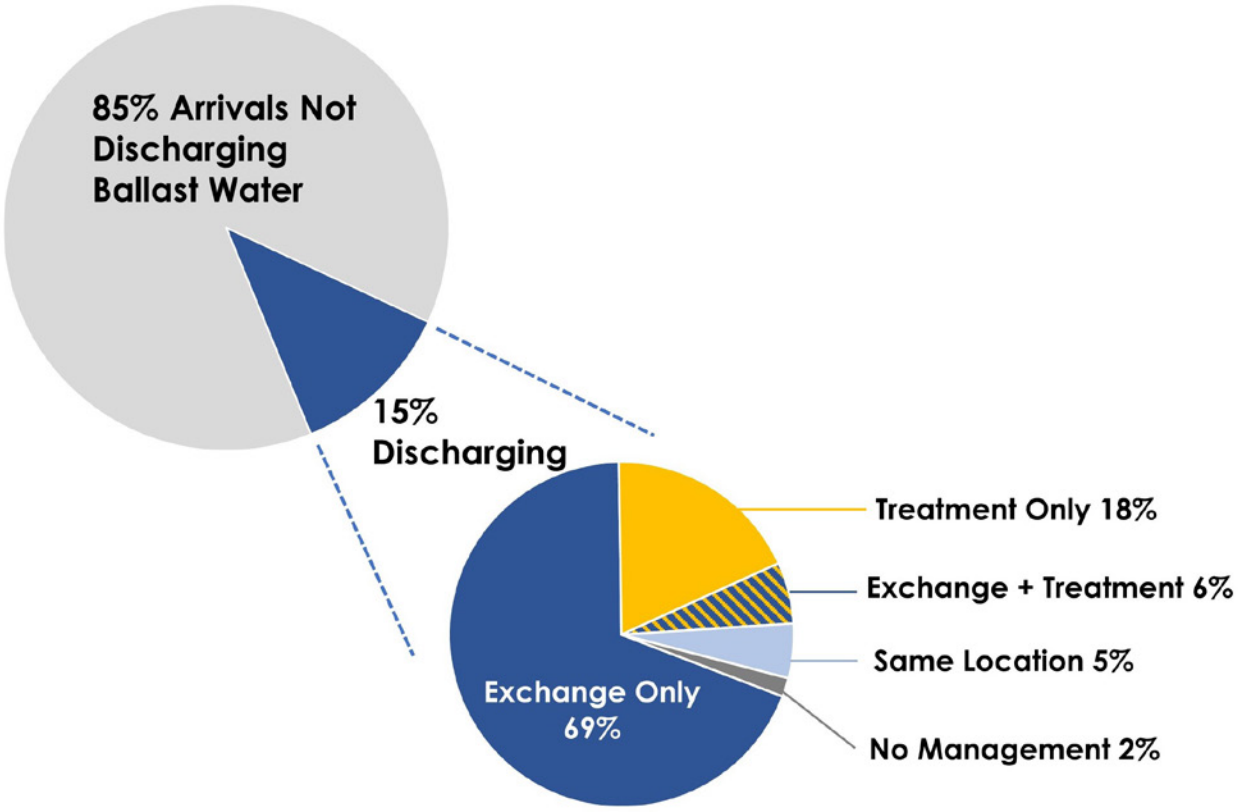


Figure 6-1. Reported use of ballast water management methods by vessels arriving at California ports during 2018 and 2019. "Same location" refers to cases where ballast water is sourced and discharged in the same location (within one NM of each other). "No management" refers to those arrivals that did not report managing their ballast water before discharging; this category includes cases where a safety exemption was claimed.

Table 6-1. A summary of ballast water management methods reported by vessel arrivals at California ports during 2018 and 2019.

Management Type Used	Number of Arrivals	
	2018	2019
Not Discharging	8,032	8,470
Exchange Only*	1,030	886
Treatment Only	178	336
Exchange + Treatment	67	93
Same Location	77	65
No Management Reported**	24	25

*Exchange numbers include: Empty-Refill, Flow Through and mid-ocean sourced water.

**Arrivals that did not report managing their ballast water before discharging; this category includes cases where a safety exemption was claimed.

Because ballast water treatment is a newer approach to ballast water management, staff examines the data closely to track how much water is being treated prior to discharge and the ballast water treatment methods that are being used. During 2018 and 2019, 292 vessels (674 arrivals) reported using a BWTS to manage ballast water prior to discharge in California waters. Those 292 vessels discharged a total volume of 5.52 million metric tons (MMT) of treated ballast (24.1% of the total volume discharged in California over that two-year period, Table 6-2).

Table 6-2. A summary of Ballast Water Treatment System (BWTS) use in California during 2018 and 2019. MMT: million metric tons

	2018	2019
Treated volume discharged (MMT)	2.02	3.5
Total volume discharged (MMT)	11.41	11.52
Percent of total volume discharged after treatment by a BWTS	17.7%	30.37%
Number of vessel arrivals discharging that used a BWTS	245 (126 unique vessels)	429 (199 unique vessels)

The number of vessels using a BWTS and the volume of treated ballast discharged are increasing from year to year (Figure 6-2). This is especially true for 2018 and 2019, when there was a dramatic increase in both the number of arrivals using a BWTS to meet California's ballast water management requirements and the volume of treated ballast discharged by those arrivals.

The use of BWTS and discharge of treated ballast water in California (in lieu of exchange) will continue to increase as vessel owners and operators install BWTS to meet the International Maritime Organization (IMO), U.S. federal government, and state ballast water discharge performance standards.

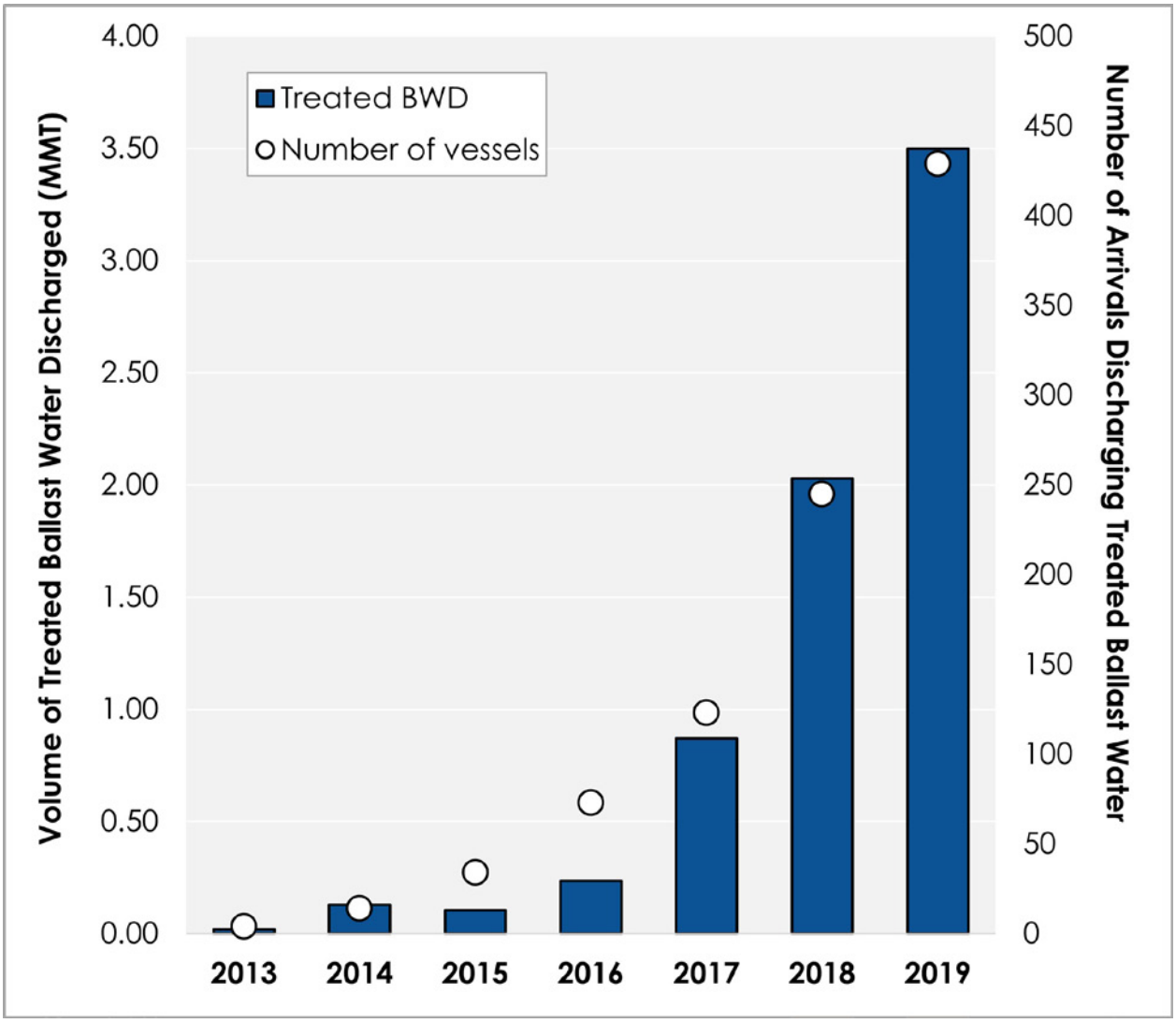


Figure 6-2. Reported volume of ballast water treated by a ballast water treatment system and discharged in California waters from 2013 through 2019 and the number of vessel arrivals that discharged treated ballast water each year. BWD: ballast water discharge.

Types of Treatment Systems:

There is a diverse array of methods used to treat organisms in ballast water. These methods are typically combined (often filtration in combination with another method) to maximize treatment. The most common methods are:

- **Filtration:** A mechanical process to remove organisms or particles based on size. During filtration, organisms are captured as water passes through a porous screen or mesh. Filtration is usually applied during intake of the water.
- **Ultraviolet:** A physical mechanism that kills or sterilizes the organisms present in the water by exposing them to ultraviolet irradiation (UV). UV damages an organism's genetic material disrupting reproduction and physiological functions.
- **Biocidal:** Involves the addition (chemical injection) or generation (electrolysis or ozonation) of chemicals to kill the organisms present in the ballast water. These mechanisms can be used during intake, in transit, or at discharge, depending on the type of BWTS. To reduce the environmental impacts of chemicals used in these systems, the residuals or byproducts must be neutralized or reduced to environmentally acceptable levels before discharging treated water.

Among the 24% of the vessel arrivals (voyages) that reported using a BWTS to treat ballast water before discharge in California during 2018 and 2019, 126 vessels used electrolysis (a type of biocidal treatment) representing 43% of these arrivals, 115 vessels (40%) used UV irradiation, 42 vessels (10%) chemical injection, and 5 vessels used ozonation (15%) (Figure 6-3).

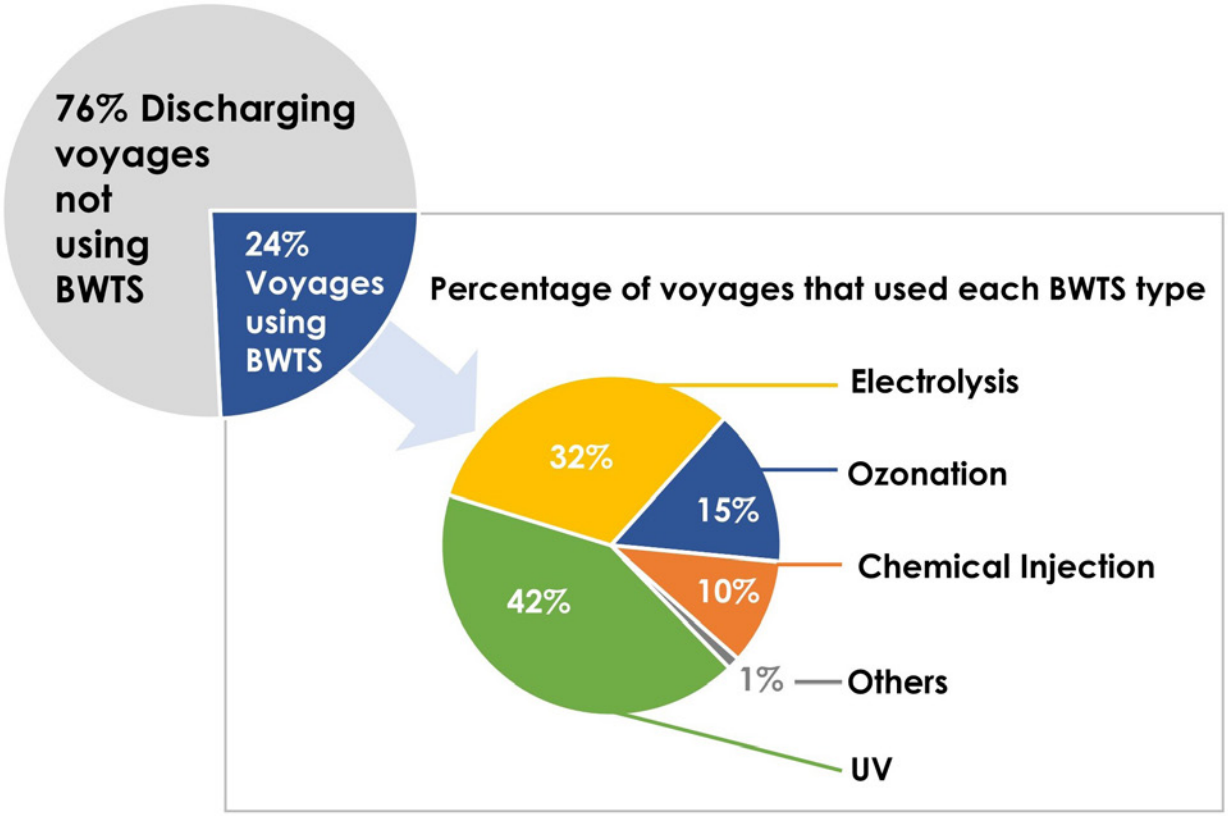


Figure 6-3. Percentage of voyages (vessel arrivals) that reported using a ballast water treatment system (BWTS) before discharging in California during 2018-2019 and the types of treatment systems used. Most of these treatment methods were used in combination with a filtration process.

6.3 Ballast Water Discharge Patterns in California

- Approximately 85% of the vessels that submitted Ballast Water Management Reports for arrivals at California ports reported that they did not discharge ballast water.
- An average of 11.05 million metric tons of ballast water was reported discharged in California per year between 2010 and 2019.
- Bulk and tank vessels reported more ballast water discharge by volume than all other vessel types combined.

Factors like vessel type and local environmental conditions influence whether a vessel needs to carry and discharge ballast water. Analyzing ballast water discharge patterns enables Commission staff to assess the risk of vessel-mediated NIS introductions to California waters and help frame future policy and management recommendations.

During 2018 and 2019, 87.6% of all vessel arrivals at California ports submitted a Ballast Water Management Report (BWMR, see section 4.4.1 for Reporting Compliance). Of those arrivals with a corresponding BWMR, 85.5% reported that they did not discharge any ballast water. These vessels pose no risk of NIS introductions through ballast water. The remaining 14.5% of arrivals reported that they did discharge ballast water in California. The ballast water activities of the 12.4% of arrivals that did not submit a Ballast Water Management Report are unknown (Figure 6-4).

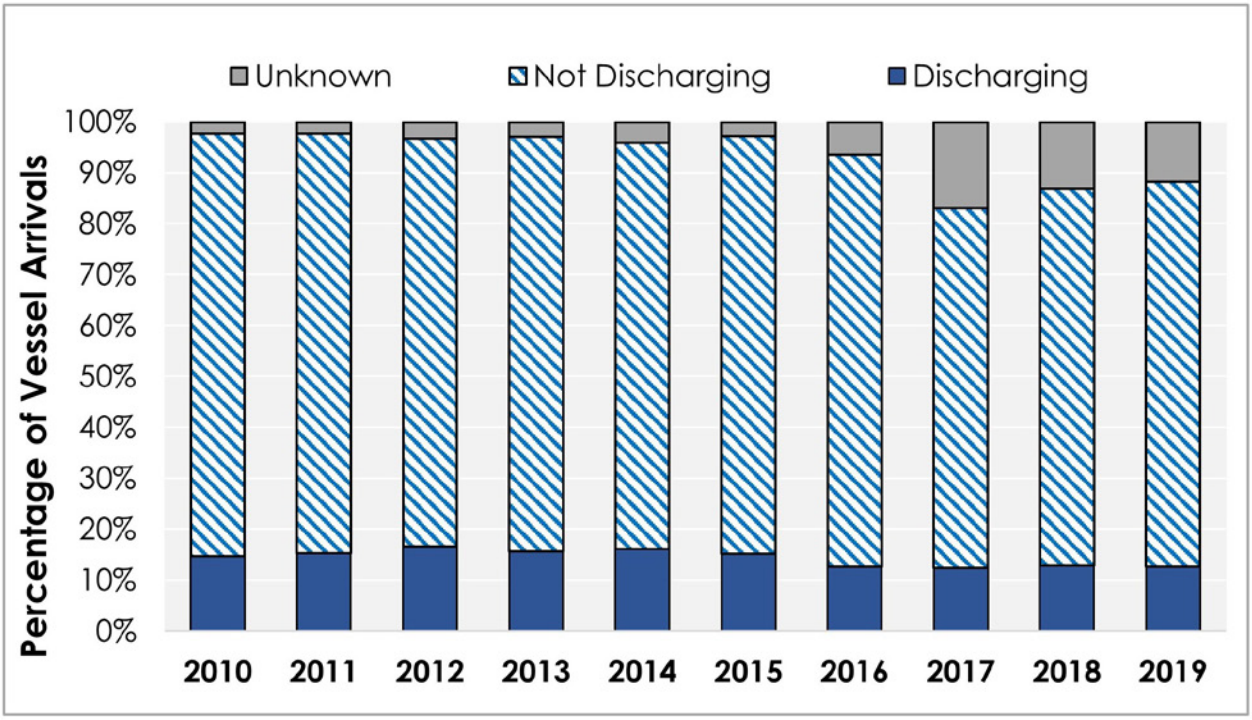


Figure 6-4. Percentage of vessel arrivals in California waters that reported ballast water discharge. "Unknown" represents the vessel arrivals for which a Ballast Water Management Report was not submitted, and their ballast water operations remain unknown.

During the two-year period for this report (2018 and 2019), 22.9 MMT of ballast water was reported discharged in California waters (an average of 11.5 MMT per year). The volume of reported ballast water discharge in California varied between 9.6 and 12.6 million metric tons (MMT) between 2010 and 2019 with an annual average of 11.05 ± 1.0 (standard deviation) MMT (Figure 6-5).

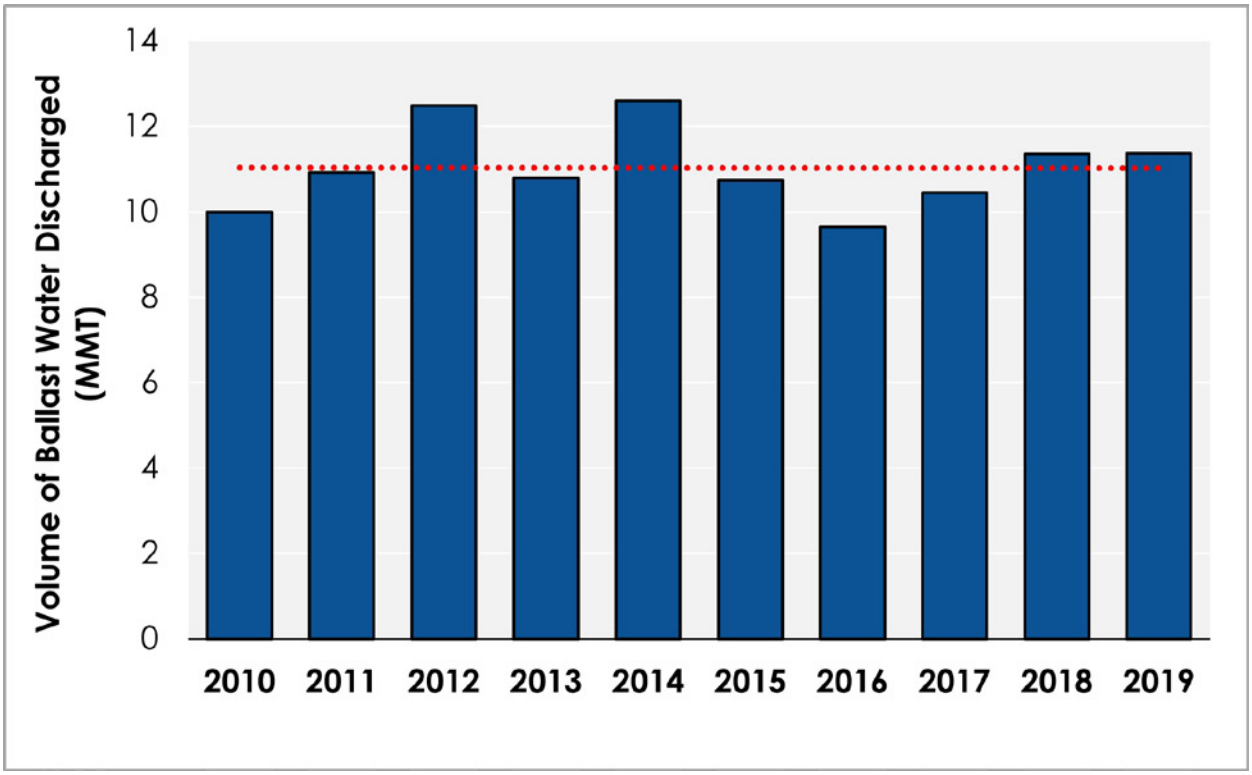


Figure 6-5. Total volume of reported ballast water discharge in California waters annually. Dotted line represents the annual average (million metric tons: MMT).

The risk of ballast water-mediated introductions depends on factors such as the frequency and volume of discharge. The highest risk vessel arrivals are those that frequently discharge large volumes of ballast water. During the reporting period (2018 and 2019), bulk (11.8 MMT) and tank (8.1 MMT) vessels reported discharging more ballast water than all other types of vessels combined (2.9 MMT) (Figure 6-6). Bulk and tank vessels typically have the greatest ballast water capacity of all vessel types, and their cargo operations often require all-or-nothing ballast water discharges (i.e., partial discharges are rare). Other vessel types, like passenger vessels, represent a risk mostly due to their frequency of discharge, not necessarily due to the total volume discharged. Based on the patterns observed in California, auto carriers pose the lowest risk of ballast water-mediated introductions because they discharge small volumes of ballast water infrequently (Figure 6-6).

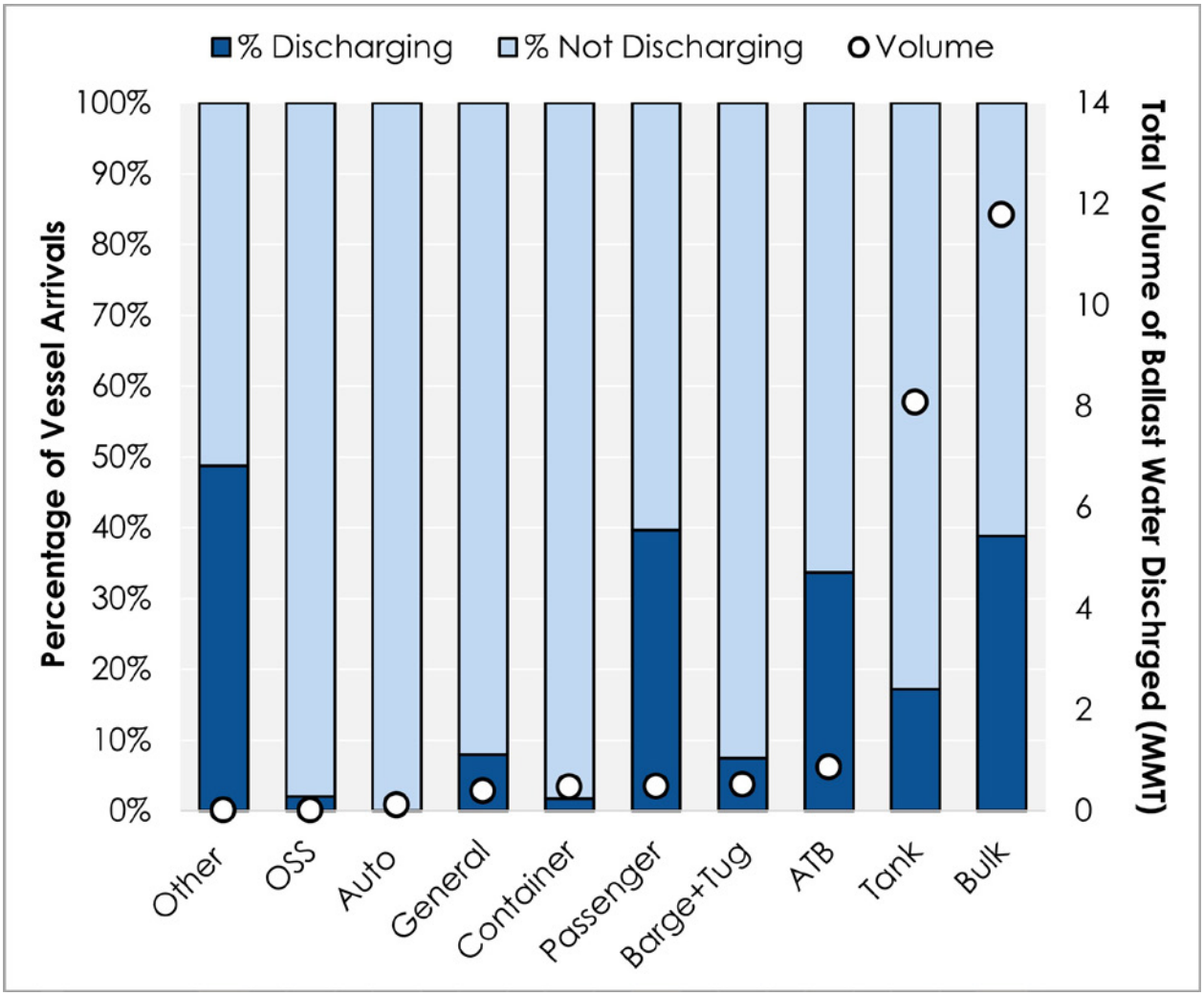


Figure 6-6. Ballast water discharge patterns by vessel type (percentage of arrivals and total volume of ballast water discharged) as reported during 2018 and 2019 (MMT: million metric tons). Vessel types are described in Table 4-1. Total number of arrivals per vessel type is presented in Appendix D.

6.4 Ballast Water Compliance

6.4.1 Compliance Assessment Process

The Commission uses a variety of processes to assess vessel compliance with the MISA and associated regulations. For each vessel that reports the intent to discharge ballast water, staff reviews the information from the BWMR and starts the compliance assessment process. The assessment process has 3 phases:

1) **Pre-arrival assessment:** Review of the BWMR in advance of vessel arrival to determine the type of management used and identify potential noncompliant discharges
2) **Onboard inspections:** Validation of the submitted information upon arrival and assessment of recordkeeping requirements
3) **Post-arrival assessment:** Detailed analysis of ballast water management data for all arrivals within a given time period (e.g., monthly, quarterly)

1) Pre-arrival Assessment:

Vessels must submit their BWMR at least 24 hours in advance of arrival; this advance notification provides staff time to review the reports and identify vessels that intend to discharge upon arrival. Staff reviews the reported ballast water management information and plots the coordinates of ballast water exchange (latitude and longitude) using Google Earth Pro to assess potential noncompliant discharges.

When staff identifies a vessel that is planning to discharge ballast water in California that was not managed properly (e.g., the vessel did not exchange ballast water at an appropriate distance from land), staff immediately notifies the vessel's agent about the potential violation. This pre-arrival assessment and notification process provides the vessel master with an opportunity to either properly manage ballast water prior to discharge or, if possible, change operations so the ballast water can be retained onboard upon arrival in California. This process allows staff to reduce the risk of NIS introductions from ballast water discharge.

2) Onboard Inspection

Onboard vessel inspection by Field Operation staff (see section 5.1) is a critical part of the compliance assessment process. During an inspection, staff:

- Reviews all required documentation kept on board the vessel (e.g., Ballast Water Management Plan and log books)
- Determines if ballast water management was performed according to the requirements (e.g., correct exchange location depending on the origin of the voyage and source of the ballast water, see PCR map Figure 4-8)
- Verifies that the activities recorded in the log book are reflected in the submitted forms
- Documents violations if needed (documented violations are later analyzed by administrative staff to determine enforcement options)
- Provides outreach to the vessel's crew and clarifies questions about the requirements

3) Post-arrival Assessment: Detailed Analysis of Ballast Water Management Data

Staff assesses ballast water management compliance with the MISA and associated regulations for all discharging vessels using the Geographic Information Systems (GIS) software ArcMap. The GIS analysis accurately maps reported ballast water source and management locations (latitude and longitude), which helps staff identify patterns of noncompliance. ArcMap is capable of handling very large datasets, allowing staff to evaluate the ballast water management practices of all vessel arrivals statewide. Staff conducts GIS compliance analyses on a quarterly basis.

6.4.2 Noncompliant Discharges

- 99% of the reported ballast water discharged in California waters during 2018 and 2019 was compliant with ballast water management requirements.
- 93% (126,586 metric tons) of the reported noncompliant ballast water was discharged by bulk and tank vessels.
- Half of all noncompliant ballast water reported discharged in California was sourced in Mexico and was not exchanged at the required distance from land. This noncompliance is likely due to the presence of islands off Baja California that may not be considered by vessel crews when calculating distance from "land."

Ninety-nine percent of reported ballast water discharge in California during 2018 and 2019 was compliant with the MISA and associated regulations. The noncompliant discharged ballast water, by volume (135,650 metric tons (MT)), was either exchanged in the wrong location or was not managed at all (Figure 6-7).

Ballast water source is an important consideration when assessing the risk of noncompliant water discharged in California. Fifty-seven percent of the noncompliant ballast water discharged (65,042 MT) during the reporting period was sourced from North American ports (most commonly from the west coast of Mexico and the U.S. Pacific coast) (Figure 6-7). This is likely due to confusion about the definition of "land" when determining the required ballast water exchange distance from land. Vessel crews may not realize that islands (PCR map; Figure 4-8) are included in the definition of land and conduct exchanges that are not at the required distances.

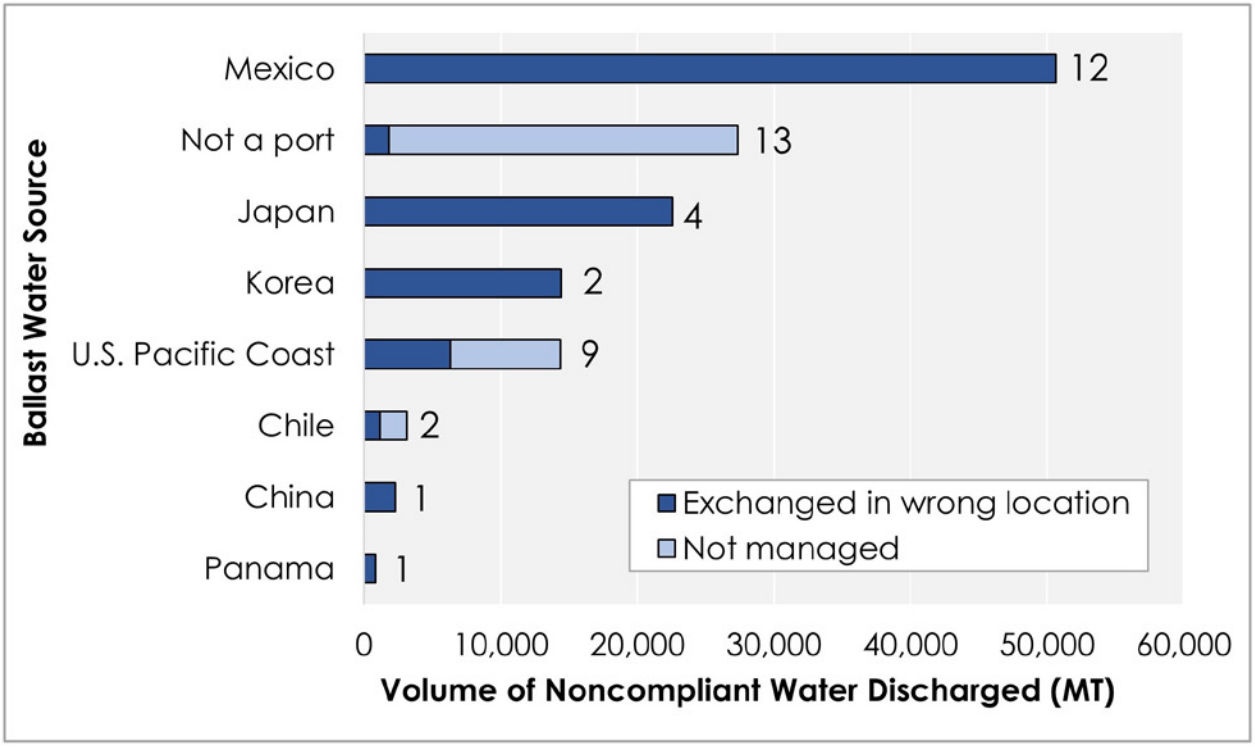


Figure 6-7. Reported source of noncompliant ballast water discharged in California waters during 2018 and 2019. "Not a port" represents discharges where the source was primarily from coastal waters but not at a legal distance from land. The number at the end of each bar represents the number of vessel arrivals carrying ballast water from the ballast water source location. MT: metric tons.

During the reporting period, the largest share of unmanaged ballast water discharged in California was sourced primarily from coastal waters at a noncompliant distance-from land (Figure 6-7, see requirments for ballast water management in section 6.1). The NIS introduction risk associated with this coastally sourced ballast water is likely less than if the water was sourced at a port.

6.4.3 Ballast Water Violations and Enforcement

There are two types of violations of the MISA: administrative and operational. Administrative violations involve reporting (document submission) and recordkeeping (see section 6.1.3). Operational violations (i.e., improper ballast water management) are detected by analyzing the vessel-submitted ballast water management information during vessel inspections and using the GIS compliance analysis process described in section 6.4.1.

In 2016, the Commission adopted regulations codifying the Marine Invasive Species Act Enforcement and Hearing Process (California Code of Regulations, title 2, section 2299.01 et seq.), hereafter referred to as the MISA Enforcement Regulations. The regulations became effective on July 1, 2017, and established an administrative enforcement procedure for processing violations of the MISA and associated regulations. These enforcement regulations lay out clear and transparent procedures outlining the severity of specific violations and provide a matrix to establish maximum penalties associated with different classes of violations. (For more information on the MISA Enforcement Regulations including violation classification and penalty schedule please see Appendix C.)

Ballast water that is not managed prior to discharge represents the greatest potential NIS introduction risk because the organisms taken up at the source are directly discharged in the recipient port. This risk is even greater if the source and discharge ports have a strong environmental match. Environmental match refers to the similarity of environmental parameters (e.g., salinity and temperature, Spalding et al. 2007) between source and discharge locations, and it is a major driver for a successful NIS introduction and subsequent establishment (Ricciardi et al. 2013). Thus, environmental match is one of the factors considered during the enforcement process and penalty assessment.

Vessels that are not compliant with ballast water management requirements under the MISA (operational violations) are issued a Notice of Violation and are subject to enforcement action (see Appendix C). During this reporting period (2018-2019), only 0.16% of vessel arrivals (36 total arrivals) violated the ballast water management requirements of the MISA and associated regulations. The Commission initiated and settled 13 enforcement actions against those violators. The penalties on those violations ranged from $15,000 to $400,000 and were based on the number of tanks in violation and the severity of the violation. Those violators have paid a total of $432,750 in penalties. Penalties from enforcement actions are deposited into the Marine Invasive Species Control Fund.

6.5 Ballast Water Discharge Performance Standards

The previous sections (6.1-6.4) reviewed the patterns of ballast water management in California during 2018 and 2019; this section will discuss progress towards the implementation of ballast water discharge performance standards in California.

As previously mentioned, ballast water exchange is variable in its efficacy, and ballast water treatment technologies hold the promise of being more effective than exchange. As a result, in 2006, the Legislature authorized the Commission to adopt and implement interim and final ballast water discharge performance standards. These performance standards would limit the allowable concentration of living organisms in ballast water discharged in California waters. (SB 497 (2006 Reg. Sess.) § 3.)

California's interim and final ballast water discharge standards are more stringent than the U.S. federal standards (see Table 6-3). The California standards were aspirational and set to be phased in over time to allow for the development of technologies that would enable vessels to meet the standards. Prior to implementing the performance standards, the Commission is required to report to the Legislature on the efficacy, availability, and environmental impacts of currently available ballast water management technologies. (Pub. Resources Code, § 71205.3.)

Table 6-3. Ballast Water Discharge Performance Standards (cfu: colony forming unit, ml: milliliters, µm: micrometers)

Organism Size Class	U.S. Federal As of July 1, 2020	California Interim Standards Implementation January 1, 2030
Organisms greater than 50µm in minimum dimension	< 10 living organisms per cubic meter	No detectable living organisms
Organisms 10-50µm in minimum dimension	< 10 living organisms per ml	< 0.01 living organisms per ml
Living organisms less than 10µm in minimum dimension	No standard exists	$< 10^3$ bacteria/100 ml $< 10^4$ viruses/100 ml
Escherichia coli	< 250 cfu/100 ml	< 126 cfu/100ml
Intestinal enterococci	< 100 cfu/100 ml	< 33 cfu/100 ml
Toxicogenic *Vibrio cholerae* (O1 & O139)	< 1 cfu/100 ml or < 1 cfu/gram wet weight zoological samples	< 1 cfu/100 ml or < 1 cfu/gram wet weight zoological samples

Thus far, six ballast water treatment technology assessment reports have been submitted to the Legislature demonstrating that there were no technologies available that would enable the regulated community to meet the California ballast water discharge performance standards (Dobroski et al. 2007, Dobroski et al. 2009, Commission 2010, Commission 2013, Commission 2014, Commission 2018). In response to the lack of available technologies and recommendations in the Commission's reports, the Legislature delayed implementation of the interim California standards multiple times. (SB 1781 (2008 Reg. Sess.) § 30; SB 814 (2013 Reg. Sess.) § 8; AB 1312 (2015 Reg. Sess.) §§ 3, 4.)

Most recently, the Legislature passed AB 912 (Chapter 433, Statutes of 2019, section 3.1), which delayed implementation of the interim and final California ballast water discharge performance standards until January 1, 2030, and January 1, 2040, respectively. Prior to the implementation of the interim California standards in 2030, the Commission must assess the availability of technology to meet those standards in a report to be submitted to the California Legislature by July 1, 2025.

Further, following the recommendations included in the 2018 Commission report, AB 912 mandates that the Commission adopt regulations requiring vessels to comply with the federal ballast water discharge standards set by the U.S. Coast Guard. Once the regulations are adopted, the Commission intends to amend the MISP enforcement regulations (California Code of Regulations, title 2, section 2299.01 et seq.), which will enable staff to enforce violations of the federal standards by vessels arriving at California ports (see section 12.1 (1)). Implementing the federal standards in the near term is the best available option to protect California from vessel-mediated species introductions until technology can be proven to meet the more stringent interim California ballast water discharge performance standards (see section 12.1 (2)).

6.6 Ballast Water Collaborations and Funded Research

The Commission is committed to using the best available science to develop and implement ballast water management policies. Therefore, the Commission funds, conducts, and collaborates on research that advances the development of strategies to prevent the introduction of NIS from ballast water. This section summarizes these efforts during 2018 and 2019.

1) Development of a Ballast Water Sampling Tool

The Commission funded the Golden Bear Research Center (GBRC), based onboard the California Maritime Academy's training ship *Golden Bear,* and a sub-awardee, Glosten Inc., to improve a previously developed ballast water sampling tool. The improvements will make the device compact and explosion-proof. The tool has been assembled, which completes phase II of the project. The contractors are beginning phase III, which consists of shipboard functional and biological testing of the sampling tool. This project is scheduled to be completed by early 2021.

2) Ballast Water Compliance Testing

In 2019, the Commission funded the GBRC to sample commercial vessels discharging treated ballast water into California waters to:

- Provide the Commission with information on the feasibility of, and effort required for, assessing compliance with ballast water discharge performance standards.
- Collect and analyze samples to evaluate the efficacy of ballast water treatment systems installed on board vessels

This research is scheduled for completion by the end of 2021

3) Historical Shipping Patterns in San Francisco Bay

In 2017, the Commission funded the Smithsonian Environmental Research Center (SERC) to study the historical patterns of shipping traffic in the San Francisco Bay Area and links to the transport of non-native species. This work is important because an accurate historical baseline of both invasion rate and incoming ballast water transport is required for comparison to contemporary data and to assess the effectiveness of ballast water management requirements. This project will conclude in 2021 with the submission of a final report to the Commission and a peer-reviewed manuscript.

4) Evaluation of the Combined Use of Ballast Water Exchange Plus Treatment Systems

The increased worldwide use of BWTS has led to a discussion of whether conducting ballast water exchange in conjunction with ballast water treatment is more effective than ballast water treatment alone. Through funding provided by the Commission, the GBRC tested the efficacy of ballast water treatment alone versus the use of ballast water exchange plus ballast water treatment.

The research trials used a ballast water treatment system that was undergoing USCG type approval testing on the *T/S Golden Bear.* The results showed no difference between ballast water treatment used alone versus ballast water exchange used in conjunction with ballast water treatment. Each trial produced no detectable living organisms in the greater than 50 µm and the 10 - 50 µm size classes; similar results were observed in the microbial size classes (less than 10 µm).

In this case, the ballast water treatment system, regardless of whether it was coupled with ballast water exchange, effectively reduced the concentration of organisms entrained in the ballast water to levels far below the U.S. federal discharge standards (see Table 6-3). Additional research, using a variety of treatment types and systems, is necessary to better understand the relative effectiveness of ballast water exchange plus ballast water treatment compared to treatment alone.

7. BIOFOULING

7.1 Biofouling Management Requirements

The Commission adopted vessel biofouling management regulations in April 2017 (*Article 4.8. Biofouling Management to Minimize the Transfer of Nonindigenous Species from Vessels Arriving at California Ports* (California Code of Regulations, title 2, section 2298 et seq.)), hereafter referred to as the "California Biofouling Management Regulations." These regulations became effective on October 1, 2017.

The regulations apply to new vessels delivered into service on or after January 1, 2018, and existing vessels that complete a regularly scheduled out-of-water maintenance (i.e., dry docking) on or after January 1, 2018.

The principal components of the California Biofouling Management Regulations include:

1) Vessel-specific Biofouling Management Plan and Biofouling Record Book
2) Strategies to manage biofouling on vessel's wetted surfaces
3) Management of biofouling after extended idle periods
4) Submission of the Annual Vessel Reporting Form

1) Vessel-specific Biofouling Management Plan and Biofouling Record Book

The Biofouling Management Plan must:

- Describe the vessel's operational profile (e.g., typical speed, activity level)
- Describe the vessel's maintenance practices for preventing and removing biofouling organisms on a vessel's hull and niche areas (i.e., underwater recesses and appendages)
- Indicate the effective lifespan of the antifouling coating used on the vessel (i.e., length of time the coating is expected to be effective based on coating formulation and applied thickness). See section 7.2.2 for more information about antifouling coatings.
- Be consistent with components of the biofouling management plan described in the IMO's voluntary "Guidelines for the Control and Management of Ships' Biofouling to Minimize the Transfer of Invasive Aquatic Species," hereafter referred to as "IMO Biofouling Guidelines" (IMO 2011)

The Biofouling Record Book must:

- Be consistent with components of the Biofouling Record Book described in the IMO Biofouling Guidelines
- Record all completed biofouling inspections and management practices

The California Biofouling Management Regulations are the first set of regulations worldwide to require vessels to have a Biofouling Management Plan and Biofouling Record Book. Collectively, these documents should describe each vessel's biofouling management strategy and document that the strategy is being implemented. A vessel's strategy should include proactive measures (e.g., coatings, cleaning) to prevent biofouling accumulation and reactive measures (e.g., cleaning) to remove biofouling from vessel surfaces when necessary (Scianni and Georgiades 2019). These strategies should change from vessel to vessel based on the vessel's design and operational profile.

New regulations learning curve:

Because the California Biofouling Management Regulations were the first of their kind, a steep learning curve was expected. To reduce this effect, a 60-day grace period provision was included in the regulations to allow a vessel with a noncompliant or missing Biofouling Management Plan or Biofouling Record Book 60 days to correct any deficiency that results in a violation. Following the 60-day grace period, the vessel will be a high priority for inspection until it is inspected to determine if the deficiency was corrected.

2) Strategies to Manage Biofouling on Vessel's Wetted Surfaces

- **Management of a Vessel's Hull:** The Biofouling Management Plan must describe the strategies used to manage biofouling on the hull. An acceptable option is the use of an antifouling or foul-release coating that is not aged beyond its expected coating lifespan. The Biofouling Management Plan must include any action describing how biofouling on the hull will be managed after the expected lifespan of an antifouling or foul-release coating is exceeded or in the absence of an antifouling or foul-release coating.
- **Management of Niche areas:** Biofouling on eight specific niche areas must be managed in a manner chosen by a vessel's master, owner, operator, or person in charge as indicated in the Biofouling Management Plan. Specific niche areas that require management are shown in Figure 7-1.

What are Niche Areas?

Niche areas include recesses, appendages, and other wetted vessel surfaces of the vessel that are more susceptible to biofouling due to structural complexity and inadequate protection by antifouling or foul-release coatings and other antifouling systems.

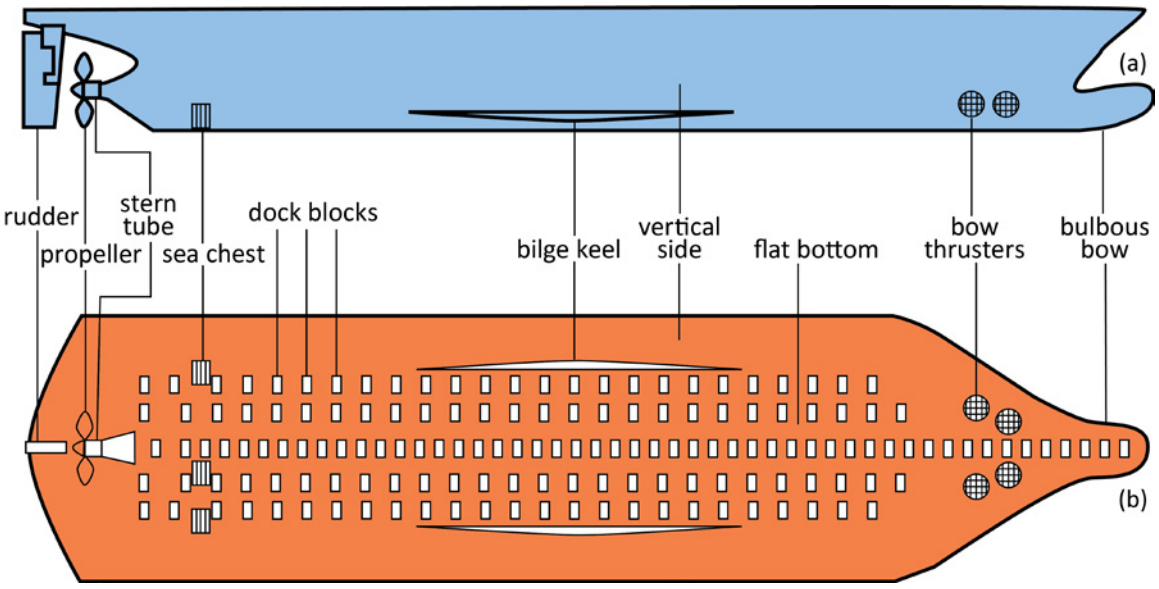


Figure 7-1. Niche areas susceptible to biofouling accumulation. a) Lateral view of a vessel. b) Bottom view of a vessel. Figure originally from Davidson et al. 2016.

3) Management of Biofouling After Extended Idle Periods

Any vessel subject to the California Biofouling Management Regulations that remains in one port consecutively for 45 days or longer must manage niche area biofouling in a manner consistent with the management actions described in its Biofouling Management Plan prior to arrival at a California port. In most cases, biofouling that accumulates because of an extended idle period of 45 days or longer (also referred to as "residency periods") should be managed in the same location where the residency period occurred to prevent the movement of the biofouling community to a new location.

4) Submission of the Annual Vessel Reporting Form

Vessels are required to report their biofouling maintenance and operational practices to the Commission via the Annual Vessel Reporting Form (AVRF; see section 4.1). The AVRF is used by Commission staff to assess compliance with biofouling management requirements and to conduct pre-arrival risk assessments to prioritize vessels for inspection. The AVRF also requires vessels to document use of a BWTS.

7.2 Biofouling Patterns in California

- 266 million square meters of cumulative wetted surface area arrived at California ports during 2018 and 2019 — equivalent to the area of nearly 50,000 American football fields.
- 72% of all wetted surface area that arrived at California ports was from container and tank vessels.

7.2.1 Wetted Surface Area

A common proxy used to evaluate the potential for vessels to unintentionally transfer NIS on their underwater, or wetted surfaces, is wetted surface area (WSA). WSA is an estimate of the total surface area of a vessel that is temporarily or continuously submerged in water and that can be colonized by biofouling organisms. WSA differs among vessel types because of their different sizes and operational needs. Based on the vessel arrivals at California ports during the past two years (2018 and 2019), container, passenger, and tank vessels had the greatest average WSA relative to the other vessel categories. Each vessel arrival accounted for between 2 to 3 "football fields" of wetted surface area (Figure 7-2).

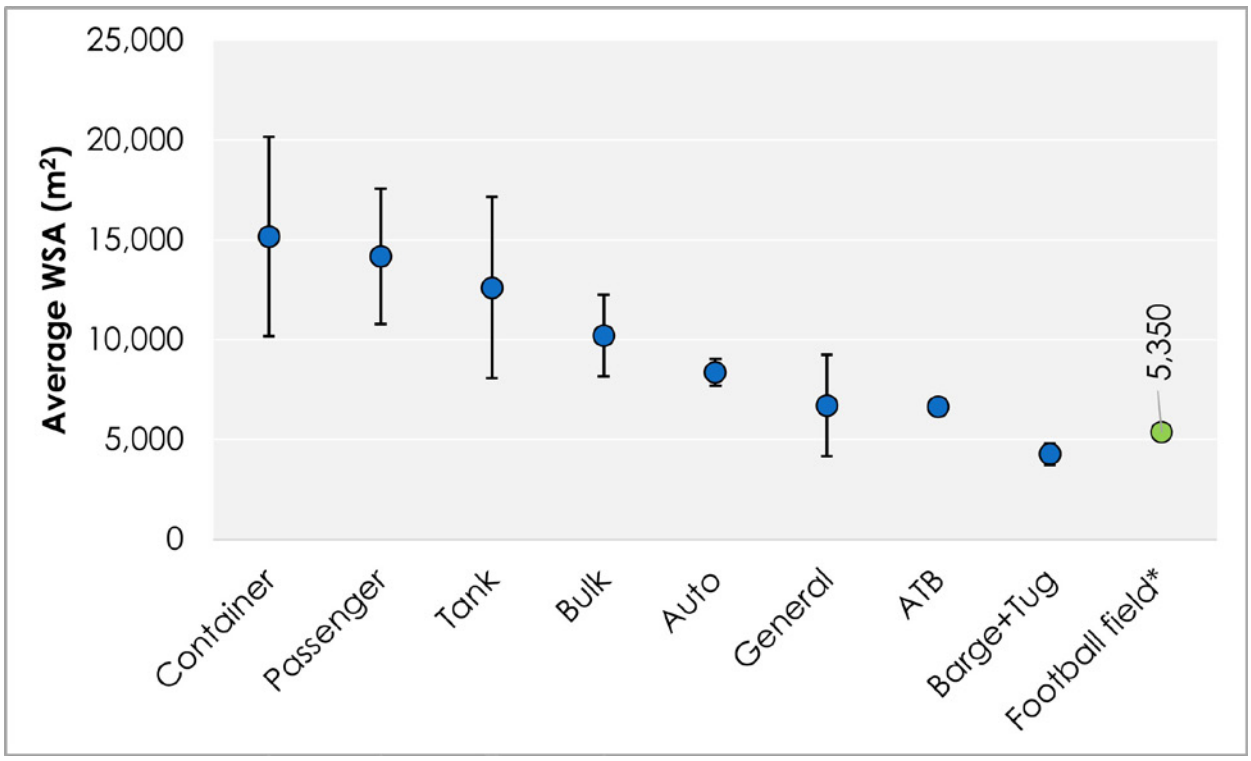


Figure 7-2. Average wetted surface area (WSA) of vessels that arrived at California ports during 2018 and 2019 (error bars represent standard deviation). The description of vessel type categories is presented in Table 4-1.

*area of an American football field is included for comparison.

Evaluating WSA for all vessels arriving at specific ports or over a specific period provides insight into the potential magnitude of NIS able to be introduced via biofouling. California received 266 million square meters of vessel WSA, an area equivalent to 49,706 American football fields, during 2018 and 2019. Vessels that arrived at southern California ports accounted for more than half (54%) of this WSA, with the remaining 46% arriving at northern California ports. Across California, container and tank vessels were the primary WSA contributors, accounting for approximately 72% of all WSA during 2018 and 2019 (Figure 7-3).

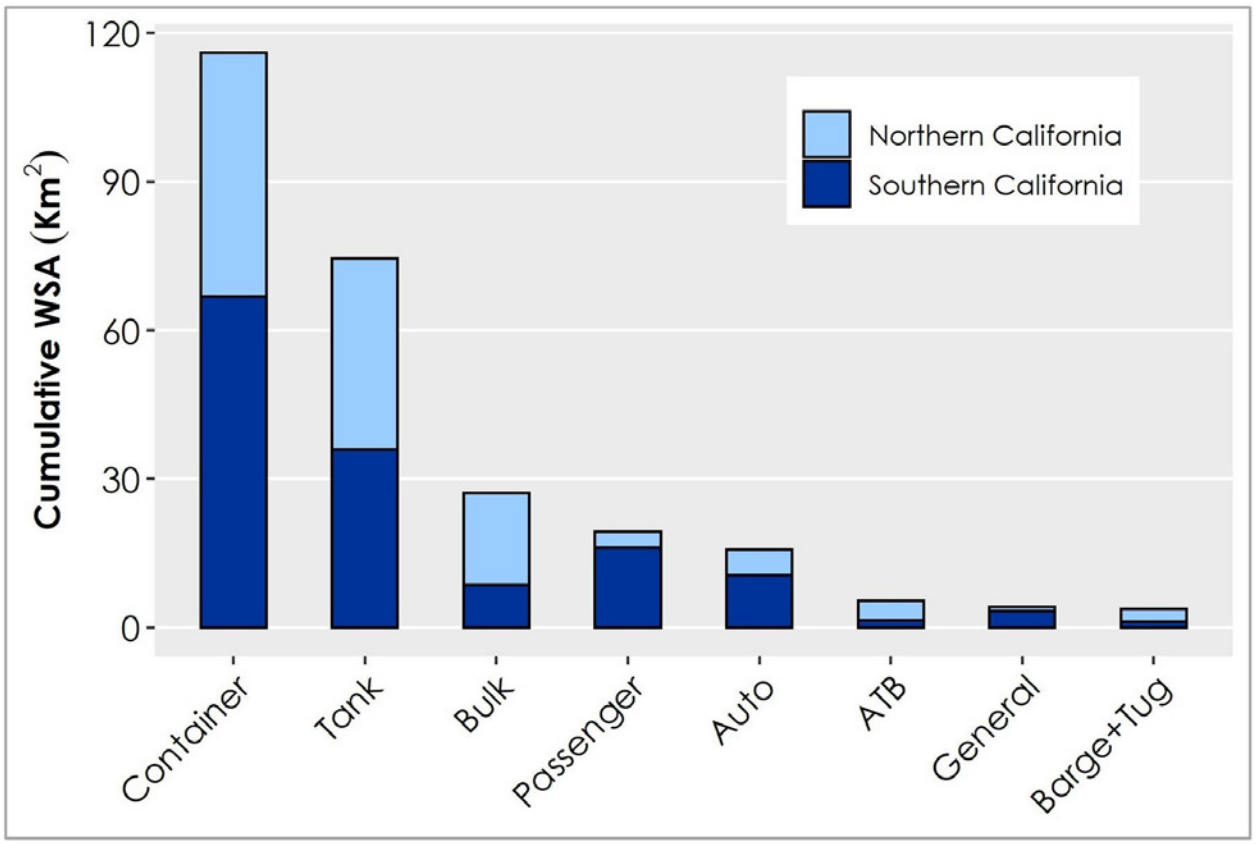


Figure 7-3. Cumulative wetted surface area (WSA) of vessels arriving at northern and southern California ports during 2018 and 2019. The description of the vessel type categories is presented in Table 4-1. Vessel arrivals from "OSS" and "Other" categories (1.2% of all arrivals) were removed from this analysis because the WSA could not be calculated due to the variability of each of these categories and/or the lack of specific details about the vessel.

7.2.2 Biofouling Maintenance and Vessel Operational Practices

The likelihood that a vessel has extensive biofouling is influenced by many factors. Through submission of the AVRF, Commission staff collects data and analyzes the parameters that are likely to increase or decrease the presence of biofouling on vessels arriving at California ports. Some of the parameters analyzed are:

1) Type and age of antifouling coatings
2) Frequency and duration of idle periods
3) Vessel average speed
4) Freshwater transits

Antifouling coatings

An antifouling coating is a specialized paint that is applied to the wetted surfaces of a vessel (e.g., the hull) to prevent the accumulation of biofouling organisms. There are two main types of antifouling coatings:

- **Biocidal coatings:** rely on toxic substances (e.g., copper, zinc) to prevent organisms from attaching to, or growing on, the coated surface
- **Foul-release coatings:** rely on slippery surfaces, made from biocide-free materials like silicone, to prevent organisms from staying attached once the vessel starts to move

Vessel owners/operators determine the type of coating to be used based on the vessel's operational profile (e.g., how fast it moves, the locations through which it transits, the frequency and duration of its idle periods).

1) Type and Age of Antifouling Coatings

There are a variety of antifouling coatings available to vessels to prevent biofouling accumulation. During 2018 and 2019, many of the vessels that arrived at California ports relied solely on biocidal antifouling coatings (91% of unique vessels; Figure 7-4A) to prevent the attachment of organisms to the vessel; copper-based biocidal coatings were the most prevalent. Only 1% of vessels relied solely on biocide-free foul-release coatings that use materials like silicone to make the vessel's surfaces slippery and are intended to make it difficult for organisms to remain attached once the vessel moves. Four percent of vessels that arrived at California ports employed a mixed strategy, relying on a combination of biocide-containing coatings on some surfaces (e.g., niche areas) and biocide-free foul-release coatings on other surfaces (e.g., the hull).

Most antifouling coatings are designed to be effective for three to five years. Three-quarters of vessels that arrived at California ports during 2018 and 2019 had coatings that were applied within the prior three years, indicative of coatings that are likely to still be effective at minimizing biofouling accumulation (Figure 7-4B). Coatings aged beyond three years are in the latter stages of their service life and are likely to have reduced effectiveness because most of their antifouling properties fade with time and use. Coatings that were between 3 and 5 years old were reported for 23% of the vessels operating in California during 2018 and 2019. Only 2% of the vessels had coatings that were aged beyond 5 years.

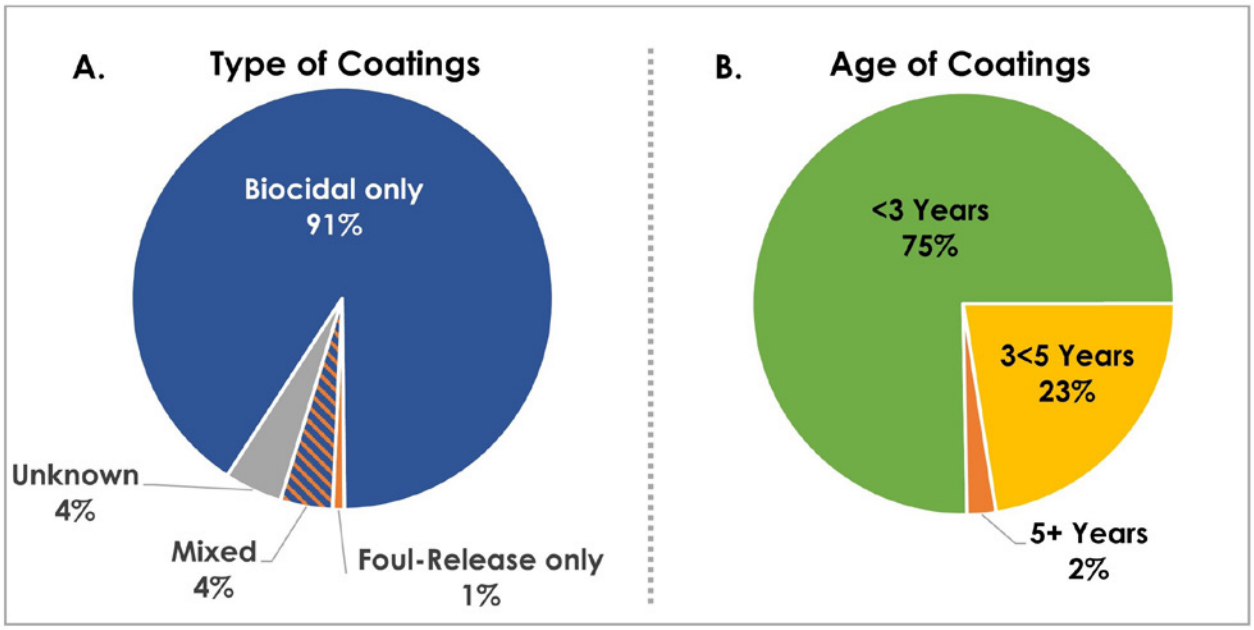


Figure 7-4. A. Breakdown of antifouling coating types used by vessels that arrived at California during 2018 and 2019. "Mixed" represents a combination of biocide-containing and foul-release. **B.** Breakdown of coating ages (i.e., time since coating was applied).

2) Frequency and Duration of Idle Periods

Antifouling coatings often require vessel movement to effectively prevent biofouling accumulation because the coatings are designed to either release small amounts of biocide or make it difficult for organisms to remain attached when the vessel is in motion. Long and frequent idle periods therefore, often lead to more biofouling accumulation because the biocides within the coating are not being released. The longer these idle periods are, the more likely biofouling will accumulate, and the greater the risk of transporting those attached species to a new location during their next voyage.

During 2018 and 2019, 3,474 individual vessels (i.e., not arrivals) reported 4,637 idle periods of 10 days or greater since their hull was last cleaned (Figure 7-5). Most (80.1%) of these idle periods were between 10 and 19.9 days, but 2.2% of them were greater than 45 days. The longer the idle period, the more likely the vessel is to accumulate biofouling and have many different species present (Davidson et al. 2020).

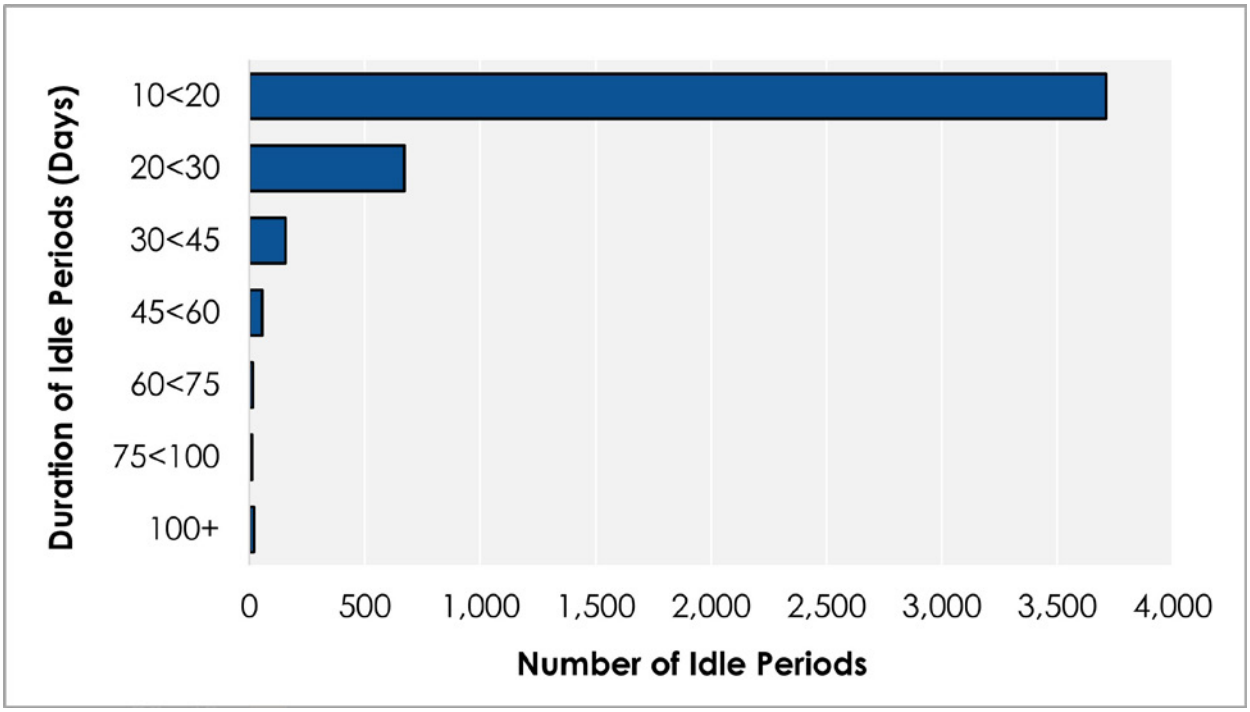


Figure 7-5. Number and duration of idle periods reported by vessels that arrived at least once at a California port during 2018 and 2019.

Commission staff expects to see an increase in the number of vessels reporting idle periods due to the COVID-19 pandemic and associated recession. During the early phase of the pandemic, shipping slowed significantly around the world. Tank vessels, in particular, were idled as floating storage tanks until the need for petroleum products resumed. In the upcoming years, the Commission will analyze the effect of the recession caused by the COVID-19 on shipping traffic and NIS introduction risk by tracking the arrival of vessels that were idle for long periods of time in order to assess their compliance with the biofouling management regulations (see section 12.1 (8)).

3) Vessel Average Speed

Vessel traveling speed influences the retention of organisms on a vessel's wetted surfaces, with slower speeds likely to result in better retention or survival (Coutts et al. 2010, Davidson et al. 2020). Since 2008, the maritime shipping industry has implemented a "slow steaming" strategy, reducing speeds to improve efficiency and decrease both fuel costs and greenhouse gas emissions. The average speed of the vessels operating in California has decreased steadily from 16.8 nautical miles per hour (knots) in 2008 to 13.8 knots in 2019, an 18% reduction (Figure 7-6).

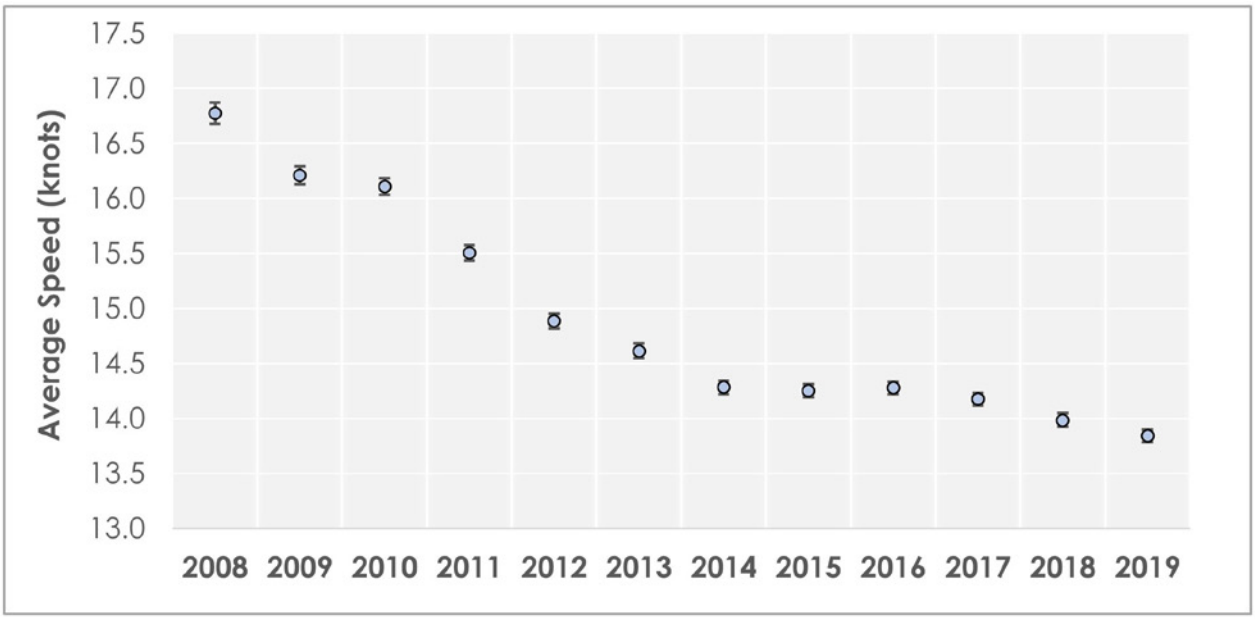


Figure 7-6. Average reported traveling speed (error bars represent standard error) for vessels that came to California between 2008 and 2019.

4) Freshwater Transits

Traveling through freshwater can reduce the likelihood of introducing NIS via biofouling, as freshwater is a natural biocide for marine organisms. Visiting freshwater ports or traveling through the freshwater Panama Canal will likely kill some, if not all, of a vessel's biofouling community. Nearly three-quarters (71.8%) of vessels operating in California during 2018 and 2019 reported at least one freshwater port visit or a Panama Canal transit since the vessel's hull was last cleaned (Figure 7-7).

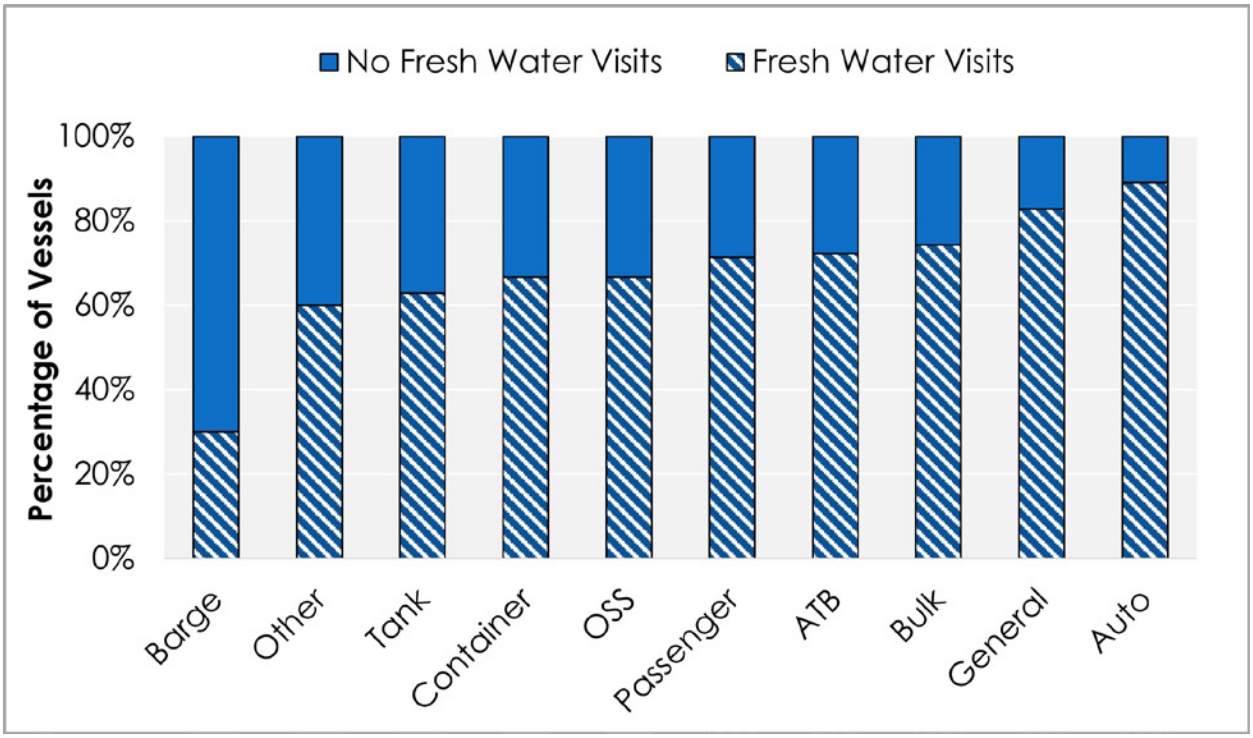


Figure 7-7. Percentage of vessels that reported traveling to a freshwater port or transiting the freshwater Panama Canal before arriving at a California port during 2018 and 2019. The description of vessel type categories is presented in Table 4-1.

7.3 Biofouling Compliance

- 3,885 vessel arrivals that were required to comply with the California Biofouling Management Regulations arrived at California ports during 2018 and 2019.
- 33% of initial vessel inspections resulted in violations that required a 60-day grace period.
- 129 out of 134 (96%) vessels that received a 60-day grace period were found compliant in a follow-up inspection.
- Most violations were issued for failure to include required information in Biofouling Management Plans.

In total, there were 3,885 vessel arrivals during 2018 and 2019 that were required to comply with the California Biofouling Management Regulations (Figure 7-8). Commission staff inspected 805 (20.7% of the total) of those arrivals, prioritizing each vessel's first arrival at a California port after it became subject to the California Biofouling Management Regulations.

During inspections in 2018 and 2019, Commission staff identified deficiencies and issued 60-day grace periods for 265 vessels (32.9% of inspected arrivals). Almost half of these grace periods (45.7% of all grace periods) were granted for more than one violation. The most common violations were for missing or incomplete information related to:

- The expected effective lifespan of antifouling coatings in use (identified for 77.4% of issued grace periods)
- Biofouling management description for out-of-water support strips (i.e., niche areas on the hull bottom; 33.6%)
- Biofouling Record Books (37.0%)

From the 265 vessels that were issued 60-day grace periods during 2018 and 2019, a follow-up inspection was conducted on 134 cases after the expiration of the grace period (Figure 7-8). From these 134 inspections, 129 (96%) of them had corrected the original deficiency(ies) and were found compliant; five were still in violation.

The Commission currently does not have an enforcement process for addressing violations of the biofouling management regulations. The Commission's MISA enforcement regulations (California Code of Regulations, title 2, section 2299.01 et seq.) were adopted prior to the adoption of the biofouling regulations, so there are no enforcement regulations specific to biofouling violations. Commission staff intends to update the enforcement regulations in the near future to create a more comprehensive enforcement process for all violations of the MISA (see section 12.1 (1)).

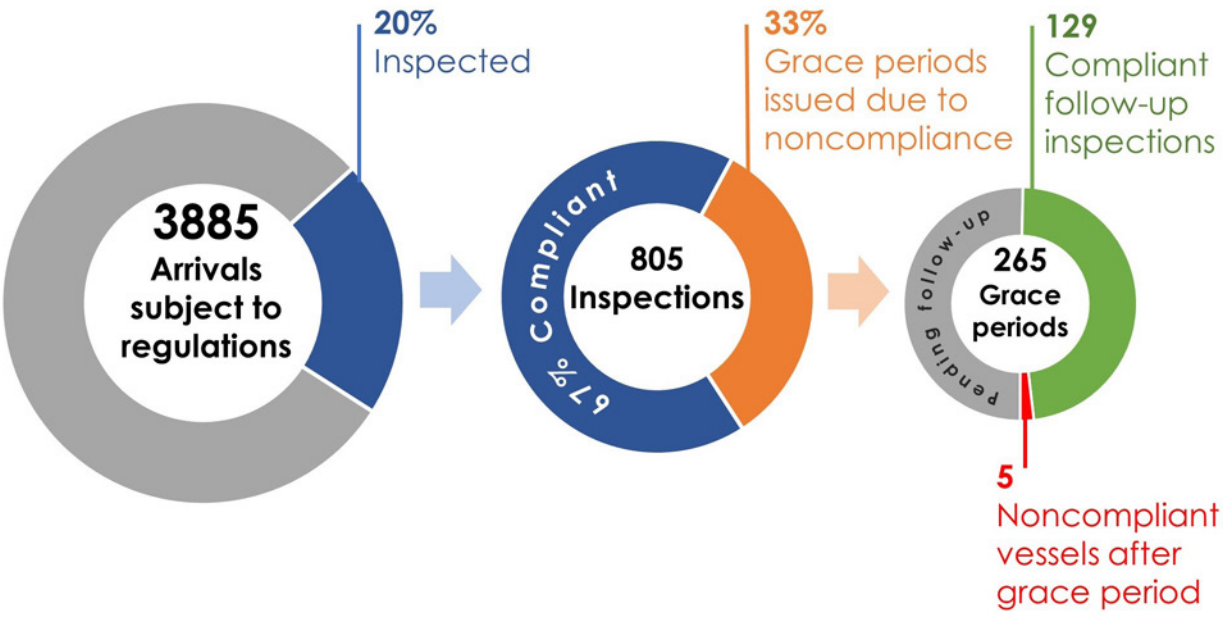


Figure 7-8. Inspection and compliance trends for vessels subject to the California Biofouling Management Regulations during the reporting period.

7.4 Biofouling Outreach Efforts

California ushered in the first-in-the-world biofouling regulations for the maritime shipping industry. Commission staff provided a variety of outreach to different stakeholder groups prior to, and after, implementation of these regulations. The outreach was provided to increase the maritime shipping industry's knowledge and awareness of the new regulations to help ensure industry compliance.

Outreach efforts included:

- A regulatory guidance document to provide an easy-to-read summary of the California Biofouling Management Regulations (see Commission 2017a)
- An initial webinar to provide an easy-to-interpret summary of the California Biofouling Management Regulations (see Commission 2017b)
- A follow-up webinar a year after implementation to clarify requirements and highlight identified issues (see Commission 2018)
- Customer service meetings in northern and southern California during September 2017 to provide information directly to shipping agents located near California's main port regions
- Information sheets for distribution and discussion with vessel crews during inspections (see Commission 2017c, 2017d)

7.5 Biofouling Collaborations and Funded Research

Commission staff continues to actively fund and collaborate on biofouling research to improve policy development and implementation. The following five projects were either completed or were close to completion during 2018 and 2019.

1) Vessel Specialization and Consequences for Marine Invasions, Management, and Policy

Commission staff collaborated with researchers from the Smithsonian Environmental Research Center (SERC) to study how vessels have become specialized over time for specific types of trade (e.g., container, tank vessels) and how that specialization led to vessel behaviors (e.g., speed, port residency time) that can influence the likelihood of NIS transport and introduction.

MISP data on vessel maintenance and operational practices contributed to this study that was published in the peer-reviewed *Journal of Applied Ecology* (see Davidson et al. 2018).

2) Effect of Idle Periods and Transit on Biofouling Communities

The Commission provided funds to SERC to investigate the impact of vessel idle or stationary periods at six durations ranging from three to 60 days on the development of biofouling communities. These experiments compared biofouling communities attached to panels with biocide-containing or foul-release (biocidal-free) coatings. The study also included the exposure of biofouling communities to water flow at 14 knots through a purpose-built flume to simulate vessels in transit to understand how vessel movement impacts the retention of vessel biofouling communities.

The experiments showed that panels exposed for longer durations accumulated more biofouling and confirmed the hypothesis that simulated vessel movement reduced biofouling on both antifouling and foul-release coatings. These results provide insight into the amount of biofouling that can be expected on vessels that are idle for various time periods and that subsequently travel to California ports.

This study was published in the peer-reviewed journal Biofouling (see Davidson et al. 2020).

3) Environmental Risks Associated with Different In-Water Cleaning Approaches

Commission staff collaborated with a researcher from New Zealand's Ministry for Primary Industries to study different approaches to remove vessel biofouling in water (known as "in-water cleaning") and evaluate the water quality parameters (e.g., biocide concentration) and NIS introduction risks associated with each approach. The approaches are divided in two main groups:

- Proactive cleaning to keep hulls clean
- Reactive cleaning to remove extensive biofouling

Some approaches released removed debris into the environment, while others captured, treated, and retained the removed debris. The environmental risks associated with many of these approaches included the risk of introducing NIS and releasing heavy metal biocides in the water.

This study was published in the peer-reviewed journal *Frontiers in Marine Science* (see Scianni and Georgiades, 2019).

4) Assessing the Efficacy and Risk-Reduction of In-Water Cleaning Technologies

Commission staff collaborated with researchers from the University of Maryland, SERC, the Naval Research Lab, and the Hawaii Department of Land and Natural Resources to evaluate the effectiveness of reactive in-water cleaning (used to remove existing biofouling organisms) and capture technologies used to clean a vessel's hull. The research team tested one technology during two trials, measuring the reduction in biofouling on the vessels, the release of biocides during cleaning (i.e., adjacent to the cleaning unit), and the release of organisms and biocides in the waste stream after treatment and filtration. Although the trials showed significant reductions in biofouling after cleaning and no measurable release of biocides adjacent to the cleaning unit, the discharge stream showed elevated heavy metal concentrations (i.e., above allowable limits). Additional secondary treatment steps (e.g., filtration through organo-clay to remove dissolved metals) are necessary to bring the metal concentrations down to water quality discharge limits.

This project was summarized in a final report (see ACT/MERC 2019) and was published in the peer-reviewed journal *Frontiers in Marine Science* (see Tamburri et al. 2020).

5) Impact of Artificial Structure Density on Biofouling Species Diversity

The Commission provided funds to researchers at San Jose State University to evaluate conditions that influence the diversity of both native species and NIS. The research team evaluated the effects of harbor copper pollution levels, water temperature, vessel activity, proximity to the open coast, and the amount of artificial structure (e.g., docks) on the composition and abundance of the organisms that live in the harbor. The study included 28 sites across California and two sites in Australia.

The researchers found that more artificial structure resulted in greater native and NIS diversity. The researchers recommended considering the amount of artificial structure in a harbor when predicting locations that are likely to provide available space for NIS to accumulate.

The results of this project were published in the peer-reviewed journal *Biological Invasions* (see Susick et al. 2019).

8. REVIEW OF CURRENT RESEARCH

As required by Public Resources Code section 71212(e), this Biennial Report includes a summary of recent research relating to vessel vectors and NIS introductions. This section summarizes selected peer-reviewed articles published during 2018 and 2019.

8.1 Ballast Water Research

Gerhard and Gunsch (2018) evaluated ballasting behavior of vessels arriving at U.S. ports between 2005 and 2017 and found that although arrivals increased by 1.2% per year, total ballast water discharged per vessel increased at a rate more than six times faster, by 7.6% per year. With more ballast water being discharged per vessel and more vessels installing and using ballast water treatment systems to meet ballast water discharge performance standards, regulators will need to identify appropriate sampling tools and devices to collect ballast water samples for compliance assessment.

Moser et al. (2018) designed, built, and validated a pocket-sized Compliance Sampling Device to collect samples from a ballast water discharge pipe without damaging the collected organisms, as damaging the organisms ruins compliance assessment. The Compliance Sampling Device did not kill or damage organisms during sampling, and the authors suggested that it would be acceptable for collecting compliance samples on board ships.

Once a ballast water sample is collected, regulatory agencies need quick, reliable rapid assessment tools to screen for possible noncompliance. **Bradie et al. (2018)** assessed the ability of eight rapid assessment tools to detect the effects of ultraviolet ballast water treatment. All devices performed well for larger (>50 µm) and smaller (<10 µm) organism sizes but were inconsistent for medium-sized (between 10 and 50 µm) organisms. **Molina et al. (2019)** evaluated another approach to determine the effectiveness of ultraviolet ballast water treatment. The authors measured DNA

concentrations in small samples after incubations of one, five, and 14 days to determine if treated organisms could reproduce. The method was successful, and the authors suggest that this type of approach could be effective and useful because it relies on small sample volumes and provides results within a day.

Most ballast water treatment studies focus on how treatment affects algae and animals; fewer studies focus on microscopic bacteria and viruses even though they are more numerous in nature. **Hess-Erga et al. (2019)** reviewed the effects of ballast water treatment using UV and ozone on bacteria populations and found that treatment can alter the bacterial community by selectively killing some species and allowing for regrowth and population expansion of others that can withstand treatment. **Gerhard and Gunsch (2019)** used DNA-based molecular methods to examine the microbial communities found in 41 ships' ballast tanks, 20 harbors, and six open ocean samples. The authors used machine learning to classify and determine the type of sample (ballast, harbor, or open ocean) based on the microbial community makeup and suggested additional research into this approach to be able to rapidly assess ballast water origin. **Hwang et al. (2018)** also used DNA-based molecular methods to evaluate viruses in ballast water. The authors found substantial viral diversity, including viruses known to infect algae, invertebrates, humans, and other animals.

Ballast water treatment approaches that rely on the use of chemicals often produce disinfection by-products, even when the original chemical disinfectant is neutralized. **Lee et al. (2019)** found that the discharged chemicals and disinfection by-products tested in this study decayed at lower rates (i.e., remain in the environment longer) in low salinity environments.

David et al. (2018) analyzed all BWTSs that received IMO final approval over a decade to determine the impact of chemical discharges on the aquatic environment in two commercial ports, Koper, Slovenia and Hamburg, Germany. The authors found that some chemicals and disinfection by-products reached toxic levels for aquatic organisms. **Dock et al. (2019)** used the same dataset and ports to determine the impact of discharges on human health. None of the chemicals reached levels of concern that would indicate a risk for humans, but there were chemicals that could be stored in fat and may accumulate in aquatic organism tissues, which, if consumed, could become problematic for humans over time.

8.2 Biofouling Research

With biofouling regulations implemented in California and New Zealand and under development in other jurisdictions, **Zabin et al. (2018)** evaluated potential compliance assessment approaches. The authors recommended a combination of:

- Risk profiling (i.e., assessing the vessels' operational and maintenance practices that influence biofouling accumulation)

- Evaluating biofouling management documentation (e.g., Biofouling Management Plans)
- Review of archival data and images (e.g., vessel underwater inspection reports)
- Real-time in-water biofouling surveys made by divers or remotely operated vehicles

The primary biofouling management method for vessels in marine waters is the use of antifouling coatings (specialized paints) that prevent the accumulation of biofouling organisms (see Figure 7-4). Several alternative methods have been evaluated recently. **Hunsucker et al. (2019)** evaluated the efficacy of ultraviolet light in combination with different antifouling coatings to prevent biofouling accumulation. The authors found that intermittent ultraviolet light exposure with underwater lamps was effective at preventing biofouling without damaging the coatings. **Park and Lee (2018)** deployed ultrasonic projectors (i.e., devices that produce ultrasonic vibrations) on one side of a vessel to determine if high frequency sound (and resulting vibrations) prevented biofouling accumulation. Although this method was only trialed on one vessel, the side of the vessel exposed to ultrasonic sound waves had less biofouling than the other side of the vessel, which was not exposed to the treatment.

In-water cleaning of vessel hulls and niche areas is another way to manage biofouling, but there are environmental impacts and trade-offs that must be considered prior to cleaning a vessel. **Pagoropoulos et al. (2018)** evaluated the economic benefits of in-water cleaning to determine the impact of frequent hull cleaning on fuel savings and overall operational costs. While regular cleaning improves the overall fuel and operational efficiency of the vessel, the costs of frequent cleaning can offset fuel savings. **Scianni and Georgiades (2019)** described the water quality and NIS introduction risks associated with different approaches to in-water cleaning, including proactive cleaning to prevent the buildup of biofouling and reactive cleaning to remove biofouling that has already accumulated. Many of these risks can be minimized by using cleaning technologies that capture and retain the removed debris.

Most biofouling management is directed at vessel hulls, without a clear and effective way to manage biofouling in many niche areas. **Joyce et al. (2019)** found that several minutes of steam exposure can kill biofouling and decontaminate internal niche areas like piping networks and sea chests that can be closed to external water. **Cahill et al. (2019)** also evaluated the use of heat to treat extensive biofouling in internal niche areas, successfully using

a portable system to deliver heated water to internal niche areas and kill biofouling organisms. Low salinity water has also been suggested as a treatment for niche areas, and **de Castro et al. (2019)** found that exposure to low salinity water for two hours killed almost all biofouling organisms within experimental sea chests. The authors suggested a two-hour flush with freshwater prior to leaving a port to effectively manage sea chest biofouling. Discharge of freshwater must comply with local water quality requirements.

8.3 Impacts of Climate Change on NIS

Climate change and associated habitat changes are expected to influence the establishment and distribution of NIS globally. **Beaury et al. (2019)** surveyed 211 natural resource managers to understand how climate change influences their decision-making for invasive species management. Two-thirds of surveyed managers incorporate climate change into their invasive species-related strategic planning, preventive management, and outreach. The authors, however, identified a clear and pressing need for more targeted research, accessible science communication, and two-way dialogue between researchers and managers.

A changing climate may provide more opportunities for species to be introduced and become established, especially in areas like the Arctic that are becoming more accessible to vessels under current and future climate scenarios. **Chan et al. (2018)** identified 54 aquatic NIS introduction events in the Arctic between 1960 and 2015, with most new species detections attributed to commercial and recreational vessels, natural spread, and aquaculture.

Climate change can have different impacts for different types of organisms. **Dobretsov et al. (2019)** discussed positive (e.g., greater growth rates) and negative (e.g., lower species diversity) impacts on biofouling growth and community composition; whereas **Meng et al. (2019)**, found that tubeworms that build calcium-based tubes would produce weaker and structurally impaired tubes under future climate and ocean acidification conditions.

9. PARTNER AGENCIES UPDATES

9.1 California Department of Fish and Wildlife

Since 2000, pursuant to Public Resources Code section 71211, the California Department of Fish and Wildlife's Marine Invasive Species Program (CDFW-MISP) has conducted periodic surveys to monitor the distribution of nonindigenous species (NIS) introduced into the state's estuaries and marine waters.

Results of these surveys are used to:

- Understand the distribution of NIS in California
- Understand how NIS are introduced and how they spread from introduction points
- Understand how NIS respond to specific management strategies

Before 2012, the program identified all NIS collected in its surveys using traditional microscope techniques. Although this approach can be very effective, it is expensive, time consuming, and there are very few specialists who have the skills to do this work. To deal with this issue, CDFW-MISP has been developing the capacity to identify NIS from their genetic material (i.e., DNA) and is now establishing a new genetic baseline of marine NIS distributions along California's coast. This effort is expected to greatly increase the speed, accuracy, and cost effectiveness of NIS identification going forward. Unless stated otherwise, both traditional and genetic approaches were used to identify NIS for all projects reported here.

During the reporting period of January 2018 through December 2019, CDFW-MISP engaged in new monitoring projects as well as enhancements to the program's past efforts as outlined below. These projects were significantly enhanced by a budget augmentation from the Marine Invasive Species Control Fund in 2017.

9.1.1 Core Monitoring

CDFW-MISP partners with the Smithsonian Environmental Research Center (SERC) and the Molecular Ecology Laboratory at Moss Landing Marine Laboratories (MLML) to conduct its surveys. SERC generally collects samples in the field and identifies the species found, while MLML conducts genetic analyses on subsamples of the collected material.

Since 2012, the program has concentrated its monitoring efforts on 10 focal estuaries, including five where commercial shipping occurs (Humboldt Bay, San Francisco Bay, Port Hueneme, Los Angeles/Long Beach Harbors, and San Diego Bay) and five that are not visited by commercial shipping vessels (Bodega/Tomales Bay, Morro Bay, Marina del Rey, Newport Bay, and Mission Bay). Two of these locations, San Francisco Bay and Los Angeles/Long Beach Harbors, receive extra sampling effort because they have very high vessel traffic and potential for new NIS introductions.

For the current reporting period (2018-2019), CDFW-MISP's core monitoring activities included the following elements:

- **Completion of Prior Surveys:** Two estuaries, Los Angeles/Long Beach Harbors and Newport Bay were sampled for organisms attached to hard surfaces (attached organisms) and those that are free-floating (plankton). In addition, soft sediment samples were collected from Los Angeles/Long Beach Harbors and analyzed by traditional microscopic methods. Although genetic analyses were not performed on the soft sediment samples, specimens of unique or high value species (i.e., species that are highly invasive but not well known, species that are difficult to distinguish between native and non-native, or species that move around a lot and are likely to spread and establish in new locations) were sent to MLML for genetic identification. This completes the full set of estuary surveys begun in 2012 (for more information see Dobroski et al. 2015, Brown et al. 2017, and Scianni et al. 2019).
- **New Monitoring Rounds:** Six of the focal estuaries were sampled for attached organisms and plankton: Humboldt Bay, Bodega/Tomales Bays, San Francisco Bay, Los Angeles/Long Beach Harbors, Mission Bay, and San Diego Bay.
- **Outer Coast Surveys:** These surveys of attached organisms at 12 rocky intertidal sites and eight subtidal sites were conducted to determine whether any of our target NIS found previously at these sites in 2015 have spilled over into or from adjacent bays or estuaries (Zabin et al. 2018).

9.1.2 Program Enhancement

The monitoring program continues to generate a large amount of data, and this remains the priority for the program, but CDFW-MISP has also made additional investments that will make these data more useful to the Legislature, the public, and other scientists. The program prioritized several projects that will improve the quality and

accessibility of the data and accelerate the transition to genetics-based identification of invasive species:

- **Expansion of the Cal-NEMO database:** Cal-NEMO is a database containing records of marine invasive species found in California. The database is a collaboration between SERC and CDFW-MISP. New records are continuously added to this database as CDFW-MISP monitoring projects generate new data. These records are supplemented with a growing catalog of historical and literature reported data that are also captured in Cal-NEMO. CDFW-MISP staff added 2,047 literature-based records during 2018 and 2019. Work is continuing by culling appropriate invasive species data from the following datasets:
  - CDFW Interagency Ecological Project San Francisco Bay Zooplankton Study, 1972-2018 (https://wildlife.ca.gov/Conservation/Delta/Zooplankton-Study)
  - California Department of Water Resources Benthic Surveys, 1971-2018 (https://emp.baydeltalive.com/projects/11280)
- **Bio-Blitz Targeted Surveys:** SERC organized three special survey expeditions to collect specimens of unique or underrepresented species around San Francisco Bay to fill in gaps in our DNA database. These were not completed, in part due to travel restrictions associated with COVID-19. However, five bio-blitz surveys are planned for the next round of work.
- **Environmental DNA Analysis:** SERC and MLML designed a pilot project to genetically describe whole-community composition from environmental free-floating DNA (eDNA). A pilot study was conducted to compare genetic data from eDNA samples to those collected from settling plates (sampling devices) placed in the same locations. If successful, this method might result in significant cost savings as analysis of these samples requires less preparation time, fewer staff, and smaller quantities of reagents than whole-organism samples taken directly from surfaces or sediments.

9.1.3 Publications from Previous and Current Contracts

The following peer-reviewed journal articles about surveys conducted in partnership with CDFW-MISP were published or submitted for publication during this reporting period:

- A roadmap for linking DNA-based methods to actionable marine environmental management (Aylagas et al. *in press*)
- Down the up staircase: equatorward march of a cold-water ascidian and broader implications for invasion ecology (*Chang* et al. *in press*)
- Re-description of *Parasabella fullo* (Grube 1878) (Polychaeta: Sabellidae) and diagnostic characteristics for detection in California (Keppel et al. *in press*)

- Soft-sediment community stability across years in San Francisco Bay (Jimenez et al. 2019)
- Intact vs. homogenized subsampling: Testing impacts of pre-extraction processing of multi-species samples on invasive species detection. (Lohan et al. 2019)
- Dry and wet periods drive rapid shifts in community assembly in an estuarine ecosystem (Chang et al. 2018)
- A database of metazoan cytochrome c oxidase subunit I gene sequences derived from GenBank with CO-ARBitrator (Heller et al. 2018)
- Invasions in marine communities: Contrasting species richness and community composition across habitats and salinity (Jimenez et al. 2018)
- New records of the non-indigenous species *Branchiomma bairdi* and *B. conspersum* (Polychaeta: Sabellidea) on the Pacific coast of North America (Keppel et al. 2018)
- Non-native species colonization of highly diverse, wave swept outer coast habitats in Central California (Zabin et al. 2018)

9.1.4 Chinese Mitten Crab Sighting

The Chinese mitten crab (*Eriochir sinensis*) is a species of considerable concern in California as its population expanded rapidly throughout the San Francisco Bay-Delta region during the 1990s. Chinese mitten crabs burrow extensively, which can cause serious damage to flood control and water supply systems. However, their population in California crashed in the late 1990s, and there have been very few sightings since.

On October 8, 2019, CDFW Bay-Delta Field Office staff reported that an adult male Chinese mitten crab had been collected at the Federal Fish Salvage Facility (U.S. Bureau of Reclamation, Central Valley Project) during the previous night. This was the first individual observed in California since October 2010 (also at this same location). No subsequent sightings have been noted to date, but the CDFW-MISP is exploring the potential to use eDNA techniques to monitor for their presence.

9.1.5 New Contracts Commencing Fiscal Year 2020/2021

The CDFW-MISP has developed new three-year agreements with MLML and SERC to continue the sampling and analysis efforts. The MLML contract is fully executed, and the SERC contract is in final review with the California Department of General Services.

The new contracts will fund continued monitoring at six long term assessment sites (Los Angeles/Long Beach Harbors, San Francisco Bay, Humboldt Bay, San Diego Bay, Bodega/Tomales, Mission Bay) with a focus on the two key estuaries, San Francisco Bay and Los Angeles/Long Beach Harbors. New surveys will also be conducted in the Channel Islands to study spread of invasive species from the mainland. Efforts to develop genetic capabilities have progressed to the point that the new contracts will

rely exclusively on genetic identification methods for most samples. Use of traditional microscope-based approaches will be limited to samples from new sites or sites where there is a high probability of detecting new invasive species.

9.2 California Department of Tax and Fee Administration

The Commission contracts with the California Department of Tax and Fee Administration (CDTFA) to collect a $1,000 fee from the owner or operator of each vessel that arrives at a California port from a port outside of California. (Table 9-1; Pub. Resources Code, § 71215) All fees are deposited into the Marine Invasive Species Control Fund (MISCF). Vessels moving from one port in California to another are not assessed a fee for the subsequent arrivals within the State. Once a vessel leaves State waters, it will be assessed the fee upon the next arrival at a California port. The MISCF supports all MISP operations and personnel, including the Commission's contract with CDTFA for fee collection. The MISP receives no General Fund dollars.

Table 9-1. Annual Summary of Collected Marine Invasive Species Program Fees

Year	Voyages Billed	Voyages Reported*	Total Voyages	Fees Billed ($)	Fees Reported ($)	Total Fees ($)	Payments Recd. for Period** ($)
2010	5,067	899	5,966	4,306,950	764,150	5,017,100	5,009,473
2011	5,174	930	6,104	4,397,900	790,500	5,188,400	5,143,239
2012	4,479	767	5,246	3,807,150	651,950	4,459,100	4,356,722
2013	4,753	819	5,572	4,070,050	696,150	4,766,200	4,662,171
2014	4,864	768	5,632	4,134,400	652,800	4,787,200	4,697,234
2015	4,764	753	5,517	4,049,400	633,250	4,682,650	4,517,499
2016	4,817	859	5,676	4,085,950	730,150	4,816,100	4,706,981
2017	5,047	813	5,860	4,865,200	781,950	5,647,150	5,516,217
2018	5,046	642	5,688	5,046,000	642,000	5,688,000	5,567,095
2019	5,184	531	5,715	5,184,000	531,000	5,715,000	5,617,923
TOTAL	**104,459**	**16,864**	**121,323**	**67,735,009**	**10,703,925**	**78,384,934**	**77,227,174**

**Voyages Reported* are vessel operators/owners that self-report to CDTFA once a month.

***Actual amounts received may exceed amount billed because of penalties and interest charges.

The CDTFA receives daily reports from the Marine Exchanges of Southern California and the San Francisco Bay Region. The reports provide a list of all arrivals at California ports. These reports are reviewed by CDFTA to identify arrivals that are subject to the fee. Vessel accounts are billed based on the arrival information. Between January 1, 2018, and December 31, 2019, an average of 475 vessel arrivals were billed per month. The average collection rate was 98.1% (Table 9-1).

During 2018 and 2019, vessel agents often paid the fees on behalf of the vessel owners and operators. Beginning in March 2020, CDTFA staff communicated that it is now their position that invoices cannot be sent to vessel agents due to section 55381, subsection (b) of the Revenue and Taxation Code, a provision relating to disclosure of information that applies broadly to all programs administered by CDTFA. CDTFA attorneys interpret this provision as prohibiting the disclosure of any information, including whether a fee is owed, to any party except the feepayer, which in the case of the Marine Invasive Species Act is the vessel owner or operator. This change in interpretation of the Revenue and Taxation Code makes fee collection difficult because the vessel agent is often easier to reach than the owner or operator of the vessel.

To address this situation, CDTFA developed a Power of Attorney form that vessel owners and operators can submit authorizing the vessel agent to receive billing information on their behalf. This approach has helped improve the dissemination of invoices in a timely fashion, but until a vessel owner or operator submits the Power of Attorney form, the invoice must go to the physical mailing address of the owner and operator, which is often difficult to find as most shipping companies are based outside of the U.S.

Commission staff is working with CDTFA staff to propose amendments to the Revenue and Taxation Code that would add an exception to this information disclosure prohibition to allow CDTFA to share information related to fees owed pursuant to the MISA with vessel agents. The goal of the amendment is to ensure that billing for the MISP fee occurs as efficiently and effectively as possible (see section 12.2 (2)).

10. MISP ACCOMPLISHMENTS

The Commission's Marine Invasive Species Program continues to be globally recognized as an active, cutting-edge program at the forefront of marine invasive species research and policy development. This section summarizes some of the major accomplishments achieved during 2018 and 2019.

1) High Compliance Rate

- During 2018 and 2019, 97.5% of all California arrivals were compliant with both biofouling and ballast water management requirements.
- 99.8% of arrivals were compliant with ballast water management requirements.

Prevention of species introductions through vector management is considered the most desirable and cost-effective way to control the spread of NIS. Detection and enforcement of violations is an effective way to incentivize the regulated community to achieve compliance; at the same time, tracking violations allows the Commission staff to identify the areas where targeted outreach may be needed.

After more than two years of implementation and consistent with the Commission's Strategic Plan Goal 1 (Key Action 1.1.3, Commission 2015), Commission staff is seeing a positive shift in the shipping industry's reporting and recordkeeping of biofouling management practices. After follow-up inspections, 96% of the vessels that received a violation during their first arrival subject to the regulations corrected their deficiencies and were found compliant in subsequent inspections. Staff has engaged in extensive outreach to vessel owners, operators, and crew, and has seen a resulting decrease in

violations of the reporting and recordkeeping requirements. Staff has heard from shipyards that the industry is altering their practices to adhere to California requirements.

Overall, Commission staff detected a total of 490 violation cases in 2018 and 2019, including noncompliance with reporting, recordkeeping, biofouling management, and ballast water management requirements (Figure 10-1).

- The largest number of violations (63%) were related to the recently implemented biofouling management regulations (see section 7.3 for more details about biofouling compliance).
- Reporting noncompliance (vessels not submitting the BWMR and/or AVRF on time) accounted for 23% of all violations.
- In 7% of the detected violations, the deficiency was due to not having the ballast water logbooks up-to-date or not recording management events correctly (recordkeeping).
- Out of the 19,299 reported arrivals during 2018 and 2019, only 33 (7% of violations and only 0.2% of all California arrivals) were identified as having ballast water management violations. These violations refer to cases where improper management was used (ballast water exchange was performed in the wrong location or not managed before discharge) and are considered the riskiest of arrivals in terms of NIS introductions through ballast water.

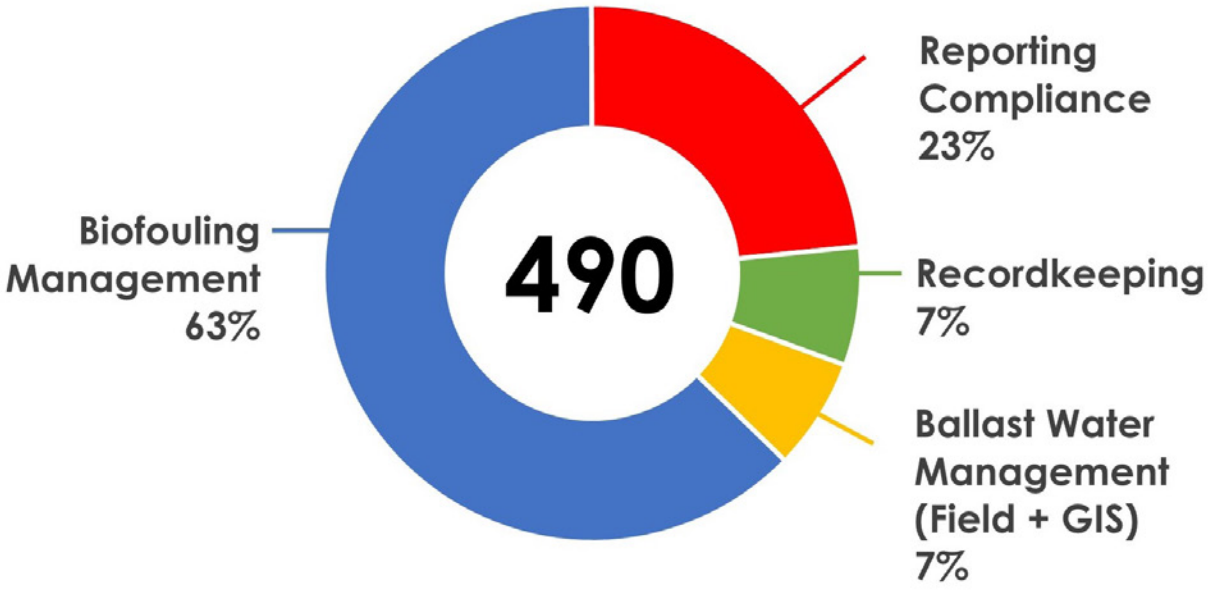


Figure 10-1. Violation cases detected during 2018 and 2019. Ballast water management violations are detected either during inspections (field) or through GIS ballast water compliance analysis (explained in the Ballast water Compliance Assessment, section 6.4).

2) 2018 Ballast Water Treatment Technology Assessment Report

In 2018, the Commission approved the report, "2018 Assessment of the Efficacy, Availability, and Environmental Impacts of Ballast Water Treatment Technologies for use in California Waters" (Commission 2018), which fulfills the Commission's Strategic Plan Goal 1 (Key Action 1.1.3, Commission 2015). The report concluded that no ballast water treatment technologies were available to enable implementation of the interim California ballast water discharge performance standards on January 1, 2020.

In response to the recommendations in the report, the Legislature passed AB 912 delaying implementation of the California interim and final ballast water discharge standards to 2030 and 2040, respectively. The bill also authorizes the Commission to adopt and implement the federal ballast water discharge standards until the California ballast water discharge standards are implemented. The bill was signed by the Governor in October 2019 and went into effect on January 1, 2020 (see section 3.1 for details on AB 912). The report is available at https://www.slc.ca.gov/wp-content/uploads/2019/01/2018.pdf.

3) 2019 Biennial Report

On February 4, 2019, the Commission approved a report to the California Legislature summarizing the activities and accomplishments of the California Marine Invasive Species Program during the period from July 1, 2016 through June 30, 2018. The report includes a summary of data collected through vessel-submitted reporting forms, Commission-funded research to prevent marine invasive species introductions, a review of recent literature on marine invasive species science and technology, and a list of next steps that the Marine Invasive Species Program will take to continue to prevent species introductions in California. The report is available at https://www.slc.ca.gov/wp-content/uploads/2019/02/2019_MISPBiennial_FINAL.pdf.

4) Update of the Vessel Inspection Training Program

In the past two years, Commission staff has improved the vessel inspection program by:

- Holding monthly meetings with Field Operations staff to deliver detailed and targeted training to clarify inspection policies, review requirements for vessels arriving at California ports, and clarify inspection procedures (e.g., data collection, database use, NIS-related topics, GIS compliance analysis, violation enforcement process)
- Updating the vessel inspection manual that describes inspection protocols and policies

- Developing a comprehensive inspection checklist with a detailed step-by-step process that ensures consistent and effective inspections
- Updating outreach materials for the maritime shipping industry (consistent with Strategic Plan Goal 3, Key Action 3.1.3, Commission 2015) reflecting recent changes in the reporting, recordkeeping, and management requirements

5) Database Improvements

In accordance with Goal 4 of the Commission's Strategic Plan (Key Action 4.1.6, Commission 2015), Commission staff has worked with database contractor M Corp to improve program operations efficiency by developing new processes to enable the automatic import of data into the MISP database from BWMRs submitted via email. This novel process has significantly decreased processing times and has allowed the MISP to redirect some staff time from data entry to other high priority projects, including enforcement tracking and processing.

In addition, amendments to title 2, California Code of Regulations, section 2298.5, were proposed to require the submission of the AVRF via the Commission's web-based user interface (MISP.IO) instead of via email or fax. This change will further increase efficiency by reducing the amount of data that is entered manually. During the development of these amendments, the Commission worked closely with the shipping industry to address their concerns about the ability of ships to access a web-based form while at sea. Staff continues to provide outreach regarding the proposed change and gather input on how to improve the form submission process and the MISP.IO user experience (see section 12.1 (6) and (7).

6) Outreach and Engagement

MISP staff presents at conferences and is involved in workgroups focused on invasive species science and management. Participation is important given the global nature of shipping as a pathway for the transport of NIS. In many cases, MISP staff is invited to participate due to staff's extensive knowledge and experience with vessel vector management (consistent with the Commission's Strategic Plan Goal 3 (Key Action 3.1.3, Commission 2015). Since January 2018, MISP staff has participated at numerous local, state, national, and international meetings and training events, including (but not limited to):

- International Congress on Marine Corrosion and Fouling
- Oceanology International Americas
- California Marinas and Antifouling Strategies Interagency Coordinating Committee
- International Maritime Organization GloFouling Partnership Biofouling Workshop, Mexico

- Western Regional Panel on Aquatic Nuisance Species Annual Meeting
- Aquatic Nuisance Species Task Force meeting
- Australia, New Zealand, and Pacific countries Workshop on Biofouling Management for Sustainable Shipping
- Commission Marine Environmental Protection Division Customer Service Meetings
- California State Lands Commission's Prevention First Symposium
- National Hazard Analysis and Critical Control Point for Natural Resource Managers team
- Pacific Ballast Water Group meetings

7) Peer-Reviewed Scientific Journal Publications

Staff has co-authored four peer-reviewed journal articles during the last two years and now requires all funded research contracts to include submission of a manuscript to a peer-reviewed journal as one of the deliverables.

- Non-native species colonization of highly diverse, wave swept outer coast habitats in Central California (Zabin et al. 2018)
- A history of ship specialization and consequences for marine invasions, management and policy (Davidson et al. 2018)
- Vessel in-water cleaning or treatment: Identification of environmental risks and science needs for evidence-based decision making (Scianni and Georgiades 2019)
- Artificial structure density predicts fouling community diversity on settlement panels (Susick et al. 2019)

Staff is actively working on a number of new scientific manuscripts. Submission and publication of these manuscripts is expected in early 2021.

11. THE VESSEL INCIDENTAL DISCHARGE ACT

In late 2018, after months of negotiations, the U.S. Congress passed the Vessel Incidental Discharge Act (VIDA), included as Title IX within S.140, the Frank Lobiando Coast Guard Reauthorization Act of 2018. On December 4, 2018, the President signed VIDA into law. The law:

- Designates the U.S. Environmental Protection Agency (U.S. EPA) as the lead authority to establish national water quality standards for vessel discharges, including ballast water
- Designates the U.S. Coast Guard (USCG) as the lead authority to implement and enforce the national standards set by the U.S. EPA
- Will preempt state authority, once fully implemented, to adopt or implement state-specific management requirements or standards for vessel discharges, including ballast water, that are stricter than the federal standards

Certain provisions were included in VIDA that protect states from some of the impacts to their authority, including:

- Individual states retain authority to inspect vessels and enforce the federal ballast water management requirements
- Individual states retain authority to collect fees (with a cap) and Ballast Water Management Reports from vessels arriving at state ports
- Individual states may, through their Governors, petition U.S. EPA for stricter discharge standards

State law is not preempted until U.S. EPA and the USCG adopt regulations to establish discharge standards and implement enforcement procedures. The combined rulemaking process could take four years or more from the time VIDA was signed into law, as U.S. EPA must first adopt regulations prior to USCG initiating its rulemaking process. During this time, states retain authority to continue implementing existing management programs.

Impacts Upon State Authority

Upon implementation of VIDA and state preemption, California will lose the authority to establish or implement any standards for discharges incidental to the normal operation of a vessel (including ballast water and hull husbandry discharges (e.g., vessel in-water cleaning activities)) that are stricter than the federal standards. This means that unless changes are made to the federal law, California would be preempted from moving forward with the State's interim and final ballast discharge performance standards in 2030 and 2040, respectively. While the Governor can petition U.S. EPA to set stricter standards, the process is complicated, and it is not entirely clear what data and information would need to be provided for a petition to be approved.

Fiscal Impacts

The implementation of VIDA will also initiate a cap on state fees that qualifying voyage arrivals must pay upon arrival at state ports to support ballast water management programs. The fee cap under VIDA is $1,000 per qualifying voyage. The California MISP fee is currently set at $1,000, so the Commission will be restricted from raising the fee due to fiscal need (although the cap may be adjusted for inflation once every five years). Additionally, VIDA sets a cap of $5,000 on the total amount of state fees that may be assessed per year on each U.S. flagged vessel. Due to this restriction, the Marine Invasive Species Control Fund (MISCF) is projected to lose between $300,000 and $500,000 in revenue each year. This loss of revenue will push the Marine Invasive Species Control Fund towards insolvency by Fiscal Year 2024. (Note: Due to COVID-related impacts to the shipping industry, budget projections completed in October 2020 showed that the MISCF will reach insolvency as soon as Fiscal Year 2022.)

State Response

In response to the passage of VIDA, the California Legislature took steps to register its objection to the preemption of state authority. In September 2019, Assembly Member Friedman introduced Assembly Joint Resolution (AJR) 25. The non-binding measure would:

> ***"state that the Legislature strongly and unequivocally objects to the federal preemption of state authority relating to the regulation of vessel discharges in California waters, remains steadfast in its commitment to protect California's waters from aquatic invasive species introductions, and is resolved to consider any appropriate actions to overturn the federal preemption of California authority."***

The resolution was scheduled for hearing in committee in early 2020 when the COVID-19 pandemic hit and upended the 2020 legislative session. Commission staff plan to work with the author's office to re-introduce the resolution in 2021.

In October 2020, U.S. EPA proposed regulations in the Federal Register to establish national standards of performance for discharges incidental to the normal operation of a vessel. The public comment period was open for 30 days. The Commission staff is preparing comments in response and working closely with partner agencies in the west coast states to develop a regional response to the U.S. EPA.

Commission staff continues to work closely with the Governor's Office, U.S. EPA and USCG staff, and our state partners to review proposed regulations, identify potential impacts, and determine next steps to address the negative effects caused by the implementation of VIDA (see section 12.1 (9).

12. NEXT STEPS AND RECOMMENDATIONS

12.1 Next Steps

Over the next two years, MISP staff will work on high priority actions to improve the protection of California waters from the introduction of nonindigenous species, including:

1) **Update and improve the Marine Invasive Species Act (MISA) enforcement process:**
   - Amend enforcement regulations (Article 4.9, *Marine Invasive Species Act Enforcement and Hearing Process,* California Code of Regulations, title 2, section 2299.01 et seq.) to incorporate an enforcement process for violations of the biofouling regulations (section 7.3) and the ballast water discharge performance standards (section 6.5).
   - Develop and implement a process to track and enforce upon reporting compliance violations of the MISA (see section 4.1.1 and Class 3 violations in Appendix C).
2) **Adopt the federal ballast water discharge performance standards:** Adopt regulations to implement the federal ballast water discharge performance standards in accordance with AB 912 (see section 3.1). In collaboration with experts (a Technical Advisory Group was created for this purpose), Article 4.7 *Performance standards and compliance assessment for the discharge of ballast water for vessels operating in California waters* (California Code of Regulations, title 2, section 2291 et seq.) is in the process of being amended to incorporate the provisions mandated in AB 912. The public rulemaking process is expected to begin in late 2020.

3) **Develop ballast water discharge performance standards compliance assessment protocols:** Develop a process to assess vessel compliance with the ballast water discharge performance standards. Assess if ballast water treatment systems that are being used to meet the discharge standards are operated according to the manufacturer's recommendations to ensure efficacy in their performance.

4) **Implement a weighted risk assessment:** Implement a new pre-arrival risk-based process for identifying high priority vessels for inspection to achieve more effective and efficient use of available resources. The new approach combines ballast water and vessel biofouling risk factors and relies on data collected via vessel-submitted forms (BWMR and AVRF) (see section 5.1).

5) **Leverage technology to improve accessibility to vessels for inspections:** Evaluate how the Commission can leverage technology to engage in virtual vessel inspections to augment onboard inspections to assess compliance with the MISA. Virtual vessel inspections are particularly important to improve the Commission's ability to inspect vessels that are not accessible due to location at anchorage or that present other logistical or safety challenges (see section 5.2).

6) **Improve the functionality and user experience of the web-based user interface, MISP.IO:** Evaluate ways to improve the efficiency and effectiveness of MISP.IO for both Commission staff and external stakeholders:
   - Hold townhall events with stakeholders to gather input on the user experience
   - Develop a more efficient process to track form submission and to report to responsible parties when forms have not been submitted on time

7) **Implement the recently adopted amendment to the AVRF submission requirements:** Persuant to title 2, California Code of Regulations, section 2298.5, the Commission currently requires submission of the AVRF to the Commission in written or electronic form at least twenty-four hours in advance of the first arrival of each calendar year at a California port of call. Currently, the data collected in these forms are entered manually by Commission staff, which is a very inefficient and resource intensive process. To address this, a proposed regulatory amendment which would require the AVRF to be submitted using the Commission's web-based user interface (see section 10 (5)) is in progress.

8) **Track the arrival of vessels that have been idled during and after the recession caused by the COVID-19 pandemic to assess the risk of species introductions:** Many vessels globally have been idled for weeks to months during the current recession. Long idle periods are associated with an increased likelihood of biofouling accumulation and these idled vessels are likely to carry extensive biofouling when they re-enter service. These vessels can introduce NIS into California if their biofouling is not managed (i.e., dry dock or in-water cleaning) prior to their arrival at a California port. Staff will track vessels during the coming years to

assess the risk to California waters and will target vessels for inspection to ensure compliance with California's biofouling regulations (see section 7.2.2).

9) **Actively engage and participate in the process to implement VIDA:** Work with the Governor's Office, and state representatives to comment on proposed federal regulations to adopt and implement national standards of performance for discharges incidental to the normal operation of vessels pursuant to VIDA (see section 11).

12.2 Recommendations

The Commission makes the following recommendations to the Legislature and California state agencies and departments based upon the information and data presented in this report:

1) Support the Commission's efforts to remove recruitment barriers for the Marine Safety series of job classifications to establish a more equitable recruitment process that results in a qualified candidate pool that is larger, more diverse, and maximally inclusive to better reflect the people of California (see section 5.2).
2) Support proposed amendments to the Revenue and Taxation Code by the California Department of Tax and Fee Administration to address the difficulties associated with the recent change in the interpretation of section 55381, subsection (b) of the Revenue and Taxation Code. This new interpretation prevents invoices to be sent to vessel agents instead of vessel owners due to a provision relating to disclosure of information, making the fee collection process complicated and difficult (see section 9.2).
3) Work collaboratively with all stakeholders and the regulated community to secure ongoing funding for the Marine Invasive Species Control Fund. After the implementation of the federal Vessel Incidental Discharge Act, the California Marine Invasive Species Control Fund is projected to lose between $300,000 and $500,000 in revenue each year and become insolvent by 2024. In addition, the fund revenue is being critically impacted by the COVID-19 pandemic due to a reduction in shipping traffic and trade. (see section 11).
4) Support the reintroduction and passage of Assembly Joint Resolution 25 in 2021 to signal California's opposition to preemption of state authority to regulate discharges into state waters incidental to the normal operation of a vessel (see section 11).

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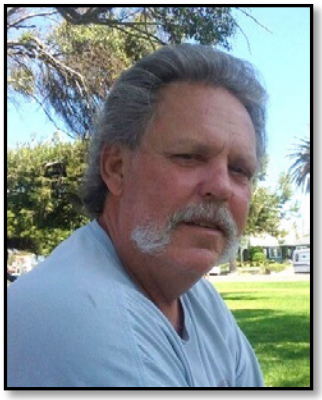

In memory of Virgil Arbogast

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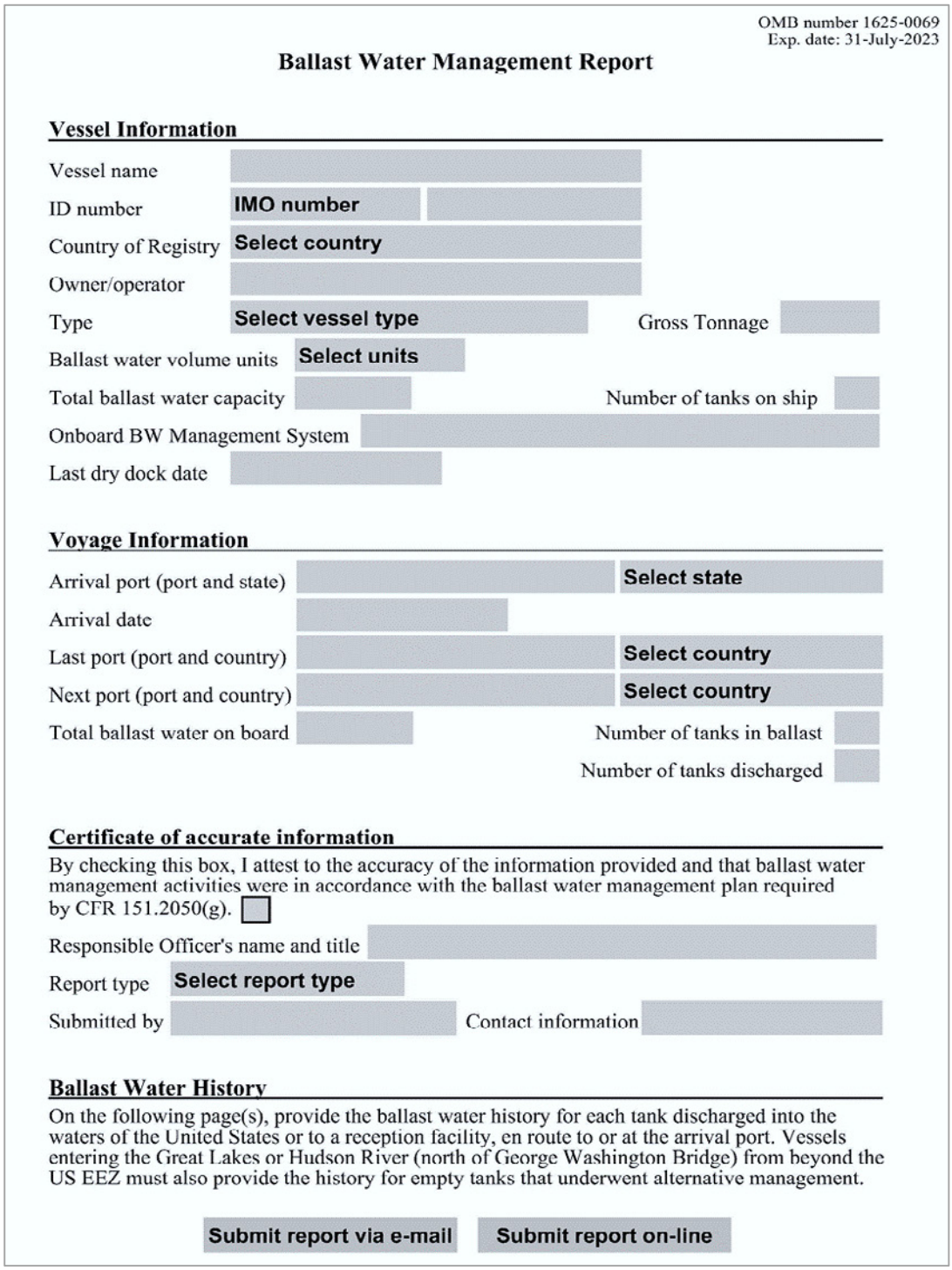
APPENDIX A

Ballast Water Management Report[1] Page 1 of 2)



OMB number 1625-0069
Exp. date: 31-July-2023

Ballast Water Management Report

Vessel Information

Vessel name
ID number — IMO number
Country of Registry — Select country
Owner/operator
Type — Select vessel type — Gross Tonnage
Ballast water volume units — Select units
Total ballast water capacity — Number of tanks on ship
Onboard BW Management System
Last dry dock date

Voyage Information

Arrival port (port and state) — Select state
Arrival date
Last port (port and country) — Select country
Next port (port and country) — Select country
Total ballast water on board — Number of tanks in ballast
Number of tanks discharged

Certificate of accurate information

By checking this box, I attest to the accuracy of the information provided and that ballast water management activities were in accordance with the ballast water management plan required by CFR 151.2050(g). ☐

Responsible Officer's name and title
Report type — Select report type
Submitted by — Contact information

Ballast Water History

On the following page(s), provide the ballast water history for each tank discharged into the waters of the United States or to a reception facility, en route to or at the arrival port. Vessels entering the Great Lakes or Hudson River (north of George Washington Bridge) from beyond the US EEZ must also provide the history for empty tanks that underwent alternative management.

Submit report via e-mail | Submit report on-line

[1] This is a sample: a complete downloadable form can be found at https://www.slc.ca.gov/marine-invasive-species-program/information-for-vessels-arriving-at-california-ports/.

APPENDIX A

Ballast Water Management Report (Page 2 of 2)

Ballast Water History

Tank name/number ____ Tank capacity ____

Event	Date	Location(s) (for Management event include Start pt. / End pt.)	Volume
Discharge to US waters			
Select event			
Select event			
Select event			
Select event			

If BW management was *not* conducted for this tank, select one of the following reasons **Select reason**

Tank name/number ____ Tank capacity ____

Event	Date	Location(s) (for Management event include Start pt. / End pt.)	Volume
Discharge to US waters			
Select event			
Select event			
Select event			
Select event			

If BW management was *not* conducted for this tank, select one of the following reasons **Select reason**

Tank name/number ____ Tank capacity ____

Event	Date	Location(s) (for Management event include Start pt. / End pt.)	Volume
Discharge to US waters			
Select event			
Select event			
Select event			
Select event			

If BW management was *not* conducted for this tank, select one of the following reasons **Select reason**

Tank name/number ____ Tank capacity ____

Event	Date	Location(s) (for Management event include Start pt. / End pt.)	Volume
Discharge to US waters			
Select event			
Select event			
Select event			
Select event			

If BW management was *not* conducted for this tank, select one of the following reasons **Select reason**

APPENDIX B

Marine Invasive Species Program Annual Vessel Reporting Form[2] (Page 1 of 6)

STATE OF CALIFORNIA – STATE LANDS COMMISSION
MARINE INVASIVE SPECIES PROGRAM ANNUAL VESSEL REPORTING FORM
SLC 600.12 (Revised 08/17)
Public Resources Code Sections 71201.7, 71205

Vessel Name:
Official / IMO Number:
Responsible Officer's Name and Title:
Date Submitted (Day/Month/Year):

1. Does the vessel have a ballast water treatment system installed?

Yes ☐ IF "YES" Complete sections 1 and 2
No ☐ IF "NO" Complete section 1 only

Section 1: Hull Husbandry Maintenance and Operational Information

2. Since delivery, has this vessel ever been removed from the water for maintenance?

Yes ☐ No ☐

a. If Yes, enter the date and location of the most recent out-of-water maintenance.

Last date out of water (**Day/Month/Year**):	
Port or Position:	Country:

b. If No, enter the delivery date and location where the vessel was built:

Delivery Date (**Day/Month/Year**):	
Port or Position:	Country:

3. Were the submerged portions of the vessel coated with an anti-fouling treatment or coating during the **out-of-water** maintenance or shipbuilding process listed above?

Yes, full coat applied ☐
Yes, partial coat ☐ Date last full coat applied (**Day/Month/Year**)
No coat applied ☐ Date last full coat applied (**Day/Month/Year**)

Official / IMO Number_____

[2] This is a sample; a complete downloadable form can be found at https://www.slc.ca.gov/marine-invasive-species-program/information-for-vessels-arriving-at-california-ports/.

APPENDIX B

Marine Invasive Species Program Annual Vessel Reporting Form (Page 2 of 6)

STATE OF CALIFORNIA – STATE LANDS COMMISSION
MARINE INVASIVE SPECIES PROGRAM ANNUAL VESSEL REPORTING FORM
SLC 600.12 (Revised 08/17)
Public Resources Code Sections 71201.7, 71205

4. For the most recent full coat application of anti-fouling treatment, what type of anti-fouling treatment was applied and to which specific sections of the submerged portion of the vessel was it applied?

Manufacturer/Company:
Product Name:
Applied on **(Check all that apply)**: Hull Sides ☐ Hull Bottom ☐ Sea Chests ☐ Sea Chest Gratings ☐ Propeller ☐ Rope Guard/Propeller Shaft ☐ Previous Docking Blocks ☐ Thrusters ☐ Rudder ☐ Bilge Keels ☐

Manufacturer/Company:
Product Name:
Applied on **(Check all that apply)**: Hull Sides ☐ Hull Bottom ☐ Sea Chests ☐ Sea Chest Gratings ☐ Propeller ☐ Rope Guard/Propeller Shaft ☐ Previous Docking Blocks ☐ Thrusters ☐ Rudder ☐ Bilge Keels ☐

Manufacturer/Company:
Product Name:
Applied on **(Check all that apply)**: Hull Sides ☐ Hull Bottom ☐ Sea Chests ☐ Sea Chest Gratings ☐ Propeller ☐ Rope Guard/Propeller Shaft ☐ Previous Docking Blocks ☐ Thrusters ☐ Rudder ☐ Bilge Keels ☐

5. Were the sea chests inspected and/or cleaned during the out-of-water maintenance listed above? If no out-of-water maintenance was performed since delivery, select Not Applicable.

(Check all that apply) Yes, sea chests inspected ☐	Yes, sea chests cleaned ☐
No, sea chests not inspected or cleaned ☐	Not Applicable ☐

6. Are Marine Growth Prevention Systems (MGPS) installed in the sea chest(s) or sea strainer(s)?

Yes ☐ Manufacturer:	Model:
If Yes, MGPS installed in (**check all that apply**): Sea Chest(s) ☐ Sea strainer(s) ☐	
No ☐	

Official / IMO Number________________

APPENDIX B

Marine Invasive Species Program Annual Vessel Reporting Form (Page 3 of 6)

STATE OF CALIFORNIA – STATE LANDS COMMISSION
MARINE INVASIVE SPECIES PROGRAM ANNUAL VESSEL REPORTING FORM
SLC 600.12 (Revised 08/17)
Public Resources Code Sections 71201.7, 71205

7. Has the vessel undergone in-water cleaning to the submerged portions of the vessel since the last out-of-water maintenance period? Yes ☐ No ☐

a. If Yes, when and where did the vessel most recently undergo **in-water** cleaning?
(Do not include cleaning performed during out-of-water maintenance period)

Date (**Day/Month/Year**):	
Port or Position:	Country:
Vendor providing cleaning service:	
Section(s) cleaned (**Check all that apply**): Hull Sides ☐ Hull Bottom ☐ Propeller ☐ Sea Chest Grating ☐ Sea Chest ☐ Bilge Keels ☐ Rudder ☐ Docking Blocks ☐ Thrusters ☐ Unknown ☐	
Cleaning method: Divers ☐ Robotic ☐ Both ☐	

8. Has the propeller been polished since the last **out-of-water** maintenance (including shipbuilding process) or **in-water** cleaning?

Yes ☐	Date of propeller polishing (**Day/Month/Year**):
No ☐	

9. Are the anchor and anchor chains rinsed during retrieval? Yes ☐ No ☐

10. List the following information for this vessel averaged over the last four months:

a. **Average** Voyage Speed (knots):
b. **Average** Port Residency Time (hours or days): **Hours** or **Days**

11. Since the hull was last cleaned (out-of-water or in-water), has the vessel visited:

a. Fresh water ports (Specific gravity of less than 1.005)?

Yes ☐	How many times?
No ☐	

b. Tropical ports (between 23.5° S and 23.5° N latitude)?

Yes ☐	How many times?
No ☐	

c. Panama Canal?

Yes ☐	How many times?
No ☐	

Official / IMO Number_____

APPENDIX B

Marine Invasive Species Program Annual Vessel Reporting Form (Page 4 of 6)

STATE OF CALIFORNIA – STATE LANDS COMMISSION
MARINE INVASIVE SPECIES PROGRAM ANNUAL VESSEL REPORTING FORM
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Public Resources Code Sections 71201.7, 71205

12. List the previous 10 ports visited by this vessel in the order they were visited (start with most recent). You do not have to use all 10 spaces if the vessel has a regular route that involves less than 10 ports.

Check here ☐ if the vessel visits the same ports on a regular route.

List dates as (**Day/Month/Year**).

Port or Position:	Country:
Arrival date:	Departure date:
Port or Position:	Country:
Arrival date:	Departure date:
Port or Position:	Country:
Arrival date:	Departure date:
Port or Position:	Country:
Arrival date:	Departure date:
Port or Position:	Country:
Arrival date:	Departure date:
Port or Position:	Country:
Arrival date:	Departure date:
Port or Position:	Country:
Arrival date:	Departure date:
Port or Position:	Country:
Arrival date:	Departure date:
Port or Position:	Country:
Arrival date:	Departure date:
Port or Position:	Country:
Arrival date:	Departure date:

Official / IMO Number_____

APPENDIX B

Marine Invasive Species Program Annual Vessel Reporting Form (Page 5 of 6)

STATE OF CALIFORNIA – STATE LANDS COMMISSION
MARINE INVASIVE SPECIES PROGRAM ANNUAL VESSEL REPORTING FORM
SLC 600.12 (Revised 08/17)
Public Resources Code Sections 71201.7, 71205

13. Since the most recent hull cleaning (out-of-water or in-water) or delivery, has the vessel spent 10 or more consecutive days in any single location? (Do not include time out-of-water or during in-water cleaning.)

No ☐ Indicate the longest amount of time spent in a single location since the last hull cleaning

Number of Days:	Date of Arrival:
Port or Position:	Country:

Yes ☐ List all of the occurrences where the vessel spent 10 or more consecutive days in any single location since the last hull cleaning. List dates as (**Day/Month/Year**):

Number of Days:	Date of Arrival:
Port or Position:	Country:
Number of Days:	Date of Arrival:
Port or Position:	Country:
Number of Days:	Date of Arrival:
Port or Position:	Country:
Number of Days:	Date of Arrival:
Port or Position:	Country:
Number of Days:	Date of Arrival:
Port or Position:	Country:
Number of Days:	Date of Arrival:
Port or Position:	Country:
Number of Days:	Date of Arrival:
Port or Position:	Country:
Number of Days:	Date of Arrival:
Port or Position:	Country:
Number of Days:	Date of Arrival:
Port or Position:	Country:

Official / IMO Number_____

APPENDIX B

Marine Invasive Species Program Annual Vessel Reporting Form (Page 6 of 6)

STATE OF CALIFORNIA – STATE LANDS COMMISSION
MARINE INVASIVE SPECIES PROGRAM ANNUAL VESSEL REPORTING FORM
SLC 600.12 (Revised 08/17)
Public Resources Code Sections 71201.7, 71205

Section 2: Ballast Water Treatment System Information

COMPLETE ONLY IF VESSEL HAS A BALLAST WATER TREATMENT SYSTEM INSTALLED

Note: Complete a separate Section 2 for each installed ballast water treatment system.

14. Provide the following information about the vessel's installed ballast water treatment system:

Manufacturer/Company:
Product Name:
Model Number:
Date System Commissioned (**Day/Month/Year**):

15. Has the installed ballast water treatment system been used to treat ballast water in the last 12 months?

Yes ☐
Number of times the system was used in the last 12 months:
No ☐

16. Has the installed ballast water treatment system malfunctioned in the last 12 months?

Yes ☐	Date of Most Recent Malfunction (**Day/Month/Year**)
Describe all malfunctions during the previous 12 months:	
Describe all repairs for all malfunctions during the previous 12 months :	
No ☐	

17. Has an onboard test for biological performance of the vessel's installed ballast water treatment system been completed since the system was commissioned?

Yes ☐ If "YES", List the dates of the tests (**Day/Month/Year**):
No ☐

Official / IMO Number_____

APPENDIX C

In August 2016, the Commission adopted regulations to codify the Marine Invasive Species Act Enforcement and Hearing Process (California Code of Regulations, title 2, section 2299.01 et seq.). The regulations established an administrative enforcement process for violations of the MISA and associated regulations. The violations and associated penalties are classified as follows:

	Type of Violation	Maximum Penalty
Class 1: Noncompliant ballast water discharges classified based on the distance from land at which ballast water exchange was conducted (operational violation) **Note: Violations are assessed on per tank basis.**	**Minor:** • Arrival from outside of the Pacific Coast Region (PCR) and carrying ballast water from outside the PCR: Ballast water exchanged less than 200 nautical miles (nm) and equal to or greater than 180 nm from land • Arrival from inside the PCR and carrying ballast water from inside the PCR: Ballast water exchanged less than 50 nm and equal to or greater than 45 nm from land	$5,000
	Moderate: • Arrival from outside of the PCR and carrying ballast water from outside the PCR: Ballast water exchanged less than 180 nm and equal to or greater than 100 nm from land • Arrival from inside the PCR and carrying ballast water from inside the PCR: Ballast water exchanged less than 45 nm and equal to or greater than 25 nm from land	$10,000
	Major I: • Arrival from outside the Pacific Coast Region (PCR) and carrying ballast water from outside the PCR: Ballast water exchanged less than 100 nm from land • Arrival from inside the PCR and carrying ballast water from inside the PCR: Ballast water exchanged less than 25 nm from land	$20,000
	Major II: No Ballast water change	$27,500

	Type of Violation	Maximum Penalty
Class 2: Failure to properly maintain required documentation on board (administrative violation)	First occurrence: A Letter of Noncompliance is issued	No monetary penalty
	Second occurrence of a Class 2 violation	$10,000 per violation
Class 3: Failure to submit required reporting information to the Commission (administrative violation)	First occurrence: A Letter of Noncompliance is issued	No monetary penalty
	Second occurrence of a Class 3 violation	$1,000 per violation

APPENDIX D

Table D-1. Number of arrivals at California ports during 2018. Darker shades represent higher numbers and lighter shades lower numbers. The description of vessel type categories is presented in Table 1.

PORT	2018										2018 Total
	Container	Tank	Bulk	Auto	Passenger	Unm_Bg_Tug	ATB	General	Other	OSS	
Oakland	1545		28		1			1	2	1	1578
San Francisco Bay (Anchorages)	89	507	386	12		56	89	12	7	1	1159
Carquinez	1	483	70	160		57	132	7	1		911
Richmond		482	129	86		167	9	12	1		886
Stockton		75	151					18			244
Port of San Francisco	2		5	36	79	7		2	1	1	133
Redwood		1	70								71
Sacramento		4	48					5			57
Moss Landing									19		19
Santa Barbara					16						16
Humboldt			8		1	28		3	1		41
Monterey					7						7
Morro Bay											
Northern California Total	1637	1552	895	294	104	315	230	60	32	3	5122
Los Angeles/Long Beach	2128	966	405	233	370	113	95	137	34	4	4485
San Diego	53	13	10	199	89			71	34	11	480
Hueneme	121	14		199				49	8		391
El Segundo		225				21					246
Avalon/Catalina					110					4	114
Marina Del Rey									2		2
Southern California Total	2302	1218	415	631	569	134	95	257	78	19	5718

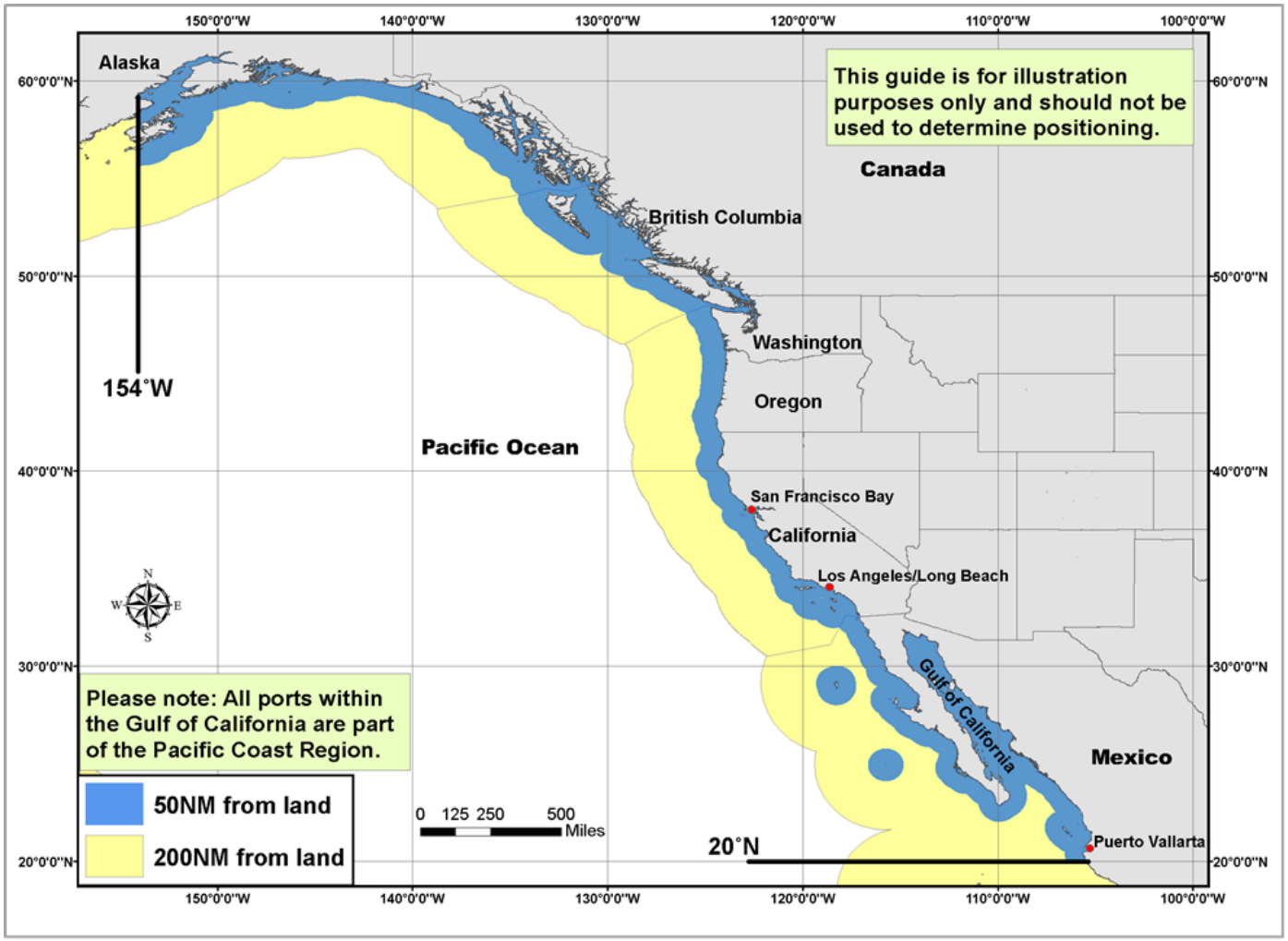
Table D-2. Number of arrivals at California ports during 2019. Darker shades represent higher numbers and lighter shades lower numbers. The description of vessel type categories is presented in Table 1.

PORT	2019											2019 Total
	Container	Tank	Bulk	Auto	Passenger	ATB	Unm_Bg_Tug	General	Other	OSS	Tug_Only	
Oakland	1408	1	24						3			1436
San Francisco Bay (Anchorages)	133	696	426	21	1	142	71	14	4	1		1509
Carquinez	3	514	79	163		178	46	14	2			999
Richmond	1	503	122	86		36	156	5			1	910
Stockton		71	129					21				221
Port of San Francisco	1		6	52	85	1		1	2			148
Redwood			74					1				75
Sacramento		1	46					4				51
Moss Landing									21			21
Santa Barbara					15							15
Humboldt			3				8	1	1			13
Monterey					10							10
Morro Bay									1			1
Northern California Total	1546	1786	909	322	111	357	281	61	34	1	1	5409
Los Angeles/Long Beach	1985	1079	419	242	377	130	116	137	33	8	2	4528
San Diego	53	9	14	187	98			57	34	20		472
Hueneme	124	18	1	205				51		2		401
El Segundo		248					32					280
Avalon/Catalina					108					1		109
Marina Del Rey												
Southern California Total	2162	1354	434	634	583	130	148	245	67	31	2	5790

Table D-3. Arrivals by month over the 2018-2019 period. Darker shades represent higher numbers and lighter shades lower numbers. The description of vessel type categories is presented in Table 1.

Vessel type	2018												2018 Total	2019											2019 Total
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Container	347	304	322	327	344	332	341	330	313	337	314	328	**3939**	340	315	309	307	312	292	335	309	303	308	278	300	**3708**
Tank	250	214	231	264	233	232	241	242	219	223	186	235	**2770**	246	256	262	272	266	254	267	252	252	290	264	259	**3140**
Bulk	86	98	128	123	110	108	108	125	103	117	109	95	**1310**	123	93	103	108	116	101	114	112	104	126	100	143	**1343**
Auto	75	72	87	81	75	83	81	76	67	69	73	86	**925**	86	77	80	74	88	76	80	81	76	76	74	88	**956**
Passenger	55	54	54	64	69	38	37	38	68	80	52	64	**673**	63	57	68	74	51	38	37	34	58	81	60	73	**694**
ATB	25	26	29	22	21	24	31	26	23	32	32	34	**325**	41	41	57	43	48	36	38	37	40	31	32	43	**487**
Unm_Bg_Tug	35	29	47	37	47	31	38	32	33	38	38	44	**449**	40	34	43	37	33	29	40	39	35	35	29	35	**429**
General	25	27	36	23	32	26	22	23	28	24	22	29	**317**	28	33	39	25	15	22	22	19	33	19	28	23	**306**
Other	6	7	7	8	9	10	11	10	10	13	11	8	**110**	10	5	7	8	10	8	9	8	6	11	8	11	**101**
OSS	1	5		1			2	5	2		2	4	**22**	4	3	4	2	1	4	1	1	1	2	5	4	**32**
Tug_Only															2									1		**3**
TOTAL	905	836	941	950	940	884	912	907	866	933	839	927	**10840**	981	916	972	950	940	860	943	892	908	979	879	979	**11199**

APPENDIX E



Map of the current Pacific Coast Region (PCR). Effective January 1, 2020, the PCR was extended to 20˚ N. (Please note that the boundaries of the current PCR became effective after the reporting period and do not apply to the ballast water management data presented in this report.

PHOTO CREDIT INSIDE PAGES

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