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WASHINGTON STATE VESSEL-RELATED BIOFOULING MANAGEMENT 6-YEAR STRATEGIC PLAN

RAMBOLL ENVIRON

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ACRONYMS AND ABBREVIATIONS

ABS	American Bureau of Shipping
AIS	aquatic invasive species
AFC	antifouling coatings
AFS	antifouling systems
ANS	aquatic nuisance species
ANSTF	Aquatic Nuisance Species Task Force
APEC	Asia Pacific Economic Cooperation Forum
ATB/ITB	Articulated Tug and Barge / Integrated Tug and Barge
AWO	American Waterways Organization
BC	British Columbia
BMP	Biofouling Management Plan
BWWG	Ballast Water Work Group
CBD	Convention on Biological Diversity
CDFW	California Department of Fish and Wildlife
CSLC	California State Lands Commission
EPA	Environmental Protection Agency
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act
FTE	full time employee
GRT	gross registered tons
HRS	Hawaii Revised Statutes
IACS	International Association of Classification Societies
IMO	International Maritime Organization
MEPC	Marine Environmental Protection Committee
MGPS	marine growth prevention systems
MPI	Ministry for Primary Industries (New Zealand)
NANPCA	Non-indigenous Aquatic Nuisance Prevention and Control Act
NBIC	National Ballast Information Clearinghouse
NGO	Non-governmental Organization
NISA	National Invasive Species Act
OAR	Oregon Administrative Rule
PMSA	Pacific Merchant Shipping Association

PNWER	Pacific Northwest Economic Region
PSMFC	Pacific States Marine Fisheries Commission
RBM	risk-based management
RCW	Revised Code of Washington
SQEP	suitably qualified and experienced person
UNEP	United Nations Environment Programme
U.S.	United States
USCG	United States Coast Guard
VGP	Vessel General Permit
VeRSA	Vessel Risk Self-Assessment
WAC	Washington Administrative Code
WDFW	Washington Department of Fish and Wildlife
WSG	Washington Sea Grant

GLOSSARY OF TERMS

Aquatic	Relates to water, including freshwater, estuarine and marine.
Appropriate Level of Protection	The level of protection deemed appropriate by a country establishing a sanitary or phytosanitary measure to protect human, animal or plant life or health within its territory.
Ballast Water	Water taken up by ships to assist with vessel stability and balance.
Biofouling	The fouling of pipes and underwater surfaces by organisms such as barnacles and algae.
Biosecurity	The management of the risks to the economy, the environment, and the community, of pests and diseases entering, emerging, establishing, or spreading.
Biosecurity emergency	Circumstances in which a pest or disease poses a significant and immediate threat to part or parts of the state's economy, environment or community.
Compliance	Status whereby all aspects of product, facilities, people, programs, and systems meet regulatory requirements and, where applicable, importing jurisdiction's official requirements.
Inspection	Examination of an animal, plant, food and human health product, vectors and/or systems to verify that they conform to biosecurity requirements.
Pathway	General means or activity by which an organism can be translocated
Risk assessment	The evaluation of the likelihood and the biological and economic consequences of entry, establishment, or spread of a pest or disease within the territory of an importing country.
Risk management	The process of identifying, selecting and implementing measures that can be applied to reduce the level of risks.
Surveillance	Activities to investigate the presence or prevalence of a pest or disease in a given plant or animal population and its environment.
Terrestrial	Relates to the earth, or dry land, as separate from the water.
Vector	Specific physical agent/mechanism for carrying or transmitting pests, diseases or infections.
Vector Traffic	The frequency and volume of vessel movements through a given reporting area or jurisdiction

EXECUTIVE SUMMARY

The Washington State vessel-related biofouling management 6-year strategic plan (Plan) was developed at the request of the Washington Department of Fish and Wildlife (WDFW) and their stakeholder Ballast Water Work Group (BWWG) through funding by the U.S. Environmental Protection Agency - Puget Sound Marine and Nearshore Grant Program and legislative proviso funding from the Washington State Aquatic Lands Enhancement Account. This Plan is the culmination of multiple years of effort and builds upon two previous reports produced for WDFW (Davidson et al. 2014a; Glosten 2016). The purpose of this strategic plan is to provide the rationale and framework for a state biofouling management program which is protective of state aquatic resources through minimizing the impacts of aquatic invasive species (AIS) that can cause significant environmental, economic, and human health harm.

Biofouling is the community of organisms that attach to submerged surfaces of other organisms or objects and is also a term used to describe a pathway by which an organism can be translocated outside its native range attached to the hull of a vessel (the vector). The movement and introduction of AIS through the biofouling pathway is considered to be one of the four greatest threats to the world's oceans (MEA 2005; IMO 2016). In the U.S. the invasion, introduction and spread of AIS results in hundreds of millions of dollars in damages and management costs per year to infrastructure, fisheries and coastal communities (ANS 2016).

Washington State is at high risk of biofouling-related AIS invasions due to the frequency and diversity of vessel visits from our evolving regional and global markets. Analysis shows that there are 94 different AIS currently established in the state's coastal and estuarine waters (Davidson et al. 2014a). Puget Sound alone contains 74 AIS, a of which 58% are likely transported as biofouling on vessel hulls. The proportion of AIS arrivals attributed to biofouling has increased over time, rising from approximately 37% prior to 1950 to 64% since that time (Davidson et al. 2014a). A number of factors have contributed to this rise, including changes in vessel maintenance practices and increased vessel/vector traffic. As the level of vector pressure (=vessel activity) rises, so does the probability that additional AIS will be introduced to and spread within the Puget Sound area and from there to other State coastal and estuarine waters.

There are many potential vectors that can carry biofouling organisms, but the Plan focuses on large (> 300 gross registered tons (GRT)) marine vessels and other large mobile waterborne equipment or infrastructure, as they are considered responsible for the majority of AIS invasions. Overall, there are approximately 4,200 arrivals per year of the large vessels covered under this Plan. With vessel activity projected to rise up to 4% per annum, it is anticipated that this vector pressure will rise by more than 25% increase over the 6 year life of this plan. Management of these vectors, now and into the future, is essential to minimizing the ecological, societal and economic impacts on state waters. The Plan recommends that over time WDFW integrate other vector classes (e.g., recreational vessels, fishing vessels) into the program to provide comprehensive protection of state resources against the biofouling pathway.

Analysis of state, international, federal, and regional regulatory biofouling pathway protections has identified significant gaps which put Washington State at risk of continued AIS invasions. Currently, Washington State's management of the vessel-related biofouling

pathway is largely undertaken on an ad hoc basis and using resources that would otherwise be spent on protecting state waters from zebra and quagga mussels or AIS carried through ballast water pathways. This informal process creates gaps in the state's ability to monitor and address biofouling risks and to provide incentives for proactive hull husbandry practices. Assessment of international and federal protections also identifies significant regulatory gaps in protection of State waters. The International Maritime Organization (IMO) provides only voluntary guidelines for managing biofouling and keeping records of that management. The United States Coast Guard (USCG) and the U.S. Environmental Protection Agency (EPA) provide limited federal regulation of the biofouling pathway through best management hull (and associated internal systems) husbandry practices, with compliance assessed through routine reporting and both random and targeted audits of documentation.

The models proposed here for an effective biofouling management program are based on and extend established and developing programs in New Zealand, Australia and California. New Zealand and Australia manage the risks associated with the biofouling pathway through the application of standards relating to hull husbandry practices. These standards require or promote maintaining a clean hull (or demonstrate equivalent practices) to limit risk and/or prevent or limit occurrences of particular target AIS of concern. California is nearing implementation of perhaps the most protective program for biofouling management in the nation, with a focus on good hull husbandry practice and reporting. Their program is underpinned by an extensive monitoring package, which includes large scale surveys and community outreach.

This strategic Plan contains seven guiding principles that are central to developing a recommended approach to managing the State's biofouling pathway risk. Each of these principles is associated with outcomes and activities for managing risk associated with the applicable biofouling vectors and provides a consensus approach for the stakeholders in the BWWG. Briefly, the principles (and outcomes that support those principles) are as follows:

- **Environmental, Economic & Community Protection**: aquatic ecosystems in the state will be healthy, ecologically resilient and resistant to invasion, economic and socio-cultural values will not be degraded nor will human health be affected by AIS.
- **Shared Responsibility**: partners in the biosecurity system understand and agree with the goals and objectives of the biofouling management strategy and are actively engaged in managing the biofouling pathway.
- **Preventative Approach**: efforts are focused on preventing the arrival and spread of AIS in State waters.
- **Risk-Based Management**: the risk profiles of different resource users and potential impacts will inform decision-making; factors under consideration when contemplating a response to AIS include the costs and benefits, feasibility of success and potential impacts on environmental, economic and cultural values and human health.
- **Integrated Regulatory Approach**: the ongoing development and implementation of the program is coordinated with other regional, federal and international agencies to create a seamless system that functions consistently and without unnecessary duplication.

- **Performance Measures**: a suite of performance measures designed to address the success of pre-border, border and post-border activities and identify priorities for further research that will aid adaptive management.
- **Applied Research and Development**: the state biofouling management program has the capacity to respond to evolving biofouling and vector risks, and ability to adjust program efforts as necessary to minimize duplication in regulatory efforts with federal and regional partners.

The Plan is to be supported by a number of sub-programs that will provide the information required for evidence-based management of biofouling risks. These include a responsive, risk-based compliance program and a robust communications and engagement framework. Several disparate but related programs that inform technical risk comprise other important sub-programs, including assessments of vector risk, the threats and impacts of different species and ongoing surveillance and monitoring of high risk vectors and areas.

An effective and efficient state biofouling management program is recommended to protect state waters from vessel-related biofouling risks. The recommendation is based on risk and regulatory gap analyses, regulatory models, and guiding principles that recognize and include the wide variety of stakeholders, including vector operators, which will be affected by implementation of this program.

The intent, given the multiplicity of stakeholders and interacting jurisdictions, is to provide a regulatory/statutory framework that avoids duplication of effort and is responsive to changes in regulatory approaches as new information is brought into the discussion. The recommended program also considers the need for regulatory/statutory flexibility that facilitates rapid response in the event of detection in State waters of a previously unrecorded AIS.

Although draft versions of this strategy have been reviewed on two separate occasions by the Department's Ballast Water Working Group (BWWG), evaluation of consensus or nonconsensus will be completed by the Department after this document is finalized.

1. INTRODUCTION TO WASHINGTON DEPARTMENT OF FISH AND WILDLIFE

1.1 Departmental Background Information

Beginning with the appointment of the first Fish Commissioner in 1890, the Washington Department of Fish and Wildlife (WDFW/also referred to as the Department) has developed into an agency dedicated to preserving, protecting and perpetuating the State's fish and wildlife resources. The department operates under a dual mandate from the Washington Legislature to:

- Protect and enhance fish and wildlife and their habitats.
- Provide sustainable, fish- and wildlife-related recreational and commercial opportunities.

In support of the dual mandates, WDFW is responsible for control of aquatic invasive species (AIS; also referred to as aquatic nuisance species or ANS). The Revised Code of Washington (RCW) 77.135.010 defines the term invasive species as a "nonnative species of the animal kingdom that are not naturally occurring in Washington for purposes of breeding, resting, or foraging, and that pose an invasive risk of harming or threatening the state's environmental, economic, or human resources." The introduction of AIS into the marine and fresh waters of Washington threatens the ecological integrity of the State's water resources, as well as economic, social, and public health conditions within the State. Because there are few natural controls in their new habitat, AIS spread rapidly, damaging recreational opportunities, lowering property values, clogging waterways, impacting irrigation and power generation, destroying native plant and animal habitat, and sometimes destroying or endangering native species.

The vessel-related biofouling pathway was first identified as a significant AIS risk in the state's Aquatic Nuisance Species Management Plan (ANSPC 1998) which was approved by the Governor and submitted to the U.S. Fish and Wildlife Service under Section 1204 of the Non-indigenous Aquatic Nuisance Prevention and Control Act (NANPCA) of 1990. The proposed biofouling management plan in this document follows task recommendations in the 2001 version of the state plan under SA 5C2 to identify pathways and assess risk of invasions and SA 6A1a to review state laws for gaps and overlaps, compare with other state and federal laws, and recommend changes (ANSC 2001).

The Ballast Water Work Group (BWWG) was established in 2002 by the legislature under Senate Bill 6538 and is comprised of representatives of shipping interests, ports, shellfish growers, fisheries managers, environmental interests, citizens who have knowledge of the issues, and appropriate governmental representatives including the USCG, EPA, and tribal governments. In 2007, the BWWG issued a report to the legislature which recommended, by consensus, that their legislative mandate be expanded to include review and recommendations for a biofouling management program. In 2009, the BWWG was re-established under Washington Administrative Code (WAC) 220-150-010 to advise the Department on developing, revising, and implementing chapters RCW 77.120 and WAC 220-150 regarding ballast water and biofouling management.

In 2012, the Aquatic Nuisance Species Committee issued a report to the legislature recommending they address biofouling risks in support of the West Coast Governors'

Association Action 2.3, the Western Governors' Association Policy Resolution 10-4, the Puget Sound Partnership's Action Agenda, and the Washington Invasive Species Council's Strategic Plan Action 22.2 (ANSC 2012).

In addition, WDFW engages with federal, regional state, and internal state agencies to standardize regulations to the extent practical and appropriate, minimize duplication of efforts and share information. Regional consultation and coordination is provided through the Pacific States Marine Fisheries Commission via the Pacific Ballast Work Group and 100th Meridian Initiative's Columbia River Basin Team as well as the Aquatic Nuisance Species Task Force's Western Regional Panel, which is coordinated by the U.S. Fish and Wildlife Service.

While progress has been made in ballast water management, management of the biofouling pathway of AIS introduction has lagged behind, even though it is suspected that 58% of AIS have been introduced to Washington State via biofouling (Davidson et al. 2014a). Biofouling is regulated under the general invasive species provisions of chapter 77.135 RCW and enforcement provisions of chapter 77.15.809 RCW. A monitoring plan has been in place since 2008 to control introduction of AIS from vessels transported overland to freshwater and marine water bodies.

This Plan has been created to address the biofouling pathway for vessels, 300 GRT and greater, arriving in the State by sea and also those moving within State waters.

1.2 Management Structure

Figure 1 provides a depiction of the proposed management/operational team involved with the AIS program. Other agencies such as the Fish and Wildlife Commission also play a role in the execution of an AIS program. The final overall structure will be developed in consultation with WDFW and Ballast Water working Group as this strategic plan matures.

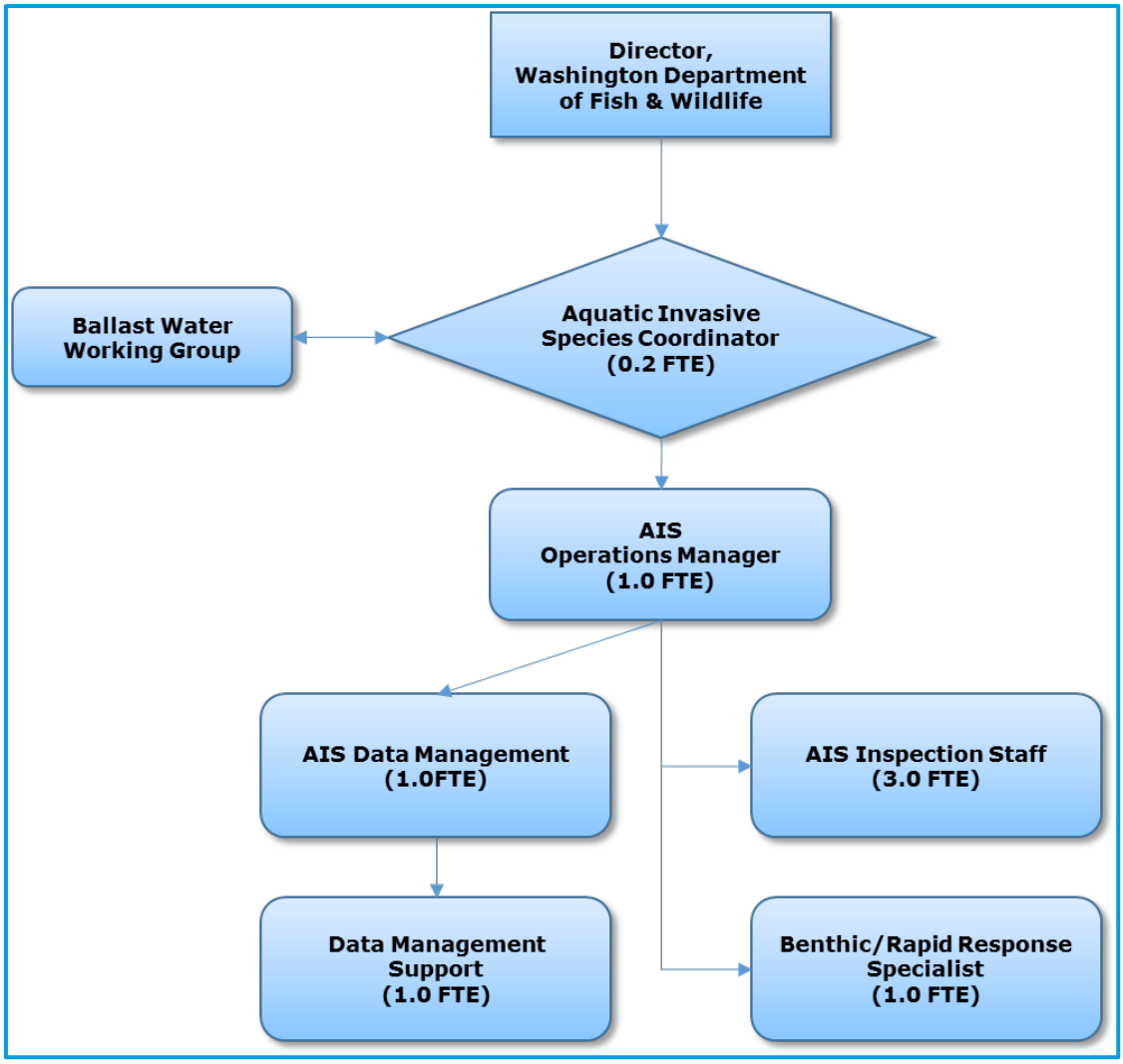

Figure 1: Proposed AIS Management & Operations Team Structure

1.3 Values

The Department strives to protect the State's fish and wildlife resources while recognizing that commercial and recreational boating are integral to the economic vitality of the state. Therefore, a core value of the Plan is to protect resources from biofouling AIS in a manner that minimizes impact on activities in Washington's coastal marine environment.

1.4 Mission & Vision

The Department's mission is to preserve, protect and perpetuate fish, wildlife and ecosystems while providing sustainable fish and wildlife recreational and commercial opportunities. The Department's vision is for the conservation of Washington's fish and wildlife resources and ecosystems.

To achieve this mission and vision, WDFW focuses activities on the following four goals:

- To conserve and protect native fish and wildlife.
- To provide sustainable fishing, hunting, and other wildlife-related recreational and commercial experiences.
- To promote a healthy economy, protect community character, maintain an overall high quality of life, and deliver high-quality customer service.
- To build an effective and efficient organization by supporting our workforce, improving business processes, and investing in technology.

This Plan will strive to achieve these goals by implementing an efficient biofouling management program that fits seamlessly within a regional framework to both minimize the risk and impacts of introduced AIS into Washington State and also standardize the compliance expected from vessel operators.

2. BIOFOULING PATHWAY AND VECTOR ANALYSIS

2.1 Problem Statement: The Management Imperative

The human-assisted movement and introduction of AIS is considered to be one of the four greatest threats to the world's oceans (MEA 2005; IMO 2016). In the U.S., the invasion, introduction and spread of AIS results in hundreds of millions of dollars in damages and management costs per year to infrastructure, fisheries and coastal communities (ANS 2016). The majority of these invasions occur via waterborne transport on or within ships, drill rigs, dredgers and other mobile equipment or infrastructure.

Management of the means by which AIS are spread, is therefore, essential to minimizing the ecological, societal and economic impacts on local communities.

An effective biosecurity system is aimed at protecting the natural biota and habitats of geographically distinctive communities' susceptible to damage from AIS. While a number of different components are required for success of the system, the basis should focus on an appropriately constructed strategic regulatory framework with which to develop operational responses. The strategic framework sets in place the aims and objectives for identifying high risk invasive and potentially invasive species, intercepting high risk vectors before arrival in Washington, and mitigating potential environmental risks and impacts after entrance to Washington.

2.1.1 The Pathways and Vectors of AIS

The two primary pathways for the unintentional introduction of marine AIS are ballast water and biofouling. Each pathway poses a different biosecurity risk profile, the nature of which is defined primarily by vessel 'history'. Vessel 'history' refers to all the events that lead to the colonization of the vessel hull and niche areas by an AIS. Factors to be considered include (but are not limited to) the voyages undertaken and ports visited, routine and extraordinary maintenance regimes, dry-docking intervals, and the presence/type of antifouling coatings (AFCs) and marine growth prevention systems (MGPS) used.

The ballast water pathway of AIS introduction has been well recognized globally for many decades and the measures to manage the associated biosecurity risk are relatively well understood. Regulatory frameworks for management occur at multiple levels (State, Federal and International). Washington State currently manages the ballast water pathway through RCW 77.120 and WAC 220-150. The companion program to this project on biofouling, therefore, builds upon these existing frameworks for more effective management of the ballast water pathway and its vectors in Washington State.

Given widespread port-state requirements for mid-ocean ballast water exchange prior to arrival, the risk profile arising from the ballast water vector is heavily weighted by the last port of call or area from which ballast water was collected. The temporal and spatial limits of that risk are therefore relatively well bounded and assessed.

The biofouling pathway, however, creates an integrative risk profile. AIS can potentially colonize a vessel (either the external hull or wetted internal systems and equipment) or immersed infrastructure at multiple points throughout the vessel's operational history. Biofouling thus integrates (in a non-linear manner) the risk associated with multiple ports and bio-regions where the vessel or equipment has been stationary or operating at low

activity levels (e.g., slow moving ships operating close to shore) since the last hull cleaning and application of AFCs.

This project is focused on developing, in a strategic fashion, the basis for a new State program for managing the biofouling pathway. Vector management is one of the core components of the overarching risk reduction strategy and regulatory framework for this pathway.

2.1.2 Factors Increasing Risk – the Drivers

A wide variety of factors are responsible for increasing the biosecurity risk due to the biofouling vector over time. Vector traffic is the key consideration. Trade globalization, which results in the transport of AIS as biofouling on ships hulls, is an important component of this risk profile.

There is considerable vessel activity within Puget Sound; traffic to the region has been estimated at approximately 50,000 vessels per year. In addition, 74 different AIS are known to be present in Puget Sound 58% of this group are likely transported as biofouling on vessel hulls (Davidson et al. 2014a). Davidson et al. (2014a) notes that the proportion of AIS arrivals attributed to biofouling has increased over time, rising from approximately 37% prior to 1950 to 64% since that time.

As the level of vessel activity rises, so does the probability that additional AIS will be introduced to and spread within the Puget Sound area. The risk of AIS introduction is not necessarily equal for every port in Washington, nor every vessel entering Washington waters. The risk will be influenced by the volume of vessels received at a given port, the type of water at the receiving port (i.e. saltwater vs. freshwater), the originating port, the type of vessel, the maintenance schedule of the vessel (e.g. application of antifouling paint and in-water cleaning), the amount of time spent stationary in ports, and the speed of the vessel (Davidson et al. 2016). Each risk factor is examined in more detail below.

Climate variability can also contribute towards the vector-related spread of AIS (EPA 2008). This variability may permit survival of AIS in the Puget Sound area that previously were unable to tolerate local conditions, or conversely, create unsuitable conditions for native populations and thus create a niche for invasive species. It is possible that AIS already present at low numbers in the region will respond positively to climate variability and dramatically increase in density. Such lag-periods are widely recognized in the literature (Crooks 2005) and are attributed to a variety of factors, including anthropogenically-induced change.

Volume of Commercial Vessels Arriving at Washington Ports

It is important to note that the U.S. Coast Guard's National Ballast Information Clearinghouse (NBIC) database as well as the WDFW ballast water database used in this analysis track large and primarily commercial vessels. There is little tracking information on smaller vessels, in particular recreational vessels. Some vector pressure information on smaller vessels can be found in Davidson et al. (2014a). For this vector pressure analysis we focus on large vessels.

A study of the NBIC records from January 1, 2008 to July 6, 2016 indicated 30,977 vessel arrivals to Washington. The volume of commercial vessels arriving at the top 10 ports in Washington is summarized in Figure 2.

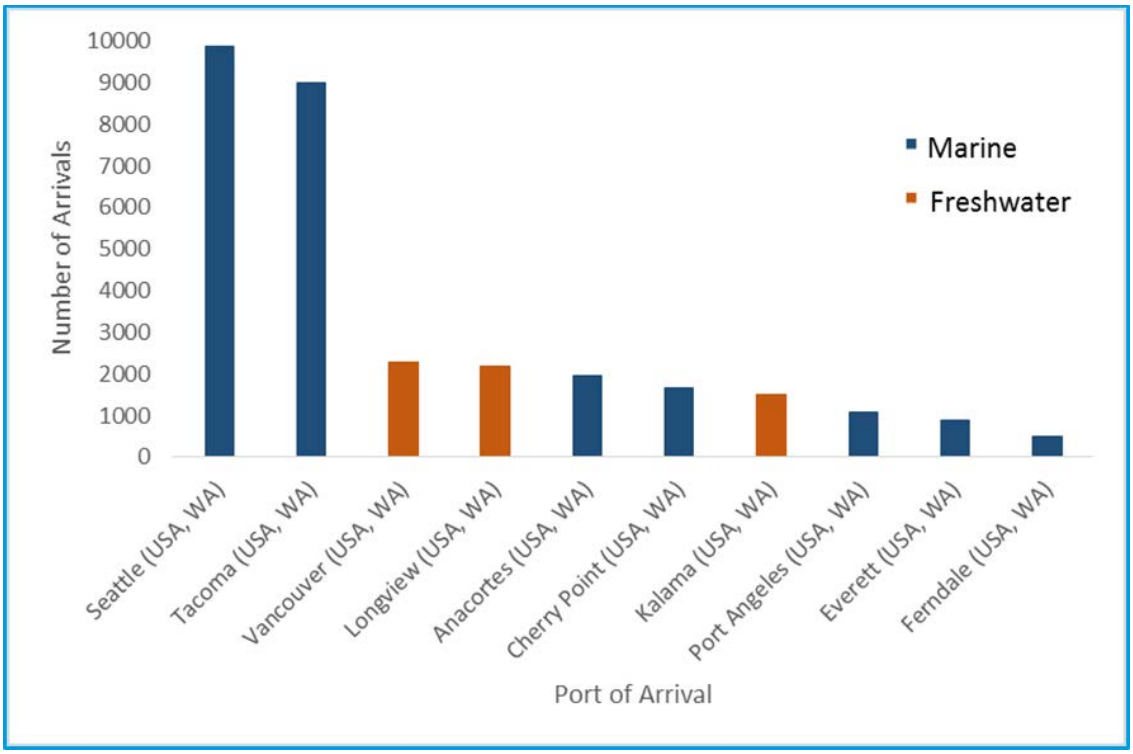

Figure 2: Commercial Vessel Arrivals to Top 10 Washington Ports From Jan 2008 to July 2016

Seattle and Tacoma receive the majority of the commercial vessel arrivals in Washington, and thus are expected to be at greater risk of AIS introduction. The next two ports, Vancouver and Longview, along with Kalama, are situated along the Columbia River. Several studies have shown that exposure to freshwater decreases biofouling-mediated AIS introductions from ocean going vessels, and the low salinity and poor habitat provided by the Columbia River will likely decrease the risk of marine AIS introduction in its ports and even subsequent ports (Davidson et al. 2006, Sylvester and MacIsaac 2010, Davidson et al. 2009a, Davidson et al. 2014b). However, if vessels are moving between freshwater ports within the Columbia River, there is a chance of freshwater AIS spread from one colonized port to another port, as will be discussed in more detail below. Anacortes, Cherry Point, Port Angeles, Everett and Ferndale, along with other smaller ports situated in saltwater, will likely have a lower risk than Seattle and Tacoma based on commercial traffic volume.

Last Port of Call of Commercial Vessels Arriving at Washington Ports

A search of NBIC records from January 1, 2008 to July 6, 2016 indicated that the majority of commercial vessel arrivals to Washington came from other ports within the US (Figure 3). The bulk of vessel arrivals from foreign waters came from Canada, Japan, South Korea and China. The results are the same as was found in the Puget Sound vector analysis performed by Davidson et al. (2014a). Of the 6579 arrivals from Canada, all but 2 arrived from British Columbia, and 92% of those were from within the Salish Sea. Thus, based on last port of call alone, arrivals from Canada are expected to present a low risk unless coming from a port with a known AIS invasion.

Last Port of Call is not, however, an ideal indicator of biofouling risk as it integrates the risk that accumulates since the last time the vessel was cleaned or recoated with antifouling

paint. Understanding the total voyage history since that time is therefore critical to accurately gauging the risk.

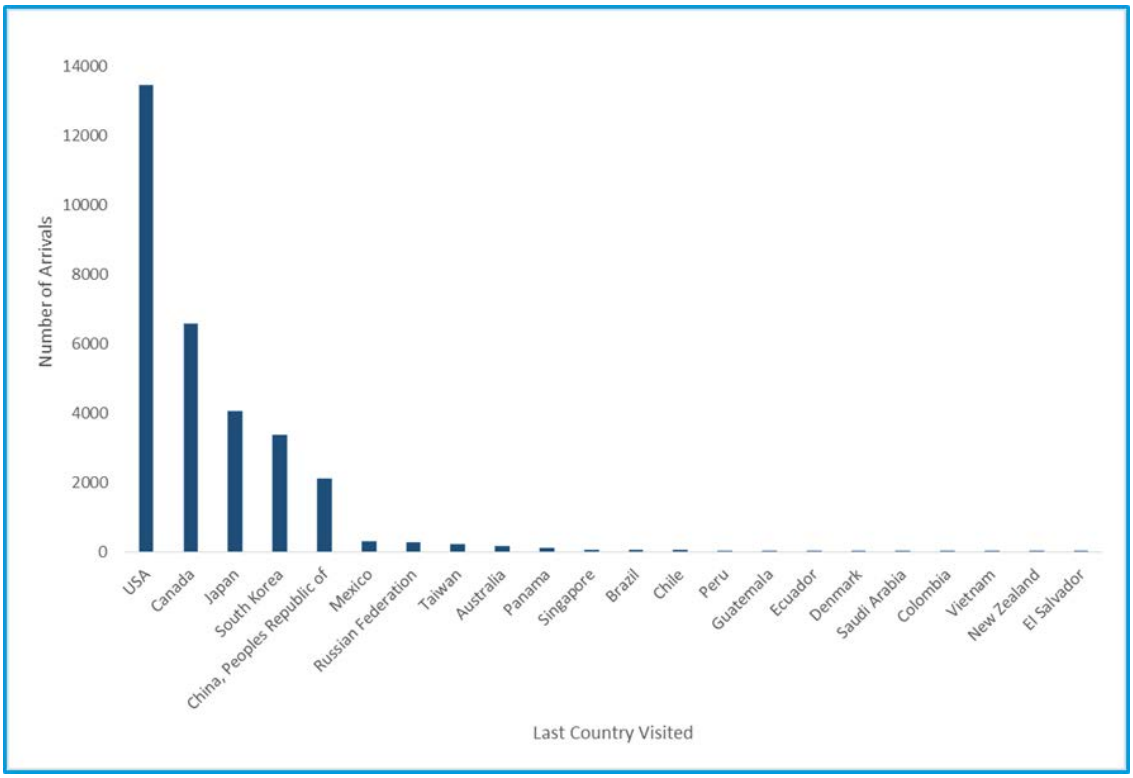

Figure 3: Last Country Visited for Commercial Vessels Arriving to Washington Ports From Jan 2008 to July 2016

A California biofouling study Davidson et al. (2014b) found a positive correlation of biofouling with tropical port visits, and a study by Sylvester et al. (2011) conducted in Nova Scotia and British Columbia, Canada found a negative correlation of propagule and colonization pressure (total number of individuals of a species introduced at a given location, and total number of species introduced, respectively) with latitude of last port of call. Both studies would indicate that the lower the latitude of the last port of call, the greater the risk of AIS introduction.

However, AIS introduction risk is not necessarily correlated with AIS establishment risk. Tropical organisms are not as likely to survive in Washington's temperate waters as organisms introduced from other temperate environments, and indeed, a study performed by Lacoursière-Roussel et al. (2016) found that exotic species richness in sampled ports was best correlated with arrivals of non-merchant ships from close regions. If the AIS establishment risk is indeed higher when the AIS are from a similar environment, arrivals from Japan and South Korea would provide a higher risk, while China, Mexico, Australia (depending upon the latitude of the ports within these countries), Russia and Taiwan would provide a lower risk in terms of both latitude and volume of vessels arriving from their ports.

Similarly, populations of biofouling organisms that experience osmotic shock though immersion in freshwater (e.g., during the short transit through the Panama Canal) may experience increased mortality and lower the risk of AIS introduction for the reasons outlined above. Some biofouling organisms, however, can survive such short term shocks (e.g. the acorn barnacle *Amphibalanus retuculatus;* Davidson et al 2009).

Within the United States there were more vessel arrivals from California than any other state, followed by Alaska, Oregon and Hawaii (Figure 4). There were less than ten vessel arrivals from each of ten other states. The NBIC data indicated a fair amount of movement within Washington, as 2546 arrivals indicated a port within Washington as their last port visited. The results are similar to the Puget Sound vector analysis in Davidson et al. (2014a), though there were more vessels arriving from Alaska than California in their study, as well as more arriving from Hawaii than Oregon. If the assumption that risk of AIS introduction is higher when the climate in the originating port is similar, then based on volume of vessels and latitude of last port of call, vessels arriving from California and Oregon provide the greatest risk. It is important to remember that if the vessel is arriving from a port with a known priority AIS presence (such as ports in California with known *Undaria pinnatifida* [wakame] presence), risk will also be elevated.

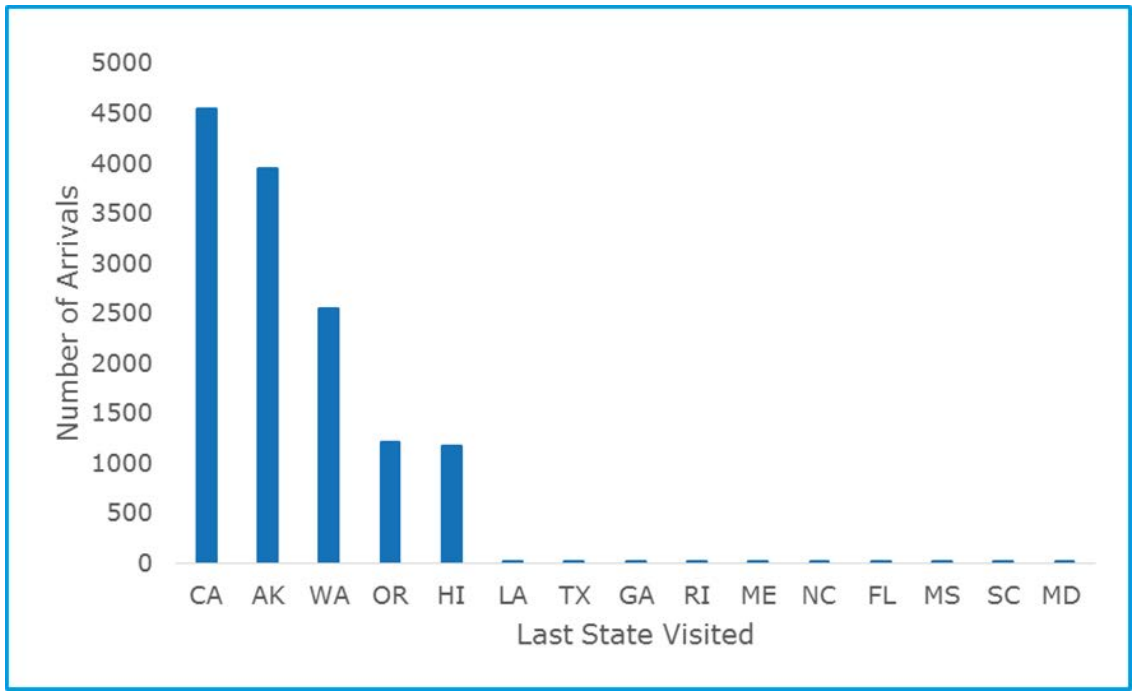

Figure 4: Last State Visited for Commercial Vessels Arriving in Washington from the US From Jan 2008 to July 2016

Movement of vessels within the local region can also pose a risk of AIS spread if the vessel is moving from a port with an AIS presence to a port without a presence. There are currently three priority AIS with a known presence in regional waters: New Zealand freshwater mudsnails (*Potamopyrgus antipodarum*), invasive marine tunicates (*Styela clava*, *Didemnum vexillum*, *Ciona savigni*), and European green marine crabs (*Carcinus maenas*). In the Columbia River New Zealand mudsnails have been recorded at several sites in and around Astoria, OR, and Kalama (Bersine et al. 2008, WDFW 2015a). Vessels moving directly from Astoria or Kalama to other ports along the Columbia River could be at risk of transporting the mudsnail, especially if the vessel has been in contact with the sediment (e.g. dredging vessels). Invasive tunicates have been found in isolated locations near the ports of Seattle, Bremerton, Blaine and Edmonds (WDFW 2016). European green crabs have been documented in Greys Harbor and Padilla Bay as well as near Sooke in British Columbia (Amanda Newsom and Allen Pleus, WDFW, pers. comm.). Movement of vessels from these locations to other nearby marine ports may be at risk of transporting AIS. Figure 5 provides

the volume of arrivals from Washington ports to another Washington port, and also indicates ports with a potential presence of AIS. Ports with both an elevated volume of vessels and the presence of AIS may pose a risk of acting as a source of AIS.

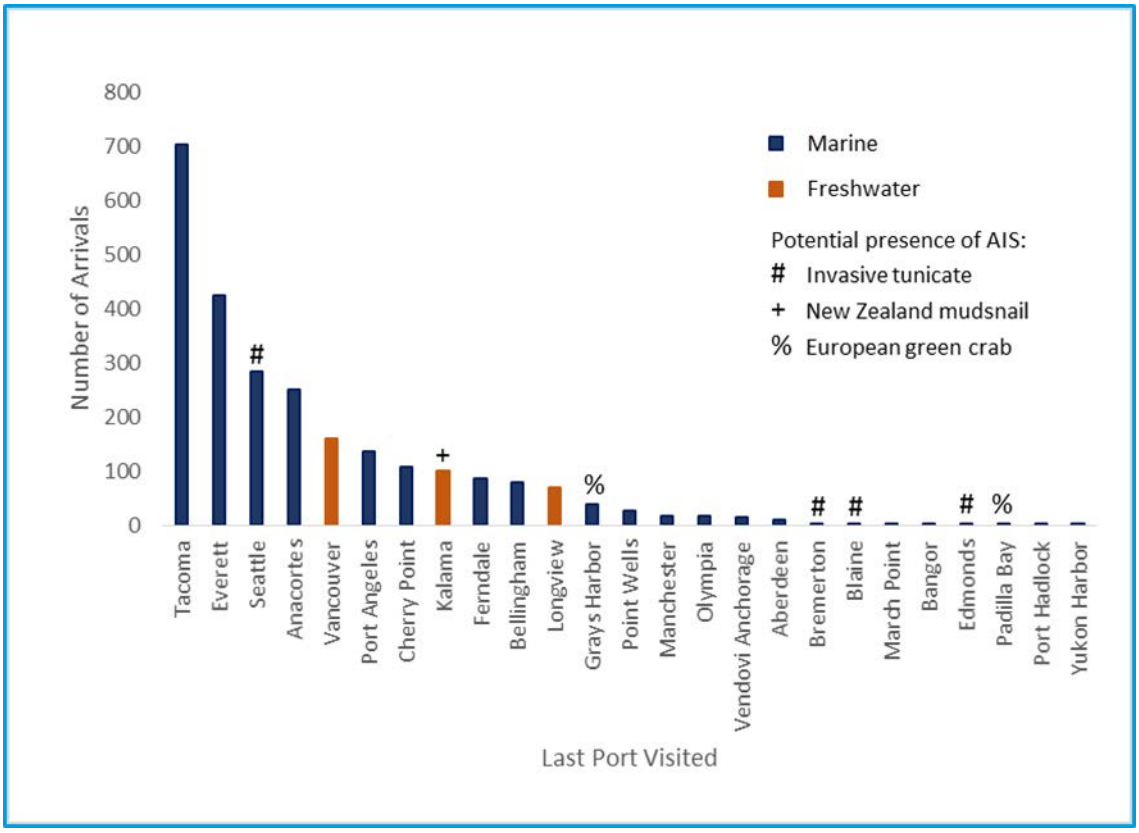

Figure 5: Last Port/Anchorage Visited for Commercial Vessels Moving Between Ports within WA From Jan 2008 to July 2016. Ports with nearby sightings of priority AIS are noted.

Vessel Type

Vessel types have been categorized into low, moderate, high and very high risk categories for AIS introduction by taking into consideration the following characteristics (modified from McDonald et al. 2015):

- Mean dead weight tonnage (the bigger the vessel the greater the surface area for biofouling)
- Number and range of niche areas (the more niche areas the greater the potential to retain biofouling organisms)
- Port duration time (the greater the duration of stay the greater the likelihood of accumulation and transfer)
- Working speed of the vessel (the slower the vessel the greater the likelihood of hull colonization and organism survival)
- Antifouling coat depletion rate
- Maintenance constraints (vessels with structural profiles that inhibit effective maintenance of antifouling measures have increased likelihood of hull colonization)

- Contact with seabed (vessels that commonly come into contact with the seabed are more likely to pick up biofouling organisms)

Arrivals data collected from WDFW's ballast water database for the years 2008 through 2015 were cross-referenced with the vessel information database to determine the number of arrivals of each vessel type of at least 300 gross tons to Washington ports during the above time period. In the event that two or more vessels had the same name but different structure, the vessels were removed from consideration.

The arrival data was then grouped by general risk levels provided in McDonald et al. 2015, with further delineation of risk posed by cargo vessels based on average port residence times and speed from Davidson et al. 2014a. Table 1 provides a summary of the number of arrivals of each vessel type. Figures 6 through 9 provide the relative proportions of low, moderate, high and very high risk vessels, respectively, arriving in Washington between 2008 and 2015.

Table 1: Number of Arrivals to Washington Ports by Vessel Type from 2008 - 2015

Vessel Type	Number of Arrivals	Risk Category
Container	9490	Low
Auto Carrier	3153	Low
Passenger	1458	Low
Bulk	7315	Moderate
Tanker	4496	Moderate
General Cargo	1967	Moderate
Articulated Tug and Barge/Integrated Tug and Barge (ATB/ITB)	2467	High
Barge	1161	High
Fishing/Fish Processing	792	High
Towing/Tug	63	High
Research	35	High
Dredge	13	Very High
Drilling	7	Very High

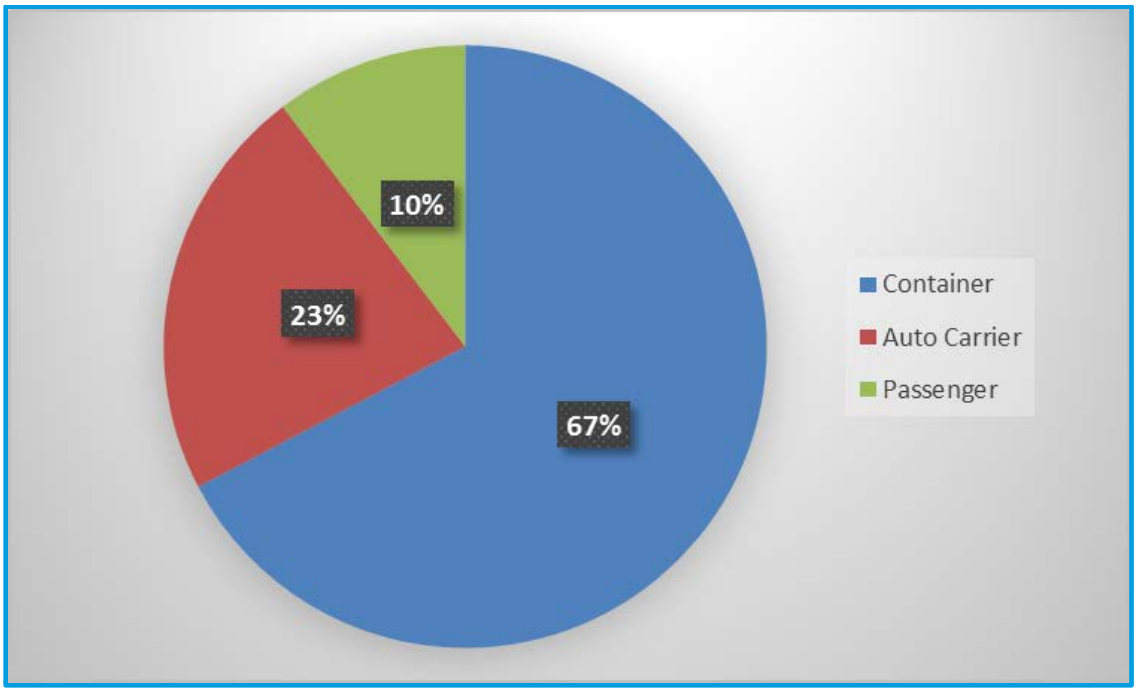

Figure 6: Relative Proportion of Low Risk Vessel Arrivals to Washington Ports From 2008 to 2015 (N=14,101)

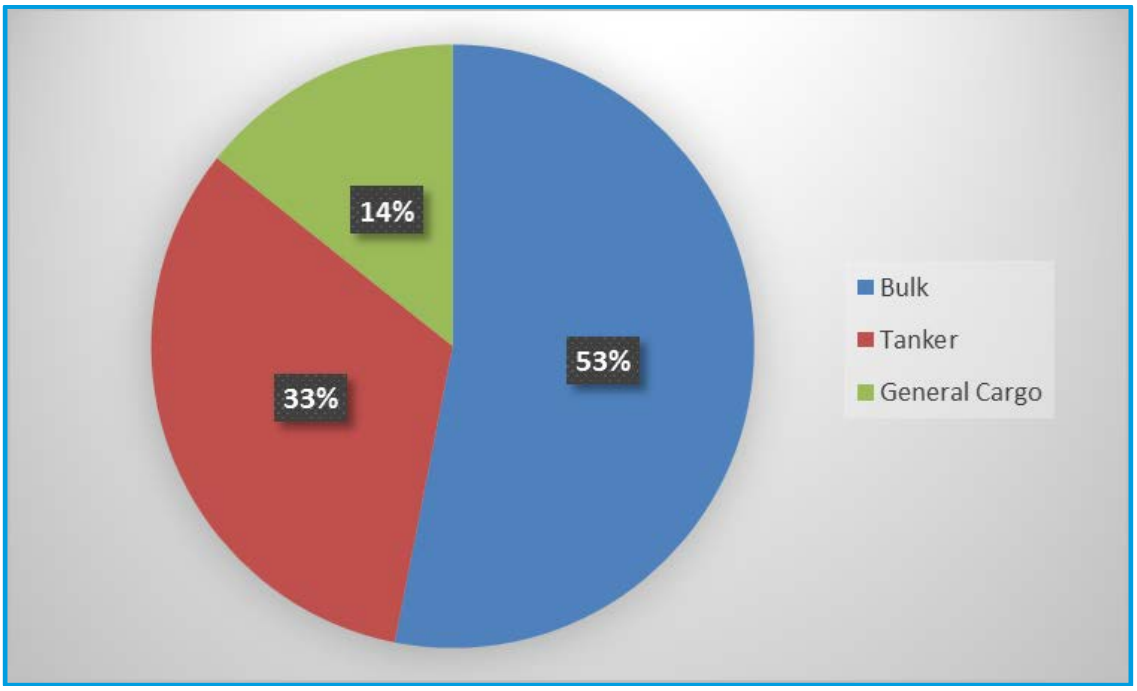

Figure 7: Relative Proportion of Moderate Risk Vessel Arrivals to Washington Ports From 2008 to 2015 (N=13,778)

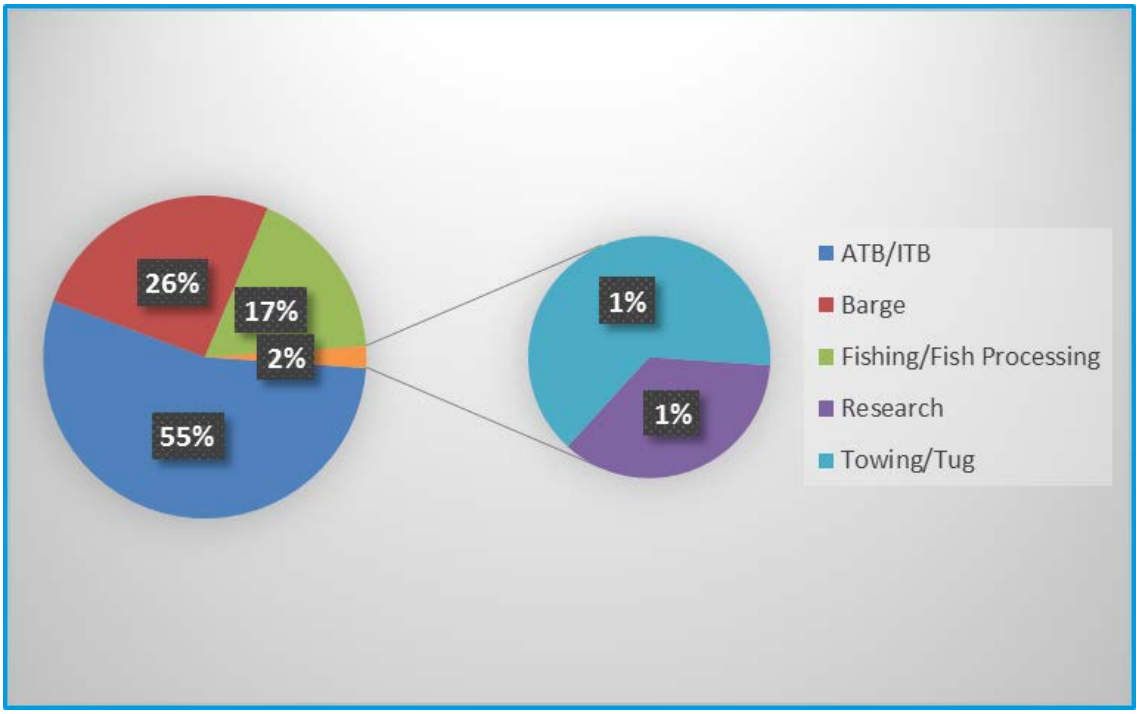

Figure 8: Relative Proportion of High Risk Vessel Arrivals to Washington Ports From 2008 to 2015 (N= 4,518)

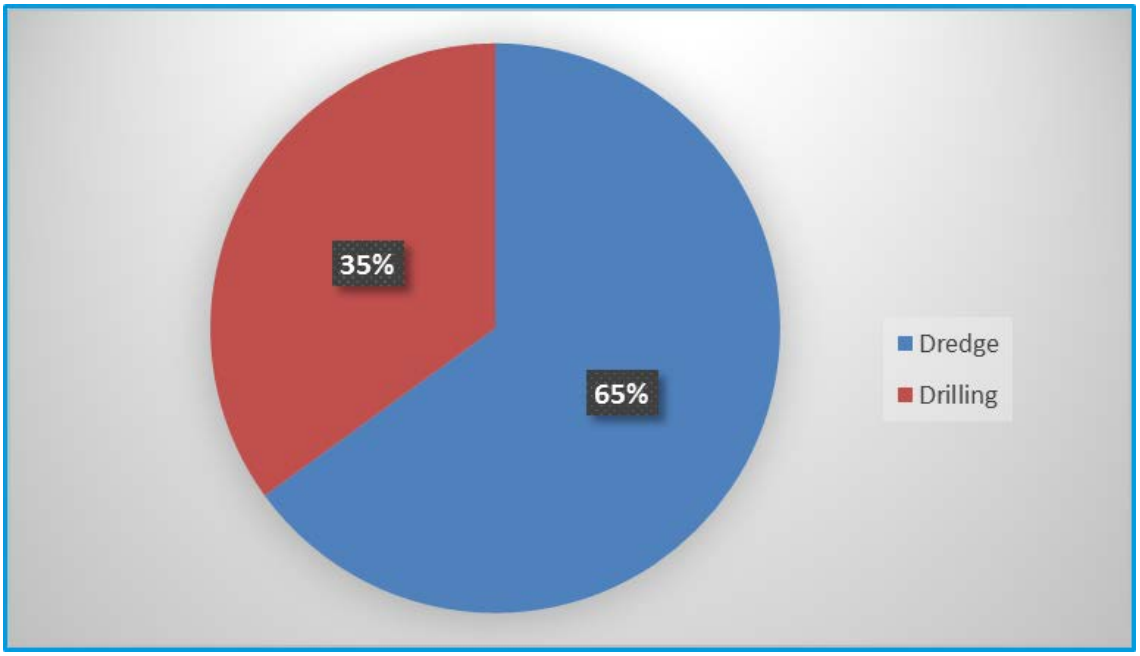

Figure 9: Relative Proportion of Very High Risk Vessel Arrivals to Washington Ports From 2008 to 2015 (N= 20)

Representing all vessel types by risk category can provide a picture of the relative arrival risk (Figure 10). 43.5% of arrivals fell into the low-risk, 42.5% in the moderate-risk, 13.9% in the high-risk, and less than 0.1% in the high-risk vessel category.

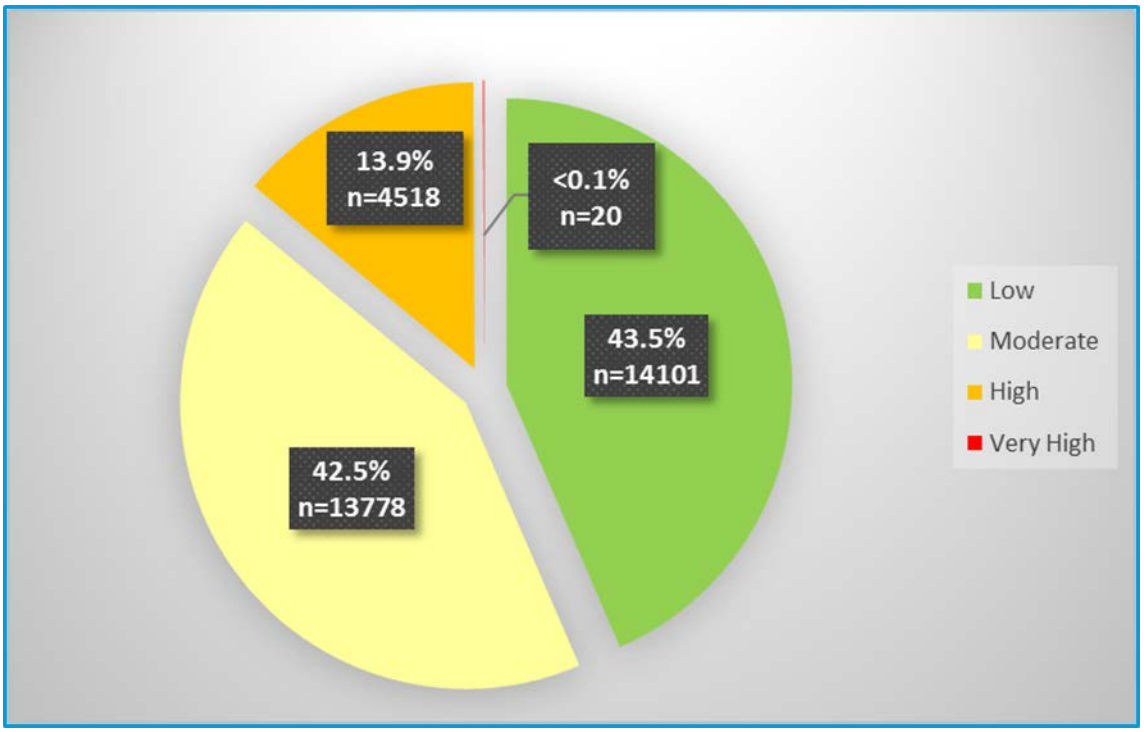

Figure 10: Relative Proportion of Vessels in Each Risk Category to Arrive in Washington Ports From 2008 to 2015

While general assumptions of biofouling risk based on vessel type can be made, individual vessel maintenance and operation can either mitigate or exacerbate risk. Factors include hull maintenance, operating speed, stationary period and cumulative time spent in ports before arrival. Each factor is highlighted below. There is little information on vessel maintenance and operation that is specific to biofouling risk for vessels arriving in Washington, therefore other sources were used to analyze risk.

Hull Maintenance

There are a variety of antifouling paints in use today, each with its own projected life span. The most effective way to assess risk from poor hull maintenance is to determine the product and manufacturer used, as well as the date applied and any hull cleaning since application, especially in niche areas. If the product is past its expected life span and the hull hasn't been cleaned, then the likelihood of fouling is high. If, however, product information is not available then biofouling risk may be inferred based on date of paint application and date of hull cleaning alone.

Sylvester et al. (2011) found that vessels in Vancouver, BC with paint up to 427 days old were relatively clean, but heavy fouling occurred thereafter. Therefore, if more than about 1.5 years has passed since dry docking or delivery, and no hull and niche cleaning has been performed there may be an increased risk of biofouling. Davidson et al. (2014a) collected information on hull maintenance activity from hull husbandry forms submitted to California State Lands Commission (CSLC) in 2010-2011. Of the 404 vessels documented, the majority

(44%) were containerships, followed by tankers and auto carriers. Passenger, barge, bulk and general cargo vessels were also represented to a lesser degree.

Forty-four percent of vessels reported application of antifouling or foul-release coating of hulls and niches more than two years prior to reporting. One vessel's antifouling paint exceeded the typical five-year maximum between applications. Twelve percent reported in-water cleaning since last dry-docking or delivery, though 20% had polished their propellers (Figure 10). Therefore, it appears that a significant portion of vessels entering California had at least a moderate risk of biofouling.

Speed

In general it is believed that slower sailing speeds are associated with greater biofouling. Coutts et al. 2010 found that vessels travelling at 17.9 knots contained fewer species and less percent cover on their hull at the completion of their voyage than vessels travelling at 8.4 knots or less, and that number continued to decline 7 days post travel. Colonial, erect, and soft, flexible organisms were most affected.

Sylvester et al. 2011 found that sailing speed had a negative effect on propagule pressure (total number of individuals of a species introduced at a given location), consistent with other studies (Davidson et al. 2009b, Coutts et al. 2010). However, they also found a neutral or slight positive effect on colonization pressure (total number of species released). Therefore, the relationship of speed and biofouling pressure may be more complex and need further study.

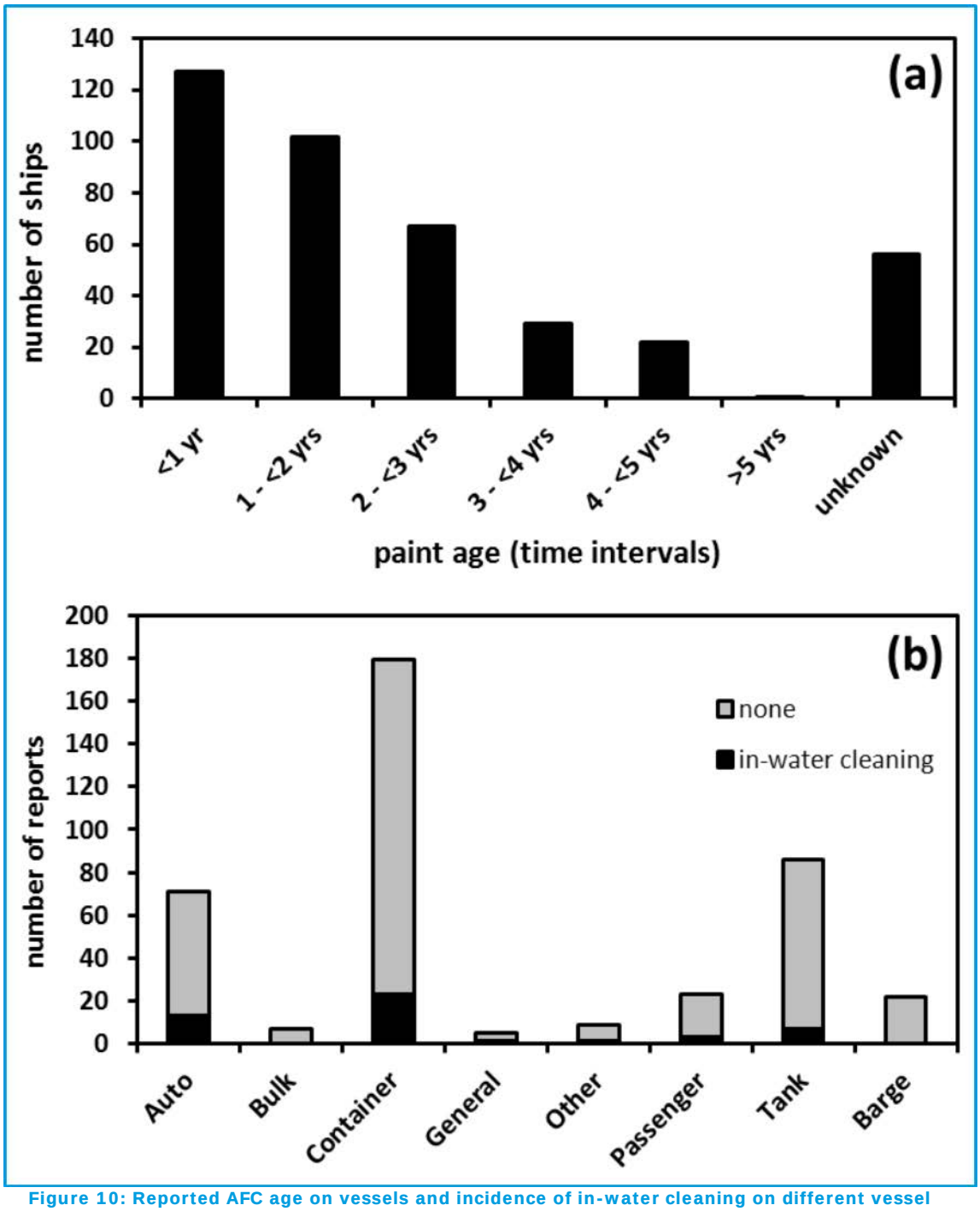

Figure 10: Reported AFC age on vessels and incidence of in-water cleaning on different vessel types[1]

[1] From Davidson et al. 2014a

Using the same data set as described above for hull maintenance, Davidson et al. (2014a) noted outliers from the expected speed of a vessel class, indicating the need to document the actual speed of individual vessels to more accurately assess risk.

Stationary period prior to arrival and cumulative time spent in ports

Sylvester et al. 2011 documented a strong relationship between total time spent in port during the previous year and combined propagule (total number of all species transported by a vector) and colonization pressure (total number of species released). The number of regions visited over the previous year was also correlated with colonization pressure.

Current ballast water data collection does not capture total time in port or total number of port visits, as they are not considered as relevant for ballast water risk management. In the Davidson et al. (2014a) study they found a substantial variability in port resident time among individual tankers and bulkers, which indicates a need to document individual vessel port visits and durations to more accurately assess risk.

2.1.3 Arrivals Forecast

This forecast provides a general view of expected increases in shipping over the next few years, as well as trends in port visits by vessels in moderate to high biofouling risk categories. The information can be used to estimate the volume of data WDFW may be receiving from incoming vessels upon implementation of the biofouling management plan, and help pinpoint which ports may be more likely to require inspection visits.

BST Associates and Mainline Management prepared a forecast of shipping trends for the Pacific Northwest Rail Association in 2011 (BST 2011). In the lower Columbia River they anticipated an annual growth of 4.3 to 7% in marine shipping, primarily driven by expansion projects in Kalama and Vancouver to increase capacity for grain, as well as expected increases in dry bulk demand. Both types of shipments would likely require bulkers; vessels that pose a moderate risk. Figure 11 provides the volume of arrivals over time, in Kalama, Longview and Vancouver combined, from the NBIC database, along with projected increases based on BST 2011.

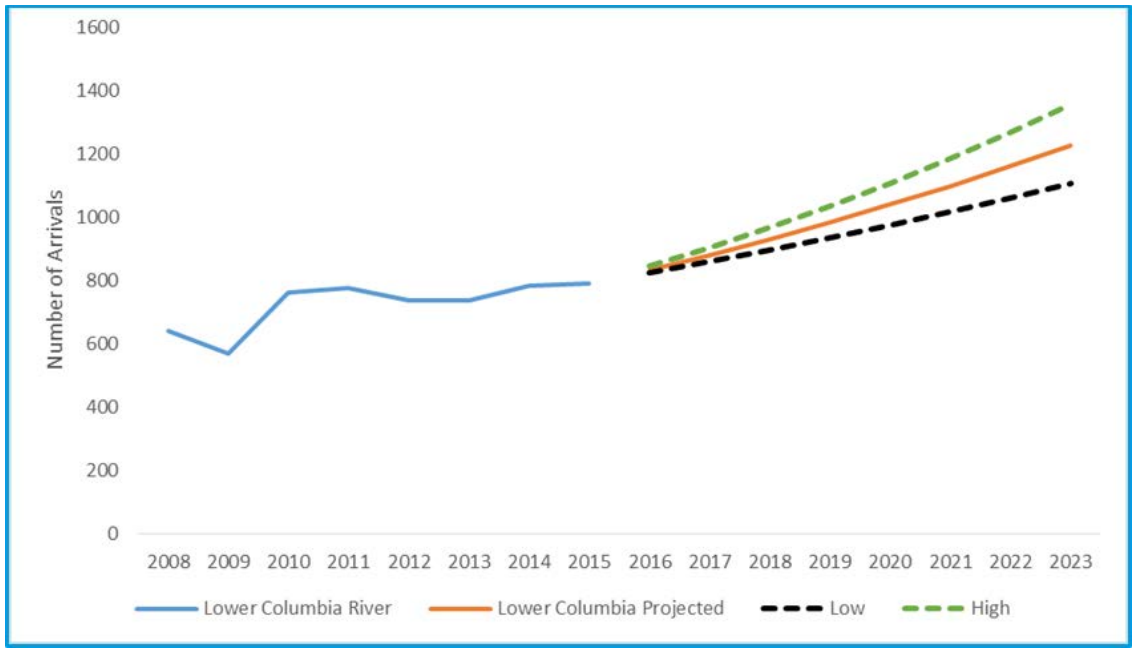

Figure 11: Actual and projected arrivals over time in the lower Columbia River

Puget Sound and the Washington coast were anticipated to receive an annual increase in marine shipping of 2.6 to 4.2%, primarily driven by dry bulk and container shipping, vessels in the moderate and low biofouling risk categories, respectively. Figure 12 provides a depiction of actual and projected shipping volumes over time for the ports of Seattle, Tacoma, Anacortes, Cherry Point, Port Angeles, Everett and Ferndale, combined.

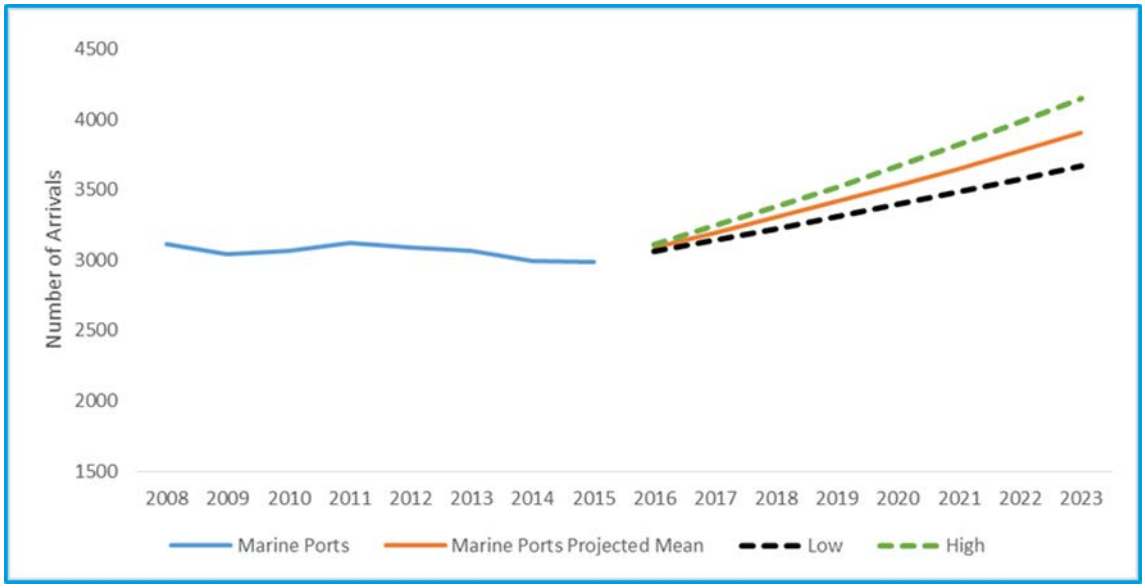

Figure 12: Actual and projected arrivals over time in marine ports

According to the NBIC database, about 1,100 to 1,300 unique low to moderate biofouling-risk vessels per year arrived to the 10 major ports in Washington, bulkers making up the majority. It is important to note that container ships, in particular, are becoming larger, and that increase in volume per vessel may mitigate the increase in expected shipping volume. Therefore, even though the shipping volume may be increasing, the number of individual vessels arriving may not increase at the same rate, nor will the volume of data WDFW receives from arriving vessels. However, larger vessels will result in more wetted surface area arriving at Washington ports, resulting in more potentially fouled surfaces. In addition, larger container vessels are likely to have more niche areas than smaller container vessels, including more thrusters, more sea chests, more stabilizer fins, and possibly more rudders and propellers, which may lead to a need for increased inspections.

While there is little forecast information available specifically for high-biofouling-risk vessels, trends from previous years may be evaluated to predict ports or anchorages more likely to be visited by these vessels. Figure 13 provides arrival volume trends for all Washington ports for the high risk vessels highlighted in Figure 8. The data are derived from the WDFW ballast water database.

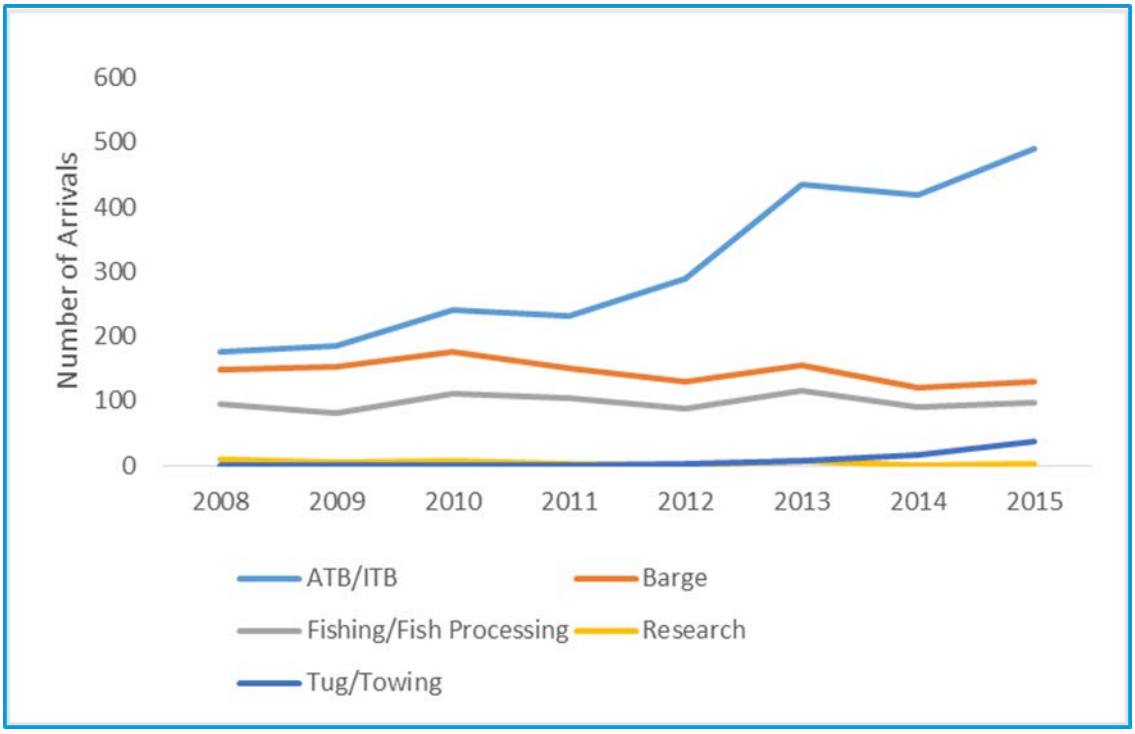

Figure 13: Arrivals over time for high biofouling risk vessels

The largest increase in volume is seen for articulated tug and barge/integrated tug and barge (ATB/ITB) vessels. Figure 14 provides more ATB/ITB arrival information by port.

Though there were over 2,000 ATB/ITB arrivals from 2008 to 2015, there were only 21 individual vessels involved. The increase in ATB/ITB vessel arrivals was driven by arrivals in Anacortes and Cherry Point. These types of vessels are commonly used to transport refined petroleum products, and were most likely visiting the refineries in the area.

Forty-three individual barges made over 1,000 arrivals to Washington from 2008 to 2015 (Figure 15). Though arrivals initially were highest in Seattle, the volume has dropped over

time and been replaced by an increase in barge arrivals to Anacortes and Tacoma. Figure 16 provides information on fishing vessel traffic.

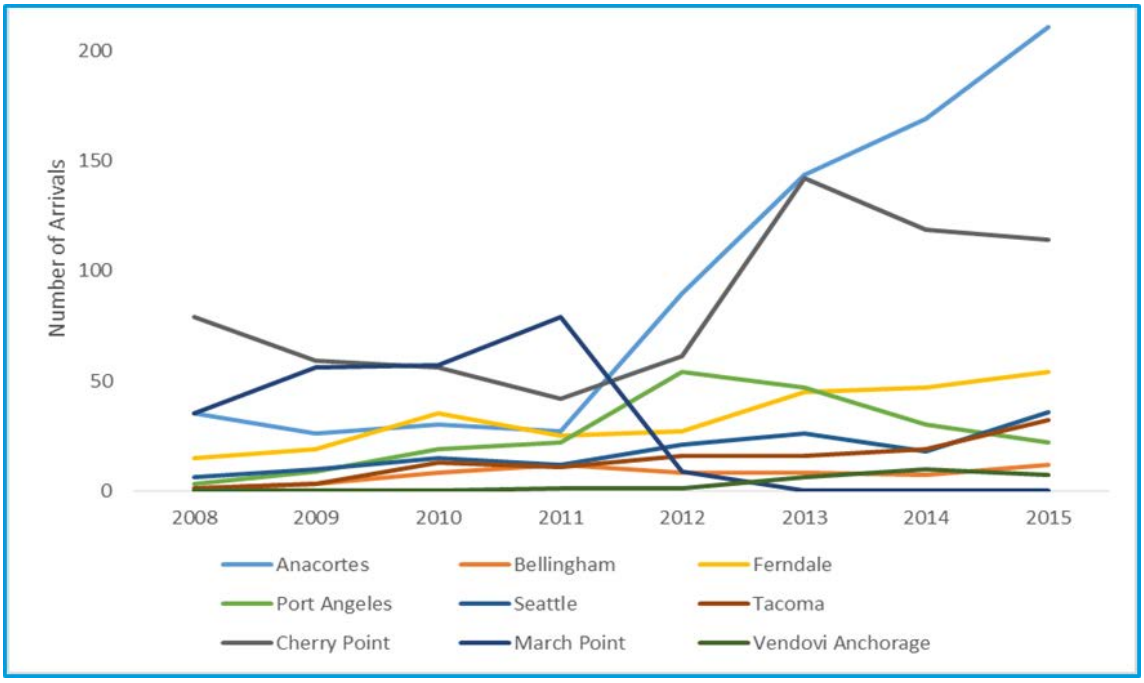

Figure 14: ATB / ITB arrivals over time by port / anchorage

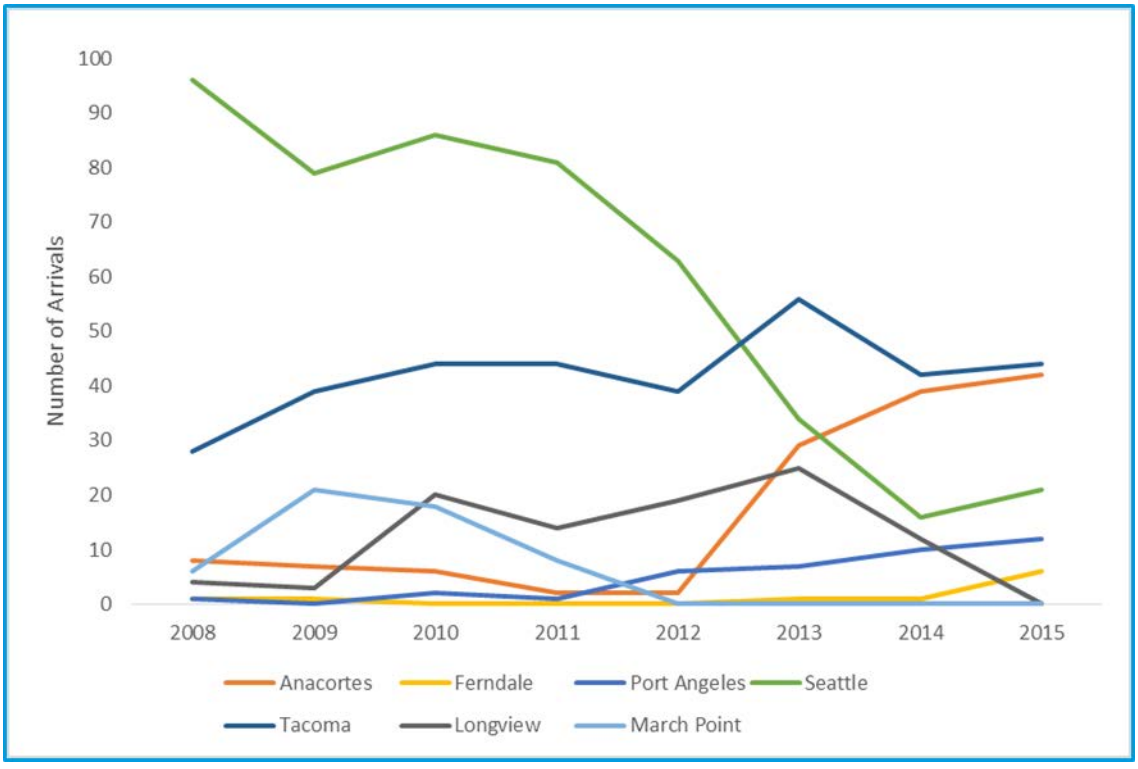

Figure 15: Barge arrivals over time by port

Seventeen individual fish processing vessels and 60 individual fishing vessels (≥300GRT) made over 750 visits to Washington from 2008 to 2015, most commonly to Seattle.

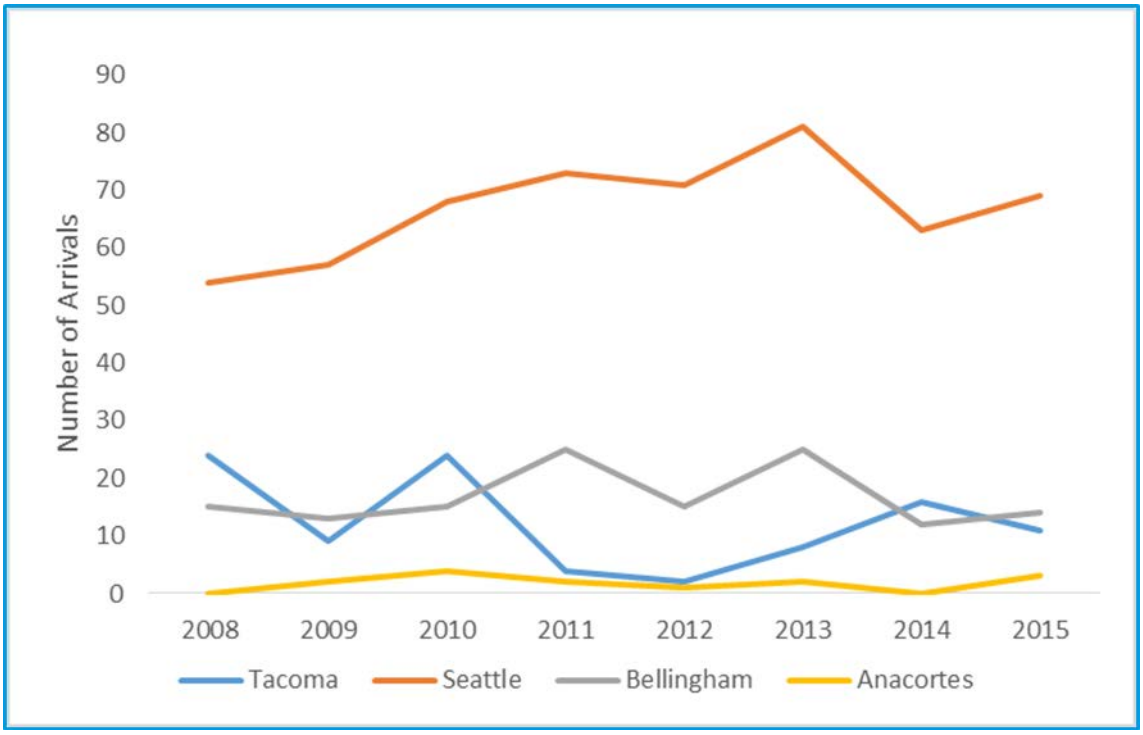

Figure 16: Fishing and fish processing vessel arrivals over time by port

Fourteen research vessels arrived 35 times to Washington from 2008 to 2015, again most commonly to Seattle (Figure 17).

Twelve large tugs or towing vessels arrived over 60 times to Washington ports from 2008 to 2015 (Figure 18). The volume was driven by arrivals in later years. There were almost no arrivals reported up to 2012, though whether this is due to a lack of arrivals or a lack of reporting is unknown. The highest volumes appear to have been in Anacortes and Everett.

Vessels in the 'Very High' biofouling risk category include drilling and dredging vessels. The 7 arrivals of drilling vessels from 2008 to 2015 were made by 3 vessels, all staging for Arctic oil exploration. Due to low hydrocarbon prices and the poor result of the exploration of the Chukchi Sea in 2015, it is unlikely that Washington will see more drilling vessels in the near future.

The 13 dredging vessel arrivals were comprised of multiple visits by a total of 4 unique vessels. Dredge projects are expected to continue through at least 2023, though the ports visited will change over time as needed. According to the Dredged Material Management Program, there were 42 dredging projects in the pipeline to be characterized for an approval determination in 2014/2015 (Army Corps 2015). The projects ranged throughout the state, with the largest project volumes in the ports of Clarkston and Lewiston (Lower Snake/Clearwater Channel), Longview (Columbia River), Olympia Harbor (Puget Sound), and Grays Harbor (Coast).

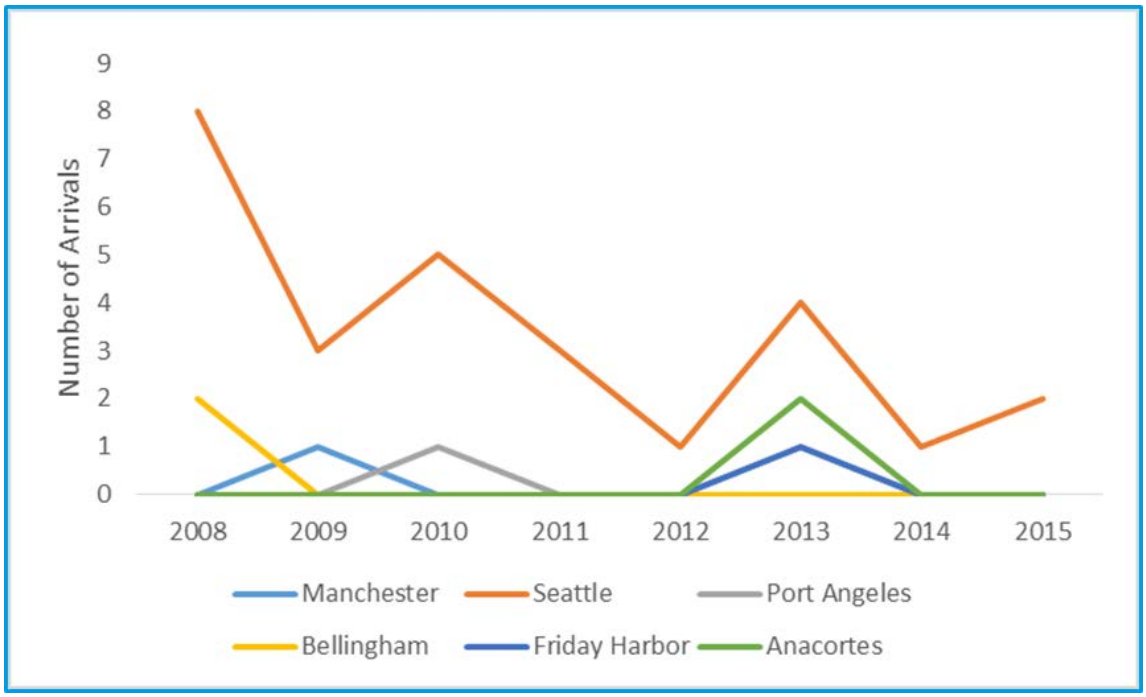

Figure 17: Research vessel arrivals over time by port

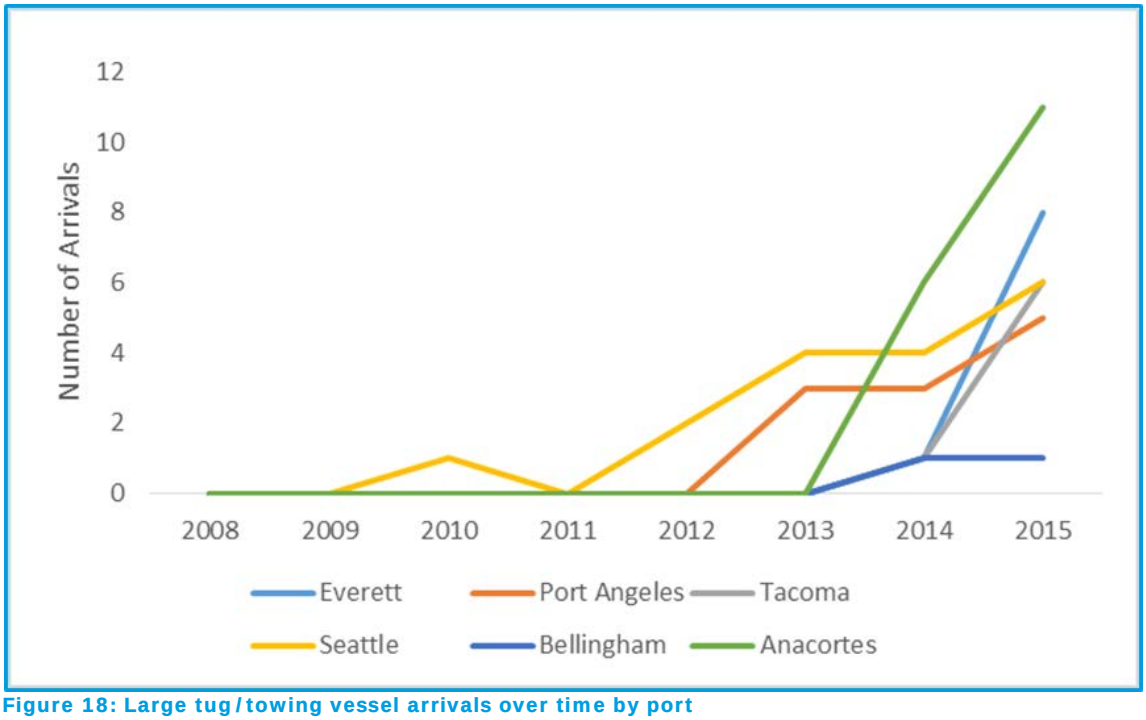

Figure 18: Large tug/towing vessel arrivals over time by port

2.2 Biosecurity / Biofouling Management in Context: Global, Federal, State and Regional Approaches

International Maritime Organization / Marine Environmental Protection Committee

The IMO was established as part of the United Nations with the purpose of establishing joint guidance and legislation to promote international safety and pollution prevention in the maritime sector. The Marine Environmental Protection Committee (MEPC) is responsible for putting forth guidance and building consensus among member states to create regulations related to biofouling. The current guidance for biofouling management by MEPC is Annex 26: Resolution MEPC 207(62) which was adopted on 15 July 2011. This annex was created to commit to minimizing the transfer of invasive aquatic species which led to the commitment to also consider guidance related to biofouling. Other notable organizations have recognized the importance of management of AIS. These organizations include the Convention on Biological Diversity (CBD) and several United Nations Environment Programs (UNEP) Regional Conventions (such as the Barcelona Convention for the Protection of the Mediterranean Seas and the Asia Pacific Economic Cooperation Forum, or APEC).

The IMO guidelines for control and management of AIS are intended to provide global continuity to the approach of management of biofouling. Additionally, the guidance is meant to be useful to all parties involved with shipping, including regulators, shipmasters, operators and owners, shipbuilders, ship cleaning and maintenance operators, port authorities, ship repair, dry dock facilities, ship designers, anti-fouling paint manufacturers, and other interested parties.

While the MEPC guidance will not be discussed in detail in this document, this section is intended to provide an overview of its suggested biofouling management practices. The relevant sections of the MEPC Annex 26 consist of:

- A biofouling management plan can be a standalone document or part of a ships operations and procedures manual. Elements of the Plan should include:
  - Details of the anti-fouling systems and operational practices or treatment used;
  - Hull locations susceptible to biofouling, and details related to planned inspections, repairs and maintenance;
  - Details of the operating conditions suitable for the selected anti-fouling system;
  - Details of the documentation required to verify success of any treatments.
- Biofouling Record Book detailing the inspection and biofouling management practices undertaken on board the ship. Deviations from the expected operational profile of the vessel that may increase biofouling are also recorded, as well as dates and locations of extended lay-up periods. The record should be maintained for the life of the ship.
- Anti-fouling system installation and maintenance should be chosen based on the ships operating profile. The anti-fouling system approach should include scheduled maintenance, re-installation and repair procedures.
- Facilities related to ship maintenance and recycling should also adopt measures to ensure AIS are not released into the local environment. Such measures may include capture of biological material, testing of biological material prior to disposal, removing biofouling when ship is in dry dock.

- In-water inspection, cleaning and maintenance to help prevent spread of AIS. Inspections may be conducted before and after period of inactivity or significant changes in ships operating profile, prior to any in water cleaning determine the presence of AIS, or following damage or failure of anti-fouling system. In-water cleaning may be regulated at a regional level and each state or region should conduct a risk assessment to evaluate any potential threats to surrounding environment from cleaning practices.
- Design and construction of ships should employ design practices in which small niches and sheltered areas are either excluded from the design if practical or made easily accessible for cleaning purposes. Other considerations include rounding and/or beveling corners, and providing means to more easily access areas that need to be cleaned or treated.
- Dissemination of information is encouraged among member states to share knowledge and promote collaboration amongst entities. States are encouraged to provide MEPC with copies of current regional, national, and local laws standards or exemptions. It is important to share in technical research and educational materials and provide the location of cleaning and maintenance services, including:
  - Training and education should be provided for ships masters and crew and operators of cleaning and maintenance facilities related to the application of biofouling management treatments and maintenance of appropriate records and logs;
  - Member States should encourage and support research into and development of technologies to minimize and manage AIS, in water cleaning, strategies related to comprehensive risk assessments, and rapid response tools to AIS incursions.

The MEPC also adopted guidance to minimize transfer of AIS for recreational craft (MEPC.1/Circ.792). Similar guidance is provided to smaller craft vessels, which includes appropriate anti-fouling coating systems, maintenance of anti-fouling coatings, record keeping, and routine cleaning (with vessel haul-out the preferred option over in-water cleaning that may be suitable for light fouling), and record keeping.

U.S. Coast Guard (USCG)

The U.S. Coast Guard has the authority to regulate AIS based on the enactment of two laws, including: 1) the Non-indigenous Aquatic Nuisance Prevention and Control Act of 1990 (NANPCA) and 2) the National Invasive Species Act of 1996 (NISA). Under NANPCA the Coast Guard is directed to issue regulations and guidelines to control the introduction and spread of AIS in the Great Lakes ecosystem.

The Coast Guard plays an active role on the Aquatic Nuisance Species Task Force (ANSTF). Formed under NANPCA to provide an intergovernmental organization whose mission is to prevent and control the spread of ANS, the ANSTF has seven federal agencies and 13 ex-officio members. It is co-chaired by the U.S. Fish and Wildlife Service and the National Oceanic and Atmospheric Administration. The ANSTF coordinates government interests with those of the private sector through regional panels and issue specific committees.

In addition, the U.S. Coast Guard addresses hull fouling and hull husbandry related to nonindigenous species through regulations included in 33 CFR §151.2035 that require rinsing of anchors and anchor chains to remove organisms and sediment, and removal of fouling organisms from the hull, piping and tanks on a regular basis. Crude oil tankers engaged in coast wide trade are exempt from the requirements of 33 CFR §151.2035 by statute,

however many tank ship companies conduct voluntary hull maintenance operations; typically in conjunction with dry dock inspections mandated by Merchant Class Societies such as the International Association of Classification Societies, Ltd (IACS), and the U.S. Coast Guard.

The USCG and the U.S. EPA signed a memorandum of understanding on February 14, 2011 to cooperate on vessel compliance with the issuance of the Vessel General Permit.

United States Environmental Protection Agency

The 2008 Vessel General Permit (VGP) regulates discharges incidental to the normal operation of vessels operating as a means of transportation. The VGP is issued by the permitting authority which is the EPA. The permit covers the following limits or requirements: 1) general effluent limits applicable to all discharges; 2) effluent limits applicable to 26 specific discharge streams; 3) narrative water-quality based effluent limits; 4) inspection, 5) monitoring, 6) recordkeeping and reporting requirements; and 7) additional requirements applicable to certain vessel types (USEPA, 2008a).

The EPA added hull husbandry practices into the VGP (EPA 00-R-11-004 November 2011). They include selecting an appropriate antifoulant management system and maintaining that system, in water inspection, cleaning, and maintenance of hulls, and thorough hull and other niche area cleaning when a vessel is in drydock. Overall, there is less detail on biofouling management in the VGP than is provided by the IMO, but the VGP does provide more information on hull cleaning practices and the type of AFCs allowed. Regulations within the VGP state that underwater ship husbandry must be conducted in a manner that minimizes the discharge of fouling organisms and antifouling hull coatings, and the cleaning of copper-based AFCs must not produce a visible plume of paint. It also states vessels must dispose of wastes in accordance with federal, state and local laws. AFCs are subject to registration under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) (see 40 CFR § 152.15) and must be registered, sold or distributed, applied, maintained and removed in a manner consistent with applicable requirements on the coatings' FIFRA label.

Vessels are expected to file annual reports with the EPA under the VGP, which include whether an AFC is used, product specifications and application date.

2.2.1 Regional and International Approaches

Biofouling management programs vary greatly within the Northwest region and between West Coast states. All states have noted the importance of managing the movement of aquatic invasive organisms between waterways. However, biofouling management approaches range from non-existent (Alaska), to researched/planned but not yet enacted (Hawaii, California).

Washington

While an all-encompassing biofouling management program does not yet exist for the state of Washington, there are two lead programs that manage the movement of aquatic invasive species to state waters including: the Aquatic Invasive Species Program and the Ballast Water Management Program, both of which are operated by the WDFW. WDFW regularly conducts mandatory watercraft check stations for overland transport of recreational boats, and requires all vessels on which AIS are detected to follow the applicable decontamination orders pursuant to RCW 77.135.130. However, focus has been placed on the prevention and elimination of invasive zebra and quagga mussels with check stations primarily located at freshwater boat launches. An action plan to address and control biofouling of commercial shipping vessels in state waters is not in place.

The Water Quality Program operated by the Washington State Department of Ecology provides guidance on hull cleaning and removal of fouling organisms. Currently it is unlawful for in-water hull cleaning of boats coated with soft toxic paints. Those with non-toxic paints require approval prior to any in-water hull cleaning (ECY 2014).

Oregon

As in Washington, the state of Oregon does not have a biofouling or aquatic invasive species management plan that encompasses all vessels (whether recreational or commercial) and in all waterways (whether freshwater or marine). The Department of Environmental Quality Ballast Water Program regulates the discharge of commercial vessel ballast water within state waters and has been recommended (via the interagency Shipping Transport of Aquatic Invasive Species Task Force) to enact management of biofouling within the commercial sector. This would include an increased awareness and ongoing monitoring of biofouling management policy developments in neighboring jurisdictions as well as shipbreaking activities on Oregon shores that may require biofouling prevention measures (DEQ 2015).

The Oregon Department of Fish and Wildlife Aquatic Invasive Species Prevention Program regulates the movement of aquatic invasive species from personal/recreational watercraft. As per Oregon Administrative Rule (OAR) 635-059-0010), if aquatic invasive species are found on or inside a watercraft, the owner/operator must provide the department with an accurate history as to where the watercraft has been during the last six months. The department operates mandatory overland watercraft inspection check stations at ports of entry for AIS detection and decontamination of personal watercraft. In addition, AIS prevention permits are required for all motorized (any length) and non-motorized (longer than 10ft) watercraft (ODFW 2016).

California

If adopted, beginning July 1st, 2017, California will operate the most stringent and comprehensive plan on biofouling management on the West Coast. The Marine Invasive Species Program, operated by the CSLC, has regulated ballast water management since 2000; the proposed regulations will add comprehensive biofouling management to the program's regulatory oversight. As per the California Code of Regulations (Title 2, Division 3, Ch. 1, Article 4.8), since 2008 any vessel carrying, or capable of carrying, ballast water into the coastal waters of the State has been required to file the annual "Hull Husbandry Reporting Form" developed by the CSLC that provides information regarding the hull husbandry practices relating to the vessel, within 60 days of receiving a written or electronic request from the Commission.

Biofouling management requirements apply to vessels equal to or greater than 300 gross registered tons and capable of carrying ballast water. Hull fouling organisms must be removed regularly, which is defined as either no longer than: 1) the expiration date of vessel's Safety Construction Certificate, 2) the vessel's US Coast Guard Certificate of Inspection, or 3) Five years since the vessel's most recent dry docking (CSLC 2015). Currently, a Hull Husbandry Reporting Form is required to be submitted within 60 days of a written or electronic request from the CSLC. The proposed Marine Invasive Species Program will include a new Marine Invasive Species Program Annual Vessel Reporting Form that will replace the Hull Husbandry Reporting Form and be required 24 hours in advance of the first arrival at a California port during a calendar year. Additional CSLC proposed regulations include requiring vessels arriving at California ports to have a biofouling management plan and a biofouling record book of inspections and hull husbandry maintenance. The management plan and record book follow guidelines outlined by the IMO (2011), though

California requests more detail in specific areas. For example, where the IMO states that the management plan should include "anti-fouling system specifications (including dry film thickness for coatings, dosing and frequency for MGPSs, etc.) together with the expected effective life, operating conditions required for coatings to be effective, cleaning requirements and any other specifications relevant for paint performance", California specifies "include the vessel's final specification document for the anti-fouling coating applied or a separate list documenting the information required by this subparagraph. The specification document or separate list shall include the parameters of the vessel's operating profile used for the specification of the anti-fouling system, including, at a minimum:

- The specified intended out-of-water maintenance or dry-docking interval of the vessel;
- The specified range of vessel operating speeds;
- The specified vessel activity level (e.g. percentage of time underway at sea compared with percentage of time berthed, anchored, moored, or adrift), if applicable;
- The specified vessel operating area or trading routes (e.g. coastal, deep-sea), if applicable.
- Specify the applied dry film thickness;
- Specify the manufacturer's expected effective coating lifespan (e.g. 60 months) at applied dry film thickness
- Include a copy of the vessel's International Anti-fouling System Certificate used to comply with the International Maritime Organization's Convention on the Control of Harmful Anti-Fouling Systems on Ships (also known as AFS Convention; entered into force on September 17, 2008), if applicable.

And for marine growth prevention systems

- Indicate where anodes or dosing outlets are installed (i.e. sea chest, strainer, or other location within seawater intake system); and
- Specify manufacturer's recommended doses and dosage frequency, if applicable.

The California Department of Fish and Wildlife (CDFW) monitors invasive species populations and the effectiveness of prevention/eradication programs. This includes large-scale surveys of impacted or sensitive areas, a publicly available database of invasive species present in California, rapid-response management practices to help eradicate infestations and limit spread, and educational outreach to quickly distribute AIS awareness (CDFW 2008).

Alaska

There are currently no biofouling regulations or management practices in place for the state of Alaska. The release of aquatic invasive species via ballast water is also not monitored. In 2002, an Aquatic Nuisance Species Management Plan was approved by the federal Aquatic Nuisance Species Task Force. This plan proposes various actions to prevent, detect, and eradicate invasive species. Some suggested ideas are coordination with British Columbia, Washington, and Oregon over aquatic invasive species management including:
1) detection/monitoring/eradication of aquatic invasives in Alaska quickly with minimal environmental harm, 2) development of a database of AIS sightings/populations; and
3) public outreach in regards to aquatic invasive species threats in Alaska (ADFG 2002).

Hawaii

Within the state of Hawaii, the Department of Land and Natural Resources has been appointed the lead agency in biosecurity and biofouling management, as per Hawaii Revised Statutes (HRS) 187A-32. Extensive and comprehensive ballast water and biofouling policies are currently being funded and developed for Hawaii. Proposed management ideas include mandatory hull inspections/certification, establishment of hull cleaning standards, and targeted biofouling outreach towards shipping and fishing industries (DON 2015). In 2013, commercial and recreational boating surveys were conducted to obtain data on hull husbandry (in-water vs dry dock cleaning), biofouling prevention, and vessel history. While there are no current management requirements in place for biofouling or AIS in the commercial vessel vector, an all-encompassing regional biosecurity risk assessment and plan between Micronesia communities (including Hawaii and Guam) has been published (DON 2015).

British Columbia (Canada)

Two provincial agencies in British Columbia (BC), Canada oversee aquatic invasive species management including the BC Ministry of Forests, Lands, and Natural Resource Operations and the BC Ministry of Environment. Current biofouling plans are targeted to freshwater AIS management. A recreational watercraft inspection program was started in 2015 and is focused on the detection, prevention, and eradication of zebra and quagga mussels (MOE 2015).

At the national level, there currently are no regulatory initiatives in Canada to reduce dispersal by means of hull fouling. However, Transport Canada adopted the IMO (2011) "Guidelines for the control and management of ships' biofouling to minimize the transfer of invasive aquatic species", along with the IMO (2012) "Guidance for Minimizing the Transfer of Invasive Aquatic Species as Biofouling (Hull Fouling) for Recreational Craft" for owners and operators of recreational craft less than 24m in length. These guidelines recommend that every ship should have a biofouling plan, anti-fouling systems/practices in place, and a biofouling record/management book that records all details pertaining to vessel anti-fouling management and inspections. In addition, out-of-water hull cleaning activities are recommended at least annually and/or before a trip.

New Zealand & Australia

As discussed by Davidson et al. (2014a), New Zealand and Australia have well developed legislative, policy and regulatory tools for managing the biosecurity risks in general, including those arising due to the biofouling pathway. Although markedly different in size, both these island-nations share a high degree of geographic isolation, which has led to a high degree of biodiversity and biological endemism. This isolation has also led to a heavy reliance on trade and a recognition of the threat that AIS (as well as invasive terrestrial species) pose to environmental, economic and socio-cultural values (Hewitt et al. 2004; Hewitt & Campbell 2007).

In New Zealand, biofouling is managed through application of a standard to limit excessive levels of growth. The 'Craft Risk Management Standard' is currently voluntary but comes into force in 2018 (Ministry for Primary Industries (MPI) 2014). Vessels must arrive in New Zealand with a 'clean hull' which is defined based on the expected duration of stay in New Zealand waters.

'Short stay' vessels are those which remain in New Zealand for 20 days or less and are restricted to designated first ports of arrival. Short stay vessels are permitted to carry (apart from a 'slime' layer or goose barnacles) some macro-fouling including tubeworms, barnacles,

bryozoans and algae, to a level of no more than about 1-5% coverage of the hull or individual niche areas. 'Long stay' vessels, will only be allowed to carry a slime layer and goose barnacles; no other live biofouling will be permitted.

A number of alternative means are specified in order to permit meeting this clean hull standard, including:

- Cleaning before arrival in New Zealand, (or immediately on arrival in a facility or by a system, approved by MPI), with biofouling removed from all parts of the hull, less than 30 days before arrival in New Zealand or within 24 hours after time of arrival;
- Continual Maintenance using best practice including: application of appropriate antifoul coatings; operation of marine growth prevention systems on sea-chests; and in-water inspections with biofouling removal as required. Following the IMO Biofouling Guidelines is recognized as an example of best practice;
- Application of Approved Treatments. Treatments are approved and listed under the Approved Biosecurity Treatments MPI-STD- ABTRT.

Alternatively, vessel operators may submit to MPI for approval a 'Craft Risk Management Plan', which includes steps taken to reduce the risk to a level similar to these standards.

In Australia, biofouling is managed under a variety of acts, including the Quarantine Act (1906), the Biological Control Act (1984) and more recently the Biosecurity Act (2015). Prior to the latter act, a National System for the Prevention and Management of Marine Pest Incursions provided the framework for managing biofouling. A number of sector-based biofouling management guidelines were prepared, including for commercial, non-trading, fishing, petroleum and aquaculture vectors.

Those guidelines took a target-species based approach where management for a suite of unwanted species was undertaken in the different vector classes. This approach is currently under review and it is expected that revised policy statements and guidelines will be released in later 2017. Based on the current public consultation documents (DAWR, 2016), it is likely that there will be a move towards a risk management approach, with a focus on managing the pathways and vectors of introduction of AIS.

2.2.2 Stakeholders in Biofouling Management

A variety of key stakeholders in Washington are involved in biofouling management, ranging from government and industry to private interests and the general public. The BWWG includes representation from a variety of different sectors and is the initial point of contact during consultations.

Puget Sound is heavily used by industry, and stakeholders include the vector operators, including (but not limited to) commercial organizations involved in shipping, transport, fishing, aquaculture, tourism and service providers. Community groups also have an interest in biofouling management, namely the owner/operators of recreational vessels and recreational/cultural users of the coasts and coastal waterways. There are also a number of coastal tribes that border or have customary interest in the marine environment of Puget Sound.

Agencies and interested/stakeholding parties include:

Government agencies

- Washington Department of Fish and Wildlife: regulates AIS prevention and management throughout the state.
- Washington Department of Ecology: governs water quality of state waterways and provides guidance on hull cleaning of biofouling organisms.
- Washington State Invasive Species Council (part of the Washington State Recreation and Conservation Office): provides research, funding, and educational outreach between government and non-government organizations as well as community conservation groups and tribes.

Non-government organizations and community work groups

- Pacific States Marine Fisheries Commission (PSMFC) - AIS Prevention Program: This program includes two stakeholder work groups. The Pacific Ballast Water Group promotes development and implementation of ballast/biofouling AIS management along the West Coast associated with shipping. The PSMFC 100th Meridian Initiative's Columbia River Basin Team is a freshwater group that is focused on preventing the spread of zebra mussels and AIS in the west. It also conducts voluntary boater surveys and monitoring.
- Aquatic Nuisance Species Task Force's Western Regional Panel: This joint group between public and private sectors promotes AIS management in western region of North America. It coordinates with governmental agencies, state tribes, universities, community conservation groups, and commercial stakeholders.
- Pacific Northwest Economic Region (PNWER) Foundation's Invasive Species Working Group: This working group has developed a framework to prevent the introduction of invasive quagga and zebra mussels into the region.

Regulated Community

- Organizations, companies and individuals that will be directly affected by this program, that is, will be required to more effectively manage biofouling through compliance with this policy and subsequent regulations. This may include representatives of the existing Ballast Water Work Group including, for example, the American Waterways Organization (AWO) and the Pacific Merchant Shipping Association (PMSA), as well as individual shipping/logistics companies. Representatives of vessel classification societies, such as the American Bureau of Shipping (ABS) may also be considered part of this community.

Academic stakeholders and programs

- Washington Sea Grant (WSG): Sea Grant is a federal program that varies its focus by state. Washington Sea Grant provides educational outreach and research specific to WA state waters. In addition to its environmental programs, WSG actively engages the K-12 community in AIS education by providing tool kits to identify invasive aquatic organisms as well as an understanding of the importance behind their management.
- Universities and Research Institutes: There are numerous tertiary academic institutions in Washington State and the nearby Canadian province of British Columbia with interests in the marine environment of Puget Sound. Several marine research laboratories are also present, including at Friday Harbor, Rosario Beach, Port Gamble, Sequim and Shannon Point.

3. BIOFOULING MANAGEMENT STRATEGY: GUIDING PRINCIPLES

3.1 Principles & Outcomes: The Objectives and Scope of the Plan

Fundamentally, the objective of an effective biofouling management system is to minimize the risks and impacts to environmental, economic and community values associated with this vector. It is acknowledged, however, that this risk cannot be reduced to zero and as such, new incursions of AIS, and subsequent negative impacts will likely occur.

With this in mind, seven Principles have been identified that are central to the State's approach to minimizing risk due to the biofouling pathway. Each of these guiding Principles is associated with outcomes for achieving the goals for the State. The seven key Principles for managing risk associated with the biofouling pathway are:

- Environmental, economic, and community protection.
- Shared responsibility.
- Preventative approach.
- Risk-based management.
- Integrated regulatory approach.
- Performance measures.
- Applied Research and Development.

These Principles, with their associated outcomes and activities, are discussed in the following sections.

3.1.1 Principle 1: Environmental, Economic & Community Protection

The fundamental goal of biofouling management is to protect the environmental, economic and community values of Washington State from damage due to the introduction and spread of AIS via the biofouling pathway. The introduction, establishment and spread of an AIS in the Puget Sound area can significantly impact local environments through displacing, smothering and/or out-competing native species for vital resources that may be essential for supporting commercial production, including capture fisheries and aquaculture. Some AIS have the ability to grow and reproduce rapidly and can completely obstruct cooling water intakes in short time periods, posing significant economic costs for cleanup and ongoing control. Other AIS can produce toxins that can be biomagnified by cultured food species and thus pose a risk to human health.

Outcomes, which will promote this Principle and the activities that support these outcomes, include:

Outcome 1.1: Healthy, resilient ecosystems that are resistant to invasion by AIS. This outcome is supported by the following activities:

- Habitat protection throughout Puget Sound is prioritized.
- Environments already degraded by AIS are remediated.
- High biodiversity value assets are identified for protection through surveillance and monitoring.

Outcome 1.2: Economic activity is not impacted by AIS, which is maintained by:

- Prioritization of commercially valuable marine resources for protection through surveillance and monitoring.
- Development and (when required) implementation of rapid response protocols, including the requisite legislative/regulatory instruments for AIS that may impact commercially valuable species.
- Effort is made to ensure that commoditized marine resources are considered by our markets to be pest and disease-free.

Outcome 1.3: Recreational, aesthetic and cultural values of coastal environments are not degraded by AIS through:

- Recreationally and culturally valuable areas are targeted for surveillance and monitoring for AIS.
- AIS already present in Washington are managed to reduce potential impacts on recreational and cultural use and enjoyment.

Outcome 1.4: Human health and wellbeing are not affected by AIS, through:

- Surveillance for AIS that can negatively impact on human health.
- Development (and if necessary implementation) of rapid response, control and mitigation protocols for those species that can affect human health and wellbeing.

3.1.2 Principle 2: Shared Responsibility

Biofouling management is viewed collectively as a responsibility that is shared by the State, general public, resource managers and users. Aside from the commercial users of the resource, the wider community can play an important role in the detection and management of AIS through the State. Although 'Shared Responsibility' is a core Principle upon which effective management lies, it does not imply that all participants within the biosecurity system will play identical roles, nor have identical responsibilities. Principle outcomes, with their supporting activities, include:

Outcome 2.1: All partners in the biosecurity system understand and agree with the aims and objectives of the biofouling management strategy and individual roles and responsibilities. This outcome is achieved through the participants having:

- A shared vision for managing biofouling risks.
- Clearly articulated and understood roles and responsibilities.
- The capability and willingness to deliver on their roles and responsibilities.

Outcome 2.2: The wider community is aware of the importance and is actively engaged in managing the biofouling pathway. Activities that can help achieve this outcome include:

- Development and distribution (including via social media) of educational/awareness materials to inform the public of the problem, risks and the solutions.
- Developing and implementing a program of active community engagement.
- Regular, ongoing liaison between government and all stakeholders.
- Governance structures are in place to facilitate shared responsibility.

- Information on the biology, dispersal characteristics and habitat requirements of AIS.
- Consideration of the potential relationships between vectors and AIS impacts.

3.1.3 Principle 3: Preventative Approach

International experience has conclusively shown that preventing the introduction of AIS is far more cost effective and environmentally friendly than eradication or control. This is demonstrated in a graphic obtained from the Australian state of Victoria which provides indicative economic returns for different levels of management response (Figure 19).

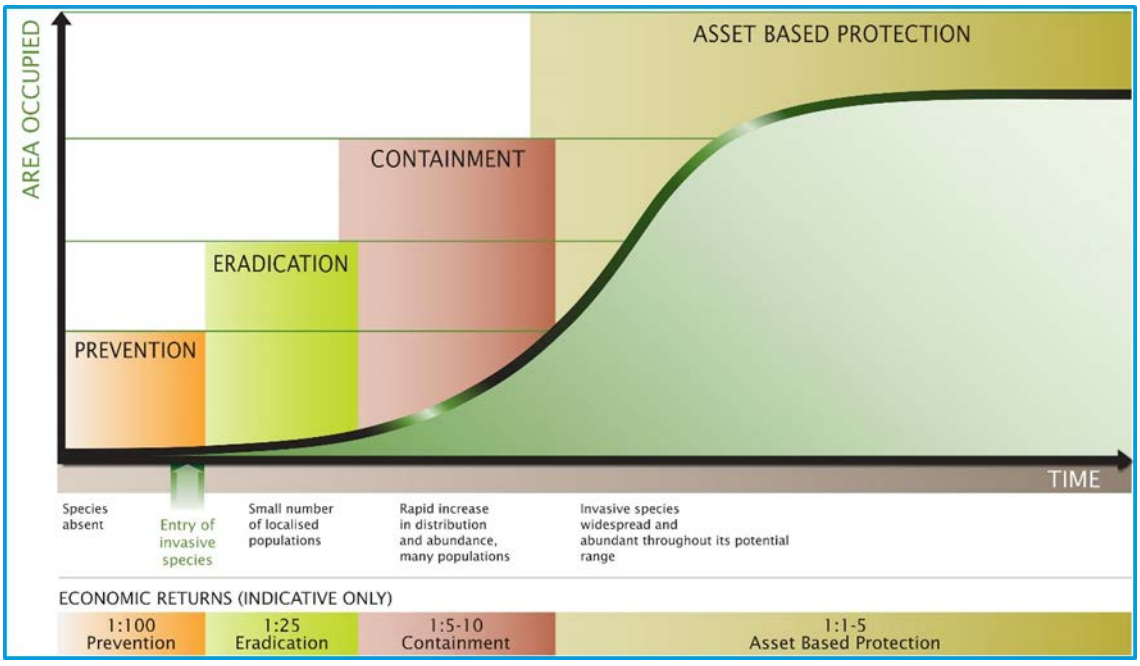

Figure 19: Indicative economic returns for different levels of management response Generalized invasion curve (solid green line) outlining the type of actions possible (prevention, eradication, containment, protection) and indicative economic returns during the different phases of an invasion[2]

Preventing the introduction of AIS via the biofouling pathway will be the focus of this Biofouling Management Strategy. This Principle is supported by the following outcomes and actions:

Outcome 3.1: Effort is focused on preventing the arrival and spread of AIS in State waters. Activities that can help achieve this outcome include:

- Promoting the application of Biofouling Management Plans (BMP) and Record Books among vessels entering Washington State thus minimizing the occurrence of fouling on vessels and fouled vessels.
- Risk assessment of potentially high risk vectors occurs prior to arrivals in State waters.
- Communicating the importance of stopping or preventing the spread of AIS on vessel hulls.

[2] agriculture.vic.gov.au/agriculture/pests-diseases-and-weeds/protecting-victoria-from-pest-animals-and-weeds; accessed 27/07/2016

3.1.4 Principle 4: Risk-Based Management

Traditionally, prescriptive approaches to managing potential environmental impacts were designed to apply to all potential resource users equally, regardless of the likelihood of an impact attributable to a particular activity. Decision makers effectively have a choice to either permit or prohibit an activity based on pre-determined criteria.

An example of such an approach, in a biosecurity context, would be a complete ban on the movement of vessels into a given high value area to protect the area from a potential incursion by a given pest species. Such a regulation, while likely resulting in a reduction in the risk, can be viewed as overly restrictive of access to the area in question when the likelihood of translocating the pest varies markedly between different vessel types.

Risk-based management (RBM), on the other hand, facilitates an alternative approach environmental management by introducing the option of considering additional evidence prior to decision making[3]. RBM takes into account both the likelihood and consequences of a potential impact by a particular class or category of users. Using RBM, only those vessels or vectors that are assessed as posing a high risk might be restricted from access, or require mitigation efforts to reduce the risk prior to gaining access. In essence, additional information is used in a precautionary, proportionate manner to assess the potential impact prior to making a decision on access.

RBM takes into account the risk profiles of different resource users or potential impacts prior to making a decision, such as whether to prioritize or commit resources to a response. Factors to be considered when evaluating a course of action would include, among other things, the costs and benefits, feasibility of success and potential impacts on environmental, economic and cultural values and human health.

The risk-based framework for decision making is thus:

- Flexible: RBM frameworks are more flexible than traditionally prescriptive regulatory measures, being applied based on the perceived risk rather than a 'one size fits all approach'.
- Precautionary: RBM can facilitate rapid responses to biosecurity emergencies in the absence of 'complete' evidence.
- Proportionate: Decisions to manage the risk are effective and proportionate.
- Transparent: Prioritization of investment decisions is consistent and transparent, particularly when faced with uncertainty (Campbell 2008).

In the context of biosecurity, RBM relies upon the following:

- Vector Characterization: the nature of the vectors of AIS – for example, what are they (e.g., ships, boats, barges, recreational yacht), where are they located, what are the spatial and temporal movement patterns or pathways.
- Risk Assessment: the likelihood of an AIS becoming introduced and established and what are the consequences (public health/environment/community/economy).

[3] It is worth noting that several other jurisdictions, including California, use performance standard-based regulations rather than prescriptive requirements. The performance standard approach is similar in effect and flexibility to the risk-based management approach.

- Mitigation Methods: the efforts made to mitigate the risk and effects of introduction and establishment; the hierarchy of responses ranges from actions undertaken prior to arrival (pre-border), upon arrival (border) and after arrival (post-border) in State waters: no intervention → vector management → surveillance & response → population management → eradication.
- Legislation: a legislative/regulatory framework that permits a flexible, precautionary and proportionate approach to managing risk and rapid responses.

Outcomes and activities that support this Principle include the following.

Outcome 4.1: Vector risks (likelihood and consequence of impacts) are evaluated and understood, including:

- Factors influencing vector risk are defined.
- Risks posed by different vector types are assessed.
- Vector pressure (frequency * volume) is understood.
- Vector origin and maintenance history inform the risk evaluation.
- Consideration is given to changes in the vector risk profile during the risk evaluation.

Outcome 4.2: Organism risks are understood, including:

- Organism threat assessments are conducted when required (e.g. in event of a new incursion), including:
  - Organism distribution, abundance and biogeographic information (native and introduced ranges) is compiled and used to inform the risk evaluation.
  - Potential impacts on environmental, economic and community values and human health are assessed.
  - Potential intervention costs under different scenarios (e.g. eradication, containment, asset protection) are evaluated.

Outcome 4.3: Vector and habitat surveillance, monitoring and record keeping inform regular upgrades, including:

- Routine, targeted inspection for AIS on high and medium risk vectors with random auditing.
- Routine habitat and fixed infrastructure monitoring for AIS (including by passive methods) is conducted in order to both detect new incursions and inform risk assessments.
- Vector operators maintain records of biofouling management practices (e.g. docking and/or cleaning intervals, antifouling coatings, marine growth prevention systems) and activity profiles that are routinely audited to help inform both general and vector-specific risk assessments.

3.1.5 Principle 5: Integrated Regulatory Approach

The Washington State legislative body institutes an approach that recognizes that Washington State is an integral part of regional, national and trans-national governance with respect to biosecurity issues. Other regulatory regimes, programs, quasi-governmental and

non-governmental organizations are involved in biofouling management. Ongoing development and implementation of this program will be coordinated with other regional, federal and international agencies, to create a seamless system that functions consistently and without unnecessary duplication across these different levels.

Outcome 5.1: Keeping in line with the protective purposes of this plan there is cooperative management of the biofouling pathway, which is achieved through the following activities:

- State agencies manage the biofouling pathway in an integrated and consistent fashion across different jurisdictions.
- State and federal-level codes for biofouling management are harmonized to remove inconsistencies.
- State codes are at minimum aligned with IMO approaches.
- Regulated actors (e.g. vessel operators, commercial and recreational users) have input to the development and implementation of biofouling management guidance.
- There is coordination with other regional and international entities/organizations with responsibility for biofouling management.
- Liaison between government, non-governmental and advisory agencies occurs in an ongoing fashion to ensure that biofouling management is efficient and non-duplicative.
- Biofouling management regulations are reviewed at varying stages of development/implementation with regional partners to ensure consistency across jurisdictions to the extent possible.

3.1.6 Principle 6: Performance Measures

A fundamental consideration during the development and implementation of any management plan is an understanding of how success (or otherwise) is measured. The ideal performance outcome from a biosecurity perspective would be the prevention of any further introductions of AIS to State waters. There are a variety of measures which will contribute towards reaching this outcome, including actions that occur prior to an AIS reaching state waters (pre-border activities), at the border and after an introduction has occurred (post border activities).

Pre-border activities focus on identifying potential vector threats and undertaking risk assessment. Vectors identified as high risk must then either have their movement restricted while in State waters, or mitigations must be put in place to reduce the biofouling risk to an acceptable level.

Performance Measure 6.1: All potential biofouled vectors are identified and their relative risks assessed.

Performance Measure 6.2: The number of high risk biofouling vectors entering State waters is minimized.

Performance Measure 6.3: Mitigation plans are developed for high risk vectors that are deemed as necessary arrivals and the mitigations are successful in reducing the biofouling risk to acceptable levels.

Activities at the border include intercepting high or uncertain risk vectors that are not identified prior to entry to State waters. Follow-up activities can include further risk

assessment, direct inspection and the development and implementation of risk mitigation plans.

Performance Measure 6.4: All biofouling vectors considered to pose an uncertain or high risk are either subject to restricted movement in State waters or become subject to management intervention at the border.

Performance Measure 6.5: The biofouling risk of all vectors intercepted at the border is accurately assessed in sufficient time to effect management.

Performance Measure 6.6: Mitigation plans are developed and successfully implemented for high risk vectors that arrive in State waters.

Post-border activities are those that focus on managing the potential impacts of uncertain or high risk vectors and AIS that are already present in State waters. Post-border activities would include auditing biofouling management records, preparing/updating vector risk assessments, inspecting high risk vectors and undertaking mitigation actions (e.g. cleaning, imposition of movement controls) on those vectors still considered to pose a high risk of translocating AIS to or around State waters.

Performance Measure 6.7: The biofouling management records of all formerly (prior to mitigations) uncertain and high risk vectors remaining in State waters are routinely audited and risk assessments updated.

Performance Measure 6.8: All formerly uncertain and high risk vectors are considered for routine inspection and mitigation actions as part of ongoing management.

Also of relevance to the ongoing success of biofouling management is the degree to which stakeholders remain engaged in the strategy and its guiding Principles. This will be effected through ongoing liaison with stakeholder representative groups (e.g. the BWWG), individual stakeholders, public education and outreach.

Performance Measure 6.9: Stakeholders remain engaged with the biofouling management program and actively promote its aims and goals.

Performance Measure 6.10: The Department continues to engage on a regular basis with stakeholders through both structured meetings and general outreach and incorporates stakeholder concerns into the ongoing development of the program.

3.1.7 Principle 7: Applied Research & Development

An important principle to consider for effective management of the biofouling pathway is the extent to which biosecurity threats are subject to stochastic, previously unpredictable processes. The risk profile for a given species can, for example, change with time as their geographic distribution or population density changes. The nature of the vector threat itself could possibly change as shipping modalities or intensities change or as new vectors (e.g. hull cleaning practices) arise. As discussed, climate variability can affect the invasive characteristics of a species and the implications of synergistic (e.g. *invasional meltdown*) and cumulative effects to occur. The manner in which the strategy and plan is able to respond to these and other future biosecurity challenges will define its success.

A prioritized program of applied biofouling research will facilitate the ongoing success of the program and underpin building future capabilities and human capacity. Research and development areas, incorporating technological advances where possible, should include focus on:

- Early detection tools.
- Rapid response capabilities
- Long term control tools.

It is important for the State to remain at the forefront of applied biosecurity research in order to provide an approach to biofouling management that is cost effective in the long term. Once operational, ongoing review of the Plan will ensure that it remains flexible and take advantage as new advances in research and data gathering/analysis lead to improved sensitivity in risk assessment, detection and rapid response.

Cost efficiency also requires that research priorities are set in consultation with stakeholders and also other regional and global partners in biosecurity/biofouling management. This will ensure that there is minimal duplication of effort, as well as position the State to take advantage of the best available global expertise and experience.

Outcome 7.1: A suite of early detection tools is developed and implemented:

While pre-border vector management, along with managing the pathways of invasion and spread post-border are essential tools, incursions of AIS must be detected as early as possible. This relies upon the ability to correctly and rapidly distinguish native from non-native taxa. It is also hampered by the fact that the abundance and spatial distribution of AIS at the early stage of an invasion –when management efforts are likely to be most successful- are small and highly localized. With a global shortage in skilled taxonomists, the development of automated technologies to rapidly screen large quantities of samples collected during routine monitoring would be a significant advance over the current state of play.

Molecular identification techniques (e.g., next generation DNA fingerprinting, multiplex PCR, RNA/DNA microarrays) have great promise for the simultaneous screening of large quantities of samples for several species. For example, microarray techniques offer the ability to potentially evaluate tens of thousands of fragments of genetic material –which can then be matched against genetic profiles of known pest species. Molecular methods can also permit determining invasion pathways, to facilitate improved pre-border management.

Outcome 7.2: A coordinated, appropriately resourced rapid response capability is in place:

Once an AIS is detected in State waters, be it on a vessel hull, fixed infrastructure, or on natural substrates, conducting an effective rapid response effort is critical to success. A structured response is critical to success and must include pre-planning, identification of personnel and response tools/equipment, statutory approvals, communications protocols, among other components.

Treating the detection of an AIS on a vessel is particularly problematic, as care must be taken to ensure that the treatment itself does not promote the spread of the target species in question.

Traditional hull cleaning, using mechanical brush-carts and hand scrapers, can result in the spread of viable propagules –either by allowing intact individuals to drop to the seabed or by promoting release of gametes or larval stage propagules from the dying or disrupted adult animal. Recognizing this issue, a number commercial dive contractors around the world have attempted to develop 'total recapture' hull cleaning technologies to prevent the loss of any material arising from hull cleaning.

Alternatively, AIS present on fouled vectors could be treated *in situ* using vessel encapsulation techniques (e.g. Golder Associates 2008; Morrisey et al 2016), rendering all biofouling non-viable while leaving the antifouling coatings intact.

Outcome 7.3: Long term control tools/protocols are developed and available.

It is likely that new AIS will become established in State waters. Developing the means to limit their spread (through vector management) and impact (through population control) is thus a central component of the Plan. Vessel encapsulation, for example can also potentially be used as a longer-term control tool. One regional government in New Zealand (equivalent to a State Environmental Agency), for instance, is currently developing a re-usable floating dock for sterilizing the hulls of vessels up to 25 m long (D. McKenzie, Northland Regional Council, pers. comm to D McClary) with biocides. It is envisioned that resident vessels will routinely use the dock (paying a nominal fee) to reduce the risk that they carry viable AIS. This permits those vessels to journey from areas where AIS are known to be present to those that are identified for protection.

While this is not directly useful for the vessel class to which this Plan applies, there are also plans in development by other research providers to 'segmentally' encapsulate large (up to 200 m long) vessels as well. Such a project would be initially very expensive, but applied across multiple vessels, the unit cost would be at a more manageable level. Longer term control of biofouling risks will also be improved through the ongoing development of novel, highly effective and long lasting antifouling coatings.

4. BIOFOULING OPERATIONAL MANAGEMENT FRAMEWORK

4.1 Introduction

The previous sections of this document have provided information on the management imperative and the resulting strategic direction that the Department intends to follow to manage the biofouling pathway of AIS. The remainder of this document outlines the recommended approach to managing the vector through this Biofouling Operational Management Framework and avenues for essential research in order to better prepare for any introduction of new AIS in the future.

The Operational Framework is comprised of a core operational framework, which includes consideration of the organizational structure required to administer and execute the program. An appropriately designed communications framework for effective stakeholder and public engagement is essential, as is a suite of supporting programs that will inform risk-based management of the biofouling pathway. Compliance with and performance of the Plan in reducing the risk of AIS incursions will also be measured.

This Operational Framework is rooted in our current understanding of the nature of marine biological invasions and associated transport vectors. Research and development, to prepare for the uncertainties in the coming years, is central to the development of the Plan. There will be a need to build future capabilities and capacity in the prevention, detection, rapid response and control of AIS and to incorporate technological advances as they mature. The State must be able to respond to or account for variability in vector pressure, such as changing patterns of vector movements or the appearance of new vector threats due to commercial shipping or exploration activities.

Further, the current practices for in-water cleaning need to be evaluated, both within Washington and in neighboring jurisdictions. There has been a great deal of investment into the development of so-called 'green' vessel cleaning technologies that recapture both biological and chemical contaminants. Such emerging technologies include vessel wrapping and scrub-capture-filtration systems. These technologies require ongoing evaluation to determine efficacy in meeting our guiding Principles for managing the biofouling pathway.

In-water cleaning is currently regulated on an *ad hoc* basis through the general requirement that vessels do not pollute State waters or release prohibited, regulated or unlistedorganisms. Should alterations (or abandonment) to in-water cleaning regulations elsewhere result in increased risk of AIS introduction, the State must be in a position to respond to this increased risk.

Climate variability can also impact the distribution, establishment and spread of AIS. Variable sea temperatures can lead to large scale changes to patterns of ocean currents, altering pathways for the introductions of AIS -potentially resulting in introductions that are not related to the biofouling pathway. Climate variability can alter the resilience of habitats to resist the establishment of AIS. In another scenario, climate change can lead to *invasional meltdown* wherein changing environmental conditions favor establishment of an AIS, which in turn may result in habitat alteration, facilitating opportunities for further introduction of other AIS and related impacts (Simberloff & Von Holle 1999).

The EPA (2008) provided a review of the potential impacts of climate change on AIS, which are summarized in Figure 20 (adapted from EPA 2008).

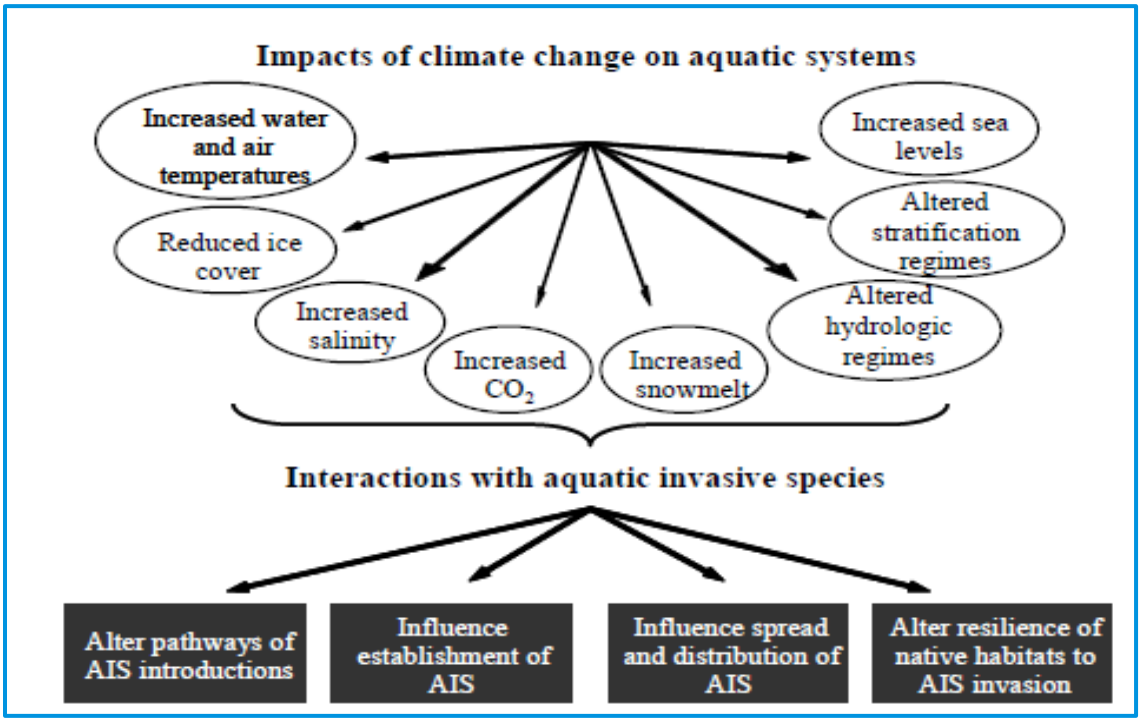

Figure 20: Potential interactions between climate variability and AIS

4.2 Regulatory Gap Analysis

Both section 2.2 on this document and a regulatory gap analysis performed by Glosten (2016) highlight inconsistencies between regional, federal and international approaches to biofouling risk management. Since attempts at management of AIS introduction via biofouling have been undertaken only recently, discrepancies in approaches are not unexpected. After review of the varied regulatory approaches this Plan proposes a level of effort expected to provide sufficient protection of the Washington aquatic environment while minimizing time and costs to both the State and vessels.

Table 2 summarizes the amount of detail or level of effort for each component of biofouling management for each program. More detail and/or effort leads to a higher level of biofouling risk management. The current level of risk management in Washington falls below both federal and international guidelines, as well as those of California. The proposed level of risk management aligns at a minimum with that of California. More detail for alignment to IMO, USCG, EPA and California programs is provided below.

Maintenance requirements: IMO (2011) provides far more detail than both the USCG and the EPA on proper application and maintenance of antifouling systems to minimize biofouling risk, and represents best management practices currently available. Vessels will be required to follow IMO biofouling management plan guidelines, as is expected for California.

Record keeping: While the EPA VGP requires vessels to record any maintenance and inspections performed as part of biofouling management, IMO provides a higher level of detail on the information that should be listed in a biofouling management record book.

California does not request any information different from that of IMO, but it does provide some specificity for elements that help regulators assess biofouling risk, including antifouling application date, designated operational parameters to maintain the highest effectiveness of the antifouling systems, and location and manufacturer's recommended dose for MGPS. Vessels will be required to follow California requirements for record keeping.

Table 2: Comparison of regulations in different jurisdictions for managing biofouling on large vessels

Regulator	Maintenance Requirements	Record Keeping	Reporting	Regulatory Inspections	Data Management	Enforcement	Environmental. Standards - In Water Hull Cleaning	Rapid Response	Infested Site Management	Early Detection[3]
IMO	L3-V	L3-V	--	--	--	--	L1-V	--	--	--
USCG	L1	L1	--	L1	L1	L1	--	--	--	--
EPA	L2	L2	L1	--	--	--	L2	L1	L1	L1
WA (current)	L1	--	--	--	--	--	L3	L2	L2	L2
WA (proposed)	L3	L4	L3	L2	L3	L2	L3	L3	L3	L3
CA (pending)	L3	L4	L2	L2	L2	L2	L3	L3	L3	L3
HI	--	--	--	--	--	--	--	L2	L2	--
OR	--	--	--	--	--	--	--	L2	L2	L2
AK	--	--	--	--	--	--	--	--	--	--
Canada (BC only)	L3-V	L3-V	--	--	--	--	L1-V	L2	L2	L2
New Zealand[1]	L3-V	L3-V	L2	L2	L2	L2	L2-V	L3	L2-V	L3
Australia[2]	L2	L2	--	L1	--	L1	L3	L3	L2	L3

Notes:
1 Regulations are currently voluntary, and become mandatory in 2018
2 Requirements vary by State (highest shown)
3 Ambient monitoring is conducted on both artificial and natural substrates
Key:
"—": Not Specified; **L1**: Lowest level of effort/detail/risk management; **L2**: Higher level of effort/detail/risk management than L1; **L3**: Higher level of effort/detail/risk management than L2; **V**: voluntary

Reporting: The annual report submitted under the EPA's VGP asks 1) does the vessel use an antifouling coating, 2) if so, what type and product, 3) date applied. Once updated California's Annual Vessel Reporting Form is expected to ask for information on cleaning and maintenance, MGPS, and voyage history which are all necessary to better characterize risk than the information currently requested under the VGP. The California form does not provide information on the total time spent in freshwater ports, just the number of freshwater ports visited. This form also asks only for the last 10 ports visited, and since reporting is annual, it is possible that a visit to a high-risk port may be missed. The California form places the burden of assigning risk, based on the information provided, onto the data management staff at the State. Based on these drawbacks vessels in Washington will be required to use an alternative reporting form, which is detailed in Section 4.5.1 and Appendix C.

Regulatory inspections: When conducting an inspection, the USCG will monitor compliance by following the EPA VGP, but biofouling management is not emphasized. To fully characterize a vessel's AIS introduction risk WDFW inspection staff will need to 1) audit biofouling record books, 2) inspect hulls of identified high-risk vessels, 3) collect organisms from heavily fouled vessels to identify potential AIS. It is expected that vessels demonstrating voluntary compliance will require less inspections over time.

Data management: Neither the IMO nor the federal government maintain records related to biofouling vectors. The WDFW will expand their ballast water data collection and management to include information collected on the biofouling reporting forms. It is expected that the reporting forms will be submitted more frequently than the annual submission required by California, resulting in more effort required by WDFW staff, but that effort will be mitigated somewhat because the suggested reporting forms automatically assign risk instead of requiring the staff to do so.

Enforcement: More AIS introduction vectors will be identified under this Plan, requiring more hull-cleaning enforcement than currently required based on USCG inspections.

Environmental standards for in-water hull cleaning: The IMO provides general guidance on hull cleaning to minimize release of both AIS and antifouling compounds into the environment, and also maximize the lifespan of AFS. IMO guidance states that local regulatory agencies may need to conduct risk assessments to minimize potential threats to their environment, and vessels should be aware of any local regulations before undertaking hull cleaning. The EPA's VGP recommends dry-docking a vessel whenever vigorous hull cleaning is required, but if hull cleaning is conducted in the water then specific efforts must be made to minimize organism, paint and antifouling compound release. The VGP also prohibits in-water hull cleaning in California unless it is conducted using best available technology as determined by California State Water Resources Control Board staff. In Washington in-water hull cleaning is monitored by both the Department of Ecology (to minimize the introduction of toxic antifouling chemicals to the environment) and WDFW (to minimize the introduction of invasive macrofouling organisms). Both departments must be notified before any cleaning is conducted. The Department of Natural Resources must also be notified if the cleaning will be conducted on state-owned aquatic lands. The same level of oversight will be maintained under this Plan to ensure that, when in-water hull cleaning is approved, best available technology is used to minimize impacts on the local environment.

Rapid Response: Rapid-response actions assess and decontaminate AIS infested waters or equipment used in those waters. The goal is to rapidly respond to a newly discovered

infestation to verify species identification, assess risk and eliminate or minimize damage before AIS can become established or spread (WDFW 2015b). The IMO does not address rapid response. The EPA conducts research in support of rapid response, but state and local agencies are primarily responsible for the actual response efforts, with support from the U.S. Fish and Wildlife Service. However, there are federal regulations, such as the Clean Water Act and the Federal Insecticide, Fungicide and Rodenticide Act, which the EPA oversees that may affect the response options available to regional agencies (EPA 2005). Washington has procured decontamination equipment to handle small vectors (WDFW 2015b), but it will require different equipment to handle the larger vectors addressed by this Plan. The State has conducted successful response efforts to control AIS introduction via tsunami debris (WDFW 2015b), but response efforts will need to increase to control introductions addressed by vectors in this Plan.

Infested Site Management: This management area involves efforts to monitor established AIS infestations, test various treatments and pursue eradication. Again, the EPA provides research in support of management, but does not conduct the management itself. The State has been actively monitoring the spread of European Green Crabs, invasive tunicates and New Zealand mudsnails, by deploying divers to physically remove tunicates, and investigated methods to eradicate mudsnails, yet the infestations have not been completely controlled (WDFW 2015b). Increased funding will be necessary to more effectively control the spread of current and future AIS infestations, though if prevention and rapid response efforts are successful they will significantly decrease future eradication costs.

Early Detection Monitoring: Ambient monitoring, especially in high risk areas, is necessary to catch AIS infestations early enough for a rapid response and to determine the effectiveness of prevention programs. The EPA has been conducting research on early detection using techniques such as DNA sequencing technology (Darling and Mahon 2011), but regional agencies are responsible for monitoring. Early detection monitoring in Washington has been primarily focused on zebra/quagga mussels in freshwater (WDFW 2015b), and should be expanded to other species and environments, following methods similar to those used by the California Department of Fish and Wildlife's Marine Invasive Species Monitoring Program.

The above section highlights the level of biofouling risk management proposed for Washington relative to other regulatory programs. More detail on the Operational Framework is provided below.

4.3 Regulatory & Cooperative Management Approach

The key requirement for successful management of the biofouling pathway is an approach that recognizes and includes the wide variety of stakeholders, including vector operators affected by implementation of this policy. Supporting legislation and regulations will need to encompass the views of these different stakeholders, notably those in other levels of regional and federal governments.

The intent, given the multiplicity of stakeholders, is to provide a regulatory/statutory framework that avoids duplication of effort and is responsive to changes in regulatory approaches as new information is brought into the discussion. The framework must also take into account the need for a regulatory/statutory flexibility that facilitates rapid response in the event of detection in State waters of a previously unrecorded AIS.

The proposed level of effort for Washington State assumes that the State's biofouling program requirements are brought (at minimum) to the standards to be set by California as outlined in Table 2 above.

4.4 Administrative Framework

Staff and resources should be procured to execute this plan and it is assumed duties of current ballast water program staff and data management systems can provide resources for this purpose. The following sections provide *suggestions* for consideration and budget setting priorities in the development of this program. This section is intended to be forward looking, as the program matures additional personnel and resources beyond these proposed levels may be required.

Key components of the administrative framework include:

- Personnel resourcing, training & travel
- Supplies and equipment requirements, including capital investments
- Contracting arrangements

The Roles & Responsibilities of departmental personnel should be clearly defined and delineated. As duties will be spread across pre-border to post-border areas, additional staffing is required to meet program goals. Based on the current state of knowledge regarding the AIS program, it is expected that the staff currently assigned to ballast water management will expand their duties to include biofouling management, and that additional employees will need to be added to key positions to help handle the increased workload. The following proposed personnel roster (and their duties) includes:

- Aquatic Invasive Species Coordinator (Current 1.0 full time employee (FTE), with 0.2 FTE of time dedicated to biofouling management)
  - strategic, technical and operational oversight across the program
  - coordinates all external and internal liaison
  - responsible for financial and personnel management
- AIS Operations Manager (New 1.0 FTE)
  - day to day operational and inspection team management
  - implementation of pre-border activities
  - implementation of inspection team operational protocols
  - rapid response coordinator
  - responsibilities encompass both biofouling and ballast water pathways
- Data Management (2.0 FTEs, 1 current employee and 1 new employee)
  - collates and evaluates incoming Biofouling Record Books and electronically submitted data
  - vector risk analysis
  - liaison with operations manager to direct physical inspections
- Benthic/Rapid Response Specialist (New 1.0 FTE)
  - benthic ecologist and invasion biology specialist

  - develops rapid response procedures and implementation protocols
  - field team leader for rapid response to AIS incursions
  - coordinates the State's forward looking program of applied biofouling research and development, particularly with respect to the development of novel AIS incursion/rapid response tools
  - coordinates with inspection staff and participates in vessel inspections if required
- Inspection Staff (3.0 FTEs, 2 current and 1 new employee)
  - onsite compliance inspections/audits of biofouling record books
  - onsite vessel hull inspections for identified high risk vectors
  - onsite vessel hull inspections for the purposes of random compliance audits

Given the proposed intentions to manage the biofouling pathway on the basis of risk, it is likely that staffing requirements will rise above these levels as vector traffic rises. The specific position descriptions would be developed following budgetary approval. There will be a requirement to adequately resource inspection teams in terms of both office and field based equipment.

Inspection teams will follow consistent protocols and documentation of records. Training and protocol development and execution should be conducted to ensure consistency amongst the team. A training program may consist of initial training on new regulations for maintenance of Biofouling Record Books, protocols for undertaking in-water and in-dry dock inspections and training on collection of biofouling organisms for taxonomic identification and parataxonomic screening.

Travel stipends will be necessary to send inspectors to the field when hull inspection services are required. Based on the findings from the vessel traffic database, likely points of inspection include Port Angeles, the Puget Sound, and the Columbia River region. A travel budget including meals, lodging and general stipend should be allocated. Travel will also be required to facilitate regional coordination as well as attend public and inter-agency meetings and technical conferences.

The need for capital investments such as access to vehicles for inspections, remotely operated/autonomous underwater inspection equipment, software related to database management and inspection equipment (e.g. cameras, microscopes, PPE) must be considered. The capital investment budget will evolve along with the AIS program.

The AIS program may involve contracting with entities outside of the WDFW. Such entities may include commercial diving operations, consultants, benthic taxonomy experts and collaboration with institutions involved with AIS research.

4.5 Communications Framework

As described above, Washington State's approach to managing biofouling rests on the key principles of prevention and protection, shared responsibility and adopting a risk-based approach, supported by an integrated and targeted regulatory framework.

Experience in other jurisdictions has repeatedly demonstrated that risk-based and cooperative management program that rely on voluntary participation are more effective and economical in the long term. However, successful implementation of this approach requires

the development and implementation of a broad and inclusive stakeholder engagement and communications program. The key features of such a program are set out below.

4.5.1 Stakeholder Engagement

To be effective and sustainable, a stakeholder engagement program must:

- Clearly identify who the stakeholders are, as well as their respective roles and responsibilities.
- Be based on good faith, openness and a commitment to sharing information and knowledge.
- Be resourced to allow participation of all relevant stakeholder groups, and be coordinated to minimize barriers to participation.
- Be supported by relevant and accessible information and education material.
- These key elements are further described below to provide the strategic framework for the subsequent development of a detailed implementation plan.

Identification of Stakeholders

At a strategic level, stakeholder groups are:

- Regulatory agencies – international, federal, other states, and local.
  - One of the key features of the proposed biofouling management strategy is an integrated regulatory framework. It is therefore essential that relevant policies, regulations and procedures are developed and both vertically integrated (i.e. internationally - neighboring countries and other maritime nations similarly affected by biofouling issues) and horizontally managed (promoting cooperation between federal, state and local regulatory agencies).
- Industry – Vector operators (e.g. shipping companies, recreational vessel owners), potentially affected industries (e.g. aquaculture, fisheries, tourism operators), goods and service providers (i.e. industries that are involved in manufacturing and distributing products or services necessary for carrying out preventative measures, emergency response or other biofouling control measures).
  - The inclusion of industry stakeholders is critical to the success of the biofouling management strategy because of its intended reliance on voluntary compliance and self-management, and to ensure the equitable sharing of responsibilities.
- Research agencies – universities and research institutes that undertake identified scientific research programs, development of control systems or relevant impact assessments.
- The proposed risk-management approach will require robust and science-based information to enable good decision-making and prioritization of effort and expenditure. Involving the entities that are likely to undertake this work from the outset will provide insight into what research /investigation directions are likely to be the most useful, as well as enabling mutual learning and appreciation of what is needed.
- Community – Potentially directly affected local communities, specific community groups (e.g. recreational fishing groups, environmental advocacy groups).

- Those directly affected by the spread of invasive species have a considerable stake and interest in the prevention and management of this issue, and often 'grass roots' knowledge that can be very effective and a critical factor in fast and timely intervention.
- Tribal communities – Many of the 29 federally-recognized Indian tribes live in areas that are subject to the threat of invasive species, and would likely be severely affected by their spread.
- Non-governmental Organizations (NGOs), cross-agency groups and similar, such as the Pacific North-West Economic Region (PNWER) Invasive Species Working Group, which is active in increasing awareness regarding invasive species, addressing the regional economic and environmental impact of invasive species and promoting regional collaboration and sharing of best practices.

Stakeholder engagement activities are likely to fall into two distinct but overlapping categories, including:

- *Core stakeholders*. This group will be directly involved in undertaking or contributing to biofouling management and control work. Interaction at this level must be characterized by regular, consistent and committed collaboration to achieve jointly developed goals and objectives.

  Members of this group will be representatives of the vector operators, affected industries, affected local communities (including tribal communities) and relevant regulatory agencies (local and neighboring states).

- *Peripheral stakeholders*. This group plays a vital role in generating, disseminating and using information and research to increase the profile and awareness/knowledge of biofouling and its impacts within the general public.

  Members of this group will need to be kept informed, but are less likely to participate directly in regular working groups or similar activities.

Terms of Reference / Guiding Principles

Fundamental to the functioning, success and longevity of both core and peripheral stakeholder groups are jointly developed and agreed Terms of Reference that clearly set out the following:

- Purpose, vision, objectives and scope.
- Membership, including roles and responsibilities.
- Group culture and behaviors, for example a commitment to collaboration, accountability and being outcome-focused.
- Group structure and operational arrangements, such as chairing the group, meeting frequency and location and similar concerns.
- Administrative arrangements, for example secretarial support and the funding thereof, financial management and similar.

Development of the Terms of Reference should always be the first task of the newly formed stakeholder group.

Resourcing and Support

Successful stakeholder engagement, particularly over the long term, is characterized by recognizing the needs of the different stakeholder groups and providing for them, through:

- Identifying and removing barriers to participation. Barriers can include a wide variety of factors, from being unable to attend meetings because they are scheduled at inconvenient times or transport is lacking, to organizational constraints preventing a suitable and experienced staff member representing his or her organization. Often, a lack of awareness that barriers exist creates time delays and inefficiencies when initiating the stakeholder engagement program.
- Identifying resourcing needs and providing appropriate support. Resources for all or some stakeholder groups or representatives may be required in the form of financial assistance, information and/or educational material, or formal requests for the time or contribution of representatives.

Implementation Planning

Detailed implementation planning will occur following the three initiating steps outlined above (identification of stakeholders and their respective level of contribution, establishing Terms of Reference, and putting in place resourcing and support structures to assist participation).

The Stakeholder Engagement Implementation Plan will set out work programs and timeframes, roles and responsibilities, deliverables, funding arrangements and make provision for reporting, which should include annual reporting for and by the stakeholders and a public report setting out achievements and planned initiatives for the next reporting period.

As is the case with the Terms of Reference, the Stakeholder Engagement Implementation Plan is intended to be a collaborative effort to ensure a solid basis of support.

4.5.2 Public Information & Education

In addition to the focused stakeholder engagement program described above, the proposed invasive species management approach must be supported by a consistent, ongoing and high-quality public education program to ensure wide-spread societal recognition of the issue, the impacts of invasive species and the need for individual behaviors to reduce the threat.

There are many public information/education campaigns on a wide range of issues, generally similar in structure and intent, although some are more successful than others. Key learnings from previous campaigns at both ends of the success spectrum will be incorporated into the invasive species education program.

Information and education material will be targeted at key groups, including recreational vessel owners and schools, and utilize a wide range of dissemination channels, including social media.

To the extent possible, information/education material will be consistent across the State as well as interstate, and use existing information where appropriate.

4.6 Programs Supporting Risk-based Management

The efficacy of evidence-based decision making is entirely dependent on the quality of information on which it relies. A variety of data collection programs must therefore be implemented to facilitate effective risk-based management of the biofouling pathway. An understanding of the likely and actual nature and type of biofouling hosted by a vector is required to assess the risk that an AIS is present.

4.6.1 Vector Risk Assessment

The likelihood that a particular vector harbors AIS is dependent on a variety of factors (Floerl et al. 2010; Hopkins & Forrest 2010; Lacoursière-Roussel et al. 2012; Forrest 2013). All vectors greater than 300 GRT intending to reside in State waters for more than two days will be subject to a risk assessment to evaluate this likelihood. This size threshold reflects the high volume of low to high risk vector traffic forecast through State waters over the period for which this Strategy applies (see section 2.1.3). A two day trigger for inclusion for further assessment will permit short term emergency visits and provide an exemption for transient vessels.

This risk assessment would include consideration of factors including operational profile (e.g. speed, frequency of movements; Coutts et al. 2010a, b), voyage history since last application of AFC, and hull husbandry practice. Such an approach has been widely used in Australia, where pre-arrival risk assessment of vessels travelling to sensitive areas is common.

The initial risk assessment should be conducted prior to the vessel arriving in State waters. Incoming vessels greater than 300 gross registered tons (GRT) intending to be present in State waters for more than 2 days will be required to complete a Vessel Risk Self-Assessment (VeRSA) to be submitted to the Department at least 10 days in advance of arrival. The VeRSA tool is a rapid, semi-quantitative assessment using a spreadsheet which calculates a risk rating that can be readily verified from ships records. The form of the VeRSA is provided in Figure 21. Derivation of the metrics for assigning low, medium and high risk is discussed in Appendix C.

The amount or level of biofouling present on the hull would be used as an indicator of risk. Investigations in New Zealand (Inglis et al. 2008) indicate that there is a strong correlation between the levels of conspicuous fouling (macro-fouling) present on a vessel hull and in niche areas (e.g. sea chest gratings, dry dock block marks) and the likelihood that an AIS is present. Vessels (vectors) in which the coverage of the hull by macro-fouling (excluding algal 'slime' layers) exceeds 5% of any niche area may be considered to pose a biosecurity risk (Georgiades, pers. comm.; Georgiades & Kluza 2014) requiring some level of management intervention such as hull cleaning or immersion in freshwater.

Vectors that are assessed as posing a low risk of translocating AIS to or around State waters will be considered compliant with the State's policy for biofouling management. Those that pose an intermediate risk (based, possibly, on an uncertain voyage report or history of hull husbandry) may require inspection by a suitably qualified and experience person, who would advise the Department whether the vector can be considered compliant, require some level of intervention before compliancy was re-assessed, or is not compliant and unlikely to reach compliant status. Vectors falling into the last category may be requested to perform mitigations prior to entry.

Biofouling Record Keeping

The nature of hull husbandry practiced by the vector operator is directly related to the AIS risk. Poor practice (e.g., relying on AFS that are beyond their effective lifespan, failure to maintain/treat the hull and internal systems) generally lead to higher biofouling loads and increased likelihood that AIS are present on the hull or in niche areas. Examination of records of biofouling management practice facilitates the evaluation of the risk posed by a vector.

The IMO, for instance, recommends that every ship has a BMP and maintain a Biofouling Record Book onboard (IMO 2011). The BMP is to include, among other things, details of the AFS used (e.g., type, date employed, effective life), operational practices and conditions and the location and management of hull niche areas. The details of any out of water maintenance conducted (e.g., remove biofouling, renew AFCs, decontaminate internal systems) is also to be recorded.

The development of BMPs and maintaining Biofouling Record Books are not compulsory actions. The Department, however, is choosing to adopt IMO (2011) Guidelines for all vessels affected by this Plan. In addition, each vessel will maintain records and submit an annual Husbandry and Voyage History reporting form. The Department will work with other jurisdictions to develop the form of record keeping and reporting to ensure inter-compatibility with similar reporting requirements elsewhere and minimize duplication of effort.

Records are to be made available for inspection and audit by the Department. Organizations that demonstrate effective and sustained management of risk due to the biofouling pathway may be considered eligible for self-management (see Section 4.7.4).

Washington State Biofouling Management: Vessel Risk Self Assessment (VeRSA)

Vessel:	**IMO:**	**Call Sign:**	**Date: (mm-dd-yy)**
Operating Company:	**Assessor & Affiliation:**		
Proposed Arrival Port (& date):	**Last Port of Call & Date:**		

Risk Factors	Factor Score	COMMENTS	Vessel Score
AIS not detected during a physical inspection of the vessel		45 days chosen as an inspector is unlikely to visually detect anything prior	Insert applicable score in this column
No inspection prior to date of arrival	1.00		
Previous AIS inspection undertaken within the 45 days of arrival	0.85		
One independent in-water AIS inspection undertaken within 45 days of arrival	0.50		
One independent out-of-water AIS inspection undertaken within 45 days of arrival	0.25		
AIS inspection included internal systems and immersible equipment			
Yes (retain a digital image of the main sea strainer)	0.75		
No (or not an independent inspection)	1.00		
Vessel has resided in freshwater (> 10d) immediately before arrival		Assumes that the risk of marine AIS is reduced by extended immersion in freshwater	
Yes	0.50		
No	2.00		
Marine growth protection system present and operating as per manufacturers specifications (specify type and review operational records)		These systems are variably effective at reducing growth in seachests	
Yes - through addition of biocide	0.50		
Yes - impressed current type	0.75		
No	1.00		
Vessel internal systems specifically treated using suitable thermal, chemical or mechanical treatment (specify)			
>12 months or unknown	2.00		
>6-12 months	1.00		
>3-6 months	0.50		
1-3 months	0.40		
<1 month	0.25		

Risk Factors	Factor Score	COMMENTS	Vessel Score
Condition and suitability of antifouling coatings (AFC)		Values based on ageing and depletion of the AFC over time	Insert applicable score in this column
AFC type is unknown, unsuited or absent	5.00		
AFC type is known, suited to activity and speed and documented age on arrival:			
> 24 months	4.00		
>12 - 24 months	2.00		
>9-12 months	1.00		
>6-9 months	0.85		
>3-6 months	0.75		
1-3 months	0.40		
<1 month	0.25		
Risk Regions/Climate Matching (Refer to World Bioregions Chart)		Assumes that being in a risk region more than doubles the risk compared to other similar bioregions	
Vessel has been located in nominated high risk ports/regions since AFC last applied	6.00		
Similar climatic region	3.00		
Adjacent climatic region	2.00		
Separate climatic region	1.00		
Number of stationary / slow speed periods (10 days or greater) in port or coastal waters since last application of AFC or clean AIS inspection or >10 d residence in freshwater		The risk of innoculation by an AIS rises during extended layup or "go slow" periods	
Total # of stationary periods > 4	3.00		
Total # of stationary periods between 2 - 4	2.00		
Total # of stationary periods between 1 and 2	1.00		
Stationary period is < 1 week	0.50		
Region of any stationary/slow speed periods since last application of AFC or clean AIS inspection or >10 d residence in freshwater		Assumes that being in a risk region more than doubles the risk compared to other similar bioregions	
High Risk Region	6.00		
Similar climatic region	3.00		
Adjacent climatic region	1.50		
Separate climatic region	0.80		
If not applicable	0.00		

Vessel Risk Score	The calculated risk level will be displayed here	**0.00**

If score <15 Low risk:	**If score 15-25 = Uncertain risk:**	**If score >25 - High risk:**
Vessel is compliant with WDFW objectives -approved for travel to Washington State waters; details require checks/confirmation only;	Precautionary principal applied: confirmatory independent inspection and/or mitigation actions reccomended	pre-arrival mitigation actions required

AIS risk assessments are to be submitted to the Washington Department of Fish & Wildlife

at least 10 days prior to anticipated arrival in State waters

Low Risk — The final risk assessment result will be displayed here

Figure 21: VeRSA tool for evaluating the relative biosecurity risk for vessels greater than 300 GRT (see also Appendix C for further detail)

4.6.2 Surveillance, Inspection and Monitoring

Surveillance is a systematic process that involves collecting information, analyzing and interpreting it, then using it to guide management. The focus of surveillance for the purposes of managing biosecurity threats in this context is to collect data that will contribute towards detecting incursions of new AIS early enough in the invasion cycle to permit successful management. Surveillance can also help to inform management of AIS that are already present in State waters as well as detect and monitor new and emerging threats.

There are several different approaches that are used during surveillance, depending on the nature of the information that is required. Targeted surveillance is used when a specific target species (or group of species) is of interest, usually in the specific habitats in which they are found. 'Hot spot' surveillance focuses on high risk sites or nodes where AIS are considered most likely to be found, for example, alongside a wharf that is heavily used by international trading vessels. Passive site surveillance involves the routine monitoring of sites of interest for AIS, responding to and investigating notifications of suspect species and monitoring trends in invasions, including:

- Pathway management places an emphasis on the nodes of introduction, those areas or features that are considered at highest risk of incursion by AIS. This can include inspection of wharf pylons or sheet walls, floating pontoons, careening areas or even natural areas that are at high risk of initial invasion by AIS. Pathway surveillance events typically occur on a regular basis at a set frequency. Surveillance may also occur on an ad hoc basis where the timing of high risk vector traffic to a node is highly variable.
- Targeted approaches focus surveillance activities on detecting particular species or suites of species in specific habitats. Surveys can include benthic habitats in natural systems or on fixed infrastructure such as wharves and jetties or moorings or on mobile vectors (vessels). They are aimed at detection of AIS in the early stages of the invasion cycle when the likelihood of a successful eradication is highest and the costs are lowest. Targeted surveillance programs are likely to be most effective when the biology of the target organism is considered during the design of the program to maximize the likelihood of detection. Targeted surveillance of biofouling pathways may also be considered, based on an assessment of risk associated with an individual vector. Vectors considered on 'first principles' to pose a high risk of translocating AIS to or around State waters would require inspection by a suitably qualified and experienced person. Vessels considered to pose a high risk post inspection would be the subject of interventions to reduce that risk, or be restricted in movement.
- Passive surveillance involves routine monitoring for AIS and investigating reports of potential aquatic pests. Routine monitoring can include regular port surveys for AIS and through monitoring artificial substrates (e.g. 'settlement plates') for direct colonization by marine species. Passive surveillance can be laborious and cost intensive, requiring many hundreds of hours of field time, laboratory analysis/identification and reporting. DNA sequencing technology offers a potentially valuable and cost effective tool for screening samples for AIS, though the technology is not yet at a mature stage of development. Passive surveillance techniques also include risk assessment functions analyzing trends in AIS and vector distribution and pressure to predict potential incursions (UNEP-MAP 2016). This includes considering the

abundance of AIS and spatial and temporal distribution at high risks nodes along their introduction pathways.

4.6.3 Organism Biology, Threats, Impacts and Risk Assessment

As indicated in the previous section, an understanding of the biology of AIS is crucial to both inform pre-border risk assessment and enable effective border and post-border responses under a target-species approach to management. This type of information is particularly valuable where a target species approach to AIS is the preferred management framework. It is also a valuable component of any rapid response strategy for dealing with incursions of new AIS.

One example is a single species having a two phase life history cycle. This diphasic species alternates between a physically hardy stage that is invisible to the naked eye and a large and annual conspicuous stage, which in turn reproduces to create the microscopic stage. Considerable effort could be invested in controlling the latter stage by manual removal, and yet if through a lack of understanding the microscopic stage is left to persist, the conspicuous population will simply be re-established, apparently spontaneously.

An understanding of the biology of the organism, in this case the 'wakame' seaweed *Undaria pinnatifida*, would guide control actions to focus on the conspicuous stage before it releases new spores. The microscopic stage would then be neutralized by sterilizing the substrate through the application of heat or biocides (e.g. Stuart 2004).

In a similar manner, understanding the biology of AIS can inform one component of the risk assessment. Using the same example as above, a vector present in an *Undaria*–infested location during the period of the year that spores are being released by the conspicuous phase (the sporophyte) would pose a higher risk of becoming infected and translocating *Undaria* than a vessel that visited during the period when no mature sporophytes were present.

Applying the risk-based approach at a species level can thus help guide management actions. Considering the likelihood, and determining the consequences, that a particular species will impact upon the environmental, economic and socio-cultural values of Puget Sound is central to this approach. Using this as a basis for evaluating a number of species of concern, risk-rankings for different species can be determined, which can be used to help guide management decisions (Campbell 2008).

This example illustrates difficulty in implementing a target species approach in isolation: the stochastic, unpredictable nature of invasion by AIS contrasting with the need for high quality data. While this information is useful for responding to or preventing the arrival of known species of concern, it fails to account for those species that are not *a priori* considered to be AIS.

A plan to manage risk using a 'pathways' approach avoids these issues, however, by reducing the AIS pressure of high risk vector arrivals, both for known pest species and those that are as yet unknown.

4.7 Compliance & Self-Management

4.7.1 Compliance Framework

A key requirement for the effective implementation of any regulatory strategy is the ability to measure compliance. In keeping with the risk-based approach that we have adopted for managing biosecurity, we propose to implement a program of risk-based, responsive regulation; a compliance program that actively works with stakeholders to measure and manage the application and compliance with the regulations.

As the spectrum of compliance risk ranges from voluntary compliance (the majority of stakeholders usually fall in this category) to strategic non-compliance (generally comprised of very few stakeholders), the compliance tools and responses that are invoked are also based on that spectrum (Figure 22). The relative number of stakeholders in the different compliance categories is reflected in the width of the pyramid (on the left), thus most stakeholders are (usually) voluntarily compliant and relatively few stakeholders are deliberately non-compliant. As the level of non-compliance increases (pyramid on the right), so does management scrutiny and the need for and severity of sanctions.

This type of process generally leads to compliant stakeholders that are demonstrably pro-active in managing the risk (those, including 'good corporate citizens', illustrated near the base of the compliance pyramid) can be awarded the right to self-management. Successful self-management typically results in cost savings through reduced compliance and enforcement costs. Alternatively, sanctions for the systematic, deliberate offenders can range from suspension or, in some jurisdictions, revocation of operating licenses.

The goal of risk-based responsive regulation is to achieve full compliance through improving stakeholder behaviors and attitudes.

In keeping with the shift to a risk-based, pathway management approach, the proposed compliance management program will be enabling, adaptive and outcome-focused. The key components of the proposed Biofouling Compliance Management Framework are set out below. A detailed compliance management implementation program setting out reporting requirements (including the expected level of detail), time frames, quality control measures and procedures and other operational detail will be developed in consultation with the affected parties represented in the core stakeholder group.

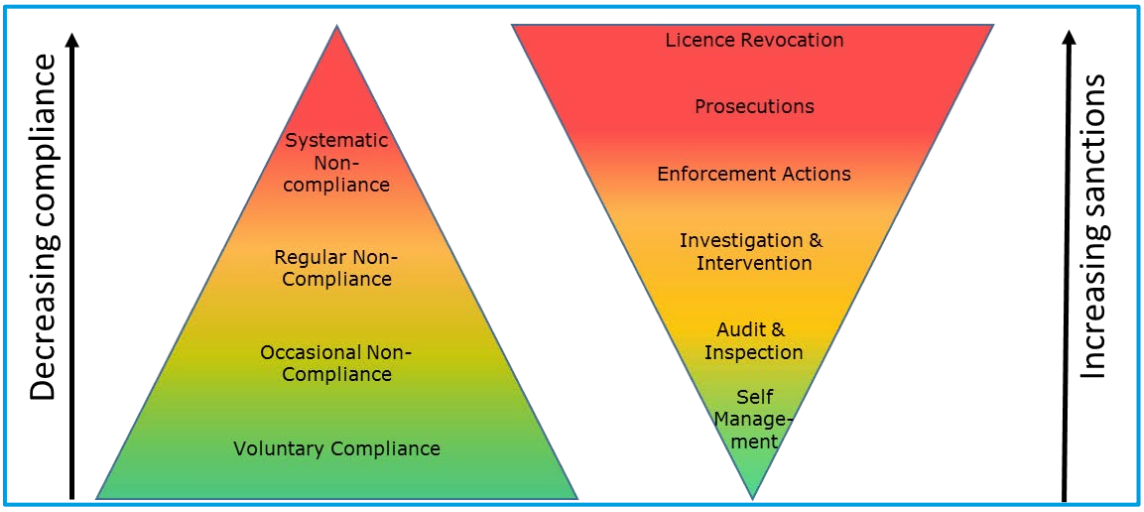

Figure 22: The Compliance and Sanctions Pyramids
Compliance (left) and Sanctions (right) pyramids; as the level of compliance decreases (narrows along the left pyramid) the need / severity of sanctions increases (widens along the right) [4]

4.7.2 Recognition of risk-based management in regulation

As noted previously, the Department is committed to shifting away from the more traditional 'one-size-fits-all' biofouling management system to a risk-based approach. This will be underpinned by State regulations developed specifically to foster and enable risk-based management, with the aim of ultimately gaining regulatory consistency with other agencies.

This regulation will provide a more responsive system of compliance, ranging from enabling and rewarding full and voluntary evidence-based compliance to introducing sanctions and penalties appropriate to the level of non-compliance.

4.7.3 Clear expectations of what constitutes compliance

To support the shift towards voluntary compliance, the regulatory framework will be complemented by in-depth guidance on what actions need to occur to achieve compliance and what evidence must be supplied to the regulator to demonstrate compliance.

For example, requirements are likely to include a routine surveillance program to be undertaken by the vessel operator, which will include fouling assessments. Similarly, a vessel-specific hull husbandry system is expected to form part of the vessel's biofouling management plan.

Where possible and appropriate, templates and best practice guidance will be provided.

4.7.4 Self-management privileges for responsible and pro-active operators

Sharing responsibility and managing biofouling on the basis of risk and implementing responsive regulation require considerable flexibility, a commitment to cooperation and communication and the ability to incorporate learnings from the process. Successful self-management systems must have a solid and balanced foundation of assistance (see Section 4.7.5), incentives and sanctions.

[4] Adapted from : http://www.agriculture.gov.au/biosecurity/legislation/new-biosecurity-legislation/approach-compliance

The Department is considering the introduction of compliance categories (voluntary full compliance, voluntary partial compliance, regular non-compliance and systematic non-compliance). Expectations and requirements for each category are clearly defined. Guidance on how to gain voluntary full compliance will be provided, and an assistance program to enable operators to move from voluntary partial compliance to full compliance is intended to be developed. Table 3 provides an overview of the proposed compliance categories and how they will be managed.

4.7.5 Self-management tool box

Assistance with developing and implementing vessel-specific compliance systems will be provided in the form of a Biofouling Management Toolbox. The Department intends to prepare this tool box in collaboration with the Stakeholder Core Group to ensure that the instruments provided meet the needs of vessel operators. Table 3 provides a possible approach to manage a voluntary compliance program. The actual plan will be developed in consultation with WDFW and industry.

Although use of the various templates and systems provided in the tool box is not intended to be mandatory, they will be designed to be complementary with the regulatory framework, and are thus likely to facilitate proof of compliance.

4.7.6 Simplified and consistent record keeping and reporting

Accurate and reliable record keeping is the foundation of a well-functioning self-management system. To the extent possible, a standardized approach to record keeping procedures, the format of biofouling management records, survey data format and similar items, will be taken, with a strong focus on electronic data transfer. All compliance evidence must be submitted and certified by a suitably qualified and experienced person, as defined by the Department. From time to time, the Department will audit the evidence to verify compliance.

4.7.7 Horizontally integrated sanctions for non-compliance

The Department will actively work with federal, state and local regulatory and enforcement agencies to ensure that non-compliance is detected and acted upon across the jurisdictions involved, to ensure that voluntary compliance is not dis-incentivized over time.

4.8 Revision – Regular Review and Updates

One of the underlying themes of this Strategy is the recognition that a flexible, dynamic approach to management requires ongoing self-evaluation. A program of periodic review will be included to evaluate the efficacy of the Strategy and the implementation of the Plan.

Reviews should be undertaken at minimum annually and should include consideration of whether the Plan is contributing towards the following:

- Reducing the frequency of high risk vectors arriving in State waters;
- Reducing the frequency of AIS arriving and becoming established in State waters;
- Facilitating effective rapid response actions;
- Risk management decisions that are effective and proportionate;
- Improved vector characterization;
- Improved detection abilities;
- High uptake and voluntary compliance rates.

The Plan must also be regularly updated with advances in technology and information management. The field of biosecurity science is rapidly evolving as technology for screening AIS improves and advances in information gathering and processing capabilities contribute towards risk identification and detection. International Biosecurity Intelligence System[5], for example, is a web-based tool for tracking and forecasting emerging biosecurity issues.

[5] http://biointel.org/home

Table 3: Compliance Categories

Category		Criteria	Validation	Incentives	Sanctions
1	Full Voluntary Compliance	• Undertakes all specified activities • Compliance systems function well and generally achieve 100% compliance • Provides all required evidence on time • Compliance evidence is certified by a recognized suitably qualified and experienced person (SQEP)[6] • Has a history (minimum of 3 years) of Partial Voluntary Compliance status • Self-reporting of minor compliance breaches and subsequent mitigation	• Full Voluntary Compliance Status • Certification of Full Voluntary Compliance Status valid for 3 years • Random Audits commensurate with overall performance	• Cost savings through self-management • No audit fees • Low certification fee	• None
2	Partial Voluntary Compliance	• Undertakes all specified activities • Compliance systems do not generally achieve 100% compliance but an improvement program is under way • Generally provides all required evidence on time • Compliance evidence is certified by a recognized SQEP • Self-reporting of minor compliance breaches and subsequent mitigation	• Regular auditing and compliance inspections by Department	• Department assistance program to gain Full Voluntary Compliance Status	• Full auditing/compliance inspection fees • None, provide that an improvement plan aimed at achieving Full Voluntary Compliance Status and agreed with the Department is in place
3	Regular Non-Compliance	• Undertakes specified activities, but not consistently • Has no compliance systems in place, or systems do not perform well • Compliance evidence is only partially provided, or not at all • Compliance evidence is not certified by a recognized SQEP • Does not inform Department of compliance breaches	• Regular auditing and compliance inspections by Department	• Department assistance program to improve compliance	• Full auditing/compliance inspection fees • Department intervention/orders to undertake compliance activities at cost to the operator • Enforcement action commensurate with the level on non-compliance, which may include prosecution for severe compliance breaches
4	Systematic Non-Compliance	• Does not undertake compliance activities • Actively avoids inspections and contact with Department • Does not provide compliance evidence • Does not inform Department of compliance breaches			• Prosecution

[6] Suitably Qualified and Experienced Person

4.9 Application and Exemptions

This policy applies to all owners or operators of vessels greater than 300 GRT that are domiciled or arriving in Washington and remaining for two days or more, unless the conditions listed below apply (see also Figure 23).

- A vessel makes an unscheduled arrival in a port, harbor, or other place in Washington in the event of an emergency and the person in charge informs the Department within twenty-four hours of arrival.
- A port, harbor, or other place in Washington is the first port of call since docking or delivery from boat builder or vessel received out of water maintenance and servicing including application of new AFC within the past 7 days and the vessel intends to remains in Washington State waters for less than 45 days.
- A vessel has been inspected and assessed within the last 45 days (being the time prior to which point visual inspections are unlikely to detect any recently settled biofouling that may be present) to pose a low biofouling risk by an independent expert recognized by the Department as appropriately experienced and qualified to conduct pre-arrival biosecurity risk assessments.
- Vessels of the US Navy, US Coast Guard or state Naval Militia.

Vessels intending to remain in State waters for two days or more should compile the relevant information to prepare a VeRSA (see Section 4.6.1; Figure 21) and submit to the Department at least 10 days in advance of the visit. If, based on its review, the Department concurs that the assessed risk is low, approval to remain in State waters longer than 2 days will be granted. Where the assessed risk is Uncertain or High, the Department will provide guidance on further mitigation measures that may be required prior to arrival.

The vessel operators may be required to:

- Have the vessel hull and relevant internal systems inspected for the presence of AIS by a suitably qualified and experienced person;
- Have the vessel cleaned or treated, in consultation with and approval by the Department and if necessary other State agencies, to remove or otherwise neutralize the conspicuous biofouling present on the hull;
- Have movement restrictions imposed.

The application scheme is based on biological data and the contractor's best estimate of the time required for meaningful response by Program staff to reduce risk of invasions. In consultation with the BWWG, the Program should determine a course of action that adheres as closely as possible to these recommendations, while establishing protocols that are logistically feasible for regulators and stakeholders.

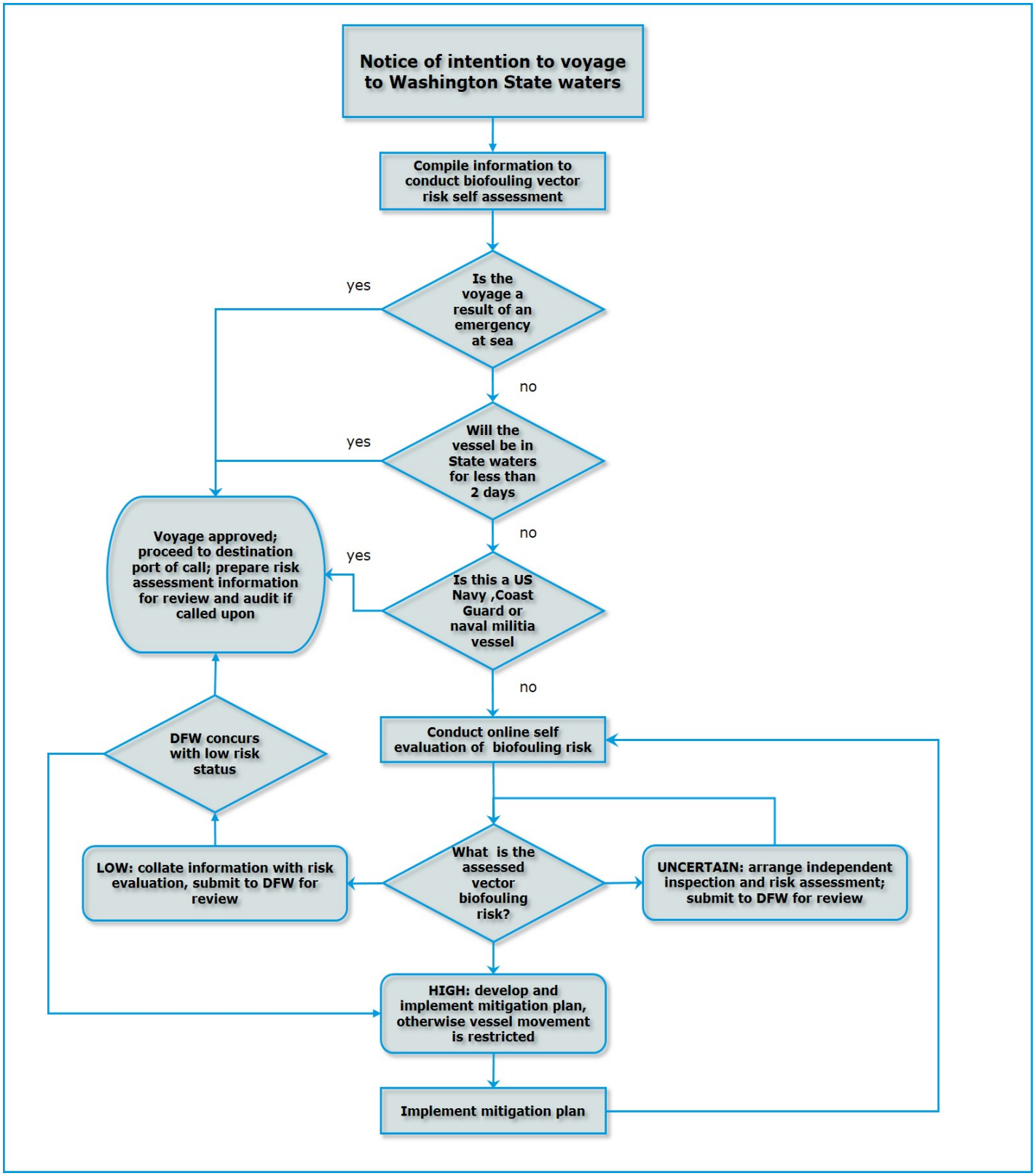

Figure 23: Decision flowchart for managing the movement of vectors to or around State waters

5. SUMMARY

This biofouling management strategy plan is focused on protecting the ecological, economic, and human health of Washington State's marine and estuarine areas by preventing the intentional or unintentional introduction and spread of marine and nearshore AIS.

An integrated, risk-based management approach for managing the risks and impacts of AIS is proposed. This approach is to be informed by rigorous science and is comprised of a core operational framework and supporting programs for informing management through reducing risk and building future capability/capacity. Research and development priorities focus efforts for 'enhanced' management where funds permit.

The Plan is to be supported by a number of sub-programs that will provide the information required for evidence-based management of biofouling risks. These include a responsive, risk-based compliance program and a robust communications and engagement framework. Several disparate but related programs that inform technical risk comprise other important sub-programs, including assessments of vector risk, the threats and impacts of different species and ongoing surveillance and monitoring of high risk vectors and areas.

Management will occur within a legislative/regulatory framework that is consistent and cooperative with other regional, national and international approaches.

Implementation of this Strategy will need to be carefully phased to be effective, both in terms of the environmental benefits to be gained and cost efficiency. Legislative timeframes will also need consideration to promulgate the appropriate regulations.

In brief, the Strategy and Plan should be finalized in 2017, with a wide roll-out and publicity campaign to affected parties and stakeholders. Concurrent with this, efforts should be made to widen the group of stakeholders and consulted parties to include operators of vessels smaller than 300 GRT, for example the commercial fishing and recreational sectors. The Plan should be initially implemented on a voluntary basis, to assist with stakeholder uptake and to provide for the Department's internal structures and processes to be set in place. Following the short voluntary implementation period, the BFSMP will come into force for vessels greater than 300 GRT by Q2 of 2018, with a goal of extending this to smaller vessels by the start of Q4, 2018.

Additional detail surrounding implementation is provided in Figure 24. Draft versions of this strategy have been reviewed on two separate occasions by the Department's BWWG. Evaluation of consensus or nonconsensus will be completed by the Department after this document is finalized

Description	Start	Completion
Finalize BFSMP	1/1/2017	6/30/2017
Finalize VeRSA, reporting forms	3/1/2017	6/30/2017
Operations Manager (1.0 FTE) Recruitment	3/1/2017	5/31/2017
Operations Manager Start	7/1/2017	7/1/2017
Rollout BFSMP to vessel operators	7/1/2017	9/30/2017
Work to extend BFSMP to vessels < 300 GRT	7/1/2017	9/30/2017
Finalize data/admin structures	9/1/2017	12/31/2017
Consultation and revisions to extend BFSMP to vessels < 300 GRT	10/1/2017	12/31/2017
Recruitment (2.0 FTE) of inspection and response staff	10/1/2017	11/30/2017
Inspection and rapid response staff begin	1/1/2018	1/1/2018
Voluntary implementation period	1/1/2018	3/31/2018
BFSMP comes into force for vessels > 300 GRT	4/1/2018	4/1/2018
Recruitment (2.0 FTE) of inspection and data management staff	7/1/2018	8/31/2018
BFSMP comes into force for vessels < 300 GRT	10/1/2018	10/1/2018
Inspection and data management staff begin	10/1/2018	10/1/2018
First Performance Review	12/1/2018	12/31/2018
Biannual Performance Reviews	6/30/2019	12/31/2022

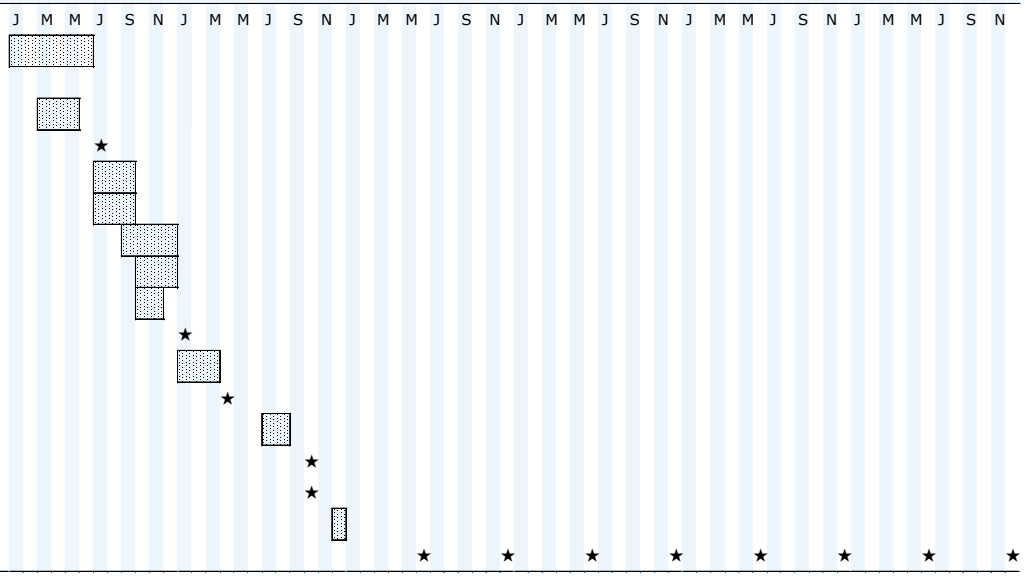

Figure 24: Estimated Implementation Schedule

6. REFERENCES

ADFG [Alaska Department of Fish and Game]. 2002. Alaska Aquatic Nuisance Species Management Plan.

Aquatic Nuisance Species Committee. 2001. Washington State Aquatic Nuisance Species Management Plan. http://wdfw.wa.gov/publications/00105

Aquatic Nuisance Species Committee. 2012. Report to the 2012 Legislature. http://wdfw.wa.gov/publications/01391

Aquatic Nuisance Species Planning Committee. 1998. Washington State Aquatic Nuisance Species Management Plan.

Aquatic Nuisance Species (ANS) Task Force. Aquatic Nuisance Species Impacts. http://www.anstaskforce.gov/impacts.php. Accessed 01 Sept 2016

Army Corps of Engineers (Army Corps). 2015. Dredged material management program, state of Washington: including Puget Sound, Grays Harbor, Willapa Bay and the Pacific Coast, Columbia River Basin. Biannual report, dredging years 2014/2015. Prepared by the dredged material management agencies: Army Corps of Engineers, Washington State Department of Natural Resources, US Environmental Protection Agency, Washington State Department of Ecology. 74pp.

Bersine K, Brenneis VEF, Draheim RC, Wargo Rub AM, Zamon JE, Litton RK, Hinton SA, Sytsma MD, Cordell JR, Chapman JW. 2008. Distribution of the invasive New Zealand mudsnail (*Potamopyrgus antipodarum*) in the Columbia River Estuary and its first recorded occurrence in the diet of juvenile Chinook salmon (*Oncorhynchus tshawytscha*). Biological Invasions 10: 1381-1388.

BST Associates and Mainline Management. 2011. Pacific northwest marine cargo forecast update and rail capacity assessment. Final report to the Pacific Northwest Rail Coalition. 46pp.

Campbell ML 2008: Organism impact assessment: risk analysis for post-incursion management. ICES Journal of Marine Science, 65: 795–804

CDFW [State of California Department of Fish and Wildlife]. 2008. California Aquatic Invasive Species Management Plan.

Crooks J 2005: Lag times and exotic species: The ecology and management of biological invasions in slow-motion. Ecoscience 12(3):316-329

Coutts ADM, Piola RF, Hewitt CL, Connell SD, Gardner JPA. 2010a. Effect of vessel voyage speed on survival of biofouling organisms: implications for translocation of non-indigenous marine species. Biofouling 26: 1-13.

Coutts ADM, Piola RF, Taylor MD, Hewitt CL, Gardner JPA 2010b. The effect of vessel speed on the survivorship of biofouling organisms at different hull locations. Biofouling 26: 539-553.

CSLC [California State Lands Commission: Marine Invasive Species Program]. August 2015. Biofouling Removal and Hull Husbandry Reporting.

Darling JA and Mahon AR 2011. From molecules to management: adopting DNA-based methods for monitoring biological invasions in aquatic environments. Environmental Research 111(7): 978-88.

Davidson I, Sytsma M, Ruiz G. 2006. Preliminary investigations of biofouling of ships' hulls: ANS investigations in the Columbia River. United States Coast Guard Research and Development Center, Groton, CT. 65pp.

Davidson I, Sytsma M, Ruiz G. 2009a. An experimental analysis of salinity shock on biofouling communities: a pilot study. Report to the California State Lands Commission, Marine Invasive Species Program, Sacramento, CA. 22pp.

Davidson I, McCann L, Fofonoff P, Sytsma M, Ruiz G. 2009b. The role of containerships as transfer mechanisms of marine biofouling species. Biofouling 25: 645-655.

Davidson I, Zabin C, Ashton G, Ruiz G 2014a. An assessment of marine biofouling introductions to the Puget Sound region of Washington State. Report to the Washington Department of Fish & Wildlife and Washington Department of Natural Resources, Olympia, Washington. 111pp.

Davidson I, Scianni C, Ceballos L, Zabin C, Ashton G, Ruiz G. 2014b. Evaluating ship biofouling and emerging management tools for reducing biofouling-mediated species incursions. Report to the Marine Invasive Species Program of the California State Lands Commission, Sacramento, CA. 36pp.

Davidson I, Scianni C, Hewitt C, Everett R, Holm E, Tamburri M, Ruiz G. 2016. Mini-review: Assessing the drivers of ship biofouling management – aligning industry and biosecurity goals. Biofouling 32(4): 411-428.

DAWR [Australian Department of Agriculture and Water Resources] 2016: Marine Pest Plan 2017-2022: the National Strategic Plan for Marine Pest Biosecurity 2017-2022. Department of Agriculture and Water Resources, Canberra, [CONSULTATION DRAFT, November 2016]

DEQ [Oregon State Department of Environmental Quality]. 2015. Oregon Task Force on the Shipping Transport of Aquatic Invasive Species: Report to the 2015 Legislature. 62pp.

DoF 2015: Vessel check biofouling risk assessment tool. Version 2.0, Prepared by Aquatic Biosecurity Section, Western Australia Department of Fisheries, Aquatic Environment Branch

DON [United States Department of the Navy]. 2015. Regional Biosecurity Plan Attachment K: State of Hawaii Biosecurity Recommendations. Eds. University of Guam and the Secretariat of the Pacific Community.

ECY [Washington Department of Ecology]. February 2014. Water quality Program: Focus on In-Water Hull Cleaning. Publication Number: 14-10-012. 4pp.

EPA [U.S. Environmental Protection Agency] 2008. Effects of climate change for aquatic invasive species and implications for management and research. National Center for Environmental Assessment, Washington, DC; EPA/600/R-08/014.

EPA [U.S. Environmental Protection Agency] 2005. Overview of EPA authorities for natural resource managers developing aquatic invasive species rapid response and management plans. US EPA Office of Wetlands, Oceans and Watersheds, Washington DC; 842B05002.

Floerl O, Wilkens S, Woods, C 2010: Temporal development of biofouling assemblages: Prepared for the Commonwealth Government of Australia, Department of Agriculture, Fisheries and Forestry by National Institute of Water & Atmospheric Research Ltd.

Forrest B 2013. Vessel hull fouling as a marine biosecurity indicator in the Top of the South: 2013 survey. Top of the South Marine Biosecurity Partnership, Technical Report 2013/01. 26 p.

Georgiades E, Kluza D 2014: Science Underpinning the Thresholds Proposed in the CRMS: Biofouling on Vessels Arriving to New Zealand. MPI Technical paper 2014/22. New Zealand Ministry for Primary Industries, July 2014

Golder Associates NZ Ltd (2008): Hull encapsulation as an incursion response tool for marine fouling organisms: a trial on a large vessel. Technical Paper No: 2007/ prepared for MAF Biosecurity New Zealand Project BO_186_2006 Wellington, 19 p.

Glosten 2016. Ballast water and biofouling regulatory gap analysis: gap analysis report. Prepared for Washington Department of Fish and Wildlife, Olympia, Washington. File No. 16023.01, Rev. A, 6 July 2016. 108 pp.

Hewitt C, Campbell M, Thresher R, Martin R, Boyd S, Cohen B, Currie D, Gomon M, Keough M, Lewis J, Lockett M, Mays N, McArthur M, O'Hara T, Poore G, Ross J, Storey M, Watson J, Wilson R 2004: Introduced and cryptogenic and species in Port Phillip Bay, Victoria, Australia. Marine Biology. 144: 183–202.

Hewitt CL, Campbell ML 2007: Mechanisms for the prevention of marine bioinvasions for better biosecurity. Marine Pollution Bulletin. 55: 395-401.

Hopkins GA, Forrest BM 2010. A preliminary assessment of biofouling and non-indigenous marine species associated with commercial slow-moving vessels arriving in New Zealand. Biofouling 26: 613-621.

Inglis GJ, Floerl O, Ahyong S, Cox S, Unwin M, Ponder-Sutton A, Seaward K, Kospartov M, Read G, Gordon D, Hosie A, Nelson W, d'Archino R, Bell A, Kluza D. 2010. The biosecurity risks associated with biofouling on international vessels arriving in New Zealand: summary of the patterns and predictors of fouling. Biosecurity New Zealand Technical Paper No: 2008. A report prepared for MAF Biosecurity New Zealand, Policy and Risk Directorate, Project FP0811321 No. 182.

International Maritime Organization 2011: Guidelines for the control and management of ships' biofouling to minimize the transfer of invasive aquatic species. MEPC Resolution 207(62) MEPC/62/24-Add-1.

IMO [International Maritime Organization]. November 2012. Guidance for Minimizing the Transfer of Invasive Aquatic Species as Biofouling (Hull Fouling) for Recreational Craft. MEPC.1/Circ. 792.

International Maritime Organization 2016: Globallast Project. http://globallast.imo.org/ accessed 23.07.16

Lacoursière-Roussel A, Forrest B, Guichard F, Piola R, McKindsey C 2012. Modeling biofouling from boat and source characteristics: a comparative study between Canada and New Zealand. Biological Invasions 14: 2301-2314.

Laoursière-Roussel A, Bock DG, Cristescu ME, Guichard F, McKindsey CW. 2016. Effect of shipping traffic on biofouling invasion success at population and community levels. Biological Invasions. Published online 18 Aug, DOI: 10.1007/s10530-016-1258-3

McDonald J, Bridgwood S, Hourston M. 2015. Likelihood of marine pest introduction to the Indian Ocean territories. Fisheries Research Report No. 264. Department of Fisheries, Western Australia. 40pp.

Millennium Ecosystem Assessment (MEA) 2005. Ecosystems and human well-being: Synthesis. Island Press, Washington DC.

Ministry of Primary Industries 2014: Craft Risk Management Standard: Biofouling on Vessels Arriving to New Zealand (CRMS – BIOFOUL). 15 May 2014

MOE [BC Ministry of Environment]. BC Invasive Mussel Defence Program 2015 Watercraft Inspection Final Report. Ecosystems Branch, BC Ministry of Environment. March 2016.

Morrisey DJ, Depree CV, Hickey CW, McKenzie DS, Middleton I, Smith MD, Stewart M, Thompson, KJ 2016. Rapid treatment of vessels fouled with an invasive polychaete, Sabella spallanzanii, using a floating dock and chlorine as a biocide. Biofouling, 32(2), 135-144.

ODFW [Oregon Department of Fish and Wildlife]. Reesman, M., Dolphin, G., and Boatner, R. February 2016. Oregon's Aquatic Invasive Species Prevention Program: 2015 Program Report. 9pp.

Simberloff D, Von Holle B 1999: Positive interactions of nonindigenous species: invasional meltdown? Biological Invasions 1:21–32

Stuart, MD 2004: Review of research on Undaria pinnatifida in New Zealand and its potential impacts on the eastern coast of the South Island'. Department of Conservation, DOC Science Internal Series 166.

Sylvester F and MacIsaac HJ. 2010. Is vessel hull fouling an invasion threat to the Great Lakes. Diversity and Distributions 16: 132-143.

Sylvester F, Kalaci O, Leung B, Laoursière-Roussel A, Clarke Murray C, Choi MA, Therriault TW, MacIsaac HJ. 2011. Hull fouling as an invasion vector: can simple models explain a complex problem? Journal of Applied Ecology 48: 415-423.

United Nations/Mediterranean Action Plan (UN/MAP) 2016: Integrated monitoring and assessment guidance. Chapter 3: Monitoring and assessment methodological guidance on E02 non-indigenous species p55-66 (UNEP(DEPI)/MED IG.22/Inf.7)

WDFW [Washington Department of Fish and Wildlife] 2015a. New Zealand Mudsnail (NZMS) statewide action summary. June 22, 2015. 7pp.

WDFW [Washington Department of Fish and Wildlife] 2015b. Washington State aquatic invasive species prevention and enforcement program: 2015 report to the legislature. January 2015. 15pp.

WDFW [Washington Department of Fish and Wildlife] 2016. Washington Department of Fish and Wildlife's aquatic invasive species invasive tunicate species management program. http://wdfw.wa.gov/ais/tunicates.html, accessed Nov. 2, 2016.

APPENDIX A
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STAKEHOLDER CONSULTATION LIST

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APPENDIX B
AIS KNOWN IN WASHINGTON

Species	Taxonomic Group
Sargassum muticum	Algae
Lomentaria hakodatensis	Algae
Caulacanthus ustulatus	Algae
Gelidium vagum	Algae
Ceramium kondoi	Algae
Limnodriloides monothecus	Annelids-Oligochaetes
Tubificoides diazi	Annelids-Oligochaetes
Hobsonia florida	Annelids-Polychaetes
Pseudopolydora kempi	Annelids-Polychaetes
Streblospio benedicti	Annelids-Polychaetes
Pseudopolydora paucibranchiata	Annelids-Polychaetes
Alitta succinea	Annelids-Polychaetes
Clymenella torquata	Annelids-Polychaetes
Aedes togoi	Arthropoda-Insects
Chilacis typhae	Arthropoda-Insects
Diadumene lineata	Coelenterates-Anthozoan
Nematostella vectensis	Coelenterates-Anthozoan
Cordylophora caspia	Coelenterates-Hydrozoans
Cladonema radiatum	Coelenterates-Hydrozoans
Monocorophium acherusicum	Crustaceans-Amphipods
Monocorophium insidiosum	Crustaceans-Amphipods
Melita nitida	Crustaceans-Amphipods
Grandidierella japonica	Crustaceans-Amphipods
Eochelidium sp. A	Crustaceans-Amphipods
Ampithoe valida	Crustaceans-Amphipods
Caprella mutica	Crustaceans-Amphipods
Incisocalliope derzhavini	Crustaceans-Amphipods
Jassa marmorata	Crustaceans-Amphipods
Mytilicola orientalis	Crustaceans-Copepods
Harpacticella paradoxa	Crustaceans-Copepods
Nippoleucon hinumensis	Crustaceans-Cumaceans
Limnoria tripunctata	Crustaceans-Isopods
Orthione griffenis	Crustaceans-Isopods
Caecidotea racovitzai	Crustaceans-Isopods
Sinelobus cf. stanfordi	Crustaceans-Tanaids
Schizoporella japonica	Ectoprocts
Bowerbankia gracilis	Ectoprocts
Cryptosula pallasiana	Ectoprocts
Bugula sp. 1	Ectoprocts
Bugula sp. 2	Ectoprocts
Bugula stolonifera	Ectoprocts

Species	Taxonomic Group
Watersipora subtorquata	Ectoprocts
Barentsia benedeni	Entoprocts
Mya arenaria	Mollusks-Bivalves
Crassostrea virginica	Mollusks-Bivalves
Crassostrea gigas	Mollusks-Bivalves
Venerupis philippinarum	Mollusks-Bivalves
Neotrapezium liratum	Mollusks-Bivalves
Musculista senhousia	Mollusks-Bivalves
Nuttallia obscurata	Mollusks-Bivalves
Mytilus galloprovincialis	Mollusks-Bivalves
Batillaria attramentaria	Mollusks-Gastropods
Pteropurpura inornata	Mollusks-Gastropods
Urosalpinx cinerea	Mollusks-Gastropods
Crepidula fornicata	Mollusks-Gastropods
Myosotella myosotis	Mollusks-Gastropods
Ilyanassa obsoleta	Mollusks-Gastropods
Crepidula plana	Mollusks-Gastropods
Nassarius fraterculus	Mollusks-Gastropods
Cecina manchurica	Mollusks-Gastropods
Crepidula convexa	Mollusks-Gastropods
Haminoea japonica	Mollusks-Gastropods
Potamopyrgus antipodarum	Mollusks-Gastropods
Pseudostylochus ostreophagus	Platyhelminthes
Cercaria batillariae	Platyhelminthes
Trochammina hadai	Protozoans
Cliona sp.	Sponges
Diplosoma listerianum	Tunicates
Botrylloides violaceus	Tunicates
Botryllus schlosseri	Tunicates
Ciona savignyi	Tunicates
Molgula manhattensis	Tunicates
Styela clava	Tunicates
Didemnum vexillum	Tunicates
Source: Davidson I, Zabin C, Ashton G, Ruiz G 2014a. An assessment of marine biofouling introductions to the Puget Sound region of Washington State. Report to the Washington Department of Fish & Wildlife and Washington Department of Natural Resources, Olympia, Washington. 111pp. Appendix 1	

APPENDIX C
DERIVATION OF THE VECTOR RISK SELF-ASSESSMENT CALCULATIONS

DERIVATION OF THE VECTOR RISK SELF-ASSESSMENT CALCULATIONS

A spreadsheet (Microsoft Excel) –based tool has been developed to assist vessel operators to evaluate the status of their vessels against Washington State's biofouling management requirements. The vessel risk self-assessment (**VeRSA**; Figure C-1)) is drawn from a similar approach used for vessels servicing the resources sector in Australia over the last decade. Completion of the **VeRSA** tool requires that vessel operators or managers use information on the vessels voyage history and maintenance practices to input a score into each of 9 cells in the worksheet. **VeRSA** automatically calculates a risk score which can be used to help determine compliance with the Department's biofouling management strategy.

VeRSA is based on the premise that all vessels greater than 300 GRT pose the same level of risk. Arguments may, however, be made for treating the various classes of vessels in this range differently; while there is merit in that approach, we consider that the risk factor differences are negligible for trading vessels. Vessels that interact with the seabed (aside for anchoring), such as dredgers, drill ships, pipe/cable lay ships do offer a different risk profile, and given the low frequency of arrivals into the State should be considered on a case-by-case basis.

Factors affecting risk may be considered to include two broad categories- Mitigating Factors and Risk Factors. Mitigating factors include a recent vessel inspection for AIS, whether the vessel has spent time in freshwater, and whether the internal systems have been treated to reduce the likelihood that AIS are present. Risk factors include the condition of the AFC, the climactic regions or risk profile of the source port for the vessel as well as whether there have been any stationary or slow speed periods.

Mitigating/Risk Factors

1. Inspection. An physical inspection of the vessel that did not detect any AIS on the hull or in the internal systems in the last 45 days contributes towards a low risk profile. The 45 day threshold is chosen as it is considered unlikely o detect AIS that have colonised the vessel prior to this time. A documented inspection of the vessel by an independent inspector (as recognized by the Department) contributes a better risk score than does a non-independent inspection, as does inspection of the internal systems. All inspections should be documented to the satisfaction of the Department.
2. Freshwater. It is considered spending more than 10 days in freshwater (e.g. the Columbia River) will result in the death of a variety of marine AIS, reducing the risk factor to a quarter of that if no time has been spent immersed in a freshwater system.
3. MGPS and Internal Treatment. Marine growth prevention systems are able, if used as per manufacturers recommendations, to limit the growth of biofouling in internal systems. Systems in which biocide is added directly to the pipework are generally considered to be more effective than those that utilize impressed current to liberate copper or chlorine ions. In all cases strict adherence to the manufacturers operational specifications is essential for effective protection and hence the risk assessor must view the vessel's operational records for the installation. Periodic internal treatment of internal systems (usually using descaling solutions, but also by mechanical means) also limits biofouling growth and depresses the risk profile.

4. AFC. The age and condition of the antifouling coating is one of the most important factors affecting the risk profile of a vessel. While many commercially applied AFCs can function effectively for 48 months or longer, efficacy declines markedly after the first 12-18 months of use. A more sensitive risk evaluation might assess AFC efficacy as a proportion of the remaining service life, though this can be complicated by the wide variety of types of different AFCs, different service intervals and whether the vessel has been cleaned in-water between re-coatings. The type of AFC must also be matched to the operational profile of the vessel. Hard coatings, for example, are those that require constant polishing by seawater to maintain their efficacy, while soft coatings will perform better at lower surface velocities.
5. Risk Regions/Climactic Matching. It is widely recognized that certain, heavily invaded locations pose a higher risk of being sources for potential AIS. Vessels that regularly stop in these locations, particularly those that remain at anchor or alongside for extended periods have a higher risk profile than those that do not. Similarly, vessels that spend much of their time in areas that have similar climate (usually defined by average annual sea surface temperature) to the receiving area pose a higher risk than those that do not. Such vessels are more likely to carry biofouling that can survive in the local receiving environment, and thus pose a higher risk. For risk assessors, where there is uncertainty in assigning a zone when the vessel has been in a region bordering the different temperature zones, the zone that is further away or 'more different' from that of the destination port is to be used.
6. Stationary/Slow Speeds. Most AFCs work best when appropriately matched with the operational profile of the vessel. AFC performance drops markedly when the operational profile changes –for example, when a vessel is laid up or 'cold stacked' for an extended period alongside or at anchor. Even slow speed periods (less than an average of 5 knots) of more than a week can result in reduced AFC performance and increased biofouling load. If these slow speed or stationary periods occur in high risk ports or similar climactic areas to the receiving environment, the risk score rises. We have chosen a slightly less conservative slow-speed interval of 10 days or more to match the approach proposed by the State of California.

These factors are used in the **VeRSA** to estimate a risk score for the vessel. Vessels that are ranked as 'LOW' risk are considered to be compliant with DFW objectives and would receive approval for a voyage to State waters. An 'UNCERTAIN' score would lead to further investigation of the vessel history, and perhaps a physical inspection of the vessel to elucidate the risk before the voyage could be confirmed. Mitigation activities, such as hull cleaning, may be required before approval was granted. A vessel that receives a 'HIGH' risk score is considered to pose an unacceptable biofouling risk and mitigation activities will be required before approval to voyage to and remain in State waters for two days or more will be granted.

SCENARIO TESTING.

Scenario 1: A hypothetical vessel requests arrival clearance to enter state waters and provides the following information:

- The AFC that was applied 18 months ago is considered appropriate for the vessels

- No additional treatment of the internal systems or sea chests has been applied since the last dry docking 18 months prior.
- The vessel has been to a high risk area (e.g. San Francisco Bay) since the last AFC application
- 42 days ago the vessel hull and internal systems was inspected in-water for AIS by a qualified biosecurity scientist and found to be clear of pests.
- The vessel has since been working up and down the west coast since the inspection, with the longest single non-activity period being 6 days spent at anchor in San Francisco Bay (a designated high risk port) two weeks ago.

Under this scenario, the vessel *MV Hypothetical1* achieves an 'Uncertain' risk rating. Consultation with the Department would be required prior to arrival in State waters. A 'clean' independent inspection of the hull an internal systems, though not resulting in a change to the risk score, would permit the vessel to complete the voyage.

Scenario 2: Use the same vessel information as above, but amend the period spent in San Francisco Bay to 10 days duration. Under this scenario the risk score jumps to 'High' and mitigation actions will be required prior to receiving consent to arrive in State waters.

The **VeRSA** sheets for these two scenarios are provided in Figures C-2 and C-3. Figure C-4 illustrates the different temperature-based oceanic climatic zones: polar <10°C, temperate 10-20°C, tropical >20°C.r

Washington State Biofouling Management: Vessel Risk Self Assessment (VeRSA)

Vessel:	IMO:	Call Sign:	Date: (mm-dd-yy)
Operating Company:	Assessor & Affiliation:		
Proposed Arrival Port (& date):	Last Port of Call & Date:		

Risk Factors	Factor Score	COMMENTS	Vessel Score
AIS not detected during a physical inspection of the vessel		45 days chosen as an inspector is unlikely to visually detect anything prior	Insert applicable score in this column
No inspection prior to date of arrival	1.00		
Previous AIS inspection undertaken within the 45 days of arrival	0.85		
One independent in-water AIS inspection undertaken within 45 days of arrival	0.50		
One independent out-of-water AIS inspection undertaken within 45 days of arrival	0.25		
AIS inspection included internal systems and immersible equipment			
Yes (retain a digital image of the main sea strainer)	0.75		
No (or not an independent inspection)	1.00		
Vessel has resided in freshwater (> 10d) immediately before arrival		Assumes that the risk of marine AIS is reduced by extended immersion in freshwater	
Yes	0.50		
No	2.00		
Marine growth protection system present and operating as per manufacturers specifications (specify type and review operational records)		These systems are variably effective at reducing growth in seachests	
Yes - through addition of biocide	0.50		
Yes - impressed current type	0.75		
No	1.00		
Vessel internal systems specifically treated using suitable thermal, chemical or mechanical treatment (specify)			
>12 months or unknown	2.00		
>6-12 months	1.00		
>3-6 months	0.50		
1-3 months	0.40		
<1 month	0.25		

Risk Factors	Factor Score	COMMENTS	Vessel Score
Condition and suitability of antifouling coatings (AFC)		Values based on ageing and depletion of the AFC over time	Insert applicable score in this column
AFC type is unknown, unsuited or absent	5.00		
AFC type is known, suited to activity and speed and documented age on arrival:			
> 24 months	4.00		
>12 - 24 months	2.00		
>9-12 months	1.00		
>6-9 months	0.85		
>3-6 months	0.75		
1-3 months	0.40		
<1 month	0.25		
Risk Regions/Climate Matching (Refer to World Bioregions Chart)		Assumes that being in a risk region more than doubles the risk compared to other similar bioregions	
Vessel has been located in nominated high risk ports/regions since AFC last applied	6.00		
Similar climatic region	3.00		
Adjacent climatic region	2.00		
Separate climatic region	1.00		
Number of stationary / slow speed periods (10 days or greater) in port or coastal waters since last application of AFC or clean AIS inspection or >10 d residence in freshwater		The risk of innoculation by an AIS rises during extended layup or "go slow" periods	
Total # of stationary periods > 4	3.00		
Total # of stationary periods between 2 - 4	2.00		
Total # of stationary periods between 1 and 2	1.00		
Stationary period is < 1 week	0.50		
Region of any stationary/slow speed periods since last application of AFC or clean AIS inspection or >10 d residence in freshwater		Assumes that being in a risk region more than doubles the risk compared to other similar bioregions	
High Risk Region	6.00		
Similar climatic region	3.00		
Adjacent climatic region	1.50		
Separate climatic region	0.80		
If not applicable	0.00		

Vessel Risk Score	The calculated risk level will be displayed here	0.00

If score <15 Low risk:	If score 15-25 = Uncertain risk:	If score >25 - High risk:
Vessel is compliant with WDFW objectives -approved for travel to Washington State waters; details require checks/confirmation only;	Precautionary principal applied: confirmatory independent inspection and/or mitigation actions reccomended	pre-arrival mitigation actions required

AIS risk assessments are to be submitted to the Washington Department of Fish & Wildlife

at least 10 days prior to anticipated arrival in State waters

Low Risk — The final risk assessment result will be displayed here

Figure C-1: Vessel Risk Self-Assessment Tool (annotated)

Washington State Biofouling Management: Vessel Risk Self Assessment (VeRSA)

Vessel:	MV *Hypothetical1*	**IMO:**	123X567	**Call Sign:** ZMT8304	**Date:** 15-Feb-17
Operating	11/21/2016	**Assessor &**	DM, WDFW		
Proposed Arrival	Seattle 23-Feb-17	**Last Port of Call &**	Newport, OR 15-Feb-17		

Risk Factors	Factor Score	COMMENTS	Vessel Score
AIS not detected during a physical inspection of the vessel			
No inspection prior to date of arrival	1.00	An inspection performed 42 days prior to the expected arrival date did not detect any AIS on the hull or internal systems	0.50
Previous AIS inspection undertaken within the 45 days of arrival	0.85		
One independent in-water AIS inspection undertaken within 45 days of arrival	**0.50**		
One independent out-of-water AIS inspection undertaken within 45 days of arrival	0.25		
AIS inspection included internal systems and immersible equipment			
Yes (retain a digital image of the main sea strainer)	**0.75**	yes	0.75
No (or not an independent inspection)	1.00		
Vessel has resided in freshwater (> 10d) immediately before arrival			
Yes	0.50	no	2.00
No	**2.00**		
Marine growth protection system present and operating as per manufacturers specifications (specify type and review operational records)			
Yes- through addition of biocide	0.50	An impressed current-type MGPS is installed on the vessel but an examination of records indicates that it has not been correctly operating for the last 6 months	1.00
Yes -impressed current type	0.75		
No	**1.00**		
Vessel internal systems specifically treated using suitable thermal, chemical or mechanical treatment (specify)			
> 12 months or unknown	**2.00**	unknown	2.00
>6-12 months	1.00		
>3-6 months	0.50		
1-3 months	0.40		
<1 month	0.25		

The risk factor score for the vessel is to be inserted in the 'Vessel Score' column

Risk Factors	Factor Score	COMMENTS	Vessel Score
Condition and suitability of antifouling coatings (AFC)			
AFC type is unknown, unsuited or absent	5.00	The AFC is suited to the vessel's operating profile and was applied 18 months prior to the expected arrival date	2.00
AFC type is known, suited to activity and speed and documented age on arrival:			
> 24 months	4.00		
>12 - 24 months	**2.00**		
>9-12 months	1.00		
>6-9 months	0.85		
>3-6 months	0.75		
1-3 months	0.40		
<1 month	0.25		
Risk Regions/Climate Matching (Refer to World Bioregions Chart)			
Vessel has been located in nominated high risk ports/regions since AFC last applied	**6.00**	The vessel spent 6 days at anchor in San Francisco Bay two weeks prior to arrival	6.00
Similar climatic region	3.00		
Adjacent climatic region	2.00		
Separate climatic region	1.00		
Number of stationary / slow speed periods (10 days or greater) in port or coastal waters since last application of AFC or clean AIS inspection or >10 d residence in freshwater			
Total # of stationary periods > 4	3.00	no stationary periods in excess of 10 days since the last clean AIS inspection	0.50
Total # of stationary periods between 2 - 4	2.00		
Total # of stationary periods between 1 and 2	1.00		
Stationary period is < 10 days	**0.50**		
Region of any stationary/slow speed periods since last application of AFC or clean AIS inspection or >10 d residence in freshwater			
High Risk Region	6.00	n/a	0.00
Similar climatic region	3.00		
Adjacent climatic region	1.50		
Separate climatic region	0.80		
If not applicable	**0.00**		

Vessel Risk Score	The calculated risk assessment score is displayed here:	18.00

If score <15 Low risk:	If score 15-25 = Uncertain risk:	If score >25 - High risk:
Vessel is compliant with WDFW objectives -approved for travel to Washington State waters; details require checks/confirmation only;	Precautionary principal applied: confirmatory independent inspection and/or mitigation actions reccomended	pre-arrival mitigation actions required

AIS risk assessments are to be submitted to the Washington Department of Fish & Wildlife at least 10 days prior to anticipated arrival in State waters

The risk assessment result is displayed here: **Uncertain Risk - Caution required**

Figure C-2: VeRSA Scenario 1

Washington State Biofouling Management: Vessel Risk Self Assessment (VeRSA)

Vessel:	MV *Hypothetical2*	**IMO:**	123X567	**Call Sign:** ZMT8304	**Date:** 15-Feb-17
Operating	11/21/2016	**Assessor &**	DM, WDFW		
Proposed Arrival	Seattle 23-Feb-17	**Last Port of Call &**	Newport, OR 15-Feb-17		

Risk Factors	Factor Score	COMMENTS	Vessel Score
AIS not detected during a physical inspection of the vessel		An inspection performed 42 days prior to the expected arrival date did not detect any AIS on the hull or internal systems	0.50
No inspection prior to date of arrival	1.00		
Previous AIS inspection undertaken within the 45 days of arrival	0.85		
One independent in-water AIS inspection undertaken within 45 days of arrival	**0.50**		
One independent out-of-water AIS inspection undertaken within 45 days of arrival	0.25		
AIS inspection included internal systems and immersible equipment		yes	0.75
Yes (retain a digital image of the main sea strainer)	**0.75**		
No (or not an independent inspection)	1.00		
Vessel has resided in freshwater (> 10d) immediately before arrival		no	2.00
Yes	0.50		
No	**2.00**		
Marine growth protection system present and operating as per manufacturers specifications (specify type and review operational records)		An impressed current-type MGPS is installed on the vessel but an examination of records indicates that it has not been correctly operating for the last 6 months	1.00
Yes- through addition of biocide	0.50		
Yes -impressed current type	0.75		
No	**1.00**		
Vessel internal systems specifically treated using suitable thermal, chemical or mechanical treatment (specify)		unknown	2.00
>12 months or unknown	**2.00**		
>6-12 months	1.00		
>3-6 months	0.50		
1-3 months	0.40		
<1 month	0.25		

Risk Factors	Factor Score	COMMENTS	Vessel Score
Condition and suitability of antifouling coatings (AFC)		The AFC is suited to the vessel's operating profile and was applied 18 months prior to the expected arrival date	2.00
AFC type is unknown, unsuited or absent	5.00		
AFC type is known, suited to activity and speed and documented age on arrival:			
> 24 months	4.00		
>12 - 24 months	**2.00**		
>9-12 months	1.00		
>6-9 months	0.85		
>3-6 months	0.75		
1-3 months	0.40		
<1 month	0.25		
Risk Regions/Climate Matching (Refer to World Bioregions Chart)		The vessel spent 6 days at anchor in San Francisco Bay two weeks prior to arrival	6.00
Vessel has been located in nominated high risk ports/regions since AFC last applied	**6.00**		
Similar climatic region	3.00		
Adjacent climatic region	2.00		
Separate climatic region	1.00		
Number of stationary / slow speed periods (10 days or greater) in port or coastal waters since last application of AFC or clean AIS inspection or >10 d residence in freshwater		no stationary periods in excess of 10 days since the last clean AIS inspection	0.50
Total # of stationary periods > 4	3.00		
Total # of stationary periods between 2 - 4	2.00		
Total # of stationary periods between 1 and 2	1.00		
Stationary period is < 10 days	**0.50**		
Region of any stationary/slow speed periods since last application of AFC or clean AIS inspection or >10 d residence in freshwater		n/a	6.00
High Risk Region	**6.00**		
Similar climatic region	3.00		
Adjacent climatic region	1.50		
Separate climatic region	0.80		
If not applicable	0.00		

Vessel Risk Score	27.00

If score <15 Low risk:	If score 15-25 = Uncertain risk:	If score >25 - High risk:
Vessel is compliant with WDFW objectives -approved for travel to Washington State waters; details require checks/confirmation only;	Precautionary principal applied: confirmatory independent inspection and/or mitigation actions reccomended	pre-arrival mitigation actions required

AIS risk assessments are to be submitted to the Washington Department of Fish & Wildlife at least 10 days prior to anticipated arrival in State waters

High Risk

Figure C-3: VeRSA Scenario 2

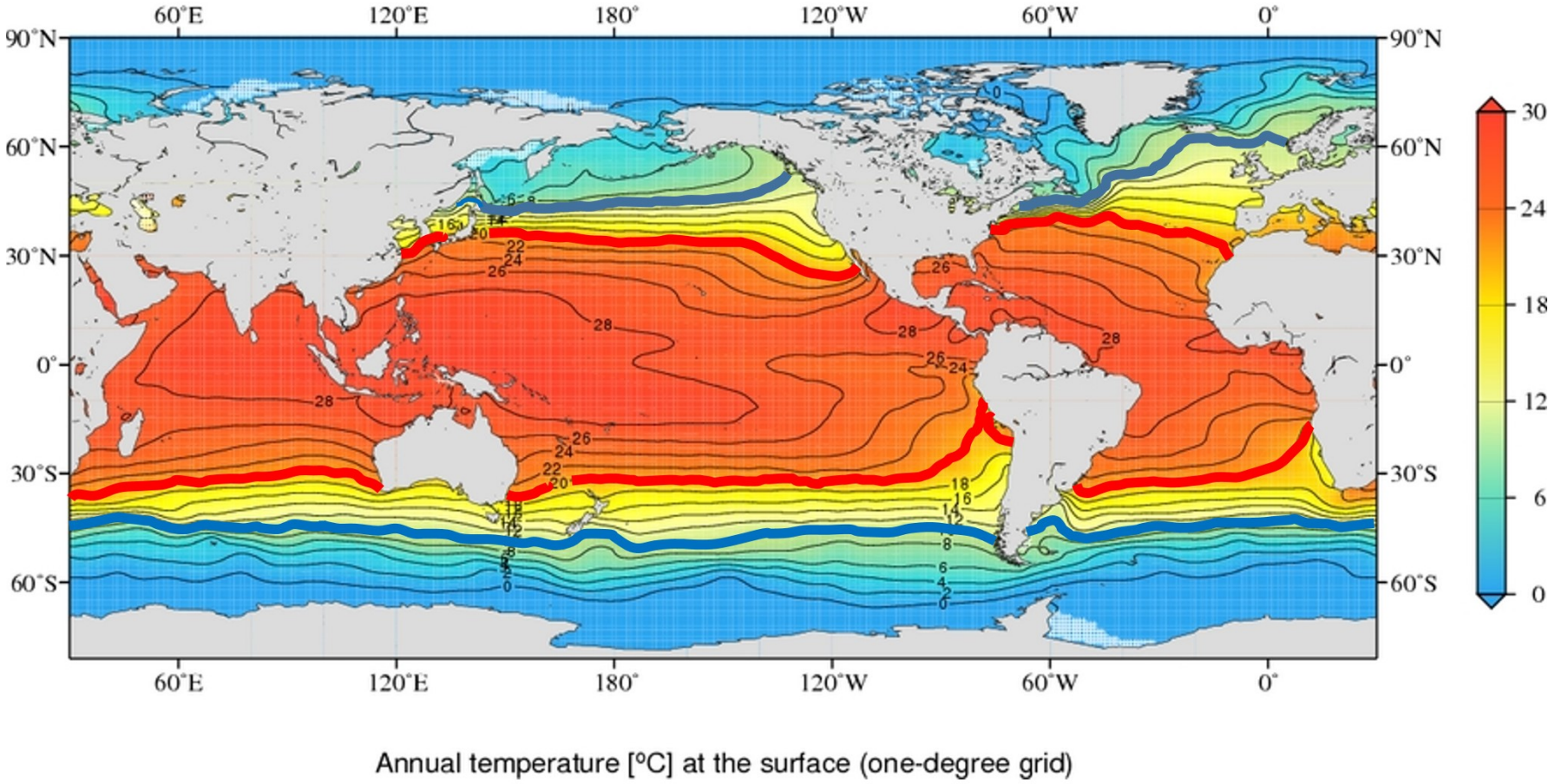

Figure C-4: Major oceanic climactic zones; polar <100C; temperate 10-200C; tropical >200C (World Ocean Atlas 2013: Mean annual sea surface temperature (SST) for 2005-2012)

APPENDIX D
ISSUES NOTED DURING CONSULTATIONS AND RESPONSES OF THE DEVELOPMENT TEAM

Date	Sender	Company	Draft Version Dated:	Comment	Action / Response	Status
10/3/2016	Cpt. Mike Moore	Pacific Merchant Shipping Association (PMSA)	09/01/2016	It is not clear how the 7 day and 21 day thresholds were developed or specifically what would be required for various sectors.	Thresholds adjusted	Closed
10/4/2016	Mike Moore	PMSA	09/01/2016	We assume that there are different risk factors for different vessel operating categories: recreational vessels both resident and non-resident, residential harbor services, coastal/ international trade, vessels going into or out of lay up status, and so on. What specific operational requirements would each of these vessel operational scenarios and sectors be subject to?	Vector pressure analysis has been added addressing the risk factors for different vessel types. We are not proposing operational restrictions, only reporting that will inform WDFW if operational parameters fall into an increased risk category, so that inspections can be conducted to see if biofouling has reached a critical level (the VeRSA)	Closed
10/5/2016	Mike Moore	PMSA	09/01/2016	What would be required of resident commercial vessels like tugs and bunker barges that move around the greater Puget Sound area to provide vessel assist, vessel escort and to move bunker barges to delivery points and back? We also have tug rotations to/from Neah Bay complying with a state contingency plan requirement so is this specific in-area movement a target for biofouling requirements or is this considered common waters? In summary, please clarify expectations of these resident vessel operations as there is significant uncertainty about the intended potential requirement list for these vessel operations.	The potential risk of vessel movement within WA waters is now addressed in the vector pressure analysis (section 2.1.2). The risk is expected to be low unless the vessels are moving from a port with an invasion of priority AIS. As the proposal currently stands vessels are only expected to report when they enter WA waters, which would exclude vessels moving within WA waters. It may be necessary during the implementation phase to require the filing of a VeRSA when moving from a port where the AIS biofouling risk is deemed elevated by the AIS program.	Closed
10/6/2016	Mike Moore	PMSA	09/01/2016	Can a side by side comparison be made between regimes including IMO, CG, BC, Oregon and California? That would make it helpful for operators to evaluate and compare and provide feedback.	Section 2 addresses existing Biofouling management plans	Closed
10/3/2016	Nicole Dobroski	California State Lands Commission (CSLC)	09/01/2016	There is an overarching lack of clarity on the population of vessels operating in Washington state waters, and the relative proportion of arrivals for each type of vessel. This information is necessary to properly evaluate NIS introduction risk to the state, especially the relative risk presented by each type of vessel. There is reference to a vector-pressure evaluation that is forthcoming, but it seems premature to lay out an extensive strategic plan and framework for regulatory requirements before knowing where the majority of the NIS introduction risk is coming from. Davidson et al. (2014) discuss risks and management gaps for commercial trading, fishing, and recreational vessels. The proposed strategic plan appears to be targeted less at these types of vessels and more at long-stay oil and gas movable infrastructure and support vessels. This approach is modeled after templates from areas with heavy oil and gas influence. We are not sure how prevalent those types of vessels are in Washington and what the relative AIS introduction risk would be for them when compared to commercial trading vessels.	Section 2	Closed
10/4/2016	Nicole Dobroski	CSLC	09/01/2016	We suggest holding off on finalizing this strategic plan until the vector-pressure evaluation can be completed and incorporated. Information on the relative proportion that each vessel type contributes to the overall vector population, and the relative NIS introduction risk from each type of vessel, is critically important to developing an effective strategic plan.	Section 2 addresses this issue	Closed
10/5/2016	Nicole Dobroski	CSLC	09/01/2016	The 7- and 21-day exemption thresholds effectively exclude a large portion of vessels from regulation, especially commercial trading and passenger vessels that present AIS introduction risk to Washington (see Davidson et al. 2014). As stated in General Comment 1, it appears that the strategic plan is written to capture risks associated with long-stay oil and gas vessels. We know that commercial vessels present NIS introduction risks, and the proposed strategic plan does little to address those risks. This approach of excluding commercial trading and passenger vessels is not aligned with the IMO Biofouling Guidelines nor with the approaches being developed and considered by regional state partners. We suggest reconsidering the focus of the strategic plan and future regulations to include commercial trading and passenger vessels and removing the thresholds that exempt them.	The exemption thresholds were modified to address these concerns.	Closed

Date	Sender	Company	Draft Version Dated:	Comment	Action / Response	Status
10/6/2016	Nicole Dobroski	CSLC	09/01/2016	Executive Summary, Para 7, Line 5-6: The California program includes monitoring and surveys, but does not include a response component. There are other agencies and programs that focus, in part, on response, but they are not a part of California's Marine Invasive Species Program.	Executive summary re-written	Closed
10/7/2016	Nicole Dobroski	CSLC	09/01/2016	Page 5, Section 2.1.2, Para 5 (starts with HOLD): The vector-pressure evaluation is one of the most important components to rely on while developing this strategic plan. It seems premature to develop a framework for policy without knowing where the risk is. For example, Davidson et al. (2014) focused on risks related to commercial trading, fishing, and recreational vessels, but much of this strategic plan is focused on oil and gas vessels. We unaware of the relative risk from these vessels. We should have a good understanding of the risks before proposing strategies to manage those risks.	Section 2 addresses this issue	Closed
10/8/2016	Nicole Dobroski	CSLC	09/01/2016	Page 5, Section 2.2, Para 1, Lines 7-8: Suggest revising to clarify that IMO Biofouling Guidelines adopted in July 2011 were not part of a convention (as stated in text).	Adjusted wording	Closed
10/9/2016	Nicole Dobroski	CSLC	09/01/2016	Page 9, California, Line 1: California's biofouling management regulations will be proposed to go into effect July 1, 2017. Suggest referencing that date instead of the end of 2016.	Added correct date	Closed
10/10/2016	Nicole Dobroski	CSLC	09/01/2016	Page 9, California, Lines 2-4: The two programs referenced are one in the same, the Marine Invasive Species Program covers both ballast water and biofouling management. The Biofouling Technical Advisory Group referenced is an advisory body of representative stakeholders that is convened by the Marine Invasive Species Program.	Adjusted wording	Closed
10/11/2016	Nicole Dobroski	CSLC	09/01/2016	Page 10, Para 1, Line 1: Please revise to "Biofouling management requirements apply to vessels equal to or greater than 300…"	Corrected	Closed
10/12/2016	Nicole Dobroski	CSLC	09/01/2016	Page 10, Para 1, Line 5: Please change 2105 to 2015.	Corrected	Closed
10/13/2016	Nicole Dobroski	CSLC	09/01/2016	Page 10, Para 1, Line 7: The Hull Husbandry Reporting Form is currently required to be submitted within 60 days of a written or electronic request from the Commission. Our proposed regulations will include a new Marine Invasive Species Program Annual Vessel Reporting Form that will be required 24 hours in advance of the first arrival at a California port during a calendar year, but that is not proposed to become effective until July 1, 2017.	Adjusted wording	Closed
10/14/2016	Nicole Dobroski	CSLC	09/01/2016	Page 12, Non-government organizations, Bullet 1, Line 2: Please replace PSMFC Ballast Water Group with Pacific Ballast Water Group.	Corrected	Closed
10/15/2016	Nicole Dobroski	CSLC	09/01/2016	Page 17, Outcome 5.1: Suggest including a bullet that emphasizes reviewing biofouling management regulations in varying stages of development/implementation with regional partners and evaluating whether those strategies are appropriate for Washington, as a first step towards consistency across jurisdictions.	Added text	Closed
10/16/2016	Nicole Dobroski	CSLC	09/01/2016	Page 22, Section 4.3.1, Bullet 4: What will future inspections entail? How do we know one additional inspector is the appropriate number?	More information on inspections provided.	Closed
10/17/2016	Nicole Dobroski	CSLC	09/01/2016	Page 27, Section 4.6.1, Line 3: Why was seven days chosen as a threshold? A severely fouled vector that is in state waters for six days would not be subject to any management requirements under this scenario, but it would still represent AIS introduction risk. We remain unsure about the population of vessels that are intended to fall under these requirements, and how their AIS introduction risk compares to the vectors that would be exempted based on this threshold.	Thresholds adjusted	Closed
10/18/2016	Nicole Dobroski	CSLC	09/01/2016	Page 27, Section 4.6.1, Para 3, Lines 3-4: There is uncertainty about who would be a suitably qualified and experienced person, would it be a state employee or a consultant? Are there qualifications and certifications associated with this classification? Who would be the designating authority?	to be addressed during the implementation phase of the program	Open

Date	Sender	Company	Draft Version Dated:	Comment	Action / Response	Status
10/19/2016	Nicole Dobroski	CSLC	09/01/2016	Page 27, Section 4.6.1, Para 3, Line 8: Does DFW have the authority to require a vessel to leave state waters?	Changed to "vectors falling in to the last [high risk] category may be requested to perform mitigations prior to entry"	Closed
10/20/2016	Nicole Dobroski	CSLC	09/01/2016	Page 28, Lines 2-3: Good news that DFW will make adoption of the IMO Biofouling Guidelines mandatory, but does this also apply to recreational vessels? It appears that it does. The IMO Biofouling Guidelines weren't necessarily targeted at recreational craft. The IMO Biofouling Guidelines reference a separate document that presents guidance for recreational craft. There is still uncertainty about which types of vessels are intended to fall under all of these requirements.	Recreational vessels are not included in this version of the Plan. These will be rolled into the plan at a later date.	Closed
10/21/2016	Nicole Dobroski	CSLC	09/01/2016	Page 29, Figure 5: This model vector risk-assessment tool is not generally applicable to commercial trading or passenger vessels. There's a focus on "contract commencement," and is similar to the approach taken for oil and gas movable infrastructure and support vessels in Australia. It appears that the intended vector population for these requirements are long-stay oil and gas type vessels; what is the relative NIS introduction risk from these vessels versus commercial traders and passenger vessels? Both present risks, but it appears that the commercial trading and passenger vessels are overlooked.	Risk assessment tool has been updated	Closed
10/22/2016	Nicole Dobroski	CSLC	09/01/2016	Page 34, Section 4.8, Para 1, Lines 1-2: Same comment as earlier. What is the reason for exempting vessels that are in state waters for less than 7 days? This approach may incentivize a lack of management for vessels that will be in state waters for 6 days or less.	Thresholds adjusted	Closed
10/23/2016	Nicole Dobroski	CSLC	09/01/2016	Page 34, Section 4.8, Bullet 1: Why are commercial trading vessels that remain in state waters for less than 21 days exempt? Under this scenario, the only commercial vessels that will be covered by these requirements will be those that are placed into layup within Washington state waters, all others would be exempted. This approach is not consistent with the results presented by Davidson et al. (2014), and is not consistent with the IMO Biofouling Guidelines nor regional state regulations in various stages of development. We know that commercial trading vessels present NIS introduction risk, exempting these vessels does nothing to reduce this risk.	Thresholds adjusted	Closed
10/24/2016	Nicole Dobroski	CSLC	09/01/2016	Page 35, Lines 3-4: This sentence states that the reason for the 7-day threshold is because it is a practical estimate for the time it takes for AIS to potentially colonize a vessel, but that is a typical "pre-border" concern (i.e. concern about the colonization of a vessel prior to entry into state waters). The 7-day time period is being proposed for a "post-border" threshold for the amount of time a vessel stays in state waters before it is subject to requirements. There is a disconnect here between the reasoning for the threshold and how it is being applied. Once in Washington waters, DFW should be most concerned about propagules moving from the vessel to the receiving waters, not the other way around (in most cases). California is proposing a 45-day threshold for remaining in one location (most often pre-border) prior to arrival, because of the NIS introduction risk they present. An approach like that is more aligned with the reasoning for the 7-day threshold referenced in the Washington strategic plan.	Thresholds adjusted	Closed
10/25/2016	Nicole Dobroski	CSLC	09/01/2016	Page 35, Figure 6: The 4th diamond in the flowchart states that if a vessel is in state waters for less than 7 days, they are approved and must prepare risk assessment information. However, the previous page (Section 4.8) states that the requirements (presumably including preparation of risk assessment information) only applies if the vessel remains for more than 7 days. These are in conflict; the text needs to clarify what is expected of vessels that remain in state waters for less than 7 days (do they or do they not need to prepare risk assessment information?).	Thresholds adjusted	Closed

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10/26/2016	Nicole Dobroski	CSLC	09/01/2016	Page 35, Figure 6: The 4th diamond in the flowchart describes what happens when a vessel stays in state waters for less than 7 days. The text on the previous page references vessels that stay in state waters for more than 7 days. Which side of the equation should vessel be if they are in state waters for exactly 7 days?	Thresholds adjusted	Closed
10/27/2016	Nicole Dobroski	CSLC	09/01/2016	Page 36, Section 4.9, Performance Measure #2: Does DFW have the authority to prevent a vessel from entering state waters?	Removed	Closed
10/4/2016	Julie Kuo	Hawaii Department of Land and Natural Resources (HDLNR)	09/01/2016	Are there areas in Washington where non-compliant vessels can perform in-water-cleaning of their vessel? In other words, as part of the rapid response procedure, will you be requiring vessels to dry dock or will you allow the cleaning of vessels in-water in certain locations?	This will need to be coordinated with the Department of Ecology during the implementation phase.	
10/5/2016	Julie Kuo	HDLNR	09/01/2016	Do you need to identify who is responsible for hull husbandry effluent? The in-water-cleaning vendor or the vessel owner/operator?	This is more under the jurisdiction of the Department of Ecology. Not addressing in this plan.	Closed
10/6/2016	Julie Kuo	HDLNR	09/01/2016	Are there estimated damages and expenditures already incurred by AIS to agriculture industry or tourism industry or the state that could be used in the introduction?	We don't have specific information on damage, just presence.	Closed
10/7/2016	Julie Kuo	HDLNR	09/01/2016	Necessary to include ranges of funds for new positions and other costs to support the program?	Presenting as number of FTEs necessary to run program in Figure 1	Closed
11/24/2016	Allen Pleus	Washington State Department of Fish and Wildlife (WDFW)	11/21/2016	Page 3 - Aquatic Nuisance Species Committee "paragraph not important to this document"	Paragraph deleted	Closed
11/24/2016	Allen Pleus	WDFW	11/21/2016	Figure 1 - Chapter 1 - "Remove personnel names"	Names removed	Closed
11/24/2016	Allen Pleus	WDFW	11/21/2016	Suggested new Section Heading for Chapter 2	Update made	Closed
11/24/2016	Allen Pleus	WDFW	11/21/2016	Page 27 - Regional and International approach - "I would recommend moving Table 3 up here and modifying as below if you want to include the other states BC, NZ, and AUS. My initial read with such close scoring made me think WA was pretty far ahead - almost as good as CA, which is not the case. Further reading of the comparative elements did not seem relevant to biofouling."	Deleted Regulatory Scoring Table. Moved Table 2: Comparison of regulations in different jurisdictions for managing biofouling on large vessels to this section as suggested.	Closed
11/24/2016	Allen Pleus	WDFW	11/21/2016	Section 2.4 - "This seems very similar to Sec. 3 and I think should form the foundation for that section. See more comments on page"	Re-worked sections	Closed
11/24/2016	Allen Pleus	WDFW	11/21/2016	Chapter 3 - "Unless I'm missing something, many of the points made in this section seem redundant to the guiding principles above. I think it would be much clearer and cleaner to use the Sec. 2.4 format for this section and integrate this information as necessary by principle."	Re-worked sections	Closed
11/24/2016	Allen Pleus	WDFW	11/21/2016	Section 4.1 - "The report is a recommendation to the department"	Adjusted wording	Closed
11/24/2016	Allen Pleus	WDFW	11/21/2016	Section 4.2 - "Document voice is a recommendation to WDFW"	Adjusted wording	Closed
11/24/2016	Allen Pleus	WDFW	11/21/2016	Section 4.3 - "Would be best to calculate FTEs for each position below needed in addition to/or proportion share between existing BW staff and duties. For example, do you recommend my time (AIS Coord) dedication to this task at .1 or .2 FTE? Would Op Mngr require new full time FTE or a portion of an FTE? We would then have to decide whether one person can do both adequately."	Adjusted FTE to address comment	Closed
11/24/2016	Allen Pleus	WDFW	11/21/2016	Section 4.5.3 Heading - "Maybe I'm paranoid, but "surveillance" sounds like a sneaky military tactic. If you decide to change, need to change in rest of section too."	Adjusted wording	Closed
11/24/2016	Allen Pleus	WDFW	11/21/2016	Section 5 Heading - "Term "future proofing" not common and can create confusion."	Changed 'Future Proofing' to 'Adaptive Management'	Closed

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11/24/2016	Allen Pleus	WDFW	11/21/2016	Section 6 - "I don't see the Glosten gap analysis report cited here."	Added reference	Closed
2nd Workshop Comments						
12/14/2016	Dan Smith	Crowley Maritime Corporation (Crowley)	12/01/2016	VeRSA -The global scale of the bioregions graphic may make it difficult for operators to assign a specific source bioregion- please clarify	The boundaries between the temperature-based regions are not finely delimited; where there is doubt about the specific location in such areas, the risk assessor should select the region that is more different than the destination port	Closed
12/14/2016	Zach Robertson	United States Coast Guard (USCG)	12/01/2016	VeRSA - ambiguity over the 7 day slow period; if a vessel remained in Tacoma for a three days, transited over a day slowly to Seattle, then remained there for 3 days, would that count as a 'slow period'?	Yes	Closed
12/14/2016	Dan Smith	Crowley	12/01/2016	VeRSA - scores for the risk ranges appear to overlap	This was an error in the distributed form (now corrected); the correct ranges are: Low- <15; Uncertain- 15-25; High >25	Closed
12/14/2016	Jordan Royer	PMSA	12/01/2016	The 10d and 2d limits may not be practicable; ships don't often know that far in advance when they will be arriving, nor do they know how long it will take to offload/load their vessels.	Understood that this is a challenge	Closed
12/14/2016	Jules Kuo	HDLNR	12/01/2016	How will high risk port areas be identified	This will need to be addressed prior to implementation of the plan but will be based on areas in similar climactic zones that are highly invaded (e.g. San Francisco Bay, Port Philip Bay in Australia, etc.)	Closed
12/14/2016	Dan Smith	Crowley	12/01/2016	VeRSA -it indicates that vessel inspectors need to be qualified. Does this apply to those filling out these Risk Assessments too?	No, only to the Inspectors (wording on form changed in final version)	Closed
12/14/2016	Jules Kuo	HDLNR	12/01/2016	How are bioregions defined.	Somewhat coarsely using mean annual SST; polar<10°C, temperate 10-20°C, tropical>20°C	Closed
12/14/2016	Allen Pleus	WDFW	12/01/2016	Add implementation plan to end of document, including necessary cooperative agreements, frequency of completing VeRSA forms, inclusion in biofouling management plans and annual reporting (as in CA).	Provided in final section of document	Closed
12/14/2016	Allen Pleus	WDFW	12/01/2016	Include areas where this plan overlaps with requirements in other jurisdictions and where it deviates	discussed in Section 4.2	Closed
12/14/2016	Allen Pleus	WDFW	12/01/2016	Suggest that risk associated with AFC age is amended from the time since last application to percent of effective life span, to take into account differences in lifespans between types and brands of antifouling coatings.	this information is not always immediately available for operator when filling out the VeRSA while AFC age is an easy to use surrogate; it should fall to the regulatory vessel audit team to consider these differences when judging uncertain assessment results	Closed
12/14/2016	Amanda Newsom	WDFW	12/01/2016	VeRSA- How likely is it that an independent inspection would not include internal systems? In a situation where other mitigating factors are relatively low-risk, lack of internal piping investigation does not currently result in a higher risk ranking at this time, even if the vessel has been to a high-risk area for less than a week.	Generally speaking, an inspection will include consideration of internal systems if it is required by regulatory agencies! A professional, independent inspector will always want to know what is inside in order to inform risk, but in the end if the regulator is not interested and the client does not want to go to the trouble or cost, then it does not happen. We think all vessel operators know that an internal inspection can only make things worse for them if they already have a ship with old AFC or that was in a high risk area for an extended period! This example shows that some vessels will always need to be considered carefully. In that instance, the risk level is being driven down primarily by a combination of a clean inspection and time in freshwater. We suggest that a 'flag' for Departmental review of a self-assessment is one where the vessel has spent some time at a high risk area, even if it all comes out looking 'green.'	Closed

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12/14/2016	Amanda Newsom	WDFW	12/01/2016	Table 2 – Comparison of regulations; the way this table fits into strategic plan is still not entirely clear	The table has been moved to Section 4.2 and discussed in Additional detail	Closed
12/14/2016	Amanda Newsom	WDFW	12/01/2016	Page 32 – Include regulated community as stakeholders. Would recommend giving examples of participants in BWWG such as AWO, WSPA, and PMSA as likely organizations, as well as maritime classification societies such as ABS and Lloyd's if appropriate.	revisions included in Section 2.2.2	Closed
01/3/2017	Cpt Mike Moore / Charles Constanzo	PMSA / American Waterways Organization (AWO)-Pacific region	12/01/2016	We urge Washington to align with the IMO, as this would assist in compliance, reduce the need for increased staffing levels, and to avoid confusion and duplicative efforts	To be considered by the Department	OPEN
01/3/2017	Cpt Mike Moore / Charles Constanzo	PMSA / AWO-Pacific region	12/01/2016	It also would benefit the process to involve the Army Corps of Engineers and ports as some of the highest risk vessels appear to be involved in dredging operations….	Agreed; to be considered by DFW	Closed
01/3/2017	Allen Pleus	WDFW	12/01/2016	Noting that some stakeholders have advised they will not comment until the plan is finalized, please include in the Executive Summary and at the end of the report that it went through two reviews by the BWWG during the draft stages, but evaluation of consensus or nonconsensus will be completed by the department after the report is finalized	revisions included	Closed
01/3/2017	Nicole Dobroski	CSLC	12/01/2016	Pages 10-12, Last Port of Call subsection: Although a vessel's last port of call (LPOC) provides some detail about the recent operational history of a vessel, the NIS introduction risk that an individual vessel represents depends, in part, on the integrative history of all ports visited by that vessel since it was last defouled and/or antifouled. We would suggest caution in categorizing levels of NIS risk based solely on a vessel's last port of call. LPOC-based risk analysis could inadvertently misdirect resources away from high-risk vessels, or misappropriate resources towards low-risk vessels	Agreed; POCs since the last docking are all important (additional wording in text)	Closed
01/3/2017	Nicole Dobroski	CSLC	12/01/2016	Page 11, Para 1: A positive correlation between tropical ports and biofouling extent (Davidson et al 2014b) and a negative correlation between propagule and colonization pressure and latitude of LPOC (Sylvester et al. 2011) suggests possible indicators for biofouling extent, not necessarily NIS introduction risk to Washington's temperate waters. Knowing that environmental matching is a factor that may play a role in successful introduction events, we caution against statements indicating that vessels with tropical LPOCs would represent a greater NIS introduction risk than vessels arriving from temperate LPOCs. In other words, what is the difference in NIS introduction risk to Washington between a vessel with more biofouling extent but from an environmental mismatch and a vessel with less biofouling extent but with an environmental match?	agree; addressed in final report	Closed
01/3/2017	Nicole Dobroski	CSLC	12/01/2016	Page 11, Para 1, Lines 14-15: Although transiting through the Panama Canal is likely to minimize some of the NIS introduction risk, it will likely not mitigate all of the risk. For example, Davidson et al. (2009) found that simulated transits through the Panama Canal resulted in reduced abundance and richness, but freshwater immersion had no effect on certain species (e.g. Amphibalanus reticulatus). In some cases, barnacles and polychaetes exhibited reproductive behavior (release of egg masses or larvae) after treatment conditions. [Davidson, I., M. Sytsma, G. Ruiz. 2009. An experimental analysis of salinity shock on biofouling communities: a pilot study. Final report prepared for the California State Lands Commission. 22 pp.]	agree; addressed in final report	Closed
01/3/2017	Nicole Dobroski	CSLC	12/01/2016	Page 13, Bullet 3: Suggest adding "accumulation and" to read "(the greater the duration of stay the greater the likelihood of accumulation and transfer).	agree; addressed in final report	Closed

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01/3/2017	Nicole Dobroski	CSLC	12/01/2016	Page 13, Bullet 4: Suggest adding text to indicate that slower speeds also increase the likelihood of organism survival (Coutts et al. 2010). [Coutts, A.D.M., R.F. Piola, C.L. Hewitt, S.D. Connel, J.P. Gardner. 2010. Effect of vessel voyage speed on survival of biofouling organisms: implications for translocation of non-indigenous marine species. Biofouling 26(1): 1-13.]	agree; addressed in final report	Closed
01/3/2017	Nicole Dobroski	CSLC	12/01/2016	Page 14, Table 1: We suggest caution against using a three-level categorical ranking of risk for such a wide spectrum of vessel types. An unintended result of this type of categorical ranking is the loss of detail in risk between the various categories of commercial merchant and passenger vessels (including container, bulk, tanker, auto carrier, general cargo, passenger, and miscellaneous cargo). These commercial merchant and passenger vessels outnumber the arrivals of the other vessel categories by orders of magnitude, therefore the focus of delineating risk should be placed on this group. The other vessel categories are likely to be relatively higher risk, but that doesn't mean these commercial vessels should all be categorized as low risk. The operational profile of a bulk vessel is dramatically different than a container vessel, with the former typically exhibiting much longer port residency times and much slower operating speeds. Underlying these differences are often different antifouling strategies, because biofouling drag-induced fuel consumption is often more of a concern for container vessels than bulk vessels. These differences are likely to effect the relative NIS introduction risk related to each vessel type.	agree; categorical rankings can have the unintended effect of masking risk, though there is a need to group similar types of vessels in order to facilitate management of a large commercial fleet; a four-category risk ranking is now used: low, moderate, high and very high; see revised Table 1, Figures 6-10 and the associated text	Closed
01/3/2017	Nicole Dobroski	CSLC	12/01/2016	Page 14, Table 1, Fishing/Fish Processing: This table shows 792 fishing vessel arrivals between 2008 and 2015. Davidson et al. (2014) indicated that there were 105,494 fishing vessel arrivals between 2008 and 2011. The latter dataset includes 13000% more arrivals in half of the time than the data indicated in the Strategic Plan. We suggest incorporating the Davidson et al. (2014) dataset into the Plan, and suggest reevaluating the proposed approach to managing fishing vessel biofouling in Washington. [Davidson, I, C Zabin, G Ashton, G Ruiz. 2014. An assessment of the biofouling introductions to the Puget Sound region of Washington State. Report prepared for the Washington Department of Fish & Wildlife and Washington Department of Natural Resources, Olympia, Washington. 111 pp]	Vessels less than 300 GRT are not being managed under this program; this will be considered in greater detail at a later date	Closed
01/3/2017	Nicole Dobroski	CSLC	12/01/2016	Page 17, Para 1: As mentioned earlier, we caution against treating all commercial merchant and passenger vessels as a single low risk category. The relative risk between the different types of vessels is likely to be different, and these differences should be accounted for in categorical rankings.	see above	Closed
01/3/2017	Nicole Dobroski	CSLC	12/01/2016	Page 19, 2.1.3 Arrivals Forecast, Para 2, Lines 5-6: One of the results of treating bulk vessels as presenting low NIS introduction risk is that projected increases in bulk vessel arrivals will also be viewed as low risk (as indicated in this section). Among commercial merchant and passenger vessels, bulk vessels typical operating profiles suggest they are more likely than others to be fouled and therefore could have a greater relative risk than other commercial merchant vessels. The forecast projected in this section is currently being viewed as posing a relatively low risk, but the opposite may be true (and missed).	see above	Closed
01/3/2017	Nicole Dobroski	CSLC	12/01/2016	Page 21, Para 1, Lines 2-6: Although container vessels are getting larger and may be able to handle increased shipping volumes without increasing the number of vessels in use, that doesn't necessarily indicate that NIS introduction risk will remain the same. Even if the number of container vessels remains unchanged in the future, larger vessels will result in more wetted surface area arriving at Washington ports, resulting in more potentially fouled surfaces. In addition, larger container vessels are likely to have more niche areas than smaller container vessels, including more thrusters, more sea chests, more stabilizer fins, and possibly more rudders and propellers.	agree; addressed in final report	Closed

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01/3/2017	Nicole Dobroski	CSLC	12/01/2016	Page 23, Figure 16: Suggest utilizing fishing vessel dataset from Davidson et al. 2014, indicating orders of magnitude more arrivals than what is presented here.	see comment above	Closed
01/3/2017	Nicole Dobroski	CSLC	12/01/2016	Page 28, California: Several pieces of clarification are included below: o The first sentence is correct, but only if preceded by the words "If adopted." California's proposed regulations will have to be approved by our Commissioners and reviewed by California's Office of Administrative Law before they become effective. o The Marine Invasive Species Program (MISP) is already in existence, and has been since 2000. The MISP has regulated ballast water management since 2000; the proposed regulations will add comprehensive biofouling management to the program's regulatory oversight. o The requirement to submit the Hull Husbandry Reporting Form (HHRF) once per calendar year has been mandatory since 2008 o The proposed regulations will remove the requirement to submit the HHRF, but will replace it with a requirement to submit the Marine Invasive Species Program Annual Vessel Reporting Form. o The proposed regulations will also require the maintenance of a Biofouling Management Plan and a Biofouling Record Book	addressed in final report	Closed
01/3/2017	Nicole Dobroski	CSLC	12/01/2016	Page 29, British Columbia (Canada), Para 2, Lines 4-6: Suggest using the official document names when referencing the IMO Biofouling Management Plan and Biofouling Record Book to improve clarity.	addressed in final report	Closed
01/3/2017	Nicole Dobroski	CSLC	12/01/2016	Page 30, Last Para, Lines 6-8: Suggest revising. California's proposed regulation intentionally do not specify the required use of anti-fouling systems (outside of our legal jurisdiction). California's proposed regulations state that if anti-fouling systems are used, they must not exceed the system's designed effective lifespan (e.g. a 36-month coating should not be extended to 60 months).	addressed in final report	Closed
01/3/2017	Nicole Dobroski	CSLC	12/01/2016	Page 31, Table 2: We suggest including a description of how these levels (L1, L2, L3) were decided upon. They seem subjective and as a reader, I don't know how to interpret them because I don't know how they were developed. There are a lot of different jurisdictions represented here, we suggest reaching out to them all to better understand the programs and policies in place or in development. Perhaps a small conference call would help to refine this table.	Table has been moved to section 4.2 with additional discussion	Closed
01/3/2017	Nicole Dobroski	CSLC	12/01/2016	Page 31, Section 2.2.2 Stakeholders in biofouling management: Suggest including regulated industries (vector owners and operators) and regional regulatory partners in the categories of stakeholders.	agree; addressed in final report	Closed
01/3/2017	Nicole Dobroski	CSLC	12/01/2016	Page 33, Section 3.1.1 Principle 1: Principle 1 and all of the outcomes associated with it appear to be broad in scope and would be more appropriate as general WDFW invasive species program principles and outcomes rather than specifically for biofouling management.	agree but will retain here as well	Closed
01/3/2017	Nicole Dobroski	CSLC	12/01/2016	Page 36, Section 3.1.4 Principle 4: California, and other states, have regulatory procedures that require performance standard-based regulations rather than prescriptive requirements. The performance standard approach is similar in effect to the risk-based management approach described in this section. We suggest including similarities between the described risk-based approach and the performance standard approach to show consistency across the region.	agree; addressed in final report	Closed
01/3/2017	Nicole Dobroski	CSLC	12/01/2016	Pages 37-38: It appears that there is text missing between the end of page 37 and the beginning of page 38.	addressed in final report	Closed
01/3/2017	Nicole Dobroski	CSLC	12/01/2016	Page 43, Section 4.3: It is unclear whether the positions outlined in this section are solely responsible for biofouling management/enforcement or part of a larger WDFW program and therefore responsible for other aspects of the program (e.g. ballast water data management). We suggest clarifying the descriptions.	addressed in final report	Closed

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01/3/2017	Nicole Dobroski	CSLC	12/01/2016	Page 48, Section 4.5.1 Vector Risk Assessment: Vessels remaining in Washington waters for two days or less still present an NIS introduction risk, we are unsure of the rationale for providing this exemption. What specifically is meant by transient vessels and why are they exempt from coverage?	agree but this is an operational decision to provide some leeway to the regulator; if the regulatory approach requires a strict line then no vessels save emergency arrivals should be exempt	Closed
01/3/2017	Nicole Dobroski	CSLC	12/01/2016	Page 49, Para 3, Line 4: It is not clear who would be considered a suitably qualified and experienced person. Would this be a WDFW employee? If not, who would train or certify that they were suitably qualified and experienced? How would their qualifications and experience be evaluated?	This must be addressed during the implementation phase of the program	Open
01/3/2017	Nicole Dobroski	CSLC	12/01/2016	Page 50, Figure 21: Several comments related to the Risk Assessment Form:		
01/3/2017	Nicole Dobroski	CSLC	12/01/2016	**Why does a vessel get positive risk points if it answers Yes to the freshwater residence question?	freshwater residence reduces viability of marine organism- but does not reduce that to zero	Closed
01/3/2017	Nicole Dobroski	CSLC	12/01/2016	**Biocidally-based MGPS could include both types of MGPSs, those that produce and dispense sodium hypochlorite and systems that used impressed currents to dispense copper ions from anodes. Either sodium hypochlorite or copper could be considered the biocide. Impressed current cathodic protection systems aren't necessarily MGPSs as they don't function to prevent or deter biofouling organisms. Rather, they are designed and operated to protect the vessel surfaces from corrosion. There is a practical difference between impressed current cathodic protection systems and impressed current MGPSs that utilize copper anodes, this question appears to blend the two.	agree; clarified in latest revision	Closed
01/3/2017	Nicole Dobroski	CSLC	12/01/2016	**For the stationary or slow period question, we suggest revising the stationary period to indicate periods of 10 days or greater, to align with California's Hull Husbandry Reporting Form. This would allow for better data sharing between our programs, and would allow for better recordkeeping on the part of the regulated industry.	accepted to align requirements	Closed
01/3/2017	Nicole Dobroski	CSLC	12/01/2016	**Also for the stationary period question, it is also useful to know the cumulative number of days the vessel remained stationary over multiple residency periods. For example, three residency periods of 10 days is different than one residency period of 90 days. The risk assessment would score the 90-day period as half as risky as the three 10-day periods.	interesting and a good point; it is strongly recommended that additional development of this aspect of the VeRSA is conducted	OPEN
01/3/2017	Nicole Dobroski	CSLC	12/01/2016	**We would suggest running a subset of actual arriving vessels through this risk assessment to determine the proportion of vessels that may be categorized as high, uncertain, or low risk. If Washington DFW is interested, we (California MISP) have Hull Husbandry Reporting Form data coupled with biofouling survey data that could be used to test this risk assessment.	the VeRSA has been tested using existing data from databases held by the Department and is subject to ongoing refinement; liaison between DFW and CSLC to undertake further testing of the VeRSA is highly recommended	Open
01/3/2017	Nicole Dobroski	CSLC	12/01/2016	Page 51, Section 4.5.2: Would this surveillance be specific to biofouling? Or would it be more broadly applied to a larger WDFW program?	to be considered by DFW	Closed
01/3/2017	Nicole Dobroski	CSLC	12/01/2016	Page 56, Table 3, Category 1: There is a circular argument in bullet 5 of the criteria. To obtain status as a Full Voluntary Compliance vessel, that vessel must have a history of 3 years of Full Voluntary Compliance status.	should read: "…3 years of Partial Voluntary Compliance." changes made in the text	Closed
01/3/2017	Nicole Dobroski	CSLC	12/01/2016	Page 57, Section 4.8, Para 1, Line 2: We are still unsure about the rationale for designating two days in Washington waters as the trigger for coverage.	revised to read 'two days or more'	Closed

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02/16/17	Amanda Newsom	WDFW	02/10/17	On page 63, Application and Exemptions, we have the following concerns: The population of vessels that remain in Washington for more than 2 days is very large – and 10 days out from arrival will be difficult for the program to track, if not impossible for some vessels. While many vessels may know their next port this far in advance, others will not. From a tracking perspective, we rely at this time on the Marine Exchange reports, which aren't very accurate once you look more than 3 days out. Please note that this is not seen as a flaw in the document, as we feel that biological reality must guide the Plan. There will naturally be some tension between the recommendations provided and what is logistically feasible, particularly in the first few years of application. To acknowledge this, we recommend something along the lines of the following insertion into section 4.9: "The application schema is based on biological data and the contractor's best estimate of the time required for meaningful response by Program staff to reduce risk of invasions. In consultation with the BWWG, the Program should determine a course of action that adheres as closely as possible to these recommendations, while establishing protocols that are logistically feasible for regulators and stakeholders."	The suggested text has been added.	Closed