GloFouling
PARTNERSHIPS
Global Industry Alliance

Compilation and Comparative Analysis of Existing and Emerging Regulations, Standards and Practices Related to Ships' Biofouling Management

gef

UNDP
Empowered lives.
Resilient nations.

IMO INTERNATIONAL MARITIME ORGANIZATION

Compilation and Comparative Analysis of Existing and Emerging Regulations, Standards and Practices Related to Ships' Biofouling Management

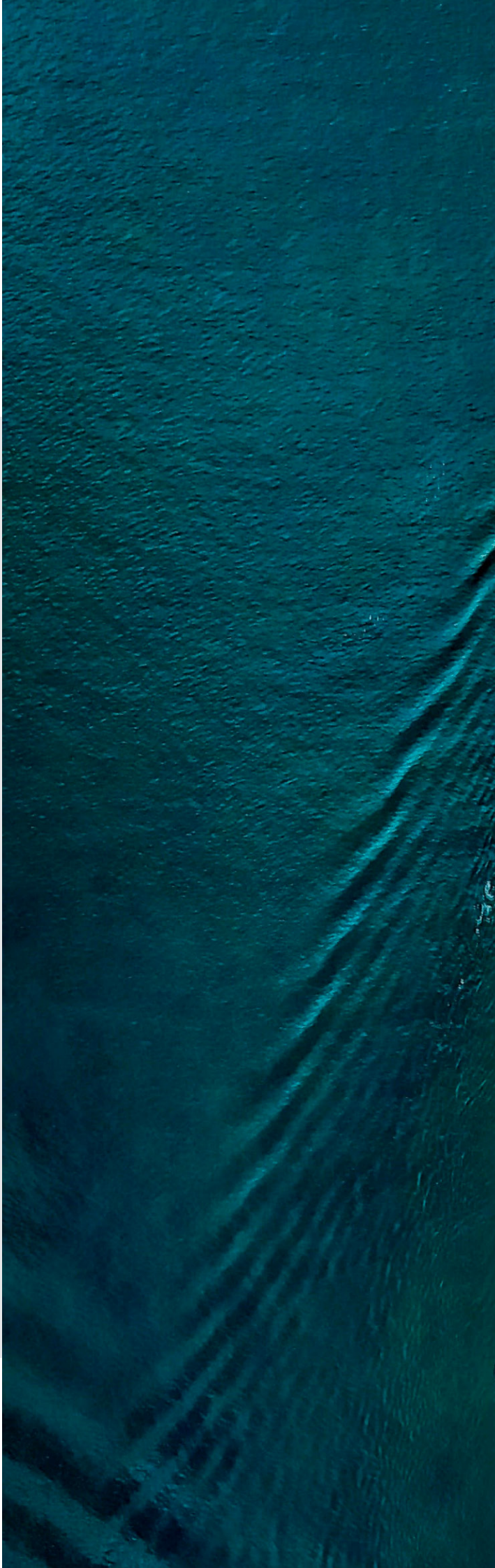
Empowered lives.
Resilient nations.

Published* in 2022 by the
GloFouling Partnerships Project Coordination Unit
International Maritime Organization
4 Albert Embankment
London SE1 7SR
United Kingdom

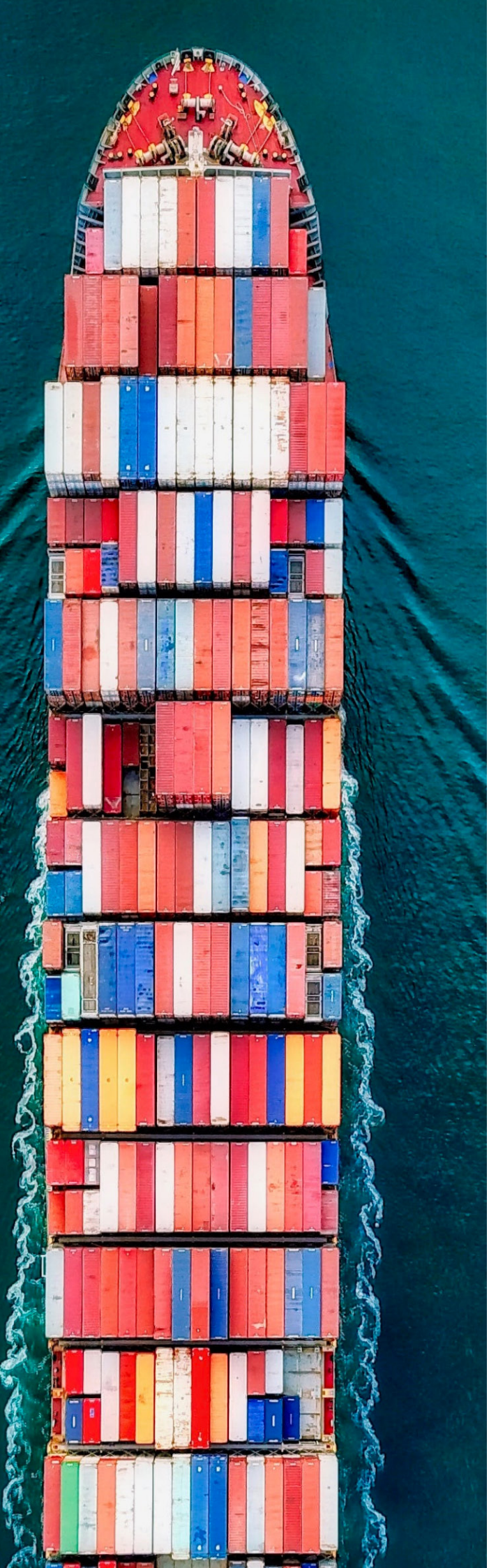
Cover Design by Tina Davidian

Photo and Infographic credits:
©Eric Gao, Adel Kacimi and shutterstock (cover); ©Adel Kacimi (page 3); ©Eric Gao (page 7); ©shutterstock (page 10); ©Government of Canada (page 24); ©Gabuchan (WikiCommons) (page 43); ©EcoSubSea (page 48); ©ARMADA De Chile (Chilean Navy) 2018, Australian Government 2015a, Environment and Resources Authority of Malta 2020, Hellenic Republic 2019 and United States Government 2013 (page 53).

Please cite this document as: GEF-UNDP-IMO GloFouling Partnerships Project and GIA for Marine Biosafety, 2022, Compilation and Comparative Analysis of Existing and Emerging Regulations, Standards and Practices Related to Ships' Biofouling Management.



*Electronic version available for download at https://www.glofouling.imo.org/publications-menu



GLOFOULING PARTNERSHIPS

Building Partnerships to Assist Developing Countries to Minimize the Impacts from Aquatic Biofouling (GloFouling Partnerships) is a collaboration between the Global Environment Facility (GEF), the United Nations Development Programme (UNDP) and the International Maritime Organization (IMO). The project aims to develop tools and solutions to help developing countries to reduce the transfer of aquatic invasive species through the implementation of the IMO Guidelines for the control and management of ships' biofouling.
www.glofouling.imo.org

FUNDING AGENCY

GEF - the Global Environment Facility - was established on the eve of the 1992 Rio Earth Summit to help tackle our planet's most pressing environmental problems. Since then, the GEF has provided over USD 21.1 billion in grants and mobilized an additional USD 114 billion in co-financing for more than 5000 projects in 170 countries. Today, the GEF is an international partnership of 184 countries, international institutions, civil society organizations and the private sector that addresses global environmental issues.
www.thegef.org

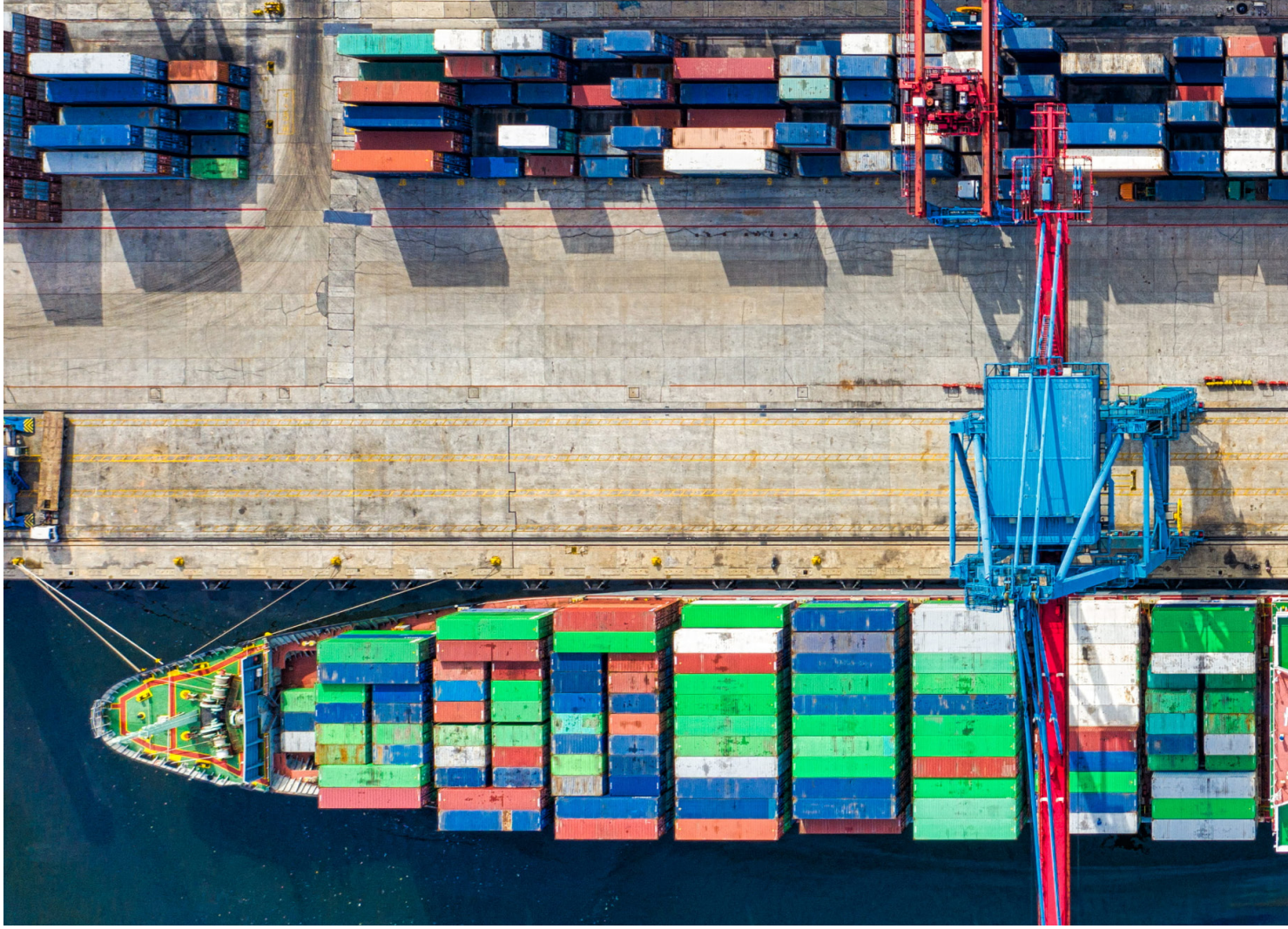
IMPLEMENTING AGENCY

UNDP – the United Nations Development Programme – partners with people at all levels of society to help build nations that can withstand crisis, drive and sustain the kind of growth that improves the quality of life for everyone. On the ground in nearly 170 countries and territories, we offer global perspective and local insight to help empower lives and build resilient nations.
www.undp.org

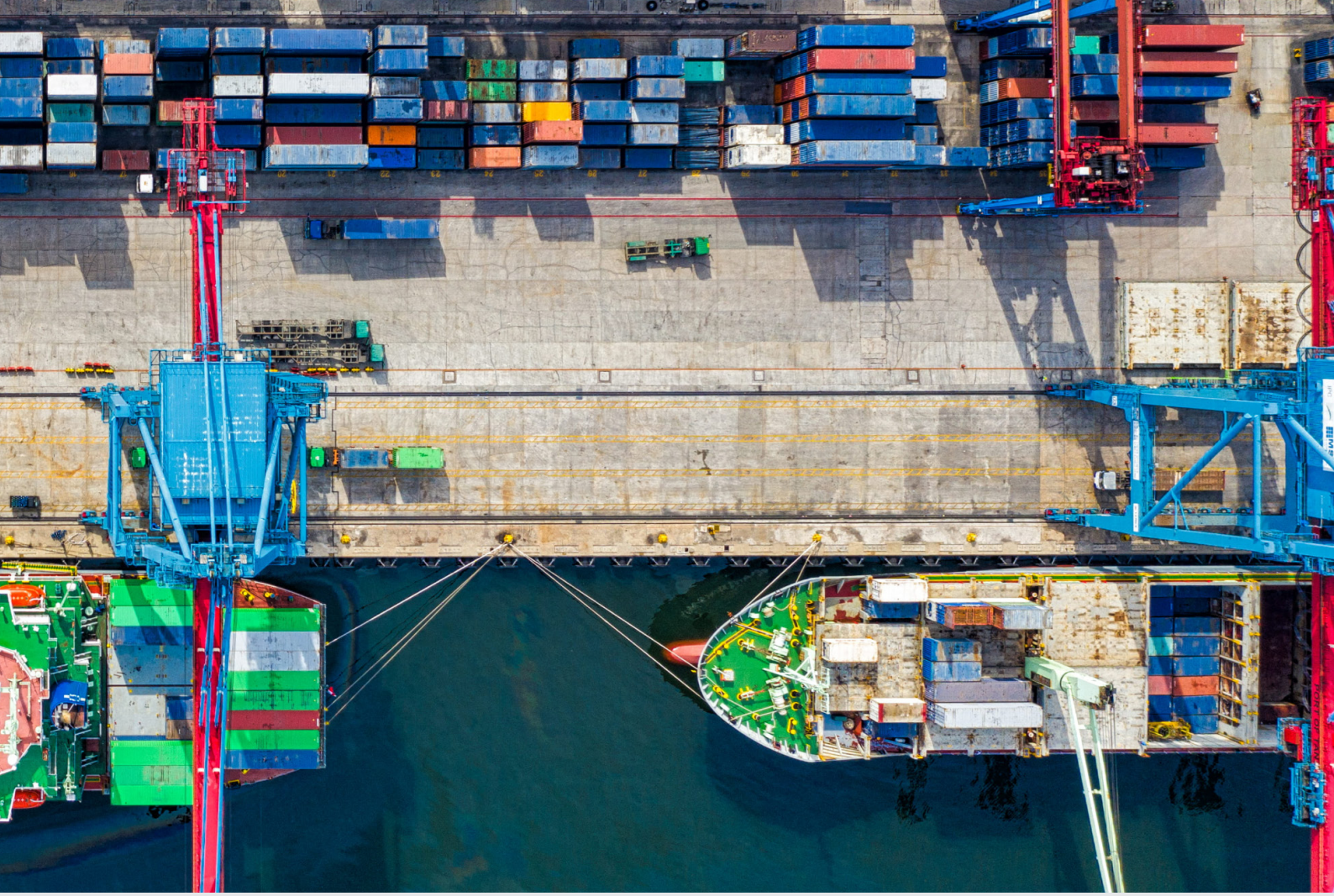
EXECUTING AGENCY

IMO - the International Maritime Organization – is the United Nations specialized agency with responsibility for the safety and security of shipping and the prevention of marine pollution by ships.
www.imo.org

TABLE OF CONTENTS



LIST OF TABLES



LIST OF FIGURES

ACRONYMS AND ABBREVIATIONS

AFS – Anti-fouling System

BFMP – Biofouling Management Plan

BFRB – Biofouling Record Book

CRMS – Craft Risk Management Standard: Biofouling on Vessels Arriving to New Zealand

FR – Fouling Rating

GFP – Building Partnerships to Assist Developing Countries to Minimize the Impacts from Aquatic Biofouling (GloFouling Partnerships Projrect) referred to as 'GEF-UNDP-IMO GloFouling Partnerships Project'

GHG – Greenhouse gases

GIA – Global Industry Alliance

IAS – Invasive Aquatic Species

IOGP – International Association of Oil and Gas Producers

IMarEST – Institute of Marine Engineering, Science and Technology

IMO – International Maritime Organization

IWC – In-Water Cleaning

LPC –Lead Partnering Country for GloFouling Partnerships Countries

MEPC – Marine Environment Protection Committee (IMO)

MGPS – Marine Growth Prevention System

MHWS – Mean High-Water Springs

MODU – Mobile Offshore Drilling Unit

MSDS – Material Safety Data Sheet

OWC – Out of Water Cleaning

RCO – Regional Coordinating Organization

TBT – Tributyltin

UNDP – United Nations Development Programme

GLOSSARY OF TERMS

Ablative Anti-fouling Coating – Also known as a self-polishing anti-fouling coating, this is a soft coating that wears off at a controlled rate.

AFS Convention – International Convention on the Control of Harmful Anti-fouling Systems on Ships.

Anti-fouling System (AFS) – A coating, paint, surface treatment, surface or device that is used on a ship to control or prevent attachment of unwanted organisms.

Biocide – A chemical substance sometimes incorporated into anti-fouling systems to prevent settlement or survival of aquatic organisms.

Biofouling – The accumulation of aquatic organisms, such as microorganisms, plants and animals, on surfaces and structures immersed in, or exposed to, the aquatic environment. May include microfouling and macrofouling.

Biofouling policy or practice – A policy or practice that seeks to modify behaviours and practices related to the management of submerged surfaces, with the purpose of minimizing the risk of introduction of IAS via fouling on submerged surfaces.

Contaminant – Any detrimental substance occurring in the environment as a result of human activities, even without adverse effects being observed.

Debris (in relation to surface cleaning) – Biological and coating material released during surface cleaning.

IMO – International Maritime Organization, a specialized agency of the United Nations, it is the global standard-setting authority for the safety, security and environmental performance of international shipping.

IMO Biofouling Guidelines – *The Guidelines for the control and management of ships' biofouling to minimize the transfer of invasive aquatic species* (resolution MEPC.207(62)), 15 July 2011.

IMO Biofouling Guidance for Recreational Craft – *Guidance for Minimizing the Transfer of Invasive Aquatic Species as Biofouling (Hull Fouling) for Recreational Craft* (MEPC.1/Circ.792), 2012.

In-water cleaning (IWC) – The physical removal of biofouling from a ship or other submerged structure while in the water.

In-water cleaning policy or practice – A policy or practice that seeks to modify behaviours and practices related to the cleaning of submerged surfaces in situ, with the purpose of minimizing the risk of introduction of IAS via release of fouling organisms from the surfaces during cleaning and/or minimizing the environmental and safety risks associated with the cleaning of anti-fouling coatings.

In-water cleaning provider – A company that conducts in-water cleaning of ships. Companies may use different cleaning methods and technologies to provide in-water cleaning services.

Invasive Aquatic Species (IAS) – A non-indigenous species which may pose threats to human, animal and plant life, economic and cultural activities and the aquatic environment.

Jurisdiction – the limits or territory within which authority may be exercised.

Macrofouling – Large, distinct multicellular organisms visible to the human eye, such as barnacles, tubeworms, or fronds of algae.

Marine Growth Prevention System – an anti-fouling system used for the prevention of biofouling accumulation in niche areas.

Microfouling – Microscopic organisms including bacteria and diatoms and the slimy substances they produce. Biofouling comprised only of microfouling is commonly referred to as the slime layer.

Niche areas – Areas on a ship that may be more susceptible to biofouling due to different hydrodynamic forces, susceptibility to coating system wear or damage, or being inadequately, or not, painted, e.g., sea chests, bow thrusters, propeller shafts, inlet gratings, dry-dock support strips, etc.

Out of water cleaning policy or practice – A policy or practice that seeks to modify behaviours and practices related to the cleaning of surfaces out of the water at shipyards, marina's, boat ramps and other maintenance facilities, with the purpose of minimizing the risk of introduction of IAS via release of fouling organisms from the surfaces during cleaning and/or minimizing the environmental and safety risks associated with cleaning and applying anti-fouling coatings.

Ship – For the purposes of this report, the definition of ship is consistent with the definition in the IMO Biofouling Guidelines: A vessel of any type whatsoever operating in the aquatic environment and includes hydrofoil boats, air-cushion vehicles, submersibles, floating craft, fixed or floating platforms, floating storage and production units (FSUs) and floating production storage and off-loading units (FPSOs).

Sub-national – Any location existing or occurring below a national level, for example states, provinces, municipalities and ports.

ACKNOWLEDGMENTS

THIS REPORT IS THE PRODUCT OF THE GEF-UNDP-IMO GLOFOULING PARTNERSHIPS PROJECT.

The report Compilation and Comparative Analysis of Existing and Emerging Regulations, Standards and Practices Related to Ships' Biofouling Management was written by Susie Kropman[1], independent consultant, with contribution, editorial review, comments and inputs from Lilia Khodjet El Khil, Project Technical Manager; John Alonso, Project Technical Analyst, GloFouling Partnerships Project, the Department of Partnerships and Projects, IMO; and Teo Karayannis, Head of Marine Biosafety, Marine Environment Division, IMO.

Great thanks are also due to Violeta Luque, Senior Project Assistant; and Jurga Shaule, Project Assistant, GloFouling Partnerships Project, the Department of Partnerships and Projects, IMO, who provided coordination and editing support to produce this report.

The GloFouling Partnerships Project Coordination Unit (PCU) would like to acknowledge the contributions of the many stakeholders from the shipping, in-water cleaning, and coatings industries; shipyards and ports; and government authorities around the world who distributed and completed surveys, participated in interviews, and provided written input. Special thanks are given to the members of Global Industry Alliance (GIA) for Marine Biosafety, who commissioned and financed the study and provided contacts, information, and industry insights. We truly appreciate their time, effort, expertise, and cooperation.

At the time of printing this report, the members of the GIA for Marine Biosafety were: AkzoNobel, CleanSubSea, ECOsubsea, Tas Global, Hapag-Lloyd, HullWiper, KCC Marine Coatings, SLM Global and Sonihull. For further information please contact:

GloFouling Partnerships Project Coordination Unit
Department of Partnerships and Projects
International Maritime Organization
4 Albert Embankment
London SE1 7SR
United Kingdom
Web: www.glofouling.imo.org

[1] *The views expressed are those of the author, who undertook this task as an independent consultant, and do not reflect the view or policy of the Australian Government.*


MAERSK
EVERGREEN
CMA CGM
MSC

EXECUTIVE SUMMARY

Biofouling is recognized as a major vector for the introduction and spread of Invasive Aquatic Species (IAS) and can reduce ship performance, increasing fuel consumption and greenhouse gas (GHG) emissions. The 2011 International Maritime Organization Guidelines for the Control and Management of Ships' Biofouling to Minimize the Transfer of Invasive Aquatic Species (IMO Biofouling Guidelines) are the international standard for biofouling management policy. However, the Guidelines are non-mandatory and do not provide specific international rules or standards for the regulation of biofouling management.

Some national and sub-national authorities have developed and implemented biofouling management regulations and policies to mitigate risks associated with the transfer of IAS and manage the environmental risks of cleaning submerged surfaces. This report identifies and describes current and proposed biofouling management and IWC regulations and policies. This report also identifies key issues that impede the implementation of consistent and effective biofouling and in-water cleaning (IWC) policies and provides recommendations for actions that may address these issues.

Based on the result of focused research, surveys and interviews conducted with all stakeholders, the following key findings were identified:

The review of the IMO Biofouling Guidelines is critical to minimize any further variation in implementation of biofouling management and in-water cleaning policy. The IMO Biofouling Guidelines are currently being reviewed by IMO Member States (see Case Study 1, page 20). Variation in, and barriers to, implementation of the Guidelines were identified. With 19 regional, national and sub-national biofouling policies and practices already in place, and a further 27 policies intended to be developed in the next five years (see **Sections 2.2 and 2.3**), the timing and content of the review essential to minimizing further variation.

Comprehensive biofouling management policies are not widespread and those that do implement comprehensive policies are not consistent. Many policies identified in this report do not apply to all ships or provide limited guidance on what is acceptable or not. The most comprehensive biofouling management policies are those of New Zealand and the state of California (United States). Both policies are mandatory regimes that have documentary, reporting and verification requirements. Despite both being consistent with the IMO Biofouling Guidelines, there are differences in approach (see **Section 2.3.5**).

There is a lot of variation in IWC policies. The IWC polices and measures identified contain recommendations and requirements that differ based on a range of factors, including, for example, the type of fouling, the type of anti-fouling system applied to the submerged surface, the submerged area to be cleared, and handling of waste. Many authorities have water quality regulations or guidelines that limit the types and quantities of contaminants and substances in their waters (see **Section 3.2.1**). Key features of IWC policies also vary, particularly in relation to capture rate; location, filtration, sampling and documentary requirements; and the need for expert approval of IWC systems (see **Section 3.2.3**).

There are barriers to the implementation of consistent and effective biofouling management policy that cannot necessarily be solved by the revision of the IMO Biofouling Guidelines. These include the non-mandatory nature of the Guidelines, uncertainty surrounding in-water cleaning policy, and the performance of existing biofouling management practices (see **CHAPTER 4**).

Without an overarching international rule or convention on biofouling management, inconsistencies will continue to occur. This is particularly likely for the implementation of mandatory biofouling management requirements, where the nature of the mandatory requirement, documentary and reporting requirements, and compliance and enforcement activities may vary (see **Section 4.1**).

Uncertainty surrounding IWC policy can result in inconsistent conditions being applied by authorities. There is international agreement on what a comprehensive IWC policy should contain. Without this, and with no internationally agreed in-water cleaning standard, no internationally agreed IWC system testing procedures and a lack of identified independent expert approval bodies, authorities attempting to mitigate environmental risks from in-water cleaning may be forced to take a precautionary approach. Varying conditions are placed on in-water cleaning activities, if in-water cleaning is allowed at all (see **Section 4.2**).

The performance of Anti-Fouling Systems can be variable. The International Convention on the Control of Harmful Anti-Fouling Systems on Ships (2001) (AFS Convention) provides some limitations on coating contents by prohibiting harmful organotins, but the AFS Convention does not extend beyond this. Variation in performance may result in more in-water inspections, and potentially more IWC, between dry docking periods (see **Section 4.3**).

Inconsistency in biofouling and IWC policies creates a major challenge for the shipping industry when attempting to proactively implement biofouling management practices and IWC providers who may operate in multiple locations. Shipping is a global industry, and operators need clarity of how to comply with local rules to minimise operational disruptions and support their own biofouling management practices. (see **Section 4.4**).

As a result of the key findings summarised above and input received from stakeholders, a number of steps can be taken to complete the international framework for biofouling and IWC policy consistency and address these issues:

- Complete the review of the IMO Biofouling Guidelines to improve their specificity and in-water cleaning guidance;
- Consider the development of a mandatory international instrument for biofouling, based on the revised IMO Biofouling Guidelines; and
- Develop an internationally agreed IWC performance standard, noting that once an IWC performance standard is agreed, methods for testing IWC system performance should also be developed and agreed, and independent, expert approval bodies for testing IWC systems, should be identified.

CHAPTER 1

ABOUT THE REPORT

1.1 REPORT PURPOSE AND SCOPE

To support implementation of the IMO Biofouling Guidelines, the GEF-UNDP-IMO GloFouling Partnerships Project (GFP) was launched in December 2018. The GFP aims to build capacity in twelve Lead Partnering Countries (LPCs) to implement the IMO Biofouling Guidelines, as well as other relevant guidelines and best practices relating to biofouling management, to catalyse overall reductions in the transboundary introduction of biofouling-mediated Invasive Aquatic Species (IAS).

The Global Industry Alliance (GIA) for Marine Biosafety has been established under the GFP as an alliance of leaders from the private sector representing maritime industries, who work together to support improved biofouling management and marine biosafety initiatives.

The GIA Task Force has commissioned this report to identify existing and impending biofouling regulations and standards. The aim of the report is to provide higher clarity to the industry, with a view to facilitate compliance.

This report has a broad geographic scope, with information sought globally from national and sub-national government authorities, ports and shipyards, ship owners and operators, in-water cleaning providers and anti-fouling coating stakeholders. This report seeks to identify and describe key features of international, national and sub-national regulations, policies and guidelines related to biofouling and hull cleaning; the impacts of these policies on shipping and hull cleaning industries; and the regulatory barriers that hamper the adoption of new practices and/or technologies related to biofouling prevention and management.

The information presented in this report reflects the latest developments as of 28 January 2022.

1.2 REPORT STRUCTURE

This report identifies and describes current and proposed biofouling management and IWC regulations and policies. This report also identifies key issues that impede the implementation of consistent and effective biofouling and in-water cleaning (IWC) policies and provides recommendations for actions that may address these issues.

CHAPTER 1
includes the report methodology and provides background on the development of international standards for biofouling management and IWC.

CHAPTER 2
describes current international guidelines and recommendations, and regional, national and sub-national biofouling management policies and regulations for biofouling management. Chapter 2 identifies regions, nations and sub-national jurisdictions that have indicated an intention to develop biofouling management policies or regulations in the near future, and includes an analysis of key features of biofouling policies and regulations.

CHAPTER 3
describes current international recommendations and requirements, and regional, national and sub-national hull cleaning policies and requirements. Chapter 3 also includes an analysis of key features of IWC policies and discusses out of water hull cleaning policies and requirements.

CHAPTER 4
identifies and discusses the barriers, challenges and impacts of biofouling management and IWC policy and regulation for authorities and industry stakeholders.

CHAPTER 5
provides the conclusion of the report and recommendations to address issues identified.

1.3 REPORT METHODOLOGY

Information was gathered for this report through a number of means, including surveys, direct engagement and a literature review.

Surveys were used to ensure a maximum number of stakeholders were reached, and all respondents in each sector were asked the same questions, to enable collection and analysis of the information in a consistent manner. Surveys enabled the collection of detailed information as well as patterns in biofouling policies and regulation, and the impacts on shipping and hull cleaning industries.

ANNEX A provides more information about the survey methodology and results.

Information was also collected through direct engagement with members of the shipping industry, in-water cleaning providers, anti-fouling coating companies, governments, shipyards and ports; and a comprehensive literature review, including IMO documents; Elsevier and other available publications and literature.

1.3.1 Key Aspects Identified and Compared

For locations with biofouling policies and practices currently in place or proposed, key aspects of these biofouling policies and practices were identified and compared, including:

- The nature of the policy or practice (mandatory or voluntary),
- Documentary recommendations or requirements,
- Reporting recommendations or requirements, and
- Verification mechanisms.

For locations with publicly available policies or practices in place or proposed that specifically apply to in-water cleaning, key aspects of these were also identified and compared, including:

- Whether in-water cleaning is allowed or prohibited,
- If allowed, whether the in-water cleaning policy or practice is mandatory or voluntary,
- Whether in-water cleaning operators must have approval to operate in the location, and if there are conditions associated with this approval,
- Whether an in-water cleaning activity requires prior permission, and if there are conditions associated with this permission, and
- Whether penalties apply if the in-water cleaning policy or practice is not adhered to.

In relation to out-of-water cleaning, key aspects in relation to environmental management were identified and examples provided in relation to:

- Management of waste derived from hull maintenance practices,
- Regulation of the active ingredients of anti-fouling systems (AFS), and
- Implementation of the AFS Convention.

1.4 BACKGROUND – DEVELOPMENT OF INTERNATIONAL STANDARDS FOR BIOFOULING MANAGEMENT

The **movement of ships and other floating structures provides pathways for the introduction of IAS** to new marine areas. Introduction by ships can occur through discharge of ships' ballast water and via biofouling on ship hulls, submerged structures and equipment[2].

The International Maritime Organization (IMO) has been at the forefront of international efforts to tackle the spread of IAS. **The IMO, through its Marine Environment Protection Committee (MEPC), adopted the *Guidelines for the Control and Management of Ships' Biofouling to Minimize the Transfer of Invasive Aquatic Species*[3] (IMO Biofouling Guidelines) in 2011. MEPC also approved the *Guidance for Minimizing the Transfer of Invasive Aquatic Species as Biofouling (Hull Fouling) for Recreational Craft*[4] (IMO Biofouling Guidance for Recreational Craft) in 2012.** In addition, the International Convention for the Control and Management of Ships' Ballast Water and Sediments

[2] *The www.glofouling.imo.org provides background information on the biofouling issue in relation to IAS transfer and GHG emissions.*
[3] *International Maritime Organization, 2011a.*
[4] *International Maritime Organization, 2012.*

entered into force globally in 2017 to prevent the spread of harmful aquatic organisms though another vector, namely ships' ballast water.

The **IMO also spearheads international efforts to reduce pollution from ships.** An important part of this is managing harmful substances used to deter or prevent biofouling organisms from settling on submerged surfaces. Some substances, historically used in anti-fouling systems (AFS), can cause human health risks to personnel applying the substances, and can leach into the marine environment, some causing harm to aquatic organisms and/or remaining persistent in the marine environment for long periods of time.

To address these concerns, the *International Convention on the Control of Harmful Anti-fouling Systems on Ships* (the AFS Convention) entered into force in 2008, banning the use of tributyltin (TBT) in AFS and establishing a science-based mechanism to consider future restrictions of harmful substances in AFS.

The IMO Biofouling Guidelines and the AFS Convention have very different purposes (Table 1). It was apparent from the documents and responses received as input to this report that many stakeholders, including authorities and industry, **confuse biofouling management policy and the AFS Convention**. Many stakeholders that claimed to have or know of biofouling management policies submitted documents relating to the AFS Convention, AFS cleaning or application, or general port operations, such as diving, safety and environmental policies, that do not specifically refer to biofouling or IWC.

Table 1. Comparison of the IMO Biofouling Guidelines and the AFS Convention

	IMO Biofouling Guidelines	AFS Convention
Nature	Voluntary	Mandatory
Purpose	Reduce the likelihood of transfer of IAS via shipping	Restrict the use of pollutants in AFS that represent an unacceptable risk to harm human health and/or the marine environment
Effective Mechanism(s)	Promote best practice biofouling management, including the use of Biofouling Management Plan (BFMP) and Biofouling Record Books (BFRB)	Ban the use of substances in AFS that are deemed unsafe via a comprehensive risk assessment process

More detail on AFS, their components, pollution risks and effectiveness, is outside the scope of this report.

CHAPTER 2

BIOFOULING MANAGEMENT

CHAPTER 2 CONTAINS:

- International guidelines and recommendations for biofouling management (**Section 2.1**),
- Current and proposed regional biofouling management policies (**Section 2.2**),
- Current and proposed national and subnational biofouling management policies (**Section 2.3**). This includes sector-specific biofouling management policies as well as an analysis of key features of biofouling management policies.

2.1 INTERNATIONAL GUIDELINES AND RECOMMENDATIONS FOR BIOFOULING MANAGEMENT

Currently there are no mandatory international requirements relating to management of biofouling.

There are however a number of international guidelines and industry standards relevant to biofouling management (**Table 2**).

Of these, the most comprehensive is the **IMO Biofouling Guidelines**. The Guidelines are non-mandatory and provide best practice recommendations for minimizing biofouling, with a focus on prevention. The Guidelines address both management of biofouling and in-water cleaning, however inadequacies in both have been identified in the review process currently underway in the IMO's Pollution Prevention and Response (PPR) Sub-Committee (see **Case Study 1**, page 20).

A key component of the IMO Biofouling Guidelines is the preparation of ship-specific Biofouling Management Plans (BFMP) and Biofouling Record Books (BFRB). There are specific recommendations for inclusions in BFMP and BFRB, and a template for each. This documentation is the cornerstone of many current and proposed national and sub-national biofouling management policies and practices. As described in **Section 1.4**, the **AFS Convention**, and associated **ISO Standards**[5], are relevant to biofouling management policy and practice, in that the Convention prohibits the use of specific harmful organotins in AFS. However, **implementation of the AFS Convention itself does not equate to having a biofouling management policy or practice.**

Similarly, the **IMO Biofouling Guidance for Recreational Craft** provide biofouling education and best practice advice for recreational craft (less than 25 meters) owners and operators to minimize biofouling. The guidance is of general nature and does not include recommendations for BFMP or BFRB.

A KEY COMPONENT OF THE IMO BIOFOULING GUIDELINES IS THE PREPARATION OF SHIP-SPECIFIC BIOFOULING MANAGEMENT PLANS (BFMP) AND BIOFOULING RECORD BOOKS (BFRB). THERE ARE SPECIFIC RECOMMENDATIONS FOR INCLUSIONS IN BFMP AND BFRB, AND A TEMPLATE FOR EACH. THIS DOCUMENTATION IS THE CORNERSTONE OF MANY CURRENT AND PROPOSED NATIONAL AND SUB-NATIONAL BIOFOULING MANAGEMENT POLICIES AND PRACTICES.

[5] *ISO Is the International Organization for Standardization (www.iso.org/standards.html). ISO is an independent, non-governmental international organization that brings together experts to share knowledge and develop voluntary, consensus-based, market relevant international standards.*

Other biofouling specific industry guidelines and standards share similar characteristics, or refer, to the IMO Biofouling Guidelines. This includes guidance specifically for ship owners and operators, such as those prepared by **INTERTANKO**.

The **IOGP/IPIECA Guidance for the Oil and Gas Industry, addressing ships operating in the offshore and gas sector,** despite being produced before the IMO Biofouling Guidelines were finalised, includes the recommendation to prepare a BFMP and provides practical guidance to the offshore sector to minimize the accumulation and spread of biofouling.

In 2020, BIMCO released its **Industry standard on in-water cleaning with capture**. The standard includes specific recommendations in relation to biofouling management as a means to minimize biofouling and reduce the need for in-water cleaning of macrofouling. As well as being in-line with the IMO Biofouling Guidelines, the industry standard expands on details to include in a BFMP and BFRB, for example, when an in-water inspection should occur, and plans for contingencies when a ship operates outside its normal operating profile.

It is anticipated that biofouling best management practice reports will be released by the GloFouling Partnerships Project. These will be targeted to sectors, including recreational craft, offshore oil and gas, and aquaculture.

Table 2. Overview of current international biofouling guidelines and recommendations

Current international biofouling guidelines and recommendations	
IMO Biofouling Guidelines[6]	In July 2011, IMO adopted the IMO Biofouling Guidelines, in response to concerns raised by its Member States about the risk of transfer of IAS posed by biofouling on ships. The IMO Biofouling Guidelines are broadly applicable, as the definition of 'ships' includes: *"A vessel of any type whatsoever operating in the aquatic environment and includes hydrofoil boats, air-cushion vehicles, submersibles, floating craft, fixed or floating platforms, floating storage and production units (FSUs) and floating production storage and off-loading units (FPSOs)".* **As Guidelines, the IMO Biofouling Guidelines are non-mandatory.** **The Guidelines focus on preventative measures to minimize biofouling.** The IMO Biofouling Guidelines recognise that effective anti-fouling application and maintenance are the primary means of biofouling prevention and control for existing ships' submerged surfaces, including hull and niche areas. They include guidance on AFS installation and maintenance; in-water inspection, cleaning and maintenance; design and construction; disseminating information; and training and education. **The guidelines recommend that all ships have a Biofouling Management Plan (BFMP) and Biofouling Record Book (BFRB).** A BFMP is to be ship-specific and provide a description of the biofouling management strategy for the ship with sufficient details to allow the ship's Master and crew members to understand and implement the plan. The IMO Biofouling Guidelines includes the recommended format and content for a BFMP. A BFRB should include records of all inspections and biofouling management measures undertaken on the ship. The BFMP and BFRB assist interested Member State authorities to assess the potential biofouling risk of the ship. Under the IMO Biofouling Guidelines, the BFMP and BFRB may stand alone, or be integrated into a ship's existing operational and procedural manuals and/or planned maintenance program. **The IMO Biofouling Guidelines are currently being reviewed (see Case Study 1, page 20).**

[6] *International Maritime Organization, 2011a.*

Current international biofouling guidelines and recommendations	
IMO Biofouling Guidance for Recreational Craft[7]	The IMO also adopted the *Guidance for Minimizing the Transfer of Invasive Aquatic Species as Biofouling (Hull Fouling) for Recreational Craft in 2012.* **The Guidance is of general nature, for use by all owners and operators of recreational craft less than 24 metres in length.** **As Guidance, the IMO Guidance for Recreational Craft is non-mandatory.** The Guidance describes the factors that influence the amount of biofouling on a recreational craft, including the type, age and condition of AFS and hull cleaning practices, the operational profile, places visited, design and construction, particularly areas susceptible to biofouling such as rudders, propellers and propeller shafts. Considerations for choosing an AFS are also provided, as well as how to minimize biofouling in niche areas. In relation to cleaning, the Guidance advises cleaning out of water where possible in order to capture waste for proper disposal. In-water cleaning is recommended only for removing light fouling (microfouling) with gentle techniques to minimize potential environmental risks, noting the need to seek local authority approval beforehand. Capture technology is recommended with appropriate onshore disposal of waste. **Although the guidance does not include recommendations on BMFP and BFRB, it recommends retaining biofouling information in one place such as the logbook**, including information such as details of the AFS used, inspections and notes on the effectiveness of the AFS. The records should include a diagram of the hull and niche areas with plans on how to minimize biofouling. There are also recommendations for measures that should be taken to avoid transfer of IAS on trailered recreational craft.
INTERTANKO Guide to Modern Anti-fouling Systems and Biofouling Management[8]	The Guide was produced by INTERTANKO's Environmental Committee. The Guide provides information and **advice on coating selection and hull management for shipowners and operators, and addresses common issues such as hull management following a 10-day idle period.** The Guide identifies considerations for the selection of anti-fouling systems, including ship operating profile and the physical parameters of the coating, such as binder technology, polishing rate, polishing linearity, leach layer and cleaning resistance, noting that this information can be difficult to obtain directly from coating suppliers. INTERTANKO provide a page on their website[9] for members to exchange and share experiences on hull coatings.
IOGP/IPIECA Alien Invasive Species and the oil and gas industry: Guidance for prevention and management[10]	The IOGP/IPIECA Guide for the oil and gas industry[10] highlights the unique characteristics of the oil and gas industry that magnify the importance of preventing the establishment of IAS in new areas through oil and gas industry activities. The guide provides practical information for a range of oil and gas industry activities and staff to identify key issues and solutions. **The guide identifies biofouling as a direct pathway for IAS introduction during the production, product transport and decommissioning phases of operation and provides a step-by-step guide to ensure consideration of IAS is incorporated early in the project planning process.** Guidance is included on: • Removal of biofouling as part of day-to-day activities, from anchor and chain, ropes, cables etc., and anchor wells and chain lockers, • Using various methods such as blasting, scraping or air exposure to remove biofouling less frequently from submerged structures, and • Cleaning of internal seawater systems. Procedures for the appropriate disposal of removed residues is highlighted, including the recommendation to record waste disposal in the Biofouling Management Plan (BFMP).

[7] *International Maritime Organization, 2012.*
[8] *INTERTANKO, 2016.*
[9] *www.intertanko.com/topics-issues/issue/environment/antifouling-paints.*
[10] *IOGP/IPIECA, 2010.*

Table 2. Overview of current international biofouling guidelines and recommendations continued...

Current international biofouling guidelines and recommendations	
BIMCO Industry standard on in-water cleaning with capture[11]	**The BIMCO Industry Standard includes a list of what should be included in BFMP to support IWC practices and approvals. This includes:** • Reference areas to be used for inspections and reporting, • Contingency planning for managing biofouling when the ship is inactive for an extended period and for incidents such as grounding that may damage the AFS, • Under what conditions an in-water inspection should occur, including prescheduled inspections and inspections in accordance with the operational profile, • Information provided by the AFS supplier, including the type and specifications of the coating (thickness, expected service life, operating conditions required for the coating to be effective), • Information used to determine the appropriate AFS, including the assumed typical operating speed of the ship, assumed activity period, maximum acceptable idle period and assumed areas of operation, • Details of any Marine Growth Prevention Systems (MGPS), including the type, date of application and performance lifetime, location installed, expected lifetime of consumable elements, operating conditions required for the MGPS to be effective, dosing and application frequency of the MGPS and, if using chemicals, the amount of chemical to be used as well as safety information. The standard includes that the parameters used to determine the appropriate AFS should be periodically reviewed during a ships operation to identify periods when the AFS may not perform according to specifications. If deviations occur, these should be discussed with the coating manufacturer to determine the impact on the efficacy of the AFS.
International Convention on the Control of Harmful Anti-fouling Systems on Ships **(AFS Convention)**[12]	The **AFS Convention is mandatory** and entered into force in 2008. The Convention **prohibits the use of harmful organotins in anti-fouling paints used on ships** and establishes a mechanism to prevent the potential future use of other harmful substances in anti-fouling systems. There are 91 contracting states to the AFS Convention, representing 95.93% of world tonnage. There is an obvious relationship between the AFS Convention, biofouling management, however, **implementation of the AFS Convention does not equate to having a biofouling policy. The AFS Convention is not intended to manage biofouling. Instead, the AFS Convention provides a framework to limit the impact of harmful AFS. It does not regulate or set performance standards for AFS.** Currently, the organotin tributyltin (TBT) is the only prohibited substance under the AFS Convention, however the IMO agreed in June 2021 to prohibit the use of Cybutryne (also known as Irgirol) in anti-fouling systems from 1 January 2023. To support implementation of the AFS Convention, the IMO also released guidelines: • 2003 Guidelines for brief sampling of anti-fouling systems on ships, • 2009 Guidance on best management practices for removal of anti-fouling coatings from ships, including TBT paints, • 2010 Guidelines for survey and certification of anti-fouling systems on ships, and • 2011 Guidelines for inspection of anti-fouling systems on ships[13].

[11] *BIMCO, 2021a.*
[12] *BIMCO, 2021a*
[13] *International Maritime Organization, 2003, 2009, 2010 and 2011b.*

Current international biofouling guidelines and recommendations	
ISO Standards	There are a number of ISO standards relevant to the AFS Convention and ship in-water cleaning. These specifically relate to determining release rates for biocides or undertaking environmental risk assessments in relation to biocides: • ISO 13073-1[14] (Ships and marine technology – Risk assessment on anti-fouling systems on ships) supports implementation of the AFS Convention by specifying a risk assessment method for biocide-active substances in AFS. • ISO 19030-1[15] (Ships and marine technology – Measurement of changes in hull and propeller performance) provides a method for measuring hull and propellor performance. However, does not extend to assessing whether biofouling has influenced the performance. • ISO 8502-9[16] (Field method for the conductometric determination of water-soluble salts) is used to evaluate the residual soluble salt contamination after washing the hull using high pressure water jet cleaning. • ISO 8501-1[17] (Rust grades and preparation grades of uncoated steel substrates and of steel substrates after overall removal of previous coatings) which has been recommended as a reference to describe blasting performance[18].

CASE STUDY 1.

REVIEW OF THE IMO BIOFOULING GUIDELINES

A **review of the 2011 IMO Biofouling Guidelines began in 2020**.

Member States and observers involved in the review identified impediments to the implementation of the IMO Biofouling Guidelines, noting that **even where efforts had been made to disseminate information and promote the guidelines, there was variable awareness and limited uptake.**

In June 2021, IMO's Marine Environment Protection Committee (MEPC) agreed to extend the completion date of the review to 2023 and revise the guidelines based on the recommendations presented by the IMO's Pollution, Prevention and Response (PPR) Subcommittee[19].

The recommendations include:

- **Restructure** of the Guidelines to result in more user-specific guidance that is clearer, more concise and less general,
- More specific guidance on biofouling management plans and record books so that plans are ship-specific and user-friendly,
- A **quantitative definition of micro- and macro-fouling** in terms of thickness and substances/species and recommended maximum acceptable levels,
- Inclusion of recommendations for format and content of inspection and cleaning reports and records for maintenance of the anti-fouling system,
- A recommended biofouling level that should lead to cleaning or other management actions, in order to minimize or avoid the transfer of IAS,
- A **recommended outcome (biofouling level) for in-water cleaning operations** and how cleaning operations should be documented in the record book,
- **Recommended handling (capture and disposal) of biological waste** from cleaning operations, and
- General guidance on assessment of biofouling management practices and appropriate contingency measures.

[14] *International Standards Organization (ISO), 2012.*
[15] *International Standards Organization (ISO), 2016.*
[16] *International Standards Organization (ISO), 2020.*
[17] *International Standards Organization (ISO), 2007.*
[18] *INTERTANKO, 2016.*
[19] *International Maritime Organization, 2021a, b and c.*

2.2 REGIONAL BIOFOULING MANAGEMENT STRATEGIES AND POLICIES

Currently, there is only one publicly available, regional biofouling management policy, issued by the Secretariat of the Pacific Regional Environment Program (SPREP). SPREP prepared its 'Shipping related introduced marine pests in the Pacific Islands: a regional strategy (SRIMP-Pac)' in 2006 (**Table 3**).

As the SPREP strategy was prepared prior to the finalization of the IMO Biofouling Guidelines, the strategy is silent regarding documentation of biofouling management practices (such as BFMP and BFRB). However, the strategy does promote good maintenance and anti-fouling practices.

SPREP is a regional partner of the GloFouling Partnerships Project, therefore it can be anticipated that the SRIMP-Pac strategy will be updated as part of the project.

Table 3. Current regional biofouling management policy

Regional Biofouling Management Policy	The **Secretariat of the Pacific Regional Environment Program (SPREP):** 2006 'Shipping related introduced marine pests in the Pacific Islands: a regional strategy (SRIMP-Pac)'[20].
Nature of Policy	**Strategy (Voluntary guidance).** **The strategy recommends regulations be introduced to address both ballast water and biofouling.** It recognizes the absence of an international convention for biofouling management and includes that Pacific Island Countries should work through the IMO to initiate and accelerate the development of an international regulatory regime for the biofouling vector, to complement the Ballast Water Management Convention. Technical training and capacity building, as well as working with Pacific-Rim countries to ensure best-practice biofouling prevention and control measures are implemented, are included.
Verification activities	The strategy recommends that hulls and niche areas are inspected and cleaned before leaving Pacific-Rim countries and that Pacific Island Countries should work to implement fouling prevention and control measures in their own ports. The strategy recommends: scrutinizing ships and other floating facilities before allowing entry to port, inspection of international yachts and other recreational craft at first port of call.

In addition to the SPREP strategy, the Permanent Commission for the South Pacific (CPPS) also has a regional strategy that references biofouling[21]. This strategy is not publicly available; however, it does include the objective of supporting Southeast Pacific countries to implement IMO Guidelines and other international instruments on marine bioinvasion, including the IMO Biofouling Guidelines.

Five regional secretariats (also called Regional Coordinating Organizations (RCOs) under the GloFouling Partnerships Project) are involved in the GloFouling Partnerships Project:

- Permanent Commission for the South Pacific (CPPS),
- Partnerships in Environmental Management for the Seas of East Asia (PEMSEA),
- Regional Organization for the Conservation of the Environment of the Red Sea & Gulf of Aden (PERSGA),
- South Asia Co-operative Environment Programme (SACEP), and
- South Pacific Regional Environment Programme (SPREP).

[20] *Secretariat of the Pacific Regional Environment Program, 2006.*
[21] *CPPS, 2021.*

As part of the project, it is intended that each RCO will prepare a Regional Biofouling Management Strategy to ensure regional harmonization of biofouling management requirements.

The countries participating in each regional secretariat are:

CPPS: Chile, Colombia, Ecuador, Peru

PEMSEA: Cambodia, China, Republic of Korea, Indonesia, Japan, Lao, Philippines, Singapore, Timor-Leste, Vietnam

PERSGA: Djibouti, Egypt, Jordan, the Kingdom of Saudi Arabia, Somalia, Sudan, Yemen

SACEP: Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan, Sri Lanka

SPREP: Cook Islands, Federated States of Micronesia, Fiji, Kiribati, Marshall Islands, Nauru, Niue, Palau, Papua New Guinea, Samoa, Solomon Islands, Tonga, Tuvalu, Vanuatu

2.2.1 PROPOSED REGIONAL BIOFOULING MANAGEMENT POLICIES

Two regions have publicly available proposals to develop biofouling management policies (**Table 4**), including the:

- Baltic Sea, through the Baltic COMPLETE project which aimed to complete management options in the Baltic Sea Region to reduce the risk of invasive species introduction by shipping, and
- Mediterranean Sea, through the Regional Marine Pollution Emergency Centre for the Mediterranean Sea (REMPEC).

Table 4. Proposed regional biofouling management policies

Region	Nature of proposed regional biofouling management policy
Baltic Sea The COMPLETE Project's Proposal for a Regional Baltic Biofouling Management Roadmap[22]	**Proposed voluntary guidance.** The proposed roadmap includes a guide on best practices for biofouling management in the Baltic Sea. The proposal also includes a biofouling assessment protocol for leisure boats and marinas and recommendations for mitigating potential risks related to biofouling of leisure boats. The roadmap includes specific recommendations for AFS for ships, including recreational craft, operating in the Baltic Sea. The roadmap includes that all ships should have a BFMP that: • Is ship specific, • Accounts for changes in operational profile and be consistent with the IMO Biofouling Guidelines, • Includes a description of biofouling management practices, The roadmap Includes a maintenance plan and details of the AFS used for the hull and niche areas.
Mediterranean Sea The Regional Marine Pollution Emergency Response Centre for the Mediterranean Sea (REMPEC): Draft Mediterranean strategy for the prevention of and response to marine pollution from ships (2022-2031)[23] and Draft Ballast Water Management Strategy for the Mediterranean Sea (2022-2027)[24].	**Proposed (to be adopted in 2022) voluntary guidance (although a reporting system on implementation is in place at the regional level to assess implementation).** The marine pollution strategy recognizes biofouling on ships hulls and niche areas as a major vector for IAS introductions and proposes actions to eliminate introductions of IAS by shipping, including contributing to the work of the IMO, implementing targeted technical cooperation and capacity building activities to address implementation issues related to biosafety, including the AFS Convention and the IMO Biofouling Guidelines. Further, actions include contributing to the possible establishment of IMO projects, such as the GloFouling Partnerships Project, and promoting, disseminating and revising new and existing recommendations, principles and guidelines aimed at facilitating implementation of the IMO Biofouling Guidelines and the IMO Biofouling Guidance for Recreational Craft. The ballast water strategy recognizes that Good Environmental Status (GES) cannot be done solely by managing ballast water. Therefore, the strategy was broadened to include biofouling. The overall objectives of the strategy include initiating preliminary activities relating to the management of ships biofouling in the Mediterranean region, whilst the strategic priorities include enhancing expertise for the management of ballast water and biofouling in the Mediterranean region, and building political will for the implementation of ballast water and biofouling management measures in the Mediterranean. The actions associated with the strategy include undertaking national status assessments of biofouling (2023-2025) and developing national strategies and action plans to manage biofouling (2025-2027).

[22] *COMPLETE, 2021. Further work has started under the "COMPLETE PLUS" project, to be completed in December 2021 ("Practical implementation of the COMPLETE project outputs and tools").*
[23] *Regional Marine Pollution Emergency Response Centre for the Mediterranean Sea (REMPEC), 2021a.*
[24] *Regional Marine Pollution Emergency Response Centre for the Mediterranean Sea (REMPEC), 2021b.*

2.3 NATIONAL AND SUB-NATIONAL BIOFOULING MANAGEMENT POLICIES

Information was collected from a number of national and sub-national[25] authorities regarding current and proposed biofouling management policies.

The policies described in this report are publicly available and/or have been fact checked with the relevant authorities.

2.3.1 NATIONAL BIOFOULING MANAGEMENT POLICIES

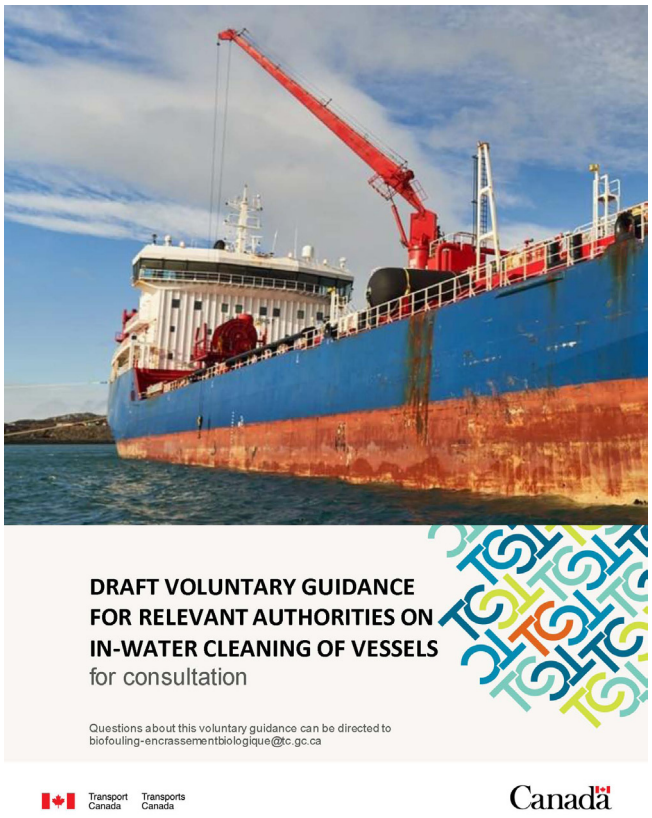
There are relatively few national biofouling management regulations or policies in place globally (that are currently publicly available) (**Table 5**).

Five existing national policies were identified (Australia, Chile; New Zealand; South Africa, the United States), of which three are mandatory:

- **New Zealand,**
- **South Africa,** and
- **the United States.**

The **Australian national policy has a combination of mandatory requirements and voluntary guidelines** whilst **Chile has voluntary guidelines**.

Canada has mandatory requirements relating to the import, transport or release of species listed under the ***Aquatic Invasive Species Regulations 2015***[26], however an overview of biofouling management in Canadian waters in 2018[27] concluded that risks from ships' biofouling have not yet been addressed in Canadian regulations. In June 2021, Canada issued *Draft Voluntary Guidance for Relevant Authorities on In-water Cleaning of Vessels* for consultation. The guidance applies to relevant authorities that manage port operations and align with IMO Biofouling Guidelines. The final version of the voluntary guidance will be published online in 2022.



IN JUNE 2021, CANADA ISSUED DRAFT VOLUNTARY GUIDANCE FOR RELEVANT AUTHORITIES ON IN-WATER CLEANING OF VESSELS FOR CONSULTATION. THE GUIDANCE APPLIES TO RELEVANT AUTHORITIES THAT MANAGE PORT OPERATIONS AND ALIGN WITH IMO BIOFOULING GUIDELINES. THE FINAL VERSION OF THE VOLUNTARY GUIDANCE WILL BE PUBLISHED ONLINE IN 2022.

[25] *Sub-national locations may include any location existing or occurring below a national level, for example states, provinces, municipalities and ports.*
[26] *Government of Canada, 2015*
[27] *Green Marine Management Corporation, 2018.*

Table 5. Current national biofouling management policies

Country	Nature of Policy	Documentation	Reporting	Verification
Australia New requirements for managing biofouling on international vessels arriving in Australia will begin on 15 June 2022. The Australian biofouling requirements are best described in the Australian Government's dedicated website page[28]. Additionally, more information on the development of these new requirements can be found in the Australian biofouling requirements for international arrivals: Consultation Regulation Impact Statement[29] – 'status quo' option.	There is both a mandatory and voluntary element to current Australian biofouling management requirements. *Mandatory: Australia implements its Biosecurity Act 2015* to manage unacceptable biofouling related biosecurity risk. *Voluntary:* Australia promotes voluntary best practice management of biofouling in line with the IMO Biofouling Guidelines: Australia has produced biofouling guidance for petroleum activities, recreational craft, commercial ships, commercial fishing ships, non-trading ships and the aquaculture industry[30].	Vessels will need to provide information on how biofouling has been managed prior to arriving in Australian territorial seas. Vessel operators will have to comply with one of the following three accepted biofouling management practices: • Implementation of an effective Biofouling Management Plan; or • Cleaned all biofouling within 30 days prior to arriving in Australian territory; or • Implementation of an alternative biofouling management method pre-approved by the department. More details on the accepted biofouling management practices is expected to be released by the Department of Agriculture, Water and the Environment prior to the entry into force of the new regulation (15 June 2022).	Operators of all vessels subject to biosecurity control will be required to provide information on how biofouling has been managed prior to arriving in Australian territorial seas. This information will need to be reported through the Maritime Arrivals Reporting System (MARS) operated by the Department of Agriculture, Water and the Environment.	The Australian Government will use vessel information to target vessel interventions. A vessel operator that has not applied one of the three accepted biofouling management practices will be subject to further questions and assessment of the biosecurity risk associated with biofouling on the vessel. Biosecurity Officers, under the Australian Biosecurity Act 2015[31], have powers to assess and manage biosecurity risk, including biofouling, including powers to inspect ships; ask questions; or require documents to be provided in order to assess and manage biosecurity risk. Actions can be taken, if appropriate, including issuing a direction to a ship owner or operator, applying movement or time restrictions to ships, denying entry to ships or directing a ship to leave.

[28] www.agriculture.gov.au/biosecurity-trade/aircraft-vessels-military/vessels/marine-pest-biosecurity/biofouling
[29] *Australian Government, 2019.*
[30] *Marine Pest Sectoral Committee 2009a-e, and Marine Pest Sectoral Committee 2013.*
[31] *Australian Government, 2015b.*

Country	Nature of Policy	Documentation	Reporting	Verification
Chile General Directorate of the Territory Maritime and Merchant Marine. Circular A-52/007[32].	Voluntary guidance	Recommends all ships have a BFMP. The BFMP should be ship specific, identify places on the ship prone to biofouling, and include: • Details of the AFS or applied treatments, including for niche areas, • Operational practices of the ship, • A program of inspection, repairs, maintenance and reapplication of the AFS, • Details of recommended operating conditions for the AFS, and • Safety aspects relating to the AFS for the crew. A BFRB is recommended to verify the traceability of what is in the BFMP.	The guidance does not include reporting requirements.	The guidance does not specify verification requirements.

[32] *ARMADA De Chile (Chilean Navy), 2018.*

Table 5. Current national biofouling management policies continued...

Country	Nature of Policy	Documentation	Reporting	Verification
New Zealand The New Zealand (NZ) Craft Risk Management Standard[33] (CRMS) came into force in 2018. The New Zealand Ministry of Primary Industries has produced a number of guidance documents to support implementation, including Frequently asked questions, Guidelines for assessing biofouling risk, and Guidelines for diving service providers inspecting ships[34].	Mandatory (regulation) The NZ CRMS requires all ships (commercial and recreational) to arrive in NZ with a 'clean hull'. A clean hull is described as being 'when no biofouling of live organisms is present other than that within the thresholds'. The NZ CRMS provides different clean hull standards for ships depending on the length of stay in NZ. Short stay ships (less than three weeks) are allowed slime layer and goose barnacles with 5% macrofouling growth (tubeworms, bryozoan, barnacles) in niche areas, whilst long stay ships (greater than three weeks) must only have microfouling on the hull and niche areas. Thresholds are explained in detail by Georgiades and Kluza (2017).	Information that must be held onboard includes: • Details of the AFS and any MGPS used, • Whether ship is applying the IMO Biofouling Guidelines, including having a BFMP showing hull maintenance and inspection regime and a BFRB, preferably consistent with the IMO Biofouling Guidelines templates, • Latest AFS certificate, and • Date and report of the last hull inspection. Guidance on appropriate forms of documentation is available on the MPI website[35]. There is also Guidance for developing a BFMP[36], using a BFMP template and detailed descriptions of what should go on each page.	Submission of relevant documentation prior to arrival is required. Documentation should include: • Intended length of stay in NZ and places to be visited, • Whether the ship has had any extended periods stationary in a single location, • If the vessel is planning to IWC on arrival in NZ, • What measures have been or will be used to meet the requirements of the CRMS, and • Whether a craft risk management plan is in place.	To demonstrate that the clean hull standard has been met, ships must either: • Clean within 30 days before visiting NZ or within 24 hours of arrival, noting that no IWC is allowed within 12nm of the NZ coastline, or • Demonstrate continual maintenance using best practice, including application of an anti-fouling coating, operation of MGPS on sea-chests, and in-water inspections with biofouling removal as required (the CRMS refers to the IMO Biofouling Guidelines as an example of best practice), or • Apply approved treatments (currently haul out/dry docking is the only approved treatment), or • Submit a Craft Risk Management Plan for approval.

[33] *Ministry for Primary Industries, 2018a.*
[34] *Ministry for Primary Industries, 2018b, c, and e.*
[35] *www.mpi.govt.nz/import/border-clearance/ships-and-boats-border-clearance/biofouling/biofouling-management/*
[36] *Ministry for Primary Industries, 2018d.*

Country	Nature of Policy	Documentation	Reporting	Verification
South Africa The Port Rules Act[37], managed by the Transnet National Ports Authority[38] (TNPA) refers to biofouling.	Mandatory (regulation)	Ships seeking to IWC must submit a ship-specific BFMP in-line with the IMO Biofouling Guidelines.	Reporting is only required if a ship is seeking to IWC.	The Act does not specify verification requirements.
United States US Coast Guard Regulation 33 CFR 151.2050[39] 2013 Vessel General Permit[40] (VGP) Note: Guidance has been provided by the American Bureau of Shipping's Guidance Notes on Biofouling Management Plans[41] which describes the current requirements in the US.	Mandatory (regulation)	US Coast Guard (USCG) Regulations specify that a Ballast Water Management Plan is required, and that the plan must include detailed fouling maintenance procedures. The regulations don't detail what the procedures must include. According to the ABS publication, the USCG advises that the IMO Biofouling Guidelines and the California Biofouling Regulations provide a basis for developing and implementing a ship-specific BFMP, to be included or referenced in the ballast water management plan.	The 2013 Vessel General Permit (VGP)[40] requires submission of a Notice of Intent to discharge pollutants into the waters of the United States. This is required if a ship is seeking to IWC. Discharges that must be reported include anti-fouling hull coatings, chain locker effluent, seawater piping biofouling prevention, and underwater ship husbandry. Dry dock reports are also required under the VGP (part 4.1.4) that describe how biofouling has been managed. These must be made available to the US Environment Protection Authority.	Part 4.1.3 of the VGP requires ship inspection every 12 months. Inspections must cover all areas affected by VGP requirements, including the ship's hull and niche areas, for fouling organisms, flaking anti-fouling paint and/or exposed TBT. If inspections reveal deficiencies, the shipowner must take corrective action.

[37] *Transnet National Ports Authority, 2009.*
[38] *www.transnetnationalportsauthority.net/Harbour%20Master%20Authorisations/Pages/Hull-Cleaning-Permit.aspx*
[39] *United States Government, 2014.*
[40] *United States Government, 2013.*
[41] *American Bureau of Shipping, 2019.*

2.3.2 SECTOR-SPECIFIC BIOFOULING MANAGEMENT POLICIES

Australia and Brazil are the only locations identified as having biofouling management policy specific to ships operating in, or supporting, the offshore oil and gas sector.

Australia

Australia has a national policy for ships operating in **Australia's offshore oil and gas sector** (**Table 6**).

Table 6. Australia's offshore oil and gas sector biofouling policy

	Australia – Offshore oil and gas sector
Nature of pol-icy	**Mandatory (regulation) and Voluntary** When a ship, mobile offshore drilling unit (MODU) or other mobile component is engaged in an offshore activity in Australian waters, a range of biofouling management requirements may be applicable depending on where the activity is occurring. These include a combination of Australian state and territory biosecurity requirements (see **Section 2.3.3**), national requirements (see Australia - **Table 5**) and National Offshore Petroleum Safety and Environmental Management Authority's (NOPSEMA) requirements (under the *Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009* (Environment Regulations)). NOPSEMA released an information paper to describe this combination of voluntary guidelines and mandatory requirements applicable to ships operating in Australia's offshore oil and gas industry: 'Reducing marine pest biosecurity risks through good practice biofouling management'[42]. The information paper clarifies biosecurity requirements for titleholders, mobile offshore drilling unit (MODU) operators and vessel contractors servicing the offshore industry in Australia. In addition to the state and territory biosecurity requirements and the Australian national policy, the Environment Regulations require offshore activities to be undertaken in line with an approved Environment Plan. The paper provides good practice advice and refers to the *National biofouling management guidelines for the petroleum production and exploration industry*[43].
Documentation	The Environment Plan must include details of all environmental impacts and risks for the activity, an evaluation of those impacts and risks and details of control measures that will be used to reduce the impacts and risks to as low as reasonably practicable and an acceptable level. • NOPSEMA's expectation is that titleholders and their contracted vessels/mobile facility operators apply relevant guidance from the IMO Biofouling Guidelines at a minimum.
Verification	NOPSEMA monitors titleholder compliance and may monitor implementation of biofouling risk management measures. NOPSEMA may use enforcement powers if necessary.

[42] *Australian Government, 2020.*
[43] *Marine Pest Sectoral Committee, 2009a.*

Brazil

Brazil also has voluntary guidance on biofouling management for **Brazil's oil and gas industry** that is not currently publicly available: the National Plan for the Prevention, Control and Monitoring of Sun Coral in Brazil[44]. The Plan:

- Recommends implementation of the IMO Biofouling Guidelines,
- Refers to the **IOGP/IPIECA Guidance for prevention and management**[45] for the oil and gas industry,
- Recommends the requirement that all new hulls of platforms arriving in Brazil, originating from abroad, must be free of sun coral and that this should be validated through inspection and cleaning in the original location, and
- Provides recommendations for cleaning methods for different ships and surfaces.

2.3.3 SUB-NATIONAL BIOFOULING MANAGEMENT POLICIES

Thirteen publicly available sub-national biofouling management policies and practices were identified (**Table 7**).

Of these, nine policies include mandatory biofouling requirements:

- Northern Territory, Australia,
- Queensland, Australia,
- Western Australia, Australia,
- Galapagos Marine Reserve, Ecuador,
- Auckland, New Zealand,
- Kermadec Islands and Subantarctic Islands, New Zealand,
- Northland (Ports of Opua and Whangarei, New Zealand,
- California, United States, and
- Papahanaumokuakea Marine National Monument (Hawaii), United States.

Two include a combination of mandatory requirements and voluntary guidelines:

- South Australia, in Australia, and
- Abu Dhabi Ports, United Arab Emirates.

And **one provides voluntary guidelines:**

- Port of Gothenburg, Sweden.

[44] *Ministry of Environment, Brazil, 2018.*
[45] *IOGP/IPIECA, 2010.*

Table 7. Current sub-national biofouling management and policies

Sub-national Juris-diction	Nature of Policy	Documentation	Reporting	Verification
Australia – Northern Territory Hull pest inspections for visiting boats[46]	Mandatory The Northern Territory Government requires that some recreational craft that have travelled through international waters and from some interstate locations may need to be inspected and treated for IAS before they enter a marina in Darwin.	Documentary requirements are not specified.	Owners/operators of both international and interstate (domestically travelling) recreational craft must contact the Northern Territory Government's Aquatic Biosecurity Unit before arriving to find out if an inspection and treatment are needed.	The inspection and treatment are free services provided by the Northern Territory Government. Owners/operators will be asked where the ship has travelled, the age of the anti-fouling coating, when the ship was last cleaned and when and for how long the ship was last on a hardstand in Australia. If it is deemed that an inspection and treatment is needed, divers will inspect the hull and all seawater pipes will be disinfected.
Australia – Queensland Queensland Biosecurity Act 2014[47]	Mandatory (regulation) The Queensland Biosecurity Act 2014 includes a general biosecurity obligation to take all reasonable and practical steps to minimize the risk of introducing or spreading marine pests. Queensland has an intention to develop a more specific biofouling policy in the next 5 years. The Biosecurity Act also contains a list[48] of prohibited marine animals and plants.	If ships are planning to IWC, they are required to demonstrate that biofouling has been managed through ship-board documentation (a BFMP and BFRB) and evidence (e.g. a report) of a hull inspection.	Reporting requirements are not specified.	Verification is not specified.

[46] *Northern Territory Government, 2021.*
[47] *Queensland Government, 2014.*
[48] *www.legislation.qld.gov.au/view/pdf/inforce/current/act-2014-007.*

Sub-national Juris-diction	Nature of Policy	Documentation	Reporting	Verification
Australia – South Australia *Fisheries Management Act 2007*[49] The Department of Primary Industries and Regions[50] provides guidance for biofouling management under the Act.	A mix of mandatory and voluntary provisions. Under the South Australian Fisheries Management Act, it is illegal to bring noxious species or notifiable aquatic pests and diseases into South Australia, and/or release or deposit exotic species into any waters. The guidance includes good ship cleaning practices, and links to cleaning facilities in South Australia.	The guidance notes that a BFMP and BFRB should be consistently maintained as a measure to minimize biofouling. It should meet all the requirements under IMO Biofouling Guidelines.	Reporting requirements are not specified.	The Department of Primary Industries and Regions may order a ship known to carry exotic species (including noxious species) out of state waters or immediately out of the water to be cleaned if it poses a risk to South Australia. Exotic aquatic organism is defined: fish or an aquatic plant of a species that is not endemic to the waters to which the Fisheries Management Act 2007 applies.
Australia – Western Australia (WA) Department of Primary Industries and Regional Development Biofouling Biosecurity Policy[51]	Mandatory The requirements in the WA biofouling policy apply to all ships, moveable structures and submersible equipment. The policy is that ships should be 'clean' before leaving for new destinations within WA. This means the risk of aquatic pest and disease transport should be kept to an acceptable (low) level. Under the *Fish Resources Management Regulations 1995*[52] it is an offence to translocate live non-endemic fish and noxious fish to WA without permission. The WA Prevention List for Introduced Marine Pests[53] lists species that are prescribed as noxious fish.	WA recommends having a BFMP and BFRB to demonstrate reasonable actions have been taken to minimize the change of committing offences. The BFMP and BFRB should be consistent with the IMO Biofouling Guidelines. *A Good Vessel Maintenance*[54] brochure is also available.	The WA Department of Primary Industries and Regional Development provide an online risk assessment tool Vessel Check[55], designed to determine the risk of a ship carrying IAS into WA and provide recommended risk reduction measures. Use of the tool is recommended before travelling to WA.	The WA Department of Primary Industries and Regional Development has emergency powers to deal with incursions of IAS, including directing a person to carry out activities to prevent or control the spread of IAS, or to eradicate them in WA waters. If these activities are not undertaken, the department may carry out the activities and recover costs incurred from the person initially directed to do so.

[49] *Government of South Australia, 2007.*
[50] *www.pir.sa.gov.au/biosecurity/aquatics/biofouling_and_ballast_water.*
[51] *Department of Primary Industries and Regional Development, 2017a.*
[52] *Government of Western Australia, 1995.*
[53] *Department of Primary Industries and Regional Development, 2016.*
[54] *Government of Western Australia, date unspecified.*
[55] *www.fish.wa.gov.au/Sustainability-and-Environment/Aquatic-Biosecurity/Vessels-And-Ports/Pages/Vessel-Check.aspx.*

Table 7. Current sub-national biofouling management and policies continued...

Sub-national Juris-diction	Nature of Policy	Documentation	Reporting	Verification
Ecuador – Galapagos Marine Reserve Inspection Instructions for Hull Inspections[56].	Mandatory Ships are inspected for IAS.	Documentary requirements are not specified.	Any ship arriving in Galapagos must request a hull inspection at least 8 days in advance[57].	Any ship that enters the Galapagos Marine Reserve and whose last port of departure was not the Galapagos must have a hull inspection. Inspection of both submerged areas and non-submerged areas that may have come into contact with the water. All macrofouling species are sampled and identified.
New Zealand – Auckland Auckland Council's Navigating the rules: doing your bit to stop invasive marine pest species[58] These requirements do not supersede New Zealand's national biofouling requirements (the CRMS) for international arrivals and are targeted at ships moving domestically within New Zealand.	Mandatory The rules refer to nine specific pest species that are of concern, however the rules require a level of fouling to be met and are not species specific. The rules state that the level of fouling must not exceed 'light' fouling – 'light' being no more than a slime layer and scattered barnacles on 5% of the hull. Under the rules it is unlawful to allow a hull to become so heavily fouled that passive discharges occur. This is said to occur when biofouling reaches the macrofouling stage.	Documentary requirements are not specified.	Reporting requirements are not specified.	Verification is not specified.

[56] *Agency for Regulation and Control of Biosecurity and Quarantine for Galapagos, 2015.*
[57] *Zabin et al., 2018.*
[58] *Auckland Council, 2021.*

Sub-national Juris-diction	Nature of Policy	Documentation	Reporting	Verification
New Zealand – Kermadec Islands and Subantarctic Islands Regional coastal plan: Kermadec and Subantarctic Islands[59]	Mandatory The introduction of any species of flora or fauna new to the coastal marine areas of the Kermadec and Subantarctic Islands is prohibited. Ships must comply with performance standards, including: • Fouling thresholds that are consistent with those in the New Zealand CRMS, • Recording keeping and documentary (BFMP and BFRB) requirements, • AFS requirements – applied in line with manufacturer's instructions, within effective life span, evidence of application date, and The policy requires ships intending to go within 1000 metres of the mean high-water springs (MHWS) of the islands to have a clean hull – those ships AFS must be less than 6 months old. If older, must meet a more stringent performance standard. There are also specific requirements for ships that have berthed, anchored or moored for more than 7 consecutive days.	Ships within 1000 metres of MHWS (Mean High Water Spring) of any of the islands must have a BFMP and BFRB in accordance with the coastal plan. To demonstrate compliance with the performance standard. The BFMP must identify all areas particularly susceptible to biofouling and include: • Documentation that the AFS is no more than 12 months old and complies with the performance standard, • Describe the AFS, • Reports of the performance of the AFS for the previous 5 years, • Description of the operating profile, • Vessel hull and niche area maintenance, including the timing of operational and maintenance activities and IWC and maintenance procedures, • Safety procedures for the vessel and crew, • Disposal of biological waste, and • Recording requirements. The plan also includes specific requirements for inclusions in the BFRB.	A hull inspection must be completed and submitted before departure for the islands or a risk assessment can be conducted in accordance with the protocol outlined in the plan. Ships within 1000 metres of MHWS of any of the islands must submit the BFMP and BFRB seven days prior to the ships' first voyage to any of the islands after application of the AFS.	Ships within 1000 metres of MHWS of any of the islands must inspect the hull between 4 and 8 months from the date of application of the AFS and demonstrate compliance with the relevant performance standard.

[59] *Department of Conservation, 2017.*

Table 7. Current sub-national biofouling management and policies continued...

Sub-national Juris-diction	Nature of Policy	Documentation	Reporting	Verification
New Zealand – Northland (Ports of Opua and Whangarei) Northland Regional Pest and Marine Pathway Management Plan 2017-2027[60]	Mandatory – apply to domestically travelling ships only (the NZ CRMS applies to international arrivals). Rules apply to the area around Northland's coast from MHWS to the 12 nautical mile limit of New Zealand's territorial sea. Under the rules, a person in charge of a ship is required to ensure there are no pest species or unwanted organisms present on the hull of the ship. Pest species are identified in the plan. A person in charge of a ship is also required to ensure that the fouling on the hull and niche areas does not exceed 'light fouling'[61].	Ships may apply for an Anti-fouling Declaration which verifies that the ship has had anti-fouling paint applied to its hull in accordance with manufacturer's instructions within the preceding 12 months. The declaration is valid for 12 months.	Reporting requirements are not specified.	Northland Council staff and/or contractors may conduct surveys to assess hull fouling on ships in all areas within Northland. Enforcement actions, prosecutions and rule exemptions may apply. If the rules are not met, prosecution can be avoided if the ship has a current Anti-fouling Declaration, has evidence of application of anti-fouling paint in the preceding 12 months, and macrofouling or filamentous algae does not exceed 15% of the visible hull surface.

[60] *Northland Regional Council, 2018.*
[61] *Light fouling is defined as: small patches (up to 100 millimeters in diameter) of visible fouling, totaling less than 5% of the hull and niche areas. A slime layer and/or species of barnacles are allowable fouling.*

Sub-national Juris-diction	Nature of Policy	Documentation	Reporting	Verification
Sweden – Port of Gothenburg General Port Regulations 2017[62]	Voluntary	The Regulations recommend that all ships use a BFMP and BFRB in accordance with the IMO Biofouling Guidelines.	Reporting requirements are not specified.	Verification is not specified.
United Arab Emirates (UAE) – Abu Dhabi Ports Vessel Discharge and Maintenance: Guidelines for Owners, Masters and Agents[63]	Mix of Mandatory and Voluntary Measures The guidelines include that chain lockers must not be rinsed or pumped out in port and that no chemicals or pesticides, who use is banned in the UAE, may be discharged in cleaning seawater piping in port waters. Fouling organisms should be disposed of as hazardous waste. The use of TBT or other organotins is prohibited.	If a ship spends considerable time in port waters (more than 30 days per year) or uses Abu Dhabi as its home port, the owner/operator should consider using an AFS that relies on a rapidly biodegradable biocide or another alternative to copper-based coatings. If a ship operator continues to use copper-based AFS, this decision should be documented.	Reporting requirements are not specified.	Verification is not specified.

[62] *Port of Gothenburg, 2017.*
[63] *Abu Dhabi Ports, 2018.*

Table 7. Current sub-national biofouling management and policies continued...

Sub-national Juris-diction	Nature of Policy	Documentation	Reporting	Verification
United States – California The Californian Biofouling Regulations[64] came into force in 2017. Guidance Document for California's Biofouling Management Regulations[65]	Mandatory California's regulations apply to all vessels 300 gross registered tons or above that carry, or are capable of carrying, ballast water, that arrive at a Californian port. The regulations identify niche areas and include that biofouling in niche areas must be managed. Niche areas identified include (if present): sea chests, sea chest gratings, bow and stern thrusters, bow and stern thruster gratings, fin stabilizers and recesses, out of water support strips, propellers and propeller shafts, and rudders. The regulations include separate requirements in relation to niche area management for extended stays (45 consecutive days or longer in the same port).	Specific requirements for BFMP's: • Vessel specific, • Describe the biofouling management strategy, • Consistent with the IMO Biofouling Guidelines, • Current as of the most recent out of water maintenance or delivery, and • Describe the practices and AFS used for the hull and niche areas. A specific format is not required, although the IMarEST template[66] is provided as a template. BFRB are required to contain details of all in-water inspections and biofouling management measures; be consistent with the IMO Biofouling Guidelines; and include descriptions of niche area management practices. No specific format is required. A ship's AFS must not be aged beyond its effective coating lifespan. If it is, the BFMP must document how biofouling will be managed. If there is no AFS, the BFMP must describe how biofouling will be managed in the absence of a coating.	Ships must submit a Marine Invasive Species Program Annual Vessel Reporting Form[67] annually. The form is submitted electronically. The report must include: • Details of the last out of water maintenance, • Type of AFS and where it is applied; • Whether sea chests were inspected and/or cleaned during the last out of water maintenance, • Whether Marine Growth Prevention Systems (MGPS) are installed on sea chests and/or sea strainers, • Any IWC since the last out of water maintenance, • Whether the propeller has been polished and the anchor and chains rinsed, • The average speed of the ship and average time spent in port over the last four months, • Whether the ship has visited any freshwater ports, the Panama Canal or tropical ports since the last clean, • Details of the last ten ports visited, and Whether the ship has spent more than ten consecutive days in port since the last clean.	California State Lands Commission staff undertake onboard inspections to review documentation and compliance with the regulations. Depending on the violation, a Letter of Non-compliance or Notice of Violation is issued to the owner. In most cases, the ship has 60 days to come into compliance. Enforcement regulations are under development to create a transparent penalty structure for further violations.

[64] *California State Lands Commission, 2018.*
[65] *California State Lands Commission, 2017.*
[66] *International Maritime Organization, 2016.*
[67] *https://misp.io/.*

Sub-national Juris-diction	Nature of Policy	Documentation	Reporting	Verification
United States – Papa-hanaumokuakea Marine National Monument in Hawaii Marine Alien Species Inspec-tion Standards for Maritime Vessels[68]	Mandatory All submerged and waterline surfaces must be free of macrofouling consisting of marine plants and animals. Surfaces must be free of green, brown and red macro-algal species. Surfaces must also be free of macro-invertebrates.	Documentary requirements are not specified.	Reporting requirements are not specified.	All ships must be inspected for the presence of IAS prior to approval for an entry permit. The inspection involves detection of IAS associated with ballast water, biofouling associated with the primary ship and tender craft, biofouling of scientific equipment and/or instrument arrays or live organism transport.

2.3.4 PROPOSED OR INTENDED NATIONAL AND SUB-NATIONAL BIOFOULING MANAGEMENT POLICIES

National

Australia and the United States have proposed or intended biofouling management policies that have been released for public consultation (at the time of printing, Australian regulations will be entering into force on 15 June 2022). Both proposed policies are consistent with the IMO Biofouling Guidelines and focus on best practice biofouling management to minimize the accumulation of biofouling on hulls and niche areas.

However, these policies differ in their approach in several aspects (**Table 8**). Whilst not all details of the policies are available, the proposed rules would see differences in the documentary requirements as well as requirements relating to the AFS.

These policies also differ from those already in force in New Zealand and California. Australia's proposed requirements most closely resemble California's. Whilst all four policies have a documentary focus, New Zealand's thresholds and the US proposed AFS requirements are important points of difference.

This variation in the mandatory requirement, reporting and documentation (albeit in line with the IMO Biofouling Guidelines, however specific content requirements vary slightly between New Zealand, California and the US) suggests that the IMO Biofouling Guidelines are not specific enough to ensure consistent application of mandatory biofouling management policies globally.

In addition to Australia and the United States, other nations are also likely to prepare biofouling management policies or practices in the near-term. These include the GloFouling Lead Partnering Countries (LPC's) (Brazil, Ecuador, Fiji, Indonesia, Jordan, Mauritius, Mexico, Peru, Philippines, Sri Lanka and Tonga). Representatives from Cambodia, Denmark and Nigeria also indicated a biofouling management policy would soon be developed.

Sub-National

The states of South Australia (in Australia) and the Washington (in the United States) both have publicly available documents that indicate an intention to implement biofouling management policies.

The South Australian Government is developing a new Biosecurity Act. The **2020 consultation paper**[69] states that biofouling management currently relies in part on the goodwill of vessel owners and indicates that this gap in mandatory biofouling management will be addressed in the new Act.

In Washington State, the **Washington State vessel-related biofouling management 6-year strategic plan**[70]

[68] *Papahanaumokuakea Marine National Monument, 2014.*
[69] *Government of South Australia, 2020.*
[70] *Ramboll Environ US Corporation, 2017.*

provides the rationale and framework for a state biofouling management program. The plan focuses on ships more than 300 gross registered tons and other large mobile waterborne equipment and infrastructure, and recommends integration of other ships over time.

The plan proposes a biofouling management model based on the biofouling management requirements in New Zealand, Australia and California. The plan would require each ship to develop a BFMP and BFRB and submit an annual hull husbandry and voyage history reporting form, similar to California's requirement.

In addition to South Australia and the state of Washington, representatives from a number of ports and authorities indicated biofouling management policy would be soon developed in their jurisdictions, including: North Queensland Bulk Ports, which manages the ports of Mackay, Weipa, Abbot Point and Hay Point in Queensland, Australia; Westhaven Marina and the ports of Lyttleton and Timaru, in New Zealand; the Port Authority of the Balearic Islands, which manages the ports of Palma de Mallorca, Alcudia, Mahon, Ciutadella, Ibiza and la Savina, and the Port of Castello, in Spain; and the Port of Southampton, in the United Kingdom.

All locations with current or proposed biofouling policies, including the GloFouling LPC's, are shown on the map in **Figure 1**.

Table 8. Comparison of Australian and United States proposed biofouling management policies

	Australia – entry into force 15 June 2022 *Australian biofouling requirements for international arrivals: Consultation Regulation Impact Statement*[71]	**United States (US) – proposed** *2018 Vessel Incidental Discharge Act (VIDA)*[72]
Mandatory requirement	All ships under biosecurity control, in accordance with the *Biosecurity Act 2015*[73], would be required to minimize biofouling growth on hulls and niche areas. Pre-arrival reporting would be required.	The United States Environmental Protection Agency (EPA) published its Notice of Proposed Rulemaking – Vessel Incidental Discharge National Standards of Performance[74] for public comment in October 2020. Two years after the EPA publishes the final standards, the US Coast Guard is required to develop corresponding implementation, compliance and enforcement regulations.
Documentation requirements	During the first five years of implementation, ships must either: • Implement a BFMP in-line with the policy, • Treat or clean the hull and niche areas less than 30 days prior to arrival in Australia, or • Implement an alternative approved biofouling risk management practice (e.g. meet New Zealand or California requirements).	The proposed rule would require each vessel to develop and follow a BFMP to prevent macrofouling. The BFMP would be consistent with the current requirements under the VGP and provide: • A holistic strategy that considers the operational profile, • Identifies appropriate AFS, and • Details the biofouling management practices for specific areas of the ship. The plan elements must prioritize procedures and strategies to prevent macrofouling.
AFS requirement	The proposed Australian biofouling management policy does not specify AFS requirements.	The proposed rule would require selection of an AFS to be specific to the operational profile and would prohibit the use of TBT and cybutryne in AFS. Seawater piping systems (sea chests, grates and any sea piping) that accumulate biofouling that exceeds a fouling rate of FR-20[75] would be required to be fitted with a MGPS[76].

[71] *Australian Government, 2019.*
[72] *United States Government, 2018.*
[73] *Australian Government, 2015b.*
[74] *Environmental Protection Agency, 2020.*
[75] *Fouling rating (FR) means the scale developed by the U.S. Navy (Naval Sea Systems Command (NAVSEA), 2006).*
[76] *MGPS = Marine Growth Prevention System. The rule includes an expanded definition of a MGPS, to include systems utilizing: sacrificial anodic copper, chlorine-based dosing, chemical injection, electrolysis, ultrasound, ultraviolet radiation, or electrochlorination, application of an anti-fouling coating, or use of cupro-nickel piping.*

Figure 1. Locations with current and proposed biofouling management policies, including GloFouling Lead Partnering Countries.

- Current biofouling policy
- Intend to develop or revise biofouling policy in the next five years
- GloFouling Lead Partnering Countries

2.3.5 ANALYSIS OF KEY FEATURES OF BIOFOULING MANAGEMENT POLICIES

There is variation amongst national and sub-national biofouling management mandatory and voluntary policies.

The most comprehensive biofouling management policies are those of New Zealand and California. Their policies are both mandatory regimes that have documentary, reporting and verification requirements. Both are consistent with the IMO Biofouling Guidelines and focus on prevention and the implementation of best practice biofouling management in order to minimize biofouling accumulation on ship hulls and niche areas. However, there are differences in approach to achieve the common goal of minimizing the amount of biofouling entering their jurisdictions (**Table 9**).

In part, these differences are a result of a different starting point: New Zealand's requirements are a stand-alone regulatory instrument - the Craft Risk Management Standard, created from scratch specifically to manage biofouling. California's biofouling requirements were retrofitted into the existing Californian ballast water requirements, and hence adapted to the existing arrangements.

Table 9. Comparison of New Zealand and California biofouling management requirements

	New Zealand (NZ)	California
Mandatory requirement	All ships must arrive in NZ with a 'clean hull'. The NZ CRMS defines a clean hull as one that is compliant with thresholds (levels) of biofouling. The thresholds are different for short (less than 3 weeks) and long (more than 3 weeks) stay ships.	Require ships to have implemented and documented biofouling man-agement practices for the hull and niche areas in order to minimize biofouling.
Application	All ships (commercial and recrea-tional)	All ships over 300 gross registered tons or above that carry, or are ca-pable of carrying, ballast water
Documentation requirements	Specific information must be held on board and reported prior to arrival providing evidence that the ship meets the requirements, either: • Cleaned within 30 days prior to arrival or within 24 hours of arrival in NZ, • Demonstrate continual maintenance using best practice, • Apply approved treatments, or • Implement an approved Craft Risk Management Plan.	California has specific requirements for BFMP and BFRB, including that biofouling management must address all niche areas, including (if present): sea chests, sea chest gratings, bow and stern thrusters, bow and stern thruster gratings, fin stabilizers and recesses, out of water support strips, propellers and propeller shafts, and rudders.
Reporting requirements	Ships must provide documentation prior to each arrival in NZ.	Ships must provide an annual report.

Some current biofouling management policies have unique features, such as the recommendation to use an online ship risk assessment (Vessel Check) prior to arrival in Western Australia, or annual hull biofouling inspections as part of ship inspection requirements in the United States.

Other policies recognise the unique environmental qualities of the jurisdiction and have stricter requirements to protect these, such as the Kermadec and Subantarctic Islands of New Zealand, the Galapagos Marine Reserve of Ecuador and the Paphanoumakuakea Marine National Monument in Hawaii.

Several policies and practices are more closely linked to the practice of in-water cleaning (IWC), such as South Africa and Queensland, Australia, which require ships seeking to IWC to provide evidence that biofouling has been managed, through ship-board documentation (BFMP and BFRB) in line with the IMO Biofouling Guidelines.

Two-thirds of current policies focus on documentation in line with the IMO Biofouling Guidelines, either recommending or requiring BFMP and BFRB. Whilst some of these policies do not have specific regulatory requirements, such as Australia and Chile, these recommendations lay the foundation for consistency with the IMO Biofouling Guidelines.

Several policies provide detailed guidance for what to include in BFMP, in particular New Zealand, Western Australia, the New Zealand Kermadec and Subantarctic Islands, and California.

A common feature of policies is a focus on particular species. Many jurisdictions have regulations in place that prohibit the introduction of certain, usually listed, noxious or non-indigenous species. For example, in Australia, each state has a list – for example Western Australia[77] and Queensland[78] - and there are several national[79] lists[80]). Similarly, Brazil's plan focuses on the prevention of introduction of Sun Coral.

This type of species-specific regulation was likely created before the finalization of the IMO Biofouling Guidelines, which recommend preventing biofouling as a whole. Species-specific regulation may not allow for regional or international consistency. It can also potentially limit the effectiveness of a biofouling management policy, as it is not possible to accurately predict the identity of future IAS and their impacts, making a list difficult to create and maintain at all times.

[77] *Department of Primary Industries and Regional Development, 2016.*
[78] *www.qld.gov.au/environment/coasts-waterways/marine-pests.*
[79] *www.marinepests.gov.au/what-we-do/apmpl.*
[80] *www.agriculture.gov.au/biosecurity-trade/policy/environmental/priority-list.*

CHAPTER 3

HULL CLEANING

Hull cleaning and maintenance can take place while the surface is submerged (in-water cleaning) or out of the water.

In-water cleaning (IWC) can be an important part of biofouling management regime for a ship; however, IWC activities vary in effectiveness and the risks they pose to the marine environment.

The potential environmental risks from IWC include:

- Release or escape of IAS from biofouling, and
- Chemical contamination (and potentially microplastics) from coating debris[81].

The importance of hull and niche area cleaning and maintenance during dry docking has long been recognized, with most commercial ships undertaking a dry dock every five years. This aligns with cycles of ship maintenance for other parameters, such as ship safety, regulated by the IMO.

For recreational craft, out of water cleaning and maintenance may occur on a more ad-hoc basis and in locations such as marinas and shipyards with lift facilities. These sometimes suspend the craft over the water, presenting challenges for collection of debris.

Out of water cleaning and maintenance can also pose potential environmental risks if debris removed during the cleaning process is not appropriately contained and disposed of.

Chapter 3 includes:

- International recommendations, requirements and industry standards for hull cleaning (**Section 3.1**), and
- Regional, national and sub-national hull cleaning policies (**Section 3.2**). This includes current and proposed IWC policies (**Section 3.2.1**), an analysis of key features of IWC policies (**Section 3.2.3**) and an overview of out of water hull maintenance policies (**Section 3.2.4**).

3.1 INTERNATIONAL GUIDANCE, REQUIREMENTS AND INDUSTRY STANDARDS FOR HULL CLEANING

The **IMO Biofouling Guidelines** recognise IWC and out of water cleaning (OWC) and maintenance as important parts of biofouling management, acknowledging also that IWC can introduce different degrees of environmental risk, depending on the level of biofouling, the amount or type of AFS, and the biocidal content of the AFS.

In addition to the IMO Biofouling Guidelines, the **IMO Biofouling Guidance for Recreational Craft** recognizes the importance of IWC in managing light fouling (microfouling) with gentle techniques, whilst also acknowledging the need to check with local authorities for IWC regulations.

Despite these IMO instruments, there is **not currently an internationally agreed standard for how to conduct IWC** (for example, the level of filtration or collection of debris) or **what level of biofouling, if any, should remain after IWC**.

However, guidance in relation to IWC and OWC can be find in other IMO's instruments and in several industry standards.

The **London Convention and Protocol** is relevant to IWC and OWC, as States implementing the Convention and Protocol are required to ensure that all dumping of wastes into the marine environment, except of listed acceptable wastes, is prohibited. The Convention and Protocol therefore prohibit the release into the sea of biofouling, AFS debris and residue removed from the ship hull and niche areas during IWC and OWC.

The **AFS Convention** is relevant for both IWC and OWC. States implementing the Convention do not allow the application of AFS containing tributyltin (TBT), and Cybutryne will soon also be prohibited. Some authorities also prohibit the IWC of hulls coated with TBT. In 2021, the BIMCO released the first version of its Industry standard on IWC with capture and Approval procedure for IWC companies. These documents provide a standard for the amount of biofouling that should be removed during IWC

[81] *Scianni and Georgiades, 2019, Tamburri et al., 2020.*

(90%) and the quantity of debris that should be captured (90%) and filtered (through a 10-micron filter).

The **BIMCO** standard and procedure do not require IWC systems to be tested to ensure they do not significantly elevate levels of dissolved or particulate biocides found in the AFS. This may be tested under the procedure, but is not a criterion for approval.

The **INTERTANKO** Guide provides recommendations to shipowners and operators for all aspects of hull management. This includes pre-dry docking and dry-docking activities, as well as hull performance monitoring. The Guide recommends setting a performance goal for AFS for the period between dry docking, including that surfaces to which the AFS is applied should:

- Remain free from macrofouling,
- Accumulate microfouling only after 3 years, and
- Require IWC of microfouling only, on up to 2 occasions during the period between dry dock

The INTERTANKO Guide includes that IWC is an inevitable part of modern hull management, and notes that IWC of macrofouling presents a greater risk of IAS dispersal than IWC of microfouling, often also called 'grooming'.

The **IOGP/IPIECA** Guidance for the oil and gas industry does not recommend IWC due to the potential environmental risks. The Guidance provides advice for onshore activities, including washdown sites and maintaining an 'anti-IAS' regime.

Several **ISO standards** are relevant for OWC in relation to the application of the AFS Convention, whilst there are also ISO standards that are relevant for the environmental management of dry- docking facilities, including waste removal and disposal. For example, Drydocks World in Dubai has, amongst its **certifications**, approval by Lloyds Register to ISO Standard **9001** (Quality management systems – requirements)[82]. This standard is not specific to environmental management systems. However, it does specify requirements for quality management systems for an organization to meet applicable statutory and regulatory requirements.

ISO Standard **14001** (Environmental management systems – requirements with guidance for use)[83] which specifies the requirements for an environmental system for an organization to enhance its environmental performance, may also be relevant to facilities offering OWC services.

The above information is detailed in **Table 10**.

[82] *International Standards Organization, 2015a.*
[83] *International Standards Organization, 2015b.*

Table 10. International guidance, requirements and industry standards and relating to hull cleaning

	Recommendation or Requirement	Considerations for IWC Activities	Considerations for OWC Activities
IMO **IMO Biofouling Guidelines**[84] It should be noted that the review of the IMO Biofouling Guidelines includes specific recommendations relating to IWC (see **Case Study 1**, page 20).	The IMO Biofouling Guidelines include voluntary guidance on AFS installation and maintenance, including OWC, in-water inspection of ships, IWC and in-water maintenance. For the purposes of IWC, the Guidelines distinguish between macrofouling and microfouling. IWC of microfouling when practical is recommended using soft methods to prevent accumulation of macrofouling, minimize degradation of the AFS and/or biocide release.	Guidelines recommend Member States conduct a risk assessment to evaluate the risk of IWC activities. Risk factors to consider include biological risks, factors that may influence biofouling accumulation, geographical area that was the source of biofouling on the ship and toxic effects related to substances within the AFS. IWC providers should use appropriate technology to minimize the release of both anti-fouling coating and viable adult, juvenile or reproductive stages of macrofouling organisms, including disposing of collected material appropriately. Cleaning techniques should minimize biocide release (where applicable). Recommends regular polishing of uncoated propellers will minimize macrofouling accumulation. During regular propeller polishing, sea chests and other niche areas should be inspected for macrofouling. Recommends regular monitoring of internal seawater cooling systems and treatment, where applicable.	The Guidelines include that ship maintenance and recycling facilities should adopt measures, consistent with local requirements, to ensure viable biofouling organisms or chemical and physical pollutants are not released into the aquatic environment. Advice is also provided on specific management of niche areas during OWC as well as considerations for the selection of the AFS.

[84] *International Maritime Organization, 2011a.*

Table 10. International guidance, requirements and industry standards and relating to hull cleaning continued...

	Recommendation or Requirement	Considerations for IWC Activities	Considerations for OWC Activities
IMO **IMO Biofouling Guidance for Recreational Craft**[85]	The Guidance notes that it is always preferable to clean the hull and niche areas out of water. The Guidance includes that IWC may be suitable for removing light fouling (microfouling) with gentle techniques. Scrubbing of craft in-water is not recommended.	Operators should check with local authorities for regulations regarding IWC and/or the discharge of chemicals into the water, prior to any IWC activities. Consideration should be given to coordinating cleaning and/or maintenance of the AFS, hull and niche areas with voyage or trip planning to ensure that the craft starts significant journeys as clean as practical.	The Guidance recommends hauling craft out of the water to OWC at least once per year. Methods that capture biological, chemical and physical debris are recommended. OWC should follow AFS manufacturer's instructions for application and maintenance
IMO **London Convention and Protocol**[86] The London Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter 1972 and its 1996 Protocol to the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, otherwise known as the London Convention and Protocol.	The Convention requires Parties to the Convention to take all reasonable steps to prevent pollution of the sea by dumping of wastes and other matter. The Convention was modernized in 1996 in the form of the London Protocol. The London Protocol prohibits all dumping, except for listed acceptable wastes. The protocol entered into force in 2006.	The Protocol is relevant for both IWC and out of water cleaning – any wastes generated during these processes must be captured and disposed of appropriately to avoid non-compliance with the Protocol. Whilst most ports and dry docks have facilities and existing environmental plans and policies for disposal of wastes, IWC does not always occur in these locations, so IWC providers that capture waste must ensure it is able to be stored and ultimately disposed of appropriately.	
IMO **AFS Convention** International Convention on the Control of Harmful Anti-fouling Systems on Ships[87]	The AFS Convention entered into force in 2008 and prohibits the use of harmful organotins in anti-fouling paints used on ships and establishes a mechanism to prevent the potential future use of other harmful substances in anti-fouling systems. Currently, the organotin tributyltin (TBT) is prohibited under the AFS Convention. The use of Cybutryne (also known as Irgirol) in AFS will be prohibited from 1 January 2023.	Some authorities do not allow IWC of surfaces coated with TBT.	Guidelines have been released to support implementation of the AFS Convention (see **Table 2**). Relevant for OWC: 2009[88] Guidelines on best management practices for removal of anti-fouling coatings from ships, including TBT paints, and 2011 Guidelines for inspection of anti-fouling systems on ships[89].

[85] *International Maritime Organization, 2012.*
[86] *International Maritime Organization, 1996.*
[87] *International Maritime Organization, 2001.*
[88] *International Maritime Organization, 2009.*
[89] *International Maritime Organization, 2011.*

	Recommendation or Requirement	Considerations for IWC Activities	Considerations for OWC Activities
BIMCO Industry standard on in-water cleaning with capture[90] And Approval procedure for in-water cleaning companies[91]	In February 2021, BIMCO published the first version of its industry standard and approval procedure for in-water cleaning of ships. The approval procedure outlines minimum requirements on approving IWC providers. It includes testing verified by accredited laboratories and certification through an independent approval body (note that the accredited laboratories and independent approval body are not specified). The standard and approval procedure are now being tested by industry participants with a view to revising the documents as needed.	The standard for IWC with capture includes that the IWC process must: • Remove at least 90% of macrofouling, • Separate and/or treat captured materials so that at least 90% of material is removed from the seawater and at least 95% of particulate material in effluent water is less than 10 microns in equivalent spherical diameter (i.e., a 10-micron filter must be used), • Not elevate local water quality parameters of total suspended solids above ambient levels. IWC systems may also be tested to ensure they do not significantly elevate levels of dissolved or particulate biocides found in the AFS (e.g., copper and zinc) above ambient levels, however this is not a condition of approval. The results of this testing may be displayed on an approval certificate so that local authorities can determine the suitability of the system for use. The approval procedure also allows for cleaning of macrofouling beyond the tested capability of the IWC system if niche areas contain soft or hard macrofouling provided the total area of the fouled hull and niche areas does not cover more than 5% of the submerged area of the hull.	
INTERTANKO Guide to Modern Anti-fouling Systems and Biofouling Management[92]	Provides guidance on hull cleaning to shipowners and operators. • The Guide notes that in-water cleaning is an inevitable part of modern hull management and includes advice on in-water cleaning different types of coatings. • The Guide recommends continuous hull monitoring of the AFS performance, including diver surveys during propellor polishing events, IWC as needed, and monitoring performance, for example using the International Standards Organization's Standard ISO 19030 for the Measurement of changes in hull and propeller performance[93].	The Guide separates in-water hull grooming, or the removal of microfouling, and in-water hull cleaning, the removal of macrofouling, noting the latter presents a greater risk of IAS dispersal. A case-by-case approach to selection of IWC methods is recommended to minimize damage to the anti-fouling coating and achieve the goals of the IWC activity from the shipowner's perspective. Development of location-based fouling risk assessments are recommended to inform the location and timing for IWC activities.	Guidance on pre-docking activities, which should aim to identify the performance of the AFS applied at last dry-dock. From this, the shipowner/operator can develop specific aims for the intended performance of the AFS for the period between this dry dock and the next, including that the hull should be free from macrofouling, microfouling showing only after (3) years, and the hull only requiring (2) IWC of microfouling events. The guide provides advice for activities during dry docking, including determining which standard (ISO 8501-1[94]) which should be applied to assess blasting performance.

[90] *BIMCO and International Chamber of Shipping, 2021a.*
[91] *BIMCO, 2021b.*
[92] *INTERTANKO, 2016.*
[93] *International Standards Organization, 2016.*
[94] *International Standards Organization, 2007.*

Table 10. International guidance, requirements and industry standards and relating to hull cleaning continued...

	Recommendation or Requirement	Considerations for IWC Activities	Considerations for OWC Activities
IOGP/IPIECA Alien Invasive Species and the oil and gas industry: Guidance for prevention and management[95]	Guidance is provided on removal of biofouling.	The guidelines do not recommend IWC due to the potential environmental risks associated with contaminants from anti-fouling coatings.	Guidance is provided for onshore activities, including washing down. The guidance recommends treating all vehicles and their movements as potential IAS pathways, and that it is important to maintain an anti-IAS regime at all times. Wash-down in areas that present minimum risk for IAS establishment, such as a sealed tarmac, is recommended. Guidance is also provided for disposal of waste derived from cleaning biofouling off non-permanently submerged structures, such as anchor and chain, ropes, cables etc. Recording of waste disposal is recommended.
ISO **ISO Standards**	As outlined in Table 2, there are ISO standards relevant to the AFS Convention and hull cleaning.		Relevant ISO standards for OWC: ISO 8502-9[96]: used to evaluate residual soluble salt contamination after washing the hull. ISO 8501-1[97]: recommended as a reference to describe blasting performance[98].

[95] *IOGP/IPIECA, 2010.*
[96] *International Standards Organization (ISO), 2020.*
[97] *International Standards Organization (ISO), 2007.*
[98] *INTERTANKO, 2016.*

3.2 HULL CLEANING PROVISIONS

This chapter contains:

- Current national and sub-national in-water cleaning (IWC) provisions, including those that recommend prohibiting, or do not allow, IWC (**Section 3.2.1**),
- Proposed national and sub-national IWC provisions (**Section 3.2.2**),
- An analysis of key features of IWC provisions (**Section 3.2.3**), and
- An overview of out of water (OWC) hull maintenance provisions (**Section 3.2.4**).

3.2.1 CURRENT IN-WATER CLEANING PROVISIONS

There is a lot of variation in the regulation and provisions related to in-water cleaning (IWC).

National (**Table 11**) and sub-national (**Table 12**) IWC provisions contain recommendations and requirements that differ based on:

- The type of fouling (e.g. microfouling or macrofouling),
- The type of AFS applied to the hull and niche areas (e.g. ablative, biocidal or non-biocidal coatings),
- The service life of the AFS (within date or expired),
- The submerged area to be cleaned (e.g. hull, propeller or niche areas),
- Whether waste must be handled in a particular way,
- Whether IWC providers require approval to operate and if so, whether independent verification of the IWC method is required to demonstrate it can meet specified standards,
- Whether each IWC activity requires permission, and if so, what conditions are placed on each activity, and
- The types of evidence must be collected and kept to verify IWC activities are undertaken in line with the policy.

Many provisions acknowledge the potential risk of IWC activities for their potential biological (from released biofouling) and contaminant (from released particulate or dissolved AFS) risks. As discussed in **Section 2.3**, some authorities have general policies in place to restrict the introduction of IAS into their aquatic environments.

Similarly, many authorities have water quality regulations or guidelines that limit the types and quantities of contaminants and substances that may be present in the aquatic environment. For example, in Australia **Water Quality Guidelines** provide default guideline water quality values, although many jurisdictions have derived their own local guideline values for physical and chemical stressors.

These guidelines and regulations influence IWC decision makers, who should consider the risk of physical and chemical contamination of the aquatic environment from IWC.

Table 11. Current national IWC provisions

Country	IWC provisions	Considerations for IWC Activities
Australia Anti-fouling and in-water cleaning guidelines[99]	Australia's voluntary guidelines provide best practice approaches to applying, maintaining, removing and disposing of anti-fouling coatings and managing biofouling and IAS on ships and moveable structures in Australia and New Zealand. Included is guidance on shore-based application, maintenance, removal and disposal of anti-fouling coatings; IWC and maintenance, including sources of contamination and biological risk and recommendations for decision makers; a decision support tool for IWC; information on types of coatings and IWC technologies, and images of microfouling and macrofouling. Jurisdiction contact points in Australia are provided, noting that the responsible authority for decision making in relation to IWC in Australia is dependent on the proposed IWC location. Australia has also released an IWC standard for public consultation (see **table 14**)	The guidelines intend to assist authorities to decide if IWC operations are appropriate in general and on a case-by-case basis. The guidelines distinguish between cleaning AFS that contain biocides and those that do not. The guidelines also distinguish between cleaning of microfouling and macrofouling, noting that the type of biofouling contributes to the level of biological risk. IWC of macrofouling is not recommended as a substitute for earlier or better biofouling maintenance. IWC is recommended only where: contaminant discharges meet any standards and requirements set by relevant authorities; the anti-fouling coating is suitable for IWC; the anti-fouling coating is within its planned in-service period; the technology used does not harm the coating or result in excessive release of contaminants; the technology used has been independently verified; the technology is capable of capturing debris greater than 50 microns; and disposal of waste is in compliance with relevant waste disposal requirements. Cleaning should only occur in locations with appropriate infrastructure and within relatively contained waters, not near areas of high conservation value. Cleaning should cease if IAS are encountered. Guidance for decision makers includes that: • Microfouling can be removed without the need for full containment of biofouling waste, provided the cleaning method is consistent with the coating manufacturers recommendations, • Macrofouling of subnational (referred to as regional within the guidelines) origin may be removed without need for full containment, • Macrofouling of national (referred to as domestic) origin may be removed without need for full containment, and • Macrofouling of international origin should only be removed using methods that minimize release of all organisms or parts of organisms and anti-fouling coating debris.
Brazil Navy Board of Ports and Coasts: Maritime Authority Rules for the Control of Anti-Fouling Systems on Vessels (NORMAM-23)[100]	The rules largely apply the AFS Convention, however they do also have rules relating to waste generated during IWC.	The dumping of waste that may contain TBT, generated by IWC, into the sea is prohibited. Residues must be collected in ports and shipyards. Collection, transport, storage and final disposal of waste must be the responsibility of a specialized company, licensed by the environmental agency.

[99] *Australian Government, 2015a.*
[100] *Marinha Do Brasil, 2007.*

Country	IWC provisions	Considerations for IWC Activities
Chile General Directorate of the Territory Maritime and Merchant Marine. Circular A-52/007[101]	The circular includes mandatory requirements for IWC.	IWC (hull, rudder and/or propeller) must be approved by the Maritime Authority prior to cleaning. Manual and automatic cleaning systems must meet a performance standard: • Capture rate of 50-60%, with water samples measured 2 meters from cleaning activity and analyzed for turbidity or total suspended solids, • Must not harm AFS or remove substances harmful to the marine environment, and • Use of pressurized water allowed if cleaning microfouling only. It is forbidden to IWC hulls painted with TBT. Cleaning approval depends on level of biofouling (can only clean if less than 50% fouling cover), level of risk of identified fauna and efficiency of capture system. The IWC provider must provide a survey of hull biofouling with their application. Requests for approval must include IWC and maintenance plan for the AFS. IWC provider must use technology appropriate to AFS. IWC providers must deliver a final report including photos and video to the Harbour Master.
Gibraltar Gibraltar Port Authority Handbook 2018-20[102]	The Port Authority Handbook only allows IWC at anchorage.	Location of cleaning should be considered.
Greece Newspaper of the Government of the Hellenic Republic No. 2396[103]	The Newspaper includes diver requirements for underwater work.	IWC providers must have approval to IWC. Applications must include: type of work, location, ship details and materials and tools to be used. Must IWC in specific locations only – exclusively in sea areas/ at moorings, to be determined by the Port Authority. IWC providers must use equipment appropriate to the AFS so as not to peel off hull paints, rust or other hazardous waste materials. The Port Authority may order the activity to stop if the IWC provider does not conform with the requirement to protect the marine environment.

[101] *ARMADA De Chile (Chilean Navy), 2018.*
[102] *Gibraltar Port Authority, 2018.*
[103] *Hellenic Republic, 2019.*

Table 11. Current national IWC provisions continued...

Country	IWC provisions	Considerations for IWC Activities
Malta Environment and Resources Authority (ERA) of Malta: Environmental Conditions for Underwater Cleaning of Maritime Vessels GBR No. 17[104]. ERA Guidance note: underwater cleaning of maritime vessels[105]	The Conditions include mandatory requirements for IWC in Malta. The requirements apply to all ships including yachts greater than 50 meters and fishing vessels greater than 30 meters.	Requires IWC providers to submit a method statement to register to IWC. Registrations are renewed annually if a renewal request submitted. IWC providers must notify the ERA prior to each IWC activity and gain approval. Notifications must include: ship details, proposed works, type of AFS, location, photos of biofouling to be cleaned, AFS certificate, date of last cleaning. Conditions of permission: • Must only clean in approved areas, • Must use method approved as per registration, • Must capture all debris, • No IWC on hulls coated with TBT, • IWC of microfouling on self-polishing paints only allowed if soft sponges used, • No IWC macrofouling on self-polishing paints, • No sanding, stripping, chipping of AFS, and • No AFS paint chips to be released into the sea. Grit blasting with metal particles is prohibited. All waste must be treated as hazardous, contained in sealed drums and collected for disposal by authorized waste carrier. Waste collection is not required for propeller cleaning offshore. IWC providers must cease cleaning if underwater plume or cloud visible. May be required to engage environmental consultant to take samples of marine growth before and after collection. IWC provider may be asked to carry out species identification as well as chemical analyses of fouling removed.
Netherlands Review of the implementation of the IMO's 2011 Biofouling Guidelines in the Netherlands[106]	The Dutch Government (Rijkswaterstaat) issues permits for in-water cleaning operations (hull and propeller cleaning) in about 200 harbours with access to the sea.	It is a condition of permits that biofouling removed is captured and collected on site. The permit is currently only based on physical and chemical parameters and not on the amount and type of IAS present.
New Zealand NZ Ministry of Primary Industries website[107]	The website states that IWC of international ships is not currently allowed in NZ.	

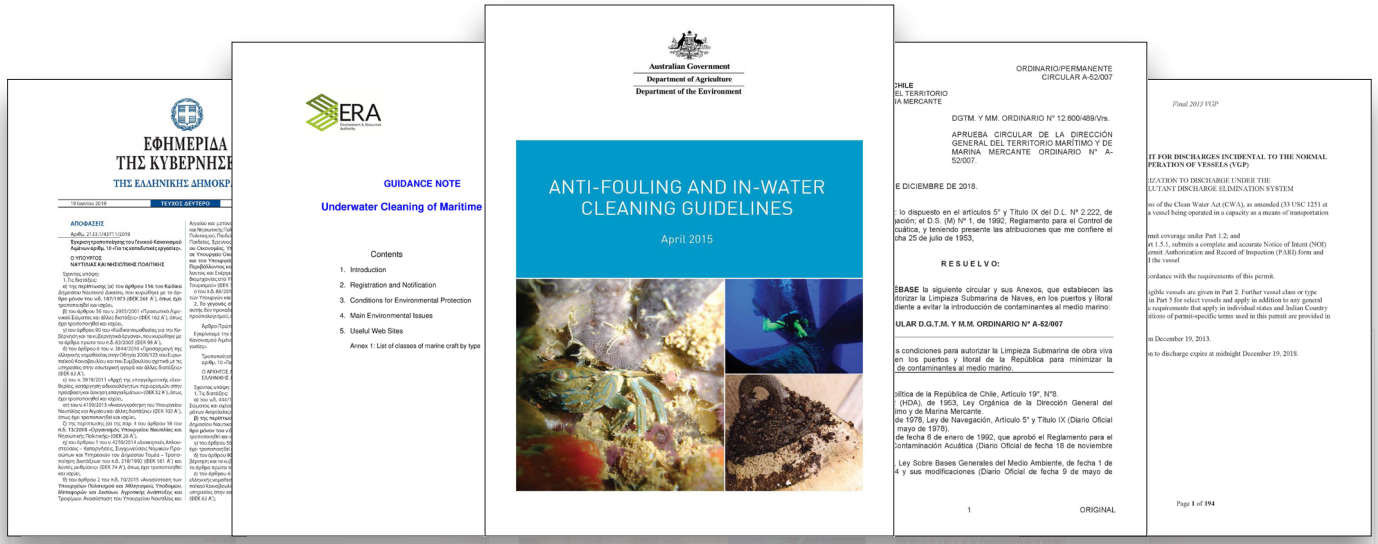
[104] *Environment and Resources Authority of Malta, 2020.*
[105] *Environment and Resources Authority of Malta, date unspecified.*
[106] *Strietman, W.J. and Leemans, E. 2019.*
[107] *www.mpi.govt.nz/import/border-clearance/ships-and-boats-border-clearance/biofouling/biofouling-management/.*

Country	IWC provisions	Considerations for IWC Activities
Singapore Maritime and Port Authority of Singapore (MPA): Port Marine Circular No. 23[108]	The circular states that to IWC in Singapore, the MPA must be notified through the MARINET online system.	The relevant terminal, yard or wharf operator's permission must be sought (noting they may have additional conditions, including specifying the location of IWC). IWC providers must be competent.
South Africa Transnet National Ports Authority (TNPA)[109]: Port Rules Act[110]	The Port Rules Act includes mandatory requirements for IWC for all South African ports.	The Port Rules Act requires IWC providers to apply for a permit. Permits last 3 years. To obtain a permit, IWC providers must demonstrate the efficacy of their cleaning equipment. Independent confirmation that equipment meets the capture requirement (debris greater than 50 microns in diameter is captured) is required from a relevant certification body. IWC permit conditions[111] include: • IWC only in certain port areas, • IWC providers must be suitably qualified and equipment used must be the same as that demonstrated in permit application, • Must submit an environmental management plan for each IWC activity, • Must have a competent, accredited, independent Environmental Practitioner, nominated by the TNPA, to have oversight of IWC activity. The practitioner must take baseline water quality measurements and ongoing monitoring of water and sediment quality, and consider the long-term impacts of loss of debris during IWC and potential contamination from the AFS, and • Must continuously monitor for IAS. For each IWC activity, the IWC provider must submit the ship BFMP in-line with the IMO Biofouling Guidelines and a risk assessment for the IWC activity to the Harbour Master and Department of Environmental Affairs for approval. Must only clean AFS suitable for cleaning. Must not clean AFS that have reached or exceeded their planned in-service period. If cleaning macrofouling, equipment must capture debris greater than 50 microns in diameter. Only non-abrasive cleaning of ablative coatings is allowed. No IWC of ablative coatings with hard encrusted growths (macrofouling). IWC provider must pay for the costs of environmental monitoring undertaken by regulatory authorities. Captured waste must be disposed of in accordance with applicable legislation.

[108] *Maritime and Port Authority of Singapore, 2017*
[109] *www.transnetnationalportsauthority.net/Harbour%20Master%20Authorisations/Pages/Hull-Cleaning-Permit.aspx.*
[110] *Transnet National Ports Authority, 2009.*
[111] *www.transnetnationalportsauthority.net/Legal,%20Risk%20and%20Compliance/NationalPortAct/Documents/ANNEXURE%20D%20Hull%20cleaning%20conditions.pdf.*

Table 11. Current national IWC provisions continued...

Country	IWC provisions	Considerations for IWC Activities
United States 2013 Vessel General Permit[112] The American Bureau of Shipping's Guidance Notes on Biofouling Management Plans[113] describes the current requirements in the US.	Part 4.1.3 of the 2013 Vessel General Permit[112] includes that rigorous hull cleaning should take place in dry dock wherever possible.	Where IWC is undertaken, materials removed should not be allowed to contaminate nearby waters. IWC must employ methods that minimize the discharge of fouling organisms and the anti-fouling coating. Methods might include appropriate brushes or sponges, limiting the use of hard brushes to the removal of hard growth, and the use of vacuum control techniques when available and feasible. IWC should minimize the release of copper-based anti-fouling paints. IWC of surfaces coated with copper must not result in a visible cloud plume. Ships using copper-based paints must not clean in copper-impaired waters within one year of application of the paint. A Notice of Intent is required to be submitted for discharges that include anti-fouling coatings and other discharges relevant to IWC.



[112] *United States Government, 2013.*
[113] *American Bureau of Shipping, 2019.*

Table 12. Current sub-national IWC policies

Sub-National Jurisdic-tion	IWC Provisions	Considerations for IWC Activities
Australia - Queensland Biosecurity Queensland: Recommendations for minimizing biosecurity risk associated with in-water vessel cleaning systems[114]	The recommendations include that IWC should be undertaken in line with the Australian Anti-fouling and in-water cleaning guidelines[115] (Note: The recommendations are not currently available online. A copy may be requested by contacting Biosecurity Queensland[116]).	Prior to IWC a biosecurity risk assessment should be undertaken. Biosecurity Queensland should be notified at least 10 days prior to proposed IWC. Permission should be gained from all relevant authorities (e.g. Environment Department, Marine Park Authorities, Maritime Safety Authority and Port Authority). A pre-cleaning inspection should be undertaken to ensure biofouling is within capabilities of proposed IWC system. Macrofouling of international or unknown origin represents an unacceptable biological risk. Macrofouling can only be cleaned if an independent marine pest inspection demonstrates that no marine pests are on the ship. IWC providers must have an Operational Management Plan with standard operating procedures (e.g. for the maintenance of filters, safety considerations, waste handling and disposal and incident management). If a suspected IAS is encountered during IWC, IWC must cease and report to authorities. Video footage of the pre-inspection and IWC activities should be retained. Queensland Biosecurity Officers may request to inspect the IWC operations and may request that water samples be taken. A report should be submitted to Biosecurity Queensland every 6 months detailing IWC activities to verify they are conducted in line with the recommendations.
	The Queensland Ports of Gladstone, Bundaberg and Rockhampton, under the authority of the Gladstone Ports Corporation (GPC), also manage IWC under the *Contractors and Port Users Safety, Environment and Security Standard*[117].	The standard requires ships wishing to IWC to seek permission a minimum of 28 hours prior to arrival at berth. Under the GPC Standard, requests to IWC must be accompanied by a risk assessment and/or management plan that has identified the environmental hazards and risks associated with the work and the controls that will be implemented to mitigate the risks. IWC is acceptable if there is evidence that the activity meets the Australian Anti-fouling and In-water Cleaning Guidelines[115] and the IWC provider has the appropriate environmental approvals.
Australia – New South Wales (NSW) Marine pests & pesticide plan[118]	The Plan refers to the Australian Anti-fouling and in-water cleaning guidelines[119]	Owners and operators wishing to IWC in NSW should contact the Port Authority and/or the Department of Primary Industries – approval from relevant state authorities is required before IWC activities.

[114] *Biosecurity Queensland, 2020.*
[115] *Australian Government, 2015a.*
[116] *marinepests@daf.qld.gov.au*
[117] *Gladstone Ports Corporation, 2020.*
[118] *Port Authority of New South Wales, 2021.*
[119] *Australian Government, 2015a.*

Table 12. Current sub-national IWC policies continued...

Sub-National Jurisdic-tion	IWC Provisions	Considerations for IWC Activities
Australia – South Australia Code of Practice for vessel and facility management (marine and inland waters)[120]	The code includes that hull cleaning must be performed in dry dock unless extraordinary circumstances prevail. Whilst the code advises regular hull cleaning, it strongly discourages IWC and recommends slipways be used and the wastewater and solids captured for land-based disposal.	The code of practice requires that ship operators must not perform IWC that results in the removal of applied surface coating material (e.g. antifoulant) unless written approval by the South Australian Environment Protection Authority has been granted.
Australia – Western Australia (WA) Department of Primary Industries and Regional Development[121] Guidance Statement: In-water cleaning of vessels in WA[122]	The WA guidance statement outlines recommendations for IWC, noting that ships should be removed from the water for cleaning and maintenance in preference to in-water operations, where operationally practical. All IWC should meet the Australian national guidelines (see above) and address contaminant release risks.	The WA guidance statement requires that the relevant authority must approve the proposed IWC location. Microfouling can be removed regardless of origin without the need for full containment of biofouling waste. Ships with regional biofouling (biofouling originating from within WA) are considered low risk, however exceptions may be applied. Ships with domestic Australian or international biofouling should have their risk assessed using the online Vessel Check[123] tool. Low or acceptable risk ships will generally be considered to present an acceptable level of risk. Uncertain or high-risk ships do not present an acceptable level of risk. Those ships must be inspected for IAS by a suitably qualified expert at least 75 days after departure from an overseas or interstate location and the final report should conclude that no IAS were detected. Information on proposed IWC must be submitted 10 days prior to proposed cleaning. Compliance inspections are conducted. Ships should only be cleaned by IWC systems for which there is high-quality evidence based on independent testing that they're capable of capturing and containing biofouling. Conditions associated with IWC systems are: • The integrity of the anti-fouling coating must remain unaffected by the cleaning system, • All cleaned surfaces are free from visible macrofouling or the fouling has been rendered unviable, • All material greater than 50 microns must be contained, collected and treated, • There is no escape of material in-water or after removal, during and after the cleaning process, and • Collected material is only released back into the marine environment if the system includes a mechanism that effectively renders it non-viable.
	The WA Port of Fremantle also refers to IWC in its Port Information Guide[124].	IWC is prohibited within the port except in extraordinary circumstances. The Fremantle Port Authority has approved a particular IWC provider to operate at several sites in the waters off Fremantle, although each IWC activity must also have Port Authority approval.

[120] *South Australian Environment Protection Authority, 2019.*
[121] *www.fish.wa.gov.au/Sustainability-and-Environment/Aquatic-Biosecurity/Vessels-And-Ports/Pages/In-water-treatment-of-vessels-in-wa.aspx.*
[122] *Department of Primary Industries and Regional Development, 2017b.*
[123] *www.fish.wa.gov.au/Sustainability-and-Environment/Aquatic-Biosecrity/Vessels-And-Ports/Pages/Vessel-Check.aspx.*
[124] *Fremantle Port Authority, 2018.*

Sub-National Jurisdic-tion	IWC Provisions	Considerations for IWC Activities
Estonia – Port of Tallinn (Old City Harbour, Saaremaa Harbour, Muuga Harbour, Paldiski South Harbour)	According to the Port of Tallinn website[125], the authority began requiring the collection of residues from IWC from May 2021.	Permission to IWC must be gained from the Vessel Traffic Shift Manager and will only be granted if cleaning residues are collected and not released into the marine environment.
Netherlands – Port of Rotterdam Port Information Guide[126]	The guide contains mandatory requirements for IWC and propeller cleaning.	IWC and propeller cleaning only permitted if the IWC provider has a permit issued by Rijkswaterstaat. Permission from the Harbour Master can be granted for special activities such as cleaning and repairs.
New Zealand – Auckland Auckland Council: Navigating the rules: doing your bit to stop invasive marine pest species[127]	The Auckland Council publication includes requirements for IWC of ships moving domestically within New Zealand waters. These rules do not supersede New Zealand's national prohibition on IWC of international ships in their waters.	Auckland's requirements include that IWC is prohibited within 500 metres of the coastline of the Hauraki Gulf Conservation Islands. When IWC, the cleaning method must not compromise the existing AFS. The AFS must not have exceeded its planned service life. Cleaning technologies must capture debris greater than 50 microns and captured debris must be collected and disposed of appropriately. If unusual or suspected IAS are found during cleaning, cleaning must cease and the IWC provider must notify the Council.
New Zealand – Kermadec Islands and Subantarctic Islands Regional coastal plan: Kermadec and Subantarctic Islands[128]	Offences relating to IWC are included in the plan.	It is an offence to deposit a substance from the scraping and/or cleaning of a ship (whether above or below the water surface) to the foreshore and seabed.
New Zealand – Northland (Ports of Opua and Whangarei) Northland Regional Pest and Marine Pathway Management Plan 2017-2027[129]	The regional plan has rules relating to IWC. The rules relate to offences in the *New Zealand Resource Management Act 1991*[130].	The Act has offences relating to the discharge of contaminants to water; depositing any substance in, on and under any foreshore or seabed; and introducing or plant any marine pest in, on or under any foreshore or seabed.

[125] www.ts.ee/en/port-of-tallinn-fortified-environmental-measures-in-operating-areas/.
[126] Port of Rotterdam, 2021.
[127] Auckland Council, 2021.
[128] Department of Conservation, 2017.
[129] Northland Regional Council, 2018.
[130] New Zealand Government, 1991.

Table 12. Current sub-national IWC policies continued...

Sub-National Jurisdic-tion	IWC Provisions	Considerations for IWC Activities
Sweden – Port of Gothenburg General Port Regulations 2017[131]	IWC is not permitted without a permit from the Port Authority.	Ships that operate only in the North Sea or Baltic Sea and have a hard or non-biocidal AFS may IWC if the work is carried out using an approved method. Other ships must be assessed on a case-by-case and will depend on the AFS, route, IWC method and IWC location. Applications to IWC are made to the Port Authority. Port Authority will grant permissions if the IWC method is approved by the Environmental Management.
United Arab Emirates – Abu Dhabi Ports Vessel Discharge and Maintenance: Guidelines for Owners, Masters and Agents[132]	IWC is only permitted if it is essential to ensuring ship safety and/or maintaining efficient operation to fulfil IMO regulatory requirements.	Permission for IWC must be gained from the Harbour Master, who will determine conditions to be applied to the permit. Permits will normally only be granted if the ship is at anchor and has engaged on voyages within the Arabian Gulf region. IWC alongside in the ports is only permitted in emergencies, for example seawater intakes. Separate permits are required. IWC methods that ensure there is no discharge of AFS and/or organisms should be used, including vacuum technologies.
United States – California Guidance Document for California's Biofouling Management Regulations[133]	The 2017 California Biofouling Regulations[134] do not prohibit IWC in Californian waters.	IWC without capture is regulated under the US EPA Vessel General Permit[135], with additional conditions placed by the California State Water Resources Control Board prohibiting IWC in waters that are already copper-impaired. IWC with capture is regulated by regional water quality control boards under the Federal National Pollutant Discharge Elimination System permitting program. Ship owners/operators must ensure compliance with these requirements.
United States – Washington State Washington State vessel-related biofouling management 6-year strategic plan[136]	Washington State's current IWC requirements are outlined in the strategic plan. IWC is regulated by the Department of Ecology and the Washington Department of Fish and Wildlife.	Both the Department of Ecology and the Washington Department of Fish and Wildlife must be notified prior to IWC. The Department of Natural Resources must also be notified if IWC will be conducted on state-owned aquatic lands.
	Washington State Marina's Clean Marina Washington: Pollution Prevention for Washington State Marinas[137] The Clean Marina publication includes guidance to marina managers in Washington State on regulating IWC.	The guidance recommends that IWC of hulls coated with ablative coatings should be prohibited. Out of water cleaning, where waste can be collected and treated, is recommended. If IWC is conducted, the guidance recommends a 'no visible plume' rule.

[131] *Port of Gothenburg, 2017.*
[132] *Abu Dhabi Ports, 2018.*
[133] *California State Lands Commission, 2017.*
[134] *California State Lands Commission, 2018.*
[135] *United States Government, 2013.*
[136] *Ramboll Environ US Corporation, 2017.*
[137] *Clean Marina Washington (periodically updated).*

In addition to those provisions listed in **Table 11** and **Table 12**, a further:

- 105 IWC provisions were identified that are not publicly available, of these:
  - 90% were sub-national, and
  - 10% were national.

Several publicly available provisions recommend prohibiting, or do not allow, any IWC (**Table 13**).

Table 13. Publicly available IWC provisions that recommend prohibiting, or do not allow, IWC

Location	IWC Policy or Recommendation
Regional - Pacific Secretariat of the Pacific Regional Environment Program: Shipping related introduced marine pests in the Pacific Islands: a regional strategy (SRIMP-Pac)[138]	The strategy, prepared in 2006, provides a template for introduced marine pest legislation for Pacific Island Countries that includes hull scraping and cleaning. The strategy recommends that scraping and cleaning of hulls and other external surfaces of vessels in a way that may result in the introduction of IAS should be prohibited, and that offences, such as fines, should be associated with non-compliance.
National - New Zealand Ministry of Primary Industries website[139]	The New Zealand Ministry of Primary Industries website states that IWC of international ships is not currently allowed in NZ.
Sub-National – Australia – State of Victoria Ports Victorian Ports Corporation: *Port Information Guide 4th Edition*[140]	The Victorian ports guide covers activities proposed to be undertaken both above and below the load line. The procedure prohibits cleaning, painting and/or maintenance of any part of the hull below the load line within port waters.

3.2.2 PROPOSED IN-WATER CLEANING POLICIES

Six proposed or intended IWC policies were identified (**Table 14**), of these:

- Two were intended policies (one national, one sub-national) that are not publicly available, and
- Four are publicly available, including:
  - One regional policy – the Baltic Sea, and
  - Three national policies:
    - The proposed Australian IWC Standards,
    - The Canadian draft voluntary guidance for relevant authorities on IWC of vessels, and
    - The United States Vessel Incidental Discharge Act (VIDA).

[138] *Secretariat of the Pacific Regional Environment Program, 2006.*
[139] *www.mpi.govt.nz/import/border-clearance/ships-and-boats-border-clearance/biofouling/biofouling-management*
[140] *Victorian Ports Corporation, 2018.*

Table 14. Intended or proposed IWC policies

	Details of intended or proposed IWC policies
Regional	
Baltic Sea COMPLETE Project: Proposal for a Regional Baltic Biofouling Management Roadmap[141]	The proposal notes that at the point of writing (2021), there was no common understanding of the regulation of IWC and no common basis for granting permission to IWC amongst relevant Baltic Sea countries and ports. The proposal sites a lack of information on IWC technologies, facilities and procedures as the cause of this. The Federal Maritime Hydrographic Agency of Germany's (BSH) Biofouling Management Database[142] aims to provide information on the status and opportunities for IWC in the region. It lists whether IWC is allowed and/or who to contact in many ports in the region. The proposal recommends capturing waste to avoid the spread of IAS and pollution. The size of filtration should be selected to capture viable stages of fouling organisms as well as the commonly found sizes of paint particles. Ten microns are recommended. Waste should be handled on land. Cleaning should target early-stage fouling and avoid extensively developed biofouling. Best practice IWC is described as IWC on abrasion resistant, non-biocidal hard coatings in combination with capture and filtration and subsequent waste treatment and disposal. For IWC biocidal coatings, the proposal recommends pre- and post-cleaning inspections and testing the cleaning tools on a reference area to determine efficacy and ability to collect undissolved paint particles and dissolved biocides. Water samples should be taken and analysed by accredited laboratories pre-and post-cleaning. Reliable and validated reports on the cleaning test on reference areas should be provided. The proposal also includes useful information on the best available techniques for IWC.

[141] *COMPLETE, 2021.*
[142] *Bundesamt Fur Seeschifffahrt Und Hydrographie (BSH) which is the Federal Maritime and Hydrographic Agency of Germany, 2021.*

	Details of intended or proposed IWC policies
National	
Australia Australian in-water cleaning standards: consultation draft – Minimum standards for in-water cleaning of biofouling on vessels in Australian waters[143]	Australia released a consultation draft of the Australian IWC standards in September 2021. The draft specifies minimum requirements for IWC of biofouling from ships in Australian territorial seas (out to 12 nautical miles). The draft includes: • The required outcomes of IWC operations (a capture standard, biosecurity standard and chemical contamination standard) • Requirements for documentation and IWC operators, and • A decision-making framework to determine whether an IWC event meets the standard. The draft distinguishes between cleaning different levels of biofouling, with different standards applying to IWC of microfouling and macrofouling, propeller cleaning or polishing and niche area cleaning. The draft is intended to provide guidance to decision makers to support consistency in regulation of IWC activities across Australia. Ships with microfouling must meet the chemical contamination standard, whilst ships with macrofouling must meet the capture, biosecurity and chemical contamination standards. The capture standard requires at least 99% of debris generated at the cleaning head to be captured and disposed of in accordance with local waste disposal requirements. The biosecurity standard requires that effluent does not contain suspended solids greater than 10 microns. If all biofouling has been previously rendered non-viable, the standard specifies that effluent must not contain biological material greater than 1 millimetre. The chemical contamination standard requires that effluent does not contain toxicants in concentrations that exceed the 95% level of protection for marine water quality default guideline values[144] in Australia. Alternatively, a water quality and sediment testing regime can be used to demonstrate that environmental concentrations of toxicants do not exceed the 95% level of protection. The standards include that IWC equipment has been assessed by an independent organization to determine that the capture, biosecurity and chemical contamination standards are met by the technology and operations. The Australian Government previously commissioned research inform the IWC standards. These include: • Review of minimum viable propagule sizes[145] of key biofouling taxa to assess the potential for release of organisms during IWC and inform the filtration level of the standard, • Collation and evaluation of available information on chemical contaminant risks[146], and • Use of the Marine Antifoulant Model for Predicting Environmental Concentration (MAMPEC) to predict the amount of copper that may be released[147] within key Australian ports under different cleaning scenarios.

[143] *Australian Government, 2021.*
[144] *www.waterquality.gov.au/anz-guidelines/guideline-values/default.*
[145] *www.agriculture.gov.au/sites/default/files/documents/assessment-of-reproductive-propagule-size-for-biofouling-risk-groups.pdf.*
[146] *www.agriculture.gov.au/sites/default/files/documents/chemical-contaminant-risks-associated-with-iwc-of-vessels.pdf.*
[147] *https://cebra.unimelb.edu.au/__data/assets/pdf_file/0009/3457134/in-water-cleaning-final-V3.pdf.*

Table 14. Intended or proposed IWC policies continued...

	Details of intended or proposed IWC policies
Canada Draft voluntary guidance for relevant authorities on in-water cleaning of vessels[148]	Canada's draft guidance includes best practices and suggests that relevant authorities should decide whether IWC providers should operate in their waters, and review requests on a case-by-case basis. The guidance suggests that IWC providers are responsible for any research, testing, verifying, and documenting the IWC technology whilst vessel owners and operators are responsible for arranging under-water inspections and preparing all biofouling documentation. Guidance recommends IWC of microfouling only but recognizes that in some cases, cleaning of macrofouling is needed. The guidance therefore proposes best practices for IWC of both microfouling and macrofouling. • Under the guidance: • All IWC technology should be tested at an approved, certified and audited facility by an independent accreditation body. • Testing should show the method meets all legal requirements in the jurisdiction where IWC is proposed. • Appropriate technology should be used for the coating as per manufacturer's instructions, • Criteria for IWC with capture, including: • Capture build-up dislodged during IWC 50cm from the cleaning unit • System has a separation unit that can filter particles with a diameter of 15 microns, or more • Waste from IWC should be treated to kill any organisms (using UV light, heat or chemicals) – noting separation units that can filter out particles of 2 microns diameter don't need a secondary treatment unit • Remove or neutralize biocides and other contaminants before discharging cleaning waste, and • Monitor its capture performance in real time, using sensors or cameras. Under the guidance, a ship should only be cleaned without capture technology if the biofouling is microfouling or it can be confirmed that the source of the biofouling is local.
United States 2018 Vessel Incidental Discharge Act (VIDA)[149] VIDA establishes a framework for the regulation of discharges incidental to the normal operation of a ship. This includes biofouling. The United States Environmental Protection Agency (EPA) published its Notice of Proposed Rulemaking – Vessel Incidental Discharge National Standards of Performance[150] in the Federal Register for public comment in October 2020.	The proposed rule recommends cleaning at drydock where possible. The proposed rule does not prohibit IWC. Consistent with current VGP requirements, the proposed rule includes that ship hulls and niche areas must be cleaned regularly to minimize biofouling, which is considered industry best practice. Cleaning methods must cause no or minimal damage to the underlying coating, ensuring the coating is not degraded and the release of biocides is minimized. The proposed rule would prohibit IWC of biofouling that exceed a fouling rate of FR-20, except when the fouling is of local origin and the cleaning does not result in substantial removal of a biocidal coating, as indicated by a plume or cloud of paint, or when an IWC and capture system is used that is designed and operated to capture coatings and biofouling organisms, filter biofouling organisms from effluent and minimize the release of biocides. If IWC and capture is used, no waste must be discharged. The proposed rule recommends the use of IWC and capture for removal of local macrofouling. Consistent with current requirements, the proposed rule would only allow IWC of copper-based AFS in copper-impaired waters within the first 365 days following application if IWC and capture was used. The proposed rule would prohibit IWC on any section of biocidal coating shown to have significant deterioration. The proposed rule would also require additional controls for discharges from IWC when ships are operating in federally protected waters.

[148] *Transport Canada, 2021.*
[149] *United States Government, 2018.*
[150] *Environmental Protection Agency, 2020.*

3.2.3 ANALYSIS OF KEY FEATURES OF IWC PROVISIONS

As is evident from the earlier tables, key features of current and proposed national and sub-national biofouling provisions vary greatly in both the features they contain and the level of detail.

Of the 138 identified provisions, 14% reportedly do not allow any IWC. The remainder allow IWC under certain circumstances.

Analysis of all identified IWC provisions (**Figure 2**) indicates that the most common features among IWC provisions include:

- **Each IWC activity requires permission** from at least one relevant authority, included in 37% of policies, and
- **Capture of debris** generated during IWC is required or recommended, included in 28% of policies.

Only nine of the identified provisions specify **capture rates**, and of these, 62% require a capture rate of 90% or higher, whilst 37% require a capture rate of 80%.

These same nine provisions also specify **filtration requirements**, with 62% requiring filters of 50 microns to be used, with 10 and 15 microns specified in other policies. One provisions, the **proposed Canadian IWC guidance,** includes that IWC systems should either:

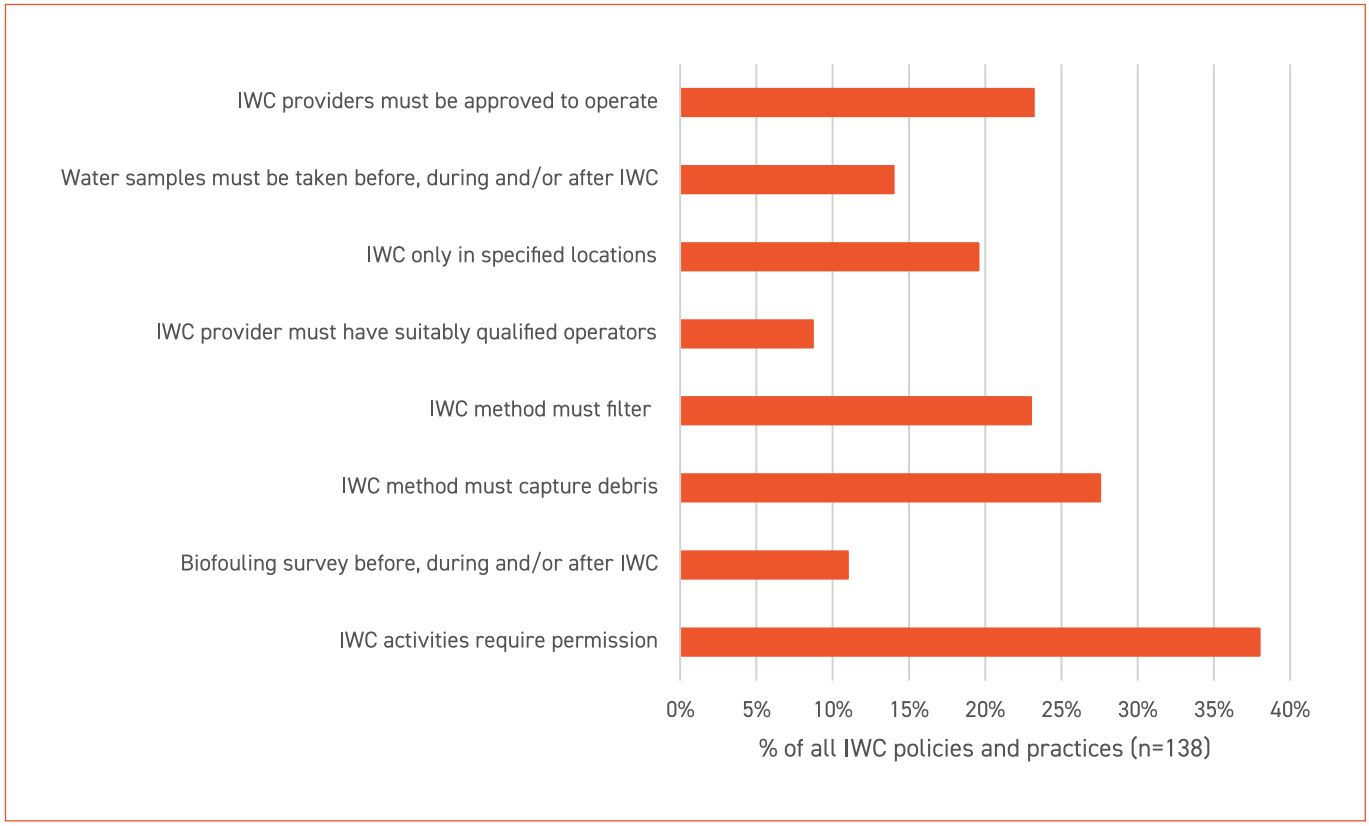
- Filter to 2 microns, or
- Filter to 15 microns and have a waste treatment system to kill organisms (using UV light, heat or chemicals).

The proposed Australian IWC standards include that IWC systems should either:

- Filter to 10 microns, or
- Render biofouling non-viable, then filter to 1 millimetre.

Provisions commonly require or recommend IWC only in specific locations (20% of provisions), whilst recommendations or requirements to take water samples before, during and/or after IWC events are less prevalent (14% of all provisions).

Figure 2. Key features of all identified IWC provisions



IWC providers are required to have **approval to operate** in 23% of all identified provisions.

Of the 29 publicly available provisions, ten (34%) require or recommend independent expert approval of IWC system performance (**Figure 3**). There is no internationally agreed standard for testing and approving IWC systems in relation to their ability to prevent or minimize contamination.

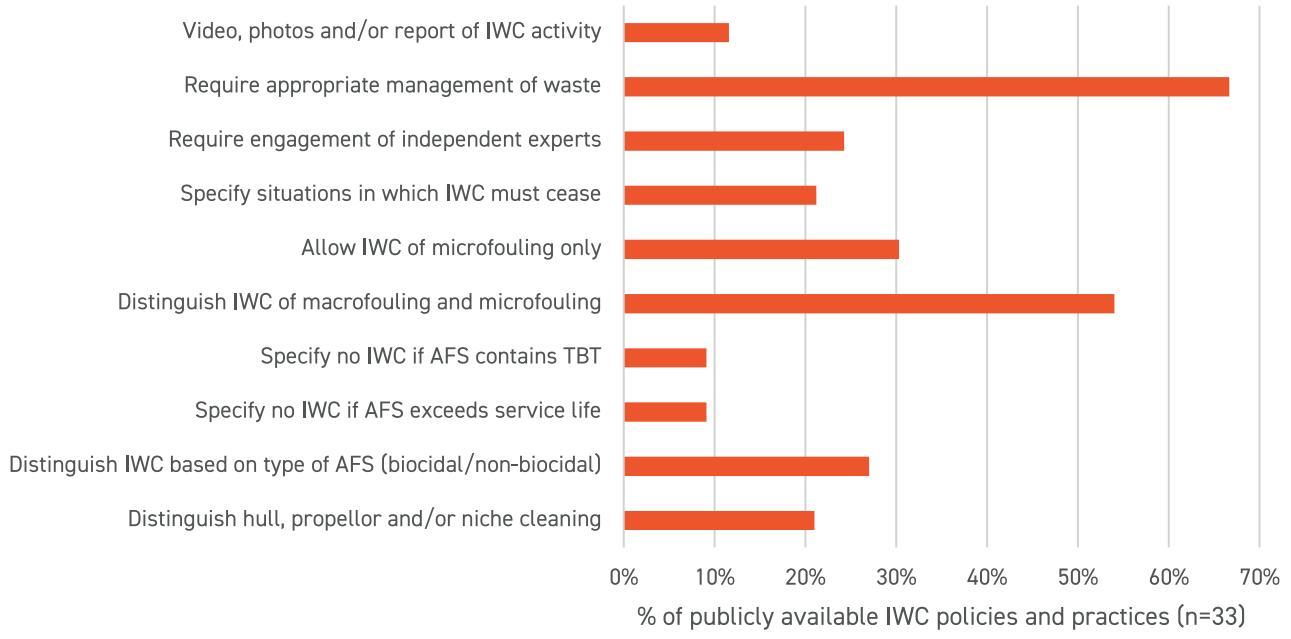
There have been significant efforts to develop testing protocols[151] for IWC systems including a recent **New Zealand Government report**[152] that tested reactive IWC systems against the New Zealand draft biosecurity testing framework[153] and environmental water quality sampling plan[154].

However, of the current publicly available IWC provisions, only the **BIMCO IWC standard and approval procedure** and procedures developed by **Flemish ports for hull and propeller cleaning** (see **Case Study 2**, page 64) provide detailed testing procedures. Whilst the Flemish port procedures are not yet publicly available, the Ports have provided permission for the author to share details of these procedures. **Case Study 2** includes a **summary only** and the ports[155] should be contacted for a copy of the complete procedures.

The Flemish procedures are the only provisions to identify specific independent testing bodies for water sample analysis. All other 9 provisions that require independent expert approval of IWC systems, including the BIMCO standard and approval procedure, do not specify the independent expert or approval body.

This lack of identified available independent experts for IWC system performance testing limits the ability of decision makers to make this a requirement, and therefore limits their confidence in the environmental performance of the IWC systems themselves.

Figure 3. Features of publicly available IWC provisions



[151] *Tamburri, 2020; Tamburri et al., 2021.*
[152] *Ministry for Primary Industries, 2021.*
[153] *Ministry for Primary Industries, 2017.*
[154] *Lewis, 2015.*
[155] *Port of Antwerp: https://www.portofantwerp.com/en/servicedesk; North Sea Port: https://en.northseaport.com/contact-en; Port of Zeebrugge: email - info@portofzeebrugge.be*

CASE STUDY 2.

FLEMISH PORTS HULL CLEANING AND PROPELLER CLEANING PROCEDURES

Under the Flemish Ports Hull Cleaning Procedure, IWC of microfouling is only allowed if the IWC provider has a permit issued by the Flemish Ports. Macrofouling can only be cleaned if the IWC provider has demonstrated in advance, through testing, that the IWC method meets the standard required. IWC providers applying for a permit must demonstrate by testing that their equipment and working methods comply with the standard set by the procedure, and that the marine environment will be protected at all times.

To gain a permit, IWC providers must undertake ex-situ (laboratory) and in-situ testing of their cleaning procedures. Detailed methods are provided for both ex-situ and in-situ testing. A representative from the Flemish Ports must be present during testing. During ex-situ testing, the suction performance is tested and water samples are taken for suspended solids. Water samples must be analysed by an authorised laboratory. The procedure provides a calculation for determining suction performance and acceptance criteria for the test: that there is no visual contamination of the water column and the suction performance is at least 90%.

After successful completion of ex-situ testing, a one-time authorisation is provided to clean a ship's hull in a Flemish Port for the in-situ test. Similar to the ex-situ testing, a port representative must be present for testing. Prior to the in-situ test, a BFMP and/or survey report, and the Material Safety Data Sheet (MSDS) for the AFS, must be supplied. Biofouling must be limited to microfouling. IWC providers must also provide work instructions for the IWC activity and have Harbour Master approval. Various samples must be taken and analysed by an independent authorised laboratory. The suction performance is not tested again during in-situ testing, however any debris that escapes is assessed qualitatively and through water testing. Water samples are analysed for suspended solids, copper, aluminium, nickel, zinc and iron. There is a calculation for filter performance and acceptance criteria for the test:

- There are no spillage (debris) losses – concentrations in the mixed sample may not deviate from baseline concentrations by more than 5%,
- Effluent is sufficiently purified and the filter performance is at least 90%,
- The total performance – the product of the suction performance and the filter performance – must be at least 80%, and
- Work instructions are carried out completely and correctly.

Permits are granted for one year, with an option to apply for an extension of 2 years through completion of in-situ testing again after 12 months.

Once permitted, IWC providers must notify the harbour master prior to each IWC activity. A BFMP and/or survey report must be provided to demonstrate biofouling to be cleaned is microfouling. Operations must be filmed throughout with two cameras attached to the front and rear of the cleaning tool, with images tagged with the date, time, name of ship. Residues from cleaning must be removed and treated in accordance with applicable waste processing regulations.

The Propeller Polishing Procedure is similar to the Hull Cleaning Procedure, in that IWC providers require a permit, based on ex-situ and in-situ testing. Ex-situ testing is required to test the suction and filter performance, and in-situ testing required to test the filter performance. Acceptance criteria for both are provided.

The majority (67%) of publicly available provisions require **appropriate handling of waste** derived from IWC activities. Almost all require that waste is not returned to the aquatic environment unless it is rendered unviable, often referring to local waste disposal requirements.

Of the publicly available provisions, 54% include different recommendations or requirements for IWC based on whether **macrofouling or microfouling** is to be cleaned. 30% of publicly available provisions allow or recommend cleaning of microfouling only.

27% of publicly available provisions include different recommendations or requirements for IWC based on the **type of AFS**, in particular whether the AFS contains biocides or not. Nine percent of provisions do not recommend

IWC if the AFS has exceeded its service life, whilst 9% of provisions prohibit IWC of AFS containing TBT.

Some publicly available policies specify **documentary requirements or recommendations**, such as:

- Surveys of the areas to be cleaned prior to IWC activities to determine biofouling level and/or identify potential IAS (15% of provisions),
- Work instructions and/or environmental plans for IWC activities (10% of provisions), or
- Video and photographic evidence and/or reports of IWC activities (16% of provisions).

In addition, 21% of publicly available provisions explicitly state reasons why IWC should cease immediately, these being either the identification of a potential IAS species and/or observation of a visible plume.

3.2.4 OUT OF WATER HULL MAINTENANCE PROVISIONS

Regulations that apply to the out of water hull and niche area cleaning, and application of AFS whilst a ship is out of water, can be complex. These regulations may involve waste disposal regulations and chemical regulations, as well as legislation designed to implement the AFS Convention for those nations that are signatories.

Waste disposal regulations are often captured at multiple levels, including national environmental legislation on handling of waste, port or dry dock facility legislation that may require waste handling in line with a facility environmental or waste management plan.

For example, in South Africa, a number of national acts apply to port waste management (the Environment Conservation Act 1989, the National Environmental Management Act 198, the National Environmental Management: Waste Act 2008, National Water Act 1998, National Environmental Management: Integrated Coastal Management Act 2008, National Ports Act 2005. In addition to this, the Transnet National Ports Authority Waste Management Strategy and individual port rules also apply[156].

Chemical use in AFS is equally complex. In the EU, **Cybutryne was not approved as an active substance for use in biocidal products** in 2016. This decision was made with regard to Regulation (EU) No 528/2012 of the European Parliament and Council 2012, which concerns the making available on the market and use of biocidal products[157].

A survey of coatings industry stakeholders yielded only five responses, however still provided useful information, in particular that, in addition to the EU, **Cybutryne is also already regulated in the United States**. As previously mentioned, Cybutryne has now also been added to the AFS Convention, and will be prohibited for use in AFS in countries that are Party to the AFS Convention from 1 January 2023.

In Australia, the sale and supply of anti-fouling paints is regulated by the Australian Pesticides and Veterinary Medicines Authority (APVMA). The APVMA requires that anti-fouling paints contain approved active constituent/s and assess anti-fouling paints for registration based on the chemistry and manufacture of the product, efficacy of the product, human safety and the environment[158].

In Canada, the AFS Convention is applied through the Canada Shipping Act 2021 and the Vessel Pollution and Dangerous Chemicals Regulations. The Canadian Pest Management Regulatory Agency maintains a list of currently registered anti-fouling paints that may be imported, sold or used in Canada[159].

Whilst only 26% of the 79 ports and governments survey respondents indicated that they had out of water hull cleaning provisions, it is assumed that this is because the majority of respondents work in areas specific to shipping or IAS, and are not necessarily across legislation that implements waste and/or chemical use requirements.

Many dry dock facilities are privately owned and as such have a range of management systems and policies in place to ensure compliance with local environmental regulations, such as Quality Management Systems in accordance with ISO Standard 9001 and/or Environmental, Sustainability and Governance (ESG) policies, which are fast becoming necessary for businesses to demonstrate their commitment to environmentally sound practices and hence be more favourably viewed as an investment or business entity.

For example, Hyundai Heavy Industries Ulsan Shipyard in South Korea included in its **2021 Integrated Report**[160] that it has formed an ESG organization in an effort to strengthen company-wide ESG management, in line with the accelerating global ESG management trend and an investment paradigm shift towards ESG.

As part of quality management systems and ESG policies, it can be assumed that most out of water hull maintenance facilities have policies relating to waste management. This is reinforced by results from the survey, in which 86% of ports, shipyards and government stakeholders (of the 22 that indicated they had out of water cleaning policies) **require the capture and appropriate disposal of material dislodged during hull cleaning**.

[156] *Naidoo, 2015.*
[157] *Official Journal of the European Union, 2016.*
[158] *Australian Pesticides and Veterinary Medicines Authority, 2020.*
[159] *Government of Canada, 2020.*
[160] *Korea Shipbuilding and Offshore Engineering, 2021.*

CHAPTER 4

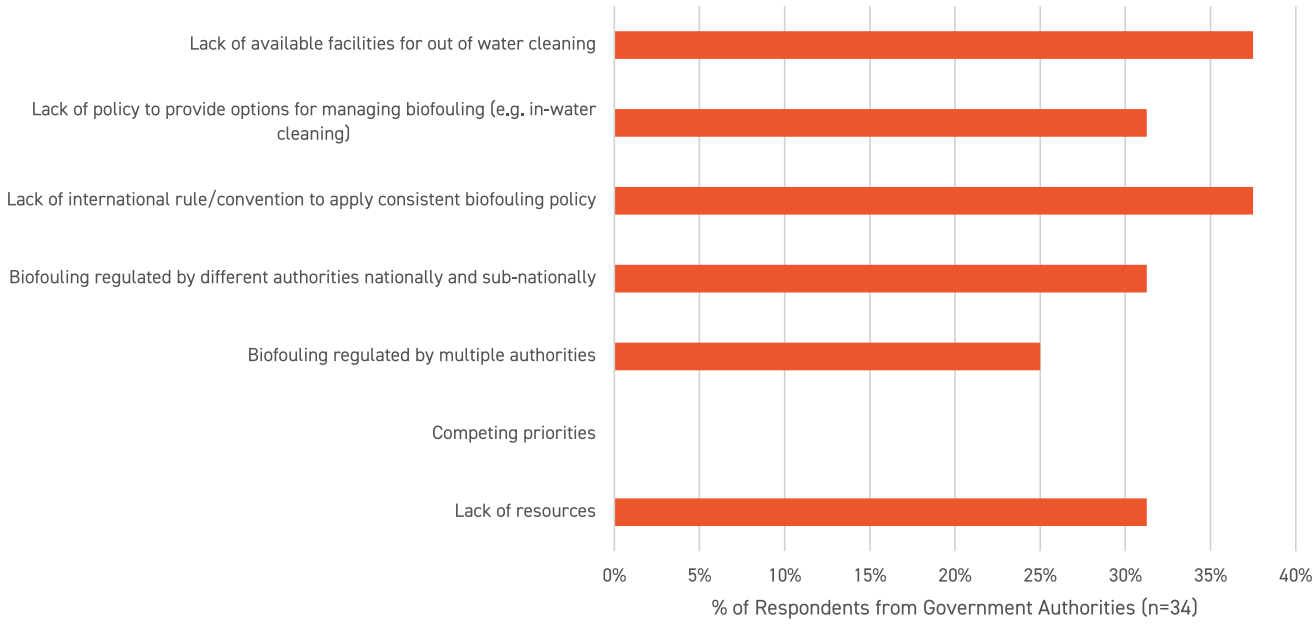
BARRIERS, CHALLENGES AND IMPACTS

Biofouling on ships is recognised internationally (IMO Biofouling Guidelines) as an important means of transferring IAS which, if established in new ecosystems, may pose threats to the environment, human health, property and resources

The IMO Marine Environment Protection Committee (MEPC) requested in 2011 that Member States take urgent action to apply the IMO Biofouling Guidelines in 2011, however only 5 countries (Australia, Chile; New Zealand; South Africa, the United States) and 13 sub-national jurisdictions (the Northern Territory, Queensland, South Australia and Western Australia in Australia; Galapagos Marine Reserve in Ecuador; Auckland, the Kermadec Islands and Subantarctic Islands, and Northland in New Zealand; Port of Gothenburg in Sweden; Abu Dhabi Ports in United Arab Emirates; and California and the Paphanoumakuakea Marine National Monument (Hawaii) in the United States) have implemented biofouling management related policies.

This lack of implementation of biofouling management policy suggests there are barriers that governments face when attempting to implement effective biofouling management policy.

Figure 4. Barriers to implementing biofouling policy for government authorities



Submissions to the review of the IMO Biofouling Guidelines[161] identified a number of impediments to implementation. Many of the issues identified, relating to the lack of detail in the Guidelines, should be addressed in the subsequent revision of the Guidelines.

However, **other barriers and challenges exist that cannot necessarily be solved by the revision of the Guidelines**, including the:

- Non-mandatory nature of the guidelines leading to variation in biofouling management policy and practices (**Section 4.1**),
- **Lack of agreed international standard for IWC and a lack of available facilities for IWC** leading to variation in IWC policies and practices and uncertainty for the shipping industry as to what the rules are for IWC in ports they visit, if it is allowed at all (**Section 4.2**), and
- Variable performance of AFS and uncertainty in the effectiveness of AFS over time in minimizing biofouling to comply with biofouling management policies and practices (**Section 4.3**).

Other barriers to implementing biofouling policy were also identified by government authority stakeholders, such as complex arrangements between national and sub-national authorities for the regulation of IAS and biofouling, and a lack of resources to implement biofouling policy or practice (**Figure 4**).

4.1 NON-MANDATORY NATURE OF THE IMO BIOFOULING GUIDELINES

The **non-mandatory nature** of the Guidelines was identified as a barrier to the implementation of biofouling management policy in several IMO submissions.

A submission by Australia, Finland, Japan, Netherlands, New Zealand, Norway and IMarEST[162] to the review of the IMO Biofouling Guidelines in 2020 noted that the non-mandatory nature of the Guidelines has contributed to the lack of adoption of pro-active, preventative practices, and is likely a factor in why ships have not developed and implemented Biofouling Management Plan.

An ICES ad hoc report, included with an ICES submission to the review of the Guidelines[163], also stated that reliance on self-management with limited oversight and enforcement is insufficient for the biofouling vector's control.

An international rule or convention was proposed by the Islamic Republic of Iran in a submission to MEPC in 2018[164], noting that even full implementation of the Ballast Water Management Convention is not sufficient to protect aquatic ecosystems from IAS.

In addition, Finland included, in a **proposal** for the update of the Baltic Sea Action Plan, the expectation that after the revision of the IMO Biofouling Guidelines, work towards an international biofouling convention would begin. The proposal includes that an equal level of mandatory measures to the Ballast Water Management Convention should be established for preventing the spread of harmful aquatic organisms via hull fouling[165].

Of the 16 government authorities surveyed that identified barriers to implementing biofouling management policy, 38% said that a **lack of international rule or convention** to apply consistent biofouling policy was a barrier to biofouling management policy implementation (**Figure 4**).

The review and subsequent update of the IMO Biofouling Guidelines will provide guidance that is more specific, easier to understand, and fills critical gaps. However, some issues will remain particularly for nations or sub-national locations seeking to implement mandatory biofouling requirements.

Without an overarching international rule or convention, inconsistencies, identified in **Section 2.3**, will continue to occur in relation to the nature of the mandatory requirement, documentary and reporting requirements, and compliance and enforcement activities.

Challenges and impacts for the shipping industry in complying with current biofouling policies and practices also suggest that there is a need for greater international consistency, which could be provided by an international rule or convention on biofouling. Twenty five percent of shipowners and operators surveyed identified a **lack of consistency** in biofouling policy was as a challenge to complying with existing biofouling requirements (25%).

4.2 IN-WATER CLEANING

Significant variation exists between current in-water cleaning (IWC) policies and practices (**Section 3.2.1**). This variation suggests that authorities attempting to regulate IWC activities are doing so with differing sources of information and potentially different appetites for risk.

The challenges associated with IWC were identified as barriers to the implementation of biofouling policy submissions to the IMO Biofouling Guidelines review (see Case Study 1, page 20)[166] and were identified by government stakeholders surveyed (**Figure 4**).

[161] *International Maritime Organization, 2020b and 2020c.*
[162] *International Maritime Organization, 2020b.*
[163] *International Maritime Organization, 2020c.*
[164] *International Maritime Organization, 2018.*
[165] *Baltic Marine Environment Protection Commission, 2019.*
[166] *International Maritime Organization, 2020a.*

Whilst a large number of authorities at sub-national and national levels have implemented some form of IWC policy or practice, the inconsistency in these IWC policies and practices suggests that barriers exist to implementing IWC policy or practice that effectively mitigates the environmental risks associated with IWC.

The majority of IWC policies that attempt to mitigate environmental risks are not comprehensive. For example, **the majority of policies that require independent verification of IWC systems do not indicate who or what independent experts are approved for this purpose**. Similarly, policies that require certain capture and filtration performance do not, with the exception of the Flemish ports policy, provide how this performance should be tested.

A lack of agreed international standards for ensuring environmental risks associated with IWC are mitigated and IWC systems are tested and approved were identified as being major barriers to the implementation of effective IWC policy or practice.

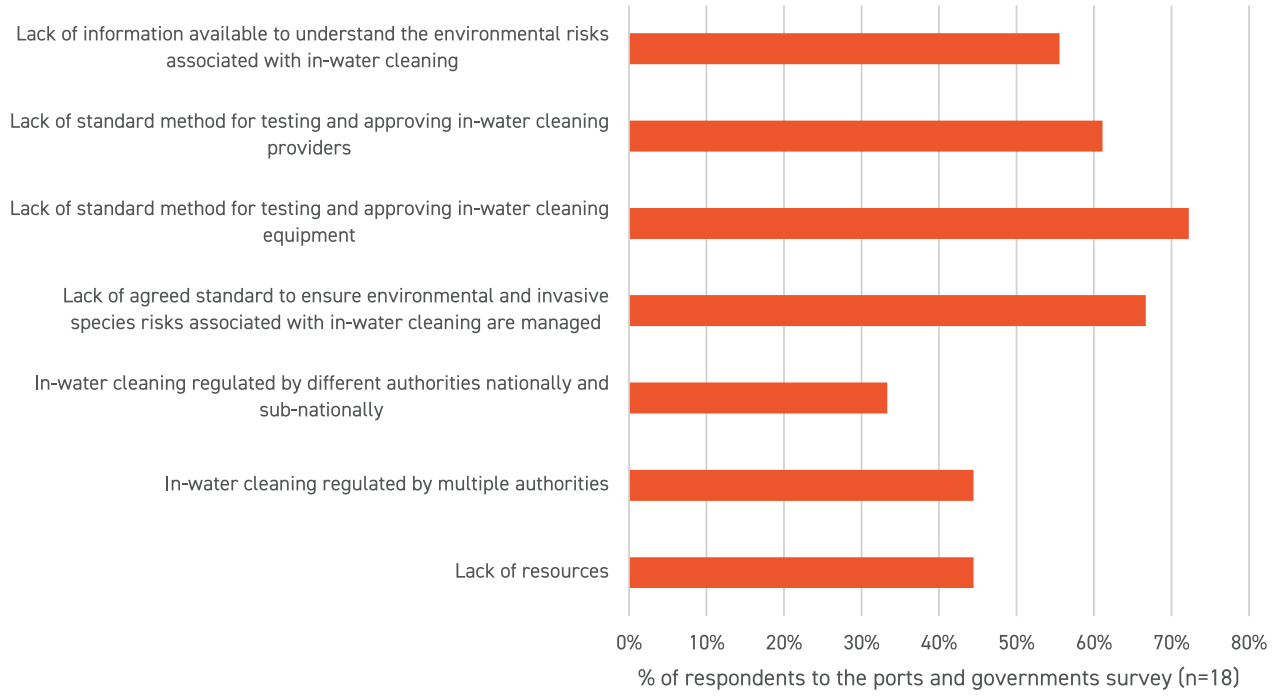
Of the 18 government authorities that identified barriers to implementing IWC policy and practice, 72% identified a **lack of a standard method for testing and approving IWC equipment as** a barrier (**Figure 5**).

67% of government stakeholders identified a **lack of agreed standard to ensure biological and contaminant associated with IWC are managed**, whilst 61% identified a **lack of standard method for testing and approving IWC providers** as barriers to implementing effective IWC policies.

A **lack of information available to understand the environmental risks associated with IWC** was also identified by over half of government stakeholders (56%).

In addition to alleviating some of the barriers to implementing IWC policies for authorities, agreed international standards for ensuring environmental risks

Figure 5. Barriers to the implementation of IWC policies



associated with IWC are mitigated and IWC systems are tested and approved may in turn alleviate challenges for the shipping industry in complying with biofouling policy.

More than a third of the 53 shipowners and operators surveyed identified the **inability to IWC** (39%) and **lack of IWC providers** (38%) as the main challenges they face in complying with biofouling policy (**Figure 6**).

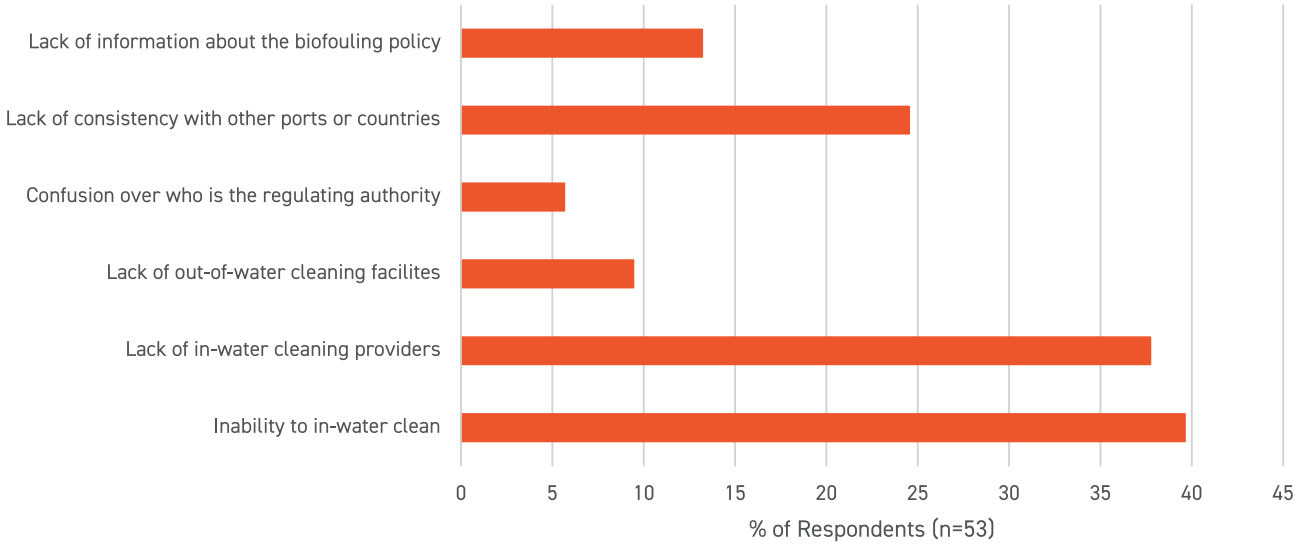
In addition, shipowners and operators identified two main challenges when attempting to comply with in-water cleaning policies: **insufficient or ineffective communication** (33%) and a **lack of consistency with other ports and/or countries** (31%) (**Figure 7**).

Whilst the review of the IMO Biofouling Guidelines will address some of the key issues needed to guide IWC activities, the amendments are unlikely to be sufficient to assist government authorities in facilitating or regulating IWC activities and ensure environmental risks are mitigated.

The amendments will not provide a standard for IWC that should be met, approval procedures for IWC systems or IWC providers that deliver assurance that both biological and contamination risks will be minimized, or identify independent experts capable of undertaking this approval work.

Without these internationally agreed standards, IWC policies risk either being ineffective at mitigating risk, or having the effect that no ships proactively engage in IWC in those jurisdictions. This subsequently impacts on shipowners and operators' ability to execute what is likely to be a key component of their biofouling management regime.

Figure 6. Challenges facing shipowners and operators in complying with biofouling policy



4.3 AFS PERFORMANCE

Guidance on the selection, installation and maintenance of AFS is included in the IMO Biofouling Guidelines, which note that AFS and operational practices are the primary means of biofouling prevention and control for existing ships' submerged surfaces, including the hull and niche areas. However, the Guidelines do not provide performance criteria for AFS.

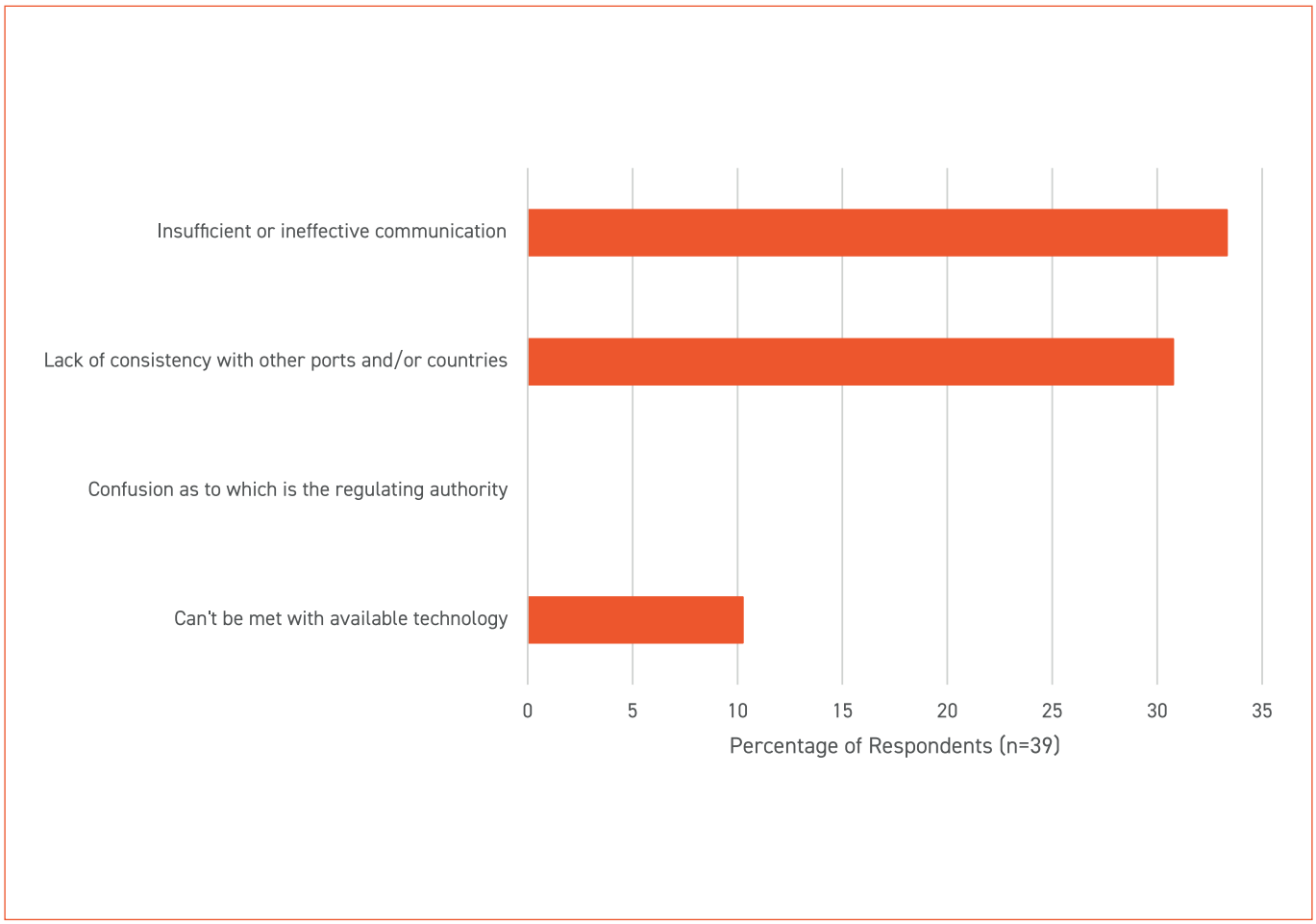
The review of the Guidelines will also not provide detailed technical specifications and technical guidance on AFS, or specifications for AFS performance. This uncertainty in the effectiveness of AFS may result in ships having to carry out more in-water inspections, and potentially also IWC, between dry dockings. This creates a challenge for shipowners and authorities, particularly if the AFS is ineffective over time and macrofouling accumulates on the submerged surfaces.

Shipowners and operators may face higher costs of implementing biofouling management measures such as in-water inspections and cleaning, whilst authorities face the task of making decisions on the environmental risks of IWC macrofouling.

INTERTANKO's guidance recommends that shipowners and operators should specify criteria for AFS performance, including that surfaces to which the AFS is applied should:

- Remain free from macrofouling,
- Accumulate microfouling only after 3 years, and
- Require IWC of microfouling only, on up to 2 occasions during the period between dry dock.

Figure 7. Challenges facing shipowners and operators in complying with IWC policies



4.4 IMPACTS AND BENEFITS OF BIOFOULING AND IWC POLICIES ON INDUSTRY STAKEHOLDERS

The variability in both biofouling and in-water cleaning (IWC) policies and practices, and the barriers and challenges to implementation of biofouling management (**Sections 4.1, 4.2, and 4.3**) mean that existing biofouling and IWC policies and practices are impacting on industry stakeholders.

A benefit of biofouling policy was also identified. 47% of shipowners and operators surveyed indicated they are more likely to implement ship biofouling management practices to minimize biofouling, thereby increasing ship efficiency and reducing the risk of translocation of IAS via biofouling (**Figure 8**).

However, managing biofouling also comes at a cost for industry, with the development and implementation of new documentation (biofouling management plans and record books), in-water inspections and potentially IWC. 43% of shipping industry stakeholders said they faced increased costs to manage biofouling in accordance with biofouling policies and practices (**Figure 9**).

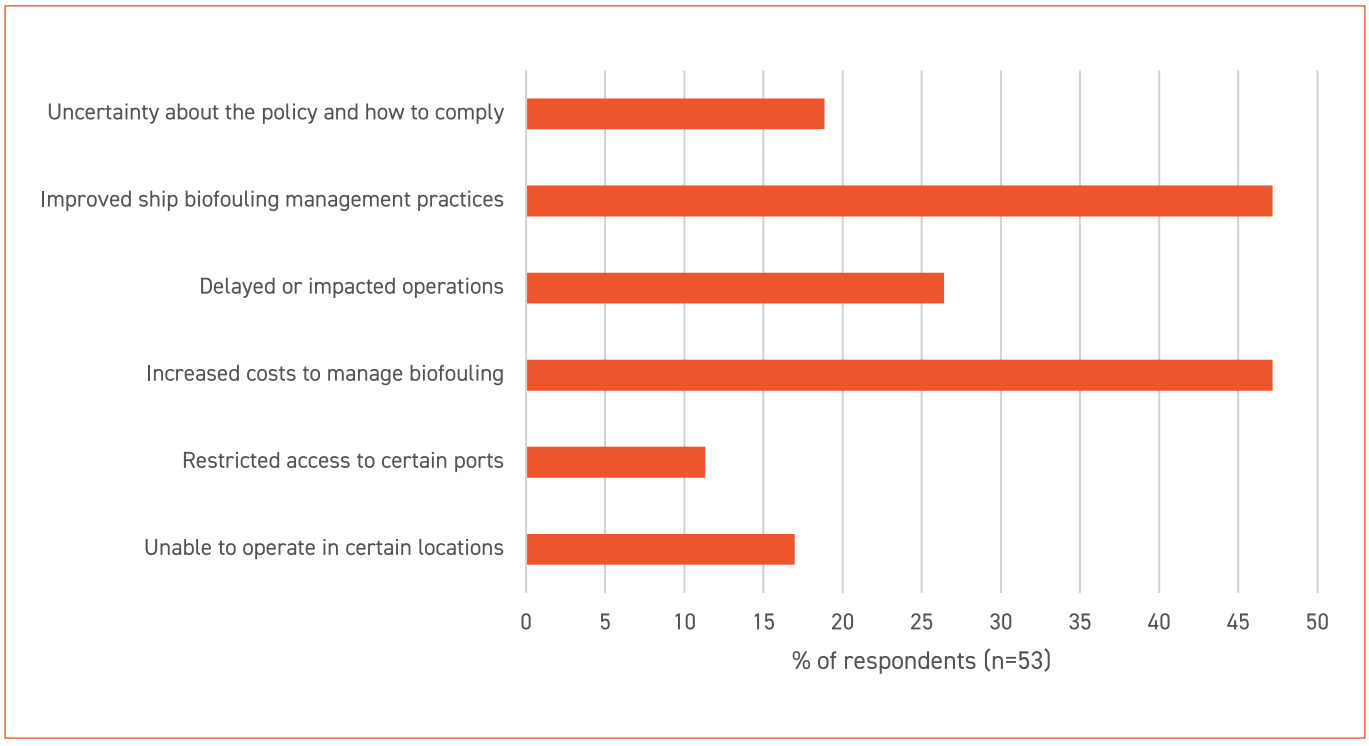
IWC providers also face increased costs to comply with IWC requirements to minimize the environmental risks of IWC. This may mean the need for independent verification of IWC systems, additional sampling and more sophisticated equipment. 45% of IWC providers surveyed identified increased costs to comply with IWC requirements as an impact on their operations (**Figure 10**).

Some shipping industry stakeholders identified having delayed or impacted operations as a result of biofouling management policies. This is possibly linked to the introduction of relatively new mandatory biofouling requirements in places such as New Zealand and California.

A review of implementation of these mandatory biofouling requirements[167] showed that in California, 40% of ships inspected in the period from 1 August 2018 to 31 July 2019 were non-compliant, were issued a 60-day grace period and were flagged for a follow-up inspection. In New Zealand, 17% of ships inspected in the same period failed the inspection. Of these 83 ships, 16 had itineraries restricted and 1 was directed to dry dock.

Biofouling and IWC policies also appear to be limiting the operational areas of some ships and IWC providers. 40% of IWC providers said they were **unwilling or unable to operate in certain areas** due to IWC policies in place, thus limiting the availability of IWC in those locations. In addition, 17% of shipowners and operators said they were unable to operate in certain locations based on biofouling policies in place.

Figure 8. Benefits and impacts of biofouling policies on shipowners and operators.



[167] *Scianni et al., 2021.*

Figure 9. Benefits and impacts of in-water cleaning policies on shipowners and operators

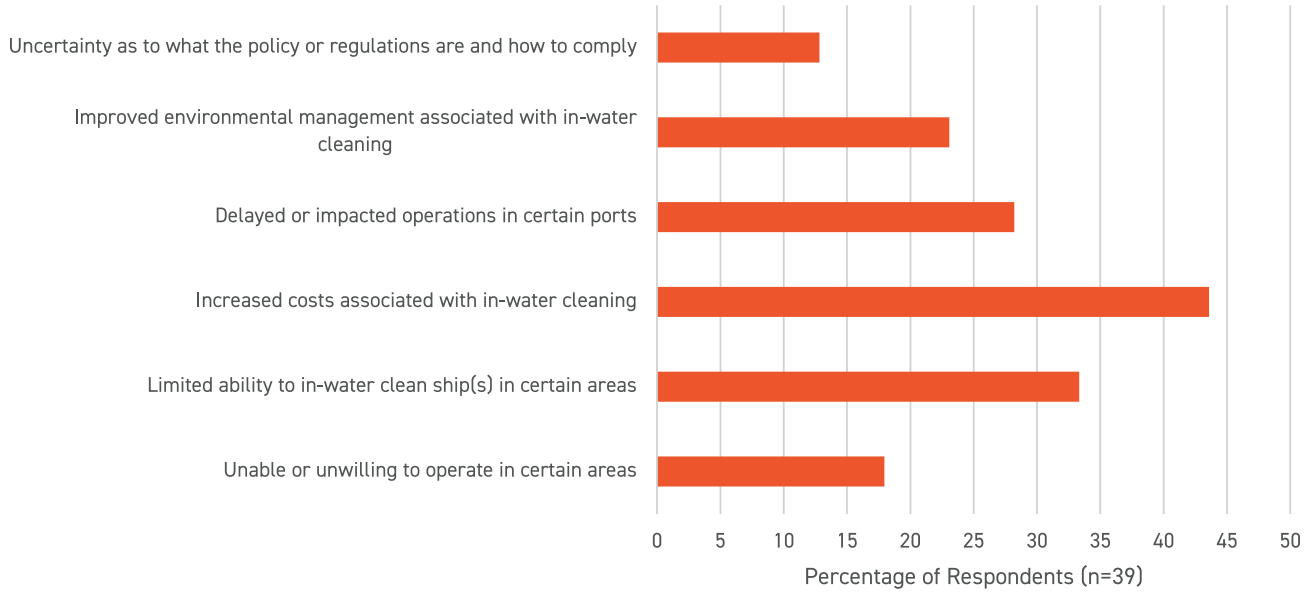
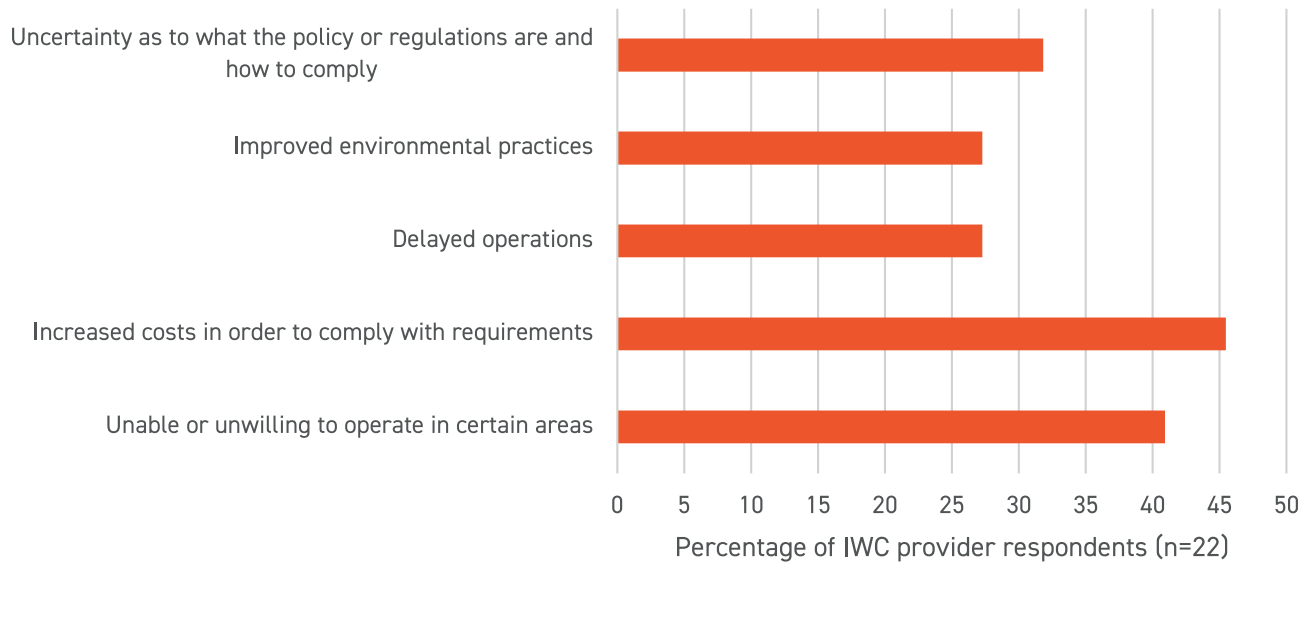


Figure 10. Benefits and impacts of in-water cleaning policies on in-water cleaning providers



CHAPTER 5

CONCLUSION

With 19 regional, national and sub-national biofouling policies and practices already in place, and a further 27 policies intended to be developed in the next five years, it is important that the IMO Biofouling Guidelines provides the best possible global standard for biofouling management policy.

To do so, improvements to the IMO Biofouling Guidelines identified in the process of the review of the Guidelines need to be made in a timely manner. However, as identified in **CHAPTER 4**, there are some barriers to the implementation of effective biofouling management policy that will not be remedied by the review of the Guidelines.

The **non-mandatory nature of the Guidelines** may lead to variation in the nature of mandatory requirements, documentary and reporting requirements, and compliance and enforcement activities. As previously noted by ICES, relying on voluntary self-management with limited oversight and enforcement may be insufficient to reduce the risk of translocation of IAS via biofouling.

Regional collaboration is also an important step to minimize variation between biofouling management policies. The collaboration of Baltic Sea locations to produce the proposed Baltic Sea roadmap for biofouling management provides a good example of working together to achieve regional consistency. Other regions (Mediterranean Sea for example) are also working towards harmonization of action at the regional level. The GloFouling Partnerships Project is active in 5 regions which provides an opportunity to further regional harmonization.

For authorities and industry, a **lack of internationally agreed standard and approval mechanisms for in-water cleaning** (IWC) remains a significant challenge when attempting to implement and comply with biofouling and IWC policies.

This may lead to uncertainty as to whether the environmental risks associated with IWC are being managed. Authorities may implement necessary precautionary approaches in the face of such uncertainty. This can limit the availability of IWC, despite IWC, particularly of microfouling, being recognised as a key tool in the biofouling management toolkit.

Whilst New Zealand and California have provided examples of comprehensive mandatory biofouling management policies, albeit with differences as previously outlined (**Table 5., Section 2.3**), there is not yet publicly available guidance or policy demonstrating what a **comprehensive IWC policy** looks like. The BIMCO IWC standard and approval procedure, Flemish ports procedures and the proposed Australian IWC standards provide the most comprehensive policies identified, however gaps remain, particularly in relation to the identification of independent experts to test and approve IWC methods and/or systems.

A lack of identified independent experts for the approval of IWC methods creates problems implementing IWC policies for the shipping industry, IWC providers and government authorities. The shipping industry do not know which IWC providers have equipment that will meet the standard required in the proposed cleaning location, IWC providers lack certainty on their ability to gain approval and may waste time and money on approval testing only to find their chosen testing expert is not approved by authorities, and authorities cannot necessarily rely on the independent testing results.

An independent, internationally recognized expert group may be the most appropriate solution.

In addition, formation of an IMO accredited **IWC provider representative body**, with criteria for membership including that the IWC provider meets a certain standard of environmental performance in their IWC activities would give IWC providers a unified voice in discussions on IWC, such as those occurring at the IMO in the revision of the IMO Biofouling Guidelines. It is important to ensure conditions applied to IWC activities by authorities reflect the available technology and, in doing so, identify where technological improvements may be needed.

An 'ideal' IWC policy might include many of the components of existing policies for example:

- A requirement for **independent expert approval of IWC methods**, with a list of approved experts provided,
- Risk assessment for each activity, including identification of the level of fouling during an in-water inspection and assessment of the AFS and the suitability of the IWC method,
- An environmental plan for each IWC activity, including how environmental and contamination risks will be mitigated at every step,
- Capture standard, biological standard and a contamination standard (for example those contained in the proposed Australian IWC standards),
- Guidance on when to stop IWC, for example when suspected IAS are observed, when a plume is visible, when damage to the AFS is observed or when IWC equipment malfunctions,
- What steps must be taken if any of these occur, for example monitoring or remediation activities, and who is responsible for these activities,
- Waste disposal requirements, and
- Evidentiary requirements to verify the activity has followed its environmental plan and complied with the policy, including appropriate video, photos and a report.

Whilst IWC requirements are likely to continue to vary, reflecting different governance arrangements as well as the sensitivity of the marine environment in certain locations, there is opportunity for authorities to **improve the transparency of their requirements and decision-making processes**. Identifying areas where there is a lack of information and therefore a precautionary principle is employed would be helpful in determining research and development needs.

Meanwhile, there is further good work being done to **develop standards and testing protocols**, such as the work by Flemish ports, the Proposed Regional Baltic Biofouling Management Roadmap, and in Australia, Canada, New Zealand, the United States[168] and others.

Underlying the need to improve the consistency of biofouling and in-water cleaning policies, is the need to **improve the effectiveness of biofouling management practices** themselves. Whilst coating industry stakeholders indicated that they work with shipowners and operators to improve the performance of AFS, the fact that shipowners and operators identify issues with IWC as their biggest challenge to complying with biofouling policies suggests that the **performance of AFS can be improved**.

Anti-fouling coating suppliers that track the effectiveness of coatings over time will have a substantial database on which to base recommendations for frequency to inspect, and methods to clean AFS, based on different operational profiles of ships. Including this level of detail in a Biofouling Management Plan and recording the outcomes of this in a Biofouling Record Book could lead to substantial improvements over time in the performance of AFS.

In summary, additional measures that may also be needed to complete the international framework and aid policy consistency for biofouling and IWC include:

- Completion of the review of the IMO Biofouling Guidelines to improve their specificity and in-water cleaning guidance,
- Consideration of a mandatory international biofouling rule or convention,
- Development of an internationally agreed IWC performance standard, noting that once an IWC performance standard is agreed, methods for testing IWC system performance should also be developed and agreed, and independent, expert approval bodies for testing IWC systems, should be identified,
- Preparation of a template for a comprehensive IWC policy, and
- Formation of an IMO accredited international representative body for IWC providers.

[168] *Ministry of Primary Industries, 2021; Tamburri, 2020; Tamburri et al., 2020.*

REFERENCES AND USEFUL LINKS

Abu Dhabi Ports, 2018. Vessel discharge and maintenance: guidelines for owners, masters and agents. Available online at: https://www.adports.ae/wp-content/uploads/2013/01/Vessel-Discharge-Issue-2-NRF1.pdf

Agency for Regulation and Control of Biosecurity and Quarantine for Galapagos (Agencia de Regulacion y Control de la Bioseguridad y Cuarentena para Galapagos), 2015. Procedimiento 07: Inspeccion de cascos de embarcaciones. Puerto Ayora, Santa Cruz, Islas Galapagos, Ecuador. Available online at: https://www.abgalapagos.gob.ec/wp-content/uploads/downloads/publico/2020/manual_de_procedimientos_desgloce_2020/P07_INSPECCION_DE_CASCOS_DE_EMBARCACIONES.pdf

ARMADA De Chile (Chilean Navy), 2018. General Directorate of the Territory Maritime and Merchant Marine. Circular A-52/007. Available online at: https://www.directemar.cl/directemar/site/artic/20190111/asocfile/20190111145947/a_52__007_06_12_18.pdf

American Bureau of Shipping, 2019. Guidance notes on biofouling management plans. Available online at: https://ww2.eagle.org/content/dam/eagle/rules-and-guides/current/other/192_bfmp/biofouling-gn-aug-19.pdf

Auckland Council, 2021. Navigating the rules: doing your bit to stop invasive marine pest species. Available online at: https://www.aucklandcouncil.govt.nz/environment/plants-animals/pests-weeds/Documents/biofouling-and-invasive-marine-pest-species.pdf

Australian Government, 2015a. Anti-fouling and in-water cleaning guidelines. Department of Agriculture and the Environment. Available online at: https://www.agriculture.gov.au/sites/default/files/sitecollectiondocuments/animal-plant/pests-diseases/marine-pests/antifouling-consultation/antifouling-guidelines.pdf

Australian Government, 2015b. Biosecurity Act 2015. Available online at: https://www.legislation.gov.au/Details/C2017C00303

Australian Government, 2019. Australian biofouling requirements for international vessel arrivals: Consultation Regulation Impact Statement. Available online at: https://www.agriculture.gov.au/biosecurity/avm/vessels/marine-pest-biosecurity/biofouling/consultation-reg-impact-statement

Australian Government, 2020. Reducing marine pest biosecurity risks through good practice biofouling management. Document No: N-04750-IP1899 A715054. National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA). Available online at: https://www.nopsema.gov.au/assets/Environment-resources/A715054.pdf

Australian Government, 2021. Australian in-water cleaning standards: consultation draft – Minimum standards for in-water cleaning of biofouling on vessels in Australian waters. Available online at: https://haveyoursay.awe.gov.au/in-water-cleaning

Australian Pesticides and Veterinary Medicines Authority, 2020. Anti-fouling paint for use on boat hulls: Guidance document. Available online at: https://apvma.gov.au/sites/default/files/publication/63846-anti-fouling_paint_for_use_on_boat_hulls_guidance_document_march_2020.pdf

BIMCO and International Chamber of Shipping, 2021a. Industry standard on in-water cleaning with capture v1.0. Available online at: https://www.ics-shipping.org/wp-content/uploads/2021/01/Industry-standard-for-inwater-cleaning.pdf

BIMCO and International Chamber of Shipping, 2021b. Approval procedure for in-water cleaning companies. Available online at: https://www.ics-shipping.org/wp-content/uploads/2021/02/Approval-procedure-for-inwater-cleaning.pdf

Baltic Marine Environment Protection Commission, 2019. Work for the harmonized implementation of the IMO Biofouling Guidelines and Guidance documents, and further work toward the International Biofouling Convention by contributing to the work carried out in the International Maritime Organization. Submitted by Finland.

Available online at: https://portal.helcom.fi/workspaces/BSAP%20UP%20NEW%20ACTIONS-183/Shared%20Documents/Synopses%20-%20proposals%20received/Biofouling%20Guidelines%20and%20Guidance%20documents%20and%20further%20work%20toward%20the%20International%20Biofouling%20Convention.pdf

Biosecurity Queensland, 2020. Recommendations for minimizing biosecurity risk associated with in-water vessel cleaning systems. Contact marinepests@daf.qld.gov.au to request a copy.

Brazil Ministry of Environment, 2018. National Plan for the Prevention, Control and Monitoring of Sun Coral in Brazil. Chico Mendes Institute for Biodiversity Conservation. Not available online.

Bundesamt Fur Seeschifffahrt Und Hydrographie (BSH), 2021. COMPLETE database on Biofouling Management. Available online at: https://biofouling-database.bsh.de/

California State Lands Commission, 2017. Guidance Document for: Biofouling Management Regulations to Minimize the Transfer of Nonindigenous Species from Vessels Arriving at California Ports. Available at: https://www.slc.ca.gov/2017/09/ and www.slc.ca.gov/wp-content/uploads/2018/10/4_8_GuidanceDoc.pdf

California State Lands Commission, 2018. Article 4.8. Biofouling Management to Minimize the Transfer of Non-indigenous Species from Vessels Arriving at California Ports. California Code of Regulations. Available online at: https://casetext.com/regulation/california-code-of-regulations/title-2-administration/division-3-state-property-operations/chapter-1-state-lands-commission/article-48-biofouling-management-to-minimize-the-transfer-of-nonindigenous-species-from-vessels-arriving-at-california-ports

Clean Marina Washington (periodically updated). Pollution Prevention for Washington State Marinas. Available online at: https://wsg.washington.edu/marina-handbook

COMPLETE, 2021. Proposal for a Regional Baltic Biofouling Management Roadmap. Developed by the 'Completing management options in the Baltic Sea Region to reduce the risk of invasive species introduction by shipping' Project. Available online at:

https://balticcomplete.com/attachments/article/320/Proposal%20for%20a%20Regional%20Baltic%20Biofouling%20Management%20Roadmap%20COMPLETE%2020210309.pdf

CPPS, 2021. Estrategia Regional Para Prevenir Y Reducir Riesgos Y Efectos De La Introduccion De Especies Exogenas Marinas En El Pacifico Sudeste. Secretaría Ejecutiva del Plan de Acción para la Protección del Medio Marino y Áreas Costeras del Pacífico Sudeste.

Department of Conservation, 2017. Regional coastal plan: Kermadec and Subantarctic Islands. Available online at: https://www.doc.govt.nz/about-us/our-role/managing-conservation/coastal-management/regional-coastal-plan-kermadec-and-subantarctic-islands/

Department of Primary Industries and Regional Development, 2016. Western Australian Prevention List for Introduced Marine Pests. Available online at: http://www.fish.wa.gov.au/Documents/biosecurity/epa_introduced_marine_pests.pdf

Department of Primary Industries and Regional Development, 2017a. Biofouling Biosecurity Policy. Government of Western Australia. Available online at: https://www.fish.wa.gov.au/Documents/biosecurity/biofouling_biosecurity_policy.pdf

Department of Primary Industries and Regional Development, 2017b. Guidance statement: in-water cleaning of vessels in WA. Available online at: http://www.fish.wa.gov.au/Documents/biosecurity/inwater_cleaning_guidance_statement.pdf

Environment and Resources Authority of Malta, 2020. General Binding Rule No.17: Guidance Note – Underwater Cleaning of Maritime Vessels. Available online at: https://era.org.mt/wp-content/uploads/2020/10/GN-17-Hull-Cleaning.pdf

Environment and Resources Authority of Malta, date

unspecified. Guidance note: underwater cleaning of maritime vessels. Available online at: https://era.org.mt/wp-content/uploads/2020/10/GN-17-Hull-Cleaning.pdf

Environmental Protection Agency, 2020. Vessel Incidental Discharge National Standards of Performance. Federal Register – the Daily Journal of the United States Government. Available online at: https://www.federalregister.gov/documents/2020/10/26/2020-22385/vessel-incidental-discharge-national-standards-of-performance

Fremantle Port Authority, 2018. Port Information Guide. Available online at: https://www.fremantleports.com.au/docs/default-source/shipping-docs/port-information-guide-2018.pdf?sfvrsn=5eabd16d_10

Georgiades E. & Kluza, D. 2017. Evidence-Based Decision Making to Underpin the Thresholds in New Zealand's Craft Risk Management Standard: Biofouling on Vessels Arriving to New Zealand. Marine Science and Technology Journal. 51(2): 76-88. Available online at: https://www.researchgate.net/publication/316549196_Evidence-Based_Decision_Making_to_Underpin_the_Thresholds_in_New_Zealand%27s_Craft_Risk_Management_Standard_Biofouling_on_Vessels_Arriving_to_New_Zealand

Gibraltar Port Authority, 2018. Gibraltar Port Authority Handbook 2018-20. Available online at: https://www.gibraltarport.com/port-information/port-handbook

Gladstone Ports Corporation, 2020. Contractors and Port Users Safety, Environment and Security Standard. Available online at: https://37a60919-af70-449e-a074-269d8ed5cd0e.filesusr.com/ugd/31e2c5_c2a347126458438db310c03d216d738f.pdf

Government of Canada, 2015. Aquatic Invasive Species Regulations. Available online at: https://laws-lois.justice.gc.ca/eng/regulations/sor-2015-121/FullText.html

Government of Canada, 2020. Anti-fouling systems on ships: international convention. Available online at: https://www.canada.ca/en/environment-climate-change/corporate/international-affairs/partnerships-organizations/anti-fouling-systems-ships.html

Government of South Australia, 2007. Fisheries Management Act, 2007. Available online at: https://www.legislation.sa.gov.au/LZ/C/A/Fisheries%20Management%20Act%202007.aspx

Government of South Australia, 2020. Building a new Biosecurity Act for South Australia. Available online at: https://www.pir.sa.gov.au/__data/assets/pdf_file/0006/373083/New_Biosecurity_Act_-_Consultation_Paper.pdf

Government of Western Australia, 1995. Fish Resources Management Regulations 1995. Available online at: https://www.legislation.wa.gov.au/legislation/statutes.nsf/law_s4447.html and https://www.fish.wa.gov.au/About-Us/Legislation/Western_Australian_Fisheries_Legislation/Pages/default.aspx

Government of Western Australia, date unspecified. Good Vessel Maintenance: Keep your bottom clean. Available online at: http://www.fish.wa.gov.au/Documents/biosecurity/good_vessel_maintenance.pdf

Green Marine Management Corporation, 2018. Overview of biofouling management and maintenance practices and technologies in Canadian waters. Prepared for and submitted to Transport Canada.

Hellenic Republic, 2019. Newspaper of the Government of the Hellenic Republic No. 2396. Available online at: https://www.elinyae.gr/sites/default/files/2019-10/2396B_2019.1561636468536.pdf

International Maritime Organization, 1996. London Protocol and 1996 Amendments. Available online at: https://www.imo.org/en/OurWork/Environment/Pages/London-Convention-Protocol.aspx

International Maritime Organization, 2001. International Convention on the Control of Harmful Anti-fouling Systems on Ships. Available online at: https://www.imo.org/en/About/Conventions/Pages/International-Convention-on-the-Control-of-Harmful-Anti-fouling-Systems-on-Ships-%28AFS%29.aspx

International Maritime Organization, 2003. *Guidelines for the inspection of anti-fouling systems on ships.* (Resolution MEPC.105(49)). Available online at: https://wwwcdn.imo.org/localresources/en/KnowledgeCentre/IndexofIMOResolutions/MEPCDocuments/MEPC.105(49).pdf

International Maritime Organization, 2009. Guidance on best management practices for removal of anti-fouling coatings from ships, including TBT hull paints. AFS.3/Circ.3. Available online at: https://www.imo.org/en/OurWork/Environment/Pages/Anti-fouling.aspx

International Maritime Organization, 2010. *Guidelines for survey and certification of anti-fouling systems on ships.* (Resolution MEPC 195(61)). Available online at: https://www.imo.org/en/OurWork/Environment/Pages/Anti-fouling.aspx

International Maritime Organization, 2011a. *Guidelines for the Control and Management of Ships' Biofouling to Minimize the Transfer of Invasive Aquatic Species*. (Resolution MEPC.207(62)). Available online at: https://www.glofouling.imo.org/regulations-imo

International Maritime Organization, 2011b. *Guidelines for inspection of anti-fouling systems on ships*. (Resolution MEPC.208(62)). Available online at: https://www.imo.org/en/OurWork/Environment/Pages/Anti-fouling.aspx

International Maritime Organization, 2012. *Guidance for Minimizing the Transfer of Invasive Aquatic Species* as *Biofouling (Hull Fouling) For Recreational Craft*. (MEPC.1/Circ.792). Available online at: https://www.glofouling.imo.org/regulations-imo

International Maritime Organization, 2013. Guidance for Evaluating the 2011 Guidelines for the Control and Management of Ships' Biofouling to Minimize the Transfer of Invasive Aquatic Species. MEPC.1/Circ.811. Available online at: https://www.glofouling.imo.org/regulations-imo

International Maritime Organization, 2016. A template for the completion of a biofouling management plan. Submitted by IMarEST and IPPIC. MEPC 70/INF.23. Available online at: https://www.imarest.org/policy-news/institute-news/item/3506-imarest-and-ippic-launch-template-for-biofouling-management-plan and www.imarest.org/special-interest-groups/biofouling-management/item/3505-template-for-biofouling-management-plan

International Maritime Organization, 2018. Biofouling transfer of non-indigenous/invasive species through ships. Submitted by the Islamic Republic of Iran. MEPC 73/18/1.

International Maritime Organization, 2020a. Preliminary findings of a range of Member State, observer and industry perspectives. Submitted by Australia, Finland, Japan, Netherlands, New Zealand, Norway, INTERTANKO and ACOPS. PPR 7/7/2.

International Maritime Organization, 2020b. Key issues and intentions for the review of the Guidelines. Submitted by Australia, Finland, Japan, Netherlands, New Zealand, Norway and IMarEST. PPR 7/7/4.

International Maritime Organization, 2020c. References to inform additional actions to evaluate and minimize biofouling introductions. Submitted by ICES. PPR 7/INF.2.

International Maritime Organization, 2021a. Report of the Correspondence Group on Review of the Biofouling Guidelines. Submitted by Norway. PPR 8/4.

International Maritime Organization, 2021b. Comments on the report of the correspondence group on review of the biofouling guidelines (PPR 8/4). Submitted by Finland, Germany and Poland. PPR 8/4/1.

International Maritime Organization, 2021c. Report to the Maritime Environment Protection Committee. PPR 8/13.

International Standards Organization (ISO), 2007. ISO 8501-1: Preparation of steel substrates before application of paints and related products – visual assessment of surface cleanliness – Part 1: Rust grades and preparation grades of uncoated steel substrates and of steel substrates after overall removal of previous coatings. Available online at: https://www.iso.org/obp/ui/#iso:std:iso:8501:-1:ed-2:v1:en

International Standards Organization (ISO), 2012. ISO 13073-1: Ships and marine technology – Risk assessment on anti-fouling systems on ships – Part 1: Marine environmental risk assessment method of biocidally active substances used for anti-fouling systems on ships. Available online at: https://www.iso.org/standard/52601.html

International Standards Organization (ISO), 2015a. ISO 9001: Quality management systems – requirements. Available online at: https://www.iso.org/standard/62085.html

International Standards Organization (ISO), 2015b. ISO 14001: Environmental management systems – requirements with guidance for use. Available online at: https://www.iso.org/standard/60857.html

International Standards Organization (ISO), 2016. ISO 19030-1: Ships and marine technology – Measurement of changes in hull and propeller performance. Available online at: ISO - ISO 19030-1:2016 - Ships and marine technology — Measurement of changes in hull and propeller performance — Part 1: General principles (https://www.iso.org/standard/63774.html)

International Standards Organization (ISO), 2020. ISO 8502-9: Preparation of steel substrates before application of paints and related products – Part 9: Field method for the conductometric determination of water-soluble salts. Available online at: https://cdn.standards.iteh.ai/samples/73863/e75cf9a25c014b628e7cb89da1589f87/ISO-8502-9-2020.pdf

INTERTANKO, 2016. INTERTANKO Guide to Modern Anti-fouling Systems and Biofouling Management 1st Edition. Available (for members only) online at: https://www.intertanko.com/topics-issues/issue/biofouling-management

IOGP/IPIECA, 2010. Alien invasive species and the oil and gas industry: guidance for prevention and management. OGP Report Number 436. Available online at: https://www.iogp.org/bookstore/product/alien-invasive-species-and-the-oil-gas-industry-guidance-for-prevention-management/

Korea Shipbuilding and Offshore Engineering, 2021. KSOE Integrated Report 2021. Available online at: https://english.hhi.co.kr/img/filedown/2021_KSOE_IR_EN.pdf

Lewis, J.A. 2015. Chemical contamination sampling plan. Appendix B (incorporated into the Request for Proposal documentation for MPI project 405364.

Marine Pest Sectoral Committee. 2009a. National biofouling management guidelines for the petroleum production and exploration industry. Department of Agriculture and Water Resources, Canberra. Available online at: https://www.marinepests.gov.au/sites/default/files/Documents/petroleum-exploration-biofouling-guidelines.pdf

Marine Pest Sectoral Committee. 2009b. National biofouling management guidelines for recreational vessels. Department of Agriculture and Water Resources, Canberra. Available online at: https://www.marinepests.gov.au/commercial/vessels/biofouling-recreational

Marine Pest Sectoral Committee. 2009c. National biofouling management guidelines for commercial vessels. Department of Agriculture and Water Resources, Canberra. Available online at: https://www.marinepests.gov.au/commercial/vessels/biofouling-commercial

Marine Pest Sectoral Committee. 2009d. National biofouling management guidelines for commercial fishing vessels. Department of Agriculture and Water Resources, Canberra. Available online at: https://www.marinepests.gov.au/commercial/vessels/biofouling-commercial-fishing

Marine Pest Sectoral Committee. 2009e. National biofouling management guidelines for non-trading vessels. Department of Agriculture and Water Resources, Canberra. Available online at: https://www.marinepests.gov.au/commercial/vessels/biofouling-non-trading

Marine Pest Sectoral Committee. 2013. National biofouling management guidelines for the aquaculture industry. Department of Agriculture and Water Resources, Canberra. Available online at: https://www.marinepests.gov.au/commercial/aquaculture/biofouling

Marinha Do Brasil, 2007. Normas da autoridade maritima para o controle de sistemas antiincrustantes em embarcacoes. Normam-23/DPC. Diretoria de Portos e Costas. Available online at: https://www.marinha.mil.br/dpc/sites/www.marinha.mil.br.dpc/files/normam23_0.pdf

Maritime and Port Authority of Singapore, 2017. Port Marine Circular No. 23.

Ministry for Primary Industries, 2017. Procedures for evaluating in-water systems to remove or treat vessel biofouling: External hull and niche areas. MPI Draft Technical Standard. Ministry for Primary Industries, Wellington

Ministry for Primary Industries. 2018a. Craft Risk Management Standard: Biofouling on Vessels Arriving in New Zealand. Wellington, New Zealand. Available online at: https://www.biosecurity.govt.nz/dmsdocument/11668-Biofouling-on-Vessels-Arriving-to-New-Zealand-Craft-Risk-Management-Standard

Ministry for Primary Industries. 2018b. The Craft Risk Management Standard for Biofouling: Frequently Asked Questions. Wellington, New Zealand. Available online at: https://www.biosecurity.govt.nz/dmsdocument/27444-Craft-Risk-Management-Standard-FAQs

Ministry for Primary Industries. 2018c. Guidelines for assessing the biosecurity risk of vessels arriving to New Zealand. Wellington, New Zealand.

Ministry for Primary Industries, 2018d. Guidance for vessel owners: developing a Biofouling Management Plan. Wellington, New Zealand. Available online at: https://www.biosecurity.govt.nz/dmsdocument/27855-Guidance-for-vessel-owners-developing-a-Biofouling-Management-Plan

Ministry for Primary Industries, 2018e. Guidelines for diving service providers inspecting vessels arriving to New Zealand. Wellington, New Zealand. Available online at: https://www.biosecurity.govt.nz/dmsdocument/27852-Guidelines-for-diving-service-providers-inspecting-vessels-arriving-to-New-Zealand

Ministry for Primary Industries, 2021. Summary – Testing of reactive in-water cleaning systems for removal of vessel biofouling. Biosecurity New Zealand Technical Paper No. 2021/11. Available online at: https://www.mpi.govt.nz/dmsdocument/47629/direct

Ministry of the Environment, Brazil, 2018. National Prevention Plan for the control and monitoring of Sun Coral (Tibastraea spp.) in Brazil. Brazilian Institute for the Environment and Natural Resources, Chico Mendes Institute for Biodiversity Conservation.

Naidoo, N.C., 2015. Assessment of the waste management

practices at Transnet National Ports Authority, Port of Richards Bay. University of South Africa. Available online at: https://uir.unisa.ac.za/bitstream/handle/10500/19202/dissertation_naidoo_nc.pdf?sequence=3

New Zealand Government, 1991. Resource Management Act 1991. Available online at: https://www.legislation.govt.nz/act/public/1991/0069/latest/DLM230265.html?search=qs_act%40bill%40regulation%40deemedreg_resource+management+act_resel_25_h&p=1&sr=1

Northern Territory Government, 2021. Hull pest inspections for visiting boats. Available online at: https://nt.gov.au/marine/for-all-harbour-and-boat-users/biosecurity/hull-pest-inspections-for-visiting-boats

Northland Regional Council, 2018. Northland Regional Pest and Marine Pathway Management Plan 2017-2027. Available online at: https://www.nrc.govt.nz/resource-library-summary/plans-and-policies/pest-management/northland-regional-pest-and-marine-pathway-management-plan/

OECD, 2021. Ocean shipping and shipbuilding. Available online at: https://www.oecd.org/ocean/topics/ocean-shipping/

Official Journal of the European Union, 2016. Commission implementing decision (EU) 2016/107 of 27 January 2016 not approving cybutryne as an existing active substance for use in biocidal products for product-type 21. European Commission. Available online at: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX%3A32016D0107&from

Papahanaumokuakea Marine National Monument, 2014. Marine Alien Species Inspection Standards for Maritime Vessels. Available online at: https://nmspapahanaumokuakea.blob.core.windows.net/papahanaumokuakea-prod/media/archive/permit/bmp/001_marinealien.pdf

Port Authority of New South Wales, 2021. Marine Pests and Pesticide Plan. Available online at: https://www.portauthoritynsw.com.au/environment/environmental-management/marine-pests-pesticide-plan/

Port of Gothenburg, 2017. General Port Regulations. Available online at: https://www.portofgothenburg.com/FileDownload/?contentReferenceID=12723

Port of Rotterdam, 2021. Port Information Guide. Available online at: https://www.portofrotterdam.com/sites/default/files/2021-05/port-information-guide.pdf

Queensland Government, 2014. Biosecurity Act 2014. Available online at: www.legislation.qld.gov.au/view/html/inforce/current/act-2014-007.

Queensland Government, 2019. Environmental Protection (Water and Wetland Biodiversity) Policy 2019. Available online at: https://www.legislation.qld.gov.au/

Ramboll Environ US Corporation, 2017. Washington State Vessel-Related Biofouling Management 6-Year Strategic Plan. Prepared for the Washington Department of Fish and Wildlife. Available online at: https://wdfw.wa.gov/sites/default/files/publications/02252/wdfw02252.pdf

Regional Marine Pollution Emergency Response Centre for the Mediterranean Sea (REMPEC), 2021a. Draft Mediterranean strategy for the prevention of and response to marine pollution from ships (2022-2031). Available online at: https://www.rempec.org/en/events/rempec-events/fourteenth-meeting-of-the-focal-points-of-the-regional-marine-pollution-emergency-response-centre-for-the-mediterranean-sea-rempec

Regional Marine Pollution Emergency Response Centre for the Mediterranean Sea (REMPEC), 2021b. Draft Ballast Water Management Strategy for the Mediterranean Sea (2022-2027). Available online at: https://www.rempec.org/en/events/rempec-events/fourteenth-meeting-of-the-focal-points-of-the-regional-marine-pollution-emergency-response-centre-for-the-mediterranean-sea-rempec

Scianni, C. and Georgiades, E. 2019. Vessel In-Water Cleaning or Treatment: Identification of Environmental Risks and Science Needs for Evidence-Based Decision Making. Front. Mar. Sci., 26 July 2019. Available online at: https://doi.org/10.3389/fmars.2019.00467

Scianni, C., Lubarsky, K., Ceballos-Osuna, L., Bates, T. 2021. Yes, we CANZ: initial compliance and lessons learned from regulating vessel biofouling management in California and New Zealand. Management of Biological Invasions 12(3): 727-746. Available online at: https://www.reabic.net/journals/mbi/2021/3/MBI_2021_Scianni_etal.pdf

Secretariat of the Pacific Regional Environment Program, 2006. Shipping related introduced marine pests in the Pacific Islands: a regional strategy (SRIMP-Pac). Available online at: https://www.sprep.org/att/IRC/eCOPIES/Pacific_Region/105.pdf

Strietman, W.J. and Leemans, E. 2019. Review of the implementation of the IMO's 2011 Biofouling Guidelines in the Netherlands. Wageningen Economic Research report; No. 2019-013. Wageningen Economic Research. Available online at: https://doi.org/10.18174/470572

South Australian Environment Protection Authority, 2019. Code of practice for vessel and facility management (marine and inland waters). Available online at: https://www.epa.sa.gov.au/files/47792_vessels.pdf

Tamburri, M.N. 2020. ACT/MERC Test Plan for Evaluations of the Jotun Hull Skating Solution: A Proactive Biofouling In-Water Cleaning Solution. ACT/MERC Test Plan EP20-1. University of Maryland Center for Environmental Science, Maryland USA.

Tamburri, M.N., Davidson, I.C., First, M.R., Scianni, C., Newcomer, K., Inglis, G.J., Georgiades, E.T., Barnes, J.M. and Ruiz, G.M. 2020. In-Water Cleaning and Capture to Remove Ship Biofouling: An Initial Evaluation of Efficacy and Environmental Safety. Frontiers in Marine Science. 7:437.

Transnet National Ports Authority, 2009. Ports Rules No. 255. South African Department of Transport. Available online at: http://extwprlegs1.fao.org/docs/pdf/saf85789.pdf

Transport Canada, 2021. Draft voluntary guidance for relevant authorities on in-water cleaning of vessels. Available online at: https://letstalktransportation.ca/iwcv

United States Government, 2013. Vessel General Permit. Available online at: https://www3.epa.gov/npdes/pubs/vgp_permit2013.pdf

United States Government, 2014. 33 CFR 151.2050 – Additional requirements – nonindigenous species reduction practices. US Coast Guard Regulation. Available online at: https://www.law.cornell.edu/cfr/text/33/151.2050

United States Government, 2018. Vessel Incidental Discharge Act. Available online at: https://www.epa.gov/vessels-marinas-and-ports/vessel-incidental-discharge-act-vida

Victorian Ports Corporation, 2018. Port Information Guide 4th Edition. Available online at: https://www.vicports.vic.gov.au/publications/Pages/hmd-and-port-information-guide.aspx

Zabin, C.J., Davidson, I.C., Holzer, K.K., Smith, G., Ashton, G.V., Tamburri, M.N. and Ruiz, G.M. 2018. How will vessels be inspected to meet emerging biofouling regulations for the prevention of marine invasions? Management of Biological Invasions 9(3):195-208. Available online at: https://www.reabic.net/journals/mbi/2018/3/MBI_2018_Zabin_etal.pdf

ANNEX A.

SURVEY METHODOLOGY AND RESULTS

Survey targeted specific audiences, including:

- Ports, shipyards and governments (ANNEX B),
- Ship owners and operators (ANNEX C),
- In-water cleaning providers (ANNEX D), and
- Coating industry stakeholders (ANNEX E).

Information received in survey responses was cross checked and validated through follow up and/or additional research where possible. Information received that was not able to be validated is identified as such.

It should be noted that respondents completing the surveys acknowledged that they did not always have full knowledge of all aspects of biofouling and hull cleaning. In particular, many respondents stated that they were not aware of the out of water cleaning policies in their jurisdiction.

Respondents to the shipowners and operators survey (SO) operated in many more ports (as shown in **Figure 11**) than those represented by the ports, shipyards and governments (P&G) survey (**Figure 12**).

Figure 11. Map indicating the most frequently visited ports by respondents to the shipowners and operators survey

Figure 12. Map indicating the locations of respondents to the ports, shipyards and governments survey

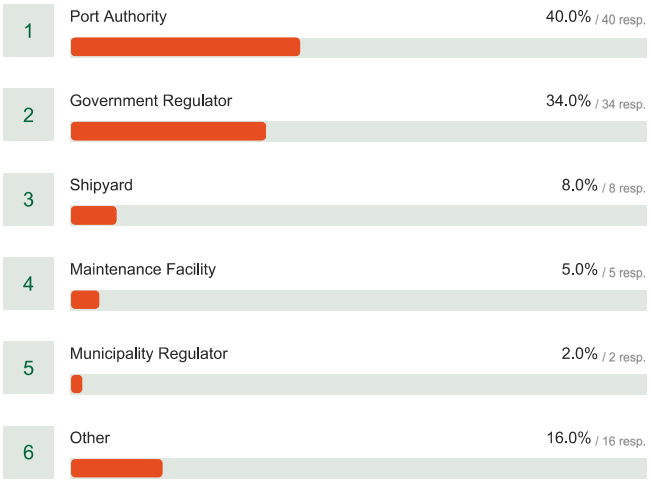
The results of the coating industry stakeholders survey were used to supplement the findings. Despite attempts to distribute this survey, there were only five respondents, with only two of the completing the survey in full. However, the information gathered in this survey provide useful opinion that is incorporated into this report.

The information collected during the surveys on the existing and proposed national and sub-national policies presented in this report was cross-checked with documents linked or submitted, fact-checked with survey responders and supplemented with further research.

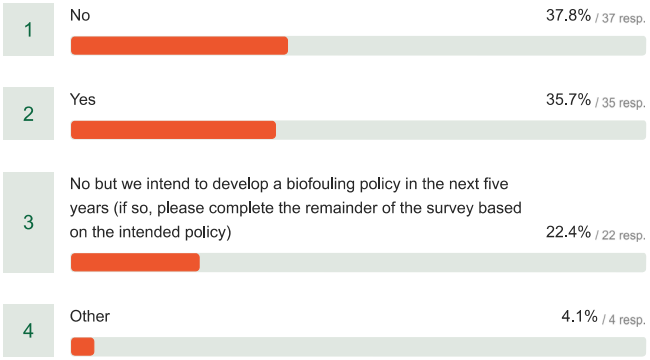
ANNEX B.

SURVEY QUESTIONS & RESULTS - PORTS, SHIPYARDS & GOVERNMENTS

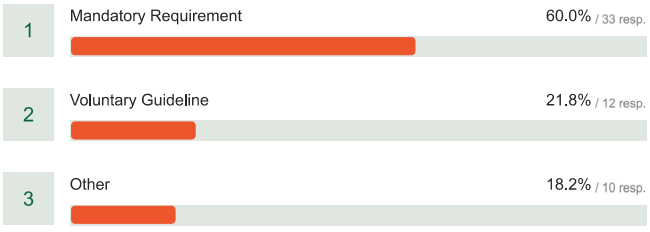
You are a:



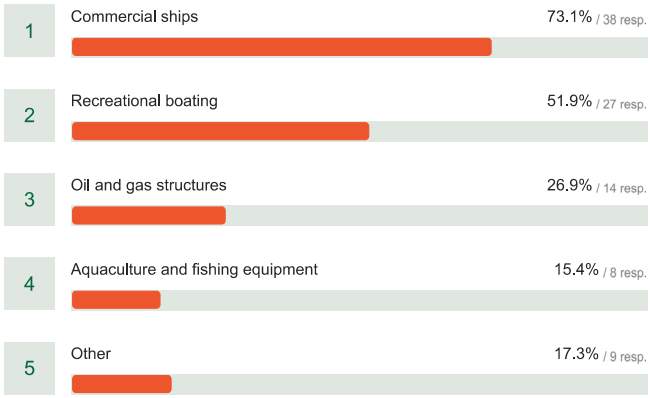
Is there a current or intended policy or practice on biofouling applicable to ships, structures, ports or shipyards under your jurisdiction or responsibility?



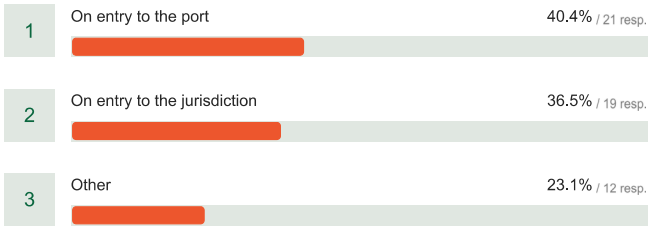
What is the nature of the biofouling policy or practice?



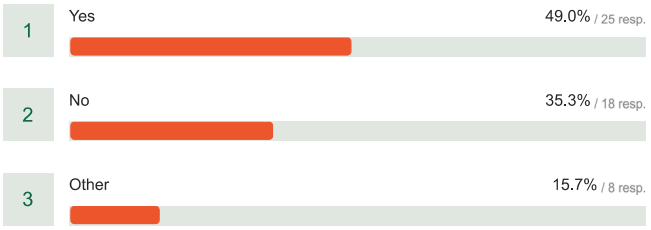
Which ships or structures does the biofouling policy or practice apply to?



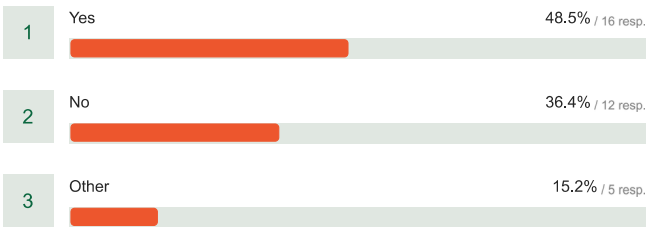
When does the biofouling policy or practice apply to these ships and structures?



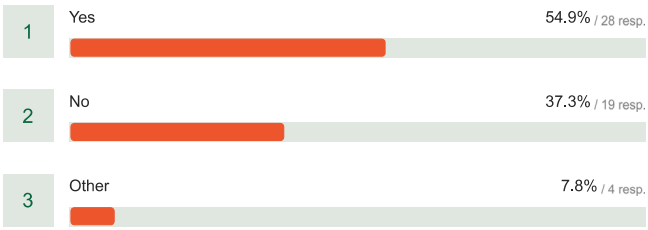
Are ships or structures required to minimize the amount of biofouling on submerged surfaces?



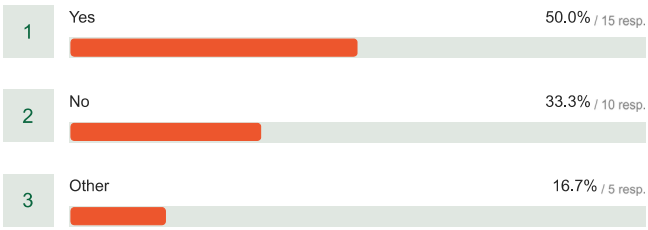
Is there a specific limit on the amount of biofouling allowed on a submerged surface?



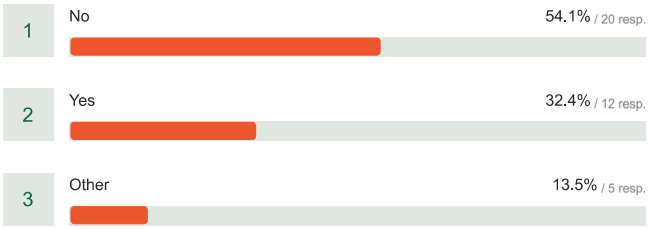
Are ships or structures required to ensure they do not introduce any particular Invasive Aquatic Species of concern via biofouling?



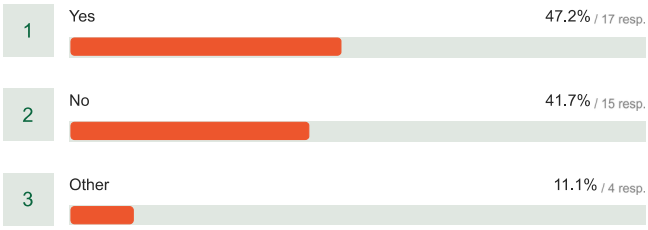
Does the policy or practice include any compliance related activities, such as reporting or inspections?



Are ships or structures required to report biofouling status prior to arrival?

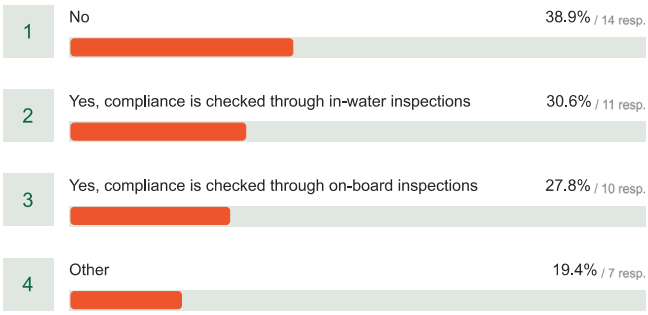


Are ships or structures required to demonstrate biofouling has been managed?

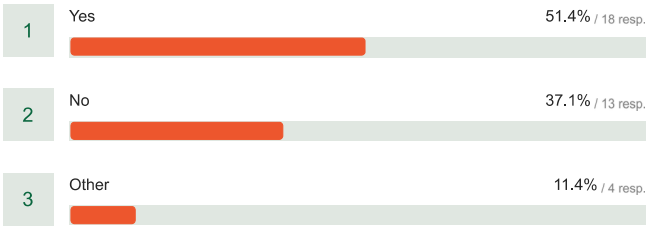


Please select how ships or structures are required to demonstrate biofouling has been managed.

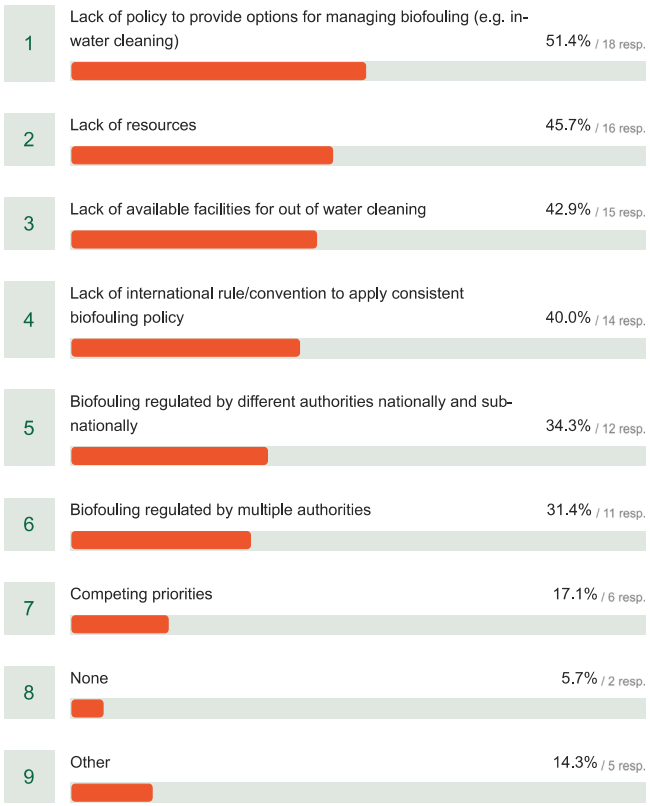
Is compliance with the biofouling policy or practice checked?



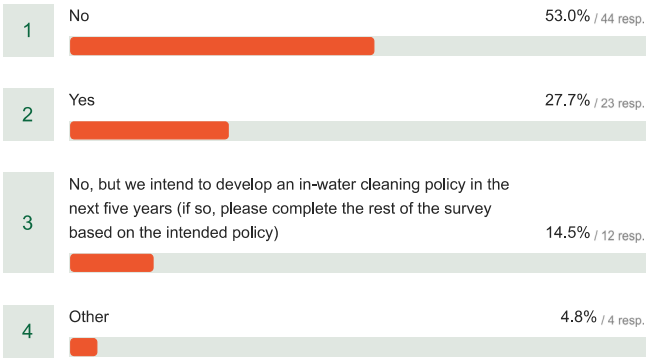
Are there any penalties or actions that can be taken if a ship or structure is found non-compliant with the biofouling policy or practice?



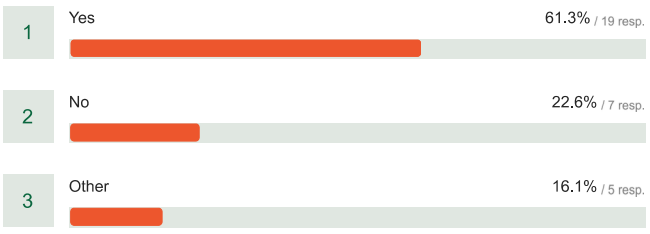
What, if any, are your greatest challenges in implementing the biofouling policy or practice?



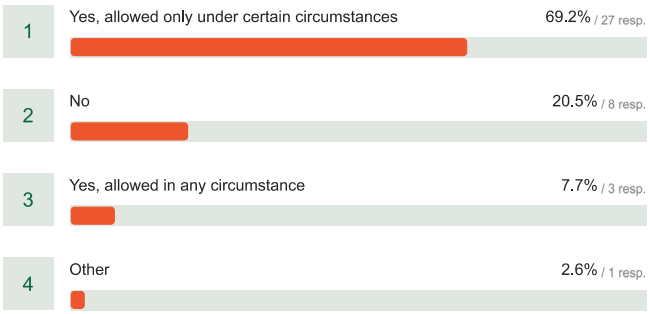
Is there a current or intended policy or practice on in-water cleaning applicable to ships and/or structures under your jurisdiction or responsibility?



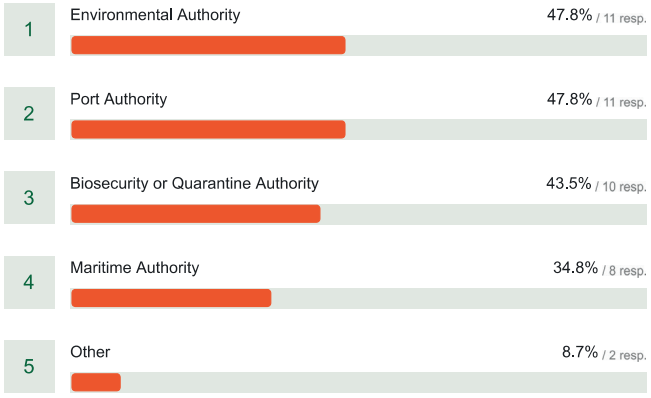
Do in-water cleaning providers require approval to clean in the port or country?



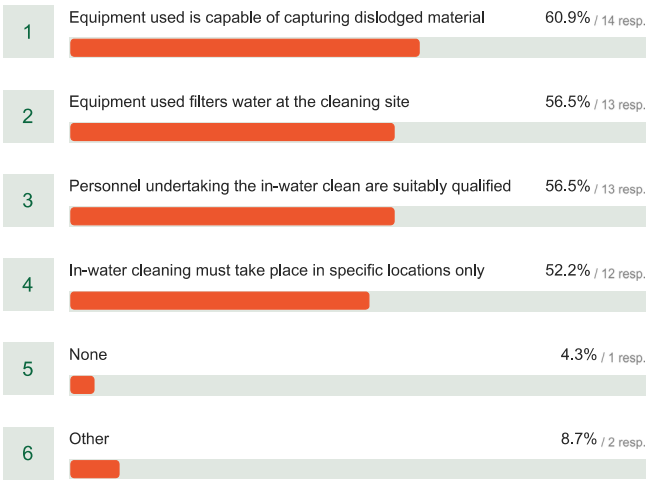
Is in-water cleaning of biofouling on ships or structures allowed?



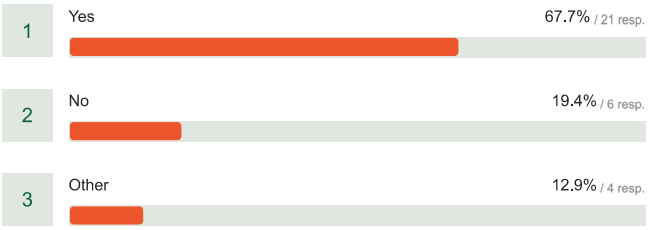
Who assesses and approves in-water cleaning providers?



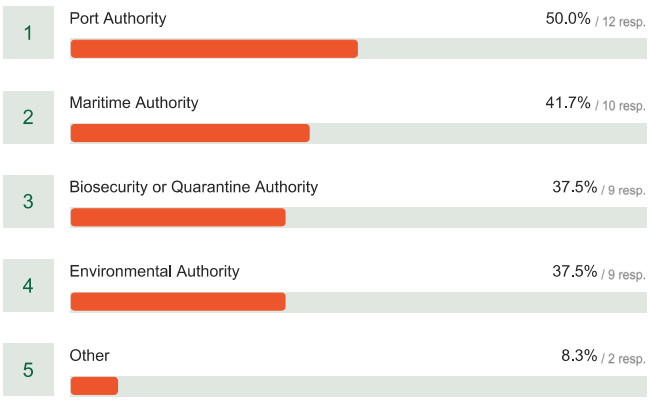
Are there any conditions associated with approval of an in-water cleaning provider?



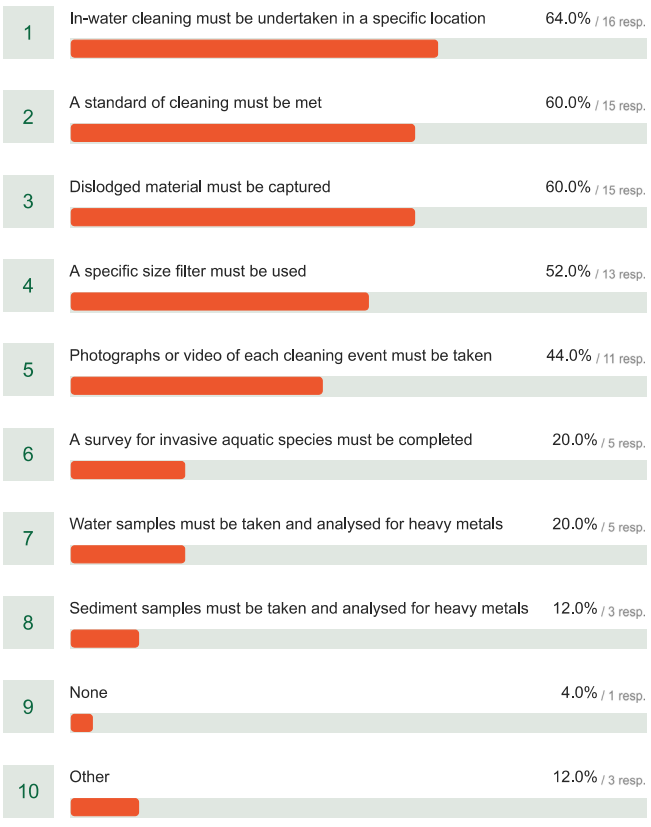
Does each in-water cleaning activity require permission?



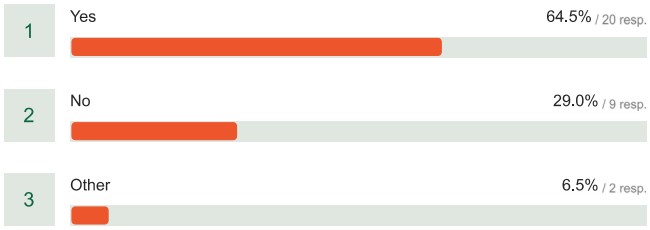
Who assesses and approves each in-water cleaning activity?



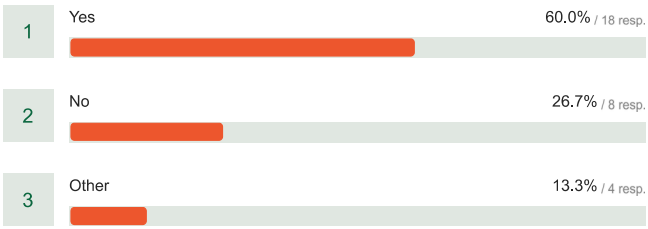
Are there any conditions associated with permission to in-water clean?



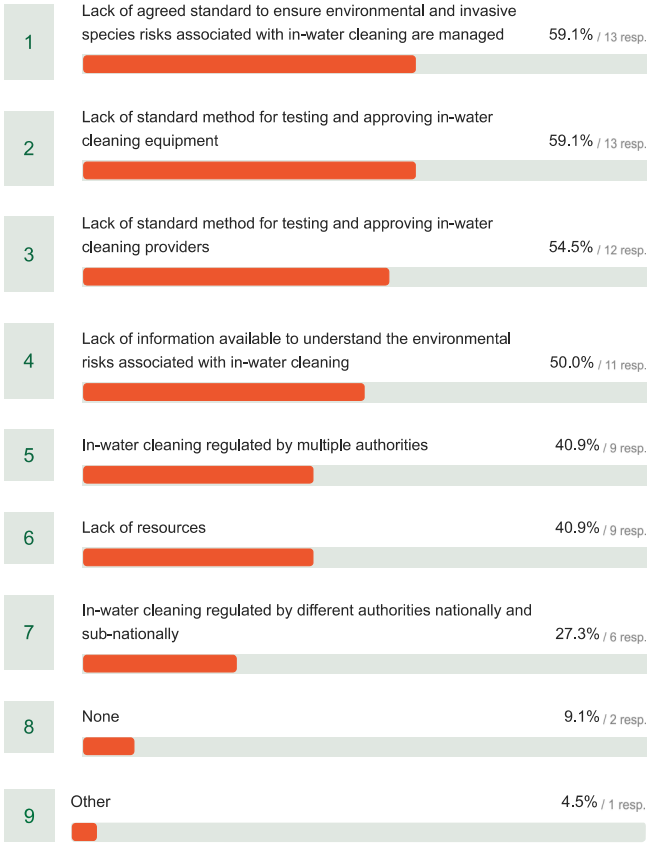
Is compliance with the in-water cleaning policy or practice checked?



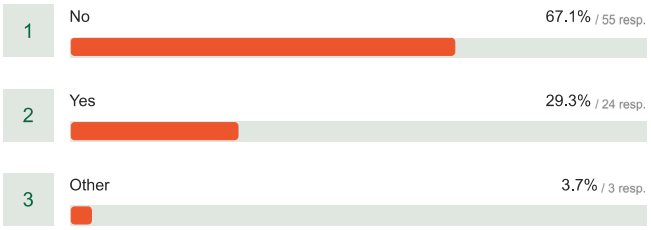
Are there any penalties or actions that can be taken if a ship or structure is found non-compliant with the in-water cleaning policy or practice?



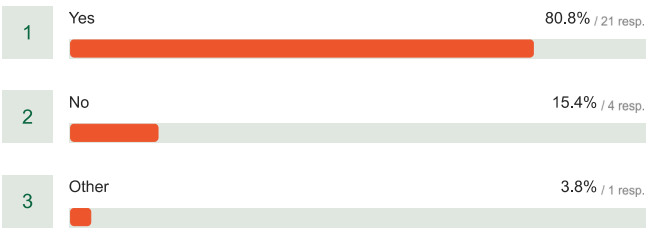
What, if any, are your greatest challenges in implementing the in-water cleaning policy or practice?



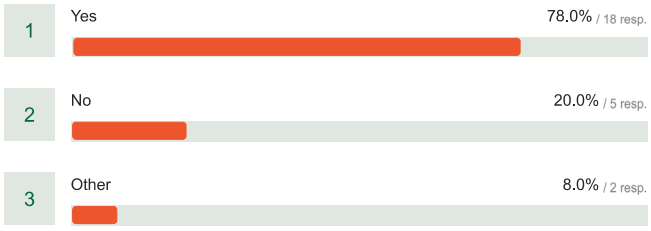
Is there a policy or practice relating to out of water ship or structure cleaning under your jurisdiction or responsibility?



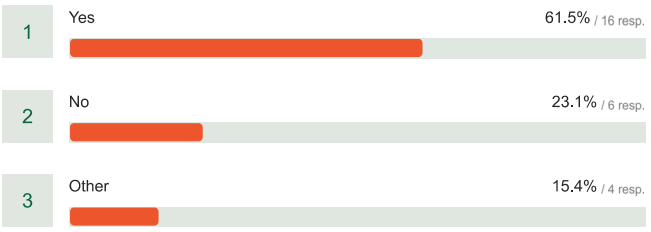
Is material dislodged during out of water cleaning required to be captured and appropriately disposed of?



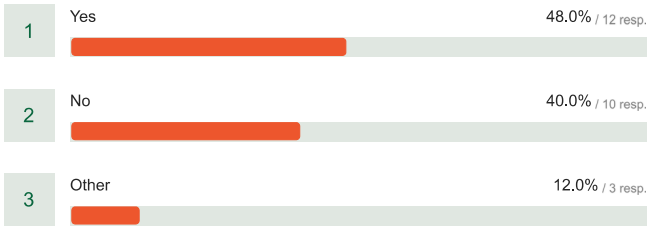
Is compliance with the out of water cleaning policy or practice checked?



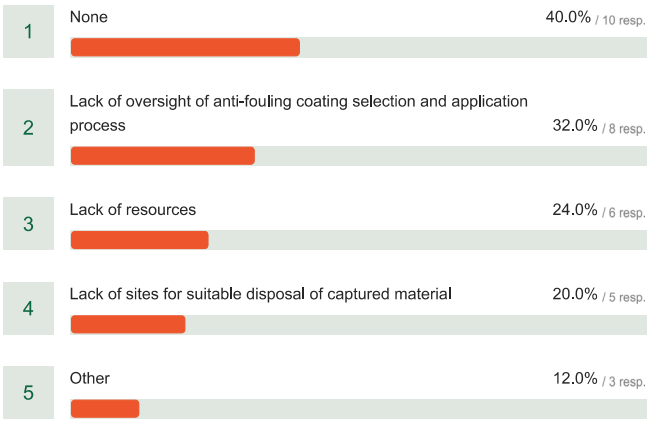
Are there any penalties or compliance actions that can be taken if a ship or structure is found non-compliant with the out of water cleaning policy or practice?



Is the International Convention on the Control of Harmful Anti-fouling Systems in Ships (AFS Convention), or equivalent requirements, implemented?



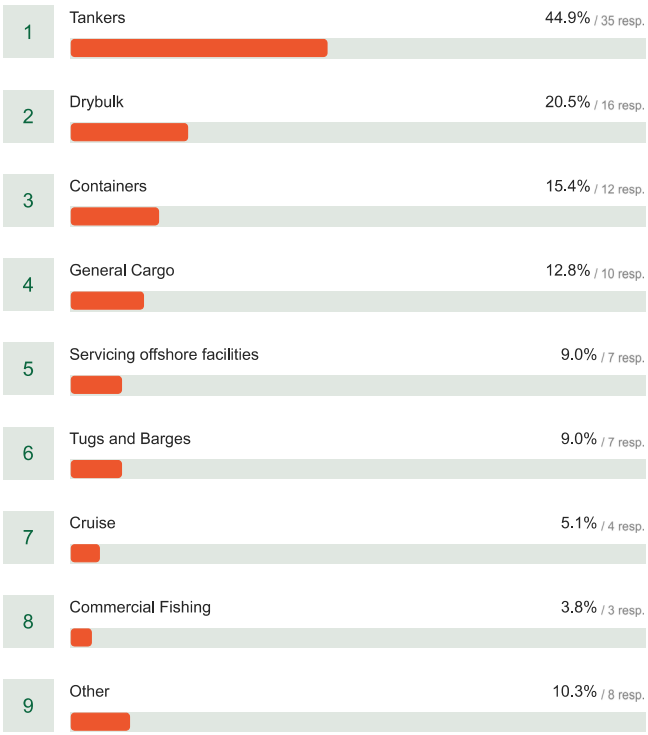
What, if any, are your greatest challenges in implementing the out of water cleaning policy or practice?



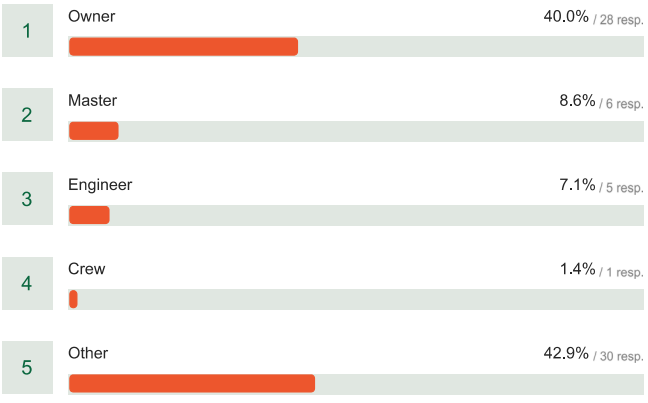
ANNEX C.

SURVEY QUESTIONS & RESULTS – SHIP OWNERS AND OPERATORS

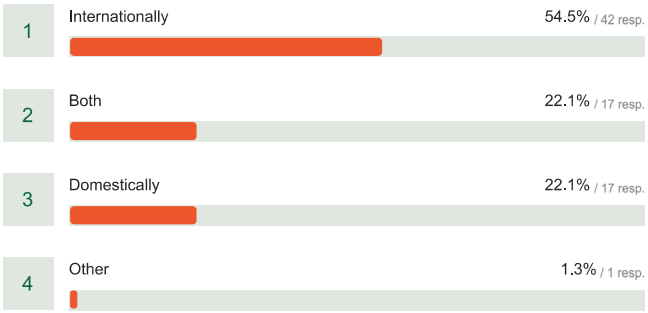
Please select your company's primary operating sector. If you operate in two or three sectors equally, please select all that apply:



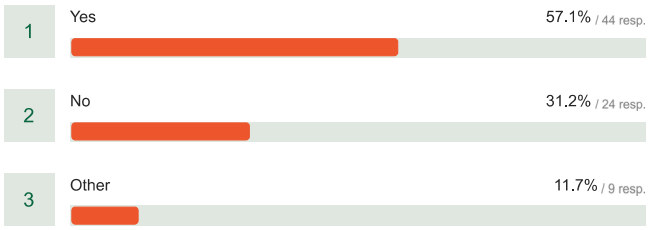
What is your role in the company?



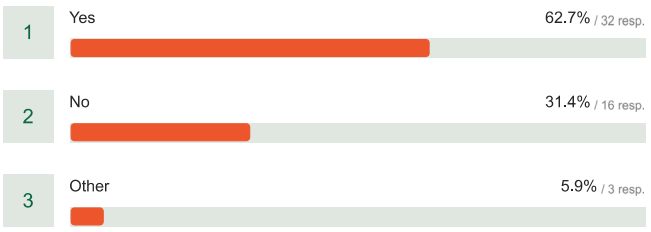
Do your ships operate domestically (exclusively within the waters of one country), internationally, or both?



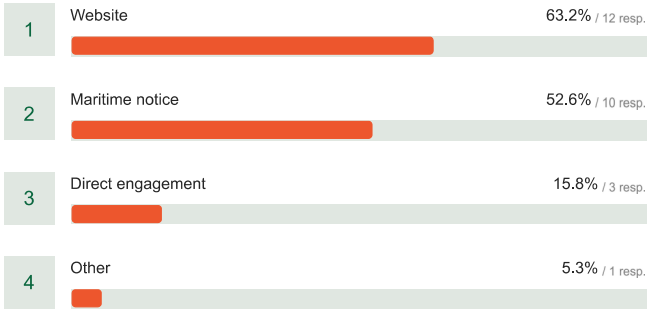
Do any of the ports or countries you operate in have biofouling related policies, practices or requirements?



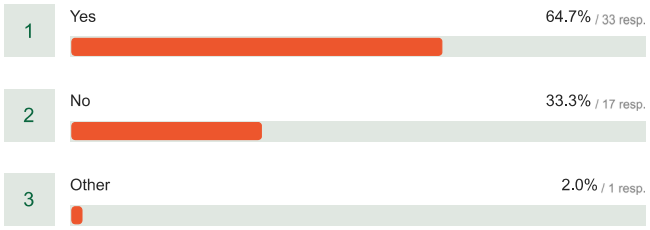
In your view, is there sufficient information and explanatory material available to you about the biofouling policies or practices to support your compliance?



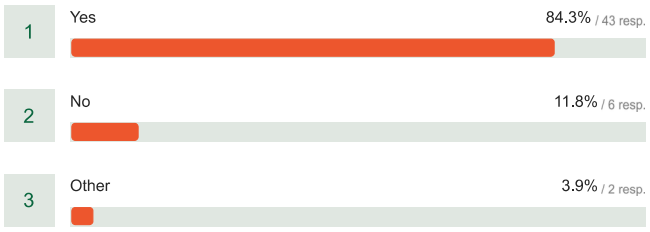
What are the most common methods that ports and governments use to communicate biofouling policies?



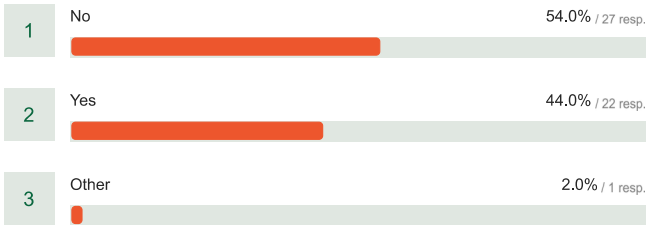
Are you required to notify any ports or countries prior to arrival about the status of the ship's biofouling?



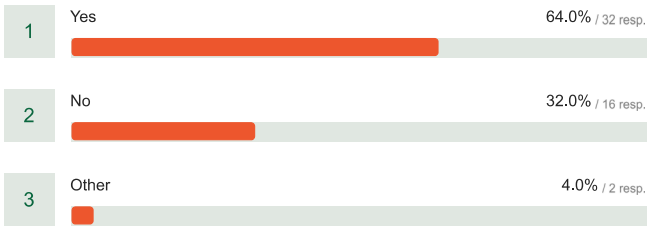
Do inspections of your ships in any ports or countries include biofouling management related questions?



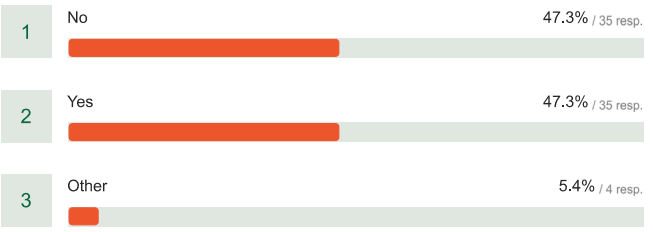
Have any ports or countries required an in-water inspection of your ship's biofouling?



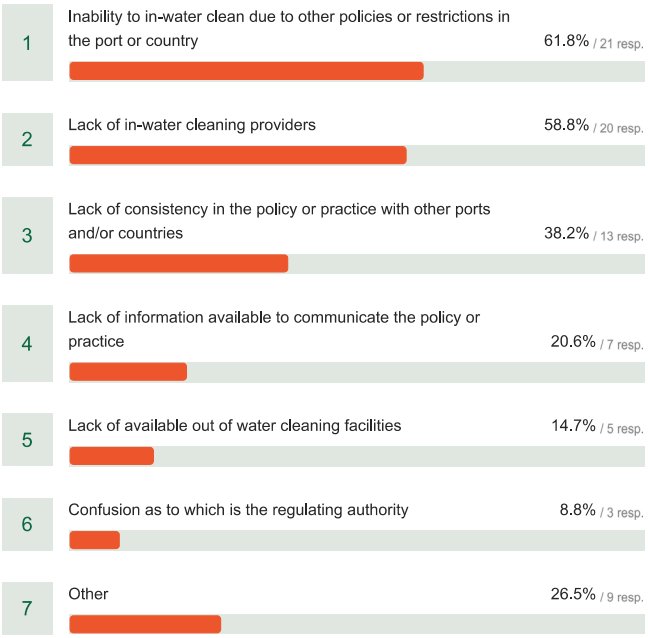
Are you aware of any penalties or compliance actions taken against ships in relation to unacceptable biofouling in any of the ports or countries that you operate?



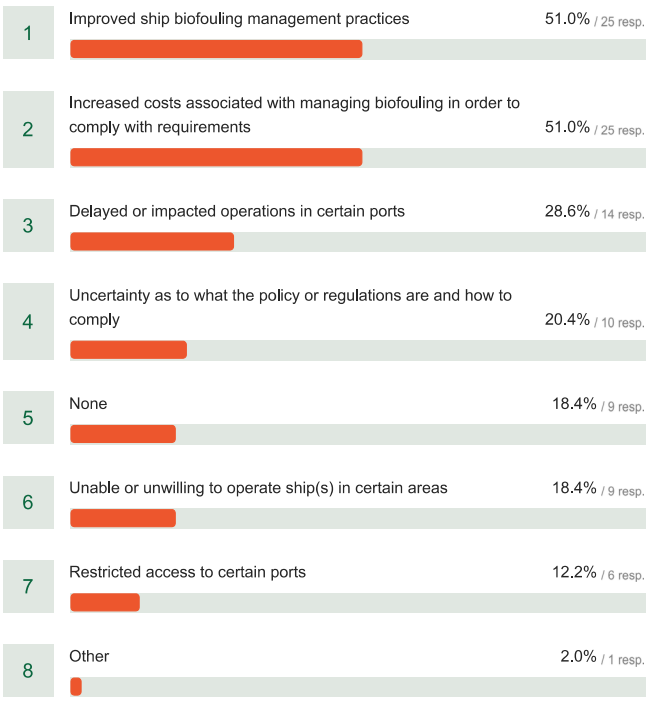
Do any of the ports or countries you operate in have in-water cleaning related policies, practices or requirements?



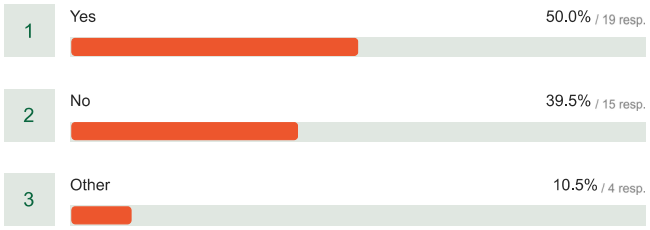
What are the main barriers, if any, to your ability to comply with biofouling policies or practices in the ports and countries that you operate in?



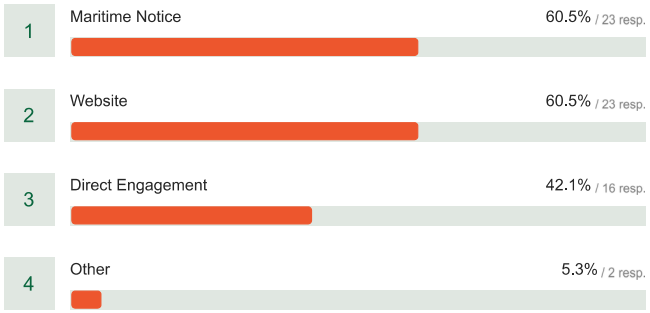
What impact have port/country biofouling policies or practices had on your ship(s)?



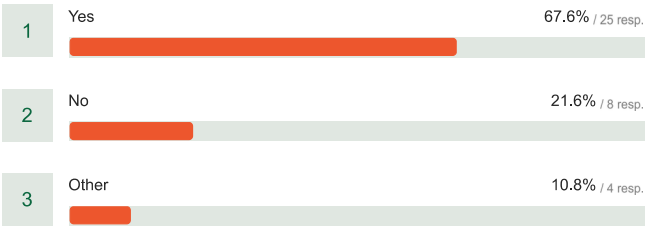
In your view, is there sufficient communication from the ports or countries you operate in about their in-water cleaning policies or practices?



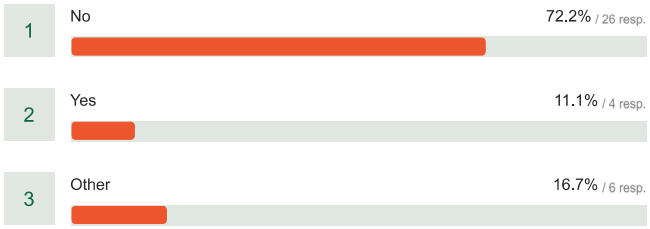
What are the most common methods ports and governments use to communicate in-water cleaning policies and practices?



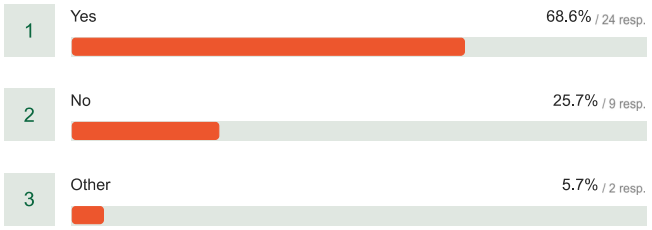
Are there any ports or countries where your ships are not allowed to in-water clean?



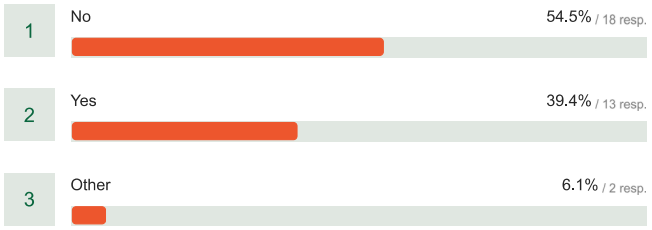
Do any of the ports or countries you operate in require you to use a specified in-water cleaning operator?



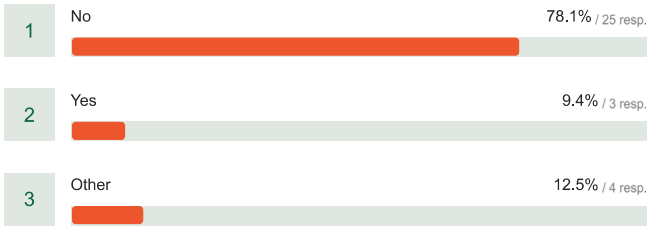
Do any of the ports or countries you operate in require you to have approval to in-water clean?



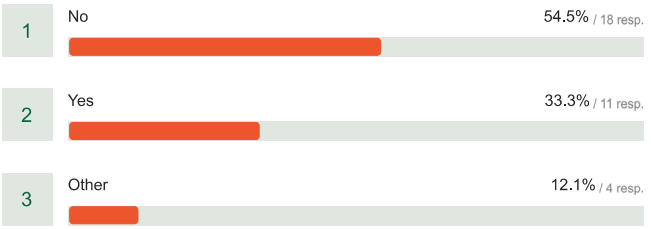
Do any of the ports or countries require you to in-water clean using a specific method?



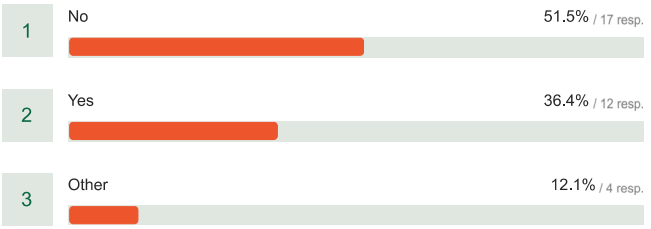
Do any of the ports or countries you operate in require you to sample and test water at or near the in-water cleaning site?



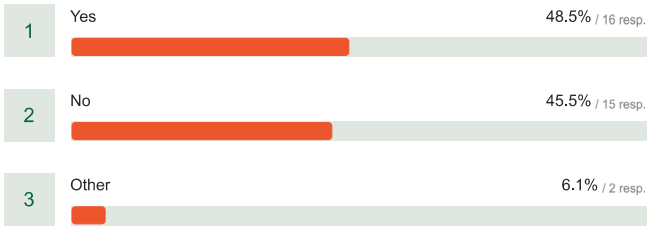
Do any of the ports or countries you operate in require you to provide video or photographs of the in-water cleaning event?



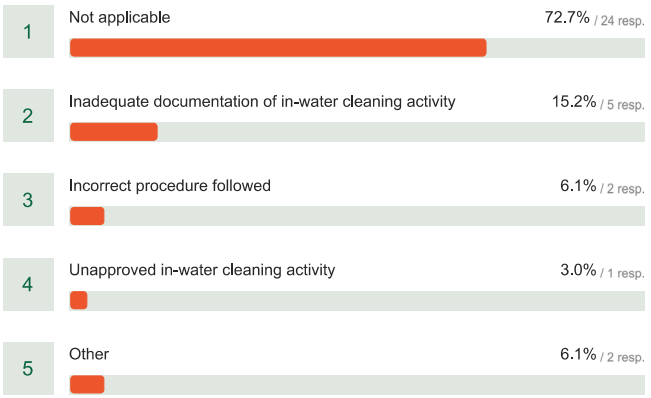
Do any of the ports or countries you operate in require you to provide a report of the in-water cleaning event?



Are you aware of any penalties or compliance actions taken against ships in relation to in-water cleaning in any of the ports or countries that you operate?

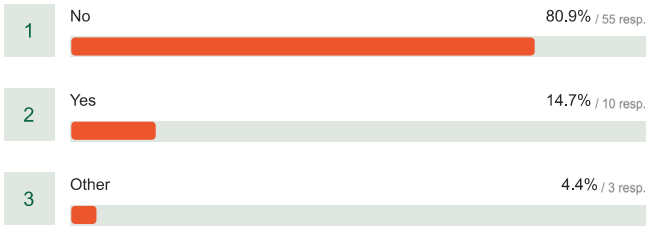


If you have experienced compliance issues in ports relating to in-water cleaning, what have been the main reasons for this?

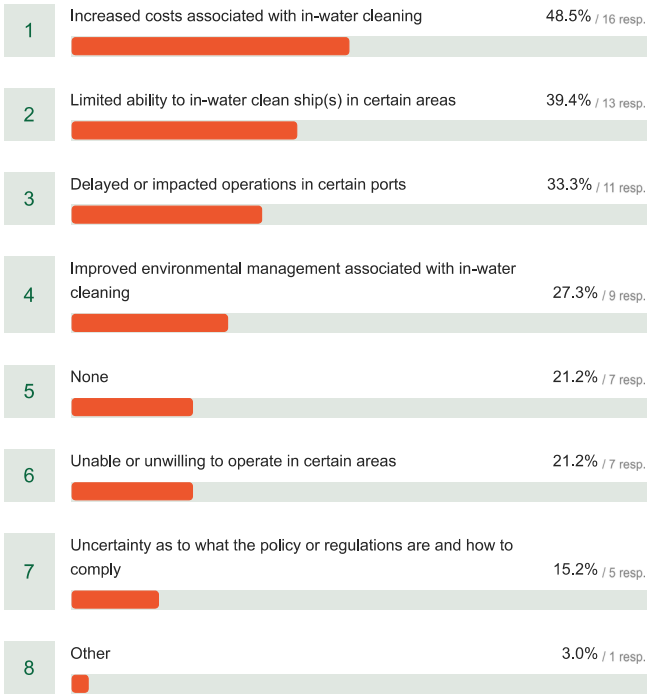


What are the main barriers, if any, to your ability to comply with in-water cleaning policies or practices in the ports and countries that you operate in?

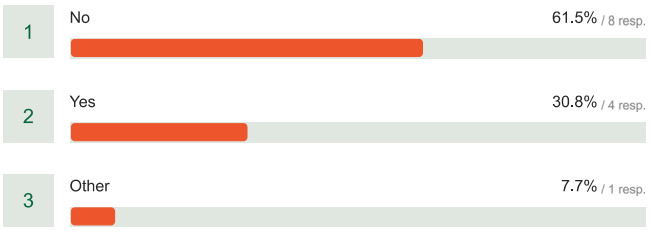
Do you undertake out of water hull cleaning in any ports or countries with specific policies or requirements?



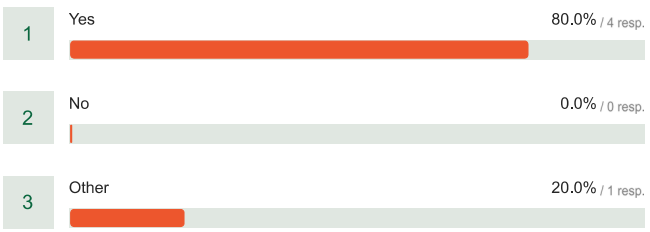
What impact has a port or country's compliance policies relating to in-water cleaning had on your company's ships?



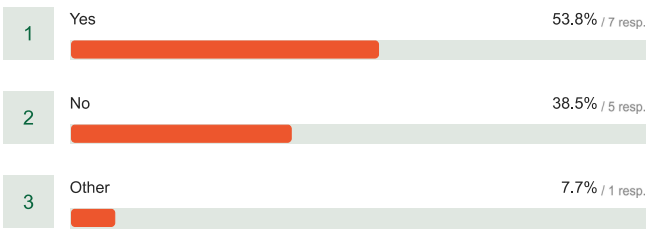
Do any of the ports or countries you operate in require you to collect the material dislodged during out of water cleaning?



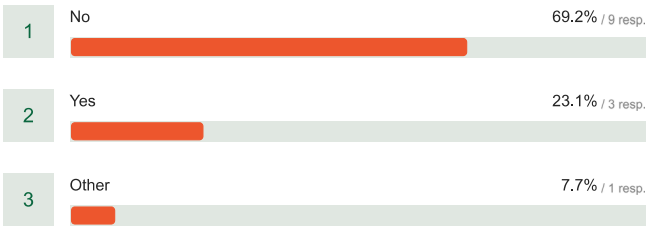
Do any of the ports or countries you operate in require you to dispose of collected material in a particular way?



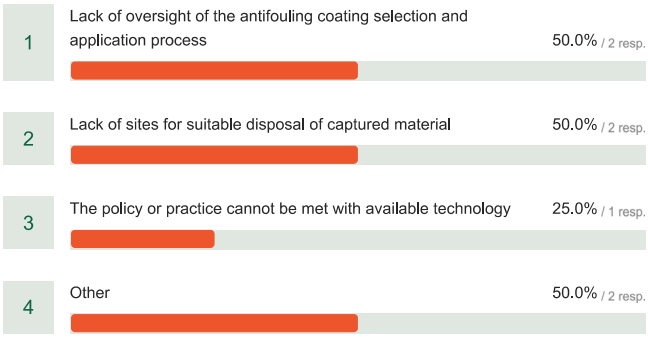
Do any of the ports or countries you operate in require you to comply with the International Convention on the Control of Harmful Anti-fouling Systems in Ships (AFS Convention), or equivalent requirements?



Do any of the ports or countries you operate in have any additional requirements for out of water cleaning?



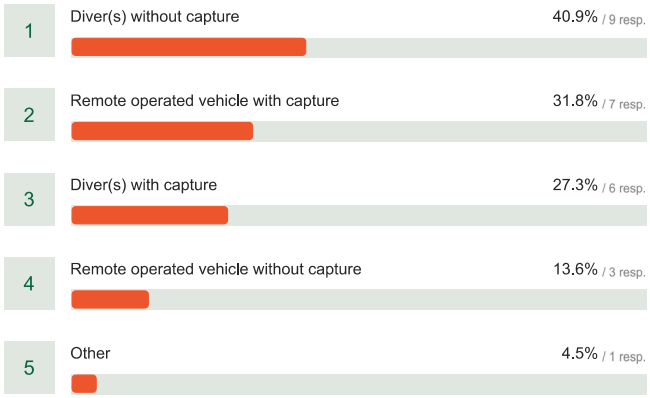
What are the main barriers, if any, to your ability to comply with out of water cleaning policies or practices in the ports and countries that you operate in?



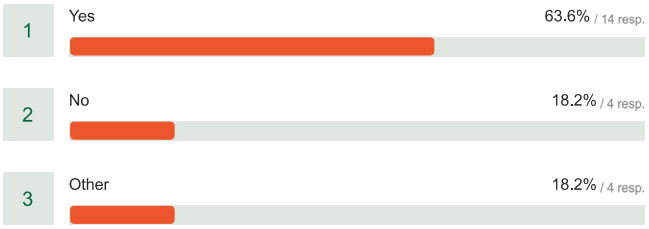
ANNEX D.

SURVEY QUESTIONS & RESULTS – IN-WATER CLEANING OPERATORS

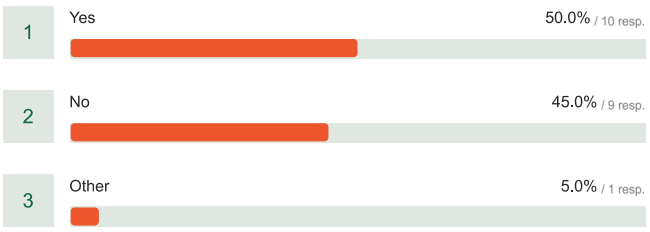
Please select your company's primary cleaning method:



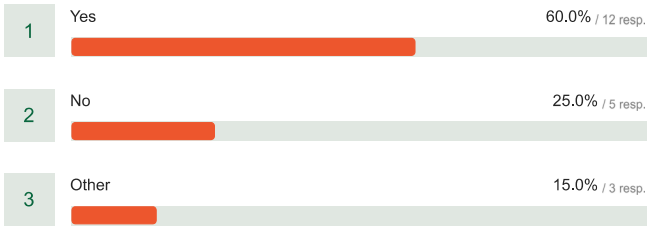
Do any of the ports or countries you operate in have in-water cleaning related policies, practices or requirements?



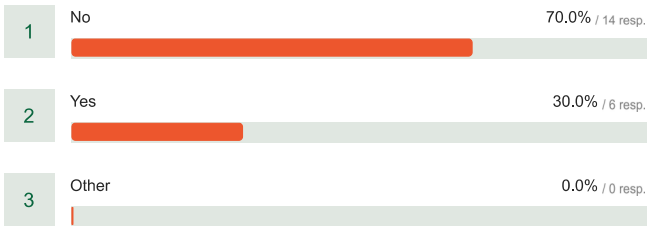
Do any of the ports or countries you operate in require you to apply for approval to operate as an in-water cleaning provider, prior to performing any in-water cleaning?



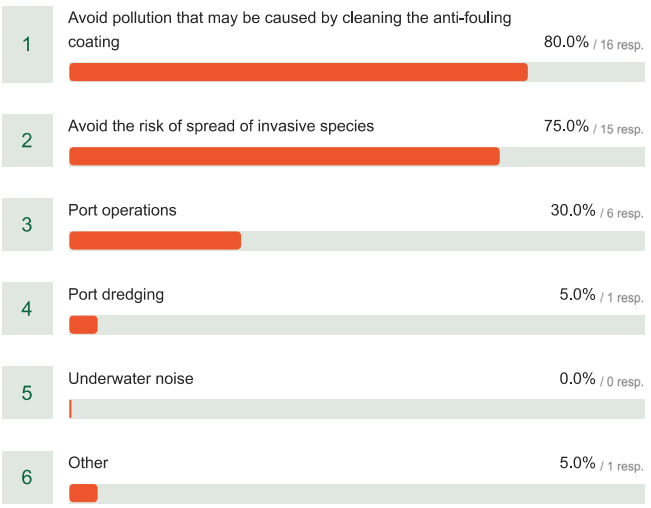
Do any of the ports or countries you operate in require you to have permission for each in-water cleaning activity?



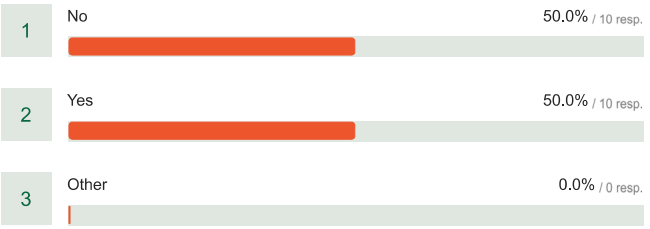
Has a port or country ever not allowed your company to in-water clean?



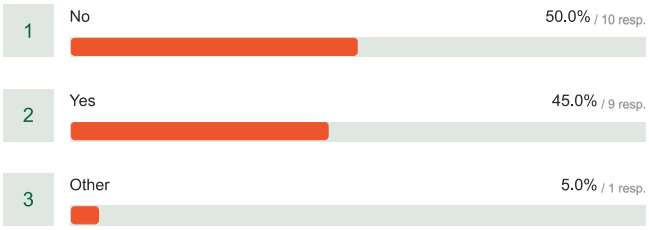
In your view, what are the main reasons that ports or countries do not allow in-water cleaning?



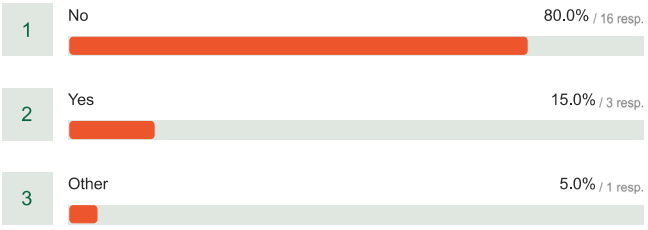
Do any of the ports or countries you operate in allow in-water cleaning only in certain locations?



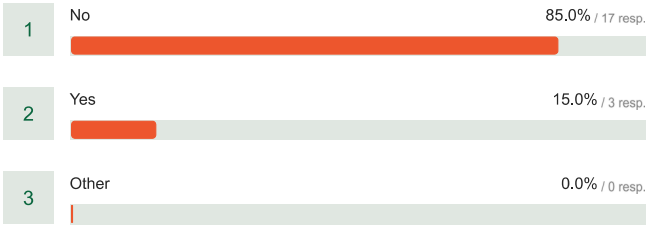
Do any ports or countries place conditions on your in-water cleaning activities? Conditions might include taking photographic evidence of the cleaning event, collecting and analyzing water or sediment samples, filtering and/or capturing material dislodged during cleaning.



Are there any ports or jurisdictions that have placed conditions on in-water cleaning activities that your company has been unable to meet?

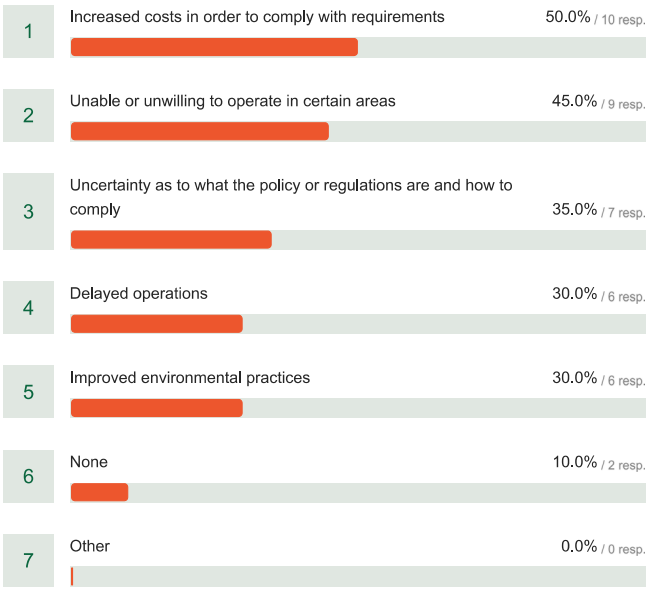


Are you aware of a port or country ever penalizing in-water cleaning service providers for not meeting conditions related to in-water cleaning activities?



In your view, what are the main barriers to complying with in-water cleaning policies or practices?

In general, what impact have port and/or country in-water cleaning policies had on your business?

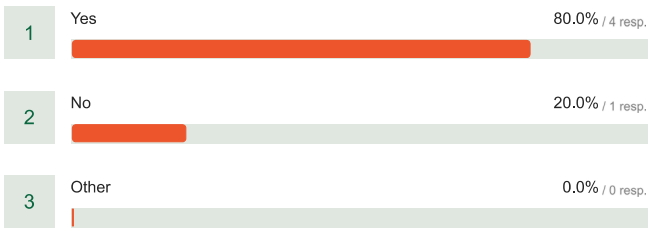


ANNEX E.

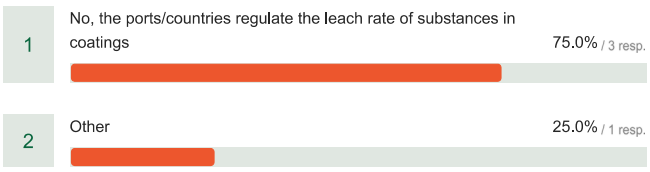
SURVEY QUESTIONS & RESULTS – COATINGS STAKEHOLDERS

Please identify your role in the coatings industry:

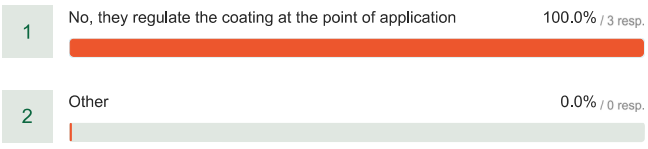
Are you aware of any ports or countries that regulate, or intend to regulate, substances in coatings beyond those included in the International Convention on the Control of Harmful Anti-fouling Systems in Ships (AFS Convention)?



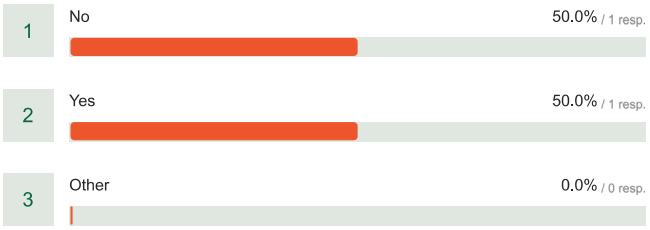
Of the ports and/or countries that regulate substances in coatings, do any specify the quantity of particular substances allowed in a coating?



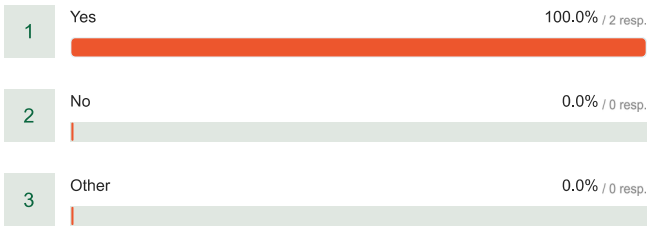
Of the ports and/or countries that regulate substances in coatings, do any deny entry to ships that have coatings that do not comply?



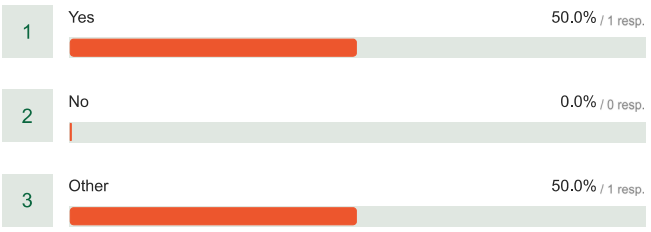
When working with customers to select coatings based on their operating profile, are contingencies taken into account for unexpected operations or periods of inactivity?



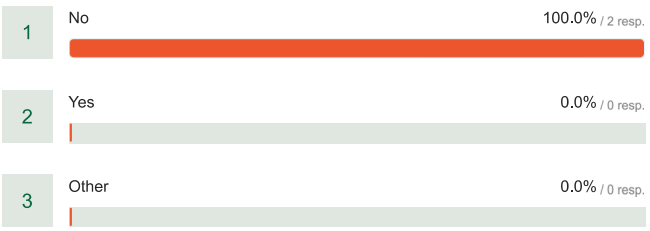
When working with customers to select coatings, do you provide information to the customer related to the cost/ benefit of coatings options, so that the customer is aware of the potential fuel efficiency gains with certain coatings?



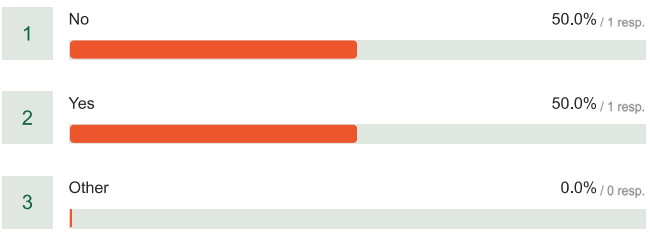
When a customer has selected a coating, do you provide a recommended inspection regime?



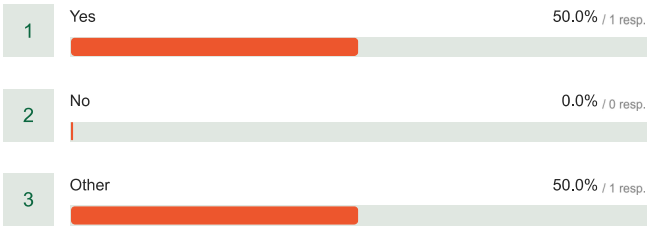
When a customer has selected a coating, do you provide recommended thresholds for biofouling growth, at which point cleaning should be undertaken?



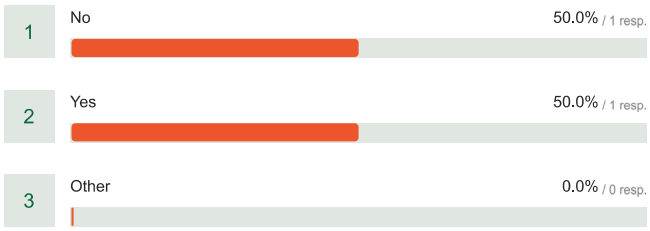
If you do provide biofouling growth thresholds at which point cleaning should be undertaken, do you suggest methods or providers for cleaning that should be used to minimize damage to the coating?



In your experience, do customers have sufficient knowledge and experience to be able to engage in a discussion with a coating provider, to ensure the best coating is selected, and not just the cheapest?



Do you work with customers at dry dock to analyze the performance of the previously used coating, and provide recommendations for the next coating cycle?



NOTES

NOTES

More information:
GloFouling Partnerships Project Coordination Unit
Department of Partnerships and Projects
International Maritime Organization
4 Albert Embankment
London SE1 7SR
United Kingdom
www.glofouling.imo.org

IMO INTERNATIONAL MARITIME ORGANIZATION