



A Rapid Assessment Study on Biofouling Management and Invasive Aquatic Species in the East Asian Seas Region

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Preface

The UNDP/GEF/IMO GloFouling Partnerships Project is aimed at catalyzing government action, industry innovation and know-how in order to reduce the transfer of invasive aquatic species (IAS) from international shipping and other marine sectors in a holistic approach. While the reach is global, all the intended outcomes, outputs and activities are directly geared towards the national and regional levels with a view to improving maritime institutions, technologies and operations as well as achieving improved monitoring and impact mitigation in the participating developing countries.

This regional stock taking report on the state of biofouling management and approaches in the EAS region served as one of the reference materials of the awareness raising seminar on the issue of minimizing the transfer of invasive aquatic species through biofouling and exchange information and knowledge on biofouling management and approaches in countries in the region.

The activity is part of a series of actions that will lead to examining options for regional cooperation and the coordination of biofouling management measures and developing a strategy to promote regional harmonization of biofouling management.

The paper was undertaken through secondary research and survey, and provides best available information that

- identify and map the invasive alien species commonly found in the region, their uses and impacts
- compile relevant laws, policies, and studies related to biofouling/IAS management in the region, when applicable
- classify existing policies, plans, research and good practice examples per country in the region
- present relevant institutional arrangements, capacity, and available resources
- identify key stakeholders and players in the region on biofouling management.

Partnerships in Environmental Management for the Seas of East Asia (PEMSEA) which is the regional coordinating organization for the GloFouling Partnerships Project in the ASEAN/East Asian region, is open to inputs and comments from relevant countries in the region to provide information, studies and regulations that may not have been captured in this report. Inputs and suggestions can be coursed through info@pemsea.org

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1. Introduction

The introduction of invasive aquatic species to new environments by ships has been identified as a major threat to the world's oceans and to the conservation of biodiversity. An IUCN 2009 report highlighted ballast water as one of the main vectors for the transport of many invasive aquatic species.

On the other hand, studies have shown that biofouling can be a significant vector for the transfer of invasive aquatic species. Biofouling on ships may pose threats to human, animal and plant life, economic, cultural activities and the aquatic environment.

In South East Asia in particular, the problem of invasive species carried by ships has intensified over the last few decades due to expanded trade and traffic volume and since the volumes of seaborne trade continue to increase, the problem may not yet have reached its peak. The effect in many areas of the world has been devastating. Quantitative data show that the rate of bio-invasions is continuing to increase at an alarming rate and new areas are being invaded all the time.

The risk posed by IAS in vessels' ballast water is now regulated internationally by the Ballast Water Management (BWM) Convention, which entered into force on 8 September 2017. However, the control of vessel biofouling remains largely voluntary.

IMO adopted Resolution MEPC.207(62) outlining the *Guidelines for the Control and Management of Ships' Biofouling to Minimize the Transfer of Invasive Aquatic Species* (IMO Biofouling Guidelines) in 2011. These voluntary guidelines are intended to provide a globally consistent approach to the management of biofouling and recommend vessels carry a Biofouling Management Plan onboard that outlines practices to manage a vessel's

biofouling. Management practices may include applying an up-to-date anti-fouling coating, installing a marine growth prevention system and having in-water inspections and cleaning after extended stationary periods. Recommendations also include developing a Biofouling Management Plan specific for each ship and carrying an onboard a Biofouling Record Book detailing all inspections and biofouling management measures undertaken.

As part of the wider efforts by the International Maritime Organization (IMO) in collaboration with the United Nations Development Programme (UNDP) and the Global Environment Facility (GEF), to protect marine ecosystems from the negative effects of invasive species the GloFouling Partnerships Project was initiated in 2019, as a natural follow-up to the GloBallast Programme (2001-2017 which focused on ballast water management).

The overall objective of the GloFouling Partnerships Project is to develop tools and guidance that can help build capacity in developing countries for implementing the IMO Biofouling Guidelines and relevant recommendations for other maritime industries affected by biofouling and to catalyse overall reductions in the transboundary introduction of biofouling-mediated IAS with additional benefits in the reduction of GHG emissions from global shipping.

One of the core activities of the Project is to raise awareness on the issue and impacts of invasive aquatic species transferred through biofouling and exchange information and knowledge on biofouling management and approaches in respective countries to protect marine biodiversity and the ecosystem services they provide to society.

A regional strategy that is aligned to the IMO Biofouling Guidelines is considered to be the way forward towards achieving a consistent and holistic approach and promote a regional harmonization of biofouling management practices. Thus, this study is conducted as input to the regional strategy for biofouling management in the East Asian Seas region.

2. Objectives of the study

In order to develop and implement effective biofouling management practices and to develop a regional strategy for biofouling management, the GloFouling Partnerships Project, through PEMSEA (the Regional Coordinating Organization for the EAS region), has instigated the development of a Rapid Assessment Study on Invasive Aquatic Species and Biofouling Management in the EAS region. The study is aimed at determining the current status of biofouling management and issues related to invasive aquatic species (IAS) in the EAS region. Specifically, it endeavours to establish baseline information with regard to the following:

- a. IAS commonly found in the EAS region and their impacts;
- b. Extent or potential for introduction and spread of IAS in the region;
- c. Relevant laws, policies, studies and institutional arrangements related to biofouling management and IAS in the EAS region; and
- d. Key stakeholders and players on biofouling management.

The result of the rapid assessment study serves as input to developing a framework for the regional strategy for managing biofouling in the EAS region.

3. Methodology

A survey questionnaire was developed using the IMO developed Guide to Developing National Status Assessment on Biofouling Management (Self-Assessment Checklist). It consisted of 7 sections as follows:

- a. Assessing the likelihood of Invasive Aquatic Species (IAS) Introduction
- b. Assessing the likelihood of Invasive Aquatic Species (IAS) Spreading
- c. Impact of Invasive Aquatic Species (AIS) on Socio-Economic Activities
- d. Policy and Legal Frameworks
- e. Institutional Arrangement
- f. National Strategy and Action Plan for Biofouling
- g. Studies and Researches on Biofouling and/or Invasive Aquatic Species

The survey questionnaire was sent to PEMSEA and IMO focal points. Due to limited duration of the study (May 16-June 16), only 10 filled-in questionnaires were retrieved from 8 countries consisting of Cambodia, China, Malaysia, Philippines, Republic of Korea, Singapore and Thailand. Document review on related literatures such as studies, legislations and national strategies supplemented the data collected from the survey questionnaires. A sample of the survey questionnaire is attached as **ANNEX A**.

4. Results and Discussion

4.1 Presence of IAS in the EAS Region

The ASEAN–India Cooperation Project on Extent of Transfer of Alien Invasive Organisms in South/Southeast Asia Region by Shipping has introduced a regional perspective on the issue of alien invasive organisms. This Project successfully achieved its objective in developing regional cooperation and networks to address the issue of alien invasive organisms (Anil.2018). Under this project, studies on AIS were conducted and enabled participating countries to identify AIS that are present in the region.

Some of the pertinent invasive aquatic species for the purpose of this biofouling study including those conducted under the ASEAN- India Cooperation Project are as follows:

a. *Mytella Strigata*

A study of IAS. (2018) indicated that the American brackish-water mussel ***Mytella strigata*** is reported from Singapore for the first time. It indicated that this alien mussel recently introduced to **Singapore** is spreading rapidly. In 2016, a survey of intertidal hard structures revealed that the mussel densely covers large areas of the Johor Strait. Native to Central and South America, it was previously known as ***Mytella charruana*** or the *Charru mussel*. It has since invaded other warm waters in the USA, India, Thailand and the Philippines. It is believed that the species may have been transported in ballast water and/or with fouling directly from its native provinces, or spread from the Philippines where there are already

established populations of *M. strigata* since the 19th century. The study found that this invasive mussel is displacing the Green mussel. There are instances pointing to its impacts on floating solar energy panel arrangements in Singapore, compromising the stability of the structure and increasing the costs of maintenance (cleaning). Likewise, the study published by Vallejo, B. et al (2017) reported the presence of the Charru mussel, in Manila South Harbor, Manila Bay, Luzon Island, Philippines. The trends in abundance of *Mytella* during the 2014–2015 sampling season are described and the potential of this new species to become invasive and competitive with native *Perna viridis* (Linnaeus, 1758).

Spreading fast in Singapore

A new species of mussel – *Mytella strigata* – that could have come from as far away as the Americas has since 2016 been spreading rapidly along Singapore's northern coast.



WHERE ARE THE MUSSELS FOUND

1 Gedong Buoy	8 Serangoon Buoy
2 Lim Chu Kang	9 Pasir Ris
3 Sungei Buloh	10 Changi Fish Farm
4 Kranji	11 CAAS Buoy
5 Sembawang	12 Sungei Jurong
6 Punggol	13 Republic of Singapore Yacht Club
7 Pulau Ubin	

DISTRIBUTION (Based on published sources)



WHY ITS PRESENCE IS OF CONCERN



- Observed in clumps of up to 10,000 individual shellfish (above), the invasive American brackish-water mussel has been clogging up nets in fish farms here, and displacing the Asian green mussel native to Singapore.
- It has also been forming dense mats at the Kranji mudflats – home to rare horseshoe crabs – and the appearance of the mussels in these ancient creatures' habitat has made it difficult for them to burrow into the sand.

PHOTOS AND SOURCES: ST JOHN'S ISLAND NATIONAL MARINE LABORATORY, TROPICAL MARINE SCIENCE INSTITUTE, NATIONAL UNIVERSITY OF SINGAPORE, RIA TAN/WILDSINGAPORE.COM STRAITS TIMES GRAPHICS

b. *Mytilopsis sallei*

Another IAS found in Manila Bay (Philippines), Songkhla Port (Thailand) and Singapore is the Caribbean bivalve *Mytilopsis sallei* (**black striped mussel**). The study on *The Invasive*

Caribbean Mytilopsis sallei (Bivalvia: Dreissenidae): A short review by Tan and Morton in 2006 indicated that the mussel-like bivalve species

from the Caribbean, *Mytilopsis sallei*, is now well established in the vicinities of several ports in South and Southeast Asia. This mussel has the ability to colonise and displace native species in intertidal and subtidal habitats (Tan, K. et al. 2018).



Source: en.wikipedia.org

Mytilopsis sallei has similar impacts to the zebra mussel *Dreissena polymorpha* and a major fouling species, forming dense monocultures which can lead to a substantial reduction in biodiversity.

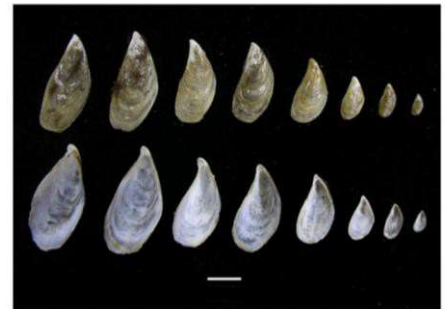
(<http://chm.aseanbiodiversity.org/invasivealienspecies/aistaxonomictree/SpeciesSummary>.)

c. **Mytilopsis adamsi** Morrison, 1946 (Bivalvia: Dreissenidae)

The *Mytilopsis adamsi* Morrison, 1946 (Bivalvia: Dreissenidae), a brackish water bivalve, native to tropical West Pacific coast of central America has now become established in East Asian, South Asian and Southeast Asian countries specifically in the

lower part of the Gulf of Thailand, in Haad-kaew Lagoon and Thale Sap Songkhla, in

Songkhla province, and the Pak Phanang Estuary in Nakhon Si Thammarat province, south Thailand. This was revealed in a study published by Wangkulangkul in Oct 2008.



Source: researchgate.net

d. **Asian Green Mussel**

The study conducted by Huhn, et al of the Marine Center, Bogor University indicated that *Asian Green Mussel* was detected in Eastern Indonesia. The study further stressed that the discovery of *Perna viridis* on two ferries demonstrates the

potential role of domestic ship traffic as a vector for species transfer within the Indonesian archipelago (Hunh 2015).

The establishment of the Asian green mussel in the Banda and Arafura Sea, which are part of one

of the world's biodiversity hotspots and support a large number of marine endemic species (Allen 2008),

represents a major risk to the

integrity of these unique marine ecosystems.



An extensive listing of invasive species can be found in the [IUCN Global Invasive Species Database](#).

The Global Invasive Species Database is a free, online searchable source of information about alien and invasive species that negatively impact biodiversity. The GISD aims to increase public awareness about invasive species and to facilitate effective prevention and management activities by disseminating specialist's knowledge and experience to a broad global audience. It focuses on invasive alien species that threaten native biodiversity and natural areas and covers all taxonomic groups from micro-organisms to animals and plants.

The studies revealed that the presence and extent of Invasive Aquatic Species in the region is increasing and has been causing negative impacts to some of the socio-economic activities in the region. Some of the researches and studies indicated in the survey are listed in **ANNEX B**.

4.2 Databases and Information Sources on Invasive Aquatic Species

This study gathered information on information sources and available databases on IAS from the [GEF/UNDP/IMO GloFouling Partnerships Project](#) which has links to all major global, regional and national databases available in its [knowledge hub](#).

The Invasive Species Specialist Group (ISSG) of IUCN's Species Survival Commission (SSC) ISSG aims to reduce threats to natural ecosystems and the native species they contain by increasing awareness of invasive alien species, and of ways to prevent, control or eradicate them. ISSG also produces the newsletter 'Alien', and maintains a list serve. <http://www.issg.org>

ISSG manages *the Global Invasive Species Database* which aims to increase awareness about invasive alien species and to facilitate effective prevention and management activities. <http://www.issg.org/database>

Invasive Species Information Node of the National Biological Information Infrastructure

The Invasive Species Information Node provides links to invasive species data sources including a catalogue of invasive alien species information systems, databases and datasets. <http://invasivespecies.nbi.gov/dbases.html>

IUCN Global Marine Programme IUCN's *Global Marine Programme* focuses on eight broad themes, one of which is managing marine alien invasive species. Activities include field projects on detection and management of marine alien invasive species, capacity building and awareness raising, as well as policy work to strengthen international regulations to manage marine species introductions. <http://www.iucn.org/marine>

The Global Invasive Species Programme (GISP) GISP is an international partnership with the aim of conserving biodiversity and sustaining livelihoods by minimising the spread and impact of invasive species. GISP provides support to the implementation of Article 8(h) of the Convention on Biological Diversity and has contributed extensively to the knowledge and awareness of invasive species through the development of a range of products and publications. <http://www.gisp.org>

The Convention on Biological Diversity (CBD) The Convention on Biological Diversity sets commitments for maintaining the world's biological diversity. The Convention establishes three main goals: conservation of biological diversity, sustainable use of its components,

and fair and equitable sharing of the benefits from the use of genetic resources. Article 8h of the Convention calls on parties to prevent the introduction of, control or eradicate those alien species which threaten ecosystems, habitats or species; and several Plans of Work under the CBD specifically mention invasive species. <http://www.biodiv.org>

Malaysia indicated to have a database on AIS which is the *Malaysia Biodiversity Information* from MyBIS provides the information exchange platform of the Convention on Biological Diversity. Created in accordance with Article 18(3), it has evolved into a global network of websites with the CBD website (www.cbd.int) as its central node, and MyBIS as national nodes of the network. Biodiversity information deposited in this website are abstracted published books, journals, expert checklists and specimen databases.

The Ministry of Fisheries (MOF) of Republic of Korea operates the Marine Environment Information Website which can be accessed at <https://www.meis.go.kr/mes/marineLife/disturb/species.do>. In addition, Information of Korean Alien Species can be accessed at kias.nie.re.kr

Other countries such as China and Singapore indicated to have a database on AIS but did not indicate details.

4.3 Socio-Economic Impacts of IAS

In marine ecosystems, the negative impacts of invasive aquatic species include the following:

- a) displace native species,
- b) cause the loss of native genotypes,
- c.) modify habitats,
- d) change community structure,
- e) affect foodweb properties and ecosystem processes,
- f) impede the provision of ecosystem services,
- g) impact human health, and

- h) cause substantial economic losses (Grosholz 2002; Perrings 2002; Wallentinus and Nyberg 2007; Molnar et al. 2008; Vilà et al. 2010).

Hence, the survey made an attempt to determine the impact of IAS to socio-economic activities in the region. Majority of respondents from the 8 countries who participated in the survey recognized that invasive aquatic species is a growing threat to the region and have negative impact to capture fisheries, aquaculture, tourism and powerplants.

Specific examples of these are the following:

- China: The invasive bivalve *Mytella Salliei* changed the community structure of fouling macrofauna and reduced the species diversity index in Yundang Lagoon, Xiamen. Results of the study confirmed that this invasive species changed the density and biomass compositions of fouling macrofauna, reduced the species diversity index during the summer period, and somewhat worsened the aquatic environmental quality in Yundang Lagoon, because the pH and the DO were the lowest, and the BOD and the COD were the second lowest in summer among four seasons (Cai, et al. 2014).
- A study conducted under the ASEAN-India Cooperation Project revealed that *Perna viridis* can be a major fouling species in seawater cooling systems of coastal power plants in the tropics. The green mussel *Perna viridis*, native to the Asia-Pacific region, has been introduced to other regions such as the Caribbean, Japan and North and South America. It is a large, commercially

important species, widely cultivated and harvested in Southeast Asia, but is also considered an invasive species elsewhere, capable of replacing native species. As a fouling organism in intake systems of coastal power plants, it causes flow blockage and loss of cooling efficiency. (Venugopalan, 2018)

Most of the studies indicated by respondents of the survey are on the impact of invasive aquatic species on fisheries. However, respondents have not indicated studies relating to the impacts of IAS on tourism and power plants. There is also a need to conduct more consultations with the aquaculture sector in the region as studies have indicated that the European carp, for example is a potential carrier of the white spot disease that severely affect shrimp aquaculture.

4.4 Policy and Legal Framework on IAs and Biofouling Management

The overall commitment of the Government in dealing with biofouling/IAS can be attributed to the international instruments the Government is a party to. The potential for invasive aquatic species transferred through biofouling to cause harm has been recognized in various international instruments such as the Convention on Biological Diversity (CBD), and in various UNEP Regional Seas Conventions (e.g. Barcelona Convention for the Protection of the Mediterranean Sea Against Pollution) and international organizations and regional programmes such as the International Maritime Organization, the Asia Pacific Economic Cooperation forum (APEC) and the Secretariat of the Pacific Region Environment Programme (SPREP).

The Convention on Biological Diversity recognizes that there is an urgent need to address the impact of invasive alien species. Specifically, Article 8(h) of the CBD states that, “Each contracting Party shall, as far as possible and as appropriate, prevent the introduction of, control or eradicate those alien species which threaten ecosystems, habitats or species”.

BWM Convention is aimed at preventing the spread of potentially invasive species in ship’s ballast water and the AFS Convention prohibits the use of harmful organotin compounds in anti-fouling paints used on ships and will establish a mechanism to prevent the potential future use of other harmful substances in anti-fouling systems.

Table 1 shows the status of ratification of countries in the region to the Convention on Biological Diversity (CBD) and Ballast Water Management (BWM) Convention. These conventions provide legal frameworks in addressing IAS and biofouling risks at the global level.

Country	CBD*	BWM**
Cambodia	✓	X
China	✓	✓
Indonesia	✓	✓
Malaysia	✓	✓
Philippines	✓	✓
RO Korea	✓	✓
Singapore	✓	✓
Thailand	✓	X
Vietnam	✓	X

China, Indonesia, RO Korea and Singapore have translated both the BWM Convention into domestic law. Cambodia and Thailand have not ratified the BWM Convention while Vietnam is not yet a party to the BWM Convention.

Since most of the countries in the EAS region are Party to these international instruments, it indicates their commitment to addressing the issue of IAS by ships. However, the survey revealed that the countries have no specific national policy that addresses biofouling.

The survey revealed that the IMO Biofouling Guidelines have not been implemented in the majority of the countries covered in this survey.

However, countries who have implemented the mentioned conventions may build on their experience in drafting the BWM and in developing their strategy for biofouling management.

4.5 Institutional Arrangement for IAS and Biofouling Management

Result of the survey indicated that there is no single agency with over-all responsibility for biofouling management in majority of countries.

The various ministries and government agencies involved in managing biofouling in respective countries are:

- Ministry of Environment
- Ministry of Natural Resources
- Ministry of Agriculture and Fisheries
- Ministry of Health
- Ministry of Energy
- Ministry of Transport
- Maritime Administration
- Customs Department
- Biodiversity Management Bureau or equivalent
- Academe
- Non-Governmental Organizations

In some countries various regulatory agencies coordinate among themselves through a National Committee or Commission as shown in Table 2.

Table 2 Inter-agency Coordinating Mechanism for Biofouling Management		
Country	Interagency Mechanism	Description
China	National Committee for Biodiversity Conservation	Established in 2011, composed of 23 departments under the State Council and headed by a Vice Premier, was established to promote communication and collaboration among departments and coordinate biodiversity actions at the national level. https://www.fmprc.gov.cn/mfa_eng/
Malaysia	National Committee on IAS	The National Committee on IAS membership involves various cross-functional agencies that are responsible to perform research, registration, enforcement, monitoring and instill public awareness on IAS. The committee normally meets twice a year but additional meeting(s) could be called upon if the need arises. The committee meeting is chaired by the Director - General of Department of Agriculture (DOA) Malaysia and the Plant Biosecurity Division of DOA serves as the Secretariat of this committee. Appendix II could be referred to for details of the committee members (<i>source: Malaysia National Action Plan on IAS 2021-2025</i>)
Philippines	Inter-agency Committee on the Ratification and Implementation of Maritime Conventions (ICCRIMC)	This interagency coordinating mechanism is a forum for discussing issues related to ratification and implementation of maritime conventions to which the Philippines is a Party of.

4.6 National Strategies and Action Plan

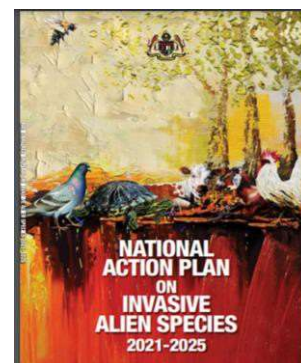
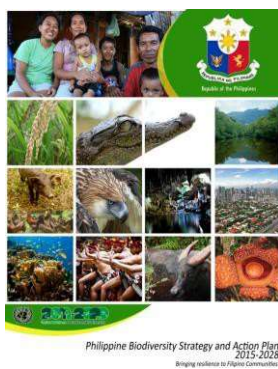
The survey indicated that there are no national strategies and /or action plans for biofouling management in the 8 countries who responded to the survey. Majority of countries have incorporated biofouling management in their National Biodiversity Strategies and Action Plan (NBSAP).

All 8 countries (Cambodia, China, Indonesia, Malaysia, Philippines, RO Korea, Singapore, and Thailand) are signatories to the Convention on Biological Diversity and therefore, have their National Biodiversity and Strategies and Action Plan in place as reflected in Table 3. This is in accordance with Article 6 of the Convention on Biological Diversity which states that each Contracting Party shall, in accordance with its particular conditions and capabilities:

(a) Develop national strategies, plans or programmes for the conservation and sustainable use of biological diversity or adapt for this purpose existing strategies, plans or programmes which shall reflect, inter alia, the measures set out in this Convention relevant to the

Contracting Party concerned

(b) Integrate, as far as possible and as appropriate, the conservation and sustainable use of biological diversity into relevant sectoral or cross- sectoral plans, programmes and policies.



Article 6 creates an obligation for national biodiversity planning. It reflects how the country intends to fulfill the objectives of the Convention taking into consideration specific national circumstances.

Table 3 National Biodiversity Strategy and Action Plan	
Cambodia	National Biodiversity Strategy and Action Plan(Feb 2016) https://www.cbd.int/doc/world/kh/kh-nbsap-v2-en.pdf
China	China Biodiversity Conservation Strategy and Action Plan (2011- 2030) https://www.cbd.int/doc/world/cn/cn-nbsap-v2-en.pdf
Indonesia	Indonesian Biodiversity Strategy and Action Plan 2015-2020 https://www.cbd.int/doc/world/id/id-nbsap-v3-en.pdf
Malaysia	National Action Plan on Invasive Alien Species 2021-2025 http://www.doa.gov.my/index/resources/aktiviti_sumber/sumber

	_awam/penerbitan/buku/national_action_plan_on_invasive_alien_species_2021-2025.pdf
Philippines	Philippine Biodiversity Strategy and Action Plan 2015-2028 https://www.cbd.int/doc/world/ph/ph-nbsap-v3-en.pdf
RO Korea	The Republic of Korea's Fourth National Biodiversity Strategy 2019 – 2023 https://www.cbd.int/doc/world/kr/kr-nbsap-v4-en.pdf
Singapore	Singapore's https://www.cbd.int/doc/world/kr/kr-nbsap-v4-en.pdf National Biodiversity Strategy and Action Plan (updated in May 2019 based on Aichi Biodiversity Target 2011-2020) https://www.nparks.gov.sg/-/media/nparks-real-content/biodiversity/national-plan/singapore_2009-nbsap_updated-may-2019
Thailand	The Master Plan for Integrated Biodiversity Management B.E. 2558-B.E. 2564 https://www.cbd.int/doc/world/th/th-nbsap-v4-en.pdf

4.7 IAS and Biofouling Monitoring Programmes

Monitoring mechanisms on invasive aquatic species and biofouling risks varies across countries in the region. In China, information on invasive species is included in the Bulletin on the State of China's Ecology and Environment. While in Malaysia, IAS/biofouling is monitored under the Malaysian Quarantine and Inspection Services, Royal Malaysian Customs Department and Marine Department of Malaysia. In Singapore, there is no specific IAS/biofouling monitoring programme but IAS is recorded during various habitat surveys.

Other countries indicated that there is no IAS/biofouling monitoring programme implemented in their country.

4.8 Regional Stakeholders

Some of the regional stakeholders and organizations identified in the study are as follows:

- ASEAN Ports Association (APA)
<https://apaport.org/>
- Asian Shipowners Association
<https://asianshipowners.org/>

- Federation of ASEAN Shipowners Association
<http://www.fasa.org.sg/>
- Southeast Asian Fisheries Development Center (SEAFDEC)_
www.seafdec.org.ph
- ASEAN Biodiversity Center_
<https://aseanbiodiversity.org/>
- Association of Asian Classification Societies (ACS)_
<http://www.asiancs.org/html/>
- ASEAN Tourism Association_
<https://www.aseanta.org/en>
- Singapore Boating Industry Association_
<http://singaporeboating.org/>
- Coral Triangle Initiative on Cora Reefs, Fisheries and Food Security_
<https://www.coraltriangleinitiative.org/>

5. Conclusion and Recommendations

Based on the result of the study, the following conclusions and recommendations are presented:

- While pathways for the transfer of IAS were identified by countries, there is lack of studies in establishing the extent of its transfer and spread.
- Countries recognized that IAS and biofouling have negative impacts on socio- economic activities such as on capture fisheries, aquaculture, tourism and powerplants. However, further studies need to be conducted to establish its economic and ecological impacts on specific sectors.
- No single ministry/agency is responsible for IAS and biofouling, not well defined in some countries. This is to be expected as many different industries/sectors can be affected by biofouling.

- No specific policy addressing biofouling.
- No strategy and action plan specific to biofouling management. Majority of countries have incorporated IAS and biofouling in their National Biodiversity Strategies and Action Plan (NBSAP) as part of their commitment to the Convention on Biological Diversity.
- Awareness building and capacity development is needed for better understanding of the issue.
- Difficult to obtain data/information coming from different ministries (at national level). Hence, there is a need for an integrated information management system at country and regional level to obtain comprehensive baseline information on the extent of IAS in the region.

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Studies/ Researches conducted in Korea:

Techniques development for management and evaluation of biofouling on ship hulls (KIOST)

Development of risk assessment and management process of ship's biofouling debris discharged from in-water cleaning (KIOST)

ANNEX A
Sample Survey Questionnaire

**A Rapid Assessment Study on Bio fouling Management and Invasive Aquatic
Species in the EAS Region**

Purpose: *This rapid assessment study is conducted to determine the current status of biofouling management and issues on invasive aquatic species in the EAS region.*

Objective: *Specifically, it endeavours to establish baseline information with regard to the following:*

- a. IAS commonly found in the EAS region and their impacts;*
- b. Extent or potential for introduction and spread of IAS in the region;*
- c. Relevant laws, policies, studies and institutional arrangements related to biofouling management and IAS in the EAS region; and*
- d. Key stakeholders and players on biofouling management.*

The result of the rapid assessment study will serve as an input in developing a framework for the regional strategy for managing biofouling in the EAS region.

Respondents Name: _____

Position: _____

Organization: _____

Country: _____

EXISTING ARRANGEMENTS TO MANAGE AND CONTROL BIOFOULING RISKS	Yes	No
I. Assessing the likelihood of Invasive Aquatic Species (IAS) Introduction		
1. <i>Are IAS have already been identified in the country?</i>		
2. <i>Which IAS are found in your country?</i>		
3. <i>Which of the following primary biofouling transfer pathways are known to exist in your country</i>		
• International trading and non-trading ships		
• Fishing vessels (foreign flag and domestic)		
• International recreational craft (super yacht)		
• Mobile oil and gas platform		
4. <i>Which of the following potential secondary biofouling transfer pathways are known to exist in the country?</i>		
• Domestic trading and non- trading		
• Fishing vessels		
• Recreational craft		
II. Assessing the Likelihood of Invasive Aquatic Species (IAS) Spreading		
5. <i>Which of the following structures are known to exist in the country</i>		
• Ports and Harbours		
• Marinas and recreational boating facilities		
• Offshore oil and gas platforms		
• Aquaculture Structures		
• Marine renewable energy structures		
III. Impact of Invasive Aquatic Species (AIS)		
6. Is there an evidence of previous impacts of IAS to capture fisheries? (Pls indicate studies or sources of information)		
7. Is there an evidence of previous impacts of IAS to aquaculture activities? (Pls indicate studies or sources of information)		
8. Is there an evidence of previous impacts of IAS to tourism activities? (Pls indicate studies or sources of information)		
9. Is there an evidence of previous impacts of IAS to power		

plants in the country? (Pls indicate studies or sources of information)		
IV. Policy and Legal Framework		
10. Has a national policy been developed that addresses biofouling?		
If YES, under what specific national policy is biofouling addressed? (E.g., <i>Biosecurity Policy, National Oceans Policy, Biodiversity Policy</i> etc.)?		
If NO, which of the following approaches will be adopted by your country? <ul style="list-style-type: none"> • Specific inclusion of IAS/biofouling in a national <i>Biosecurity Act</i> that addresses all types of biosecurity risk; • Development of specific regulations addressing biofouling risks under an existing parent act (e.g., <i>Environmental Protection Act</i>); • Specific inclusion of IAS/biofouling in sector specific legislation or regulations promulgated pursuant to such an act (e.g., <i>Maritime Transport Act</i>). 		
11. Has your country ratified or acceded to the <i>Anti-fouling Systems Convention</i> ?		
12. Has the <i>Anti-fouling Systems Convention</i> been implemented in domestic law?		
13. Has your country ratified or acceded to the <i>Ballast Water Management Convention</i> ?		
14. Has the <i>Ballast Water Management Convention</i> been implemented in domestic law?		
15. Have the <i>Biofouling Guidelines</i> been implemented in domestic law?		
Under what national legislation have any of the conventions/guidelines (AFS, BWM and Biofouling) indicated above been given legal effect? Pls provide a copy if possible.		
16. Is ballast water managed as part of the country's Port State Control procedure?		
If YES, provide details of what reporting and inspection measures are in place to enforce requirements?		
V. Institutional Arrangements		
17. Is there a single agency with overall responsibility for biofouling management?		
If yes, which agency?		

If No, which entity (agency/authority) has primary responsibility for managing biofouling?		
18. Which other government departments/agencies are involved in managing biofouling?		
19. How do the various regulatory agencies coordinate among themselves to address biofouling risks? (e.g., is there a dedicated committee or task force for invasive marine species at the national/regional levels?)		
20. How are the private sector and non-governmental interests involved in decision-making and management?		
21. non-government stakeholders in Biofouling Management		
To successfully undertake the rapid assessment, it will be necessary to have the cooperation and support of a wide range of stakeholders (state and key non state actors who can help craft the regional strategy on biofouling management. Please identify non-government actors involved in biofouling management in your country.		
VI. National Strategy and Action Plan for Biofouling		
22. Is there any national strategy and/or action plan for biofouling management. If YES, pls provide details or a copy of the national strategy and/or action.		
23. If biofouling management is incorporated in other national strategies/action plans (Ex. National Biodiversity Strategic Plan), pls indicate under which national strategy and plan biofouling management is addressed.		
VII. Studies and Researches on Biofouling and/or Invasive Aquatic Species		
24. Are any existing IAS/biofouling research or monitoring programmes being implemented in your country? If YES, provide details.		
25. Are there any data base on invasive aquatic species in your country		

ANNEX B

List of Researches and Studies on IAS and Biofouling

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