Marine biosecurity toolkit: Biofouling assessment guidance

Document A

Introduction

Preventing the arrival, establishment and spread of marine non-indigenous species (NIS) is most cost- and time-effective during the transport stage. Vessels can accumulate biofouling (attached aquatic plants and animals) and spread them beyond their natural range. If conditions are suitable for survival in the new location, marine NIS can cause serious ecological, economic, social, and sometimes human health impacts. Fouling organisms accumulate naturally on the hull and other submerged structures of commercial and recreational vessels in marine environments. The growth of biofouling is managed through regular cleaning of these surfaces and the application of antifouling coatings to prevent the attachment and growth of biofouling organisms. To prevent new marine NIS from becoming established in local ports and harbours it is important to have techniques to quantify the number of vessels that carry biofouling and the abundance of marine organisms on individual vessels.

The amount of biofouling on a vessel depends on a variety of factors, including how well a vessel is maintained and how often it is used. The performance of many antifouling paints depends on movement of water past their surface, so vessels that have been idle for a long time will accumulate more biofouling than those that are used regularly. Also, the effectiveness of most antifouling paints in preventing biofouling declines over time. The longer the vessel has been in the water since last painted, and/or cleaned, can be an indicator of the presence and abundance of biofouling. Some antifouling coatings only provide effective protection from biofouling for 9–18 months, while others can offer lasting protection for over 2 years[1] [2]. Generally, the vessels with the greatest abundance and diversity of biofouling are those that have not been used for extended periods or which have antifouling coatings older than 2 years. The age and type of vessel and its recent travel history are important, because the vessel type will determine the numbers and types of niche areas particularly susceptible to biofouling. These niche areas on vessels include rudders, propellors and propellor shafts, intake, and discharge points.

It is important to assess the degree of biofouling on visiting vessels regularly to help reduce the risk of introducing marine NIS into local waters. This guidance document provides information on how to do a simple assessment of vessel biofouling and collate information on vessel maintenance and travel history to determine those vessels that may pose a higher risk of introducing marine NIS.

Methods

There are three steps to performing a biofouling risk assessment.

1. Collect information on a vessel, its maintenance, and voyage history.
2. Carry out a visual assessment of the vessel hull to determine the level of fouling (LOF).
3. Perform post-assessment actions.

Step 1

The following information should be collected from the vessels' captain/owner, if possible, either before or promptly after entry into local waters.

Part I:		
Information about the vessel	Vessel name and Identification number	Vessel names are not unique. To keep track of individual vessels, call signs and/or IMO numbers should also be recorded if possible.

[1] Floerl et al. 2005
[2] Hayes et al. 2019

	Vessel type	Faster vessels tend to have fewer species present on the vessel hull overall than smaller and slower vessels. Recreational vessels also tend to have longer lay-up periods and are less restricted to deeper water ports and harbours, as a result they may also have increased biofouling (see Appendix B).
	Where the vessel is stored	If the vessel is recreational, is it stored on land or in the water – part, or full time. If the vessel is stored out of the water this will decrease the risk of transport of marine NIS.
Part II:		
Antifouling and maintenance	Date of last manual cleaning or hull inspection	If recently cleaned[3], the vessel will pose a lower risk.
	Date of last antifouling paint renewal	Vessels with new antifouling paint will pose a significantly lower risk of transporting marine NIS, especially if painted within the last three months[4].
Part III:		
Voyage history	Port of origin	Does the vessel come from an area with similar environmental conditions or areas where known problematic marine NIS already occur?
	Last port of call	If different from port of origin, then this could provide information on which species might be present in the biofouling.
	28-day voyage history	Provides information on places that have been visited and species that may have settled on the vessel that have not yet become an adult and which will have the ability to reproduce when grown. May prove useful if antifouling paint is older than four weeks.
	Duration of stay at each location	The longer a vessel is in a location, the more likely it is to have biofouling present, increasing the risk of transporting marine NIS.

To improve local knowledge of vessels, biofouling levels and how to implement any subsequent actions, it is initially recommended to carry out visual inspections on all vessels arriving into local waters.

Once the systems for collating this information are more streamlined, local decisions can be made by the assessor after collecting vessel, maintenance, and voyage history information about whether a vessel hull inspection may be required. This change in assessment protocol is taken from studies that show that the age of antifouling paint on a vessel is the best factor in predicting how much biofouling will be present on a vessel. If a vessel can provide evidence that their anti-fouling paint has been renewed or the vessel has undergone a significant hull clean within

[3]Less than three months old

[4] Taken from information based on the regional coastal plan for the Kermadec and Subantarctic Islands

four weeks of their arrival to port, then they could be provided with an exemption from inspection. In some locations it may not be feasible to perform visual inspections on all vessel arrivals, especially at times when there is a high number arriving at one time. In all instances, information about the vessel, maintenance, and voyage history should be collated. This can allow assessors to prioritise those vessels that pose a higher likelihood of biofouling present on the hull, to carry out a level of fouling inspection. Vessels that are less likely to need a visual assessment include those that are only visiting for a stay less than three days. However, those vessels that spent more than two weeks at their last port of call and have antifouling paint more than nine months old will always need to be inspected.

Step 2.

The level of fouling (LoF) rank scale was developed as a way for surface observers to evaluate and determine the level of biofouling on a vessel without having to get into the water to perform an inspection. It was calibrated based on arrivals of yachts into New Zealand waters but has been used to assess a variety of vessels in several international locations. The rank scale ranges from 0 (no fouling) to 5 (very heavy fouling). Although sometimes a surface fouling rank may result in an underestimation of true biofouling levels, a high surface level rank is generally consistent with the degree of fouling found in the deeper submerged surfaces of the hull. If they are available, underwater digital video cameras mounted on poles or other submersible remotely operated video systems can also be used to make a more accurate LOF assessment.

All information should be entered into a datasheet or digital form (template provided in Appendix A). If possible, digital images or video footage should be taken and image numbers recorded with the corresponding datasheet. If potential marine NIS are found during the inspection, and if it is possible and safe to do so, samples of suspect organisms should be taken following sampling guidance found in (Document C).

During a vessel inspection, one score should be allocated per vessel to the entire area submerged underwater that is visible to the assessor. See Table 1 for LoF descriptions, examples, and actions.

Step 3.

The results of the inspection have been categorised into three post-assessment actions depending on the levels of fouling discovered. For vessels scoring:

0 or 1: Acceptable – No action required.

2: Borderline – Vessel advised to clean the hull soon, or before returning to the local area.

3, 4 or 5: Unacceptable – Depends on the location of inspection. The vessel should either haul-out and clean the hull if suitable facilities are available or if no facilities are available, the hull should be cleaned in a proper facility elsewhere before returning to the local area. The vessel should not be allowed to clean the hull whilst in local waters. Follow up is required to ensure compliance (if ordered to clean the hull).

Raising awareness of the requirements and expectation of a hull inspection upon arrival for all vessels visiting the local area is highly recommended. Messaging should target potential arrivals through social media, yachting magazines, and marina websites where possible. For commercial vessels, information should be disseminated through shipping line companies and agents responsible for chartering vessels.

Information should also be made available at the port/harbour website along with other information for visiting vessels and leaflets provided for vessels given a score of 2 or above.

Materials should explain the range of best practice options available for prevention and mitigation of hull biofouling for different vessel types highlighting the importance of:

- Regularly checking and cleaning vessels, especially areas that are prone to biofouling (e.g. around the rudder, propellor, and water intake pipes)
- Thoroughly cleaning vessels in an appropriate dry dock or haul out facility before moving to a new location
- Using a suitable antifouling coating, appropriate to the vessels operational profile, and applied and maintained according to the manufacturer's instructions.

Table 01. Criteria for allocating LoF ranks by visual inspection from above the water surface

LoF Rank	Example	Description	Visual estimate of fouling cover	Actions
0		No visible fouling. Hull entirely clean, no biofilm(slime) on any visible submerged parts of the hull.	NIL	The extent of biofouling is **acceptable**, and no action is required.
1		Slime fouling only. Submerged hull areas partially or entirely covered in biofilm, but absence of any macrofouling.	Nil	

LoF Rank	Example	Description	Visual estimate of fouling cover	Actions
2		Light fouling. Hull covered in biofilm and 1–2 very small patches of macrofouling (only one taxon).	1–5% of visible submerged surfaces	Vessels are considered **borderline**. The captain/owner should be advised of the need to clean the hull in the near future or before returning to the local area. This vessel should not be allowed to clean their hull while in the water.
3		Considerable fouling. Presence of biofilm, and macrofouling still patchy but clearly visible and comprised of either one single or several different taxa.	6–15% of visible submerged surfaces	• The extent of the biofouling is considered **unacceptable** and poses a significant biosecurity threat. • If the port/harbour has appropriate facilities, the vessel should be removed from the water and cleaned to remove all biofouling. The vessel should not be allowed

LoF Rank	Example	Description	Visual estimate of fouling cover	Actions
4		Extensive fouling. Presence of biofilm and abundant fouling assemblages consisting of more than one taxon.	16–40% of visible submerged surfaces	to clean the hull while in the water. • If haul-out facilities are not available, then the vessel captain/owner should be made aware of the marine NIS risk and advised to clean their hull before returning to the local area. • Any records of known marine NIS or unidentified organisms of concern are kept, identified, and reported as soon as possible.
5		Very heavy fouling. Diverse assemblages covering most visible hull surfaces	41–100% of visible submerged surfaces	

Appendix A Vessel biofouling assessment datasheet example

Observer:	Assessment Date:		
Vessel biofouling assessment			
TO BE COMPLETED FOR ALL ARRIVING VESSELS			
Part I: Information about the vessel			
Vessel name			
Vessel identification number			
Vessel type			
Arrival location			
Date of arrival			
Voyage number (if applicable)			
Vessel storage location (if applicable) (please circle one)	In water	In water part time, part time on land	on land
Do you have a biofouling management plan on board			
Do you keep a biofouling record book?			
Part II: Antifouling and maintenance			
Date of last manual cleaning or hull inspection			
Date of last antifouling paint renewal			
Part III: Voyage history			
Port of origin			
Last port of call			
Voyage history			
Location	no. days	Location	no. days

Appendix B International maritime organisation vessel types

GEN TYPE	VESSEL TYPE
B	Bulk Carrier
C	Combined bulk and ore carriers
D	Dredgers- cutter, suction, hopper, sand, trailing
F	Fish- carrier, factory, protection, trawler, whaler
G	General cargo - reefer, container capacity,
L	Liquified natural gas - storage, carrier
M	Carrier - livestock, passenger, vehicle
N	Naval vessel- auxiliary vessel
O	Miscellaneous - barge, crane, cable, ferry, icebreaker, mining, maintenance, salvage, pilot, yacht
P	Passenger
R	Research - seismographic, meteorological, oceanographic
T	Tanker - asphalt, bunkering, chemical, crude oil, wine, water
U	Roll on roll off- barge container carrier, fully cellular containership
X	Anchor handling - tug supply, fire fighting
Y	Drill platform- drill ship