GOOD PRACTICES MANUAL

MAINTENANCE OF VESSELS, EQUIPMENT AND INFRASTRUCTURE RELATED TO THE DIFFERENT MARITIME ACTIVITIES

SEAS WITHOUT INVASIVE ALIEN SPECIES

ALL OF US ARE PART OF THE SOLUTION LET´S STOP THE SPREAD

Organización de las Naciones Unidas para la Alimentación y la Agricultura

FONDO PARA EL MEDIO AMBIENTE MUNDIAL
fmam INVERTIMOS EN NUESTRO PLANETA

PREFECTURA NAVAL ARGENTINA
AUTORIDAD MARÍTIMA

Ministerio de Ambiente y Desarrollo Sostenible
Argentina

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Abstract

Coastal marine species may be transported from one place to another through different ways, among which vessels and all the equipment they use are mainly responsible for the dispersion along the coasts and the oceans. In turn, many of the species transported to new habitats may survive and cause a great diversity of environmental, social or economic impacts.

The purpose of this Handbook of Good Practices is to provide recommendations about the maintenance methods and the importance for vessels, their equipment and their infrastructure related with the multiple marine activities. The mere implementation of some of the habits herein described and explained will contribute responsibly to the protection of our seas and their biologic wealth, and also to improve the quality of our own lives and of those around us and those of future generations.

1. Introduction

This document is a guide intended to those people who directly or indirectly make use the sea. It is aimed at all areas of the public and seeks to help improve everyday practices of the multiple activities in the marine sector. It is highly recommendable to implement a plan for the different sectors and users involved in commercial port and recreational activities in order to communicate about the problem of biofouling and consequences and the benefits of collaborating with the proposed good practices. Just implementing some of the habits herein described and explained will contribute responsibly to the protection of our seas and their biologic wealth, and also to improve the quality of our own lives and of those around us and those of future generations.

This handbook is in line with the Guidelines for the control and management of ships' biofouling to minimize the transfer of invasive aquatic species (Biofouling Guidelines) (Resolution MEPC.207 (62)), adopted in 2011 (https: //bit.ly/2yKF8F8). These Guidelines highlight the need to remove those fouled from the ship hulls and other submerged surfaces. In addition, this handbook is in line with the Guidance for Minimizing the Transfer of Invasive Aquatic Species as Biofouling (Hull Fouling) for Recreational Craft, as adopted by IMO´s MEPC.1/ Circ.792 (https: //bit.ly/2qbaSgt).

2.The importance of good practices in the marine ecosystem

The introduction of species is among the five most important and with greatest impact of all the threats to biodiversity, economy, public health and cultural assets. Exotic species may radically change the lives and traditions of societies, both in the short or long term, and may also affect economic resources (e.g. tourism, non-industrial fishing, and mariculture), human health (e.g. diseases), cultural assets (e.g. landscapes, habitats) and environmental goods (e.g. richness and diversity of native species). It is enough with some examples around the world to understand that we humans are the perpetrators of this problem; therefore, it is our responsibility to implement concrete solutions.

The greatest portion of the planet´s surface is covered by sea; however, the sea is a little-known space, and one of the most valuable and least protected in the planet. Not only is it the home to millions of species, most of which are still unknown, but also is the means par excellence to exchange goods and develop commercial and social relations since historical times. Nowadays, 90% of the goods that we use or we produce are transported by sea. Therefore, the dependence of humans on the sea is extreme and that obliges us to take greater care and to work towards its sustainability. All of us have the responsibility to protect those things that bring us multiple benefits.

Vessels bear the principal responsibility for the spread of invasive species along the coasts and across the oceans. If

activities (recreational, commercial or for sport) are to be performed in the sea, it is important to make a responsible use of the environment, respecting both the flora and the fauna that inhabit there.

Any structure that is submerged in the sea for some time is subject to colonization by marine species (biofouling). Colonization may occur rapidly and, although it depends on many variables, in a few days many organisms may become adhered and grow on any kind of substrata. Therefore, it is important to constantly clean and maintain all the equipment that was or is to be submerged in the sea. Even those that do not remain permanently in the water should be cleaned at the end of each activity, and with special emphasis when planning to visit a different coastal area using the same gear. If vessels and all their related equipment are kept clean from fouling organisms, we are acting with responsibility not only for the care of the seas, but also for the protection of the population ´s health and economy.

Eliminating biofouling from hulls also indirectly reduces the environmental pollution and increases fuel consumption efficiency. This is because a vessel with a clean hull consumes less fuel and therefore releases less pollutant gases to the atmosphere. Moreover, indiscriminate growth of organisms may even affect the vessels' safety, reducing its maneuverability and physical damage to essential parts for navigation. Therefore, maintaining clean and in good conditions a vessel´s hull, regardless of its size, together with all its equipment and infrastructure bring multiple benefits. Good practices of individuals, even at a small scale, generate global benefits in the long and short term for marine-coastal ecosystems.

YOU SHOULD REMEMBER

Benefits of periodic cleaning of vessels and their equipment (see chart)

1. Reduces fuel consumption.
2. Reduces maintenance costs.
3. Increases vessel´s durability.
4. Reduces the emission of pollutant gases to the air.
5. Increases maneuverability and safety of navigation.
6. Protects the environments where we perform our activities.

3. Risk of introduction of exotic species into marine ecosystems

The risk of introduction of exotic species into marine ecosystems is difficult to establish with accuracy, since there are many related variables that interact. However, although they cannot be precisely defined, it is known that shipping routes and their connectivity, the type of vessel, the maintenance conditions, the time of stay at each port of call, the season when the journeys take place, the intensity of travel and the environmental characteristics of both origin and destination ports are some of the variables that have great influence when determining the risk and are those on which management measures should be emphasized. The combination of these variables will define the amount and origin of the vessels´ biofouling, and therefore the risk posed by vessels of introducing new invasive species or spreading those exotic species already introduced.

When a vessel navigates in a restricted area and without traveling across different localities, it is expected that the biofouling will originate in that same place where cleaning and maintenance activities will also occur. Hence, the risk of introducing new exotic species is relatively low. For example, those vessels navigating exclusively in waters of the Nuevo Gulf (Patagonia, Argentina) will accumulate biofouling already present in the surrounding areas. However, it must be taken into account that if the vessel has biofouling, even from of local origin, it will contribute to the local spread of species already introduced.

The risk for the introduction of new exotic species in a given site increases when biofouling comes from distant regions, even within the same country, in relation to the place where cleaning and maintenance operations of vessels and their equipment are carried out. For example, if a vessel traveling from Bahía Blanca (Argentina) receives hull cleaning at the port of San Antonio Este (Argentina), it will be contributing to the regional spread of exotic species along the Argentine coast.

Finally, the risk of introduction of new exotic species is greatest when international ships receive a cleaning of the hull and related equipment within the country, or when vessels with heavily biofouled hulls arrive in Argentine ports.

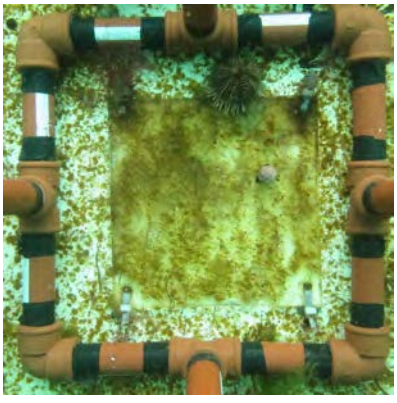
4. Types of biofouling

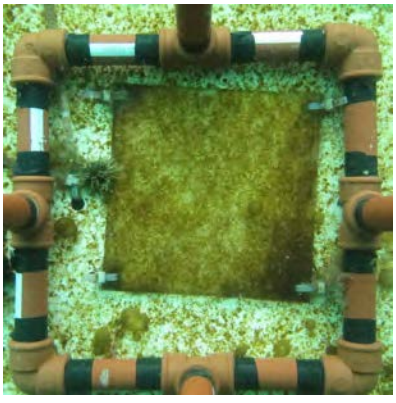
There is a variety of species that are typical to different biofouling communities. These communities vary in species diversity, age and abundance. In broad terms, they can be divided into micro and macrofouling (see Figure 1). Microfouling is defined by being composed of microorganisms not visible, individually, to the naked eye. They have a dirty, slippery aspect and they are easily removed by swiping a finger across the surface. This is the first biofouling that appears after submerging an object in the sea. On the contrary, macrofouling is distinguished because it is formed by

organisms that are visible to the naked eye and are easily individualized. Examples of macrofouling organisms are barnacles, mussels, sea squirts, sea anemones and macroalgae.

Microfouling

(easily removed with a sponge or a soft brush)





Macrofouling

(for removal they require pressure washer, paint scrapers, etc.)

surface with barnacles

Surface with sea squirts, mussels and sea anemones

Figure 1. Examples of microfouling (above) and macrofouling (below) on submerged artificial structures in the sea water for some time. Photos E. Schwindt.

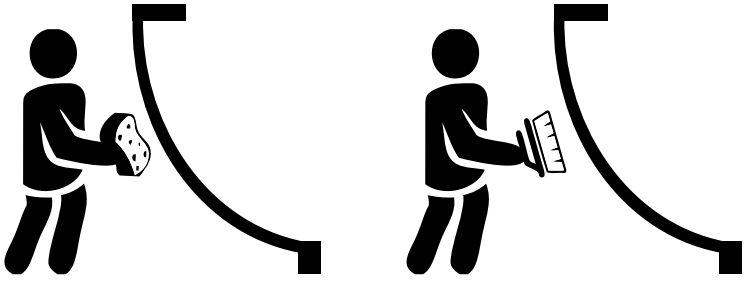
5. Cleaning methods

The cleaning methodology depends on the type of biofouling of the vessel. In-water hull cleaning implies that, unless they are collected, the residues of rust, paint and organisms are released directly into the marine environment and may cause serious environmental damage because of chemical pollution and species introduction. This is the case when using brushes, scrapers and sponges not fit to contain all the residues generated from in-water cleaning. Due to this chemical and biological pollution, many countries are developing regulations to minimize or eliminate the impact of these type of activities.

Below there is a description of the different known cleaning methodologies, which vary in effectiveness depending on the type of biofouling that has to be removed. The election of the method depends on many variables. It is advisable to make a thorough assessment of both the economic and environmental costs and benefits when selecting the cleaning method.

a. Soft brush or sponge

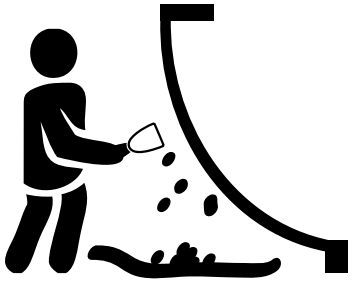
They can be used in those cases where only a thin layer of microfouling is observed, but they will not be effective if there is a high abundance of biofouling. They can be used both inside and outside the water, but it is strongly advisable recommendable to use them outside the water.



b. Manual brushes and paint scrapers

They are widely used because they are effective to remove biofouling from most kinds of surfaces, particularly smooth surfaces, although not so effective on rough ones. Depending on the stiffness of the brush bristles or on the pressure exerted with the paint scraper, the anti-fouling coating of the vessel, if any, will be affected to a greater or lesser degree. However,

may be practical to use for cleaning ropes, nets and other small structures (trailers, fishing and diving gear, anchors, etc.). Brushes and paint scrapers are generally used in small boats when fouling organisms are grouped into patches and in specified sectors. They can be used either inside or outside the water. It is advisable to make the cleaning operations outside the water.



Although it may appear, to the naked eye, that all the organisms have been removed, these techniques are not adequate to remove microscopic organisms (non visible to the naked eye) or also microscopic dispersion stages or structures of macroorganisms. Therefore, although they achieve a certain degree of cleanliness of the vessel, it is important to remember that they usually do not eliminate the risk of species introduction. These methods are ineffective to collect the residues released by in-water cleaning. At best, the larger organisms could be collected, but it will be impossible to collect the whole amount of viable fragments, dispersal structures, or the remains of toxic residues that not only affect the marine environment but also they could affect the land/coastal

environment where they are deposited. Even so, the use of paint scrapers under the water will be preferable for small vessels or when there is little amount of biofouling, provided they are handled with care and the removed organisms are collected in a bag.

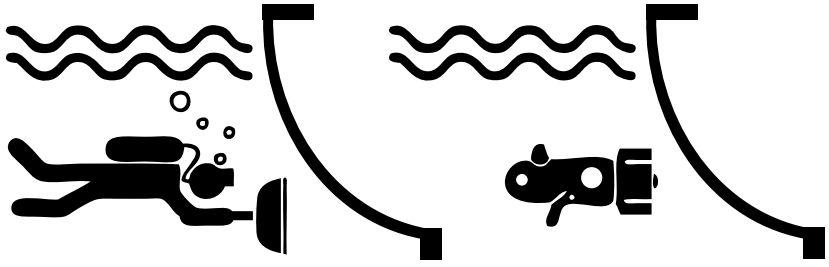
c. Pressure washers:

This method can be used when the cleaning is made outside the water. It is not the most recommended method, because the pressure exerted over the surface of the hull and on the organisms makes it difficult to collect the residues at the end of the cleaning process. On the contrary, it is advisable to use this method in places far from the coast, where residues pose no risk of returning into the sea. Anyway, we should not forget that the residues generated need to be collected and appropriately disposed.

The benefit of this method is that it is faster than those mentioned above; it is applied outside the water, and it uses fresh water. So, if it is carefully done, and the day is not windy, a higher amount of residues could be collected with respect to in-water cleaning.

d. Robotic or non-robotic rotating brushes:

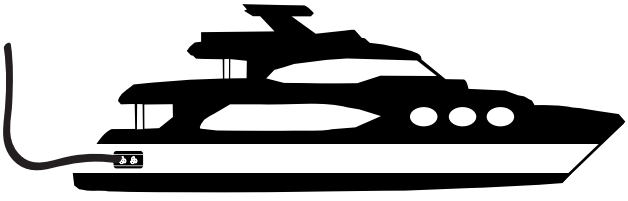
These brushes are usually used by professionals who work for companies devoted to in-water surveys and maintenance of large size commercial ships. This method is faster, but it is also more expensive, and all the chemical and biological residues are released directly into the sea. The cleaning is very effective on smooth surfaces, but is somewhat inefficient in curved or hollowed areas.



e. Robotic vehicles with waste collector:

This kind of technology is usually used and applied by professionals who work for companies devoted to in-water surveys and maintenance of large size commercial ships. There is an important trend at the international level towards the development of technologies that minimize the environmental impacts and are fast, safe and efficient. They are remotely-operated systems, with or without brush, that not only clean the surfaces but also collect all the residues that are generated. The variety of vehicles developed by the

, New Zealand and Australia, among other countries, is very large; and although they are not 100% effective in collecting residues, they improve day by day with new designs. Despite this technology is still not applied in Argentina, it is highly recommended and very urgent to encourage its development.



6. Maintenance guide

This guide is intended mainly, but not exclusively, to vessels of national origin whatever their type, and to any equipment associated with different marine specific activities (for example, anchors, ropes, nets, trailers, fishing rods, boots, neoprene suits, diving equipments, etc.). It is also applicable to the infrastructure of ports, marinas, and any other artificial structure such as pontoons, piles, sea front walls, buoys, etc. In all these cases, it is highly advisable to keep adequate and orderly records of the maintenance and cleaning operations.

a. Removal of fouling organisms

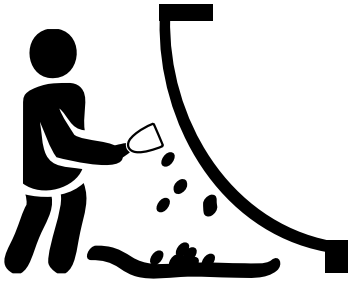
Biofouling organisms on vessels should preferably be removed outside the water. In this way, none of the extracted organisms or chemical residues such as antifouling coatings will be deposited in the sea. Chemical and biological residues produced by cleaning should be deposited in containers and treated as land residues as indicated by the competent authorities and the regulations in force in each place.

There are several techniques for the removal of organisms, which are detailed below. It is important to make an assessment of the overall situation, as well as of the economic and environmental costs and benefits associated with each technique.

a.1. Small recreational vessels

When vessels are small (like sailing vessels and low tonnage boats) and there is a possibility to make cleaning and maintenance operations outside the water, it is recommended to choose these techniques and collect the generated residues. In these cases, using a paint scraper is preferable to the use of a pressure washer, because it will be easier and more efficient to collect the residues that are produced. As mentioned before, the use of a pressure washer is advisable due to its speed, as long as the cleaning is made outside the water, where residues pose no risk of returning into the sea. At the same, we should not forget that the residues need to be collected and appropriated disposed.

Therefore, when the small recreational vessel is dry-docked, a thick nylon film/sheet (200 microns or less,) could/should be placed under it (if the operation is to take place in an area with risk of polluting the water body), and the cleaning may be proceeded.



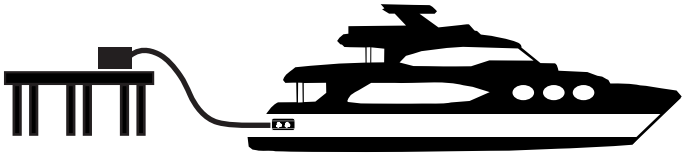
All the material collected on the nylon film should be processed as an on-land residue. Preferably, this activity should be done on days with little or no wind to avoid dispersion of residues. After the removal of the biofouling, the vessel should be rinsed both inside and outside with fresh water. If possible, it should also be allowed to dry completely for 3 or 4 days.

a.2. Large recreational vessels

Ships, like ocean commercial ships, are generally scheduled to dry dock for maintenance and survey. However, there are other large recreational vessels for which it is not possible to dry dock them regularly for maintenance. Therefore, it is vital for these recreational vessels to undergo periodic revisions and maintenance to avoid big biofouling accumulations, which are more difficult to eliminate.

Maintenance inside the water, in areas where it is permitted, should preferably be performed with equipment that is specifically designed for collecting the residues generated during the cleaning. In those cases where it is not possible to use this kind of equipment, the hull´s cleaning should be made in small areas, where it is possible to collect all the residues produced during the operation. Afterwards, the residues should be deposited in land, following the treatment procedures as previously indicated. Again, it is highly recommended to perform periodic maintenance in order to avoid macrofouling, which is more difficult to eliminate.

It is important to bear in mind that in vessels with anti-fouling treatments, the procedure to remove organisms, whatever it may be, will also eliminate part of the anti-fouling coating. Therefore, we should always take into account that all the residues that are collected will be composed of both biological and chemical remains, even if they are imperceptible for the naked eye.



YOU SHOULD ALWAYS REMEMBER

In case of suspicion of a new exotic invasive species:

TAKE PHOTOS

RECORD DATA

GUARDAR

REPORT TO:

PREFECTURA NAVAL ARGENTINA **106**

b. Vessel areas with greater biofouling density

It is important to pay attention and clean with a special emphasis those areas that, according to scientific research, are called “niches” due to the high concentration of biofouling. In broad terms, organisms concentrate mostly in hollows and to a lesser amount in plain surfaces.

Below, there is a detailed list of the parts of small vessels that should be checked and cleaned periodically to avoid the accumulation of biofouling (Figure 2):

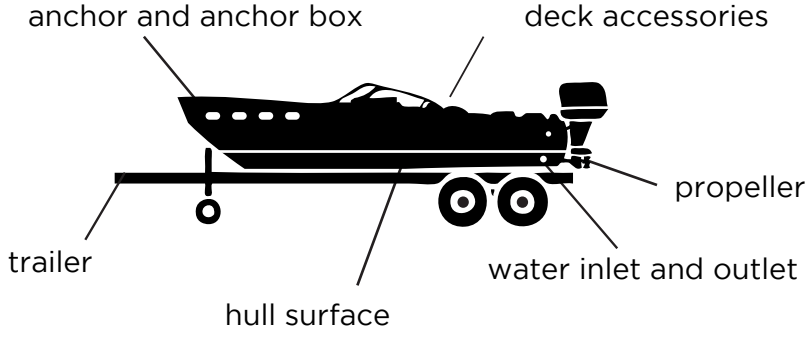


Figure 2: parts of small vessels that should be checked and cleaned periodically to avoid the accumulation of biofouling

Depending on the vessel´s type, there can be other areas concentrating fouling organisms which should be checked frequently, such as:

– Propellers, thrusters and propulsion units, keel;
– Rudder stock and hinges;

- Thimbles, horn joints, propeller shafts;
- Openings and non-floodable areas;
- Areas where the anti-fouling coating may get damaged by groundings;
- Anodes;
- Openings, water and air inlets, cooling pipes, grids;
- Anchors, anchor boxes, chains and chain boxes;
- Acoustic probe and speed probes.

c. Vessel´s Maintenance Record Book

It is recommended that all vessels, regardless of their type and size, keep an updated record book of their periodic maintenance and cleaning operations. The data that should at least be recorded is listed below:

a. Data of the Maintenance Record Book:

Vessel´s name:
Vessel´s flag:
Port of Registry:
IMO Number (if any):
Registration number:
Vessel´s type:
MMSI:

b. Anti-fouling system (if any):

Type and name/trademark:
Date of manufacture:
Place of manufacture:

c. Vessel maintenance

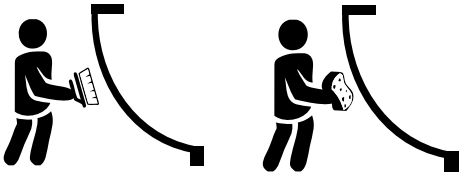
1. Name of the surveryor´s company (if applicable);
2. Description of the activity performed (e.g. photos of the vessel, cleaning on land, residue collection, fresh water rinse, drying. No remarkable or exotic organisms observed and reported);
3. Date and place of the cleaning procedures (e.g.. Puerto Madryn, 03-14-2019);
4. Description of the cleaning procedure detailing the method and the areas cleaned *(e.g.., propellers and water intakes, outside-the-water paint scrapers or brush method, use of nylon film to collect residues, freshwater rinse with pressure washer and drying);*
5. General description of the biological residues collected *(e.g. barnacles, mussels, algae, sea squirt)*
6. Type and amount of collected residues *(e.g. approximately 2 m3 in container, only biological residues);*
7. Subsequent treatment of the residues produced *(e.g., deposited in containers for treatment as fishing discard material in land).*

7. Quick Guide to Good Practices for Maintenance and Cleaning of Vessels and their Related Equipment

1. With as much detail as possible, keep an updated Biofouling Record Book for maintenance and cleaning operations of the vessel and its related equipment.

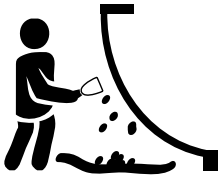
2. Maintain the vessel, the trailer and any other equipment used in the water in good cleaning conditions, especially if they are to be used in any other place.

3. Remove biofouling frequently. It is simpler to do it when there is only a microfouling layer, as it only requires of a sponge.



4 If the vessel is small, or if it is large but there are dry-dock facilities in place, remove/clean the biofouling outside the water.

5 Before starting the cleaning procedure on land, place a nylon film under the vessel and preferably choose a day with very little wind.



6 Select the best cleaning method according to an economic and environmental cost-benefit assessment.
The options are:

a. Brush/sponge 

b. Paint scraper 

c. Pressure washer 

7 Rinse with freshwater after cleaning. 

8 Let dry in the sun or outdoors for 3/4 days.

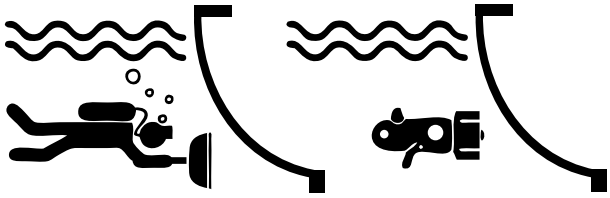
9 Collect the residues for in-land treatment according to the regulations in force in the area.

10 If the vessel is large (e.g., a yatch), or if there are no logistic or available facilities in place for outside-the-water cleaning, make the biofouling cleaning inside the water, in sites where it is permitted. Prior authorization from the Maritime Authority is required.

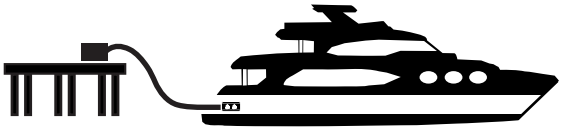
11 Select the best cleaning method according to an economic and environmental costs and benefits assessment. If possible, use methods and technology that allow the collection of residues for subsequent land treatment. The options are:

a. Paint scraper 

b. Robotized or non-robotized rotary brushes



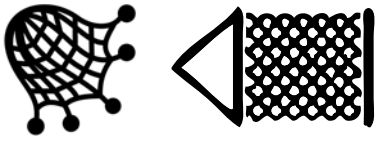
c. Automated vehicles with residue collector



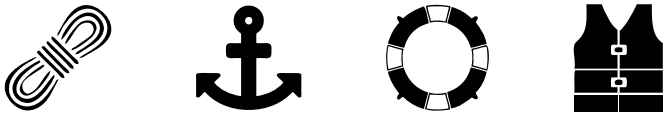
12 Collect the residues for in-land treatment according to the regulations in force in the area.

13 The equipment used on vessels or in recreational activities should always be cleaned outside the water. Thus, it is important to follow the steps 6 to 9. Examples of equipment to be cleaned outside the water include:

a. Fishing nets

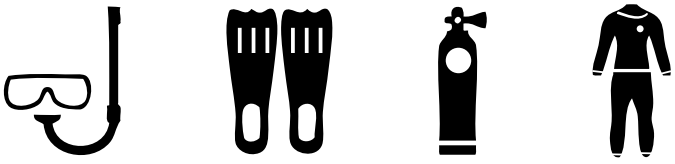


b. Ropes, anchors, etc.



c. Trailers.

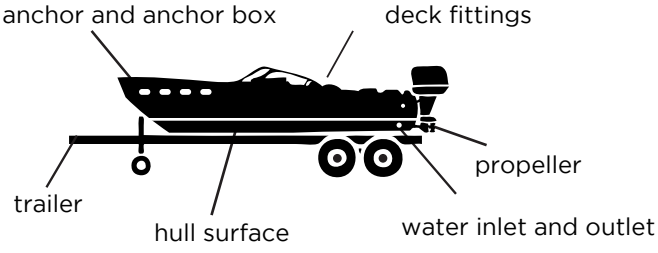
d. Diving equipment



e. Fishing equipment

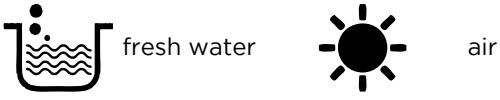
SEAS WITHOUT INVASIVE ALIEN SPECIES

HOW TO CLEAN BIO-FOULING



BASIC METHODS

RINSING AND DRYING



DUMPING RESIDUES IN LAND

REMEMBER TO CLEAN YOUR EQUIPMENT OR VESSEL WHEN TAKEN OUT FROM THE WATER

SEAS WITHOUT INVASIVE ALIEN SPECIES

IF YOU SEE OR HAVE SUSPECTS OF A NEW ALIEN INVASIVE SPECIES

TAKE PHOTOS 

RECORD DATA 

KEEP THE SPECIES 

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TALL OF US ARE PART OF THE SOLUTION

LET´S STOP THE SPREAD

8. Glossary

Exotic species: species, sub-species or lower taxa of organisms introduced by humans from outside their known natural range. Includes any part of the organism, such as gametes, seeds, eggs or propagules that can survive and reproduce.

Invasive exotic species: an exotic species capable of settling self-sustainable populations and of spreading beyond the introduction site, colonizing natural or semi-natural environments and threatening biological diversity, the economy, human health or cultural values.

Introduction: movement of a species, sub-species or lower taxon from outside its known natural range, by direct or indirect, voluntary or accidental human action.

Biofouling: a group of aquatic organisms that are attached to a hull or any other structure that remains submerged in a temporary or permanent way. Together with ballast water, it is recognized as one of the main introduction vectors of marine and freshwater invasive alien species.

Residue: chemical or biological material that is produced when cleaning vessels, their equipment or any other infrastructure that is submerged in the aquatic environment.