

WHAT IS BIOFOULING?

Biofouling is defined as an undesirable accumulation of aquatic organisms, such as micro-organisms, plants, and animals, on surfaces and structures immersed in or exposed to the aquatic environment. Biofouling includes microfouling and macrofouling. (Source from [IMO](#))



Figure from [SmithsonianMagazine](#)

MICROFOULING

Microscopic organisms including bacteria and diatoms and the slimy substances that they produce. Biofilm, often referred to as a “slime layer”, is biofouling made up of only microfouling

(Source from [Transport Canada](#))



Figure from [International Maritime Organization \(IMO\)](#)

MACROFOULING

Macrofouling is an easy-to-see build-up of large organisms containing distinct multicellular organisms like barnacles, tubeworms, bryozoans, or fronds of algae. It can be either considered soft or hard macrofouling, depending on the organisms and time allowed to latch

(Source from [Transport Canada](#))

HOW DOES IT SPREAD?

Biofouling starts to build-up on a vessel within a few hours of being in the water. There are many factors that can affect the amount of biofouling that accumulates on a vessel, these include:

- Age, condition, and type of anti-fouling system installed
- Idle time of vessel in water (mooring and anchorage)
- Salinity level of water body
- Travel history of vessel
- Frequency of vessel maintenance and cleanings (dry-docking and in-water cleaning)
- Vessel travel speed

(Source from [Transport Canada](#))



WHERE DOES BIOFOULING OCCUR?

HULL

Immersed surfaces of a vessel that includes the hull area, niche areas, and wind/water line

(Source from [Govt. of New Zealand](#))

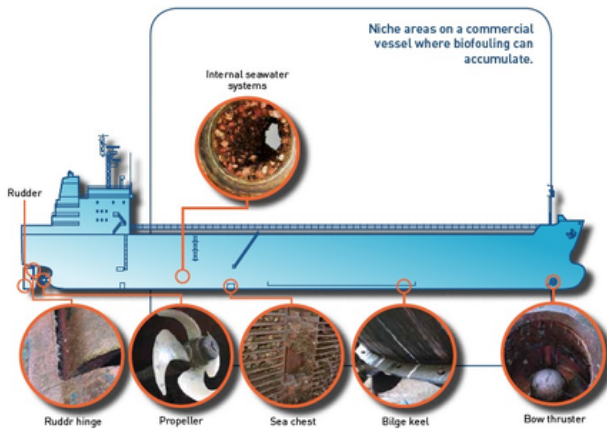


Figure from [NZ.gov](#)

Vessel diagram provided by the Department of Agriculture and Water Resources

NICHE AREA

Areas on a vessel that may be more susceptible to biofouling due to different hydrodynamic forces, coating system wear or damage, or being inadequately painted

(Source from [ICS](#))

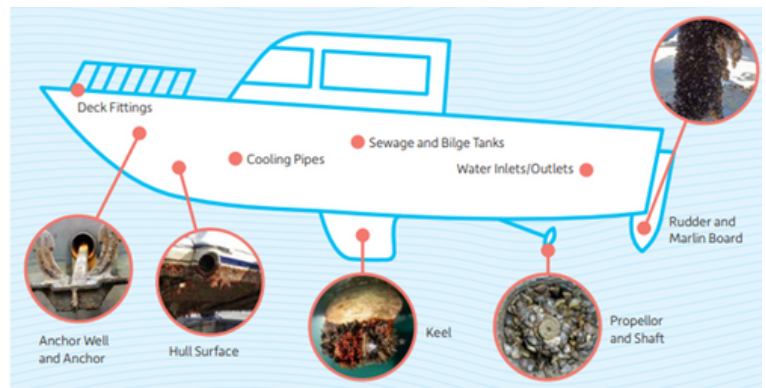
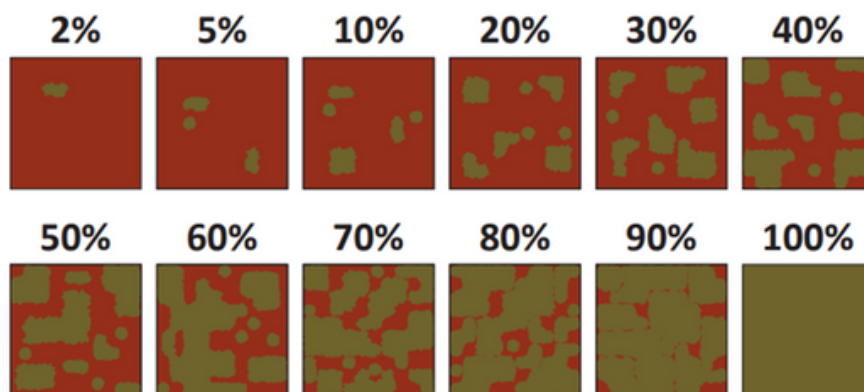


Figure from [IMO](#)

WHAT DOES BIOFOULING IMPACT?

- Increases the spread of invasive aquatic species
- Lessens vessel maneuverability and speed
- Increases fuel consumption by as much as 35%
- Produces more emissions output (Source from [IIMS](#))

Preliminary findings for commercial ships found that a thin slime layer of 0.5 mm covering up to 50% of the hull can increase greenhouse gas (GHG) emissions by 20-25%. A light layer of small calcareous growth (barnacles/tubeworms) on a container ship can cause up to a 55% increase in GHG emissions. (Source from [IMO](#))



Representation of % coverage of biofouling on effected areas.

(Figure from [ICS](#))



PREVENTING THE SPREAD OF INVASIVE AQUATIC SPECIES

INVASIVE AQUATIC SPECIES:

A non-indigenous species that may pose threats to human, animal, and plant life, economic and cultural activities, and the aquatic environment. (Source from [Transport Canada](#)).

Invasive aquatic species are often spread via the discharge of contaminated ballast water or by latching onto vessels through biofouling. If appropriate measures are not taken to prevent this spread, these species can cause irreparable damage to the ecosystems they impact. (Source from [IMO](#))



Figure from [Gov. of Alberta](#)



Figure from [Minnesota Department of Natural Resources](#)

An anti-fouling system is often a key part to prevent the spread of hull fouling species.

ANTI-FOULING SYSTEM (AFS):

A combination of all coatings, paints, surface treatments, surfaces, or devices that are used on a ship to control or prevent the attachment of unwanted organisms. (Source from [IMO](#))

Examples of anti-fouling systems include primers, sealers, and anti-corrosive and anti-fouling coatings.



Figure from [IMO](#)



EXAMPLES OF INVASIVE AQUATIC SPECIES

COMMON HULL FOULING SPECIES

ZEBRA MUSSEL



(Figure and Source from [USGS](#))

Zebra Mussels, *Dreissena polymorpha*, have spread throughout the Great Lakes and many freshwater rivers and lakes within the United States. They have had a negative effect on the phytoplankton population and man-made structures in the invaded areas.

QUAGGA MUSSEL

Quagga Mussels, *Dreissena bugensis*, are often associated with Zebra Mussels as a *Dreissenia* species and affect the environment in a similar way. A concern with the *Dreissenia* species is the potential rapid adaptation to the environments they inhabit.



(Figure and Source from [USGS](#))

COMMON HULL FOULING SPECIES FOUND IN THE GULF OF MEXICO

GREEN MUSSEL



(Figure and Source from [USGS](#))

Green Mussels, *Perna viridis*, or Asian Green Mussels, are native to the Indo-Pacific region and have been introduced into the Gulf of Mexico and the Caribbean Sea. Common impacts include fouling of power plant intake pipes, displacing native species, and carrying disease.

PLEATED SEA SQUIRT

The Pleated Sea Squirt, *Styela plicata*, or Pleated Tunicate, is distributed worldwide. Pleated Sea Squirts often displace and outcompete native species and are a dominant fouling species. (Source from [GISD](#))



Figure from [Smithsonian](#)

COMMERCIAL & PORT POLICY

PORT OF CORPUS CHRISTI POLICY ON IN-WATER CLEANING AND DISCHARGE OF COMMERCIAL VESSELS

During in-water cleaning, all materials must be captured and properly disposed of. For in-water cleaning to be conducted in port waters, a detailed plan must be shared with the Director of Environmental Planning & Compliance for approval prior to starting any cleaning operations.

For information regarding Port policies, refer to the environmental section of the Port of Corpus Christi [Tarriff 200](#).

COMMERCIAL VESSEL POLICIES

With guidance from the International Maritime Organization (IMO), commercial vessels have implemented best management practices that aim to reduce the spread of invasive aquatic species via biofouling. Some practices include an implementation of a Biofouling Management Plan (BFMP) and maintaining a Biofouling Record Book (BFRB).

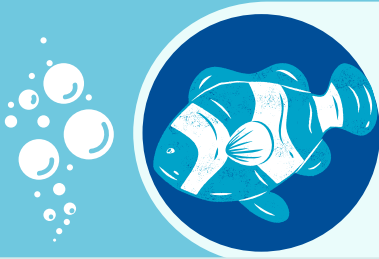
A Biofouling Management Plan is specific for each vessel and provides details regarding its installed AFS, documentation/reports required to document biofouling activities, and information to aim to maintain a fouling rating of ≤ 1 .

A Biofouling Record Book describes the maintenance activities, which includes the ship cleaning activities, inspection history, and relevant repair and dry-docking facilities for the vessel.



For additional information regarding commercial practices, refer to [IMO biofouling_guidelines resolution MEPC.378\(80\)](#).

How you can help **STOP THE SPREAD OF INVASIVE SPECIES**

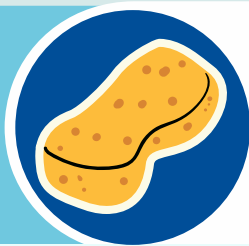
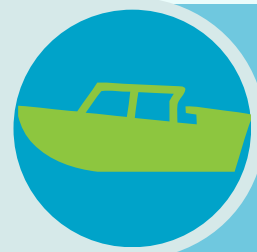


1. Plan and Prepare

Research local authorities policies in place to protect the local waters and species.

2. Use the right AFS for your vessel

There are many options to choose from, select the best option for your vessel and the environments you frequent.



3. Clean your vessel often

Regularly clean and maintain your vessel to ensure biofouling is removed.

4. Don't forget your gear!

Any gear and equipment that is exposed to a body of water is susceptible to carrying fouling species. Don't forget to clean before future use.



5. Properly contain & dispose of debris

Properly dispose of any physical debris or wastewater after cleaning off your vessel or equipment.

For more information

Visit [Biofouling Management for Recreational Boating from the IMO and GloFouling](#)

