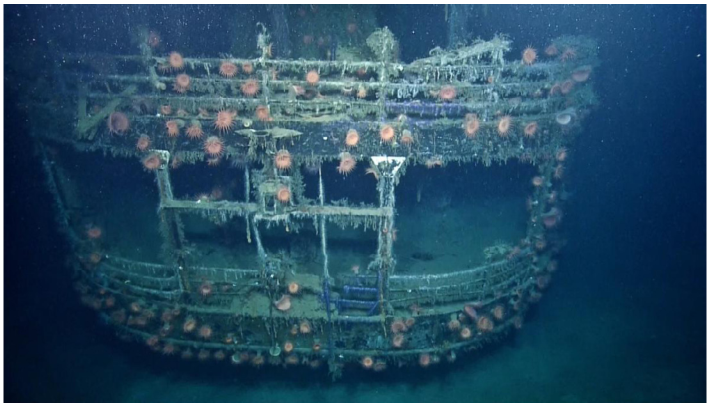
The Ecology of Maritime Heritage/Maritime Archaeological Sites

Shipwrecks, plane wrecks, and other maritime heritage sites are important historical and cultural resources. However, these sunken structures also influence the shape, chemistry, and biological makeup of marine ecosystems, even decades after a wreck or other event has occurred.

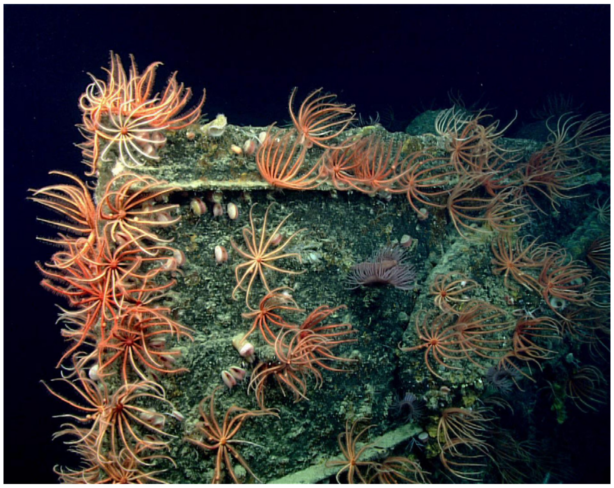


Wreck of the steam passenger ship, *Robert E. Lee*, covered in fly trap anemones. *Image courtesy of Ocean Exploration Trust.*

Why are maritime heritage sites biodiversity hotspots?

Maritime heritage sites often function as "islands of biodiversity," or hotspots, creating an ideal home for a variety of marine species.

A community grows around an anchor and some ceramic dishes found at the wreck site of a 19th century wooden-hulled sailing vessel. *Image captured by ROV Odysseus, courtesy of Microbial Stowaways.*



A knife-edge bow stem of the USS *Baltimore* was covered in brisingid sea stars and other deepwater animals. *Image courtesy of NOAA Ocean Exploration.*

Substrate

Submerged maritime heritage sites provide artificial structure and materials that are very different from the surrounding ecosystem. They create a hard surface, or substrate, on which many sessile (anchored in place) organisms can attach. Wooden wrecks typically decompose over time, but ships made of metal, and metal parts (like cannons, anchors, and propellers) can often provide perfect landing spots for many species.

Marine microbes are often the first to settle at a site, creating a slimy surface layer (**biofilm**) that acts as a physical and chemical signal to attract other organisms. Corals, sponges, and other sessile organisms settle on hard surfaces, providing additional habitat and food. Small fishes, crabs, urchins, and other mobile species shelter in the nooks and crevices of the sunken material, and larger fishes, octopus, and other predators use the sites as feeding grounds or rest stops as they move from one location to another. Different organisms may choose different places on a wreck depending on their specific needs.

Feeding

Along with a hard substrate, submerged structures also provide elevation above the seafloor, lifting animals into the surrounding current. Facing into the current saves energy and gives easy access to potential food that drifts by. This is why sponges, corals, anemones, and other species often settle up off the seafloor on a wreck (or a rocky outcrop), facing into the current.

Reproduction/Dispersal

By creating hard-bottom habitats where there was previously only sand or mud, maritime heritage sites can also influence the movement and settling of larvae in the deep sea. Many marine species begin their lives as tiny larvae floating through the ocean. If they come into contact with the hard surface of a shipwreck, or detect a chemical signal from biofilm, then they'll settle and grow at that location.

What is Maritime Heritage Ecology?

Maritime heritage sites provide unique opportunities to study the relationships between living organisms and their physical environment (**ecology**). Structures and artifacts made up of different materials, like wood, limestone, metal, or fiberglass, will break down at different rates. Which organisms settle at these sites depends on the substrate available, currents, and other environmental conditions. Archaeologists, biologists, geologists, chemists, engineers, and others all work together to understand what processes impact these sites, how they change over time (succession), and how these changes affect the growth of biological communities.

Can maritime heritage sites have negative impacts?

While shipwrecks can act as "biodiversity hotspots," they can also house and cause the spread of invasive species, damage or change existing habitat and biological communities, or release harmful cargo, like oil. For example, invasive zebra and quagga mussels eat the planktonic food of native species in the Great Lakes and this has changed the lake ecosystems. Huge masses of mussel growth have also impacted many lake shipwrecks.

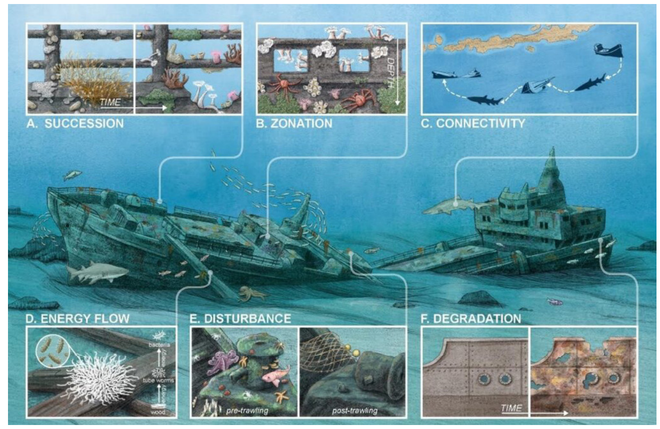
What are threats to maritime heritage sites?

Maritime heritage sites are impacted by natural factors such as storms, currents, and breakdown by shipworms and other marine animals. Human impacts, including pollution, coastal development, illegal looting and salvage, bottom trawling, and lost or abandoned fishing gear are also threats to maritime heritage sites. Once a site or its artifacts have been disturbed or damaged, there is no way to recreate the story they might have told. Cultural preservation policies have been developed by resource managers and other officials to protect these sites.

How are maritime heritage sites preserved?

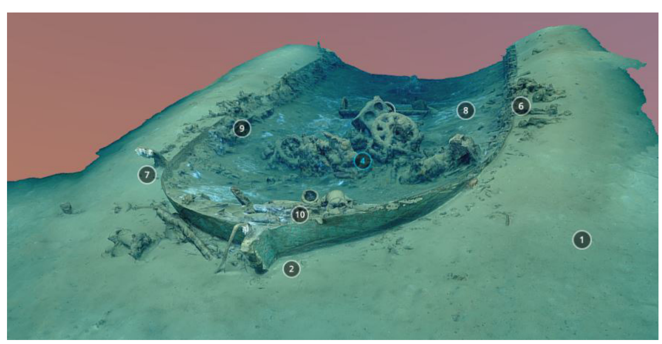
Today's maritime archaeology efforts mostly aim to preserve sites in place *(in situ)*. When a site is first discovered, teams may map and document it using a number of different tools. These records allow scientists to study the site from shore, and then possibly revisit sites, measure any changes, and note new discoveries.

Sometimes teams may choose to excavate a site, bringing up key artifacts and preserving them at a museum. This allows for in-depth study and public viewing of specific pieces. However, advancements in technology, like photogrammetric 3D models and virtual reality, are allowing archaeological sites to be viewed and studied in ways that preserve artifacts and structures without removing them.



Each inset panel of this diagram shows examples of the ecological processes and functions that can take place on metal shipwrecks in particular ocean depths and geographic regions. (A) Succession where primary biofilm colonizers and other initial colonizers prepare shipwreck structure for secondary colonizers. (B) Zonation where large invertebrate suspension feeders are on upper (shallower) parts of shipwrecks with mobile and smaller encrusting invertebrates closer to the seabed. (C) Connectivity where shipwrecks act as stepping stones to the movement of organisms. (D) Energy flow where chemosynthetic bacteria support tubeworms growing on organic matter. (E) Disturbance where human-caused pressures, such as trawling, can alter shipwreck shape, influencing what can live there. (F) Degradation of shipwreck structure over time through corrosion. *Illustration courtesy of Alex Boersma.*

An anchor from the schooner, *Kyle Spangler*, clearly visible five years earlier (left), is covered by quagga mussels (right), affecting the archaeological and recreational value of the site. *Image courtesy of NOAA Thunder Bay National Marine Sanctuary.*



High resolution photogrammetry of Shipwreck 15377 in the Gulf of Mexico, likely a 19th century merchant vessel transporting cargo. Take a look here for some close-up views of a number of intriguing maritime heritage sites and structures! BOEM Virtual Archaeology Museum. *Image courtesy NOAA Ocean Exploration/BOEM.*

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