
Ethan Nedeau

Habitats Formed by Human Activity

The habitats described in this section owe their existence to human activity. They include biogenic habitats formed by invasive species and physical habitat on the surfaces of docks, boat hulls, and other structures in the water. Many invasive species have become established in the Gulf of Maine. They arrive through a variety of human activities, such as shipping, aquaculture, and release of aquarium pets. Sometimes these invaders attain high enough densities to replace other habitats and cause profound ecological changes. Two notable habitat-modifying, invasive species in the Gulf of Maine are the common reed, *Phragmites australis*, and the green alga *Codium fragile* ssp. *tomentosoides*. Unlike the habitats described in the previous chapters, areas of invasive *Phragmites* and *Codium* are viewed generally as habitats to be contained or eliminated, rather than protected. Barnacles, mussels, and many other invertebrates and algae thrive attached to the underwater surfaces of human-made structures such as docks and boat hulls. These assemblages of species are called fouling communities. Fouling communities, which can include native and non-native organisms, may cause problems by exacerbating the spread of invasive species around the Gulf of Maine.

Invasive-Plant Habitats

Fouling Communities

CHAPTER ELEVEN

Invasive-Plant Habitats

A tall stand of non-native *Phragmites australis* invades a salt marsh, visibly altering the habitat. Ethan Nedeau

Common Reed
(*Phragmites australis*)

General Description

The common reed, *Phragmites australis*, is a grass that grows up to five meters tall. It lives along the borders of rivers, lakes, and other freshwater environments, as well as salt marshes in areas of low salinity. A perennial species, its standing litter persists through the winter. The distribution and abundance of the common reed has increased dramatically along the Atlantic coast within the last 150 years (Saltonstall 2002). A non-native genotype of this species has displaced native strains and spread into areas where *Phragmites* did not historically occur (Saltonstall 2002). The invasive form has spread rapidly in degraded salt marsh habitats and areas with naturally low salinity, forming extensive monotypic stands.

Phragmites can spread in several ways. Its most common method of expansion is through underground rhizomes. To spread across barren surfaces, *Phragmites* produces stolons, or shoots that grow horizontally over the ground. It also produces small seeds that are carried by the wind. Often, small, isolated patches of *Phragmites* enlarge and coalesce into larger stands (Lathrop *et al*. 2003).

Low salinity and soil disturbance are factors that allow *Phragmites* to become established. Typically, tidal restrictions or increased runoff lower the salinity of a salt marsh. When salt marsh habitats are degraded or disturbed, *Phragmites* may outcompete native salt marsh vegetation, including salt marsh cordgrass (Burdick and Konisky 2003).

Various management methods have been used to control the spread of *Phragmites* along the Atlantic coast. One of the most effective and commonly used approaches is to restore tidal flow to the marsh by removing tidal restrictions or installing larger culverts (Blossey 2003). Prescribed burning, selective application of herbicide, and physical removal of plants have been used to wipe out or slow the spread of *Phragmites*. Attempts at biological control using the

The flowering structure of *Phragmites australis*. Ethan Nedeau

European beetle *Rhizedra lutosa*—a natural enemy—have not proved successful (Casagrande *et al*. 2003).

Distribution

Phragmites occurs in areas along the entire Gulf of Maine coastline. Its distribution has been mapped in some places, but the lack of a comprehensive mapping program makes it difficult to track its expansion. The areas most susceptible to invasion are the upper edges of salt marshes, especially marshes that have been disturbed by construction, fill, or tidal restriction.

Management Considerations

Increased sediment accumulation rates caused by dense stands of *Phragmites* may change marsh drainage patterns by eliminating some small intertidal channels. Eventually *Phragmites* expansion reduces tidal flooding and increases the proportion of high intertidal habitat. Organic matter produced by *Phragmites* may fill in the pools that mummichogs use for spawning and nurseries (Osgood *et al*. 2003, Raichel *et al*. 2003). Flow across *Phragmites*-dominated marshes becomes sheet-like because of the smooth surface, whereas in cordgrass-dominated marshes drainage occurs via rivulets and small creeks (Raichel *et al*. 2003). Because *Phragmites* grows taller than native salt marsh vegetation, it blocks sunlight needed by other plants, reducing their growth and survival (Burdick and Konisky 2003).

Phragmites has some positive ecological effects that arise from its high productivity, carbon storage, and erosion control (reviewed by Burdick and Konisky 2003). *Phragmites*-dominated marshes have such high rates of sediment accumulation—due to high production, lack of export of litter, and slow decay rates—that this invasive reed might help offset the problems that rapid sea-level rise poses to many coastal marshes (Rooth *et al*. 2003).

Unlike most salt marsh plants, *Phragmites* persists throughout the winter as standing litter. Some birds such as common yellowthroats, marsh wrens, salt marsh sparrows, and the imperiled least bittern may roost in *Phragmites* when other salt marsh vegetation has senesced (J. Smith, Massachusetts Bays Program, personal communication). Red-winged blackbirds and some wading birds nest in *Phragmites* stands (Parsons 2003).

The effects of *Phragmites* on the salt marsh food web are unclear. Replacement of native salt marsh vegetation by

Phragmites stands can be dense, and the persistent dead plants may be a fire risk throughout the year. Ethan Nedeau

Phragmites likely affects most marsh-dwelling herbivores and secondary consumers such as mummichogs (e.g., Raichel *et al*. 2003). One study found only the spotfin killifish in *Phragmites*-dominated marshes, suggesting that the diversity of marsh fish may be affected when *Phragmites* replaces cordgrass (Able *et al*. 2003). Similarly, species that live in tidal creeks, such as the grass shrimp, may decline as *Phragmites* fills in small creeks (Osgood *et al*. 2003). Thickets of *Phragmites* along creek banks may block non-resident fish and swimming crustaceans from entering the salt marsh. *Phragmites* also may inhibit the movement of other large animals, including the diamondback terrapin (Neider in Lathrop *et al*. 2003).

Habitat changes caused by *Phragmites* could harm commercially important species that use salt marshes as nurseries and feeding grounds. While the ecological and economic effects have yet to be quantified, these concerns have spurred efforts to remove *Phragmites* (Grothues and Able 2003).

Because it grows so tall, *Phragmites* obscures salt marsh views for coastal landowners, potentially reducing property values, and it hinders recreational bird watching. The standing, dry litter during winter is a significant fire risk. Higher rates of sedimentation brought on by *Phragmites* could degrade the recreational value of marshes for fishing and kayaking.

Deadman's Fingers (*Codium fragile* ssp. *tomentosoides*)

General Description

Deadman's fingers (*Codium fragile* ssp. *tomentosoides*) is a green alga that is native to Japan. It attaches to rock surfaces and mollusk shells, and it is one of the most invasive seaweeds in the world (Trowbridge 1998). In the early 1960s, *Codium* was introduced to southern Massachusetts attached to the shells of transplanted oysters from Long Island Sound (Carlton and Scanlon 1985). *Codium* has invaded many regions such as northwestern Europe, the Mediterranean, and New Zealand (Chapman 1999, Mathieson *et al*. 2003).

Codium lives in intertidal pools and in the subtidal zone as deep as fifteen meters (Chapman 1999), where it is found in both sheltered and wave-exposed environments. In some locations in the Gulf of Maine, *Codium* now dominates the algal community above seven meters depth; its abundance below this depth varies among sites (Harris and Mathieson 1999; Mathieson *et al*. 2003). The plant can grow very fast (Fralick and Mathieson 1973), reach heights of more than one meter, and thrive with relatively little light (Chapman 1999). Because *Codium* can reproduce through fragmentation, it can spread easily.

Invasive *Codium* can dramatically change the seafloor habitat, as shown here along Nova Scotia's coast. Alan Pinder

The bushy growth form of *Codium* creates a different biogenic habitat than the blades of kelp that it replaces. Alan Pinder

Codium frequently associates with, and sometimes replaces, kelp beds (see Chapter 8). This represents a major change in the seafloor habitat because *Codium* has a bushy growth form that is markedly different from the long stipes and blades of kelp. As a result, *Codium* beds support a very different ecological community than kelp beds. *Codium* has become prominent in some bays where eelgrass has declined, suggesting that *Codium* may flourish in the niche formerly occupied by eelgrass (Trowbridge 1998). When attached to shells, *Codium* increases drag, which can result in shellfish being ripped from the bottom. *Codium* can also attach to other plants, including coralline algae and various red and brown algae that are common in the understory. *Codium* blocks light penetration to these species and reduces their growth and survival.

Herbivory by the native sea slug *Placida dendritica* and overgrowth by the introduced lacy crust bryozoan may constrain the spread of *Codium*, especially in sheltered areas. In areas exposed to waves, strong storms dislodge *Codium* from the seafloor and help to clear space for other species to colonize.

Distribution

Codium was found at limited sites north of Cape Cod by the 1970s, presumably reaching these locations via dispersal through the Cape Cod Canal (Carlton and Scanlon 1985, Mathieson *et al*. 2003). Evidence suggests that nutrient-rich sites, such as bays that receive nutrient inputs from land-based activities, may be most susceptible to establishment of *Codium* (Trowbridge 1998 and references therein).

Management Considerations

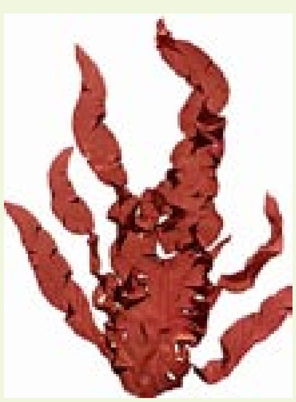
Codium is eaten by a variety of native herbivores, including snails, sea slugs, and the green sea urchin (Freeman and Smith 1999). However, urchins prefer kelp and consume relatively little *Codium* under natural conditions, possibly due to its lack of chemical attractant (Prince and LeBlanc 1992).

The dense branches of *Codium* may shelter small animals from predators. However, *Codium* beds have less habitat value than kelp beds for larger organisms, such as juvenile cunner and other fish (Levin *et al*. 2002). *Codium*'s dense growth form also shades the understory, impeding the establishment of young kelp in *Codium* beds.

Codium is colonized by other introduced species, including the epiphytic red alga *Neosiphonia harveyi*, the lacy crust bryozoan, and the tunicates *Botrylloides violaceus* and *Diplosoma listerianum*. Drifting fragments of *Codium* may help to spread these other introduced species to new locations.

In *Codium*'s introduced range, its dense beds have negative economic effects. It attaches to shellfish, including commercially valuable blue mussels, bay scallops, and oysters. It may harm these species by increasing drag and buoyancy, making these species more susceptible to being ripped up and deposited on the beach during storms. *Codium* also clogs fishing gear, reducing the efficiency of the gear. Although people harvest and eat *Codium* in its native Asia, the alga is not harvested commercially in the Gulf of Maine.

The species may contain potentially valuable antibiotic, anticarcinogenic, and immunosuppressive compounds. Additional exploration of *Codium*'s properties could reveal other possible beneficial uses (Trowbridge 1998).

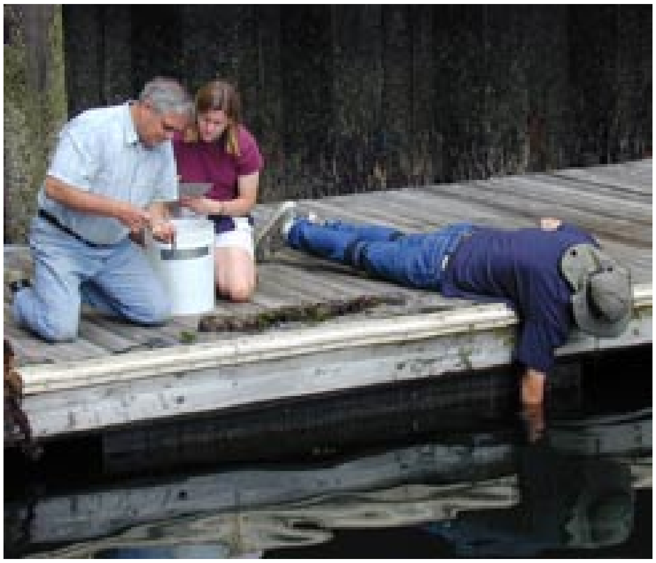


In the next few decades, other non-native species may attain sufficient densities to modify native habitats and qualify as distinct biogenic habitats. For example, the non-native red alga *Grateloupia turuturu*, which grows as long as two meters, occurs in southern Narragansett Bay. If it continues to spread along the east coast, this species could become a problem in the Gulf of Maine.

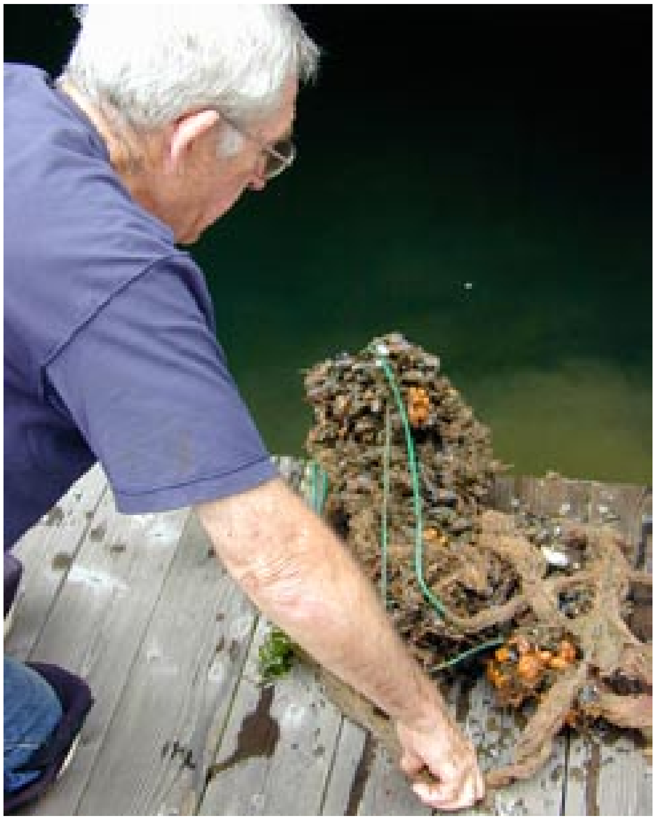
Fouling Communities

General Description

Piers, docks, wharves, shipwrecks, artificial reefs, bridge abutments, and other human-made structures provide habitat for a variety of marine animals and plants. The assemblages of seaweeds and invertebrates that attach to artificial substrates are called fouling communities. In the Gulf of Maine, fouling communities typically include blue mussels, barnacles, encrusting and upright bryozoans, sabellid and spirorbid worms, caprellid shrimp, tunicates, sponges, and a roster of other species. Many non-native species are found in fouling communities. In fact, surveys intended to find non-native marine and estuarine species often target docks and wharves because of their tendency to host invaders. By building structures in the water, humans may inadvertently help non-native species become established.



Wooden piling in Boston Harbor, Massachusetts, colonized by a fouling community. Ben Fertig



Top: Scientists analyze fouling communities on a permanently floating dock in Boston Harbor. Above: Organisms were scraped off from the underside of the dock and identified in a "rapid assessment survey" to detect the presence of non-native species. Peter Hanlon, Massachusetts Bays Program