Ribbed Mussel

Geukensia demissa

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http://www.jaxshells.org/gdim.htm

DESCRIPTION:

Taxonomy and Basic Description

The ribbed marsh mussel (*Geukensia demissa*) was first described by Dwillyn in 1817. It belongs to the molluscan group (Bivalvia) whose members all have two valves or shells. Within that group it collectively is included in a diverse group called 'mussels.' This mussel was formerly placed in the genus *Modiolus*. It is relatively large, growing to nearly 10 cm (4 inches) in length. The surface is grooved with obvious ribs from which its name is derived. It has a glossy brown-black shell often with some yellow to a bleached white color outside; the inner surface is generally white. It has no external siphon; rather it draws water loosely over the gills. The ribbed mussel is distinguished from other South Carolina intertidal mussels by its oblong shape, parallel dorsal and ventral margins, very close exterior ridges and lack of teeth on the hinge. The other common mussels in South Carolina, *Brachydontes exustus* (scorched mussel) and *Ischadium recurvum* (hooked mussel) differ in several aspects; both reach sizes as adults of no more than 2.5 to 5 cm (1 to 2 inches). Further, the scorched mussel has a higher divergent angle from the umbo than the ribbed mussel, small cardinal teeth on the hinge and its shell is thicker and more stout than the ribbed mussel. Mussels are also characterized by having byssal threads, sticky filaments that are used to stabilize mussels when they attach to a substrate.

Mussels are known as filter feeders. During high tides, mussels "pump" water over their gills where particles are either selected for and passed into the digestive system or selected against and passed out as pseudofeces. Ribbed mussels are one of the few bivalves able to forage on small-sized bacterioplankton (Newell and Kambeck 1995; Kreeger et al. 1990); most bivalves only consume larger phytoplankton. As with South Carolina's intertidal oyster, the ribbed mussel feeds only when submerged. At low tide, the shells remain closed to conserve water. Lent (1967, 1969) showed that mussels exposed at low tide are able to respire by "air-gaping."

Ribbed mussels are aged by counting annual growth ribs on the shell (Brousseau 1982). Shell growth is greatest in late summer in the northeast. Ribbed mussels are not hermaphroditic; their sex can be determined by the color of the mantle. Females tend to be a medium brown whereas

males are a yellowish-cream color. Reproduction usually occurs in spring and peaks by midsummer. Mussels are not known to spawn more than once in a season.

Status

The ribbed mussel is not a federally listed species; however, it is a very ecologically important species in marine ecosystems. Filter feeders improve water quality and affect nutrient cycling in estuarine habitats, especially with regard to the water-column microbiota community structure. Ribbed mussels are also important because they increase structural complexity of the habitat, both as living and dead animals (Kuenzler 1961; Bertness 1980; Jordan and Valiela 1982; Bertness and Grosholz 1985; Borrero 1987; Borrero and Hilbish 1988; Kemp et al. 1990; Stiven and Gardner 1992; Franz 1993, 1997).

POPULATION DISTRIBUTION AND SIZE

The ribbed mussel can be found in coastal waters from the Gulf of St. Lawrence to Texas. In South Carolina, the ribbed mussel is found in and amongst fringing marsh grasses and intertidal oyster reefs. Although the actual population size of ribbed mussels is unknown for South Carolina, they are assumed to be very abundant and form rather dense colonies (Franz 2001); they can be found in and among intertidal oyster reef clusters in numbers over 1,500 per m^2 (139 per square foot) (Coen et al. 1999; Luckenbach et al. 2005). Unlike oysters, ribbed mussels have the ability to reattach if dislodged, providing this species with more opportunities to respond to disturbance. Marsh mussels do not seem to be declining in South Carolina; however, we know little about their populations here as elsewhere. As marshes and oyster reefs decline one can assume that these mussels will also decline.

HABITAT AND NATURAL COMMUNITY REQUIREMENTS

The ribbed mussel is a common filter feeder within South Carolina intertidal habitats including marshes, on pilings or within oyster reefs (Coen et al. 1999, 2004; Coen and Luckenbach 2000; Luckenbach et al. in press). Ribbed mussels attach by byssal threads to any hard substrate like oyster shells and cordgrass stems and protrude above the surface. Typically, one can find ribbed mussels embedded in and amongst salt marshes sediments attached by byssal threads to each other and/or to *Spartina* stalks. Ribbed mussels can be found throughout the mid- to low-intertidal elevations in most southeastern estuaries. Upper intertidal limits are determined by both exposure to high temperatures and limited food availability during the longer periods of tidal exposure. Lower intertidal limits are determined by the availability of effective refuge, mainly from crab predators. Although growth rates decline at higher shore levels, this is offset by increased survival (Bertness 1980; Bertness and Grosholz 1985; Stiven and Gardner 1992; Franz 2001).

CHALLENGES

Habitat loss and pollution associated with coastal development is the main challenge to conserving the ribbed mussel. The ability of mussels to survive in a variety of habitats that provide both the appropriate attachment sites and refuge from predators will ameliorate, but not

eliminate, the effects of habitat loss. Salt marshes and oyster reefs, sites for major mussel populations, are two habitats experiencing both quantitative and qualitative declines in many Mid-Atlantic States (Kelly 2001; Kirby 2004). Additionally, development of terrestrial-marsh ecotones will change hydrodynamics at the wetland boundary, likely altering patterns of fresh water flow in high- and mid-marsh locations (Walters et al. unpub. data). The increased survival as a result of reduced predation in higher marsh elevations may be offset by decreased survival from changes in land-based freshwater flow regimes.

Mussels have frequently been used for pollution assessment studies (O'Connor 2002; Hellou & Law 2003). "Mussel Watch" programs, in which mussels (typically *Mytilus* spp.) and oysters are used as valuable bioindicators of pollutant exposures and effects, have been used by the National Oceanic and Atmospheric Association (NOAA) in the United States and in a variety of countries throughout the world. They are regarded as especially valuable bioindicator organisms because they readily accumulate pollutants in their tissues; a number of valuable cellular biomarker approaches have been developed for characterizing adverse effects. Comparative studies with oysters have demonstrated some similarities in mussel bioaccumulation and biomarker responses, but these studies also suggest that marsh mussels may be more sensitive to pollutants. Therefore, marsh mussels may be particularly important as bioindicators of pollutants in marsh grass habitats where oysters are less common. Moreover, since *Mytilus* spp. does not occur in the southeast, *Geukensia demissa* may be used as a valuable alternative mussel species. More recently work here in South Carolina (Ringwood 1999) and elsewhere (Ford et al. 2005) suggests that this mussel is an excellent subject to evaluate sediment contamination impacts. The results in South Carolina for the ribbed mussel were very similar to those observed previously by Ringwood et al. (1998a; 1998b; 1999a; 1999b) for *Crassostrea virginica*. Their employed cellular 'biomarkers' appear to be extremely useful in assessing contaminant sub lethal exposures under field and lab conditions.

CONSERVATION ACCOMPLISHMENTS

The South Carolina Department of Natural Resources annually samples natural and restored oyster reefs throughout the state, using quadrants, in which mussels are counted as well. Mussels seem to respond well to artificial structures such as docks, causeways and impoundments; however, the overall effect on mussel densities within the estuarine systems is unknown.

CONSERVATION RECOMMENDATIONS

- Document the distribution of mussels in the near shore environment and develop models to predict future distribution.
- Evaluate reef contributions to overall mussel population by studying interactions between mussels and oyster reefs population dynamics, and the role of mussels in reef development.
- Study ribbed mussel contributions to the nutrient dynamics of salt marshes and the possible role of mussels in the restoration of marsh habitats.

- Develop ways to use mussels as a bioassay for indicating pollution and a potential indicator of the functional health of communities (oyster reefs, salt marshes) and ecosystems.
- Partner with local governments and the Department of Environmental Health and Control (DHEC) to deter development in sensitive areas or other places where development will have negative effects on oyster and mussel populations.
- Implement and improve Best Management Practices (BMPs) in future urban and commercial developments to protect water quality.
- Enhance/expand SCDNR's oyster restoration programs.
- Continue mussel and oyster surveying.
- Develop a management plan for mussels and/or live bottom habitat in South Carolina.

MEASURES OF SUCCESS

Because mussels are excellent bioindicators of water quality, monitoring mussel and oyster reefs will yield information about the success of efforts to improve water quality. In addition, by implementing the conservation actions listed above, SCDNR will be able to encourage stable, or even increasing, populations of ribbed mussels in South Carolina that will be documented during annual sampling of oyster reefs.

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