# Scientists Flex Mussels to Protect Shorelines

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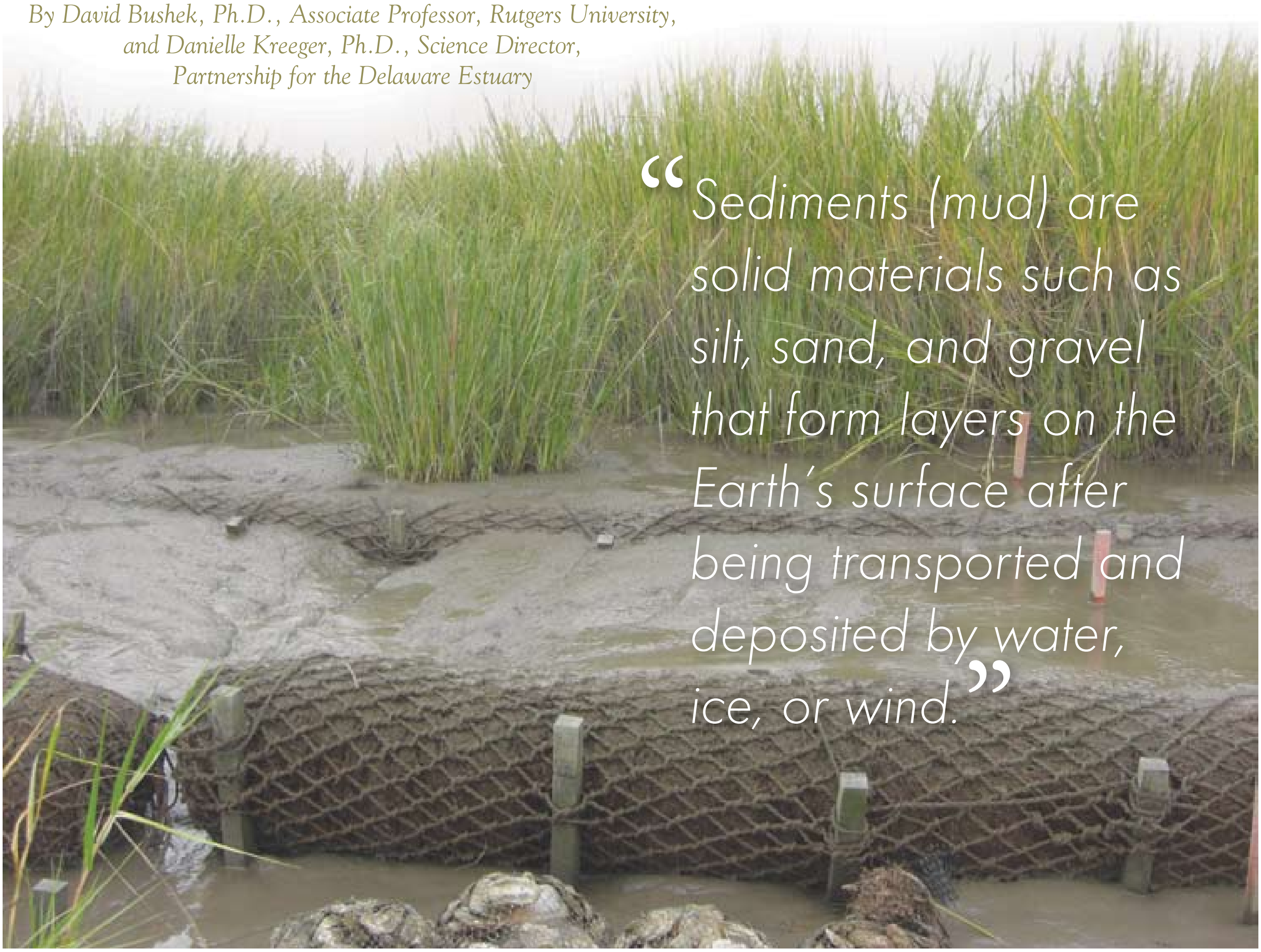

"Sediments (mud) are solid materials such as silt, sand, and gravel that form layers on the Earth's surface after being transported and deposited by water, ice, or wind."

Credit: Haskin Shellfish Research Laboratory, Rutgers University

**Sediments (mud) are trapped by a barrier called a "biolog," which prevents them from eroding into the Maurice River near Bivalve, New Jersey.**

With nowhere to move landward because of upland development, what's a salt marsh to do as sea level rises? Over millennia, salt marshes have migrated as sea level has risen and fallen. Salt marshes grow vertically by trapping sediments suspended in each flooding tide. But what happens if sediment availability declines or sea level rises faster than sediments can be trapped? Worse, what happens when a marsh is diked for long periods, depriving it of its daily dose of sediment from the rising and falling tides?

For nearly a century, dikes and other tidal restrictions around Delaware Bay have inadvertently slowed the natural build up of marshes by short-circuiting tidal sediment supply. Many dikes are no longer being maintained either by design or neglect. When a dike eventually fails, the former tidal wetland often finds itself too low to rebuild. Grasses, which previously thrived, struggle to maintain themselves and quickly drown. Excess nutrients, common in many marshes along tributaries, can cause grasses to invest less in belowground root production (peat), making the top-heavy plants more vulnerable to erosion. When salt marshes erode away, adjacent upland areas have no natural barrier against rising waters.

The Delaware Estuary Living Shorelines Initiative (DELSI) aims to slow the erosion of salt-marsh shorelines by taking advantage of a unique relationship between the dominant plant and animal: the salt-mash cordgrass *Spartina alterniflora* and the ribbed mussel *Geukensia demissa*. Cordgrass and ribbed mussels have a *symbiotic*, or mutually beneficial relationship. Roots of the grass provide a habitat to which mussels attach thin, but very strong, byssal threads that hold them in place. Hundreds of threads help pull each mussel down into the mud, safely away from predators. In return, the mussels fertilize the mud with nutrients that are extracted from the plankton they eat as the tides pass. Grasses nourished by the extra nutrients grow denser along the edge which slows water currents, increasing the *sedimentation*, or trapping of suspended particles. The combined active and passive trapping of sediments builds up the marsh edge, forming a strong, natural, self-maintained levee.

By exploiting this mussel-plant relationship, scientists involved in the DELSI hope to protect salt-marsh shorelines around the Delaware Estuary. With support from the National Fish and Wildlife Foundation, New Jersey Sea Grant, New Jersey Department of Environmental Protection, Rutgers University, and the Partnership for the Delaware Estuary, we have been exploring methods to enhance mussel and plant densities at sites of marsh erosion using natural materials such as coconut fibers.

Credit: Haskin Shellfish Research Laboratory, Rutgers University

**Ribbed mussels are being examined as a tactic to help prevent salt marshes from eroding into Delaware Bay. By attaching to plant roots using "byssal" threads made of proteins, colonies of mussels may effectively armor the shoreline against waves whipped up by boats, currents, and wind.**

Fibers from the husks of coconuts, an industry byproduct, are spun into biodegradable twine called *coir* that is stitched into 20-foot-long *biologs*. These are installed in a semicircle mimicking the natural shoreline, to connect two points along an eroding marsh edge. Mussels placed into the coir logs readily attach with their strong byssal threads, and plugs of cordgrass salvaged from eroding areas can also be planted directly into the logs. The logs immediately trap sediments within and behind them, increasing the elevation of the marsh surface. As marsh plants and mussels colonize the elevated surface, resilience should increase.

Since the first DELSI installations in 2008, we've learned that logs fail in areas with lots of wave action, but that this appears to be a useful and cost-effective tactic at the back of coves, around marinas, and along shorelines where low-to-moderate wave action necessitates protection. We are still experimenting with methodologies and hope to soon establish a demonstration site at the Heislerville Fish and Wildlife Management Area along the Maurice River in Cumberland County, New Jersey. Beginning next year, we will begin to document the use of restored-versus-eroded areas by fish and wildlife.

For more information about the DELSI, please visit our website at www.DelawareEstuary.org/Science_Projects_Living_Shoreline.asp. ■

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of oysters produced from plantings each year can equal or exceed the total quota for the harvest of oysters, thanks in part to conservative harvest management by both states. This provides an opportunity to expand the industry while retaining a sustainable population. Economic estimates show high returns for each dollar invested in this program. The dockside return for each $1 spent averages $6.70. Using the usual economic multiplier (think "plateside" return) for fisheries products raises the "bang for the buck" number to an impressive $40 returned for every $1 spent! And the ecological return for this program is, of course, priceless. ■