Shoreline armoring's effect on the food web

The removal of shoreline armoring in Puget Sound has become a priority for state and federal agencies, but until recently there have been relatively few scientific studies of armoring's local impact. New research looks at the pronounced biological and ecological effects of these common shoreline structures, especially for tiny beach-dwelling creatures that make up the base of the food web.

Storm surges against the bulkheads protecting beach houses at Mutiny Bay, WA. Photo: Scott Smithson (CC BY-NC-ND 2.0) https://www.flickr.com/photos/dtwpuck/15725058917

It's plain to see that bulkheads, seawalls, and other types of armoring change the shape of shorelines. It stands to reason then that they would affect the

Rethinking shoreline armoring
Salish Sea Currents

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A review of Puget Sound marine and

organisms that grow, dwell, and forage there. But just how armoring affects Puget Sound's plants and animals has often been more a matter of guesswork and casual observation than of measurement and science.

A clear picture of armoring's impacts specific to Puget Sound has been elusive, but a series of studies, led by biologist Megan Dethier of UW's Friday Harbor Laboratories, with support from Washington Sea Grant and the EPA's National Estuary Program, may change that. Several related papers published by Dethier and others are already starting to document armoring's effects in the Central and South Sound in unprecedented depth and detail.

One such study focuses on the unsung heroes of Puget Sound's beach habitat, the tiny insects and other invertebrates that make up the base of the food web. These creatures go by names like talitrids and collembolans, and they are found in the logs and other organic debris that wash up on shore. Although you may not have heard of them, they, and other similar species, are immensely important to fish such as salmon that rely on them as a sort of floating buffet. Scientists have wondered how these small creatures fared on armored versus unarmored beaches, and it turns out that the messier the beach—organically, at least—the better its habitat.

> *"There are more effects than just what you see at the beach. The beach is the connection zone between the land and water. It affects what happens on both."*
>
> —Sarah Heerhartz, UW student

Comparing twins

For three years, Dethier and her student Sarah Heerhartz, together with UW Aquatic and Fishery Sciences researchers Jason Toft and Jeff Cordell, UW School of Oceanography professor Andrea Ogston, and Helen Berry from the Washington Department of Natural Resources, meticulously surveyed 29 pairs of armored and unarmored beaches from Bainbridge Island in the north to Case Inlet in the south. The twinned, often adjacent beaches had similar shapes, wind and sun aspects, and wave exposures.

nearshore grant program results, Part 1

Related Species

Song Sparrow (Melospiza melodia)

Chinook Salmon (Oncorhynchus tshawytscha)

Chum Salmon (Oncorhynchus keta)

Pink Salmon (Oncorhynchus gorbuscha)

Jeff Cordell and Erin Morgan survey sea wrack on a Puget Sound beach. Photo: Megan Dethier

At each beach, the researchers catalogued features like sediment and log buildup, while precisely sorting and measuring nearby algae and plants. They also looked at the numbers of insects.

The studies showed clear differences in organic material and ecological communities. Unarmored beaches along Puget Sound had nearly 18 times as many washed-up logs; their “log lines” providing shelter and cooling shade for a wide range of organisms. The unarmored beaches had 58 percent more wrack (washed up kelp and seagrass) coverage and more than twice as much wrack biomass, including nearly four times the terrestrial plant debris.

The figures were pronounced for invertebrate species as well. Talitrids (also known as sand fleas) were the most abundant arthropods overall, and were eight times as numerous on unarmored beaches. Collembolans (sometimes called springtails) were nearly twice as abundant, beetles about three times as common, and flies four times as plentiful, although their numbers varied widely between sites.

These wrack dwellers and shore insects often fall into the water, providing rich fare for young salmon, especially Chinook, chum, and, in alternate years, pinks, which forage close to shore. The researchers hypothesized that unarmored beaches that support more insects might then provide better habitat for salmon.

The researchers devised an ingenious, noninvasive method for gauging whether this was true. One would snorkel offshore until she spotted a single salmon or school. She would signal to an observer, then follow the fish, trying to stay within one meter, for 15 minutes or until they eluded her, recording species, number, estimated size, and number of attempts to catch prey. She would signal again at the end of each pursuit. The observer, standing at a known GPS position, would record the snorkeler's start and endpoint coordinates. A waterproof GPS unit at the snorkeler's waist would record her movements between those points. The result was a meticulous record of each salmon's movements and foraging behavior.

Sarah Heerhartz monitoring fish movements in snorkel gear. Photo: Jesse Colangelo-Lillis

Crunching these data, Heerhartz and Toft found that more fish visited the unarmored than the armored beaches and that they spent more time there, zigging and zagging and varying their speed, as they would when pursuing prey. They also foraged along the armored beaches but proceeded more directly along them, apparently because they found less prey there.

A draw for many species

Heerhartz also gathered what she calls "really preliminary" data on what kinds of birds used what kind of beach. Seabirds and crows favored the open, unobstructed expanses of the armored beaches. Sparrows, especially song sparrows, thronged to the perchable, prey-rich wrack and logs of the unarmored beaches.

Song sparrow foraging on a beach near Seattle, WA. Photo: Ingrid Taylar (CC BY 2.0) https://www.flickr.com/photos/taylar/5164615573

"There's been a lot more focus on seabirds [using beach habitat] than on shorebirds," Heerhartz explains, "but it seems like it can be an important foraging area for shorebirds as well. There needs to be a directed study."

Likewise for the terrestrial mammals that forage along the beaches. Heerhartz and her colleagues found shrews, small rodents, otter scat, and raccoon footprints on the beaches they studied. In British Columbia, black bears have been observed not only foraging on but denning beside saltwater beaches.

"There are more effects than just what you see at the beach," Heerhartz says. "The beach is the connection zone between the land and water. It affects what happens on both."

A larger, six-year study from Dethier and her group is in review at a scientific journal and will cover an even broader range of ecological impacts.

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Eric Scigliano's reporting on social and environmental issues for The Weekly (later Seattle Weekly) won Livingston, Kennedy, American Association for the Advancement of Science, and other honors. He has also written for Harper's, New Scientist, and many other publications. One of his books, Michelangelo's Mountain, was a finalist for the Washington Book Award. His other books include Puget Sound; Love, War, and Circuses (aka Seeing the Elephant); and, with Curtis E. Ebbesmeyer, Flotsametrics. Scigliano also works as a science writer at Washington Sea Grant, a marine science and environmental program based at the University of Washington.

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