Shore Stewards News
GUIDELINES AND RESOURCES FOR LIVING NEAR WATER | ESTABLISHED 2003

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Recognizing How Bulkheads Change the Shoreline

Photo: Scott Chase

Bulkheads, seawalls, and riprap are some of the words that describe man-made structures meant to hold back the erosion caused by waves, wind, and tides. This armoring also includes boat ramps, piers, docks, and any other structure on the beach. Such structures contribute to the armoring or hardening of the shorelines of Puget Sound. It is estimated that more than a quarter of Puget Sound shorelines are currently armored.

While armoring may serve to protect the bluff against wave erosion, the energy of the waves may be diverted elsewhere, often toward the bottom of the bulkhead. This water movement scoops away sand and may eventually cause the bulkhead to be undermined and lean towards the water. In all cases, however, the wave energy is also directed back towards the beach, scouring away the sand and small gravel, leaving larger gravel and sometimes bedrock in place of the once sandy beach. When several homes or a community have hundreds of feet of bulkhead along the beach, this effect may be more dramatic. The finer sand and gravel may end up being moved from in front of the bulkheads to sites at one or the other end of the bulkheads, due to littoral drift. If the beach was a location where fish like surf smelt or sand lance deposited their eggs, the change of sand and gravel compositions could cause the beach to no longer be a reliable spawning location for these important forage fish. Salmon, seabirds, and many other marine species depend on such forage fish in their diet. Likewise, the change in a beach's characteristics could mean the end of its ability to support the important habitat provided by eelgrass beds, which are nature's nurseries for a wide range of marine species. Over the past century there have been significant reductions in the size and number of eelgrass beds in Puget Sound.

Without armoring, long term erosion is generally quite slow, often less than one foot per decade. Some locations of Puget Sound that experience more dynamic wave action have higher erosion rates. Erosion usually does not occur at a constant rate so it is hard to predict erosion patterns. You could experience little erosion of your property for 40 years, and then a landslide removes a large piece of your bluff at one time. Sometimes these landslides are not caused by erosion from wave action, but due to heavy rains, which cause heavy super-saturated soils.

Shoreline Armoring in Puget Sound

Shoreline armoring photo courtesy NOAA

A large portion of Puget Sound's over-2500 miles of shoreline is vulnerable to erosion, depending on hydrologic forces such as tides, runoff and wave action, as well as composition (sandy bluff, bedrock, etc.) In the past, this erosion was viewed not as a natural process that is an important factor in the health of the Sound, but as a problem that needed to be controlled. This was particularly evident with private property owners, both residential and commercial, who installed bulkheads and other armoring to halt any erosion, even in locations that experienced little or very slow erosion. In a 2010 report, the Washington Department of Ecology estimated that over 700 miles of the shoreline in Puget Sound is armored, which varies by county. Over 90% of the urban waterfront between Everett and Tacoma, for example, is armored by riprap protecting the railroad tracks that parallel the shoreline, residential armoring, and bulkheads and seawalls in front of piers, ports and government-owned land. In rural San Juan County, however, the percentage of armored shoreline is closer to 4 – 5%.

The Puget Sound Partnership, a state agency, has proposed that by 2020, the amount of armoring removed should exceed that amount of new armoring. This will primarily happen in public areas, like beaches and parks. When armoring must be replaced, for which it is increasingly difficult to obtain a permit, they will emphasize the use of "soft shore" or more natural techniques. These techniques will be discussed in upcoming newsletters.

New Shoreline Armoring Study Shows Effects on Ecosystem

Megan Dethier, a research professor of biology at the University of Washington's Friday Harbor Laboratories, has just released the results of a study that analyzes multiple sites within the Puget Sound region, offering the first comprehensive look at how shoreline armoring impacts the Puget Sound ecosystem. Though there are hundreds of different factors that impact the shoreline ecosystem, the researchers had to search for patterns that were driven by armoring alone. The paper describing their results was published in April 2016 in the journal *Estuarine, Coastal and Shelf Science*.

Sites were examined in south, central and north Puget Sound, and the findings were that beaches with armoring became steeper and slightly narrower over time, with finer grained sediment and sand being replaced by larger pebbles. With the large amount of samples, and variety of beach types that were sampled, it was found that the shape and texture of the beaches happened slowly, over a period of time, something that was not as evident before.

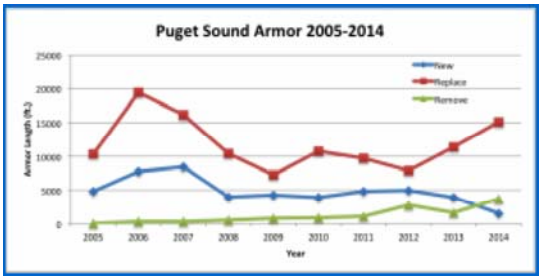
The study was conducted by identifying 65 pairs of sites around Puget Sound, with each pair including one site with some degree of armoring and a nearby one with no armoring. Each pair of sites was within a distinct shoreline unit, called a drift cell. The amount of armored shoreline in each drift cell varied. Data collected at each site included the number of logs on the shore; the amount of natural debris, such as algae and seagrass; size of beach sediment; amount of overhanging vegetation (which drops insects and other food into the water); invertebrates like sand fleas and insects; and the slope of the beach.

Armored beaches were found to have fewer drift logs, seagrass, algae, and other organic debris than the unarmored beaches. Since this vegetation is relied upon by insects and crustaceans for food, there were fewer invertebrates at the armored locations. Surf smelt and sand lance depend on sandy beaches for spawning habitat, which was replaced by coarser sediment in areas with armoring. All of these nearshore habitat changes were found to likely alter the migration and feeding patterns of juvenile salmon in Puget Sound. And in drift cells that had a higher percentage of armoring, even unarmored sites had less sand and larger sediment. Additional information on Megan Dethier's studies can be found in the links in the Resources section.

Is Shoreline Armoring in Puget Sound Declining?

After many decades of degradation, the amount of shoreline armoring that was removed from Puget Sound in 2014 exceeded the amount of newly constructed armoring. With growing realization that bulkheads are harmful to our shoreline ecology, and increased difficulty in getting permits to build or replace bulkheads, that amount of new shoreline armoring has slowed. Bulkhead removal, particularly in public access locations, has contributed to shoreline restoration. Federal, state and local grant programs are helping shoreline property owners replace their bulkheads with more natural solutions. When Washington Department of Fish and Wildlife officials reviewed all permits they issued in Puget Sound, they discovered they had surpassed that milestone that Puget Sound

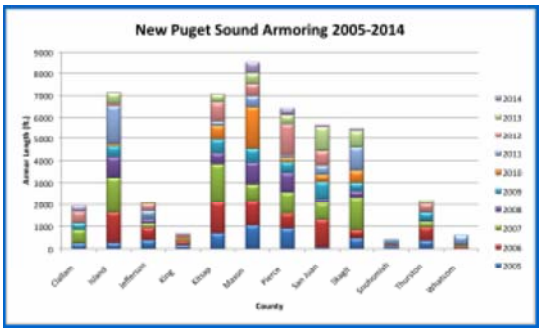
Partnership had hoped to achieve by 2020. This figure was just for one year, however, and more work needs to be done between now and 2020.



New, replaced, and removed Puget Sound armoring (2005-2014). Source: WDFW

There was 1,530 feet of new armoring constructed around Puget Sound in 2014, with 3,710 feet of armoring that was removed and not replaced with anything else. The amount of new armoring has decreased drastically: 8,493 feet was installed in 2007, dropping to 3,924 feet in 2013 and 1,530 feet in 2014. No armoring was added in Whatcom, Thurston or Jefferson counties in 2014.

The amount of bulkheads removed in 2007 was 314 feet, jumping to 1,647 feet in 2013 and 3,710 feet in 2014. One large scale habitat-restoration project in Jefferson County included the removal of a 1,150 foot long seawall in Discovery Bay, resulting in forage fish spawning where none was previously observed. Some complications in making these calculations include recent studies, funded by the EPA, which included surveys of shorelines by boat to check new construction along the shoreline. It was found that some bulkheads have been built without appropriate permits, and the amount of these bulkheads is unknown. Though these should be counted as new construction, they are not included in the WDFW figures. Also, soft-shore or natural armoring is counted as new construction, the same as concrete bulkheads. Soft-shore armoring is an improvement over concrete, but that is not taken into account. How these factors affect the reporting of the amount of armoring is unknown. The following chart shows the amount of new armoring in Puget Sound, by county, for the time period 2005 – 2014.



New Puget Sound armoring by county by year (2005-2014). Source: WDFW

Resources

1. Rethinking Shoreline Armoring – *A series of Salish Sea Currents magazine.*Encyclopedia of Puget Sound. (The Encyclopedia of Puget Sound is published by the University of Washington's Puget Sound Institute) https://www.eopugetsound.org/magazine/shoreline-armoring
2. Detheir, Megan N. et al. Multiscale impacts of armoring on Salish Sea shorelines: Evidence for cumulative and threshold effects, *Estuarine, Coastal and Shelf Science* (2016 Provided by: University of Washington)
3. Kinney, Aimee et al. Analysis of Effective Regulation and Stewardship Findings, Dec 2015. Puget Sound Institute. Link
4. Scigliano, Eric Shoreline armoring's effect on the food web. Encyclopedia of Puget Sound. https://www.eopugetsound.org/magazine/armoring-foodweb
5. Guide for Shoreline Living, 2015. Washington State University Extension.http://shorestewards.cw.wsu.edu/guidelines/

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