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Nearshore Habitat How Bank Armoring & Overwater Structures Shape the Health of Pacific Salmon & Steelhead

Nearshore habitat is the shallow water and land adjacent to our shorelines and streambanks within Puget Sound and coastal areas. It includes the beach, intertidal and subtidal zones, and the upland area of the shore itself. Within rivers and streams, it includes the water's edge, the slope to the top of the bank, the floodplain, and the riparian area. Throughout the Northwest, nearshore habitats are some of the primary places where young salmon and steelhead find refuge, food, and passage to the sea. These important rearing, feeding, and migration areas are the result of natural processes that move sediments; provide nutrients, organic matter, and large woody debris from plants; and produce insects and similar marine animals.

Nearshore environments have been heavily altered to meet the demands of a growing human population. Bulkheads, dikes, fill, port development, and commercial and residential building collectively impact these areas. Significant portions of our shorelines and streambanks now are armored with bulkheads and human-placed boulders, or "riprap." In Puget Sound, roughly one-third of the region's shorelines are armored. In addition, we have placed structures—such as docks, marinas, and boat ramps—in and over the water to provide human access to our region's waterways. While overwater structures and bank armoring can provide important functions for communities and local economies, they can also degrade ecosystem conditions, and thereby pose threats to Pacific salmon and steelhead.

What Science Tells Us About Bank Armoring, Overwater Structures, and their Impact on Salmon

Bank Armoring

By placing walls of concrete and rock along our shorelines and streambanks, we change the natural conditions that are essential for the creation and maintenance of aquatic habitat. Sediment erosion and deposition are major factors influencing nearshore habitats. When sediment no longer moves freely because of armoring, the area and physical complexity can be reduced, and potentially make shorelines less suitable for the plants and animals that normally live there, including salmon and steelhead. Armored shorelines can have the following impacts on salmon and steelhead:

- Limit productive feeding grounds for juvenile salmon by taking away potential production of invertebrate prey, herring, and small fish that salmon eat. Bulkheads built atop sandy beaches typically will result in the sand washing away and leaving the larger rocks and hardpan beneath, which forage fish cannot use for spawning; and
- Through placement of hard, vertical structures, reduce the shallow waters available, thereby forcing young salmon into deeper water where they may be more likely to be eaten by larger fish.

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Overwater Structures

Overwater structures can have direct physical effects on aquatic habitat from construction, as well as indirect effects associated with long-term changes in sediments, shading, and water quality from the ongoing operation of the structures and boat traffic. Direct effects can be a range of changes in the physical structure of the habitat, ambient light conditions, and water flow patterns and sediment movements. Also, the human use of overwater structures, via such things as boating activities, indirectly alters the environment by changing its physical and chemical composition (e.g., water quality degradation, propeller scour, and noise). Together, the direct and indirect effects of overwater structures can be so great as to alter the physical environment, resulting in harm to salmon and steelhead.



Shade cast from overwater structures limits the amount of light energy available for photosynthesis of phytoplankton, algae, and eelgrass, each of which is an important part of the food web that supports juvenile salmon in the nearshore environment. In addition, darkly shaded areas can delay fish migration and drive juvenile salmon into deeper waters during daylight. This, in turn, increases the risk of predation by exposing young salmon to larger fish.

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Best Practices for Protecting Nearshore Habitat

Protecting nearshore habitat does not require us to remove all structures that may inhibit habitat formation. There are several measures you can take to limit the adverse effects of bank armoring and overwater structures on salmon and steelhead. This is particularly important because several species of salmon and steelhead are threatened with extinction and protected by the Endangered Species Act. The following measures will also benefit other aquatic species and contribute to the overall health of the ecosystem:

Evaluate the Project's Necessity: Armoring measures may not be necessary or the only solution to limit shoreline erosion. In many cases, bank armoring is not necessary and can be avoided. Before armoring the shoreline, seek expert help to evaluate the true need of a given project and whether it is critical to achieving the project's objectives.

Soft Engineering Techniques: A bioengineered approach to bank stabilization, including the use of soft materials and native vegetation rather than rock, maximizes habitat for young fish. The analysis and soft methods illustrated in the Integrated Streambank Protection Guidelines (available at: <http://wdfw.wa.gov/publications/pub.php?id=00046>) can be used to successfully protect infrastructure without undue harm to salmon and steelhead. Native woody vegetation adjacent to the shoreline, even if it includes armoring, provides benefits to salmon and steelhead. If visibility is a concern, choose low growing native shrubs.

Design, Placement, and Reconstruction of Docks & Marinas: Fully understand the pathways of sediments and flows, wave energy, salinity gradients, extent of marine plants, and light regimes supporting nearshore habitat in a specific area in order to minimize adverse effects on aquatic species. Docks should be constructed to the minimum size necessary to accommodate berthing a vessel, and placed offshore a sufficient distance to not impede the free movement of small salmon and steelhead along the shoreline.

Light Requirements: Minimize the impacts of shading around overwater structures by using particular construction materials, such as glass blocks and grating, or configure the structures to minimize the area of shaded shallow waters. Also consider the structural design, such as height, width, and sun orientation, to allow light to reach the water.

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For More Information

If you would like to learn more about how bank armoring and overwater structures affect the health of nearshore habitat, or if you would like to implement best management practices into your projects, please consider the following sources:

- Puget Sound Shorelines and the Impacts of Armoring—Proceedings of a State of the Science Workshop, May 2009. Available at: <http://pubs.usgs.gov/sir/2010/5254/>
- Overwater Structures: Marine Issues, May 2001. Available at: <http://wdfw.wa.gov/publications/00051/>
- Frequently Asked Questions, Marine Shoreline Armoring and Puget Sound, Feb 2010. Available at: <http://www.ecy.wa.gov/pubs/1006003.pdf>
- Nonfishing Effects on West Coast Groundfish Essential Fish Habitat and Recommended Conservation Measures. Available at: http://www.pcouncil.org/wp-content/uploads/GF_FMP_App_D.pdf
- NOAA Fisheries' Programmatic Biological Opinion on Revisions to Standard Local Operating Procedures for Endangered Species (SLOPES IV In-Water Over-Water Structures). Available at: [https://pcts.nmfs.noaa.gov/pls/pcts-pub/biop_results_detail?reg_inclause_in=\('NWR'\)&idin=135065](https://pcts.nmfs.noaa.gov/pls/pcts-pub/biop_results_detail?reg_inclause_in=('NWR')&idin=135065)
- NOAA Fisheries' Programmatic Biological Opinion on Revisions to Standard Local Operating Procedures for Endangered Species to Administer Stream Restoration and Fish Passage Improvement Activities (SLOPES IV Restoration). Available at: https://pcts.nmfs.noaa.gov/pls/pcts-pub/sxn7.pcts_upload.summary_list_biop?p_id=103803
- NOAA Fisheries' Programmatic Biological Opinion on Revisions to Standard Local Operating Procedures for Endangered Species to Administer Maintenance or Improvement of Road, Culvert, Bridge and Utility Lines (SLOPES IV Roads, Culverts, Bridges and Utility Lines). Available at: [https://pcts.nmfs.noaa.gov/pls/pcts-pub/biop_results_detail?reg_inclause_in=\('NWR'\)&idin=109294](https://pcts.nmfs.noaa.gov/pls/pcts-pub/biop_results_detail?reg_inclause_in=('NWR')&idin=109294)
- Management Measures for Marinas and Recreational Boating, U.S. Environmental Protection Agency. Available at: <http://www.epa.gov/owow/nps/MMGI/Chapter5/ch5-1.html>
- Washington Department of Fish and Wildlife Position Paper: Effects of Shading from Overwater Structures on Predation of Juvenile Salmonids. Washington Department of Fish and Wildlife Region 5. Vancouver, WA.
- Minimizing Effects of Overwater Docks on Federally Listed Fish Stocks in McNary Reservoir: A Literature Review for Criteria. U.S. Army Corps of Engineers, Walla Walla District. Anadromous Fish Evaluation Program Report 2010-W68SBV91602084. Available at: <http://www.mercergov.org/files/Rondorf%20Minimizing%20Effects%20of%20Over-Water%20Docks.pdf>