September 2008

PRESSING ON:

DO RESIDENTIAL DOCKS REALLY IMPEDE PASSING SALMON?

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There are studies showing that docks' shadows affect the welfare of juvenile salmon headed toward the sea. Wide docks (ships' piers and ferry terminals) create sharp breaks between sunlight and deep shade.

One effect, shading-out of eelgrass, is observed but the impacts on salmon have not been measured and aren't discussed here.

It has been supposed that predator fish, lurking in the darkness, will dash out to consume the passing salmon. Shade-based predation has been discounted, as discussed later.

Abrupt light-to-dark transitions, on sunny days under large docks, cause some salmon to detour around the discontinuity. Shade-driven diversion has been reported.

But not under narrow residential docks.

If residential docks are making a difference to emigrating juvenile salmon, how large might that impact be? Small, according to calculations shown here. An average of 93 feet are added to the 55-mile swim from Kitsap County's Sinclair Inlet to Puget Sound's exit.

Docks have been crucial, stable platforms on capricious waters

Docks and wharves, piers and floats have reached out into the world's tidewater, lakes and rivers for four thousand years at least. People of Puget Sound received their first piano and their first steam engine across docks. Without docks the essentials of civilized life would have been lowered with ships' tackle into longboats, and struggled across beaches one bit at a time. The cumbersome alternative was scows, hauled back and forth with ropes and grounded on the shore.

Yesterday's mosquito-fleet docks with their freight sheds are gone, replaced by light-duty piers and floats as shoreline use has become largely residential and recreational. Most residential docks are tucked into protected bays. On Bainbridge Island, for example, two-thirds of all docks are on the two-fifths of the shore that is sheltered.[1] One of Puget Sound life's great pleasures is standing quietly on a float, watching schools of 'shiners' move past and beneath.

Lately docks have been criticized for their ecologic effects.

There is a considerable literature on the badness of docks for eelgrass and passing salmon. Eelgrass, with its various contradictions,[2] isn't treated here. The fish matter is mainly one of deep shade beneath large docks, and the related research derives almost entirely from ferry terminals[3] and industrial wharves.

Out-migrating salmon pay attention to sun/shade 'edges'.

Research on salmons' eyesight has shown that fishes' size correlates inversely with ultraviolet-light acuity; the latter helps find inshore planktonic prey, which reflect UV light. Too, the time required for fry eyes to adapt back and forth between light and dark is 20 to 40 minutes.[4]

It is assumed that fish are reluctant to go where they cannot see.[5] "Findings have demonstrated that fishes' responses to piers are ambiguous with some individuals passing under the dock, some pausing and going around the dock, schools breaking up upon encountering docks, and some pausing and eventually going under the dock..."[6]

Some numbers have been put on that reluctance. Acoustic tracking of a (small) number of fish at the Port Townsend ferry terminal (120 feet wide) found that half crossed under the terminal, with the rest going around (adding perhaps 650 feet to their longshore trip).[7]

The same analysts also watched school of fish gather adjacent to terminals, suggesting they queue up before pressing on, at least in daylight when confronted with sharp shade lines under the docks.

None of the studies considered the acoustic effects of dock traffic.

A number of factors have been suggested to explain whatever outgoing salmon do around docks. State of the tide, currents, brightness and angle of the sun, height of the dock and width of the terminal, and predator presence have been mentioned. Unmentioned is sound and vibration from vehicles, the latter telegraphed to tidewater through piling. A ferry terminal supporting an hourly schedule may have a nearly continuous series of vehicles arriving in the dock-borne queue and departing the vessel.

Contrary to received dock doctrine, increased loss of young salmon to predators has never been documented.

"Such a move [around the end of a dock] to deeper waters likely increases the risk of predation by larger predators occupying pelagic waters"[8] and "...the shaded, deep-water environment under piers can create a favorable habitat for predatory fish"[9]. A marine biologist notes, "...there is no evidence, despite many efforts to find it, that such structures in marine waters lead to a concentration of predators on juvenile salmonids or increase vulnerability of juvenile salmonids to those predators that may be present."[10]

There have been virtually no impact studies of residential (small) docks on Puget Sound.

A mid-'90s study examined the effects of small docks, with and without central gratings, on performance of eelgrass beds.[11] This was not a fish-behavior study.

Informal field observations suggest that residential docks less than eight feet wide are hospitable to transiting fish, including salmon. "...docks less than 8 feet wide allow substantial light penetration underneath them, especially during periods of low sun angles."[12]

I have seen schools of fingerlings take refuge in shade under floats and docks. Houghton says, "If [floats or floating docks] are relatively narrow, e.g., 6 feet wide or less, fish would ultimately pass under or around them with little delay....juvenile salmonids have been observed to move freely along floating structures, ultimately passing under them in response to uncertain stimuli, or through gaps between floating sections, e.g., spaces between segments of a log boom."[13]

Requiring mid-dock grating to bring daylight to the depths is an untested mandate.

If the research base is as limited as this, it is surprising that jurisdictions seem to be routinely requiring gratings on residential docks unrelated to eelgrass. It is even more surprising that research agencies are not studying migrant-fish behavior in the presence of narrow docks.

In any case, the likelihood that salmon suffer from residential docks, is apparently small.

This statement is based on more estimates (less data) than I would like. We begin with the number of docks encountered between the salmon's natal stream and the ocean. We consider the distances around them and the proportion of fish that will use the roundabout option.

A small salmon leaving the Gorst Creek hatchery west of Bremerton and taking the express route, the "inside passage" to the sea, encounters 55 residential docks. This route passes Dyes Inlet at Bremerton, the mainland west of Bainbridge, past the openings to Liberty and Miller Bays, circles through Appletree Cove at Kingston, rounds Point No Point and crosses the entrance to Hood Canal en route to Marrowstone Island and Point Wilson, there leaving the Sound heading west.[14] Along this 55-mile tidewater route twenty of the residential docks are 30 feet long or shorter, no impediment to salmon even at highest tides.[15]

The average length of the other 35 residential docks is 81 feet.[16] Salmon are unlikely to be swimming within 35 feet of the shore.[17] What is the probability of their swimming around a dock? It happens in daylight, on sunny days, when the water is deep enough to invite visits inboard from the end of the dock. The probability of this joint event is about .035.[18]

Multiplication does the rest, suggesting that residential docks add an average of about 93 feet or .032 percent to salmons' travel from the central Sound to the Strait of Juan de Fuca.[19] Considering that few residential docks will be encountered thereafter, the burden of diversion adds only about .012 percent to the fishes' 150-mile swimming distance to the ocean.

There remains the possibility, mentioned earlier, that residential docks do not matter at all to salmon.

Residential docks are:

Few in number,

Narrow, offering diffused shade,

Relatively short, and

Quiet, creating little disturbance by carrying little traffic, all pedestrian.

NOTES

1. Williams, Gregory D., et al. 2004. Bainbridge Island nearshore habitat characterization & assessment, management strategy prioritization, and monitoring recommendations. Sequim: Battelle Memorial Institute, Marine Sciences Laboratory, p. 32.

2. For instance, eelgrass is said to be in decline, yet it is increasing in Puget Sound. It is said to nurture juvenile fish yet it lies downhill from their preferred cruising routes. It is said to be unique habitat yet kelp provides the same functions. It is said to defy culture yet planting works.

Eelgrass, pocket estuaries, and shallow tidewater are considered three key legs supporting emigration of young salmon. Yet estimates of the proportional uses of these habitats were not found.

3. At least ten terminals have been studied, with the sophistication of tallying fish impacts improving steadily. Recent state Department of Transportation studies of terminal biology include:

> Olson, A. M., S. D. Visconty and C. M. Sweeney. 1997. Modeling the shade cast by overwater [ferry] structures. University of Washington School of Marine Affairs. For Washington Department of Transportation.
>
> Simenstad, Charles A., et al. 1999. Impacts of ferry terminals on juvenile salmon migrating along Puget Sound shorelines. Phase I: Synthesis of state of knowledge. Seattle: Washington State Transportation Center.
>
> Shreffler, D. K. And R. Moursund. 1999. Impacts of ferry terminals on migrating juvenile salmon along Puget Sound shorelines: Phase II: Field studies at Port Townsend Ferry Terminal.
>
> Haas, Melora Elizabeth, et al. 2002. Effects of large overwater structures on epibenthic juvenile salmon prey assemblages in Puget Sound, Washington. University of Washington School of Aquatic and Fishery Sciences and Washington State Transportation Center.
>
> Williams, G. D., et al. 2003. Assessing overwater structure-related predation risk on juvenile salmon: Field observations and recommended protocols. Battelle, for Washington Department of Transportation.
>
> Southard, S. L., et al. 2006. Impacts of ferry terminals on juvenile salmon movement along Puget Sound shorelines. Battelle for Washington State Department of Transportation.

4. Nightingale, Barbara and Charles Simenstad. 2001. White paper: Overwater structures: marine issues. University of Washington School of Aquatic and Fishery Sciences. A literature compilation.

5. A discussion of all this is in Nightingale and Simenstad 2001, above, p. 39ff.

6. Nightingale and Simenstad 2001, above, p. 43.

7. Southard, S. L., et al. 2006, above. P. 42.

8. Nightingale and Simenstad 2001, above, p. 43.

9. Envirovision, Herrera Environmental, and Aquatic Habitat Guidelines Working Group. 2007. Protecting nearshore habitat and functions in Puget Sound, an interim guide. Olympia: Washington Department of Fish and Wildlife, p. III-3. Contrary to the associated Table III.1, most of the 'impacts' of overwater structures are unsupported by quantified research.

10. Houghton, Jon. 2006. Best available science review of proposed overwater structure restrictions in Blakely Harbor, Bainbridge Island, Washington. Edmonds, Washington: Pentec Environmental, p. 15.

11. Fresh, K. L., et al. 1995. Overwater structures and impacts on eelgrass in Puget Sound, Washington. Proceedings, Puget Sound Research 1995. Vol 2 p. 537-43.

12. Houghton, Jon, 2006, above, p. 7.

13. Houghton, Jon, 2006, above, p. 4.

14. This route is conjectural; given the tendency of salmon to 'stray', Gorst Creek may be sending salmon to the far corners of the Sound. In time, acoustic tagging and other techniques will surely answer the route question.

15. Assuming that juvenile salmon migrating inshore want at least 3-1/2 feet of water, and there is a 1:10 beach profile gradient.

16. The dock counts and lengths are taken from Google Maps satellite images.

17. Given the assumptions in note 15.

18. On average, 26 of the 92 days of the May-July migration season are clear (28%). Assume 12 hours of bright sunlight on those clear days (50% of the day). The joint probability of arriving at a dock in bright daylight is thus (.28 x .5) = .14.

Now consider the tide. Assume the landward end of the dock is at MHHW, 11.4 feet above MLLW [tidal data from NOAA for Seattle datum]. MHW is at 10.5 feet. MTL is at 6.7 feet, 47 feet [(11.4-6.7) x 10] out from the bank. MTL is 34 feet [81-47] from the average dock's outer end, where the water is 3.4 feet deep at Mean Tide. At this tide level and below, which is the status half of the time, the low water pushes approaching salmon farther out than the average dock reaches. In fact, at mean low tide the 3.5-foot depth threshold for salmon is 39 feet beyond the dock; at mean tide level that threshold is still a foot beyond the dock.

The other half of the time, when the tide is higher than its overall average level, its mean level is 3.8 feet higher than MTL. As the water comes inland it brings the 3.5-foot threshold closer to the upland by 38 feet.

Thus half the time they would swim past without pause; the other half they would confront the dock at an average distance of 38 feet from its outer end.

19. The added swimming distance averages 38 x 2 = 76 feet. The expected value of swimming-around distance at any long dock is .035 x 76 = 2.66 feet.

There are 35 docks with which to deal, so the probable added swimming distance for each fish is 2.66 x 35 = 93 feet. This in a journey of 55 miles.