Sediment Composition in the Coos Estuary

Summary:

- *Coos estuary sediment contains a high percentage of fine-grained silt and clay.*
- *Sediment in the upper estuary contains more silt and clay than the sandier sediments located closer to the mouth of the estuary.*
- *The coastal rivers of southern Oregon contain more fine-grained sediments than Oregon's north coast rivers*
- *The composition of Coos River sediments may be moderately stressful to macroinvertebrates, key biological community.*

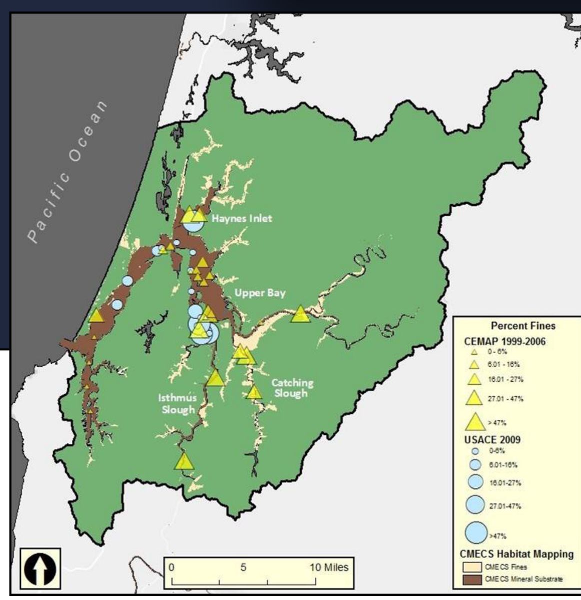

Figure 1. Sediment composition in the Coos Estuary. Larger symbolize represent "muddier" sediment (i.e., greater percentage of fines). Generalized areas of fine-grained sediment (tan) were created from the CMECS habitat classification scheme for the Coos estuary. Data: ODEQ 1999, 2001, 2004, 2005, 2006; USACE 2009; CMECS 2014

Evaluation

Fine-grain sediment may elevate the risk for pollutant transport and excessive sedimentation.

What's happening?

The Coos estuary has been classified as one of the muddiest estuaries in Oregon (Lee II and Brown 2009) due to the relatively high percentage of "fines" (i.e., silt and clay) (Figures 1 and 2), a classification particularly applicable to the upper estuary. Data from the Oregon Department of Environmental

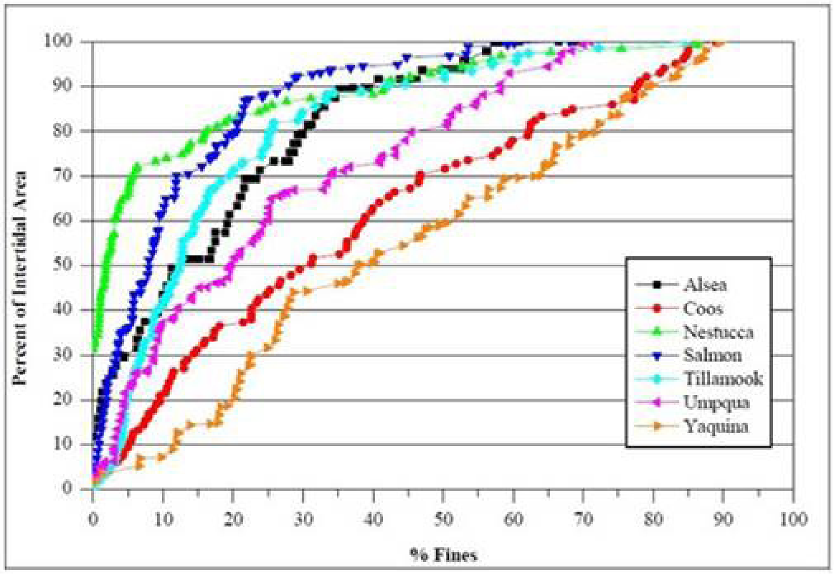

Figure 2. Cumulative distribution functions (CDFs) show the percentage of fine sediment versus the total area of seven Oregon estuaries. Relatively steep CDFs represent sandy estuaries (e.g., Nestucca and Salmon). CDFs with shallow gradients indicate "silty" estuaries (e.g., Yaquina and Coos). Source: Lee II and Brown 2009

Quality (ODEQ 1999, 2001, 2004, 2005, 2006) and the United States Army Corps of Engineers (USACE 2009) confirm that sediment in the estuary's upper reaches (e.g., Haynes Inlet, Upper Bay, Isthmus Slough, and Catching Slough) is muddier than sediment near the mouth of the estuary (e.g., lower South Slough and Lower Bay Subsystems). Sediment composition is commonly classified using the Wenthworth Grade Scale, based on the particle size and cohesive properties of a material (Wenthworth 1922)(Table 1).

Material	Particle Size (mm)	Cohesive Properties
Cobble	256 - 64	Non-Cohesive
Gravel	64 - 2	"
Very Coarse Sand	2 - 1	Non-Cohesive Sediment
Coarse Sand	1 - 0.5	"
Medium Sand	0.5 - 0.25	"
Fine Sand	0.125 - 0.063	"
Silt	0.062 - 0.004	Cohesive Sediment
Clay	0.004 - 0.00024	"

Table 1. Wentworth Scale for Sediment Classification
Source: Bartram and Balance 1996

These conclusions are generally supported by Oregon's newly developed estuary habitat classification maps using NOAA's Coastal and Marine Ecological Classification Standard (CMECS) applied to Oregon estuaries by the Oregon Department of Land Conservation and Development (Figure 1).

<u>Coos River Sediment</u>

Hubler (2008) suggests that elevated levels of fine sediments in some rivers and streams on the southern Oregon coast may be stressful to aquatic biota. In her report, fine sediment stress is categorized into four categories (Figure 3). Fines in the Coos River subsystem sampling sites exceeded Hubler's lowest/least stress sediment category (0-10% fines) considered to be stressful to macroinvertebrate communities. However, the median sediment score in the Coos river did meet the moderate stress benchmark (11-20% fines). Thus, sediment stress in the Coos river is higher than the smaller estuaries (e.g., Necanicum,

Figure 3. Fine Sediment Stressor categories. Source: Hubler 2008

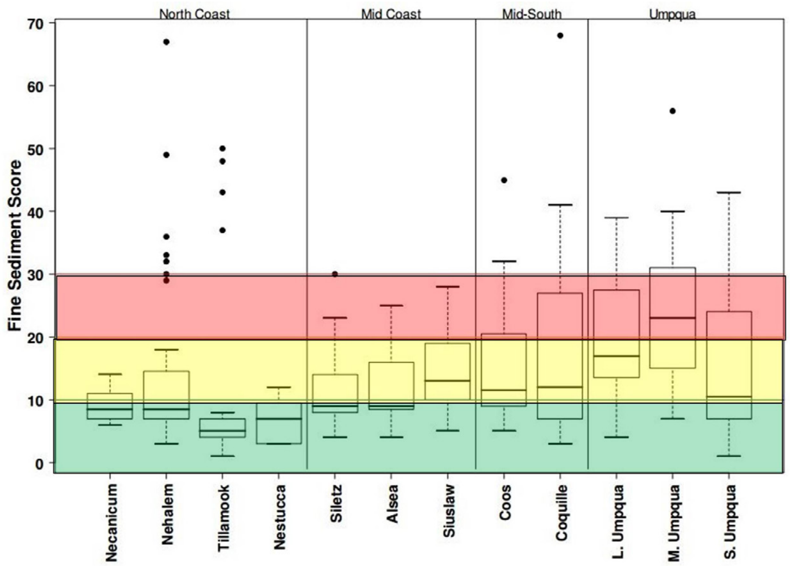

Figure 4. The Fine Sediment Score indicates the amount of sediment-related stress on macroinvertebrates in coastal streams and rivers. Low stress environments (green) are generally found on the north coast, while southern Oregon streams tend to be moderately stressful (yellow) or highly stressful (red) environments. Source: Hubler 2008

Nehalem) but lower than, or similar to, the estuaries associated with major coastal rivers (e.g., Coquille, Umpqua rivers)(Figure 4).

Background

Sediment distribution in estuaries is determined by dynamic hydrologic processes that control sediment inputs and outflows (Thrush et al. 2004; Bell et. al 2000). Sediment distribution and estuarine residence time depends on many factors including: a) particle density, size, and shape; b) flow conditions; c) tidal and wave motion; d) vegetation; and e) precipitation (Bell et al. 2000; Stevenson et al. 1988; Wright 1977; Bartram and Balance 1996). Many determinants of estuarine sediment dynamics are naturally occurring, but human activities (e.g., shellfish culture, land use changes, dredging) can also change the way sediments are distributed (Bell et al. 2000; Pregnall 1993).

Sediments provide vital estuarine habitat for many organisms such as bivalves, snails, worms, echinoderms, crustaceans, etc. These organisms live in the sediment and often facilitate important ecological and geochemical processes in the estuary (Thrush et al. 2004). Sediments also facilitate the transport of nutrients and contaminants within aquatic ecosystems (Bartram and Ballance 1996; Swett 2010). This is particularly true of fine sediments (i.e., silt and clay), which are "responsible for a significant proportion of the annual transport of metals, phosphorus, chlorinated pesticides, and many industrial compounds such as polynuclear aromatic hydrocarbons, polychlorinated biphenyls, dioxins and furans" (Bartram and Ballance 1996).

Although sediments are a fundamental part of a fully functioning estuary, excessive sediment loading is increasingly recognized as a threat to the quality of coastal and estuarine environments (Thrush et al. 2004). Bell et al. (2000), explain that rapid changes to sediment patterns can harm many of the animals that live in aquatic systems. Fine sediments, in particular, "can easily push the sedimentation balance towards irreversible infilling."

References

Bartram, J. and R. Ballance [Eds]. 1996. Water Quality Monitoring. A Practical Guide to the Design and Implementation of Fresh Water Quality Studies and Monitoring Programmes. Chapman & Hall, London.

Bell, Rob, Mal Green, Terry Hume, and Richard Gorman. 2000. Estuaries: What Regulates Sedimentation in Estuaries? Water and Atmosphere 8 (4): 13-16.

Coastal and Marine Ecological Classification Standard (CMECS). 2014. [Unpublished shapefiles for ArcGIS from the National Oceanographic and Atmospheric Association (NOAA)]. Accessed from the Estuarine and Coastal Sciences Laboratory of South Slough National Estuarine Research Reserve.

Hubler, Shannon. 2008. Macroinvertebrate Report: Oregon Coast Coho Evolutionarily Significant Unit (2006-2007). [Reported prepared by the Oregon Department of Environmental Quality]. Accessed 25 August 2014. Available http://www.oregon.gov/OWEB/MONITOR/docs/mr_odfwbugreport.pdf

Lee II, H. and Brown, C.A. (eds.) 2009. Classification of Regional Patterns of Environmental Drivers and Benthic Habitats in Pacific Northwest Estuaries. U.S. EPA. Office of Research and Development, National Health and Environmental Effects Research Laboratory, Western Ecology Division. EPA/600/R-09-140. Retrieved from: http://www.epa.gov/wed/pages/publications/authored.htm

Oregon Department of Environmental Quality (ODEQ). 1999. [CEMAP Sediments]. Unpublished raw data. Retrieved from: http://deq12.deq.state.or.us/lasar2/

Oregon Department of Environmental Quality (ODEQ). 2001. [CEMAP Sediments]. Unpublished raw data. Retrieved from: http://deq12.deq.state.or.us/lasar2/

Oregon Department of Environmental Quality (ODEQ). 2004. [CEMAP Sediments]. Unpublished raw data. Retrieved from: http://deq12.deq.state.or.us/lasar2/

Oregon Department of Environmental Quality (ODEQ). 2005. [CEMAP Sediments]. Unpublished raw data. Retrieved from: http://deq12.deq.state.or.us/lasar2/

Oregon Department of Environmental Quality (ODEQ). 2006. [CEMAP Sediments]. Unpublished raw data. Retrieved from: http://deq12.deq.state.or.us/lasar2/

Pregnall, Maribel Marcy. 1993. Regrowth and Recruitment of Eel Grass (*Zostera marina*) and Recovery of Benthic Community Structure in Areas Disturbed by Commercial Oyster Culture in the South Slough National Estuarine Research Reserve, Oregon. [Master's thesis]. Department of Environmental Sciences, Bard College, Annandale-On-Hudson, New York.

Stevenson, J., L. G. Ward, and M. S. Kearney. 1988. Sediment transport and trapping in marsh systems: implications of tidal flux studies. Marine Geology,80(1), 37-59.

Swett, Michael P. 2010. Assessment of Benthic Flux of Dissolved Organic Carbon in Estuaries Using the Eddy Correlation Technique. Master's Thesis, University of Maine.

Thrush, S. F., J. E. Hewitt, V. J. Cummings, J. I. Ellis, C. Hatton, A. Lohrer, and A. Norkko. 2004. Muddy waters: elevating sediment input to coastal and estuarine habitats. Frontiers in Ecology and the Environment, 2(6), 299-306.

United States Army Corps of Engineers (USACE). 2009. Coos Bay Sediment Quality Evaluation Report. [report prepared by Wendy Briner and Mark Siipola of the Portland District USACE].

Wentworth, C. K. 1922. A scale of grade and class terms for clastic sediments. The Journal of Geology, 377-392.

Wright, L. D. 1977. Sediment transport and deposition at river mouths: a synthesis. Geological Society of America Bulletin, 88(6), 857-868.