PREDICTING LONG-TERM RIVER ADAPTATION TO DAM REMOVAL

A. A. Lee* [1, 2], A. Crosato** [1], A. Omer*** [2]

[1] UNESCO-IHE, Department of Water Engineering, PO Box 3015, 2601 GA, Delft, the Netherlands
[2] Deltares, Department of River Dynamics and Inland Water Transport, PO Box 177, 2600 MH, Delft, the Netherlands

Correspondence to: *E-mail: lee35@unesco-ihe.org, **E-mail: a.crosato@unesco-ihe.org, ***E-mail : Amgad.Omer@deltares.nl

Introduction

Located on the Sandy River (OR, USA), Marmot Dam was a 14m-high dam purposed for water diversion. Its 94 year operation contributed to the severe decline of fish populations in the basin (Taylor, 1998). The removal of Marmot Dam in 2007 was prompted by mandated structural improvements.

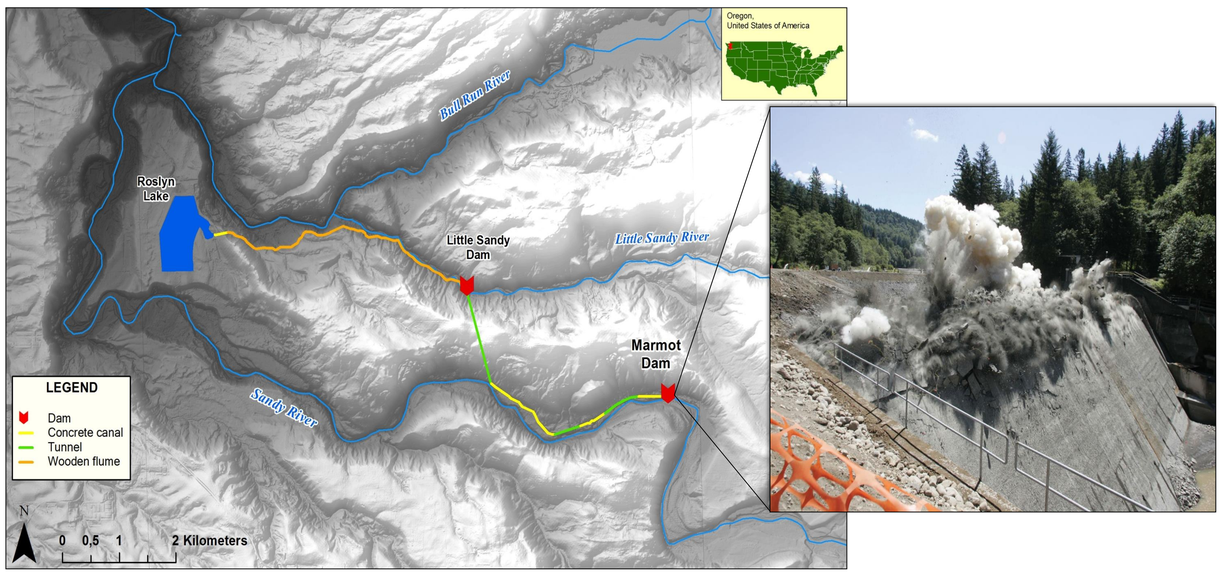


Fig 1. Project area map, and Marmot Dam demolition (Keller, 2010).

Approximately 730,000 m^3 of impounded sand and gravel was exposed to fluvial processes (Major, 2012). Extensive monitoring of discharge, sediment transport, and changes in topography cover pre- and post-removal periods.

Fig 2. Sandy River before and after Marmot Dam removal (Podolak, 2011).

Pacific Anadromous Fish

The Sandy River basin is critical habitat to several native Salmonid species under federal protection.

Fig 3. Spawning Pacific salmon (http://bristolbaysockeye.org/)

Research Objectives

- Estimate the duration to establish a new equilibrium, in terms of bed-material load transport.
- Predict potential locations of adequate habitat that support the entire life-cycle of Pacific Salmon.
- Quantify the long-term effect of different removal strategies.

2D Morphodynamic Model

Delft3D is used to model the quasi-3D transport of three sediment fractions: gravel and sand (development of bed topography), and mud (affecting spawning habitat).

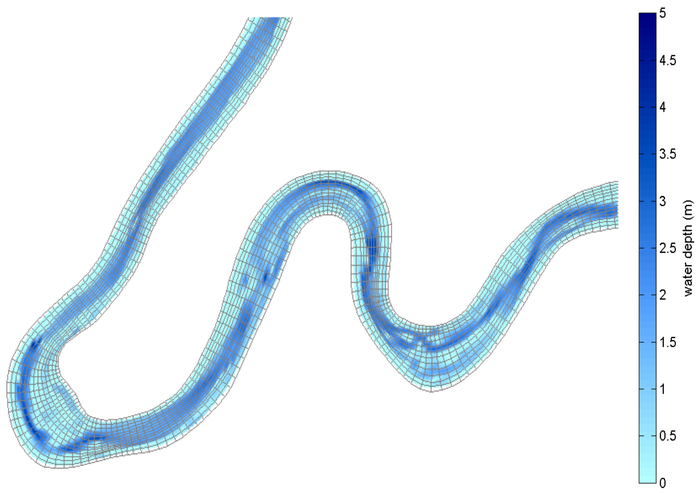


Fig 4. Modelled water depth at section of Sandy River.

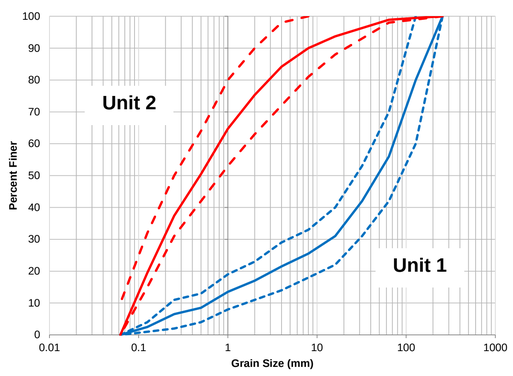


Fig 5. Reservoir sediment GSD (Squier Associates, 2000).

Habitat Analysis

The Habitat Suitability Index method is used to identify potential locations of habitat, based on a semi-quantitative mapping approach.

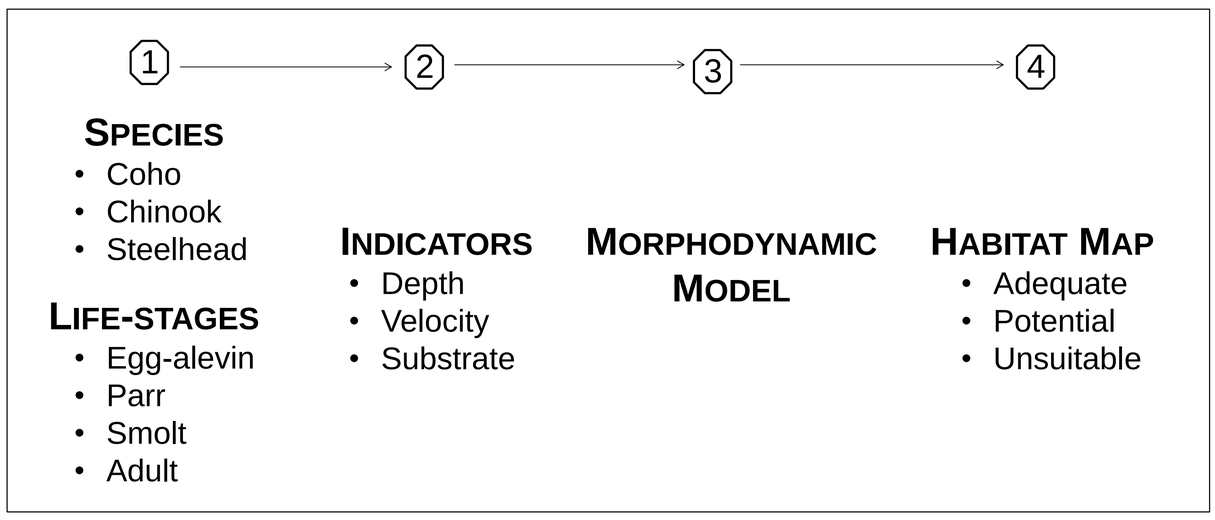
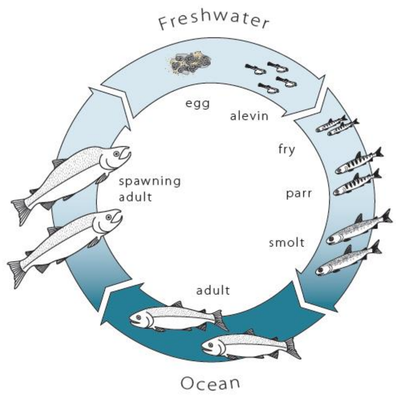


Fig 6. Framework of habitat analysis.



The Pacific species of ocean-migrating (anadromous) Salmonid spawn only once in their lifetime. They have distinct life-stages, and varying spawning seasons and habitat preferences depending on the sub-species (Bell, 1990).

Fig 7. Pacific Salmon life-cycle (https://www.nwfsc.noaa.gov).

References

Bell, M. C. (1990). Fisheries handbook of engineering requirements and biological criteria. CORPS OF ENGINEERS PORTLAND OR NORTH PACIFIC DIV.

Keller, T. (2010). What PGE learned while removing Marmot Dam, http://www.djc.com/news/ae/-12023010.html. Last accessed Dec. 2016.

Major, J.J., O'Connor, J.E., Podolak, C.J., Keith, M.K., Grant, G.E., Spicer, K.R., Pittman, S., Bragg, H.M., Wallick, J.R., Tanner, D.Q., Rhode, A., and Wilcock, P.R. (2012). Geomorphic response of the Sandy River, Oregon, to removal of Marmot Dam: U.S. Geological Survey Professional Paper 1792, 64 p.

Podolak, C. (2011). Marmot Dam Removal Geomorphic Monitoring & Modelling Project. 2000. Print. Prepared for the Sandy River Basin Watershed Council.

Squier Associates. (2000). "Sandy River sediment study, Bull Run Hydroelectric Project." Draft report prepared for Portland General Electric, Squier Associates, Lake Oswego, Oregon.

Taylor, B. (1999). Salmon and steelhead runs and related events of the Clackamas River basin–a historical perspective. Prepared for Portland General Electric Company, Portland, Oregon.

UNESCO-IHE Institute for Water Education

Deltares Enabling Delta Life

NCR DAYS 2017 from Catchment to Delta Wageningen UR