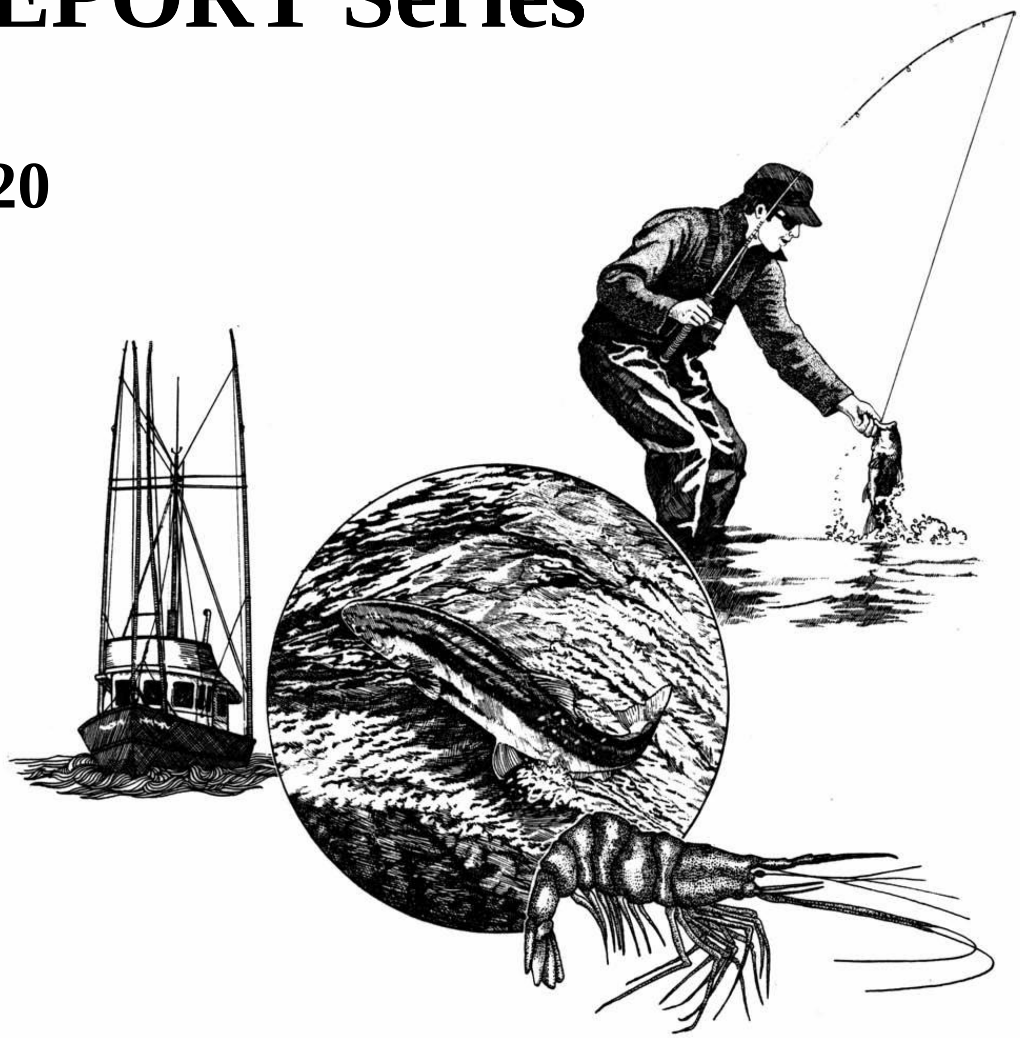
ODFW PROGRESS REPORT Series

2020



Oregon Department of Fish and Wildlife

Evaluating an Ocular Estimation Method that Describes Individual Substrate Size Classes in Stream Habitats

Progress Report No. OPSW-ODFW-2020-5

PROGRESS REPORT
FISH RESEARCH PROJECT
OREGON

PROJECT TITLE: Evaluating an Ocular Estimation Method that Describes Individual Substrate Size Classes in Stream Habitats

PROJECT NUMBER: *OPSW-ODFW-2020-5*

PROJECT PERIOD: July 2016 – September 2016

Prepared by: Matt J. Strickland and Morgan Davies

Oregon Department of Fish and Wildlife
4034 Fairview Industrial Drive SE
Salem, OR 97302

This project was funded in part by the Conservation and Recovery Program

CONTENTS

OREGON
Fish & Wildlife

4034 Fairview Industrial Drive SE
Salem, OR 97302

Abstract

The Aquatic Inventories Project and numerous field biologists conduct stream habitat surveys across the state of Oregon each summer. During those surveys, stream substrate is quantified by individual field biologists as a percent distribution of the wetted streambed area using ocular estimation. Unfortunately, even with consistent training slight differences in ocular observation can be expected between field biologists creating inherent bias within and across surveys. Because of this potential bias we resampled 19 unique sites and 155 individual habitat units using an intensive Wolman Pebble Count. Using this method we were able to derive precise substrate percentages based on individual substrate size classes. A simple linear regression was used to assess whether percent substrate derived from ocular estimates differed from counts derived from a Wolman Pebble Count. Results of the linear regression showed the use of ocular observation can sufficiently estimate individual substrate classes by trained field surveyors within individual habitat units.

Introduction

The composition of streambed material is often described as an important indicator of general physical behavior and geomorphology of streams (Cislaghi et al. 2015, Hawkins et al. 1993, and O'Connor et al. 2014). Composition of bedload material may also influence the utilization and productivity of various life stages of fishes within stream reaches (Montgomery et al. 1999, Suttle et al. 2004, and Vannote et al. 1980). The Oregon Department of Fish and Wildlife's Aquatic Inventories Project (AQI) quantifies substrate as a percent distribution of the wetted streambed area. In instances of dry streambeds, those percentages are distributed across the entire active channel (a.k.a. bank-full width). AQI percentages are derived from ocular observations from trained field biologists. Numerous survey crews (teams of two) sample streams across the state of Oregon each field season. Even with consistent training slight differences in ocular observation can be expected creating potential bias within and across surveys. Because of this, we resampled sites using a known and accepted quantitative description of the bed material, a Wolman Pebble Count (Wolman 1954). Using this technique we were able to obtain a known quantity of substrate within individual habitat units and compare with those previously sampled using ocular estimates described in Moore et al. (2016).

Methods

In the summer of 2016 AQI surveyed 195 unique sites across four monitoring strata (North Coast, Mid Coast, Mid-South Coast, and Umpqua) within the Oregon Coast Coho ESU using a Generalized Random Tessellation Stratification (GRTS) sample design (Anlauf-Dunn and Jones 2012). Surveys were conducted using the Aquatic Inventories Project Methods for Stream Habitat and Snorkel Surveys (Moore et al. 2016). In order to generate absolute substrate values from a subset of those unique sites we randomly selected five from each monitoring strata using R software (R Development Core Team 2006). A total of 20 sites were selected for substrate verification using a Wolman Pebble Count within a preselected sample reach (Figure 1).

Survey crews flagged the start and end of individual habitat units (pools, riffles, cascades, etc.) within the bounds of the survey start and first channel metric measurement, a total stream distance of approximately 250 meters (See Moore et al. 2016). Within the bounds of each habitat unit a cross-sectional transect occurred at 0%, 25%, 50%, and 75% of the longitudinal thalweg profile. Based on channel width, 25 particles were collected at evenly spaced intervals within each cross-section for a total of 100 particle measurements within each individual habitat unit. Transects started at the wetted edge of the channel margin unless the streambed was dry, in those instances transects started at the active channel margin.

AQI characterizes substrate based on size classes described in Table 1. Particles <2 mm are described as either silt and fine surface organic matter, or sand depending on texture and dispersal in the water column. During both ocular estimations and pebble counts, surveyors split these into two distinct substrate classes, but during data processing these are grouped into one substrate class, percent fines.

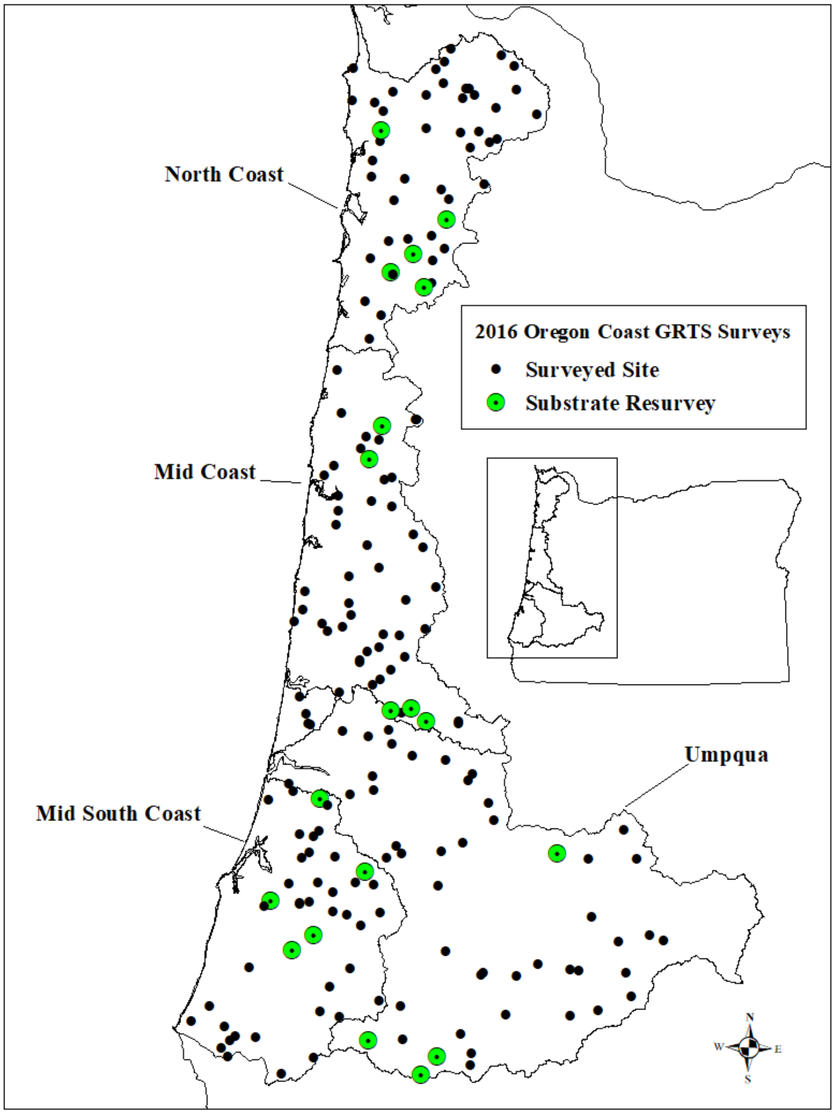


Figure 1. 2016 Oregon Plan study area and location of sampled sites.

Table 1. Substrate size classes.

Size Class	Size Range (mm)
Silt/Organic	Undefined, particles
Sand	< 2
Gravel	2 - 64
Cobble	64-256
Boulder	> 256
Bedrock	Undefined, continuous

Results

Of the 20 sites selected for verification, 19 were adequately sampled. Due to a loss of flagging at unique habitat units, one site was dropped because exact sampling locations could not be replicated. Within the 19 sampled stream reaches, replication of ocular estimates using a Wolman Pebble Count was made at 155 unique habitat units.

A simple linear regression was used to assess whether percent substrate derived from ocular estimates differed from counts derived from a Wolman Pebble Count.

$$Y_i = \beta_0 + \beta_1 X_i + \varepsilon_i$$

All analyses were performed using R software (R Development Core Team 2006). Results showed moderate to strong linear relationships across all substrate size classes ($R^2 = 0.58 – 0.74$, Table 2).

Table 2. Method Comparison.

Substrate Class	Residual DF	DF	F-statistic	P-value	Adjusted R^2
Fines	153	1	212.9	<0.0001	0.5792
Gravel	153	1	433.2	<0.0001	0.7373
Cobble	153	1	367.4	<0.0001	0.7041
Boulder	153	1	338.2	<0.0001	0.6865
Bedrock	153	1	404.4	<0.0001	0.7237

Discussion

Results of the linear regression showed the use of ocular observation can sufficiently estimate individual substrate classes by trained field surveyors within individual habitat units. These results were similar to other studies comparing visual and measurement based sediment techniques (Conroy et al. 2016, McHugh and Budy 2005, and Sutherland et al. 2010). While these studies were able to show the relative accuracy of visual estimates for particular attributes (i.e. surface fines or cobble embeddedness), this study was unique in that it showed ocular estimates across all collected bedload attributes to be of acceptable precision. These data are also unique in that they are used across large spatial and temporal scales to quantify status of particular habitat and detect trend. Monitoring and data collection of this magnitude require a protocol that is efficient, cost effective and repeatable across time. These results suggest the use of visual estimates to obtain percent bedload within stream habitat units are both effective and efficient.

Acknowledgements

We would like to thank the numerous field biologists that spent their summer collecting stream habitat information across Western Oregon, along with Joshua Edwards and Erin Gilbert who participated in the pebble counts. Additionally, we would like to thank Charlie Stein for his guidance along with Kara Anlauf-Dunn and Eric Brown for their help reviewing methods and editing.

References

Anlauf-Dunn, K.J. and K.K. Jones. 2012. Stream Habitat Conditions in Western Oregon, 2006-2010. OPSW-ODFW-2012-5, Oregon Department of Fish and Wildlife, Salem.

Cislaghi, A., E.A. Chiaradia, and G.B. Bischetti. 2015. A comparison between different methods for determining grain distribution in coarse channel beds. International Journal of Sediment Research 31 (2016) 97-109.

Conroy, E., J.N. Turner, A. Rymszewicz, M. Bruen, J.J. O'Sullivan, and M. Kelly-Quinn. 2016. An evaluation of visual and measurement-based methods for estimating deposited fine sediment. International Journal of Sediment Research 31 (2016) 368-375.

Hawkins, C.P., J.L. Kershner, P. Bisson, M. Bryant, L. Decker, S.V. Gregory, D.A. McCullough, K. Overton, G. Reeves, R. Steedman, and M. Young. 1993. A Heriarchical approach to classifying stream habitat features. Fisheries 18:3-12.

McHugh, P. and P. Budy. 2005. A comparison of visual and measurement-based techniques for quantifying cobble embeddedness and fine-sediment levels in salmonid bearing streams. North American Journal of Fisheries Management, 25:1208-1214.

Montgomery, D.R., E.M. Beamer, G.R. Pess, and T.P. Quinn. 1999. Channel type and salmonid spawning distribution and abundance. Can. J. Fish. Aquat. Sci. 56: 377-387.

Moore, K.M.S., K.K. Jones, J.M. Dambacher and C.H. Stein. 2016. Methods for stream habitat surveys. Oregon Department of Fish and Wildlife, Corvallis, Oregon.

O'Connor, J.E., J.F. Mangano, S.W. Anderson, J.R. Wallick, K.L. Jones, and M.K. Keith. 2014. Geological Society of America Bulletin, vol. 126, issue 3-4, pp. 377-397.

R Development Core Team. 2006. R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. http://www.R-project.org.

Sutherland, A.B., J.M. Culp, and G.A. Benoy. 2010. Characterizing deposited sediment for stream habitat assessment. Limnol.Oceanogr.: Methods 8, 2010, 30-44.

Suttle, K.B., M.E. Power, J.M. Levine, and C. McNeely. 2004. How fine sediment in riverbeds impairs growth and survival of juvenile salmonids. Ecological Applications, 14: 969-974. Doi:10.1890/03-5190.

Vannote, R.L., G.W. Minshall, K.W. Cummins, J.R. Sedell, and C.E. Cushing. 1980. The river continuum concept. Can. J. Fish. Aquat. Sci. 37: 130-137.

Wolman, M.G. 1954. A method of sampling coarse riverbed material. Transactions of the American Geophysical Union 35:951-956.