large woody debris

Large woody debris
How much is enough?

Introduction

Thirty years ago people cleared streams and rivers of logs and rootwads to improve fish passage. However, research findings over the past decade have shown that instream wood is intricately linked to stream health. Stream channel assessments and enhancement efforts often associate salmon habitat quality to the quantity and volume of woody debris. Yet the current wood targets used to assist resource managers do not adequately account for variations in quantity or volume potentially attributed to differences in geomorphology, region, or disturbance regimes.

To address this issue, field data on instream wood quantities and volumes from 150 stream segments draining unmanaged basins within Washington State were used to develop reference conditions for restoration and management. These guidelines consider the variability found in natural basins with different regional climate, geomorphology, and hydrological influences. Based on the assumption that streams draining unmanaged forested basins incorporate the range of conditions to which salmonids and other species have adapted, wood loads in these systems should provide an improved reference for management.

Large woody debris

Large woody debris (LWD) is defined as a log having a mid-point diameter of at least 10 cm, a length of 2 m, and protruding into the bankfull channel. LWD is recruited into the stream channel by various processes such as direct tree mortality, channel migration, bank erosion, landslides, and snow avalanches. The adjacent riparian forests up to the headwaters provide the source of this wood, and the characteristics of these forest stands are closely related to the quality and quantity of wood in the stream. Once in the stream, this wood can store fine sediment, retain spawning gravels, form pools, provide cover and nutrients, and fulfill other functions that promote favorable fish habitat.

Current wood targets do not take into account differences in channel size and ecoregion and therefore may be inappropriate for some channel types and regions, leading to habitat assessments or enhancement objectives that are misrepresentative of basin and local characteristics. Based on recent research, wood volumes and quantities in unmanaged reference streams can be predicted most reliably by basin size (which correlates with bankfull width) and ecoregion.

Key pieces

Key pieces are individual logs with attached rootwads that are less likely to move than other wood pieces during a bankfull flow. Key pieces are currently a regulatory metric for large pieces of instream wood as defined by the Washington Forest Practices Board (1997) for western Washington channels <20 m in bankfull width; however, current regulations do not define key pieces or quantities in channels between 20-100 m bankfull width, or for any channels in eastern Washington.

Suggested wood targets for management

The percentile (box-plot) distributions for LWD quantity and volume as well as key piece quantity (see figure on reverse side) represent the range of conditions found in streams draining unmanaged forests subject to natural rates of disturbance (except for fire suppression). Since these data undoubtedly include both favorable and unfavorable habitat conditions related to instream wood, the central 50% of these data (i.e., as bounded by the 25th and 75th percentiles) are broadly taken to represent the median condition for basing targets for habitat restoration, enhancement, regulation, and evaluation. The 75th percentile is taken as the point where conditions clearly exceed the central range and is therefore the recommended base target value for instream wood loads. Wood quantities and volumes below the 25th percentile would similarly represent a “poor” condition as it relates to instream wood loads.

Minimum log volumes used to define key pieces should consider the role rootwads play in achieving stability. For instance, in channels greater than 30 m bankfull width, >91% of all key pieces had rootwads attached. To meet the objective of defining a key piece, not only do the prescribed minimum volumes need to be met but also rootwads must be considered in this definition. Without rootwads to stabilize key pieces, the minimum volume needed for stability in large channels would be very large, and subsequently rare. Logs of this size are likely impossible to obtain for stream habitat enhancement projects, let alone to transport and position into a channel. Therefore, for channels greater than 30 m, a log must have a rootwad attached to meet the definition of a key piece.

The precise quantities and volumes of wood required for maximum salmonid production are not well understood. Studies linking instream wood loads directly to salmonid production would have unavoidably high levels of uncertainty owing to the multiple variables influencing salmonid production. However, we do know that historical salmon populations were much higher than those found today, and unmanaged forests offer a good source of information on those wood loads supporting historical populations. For management actions that seek to restore natural wood loading conditions, establishing instream wood targets based on this comprehensive data set from largely or entirely undisturbed watersheds is reasonable and prudent.

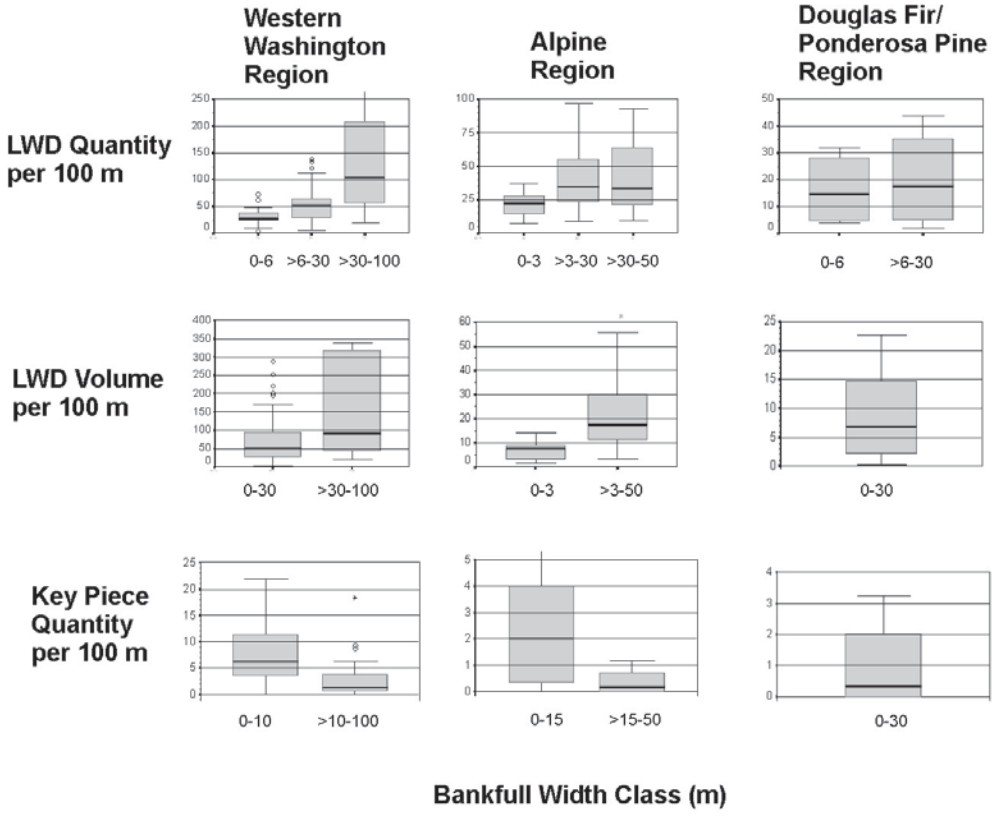
Further reading

Bilby, R.E. and Ward, J.W. 1989. Changes in characteristics and function of woody debris with increasing size of streams in western Washington. Transactions of the American Fisheries Society 118:368-378.

Fox, M.J. 2003. Reference conditions for instream wood in western Washington. In D.R. Montgomery et al. Restoration of Puget Sound Rivers. University Press, Seattle. 361-393.

Fox, M.J. 2003. Spatial organization, position, and source characteristics of large, woody debris in natural systems. PhD dissertation, University of Washington. Available online at: http://depts.washington.edu/cwws/Theses/Fox-2003-dissertation.pdf

Ralph, S.C., Poole, G.C., Conquest, L.L., and Naiman, R.J. 1991. Stream channel morphology and woody debris in logged and unlogged basins of western Washington. Canadian Journal of Fisheries and Aquatic Sciences 51:37-51.



Martin Fox

The Water Center

University of Washington ◆ Box 352100 ◆ Seattle, Washington 98195-2100

206.543.6920 ◆ cwws@u.washington.edu ◆ http://depts.washington.edu/cwws