Scappoose Creek (North and South)

Limiting Factors Analysis (LFA)

Executive Summary

Purpose

This document identifies the dominant processes and habitat characteristics that currently limit the production of coho salmon smolts in the Scappoose Creek basin, a tributary of Scappoose Bay in the lower Willamette River. The plan concept is a limiting factor analysis that identifies habitat conditions restricting the success of one or more coho life history stages.

The scale of effort is confined to a single target species (Coho) within a restricted geographic zone, in this case two adjacent 6th field HUC subbasins. The primary attributes evaluated are fish distribution, the abundance and distribution of aquatic habitats, spatial differences in thermal water quality, and historical upslope management activities.

The assessment process relies on responses to structured sets of questions that progressively reveal the status and needs of stream channels in relation to coho habitat use. The end product of the analysis is a list of specific needs and actions (prescriptions) prioritized according to their effectiveness at addressing the identified seasonal habitat limitation, boosting survival at each life history stage, urgency and practicality. The prescriptions include a mix of strategies involving the recovery of riparian canopies, culvert removal or improvement, securing headwater wood and substrate recruitment corridors, instream wood placement, road assessment/removal, easement acquisition and cooperative planning strategies.

System overview

The Scappoose Creek watershed 40,663 acres in size, includes both the North and South Scappoose Creek sub watersheds, and contains 25 miles of mainstem stream corridor exhibiting the potential for anadromous use. Ten main tributary corridors provide an additional 14 miles of potential habitat.

Stream functions have been dramatically altered from historical conditions. The changes have resulted from the shift from a forested ecosystem to an agricultural / forest industry emphasis, changing stream processes that historically generated great numbers of migratory salmonids. These changes have created a trajectory toward channel simplification that has taken 150 years to mature. Without intervention, these simplification processes will continue into the future until most of the remaining stream functions are also lost. The primary indicator of this process has been the steady decline in the abundance of the naturally spawning salmon species that were once abundant.

The effect of management practices and land use

The primary causes of habitat change are 150 years of fur trapping, mining, logging, agriculture/farming, residential development, water withdrawal and the introduction of invasive plant species like reed canary grass.

The destructive influences have been diverse and extensive:

- Timber harvest that began in the Scappoose basin during the early 1840's used splash damming. Extensive logging began in the early 1900's, and most original old growth timber resources were exhausted by 1950. Current management is for early rotation timber harvest.
- Aggressive fire suppression has eliminated the delivery of fire-toppled trees to the stream corridor.
- Extensive agriculture, residential, and small scale industry development has led to extensive flood control measures that included diking and filling both historic floodplains and complex off channel matrixes. Much lowland estuary habitat has been lost.
- The first of several dam constructions began in 1856, creating additional impacts on habitat quality and accessibility.
- In 1960's and 1970's state and federal management agencies removed large wood from streams to allow upstream access by adult salmon. This exacerbated the harmful effects of land use by accelerating the trajectory toward channel simplification.

The cumulative effects of 150 years of these practices have been to create over-heated, confined, silt-laden, simplified stream corridors. The large wood that historically provided stability, channel diversity, floodplain interaction and complex cover is for the most part gone. Current riparian buffers are unable to function as an essential and fundamental natural source of wood.

What remains of the land and aquatic resources needed to sustain viable salmonid populations are currently being lost as the system continues to unravel.

Beaver colonies

The historic contribution of beaver to the processes that support a vibrant salmonid population in the Scappoose watershed has been nearly eliminated. Today remnant colonies exist throughout the basin, but their use of available habitats is very low and appears to be dwindling even in the locations that exhibit a recent legacy of use. In a 2008 survey, only 24 beaver dams were found in the entire Scappoose watershed's 39 stream miles of anadromous salmonid distribution.

Conflicts with infrastructure, the loss of early seral food sources, and the progression of invasive plant species are prominent causes of the decline. Invasive reed canary grass has converted legacy beaver flats to a permanent vegetative climax which provides no stream-adjacent forage. The modern, altered landscape of headwater reaches do not allow successful dam building.

The positive effects of beaver dam construction on aquatic habitats include storage of winter runoff, nutrient rich sediments that support a complex food web, and mobile spawning gravels. Beaver impoundments provide vast surface areas of high quality summer and winter salmonid rearing habitat. They store winter flows as ground water across a saturated floodplain and later deliver stratified cold water through their porous dams, thus maintaining cool summer

temperatures favorable to juvenile salmonids.

These functions have all been dramatically reduced from historic levels, with equally dramatic effects on salmonid populations.

Status of Coho

Available data for North Scappoose show that the number of coho spawners has been variable but consistently low, ranging between 12 in 2005 and 139 in 2010. The average number of female coho per kilometer of spawning/rearing habitat (spawner density) at North Scappoose is 0.83, nearly four times lower than any other LCM site.

Based on a 2008 survey estimate of 16,194 juveniles, the parent population was calculated as 135-154 coho for the combined South and North Scappoose watershed.

Coho smolt estimates at the ODFW Life History Monitoring site below Bonnie Falls were highest in sample year 2009 and lowest in 2000 with no clear trend over the course of the monitoring.

These and other evaluations strongly indicate that the watershed is severely under-seeded, and that even considering the drastic losses of rearing habitat, adult escapement is the primary factor currently limiting the development of a self-sustaining coho population.

Concepts and approach

The concepts of Core Area and Anchor Site are used to specify project goals and focus effort. Definitions of these terms direct the investigation in identifying the specific sites and conditions of the aquatic system that support the remnant population by determining how these sites function together to allow completion of the Coho freshwater life history.

***Core Area*:** A contiguous section of stream channel or channel system where juveniles rear on a consistent (year to year) basis.

Anchor Site: A portion of the Core Area which provides all essential habitat features necessary to support the complete Coho freshwater life history. An Anchor Site is a stream reach that supports all of the seasonal habitat needs of Coho salmon from egg to smolt migration: optimal gradient, potential for floodplain interaction, and accumulation of spawning gravels. It provides the greatest opportunity for boosting or restoring channel function.

The prioritization process thus relies on identifying the Core Area where the remnant population is sustained, and then identifying the enclosed habitats that function as Anchor Sites. The overarching goal is to conserve and expand the population within the Core Area, and to do this in ways that contribute to normalized landscape and stream function.

In addition to distributional analyses, we employed the concept of “seasonal habitat bottleneck” developed by Tom Nickelson of ODFW. The model uses habitat areas and coho seasonal survival rates to determine which seasonal habitat most restricts smolt production.

Results

Core Area

Field and topographic work identified the Core Area in the S Scappoose as extending from the head of tide to the end of anadromous distribution at RM 12.5. In addition, the core includes 12.5 miles of habitat in the N Scappoose from the confluence with the South to the end of anadromous distribution. These stream segments and an additional 14 miles of tributary habitat within the Core area describe the full extent of potential coho distribution. The actual distribution of juvenile coho is slightly more limited.

Anchor Sites

Twelve anchor sites were identified within the Core Area, five in the mainstem S Scappoose, three in mainstem N Scappoose and one each in Raymond Cr, Alder Cr, Cedar Cr and Brush Cr. The anchor site locations can be viewed in Appendix 13.

Basin-wide limiting factors

The Nickelson Model identified summer pool surface area as the seasonal habitat that currently most limits smolt production. This conclusion is strengthened when the pool surface areas in the lower 5.5 miles of mainstem S Scappoose and the lower 3 miles of N Scappoose are removed from the sum of summer habitats based on severe temperature limitations that render these habitats unsuitable for coho.

The aquatic corridor throughout the basin is extremely deficient in LWD complexity and beaver dams. These are the only two things that can trap, store and sort the migratory resources (bedload, canopy litter, wood and water) that continually move through a stream network.

By storing bedload and water, large wood complexes and beaver dams retain spring runoff for a longer period into the summer, and this reduces the duration of pinch period summer flows. In addition, the increased bedload storage improves the depth of the hyporheic lens and protects larger volumes of summer flows from solar exposure. The increased bedload accumulated by wood complexes and beaver dams are highly erodible and improve residual depths and the frequency of pools. Both features increase summer and winter rearing capacity by increasing surface area. All of these functions improve coho survival rates and directly address downstream temperature limitations.

The decline in the abundance of instream wood is a cumulative issue similar to that observed in stream temperature profiles. When there are impacts to a specific stream reach that remove existing instream wood (stream cleaning, debris torrent) or remove the future potential from the riparian corridor (unbuffered harvest, clearing for agriculture) then the stream hydrology has been altered (immediate or delayed response time). These types of shifts in stream hydrology always have negative consequences for habitats within the altered reach and in adjacent reaches (above and below). Without the hydraulic buffer of instream wood a stream strives for simplicity. Simple is synonymous with straight and uniform, similar to the way a culvert functions. Simple is confined, exhibiting no active erosion, simple does not accumulate bedload or display channel braiding. Simplification can start anywhere in the stream network and can be accelerated or retarded by a myriad of actions. The sum total of the historical actions within the

Scappoose watershed in the last century have resulted in a highly simplified stream network. Recovery is not imminent, a step wise, big picture plan will be required to overcome current levels of simplification.

To summarize, the primary causes for limited summer rearing capacity are:

1) Severely elevated temperatures in the lower reaches of both the North and South Scappoose, and to varying levels in the remainder of the mainstems and most of the tributaries.
2) Diminished beaver populations, with consequent reductions in pool surface area and storage of water, nutrients and gravel.
3) Land use practices, which have converted riparian corridors to agriculture, residential or industrial forest interfaces. Large stable conifers are no longer delivered to the aquatic corridor. Greatly reduced large wood complexity in the stream channel has led to channel simplification, deep channel incision, and floodplain isolation.

Despite these severe summer habitat restrictions, adult escapement is so low that viable salmonid habitats are under utilized. This leads to a highly important conclusion: ***The greatest current limitation to coho production is inadequate adult escapement*.**

Site-specific limiting factors

While the model identifies summer rearing habitat as the primary seasonal limitation for the Scappoose Creek basin as a whole (South and North Scappoose combined), this limitation does not apply to every stream segment. It therefore may be necessary to assess seasonal limitations and to define restoration actions for individual tributaries separately.

The only significant example of a tributary being limited by any other season than summer occurred in Cedar Cr (Tributary of N Scappoose Cr):

1) Spawning gravels are very low in Cedar Cr suggesting that restoration prescriptions for this important segment of the Core Area should focus on improving trapping and sorting activities that boost gravel retention and functionality. These changes would allow currently functional summer and winter habitats to be adequately seeded.

Addressing the constraints

The LFA work makes it clear that progress toward recovery should give strongest emphasis to generating enough fry and insuring their survival so that currently available rearing habitats are better utilized. The following are all essential goals for a successful recovery plan:

- Protect the few returning adults.
- Improve season-to-season survival rates of the limited number of fry being produced.
- Enable variable life histories and their differing survival strategies -- a critical need for supporting a population that is depleted both numerically and genetically.

This work should be accompanied by habitat restorations, principally aimed at improving summer rearing capacity. The central theme here is easy to define: ***Restore abundant short and long term LWD resources and encourage beaver dam construction so that natural stream functions can recover and reverse the trajectory toward channel simplification.***

Using a basin-scale perspective, the report works step by step through local conditions and constraints that currently control channel function, and specifies ways to address the problems. It is easy to find restoration opportunities in a dysfunctional basin. It is harder to decide where and in what order limited resources should be spent, so that change from simplified to normal stream structures is best implemented. The LFA approach identifies key pieces of the basin that continue to exhibit some level of normal system function. These sites have been identified as anchor sites. Although every anchor site differs in its current level of function, they all display potential for recovery and are the most cost effective locations for investment in restoration.

It should be noted that choosing anchor sites as the primary focal points for recovery work does not mean that other stream segments are not of value. All parts of the stream network where function can be restored can ultimately contribute to recovery. The anchor site approach is used to bring focus to the work by initiating a practical decision making process using actions that most effectively address system limitations. The actions are presented as prioritized restoration prescriptions. These prescriptions are selected and prioritized to relieve system constraints in ways that contribute to the expansion of the Core Area, improve system health and functionality, and create sustainable coho production.

The prescription actions are briefly described, prioritized and presented in Appendix 15. Locations of the proposed actions are presented in Appendix 14. As more specific information is needed about a prescription or its location, refer to the text that describes that stream segment or anchor site. Please note that the Appendix 15 table can be copied to MS Excel, where sort and filter operations can be used to create organized short-lists of prescriptions.

Using the Report

Complexity and localization of issues

This report examines the physical and biological interactions that form a large and highly complex stream system. The approach taken assumes that a high level of inter-dependence exists among habitats that extend from the low gradient mainstem to the high gradient headwater reaches. Emphasis is placed on how current and historical conditions have broadly reduced coho habitat throughout the system.

It should also be understood that limitations defined for the whole sub-basin are not always those operating at the individual tributary or reach level. Both scales of concern have been considered in defining the prescriptions and their order of implementation. It is the conditions working at local levels that occupied most of the field and analytic work, and which the report documents. The reader should refer to the body of the report to access information about specific sites and prescriptions.

Order of restoration actions

A limiting factor analysis establishes an ordered progression of actions, not a single-effort solution. Once significant progress has been made toward resolving the seasonal limitations addressed by Priority 1 prescriptions, attention to Priority 2 prescriptions should then logically begin. However, it is understood that an orderly process like this document suggests may not occur. For one thing, the realities of owner cooperation, fund acquisition, partner priorities and physical restraints may prevent or complicate an entirely orderly process. It is also true that the effects of implementing the Priority 1 actions may create responses from the system that lead to a re-prioritizing or modification of the remaining prescriptions. Priority levels should be thought of as providing a strong set of guidelines, and not as a rigid set of rules.

Presentation of data, maps and photographs

All of the data summaries, charts, maps, prescriptions, recommendations and photographs are presented as appendices. Please refer to the appendices listed in the Table of Contents as they are referenced in the text of the report.

Note: In the electronic version of the report, it is possible to use the Table of Contents as a hot link to a topic. Hold the Control key down and left-click the heading listed in the TOC.

Acronyms used

- AQI – Aquatic Habitat Inventory (Oregon Department of Fish and Wildlife)
- AWS – Alsea Watershed Studies (survival rates)
- DBH – Diameter Breast Height
- ESU – Evolutionarily Significant Unit
- HUC – Hydrologic Unit Code
- LFA – Limiting Factor Analysis
- LWD – Large Woody Debris
- nd – no data
- OAC – Oregon American Company
- OCN – Oregon Coast Natural
- DEQ – Department of Environmental Quality
- ODF – Oregon Department of Forestry
- ODFW – Oregon Department of Fish and Wildlife
- OFP – Oregon Forest Practices
- RBA – Rapid Bio-Assessment Inventory
- RM – River Mile
- RMA – Riparian Management Area
- SRS – Stratified Random Sample
- DEA – Dean Evans and Associates, INC
- SBWC – Scappoose Bay Watershed Council
- USFS – United States Forest Service
- SBWA- Scappoose Bay Watershed Assessment
- SHG- Swanson Hydrology and Geomorphology