3. Planning Targets for Chinook Salmon Recovery

Planning targets provide a common measurement for recovery that can be used by habitat, hatchery, and harvest managers to guide recovery actions.

Planning Targets for Independent Populations

The Puget Sound Technical Recovery Team (TRT) and the Shared Strategy for Puget Sound have developed recovery planning ranges and targets (interim recovery goals) for the 22 individual Chinook salmon populations in Puget Sound. These ranges and targets provide a common measurement for recovery that can be used by habitat, hatchery, and harvest managers to guide recovery strategies within the individual watersheds and at the regional level. These targets are approximately 80% of historic salmon production.

The TRT planning range provides a broad estimate of the abundance needed for an individual Chinook salmon population to be viable over time. There are interacting factors controlling population dynamics and viability. Uncertainty inherent to this target definition includes the quality and quantity of available data and the inability to predict environmental conditions that will affect individual populations in the future. The planning target is a specific measure within a range to help evaluate recovery actions in habitat, harvest, and hatcheries. The target predicts the abundance of a Chinook salmon population based on a fully functioning estuary, improved freshwater conditions, restored access to blocked habitats, and poor ocean conditions. More measures of population viability are described in the next section.

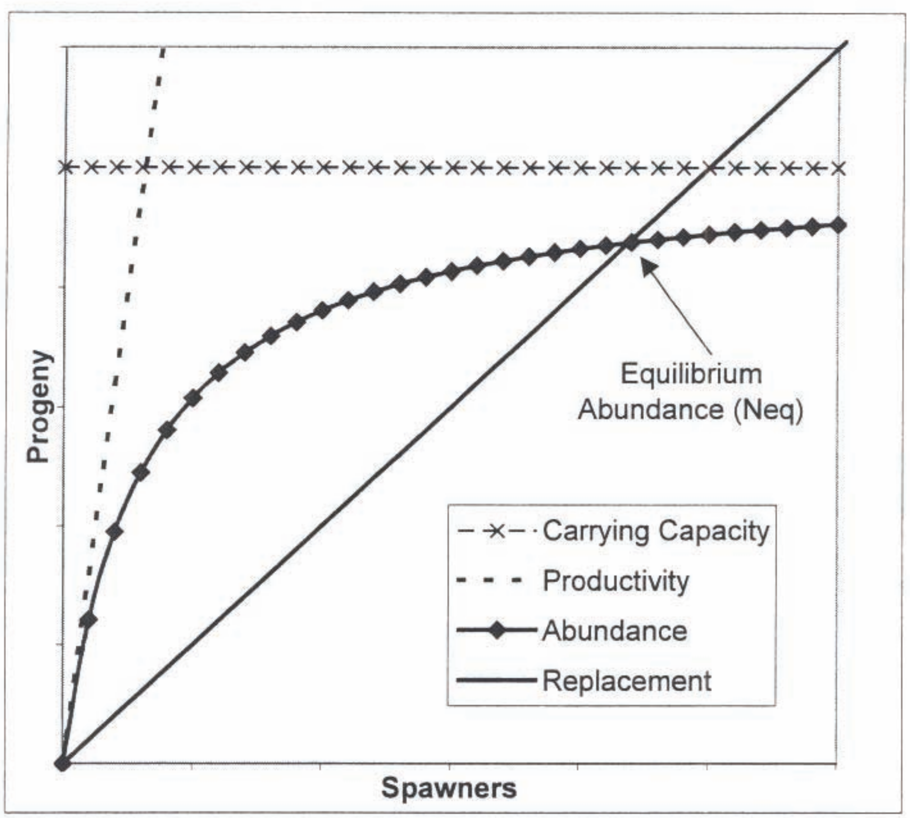
The planning targets and current spawner equilibrium abundance for the Stillaguamish Chinook salmon populations are shown in Table 7. The effects of incidental harvest or hatchery operations are not shown. It is important to recognize that these numbers represent a specific point along a population performance curve, and that the planning target (or current condition) is a specific curve, not any one number of fish. Movement along this curve is influenced by human-caused and other mortality. Equilibrium abundance is the point where spawning salmon have maximized their use of identified habitat conditions and are just replacing themselves in the next generation. Equilibrium abundance is used to compare current populations to those that may result from recovery efforts or in future scenarios.

Table 7. Chinook Salmon Adult Abundance Planning Targets and Current Conditions

Chinook Population	Scenario	Equilibrium Abundance
South Fork	Current	861
	Target	15,387
North Fork	Current	2,430
	Target	17,795

Figure 13 illustrates a conceptual population performance curve for one population (from Beverton and Holt 1957). This figure is intended to illustrate the conceptual relationship between the number of progeny or recruits (fish in the next generation) that are produced by current spawning fish. This ratio of spawners to progeny is the productivity of the population. Current and historical conditions would each be represented by a separate curve. Actual population performance curves for Stillaguamish Chinook salmon, showing historic, current, and anticipated population performance resulting from the recovery plan actions, are in Chapter 5.

Figure 13. Salmon Population Performance Relationship



Viable Salmon Populations

A viable salmon population (VSP) refers to a population with a negligible risk of extinction due to threats from demographic variation, local environmental variation, and genetic diversity changes over a 100-year timeframe (NMFS 2000). A viable salmon population has four components, or VSP parameters, that are used to determine relative health. Geographic distribution is assumed to be a key factor in maintaining variation and genetic diversity, and underlies each of the following VSP parameters:

- Abundance
- Productivity
- Diversity
- Spatial Structure

Abundance

Abundance is the number of individuals in the independent Chinook salmon population at a given life stage or time. Abundance is generally measured in terms of population size. Genetic risks of low abundance include inbreeding depression, mutation accumulation, and the overall loss of genetic diversity. When there are higher levels of environmental variability, a higher population size is required to maintain the population at a higher level (NMFS 2000). A population should be large enough to survive normal environmental variation, or human caused impacts.

Productivity

Productivity, or growth rate, represents the population's potential for increasing or maintaining its abundance over time. Productivity and population growth rate provide information on how well a population is performing in the habitats it occupies during its life cycle. Sufficient freshwater productivity is essential to maintain the overall abundance of Chinook salmon during periods of poor ocean conditions. The productivity of a population at low abundance, or inherent productivity, is often used to compare population viability between current and future populations. A continuously negative productivity value may lead a population toward extinction (a population is consistently failing to replace itself) (NMFS 2000).

Diversity

Diversity represents the variety of life histories, sizes, and other characteristics expressed by individuals within a population and refers to differences in genetic and behavioral traits. Diversity helps protect a salmon population from short-term environmental changes. Higher levels of genetic variability (diversity) allows a species to adapt to the special environmental conditions within its specific habitat areas, and to use a wider array of environments than they could without this diversity. Genetic diversity also provides the raw material for surviving long-term environmental change (NMFS 2000).

Spatial Structure

Spatial structure represents how the abundance at any life stage is distributed among available or potentially available habitats. Spatial structure is important because structural changes in the population may impact the population's evolution and its ability to adapt to habitat changes. Spatial structure can be assessed by looking at life history variations, distribution and type of habitat patches, spatial distribution of abundance, migration corridors, and access to unique habitat areas (NMFS 2000).

Ecosystem Diagnosis and Treatment

Ecosystem Diagnosis and Treatment (EDT) is a habitat modeling tool for rating the quality, quantity, and diversity of habitat within and along a stream, relative to the needs of a focal species such as Chinook salmon. The EDT methodology includes a conceptual framework for decision-making and a set of modeling tools that organize environmental information and rate the habitat elements in regard to the focal species. In effect, it describes how the fish would rate conditions in a stream based on our scientific understanding of their needs. EDT has been used extensively in the Pacific Northwest for a number of years in a variety of settings. In the Stillaguamish Watershed, EDT was used to model the anticipated results of several Chinook salmon recovery scenarios.

Biological performance, a central feature of the EDT framework, is defined in terms of three elements - life history diversity, productivity, and capacity[14] (and therefore abundance). These elements of performance are characteristics of the ecosystem that describe persistence, abundance, and distribution potential of a population.

The EDT analytical model is the tool used to analyze environmental information and draw conclusions about the ecosystem. The model incorporates an environmental attributes database and a set of mathematical algorithms that compute productivity and capacity parameters for the diagnostic species. Existing and potential conditions are compared to identify the factors or functions that are preventing the realization of population

[14] Capacity represents the upper limit that the river system can support, given available (or assumed) habitat conditions.

objectives. The diagnosis can be qualitative or quantitative, depending on the type and quality of the information used to describe the ecosystem.

The EDT output is a clear statement about the present conditions of the watershed as related to the diagnostic species. The EDT model is used to estimate the Chinook salmon population response to alternative scenarios. It also provides a practical, science-based approach for developing working hypotheses as a basis for moving forward with watershed protection and restoration activities.

Figure 14. EDT Reaches

Properly Functioning Conditions

The ultimate habitat recovery goal is to maintain and restore natural ecosystem conditions that sustain salmonid productivity. To achieve this goal for Chinook salmon, individual habitat parameters should at least meet the quantitative measurement known as "properly functioning conditions" (NMFS 1996). Maintenance and recovery of the four VSP parameters necessary for a healthy salmon population depend at least on the achievement of properly functioning habitat conditions, similar in complexity and area to what was found in the watershed historically. In order to achieve properly functioning conditions, the following goals must be met:

- Maintain and restore natural watershed processes;
- Maintain a well-dispersed and well-connected network of high quality habitat that addresses the needs of all life history stages; and
- Develop, evaluate, and adapt land management activities using monitoring and assessment in order to achieve the objectives listed above.

Properly functioning conditions have been analyzed using the EDT model for the Stillaguamish Watershed[15]. These results are shown in Chapter 5. The estimated Chinook salmon populations levels associated with properly functioning conditions are robust and generally achieve the Shared Strategy population target levels. These results are important since they allow the overall Shared Strategy target to be translated into long-term properly functioning conditions habitat condition performance targets for each of the six habitat limiting factors categories. Habitat restoration actions, both short-term (10 years) and long-term (50 years), to achieve properly functioning conditions are described in Chapter 5.

Riparian

The Stillaguamish Technical Advisory Group (STAG)[16] defined properly functioning conditions for the Stillaguamish riparian zones as 80% of stream shorelines (contiguous area within the channel migration zone) having a riparian buffer width equal to or greater than one Site Potential Tree Height[17]

[15] Recent EDT modeling of properly functioning conditions assumed a pre-1870 estuarine condition and did not account for harvest impacts, loss of genetic fitness due to hatchery operations, and potential degradation of habitat. As additional EDT modeling is completed, more specific and optimal habitat restoration and protection strategies may be identified.
[16] The STAG is made up of scientists from several agencies throughout the watershed, including the Stillaguamish and Tulalip Tribes, Snohomish County, WDFW, USFS, the City of Arlington, and the Snohomish Conservation District.
[17] Site Potential Tree Height is over 200 feet for trees in the Stillaguamish Watershed (Pollock and Kennard 1998). 200' SPTH applies to most riparian areas within the Chinook anadromous zone.

on fish bearing waters to ensure properly functioning riparian habitats (NMFS 1996; STAG 2000).

Approximately 8,000 acres of riparian area would need to be planted, restored, maintained and protected to achieve properly functioning conditions in the nine subbasins that contribute to the majority of Chinook salmon productivity within the Stillaguamish Watershed.[18] This calculation is based on analysis of 2001 land cover (Purser et al. 2003). Areas upstream of these nine subbasins exhibit more riparian function.

Estuary/Nearshore

The Stillaguamish Technical Advisory Group (STAG) recommends that at least 80% of historic estuarine and nearshore habitat must be accessible and usable for properly functioning conditions (NMFS 1996; STAG 2000). Based on research by Collins (1997), approximately 2,020 acres of estuarine area would have to be restored to achieve this 80% target for properly functioning conditions.

Large Woody Debris

The STAG recommends that 80 pieces (24-inch by 50-foot) of large woody debris (LWD) per mile be added and/or maintained on the mainstem Stillaguamish River and tributaries to ensure properly functioning instream wood conditions (NMFS 1996; STAG 2000). Based on instream data gathered during 2002 from the North Fork and South Fork Stillaguamish, an additional 3,700 pieces of LWD would be needed to achieve the properly functioning conditions standard in the 40+ miles of these reaches. This is equivalent to approximately 62 engineered log-jams similar to those that have been built on the North Fork Stillaguamish, with additional single pieces throughout the system.

Floodplain

The STAG recommends that no more than 10% of streambanks in any reach[19] be hardened to ensure adequate floodplain and off-channel connectivity (NMFS 1996; STAG 2000). The existing amount of hardened bank in Chinook-bearing reaches throughout the Stillaguamish Watershed is shown in Table 4. The gap between current conditions and achieving this properly functioning conditions target in the North and South Fork Stillaguamish is 4.1 miles of existing hardened bank. The total mileage of hardened bank in the North and South Forks of the Stillaguamish from Table 4 is 13.4 miles, while

[18] These key subbasins are: Lower Stillaguamish, Lower Pilchuck, Lower South Fork, Lower North Fork, Middle North Fork, Boulder River, French-Segelsen, Squire Creek and Upper North Fork. Other subbasins may contribute to overall ecosystem health or downstream Chinook salmon habitat but do not have significant Chinook salmon spawning habitat within them.

[19] Stream reaches identified for use in EDT analysis (Haas et al. 2003).

the total mileage of bank length in these areas is 92.8 miles. 10% hardened banks to achieve properly functioning conditions in the North and South Forks would be a total of 9.3 miles. The gap between properly functioning conditions and existing conditions is therefore 4.1 miles of hardened banks to be removed.

The lower Stillaguamish mainstem is extremely important for both populations of Chinook salmon and is a candidate for floodplain restoration projects. Hardened streambanks in the lower Stillaguamish present a major impediment to Chinook salmon productivity improvements. Achieving properly functioning conditions in the lower Stillaguamish would require removal of 18 miles of hardened streambanks.

Sediment

The STAG has defined properly functioning conditions as less than 12% concentrations of fine sediment (<6.35mm) in spawning areas (Bjornn and Reiser 1991; NMFS 1996; STAG 2000). The 2004 Stillaguamish Lead Entity Strategy (Waller and Stevenson 2004) identified over 124 miles of potentially unstable forest roads on federal, state and private land. At least two large deep-seated landslides and numerous unstable banks (Haas et al. 2003) are also known to be contributing to sediment conditions. It is unknown to what degree the attenuation of these sources will lead to properly functioning conditions.

Hydrology

The STAG recommends that the cumulative subbasin total of hydrologically mature forest be 80% of total forest cover (Nichols 1990). In the 14 subbasins dominated by forestry land use, 35,596 acres of immature forest would need to mature to achieve the properly functioning conditions target (Purser et al. 2003).[20] This assumes no net loss in existing mature forest cover. This assumption may be overly conservative given current land use pressures and forest management trends toward marketing smaller logs to processing plants. Additional actions to achieve properly functioning conditions include improving wetland function and reducing bank armoring and channelization in the lower watershed.

Instream flow levels should be set at an optimum level to ensure recovery goals and actions within this recovery plan are achieved. To determine optimal flows for rearing, spawning and holding, representatives from the Washington Department of Ecology, Washington Department of Fish & Wildlife, Tulalip and Stillaguamish Tribes negotiated instream flow levels based on an Instream Flow Incremental Methodology (IFIM) study. With the

[20] Subbasins dominated by forestry land use are: Upper Pilchuck, Upper South Fork, Gold Basin, Robe Valley, Upper Canyon Creek, Lower Canyon Creek, Jim Creek, Upper North Fork, Boulder River, French-Segelsen, Squire Creek, Deer Creek, Middle North Fork, and Stillaguamish Canyon.

study results, a determination can be made on how much flow would provide optimum habitat for the priority species/life stage during a particular time of the year. For example, flows will be set in the river from late August to October to provide optimum habitat for Chinook spawning in the North Fork Stillaguamish.