Appendix B
Viable Salmonid Population

In 2008, the Interior Columbia River Technical Recovery Team identified the Touchet River as having an ***intermediate*** population size at a ***high risk*** status. The restoration objective for the Upper Touchet basin is to improve habitat conditions for Endangered Species Act (ESA)-listed species (Columbia River steelhead, and bull trout) as well as the reintroduced spring Chinook salmon for all life history stages within the Upper Touchet basin. Improving habitat conditions may lead to an increase in the abundance of listed species returning to the river. Increasing abundance could lead to delisting of the species, which is the overall recovery goal for the system.

Throughout this appendix, steelhead are used as an example species to help clarify the discussion and to provide examples for the types of data collected and evaluated in the basin. Similar types of data (where available) are also being evaluated for the other ESA-listed species included in the prioritization framework.

1.1 Viable Salmonid Population Definition

The National Marine Fisheries Service (NMFS) defines a Viable Salmon Population (VSP) as an "independent population of any Pacific salmonid (genus *Oncorhynchus*) that has a negligible risk of extinction due to threats from demographic variation, local environmental variation, and genetic diversity changes over a 100-year time frame" (McElhany et al. 2000). McElhany et al. (2000) identified four key population characteristics or parameters for evaluating population viability status:

- Abundance
- Population growth rate or entire life cycle productivity
- Population spatial structure
- Diversity

The following sections present a brief introduction to each of the VSP parameters and how these apply to the Touchet basin habitat conditions and future restoration planning.

It must be emphasized that any change in risk associated with these population parameters is affected by myriad factors (including in-basin factors; conditions in the Walla Walla and Columbia rivers; predation from avian, mammal, and piscivorous species; and ocean conditions), and consequently is a long-term proposition. Many of these factors (e.g., ocean conditions and marine survival rates) are largely outside of human control. Moreover, changes expected from the types of actions considered in this report are most likely to occur on a generational scale; the likelihood is low that there would be detectable changes in the near future. Also, there is uncertainty associated with the Touchet River supplemental hatchery program that may affect the steelhead population in ways that may not be well understood.

1.1.1 Abundance

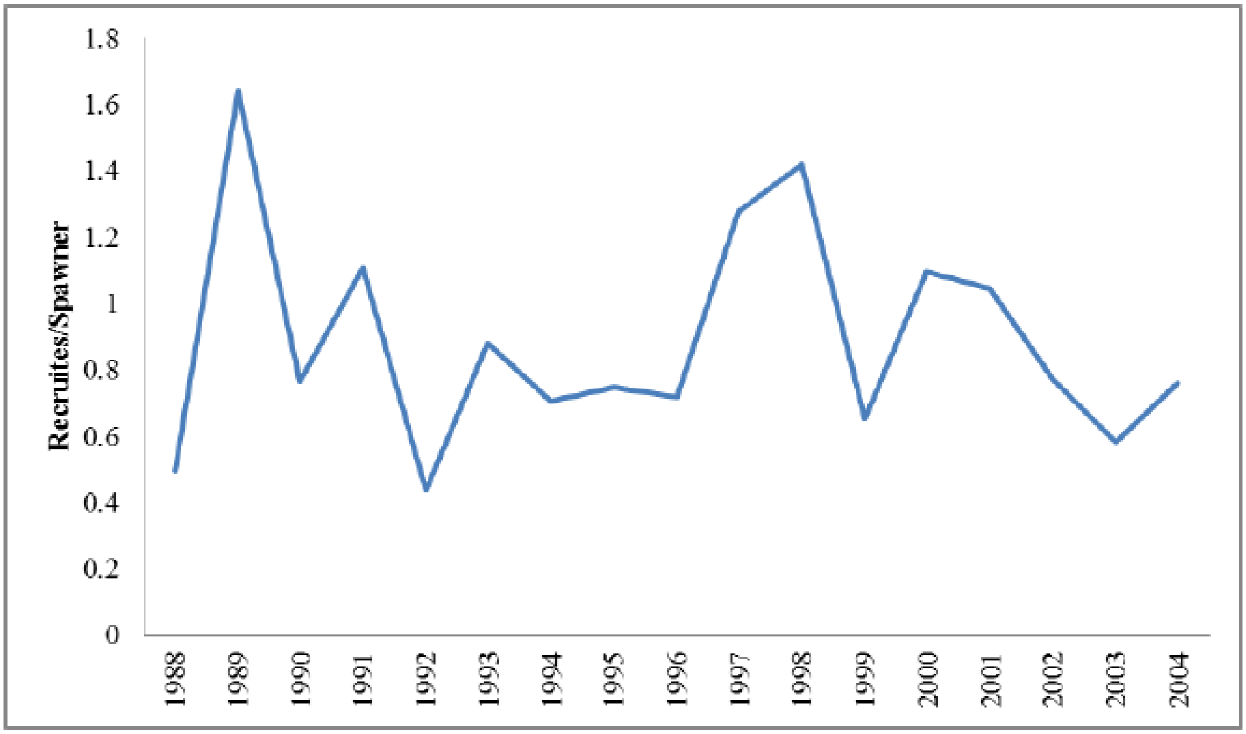
Population size is perhaps the most straightforward measure of the VSP parameters and is an important consideration in estimating extinction risk. All other factors being equal, a population at low abundance is intrinsically at greater risk of extinction than is a larger one. The primary drivers of this increased risk are the many processes that regulate population dynamics, particularly those that operate differently on a relatively small population, such as Walla Walla steelhead. Examples include environmental variation and catastrophes, demographic stochasticity (intrinsic random variability in population size), selected genetic processes (e.g., inbreeding depression), and deterministic density effects. Although the negative interaction between abundance and productivity may protect some small populations, there is obviously a point below which a population is unlikely to persist (McElhany et al. 2000).

The Touchet River has two major spawning areas, the middle and upper Touchet River, and one minor spawning area, Patit Creek. Recovery planners set a goal of ***maintained*** status as part of the delisting scenarios, requiring a spawner abundance of greater than 500 fish (note that this is a 10-year geomean). Beyond minimum recovery goals for meeting viability criteria, the Columbia basin Partnership identified a ***broad sense goal*** of 3,000 spawners. Data are limited for the Touchet watershed and the data series is insufficient to provide the current status for spawner abundance and productivity for the entire basin; however, recent abundance estimates have been 200 to 382 adults (2015 NOAA status and Columbia Basin Partnership estimates), short of the maintained status delisting goal of 500 and well short of the viability goal of more than 1,000.

1.1.2 Life Cycle Productivity

Population growth rate (λ) or productivity over the entire life cycle is a key measure of population performance in a species' habitat. In simple terms, it describes the degree to which a population is replacing itself. A population growth rate of 1 ($\lambda = 1.0$) means that a population is exactly replacing itself (one spawner produces one spawner in the next generation). Recovery planners set a goal of ***maintained*** status as part of the delisting scenarios requiring an ***intrinsic productivity*** (adjusted recruits/spawner) of 1.35, whereas most recently a value of 0.89 was estimated for summer steelhead in the Touchet River in 2011 (SRSRB 2011). Figure B-1 shows the steelhead recruits/spawners (R/S) from 1988 to 2004.

Figure B-1
Steelhead Recruits/Spawners in the Touchet River 1988 to 2004



Source: SRSRB 2011, Figure B-23

The causes for the low R/S are not precisely known and likely include multiple factors that are difficult to quantify, such as potential effects from habitat conditions and habitat capacity (WDFW 2011). Hatchery supplementation, the Columbia and Snake rivers, predation, harvest, and ocean conditions are also factors of the R/S value.

1.1.3 Spatial Structure

Spatial structure, as the term suggests, refers to the geographic distribution of individuals in a population unit and the processes that generate that distribution. Distributed populations that interact genetically are often referred to as a metapopulation. Although the spatial distribution of a population, and thus its metapopulation structure, is influenced by many factors, none are perhaps as important as the quantity, quality, and distribution of habitat. One way to think about the importance or value of a broad geospatial distribution is to consider that in the presence of such a distribution, a population is less likely to go extinct from a localized catastrophic event or localized environmental perturbations (McElhany et al. 2000).

The Touchet population currently meets the spatial structure goal, while spatial distribution (of spawning and summer rearing) of summer steelhead in the Touchet River is primarily restricted to the area upstream of Coppei Creek to the headwaters. Significant passage improvements have been made in the Touchet River and multiple instream habitat, floodplain reconnection, and protection projects have been implemented.

1.1.4 Life History Diversity

Biological diversity within and among populations of salmon is generally considered important for three reasons (McElhany et al. 2000):

- Diversity of life history patterns is associated with the use of a wider array of habitats.
- Diversity protects a species against short-term spatial and temporal changes in the environment.
- Genetic diversity is the so-called raw material for adapting to long-term environmental change.

The latter two reasons are often described as nature's way of hedging its bets—a mechanism for dealing with the inevitable fluctuations in environmental conditions—in the long and short terms. With respect to diversity, more is better to minimize the risk of extinction.

1.2 Restoration Expectations Related to Viable Salmonid Population Goals

To inform habitat restoration actions, steelhead in the North Fork Touchet were identified as a species to focus on with the expectation that restoration actions targeted at improving habitat conditions for steelhead life stages will also improve conditions for spring Chinook salmon and other species important to the Touchet basin.

1.2.1 Abundance

Population abundance is a key parameter used to assess the status of a stock and evaluate trends in stock improvement or decline. Abundance is also useful in identifying critical population dynamics that can be used to identify success in restoring a stock or levels at which extinction risk is high and the level of attention given to restoration be increased. Collectively proposed restoration actions in the Touchet basin are intended to improve abundance holistically; hence, no restoration action proposed in this report is targeting abundance specifically.

1.2.2 Life Cycle Productivity

Previous studies have identified degraded habitat conditions and juvenile carrying capacity as primary causes for the low R/S ratio currently observed in the Touchet River. Therefore, proposed restoration actions are highly focused on addressing limitations to productivity. The largest mortality occurs between egg and smolt, with the majority of the mortality occurring between egg and parr (SRSRB 2011). In addition, WDFW data indicate that in the nearby Tucannon basin smolt production generally increases with an increase in adult returns, although a carrying capacity issue may exist above approximately 200 female spawners (Gallinat and Ross 2010).

The life stage between egg and parr coincides with late summer low flow, winter storm flows, and the spring runoff period. Summer low flows are unpredictable, and other efforts in the basin are focused on improving water quality and quantity. Winter storm events are stochastic and vary greatly in the effect that they may have on growth and productivity.

Based on high egg-to-parr mortality and uncertainty related to much of the hydrologic cycle during the egg-to-parr timeline, improving habitat conditions for juveniles during the spring runoff period was determined to be of high priority and to provide the greatest certainty of success with respect to improving growth and productivity for the ESA-listed species collectively. Therefore, restoration actions that will provide hydraulic complexity; improve or create side channels, alcoves, or hydraulic refuge and cover; or improve low-lying floodplain connectivity will be considered to have high biological benefit when developing conceptual projects.

Installing necessary instream structure to provide adequate cover and complexity, while designing within the basin and reach-scale geomorphic context, will be critical to achieving both an immediate biological benefit and long-term restoration success. Hydraulic complexity and off-channel habitat projects will provide hydraulic refuge and rearing habitat for juvenile salmonids during moderate to high flows and will also provide more desirable habitat during lower flow conditions. Large woody debris placements will provide refuge and cover and will be used to initiate a geomorphic response in many locations where natural channel development and floodplain connectivity can be achieved. Levee and riprap removal will remove stressors in the system, allowing for more natural geomorphic processes and promoting habitat recovery. See Appendices I and J for more details on specific restoration actions proposed for the Touchet basin.

Collectively, these improvements can re-establish natural "processes of material and energy transfer across the watershed that enables the formation and maintenance of productive habitat." It is expected that these improvements will promote the re-establishment of natural processes, which will increase habitat diversity and total rearing area available for juveniles and will improve their survival and productivity. The habitat improvements should also increase spawning and emergence conditions over time through improved energy dissipation from increases in channel complexity, improved temperature conditions, and improved distribution of nutrients and fine sediment across the floodplain.

1.2.3 Spatial Structure

Improving the population spatial structure relates to improving habitat conditions throughout the river corridor such that habitat needs are met across the various life stages and hydrologic regimes, and the health of the population is not jeopardized by local environmental effects. The restoration approach for the Touchet basin does not focus exclusively on one reach or segment of the study area, but values both areas of the river currently experiencing high fish use, as well as areas with high restoration potential should a "full build out" of restoration opportunity be realized. This approach is further described here and in Section 4 of the main report.

In general terms, the restoration strategy for the Touchet basin is a holistic basin-scale approach that values both immediate and long-term biological benefits. Implementation of restoration projects will likely occur in high-use areas early to maximize growth and productivity in areas of current use. In addition, projects with high benefit and low cost will be highly recommended regardless of location to maximize the growth and productivity of the segment of the population currently using those areas. Projects implemented on the fringes of the current high-use areas will expand the linear extent of high-quality habitat throughout the river corridor, increasing the distribution and carrying capacity for fish using those areas. Projects removing stressors on habitat will allow for natural recovery of the system and better habitat continuity through the river in the long term.

This restoration strategy will improve the spatial distribution of the stock by improving existing high-use areas, implementing high-benefit/low-cost projects in non-high-use areas, expanding the size of high-use areas by implementing projects on the fringes of those areas, removing stressors affecting natural processes for long-term improvement of quality habitat throughout the river corridor production, and improving the spatial distribution of the stock.

1.2.4 Life History Diversity

None of the proposed restoration actions will specifically target improving life history diversity within the target species.

1.3 References

Gallinat, M.P., and L.A. Ross, 2010. *Tucannon River Spring Chinook Salmon Hatchery Evaluation Program 2009 Annual Report*. Washington Department of Fish and Wildlife. August 2010.

McElhany, P., M.H. Ruckelshaus, M.J. Ford, T.C. Wainwright, and E.P. Bjorkstedt, 2000. *Viable salmonid populations and the recovery of evolutionarily significant units*. U.S. Department of Commerce, NOAA Technical Memorandum. June 2000.

SRSRB (Snake River Salmon Recovery Board), 2011. *Snake River Salmon Recovery Plan for SE Washington*. Prepared by Snake River Salmon Recovery Board. Prepared for Washington Governor's Salmon Recovery Office. December 2011.

WDFW (Washington Department of Fish and Wildlife), 2011. Personal communication from Glen Mendel. September 2011.