IMST Conceptual Scientific Framework

The recovery of wild salmonids in Oregon depends on many factors, including the availability of quality freshwater and estuarine habitats, ocean conditions, the management of fish harvest, and the adequacy of natural and artificial propagation. Freshwater habitat extends across all the lands of the State, and includes urban areas and lands devoted to agriculture, forestry, and other uses. Estuaries provide a transition between fresh water and the ocean, and are a critical part of the habitat of wild anadromous salmonids. The ocean on which salmonids depend extends well beyond Oregon and is subject to fluctuations in productivity that markedly affect adult recruitment. Fish propagation and fish harvest are critical activities in which humans are directly involved with anadromous fish. The IMST is evaluating the science behind the management practices and policies that affect all of these freshwater and estuarine habitats and the management of fish and fisheries.

IMST is conducting its analysis of land use practices and fish management within a framework made up of the following three fundamental concepts:

1. **Wild salmonids are a natural part of the ecosystem of the Pacific Northwest, and they have co-evolved with it.** The contemporary geological landscape of the Pacific Northwest was established with the formation of the major river/stream basins of the region, approximately two to five million years ago. The modern salmonids of the region largely developed from that time (Lichatowich 1999). The abundance of these species at the time of Euro-American migration to Oregon is a reflection of more than 10,000 years of adaptation to the post-glacial environment and 4,000 to 5,000 years of adaptation to contemporary climatic and forest patterns. There is some indirect evidence from anthropological studies that salmon in Oregon's coastal streams may not have reached the high levels of abundance that the first Euro-Americans saw until about 1,000 to 2,000 years ago (Matson and Coupland 1995). The point is that the salmonid stocks of today co-evolved with the environment over a relatively long period compared with the length of time since Euro-Americans entered this landscape.

2. **High quality habitat for wild salmonids was the result of naturally occurring processes that operated across the landscape and over time.** These same processes occur today, but humans have altered their extent, frequency, and to some degree, their nature. Humans will continue to exert a dominant force on the terrestrial, freshwater, and estuarine landscape of the Pacific Northwest, but current ecosystems need to better reflect the range of historical conditions (Benda 1994; Reeves et al. 1995).

3. **The environment and habitat of these species is dynamic, not static.** At any given location, there were periods of time when habitat conditions were better and times when habitat conditions were worse. At any given time, there were locations where habitat was better and locations where it was worse. Over time, the location of better habitat shifted, both in fresh water and the ocean.

Fresh water and estuarine salmonid habitat in the Pacific Northwest has been a continuously shifting mosaic of disturbed and undisturbed habitats. One of the legacies of salmonid evolution in a highly fluctuating environment is the ability to colonize and adapt to new or recovered habitat.

The ocean habitat also fluctuates and is dynamic, changing over several time scales. There are inter-decadal variations in climate called regimes (as well as shorter term variations) that affect the ocean productivity for salmonids. One regime that resulted in a shift from favorable to unfavorable ocean conditions, especially for coho salmon, occurred in 1977. Some believe that we are entering a more favorable regime that began with the 1998 La Niña. However, it is important to realize that full recovery of salmonid populations is a long-term process. A major assumption is that improved conditions of freshwater and estuarine habitat are buffers to poor ocean conditions. Without improvement of the condition of these habitats, the return to poor

ocean conditions in the future will be more devastating to salmonids than what was experienced in the early 1990s (Lawson 1993).

These concepts apply regardless of the land use or fish management strategy and are the basis for the evaluations in this report.

Wild salmonid stocks historically accommodated changes in their environment through a combination of three strategies. **Long-term adaptation** produced the highly varied life history forms of these species, providing the genetic diversity needed to accommodate a wide range of changing conditions. **High fish abundance distributed in multiple locations (stocks)** increased the likelihood that metapopulations and their gene pools would survive. **Occupation of refugia** (higher quality habitat) provided the base for recolonization of poor habitat as conditions improved over time.

Since the mid 1850s, the rate and extent to which habitat conditions have changed has sometimes exceeded the ability of these species to adapt; therefore, abundance currently is greatly reduced. Although refugia exist (at a reduced level) today, population levels of wild salmonid stocks are seriously depressed because of other factors (ocean conditions, fisheries and hatchery management, land-use patterns and practices) that limit habitat productivity and the rate and extent to which recolonization can occur. In addition, some harvest and hatchery practices may have diminished the genetic diversity of salmonids (reviewed in Allendorf and Waples 1996; NRC 1996), potentially limiting their ability to cope with climate fluctuations. It is the combination of these factors and their cumulative effects since 1850 that have produced the depressed stocks of today.

The historical range of ecological conditions and the diversity of salmonid stocks in the Pacific Northwest are important because they provide a framework for developing policy and management plans for the future. The persistence and performance of salmonids under historical ecological conditions is evidence that these habitats were compatible with salmon reproduction and survival. Prior to European settlement of the western United States, artificial propagation was not practiced, yet the level of harvest by Native Americans may have reached the levels of peak harvests by Euro-Americans (Beiningen 1976; Schalk 1986).

Land uses and fish management strategies resulting in non-historical ecological conditions may support productive salmonid populations, but the evidence for recovery of wild salmonids under these circumstances is neither extensive nor compelling. Recovery of wild salmonids also requires fish management (artificial propagation and harvest) strategies that are consistent with the goals of recovery and are compatible with the condition of the terrestrial and ocean landscape within which they operate.

Therefore, we conclude that:

- The goal of land use management and policy should be to emulate (not duplicate) natural processes within their historical range.
- The goal of fish management and policy should be to produce and take fish in a manner that is consistent with the condition of the environment and how it changes with time.
- The recovery of wild salmonid stocks is an iterative and a long-term process. Just as policy and management have changed in the past they will continue to change in the future, guided by what we learn from science and from experience.

References:

Allendorf, F.W., and Waples, R.S. 1996. Conservation and genetics of salmonid fishes. Pp. 238–280 in Conservation genetics: Case histories from nature. Edited by J.C. Avise and J.L. Hamrick. Chapman & Hall, New York.

Beiningen, K. T. 1976. Fish runs. Section E: Investigative reports of Columbia River fisheries project. Pacific Northwest Regional Commission, Vancouver, WA.

Benda, L. 1994. Stochastic geomorphology in a humid mountain landscape. Ph.D. thesis, University of Washington, Seattle.

Lawson, P.W. 1993. Cycles in ocean productivity, trends in habitat quality, and the restoration of salmon runs in Oregon. Fisheries 18: 6–10.

Lichatowich, J. 1999. Salmon without rivers. Island Press, Covelo, CA.

Matson, R.G., and Coupland, G. 1995. The prehistory of the northwest coast. Academic Press, New York.

National Research Council (NRC). 1996. Upstream: Salmon and society in the Pacific Northwest. National Academy Press, Washington, DC.

Reeves, G.H., Benda, L.E., Burnett, K.M., Bisson, P.A., and Sedell, J.R. 1995. A disturbance-based ecosystem approach to maintaining and restoring freshwater habitats of evolutionarily significant units of anadromous salmonids in the Pacific Northwest. American Fisheries Society Symposium 17: 334–349.

Schalk, R. 1986. Estimating salmon and steelhead usage in the Columbia Basin before 1850: The anthropological perspective. Northwest Environmental Journal 2(2): 1–29.