



## **HABITAT STATUS AND TRENDS**

# **DIAGNOSIS AND TREATMENT OF THE OKANOGAN ECOSYSTEM THROUGH TIME**

### **PREPARED FOR:**

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## Executive Summary

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Habitat restoration is a continuous improvement process aimed to restore impaired ecosystems and protect against future threats. Multiple restoration actions may be implemented across a watershed at multiple scales using various techniques that mature at variable lag times with uncertain efficacy. Single actions occur simultaneous with other restoration and degradation actions, and concurrent with natural decay and recovery, masking or amplifying their actual efficacy. Therefore, the effects of actions on ecosystem status can be difficult to validate at the site level due to its limited scale and context.

The Ecosystem Diagnosis & Treatment (EDT) approach provides a framework for integrating site specific information with larger spatial scales and broader ecological processes. EDT scenarios represent a snap shot of environmental attributes that, when coupled with appropriate biological assumptions, can be used to evaluate the status of an ecosystem through the eyes of a focal species in terms of their performance and limiting factors. The use of a focal species provides a common currency by which multiple scenarios can be compared through time, allowing for the evaluation of habitat status and trends.

The potential of habitat in the Okanogan River to support spring Chinook salmon and steelhead was analyzed for a template (system potential) scenario and for two patient scenarios; 2004 and 2008. The 2004 scenario consisted of the Okanogan Subbasin Plan model that relied heavily, though not entirely, on professional judgment of ecological conditions. The 2008 scenario was developed using information from the Okanogan Basin Monitoring and Evaluation Program (OBMEP) data which was collected by the Confederated Tribes of the Colville Indian Reservation.

Previously published techniques were used to process OBMEP level 1 data into level 2 EDT environmental attributes. OBMEP estimates of alkalinity, dissolved oxygen, embeddedness, fine sediment, flow, gradient, large woody debris, and wetted width were used to populate attribute rankings to produce the 2008 scenario. The remaining attribute rankings remained in common between the 2004 and 2008 scenarios. The two patient scenarios had different values for 681 attribute rankings across 84 stream reaches. Each scenario used the same river geometry, life history assumptions, and out-of-basin survival assumptions. The original template scenario was used in the diagnostic comparison against both the 2004 & 2008 scenario to evaluate changes in the limiting factors analysis through time.

We evaluated habitat status and trends in terms of the performance of each focal species, and the change in limiting conditions relative to the template using Patient-Template Analysis (PTA). We compared habitat performance between the 2004 and 2008 scenarios based on the estimates of the level 5 population performance metrics of diversity, productivity, capacity and equilibrium abundance from the Beverton-Holt stock recruitment curves produced by EDT. We evaluated changes in limiting factors based on the level 3 attribute sensitivities at the diagnostic-unit and life stage level using three status and trend diagnostic factors; condition, prevalence of sensitivities, and severity of impairment.

Change in the condition of each diagnostic unit was evaluated in terms of decreased restoration rank or increased protection rank for each level 5 metric based on the diagnostic unit priorities analysis. Change in prevalence of sensitivity was evaluated in terms of the fraction of EDT level 3 attribute sensitivities that improved in the limiting factors analysis for each life stage, and the fraction of level 5 metrics that improved in the limiting factors analysis for each diagnostic unit. Change in the severity of impairment was evaluated in terms of the change in the relative magnitude of degradation in productivity for each level 3 attribute for each life stage, and the change in relative degradation of each level 5 metric for each diagnostic unit. An index of improvement was generated for each diagnostic unit by assigning a -1 (increased impairment), 0 (no change), or +1 (improvement) to each of the three status and trend diagnostic factors.

Based on the limiting factors analysis the priority life stage for summer Chinook remained egg incubation for both focal species. The relative importance of spawning increased for summer Chinook, with a corresponding decrease in the relative importance of pre-spawning, due to a small shift in the temperature patterns between the two patient scenarios. The importance of fry colonization decreased for summer steelhead due to revised estimates of habitat diversity in the 2008 scenario. Across all summer Chinook life stages and attributes there was a 4% increase in the prevalence of sensitivities, but an 11% improvement in the severity of impairment. For summer steelhead there was no change in the prevalence of sensitivities, but a 21% improvement in the severity of impairment.

When comparing the 2004 versus the 2008 scenario the mainstem Okanogan and Similkameen River remain the priority restoration and protection areas for summer Chinook. For summer steelhead Omak Creek remained the priority restoration area, and the Lower Salmon remained the priority protection area. The condition of 73% and 63% of the diagnostic units improved for summer Chinook and summer steelhead accordingly. Across all diagnostic units and performance metrics there was a 52% improvement in prevalence of sensitivities for summer Chinook, and a 36% improvement for summer steelhead. There was a 17% improvement in the severity of impairment for summer Chinook, and a 26% improvement for summer steelhead. The overall index of improvement was 1.47 for summer Chinook and 0.95 for summer steelhead.

In comparing the performance of the 2004 versus 2008 scenarios the estimate of life history diversity decreased from 19% to 64% for summer Chinook, and remained <1% for steelhead in both scenarios. Excluding the effects of harvest the estimate of productivity increased from 1.7 to 3.0 for Chinook, and decreased from 1.6 to 1.5 for steelhead. The estimate of habitat capacity increased from 9,972 to 24,421 for Chinook, and from 126 to 422 for steelhead. The estimate of equilibrium abundance of Okanogan habitat excluding harvest increased from 4,159 to 16,218 for Chinook, and from 49 to 139.

The status and trend assessment includes two sources of change; change in accuracy and change in condition. For summer Chinook this initial status and trends assessment was highly influenced by a change in accuracy of the information used to populate the patient scenario. The estimates of wetted width in the priority areas were highly understated in the 2004 scenario, creating an artificial bottleneck for sub-yearling summer Chinook. The correction of those values resulted in the dramatic change in capacity between the two scenarios.

Trends in the other ecosystem performance metrics resulted from some combination of better scientific information and actual change in the Okanogan ecosystem. Future ecosystem status and trends analyses will be influenced by both of these contributing factors. Restoration actions will continue to improve the quality of the Okanogan ecosystem, and this influence will begin to dominate the evaluation of trends. Information provided by OBMEP has and will continue to improve the quality of the patient scenario and the influence of information quality on the evaluation of status and trends should decrease through time.

The EDT process provides a much needed framework for synthesizing habitat information collected from the environment, and evaluating the efficacy of restoration programs. Previous attempts to evaluate the ecological effectiveness of restoration programs have focused on project-level accounting of action types, efficacy, and lag time with limited results. The EDT process uses incorporates project accounting as part of the treatment planning step. In this context specific restoration actions are evaluated against the limiting factors analysis, and adopted based on their expected outcomes under ideal conditions. Ecosystem status and trends analysis provides an opportunity to evaluate the actual conditions, to revise the understanding of limiting factors, and to adapt the treatment plan as new knowledge becomes available. Though imperfect, the approach is free from many of the assumptions and uncertainties at the project level, and provides a common currency and lexicon for tackling these complex issues.

The production version of EDT3, due for release in Q1 of 2011, includes the software and tools needed to conduct an ecosystem status and trends analysis. The system includes an online help file which includes tutorials and walkthroughs for conducting the analyses and downloading the relevant reports. The system provides the ability to maintain and evaluate multiple patient scenarios through time, and to evaluate each time period against a common template scenario. The most recent patient analysis can be cloned in the system, and then updated with revised estimates of environmental attributes for the new time period. The new patient scenario can then be compared against the template to provide an updated limiting factor analysis, and can be compared against previous time periods to evaluate trends in ecosystem status in terms of condition, prevalence, severity and an index of improvement. The results are incorporated in an "Ecosystem Status & Trends" report which can be retrieved from the EDT3 system.