Pacific Northwest Aquatic Monitoring Partnership

Overview of the PNAMP Integrated Status and Trends Demonstration (ISTM) Habitat Workgroup Goals, Objectives, Approach and Timeline

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Issue

Throughout the Pacific Northwest there is an increasing demand for comprehensive information on the status and trend of aquatic ecosystems. At the same time, economic realities mean that the entities charged with obtaining this information are expected to do more with less. Currently, there are at least five different programs proposed or underway for monitoring of aquatic resources in the Pacific Northwest. Often there is significant overlap in questions being addressed, methodology, and spatial domains of inference of these habitat monitoring programs. Despite this overlap, it is often difficult to share data among habitat monitoring entities because of potentially rectifiable differences in study designs. The premise of PNAMP's Integrated Status and Trend Monitoring (ISTM) project is that better coordination among the habitat monitoring programs will lead to more efficient and effective aquatic resource monitoring throughout the region. For this to occur, monitoring entities need to compare goals, objectives, protocols, and inference domains. By identifying commonalities and rectifiable differences, it will be possible to develop more coordinated, effective, and efficient multi-agency aquatic monitoring programs for the Pacific Northwest.

Goal

The goal of Pacific Northwest Aquatic Monitoring Partnership's (PNAMP) Integrated Status and Trend Monitoring (ISTM) project is to develop recommendations for regional aquatic ecosystem monitoring entities on ways to design and implement more coordinated, efficient, and effective aquatic ecosystem monitoring. To do this, the ISTM project is divided into two workgroups. A fish workgroup is working on recommendations for salmon and steelhead monitoring. A habitat workgroup[1] (for which this document provides an overview) is working on recommendations for aquatic ecosystem monitoring.

Objectives

Objectives for the ISTM habitat workgroup are:

1. Identify & prioritize decisions, questions, and objectives
2. Review existing programs and designs and identify gaps
3. Identify monitoring designs, sampling frames, protocols, and analytical tools that facilitate more coordinated, efficient, and effective monitoring programs
4. Use trade-off analyses to develop recommendations for monitoring
5. Recommend implementation and reporting mechanisms

Geographic Scope

To demonstrate the utility and tools associated with regionally and locally integrated status and trend monitoring, the PNAMP ISTM habitat workgroup selected non-tidal tributaries in the Lower Columbia River (LCR) from Hood River to the mouth of the Columbia River. The reasons for selecting this area are that various entities have already or are in the process of reviewing and applying integration tools for habitat and fish in their monitoring plans. These entities include the ODFW, USFS, LCFRB, Washington departments of Ecology (ECY) and Fish and Wildlife (WDFW), NOAA Fisheries, and other monitoring agencies to facilitate a more coordinated approach to monitoring natural resources. This area is within the jurisdiction of two states

[1] Representatives from ODFW, ODEQ, USFS, LCFRB, NOAA, and WDE are on the ISTM habitat workgroup.

(Oregon and Washington) and numerous federal, tribal, watershed council, county, and municipal entities. It is the focus of ongoing recovery efforts for four ESA listed anadromous salmonid species (coho, chum, Chinook, and steelhead), and bull trout, and has diverse land use and increasing human population pressures.

Approach and Progress to Date

Objective 1. Priority habitat monitoring needs.

Because salmon and steelhead populations in the LCR are influenced by essentially every aspect of the aquatic ecosystems in which they reside, Oregon and Washington's recovery plans for LCR salmon and steelhead provide a comprehensive resource for identifying priority aquatic ecosystem monitoring needs in the LCR (LCFRB 2010 and ODFW 2010). . The following is a list of high level indicators of aquatic ecosystem health identified by the two states recovery plans:

- Biological Condition
- Channel Structure
- Disturbance
- Floodplain Connectivity and Function
- Geomorphology
- Invasives
- Riparian Condition
- Stream Connectivity
- Stream Flow
- Substrate
- Upslope Condition
- Water Quality

These plans, however, do not prioritize these indicators nor do they provide much guidance on the preferred approach to gathering data that will be used to generate them. Crawford and Rumsey (2011) do provide some additional guidance from NOAA on habitat monitoring priorities with a general guide to the parameters that most affect salmon populations and the field measurement recommended for use (Table 1). They do emphasize, however, that these are "general" guidelines and that "the method used in measuring these protocols in the field should be resolved and incorporated into the major habitat status/trend monitoring programs in the Pacific Northwest as soon as possible in order to meet pending policy and legal requirements". The ISTM project will develop recommendations for more coordinated, effective, and efficient habitat monitoring programs in the LCR by using a combination of NOAA priority guidance and evaluation of commonalities among region monitoring programs as the basis for identifying priorities. Under this premise, indicators that regional programs have in common, and that are believed to have the most direct effect on salmon and steelhead populations should become priorities for *regional* habitat monitoring. Using this approach means that the results of Objective 2 (identifying existing monitoring and gaps) will be an integral part of delineating common regional habitat monitoring priorities.

Table 1. NOAA's key habitat parameters for determining status/trends (Crawford and Rumsey 2011).

High Level Indicators (ESU, MPG, Population Scale)	Water Quality	Biological Diversity	Physical Habitat Quality (freshwater)	Flow Conditions	Fish Passage
TRT Limiting Factors Addressed	• Poor water quality • Extreme Tempera-tures	• Presence of invasive species, predation and competition	• Excessive sediments • Loss of Channel Complexity • Loss of riparian habitat and wood	• Extreme flows both high and low	• Loss of access to former range
Calculated Metric	• Water Quality Index (WQI) • Instream thermister	• Fish Index of Biological Integrity (IBI) Macro-Invertebrate Multimetric Index (MMI)	• Physical Habitat Index for Salmonids (PHI) (Chadd & Mowe, May 2004), USFS EMDS • Land use/Land cover **TBD**	• Annual and daily flow fluctuations using gauging station. • IFIM if calculated	• Number artificial barriers • Number corrected • Wetted usable area restored
Protocols / Procedures	• NW Data Exchange Network – USEPA, IDEQ, ODEQ, WECY	• (Hayslip, May 18, 2006) • (Mebane & Hughes, 2003)	• Landsat-Aerial photography • Streamside protocols page 57	• USGS protocols	• BMPs for repair of culverts, dams, bridges, etc
Field Parameters Measured	• DO, Nitrate, Phosphate, Fecal coliform, pH, Turbidity	• Fish species present, Species relative abundance, macro-invertebrates present, Relative abundance of invertebrates	• LWD frequency and volume, Riparian vegetation, Residual pool depth, Pool volume, % Pool habitat, Sinuosity, Gradient, % fine Substrate, Bank Full Width, % undercut banks, and Bank angle	• Total annual discharge, Mean low flow, Winter peak flows	• Velocity, depth, gradient, drop

<u>Objective 2. Review of existing monitoring programs</u>

In order to identify similarities and differences in regional habitat monitoring programs we need a conceptual framework with clearly defined terminology for organizing the information gathering components of a monitoring program. With this conceptual framework in place we can create a database where information from any habitat monitoring program can be entered into appropriate compartments that can then be compared to similar information from other monitoring programs.

The conceptual framework we are using to catalog habitat monitoring program information can essentially be broken down into two elements. The first element is a standardized language that describes the flow of habitat information from a field (or laboratory) data collection event to a regional (i.e. domain of inference) habitat characterization. There are four key terms that we use to describe the information that monitoring programs gather or produce:

- Attribute: A habitat characteristic (e.g. wetted channel width).
- Measurement: A field data collection event (e.g. the wetted channel width is measured to the nearest cm with a measuring tape at 10 transects perpendicular to the channel thalweg located equidistant along the survey reach).
- Metric: The reduction or processing of measurements to describe an attribute for a sample site (e.g. average wetted channel width).
- Indicator: The reduction or processing of site metrics to describe an attribute for the area of inference (e.g. cumulative distribution function of wetted channel widths for a river basin).

The relationship of these four terms is shown in Figure 1.

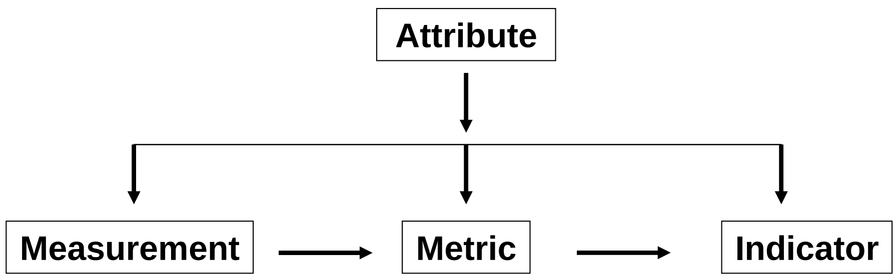

Figure 1. The relationship between four key terms used to describe the components of information gathering and processing. The characterization of a habitat feature (i.e. an "attribute") generally involves one or more field or lab "measurements" at a site. The site measurements are processed to produce a site "metric" for the attribute, which in turn can be processed with attribute metrics from other sites to produce a regional (or area of inference) indicator.

The second element of the conceptual framework we use to organize monitoring program information involves describing the four key components of a monitoring program design. Following the lead of a recently developed website on designing salmon monitoring programs[2], we use the acronym STRIDE for these four components. These four components, along with a standardized nomenclature for their sub-components, are described below:

- **S**patial design (how we select monitoring sites)
  - Census
  - Model-based
  - Survey
    - Non-stratified Independent Random Survey
    - Stratified or Variable Probability Independent Random Survey
    - Non-stratified Generalized Random-Tessellation Stratified (GRTS) Survey
    - Stratified or Variable Probability GRTS Survey
    - Non-stratified Systematic Survey
    - Stratified Systematic
  - Opportunistic
- **T**emporal design (how we select when we monitor sites)
  - Always revisit
  - Never revisit

[2] https://salmonmonitoringadvisor.org/2-design/2.0.2-design_introduction

    - Rotating revisit
    - Split revisit
- **R**esponse design (what and how we measure at sites)
    - What (i.e. attributes)
    - Where (i.e. location of measurements at a site)
    - When (measurement and metric methods)
- **I**nference **DE**sign (how we analyze the data to generate regional indicators)

Using the above concepts we have developed a database for inputting information from five habitat monitoring programs[3] that are either currently implemented or proposed for implementation in portions of the LCR. After all the monitoring programs have input their monitoring protocols into the database we will analyze it for attribute to indicator commonalities as well as compatibilities of program STRIDE components. . In addition, the database will be used to compare against recovery plan recommendations and identify gaps in recommended monitoring.

Objective 3. Identify monitoring designs, sampling frames, protocols, and analytical tools that facilitate more coordinated, efficient, and effective monitoring programs

One set of tools that will undoubtedly emerge from reviewing the results of objective 1 and 2 is the need for a regional GRTS-based master pull of sample sites that monitoring programs can access on the web and use to select where they will sample habitat. In fact, NOAA monitoring recommendation #17 (Crawford and Rumsey 2011) is to "implement a generalized random tessellation stratified (GRTS) habitat status/trend monitoring program incorporating on the ground protocols coupled with remote sensing of land use and land cover". By selecting sites from the same set of GRTS-based sample sites, programs will be able to more easily share site data because of a common spatial survey design. The system should allow users to:

- Know who else has selected sites from the master sample covering stream networks in their domains
- Design individual or integrated monitoring programs
- Know how existing sites relate to a common master sample
- Know what information is being collecting at the site over time

In conjunction with the development and use of the web-based master sample management tool a need is anticipated for dedicated analytical support for design and utilization of results of the monitoring design based on master sample. Oregon State University has been funded to develop the prototype master sample management tool using the Lower Columbia region and to provide the necessary statistical support[4]. Additional monitoring designs, sampling frames, protocols, and analytical tools await completion of Objective 2.

Objective 4. Trade-off analyses to develop recommendations for monitoring

The results of Objectives 1 and 2 should lead to an understanding of which habitat indicators and protocols are:

- essentially the same between monitoring programs
- could be the same with relatively minor protocol adjustments
- would take significant protocol adjustments by one or more existing monitoring programs in order to enable data sharing

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[3] ODFW Aquatic Inventories; Washington Dept. Ecology; USFS AREMP; CHaMP; ODEQ

[4] Visit the prototype website: http://pnamp.science.oregonstate.edu/

- could be compared by developing an index system
- are unique to an individual monitoring program

The trade-off analysis will evaluate the relative cost and potential for protocol adjustments within programs versus the anticipated benefit gained (in terms of indictor need, precision, and bias) and will consider recovery-based goals and other management goals and constraints. It is anticipated that the trade-off analysis will result in the documentation of two alternative scenarios for future monitoring in the LCR:

1. Status quo (i.e. no change in existing monitoring programs and little data sharing)
2. Data sharing for common indictors and indictors requiring minor program protocol adjustments

In addition, a "gap filling" monitoring plan will be developed that will address LCR wide habitat monitoring needs not covered by either of the two scenarios listed above.

<u>Objective 5. Recommend implementation and reporting mechanisms</u>
The ISTM effort will result in recommendations to PNAMP and ISTM partners about implementation mechanisms and improved communications and reporting. It will also include recommendations for complementary data management and analytical approaches.

Anticipated Timeline

Objective	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1. Identify & prioritize decisions, questions, and objectives	Completed										
2. Review existing programs and designs and identify gaps	A		B								
3. Identify monitoring designs, sampling frames, protocols, and analytical tools that facilitate more coordinated, efficient, and effective monitoring programs											
4. Use trade-off analyses to develop recommendations for monitoring											
5. Recommend implementation and reporting mechanisms											

A - Complete entry of current LCR habitat monitoring program protocols into comparison database

B - Analyze habitat monitoring protocols and prepare report summarizing program commonalities and differences

References

Crawford, B.A. and S. Rumsey. 2011. Guidance for monitoring recovery of salmon and steelhead listed under the federal Endangered Species Act (Idaho, Oregon, and Washington). January, 2011. NOAA Fisheries, Portland, Oregon.

Lower Columbia Fish Recovery Board (LCFRB). 2010. Washington Lower Columbia Salmon Recovery and Fish & Wildlife Subbasin Plan. LCFRB. Longview, WA.

Oregon Department of Fish and Wildlife (ODFW). 2010. Lower Columbia River Conservation and Recovery Plan for Oregon Populations of Salmon and Steelhead. ODFW. Salem, OR.