

**Toward “A Small, but Powerful” Set  
of Regional Salmon Habitat Indicators  
for the Pacific Northwest**

**Prepared for the  
*Pacific Northwest Salmon Habitat Indicators Work Group***

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**by the**



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## I. Executive Summary

The Pacific Northwest Environmental Indicator Work Group (PNWEIWG) has representation from the following environmental management agencies: British Columbia Ministry of Environment, Lands, and Parks; Alaska Department of Environmental Conservation; Idaho Division of Environmental Quality; Oregon Department of Environmental Quality; Washington Department of Ecology; Environment Canada (Pacific and Yukon Region); and the U.S. Environmental Protection Agency (Region 10).

In early 1997, the directors of the participating agencies asked the PNWEIWG to pilot the development of regional indicators associated with salmonid stocks at risk, particularly as they relate to areas for which the agencies have some responsibility. To conceptually describe salmonids at risk using indicators, the PNWEIWG identified four key interrelated salmon management issues: habitat; hydropower; harvest; and hatcheries. In starting work on a comprehensive set of salmon indicators focusing on these key issues, the PNWEIWG selected habitat (and associated aspects of hydropower) as the most relevant and tractable set of salmon measures for the participating agencies.

To further organize and categorize the salmon habitat indicators, the PNWEIWG selected the widely used pressure-state-response model. The model differentiates indicators of changes or trends in the physical or biological *state* of the environment from indicators of stresses or *pressures* from human activities that cause environmental change and measures of programs and policies created in *response* to environmental problems.

The first Salmon Habitat Indicators Workshop June was held 17-18, 1997 in Seattle as the initial outreach effort for this project and was designed to:

- identify factors within the PNWEIWG agencies' shared responsibilities that most directly affect salmonid stocks at risk;
- develop priority environmental indicators related to habitat and related to underlying factors essential to salmon;
- identify data sources to support development of selected indicators; and
- build bridges to and promote cross-fertilization with other agencies, organizations, and individuals that share the goals of and responsibility for protecting and managing salmonid stocks.

Twenty-eight technical and policy experts from governmental and nongovernmental agencies and organizations across the region participated. The focus of the June Workshop was on developing indicators that the PNWEIWG agencies could use to set management priorities, measure program effectiveness, and communicate salmon information to others. Participants initially identified 113 candidate indicators that they then winnowed to the 46 presented in this report as Appendix 1, page 16.

Pursuing a goal of "a small, but powerful" set of salmon habitat indicators, the Work Group evaluated and numerically scored all 46 indicators using a two-round process. In Round One, the 46 indicators were evaluated against three groups of selection criteria—data reliability, issue relevance and usefulness. In Round Two, the highest scoring indicators from Round One were evaluated and scored against three secondary selection criteria. The product of this process was reviewed and refined at a one-day December 1997 Workshop by the PNWEIWG and a group of "institutional leads"(agency staff charged with coordinating technical implementation of the indicators).

Emerging from the December 1997 Workshop and subsequent work in January 1998 was a suite of 21 indicators (listed on pages 9 and 10) that form the basis for "a small, but powerful" set that could become operational on a regional basis. Twelve of the 21 indicators form the physical habitat category. The Salmon Habitat Indicators Work Group, composed of the PNWEIWG and the institutional leads, is refining these 12 indicators into four indicators that would represent essential aspects of salmon habitat: impediments and accessibility; morphology; sediment; and land types adjacent to water (the land-water complex). A display of the "habitat concept" is presented on page 11.

The Salmon Habitat Indicators Work Group concluded that the suite, taken as a whole:

- "has value" and is ready to be operationalized;
- "captures" key features of salmon habitat;
- is reasonable in number;
- reflects the seven agencies' shared responsibility/accountability; and
- appears to be technically feasible.

The Work Group presented the "small, but powerful" suite of indicators selected for operationalizing and regionalizing to the directors of seven agencies on February 6, 1998. Their presentation noted that implementing the suite will require additional and significant effort from organizational, funding resources, and intellectual capital standpoints.

## **II. Purpose and History of the Pacific Northwest Environmental Indicators Work Group and the December 1997 Salmon Habitat Workshop Context**

### **Overall Charge and Products**

The Pacific Northwest Environmental Indicator Work Group (PNWEIWG) has representation from the following environmental management agencies: British Columbia Ministry of Environment, Lands, and Parks; Alaska Department of Environmental Conservation; Idaho Division of Environmental Quality; Oregon Department of Environmental Quality; Washington Department of Ecology; Environment Canada (Pacific and Yukon Region); and the U.S. Environmental Protection Agency (Region 10). The heads of these agencies convened the PNWEIWG in late 1995 for the purpose of working cooperatively in a regional context to identify and develop environmental indicators to:

- collect and report environmental data in a common fashion;
- develop a tool to assist in comprehensively measuring the effectiveness of the agencies' environmental programs;
- help determine the current condition of the Pacific Northwest environment; and
- use environmental data to set management priorities on a regional basis.

As part of their charge, the PNWEIWG was asked in 1996 to consider the feasibility of developing environmental indicators that could be used across the region, as appropriate, by these agencies. Based on its research, the PNWEIWG determined that regional indicators were feasible, if focused around environmental issues of common regional concern. The agency heads concurred, and in early 1997 asked the PNWEIWG to pilot the development of regional indicators associated with salmonid stocks at risk, particularly as they relate to areas for which the agencies have some responsibility.

To conceptually describe salmonids at risk using indicators, the PNWEIWG identified four key interrelated salmon management issues: habitat, hydropower, harvest, and hatcheries. In starting work on a comprehensive set of salmon indicators focusing on these key issues, the PNWEIWG selected habitat (and associated aspects of hydropower) as the most relevant and tractable set of salmon measures for the participating agencies.

To further organize and categorize the salmon habitat indicators, the PNWEIWG selected the pressure-state-response (P-S-R) model. The P-S-R model is a widely used means of categorizing indicators. It was developed from a seemingly simple set of questions: What is happening to the state of the environment or natural resources? Why is it happening? Why is it significant? What are we doing about it? Indicators of changes or trends in the physical or biological *state* of the environment try to answer the first question. Indicators of stresses or *pressures* from human activities that cause environmental change attempt to answer the second question. Both *state* and *pressure* indicators combined address the question of significance to environmental and human health. Measures of programs and policies created in *response* to environmental problems answer the last question.

### **June 1997 Salmon Habitat Workshop Design, Process, and Results**

In the spring of 1997, the PNWEIWG set a goal of identifying “a small, but powerful suite of indicators” that could be used to develop specific recommendations and a path forward for the directors of the PNWEIWG agencies. The June 1997 Salmon Habitat Indicators Workshop was held as the first outreach effort for this project and was designed to:

- identify factors within the PNWEIWG agencies’ shared responsibilities that most directly affect salmonid stocks at risk;
- develop priority environmental indicators related to habitat and related to underlying factors essential to salmon;
- identify data sources to support development of selected indicators; and
- build bridges to and promote cross-fertilization with other agencies, organizations, and individuals that share the goals of and responsibility for protecting and managing salmonid stocks.

Twenty-eight technical and policy experts from around the region participated in a two-day Salmon Habitat Indicators Workshop June 17-18, 1997 at the U.S. Environmental Protection Agency Region 10 offices in Seattle. In addition to the PNWEIWG, knowledgeable individuals from other provincial, state, and federal agencies, as well as nongovernmental environmental organizations attended. The Workshop focused on developing indicators that the PNWEIWG agencies could use to set management priorities, measure program effectiveness, and communicate salmon information to others primarily by using existing sources of data.

Participants were provided with materials to assist them in identifying salmon habitat indicators. A *Concept Paper: A Framework for Developing Salmon Indicators in the Pacific Northwest*, August 1997, lays out the framework that the PNWEIWG developed for organizing all salmon indicators built around the Pressure-State-Response model. It focuses on habitat-related indicators that are of special concern to the PNWEIWG agencies. A menu of salmon habitat indicators was offered as a starting point for discussion. The list was annotated by four groupings (Water Quantity, Water Quality, Land Use/Land Cover, and Physical Habitat) and by data source to further assist the discussion.

The Workshop was organized around a series of facilitated plenary and breakout sessions designed to discuss, evaluate, and refine the menu of salmon habitat indicators. Four breakout groups identified 113 indicators on the first day. Participants continued to refine these indicators during the morning of the second day, distilling the number of indicators to the 46 presented in this report as Appendix 1. The full group then evaluated the full suite of proposed indicators and weighted the indicators according to their relative importance and feasibility through a multi-voting process. Participants were able to discuss appropriate uses and limitations of some of the indicators.

The indicators and the June Workshop are covered in more detail in a previous report, *Report of the Pacific Northwest Environmental Indicators Work Group Salmon Habitat Indicators Workshop*, August 1997.

The June Workshop was the first step in what is viewed as an iterative process. The Workshop was an important forum for sharing ideas and building relationships with, and connections between Canadian and U.S. leaders in the fields of environmental indicators and salmon stocks at risk. Subsequent phases may focus on developing other salmon indicators that may best be supported by additional data gathering efforts.

### **July 1997 Charge from the Directors of the Seven Agencies to Refine the Salmon Habitat Indicators**

In July 1997, when they reported on the June workshop, the PNWEIWG was charged by their directors to choose indicators that:

- were relevant to the authorities of the seven agencies;

- communicate and inform the seven agencies;
- have meaning across the Pacific Northwest Region; and
- build bridges with other agencies and stakeholders interested or involved with salmon habitat.

In considering this charge and pursuing their goal of “a small, but powerful” set of salmon habitat indicators, the PNWEIWG evaluated and numerically scored all 46 indicators generated at the June Workshop using a two-round process described in more detail below. In Round One, the 46 indicators were evaluated against three groups of selection criteria—data reliability, issue relevance and usefulness. In Round Two, the highest scoring indicators from Round One were evaluated and scored against three secondary selection criteria. The product of this process was reviewed and refined at a one-day December 1997 workshop by the PNWEIWG and a group of “institutional leads” (agency staff charged with coordinating technical implementation of the indicators).

## **Work Since July 1997: Round One Selection Process and Results**

Using the PNWEIWG’s 14 agreed upon selection criteria (see Appendix 2) clustered in three groups (data reliability, issue relevance, and usefulness), Work Group jurisdictions first evaluated all 46 indicators, generating an individual score for each criterion for each indicator. PNWEIWG members worked with persons knowledgeable about salmon habitat (both within and external to their agencies, but within their jurisdictions) to generate composite scores. The scoring system used was 0 = no data available or uncertainty; 1 = does not meet criterion; 3 = partially meets criterion; and 5 = fully meets criterion.

In Round One, a differential understanding and application of the scoring system resulted in some outliers and inconsistent evaluation of the indicators. The composite jurisdiction scores, regional ranges and means scores for Round One appear as Appendix 3.

### **Round Two Selection Process and Results**

Based on the Round One scoring, the PNWEIWG initially agreed that the 18 indicators with scores greater than or equal to the arithmetic mean would move forward into Round Two. Upon further review of the scores, correction of computation errors, and reconciliation of the differential Round One results, the original 18 indicators were reaffirmed and an additional 12 indicators from the June workshop list were put forward for Round Two consideration. The set of 30 indicators included nine of the original 11 water quantity indicators, three of the five water quality indicators, five of the 13 land use/land cover indicators, and 13 of the 15 physical habitat indicators from the June Workshop list.

Round Two involved a second round of evaluation using three selection criteria:

1. **Data Availability.** The indicator(s) are supported by data available in all Pacific Northwest Region jurisdictions collected using comparable methods, representative of the Pacific Northwest collectively.
2. **Accountability.** The indicator(s) are integral to performance measurement in the PNWEIWG agencies.
3. **Institutionalizability/operationalizability.** The indicator(s) are able to be reported cost-effectively based on a commitment to monitoring programs that deliver the supporting data, and the political will to standardize collection methods.

The Round Two scoring was undertaken immediately prior to the December 1997 salmon habitat indicators workshop as a joint effort of the PNWEIWG and the institutional leads to obtain both policy and technical perspectives in each jurisdiction. The results of the Round Two scoring were to be used to confirm the importance and relative feasibility of the indicators selected in Round One.

The Round Two scoring system used was the same as for Round One. The full results of the Round Two scoring appear as Appendix 4.

## **III. December 19, 1997 Salmon Habitat Indicators Workshop: Purpose and Process**

At the December 19, 1997 Salmon Habitat Indicators Workshop, 14 PNWEIWG members and institutional leads reviewed the work undertaken since the June 1997 Workshop and selected a smaller suite of indicators that could be operationalized and regionalized. The meeting was facilitated by staff from Ross & Associates Environmental Consulting, Ltd. (Anne Dettelbach and Keith Hinman) and the Green Mountain Institute for Environmental Democracy (James Bernard). A full listing of participants and workshop staff present at the December 1997 Workshop is provided as Appendix 5.

### **Prioritization and Selection Process**

Workshop participants were first asked to look at indicator definitions and associated explanatory notes in an effort to achieve a common understanding of the language and the specific feature of salmon habitat that the individual indicator is intended to address. Participants briefly reviewed the Round One and Round Two scores, ranges, and rankings for the 30 indicators, noting areas of convergence between the two rounds around high and low scores and rankings of the indicators. Indicators with significant scoring ranges and/or outliers were identified. Clusters and pairs of indicators addressing similar features of interest were also highlighted. Indicators reflecting higher scores in Round One and lower scores in Round Two were noted. Indicators not subject to Round Two analysis automatically defaulted to a “low” category.

Participants proposed language clarifications and combinations or consolidations of indicators that covered similar ground. Participants agreed to place some lower scoring, less essential indicators in the low category.

Three indicators were added for consideration: a habitat quality index, a sediment indicator (% fines), and large woody debris indicator. All three were considered to be conceptually important to the set of salmon habitat indicators. Sediment was noted as an important component of salmon habitat that had been strongly considered, but ultimately overlooked, by all of the breakout groups at the June Workshop.

Participants agreed on a list of 25 indicators for consideration in a multivoting exercise with the intent of further winnowing the list. Participants agreed that each jurisdiction would be given  $n / 2 + 1$  ( $n$  = total number of indicators) votes and that a jurisdiction could not place multiple votes on any indicator. Each jurisdiction was provided with 13 votes. A vote for an indicator by a jurisdiction indicated support for considering it as part of the “small, but powerful” regional suite. Decisionmaking involved caucusing between individual Work Group members and the corresponding institutional leads.

### **Results of the December Workshop and January 1998 Refinements**

Following the multivote, participants agreed fully that five indicators (instream flow, temperature, a combination of two biological water quality indexes, land use conversion, and transportation impacts) should be placed in a high category. The participants made this decision based on the number of votes an indicator received and the group’s sense that these indicators were important to describing salmon habitat. They also agreed that five votes (i.e., support of five jurisdictions) was a threshold level and that these indicators should be considered further.

In looking at the results of the multivoting and the number of indicators in play, a “habitat concept” was put forward for discussion and ultimate agreement. The concept is that the essential aspects of salmon habitat are represented by four components: the interrelated impediments and accessibility issues; morphology; sediment; and land types adjacent to water (the land-water complex). Participants placed individual

physical habitat indicators into these four categories for later resolution. The habitat concept is displayed as a diagram on page 11 and will be further refined in early 1998.

In post-workshop sessions, the Salmon Habitat Indicators Work Group, composed of the PNWEIWG, the institutional leads, and several technical experts, continued to refine the results of the December Workshop. The Salmon Habitat Indicators Work Group decided to consider indicators that received three or four votes at the Workshop for implementation. High (five or more votes) and medium (less than five votes) designations were given to the indicators under consideration for regionalizing and operationalizing. Specific language changes were made to clarify the indicators. The indicator counting numbers of salmonids (“let the fish be our guide”)--change in the number of fish by life stage, by species--has been pulled out of the habitat concept to stand on its own merit.

The salmon habitat indicators under consideration for the “small, but powerful” set are presented on the following two pages. The indicators are further explained in Appendix 6.

## ***Pacific Northwest Salmon Habitat Indicators Under Consideration for Implementation***

(by functional category with language and organizational changes from February 1998 report in *italics*)

### ***Fish Abundance***

- 1.1 **Salmonids**--change in # of fish by life stage, by species

oxygen, biological oxygen demand, pH, ammonia+nitrate nitrogen, total phosphorus, total suspended solids, and bacteria to produce a single number)

### ***Water Quantity***

- 2.1 **Instream Flow**--% of stream miles with instream flow meeting instream water rights, seasonal flow requirements for salmonids, and/or sufficient to allow salmonid access
- 2.2 **Flow Hydrology**--% of waterbodies with minimal, moderate, extreme changes in hydrology from historical patterns (captures low and high flow extremes-deviation)

### ***Land Use/Land Cover***

- 4.1 **Land Use Conversion**--# of acres in a watershed converted from land use/land cover classifications (e.g., forestry, agriculture, rural residential, industrial, protected status, etc.) to other land use/land cover types over time with emphasis on floodplain to riparian area

### ***Water Quality***

- 3.1 **Temperature**--% of assessed waterbodies where the daily maximum falls into: <10 degrees C - no impairment; 10-15 degrees C - potential impairment to sensitive species; 15-20 degrees C - moderate impairment; >20 degrees C - severe impairment

- 4.2 **Transportation Impacts**--miles of road by type *and road crossings* within one mile of historically anadromous salmonid streams, floodplains, and marine shorelines

- 4.3 **Impervious Surface**--% of impervious surface (roads, rooftops, and parking lots) in a watershed

### ***Physical Habitat***

- 3.2 **Biological Water Quality Index**--% of water rated excellent, good, fair, poor (possible parameters would include fish community and benthic macroinvertebrate species or taxa composition and richness using similar bioassessment protocols
- 3.3 **Chemical Water Quality Index**--% of waters rated excellent, good, fair, poor (possible parameters would include temperature, dissolved

The "habitat concept" includes four components:

- 5.1 impediments/accessibility;  
5.2 morphology; 5.3 sediment;  
5.4 land type adjacent to water (land-water complex).

- 5.1.1 **Impediments and Accessibility to Salmon Habitat**--# of locations where salmon are impeded, by type, and the *amount, by type*, of historically anadromous salmonid

- habitat rendered inaccessible by these impediments*
- 5.2.1 Large Woody Debris** – *Counts of debris pieces with lengths equal or greater than channel widths, noting presence/absence of root wads, per historically anadromous salmonid stream mile*
- 5.2.2 Stream Depth** – *variance of thalweg depths (flow path of the deepest water in a stream)*
- 5.3.1 Sediment** – *change in sediment loading rates*
- 5.3.2 Spawning Area** – *% change in spawning areas*
- 5.4.1 Habitat Type Associated with Water** – *the amount of habitat, by category (e.g., riparian forest, off-channel, wetland, estuary) associated with the margins of the water course in a watershed and the value of the habitat to the salmonid life-cycle*

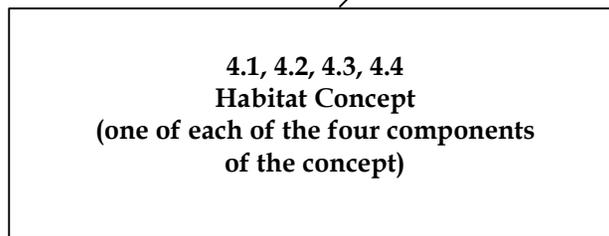
## Displaying the Indicators Supporting the Habitat Concept

**4.1.1 Impediments and Accessibility to Salmon**--# of locations where salmon are impeded, by type, and the # of historically anadromous salmonid stream miles rendered inaccessible by these impediments

*Impediments/Accessibility*

**4.3.1 Sediment**--sediment loading rates  
**4.3.2 Spawning Area**--% change in spawning areas

*Sediment*



Land type adjacent to water (Land-Water Complex)

*Morphology*

**4.2.1 Stream Morphology Assessment**  
**4.2.2 Habitat Quality Index** –physical habitat assessment (parameters would include classifying habitat, measuring channel and riparian character, woody debris, stream discharge, and channel morphology)  
**4.2.3 Large Woody Debris**--Distribution and characterization of large woody debris per historically anadromous salmonid stream mile

**4.2.4 Pool-Riffle Ratio**--change in pool-riffle ratios

**4.2.5 Stream Width-Depth**--change in stream width-depth ratio

**4.4.1 Riparian Habitat**--% of riparian habitat or riparian zone altered by stream miles with a watershed

**4.4.2 Estuarine Habitat**--change in estuarine acreage, by type and quality

**4.4.3 Side Channel Habitat**--change in acreage of side channel habitat

**4.4.4 Wetlands**--change in wetland acreage

## Opportunities for and Challenges to Operationalizing and Regionalizing the Indicators

As part of the December Workshop, the participants identified and discussed opportunities for and challenges to operationalizing and regionalizing the salmon habitat indicators. In discussing what it means to “regionalize,” the participants identified four options:

- collect information on salmon habitat;
- collect similar/same information on salmon habitat;
- collect similar/same information on salmon habitat in a consistent/comparable way; and/or
- tell a “regional story.”

The group agreed that the goal is to strive for last two bullets. Questions were raised around the issues of degree of participation and if all jurisdictions need to be involved.

In a discussion covering the technical challenges of making indicators as words become reportable measures able to be graphically displayed, the group agreed that it would have to:

- refine and clarify the indicator language for consistent meaning;
- understand the varying spatial contexts and scales utilized in collecting data supporting regional indicators, including how data would be aggregated and disaggregated;
- identify *pressure* indicators to go with the predominantly *state* measures in the list; and
- address data comparability issues.

Among the institutional challenges identified by participants were:

- Cross-agency coordination—how can data consistency be achieved? How can trust be built?
- Cross-jurisdictional coordination--how complete should regional coordination be?
- Public and stakeholders—How can meaningful public involvement and communication be structured and encouraged?
- Internal agency coordination—How can the indicators be incorporated into the main of the agencies’ work?
- How should the agencies affirm commitment to the process?

In a wide-ranging discussion of regionalization, participants offered a number of observations:

- an indicator (e.g., temperature) might have different meaning in different latitudes and landscapes;
- do “good, fair and poor” need to be defined for specific parameters?;
- look for common elements and information across the region;
- common indicators can show trends (getting better/worse) or that we are learning from each other’s mistakes;
- collect data similarly, but interpret as appropriate for one’s own jurisdiction;
- develop a regional indicator standards manual;
- set a data comparability threshold;
- “let the fish be our guide” to what’s important; and
- structure data collection and reporting to protect historical records and comparability.

A number of observations, both policy and technical, were made by Workshop participants and are posed as questions below:

- Should the indicators be referenced to a baseline or standard?

- Can improving/degrading, danger zone, carrying capacity concepts be used as reference points for indicators?
- Can we translate “management” indicators into “public communication” indicators?

Participants identified and discussed a number of important principles involved in realizing “a small, but powerful” set of salmon habitat indicators:

- the level of effort and commitment needed for fully realized regional indicators is significant;
- industry and local governments may be implementers of the indicators;
- technical and policy people need to work together to arrive at a meaningful set of indicators;
- this work is “in the main” of the PNWEIWG agencies’ responsibilities;
- regionalizing does not mean comparing jurisdictions (it’s not about who’s doing better, but it is about how the resource is doing);
- developing regional indicators may involve tradeoffs with an individual jurisdiction’s monitoring program.

## **Organizing Further Work, Possible Uses of the Indicators, and Next Steps**

### **Organizing Further Work: Salmon Habitat Indicators Work Group Member Roles and Responsibilities**

The Salmon Habitat Indicators Work Group has decided to take a number of organizational in moving toward a realized set of regional indicators. The Institutional Leads Group has been chartered and its relationship to the original PNWEIWG has been defined. The Institutional Leads will:

- be the primary movers and shakers for implementation of salmon habitat indicators;
- primary in the effort to institutionalize the indicators and make them happen in the seven agencies;
- work together across jurisdictions; and
- build bridges to other organizations through personal and professional contacts.

The Pacific Northwest Environmental Indicators Work Group will:

- remain involved with Institutional Leads as the Salmon Habitat Indicators Work Group it moves on to another environmental issue;
- will offer to be “facilitators” and indicator consultants, sounding boards, and connectors to the agency heads or to others internally;
- build relationships with managers and policy staff in other agencies; and
- will find ways for Institutional Leads to interact with the agency heads.

Throughout the process of developing salmon habitat indicators, the Work Group has sought to involve individuals from other agencies and utilize their expertise in identifying, reviewing, and operationalizing the indicators. A listing of these participants who contributed to the salmon habitat indicators process appears as Appendix 7.

### **Possible Uses of the Indicators and Examples of Partially Operationalized Salmon Habitat Indicators**

Throughout this process, the primary audience for the salmon habitat indicators has been the agency directors and ultimately the public. The potential uses of the indicators that have been discussed are in Performance Partnership Agreements between the U.S. state environmental agencies and U.S.

Environmental Protection Agency; a regional state-of-the-habitat report, and individual jurisdiction planning, policy development and program management.

Participants in the process have noted that the salmon habitat indicators they have identified mostly cover the state of the environment or pressures placed upon it. To be able to describe a more complete picture of the agencies' role in salmon habitat management, other measures of programmatic response to environmental trends and conditions should be considered. A selected number of the salmon habitat indicators from the process have been placed (in bold face) into a matrix of the four most commonly used environmental indicator frameworks, including the Pressure-State-Response model, in combination with other possible measures and indicators as Appendix 8. The presentation attempts to show that indicators used in combination can show connections and linkages between human activities and environmental trends and conditions.

Five salmon habitat indicators, temperature, flow hydrology, impediments and accessibility to salmon habitat, land use conversion and changes in spawning area are displayed in Appendix 9 as partially regionalized and operationalized indicators. Not all of the data supporting these displays are held by the participating agencies, hereby illustrating one of the challenges facing the Work Group in operationalizing the set of indicators. The displays also cover relatively small portions of the Pacific Northwest region illustrating the challenges of collecting comparable data across multiple jurisdictions or in using subsections of the region to illustrate trends and conditions.

All of the displays are taken from *Upstream: Salmon and Society in the Pacific Northwest*, a 1996 book published by the National Academy of Sciences.

### **Next Steps**

The joint Salmon Habitat Indicators Work Group presented the "small, but powerful" suite of indicators selected for operationalizing and regionalizing to the directors of seven agencies on February 6, 1998. The Work Group concluded that the suite, taken as a whole:

- "has value" and is ready to be operationalized and used;
- "captures" key features of salmon habitat;
- is reasonable in number;
- reflects the seven agencies' shared responsibility/accountability; and
- appears to be technically feasible

The Salmon Habitat Indicators Work Group has reached a critical crossroads/decision point for the participating agencies in implementing the suite of indicators. To make the indicators a usable reality, the agencies will need to engage other agencies and constituencies in the Pacific Northwest who are involved in the management of salmon habitat. This will require significant long-term effort and multiple partnerships to achieve success.