Indicators and Protocols for Monitoring Salmon Recovery and Watershed Health

Between December 2009 and August 2010, the Forum on Monitoring Salmon Recovery and Watershed Health adopted high level indicators of salmon recovery and watershed health, a list of attributes and metrics associated with those indicators, and the protocols or methods for measuring them.

The following table shows the indicators, metrics, and protocols adopted by the forum to create greater uniformity in data collected, and to make it easier for data to be shared between organizations. The protocols in this list were chosen because they have demonstrated, under field testing, that they have low variance, high repeatability, high signal to noise ratios, ecological relevance, and consistent precision. Many of the core, ongoing monitoring programs supported by major state, federal, tribal, and local agencies in Washington already are using these methods. It is anticipated that over time, additional indicators and protocols will be added for near-shore and estuarine habitats, larger (non-wadeable) rivers, and for additional indicators or measures of interest.

Organizations are urged to require these protocols explicitly in contracts for monitoring field work, and for any in-house monitoring programs. It is expected that this list will expand and change as more information about protocols is obtained.

<table>
<thead>
<tr>
<th>High-Level Indicator</th>
<th>Attribute</th>
<th>Protocol/Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adult Salmon Abundance¹</td>
<td>Spawners</td>
<td>Johnson et al. 2007</td>
</tr>
<tr>
<td>Harvest¹</td>
<td>Harvest</td>
<td>Pacific Fishery Management Council (PFMC)²</td>
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<tr>
<td>Juvenile Migrant Abundance¹</td>
<td>Rotary Screw Traps</td>
<td>Volkhardt et al. 2007</td>
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<td></td>
<td>Inclined Plane Traps</td>
<td>Volkhardt et al. 2007</td>
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<tr>
<td></td>
<td>Fence weirs/fan traps</td>
<td>Zimmerman et al. 2007</td>
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<tr>
<td>Water Quality</td>
<td>Instantaneous Temp</td>
<td>Peck or Schuett- Hames</td>
</tr>
<tr>
<td></td>
<td>Continuous Temp</td>
<td>Ward</td>
</tr>
<tr>
<td></td>
<td>WQ Samples</td>
<td>Peck</td>
</tr>
<tr>
<td>HIGH-LEVEL INDICATOR</td>
<td>ATTRIBUTE</td>
<td>PROTOCOL/METHOD</td>
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<td>---------------------------</td>
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<td>----------------------------------------</td>
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<tr>
<td>Water Quantity</td>
<td>Instantaneous Flow</td>
<td>Peck</td>
</tr>
<tr>
<td></td>
<td>Continuous Flow</td>
<td>Butkus or U.S. Geological Survey</td>
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<tr>
<td>Biological Health</td>
<td>Macroinvertebrates</td>
<td>Hayslip et al. Merritt 2010</td>
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<tr>
<td>In-Stream Habitat</td>
<td>Wetted-width</td>
<td>Peck</td>
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<tr>
<td></td>
<td>Bank-full Width</td>
<td>Peck or Heitke</td>
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<tr>
<td></td>
<td>Gradient</td>
<td>Peck or Heitke</td>
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<tr>
<td></td>
<td>% Pools</td>
<td>Peck or Heitke</td>
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<tr>
<td></td>
<td>Residual Pool Depth</td>
<td>Peck or Heitke</td>
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<td></td>
<td>Pool Max Depth</td>
<td>Heitke</td>
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<td></td>
<td>Pool Tail Depth</td>
<td>Heitke</td>
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<tr>
<td></td>
<td>LWD Freq</td>
<td>Peck or Heitke</td>
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<tr>
<td></td>
<td>LWD Volume</td>
<td>Peck or Heitke</td>
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<tr>
<td></td>
<td>% Fine Sediment</td>
<td>TBD: Heitke</td>
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<tr>
<td></td>
<td>$D_{50}$</td>
<td>TBD: Peck or Heitke</td>
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<tr>
<td></td>
<td>% Undercut</td>
<td>Heitke</td>
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<tr>
<td></td>
<td>Bank Angle</td>
<td>Heitke</td>
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<tr>
<td>Riparian Condition</td>
<td>Canopy Cover</td>
<td>Peck - densiometer</td>
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<tr>
<td></td>
<td>Veg Structure and/or Veg Composition</td>
<td>TBD: CREP; Heitke; Schuett Hames; Peck</td>
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<tr>
<td>Land Use/Land Cover(^4)</td>
<td>% Land Use</td>
<td>Data source = MRLC/NLCD/NAIP</td>
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<tr>
<td></td>
<td>% Impervious Surface</td>
<td>Data source = MRLC/NLCD/NAIP</td>
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</tbody>
</table>

\(^1\)Salmon and steelhead adult abundance and harvest are estimates derived from a variety of methods. The Johnson et al. 2007 protocols focus on methods to collect spawner abundance data but do not describe in detail the analytical methods required to estimate that abundance. Co-
managers will make available the documentation of the methods used to estimate spawner abundance including estimated variance. (e.g. Puget Sound Indian Tribes and Washington Department of Fish and Wildlife (2004) Appendix E).

\(^2\)Pacific Fishery Management Council (PFMC) documents necessary pre-season and post season fisheries data: Pre-season stock abundance analysis, Post season annual reports: Review of ocean salmon fisheries, as well as technical reports such as: Fishery Regulation Assessment Model (FRAM) – An Overview for Coho and Chinook, which describes how data are used in this model.

\(^3\)The work group recommended additional discussion around these attributes and methods.

\(^4\)Satellite imagery and aerial photographs already exist. The reference refers to the relevant data sources.

CITATIONS

ADULT SALMON ABUNDANCE


HARVEST


**JUVENILE MIGRANT ABUNDANCE**


**WATER QUALITY**


**WATER QUANTITY**


**BIOLOGICAL HEALTH**


**IN-STREAM HABITAT**


**RIPARIAN CONDITION**


**LAND USE/LAND COVER**