

Lower Columbia River Integrated Status and Trends Monitoring Project

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Pacific Northwest
Aquatic Monitoring
Partnership

Multi-disciplinary project involves statisticians,
environmental scientists, and information
managers/web developers

Don Stevens, Lisa Madsen statisticians

Phil Larsen environmental scientist

Clif Johnson web developer/information manager

+ a large group of advisors

**Prototype Web Tool
for
Selecting and Tracking Sample Sites
from a
Master Sample of a Stream Network
for
Monitoring Status and Trend**

Context

- The Endangered Species Act, a US Federal Law, provides special protection to threatened or endangered species
- In the Pacific Northwest, a number of fish species are listed or being considered for listing under the ESA
 - Coho salmon, steelhead, Lahontan Cutthroat trout, Red-band trout, Bull trout, Sturgeon, Pacific lamprey

Context

- These fish are an important cultural and economic resource in the PNW
- They all swim in the waters of the Columbia Basin

Context

- Listing triggers special attention by multiple federal agencies (USFWS, USFS, BLM, NOAA, USEPA), state agencies (DFW, DEQ, DoF), Indian Tribes, special interest groups,.....
- Lots of agencies, lots of monitoring, little coordination

Context

- Many agencies do not have access to the skills to design a good sample:
 - Responsive to scientific, political, and legal requirements
 - Probability-based survey
 - Sites selection incorporates prior knowledge and understanding of population characteristics
 - Design uses some technique to achieve spatial regularity

Concept

- Create an easy-to-use web tool that will enable selection of an efficient, statistically-sound sample for monitoring status and trends of environmental resources
 - “pre-select” sites and store in a data base
 - Filter using site attributes in data base to add statistical structure, e.g., stratification
 - Capture site usage characteristics
 - Link to analysis functions

Generalized Random Tessellation Stratified (GRTS) Survey Designs

- Emphasize spatial-balance: Every replication of the sample exhibits a spatial density pattern that closely mimics the spatial density pattern of the resource
- Stevens & Olsen. 2004. JASA 99:262-278.
- See the website www.nheerl.epa.gov/arm to download paper & R software to implement design

Properties of GRTS Sample

- The sample is nearly regular, capturing much of the potential efficiency of a systematic sample without the potential flaws
- Any subsample consisting of a consecutive subsequence is a spatially well-balanced sample.
- Any consecutive sequence subsample, restricted to a sub-population, is a spatially well-balanced sample of the sub-population

Master Sample

- Create a design that allows and facilitates integration up front rather than after the fact.
- A Master Sample is a very large, spatially dense sample that can be subset to meet specific needs at a variety of spatial scales
- Site attributes are included, and can be used to focus subset selection

Master Sample

- GRTS methodology allows creation of a Master Sample so that sequential subsets that meet selection criteria are spatially balanced
- Include a variety of selection and analysis tools
- Make the Master Sample available on the Web so it can be accessed by all interested parties

Master Sample Web Tool

- Prototype will be developed using streams in the Lower Columbia Basin
 - Already have drawn a GRTS sample for both the Oregon and Washington sides
 - Anticipate eventual expansion to (much) larger geographic region
 - Master Sample for Washington Lower Columbia has 42,917 sites
 - ~ one site per km

Master Sample Web Tool

- Tool has solid scientific basis, statistically rigorous sample selection methods, and uses current information management technology
- Development team consists of environmental scientists, statisticians, and information managers/web developers.

Web Tool

- Use open-source software
 - DRUPAL
 - MYSQL
 - PHP
 - R

Web Tool

- Draft database structure
- Operational attributes (functions) of management system
- Critical analysis tools
 - Descriptive stats: means, variances, distributions + confidence intervals
 - Hypothesis tests, comparisons
 - Trend & change descriptions

Functionality

- Draw a sample of sites based on desired site attributes & statistical properties
 - Stratification
 - Variable probability
- Record information about sites sampled (e.g. non-target, sampled, access denied)
- Track information about samples drawn
- Perform basic statistical analyses of data from probabilistic samples

Proposed Database Structure

- Anticipated queries will define database structure.
- We need to have a good idea of the database structure before the database is created
- Need to link sample selection to analyses
 - Critical that design (selection) information gets passed to the analysis tools
 - Critical that good information on site disposition is returned by user



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Master Sample Access Site

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Site Management System

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Welcome to the Integrated Status and Trends Monitoring system of PNAMP (Pacific Northwest Aquatic Monitoring Partnership).

To begin searching the database of sites contained in this database, select one of the searches above, and use the online for to restrict your search by USGS or WRIA areas.

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Select the Region, Sub-Region, Basin and Sub-Basin in the form below
or simply enter the full USGS number into the USGS Number field

USGS Site Search

Region:

Region:

Region:

Region:

USGS Number:

Enter a full USGS number.

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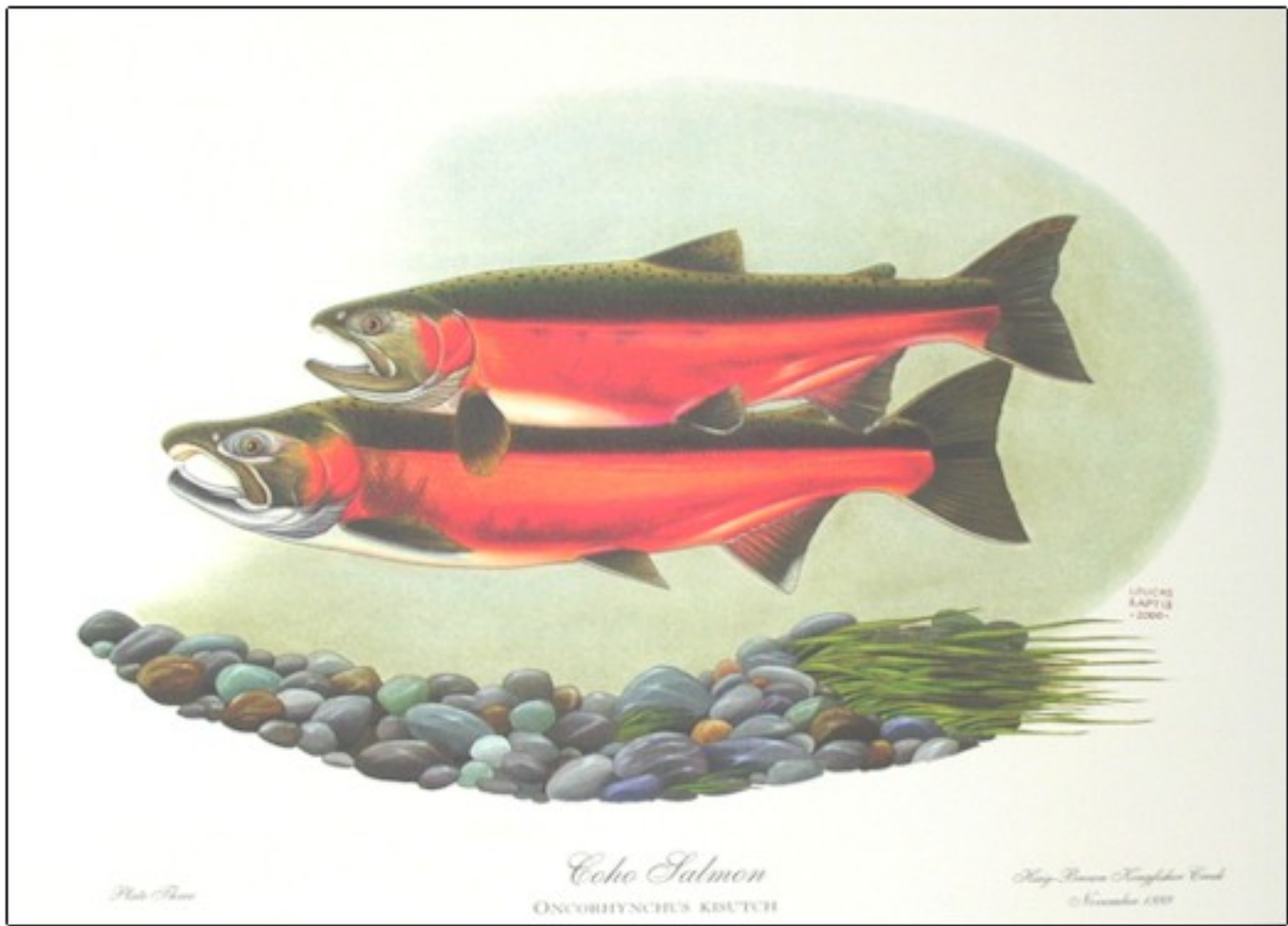
Site Search Results

Too many matches found, restricting search to 20,000

Site Name ▲	X Coord.	Y Coord.	Latitude	Longitude	County	Land Type
WAM06600-000001	1174268.71877	83341.4158	45.54713	-122.32	Clark County	Park/Non Wilderness
WAM06600-000021	1124761.35385	293199.02249	46.11913	-122.53	Cowlitz County	Non Designated Forest
WAM06600-000029	1098494.81252	414820.42191	46.45062	-122.85	Lewis County	Park/Non Wilderness
WAM06600-000033	1194603.58716	206263.07399	45.88539	-122.25	Clark County	Non Designated Forest
WAM06600-000041	1037060.3273	374693.8808	46.33579	-122.89	Cowlitz County	Wildlife Area
WAM06600-000065	1205190.47523	134790.47851	45.69007	-122.2	Skamania County	Non Designated Forest
WAM06600-000073	1123941.74938	347928.87635	46.28911	-122.54	Cowlitz County	Wildlife Area
WAM06600-000089	861966.975	366435.31492	46.29651	-123.58	Wahkiakum County	Unknown
WAM06600-000101	1002139.49539	313694.94545	46.16561	-123.02	Cowlitz County	Unknown
WAM06600-000117	1185276.24927	330867.76018	46.22643	-122.3	Cowlitz County	Monument
WAM06600-000121	1133776.13677	388711.97234	46.3816	-122.51	Cowlitz County	Wildlife Area
WAM06600-000125	1177435.96425	450126.86018	46.55289	-122.34	Lewis County	Non Designated

Flexibility/Potential

- Add classification variables by assigning sites to new classes
 - Requires georeferenced data
- Facilitates integration across programs
 - What sites already being monitored by another agency?
- Encourages:
 - Communication about monitoring designs among agencies
 - Development of common databases to share data easily
 - Agreement on common protocols



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