CSMEP Habitat Subgroup - Data Quality Objectives (DQO) Summary
Lemhi Basin Example
Specific Assessment DQO Steps 1 – 5
Detailed Monitoring Designs DQO Steps 6 - 7

DQO STEPS	LEMHI BASIN EXAMPLE	Policy Inputs[1] (✓)
1. State the Problem		
Problem:	As part of an extended Habitat Conservation Plan (HCP) to restore salmonid populations in the Lemhi a number of water conservation projects are to be implemented in the basin, primary of which are a series of approximately 10-16 actions to reconnect currently isolated tributaries to the mainstem Lemhi River in combination with reestablishment of the historical hydrograph. Evaluating the cumulative success of these actions across a range of fish performance measures is the focus of Lemhi M & E efforts.	
Stakeholders:	IDFG, Shoshone Bannock Tribes, Local landowners, Office of Species Conservation, Upper Salmon Basin Watershed Project, NOAA Fisheries, USFWS	
Non-technical Issues:	Landowner relationships, lack of funding, interagency coordination	
Conceptual Model:	The underlying assumption of the HCP is that as habitat conditions are improved, fish will respond and desired biological effects will be achieved. The conservation objectives are 1) to provide adequate flow to remove or reduce migration barriers, 2) maintain or enhance riparian conditions, and 3) improve instream conditions with respect to cover, temperature, flow, and sedimentation. The desired actions are: 1) reconnect tributaries to the Lemhi River, 2) alter channel morphology to address fish passage, 3) minimize fish entrainment, 4) enhance spawning and rearing habitat, 5) maintain minimum flows, 6) improve riparian corridors, 7) mimic the natural hydrograph. Some are these actions will be quite local, while others will address the entire Lemhi watershed.	
2. Identify the Decision		
Principal Questions	Have the actions implemented under the Lemhi HCP: • Expanded the distribution of rearing juvenile salmonids? • Increased the density of rearing juvenile salmonids? • Increased the number of chinook smolts leaving the Lemhi River? • Caused any changes in seasonal migration pulses and size distribution of Chinook smolts leaving the Lemhi River? • Increased abundance of bull trout in reconnected tributaries? • Increase parr-smolt survival of juvenile Chinook leaving the Lemhi? • Increased returns of adult Chinook salmon to the Lemhi basin?	✓
Alternative Actions:	Maintain current Lemhi HCP program of habitat actions Make adaptive management changes to design of current habitat actions to improve performance of HCP habitat actions and increase benefits to fish populations. Discontinue plans for HCP habitat actions as currently designed, adopt different strategy for restoring fish populations	✓
Decision Statement:	Is the current program of habitat actions achieving the objectives for improved fish habitat and fish population performance measures so that program modifications, reductions/expansions, or elimination are not	✓

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	required?	
3. Identify the Inputs		
Information Required:	**<u>Habitat Performance Measures:</u>** 1. Temperature – creation of summer refugia in reconnected tributaries & adjacent main stem 2. Flow – increased ease of passage & survival of adults & juveniles 3. Substrate & channel characteristics – increase amount of optimal spawning/rearing habitat **<u>Fish Performance Measures:</u>** 1. Spatial distribution (chinook parr, steelhead parr/smolts, all bull trout) 2. Parr density (chinook) 3. Smolts per redd (chinook) 4. Migratory timing & size (chinook) 5. Population abundance (bull trout) 6. Parr-to-smolt survival (chinook) 7. Redd counts (chinook) – to account for effect of seeding level and changes in spawning distribution. 8. Spawning adults (chinook) – weir counts, to account for effect of seeding level	
Sources of Data:	IDFG Chinook redd counts, IDFG snorkel surveys, IDFG juvenile screw traps, IDFG tributary surveys (bull trout redd counts, electofishing surveys, tissue sampling), IDFG PIT tag detectors at diverstion bypasses in Lower Lemhi, Idaho State University telemetry tracking of bull trout in upper Lemhi and Hayden Creek, IDWR flow and temperature gauges at several sites, USGS flow gauges, flow modeling by BoR and University of Idaho, IDEQ FLIR flight of Lemhi mainstem, IDFG water temperature monitoring at remote sites in mainstem and tributaries, baseline instream and riparian habitat inventory (1994) by multi-agency group, PIBO reach inventories	
Quality of Existing Data:	• Long time series of consistently done single pass-pass chinook redd counts • Little hatchery influence on datasets (no hatcheries on Lemhi) • Estimates of outmigrating juveniles available from traps	
New Data Required:	• Adult weir is needed on Big Timber Creek tributary to evaluate movements of fluvial trout • Expanded telemetry tracking of trout in Upper Lemhi • Increased in the number and frequency of parr density surveys • Systematic steelhead abundance estimates • More information in general is required for other areas of the Lemhi watershed, particularly Hayden Creek and the lower mainstem	
Analytical Methods:	B-A, or BACI designs, where differences between before and after treatment values of performance measures may be compared to Action Levels using a t-test and confidence intervals. To account for important covariates and confounding factors, it may be necessary to apply more complex analytical models. Preliminary designs divide the Lemhi into three Sections:	

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	▪ Section A – mainstem Lemhi and tribs below Hayden Creek. Tentatively an additional control area. ▪ Section B – mainstem Lemhi and tribs above Hayden Creek. Tentatively the Treatment area. ▪ Section C – Hayden Creek and tribs. Tentatively the Control area.	
4. Define the Boundaries		
Target Populations:	Sp/Summer Chinook Bull Trout	
Spatial and Temporal Boundaries (study):	The sampling design (where, when, and for how long the protocols are activated) is dependent on the spatial contrast and protocol of interest. For example, if a snorkelling protocol were activated to address the effects of channel reconnection in the Lemhi watershed, randomly selected sites could be snorkelled in treatment and control areas of the Lemhi inter- and intra-annually for a period of 20 years. Five-year check-ins could be included for progress evaluation. Alternatively, if a snorkelling protocol were activated to address the effects of channel reconnection in tributary/mainstem junctions, snorkelling would occur at fixed and random sites only within the treatment areas on an inter- and intra-annual basis for a period of 20 years. For either question, sampling intensity (number and size of the sample units) will be determined based on desired statistical attributes (accuracy, precision, and power)	
Practical Constraints:	Funding Access to sample sites, project locations, or data. Statistical constraints such as feasibility of acquiring required data Inherent variability of the Lemhi system	
Spatial Boundaries (decisions):	Lemhi Basin	
Temporal Boundaries (decisions):	Habitat Conservation Plan (HCP) for Lemhi Basin is 30 years duration)	
5. Decision Rules		
Critical Components and Population Parameters (key examples):	Have the actions implemented under the Lemhi HCP **expanded the distribution** of rearing juvenile salmonids within the basin and **increased the density** of rearing juvenile salmonids relative to average mainstem densities by X% over 30 years (with some precision) when the number of spawners, natural disturbances, climate indicators, and habitat conditions not-impacted by the actions have been accounted for? Have the actions implemented under the Lemhi HCP produced at least a 100% **increase in the number** juvenile **spring Chinook** salmon leaving the Lemhi River in 30 years (+/- X%) when the number of spawners, natural disturbances, climate indicators, and habitat conditions not-impacted by the actions have been accounted for? Have the relative **magnitudes of the seasonal migration pulses** and **size distribution** of migrating **Chinook juveniles** leaving the Lemhi River **changed** over the life of the Lemhi HCP?	✓

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	Have the actions implemented under the Lemhi HCP **increased the abundance of bull trout** in reconnected tributaries relative to unconnected tributaries by X% over 30 years (with some precision)? Have the actions implemented under the Lemhi HCP **increased parr-smolt survival** (X% +/-specified precision) of juvenile **spring Chinook** salmon leaving the Lemhi River in 30 years when the number of spawners, natural disturbances, climate indicators, and habitat conditions not-impacted by the actions have been accounted for? Have the **returns of adult Chinook salmon to the Lemhi basin increased** X% (+/-specified precision, see VSP criteria developed by ICTRT) of the life of the Lemhi HCP?	
Critical Effect Sizes:	Have not been defined for the Lemhi HCP	✓
If –Then Decision Statements:	These have not yet been defined for the Lemhi HCP (i.e., what would be the appropriate response if the actions do/do not result in expected improvements in habitat/fish performance measures)	✓
Consequences of Decision Errors:	May continue/expand actions that have little beneficial effect (Type I error); May discontinue actions that really do work (Type II error); Undue or increased cost	✓

Steps 6 and 7. Optimizing the Design *(examples)*	**Evaluation Design** ***(How data will be analyzed to answer a question)***	**Sampling Design** ***(Where and When data will be collected)***	**Response Design** ***(What and How data are collected)***
Question 1: Has the spatial distribution of juvenile chinook changed as a result of tributary reconnections?	**L:** ($ 285K/year; price includes snorkeling, seining, electroshocking, tagging efforts) Compare connected and unconnected tribs within each of sections A, B, C using BACI like design w/covariates	***Hayden Creek (section C)***, ***Upper Lemhi (section B)***, and ***lower Lemhi (section A)***, including tributaries – several times per year for each site.	Snorkel surveys to estimate parr numbers, several times per year for each site. Verify detection rates with multi-pass electro-shocking.
	M: ($354K/year; price includes snorkeling, seining, electroshocking, tagging efforts) Compare connected and unconnected tribs within each of sections A, B, C using BACI like design w/covariates	Add more sites to Hayden Creek (C), Upper Lemhi (B), and lower Lemhi (A), including tributaries – several times per year for each site	Snorkel surveys to estimate parr numbers, several times per year for each site. Verify detection rates with multi-pass electro-shocking
	H: ($421K/year; price includes snorkeling, seining, electroshocking, tagging efforts) Compare connected and unconnected tribs within each of sections A, B, C using BACI-like design w/covariates.	Same number of sites as M design but more effort towards tagging in Hayden Creek (C), Upper Lemhi (B), and lower Lemhi (A), including tributaries – several times per year for each site	Snorkel surveys to estimate parr numbers, several times per year for each site. Verify detection rates with multi-pass electro-shocking

Question 2: Have the actions implemented under the Lemhi HCP increased parr-smolt survival of juvenile spring Chinook salmon leaving the Lemhi River?	**L:** (60K/year; Cost assumes Question 1 work paid for PIT tagging of all fish captured + cost of screwtrap operation) Compare between sections A, B, & C using BACI-like design w/covariates.	**Hayden Creek (Section C)**, **Upper Lemhi (Section B)**, and **lower Lemhi (Section A)** once per year.	Collection and tagging of parr during parr surveys plus collection of parr in screwtraps and detection of tagged smolts at Lower Granite dam.
	M: ($60K/year; Cost assumes Question 1 is paid for tagging of all fish captured with PIT tags + cost of screwtrap operation) Compare between sections A, B, & C using BACI-like design w/covariates. This design provides more power than the low design because more fish are tagged at more sites. There are no additional tagging costs because these are included in work to address Question 1.	Hayden Creek (C), Upper Lemhi (B), and lower Lemhi (A) once per year.	Collection and tagging of parr during parr surveys plus collection of parr in screwtraps and detection of tagged smolts at Lower Granite dam.

	H: ($69-97K/year; Cost assumes all fish captured under Question 1 were tagged with PIT tags + cost of screwtrap operation+ cost of either 3 mainstem PIT tag detectors, 11 mainstem detectors, or mainstem and tributary detectors) Compare connected and unconnected tribs within each of sections A, B, C using BACI-like design w/covariates. This is the most powerful design. The addition of several PIT tag detectors, multiple treatment and control sites and more tagged fish will allow better estimation of large scale effects on fish survival and distribution as well as the development and testing of relationships between habitat changes and fish survival.	Hayden Creek (C), Upper Lemhi (B), and lower Lemhi (A) and tributaries multiple times a year.	Collection and tagging of parr during parr surveys plus collection of parr in screwtraps and detection of tagged parr and smolts in tributaries and mainstem Lemhi and at Lower Granite dam.