Habitat Effectiveness DQO Subgroup Summary

Nampa, ID. April 12-14th, 2005.

Keith Wolf, Steve Katz, Nick Bouwes, Charlie Paulsen, Tim Copeland, Ian Parnell

Findings – Habitat Effectiveness

1. Monitoring designs for habitat effectiveness can be highly variable. A true template is elusive.
2. High degree of work group agreement (synergy) on the complexities – numerous options.
3. A “process” is a better descriptor than “template” Habitat effectiveness.
4. Examples from the Lemhi + X? may provide a good compare/contrast
5. Steps 6+7 may define an adaptive management process (e.g., 5 years of monitoring under design, then evaluate).
6. The DQO process may provide an optimization process for existing programs.
7. Cost + tradeoffs are relative to the M&E effort. 1) small / cheap – no tradeoff, 2) Large/ deep/ expensive – big tradeoffs
8. Linkages between the physical and the biological indicators and variables need additional discussion and incorporation into the design.
9. Refer to next steps at end of this presentation

Approach

- Used Lemhi as a real example for focus.
  - Population scale,
  - Tier 3.2: Did groups of projects within a subpopulation or sub watershed on aggregate affect fish survival, abundance or condition in a larger demographic unit?
- Example questions for DQO
  - Tested “Bouwes-Katz” Question Clarification Process.
  - Completed first pass at developing Juvenile distribution and Sm/Sp questions.
- Prepared LOM and Next Steps.

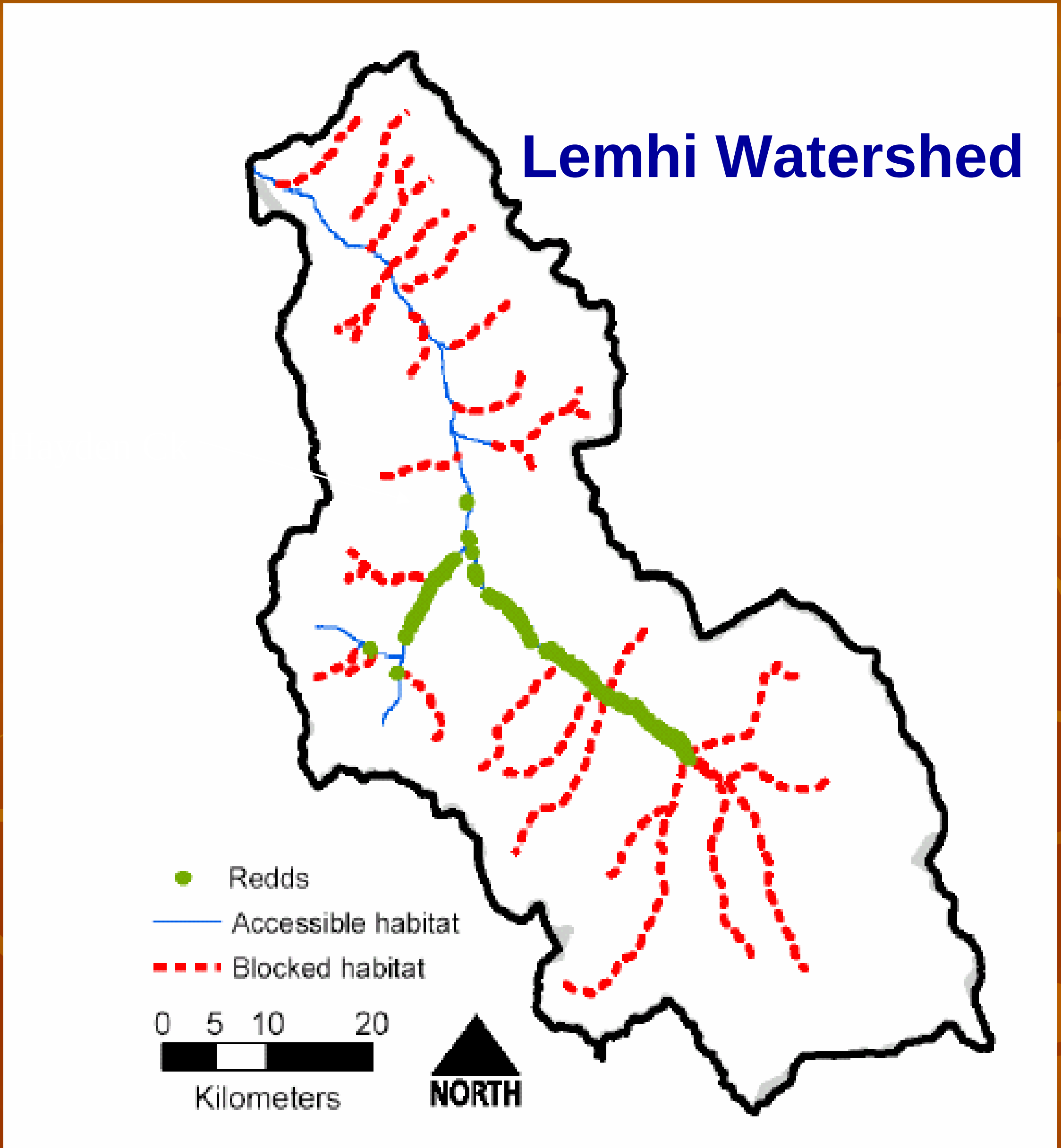


Figure 2-29. Distribution of Chinook salmon redds and location of inaccessible habitat for Chinook salmon in the Lemhi watershed. Salmon Subbasin Assessment, May 28 2004.

Question Clarification Process

- What are all the species, down to life-history type and gender, of interest?

- What is the spatial boundary of the population for which inferences will be made?

- What is the population response variable you want to evaluate to determine whether a change has occurred?

- Define change in the population response variable (i.e. what is the reference and final condition)?

- What is the size of change in population response you want to be able to detect?

- Over what time period(s) do you want to describe this population response?

- Are there surrogate measures that you can use to answer your question?

- To what factors do you want to be able to attribute the observed population response?

- Tradeoffs between uncertainty, errors, and costs.

- The Clarified question (s).

Lemhi – 1st pass.

- **What are all the species, down to life-history type and gender, of interest?**
  - Spring Chinook, steelhead, bull trout.
-
- **What is the spatial boundary of the population for which inferences will be made?**
  - Lemhi watershed - population scale.

Lemhi 1st Pass cont.

- **What is the population response variable you want to evaluate to determine whether a change has occurred?**
  - Distribution of parr through system
  - Smolts per spawner,
  - bull trout population abundance
  - Parr – to – smolt survival (within subbasin, Hayden to Salmon)
  - Adult returns (abundance as indexed by redd counts)
  - Diversity of emigration strategies

Lemhi 1st Pass cont.

- **To what factors do you want to be able to attribute the observed population response?**
  - **Actions**: Tributary reconnections (flow augmentation and shaping) and to a lesser extent riparian fencing.
  - **Biological**: Number of spawners
  - **Habitat**: water quality, flow, temp, sediment , habitat (mainstem), exotics (e.g., brook trout).
  - **Land use / land cover**.
  - **Climate indices**: drought and temperature.

Refined List of Questions

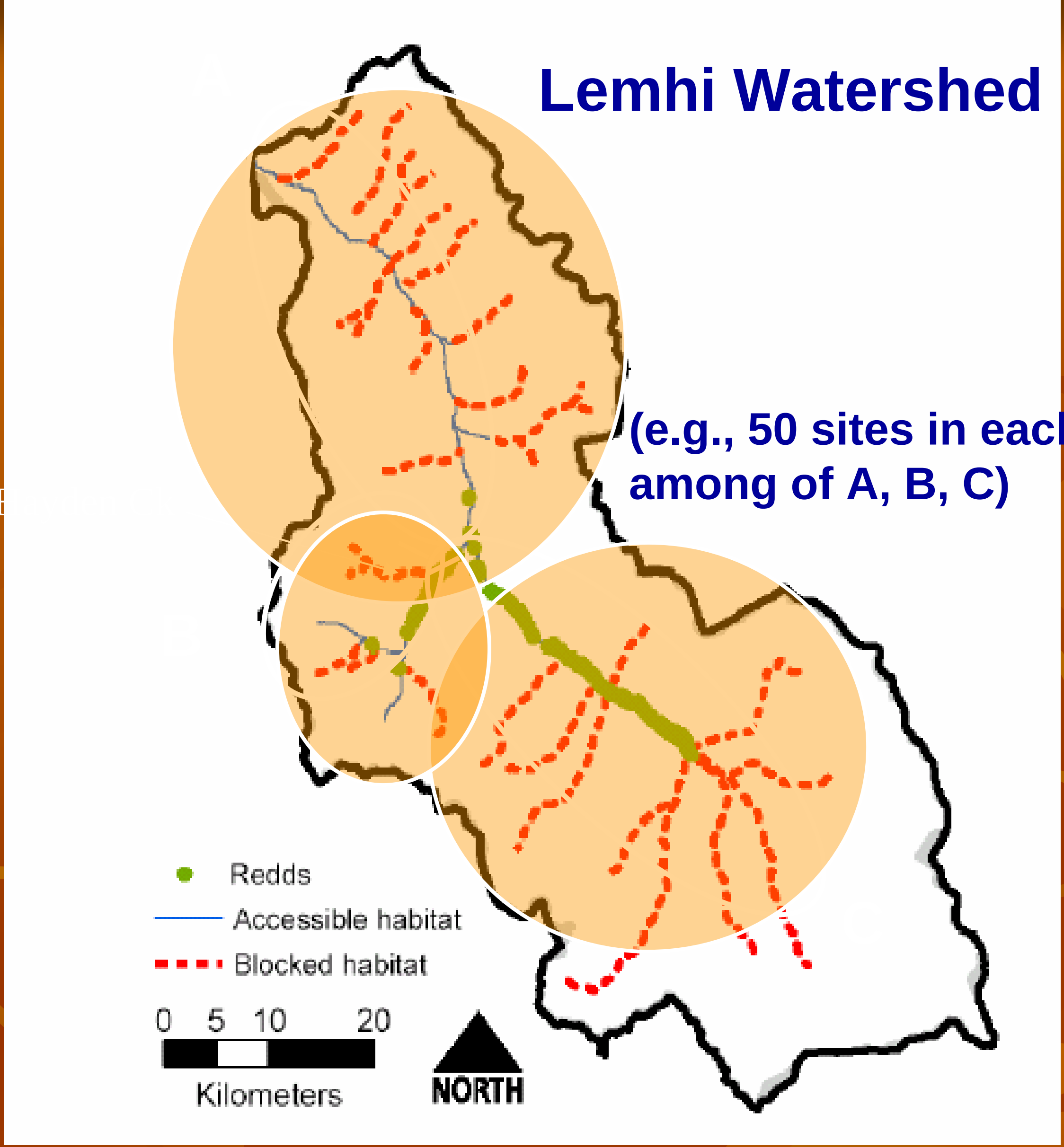
Population response	**Spatial**	**Temporal**	**Other**
Parr distribution	Extent Lemhi Resolution trib	Annual at least Monthly at best	Trib/reach Bull trout down Chinook up 18 to reconnect
Smolts / Spawner Spawners as above	Basin wide Hayden +upper main @ Salmon Upper reaches from Hayden including Hayden Ck mouth	March – Nov Annual totals Annual	Length Wt. Increase freq of redd counts
Bull trout abundance Resident vs. Fluvial	Lemhi-wide + tribs, depletion, redd surveys, snorkel-mainstem tagging	Annual	Not same each year – rotating panel for dist. Annual all places each year, probabilistic.
CH **Parr-to-smolt survvial** Within Lemhi Parr – LGR survival Mark/recap	Lemhi + tribs like smolts / Spawner	Annual + Seasonal Spring vs.	Tag within rearing areas PIT tag detectors at screens
SH (Not survival)	Lemhi	Annual	Steelhead vs. Resident
Spawners	Lemhi	Annual, census redd counts	Compare to index redds

Juvenile Distribution-1

- **What are all the species, down to life-history type and gender, of interest?**
- Spring-summer Chinook, steelhead, and bull trout.

- **What is the spatial boundary of the population(s) for which inferences will be made?**
- Lemhi, with answers resolved to tributary (connected, reconnected) and reach (A, B, C).

- **What is the population response variable you want to evaluate to determine whether a change has occurred?**
- Change in juvenile salmonid densities and distributions..



(e.g., 50 sites in each of or among of A, B, C)

Figure 2-29. Distribution of Chinook salmon redds and location of inaccessible habitat for Chinook salmon in the Lemhi watershed. Salmon Subbasin Assessment, May 28 2004.

Juvenile Distribution -2

- **Define change in the population response variable (i.e. what is the reference and final condition)?**
- Change in average snorkel-based juvenile density before and after reconnection begins in both reconnected and control areas;
-

  Avg. $d_t = (\Sigma d_{i,t} \times \delta_{i,t}) / \Sigma \delta_{i,t}$ where $\delta_{i,t} = 0$ or 1, and d = density.

- After reconnections start, some 0's will be 1's, accounts for changes in densities due to redistribution.

- **What is the size of change in population response you want to be able to detect?**
- d_i across reconnected tributaries is X% of current average parr density in mainstem (average is about 7 parr/100m^2).

Juvenile Distribution -3

- **Over what time period(s) do you want to describe this population response?**
- 20 years, with 5 year check-ins for AM responses - direction, magnitude and quality of your data – adapt monitoring and check for gross undesired changes (e.g., 0’s everywhere). Difficult because not expecting a big change in 5 years.

Juvenile Distribution -4

- **Are there surrogate measures that can be used to answer your question?**
- No

- **To what factors do you want to be able to attribute the observed population response?**
- Suite of reconnection projects + previous list

- **Tradeoffs between uncertainty, errors, and costs.**
- <punting for now>
- Thought a little about costing out design. <u>Relatively</u> cheap to do snorkel sampling. Assume 50 sites per unit A, B, C.
- Currently a dozen sites being snorkeled in the Lemhi. Could double current effort pretty easily, but begin to hit budget constraints when getting to 50 sites. Travel time between sites is a big cost.

Juvenile Distribution -5

Clarified Question:

- Have the tributary reconnection projects in the Lemhi watershed of the Salmon River expanded the distribution of rearing juvenile *salmonids* and increased the density of rearing juvenile salmonids relative to average mainstem densities by X% over 20 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?

Smolts per Spawner

- **What are all the species, down to life-history type and gender, of interest?**
- Sp chinook female spawners, smolts

- **What is the spatial boundary of the population for which inferences will be made?**
- Sum total of A, B and C. B is control. Need 3 rotary screw traps.
-
- **What is the population response variable you want to evaluate to determine whether a change has occurred?**
- Smolts / spawner

- **Define change in the population response variable (i.e. what is the reference and final condition)?**
- Difference between Treatment and Control; Before and After onset of treatments – staircase design. Treatments will be implemented a few at a time. Won't get huge step, may be gradual increase over time. Emerging fry of the following year. After some number have been implemented, maybe weight value by number of reconnects that have occurred. TC- projects come on line over life of plan – e.g., first 6 over first five years, etc. SK – MARS (a la Brian Dennis -   moving autoregressive . . .)

Smolts per Spawner

- **What is the size of change in population response you want to be able to detect?**
- Doubling.

- **Over what time period(s) do you want to describe this population response?**
- 20 years, 5 year check-ins

- **Are there surrogate measures that you can use to answer your question?**
- Redds instead of female spawners,
- Emigrants instead of smolts,

- **To what factors do you want to be able to attribute the observed population response?**
- <see previous list>

- **Tradeoffs between uncertainty, errors, and costs.**
- Smolts - Trap efficiency – mark-recapture experiments. 15-20000 capital cost for trap, Cost of operating a trap per year – threatened so daily checks required. 50-60000 per person per trap. SK – 3 traps $200K per year.
- Adults – increase precision and do true spawners add weirs, maybe weir at mouth (though not popular in some circles) and one above Hayden Ck. (was old one there from Bjornn's work).

- **Clarified Question:**
- Have the reconnection and riparian fencing projects in the Lemhi watershed of the Salmon River produced at least a 100% increase in the number of outmigrating juvenile spring Chinook salmon per spawner in 20 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?

LOM – Lemhi Scale

- **Data needed from outside of the watershed for examining trends to support inferences:**
  - Assume correlated conditions outside of basin – once fish leave subbasins and enter Salmon mainstem pass through same dams, fisheries etc.

- ***Status and Trend***:
  - redd counts from other subbasins (general trends relative to other places).
- ***Hatchery:***
  - Stray rate
- ***Harvest:***
  - Harvest on Lemhi adults
- ***Hydrosystem:***
  - Dam counts/ PIT tag detections for adults and juveniles.
  - Mainstem survival of fish tagged as parr and migrating smolts.

Tasks before June 21-22

- **Finish list of Example Habitat DQO Questions for Lemhi.**
- **Ground truth**: Review Salmon Subbasin plan to see what fraction of subbasin plan the questions address.
- **Design**: detailed design component for Parr distribution question (18 sites, staircase design for staggered implementation of actions). Linkages between the physical and the biological indicators and variables need additional discussion and incorporation into the design.
- **Expand on Tradeoffs**: uncertainties, errors, costs.
- **Data**: For Step 6, explore level of variability in similar data from other sources; try and separate observer (sampling and measurement) and process error (C Paulsen).
  - SFSR as a reference system for data
  - Review of Salmon and Clearwater Data for estimates of variability(Chris Beasley)
  - Snorkel surveys in OR Coastal CO – multiple crew variability (Bruce MacIntosh),
  - IDFG GPM data (Tim Copeland).
  - Other sources (e.g., Hiram Li’s work on snorkel counts). separate Observer (sampling and measurement) and Process error.
- **Writing tasks**:
  - Review current draft, provide more of a narrative of what DQO questions mean, then run an example of the questions weve developed here through the DQO. (Nick B.)

End of Summary

Lemhi Background

- **Used Lemhi as a real example** (see IDFG map – color coded map on wall)
  - East ID, flows NW into main Salmon at Salmon City
  - Historically the most productive stream in Salmon subbasin
  - Valley heavily irrigated for hay; lots of irrigation withdrawals.
  - Hayden Ck is now the only tributary that flows all year , others get sucked dry seasonally
  - ***Problem***: During irrigation season several years ago the lower river dried up. Raised threat of ESA hammer for local ranchers, they came up with a plan to get out from under this. The "plan" is in draft form, cooperatively developed. Draft plan available on Upper Salmon Basin Watershed project website.
  - Funded through PCSRF. Also an planned Federal RME process, provide funding to supplement ongoing work (e.g., more snorkel sites, or more passes for redd counts).
  - ***Proposed actions***: riparian fencing, channel reconnects (18-20), most withdrawals (~ 90%+) already screened, would like to buy water rights and recreate natural hydrograph. Reconnects allow bull trout movement to headwater populations. Staggered implementation of reconnects over 20 years.
  - ***Focal species***: spring chinook (Hayden Ck and its tributaries), steelhead, and bull trout

- **Data:**
  - 30-40 years of work so some data (e.g., T. Bjornn),
  - screen shop surveying some of the major tributaries,
  - redd counts in Bear valley (Major trib to Hayden – USFS land, PIBO sites), Hayden, mainstem Lemhi (Big Springs ck alluvial channel (recharge from leaky old ditches),
  - 8 snorkel sites, RST above confluence with Hayden (length about 10 years) and one just started at Salmon City,
  - PIT tagging 15 years plus, looking at putting one on Hayden Ck as well.
  - BLM (13 years ago – mainstem habitat survey, baseline habitat data).
  - BLM - LANDSAT, LiDAR, FLIR – thermal regime in the mainstem.
  - 2^{nd} round CSMEP Data Inventory of Lemhi basin.
  - Subbasin plans
  - Most information on the dense restoration activities above the Hayden Ck confluence on higher order tributaries out of the main flood plain.
  - Most sp chinook spawning in the mainstem occurs above the Hayden Ck confluence
  - Increase flows into main channel to control temperatures and perhaps reestablish geomorphic processes.

Lemhi Example

- **Client(s):**
  - Planning process dependent on irrigators; there is sort of a Lemhi Watershed Council, but no formal applicant yet.
  - Also SBT, NPT, USFS, USFWS, BLM, IDFG.
- **Other influences:**
  - Agriculture, not much timber, some fishing for steelhead, hopefully for CH soon .
  - Hatchery - ISS control stream.
  - Channelization - most push-up dams on mainstem eliminated, most tributaries still divert all water from tributaries.
  - Subbasin planning limiting factor analyses - Sedimentation in stream from grazing.

- **General discussion:**
  - SK, Attributing causation – hydrograph modeling as an explicit causative factor explicit response to habitat?
  - NB, nested response?
  - TC – stream gauges.
  - Document physical habitat impact of thing you are doing.
  - C Pls. Action –> Habitat –> Fish, (IP Table 2.3 of DQO)
  - KW changes in spatial structure (captured under goals earlier).
  - SK – (don't act on this, but . ..) science question is it's own monitoring program, explored as its own geology problem. This process so far sweeps this under the rug. Implicit. Cpls included as factors. SK geology problem may have a different set of problems. Be aware of this shortcut.
  - TC – change in life history stratefies? (shift in emigration timing)
  - KW – surrogates help deal with the masking effect.
  - NB growth rate – numbers vs. biomass question. (gms sm/sp)
  - KW – RSTs for measuring smolts.
  - TC info for adult returns will remain

- **Uncertainties, errors and costs**:
  - Alpha = 0.1 (at least!)
  - Power = 0.2
  - N=1 (one Lemhi)

- **Design framework discussion**:
  - Hayden Creek / Bear Valley Creek is a possible control for Lemhi mainstem.
  - Hayden spawning aggregate is same as mainstem spawning aggregate according to TRT.
  - For higher scales, Pasimeroi is probably not a good as a comparable basin. Hatchery influence. Won't wait, have already started on projects,
  - Possibly divide into 50 segments, lay out a gradient.
  - Hydrology models – compare flow below with and without reconnects.
  - Some diversion projects in Hayden Creek, some riparian projects (on part of Basin Ck), but really dense, all screened already. Not something that is changing now.
  - Are there academic studies on where fish go to rear?
  - Screen of diversions could capture and record PIT tags, mark-recapture for survival estimates, seen vs.
  - 1) Effects of actions on fish (using BA or BACI), 2) Hydrology questions. The scales of these questions will be different. May be able to use tributaries as independent units for hydrology, and distribution of juvenile chinook. On the other hand for sm/sp its Hayden creek vs. everything else.
  - Moving from the Lemhi scale to higher scales will be difficult because the question changes fundamentally.
  - Explore granularity of responses, their scales, to refine this question.
  - Juvneile densities: For example, 18 streams to be reconnected,staggered through time, use staircase recruit treatments. How many untreated connected? 1 (Hayden) - connected tribs with juvenile fish. Not sure about Basin Creek. 1 strata 18 junction sites, then 18 untreated sites. NB – why wait 20 years? Should be pretty immediate with flow - think Bayesian, start with priors and update as more treatments are added in. Gives a probability vs. a yes-no question. CPlsn. NB what is the implementation plan, does it specify what the implementation timing of reconnects should be. SK – would this idea sell? Maybe more info if say in five years we are going to reevaluate. NB – "learn as projects come on line." CPlsn – sampling very cheap for this question.
  - Hydrologically reconnected – implmentation monitoring (did they do what they said it woud do), and does it affect the habitat? TMDL models for temperature, combined with temperature monitors up and down stream. FLIR for spatial distribution. Monitors ground truth radar.

- SK specify question to take to a statistician, but can't write the whole book on all permutations of designs, no one durable template. Re NOAA paper, cost function cause the most problems. Interactions between way you sample and structure of the population you are sampling – annual changes to spawning locations that weren't anticipated. Interactions with the distribution of projects, what if another system, Stillaguamish, designs from Lemhi may not be appropriate here.
- CPlsn – What if sum ch in lower river – only 1, so only BA, in contrast a bunch of more or less independent Steelhead populations – BACI, bunches of treatments and bunches of controls. This is not a one size fits all.
- KW – can't design a durable extended template, but we have a specific example for this population – follow 7 steps this is as good as it gets.
- SK – argue, as you do any of these processes (e.g., DQO etc) as you get to more specific conclusion you trade off for generality. For Status you can get further out before you lose your general conclusion.
- TC – can mature your designs as well as maturing your mature your questions. At least provide some guidance.
- NB – perhaps a design tree – simplest. No tribs, only mainstem. But if another trib . . . Then another trib . . . You can do this.
- SK – How treatments are allocated.
- NB - more a template on how you design a monitoring program. (IP but feeding into other H's).
- SK – We have a question that's more relevant to reality
- NB – Take three responses and see where we get.

What next – aft 1

- SK What's not covered in the response question Table? 50 A and 50 in B to get enough coverage for parr dist
- Habitat inventory
- Parr taggings
- CPlsn – tradeoff wise – more money on tagging parr or more money on tagging smolts?
- 1) Redd count census, 2) 50 sites (EMAP): 50 A and 50 B (regions A, B, C), 4) pit tagging of parr, 5) habitat inventory on a rationale scale, after 5 –year evaluate precision and where we can economize.
- Turned steps 6 and 7 into adaptive management.
-
- NB to be useful we shouldn't do in Lemhi, people already exploring it. Perhaps SFSR – lots of resources allocated there for effectiveness monitoring. <where>

- SK design interacts with actions – lose generality. Structure of analytical tool has an interaction as well. Where cross line from generality to specificity.

****

- KW finish for Lemhi, proof of concept, then see if group thinks we should move to apply steps 6-7 elsewhere.
- Go back to guys who know Lemhi and ask them how far away are we now from where we want to be design wise (e.g., RST placements). CPlsn – already doing some stuff.

What next – aft 2

- SK – sp ch, Lemhi, Sm/Sp, 20 years, 100%, redds for spawners, fluctuations in pop, flow, temp, land use habitat.
- SK – parr distribution
- TC – what's general about what we want to estimated in the Lemhi – some things we're going to want to know everywhere.

- The matured question:
- Parr:

- How we will do it:

- Habit inv – geomorph etc., how will sample for each . . .parse space by A, B, and C – for 5 years. Large vectors. What do you do with all the data – analytical model for this? CPln – in 5 years, measurement error for smolt number was unacceptable high and put more dollars in the smolt program. Explore with different approaches, is one better than another.
- Sk vector sketch Sm/Sp = {SP}, {Sm} +{Hab} . . .vector of vectors A, B, C locations. Variety of ways to slice for different statistical models (this is a description of the data set} – into some discriminant model. Has to go into the machine to decide whether it is too noisy – have to describe the machine for Steps 6 and 7.