OTHER DOCUMENT 10

Meeting Summary

Trinity River Restoration Program (TRRP) Objectives Workshop

Trinity County Library, Weaverville, CA

May 22, 2013

Participants

U.S. Bureau of Reclamation (USBR): Robin Schrock (TRRP Executive Director), DJ Bandrowski (TRRP Implementation Branch Chief), Andreas Krause (TRRP), Rod Wittler (via teleconference)

U.S. Fish and Wildlife Service (FWS): Ernie Clarke (TRRP Science Coordinator), Joe Polos, Nicole Athearn, Charles Chamberlain

Hoopa Valley Tribe (HVT): George Kautsky, Robert Franklin, James Lee

Trinity County: Judy Pflueger

Yurok Tribe: Tim Hayden, Aaron Martin

California Department of Fish and Wildlife (CDFW): Andrew Jensen, Wade Sinnen, Steve Cannata (via teleconference)

California Department of Water Resources (DWR): Scott Kennedy

U.S. Forest Service: Bill Brock

National Oceanic and Atmospheric Administration (NOAA) – National Marine Fisheries Service (NMFS): Seth Naman, Ann Garrett, Wes Smith

Atkins: Tom St Clair (facilitator), Rebecca Burns (note taker)

Pre-Workshop Preparation

The email announcement for the workshop (Appendix A)invited attendees to two webinars on the Integrated Assessment Program (IAP) objectives and the structured decision making (SDM) process. These webinars were held on May 8 and May 10, 2013, respectively, and the presentations are included as Appendix B. The email announcement also included a pre-workshop assignment for attendees to identify the purpose of each of the IAP objectives in order to identify any redundancies and separate fundamental and means objectives. The pre-workshop assignment is included as Appendix C.

Desired Outcome

A refined, consolidated list of objectives that distinguishes between fundamental and means objectives.

Summaries for Agenda Items

1. **Introductions, Meeting Objectives, Ground Rules and Agenda Review**

Ernie Clarke opened the workshop by welcoming everyone and introducing Nicole Athearn, Tom St. Clair and Rebecca Burns, the workshop facilitators.

Tom St. Clair asked everyone to introduce themselves, then presented the workshop objectives, and ground rules and expectations (Appendix D) and reviewed the workshop agenda (Appendix E).

2. Lessons Learned from other Adaptive Management Applications

The purpose of this agenda item was to present lessons learned from other natural resource management programs on defining and specifying objectives, including explicitly stating stakeholder objectives.

Tom St. Clair presented a brief example from the Comprehensive Everglades Restoration Program (CERP) where the purpose of an established restoration project was modified, resulting in the need to reevaluate the project's objectives.

Rebecca Burns presented lessons learned from four case studies that were included in the Decision Support System (DSS) Literature Review Atkins recently prepared for the TRRP. The presentation is included as Appendix D.

Robert Franklin and Wade Sinnen questioned the purpose and relevance of presenting these examples, given that the TRRP has already defined its objectives. Tom St. Clair responded that these examples were presented so that attendees could recognize the challenges that other programs have faced in specifying and reevaluating objectives. Robert Franklin pointed out that stakeholders were not represented at the workshop to define stakeholder objectives. Robin Schrock responded that the Trinity Adaptive Management Working Group (TAMWG) was invited to the workshop, but they opted to leave this process to the technical staff and are more concerned with implementation (i.e., the way projects are built to meet objectives). Stakeholder concurrence and involvement was added to the "Parking Lot" of topics to be addressed later.

3. Brief Introduction to Structured Decision Making

Nicole Athearn presented an overview of structured decision making and adaptive management, including the characteristics of fundamental objectives, the difference between fundamental and means objectives and the role of monitoring in restoration programs (Appendix F).

Wade Sinnen asked how ambiguous objectives could be grouped and evaluated to determine sensitivity to management alternatives. Nicole Athearn explained that subjective and less tangible objectives can still be measured by asking the proponent to develop a scale (e.g., a teenage boy developing a "coolness" scale to evaluate car options). She added that collaborative processes involving stakeholders, as well as legal mandates and other factors determine which objectives are fundamental depending on the values of the decision maker. George Kautsky asked about the process to assign weights to objectives. Nicole Athearn said the weighting process is absolutely necessary and there are many ways to do this, which all involve discussions with decision makers to obtain concurrence. This topic was added to the "Parking Lot."

4. Review Results of Pre-Workshop Assignment and Determine Fundamental Objectives

Tom St. Clair began by asking attendees for their observations on the pre-workshop assignment. James Lee noted that there are other purposes not reflected in the existing objective lists, some which were alluded to but not captured completely. Robin Schrock pointed out the many redundancies resulting from multiple versions of the same objective depending on the author and their discipline. Judy Pflueger agreed and said many of the objectives could have been consolidated, but were split due to wording preferences. Tim Hayden explained that the IAP was written by many authors and its very structure lent itself to organizing the objectives in this manner.

After receiving the completed pre-workshop assignments from a majority of attendees (completed by staff from HVT, FWS, NOAA-NMFS, CDFW, Yurok Tribe, USBR and DWR), Nicole Athearn compiled all of the responses and developed a spreadsheet to summarize the results (Appendix G). Nicole explained the process by which she summarized the information as follows:

a. Consolidated the objectives provided as the purposes for each objective and also included a tally row above each one to indicate how many people gave that as a response. If it is blank, then only one person did.
b. Summarized objectives by how many other objectives had it listed as a purpose, and sorted those from high to low to identify the most popular objectives (i.e., those that were chosen most often).
c. Picked the top 15 objectives (by considering what was a good natural break, which was those with 20 or more objectives citing them), and highlighted those in yellow to consider as higher-level objectives.

Nicole then reorganized the objectives into a new hierarchy, organized by the primary (i.e., most popular) "purpose" objectives identified in the responses (Appendix H). This hierarchy includes Nicole's notes (in purple) to explain her rationale, but no objectives were deleted or reworded. The results of this assignment, as organized by Nicole, identified two fundamental objectives that can be loosely summarized as (1) Facilitate harvest and (2) Restore an ecologically functioning river system, as well as one major group of means objectives related to physical habitat.

Nicole noted that the following objective, which is summarized as the "Facilitate harvest" fundamental objective, had the highest degree of consistency among the respondents:

> Restore adult anadromous fish numbers to pre-Trinity River Dam levels in order to facilitate dependent tribal, commercial and sport fisheries full participation in the benefits of restoration via enhanced harvest opportunities

Wes Smith noted the wording implies that restoring fish numbers is a means objective to facilitate harvest; however, this may not have been the intention of the original authors since the goal of the program is to restore fish numbers. Tim Hayden said the IAP authors recognized that harvest can be facilitated in many different ways so they worded the objective to be specific about how that should be accomplished. There was discussion among the attendees on whether facilitating harvest is a

fundamental objective of the TRRP. Andreas Krause summarized a statement from Jim Peterson's presentation at a symposium held in February regarding how to separate a fundamental from a means objective. He asked the question: if the Program was successful in restoring all of the qualities of a functioning river system, including increased fish numbers, but did not facilitate harvest, would it be successful? In his mind the answer is no and thus harvest is the fundamental objective. Nicole Athearn reminded attendees that there can be multiple fundamental objectives, some of which can be secondary to the primary goal of the Program. Judy Pflueger stated that harvest is a result of the fundamental objective to restore the fish in the river.

5. Lessons from Klamath Objectives Hierarchy

The agenda was modified to skip this item and allow more time for discussion of the TRRP fundamental and means objectives. Nicole Athearn's presentation on the Klamath objectives hierarchy is included as Appendix I.

6. Revise Objectives: Sessions 1, 2 and 3

Identify Fundamental Objectives

For the remainder of the workshop attendees discussed the fundamental objectives of the Program. George Kautsky asked how the hierarchy created from the pre-workshop assignment differs from the hierarchy in the IAP. Nicole Athearn explained that the exercise identified that some of the six level 1 objectives in the IAP are actually means objective, so there are differences at the highest level of the hierarchy, but the lower levels remained intact.

There was significant discussion among the attendees on whether there are one (restore fish populations) or two (restore fish populations and a healthy river system) fundamental objectives of the Program or whether restoring a healthy river system is a means to restoring fish populations. With a single fundamental objective to restore fish populations, the wildlife/riparian means objectives in the IAP do not fit into the hierarchy; however, they would be encompassed in a healthy river system objective. Robert Franklin explained that the fundamental objective from the Hoopa Valley Tribe perspective is to restore the health of the river which produces fish. Tim Hayden agreed with two fundamental objectives and said there is still ambiguity in defining "harvest."

Joe Polos pointed to Figure 2.1 of the IAP which shows how the objectives link to one another and suggested that the highest level box in the figure is the fundamental objective or overarching goal of the Program:

> Restore and sustain natural production of adult anadromous fish populations downstream of Lewiston Dam to pre-dam levels, to facilitate dependent tribal, commercial and sport fisheries full participation in the benefits of restoration via enhanced harvest opportunities. The TRRP strategy for accomplishing this goal restores and perpetually maintains fish and wildlife

resources (including T&E species) by restoring the processes that produce a healthy alluvial river system.

DJ Bandrowski agreed that this is the fundamental objective and the six level 1 objectives in the IAP are means objectives. Nicole Athearn noted that this includes multiple fundamental objectives and when a decision needs to be made based on how well alternatives meet the fundamental objective, it is unclear how important one objective is versus another. Wes Smith noted that fundamental objectives can be separated from the overarching goal and metrics can be developed as needed, but otherwise the goal can be left as is. Ernie Clarke agreed with this idea and emphasized the importance of portraying a consistent picture of the Program's objectives.

George Kautsky and Robert Franklin questioned how these objectives will be used as part of a potential DSS. George noted that the complexity of modeling and analysis increases exponentially with the number of objectives. He also raised the issue of the consequences of the DSS on the monitoring program. These topics were added to the "Parking Lot" and will be discussed within the context of the DSS.

Andreas Krause advocated for two objectives: one focused on fish production, one related to inherent value of healthy ecosystem, which includes other objectives, such as wildlife, that are not as important to the Program as fish. There was discussion of a single overarching goal with two fundamental objectives, as stated below:

- **Overarching Goal:** Restore and sustain natural production of adult anadromous fish populations downstream of Lewiston Dam to pre-dam levels, to facilitate dependent tribal, commercial and sport fisheries full participation in the benefits of restoration via enhanced harvest opportunities. The TRRP strategy for accomplishing this goal restores and perpetually maintains fish and wildlife resources (including T&E species) by restoring the processes that produce a healthy alluvial river system.
- **Fundamental Objectives:**
    - Restore and sustain natural production of anadromous fish populations downstream of Lewiston dam to pre-dam levels.
    - Restore the processes and attributes of a healthy alluvial river system.

Two concerns were raised with the proposed fundamental objectives. Steve Cannata raised concern about including the phrase "pre-dam levels," given that historically most of the spring Chinook and coho salmon production occurred upstream of the dam. His understanding of the TRRP goal is to restore habitat for anadromous fish downstream of the dam, but it may not be to pre-dam levels. Several attendees noted that the goal of the mitigation hatcheries is to produce salmonids upstream of the dam. Robin Schrock noted that the targets for spring Chinook and coho salmon numbers are established pre-dam levels for the entire Trinity River that included the area above the dam.

Ann Garrett raised concern about removing harvest from the fundamental objectives, stating that since it is a goal of the Program it should be explicitly stated. Robin Schrock responded that the fundamental objectives are things that the Program can influence and since the TRRP does not manage fisheries (e.g.,

set quotas for harvest), harvest should not be included as a fundamental objective. Nicole Athearn added that, in a DSS, the fundamental objectives include all stakeholder objectives that are considered during decision making and harvest could be included in that category. Attendees agreed to keep the two fundamental objectives as is and include a placeholder for stakeholder objectives (to be determined at a later date) that includes facilitating harvest/fishing.

Eliminate Redundancies

Nicole Athearn quickly summarized her observations on redundancies among the IAP objectives. Different work groups developed the level 2 and 3 objectives in the IAP, resulting in objectives that are related but slightly different from one another. For example, the Fish Work Group established objectives for minimizing impacts to various species, whereas the Physical WG developed related objectives for sinuosity, substrate patch diversity, etc. There are opportunities to consolidate these objectives by specifying fish needs, which then become targets for the Physical Work Group. Nicole also noted that the Conceptual Models Report identifies objectives that were not included in the IAP.

7. **Post-Workshop Activities**

This portion of the agenda was reserved for developing plans to identify linkages between objectives and management actions, and develop quantitative metrics for each objective, the third and fourth objectives of the workshop. The work groups will be responsible for completing these activities, with coordination by the Interdisciplinary Team (IDT). Ernie Clarke said he will work with the Work Group Coordinators to develop a realistic schedule for completion.

8. **Wrap-Up, Review Outcomes and Next Steps**

The four action items for the work groups that emerged from the discussion were:

1. Reduce redundancies among means objectives;
2. Review the Conceptual Models Report to identify any missing objectives;
3. Identify linkages between objectives and management actions; and
4. Develop quantitative metrics for each objective.

Robin Schrock noted that many objectives are simply to increase a particular species' population or an attribute of the river. These objectives should be revised to specify the meaning of "increase," including whether it applies to the project or system scale (i.e., future ideal conditions).

Adjourn

The meeting was adjourned at 4:30pm.

Appendices

Appendix A: Workshop Email Announcement

Appendix B: Pre-Workshop Webinars on the IAP Objectives and SDM Process

Appendix C: Pre-Workshop Assignment

Appendix D: Workshop Introduction Presentation

Appendix E: Workshop Agenda

Appendix F: Workshop SDM Presentation

Appendix G: Pre-Workshop Assignment Summary Spreadsheet

Appendix H: Revised Objective Hierarchy based on Pre-Workshop Assignment

Appendix I: Klamath Objectives Hierarchy Presentation

Appendix A: Workshop Email Announcement

Burns, Rebecca E

From:	Clarke, Ernest [ernest_clarke@fws.gov]
Sent:	Wednesday, May 01, 2013 5:28 PM
To:	idt@trrp.net; Ann Garrett - NOAA Federal; Brock, William -FS; cmilliro@dfg.ca.gov; Hadley,Elizabeth; gilsaliba@aol.com; Dave Hillemeier; jpflueger@trinitycounty.org; Mike Orcutt; BRIANPERSON; Joe Polos; Robin Schrock; sheywood@fs.fed.us; Ed Duggan; Kelli Gant; Tom Stokely; Emelia Berol; Dave Steinhauser; Joe McCarthy; Liam Gogan; Paul Hauser; Rich Lorenz; Sandy Denn; Travis Michel; CarrieNichols; Ernie Clarke
Cc:	St Clair, G Tom; Burns, Rebecca E; Nicole Athearn
Subject:	May 22 TRRP Workshop
Attachments:	Objective Hierarchy Assignment.xlsx

Hello all,

This email provides additional information on the upcoming **TRRP Objectives for Decision Support System (DSS) Development workshop,** as well as pre-workshop materials and an assignment. **RSVP to Ernie Clarke by May 7, 2013.** Space is limited, thus we will determine the right mix of attendees to ensure broad participation across the program.

Logistics: The workshop will be held on **May 22, 2013 from 9:30am to 4:30pm** at the Trinity County Library located at 351 Main Street in Weaverville. A detailed agenda will be distributed by May 20. From 12 to 12:30pm we will break for lunch, which will be ordered from Trinideli (http://www.trinideli.com/Lunch_menu.html). We will place the lunch order in the morning, so **please come to the workshop with your order and cash (preferably exact change) to pay for your lunch.**

Expectations:

- Because this is limited to a one-day workshop, please come prepared, having read the pre-workshop materials and completed the assignment (see below).

- This workshop is intended to assist in the development of a DSS for the TRRP and is not an academic exercise. This step is necessary because:

    - The adaptive management process requires restoration objectives periodically be reviewed to ensure new learning of Trinity River ecosystem functionality is captured in both fundamental and means objectives.

    - Reducing the overall number of objectives (by eliminating redundancy) to clearly distinguish between fundamental and means objectives is necessary to design a DSS that captures the relationships between them (i.e., means objectives as potential ways (hypotheses) to achieve fundamental objectives).

- The desired outcome of this workshop is: A refined, consolidated list of objectives that distinguishes between fundamental and means objectives.

- Given the workshop purpose and limited time available, we will not be revisiting past exercises or decisions in great detail.

- Workshop attendees will have expertise in both policy and technical arenas and we will ensure equal representation.

Pre-Workshop Webinars:

Two webinars will be held in advance of the workshop to provide background on the structured decision-making (SDM) process, as well as the Integrated Assessment Program (IAP) objectives for the TRRP:

- IAP Objectives Webinar (hosted by Ernie Clarke): May 8 at 3pm PT
- SDM Webinar (hosted by Nicole Athearn): May 10 at 3pm PT

There will be time for questions during the live webinars, and the recordings will be made available for those who cannot participate at those times. Also, the Structured Decision Making for Recurrent Decisions presentation by Mike Runge (http://nctc.fws.gov/courses/SDM/courses/adaptive_management.html) is a good resource.

Pre-Workshop Materials:

Necessary:

This workshop was recommended by the TRRP's Scientific Advisory Board (SAB) and the following sections of the DSS Framework provide essential background on the role of objectives in a DSS for the TRRP.

1) DRAFT Decision Support System Framework (Appendix H of Phase I Report) (**This is a draft and is not for distribution**)

   a. Section 2.2: Stakeholder Objectives

   b. Section 2.3: Example of a DSS

   c. Section 3: Structure of the Trinity River DSS

Optional:

Everyone should be familiar with these documents, but refreshing your memory of the specific sections below would be helpful for establishing an overall context.

2) Integrated Assessment Plan (IAP) http://odp.trrp.net/Data/Documents/Details.aspx?document=400

   a. Section 1.3: Program management actions

   b. Section 1.4: Adaptive Environmental Assessment and Management (AEAM)

   c. Chapter 2: Overview of assessment needs

   d. Chapter 3: Why is each assessment required and what does it involve?

3) Conceptual Models Report http://odp.trrp.net/Data/Documents/Details.aspx?document=1203

4) Trinity River Flow Evaluation Report http://odp.trrp.net/Data/Documents/Details.aspx?document=226

   a. Chapter 7: Restoration Strategy

b. Chapter 8: Recommendations

In addition, familiarizing yourself with the applicability of adaptive management to natural resource conservation, as described in the US Department of the Interior Adaptive Management Applications Guide (http://www.usgs.gov/sdc/doc/DOI-Adaptive-Management-Applications-Guide-27.pdf), would be beneficial.

Pre-Workshop Assignment

Lastly, we have developed a pre-workshop assignment, the results of which will be used to guide workshop discussions. The goal of the assignment is for attendees to identify the purpose of each of the TRRP objectives. This will assist in reducing redundancy among objectives and distinguishing between fundamental and means objectives. The assignment and instructions are included in the attached spreadsheet. We do not expect you to spend more than 2 hours at the most on this assignment. **Please send your completed assignment to Ernie Clarke by May 15.**

Post-Workshop Assignment

This workshop is the first phase of a two-phased approach. The third and fourth objectives of the workshop will be accomplished in the second phase; however, there will be post-workshop assignments to facilitate Phase 2. A plan for the second phase will be developed during the workshop.

Regards,

Ernie

Ernie Clarke
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Trinity River Restoration Program
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Appendix B: Pre-Workshop Webinars on the IAP Objectives and SDM Process

Pre-Workshop Webinar Participants

Integrated Assessment Plan Objectives Webinar (hosted by Ernie Clarke, FWS):
Nicole Athearn (FWS)
Joe Polos (FWS)
Steve Cannata (CDFW)
Scott Kennedy (DWR)
Teresa Connor (DWR)
Ann Garrett (NOAA – NMFS)
Justin Day (Redding Electric)

Structured Decision Making Webinar (hosted by Nicole Athearn, FWS):
Ernie Clarke (FWS)
Charlie Chamberlain (FWS)
Steve Cannata (CDFW)
Teresa Connor (DWR)
Robin Schrock (USBR)
Justin Day (Redding Electric)

IAP Objectives Webinar

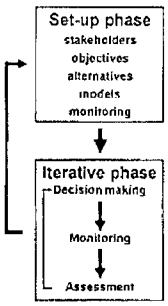
Ernie Clarke

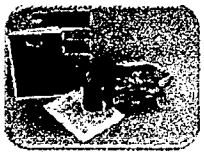
May 8, 2013

Goals of May 22 Workshop

- Primary Goals of Workshop
  - Review the three levels of objectives listed in Table 2.1 of the IAP
  - Minimize redundancy and the potential total number of objectives
  - Separate fundamental and means objectives
- Secondary Goals (to be accomplished following workshop)
  - Identify linkages between objectives and management actions to support development of the TRRP DSS
  - Develop quantitative metrics for each objective

Adaptive Management Framework





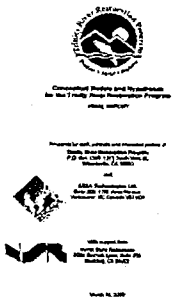
Goal / Strategy / Foundational Documents

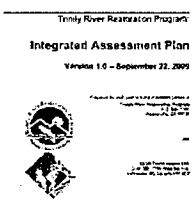
Goal: Restore and sustain natural production of anadromous fish populations to facilitate enhanced harvest opportunities by dependent tribal, commercial, and sport fisheries'.

Strategy: Restore riverine habitats by restoring the processes that produce a healthy alluvial river ecosystem.

The above restoration strategy will be achieved by implementing management actions in a science-based adaptive management program (source TRFE and ROD).

Foundational Documents continued





IAP Structure

Executive summary

Recommendations of the IAP steering committee concerning the next steps for the IAP

1. Overview
2. → Overview of assessment needs
3. Why is each assessment required and what does it involve?
4. Sampling framework for the program area

IAP Structure continued

- 16 Appendices
- Appendix E. Nested objectives for the Trinity River Integrated Assessment Plan
- Appendix F. Looking outward matrix
- Appendix H. Table of assessments

Table 2.1 - IAP Objectives

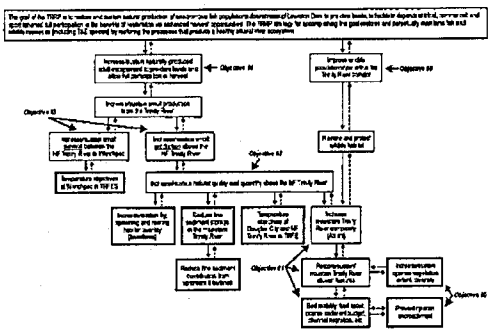
- Provides 3 levels of objectives (Appendix E lists 5 levels)
- Includes relative within Level 1 Objective (Appendix H includes cross domain prioritization)
- Documents linkages between objectives
- Listing objectives leads to delineation of performance measures and quantitative thresholds

Level 1 Objectives

1. Create and maintain spatially complex channel morphology
2. Increase/improve habitats for freshwater life stages of anadromous fish to the extent necessary to meet or exceed production goals
3. Restore and maintain natural production of anadromous fish populations
4. Restore and sustain natural production of anadromous fish populations downstream of Lewiston Dam to pre-dam levels, to facilitate dependent tribal, commercial, and sport fisheries' full participation in the benefits of restoration via enhanced harvest opportunities
5. Establish and maintain riparian vegetation that supports fish and wildlife
6. Rehabilitate and protect wildlife habitats and maintain or enhance wildlife populations following implementation

IAP Meeting Beyond Fall 1

Conceptual Model for the TRRP with Physical and Biological Objectives



Example of Objective Levels

- Objectives expressed in levels of complexity as illustrated below:
  - *Level 1*: Create and maintain spatially complex channel morphology
  - *Level 2*: Reduce fine sediment storage in the mainstem Trinity River
  - *Level 3:* Transport fine sediment through mainstem at a rate greater than tributary input

Objective 1: Physical Features and Processes

Level 1 Objectives	Level 2 Objectives	Level 3 Objectives
1. Create and maintain spatially complex channel morphology	1.1. Increase physical habitat diversity and availability (to achieve Fish Habitat objective 2.1, Riparian objectives 5.1 & 5.2, and Wildlife objectives 6.4.1 & 6.5.1)	1.1.1 Increase the size, frequency and topographic relief of bar/pool sequences
		1.1.2 Increase channel/floodplain sinuosity
		1.1.3 Increase geomorphic and and substrate patch diversity
	1.2 Increase coarse sediment transport and channel dynamics	1.2.1 Increase and maintain target coarse sediment transport rates
		1.2.2 Frequently exceed channel migration, bed mobilization, and bed scour thresholds
		1.2.3. Encourage bed level fluctuations on annual to multi-year time scales
		1.2.4 Route coarse sediment through all reaches
	1.3 Increase and maintain coarse sediment storage	1.3.1 Increase bars, sidechannels, alcoves, and other complex alluvial features
	1.4 Reduce fine sediment storage in the mainstem Trinity River	1.4.1 Transport fine sediment through mainstem at a rate greater than tributary input
		1.4.2 Reduce fine sediment supply from tributary watersheds
		1.4.3 Encourage fine sediment deposition on floodplains

Objective 2: Fish Habitat

Level 1 Objectives	Level 2 Objectives	Level 3 Objectives
2. Increase/improve habitats for freshwater life stages of anadromous fish to the extent necessary to meet or exceed production goals	2.1 Increase and maintain salmonid habitat availability for all freshwater (in-river and tributary) life stages *(linkage to Riparian Objectives 5.1.2 & 5.2)*	2.1.1 Increase/maintain salmonid fry and juvenile rearing habitat in the upper 40 miles of the mainstem Trinity River by a minimum of 400 % following rehabilitation of fluvial attributes
		2.1.2 Increase/maintain spawning habitat quantity and quality to 2,500,000 square feet in the upper 40 miles of the mainstem Trinity River
		2.1.3 Create channel form that reduces loss of fry to stranding in the upper 40 miles of the mainstem Trinity River following rehabilitation during high flows
		2.1.4 Maintain or increase adult holding habitat from baseline conditions in the mainstem Trinity River
		2.1.5 Minimize physical impacts to lamprey habitat
		2.1.6 Minimize physical impacts to other native fish habitats
		2.1.7 Maintain or increase tributary habitat
	2.2 Improve riverine thermal conditions for growth and survival of natural anadromous salmonids	2.2.1 Provide optimal temperatures to improve spawning success of spring and fall-run Chinook salmon
		2.2.2 Improve thermal regimes for rearing growth and survival of juvenile steelhead, coho salmon and Chinook salmon
		2.2.3 Improve thermal regimes for outmigrant salmonid growth and survival (dependent on water year)
		2.2.4 Minimize temperature impacts to other native fish habitats
	2.3 Enhance or maintain food availability for fry and juvenile salmonids	2.3.1 Increase and maintain macroinvertebrate populations *(achieve Fish Production objective 3.1.1)*

Objective 3: Fish Production

Level 1 Objectives	Level 2 Objectives	Level 3 Objectives
3. Restore and maintain natural production of anadromous fish populations	3.1 Increase spawning, incubation and emergence success of anadromous spawners	3.1.1 Optimize adult utilization of suitable spawning habitat areas in the mainstem within 3-4 brood cycles following rehabilitation of fluvial river processes
		3.1.2 Optimize adult utilization of suitable spawning habitat areas in tributaries within 3-4 brood cycles following rehabilitation of fluvial river processes
		3.1.3 Reduce temperature related pre-spawning mortality and protect in-river egg viability of anadromous spawners in the mainstem Trinity River
	3.2 Increase freshwater production of anadromous fish	3.2.1 Increase fry abundance, growth, physical condition, and health from baseline conditions in the mainstem Trinity River within 3-4 brood cycles following rehabilitation of fluvial river processes
		3.2.2 Increase outmigrant juvenile life stage abundance, growth, physical condition and health from baseline conditions in the mainstem Trinity River within 3-4 brood cycles following rehabilitation of fluvial river processes
		3.2.3 Improve juvenile fish production as a function of water temperature and habitat flow relationships from baseline conditions in the mainstem Trinity River within 3-4 brood cycles following rehabilitation of fluvial river processes
		3.2.4 Reduce clinical disease incidence in Trinity River origin outmigrants in the Klamath River to less than 20% within 5 years
		3.2.5. Reduce fry stranding in the upper 40 miles of the mainstem Trinity River by 50% following rehabilitation of fluvial river processes
		3.2.6 Reduce non-native fish predation on naturally produced fish by 50% in the mainstem Trinity River within 3-4 brood cycles following rehabilitation of fluvial river processes *(linkage to Wildlife objective 6.3)*
	3.3 Minimize impacts of predation, competition, and genetic interactions between and among hatchery and natural anadromous fish	3.3.1 Limit impacts of hatchery fish predation on naturally produced juvenile salmonids to less than 20% over the 40 miles
		3.3.2 Increase proportion of Natural Influence (pNI) to 0.7 or greater

Objective 4: Harvest and Escapement

Level 1 Objectives	Level 2 Objectives	Level 3 Objectives
4. Restore and sustain natural production of anadromous fish populations downstream of Lewiston Dam to pre-dam levels, to facilitate dependent tribal, commercial, and sport fisheries' full participation in the benefits of restoration via enhanced harvest opportunities	4.1 Increase naturally produced fall-run Chinook salmon adult production to the extent necessary to meet or exceed escapement objectives and facilitate expanded harvest opportunity	4.1.1 Increase escapement of naturally produced fall-run Chinook salmon to 62,000 adults
		4.1.2 Increase harvest of naturally produced fall-run Chinook salmon adults
	4.2 Increase naturally produced spring-run Chinook salmon adult production to the extent necessary to meet or exceed escapement objectives and facilitate expanded harvest opportunity	4.2.1 Increase escapement of naturally produced spring-run Chinook salmon to 6,000 adults
		4.2.2 Increase harvest of naturally produced spring-run Chinook salmon adults
	4.3 Increase naturally produced coho salmon adult production to the extent necessary to meet or exceed escapement objectives and facilitate expanded harvest opportunity	4.3.1 Increase escapement of naturally produced coho salmon to 1,400 adults
		4.3.2 Increase harvest of naturally produced coho adult salmon adults
	4.4 Increase naturally produced steelhead adult production to the extent necessary to meet or exceed escapement objectives and facilitate expanded harvest opportunity	4.4.1 Increase escapement of naturally produced steelhead to 40,000 adults
		4.4.2 Increase harvest of naturally produced steelhead adults
	4.5 Increase naturally produced Pacific lamprey adult production to the extent necessary to meet or exceed escapement objectives and facilitate expanded harvest opportunity	4.5.1 Increase escapement of Pacific lamprey adults
		4.5.2 Increase harvest of Pacific lamprey adults
	4.6 Increase naturally produced green sturgeon adult production to the extent necessary to meet or exceed escapement objectives and facilitate expanded harvest opportunity	4.6.1 Increase escapement of green sturgeon adults
		4.6.2 Increase harvest of green sturgeon adults

Objective 5: Riparian

Level 1 Objectives	Level 2 Objectives	Level 3 Objectives
5. Establish and maintain riparian vegetation that supports fish and wildlife	5.1 Promote diverse native riparian vegetation on different geomorphic surfaces that contribute to complex channel morphology and high quality aquatic and terrestrial habitat *(achieve Fish Habitat objective 2, Fish Production objective 3.1, and Wildlife objective 6.1)*	5.1.1 Increase species, structural, and age diversity of riparian vegetation to improve and maintain wildlife habitat
		5.1.2 Encourage establishment of riparian species on surfaces within the future channel migration corridor that will recruit LWD
		5.1.3 Encourage establishment of vegetation that provides habitat for anadromous fish, aquatic organisms and aquatic / riparian wildlife
	5.2 Prevent riparian vegetation from exceeding thresholds leading to encroachment that simplifies channel morphology and degrades aquatic habitat quality *(achieve Fish Habitat objective 2.1, Wildlife Objectives 6.2 & 6.4)*	5.2.1 Manage flows, coarse sediment augmentation, and channel rehabilitation that cause sufficient riparian plant mortality along low water margins to prevent channel simplification leading to degraded fish habitat
	5.3 Recover riparian vegetation area equal or greater than disturbed by physical rehabilitation (achieve Wildlife Objective 6.1)	- no level 3 objective required, as level 2 objective is sufficiently specific

Objective 6: Wildlife Habitats and Populations

Level 1 Objectives	Level 2 Objectives	Level 3 Objectives
6. Rehabilitate and protect wildlife habitats and maintain or enhance wildlife populations following implementation	6.1 Maintain Trinity populations and species diversity of birds using the riparian zone in the Program area	6.1.1 Enhance quality and maintain quantity of riparian bird nesting and foraging habitats *(linkage to Riparian objective 5.1)*
	6.2 Maintain Trinity River riverine bird populations and species diversity in the Program area *(linkage to Riparian Objectives 5.1.2 & 5.2)*	6.2.1 Enhance quality and maintain quantity of riverine bird nesting and foraging habitats *(linkage to Physical objective 1.1, Fish Habitat objective 2.3.1, Fish Production objectives 2.2.1 & 3.2.2 and Riparian objectives 5.1 & 5.2)*
	6.3 Minimize impacts of riverine bird predation on fry and smolts	6.3.1 Adapt timing of hatchery release to alter distribution of avian predators and minimize predation on natural fry and smolts *(achieve Fish Production objective 3.3.3)*
	6.4 Increase population size, survival, distribution, and recruitment success of Foothill Yellow-legged Frogs (FYLF)	6.4.1 Increase population size, survival, distribution, and recruitment success of Foothill Yellow-legged Frogs
		6.4.2 Increase quality and quantity of breeding and rearing habitat for Foothill Yellow-legged Frogs *(linkage to Riparian objectives 5.1 & 5.2)*
	6.5 Increase population size, survival, distribution, and recruitment success of Western Pond Turtle (WPT)	6.5.1 Increase population size, survival, distribution, and recruitment success of Western Pond Turtles
		6.5.2 Increase structural and thermal diversity of aquatic habitats used by various age classes of Western Pond Turtles
		6.5.3 Increase recruitment of younger age classes of Western Pond Turtles
	6.6 Minimize adverse impacts to additional native riparian or aquatic associated wildlife from Program activities. Focus on wildlife species associated with a healthy river ecosystem, not necessarily all species	6.6.1 Discourage invasive species

TRRP Adaptive Management - Challenges

Initial confusion and disagreement on the goals of the program:

Implement channel rehabilitation projects, coarse sediment augmentation, and release flows

Restore the fishery resources of the Trinity River impacted by the construction and operation of the TRD.

TRRP Adaptive Management - Challenges

Confusion and disagreement on the role of channel rehabilitation:

Construct features that will allow the fluvial processes to create and maintain habitat

Build habitat for immediate benefit

A combination of the above

Structured Decision Making and Adaptive Management

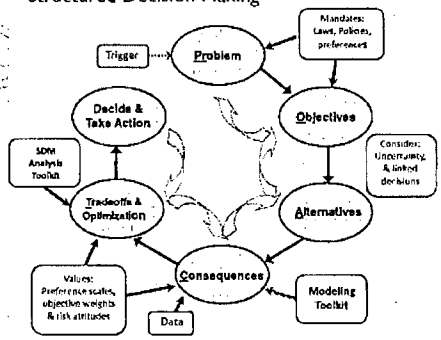
Reducing Uncertainty and Clarifying Linkages

Structured Decision Making

- Carefully organized problem analysis used to reach decisions that are focused clearly on achieving fundamental objectives
- Explicitly integrates science and policy
- Decisions are transparent with respect to legal mandates and public preferences or values
- Uncertainty is dealt with explicitly

Structured Decision Making

"PrOACT"



Problem Definition

- The way you state your problem frames your decision.
- Every decision has a trigger – it is important to consider the trigger in defining your problem.

Objectives …

- Form the basis for evaluating the alternatives available to you
- Keep you on the right track
- A full set of objectives can help us identify more and better alternatives than the ones that seem obvious
- Help you determine what information to seek
- Help you explain your choice to others
- Determine a decision's importance and, consequently, how much time and effort it deserves

Cautions

- Must identify ALL objectives to avoid making an unbalanced decision.
  - If a prospective decisions sits uncomfortably in your mind, you may have overlooked an important objective
- Pitfalls include taking too narrow a focus
  - Focus too much on tangibles without enough attention to intangibles
  - In science, this can be looking too hard for a science-based decision without adequately considering social and cultural issues
- Need to look beyond "obvious" objectives – so this will be an iterative process
- Don't eliminate an objective because of the perception that it is not measurable

But, well thought out fundamental objectives for similar problems should remain relatively stable over time (which is why prior work that involved objective-setting will be helpful).

A Good Set of Fundamental Objectives is…

- Complete. No essential objectives are missing.
- Concise. Nothing unnecessary or ambiguous. Similar objectives grouped together; no double accounting.
- Sensitive. The objectives are influenced by the alternatives under consideration.
- Understandable. Use commonly understood terms. May need to be defined by sub-objectives and performance measures.
- Independent. "Preferentially independent" -- contribute independently to the overall performance of an alternative, you don't need to know what is happening in one objective to evaluate performance in another

Steps in Developing Objectives

1. Brainstorm what matters
2. Separate means from ends
3. Separate "process" and "strategic" objectives from "fundamental" objectives
4. Build a hierarchy of objectives
5. Test to make sure they are useful

Fundamental vs. Means Objectives

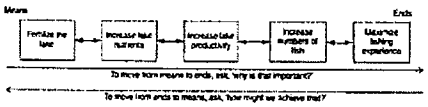


Figure 4.1 A simple means-ends diagram.

- Means to an end vs. ends in themselves (Fundamental objectives)
- Keep asking "Why?" until you can't go any farther
- Means objectives represent way stations in the progress towards a fundamental objective, the point where you can say "I want this for its own sake"
- Fundamental objectives constitute the broadest objectives directly influenced by your decision alternatives

A Typical Objective Hierarchy

Maximize safety
Maximize operator safety
Maximize public safety

Maximize net revenue
Maximize revenue from ore sales
Minimize capital costs
Minimize operating costs

Minimize impacts on First Nations traditional use activities
Minimize impacts to ceremonial sites
Minimize access impediments to traditional food gathering areas

Minimize adverse environmental impacts
Minimize soil contamination from tailings
Minimize material waste
Minimize air emissions
Minimize impacts on groundwater

Minimize disturbances to recreational activities
Minimize disturbance to viewscapes
Minimize trail access blockages
Minimize noise from construction /operations

Fundamental Objective

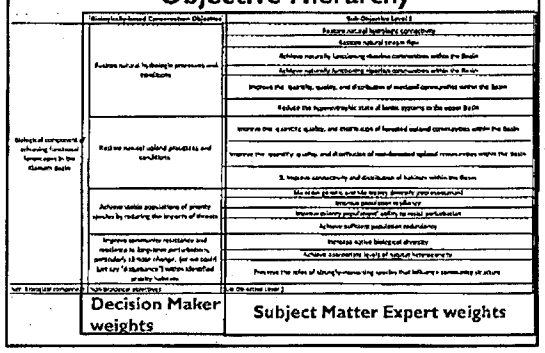
For the U.S. Fish and Wildlife Service

To characterize and maintain functional landscapes capable of supporting self-sustaining fish, wildlife, and plant populations.

Functional landscapes are defined as lands and waters with the properties and elements required to support desirable populations of fish and wildlife, while also providing human society with desired goods and services, including food, fiber, water, energy, and living space.

TRRP: "to restore and maintain the Trinity River's anadromous fishery resources"

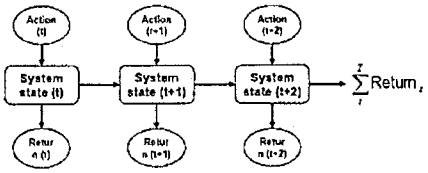
Objective Hierarchy



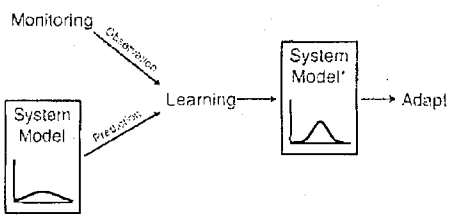
Adaptive Management as a Special Case of SDM

- Some decisions are repeated over time, at regular (or irregular) intervals
- How it is different
  - Added complexity
    - Current decisions influence future state(s) and, therefore, future actions
  - Opportunity to learn
    - Comparison of model-based predictions with monitoring data permit learning

Added Complexity



Opportunity to Learn



Elements of an Informed Decision Process (SDM for Recurrent Decisions)

1. Objective(s): what do you want to achieve
2. Restoration alternatives: stuff you can do
3. Model(s) of system response to restoration actions (for prediction)
4. Measures of model credibility
5. Monitoring program to estimate system state and other relevant variables
6. Solution algorithm (e.g., optimization)

- 1-2: based on societal values, law, politics, stakeholders
- 3-6: scientists and managers

Objectives in ARM

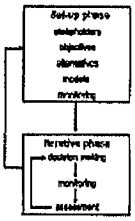
- Objectives drive the development of other aspects of the ARM framework (DSS)
- May be significant input from stakeholders
  - Balance regulatory responsibilities of agencies with stakeholder input

Actions

- Need to consider how the set of alternative actions may change over time for recurrent decisions
- Potential scenarios
  - Fixed set of alternatives
  - Time-dependent set of alternatives (linked decisions)
  - Dynamic set of alternatives
    - Decision today affects options tomorrow in a known way
  - Adaptive set of alternatives

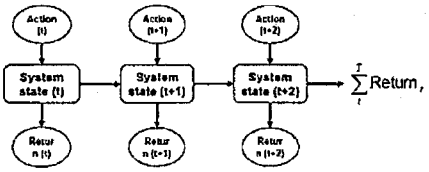
Evolution of Objectives and Actions

- "Double loop learning"
- Revisit objectives due to new information, experience, or change in values
- Alternative management actions may also evolve



Models for Recurrent Decisions

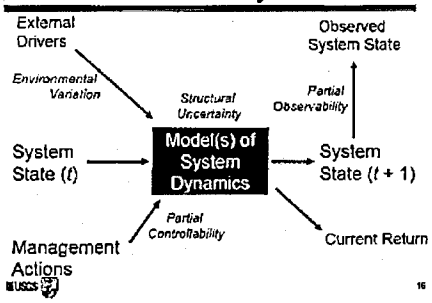
- What is the expected current return (value) of an action?
- How will resource conditions change as a result of an action?



Types of Uncertainty

- Environmental variation
- Partial controllability
- Partial observability
- Structural uncertainty
  - Competing ideas about effects of management actions
  - Focus of adaptive management
  - Focus on effects of alternative actions -- uncertainty that matters to your ability to achieve your objectives
  - May be expressed as competing (alternative) system models
  - What uncertainty makes the decision difficult?

Forms of uncertainty



Why Monitor?

- Science
  - Understand ecological systems
  - Learn
- Management, Conservation, Restoration
  - Apply decision-theoretic approaches
  - Make smart decisions

Purpose of Monitoring

- To assess the state of the system for the purpose of making state-dependent decisions
- To determine if the objectives are being met
  - Estimate system state for comparison with model-based predictions to learn about system dynamics
- To resolve uncertainty
  - Estimate parameters needed for model development
- The development of the monitoring system should be tailored to these needs & driven by the decision context

Monitoring and Restoration

- It is not efficient to simply collect information about physical conditions or a population of conservation concern
  - There is a very large number of quantities that we could potentially estimate
- Instead, we need to ask:
  - What information is most useful for making conservation and restoration decisions?
  - What explicit, measurable parameters can be used to assess restoration effectiveness?
    - Address multiple scales

All Information is Not Equally Useful for Science or Decisions

"Biology, with its vast informational detail and complexity, is a 'high-information' field, where years and decades can easily be wasted on the usual type of 'low-information' observations and experiments if one does not think carefully in advance about what the most important and conclusive experiments would be." (Platt 1964)

Value of Information

- Formal concept from decision theory
- How much management is expected to improve if uncertainty is reduced
- VOI is high when:
  - Different actions would be chosen under different hypotheses
  - The predicted outcomes are very different under different hypotheses
- Types: expected value of perfect information, partial information

EVPI and Model Discrimination

Quantifies the importance of model discrimination

- Basic idea: how much better is it to know which model is "best" than to base decisions on average (across models) model performance

Compares:

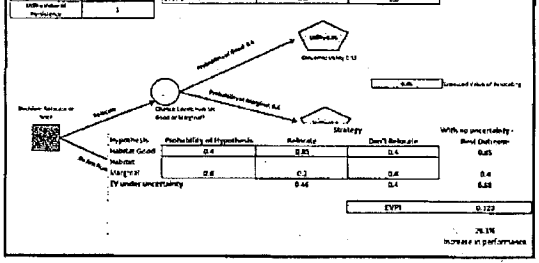
- weighted average of model-specific maximum values, across models
- maximum of an average of values (based on average model performance; value under best nonadaptive decision)

EVPI Example

Relocate to West Creek	Probability of West Creek Habitat Type	Probability Persistence Habitat Type	Probability Extinction Habitat Type
Marginal	0.4	0.2	0.8
Good	0.6	0.95	0.15

Do Not Relocate	Probability of Persistence	Probability of Extinction
East Creek	0.8	0.4

Utility value of not extinct	0
Utility value of Relocated Persistence	1



Hypothesis: Habitat	Probability of Hypothesis	Relocate	Don't Relocate
Habitat Good	0.6	0.95	0.4
Habitat Marginal	0.4	0.2	0.4
EV under uncertainty		0.66	0.4

With no uncertainty - Best Decision: 0.65

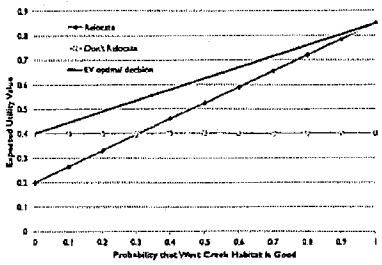
0.4

0.58

EVPI	0.123

78.3% Increase in performance

Role of Information in Decisions



Conceptual model approach

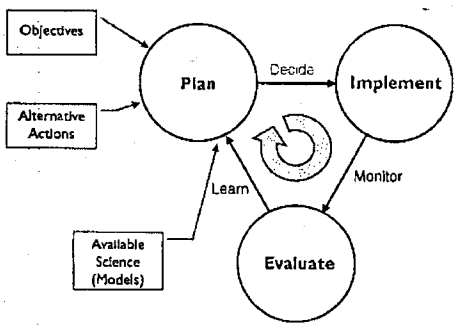
- A graphical or verbal representation of the relationships between:
  - human activities, watershed processes, potential impacts or sources of stress and the effects on ecological function/endpoints
  - Physical and biological processes (e.g., TRRP components)
- Makes explicit statements about hypothesized functional relationships underlying management decisions
- Process descriptions are based on various conceptualizations of the components of process of interest – here, fish recovery
- Use to explore need for quantitative models and additional mechanistic relationships

Objectives and TRRP

Comments from Peter Wilcox

"... the exercise of defining objectives and hypotheses has been done, particularly in the IAP. The IAP has some issues – it is overly detailed and repetitive, it places the overarching 'restore fish' objective at the same level as some means objectives – but the hard work has been done."

- What is needed is NOT to start over but to revisit and perhaps reorganize the objectives to form a clear hierarchy



Climate Change and Adaptive Management

- Climate change as a special case of system change
- Focus on external system change that is outside of the control of management
  - That is, we're not focusing on how to adaptively manage the system change itself, but how to manage in the face of it
  - Re-evaluate objectives and alternatives considering the potential system change
  - Incorporate system change into models
- Both spatial and temporal aspects to the system change
  - Do our management scales need to change?

Summary

- Conceptual models can be used to make explicit our understanding of system and program component linkages, and associated uncertainties
- System uncertainties can be expressed as alternative models, which can be evaluated with monitoring data
- Models can help identify high priority data needs for decision-making
- An SDM-based DSS will increase decision-making transparency and enhance learning and communications

Appendix C: Pre-Workshop Assignment

Instructions for pre-workshop assignment:

Background:
For this assignment, the IAP objectives have been randomized and grouped into two groups (A and B).
We would like you to think creatively about the *purpose* of each objective instead of reverting back to the IAP structure, so please deliberately disassociate these objectives from those listed hierarchically in the IAP.
Identifying the purpose of each objective will help distinguish between fundamental and means objectives.
We do not expect you to spend more than 2 hours at the most on this assignment.

Steps:
1) Start with the objectives in the Group A tab. What is the purpose of this objective? Fill in the purpose in Column C, which should be one or more of the objectives from the Group B list (copied to the right). Insert the number(s) of the corresponding objective(s) in Column C. In some cases, the objective may not have a higher purpose. If so, leave this blank.
2) Next, move to the objectives in the Group B tab and repeat step 1 above.In this case use the Group A OR Group B objectives as the purpose and insert the number(s) in Column C. Leave any objectives without a higher purpose blank.

Number	Objective	Purpose (enter Group B objective number(s) from list to the right)
A1	Frequently exceed channel migration, bed mobilization, and bed scour thresholds	
A2	Reduce temperature related pre-spawning mortality and protect in-vivo egg viability of anadromous spawners in the mainstem Trinity River	
A3	Transport fine sediment through mainstem at a rate greater than tributary input	
A4	Encourage bed-level fluctuations on annual to multi-year time scales	
A5	Increase/maintain spawning habitat quantity and quality to 2,550,000 square feet in the upper 40 miles of the mainstem Trinity River	
A6	Minimize temperature impacts to other native fish habitats	
A7	Increase channel/thalweg sinuosity	
A8	Increase harvest of naturally produced spring-run Chinook salmon adults	
A9	Route coarse sediment through all reaches	
A10	Reduce fine sediment supply from tributary watersheds	
A11	Increase escapement of naturally produced fall-run Chinook salmon to 62,000 adults	
A12	Improve thermal regimes for outmigrant salmonid growth and survival (dependent on water year)	
A13	Increase escapement of Pacific lamprey adults	
A14	Increase structural and thermal diversity of aquatic habitats used by various age classes of Western Pond Turtles	
A15	Minimize physical impacts to other native fish habitats	
A16	Increase and maintain macroinvertebrate populations	
A17	Limit impacts of hatchery fish predation on naturally produced juvenile salmonids to less than 20% over the 40 miles	
A18	Increase population size, survival, distribution, and recruitment success of Foothill Yellow-legged Frogs	

Number	Objective
B1	Increase freshwater production of anadromous fish
B2	Minimize impacts of predation, competition, and genetic interactions between and among hatchery and natural anadromous fish
B3	Increase physical habitat diversity and availability
B4	Increase and maintain coarse sediment storage
B5	Increase naturally produced coho salmon adult production to the extent necessary to meet or exceed escapement objectives and facilitate expanded harvest opportunity
B6	Increase population size, survival, distribution, and recruitment success of Foothill Yellow-legged Frogs (FYLF)
B7	Minimize adverse impacts to additional native riparian or aquatic associated wildlife from Program activities. Focus on wildlife species associated with a healthy river ecosystem, not necessarily all species
B8	Create and maintain spatially complex channel morphology
B9	Increase naturally produced fall-run Chinook salmon adult production to the extent necessary to meet or exceed escapement objectives and facilitate expanded harvest opportunity
B10	Recover riparian vegetation area equal or greater than disturbed by physical rehabilitation
B11	Restore and maintain natural production of anadromous fish populations
B12	Increase population size, survival, distribution, and recruitment success of Western Pond Turtle (WPT)
B13	Restore adult anadromous fish numbers to pre-Trinity River Dam levels in order to facilitate dependent tribal, commercial, and sport fisheries full participation in the benefits of restoration via enhanced harvest opportunities
B14	Prevent riparian vegetation from exceeding thresholds leading to encroachment that simplifies channel morphology and degrades aquatic habitat quality
B15	Maintain Trinity River riverine bird populations and species diversity in the Program area
B16	Increase naturally produced green sturgeon adult production to the extent necessary to meet or exceed escapement objectives and facilitate expanded harvest opportunity
B17	Reduce fine sediment storage in the mainstem Trinity River
B18	Maintain Trinity populations and species diversity of birds using the riparian zone in the Program area

A19	Encourage establishment of riparian species on surfaces within the future channel migration corridor that will recruit LWD	
A20	Increase escapement of naturally produced spring-run Chinook salmon to 6,000 adults	
A21	Maintain or increase adult holding habitat from baseline conditions in the mainstem Trinity River	
A22	Increase geomorphic unit and substrate patch diversity	
A23	Increase harvest of naturally produced coho adult salmon adults	
A24	Increase outmigrant juvenile life stage abundance, growth, physical condition and health from baseline conditions in the mainstem Trinity River within 3-4 brood cycles following rehabilitation of fluvial river processes	
A25	Increase harvest of naturally produced steelhead adults	
A26	Discourage invasive species	
A27	Increase and maintain target coarse sediment transport rates	
A28	Improve juvenile fish production as a function of water temperature and habitat flow relationships from baseline conditions in the mainstem Trinity River within 3-4 brood cycles following rehabilitation of fluvial river processes	
A29	Increase species, structural, and age diversity of riparian vegetation to improve and maintain wildlife habitat	
A30	Increase proportion of Natural Influence (pNI) to 0.7 or greater	
A31	Increase bars, side-channels, alcoves, and other complex alluvial features	
A32	Increase recruitment of younger age classes of Western Pond Turtles	
A33	Adapt timing of hatchery release to alter distribution of avian predators and minimize predation on natural fry and smolts	
A34	Improve thermal regimes for rearing growth and survival of juvenile steelhead, coho salmon and Chinook salmon	
A35	Provide optimal temperatures to improve spawning success of spring and fall-run Chinook salmon	
A36	Manage flows, coarse sediment augmentation, and channel rehabilitation that cause sufficient riparian plant mortality along low water margins to prevent channel simplification leading to degraded fish habitat	
A37	Increase escapement of naturally produced coho salmon to 1,400 adults	

B19	Establish and maintain riparian vegetation that supports fish and wildlife
B20	Increase and maintain salmonid habitat availability for all freshwater (in-river and tributary) life stages
B21	Increase/improve habitats for freshwater life stages of anadromous fish to the extent necessary to meet or exceed production goals
B22	Enhance or maintain food availability for fry and juvenile salmonids
B23	Increase naturally produced spring-run Chinook salmon adult production to the extent necessary to meet or exceed escapement objectives and facilitate expanded harvest opportunity
B24	Increase naturally produced Pacific lamprey adult production to the extent necessary to meet or exceed escapement objectives and facilitate expanded harvest opportunity
B25	Rehabilitate and protect wildlife habitats and maintain or enhance wildlife populations following implementation
B26	Improve riverine thermal conditions for growth and survival of natural anadromous salmonids
B27	Increase naturally produced steelhead adult production to the extent necessary to meet or exceed escapement objectives and facilitate expanded harvest opportunity
B28	Increase coarse sediment transport and channel dynamics
B29	Minimize impacts of riverine bird predation on fry and smolts
B30	Increase spawning, incubation and emergence success of anadromous spawners
B31	Promote diverse native riparian vegetation on different geomorphic surfaces that contribute to complex channel morphology and high quality aquatic and terrestrial habitat

A38	Reduce non-native fish predation on naturally produced fish by 50% in the mainstem Trinity River within 3-4 brood cycles following rehabilitation of fluvial river processes	
A39	Increase fry abundance, growth, physical condition, and health from baseline conditions in the mainstem Trinity River within 3-4 brood cycles following rehabilitation of fluvial river processes	
A40	Optimize adult utilization of suitable spawning habitat areas in tributaries within 3-4 brood cycles following rehabilitation of fluvial river processes	
A41	Enhance quality and maintain quantity of riparian bird nesting and foraging habitats	
A42	Increase/maintain salmonid fry and juvenile rearing habitat in the upper 40 miles of the mainstem Trinity River by a minimum of 400 % following rehabilitation of fluvial attributes	
A43	Maintain or increase tributary habitat	
A44	Minimize physical impacts to lamprey habitat	
A45	Encourage establishment of vegetation that provides habitat for anadromous fish, aquatic organisms and aquatic / riparian wildlife	
A46	Increase harvest of green sturgeon adults	
A47	Enhance quality and maintain quantity of riverine bird nesting and foraging habitats	
A48	Increase escapement of naturally produced steelhead to 40,000 adults	
A49	Optimize adult utilization of suitable spawning habitat areas in the mainstem within 3-4 brood cycles following rehabilitation of fluvial river processes	
A50	Reduce clinical disease incidence in Trinity River origin outmigrants in	
A51	Encourage fine sediment deposition on floodplains	
A52	Create channel form that reduces loss of fry to stranding in the upper 40	
A53	Reduce fry stranding in the upper 40 miles of the mainstem Trinity River by 50% following rehabilitation of fluvial river processes	
A54	Increase escapement of green sturgeon adults	
A55	Increase quality and quantity of breeding and rearing habitat for Foothill Yellow-legged Frogs	
A56	Increase harvest of naturally produced fall-run Chinook salmon adults	
A57	Increase harvest of Pacific lamprey adults	
A58	Increase the size, frequency and topographic relief of bar/pool sequences	
A59	Increase population size, survival, distribution, and recruitment success of Western Pond Turtles	

Number	Objective	Purpose (enter Group A objective number(s) from list to the right or from Group B list to the left)
B1	Increase freshwater production of anadromous fish	
B2	Minimize impacts of predation, competition, and genetic interactions between and among hatchery and natural anadromous fish	
B3	Increase physical habitat diversity and availability	
B4	Increase and maintain coarse sediment storage	
B5	Increase naturally produced coho salmon adult production to the extent necessary to meet or exceed escapement objectives and facilitate expanded harvest opportunity	
B6	Increase population size, survival, distribution, and recruitment	
B7	Minimize adverse impacts to additional native riparian or aquatic	
B8	Create and maintain spatially complex channel morphology	
B9	Increase naturally produced fall-run Chinook salmon adult production to the extent necessary to meet or exceed escapement objectives and facilitate expanded harvest opportunity	
B10	Recover riparian vegetation area equal or greater than disturbed by physical rehabilitation	
B11	Restore and maintain natural production of anadromous fish populations	
B12	Increase population size, survival, distribution, and recruitment success of Western Pond Turtle (WPT)	
B13	Restore adult anadromous fish numbers to pre-Trinity River Dam levels in order to facilitate dependent tribal, commercial, and sport fisheries full participation in the benefits of restoration via enhanced harvest opportunities	
B14	Prevent riparian vegetation from exceeding thresholds leading to encroachment that simplifies channel morphology and degrades aquatic habitat quality	
B15	Maintain Trinity River riverine bird populations and species diversity in the Program area	
B16	Increase naturally produced green sturgeon adult production to the extent necessary to meet or exceed escapement objectives and facilitate expanded harvest opportunity	
B17	Reduce fine sediment storage in the mainstem Trinity River	
B18	Maintain Trinity populations and species diversity of birds using the riparian zone in the Program area	

Number	Objective
A1	Frequently exceed channel migration, bed mobilization, and bed scour thresholds
A2	Reduce temperature related pre-spawning mortality and protect in-vivo egg viability of anadromous spawners in the mainstem Trinity River
A3	Transport fine sediment through mainstem at a rate greater than tributary input
A4	Encourage bed-level fluctuations on annual to multi-year time scales
A5	Increase/maintain spawning habitat quantity and quality to 2,550,000 square feet in the upper 40 miles of the mainstem Trinity River
A6	Minimize temperature impacts to other native fish habitats
A7	Increase channel/thalweg sinuosity
A8	Increase harvest of naturally produced spring-run Chinook salmon adults
A9	Route coarse sediment through all reaches
A10	Reduce fine sediment supply from tributary watersheds
A11	Increase escapement of naturally produced fall-run Chinook salmon to 62,000 adults
A12	Improve thermal regimes for outmigrant salmonid growth and survival (dependent on water year)
A13	Increase escapement of Pacific lamprey adults
A14	Increase structural and thermal diversity of aquatic habitats used by various age classes of Western Pond Turtles
A15	Minimize physical impacts to other native fish habitats
A16	Increase and maintain macroinvertebrate populations
A17	Limit impacts of hatchery fish predation on naturally produced juvenile salmonids to less than 20% over the 40 miles
A18	Increase population size, survival, distribution, and recruitment success of Foothill Yellow-legged Frogs

B19	Establish and maintain riparian vegetation that supports fish and wildlife	
B20	Increase and maintain salmonid habitat availability for all freshwater (in-river and tributary) life stages	
B21	Increase/improve habitats for freshwater life stages of anadromous fish to the extent necessary to meet or exceed production goals	
B22	Enhance or maintain food availability for fry and juvenile salmonids	
B23	Increase naturally produced spring-run Chinook salmon adult production to the extent necessary to meet or exceed escapement objectives and facilitate expanded harvest opportunity	
B24	Increase naturally produced Pacific lamprey adult production to the extent necessary to meet or exceed escapement objectives and facilitate expanded harvest opportunity	
B25	Rehabilitate and protect wildlife habitats and maintain or enhance wildlife populations following implementation	
B26	Improve riverine thermal conditions for growth and survival of natural anadromous salmonids	
B27	Increase naturally produced steelhead adult production to the extent necessary to meet or exceed escapement objectives and facilitate expanded harvest opportunity	
B28	Increase coarse sediment transport and channel dynamics	
B29	Minimize impacts of riverine bird predation on fry and smolts	
B30	Increase spawning, incubation and emergence success of anadromous spawners	
B31	Promote diverse native riparian vegetation on different geomorphic surfaces that contribute to complex channel morphology and high quality aquatic and terrestrial habitat	

A19	Encourage establishment of riparian species on surfaces within the future channel migration corridor that will recruit LWD
A20	Increase escapement of naturally produced spring-run Chinook salmon to 6,000 adults
A21	Maintain or increase adult holding habitat from baseline conditions in the mainstem Trinity River
A22	Increase geomorphic unit and substrate patch diversity
A23	Increase harvest of naturally produced coho adult salmon adults
A24	Increase outmigrant juvenile life stage abundance, growth, physical condition and health from baseline conditions in the mainstem Trinity River within 3-4 brood cycles following rehabilitation of fluvial river processes
A25	Increase harvest of naturally produced steelhead adults
A26	Discourage invasive species
A27	Increase and maintain target coarse sediment transport rates
A28	Improve juvenile fish production as a function of water temperature and habitat flow relationships from baseline conditions in the mainstem Trinity River within 3-4 brood cycles following rehabilitation of fluvial river processes
A29	Increase species, structural, and age diversity of riparian vegetation to improve and maintain wildlife habitat
A30	Increase proportion of Natural Influence (pNI) to 0.7 or greater
A31	Increase bars, side-channels, alcoves, and other complex alluvial features
A32	Increase recruitment of younger age classes of Western Pond Turtles
A33	Adapt timing of hatchery release to alter distribution of avian predators and minimize predation on natural fry and smolts
A34	Improve thermal regimes for rearing growth and survival of juvenile steelhead, coho salmon and Chinook salmon
A35	Provide optimal temperatures to improve spawning success of spring and fall-run Chinook salmon

A36	Manage flows, coarse sediment augmentation, and channel rehabilitation that cause sufficient riparian plant mortality along low water margins to prevent channel simplification leading to degraded fish habitat
A37	Increase escapement of naturally produced coho salmon to 1,400 adults
A38	Reduce non-native fish predation on naturally produced fish by 50% in the mainstem Trinity River within 3-4 brood cycles following rehabilitation of fluvial river processes
A39	Increase fry abundance, growth, physical condition, and health from baseline conditions in the mainstem Trinity River within 3-4 brood cycles following rehabilitation of fluvial river processes
A40	Optimize adult utilization of suitable spawning habitat areas in tributaries within 3-4 brood cycles following rehabilitation of fluvial river processes
A41	Enhance quality and maintain quantity of riparian bird nesting and foraging habitats
A42	Increase/maintain salmonid fry and juvenile rearing habitat in the upper 40 miles of the mainstem Trinity River by a minimum of 400 % following rehabilitation of fluvial attributes
A43	Maintain or increase tributary habitat
A44	Minimize physical impacts to lamprey habitat
A45	Encourage establishment of vegetation that provides habitat for anadromous fish, aquatic organisms and aquatic / riparian wildlife
A46	Increase harvest of green sturgeon adults
A47	Enhance quality and maintain quantity of riverine bird nesting and foraging habitats
A48	Increase escapement of naturally produced steelhead to 40,000 adults
A49	Optimize adult utilization of suitable spawning habitat areas in the mainstem within 3-4 brood cycles following rehabilitation of fluvial river processes
A50	Reduce clinical disease incidence in Trinity River origin outmigrants in the Klamath River to less than 20% within 5 years
A51	Encourage fine sediment deposition on floodplains
A52	Create channel form that reduces loss of fry to stranding in the upper 40 miles of the mainstem Trinity River following rehabilitation during high flows
A53	Reduce fry stranding in the upper 40 miles of the mainstem Trinity River by 50% following rehabilitation of fluvial river processes
A54	Increase escapement of green sturgeon adults

A55	Increase quality and quantity of breeding and rearing habitat for Foothill Yellow-legged Frogs
A56	Increase harvest of naturally produced fall-run Chinook salmon adults
A57	Increase harvest of Pacific lamprey adults
A58	Increase the size, frequency and topographic relief of bar/pool sequences
A59	Increase population size, survival, distribution, and recruitment success of Western Pond Turtles

Appendix D: Workshop Introduction Presentation

Trinity River Restoration Program Objectives Workshop

May 22, 2013

Ground Rules and Expectations

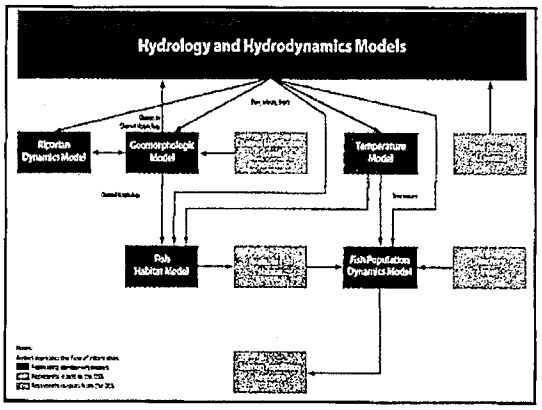
- Arrive on time; stay until the end of the meeting
- Be present, focused and prepared
- Avoid interruptions (we will use a queue)
- Listen before responding
- Be future orientated; avoid rehashing past exercises/decisions
- Stay on agenda (we will use a "parking lot"); avoid policy debates
- Keep an open mind as there will be differing perspectives
- Avoid assumptions; ask for clarification

Workshop Goals

- Primary Goals of Workshop
  - Review the three levels of objectives listed in Table 2.1 of the IAP
  - Minimize redundancy and potentially the total number of objectives
  - Separate fundamental and means objectives
- Secondary Goals (to be accomplished following workshop)
  - Identify linkages between objectives and management actions
  - Develop quantitative metrics for each objective

Why is this necessary?

- The adaptive management process requires restoration objectives periodically be reviewed to ensure new learning of Trinity River ecosystem functionality is captured in both fundamental and means objectives.
- Reducing the overall number of objectives (by eliminating redundancy) to clearly distinguish between fundamental and means objectives is necessary to design a DSS that captures the relationships between them (i.e., means objectives as potential ways (hypotheses) to achieve fundamental objectives).



Lessons Learned from other AM Applications

- DSS Case Studies
  - Horseshoe Crab-Red Knot Management
  - Adaptive Harvest Management of Waterfowl
  - Tallapoosa River
  - Cultus Lake Salmon
- Everglades Restoration

Horseshoe Crab-Red Knot and Adaptive Harvest Management (Waterfowl)

- Link species population models to inform harvest management decisions
- Collaborative effort with stakeholders
- First steps in developing DSS were defining problem statement and establishing objectives
- These steps, along with concurrence on models, were most time-intensive
- As new information is gained, objectives and underlying hypotheses will be reevaluated

Tallapoosa River Flow Management

- Establishes flow regimes to meet multiple objectives: hydropower production, recreational boater weekends and protection of ecological resources (spawning windows)
- Workshop to identify stakeholder values and objectives
- Established fundamental and means objectives and a flow regime that was the product of a series of compromises
- Structured decision making process allowed trust to be established among stakeholders

Cultus Lake Salmon

- Structured decision making process on sockeye salmon management alternatives
- Formed consultative stakeholder committee
- Held three workshops to develop objectives, performance measures and management options
  - Four objective categories: conservation, cost, catch and employment
- Process introduced rigor into development of objectives and management options, and recognition of tradeoffs

Appendix E: Workshop Agenda

Trinity River Restoration Program (TRRP) Objectives Workshop
Agenda

May 22, 2013 9:30am to 4:30pm

Workshop Location: Trinity County Library
351 Main Street
Weaverville, CA

WebEx Online Meeting:
https://trrp.webex.com/trrp/j.php?ED=229138717&UID=487141902&PW=NNDMyNTU2NmFi&RT=MiM0

Meeting Number and Access Code (for online meeting and audio conference): 577 665 038
Meeting Password (for online meeting): Abc123
Call-In Number: 1-408-792-6300

Workshop Objectives:

1) Review the three levels of objectives listed in Table 2.1 of the IAP to determine if the total number of objectives can be reduced to minimize redundancy
2) Separate fundamental and means objectives
3) Develop a plan to identify linkages between objectives and management actions
4) Develop a plan to develop quantitative metrics for each objective

Desired Outcome: A refined, consolidated list of objectives that distinguishes between fundamental and means objectives.

Meeting Facilitators: Nicole Athearn (USFWS); Tom St. Clair, Rebecca Burns (Atkins)	
9:30am – 10:00am	Introductions, Workshop Objectives, Ground Rules and Agenda Review
10:00am – 10:15am	Lessons Learned from other Adaptive Management Applications
10:15am – 10:30am	Brief Introduction to Structured Decision Making
10:30am – 10:40am	Break
10:40am – 11:30am	Review Results of Pre-Workshop Assignment • Determine fundamental objectives
11:30am – 12:00pm	Revise Objectives: Session 1
12:00pm – 12:30pm	Catered Lunch
12:30pm – 1:00pm	Lessons from Klamath Objectives Hierarchy
1:00pm – 2:15pm	Revise Objectives: Session 2
2:15pm – 2:30pm	Break
2:30pm – 3:45pm	Revise Objectives: Session 3
3:45pm – 4:15pm	Post-Workshop Activities
4:15pm – 4:30pm	Wrap-Up, Review Outcomes and Next Steps
4:30pm	***Adjourn***

Appendix F: Workshop SDM Presentation

Structured Decision Making and Adaptive Management

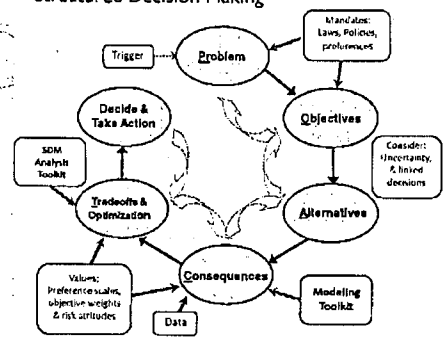
Reducing Uncertainty and Clarifying Linkages

Structured Decision Making

- Carefully organized problem analysis used to reach decisions that are focused clearly on achieving fundamental objectives
- Explicitly integrates science and policy
- Decisions are transparent with respect to legal mandates and public preferences or values
- Uncertainty is dealt with explicitly

Structured Decision Making

"PrOACT"



Problem Definition

- The way you state your problem frames your decision.
- Every decision has a trigger – it is important to consider the trigger in defining your problem.

Objectives …

- Form the basis for evaluating the alternatives available to you
- Keep you on the right track
- A full set of objectives can help us identify more and better alternatives than the ones that seem obvious
- Help you determine what information to seek
- Help you explain your choice to others
- Determine a decision's importance and, consequently, how much time and effort it deserves

Cautions

- Must identify ALL objectives to avoid making an unbalanced decision.
  - If a prospective decisions sits uncomfortably in your mind, you may have overlooked an important objective
- Pitfalls include taking too narrow a focus
  - Focus too much on tangibles without enough attention to intangibles
  - In science, this can be looking too hard for a science-based decision without adequately considering social and cultural issues
- Need to look beyond "obvious" objectives – so this will be an iterative process
- Don't eliminate an objective because of the perception that it is not measurable

A Good Set of Fundamental Objectives is…

- Complete. No essential objectives are missing.
- Concise. Nothing unnecessary or ambiguous. Similar objectives grouped together; no double accounting.
- Sensitive. The objectives are influenced by the alternatives under consideration.
- Understandable. Use commonly understood terms. May need to be defined by sub-objectives and performance measures.
- Independent. "Preferentially independent" -- contribute independently to the overall performance of an alternative, you don't need to know what is happening in one objective to evaluate performance in another

Fundamental vs. Means Objectives

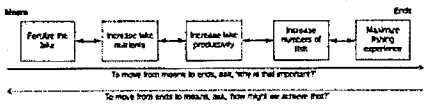


Figure 4.2 A simple means-ends diagram.

- Means to an end vs. ends in themselves (Fundamental objectives)
- Keep asking "Why?" until you can't go any farther
- Means objectives represent way stations in the progress towards a fundamental objective, the point where you can say "I want this for its own sake"
- Fundamental objectives constitute the broadest objectives directly influenced by your decision alternatives
  - A Fundamental objective is not necessarily an "important" objective

A Typical Objective Hierarchy

Maximize safety
- Maximize operator safety
- Maximize public safety

Maximize net revenue
- Maximize revenue from ore sales
- Minimize capital costs
- Minimize operating costs

Minimize impacts on First Nations traditional use activities
- Minimize impacts to ceremonial sites
- Minimize access impediments to traditional food gathering areas

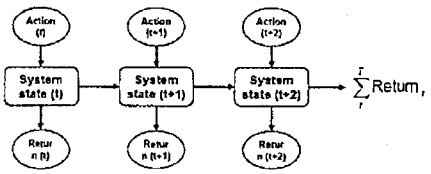
Minimize adverse environmental impacts
- Minimize soil contamination from tailings
- Minimize material waste
- Minimize air emissions
- Minimize impacts on groundwater

Minimize disturbances to recreational activities
- Minimize disturbance to viewscapes
- Minimize trail access blockages
- Minimize noise from construction /operations

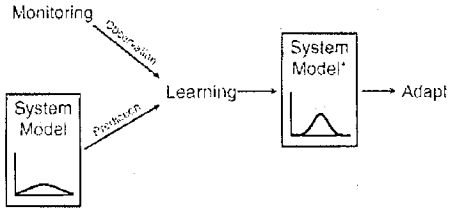
Adaptive Management as a Special Case of SDM

- Some decisions are repeated over time, at regular (or irregular) intervals
- How it is different
  - Added complexity
    - Current decisions influence future state(s) and, therefore, future actions
  - Opportunity to learn
    - Comparison of model-based predictions with monitoring data permit learning

Added Complexity



Opportunity to Learn



Elements of an Informed Decision Process (SDM for Recurrent Decisions)

1. Objective(s): what do you want to achieve
2. Restoration alternatives: stuff you can do
3. Model(s) of system response to restoration actions (for prediction)
4. Measures of model credibility
5. Monitoring program to estimate system state and other relevant variables
6. Solution algorithm (e.g., optimization)

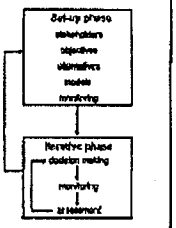
- 1-2: based on societal values, law, politics, stakeholders
- 3-6: scientists and managers

Objectives in ARM

- Objectives drive the development of other aspects of the ARM framework
- May be significant input from stakeholders
  - Balance regulatory responsibilities of agencies with stakeholder input

Evolution of Objectives and Actions

- "Double loop learning"
- Revisit objectives due to new information, experience, or change in values
- Alternative management actions may also evolve



Purpose of Monitoring

- To assess the state of the system for the purpose of making state-dependent decisions
- To determine if the objectives are being met
  - Estimate system state for comparison with model-based predictions to learn about system dynamics
- To resolve uncertainty
  - Estimate parameters needed for model development
- The development of the monitoring system should be tailored to these needs & driven by the decision context

Monitoring and Restoration

- It is not efficient to simply collect information about physical conditions or a population of conservation concern
  - There is a very large number of quantities that we could potentially estimate
- Instead, we need to ask:
  - What information is most useful for making conservation and restoration decisions?
  - What explicit measurable parameters can be used to assess restoration effectiveness?
    - Address multiple scales

Value of Information

- Formal concept from decision theory
- How much management is expected to improve if uncertainty is reduced
- VOI is high when:
  - Different actions would be chosen under different hypotheses
  - The predicted outcomes are very different under different hypotheses
- Types: expected value of perfect information, partial information

Conceptual model approach

- A **graphical or verbal representation** of the **relationships** between:
  - human activities, watershed processes, potential impacts or sources of stress and the effects on ecological function/endpoints
  - Physical and biological processes (e.g., TRRP components)
- Makes explicit statements about hypothesized **functional relationships** underlying management decisions
- Process descriptions are based on various conceptualizations of the components of process of interest – here, fish recovery
- Use to explore need for quantitative models and additional mechanistic relationships

Summary

- Conceptual models can be used to make explicit our understanding of system and program component linkages, and associated uncertainties
- System uncertainties can be expressed as alternative models, which can be evaluated with monitoring data
- Models can help identify high priority data needs for decision-making
- An SDM-based DSS will increase decision-making transparency and enhance learning and communications

Appendix G: Pre-Workshop Assignment Summary Spreadsheet

Number	# purpose objectives	Objective	Purpose Objectives																								
			3	10		2	14			3	4	12	5	2	3	5	2		2	2	11	2	6				
A1	21	Frequently exceed channel migration, bed mobilization, and bed scour thresholds	B1	B3	B4	B5	B8	B9	B10	B11	B13	B14	B17	B19	B20	B21	B23	B25	B26	B27	B28	B30	B31				
			12	5	8	10	9		3	4	7	11	4	10													
A2	12	Reduce temperature related pre-spawning mortality and protect in-vivo egg viability of anadromous spawners in the mainstem Trinity River	B1	B5	B9	B11	B13	B17	B20	B21	B23	B26	B27	B30													
			5	2	3	3	3	4	5	4	13	3	7	5	4		3		8								
A3	18	Transport fine sediment through mainstem at a rate greater than tributary input	B1	B3	B5	B8	B9	B11	B13	B14	B17	B20	B21	B22	B23	B24	B27	B28	B30	B31							
			4	12	4	2	13		2	3	8	3		2	4	2	2	2	9	4	3						
A4	19	Encourage bed-level fluctuations on annual to multi-year time scales	B1	B3	B4	B5	B8	B9	B11	B13	B14	B17	B19	B20	B21	B23	B26	B27	B28	B30	B31						
			9		8		6	2	7	9	8		7	10		8		5		10							
A5	18	Increase/maintain spawning habitat quantity and quality to 2,550,000 square feet in the upper 40 miles of the mainstem Trinity River	B1	B2	B3	B4	B5	B8	B9	B11	B13	B17	B20	B21	B22	B23	B26	B27	B28	B30							
					3				5					6	5		2										
A6	16	Minimize temperature impacts to other native fish habitats	B1	B5	B7	B9	B11	B13	B16	B19	B20	B21	B23	B24	B26	B27	B30	B31									
			3	11	4	2	12			4	3	5	3		6	6	3			3	6	2	2				
A7	21	Increase channel/thalweg sinuosity	B1	B3	B4	B5	B8	B9	B10	B11	B13	B14	B17	B19	B20	B21	B23	B24	B26	B27	B28	B30	B31				
			6	5																							
A8	2	Increase harvest of naturally produced spring-run Chinook salmon adults	B13	B23																							
			4	9	7	2	12	2	4	4	3	4		4	6		3			2	9	4					
A9	21	Route coarse sediment through all reaches	B1	B3	B4	B5	B8	B9	B11	B13	B14	B17	B19	B20	B21	B22	B23	B24	B26	B27	B28	B30	B31				
			3	3		2	3	2	4	4	3	12	4	6	5	3		4		6	2						
A10	19	Reduce fine sediment supply from tributary watersheds	B1	B3	B4	B5	B8	B9	B11	B13	B14	B17	B20	B21	B22	B23	B24	B27	B28	B30	B31						
			4			7	4	10																			
A11	8	Increase escapement of naturally produced fall-run Chinook salmon to 62,000 adults	B1	B2	B3	B9	B11	B13	B23	B30																	
			11		6	6	11	9		4	5	5	2	7	6	4											
A12	14	Improve thermal regimes for outmigrant salmonid growth and survival (dependent on water year)	B1	B3	B5	B9	B11	B13	B16	B20	B21	B23	B24	B26	B27	B30											
			5	3	5			9																			
A13	6	Increase escapement of Pacific lamprey adults	B1	B11	B13	B14	B21	B24																			
			2	6		11	6	3																			
A14	6	Increase structural and thermal diversity of aquatic habitats used by various age classes of Western Pond Turtles	B3	B7	B8	B12	B25	B31																			
			3				2			2	2		4						4								
A15	21	Minimize physical impacts to other native fish habitats	B1	B3	B4	B5	B7	B8	B9	B11	B13	B14	B16	B17	B19	B20	B21	B23	B24	B26	B27	B30	B31				
			7		5	4	5	6	2	4	2	2		3		2	9	2		4							
A16	18	Increase and maintain macroinvertebrate populations	B1	B2	B5	B6	B9	B11	B12	B13	B15	B16	B17	B18	B20	B21	B22	B23	B24	B27							
			6	12	5	4	5	2			5	5															
A17	10	Limit impacts of hatchery fish predation on naturally produced juvenile salmonids to less than 20% over the 40 miles	B1	B2	B5	B9	B11	B13	B20	B21	B23	B27															
			7	4		6																					
A18	5	Increase population size, survival, distribution, and recruitment success of Foothill Yellow-legged Frogs	B6	B7	B19	B25	B31																				
			2	9	2	2		7	3	2	3		4	3			8	4	5		3		2	3	2		9
A19	25	Encourage establishment of riparian species on surfaces within the future channel migration corridor that will recruit LWD	B1	B3	B4	B5	B7	B8	B9	B10	B11	B12	B13	B14	B15	B18	B19	B20	B21	B22	B23	B25	B26	B27	B28	B29	B31
			4	5	8	7																					
A20	4	Increase escapement of naturally produced spring-run Chinook salmon to 6,000 adults	B1	B11	B13	B23																					
			4	4	2	4	3	4	5	6	3	7	7	6		4											

Number	Objective	# means objectives
B1	Increase freshwater production of anadromous fish	48
B2	Minimize impacts of predation, competition, and genetic interactions between and among hatchery and natural anadromous fish	9
B3	Increase physical habitat diversity and availability	34
B4	Increase and maintain coarse sediment storage	27
B5	Increase naturally produced coho salmon adult production to the extent necessary to meet or exceed escapement objectives and facilitate expanded harvest opportunity	28
B6	Increase population size, survival, distribution, and recruitment success of Foothill Yellow-legged Frogs (FYLF)	5
B7	Minimize adverse impacts to additional native riparian or aquatic associated wildlife from Program activities. Focus on wildlife species associated with a healthy river ecosystem, not necessarily all species	12
B8	Create and maintain spatially complex channel morphology	25
B9	Increase naturally produced fall-run Chinook salmon adult production to the extent necessary to meet or exceed escapement objectives and facilitate expanded harvest opportunity	23
B10	Recover riparian vegetation area equal or greater than disturbed by physical rehabilitation	5
B11	Restore and maintain natural production of anadromous fish populations	23
B12	Increase population size, survival, distribution, and recruitment success of Western Pond Turtle (WPT)	7
B13	Restore adult anadromous fish numbers to pre-Trinity River Dam levels in order to facilitate dependent tribal, commercial, and sport fisheries full participation in the benefits of restoration via enhanced harvest opportunities	32
B14	Prevent riparian vegetation from exceeding thresholds leading to encroachment that simplifies channel morphology and degrades aquatic habitat quality	17
B15	Maintain Trinity River riverine bird populations and species diversity in the Program area	6
B16	Increase naturally produced green sturgeon adult production to the extent necessary to meet or exceed escapement objectives and facilitate expanded harvest opportunity	23
B17	Reduce fine sediment storage in the mainstem Trinity River	12
B18	Maintain Trinity populations and species diversity of birds using the riparian zone in the Program area	4
B19	Establish and maintain riparian vegetation that supports fish and wildlife	10
B20	Increase and maintain salmonid habitat availability for all freshwater (in-river and tributary) life stages	25

A21	14	Maintain or increase adult holding habitat from baseline conditions in the mainstem Trinity River	B1	B3	B4	B5	B8	B9	B11	B13	B16	B20	B21	B23	B26	B27																	B21	Increase/improve habitats for freshwater life stages of anadromous fish to the extent necessary to meet or exceed production goals	22
			2	8			9			2	2	3	2					2	2																	
A22	17	Increase geomorphic unit and substrate patch diversity	B1	B3	B4	B5	B8	B9	B11	B13	B17	B20	B21	B22	B23	B26	B27	B28	B30														B22	Enhance or maintain food availability for fry and juvenile salmonids	5
			3		4																															
A23	3	Increase harvest of naturally produced coho adult salmon adults	B5	B11	B13																												B23	Increase naturally produced spring-run Chinook salmon adult production to the extent necessary to meet or exceed escapement objectives and facilitate expanded harvest opportunity	21
			9		7	6	6	10		5		2	6																							
A24	12	Increase outmigrant juvenile life stage abundance, growth, physical condition and health from baseline conditions in the mainstem Trinity River within 3-4 brood cycles following rehabilitation of fluvial river processes	B1	B2	B5	B9	B11	B13	B20	B23	B24	B26	B27	B29																			B24	Increase naturally produced Pacific lamprey adult production to the extent necessary to meet or exceed escapement objectives and facilitate expanded harvest opportunity	15
			5	4																																
A25	2	Increase harvest of naturally produced steelhead adults	B13	B27																													B25	Rehabilitate and protect wildlife habitats and maintain or enhance wildlife populations following implementation	9
			4		3	4	4		3		4	4	2	3	2	3	4	2	3	2	3	3	3		3		4								
A26	25	Discourage invasive species	B1	B3	B5	B6	B7	B8	B9	B10	B11	B13	B14	B15	B16	B18	B19	B20	B21	B22	B23	B24	B25	B26	B27	B30	B31						B26	Improve riverine thermal conditions for growth and survival of natural anadromous salmonids	14
			4	11	8	3	9	3	3	4				3	3		3		3	6	2														
A27	19	Increase and maintain target coarse sediment transport rates	B1	B3	B4	B5	B8	B9	B11	B13	B14	B16	B17	B20	B21	B22	B23	B26	B27	B28	B30												B27	Increase naturally produced steelhead adult production to the extent necessary to meet or exceed escapement objectives and facilitate expanded harvest opportunity	21
			9	2		6		6	7	9		3	3		5		5																			
A28	16	Improve juvenile fish production as a function of water temperature and habitat flow relationships from baseline conditions in the mainstem Trinity River within 3-4 brood cycles following rehabilitation of fluvial river processes	B1	B3	B4	B5	B8	B9	B11	B13	B16	B20	B21	B22	B23	B26	B27	B30															B28	Increase coarse sediment transport and channel dynamics	14
			5		3	7		2	6	4	8	8			6																					
A29	13	Increase species, structural, and age diversity of riparian vegetation to improve and maintain wildlife habitat	B3	B6	B7	B10	B12	B14	B15	B18	B19	B25	B26	B29	B31																		B29	Minimize impacts of riverine bird predation on fry and smolts	4
			6	7	2		5		5	5	6		2		4	5																				
A30	15	Increase proportion of Natural Influence (pNI) to 0.7 or greater	B1	B2	B3	B4	B5	B8	B9	B11	B13	B16	B20	B21	B23	B27	B30																B30	Increase spawning, incubation and emergence success of anadromous spawners	23
			5	9	2	3		11	3	5		4		2	3	4		3			3	2														
A31	22	Increase bars, side-channels, alcoves, and other complex alluvial features	B1	B3	B4	B5	B6	B8	B9	B11	B12	B13	B14	B16	B20	B21	B22	B23	B25	B26	B27	B28	B30	B31									B31	Promote diverse native riparian vegetation on different geomorphic surfaces that contribute to complex channel morphology and high quality aquatic and terrestrial habitat	15
					3		8	5																												
A32	7	Increase recruitment of younger age classes of Western Pond Turtles	B3	B6	B7	B8	B12	B25	B31																											
			4	7			2		3	3	3				3	3	7																			
A33	15	Adapt timing of hatchery release to alter distribution of avian predators and minimize predation on natural fry and smolts	B1	B2	B3	B4	B5	B8	B9	B11	B13	B16	B20	B21	B23	B27	B29																			
			8			7		6	6	7	2	3	4	6		7	5		3																	
A34	17	Improve thermal regimes for rearing growth and survival of juvenile steelhead, coho salmon and Chinook salmon	B1	B3	B4	B5	B8	B9	B11	B13	B16	B20	B21	B23	B24	B26	B27	B28	B30																	
			7	2	8	5	5	5	7	5		5																								
A35	9	Provide optimal temperatures to improve spawning success of spring and fall-run Chinook salmon	B1	B5	B9	B11	B13	B21	B23	B26	B27	B30																								
			3	6		2		8	2		2	4	7			2	2	3		2		2			6											
A36	23	Manage flows, coarse sediment augmentation, and channel rehabilitation that cause sufficient riparian plant mortality along low water margins to prevent channel simplification leading to degraded fish habitat	B1	B3	B4	B5	B7	B8	B9	B10	B11	B13	B14	B16	B17	B19	B20	B21	B22	B23	B26	B27	B28	B30	B31											
			3	9		5																														
A37	4	Increase escapement of naturally produced coho salmon to 1,400 adults	B1	B5	B11	B13																														
			7	4			5		5	8	5		2	4	5	4																				
A38	16	Reduce non-native fish predation on naturally produced fish by 50% in the mainstem Trinity River within 3-4 brood cycles following rehabilitation of fluvial river processes	B1	B2	B3	B4	B5	B8	B9	B11	B13	B16	B20	B21	B23	B27	B28	B30																		
			10				6		6	8	7			2	6	5																				
A39	15	Increase fry abundance, growth, physical condition, and health from baseline conditions in the mainstem Trinity River within 3-4 brood cycles following rehabilitation of fluvial river processes	B1	B2	B3	B4	B5	B8	B9	B11	B13	B16	B20	B21	B23	B27	B30																			
			7	3		6	2	6	6	8		3	3	6	5		4																			

A40	15	Optimize adult utilization of suitable spawning habitat areas in tributaries within 3-4 brood cycles following rehabilitation of fluvial river processes	B1	B3	B4	B5	B8	B9	B11	B13	B16	B20	B21	B23	B27	B28	B30																			
			2	4		5	7	2	7	3																										
A41	8	Enhance quality and maintain quantity of riparian bird nesting and foraging habitats	B3	B7	B12	B15	B18	B19	B25	B31																										
			9	4		6	3	6	7	8		4	5	6	5	2	2																			
A42	15	Increase/maintain salmonid fry and juvenile rearing habitat in the upper 40 miles of the mainstem Trinity River by a minimum of 400 % following rehabilitation of fluvial attributes	B1	B3	B4	B5	B8	B9	B11	B13	B16	B20	B21	B23	B27	B28	B30																			
			8		5		5	2	5	5	7			4	4		5				6		2													
A43	21	Maintain or increase tributary habitat	B1	B2	B3	B4	B5	B8	B9	B11	B13	B16	B17	B20	B21	B22	B23	B24	B25	B26	B27	B28	B30													
			3			2			9																											
A44	7	Minimize physical impacts to lamprey habitat	B1	B3	B11	B13	B20	B21	B24																											
			7	5		3	5	4	3	4	4		5	2	3		3	8	2	5	2	3	5		3		9									
A45	23	Encourage establishment of vegetation that provides habitat for anadromous fish, aquatic organisms and aquatic / riparian wildlife	B1	B3	B4	B5	B7	B8	B9	B10	B11	B12	B13	B14	B15	B16	B18	B19	B20	B21	B22	B23	B25	B26	B27	B30	B31									
				2	4																															
A46	3	Increase harvest of green sturgeon adults	B1	B13	B16																															
					3	2	3			7	4	5	7	4																						
A47	12	Enhance quality and maintain quantity of riverine bird nesting and foraging habitats	B1	B3	B7	B8	B10	B13	B14	B15	B18	B19	B25	B31																						
			4	7					6																											
A48	7	Increase escapement of naturally produced steelhead to 40,000 adults	B1	B13	B15	B18	B19	B25	B27																											
			7	3		4		5	6	6		2	4	5	6	4																				
A49	14	Optimize adult utilization of suitable spawning habitat areas in the mainstem within 3-4 brood cycles following rehabilitation of fluvial river processes	B1	B3	B4	B5	B8	B9	B11	B13	B16	B20	B21	B23	B27	B30																				
			11			4		4	9	6	2		3	4		3																				
A50	15	Reduce clinical disease incidence in Trinity	B1	B3	B4	B5	B8	B9	B11	B13	B16	B20	B21	B23	B24	B27	B30																			
			2	3	2		4	2	9	2	2		5		7				2		2		7													
A51	21	Encourage fine sediment deposition on floodplains	B1	B3	B5	B7	B8	B9	B10	B11	B13	B15	B17	B18	B19	B20	B21	B22	B23	B25	B27	B28	B31													
			9	2		4		2	4	8	5			4	4	4	3																			
A52	17	Create channel form that reduces loss of	B1	B3	B4	B5	B7	B8	B9	B11	B13	B14	B16	B20	B21	B23	B27	B29	B30																	
			9	2		4		2	4	8	5			3	4	4	4																			
A53	17	Reduce fry stranding in the upper 40 miles of the mainstem Trinity River by 50% following rehabilitation of fluvial river processes	B1	B3	B4	B5	B7	B8	B9	B11	B13	B14	B16	B20	B21	B23	B27	B29	B30																	
			2		5	8																														
A54	5	Increase escapement of green sturgeon adults	B1	B11	B13	B16	B24																													
			2	10	3			5																												
A55	5	Increase quality and quantity of breeding and rearing habitat for Foothill Yellow-legged Frogs	B3	B6	B7	B15	B19	B25																												
				3	4																															
A56	3	Increase harvest of naturally produced fall-run Chinook salmon adults	B1	B9	B13																															
				4	4																															
A57	3	Increase harvest of Pacific lamprey adults	B1	B13	B24																															
			2	9	3		11		2	2	2	4	4			2		2	3																	
A58	17	Increase the size, frequency and topographic relief of bar/pool sequences	B1	B3	B4	B5	B8	B9	B11	B13	B14	B20	B21	B22	B23	B26	B27	B28	B30																	
				3	7	3																														
A59	5	Increase population size, survival, distribution, and recruitment success of Western Pond Turtles	B3	B7	B12	B25	B31																													

Number	# purpose objectives	Objective	Purpose Objectives																														Number	Objective	# means objectives
			3	10		2	14			3	4	12	5	2	3	5	2		2	2	11	2	6												
A1	21	Frequently exceed channel migration, bed mobilization, and bed scour thresholds	B1	B3	B4	B5	B8	B9	B10	B11	B13	B14	B17	B19	B20	B21	B23	B25	B26	B27	B28	B30	B31										B1	Increase freshwater production of anadromous fish	48
			12	5	8	10	9		3	4	7	11	4	10																					
A2	12	Reduce temperature related pre-spawning mortality and protect in-vivo egg viability of anadromous spawners in the mainstem Trinity River	B1	B5	B9	B11	B13	B17	B20	B21	B23	B26	B27	B30																			B2	Minimize impacts of predation, competition, and genetic interactions between and among hatchery and natural anadromous fish	9
			5	2	3	3	3	4	5	4	13	3	7	5	4		3		8																
A3	18	Transport fine sediment through mainstem at a rate greater than tributary input	B1	B3	B5	B8	B9	B11	B13	B14	B17	B20	B21	B22	B23	B24	B27	B28	B30	B31													B3	Increase physical habitat diversity and availability	34
			4	12	4	2	13		2	3	8	3		2	4	2	2	2	9	4	3														
A4	19	Encourage bed-level fluctuations on annual to multi-year time scales	B1	B3	B4	B5	B8	B9	B11	B13	B14	B17	B19	B20	B21	B23	B26	B27	B28	B30	B31												B4	Increase and maintain coarse sediment storage	27
			9		8		6	2	7	9	8		7	10		8		5		10															
A5	18	Increase/maintain spawning habitat quantity and quality to 2,550,000 square feet in the upper 40 miles of the mainstem Trinity River	B1	B2	B3	B4	B5	B8	B9	B11	B13	B17	B20	B21	B22	B23	B26	B27	B28	B30													B5	Increase naturally produced coho salmon adult production to the extent necessary to meet or exceed escapement objectives and facilitate expanded harvest opportunity	28
					3				5					6	5		2																		
A6	16	Minimize temperature impacts to other native fish habitats	B1	B5	B7	B9	B11	B13	B16	B19	B20	B21	B23	B24	B26	B27	B30	B31															B6	Increase population size, survival, distribution, and recruitment success of Foothill Yellow-legged Frogs (FYLF)	5
			3	11	4	2	12			4	3	5	3		6	6	3			3	6	2	2												
A7	21	Increase channel/thalweg sinuosity	B1	B3	B4	B5	B8	B9	B10	B11	B13	B14	B17	B19	B20	B21	B23	B24	B26	B27	B28	B30	B31										B7	Minimize adverse impacts to additional native riparian or aquatic associated wildlife from Program activities. Focus on wildlife species associated with a healthy river ecosystem, not necessarily all species	12
			6	5																															
A8	2	Increase harvest of naturally produced spring-run Chinook salmon adults	B13	B23																											B8	Create and maintain spatially complex channel morphology	25
			4	9	7	2	12	2	4	4	3	4		4	6		3			2	9	4													
A9	21	Route coarse sediment through all reaches	B1	B3	B4	B5	B8	B9	B11	B13	B14	B17	B19	B20	B21	B22	B23	B24	B26	B27	B28	B30	B31										B9	Increase naturally produced fall-run Chinook salmon adult production to the extent necessary to meet or exceed escapement objectives and facilitate expanded harvest opportunity	23
			3	3		2	3	2	4	4	3	12	4	6	5	3		4		6	2														
A10	19	Reduce fine sediment supply from tributary watersheds	B1	B3	B4	B5	B8	B9	B11	B13	B14	B17	B20	B21	B22	B23	B24	B27	B28	B30	B31												B10	Recover riparian vegetation area equal or greater than disturbed by physical rehabilitation	5
			4			7	4	10																											
A11	8	Increase escapement of naturally produced fall-run Chinook salmon to 62,000 adults	B1	B2	B3	B9	B11	B13	B23	B30																							B11	Restore and maintain natural production of anadromous fish populations	23
			11		6	6	11	9		4	5	5	2	7	6	4																			
A12	14	Improve thermal regimes for outmigrant salmonid growth and survival (dependent on water year)	B1	B3	B5	B9	B11	B13	B16	B20	B21	B23	B24	B26	B27	B30																	B12	Increase population size, survival, distribution, and recruitment success of Western Pond Turtle (WPT)	7
			5	3	5			9																											
A13	6	Increase escapement of Pacific lamprey adults	B1	B11	B13	B14	B21	B24																									B13	Restore adult anadromous fish numbers to pre-Trinity River Dam levels in order to facilitate dependent tribal, commercial, and sport fisheries full participation in the benefits of restoration via enhanced harvest opportunities	32
			2	6		11	6	3																											
A14	6	Increase structural and thermal diversity of aquatic habitats used by various age classes of Western Pond Turtles	B3	B7	B8	B12	B25	B31																									B14	Prevent riparian vegetation from exceeding thresholds leading to encroachment that simplifies channel morphology and degrades aquatic habitat quality	17
			3				2			2	2		4						4																
A15	21	Minimize physical impacts to other native fish habitats	B1	B3	B4	B5	B7	B8	B9	B11	B13	B14	B16	B17	B19	B20	B21	B23	B24	B26	B27	B30	B31										B15	Maintain Trinity River riverine bird populations and species diversity in the Program area	6
			7		5	4	5	6	2	4	2	2		3		2	9	2		4															
A16	18	Increase and maintain macroinvertebrate populations	B1	B2	B5	B6	B9	B11	B12	B13	B15	B16	B17	B18	B20	B21	B22	B23	B24	B27													B16	Increase naturally produced green sturgeon adult production to the extent necessary to meet or exceed escapement objectives and facilitate expanded harvest opportunity	23
			6	12	5	4	5	2			5	5																							
A17	10	Limit impacts of hatchery fish predation on naturally produced juvenile salmonids to less than 20% over the 40 miles	B1	B2	B5	B9	B11	B13	B20	B21	B23	B27																					B17	Reduce fine sediment storage in the mainstem Trinity River	12
			7	4		6																													
A18	5	Increase population size, survival, distribution, and recruitment success of Foothill Yellow-legged Frogs	B6	B7	B19	B25	B31																										B18	Maintain Trinity populations and species diversity of birds using the riparian zone in the Program area	4
			2	9	2	2		7	3	2	3		4	3			8	4	5		3		2	3	2		9								
A19	25	Encourage establishment of riparian species on surfaces within the future channel migration corridor that will recruit LWD	B1	B3	B4	B5	B7	B8	B9	B10	B11	B12	B13	B14	B15	B18	B19	B20	B21	B22	B23	B25	B26	B27	B28	B29	B31						B19	Establish and maintain riparian vegetation that supports fish and wildlife	10
			4	5	8	7																													
A20	4	Increase escapement of naturally produced spring-run Chinook salmon to 6,000 adults	B1	B11	B13	B23																											B20	Increase and maintain salmonid habitat availability for all freshwater (in-river and tributary) life stages	25
			4	4	2	4	3	4	5	6	3	7	7	6		4																			

A21	14	Maintain or increase adult holding habitat from baseline conditions in the mainstem Trinity River	B1	B3	B4	B5	B8	B9	B11	B13	B16	B20	B21	B23	B26	B27																		B21	Increase/improve habitats for freshwater life stages of anadromous fish to the extent necessary to meet or exceed production goals	22
			2	8			9			2	2	3	2					2	2																
A22	17	Increase geomorphic unit and substrate patch diversity	B1	B3	B4	B5	B8	B9	B11	B13	B17	B20	B21	B22	B23	B26	B27	B28	B30															B22	Enhance or maintain food availability for fry and juvenile salmonids	5
			3		4																														
A23	3	Increase harvest of naturally produced coho adult salmon adults	B5	B11	B13																													B23	Increase naturally produced spring-run Chinook salmon adult production to the extent necessary to meet or exceed escapement objectives and facilitate expanded harvest opportunity	21
			9		7	6	6	10		5		2	6																						
A24	12	Increase outmigrant juvenile life stage abundance, growth, physical condition and health from baseline conditions in the mainstem Trinity River within 3-4 brood cycles following rehabilitation of fluvial river processes	B1	B2	B5	B9	B11	B13	B20	B23	B24	B26	B27	B29																				B24	Increase naturally produced Pacific lamprey adult production to the extent necessary to meet or exceed escapement objectives and facilitate expanded harvest opportunity	15
			5	4																															
A25	2	Increase harvest of naturally produced steelhead adults	B13	B27																														B25	Rehabilitate and protect wildlife habitats and maintain or enhance wildlife populations following implementation	9
			4		3	4	4		3		4	4	2	3	2	3	4	2	3	2	3	3	3		3		4								
A26	25	Discourage invasive species	B1	B3	B5	B6	B7	B8	B9	B10	B11	B13	B14	B15	B16	B18	B19	B20	B21	B22	B23	B24	B25	B26	B27	B30	B31							B26	Improve riverine thermal conditions for growth and survival of natural anadromous salmonids	14
			4	11	8	3	9	3	3	4				3	3		3		3	6	2														
A27	19	Increase and maintain target coarse sediment transport rates	B1	B3	B4	B5	B8	B9	B11	B13	B14	B16	B17	B20	B21	B22	B23	B26	B27	B28	B30													B27	Increase naturally produced steelhead adult production to the extent necessary to meet or exceed escapement objectives and facilitate expanded harvest opportunity	21
			9	2		6		6	7	9		3	3		5		5																		
A28	16	Improve juvenile fish production as a function of water temperature and habitat flow relationships from baseline conditions in the mainstem Trinity River within 3-4 brood cycles following rehabilitation of fluvial river processes	B1	B3	B4	B5	B8	B9	B11	B13	B16	B20	B21	B22	B23	B26	B27	B30																B28	Increase coarse sediment transport and channel dynamics	14
			5		3	7		2	6	4	8	8			6																				
A29	13	Increase species, structural, and age diversity of riparian vegetation to improve and maintain wildlife habitat	B3	B6	B7	B10	B12	B14	B15	B18	B19	B25	B26	B29	B31																			B29	Minimize impacts of riverine bird predation on fry and smolts	4
			6	7	2		5		5	5	6		2		4	5																			
A30	15	Increase proportion of Natural Influence (pNI) to 0.7 or greater	B1	B2	B3	B4	B5	B8	B9	B11	B13	B16	B20	B21	B23	B27	B30																	B30	Increase spawning, incubation and emergence success of anadromous spawners	23
			5	9	2	3		11	3	5		4		2	3	4		3			3	2													
A31	22	Increase bars, side-channels, alcoves, and other complex alluvial features	B1	B3	B4	B5	B6	B8	B9	B11	B12	B13	B14	B16	B20	B21	B22	B23	B25	B26	B27	B28	B30	B31										B31	Promote diverse native riparian vegetation on different geomorphic surfaces that contribute to complex channel morphology and high quality aquatic and terrestrial habitat	15
					3		8	5																											
A32	7	Increase recruitment of younger age classes of Western Pond Turtles	B3	B6	B7	B8	B12	B25	B31																										
			4	7			2		3	3	3				3	3	7																		
A33	15	Adapt timing of hatchery release to alter distribution of avian predators and minimize predation on natural fry and smolts	B1	B2	B3	B4	B5	B8	B9	B11	B13	B16	B20	B21	B23	B27	B29																		
			8			7		6	6	7	2	3	4	6		7	5		3																
A34	17	Improve thermal regimes for rearing growth and survival of juvenile steelhead, coho salmon and Chinook salmon	B1	B3	B4	B5	B8	B9	B11	B13	B16	B20	B21	B23	B24	B26	B27	B28	B30																
			7	2	8	5	5	5	7	5		5																							
A35	9	Provide optimal temperatures to improve spawning success of spring and fall-run Chinook salmon	B1	B5	B9	B11	B13	B21	B23	B26	B27	B30																							
			3	6		2		8	2		2	4	7			2	2	3		2		2			6										
A36	23	Manage flows, coarse sediment augmentation, and channel rehabilitation that cause sufficient riparian plant mortality along low water margins to prevent channel simplification leading to degraded fish habitat	B1	B3	B4	B5	B7	B8	B9	B10	B11	B13	B14	B16	B17	B19	B20	B21	B22	B23	B26	B27	B28	B30	B31										
			3	9		5																													
A37	4	Increase escapement of naturally produced coho salmon to 1,400 adults	B1	B5	B11	B13																													
			7	4			5		5	8	5		2	4	5	4																			
A38	16	Reduce non-native fish predation on naturally produced fish by 50% in the mainstem Trinity River within 3-4 brood cycles following rehabilitation of fluvial river processes	B1	B2	B3	B4	B5	B8	B9	B11	B13	B16	B20	B21	B23	B27	B28	B30																	
			10				6		6	8	7			2	6	5																			
A39	15	Increase fry abundance, growth, physical condition, and health from baseline conditions in the mainstem Trinity River within 3-4 brood cycles following rehabilitation of fluvial river processes	B1	B2	B3	B4	B5	B8	B9	B11	B13	B16	B20	B21	B23	B27	B30																		
			7	3		6	2	6	6	8		3	3	6	5		4																		

A40	15	Optimize adult utilization of suitable spawning habitat areas in tributaries within 3-4 brood cycles following rehabilitation of fluvial river processes	B1	B3	B4	B5	B8	B9	B11	B13	B16	B20	B21	B23	B27	B28	B30																		
			2	4		5	7	2	7	3																									
A41	8	Enhance quality and maintain quantity of riparian bird nesting and foraging habitats	B3	B7	B12	B15	B18	B19	B25	B31																									
			9	4		6	3	6	7	8		4	5	6	5	2	2																		
A42	15	Increase/maintain salmonid fry and juvenile rearing habitat in the upper 40 miles of the mainstem Trinity River by a minimum of 400 % following rehabilitation of fluvial attributes	B1	B3	B4	B5	B8	B9	B11	B13	B16	B20	B21	B23	B27	B28	B30																		
			8		5		5	2	5	5	7			4	4		5				6		2												
A43	21	Maintain or increase tributary habitat	B1	B2	B3	B4	B5	B8	B9	B11	B13	B16	B17	B20	B21	B22	B23	B24	B25	B26	B27	B28	B30												
			3			2			9																										
A44	7	Minimize physical impacts to lamprey habitat	B1	B3	B11	B13	B20	B21	B24																										
			7	5		3	5	4	3	4	4		5	2	3		3	8	2	5	2	3	5		3		9								
A45	23	Encourage establishment of vegetation that provides habitat for anadromous fish, aquatic organisms and aquatic / riparian wildlife	B1	B3	B4	B5	B7	B8	B9	B10	B11	B12	B13	B14	B15	B16	B18	B19	B20	B21	B22	B23	B25	B26	B27	B30	B31								
				2	4																														
A46	3	Increase harvest of green sturgeon adults	B1	B13	B16																														
					3	2	3			7	4	5	7	4																					
A47	12	Enhance quality and maintain quantity of riverine bird nesting and foraging habitats	B1	B3	B7	B8	B10	B13	B14	B15	B18	B19	B25	B31																					
			4	7					6																										
A48	7	Increase escapement of naturally produced steelhead to 40,000 adults	B1	B13	B15	B18	B19	B25	B27																										
			7	3		4		5	6	6		2	4	5	6	4																			
A49	14	Optimize adult utilization of suitable spawning habitat areas in the mainstem within 3-4 brood cycles following rehabilitation of fluvial river processes	B1	B3	B4	B5	B8	B9	B11	B13	B16	B20	B21	B23	B27	B30																			
			11			4		4	9	6	2		3	4		3																			
A50	15	Reduce clinical disease incidence in Trinity	B1	B3	B4	B5	B8	B9	B11	B13	B16	B20	B21	B23	B24	B27	B30																		
			2	3	2		4	2	9	2	2		5		7				2		2		7												
A51	21	Encourage fine sediment deposition on floodplains	B1	B3	B5	B7	B8	B9	B10	B11	B13	B15	B17	B18	B19	B20	B21	B22	B23	B25	B27	B28	B31												
			9	2		4		2	4	8	5			4	4	4	3																		
A52	17	Create channel form that reduces loss of	B1	B3	B4	B5	B7	B8	B9	B11	B13	B14	B16	B20	B21	B23	B27	B29	B30																
			9	2		4		2	4	8	5			3	4	4	4																		
A53	17	Reduce fry stranding in the upper 40 miles of the mainstem Trinity River by 50% following rehabilitation of fluvial river processes	B1	B3	B4	B5	B7	B8	B9	B11	B13	B14	B16	B20	B21	B23	B27	B29	B30																
			2		5	8																													
A54	5	Increase escapement of green sturgeon adults	B1	B11	B13	B16	B24																												
			2	10	3			5																											
A55	5	Increase quality and quantity of breeding and rearing habitat for Foothill Yellow-legged Frogs	B3	B6	B7	B15	B19	B25																											
				3	4																														
A56	3	Increase harvest of naturally produced fall-run Chinook salmon adults	B1	B9	B13																														
				4	4																														
A57	3	Increase harvest of Pacific lamprey adults	B1	B13	B24																														
			2	9	3		11		2	2	2	4	4			2		2	3																
A58	17	Increase the size, frequency and topographic relief of bar/pool sequences	B1	B3	B4	B5	B8	B9	B11	B13	B14	B20	B21	B22	B23	B26	B27	B28	B30																
				3	7	3																													
A59	5	Increase population size, survival, distribution, and recruitment success of Western Pond Turtles	B3	B7	B12	B25	B31																												

Number	Objective	Number	# means objectives	# pupose objectives
B1	Increase freshwater production of anadromous fish	B1	48	27
B3	Increase physical habitat diversity and availability	B3	34	36
B13	Restore adult anadromous fish numbers to pre-Trinity River Dam levels in order to facilitate dependent tribal, commercial, and sport fisheries full participation in the benefits of restoration via enhanced harvest opportunities	B13	32	23
B5	Increase naturally produced coho salmon adult production to the extent necessary to meet or exceed escapement objectives and facilitate expanded harvest opportunity	B5	28	15
B4	Increase and maintain coarse sediment storage	B4	27	32
B8	Create and maintain spatially complex channel morphology	B8	25	43
B20	Increase and maintain salmonid habitat availability for all freshwater (in-river and tributary) life stages	B20	25	32
B9	Increase naturally produced fall-run Chinook salmon adult production to the extent necessary to meet or exceed escapement objectives and facilitate expanded harvest opportunity	B9	23	7
B11	Restore and maintain natural production of anadromous fish populations	B11	23	22
B16	Increase naturally produced green sturgeon adult production to the extent necessary to meet or exceed escapement objectives and facilitate expanded harvest opportunity	B16	23	4
B30	Increase spawning, incubation and emergence success of anadromous spawners	B30	23	20
B21	Increase/improve habitats for freshwater life stages of anadromous fish to the extent necessary to meet or exceed production goals	B21	22	35
B23	Increase naturally produced spring-run Chinook salmon adult production to the extent necessary to meet or exceed escapement objectives and facilitate expanded harvest opportunity	B23	21	5
B27	Increase naturally produced steelhead adult production to the extent necessary to meet or exceed escapement objectives and facilitate expanded harvest opportunity	B27	21	15
A8	Increase harvest of naturally produced spring-run Chinook salmon adults	A8	21	2
B14	Prevent riparian vegetation from exceeding thresholds leading to encroachment that simplifies channel morphology and degrades aquatic habitat quality	B14	17	31
A43	Maintain or increase tributary habitat	A43	17	21
B24	Increase naturally produced Pacific lamprey adult production to the extent necessary to meet or exceed escapement objectives and facilitate expanded harvest opportunity	B24	15	3
B31	Promote diverse native riparian vegetation on different geomorphic surfaces that contribute to complex channel morphology and high quality aquatic and terrestrial habitat	B31	15	29
A11	Increase escapement of naturally produced fall-run Chinook salmon to 62,000 adults	A11	15	8
A20	Increase escapement of naturally produced spring-run Chinook salmon to 6,000 adults	A20	15	4
A46	Increase harvest of green sturgeon adults	A46	15	3
B26	Improve riverine thermal conditions for growth and survival of natural anadromous salmonids	B26	14	29
B28	Increase coarse sediment transport and channel dynamics	B28	14	15
A13	Increase escapement of Pacific lamprey adults	A13	14	6
A56	Increase harvest of naturally produced fall-run Chinook salmon adults	A56	14	3

Sorted by means objectives, highest to lowest

Highlighted the top 15 (with >= 20 means objectives)

A57	Increase harvest of Pacific lamprey adults	A57	14	3
A30	Increase proportion of Natural Influence (pNI) to 0.7 or greater	A30	13	15
A37	Increase escapement of naturally produced coho salmon to 1,400 adults	A37	13	4
A54	Increase escapement of green sturgeon adults	A54	13	5
B7	Minimize adverse impacts to additional native riparian or aquatic associated wildlife from Program activities. Focus on wildlife species associated with a healthy river ecosystem, not necessarily all species	B7	12	27
B17	Reduce fine sediment storage in the mainstem Trinity River	B17	12	26
A48	Increase escapement of naturally produced steelhead to 40,000 adults	A48	12	7
A23	Increase harvest of naturally produced coho adult salmon adults	A23	11	3
A24	Increase outmigrant juvenile life stage abundance, growth, physical condition and health from baseline conditions in the mainstem Trinity River within 3-4 brood cycles following rehabilitation of fluvial river processes	A24	11	12
A25	Increase harvest of naturally produced steelhead adults	A25	11	2
B19	Establish and maintain riparian vegetation that supports fish and wildlife	B19	10	49
B2	Minimize impacts of predation, competition, and genetic interactions between and among hatchery and natural anadromous fish	B2	9	21
B25	Rehabilitate and protect wildlife habitats and maintain or enhance wildlife populations following implementation	B25	9	9
A5	Increase/maintain spawning habitat quantity and quality to 2,550,000 square feet in the upper 40 miles of the mainstem Trinity River	A5	9	18
A42	Increase/maintain salmonid fry and juvenile rearing habitat in the upper 40 miles of the mainstem Trinity River by a minimum of 400 % following rehabilitation of fluvial attributes	A42	9	15
B12	Increase population size, survival, distribution, and recruitment success of Western Pond Turtle (WPT)	B12	7	2
A22	Increase geomorphic unit and substrate patch diversity	A22	7	17
A49	Optimize adult utilization of suitable spawning habitat areas in the mainstem within 3-4 brood cycles following rehabilitation of fluvial river processes	A49	7	14
B15	Maintain Trinity River riverine bird populations and species diversity in the Program area	B15	6	3
A16	Increase and maintain macroinvertebrate populations	A16	6	18
A19	Encourage establishment of riparian species on surfaces within the future channel migration corridor that will recruit LWD	A19	6	25
A28	Improve juvenile fish production as a function of water temperature and habitat flow relationships from baseline conditions in the mainstem Trinity River within 3-4 brood cycles following rehabilitation of fluvial river processes	A28	6	16
A34	Improve thermal regimes for rearing growth and survival of juvenile steelhead, coho salmon and Chinook salmon	A34	6	17
A39	Increase fry abundance, growth, physical condition, and health from baseline conditions in the mainstem Trinity River within 3-4 brood cycles following rehabilitation of fluvial river processes	A39	6	15
A53	Reduce fry stranding in the upper 40 miles of the mainstem Trinity River by 50% following rehabilitation of fluvial river processes	A53	6	17
B6	Increase population size, survival, distribution, and recruitment success of Foothill Yellow-legged Frogs (FYLF)	B6	5	5
B10	Recover riparian vegetation area equal or greater than disturbed by physical rehabilitation	B10	5	15
B22	Enhance or maintain food availability for fry and juvenile salmonids	B22	5	18
A7	Increase channel/thalweg sinuosity	A7	5	21

A12	Improve thermal regimes for outmigrant salmonid growth and survival (dependent on water year)	A12	5	14
A14	Increase structural and thermal diversity of aquatic habitats used by various age classes of Western Pond Turtles	A14	5	6
A18	Increase population size, survival, distribution, and recruitment success of Foothill Yellow-legged Frogs	A18	5	5
A29	Increase species, structural, and age diversity of riparian vegetation to improve and maintain wildlife habitat	A29	5	13
A35	Provide optimal temperatures to improve spawning success of spring and fall-run Chinook salmon	A35	5	9
A41	Enhance quality and maintain quantity of riparian bird nesting and foraging habitats	A41	5	8
A52	Create channel form that reduces loss of fry to stranding in the upper 40 miles of the mainstem Trinity River following rehabilitation during high flows	A52	5	17
A59	Increase population size, survival, distribution, and recruitment success of Western Pond Turtles	A59	5	5
B18	Maintain Trinity populations and species diversity of birds using the riparian zone in the Program area	B18	4	3
B29	Minimize impacts of riverine bird predation on fry and smolts	B29	4	13
A1	Frequently exceed channel migration, bed mobilization, and bed scour thresholds	A1	4	21
A6	Minimize temperature impacts to other native fish habitats	A6	4	16
A27	Increase and maintain target coarse sediment transport rates	A27	4	19
A31	Increase bars, side-channels, alcoves, and other complex alluvial features	A31	4	22
A45	Encourage establishment of vegetation that provides habitat for anadromous fish, aquatic organisms and aquatic / riparian wildlife	A45	4	23
A55	Increase quality and quantity of breeding and rearing habitat for Foothill Yellow-legged Frogs	A55	4	5
A58	Increase the size, frequency and topographic relief of bar/pool sequences	A58	4	17
A4	Encourage bed-level fluctuations on annual to multi-year time scales	A4	3	19
A9	Route coarse sediment through all reaches	A9	3	21
A17	Limit impacts of hatchery fish predation on naturally produced juvenile salmonids to less than 20% over the 40 miles	A17	3	10
A21	Maintain or increase adult holding habitat from baseline conditions in the mainstem Trinity River	A21	3	14
A47	Enhance quality and maintain quantity of riverine bird nesting and foraging habitats	A47	3	12
A26	Discourage invasive species	A26	2	25
A32	Increase recruitment of younger age classes of Western Pond Turtles	A32	2	7
A36	Manage flows, coarse sediment augmentation, and channel rehabilitation that cause sufficient riparian plant mortality along low water margins to prevent channel simplification leading to degraded fish habitat	A36	2	23
A51	Encourage fine sediment deposition on floodplains	A51	2	21
A2	Reduce temperature related pre-spawning mortality and protect in-vivo egg viability of anadromous spawners in the mainstem Trinity River	A2	1	12
A3	Transport fine sediment through mainstem at a rate greater than tributary input	A3	1	18
A10	Reduce fine sediment supply from tributary watersheds	A10	1	19
A15	Minimize physical impacts to other native fish habitats	A15	1	21

A38	Reduce non-native fish predation on naturally produced fish by 50% in the mainstem Trinity River within 3-4 brood cycles following rehabilitation of fluvial river processes	A38	1	16
A40	Optimize adult utilization of suitable spawning habitat areas in tributaries within 3-4 brood cycles following rehabilitation of fluvial river processes	A40	1	15
A33	Adapt timing of hatchery release to alter distribution of avian predators and minimize predation on natural fry and smolts	A33	0	15
A44	Minimize physical impacts to lamprey habitat	A44	0	7
A50	Reduce clinical disease incidence in Trinity River origin outmigrants in the Klamath River to less than 20% within 5 years	A50	0	15

Number	Objective	# means objectives	# pupose objectives
A8	Increase harvest of naturally produced spring-run Chinook salmon adults	21	2
A25	Increase harvest of naturally produced steelhead adults	11	2
B12	Increase population size, survival, distribution, and recruitment success of Western Pond Turtle (WPT)	7	2
B24	Increase naturally produced Pacific lamprey adult production to the extent necessary to meet or exceed escapement objectives and facilitate expanded harvest opportunity	15	3
A46	Increase harvest of green sturgeon adults	15	3
A56	Increase harvest of naturally produced fall-run Chinook salmon adults	14	3
A57	Increase harvest of Pacific lamprey adults	14	3
A23	Increase harvest of naturally produced coho adult salmon adults	11	3
B15	Maintain Trinity River riverine bird populations and species diversity in the Program area	6	3
B18	Maintain Trinity populations and species diversity of birds using the riparian zone in the Program area	4	3
B16	Increase naturally produced green sturgeon adult production to the extent necessary to meet or exceed escapement objectives and facilitate expanded harvest opportunity	23	4
A20	Increase escapement of naturally produced spring-run Chinook salmon to 6,000 adults	15	4
A37	Increase escapement of naturally produced coho salmon to 1,400 adults	13	4
B23	Increase naturally produced spring-run Chinook salmon adult production to the extent necessary to meet or exceed escapement objectives and facilitate expanded harvest opportunity	21	5
A54	Increase escapement of green sturgeon adults	13	5
B6	Increase population size, survival, distribution, and recruitment success of Foothill Yellow-legged Frogs (FYLF)	5	5
A18	Increase population size, survival, distribution, and recruitment success of Foothill Yellow-legged Frogs	5	5
A59	Increase population size, survival, distribution, and recruitment success of Western Pond Turtles	5	5
A55	Increase quality and quantity of breeding and rearing habitat for Foothill Yellow-legged Frogs	4	5
A13	Increase escapement of Pacific lamprey adults	14	6
A14	Increase structural and thermal diversity of aquatic habitats used by various age classes of Western Pond Turtles	5	6
B9	Increase naturally produced fall-run Chinook salmon adult production to the extent necessary to meet or exceed escapement objectives and facilitate expanded harvest opportunity	23	7
A48	Increase escapement of naturally produced steelhead to 40,000 adults	12	7
A32	Increase recruitment of younger age classes of Western Pond Turtles	2	7
A44	Minimize physical impacts to lamprey habitat	0	7
A11	Increase escapement of naturally produced fall-run Chinook salmon to 62,000 adults	15	8

Sorted by purpose objectives, lowest to highest

A41	Enhance quality and maintain quantity of riparian bird nesting and foraging habitats	5	8
B25	Rehabilitate and protect wildlife habitats and maintain or enhance wildlife populations following implementation	9	9
A35	Provide optimal temperatures to improve spawning success of spring and fall-run Chinook salmon	5	9
A17	Limit impacts of hatchery fish predation on naturally produced juvenile salmonids to less than 20% over the 40 miles	3	10
A24	Increase outmigrant juvenile life stage abundance, growth, physical condition and health from baseline conditions in the mainstem Trinity River within 3-4 brood cycles following rehabilitation of fluvial river processes	11	12
A47	Enhance quality and maintain quantity of riverine bird nesting and foraging habitats	3	12
A2	Reduce temperature related pre-spawning mortality and protect in-vivo egg viability of anadromous spawners in the mainstem Trinity River	1	12
A29	Increase species, structural, and age diversity of riparian vegetation to improve and maintain wildlife habitat	5	13
B29	Minimize impacts of riverine bird predation on fry and smolts	4	13
A49	Optimize adult utilization of suitable spawning habitat areas in the mainstem within 3-4 brood cycles following rehabilitation of fluvial river processes	7	14
A12	Improve thermal regimes for outmigrant salmonid growth and survival (dependent on water year)	5	14
A21	Maintain or increase adult holding habitat from baseline conditions in the mainstem Trinity River	3	14
B5	Increase naturally produced coho salmon adult production to the extent necessary to meet or exceed escapement objectives and facilitate expanded harvest opportunity	28	15
B27	Increase naturally produced steelhead adult production to the extent necessary to meet or exceed escapement objectives and facilitate expanded harvest opportunity	21	15
B28	Increase coarse sediment transport and channel dynamics	14	15
A30	Increase proportion of Natural Influence (pNI) to 0.7 or greater	13	15
A42	Increase/maintain salmonid fry and juvenile rearing habitat in the upper 40 miles of the mainstem Trinity River by a minimum of 400 % following rehabilitation of fluvial attributes	9	15
A39	Increase fry abundance, growth, physical condition, and health from baseline conditions in the mainstem Trinity River within 3-4 brood cycles following rehabilitation of fluvial river processes	6	15
B10	Recover riparian vegetation area equal or greater than disturbed by physical rehabilitation	5	15
A40	Optimize adult utilization of suitable spawning habitat areas in tributaries within 3-4 brood cycles following rehabilitation of fluvial river processes	1	15
A33	Adapt timing of hatchery release to alter distribution of avian predators and minimize predation on natural fry and smolts	0	15
A50	Reduce clinical disease incidence in Trinity River origin outmigrants in the Klamath River to less than 20% within 5 years	0	15

A28	Improve juvenile fish production as a function of water temperature and habitat flow relationships from baseline conditions in the mainstem Trinity River within 3-4 brood cycles following rehabilitation of fluvial river processes	6	16
A6	Minimize temperature impacts to other native fish habitats	4	16
A38	Reduce non-native fish predation on naturally produced fish by 50% in the mainstem Trinity River within 3-4 brood cycles following rehabilitation of fluvial river processes	1	16
A22	Increase geomorphic unit and substrate patch diversity	7	17
A34	Improve thermal regimes for rearing growth and survival of juvenile steelhead, coho salmon and Chinook salmon	6	17
A53	Reduce fry stranding in the upper 40 miles of the mainstem Trinity River by 50% following rehabilitation of fluvial river processes	6	17
A52	Create channel form that reduces loss of fry to stranding in the upper 40 miles of the mainstem Trinity River following rehabilitation during high flows	5	17
A58	Increase the size, frequency and topographic relief of bar/pool sequences	4	17
A5	Increase/maintain spawning habitat quantity and quality to 2,550,000 square feet in the upper 40 miles of the mainstem Trinity River	9	18
A16	Increase and maintain macroinvertebrate populations	6	18
B22	Enhance or maintain food availability for fry and juvenile salmonids	5	18
A3	Transport fine sediment through mainstem at a rate greater than tributary input	1	18
A27	Increase and maintain target coarse sediment transport rates	4	19
A4	Encourage bed-level fluctuations on annual to multi-year time scales	3	19
A10	Reduce fine sediment supply from tributary watersheds	1	19
B30	Increase spawning, incubation and emergence success of anadromous spawners	23	20
A43	Maintain or increase tributary habitat	17	21
B2	Minimize impacts of predation, competition, and genetic interactions between and among hatchery and natural anadromous fish	9	21
A7	Increase channel/thalweg sinuosity	5	21
A1	Frequently exceed channel migration, bed mobilization, and bed scour thresholds	4	21
A9	Route coarse sediment through all reaches	3	21
A51	Encourage fine sediment deposition on floodplains	2	21
A15	Minimize physical impacts to other native fish habitats	1	21
B11	Restore and maintain natural production of anadromous fish populations	23	22
A31	Increase bars, side-channels, alcoves, and other complex alluvial features	4	22
B13	Restore adult anadromous fish numbers to pre-Trinity River Dam levels in order to facilitate dependent tribal, commercial, and sport fisheries full participation in the benefits of restoration via enhanced harvest opportunities	32	23
A45	Encourage establishment of vegetation that provides habitat for anadromous fish, aquatic organisms and aquatic / riparian wildlife	4	23
A36	Manage flows, coarse sediment augmentation, and channel rehabilitation that cause sufficient riparian plant mortality along low water margins to prevent channel simplification leading to degraded fish habitat	2	23
A19	Encourage establishment of riparian species on surfaces within the future channel migration corridor that will recruit LWD	6	25
A26	Discourage invasive species	2	25

B17	Reduce fine sediment storage in the mainstem Trinity River	12	26
B1	Increase freshwater production of anadromous fish	48	27
B7	Minimize adverse impacts to additional native riparian or aquatic associated wildlife from Program activities. Focus on wildlife species associated with a healthy river ecosystem, not necessarily all species	12	27
B31	Promote diverse native riparian vegetation on different geomorphic surfaces that contribute to complex channel morphology and high quality aquatic and terrestrial habitat	15	29
B26	Improve riverine thermal conditions for growth and survival of natural anadromous salmonids	14	29
B14	Prevent riparian vegetation from exceeding thresholds leading to encroachment that simplifies channel morphology and degrades aquatic habitat quality	17	31
B4	Increase and maintain coarse sediment storage	27	32
B20	Increase and maintain salmonid habitat availability for all freshwater (in-river and tributary) life stages	25	32
B21	Increase/improve habitats for freshwater life stages of anadromous fish to the extent necessary to meet or exceed production goals	22	35
B3	Increase physical habitat diversity and availability	34	36
B8	Create and maintain spatially complex channel morphology	25	43
B19	Establish and maintain riparian vegetation that supports fish and wildlife	10	49

Appendix H: Revised Objective Hierarchy based on Pre-Workshop Assignment

Objectives here are rearranged using the homework responses as a guide.

Everything in purple is Nicole's comments.

Numbers refer to the numbers from the homework exercise. Numbers in () are the primary (i.e., most popular) responses that indicate the PURPOSE of that objective. The underlined number following the () is the number of the objective itself.

- FUNDAMENTAL OBJECTIVE 1 (WHAT AND WHY): FACILITATE HARVEST
  - Restore adult anadromous fish numbers to pre-Trinity River Dam levels in order to facilitate dependent tribal, commercial, and sport fisheries full participation in the benefits of restoration via enhanced harvest opportunities (Fundamental) (A8, A23, A25, A46, A56) B13 (Fundamental; Facilitate Harvest) I think there is an additional implied sociopolitical objective here, for which increasing numbers of fish is a means objective. It might be good to separate those out for the sake of clarity.
    - NATURAL FISH POPULATIONS - restoring natural fish production will result in increased abundance and increase harvest opportunities. See below for the objectives for NATURAL FISH POPULATIONS.
    - Increase harvest of naturally produced spring-run Chinook salmon adults (B13, B23) A8
      - Increase escapement of naturally produced spring-run Chinook salmon to 6,000 adults (B1, B11, **B13, B23**) A20
      - Increase naturally produced spring-run Chinook salmon adult production to the extent necessary to meet or exceed escapement objectives and facilitate expanded harvest opportunity (A8, A20, B13) B23
    - Increase harvest of naturally produced fall-run Chinook salmon adults (B9, B13) A56
      - Increase escapement of naturally produced fall-run Chinook salmon to 62,000 adults (B1, B11, B9, **B13**) A11
      - Increase naturally produced fall-run Chinook salmon adult production to the extent necessary to meet or exceed escapement objectives and facilitate expanded harvest opportunity (A11, A56, B13) B9
    - Increase harvest of naturally produced coho adult salmon adults (B5, B13) A23
      - Increase naturally produced coho salmon adult production to the extent necessary to meet or exceed escapement objectives and facilitate expanded harvest opportunity (A23, A37, B13) B5
      - Increase escapement of naturally produced coho salmon to 1,400 adults (B1, **B5**, B13) A37
    - Increase harvest of naturally produced steelhead adults (B13, B27) A25
      - Increase escapement of naturally produced steelhead to 40,000 adults (B1, **B13, B27**) A48

        - Increase naturally produced steelhead adult production to the extent necessary to meet or exceed escapement objectives and facilitate expanded harvest opportunity (A25, A48, B13) B27
    - Increase harvest of green sturgeon adults (B13, **B16**) A46
        - Increase escapement of green sturgeon adults (B13, **B16**) A54
        - Increase naturally produced green sturgeon adult production to the extent necessary to meet or exceed escapement objectives and facilitate expanded harvest opportunity (A46, A54, B13) B16
    - Increase harvest of Pacific lamprey adults (B13, B24) A57
        - Increase naturally produced Pacific lamprey adult production to the extent necessary to meet or exceed escapement objectives and facilitate expanded harvest opportunity (A13, A57, B13) B24
        - Increase escapement of Pacific lamprey adults (B1, B13, **B24**) A13
  - **QUESTION: Is hatchery supplementation beneficial to harvest? If so, should hatchery releases be mentioned here? It sets up a conflict in the objectives between releasing hatchery fish for harvest but minimizing impacts on natural populations, but isn't that the reality?**

- **FUNDAMENTAL OBJECTIVE 2 (WHAT AND WHY): RESTORE AN ECOLOGICALLY FUNCTIONING RIVER SYSTEM need to develop wording for this objective to support the non-harvest related goals.**
  - NATURAL FISH POPULATIONS (to support fish numbers for harvest and also healthy natural fish populations for a naturally functioning river system)
    - Restore and maintain natural production of anadromous fish populations (A8, A11, A20, A23, A25, A37, A46, A48, A56, B13) B11 (Fundamental; Natural Fish Populations)
        - Increase freshwater production of anadromous fish (B13, Fundamental) B1 Is this distinction between B1 and B11 necessary?
            - Discourage invasive species (**B1**, B5, **B6, B7**, B9, A26, **B11, B13**, B15, B18, **B19**, B21, B23, B24, B25, B27) A26 Currently under "other wildlife." Consider rewording as an overarching "ecological health" objective, OR repeating a similar one for "natural fish populations" (could be inclusive of hatchery fish). THIS IS A REPEATED OBJECTIVE FROM OTHER WILDLIFE.
            - (Increase reproduction) Increase spawning, incubation and emergence success of anadromous spawners (A24, A39, B1, B11) B30
                - Provide optimal temperatures to improve spawning success of spring and fall-run Chinook salmon (**B1, B9**, B11, B13, B21, **B23**, B26, B30) A35
                - Optimize adult utilization of suitable spawning habitat areas in the mainstem within 3-4 brood cycles following rehabilitation of fluvial river processes (**B1**, B5, B9, **B11, B13**, B23, **B27,** B30) A49
                - Optimize adult utilization of suitable spawning habitat areas in tributaries within 3-4 brood cycles following rehabilitation of fluvial river processes (**B1**, B5, B9, B11, **B13**, B23, B27, B30) A40

- Increase growth - need to develop an overarching objective for this group
    - Increase outmigrant juvenile life stage abundance, growth, physical condition and health from baseline conditions in the mainstem Trinity River within 3-4 brood cycles following rehabilitation of fluvial river processes (**B1**, B5, B9, B11, **B13**, B27) A24
        - Improve thermal regimes for outmigrant salmonid growth and survival (dependent on water year) (B1, B11) A12
    - Improve riverine thermal conditions for growth and survival of natural anadromous salmonids (A24, A28, A39, B1) B26
        - Improve thermal regimes for rearing growth and survival of juvenile steelhead, coho salmon and Chinook salmon (**B1, B5**, B9, B11, **B13**, B23, **B26**) A34
    - Improve juvenile fish production as a function of water temperature and habitat flow relationships from baseline conditions in the mainstem Trinity River within 3-4 brood cycles following rehabilitation of fluvial river processes (**B1**, B5, B9, B11, **B13**, B23, B27) A28
    - Increase fry abundance, growth, physical condition, and health from baseline conditions in the mainstem Trinity River within 3-4 brood cycles following rehabilitation of fluvial river processes (**B1**, B5, B9, **B11**, B13, B23, B27) A39
    - Enhance or maintain food availability for fry and juvenile salmonids (A24, A39, B1, B11) B22
        - Increase and maintain macroinvertebrate populations (B1, B11, **B22**) A16 This could be food or as a surrogate for water quality conditions, or both
- Increase survival - could separate into predation, competition, disease, food availability, and lethal habitat conditions (e.g. temperature, stranding)
    - Minimize impacts of riverine bird predation on fry and smolts (A24, A39, B1, B11) B29
        - Adapt timing of hatchery release to alter distribution of avian predators and minimize predation on natural fry and smolts (B1, **B2, B29**) A33
    - Minimize impacts of predation, competition, and genetic interactions between and among hatchery and natural anadromous fish (A8, A11, A20, A30, A48, B1, B13) B2 (repeated for survival)
        - Limit impacts of hatchery fish predation on naturally produced juvenile salmonids to less than 20% over the 40 miles (B2) A17
    - Reduce temperature related pre-spawning mortality and protect in-vivo egg viability of anadromous spawners in the mainstem Trinity River (B1, B11, B26, B30) A2

- Reduce clinical disease incidence in Trinity River origin outmigrants in the Klamath River to less than 20% within 5 years (**B1, B11**, B13)A50
- Reduce non-native fish predation on naturally produced fish by 50% in the mainstem Trinity River within 3-4 brood cycles following rehabilitation of fluvial river processes (**B1**, B2, B5, B9, **B11**, B13, B23) A38
- Reduce fry stranding in the upper 40 miles of the mainstem Trinity River by 50% following rehabilitation of fluvial river processes (**B1**, B5, B9, **B11**, B13, B21, B23, B27) A53

- Preserve genetic integrity of natural fish - this is implied but need an inclusive objective statement.
  - Minimize impacts of predation, competition, and genetic interactions between and among hatchery and natural anadromous fish (A8, A11, A20, A30, A48, B1, B13) B2 (repeated for genetics)
  - Increase proportion of Natural Influence (pNI) to 0.7 or greater (**B1, B2**, B5, B9, B11, **B13**, B27) A30
- Improve aquatic habitats to support fish reproduction, growth, and survival
  - Maintain appropriate thermal conditions within the river - objectives mentioning temperature are mostly in growth, survival, and reproduction. They are the "Why" but not the "How" - need to articulate the "How"
  - Maintain appropriate structural conditions within the river and on the floodplain.

- Minimize adverse impacts to additional native riparian or aquatic associated wildlife from Program activities. Focus on wildlife species associated with a healthy river ecosystem, not necessarily all species (A18, A59, B18) B7 The subobjectives seem to go farther than just "minimize adverse impacts"
  - Rehabilitate and protect wildlife habitats and maintain or enhance wildlife populations following implementation (A18, A59, B3, B7, B8, B14) B25
  - Establish and maintain riparian vegetation that supports fish and wildlife (A12, A19, A29, A41, B13, B20) B19
    - Discourage invasive species (**B1**, B5, **B6, B7**, B9, A26, **B11, B13**, B15, B18, **B19**, B21, B23, B24, B25, B27) A26 Currently under "other wildlife." Consider rewording as an overarching "ecological health" objective, OR repeating a similar one for "natural fish populations" (could be inclusive of hatchery fish).
  - OTHER AQUATIC SPECIES
    - Minimize physical impacts to other native fish habitats (B1, B16, B24) A15 Minimize impacts, but there are also positive goals associated with "other species." This objective may not be necessary, or should be more clearly stated.
    - Minimize temperature impacts to other native fish habitats (B16, B24, B26) A6 too vague
    - Maintain Trinity River riverine bird populations and species diversity in the Program area (B25) B15

        - Enhance quality and maintain quantity of riverine bird nesting and foraging habitats (**B15**, B19, **B25**) A47
    - Increase population size, survival, distribution, and recruitment success of Western Pond Turtle (WPT) (A59, B25) B12
        - ~~Increase population size, survival, distribution, and recruitment success of Western Pond Turtles (B7, **B12**, B25) A59~~ Duplicate of B12
        - Increase recruitment of younger age classes of Western Pond Turtles (B7, **B12**, B25) A32
        - Increase structural and thermal diversity of aquatic habitats used by various age classes of Western Pond Turtles (B7, **B12**, B25) A14
- RIPARIAN SPECIES
    - Increase species, structural, and age diversity of riparian vegetation to improve and maintain wildlife habitat (B3, B10, B15, **B19, B25**, B31) A29
        - Encourage establishment of vegetation that provides habitat for anadromous fish, aquatic organisms and aquatic / riparian wildlife (**B1**, B3, B7, B13, **B19**, B21, B25, **B31**) A45 consider parsing this out by anadromous fish habitat, other aquatic species habitat, and riparian habitat
    - Maintain Trinity populations and species diversity of birds using the riparian zone in the Program area (B25) B18
        - Enhance quality and maintain quantity of riparian bird nesting and foraging habitats (B15, **B18, B25**) A41
    - Increase population size, survival, distribution, and recruitment success of Foothill Yellow-legged Frogs (FYLF) (A18, A55, B7, B25) B6
        - ~~Increase population size, survival, distribution, and recruitment success of Foothill Yellow-legged Frogs (B6, B25) A18~~ Duplicate of B6
        - Increase quality and quantity of breeding and rearing habitat for Foothill Yellow-legged Frogs (**B6**, B25) A55

- **PHYSICAL HABITAT (THIS IS THE HOW: A Major means objective for restoring an ecologically functioning river)**
    - Increase physical habitat diversity and availability (A42, B1, B11, B20) B3
        - Increase and maintain salmonid habitat availability for all freshwater (in-river and tributary) life stages (A8, A11, A20, A23, A25, A37, A54, A56, B1, B11, B13) B20
        - Increase/improve habitats for freshwater life stages of anadromous fish to the extent necessary to meet or exceed production goals (A8, A11, A20, A37, A46, A48, A54, B11, B13) B21 This seems redundant with the harvest and natural production objectives and B20 above
            - Increase/maintain salmonid fry and juvenile rearing habitat in the upper 40 miles of the mainstem Trinity River by a minimum of 400 % following rehabilitation of fluvial attributes (**B1**, B5, B9, B11, **B13**, B21, B23, B27) A42
            - Increase/maintain spawning habitat quantity and quality to 2,550,000 square feet in the upper 40 miles of the mainstem Trinity River (B1, B21, B30)A5

- Maintain or increase adult holding habitat from baseline conditions in the mainstem Trinity River (B13, **B20, B21**, B23) A21
- Create channel form that reduces loss of fry to stranding in the upper 40 miles of the mainstem Trinity River following rehabilitation during high flows (**B1,** B5, B9**, B11**, B13, B20, B21, B23) A52
- Maintain or increase tributary habitat (**B1**, B3, B9, B1, **B13**, B23, **B27**) A43
- Minimize physical impacts to lamprey habitat (B1, B13, **B24**) A44
- Reduce fine sediment storage in the mainstem Trinity River (A5, A16, B30) B17
  - Transport fine sediment through mainstem at a rate greater than tributary input (B17) A3
  - Reduce fine sediment supply from tributary watersheds (B17) A10

- Create and maintain spatially complex channel morphology (A31, A58, B3) B8
  - Increase coarse sediment transport and channel dynamics (A4, A31, B3, B8) B28
    - Route coarse sediment through all reaches (B3, **B8**, B28) A9
  - Encourage bed-level fluctuations on annual to multi-year time scales (B3, B8) A4
  - Increase bars, side-channels, alcoves, and other complex alluvial features (B1, **B3, B8**, B11) A31
    - Increase and maintain coarse sediment storage (A4, **A31**, B3, B8) B4
  - Increase channel/thalweg sinuosity (B3, B8) A7
  - Increase geomorphic unit and substrate patch diversity (B3, B8) A22
  - Increase the size, frequency and topographic relief of bar/pool sequences (B3, **B8**) A58
  - Frequently exceed channel migration, bed mobilization, and bed scour thresholds (B3, B8, B14, B28) A1
  - Increase and maintain target coarse sediment transport rates (**B3**, B4, B8) A27
    - Manage flows, coarse sediment augmentation, and channel rehabilitation that cause sufficient riparian plant mortality along low water margins to prevent channel simplification leading to degraded fish habitat (B3, **B8, B14**, B31) A36
  - Promote diverse native riparian vegetation on different geomorphic surfaces that contribute to complex channel morphology and high quality aquatic and terrestrial habitat (A29, A41, A47, B1, B8, B11) B31 Could duplicate for riparian and aquatic species or reword
    - Prevent riparian vegetation from exceeding thresholds leading to encroachment that simplifies channel morphology and degrades aquatic habitat quality (A29, A31, B31) B14
    - Encourage establishment of riparian species on surfaces within the future channel migration corridor that will recruit LWD (**B3**, B8, B19, **B31**) A19
    - Recover riparian vegetation area equal or greater than disturbed by physical rehabilitation (A19, A29, A41, A45, A47, B19, B25, B31) B10

- Encourage fine sediment deposition on floodplains (**B10**, B17, B19, B31) A51

Appendix I: Klamath Objectives Hierarchy Presentation

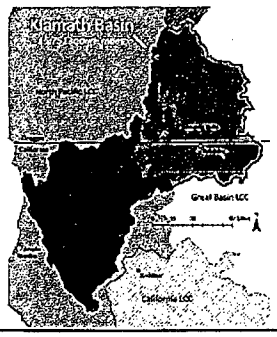
Developing Conservation Objectives for Landscape-scale Conservation in the Klamath River Watershed

Nicole Athearn

May22, 2013

Klamath Landscape Conservation Planning

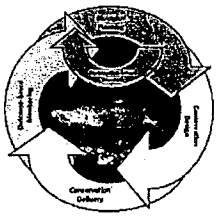
- Finite watershed with shared resource issues
- Recent history of working together internally and with partners
  - e.g., dam removal discussions
- Shared objectives and the beginnings of a "One Service in the Basin" approach



Landscape-level Concerns

- Degraded ecosystem function
- Need to manage for many species with competing needs
- Connections among land use, water quality/quantity, habitats, cultural values, economic prosperity
- Need for efficiency given limited funding and other resources (e.g., water); need to identify priorities

Developing a Conservation Strategy



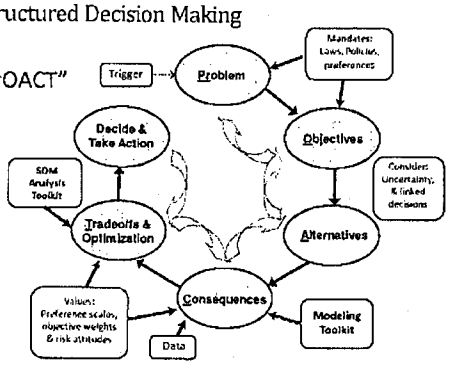
Problems:
1. Uncertainty
2. Time (not enough)
3. Money (not enough!)

Challenge:
To find a way to maximize the benefits of the work we do, while minimizing costs and reducing uncertainty so that future work is more effective

Connection to big-picture goals + landscape-level prioritization + adaptive management + partnerships = **SHC**

Structured Decision Making

"PrOACT"



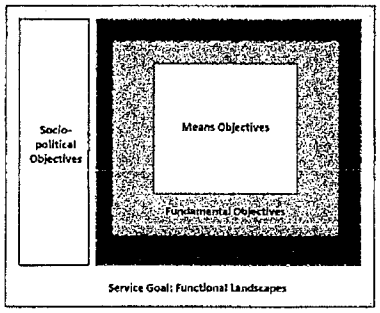
Service's Goal

For Landscape-scale Conservation

To characterize and maintain functional landscapes capable of supporting self-sustaining fish, wildlife, and plant populations.

Fundamental Objective:
Biological component of achieving functional landscapes in the Klamath River watershed.

Objectives – Clarifying Terms

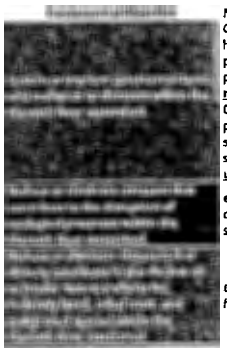


Fundamental Objective	Means Level 1 Objective
Restore natural hydrologic processes and conditions	Achieve naturally functioning riverine communities
	Achieve naturally functioning riparian communities
	Restore natural hydrologic connectivity
	Restore natural stream flow
	Improve the quantity, quality, and distribution of wetland communities
	Reduce the hypereutrophic state of lentic systems in the upper Basin
Restore natural upland processes and conditions	Improve the quantity, quality, and distribution of forested upland communities
	Improve the quantity, quality, and distribution of non forested upland communities
	Improve connectivity and distribution of habitats
Achieve viable populations of priority species by reducing the impact of threats	Maintain genetic and life history diversity
	Improve population resiliency
	Improve priority populations' ability to resist perturbation
	Achieve sufficient population redundancy
Improve community resistance and resilience to long-term perturbations, particularly climate change, within identified priority habitats	Increase native biological diversity
	Achieve appropriate levels of habitat heterogeneity
	Preserve the roles of strongly-interacting species that influence community structure
Mitigate or reduce the impact of anthropogenic environmental stressors	Contaminants, climate change, and others

"Achieve Naturally Functioning Riverine Communities"

Objectives represent attaining desired conditions, such as:

- High water and sediment quality
- Instream channel complexity (e.g., from large wood or boulders)
- Channel sinuosity and/or longitudinal complexity
- Reduced fine sediments in the channel substrate
- Presence of low-velocity side channels and pools
- Presence of channel bank cover, such as resulting from emergent aquatic vegetation or bank structural characteristics



Means Level 1 Objective

Conserve, restore, rehabilitate, and enhance hydrologic and other physical processes that provide conditions supporting self-sustaining populations of native species dependent on natural and managed aquatic systems.

Conserve, restore, rehabilitate, and enhance physical processes that provide conditions supporting self-sustaining populations of native species dependent on natural and managed upland systems.

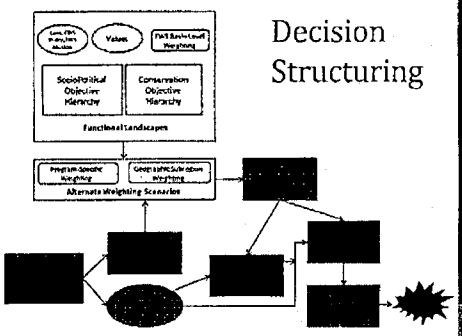
e.g., disease, contaminants, invasive species, dams and other development, water cycle stressors including diversions

e.g., listed species, migratory birds, anadromous fishes

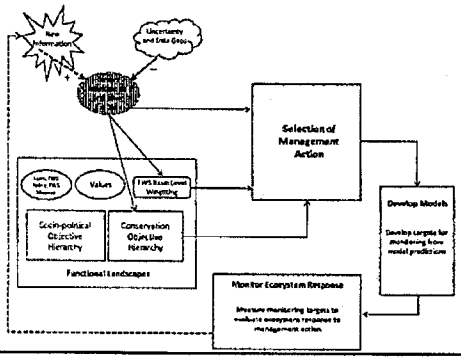
"Improve resilience to stressors"

- Conserve, restore, rehabilitate, and enhance hydrologic and other physical processes that provide conditions supporting self-sustaining populations of native species dependent on instream (below bank full) systems.
- Conserve, restore, rehabilitate, and enhance physical and biological processes that provide conditions supporting self-sustaining populations of native species dependent on riparian systems.
- For wetland systems:
  - Create managed wetlands to re-establish key ecological functions that support target and/or native wetland-dependent species in areas where hydrology has been modified beyond practical restoration potential.
  - Conserve, restore, rehabilitate, and enhance isolated palustrine wetlands where appropriate (based on historic presence) to re-establish physical and biological processes that provide conditions supporting self-sustaining populations of target and/or native wetland species assemblages.
- And so forth for lacustrine, spring, and estuarine systems.

Decision Structuring



Incorporating New Information



Thoughts

- Development of conservation and restoration objectives has broad implications for decision making, within or outside of a DSS
- Stated objectives lead to greater transparency and restoration effectiveness
- Inclusion of objectives does not imply preference or priority