Coleman National Fish Hatchery Adaptive Management Plan

Current Overview Summary

October 2013

We do not learn from a system that is constant. This is not serious if the system is known, is static, and presents no surprises. But resource systems are exactly the opposite. They are known only very partially, which will always be so; they are dynamic and they produce endless surprises –from the collapse of fisheries to the reemergence of other ecosystems. And the act of management and harvesting changes the fundamental structure of the resource itself. Walters (1986).

Forward – What is Adaptive Management?

Adaptive Management is one type of management strategy that can be used to manage complex ecological systems. It provides a rational approach for addressing problems where competing but uncertain solutions exist, and for which management cannot be delayed until the problems and solutions are fully understood. Adaptive management is often considered for use in systems where conflicts exist, the stakes are high, and there is uncertainty about the best way to proceed. It integrates science practices and principals into the management system, whereby ongoing management becomes a source of information about the problems and the efficacy of chosen solutions.

The CALFED Record of Decision (ROD, CALFED 1999) required that scientific-based decision-making be integrated into the implementation of CALFED through a process called "adaptive management." However a 2005 review by the Little Hoover Commission found that "The ROD envisioned a CALFED that was guided by an assertive adaptive management system, but that system has not been put in place." The Battle Creek Restoration Project and Coleman National Fish Hatchery are notable exceptions to this finding.

Introduction

In early 1999, a cooperative effort among the U.S. Department of Interior, Bureau of Reclamation (Reclamation), the U.S. Fish and Wildlife Service (USFWS), National Marine Fisheries Service (NOAA Fisheries), the California Department of Fish and Game (DFG), and the Pacific Gas and Electric Company (PG&E) led to the signing of an Agreement in Principle to pursue a restoration project for Battle Creek. In mid-1999, the parties signed a detailed, formal Memorandum of Understanding (MOU) in conformance with the Agreement in Principle, allowing the release of $28 million in California Bay-Delta Authority (CBDA) funding for the agencies' responsibilities in the partnership. See http://www.usbr.gov/mp/battlecreek/index.html for more information about the BCRP.

Agency and stakeholder representatives with interests in the Battle Creek watershed have worked over the last two decades to reconcile the conflicts between ecological functions and human services. Reconciliation efforts have mainly focused on aquatic habitats, the functions these habitats provide for native salmonids, and the interrelated human services including hydropower production and fish hatchery operations. Formal protection of three salmonid stocks (i.e., winter and spring Chinook salmon, and Central Valley steelhead) under the California and Federal endangered species acts, and the subsequent identification of the Battle Creek watershed as important recovery habitat (NMFS 2009) further emphasized the need to improve ecological functions, while striving to optimize existing human services. The Coleman National Fish Hatchery (CNFH) is a dominant feature in lower Battle Creek, and minimizing or avoiding the adverse impacts its infrastructure and operations may have on the success of the Battle Creek Restoration Project (BCRP) is now a focus of the reconciliation efforts.

Restoring the Battle Creek Watershed

Restoration of the Battle Creek watershed is a major outcome of past reconciliation efforts. Although highly unique and historically important to several salmonids stocks, the watershed has been substantially modified to support hydropower production (Jones and Stokes 2005a). Construction associated with completion of the BCRP began in early 2010. The BCRP focuses on restoring in-stream flows and improving fish passage through modification of existing hydropower infrastructure (Figure 1). The goal is to provide high quality habitat and improve fish passage, which together will support self-sustaining populations of several Chinook salmon stocks, and Central Valley steelhead throughout 48 miles of stream habitat (Terraqua 2004).

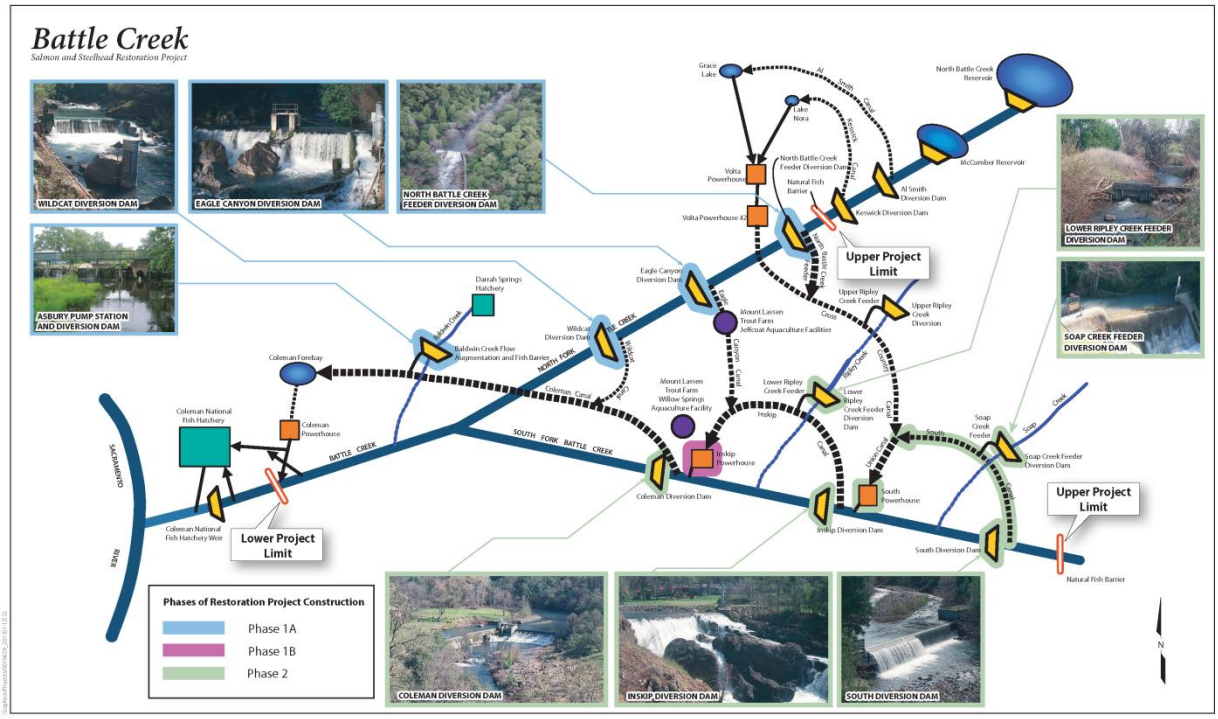

Figure 1. Schematic diagram of the Battle Creek watershed identifying the modifications to hydropower infrastructure to be completed through the course of the restoration project. See Jones and Stokes (2005a) for more details on the restoration project.

Origin and Purpose of the Coleman National Fish Hatchery

Construction of CNFH was completed in 1942, and fish culture operations began in 1943. CNFH is the principle remaining feature of the original Shasta Salvage Plan, and it provides partial mitigation for the loss of salmonid habitat resulting from the construction of Shasta and Keswick dams (USFWS 2011). Currently, CNFH annually propagates three salmonid stocks: fall Chinook salmon, late-fall Chinook salmon, and Central Valley steelhead. Fish produced at the CNFH contribute substantially to the multi-million dollar commercial and recreational fishing industry in California, and the hatchery is considered a benefit to the region's social, cultural, and economic well-being (USFWS 2011).

The primary goal of the CNFH fall and late-fall Chinook propagation programs is to mitigate for the loss of salmonid spawning and rearing habitat above Shasta and Keswick dams, and the consequent reduction in the population size of these salmon stocks. Fall and late-fall Chinook are produced to contribute to harvest in the ocean commercial fishery, ocean sport fishery, and freshwater sport fishery. The fall Chinook propagation program annually releases approximately 12 million juvenile fish in April at a size of 90 fish/lb, which are expected to contribute a total of 120,000 fish to harvest and escapement over the life of the brood (60-75% for harvest; HSRG 2012). The late-fall Chinook propagation

program annually releases approximately 1 million yearling fish in December at a size of 13 fish/lb, which are expected to contribute a total of 10,000 fish to harvest and escapement over the life of the brood (50% for harvest; HSRG 2012).

The primary goal of the CNFH Central Valley steelhead propagation program is to mitigate for the loss of steelhead spawning and rearing habitat above Shasta Dam. Returning steelhead are intended to contribute to the sport fishery in the Sacramento-San Joaquin Delta and Sacramento River, and to CNFH broodstock. More specifically, HSRG (2012) indicates that the CNFH steelhead propagation program is expected to contribute 3,000 fish to the annual run: 1,000 fish (33%) for harvest in the sport fishery, with the balance (2,000 fish) contributing to adult escapement.

Substantial modifications to the CNFH have occurred over the last decade to address what many considered the major adverse impacts of the hatchery on the Battle Creek watershed and its living resources. These modifications addressed long-standing concerns about: (1) the hatchery's initiation and transmission of fish diseases; (2) adult fish passage through the hatchery's barrier weir and fish ladder system; and (3) entrainment of natural origin juvenile salmonids emigrating from upper Battle Creek (USFWS 2011). However, concerns remain about the continuing impacts the CNFH may have on the attainment of BCRP goals to restore self-sustaining anadromous salmonid populations in upper Battle Creek.

Adaptive Management in the Battle Creek Watershed

In 2004 an independent technical panel examined the compatibility of CNFH operations and restoration of salmonids in Battle Creek (Technical Review Panel 2004). A major conclusion of this panel stated,

> *The success of the Battle Creek restoration project will depend a great deal on CNFH and possibly Livingston Stone National Hatchery operations. Project planners and USFWS staff need to develop a detailed plan to ensure that hatchery operations are compatible with the recovery goals for Battle Creek.*

An adaptive management plan was developed in 2004 to guide ongoing management of the BCRP (Terraqua 2004; hereafter referred to as BCRP-AMP); however, this plan did not include the CNFH because the two programs operate under different authorities and responsibilities.

Development of an adaptive management plan for the CNFH (hereafter referred to as CNFH-AMP) is underway. The adaptive management plan will be based on the CNFH facilities and operations as described in the 2011 biological assessment for the hatchery (USFWS 2011). The expectation is that development of an adaptive management plan for the CNFH will provide: (1) objective information on the importance and understanding of specific hatchery issues that may adversely affect the restoration of salmonid stocks in upper Battle Creek; and (2) processes and structure to identify, evaluate, and address existing and future concerns. The overall aim is to maximize compatibility of the CNFH with the BCRP, thereby contributing to the further reconciliation of ecological functions and human services in the Battle Creek watershed.

CNFH-AMP Purpose, Goal, Objectives, and Scope

The **purpose** of the CNFH-AMP is to acknowledge, identify, study, and evaluate uncertainties regarding the operation of a large scale fish hatchery in a watershed being restored for natural salmonid populations. The CNFH-AMP is intended to closely coordinate with the BCRP-AMP, so that together the two adaptive management plans form a single integrated framework for adaptive management in Battle Creek (Jones and Stokes 2005a).

The **goal** of the CNFH-AMP is to provide solutions and processes to support optimization of CNFH programs, operations, and infrastructure so that the hatchery mitigation goals and objectives are achieved, while maximizing its compatibility with the BCRP.

The **objectives** of the CNFH-AMP are as follows:

- Describe and evaluate the most promising solutions for eleven identified issue statements. Develop cost and resource estimates to implement the tier 1 solutions by 2018.
- Provide monitoring and analysis methods that inform the evaluation of selected solutions.
- Identify and describe diagnostic studies that address the greatest areas of uncertainty. Provide cost and resource estimates to complete the tier 1 diagnostic studies by 2018.
- Describe the steps and processes for adaptive management in sufficient detail so that the CNFH-AMP remains a durable plan with ongoing utility.

The **scope** of the CNFH-AMP is primarily focused on the CNFH and Battle Creek watershed (Figure 2). However, the scope of this project also considers interactions and processes downstream of Battle Creek, including the main-stem Sacramento River, the San Francisco Estuary, and the Pacific Ocean. An expanded scope of geographic interest is necessary given the complex life cycle of the species of interest, and the important events and processes that occur throughout their life cycle. Additionally, consideration of a broader geographic scope is warranted because some possible actions may expand or redistribute the geographic scope and magnitude of the hatchery's influence beyond those resulting from current operations.

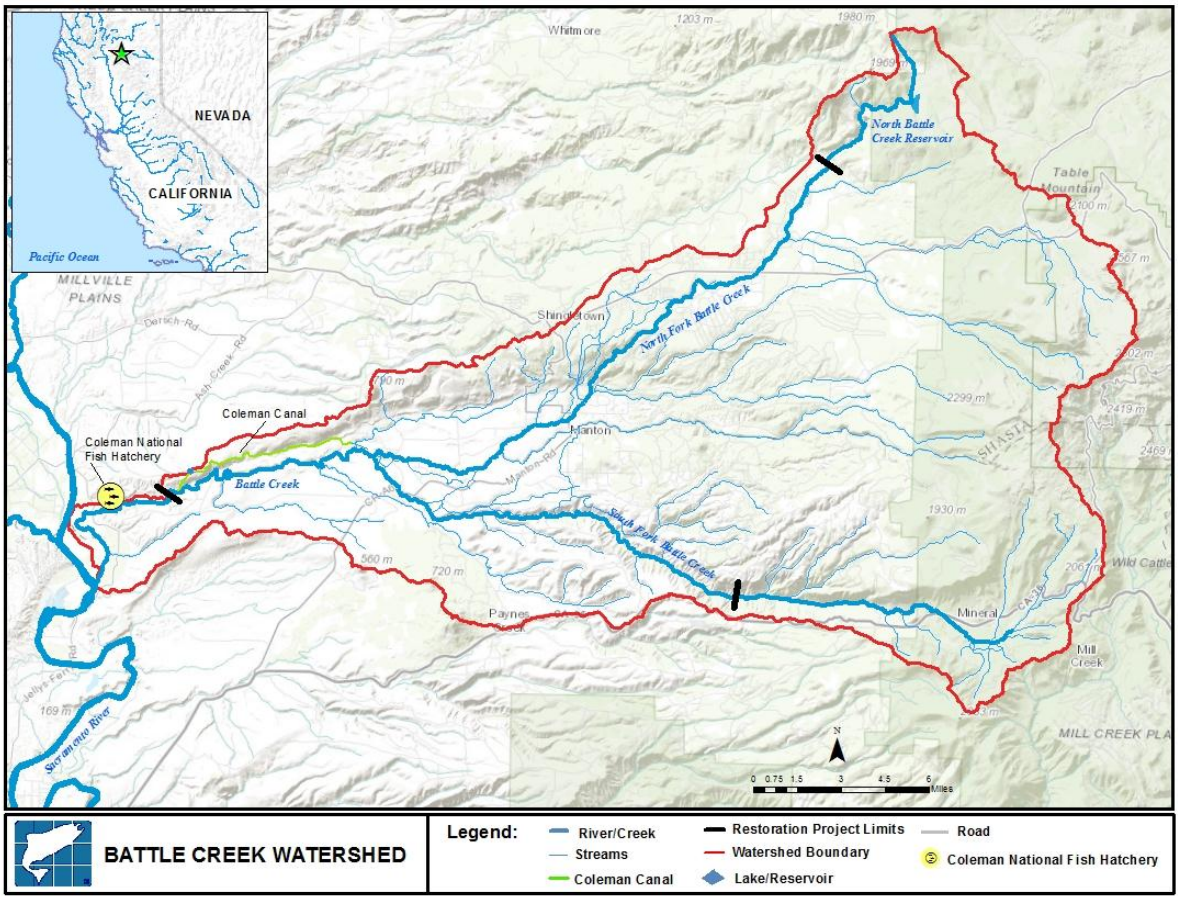

Figure 2. Water courses in the Battle Creek watershed. Upstream and downstream boundaries of the Battle Creek Restoration Project also are indicated. The Coleman National Fish Hatchery fish barrier weir (located adjacent to the hatchery) is the first substantial man-made structure encountered by anadromous fish returning to Battle Creek.

CNFH AMP Adaptive Management Cycle

The CNFH-AMP adaptive management cycle generally relies on a passive adaptive management approach similar to that used in the BCRP-AMP (Terraqua 2004), although some important changes were incorporated to more accurately reflect the order of the steps and process used to develop the CNFH-AMP, and to address the unique relationship between the CNFH and this adaptive management plan (Figure 3). In passive adaptive management, historical information is used to frame a single best approach along a linear path assumed to be correct (i.e., it is based on the belief that past assumptions and antecedent conditions still apply; Stankey et al. 2005). This approach applies a formal, rigorous, albeit retrospective analysis to data and information as a means of framing new choices, providing understanding, and making decisions.

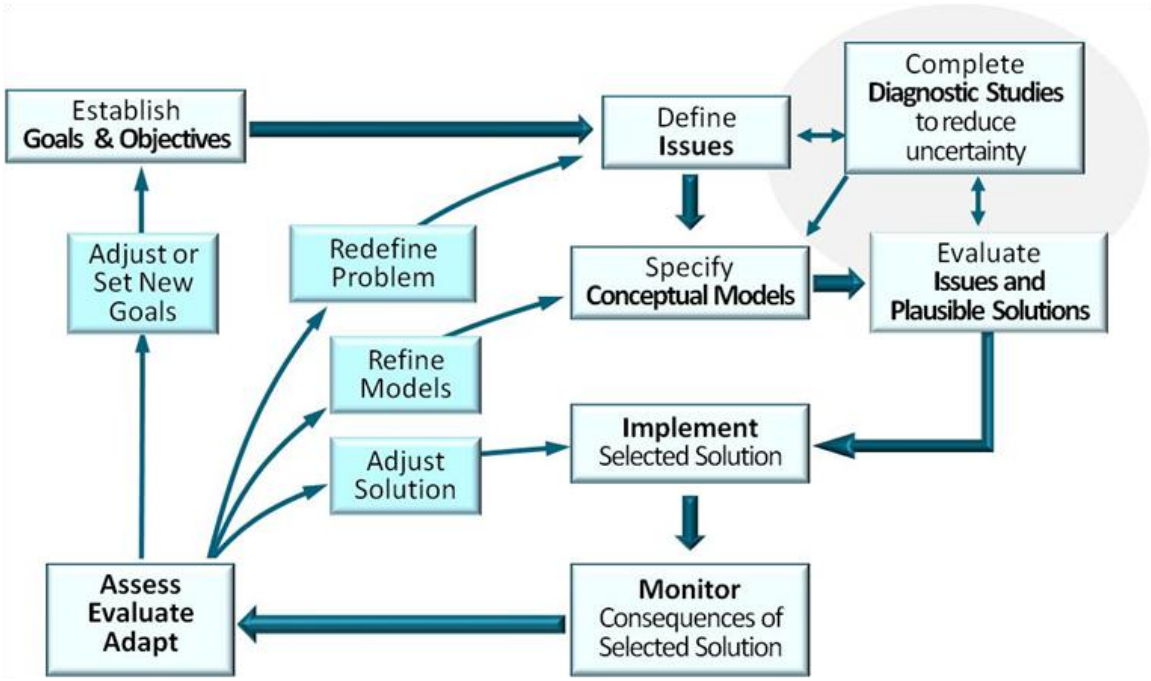

Figure 3. Diagram of the adaptive management cycle developed for the CNFH-AMP. (Adapted from Healey et al. 2008). The route with thicker arrows generally follows the passive adaptive management cycle used in the BCRP-AMP. The shaded area (upper right) indicates where active adaptive management can occur within the cycle.

Routes in the CNFH-AMP adaptive management cycle are included to incorporate diagnostic studies, and their inputs into other steps in the cycle are together considered the active adaptive management loop (Figure 3). Active adaptive management allows for the purposeful integration of experimentation into policy and management design and implementation (Kusel et al. 1996 as cited in Stankey et al. 2005). However, the application of active adaptive management in the CNFH-AMP focuses on the use of experimentation to reduce uncertainty associated with defining/clarifying issues, evaluating issue importance, and evaluating alternative solutions.

CNFH-AMP Issue Statements

Four conceptual models were developed to structure the analyses of eleven CNFH issues that may affect the timely restoration of target anadromous salmonid populations in upper Battle Creek. All of the issues were identified and refined through detailed discussions with a technical advisory committee. These issues are intended to describe the potential problems as specifically as possible. The issues will then be analyzed in the context of the relevant conceptual model to evaluate importance and understanding.

Preliminary results are presented below. However, the consultant team has begun to develop a life-cycle model for the salmonid stocks of interest. The resulting model will provide a quantitative analytical framework to (1) evaluate issue importance and understanding, (2) evaluate potential actions, and (3) to identify essential performance measures. Thus, the preliminary results presented below may change substantially as a result of further evaluations using the quantitative analytical framework.

Unlike most other anadromous fish hatcheries in California, the CNFH is not situated immediately downstream from an existing dam and reservoir. Instead the CNFH was established in the lower reach of a unique watershed that is undergoing restoration to support self-sustaining populations of anadromous salmonids (Jones and Stokes 2005a). Thus, the overarching issue is the existence of the hatchery and the effects its ongoing operations may have on the restoration of anadromous salmonid populations in upper Battle Creek. This overarching issue can be parsed into several more specific potential issues, which are described in the statements below.

Issue Statement 1– An unscreened water diversion used at times to deliver water to the CNFH may result in the entrainment of Battle Creek juvenile salmonids.

Issue Statement 2 – The current CNFH steelhead program excludes naturally produced (unmarked) fish from the broodstock. This practice leads to continued domestication and potential for reduced fitness when hatchery fish spawn in the restoration area.

Issue Statement 3 – Current operations at CNFH and at the fish barrier weir cannot always identify and prevent passage of (1) hatchery origin salmonids, and (2) non-target runs of Chinook salmon.

Issue Statement 4 – Fall Chinook (hatchery or wild), hatchery late-fall Chinook, and hatchery-origin steelhead may reach the restoration area during high flow events where they may have adverse effects on Battle Creek steelhead, late-fall, spring, and winter Chinook salmon.

Issue Statement 5 – Trapping, handling, and sorting, of salmonids within CNFH and at the CNFH fish ladder results in migratory delay and may result in direct mortality or sub-lethal effects to natural origin winter Chinook, late-fall Chinook, spring Chinook, and steelhead trying to access the restoration area.

Issue Statement 6 - Pathogens resulting from CNFH operations may be transmitted to and expressed among wild fish in the restoration area.

Issue Statement 7 – In-stream flows in upper Battle Creek are reduced by CNFH water diversion(s) between the diversion site(s) downstream to the return effluent site (distance of 1.2 to 1.6 miles depending on location of the water intake). These diversions may result in inadequate in-stream flows or increased water temperatures in this segment of the river during drought conditions and in association with operations at upstream hydropower facilities.

Issue Statement 8 - High abundance of hatchery-origin adult salmon in lower Battle Creek may create adverse effects including (1) reduction of in-stream spawning success due to the physical destruction of redds; (2) interbreeding between natural and hatchery origin Chinook salmon; and (3) increased mortality of juvenile salmonids emigrating from upper Battle Creek.

Issue Statement 9 – Releases of hatchery produced juvenile Chinook salmon and steelhead from CNFH may result in predation on and behavior modifications to natural origin fish produced in the restoration area.

Issue Statement 10 – Production releases of CNFH juvenile fall Chinook salmon are explicitly intended for commercial and recreational harvest and allowable harvest is determined in part by

the abundance of CNFH fall Chinook salmon. Thus, production levels of CNFH fall Chinook may lead to additional incidental take of natural origin Battle Creek Chinook salmon.

Issue Statement 11 - Current production releases of CNFH juvenile fall Chinook salmon may contribute to exceeding the carrying capacity for Chinook salmon in the Sacramento River, San Francisco Estuary, or the Pacific Ocean leading to reduced success of Battle Creek origin salmonids.

Next steps:

Development of the CNFH-AMP is underway including the following major tasks:

Develop a quantitative life-cycle model for the target stocks. This model will provide an analytical framework for use during implementation of the adaptive management plan. In particular, the model will be used to (1) assess the importance and understanding of the eleven identified issues, (2) estimate the influence various actions may have on issues of high importance, (3) aid in the identification of performance measures, which will be to assess the performance of selected actions over time.

Develop an integrated monitoring plan. This monitoring plan will only include existing and proposed monitoring efforts that provide data and information of direct relevance to those performance metrics of relevance to the CNFH and the BCRP adaptive management plans, the quantitative life-cycle model, and target species status and trends. The plan will identify the resources and funding necessary to carry out the monitoring program. This monitoring plan also will consider data and information sharing and reporting to facilitate the 'assess, evaluate, and adapt' step in the adaptive management cycle.

Develop a more integrated adaptive management plan. The integrated AMP will maintain an emphasis on the CNFH, but also will address conditions in the upper Battle Creek watershed, and will provide stronger quantitative linkages to the existing BCRP-AMP. Key features will include:

- Goals and objectives will largely remain as is in the draft CNFH-AMP (see above), although some adjustments may be needed to support integration of existing BCRP-AMP performance metrics.
- Coordinated governance structure. The CNFH and BCRP governance structures would remain separate, but details will be provided on how the various entities will coordinate to share information and deal with issues of mutual interest.
- Addition of a quantitative life cycle model as the analytical and the decision making framework.
- Time horizons for project goals and objectives would be specified for testing against predictions of the life cycle model. In this context, simulation model results will be used to help understand the effectiveness of alternative management actions.

Project Schedule:

TBD