NEPA & Fisheries Management: Implementing Adaptive Management at Yellowstone National Park

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ABSTRACT

Adaptive management was first introduced in the late 1960s by C.S. Holling and several colleagues as a means to manage resources with increased flexibility in a system of uncertainty. Although this form of management has been in use for over fifty years, few planning efforts have successfully incorporated adaptive management and the National Environmental Policy Act (NEPA) together into a comprehensive ecosystem-wide document defensible in court. In the face of climate change, managers are now looking for creative ways to manage resources to account for the potential effects of climate change and other factors, while re-defining “baseline data” and the possibility of failure of a resource.

Yellowstone National Park completed an adaptively managed comprehensive Native Fish Conservation Plan Environmental Assessment in May 2011. With over a full year of implementation, this paper will explain why and how adaptive management was utilized under NEPA and will analyze the use of adaptive management in the fisheries program, while providing insight into the strengths and weaknesses of the approach.
Introduction

In early 2010, an interdivisional team was formed at Yellowstone National Park to begin internal scoping for the first major comprehensive plan/environmental assessment (EA) for fisheries management in the park. Subsequently, single project plans/EAs had been prepared, and it was generally felt that with so many proposed projects with uncertain outcomes, this plan would not fit the traditional project specific EA mold. The intent of the first several meetings of the team were to discuss the purpose and need, and the proposed goals and objectives that the future plan would be focused on. As the list of potential projects grew, and the uncertainty of potential outcomes of the projects due to climate change and other factors grew, it became clear that an adaptively managed approach would best suit the intent of this ecosystem wide plan. The plan would focus on the aggressive preservation and restoration of several of Yellowstone’s iconic species including: fluvial Arctic graying (*Thymallus arcticus montanus*), westslope cutthroat trout (*Oncorhynchus clarki lewisi*) and Yellowstone cutthroat trout (*Oncorhynchus clarki bouvieri*). Although none of the species have status under the Endangered Species act, grayling has been petitioned to be listed and is warranted but precluded at this time\(^1\), and all are considered by park management to be species of concern.

In developing the EA, two domains (with an explanation of overall projects), were identified: 1) Yellowstone Lake Ecosystem - focusing on lake trout (*Salvelinus namaycush*) suppression to allow recovery of Yellowstone cutthroat trout and 2) rivers, streams and lakes (other than Yellowstone Lake) – includes the restoration of water bodies by removing non-native species such as brown trout (*Salmo trutta*), eastern brook trout (*Salvelinus fontinalis*), and rainbow trout (*Oncorhynchus mykiss*) and reintroducing native species. The Native Fish Conservation Plan Environmental Assessment was completed on December 16, 2010, with a signed Finding of No Significant Impact on May 18, 2011.

The purpose of the EA was to identify and disclose impacts to the human environment that would result from the implementation of the proposed conservation activities while preparing a document in accordance with the National Environmental Policy Act (NEPA), regulations of the Council on Environmental Quality (CFR 1508.9), and the National Park Service Director’s Order
12 (Conservation Planning, Environmental Impact Analysis, and Decision Making). The plan focused on waters inside the park including rivers, streams and lakes, with the exception of the mainstem Madison River and Firehole River. See Figure 1.

Since the park was established in 1872, the management of fisheries has changed considerably. During the early years when the United States Army provided oversight of the park, 12 species of native fish were abundant as indicated by scientific records, soldier reports, and visitor publications. Fishless areas were also common in some of the major rivers and lakes. Of the 12 species, declines in the historic ranges of native fluvial arctic grayling, westslope cutthroat trout and Yellowstone cutthroat trout have been recorded in the last century. Early stocking of waters with popular sport and sustenance fish have contributed to this decline. As early as 1881, park managers were planting native fish in fishless waters, and records indicate that in 1889, non-natives were being introduced into the park.\textsuperscript{2} Stocking of Yellowstone cutthroat trout throughout the park, and outside their native range, in addition to other species continued until the mid-1950s when almost all park waters, including those in the remote backcountry, were stocked. In the 1950s fish management began to change with a cease in stocking and an appreciation of native fish began. By then however, “over 300 million fish had been stocked in park waters and non-native species were firmly established in most lakes, rivers, and streams.”\textsuperscript{3}
With the stocking of sport fish and other species in the early history of the park, it isn’t hard to understand the challenges faced by managers today. Although conservation of natives has been a goal since the 1950s, even as recently as the mid-1980s, the non-native and very aggressive species, lake trout, were introduced. The introduction method is still unknown; however, illegal actions are thought to have brought the species to Yellowstone Lake. It wasn’t until 1994, that the crisis of their introduction was fully realized, as lake trout began appearing in angler catch reports. Soon thereafter, Yellowstone cutthroat trout numbers began declining due to the lake

Figure 1  WCT and YCT historical ranges in Yellowstone National Park and the project areas proposed under the Native Fish Conservation Plan. From the Yellowstone National Park Native Fish Conservation Plan Environmental Assessment.
trout introduction combined with several years of drought and the effects of whirling disease, caused by an exotic parasite found to be in the park in 1998.\textsuperscript{4}

Other threats to native fish in Yellowstone include hybridization with non-natives, global climate change, and non-native fish disease. Climate change alone has major implications for all native species parkwide to include decreases in snow pack and changes in the timing and intensity of spring run-off. These factors combined with the rapidly decreasing native fish populations made a strong case for a robust adaptively managed ecosystem-wide plan for Yellowstone’s native fish species.

**What is adaptive management?**

The term “adaptive management” was first coined in the late 1960s by C.S. Holling and several colleagues and was first implemented in 1968 under the Gulf Island Recreation Land Simulation.\textsuperscript{5} Holling and colleagues defined adaptive management as “…an inductive approach, relying on comparative studies that blend ecological theories with observation and with the design of planned interventions in nature and with the understanding of human response processes.”\textsuperscript{6} The United States Department of Interior defines adaptive management as “a decision process that promotes flexible decision making that can be adjusted in the face of uncertainties as outcomes from management actions and other events become better understood.”\textsuperscript{7} There are many definitions for adaptive management available for interpretation; however its most basic premise is to actively learn and adapt.

In the past few decades a flux in our understanding of ecosystems has occurred, with climate change more recently leading the charge. Many of the environmental laws of the early 1970’s, including NEPA, were formed on the basic premise of ecosystem equilibrium whereby the natural balance of an ecosystem stays the same without the influence of man. In recent years more and more data have come to light revealing that ecosystems are in a constant flux, and climate change is a major player in this paradigm shift due to both anthropogenic influences and natural phenomena. In the face of climate change, managers are now faced with so much uncertainty that those laws created during the ecosystem equilibrium era are being challenged
due to inflexibility. In a Comment by Julie Thrower⁸, she examines the framework of NEPA for applicability of adaptive management and concludes that because legislative change is unlikely, the relevancy of regulation will depend on the expertise of the agencies in implementation. She further suggests that “periodic updates on the real impacts of agency actions after a proposed plan is implemented, compared to the expected results, will enable each agency to better perform its role as a protector of the environment.” This capstone paper will attempt to examine the use of adaptive management under NEPA for Yellowstone’s Native Fish Conservation Plan and although it will not examine the impacts compared to the results as suggested by Thrower, it will bring to light some of the strengths and weaknesses of the adaptive management approach. Because the plan is projected to provide a framework for approximately 20 years, follow-up examination more closely examining the results should be provided in the future.

**Why use Adaptive Management?**

The Native Fish Conservation Plan was developed to include adaptive management in three of the four alternatives described, with the preferred and environmentally preferred both under the framework. Adaptive management is based on the model – plan, act, monitor, adjust. This approach was considered a good fit for a program already based on sound scientific monitoring. Both the lake trout suppression program and the stream restoration projects proposed all followed a similar model, and could easily be incorporated into a programmatic adaptive management approach. The final decision to use adaptive management came from the many discussions of baseline data for the lake trout suppression program. In setting up the objectives around the recovery of native Yellowstone cutthroat trout, what year of baseline data would best reflect a successful recovery? Due to climate change, what is the new norm for the Yellowstone ecosystem, and could the recovery effort truly come close to the pre-lake trout invasion numbers? The very definition of baseline data for resources had been challenged due to the cumulative unknown effects of climate change and other influences, such as non-native species invasion. Many questions surrounded the goals of the plan. Would setting the baseline data year at pre-invasion be adequate, or because of climate change is this a completely unrealistic goal? Will the lake trout suppression efforts help toward Yellowstone cutthroat trout recovery? What do recovery and failure scenarios look like? These were all questions that confirmed that much
uncertainty existed in this planning effort and a flexible approach like adaptive management would be necessary in order to make adjustments along the way based on the monitoring that would take place.

The public scoping and environmental assessment comment periods brought about an overwhelming response of support for the actions proposed under the plan. Positive support came not only from the written comments submitted, but also from several non-profit organizations conducting fundraising campaigns and outreach, local fish bloggers offering support and encouragement, and from a massive form letter writing campaign that helped to accumulate 2998 pieces of correspondence of which the majority supported the efforts of the plan. It quickly became apparent that including a no action alternative, with an underlying theme of Yellowstone cutthroat trout species failure, was not an option.

Originally, the plan included an alternative that discussed failure of the Yellowstone cutthroat trout fishery. After numerous discussions with the ID team, it was decided that failure would not be a part of the plan because to some extent, Yellowstone cutthroat trout would be managed throughout the course of time due to its importance as a keystone species in the greater Yellowstone ecosystem. The fact that Yellowstone cutthroat trout live in the park is in some way offering a form of protection and management in and of itself. If the population of Yellowstone cutthroat trout was ever deemed a complete failure and has crashed beyond recovery, a new NEPA planning effort would need to be completed to manage Yellowstone Lake as a recreational fishery. The Madison River within the park is currently managed as a recreational fishery due to the population of non-native sport fish that already live there, and the potential for controversy if actions were taken to remove species that fisherman have been coming to Yellowstone to fish for decades. Failure in the plan was also discussed originally as an option to cease all lake trout suppression; as this costly endeavor may prove over time to be a herculean effort that no amount of money can ameliorate due to a variety of uncontrollable factors.
Incorporating Adaptive Management

As previously stated, Yellowstone has a long history of active fish management in the park, so the challenge for the development of this plan fell on the park’s fisheries staff already doing many aspects of the work, on a much smaller scale. Previous compliance covered single projects such as a project to restore westslope cutthroat trout to the East Fork of the Specimen Creek Watershed. This project was implemented to remove rainbow trout first introduced to the watershed in 1923 in order to re-introduce genetically pure westslope cutthroat trout and provide a geographically isolated stronghold for the species through natural barrier manipulation and reintroduction. Knowing the workload it took to complete this planning effort, along with the projections of a minimum of 12 projects similar in scope, made an adaptive management approach highly desirable. Lake trout suppression was also taking place, however, data collection and analysis revealed that a much more aggressive suppression program would be needed to truly make a difference toward Yellowstone cutthroat trout recovery.

Knowing past actions, current efforts, and needed future projects, the fisheries staff developed a hierarchical approach to the management of the park’s fisheries that integrated well into the adaptive management framework, and alternatives in the EA reflected these management objectives. Each alternative covered actions that were: physically and financially feasible; ensured continued protection of the park’s natural and cultural resources; provided effective and efficient methodology for native fish and ecosystem conservation; and ensured human health and safety.

Alternatives included in the plan are listed below:

- Alternative 1 - Continuation of current management practices
- Alternative 2 – Full use of native fish conservation techniques and lake trout returned to Yellowstone Lake (Preferred)
- Alternative 3 – Full use of native fish conservation techniques and lake trout marketed and/or donated
- Alternative 4 – Limited use of native fish conservation techniques.
Through the internal and external scoping process, it was determined that the disposition of lake trout after being removed from Yellowstone Lake was something that should be analyzed clearly in the document and a focus of the alternatives. The preferred alternative reflects the decision to return lake trout to the lake in order to more efficiently and effectively work toward a successful suppression program.

As mentioned previously, adaptive management was included in all alternatives except Alternative 1 that would continue current management practices. Using the domains established (Yellowstone Lake; and all rivers, streams and lakes other than Yellowstone Lake) a hierarchical series of desired conditions were established to provide a hypothesized outcome based on the current state of the system and the proposed actions. Initially the most desired condition would be strived for and as monitoring programs provide data on successes and shortfalls, adjustments of actions would be considered. Decisions regarding future actions would be based on the model in Figure 2. This model is based on the hierarchal series of desired conditions within the alternatives, and would include external stakeholders and the public in the decision making process.

**Figure 2.** Adaptive management strategy conceptual model for native fish conservation in Yellowstone National Park. Desired conditions (A), conservation actions (B), quantitative responses (C), and performance metrics (D) are defined in the text and listed in Tables 5 and 6 of the Native Fish Conservation Plan.
Plan, Act, Monitor, Adjust

The Native Fish Conservation Plan is in year two of full implementation. To date, over 1 million lake trout have been removed from Yellowstone Lake, the fish weir on Clear Creek has been reconstructed, Goose Lake has been treated with rotenone to prepare for west slope cutthroat trout brood stock, and construction of two fish barriers will occur this fall. With a May 2011 Finding of No Significant Impact, project implementation is in full swing, and monitoring and adjustment is occurring at different rates depending on the domain.

For the lake trout suppression program, monitoring and adjustments occur almost daily. As the park staff discover new areas of spawning lake trout, the netting crews are contacted to plan setting nets in that location the next day, or very soon thereafter. Data on net location, set depth, net mesh size, and numbers of fish caught are collected and analyzed weekly to determine the catch per unit effort. Adjustments in location, net size, and depth are made based on the catch per unit effort rates. These real-time data collection efforts, monitoring, and adjustments are possible under the adaptive management framework.

Native fish restoration projects, however, take months to years to determine if adjustments are needed. This program is in the early stages of capacity building with fish barriers and brood stock development as the first steps. Success rates vary from months to years to decades or more depending on the project. For a barrier project for example, from initial design of the barrier all the way to sampling the population to determine if there is a population that reflects a natural age-class structure can take up to ten years to determine success of the project. Some indicators of success such as natural reproduction can be seen before the ten year mark, but most restoration projects do take time.

This marked difference in monitoring and adjustment rates between the two programs is a good example of how flexible the adaptive management framework can be. The use of real-time data collection efforts, monitoring, and adjustments also make good financial sense. Being able to quickly adjust to the movement of fish in order to increase catch rates helps to save time and ultimately, money. The conventional trial and error methodology does work here, but with the
more robust continual feedback loop of adaptive management, more informed decision making for effective, efficient, and fiscally responsible management can take place.

Long-term monitoring and restoration expertise has been sought for many years from stakeholders outside the park including the Yellowstone Cutthroat Trout Interstate Workgroup, the Montana Cutthroat Trout Steering Committee, the Fluvial Grayling Workgroup and the Science Review Panel for Yellowstone Lake. To aid in the planning and adjustment phases of the lake trout program, this science panel was developed prior to the development of the Native Fish Conservation Plan to ensure that best management practices and sound science was being used to most effectively suppress lake trout in Yellowstone Lake. The science panel consists of academics, state and government officials, and specialists in the various fields related to the program. This panel offers assessments of the long-term monitoring design and past recovery efforts, analysis of data collected, and makes continual suggestions to improve the program. The science panel adds to every phase of the adaptive management approach and lends additional expertise, and research, beyond what the staff of Yellowstone National Park can offer. Similar collaboration occurs throughout the adaptive management model for fish restoration efforts as well.

**Notable Shortfalls**

Not all legislation aligns neatly into an adaptive management approach, nor will every detail of a project be discussed and analyzed for impacts because some projects and emergencies cannot be predicted. Generalizations are made to provide for flexibility and ranges of impacts are analyzed to provide managers the ability to adjust actions as necessary. Although the goal of developing a robust adaptive management plan is to programmatically analyze all impacts under each and every piece of legislation necessary in order to have a stand-alone plan, often follow-up, or tiered compliance is necessary. Other legislation that needs to be taken into account but that does not fit into the adaptive management framework includes: consultation with the State Historic Preservation Office for cultural resources; Section 404 of the Clean Water Act for wetland permitting; and the minimum requirement analysis required under the Wilderness Act. Each of these examples could potentially be covered programmatically under an adaptive management
plan if careful forethought is taken to meet and discuss the potential impacts of the projects with local regulators well in advance.

Follow-up permitting is currently being done under the Native Fish Conservation Plan for wetland permitting despite the fact that a wetland statement of findings was prepared for the plan. The level of detail was simply not available to make the statement of findings a document that adequately covered work being proposed in wetlands.

To ensure compliance under the Wilderness Act, a programmatic minimum requirement analysis (MRA) could have been prepared to cover standard techniques such as the use of permanganate stations for restoration projects, or for the use of boats in the non-motorized zones of Yellowstone’s South and Southeast Arms. Detailed analysis of each of these activities could have been included in the document. The Native Fish Conservation Plan failed to include MRAs specific to certain techniques with the potential to be implemented in wilderness and instead, the use of an MRA was discussed more generally. Due to this lack of foresight, each project proposed in wilderness now must include follow-up reviews by the wilderness committee and additional time is being spent in the discussion of projects with area specific law enforcement.

Programmatic agreements between the National Park Service and the State Historic Preservation Officer under the National Historic Preservation Act are often developed at the park level for actions similar in scope and impact. Although this effort was deemed unnecessary for the plan, the possibility of developing a programmatic with the SHPO is a good option for programs that will potentially have archeology or historic assets at stake.

Another thing to note in the development of an adaptive management plan is to ensure the creation of a method of assessing the adequacy of the NEPA documentation. Having an adequacy checklist, questionnaire, or memo to file template available to help in the planning and project implementation phase is an effective way to document that a careful review of NEPA adequacy has taken place prior to project implementation. This would also ensure that adequate time is available in the event that additional follow-up compliance (permits, MRAs, etc.) is needed.
Other Adaptive Management Plans

Adaptive Management isn’t new to managers at Yellowstone. Nor are the adaptively managed plans new to the public due to their complex and political nature. The two plans include the Federal Interagency Bison Management Plan Environmental Impact Statement (EIS) and the Winter Use Plan EIS.

The Federal Interagency Bison Management Plan Environmental Impact Statement (EIS), of which Yellowstone is a cooperating agency, was completed with a signed Record of Decision in December of 2000. While this plan is currently under litigation for the decision to allow bison to access federal lands north of the park boundary, it has a history of implementation under an adaptively managed framework.

The Draft Supplemental EIS for the Winter Use Plan currently out for public comment includes adaptive management in each of the action alternatives in order to allow the park to monitor impacts and adjust management. Specifically, the noncommercial guided program is a new aspect of the plan that will be carefully monitored for impacts and has the potential to be altered or ceased by adaptive management.

As evident by these examples, adaptive management can be an effective framework for basing decisions and making adjustments that ensure the proper level of impacts are not being exceeded according to the NEPA in order to protect park resources.
Conclusion

With only one year of implementation of the Native Fish Conservation Plan, it’s too early to discuss the relative “success” of the adaptive management framework. Additional status reports should be considered in the future to determine if impacts were adequately analyzed in the document. Use of this information would be helpful to others interested in developing similar comprehensive adaptively managed conservation efforts.

Developing a successful adaptively managed plan is no small task, and may seem overwhelming compared to traditional project specific NEPA documents. The impact sections and threshold development take time and collaboration with resource specialists to properly capture. However, if the potential actions being proposed have uncertain outcomes, adaptive management should be considered. In the face of budget cuts, decreased donations to park partner organizations and an increase in competing priorities, careful spending and creative use of resources will become even more important in the future. Adaptive management under NEPA isn’t the appropriate pathway for every project, but with the proper forethought, it can be a very effective means of balancing the spirit and intent of the law and ultimately the protection of the environment and natural resources.

13 Personal communication – Todd Koel, Supervisory Fisheries Biologist, Yellowstone National Park.
14 Personal communication – Jeff Arnold, Aquatic Ecologist, Yellowstone National Park.
15 Personal communication – Mike Ruhl, Fisheries Biologist, Yellowstone National Park.