

RESERVOIRS AND FERC RELICENSING - THE MISSING LINK BETWEEN FISHERIES, WILDLIFE, AND RECREATION

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This paper addresses FERC relicensing and the opportunity it provides to restore riparian, littoral, and adjacent upland habitat in reservoirs. The analysis focuses on the function and value of littoral and riparian habitat, lake aging, habitat needs of aquatic and terrestrial species, T&E species, angling recreation, and effects of hydropower facility operation on shorelines. Sources include: peer-reviewed journals, fish habitat technical bulletins, reservoir management plans, recent FERC project conditions resource management plans, research papers, FERC relicensing stakeholders, and extensive professional experience. This paper may serve as a guideline for those interested in pursuing a reservoir management plan and fish and wildlife habitat restoration activities during the FERC relicensing process.

BACKGROUND ON FERC RELICENSING:

The California Hydropower Reform Coalition reports that in the next fifteen years, over 150 dams in California will apply for new operating licenses¹. Approximately 50 hydroelectric dams in the west slope Sierras are scheduled to initiate or complete required relicensing agreements under the current Federal Energy Regulatory Commission (FERC) Program within this timeframe. There are many more dams throughout the western states under similar schedules. Hydropower relicensing is considered by many to provide a “once-in-lifetime opportunity” to improve instream flow regimes, water quality and fish passage, and to restore aquatic and riparian ecosystems associated with hydropower generation facilities. Relicensing should also provide an opportunity to focus fish and wildlife habitat restoration efforts and enhanced recreational opportunities on the reservoir and related facilities created by a dam. These reservoirs were created directly or indirectly as an integral part of a hydroelectric facility and are in part, managed extensively for power generation.

With the decline of many fish populations in most lower elevation areas of California, including the Sacramento-San Joaquin Delta, many recreational anglers are looking at other locations to provide quality fisheries and recreational opportunities. A requirement of the FERC Relicensing negotiation process is to provide equal consideration to fish and wildlife habitat when compared to other beneficial uses within the negotiation settlements. Historically, most protection given to fish and wildlife habitat resources have focused on lotic resources below reservoirs instead of lentic habitats created by the hydropower facilities. Specifically, conservation efforts have failed to address reservoir management planning and in-reservoir fish and wildlife habitats focusing attention instead on impacts to downstream riverine habitat, water quality, and recreation. When considered during FERC Relicensing negotiations, in-reservoir enhancement of fish resources is usually satisfied by stocking desirable game species for recreational fisheries in the reservoir in concert with downstream mitigation measures. Rather than stocking fish, this paper focuses on reservoir management and habitat to enhance resident fish and wildlife.

Habitat enhancement projects in reservoirs and related lentic habitats are often conducted to restore fish and wildlife habitats that are lost or degraded due to anthropogenic impacts. Natural processes of decomposition over the years combined with fluctuating surface water elevations in reservoirs that exacerbate wood decay have resulted in significant loss to submerged and littoral wood and organic matter important as habitat structures for fish and wildlife species. Without the adoption of an adequate reservoir management plan, the quantity and quality of important submerged fish habitat, emergent and shoreline wildlife habitat, recreational resources, water quality, and status of protected species populations using the reservoir is likely unknown.

NEED FOR RESERVOIR MANAGEMENT PLANS:

Littoral zones and riparian areas along reservoirs provide many benefits. They supply habitat for a great number of fish and wildlife species, minimize shoreline erosion, filter and trap sediment and contaminants in stormwater runoff, and are a source of organic matter and nutrients to the nearshore area. They also serve as sites for camping, fishing, wildlife viewing and other recreation. Unfortunately, unless such important habitat is documented, the function and value of littoral and riparian habitat to a reservoir and its particular fish and wildlife species are unknown. Given the attention that downstream habitats warrant, it is not surprising that the impact of project operations on the quantity and quality of lentic habitat is often a low priority during a FERC relicensing process. Impacts to these resources can result in decreased fisheries production in the reservoir and reduced use of riparian areas by wildlife. A reservoir management plan would directly assess the condition, function, and value of littoral and riparian habitat and identify and mitigate potential impacts to balance habitat protection with other reservoir interests.

With the ever increasing pressure to support diverse beneficial uses on aquatic resources in California and the western states, large lakes and reservoirs can provide very important recreational uses while also protecting and conserving existing fisheries and wildlife resources. On a national scale, the United States Fish and Wildlife Service reports that excluding the Great Lakes, 84 percent or 21.1 million of all freshwater anglers fished in reservoirs, lakes, and ponds². However, reservoirs cannot manage themselves nor should they be primarily managed for a single use. Ideally, all beneficial uses in a reservoir would be managed under an adopted reservoir management plan. The plan should be implemented for the long-term but updated on a regular basis to reflect changing needs or philosophies, enhanced protection of biological resources, new federal or state listing of protected species, adaptive management, or flood control.

Reservoir management planning should be a collaborative process involving all interested parties - along with qualified resource specialists. Ideally a reservoir management plan is a long-term action plan, developed by entities having water management responsibilities and interested stakeholders, to protect multiple uses of the reservoir while continuing to produce electricity and maintain flood control. The plan should reflect responsible management agency and participating stakeholder consensus regarding actions needed to protect the physical, biological, cultural, recreational, and economical aspects of a reservoir and its watershed. Planning strategies may lead to the development of separate resource plans for fisheries management, wildlife resource management, and water quality management.

Littoral structures located in reservoirs that exhibit large fluctuations in surface water elevations may become dry at times during the year eliminating their value as fish habitat but many provide a variety of beneficial wildlife habitats. Downed woody debris provides cover and nesting habitat for amphibians, reptiles, birds, and small mammals. Snags supply nesting habitat for cavity-nesting birds, foraging habitat for insectivorous birds, and roosting habitat for bats.

Reservoirs that undergo significant changes in surface water elevations, especially during the spring breeding season may dewater spawning beds prior to fry emergence. Fish and wildlife resources in these reservoirs would benefit from the development and implementation of an effective reservoir management plan designed to reduce or mitigate impacts on habitat lost prematurely from large and rapid seasonal fluctuations in surface water elevations. For example, a management plan might include establishment of vertical habitat structure perpendicular to the shoreline to provide continuous submerged and emergent habitat for fish, amphibians, and reptiles at various surface water levels. Water management decisions could include the protection of spawning habitat during the spring spawning season for many sunfish species - including the largemouth bass, considered the most sought-after freshwater sport fish in the United States³. The maintenance of a consistent surface water elevation for the approximately three weeks during the incubation and brooding period greatly enhances spawning success.

Additional information important for lake management might include: an inventory of state or federally-listed fish and wildlife species or essential habitat for such species in the project action area; assessment of existing shoreline and habitat characterization (identification of spawning substrate/spawning areas, basking structures, littoral habitat structure, riparian communities, wetlands, erosion prone shorelines, etc.); and planting appropriate native shrubs and trees along the shoreline for habitat enhancement and erosion control.

NEED FOR RESERVOIR HABITAT ENHANCEMENT:

Newly created and inundated reservoirs undergo a natural aging process whereby dissolved nutrients created from the decay of organic matter in the warmer, oxygen rich littoral zones support a rich planktonic community maintaining healthy and productive fisheries. Available submerged woody debris such as trees, logs, brush, and stumps provide valuable fish habitat structure. Fish use these areas for protection, social communication, as places to ambush prey, and sometimes as spawning areas. Depending on location, the function of natural fish habitat structures will vary greatly in a newly inundated reservoir. Submerged structures in relatively deeper water will provide summer loafing and feeding habitat for adult fish, mid-depth structures provide habitat for juvenile fish, and shallow water structures provide habitat for spawning, young-of-year, or recently stocked small fish. Emergent structures including floating logs or wood along the shoreline and riparian shrubs provide valuable basking, cover, foraging and breeding habitat for birds, turtles, and amphibians to name a few.

As a reservoir ages fertility declines, and fish and wildlife habitat structures are lost through the natural process of decay in the littoral zone. The rate of decay is often accelerated with large and frequent fluctuations in surface water elevations typical of hydroelectric impoundments. Decreased fertility and a loss of submergent and emergent habitat are two important aspects of reservoir aging adversely affecting fish and wildlife populations. This loss of habitat will significantly reduce the number, diversity, and age class recruitment of fish and wildlife species a reservoir can support. Furthermore, impacts to anglers fishing from the bank are increased as aquatic habitat degrades and the reproduction and growth of fish species that live near shore decline. Decreases in submerged wood and woody debris also results in decreased aquatic invertebrate numbers and community diversity, which reduces available food. The degradation of aquatic habitat can impact the availability of shoreline habitat for wildlife species if the habitat was historically emerged during seasonal fluctuations in surface water elevations. The most effective direct way to restore lost habitat and return productivity and sustainability to fisheries and wildlife resources is to provide littoral habitat structure.

Wildlife habitat structures that support amphibian and reptile species require a physical connection between aquatic and terrestrial habitats. This allows species to access the structure directly from the shore or by a short swim. Emergent habitat in the form of basking structures for amphibians and reptiles frequently requires submerged escape cover in close proximity to the basking structure to insure the highest quality structure. Escape cover structures are typically composed of submerged groups of densely compacted limbs taken from local tree or shrub species and placed immediately adjacent to the basking structure.

The location in relation to water depth of submerged fish habitat and emergent and shoreline wildlife habitat structures vary with changes in surface water elevations. Seasonal fluctuations to surface water elevations results in dynamic shoreline characteristics and varying water depths within the littoral zone. Also, there is usually a significant disconnect from upland habitat. These changing parameters influence the quality of fish and wildlife habitats within areas of a reservoir that support the greatest number and diversity of fish and wildlife species. As surface water elevations fluctuate, the location, depth, and quality of submerged habitat changes. In addition, as surface water elevations decrease, the proximity to and connectedness with suitable upland riparian habitats for many wildlife species decreases. Lack of continuous suitable shoreline habitat during lower lake levels impact many aquatic and terrestrial wildlife species.

In addition to wildlife benefits, added littoral structure can help reduce the erosive force of boat or wind-driven waves and seiches against the reservoir shoreline. Adding littoral structure where erosion is occurring will reduce localized turbidity in the nearshore and sedimentation of more pelagic habitat.

Measures to mitigate the pre-mature loss of littoral structure from large and rapid seasonal fluctuations in surface water elevations are discussed in the paragraphs that follow. They have proven to be effective in California reservoirs.

RESERVOIR HABITAT ENHANCEMENT:

To offset natural processes exacerbated by large and rapid seasonal fluctuations in water level leading to reduced fish and wildlife habitat, artificial submerged and emergent habitat structures are often created to replace that which is lost over time. The importance of fish habitat restoration efforts as part of a relicensing process was recognized in 2004 during the Lake Oroville⁴ relicensing process. Habitat improvements often come in many forms of fish attractors typically used to concentrate fish for anglers or as emergent structures for basking turtles or feeding perches for birds. Submerged fish habitat can be of various shapes and sizes, and made from a number of natural and artificial materials, but all serve the purpose of providing both underwater habitat structure for fish and invertebrates as a food source. Emergent turtle and amphibian basking structures and feeding perches for insectivorous and piscivorous birds include large wood and highly branched wood structures. Properly designed and constructed emergent habitat structures provide suitable fish habitat structures when submerged and suitable wildlife habitat when above the water surface. Low seasonal water levels created by project operations and dry weather conditions provide optimal field conditions for installing and properly configuring such habitat in the littoral zone of reservoirs.

Quality fishery and wildlife habitat projects are developed based upon sound biological information and may be intensively managed or modified for a period of up to four years after its initial development. The correct balance of habitat type, location, and configuration are important components to successful habitat enhancement projects. Habitat projects should be closely monitored over time by examining predator-prey relationships using the structures, water quality, adequate foraging opportunities by predators, sufficient escape cover for prey species, habitat maturation, species age classes, and species size distributions within the habitat areas. All of these factors tend to indicate the overall health of the aquatic environment and response to reservoir enhancement activities. Performance measures for various post-construction monitoring activities could be included in reservoir management plans.

Larger organic material from forest or woodlands located in close proximity to the reservoir typically provides sufficient wood resources for constructing submerged fish habitat structures. Integrating locally available forest materials into a fish and wildlife improvement project has significant local advantages. The use of local forest materials for habitat structures reduces fuel loading and the threat of wildland fires for communities near reservoirs. Thus, fish and wildlife habitat projects can be viewed as an opportunity to use intact forest wood that may have recently died or that poses a significant risk for wildfire. Such material can include trees dying from drought and forest insects, fire salvage trees, trees removed for nearby construction activities, or Christmas trees as part of a larger community recycling effort. The closer the wood is to the reservoir or shoreline, the easier it will be to incorporate into a well designed and implemented habitat project.

When available, manzanita is the best choice for submerged habitat structures as it is one of the most dense and highly branched woods available, often retaining its high habitat value for decades in reservoirs. Although providing much less overall quality, some tree species do share the characteristic for having dense wood and remaining intact while submerged for many years. Madrone, oak, and conifer logs and tops can be used as a substitute for manzanita branches. In some areas, living trees such as black willow and other *Salix* species that can withstand seasonal inundation are viable options. A variety of artificial materials may be available for submerged and emergent habitat.

Large rock structures are important habitats for many fish species. Rock structure is typically the most common submerged habitat type found in reservoirs today as they do not decay over time. Seasonal shoreline erosion and currents help to create and maintain such habitat. However, many reservoirs have areas with limited submerged rock habitat on a temporal or spatial scale depending on shoreline location and surface water elevation. Large rock structures at various depths and locations throughout the reservoir provide habitat to all age classes of fish. The largest adult fish spend most of time in summer months loafing around large rock structures in relatively deeper water. Smaller forage fish if present, will occasionally key into these structures as they search for food organisms. Rock structures can be constructed during low water conditions within areas devoid of rock habitat.

Other wildlife habitat structures at or near the shoreline influenced by hydropower operations include but are not limited to raptor nesting and feeding perches, bat roost trees, wildlife snag trees, cavity trees, and hollow trunk trees. The loss of these habitat structures can have a significant impact on a diverse number of wildlife species that use the reservoir or shoreline habitats for feeding and reproduction.

DISCUSSION:

There is opportunity for increased focus on the development of reservoir management plans or fish and wildlife habitat restoration projects in reservoirs during FERC relicensing negotiations. The continued increase in pressure on lake recreational resources and the need to conserve or enhance populations of protected amphibian and reptile species found in these reservoirs now warrants significant attention.

Successful fish and wildlife habitat restoration projects can:

- 1) Improve recreational fishing by restoring and enhancing fish habitat complexity,
- 2) Increase year class recruitment into the fisheries and wildlife populations,
- 3) Enhance the population of desired gamefish species to a recreational resource,
- 4) Enhance the population of state and federally-protected species,
- 5) Reduce the erosive effects of wave action and concomitant turbidity in habitat enhancement areas,
- 6) Benefit the growth of salmonids by increasing invertebrate production,
- 7) Enhance nesting habitat for ground nesting birds,
- 8) Increase foraging and escape cover for aquatic and terrestrial wildlife with an increase in habitat structural diversity of the fluctuating shoreline area,
- 9) Provide habitat for perching birds feeding near the shoreline,
- 10) Reduce forest fire fuel loads in forest environments,
- 11) Reduce air quality impacts by reduced fuel loads and occurrence of wildfires, and
- 12) Garner improved public relations. Projects are well received by the local public and generate a significant amount of positive public relations for responsible reservoir management agencies.

These benefits will be maximized only after effective and collaborative reservoir management plans are completed for each reservoir and associated facilities that focus on fisheries, wildlife, recreational resources, water quality, and the production of hydroelectricity. The relicensing process provides an ideal, and possibly the only viable opportunity to mandate necessary reservoir management plans focused on the restoration of biological, recreational, and water quality resources depleted over the lifetime of the reservoir. To be a meaningful process, participants should represent a wide variety of interested stakeholders, resource agency staff with expertise in reservoir management, and the licensee. Potential financial resources to support such projects might include among others, concessionaires on reservoirs, National Fish and Wildlife Foundation (NFWF) grants, federal Dingle Johnson funds (Federal Aid in Fish Restoration Act), state and federal land and water conservation funds, local fishing clubs, local businesses, lake homeowners associations, or other community groups.

It is the opinion of the authors that relicensing efforts with all reservoirs and related facilities should also focus on the establishment of reservoir management plans, fish and wildlife habitat restoration, and enhancement of recreational opportunities as a reasonable requirement for all current, new, and future relicensing agreements. Many reservoir enhancement projects have included significant volunteer efforts from local community groups. As a result, the beneficial public relations and positive engagement of local stakeholders afforded by providing an opportunity for hands-on resource conservation can be substantial.

CONCLUSION:

Reservoirs provide an important and irreplaceable source of angling, boating, aesthetic enjoyment, and habitat for protected wildlife species. Because of the impacts to these resources as a direct result of reservoir management for hydroelectric production, along with the natural loss of wood and woody debris, the development of reservoir management plans and enhancement of fish and wildlife habitats and in-reservoir recreational resources should be a mandatory activity required within all relicensing agreements.

The development of reservoir management plans including the restoration of fish and wildlife habitat as a part of the relicensing agreement will help to insure that the quantity and quality of vitally important in-reservoir resources are best managed for the beneficial uses of the public now and well into the future. Focusing attention on reservoir resources during the relicensing process will better help to provide the important "equal consideration" to other non-hydropower related uses of a river basin. Relicensing efforts which place a greater emphasis on the conservation and protection of important physical, biological, cultural, recreational, and economical aspects of a reservoir will lead to agreements that maximize enduring benefits to multiple users and stakeholders.

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