RESERVOIR FISHERIES HABITAT PARTNERSHIP

Conserving Healthy Reservoir Systems

A Framework for Strategic Conservation of Fish Habitat In the Reservoir Systems of the United States

Prepared by the Partners of the Reservoir Fisheries Habitat Partnership
Candidate Fish Habitat Partnership, National Fish Habitat Action Plan
August, 2009

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Executive Summary

Reservoirs are inextricable parts of our natural landscapes. Constructed to meet a variety of human needs, they impact almost every major river system in the United States, affecting to various degrees habitat for fish and other aquatic species and, in turn, are affected by the health of the watershed in which they reside. Reservoirs, their associated watersheds, and their downstream flows constitute interdependent, functioning systems. Effective management of these *reservoir systems* – maintaining their ecological function and biological health – is essential to the conservation of our nation's aquatic resources and their habitats. It requires that we minimize the adverse impacts of reservoirs on their watersheds and maximize their utility for aquatic habitat.

Conservation of reservoir systems is also essential to maintaining the quality of life for the American people. Reservoirs provide essential infrastructure services, from the storage and delivery of water to the generation of power to the reduction of flood risk in downstream communities. Reservoirs are focal points of recreation for tens of millions of Americans, from anglers to birdwatchers, and they generate tens of billions of dollars for local economies and national recreational industries. Innumerable species of fish and wildlife, too, benefit from the habitat that reservoirs provide.

Multiple impairments are found in reservoir systems. These impairments, exacerbated by human population growth and projected changes in temperature and rainfall caused by climate change, adversely affect fish, other aquatic species, and their habitats and diminish the quality of life for people. To address these, State and Federal agencies, non-governmental organizations, businesses, and committed individuals met over a period of three years to form the Reservoir Fisheries Habitat Partnership (RFHP), a candidate Fish Habitat Partnership of the National Fish Habitat Action Plan (NFHAP).

The RFHP is a national collaborative partnership established to promote the protection, restoration, and enhancement of habitat for fish and other aquatic species and communities in reservoir systems through cooperative and voluntary actions. The RFHP provides strategic coordination and direction in the conservation of fish and aquatic habitat in reservoir systems. It is committed to integrating watershed conservation, in-reservoir management, and the management of downstream flows to attain more holistic and coherent strategies for addressing aquatic habitat impairment issues in reservoir systems. The RFHP works through partnerships to implement conservation actions needed to achieve and sustain healthy reservoir systems. It does this by facilitating, informing, equipping, and supporting a bottom-up approach to implementation of conservation – enabled, in turn, by the partnership's wealth of technical expertise.

The RFHP governance structure has three major parts. A national Executive Committee supported by staff and working committees sets policy and guidance, and determines conservation priorities and project funding allocations. Four Regional Workgroups, each

corresponding to one of the four regional Association of Fish and Wildlife Agencies (AFWA) associations, set regional priorities and oversee implementation of projects within their operational areas. Friends of Reservoirs, the third pillar of the partnership, provides multiple paths to reservoir stakeholders to participate in the RFHP and, in turn, to support the RFHP in the long-term through fund raising and volunteer contributions.

The RFHP strategic plan derives its purpose and structure from the conservation mission, goals, and objectives of the National Fish Habitat Action Plan. It is the partnership's roadmap to healthy reservoir systems. It sets forth goals, objectives and targets to guide the partnership into the future. It includes, too, conservation actions for its first 5-year planning phase and monitoring and performance reporting protocols. The process and criteria to strategically identify conservation priorities and to select and implement conservation actions and projects is included.

Framework for Strategic Conservation of Fish Habitat
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Introduction

The Reservoir Fisheries Habitat Partnership (RFHP) is a candidate Fish Habitat Partnership of the National Fish Habitat Action Plan (NFHAP). It evolved from three years of discussions, meetings, and collaboration among State and Federal agencies, conservation organizations, private sector businesses, and committed individuals. A common interest in the health of the nation's reservoir systems brought people of differing outlooks and wide-ranging locales together for a shared cause. From its first meeting in Atlanta, Georgia, in June, 2007 at the 4th International Reservoir Symposium to meetings in Louisville, Kentucky (2007), Chicago, Illinois (2007), the National Conservation Training Center in Shepherdstown, West Virginia (2008), the 2009 North American Wildlife and Natural Resources Conference in Arlington, Virginia, and Big Cedar Lodge in Ridgedale, Missouri (2009), the partnership articulated a vision and created a strategic framework to protect, restore, and enhance fish and aquatic communities within reservoirs and their watersheds.

Shared scientific values and a common understanding of the importance of reservoirs structured the dialogue that initiated and developed the partnership. In particular, three core facts guided the formation of the partnership. First, reservoirs are ubiquitous; found in almost every major river system in the United States, they number in the tens of thousands. They have often dramatically altered the ecological functions and processes upon which aquatic species rely. Two, reservoirs are persistent, albeit human-made, features of the natural landscape. Over time a small number will be removed, but across the lifespan of multiple human generations the majority of reservoirs will remain intact. Three, reservoirs provide important services to people and their communities, from drinking water to flood risk reduction, to navigation, to power generation, to fishing and boating and other forms of recreation. Reservoirs add to the quality of human life.

The RFHP is committed to advancing the quality of life for all species. We believe that reservoirs in conjunction with their downstream and watershed components – what we term the *reservoir system* – can, through considered and strategic conservation, provide for the needs of both human and aquatic communities. Yet, the barriers to do so – *all of which are related to how we govern and make decisions about our reservoirs* – are substantial and daunting. For example:

- Reservoir responsibilities are divided among dozens of agencies and across multiple jurisdictions, fragmenting reservoir management and often disconnecting that management from the health of downstream waters and the upstream land uses and flows that ultimately determine their longevity and health.
- Data that are essential to conservation of fish habitat in reservoirs, downstream, and in watershed tributaries are scattered and incomplete, challenging management agencies in need of sound data to implement best management practices.

- Communication and networking among reservoir managers nationwide needs to be improved to facilitate the sharing of information and the development and testing of best management practices and new restoration technologies.
- Reservoirs are key habitat types, yet information regarding them is either missing from or not integrated into our national aquatic landscape models, plans, and conservation strategies.
- Public awareness and understanding of the role of reservoirs in watershed health, and the importance of healthy reservoir systems to overall human well-being, is insufficient and incomplete, impeding the progress of effective public policy needed to address the many issues challenging reservoirs and their watersheds.

Institutional barriers to reservoir management are not the only threat to quality of life: environmental challenges are multi-faceted and increasing. Quality of life for aquatic organisms and people is threatened when:

- Ailing watersheds deliver water to reservoirs at the wrong time and in the wrong amounts.
- Bad watershed management practices accumulate *unnatural* nutrient loads and sediments in reservoirs and downstream waters.
- Human actions result in the spread of invasive aquatic species throughout reservoir systems.
- Timing and quantities of downstream flows are disconnected from the needs of downstream human and aquatic communities.
- Reservoirs age, fish habitat structures disappear, and prey availability declines.
- Human development erodes or directly destroys riparian and nearshore aquatic habitat along reservoir shorelines.
- Ecological functions essential to aquatic life and its habitat falter under the cumulative burden of all of these transformations.

The RFHP is a unified and collaborative response to the governance barriers and environmental challenges that threaten the quality of our lives. Collectively, these threats are systemic, affecting every impounded river and associated watershed in the nation, from the coastal and piedmont region of the south to the prairies of the Midwest to the Rocky Mountains and intermountain West to the far western Pacific ranges and valleys to the distant landmasses in Alaska and the Pacific Islands. Our partnership is, by necessity, national in scope and will be active wherever there are willing partners. It embraces the commonalities that unite reservoirs nationwide – from physically similar systems to shared environmental threats and habitat issues to the pressing challenges presented by complex and overlapping jurisdictions, varied and impassioned human uses, and national security and public policy themes. All of these factors bind U.S. reservoirs together as a single natural resource of great national importance.

Although our partnership is national in scope, cutting across the human-made boundaries that divide our nation into political jurisdictions, natural boundaries exist that are critical to structuring our partnership, determining who we are, what we do, and how we do it. Watershed boundaries are pre-eminent in our conservation strategy. Our immediate target

is the health of reservoirs and associated fisheries, but our long-term focus is on the health of the waters that feed, reside in, and flow from those impoundments. We will address both by collecting management information on reservoir systems and developing improved management practices based upon it.

Reservoir health is a direct reflection of the health of the watershed in which it is located. We know that we can best protect, restore, and enhance fish and aquatic communities when our habitat conservation strategies and actions contribute to the ecological integrity and function of the watersheds in which our reservoirs reside. Structurally-intact and well-functioning watersheds yield cascading benefits, from healthier reservoirs to healthy fish habitat to a healthful day of fishing – a facet among many to the quality of life we seek as a nation.

Partnership boundaries are also vital to our purpose. They may be small or large, focused on a species or a geographic area. However constituted, they demarcate the places where those partnerships practice their conservation. For the RFHP this is critical: to achieve our reservoir-based mission we must work with other partnerships in the places where they work. Their boundaries create opportunities for us – *opportunities to work collaboratively with them in their areas of operation and expertise to implement fish habitat conservation that coincides with our strategic reservoir priorities.*

As a national entity, we can fill a unique niche. Operating across all States, and functioning as a system-based rather than geographic-rooted Fish Habitat Partnership of the NFHAP, we are well positioned to:

- Identify national and regional reservoir conservation priorities and support the reservoir priorities of other partnerships
- Network and connect people, ideas, and technologies to enhance the science and practice of reservoir and fisheries management
- Collect, refine, and process information for reservoir and fisheries management
- Tap new sources of funding for strategic reservoir protection, restoration and enhancement
- Work collaboratively with all participating States to support the continued development of State Wildlife Action Plans, including (1) the incorporation of reservoir conservation issues and priorities into those plans and (2) the identification of Priority Conservation Areas and Species of Greatest Conservation Need overlapping or associated with priority reservoir systems
- Guide and influence public opinion and public policy on the importance of *healthy reservoir systems* to quality of life, national security, and human welfare

Where our role ends, however, is with the implementation of on-the-ground fish habitat conservation at the reservoir level. Our mission is to catalyze and enable strategic fish habitat conservation in priority reservoir systems. To make this happen, we adopt a "bottom-up" approach; we select and implement conservation projects by supporting local, hands-on efforts to protect, restore and enhance key fish habitats. In coordination with our partners – whether members of the RFHP, other Fish Habitat Partnerships of the

NFHAP, or unaffiliated local, State or regional groups – we will identify potential projects consistent with our goals, assess them by scientifically-based and transparent scoring criteria, and fund them if they are selected. We will support them, too, with information networks, conservation guidance, databases, technological assistance, and landscape-level coordination among critical jurisdictions and ownerships. We will also evaluate our actions on a regular basis to ensure consistency with the National Fish Habitat Action Plan and the Science and Data *Framework for Assessing the Nation's Fish Habitat*, and to continually improve our conservation efforts.

Our reliance on natural systems and place-based partnerships to structure and implement the RFHP underscores our commitment to the science-based, cooperative, and landscape-scale conservation approach of the NFHAP. We occupy an essential niche in the NFHAP structure and its predominantly geographic based-partnerships: we address a structural component of aquatic systems that impacts every Fish Habitat Partnership and for which there is often a need for tools, technologies and skills to address reservoir-related issues. This puts us in the position to help other partnerships at the points where our reservoir and fisheries' interests intersect their interests.

We have the unique opportunity to learn how the processes detailed in the NFHAP plan and framework are affected by reservoirs and how best to develop management strategies to reduce reservoir-related impairments. We will work closely with and continually support the efforts of the National Fish Habitat Assessment and the NFHAP Science and Data Committee in matters concerning reservoir systems. We will support, not supplant, the decisive role of place-based partnerships in delivering conservation within reservoir systems, whether to target reservoir-issues head-on or to address them as intermediate steps to another fisheries goal. It is at the intersection of our interests and those of other partnerships – where threats to aquatic systems and the fisheries they sustain are often most acute – that the reservoir specific data, practices, and technologies that we offer are most needed.

Reservoir Challenges to Fish Habitat

The Conservation Challenge – Science-based conservation of reservoir systems for the health of fish habitat is the primary goal of the RFHP. Reservoirs are human modifications of watershed systems resulting from the damming or impounding of a free-flowing stream or river, and are designed to deliver water, navigation, hydro-power, flood risk reduction, and other services to communities. These impoundments alter and transform natural streams or river systems, affecting (even eliminating) resident populations of aquatic species and the ecological functions and habitat upon which those populations depend (IUCN, 1997). In time, reservoir functions are affected by land uses in the watershed that affect, in turn, water quantity and quality.

These cumulative impairments – whether caused by reservoirs or evidenced in their health and the health of their watersheds – must be properly measured and addressed to protect, restore, and enhance habitat for fish and other aquatic species. In some cases, the best course of action is to remove reservoirs from watershed systems, especially when science and social opinions concur. In most other cases, removal of reservoirs is not an option; they are, in effect, virtually permanent, *naturalized components* of their watersheds, and the impairments associated with them must be addressed both within and beyond their spatial boundaries.

Most reservoirs are built for one or more of four primary uses: hydropower, flood risk reduction, irrigation water, or as a drinking-water resource. Once constructed, these water bodies are also used for wildlife and fisheries habitat, aquaculture, recreation, transportation, land development, and to provide aesthetic values for people. Research suggests that reservoirs also function as sites for carbon sequestration (Dean and Gorham, 1998; Einsele and others, 2001) and, if properly managed, can be used to offset local and even regional carbon emissions, reducing the carbon footprint of the communities surrounding them. Traditionally, the four primary reservoir uses and their management take precedent over secondary and competing uses, constraining other conservation objectives – including fish habitat conservation. As a result, management of fisheries habitat in reservoirs is challenged: it must be pursued and optimized consistent with delivery of the primary uses. A greater knowledge of the true value of reservoir fisheries may, in time, alter the balance of uses.

Why Reservoirs are Important **–** Water that is stored in reservoirs and regulated by dams provides a number of essential benefits to society, including water supply (agricultural and domestic), navigation, hydroelectric power production, flood risk reduction, outdoor recreation, sport fishing, tourism, fish and wildlife habitat, and an aesthetically pleasing setting. Water from reservoirs is used to improve crop yields, provide drinking water, generate renewable and environmentally clean energy, and offer drought and flood mitigation. These reservoir services help sustain our economy and our civilization.

For example, reservoirs enhance the economic growth of both local and regional communities that lie adjacent to them or in their general proximity. The population growth and quality of life in northwest Arkansas, home of WalMart, Tyson Foods, and

other major industries, would not be the same without the attraction and benefits of Beaver Lake, a U.S. Army Corps of Engineers hydroelectric power generation, flood-risk-reduction, and water-supply reservoir. The same is true for the communities between and including Branson and Springfield, Missouri. There, Table Rock Lake - the reservoir immediately downstream from Beaver Lake – adds enormously to the livability and attractiveness of those towns and cities. Elsewhere, the same story is repeated: reservoirs enrich the quality of life for many Americans across the nation.

Why Reservoirs Cannot be Ignored -- Sportfishing alone brings in billions of dollars per year into the U.S. economy. The American Sportfishing Association analyzed the economic effect of reservoirs in 2006 (American Sportfishing Association, 2008) and found that America's nearly 40 million anglers spent over $45 billion per year on fishing equipment, transportation, lodging, and other expenses, much of it directly attributable to reservoirs. These expenditures, in turn, generated $125 billion annually for the national economy and supported over 1 million jobs – jobs that generated $34 billion in yearly wages and $16 billion in annual taxes. Of fishing's total economic impact, about 70 percent is attributable to freshwater activities (not including the Great Lakes), and of that percentage the majority is attributable to reservoir sportfishing. Significantly, almost $1.2 billion of annual sportfishing revenue has been reinvested into aquatic conservation and protection programs in recent years. Today, these dollars are the primary source of funding to improve fish habitat, ensure adequate public access to waterways, and provide environmental education.

Sport-fishing enthusiasts are not the only ones to benefit from reservoir-based recreation. Over 75 million Americans, including 47 million bird watchers, rely on reservoirs to provide an array of non-fishing, outdoor activities – extending from picnics to boating to trail hiking to nature photography and viewing. In their pursuit of wildlife viewing, alone, Americans spend nearly $45 billion a year, matching the expenditures of anglers – and, according to projections, likely to exceed those expenditures in the future. In many ways, reservoirs are the nation's multi-use gateways to nature and wildlife for a growing number of Americans whose exposure to the outdoors is increasingly constrained by population growth, development, and urbanization.

Economics elevates the importance of reservoirs, but it does not explain the ecological significance of reservoirs to the management of America's fisheries. As unnatural intrusions into natural streams and rivers, reservoirs transform water flows, vegetation, structure, sedimentation rates, oxygen levels, temperature stratification, and other physical and biological parameters that are essential to healthy fish habitat. As such, they affect resident fish populations, alter downstream aquatic environments and, in turn, are affected by the health of the watershed above, making them indisputable features of the human and natural landscape. Reservoirs shape and are shaped by the respective watershed in which each of them exists.

Ailing reservoirs usually mean ailing watersheds; causatively, the two go hand-in-hand, almost always inseparable. In contrast, a healthy reservoir – *the principle goal of this partnership* – implies a healthy watershed, the product of which is a healthy reservoir system. For our partnership, healthy reservoir systems mean (1) downstream flows are

adequate to sustain below-dam native and naturalized flora and fauna; (2) watersheds above the reservoir yield flows and water-borne materials (e.g., sediments and woody debris) that are appropriate in timing, quantity, and quality to sustain fish and other aquatic communities; and (3) aquatic habitat within the impoundment supports rich and diverse aquatic communities. Reservoirs are the metaphorical canary in the labyrinth of waterways that comprise reservoir systems; they can be ignored only at great peril to the nation's freshwater fish and other aquatic life.

Reservoir Management Constraints **–** As noted above, most reservoirs are built for one or more of four primary uses: generation of power, flood risk reduction, irrigation water, or as a drinking water resource. There are, of course, secondary benefits and uses linked to reservoirs, some of which are purposeful and others incidental. Reservoirs can provide wildlife and fisheries habitat, aesthetic values and experiences, and opportunities for aquaculture, recreation, transportation, and land development. As is often the case, these secondary benefits and uses may exceed the economic and social value of the primary uses to which the reservoir was originally dedicated. This can be a divisive issue within local and regional communities when demographic changes result in new and discordant perspectives on what uses and benefits reservoirs should prioritize and deliver. Despite shifts in values and perspectives toward secondary benefits and uses, most reservoirs continue to be managed and operated based on their designated primary uses, and the constraints those primary uses impose on secondary products. This imbalance between uses impinges upon our conservation options; it must be addressed. This is the ultimate challenge our partnership faces as it moves forward to conserve fish habitat in reservoirs: we must achieve our mission within the constraints set by the governing purpose of each reservoir.

Reservoir Challenges and Issues – When a river is impounded, the river valley becomes submerged beneath the surface of the reservoir pool. Nutrients and organic matter in the soil and from the decomposition of pre-existing terrestrial vegetation provide an abundant energy source for primary production (Kimmel and Groeger, 1986). This energy moves through the food chain allowing for rapid and luxuriant growth of phyto- and zooplankton and benthic invertebrates, the food source of prey species, which in turn become the food source for piscivorous fish. The submerged trees and shrubs and other landscape features provide habitat for spawning and protection from predators for eggs and larval fish. This classic habitat progression that follows impoundment is called the "trophic upsurge." After five to twenty years, the initial biomass and production of fish declines in what is called the "trophic decline." Much of the original habitat structure decomposes and is eliminated, or it is covered up with silt and sediments. The reservoir eventually reaches an equilibrium level of low productivity and limited success for sport fishing, which, in turn, often results in public outcry – the very result that reservoir fisheries biologists try to avoid.

Reservoirs face many challenges pertaining to healthy fish habitat. These challenges can be grouped into six habitat impairment categories, each of which corresponds to habitat improvement objectives addressed in the RFHP conservation strategy and ecosystem processes detailed in the NFHAP Science and Data Committee *Framework for Assessing the Nation's Fish Habitat.*

- Riparian, Shoreline, and Littoral Zone Hydrologic Conditions (Material Recruitment, Hydrology, and Bottom Form in the NFHAP framework document). Water levels in reservoirs often fluctuate significantly in frequency and can vary widely in height – the outcome of weather extremes, irrigation schedules, watershed condition, and power generation. Regardless of the cause, fluctuating water levels affect the spatial positions, temporal extent, and function of the wetted riparian, shoreline, and littoral zones. In the shallow littoral zone, gravel beds occur in the top few meters where wave action keeps the bottom free of silt. Persistent drawdown below this level minimizes vegetation and alters bottom structure. Soil type, wave action, shoreline erosion, and high turbidity further impact littoral zone plant and bottom substrate. Less vegetation and altered bottom substrate reduces spawning habitat (and spawning success) for nest building fish or any fish in which the eggs attach to a particular substrate (O'Brien, 1990). Increasing water levels in the spring through watershed restoration or reservoir pool management may improve spawning success by inundating gravel areas and terrestrial vegetation. Degradation of riparian and shoreline habitat caused by persistent water fluctuations is incremental and cumulative (Jennings et al., 1999). Loss of riparian buffer strips and associated erosion of shoreline zones impact vegetation and other physical structure, diminishing spawning habitat and nursery and feeding areas and increasing the vulnerability of larval fish – highly dependent on vegetation for protective cover – to predators (O'Brien, 1990). Poor development or loss of riparian zones, and diminishment of the functional role they would otherwise play in filtering runoff water, may also lead to turbidity and nutrient levels above that expected if natural process were intact in reservoirs. This, in turn, may further prevent establishment of macrophytes, causing a shift toward algal-based primary production. Severe water fluctuations also impact angler access, habitat connectivity, downstream flow, and other key habitat issues.

- Watershed Connectivity. Irregular water level fluctuations affect the hydrologic connectivity reservoirs have with their watersheds, impacting (1) resident and adfluvial reservoir fish populations and (2) diadromous and fluvial populations in impounded rivers. The life history of many reservoir fish species requires access to backwater areas and other littoral habitats, as well as upstream and downstream rivers and streams. For some species, these areas are critical to spawning and recruitment. Reservoir system operations related to flood risk reduction, water supply, and hydropower generation can impact availability of these key habitats. Sometimes, multiple reservoirs are located on a major river system, forming a chain or cascade of reservoirs. Under these circumstances, watershed connectivity is almost totally absent in downstream reservoirs where inflows are controlled by upstream dams. These controlled flows, in turn, create substantial barriers to fish passage and can severely impact loading of materials such as sediment, nutrients, and organic matter. Reductions in these functions impact the energy flow and food web of the receiving reservoir (Ward and Stanford, 1983), further impacting fish habitat. Other fish passage barriers such as low head dams, concrete channels, and poorly designed culverts further fragment these systems, reducing available habitat. Additionally, the thermal regime of the inflow will be altered if in close proximity to the upstream bottom-release reservoir. No less important, human activities and land uses within the

watershed can accelerate erosion, and result in sedimentation that creates further barriers to fish passage.

- Water Quality. The health of a reservoir system is strongly influenced by the quality of water that enters and flows through it. Land use practices, point and non-point pollution, nutrient loading, internal reservoir processes and dam releases all influence water quality in a reservoir system. Water temperature and dissolved oxygen dynamics in reservoirs follow patterns similar to those in natural lakes as described in the limnology texts, but differ in many aspects as a result of the retention times and chemical release dynamics of each unique reservoir system (Cole and Hannan, 1990). Turbidity and nutrient levels can impact the volume of hypoxic water in a reservoir which, in turn, limits the habitat available to fish. These same parameters can also influence the type and amount of aquatic macrophytes present in the reservoir system as well as the degree of impact of nuisance plant species. Point and non-point source pollution, and the pathogens contained within, can lead to fish and human health advisories. Nutrient enrichment can also produce toxic algal blooms that detract from the economic and social benefits that reservoir systems provide. However, when considering fish habitat, it is important to note that reducing nutrient inputs below historical levels can lead to trophic decline – a depression in the reservoir feeding base and a subsequent reduction in fish production (Maceina and Bayne, 2001 and Ney, 1996). Maintaining systems within the bounds of their natural variations is critical (NFHAP framework document).

  Dam operations impact water quality upstream and downstream. Bottom release withdrawal at the dam accelerates the development of the anoxic zone in the hypolimnion, by influencing water temperature and the volume of the hypolimnion (the more rapidly that water is discharged downstream, the greater is the anoxic zone near the dam). The cold, oxygenated water that is mined out of the hypolimnion is replaced by warmer, less oxygenated water from above. All of this will determine the size and extent of the thermal refuge in the reservoir upstream of the dam during and throughout the stratification season. Dam operations will also affect habitat conditions downstream in the tailwater because of changes in temperature, dissolved oxygen, and flow regimes, all influencing fish and invertebrate assemblages.

- Sediment Inputs (Material Recruitment in the NFHAP framework document). Longitudinal connectivity in river systems is disrupted by transformation of rivers into reservoir cascades (Ward and Stanford, 1983; Miranda et al., 2008). As a result, natural sediment flows are disrupted both in the river system and in each reservoir sub-system. In many cases, sediments may be trapped in the upper reservoir and not distributed naturally downstream, leading to a loss of habitat or creating sediment hungry systems that degrade the bed elevations of tailwater areas. Sediment deficits typically contribute to incision, downcutting, armoring, and narrowing of channels in areas downstream from dams. Accelerated sediment yields resulting from watershed land use practices not only lead to excessive sedimentation in the upper reservoir, but can alter water flows in reservoir tributaries. Such sediments often carry with them nutrients, pathogens, metals, and other inorganic and organic contaminants impacting the water quality of the receiving reservoir.

- Physical Habitat (Bottom Form and Living Habitat in the NFHAP framework document). Physical habitat may include gravel substrates, submergent or emergent aquatic vegetation, large woody debris or other forms of structural habitat, all of which are critical to some aspect of a fish species' life history. Preferred habitat types will vary among species, but in all cases they will play some role in spawning, recruitment, feeding, staging, and other activities. Overall, physical habitat can help reduce near shore erosion and sedimentation, and provide anglers with essential fishing structure. Many southern reservoirs are lacking complex physical habitat due to basin clearing during construction (Jenkins, 1970). Other reservoirs may be lacking this type of habitat due to residential development in the riparian zone (Barwick, 2004). Ultimately, as reservoirs age, some forms of physical habitat will degrade while others may proliferate (e.g., native and/or invasive aquatic vegetation).

- Nuisance Species (Food Webs and Energy Flows in the NFHAP framework document). The presence of invasive nuisance species can negatively impact reservoir ecosystems, degrade reservoir infrastructure and present other problems to reservoir managers. When nuisance species become prevalent in a reservoir, the native species tend to suffer. In the case of fish and other aquatic organisms, the nuisance species may displace native and naturalized species through predation, competition, or their ability to tolerate greater variations in reservoir conditions, often caused by existing reservoir system habitat issues. Nuisance aquatic plant species may displace native species through crowding and shading. Dense populations of nuisance aquatic macrophytes can provide greater protection, and therefore survivorship, of prey species, reducing sport fish production (O'Brien, 1990). Nuisance aquatic and riparian species not only pose a threat to native species, but they may reduce the recreational quality of a reservoir system and affect downstream resources. Quagga and zebra mussels, for example, broadly impact dam functions, including power and water delivery. This, in turn, can impact recreation through boating and other reservoir-use restrictions.

Importance of Healthy Reservoirs – Renewable water resources are becoming increasingly valuable as human population continues to increase and shifts to concentrated urban and metropolitan areas. In 2007, the world population moved from a rural to an urban majority. The U.S. Census Bureau projects that world population will grow from 6.1 billion in 2000 to 9.4 billion by 2050 – a 50 percent increase. The demand for abundant, clean water will accelerate in tandem with population growth and urban demands. As a result, the need for large and sustainable potable water-supply sources will continue to grow, stressing our existing multi-purpose reservoir systems, and prompting either the development of new reservoirs or inter-basin transfer of water from one reservoir to another. Water stored in reservoirs will increasingly be the primary source to supply and meet mounting human demands, while satisfying the habitat needs of fish and other aquatic organisms. Given the financial and environmental costs of constructing new reservoirs, it is particularly critical that our existing reservoirs and their supplying watersheds remain healthy, and that those impoundments remain clean and at full capacity to sustain multiple and often conflicting purposes.

Additionally, as population centers become more concentrated around reservoirs and more dependent on them for their water-supply, recreation, and leisure benefits, proper management of these reservoirs and their watersheds will be critical to not only sustain these benefits but to meet downstream resource needs, including healthy habitat for fish and other aquatic organisms. Inter-basin transfer of water between reservoirs will be required to deliver water to areas of greatest need. Mixing waters of different qualities and contents will have its problems, including the transfer of exotic species, pathogens and viruses, contaminants, and other physical and biotic components. Maintaining healthy reservoirs and properly functioning watersheds is critical today; but it will become even more important as a *social priority* in the future, one with broad economic and ecological ramifications. Protecting intact and fully functioning reservoir systems will be the highest priority for the RFHP.

Climate Change – Current climate change models for the U.S. predict regional increases in temperature and mild to dramatic variations in precipitation amounts and long-term rainfall trends. As providers of renewable water storage, reservoirs buffer against rapid decreases in water supply due to drought and high demand. Their effectiveness, however, relies on replenishment, which is directly affected by climate change. Indeed, additional precipitation in a regime of climate change may not necessarily yield more storage if rising temperatures increase effective evaporation – and, in regimes where precipitation falls, increasing temperatures could likely exhaust water storage at an accelerated rate.

Climate change may also impact reservoir fisheries in dramatic ways. Reservoirs that have historically supported coldwater species (e.g., salmonids) may experience a shift in water conditions that are now more suitable to supporting either coolwater or warmwater fish assemblages. This will require a shift in reservoir management to accommodate the habitat needs of new aquatic communities. Managing reservoir pool elevation will become critically important. Cool and warmwater species are more reliant than salmonids on in-reservoir spawning and rearing habitats. Maintaining those habitats through water level management will be essential.

Healthy reservoir systems can combat some of the effects of climate change through watershed-wide increases in water storage and reductions in sedimentation and excessive flows during high precipitation events. Moreover, efficiencies in water storage and disbursement can add to the potential buffering effect of reservoirs. Further, reservoirs can be repositories of carbon when they are managed properly (Dean and Gorham, 1998; Einsele and others, 2001). Reservoirs sequester atmospheric carbon dioxide through primary production and deposition and burial of natural organic matter in their bed material. This form of carbon sequestration can reduce the ‘carbon footprint’ of the local and regional communities associated with a particular reservoir.

References

Barwick, D.H. 2004. Species Richness and Centrarchid Abundance in Littoral Habitats of Three Southern U.S. Reservoirs. North American Journal of Fisheries Management 24:76-81.

Cole, T.M. and Hannan, H.H. 1990. Dissolved oxygen dynamics, *In* K. W. Thornton, B. L. Kimmel, AND F. E. Payne [eds.], Reservoir limnology—ecological perspectives. Wiley. pgs 71-107.

Dean, W.E. and E. Gorham. 1998. Magnitude and significance of carbon burial in lakes, reservoirs, and peatlands. Geology. 26(6): 535-538.

Einsele, G., J. Yan and M. Hinderer. 2001. Atmospheric carbon burial in modern lake basins and its significance for the global carbon budget. Global and Planetary Change. 30: 167-195.

IUCN - The World Conservation Union and the World Bank Group. July 1997. *Large Dams: Learning from the Past, Looking at the Future. Workshop Proceedings.* IUCN, Gland, Switzerland and Cambridge, UK and the World Bank Group, Washington, DC. v. + 145 pp.

Jenkins, R. M. 1970. Reservoir fish management. Pages 173–182 *in* N. G. Benson, editor. A century of fishes in North America. American Fisheries Society, Special Publication 7, Bethesda, Maryland.

Jennings, M. J., M. A. Bozek, G. R. Hatzenbeler, E. E. Emmons, and M. D. Staggs. 1999. Incremental shoreline habitat modifications, cumulative effects, and fish assemblages in north temperate lakes. North American Journal of Fisheries Management 19:18–27.

Kimmel, B.L. and A.W. Groeger. 1986. Limnological and ecological changes associated with reservoir aging, *in* G.E. Hall and M.J. Van Den Avyle [eds.], Reservoir fisheries management strategies for the 80's, pages 103-109. American Fisheries Society, Southern Division, Reservoir Committee, Bethesda, Maryland.

Ney, J.J. 1996. Oligotrophication and its discontents: effects of reduced nutrient loading on reservoir fisheries *in* L.E. Miranda and D.R. DeVries, editors, American Fisheries Society, Symposium 16, Bethesda, Maryland.

Maceina, M.J. and D.R. Bayne. 2001. Changes in the black bass community and fishery with oligotrophication in West Point Reservoir, Georgia. North American Journal of Fisheries Management 21:745-755.

Miranda, L.E., M.D. Habrat, and S. Miyazono. 2008. Longitudinal Gradients along a Reservoir Cascade. Transactions of the American Fisheries Society 137: 1851-1865.

O'Brien, J.W. 1990. Perspectives on fish in reservoir limnology, *In* K. W. Thornton, B. L. Kimmel, AND F. E. Payne [eds.], Reservoir limnology—ecological perspectives. Wiley. pages 209-225.

Ward, J.V., and Stanford, J.A. 1983. The serial discontinuity concept of lotic ecosystems, *In* T.D. Fontaine, III and S.M. Bartell [eds.], Dynamics of Lotic Ecosystems. An Arbor Science Publishers. Pgs 29-41.

Our Reservoir Habitat Assessment

Background – To better gauge the level of habitat impairment in reservoir systems, the RFHP initiated research into the qualitative and quantitative stressors associated with the habitat challenges listed above. Initial efforts utilized and modified methods established by Dr. Steve Miranda (Assistant Unit Leader, Mississippi Cooperative Fish and Wildlife Unit, Mississippi State University) to survey qualitative habitat impairment sources. Fisheries biologists and other fisheries professionals across eight states (Arkansas, California, Iowa, Kansas, Kentucky, North Carolina, Oklahoma, and Texas) were asked to rank the level of impairment for 23 metrics in each of their reservoirs over 250 acres in size. [The 250-acre size limit yielded a reservoir sample that was most manageable for our initial analysis and for which data were most likely to exist and to be accessible.] A full listing of survey variables and initial results can be found in Appendix II.

Survey metrics addressed issues pertaining to turbidity, sedimentation, erosion, nutrients, pollution, contaminants, oxygen and temperature stratification, water levels, water storage, aquatic macrophytes, watershed disconnectivity, nuisance species, land-water interface, harmful algal blooms, and downstream impacts of reservoir discharge. Factor analysis was run on the responses to each metric to identify groups of metrics (factors) which may serve as strong measures of reservoir habitat impairment. The objective of the analysis was to identify the underlying processes that account for the greatest sources of variation in habitat impairments among reservoirs across the United States.

[Note on the assessment – *When survey respondents entered "I do not know" to any particular impairment question, an issue arose that is particular to how factor analysis procedures incorporate these responses. Typically, "I do not know" types of responses are converted to "missing values" because factor analysis requires measurement scales that are either ordinal or interval in nature; "I do not know" responses are interpreted as nominal-scale responses in the factor analysis process. Two options were considered when determining whether a reservoir survey with one or more "I do not know" entries should be included or not in the factor analysis. The first option – the default methodology – removes from the analysis all reservoirs for which one or more "I do not know" responses are scored on any of the 23 metrics. In the survey of the eight states, this would have excluded a large number of reservoirs from the analysis. The alternative option was to convert all "I do not know" responses to "no impairment" responses (thereby giving the metrics for those responses a value of "0") under the assumption that if the surveyed fisheries professional was not aware of any impairment, then there likely was not one. We adopted the alternative option for the factor analysis in our assessment, fully aware that the "I do not know" response might have a substantial influence on the factor patterns, reflecting a lack of information. We content that such a source of variation in impairment scores is indicative of an "impairment" issue (i.e., lack of knowledge) that needs to be addressed by our partnership.]*

Impairment Factors – Based on the results of the analysis, six significant factors were detected, each of which contains statistically significant, spatially-associated impairment metrics or variables. Additionally, each factor represents to some degree one of the three

environmental parameters – physical, chemical, and biological – that drive reservoir functions. Moreover, the variables comprising each factor were judged to have some degree of contribution to reservoir system habitat impairment, as indicated above. However, it is important to keep in mind that the ranking of factors was determined by sequential partitioning of the variation in the subjective scorings among the suite of the 23 habitat impairment metrics that were solicited from participating fisheries professionals. The highest ranking factor explains the most variation among the reservoirs and their metrics (telling us the most about the underlying processes that drive the variation in the impairment scores for reservoirs); each subsequent factor accounts for any "left-over" variation, culminating in the least variation, which is associated with the final factor. The factors are:

- Factor One. The first factor (highest significance) includes temperature, dissolved oxygen, and structure variables associated with downstream habitat. These variables were closely related at a high level of significance in the analysis. However, as noted above, they were the variables that received the most "I do not know" responses. After conversion of "I do not know" responses to a "no impairment" response, these variables tended to group together as would be expected. Since this response conversion had to be made for a large number of reservoirs, some of the variation is attributable to a lack of knowledge. That fact must be considered in interpretation of this factor.

- Factor Two. The second factor (next highest significance) includes the physical variables of turbidity, sedimentation, shoreline erosion, and insufficient water storage. These variables are internally coherent; they represent impairment issues causing or resulting from sediments, sedimentation, and water clarity. These variables also play a role to some degree in the six reservoir habitat challenges discussed above.

- Factor Three. The third factor (next highest significance) includes the chemical variables of excessive nutrients, point- and non-point source pollution, contaminants, and physical watershed disconnectivity. This factor has a strong bearing on the water quality and watershed connectivity habitat challenges discussed above.

- Factor Four. The fourth factor (next highest significance) includes the hydrologic variables of seasonal and daily flows related to habitat downstream of the reservoir's dam release. This factor covers the hydrologic condition issues of the reservoir system, especially as they pertain to habitat below the reservoir.

- Factor Five. The fifth factor (next highest significance) includes the biological variables of excessive aquatic macrophytes, lack of aquatic macrophytes, and invasive plant species. This factor centers on plants, an integral part of physical habitat, and pertains directly to the critical issues of nuisance species, littoral habitat, and water quality in reservoir systems.

- Factor Six. The sixth factor includes the structural habitat and land-water interface variables. These are two key components to the survival and health of fish populations in reservoirs.

Each of the factor associations relates to one or more of the six reservoir habitat impairment challenges discussed earlier, as well as the habitat condition variables described in the NFHAP *Framework for Assessing the Nation's Fish Habitat*. As a whole, they identify the principal categories of impairments for which our partnership is established to address. Our initial 8-state research indicates that specific qualitative metrics can be used to efficiently and effectively assess habitat impairment in reservoirs. We intend to refine and expand application of this methodology and analysis to other participating States.

Our preliminary assessment provides a critical starting point for implementing the RFHP strategic plan. For example, cluster analysis of the significant factors allows us to identify and group reservoirs with significant impairments, and to group those impairments in physical, chemical and biological categories. At the same time, the analysis also reveals significant numbers of reservoirs with limited or no impairment. By separating reservoirs by impairment type and degree we are able to identify (1) reservoirs in need of restoration or enhancement (and the types of conservation actions needed for different impairments) and (2) reservoirs in need of maintenance or protection.

Integrated Methodology – In addition to the survey assessment described above and detailed in Appendix I, the partnership is also collecting quantitative metrics from the 8 States for key physical parameters that affect the biological and chemical processes in reservoirs. These measurements – which will be expanded to all participating States – will be used to develop models to classify reservoirs, predict reservoir impairments (and likely responses to treatments), and to supplement pre-existing qualitative metrics. Combined, the two methodologies will facilitate a more robust assessment of reservoirs and enable the identification of reservoir systems with the greatest habitat conservation needs – *whether for protection or rehabilitation*. Further, by integrating the partnership's reservoir classification system (Appendix I) into the methodological mix, we will have the basis (with socioeconomic variables added) to set strategic priorities to implement our strategic plan. In summary, our assessment tools and reservoir typology will provide:

- Decision Support. Our assessment data will help prioritize conservation needs in reservoirs – *where we need to focus our attention* – in conjunction with other socioeconomic, cost-benefit, risk (success/failure), partnership, and conservation need considerations (e.g., what is the conservation need that needs to be addressed: protection, restoration, or enhancement?). It will enable us to know:

  (1) Where are the most intact reservoir systems for purposes of protection?
  (2) Where are the most impaired reservoir systems located, for purposes of directing restoration, and precisely where and how should that restoration be directed?
  (3) Which impaired reservoir systems can be moved into the intact group for purposes of strategically re-directing conservation where it can do the most good at the least cost?
  (4) Which ecological and biological functions are impaired (and where) in reservoir systems, and what conservation actions and tools are most appropriate for

directing conservation in a manner that is comprehensive, strategic, and ecologically sound

- Means to Rate and Compare Reservoir Systems. Our assessment data in conjunction with our reservoir classification will enable us to rate and compare reservoirs and reservoir systems of similar types

- Reservoir Information Transfer. A robust classification system (Appendix I) coupled with knowledge of impairments within reservoir types will allow us to develop objectives for specific reservoirs, identify management options and habitat tools by reservoir type, and share methods, information, and technologies among similar reservoir and reservoir systems

- Standardization of Assessment Methods. Over the long-term, our objective is to identify a subset of metrics that can be used with standardized methodologies to quantitatively assess reservoir system health, supplementing existing qualitative survey metrics to provide a more solid scientific foundation to fish habitat assessment and conservation in reservoir systems.

The RFHP will work with the National Fish Habitat Assessment Team and the NFHAP Board's Science and Data Committee to evaluate, transfer, and integrate all results of both the classification and assessment efforts into the National Fish Habitat Assessment. The partnership will also provide support information to each of the Fish Habitat Partnerships and develop working relationships with each of their Science and Data Committees.

NFHAP Fish Habitat Assessment Framework – The RFHP reservoir assessment follows and builds upon the NFHAP Science and Data Committee *Framework for Assessing the Nation's Fish Habitat*. Classification of reservoir systems is the foundation for our assessment work: when completed, it will provide the basis upon which to (1) structure our reservoir assessment; (2) understand the functional and biological conditions of reservoir systems; (3) compare conditions within reservoir systems in a meaningful way; and (4) develop and transfer knowledge and rehabilitation techniques between reservoir systems.

Our assessment is based on 23 impairment metrics and their grouping into six factors that largely match the habitat condition variables set forth in the NFHAP framework document: Connectivity, Hydrology, Circulation, Bottom Form Complexity, Material Recruitment, Water Quality, and Food Webs and Energy Flow. For example, the six reservoir challenges described in the earlier section, **Reservoir Challenges to Fish Habitat**, correspond to one or more of the habitat variables – except for circulation, which is a coastal habitat variable. More significantly, each of the six factors extracted from the RFHP assessment – which are simply clusters of spatially-associated impairment metrics – include one or more of the relevant habitat condition variables described in the NFHAP framework document (see also Rotated Factor Pattern chart on pages 49-50):

- *Factor One* (Tailwater Water Quality) – Includes Water Quality, Connectivity and Bottom Form Complexity
- *Factor Two* (Sediments) – Includes Hydrology, Material Recruitment, and Connectivity
- *Factor Three* (Pollution) – Includes Water Quality, Food Webs and Energy Flows, and Connectivity
- *Factor Four* (Tailwater Flows) – Includes Connectivity and Hydrology
- *Factor Five* (Macrophytes) – Includes Bottom Form Complexity and Food Webs and Energy Flows
- *Factor Six* (Habitat Structure) – Includes Bottom Form Complexity

Following the methodology of the *NFHAP* framework document we are developing metrics for the impairment categories and will use them to formulate habitat condition scores. In cooperation with Michigan State University (MSU) and the NFHAP Science and Data Committee, we will provide reservoir condition scores for the national fish habitat assessment and its NHD+ database. Additionally, we will work with MSU and the NFHAP Science and Data Committee to update the NHD+ database to address critical reservoir-associated data gaps that occur in it.

Our Partnership

Mission - The Reservoir Fisheries Habitat Partnership is a national partnership established to promote and facilitate the conservation of habitat for fish and other aquatic species in reservoir systems through collaborative actions that contribute to:

- The ecological health and function of reservoirs and their associated waters and watersheds
- The restoration, protection and enhancement of fish and other aquatic species and communities, therein
- The sustainability and enhancement of reservoir fisheries
- Public awareness of the conservation issues and challenges facing reservoir and associated waters and watershed management in the 21st Century
- The quality of life of the American people

Vision - Clean water and healthy aquatic habitat in reservoirs and their connected waterways are not optional for our nation's future. Healthy reservoir systems are critical if we are to provide water in sufficient quantity and quality to support humans and their communities, and the aquatic life that thrives within their waters. *We envision a future of healthy reservoir systems that are sustained by collaborative action to benefit (1) people, their communities, and their economies and (2) fish and other aquatic species, and their communities, for future generations*. It is a future where:

- Our partnership leads in identifying and implementing, through collaborative partnerships, priority habitat projects within reservoirs and their associated waters to protect, restore, and enhance important fisheries
- Sustainable management of reservoir systems is supported by broad public participation based on dialogue, collaboration, and consensus building
- Partners who have not traditionally worked together in addressing reservoirs and connected lands and waters will now plan, fund, and support actions to protect aquatic habitat in those systems
- Reservoirs are managed as part of encompassing natural systems that include both upstream and downstream flow components, and terrestrial areas impacting or influenced by those components
- The value of healthy and sustainable reservoir systems are understood and appreciated by the millions of Americans who use them and the elected officials who determine the policies that govern them
- Our partnership is instrumental in motivating and coalescing reservoir stakeholder groups and other conservation partnerships to support and implement actions that address priority aquatic habitat needs in reservoirs, downstream waters, and associated watersheds
- Sustainable economic development is predominant and contributes toward the conservation of healthy reservoir systems nationwide
- Adequate information systems and communication networks exist to support the development of best management practices and appropriate technologies to support the conservation of fish habitat in reservoir systems

- Our partnership can scientifically contribute to informed policy decisions on the management of reservoir systems and their future modification, including removal of impoundment structures that are no longer needed or that are deemed harmful to human and aquatic life
- Recreational uses of reservoir systems are expanded, made more available to all Americans, and connected through volunteerism to the conservation of those systems
- Regulatory agencies and ownership jurisdictions within reservoir systems cooperate to establish seamless management and conservation

Commitment to Collaboration – Reservoirs, and the waters that feed into and flow from them, cross innumerable ownership jurisdictions and engage multiple agencies in their management and regulation. No single ownership or government entity has the authority or the capacity to manage reservoirs as parts of watershed systems. Moreover, our capability to conserve habitat that is vital to fish and other aquatic organisms that are associated with reservoir systems depends on our ability to access those systems and implement appropriate conservation actions.

Reservoir conservation is, by necessity, collaborative. The RFHP depends on collaborative conservation in two critical ways. One, our partnership must have the depth of membership and the expanse of inclusion to ensure that all of the key stakeholders are gathered under a single organizational umbrella, and that each of the constituent parts to our partnership have commitment to and ownership in the partnership and its goals and objectives. We address this in our strategic plan. Two, our partnership depends on collaboration with others to implement the strategic conservation actions we deem essential to achieve and sustain healthy reservoirs, associated waters, and related fisheries across the great expanse of our nation. We will help facilitate, inform, equip, and support a bottom-up approach to the implementation of our strategic targets through partnerships at the local, State, and regional level.

Scope of Action – The RFHP includes in its scope of action all manmade bodies of water formed by the impoundment of otherwise free-flowing rivers and streams and that are both accessible to the public and that support, or have the potential to support, a sport fishery. We include in this scope of action (1) those sections of downstream tailwaters, and adjacent wetlands and riparian areas that are affected measurably by dam releases and (2) the upstream headwaters, tributaries, and lands of the watershed whose flows and uses demonstrably impact the quality and quantity of water entering reservoirs.

We limit the scope of our action within reservoir systems in two important ways. One, the partnership will only address reservoirs that are accessible to the public. Reservoirs that are closed to public access by virtue of ownership or regulation are unlikely to afford opportunities for partnered conservation action. Moreover, public access is a principle that underscores this partnership's commitment to citizen participation in the conservation of reservoir resources. Two, the partnership excludes from its scope of action those reservoirs that do not support and do not have the potential to support a sport fishery. We are committed as a partnership to conserve fish habitat in order to protect, restore, and enhance fish and other aquatic populations. We are also committed to quality

sport fish recreation and sustainable fisheries in the reservoirs we seek to protect, or return to healthy status. Reservoirs that do not or cannot support a sport fishery fall outside the scope of our conservation strategy.

We also limit our scope of action to impounded streams and rivers. We do this for two reasons. One, impounded streams and rivers have similar management issues and present a well-defined target for our conservation action. Two, the universe of impounded streams and rivers is enormous and includes tens of thousands of small to large reservoir bodies. Inventorying, classifying, and assessing these impoundments is a daunting prospect for a partnership in its formative stage. However, we are acutely aware that impounded streams and rivers share key habitat and fisheries characteristics with both natural lakes and impounded natural lakes. We are also aware that these bodies of water are no less important than reservoirs for fish and their habitat, that they are no less structural and functional parts of watershed systems, and that their exclusion from our scope of action is necessarily arbitrary, driven by pragmatic considerations. For these reasons, the partnership will revisit the issue of natural and impounded lakes to determine whether they should be included, fully or in part, in the partnership. Our determination will be influenced by the presence or absence of other regional or national partnerships dedicated to fish habitat conservation in these lentic waters.

Although our operational definition of *treatable* reservoirs narrows our scope of action, the pool of reservoirs (and their associated tailwaters and watersheds) available to us for fish habitat conservation is substantial, covering every state and major physiographic region of the U.S. The thousands of reservoirs currently in our inventory, or soon to be added, span and include the full typology of reservoir types found in the this country. Our preliminary classification of reservoirs (Appendix I), adapted from a physiographic typology developed by *In-Fisherman*, include:

- Canyon Reservoirs
- Plateau Reservoirs
- Highland Reservoirs
- Hill-Land Reservoirs
- Flatland Reservoirs
- Lowland Reservoirs

Structure and Governance – Our partnership structure is made up of three parts:

- A national **Executive Committee**
- Four **Regional Workgroups** (each corresponding to and associated with one of the four regional AFWA associations: the Northeast Association of Fish and Wildlife Agencies; the Southeast Association of Fish and Wildlife Agencies (represented by the Southeast Aquatic Resources Partnership); the Midwest Association of Fish and Wildlife Agencies; and the Western Association of Fish and Wildlife Agencies)
- A **Friends of Reservoirs** national foundation with an affiliated network of local chapters

The 15-member Executive Committee constitutes the governing structure of the partnership. Its role is to (1) implement the RFHP Strategic Plan; (2) set partnership policy; (3) establish national procedures and guidelines; (4) review and approve national conservation priorities; (4) request, acquire and allocate funds to projects; (5) provide oversight of and direction to Regional Workgroups, (6) conduct national assessments; (7) maintain a reservoir database coordinated with the NFHAP database; and (8) oversee monitoring and performance measurement and reporting. Three bodies serve the Executive Committee:

- *Staff* – a full-time paid coordinator (supported by voluntary staff from partnering agencies and organizations) who manages partnership operations
- *Science and Data Committee* – RFHP volunteers who provide scientific consultation on implementation of the strategic plan, assessments, databases, and consistency with the NFHAP national strategic plan
- *Outreach and Communication Committee* – RFHP volunteers who support partnership development, advance public education, and address policy issues and needs

The Regional Workgroups are established by each of the four regional AFWA associations. They are the workhorses of the partnership; they link the national organization to the on-the-ground projects supported by the partnership. They identify regional priorities, participate in development and selection of projects, and facilitate, monitor, and report project implementation. In addition, Regional Workgroups implement policies and strategic actions determined by the Executive Committee and support the Committee in implementation of the strategic plan, national assessments and databases, and periodic performance reporting. Each Regional Workgroup is supported by staff structures specific to their needs and means.

Friends of Reservoirs is the third arm of governance of the RFHP. Its purpose is to create an institutional base upon which to build and sustain the partnership in the long-term. It will engage the national constituency of reservoir stakeholders – those who rely on reservoirs and their watersheds for an array of ecological, economic, and recreational services – in the conservation of healthy reservoir systems through both a national foundation and an affiliated network of State and reservoir-level chapters. Friends of Reservoirs will provide the participatory channels, volunteer force, and long-term support required by the partnership to meet its mission. It will create entry points into the everyday operations of the RFHP for both national and local supporters. In turn, it will provide to the RFHP direction in the setting of reservoir conservation priorities.

Details on the governance structure of the partnership are included in Appendix III.

Our Conservation Strategy

Healthy reservoir systems are vital to the security of the United States, to the quality of life of its citizens, and to the quality and quantity of aquatic habitat needed to sustain our native and sport fisheries. Our conservation strategy to protect, restore and enhance healthy reservoir systems – and the fish habitat that relies upon them – is built on the foundation of five goals:

- Protect, restore and enhance fish habitat in reservoir systems to support productive fisheries and healthy aquatic ecosystems
- Manage reservoir systems to provide, protect and enrich quality of life for the American people
- Develop and foster partnerships that implement landscape-scale approaches to the conservation of fish habitat in reservoir systems
- Develop and sustain institutional arrangements and sources of funding to support the long-term conservation of fish habitat in reservoir systems
- Support education and outreach initiatives that advance public awareness and understanding of the value of healthy reservoir systems

To meet these goals, the RFHP is guided by four principles:

(1) Solutions to reservoir issues must be system-based. This means that the conservation actions we support to conserve fish habitat must address the causes, not the symptoms, of environmental, ecological and biological degradation in reservoir systems – and that this entails looking at causation across the watershed, not just within the reservoir proper. It also means that the role that people and their institutions play in managing reservoirs must be considered and addressed if conservation of fish habitat is to be meaningful and the health of reservoir systems sustained. Institutional, policy, and educational barriers to healthy reservoir systems must be rectified.

(2) Conservation actions must be sustainable. This principle flows from the first. The conservation actions we support must address not only primary causes of reservoir system decline but result in outcomes that persist. The RFHP seeks more than ephemeral changes in the status of fish habitat and associated fisheries. Our conservation actions – *if they are to be sustainable* – must withstand and effectively address the combined impacts of population growth, development, and projected shifts in local and regional climate.

(3) Conservation of reservoir systems must be collaborative and local. This principle is intrinsic to principles one and two. Our ability to function effectively and successfully at a watershed scale demands collaboration among the disparate authorities and interests responsible for and reliant upon any particular reservoir. Anything short of full stakeholder engagement impedes meaningful system-based conservation action. Moreover, our ability to deliver the conservation we identify as strategic relies on the driving force of local engagement.

(4) Conservation of reservoir systems relies on information sharing. Principles one, two and three are conditional on this last principle. Our ability to address fish

habitat strategically, sustainably, and collaboratively within reservoir systems depends on information – and our success in disseminating that information among the thousands of reservoir managers and stakeholders who hold the future of those systems in their hands. Knowledge that informs reservoir managers of best practices, educates, entertains, and engages users in reservoir conservation, and enlightens, motivates and guides decision makers in promulgating good conservation policy is fundamental to everything we do.

The components of our conservation strategy that follow – our goals, objectives, and targets – establish the outline of a long-term road map to success, one which we believe will lead to the realization of our mission, our vision, and our principles. We acknowledge that many of the objectives and targets we set forth must await subsequent 5-year revisions of the plan to be met and fulfilled. Accordingly, each goal is followed by a set of primary strategic actions that are scheduled to be implemented and met in the first planning cycle of the partnership (2010 – 2014). Some of these actions entail immediate information needs, such as completion of the RFHP national reservoir classification and assessment. Others entail preparatory actions necessary to either initiate or meet portions of other targets – with the expectation that completion may lie beyond the initial 5-year planning cycle. By stepping down broad, multi-year targets to a set of primary actions that we can achieve in our first 5 years, we can provide not only a road map of where we are headed, but a detailed look at our first stop along this long journey.

Goal One: ***Protect, restore and enhance fish habitat in reservoir systems to support productive fisheries and healthy aquatic ecosystems*.**

Reservoirs are human modifications of watershed systems designed to deliver water, navigation, power, flood risk reduction, recreation and other services. They alter and sometimes transform those systems, affecting resident populations of aquatic species and the ecological functions and structures upon which those populations depend. In turn, reservoirs are impacted by land uses in the watershed that affect water quantity and quality.

The objectives, targets and conservation actions that follow derive from the reservoir system impairments identified by the RFHP in its preliminary assessment. Additionally, these objectives and targets set forth the general framework for the four region-specific implementation plans that will be developed by the Regional Workgroups during the partnership's first planning cycle. These plans will translate the broad objectives and targets listed below into concrete, measurable conservation actions aimed at conserving fish habitat in reservoir systems. Primary conservation actions that will be attained in the first 5-year planning cycle are listed separately at the conclusion of Goal One.

Objective 1A – Protect, restore and enhance the structure and function of riparian and shoreline zones in reservoir systems to support healthy aquatic ecosystems.

Target 1A1. Develop guidelines and protocols for the conservation of riparian and shoreline zones.

Target 1A2. Protect intact riparian and shoreline zones through conservation easements or other long-term conservation mechanisms.

Target 1A3. Increase coordination and cooperation with entities promoting the conservation of riparian and shoreline zones.

Objective 1B **–** Protect, restore or enhance physical habitat for desired fisheries.

Target 1B1. Increase complex littoral habitats as overall percentage of total reservoir area in accordance with reservoir type, location, and best management practices.

Target 1B2. Increase/restore spawning/juvenile habitat in reservoir systems and create such habitats that would not be dewatered if reservoir water-levels or downstream flows fall below normal expected variation.

Target 1B3. Ensure partners have best available equipment and up-to-date guidance documents for planting of native aquatic macrophytes and habitat supplementation with complex woody debris.

Objective 1C – Manage aquatic and riparian nuisance species to avoid or minimize detrimental impacts to fish and aquatic resources.

Target 1C1. Develop best management practices for prevention, control or eradication of aquatic and riparian nuisance species.

Target 1C2. Support public prevention efforts for aquatic recreation users to limit spread of nuisance aquatic species.

Target 1C3. Establish online information network exchange for sharing, displaying, and discussing projects, strategies and technologies for prevention, control, or eradication of aquatic and riparian nuisance species.

Objective 1D – Maintain or restore appropriate hydrologic conditions in reservoir systems to support healthy aquatic ecosystems.

Target 1D1. Coordinate and cooperate with reservoir controlling authorities to ensure consideration of the needs of fish and aquatic resources within reservoir operations plans.

Target 1D2. Coordinate and cooperate with reservoir controlling authorities to adapt reservoir operations plans to address the projected effects of climate change.

Target 1D3. Coordinate and cooperate with reservoir controlling authorities and downstream property owners to restore flood plain function.

Objective 1E – Protect, restore and enhance watershed connectivity.

Target 1E1. Protect, restore and enhance fish access to backwater spawning habitats.

Target 1E2. Remove or mitigate upstream and downstream barriers to fish passage.

Target 1E3. Develop guidelines for addressing fish passage issues within the design of proposed reservoirs.

Target 1E4. Provide technical guidance to support decision-making processes focused on dam removal.

Objective 1F **–** Maintain or restore water quality in reservoir systems.

Target 1F1. Develop and refine tools and methodologies for evaluating water quality in reservoir systems.

Target 1F2. Encourage State partners to participate in water quality standards development and review to provide consideration for the habitat needs of fish and aquatic organisms.

Target 1F3. Maintain or restore the function of riparian and upland habitats to maintain water quality.

Objective 1G – Maintain or restore sediment flows in reservoir systems to support healthy aquatic ecosystems.

Target 1G1. Restore natural hydrologic regimes in reservoir systems to minimize the effects of river impoundment and maintain the natural expected variation of sediment flows.

Target 1G2. Promote best management practices within the watershed that prevent erosion and reduce sediment loads entering reservoir systems.

Objective 1H – Develop procedures and methodologies to prioritize and select fish habitat projects, and to monitor and evaluate the health of fish habitat in reservoir systems.

Target 1H1. Develop standardized methodologies to assess fish habitat in reservoir systems, including a reservoir classification system to organize assessment data in a format accessible to, useable by, and practical for fishery and reservoir managers.

Target 1H2. Develop a science-based prioritization process to select projects for support and implementation by the RFHP and its partners

Target 1H3. Develop and maintain a central web-based, geo-referenced database for (a) fish habitat data; (b) reservoir assessments, project tracking, and research; and (c) project applications and submissions.

Target 1H4. Conduct periodic reviews that outline the state of fish habitat in reservoir systems.

2010 – 2014 Primary Conservation Actions for Goal One

- *Complete final version of RFHP Strategic Plan by end of 2010* (Target IH1)
- *Complete national reservoir classification by end of 2010* (Target 1H1)
- *Establish technical assistance teams for policy and project support by end of 2010* (Targets 1C2, 1D2, 1D3, 1E4, 1G2)
- *Complete reservoir assessment for fish habitat by end of 2010* (Target 1H1)
- *Complete science-based prioritization process for identification of fish habitat priorities in reservoir systems by end of 2010* (Target 1H2)
  - Complete prioritization, monitoring, and reporting protocols
  - Complete national and regional reservoir system and project priority lists

- *Develop reservoir impairment model from key metrics to identify major impairments and their severity by end of 2011* (Target 1H1)
- *Complete Regional Workgroup implementation plans by end of 2011*(Target 1H2)
- *Develop information network and exchange for sharing and dissemination of best management practices, appropriate technologies, and reservoir user practices and ethics by end of 2011* (Targets 1B3, 1C1, 1C2, 1C3, 1G2)
- *Issue regional reports on fisheries and fish habitat trends and conditions in reservoirs and reservoir impacted waters starting in* 2011 (Target 1H4)
- *Develop first iteration of tools, guidelines, methodologies and protocols for fish habitat conservation in reservoir systems by end of 2012; present at AFWA regional meetings and American Fisheries Society* (Targets 1A1, 1B3, 1E3, 1F1)
- *Establish and implement MOUs and other broad voluntary agreements to establish and foster a collaborative relationship between the RFHP and major reservoir regulatory and ownership authorities and other partnerships engaged in management and conservation of reservoir systems by the end of 2012* (Targets 1A3, 1D1, 1D2, 1D3, 1F2)
- *Complete development of national reservoir fish habitat assessment and project database by end of 2012* (Target 1H3)
- *Support project implementation starting in 2011*(Targets 1A2, 1B1, 1B2, 1E1, 1E2, 1F3, 1G1)
    - Complete regional implementation plans by end of 2010
    - Complete list of top ten priority reservoir systems for 2011
    - Support 10 - 20 fish habitat conservation projects in priority systems in 2011
    - Complete list of top ten priority reservoir systems for 2012
    - Support 15 – 25 fish habitat conservation projects in priority systems in 2012
    - Complete list of top ten priority reservoir systems for 2013
    - Support 20 – 25 fish habitat conservation projects in priority systems in 2013
    - Complete list of top ten priority reservoir systems for 2014
    - Support 35 – 30 fish habitat conservation projects in priority systems in 2014

Goal Two: *Manage reservoir systems to provide, protect and enrich quality of life for the American people.*

Reservoir systems draw millions of Americans each year to the outdoors by providing a multitude of recreational opportunities including fishing, swimming, boating and other forms of water-based recreation. As such, they serve as gateways to nature, offering endless opportunities to nurture an ethic of stewardship. Furthermore, they provide outdoor outlets for an increasingly urban population upon whose shoulders rests the future of conservation in America.

The objectives and targets that follow address the quality of life issues that pertain to the social and economic contributions of reservoirs and to the recruitment of citizens to the stewardship of reservoirs and their associated watersheds. They also set forth the general framework for the four region-specific implementation plans that will be developed by the Regional Workgroups during the partnership's first planning cycle. Those plans will

translate the broad objectives and targets listed below into concrete, measurable conservation actions aimed at conserving fish habitat in reservoir systems. Primary conservation actions that will be attained in the first 5-year planning cycle are listed separately at the conclusion of Goal Two.

Objective 2A – Develop environmental amenities, nature experiences, and wildlife-based activities and opportunities on lands adjacent to reservoir systems to engage and inform local communities and the visiting public on the values and benefits of healthy reservoir systems.

Target 2A1. Establish nature amenity partnerships to develop non-traditional nature-based recreational opportunities.

Target 2A2. Build reservoir-based volunteer corps to provide interpretation, education, and other nature-related assistance to the public.

Target 2A3. Promote volunteer shoreline cleanups.

Target 2A4. Develop educational curricula, nature programs, and outdoor fish and wildlife activities for adoption and implementation by reservoir management and volunteer services

Objective 2B – Promote conservation of fish and aquatic resources to boaters and other water-based recreationists.

Target 2B1. Develop conservation-related programs and activities for boaters.

Target 2B2. Develop self-guided aquatic discovery trails for canoes and kayaks.

Target 2B3. Develop volunteer boating corps to assist in the conservation of fish habitat and aquatic resources; consider partnering with the Coast Guard Auxiliary.

Objective 2C – Maintain and enhance public access.

Target 2C1. Support States in expanding angler and boater access areas and facilities.

Target 2C2. Provide public education on ethics and etiquette for access across private lands.

Objective 2D – Support recreational industries and related economic activities that advance watershed health and contribute to the conservation of fisheries and aquatic habitats in reservoir systems.

Target 2D1. Develop partnerships with industries and commercial endeavors that most affect or are most affected by reservoirs and their watersheds.

Target 2D2. Seek corporate support for the RFHP operations and projects.

Target 2D3. Develop joint conservation ventures with corporate supporters.

Target 2D4. Consistent with other goals, identify and prioritize conservation projects that engage business stakeholders in a way that promotes both economic activity and watershed health.

2010 – 2014 Primary Conservation Actions for Goal Two

- *Develop and implement Friends of Reservoirs starting in 2010* (Targets 2A1, 2A2, 2A3, 2A4, 2B1, 2B2, 2B3, 2C2)

    - Friends of Reservoir Steering Committee established by June, 2010
    - Friends of Reservoirs framework and guidelines established by September, 2010
    - Friends of Reservoirs chapters established in 2 States (2010), 6 States (2011), 12 States (2012), 24 States (2013), 36 States (2014)
- *Outreach Committee complete Outreach and Communication plan by end of 2010* (Targets 2A4, 2B1, 2B2, 2D1, 2D2)
- *Establish technical assistance teams for policy and project support by end of 2010* (Targets 2C1, 2C2, 2D1)
- *Work with States to identify, augment, and fund needed additions to angler access to reservoirs and associated waters* (Target C1)
- *Develop information network and exchange for sharing and dissemination of access management practices, appropriate strategies, and reservoir user practices and ethics by end of 2011* (Target 2C2)
- *Support project implementation starting in 2011* (Target 2D4 – see also last bulleted conservation action for Goal One)
- *Establish and implement MOUs and other appropriate voluntary agreements for coordination of conservation action among major recreational businesses and reservoir-affiliated enterprises by end of 2012* (Targets 2D1, 2D3)

Goal Three: *Develop and foster partnerships that implement landscape-scale approaches to the conservation of fish habitat in reservoir systems.*

Given that impairments to fish habitat in reservoir systems are often the result of activities that occur within the watershed, conservation actions must occur at landscape scales. Many government agencies, private organizations, businesses, local communities, and citizens recognize the value of fishery and other aquatic resources in reservoir systems and work diligently to conserve them. However, previous efforts to halt their decline have often been conducted independently. Coordination and cooperation by partners will provide synergism to these fragmented efforts and enhance the overall outcome by leveraging knowledge and limited available resources.

The objectives and targets that follow address the development of the RFHP partnership base and its scientific and technical capacities to assist reservoir managers and support local partners in reservoir-related fish habitat conservation actions. They also set forth the general framework for the four region-specific implementation plans that will be developed by the Regional Workgroups during the partnership's first planning cycle. Those plans will translate the broad objectives and targets listed below into concrete, measurable conservation actions aimed at conserving fish habitat in reservoir systems. Primary conservation actions that will be attained in the first 5-year planning cycle are listed separately at the conclusion of Goal Three.

Objective 3A – Expand the partnership base of the RFHP to include additional States, relevant federal and tribal agencies, major non-profit and NGO organizations, recreational industries and industry associations, reservoir and power generation

authorities, reservoir homeowner associations and home developers, municipalities and local businesses, local watershed associations and conservation groups, irrigators, and others affected by reservoirs.

Target 3A1. Prepare partnership outreach and development plan.

Target 3A2. Establish outreach and partnership developmental tools.

Objective 3B – Establish national and regional technological assistance, data sharing and information network capacities to support development and adoption of best management practices among managers and among individuals and organizations engaged in the conservation of fish habitat in reservoir systems.

Target 3B1. Establish Memorandums of Understanding and other instruments of collaboration with established fish habitat partnerships, and other landscape-scale environmental ventures, to support fish habitat conservation in reservoir systems through communication networks, information sharing, and implementation of best management practices.

Target 3B2. Establish and maintain a RFHP operational database – coordinated with the national NFHAP fish habitat database – to store and make available to RFHP partners a broad range of reservoir data and information, including assessments, projects, and technical support materials.

Target 3B3. In collaboration with partners, prepare, distribute and periodically update a compendium of best management practices for fish habitat conservation in reservoir systems.

Target 3B4. Prepare and deliver training and support materials to managers and other stakeholders engaged in fish habitat conservation in reservoir systems.

Target 3B5. Establish and maintain an interactive RFHP web-site to foster collaboration, share and disseminate information, support training, develop communication networks, and support a national reservoir system fish habitat conservation database.

Target 3B6. Develop a national listserve to foster communication and networking among reservoir managers, reservoir stakeholders, and partners and participants in the RFHP.

Objective 3C – Support and participate in watershed planning initiatives to promote implementation of best management practices for conservation of fisheries and fish habitat in reservoir systems.

Target 3C1 – Partner with existing watershed alliances or facilitate the creation of watershed alliances in their absence.

Target 3C2 – Provide technical information/support to these watershed groups in promoting/implementing best management practices.

Objective 3D – To ensure practitioner awareness of and access to the RFHP and its support capacities, establish outreach to reservoir managers, relevant authorities and communities within reservoir systems, and other private and public stakeholders engaged in conservation of those systems and their fisheries.

Target 3D1. Proliferate internet linkages to the RFHP web-site.
Target 3D2. Build networks with reservoir-system-based conservation entities.
Target 3D3. Provide presentations to authorities, agencies, and conservation stakeholders through regional workgroups.
Target 3D4. Disseminate the RFHP listserve.

2010 – 2014 Primary Conservation Actions for Goal Three

- *Prepare and disseminate Reservoir newsletter and other partnership recruitment materials* (Target 3A1,3A2,3D3)
- *Outreach Committee complete Outreach and Communication plan by end of 2010* (Target 3A1, 3A2)
- *Complete recruitment of State and Federal partners in 2010 (Target 3A1, 3A2*
- *Establish partnership ties with 2 or more tribal agencies and one or more tribal associations by end of 2010* (Target 3A1, 3A2)
- *Develop list of all watershed associations in the U.S. and submit informational mailings by end of 2010* (Target 3A1, 3A2)
- *Develop list of reservoir homeowner associations and developers and submit informational mailings by end of 2010* (Target 3A1, 3A2)
- *Develop list of all reservoir related major industries and industry associations and submit letters of invitation by end of 2010* (Target 3A1, 3A2)
- *Develop list of all reservoir management and power generation authorities and submit letters of invitation by end of 2010* (Target 3A1, 3A2)
- *Establish technical assistance teams for policy and project support by end of 2010* (Targets 3B4, 3D3)
- *Develop information network and exchange for sharing and dissemination of best management practices, appropriate technologies, and reservoir user practices and ethics by end of 2011* (Targets 3B3, 3B5, 3B6, 3C2, 3D4)
- *Establish and implement MOUs and other appropriate voluntary agreements for coordination of conservation action among all major reservoir regulatory and ownership authorities and other partnerships engaged in conservation impacting reservoir systems by end of 2012* (Targets 3B1, 3C1, 3D2)
- *Complete development of national reservoir fish habitat assessment and project database by end of 2012* (Target 3B2)
- *Develop first iteration of tools, guidelines, methodologies and protocols for fish habitat conservation in reservoir systems by end of 2012; present at AFWA regional meetings of American Fisheries Society* (Targets 3B3, 3C2)

Goal Four: ***Develop and sustain institutional arrangements and sources of funding to support the long-term conservation of fish habitat in reservoir systems***

Large-scale habitat restoration and enhancement efforts are, by nature, long-term, expensive undertakings. Such projects typically cross jurisdictional boundaries and, hence, require a formal coordination process for implementation and efficient function. A stable, long-term source of funding is also needed to provide base funding and to leverage additional funds from agencies and local governmental and private partners.

Institutional support for the RFHP will come from two primary sources: the National Fish Habitat Action Plan and a Friends of Reservoirs Foundation and chapter affiliates. Each will provide essential institutional support to the RFHP: (1) a network of Fish Habitat Partnerships in which the RFHP can operate and from which it can receive support and (2) a Friends of Reservoirs to provide the RFHP critical bottom-up volunteer and fundraising support. In turn, the RFHP provides essential services to both the NFHAP and Friends of Reservoirs. Our partnership will help develop new sources of funding for the NFHAP and provide essential project support to all Fish Habitat Partnerships. Similarly, we will provide reservoir stakeholders an institutional framework in which they can advance their conservation interests and through which they can participate in the conservation of fish habitat in reservoir systems.

The objectives and targets that follow establish the institutional foundation for supporting, implementing and sustaining the conservation mission of the RFHP. They also set forth the general framework for the four region-specific implementation plans that will be developed by the Regional Workgroups during the partnership's first planning cycle. Those plans will translate the broad objectives and targets listed below into concrete, measurable conservation actions aimed at conserving fish habitat in reservoir systems. Primary conservation actions that will be attained in the first 5-year planning cycle are listed separately at the conclusion of Goal Four.

Objective 4A – Develop and formalize institutional relationships between RFHP and principle partners to establish landscape-level networks of communication and governance that will facilitate effective, efficient, and sustaining conservation of aquatic habitat in reservoir systems.

Target 4A1. Establish Memorandums of Understanding with all Fish Habitat Partnerships; establish appropriate collaborative agreements with partnerships unaffiliated with the NFHAP.

Target 4A2. Establish web-linking of relevant organizations and facilitate communication networks between all entities.

Target 4A3. Regularly convene joint partnership workshops at regional and State levels to share information, advance cooperation, and more effectively engage the full community of stakeholders.

Target 4A4. Coordinate legislative outreach to strengthen or create needed environmental laws and renew or upgrade existing federal funding for habitat restoration.

Target 4A5. Establish protocols and procedures for collaborative development and dissemination of best management practices and the sharing of data across management and political jurisdictions within reservoir systems.

Objective 4B - Identify and develop long-term funding opportunities for RFHP projects and operations.

Target 4B1. Establish a national foundation (through Friends of Reservoirs) to hold and distribute funding in coordination with the NFHAP for reservoir system fish habitat projects.

Target 4B2. Identify traditional sources of funding from government and non-profit grant-making foundations and develop/implement a short- and intermediate-term financial plan.

Target 4B3. Identify business partners within the recreational boating and fishing industry and develop fund-raising plan to meet intermediate- and long-term goals.

Target 4B4. Work with the NFHAP to identify and pursue non-traditional funding sources.

Target 4B5. Establish a clearinghouse to match available funding sources and projects.

Objective 4C – Establish staff infrastructure to administer operations of RFHP.

Target 4C1. Hire full-time Coordinator to oversee routine functions of RFHP.

Target 4C2. Develop a pool of rotating part-time staff from States and other principle partners to support Coordinator.

Target 4C3. Activate permanent committees to coordinate major RFHP activities.

Target 4C4. Build voluntary mechanisms to support RFHP activities.

Target 4C5. Organize meetings to facilitate information exchange and conduct business within the partnership and with external partners.

2010 – 2014 Primary Conservation Actions for Goal Four

- *Establish RFHP operational staff in 2010* (Targets *4A3, 4C1-4C4*)
  - Hire RFHP Coordinator
  - Identify and establish a volunteer, part-time staff support system on rotating basis drawn from the RFHP member agencies and organizations
  - Establish permanent committees (Outreach-Communication/Science-Data)
- *Develop and implement Friends of Reservoirs starting in 2010* (Targets 4B1. 4B2, 4B4, 4C4)
  - Friends of Reservoir National Foundation and Steering Committee established by June, 2010
  - Friends of Reservoirs national framework and guidelines for affiliated chapters established by September, 2010
  - Friends of Reservoirs 501(c)(3) tax exempt Foundation established by end of 2010
  - Friends of Reservoirs chapters established in 2 States (2010), 6 States (2011), 12 States (2012), 24 States (2013), 36 States (2014)
  - Establish coordination between Friends of Reservoirs and the NFHAP for support of fish habitat projects in reservoir systems
- Sch*edule and host partnership meetings starting in 2010* (Targets 4A3, 4C5)
- *Prepare a long-term financial plan for the RFHP* (Targets 4B1, 4B2, 4B3)
- *Outreach Committee complete Outreach and Communication plan by end of 2010* (Targets 4A4, 4B2, 4B3, 4A4, 4B4, 4B5)
- *Develop information network and exchange for sharing and dissemination of best management practices, appropriate technologies, and reservoir user practices and ethics by end of 2011* (Target 4A2)

- *Establish and implement Memorandums of Understanding and other appropriate agreements for coordination of conservation action among all major reservoir regulatory and ownership authorities and other partnerships engaged in conservation impacting reservoir systems by end of 2012* (Target 4A1)
- *Develop first iteration of tools, guidelines, methodologies and protocols for fish habitat conservation in reservoir systems by end of 2012* (Target 4A5)

Goal 5*: Support education and outreach initiatives that advance public awareness and understanding of the value of healthy reservoir systems.*

Effective conservation of fish habitat and aquatic resources in reservoir systems is dependent upon a public that is well-informed of the benefits of healthy reservoir systems and a citizenry that is well-prepared and properly enabled to act as stewards of those resources. Effective public outreach and education by the RFHP at the national, regional and local levels will ensure a well-informed public that will garner support for conservation of reservoir systems nationwide.

The objectives and targets that follow establish the public outreach, citizen education, and policy development functions of the RFHP. They also set forth the general framework for the four region-specific implementation plans that will be developed by the Regional Workgroups during the partnership's first planning cycle. Those plans will translate the broad objectives and targets listed below into concrete, measurable conservation actions aimed at conserving fish habitat in reservoir systems. Primary conservation actions that will be attained in the first 5-year planning cycle are listed separately at the conclusion of Goal Five.

Objective 5A – Advance public awareness of the economic, societal and ecological value and benefits of healthy reservoir systems

Target 5A1. Develop an outreach strategy, actions and support materials to improve public knowledge of the value of fishery and aquatic resources in reservoir systems.

Target 5A2. Support, and develop when necessary, programs to promote angling and other recreational opportunities available in reservoir systems.

Target 5A3. Establish e-based forums and public programs to improve public knowledge of the roles and responsibilities of the agencies involved in the management of both reservoir systems and their associated resources.

Target 5A4. In support of the mission and principal goal of RFHP, develop programs, activities, and educational opportunities to ensure a broad base of public and political support for the conservation of fish habitat in reservoir systems.

Target 5A5. In partnership with others, develop web-based tools to increase public awareness of the location, access to and services provided by reservoirs.

Objective 5B – Advance public understanding of the connections between habitat quality in reservoir systems and land-use practices within their associated watersheds.

Target 5B1. Develop programs, activities, and educational opportunities to promote natural resource conservation and stewardship within watersheds.

Target 5B2. Design conservation actions and outreach to better inform private landowners, communities and the public, and encourage their participation through watershed planning and implementation teams in land and water conservation strategies and actions that improve or maintain habitat quality in reservoir systems.

Target 5B3. Develop and support education and outreach initiatives aimed at developing the skills, knowledge, and attitudes needed to be responsible public stewards of fishery and aquatic resources in reservoir systems.

Objective 5C – Nurture a public that is well-informed and involved in current and emerging resource issues in reservoir systems.

Target 5C1. Support public education programs on the control of aquatic nuisance species.

Target 5C2. Identify, evaluate and report to the public the significance of emerging reservoir-related policy and conservation issues.

Target 5C3. Develop and implement programs to foster ethical use of aquatic resources by the public.

Target 5C4. Develop and disseminate position papers and action plans to address controversial and emerging reservoir-related issues.

Target 5C5. Monitor effectiveness in informing and involving the public in addressing key reservoir-related issues.

Target 5C6. Develop partnerships with non-traditional partners to implement cooperative aquatic habitat conservation projects and initiatives in reservoir systems.

2010 – 2014 Primary Conservation Actions for Goal Five

- *Outreach Committee complete Outreach and Communication plan by end of 2010* (Targets 5A1, 5A2, 5A3, 5B1, 5B2, 5B3, 5C1, 5C2, 5C5, 5C6)
- *Develop and implement Friends of Reservoirs starting in 2010* (Targets 5A3, 5A4, 5A5, 5B1, 5B2, 5C1)
  - Friends of Reservoir Steering Committee established by June, 2010
  - Friends of Reservoirs framework and guidelines established by September, 2010
  - Friends of Reservoirs chapters established in 2 States (2010), 6 States (2011), 12 States (2012), 24 States (2013), 36 States (2014)
- *Establish technical assistance teams for policy and project support by end of 2010* (Targets 5C2, 5C4, 5C5)
- *Develop information network and exchange for sharing and dissemination of best management practices, appropriate technologies, and reservoir user practices and ethics by end of 2011* (Targets 5A5, 5B3)
- *Develop first iteration of tools, guidelines, methodologies and protocols for fish habitat conservation in reservoir systems by end of 2012* (Target 5C4)

Strategic Conservation Priorities and Project Implementation

The RFHP conservation strategy identifies goals, targets and actions to meet and fulfill the partnership's mission and vision. *Goal One* is the heart of the RFHP strategy: it builds on the reservoir system impairments identified through the RFHP assessment and it sets conservation priorities. Each objective of *Goal One*, in turn, corresponds to one or more of the systemic impairments identified in the assessment.

Our ability to set strategic conservation priorities stems from the informational base of our reservoir assessment (Appendix II) in conjunction with the typology established by our reservoir classification system (Appendix I) – both in preliminary stages of development and both scheduled for completion by the end of 2010. We are closely coordinating development of our assessment with the NFHAP *Framework for Assessing the Nation's Fish Habitat* and the NFHAP national fish habitat assessment now underway. We are working with Michigan State University and the NFHAP Science and Data Committee to address data gaps in the NHD+ database.

The process by which we set our conservation priorities will rely heavily on that coordination. The reservoir assessment will provide an initial ranking of reservoir systems based on presence and severity of impairments to fish habitat within the reservoirs of each system, their upstream areas, and tailwaters. The classification system will provide the framework to sort impaired reservoir systems using modified physio-geographic types (Appendix II) and will be used to both refine strategic conservation strategies and to develop and deliver reservoir system-appropriate conservation actions.

The initial ranking and sorting of reservoir systems by type and degree of impairments and by classification category will establish the database from which strategic conservation priorities – those reservoir systems in greatest conservation need – will be selected. Overlaying the RFHP database with Priority Conservation Areas and Species of Greatest Conservation Need from the 50 State Wildlife Action Plans, and using other Federal, State and regional species recovery, focus area and land-use documents, a suite of strategic conservation priorities will be identified. The reservoir systems selected in this manner will be the focus areas within which we seek and solicit projects to address the principal impairments identified in the assessment.

The RFHP will consider providing support to any habitat improvement project that contributes to one or more of its five strategic goals.

- *Protect, restore and enhance fish habitat in reservoir systems to support productive fisheries and healthy aquatic ecosystems*
- *Manage reservoir systems to provide, protect and enrich quality of life for the American people*
- *Develop and foster partnerships that implement landscape-scale approaches to the conservation of fish habitat in reservoir systems*
- *Develop and sustain institutional arrangements and sources of funding to support the long-term conservation of fish habitat in reservoir systems*

- *Support education and outreach initiatives that advance public awareness and understanding of the value of healthy reservoir systems*

Project Prioritization – Candidate fish habitat projects will be solicited through a Request for Proposal (RFP) process and will be evaluated using a goal-driven mathematical scoring system (Appendix IV). Project proposals will be evaluated initially at the region in which they are submitted, by the Regional Workgroups associated with the four regional subdivisions of the Association of Fish and Wildlife Agencies. The Regional Workgroups will use reservoir classification and assessment data and reservoir system rankings provided by the RFHP Science and Data Committee to assist them in identifying and prioritizing key reservoir impairment issues and opportunities for fish habitat improvements within the reservoir, its watershed system, and the region in which it resides.

The Regional Workgroups will place a high priority on reservoir fish habitat projects that support, strengthen, or fill-in information gaps in State Wildlife Action Plans, watershed protection plans, recovery plans, land and water use plans, or other regional-scale plans. Priority projects of each Regional Workgroup will be submitted to the RFHP Executive Committee for potential funding. The Executive Committee, in turn, will review and approve projects for RFHP funding (or review and submit priority projects to the NFHAP Board for NFHAP funding), based on criteria to ensure that selected RFHP projects: 1) are spread across all geographic regions of the United States; 2) address the priority reservoir impairment issues as identified through the reservoir assessment process; and 3) take full advantage of existing partnerships (e.g., Fish Habitat Partnerships) or new partnerships (e.g., Friends of Reservoirs affiliates) that would promote active citizen, community, and business involvement and participation in reservoir system conservation.

Program and Project Evaluation – Monitoring of partnership progress and project outcomes will be achieved through annual reporting to RFHP partners and the NFHP. We will develop criteria to measure progress and success of our program and the fish habitat conservation projects we support. Evaluation criteria will link directly to RFHP goals, objectives, and targets, and to the goals and objectives of the National Fish Habitat Action Plan. They will indicate changes in habitat condition, adjust to new restoration techniques, and adapt to changes in the scope of projects brought about by available funding. They will also provide the analytic framework by which to adapt fish habitat conservation projects to new knowledge and changing circumstances.

Given the breadth of the RFHP goals, the metrics we use to gauge progress will change through time, shifting as the focus of RFHP moves from one of development and growth to one of implementation. During development, the RFHP will evaluate progress by monitoring completion of scheduled actions, tracking membership and support, and measuring funding availability. During project implementation, the RFHP will rely on quantifiable metrics to measure and evaluate conservation outcomes. Metrics used to assess and report progress toward fish habitat restoration in reservoir systems, and its impact on sport fisheries and nongame fish populations, will be evaluated at variable intervals to track short-term (5-year) and long-term (20-year) outcomes and trends.

Short-term assessment of progress will focus on specific results of individual projects or cumulative results of related projects. Examples of short-term habitat restoration metrics include:

- Miles of reservoir shoreline stabilized/restored
- Miles of streambank stabilized
- Acres of native aquatic plants established
- Acres of riparian buffer zones protected, restored, or established
- Fish population trends (e.g., size and age structure, catch rate, body condition, and growth rates)
- Fish caught and harvested by anglers
- Acres of water where invasive species were controlled
- Increase in reservoir fishery economic indicators (e.g., fishing, boating, and recreational numbers and revenues)
- Years added to the functional life of a reservoir

Additionally, short-term measures outside the scope of individual projects will be considered in the evaluative process. These measures, implemented through the efforts of the Coordinator, Executive Committee and its working committees, Regional Workgroups, and Friends of Reservoirs, include:

- Establishment of a Friends of Reservoirs foundation to hold and distribute funds, establish fund-raising plans, and identify and network with partners
- Establishment of a web-based clearing house to match projects with established funding mechanisms
- Working with managing agencies and policy makers to: (1) elevate recreation and recreational angling as mandated uses of reservoirs; (2) allocate water for fisheries management purposes; and (3) develop water level management plans to bolster fish populations
- Production of technical publications resulting from RFHP-supported research and data sharing
- Numbers of new partnerships established as a result of RFHP-funded activities

Long-term measures of reservoir habitat restoration will enumerate improvements in water quality, water quantity, biological impairments, structural habitat, hydrologic connectivity, sport fish population trends, quality and quantity of recreational uses and experiences, economic benefits accruing to local communities, and the numbers of fish consumption advisories. These measures will also address watershed-scale issues, including land-use practices that impact reservoir health and flow regimes that affect downstream aquatic habitats and fish populations. An adaptive approach to long-term measurement and evaluation of fish habitat conservation is needed in the face of changing land-use practices (continued development and population shifts), climate change, funding availability, and evolving public policies. Monitoring data will be used adaptively to identify successful project strategies and to develop effective management prescriptions.

Data Management – The RFHP has been compiling already existing data on physical, chemical, and biological parameters from reservoirs in eight target states (Appendix I and II). This effort will be expanded to include data from all states participating in the RFHP. Metric data will be available on-line to allow managers and partners to track changes in habitat parameters and conditions as projects progress. All data will be made available to the Science and Data Committee of the National Fish Habitat Partnership. Additionally, the RFHP will work with States to provide GIS files of reservoir boundaries and locations within their respective watersheds. RFHP will also partner with the NFHAP Science and Data Committee to monitor and record changes in reservoir system metrics affected by land-use practices and development, population shifts, and climate change. RFHP reports and links to non-RFHP reservoir materials will be available on-line at the RFHP web site.

Reporting – Annual program assessments and project evaluations will be provided to the Executive Committee and made available online at the RFHP web page to cooperating partners, other Fish Habitat Partnerships, general stakeholders, and the National Fish Habitat Action Plan Board and staff. Reporting requirements will be established by the RFHP Executive Committee. The Strategic Plan will be revised every five years. Long-term targets will be adjusted in the revisions of the strategic plan to reflect changes in technology, funding priorities, and changing landscapes due to the affects of climate change.

Plan Revisions and Next Steps

This strategic plan sets forth the vision and the conceptual framework for building and implementing the RFHP. Over the next 12-month period, the current draft plan will be revised and finalized, with a final strategic plan issued in fall, 2010. Simultaneous with completion of the final plan, the partnership will expand, complete and incorporate its reservoir system classification and assessment into the planning document. Additionally, the partnership will finalize and implement guidance for performance monitoring and reporting, and will initiate development of the reservoir data base to support RFHP operations. Concurrent with completion of these activities, the partnership will continue outreach efforts and allocate significant resources to development of the Friends of Reservoirs initiative. These conservation and operational actions are set forth in the discussion of goals, objectives, targets, and conservation actions.

In tandem with completion of the national conservation strategy, the four Regional Workgroups will develop regional implementation plans. These plans will step-down the goals, objectives and targets set forth in the national plan to concrete conservation actions. Specific monitoring and reporting protocols, drawing on national guidelines, will also be developed.

The RFHP strategic plan will be updated at 5-year intervals, beginning in 2015. Regional implementation plans will be updated one-year following each revision of the strategic plan.

Appendix I

Reservoir Classification

Introduction: One of the key components of the reservoir assessment (Appendix II) is the development of a classification scheme for all reservoirs as defined in the RFHP Strategic Plan. The need and requirement for this classification scheme is detailed in the NFHAP Science and Data *Framework for Assessing the Nation's Fish Habitat*. The strategy for the reservoir classification is discussed below. Its development and implementation will allow the RFHP to:

- Make comparisons among reservoirs with respect to their functional and biological conditions. It is critical that similar systems be compared to ensure that appropriate analyses are made. For example, one can not compare the condition of processes between canyon reservoirs at high altitude in the Northwest U.S. with the condition of lowland reservoirs in the Southeast U.S.: the controlling abiotic and biotic factors are too different between the two systems to allow such a comparison.

- Knowledgably and accurately answer the question: "How does my reservoir compare to other reservoirs?" The key to answering this important question – one with broad public ramifications – is to compare reservoir systems with similar characteristics, expectations and processes. Comparing dissimilar systems will provide inappropriate and confusing conclusions.

- Transfer knowledge and rehabilitation techniques among reservoir systems. A system of similarly classified reservoirs will allow for the appropriate transfer of successful rehabilitation methodologies and will provide for new insights into the functioning of reservoir systems.

Approach: A subset of eight States was selected to develop the first iteration of a reservoir classification system. Further, 705 reservoirs from the eight states (Arkansas, California, Iowa, Kansas, Kentucky, North Carolina, Oklahoma, and Texas) were examined. The framework for the classification scheme was based on key factors that control the physical and biological functioning of reservoir systems as a result of the dam and impounded waters. Measures for those factors are those most consistently used by the States and for which data exists and is readily accessible.

The database used in this analysis was developed from fisheries biologist surveys, the National Inventory of Dams, other regional datasets, USGS water resources sites for water gauging data, and the internet sites for each impounded lake. Data were cross-checked between these sources for consistency and accuracy, and only data meeting these strict criteria were selected for each reservoir.

The initial classification variables that were selected are:

- Surface Acreage – Size clearly matters with respect to reservoir processes. Surface acreage controls the amount of solar radiation received and the effect of wind action on water mixing and temperature. These factors, in turn, have direct effects on the physical and biological processes in reservoirs.

- Volume – The amount of water held in a reservoir controls chemical stratification (i.e. dissolved oxygen), the extent of wind action effects, and chemical/biological reaction time.

- Average Depth – This variable is calculated directly from surface acreage and volume and is related to all of the factors discussed above for those variables.

- Retention Time – The length of time that a particular molecule is held in the reservoir controls physical and chemical processing times. This variable is calculated using mean annual discharge (converted to acre/feet per year) to the reservoir divided by the reservoir volume.

- Estimated Reservoir Hydrography Complexity – The physical complexity, origin and configuration of a reservoir controls the availability and diversity of habitat types. Two methods are used in this analysis. The first is a descriptive classification system proposed in an *In-Fisherman* publication (1980); it is commonly used by anglers. Classified units range from lowland systems that are not usually complex to canyon systems which are very complex with a wide range of habitats being expressed. Through a survey conducted among the fisheries biologists in the eight trial states (above), the 705 reservoirs examined by the RFHP were classified into one of six physio-geographic categories:

  (1) Canyon Reservoirs - Canyon reservoirs are typically impounded by high concrete dams since earthen dams are inadequate to hold back the massive pressure exerted on dam faces. These reservoirs have the highest diversity of depths and are the deepest of all reservoirs. This reservoir group is typified by being sparsely vegetated, having high water clarity, and being encased in rock walls.
  (2) Plateau Reservoirs – Plateau reservoirs are typically found in the high plains and low plateau regions that run along the Rocky Mountains and in the lower plateau valleys that lie within the Rocky Mountain range. Typically, this reservoir group is constructed primarily for irrigation and is characterized by high water turnover/fluctuation rates. Its shorelines and adjacent terrain are generally lacking in cover. Impoundments in this group are generally larger-sized reservoirs.
  (3) Highland Reservoirs – Highland reservoirs are commonly dammed in foothills where narrow ravines provide easy closing points. As a result, these reservoirs have a wide diversity in water depths. They often border on the highlands of low mountain ranges and are often found in the eastern half of the U.S. in the Appalachian, Boston, Ouachita, Ozark, and Cumberland ranges as well as the low mountain ranges of the West Coast. They are characterized by clear water, rock outcroppings and steep-banked timber-covered hills and bluffs.
  (4) Hill-Land Reservoirs – Hill-land reservoirs have the highest diversity of physical structure of all reservoir types. This reservoir group is deeper and narrower than flatland reservoirs due to low hills and small valleys dissecting a highly variable landscape. One

often finds a wide variety of shallow and deeper waters in these reservoirs. Moreover, their bottom substrate is typified by hard clay, sandy clay, or loam with patches of rock and sand. They will have vegetated shorelines ranging from shrubs to trees, and have a physiography that varies from humps, hills, flats, sharp drops, winding river beds, large and small creeks, to smaller creek drainages. Earthen or earthen-concrete dams are common with this group of reservoirs. The surrounding land is not commonly used for row crop production.

(5) Flatland Reservoirs – Flatland reservoirs are commonly constructed in broad, river flood plains where surrounding land is or was used as cropland. They often have large amounts of shallow water habitat that cover huge flats with some gentle rises or depressions. High, sharp shorelines are rare in this reservoir group and the submerged basin tapers to the shoreline.

(6) Lowland Reservoirs – Lowland reservoirs constitute a geographically-dispersed reservoir type and are found in all areas of the country. Lowland reservoirs can be at higher elevations since "lowland" is relative to the surrounding terrain. These reservoirs are constructed in low areas of both low and higher elevations that were previously marsh, swamp, bayous or other back waters. The substrates of this reservoir group are typically soft and they have a low diversity of depths.

A more continuous representation of reservoir complexity is provided by a ratio between dam length and height which is available from the National Inventory of Dams. Dams with high values of this ratio are likely to be in wide river valleys and are more representative of lowland systems. Dams with low values of this ratio are likely to be in very tight, high gradient areas, and are representative of canyon systems. Intermediate ratio values represent reservoirs located between these physiographic extremes. Statistical relationships between complexity ratio and the *In-Fisherman* ratings system will be developed as part of classification work.

- Growing Days – This variable will be initially represented by reservoir surface elevation at conservation pool in combination with latitude. Ultimately, the variable will be replaced by "growing degree day" information for each reservoir. Growing days control biological and chemical processing by affecting temperature and solar radiation.

- Reservoir Age – This variable is represented by impoundment date. Reservoir age has direct implications on the storage of sediment and chemical constituents from upstream sources unless measures are taken to flush the reservoir – which is uncommon. Sediment and chemical storage over a long-period of time will have direct effects on the availability and diversity of habitats and, depending on the materials stored, will differentially impair biological activity in these systems.

- Location in the Watershed – This variable will be measured by the location of the dam in river miles from its mouth. [The measurement for this variable will be expressed by dividing the river miles from the mouth by total river miles, and then subtracting that total from 1]. If direct measurements are not available, then the location will be estimated from information requested in fisheries biologist surveys. Reservoir location in a watershed – including the number and size of reservoirs above

and below – has direct implications on nutrient, woody debris and sediment input that affect both physical and biological processing in these water bodies.

Group Classification. Data will be examined using descriptive statistics as an initial screening tool to examine for trends. Then, the data will be formed into groups using hierarchical cluster analysis. Cluster analysis will be performed using both unscaled data (the raw data from all variables) and scaled data (variables transformed into a 0-1 scale by dividing all values by the maximum values found in the dataset). Organizing trends will be analyzed and controlling variables or data range determined for each group.

Appendix II

Reservoir Assessment

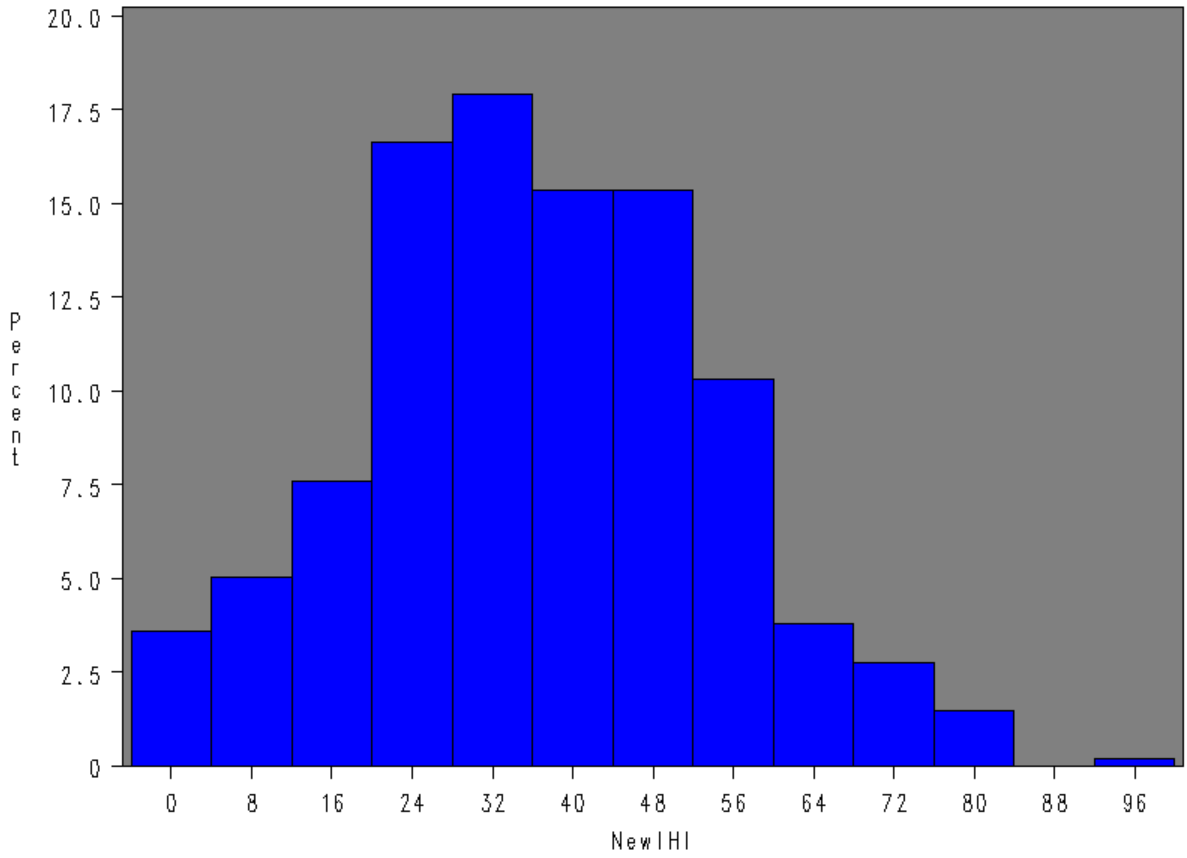
First Iteration: Perceptions of Reservoir Managers to the Severity of Habitat Impairments in Reservoirs in Eight States: AK, CA, KN, KY, IA, NC, OK, TX

Dr. Steve Miranda, of the USGS's Mississippi Cooperative Fisheries Unit, recently submitted a manuscript for review to the *North American Journal of Fisheries Management* in which he described a methodology for assessing the overall degree of in-reservoir habitat impairments with an "Index of Habitat Impairment" (IHI). He incorporated a survey of fisheries managers for randomly-selected reservoirs across the United States in which he asked the managers to score the degree of impairment they perceived for each of fourteen metrics reflecting a scope of common habitat issues. Managers were asked to score each metric on a six-point scale ranging from 0 (no-impairment) to 5 (high impairment). Miranda then proposed to sum each of the 14 metrics to generate an overall impairment score for each reservoir.

Theoretically, overall reservoir scores could range from 0 to 70; Miranda proposed that reservoirs with overall scores <20 could be considered "unimpaired", scores ranging from 20-39 could be considered "moderately impaired", and that scores $\geq$ 40 could be considered "impaired". Of the reservoirs surveyed, 18% scored in the "unimpaired" category, 69% scored as "moderately impaired", and 13% scored in the "impaired" category. The RFHP interim Steering Committee recruited Dr. Miranda to serve as a scientific advisor, and he offered the IHI as one possible methodology for classifying and identifying reservoirs by degree of habitat impairment.

Because Dr. Miranda's survey randomly sampled no more than about 20% of the total reservoirs in each state, the Science and Data Committee of the RFHP chose to ask a group of eight state fisheries agencies to help gather data on all reservoirs larger than 250 acres in size for their respective states in order to assess the utility of applying the IHI to all reservoirs across the nation. Volunteer state agencies were recruited to reflect a broad geographic distribution, and included: Arkansas, California, Kansas, Kentucky, Iowa, North Carolina, Oklahoma, and Texas. The Science and Data Committee amended Miranda's original in-reservoir metrics' list by adding to it eleven watershed and reservoir-influenced downstream habitat metrics.

To date, the Science and Data Committee has received a full set of responses from seven of the eight state agencies and a partial set of responses from California; a complete set of responses from California is expected soon and analyses will be updated accordingly. The following graph displays a frequency distribution of IHI scores for the 475 reservoirs reporting full responses.



The Science and Data Committee compiled the responses to all 26 metrics into a single dataset and used exploratory factor analysis to identify common factors underlying the variation in responses. The degree of loadings for each of the metrics on the corresponding factors was examined and the patterns of high loadings were interpreted as indicators of the underlying ecological processes that generated variation among the impairment responses. Six prominent factors were retained during factor analysis, using several criteria to assess the level of prominence (including minimum Eigen values = 1.0, minimum variance proportion = 0.05, and examination of scree plots). The following table displays the standardized regression coefficients for each habitat metric in association with each of the six retained factors. Coefficients with high values (defined as coefficients with values > 0.40) for a particular factor are highlighted in yellow. Examination of the pattern of loadings suggested underlying ecological processes that the factors reflect, and a subjective description of those underlying ecological processes is included in parentheses.

Rotated Factor Pattern (Standardized Regression Coefficients)

	Factor1 *(Tailwater WQ)*	**Factor2** *(Sediments)*	**Factor3** *(Pollution)*	**Factor4** *(Tailwater flows)*	**Factor5** *(Macrophytes)*	**Factor6** *(Structure)*
Turbidity	-0.02	0.91	-0.13	-0.03	0.05	-0.08
Sedimentation	-0.03	0.89	-0.10	-0.04	0.10	0.09
Shoreline Erosion	-0.02	0.54	0.165	0.12	-0.02	0.10
Excessive Nutrients	0.00	0.38	0.43	-0.06	0.09	-0.03
Point-Source Pollution	0.16	-0.04	0.59	-0.08	0.12	-0.03
Non-Point Source Pollution	-0.08	0.13	0.62	-0.00	0.14	0.14
Contaminants	-0.01	-0.10	0.73	0.01	-0.04	-0.16
Oxygen or Temperature Stratification	0.13	0.02	0.25	0.09	0.04	0.07
Water Level Fluctuations	0.07	0.39	0.25	0.19	-0.17	-0.14
Insufficient Water Storage	0.05	0.53	0.16	-0.03	-0.20	-0.18
Excessive Aquatic Macrophytes	0.12	-0.05	0.11	-0.04	0.60	0.01
Lack of Aquatic Macrophytes	0.10	0.28	0.15	-0.06	-0.48	0.23
Watershed Disconnectivity	-0.00	0.19	0.41	0.04	-0.11	0.04
Invasive Plant Species	0.04	0.06	0.16	0.06	0.61	-0.08
Structural Habitat	0.01	-0.15	-0.00	0.03	-0.13	0.66
Land-Water Interface	0.09	0.07	0.07	-0.02	0.02	0.53
Invasive Animal Species	-0.07	-0.01	0.34	0.06	0.14	0.21

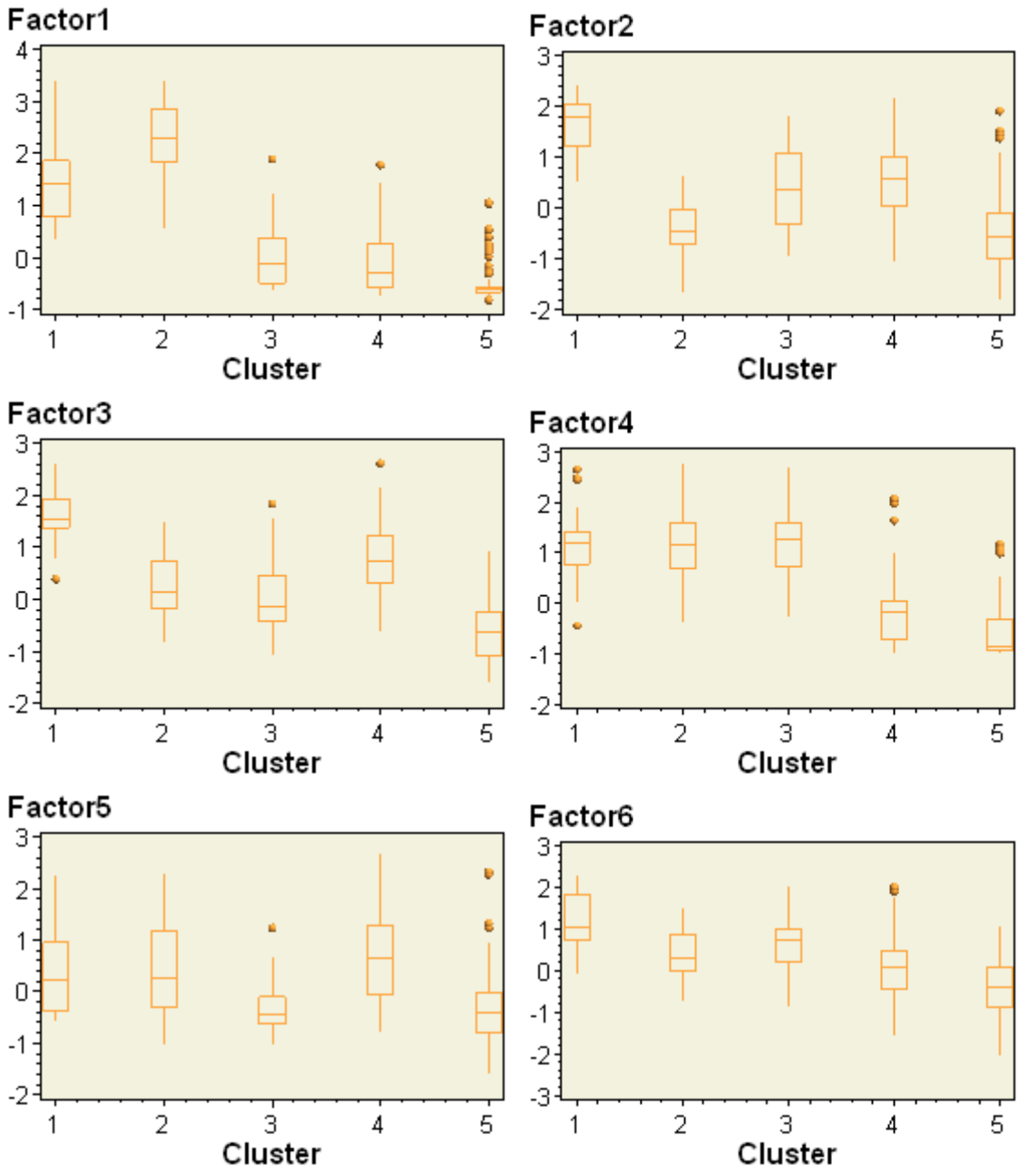
Rotated Factor Pattern (Standardized Regression Coefficients)

	Factor1 *(Tailwater WQ)*	Factor2 *(Sediments)*	Factor3 *(Pollution)*	Factor4 *(Tailwater flows)*	Factor5 *(Macrophytes)*	Factor6 *(Structure)*
Harmful Algal Blooms	-0.09	0.07	0.37	-0.08	0.02	0.14
Fish Passage Barrier	0.13	0.02	0.32	0.07	0.04	0.05
Seasonal Flows	0.11	0.03	-0.10	0.90	0.03	0.06
Daily Flows	0.03	-0.03	0.07	0.83	0.01	-0.04
Temperature Within Expected Variation	0.881	-0.08	-0.01	0.11	-0.00	0.01
Temperature Within Desired Variation	0.98	0.02	-0.02	-0.06	0.02	-0.04
Discharge Dissolved Oxygen	0.85	0.02	-0.02	-0.04	0.05	0.05
Downstream Structure	0.43	0.09	0.07	0.21	0.02	0.06

Factor scores were produced for all 475 reservoirs and reflect the degree to which each of the six impairment factors affected the individual impoundments. Cluster analysis was then performed on the factor scores to identify groups of reservoirs, if any, that displayed similar patterns of scores. Five clusters were identified. The table that follows displays the number of reservoirs that were grouped into each cluster and the geographic distribution of those reservoirs within clusters.

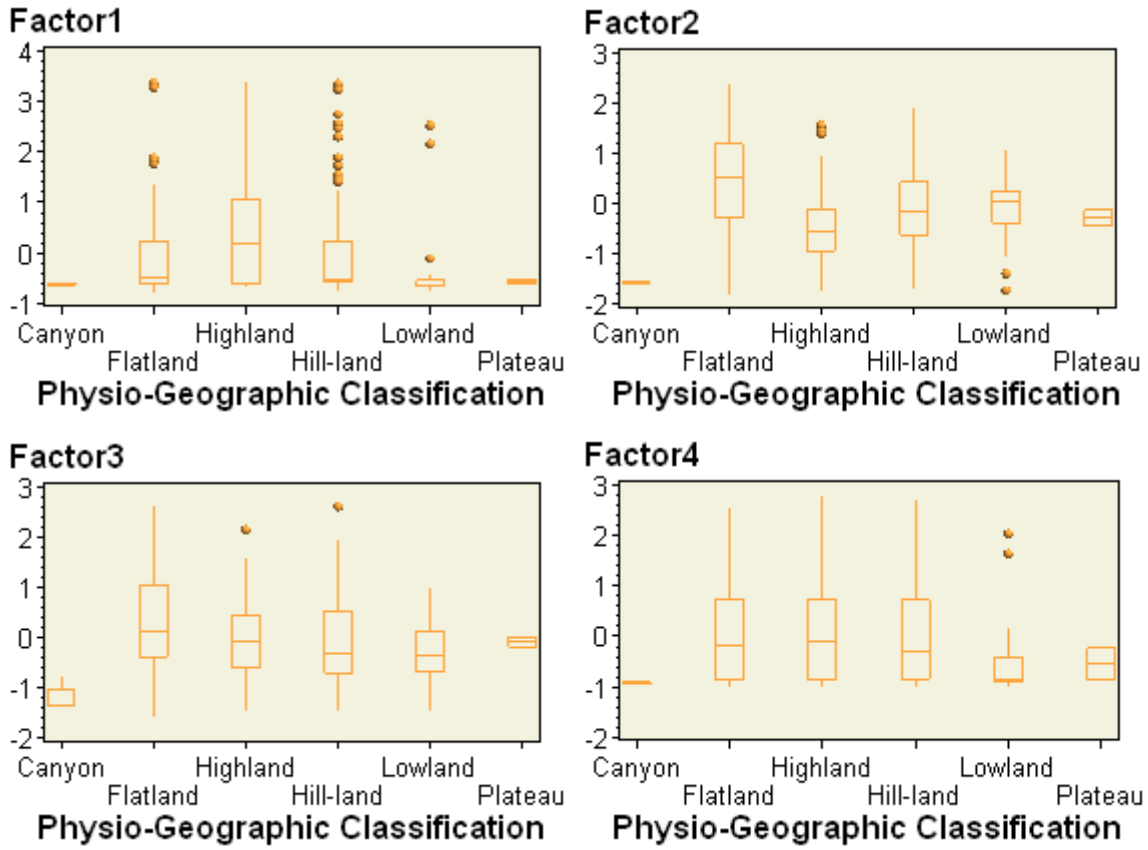
	State								
CLUSTER(Cluster)	**AR**	**CA**	**IA**	**KS**	**KY**	**NC**	**OK**	**TX**	**Total**
1	1	0	4	0	0	0	9	6	20
2	6	4	0	0	3	1	5	20	39
3	5	1	0	3	7	6	10	38	70
4	23	2	16	4	7	15	44	16	127
5	34	10	0	15	11	35	24	90	219
Total	69	17	20	22	28	57	92	170	475

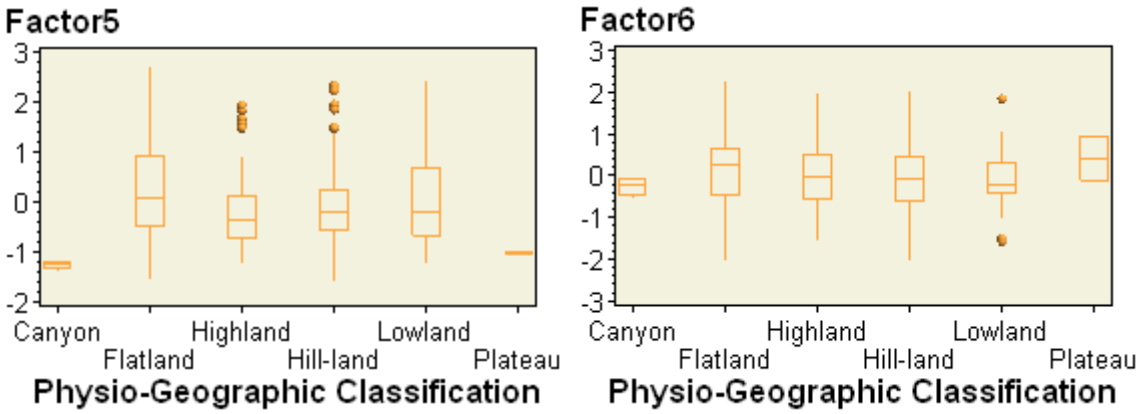
Examination of the scores within the clusters reveals the suite of habitat impairments that are associated with each of them. A series of box and whisker plots were developed to facilitate the analysis; they are shown below. They display the variation of scores within each cluster. The horizontal line dissecting each box indicates the median score; the top and bottom of the box indicates the 75th and 25th percentiles of the scores; the top and bottom of the whiskers indicate the 90th and 10th percentiles of the scores; and scores lying outside the whiskers indicate scores that exceed the 90th and 10th percentiles.



Reservoirs in Cluster 1 are characterized by chronically high scores for every impairment factor except "Macrophytes". Reservoirs in Cluster 2 scored high for "Tailwater Water Quality" and "Tailwater Flows". Reservoirs in Cluster 3 scored high for "Tailwater Flows". Reservoirs in Cluster 4 scored somewhat high for "Macrophytes". Reservoirs in Cluster 5 generally lacked high scores for any of the impairment factors, indicating these reservoirs generally lack severe habitat impairments.

The Science and Data Committee is in the process of examining the relationship between these habitat impairment scores and several classification methodologies (see Appendix I). One of these classification systems is based on physiographic characteristics of reservoirs developed by *In-Fisherman* magazine. The Science and Data Committee asked the 8 States responding to the revised Miranda survey to also classify each of the 475 reservoirs in one of the classification categories of this system (see Appendix I). The distribution of factor scores for reservoirs within each category of the physiographic classification was plotted and is displayed in the box and whisker plots below. The horizontal line dissecting each box indicates the median score; the top and bottom of the box indicates the 75th and 25th percentiles of the scores; the top and bottom of the whiskers indicate the 90th and 10th percentiles of the scores; and scores lying outside the whiskers indicate scores that exceed the 90th and 10th percentiles.





No clear association between impairment factors and physiographic classification is apparent, with the possible exception of factor one. There, as expected, tailwater-related impairments are more pronounced. These results are preliminary because of both limitations in data (database size, accuracy, and completeness) and the developing status of the reservoir classification system currently under consideration. However, even in the absence of correlation between impairment types and reservoir categories, conservation actions to address individual impairments will have to be developed and deployed to account for environmental differences between reservoir physio-geographic types.

Appendix III

Governing Elements of the Reservoir Fish Habitat Partnership

Executive Committee

The RFHP Executive Committee will promote and facilitate the actions described in the strategic plan. These actions include, but are not limited to:

- Coordinating with the NFHAP Board and its Fish Habitat Partnerships in the implementation of the National Fish Habitat Action Plan
- Supporting the development and implementation of monitoring and evaluation protocols for reservoir systems, as well as fish habitat conservation actions at national, regional and local levels
- Promoting planning efforts for fish habitat conservation among partners and stakeholders by providing direction to Regional Workgroups on funding availability, categories of potential projects, and criteria for their prioritization
- Supporting and recommending partnership projects to the National Fish Habitat Action Plan Board for funding
- Providing direction and input to partnership committees and Regional Workgroups, and creating RFHP ad-hoc task groups as needed
- Supporting the Regional Workgroups and the projects of the partnership with financial and/or staff resources as available
- Participating in marketing efforts and information campaigns to garner additional resources to meet the RFHP objectives
- Reporting to partners and stakeholders on the status and accomplishments of the RFHP
- Establishing and directing a **Science and Data Committee** to provide direction and support to the Executive Committee and the Regional Workgroups in the implementation of the strategic plan, the national reservoir assessment and database, monitoring, reporting, and performance assessment, and in the coordination of science and data related issues with the NFHAP Board, the Board's Science and Data Committee, and other Fish Habitat Partnerships
- Establishing and directing an **Outreach and Communication Committee** to further develop and expand the partnership, provide educational services, communicate the purpose, organization, activities and successes of the partnership to the public and policy makers, review and contribute to the development of policies impacting reservoir systems, and coordinate with and support Friends of Reservoirs
- Recruit and hire a full-time Coordinator to provide staff support to the Executive Committee, including dissemination of information, coordination and facilitation of actions and projects within the partnership, coordination of outreach activities, and pursuit of funding and grant opportunities
- Establish and implement a national **Friends of Reservoirs** foundation and network of affiliated **Friends** chapters to support the RFHP and to sustain its operations

The RFHP Executive Committee will not exceed 15 Members. Initial membership will include representation as follows:

- Four state agency members representing each of the four Regional Workgroups (as determined by their respective regional AFWA associations), one of which serves as Executive Committee chair; except in the case of the Southeastern Association, where the Regional Workgroup will correspond to the Southeast Aquatic Resources Partnership
- Four permanent Federal members: U.S. Fish & Wildlife Service, Bureau of Reclamation, Army Corps of Engineers, and Bureau of Land Management
- Four Non-Governmental Organizations (NGO): Candidates include Friends of Reservoirs, North American Lake Management Society, American Fisheries Society-Fish Administration Section, and The Nature Conservancy
- Three Industry Representatives: Candidates include the Bass Anglers Sportsman's Society, the American Sportfish Association, and the American Hydroelectric Association

Individual members of the Executive Committee will be selected, respectively, by the organizations that are assigned seats to the committee, as indicated above. Except for permanent State and Federal seats, as defined above, all other seats (industry and NGO) will be assigned to organizations either by the permanent members (State and Federal) or by the full committee, whichever is greater in number. Members assigned to the Executive Committee should represent a high administrative or executive level within their respective organizations to ensure the committee's authority to commit partners and partnership resources to the implementation of the RFHP strategic plan as consistent with the missions of each partnering entity and governing State and Federal laws.

Executive Committee members will remain seated on the Committee until replaced by their respective organization. A committee member's failure to attend three consecutive committee meetings, or teleconferences, can result in the member's suspension by majority vote and a request to the members' organization to select a replacement. Committee members may appoint, in writing to the Chair, a proxy to attend meetings in their place as needed.

The Executive Committee will have a Chair and two Vice-Chairs. The position of Chair will have a two-year term and will be automatically filled by the rotation alphabetically (by regional AFWA association name) of the four Regional Workgroups. A quorum of Committee members will nominate and elect the two Vice-Chairs: one from a Non-Governmental Organization and one from Industry, each serving a two-year term.

The Executive Committee will adopt a set of By-Laws incorporating the provisions described above as well as additional provisions regarding the conduct of RFHP business, including:

(1) The Executive Committee will meet annually at a time and place to be determined by the Chair in consultation with its members and staff. Executive Committee members are expected to attend at their own expense.
(2) A quorum of the committee is comprised of eight members in good standing.
(3) Executive Committee meeting agenda will be developed jointly by the Chair in consultation with the full committee and staff.
(4) Executive Committee Chair will lead the meeting following Roberts's Rules of Order. The committee will seek consensus on all business before it. In the absence of a consensus, a vote of two-thirds of the members present will carry the motion. All Executive Committee members have the right to vote on motions.
(5) Executive Committee business, including motions and resolutions, may be conducted via e-mail, fax, or teleconference.
(6) In the event that an Executive Committee member is unable to attend a meeting or conference call, he or she may designate a proxy via letter, email or fax to the Chair in advance of the meeting.

Regional Workgroups

Regional Workgroups will be selected, staffed, and supported by the four regional AFWA associations (Southeastern-SARP, Northeastern, Midwest, and Western). Each association will organize and structure its respective Regional Workgroup to meet internal administrative requirements.

Regional Workgroups will be responsible for assembling stakeholders to guide development of local joint-venture projects that address fish habitat issues in reservoir systems described in the RFHP strategic plan.

Regional Workgroups will prioritize projects for submission to the Executive Committee for either national partnership funding or funding by the NFHAP. Criteria used to prioritize regional projects will be developed from the national assessment and project criteria guidelines developed by the partnership through its Executive Committee in consultation with the Science and Data committee.

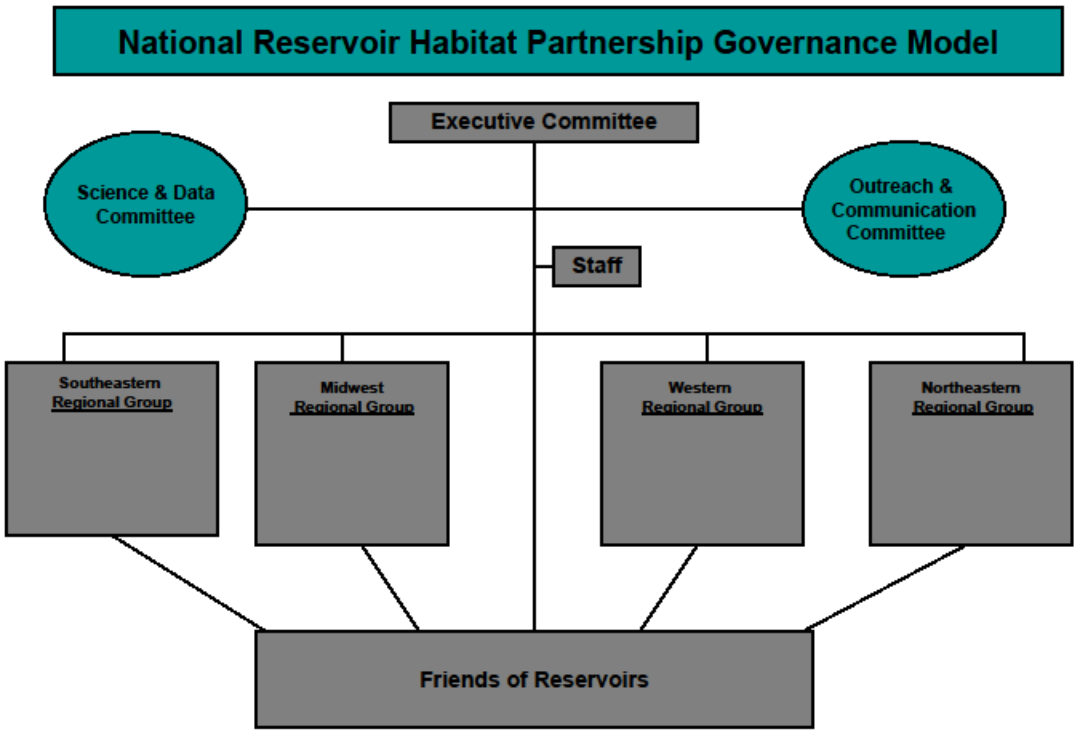
Regional Workgroups may, at any time, collaborate with reservoir managers and local stakeholders to develop and fund opportunistic projects through non-partnership funds. Additionally, Regional Workgroups will promote and communicate RFHP strategic plan goals and objectives and meet the data needs established by the Executive Committee and those required by the NFHAP.

Friends of Reservoirs

The Friends of Reservoirs national foundation and affiliated network of local chapters constitutes the primary support institution for the RFHP. It provides the institutional means to include all stakeholders with interests in healthy reservoirs in the support, implementation, and governance of the RFHP. The role of Friends of Reservoirs is four-fold:

- Provide supporters options to participate in the operation of the RFHP and to influence its governance through interaction with the Executive Committee, staff, and Regional Workgroups on the setting of reservoir conservation priorities, selection of fish habitat conservation projects, and long-term partnership goals and objectives
- Provide sustainable funding for RFHP operations and project implementation
- Help develop volunteer corps to support project implementation
- Facilitate delivery of outreach for public education, awareness, and service

Reservoir Fisheries Habitat Partnership Governance Structure



Appendix IV

Habitat Project Ranking Criteria

I. AQUATIC HABITAT CONSERVATION	**Points = 110**
I.1 Would the habitat project in question help the RFHP achieve its objectives related to the protection, restoration, and enhancement of fish habitat in reservoir systems to support productive fisheries and healthy aquatic ecosystems? ***<u>Check all that apply</u>:*** o ***Protect, restore and enhance the structure and function of riparian and shoreline zones in reservoir systems to support healthy aquatic ecosystems.*** o ***Protect, restore and enhance watershed connectivity..*** o ***Maintain or restore water quality in reservoir systems.*** o ***Maintain or restore sediment flows in reservoir systems to support healthy aquatic ecosystems.*** o ***Maintain or restore appropriate hydrologic conditions in reservoir systems to support healthy aquatic ecosystems.*** o ***Protect, restore or enhance physical habitat for desired fisheries.*** o ***Manage aquatic and riparian nuisance species to avoid or minimize detrimental impacts to fish and aquatic resources.***	
Yes, <u>≥</u> 4 objectives = 10	
Yes, <u>≥</u> 2 objectives = 7	
Yes, one objective = 5	
No = 0	
I.2 What is the Cost to Benefit Ratio: measured in acres or miles of shoreline, open water, riparian, wetland, and associated near-shore habitats in the reservoir watershed directly improved within the project footprint? (Cost to Benefit Ratio shall be calculated by dividing project cost by the metric)	
<$10,000/mile/ac = 20	
$10,000-$30,000/mile/ac = 15	
>$30,000-100,0000/mile /ac = 10	
>$100,000/mile/ac = 0	
I-3 Does the project build on previously funded NFHAP projects in the reservoir watershed?	
Yes = 10	
No = 0	
I.4 Does the project support or build upon existing State Wildlife Action Plan(s), watershed protection plan(s), land or water-use plan(s), or other regional plan(s)?	
Plans of multiple States or multiple plans within a single State = 10	
Single plan = 5	
No support of a plan = 0	
I-5 Does the project address the root cause(s) of the reservoir system impairment* [*tie to impairments revealed in the assessment*]*?	
Addresses all (100%) causes = 20	
Addresses many (75-99%) causes, to include the root cause = 15	

Addresses some (26-74%) causes, to include the root cause = 10	
Addresses some (26-74%) causes, but does not include the root cause = 5	
Addresses few (1-25 %) causes = 5	
Addresses no causes = 0	
I-6 Does the project employ best management practices, as documented in past studies or the published literature, to conserve, enhance, or create aquatic habitats?	
Yes = 10	
No = 0	
I.7 Are evaluation and monitoring components included in the proposal? [Parameters should be included such that success can be gauged by performance metrics (e.g., actual acres or miles restored; changes in water quality parameters; changes in fish population abundance, rates of recruitment, or population size structure; angler catch rates, harvest rates, and measures of directed fishing effort; measures of recreational use or economic benefit; etc) can be documented.]	
>3-year period of monitoring and evaluation included = 20	
>1-3-year period of monitoring and evaluation included = 15	
1-year period of monitoring and evaluation included = 10	
<1-year period of monitoring and evaluation included = 5	
No monitoring and evaluation included = 0	
I-8 Can major aspects of the project be completed within 12 months of receiving funding (excluding monitoring and evaluation)?	
Yes = 10	
No = 0	
II. QUALITY OF LIFE FOR AMERICANS	**Points = 110**
II.1 Would the habitat project in question help the RFHP achieve its objectives to provide, protect and enrich quality of life for all Americans? ***<u>Check all that apply</u>:*** o ***Develop environmental amenities, nature experiences, and wildlife-based activities and opportunities on lands adjacent to reservoir systems to engage and inform local communities and visiting public on the values and benefits of healthy reservoir systems.*** o ***Promote conservation of fish and aquatic resources to boaters and other water-based recreationists.*** o ***Maintain and enhance public access.*** o ***Support recreational industries and related economic activities that advance watershed health and contribute to conservation of fisheries and aquatic habitats in reservoir systems.***	
Yes, multiple objectives = 10	
Yes, one objective = 5	
No = 0	
II-2 What is the probability of long-term success of the project?	

High: Project outcomes will result in long-term benefits to people and applicant demonstrates commitment to adaptive management and regular maintenance, if necessary = 20	
Medium: Project outcomes will result in moderate-term benefits to people and applicant demonstrates commitment to adaptive management and regular maintenance, if necessary = 15	
Medium low: Project outcomes will result in short-term benefits to people and applicant demonstrates commitment to adaptive management and regular maintenance, if necessary = 10	
Low: Project outcomes will result in short-term benefit, but applicant does not demonstrate commitment to adaptive management and regular maintenance, if necessary = 5	
None: Project outcomes are unlikely to result in any benefit and the applicant does not demonstrate a commitment to adaptive management and regular maintenance, if necessary = 0	
II-3 What is the total population size surrounding the immediate project area? (Sum the population sizes of all counties or parishes, including major cities, which would be directly impacted by project outcomes. Use the latest U.S. Census Bureau statistics to determine population size)	
>1,000,000 = 10	
500,000 – 1,000,000 = 5	
<500,000 = 0	
II-4 Would the project restore/enhance habitat that would directly support an economically important or high-use fishery (as documented in past studies or the published literature) or other types of fisheries within the project area?	
Yes, multiple important fisheries = 20	
Yes, single important fishery = 15	
Yes, less significant or multiple developing fisheries = 10	
Yes, less significant or a single developing fishery = 5	
No = 0	
II.5 What is the current level of public access and visibility to the project area?	
Unlimited public access/visibility = 10	
Limited public access/visibility (e.g., Only on week days) = 5	
Minimal public access/visibility (e.g., only few days per year) = 0	
II.6 Would project outcomes increase opportunities for public access, recreational usage, or public enjoyment of the reservoir system?	
Yes = 10	
No = 0	
II.7 Would project outcomes lead to improvements in water quality for human health, recreational use, or ecological health of the reservoir system?	
Yes, direct and immediate improvement = 10	
Yes, indirect or delayed improvement = 5	
No = 0	

II.8 Are project outcomes expected to directly benefit any threatened or endangered species or any SGCN's identified within SWAP's?	
Yes, multiple species or critical habitats = 20	
Yes, single species or critical habitat = 10	
No = 0	
III. PARTNERSHIPS, FUND LEVERAGING, AND PROMOTION	**Points = 75**
III.1 Would the habitat project in question help the RFHP achieve its objectives to establish partnerships between management agencies and reservoir stakeholders; leverage outside sources of funding; and advance public awareness and understanding of the value of healthy reservoir systems? ***<u>Check all that apply</u>:*** o ***Establish national and regional technological assistance, data sharing and information network capacities to support development and adoption of best management practices among managers and among individuals and organizations engaged in the conservation of fish habitat in reservoir systems*** o ***Support and participate in watershed planning initiatives to promote implementation of best management practices for conservation of fisheries and fish habitat in reservoir systems*** o ***To ensure practitioner awareness of and access to RFHP and its support capacities, establish outreach to reservoir managers, relevant authorities and communities within reservoir systems, and other private and public stakeholders engaged in conservation of those systems and their fisheries*** o ***Develop and formalize institutional relationships between RFHP and principle partners to establish landscape-level networks of communication and governance that will facilitate effective, efficient, and sustaining conservation of aquatic habitat in reservoir systems*** o ***Identify and develop long-term funding opportunities for RFHP projects and operations*** o ***Advance public awareness of the economic, societal and ecological value and benefits of healthy reservoir systems*** o ***Advance public understanding of the connections between habitat quality in reservoir systems and land-use practices within their associated watersheds*** o ***Nurture a public that is well-informed and involved in current and emerging resource issues in reservoir systems***	
Yes, $\geq$ 4 objectives = 10	
Yes, $\geq$ 2 objectives = 7	
Yes, one objective = 5	
No = 0	
III.2 How many partners are involved in the project?	
>5 = 10	
3-4 = 7	

1-2 = 5	
0 = 0	
III.3 Will this project bring together a diverse cross-section of partners types (State government, Federal government, City or County government, water controlling authorities, universities, angler groups or clubs, civic groups or clubs, private industry, or local businesses). If so, how many partner types are directly involved in the project?	
>5 = 10	
3-4 = 7	
1-2 = 5	
0 = 0	
III.4 Are state fish and wildlife management agencies actively engaged in this project?	
Yes = 10	
No = 0	
III.5 Does the project operate within Priority Conservation Area(s) identified within State Wildlife Action Plan(s)?	
Yes = 10	
No = 0	
III.5 What amount of funds are leveraged from other sources?	
>2:1 = 10	
2:1 = 7	
> 1 < 2:1 = 5	
≤1:1 = 3	
No leveraging = 0	
III.6 Does the project have potential as a demonstration project to garner public support for habitat conservation, in support of our nations' reservoir fisheries; or have potential to advance public awareness and understanding of the value of a healthy reservoir system?	
High (e.g., long-term, far reaching education, actively managed websites, extensive media engagement, high distribution newsletter/flier/pamphlet, permanent kiosks) = 15	
Medium (e.g., good media coverage, periodic education activity, high distribution newsletter/flier/pamphlet) = 10	
Low (e.g., one time news release or low distribution newsletter/fliers/pamphlet) = 5	
None = 0	
Point Total for Goal Category I	
Point Total for Goal Category II	
Point Total for Goal Category III	
Grand Point Total for Project	

Appendix V

Partners

The RFHP built its partnership initially among State agencies, Federal agencies, and non-governmental organizations (NGOs) and industry representatives whose operations are national in scope. The support of State Fish and Wildlife agencies is critical to this effort: they have primary responsible for managing fish and wildlife resources within their jurisdictions and much of the data needed to set strategic priorities and to prioritize and justify conservation efforts are collected and housed within those State agencies. A number of key Federal agencies operate at a national scale to protect and manage publicly-owned aquatic resources; they are crucial to the partnership by virtue of their resource authorities and reservoir responsibilities. A number of non-profit organizations and NGOs were recruited to the partnership at the start of the RFHP: their conservation networks, expertise, and organizational skill are vital to success of the RFHP. National sportfishing conservation and industry groups were brought on board because of their interest in reservoir conservation and the support they have from the nation's anglers.

The second stage of partnership development will focus on engaging and recruiting the grassroots constituency the RFHP needs for success – whether as active members of the partnership or as participants in the Friends of Reservoirs national foundation and affiliated chapters. The RFHP will work with the States to recruit local conservation and watershed-based groups, tribal agencies, reservoir and power generation authorities, reservoir homeowner associations and developers, irrigators, municipalities, local businesses and communities adjacent to or affected by reservoirs, and others to build the partnership into a genuine grassroots movement and bottom-up organization.

The original contact list for candidate partners of the RFHP was developed by members of the RFHP interim steering committee, outreach and partnership working group, and those who attended the RFHP workshops at the National Conservation Training Center in Shepherdstown, WV, and Big Cedar Lodge on Table Rock Lake in southern Missouri. Ninety-one organizations/individuals were included in the original partner contact list. Each contact on the list was sent a letter of introduction, a fact sheet describing the partnership, and a Memorandum of Understanding (MOU) detailing the commitment entailed by the MOU between the RFHP signatory partners. Solicited partners were asked to sign and return the signature page of the MOU. A composite coversheet for the MOU and the MOU language is included below. Letters of endorsement were submitted to the RFHP in lieu of signed MOUs by: U.S. Geological Survey, U.S. National Park Service; Southeastern Association of Fish and Wildlife Agencies; Midwest Association of Fish and Wildlife Agencies; Western Association of Fish and Wildlife Agencies; BASS conservation; Bass Pro Shops; Arizona Game and Fish Department; California Natural Resources Agency Depart of Fish and Game; Florida Fish and Wildlife Conservation Commission; and Mississippi Department of Wildlife, Fisheries, and Parks.

Memorandum of Understanding

Between

American Fisheries Society, Fisheries Administration Section
Alabama Division of Wildlife & Freshwater Fisheries
Aquatic Ecosystem Restoration Foundation
Arkansas Game and Fish Commission
BioSonics, Inc
Colorado Division of Wildlife
FLW Outdoors
Georgia Department of Natural Resources
Idaho Department of Fish & Game
Illinois Department of Natural Resources
Indiana Department of Natural Resources, Division of Fish and Wildlife
Iowa Department of Natural Resources
Kansas Department of Wildlife & Parks
Kentucky Fish and Wildlife Resources
Louisiana Department of Wildlife & Fisheries
Maryland Department of Resources, Fisheries Service
Michigan Department of Natural Resources
Missouri Department of Conservation
Nebraska Game and Parks Commission
Nevada Department of Wildlife
North Carolina Wildlife Resources Commission
North Dakota Game & Fish Department
Ohio Department of Natural Resources, Division of Wildlife
Oklahoma Department of Wildlife Conservation
Oregon Department of Fish and Wildlife
Pure-Fishing, Berkley Conservation Institute
South Dakota Game, Fish and Parks
Tennessee Wildlife Resources Agency
Texas Parks and Wildlife Department
United States Bureau of Land Management – Lake Havasu Fisheries Program
U.S. Department of Energy, Southwestern Power Administration
U.S. Army Corps of Engineers – Department of the Army
Utah Division of Wildlife Resources
Virginia Department of Game and inland Fisheries
West Virginia Division of Natural Resources
Wisconsin Department of Natural Resources

For
Establishment of an
Reservoir Fisheries Habitat Partnership

MEMORANDUM OF UNDERSTANDING

For
Establishment of a
Reservoir Fisheries Habitat Partnership

A. PURPOSE

This Memorandum of Understanding (MOU) confirms the intent of the signatories to develop and implement a Reservoir Fisheries Habitat Partnership (RFHP). The purpose of the RFHP is to promote restoration, conservation and enhancement of fish habitat through actions that contribute to: (a) the ecological health and function of reservoirs and associated watersheds; (b) the well-being of fish and other aquatic species, therein; (c) the quality of life of the American people; and (d) public awareness of the conservation issues and challenges facing reservoir and watershed management in the 21st Century.

B. STATEMENT OF MUTUAL BENEFIT AND INTERESTS

The mission of the RFHP is: *"To promote and facilitate the conservation of fish habitat in reservoirs and associated watersheds through partnerships and cooperative efforts, coordination and sharing of information, and public awareness and knowledge of issues and challenges.*

A partnership refers to any voluntary collaboration among organizations working toward a common purpose. A partnership leverages the time, talent, and support of each partner to the mutual benefit and interest of all partners. Benefits of partnership include: (1) shared purpose; (2) enhanced communication; (3) greater access to information and management practices; (4) increased resources for conservation projects; (5) shared efficiencies; (6) innovative solutions to problems; and (7) more effective outreach to increase public support and participation.

The RFHP is established to achieve these benefits and to apply them to the management and conservation of fish habitat in the reservoirs and associated watershed systems of the United States, for the benefit of the citizens, therein. The parties to this agreement acknowledge the critical role reservoirs play in the condition of fisheries, the economy of communities, the recreational pursuits of citizens, and the security of the nation. The parties further acknowledge the vital role reservoirs play in indicating the health of the watershed upstream and, in turn, managing riverine health downstream.

The parties recognize that successful management of reservoirs and their associated watershed systems will require the ability to work across traditional jurisdictional lines, pool information and resources, and garner national support for efforts that are often multi-state in nature. The parties also recognize that successful fish habitat conservation in reservoir systems will require a broad range of strategies at multiple geographic scales.

For this reason and toward this end, the parties agree and confirm to support the RFHP mission.

C. COMMITMENT OF THE PARTIES

The partners to this MOU, to the extent practicable, hereby affirm their mutual understanding and agree to use their best effort to take the following steps:

1. To support the overall mission and purpose of the RFHP, consistent with their own missions, operating plans, and governing laws, regulations, and policies.
2. To collaboratively design and implement the RFHP conservation strategy in order to address the mission and purpose of the partnership.
3. To work together to facilitate current and future mutually agreed upon conservation activities in reservoirs and associated watersheds for the benefit of the American people.
4. To use the resources of their agencies and organizations in a manner consistent with their individual missions and the mission of the RFHP, and in a manner that avoids duplication.
5. To collectively pursue funding initiatives to support the RFHP through private, local, tribal, corporate, state, and federal sources.
6. To collectively pursue interagency/organization agreements, cooperative agreements, grants, and/or contracts to fund projects.
7. To encourage and support the participation of other appropriate agencies and organizations.

D. ADMINISTRATION OF MOU

1. Nothing in this MOU shall alter the statutory authority of the signatory Federal, State or tribal agencies, nor shall this agreement be deemed to cede authority for the management of aquatic resources from one agency to another, nor cause any non-governmental signatory to cede or alter its purpose or mission.

2. Nothing in this MOU shall be construed to obligate the United States or federal agencies, tribes, State or other agencies, or non-governmental organizations party to the MOU to any current or future expenditure of resources, for the purposes of the RFHP, to which they have not voluntarily agreed. To the extent the RFHP may involve the transfer of funds, property, or services in the future, this document creates no obligations apart from those entered into voluntarily by the parties to the MOU.

3. Nothing in this agreement restricts the signatories to the MOU from participating in similar activities or arrangements with other public or private agencies, organizations, or individuals.

4. Any changes to this MOU must be mutually agreed upon by all parties to the MOU. Such changes shall be executed as an addendum to the original MOU.

5. Any party may unilaterally terminate its participation in this MOU by providing the RFHP Steering Committee a written 30-day notice of withdrawal from participation. After such an action, this MOU will no longer be in force for that party.

6. This MOU shall become effective upon the date the RFHP's application for Fish Habitat Partnership is formally approved by the National Board of the National Fish Habitat Action Plan.

7. This MOU shall be reviewed as needed or at least once every 5 years to address changes or additions. Annually, representatives from the signatory parties shall report on the functioning of the RFHP at the AFWA annual conference.

8. The principal contact for this instrument is:

Name:	Mr. Phil Durocher
Title:	Director of Inland Fisheries
Organization:	Texas Parks and Wildlife Department
Address:	4200 Smith School Road
City/State/Zip:	Austin, Texas 78744
Phone:	512-389-4643
Email:	phil.durocher@tpwd.state.tx.us

Appendix VI

Abbreviations and Use of Terms

AFWA	Association of Fish and Wildlife Agencies
Anoxic Zone	Zone of water in a reservoir that is depleted of oxygen
Conservation	Used in consistency with the National Fish Habitat Action Plan to mean protection, restoration and enhancement
Conservation Pool	Volume of reservoir designated for industrial, municipal, agricultural, recreational and other authorized uses, distinct from volume set aside for flood risk reduction
Executive Committee	Governing body of the RFHP
Factor Analysis	Statistical clustering of variables into one or more factors
FHP	Fish Habitat Partnership – basic partnership unit and implementation arm of the NFHAP
Fish	Includes sport and non-sport fish species
Fish Habitat Conservation	Any action that protects, restores, and/or enhances habitat for fish or other aquatic species
Friends of Reservoirs	Volunteer support organization for the RFHP
Hypolimnion	Lower layer in a thermally-stratified body of water which is marked by low temperatures and is often deficient in dissolved oxygen
Hypoxic Waters	Oxygen deficient waters
Littoral Zone	Zone of high photosynthetic activity and concentrated aquatic life extending from reservoir shoreline to areas up to 15 feet in depth
NFHAP	National Fish Habitat Action Plan
Regional Workgroups	Regional governing bodies of the RFHP established under the auspices of each of the four regional AWFA associations

Reservoir	Body of water formed by the impoundment of free-flowing rivers and streams and that (1) are accessible to the public and (2) support, or could support, a sport fishery
Reservoir System	A reservoir and its associated watershed, including downstream flows
Reservoir Tailwaters	Waters downstream of a reservoir measurably affected by dam releases
RFHP	Reservoir Fisheries Habitat Partnership
Trophic Decline	Deterioration in reservoir habitat structure and productivity as reservoir ages, 5 – 20 years after impoundment
Trophic Upsurge	Progression in reservoir habitat structure and productivity immediately following impoundment of a stream or river