FLOAT TRIPS, DAMS, AND TAILWATER TROUT:

AN ENVIRONMENTAL HISTORY OF THE

WHITE RIVER OF NORTHERN

ARKANSAS, 1870-2004

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CHAPTER I

INTRODUCTION TO THE STUDY

The construction of dams for flood control, hydropower, irrigation, and for water storage was an integral part of federal water policy in the United States for much of the twentieth century. Federal agencies erected numerous dams greatly modifying the hydrology, downstream morphology, and aquatic ecosystems of rivers and streams. One significant ecological consequence of this "dam building era" is the negative impact dams have on fish, especially those reliant on free-flowing waters. Consequently, environmental histories and other academic literature tend to describe these negative impacts of dams on fish. Nonetheless, there is one "unplanned and unforeseen consequence" of dam construction receiving scant attention from historians and other academicians.[1] Tailwater trout fisheries, created or enhanced by the construction of dams have not been thoroughly researched despite their economic, cultural, and recreational importance.

Large bottom-release dams created tailwater trout fisheries on rivers originally containing fish dependent upon naturally fluctuating water temperatures and relatively warm water. These dams expel water, commonly referred to a tailwater, originating from

[1] Ken Owens, "Blue-Ribbon Tailwaters: The Unplanned Role of the U.S. Bureau of Reclamation in Creating Prime Sites for Recreational Trout Fly Fishing in Western America," (paper presented at the United States Bureau Reclamation History Conference, Las Vegas, Nev., July 2002), 1.

the hypolimnion of the reservoir. Due to thermal stratification within the lake this water stays consistently cold throughout the year, resulting in constantly cold downstream water releases. This cold water alters the aquatic ecosystem of the river, greatly impacting and sometimes destroying the warm-water fishery for a certain distance downstream from the dam. To alleviate the impact of dams upon fisheries the federal government operates a system of sixty-nine federal fish hatcheries, with a mandate to mitigate impacts of federal water projects. Some of these federal hatcheries supply trout to tailwaters to replace destroyed fisheries or supplement those negatively impacted by cold-water releases. Hatcheries are particularly important for tailwaters since trout often are not capable of reproducing in this artificial environment.

The abrupt alteration of rivers by bottom-release dams and the introduction of trout also changed sport fishing. The techniques, tackle, and traditions anglers developed over many years to catch native fish suddenly had to be adapted or replaced by methods suitable to catching exotic trout species. Anglers also had to adapt to unpredictable releases of various volumes of water in an artificial system where flows are dictated not by precipitation but mainly by the need for hydropower.

Eventually anglers developed unique techniques productive for catching tailwater trout. Many of these fisheries now attract numerous anglers since they support large numbers of trout that often grow faster and bigger than trout in rivers without dams. These trout have become economically important to local communities, attracting anglers who support a variety of fishing related businesses such as tackle shops, fishing guides, resorts, lodges, and boat docks. Anglers in turn support state fishery management agencies through the purchase of fishing licenses and trout stamps. The system is

supported by the United States Fish and Wildlife Service (USFWS) which is responsible for supplying trout to the state agencies to help mitigate the negative impacts of federal dams. This integrated system generates revenue for a variety of agencies, individuals, and private business. A study by the USFWS estimates that recreational angling for trout in the Southeastern U.S., a region where trout were previously rare, now generates $107 million and an additional $212 million in related economic activity each year.[2]

The increasing economic importance or commodification of tailwater trout fisheries often increases the pressure on management agencies to protect and enhance these fisheries.[3] Anglers and businesses dependent upon the fishery lobby managers to complete habitat restoration projects such as adding boulders, log shelters, and revetments to protect habitat from flows associated with floods or periods of high hydropower generation. Since tailwaters are often dependent upon trout stocking, these groups also seek increasing numbers and sizes of trout to attract additional anglers or to provide more sport. Certain angling groups lobby for the establishment of special catch-and-release or artificial-lure-only zones while also seeking regulations reducing creel limits or increasing length limits.

The most contentious issue relating to tailwater trout fisheries is instream flow. Most often the authorized purposes of federal dams only include hydropower, flood control, and water supply for upstream uses. Water storage for downstream uses was often not included in authorizing legislation, prompting conflicts over providing adequate instream flows for trout fisheries. These conflicts often pit state fisheries management

[2] Department of the Interior, United States Fish & Wildlife Service, "Economic Effects of Trout Production by National Fish Hatcheries in the Southeast," (Atlanta, 2001), 2.
[3] For a detailed description of the commodification of sport fishing, see Richard Hummel, *Hunting and Fishing for Sport: Commerce, Controversy, Popular Culture* (Bowling Green: Bowling Green State University Popular Press, 1994).

agencies and angling interests against federal agencies that oversee the operation of the dams and the production of hydropower. Conflicts over instream flow have become commonplace as recreational uses of the tailwaters increase in economic value.

Tailwater trout fisheries therefore provide an exceptional medium to study the evolving interrelationship between humans and the natural world. Essentially human-created and human-dependent, they exist due to the cold-water releases from dams. The dams were created predominantly to generate electricity and prevent floods, but now are expected by many to support a "natural" ecosystem conducive to trout. Dams are essentially "organic machines," artificial creations producing power and storing water, while also maintaining natural qualities and processes that sustain trout for human consumption, sport, and economic gain.[4]

Despite, or maybe because of their innate artificiality, tailwaters attract trout anglers who view them as productive, challenging, and even beautiful waters to fish. For example, *Trout Unlimited's Guide to America's 100 Best Trout Streams* includes several rivers that owe their prominence among anglers to the construction of large hydropower dams.[5] This list includes the San Juan River below Navajo Dam in New Mexico, the Green River below Flaming Gorge Dam in Utah, and the series of trout fisheries established on the White River in Arkansas (Figure 1). These four Arkansas tailwaters; Norfork, Bull Shoals, Beaver, and Greers Ferry, are perhaps the most well known tailwater trout fisheries in the world, famous for producing both trophy trout and supporting millions of stocked trout. This study examines tailwater trout fisheries

[4] Richard White, *The Organic Machine: The Remaking of the Columbia River* (New York: Hill and Wang, 1996).
[5] John Ross, *Trout Unlimited's Guide to America's 100 Best Trout Streams* (Helena: Falcon Publishing Company, 1999).

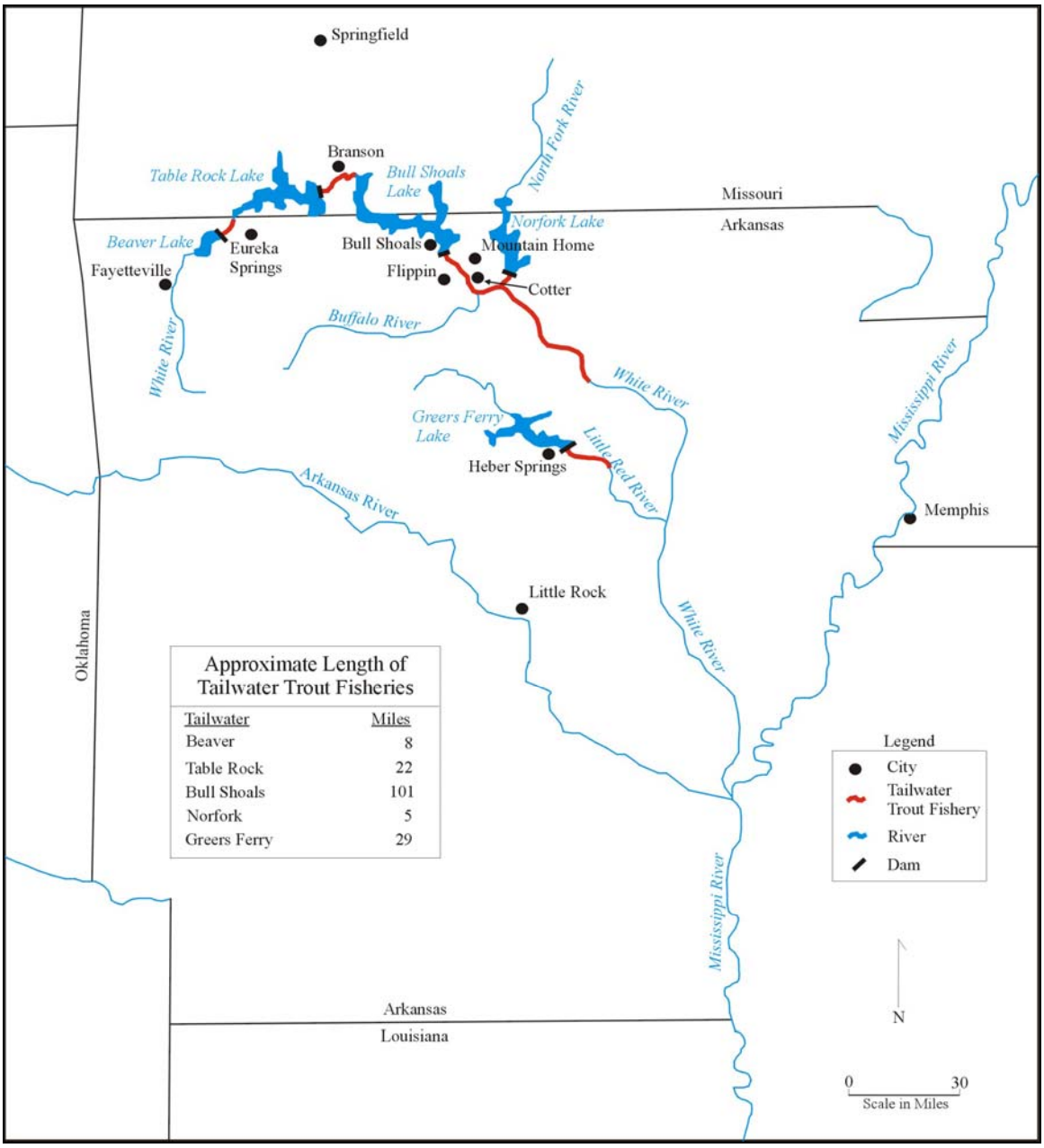

Figure 1. Study area.

through an in-depth case study of the historical development of these four tailwaters.

Statement of the Problem

Historical research examining the relationship between dams, humans, and fisheries has focused mainly on the rivers of the Pacific Northwest, particularly the role federal fish hatcheries have played in mitigating the decline in anadromous salmon caused by dam construction. These works tend to focus on the destructive impact dams have had upon native fisheries and how humans have tried, largely in vain, to mitigate these impacts. Absent from the literature is historical research concerning fisheries that were created by and are dependent upon cold-water releases from federally constructed dams, federal hatcheries supplying them with trout, and the sportfishers who use these fisheries.[6] This lack of historical inquiry exists despite the significant economic, social, ecological, and recreational importance of tailwater trout fisheries to local communities, anglers, and state and federal agencies.

Purpose of the Study

The purpose of this study is to examine the genesis and development of four tailwater trout fisheries created within the White River Basin of northern Arkansas. This study is the first of its kind to focus on the environmental history of tailwater trout fisheries created by the construction of large bottom-release hydropower dams. The objective is to describe the historical interrelationship between the river, dams, federal and state resource management agencies, and anglers in creating, managing, and using the fishery. This interrelationship is examined historically to reveal changes in the

[6] For a discussion on the need for historical work on fisheries, see Peter Moyle, "The Importance of an Historical Perspective: Fish Introductions," *Fisheries* 22, no. 10 (October 1997): 14-18.

management and use of the fishery with respect to changes in their recreational, social, and economic importance.

Research Questions

To limit and define the scope of the historical inquiry, this study focuses on the role played by three groups, 1) the federal agencies; United States Army Corps of Engineers (Corps), Southwestern Power Administration (SPA), and USFWS that built, operate, and utilize the dams and fish hatcheries, 2) the Arkansas Game and Fish Commission (AGFC) that manages the fishery, 3) and the anglers who most directly use the fishery. The interrelationship between these groups is examined by exploring the following questions:

For the federal agencies: **Has the operation of the dams and fish hatcheries changed over time in relation to changes in the economic, social, ecological, and recreational significance of the fishery?**

For the state fishery agency: **Has the management (i.e. regulations, stocking procedures, policies, objectives) of the fishery changed over time in relation to changes in the economic, social, ecological, and recreational significance of the fishery?**

For the anglers: **How have angling traditions, techniques, equipment, and attitudes about the fishery changed over time in relation to changes in its economic, social, ecological, and recreational significance?**

Significance of the Study

In the United States and throughout the World dam construction has left few unimpeded rivers. The World's rivers now contain an estimated 40,000 large dams, defined by the International Commission on Large Dams as those measuring 15 meters from base to crest.[7] The construction of large dams is a relatively recent development in World history, with all but 5,000 large dams built since 1950.[8] With over 5,000 large dams and an estimated 75,000 dams over two meters in height, the United States is one of the World's leading dam building nations.[9] This proliferation of dams is mainly attributed to the benefits they provide in controlling floods, improving navigation, generating power, providing water for irrigation, and creating recreational opportunities.

The dam construction era in the United States ended in the early 1970s but the ecological impact of dams continues to influence aquatic ecosystems. Principal impacts include upstream hydrologic change due to the creation of reservoirs, downstream morphological changes due to altered sediment load, changes in water quality, reduction of biodiversity, unnatural flows, and blockage or delay of fish migration.[10] Some of these impacts became immediately apparent upon completion of a dam, such as blocking the migration of certain fish species. Other ecological impacts, such as morphological changes, are slower in developing and scientists are still documenting the changes

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[7] Patrick McCully, *Silenced Rivers: The Ecology and Politics of Large Dams* (London: Zed Books, 1996), 3-4.
[8] McCully, *Silenced Rivers*, 4.
[9] M. Dynesius and C. Nilsson, "Fragmentation and Flow Regulation of River Systems in the Northern Third of the World," *Science* 266, no. 4 (November 1994): 753-762; William Graf, "Dam Nation: A Geographic Census of American Dams and Their Large-scale Hydrologic Impacts," *Water Resources Research* 35, no. 4 (April 1999): 1305-1311.
[10] Geoffrey Petts, *Impounded Rivers: Perspectives for Ecological Management* (New York: Wiley, 1984); E Goldsmith and N Hildyard, ed., *The Social and Environmental Impacts of Large Dams Volume Two. 2: Case Studies* (Cornwall: Wadebridge Ecological Center, 1986); McCully, *Silenced Rivers*; C. Hunt, *Down by the River: The Impact of Federal Water Projects and Policies on Biological Diversity* (Washington D.C.: Island Press, 1988); L. Glowicki and T. Penczak, "Impoundment Impact on Fish in the Warta River: Species Richness and Sample Size in the Rarefaction Method," *Journal of Fish Biology* 57 (2000): 99-108.

wrought by dams built years ago. Most of the documented changes are negatively impacting natural ecosystems. Evidence of the growing concern of these negative impacts is the rapidly developing science of dam removal.[11]

Of particular importance for this study is the alteration of riverine fisheries downstream of large deep-release or bottom-release dams. These dams draw water from the bottom of reservoirs and release it into the river directly below the dam. These river sections, most commonly called tailraces or tailwaters, exhibit unique thermal and nutrient regimes that affect aquatic life. Water released from the bottom of reservoirs is often cold due to thermal stratification, sometimes contains lower levels of dissolved oxygen (D.O.), and is often nutrient rich. These cold-water releases impact fish species requiring specific temperatures to trigger spawning or for the survival of eggs and young.[12] Warm-water fish species are therefore often exterminated or their numbers greatly reduced for a distance downstream from the dam, while cold-water dependent or adaptable species often thrive.

The numerous bottom-release dams built by the Corps, United States Bureau of Reclamation (USBR), and the Tennessee Valley Authority (TVA) are responsible for altering or destroying indigenous fisheries for varying distances downstream. To mitigate these impacts, the stocking of hatchery reared and cold-water dependent salmonidae species such as rainbow (*Oncorhynchus mykiss*), brook (*Salvelinus fontinalis*), brown (*Salmo trutta*), and cutthroat (*Oncorhynchus clarki*) trout is

[11] Elizabeth Grossman, *Watershed : The Undamming of America* (New York: Counterpoint Press, 2002); Bruce Babbit, "What Goes Up, May Come Down," *Bioscience* 52, no. 8 (August 2002): 656-658; David Hart et al., "Dam Removal: Challenges and Opportunities for Ecological Research and River Restoration," *Bioscience* 52, no. 8 (August 2002): 669-681.
[12] M. Collier et al., *Dams and Rivers: Primer on the Downstream Effects of Dams*, United States Geological Survey, Circular 1126 (Reston Virginia, 1996).

commonplace. Since the authorized purposes of dams often do not include water storage for downstream uses, controversies develop over how much water should to be released to adequately support trout. As the economic importance of trout fishing increases, state wildlife agencies, anglers, and business interests often disagree with federal agencies over instream flow.

Since the USFWS serves as the agency in charge of mitigating the impacts of federal water projects, it now operates sixty-nine national fish hatcheries producing millions of fish for mitigation, reintroduction programs, and preservation of endangered species.[13] The federal hatchery system is therefore in somewhat of a quandary. In relation to tailwaters their activities are seen as necessary to mitigate the impact of dams. Fisheries managers, anglers, and conservationists are increasingly scrutinizing the system, especially in relation to its role in the mitigation of salmon species, the stocking of fish to supplement wild populations, and in supplying trout to tailwater fisheries. They contend that the release of hatchery reared fish dilutes the genetic variability of wild salmonids through mixing with hatchery reared fish, that the loss of nutrients from wild salmon carcasses no longer fills stream beds, that wild salmonid smolts are at a competitive disadvantage when looking for food since hatchery fish are larger when released, and that introductions spread diseases originating in hatchery facilities.[14]

Although questioned by some, others view hatchery supported tailwater trout fisheries as a valuable resource.[15] Present throughout the country, these fisheries have

[13] Scott Bowen, "Hatcheries in Crises," *Outdoor Life* 207, no. 2 (May 2001), 68.
[14] Kenneth Black, ed., *Environmental Impacts of Aquaculture* (Sheffield: Academic Press, 2001); Fen Montaigne, "Atlantic Salmon," *National Geographic* 204, no. 1 (July 2003): 100-123.
[15] Michael Pearce, "A Brown for the Books," *Outdoor Life* 183, no. 6 (December 1988): 58, 97-99; Steve Price, "Arkansas' Monster Browns," *Field and Stream*, 93, no. 11 (March 1989): 122-23; Michael Pearce, "Brown Trout: A New World Record," *Outdoor Life* (August 1992): 46-47.

grown increasingly important to the 7.8 million trout anglers in the United States.[16] For instance, University of California, Sacramento historian Ken Owens identifies 31 USBR tailwaters on 24 rivers in the western United States that are considered by anglers as "blue-ribbon" fisheries.[17] These fisheries are now important destinations for anglers and economically important for many western states.[18] Tailwater trout fisheries are particularly unique in the southeastern United States since construction of dams by the TVA and the Corps led to the creation of numerous tailwater trout fisheries where trout are an exotic species. Jimmy Jacobs identifies 45 tailwater fisheries in the southeastern United States where the "impoundment... creates the trout fishery, or at least greatly improves it."[19]

The series of four tailwater trout fisheries in northern Arkansas are considered by many to be the best in the country, if not the World. These tailwaters have produced numerous world record trout while also sustaining millions of hatchery reared trout. Thousands of anglers travel long distances to fish these tailwaters, supporting a wide-range of fishing related businesses, guide services, tackle shops, and resorts. The issue of providing more instream flows for the tailwater fisheries has also been an ongoing and progressively divisive issue since the first dam was built in the early 1940s. This study therefore focuses on describing how and why these tailwater fisheries were created, and

[16] Department of the Interior, United States Fish & Wildlife Service, "2001 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation," Office of Management and Budget, survey control number 1018-0088 (2003).
[17] Owens, "Blue-Ribbon Tailwaters."
[18] For a discussion of the importance of western tailwaters among anglers and angling related businesses, see Dave Hughes, "The Other West," *Field & Stream* 54, no. 5 (September, 1989): 41, 138-39; Bob Whitaker, "Trophy Trout's Fantastic Foursome," *Outdoor Life* 185, no. 5 (March 1990): 57-59, 107, 109-10.
[19] Jimmy Jacobs, *Tailwater Trout in the South: A Guide to Finding and Fishing the Region's Man-Made Trout Fisheries*, 2nd ed. (Vermont: Backcountry Publications, 2003), 12.

especially how their recreational use, management, and economic value has evolved over time.

CHAPTER II

REVIEW OF THE LITERATURE

When you can't go fishing, console yourself by reading about it.

Harry Howard, *Sport Fishing for Pacific Salmon in Washington-Oregon-Alaska*, 1955.

In order to develop an appropriate and distinctive methodology to evaluate tailwater trout fisheries, I reviewed literature focusing on specific fish species or fisheries. The literature reviewed is eclectic, revealing works pertaining to a variety of fisheries, fish species, and water bodies. The works reviewed fall into three general categories; 1) studies pertaining to tailwater trout fisheries, 2) Pacific salmon fisheries, and 3) those focusing on the historical importance of angling.

Tailwater Trout Fisheries

Historian Ken Owens provides one of the few academic articles relating specifically to tailwater fisheries. His article "Blue-Ribbon Tailwaters: The Unplanned Role of the U.S. Bureau of Reclamation in Creating Prime Sites for Recreational Trout Fly-fishing in Western America" describes how tailwater trout fisheries became economically important to local communities and recreationally important to anglers.[1]

[1] Owens, "Blue Ribbon Tailwaters."

He describes how these tailwater fisheries were created, their rise in popularity among fly-fishers, their unique ecological traits, and how they have increased in economic importance. Owens' research does not discuss the Corps constructed dams and resulting tailwaters found on the White River.

Of particular importance is Owens discussion of the relationship between trout stocking policies, funding for state agencies, and the changing nature of the sport of fly-fishing. He relates how large-scale trout stocking programs based upon hatchery reared fish developed with the goal of maintaining put-and-take fisheries. Put-and-take fisheries are important to state management agencies since they attract anglers by providing a steady supply of trout, and a steady stream of revenue through license sales. Owens describes how fly-fishers and fishery biologists often object to this type of management. They increasingly prefer fisheries managed for wild, self-sustaining populations protected by special regulations such as length limits, reduced bag limits, barbless hooks, artificial-lures-only, and catch-and-release.

Two books reviewed focus specifically on the White River. John Fleming's *The White River of the Ozarks: From Sabertooth Tiger to Fighting Rainbows* examines the history of the White River region from prehistoric times until the early 1970s.[2] Much of this book focuses on the history of the river prior to dam construction and how settlement and economic development changed people's relationship with and use of the river. Fleming devotes the majority of his book on the history of the river prior to dam construction, describing how settlement along the river progressed in relation to improved transportation, trade, and industry.

[2] John Fleming, *The White River of the Ozarks: From Sabertooth Tiger to Fighting Rainbows* (New York: Gallinule Society Publishing, 1973).

Fleming does discuss the prevalence and importance of angling to the local inhabitants, including a description of the Ozark johnboat, which was first constructed in the region and is still in use today. In the section *The Revolution Begins*, Fleming describes how the construction of dams and the resulting reservoirs and cold-water tailwaters created an economic revolution that altered the culture of the region. He relates how the dams altered but did not destroy the traditional Ozark float trip. Although mentioned briefly, the author does not make the trout fishery a major theme of his research.

Another book specifically about the White River is Steve Wright's *Ozark Trout Tales: A Fishing Guide for the White River System*.[3] Although intended as a guidebook for anglers, it also includes a wealth of information concerning the history, ecology, management, and angling traditions related to the fishery. Wright assigns one chapter to each of the five White River Basin tailwaters, providing detailed descriptions of when each was created, the unique ecological traits exhibited by each, and how angling regulations and management has evolved. Wright's work only briefly mentions the fight over instream flow for the tailwaters.

Ed Engle in *Fly-fishing the Tailwaters* provides a detailed description of the distinctive fly-fishing opportunities that exist in tailwater trout fisheries, especially in the western United States.[4] Written as a guidebook for anglers, it describes the unique hydrological, thermal, and entomological characteristics of tailwaters, and how these influence angling. He especially concentrates on how dams change aquatic insect populations, often reducing specie diversity while allowing certain species to reproduce

[3] Steve Wright, *Ozark Trout Tales: A Fishing Guide for the White River System* (Arkansas City: White River Chronicle, 1995).
[4] Ed Engle, *Fly-fishing the Tailwaters* (Harrisburg: Stackpole Books, 1991).

in tremendous quantities. This proliferation of food often produces exceptional year-round growth rates in trout, which in turn attracts anglers eager to catch the large and often abundant fish.

In Chapter One, *The Paradox*, Engle argues that fishing for trout in tailwaters is somewhat contradictory, especially for fly-fishers. As a distinct sub-group within the angling community, fly-fishers tend to hold free-flowing streams populated with wild trout in high regard, often fighting to preserve and protect such environments. In fishing tailwaters, fly-fishers struggle with the fact that "fishing is good below the dam because of the reservoir."[5] Many fly-fishers and fly-fishing conservation groups now work to protect and enhance these tailwater fisheries by promoting special regulations such as catch-and-release while also lobbying for increased instream flows.

Another particularly relevant guidebook is *Tailwater Trout in the South*, since it concentrates on southern tailwater trout fisheries. Jimmy Jacobs identifies 45 tailwater trout fisheries located in nine states, defining these as fisheries where "the impoundment...must create the trout fishery, or at least greatly improve it."[6] The author describes each tailwater, providing information on fish species present, water flows, insect life, fishing tips, and maps showing the location of each fishery. Jacobs also describes some problems associated with the fisheries, including low D.O. levels during certain time periods and the need to establish instream flow guidelines when hydropower production is limited.

Jacobs describes the trout fisheries found in Arkansas in detail in Chapter Four, contending that "Arkansas is the best testament to the angling variety, quantity, and

[5] Ibid., 23.
[6] Jacobs, *Tailwater Trout in the South,* 12.

quality that can be achieved in tailwater trout fisheries."[7] Jacobs includes a short historical description of why dams were built in Arkansas, and how and when trout were introduced into the tailwaters. He then describes each of the four tailwater fisheries found within the White River Basin, including historical information on trout stocking and the evolution of fishing regulations.

Pacific Salmon Fisheries

A particularly relevant and sizeable body of literature exists on the impact of dams on anadromous salmon fisheries, especially those found along the Pacific coast of North America. These works tend to focus on the interrelationship between dams, management policy and regulation, humans, rivers, and the fisheries. Many of these focus on the negative impacts of human alteration of the natural world.[8] Others focus on the impact that declining salmon runs and litigation over fishing rights have had on local indigenous peoples.[9] Another less common approach is to describe in detail the measures taken by federal agencies to protect or restore salmon runs.[10] These works all use salmon as a unifying theme to explore the relationship between humans and the natural environment.

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[7] Ibid., 43.

[8] For example, see Anthony Netboy, *The Columbia River Salmon and Steelhead Trout: Their Fight for Survival* (Seattle: University of Washington Press, 1980); Jean Johnson, "Farm, Range, Forest, and Salmon: The Tucannon Watershed of the Columbia River Basin, 1850-1995," (Ph.D. diss., Washington State University, 1995); Blaine Hardin, *A River Lost: The Life and Death of the Columbia* (New York: W.W. Norton & Company, 1996).

[9] Dianne Newell, *Tangled Webs of History: Indians and the Law in Canada's Pacific Coast Fisheries* (Toronto: University of Toronto Press, 1993); Roberta Ulrich, *Empty Nets: Indians, Dams, and the Columbia River* (Corvallis: Oregon State University Press, 1999).

[10] Lisa Mighetto and Wesley Ebel, *Saving the Salmon: A History of the U.S. Army Corps of Engineers' Efforts to Protect Anadromous Fish on the Columbia and Snake Rivers* (Seattle: Historical Research Associates, Inc., 1994); Matthew Evenden, "Fish vs. Power: Remaking Salmon, Science and Society on the Fraser River, 1900--1960," (Ph.D. Diss., York University, 2000).

Selected historical works related to dams and salmon fisheries provide useful methodological context and background information for the study. In his work *The Organic Machine: The Remaking of the Columbia River*, environmental historian Richard White describes how humans remade the river into a machine for the purpose of producing goods for human consumption.[11] The river is expected to function as a machine but also to continue its role as a natural, organic system supporting fish, wildlife, and humans. White uses the concepts of "energy and work" applying them to the river, to the salmon fishery, and to humans. His intent is to use these concepts to create a social and environmental history of the river, since White believes, "we cannot understand human history without natural history and we cannot understand natural history without human history."

White's main objective is to "examine the river as an organic machine, as an energy system which, although modified by human interventions, maintains it natural, its 'unmade' qualities." Although altered by humans, the river is still organic; it still flows, supports aquatic life, and is seen by many as displaying natural qualities. In Chapter Four, titled *Salmon*, White relates how "salmon symbolize nature" to many people who live along the Columbia River. He reveals the various human attitudes, perceptions, and management policies towards salmon, reflecting upon how these have changed over time and how they have impacted salmon. In essence, White uses the plight of the salmon and the Columbia River to reveal the historical interrelationship between technology, nature, and humans.

[11] White, *Organic Machine.*

Another influential work is Arthur McEvoy's *The Fisherman's Problem: Ecology and Law in the California Fisheries, 1850-1980*.[12] This frequently cited work influenced the methodology of numerous environmental histories, including several related directly to fisheries. McEvoy uses the natural environment as the central figure in his narrative, since he contends it "not only provided the stage on which history took place but took an active role in it as well."[13] Placing the environment in general, and California's fisheries specifically, at the center of history, McEvoy then examines how humans use, exploit, perceive, and interact with the natural environment.

McEvoy states that his main objective is to examine "the remarkable ways in which ecology, economic enterprise, and legal processes interacted to shape the course of change in an important extractive industry."[14] McEvoy reveals how these three components worked together to shape the history of the fisheries, especially the failure of public agencies to take action to protect the fishery and those who exploited the resource for economic gains. An important aspect of McEvoy's work is his focus on the interplay between the economic market and the legal system. He argues that the two "do not stand in opposition to one another but rather work in tandem" to shape how fisheries are viewed and utilized.[15] Although laws concerning resource use are tied to economics, the author stresses how they are shaped by and dependent upon social and cultural factors. These factors interacting over time form "the history of human industry in relation to the 'natural' world."[16]

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[12] Arthur McEvoy, *The Fisherman's Problem: Ecology and Law in the California Fisheries, 1850-1980* (Cambridge: Cambridge University Press, 1986).
[13] Ibid., 14.
[14] Ibid., xi.
[15] Ibid., 253.
[16] Ibid., 14.

Joseph E. Taylor III in *Making Salmon: An Environmental History of the Northwest Fisheries Crisis* uses a methodology based upon the work of McEvoy.[17] Taylor melds the experiences of natives, commercial fishers, dam builders, sportfishers, and conservationists to explain the history of the declining salmon runs in the Columbia River. Similar to McEvoy, he also uses nature as a central theme, contending that, "Most historians concentrate only on human impacts upon salmon, ignoring nature's impact on history."[18] Focusing on nature's impact on the river does not mean that Taylor ignores the social history important to the story. He also argues that the crisis is the result of 125 years of failed policies, with different rival groups blaming each other for the declining salmon runs. These groups tended to perpetuate certain histories to indict others for the crises, in turn absolving themselves from responsibility. Therefore Taylor believes the "essence of the salmon crises is the struggle to define and solve a complicated environmental and social problem," with the goal of subverting people's common and simplistic ideas on the causes of the crises.[19]

Especially important for the proposed research is Taylor's discussion of the role hatcheries and fish culture played in the history of Columbia River salmon. Much of the book focuses on the common and long held "belief that humans could make salmon more efficiently than nature."[20] Taylor contends that confidence in science and technology to mitigate the impacts of dam building has allowed society to ignore its destructive activities. Hatcheries were seen as scientifically sound alternatives to natural production, and were viewed favorably by most politicians, taxpayers, and other users of the fishery.

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[17] Joseph E. Taylor III. *Making Salmon: An Environmental History of the Northwest Fisheries Crisis* (Seattle: University of Washington Press, 1999).
[18] Ibid., 6.
[19] Ibid., 4.
[20] Ibid., 10.

The hatchery system therefore grew out of progressive era science, becoming well established with strong political, economic, and recreational supporters.

Jim Lichatowich's *Salmon Without Rivers: A History of the Pacific Salmon Crisis* provides a detailed history of the Pacific salmon, with special focus on the role of fish culture.[21] In Chapter Six, Lichatowich discusses the history and development of the artificial propagation of salmon with special emphasis on the establishment and expansion of the U.S. federal hatchery system. Lichatowich contends that, "Hatcheries fit nicely into the nineteenth-century view that ecosystems were warehouses of commodities that existed solely for human use and benefit." This view also fit the widely held belief that nature could be controlled, manipulated, and improved upon for the benefit of humans. Therefore Lichatowich contends that, "hatcheries provided the perfect vehicle for ordering and controlling the aquatic realm."[22] Once dams were constructed on most of the salmon rivers, it was commonly believed that hatcheries could compensate or mitigate the declining runs.

Lichatowich's discussion of the relationship between fish culture and federal funding, politics, and local economies is particularly relevant. He relates how the federal hatchery system became an important source of income for state and federal management agencies despite the failure of stocking to restore salmon runs. Funding was linked to the political process through local constituents who viewed fish stocking as necessary to protect local economies dependent upon salmon. Federal fish hatcheries therefore operate as part of a wider economic and political system that often is not sensitive to the ecological implications of its activities.

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[21] Jim Lichatowich, *Salmon Without Rivers: A History of the Pacific Salmon Crises* (Washington D.C.: Island Press, 1999).
[22] Ibid., 128.

Michael Black's article "Tragic Remedies: A Century of Failed Fishery Policy on California's Sacramento River," relates how the policy of mitigation through hatcheries is a failed policy in relation to salmon and steelhead trout.[23] Black defines an interpretive framework called "serialistic policy" to explain the series of failed policies instituted by state and federal agencies to protect and restore the fishery. The author states that mitigation stems from the belief that technology can compensate for environmental degradation or change. By "abandoning ecology for engineering" humans have created "industrialized ecosystems" that require human management and manipulation. Black contends that manipulation requires funding, thus creating "publicly funded environmental complexes" that include hatcheries, construction of artificial spawning channels, trucking hatchery-reared fish to rivers and lakes, and the state and federal workers and agencies responsible for coordinating and implementing the complex. Black argues that these complexes, especially fish hatcheries, avert the public's attention away from the real issue; the alteration of natural ecosystems.

Historical literature related to the development of aquaculture provides useful context for the development of the hatchery system in the effort to protect and preserve salmon runs and other fish species affected by dams.[24] Robert Stickney's detailed work *Aquaculture in the United States: A Historical Survey* is especially relevant since it provides a comprehensive look at the development of fish-culture in America.[25] Stickney

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[23] Michael Black, "Tragic Remedies: A Century of Failed Fishery Policy on California's Sacramento River," *Pacific Historical Review* 64, no. 1 (1995): 37-71.

[24] For the history of fish culture in America, see J.T. Bowen, "A History of Fish Culture as Related to the Development of Fishery Programs," in *A Century of Fisheries in North America*, ed. Norman Benson (Washington D.C.: American Fisheries Society, 1970); Jerry Towle, "Authored Ecosystems: Livingstone Stone and the Transformation of California Fisheries," *Environmental History* 5, no. 1 (January, 2000): 54-74.

[25] Robert Stickney, *Aquaculture in the United States: A Historical Survey* (New York: John Wiley & Sons, Inc., 1996).

describes the origins of the fish-culture movement and the establishment in 1871 of a federal agency, the U.S. Fish and Fisheries Commission, to rebuild the nation's declining fishery resources. Chapters Three, Four, and Five focus on aquaculture activities since the early 1900s, providing information on the expansion of the federal hatchery system. Especially relevant is the author's discussion of how federal and state agencies coordinated activities related to federally funded or mandated projects.

Historical Significance of Angling

A major component of the proposed research is to examine the relationship among anglers, fishery management agencies, and the river system. Therefore, historical research related to angling was reviewed to provide relevant conceptual and methodological background information. Particularly informative was the recent issue of *Montana: The Magazine of Western History* which was devoted to the history of trout fishing in the West and its role in shaping western history. This special issue includes three articles which are especially relevant.

Paul Schullery's article "Frontier Fly-Fishing in the New West" traces the evolution of fly-fishing in the western United States. He seeks to answer the complex question, "Could something like fly-fishing--which most people might regard as little more than a 'leisure activity'--genuinely become a significant element of a region's culture?"[26] He examines how Western fly-fishing developed regionally distinct traditions, angling methods, and equipment, arguing that fly-fishing has become "one of the things that people in the East and other regions think of when they think of the

[26] Paul Schullery, "Frontier Fly-Fishing in the New West," *Montana: The Magazine of Western History* 52, no. 2 (2002): 2-9.

West."[27] Although still possessing "regionally distinct traditions," Schullery believes that fly-fishing is experiencing homogenization through the influence of popular culture and the "globalization of community."[28]

In a related article, "Fishing the Hatch: New West Romanticism and Fly-Fishing in the High Country," Ken Owens examines how fly-fishing has "assumed a specific regional identity in the West."[29] Owens relates how beginning in the 1870s, fly-fishing became a "direct cultural transplant" into the West from its American hearth area along the northeastern seaboard. Through the course of the twentieth century fly-fishing was promoted in numerous magazines and tourism brochures until for many it became synonymous with the Western experience, or what Owens terms the "New West romanticism." Owens believes the culmination of the "fly-fishing boom" was the release of the popular movie *A River Runs Through It* in 1992. This movie "gave western fly-fishing an aura of historical authenticity and credibility" that attracted numerous people to the sport of fly-fishing.[30] Owens argues that popular culture, mass media, and tourist-oriented businesses have "skillfully manipulated the image of fly-fishing" with the goal of increasing tourism.

In the final article "Trout Shangri-La: Remaking the Fishing in Yellowstone National Park," John Byorth uses the history of Yellowstone's fishery to illustrate the changes sport fishing has undergone during the twentieth century.[31] Byorth describes how, by the 1800s, the Yellowstone region's fishery was decimated through over-

[27] Ibid., 5.
[28] Ibid., 8.
[29] Owens, "Fishing the Hatch."
[30] Ibid., 17.
[31] John Byorth, "Trout Shangri-La: Remaking the Fishing in Yellowstone National Park," *Montana: The Magazine of Western History* 52, no. 2 (2002): 38-47.

harvesting, forcing managers to begin an active program of fish stocking. Fish stocking, based upon a put-and-take management philosophy, had the goal of "keeping visitors happy" with their Yellowstone fishing experience. The stocking program introduced nonnative fish species into the region, often decimating native cutthroat trout populations. Fish stocking was completely phased out by 1957, replaced with catch-and-release regulations, implemented to protect and enhance native fish species. This sequence of decimation through human use and alteration of the environment, followed by the release of hatchery reared and nonnative fish species, and then eventually to a more ecological and sustainable approach to fishery management is common in the historiography of fisheries. Byorth therefore contends that the "fishing experience in Yellowstone is in many ways the history of the American relationship with natural resources."[32]

Charles Brooks' work *The Living River,* combines environmental history and sport fishing in his description of the Madison River of Wyoming and Montana.[33] The impetus for this text was to write "a book on the complete fly-fishing experience, where all those things that make the sport so engrossing--the geology, geography, hydrology, biology, ecology, history, and other facets of the stream--had been explored and developed."[34] The resulting book, unified around the theme of fly-fishing, is an environmental and social history of the river and the people who have lived, worked, and especially recreated in and around its course. This book is relevant since it demonstrates how angling can be used as a unifying central theme in describing the natural history of a river.

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[32] Ibid., 47.
[33] Charles Brooks, *The Living River: A Fisherman's Intimate Profile of the Madison River Watershed: Its History, Ecology, Lore, and Angling Opportunities* (Garden City: Lyons Books, 1979).
[34] Ibid., ix.

While most research concerning the Columbia River focuses on commercial fishing, Lisa Mighetto's article "Sport Fishing on the Columbia River," focuses on the history of sport fishing.[35] She describes how the Columbia River was a world renowned angling destination by the beginning of the twentieth century. With this newfound notoriety came angling tourists, increased regulation, the establishment of sport fishing conservation organizations, and a growing number of angling related businesses. As recreational fishing grew in importance, its practitioners became increasingly concerned about the impact of dams, commercial fishing, and Native American fishing rights on salmon populations. Mighetto's work is especially significant since it demonstrates the importance of sportfishers in influencing management policies and regulations concerning dams and fisheries. It also demonstrates the usefulness of an historical perspective for understanding current environmental challenges.

Richard Gerstell's book *American Shad in the Susquehanna River Basin: A Three-Hundred Year History*, focuses on a specific fish living in one particular river.[36] Gerstell relates how the American Shad played an integral role in the cultural history of people living along the river in New York, Pennsylvania, and Maryland. As with many natural histories of fish and wildlife it follows the familiar-abundance, exploitation, scarcity, and restoration-timeline. He reveals this historical timeline by describing how fishing techniques and equipment evolved from a more subsistence and sustainable activity to one dominated by a more commercial and exploitive system. Gerstell provides great detail in his descriptions, with numerous images, of how fishing equipment,

[35] Lisa Mighetto, "Sport Fishing on the Columbia River," *Pacific Northwest Quarterly* 87, no. 1 (Winter, 1995/96): 5-15.
[36] Richard Gerstell, *American Shad in the Susquehanna River Basin: A Three-hundred Year History* (University Park: The Pennsylvania State University Press, 1998).

methods, and traditions evolved and impacted the fishery. In Chapters 12-14 he details the restoration efforts with a discussion on the role fish hatcheries played in this effort. Gerstell's work demonstrates how the history of particular fish specie can be used to tell a broader history of human culture and its relationship with the natural world.

Margaret Bogue's book *Fishing the Great Lakes* is a comprehensive history of the Great Lake fisheries, focusing on the impact of commodification of the resource. Bogue was prompted to conduct research on fish and water resources of the Great Lakes since most scholarly work is "tangential and piecemeal" despite it being a "showcase of the intricacy of natural and human relationships."[37] Her work focuses on four groups; the commercial fishing industry, entrepreneurial dealers, policy makers, and marine scientists, and the integral historical role played by each. She describes the complex interaction between changes to the physical environment of the Great Lakes and its fish resource as humans sought to utilize the resource for economic gain.

Courtland Smith in *Salmon Fishers of the Columbia* focuses on the growth and eventual decline of the canned salmon industry on the Columbia River.[38] Although focusing mainly on the commercial exploitation of the resource, it also provides a rich and detailed description of the evolution in fishing techniques. In describing the evolution of salmon fishing it provides an illustration of how humans interact with and use natural resources. Smith argues that fishery management is not solely about fish, it also includes managing the various human uses of the resource. Smith contends that

[37] Margaret Bogue, *Fishing the Great Lakes: An Environmental History 1783-1933* (Madison: The University of Wisconsin Press, 2000).
[38] Courtland Smith, *Salmon Fishers of the Columbia* (Corvallis: Oregon State University Press, 1979).

“The Columbia River salmon fishery is an example of the social, political, and economic processes that people used to gain these benefits."[39]

[39] Ibid., 2.

CHAPTER III

METHODOLOGY

At the core of environmental history is the realization that humans and the natural environment share a relationship that changes over time. Humans influence the natural world through their actions, while the physical world in turn influences the actions, decisions, and choices of humans and their societies.[1] The creation of tailwater trout fisheries provides a relevant medium to explore this reciprocal relationship over time. To develop an appropriate methodology and rationale for this study I researched the development of the field of environmental history and the evolving methods of inquiry its practitioners apply.

Environmental history as a distinct academic discipline has its genesis in the environmental movement of the late 1960s. Two seminal works, *Conservation and the Gospel of Efficiency* and *Wilderness and the American Mind*, were especially influential and rose to prominence amid calls for change in government policy and public attitudes

[1] For general definitions of environmental history, see Roderick Nash, "American Environmental History: A New Teaching Frontier," *Pacific Historical Review* 41 (1972): 362-372; John Opie, "Environmental History: Pitfalls and Opportunities," *Environmental Review* 7, no. 1 (Spring 1983): 8-16; Richard White, "Historiographical Essay, American Environmental History: The Development of a New Historical Field," *Pacific Historical Review* 54 (1985): 297-335; and his recent follow-up, "Environmental History: Watching a Historical Field Mature," *Pacific Historical Review* 70, no. 1 (February 2001): 103-111. See also "A Round Table: Environmental History," Donald Worster, ed. *Journal of American History* 76, no. 4 (March 1990): 1087-1147.

towards the environment.[2] Consequently, the field initially concentrated on issues related to wilderness and the conservationist/preservationist dichotomy, producing a somewhat narrowly defined scholarship which often relegated the natural world to the periphery. As the field matured into the 1970s and 1980s, it continued its demands for reform, supporting and expressing its wishes through its focus on declensionist environmental history. As Richard White relates, "many of these stories, including my own, were stories of original sin and expulsion from an original Eden."[3] Many of these histories sought to illuminate the impact of human activities and how the changes wrought were damaging to the natural world.

As the field continued to evolve, it began incorporating a more complex and integrated view of how humans and the natural world interact.[4] The intent was to show a more reciprocal relationship between humans and the natural world in relation to environmental and societal change. In his well-known essay "Doing Environmental History," Donald Worster contends that its goal "became one of deepening our understanding of how humans have been affected by their natural environment through time and, conversely, how they have affected that environment and with what results."[5] Worster then defines three levels of historical inquiry applicable to achieving his stated goals; understanding nature itself, the socioeconomic realm as it interacts with the environment, and the "purely mental or intellectual, in which perceptions, ethics, laws,

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[2] Samuel P. Hays, *Conservation and the Gospel of Efficiency: The Progressive Conservation Movement, 1890-1920* (New York: Athenaeum, 1959); Roderick Nash, *Wilderness and the American Mind* (New Haven: Yale University Press, 1967).
[3] White, "Environmental History," 105.
[4] Richard White, *Land Use, Environment, and Social Change: The Shaping of Island County, Washington* (Seattle: University of Washington Press, 1980); William Cronon, *Changes in the Land: Indians, Colonists, and the Ecology of New England* (New York: Hill and Wang, 1983).
[5] Donald Worster, "Doing Environmental History," in *The Ends of the Earth: Perspectives on Modern Environmental History*, ed. Donald Worster (New York: Cambridge University Press, 1988), 290.

myths, and other structures of meaning become part of an individual's or group's dialogue with nature."[6]

I therefore apply these three levels of analysis defined by Worster to a historical case study of the four tailwater trout fisheries created within the White River Basin, Arkansas (see Figure 1). By combining these levels of inquiry, I achieve the interdisciplinary synthesis and holistic content for which the field is increasingly known, but also limiting the scope of my inquiry to make the research manageable. To further limit the scope of the study, Table Rock Dam on the portion of the White River flowing through Missouri is not researched. Including this fishery would have necessitated gathering information from state management agencies in Missouri, greatly expanding and complicating data collection.

Worster's first level necessitates integrating literature, data, and terminology from an assortment of academic disciplines related to the natural and life sciences. I especially utilize data, terminology, and literature related to fisheries management, fisheries ecology, hydrology, limnology, entomology, and stream ecology. Since the river and its fishery is a central component of the research, relevant historical information concerning the river is also examined. The objective is to determine how the river was changed ecologically over time by human alteration, and how this influences human interactions with and use of the river.

To shed light on the socioeconomic realm, environmental historians have often used the expansive concepts of capitalism and commodification.[7] For example, Donald

[6] Ibid., 293.
[7] White, *Land Use, Environment, and Social Change*; Cronon, *Changes in the Land*; Donald Worster, *Rivers of Empire: Water, Aridity, and the Growth of the American West* (Oxford: Oxford University Press,

Worster in *Dust Bowl* argues that capitalism "has been the decisive factor in this nation's use of nature" and is the "major defining influence" in how people behave toward the land.[8] In his work *Nature's Metropolis* William Cronon adds that commodities are "our most basic connections to the natural world" and if historians want to understand the human consequences of our actions we "must reconstruct the linkages between the commodities of our economy and the resources of our ecosystem."[9] Therefore, revealing the historical linkages in the commodification of the river and its fishery is an integral part of this research.

Another often applied concept related to commodification is based upon ecologist Garrett Hardin's 1968 article "The Tragedy of the Commons."[10] Hardin uses the analogy of "a pasture open to all," that results in herdsmen seeking "to maximize his gain" by grazing as many animals as possible. Overgrazing results, producing the "tragedy" of unrestricted, unregulated access to property held in common. Hardin uses this analogy to explain environmental deterioration and predict future calamity if humans do not use restraint or "mutual coercion mutually agreed upon" to limit the use of natural resources. Louis Warren in *The Hunter's Game*, uses Hardin's concept to describe how control of the "local commons" and its natural resources were transferred from local to state and federal control.[11] This transfer had wide-ranging implications on local people and culture, especially in how they interacted with and perceived the natural world. Warren's conceptual framework is relevant since an aspect of this study is to reveal how local

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1992); Andrew Isenberg, *The Destruction of the Bison: An Environmental History, 1750-1920* (New York: Cambridge University Press, 2000).

[8] Donald Worster, *Dust Bowl: The Southern Plains in the 1930s* (Oxford: Oxford University Press, 1979).

[9] William Cronon, *Nature's Metropolis: Chicago and the Great West* (New York: W. W. Norton, 1991).

[10] Garret Hardin, "The Tragedy of the Commons," *Science* 162 (1968): 1243-1248.

[11] Louis Warren, *The Hunter's Game: Poachers and Conservationists in Twentieth-Century America* (New Haven: Yale University Press, 1997).

anglers adapted to the river, or "local commons" being increasingly controlled and managed by state and federal agencies.

Implementing Worster's third level requires using elements of social history to describe the "dialogue with nature" that people have with the river and how it has changed over time. Increasingly, environmental historians are seeking to integrate elements of social history into their narrative to provide a "bottom-up" perspective.[12] For example in *Shaping the Shoreline,* Connie Chiang states that, "scholars have cast nature as a social and cultural construction to explore how competing social groups evaluated and shaped both natural systems and human communities."[13] In this study I also focus on how sportfishers adapted to the change in the river, and how their use of the tailwaters has evolved over time.

[12] For example, see Karl Jacoby, *Crimes Against Nature: Squatters, Poachers, Thieves, and the Hidden History of American Conservation* (Berkeley: University of California Press, 2001); for a discussion of the need to combine social and environmental history, see Alan Taylor, "Unnatural Inequalities: Social and Environmental Histories," *Environmental History* 1, no. 4 (October 1996): 6-19.
[13] Connie Chiang, *Shaping the Shoreline: Environment, Society, and Culture in Monterey, California* (Ph.D. Dissertation, University of Washington, 2002), 9.

CHAPTER IV

FLOAT TRIPS, SMALLMOUTH BASS, AND CONTROLING THE RIVER: 1870-1943

Water power constitutes one of the great resources of the Ozarks.

Carl O. Sauer, *Geography of the Ozark Highland of Missouri*, 1920

To me there isn't anything in this life quite like a float.

Vance Randolph, *Ozark Outdoors*, 1935

The history of the White River is divided into two distinct periods; before dams and after. This temporal demarcation becomes particularly apparent when talking with elderly individuals whose lifetimes stretch across both eras. They often refer to a time "before the dams" when the White River flowed freely through a mostly undeveloped rural countryside. The popular pastime was experiencing the solitude of the river through long float trips; fishing, camping, and enjoying the scenery of the Ozarks. In contrast, time "after the dams" centers upon change brought upon the region by dams; lakes, retirement communities, tailwater trout, recreational tourism. Although the main focus of this study is to describe the tailwater trout fisheries created after dams, an historical perspective of the river before dams is essential in understanding later change.

Float Trips: Genesis of a Sport Fishing Tradition

The White River begins on the forested slopes of northwest Arkansas' Boston Mountains and ends 720 miles later when it joins the Mississippi River (Figure 2).

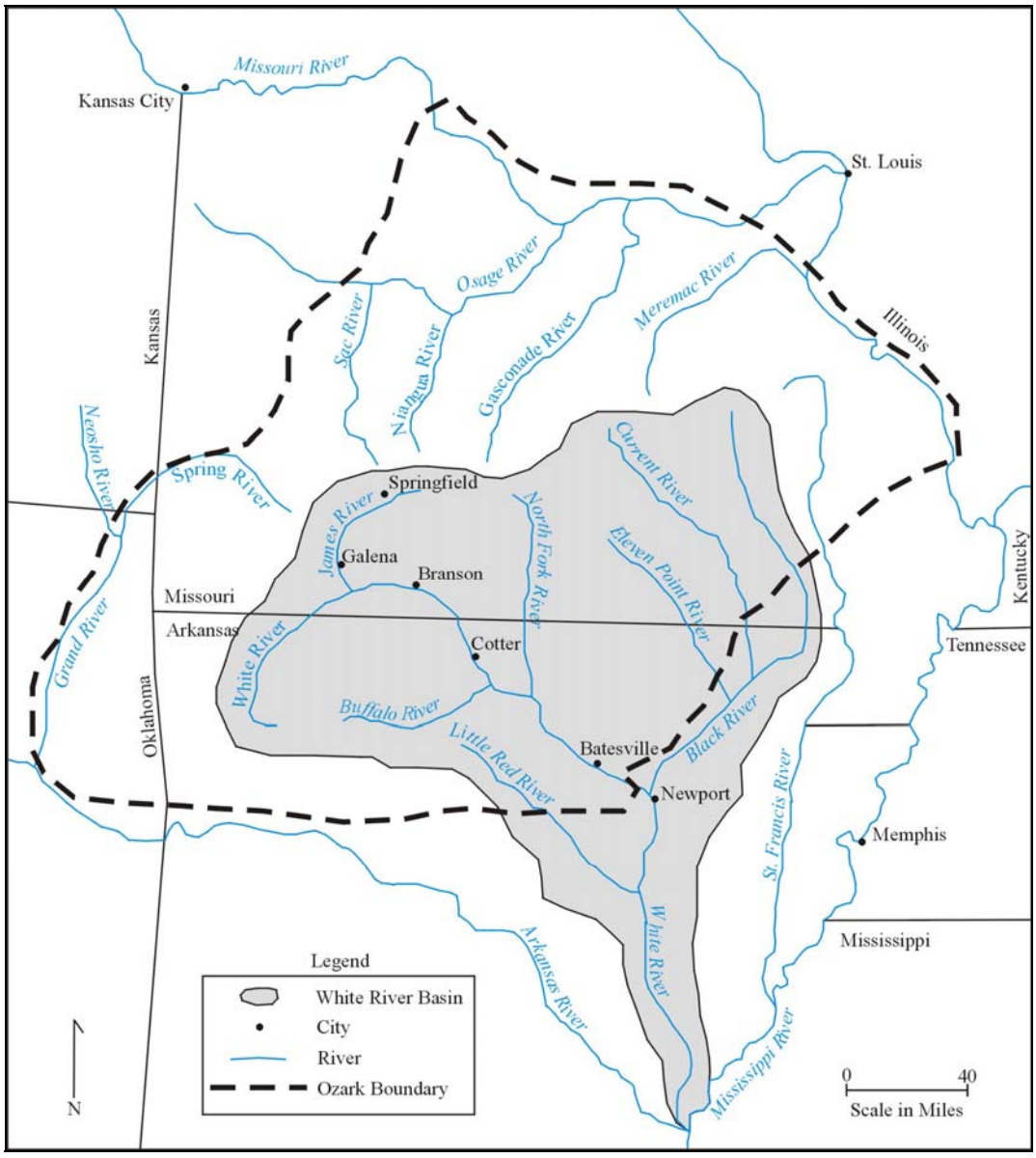

Figure 2. White River basin and Ozarks.

Similar to many other Ozark streams its headwaters reach alternates between fast flowing riffles running over rocky shoals and slower moving deeper pools. Initially running in a westerly direction it then turns northward, passing just east of Fayetteville, Arkansas. It then crosses the state line, flowing for 120 miles through southern Missouri before crossing back into Marion County, Arkansas. Continuing a meandering southeasterly course, it eventually tumbles out of the Ozarks and into the Mississippi Delta near the town of Newport, Arkansas. After traversing the delta it joins the Mississippi River about 70 miles south of Helena, Arkansas. Along with its numerous tributaries, its drainage basin encompasses over 27,000 square miles.

To fully understand and appreciate the White River one must recognize that it is really two rivers. The dividing line is the point where the river crosses the boundary between the Ozark Highlands and the Mississippi Delta. Here the river descends from the rocky Ozarks hills into the plain of the Mississippi Delta, changing from a highland "stream" to a slower moving, warmer, and more silt laden "river." This lower section slowly meanders across the delta, falling in elevation a mere 85 feet in 300 miles.[1] Eroding laterally into the rich alluvial soils its course is littered with oxbow lakes, hardwood wetlands, and sloughs.

In contrast, the 420 miles of the upper White River flows more rapidly through the Ozark Highlands, a region of rocky hills and deep valleys. This region is delineated by a bedrock dome of limestone, dolomite, chert, sandstone, and shale that was uplifted over 65 million years ago. Over time this dome has been slowly dissolved and eroded by

[1] Kenneth Shirley, “White River: A Case History," Arkansas Game and Fish Commission, Trout Program Office, Mountain Home, Arkansas (hereafter cited as AGFC-TPO), 2.

moving water, creating the rugged topography for which the region is known.[2] The White River is the largest of the Ozark streams, eroding and draining much of the southern portion of the region. Precipitation varies across the basin from 42 inches in the northwest to about 53 inches in the south. This upper reach drops about .4 feet per mile resulting in faster flows through a channel often widening to several hundred feet. Its streambed consists of gravel, rocks, and large boulders while its banks are lined by hardwood forests of oak, hickory, maple, and numerous sycamore trees that often lean precariously over the stream.[3]

Morphological and hydrological differences between the river's two sections result in starkly different fish assemblages. The lower section includes many “big river” species such as alligator gar (*Atractosteus rosae*), lake sturgeon (*Acipenser fulvescens*), buffalo (*Ictiobus niger*), and flathead catfish (*Pylodictis olivaris*). Prior to dams the seasonal flooding of the lower White River created productive floodplains producing prolific populations of these and other fish species. Fish were even sufficiently abundant to support a lucrative commercial fishery.[4] In contrast, the clear and cool waters found in the upper section of the White River supported a much different, although more diverse, assemblage of fish. Here the stream was dominated by smallmouth bass (*Micropterus dolomieu*), spotted black bass (*Micropterus punctaulatus*), largemouth black bass

[2] Milton Rafferty, *The Ozarks Land and Life*, 2nd ed. (Fayetteville: University of Arkansas Press, 2001), 7-23.
[3] White River Basin Coordinating Committee, "Comprehensive Basin Study: White River Basin Missouri and Arkansas, Main Report," (June 1968), 11-14.
[4] Bill Mathis, “The Rise and Decline of Commercial Fishing on the White River,” *Arkansas Game and Fish* 3, no. 1, (Spring 1970): 2-4.

(*Micropterus salmoides*), rock bass (*Amblplites rupestris*), green sunfish (*Lepomis cyanellus*), and numerous other species, including various darters and minnows.[5]

It would be the lower section of the White River that most nineteenth century settlers would initially experience. Since the White River was the only large river draining southward from the central Ozarks it became an important travel corridor. By the mid-1800s the White River Valley of the central Ozarks contained a string of homesteads and small settlements established by settlers entering the region mainly by traveling upstream from the Mississippi River.[6] During these early years of settlement the river's primary role was for transportation, although it was also utilized to supplement settler's diets with fresh fish. Although some undoubtedly enjoyed fishing, most were concerned more with efficiently catching large numbers of fish to eat or to sell. Fishing methods often reflected this desire, with nets and seines commonly used to catch large numbers of fish. Another popular method was gigging, where anglers would use long wooden poles with sharp points to impale fish in shallow water. Gigging was especially popular during the spawning season when fish congregated in large schools on the shoals. At night, johnboats were equipped with metal baskets full of wood that were lit on fire to illuminate fish for gigging. These "jacklights" were a popular method to secure fish both for personal consumption and sale.[7]

These and other utilitarian methods for catching fish were used in the Ozarks for many years, with some still being used today. Although these methods were undoubtedly

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[5] United States Department of the Interior, United States Fish & Wildlife Service, “A Report on the Effects on Fish and Wildlife Resources of the Bull Shoals Dam and Reservoir Project, White River, Arkansas and Missouri," Vicksburg District Office (January 1949), F-1.
[6] Edith McCall, "The White River, Highway to the Ozarks," *White River Valley Historical Quarterly* 1, no. 1 (Fall 1961): 4-8.
[7] Isaac Workman, "The Good Old Times," *White River Valley Historical Quarterly* 2, no. 7 (Spring 1966): 1-4.

viewed as enjoyable, fishing for "sport" in the modern sense did not become commonplace on the White River until the late 1800s. Its genesis coincided with a broader national interest in sport fishing and the construction of railroad lines into the region in the 1870s. Over the course of several decades railroads were extended from the larger bordering cities such as St. Louis and Kansas City into the central Ozarks.[8] This provided urban tourists relatively easy access into the region, whereupon they began exploring the region's natural wonders. Much of this initial attraction centered on the numerous hot springs and caves. It would be “Karst Tourism" and the popularity of hot springs that led to the establishment of the region's first resorts catering to urban vacationers.[9]

As these urban tourists traveled into the Ozarks, those who were anglers “undoubtedly” began fishing the region's streams.[10] Since there were few natural lakes, anglers began fishing the many streams running near railroad lines or towns. To fish more inaccessible areas required the use of boats. Urban anglers soon began bringing a variety of boats into the region, transporting them on rail cars to the railheads or towns. If anglers chose to float downstream from the railhead the scarcity of roads made it difficult to transport boats, camping gear, and other equipment back to the starting point. They adapted by hiring local residents with horse-drawn wagons to take them and their gear upstream to a "put-in" location, allowing them to float back towards the "take-out" point.[11] Since this required both teams of wagons and manpower, anglers began paying

[8] Rafferty, *The Ozarks Land and Life*, 195.
[9] Lynn Morrow and Linda Myers-Phinney, *Shepherd of the Hills Country: Tourism Transforms the Ozarks, 1880s-1930s* (Fayetteville: University of Arkansas Press, 1999), 120.
[10] Rafferty, *The Ozarks Land and Life*, 205.
[11] Morrow, *Shepherd of the Hills Country,* 116.

local residents for their services.[12] Of course, these locals had "always float-fished," but now they were being paid to not only transport gear but to guide anglers to the best fishing and camping locations.[13] Over time a commercial sport fishing business slowly emerged, with urban tourists paying local guides to take them on float fishing trips down the region's many clear streams.

Most of these early float trips were in the eastern Ozarks on streams such as the Current, Meremac, Black, and Gasconade Rivers. These were popular since they were the first accessible by railroad and were also popular with mining and lumbering companies that sometimes entertained customers with float trips.[14] Commercial float fishing then moved southwestward with the railroads into the central Ozarks, with the James and White Rivers becoming increasingly popular. In 1905 the White River Railway was completed, opening 375 miles of the White River to float fishing.[15]

By the early 1900s commercial float fishing was well-established along the White River and other larger Ozark streams. It was during these formative years that the upper White River became known as the "par excellence" of float fishing streams.[16] This was partly due to its central location, accessible to vacationers traveling from Kansas City, Springfield, St. Louis, and Joplin, Missouri. Float fishing, along with other tourist attractions, assisted in establishing Branson, Missouri as a popular and regionally important tourist destination. Branson's development was further boosted by the creation of Lake Taneycomo after the completion of Powersite Dam across the White River in

[12] Rafferty, *The Ozarks Land and Life*, 205.
[13] Milton Rafferty, *The Ozark Outdoors: A Guide for Fishermen, Hunters, and Tourists* (Norman: University of Oklahoma Press, 1985), 42.
[14] Rafferty, *The Ozarks Land and Life*, 204.
[15] Morrow, *Shepherd of the Hills*, 124.
[16] Rafferty, The Ozarks Land and Life, 204.

1913. One of the most popular float trips was a six day trip starting in Galena on the James River and ending at Lake Taneycomo, a distance of 125 miles.[17]

The ascendancy of the upper White River as the most popular float fishing stream in the Ozarks was also due to its size, excellent fishing, and scenic beauty. The stretch of stream from its confluence with the James River downstream to Cotter was perfect floating water. Water flows during the warmer months were sufficiently fast to carry johnboats downstream while still allowing fishing and leisurely sightseeing. The stream was generally deep enough to float heavily laden johnboats. It also contained an excellent mix of faster flowing runs and deeper pools creating a variety of habitat and variety for floaters. This type of habitat is also preferred by native smallmouth bass, with the White River considered one of the best bass streams in the country. The excellent fishing and floating was further enhanced by beautiful natural scenery interrupted only occasionally by scattered farmsteads. This combination of amenities made it attractive to urban tourists wishing to escape urban life and experience nature.

By the 1920s float fishing trips down the scenic White River were one of the region's "best-known institutions."[18] Since float trips required coordination and manpower to book clients, advertise, haul boats, guide anglers, set up camp, and cook meals, they led to the establishment of outfitting businesses. Local outfitters began hiring "dozens" of locals to work as float fishing guides. Although business was limited to the

[17] Harry Bruton, "Mecca of Float Fishermen: A Swan Song of the White River," *Missouri Conservationist* 9, no. 5 (May 1948), 1.
[18] Carl Sauer, *The Geography of the Ozark Highland of Missouri* (New York: Greenwood Press, 1920), 231.

warmer months, outfitters began attracting "considerable business" renting johnboats, camping gear, and supplying guides to lead vacationing anglers on float trips.[19]

Although both commercial and private float fishing developed along numerous streams around the country, the Ozark rendition, and especially that which evolved on the White River, was unique. A typical float trip began with a party of anglers and guides arriving at the predetermined put-in location. Initially the boats, gear, and anglers arrived by horse-drawn wagons, later replaced by automobiles or trucks. After loading the johnboats with necessary gear the party launched the johnboats into the stream and eased downriver towards the take-out point. Guides sat in the stern paddling and navigating the johnboats over shoals, around snags, and into the deeper pools. Clients, meanwhile, enjoyed the scenery or fished, casting lures and live bait, focusing their efforts mainly on smallmouth bass. Sometimes the guides would beach the johnboats on one of the many gravel bars to allow anglers to more thoroughly fish certain promising stretches of stream or allow them to explore wooded hillsides and rock bluffs. A commissary boat carrying cooking and camping gear often followed the main party. Shore lunches were eaten on streamside gravel bars and also served as excellent locations for overnight camps. At night guides sometimes entertained the group around driftwood campfires by telling jokes, sharing fishing stories, or relating local folklore.

The single most important and prominent piece of equipment in conducting float trips was the wooden johnboat. Although canoes were popular in other areas of the country, they were "almost unknown" on the White River since most preferred using johnboats.[20] The development and popularity of this uniquely Ozarkian watercraft is a

[19] Ibid., 231.
[20] Ibid., 230.

distinct and intriguing aspect of the region's material culture. Although the term johnboat was applied generically to describe various flat-bottomed boats with a variety of designs, the craft "spawned" for use on the White River's commercial float trips is unique. Although its exact origin is unknown, it is agreed that its creation was a process extending over many decades. Its final form followed a process of blending "local craft traditions" with boat designs introduced by urban sportsmen and outfitters who needed a watercraft capable of carrying clients and gear on overnight float trips.[21]

By about 1915 the Ozark johnboats design was "mature," being built in a similar and repeated fashion. Its design is exceedingly simple, yet functional for navigating both shallow and high water while carrying heavy loads. Square in design, the bottom consists of planks arranged lengthwise while its sides, bow, and stern are cut to fit. Although the bow and stern are turned up slightly the end product is essentially a floating rectangle with low sides. Although early versions were sometimes 30 feet long, later models were shortened to about 20 feet long and about four feet wide.[22] After being built it was placed into the river to swell or "set" the planks. Once placed into the river it often stayed for long periods, tied to trees, allowing it to rise and fall with changing water levels. Prior to boat trailers pulled by vehicles, johnboats were transported using railcars and wagons. Since it did not have seats, several johnboats could be stacked one upon another in the back of a wagon and transported to the launch site. Since passengers still needed a place to sit, folding director's chairs were placed inside the boat, providing comfortable seating that could be quickly removed. Although now constructed of

[21] Morrow, "What's in a Name, Like Johnboat," *White River Valley Historical Quarterly* 37, no. 3 (Winter 1998), 19.
[22] Ibid., 14.

fiberglass, modern day johnboats are still quite similar in design and are still stacked along the river (Figure 3).

By the 1940s commercial float trips were a common and integral part of life and tourism along the White River. Branson, Missouri was now recognized as the "float-fishing capital" of the Ozarks, supporting several outfitters and numerous guides.[23] One of the most well-known and largest outfitters was Jim Owens. His operation was capable of putting 35 johnboats on the White River in a single day, often taking clients on the 250 mile trip from Branson to Cotter, Arkansas. These trips could last as long as several weeks, with boats, gear, and anglers often loaded onto trailers and transported back to Branson.[24]

Figure 3. White River johnboats stacked along the Norfork tailwater.

[23] "Life Goes Fishing," *LIFE* (June 1941): 86-89.
[24] Jim Auckley, "The Boat Builder from White River," *Missouri Conservationist*, 57, no. 7 (July 1996).

Another well-known and commercially successful outfitter was Elmo Hurst. Born on a farm along the river in 1909 he started Hurst Fishing Service in 1931 to earn extra money during the Great Depression.[25] At that time he was the only outfitter operating between Forsythe, Missouri and Norfork, Arkansas.[26] Starting with only two guides, he slowly built his business during the 1930s. Business increased substantially in 1940 after guiding a client who had recently started making and marketing True Temper Fishing Rods. On the ensuing three-day float trip, Frank Vestal, a well-known Memphis outdoor writer chronicled the entire trip in an article for the *Memphis Commercial Appeal*. This story, describing the fantastic smallmouth bass fishing on the White River, was sent to major sporting goods stores around the country.[27] Although long important regionally, the White River was garnering national attention for its smallmouth bass fishing and scenic float trips.

When *LIFE* magazine decided to "Go Fishing" it sent its reporters to the Ozarks to take a float fishing trip with Jim Owens and several of his guides. Its June 1941 cover shows a young woman sitting in a johnboat dangling her hand in the water as she floats downstream. The accompanying article includes a montage of pictures showing anglers fishing, eating a shore lunch, setting up camp on a gravel bar, and generally enjoying life on the river.[28] Three years later *National Geographic* magazine included an entire section on "Floating down White River," in a feature article about the Ozark region.[29]

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[25] Armando Rios, "Award –winning Elmo Hurst Recalls His Life and Love of the Area's Waters," *Baxter Bulletin*, 12 August 2003.
[26] Elmo Hurst, personal biography given to author.
[27] *Baxter Bulletin-Senior Focus*, "Elmo Hurst: Master Farmer and Outfitter, and Beloved Neighbor," 9 August 1994.
[28] "Life Goes Fishing," 86-89.
[29] Frederick Simpich, "Land of a Million Smiles," *National Geographic* 83, no. 5 (May 1943): 589-623.

Float fishing was a significant part of the cultural landscape of the region, and along with hot springs, cave tours, and country music a popular tourist attraction.

Although an integral part of Ozark life, commercial float trips during this time were not economically lucrative. Float fishing was a seasonal activity restricted to the warmer months of the year and provided only supplemental or seasonal employment for guides and outfitters. Although undoubtedly an important source of personal income during a time when jobs were often scarce, its economic impact was primarily local. A 1940 USFWS survey revealed that outfitters along the 87.5 miles of the White River to be flooded by Bull Shoals Dam generated slightly over $61,000 per year through float fishing.[30]

Although not economically lucrative during this early period, the development of commercial float trips laid the "historic foundation" for later larger-scale angling tourism.[31] Float fishing on the free flowing White River established float fishing as an integral part of Ozark culture and tourism. It also created a commercial sport fishing infrastructure that would capitalize on the coming environmental changes brought by dams. Some of the region's outfitters and guides had the knowledge, equipment, and experiences to continue operating even after dams were built. Although float fishing would soon be dramatically changed, it would survive and flourish, albeit in a greatly modified form.

[30] Department of the Interior, "A Report on the Effects," (1949), 2-4.
[31] Morrow, "What's in a Name," 9.

Control the River

The same clear flowing water, forested valleys, and soaring bluffs enjoyed by float trippers on the White River also attracted engineers, hydrologists, and hydropower developers. To these individuals, the steep valley walls and reliable stream flows represented something altogether different. As johnboats carried parties of anglers downstream in search of smallmouth bass, surveying parties collected data on stream flows, bedrock stability, valley heights, width of valley floors, and projected lake storage capacities. This information would eventually lead to the construction of five dams that would end the era of warm-water float trips on the White River.

The events leading up to these surveys began at the U.S. Military Academy in West Point, New York in 1802 when the U.S. Army Corps of Engineers was formed. Initially created as a war academy and fort building agency, the Corps' role quickly expanded to include surveying and exploring the newly acquired Louisiana Purchase.[32] Realizing that rivers were the portals for entry into these western lands, Congress provided funding in 1820 for the Corps to survey the Mississippi and Ohio Rivers. It was during one of these early military reconnaissance and surveying expeditions that the Corps passed through the area that would later become Little Rock, Arkansas.[33]

The Corps' role in federal water development was further expanded with the passage of the first *Rivers and Harbors Bill* in 1824, giving the President power to assign projects to improve and maintain the nation's waterways for navigation. The federal government now had a vested interest in water resource development, with nearly every

[32] Todd Shallat, *Structures in the Stream: Water, Science, and the Rise of the U.S. Army Corps of Engineers* (Austin: University of Texas Press, 1994), 1.
[33] Mary Rathburn, *Castle on the Rock: The History of the Little Rock District U.S. Army Corps of Engineers* (Little Rock: U.S. Army Engineer District, Little Rock, 1990), 10.

preceding Congress passing a *Rivers and Harbors Act (RHA).* These consistently included two main parts; 1) Congressional authorization for the Corps to conduct surveys, and 2) preliminary examinations and authorization for construction of projects previously submitted by the Chief Engineer.[34] Thus began a symbiotic relationship between politicians and the Corps, with the former deciding the projects built based upon recommendations from the latter.

On the White River the initial activity of the Corps focused on improving navigation for steamboats. From the 1830s until the early 1900s steamboats were an important means of transporting people and goods.[35] To facilitate steamboat navigation the Corps dredged and deepened the channel while also completing additional surveys and constructing a variety of revetments, dikes, and levees. The most pressing concern on the river during the steamboat era were the numerous snags or fallen trees blocking the channel and making passage treacherous. Removing snags was of such importance that, along with dredging channels, it was the only activity the Corps was authorized to undertake in the *RHA's* of 1868, 1871, 1873, and 1874.[36]

It would not be until the 1899 *RHA* that Congress authorized the construction of the first dams on the White River. This legislation authorized a series of ten locks and dams from Guion to Batesville, Arkansas to improve navigation for steamboats and other vessels. Only three of these would be completed; Lock and Dam #1 in October 1903, Lock and Dam # 2 in 1905, and Lock and Dam # 3 in 1908.[37] Built as overflow

[34] Rathburn, *Castle on the Rock*, 13.
[35] For a detailed history of the steamboat era on the White River, see Duane Huddleston, Sammie Rose, and Pat Wood, *Steamboats and Ferries on the White River: A Heritage Revisited* (Fayetteville: University of Arkansas Press, 1998).
[36] Rathburn, *Castle on the Rock*, 19.
[37] Ibid., 41.

structures, boats could pass over them during high water while during periods of lower water vessels entered the nearby locks to allow for passage upstream. Although made obsolete rather quickly by railroad construction, the locks did operate until 1952 when they were finally sealed.

A year after Lock and Dam # 3 was completed the first major government survey pertaining to water power was undertaken. Sponsored by the Geological Commission of Arkansas, the surveying party worked for 91 days during 1909-10 to accurately locate the "principal water power sites" on the White, Buffalo, Little Red, and North Fork Rivers.[38] A series of detailed maps was produced pinpointing the optimum locations for dams in addition to the amount of electricity each could potentially produce. Although this survey did not lead directly to the construction of any dams, it did identify several locations where the Corps would later erect dams.

Although government agencies were actively surveying the hydropower potential of the Ozarks, the first project would be completed by a private company. In 1911 Empire Electric began building its Power Site Dam across the White River near Osage Beach, Missouri. Completed in 1913 at a cost of $2.2 million, the dam created 2,080 acre Lake Taneycomo. Although relatively small in size compared to later reservoirs, its impact upon the region would be significant.[39] In a region void of lakes, Lake Taneycomo soon became a major tourist attraction, with its Rockaway Beach resort rivaling the popularity of the well-known Shepherd of the Hills country.[40] Perhaps even

[38] W.N. Gladson, *Water Powers of Arkansas*, Geological Commission of Arkansas (University of Arkansas, 1911), 3
[39] Rafferty, *Ozark Outdoors*, 78.
[40] Morrow, *Shepherd of the Hills*, 164-168.

more important was the expansion of the symbiotic relationship between Ozark tourism and water recreation to include lakes in addition to streams.

Despite the obvious hydropower potential of the Ozarks it would be the destructive impact of flooding that would be the main impetus for additional and larger dams on the White River. Flooding was a common and destructive aspect of Ozark life that was exacerbated by the region's topography and geology. The region's steep hillsides covered by thin soils and underlying bedrock create short intense periods of runoff during heavy rains or snowmelts. Although these very same factors also result in water quickly draining, rapidly rising streams were a great concern. For example, heavy rainfall during the fall of 1914 caused Missouri's Merrimac and Gasconade Rivers to rise 20-30 feet overnight. The following summer heavy rains caused almost every "large river and creek" in the Ozarks to overflow its banks from "three to five times."[41] Although these floods were devastating to local residents, their impact often did not resonate outside the region.

This would change with the historic flood of 1927. Beginning in late winter and continuing into the spring, heavy rains fell throughout the Ohio and Mississippi River Valleys. By May standing water stretched from southeast Missouri to the Gulf of Mexico, transforming portions of eleven states into one immense body of water, driving at least 800,000 people from their homes.[42] Within the White River basin the flood reached its peak from 4-12 April following a deluge depositing an average of eleven inches of rain across the region.[43] The White River's water levels increased rapidly,

[41] Sauer, *The Geography of the Ozark Highland*, 51.
[42] Frederick Simpich, "The Great Mississippi Flood of 1927," *National Geographic* 52, no. 3, (September 1927).
[43] White River Basin Coordinating Committee, "Comprehensive Basin Study," 11.

eventually stretching from "bluff to bluff," until water was lapping at the steel trusses below the railroad bridge at Cotter.[44] To comprehend the magnitude of this flood I stood directly under this same bridge, marveling at the volume of water it would take to fill the valley. The 1927 flood is still the highest on record for the White River.

Galvanized by this destruction, the Corps reacted by submitting a report to Congress suggesting ways to prevent future floods. Congress responded by passing the Flood Control Act (FCA) of May 1928, placing increased emphasis on flood control through reservoir storage and appropriating the necessary funds for additional surveys. This legislation led to the publication in 1933 of the first major report by the Corps on the water resources of the White River basin. Referred to as the 308 report it examined navigation, water power, flood control, and irrigation potential within the basin. The report concluded that federal improvements to the White River basin for "navigation in combination" with flood control, irrigation, and water power was not "deemed advisable."[45]

Another destructive flood in 1937 on the upper Mississippi and Ohio Rivers once again led many to call for more federal involvement. Congress instructed the Corps Chief of Engineers to review previous reports while also requesting a comprehensive plan for flood control on both the Ohio and Mississippi River Valleys.[46] By the 1930s basin-wide comprehensive flood control in addition to hydropower production was quickly gaining popularity at the federal level. The Corps plan reflected this by recommending a system of six reservoirs, including Norfork, Greers Ferry, and Clearwater within the

[44] Elmo Hurst, personal biography given to author.
[45] White River Basin Coordinating Committee, "Comprehensive Basin Study," 7.
[46] Francis Shiras, "Norfork Dam," *Arkansas Historical Quarterly* 4, no. 1 (Spring 1945), 151.

White River basin.[47] This plan was authorized by Congress the following year with passage of the FCA of 1938. Although approving numerous projects it did not appropriate funds to complete all of them.[48]

Preliminary construction plans were soon underway at both the Clearwater and Norfork Dam sites. The Clearwater project called for a dam on the Black River in southeastern Missouri. Since the Black River is the largest tributary of the lower White River, a dam would decrease flooding in the agriculturally important delta area. Meanwhile, the chosen site for Norfork Dam was located 4.5 miles above the North Fork River's confluence with the White River. Although considerably smaller than the White River, it runs through a relatively narrow valley bordered on the southeast by a near vertical rock bluff, a perfect location for a dam. It was on this bluff that construction officially commenced on 21 May 1941 when the first explosive charges were ignited. Francis Shiras describes the rather festive scene:

> 10,000 people of the Arkansas and Missouri Ozarks met to celebrate the building of the dam - the fulfillment of their dream. Highlight of the day was the big blast set to blow the face off the bluff which was to be the left abutment of the dam. The bluff, which formerly wore a mantle of greens, had been shaved bald, and the blast sheared off its face, causing a flurry of rock and dirt to come tumbling down into the river. This was followed by “America," sung by the voices of 10,000 and accompanied by four bands.[49]

Although Norfork Dam was under construction, the onset of World War II seven months later made its completion tenuous. Civil works projects deemed unnecessary to the war effort were often halted to conserve both materials and manpower. For the Norfork project the FCA of 1941 would soon ease these concerns, calling for the modification of the Norfork project to include hydropower generation in combination

[47] “Resume Conference on Operation of White River Lakes,” 7 February 1973, AGFC-TPO.
[48] Rathburn, *Castle on the Rock*, 55.
[49] Shiras, “Norfork Dam," 155.

with flood control. Since electricity for manufacturing was vital to the war effort, the project was now considered a high priority, moving ahead of the Clearwater project which did not include hydropower. The FCA of 1941 also called for the construction of Bull Shoals and Table Rock Dams and for the installation of penstocks and other hydropower facilities at all future storage projects. Although neither "identified nor evaluated" it also mandated that these projects be developed for "other beneficial purposes."[50]

With Norfork Dam nearing completion and several other projects in the planning stages, the need arose for a federal agency to market the hydropower. Congress already had experience in such matters, having established the Bonneville Power Administration in 1937 to market the electricity produced by Bonneville and Grand Coulee Dams on the Columbia River.[51] Harold Ickes, Secretary of the Department of the Interior, responded by creating the SPA in September 1943 and headquartering it in Tulsa, Oklahoma.[52] Specific legislation defining how the SPA should market electricity and handle the associated revenue was included in the FCA of 1944. Section 5 states that electricity generated at reservoir projects was to be:

> ...delivered to the Secretary of the Interior, who shall transmit and dispose of such power and energy in such a manner as to encourage the most widespread use thereof at the lowest possible rates to consumers consistent with sound business principals…Rate schedules shall be drawn having regard to the recovery of the cost of producing and transmitting such electric energy, including the amortization of the capital investment allocated to power over a

[50] Department of the Army, United States Corps of Engineers, "White River Basin Reservoir, Missouri and Arkansas, Interim Stage II Report," (September 1979), 3-4.
[51] Bonneville Power Administration, "Who We Are?" available at http://www.bpa.gov/corporate/About_BPA/ (October 2004).
[52] Southwestern Power Administration, "50/50 Partnerships in Power," (Tulsa, 1993), 4.

> reasonable period of years…All moneys received from such sales shall be deposited in the Treasury of the United States as miscellaneous receipts.[53]

With this rather vague umbrella statute the SPA was given control over marketing and distributing electricity produced at Norfork Dam and future projects in the region. The SPA's mission statement reflects this by stating it will "take full advantage of all storage, all capacity, and all available transmission…as required by law."[54] Over the course of the next several decades the hydropower controlled and distributed by SPA would increase substantially as more dams were built and tied into an expanding electrical grid. Eventually this grid would cover a multi-state territory, utilizing hydropower from numerous dams and coal burning facilities.

Although most of the focus was on hydropower production, the FCA of 1944 called for the Corps to "construct, operate, and maintain" recreational facilities. Again, the wording of the legislation was vague, not specifically defining what recreation entailed. More importantly for future developments, no specific amount of water storage within the reservoirs was authorized for recreation. The Corps would use this provision to build an extensive system of parks and other facilities around the periphery of the lakes and also along the tailwaters.[55] Although this system of parks would prove especially important in the development of lake tourism, the lack of water storage for downstream recreation or fisheries would prove especially contentious.

The final legislative pieces needed for the Corps to complete its comprehensive plan for the White River basin followed within the next decade. The FCA of 1954 authorized the construction of Beaver reservoir for hydropower generation, flood control,

[53] Flood Control Act of 1944, Public Law 78-534, Section 5, 22 December 1944.
[54] "Resume Conference on Operation of White River Lakes," 7 February 1973, AGFC-TPO, 7.
[55] Department of the Army, "Interim Stage II Report," 23.

and other purposes. It also added hydropower generation to the Greers Ferry project. Municipal and industrial water storage for Beaver, Norfork, and Greers Ferry Lakes were outlined in the Water Supply Act of 1958, allowing cities and water supply districts to contract with the federal government for water.[56]

The future of the White River was now inextricably linked to multipurpose dam construction and the comprehensive management of the river basin. Since the White River was the largest river draining the southern Ozarks it was deemed crucial in controlling floods in the lower Mississippi River but also in producing hydropower for homes and businesses. Most local residents welcomed the construction of the dams since they would lead to economic development by providing electricity and in the process create jobs in a region noted for high poverty. In fact, as late as 1935 only about 1.2 percent of farms in Arkansas and 6.4 percent in Missouri had access to electricity.[57] The dams therefore represented economic opportunity and development. The combined benefits of electricity, recreationally attractive lakes, and prevention of destructive floods were enough incentive for most locals to welcome the building of dams. What most people and the numerous government reports, surveys, and legislation understandably overlooked was the economic influence the tailwaters would have on recreational tourism.

[56] Ibid., 5.
[57] Southwestern Power Administration, "50/50 Partnerships in Power," 6.

CHAPTER V

THE TROUT EXPERIMENT: 1944-1969

Right here in the area, we need at least a half dozen more dams like Bull Shoals and Norfork before we will begin to have the rivers harnessed for the welfare of the people.

President Harry Truman, dedication ceremony of Norfork and Bull Shoals Dams, July 1952

Trout fishing in Arkansas has emerged as a major fishing sport this spring after several years of experimentation, when most sportsmen considered it as a novelty that would soon pass from the scene.

Baxter Bulletin, April 1956

For most rural residents of the Arkansas Ozarks life in the early 1940s had changed little since the turn of the century. Roads and bridges were scarce, telephones and electricity were "luxuries" found mainly in town, and horse drawn wagons still outnumbered automobiles.[1] What these inhabitants could probably not foresee were the profound environmental, economic, and cultural changes that would impact their lives in the upcoming decades. Although the thirteen Arkansas Ozark counties would actually decline in population by one-third from 1940-60, the foundation for a "massive transformation" in population and economic development would also be laid during this

[1] Brooks Blevins, "In the Land of a Million Smiles: Twentieth-century America Discovers the Arkansas Ozarks," *Arkansas Historical Quarterly* 61, no. 1 (Spring 2002): 1-35.

same period.[2] One major impetus for this change would be five Corps dams and their resultant lakes, hydropower, and cold tailwaters.

Tailwater Trout

Norfork Lake, the first large Corps reservoir in the Ozarks, began filling with water on the 1st of February 1943. Over the next five months water draining nearly 2,000 square miles along the North Fork River would slowly fill the lake's conservation pool. After inundating thousands of hollows, ravines, and valleys carved over the years by moving water, a 22,000 acre body of still water stood glimmering in the Ozarks. In a region devoid of large lakes, a body of water this size, stretching forty miles north into Missouri and having 380 miles of shoreline was most assuredly an amazing sight for local residents.[3]

In June 1943 the first of Norfork Dam's two 35,000 kilowatt electrical generators went on-line, using water from deep within the lake. Hydropower production is maximized by locating the intake gate for the penstock near the base of the dam. Penstocks are actually large diameter steel tubes running through the base of the dam that carry water into the powerhouse to turn the turbine blades on the generator. These are located at the bottom of the reservoir to increase the amount of head; or the difference in elevation between the surface of the lake and the turbine blades on the generator. The deeper the intake gates below the surface of the lake the greater the head.[4] Like pulling the plug in a bathtub the penstock intake concentrates the weight of the lake's stored

[2] Brooks Blevins, "Retreating to the Hill: Population Replacement in the Arkansas Ozarks," *Agricultural History* 74, no. 2 (Spring 2000): 475-489.
[3] Shiras, “Norfork Dam,” 156-7.
[4] David Gillilan and Thomas Brown, *Instream Flow Protection: Seeking a Balance in Western Water Use* (Washington, D.C.: Island Press, 1997), 67.

water on a relatively small opening to produce the head necessary to efficiently generate electricity.

Locating the intake gates deep within the lake was especially significant for the 4.5 miles of the North Fork River from the dam to its confluence with the White River. This section of river was now a tailwater, reliant upon the dam for both the quantity and quality of its instream flow (Figure 4). Foremost was the decrease in water temperature

Figure 4. Norfork Dam and tailwater.

in the tailwater. Water releases would now be consistently cold due to the depth of the intake gate working in conjunction with seasonal thermal stratification within Norfork Lake. Although seasonal thermal stratification is a natural limnological process occurring in most mid-latitude lakes, it is especially influential to tailwaters receiving water from bottom-release dams.

Once full, Norfork Lake probably took several years to stabilize before beginning a consistent and predictable pattern of thermal stratification. Perhaps the best way to explain this process is to describe what occurs within the lake during a typical year. In January the lake is quite uniform in water temperature and density, with water mixing throughout the water column. Cold air temperatures and runoff during winter keeps the lake's water cold, with similarly cold downstream releases. Beginning in early spring increasing solar radiation warms the surface, slowly forming a layer of warmer water called the epilimnion. Since warm water is less dense it floats upon the underlying cooler water known as the hypolimnion. These two layers are divided by the metalimnion, or thermocline, a thin layer of water that tends to decrease in temperature rapidly with depth.[5] By early summer Norfork Lake becomes essentially “two story," with two distinct thermal layers divided by the thermocline (Figure 5).

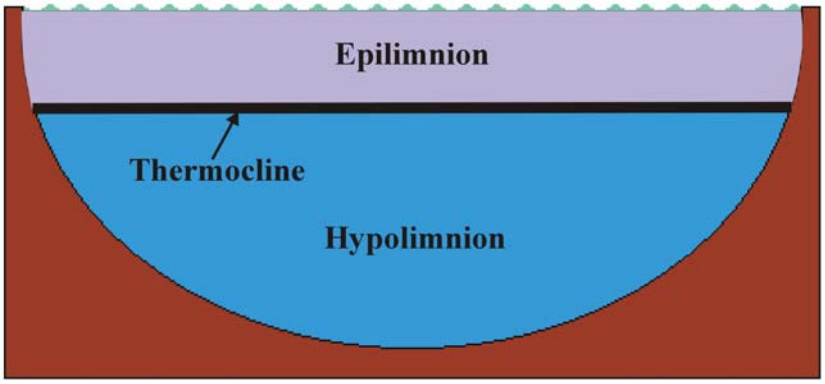

Figure 5. Summer thermal stratification in Norfork Lake.

As air temperatures increase through spring and summer the epilimnion continues to warm and deepen, eventually reaching its greatest depth sometime in late summer.

[5] Gerald Cole, *Textbook of Limnology*, 4th ed. (Prospect Heights: Waveland Press, Inc., 1994), 194.

Sunlight penetrating the epilimnion promotes the growth of aquatic plants in the littoral zone creating habitat for a variety of aquatic species. Away from shore sunlight promotes the growth of plankton in the open water or limnetic zone of the lake. The epilimnion receives abundant oxygen through photosynthesis, wave action, run-off, and direct contact with the atmosphere. A variety of nutrients are also carried into this layer during precipitation run-off. This combination of sunlight, nutrients, and oxygen creates a layer where most of Norfork Lake's biotic life is concentrated.[6]

In contrast, the hypolimnion during spring and summer stays consistently colder since it receives much less sunlight and is segregated from the epilimnion by the thermocline. During the warm months of the year there is only minimal mixing of water between the two layers. With little sunlight penetrating into the hypolimnion photosynthesis is minimal, creating a layer with less biomass. During this time oxygen is consumed in the hypolimnion through respiration and decomposition of organic matter that sinks downward from the epilimnion. In lakes with large volumes of water in the hypolimnion and small amounts of biomass in the epilimnion, depletion of oxygen is generally not a problem. If the situation is reversed oxygen may become depleted, with the hypolimnion even becoming anoxic.[7]

As air temperature decreases during fall the epilimnion begins to cool and sink into the hypolimnion with the entire lake eventually reaching a uniform temperature. At this point the lake "turns over" mixing water and distributing oxygen and nutrients throughout the water column. The timing of this turnover is quite predictable, occurring

[6] Ibid., 249.
[7] Ibid., 249.

within Norfork Lake each year between the last week of November and mid-December.[8] During the remaining winter months, water temperature remains uniform since long periods of ice cover is rare at this latitude. When spring arrives the process begins anew. The combination of thermal stratification and a bottom-release dam results in an annual temperature range consistently between 42-65°F. During the cold months the entire lake is cold, while in the summer the dam releases cold hypolimnetic water.

To determine how this and other changes to the environment were affecting fish and wildlife resources the USFWS and AGFC initiated a study three years after Norfork Dam was complete.[9] This belated study compared the projected value of the lake fishery to that previously supported by the inundated section of the North Fork River. Revealing a naivety to how economically important reservoirs would soon become, the USFWS concluded that the annual benefits provided by the un-dammed river were $40,000 greater than the gains provided by the lake. The accompanying ecological study determined that warm-water fish, except for suckers, had been practically eliminated from the tailwater.[10] Without the natural warming of the river during springtime to trigger spawning, native species slowly disappeared, creating a "biological vacuum" in the tailwater.[11]

Although fishery biologists were aware that Norfork Lake would stratify and release cold water they were unsure whether trout would survive. Therefore the USFWS and the AGFC began an investigation in 1948 to determine the "possibility" of

[8] Jim Spotts to Larry Rider, 28 October 1990, AGFC-TPO.
[9] Willis King and Edward Kinney, "Cooperation in the Solution of Water Quality Problems Associated with Flow Regulation" (paper presented at the symposium on Streamflow Regulation for Quality Control, Cincinnati, Ohio, April 1963), 27.
[10] Ibid., 28.
[11] Dick Broach, "The Why and How of Trout Fishing in Arkansas," March 1966, AGFC-TPO.

establishing a tailwater trout fishery.[12] They believed the "sole limiting factor" in creating a trout fishery was whether sufficiently low water temperatures could be sustained all year.[13] For example, rainbow trout require water temperature below 70°F with optimum temperature ranging between 50-66°F.[14] This investigation also undoubtedly included consultations with TVA officials since that agency had already created the region's first tailwater trout fishery below Norris Dam in 1936.[15] The AGFC would also seek advice in relation to the creation of the Bull Shoals tailwater trout fishery.

The investigation proved encouraging, with 600 rainbow trout fingerlings soon being transported to Arkansas from the Neosho National Fish Hatchery in Missouri. These fingerlings were "experimentally" released into the tailwater on 26 May 1948.[16] Readily adapting to the tailwater, these fingerlings soon showed "excellent survival and growth" rates.[17] Encouraged by this initial success additional rainbow trout and brown trout were stocked in 1949. The release of the first brown trout in Arkansas occurred despite objections from a TVA official who "strongly opposed" their release since anglers had "difficulty" catching them. He suggested limiting their release to more suitable "small, heavily fished" streams.[18] Despite, or maybe because of these warnings, brown trout continued to be released until 1957. During the first four years of the trout program over 19,000 rainbow and brown trout were released.

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[12] Robert Baker, "Historical Review of the Bull Shoals Dam and Norfork Dam Tailwater Trout Fishery," *Proceeding of the Southeastern Association of Game and Fish Commissions* (October 1959), 229.
[13] Ibid., 235.
[14] Richard Jones, Larry Aggus, et. al., "An Evaluation of the Effects of Increased Hydropower Generation on the Bull Shoals Lake and Lake Norfork Tailwaters," National Reservoir Research Program, United States Fish & Wildlife Service (1981), 27.
[15] Jacobs, *Tailwater Trout in the South*, 196.
[16] Baker, "Historical Review," 229.
[17] Ibid., 229.
[18] William Eschmeyer to Travis Roberts, 25 July 1949, AGFC-TPO.

Whether it was advertising by the AGFC, word of mouth, or the opportunity to catch exotic trout, anglers soon discovered the tailwaters. By the second year of the program anglers were reaping the benefits of the new fishery. Trout as large as eight pounds were being caught, revealing both phenomenal growth rates and excellent habitat and abundant food supply available in the tailwaters. Within several years the tailwater was known "throughout the area" for its trout fishing, attracting both resident and non-resident anglers.[19]

Two years after the initial stockings, the USFWS and AGFC conducted a survey to assess the progress of its nascent trout program. Norfork Dam's two generators (the second became operational in February 1950) were shut down to allow a sample of trout to be collected and analyzed. Although warm-water species such as sunfish were still present, their populations had declined significantly. Meanwhile rainbow trout were showing impressive growth rates, with some already twenty-six inches long and weighing eight pounds.[20]

As anglers were catching trout in the Norfork tailwater, construction on the much larger Bull Shoals Dam across the White River was completed in 1952. A massive structure towering 256 feet above the White River's streambed and stretching over 2,000 feet in width, it was at the time the fifth largest dam in the country (Figure 6). The 71,000 acre lake it impounded was equally impressive, backing-up water 87 miles to Powersite Dam in Missouri. Bull Shoals Lake and Lake Taneycomo were now

[19] Baker, "Historical Review," 229.
[20] Ibid., 229.

essentially one immense reservoir. A testament to its size, Bull Shoals Lake still ranks as the sixteenth largest man-made reservoir in the United States.[21]

The impact of this dam and lake on both the upstream and downstream sections of the White River was dramatic. The USFWS therefore initiated a study in 1947 to make recommendations for avoiding any unnecessary losses to fish and wildlife resources.

Figure 6. Bull Shoals Dam and tailwater.

It concluded that 87.5 miles of the main stem White River and 58.8 miles of tributary streams would incur "substantial loss" of both fish and wildlife resources.[22] Most of this loss was obvious since the study included the portion of the river inundated by the lake.

[21] United States Society on Dams, "Dams, Hydropower and Reservoir Statistics," available at http://www2.privatei.com/~uscold/ (January 2004).
[22] Department of the Interior, United States Fish and Wildlife Service, "A Report on the Effects on Fish and Wildlife Resources of the Bull Shoals Dam and Reservoir Project, White River, Arkansas and Missouri," Vicksburg District Office (June 1951), 2.

A definitive assessment of the impact on the downstream section of the river proved to be more elusive. There was agreement that cold hypolimnetic water would "eliminate" the warm-water fishery to the confluence of the Bull Shoals and Norfork tailwaters 42.2 miles downstream. Beyond that point biologists were less confident, stating the cold water would probably result in a "partial loss" of the fishery for another 35.4 miles to the mouth of Sylamore Creek. It also cautiously concluded that the tailwater would "probably" provide habitat for trout from the dam to Sylamore Creek.[23]

To more accurately assess whether the tailwaters would support trout and for what distance downstream, a series of tailwater monitoring stations was established. Biologists began collecting chemical and water temperature data from these stations in June 1951. The seven stations were strategically placed; 1) immediately below Bull Shoals dam, 2) at Cotter, 17.7 miles below Bull Shoals Dam, 3) at Shipps Ferry, 37.3 miles below Bull Shoals Dam, 4) immediately below Norfork Dam, 5) at Norfork, 4.5 miles downstream from Norfork Dam, 6) at Calico Rock, 69.5 miles below Bull Shoals Dam, and 7) at Sylamore, 86.5 miles below Bull Shoals Dam. Soon after these stations were in place the conservation pool at Bull Shoals Lake began filling.[24]

Although Bull Shoals Dam was designed to include eight generators, only four were installed by September 1952 when hydropower generation commenced. Water from the lake began flowing into the four penstock intake gates located 119' below the surface of the conservation pool and well below the thermocline. After flowing through the four 18-foot diameter penstocks and through the powerhouse, this water was released downstream. With all four generators on-line as much as 11,000 cubic feet per second

[23] Ibid., 6.
[24] Baker, "Historical Review," 230.

(c.f.s.) of cold hypolimnetic water rushed downstream. The seven monitoring stations chronicled the ensuing thermal change. From July 1951 to January 1952 the average temperature immediately below Bull Shoals Dam was 67.5°F, while at Cotter it was 67.9°F. Four years later the average temperature below the dam was 54°F, while at Cotter it declined to 56.5°F.[25]

With temperature data indicating sufficiently cold water to support trout and the success of the Norfork fishery, the AGFC did an "experimental stocking" of trout into the Bull Shoals tailwater in the fall of 1952. The release included 1,800 brown trout and over 16,000 rainbow trout averaging six-to-eight-inches in length. These were released into the upper section of the tailwater from the dam downstream 17 miles to Cotter. Since water temperature in the tailwaters slowly increases downstream, this section was most conducive to trout. Once again, the tailwaters provided excellent habitat, with these fingerlings providing angling opportunities by the following fall. Stocking increased in 1953 to over 17,000 brown trout and over 15,000 rainbow trout.[26]

By the mid-1950s the trout "experiment" had proven to be a resounding success. Local as well as many non-resident anglers from surrounding states increasingly came to the tailwaters to catch trout. In April 1956, more than 1,500 anglers turned out for opening day of the trout season, prompting the director of the AGFC to proclaim that Arkansas trout fishing could no longer be considered a "flash in the pan" sport.[27] This was good news for the AGFC, since it meant more fishing licenses and increased revenue to continue and expand its trout stocking program. Local newspapers assisted in promoting the tailwaters, deeming them a "tremendous success" since they were

[25] Ibid., 231-232.
[26] Ibid., 233.
[27] T.A. McAmis, quoted in, "Arkansas Outdoors," *Baxter Bulletin*, 26 April 1956.

providing both a unique fishing opportunity and attracting more people who spent money at local businesses.[28] By the end of the 1950s some were proclaiming the tailwaters as the "best trout streams in the country."[29]

One of the main attractions driving the success of the fishery were the numerous trophy trout coming from the tailwaters. Although the AGFC was aware that trout seemed to grow exceptionally fast, they did not have any hard data verifying actual growth rates. In 1955 the AGFC began a trout tagging survey to collect such data. Over a period of four years biologists captured and fitted nearly 8,000 trout with tags to assess survival rates, growth rates, and migration patterns. The study showed exceptional growth rates of .90 inches per month for rainbow trout and only slightly less for brown trout. Even during the cold winter months when growth typically slows, the trout were still growing at rates of .45 inches per month. One particular nine inch trout showed a "remarkable increase" by growing to a length of 17 inches in only four months.[30]

Arkansas' biologists had discovered what would become a hallmark of many tailwater trout fisheries; exceptionally high growth rates. Although growth rates are dependent upon numerous factors, several are especially ubiquitous in Arkansas tailwaters. Foremost is the "winter warm and summer cool" conditions produced by the fairly consistent year-round water temperatures.[31] Since the tailwaters are warmer in winter and cooler in summer than naturally flowing streams, they facilitate the year-round growth of aquatic plants, insects, and therefore trout. Trout also continue to feed and grow during the winter months, in contrast to natural streams where growth slows.

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[28] "Arkansas Outdoors," *Baxter Bulletin*, 26 April 1956.
[29] Baker, "Historical Review," 234.
[30] Joe Hogan to Regional Director of the United States Fish & Wildlife Service, 1 September 1954, AGFC-TPO.
[31] Engle, *Fly Fishing the Tailwaters*, 19.

The clarity of the water expelled from bottom-release dams also assists in promoting abundant forage, similar in many ways to natural spring creeks.[32] Water clarity allows light to easily penetrate to the bottom of the stream, stimulating growth of benthic vegetation through photosynthesis and creating habitat for numerous types of insects and crustaceans. This was further assisted at the Bull Shoals tailwater in 1952-53 when vegetation from local spring-fed streams was introduced.[33]

Another factor assisting growth rates is the proliferation of some types of benthic macroinvertebrates. Since Arkansas tailwaters are similar in many ways to spring creeks they tend to support fewer aquatic species.[34] Fortunately, those that do survive tend to reproduce in prolific numbers, especially certain benthic macroinvertebrates.[35] Two that thrive in large numbers in Arkansas tailwaters, and are especially important to a trout's diet, are amphipods and isopods. Amphipods are shrimp-like crustaceans commonly known as scuds, while isopods look similar to a terrestrial roly-poly and are called sowbugs. Both prefer oxygen-rich waters flowing over limestone streambeds rich in aquatic vegetation, habitat needs met particularly well in Arkansas' tailwaters.[36] Trout, meanwhile, gorge upon these protein rich crustaceans. Not surprisingly, fly-fishers mimic these two species with a variety of artificial flies. The Southern Council of the Federation of Fly-Fishers (SCFF) appropriately calls its annual conclave in Mountain Home, Arkansas the "Sowbug."

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[32] Ibid., 18.
[33] Jones et. al., "An Evaluation of the Effects," 1.
[34] James Brown, Charles Liston, and Ronald Denne, "Some Physico-Chemical and Biological Aspects of Three Cold Tailwaters in Northern Arkansas, *Proceedings of the Southeastern Association of Game and Fish Commissions* (1967), 375.
[35] Robert Blanz et. al., "Benthic Macroinvertebrates in Cold Tailwaters and Natural Streams in the State of Arkansas, *Proceedings of the Southeastern Association of Game and Fish Commissions* (1969): 281-291.
[36] Dave Whitlock, *Guide to Aquatic Trout Foods* (New York: Nick Lyons Books, 1982), 166-173.

Another factor contributing to the high trout growth rates in Arkansas tailwaters was the introduction of threadfin shad (*Dorosoma petenense*) into the White River lakes. Native to rivers in the southeastern United States including the Arkansas River, shad were introduced into the reservoirs to provide food for warm-water fish such as largemouth bass and striped bass (*Morone saxatilis*).[37] Shad make particularly good forage fish since they grow to only four or five inches in length and live in large schools near the surface of the lake. Their main weakness is their susceptibility to cold water, resulting in large die-offs when water temperatures fall below 45°F.[38] Although a negative trait for the lake fishery, it is a positive for the tailwater fishery since these dead and dying shad sink into the hypolimnion and are sucked through the penstocks and downstream into the tailwater. This annual "shad hatch" provides an additional and important high protein food source for trout during the winter months, especially in the Bull Shoals tailwater.

Despite the impressive growth rates, increasing angling, and trophy trout the tailwater fisheries were still a "man-made situation" requiring regular stocking for their continuance.[39] Although the AGFC was undoubtedly pleased with the popularity of the fishery, they also realized they needed more trout to keep pace with demand. Through a "contract" with the USFWS the AGFC "obtained" trout from the national fish hatchery in Neosho, Missouri.[40] Although the number of trout stocked had steadily increased to over 189,000 brown and rainbow trout by 1957, the logistics involved with transporting trout about 190 miles one-way made this a difficult and costly operation. This resulted in only

[37] Broach, "The Why and How," March 1966, AGFC-TPO.
[38] William Pflieger, *The Fishes of Missouri* (Jefferson City: Missouri Department of Conservation, 1975), 80.
[39] Bill Keith, "Tailwater Trout Fishing," March 1966, AGFC-TPO.
[40] Baker, "Historical Review," 233.

about 17 miles of the Bull Shoals tailwater receiving trout, despite suitable habitat extending about 60 miles downstream.[41] To fully utilize the tailwaters the AGFC needed more trout.

The answer was to build a federal fish hatchery near the tailwaters. Never authorized in any of the project plans, the USFWS had recommended a hatchery be built as "mitigation" for the loss of the warm-water fisheries.[42] The term "mitigation" at this time did not mean the same as the modern post National Environmental Policy Act concept of the word. This meant that funding for trout hatcheries to replace the loss of the warm-water fishery was not included in any of the Corps White River projects.[43] Local residents responded by raising money to send a delegation to Washington D.C. to lobby for the construction of a federal hatchery. State Representative Hugh Hackler, a member of the Game and Fish Commission and Tom Tinnon, director of the Arkansas Wildlife Federation lead the delegation, appearing before congressional committees in March 1955. Soon thereafter Arkansas Congressman Jim Trimble and influential Senator J.W. Fulbright introduced a Department of Interior appropriations bill allocating $455,000 for the construction of a federal hatchery. President Eisenhower signed the bill on 4 August 1955.[44]

On 19 October 1957 at 9:30 a.m. the Mountain Home High School band kicked off the dedication program for Norfork National Fish Hatchery (NNFH) with a rendition of the Star Spangled Banner.[45] This festive atmosphere reflected the importance of the

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[41] Jones et. al., "An Evaluation of the Effects," 11-12.
[42] Department of the Interior, "A Report on the Effects on Fish," 37.
[43] United States Army Corps of Engineers, "White River Minimum Flows Reallocation Study Report," (July 2004), 6.
[44] Jim Spotts, "White River Minimum Flow Study: Overview, Status and Recommendations," 6 June 1991, AGFC-TPO.
[45] Norfork National Fish Hatchery dedication program, 19 October 1957, AGFC-TPO.

hatchery to the assembled crowd. For anglers it meant a continuous supply of catchable trout, and hopefully more and larger holdover trout. The USFWS meanwhile had another hatchery to manage, expanding its influence and funding base. The AGFC could now stock more trout, satisfying and attracting more anglers to purchase fishing licenses and increase agency revenue. Most importantly, the local economy would benefit since outfitters, guides, resorts, bait shops, and various other local businesses would benefit from the steady supply of federal trout (Figure 7).

Figure 7. Trout raceways at Norfork National Fish Hatchery.

Once the NNFH began production the number of trout stocked into the tailwaters increased substantially. For example, in 1957 only 157,000 were stocked, while a year later it increased to 353,000. These trout were actually grown using the same water as that flowing in the tailwater. Cold hypolimnetic water from the bottom of Norfork Lake

is pumped into the hatcheries inside incubation troughs and outside raceways. Trout eggs are hatched inside and grown to fingerling size before being transferred to the outside concrete raceways. Once these trout reach nine to ten inches they are ready to be stocked by the AGFC and caught by anglers. Stocking was now quite easy since the NNFH is located about one-quarter mile from the Norfork tailwater and a relatively short distance to any point on the Bull Shoals tailwater. By 1962 the hatchery was annually producing over 1.6 million rainbow trout.[46]

These millions of trout would soon be in even greater demand. In December 1963 the final four generators at Bull Shoals Dam were installed and operating. Water releases during maximum hydropower generation more than doubled from 11,000 c.f.s. to 22,500 c.f.s. This dramatic increase in water release created a much wider and faster flowing tailwater. It also pushed cold water further downstream, increasing the length of suitable trout water from about 60 miles to 92 miles.[47] With more tailwater to stock the NNFH was expanded in 1963-64 to increase production and grow more catchable ten inch trout. Hatchery capacity was now 250,000 pounds per year, a significant increase from the original design capacity of 80,000 pounds.[48]

As the trout program expanded on the Bull Shoals and Norfork tailwaters, construction on Table Rock Dam in Missouri concluded in 1958. Built on the White River 22 miles upstream from Powersite Dam, it impounded 43,000 acre Table Rock Lake. When this dam's four hydropower generators went on-line the cold-water releases created a unique fishery by transforming Lake Taneycomo into a cold water lake. As "mitigation" the Shepherd of the Hills Hatchery was built near the base of the dam, and is

[46] King, "Cooperation in the Solution," 27.
[47] Jones et. al., “An Evaluation of the Effects,” 3.
[48] Ibid., 12.

operated by the Missouri Department of Conservation (MDC). The MDC released the first 700 rainbow trout into Lake Taneycomo in 1958.[49] Although located in Missouri, Table Rock Dam impacts Arkansas' tailwaters since its lake level and water releases influences the water levels in Bull Shoals Lake and consequently the amount of water available for the Bull Shoals tailwater.

As trout were being released into Lake Taneycomo, construction on Greers Ferry Dam on the Little Red River was already in progress. The chosen site was 80 miles upstream from the river's confluence with the White River, in the extreme southern portion of the Ozarks. Considerably smaller than the White River, its course extends only 173 miles and drains about 1,792 square miles.[50] The Little Red River was also a popular smallmouth bass stream, causing many local anglers to object to the construction of a bottom-release dam. The USFWS was concerned as well, recommending in 1957 that the Corps outfit the dam with multi-level hydropower intakes that would take water from both above and below the thermocline. This would keep water temperature in the tailwater warm enough to protect the native warm-water fishery. The Corps then requested a study to justify the design alterations and the $600,000 needed to install multi-level intakes. Funding for this study was not requested for two years due to a "mix up" in communication.[51] During the delay, construction continued using the original designs, and by the time the USFWS study was complete, construction was so advanced that the inclusion of multi-level intakes would have added millions of dollars to the project. The multi-level intakes were never installed.

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[49] Mike Kruse, "Management of Lake Taneycomo, Missouri," Missouri Department of Conservation, Sport Fish Restoration Project F-1-R-45, Study I-35, 25 July 1996.
[50] United States Army Corps of Engineers, "White River and Tributaries, Arkansas, Reconnaissance Study," (September 1989), 2.
[51] King, "Cooperation in the Solution," 29-30.

On 3 October 1963 a large crowd gathered near Greers Ferry Dam to celebrate its completion, and to hear President Kennedy publicly dedicate the dam. Soon thereafter the dam's two hydropower generators went on-line releasing cold hypolimnetic water downstream into the Little Red River (Figure 8). This cold water soon destroyed the

Figure 8. Greers Ferry Dam and tailwater. The dam's powerhouse is visible at the far left.

warm-water fishery for approximately 29 miles downstream. As "mitigation" the Greers Ferry National Fish Hatchery (GFNFH) was authorized and completed by 1965. Located alongside the tailwater a short distance downstream from the dam, it uses water piped to the hatchery from 100 feet below the surface of Greers Ferry Lake.[52] The first rainbow trout were released into the Greers Ferry tailwater in 1966. The Arkansas trout program now included about 125 miles of fishable tailwater.

[52] Department of the Interior, United States Fish & Wildlife Service, "Greers Ferry National Fish Hatchery," informational brochure (August 1998).

The same year the first trout were released into the Greers Ferry tailwater construction on Beaver Dam on the White River was complete. Located approximately six miles west of the resort town of Eureka Springs it would be the final dam built on the White River. Its two hydropower generators went on-line in 1965 releasing cold hypolimnetic water stored within 28,000 acre Beaver Lake. The penstock intakes at Beaver Dam were installed at an even greater depth than either Bull Shoals or Norfork Dams, resulting in even lower average water temperature in the tailwater.[53] Although its water release volumes are similar to Greers Ferry Dam, its tailwater is significantly shorter at only eight miles since it merges with Table Rock Lake near its terminus. From Beaver Lake to Bull Shoals Dam the upper White River was now essentially one immense reservoir connected by short stretches of cold tailwaters (Figure 9).

The AGFC stocked the first rainbow trout into the Beaver tailwater in 1966. Although a pipe was installed through the dam to supply water to a hatchery, no action was taken to build such a facility.[54] Therefore trout had to be transported from the NNFH. With the addition of the Beaver tailwater the White River Basin now had five tailwater trout fisheries covering a total stream distance of 156 miles, while Arkansas' four tailwaters stretched for 133 miles. An increasingly complex and expansive system in relation to hydropower and flood control, the AGFC was responsible for managing the expanding tailwater trout fishery. This included when, where, and in what amounts trout would be released and the type of fishing regulations enforced.[55]

[53] Brown, "Some Physico-Chemical." 372.
[54] Minutes, Minimum Flow Meeting, 30 June 1988, AGFC-TPO.
[55] Mark Hudy, "Natural State Trout," *Arkansas Game and Fish* 17, no. 2 (March/April 1986), 9.

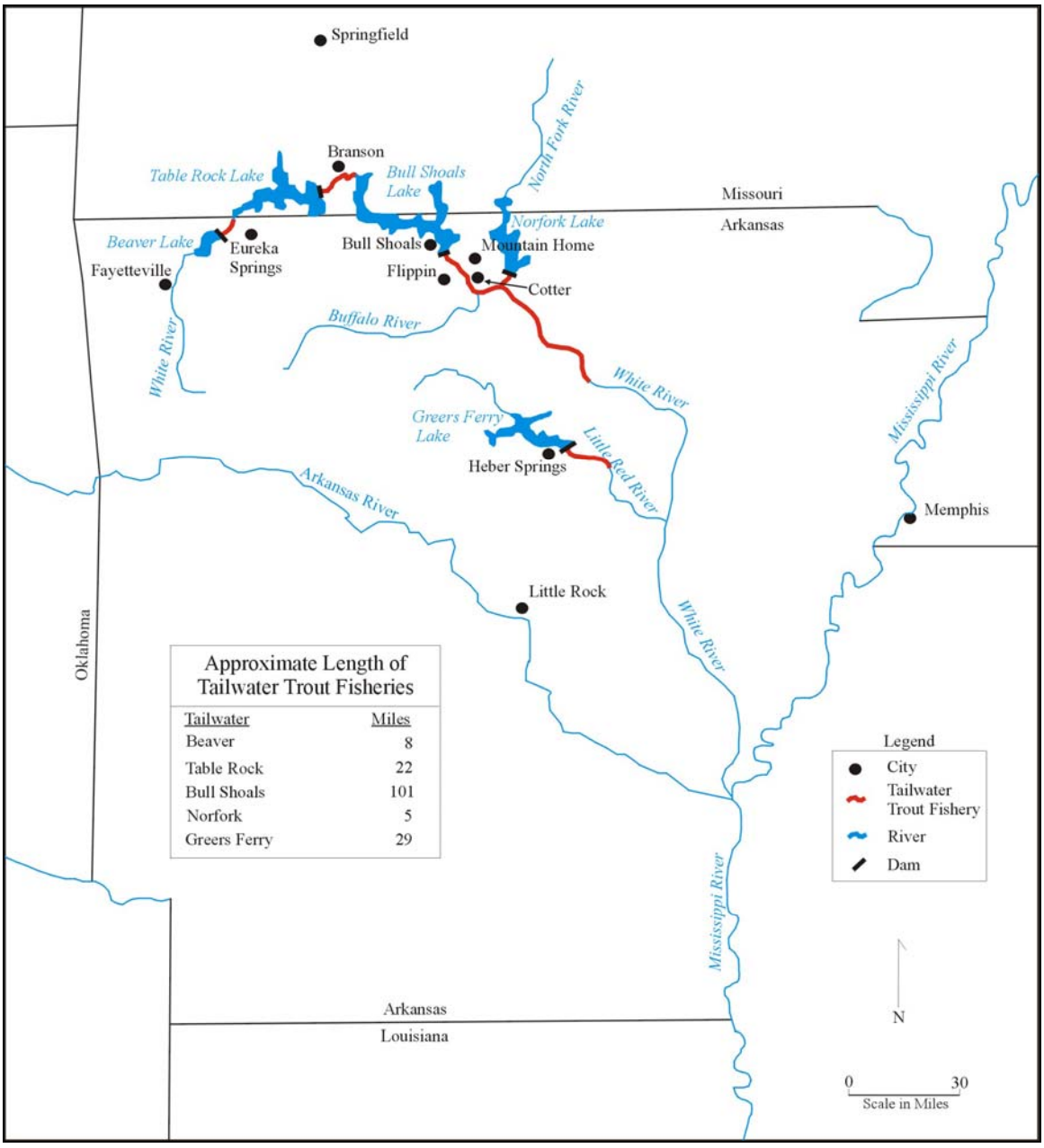

Figure 9. White River basin tailwater trout fisheries.

In striving to protect the "public interest" the agency's management strategy evolved as the fishery expanded in size and increased in popularity.[56] Although the management policy was often described as put-and-take in the early years of the trout

[56] Broach, "The Why and How," March 1966, AGFC-TPO.

program, it was actually put-grow-and-take. Stocking initially involved releasing fingerlings that were less than six inches in length, too small to provide sport for anglers. These were expected to survive at least one year to attain enough weight and length to offer both a sporting fight and sufficient meat to satisfy anglers. During the early years when fishing pressure was relatively low and anglers were still learning how to fish tailwaters, these fingerlings often did survive and grow for several years. These holdover trout were the key to the fishery since they provided sport for anglers.

As anglers became more adept at catching holdover trout, a rather brief period ensued from the late 1950s to the mid-1960s that is referred to as the "glory years" of rainbow trout fishing. Light fishing pressure and millions of stocked trout resulted in numerous trout surviving and growing for years after release. The fishing was fabulous, with anglers often catching and keeping limits of large rainbow trout and an occasional trophy brown trout. These trophy trout were mainly responsible for the labeling of the tailwaters as some of the "best trout streams" in the country.[57] This notoriety also led to a rapid decline in rainbow trout fishing. Increasing numbers of anglers came to Arkansas during the 1950s to fish both the lakes and tailwaters, making it the fifth most visited state in the country by non-resident anglers.[58] This continued into the 1960s, especially in the number of anglers using the tailwaters. For example, on the Bull Shoals tailwater the number of fishing trips increased from over 40,000 in 1959 to 250,000 by 1971.[59] More anglers meant more pressure on the fishery and fewer holdover trout surviving and

[57] Baker, "Historical Review," 234.
[58] "Arkansas Outdoors," *Baxter Bulletin*, 55, no. 24, 26 April 1956.
[59] Jones et. al., "An Evaluation of the Effects," 14 -15.

growing to larger sizes. Adding additional pressure were the liberal creel limits allowing anglers to keep from eight to ten trout each day.[60]

As fishing pressure increased and fewer large trout were caught, anglers, guides, and outfitters demanded more trout to keep fishing productive. Although the two federal hatcheries were producing millions of trout, it was still proving difficult to keep pace with demand. The AGFC tried to alleviate some of the pressure on the Bull Shoals tailwater by stocking trout in relation to fishing pressure. The tailwater was divided into three zones, 1) from Bull Shoals Dam to Buffalo City, 2) from Buffalo City to Calico Rock, and 3) from Calico Rock to Lock & Dam #3. The number of trout stocked was highest in zone one and least in zone three since most of the fishing pressure was concentrated in the upper section of the tailwater. For example, in 1969 the upper zone received over 300,000 trout, while zone two and three received only 172,000 and 164,000 respectively.[61]

Despite these attempts anglers were increasingly efficient in quickly removing trout. Since fingerling trout were caught before they could grow the management objective became to stock more catchable size nine to ten inch trout. These were stocked in relation to seasonal fishing pressure, with higher numbers released during spring and summer and fewer during the low fishing pressure winter months. The management of the fishery slowly moved toward a strictly put-and-take system, with the overall objective of maximizing the "harvest" of trout.[62] The fishery was viewed increasingly in economic terms, with supply trying to keep pace with demand. AGFC biologist Robert Baker's 1967 paper "Profits from the Rivers" reflects both the growing economic importance of

[60] John Stark et. al. "Arkansas Trout Management Plan, Draft," 13 April 2000, AGFC-TPO.
[61] Jones et. al., "An Evaluation of the Effects," 64.
[62] Keith, "Tailwater Trout Fishing." March 1966, AGFC-TPO.

the tailwaters and the management objective of the agency. Although he estimated that the Bull Shoals and Norfork tailwaters generated $5 million annually, they had not been "exploited" to their "fullest" economic potential.[63]

This economic mindset is also reflected in the agency's views concerning stricter angling regulations. Some anglers wanted the AGFC to impose size limits requiring smaller trout be released. It was also suggested that trout fishing be closed for a certain time period each year to allow trout to grow unmolested. These suggestions were viewed as a "step in the wrong direction" since they would conflict with the AGFC objective to maximize harvest, an approach that was "finally paying dividends." It was also believed that allowing trout to survive and grow to larger sizes would actually suppress growth rates by decreasing the total amount of available forage.[64]

It must also be understood that this transition to put-and-take management developed during a time when natural reproduction was underestimated and misunderstood. Successful spawning of both brown and rainbow trout was documented during the 1950s, especially in spring-fed tributary streams. For example, Cotter Spring Branch on the Bull Shoals tailwater became a popular tourist attraction since visitors could observe spawning brown trout during the fall. It was even closed to fishing to protect the spawning trout. Natural reproduction was also known to take place in both the Bull Shoals and Norfork tailwaters. The AGFC reported that brown trout ascended these tailwaters during fall and built redds (a circular shaped nest trout make in streambed gravel to lay eggs) in the shallow riffles near the dams.[65] Although "interesting," this

[63] Robert Baker, "Profits from the Rivers," (paper presented at the 8th Annual Fontana Conservation Roudup, Fontana Village, North Carolina, May 17-19 1967).
[64] Keith, "Tailwater Trout Fishing," March 1966, AGFC-TPO.
[65] Baker, "Historical Survey," 233.

spawning activity was considered “insignificant” in relation to sustaining and managing the fishery.[66] It would be natural reproduction that would greatly change the way the fisheries would be managed in the coming decades.

Fishing for Tailwater Trout

The introduction of trout into Arkansas came at a particularly good time in the history of sport fishing in the United States. Following World War II there was a renewed interest in not only angling but outdoor recreation in general. With a burgeoning national economy, increasing leisure time, and improved automobiles and highways, vacationing anglers sought out new waters to fish. Some of the most popular destinations were the numerous federal reservoirs impounded by dams. During the 1940s through the 1960s hundreds of dams were built, creating new fishing opportunities in regions that had been previously devoid of large lakes. Campgrounds, picnic areas, boat ramps, and private businesses soon ringed these reservoirs, attracting and serving millions of vacationing families, boaters, and anglers.

Norfork and Bull Shoals Lakes are two prime examples of the impact of reservoir construction on recreational tourism and development. With the completion of Bull Shoals Dam in 1952 the “Twin Lakes” region grew quickly into a tourist destination, bringing dramatic change to north-central Arkansas. Since lakes were novelties in the Ozarks, developers seized the opportunity by building a variety of tourist and retirement facilities. The change was both sudden and dramatic; in 1940 the area around Mountain Home contained only thirteen small "cottage camps" capable of housing 108 visitors, but

[66] Department of the Interior, "Initial Follow-up Report," 7.

by 1954 there were 114 capable of housing over 2,000 vacationers.[67] By the mid-1950s the "Twin Lakes" region was the most popular tourist destination in northern Arkansas.[68] Bull Shoals Lake alone would attract over one million visitors by 1954 and over 2.5 million by 1960.[69]

The popularity of the lakes among anglers and developers undoubtedly assisted in the rapid notoriety of the tailwaters. Anglers visiting the lakes to fish for largemouth bass or other warm-water species also learned about the trout fishing opportunities below the lakes. Local bait shop owners and boat dock operators undoubtedly told anglers about the fabulous trout fishing, providing advice on locations, tackle, and bait. Resorts on the lakes assisted by giving anglers a place to stay and advice on where to hire a guide or where to go to fish the tailwaters. As the tailwaters attracted more anglers, a reciprocal relationship developed between lake and tailwater businesses. Resorts and outfitters commonly promote the diversity of fishing opportunities to attract anglers. After all, where else could you go and have the opportunity to fish for largemouth bass, catfish, smallmouth bass, striped bass, brown trout, and rainbow trout all in one relatively small area?

Although this newfound fishing diversity was attractive to many, some who had fished and floated the White and Norfork Rivers for years considered them "ruined."[70] Some anglers and outfitters did not support the building of the dams since they knew it would end float fishing for smallmouth bass, a deeply rooted tradition that also allowed some to earn a living. Outfitters such as Elmo Hurst were strongly against the

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[67] Tom Dearmore, "The Ozark Outlook," *Baxter Bulletin*, 5 January 1956.
[68] Brooks Blevins, *Hill Folks: A History of Arkansas Ozarkers & Their Image* (Chapel Hill: University of North Carolina Press, 2002), 234.
[69] Department of the Interior, "Initial Follow-up Report," 1.
[70] Interview with author, 28 October 2003.

construction of the dams despite the river periodically flooding his home and business.[71] Although many other anglers and residents probably had similar views, the written record of their objections is scarce. One of the few published articles lamenting the building of the dams appeared in the *Missouri Conservationist* in May 1948. Subtitled "A Swan Song of the White River," it eloquently describes what was to be lost:

> So let this be the swan song, the death chant of a great stream that will become a series of manmade lakes. For when it is gone, it will have taken with it into oblivion something traditionally Ozarkian, something very dear to those of us who have known the White.[72]

Although upset about the dams, the only options available were to float and fish other warm-water Ozark streams, fish the lakes, or adapt and fish the tailwaters for trout. For those who decided to adapt and fish the new tailwaters, it must have been an interesting, perhaps exciting, and most assuredly a foreign experience. Although trout had been introduced into the Missouri Ozarks in the 1870s their distribution was fairly limited and most Arkansas anglers probably had little experience with them.[73] They most certainly did not have much experience with trout living in tailwaters, since these were exceptionally rare before Norfork Dam was built. The nearest and first to be established in the South was below Norris Dam on the Clinch River near Knoxville, Tennessee. Completed in 1933 its tailwater was first stocked with trout in 1936.[74]

Those anglers making their first trip to the Norfork tailwater were probably quite intrigued by how the river had changed. The first sensation they probably noticed was

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[71] Rios, "Award –winning Elmo Hurst," *Baxter Bulletin*, 12 August 2003.
[72] Bruton, "Mecca of Float Fishermen," 15.
[73] Spencer Turner, "Life History of Wild Rainbow Trout in Missouri," Missouri Department of Conservation, Dingell-Johnson Project F-1-R-27, Study S-22, Job 1 (May 1979).
[74] Jacobs, *Tailwater Trout*, 196.

how cool the air felt. The cold water flowing from the dam cools the air over the tailwaters with any slight breeze making it quite pleasant even in hot weather. Upon reaching the water's edge they probably noticed that the water itself actually looked different, it was now exceptionally clear, almost translucent. Much of the organic matter and suspended silt previously found in the river was largely gone, trapped behind the dam.

The most dramatic change was the influence hydropower generation had upon stream flow. Accustomed to the comparatively slow rise and fall of natural streams, it must have been quite startling to witness the rapid rise in stream flow when the hydropower generators went on-line. With the generators off-line only about 55 c.f.s. of water is released, making the tailwater a shallow and easily wadeable stream (Figure 10). When both generators are on-line water releases quickly increase to as much as 2,500 c.f.s., transforming the tailwater into a fast moving river nearly impossible to wade (Figure 11). The following two images show the same section of tailwater located approximately one-quarter mile below Norfork Dam. In the first image an angler is standing in the middle of the tailwater on an exposed gravel bar. Once the generators come on-line water rises quickly, completely submerging the gravel bar to a depth sufficient for a boat to pass directly over the spot where the angler previously stood. The fallen tree in the foreground provides additional perspective on the change in depth.

Figure 10. Norfork tailwater during no hydropower generation.

Figure 11. Norfork tailwater with both generators on-line.

To effectively fish the tailwaters anglers needed to learn an entirely new set of human-induced variables and how they interact and influence trout and fishing methods. Most important was learning when hydropower generation would occur, how long it would last, and the amount of water released in relation to the number of generators on-line. Anglers also needed to learn how long it would take these various water releases to reach a particular point downstream and inversely how long it would take to subside. This information was necessary to anticipate if they needed to use a boat or whether wade fishing was possible. Varying amounts of flow also affected current speed and water depth which in turn influence trout behavior. Trout feeding patterns and their location within the tailwater is directly related to the amount of instream flow. Anglers talk about being able to "read" the water, noticing slight differences in stream flow, how the current swirls and eddies, and how trout relate to various parts of a stream. The widely and constantly fluctuating flows on the tailwaters makes this particularly challenging.

Awareness of rapid changes in instream flow was particularly important for wading anglers. Anglers caught in the middle of the tailwater when hydropower releases begin risk being washed downstream. Since the water was now quite cold, anglers dunked underwater were at risk for getting hypothermia, especially during cooler weather. To warn anglers of impending water releases the Corps installed special horns near the dam that sound prior to water releases being made. Signs were also posted near the dams warning anglers about rapidly rising waters. For anglers beyond earshot of these horns other precautions must be taken. Many select a rock rising above the current near where they are fishing, periodically checking it to note changes in water level. If

water begins to cover the rock the angler retreats to shore as quickly as possible. One guide suggests placing a "hundred dollar bill" on a rock to provide extra incentive to stay attentive.[75] One local entrepreneur even sells a "Water Watcher," consisting of fluorescent orange tape tied to a lead weight that can be placed on the shore or on a rock.

Although wade or bank fishing is possible during lower flows they become difficult to impossible during higher flows. Water levels often extend high up the banks and, combined with fast moving currents, makes wade fishing impossible and bank fishing extremely difficult. For those who want to fish during high flows a boat becomes a necessity, especially on the Bull Shoals tailwater. The fast moving and rapidly changing flows also require good boat handling skills and knowledge of the tailwater to make fishing productive and safe. Low water creates other concerns, forcing boaters to navigate over shallow shoals, around submerged rocks or trees, and through narrow runs. During periods of no hydropower generation it becomes particularly difficult to float since you must often get out and push your boat through shallow areas.

The combination of varying and dangerous flows, good trout fishing, and numerous anglers proved a boon for commercial fishing guides and outfitters. In a region where commercial sport fishing had existed since the late 1800s, there were numerous individuals with the fishing skills and business savvy to seize the opportunity presented by the tailwaters. Although the exact number is unknown, some outfitters did survive the transition from warm-water to cold-water fishing. For example, Elmo Hurst's outfitting service never ceased operating and actually reached its peak in business after Bull Shoals dam was built.[76] Other operations did not fare as well; Jim Owens' float fishing business

[75] Lori Sloas, presentation given at Sowbug, Mountain Home, Arkansas, 12 March 2004.
[76] *Baxter Bulletin: Senior Focus*, "Elmo Hurst…master farmer," 9 August 1994, 17.

in Branson, Missouri was forced to close due to the inundation of the White River by Bull Shoals and Table Rock Lakes.

It is apparent that during the 1950s and 1960s the number of outfitters, guides, and resorts steadily increased. Since many tailwater anglers were non-resident and inexperienced with tailwaters they needed lodging and a guide to take them fishing. Numerous commercial fishing operations were soon established along the Norfork and especially the Bull Shoals tailwater. Most were established on the upper section of the Bull Shoals tailwater from the dam downstream to Cotter since this was the area initially stocked with trout and also had the most reliable water temperatures. Also, the additional four generators installed by 1963 made guided trips even more popular due to the inherent danger of float fishing during high flows. For example, from 1960-67 six new "fishing services" were established along the Norfork and Bull Shoals tailwaters.[77]

The importance of these businesses to the local economy was significant. Resorts, fishing lodges, boat docks, taxidermy studios, bait shops, outboard motor repair shops, as well as other businesses not directly related to sport fishing all benefited from the influx of anglers. The first survey quantifying the economic impact of these businesses was compiled by the AGFC from 1955-57. Data was solicited from outfitters concerning numbers of boat rentals and the amount of money spent on these rentals. In 1955 over 26,000 people rented over 10,000 boats on the Bull Shoals and Norfork tailwaters. This increased to over 36,000 people and more than 14,000 boats by 1957. In comparison, the use of private boats during these years grew from only 2,140 to 2,960. Money spent on boat rentals in 1955 totaled over $500,000, reaching $600,000 by 1957.[78]

[77] Baker, "Profits from the Rivers," AGFC-TPO.
[78] Baker, "Historical Survey," 234-235.

Since the survey did not include expenditures on items like lodging, gas, or food it was a conservative assessment of the economic impact of commercial angling. By 1960 tailwater anglers were spending over $1.9 million on fishing, lodging, food, and car service, with this increasing to over $2.7 million by 1963.[79]

Eventually a distinct collection of fishing related businesses was operating along the tailwaters and in surrounding towns. It was during these formative years of the fisheries that some of the most successful resorts in the Ozarks were established. Perhaps the most well known was started in 1958 by Al Gaston. He purchased 20 acres on the left bank of the river about four miles downstream from Bull Shoals Dam. His son Jim soon took over managing the resort, expanding the operation as trout fishing became more popular. Gaston's White River Resort would eventually become one of the most popular resorts in the Ozarks, with its black and red roadside billboards a distinct part of the Ozark landscape. The resort would eventually encompass 400 acres and have 79 cottages available for rental.[80]

The transformation of the rivers to cold tailwaters also impacted angling methods and equipment. Although anglers kept familiar techniques and equipment, these often had to be modified for use on the tailwaters. The Ozark johnboat for example survived the transition to cold tailwaters, proving to be an excellent craft for navigating both high and low flows. The only major change to White River johnboats was that most were now constructed of fiberglass or aluminum instead of wood. The green fiberglass rendition found on the Bull Shoals tailwater is considered to be the most similar in design to the original Ozark johnboat, and have become the most popular "river rig" for fishing (Figure

[79] Minutes, Meeting of the White River Trout Association, 29 January 1964, AGFC-TPO.
[80] Gaston's White River Resort, "History," available at http://www.gastons.com/history.htmm(December 2004).

12).[81] Float trips survived along with the johnboats, although in a modified form. Put-in locations were now limited by dams, the distance floated was much shorter, and trout replaced smallmouth bass. Despite these changes many outfitters still advertise and offer "traditional" Ozark float trips down the tailwaters, complete with shore lunches and overnight camping.

Figure 12. White River johnboats on the Norfork tailwater.

Local anglers and guides also kept many of their familiar fishing methods used previously for catfish and smallmouth bass. Since most were mainly smallmouth bass anglers, they preferred using bait casting or spinning gear.[82] Although lures and bait were modified slightly to catch trout, many of the methods were initially quite similar.

[81] Wright, *Ozark Trout Tales*, 16.
[82] Dave Whitlock, "Trout Management of Arkansas' White and Norfork Rivers," AGFC-TPO, 17 February 1990.

Anglers would launch their boats early in the morning before hydropower generation sent higher flows downstream. They would then anchor in the shallow water, casting out and still fishing with "river rigs" baited with natural baits such as worms. When higher water arrived later in the morning, they would pull anchor and drift with the current, casting artificial lures until they reached the take out. This method was especially popular during the period when only four generators were on-line at Bull Shoals Dam since water releases were predictable due to most of the electricity going to manufacturing plants during regular working hours. On weekends generation was even more limited, producing easily fished low flows.[83]

The problem with this technique was that fishing time was limited to periods of low instream flows. According to one guide it was the exceptionally heavy rainfalls during 1957 that forced anglers to adapt and learn to fish high flows. During that spring the region received heavy amounts of rainfall, with Bull Shoals Lake reaching its highest level ever on 2 July.[84] Lake levels were so high that releases stayed high throughout the summer, as the flood water was evacuated. With no shallow slow moving water anglers were forced to adapt. This allegedly occurred on a cold blustery day in March 1957. A guide and his party were sitting on a gravel bar on the Bull Shoals tailwater after another unproductive morning trying to fish the extremely high water. Soon a party of johnboats came into view with guide Forest Wood, recognizable from his ten-gallon hat, leading a party of johnboats:

> There were three boats in the party, with Forest in a boat with two ladies and a man. One of the ladies started to just drift her lure in the water and started to

[83] Personal interview with author, 28 October 2003.
[84] Pamphlet, "A Pictorial History of Bull Shoals Dam & the Town of Bull Shoals, Arkansas," produced for the 50th anniversary of the dedication of Bull Shoals Dam, 2 July 2002.

> catch fish. Once two were hanging their poles over drift fishing, the other one could not fish, so Forrest turned the boat sideways so all three could fish. They had regular bait rigs, and they had a cooler full of fish. That's how we started drift fishing. From then on it was Katy-bar the door.[85]

Word spread, and soon all the guides were turning their boats sideways and bouncing river rigs or "White River Rigs," along the bottom of the tailwater. Drift fishing with White River rigs remains a popular fishing method. Although this is only one specific example, angling techniques were continually modified to match the new conditions created by the dams.

Numerous new lures and techniques for catching trout were also developed. Although fly-fishing was rare, some of its practitioners developed new or modified old patterns to fit the tailwaters. Since flies are a "product of their environment," the tailwaters spawned a great variety of new fly patterns and lures.[86] Since sowbugs and scuds reproduce in high numbers and are a favorite trout food, there is an infinite variety of flies mimicking these invertebrates. Another unique example can be seen in the flies or lures mimicking threadfin shad. Since trout feed upon these with abandon when they are pulled through the dams, anglers use a variety of white patterns to match this "hatch." Natural baits also remained popular, especially sculpins. These native warm-water bottom-dwelling forage fish adapted to the tailwaters and are now a favorite forage fish for trout. Anglers learned how to catch sculpins using tiny pieces of worms or other natural baits, and then still fish them on the streambed to catch large brown trout. Numerous other examples exist; proof of the ingenuity of anglers when forced to adapt to an altered environment.

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[85] Personal interview with author, 28 October 2003.
[86] Schullery, *American Fly Fishing: A History* (New York: Nick Lyons Books, 1987), 147.

Another unique aspect of Arkansas tailwater trout fishing was the influence bass fishing would have upon the sport. Since most locals were primarily smallmouth bass anglers they continued to use bass fishing tackle and techniques for trout. This tendency was further strengthened with the rise in popularity of largemouth bass fishing in the South. The numerous lakes built throughout this region led to the ascension of the largemouth bass as the most popular game fish. Stocked in large numbers and capable of reproducing naturally, the pursuit of bass in the region's deep expansive lakes led to a revolution in fishing techniques, tackle, boats, and specialized electronics.[87] Many largemouth bass anglers joined the Bass Anglers Sportsman's Society (B.A.S.S.) formed in 1967 by Ray Scott. It held its first All-American Invitational Bass Tournament that same year on Arkansas' Beaver Lake.[88] Over the course of the next several decades, fishing for largemouth bass would become a "southern institution," influencing many other forms of fishing, including tailwater trout.[89]

The parallel development of largemouth bass fishing and tailwater trout fishing created long lasting connections between the sports. Instead of fly-fishing tackle, most anglers on the tailwaters used spinning or bait casting tackle preferred for bass. Anglers therefore used artificial lures heavy enough to cast with this type of tackle. Even more popular was the use of natural baits such as worms, minnows, or sculpins. Eventually "natural" baits such as corn, salmon eggs, and marshmallows would also become popular. Most anglers also preferred fishing from boats or still fishing while sitting on the shore.

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[87] Waterman, *Fishing in America*, 179.
[88] Ray Scott Outdoors, Inc., "Biography," available at http://www.rayscott.net/ (April 2005).
[89] Charles Reagan Wilson and William Ferris, ed. *Encyclopedia of Southern Culture* (Chapel Hill: University of North Carolina Press, 1989), 1221.

Forest Wood is one individual whose life and work reveals the interrelationship between Arkansas bass and tailwater trout fishing. He began guiding trout anglers in the 1950s, eventually becoming one of the most popular "float guides" on the Bull Shoals tailwater.[90] While guiding he realized there was a "need" for a boat that was both "comfortable and efficient" for bass fishing the regions lakes.[91] He began building bass boats in 1968 in a small factory in Flippin, Arkansas, not far from the Bull Shoals tailwater. His design was basically a "glorified johnboat," patterned after those he used while guiding on the tailwaters.[92] His company, Ranger Boats, eventually became one of the largest and most well-known manufacturers of bass fishing boats in the country. Wal-Mart Corporation would later name the bass tournaments it sponsors the "FLW Tour" in honor of Forrest L. Wood. He would play an influential role in trying to attain increased amounts of instream flow for the tailwater, especially following his appointment in 1998 as an Arkansas game commissioner.

Regardless of tackle used, anlgers became increasingly adept at catching tailwater trout. Although angling increased, fishing pressure during the 1950s and early 1960s was comparatively light compared to later use. With the number of trout stocked steadily increasing, many trout survived and grew quickly to trophy size. It was common during these years for anglers to catch and keep full limits of trophy trout (Figure 13).[93] One elderly guide describes this period as the "slaughter years" of the tailwaters since most

[90] Tom McNally, *Fishermen's Bible*, 2nd Ed. (Chicago: Follet Publishing Company, 1972), 147.
[91] Ranger Boats, "Heritage," available at http://www.rangerboats.com/pages/tradition/heritage.cfm (January 2005).
[92] Forrest Wood, quoted in, Wright, *Ozark Tout Tales*, 63.
[93] photograph courtesy of Arkansas Game and Fish Commission.

Figure 13. Rainbow trout caught during the late 1950s or early 1960s.

anglers believed the supply of trophy trout was inexhaustible.[94] During this time, catch-and-release fishing was not widely practiced by most anglers, with most having a catch-and-eat mentality. With more anglers keeping more trout the trophy rainbow trout fishing slowly declined.

Although rather short-lived, this period did earn the tailwaters a reputation as a "trophy" trout destination. Although a rather subjective term, trophy for most anglers means a trout weighing considerably more than the average fish. Anglers have long valued the skill and often luck needed to land particularly large fish, but there were few organized systems to compare catches. Anglers had to be content with having pictures of their trout included as front page news in local newspapers or hung on the walls of local bait shops and sporting goods stores. As angling became increasingly a sport instead of

[94] Personal interview with author, 28 October 2003.

a means to procure food, it was inevitable that systems were developed to keep "score." Organizations such as the International Game and Fish Association, formed in 1939, established official records books with certified systems for measuring and weighing fish.[95]

The AGFC assisted in the promotion of the tailwaters as a trophy destination by creating its own angling records book in 1959. The program also gave the AGFC a means to promote the success of its fisheries program, attract more anglers, and provide commercial fishing businesses useful and attractive publicity. Pictures of trophy trout were already a common site on bait shop walls, in resort brochures, and in local newspapers. These images are even more attractive when the trout are officially certified as legitimate state records by the AGFC. During the first year of the program, the Arkansas state record for rainbow trout was broken three times, with the largest weighing 17 pounds, 12 ounces.[96] All of these records book trout were caught in the Bull Shoals tailwater, further adding to its notoriety. In the coming decades, state and eventually national records book trout would become an important promotional tool for both the AGFC and the sport fishing industry.

Water for Trout

Although the tailwater trout fisheries quickly became economically and recreationally important, they were not considered a priority in the actual operation of the dams. Recreation was not included as an authorized purpose for any of the projects and therefore no water storage in the lakes was allocated for either creating or sustaining the

[95] International Game and Fish Association, "History," available at http://www.igfa.org/history.asp, January 2005.
[96] Mike Wilson, "Fishing Records Through the Years," *Arkansas Game and Fish* (Winter 1980), 18-19.

fisheries. The Norfork tailwater especially was an "unforeseen use," established four years after the completion of the dam.[97] Even though it was known that subsequent tailwaters would probably support trout, no water storage was allocated for this use. As anglers, the AGFC, and others involved with the trout fishery would soon realize, the lack of water storage for the trout fisheries would become a long-lasting and contentious issue.

As each dam was complete and operations began, the timing and volume of water releases became dependent on the need for hydropower. Although the dams are operated to meet all three of the authorized purposes, hydropower has a direct and daily impact on the downstream fisheries. Water storage in each lake is divided into two layers or pools; flood control and conservation, with the actual storage amount varying by lake. The conservation pool lies below the flood control pool and is earmarked for hydropower generation and water supply. The flood control pool is above the conservation pool and is intended to store excess water for preventing downstream flooding. The top of these respective pools is set at a certain elevation that varies at each lake.

These pool levels are manipulated to prevent floods and provide hydropower. The lakes were designed so that inflow would provide a certain amount of guaranteed power, called firm power. Water storage in each lake was also designed to assure the production of firm power even during the most critical dry period on record. Firm power is most often produced during peak electrical demand periods since this power can be sold at a higher rate. This ability to produce electricity instantaneously during peak demand periods is one of the most beneficial aspects of hydropower. Thermal plants, meanwhile, take longer to bring on-line and are therefore better suited to producing a

[97] White River Basin Coordinating Committee, "Comprehensive Basin Study", 144.

certain amount of power continuously. Peak electrical demand occurs during the early morning when people are preparing for work, during working hours when businesses and factories are open, and during the evening when people are at home. Hydropower generators within the dams can be turned on and off quickly to meet these demand periods. Although some of its electricity comes from thermoelectric facilities, SPA counts on its hydropower facilities to meet peak demand.[98]

Generally there is enough inflow into the lakes to keep the conservation pools full, allowing for the generation of firm power and even some secondary hydropower. This secondary power is sold for less than peak demand power. When lack of precipitation decreases inflows into the lakes, the conservation pools may be drawn down to generate the required firm power. During drought conditions or in late summer, lake elevations may drop considerably as water is used to produce firm power. Coincidentally, the late summer months are also a high electrical demand period, further compounding the problem of low lake elevations during this time. Low lake levels also negatively influence the efficiency of the turbines since the difference in elevation between the turbine blades and the surface of the lake decreases.[99]

During periods of heavy rainfall, excess water is stored within the flood control pool to prevent downstream flooding. During this time releases for hydropower generation are made only to meet minimum hydropower commitments. Once downstream flood control gages recede to designated levels, hydropower generation increases to normal production levels. The main objective is to evacuate water in the flood pool as quickly as possible to avoid having excess water in the flood pool in case of

[98] Gillilan, *Instream Flow Protection*, 68-69.
[99] Ibid., 67.

additional heavy rainfall. During high inflows secondary power is often produced during evacuation of the water; therefore, hydropower production sometimes supplements flood control. During periods of exceptionally high flood waters where loss of life or serious damage threatens, the SPA often must curtail even the production of firm power.[100]

The Corps and the SPA were mandated by law to use the water storage in the lakes to meet the authorized purposes of the dams. The Corps oversees the daily operations of the dams and is also responsible for maintenance. The SPA, meanwhile, distributes and markets the hydropower to electrical cooperatives and municipal utilities. As the Corps built each dam in the White River Basin the SPA linked it to its electrical grid, controlled by its operations center in Springfield, Missouri. This grid expanded as each dam was completed, eventually tied together by over 1,600 miles of transmission lines in Missouri, Arkansas, Oklahoma, and Texas.[101]

Since downstream water releases are tied directly to flood control and hydropower, the creation of a tailwater trout fishery below Norfork Dam was done on an experimental basis. The "crux" of its success was whether sufficiently low water temperatures for the trout could be maintained when hydropower generation ceased.[102] With no water storage, the fisheries were entirely dependent upon leakage from the dams and water releases from the powerhouse generators supplying electricity to the dam. At Norfork Dam this amounted to about 50 c.f.s. of water flowing downstream. This amount obviously proved sufficient in establishing the fishery.

As Bull Shoals Dam was being built, concerns were raised about the installation of a powerhouse generator releasing only 20 c.f.s. of water. The AGFC argued that 20

[100] Conference on Operation of White River Lakes, 7 February 1973, AGFC-TPO.
[101] Southwestern Power Administration, "*50/50: Partnerships in Power*," 10.
[102] Ancil Holloway to Travis Roberts, 29 July 1949, AGFC-TPO.

c.f.s. of water would create a tailwater "without any value" since water temperatures would not be low enough for trout. The AGFC requested that the Corps install a larger house unit capable of passing at least 290 c.f.s. of water.[103] The USFWS meanwhile recommended a continuous release of 100 c.f.s. of water be maintained 100 feet below the dam "at all times."[104] These recommendations were never implemented, with the dam completed using the original design. Total minimum releases were actually more than expected at 80 c.f.s., with 40 c.f.s. from the house unit and 40 c.f.s. from leakage.[105]

Apparently these releases were satisfactory in sustaining the trout fishery until 1954. Drought conditions during spring and summer caused lake elevations at both Bull Shoals and Norfork Lakes to drop significantly. Lack of inflow was so severe that the hydropower pools at both lakes were drained, the only time on record this has occurred.[106] To conserve water, hydropower generation was terminated for several weeks, with releases at Bull Shoals Dam "seldom" exceeding 100 c.f.s.[107] Meanwhile, at Norfork Dam hydropower production was curtailed by 80 percent.[108] With only minimal amounts of cold water flowing downstream the AGFC was forced to reduce its trout stocking from over 33,000 in 1953 to slightly over 8,000.[109]

Water temperature eventually reached critical levels. Although not "actually observed" by any AGFC personnel, it reported that a trout kill occurred below Bull Shoals dam due to critically high water temperatures.[110] The agency realized that

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[103] Joe Hogan to D.N. Graves, 6 April 1949, AGFC-TPO.
[104] Department of the Interior, "A Report on the Effects," 38.
[105] Department of the Interior, "Initial Follow-up Report," 8.
[106] "United States Army Corps of Engineers, White River and Tributaries, Arkansas, Reconnaissance Study," (September 1989), 4.
[107] United States Fish & Wildlife Service, "Initial Follow-up Report," 2.
[108] United States Army Corps of Engineers, "Interim Stage II Report," 21.
[109] Jones, et. al. "An Evaluation of the Effects," Appendix A, 61.
[110] Baker, "Historical Review," 235.

confirming trout kills in tailwaters is difficult, a problem that would continue for decades. What makes it particularly difficult is that dead or dying trout are often swept downstream by subsequent water releases. Struggling trout also sometimes recover when additional cold water is released or when they reach springs or deeper and cooler stretches of water. Another problem is lack of personnel and therefore response time, since trout kills are often reported during weekends and in remote locations. If and when biologists can respond, the trout are often gone or have recovered.

A later trout survey seemed to confirm the 1954 trout kill, revealing that no trout were found in the tailwaters large enough to have been released earlier than the winter of 1954-55. The AGFC tepidly claimed that this survey supported the "idea" that trout were killed during the summer of 1954.[111] Later reports by the AGFC and other agencies unequivocally state that a trout kill did occur in 1954 due to high water temperatures. The inability of the AGFC to confidently and accurately document and quantify this initial trout kill set a precedent that would continue for decades. For example, only nine of the 15 "documented" trout kills occurring from 1954-81 were actually confirmed by AGFC personnel. This became a particularly contentious issue between the AGFC and the SPA and Corps, since these agencies are often blamed for the low water releases killing trout.[112]

In the years following this trout kill the AGFC began to actively lobby the Corps and SPA for increased instream flows to protect the trout fisheries. By this time the fishery was quite popular among anglers and economically important to many businesses. Using this as justification for more water, the director of the AGFC requested that the

[111] Nelson Cox to District Engineer, United States Army Corps of Engineers, 12 July 1957, AGFC-TPO.
[112] Jones, et. al., "An Evaluation of the Effects," 28.

Corps give "consideration" to running at least one generator each day for a short period to protect the "fabulous trout fishing" that is "extremely important" to the regional economy.[113] Although this request was denied, a "gentleman's agreement" was developed where additional water releases were made during the critical months from June-October.[114] During this time rainfall tends to decrease while air temperatures rise, increasing the chance that hydropower generation will be insufficient for maintaining water temperatures low enough for trout. The AGFC began monitoring the tailwaters during these months, compiling daily reports of water temperature readings and delivering them to the Corps office in Mountain Home. If water temperatures rose too high they submitted a "special request" to the Corps for additional water releases.[115] The Corps would then respond by releasing more water, hopefully in time to avoid a trout kill.

Soon after these procedures were established, managers and anglers alike were actually faced with too much water. Heavy rains during spring 1957 swelled Bull Shoals Lake to the point where water had to be released over the flood gates. The Bull Shoals tailwater was transformed into a raging torrent as excess water was evacuated as quickly as possible in case of additional rains. Flows stayed high throughout the summer, making both fishing and the stocking of trout difficult. Fast flowing currents scoured the streambed, removing much of the aquatic vegetation that had been transplanted to provide habitat for aquatic insects and crustaceans. The resulting loss of food and cover reduced trout growth rates from .90 per month to .65 inches per month.[116] Managers and

[113] Nelson Cox to District Engineer, United States Army Corps of Engineers, 12 July 1957, AGFC-TPO.
[114] Baker, "Historical Review," 235.
[115] Southwestern Power Administration, "Water Temperature Problem, White River, Arkansas," 12 July 1971, AGFC-TPO.
[116] United States Fish & Wildlife Service, "Initial Follow-up Report," Appendix 1, 5.

anglers were once again reminded that despite the controlling power of dams, natural occurrences could still impact the fishery.

Following the 1957 flood, temperature recording devices were installed along the Bull Shoals tailwater. These devices chronicled the change in instream flow and temperature following the installation of the final four generators at Bull Shoals Dam from 1961-63. Both hydropower capacity and water releases doubled, with maximum instream flows increasing from 11,000 to 22,500 c.f.s. The increased volume of cold water pushed "dependable" trout water all the way to Lock and Dam #3, a downstream distance of about 101 miles.[117] When operating at full capacity the dam now released a torrent of cold water, increasing both the width and current speed of the tailwater. The current was so fast that aquatic vegetation was scoured from the streambed, an occurrence formerly limited to flood periods.[118] These high flows also made the tailwater even more difficult to fish safely, increasing the need for experienced guides.

Of more importance for the fishery was the decrease in generation time due to the additional generators. With eight generators electricity demands could be met more quickly, increasing the time generators were off-line each day from 20 percent to 45 percent. Although the actual amount of water released each day increased slightly from 4,639 to 5,094 c.f.s., it was released more quickly and less frequently. Since the tailwaters wetted area decreases in size when hydropower releases cease, this created large areas of streambed exposed to the sun for long periods. This decreased habitat for trout by negatively impacting the growth of aquatic vegetation. Also, with four generators water released normally ranged from 1,000 to 10,000 c.f.s., but with eight

[117] Andrew Hulsey to Administrator, Southwestern Power Administration, 14 May 1963, AGFC-TPO.
[118] Jones et. al, "An Evaluation of the Effects," 5.

generators this ranged from 1,000 to 22,500 c.f.s. Releases were not only less frequent, but more variable in volume, creating a tailwater that was less predictable and less conducive to sustaining trout habitat[119]

Another significant change could be seen in seasonal output of water releases. With four generators about 56 percent of the annual water releases from Bull Shoals Dam occurred from May through September. With eight generators this decreased to about 43 percent, reducing the total volume of water released during the warmest months. This change is particularly important since the warmer months are also the critical months for trout, when warm air temperatures increase the chance of trout kills. This, in combination with the greater short-term fluctuations in water releases, resulted in higher water temperatures in the tailwaters.[120]

The change from four to eight generators negatively impacted both trout habitat and angling. One subsequent study compared the amount of time water releases were between 500 and 5,000 c.f.s. during the four and eight generator periods. This water release range was chosen since it provides quality trout habitat and enough water depth for float fishing. With four generators, releases in this range occurred about 41 percent of the time, while with eight it dropped to only 21 percent. Since angling occurs mainly during daytime hours in the spring and summer, the study also examined daily and seasonal releases. During the four generator period, non-generation during daylight hours occurred about 7.5 percent of the time and only 4.9 percent during the high angler use months of April through September. With eight generators, non-generation increased to 29.1 percent during daylight hours and 29.9 percent during the high angler use months.

[119] Ibid., 3-5.
[120] Ibid., 7-8.

The conclusion was that four generator operations provided more stream channel for fishing, more usable trout habitat, and more dependable float fishing water.[121]

These changes in water releases would compound the effects of the drought conditions that once again threatened the fishery in 1963-65. Beginning in spring 1963 inflows into the lakes fell to below normal levels, reducing lake levels and forcing a reduction in hydropower generation to conserve water. Although the increased water releases from the additional four generators had increased the length of the tailwater, the lower section was more vulnerable to warming water temperatures. As water moves downstream from the dam it slowly warms due to contact with warm air and inflow from warmer tributary streams. With the additional cold water from the Norfork tailwater flowing in 44 miles from the dam, water temperature most often stayed cold enough to support trout to Sylamore, a distance of 79 miles. Past this point water temperatures low enough for trout are less reliable.

The lack of hydropower generation and the change in water release patterns resulted in another trout kill in May 1963. This trout kill was confirmed by AGFC biologists recording critically high water temperatures between Sylamore and Guion.[122] Water levels eventually became so low that the trout stocking boat could not operate in the shallow water. Even when trout were successfully released they often died due to high water temperatures. Stocking procedures were therefore modified, with releases limited to areas accessible by truck, while during especially critical times it was abandoned altogether. Since the AGFC could not stock trout due to low water, the

[121] Aggus, L.R., W.M. Biven, and T.O. Duncan, "Evaluation of Instream Flow Needs for Fisheries in the Tailwaters of Bull Shoals, Norfork, and Greers Ferry Lakes, Arkansas," Contract Completion Report for Little Rock District, United States Army Corps of Engineers (1981).
[122] Jones et. al, "An Evaluation of the Effects," 29.

director of the NNFH complained that his monthly allotment of trout were not being shipped, resulting in "loss and disease." The AGFC feared that if the situation continued the state's $3 million trout "industry" was at risk.[123]

Sport fishing business owners were especially distraught over the low water and lack of trout stocking. Their livelihoods depended upon trout stocking to attract anglers. Members of the White River Trout Association (WRTA), an organization of outfitters, resort owners, and guides, complained that the water levels were lowest on weekends when angler use was highest. Although weekends were the peak days for fishing, they were the off-peak days for hydropower generation since less electricity was needed for factories and businesses. Outfitters were forced to advise anglers “not to visit on weekends” since there was not enough water for float trips. This “bad publicity” for the tailwaters reduced fishing expenditures by one-third in 1963, a loss estimated at over $400,000. [124]

The SPA was also justifiably concerned since it needed to meet its contractual agreements with its customers. Since customer need was highest during week days, it sought to generate electricity during this period since the power could be sold at a higher rate. Electricity generated outside these peak times had to be sold at an “extremely low” rate making such sales less economical. The critical issue for the SPA and Corps was lack of water in the conservation pools, since this water needed to be conserved to meet the electrical demands of its customers. Releasing water for the trout fisheries would further reduce lake levels, impacting the ability of the SPA to meet future contract obligations. Although the SPA was releasing water for the "benefit of the fishermen,"

[123] Minutes, White River Trout Association, 29 January 1964, AGFC-TPO.
[124] Ibid.

these releases decreased its electrical revenues. According to the SPA the ultimate answer to the problem was the completion of Beaver Lake and its additional water supply.[125] Of course, this storage would have to travel through Table Rock Lake, Lake Taneycomo, and Bull Shoals Lake before reaching the tailwater, with the amount of water still ultimately dependent upon precipitation.

The low water conditions continued into summer 1964 with instream flow often reduced to "practically nothing," causing water temperatures to reach 80°F within just 38 miles of Bull Shoals dam. Water levels were so low that the ferry at Shipps Ferry on the Bull Shoals tailwater could not cross the river.[126] The AGFC was forced to reduce its stocking program, resulting in a precipitous decline from over one million rainbow trout in 1963 to about 372,000 during 1964.[127]

The low water levels persisted into the summer of 1965 with a trout kill taking place during June from Sylamore to Lock and Dam #3. Although later AGFC memorandums and reports include repeated references to this trout kill, there is never mention of the actual number of trout killed. A "Trout Die-off Report" filed on 30 June 1965 describes the two days in question. On 28 June an AGFC biologist traveled to the tailwater near Allison after it was reported that trout were "dying." He did observe trout "swarming the springs," seeking cooler water but found no dead trout despite the temperature gauge near Allison recording a water temperature of 86°F at 3:00 p.m. The following day he floated about 13 miles from Allison to Guion but found "only two dead trout," although it was "impossible to determine" the number of trout that may have "sunk and been washed downstream." He concluded that if a large die-off had occurred there

[125] Ibid.
[126] Robert Baker to Andrew Hulsey, 1 July 1964, AGFC-TPO.
[127] Jones et. al, "An Evaluation of the Effects," 63.

should have been numerous dead trout lodged in branches along the shoreline. The trout kill widely reported as having been "confirmed" by the AGFC was based on two dead trout.[128] Although the reports of dying trout were probably true due to the high water temperature readings, the inability of the AGFC to quantify the kill is significant, as are the future reports claiming the incident as a major trout kill.

The low water years and trout kills of the early 1960s resulted in a more systematic and streamlined procedure to avoid critically high water temperatures. Releases during the critical period from June through September would now be governed by air temperature forecasts made by the U.S. Weather Bureau for the area from Bull Shoals to Batesville. Under this procedure, when air temperatures were 90°F or below, the 24 hour average flow from Bull Shoals would be 250 c.f.s. while at Norfork it would be 145 c.f.s. As forecasted air temperatures increased, more water was released until reaching a maximum of 750 c.f.s. at Bull Shoals when temperatures rose to 105°F or higher. This system was later modified to include actual air temperature readings collected and reported to the SPA and AGFC by members of the WRTA. According to the SPA these procedures were successful in minimizing the "adverse effects" that air temperatures were having on the fishery, while improved communication could reduce it still further.[129]

Although these procedural changes improved the situation, the AGFC and other angling interests recognized the long term solution was a constant and increased amount of instream flow. The ultimate solution was a minimum flow of water “regardless of

[128] Memorandum, “Trout Die-Off Report,” 30 June 1965, AGFC-TPO.
[129] Southwestern Power Administration to Senator J. W. Fulbright, 7 February 1968, AGFC-TPO.

generation or non-generation of power."[130] To achieve this goal the AGFC began to pursue Congressional authorization to reallocate water storage in the lakes to include storage for the downstream fisheries. Letters were sent to Arkansas' Congressional Delegation "appraising them of the situation" and asking for their assistance in creating the necessary legislation or resolutions.[131]

As these requests were sent, the White River Basin Coordinating Committee released its Comprehensive Basin Report in June 1968. This multi-agency committee was formed in 1962 to determine both short and long-term plans for the management of the White River Basin. In relation to the trout fisheries, the committee recognized that trout kills had occurred despite modifications to hydropower operations. It stated that Congress recognizes that "values" from the dams "change with time" and that the uses and assigned costs of certain projects should be "reconsidered in certain instances." The committee argued that the cold water fisheries below Bull Shoals and Norfork Dams were an "unforeseen" use that had now become a valuable resource. If it could be determined that the tailwater fisheries were indeed the best use of the water resources, then it should be "protected and enhanced" by releasing more water during the summer months.[132]

Although these statements were encouraging for those wanting more instream flow, authorization for reallocating water storage would have to come from Congress. The coordinating committee recognized this, suggesting that the solution to the problem was to restudy the reservoirs to determine the "best uses in the light of total public needs" while also considering how any proposed changes would influence the authorized

[130] Bill Mathis to Hugh Hackler, 27 December 1967, AGFC-TPO.
[131] Ibid.
[132] White River Basin Coordinating Committee, *Comprehensive Basin Study*, Main Report, June 1968, 144.

purposes.[133] Although seemingly simplistic, restudying and reallocating water storage in the lakes is an exceedingly complex task. With the completion of Beaver Dam in 1966 the basin's six dams were now storing over 16 million acre-feet of water, with 5.4 million of this allocated for flood control, 3.3 million for hydropower production, 925,000 for drawdown and hydropower production, and 6.3 million for recreation, fish and wildlife, and "other purposes."[134] Since all six dams are operated as an integrated system, changing water storage allocation in one or all influences the operation of the entire system.

Further complicating the issue is the economic value of hydropower, and its ascendancy as the most important authorized use. The SPA relies on water storage in the lakes to turn 18 generators installed within the five White River basin hydropower dams. Although the generating capacity of these five projects in 1968 was 818,000 kilowatts, the SPA actually used electricity from 15 different Corps hydropower projects to meet its electrical contracts.[135] Altering the amount of electricity available from the White River Basin dams affects the operations of dams and thermal power plants in other states and in other drainage basins. Since the SPA contracts with municipalities and cooperatives to supply a certain amount of electricity, any change in storage impacts the amount of electricity needed to meet these obligations. Change in electrical production also influences SPA's revenues and therefore the amount it must repay the federal treasury for the cost of constructing the dams. Modifying this system to supply extra water for trout, an unauthorized purpose, is therefore a multifaceted task, and one that would only increase in complexity in the future.

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[133] Ibid., 144.
[134] Ibid., 43.
[135] Ibid., attachment G.

CHAPTER VI

PUT-AND-TAKE TO NATURAL BROWNS: 1970-1989

> *The catchable rainbow trout fishery in the tailwaters of Bull Shoals and Norfork Dams...has apparently reached equilibrium with respect to angler use and harvest.*
>
> Mark Oliver, AGFC, 1984

> *These very good fisheries, however, are far short of the fishery, stream ecology, recreation and economic potentials that could be realized with increased minimum flows.*
>
> Corps, *White River and Tributaries, Arkansas, Reconnaissance Study*, 1989

By the end of the 1960s the four Arkansas tailwater trout fisheries were a popular destination for anglers and an important part of the local economy. They were notable among anglers for producing trophy sized trout as well as containing large numbers of smaller hatchery reared trout. Numerous resorts, outfitters, and guides were now servicing the needs of thousands of anglers traveling to the tailwaters and spending millions of dollars each year for the experience. Although trophy trout were mainly responsible for the tailwaters notoriety, the AGFC shifted increasingly towards managing the fisheries as put-and-take. Despite the occurrence of several trout kills, water releases were sufficient in providing excellent fishing, hydropower production, and flood protection. In the next several decades the increasing economic importance of the trout

fisheries and changes in the type of angling would lead to changes in fishery management and more intense demands for increased instream flows.

Fly-fishing and Wild Trout

On 24 May 1972 Troy Lackey, a guide, was fishing the Partee Hole on the Bull Shoals tailwater when something heavy struck the crawdad he was using for bait. After a fight that reportedly lasted for nearly one hour, he managed to land the immense 31 pound, eight ounce brown trout. Exciting news for Arkansas trout anglers, it was the first brown trout to officially exceed 30 pounds and was later certified as a new state record.[1] Lackey's record would be short-lived, with a 33 pound, eight ounce brown trout eclipsing the record only five years later.[2] Brown trout of this size were thought by most to exist only in large lake systems such as Lake Michigan or Flaming Gorge Reservoir. The ability of the White River tailwaters to consistently produce such large brown trout added to its notoriety and increased the demand for more and larger trout.

Although rainbow trout dominated numerically, the presence of brown trout in the Bull Shoals and Norfork tailwaters added a unique, exciting, and natural element to the fishery. Brown trout reproduced naturally after stockings ceased in 1957. and they As a result, many anglers considered them to be wild and therefore a highly prized quarry. These "home grown" trout gave the streams a "natural appeal" that the millions of hatchery reared rainbow trout lacked.[3] Brown trout are also prized by anglers due to their innate wariness, making them more difficult to catch than hatchery raised rainbow trout. This is partly due to their propensity to feed most aggressively at night and less during

[1] Wright, *Ozark Trout Tales*, 86.
[2] Wilson, "Fishing Records Through the Years," 18-19.
[3] United States Army Corps of Engineers, "White River and Tributaries, Reconnaissance Study," E-9.

the daylight hours when most angling occurs. Anglers also like brown trout since they grow larger than rainbow trout, offering an opportunity to catch a fish measured in pounds instead of inches. Completing their persona is their aggressive predatory nature, especially their affinity for feeding on newly stocked rainbow trout. Their presence therefore adds a certain "wild" and exciting element to the tailwaters.

Although brown trout were a popular trophy fish, they were not a top priority in the management of the tailwaters. After the AGFC ceased stocking brown trout in 1957 they focused entirely upon stocking rainbow trout. In fact, by the early 1970s rainbow trout made up 99 percent of all fish caught by anglers in the Bull Shoals tailwater.[4] Since the Norfork tailwater flows into the Bull Shoals tailwater and stocking procedures were similar, catch rates would also have been quite similar. On the Greers Ferry and Beaver tailwaters rainbow trout were the only trout stocked. For anglers this meant an increasingly predictable and homogenous catch of mostly hatchery raised nine or ten inch rainbow trout. Although they become somewhat more wary with time, these trout are notoriously gullible and easy to catch when first released. Accustomed to humans and to being fed a diet of fish pellets dumped into the raceways at the hatchery, they readily bite nearly any lure or bait. This is great for anglers wanting to easily fill their limit or for guides trying to please paying clients. For others, these naive and easily caught trout are unchallenging and far inferior to "wild" trout.[5]

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[4] Larry Aggus, David Morais, and Robert Baker, "Evaluation of the Trout Fishery in the Tailwater of Bull Shoals Reservoir, Arkansas," Proceeding of the Annual Conference Southeastern Association of Fish and Wildlife Agencies (1977), 572.

[5] For an interesting description of the differences between fishing for hatchery verse wild trout, see "Matching the Hatchery," *Outdoor Life* 191, no. 4 (April 1993): 72; Monte Burke, "Rubber Trout Blues," *Sports Afield* 223, no. 2 (February 2000): 34-35.

Not only had trout fishing become increasingly homogeneous, in many ways so had the methods used to catch them. By the early 1970s angling on the Bull Shoals tailwater, where the majority of the state's tailwater trout angling occurred, had evolved into a put-and-take "seasonal boat" fishery. About 62 percent of all the angling trips took place during the four months from May to August. Vacationing anglers traveled to the tailwaters to catch rainbow trout that were stocked most heavily during this time, providing a ready supply of easily caught trout. The popularity of this system was undeniable, attracting anglers from considerable distances who then spent considerable amounts of money. By the early 1970s about 60 percent of anglers fishing the Bull Shoals tailwater traveled nearly 200 miles one-way to fish.[6]

For many of these anglers it was customary to hire a guide. They needed someone who was both skilled at catching trout and could safely navigate a johnboat in the wildly fluctuating tailwaters. By 1971 about 31 percent of anglers on the Bull Shoals tailwater hired a guide, resulting in about 50 percent of all angling hours being guided.[7] Hiring a guide or finding a resort to stay in was now quite easy along the tailwaters, especially around the towns of Mountain Home, Flippin, Bull Shoals, or Cotter (see Figure 9). Resorts often employed guides who worked exclusively for them, or they could hire one of the numerous independent guides working the tailwaters. Many resorts still advertised the "traditional" White River float trip with anglers paying about $20 per day for a regular float trip, and $35 per day if they wanted to camp overnight on the river. Float trips of three to four days were also common, with some lasting several weeks.[8]

[6] Aggus et. al., "Evaluation of the Trout Fishery," 567.
[7] Ibid., 567.
[8] McNally, *Fishermen's Bible*, 147.

Since much of the fishing was guided, these individuals were especially influential in promoting certain angling techniques and discouraging others. Guides preferred using either bait casting or spinning tackle to fish mainly natural baits while also casting artificial lures such as spinner baits or minnow plugs. The "peer pressure" exerted on visiting clients by local guides and anglers made the use of this type of tackle nearly "mandatory."[9] Meanwhile fly-fishing tackle, synonymous with trout fishing in other areas of the country, was rarely used on the tailwaters since it was both foreign and considered unproductive. Guides often openly discouraged clients from even bringing fly-fishing tackle since it was widely believed and promoted that Arkansas tailwater trout would not bite artificial flies.[10]

This scarcity of fly-fishers on Arkansas tailwaters also mimics a broader national trend in the sport. Fly-fishing declined in popularity throughout the country during the 1940s and 1950s, due partly to the ease, inexpensiveness, and popularity of spin fishing. In regions such as Arkansas where it had never been popular, its absence was even more pronounced. Fly-fishing historians sometimes refer to this period as the "dark ages" of fly-fishing when only the "most devoted" continued to pursue the sport.[11] This slowly began to change during the 1960s as the sport gradually increased in popularity. Two influential fly-fishing organizations assisted this process by focusing the resources of its membership on promoting and educating others about the sport. The first was Trout Unlimited, formed in 1959 by a group of fly-fishers concerned about the increase in the stocking of hatchery reared trout in Michigan. Six years later the Federation of Fly-fishers (FFF) held its first conclave, bringing together a disparate group of local clubs

[9] Whitlock, "Trout Management of Arkansas' White," 17 February 1990, AGFC-TPO.
[10] Wright, *Ozark Trout Tales*, 74.
[11] Schullery, *American Fly-fishing*: A History, 191.

into a single national body. Both organizations grew quickly, with the FFF claiming 59 clubs and 3,500 members by 1969.[12]

The diffusion of FFF clubs reached the Ozarks in 1968 with the establishment of the Green Country Fly-fishers (GCF). One of its founding members was a native Oklahoman named Dave Whitlock who would later become one of the most well-known fly-fishing artists, authors, and fly-tiers in the world. The primary goal of the GCF was to establish a wild trout fishery in Oklahoma, a state where only put-and-take trout angling existed. In December of 1969 the club planted 12,500 brown trout eggs in northeastern Oklahoma's Spring Creek. To insure their survival the group used Vibert boxes, small plastic incubators to protect the fragile trout eggs. This stocking was successful and Whitlock soon began a national campaign in promoting the use of Vibert boxes in stocking trout eggs. During this campaign Whitlock successfully modified and improved the box's original design which became known as the Whitlock-Vibert box.[13]

Following the success of the Oklahoma club, Whitlock helped organize the Arkansas Fly-fishers (AFF) in 1973, the first fly-fishing club in the state. Once again the initial goal of the club was to establish a wild brown trout fishery. The club's first attempt to establish a brown trout fishery in the Spring River in northeast Arkansas failed. Undaunted, they were soon given permission from AGFC director Andrew Hulsey to try to establish a fishery in the Greers Ferry tailwater. In 1975, using Whitlock-Vibert boxes the club stocked 5,000 fertilized brown trout eggs at Cow Shoals. Although most agree this was the earliest stocking of brown trout into this tailwater,

[12] Ibid., 238.
[13] Dave Whitlock, "Revolution in Trout Rearing," *Outdoor Life* 161, no. 2 (February 1978), 57.

others believe that “accidental” stockings may have occurred during the early 1970s.[14] Either way, the creation of a viable fishery was validated in December 1976 when two members of the AFF, Frank Brown and Lew Piper, caught what is believed to be the first brown trout from the Greers Ferry tailwater. Extremely excited about their catch, they reportedly froze the fish and took it to AGFC director Andrew Hulsey as proof of the success of the stockings.[15]

Stockings of brown trout continued in 1978 when the AFF planted another 20,000 eggs in the Greers Ferry tailwater and in the Little Missouri River. The following year members of the Mid-south Fly-fishers (MFF) from Memphis, Tennessee joined the cause, assisting the AFF in placing 10,000 brown trout eggs purchased from the Spring Creek Trout Hatchery in Lewiston, Montana.[16] These stockings also proved successful and were followed in 1981 by the stocking of 5,000 brown trout fingerlings. The success of these stockings was officially confirmed in 1981 when the AGFC verified that brown trout were reproducing naturally in the tailwater and acknowledged that the agency had never stocked brown trout.[17] The final release of brown trout by private clubs occurred in April 1983 when the AFF and MFF stocked 10,000 fingerlings at five different locations.[18] By 1986 the tailwater was estimated to have 436 brown trout per mile, and was already a popular destination for anglers.[19]

The creation of a brown trout fishery on the Little Red River was a pivotal point in the history of Arkansas' tailwater fisheries. It destroyed the long-held conviction that

[14] Mark Hudy to Larry Rider, 2 July 1986, AGFC-TPO.
[15] Steve Taylor, "A Brown Trout History Lesson," *Arkansas Wildlife* 30, no. 3 (Summer 1999), 20.
[16] Carl Fischer, "History of AFF Stocking of Brown Trout on Little Red River," 10 November 1985, AGFC-TPO.
[17] Mark Hudy to Larry Rider and Carl Perrin, 2 July 1986, AGFC-TPO.
[18] Taylor, "A Brown Trout History Lesson," 20.
[19] Hudy to Rider and Perrin, 2 July 1986, AGFC-TPO.

trout could not successfully reproduce in sufficient numbers to support sport fishing. In the coming years this fact alone would greatly change the way the AGFC managed its tailwater trout fisheries. Perhaps more important was the influence this would have on fly-fishing clubs and fly-fishing in general within the area. Since the AFF and MFF created the fishery, this gave its members a strong sense of ownership over how it was managed and used by others. Members of the MFF are still especially active in the management of the Greers Ferry tailwater, referring to it as one of their "Home Waters" and proudly promoting their role in its establishment.[20]

The increasing presence of fly-fishers on the Greers Ferry and the other Arkansas tailwaters was actually part of a larger “fly-fishing boom” that swept the nation during the 1970s.[21] Fueled by improvements in fly-fishing gear that made the sport easier and less expensive for beginners the number of fly-fishers increased substantially. By 1975 the Midwest Council of the FFF, consisting of the tier of states from Louisiana and Texas north through Canada, had over 4,000 members. This organization began holding its Sowbug, or annual Conclave, at Mountain Home, Arkansas. A location selected “solely” for its “proximity to the famous trout rivers” flowing from Bull Shoals and Norfork Dams.[22] These tailwaters also provided club members with fly-fishing opportunities that were much closer to their homes than having to travel to the Rocky Mountains, Appalachian Mountains, or other distant and traditional trout waters.

By the late 1970s fly-fishing was popular enough to support guides specializing in the sport. Guides such as native Californian Hank Wilson moved to Arkansas, attracted

[20] *Home Waters: Guide to Fishing Northern Arkansas, Southern Missouri, and Western Tennessee* (Bartlett: Impressions Ink, Inc., 2002).
[21] Owens, "Fishing the Hatch," 15.
[22] R.M. Cunningham to Colonel Donald Weinert, 17 March 1975, AGFC-TPO.

by its notoriety for large and plentiful trout as well as the mild climate.[23] Guiding in the Rocky Mountains or other northern areas was a warm season profession, whereas in Arkansas the tailwaters consistent water temperatures and the mild winter made guiding a year-round activity. Lack of competition was another factor. Fly-fishing in Arkansas was rare, providing ample opportunity to establish a clientele relatively free of competition from other guides. Although business was initially slow, the long-held belief that trout would not take artificial flies slowly died.

The emergence of fly-fishing in Arkansas created two disparate types of anglers in close proximity. Fly-fishers introduced methods and attitudes towards trout and trout fishing differing considerably from bait-fishers. At the most basic level, the differences are related to angling equipment and methods. Fly-fishers prefer wading shallow water, using diminutive artificial flies placed into the water with long sweeping casts of the fly line. This requires not only stealth to avoid spooking trout but also enough room to maneuver and cast. Fly-fishing therefore is a rather solitary sport, with anglers both requiring and usually preferring at least some breathing space, if not complete solitude. Although some are forced to fly-fish from johnboats during high instream flows, most prefer wading.

In contrast, bait-fishers prefer float fishing from johnboats while casting artificial lures or live bait. This is more of a social event with several anglers and often a guide in a single boat. As they fish they often talk and laugh, with the guide telling fishing stories describing shoreline landmarks or relating local history. Starting after World War II nearly all johnboats included outboard motors to take anglers upstream against the current. The humming of outboard motors pushing johnboats upstream is a common part

[23] Wright, *Ozark Trout Tales*, 74.

of fishing the tailwaters. During high flows the preferred fishing method is to repeatedly motor upstream and then float fish through certain productive stretches of water. During low flows anglers anchor their johnboats and still-fish natural baits on the streambed. Bait-fishers not using johnboats often sit along the shore or wade fish.

Differences in fishing methods translate into differing views on the amount of preferred instream flow. Fly-fishers prefer lower flows since during periods of hydropower generation the tailwaters often become impossible to wade, forcing them to either stop fishing or use a boat. Fly-fishers therefore began requesting changes in hydropower generation to accommodate their needs. They complained to the Corps that the tailwaters were not in "good fishing shape" during the 1973 conclave due to too much or widely fluctuating water levels. It threatened that if "Arkansas is to host" additional conclaves in the future there must be some "commitment" to providing water conditions allowing them to wade.[24] They also wanted the Corps and SPA to provide longer-term (15-30 day) hydropower generation schedules so they could effectively plan fishing trips to coincide with low flows, while also requesting no hydropower generation from 8-12 a.m.[25] By 1981 the USFWS recognized the preference of wading fly-fishers in relation to increasing instream flow on the Norfork tailwater. It suggested that any decisions to alter instream flows should "consider these anglers preferences" since too much water may make wading difficult.[26] Bait-fishers meanwhile often complain about low flows since it makes floating the tailwaters difficult. Exposed rocks and trees often force them to get out and push boats through certain stretches. During extremely low flows it may become impossible to float certain areas.

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[24] R.M. Cunningham to Colonel Donald Weinert, 17 March 1975, AGFC-TPO.
[25] United States Army Corps of Engineers, "Interim Stage II Report," 28.
[26] Aggus et. al., "Evaluation of Instream Flow," 17.

Views concerning catch-and-release and the use of natural baits also distinguish bait and fly-fishers. Fly-fishers were at the forefront of the catch-and-release movement in the United States. Using mainly artificial flies, they tend to place more emphasis upon the art and act of catching, and less upon securing a limit to eat. Therefor, many fly-fishers have long frowned upon the use of natural baits. Bait-fishers meanwhile often use a combination of artificial lures and natural bait, and are more likely to keep and eat what they catch. A noteworthy early exception was largemouth bass anglers, who began encouraging catch-and-release as their sport grew in popularity. By the 1970s the AGFC recognized these differences and how they affected management. The AGFC noticed that, despite more angling pressure on the Norfork tailwater, the trout caught consistently weighed more than those from the Bull Shoals tailwater. The explanation was a combination of fewer guided trips and more catch-and-release. Only one percent of the guided trips on the two tailwaters took place at Norfork, resulting in less efficient angling but also more fly-fishers and therefore more trout released. For example, about 24 percent of anglers on the Norfork tailwater did not keep any trout, compared to only 13 percent on the Bull Shoals tailwater.[27]

Perhaps most divisive and less obvious are the social, economic, and geographic differences which underlie the tension between fly-fishers and bait-fishers. Fly-fishing has long been an elitist activity, practiced mainly by the more affluent upper classes. Bait fishing meanwhile has been more of a working class or blue collar activity. This is partly due to the historic exclusivity and the higher costs of fly-fishing tackle as well as its

[27] Mark Oliver, "The Rainbow Trout Fishery in the Bull Shoals-Norfork Tailwaters, Arkansas, 1971-81," *Proceedings of the Annual Conference Southeastern Association of Fish and Wildlife Agencies* 38 (1984), 559.

genesis amongst the ruling classes of England.[28] While fly-fishing was practiced initially by east coast urban elites, rural anglers throughout the South utilized more utilitarian methods, including a variety of natural baits. As fly-fishing became more popular on the tailwaters, these two groups were now sharing the same water in close proximity. A long-lasting "silent war" between these two groups ensued, based upon these differences.[29] While conducting my research I was invariably asked by both bait and fly-fishers which type of tackle I preferred. The answer allowed the questioner to place me neatly within one of two groups, stereotyping my views on a variety of issues.

For the AGFC, the presence of both fly-fishers and bait-fishers created two distinct user groups with often diverging views on how the tailwaters should be managed. Both groups had organized clubs or associations working actively to promote their interests, lobbying the AGFC to accommodate the desires of their membership in managing the fishery. AGFC biologists and other personnel are often invited to speak at club meetings, while also receiving frequent telephone calls, letters, and personal visits from individuals wanting to influence management. The owners and operators of the many resorts and boat docks also established close relationships with AGFC trout personnel since their business interests were directly tied to the fishery. Over time, close personal and working relationships between the AGFC and the various angling interests would develop and influence management of the tailwaters.

One of the first and most unique examples of the AGFC making a management decision unpopular with one of these groups occurred in 1983. During periods of high flows guides and anglers found that their johnboats floated downstream so rapidly that

[28] Mark Chochla, "Victorian Fly-fishers on the Nipigon," *Ontario History*, 91, no. 2 (1999).
[29] Pat Perdue, quoted in Wright, *Ozark Trout Tales*, 65.

drift fishing was difficult. Anglers began hanging a heavy steel chain off the front of their johnboats that was long enough to drag along the streambed and slow their drift. Although considered by bait-fishers as an ingenious and effective method to help catch trout, it was viewed much differently by fly-fishers. They claim the drag chains remove aquatic vegetation from the streambed and damage trout habitat. Following lobbying by both groups, the use of drag chains was outlawed in 1983 on the Norfork tailwater but still continues at Bull Shoals. This was a compromise, since fly-fishing is more popular on the Norfork tailwater, while float fishing is more popular at Bull Shoals. As one guide expressed, the fight over drag chains was perhaps the first "power struggle" between fly-fishers and bait-fishers.[30] As with many other later decisions, the AGFC was now forced to compromise to accommodate both groups.

As the 1980s progressed, the popularity of fly-fishing slowly increased on the tailwaters. It was now sufficiently popular to support businesses catering exclusively to the sport. For example, in 1987 Dale Fulton moved from West Yellowstone Montana to open his Blue Ribbon Fly Shop in Mountain Home, Arkansas (Figure 14). His business strategy is to combine "good southern hospitality" with superb tailwater trout fishing.[31] This strategy proved successful, allowing for a move into a larger building with an architectural style and inventory reminiscent of similar fly shops found in the Rocky Mountains. Another indication of fly-fishing's popularity was the opening of fly-fishing schools. In 1989 Skip Halterman opened the White River School of Fly Fishing in Eureka

[30] Pat Perdue, quoted in, Wright, *Ozark Trout Tales*, 65.
[31] Blue Ribbon Fly Shop, available at http://www.mtnhome.net/brf/ (February 2005).

Springs, the first such operation within the state.[32] By the end of the 1980s fly-fishing was a well established part of the cultural landscape along the tailwaters.

Despite the increasing popularity of fly-fishing it was still practiced by only a small minority of anglers. Most anglers preferred using a variety of natural baits, presented using either spinning or bait casting tackle. One particular creel survey showed

Figure 14. Blue Ribbon Fly Shop, Mountain Home, Arkansas.

that 90 percent preferred using natural baits such as crayfish, worms, salmon eggs, corn, and sculpins.[33] Many of these anglers hired guides and also fished from johnboats. Others prefer sitting on the bank or wading, casting a variety of natural and artificial baits. Some also use both fly-fishing and spinning or bait casting tackle rigged with

[32] Wright, *Ozark Trout Tales*, 28-29.
[33] Mark Oliver to Mark Hudy, Trout Biologist, 23 September 1985, AGFC-TPO.

natural and artificial lures. Towards the end of the 1980s about 85 percent of anglers were using some form of natural bait.[34]

The main reason for the use of natural baits among anglers is the fact that they are effective. This is evident in the numerous records book trout caught in 1988. During August alone three brown trout of over 30 pounds were caught from the Norfork tailwater. The largest weighed 38 pounds, nine ounces and was caught by Mike Manley using a spinning reel and treble hook baited with corn. Sometimes known as a Del-Monte jig, corn is a popular "natural" bait among tailwater trout anglers.[35] Since the trout was caught using a treble hook the International Game and Fish Association would not recognize the trout as a new world record. Eventually the National Fresh Water Fishing Hall of Fame did recognize the fish as an all-tackle world record, eclipsing the previous record set 35 years previously in Argentina.[36]

This world record and the many other big brown trout being in caught in Arkansas led to a flurry of articles in local newspapers, resort newsletters, and national outdoor publications such as *Field & Stream* and *Outdoor Life*. With captivating titles such as "Arkansas' Monster Browns" and "A Brown for the Books" they describe in detail the world record catch and entice anglers with claims of even larger trout. Biologists from the AGFC claimed there was "really no way of telling how big a fish" could grow in these productive tailwater streams.[37] Although the tailwaters had long been publicized as the best trout streams in the United States, they were now increasingly promoted as

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[34] Mark Hudy and Larry Rider "Brown Trout Management in the Natural State," (paper presented at Wild Trout IV Symposium, Yellowstone National Park, September 18-19, 1989), 69.
[35] Michael Pearce, "A Brown for the Books" *Outdoor Life* 182, no. 6 (December 1988), 58.
[36] United States Army Corps of Engineers, "White River and Tributaries," E-5.
[37] quoted in, "Jordon's David Wooten lands a possible state record trout," *Baxter Bulletin*, 19 August 1988, 1B.

"world-class."[38] The AGFC, outfitters, guides, and resort owners all used the world record brown trout as a marketing tool to attract anglers and their money. A billboard was soon standing alongside the highway near the Norfork tailwater proclaiming it the "Home of the Worlds Record Brown Trout," proof that it was indeed the "Best Trout Fishing Anywhere" (Figure 15).

Figure 15. Billboard near the Norfork tailwater.

Rainbow Farming and Diversifying the Fishery

The world record brown trout is one indication, or perhaps culmination, of the change in management objectives of the AGFC during the 1970-80s. At the beginning of the 1970s Arkansas' four tailwaters were being managed by the AGFC as strictly put-and-take rainbow trout fisheries. Trout were grown to about nine or ten inches in the two

[38] Steve Price, "Arkansas' Monster Browns" *Field & Stream* 93, no. 11 (March 1989), 122-123.

federal hatcheries and then released into the tailwaters to be quickly removed by anglers. For example, from 1971-73 the Bull Shoals tailwater alone was annually receiving over 800,000 rainbow.[39] Despite these massive stockings, anglers efficiently removed an estimated 95 percent of these trout in 1971 and 96 percent in 1972. During the summer months when fishing pressure was highest, anglers would actually remove more trout than were stocked.[40] Although welcomed by those anglers and guides wanting solely to catch a limit, it also meant few trout growing to larger sizes. Anglers, resort owners, and guides who remembered and experienced the fabulous rainbow trout fishing during the early days of the tailwaters longed for and pressured the AGFC for larger trout.

The AGFC attempted to alleviate some of the pressure on newly stocked trout by modifying stocking procedures. A 1971-73 creel survey showed that 60 percent of the fishing on the Bull Shoals tailwater occurred on the uppermost 32 miles from the dam downstream to Buffalo City. This same stretch of tailwater also accounted for 50 percent of the catch and 75 percent of all guided fishing trips. Fishing pressure and harvest decreased steadily downstream, with the lower one-third of the tailwater receiving four to six times fewer anglers than the upper one-third.[41] Trout were therefore stocked in decreasing numbers in relation to distance downstream from the dam. Although providing more trout in the heavily fished sections, it did not result in larger trout since fishing pressure generally kept pace with supply.

Realizing the "productive capability" of the tailwaters was not being fully utilized the AGFC began examining other options. One suggestion that was eventually done was to stock more trout during the low pressure winter months, allowing trout to grow prior to

[39] Oliver, "The Rainbow Trout Fishery," 556.
[40] Aggus et. al., "Evaluation of the Trout Fishery," 570.
[41] Ibid., 565.

the high fishing pressure spring and summer months.[42] More obvious methods to protect trout after release, including special regulations, decreasing creel limits, or having a closed season, was either not considered or deemed uneconomical. The solution chosen was to grow more rainbow trout to larger sizes before release. Instead of protecting trout through regulations after release, the AGFC chose to protect them longer in the safe confines of the hatcheries.

To grow rainbow trout to larger sizes the AGFC needed additional revenue since fingerling trout need time to grow, more feed, and more hatchery space. To this point the trout program was part of the AGFC's warm-water fisheries division, receiving most of its funding through the sale of general fishing licenses. To generate revenue specifically for the trout program a special trout permit or stamp was instituted for all trout angling within the state. The first stamps were sold in July 1971 for $2 each with nearly 42,000 sold by the first year, generating over $80,000 for the trout program.[43] The AGFC now had a reliable and steady source of revenue to support its trout stocking activities. The trout stamp revenue also marks the genesis of the eventual separation between the state's warm-water and cold-water fisheries. More importantly, it created a specific paying clientele of anglers who now had a vested economic interest in how the fisheries were managed. As the AGFC would realize, its increasingly diverse customers expected results.

The AGFC decided to use a portion of the trout stamp revenue to obtain more quality-sized rainbow trout. It began purchasing 10-12 inch trout directly from local private growers while also starting a program of growing trout in special net pens. Net

[42] Ibid., 573.
[43] "Survey of Trout Anglers, 1994," AGFC-TPO, 13.

pens consist of large nets or cages attached to pontoons floating in a lake. Smaller-sized trout from the federal hatcheries are trucked to Bull Shoals Lake and Lake Ouachita, released into the pens, and fed until they grow to about one pound. These trout are then stocked into the tailwaters during the spring months prior to the summer angling season.[44] Although these net pens can only be used for trout during the winter when surface water temperatures are sufficiently cold, they are a cost effective way to supply anglers with larger trout.

Although it had modified the distribution of trout on the Bull Shoals tailwater and was stocking more quality-sized trout, the total number of trout stocked by the AGFC remained relatively constant. During 1971-81 about 800,000 trout were released annually into the Bull Shoals and Norfork tailwaters. Stocking at the Beaver and Greers Ferry tailwaters also stayed relatively constant since both federal hatcheries were now operating at or near capacity. In contrast, fishing pressure increased about 9 percent on the Bull Shoals tailwater during this same ten-year period. The use of guides also increased during this period from 31 to 40 percent of all angling trips, resulting in an increase in the "efficiency of average and inexperienced fishermen." By the early 1980s Arkansas' trout program had "reached equilibrium" with regards to angling harvest and trout stocking.[45]

If the AGFC wanted to keep pace with angler demand while also providing larger trout, it needed to increase production of rainbow trout. The apparent solution came rather unexpectedly in 1984 when the Kroger Company donated its trout hatchery to the state. Built in 1972 by Marine Protein, Inc., and later purchased by the grocery store

[44] Hudy, "Natural State Trout," 9-11.
[45] Oliver, "The Rainbow Trout Fishery," 549.

chain, it was used to raise trout for commercial sale. When Kroger eliminated the operation it donated both the hatchery and its inventory of 1.4 million trout to the AGFC.[46] The trout program now had its own hatchery, allowing it to decide the number, size, and specie of trout grown. To offset the cost of operations it increased the price of its trout stamp from three to five dollars.[47]

Eventually renamed the Spring River State Fish Hatchery (SRSFH) it is a unique and highly productive facility. Its water originates from Mammoth Springs, an appropriately named natural spring expelling about 9.7 million gallons of water every hour.[48] After flowing downstream for several miles, this 58°F water enters the hatchery through a system of underground gravity fed pipes. This water is used to fill 14 traditional concrete raceways in addition to 36 silos or "vertical raceways." Each of these silos is 13.5 feet deep and 17.5 feet in diameter and is buried to ground level. Hatcheries using round silos such as these are extremely rare, with most using the more traditional horizontal raceways. The SRSFH is now one of the largest trout hatcheries in the eastern United States.[49]

The AGFC soon began transporting five inch fingerling trout from the federal hatcheries four times each year to the SRSFH. Fingerling trout are initially placed into the concrete raceways for about three months whereupon they reach about eight inches in length. They are then transferred to the vertical silos where they are kept for another seven to nine months before reaching 12 inches or about three-quarters of a pound.[50]

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[46] Keith Sutton, "Arkansas' Fish Factories," *Arkansas Game & Fish* 8, no. 5 (September/October, 1987), 13.
[47] "Survey of Trout Anglers, 1994," AGFC-TPO, 13.
[48] Arkansas Department of Parks & Tourism, "Mammoth Spring State Park," (2003), informational pamphlet.
[49] Arkansas Game and Fish Commission, "Spring River State Fish Hatchery, Mammoth Spring, Arkansas: 'Producing Fish for Arkansas Anglers'," informational pamphlet.
[50] Sutton, "Arkansas' Fish Factories," 13.

Now officially "quality-sized" trout, they are large enough to be stocked and caught by anglers. Some anglers still refer to SRSFH trout as "Kroger trout" since they can be identified by their unworn pelvic fins. These are distinct from trout raised in the concrete raceways at the federal hatcheries, since they hold to the bottom and fray their pelvic fins.

Perhaps the most striking aspect of this hatchery is its visual and terminological similarity to intensive farm operations raising livestock. Trout are grown in "silos" and fed a diet of "specially formulated, high-protein" commercial food that causes them to gain weight quickly.[51] These trout pellets are kept in above-ground grain bins, the same type and brand used in many livestock operations. At feeding time augers load the food from the bins into grain buggies pulled by tractors (Figure 16). The pellets are then fed to

Figure 16. Spring River State Fish Hatchery near Mammoth Spring, Arkansas.

[51] Arkanas Game and Fish Commission, "Spring River State Fish Hatchery", informational pamphlet.

the fingerling trout in the concrete raceways using "self-activated demand feeders" that dispense food in a manner reminiscent of the metal hog feeders found on many livestock farms. The larger trout swimming in the vertical silos meanwhile are fed three times each day using a "mechanical blower type feeding system." Once they have gained sufficient weight the trout are "harvested from the silos" and transported to the slaughter house (i.e. the tailwater).[52] Fittingly, anglers catching especially large trout often refer to them as "hogs."

With the addition of the SRSFH and the net pen operations the AGFC significantly increased its stocking of quality-sized trout. It now had a claim "no other state" could make, boasting that one out of every five trout stocked was at least 12 inches in length.[53] These quality-sized trout were stocked mainly during the summer months, providing instant gratification to anglers. After spending an additional $483,000 expanding the SRSFH, the number of trout stocked also increased dramatically.[54] By 1989 the state was stocking over 2.2 million trout, making its trout program "unparalleled" in the Southeast for production.[55] The state and federal hatcheries were now essentially "fish factories," annually producing millions of trout in supporting a multi-million dollar fishery.[56] The state now had enough trout to also stock smaller 4-8 inch fingerlings during the winter months, with these growing quickly to 9-12 inches before spring and summer.[57]

[52] Ibid.
[53] Hudy, "Natural State Trout," 9.
[54] Arkansas Game and Fish Commission, "1988 Trout Survey," AGFC-TPO.
[55] Hudy and Rider, "Brown Trout Management in the Natural State," 67.
[56] Sutton, "Arkansas' Fish Factories", 13.
[57] Hudy, "Natural State Trout," 11.

By the end of the 1980s Arkansas' trout program was a highly efficient and economically productive put-and-take fishery. Arkansas' first trout biologist succinctly describes the program:

> Anglers buy licenses and trout permits, and the Commission uses the money to raise hatchery trout to catchable size. The trout are put into the river in large quantities, and anglers quickly remove them. Others buy licenses and permits, and the Commission raises and stocks more trout, that are caught by other anglers, who…you get the idea.[58]

In economic terms the system was highly productive for the AGFC and for many businesses dependent on trout anglers. Estimates of its economic impact had increased steadily since the first survey completed in the late 1950s. A tourist survey in 1982 estimated that anglers spent $42 million on fishing trips on the Bull Shoals and Norfork tailwaters alone.[59] A 1986 AGFC estimate put the value of the tailwaters at $60-80 million per year.[60] In 1989 a more detailed survey estimated the value of the fishery at $143 million, although this was considered a conservative estimate since it excluded the $25 million spent by trout anglers on equipment.[61] The Arkansas trout "experiment" was unquestionably successful in economic terms, infusing millions of dollars into the local and state economy.

Although economically lucrative and efficient in producing catchable rainbow trout, the put-and-take management objectives of the trout program began a slow shift towards diversity. The main impetus for this was the disappearance of the trophy rainbow trout fishing that had made the tailwaters famous. Following a slow decline

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[58] Ibid., 21.
[59] Oliver, "The Rainbow Trout Fishery," 550.
[60] Hudy, "Natural State Trout," 9.
[61] Hudy, "Brown Trout Management in the Natural State," 67.

starting in the early 1960s, the symbolic end of this era was the catching of the current state record rainbow trout from the Bull Shoals tailwater in March 1981. The AGFC thereafter began working increasingly towards creating a trophy brown trout fishery to replace trophy rainbow trout. The first indication of this shift was the resumption of brown trout stockings by the AGFC in 1981 following a hiatus of 24 years.[62] Although initially "seed" stockings to supplement natural reproduction at the Bull Shoals and Norfork tailwaters, they soon were viewed as a way to supply additional trophy trout.[63] These stockings would continue throughout the 1980s, although more emphasis would be placed upon protecting and enhancing natural reproduction of brown trout.

Another indication of the shift away from solely rainbow trout production occurred in 1983. Seeking to further add to the state's "diverse trout fishing opportunities" the AGFC released another exotic specie into the tailwaters. In a piscatorial swap, Wyoming received smallmouth bass while Arkansas obtained cutthroat trout eggs. The finely-spotted specimens sent to Arkansas are unofficially called the "Snake River" subspecies since they are native to that famous western trout stream.[64] These were initially released into the Norfork and Bull Shoals tailwaters, although releases were later made into both the Beaver and Greers Ferry tailwaters.[65] Cutthroats, with their namesake reddish-orange cut near their throat, quickly became popular as a rather rare and unique trophy. Although not as large as brown trout or as abundant as rainbows, their attraction is due more to their beauty and rarity. Since they spawn in the spring like rainbow trout they have not been successful in reproducing in the tailwaters,

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[62] Jones, et. al., "An Evaluation of the Effects," 14.
[63] Jim Spencer and Keith Sutton, "Natural State Trout," *Arkansas Wildlife* 27, no. 2 (Summer 1996).
[64] Gregg Patterson, "Cutthroat Trout Quickly Wins Popularity in Arkansas," *Arkansas Outdoors* (December 1992).
[65] Gregg Patterson, "The Cutthroat Trout," *Arkansas Wildlife* 23, no. 1 (Spring 1992), 19-20.

and must be continually stocked. The AGFC views the cutthroat introduction as "extremely successful" since it adds another trophy fish to the tailwaters.[66]

Perhaps the most significant event to alter the direction of the trout program was the hiring in 1985 of Mark Hudy, the state's first cold-water fisheries biologist. Prior to this hire, trout management had been handled at the “local level” by biologists trained primarily in the management of warm-water species. The program, therefore, was lacking any "specific objectives" or guidance in relation to trout management, relying instead upon the experience and collective knowledge gained by biologists over the previous 35 years.[67] Although these biologists had done a commendable job, the agency now had an individual to coordinate trout management statewide. More importantly, they introduced new management techniques based upon knowledge and experience of cold-water fisheries. They understood and argued that the productivity and potential of the tailwaters was not being fully utilized. Instead of solely trying to increase the numbers and sizes of stocked trout, they sought to protect trout after release and to diversify the fishery by putting increasing emphasis on natural reproduction and habitat improvement.

One of the most noticeable changes in the mid-1980s was the shift toward managing anglers instead of trout. As one writer expressed, after "years on the shoreline" the AGFC was finally "wading into the swift waters of special regulations."[68] The trout program now sought to manage anglers by placing limitations on equipment, reducing creel limits, creating size limitations, and requiring catch-and-release fishing in certain areas. Protecting large trout through catch-and-release was not entirely new since the White and North Fork Outfitters Association (WNFOA) had already initiated a voluntary

[66] Hudy, "Natural State Trout," 11.
[67] Mark Hudy, quoted in, Spencer, "Special Trout Regulations," 23.
[68] Spencer, "Special Trout Regulations," 23.

program. Realizing that increasing fishing pressure was having a detrimental effect on the number of trophy brown trout, the WNFOA began its Trophy Trout Release Program in 1983.[69] Anglers catching and releasing any large trout can fill out an application to receive a trophy pin and paper certificate verifying their trout as a "trophy." Instead of killing and hanging a trout on their wall, the goal was to provide anglers with a pin and certificate to display. This program proved to be very successful in prompting anglers to release larger trout. I can attest to this since I have a pin and certificate verifying that I caught a "trophy" from the Bull Shoals tailwater.

The trout program's goal of actually creating a law requiring anglers to release trout was more controversial. Anglers and guides fishing the tailwaters were accustomed to having few regulations limiting how and where they could float and fish. One change had been on creel limits, decreasing from eight to ten trout per day during the 1950s and 1960s to six by the 1980s. Another notable regulation was the outlawing of herding trout. This unique method developed after anglers noticed that in the clear tailwaters trout could be forced into small areas and more easily caught. Anglers began using several johnboats in tandem to herd trout into deeper pools or against underwater rock shelves. They also threw rocks or waded to congregate trout into certain areas during low water. Once trout were concentrated anglers began fishing. This method was so productive that the AGFC was forced to pass an emergency regulation in May 1981 outlawing the practice.[70] The trout regulations still state that trout "may not be driven, harassed or pursued with noise, objects, boats, or by wading to concentrate them."[71] The AGFC has an intriguing and undoubtedly rare photograph showing anglers herding trout

[69] Harry Middleton, "The Ozarks: Where the Big Trout Run," *Southern Living* 24, no. 6 (June 1989), 86.
[70] Wright, *Ozark Trout Tales*, 69.
[71] Arkansas Game and Fish Commission, *Arkansas Trout Fishing Guidebook* (2005), 18.

with a semi-circle of johnboats (Figure 17). Another photograph shows one of the anglers proudly hoisting up a big brown trout caught using the technique (Figure 18).

Figure 17. Anglers herding trout with johnboats.

To pass more restrictive regulations the AGFC would have to convince anglers and outfitters that protecting trout was beneficial both to the fishery and to business. The agency chose the Beaver tailwater for a "pilot program" to test the effectiveness of protecting brown trout through special regulations. Beaver tailwater was most likely selected since it received the least fishing pressure of the four tailwaters and also had comparatively few outfitters or guides. It also had a newly established brown trout fishery, with the first stocking occurring in 1985. The fingerlings stocked averaged only seven inches in length and therefore needed to survive several years to reach catchable

Figure 18. A brown trout caught while herding.

sizes. With the intense fishing pressure the AGFC estimated that these trout were experiencing annual mortality rates of about 95 percent.[72] To protect these fingerlings the agency proposed allowing anglers to keep only two brown trout each day, with these having to be at least 16 inches in length.

In hindsight this regulation seems rather unobtrusive, but at the time there were many who were strongly opposed. These people believed it would increase the number of larger brown trout that would in turn feed more aggressively upon smaller rainbow trout. Although brown trout would reach larger sizes, it would be at the expense of rainbow trout fishing. For those anglers and guides wanting to catch rainbow trout, the new regulation was therefore unwarranted. Although the AGFC claimed that the

[72] Larry Dablemont, "Brown Trout Need Revised Rules," *Outdoor Life* 182, no. 1 (July 1988), 11.

regulation was supported by all "major trout fishing special interest groups," it was forced to compromise by reducing the length limit on brown trout to 16 inches since setting it higher would have resulted in even larger trout more capable of eating rainbow trout.[73] As with all hunting and fishing regulation changes in Arkansas, implementation required a majority vote from the seven members of the Arkansas Game and Fish Commission. Appointed by the governor to seven-year terms, each represents a congressional district, and in a rural state where hunting and fishing is popular and economically important they wield considerable political power.

Despite the objections by some the regulation passed and went into effect on 1 January 1988. Later AGFC surveys showed the regulation had an "immediate impact," with survival rates of stocked brown trout more than doubling when compared to previous unprotected stockings.[74] Despite its passage the AGFC did not consider it the optimum regulation. A better option would have been to include an artificial-lure-only restriction to further protect brown trout. Trout hooked and released using natural baits tend to die at higher rates than those hooked and released with artificial baits. The AGFC claimed that the use of natural baits resulted in about 50 percent of caught and released trout dying.[75] Despite this evidence it was decided that an artificial-lure-only regulation was not a "politically viable" option at the time since about 85 percent of anglers used natural baits.[76]

Although not included at the Beaver tailwater, the state's first artificial-lure-only regulation also went into effect on 1 January 1988. This regulation was included along

[73] Hudy, "Brown Trout Management," 69.
[74] Ibid., 69.
[75] Mark Oliver to Mark Hudy, 23 September 1985, AGFC-TPO.
[76] Hudy, "Brown Trout Management," 69.

with catch-and-release on Dry Run Creek. As its name implies, this one-half mile long stream was originally an intermittent stream draining into the Norfork tailwater several hundred yards below the dam. When the NNFH was built the outflow from the hatchery was piped into the creek, transforming it into a constantly flowing cold-water stream. Although closed to angling since the 1950s it supported a large population of trout swimming upstream from the Norfork tailwater. The AGFC originally proposed opening the stream to anyone practicing catch-and-release, but this was opposed by "local trout-dock people" who feared a loss in business on the Norfork tailwater.[77] The AGFC compromised by designating the stream catch-and-release-only with a single, barbless hook. It is also open only to children 16 years of age or younger who are accompanied by an adult.[78] Dry Run Creek is now one of the most well-known trophy trout fishing streams in the state, and a popular location for teaching children how to fly-fish.

The passage of these two special regulation areas marks the genesis of the move toward more and stricter regulations. The AGFC trout program was slowly transitioning from strictly a put-and-take management philosophy to include put-grow-and-take. More important was the delineation between managing rainbow trout and brown trout. Brown trout were increasingly managed for trophy production while rainbow trout were managed to provide high volumes of catchable fish. The agency was striving to meet the demands of two types of anglers; those wanting to catch larger trophy trout and those wanting to catch numerous smaller trout. Of course, many anglers are included in both categories. Although put-grow-and-take management was limited, it would become increasingly popular in the next decade. The combination of millions of stocked trout

[77] Dablemont, "Brown Trout Need Revised Rules," 11.
[78] Mark Hudy to Clinton Traver, 29 September 1987, AGFC-TPO.

and larger trout protected through stricter regulations would prove to be enormously popular and economically lucrative in the near future.

Instream Flow

While Arkansas' tailwater trout fishing grew in popularity during the 1950s and 1960s, researchers throughout the country began examining the ecological consequences of dams. By the late 1960s many of the ecological impacts of dams were now becoming apparent, spurring research to assess and document changes. To this point most of the published academic articles concerning dams had been engineering studies relating mainly to reservoir safety.[79] During the early 1970s researchers began examining a broader range of issues, from changes in channel morphology and fish migrations to loss of wetlands and riparian habitat.[80] Spurred by the passage of the National Environmental Policy Act in 1970 researchers began examining the impacts of dams in a "more meaningful manner," especially in relation to issues of water resource policy.[81] This research was also driven by the increasing public awareness embodied in the emerging national environmental movement.

One specific issue increasingly scrutinized was the amounts of instream flow emanating from dams. Unlike other ecological changes that can take years to develop, the amount of water flowing from a dam and its impact on downstream fisheries is quickly apparent. This is especially true in arid western states where competition over water for offstream uses is intense, often resulting in minimal amounts of instream flow.

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[79] Petts, *Impounded Rivers*, 7.
[80] Ibid., 10-11.
[81] John Peters, "Enhancing Tailwater Fisheries" in G.E. Hall and M.J. Van Den Avyle, ed. *Reservoir Fisheries Management Strategies for the 80's*, Reservoir Committee, Southern Division American Fisheries Society (Bethesda, 1986), 278.

Researchers interested in the issue convened at the first instream flow conference in the United States in Logan, Utah in 1975, with another the following year in Boise, Idaho.[82] Revealing the complex interdisciplinary nature of the issue, the Boise conference's goal was to provide solutions to "technical, legal, and social problems" caused by increasing competition over instream flows.[83]

For those familiar with the use and management of Arkansas' tailwaters, the complexity of instream flow was already well-known. Although an informal agreement had been reached between the Corps, SPA, and the AGFC over releasing adequate amounts of water for the trout fishery, these respective agencies still held widely diverging views on the issue. A timely series of letters reveals the positions of each agency prior to the eventful summer of 1971. The AGFC stridently maintained that adequate instream flows were required as mitigation since the federal dams had "destroyed" the native fishery.[84] Although it agreed that Congressional re-authorization was necessary to reallocate water storage for the tailwater fisheries, it argued that the cost of these studies should be born by the federal government. Director Andrew Hulsey outlined his agency's position by stating that the federal government should "satisfactorily mitigate the damage" by "guaranteeing release of cold water" every day from April-November.[85] Although mitigation was the primary justification for this demand, the AGFC also stressed the economic importance of the trout fisheries to the local and state economy.

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[82] Gillilan, *Instream Flow* Protection, 111.
[83] John Orsborn and Charlena Allma, ed. *Proceeding of the Symposium and Specialty Conference on Instream Flow Needs, Vol. 1* (Bethesda: American Fisheries Society, 1976).
[84] Andrew Hulsey to Senator J.W. Fullbright, 4 June 1971, AGFC-TPO.
[85] Ibid.

The SPA meanwhile believed it had been and was cooperative in maintaining the trout fisheries. It argued that the procedure currently in place during low-flow periods was "relatively successful" in meeting the needs of the trout "industry." It argued that the current procedure was in place despite the trout fisheries not being a congressionally authorized purpose. The SPA also justified its position by noting that it made additional cold water releases for the trout fisheries despite losing revenue in the process. By the early 1970s it estimated that supplying this water during summer and fall cost the agency approximately $96,000 annually.[86] The Corp's position closely matched that of the SPA, agreeing that a "generally sufficient" amount of water was being released to maintain the trout fisheries. During those periods when hydropower generation releases were not being made, water releases from the house generating units, leakage from the dams, and flow from downstream springs provided sufficient water to maintain the fishery. It therefore maintained that "adequate provisions" had been made to supply cold water during the critical summer and fall period despite the fact that the "authorized project storages" do not include water for the trout fisheries.[87]

The provisions in place would soon prove insufficient in avoiding another trout kill. During the three-day 4th of July weekend of 1971, hydropower generation at the Bull Shoals tailwater was shut down, with only minimal amounts of cold water flowing downstream. Hot temperatures warming the water soon created a critical situation for trout. Local guides and anglers began reporting dead or dying trout to the AGFC. Biologists investigating these claims did find numerous dead trout, although once again an accurate count proved elusive. Following its investigation the AGFC was soon

[86] United States Department of the Interior, Southwestern Power Administration, "Water Temperature Problem, White River, Arkansas," 12 July 1971, AGFC-TPO.
[87] William Burns to Andrew Hulsey, Director, 17 June 1971, AGFC-TPO.

officially estimating that 200,000 trout valued at slightly over $362,000 were killed by warm water temperatures. This included over 50 percent of the trout between Calico Rock and Sylamore and 100 percent from Sylamore to Lock and Dam #3.[88]

Using information supplied by the AGFC, local newspapers soon ran bold headlines such as "The Big Trout Kill."[89] The story eventually found its way into the prominent and widely circulated national publication *Outdoor Life*. Under the disquieting title "Death of the Rainbows," the article describes the trout kill as the worst in the state's history, directly blaming the SPA for not releasing enough cold water to protect the trout.[90] Although previous trout kills were widely reported in local or regional news outlets, this is apparently the first to be reported by the national media. While an indication of the tailwater's national notoriety, it also reveals the increasing propensity of the AGFC to collaborate and share information with media sources to push its agenda of obtaining increased instream flows.

The *Outdoor Life* article prompted an especially bitter rebuttal letter from the SPA to AGFC Director Andrew Hulsey. The SPA felt it had been unjustifiably accused of causing the trout kill by not releasing enough cold-water. It argued that the agency should be given “credit” for supporting the procedure currently in place to prevent trout kills. Although not perfect, this procedure had kept water temperatures suitable "98% of the time." The SPA also felt the public should be informed that the trout fishery below Bull Shoals is put-and-take, with over 700,000 trout stocked during the past year.[91] Since the tailwater receives “constant replenishment” of trout the impact of the kill is only

[88] Bill Mathis and Robert Baker, "Administrative Report: White River Trout Kill - July 5-6, 1971," AGFC-TPO.
[89] “The Big Trout Kill,” *Arkansas Gazette*, 28 July 1971.
[90] George Purvis, "Death of the Rainbows," *Outdoor Life* (November 1971), 46.
[91] Alva Hickerson to Andrew Hulsey, 18 November 1971, AGFC-TPO.

temporary, and much different than in a natural stream requiring a “rebuilding" of the resource.[92] The SPA was essentially arguing that, since the tailwaters were artificial human-made fisheries, they were temporarily expendable.

Perhaps even more damaging was the distrust and outright hostility that developed between the state and federal agencies in relation to quantifying the trout kill. The SPA questioned why AGFC officials reported finding only 14 dead trout while estimating over 200,000 killed. The SPA therefore found the estimate “inconceivable,” suggesting that trout kill estimates should be “documented and backed up by firm data.”[93] The AGFC later confessed that an "error” had “crept in" concerning their estimate, suggesting that the kill was 75 percent of the previous total. Later references report that 150,000 trout were killed.[94] This discrepancy further soured an already contentious and often adversarial relationship between the AGFC and SPA. Over thirty years later, SPA officials would still be questioning whether reported trout kills on the tailwater had actually occurred, believing that AGFC personnel sometimes planted dead trout to further their goal of obtaining increased instream flows.[95]

The trout kill did provide impetus for action. A flurry of memos between congressional representatives, the AGFC, Corps, and SPA concerning instream flows were sent. The AGFC allied itself closely with its congressional representatives, often providing them with a "suggested letter” detailing the need for increased instream flows.[96] Members of the Arkansas congressional delegation responded, undoubtedly driven by the economic and recreational importance of the fisheries to their constituents.

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[92] James Watt to Governor Dale Bumpers, 7 October 1971, AGFC-TPO.
[93] Alva Hickerson to Andrew Hulsey, 18 November 1971, AGFC-TPO.
[94] Andrew Hulsey to Colonel Donald Weinert, 17 March 1975, AGFC-TPO.
[95] George Robbins and Bethel Harrold, interview with author, Tulsa, OK, 24 August 2004.
[96] Andrew Hulsey to Governor Dale Bumpers, 26 August 1971, AGFC-TPO.

Some of these letters lamented that trout kills occurred "regularly, in fact almost annually" on the tailwaters, with the solution being the release of enough water to "keep those trout alive."[97] The SPA and Corps meanwhile contended that the operating procedure in place is the “best method” to maintain the trout fisheries, while also reassuring congressional representatives that in the future they would take a "more active role" in protecting the trout.[98]

One thing that all the parties could agree upon was that a long-term solution required congressional reauthorization to include water storage for instream flows. Conceding that a "restudy of the reservoir goals" was necessary to obtain instream flows, the AGFC and the state congressional representatives began actively pursuing this course of action.[99] The Corps concurred, insisting that the long-term solution was to "restudy" the operation of the dams, to determine if legislation “authorizing the reallocation of project storage” was possible.[100] Although no funding was provided, these discussions led to a resolution approved by the Committee on Public Works in the House of Representatives to restudy the possibility of modifying Bull Shoals and Norfork Lakes to increase instream flows.[101] Although passed, no action would be taken.

As the political negotiations continued, an interim water release plan was developed to protect the trout. The Corps agreed to make adequate weekend releases to limit the maximum water temperature at Sylamore to 75°F. Although releases would still be based upon predicted air temperatures, the plan was modified to avoid warming water over three-day weekends. On the day prior to a three-day weekend extra hydropower

[97] Congressman Wilbur Mills, to C.B. Rogers Morton, 27 July 1971, AGFC-TPO.
[98] William Burns to Congressman J.W. Fulbright, 29 July 1971, AGFC-TPO.
[99] Gene Goss to Andrew Hulsey. 9 September 1971, AGFC-TPO.
[100] William Burns to Congressman J.W. Fulbright, 29 July 1971, AGFC-TPO.
[101] Spotts, " White River Minimum Flow Study," 6 June 1991, AGFC-TPO.

generation would be used to release additional water. Also, extra generation would occur during at least one weekend day during a three-day weekend. This plan also called for monitoring of actual water temperatures during the weekends to avoid unpredicted high air temperatures.[102]

Despite these additional precautions, water temperatures in the Bull Shoals tailwater again reached critical levels in June 1972 and August 1973.[103] Later reports discussing the 1972 trout kill state that it was "confirmed" by the AGFC to have occurred on 19 June near Sylamore.[104] This contradicts a report filed by AGFC biologist Robert Baker after he personally floated three miles of the tailwater to verify the alleged trout kill. His report states that although water temperature readings reached 78°F it was his opinion that "no trout were lost due to high water temperatures."[105] A report filed the next day by the Chief of Fisheries states that water temperatures were "critically high" near Sylamore on 19 June while also concluding that these high temperatures caused a "possible mortality" of trout.[106] According to these memos the AGFC was confirming trout kills by water temperature readings and not by actual dead trout. The 1972 trout kill would later appear as a confirmed trout kill in subsequent letters.[107]

Following these kills it was clear that the interim plan was not keeping water temperatures sufficiently cool in the lower sections of the Bull Shoals tailwater. This was due to a combination of factors; including inaccurate predictions of air temperature, the relatively short duration of water releases, and the time it takes water releases to reach the

[102] William Keech to Andrew Hulsey, 2 June 1972, AGFC-TPO.
[103] William Keith to Andrew Hulsey, 27 June 1972, AGFC-TPO.
[104] Jones et. al. "An Evaluation of the Effects," 1981, 29.
[105] Robert Baker to Bill Keith, 26 June 1972, AGFC-TPO.
[106] Bill Keith to Andrew Hulsey, 27 June 1972, AGFC-TPO.
[107] Rick Hampton and Hays Sullivan to Senator Dale Bumpers, Senator David Pryor, Governor Frank White, and Representatives Bill Alexander, Ed Bethune, John Hammerschmidt, and Beryl Anthony, 24 July 1981, AGFC-TPO.

lower ends of the fishery.[108] When water is released from the dam it may take from 16-30 hours, depending upon amount released, for it to reach Sylamore, 79 miles downstream.[109] This time delay makes avoiding trout kills on the lower section especially difficult since once high water temperatures are reported, water releases are often too late to avoid a kill. Fortunately, heavy spring rains in 1974 kept releases high during the critical summer months and no trout kills were reported, although there was still "great concern" over that prospect in future years.[110]

The low water years of the early 1970s resulted in political lobbying by the AGFC and angling interests. This eventually led to the adoption of several congressional resolutions to restudy the issue. Senator John McClellan sponsored a Senate resolution adopted on 2 August 1973 and Congressman John Hammerschmidt sponsored a similar House measure adopted on 11 April 1974.[111] These resolutions provided both authorization and funding for the Corps to begin the *White River Basin Lakes, Missouri and Arkansas* (WRBLMA) study. Begun in March 1975 its purpose was to "investigate the advisability of modifying" the operation of the six basin reservoirs in relation to "changing values and needs." Not solely concerned with instream flow it would examine water resource concerns within the entire basin, including flood control, hydropower generation, and recreation.[112] This would prove to be a daunting and complex task, requiring nearly a decade to complete.

In the meantime the Corps and SPA realized that it needed to adopt another interim plan to avoid additional trout kills. In 1976 it adopted the Administrative

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[108] Andrew Hulsey to Donald Weinert. 17 March 1975, AGFC-TPO.
[109] William Keith to Andrew Hulsey, 27 June 1972, AGFC-TPO.
[110] Jim Gaston to Congressman William Alexander, 12 April 1973, AGFC-TPO.
[111] United States Army Corps of Engineers, "Interim Stage II Report."
[112] Ibid., 7.

Seasonal Pool Process seeking to maintain adequate tailwater temperatures from May 1st through October 31st. This plan relied upon inflow into the reservoir flood pools during winter and spring for later release during the critical season. It also continued to rely upon predicted air temperatures to determine when additional water releases should be made. The plan called for three-day average releases of 2,000 daily second feet (d.s.f.) or two-day consecutive releases of 2,000 d.s.f. to maintain downstream temperatures. Since the plan was administrative and not legislative, these releases were still dependent upon the need for electricity.[113] Its primary weakness was its reliance upon sufficient inflow into the reservoirs during winter and spring to fill the flood pools. As history had shown, this did not always happen. Although no trout kills were officially reported from 1977-80, water temperatures "equaled or exceeded" 80°F a total of 55 days.[114]

Continuing an amazingly consistent decadal pattern, drought once again hit the region during 1980-81. Minimal precipitation within the basin dropped the reservoirs to their lowest levels since 1965. Water releases from Bull Shoals Dam were reduced to only 50 c.f.s. for "extended periods."[115] Following the official procedures in place, personnel at Jack's Fishing Service near Sylamore recorded water temperatures of 75°F on 19 July 1981. Efforts were made to contact the Corps to release additional water, but since it was a Sunday no one could be reached. After finally reaching a Corps official in Little Rock an additional two hours of water releases were made. These proved

[113] Spotts, "White River Minimum Flow Study," 6 June 1991, AGFC-TPO, 5-6.
[114] United States Fish and Wildlife Service, "Summary of Findings: Fish and Wildlife Resource Problems and Opportunities Associated with the Operation of the U.S. Army, Corps of Engineers White River Basin Reservoirs, Arkansas and Missouri Project," Fish and Wildlife Coordination Act Report, Atlanta, Georgia (June 1985), 5.
[115] Earl Zimmerman and Thomas Beitinger, "Investigations of Causes of Trout Mortality in Artificial Cold Water Fisheries Below Hydropower Facilities in the Southwest," Department of Biological Sciences, North Texas State University, Denton, Texas (November 1982), 27.

insufficient, with water temperatures the next day climbing to 82°F at Sylamore. Anglers and guides once again reported dead and dying trout.[116]

Although "witnessed by a large number of fishermen" and several members of the game commission, an accurate quantification of the kill again proved difficult. Since the main kill reportedly occurred during the evening hours, darkness made collecting dead trout difficult. Although several hundred "dead or dying" trout were found before dark, later water releases from Norfork Dam may have carried additional carcasses downstream. The following day "several (<50)" additional dead trout were found. Although only several hundred trout were purportedly found, the AGFC based its assessment on the number of trout recently stocked along with a decline in the number of trout that anglers subsequently caught from the area. The AGFC therefore estimated that 8,185 trout died.[117] Interestingly, a later study determined that 98 percent of trout stocked in the Bull Shoals and Norfork tailwaters from May-August 1981 were actually harvested. This high percentage was "probably" due to some trout being caught that were actually stocked prior to May and from "migration from other areas."[118]

The trout kill prompted the chairman and vice-chairman of the Game and Fish Commission to write a particularly vehement letter to Arkansas' entire congressional delegation as well as Arkansas' governor. The letter stated that this trout kill was just the "latest in a growing line of disgusting and disgraceful" kills on the Bull Shoals tailwater dating back to the 1950s. They argued that the state's 150,000 anglers were once again "forced to suffer" the consequences of rising water temperatures, with many families

[116] Robert Baker and Larry Rider, "White River Temperature Trout Kill," July 1981, AGFC-TPO.
[117] Ibid.
[118] Zimmerman, "Investigations of Causes of Trout Mortality," 27.

"packing up in sadness," forced to go home since there were "no trout to be caught."[119] Despite the hyperbole, the letter had its intended purpose, with Governor Frank White soon protesting Corps policies and enlisting the aid of Representative Ed Bethune in seeking solutions to the problem.[120]

This letter and the trout kill itself resulted in numerous additional letters and rebuttals between elected officials and various agency personnel. The AGFC argued that the policy in place was obviously not working and wanted releases to be made "solely" for the fisheries, not precluded by the need for hydropower.[121] Its letters stressed how the high water temperatures negatively impacted a fishery economically important to the local and state economy. The SPA meanwhile was mainly concerned about the "growing tendency" to use water storage for unauthorized purposes, negatively affecting its ability to meet its contractual agreements with its customers and its repayment obligations to the federal treasury.[122]

These letters and undoubtedly the associated political pressure led the Corps and SPA to further modify their operations. In 1982 they agreed to a Memorandum of Understanding (MOU) that increased the combined three-day period water release from Bull Shoals and Norfork Dams to 2,000 d.s.f. when air temperatures at Calico Rock were forecasted at or above 85°F and lake elevations were above 649 feet at Bull Shoals Lake and 545 at Norfork Lake. Although this plan was "likely to sustain trout" during most years it still had some drawbacks First, the plan was still based on the premise of sufficient inflow into the flood pools during late winter and spring for later release during

[119] Hampton to Senator Dale Bumpers et. al., 24 July 1981, AGFC-TPO.
[120] "Corps policy is protested by Governor," *Arkansas Democrat*, 31 July 1981, 2B.
[121] Steve Wilson to Colonel Larry Bonine, 15 September 1981, AGFC-TPO.
[122] James Hammet to General Hugh Robinson, 26 August 1981, AGFC-TPO.

the critical period of late summer. Secondly, water storage was still "rigidly earmarked for power generation" with water in the flood pools considered as additional hydropower storage.[123] The Corps and SPA had previously agreed in another Memorandum of Understanding in July 1980 that even during flood releases hydropower generation would be used to meet firm power needs.[124] Finally, the combined three-day 2,000 d.s.f. of water was still dependent upon the need for hydropower generation, resulting in long intervals between releases and warming water temperatures. For example, using these procedures, water temperatures exceeded 73°F every year from 1989-96, a total of 136 days.[125]

Although increasing instream flow was the answer to avoiding high water temperatures, no study had ever been conducted to determine actual optimum minimum flows. As part of its ongoing basin study, the Corps provided funds to the USFWS to conduct a study within its National Reservoir Research Program to determine minimum flow needs for the Bull Shoals, Norfork, and Greers Ferry tailwaters. Researchers utilized the Incremental Flow Methodology (IFM), a model widely applied in determining minimum flows.[126] The IFM actually consists of two models; a hydraulic simulation model examining instream flows at various discharges and a second model that uses this information to determine potential fish habitat. It identified the following optimum flows; 1,000-1,200 at Bull Shoals, 500-700 c.f.s. at Norfork, and 500 c.f.s. at Greers Ferry. These flows would "maximize" habitat for trout and benthic

[123] United States Fish and Wildlife Service, "Summary of Findings," 5.
[124] United States Army Corps of Engineers, "White River Minimum Flows Reallocation Study Report," (July 2004), 6.
[125] John Stark and Stan Todd, "An Evaluation of Bull Shoals and Norfork Tailwaters ADYN-RQUAL Modeling: Recommendations for Minimum Coverage and Temperature Control Flows, and Dissolved Oxygen Improvements," 18 August 1998, AGFC-TPO, 5.
[126] Spotts, "White River Minimum Flow Study," 6.

macroinvertebrates by increasing the overall wetted area within the tailwaters. For example, at the Bull Shoals tailwater this meant an increase in wetted area from less than one acre per 1,000 feet of channel to three acres.[127]

Following this examination, the long awaited WRBLMA study was completed in 1985. The study examined the potential for "solving or ameliorating" problems by reallocating water storage between "existing project purposes" and for additional purposes such as recreation.[128] It examined eight different plans that included computer modeling of each to determine benefits and costs. The only plan providing positive outcomes was to revise the Newport regulation stages, which would provide more flood control without "adversely" affecting recreation or hydropower production. The report also recommended that only "minor" operational changes were appropriate at the lakes, and that another study was necessary to determine how these changes would influence regulating stages and release patterns.[129] Although these findings were not encouraging to those wanting guaranteed minimum flows, the AGFC continued pursuing the issue.

Only four years after the WRBLMA found that reallocation of storage was not economically justified, another Corps study released in September 1989 found a different conclusion. Entitled the White River and Tributaries Reconnaissance Study (WRTRS), it was originally authorized to examine reallocation of water storage for commercial navigation on the lower White River. Following a request by the AGFC and U.S. Senators Dale Bumpers and David Pryor, the study was expanded to include examining

[127] Aggus et. al., "Evaluation of Instream Flow," 1.
[128] United States Army Corps of Engineers, "Summary Report, White River Lakes, White River Basin Arkansas and Missouri," 20 June 1985, AGFC-TPO.
[129] United States Army Corps of Engineers, "Summary Report, White River Lakes, White River Basin Arkansas and Missouri," 20 June 1985, AGFC-TPO.

ways to improve the tailwater trout fisheries.[130] Since previous studies had already determined that reallocation of hydropower storage for recreation was "not feasible," this study examined reallocation from the flood control pool.[131]

The WRTRS tested three plans; no-action to provide a baseline for the alternative plans, navigation, and recreation plan. For each of these plans an economic analysis was conducted to determine benefit-to-cost ratios. These would determine whether changes in storage allocation would "enhance the nation's output of goods and services" as outlined in the National Economic Development (NED) objectives. The navigation plan called for reallocating over 1.5 million acre-feet of water from the flood control pools to increase flows for downstream navigation. This plan was economically unfeasible since water releases would be so high that wade fishing would become impossible, riffle areas would disappear, and the streambed would be scoured.[132] To analyze the fishery plan various minimum flows at each tailwater were tested to determine the most environmentally and recreationally beneficial flows. In determining these flows the "local sponsors" decided that 100 percent reliability of flows was not a requirement so several release scenarios were determined based upon percent dependability.[133]

The study determined the optimum minimum flows for each of the four tailwaters. At Bull Shoals this was 1,000 c.f.s. at 89 percent reliability, a change that would necessitate reallocation of over 1.7 million acre-feet of water storage. For Norfork the plan called for 340 c.f.s. at 57 percent reliability, involving the reallocation of 58,000 thousand acre-feet of storage. At Greers Ferry 360 c.f.s at 100 percent dependability was

[130] Spotts, "White River Minimum Flow Study," 6 June 1991, AGFC-TPO., 8-9.
[131] United States Army Corps of Engineers, "White River and Tributaries, Reconnaissance Study," 1.
[132] Ibid., 12.
[133] Ibid., 11.

found most appropriate, requiring 471,000 acre-feet of storage. Finally, at Beaver 300 c.f.s. at 40 percent reliability was identified, requiring 112,000 acre-feet of storage.[134] These flows would be a significant increase from current minimum flows of 210 c.f.s. at Bull Shoals, 115 c.f.s at Norfork, 70 c.f.s. at Greers Ferry, and 55 c.f.s. at the the Beaver tailwater.[135] The higher minimum flows would cover the average shoal area below each tailwater to a depth of one foot, a significant increase from the current two to five inches.[136] Although 1.5 feet of depth at 100 percent reliability would provide the most "environmentally beneficial" scenario, this was deemed impractical due to the large amount of storage needed to maintain this coverage.[137]

Minimum flows that would cover the shoals to a depth of one foot were found by the Corps to be economically feasible. These flows would provide nearly $12 million in additional economic benefits, which was more beneficial than flood control storage. Hydropower revenues meanwhile would also increase by an estimated $2.7 million annually. When compared to flood control benefits, water storage for the trout fisheries showed a benefit-to-cost ratio of 6.6 to one. The study even examined a more conservative economic analysis of the fishery benefits. Despite using a lower estimate of the value of a day of fishing, this calculation still found a "high" benefit-to-cost ratio of 3.2. to one.[138]

The ecological and angling benefits of these minimum flows for the downstream fisheries were unarguable. Greater water depth would significantly increase the tailwaters surface and the permanently wetted area, providing more habitat for trout

[134] Ibid., 11.
[135] Ibid., E-11.
[136] Ibid., E-11
[137] Ibid., E-13.
[138] Ibid., C3-C-4.

spawning and foraging. It would also increase habitat for forage fish and macroinvertebrates, which would in turn increase growth rates and the potential to produce "more frequent national and world record" trout. Increased flows would also provide sufficient depth to navigate the tailwaters in boats, while still allowing for wade fishing. It would also improve stream aesthetics by decreasing the amount of streambed exposure. These factors would increase recreational use on the tailwaters by an estimated 34 percent.[139]

The findings of the Corps WRTRS were extremely positive toward increasing instream flows. The issue now became how to pay for these changes. Although economically feasible it required non-federal cost sharing to actually implement the reallocation. The guidelines for this process were established with the passage of the Water Resources Development of Act (WRDA) of 1986. The WRDA requires a 50/50 cost share agreement between the federal government and a non-federal sponsor. The local sponsor is responsible for 50 percent of the costs of the necessary feasibility study, annual storage costs for water reallocated to recreation, and any construction costs. If the AGFC agreed to be the non-federal co-sponsor it would cost the agency a considerable amount of money. Construction costs for dock relocations, dam modifications, and relocating recreational facilities such as campsites and restrooms on the lakes was estimated at over $12 million. The cost of modifying water storage in all four lakes would cost another $6.4 million, in addition to 50 percent of the required feasibility study.[140]

[139] Ibid., E18-E19.
[140] Ibid., 13-13B.

If the AGFC agreed to co-sponsor the feasibility study, and it was approved, then the Corps would design the plans for construction and implementation. The actual initiation of this plan would require the AGFC to sign a contract to fulfill its funding obligations. This would require the AGFC to pay its share prior to the construction contracts being advertised for bids.[141] Although the findings of the WRTRS supported many people's long-held conviction that increased instream flow would benefit the fishery, its actual implementation was far from guaranteed. Over the next decade the issue would become even more complicated, requiring additional studies, legislation, and multi-agency negotiations, cooperation, and compromise.

[141] Ibid., 14.

CHAPTER VII

A WORLD CLASS FISHERY: 1990-2004

The fishing is incomparable. The scenery is spectacular. If you're a trout angler, there's just one word that adequately describes Arkansas - paradise.

Jim Spencer and Keith Sutton, *Arkansas Wildlife*, 1996

We won't be in favor of any proposal that takes water away from us.

Bethel Herrold, Southwestern Power Administration, 2004

In 1990 Arkansas' tailwater trout program was poised to enter its sixth decade. The use, management, and economic value of the fisheries had evolved considerably over the preceding years. An ever increasing number of anglers traveled to the tailwaters for the opportunity to catch trout. Boat docks, resorts, and an assemblage of other businesses were ready to cater to the needs of these sport fishers. The AGFC meanwhile was increasingly seeking to diversify and refine its management objectives to meet the demands of all the various anglers. As the economic value of this system increased, the commercial sport fishing community and the AGFC sought to further enhance and protect the fisheries by demanding changes in the operations of the dams. A series of unexpected events in the early 1990s would continue, expand, and further complicate the long struggle to reallocate water storage for the fisheries.

A Trout Fishing Place

By the 1990s tailwater trout fisheries across the United States were recognized by fly-fishers as unique, challenging, and productive fishing destinations. Even in western states where free-flowing trout streams are abundant, anglers sought out tailwater fisheries since they provided year-round fishing and were known for supporting both high populations of trout and numerous large trout. The San Juan tailwater below Navajo Dam in northwestern New Mexico is one prime example. Flowing through a particularly arid region, its abundant population of big rainbow and brown trout has made it one of the most well-known trout rivers in the country. The San Juan and numerous other western tailwaters form what some call the "Other West," distinguishable from traditional trout streams by their unique ecological and recreational traits.[1] Ed Engle expressed a similar view in his *Fly-fishing the Tailwaters*, the first book focusing specifically on fly-fishing for tailwater trout. A how-to guide on angling western tailwaters, the author discusses in detail the ecological, physical, and operational characteristics that make them particularly challenging yet productive.[2]

In the western U.S. the popularity of fly-fishing tailwaters is understandable since this type of tackle is synonymous with trout fishing. Fly-fishing for trout has a long history in the Rocky Mountain West, and is an integral part of the culture and tourism of the region.[3] In southern states like Arkansas, fly-fishing in the early 1990s was still practiced by a relatively small minority of anglers, despite the abundance of trout water. A 1988 survey of trout anglers showed that 28 percent preferred natural bait and 15 percent preferred artificial baits, with the majority using some combination of both. It

[1] Dave Hughes, "The Other West," *Field & Stream* 54, no. 5 (September, 1989): 40-41, 138-139.
[2] Engle, *Fly-fishing the Tailwaters.*
[3] see Schullery, "Frontier Fly-Fishing in the New West."

also revealed that 46.2 percent of anglers preferred fishing from boats instead of wading.[4] Since fly-fishers most commonly wade and use strictly artificial flies, they were still in the minority on Arkansas tailwaters.

An event that did much to increase the popularity of fly-fishing in Arkansas and throughout the country was the movie *A River Runs Through It*. Released in 1992 and based on the novel by Norman McClain, it portrays the life of two brothers growing up in western Montana with fly-fishing a central theme of the story. Interspersed throughout the movie are numerous fly-fishing scenes shown against a backdrop of rugged mountains, rushing rapids, and leaping trout. The movie was a success, both at the box office and leading people to try fly-fishing. It was the first time fly-fishing "fully engaged" the attention of American popular culture, prompting many to want to experience what they saw on the screen.[5] A survey four years after the movie's release revealed that 50 percent of all fly-fishers in the U.S. had come into the sport within the last five years.[6] Neophyte fly-fishers throughout the country sought out trout streams to try their newfound hobby. The influx of fly-fishers was so intense that veterans of the sport were soon complaining about these “Minions of McClain” crowding their streams and ruining the sport.[7]

In the southern U.S. fly-fishers sought out the region's tailwaters, often the closest or only trout water available. Since the creation of the region's first tailwater trout fishery below Tennessee's Norris Dam in 1936, they had increased steadily in number over the following decades. The deep narrow valleys and reliable stream flows found

[4] Arkansas Game and Fish Commission, "1988 Trout Survey," AGFC-TPO.
[5] Owens, "Fishing the Hatch," 17.
[6] "Fly-fishing Growing," *Fly-fisherman* 28, no. 2 (February 1997), 38.
[7] Robert Cordey-Cotter, “Minions of McLain,” *Fly-fisherman* 31, no. 2 (February 2000).

across the Upland South proved to be perfect locations for numerous TVA and Corps hydropower dams. The resulting lakes were also sufficiently deep to thermally stratify and release water cold enough to support trout. Eventually, 47 tailwater trout fisheries would be established to mitigate the loss of the native fisheries, with the USFWS operating seven federal trout hatcheries in the region to supply the needed trout (Figure 19).[8]

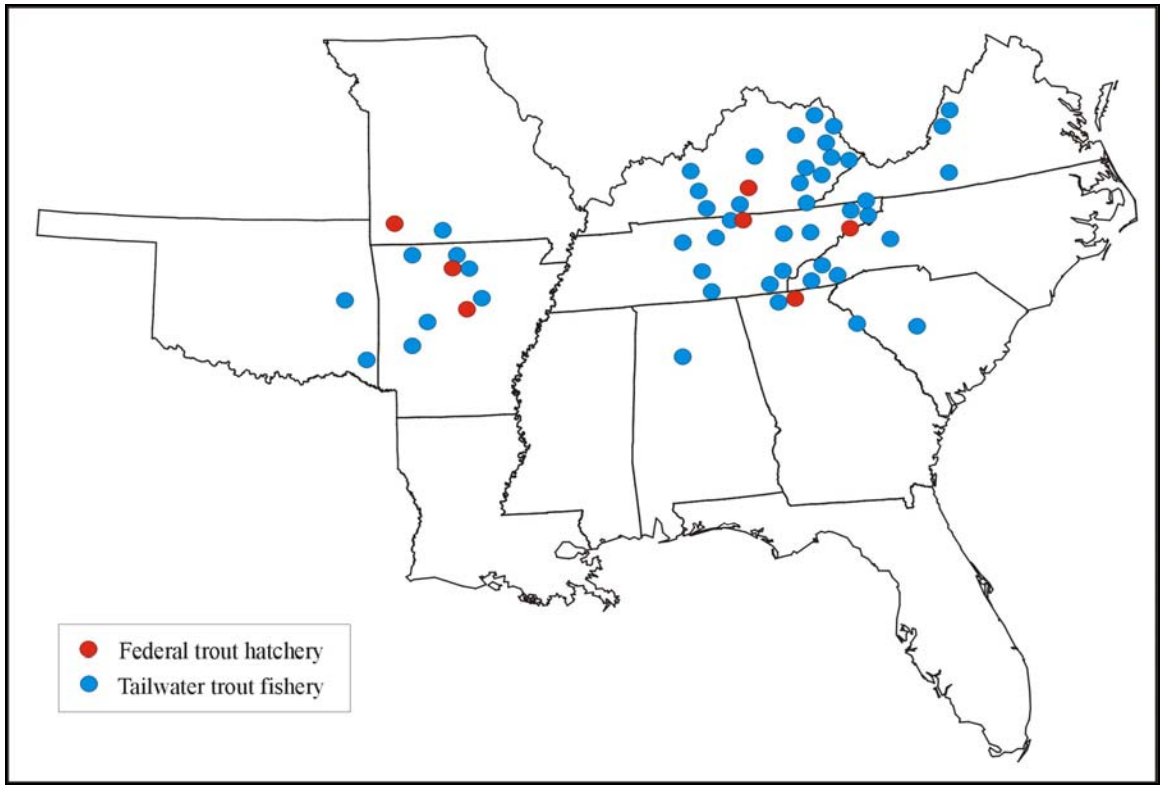

Figure 19. Southern tailwater trout fisheries and federal trout hatcheries.

These tailwater trout fisheries and hatcheries form a unique and distinct angling region. Although clustered across the Upland South, the Mississippi River Valley

[8] The tailwaters shown on this map are partially based upon a list included in Jacobs, *Tailwater Trout in the South*. I expanded this list by including Oklahoma's two tailwater trout fisheries.

noticeably divides the region. In the eastern portion of this region brook trout are a native specie and still exist in many streams, although they were not found in all of the rivers where tailwater fisheries were created. Nonetheless, the southern Appalachians extending into northern Georgia are known for trout fishing. The creation of tailwater trout fisheries therefore increased the amount of trout habitat, while also leading to the introduction of non-native rainbow, brown, and cutthroat trout.

The Ozarks and the Ouachita Mountains meanwhile contain a cluster of tailwater trout fisheries geographically separated from those found further to the east. This region is distinct since trout are not native to the region. Therefore this western cluster creates an "island" of trout fishing surrounded by plains, river deltas, and coastal lowlands devoid of trout. Although other trout fishing opportunities are found within the Ozarks, such as in spring creeks and seasonal winter fisheries, the tailwater fisheries are the most well-known and receive the most angling pressure. Anglers come to the Ozarks from considerable distances since it is the only trout fishing available. A survey of Arkansas tailwater anglers showed they travel an average one-way distance of 148 miles to Bull Shoals, 233 miles to Norfork, 145 miles to Greers Ferry, and 93 miles to the Beaver tailwater.[9] When visiting the tailwaters this is clearly evident in the variety of state license plates adorning vehicles in streamside parking lots. Anglers from Iowa, Illinois, Texas, Louisiana, Oklahoma, and Tennessee are commonplace, making one realize both the notoriety of these tailwaters and their central location within a geographic region

[9] Responsive Management, "Arkansas resident and non-resident anglers awareness of and attitudes toward fishing in Arkansas," 2000, AGFC-TPO, 41.

where trout are scarce. Although most are from bordering states, between 1995 and 1998 anglers from 47 states fished the Bull Shoals and Norfork tailwaters.[10]

The tailwater fisheries and the increasing popularity of fly-fishing also led to the establishment of numerous fly-fishing clubs. Since the establishment of the GCF in Oklahoma in 1968, fly-fishing clubs continued to be established within the Ozarks and in nearby states. Most of these are FFF affiliated clubs, and are part of the SCFF consisting of 42 clubs scattered throughout eight states. The spatial distribution of these clubs reveals their relationship with Ozark trout fishing (Figure 20).[11] West of about the 98th meridian clubs no longer exist, reflecting both the absence of trout in the Great Plains and the attraction of Ozark trout fishing. Proof of this is the annual SCFF conclave, the Sowbug, held each year in Mountain Home. During this event members from associated clubs gather to socialize, listen to various speakers, swap fishing stories, and fish for trout. It must also be noted that although most fly-fishers prefer trout, they also fish for a variety of warm-water species found throughout this eight state region.

Since the members of these clubs frequently fish Arkansas tailwaters they are also active in lobbying for their protection and enhancement. They are especially active in lobbying for the creation of special catch-and-release and artificial-lures-only areas. These provide sections of tailwaters relatively free of bait-fishers and johnboats while also supporting numerous trophy trout. Many of these clubs have also provided funds in

[10] Stan Todd, John Stark, and Mike Bivin, "Bull Shoals-Norfork Tailwater Creel, 1995-1998," Arkansas Game and Fish Commission, AGFC-TPO.
[11] Map compiled using clubs listed at Federation of Fly Fishers Southern Council, available at http://www.southerncouncilfff.org/ (February 2005).

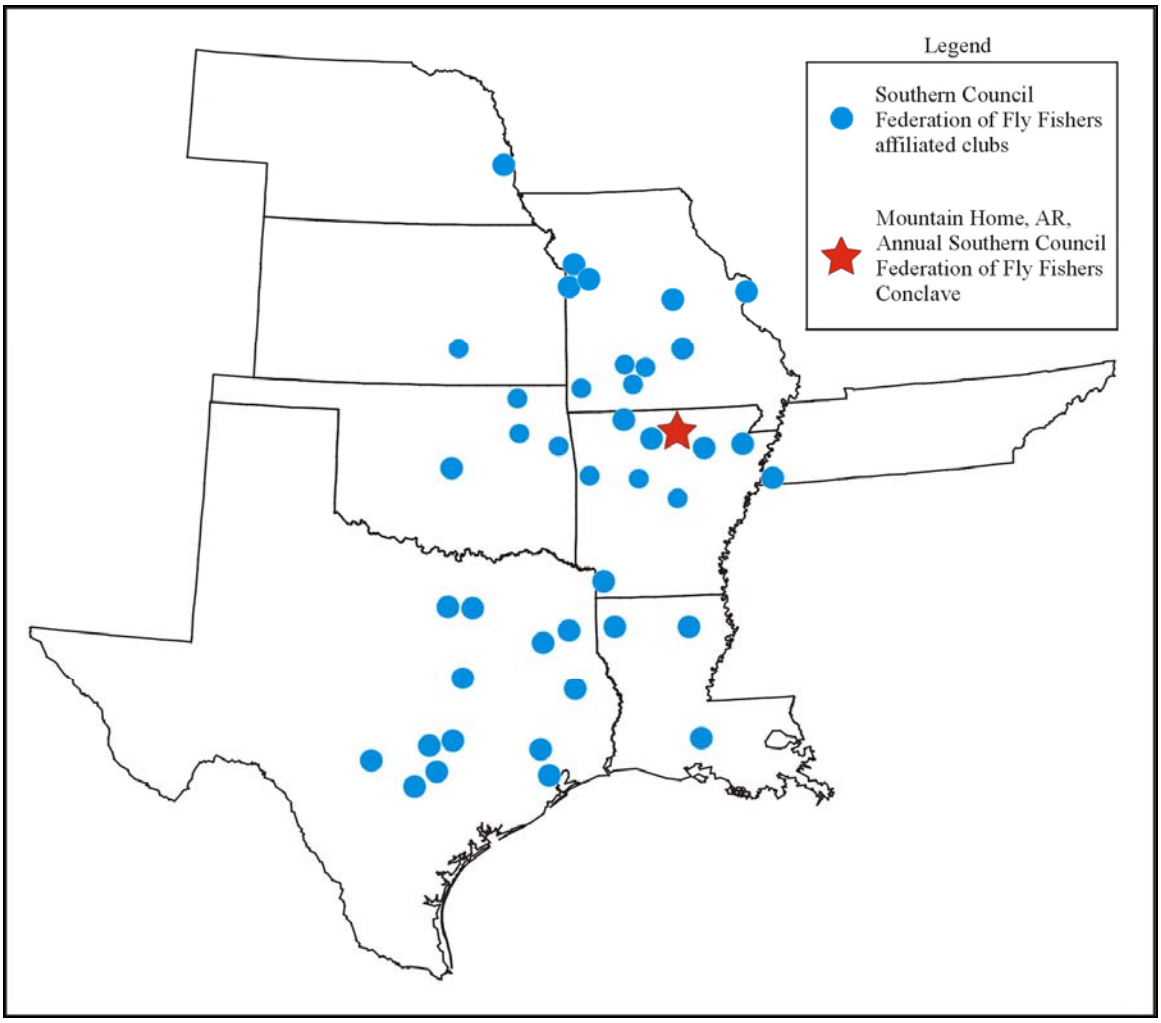

Figure 20. SCFF Clubs and annual conclave.

support of studies, habitat restoration projects, and conservation and education activities along the tailwaters. Fly-fishing clubs are also active in trying to obtain minimum flows for the tailwaters, with some providing funds for research studies.

The increasing influx of fly-fishers, coupled with the inherent danger and difficulty of fishing tailwaters, led to guides specializing in the sport. Arkansas fly-fishing guides now offer to teach the basics of fly-casting while also showing newcomers how to successfully and safely fish tailwaters. Package vacations are popular, often including lodging, tackle, and lunch on the river with the price dependent on the "level of

luxury" sought.[12] Many resorts traditionally catering to float fishers now offer fly-fishing trips. Fly-fishing is now popular enough to support fly-fishing shops along the tailwaters and in nearby cities such as Memphis and Little Rock. Dave Whitlock and his wife Emily operate a fly-fishing school near Mountain Home, with much of the instruction taking place on the tailwaters. Over the course of time Arkansas' tailwaters had become "synonymous with Southern fly-fishing."[13]

This fondness for tailwaters creates an especially interesting "paradox" for fly-fishers.[14] Both as individuals and in their various clubs and organizations, fly-fishers have always been at the forefront in protecting and enhancing free-flowing streams and wild trout. Now fly-fishers actively strive to protect and enhance tailwaters that are predominantly artificial systems reliant upon hatchery stocked trout. This transformation in attitudes was arguably inevitable, since free-flowing streams became increasingly scarce following the dam building era. It also demonstrates the excellent fishing tailwaters provide in areas outside the native range of trout. Trout Unlimited's membership even voted the five White River system tailwaters as one of "America's 100 Best Trout Streams."[15] There is also now a Tailwater Chapter of Trout Unlimited meeting monthly at the Buford Trout Hatchery near Buford Dam on Georgia's Chattahoochee River. Its membership is "proud to be associated" with this tailwater and continue to work for its "protection and survival."[16]

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[12] Stacy Kunstel, "Fishing With Dad," *Southern Living* 35, no. 10 (October 2000), 18.
[13] Bob Marshall, "Arkansas' Little Red: A Dry Fly Dream in April," *Field & Stream* 101, no. 12 (April 1997), 85.
[14] For a detailed discussion see Chapter 1 of Engle, *Fly-fishing the Tailwaters*.
[15] John Ross, *Trout Unlimited's Guide to America's 100 Best Trout Streams*.
[16] Tailwater Chapter Trout Unlimited, available at http://www.freakbox.com/tailwatertu/ (October 2004).

The same year the movie *A River Runs Through It* was released, another historic event would attract even more fly-fishers and other anglers to the tailwaters. On 9 May 1992 Howard Collins was fishing the Greers Ferry tailwater with a minuscule olive green marabou jig with his ultra-light spinning gear. A trout struck the lure, bending his tiny rod and precariously stretching the thin four pound test line. After a surprisingly brief fight, Collins landed the immense 40 pound, four ounce female brown trout, easily breaking the previous all-tackle world record caught by Mike Manley from the Norfork tailwater in 1988.[17] There are some who contend that this brown trout was one of the original 5,000 stocked into the tailwater by the AFF in 1975.[18]

The influence this trout would have on Arkansas' tailwater trout fishing is difficult to overestimate. The picture of Howard Collins struggling to lift his world record trout while standing in the tailwater is undoubtedly one of the most famous pictures ever taken on the tailwaters (Figure 21).[19] This picture and the accompanying story describing the historic catch was reproduced in countless outdoor magazines, newspapers, and more recently on internet websites. The AGFC still uses the picture on its official website to promote its trout program, while also displaying a life-size replica of the trout at its headquarters in Little Rock.[20] Although caught on the Greers Ferry tailwater, articles describing the catch often mention only the White River. The White River is now a generic term synonymous with tailwater trout fishing. One result of this publicity was more anglers drawn not to just the Greers Ferry tailwaters, but to all the White River

[17] Michael Pearce, "Brown Trout: A New World Record," *Outdoor Life* 190, no. 2 (August 1992), 47.
[18] Steve Taylor, "A Brown Trout History Lesson," *Arkansas Wildlife* 30, no. 3 (Summer 1999), 20.
[19] Photograph courtesy of Arkansas Game and Fish Commission, Little Rock, AR.
[20] Arkansas Game and Fish Commission, available at http://www.agfc.state.ar.us/fishing_ol.html (December 2004).

Figure 21. Howard Collins and his world record brown trout.

tailwaters. Although impossible to quantify, the economic impact of this world record brown trout undoubtedly meant many millions of dollars to the economy of Arkansas.

It is also revealing that the world record brown trout was caught using spinning tackle. Although fly-fishing was undoubtedly increasing in popularity, angling on the tailwaters is still done mainly with other types of tackle. For example, outside the catch-and-release areas about 95 percent of anglers on the Bull Shoals tailwater used predominantly spinning gear.[21] Even those who consider themselves predominantly fly-fishers often use several different types of tackle, natural bait, or artificial lures. For example, Howard Collins was using spinning tackle despite the fact that he is "ordinarily" a fly-fisher. As testimony of his passion for fly-fishing, upon his death in 1997 he was

[21] Todd et. al., "Bull Shoals-Norfork Tailwater Creel 1995-1998," AGFC-TPO.

buried wearing his Orvis waders and fly-rod.[22] Outfitters and guides therefore still offer bait-fishers a "traditional" Arkansas float trip, complete with green fiberglass johnboats, directors chairs tied to the gunwales, and even shore lunches and overnight camping. Much of the angling during these trips is done with a variety of "natural" baits such as worms, sculpins, and more recently dough baits such as Berkley PowerBait®.

Although anglers use natural baits because they catch trout, they are also influenced by tradition and familiarity. One of the primary reasons for the use of certain lures and tackle for trout is the continued popularity of bass fishing. For many southern anglers trout fishing is "not too different" than fishing for bass since they use similar equipment and tactics.[23] Anglers use equipment they are familiar with and already own and use it to catch trout. The blending of trout and bass fishing reached its apex when the first organized trout tournament was held on the tailwaters. In March 1995 the "1st Annual Supreme Boat Manufacturing Trout Tournament" took place on the Bull Shoals tailwater near Cotter. After paying a $25 entry fee, 94 two person teams launched into the tailwater to see who could catch the heaviest limit of four trout. The winning team received over $1400 for their winning catch, "professionally" certified by the Twin Lakes Bass Club. The AGFC noted that the tournament generated "considerable interest" and that future events would probably follow.[24] This prediction was accurate, with similar tournaments occurring regularly in following years.[25] In an area where bass fishing tournaments are common and popular and effective in promoting sport fishing products, it was inevitable that they would be transferred to trout.

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[22] Robert Boyle, "The Big One That Got Away," *Sports Illustrated* 87, no. 24 (December 15, 1997), 120.
[23] Jack Demetruk, "The Trophy Browns of the White," *Outdoor World* (March/April 1997).
[24] John Stark to Larry Rider, 6 March 1995, AGFC-TPO.
[25] Jeff Williams, "Observations of the Weekend Sportsman 'Out Trout Tree Top' Trout Tournament Held on the Little Red River, July 20, 2002," 22 July 2002, AGFC-TPO.

Arkansas tailwaters are notable for their interesting juxtaposition of fly-fishers and bait-fishers. This "any-tackle" trout fishing provides an experience and setting that is unique not only to Arkansas tailwaters but on many others throughout the South.[26] On any short stretch of tailwater you may see someone sitting on the bank fishing with corn, another angler wading and casting bass lures, while a fly-fisher wades mid-stream casting a dry-fly as johnboats motor upstream or float downstream (Figure 22). Anglers

Figure 22. Fly-fisher and bait-fisher on the Greers Ferry tailwater.

utilizing these various methods and tackle also view trout and trout fishing in various ways. Some only want to catch a limit of trout to eat, others are seeking a trophy trout, some just enjoy floating down the river in a johnboat with family and friends. Yet others

[26] H. Lea Lawrence, "The Great White," *Outdoor Life* 186, no. 1 (July 1990), 98.

focus on catching and releasing trout caught with a certain hand-tied fly. One writer describes the tailwaters by saying:

> The White, you see, can be whatever you want it to be: low water, high water; canned-corn stream, dry-fly stream; a river for loading up a stringer, a river for sticking a fish for the wall, maybe even a river for releasing a fish with shoulders and a predatory grin.[27]

The popularity of the tailwaters among all classes and types of anglers is the main reason why it is so economically lucrative. The various types of anglers and angling methods require and support a similarly diverse assemblage of businesses. Fly-fishers purchase fly-tying materials, hire fly-fishing guides, stay in resorts, attend club meetings, and frequent local fly-shops. Bait-fishers rent johnboats, buy natural baits, purchase their own johnboats, and hire guides to take them float fishing. All of these anglers purchase gas, eat in restaurants, and purchase trout fishing licenses. The AGFC worked to enhance these economic impacts by diversifying its management objectives to meet the desires of these anglers. Special regulation areas requiring catch-and-release or artificial-lures-only are especially attractive to fly-fishers, while still stocking large numbers of hatchery trout is attractive to those wanting to catch and keep a limit of trout. Managing for trophy trout, meanwhile, pleases all anglers. By 2004 this combination was responsible for making the tailwater trout angling industry worth an estimated $170 million per year.[28]

The commodification of trout fishing, its popularity among anglers, and the infrastructure necessary to maintain it, creates distinct linear trout culture regions.

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[27] Lionel Atwill, "Trout of the White," *Sports Afield* 209, no. 2 (February 1993), 65.
[28] Arkansas Game and Fish Commission staff, "Getting to Know Minimum Flow," *Arkansas Wildlife* (January/February 2004), 12.

Although the tailwaters are the core of these trout culture regions, they extend outward for various distances. They are delineated by the presence of trout related businesses, signage, trout anglers, hatcheries, dams, and johnboats that makes one aware of being in a trout fishing "place." The width of these regions varies, displaying a core verse periphery pattern with the cultural traits generally weakening as one travels outward. Similar to other regions, the periphery is difficult to define, although in some instances they are a considerable distance from the tailwaters. For example, fly-shops are now found in Little Rock and Memphis, supporting a clientele who frequently fish the tailwaters. Other evidence includes taxidermy studios, the stocking of trout tackle in stores such as Wal-Mart, fly-fishing clubs in surrounding towns, and brochures advertising trout resorts at state travel information centers.

When visiting the tailwaters the cultural landscape makes it quite obvious that you are in a tailwater trout culture region. You see numerous resorts, fly-fishers wading shallow riffles, AGFC stocking trucks delivering trout, trucks pulling johnboats, and bait shops advertising a wide assortment of trout tackle. Perhaps the most obvious visual indications are the numerous roadside billboards advertising trout fishing resorts, fly-shops, and boat docks. Especially ubiquitous are billboards showing a "leaping trout," most often a rainbow, but other times a brown, brook, or cutthroat. These trout are shown suspended in the air with mouth agape, often with an artificial fly either lodged in its mouth or about to be eaten. As I traveled along the tailwaters my children became quite adept at spotting "leaping trout" so dad could take a photograph. Gaston's White River Resort billboards are an especially well-known part of the Ozark landscape, so numerous that you can count down your arrival to the Bull Shoals tailwater by using the

mileage posted on these signs (Figure 23).

Figure 23. Gaston's White River Resort billboard.

Trout hatcheries are another prominent indicator of these trout culture regions. Open year-round they are a popular tourist attraction, offering guided tours for school children, self-guided tours for others, aquariums, visitor centers, and sometimes dispensers where people can purchase pellets to feed the trout. The Shepherd of the Hills hatchery near Branson, Missouri is especially popular, annually attracting about 250,000 people.[29] Many of these visitors are not anglers, but vacationing families wanting to see trout and how a hatchery operates. In Arkansas the NNFH is even more popular despite its relatively remote location, attracting about 280,000 visitors each year. The USFWS

[29] Missouri Department of Conservation, available at http://www.mdc.mo.gov/areas/hatchery/shepherd/ (January 2005).

attracts and entertains visitors by offering "award winning" aquariums or special activities during Earth Day and National Fishing Week.[30]

The town of Cotter, Arkansas provides another example of the cultural change brought by trout. Prior to Bull Shoals Dam, Cotter was one of the most popular put-in and take-out locations for warm-water float trips on the White River. After 1952 the town was transformed into one of the most well-known trout fishing destinations in the Ozarks. Its appropriately named and historic 1930s era Rainbow Arch Bridge is a well-known landmark attracting anglers and visitors alike. With its ideal location only 18 miles below the dam, numerous guides, outfitters, and resorts continue to operate in and around the town. In 1993 the Arkansas General Assembly passed Act 740, officially proclaiming Cotter the "Trout Capital of the U.S.A." The town's water tower proudly displays this title, while the town's police cars, letterheads, and other documents display a town seal showing a leaping rainbow trout (Figure 24). Each summer the town celebrates its relatively newfound heritage during the "Great Cotter Trout Festival."

Many other cultural traits delineating these trout regions are perhaps less noticeable. The internet now contains numerous websites describing, promoting, and advertising the tailwater trout fisheries. Visitor centers throughout the Ozarks contain numerous brochures for trout fishing guides and resorts. Federal agencies such as the USFWS, Corps, USGS, and SPA now have offices, vehicles, and personnel living and working along the tailwaters. Many people have built or purchased vacation homes along the tailwaters providing easy access to trout angling. The totality of these and many other

[30] Department of the Interior, United States Fish and Wildlife Service, available at http://fisheries.fws.gov/FWSFH/NFHmapg.htm (October 2004).

Figure 24. Cotter, Arkansas' water tower.

cultural traits interacting and evolving since the 1940s creates truly distinct trout culture regions.

Something for Everyone: Managing a World Class Fishery

Howard Collins' world record brown trout and the increasing popularity of fly-fishing focused more pressure on the AGFC to continue to diversify its management techniques and objectives. Many anglers visiting the tailwaters no longer wished to only catch a limit of freshly stocked 12 inch rainbow trout. Anglers sought diversity, not only in fish species, but in the opportunity to catch a trophy trout similar to those adorning the pages of resort brochures, magazines, and internet websites. Fly-fishers demanded changes in the way the AGFC managed the tailwaters, seeking to establish more special regulations areas on the tailwater similar to those found on other trout streams in the U.S.

Outfitters, guides, and resort owners often wanted a combination of both; large numbers of easily caught rainbow trout and more trophy trout.

Although the tailwaters were already recreationally and economically successful, the objective was to make it even better. Continuing a process begun in the mid-1980s, the AGFC trout program sought to maximize the full potential of the tailwaters through diversification. Trout biologists knew the growth potential for trout in the tailwaters was underutilized due to the quick removal of both stocked and naturally reproducing trout. If trout could be protected from harvest they would grow quickly, providing anglers with more trophy trout. One of the main goals of the program was to pass stricter regulations limiting anglers in the types of equipment used and the number or size of trout they could keep.[31]

The first step was to expand the special brown trout regulations already in effect on the Beaver tailwater statewide. This regulation limited anglers to two brown trout of at least 16 inches in length. In passing this regulation in 1988, the AGFC promoted it as a way to protect small stocked brown trout from harvest. Expanding it to the other tailwaters required a slightly different approach. The AGFC argued the regulation was necessary on the other tailwaters to protect "wild" brown trout so they could survive long enough to spawn at least once before being caught and kept by anglers.[32] Although some anglers and outfitters again opposed the regulation, it was passed by the Game Commission and went into effect on 1 January 1990. It was further expanded in 1993 to include cutthroat trout and in 1996 to include brook trout.

[31] Gregg Patterson, "Arkansas' World-Class Trout," *Arkansas Game & Fish* 21, no. 1 (January/February 1990), 10.
[32] John Stark et. al. "Trout Management Plan-Draft," 13 April 2000, AGFC-TPO.

Fly-fishers, some AGFC personnel, and other trophy anglers considered this regulation insufficient. The ultimate goal was the establishment of special catch-and-release and artificial-lures-only areas. In 1990 Dave Whitlock outlined his and many other fly-fisher's management goals for the tailwaters in a detailed letter to the head of the AGFC Fisheries Division. After expressing the desire to be "one of your consultants," he listed 16 management objectives for the tailwaters based upon his 34 years of experience fishing and living on the rivers. Although suggesting a variety of strategies, he believed the main focus of the trout program should be to limit harvest. The greatest hindrance to the fisheries was over harvest by "meat hogs," those bait-fishers and guides focusing only on "limiting out." To protect the fishery more restrictive regulations were necessary, including requiring anglers to use barbless hooks, creating catch-and-release zones, reducing creel limits, and creating sanctuaries for spawning trout.[33] Although his actual influence on policy decisions is unknown, many of his suggestions were uncannily similar to those that would later become law. Of course, state fishery biologists were already well aware of these various regulatory options since they were commonplace in many areas of the country.

Creating special regulation areas such as catch-and-release and artificial-lures-only was especially attractive to fly-fishers since it would give them their own section of tailwater. Although the presence of a variety of angling methods and tackle is viewed by some as adding a unique quality to the tailwaters, others disagree. The use of natural baits, johnboats with outboard motors, and various types of tackle cause some to label the

[33] Dave Whitlock, "Trout Management of Arkansas' White and Norfork Rivers," February 1990, AGFC-TPO.

tailwaters as "rube" streams, unfit for fly-fishers.[34] For example Dave Whitlock provides the following counsel to visiting fly-fishers:

> Fair Warning before you visit the White: To enjoy fishing here you must be willing to tolerate a majority of trout fishers using bait, chumming trout, keeping their six-trout-limit every day (with some guides contributing to your limit), 20-foot johnboats with 9 1/2-25-horsepower outboards racing up-or-downstream through the run or pool you are fishing…or worse - tossing out their anchors and bait, and casting directly where you are casting.[35]

Creating special regulations areas would alleviate these problems by segregating the tailwaters by tackle and bait preference. Although johnboats could still float through these areas, the anglers onboard could not use natural bait and would have to release trout. Fly-fishers were hopeful that such restrictions would keep them from entering these areas.

In 1994 the trout program officially proposed creating four "Trophy Trout Areas" limiting anglers to catch-and-release and artificial-lures-only. The timing of this proposal coincided with a trout permit survey showing that 53 percent of resident and 67 percent of non-resident anglers favored such regulations. It also indicated that 61 percent of resident anglers and 71 percent of non-resident anglers favored restricting the use of natural baits in these same areas.[36] This discrepancy between resident and non-resident support occurs for several reasons. Non-residents are often fly-fishers or anglers seeking trophy trout; therefore, these regulations are viewed positively. Also, since they fish the tailwaters less they are not concerned about keeping trout. Resident anglers are more often bait-fishers living closer to the tailwaters and wanting to be able to keep trout.

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[34] Atwill, "Trout of the White," 64.
[35] Dave Whitlock, "Fishing the River I Love," *Trout* (Winter 1993), 59.
[36] Arkansas Game and Fish Commission, "1994 Survey of Trout Anglers," AGFC-TPO, 9.

Although this discrepancy exists, the overall support for these regulations was high, revealing a shift in angler's attitudes.

Although supported by many, these special regulations would ultimately have to be passed by the seven members of the game commission. The AGFC therefore needed to explain how these special regulations areas would benefit both anglers and the sport fishing business community. The most obvious argument was that protecting trout would result in larger trout. Studies showed that under current regulations rainbow trout during the summer months were usually removed within 30-45 days of release.[37] Protecting trout from harvest would allow the natural growth potential of the tailwaters to be utilized for the production of larger trout, and therefore attract more anglers. Additionally, since these larger trout are free to swim up and downstream, the special regulations areas would "seed" surrounding areas with large trout.[38] This would improve the entire tailwater and provide bait-fishers with more trophy trout.

An especially persuasive argument for the inclusion of an artificial-lures-only regulation was hooking mortality rates relating to the use of natural baits. Trout biting an artificial lure tend not to ingest it as readily or as deeply as a hook containing natural bait. Studies show that mortality rates of trout hooked and then released using artificial flies generally range from 5-10 percent, while those hooked with natural baits die at a rate of 30-40 percent.[39] It would be counterproductive to create a catch-and-release area without also requiring the use of artificial lures since trout released would often die. Although the regulations would not require the use of fly-fishing tackle, the inclusion of a single

[37] John Stark, "Return of the Big 'Bows: Arkansas' Trophy Trout Areas," *Arkansas Wildlife* 30, no. 1 (Spring 1999), 2.
[38] Ibid, 3.
[39] Arkansas Game and Fish Commission, "1994 Survey of Trout Anglers," AGFC-TPO.

barbless hook regulation makes these areas far less attractive to bait-fishers since the lures they use often have treble hooks. Although these areas were obviously for fly-fishing, fly-fishers sought to downplay this fact to encourage approval of the regulations. Dave Whitlock suggested the AGFC "by no means" call these areas fly-fishing only zones, since this would be viewed as discriminatory against bait-fishers. His transparent solution was to call them "Fish for Fun" areas open to all types of tackle.[40]

Regardless of terminology, many bait-fishers, resort owners, and guides were vehemently opposed to these regulations. They believed dividing the tailwaters into disparate sections with different regulations would make float fishing exceedingly difficult and complicated. Bait-fishers floating down the tailwaters would have to stop fishing or change tackle upon reaching one of these areas, an interruption that would reduce the enjoyment of anglers and decrease business. Another concern was trout already caught and placed in live-wells or on stringers. Anglers entering catch-and-release areas could be fined for having trout caught prior to entering the area. These regulations would reduce the distance anglers could float fish, resulting in fewer anglers and less revenue for local businesses. Others complained the regulations were to please a small number of mainly non-resident fly-fishers who were politically and economically powerful. One local guide believed the regulations were the scheme of nonresident fly-fishers trying to tell locals "how to run our rivers."[41]

In August 1994 Arkansas' seven game commissioners voted on the proposed regulation change. The divisiveness of the issue resulted in a close four to three vote in favor of the regulations. On 1 January 1995 five Trophy Trout Areas (now called Catch-

[40] Dave Whitlock to Allen Carter, 17 February 1990, AGFC-TPO.
[41] Interview with author, 28 October 2003.

and-Release Areas) officially came into existence along the tailwaters. Signs were soon standing near the tailwaters instructing anglers on type of tackle they must use and requiring them to release whatever they caught (Figure 25). Representing only four percent of the tailwaters and totaling 5.5 miles in length these areas were divided among the four tailwaters. Norfork, Greers Ferry, and Beaver tailwaters received one each while Bull Shoals tailwater received two. Any trout caught in these areas must be quickly released, although "quick bragging photos or measurements" are acceptable.[42] To reduce hooking mortality, anglers are also limited to one artificial lure with a single barbless hook.

Figure 25. Special regulation area sign near Bull Shoals tailwater.

[42] Stark, "Return of the Big 'Bows," 2.

The creation of these areas marked a distinct and historic shift in management to accommodate the increasing number of fly-fishers using the tailwaters while also recognizing the importance of producing more trophy trout. Although the catch-and-release areas protected all trout species, the program continued to make a clear distinction between different species. It "chose" to protect brown trout to a greater extent since they are capable of reaching larger sizes than most rainbow trout. Brown trout are also considered harder to catch since they are capable of "learning" from past encounters with anglers. This combination of size and wariness, along with natural reproduction makes them better candidates for protection than rainbow trout. Cutthroats, meanwhile, are even less wary and easier to catch than rainbows, therefore needing special regulations for "protection."[43] In contrast, rainbow trout were still considered expendable outside the catch-and-release areas, stocked by the millions to be quickly caught by anglers.

Although the catch-and-release areas were protecting trout from being kept and killed by anglers, an unforeseen problem soon developed. During fall 1995 and into the following spring, water levels within Bull Shoals and Greers Ferry Lakes slowly declined, resulting in less instream flow during the annual brown trout spawn. As spawning trout swam upstream, anglers came in profuse numbers since they were "confident" that little generation would occur and allow wade fishing. Since the spawning area below the dam was now catch-and-release with a single barbless hook, the majority of these anglers were fly-fishers. The result was "extremely heavy" fishing pressure, with as many as 200 wading anglers per day in the uppermost seven miles of

[43] Jim Spencer, "Juggling Trout: The Whys and Wherefores of Arkansas Trout Fishing Regulations," *Arkansas Wildlife* 25, no. 3 (Summer 1994), 9.

the tailwater. Not only were these anglers destroying redds created by spawning female brown trout; they were also handling the numerous brown trout they landed. [44]

Anglers soon began catching trout with hand shaped fungal infections near the front of the tail. The situation deteriorated quickly, and by March 1996 the AGFC was receiving "daily reports" of dead or dying trout.[45] The AGFC released a statement explaining why the trout were dying and also providing tips on how to properly handle and release trout. Electro-fishing samples revealed that 3-5 percent of all brown trout were infected, while approximately 10 percent of brown trout 20 inches or longer were infected. Although the external fungus was caused by "excessive handling," the AGFC concluded the "major" factor was lack of hydropower generation during the spawning season. They argued that the resulting low instream flows make successful spawning difficult while also congregating trout into a smaller area, exposing them to anglers.[46] Since 15 November 1996 the catch-and-release area below Bull Shoals dam has been closed to all fishing from 1 November to 31 January to protect spawning brown trout (Figure 26). To further protect trout during this period the section of river located directly downstream of the catch-and-release area and bordering Bull Shoals State Park is closed to night fishing and anglers are limited to using single hook artificial lures.

Within several years the special regulations imposed on anglers were producing the intended results. Trout surveys showed a marked increase in both the number and size of trout within these areas compared to areas outside. For example, the Rim Shoals catch-and-release area had nearly 10,000 rainbow trout per mile, compared to only 1,000

[44] John Stark to Allen Carter, 18 September 1996, AGFC-TPO.
[45] Ibid.
[46] Ibid.

Figure 26. Brown trout spawning area on Bull Shoals tailwater.

per mile in areas outside. Perhaps more impressive was the increase in trout size. Rainbow trout larger than 16 inches were extremely rare outside the catch-and-release areas, while inside they were found at a rate of 1,187 per mile.[47] Using these persuasive statistics the AGFC created an additional two-mile long catch-and-release area in 1998 on the Bull Shoals tailwater above Sylamore.

A final 1.6 mile catch-and-release area would be established on the Bull Shoals tailwater following strong opposition. The AGFC proposed several locations for the new areas, with several of these on the upper section of the tailwater between the dam and Cotter. Many resort owners and guides on this upper section were especially opposed since this was prime float fishing water. They argued that creating a special regulations area in this section of the tailwater would "wipe out float fishing" operations, especially

[47] Steve Bowman, "Catch and Release Catching on for Trout," *Arkansas Democrat Gazette*, 23 February 1997, 12C.

those based in Cotter.[48] Due to the intense opposition, the catch-and-release area was established well downstream from Cotter. One guide suggested the selection of this location was purely "political," since the "operators up there carry a big stick," with more influence on the AGFC than operators further downstream.[49] Regardless of how influential these resort owners were, the popularity and economic importance of float fishing on the upper section undoubtedly influenced the decision to keep the upper section free of catch-and-release areas. This section has always been the most popular and productive area for float fishing, with anglers still free to put-in near Bull Shoals dam and float the 18 miles to Cotter without having to worry about special regulations (Figure 27).

The catch-and-release areas also successfully segregated anglers. During a three year creel survey the Bull Shoals tailwater was divided into nine zones, with two of these consisting of the catch-and-release areas. The survey showed that outside the catch-and-release areas the use of boats ranged from about 84 to 78 percent of anglers, while spinning tackle was used by about 95 percent. In contrast, within these areas only about 31 to 46 percent used boats, 64 percent wade fished, and 43 to 73 percent used fly-fishing gear. Although the number of spin fishers declined within the catch-and-release areas, the main reason for the change in proportion was a tripling in the number of fly-fishers. By restricting anglers to the use of single hook artificial lures, the AGFC effectively divided the tailwaters by fishing equipment and methods. It must also be noted that the actual numbers of boat anglers within the catch-and-release areas increased by 100

[48] Thomas Garrett, "Catch-and-release plan meets opposition," *Baxter Bulletin*, 8 May 1998, 3A.
[49] Interview with author, 28 October 2003.

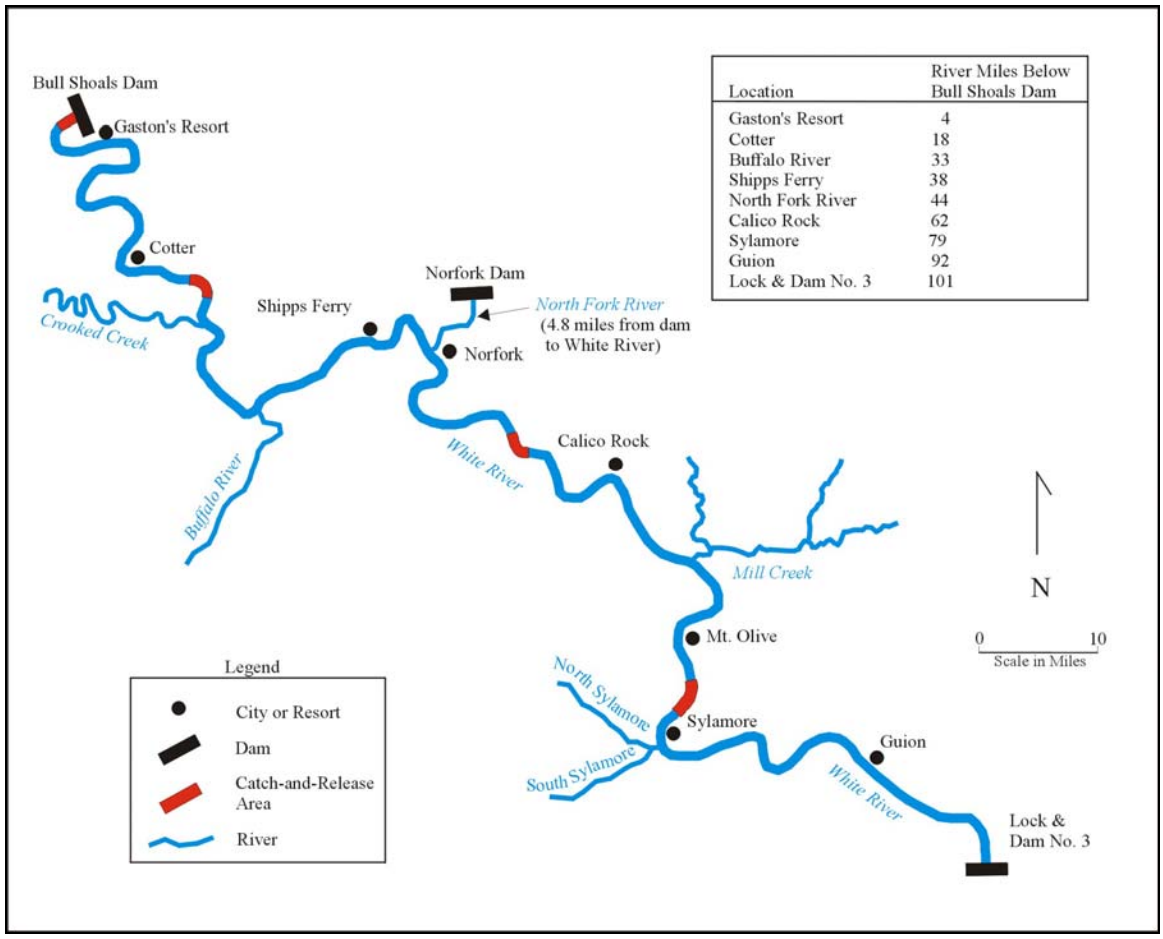

Figure 27. Bull Shoals tailwater map showing Catch-and-Release areas.

percent, showing either the use of boats by fly-fishers, or spin fishers modifying their choice of lures to fit the regulations.[50]

By the end of the 1990s it was also clear the catch-and-release areas were meeting the intended objective of producing larger trout. Trout surveys showed a two to tenfold increase in 16 inch or larger rainbow and cutthroat trout when compared to pre-regulation data. Anglers fishing these areas were six times more likely to catch a trout that was 16-18 inches in length.[51] In the fall of 2002 an angler fishing the Norfork catch-and-release

[50] Todd et. al., "Bull Shoals-Norfork Tailwater Creel 1995-1998," AGFC-TPO.
[51] Stark, "Return of the Big 'Bows," 2.

area caught an immense rainbow trout weighing an estimated 24 pounds, seven ounces. Since it could not be removed and weighed on official scales it was impossible to certify as a new state record. Regardless, the pictures confirm that is was a truly impressive trout.[52] Anglers catching rainbow trout like this prompted some suggest a return to the glory days of the 1950s and 1960s when big rainbow trout were commonplace. In this sense the tailwaters have come full circle, once again providing the trophy rainbow trout which first made these tailwaters famous.

I witnessed first hand the success of the catch-and-release areas during an electro-fishing survey during fall 2003. The AGFC trout biologists were conducting a survey of trout on the Norfork tailwater to assess growth rates. We launched our specially equipped johnboat into the tailwater near the dam at dusk and traveled downstream to the catch-and-release area. With both generators shut down to allow the survey to be conducted, water flows were minimal, forcing us to get out and push the johnboat through several shallow runs. Upon arriving at the catch-and-release area the generator in the back of the johnboat was started, sending an electrical current through the metal chains dangling in the tailwater on the front of the boat. The electricity temporarily stuns any trout nearby, forcing them to the surface. Both the number and size of the trout that the tailwater contains is incredible. I realized that anglers fishing these areas were always casting to or near trophy trout.

Since catch-and-release areas produce more trophy trout they also attract more anglers. These areas receive as much as 2.7 times the fishing pressure as other areas of the tailwaters. Since they attract more anglers, the AGFC considers them more

[52] Craig Ogilvie, "Big Rainbow Trout Again Proves Arkansas Has World-Class Action," *Arkansas Travel* (March/April 2003).

economically valuable than other areas. Estimates place the value of the catch-and-release areas at $96,000 per mile, compared to only $33,000 per mile for other areas.[53] These statistics provide justification for creating these areas, supporting the long-held objective of the trout program to maximize both the economic and recreational potential of the tailwaters. Further adding to their economic value is the fact that stocking is not as necessary, allowing more trout to be available for other areas of the tailwaters.

Although the catch-and-release areas are successful, the majority of the tailwaters are still managed as put-and-take. Growing demand for trout in these areas continued to increase, prompting the AGFC to spend $3.3 million in 2002-03 renovating and expanding the SRSFH. Eleven new fiberglass silos along with new concrete raceways were installed to increase production.[54] This expansion and the production from the two federal hatcheries allow the AGFC to annually stock nearly 1.9 million trout. The NNFH also provides about 292,000 rainbow and cutthroat trout for the Pot Shoals Net Pen operation where trout are grown to larger sizes prior to winter and spring stockings. The GFNFH also supplies about 91,000 rainbow trout for the Jim Collins Net Pen operation, which are released into the Greers Ferry tailwater after reaching 11 inches.[55] Although the great majority of hatchery trout are stocked into the four White River basin tailwaters, the AGFC also stocks three lakes, two additional tailwaters, and three other streams. An urban fishing program was also initiated, with trout released into metropolitan area lakes during winter to provide fishing opportunity and recruit new anglers.[56]

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[53] Thomas Garrett, "Catch-and-release plan meets opposition," *Baxter Bulletin*, 8 May 1998, 3A.
[54] Arkansas Game and Fish Commission, "Major construction improves Spring River fish hatchery," Arkansas Trout Fishing Guidebook (2004), 15.
[55] Arkansas Game and Fish Commission, "Trout Management Plan," 22 January 2004, AGFC-TPO, 6.
[56] Ibid., 7.

All of the various trout program stocking initiatives, management techniques, and overall objectives were formalized in the AGFC's first official strategic plan. Completed in December 2004, the plan defines its overall objective as "exploiting coldwater habitats to mitigate the loss of native warm-water fish species, and to create recreational opportunities."[57] The plan describes the three management techniques the trout program utilizes in meeting this broad goal; put-and-take, put-and-grow, and wild or self-sustaining management. Put-and-take management is used in the majority of trout waters in Arkansas and intended for areas where natural reproduction cannot sustain sport fishing. Catchable rainbow trout averaging 11 inches are stocked into these areas and are intended to be “highly exploited” by anglers. Stocking in these areas is intended to provide "good catch rates and maximize harvest efficiency.” The only regulations limiting anglers is a creel limit of five trout per day.[58]

Put-and-grow management, meanwhile, is meant to produce larger trout in areas where natural reproduction is limited. Brown, brook, and cutthroat are stocked into these areas as mainly six inch fingerlings and then protected by length limits. The catch-and-release areas created on the tailwaters were created to produce larger, at least 16 inch, rainbow trout. Since most rainbow trout are managed under put-and-take regulations, these areas are meant to produce larger trout. Anglers in these areas must release all trout caught, and are limited to using artificial lures with a single barbless hook.[59]

The final technique relates to wild or self-sustaining populations of trout. The trout program manages these areas with a mixture of put-and-grow, catch-and-release, seasonal catch-and-release, and seasonal closing during the spawn. Greers Ferry

[57] Ibid., 1
[58] Ibid., 9.
[59] Ibid., 9.

tailwater actually contains the only "totally wild" brown trout population, with spawning success prompting the implementation of a 16-21 inch slot limit to reduce numbers of smaller brown trout. In the Bull Shoals tailwater near the dam and in Cow Shoals on the Greers Ferry tailwater, spawning brown trout are protected by seasonal closing, catch-and-release, and nighttime closures. Following a request by the Friends of the Little Red River and numerous fly-fishing clubs and individual sponsors, the AGFC also created a wild population of trout at Collins Creek. Named in honor of Howard Collins, water is piped from Greers Ferry Lake into this previously intermittent stream, supporting rainbow trout and the only wild brook trout population in the state. Wild rainbow trout production is also increasing in the special catch-and-release areas on the Norfork and Bull Shoals tailwaters.[60]

Diversifying the management of the tailwaters by applying these three techniques creates a fishery for everyone. Fly-fishers can wade the catch-and-release areas, content with using artificial-lures-only and enjoying the opportunity to fish for trophy trout without excessive interruptions from johnboats and bait-fishers. Bait-fishers are still free to take float trips in johnboats, fish from the bank, or wade while catching rainbow, brown, brook, and cutthroat trout with a variety of lures and natural baits. Trophy anglers still have an excellent chance of catching a large trout, especially in the catch-and-release areas. For anglers wanting to just catch a limit, the AGFC releases a steady supply of relatively unwary federal and state hatchery trout. This variety therefore satisfies the desires and preferred angling methods of several different angler groups.

Although the AGFC strives to provide good fishing, it also wants to maximize the economic potential of the tailwaters to sustain commercial sport fishing interests and

[60] Ibid., 10.

other local businesses as well as to increase revenue for the agency. Diversifying management techniques results in more economic productivity since a greater number and variety of anglers and angling related businesses can be supported by the tailwaters. One indication of success is the steady increase in trout permit sales from slightly over 92,000 in 1982 to over 163,000 by 2001 (Figure 28).[61] Another is the value of these tailwaters to the state's economy, now estimated to be about $170 million annually.

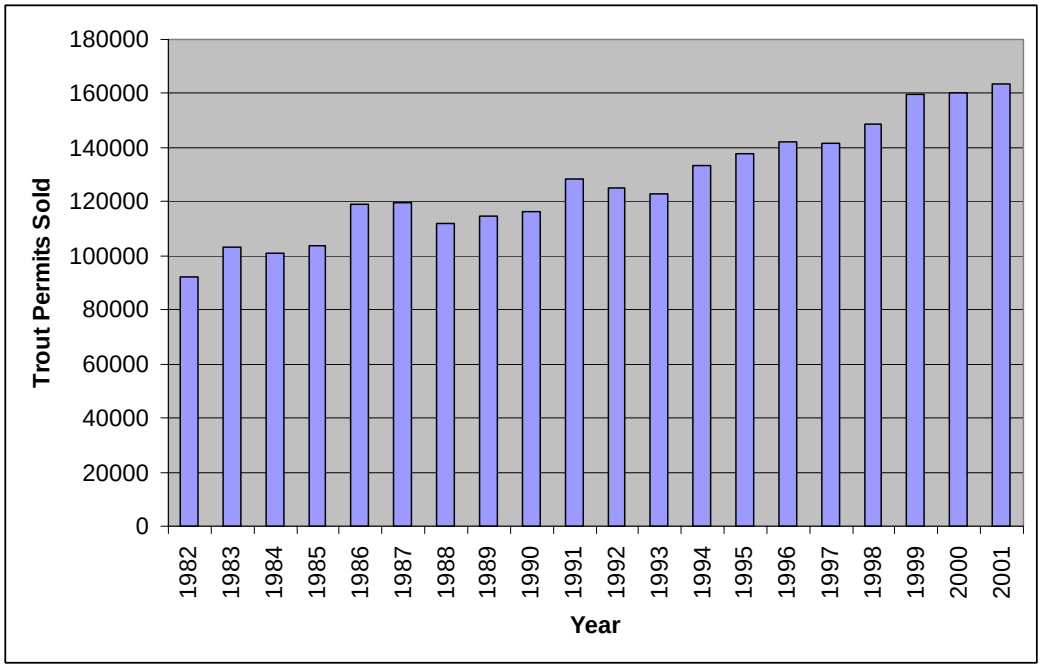

Figure 28. AGFC trout permit sales 1982-2001.

Dissolved Oxygen and Minimum Flows

If people were simply to read the articles about world record trout, catch-and-release fishing, and the millions of dollars spent annually catching trout, they might get the impression that all was well on the tailwaters. Despite these obvious economic and

[61] Arkansas Game and Fish Commission, "Fishing Licenses and Trout Permit Sales, Fiscal Years 1982-2001," AGFC-TPO.

recreational successes, the AGFC, anglers, and business owners still sought ways to improve and protect the fishery. As the 1990s began, many who had fought unsuccessfully for decades to increase the amount of instream flow for the tailwaters were decidedly optimistic. The findings of the 1989 WRTRS that certain identified minimum flows were recreationally beneficial and economically feasible were encouraging, leading some to imagine that reallocation of water storage for the fisheries would finally occur.

In early 1990 the AGFC, Arkansas Soil and Water Conservation Commission (ASWCC), and the Corps were actively negotiating the feasibility phase of the WRTRS, referred to as the White River and Tributaries Study (WRTS). For logistical reasons this study would only focus on the three mainstem White River tailwaters. The plan was to examine these three lakes as an integrated flood control system, allowing reallocation for minimum flows to be distributed between each. The target minimum flow at Bull Shoals tailwater was decreased from the 1,000 c.f.s. recommended in the WRTRS to somewhere between 500 and 700 c.f.s. This amount of flow, plus additional releases at Beaver Dam, was estimated to require reallocating from four to nine percent of the current water storage in these two lakes, an amount considered "very insignificant" by the AGFC. Although completing the WRTS would not guarantee success in obtaining minimum flows, the AGFC believed there was a "high probability of success." [62]

Although only examining reallocation in three lakes, the WRTS was still a major undertaking. Initial cost estimates were about $1 million, which would need to be cost shared by a non-federal sponsor. Although the AGFC tentatively agreed to co-sponsor, it was concerned about the high cost. Fortunately for the agency, the cost of the study was

[62] Jim Spotts to Larry Rider, 29 March 1990, AGFC-TPO.

reduced to $600,000 after "intervention" by U.S. Senator David Pryor.[63] The AGFC was now responsible for only $300,000, with one-half of this provided through in-kind services. The ASWCC meanwhile expressed interest in contributing some funding for the study.[64] With these reductions in cost and the opportunity to further pursue increasing instream flows the AGFC tentatively agreed to co-sponsor the study in April 1990.[65]

Only five months later the AGFC rescinded its support by requesting a temporary delay because the agency needed additional time to thoroughly review past minimum flow studies by the USFWS and Corps to avoid repeating past mistakes or duplicating studies. One major concern was the Corp's method of determining benefit-to-cost ratios for the study, since Congressional approval was based primarily on these findings. The Corps was proposing to use its "Contingent Value Methodology," a different evaluation process than the one used in the WRTRS. The AGFC believed this new method was too time consuming, expensive, and could possibly result in reversing the positive economic conclusions reported in the WRTRS. Another concern was the "astronomical" cost of $1 million for the necessary minimum flow test releases of the new study, paid entirely by the state sponsor.[66] Without addressing these concerns it feared the expensive study could result in another "no action scenario" similar to other past studies and recommendations.[67]

Only a month after this delay another trout kill on the Bull Shoals tailwater would greatly alter both the scope and complexity of the minimum flow issue. In early October

[63] Spotts, "White River Minimum Flow Study," AGFC-TPO, 9.
[64] Jim Spotts to Larry Rider, 29 March 1990, AGFC-TPO.
[65] Larry Rider to Jim Spotts, 24 April 1990, AGFC-TPO.
[66] Spotts, "White River Minimum Flow Study," AGFC-TPO, 10-11.
[67] Steve Wilson to Charles McCloskey, 3 September 1991, AGFC-TPO.

the AGFC began receiving reports that brown, rainbow, and cutthroat trout were dying in the tailwaters. Most were being found on gravel bars near the base of the dam and extending along a two-mile section downstream. Even with additional cold water releases from hydropower generation, trout were still "gaping and rolling" to the surface, struggling to survive. On 11 October, AGFC personnel stocking the tailwaters noticed that within "minutes" of release trout "were soon floating ventral side up." Over the next two days state personnel and fishing guides found approximately 1200-1500 dead trout, with about 25 percent of these being "mature" brown trout. This was considered a conservative estimate since it was impossible to "verify the magnitude" of the kill since seven or eight generators were often operating, washing carcasses downstream.[68]

Large numbers of trout dying this close to the dam was unprecedented. The proximity to the dam and the additional cold-water releases ruled out the usual cause of critically high water temperatures. Biologists realized the cause was probably low D.O. levels. To confirm these suspicions biologists tested the tailwater on 12 October, measuring pH and water temperature in addition to D.O. Samples taken near the dam revealed D.O. levels of only 2.7 parts per million (p.p.m.), well below the three p.p.m. lethal to trout. Twelve miles downstream at Wildcat Shoals D.O. was much higher at 5.7 p.p.m. This information was relayed to Corps and SPA officials to make them aware of the problem. The agencies agreed to conduct more thorough D.O. testing at various water release levels on 16 October.[69]

These tests were conducted using boats, allowing D.O. measurements to be taken from the middle of the tailwaters to avoid biased shoreline sampling. Readings taken at

[68] Jim Spotts to Larry Rider, 28 October 1990, AGFC-TPO.
[69] Ibid.

6:00 a.m. near the base of the dam showed D.O. levels from 1.1-1.7 p.p.m. Moving downstream the D.O. levels slowly improved, reaching 3.2 p.p.m at Bull Shoals State Park 1.5 miles from the dam, and 3.4 p.p.m. four miles from the dam. The higher D.O. levels downstream were due to water re-oxygenating as it runs through riffles and also the influence of photosynthesis as sunlight intensifies throughout the morning.[70] Although these downstream D.O. levels were above lethal limits, levels from 3-5 p.p.m. are still considered dangerous to trout. Dissolved oxygen levels need to be above five p.p.m. to be considered safe for trout.[71]

The following day the AGFC reported its testing results to the Corps and SPA, requesting that hydropower generation be limited to two generators during daylight hours and no generation at night. This would limit the amount of low D.O. water released and also allow photosynthesis to increase oxygen levels during daytime. After decades of wanting and requesting more instream flow, the AGFC was now forced to request less. Although agreeing to this request, the agencies wanted additional D.O. tests at various hydropower release levels. These were conducted on 21-22 October, again revealing low D.O. levels in the tailwater. During these tests rainbow and cutthroat trout were actually brought from the SRSFH and placed into cages submerged in the tailwater. These trout "immediately" showed signs of stress and quickly perished when D.O. levels fell to 2.1 p.p.m.[72]

Although killing trout in the tailwaters, the source of the low D.O. water was the hypolimnion of Bull Shoals Lake. On 23 October the USGS and AGFC collected D.O. samples within the lake. These revealed a lake clearly stratified in terms of both

[70] Jim Spotts to Larry Rider, 28 October 1990, AGFC-TPO.
[71] Ibid.
[72] Ibid.

temperature and D.O. Temperature was a uniform 66°F from the surface to the thermocline located at a depth of about 78 feet. Below the thermocline temperature slowly declined, eventually reaching 60°F near the penstock intake gates located 116 feet below the surface. The D.O. readings were even more definitive in showing the separation of the epilimnion and hypolimnion. At the surface D.O. was 5.74 p.p.m. before slowly declining to 4.60 p.p.m. at a depth of 76 feet. Only two feet deeper and below the thermocline D.O. levels decreased considerably to 1.8 p.p.m. Near the penstock intake gates the water was almost devoid of oxygen, with a D.O. of .54 p.p.m.[73]

The presence of low D.O. levels in the hypolimnion of the lakes was well-known, although such extremely low levels was troubling. The cause was believed to be heavy rains during the past spring washing unusually large amounts of organic matter into the lake.[74] When organic matter flows into the lake it sinks into the hypolimnion where it is decomposed, a process that consumes oxygen. Although decomposition takes place throughout the water column, it predominates in the hypolimnion. The rate of oxygen loss in the hypolimnion during thermal stratification is called the oxygen deficit. The oxygen deficit is a reflection of the amount of organic matter present in the hypolimnion when it forms and additional amounts delivered by inflow into the lake. Other factors influencing the oxygen deficit include the size and shape of the lake, prevailing direction and intensity of wind, and seasonal temperature variations. Hydropower generation is also a factor since water releases come directly from the hypolimnion. Releasing cold

[73] Ibid.
[74] Thomas Garrett, "Low oxygen damaging White River trout fishery," *Baxter Bulletin*, Thursday, November 15, 1990. vol. 89, no. 308.

water increases water temperature in the hypolimnion, resulting in higher oxygen consumption due to increased metabolic rates.[75]

This complex interaction of in-lake, upstream watershed, and downstream processes makes increasing tailwater D.O. levels complex. Usually water releases containing lower D.O. levels reach safer levels after passing through the dam's turbines and spilling into the stilling basin, a process that infuses oxygen. As water moves downstream additional oxygen is added through photosynthesis and physical mixing as it flows over shoals and other instream structure. Conversely, oxygenation is reduced during higher releases since shoals and other structures are covered to a depth where riffles are no longer present, creating laminar flows.[76] Of course, when D.O. reaches extremely low levels these processes may become insufficient in increasing oxygen levels high enough to prevent trout kills.

The extremely low D.O. levels within the lake meant that trout kills were a distinct possibility until the lake turned over. Since this generally does not occur until the last week of November or at the latest mid-December, a "major concern" was the upcoming brown trout spawning run. Occurring from early November through January, about 80-90 percent of the tailwater's brown trout swim upstream, forming redds and spawning near the dam. If low D.O. levels persisted, the AGFC believed the results could be "catastrophic" to the brown trout population.[77] To avoid this, the Corps and SPA agreed to perform a series of tests on 7 November to determine whether D.O. levels could be increased by changing hydropower generation procedures. The Corps found it

[75] W. Reed Green, "Eutrophication Trends Inferred from Hypolimnetic Dissolved-Oxygen Dynamics Within Selected White River Reservoirs, Northern Arkansas-Southern Missouri, 1974-1994," United States Geological Survey, Water-Resources Investigations Report 96-4096 (1996), 2.
[76] Allen Carter to Estus Walker, 9 April 1991, AGFC-TPO.
[77] Ibid.

could increase oxygen levels by blocking open turbine air vents, restricting maximum generation rates, and distributing generation loads over as many turbines as possible. Using this "short term" plan, the Corps was successful in increasing D.O. levels in the tailwater to 4 p.p.m. at a point 1.5 miles downstream.[78]

Although these levels were above the lethal limit for trout, they were still well below the state water quality standard of six p.p.m. The director of the AGFC informed the Arkansas Department of Pollution Control and Ecology (ADPCE) that the SPA and Corps were violating the state's water quality standards.[79] On 9 November the director of the ADPCE issued an Emergency Order (LIS 90-126) stating the Corps and SPA were violating state water quality standards, killing trout, and threatening the tailwater's "biotic community." In order to "prevent further degradation" the order demanded that the agencies immediately take "all necessary measures" to prevent the release of additional anoxic water in compliance with state standards.[80] That same day Arkansas Senators Dale Bumpers and David Pryor sent a letter to the Corps informing them that current releases were "unacceptable," requesting immediate action to correct the problem.[81]

Following this order, the various state and federal agencies became enmeshed in a heated and increasingly publicized dispute. On 15 November, the issue was front page news in Mountain Home, Arkansas' local newspaper the *Baxter Bulletin*. Trout biologist Jim Spotts claimed that, despite having the ability to increase oxygen by changing its operations, the Corps and SPA were "screwing around for three weeks," while trout were

[78] Stanley Genega to Senator David Pryor, 21 November 1990, AFGC-TPO.
[79] Steve Wilson to Randall Mathis, 9 November 1990, AGFC-TPO.
[80] Randal Mathis, "Emergency Order of the Director," Arkansas Department of Pollution Control and Ecology, LIS 90-126, 9 November 1990, AGFC-TPO.
[81] Dale Bumpers and David Pryor to Stanley Genega, 9 November 1990, AGFC-TPO.

dying in the tailwaters.[82] He warned that if the situation was not corrected the brown trout spawn would be decimated, and would probably not recover for "ten years."[83] Corps representative P.J. Spaul, meanwhile, incensed many by claiming the trout fishery existed because the Corps "built the dam," with its "policies" responsible for the excellent trout fishing. He also questioned the state's authority to impose its water quality standards on the operation of a federal dam.[84]

Despite this rhetoric, the agencies were successful in developing an interim plan to increase D.O. levels. The Corps would operate the dam's turbines at 70 percent capacity with the air turbine vents blocked open to infuse oxygen into the water. This would presumably increase D.O. to 4 p.p.m. near the dam. Although this was below the state standard of six p.p.m. it was considered the "best that can be expected" due to the mechanical limitations of running the turbines at slower speeds and the extremely low D.O. levels in the hypolimnion.[85] It was hoped that physical mixing and photosynthetic processes would further increase D.O. as water flowed downstream.

With an interim plan in place, the agencies now disagreed over where to monitor tailwater D.O. levels. The Corps wanted to monitor D.O. levels 1.5 miles downstream, treating the upper section as a "mixing zone" to increase D.O. to four p.p.m. Requiring readings directly below the dam would make it extremely difficult to meet the state standard of six p.p.m.[86] The AGFC insisted that monitoring be done near the dam since a "tremendous number" of trout, especially spawning brown trout, used this upper section.

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[82] Thomas Garrett, "Low oxygen damaging White River trout fishery," *Baxter Bulletin*, Thursday, November 15, 1990. vol. 89, no. 308.
[83] "Trout dying from lack of oxygen," *Baxter Bulletin*, 10 November 1990.
[84] Andy Gotlieb, "State Orders Fast Action on Fish Kills," *Arkansas Democrat*, Wed. November 14, 1990.
[85] Steve Wilson to Randall Mathis, 14 November 1990, AGFC-TPO.
[86] Bill Mathis, quoted in Gregg Patterson, "The Politics of Water," *Trout* (Winter 1993), 55.

The Corps and SPA also wished to continue maintaining four p.p.m. at the downstream monitoring station even after D.O. levels within the lake improved. The AGFC disagreed, insisting that the interim plan stay in place until the state mandate of six p.p.m was met. The SPA also wanted to generate hydropower at 100 percent levels for four hour periods if there was demand. The AGFC strongly disagreed, arguing that the "biological system" in the tailwaters could not "survive" such low D.O. releases.[87]

As the disagreements and negotiations continued, the Arkansas chapter of Trout Unlimited called an emergency meeting. It was decided to conduct a mass mailing to Governor Bill Clinton to inform him of the issue.[88] These mailings, an official request by the Corps, and undoubtedly other political and public pressures led the governor to ask his natural resource liaison Ken Smith to serve a mediator among the various agencies. On 27 November this tense multi-agency meeting was held in the Governor's conference room in Little Rock, with representatives of the AGFC, SPA, Corps, ADPEC, SWCC, and the Parks and Tourism Department in attendance. The Corps argued that the interim plan would probably solve the problem during most years, although it could not "guarantee" restricting hydropower generation due to the Congressional mandate to recover project costs through the sale of electricity. The SPA agreed, insisting that it would "try to help," but that it was required by law to market hydropower, and late summer and early fall was a peak demand period.[89] Although a longer-term solution was obviously necessary, any impacts to the authorized purposes would require additional studies and a non-federal sponsor to cost-share.

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[87] Steve Wilson to Randall Mathis, 14 November 1990, AGFC-TPO.
[88] Patterson, "The Politics of Water," 54.
[89] Kenneth Carter, "Memorandum for Record, Meeting to Discuss Bull Shoals Dissolved Oxygen Issue," 28 November 1990, AGFC-TPO.

The meeting participants decided the best approach would be to expand the scope of the WRTS to include analyzing D.O. levels. Two committees were formed; a Long Range Planning Committee (LRPC) examining the possible expansion of the WRTS to include D.O. and an Ad Hoc Committee on Project Operations (AHCPO) to develop a plan to avoid future trout kills. The initial multi-agency meeting of the LRPC followed a month later, with the AGFC expressing a desire to keep the minimum flow and D.O. issues separate, since it felt the D.O. problem was the sole "responsibility" of the Corps and SPA. It believed the federal agencies must meet state water quality standards, with the state not responsible for any assumed costs.[90] Once again the Corps stood by its mandate to operate the lakes in "accordance with Congressional authorization," arguing that water quality standards were met "most of the time." The SPA, meanwhile, believed that state standards did not apply to a federal dam, with any change in operation requiring "reauthorization or court direction."[91]

As these long-range negotiations were commencing, the AHCPO began formulating a plan for the upcoming low D.O. season. At its initial meeting in January 1991 it defined the critical season as occurring from June through December. The Committee's objective was to develop interim procedures to avoid future trout kills. This necessitated developing a comprehensive monitoring program to detect low D.O. levels within the tailwaters and lakes. The committee also needed to clearly define the D.O. levels that would trigger corrective actions, while still within the "physical limitations" of the projects and also the "need" for hydropower. This meant that D.O. levels would have to be maintained through opening of turbine air vents, spreading power load over as

[90] Meeting minutes, White River Long Range Planning Committee, 20 January 1991, AGFC-TPO.
[91] Ibid.

many units as possible, and limiting maximum hydropower generation. The committee members agreed to do the "best we can" under current conditions.[92]

Following a series of subsequent meetings and negotiations an official plan for the 1991 low D.O. season was completed. In June all participating agency representatives, except Bill Keith of the ADPCE, signed the plan. He refused because the plan did not guarantee that D.O. levels would be kept at or above the state water quality standard of six p.p.m.[93] Nonetheless, the plan set up a series of monitoring stations to determine when D.O. levels fell below 6 p.p.m. These stations were connected to a network of computers offering real-time data to the Corps. When D.O. levels fell below 6 p.p.m. the turbine vents would be blocked open and hydropower generation would be spread over numerous units with loads on each unit kept to about 50 percent. The AGFC would then cease stocking trout in any section with D.O. readings below 6 p.p.m. If levels fell below 5 p.p.m. the Corps would initiate additional load spreading, and the SPA would alert its customers to possible hydropower reductions. If levels fell below 4 p.p.m. hydropower generation would be reduced even more, and the AGFC would alert its trout kill assessment team.[94]

During these negotiations the SPA suggested some short-term actions. It recommended restocking the tailwaters after the end of the low D.O. season. Since the fisheries are mainly managed as put-and-take, it did not matter whether anglers or low D.O. levels killed the trout since they could be replaced through stocking. This plan

[92] Meeting minutes, Meeting of Committee on Project Operations on White River in Arkansas, 23 January 1991, AGFC-TPO.
[93] Charles McCloskey to Governor Bill Clinton, 24 June 1991, AGFC-TPO.
[94] John Sunderland and Allen Carter, "Trout vs. Hydropower at Bull Shoals Reservoir-White River: Problem or Symptom?" (paper presented at the Joint Meeting of the Arkansas-Oklahoma American Fisheries Society, 16-18 February 1993), 4.

overlooked or ignored the "natural" reproduction of brown trout. It also suggested that anglers be restricted from using the upper reaches of the tailwater during the low D.O. season, and that portable aerators be installed along the banks to "provide enclaves of higher oxygen concentrations." Of course, if these suggestions were implemented the SPA would not pay for any associated costs.[95]

In May 1991 the monitoring of water quality at Bull Shoals and Norfork tailwaters commenced. In early July it was discovered that D.O. levels in the hypolimnion in Norfork Lake were low and continuing to decline. Low D.O. levels this early in the summer were a concern, since there was still at least four months to go in the low D.O. season. Several causes were suspected; including high water from 1990 still affecting chemical and biological processes, increased nutrient loading from additional spring rains, flood control releases taking place after stratification, and generally warmer in-lake temperatures.[96] These concerns proved unwarranted, with the end of the low D.O. season occurring during the first week of December without any reported trout kills. During this week both Norfork and Bull Shoals Lakes turned over, mixing water, nutrients, silt, debris, and most importantly oxygen throughout the water column. Water temperature within the lakes now varied a mere .5°F from the surface to the bottom of the lake.[97] The threat of low D.O. in the tailwaters was over until next summer, with the initial plan generally considered a success.

During the development and implementation of this plan the state agencies were examining the possibility of legal action against the Corps for violating state water

[95] Ad Hoc Committee on Project Operations, White River, Arkansas, "Report on Plan of Operation fro 1991 Low Dissolved Oxygen Season Below Bull Shoals and Norfork," June 1991, AGFC-TPO.
[96] Jim Spotts, "Norfork River Fishery Investigations, research brief" 30 July 1991, AGFC-TPO.
[97] William Lindsay to Richard Nehrling, 10 December 1991, AGFC-TPO.

quality standards. Indeed, the actual 1991 D.O. plan included a caveat stating the "signature of agency representatives does not preclude the parties from pursuing any legal remedies."[98] The AGFC and ADPCE began examining the possibility of treating D.O. as a point source pollutant, using the state's authority under the Federal Water Pollution Control Act (FWPCA) to sue the Corps for discharging pollution into a state water body.[99] The director of the AGFC first requested that the Corps explain its position on meeting state D.O. standards. He also wanted to know the nationwide extent of low D.O. problems at other Corps hydropower facilities.[100]

The Corps responded by admitting that 36 percent of its 73 facilities release water with D.O. levels below state standards. Its goal in these situations is to do "everything possible" to meet state water quality standards, within the limitations imposed by the dams authorized purposes. In relation to its position on meeting state D.O. standards the Corps cited two relevant legal cases. The Corps cited the 1982 ruling in *State of Missouri ex rel. Ashcroft v. Department of the Army* which found that reduction of oxygen did not constitute a discharge of pollutants as defined in the FWPCA. This was upheld in the 1988 ruling *National Wildlife Federation v. Consumers Power Company* which found that the reduction of oxygen in water bodies due to hydropower operations is not considered point source pollution.[101] Therefore the Corps was exempt under the FWPCA, since D.O. released from Bull Shoals dam is not a point source pollutant. A case law examination by an environmental attorney advising the state agencies concurred, finding the Corps was "probably exempt" from complying with state water quality

[98] Ad Hoc Committee on Project Operations, "Report on Plan of Operation for 1991 Low Dissolved Oxygen Season Below Bull Shoals and Norfork," June 1991, AGFC-TPO.
[99] Ann Faitz to Steve Weaver and Chuck Bennett, 4 April 1991, AGFC-TPO.
[100] Senator Dale Bumpers to Colonel Chuck McCloskey, 11 May 1992, AGFC-TPO.
[101] Robert Davis to Senator Dale Bumpers, 10 June 1992, AGFC-TPO.

standards. She did suggest attempting a lawsuit, although winning a judgment would be a difficult "uphill climb" based upon existing case law.[102]

As the legal investigations were ongoing, the AHCPO met in February 1992 to evaluate the past year's plan. The tone of this meeting was much improved compared to the 1990 meeting in the governor's office. Two years of cooperation and communication had fostered a better "understanding" of the various agencies' obligations and challenges in striving to improve D.O. levels. They also realized that solving the problem would "require compromise" that would negatively impact the operations of all agencies.[103] This was reflected in the finalized plan for the 1992 low D.O. season. It was decided that maximum generation rates at Bull Shoals should not exceed 50 percent of capacity from September through mid-November. This recommendation was exceeded only once, resulting in D.O. levels falling to 3.5 p.p.m.[104] Although successful in increasing D.O. levels it also reduced turbine efficiency, resulting in "power sale" and "customer benefit" revenue losses of $1.2 million for the SPA.[105] These procedures did maintain a "viable" fishery, although a minor trout kill was reported below Norfork Dam on October 24 and 25. Therefore, during "most" of the period from August to October trout stocking in the 3.5 miles of tailwater below Bull Shoals Dam ceased. On the Norfork tailwater an average of about 1.5 miles of tailwater was closed during the "majority" of the season.[106]

Following the 1992 low D.O. season the AHCPO and the LRPC were combined into the White River Dissolved Oxygen Committee (WRDOC). This committee now

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[102] Ann Faitz to Steve Weaver and Chuck Bennett, 4 April 1991, AGFC-TPO.
[103] Sunderland and Carter, "Trout vs. Hydropower at Bull Shoals Reservoir," 4.
[104] "White River Dissolved Oxygen Committee Report on Plan of Operation for 1993 Low Dissolved Oxygen Season, White and Norfork Rivers, Arkansas," AGFC-TPO.
[105] Meeting minutes, White River Dissolved Oxygen Committee, 26 January 1993, AGFC-TPO.
[106] "White River Dissolved Oxygen Committee Report on Plan of Operation for 1993," AGFC-TPO.

included numerous state and federal agencies, including the addition of representatives from the MDC and Missouri Department of Natural Resources. It also formed three subcommittees. The Operations Sub-Committee would formulate a plan for the upcoming 1993 low D.O. season. A Biological Sub-Committee would be responsible for evaluating the test results and studies in relation to the biological effects of low D.O. on trout, while a Public Information Sub-Committee was formed to prepare, review, and release information to the press.[107]

The Biological Sub-Committee's main objective was to determine how short term exposure to low D.O. levels actually impacted tailwater trout. The SPA had requested the need to determine the "physiological response" of trout to D.O. levels below four p.p.m. for "short" time periods. Fish telemetry studies were conducted to determine how low D.O. influenced trout during various life cycles. The goal was to find correlations between D.O. and fish mortality, reproduction, and growth. During 1992-93 biologists surgically implanted radio transmitters into the abdominal cavities of 44 brown and rainbow trout allowing them to track individual trout in relation to D.O. levels and spawning. The study found that when D.O. levels fell to 3-4 p.p.m. trout were stressed, moving to areas with higher D.O.[108] These findings demonstrated the need for a permanent solution to the problem.

The WRDOC therefore began examining the possibility of modifying the turbines within the dams. During October 1992 members of the WRDOC participated in a four day meeting with the TVA, the "nation's leading innovator" in relation to improving D.O. within its numerous tailwaters. Following this meeting aeration testing was conducted in

[107] Meeting minutes, White River Dissolved Oxygen Committee, 26 January 1993, AGFC-TPO.
[108] Ibid., 25.

January 1993 at Bull Shoals and Norfork dams. These tests showed that D.O. levels could be improved by modifying the turbine venting systems.[109] During the summer and fall of 1993 larger air lines were installed in all eight generators at Bull Shoals Dam and at the two Norfork generators. Hub deflectors were also added to units one through four at Bull Shoals and both turbines at Norfork.[110] Also called baffles, these hub deflectors are metal cup-shaped plates attached to the inside of the draft tube or turbine hub to agitate water flow and create an area of low pressure. This pulls air in through the bypass piping, increasing D.O. levels downstream. Although successful in increasing D.O. levels they can also result in loss of turbine efficiency. The SPA spent over $138,000 on these modifications.[111]

Although these mechanical modifications would improve D.O. levels, many believed only the "symptom" had been treated. The real concern was deteriorating water quality in the upstream watershed. Urban development and agricultural practices were increasing the amounts of organic matter washing into the lakes and increasing the oxygen deficits. Well-known fly-fishing guide Skipp Halterman suggested the "primary cause" was the millions of pounds of chicken manure deposited on fields in northwest Arkansas.[112] This manure comes mainly from commercial chicken and turkey farming operations connected to large corporations such as Tyson®. Personnel at the SPA,

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[109] "White River Dissolved Oxygen Committee Report on Plan of Operation for 1993," AGFC-TPO.
[110] John Stark, Stan Todd, and Tom Penniston, "Biological Evaluation of Modifications Designed to Improve Dissolved Oxygen, Temperature and Minimum Flow in Bull Shoals and Norfork Tailwaters, DRAFT," 24 June 1996, AGFC-TPO.
[111] Carol Griffee, "Trout Fishery on the White River: The 'Symptom' Has Been Treated," *Arkansas Fish & Wildlife* (March 1994), 33.
[112] Skip Halterman to Allen Carter, 17 April 1991, AGFC-TPO.

Corps, and AGFC agreed, suggesting that the WRDOC expand its examination of D.O. levels to include a more basin-wide "holistic" approach. [113]

The WRDOC acted by requesting that the USGS conduct an analysis of eutrophication trends in the lakes. The USGS agreed, although it would only contribute one-half of the $30,000 necessary for the study, with the WRDOC responsible for the remainder. In a truly cooperative effort, various agencies and conservation groups provided the necessary funding. The ADPCE gave $10,000, the MDC $2,000, Arkansas Chapter of Trout Unlimited $1,500, Northeast Arkansas Fly-fishers $250, Mid-South Fly-fishers $625, and Dallas Fly-fishers $625.[114] The study examined temporal D.O. levels in the hypolimnion of the White River lakes to reveal changes in eutrophication. Using historical temperature and D.O. data from 1974-94 the study results were inconclusive. Change in oxygen deficits in Beaver Lake suggested decreasing eutrophication, while in the other four lakes there was little or no change.[115]

By 1995 the dam modifications, operational changes, and monitoring system put in place by the WRDOC were successful in managing the low D.O. threat. Although the WRDOC continued to meet and develop a yearly plan, this process became increasingly efficient and effective. The same factors leading to that successful mitigation also led to a renewed interest in acquiring minimum flows through water storage reallocation. The most important impetus for this was better communication and cooperation between the state and federal agencies. Another factor was the "growing awareness" that the economic value of recreation was greater than that of the authorized purposes. By 1991 tailwater angling at the four Arkansas dams was worth an estimated $128 million, while

[113] Griffee, "Trout Fishery on the White River: The 'Symptom' Has Been Treated," 34.
[114] Larry Rider to Randall Mathis, 28 June 1994, AGFC-TPO.
[115] Green, "Eutrophication Trends Inferred from Hypolimnetic Dissolved-Oxygen," 1.

hydropower was worth only about $107 million annually. Lake and tailwater recreation combined was now worth an estimated $225 million, compared to only $132 million for hydropower, flood control, and water supply.[116] This gap would only increase over the next decade, leading some to argue that the "real problem" was the "unequal consideration of fish, wildlife, and recreation values" in the management of the dams.[117]

During the meetings of the WRDOC, the AGFC often mentioned the need to increase instream flow, both to alleviate high water temperatures and to possibly assist in increasing D.O. levels. The instream flow procedure in place to avoid high water temperatures was still the 1982 MOU between the Corps and SPA. Under this agreement from June-September three-day average releases of 2,000 d.s.f. were initiated at Norfork and Bull Shoals tailwaters when forecasted air temperatures at Calico Rock are at or above 85°F. This procedure was obviously insufficient, since from 1989-96 tailwater temperatures exceeded 73°F every year for a total of 136 days.[118] Although most trout kills during the early 1990s were due to low D.O., critically high water temperature following a period of non-generation was "suspected" to have caused a "light trout kill" on the Bull Shoals tailwater in August 1993.[119]

In January 1994 the AGFC requested that the SPA follow the same "spirit of cooperation" it was showing in the WRDOC to test minimum flows.[120] Prior to the start of the low D.O. concerns it was determined that the IFIM procedure used by the USFWS in 1981 would be "most appropriate" and "legally defensible" for assessing appropriate

[116] Spotts, "White River Minimum Flow Study," 44-45.
[117] Sunderland and Carter, "Trout vs. Hydropower at Bull Shoals Reservoir," 6.
[118] Ibid., 5.
[119] Ibid., 7.
[120] Steve Wilson to David Ruf, 9 November 1994, AGFC-TPO.

minimum flows.[121] Several attempts had even been made to conduct another IFIM study but these were abandoned due to lack of funding, staff turnover, and the reluctance of the SPA to change its hydropower operations.[122] Although the SPA was now "willing" to meet and discuss modifying hydropower operations to examine minimum flows, it wanted several alternatives tested to determine operations "beneficial to the fishery" while also identifying any impacts and costs to the authorized purposes.[123]

Although the low D.O. issue undoubtedly led to more cooperation it also added to the complexity of determining and obtaining minimum flows. Although the main objective was maintaining sufficient water temperatures, any reallocation study would now have to consider D.O. in addition to a "myriad of synergistic" effects and how all of these would impact the authorized purposes.[124] The AGFC soon realized that the IFIM model was insufficient for modeling such a complex system. Following several months of research, trout biologist John Stark selected the TVA's ADYN-RQUAL model. This model had already been successfully applied to over 50 river sections by the TVA's Water Quality Modeling and Hydraulic Engineering Branch and was "fully adapted" to tailwaters experiencing fluctuating hydropower releases. The model was also capable of calculating wetted area, predicting impacts on fish growth, predicting water temperature change, and could also generate D.O. sub-models.[125]

By 1996 the various agencies were ready to gather the necessary data to run the ADYN-RQUAL model. The goal was to determine the release volumes needed to

[121] Steve Filipek to Loyd Inmon, 16 June 1992, AGFC-TPO.
[122] Stark and Todd, "An Evaluation of Bull Shoals and Norfork Tailwaters," 18 August 1998, AGFC-TPO, 7.
[123] J.M. Shafer to Steve Wilson, 23 February 1994, AGFC-TPO.
[124] John Stark to Larry Rider, 27 September 1994, AGFC-TPO.
[125] Ibid.

improve wetted areas, stream depth, water temperatures, and D.O. levels. Gathering the necessary data to achieve this goal would be a time consuming, expensive, and complex undertaking requiring considerable field work and personnel from the AGFC, ASWCC, SPA, Corps, and the TVA. From May 1996 to July 1997 the model was applied to the upper 44 miles of the Bull Shoals tailwater and the entire length of the Norfork tailwater. Various water releases were made and data collected on wetted area, water temperature, D.O. levels, stream velocities, and a myriad of other factors.[126]

The study found that a minimum flow of 800 c.f.s at the Bull Shoals tailwater and 500 c.f.s at the Norfork tailwater was optimal. An additional 800 c.f.s. at Bull Shoals was also necessary to maintain water temperatures when air temperatures reached 94°F. It also recommended that D.O. levels of six p.p.m. be maintained in releases from both dams. Implementing these recommendations would significantly improve and expand trout habitat, reproduction, and growth while also improving fishing boat navigation. These improvements would then result in more visitations to the tailwaters, adding about $8-10 million in economic value to the fisheries.[127]

Although these findings once again showed the positive effects of minimum flows, the study did not identify where or how to obtain water storage to meet the identified releases. The AGFC began examining the actual amount of annual storage needed in Bull Shoals and Norfork Lakes to provide the minimum flows. Under worst case scenarios, over 342,000 and 218,000 acre/feet of storage would be needed at Bull Shoals and Norfork Lakes respectively. This extra water would have to be stored in vertical feet within the conservation or flood pools and would therefore increase water

[126] Stark and Todd, "An Evaluation of Bull Shoals and Norfork Tailwaters," 18 August 1998, AGFC-TPO, 7-8.
[127] Ibid., 2-3.

levels within the lakes. It was suggested that storage could be distributed upstream in Table Rock and Beaver Lakes to decrease the impact of increased water levels on Bull Shoals and Norfork Lakes.[128]

In a subsequent meeting in October 1998 the AGFC expressed its desire to distribute the needed fifteen vertical feet of storage among all five lakes in the White River system. The Corps suggested that an impact study be conducted to determine how these changes would influence the authorized purposes. The AGFC realized that, although an impact study was not "absolutely necessary" prior to introducing legislation, it would probably be "politically advantageous" in showing that other uses would not be negatively impacted. At this point it seems the AGFC was determined to introduce legislation as quickly as possible, not wanting to wait at least another year for an impact study. Indeed, its "first priority" was to determine if the legislation could be introduced during the current session, since the "longer it takes...the more organized opposition may be."[129] This eagerness may have been precluded by the SPA's strong objection to the ADYN-RQUAL report. It believed the study did not provide "any alternatives or costs, benefits, and impacts to implementation," did not evaluate in-lake impacts, did not evaluate cold water storage impacts, and would cost the agency $8.5 million annually.[130] Another probable cause was political support, something the agency currently had and did not want to risk losing before legislation could be drafted.

Regardless of the cause, the AGFC moved quickly in drafting water reallocation legislation. The AGFC worked closely with its Congressional delegation, closely

[128] John Stark to Larry Rider, 15 September 1998, AGFC-TPO.
[129] John Stark to Larry Rider, 29 September 1998, AGFC-TPO.
[130] George Robbins to John Stark, 24 August 1998, AGFC-TPO.

advising Senator Tim Hutchinson in crafting the final bill.[131] It was passed by Congress on 17 August 1999, modifying Section 304 of the WRDA of 1996 to authorize the Secretary of the Interior to provide minimum flows to sustain the tailwater trout fisheries whenever hydropower generation was not taking place. It specifically called for the reauthorization of the following amounts of storage: Beaver Lake, 1.5 feet; Table Rock, two feet; Bull Shoals Lake, five feet; Norfork Lake, 3.5 feet; and Greers Ferry Lake, three feet. No funding would be provided to reallocate storage until the Chief of Engineers submitted a final report finding these allocations "technically sound, environmentally acceptable, and economically justified." The report was due to Congress on 30 July 2000.[132]

The rapidity of this legislation and its content raised concerns. A member of the AFF felt that the legislation was being "railroaded through at such a pace" that many fly-fishers did not have time to either voice concerns or provide suggestions.[133] The SPA, meanwhile, questioned why the bill did not indicate whether the storage would come from the conservation or flood pool. If storage was taken from the conservation pool it could significantly impact the amount its customers would pay for electricity. The SPA even submitted an amended version of the bill to Senator Hutchinson, omitting the specific feet of storage since this was "inappropriate" to do prior to the study.[134]

Although there were concerns, many people who had fought for years to obtain more instream flows were ecstatic. Steve Wilson, the director of the AGFC and all seven

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[131] Steve Taylor, "Minimum Flow: A Maximum Juggling Act," *Arkansas Wildlife* 32, no. 2 (March/April 2001), 8.
[132] Public Law 106-53, 106th Congress, 1st sess. (17 August 1999), *Water Resources Development Act of 1999*.
[133] Wayne Reed to John Starck, 23 June 1999, AGFC-TPO.
[134] Carmie Henry to Senator Tim Hutchinson, 28 June 1999, AGFC-TPO.

members of the game commission wrote Senator Hutchinson a glowing letter thanking him on accomplishing in a "...few months something that has been worked on for many years: MINIMUM FLOW LEGISLATION FOR ARKANSAS TROUT WATERS!!!!!!!!"[135] Similar letters were sent to the other five members of the Arkansas Congressional delegation who had either assisted with the legislation or cosigned a letter of support. Although hopes were generally high, others were understandably skeptical. A faxed memo of the proposed legislation received by the AGFC includes the words "Loophole Supreme!" scrawled in the margin next to the circled phrase "does not adversely affect other authorized purposes, and that no federal costs are incurred."[136] This would prove prophetic.

Despite some misgivings concerning the possible outcome, the White River Minimum Flow Study (WRMFRS) was officially underway. The stakes were indeed high, both for Arkansas' tailwaters and the precedent this legislation would set in improving tailwater trout fisheries nationwide. During the first year the Corps spent $100,000 conducting a series of public data gathering workshops and preparing preliminary plans. It also published a Notice of Intent to conduct the required Environmental Impact Statement (EIS) in the Federal Register in May 2000. Despite this initial progress, an additional $850,000 was needed to actually complete the study, an amount not included in the 2000 budget.[137] This prompted Steve Wilson, the Director of the AGFC, and the seven members of the Game and Fish Commission to write President Clinton a letter pleading for the necessary funding. They offered a "tour of the trout waters" to showcase how economically and recreationally important the fishery was to

[135] Steve Wilson to Senator Tim Hutchinson, 20 August 1999, AGFC-TPO.
[136] Ken Carter to Allen Carter, 23 April 1999, AGFC-TPO.
[137] "Minimum Flow, Issue Brief," 26 August 2002, AGFC-TPO.

Arkansas. Of course they also requested that he include $850,000 in the Corps fiscal year 2001 budget to complete the study.[138] Although the necessary funds would indeed be included in the fiscal year 2001 and 2002 budgets, the study was already well behind schedule. In December 2000 the WRDA was amended, extending the deadline for the WRMFRS study to 1 January 2002.[139]

Both the WRDA of 1999 and 2000 directed the Corps to examine reallocating the same specific feet of water storage in each lake. The Corps mandate was to determine whether such modifications "adversely affect" the authorized purposes and whether federal costs would be incurred. Since hydropower, flood control, and municipal water supply are the authorized purposes, the study would need to examine the entire White River basin. For example, even though reallocation was targeting the five hydropower lakes, the study included Clear Water Lake in Missouri since it influences water flows within the basin.[140] Therefore, the main objective of the report was to identify "reallocation and release scenarios" that would provide minimum flows in a manner that was "economically advantageous but also minimizes impacts/effects" to the authorized purposes.[141]

One of the first objectives of the study was to decide the exact amounts of minimum flow needed and whether the dams were capable of providing these releases. Since the AGFC had already spent considerable time and money studying optimum flows, the Corps used its minimum flow recommendations. With existing leakage and

[138] Steve Wilson, Witt Stephens, Bill Bridgeforth, Marion McCollum, Jim Hinkle, Lester Sitzes, Forrest Wood, Mike Freeze to President Bill Clinton, 25 May 2000, AGFC-TPO.
[139] Public Law 106-541, 106th Congress, 2nd sess. (11 December 2000) *Water Resources Development Act of 2000*.
[140] Meeting minutes, "Public Forum on Minimum Flow," Arkansas State University, 18 December 2003, AGFC-TPO.
[141] United States Army Corps of Engineers, "White River Minimum Flows Reallocation Study Report," (July 2004), 2.

releases from house generating units, the actual amount of additional flow needed varied considerably by dam (Figure 29). Actual test releases of these various amounts were

Dam	Leakage/house generating unit releases (c.f.s.)	Amount of Increased Minimum Flow (c.f.s.)	Total Minimum Flow (c.f.s.)
Bull Shoals	160	640	800
Norfork	110	190	300
Table Rock	80	320	400
Greers Ferry	60	140	200
Beaver	34	101	136

Figure 29. Identified minimum flows for each White River basin dam.

conducted by the AGFC, Corps, MDC, SPA, and USGS during June 2001. The objectives were threefold; 1) to calibrate discharge and gate settings at the dams, 2) evaluate hydropower potential, and 3) to show anglers what the tailwaters would look like during the targeted flows.[142] From 5-10 June the various agencies cooperated in releasing the targeted minimum flows, providing a unique glimpse of how the tailwaters would change. Water levels on the five tailwaters increased from six to nine inches, a noticeable change from the historic low flows. For example, increasing flows from 350 c.f.s. (Figure 30) to 800 c.f.s. (Figure 31) on the Bull Shoals tailwater increased stream depth by about 8.5 inches, inundating large areas of exposed streambed, flooding shoals and gravel bars, and submerging aquatic vegetation.[143] Most "wade fishermen, boat

[142] Stan Todd to Melissa Jones, 6 September 2001, AGFC-TPO.
[143] Photographs courtesy of Arkansas Game and Fish Commission.

Figure 30. Bull Shoals tailwater directly below Bull Shoals Dam during water release of approximately 350 c.f.s.

Figure 31. Bull Shoals tailwater directly below Bull Shoals dam during water release of approximately 800 c.f.s.

fishermen, outfitters, and landowners" viewing these flows reacted positively.[144]

The tests also revealed that 800 c.f.s. of flow was inadequate to maintain water temperature in the lower section of the Bull Shoals tailwaters. During the tests trout kills were reported on three separate days, although the 24 hours of no generation prior to the start of the tests may have contributed to the critically high water temperatures. Regardless, to keep water temperatures sufficiently low in the lower section of the tailwater would require more than the combined 1,100 c.f.s. from Bull Shoals and Norfork dams. Therefore, additional hydropower releases of "fish water" would still need to be made during warm weather.[145] On the other four shorter length tailwaters the targeted minimum flows would most likely keep water temperatures adequate for trout.

As the study progressed, the various stakeholder groups lobbied either for or against establishing minimum flows. The AGFC was especially active and supportive, appointing fisheries biologist Allen Carter to work full-time on the minimum flow issue. Other AGFC staff members assisted in gathering information for the study and working diligently in its promotion. A webpage was developed within the agency's official website, providing minimum flow updates and information on how to contact Arkansas' Congressional delegation. Game commissioner Forrest Wood was especially active in promoting minimum flows. He sent numerous letters to various officials, attended meetings, encouraged people to contact Congressional delegates, and even circulated a petition demonstrating people's support for reallocation.[146]

The focal point of this campaign was that minimum flows would improve the aquatic ecosystem by providing cooler water temperatures, increased wetted area, and

[144] United States Army Corps of Engineers, "White River Minimum Flows Reallocation Study," 9.
[145] Stan Todd to Melissa Jones, 6 September 2001, AGFC-TPO.
[146] Forrest Wood to Friends and Fellow Anglers, 6 October 2003, AGFC-TPO.

more aquatic insects and trout habitat. The AGFC webpage states "Fish Need Water!" explaining that only flood control, hydropower, and municipal water supply have guaranteed amounts of water storage. While "environmental restoration and mitigation" was often stated as the primary impetus for minimum flows, the economic benefits were also touted. For example, with increased minimum flows:

> ...the rivers would produce more scuds, sow bugs, mayflies and other trout foods. More food usually translates into more and bigger fish. Better fishing attracts more anglers who buy fishing licenses and trout stamps, rent boats, buy guide services and support local motels, gas stations and restaurants.[147]

The result for the state's "trout business" was a 20 percent increase in economic value from the current estimate of $170 million annually.

Although initially wary about minimum flows in relation to wade fishing, most fly-fishers and fly-fishing clubs were supportive. Especially after viewing the test releases, most felt the increase in flow would improve habitat conditions and improve fishing while still allowing wading. The various fly-fishing clubs were especially active in contacting Congressional delegates and state and federal agencies to voice their support. Club websites included information and updates about the ongoing study, encouraging members to attend public meetings and to contact the Corps or legislators to voice support or concerns about the ongoing study. One lingering concern was whether increasing flows would lead to more "boat traffic" on the Norfork tailwater.[148] This tailwater is popular among fly-fishers since during low flows it is difficult to use a boat, while still providing good wade fishing.

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[147] Arkansas Game and Fish Commission staff, "Getting to Know Minimum Flow," 14.
[148] Judy Boston, "Fish Kills and Minimum Flow," Mid-South Fly Fishers, available at http://www.msff.org/ (March 2005).

Resort owners, guides, and outfitters catering to float fishers were especially enthusiastic about the legislation. An AGFC survey of 32 guides and 10 "dock owners" on the Bull Shoals tailwaters found that 79 percent mentioned that minimum flows should be the agency's top priority.[149] Increasing minimum flow would allow boats to easily navigate over shallow shoals and also improve and expand trout habitat. The WNFROA meanwhile "strongly" supported the issue since it would increase angling, resulting in more revenue for its membership.[150] It was particularly active in emailing and writing Congressional delegates and promoting the issue through various websites and presentations at public meetings. Ninety year old Elmo Hurst even added his historic view on the issue, arguing that the free-flowing White River "never got as low then as it does now."[151] The issue was so galvanizing that at least one organization, the Friends of the North Fork and White Rivers, was formed in 2001 to lobby for its implementation. The group's stated goal is to "preserve, enhance and restore" these "beautiful" rivers.[152]

Lake interests, meanwhile, were concerned about the possibility of increased lake levels. Marina operators were worried that increasing the amounts of storage in the lakes would force them to move docks or other facilities.[153] Rising lake levels could also impact beaches, campgrounds, boat docks, and other lake recreation facilities. Some AGFC biologists were also concerned about changes to the hypolimnion, since it also served as a "thermal refuge" for cold-water fish species such as striped bass in Beaver Lake and trout in Bull Shoals Lake. Pulling more water from the hypolimnion could

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[149] Jackie Stinnett, Stan Todd, and Darrell Bowman, "Bull Shoals Tailwater Business Owner Survey," 21 October 2002, AGFC-TPO.
[150] Heather Crunkleton to Thomas Holden, 1 April 2000, AGFC-TPO.
[151] Elmo Hurst to Whom It May Concern, 15 June 1998, AGFC-TPO.
[152] Friends of the North Fork & White Rivers, Inc., available at http://www.friendsofthenorth forkandwhiterivers.com/ (January 2005).
[153] Gary Christoff to Files, 24 April 2000, AGFC-TPO.

decrease the extent of this refuge, negatively impacting these popular sport fish. There was additional concern about whether lake levels would be held high enough during the spring to adequately inundate spawning areas.[154]

The USFWS was also concerned about the impact of increasing lake levels. The manager of the NNFH had "deep concerns" about releasing cold water from the hypolimnion of the lake throughout the year. Removing more water could possibly increase water temperatures in this zone, lower oxygen saturation levels, and promote disease in the hatchery raceways.[155] Increasing lake levels could also inundate caves or other karst habitat, as well as tributary streams, impacting endangered species such as the Tumbling Creek cavesnail (Antrobia culveri), gray (Myotis grisescens) and Indiana bats (Myotis sodalis), speckled pocketbook (Lampsilis abrupta), and Ozark cavefish (Amblyopsis rosae). These concerns led the USFWS in 2002 to "not support" raising the conservation pool at Greers Ferry, Beaver, or Bull Shoals Lake.[156] This prompted a detailed rebuttal letter from the AGFC, questioning the "incomplete information" on which their position was based, since the WRMFRS had not been completed and would summarily address the aforementioned concerns.[157]

Hydropower interests were especially allied against minimum flows. An especially controversial article appeared in the September 2003 issue of *Rural Arkansas*, a magazine distributed to approximately 440,000 members of the state's electric cooperatives. Its title "The price of fish could be going up: And you may end up paying for it through your electric bill" was unambiguous. Reallocating water storage for the

[154] Carl Perrin to Mark Oliver, 30 March 2000, AGFC-TPO.
[155] Kenneth Boyles to Carl Perrin, 31 March 2000, AGFC-TPO.
[156] Margaret Harny to Colonel Benjamin Butler, 12 August 2002, AGFC-TPO.
[157] Allen Carter to Sam Hamilton, 28 August 2002, AGFC-TPO.

fisheries would mean that electrical cooperatives and their customers would be "subsidizing" trout anglers.[158] Since the SPA would lose water storage and therefore hydropower capacity, electric cooperatives would have to increase rates on its customers to purchase more expensive thermal energy. It also stated that increased flows were primarily to allow johnboats to float over shoals, while they "might" improve trout habitat. This article was not well received by the AGFC. It asserted the article was "simply wrong" in claiming that minimum flows would increase electrical rates. Releasing minimum flows would still produce saleable electricity and would definitely improve and increase trout habitat. Finally, such claims are "speculative" since the WRMFRS was not yet complete.[159]

The speculations were finally addressed in the long belated WRMFRS final report. It explained the methodology used and the results in a detailed 50 page report. Since the 1999 and 2000 WRDAs only identified certain feet of storage to be reallocated within each reservoir, the Corps was forced to identify the volume of the storage, elevation of the storage, and whether it should come from the conservation or flood pool. It formulated three storage reallocation plans; 1) taking water from the flood control pool only (Figure 32), 2) taking water from the conservation pool only (Figure 33), and 3) taking 50 percent from each (Figure 34).[160]

The Corps evaluated over 1,000 alternatives from these three storage scenarios. It then identified a National Economic Development (NED) plan providing the highest

[158] "The price of fish could be going up: And you may be paying for it through your electric bill," *Rural Arkansas* (September 2003), 13.
[159] Scott Henderson to Senator Blanche Lincoln, 18 September 2003, AGFC-TPO.
[160] Unites States Army Corps of Engineers, "White River Minimum Flows Reallocation Study Report," 29 July 2004, 2.

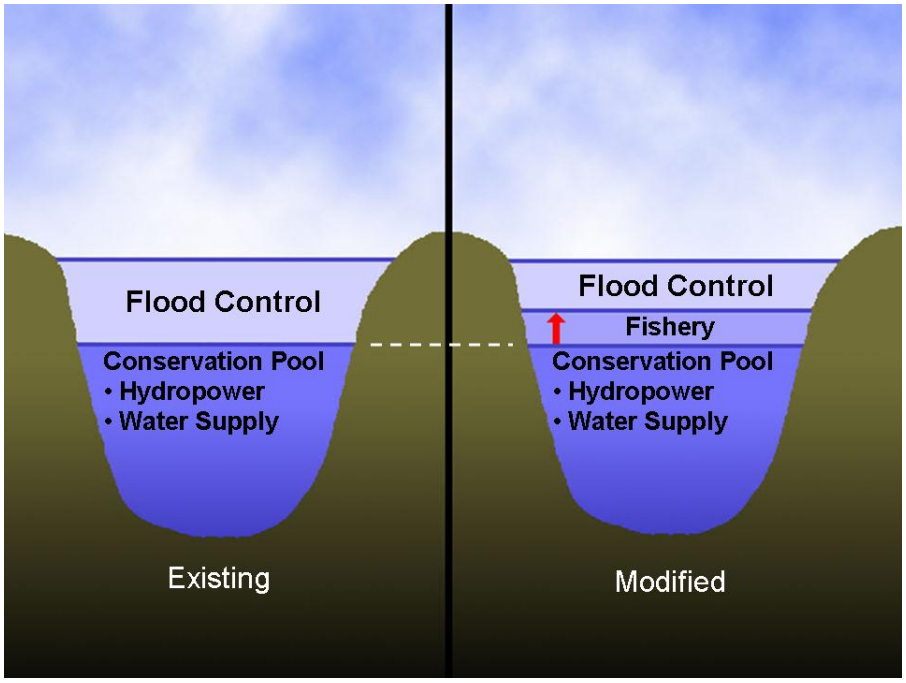

Figure 32. Water storage reallocation from flood control pool.

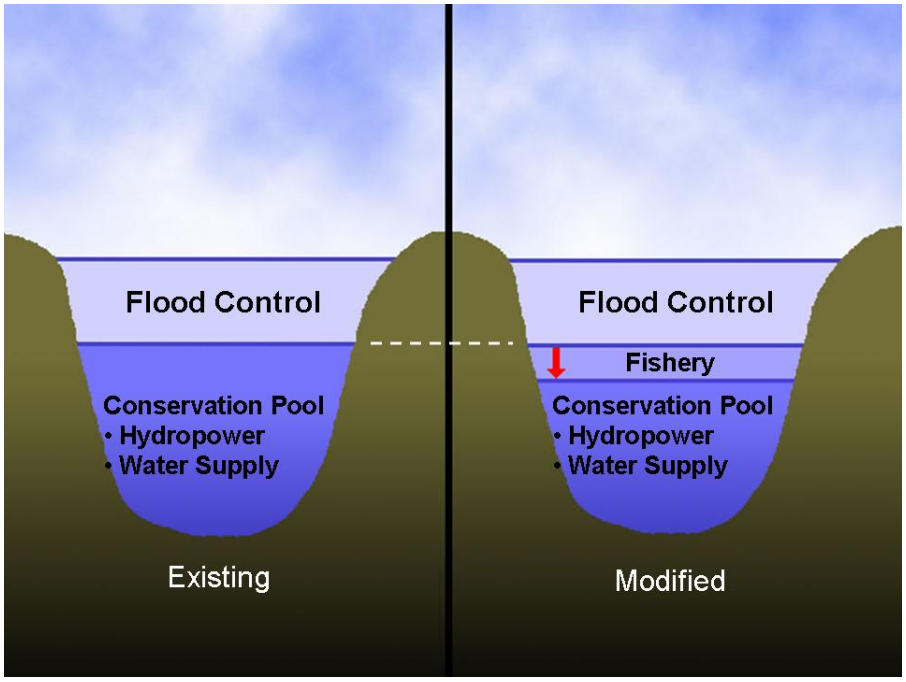

Figure 33. Water storage reallocation from conservation pool.

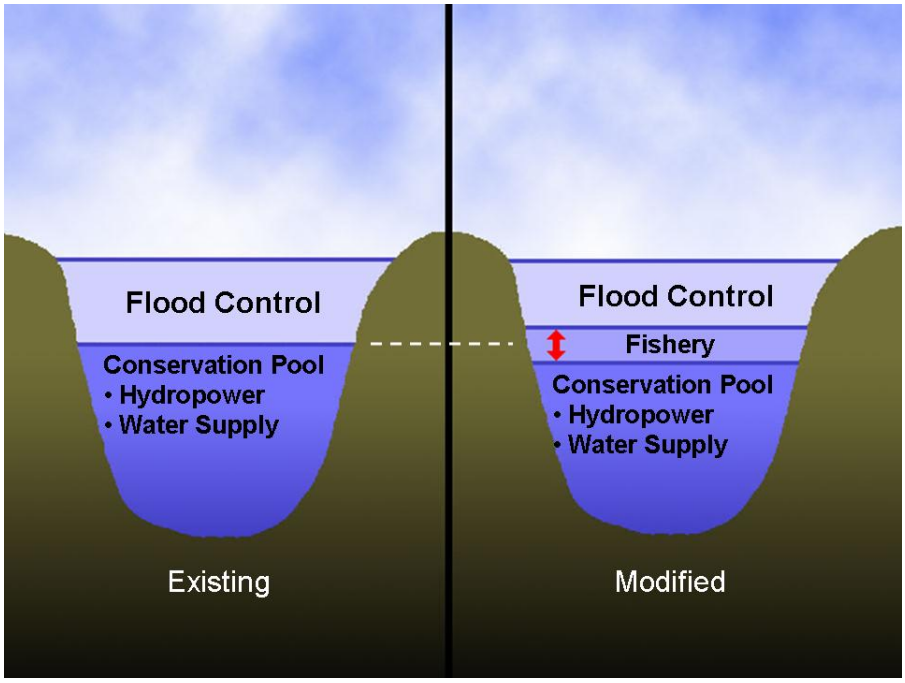

Figure 34. Water storage reallocation divided equally between the conservation and flood control pools.

economic benefits and additional plans that were economically justified. All of the proposed plans were considered "technically sound" and "environmentally acceptable." For all the various release scenarios the recreational benefits to the tailwater trout fisheries would increase. Although the lake fisheries might have "minor benefits or minor adverse effects" for a short period, they would stabilize and provide similar conditions as found presently.[161]

Unfortunately for the AGFC, anglers, and sport fishing businesses wanting minimum flows, all the reallocation alternatives would "incur cost" to the federal government. All of the plans in the district report would impact one or more of the authorized purposes. Most of the adverse affects would be to hydropower, reducing the

[161] Carl Strock, "White River Minimum Flow, Reallocation Study, Arkansas and Missouri," 30 July 2004, 2.

revenue available for the SPA to make its yearly payments to the federal treasury, and to pay for the hydropower debt. The Corps, meanwhile, would not be responsible for this loss in revenue, and there was no non-federal sponsor willing to offset these losses. The SPA, therefore, would have to "reduce power sales" and would "likely" raise the electrical rates for its customers to compensate for the loss in revenue.[162]

The main point of disagreement was whether reallocation should be designated as recreation, ecosystem restoration, or mitigation. This designation would influence the "magnitude" of the costs, and the proportion paid by the federal government and the non-federal sponsor. Designating the reallocation as mitigation would distribute the costs among all the authorized purposes. If designated ecosystem restoration, it would be cost shared 65 percent federal and 35 percent non-federal. Recreation meanwhile would mean the costs would be divided equally between the federal government and a non-federal sponsor.[163]

The AGFC believed reallocation providing minimum flows would provide "appropriate mitigation" for the impacts to the warm-water fishery. The tailwater ecosystems had also been "further deteriorated" over the last several decades by "evolving" hydropower demands. Since the purpose of the 1999 WRDA was to "partially mitigate" fishery losses, providing minimum flows would meet this objective through a more "stable aquatic environment." Because the warm-water fishery had never been appropriately mitigated, the cost of reallocation should be 100 percent federal.[164]

The SPA meanwhile argued that reallocating water would negatively impact its hydropower revenue. The five Corps dams account for 30 percent of its electricity and

[162] Ibid., 2.
[163] Ibid., 2-3.
[164] United States Army Corps of Engineers, "White River Minimum Flows Reallocation Study," 48-49.

40 percent of its capacity. This electricity therefore accounts for 33 percent of the revenues it deposits into the federal treasury. Losing water storage for minimum flows would therefore impact the "reliability and marketability" of its electricity, resulting in higher electrical rates for its customers, mostly "rural farmers" and municipalities who were already experiencing economic difficulties. Since change in allocation would impact the authorized purposes, the "beneficiary" of reallocation should pay compensation for this loss.[165]

The Corps, meanwhile, admitted that it did have the authority to reallocate water within the five lakes. This would be primarily to "improve and sustain" the trout fisheries, a recreation benefit. In accordance with "existing law and Corps policy" the cost of this reallocation would have to be cost shared equally with a non-federal sponsor. Since the AGFC supported the NED plan, this cost-sharing would be approximately $231,000 per year. Additionally it would charge the non-federal sponsor with 50 percent of the updated costs of storage, or about $11.8 million.[166] This revenue would be used to credit the SPA for losses in its revenue. Since no non-federal sponsor was willing to pay these costs, the Corps recommended to Congress that the reallocation plan not be implemented. As of 2005 the Corps is waiting for Congress on "how to proceed."[167] Over 60 years after hydropower generation began at Norfork Dam, the fight over mitigating its impact to the downstream warm-water fishery continues.

[165] Ibid., 49-50.
[166] Ibid., 7.
[167] United State Army Corps of Engineers, "White River Minimum Flow Study," available at http://www.swl.usace.army.mil/planning/wrminflows.html (October 2004).

CHAPTER VIII

CONCLUSION

I Love This Whole Dam Thing
Arkansas bumper sticker

the boundaries between this world of nature and the world of artifice, the world of things we have made, are no longer very clear
Richard White, 1996

I first visited the Bull Shoals tailwater during the winter of 1995. Along with several friends I drove over 300 miles from my home in central Oklahoma to the Sportsman's Lodge, a fishing resort on the bank of the river about seven miles from the dam. What led me to make this trip were the enticing articles I read in outdoor publications describing the huge brown trout caught from the river. Following our arrival we purchased fishing equipment, trout licenses, and hired a local guide to take us on a float trip. The next morning we loaded our gear into an olive green johnboat and spent the day floating the tailwater, using techniques and bait provided by our guide. We caught both rainbow and brown trout in the shallow clear water, enjoying the scenery as we floated over shallow shoals and around numerous gravel bars. Later that afternoon hydropower generation began, transforming the tailwater from a stream into a fast-flowing river, sending us downstream quickly and forcing us to change our fishing techniques.

Although I did not realize it at the time, I began writing this history during that first visit. During subsequent years, I made numerous trips to Arkansas' tailwaters, intrigued by the power of dams and trout in transforming the natural environment and cultural landscape. The more I read and experienced, the more convinced I became of the need for a detailed historical account of this river system, especially in relation to the tailwater trout fisheries. I now realize that my initial fishing trip was just one small episode in the long history of sport fishing on the White River.

This history began sometime around 1870 when tourists began traveling into the Ozarks to explore its many natural wonders, including the region's numerous free-flowing streams. Over the course of the next 70 years commercial float fishing evolved to become an integral part of Ozark recreational tourism, changing the way many local and non-resident anglers viewed and used the river and its fishery. Vacationing anglers came seeking respite from the artificiality of urban life, to enjoy the relatively unspoiled natural beauty, good fishing, and adventure of a float trip. Since they were paying outfitters and guides for the experience, they expected something in return; an enjoyable experience that could be repeated on return visits. Commercial outfitters and guides viewed the rivers as a commodity, a means to attract anglers and make money. Although many anglers undoubtedly fished and floated for personal enjoyment, it was the early commodification of the river that laid the "historic foundation" for large-scale commercial sport fishing on the tailwaters.[1] This early commercialization in turn transformed the cultural landscape, including how people used and influenced the natural environment.

[1] Morrow, "What's in a Name," 9.

Prior to dams, the role and presence of federal and state agencies along the White River and its tributaries was limited. Although the Corps built the first navigation dams on the lower White River during the early 1900s, its activities on the upper section were mainly limited to improving navigation and surveying. Most people living along the river had few interactions with or knowledge of federal agencies such as the Corps or USFWS. Since there were few lakes, AGFC fisheries management centered on passing and enforcing regulations for the state's free-flowing rivers. Therefore, the size and influence of the agency during this time was limited, with fishing regulations sparse and only sporadically enforced.

Although the actual presence of federal agencies within the Ozarks was limited, the legislative processes in relation to water policy began during the early decades of the twentieth century. Spurred by catastrophic flooding within the region and in the lower Mississippi River, multi-purpose dams were seen as a way to control these destructive floods while harnessing the natural power of rivers to produce electricity. Dams would also lead to more agricultural production, business, and trade within the economically depressed Ozarks. With the primary focus on economic development, the impact of dams on the natural environment was largely ignored. Inundating millions of acres of habitat and destroying free-flowing streams and native fish species was secondary. The impact of dams on downstream fisheries was considered particularly inconsequential.

During 1944-69 the goal of water policy planners and engineers to use multi-purpose dams in the comprehensive management of the White River's basin came to fruition. Long float trips on the free-flowing White River disappeared as five Corps hydropower dams were erected, transforming the river into a series of lakes. The

resulting cold-water hydropower releases from the hypolimnion of Norfork Lake led to the initial release of rainbow trout in 1948. Although mentioned as mitigation for the destruction of the warm-water fisheries, these trout were released as an afterthought and an experiment. After these initial releases proved successful, additional releases were made in subsequent years below the other four Corps dams.

For anglers, the transition from a free-flowing warm-water fishery to cold-water tailwaters stocked with trout was especially dramatic. Anglers were not only faced with an exotic fish species, they also had to learn how to successfully fish the dangerous and widely fluctuating artificial flows of tailwaters. Experienced and skilled commercial guides and outfitters already present along the river capitalized on the difficulty and danger of fishing tailwaters, establishing a lucrative sport fishing industry. Along with other anglers, they modified bass fishing techniques and equipment to catch trout, keeping intact methods such as float fishing in johnboats. With limited fishing pressure and increasing numbers of trophy trout, the tailwaters became well-known as excellent trout streams.

With the completion of the dams and release of trout, the responsibilities of the AGFC expanded immensely. Given control over the tailwater fisheries the agency worked to maximize harvest and the economic potential of the tailwaters by implementing put-and-take management techniques. As the popularity of the tailwaters increased in the 1950s the need for additional trout and powerful political connections led to the construction of the Norfork National Fish Hatchery and later the Greers Ferry National Fish Hatchery. These hatcheries benefited recreation by supplying millions of trout, which in turn attracted anglers who purchased fishing licenses and spent money at

local businesses. As the local economy became increasingly dependent on trout fishing, local politicians and business leaders placed increasing pressure on the AGFC to protect, enhance, and manage the fisheries to promote economic growth.

The authorizing legislation gave control of these dams and the electricity they produced to the Corps and SPA. These agencies and their personnel quickly became a common part of the landscape along the lakes and tailwaters. Although the main priority for the SPA and Corps were the authorized purposes of flood control and hydropower, the increasing economic and recreational importance of angling forced these agencies to make operational changes to protect the fishery. Low water conditions due to droughts in 1954 and 1963-65 led to procedures to increase instream flows to protect the fisheries from warming water temperatures during the summer and early fall.

By the 1970s angling pressure and AFGF management policies had created a put-and-take rainbow trout fishery. The large rainbow trout that had been common during the 1960s were gone, replaced by an occasional trophy brown trout. During this time fly-fishing was increasing in popularity, leading to the establishment of the first fly-fishing clubs in the state. Soon thereafter the AFF created a naturally reproducing brown trout fishery on the Little Red River, removing the long-held belief that brown trout reproduction could not support sport fishing. Natural reproduction forced managers to move away from strictly put-and-take management towards more diversified management. Spawning brown trout also gave the tailwaters an important "natural" or "wild" element that is viewed positively by anglers.

As the 1980s progressed the AGFC increasingly diversified its management. Although put-and-take rainbow trout were still the top priority, cutthroat trout were

released and brown trout management became a greater priority. With the hiring of the first trout biologist in 1985, the agency began exploring ways to take advantage of the growth potential of the tailwaters. The first special regulation protecting brown trout on the Beaver tailwater went into effect in 1988, as did the first artificial-lures-only and catch-and-release area on Dry Run Creek. These regulations were harbingers of more and stricter regulations to come.

Instream flow continued to be a contentious issue, especially following the major trout kill in 1971. This kill and subsequent trout kills in 1972-73 and 1980-81 led to more refined and detailed procedures to supply cold water during summer and fall. In 1981 the MOU between the Corps and SPA established procedures to release certain amounts of instream flow based upon forecasted air temperatures. Although the AGFC and sport fishers sought more instream flows, the Corps and SPA stood firmly by the authorizing legislation for the dams, which does not include any water storage for recreation.

The early 1990s was an especially pivotal time in the history of the tailwaters. Howard Collins' world record brown trout caught from the Little Red River was especially important in attracting anglers, as was the release of the movie *A River Runs Through It*. Increasing numbers of anglers, both bait fishers and fly-fishers, came to the tailwaters. It was during this time that tailwater trout angling became more economically lucrative than the authorized purposes of hydropower, flood control, and water supply. This was a pivotal point in the history of the tailwaters since it gave momentum to the need for reallocating water storage for the fisheries. The AGFC and the sport fishing industry used this as leverage to gain political support to increase instream flow.

The AGFC continued to push for more special regulations areas. By diversifying the fishery in relation to fishing techniques and tackle, it could increase revenue and license sales. The catch-and-release areas established during the 1990s provided fly-fishers and trophy anglers with areas suitable to their preferred angling. These areas quickly became popular and more economically valuable than areas with more traditional regulations. It also encouraged passage of special regulations protecting spawning brown trout below Bull Shoals Dam. Despite these changes the traditional float trip using bait casting or spinning tackle remained popular. The majority of the tailwaters continued to be managed as put-and-take.

The 1991 trout kills resulting from low D.O. in the Bull Shoals tailwater were influential in forcing state and federal agencies to work cooperatively to protect the fisheries. The threat of low D.O. levels killing spawning brown trout was a public relations disaster for the Corps and SPA. Following a very contentious period during the fall of 1991 that culminated in a meeting at the Governor's office, the various agencies began to work towards a solution. The increased cooperation, communication, and studies of the WRDOC led to renewed interest in increasing minimum flows. Working closely with business leaders and Congressional representatives, the AGFC sought to obtain minimum flows. The WRMFS was an especially long and contentious process that clearly defined the position of each user group in relation to minimum flows. In the end, the complexity of the system made altering water allocation difficult, especially with the requirement that the federal government incur no costs.

Findings

The history of the White River highlights the appropriateness and relevancy in applying the three levels of inquiry defined by Donald Worster. Through studying natural processes, examining how humans use natural resources for economic production, and describing how human values, perceptions, and interactions with nature change over time we can appreciate and understand the complexity and uniqueness of tailwater trout fisheries.[2] Although tailwaters are mainly artificial systems, they still retain and sustain many natural processes. As Richard White suggests, they are truly "organic machines," sustaining life and natural processes while doing the human work for which they were designed and built.[3]

This juxtaposition of the organic and mechanical functioning together is what makes tailwater trout fisheries so intriguing, challenging, and controversial to manage. Foremost is the reality that these popular fisheries exist because of dams. Cold-water releases altered the native warm-water fisheries to such an extent that trout rely upon the dams for their continuance. This is what distinguishes the history of tailwater trout fisheries from the numerous environmental narratives describing the precipitous decline of Pacific salmon in rivers such as the Columbia. Although dams have unarguably caused salmon runs to decline, they did not replace a native fishery with an exotic one. The survival of native salmon, therefore, resulted in billions of dollars spent on trying to protect and sometimes save endangered species. The fight over reallocating water storage for instream flows and increasing low D.O. levels in the tailwaters is considerably different since tailwaters are such artificial systems.

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[2] Worster, "Doing Environmental History," 293.
[3] White, *Organic Machine*, 59.

The most important factor in relation to tailwater trout fisheries is their economic importance. They began as economic systems and continue as such. Since a basic tenet of capitalism is the need for continuous growth, the AGFC has continually sought methods to increase angler satisfaction with and use of the fisheries. This is considerably easier on artificial tailwaters since managers control when, where, and how often trout are stocked. As the economic value of the fishery increased, business owners, the AGFC, and local and state politicians all strove to not only protect their economic interests but enhance them. The fight over instream flow was essentially about enhancing the economic production of the tailwaters. Although often discussed as a way to improve the aquatic ecosystem, the main objective was to provide better angling, leading to increasing revenue.

The artificiality of these systems, combined with certain natural processes makes them especially lucrative economically. Since the natural reproduction of rainbow trout is limited, millions are stocked to provide angling opportunities. Federal hatcheries subsidize the fisheries by providing millions of rainbow trout that benefit commercial sport fishing. At the same time, the ability of brown trout to reproduce in the tailwaters attracts anglers seeking "wild" or trophy trout. The AGFC assists these processes by protecting spawning brown trout through special regulations while managing rainbow trout with mainly put-and-take management.

This study also reveals the changing attitudes towards natural resources. When Norfork Dam was built in the early 1940s little concern was given to its impact on the natural environment. Our country's environmental laws and regulations were lax, allowing federal agencies to build numerous dams with only minimal consideration of the

consequences. Over the course of time people's values have changed, demanding that the environment be protected, preserved, and enhanced. During this same time sport fishing, and recreation in general, became increasingly important, especially economically. Many people now expect and demand federal agencies such as the Corps and SPA to protect downstream fisheries in the operation of dams.

Additional Research

Since this study is the first in-depth environmental history of tailwater trout fisheries, it revealed the need and opportunity for additional research. The presence of numerous tailwater fisheries, especially below TVA dams in the southeast and USBR dams in the western U.S. provide ample opportunity for additional historical case studies. Additional case studies would broaden our understanding of the ecological, recreational, and economic similarities and differences of various tailwaters. They would also provide insight into how important these fisheries are to local and state economies, anglers, and state management agencies.

Another desirable study would be a comparative analysis of how the different federal agencies respond to issues such as instream flow and low D.O. levels. Since the Corps, TVA, and USBR are all large federal dam-building bureaucracies with diverse policies and legislative mandates, it would be informative to compare how they manage tailwater trout fisheries. This should include a more detailed analysis of the legal cases and legislation that accompany how tailwaters are managed. A related study would be to compare and contrast how state fisheries agencies manage tailwaters, especially in relation to stocking procedures and special regulations.

Additional research is also needed concerning the cultural landscape of tailwater trout fisheries. Since each dam and tailwater supports and sustains a unique linear trout fishing region that changes over time, more detailed studies delineating and describing these landscapes are needed. These landscapes include a rich variety of material culture in the form of resorts, boat docks, signage, and fly-shops that can be mapped, described, or compared between regions. Another interesting study would be to examine regional differences and similarities concerning tailwater angling methods and tackle, including the homogenizing influence of popular culture in possibly minimizing these differences.

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APPENDIX

Institutional Review Board Form

Oklahoma State University
Institutional Review Board

Protocol Expires: 10/13/2004

Date: Tuesday, October 14, 2003 IRB Application No AS0422

Proposal Title: From Smallmouth Bass to Tailwater Trout: An Environmental History of Arkansas' White River, 1900-2003

Principal Investigator(s):

✓

Joel W Helmer
320 Scott Hall
Stillwater, OK 74078

Dale Lightfoot
230 Scott Hall
Stillwater, OK 74078

Reviewed and Processed as: Exempt

Approval Status Recommended by Reviewer(s): Approved

Dear PI :

Your IRB application referenced above has been approved for one calendar year. Please make note of the expiration date indicated above. It is the judgment of the reviewers that the rights and welfare of individuals who may be asked to participate in this study will be respected, and that the research will be conducted in a manner consistent with the IRB requirements as outlined in section 45 CFR 46.

As Principal Investigator, it is your responsibility to do the following:

1. Conduct this study exactly as it has been approved. Any modifications to the research protocol must be submitted with the appropriate signatures for IRB approval.
2. Submit a request for continuation if the study extends beyond the approval period of one calendar year. This continuation must receive IRB review and approval before the research can continue.
3. Report any adverse events to the IRB Chair promptly. Adverse events are those which are unanticipated and impact the subjects during the course of this research; and
4. Notify the IRB office in writing when your research project is complete.

Please note that approved projects are subject to monitoring by the IRB. If you have questions about the IRB procedures or need any assistance from the Board, please contact me in 415 Whitehurst (phone: 405-744-5700, colson@okstate.edu).

Sincerely,

Carol Olson

Carol Olson, Chair
Institutional Review Board

VITA

Joel W. Helmer

Candidate for the Degree of

Doctor of Environmental Science

Thesis: FLOAT TRIPS, DAMS, AND TAILWATER TROUT: AN ENVIRONMENTAL HISTORY OF THE WHITE RIVER OF NORTHERN ARKANSAS, 1870-2004

Major Field: Environmental Science

Biographical:

Personal Data: Born Perryville, Missouri, on December 23, 1968, the son of David and Marilyn Helmer.

Education: Graduated from Blackwell High School, Blackwell, OK in May 1987; received a Bachelor of Science degree in Secondary Education from Concordia University, Seward, Nebraska in May 1992. Completed the requirements for the Master of Arts degree with a major in Geography from the University of Akron, Akron, Ohio in August 1994. Completed the requirements for the Doctor of Philosophy degree with a major in Environmental Science at Okalahoma State University in July, 2005.

Experience: Employed by the Geography and Planning Department at the University of Akron as a graduate assistant from August 1992 until May 1994; employed by Cleveland Public Schools, Cleveland, Oklahoma as a seventh grade geography teacher from August 1992 until May 2000; employed by the Department of Geography at Oklahoma State University as a teaching associate from August 2000 until December 2003; employed by the Department of Geography at Oklahoma State University as a faculty research associate from January 2004 until present.

Professional Memberships: Association of American Geographers, National Council for Geographic Education, National Geographic Society

Name: Joel W. Helmer Date of Degree: July, 2005

Institution: Oklahoma State University Location: Stillwater, Oklahoma

Title of Study: FLOAT TRIPS, DAMS, AND TAILWATER TROUT: AN ENVIRONMENTAL HISTORY OF THE WHITE RIVER OF NORTHERN ARKANSAS, 1870-2004

Pages in Study: 251 Candidate for the Degree of Doctor of Philosophy

Major Field: Environmental Science

Scope and Method of Study: This study describes the environmental and cultural impacts of the four United States Army Corps of Engineer dams built on Arkansas' White River. Focusing especially on the establishment of the tailwater trout fisheries created below these bottom-release dams, the study examines how management of the dams and trout fisheries evolved over time as sport fishing increased in economic and recreational importance. Information for this study was collected from various historical documents, personal interviews, government reports, and the Arkansas Game and Fish Commission's Trout Program archives.

Findings and Conclusions: Beginning in about 1870 and continuing into the 1930s the White River was a popular warm-water sport fishery and float fishing destination that assisted in the development of Ozark tourism. With the completion of Norfork Dam in 1944, and continuing with the completion of Bull Shoals, Greers Ferry, and Beaver dams, the river became a series of large reservoirs and cold-water tailwaters. Exotic trout stocked into these tailwaters created a lucrative commercial trout angling industry that eventually eclipsed in value the dams authorized purposes of flood control and hydropower production. These tailwater trout fisheries eventually became world renowned among trout anglers, and important to the local and state economy. Each tailwater now supports a distinct linear trout angling region delineated by numerous resorts, outfitters, and fly-fishing shops in a region formerly devoid of trout. Since no water storage was allocated for recreation, state fisheries managers, angling interests, and the federal agencies responsible for hydropower production and flood control struggle to balance the needs of the downstream fishery and recreation with the Congressionally authorized purposes, especially in relation to the amount of instream flow.

Advisor's Approval: Dr. Dale Lightfoot