Robert W. Van Kirk
Mark Gamblin

# History of Fisheries Management in the Upper Henry's Fork Watershed

## Abstract

*During the 1970s, the rainbow trout (Oncorhynchus mykiss) fishery of the Henry's Fork of the Snake River was widely regarded as the finest in the nation. However, rainbow trout abundance in the Box Canyon reach declined 80 percent between 1978 and 1991. Rainbow and cutthroat-rainbow hybrid trout are the most popular sport fish in the watershed, but the only native trout is the Yellowstone cutthroat trout (Oncorhynchus clarki bouvieri). Prior to habitat alteration, Yellowstone cutthroat trout thrived in the watershed most likely because of life history traits that allowed optimal use of different types of lake, river and small stream habitat in an aquatic system generally lacking in soluble nutrients. Construction of Henry's Lake and Island Park dams in 1923 and 1938, respectively, created productive reservoir fisheries but greatly restricted the ability of trout to migrate throughout the watershed. Extensive stocking of hatchery rainbow trout and chemical treatments of Island Park Reservoir and the river in 1958 and 1966 essentially eliminated Yellowstone cutthroat trout from the upper watershed except in Henry's Lake. Fisheries throughout the upper watershed were supported by stocking of hatchery rainbow and hybrid trout from the 1920s until the late 1970s. Loss of hatchery supplementation after 1977 in the wild trout management reach downstream of Island Park Dam was inadvertently mitigated by introduction of large numbers of reservoir fish during drawdowns of Island Park Reservoir in 1977, 1979, 1981 and 1984. Introduction of reservoir fish into the river during the 1992 drawdown reversed the population decline of the late 1980s; however, the population declined in subsequent years. The 1979 and 1992 drawdowns were conducted to facilitate chemical treatment of the reservoir to remove Utah chubs (Gila atraria), which along with habitat degradation, have contributed to declines in wild trout abundance and return-to-creel rates of hatchery fish in the reservoir and its tributaries. Current management strategies in the upper Henry's Fork watershed include: 1) cooperatively managing winter flows from Island Park Dam to optimize trout recruitment under constraints imposed by irrigation rights and hydroelectric power needs, 2) restoring connectivity and habitat on tributaries to Henry's Lake and Island Park Reservoir, and 3) restoring wild Yellowstone cutthroat trout in the Henry's Lake system.*

**Key Words:** history, fisheries management, Island Park Reservoir, rainbow trout, Yellowstone cutthroat trout, Henry's Lake.

## Introduction

In 1979, the popular and prolific angling author Ernest Schwiebert wrote in *Fly Fisherman* magazine, "the Henry's Fork may be the finest trout stream in the United States" (Schwiebert 1979). However, as he wrote these words, the rainbow trout (*Oncorhynchus mykiss*) population in the river's Box Canyon section began an 80 percent decline that did not reverse until 1993 (Fig. 1). In the 15 years following the publication of Schwiebert's article, the Henry's Fork often was the center of national-level debates over the politics, economics,

**Robert W. Van Kirk**, Department of Mathematics, Idaho State University, Campus Box 8085, Pocatello, ID 83209
**Mark Gamblin**, Idaho Department of Fish and Game, 1515 Lincoln Road, Idaho Falls, ID 83401

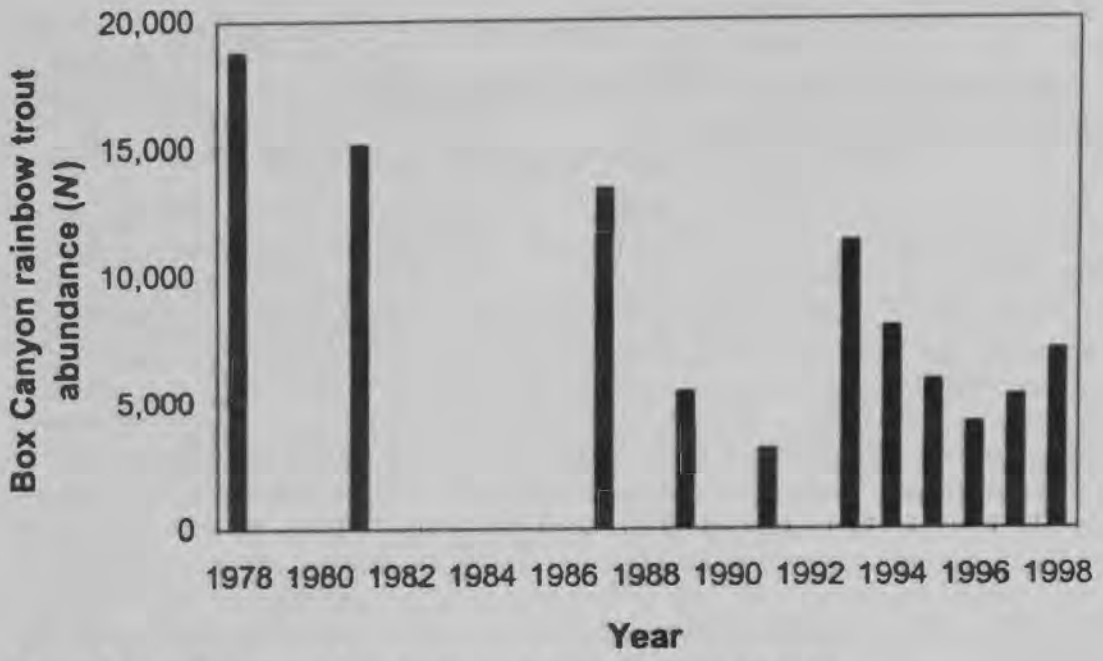


**Figure 1.** *Box Canyon rainbow trout population abundance estimates.*

aesthetics, and science of water and fisheries management (Van Kirk and Griffin 1997). A direct outcome of these debates was a program of multi-disciplinary and inter-organizational fisheries and watershed research, the products of which appear in this issue or are listed in the bibliography (Van Kirk this issue). The majority of this research focused on understanding ecological factors that could have caused the Henry's Fork rainbow trout population to decline (e.g., Platts *et al.* 1989, Angradi and Griffith 1990, Vinson *et al.* 1992, HabiTech, Inc. 1994, Griffith and Smith 1995). However, recent approaches to the management of fisheries and other natural resources have emphasized the importance of gaining a historical perspective on resource use and management to augment information gained from ecological studies (e.g., Angermeier 1997, Wissmar 1997).

In this paper we chronicle the history of fisheries management and use in the upper Henry's Fork watershed through historical accounts, Idaho Department of Fish and Game (IDFG) records and research papers. We organized the chronology into four time periods, of which each was distinguished by a distinct management emphasis. We then analyzed in more detail what has emerged as the most important aspect of fisheries management in the upper watershed, that of the relationship between Island Park Reservoir and the fisheries of the river. A discussion follows that describes how historical management has shaped the current fisheries in the Henry's Fork and how a historical perspective on these fisheries can guide future management. All geographical locations referenced in this paper appear on the maps in Van Kirk and Benjamin (this issue).

## Fisheries Management History

### The Era of Abundance: 1868-1899

Gilman Sawtell was Island Park's first white settler and likely the first to discover its productive fisheries. He settled on Henry's Lake in 1868, and by

1877 when General Howard passed through the area in pursuit of Chief Joseph and the Nez Perce, Sawtell had established a commercial fishing operation on the lake (Brooks 1986, Green 1990). Subsequent settlers also discovered the abundant Henry's Lake trout, and each winter during the 1880s and 1890s, between 25,000 and 49,000 kg (50,000 and 100,000 lbs) were harvested, frozen and shipped to markets in Butte and Salt Lake City (Arbuckle 1900, USCFF 1901, Stephens 1907, Brooks 1986, Green 1990).

Yellowstone cutthroat or "black-spotted" trout (*Oncorhynchus clarki bouvieri*), the only trout native to the Henry's Fork watershed, supported this commercial fishery (Behnke 1992). The U.S. Commission of Fish and Fisheries (USCFF) also used Henry's Lake as an early source of Yellowstone cutthroat trout eggs for distribution to other parts of the country (USCFF 1899, 1901, 1905). The USCFF was at least indirectly responsible for bringing the first nonnative trout to the watershed. Prior to formation of most fish and game departments of the western states, the USCFF collected and distributed the eggs and fry of several trout species to individuals, agencies and companies throughout the country by train (USCFF 1877, 1897, 1898, Wales 1939).

By 1900, Fremont County supported 37 commercial fish operations (Arbuckle 1900). We may never fully understand the impacts of these operations on the area's native fish populations, but we know that they were responsible for introducing nonnative fish and harvesting large quantities of wild, native fish prior to 1900 (Arbuckle 1900, Brooks 1986, Green 1990). Although the earliest date of nonnative fish introduction is unknown, Joe Sherwood established a commercial rainbow trout hatchery at Henry's Lake in 1891, and by 1893, George Rea was operating a hatchery in Shotgun Valley using brook (*Salvelinus fontinalis*) and rainbow trout (Brooks 1986, Green 1990). The ultimate sources of both early nonnative introductions are unknown. Conventional wisdom has held that the origin of almost all rainbow trout beyond their native range is the McCloud River in northern California (e.g., Keil 1928, Wales 1939, Busack and Gall 1980), and that conventional wisdom has generally prevailed on the Henry's Fork to this day. However, historical records show that some rainbow trout eggs shipped to Bozeman, Montana, in the late 19th century were collected from steelhead in the Trinity River 150 miles west of the McCloud (USCFF 1897), and Behnke (1992) notes that almost all rainbow trout propagated around the world have origins in both coastal and interior rainbow stocks. Thus, the ancestor of the modern Henry's Fork rainbow was most likely a hybrid of many different rainbow stocks rather than a pure McCloud River fish.

## Regulation, Promotion and Propagation: 1899-1945

Although fish and game laws were passed by the territory, and later the state, of Idaho, they were essentially unenforceable until the IDFG was created by an act of the 1899 legislature. Idaho's first State Game Warden, Charles Arbuckle, was assigned the task of controlling commercial harvest at Henry's Lake. He reported that many commercial fish farms consisted of wild fish held in privately constructed impoundments on public waters, and he urged "stringent legislation to suppress this growing evil, as it is fast depopulating some of our choicest streams (Arbuckle 1900)." The enforcement activities of Arbuckle's successor, W. N. Stephens, were aimed at protecting the native Yellowstone cutthroat trout, but he reported that brook trout "seem to thrive and grow in our mountain streams...better than our native fish...[The brook trout] is

considered the best of all the trout family and its propagation should be encouraged in every way possible (Stephens 1907)." Stephens' department entered the fish propagation business upon completion of the Hayspur hatchery on Silver Creek in 1907, the Sandpoint hatchery in 1908 and the leasing of the Warm River hatchery in 1908 (Stephens 1909). In 1909, Stephens (1909) noted that "the widely known and justly celebrated 'rainbow' is frequently taken in some sections..."

Stephens (1909) summarized IDFG's fisheries program during 1908 by stating that "the fish culture work of the past twelve months...will keep the streams well stocked with the finest species of fish and will insure an opportunity for all who come to catch a mess of trout...[T]he replenishment of the streams will not only afford the residents of the State pleasure, but will attract many nonresidents and this will help in the development of Idaho." Many of those nonresidents were well-known actors, politicians, and authors who fished the waters of Island Park as guests of the Harrimans, Trudes, and other landowners. In describing a 1901 fishing trip to the Buffalo River, former Chicago mayor Carter H. Harrison wrote, "at each bend there was a deep hole and in the clear crystal water we could see large cutthroat trout lazily waving tails at the bottom...That evening at the ranch, we emptied two creels, large ones, too; the creels and the side and back pockets of our hunting coats were all filled to overflowing (Green 1990)."

In 1910 the three IDFG hatcheries stocked a total of 1.26 million brook and 2.84 million cutthroat trout in Idaho waters (Stephens 1911). Stephens (1911) actively promoted Idaho's angling opportunities to nonresidents, reporting that "nearly every day...the trains coming from...Salt Lake City...are crowded with men, women and children, garbed in outing attire and provided with lunch baskets, rods and creels. From Salt Lake City they go to Bear Lake and the streams of Fremont County..." All of the streams in Fremont County lie in the Henry's Fork watershed.

Several changes in IDFG management on the Henry's Fork occurred between 1917 and 1924. In 1919 State Game Warden, W. H. Thorp, recommended to "close the Snake River to fishing from Big Springs to [Henry's Lake] outlet (Thorp 1919)," a closure to protect spawning trout that remains in effect today. Warm River hatchery was abandoned because of its remote location, and operations were moved to the Ashton hatchery, which was purchased from private owners in 1919 and remodeled in 1923 (Jones 1921, Thomas 1925). With the renovation of the Ashton hatchery, stocking programs in the Henry's Fork watershed shifted from use of cutthroat and brook trout to use of primarily rainbow trout, a trend that has continued to this day. The Ashton facility planted 40,000 brook and 262,000 rainbow trout into Fremont County waters during 1923 and 1924 (Thomas 1925). A state hatchery was established at Henry's Lake in 1924 to mitigate the loss of spawning habitat in the lower reaches of tributaries caused by construction of a dam on Henry's Lake Outlet by the North Fork Reservoir Company (Thomas 1925, Green 1990). During the first year of hatchery operations on the lake, over 2 tons of Yellowstone cutthroat trout and cutthroat-rainbow hybrids were collected that averaged 2.3 kg (5 lbs) apiece (Thomas 1925).

Whereas IDFG biennial reports contained much information on the construction of Henry's Lake Dam, its effects on the fishery, and establishment of the hatchery, these reports did not even mention construction of the larger Island Park Dam and Reservoir on the Henry's Fork. Island Park Reservoir, with a capacity of $1.67*10^8$ $m^3$ (135,000

acre-feet), was constructed in 1938 to store irrigation water for the Fremont-Madison Irrigation District (Benjamin and Van Kirk 1999). Although few data are available on pre-dam fisheries, construction of the dam undoubtedly changed the nature of fish populations throughout the watershed. Blockage of fish migration, alteration of hydrologic regime, creation of new lacustrine habitat, and management of reservoir levels affected fisheries upstream and downstream of the dam. Nonetheless, IDFG reports did not mention Island Park Reservoir until the 1950s. Relationships between the reservoir and fisheries both upstream and down are discussed in more detail in a separate section of this paper.

Between 1925 and 1945, fisheries management on the Henry's Fork did not change much although IDFG continued to grow at the state level. By 1930, the IDFG operated twelve hatcheries and a fleet of fish transport trucks (Thomas 1931). The stocking levels of 1,823,111 fish in Fremont County and 20,609,323 statewide in 1939 were representative of those during the 1930s and 1940s (Simpson 1948, IDFG 1940).

## The Post-war Years: 1946-1969

The post-World War II years brought science and technology to nearly every aspect of American society, including fisheries management. In 1950 the United States Congress passed the Federal Aid in Sport Fishery Restoration (Dingell-Johnson) Act to provide money to state fish and game departments for fisheries research, management, restoration, and education. The IDFG initiated many such projects in the Henry's Fork watershed, including research on Henry's Lake (IDFG 1954) and habitat improvements on the Buffalo River (IDFG 1962). During the 1940s and 1950s, IDFG's *Idaho Wildlife Review* magazine contained educational articles on subjects such as the role of science in fisheries management (Simpson 1948), trout habitat (Pratt 1951), the effects of human population increase on wildlife (Leonard 1953), the effects of natural resource commodity development on trout habitat (Andriano 1954), watershed management (Croft 1958), and conservation biology (Allen 1959). These articles are just as relevant today as they were 50 years ago.

Fisheries management during the post-war years relied increasingly on technological advances in fish culture techniques and chemical methods for removing undesirable fish from water bodies. In 1948 it was "the intention of the department to operate all hatcheries at capacity...Throughout the state many streams are completely fished out soon after the opening of fishing season. Therefore, to as large an extent as is possible, these streams will be planted two or more times annually in an attempt to furnish catchable fish to the greatest number of fishermen" (Simpson 1948). The 1948 IDFG long-range fisheries management plan also included a program to eradicate "rough fish" such as carp (*Cyprinus carpio*) and Utah chubs (*Gila atraria*) (Simpson 1948). In 1950 and 1951 creel surveys were conducted on Island Park Reservoir to collect baseline data on trout catch rates, as it had recently been discovered that "the Utah chub...had been introduced into this water, presumably by bait fishermen (Hauck and Irving 1952)." A fear held that expansion of the Utah chub population would cause a decline in trout numbers and thus, catch rates. In 1958, and again in 1966, Island Park Reservoir, its tributaries, and the main Henry's Fork above and below the reservoir were treated with rotenone and toxaphene to remove nongame fish (IDFG 1958, Jeppson 1966, IDFG 1968, Jeppson 1969). Although now considered a game fish, the native mountain whitefish (*Prosopium williamsoni*) also was

targeted for removal. These treatments extended downstream to Mesa Falls in 1958 and to Ashton in 1966, removing nearly all fish, including native Yellowstone cutthroat trout. Following both treatments, the reservoir and river were restocked with rainbow trout (Rohrer 1983).

## Research And Management: 1970-present

Since 1970, IDFG has increased its emphasis on research, wild trout management, and public involvement in fisheries management and funded most programs with Dingell-Johnson money. For example, a creel survey was conducted on Henry's Lake in 1971 and 1972 to compare with results of the 1951 survey. Angling pressure had increased 300 percent, the catch rate had declined 50 percent, and the average weight of creeled fish had declined from 1.3 to 0.9 kg (2.7-1.8 lbs) (IDFG 1973). "Diversion and siltation of tributaries [had] made the fishery more dependent on artificial propagation (IDFG 1973)." Brooks (1986) and Prange (1995) give histories of the formation of the nonprofit Henry's Lake Foundation in 1981 and its successes in working with IDFG and private landowners to restore wild trout populations and aquatic habitat. Systematic creel surveys performed on a regular basis since the 1970s have documented recovery of the Henry's Lake fishery, which centered around cutthroat-rainbow hybrid trout produced at the Henry's Lake hatchery.

A major reason for formation of the Henry's Lake Foundation was consideration given by IDFG to abandoning the popular cutthroat-rainbow hybrid hatchery program at Henry's Lake. The approach to maintaining the popular hybrid fishery in Henry's Lake has centered around habitat restoration on Henry's Lake tributaries to increase natural production of Yellowstone cutthroat trout, which are crossed with hatchery rainbow to produce the hybrid trout. The Henry's Lake Foundation embraced this approach. The Foundation has had an important role in working with landowners around the lake to undertake habitat improvement activities such as screening irrigation diversions, fencing livestock out of riparian areas, and re-establishing riparian vegetation. Rehabilitation of the Henry's Lake Yellowstone cutthroat and hybrid trout fisheries has been a success story in cooperative fisheries and watershed management (Van Kirk and Griffin 1997).

The careful and detailed work of fisheries biologist and manager Paul Jeppson during the 1960s and 1970s moved fisheries management on the Henry's Fork itself into the modern era. He initiated the first fisheries investigations on the Henry's Fork in 1972 and conducted a comprehensive creel survey the following year (IDFG 1973). On the 111 river-km (69 mi) between Henry's Lake Outlet and St. Anthony, Jeppson (1973) reported that 250,000 hours of angling effort, two-thirds of it by Idaho residents, resulted in the harvest of 180,000 game fish weighing 41 metric tons (45 English tons). The catch was 63 percent "wild" rainbow trout, 11 percent hatchery-reared rainbow trout, 16 percent brook trout, and 10 percent combined of hybrid trout, cutthroat trout, whitefish, kokanee salmon (*Oncorhynchus nerka*), and coho salmon (*Oncorhynchus kisutch*). The salmon were introduced into Island Park Reservoir over the previous decade. On the Harriman Ranch section of the river, the catch was 71.3 percent "wild" and 14.9 percent hatchery rainbow trout, with the remainder brook and cutthroat trout. At that time access to the Ranch was tightly controlled by the Harriman family, and the fishery was managed under special regulations consisting of flyfishing only and no trout over 356 mm (14 in) in the creel. From the Ranch

fence upstream to the Buffalo River, the catch was 89.9 percent "wild" and 6.2 percent hatchery rainbow trout, with brook trout, salmon, and hybrids also present (Jeppson 1973).

Jeppson usually used quotations around the word *wild* when describing trout populations in his reports, most likely because adult trout stocked as unmarked fingerlings (length 75-125 mm, or 3-5 in) were not easily differentiated from naturally-spawned fish; however, those stocked as catchables (length 200-300 mm, or 8-12 in) were readily identified as hatchery fish. Thus, the "wild" trout of Jeppson's reports probably included both naturally-spawned fish and those stocked as fingerlings, reflecting his understanding that fisheries in the upper Henry's Fork watershed were supported, at least in part, by hatchery supplementation during the 1960s and 1970s. Unfortunately, distribution of fish stocked into the Henry's Fork among river reaches or size classes is impossible to determine from existing records because of the way stocking activities were reported during this era. However, Jeppson (1973) did report that 31,400 catchable-sized rainbow trout were stocked into the Henry's Fork between Island Park Dam and Riverside campground during the 1973 season, and it is reasonable to assume that this level was representative of those during this time period.

Following the 1973 creel survey, Jeppson (1973) recommended: 1) continuing special regulations on the Harriman Ranch "to encourage fishing-for-fun;" 2) retaining general regulations (10-trout limit, no gear restrictions) elsewhere; 3) obtaining a minimum flow from Island Park Dam; 4) introducing brown trout below Island Park Dam to increase average trout size; and 5) exploring the feasibility of improving habitat conditions and constructing rearing reservoirs adjacent to the Henry's Fork. The rearing reservoirs would have provided additional recruitment of juvenile trout into the population below Island Park Reservoir. Although brown trout have not been introduced into the upper watershed as they have been below Mesa Falls, special regulations, a minimum flow from Island Park Dam, habitat rehabilitation efforts, and most significantly, a great deal of research and effort to improve survival of age-0 rainbow trout below Island Park Dam have become centerpieces of the nonprofit Henry's Fork Foundation's efforts from its inception in 1984 (Van Kirk and Griffin 1997). In this respect, Jeppson's understanding of the Henry's Fork fishery and his recommendations for its enhancement were well ahead of his time.

Follow-up work in 1976 found that harvest in the Ranch and Last Chance/Box Canyon sections decreased because of increased popularity of catch-and-release fishing (Coon 1977). The percentage of hatchery rainbows decreased to 13 percent of the total trout harvest on the Ranch but increased to 22 percent of the Last Chance/Box Canyon trout harvest (Coon 1977). Wild trout regulations, at that time a daily harvest limit of three fish under 305 mm (12 in) long and one over 508 mm (20 in), were implemented on the Henry's Fork from Island Park Dam to Riverside Campground in 1978 (Rohrer 1983). The Harriman Ranch section of the river continued to be managed under flyfishing only regulations, a condition the Harrimans stipulated for their donation of the Ranch to the State of Idaho (Rohrer 1983). The State Department of Parks and Recreation assumed management of the Ranch in 1977. In 1988 catch-and-release regulations were implemented from Island Park Dam to Riverside Campground, including Harriman State Park.

Recent research in the Henry's Fork watershed has provided much data on

trout population abundances, habitat conditions, growth rates, aquatic ecology, angler use, and other watershed attributes relevant to fisheries management. At the same time, the number and scope of fisheries enhancement and habitat rehabilitation projects has substantially increased; Van Kirk and Griffin (1997) discussed many projects as do other papers that appear in this issue. A few of these deserve special mention.

1. Stocking hatchery fish into streams of the upper Henry's Fork watershed has decreased significantly over the past 3 decades. Initially, a shift in management emphasis to wild fisheries caused stocking reductions. More recently, budget cuts have forced IDFG to reduce stocking levels in all waters, including lakes and reservoirs. The only streams in the upper Henry's Fork watershed that currently receive plantings of hatchery trout are the Henry's Fork in the Mack's Inn vicinity, the Buffalo River near Buffalo campground, and Warm River near Warm River campground. Each of these streams is stocked with a few thousand catchable-sized rainbow trout each summer.
2. Since the early 1970s, angler effort has increased substantially on the Henry's Fork below Island Park Dam but has decreased upstream of Island Park Dam (Van Kirk *et al.* 1999a, Van Kirk *et al.* 1999b).
3. On streams with general regulations (harvest permitted) in the upper Henry's Fork watershed, harvest rates are around 20 percent or less of the total number of fish caught (Van Kirk and Giese 1999, Van Kirk 1999, IDFG unpublished data).
4. Despite introduction of nonnative trout as early as 1890, Yellowstone cutthroat trout were still abundant in the watershed in the 1920s. However, their populations subsequently declined severely because of widespread rainbow stocking, construction of Island Park Dam, and the chemical treatments of 1958 and 1966. Other than the adfluvial Henry's Lake Yellowstone cutthroat trout population, viable populations of Yellowstone cutthroat trout are currently found only in a few isolated headwater streams in the upper Henry's Fork watershed (Van Kirk *et al.* 1997, Jaeger *et al.* this issue).

## Island Park Reservoir Management and Stream Fisheries in the Upper Watershed

### Major Effects of Island Park Dam

The most immediate effect of the dam was to block fish migration. Prior to dam construction, fish from as far downstream as Mesa Falls could migrate all the way upstream to Big Springs to spawn. The only tributaries to the Henry's Fork downstream of Island Park that provide substantial amounts of small-stream habitat for spawning and rearing are the Buffalo River and Thurmon Creek. Fish access to the Buffalo River was greatly reduced by construction of a small power dam near its mouth in the mid 1930s, although fish could still access the Buffalo for a few weeks a year during spring runoff. Small dams on the Railroad Ranch eliminated or greatly reduced access to Thurmon Creek in the early 1900s. These dams isolated fish in the 40 river-km (25 mi) from Island Park downstream to Mesa Falls and prevented their access to tributary streams. A fish ladder was constructed on the Buffalo River dam in 1996 to allow Henry's Fork rainbows access during fall, winter, and early spring to spawning and rearing habitat upstream (Van Kirk and Giese 1999). Inaccessibility of Thurmon Creek to

rainbows in the Henry's Fork has been used to the advantage of a native Yellowstone cutthroat trout reintroduction project implemented there in 1999 (Jaeger *et al.* this issue).

The second major effect of Island Park Dam has been alteration of the flow regime in the river downstream of the dam. The most substantial effect came in the form of greatly reduced winter flows (Benjamin and Van Kirk 1999). Prior to the early 1970s, reservoir outflows of <10 percent of inflow were common for periods of up to several consecutive months. Alteration of winter flows below Island Park Dam has affected juvenile trout survival (Gregory this issue) and interactions among waterfowl, macrophytes, and trout (Van Kirk and Martin this issue). Changes in dam management, implemented in the early 1970s, have increased winter flows below the dam, and Benjamin and Van Kirk (1999) recommended water management actions to increase winter flows further under the constraints of meeting irrigation rights. Furthermore, Mitro (1999) provided evidence that given a fixed amount of water available for winter release, juvenile trout survival downstream may be increased by releasing proportionately more of this water in mid-to late-winter than is discharged earlier in the winter.

A third effect of Island Park Dam was creation of the reservoir itself. Wild Yellowstone cutthroat trout, cutthroat-rainbow hybrids, and rainbow trout flourished in the new reservoir environment, and a popular trout fishery was created. Hauck and Irving (1952) noted that almost all fish observed in anglers' creels in 1950 and 1951 appeared to be cutthroat-rainbow hybrid trout. Because the first stocking of the reservoir did not occur until 1953, these fish were most likely wild fish with the same adfluvial life history as those in Henry's Lake. Ample spawning habitat was available in the Big Springs area of the upper Henry's Fork and in numerous reservoir tributaries, most notably Sheridan Creek. By the 1960s, Island Park Reservoir was as celebrated for its trophy-sized trout as Henry's Lake (Trueblood 1963), a result of shared geographic conditions that make both water bodies highly productive. The large, shallow west end of the reservoir allows absorption of solar radiation, and Sheridan Creek contributes phosphorus from natural sources in the Centennial Mountains (Whitehead 1978, Roessler 1996). The annual spawning migration of large trout out of the reservoir and into the Henry's Fork upstream is described from an angler's viewpoint by Brooks (1986).

A fourth effect that has proven to be particularly relevant to the fishery downstream is the management of reservoir levels. The reservoir has been drawn down to very low pool elevations many times since its initial filling (Table 1). Reasons for drawing down the reservoir have included high demand for irrigation water during dry years, dam inspection and repair, and the need for a small pool to facilitate efficient chemical treatments of the reservoir. Below about $2.1*10^7$ $m^3$ (17,000 acre-feet), the west end of the reservoir becomes dry or too shallow to provide fish habitat, and reservoir fish concentrate in a relatively small area of deep water immediately upstream of the dam. Substantial numbers of these fish have been observed to migrate through the dam's outlet structure and into the Henry's Fork during periods of drawdown. During the 1992 drawdown, IDFG personnel and volunteers moved an estimated 10,000 large trout from pools immediately below the dam to deeper water below the Buffalo River confluence.

A hydroelectric power plant was added to the dam in 1994, changing the flow pathways of water being discharged from the dam. During most

**Table 1.** *Summary of 10 lowest Island Park Reservoir drawdowns. Data from U.S. Bureau of Reclamation.*

| Calendar year | Minimum pool volume (cubic meters) | (acre-feet) | Percent of capacity at minimum | Date(s) of minimum |
|---|---|---|---|---|
| 1992 | $3.33*10^6$ | 270 | 0.2% | 23 to 25 September |
| 1979 | $5.30*10^6$ | 430 | 0.3% | 29 September to 1 October |
| 1966 | $6.83*10^6$ | 5,540 | 4.1% | 29 September |
| 1977 | $1.35*10^7$ | 10,910 | 8.1% | 23 September |
| 1961 | $1.53*10^7$ | 12,400 | 9.2% | 9 September |
| 1960 | $1.54*10^7$ | 12,460 | 9.2% | 10 October |
| 1981 | $1.56*10^7$ | 12,620 | 9.3% | 9 October |
| 1984 | $1.87*10^7$ | 15,193 | 11.3% | 11 September |
| 1958 | $2.97*10^7$ | 16,790 | 12.4% | 13 October |
| 1940 | $2.08*10^7$ | 16,850 | 12.5% | 27 September |

flow conditions, water passes through the dam via the power plant. A screen on the power plant intake prevents fish from passing downstream through the dam and into the river. Only when dam release exceeds 27 $m^3$ (960 cfs) does water flow either over the spillway or through the original dam gates, both of which are unscreened. Thus, addition of the power plant has greatly decreased the opportunity for downstream movement of reservoir fish into the river.

Reservoir drawdowns in 1979 and 1992 mobilized and transported large quantities of reservoir-bottom sediments into the river downstream. During the 1992 drawdown, an estimated 45,000-91,000 metric tons (50,000-100,000 English tons) of sediment were deposited into the Henry's Fork below the dam (Van Kirk and Griffin 1997). Gregory (this issue) describes effects of this sediment on winter survival of juvenile trout and subsequent attempts to remove the sediment from the river. Van Kirk and Martin (this issue) discuss the effects of sediment deposition below Island Park Dam on macrophytes and waterfowl.

## Fisheries of Island Park Reservoir and its Tributaries

Like many reservoirs in the intermountain West, Island Park has been managed since the 1950s in a cycle of chemical renovations and restocking. Treatments to remove nongame fish were conducted in 1958, 1966, 1979 and 1992. Most stocking efforts on Island Park Reservoir have used rainbow trout, but coho and kokanee salmon, splake (brook trout x lake trout *Salvelinus namaycush* hybrids) and Lahontan cutthroat trout (*O. c. henshawi*) have also been stocked. Chemical treatments and stocking of Lahontan cutthroat trout and splake were management responses to the Utah chub population in Island Park Reservoir. At peak abundance, Utah chubs account for over 90 percent by number and biomass of the fish assemblage in the reservoir. Chemical removals of chubs were designed to provide 5-10 years of improved trout production, and Lahontan cutthroat trout and splake were intended to make use of the abundant forage base provided by the chubs and provide additional angling opportunity. Lahontan cutthroat trout and splake exhibited growth and survival rates similar to those of rainbow trout, but they appeared to forage primarily on invertebrates rather than on chubs and other baitfish, so they offered no advantage over rainbow trout. As a result, stocking of Lahontan cutthroat trout and splake in Island Park Reservoir has been discontinued. Utah

chubs were discovered in Henry's Lake in the mid-1990s although declines in the trout fishery have not been observed since the discovery. If expansion of the chub population will limit trout fisheries in Henry's Lake, as occurred in Island Park Reservoir, remains to be seen.

Historical relationships between catch and stocking rates in Island Park Reservoir show that substantial change in the reservoir's fishery occurred between 1950, when the first data were collected, and the early 1980s. The biggest change in the reservoir fishery appears to have taken place around 1965, 7 years after the first chemical renovation. Ball *et al.* (1982) were the first to analyze these relationships. Regression of annual rainbow (or cutthroat-rainbow hybrid) trout catch rates against weight of fish stocked in the reservoir yield two distinct relationships by time period (Fig. 2). These relationships show that between 1950 and 1964, the wild component of the fishery ($x = 0$) provided twice the catch rate that it did between 1965 and 1981, suggesting that wild trout were twice as abundant in the reservoir prior to 1965 than after or that fish were easier to catch prior to 1965 or both. Wild Yellowstone cutthroat trout and cutthroat-rainbow hybrids were present in much larger numbers prior to the 1958 and 1966 chemical renovations than afterwards, when they were replaced by hatchery rainbows. Cutthroat trout are more easily caught than other trout species (Varley and Gresswell 1988).

Ball *et al.* (1982) attributed the loss of the wild component of the fishery to the chemical treatments themselves. They wrote, "Natural reproduction and recruitment does not presently add significantly to the reservoir as it must have in the 1950s when a substantial fishery was present without large hatchery inputs. Loss of wild populations in tributaries and the Henrys Fork above the reservoir from

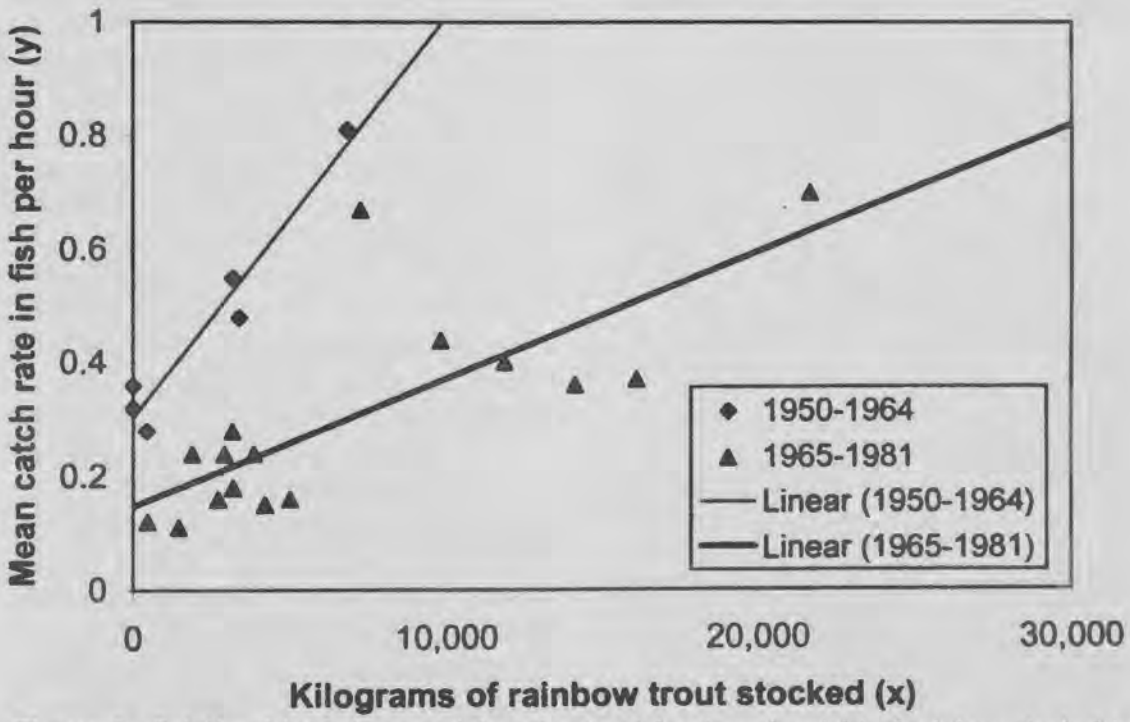


**Figure 2.** *Relationships between rainbow trout catch rate and weight of rainbow stocked in Island Park Reservoir for the periods 1950-1964 and 1965-1981. The regression line for 1950-1964 is given by* $y = 0.30 + 7.05*10^{-5}x$ ($n = 6$, $r^2 = 0.94$), *and that for 1965-1981 is given by* $y = 0.15 + 2.24*10^{-5}x$ ($n = 16$, $r^2 = 0.58$).

repeated poisoning may have resulted in this loss of natural recruitment and the need for total reliance on hatchery fish for maintenance of the Island Park Reservoir fishery."

Some of the loss in the wild component of the Island Park Reservoir fishery may possibly have been caused by loss of life history traits of wild fish removed from the reservoir and tributary streams during chemical treatments. For example, an entire subpopulation of wild fish that migrated into a particular tributary to spawn could have been eliminated during chemical treatment, and hatchery fish stocked in the reservoir after treatment might not have possessed the life history traits necessary to re-establish this migratory subpopulation. In all likelihood, life history traits that were inherited from native Yellowstone cutthroat trout have been lost because of eradication of wild Yellowstone cutthroat trout and hybrids in the 1958 and 1966 chemical treatments and subsequent replacement of them by hatchery rainbow trout.

However, rainbow trout and kokanee salmon have successfully re-established self-sustaining populations after each renovation. Recent data (e.g., Gregory 1997a) show that a strong spawning run of large rainbow trout is present seasonally in the upper Henry's Fork. The genetic composition and migration timing of these fish may be different than those of the cutthroat-rainbow hybrid trout present in the 1950s, but they are wild fish nonetheless. The largest fish present in the Henry's Fork above the reservoir are fish that spend at least part of their life in the reservoir, where growth rates are much higher than they are in the streams (Elle and Corsi 1994). The upper Henry's Fork also contains large Yellowstone cutthroat and cutthroat-rainbow hybrid trout, which migrate from Henry's Lake downstream during early summer. The large reservoir and lake fish in the upper Henry's Fork and its tributaries provide popular angling and fish-viewing opportunities that augment those provided by smaller hatchery rainbow trout and nonmigratory wild brook and rainbow trout.

The successful re-establishment of wild populations of adfluvial kokanee salmon and rainbow trout in the upper Henry's Fork after each chemical treatment shows that decline of wild trout populations in the reservoir cannot be caused solely by loss of wild fish in the treatment process. In the early years of stocking, response of catch rate to increases in stocking (slope of the regression lines in Fig. 2) was roughly three times that for the period between 1965 and 1981. Furthermore, the coefficient of determination shows that the functional relationship between catch rate and stocking level was much stronger in the pre-1965 time period, providing evidence that stocked fish returned to the creel at higher rates then. Taken together, the intercepts (component of catch resulting from wild fish) and the slopes (response of catch rate to increases in stocking) of the two regression lines in Figure 2 show that the wild population decreased at the same time performance of hatchery fish decreased. This combination suggests that the reservoir fishery declined at least in part because of environmental factors, which include alteration of the reservoir's trophic structure by a prolific chub population.

Poor habitat conditions, e.g., high water temperature, lack of riparian vegetation, and excessive fine sediment, in Sheridan Creek and loss of connectivity between the reservoir and other tributaries (Gregory 1997b, Roessler 1996) could be a significant factor in the decline of wild trout populations in the reservoir and its tributaries. Furthermore, habitat degradation along the lower 16 km (10 mi) of Sheridan Creek has likely

contributed to decline of water quality in the west end of the reservoir itself, affecting both wild and hatchery fish. Decline of water quality in and loss of access to tributary streams on the west end of the reservoir could limit the availability of refuge habitat for reservoir fish when the dissolved oxygen concentration becomes low in the reservoir during the winter and late summer, thereby contributing further to lower return-to-creel rates for stocked fish and lower survival of wild fish.

## Reservoir Management and the Fishery Downstream

As reviewed by Gregory (this issue), the single factor limiting the wild trout population below Island Park Dam is survival of juvenile rainbow trout through their first winter. Winter concealment cover for these fish is provided by spaces among boulders and cobbles on the river bottom and by deep undercut banks with dense vegetative cover. The Henry's Fork between Island Park Dam and Mesa Falls is naturally lacking in such habitat, except for Box Canyon, some banks at Last Chance, and the Pinehaven-Riverside reach. Lack of access to tributaries compounds this problem. However, in the late 1970s and early 1980s, the trout population was quite robust in the Box Canyon section (Fig. 1), exceeding 3,100 fish/ km (5,000 fish/ mi) in some years.

For years, we had asked, "why did the population decline during the 1980s?" A more constructive question has proven to be, "Why was the population so *high* in the 1970s?" Schwiebert (1979) not only proclaimed that the Henry's Fork may be the finest trout stream in the United States but also wrote, "the Henry's Fork is better fishing now than it was 3 decades ago." Indeed, the Henry's Fork was strangely absent from the popular angling literature prior to 1970. Hundreds of books and articles described outstanding fishing on the Madison, Gallatin, Snake, Bighole, Green, and Yellowstone rivers, but few mentioned the Henry's Fork, which lies only a few miles from these famous waters. Even as the outstanding fisheries of Island Park Reservoir and Henry's Lake became world-famous, the river itself, particularly below Island Park Dam, remained a second-tier fishery until a serendipitous combination of factors vaulted the Box Canyon and Harriman Ranch sections to world-class status during the 1970s.

The first of these factors was the change in dam management that increased winter water flows in the early 1970s (Benjamin and Van Kirk 1999). The lack of juvenile overwintering habitat to support natural recruitment between Island Park Dam and Riverside was mitigated by ample stocking of catchable-sized hatchery trout. The constant input of hatchery trout combined with improved winter flow conditions and the river's abundant invertebrates to produce large numbers of good-sized trout. However, the trout population did not begin a major decline in 1978, when stocking was ceased below the dam. Instead, the population appeared to decline only slightly until the mid-1980s (Fig. 1). Meanwhile, anglers reported catching many more very large trout between 1978 and the mid-1980s than they had prior to 1977, including an 8 kg (18 lb) rainbow trout caught in Box Canyon by Island Park resident Ron Dye in the fall of 1981 (Rohrer 1983). These large fish have not been seen in Box Canyon since the mid-1980s.

It may be no coincidence that the best fishing on the Henry's Fork below Island Park Dam and the highest fish population estimates occurred during a period of years when the reservoir was drawn down several times. Four of the 10 lowest drawdowns (Table 1) occurred between 1977 and 1984, when the trout population was high (Fig. 1).

Furthermore, the jump in population abundance in 1993 followed a year in which the reservoir was drawn down. Quantitative analysis of the relationship between Box Canyon rainbow trout abundance and reservoir drawdowns is not possible for years immediately following the 1977, 1979, 1981 and 1984 drawdowns because population data were collected only sporadically prior to 1993. However, following the 1992 drawdown, regression of trout abundance versus time shows a statistically significant ($P < 0.05$) decreasing exponential relationship (Fig. 3). The most plausible explanation for this relationship is that the 1993 population consisted primarily of reservoir fish introduced into the river during the 1992 drawdown. As these fish died over the next 5 years (the maximum life span of rainbow trout in the Henry's Fork is about 6 years, see, e.g., Angradi and Contor 1989 or Rohrer 1983), their loss from the population was reflected in the exponential decline shown in Figure 3. Such a decline is expected in populations when a large number of individuals are introduced at one time but are subsequently not replaced by natural recruitment, e.g., when high mountain lakes are stocked. Thus, it is reasonable to infer that fish migrating into the river during reservoir drawdowns have contributed to the population downstream in the years since stocking was ceased.

## Discussion

In 1998 the national conservation group Trout Unlimited polled its members to determine their favorite trout streams in the United States. The Henry's Fork was voted number one, despite catch rates during the 1990s that were only half of what they had been 2 decades earlier (Van Kirk *et al.* 1999a), an indication that anglers value the Henry's Fork as much for aesthetic qualities and unique angling opportunities as for the number of fish that they can land in a day. The Henry's Fork angling experience has been celebrated and immortalized in 3 decades of angling literature, ranging from classics like Schwiebert's (1984)

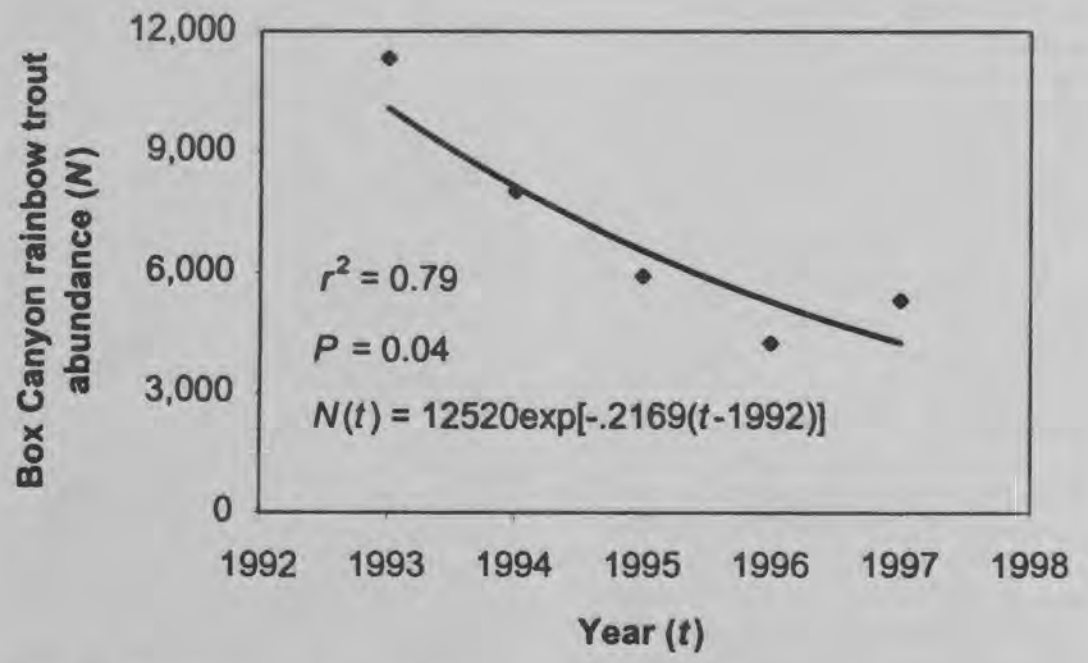


**Figure 3.** *Box Canyon rainbow trout abundance after the 1992 reservoir drawdown.*

*Death of a Riverkeeper* to hundreds of popular magazine articles. Like all great sport fisheries, the reputation of the Henry's Fork is derived in large part from the angling folklore printed in these books and articles.

Modern fisheries management has to reconcile folklore and science. Fisheries managers are pressured to provide angling experiences desired by their constituents, but they must do so within the ecological constraints of the particular watershed in question. Ecological realities often contradict the angling folklore that drives the social portion of the management equation. For example, half of the top 10 trout streams on Trout Unlimited's list are highly altered streams like the Green and Bighorn, whose trout fisheries are made possible only by cool-water releases from large dams and trout stocked into waters that previously supported diverse, native, warm-water fish assemblages. The irony that these streams are among the favorites of an organization well known for its opposition to dams and hatchery fish is epitomized by the story of the Henry's Fork.

Historical accounts leave little doubt that prior to Euro-American settlement, the water bodies of the upper Henry's Fork watershed supported large numbers of Yellowstone cutthroat trout. Data from more recent research on the Henry's Fork show that these native fisheries thrived in streams that do not contain the combinations of physical, chemical, and biological features generally associated with productive trout fisheries. As a result of geologic conditions derived from recent volcanism, the majority of streams in the upper watershed have limited floodplain and riparian area development (Jankovsky-Jones and Bezzerides this issue), possess relatively fine substrate (Bressler and Gregory this issue), and contain low concentrations of soluble nutrients (Whitehead 1978). The exceptions are streams in the Centennial and Henry's Lake mountains that drain geologic formations derived at least in part from older, sedimentary rocks and deliver large amounts of phosphorus into present-day Island Park Reservoir and Henry's Lake (Montgomery Watson 1996, Anderson 1996, Roessler 1996).

Prior to construction of Henry's Lake, Island Park and Buffalo River dams and many smaller impediments to fish migration, native Yellowstone cutthroat trout likely thrived in the upper watershed largely because of migratory life histories that allowed them to optimize their use of available habitat types. For example, lack of suitable overwinter cover for juvenile trout in the Last Chance reach was probably not a limiting factor to the trout population there because that population had access to hundreds of miles of tributary streams containing suitable overwinter habitat. However, these native fish and their environments were not subjects of angling folklore that made the Henry's Fork famous. Although the upper Henry's Fork watershed was a popular angling destination as early as the 1880s, the fishery that first put the area on pages of national magazines was the cutthroat-rainbow hybrid fishery of Henry's Lake. Nonnative fish, a hatchery, and an enlarged lake created by Henry's Lake Dam in part made this possible. After the Second World War, when people found themselves with more leisure time to pursue fishing, anglers discovered that a similar fishery had been created in Island Park Reservoir, and it received acclaim as an equal to that of Henry's Lake. The rainbow trout fishery of the river below Island Park Dam made the Henry's Fork famous among fly anglers the world over during the fly fishing renaissance of the 1970s and early 1980s.

The reputation among anglers of the rainbow trout fishery below Island Park Dam has been built largely by folklore based on three fundamental beliefs: the uniqueness of the McCloud River strain of rainbow trout present in the Henry's Fork (some people even believe that rainbows are native to the Henry's Fork), the wild nature of the population, and the inherent productivity of the river. Historical and scientific research has shown that these three beliefs are largely myth. Regardless of the original source of rainbow trout present in the Henry's Fork, almost all trout in the upper watershed were eradicated during the 1966 chemical treatment. Fish subsequently restocked into the river were products of a half-century of culture in IDFG's hatchery system. The last rainbow trout eggs taken directly from the McCloud River and distributed to other parts of the country were collected in 1888 (Wales 1939), 20 years prior to the construction of Idaho's first state fish hatchery. Furthermore, the Henry's Fork below Island Park Reservoir received annual plantings of hatchery fish until 1978. After the implementation of wild trout regulations, the river continued to receive indirect supplementation from hatchery fish stocked into Island Park Reservoir via downstream migration, especially during periods of reservoir drawdown. Even the productivity of the Henry's Fork below Island Park Dam is in part a product of the reservoir itself, which concentrates nutrients, absorbs solar radiation, and exports the resulting biologically and chemically enriched water downstream.

The history of the Henry's Fork fishery—where we have come from, where we are today and more importantly *how* we got here—begs the question "what can and what do we want to do with fishery management in the upper Henry's Fork watershed in the future?" A great benefit of historical perspective and an understanding of the constraints of a fishery is to avoid waste of resources on efforts doomed to failure and, conversely, to fully capitalize on legitimate opportunities to improve fisheries management.

Efforts to improve spawning habitat will not improve recruitment in the trout population in the Henry's Fork below Island Park Dam because spawning is not the limiting factor (Gregory 1997a, Mitro 1999, Gregory this issue). Many attempts at placement of habitat structures in the river have not significantly improved overwinter survival of juvenile trout (Gregory this issue). Controlling waterfowl herbivory to protect macrophyte beds will benefit summer and fall feeding and holding habitat and, therefore, the quality of the angling experience in the Harriman State Park section, but it will not carry more juvenile trout through the winter and improve recruitment (Van Kirk and Martin this issue). In abnormally wet years, late winter flows can be structured to increase critical winter habitat and thus recruitment (Mitro 1999), but those years with water surpluses large enough to make a significant difference will be rare (Benjamin and Van Kirk 1999). Any search for the perfect rainbow trout strain, such as the mythical McCloud progenitor of the Henry's Fork rainbow of the "glory years," would be fruitless. Hatchery supplementation could significantly improve trout numbers and ultimately catch-rates. However, a larger trout population could possibly decrease trout growth, so at best, the average size of trout would not change. Hatchery supplementation also would conflict with the wild trout management designation for this fishery (IDFG 1996).

It may be time for fishery managers and anglers alike to recognize that the reach of the Henry's Fork below Island Park Dam is currently meeting its "natural" (given the existence of the

dam) productive potential and that just as the "problem" does not exist, neither does the solution. We now know that the circumstances that created the world-famous Henry's Fork fishery 25 years ago arose from a unique combination of human-influenced environmental conditions and changes in water and fishery management policies that will not likely occur again. The reality is that catch rates for this fishery are good (0.82 trout/hr in 1996, Van Kirk *et al.* 1999a), and angler satisfaction has been consistently high from the spring of 1993 to the present.

Island Park Reservoir poses management challenges that will continue to frustrate both managers and the angling public. With its inherent productivity, the reservoir will always have the potential to support an exceptional trout fishery, but this potential will be realized only with continued hatchery supplementation, improved tributary habitat that is connected to the reservoir, ≥ 3 years of stable pool levels and control of Utah chubs. Because of suspicion of and opposition to chemical renovations by much of the public, another Island Park Reservoir renovation is uncertain at best. For the foreseeable future, Island Park Reservoir fishery management will focus on restoring tributary health, reconnecting tributaries to the reservoir, and continuing reliance on hatchery supplementation of rainbow trout and kokanee salmon. Stocking strategies will be designed to minimize avian predation of fingerling trout releases.

Perception of management issues on the Henry's Fork above Island Park Reservoir has been influenced by a popular mythology that resembles that of the river below the dam. The institutional memory of long-established fishing lodges and the experiences of long-time anglers have suggested that the exceptional fishing enjoyed 40 or more years ago has been diminished over the years by a combination of habitat degradation and over-harvest, the latter caused primarily by increasing angling effort. Again, with the benefit of historical perspective and an understanding of the production limits for this river section, we know that this fishery is limited by an inherent lack of nutrients (Whitehead 1978) and resulting slow growth rates (Elle and Corsi 1994) but is seasonally reinforced by trout migration upstream from Island Park Reservoir and downstream from Henry's Lake. The status of the fisheries in the two reservoirs has a direct effect on the angling experience in the upper Henry's Fork, in particular on the opportunity to catch large fish in this section of the river. Furthermore, angling effort on this reach has decreased over the past 3 decades, and only a small percentage of fish caught are harvested (Van Kirk *et al.* 1999b, IDFG unpublished data). High catch-rates (1.3 trout/hr) are a product of regular supplementation with hatchery catchable-sized rainbow trout, natural supplementation from the reservoirs below and above the reach and numerous but small- to-medium-sized rainbow and brook trout produced in the reach and its tributaries, including Henry's Lake Outlet.

Henry's Lake has the only remaining viable Yellowstone cutthroat trout population of substantial abundance upstream of Mesa Falls. This sets Henry's Lake apart from the rest of the drainage in fishery management issues and program direction. The Henry's Lake fishery management program now includes protection of its world famous trophy trout fishery and conservation and recovery of its native Yellowstone cutthroat trout population although emphasis will be increasingly placed on efforts to conserve and recover Yellowstone cutthroat trout. From the suspension of brook trout supplementation and a shift to sterile hybrids in the hatchery program, to

new strategies relying on the hatchery to develop and expand a stock of non-introgressed Yellowstone cutthroat trout, Yellowstone cutthroat trout conservation is determining the direction of the Henry's Lake fishery management program. Management of Henry's Lake tributaries will emphasize both habitat protection and enhancement and control of spawner escapement in favor of non-introgressed Yellowstone cutthroat trout. The fisheries management program at Henry's Lake is the only one in the watershed that emphasizes restoration (recovering native fish populations and restoring their habitat) rather than enhancement of angling opportunities (increasing catch rates or sizes or both of nonnative game fish species). This management direction seems appropriate for a fishery that was the first discovered and used by settlers in the Henry's Fork watershed.

The historical and scientific research chronicled in this paper is not intended to detract from or replace the mythology and mystique of the Henry's Fork. Our folklore is part of what makes us human and, as such, contributes substantially to our enjoyment of outdoor activities such as fishing. However, the response of fish populations to management actions is constrained by environmental factors, whether they be "natural" or created by modern human activities. Whether anglers assigned a high or low value to the "naturalness" of these environmental factors is irrelevant from a biological standpoint. What is relevant to successful fisheries management in the future is the enlightenment that a historical perspective, in combination with ecological data, can bring to both anglers and managers. On the Henry's Fork, this enlightenment has already resulted in cooperation among angling groups, government agencies and scientists. The strength of this cooperation brings hope that future management will use the vast amount of knowledge that has been gained in recent years in a way that maintains respect for the history and folklore that has made the Henry's Fork fishing experience what it is today.

## Acknowledgements

Much of this research was conducted by the senior author while he was research director of the Henry's Fork Foundation in Ashton, Idaho. As such, this research was funded in part by the National Fish and Wildlife Foundation and other donors to the Henry's Fork Foundation. The senior author also acknowledges the contributions of Susie Van Kirk toward historical research. Preparation of this paper would not have been possible without the contribution of dozens of researchers whose papers appear elsewhere in this issue or are listed in the bibliography. The authors also acknowledge the hundreds of anglers whose concern with fisheries conservation issues and participation in public forums has greatly increased the awareness of managers and anglers alike to important fisheries management issues in the watershed.

## Literature Cited

Allen, D. L. 1959. Conservation biology facts and fancies. Idaho Wildl. Rev. 12(3):3-7.

Anderson, E. 1996. Stream geomorphology and hydrology of the upper Henry's Fork watershed. Project completion report for the Henry's Fork Foundation, Ashton, ID and the Targhee National Forest, St. Anthony, ID. Department of Earth Sciences, Idaho State University, Pocatello.

Andriano, D. 1954. Tomorrow's fishing in Idaho. Idaho Wildl. Rev. 7(1):3-5.

Angermeier, P. L. 1997. Conceptual roles of biological integrity and

diversity. Pp. 49-65 *in* J. E. Williams, C. A. Wood, and M. P. Dombeck, eds., Watershed restoration: Principles and practices. American Fisheries Society, Bethesda, MD.

Angradi, T., and C. Contor. 1989. Henry's Fork fisheries investigations. Project F-71-R-12, Subproject III, Jobs 7a and 7b. Idaho Department of Fish and Game, Idaho Falls.

Angradi, T. R., and J. S. Griffith. 1990. Diel feeding chronology and diet selection of rainbow trout (*Oncorhynchus mykiss*) in the Henry's Fork of the Snake River, Idaho. Can. J. Fish. Aquat. Sci. 47:199-209.

Arbuckle, C. H. 1900. First biennial report of the state fish and game warden. Idaho Department of Fish and Game, Boise.

Ball, K., V. Moore, and J. Curran. 1982. Regional fishery management investigations, Project F-71-R-6, Job VI-b. Idaho Department of Fish and Game, Idaho Falls.

Behnke, R. J. 1992. Native trout of western North America. American Fisheries Society Monograph 6, Bethesda, MD.

Benjamin, L., and R. W. Van Kirk. 1999. Assessing instream flows and reservoir operations on an eastern Idaho river. J. Am. Wat. Resour. Assoc. 35:899-909.

Bressler, D., and J. S. Gregory. This Issue. Influence of stream habitat and land use on macroinvertebrate assemblages of the Henry's Fork watershed. Int. J. Sci. 6:178-196.

Brooks, C. E. 1986. The Henry's Fork. Winchester Press, Piscataway, NJ.

Busack, C. A., and G. A. E. Gall. 1980. Ancestry of artificially propagated California rainbow trout strains. Calif. Fish Game 66:17-24.

Coon, J. 1977. River and stream investigations. Project F-66-R-2, Job VII. Idaho Department of Fish and Game, Idaho Falls.

Croft, A. R. 1958. Water management on rangeland. Idaho Wildl. Rev. 11(3):3-7.

Elle, S., and C. Corsi. 1994. Regional fisheries management investigations, Project F-71-R-13, Job 6-c. Idaho Department of Fish and Game, Idaho Falls.

Green, D. H. 1990. History of Island Park. Gateway Publishing, Ashton, ID.

Gregory, J. 1997a. Spring spawning on the Henrys Fork and tributaries upstream from Riverside Campground. Project completion report for the Henry's Fork Foundation, Ashton, ID. Gregory Aquatics, Mackay, ID.

Gregory, J. 1997b. Upper Henrys Fork Habitat Assessment Headwaters to Island Park Dam Summer 1996. Report to Henry's Fork Foundation, Ashton, ID. Gregory Aquatics, Mackay, ID.

Gregory, J. S. This Issue. Winter fisheries research and habitat improvements on the Henry's Fork of the Snake River. Int. J. Sci. 6:232-248.

Griffith, J. S., and R. W. Smith. 1995. Failure of submersed macrophytes to provide cover for rainbow trout throughout their first winter in the Henrys Fork of the Snake River, Idaho. N. Am. J. Fish. Manage. 15:42-48.

HabiTech, Inc. 1994. Flushing flow investigations; Henry's Fork of the Snake River 1993-1994. Project completion report for Idaho Division of Environmental Quality, Idaho Falls, ID. HabiTech, Inc., Laramie, WY.

Hauck, F. R., and R. B. Irving. 1952. Island Park reservoir creel census. Idaho Wildl. Rev. 5(1):10-12.

Idaho Department of Fish and Game (IDFG). 1940. Eighteenth biennial report, 1939-40. Boise.

IDFG. 1954. Twenty-fifth biennial report, 1952-54. Boise.

IDFG. 1958. Twenty-seventh biennial report, 1956-58. Boise.

IDFG. 1962. Twenty-ninth biennial report, 1960-62. Boise.

IDFG. 1968. Thirty-second biennial report, 1966-68. Boise.

IDFG. 1973. Annual report, FY 1972-73. Boise.

IDFG. 1996. Statewide fisheries management plan 1996-2000. Boise.

Jaeger, M., R. Van Kirk, and T. Kellogg. This Issue. Distribution and status of Yellowstone cutthroat trout in the Henry's Fork watershed. Int. J. Sci. 6:197-216.

Jankovsky-Jones, M., and N. Bezzerides. This Issue. Riparian ecology in the Henry's Fork watershed. Int. J. Sci. 6:159-177.

Jeppson, P. W. 1966. Tests for increasing returns of hatchery trout. Project F-32-R-8, Job 1. Idaho Department of Fish and Game, Boise.

Jeppson, P. W. 1969. Tests for increasing the returns of hatchery trout. Project F-32-R-11, Job 8. Idaho Department of Fish and Game, Boise.

Jeppson, P. W. 1973. Snake River fisheries investigations. Project F-63-R-3, Job III-a. Idaho Department of Fish and Game, Idaho Falls.

Jones, O. M. 1921. Eighth biennial report of the state game warden, 1919-20. Idaho Department of Fish and Game, Boise.

Keil, W. M. 1928. The fishes of Idaho. Idaho Department of Fish and Game, Boise.

Leonard, R. 1953. Wildlife management. Idaho Wildl. Rev. 6(3):3-6.

Mitro, M. G. 1999. Sampling and analysis techniques and their application for estimating recruitment of juvenile rainbow trout in the Henrys Fork of the Snake River, Idaho. Ph.D. Dissertation, Montana State University, Bozeman. 288 pp.

Montgomery Watson. 1996. Report on Henry's Lake Clean Lakes Project to Idaho Department of Health and Welfare, Division of Environmental Quality. Montgomery Watson, Boise.

Platts, W. S., F. J. Wagstaff, and E. Chaney. 1989. Cattle and fish on the Henry's Fork. Rangelands 11(2):58-62.

Prange, R. 1995. An historical account of the Henrys Lake Foundation. Henry's Lake Foundation Newsletter, Fall 1995, Boise, ID.

Pratt, V. S. 1951. What has happened to our trout fishing? Idaho Wildl. Rev. 3(4):3, 12-13.

Roessler, E. C. 1996. An assessment of the nutrient inputs to and the trophic state of Island Park Reservoir in Fremont County, Idaho. Master's project report, Duke University, Durham, NC.

Rohrer, R. L. 1983. Henrys Fork Fisheries Investigations. Project F-73-R-4, Subproject IV, Study XI. Idaho Department of Fish and Game, Idaho Falls.

Schwiebert, E. 1979. The puzzle of the Henry's Fork. Fly Fisherman 10(3):57-60.

Schwiebert, E. 1984. Death of a riverkeeper. Donald S. Ellis Publishing, San Francisco, CA.

Simpson, J. C. 1948. Long-range fishing policy based on factual research. Idaho Wildl. Rev. 1(4):1-2.

Stephens, W. N. 1907. Biennial report of the state game warden, 1905-06. Idaho Department of Fish and Game, Boise.

Stephens, W. N. 1909. Second biennial report of the state game warden, 1907-08. Idaho Department of Fish and Game, Boise.

Stephens, W. N. 1911. Third biennial report of the state game warden, 1909-10. Idaho Department of Fish and Game, Boise.

Thomas, R. E. 1925. Tenth biennial report of the state game warden, 1923-24. Idaho Department of Fish and Game, Boise.

Thomas, R. E. 1931. Thirteenth biennal report of the state game warden, 1929-30. Idaho Department of Fish and Game, Boise.

Thorp, W. H. 1919. Seventh biennial report of the state game warden, 1917-18. Idaho Department of Fish and Game, Boise.

Trueblood, T. 1963. Fishing Island Park Village. Pp. 39-46 *in* Idaho hunting and fishing guide. Idaho Department of Commerce and Development, Boise.

U.S. Commission of Fish and Fisheries (USCFF). 1877. Report of the commissioner. Washington, DC.

USCFF. 1897. Report of the commissioner. Washington, DC.

USCFF. 1898. Report of the commissioner. Washington, DC.

USCFF. 1899. Report of the commissioner. Washington, DC.

USCFF. 1901. Report of the commissioner. Washington, DC.

USCFF. 1905. Report of the commissioner. Washington, DC.

Van Kirk, R. W. 1999. Angler effort, catch and attitudes on Henry's Lake Outlet. Report to the Nature Conservancy, Eastern Idaho Field Office, Idaho Falls. Department of Mathematics, Idaho State University, Pocatello.

Van Kirk, R. W. This Issue. Henry's Fork aquatic resources bibliography. Int. J. Sci. 6:312-332.

Van Kirk, R. W., S. Beesley, J. Didier, D. Hanson, and D. Hayes. 1999a. Angler effort and catch and floater use in Box Canyon. Report to Idaho Fish and Wildlife Foundation, Boise. Department of Biological Sciences, Idaho State University, Pocatello.

Van Kirk, R. W., and L. Benjamin. This Issue. Physical and human geography of the Henry's Fork watershed. Int. J. Sci. 6:106-118.

Van Kirk, R. W., E. Bergman, D. Hayes, M. Jaeger, B. Krestian, D. Morical, W. Thorson, J. Gregory and T. Kellogg. 1997. Status of Yellowstone cutthroat trout in the Upper Henry's Fork Watershed. Henry's Fork Foundation, Ashton, ID.

Van Kirk, R. W., and K. Giese. 1999. Angler effort and catch on the Buffalo River during 1998 and effects of the Buffalo River fish ladder on the Box Canyon rainbow trout population. Report to Idaho Fish and Wildlife Foundation, Boise. Department of Biological Sciences, Idaho State University, Pocatello.

Van Kirk, R. W., and C. B. Griffin. 1997. Building a collaborative process for restoration: Henrys Fork of Idaho and Wyoming. Pp. 253-276 *in* J. E. Williams, C. A. Wood, and M. P. Dombeck, eds., Watershed restoration: Principles and practices. American Fisheries Society, Bethesda, MD.

Van Kirk, R. W., D. Hanson, G. Peracca, K. Giese, and A. Kitching. 1999b. Angler attitudes on the Mack's Inn reach of the Henry's Fork of the Snake River. Report to Idaho Fish and Wildlife Foundation, Boise. Department of Biological Sciences, Idaho State University, Pocatello.

Van Kirk, R. W., and R. Martin. This Issue. Interactions among aquatic vegetation, waterfowl, flows, and the fishery below Island Park Dam. Int. J. Sci. 6:249-262

Varley, J. D., and R. E. Gresswell. 1988. Ecology, status, and management of the Yellowstone cutthroat trout. American Fisheries Society Symposium 4:13-24.

Vinson, M. R., D. K. Vinson, and T. R. Angradi. 1992. Aquatic macrophytes and instream flow characteristics of a Rocky Mountain river. Rivers 3:260-265.

Wales, J. H. 1939. General report of investigations on the McCloud River drainage in 1938. Calif. Fish Game 25:272-309.

Whitehead, R. 1978. Water resources of the Henrys Fork basin in eastern Idaho. Water Information Bulletin 46. Idaho Department of Water Resources, Boise.

Wissmar, R. C. 1997. Historical perspectives. Pp. 66-79 *in* J. E. Williams, C. A. Wood, and M. P. Dombeck, eds., Watershed restoration: Principles and practices. American Fisheries Society, Bethesda, MD.