State of California The Resources Agency DEPARTMENT OF FISH AND GAME

HEENAN LAKE FISHERY MANAGEMENT PLAN Alpine County, California



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By

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EXECUTIVE SUMMARY

Heenan Lake is a fertile irrigation storage reservoir located approximately seven miles southeast of the town of Markleeville in Alpine County. Heenan Lake contains a fish population of a federally listed threatened trout species, the Lahontan cutthroat trout (CT-L). Heenan Lake provides an important brood stock source of CT-L used in many waters throughout the State of California for the California Department of Fish and Game (Department) hatchery system. Heenan Lake is a California Fish and Game Commission designated wild trout (1983) and heritage trout (1999) water, and provides an important sport fishery for anglers from throughout the western United States.

Heenan Lake is within the 1,652 acre Heenan Lake Wildlife Area, purchased during 1982 for the protection of the Lahontan cutthroat trout fishery and to provide public access. The Department has acquired 2,324 acre feet (AF) of the water storage right in four phases, which began in 1999 and were completed December 12, 2002. The total water storage right for Heenan Lake is 2,948 AF of which the Department owns 78.8 percent. The State of California has invested over 5.5 million dollars to protect the important Lahontan cutthroat trout fishery.

For the past several years, it was recognized that problems facing those responsible for managing Heenan Lake should be addressed in a management plan. This plan identifies these problems and presents the Department's proposed solutions. The Department should maintain the popular catch and release fishery by continuing the following angling regulations and measures:

- 1. Angling will be permitted only on Friday, Saturday, and Sunday during September and October.
- 2. Only barbless hooks will be allowed, and there will be a zero (0) fish limit. All fish must be released in good condition.
- 3. Spawning fish from Independence strain CT-L taken for egg production at Heenan Lake will be returned to Heenan Lake to maintain optimum numbers of adult trout present. Excess Independence strain CT-L and Heenan strain CT-L which are hybridized with rainbow trout will be stocked out into nearby waters for use by anglers.

In order to maintain and provide a spawning broodstock of Lahontan cutthroat trout of Independence strain and to establish and reestablish these strains in California waters these actions will be followed:

- 1. Yearlings from the Independence Lake strain will be stocked each June/July with an allotment of 3,000 fish. These fish will continue to be adipose clipped to distinguish them from the Heenan strain until this strain has been eradicated from the system.
- 2. Each year estimates should be made of the abundance of each age class of CT-L Independence strain.

To perpetuate the Heenan Lake brood stock source and maintain the popular catch and release fishery for the enjoyment of the angling public, the Department recommends:

- 1. Remove the hybridized Lahontan cutthroat trout in Heenan Creek to avoid introgressive hybridization with the Independence strain brood stock.
- 2. Take eggs from CT-L during at least two to three different times of the fish run as hatchery staffing and budgets allow to maintain genetic diversity. Isolate brood stock CT-L in the hatchery system from other trout to avoid mixing and hybridization.
- 3. Maintain supervision of the fishery season by Department creek clerks, which is essential to protection of the Lahontan cutthroat trout resource from poaching and to prevent illegal introductions of fish and invasive organisms. Warden patrol of Heenan Lake must be maintained as much as possible during spring and summer before it is open to angling.
- 4. Protect Heenan Lake brood stock fish in the hatchery system from invasive exotics such as New Zealand mud snails. Continue annual fish health monitoring of adult spawners.
- 5. The Department should pursue ways to maintain maximum water levels in Heenan Lake and acquire additional water storage rights to provide downstream riparian enhancement with minimum flow releases in the event these rights become available.
- Spilling or release of water and stocking out surplus brood stock from Heenan Lake must be done as part of normal operations to assure nutrient release from the system. Monitoring of nutrient levels in Heenan Creek and Heenan Lake would be desirable to evaluate long- term trends in eutrophication.
- 7. Anglers at Heenan Lake must be advised through outreach by Department employees and signage of the several techniques that should be used to avoid unintentional mortality in angler released fish.
- 8. Maintain fencing of Heenan Lake Wildlife Area to keep trespass cattle from entering the wildlife area and grazing on sensitive riparian habitat.

In order to solve problems that restrict or reduce optimum angler use and enjoyment of the fish populations in Heenan Lake, the following actions should be followed:

- 1. Improve angler access facilities, such as entrance/exit passages, a larger parking area, and an enhanced boat launching area.
- 2. A daily angler use quota system will be considered for possible initiation should future use be determined to impact angling quality. Use by angling clubs should be monitored to evaluate the need for a reservation system.
- 3. An evaluation of reinstating the daily access/use fee should be performed. This use fee should be charged to help fund the specific facilities and fishery.

PREFACE

The California Wild Trout Program (WTP) was endorsed by the Fish and Game Commission (Commission) in 1971 to provide quality wild trout angling. Under the program, productive lakes and streams are identified for wild trout management during an ongoing statewide inventory. If suitable for management as quality fisheries, these waters are recommended by the California Department of Fish and Game (Department) to the Commission for wild trout designation. Waters in the WTP must be open to the public and capable of producing, with appropriate fishing regulations, satisfactory trout angling in terms of the number and/or size of fish caught. Stocking of domestic strains of hatchery-reared, catchable-size trout in these waters is prohibited.

Commission policy sates: "Wild trout angling is considered a quality experience which provides the angler an opportunity to fish in aesthetically pleasing and environmentally productive waters over trout populations whose numbers or sizes are largely unaffected by the angling process" (Commission Policies, Fish and Game Code, 2008). Three goals for managing designated wild trout streams were established at the outset of the statewide WTP:

- 1. To maintain wild trout populations at levels necessary to provide satisfactory angling opportunities.
- 2. To maintain and enhance, where possible, the habitat required for optimum wild trout production.
- 3. To preserve the natural character of the streamside environment.

The Commission has supported these goals through a directive in its policy that states "All necessary actions, consistent with State law, shall be taken to prevent adverse impact by land or water development projects on designated wild trout waters" (Commission Policies, Fish and Game Code, 2008). Once a stream is designated as a wild trout water by the Commission, the Department is required to develop a plan for managing the fishery.

Heenan Lake was designated by the Commission as a wild trout water during 1983 and as a heritage trout water during 1999. Heenan Lake provides an important brood stock source of Lahontan cutthroat trout for use by the Department in statewide stocking programs. Heenan Lake is within the Heenan Lake Wildlife Area, purchased for the protection of the Lahontan cutthroat trout fishery.

Problems related to the landscape, fish habitat, and fisheries management are discussed in the plan and programs or policies needed to maintain an attractive and productive wild trout fishery are recommended. The following management plan is intended as a five year plan to direct the Department's program, but not limit its flexibility or mandate its responsibility or actions. Unanticipated problems may require a revision of stated programs or policies.

RESOURCE STATUS

Lake and Resource Description

Heenan Lake is located in the East Fork Carson River drainage in Alpine County, California, 6.5 miles southeast of Markleeville (Figure 1). Heenan Lake is a small (129 surface acres), shallow (maximum depth is 35 feet), mid-elevation (7,200 feet) reservoir (Department of Water Resources 1984). The reservoir was constructed in 1929 to store water for agricultural use in Nevada by the Dangberg Land and Cattle Company. The Heenan Creek watershed drains 4.2 square miles. Heenan Lake outflow enters Monitor Creek which drains into the East Fork Carson River. Surface water temperatures range from freezing in winter to 68 ° F in summer. The lake is highly eutrophic and dense populations of planktonic and benthic invertebrates serve as a food base for two strains of Lahontan cutthroat trout (*Oncorhynchus clarki henshawi*) – the only fish species present. Limnology in Heenan Lake has been investigated in several studies (Calhoun 1942, Titus and Vanicek 1988, Titus 1990, Greene, 1990, Somer 1995)

Early Stocking History

Heenan and Independence strains of Lahontan cutthroat trout (CT-L) exist in the reservoir. The Heenan Lake strain has been historically known as the black-spotted cutthroat trout that existed originally in the West Fork Carson River at Hope Valley (Evermann 1906). The Heenan Lake strain was a fluvial strain originally stocked into Blue Lake during 1864 (Behnke and Zarn 1976) and into Heenan Lake during 1935 (Calhoun 1942). This strain occurs in the reservoir and in the lower ¹/₂ mile of Heenan Creek. The Heenan Lake strain is known to be hybridized with rainbow trout (Behnke and Zarn 1976; Gall and Loudenslager 1981; Peacock, Dunham and Ray 2001; Nielson and Sage 2002). It is believed that the Heenan strain is a source of hybridized "cutbows" or rainbow form of fish occasionally found in the lake. Department stocking records of CT-L extend back to 1938. The early plants into Heenan Lake during 1938 to 1942 were made from the Alpine Hatchery in Markleeville on Pleasant Valley Creek. Later plants were made from Hot Creek Hatchery using fish from Heenan Lake (Ryan 1983). The Independence Lake strain of cutthroat trout was introduced into Heenan Lake beginning in 1975 (Ryan 1983). This strain existed formerly throughout the Little Truckee River drainage. Both the Carson and Truckee rivers are tributary to the ancient Lahontan basin. The Independence Lake strain is presently found in Independence and Heenan lakes. In addition they are planted annually in several dozen coldwater lakes to provide a "put and grow" fishery. The Independence Lake strain in Heenan Lake is considered a back up for the source population in Independence Lake, which is one of only two self – sustaining native lacustrine populations of Lahontan cutthroat trout remaining in existence.

During August 11, 1983 one hundred seventy eight Paiute cutthroat trout were stocked in Heenan Lake from Coyote Valley Creek in an attempt to provide an egg source. These fish did not persist in Heenan Lake: Paiute trout were last reported in the spawning run during 1989.

MANAGEMENT

Fishery Regulations

Heenan Lake is a Fish and Game Commission designated wild trout and heritage trout water. The fishery is open to catch and release angling (0 limit) during Fridays, Saturdays, and Sundays from the Friday before Labor Day through the last Sunday in October. Fishing hours are from sunrise to sunset. Only artificial lures with barbless hooks may be used. All fish caught must be returned in good condition to the water. Heenan Lake tributaries are closed to fishing all year. Any portion of the Heenan Lake Wildlife Area may be closed to fishing or trespass by the Department by posting notice of the same.

Only boats propelled by oars or electric motors may be used. A steep dirt road provides access to the lake where boats may be launched. A small turn-around only allows access of one trailered boat at a time.

A three day permit was required for the purpose of controlling public use during the fishing season and to help fund management activities. Permits were issued only to holders of a valid California sport fishing license that were 16 years of age and older. Persons under 16 years of age were to be accompanied by a legally responsible adult. A fee of \$3.00 was charged for each three-day weekend period for all persons 16 years of age or older. Although the regulation remains in Title 14, the California Department of Fish and Game has not required the permit since the 1993 fishing season.

Description of the Fishery

Heenan Lake was historically closed to fishing to protect the broodstock of CT-L. Heenan was opened to fishing in 1984 following acquisition of the Heenan Lake Wildlife Area. The first season of fishing at Heenan Lake was open during July 7 through September 9 from 09:00 hrs to sunset. Artificial flies and lures with single barbless hooks were required in a zero bag limit fishery. Because of warm water temperatures angling was slow and approximately 4.6 percent of the fish caught died. This mortality was considered low (Ryan 1984) and may not have appreciably exceeded natural death rates. The Department recommended that the 1985 season be set during September and October from sunrise to sunset (Ryan 1984). Setting the angling season into the fall was further justified by the hooking mortality study of Titus and Vanicek (1988) who found mortality was less than 1.5% at water temperatures between 5.5° C and 15.5° C (60° F), but rose to nearly 50% as the temperature approached 21.0° C (70° F).

The fishery at Heenan Lake has been monitored every year by Department creel personnel. During the early years of the fishery, anglers were required to purchase a permit, and report their success to the creel clerk. During 1994 the permit was abolished and although Department personnel are present, angler effort is voluntarily reported at an angler survey box. The total use and catch since this period may be underestimated since each angler no longer has mandatory reporting. The annual fishing effort at Heenan Lake increased rapidly during the first few years of fishing from 1,700 in 1984 to 12,600 hours in 1990 with the popularity of the new fishery (Figure 2). The angling effort declined dramatically with water quality problems and fish dieoffs during the early 1990's. Acquisition of water rights led to improved water quality and fishing success increased angler effort during the late 1990's which has remained stable at near 3,000 hours in recent years. The corresponding total reported catch of CT-L has generally followed the reported effort (Figure 2). The largest catch of 6,798 CT-L was reported during the 1986 fishing season. Catch rate of CT-L in the fishery has generally exceeded 0.5 fish/hr (Figure 3), and 2 trout / angler day (Figure 4). Exceptional catch rates that exceeded 1 fish/hr were reported by anglers during 1985, 1986, and 1995 angling seasons. Total length histograms of CT-L reported released from Heenan Lake during the 2000 through 2005 seasons are presented in Figure 5. Since 1998, over 40 percent of anglers report catching CT-L greater than 18 inches in total length (Figure 6). The most successful anglers at Heenan Lake catch CT-L fishing lures by boat (Tables 1 and 2). These data support the impression that Heenan Lake is an exceptional wild trout fishery that provides a highly desirable recreational experience.

Broodstock Management

The Department of Fish and Game constructed a spawning shed and fish ladder facility on Heenan Creek to collect, hold, and spawn practically all fish that migrate up from the reservoir. CT-L move from Heenan Lake into the inlet creek from mid-May until mid-June, depending upon the water year and climatic conditions. Department personnel took eggs from Independence strain CT-L May 25, 2006. A total of 284 CT-L females and 291 CT-L males were spawned which yielded 672,510 eggs. Heenan lake CT-L produced an average of 2,368 eggs/ female during 2006. Historically, the number of eggs per female for both strains averaged 1,500 (Ryan 1983).

The Department has taken eggs from CT-L in Heenan Lake since 1939. Historically, up to 2 million eggs were collected from runs approximating 2,000 to 4,000 CT-L Heenan Lake strain spawners. The numbers of Independence strain CT-L has reached historic run sizes of the Heenan Lake strain, but in recent years has declined (Figure 7). Numbers of male, female, and immature Independence strain CT-L vary with year (Figure 8). Because of the hybridization issues the Heenan Lake strain have been phased out of the hatchery operations, but still persist in the creek and reservoir. During egg collections, CT-L Heenan Lake strain fish are culled from the spawners and stocked in other waters not managed for Lahontan cutthroat trout. In past years, the Heenan Lake strain fish were used by the Nevada Department of Wildlife that valued the "cutbow" RT x CT-L hybrid which was popular among anglers. This project apparently diminished in popularity and has been abandoned.

In 1975, 4,995 CT-L Independence strain yearlings were marked and stocked into Heenan Lake to assess survivorship. Of the 25 percent which returned to spawn, 14% returned at age 4; 59% at age 5; 18% at age 6; and 8% at age 7. CT-L Independence strain from the 1975 original plant were observed returning as eight year olds (Ryan 1983). Titus (1990) estimated the average female length and weight of 490 mm (19.3 in) FL and 1.1 kg (2.43 lbs), respectively, in the 1983 spawning run. Titus (1990) found that mean condition factor (K) was lowest (0.96) in early June just prior to spawning, highest (1.12) in late July following spawning, and intermediate (1.04) in late September. During 1983, the spawning run of 1,515 fish had an average weight of 2.5 pounds for a total estimated biomass of 3,788 pounds. A minimum estimate of 29 pounds per surface acre (Heenan Lake surface area 130 acres) of fish was determined for this run. Ryan (1983) estimated an annual production of 48 lbs per acre for the Heenan Lake broodstock fish.

Independence strain CT-L eggs are hatched at Hot Creek Hatchery and either reared at the aforementioned facility or Moccasin Hatchery. The broodstock replacement CT-L are reared in

isolation from all other trout. Future rearing programs of fingerlings and subcatchables for production needs may occur at yet other facilities. Three thousand yearling CT-L are hand sorted, adipose clipped, and restocked into Heenan Lake annually during June or July. The adipose clip serves as a mark to identify the Independence strain CT-L. The current stocking rate is 23 fish/surface acre, reduced from 35 fish/surface acre in the early 1990's and 70 fish/surface acre during the 1980's. Reduction of stocking densities has resulted in corresponding increases of mean total lengths of male and females captured in the spawning runs (Figure 9). A comparison of measured Total Lengths of CT-L Independence strain fish in the May 2006 spawning run revealed a similar distribution to that of angler reported Total Lengths three months later during the 2006 fishing season (Figure 10). Historically the average CT-L was 17 in Total Length and weighed slightly over two pounds (Ryan 1983).

Independence strain CT-L from Heenan Lake have been provided to the Nevada Department of Wildlife, and US Fish and Wildlife Service for various programs in recent years, but the bulk of eggs are received by Department hatcheries for their production needs. CT-L for general production have been reared at Hot Creek or Black Rock Hatcheries. The Department planted 41,500 yearling CT-L in 7 waters and 145,000 fingerling CT-L in 23 waters throughout California during 2006. Production of CT-L varies by year due to funding and logistical constraints of the hatcheries.

A wild population of CT-L Heenan strain exists in Heenan Creek in a stream reach that extends approximately 3,700 ft above the egg station. The upstream barrier to fish movement is a series of plunges through boulders the highest of which exceeds six feet. It is suspected that the Heenan strain fish from the creek recruit to the lake fishery and are responsible for the RT x CT-L hybrids which are caught on rare occasion. In dry years both strains of CT-L may spawn in Heenan Creek downstream of the egg station with the recession of the reservoir pool. Historically, the CT-L Heenan strain fish spawned up to a month before the CT-L Independence strain, but overlap in timing could result in hybridization of wild spawned fish. These situations allow for a number of unmarked fish to recruit to spawning runs captured in the egg station. All unmarked fish are presumed to be Heenan strain CT-L and are stocked out into other waters such as Red Lake or Indian Creek Reservoir.

Fish Health Monitoring

Infectious disease in CT-L is monitored by the Department's Fish Health Laboratory. Fish Pathologists conduct diagnostic evaluations when disease occurs at hatcheries, and annual health inspections prior to allowing outplanting of hatchery fish. Broodstock monitoring is conducted annually and samples are taken from 60 CT-L Independence strain broodstock fish at the egg station during the spawning run. To date, the following pathogens have been found in Heenan Lake fish: bacterial kidney disease (BKD), cutthroat trout virus, and *Nucleospora salmonis*. Most CT-L broodstock sampled are disease free. BKD has rarely been found in broodstock fish from Heenan Lake. The cutthroat trout virus was described in the namesake fish from Heenan Lake during the 1980's, but is widespread at the Department's broodstock hatcheries being found in ELT, CT, BN, RT, and BK trout.

A microscopic parasite, *Nucleospora salmonis* (NS), was discovered in California hatcheries in 1990. Infected fish were lethargic, and clinically they were anemic, leukemic, and were immunosuppressed making them susceptible to diseases caused by many ubiquitous aquatic

pathogens. While all salmonid species tested were susceptible to this disease, observed problems have been primarily in cutthroat trout and chinook salmon yearling programs. Typically in production lots of 60,000 to 100,000 fish daily mortality was 30 to 50 fish, and this daily mortality was continuous. The Department has buried entire production lots on two occasions due to NS. The parasite is believed to be widely distributed in California, but data on wild fish populations is entirely lacking.

Current management strategies to eliminate or minimize the effects of NS on hatchery production are needed. In the past DFG has restricted the planting of CT-L from NS+ production lots to the watershed downstream from the affected hatchery (Hot Creek Hatchery / Lake Crowley). Planting of NS+ fish into waters having healthy, successful cutthroat programs (e.g. June and Gull Lakes) or waters designated as cutthroat restoration areas (e.g. Lake Tahoe basin, West Walker River) has been prohibited. The Department has not managed cutthroat broodstock from Heenan Lake as strictly because they were not considered to be "diseased". However, from tests conducted in previous years (2003, 2004) the Department has determined that NS is present in broodstock cutthroat from Heenan Lake.

Hatchery staff set aside 10,000 or more CT-L eggs to replace the broodstock at Heenan Lake, and a backup population maintained at Red Lake. These fish are reared in an isolated facility at Hot Creek Hatchery until stocked back to Heenan and Red Lakes as yearlings. This isolation prevents infection of disease from production facility fish, and to date, these fish are thought to be free of New Zealand mud snail. Future management efforts for the broodstock CT-L rearing should ensure that these fish are disease free (or no new pathogens are introduced).

Wildlife Area Management

The Heenan Lake Wildlife Area (HLWA) consists of 1,652 acres of montane chaparral, aspen, wet meadow and coniferous forest habitats. The HLWA was purchased on November 30, 1982 by the Wildlife Conservation Board from the Trust for Public Land at a total price of \$902,500. This acquisition ensured access by the Department to Heenan Lake and the CT-L population. The original acquisition maintained a minimum pool of 500 AF for protection of the CT-L broodstock. Timber harvest rights for the property were acquired by the Department in 1985. The original grant deed also contained certain easements for full use of existing corrals and structures and the movement of cattle over existing roads, but did not include grazing rights. The Department developed a management plan for the Heenan Lake Wildlife Area in 1990 (CDFG 1990). The following goals are identified in the Department's Updated Land Management Plan for HLWA (Galloway Consulting 2007):

- 1. Maintain Heenan Lake and adjacent meadow and riparian habitat in a healthy manner to insure growth of Lahontan cutthroat trout into healthy brood stock.
- 2. Retain and enhance the wide diversity of existing vegetative communities with emphasis on riparian, meadow habitats, and preventing juniper encroachment in aspen stands.
- 3. Monitor representative species to indicate health of habitat types on the wildlife area, and enhance habitats for sage grouse, and maintain populations of bald eagles.

- 4. To provide public use recreational activities that do not conflict with the primary objectives of the acquisition.
- 5. To monitor the area for building, dam, and fence maintenance; management activities and their effectiveness.
- 6. Maintain the public fishing and hunting programs.

Water Storage Management

When the Department acquired the HLWA in 1982, the prior owners retained title to the water right, although an easement for a 500 AF minimum pool was negotiated to protect the CT-L fishery. During 1988, Department entered into a contract with the Helms family to cover pumping costs to maintain an additional 500 AF water storage in Heenan Lake. Acquisition of water storage rights in Heenan Lake to protect the CT-L fishery was identified in the 1990 Heenan Lake Wildlife Area Plan as a measure to protect over-wintering broodstock. During 1992 the U.S. Fish and Wildlife Service corresponded with the Slash Bar H Ranch, then owners of the water rights, that take of a federally listed threatened species was occurring, possibly as a result of water releases from the lake. Due to low reservoir storage in a drought cycle, nutrient loading, and algal blooms and die-off, Heenan Lake experienced a massive fish kill in September of 1994 leading to the closure of the fishery for the year. Department staff observed 1,200 dead fish (Somer 1995). Fortunately, 1995 provided a good water year and the fishery rebounded. Fish kills and poor water quality had been described in previous years (Calhoun 1942, Greene 1990, Somer 1992).

Efforts to acquire water storage rights for Heenan Lake began as early as 1996. The Department has acquired 2,324 acre feet (AF) of water storage right in four phases, which began in 1999 and were completed December 12, 2002. The total water storage right for Heenan Lake is 2,948 AF of which the Department owns 78.8 percent. The Wildlife Conservation Board purchased 1,824 AF of water storage right at a purchase price of \$2,500 per AF for a total of \$4,560,000. An additional 500 AF of storage was donated by the sellers as the original minimum pool easement set aside in the Heenan Lake Wildlife Area Acquisition. The Department has indicated in interest to acquire the remaining water storage rights should the funds become available and the current owners are willing sellers.

The Department operates the 2,324 AF water storage right in Heenan Lake by maintaining storage in the reservoir for the protection of CT-L broodstock and the fall catch and release fishery. The owner of the remaining 624 AF utilizes its water storage right for irrigation of agricultural lands in Nevada. Should additional water rights be acquired they could be used to simplify ownership and management, provide minimum streamflow releases to Monitor Creek downstream, and enhance riparian habitat.

GOALS AND OBJECTIVES

The Department is committed to managing the Heenan Lake fishery for the following purposes:

- 1. Protect the broodstock source of Lahontan cutthroat trout Independence strain.
- 2. Provide a backup of Lahontan cutthroat trout for Independence Lake.
- 3. Provide a source for restoration of Lahontan cutthroat trout to other waters.
- 4. Maintain a popular catch and release fishery for trophy size Lahontan cutthroat trout in Heenan Lake.
- 5. Provide a source of Lahontan cutthroat trout for recreational fishing in other waters

PROBLEMS DETRIMENTAL TO FISH POPULATIONS

The following problems are detrimental to the fish populations in Heenan Lake; and they are listed in order of relative importance. Possible solutions are identified and evaluated for each problem:

1. Heenan Creek Hybridization Threat

An electrofishing survey of Heenan Creek during Oct 31, 2006 confirmed that most of the trout in the stream appear to exhibit hybridization with RT. It is likely that most if not all trout in the creek are RT x CT-L. Occasionally, fish resembling pure rainbows or "cutbows" are caught in the Heenan Lake fishery. It is believed these fish originated from Heenan Creek, and present a risk to maintaining pure CT-L of Independence strain.

Potential Solutions:

The hybridized trout in Heenan Creek should be removed. Once the hybridized fish die out in the lake, the fish barrier at the egg station could be retrofitted to allow fish passage and natural spawning in Heenan Creek. This would be beneficial in allowing additional wild life stages in the fish population.

2. Maintenance of Lahontan Cutthroat Trout Population Genetics

There is concern among biologists that collecting eggs from CT-L once during the spawning season may impart artificial selection in run timing of fish, and may influence other unforeseen attributes in fish. In addition, concern exists in the maintenance of a pure broodstock source. In past years, CT-L held to yearling size for Heenan Lake were held in outside ponds and fish had to be hand selected to remove RT which inadvertently made their way into the ponds. The current system is to hold yearling broodstock replacement in an isolated hatchery facility at Hot Creek Hatchery which ensures no mixing of fish, although the growth of fish is severely reduced because fish are held inside a hatchery building in metal raceways.

Potential Solutions:

Take eggs from CT-L during at least two to three different times of the fish run as hatchery staffing and budgets allow. Maintain brood stock CT-L in the hatchery system in facilities isolated from other trout to avoid mixing and potential hybridization.

3. Illegal Introductions of Fish/ Poaching and Illegal Take

Heenan Lake contains only Lahontan cutthroat trout: no other game or non-game fish. Introduction of bait fish or other non-native fishes by ill- willed or uninformed anglers could have catastrophic effects to the food web of Heenan Lake.

During 1990 some serious, effective poachers were caught and cited at Heenan Lake. Fish and Game Warden patrol efforts are required to stop law violators at Heenan Lake. Ironically, poachers are unaware that fish in Heenan Lake do not have desirable eating qualities due to the nutrient and algal rich lake waters. The abundant population of large fish draws the criminal element.

Potential Solutions:

Supervision of the fishery season by Department creek clerks is essential to protection of the Lahontan cutthroat trout resource. As all anglers must enter and leave Heenan Lake via one entrance – where they are easily observed – illegal transport of live fish and take of CT-L should be detected by Department creel clerks that supervise the fishery. Creel clerks are assisted by anglers which frequently "self-police" each other in terms of assuring compliance with regulations. Warden patrol of Heenan Lake must be maintained as much as possible during spring and summer before Heenan Lake is open to angling. During the winter the road is closed and not plowed, substantially reducing access to the Heenan Lake Wildlife Area. The lake is also covered with snow and ice, making poaching during winter a difficult venture. However, increased winter activity in the area by snowmobile users could increase the potential for poaching and illegal bait fish use.

4. Lahontan Cutthroat Trout Health

CT-L monitored for disease by the Department Fish Heath Laboratory in Heenan Lake have been generally found to be healthy. Most CT-L broodstock sampled are disease free. To date, the following pathogens have been found in Heenan Lake fish: nucleospora, cutthroat trout virus, and bacterial kidney disease (BKD). Department pathologists have found that nucleospora may be vertically transmitted. Nucleospora infection in production lots of CT-L has become a major problem in hatchery rearing of fish. Management should strive to minimize the potential of disease introduction to the CT-L population.

Potential Solutions:

Isolate CT-L broodstock in hatchery system with unique water supply and ponds to avoid infection from other diseases present in the hatchery. Also isolate Heenan Lake brood stock fish from invasive exotics which could be spread by fish such as New Zealand mud snails. Continue monitoring fish health of adult spawners on an annual basis.

5. Water Storage Withdrawals

Annual extraction of irrigation water for lands in the Gardnerville/Minden region of western Nevada has been an historic impact to the fish population of Heenan Lake. Historically, the reservoir was drawn down to a minimum pool of 500 acre feet, or lower.

This led to fish kills during low water years in fall and winter. Fish kills during fall have generally been a result of algal blooms and die off. Winter fish kills result from low water volume and resultant low dissolved oxygen concentrations. The Department has since purchased 78.8 percent of the 2,948 acre foot water storage right, the remainder held by Parks Cattle Company. Large scale fish kills have not been observed since the Department acquired the water right which has been maintained in the reservoir for protection of the CT-L. The reservoir and approximately 1,652 acres of adjacent lands are owned by the Department. Current reservoir management is for the Department to retain water storage for the protection of CT-L. The Parks Cattle Company typically releases their water storage right over a two to three week period for irrigation use in Nevada. In this scenario, there is no riparian water right release.

Potential Solutions:

Acquisition of the remaining water storage right could provide the following benefits: streamline and simplify water management; allow for downstream release to benefit Monitor Creek; provide some slight flow augmentation for the East Carson River in extreme dry years; increase the opportunities for water storage management for fish and wildlife in the East Carson River basin. Protection and maintenance of existing water storage rights for Heenan Lake CT-L is of paramount importance.

6. Nutrient Loading (Eutrophication) and Algal Blooms

There are no identified pollutants or toxic effluents entering into Heenan Lake. An abandoned cattle corral on Heenan Creek may have historically held ample cattle manure that enhanced enrichment of Heenan Lake. Most nutrient loading in Heenan Lake must be derived from the nutrient rich soils of the watershed. Nutrient loading can accentuate algal blooms in drought cycles, resulting in potential fish kills.

Potential Solutions:

Spilling or release of water from Heenan Lake must be done as part of normal operations to assure nutrient release from the system. In addition, stocking out fish from Heenan Lake will take nutrients out of the system. Stocking rates of fish into the system must be maintained at rates which allow for good trout growth. Monitoring of nutrient levels in Heenan Creek and Heenan Lake would be desirable to evaluate long- term trends in eutrophication. As the reservoir ages, nutrient build up may again cause algal blooms and die offs that kill fish. At that time, more elaborate nutrient management may be necessary.

7. Unintentional Mortality in Angler Released Fish:

All fish caught at Heenan Lake must be released in good condition. Unfortunately, some anglers are unaware of techniques to use in catching, landing, and returning fish that will result in maximum survival. Anglers using illegal gear may also contribute to fish mortality by causing injury. Even when handled expertly, however, some fish will die due to hooking injuries and stress.

Potential Solutions:

An active, continuous angler information program should be conducted at Heenan Lake. Each angler must be made aware of techniques that will minimize mortality of hooked fish. This outreach effort could be made by Department personnel conducting creel census, game wardens, or by trained docents. Temporary displays (signs, posters) that illustrate such techniques should be established at the check station.

8. Trespass Grazing

Trespass cattle from adjacent allotments on National Forest lands have been observed impacting sensitive riparian habitat in the Heenan Lake Wildlife Area.

Potential Solutions:

Maintain fencing of Heenan Lake Wildlife Area to keep trespass cattle from entering the wildlife area and grazing on sensitive riparian habitat. Coordinate with Humboldt-Toiyabe National Forest on activity of allotments on adjacent properties. Periodically monitor the Heenan Lake Wildlife Area for activity of trespass cattle.

PROBLEMS OF HUMAN USE OF FISH POPULATIONS

The following problems reduce or restrict human use of the fish populations in Heenan Lake, and they are listed in order of importance. Possible solutions are identified and evaluated for each problem:

1. Inadequate Parking and Boat Launch Facilities:

The present parking and boat launch facilities are inadequate and can contribute to accidents and angry confrontations among users during peak angling periods.

Potential Solutions:

The parking site should be graded, expanded, and designed to permit easy entrance and exit. The boat launching area needs a wider, better graded turnaround to reduce traffic congestion. Parking and launching areas could be improved with funds derived from the daily access/user fee or from other funding sources.

2. Angler Overcrowding:

On some days over 100 anglers fish Heenan Lake. If that use doubled, angling use would begin to detract from the angling experience most desire.

Potential Solutions:

A daily angler use quota system may be considered for possible initiation if future use impacts the quality of angling. Use by angling clubs should be monitored. Should such use by angling clubs become problematic, a reservation system may become necessary to spread use over the fishing season.

3. Funding of Facilities:

The Department annually struggles to fund the creel survey, other fishery management efforts, and to find funds for maintenance and improvement projects.

Potential Solutions:

Reinstate angler access/user fee to a level that would fund a seasonal Department employee to supervise the fishery, fund outhouses and maintenance of facilities.

FISHERY MANAGEMENT PROGRAM

This management program describes activities to meet both Department objectives and to also solve the fishery resource and human use problems at Heenan Lake.

Activities Designed to Meet Objectives

- I. In order to provide an exceptional catch-and-release trophy fishery for wild Lahontan cutthroat trout with optimum numbers of fish over five pounds, these actions will be followed:
 - 1. Angling will be permitted only on Friday, Saturday, and Sunday during September and October.
 - 2. Only barbless hooks will be allowed, and there will be a zero (0) fish limit. All fish must be released in good condition.
 - 3. Spawning fish from Independence strain CT-L taken for egg production at Heenan Lake will be returned to Heenan Lake to maintain optimum numbers of adult trout present. Excess Independence strain CT-L and Heenan strain CT-L which are hybridized with rainbow trout will be stocked out into nearby waters for use by anglers.
- II. In order to maintain and provide a spawning broodstock of Lahontan cutthroat trout of Independence strain and to establish and reestablish these strains in California waters these actions will be followed:
 - 1. Yearlings from the Independence Lake strain will be stocked each June/July with an allotment of 3,000 fish. Numbers of fish plants may be modified to optimize the size and number of CT-L as needed. These fish will continue to be adipose clipped to distinguish them from the Heenan strain until this strain has been eradicated from the system.
 - 2. Each year estimates should be made of the abundance of each age class of CT-L Independence strain. Such estimates can be derived to some extent from analyses of both spawning runs and from creel census data. Reservoir fish populations could be assessed through hydroacoustic or trapping studies.

Activities Designed to Solve Problems

I. In order to sole problems detrimental to the fishery resource, the following actions will be followed:

1. Heenan Creek Hybridization Threat

The hybridized trout in Heenan Creek should be removed. Once the hybridized fish die out in the lake, the fish barrier at the egg station could be retrofitted to allow fish passage and natural spawning in Heenan Creek. This would be beneficial in allowing additional wild life stages in the fish population.

2. Maintenance of Lahontan Cutthroat Trout Population Genetics

Take eggs from CT-L at different times of the fish run as hatchery staffing and budgets allow. Two to three collections of eggs spaced temporally during the spawning run would be optimal. Maintain fish in the hatchery system separate from other fish in facilities isolated from other fish to avoid mixing with other trout. Explore the construction of facilities to provide isolation from other fish and disease and allow for greater growth in CT-L.

3. Illegal Introductions of Fish / Poaching and Illegal Take

Continued staffing of creel census clerks during the fishing season is necessary to maintain a Department presence and manage the fishing public. Warden patrol of Heenan Lake must be maintained as much as possible during the spring and summer. Winter patrol of Heenan Lake would be a valuable deterrent as feasible with funding and weather constraints. Education of the public through contact by Department employees and informational kiosks and handouts is also an important action.

4. Lahontan Cutthroat Trout Health

Isolate CT-L broodstock in hatchery system with unique water supply and ponds to avoid infection from other diseases present in the hatchery. Also isolate CT-L from invasive exotics which could be spread by fish such as New Zealand mud snails. Continue monitoring fish health of adult spawners on an annual basis.

5. Water Storage Withdrawals

The Department will pursue ways to maintain maximum water levels in Heenan Lake and provide downstream riparian enhancement should additional water storage become available. This may involve purchase of the water rights by the Wildlife Conservation Board, a cooperating agency, or an interested organization; or the purchase and exchange of water rights in the Carson River drainage for Heenan Lake water rights. Protection and maintenance of existing water storage rights for Heenan Lake CT-L is of paramount importance.

6. Nutrient Loading (Eutrophication) and Algal Blooms

Spilling or release of water from Heenan Lake must be done as part of normal operations to assure nutrient release from the system. In addition, stocking out of

excess adult fish from Heenan Lake will take nutrients out of the system. Stocking rates of fish into Heenan Lake must be maintained at rates which allow for good trout growth. Monitoring of nutrient levels in Heenan Creek and Heenan Lake would be desirable to evaluate long- term trends in eutrophication. As the reservoir ages, nutrient build up may again cause algal blooms and die offs that kill fish. At that time, more elaborate nutrient management may be necessary.

7. Unintentional Mortality in Angler Released Fish

Anglers at Heenan Lake must be advised of the several techniques that should be used to avoid killing trout they catch and release. An active, continuous angler information program should be conducted at Heenan Lake. It is important to staff a Department creel census clerk during the fishery that could oversee this effort. This outreach effort could be assisted by other Department personnel conducting creel census, trained docents, and through displays (signs, posters) that illustrate such techniques.

8. Trespass Grazing

Maintain fencing of Heenan Lake Wildlife Area to keep trespass cattle from entering the wildlife area and grazing on sensitive riparian habitat. Coordinate with Humboldt-Toiyabe National Forest on activity of allotments on adjacent properties. Periodically monitor the Heenan Lake Wildlife Area for activity of trespass cattle.

II. In order to solve problems that restrict or reduce optimum angler use and enjoyment of the fish populations in Heenan Lake, the following actions will be followed:

1. **Parking Facility Enhancement**

Improved entrance/exit passages, a larger parking area, and an enhanced boat launching area should be developed.

2. Angler Quotas

A daily angler use quota system will be considered for possible initiation should future use be determined to impact angling quality. Use by angling clubs should be monitored to evaluate the need for a reservation system.

3. Angler Use Fee

An evaluation of reinstating the daily access/use fee should be performed. This use fee should be charged to help pay for the specific facilities and fishery evaluations required at Heenan Lake. The fee should be adjusted as needed to defray temporary help costs and at least half of the costs for patrol and fishery evaluations. Fee schedules must be submitted for Fish and Game Commission approval in January of each year.

IMPLEMENTATION

Each winter the Department Regional and Fisheries Program biologists will review this plan to see if changes are needed and what, if any biological investigations should be conducted. To the extent feasible, cooperative investigations with colleges, volunteer conservation groups, and other agencies should be utilized to share costs with program beneficiaries.

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Figure 1. Location map of Heenan Lake, Alpine County, California.



Figure 2. Heenan Lake, Alpine County, angler hours and number of Lahontan cutthroat trout caught during the fishery from 1984 through 2006.



Figure 3. Heenan Lake, Alpine County, Lahontan cutthroat trout catch per hour of angling effort, 1984 through 2006.



Figure 4. Heenan Lake, Alpine County, Lahontan cutthroat trout catch per angler day of effort, 1984 through 2006.



Figure 5. Total Length histograms of Lahontan cutthroat trout reported released from Heenan Lake, Alpine County, during the 2000 through 2006 seasons.



Figure 6. Percent of Lahontan cutthroat trout released from Heenan Lake, Alpine County, greater than 18 inches Total Length during the 1993 through 2006 seasons.



Figure 7. Total numbers of Lahontan cutthroat trout captured in spawning runs at the Heenan Lake egg station, 1992 through 2006. Numbers above bars indicate the number of times fish were spawned that year.



Figure 8. Numbers of male, female, immature, and unmarked Lahontan cutthroat trout captured in spawning runs at the Heenan Lake egg station, 1992 through 2006.



Figure 9. Stocking densities of CT-L (Independence strain) and mean total lengths of male and females captured in Heenan Creek spawning runs 1984 through 2006.



Figure 10. Comparison of spawning run CT-L (Independence strain) Total Lengths measured in May 2006 with angler survey reported Total Lengths of CT-L during the September and October 2006 fishing season in Heenan Lake.

		Catch/Hour				Trout/Angler Shore/Wading Float Tube Boat			
Year	Shore/Wading	Float Tube	Boat	Multiple*		Shore/Wading	Float Tube	Boat	Multiple*
1993	0.61	0.53	0.75	0.00		2.1	2.9	4.2	0.0
1994	1.80	0.57	0.75	0.63		5.8	2.6	3.4	3.0
1995	1.01	0.84	1.43	1.50		3.9	3.9	9.0	1.5
1996	0.58	0.40	0.71	0.88		1.7	2.1	4.1	7.0
1997	0.74	0.61	1.23	1.00		2.6	3.2	6.6	1.0
1998	0.70	0.61	1.00	0.86		2.2	2.9	5.3	4.5
1999	0.45	0.62	0.70	0.73		1.5	2.8	3.9	3.8
2000	0.64	0.57	0.99	0.63		2.2	2.8	4.5	3.2
2001	0.21	0.40	0.61	0.57		0.6	2.0	3.3	4.1
2002	0.24	0.18	0.39	0.14		0.3	0.7	1.9	1.0
2003	0.30	0.51	0.84	1.14		0.5	2.5	4.2	6.1
2004	0.40	0.58	1.19	0.13		1.2	3.0	6.1	0.3
2005	0.72	0.71	1.05	1.75		2.5	3.8	5.6	3.9
2006	0.43	0.44	0.69	0.3		1.4	2.4	3.9	1.4
AVERAGE	0.63	0.54	0.88	0.73		2.0	2.7	4.7	2.9
* Anglers who reported using more than one method type									

Table 1. Heenan Lake, Alpine County, catch statistics for Lahontan cutthroat trout reported by
anglers during 1993 through 2006 by method.

Catch/Hour					Trout/Angler			
Year	Fly	Lure	Multiple*	\Box	Fly	Lure	Multiple*	
1993	0.53	0.79	0.26		2.8	3.5	1.4	
1994	0.87	0.76	1.00		3.8	2.8	3.0	
1995	0.64	1.31	0.39		2.7	6.5	1.8	
1996	0.32	0.72	0.19		1.6	3.3	0.7	
1997	0.55	0.99	1.33		2.7	4.7	4.4	
1998	0.56	0.92	0.41		2.6	3.6	2.1	
1999	0.58	0.64	0.73		2.6	2.7	2.8	
2000	0.53	0.87	0.79		2.4	3.4	4.3	
2001	0.37	0.58	0.24		1.8	2.5	0.8	
2002	0.13	0.44	0.07		0.6	1.7	0.2	
2003	0.42	0.92	1.25		2.1	4.3	6.0	
2004	0.46	1.34	0.43		2.4	6.4	1.5	
2005	0.65	1.07	0.43		3.5	5.1	2.5	
2006	0.4	0.67	0.3	\Box	2.1	3.3	1.4	
				\Box				
AVERAGE	0.50	0.86	0.56		2.41	3.84	2.35	
* Anglers who reported using more than one gear type								

Table 2.Heenan Lake, Alpine County, catch statistics for Lahontan cutthroat trout reported by
anglers during 1993 through 2006 by gear type.

YEAR	Number of Males	Number of Females	Total CT-L Spawned	Number of eggs collected	Average Eggs per Female
1992	152	259	411	536,480	2,071
1993	534	567	1101	1,105,946	1,950
1994	263	268	531		
1995	337	264	601	397,701	
1996	477	491	968	1,287,466	
1997	192	341	533	785,168	
1998	324	431	755	696,390	
1999	536	536	1072	906,768	
2000	498	522	1020	904,840	1,733
2001	211	364	575	701,758	1,912
2002	191	241	432	445,658	1,849
2003	260	257	517	662,167	2,550
2004	78	75	153	207,944	2,728
2005	195	197	392	512,720	2,602
2006	291	284	575	672,510	2,365

Table 3.Heenan Lake, Alpine County, numbers of male and female Lahontan cutthroat trout
spawned and eggs taken during 1987 through 2006.