# 1999 STATEWIDE FISH STOCKING PROGRAM

# PUT-GROW-AND-TAKE

# F-81-D-10

**IDFG 02-06**
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# INTRODUCTION

Cabinet Gorge Fish Hatchery (CGFH) is located on the south bank of the Clark Fork River in Bonner County, Idaho approximately eight miles southeast of the community of Clark Fork. The hatchery was constructed in 1985 and was co-funded by Avista Corporation (formerly Washington Water Power), Bonneville Power Administration (BPA), and Idaho Department of Fish and Game (Department). The primary purpose for CGFH is to produce late-spawning kokanee salmon *Oncorhynchus nerka kennerlyi* fry for release into Idaho's Lake Pend Oreille. Kokanee fry are needed to mitigate for the loss of wild kokanee recruitment caused by hydroelectric power projects in the Pend Oreille watershed. The kokanee fry release is timed to coincide with cycles of zooplankton blooms.

Two permanent state employees staff the CGFH. Thirty-three months of temporary labor are available for use during the year. Housing accommodations include two residences for the permanent staff, and crew quarters for two temporary employees.

## Water Supply

Cabinet Gorge Dam is located approximately one mile upstream from the hatchery. After its completion in 1952, artesian springs began appearing along the Clark Fork River at the present site of the hatchery. The CGFH water supply consists of approximately 4.4 cubic feet per second (cfs) from a spring and approximately 20 cfs from a wellfield. The temperatures of the lower spring and upper wellfield vary inversely with each other over a 12-month period. The cooler water from the lower springs (pumps #7 and #8) was utilized to incubate eggs until December 14, 1998. At that time, a mixture of the two water sources allowed incubation and early-rearing water temperatures to be maintained around 50°F (range 44°F to 52.4°F). Production water ranged from 39°F to 50.9°F.

The hatchery utilizes six pumps to move water to a common headbox. The lower spring and upper wellfield water serves the 31,000 cubic feet (cf) of rearing space in the hatchery building and the 1,500 cf of space in the adult holding ponds.

## Rearing Facilities

Rearing facilities at the hatchery include 192 upwelling incubators and 64 concrete raceways. The incubators are 12-inches in diameter by 24-inches high with a maximum capacity of 140,000 kokanee eggs each. In addition, a total of 30 upwelling incubators, 6-inches in diameter and 18-inches high, are available. The smaller incubators have a maximum capacity of 30,000 kokanee eggs each. The 64 concrete raceways have 31,000 cf of rearing space. The hatchery building encloses approximately one-third of each raceway. The adult kokanee holding area consists of two holding ponds (10-ft x 30-ft each) at the head of the fish ladder. Additional adult holding is available in three (10-ft by 30-ft each) holding ponds.

## PRODUCTION

Between January 1, 1999 and December 31, 1999, CGFH produced a total of 9,903,920 fish weighing 28,668 lbs (Appendix 1). On January 1, 2000, a total of 17,344,049 Lake Pend Oreille kokanee eggs and newly hatched fry were on hand (Appendix 2). In addition, a total of 1,035,243 early kokanee salmon fry and 44,120 fall Chinook salmon fry were on hand.

A total of 27,310 lbs of feed produced 26,727 lbs of gain for an overall feed conversion of 1.02. Total production cost (less capital outlay) was $186,573.30, resulting in a cost per lb of fish of $6.51, cost per inch of fish of $0.0090, and $18.84 per thousand fish (Appendix 1).

## Lake Pend Oreille Kokanee

### General Rearing

Fertilized eggs were brought to the CGFH and disinfected in 100-ppm PVP iodine for 10 minutes. After enumeration, the green eggs were placed into upwelling incubators and rolled until eye-up. At eye-up the eggs were shocked, sorted, and counted with the Jensorter JHC-114 model sorter. Fry were allowed to swim out of the incubators into the raceways at 1,300 to 1,520 temperature units (TUs). All fry were thermally mass-marked via temperature manipulation in the raceways. Feed training began at 1,700 to 1,720 TUs.

Kokanee were feed trained at approximately 48°F to 50°F using Rangen Trout and Salmon Starter for 17 days. Feed training continued from the 18$^{th}$ day to the 34$^{th}$ day utilizing a 50:50 mix of Trout and Salmon Starter and Trout and Salmon Starter #1. On day 35 the fry were placed on Trout and Salmon Starter #1 only. The fry remained on Trout and Salmon Starter #1 until they reached an average size of 800 fish per pound (fpp). The fry were then placed on Trout and Salmon Starter #2 for the remainder of the rearing season. Release size objectives have changed from about 1.3 fry inches (1986) when the hatchery began operations to the present request of a 2-inch average size at release. To meet the request, the hatchery capacity has been reduced from 30 million fry to 16 million fry.

Egg collection lasts over two months, and a cross-section of the run is required for each release strategy. Growth rates were not manipulated during the 1999 season to achieve a universally sized 2-inch fry. The fish were reared using 35 monthly TUs per inch of growth. For the fifth consecutive season, fish were not taken off feed or overfed to attain the average 2-inch size parameter at release. After approximately 6 weeks of feed training, the fry were extended in the raceway, and water temperatures were lowered to emulate natural production in Lake Pend Oreille.

A total of 7,127,261 late kokanee fry were produced at an average length of 1.99 inches and an average weight of 427.35 fpp. These fish gained 15,445 lbs from 14,825 lbs of feed, resulting in a conversion rate of .96:1.0. Fish feed production cost was $6.07 per lb, $0.0071 per inch, and $14.21 per thousand.

Survival of green eggs to feeding fry was estimated at 79.8% (1998, 76.9%). Survival from first feeding to release was estimated at 99.8% (1998, 98.1%), resulting in survival from green egg to release of 79.6% (1998, 75.0%).

## Fish Marking

To evaluate the success of a kokanee *O. nerka kennerlyi* stocking program in Lake Pend Oreille, an otolith thermal mass-marking (Volk et al. 1990) program was utilized at CGFH. All kokanee fry received a thermally induced otolith pattern.

Otolith marking normally occurs between eye-up and button-up stages, but plumbing at CGFH precluded normal procedures due to its inability to accommodate supplying two water sources of different temperatures to the incubating eggs and sac fry. The incubation vessels, however, allowed for volitional swim-up of fry into separate rearing raceways, which were plumbed to accommodate a Tmarking program. This situation provided the impetus to Tmark fry at the end of button-up.

Analysis of pre-release voucher specimens (Grimm et al. 1999) verified the presence of a recognizable otolith mark on all thermally treated fry. Although there was significant variability in the expression of the Tmark, ambiguous marks could be confirmed by carefully observing incremental patterns at the measured area where the Tmark was expected to occur.

Two factors contributed to the success of the Tmarking and recovery of the Tmarks. The first was the ability to manipulate water sources separately in each raceway without affecting the water in the other raceways. The second was the small (less than seven days) spread of the egg takes that were in each raceway. These factors allowed hatchery personnel to thermally treat groups of fry that collectively were at the same developmental stage. That is important because it places the otolith pattern in relatively the same geographic region of the otolith, making examination for and recovery of the mark much easier.

Creating and recovering the Tmark for the 1996, 1997, and 1998 CGFH kokanee brood was successful. Adjustments to spacing between thermal events will be made to the 2000 brood Tmarking effort to create artificial patterns less similar to natural daily increments patterns.

Trawl surveys in Lake Pend Oreille were conducted during the fall of 1999. Fry were collected from three areas of the lake. A number of the fry collected were sent to the Washington Department of Fish and Wildlife otolith lab for analysis. By examining their otoliths, they are able to determine wild fry from hatchery fry. To date, no results have been received from last year's samples.

## Fish Liberation

On June 14, 1999, 3,067,108 late kokanee fry were released from CGFH into the Clark Fork River. On June 15 and 16, 1999, 4,060,103 late kokanee fry were released into Sullivan Springs. On June 17, 1999, 801,482 early kokanee fry were released into Spring Creek. On June 23, 1999, 319,577 early kokanee fry were released into Trestle Creek.

Numbers at release were based on Jensorter counter/sorter inventory numbers at eye-up, minus mortality. All fish were off feed for three full days before inventory pound counts were taken. Pound counts were completed on all raceways one to three days prior to fish being loaded onto the transport vehicles or being released into the Clark Fork River. All raceways were displaced onto the transport trucks during the Sullivan Springs release to double-check inventory numbers. Weight displacements were performed to support current fish inventory numbers on hand at the time of release. No weight displacements were conducted prior to releasing the fish into the Clark Fork River.

The Clark Fork River release groups were liberated at night. Only three raceways were released at one time. The entire release took less than two hours.

The Sullivan Springs release group was transported in two 3,000-gallon capacity Department tankers. Loading densities of small fish in the tankers was kept below 0.60 lbs per gal. Fish were planted below the bridge on the access road to the Department patrol cabin. Two tankers made eight releases during the period of June 15 and 16, 1999.

## Other Species

On May 19, 1999, a total of 630,932 rainbow trout were transferred to Hagerman State Fish Hatchery. The fry averaged 259.86 fish per lb and had attained a length of 2.13 inches.

On June 8 and 9, 1999, a total of 25,527 fall Chinook salmon were planted into Lake Coeur d'Alene. The fish averaged 59 fish per lb and had reached a length of 3.85 inches.

On June 17, 1999, a total of 57,450 fall Chinook salmon were planted into American Falls Reservoir and a total of 12,019 fall Chinook salmon were planted into Lucky Peak Reservoir. The fish averaged 57 fish per lb and had attained a length of 3.89 inches.

On May 25, 1999, a total of 25,000 early kokanee salmon were distributed into Waha Lake (5,000), Winchester Lake (5,000), Manns Lake (10,000), and Soldiers Meadow Reservoir (5,000). The fry averaged 352 fish per lb and had grown to a length of 2.11 inches.

On June 22 and 23, 1999, a total of 904,672 early kokanee salmon were planted into the North Fork Clearwater River. The majority of the fry originated from Deadwood stock. The fry were 2.44 inches in length and averaged 229 fpp. Meadow Creek early kokanee production cost was $6.85 per lb, $0.0105 per inch, and $23.75 per thousand (Appendix 1). Deadwood early kokanee production cost was $7.13 per lb, $0.0129 per inch, and $31.59 per thousand (Appendix 1). Meadow Creek early kokanee survival of green eggs to feeding fry was estimated at 74.8%. Survival from first feeding to release was estimated at 98.4%, resulting in survival from green egg to release of 73.2%. Deadwood early kokanee survival of green eggs to feeding

fry was estimated at 54.5%. Survival from first feeding to release was estimated at 98.49%, resulting in survival from green egg to release of 53.01%.

## HATCHERY IMPROVEMENTS

### Repairs and Improvements

- OSHA safety inspector, Bob Hoop, looked over the facility during 1999, found no violations, and had no recommendations.

- The weatherboards that cover the dam boards at the end of the early rearing portion of the raceway were modified and improved. The new weatherboards are attached to the building frame. The modification will prevent raceways from flooding and will also reduce the number of items handled during cleaning operations.

- Pump indicator lamps were replaced in the generator #1 building.

- Fourteen new raceway catwalks were constructed. The hatchery now has catwalks for each raceway that is utilized outside.

- The partition between the shop and the vat room was painted.

- Two wood duck boxes and one goose-nesting platform were installed near the sedimentation pond.

- All department vehicles, tractors, and small engines were serviced regularly and repaired as needed.

- Back-up generator #1 was load tested weekly and maintenance-checked daily during operations. Generator #2 was operated weekly (with no load) and load tested monthly (with pump #8 only).

- The Okidata printer was cleaned and repaired. In addition, the photocopy machine was serviced, and a new computer monitor was purchased.

- Modifications to the Sullivan Springs/Granite Creek Fish Trap were completed during the summer of 1999. Logs were installed along the bank to prevent erosion during spawning operations

- A new phone line was installed to Residence #2 by GTE.

- All of the hatchery fire extinguishers received annual servicing.

- All of the upwelling incubators were standardized during 1999. In addition, new pads were purchased and installed in each incubator.

- The power washer was repaired during the 1999 season. A blown gasket was causing oil to mix with the gas.

- A new heater was installed in the shop to replace red-flagged heaters.

- Cedar Street Electric repaired the hatchery building lighting.

- Bill Armstrong, of Intermountain Generator, repaired the generator #1 block heater, louvers, and fan belts during October 1999.

- A broken line from the spring area was repaired. The break in the line caused sinkholes near the spring box that will need to be addressed next season.

- The spawn-shed frame was erected during the fall of 1999.

- The batteries in the hatchery alarm system were replaced during December 1999.

- The computer system was upgraded to Internet Explorer 5.0 and Y2K programs downloaded prior to 2000.

- The foundation at the spawning area at CGFH was repaired to prevent erosion during spring runoff.

- Pump #4 (50 hp) was removed by R.C. Worst and taken in for repairs.

- Water production lines were modified in the hatchery building.

- Sediment was removed from the sedimentation pond. The removal of excess waste material from the pond should lower our EPA sediment levels.

- Four raceways were sandblasted and painted to test the process.

- Risers were installed on the PAC columns to eliminate sunlight from the column and the Koch rings inside the columns.

- Log structures in Granite Creek were repaired in October 1999.

## HATCHERY RECOMMENDATIONS

Inadequate amounts of available warm water (50°F) during the production months remains the limiting factor for fish production. Although the upper wellfield can yield up to 20 cfs, it is too cold during the production cycle. Warmer water from the lower springs must be added to temper the upper wellfield water. Unfortunately, only 4.4 cfs is available from the lower springs. It has been proposed that an additional pumping station be installed on the lower spring's pipeline to help lift or push the water up to the hatchery headbox. The additional station could add approximately 1.6 cfs of warm water to the current system. The lower springs

collects approximately 6 cfs of available water but the means to pump it is not available. Currently generator #1 backs up a total of 17.2 cfs (pumps #8 or #7, and #6, #5, and #4 or pumps #8, #7, and #6 & #5, or #5 & #4, or #4 & #6) and a total of 7.2 cfs is backed up by generator #2 (pumps #3 and #8).

## FISH SPAWNING

### Fish Trapping

The Clark Fork River fish trap was in operation from August 30, 1999 to December 28, 1999. The first adult kokanee entered the trap on October 25, 1999 and trapping and spawning continued through the end of December. There were 31,625 adult kokanee trapped. Spawntaking records indicated 31.42% of the spawning run was female (9,938). From September 1, 1999 to October 25, 1999 the trap was used to collect and sample bull trout. A total of 34 adult bull trout were trapped, tagged, held, and released. Two male bull trout mortalities were recorded.

The Sullivan Springs trap was in operation from October 19, 1999 to January 6, 2000. The Sullivan Springs trap collected 193,915 (88,120 in 1998) adult kokanee salmon. Of these, 14,476 (6,320 in 1998) adults were passed above the trap to spawn naturally in Sullivan Springs Creek. Spawntaking records showed that 36.2% (37.36% in 1998) of the run was female (64,949).

### Spawntaking and Eggs Received

Clark Fork River kokanee spawntaking began on November 9, 1999 and continued to December 28, 1999. Spawntaking activities occurred from November 1, 1999 to January 6, 2000 at the Sullivan Springs collection facility.

A total of 21,436,808 green fertilized kokanee eggs were collected during the 1999-2000 spawning season. Of those, 2,188,146 (324,926 in 1998) were obtained from 7,326 female kokanee at CGFH, and 19,248,662 (8,631,046 in 1998) were obtained from 57,971 female kokanee at the Sullivan Springs trap. A total of 2,468,875 green fertilized kokanee eggs from Sullivan Springs were shipped to Clark Fork Fish Hatchery.

## FISH FEED

The fish produced during 1999 were fed a total of 27,310 lbs of feed. Fish feed was acquired from Rangen Inc, and a feed study was conducted with Moore-Clark Nutra Feeds. The overall conversion was 1.02 lbs of feed to produce 1 lb of fish, not including the weight of mortality (Appendix 2).

## PUBLIC RELATIONS

The surrounding communities recognize the CGFH as the major contributor of kokanee to the Lake Pend Oreille fishery. The importance of this fishery to the local economy is presently estimated at over five million dollars. The hatchery has been the focus of many radio, television, and newspaper stories in recent years. With the decline of kokanee numbers in recent years even more attention is focused on the hatchery. Because of the popularity of the lake and its attractions, tourism is a booming business, and we have people from all over the world visiting the hatchery.

A total of 200 people signed our guest register book this year. An estimated 500 visitors toured the hatchery during the 1999 season. In addition, tours were given to school groups and other organizations.

## ACKNOWLEDGMENTS

The CGFH staff would like to thank the Cabinet Gorge Dam and Northern Lights personnel for their continued cooperation with hatchery operations. Thanks also to the Lake Pend Oreille Idaho Club, Bonner County Sportsmen's Association, numerous volunteers, and various regional and hatchery Department personnel for their cooperation during the spawning season.

## LITERATURE CITED

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Grimm, J.J., Anderson, D.J., Nguyen, L.C., and Volk, E.C., 1999. Results of Idaho Department of Fish and Game 1998 Lake Pend Oreille Kokanee Otolith Thermal Mark Recovery, Brood Year 1996 and 1997 Kokanee. Washington Department of Fish and Wildlife Otolith Laboratory.

Appendix 1. Production Summary, all species, Cabinet Gorge Fish Hatchery, 1999

| Species | Number | Pounds | Length | Fish /lb | Feed Fed | Feed Cost A | Annual Cost B | Cost/lb Of fish | Cost/1000 Fish | Cost/inch Of fish | Conversion |
|---|---|---|---|---|---|---|---|---|---|---|---|
| PdO KL | 7,127,261 | 16,678 | 1.99 | 427 | 14,825 | $7,646.74 | $101,278.79 | $6.07 | $14.21 | 0.0071 | 0.96 |
| Can. KE | 1,248,121 | 4,326 | 2.26 | 289 | 4,339 | $2,420.02 | $29,638.99 | $6.85 | $23.75 | 0.0105 | 1.06 |
| Dwd. KE | 802,610 | 3,556 | 2.45 | 226 | 3,711 | $1,914.26 | $25,353.86 | $7.13 | $31.59 | 0.0129 | 1.09 |
| Ore. FC | 94,996 | 1,680 | 3.89 | 57 | 1,738 | $896.20 | $11,869.94 | $7.07 | $124.95 | 0.0321 | 1.09 |
| Hayspur RB | 630,932 | 2,428 | 2.13 | 260 | 2,698 | $1,391.63 | $18,431.72 | $7.59 | $29.21 | 0.0137 | 1.24 |
| **TOTALS/ AVERAGE** | **9,903,920** | **28,668** | **2.09** | **345** | **27,310** | **$14,268.84** | **$186,573.30** | **$6.51** | **$18.84** | **0.0090** | **1.02** |

Appendix 2. Lake Pend Oreille Kokanee Spawntaking Summary, 1999

| Spawntaking Site | Total Fish | Females Spawned | Green Eggs | Fecundity | Percent Females |
|---|---|---|---|---|---|
| | | | | | |
| Sullivan Sps. | 193,915 | 57,971 | 19,248,662 | 332 | 36.20% |
| Cabinet Gorge | 31,625 | 7,326 | 2,188,146 | 299 | 31.42% |
| | | | | | |
| **Totals/ Average:** | **225,540** | **65,297** | **21,436,808** | **328** | **35.48%** |

Includes male/female prespawn mortality

## 2000 ANNUAL PERFORMANCE REPORT

State of: Idaho | Program: Fisheries Management F-71-R-24

Project I: Surveys and Inventories | Subproject I-G: Upper Snake Region

Job: b - Henrys Lake | Title: Henrys Lake Investigations

Contract Period: 1 July 2000 to 30 June 2001

## ABSTRACT


The 2000 spawning operations at Henrys Lake produced 1,436,500-eyed Cutthroat trout *O. clarki* eggs and 343,800-eyed hybrid trout eggs. All hybrid trout eggs were heat-shocked to produce sterile triploids. Cutthroat trout in the Hatchery Creek run averaged 436 mm and hybrid trout averaged 443 mm. No brook trout eggs were taken in 2000. Catch composition in six net nights of gillnetting (custom nets) at Henrys Lake was 10% Cutthroat trout, 52% hybrid trout, 28% brook trout, and 10% Utah chubs. Catch composition in additional sampling with standard Department experimental gillnets was 29% Cutthroat trout, 13% hybrid trout, 6% brook trout, 50% Utah chubs, and 2% redside shiners.

Natural production from three main spawning tributaries to Henrys Lake (Duck, Targhee, and Howard creeks) was estimated at 138,640 fish. The apparent low production from these tributaries warrants further investigation.

An assessment of genetic status of Yellowstone Cutthroat populations in Henrys Lake and its tributaries was continued. In random lake samples of *Oncorhynchus spp* (n = 71), the overall introgression level was 14%. However, within this sample, those fish phenotypically identified as Cutthroat trout (n = 37) were less than 1% introgressed.

Late winter dissolved oxygen concentrations were assessed at established sampling sites. Oxygen concentrations were monitored to establish oxygen depletion rates and predict possible hazardous oxygen levels for fish in the lake. Sufficient levels of oxygen concentrations were predicted and subsequently maintained throughout the winter.

Riparian fencing, fish diversion structures, and screening were maintained on the tributaries of Henrys Lake. Tributaries maintained were Howard Creek, Targhee Creek, Duck Creek, Timber Creek, and Kelly Creek. Additionally, fencing was maintained on the shoreline on the west side of Henrys Lake.

# METHODS

## Spawning Operation

The Hatchery Creek fish ladder was opened on 1 March and remained in operation until 5 May. Fish ascending the ladder were identified as cutthroat trout or hybrid trout and enumerated. A sub-sample of approximately 10% of each group was measured (fork length - mm). Hybrid trout were produced with cutthroat trout eggs and Kamloops rainbow trout sperm obtained from Hayspur Hatchery. Cutthroat trout males and females were spawned to produce cutthroat trout for supplemental stocking in Henrys Lake and other Idaho fisheries. No brook trout eggs were taken from Henrys Lake in 2000.

As in 1999, all hybrid eggs produced in 2000 were subjected to heat shock to induce triploidy. In 1999, all eggs for hybrid production were taken the first four days the fish ladder was open. Because both eye-up and triploidy induction rates were relatively poor in 1999, we elected to take eggs for hybrid production later in the run in 2000. Eggs for hybrid trout production were taken on March 23 and 27 and on April 6 and 27. It is hypothesized that egg quality, and perhaps survival and induction rates, would improve with later egg collection. For each spawn day, cutthroat trout eggs (seven females, pooled) were fertilized with Hayspur Kamloops sperm (five males, pooled). Ten minutes after fertilization, eggs were poured into Heath trays and immersed in a 27°C circulating water bath for 20 min. Eye-up rates were monitored and compared to 1999 hybrid egg lots. All hybrid eggs were shipped to Mackay Hatchery for hatch and rearing. In early September, research personnel took blood samples from 60 fish, and had the samples analyzed for ploidy.

Disease samples were taken from the cutthroat trout spawning run. Ovarian fluids were collected from cutthroat trout (seven fish, pooled samples) during spawning at Henrys Lake Hatchery. Twelve batches of five fish each (60 fish total) were sacrificed for whirling disease sampling. All samples were sent to the Eagle Fish Health Laboratory for analysis.

## Genetic Analyses

The genetic inventory of the Henrys Lake cutthroat trout population continued in 2000. The focus of this inventory was to estimate the level of rainbow trout introgression in a random lake wide sample of *Oncorhynchus spp.*, and within this sample to estimate introgression in fish identified phenotypically as cutthroat trout. On 13-15 July, 10 experimental gill nets were set at random sites around the lake. By this date, it was assumed that all surviving spawners from the previous spring would have reentered the lake, and were randomly mixed within the lake. Each net was set at dusk and pulled the following morning. To avoid any bias in selection of fish, a sampling protocol was implemented before each net was pulled and before any fish were observed. For each set, every second or third *Oncorhynchus* encountered was included in the genetics sample. Each fish was placed on ice and returned to Henrys Lake Hatchery. At the hatchery, each fish was identified based on phenotype and measured (total length – mm). Tissue samples (eye, liver, heart, and muscle) were collected from each fish, placed in labeled bags, and frozen. Samples were shipped frozen to the Washington Department of Fish and Wildlife genetics lab in Olympia, WA for genetic analysis using protein electrophoresis. A total

of 13 protein loci were examined, eight of which were reliably diagnostic between rainbow trout and cutthroat trout. Genetic results were expressed as the overall level of rainbow trout introgression present in the sample (i.e. the number of rainbow trout alleles observed / total number of alleles examined).

## Gillnetting

As part of routine population monitoring, gill net samples were collected from six standardized locations (total six net nights) on 22-24 May. Nets were set at dusk and retrieved the following morning. Set and pull times were recorded and captured fish were identified to species and measured (total length – mm).

Because the gill nets used for standard monitoring at Henrys Lake do not effectively sample Utah chubs, trend data for chub abundance and size structure are lacking. On May 22-24, six additional gill net locations were established for using standard Department experimental gill nets. Again, set and pull times were recorded, and captured fish were identified and measured.

## Tributary Fry Trapping

Prior to 2000, natural production to Henrys Lake has never been quantified. Tributary fencing, canal fish screens, and fish passage projects have been in place since the late 1980s, and habitat conditions in major spawning tributaries (Howard, Targhee, and Duck creeks) appear to have improved. However, natural reproduction in the lake appears to be insignificant. In 1998 fry trapping efforts, partial estimate of natural production in Howard Creek was obtained, but traps were installed too late to estimate total production. Based on observations of fin-clipped fish during the 1999 creel survey, hatchery fish comprised over 90% of the cutthroat trout harvest.

During 2000, Krey-Meekin fry traps were used to monitor and estimate total fry production from Howard, Targhee, and Duck creeks. Traps were installed on 7-8 June near the mouths of each tributary. In Duck Creek, an additional trap was installed on 23 June approximately 1 km upstream of the mouth due to poor catch near the mouth. Each trap was checked daily. All captured fry were enumerated, and a sub sample was measured (total length – mm). When catch rates were sufficient, marking and releasing fry estimated trapping efficiency 200-400 m upstream of the trap. Marking was done by immersing 100-150 fry in a solution of Bismark brown dye (0.75g per 3 gal water) for 20 min. All marked fry were held overnight to assess mortality before release. Recaptures were identified and enumerated at each trap site. Total fry emigration for each mark-recapture interval was estimated by dividing the total number of new fry captured during that interval by the efficiency for that interval. Interval estimates and variances were summed to provide an overall estimate of fry emigration in each tributary.

## Riparian Fencing and Fish Screening

Electric fencing has been in place at Henrys Lake since the early 1990s. Fencing was stretched and solar panels, batteries, and connections were installed during May 2000 at ten sites on the tributaries of Henrys Lake. Fencing was checked daily during the summer and fall months for proper voltage and function. Voltage was checked using a voltmeter at each of the ten sites.

Fish diversion screens are located at nine sites on the tributaries of Henrys Lake. Screens were maintained, cleaned and checked for proper operation on a daily basis during the summer of fall months of 2000.

## Water Quality

Late winter (January, February, and March 2000) dissolved oxygen concentrations and water temperatures were taken at established sampling sites. Sites were located using GPS readings and holes in the ice were drilled prior to sampling. Samples were taken using a YSI oxygen probe and by sampling at each site at ice bottom and subsequent one-meter intervals until the bottom of the lake were incurred. Total $g/m^2$ of oxygen were calculated for each site.

# RESULTS AND DISCUSSION

## Spawning Operation

A total of 4,195 cutthroat trout ascended the spawning ladder between March 1 and May 5, with 2,215 males and 1,980 females. Hybrid trout totaled 8,530 fish, with 3,788 males and 4,742 females. Mean length for male and female cutthroat trout was 440 and 433 mm, respectively (Figure 1). Combined average cutthroat trout length was 437 mm. Hybrid trout males and females averaged 450 and 438 mm, respectively (Figure 2). Combined average hybrid trout length was 443 mm.

The proportion of cutthroat trout in the spawning run was 33%, much lower than recorded in the recent past. Over the previous five years, cutthroat trout comprised an average of 70% of the spawning run. However, selection and classification at the hatchery ladder has changed markedly in the last year. With the recent emphasis on genetic analyses, awareness of genetic issues has increased, and hatchery and management personnel have been much more selective in which fish are classified as cutthroat trout. With this change in classification criteria, cutthroat trout numbers appear to be declining, both in the 2000 hatchery ladder data and in the 1999 creel survey data. Clearly, cutthroat trout numbers have not declined as dramatically as these data suggest, and this is largely an artifact of more conservative fish classification. It is also important to note that despite several decades of less stringent selection criteria at the hatchery ladder, current introgression levels in phenotypic cutthroat trout are low (see genetic analysis section below). In future monitoring activities, it is recommended the

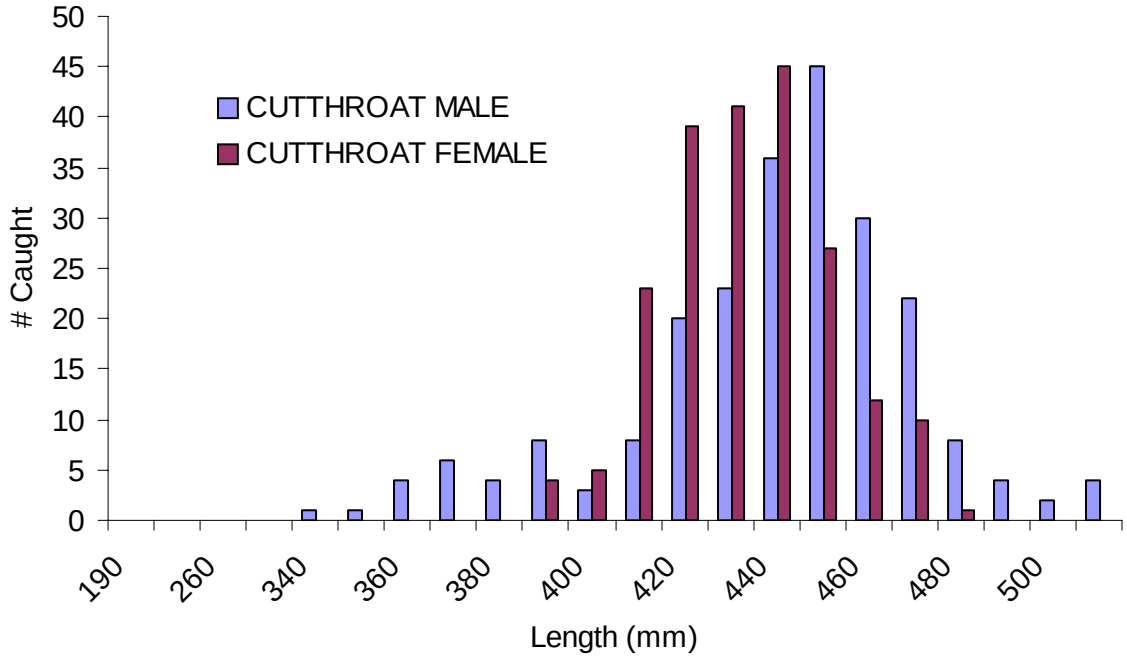


Figure 1. Length-frequency distribution of cutthroat trout captured ascending the Hatchery Creek fish ladder, Henrys Lake 2000.

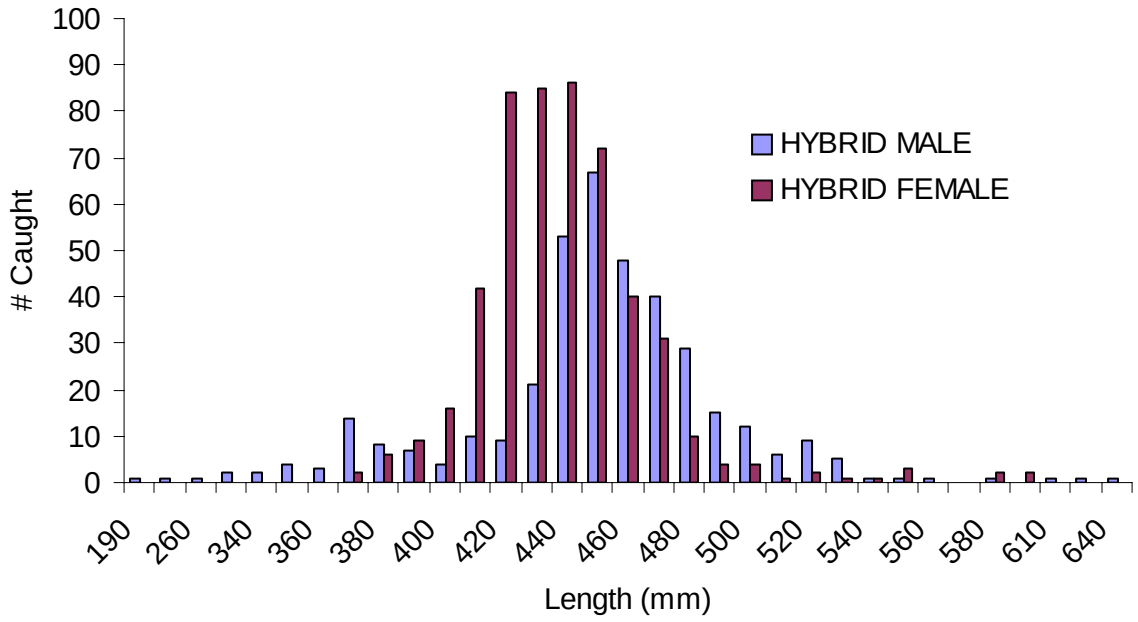


Figure 2. Length-frequency distribution of hybrid trout captured ascending the Hatchery Creek fish ladder, Henrys Lake 2000.

ladder be sorted into three groups of fish: 1) phenotypically “pure” cutthroat trout which meet our intensive selection criteria and could be used for spawning; 2) cutthroat trout which are not obvious hybrids but do not meet the criteria; and 3) obvious phenotypic hybrid trout.

Cutthroat trout green eggs totaled 2,386,437 from 904 females for an average fecundity of 2,639 eggs per female. Eyed cutthroat trout eggs totaled 1,436,528 for an overall eye-up rate of 60%.

Hybrid trout green eggs (all heat-shocked) totaled 993,750 from 375 cutthroat trout females for an average fecundity of 2,650 eggs per female. Eyed hybrid trout eggs totaled 343,798 for an overall eye-up rate of 35%.

Results from cutthroat trout ovarian fluid disease samples were not obtained in time for inclusion in this report. Eleven of 12-pooled samples (five fish each) from the ladder tested positive for *Myxobolus cerebralis*, the causative agent for whirling disease.

This was the second year induction of triploidy was attempted for all Henrys Lake hybrids. Overall eye-up rate was poor again (35%) and about 25-40% lower than typical for untreated hybrid eggs. Estimated overall triploidy induction rate was 65%, substantially lower than is being achieved in domestic Hayspur and Kamloop rainbow trout. Additional modifications to the heat shock process may be necessary to achieve induction rates approaching 100%. Hydrostatic pressure shock should also be investigated as a means of achieving sterility, although using this technique at a production level will be more difficult than heat-shocking. One additional alternative may be producing a reciprocal hybrid cross with cutthroat trout sperm and Kamloop rainbow trout eggs, although performance of such a cross is unknown.

## Genetic Analysis

Lake-wide sampling effort (10 net nights) resulted in capture of 298 fish. Seventy-one *Oncorhynchus spp*. were randomly selected for genetic analysis. Of these, 37 were phenotypically identified as cutthroat trout, 29 as hybrid trout, and five as undetermined.

In the overall sample (n = 71 fish) 1,076 alleles were examined. Of these, 148 (14%) were rainbow trout alleles. This is probably the best estimate of the introgression level in the Henrys Lake trout population. In those fish phenotypically identified as cutthroat trout (n = 37) a total of 552 alleles were examined. Of these, only 4 (1%) were rainbow trout alleles. In phenotypically indeterminate fish (n = 5) a total of 78 alleles were examined, 6 (8%) of which were rainbow trout alleles.

A number of conclusions can be drawn from these results. The most important is that, despite a long history of hybrid and rainbow trout stocking, the overall introgression level of rainbow trout genes in Henrys Lake is moderate. Note that this sample included hybrid trout that are produced at the hatchery and stocked annually. Fish that we identified in the field as cutthroat trout appear to be introgressed at a very low level (<1%). This suggests that hatchery selection for “pure” cutthroat trout has been quite successful over time, and that the reproductive contribution of hybrids to the overall lake population has been negligible.

In the six Henrys Lake tributaries sampled in 1998-1999, nuclear and mitochondrial DNA techniques did detect varying levels of introgression (Dillon and Gamblin 1999). Although phenotypic hybrid trout do ascend Henrys Lake tributaries and are assumed to spawn in the wild with other hybrids and with cutthroat trout, there is no evidence that this has resulted in extensive hybridization in the lake wide cutthroat trout population. This could be because the contribution of natural recruitment to the lake population is low (see fry trapping section below). Alternatively, hybrid trout may be reproductively less fit than native cutthroat trout, or backcrossed hybrids may be less viable than F1 hybrids or native cutthroat trout.

## Gillnetting

A total of 81 fish were collected in the seven net nights with standard Henrys Lake nets (Figure 3). Catch composition was 10% cutthroat trout, 52% hybrid trout, 28% brook trout, and 10% Utah chub. Cutthroat trout ranged from 274 to 482 mm total length, hybrid trout 225 to 536 mm, and brook trout 240 to 449 mm. Brook trout contribution to gill net catches has increased markedly in the last five years, up from 3% in 1995. Although total sample size is relatively small, the Utah chub component is the highest ever recorded for this standard netting effort, up from 8% in 1999.

Six experimental gill nets set to establish monitoring sites for Utah chubs captured a total of 193 fish (Figure 4). Utah chubs comprised 50% of the sample, cutthroat trout 29%, hybrid trout 13%, brook trout 6%, and redside shiners 2%. This effort should be duplicated annually to monitor relative abundance of chubs and salmonids over time.

## Tributary Fry Trapping

In each tributary, traps were installed prior to migration of trout fry back to Henrys Lake (7-8 June). Fry emigration peaked in early July in Howard Creek, mid-July in Duck Creek, and late July in Targhee Creek (Figure 5).

In Howard Creek, catch rates were sufficient to conduct seven efficiency estimates from 16 June to 26 July. Efficiency ranged from 14% to 41%. Total fry out-migration from June 7 to September 2 was estimated at 41,737 (SE 8,389).

In Duck Creek, the bulk of the emigration took place from July 5 to August. 1. Four efficiency estimates were made during this time, ranging from 2% to 16%. Total fry out-migration from June 23 to September 12 was 86,809 (SE 30,175). Poor efficiency, particularly late in the out-migration period, contributed to broad confidence bounds for this estimate.

In Targhee Creek, catch rates were much lower than in other tributaries. Only two efficiency estimates were attempted, on July 29 and August 5. Because estimated efficiencies were similar among intervals, results were pooled to provide and overall efficiency estimate of 13%. Based on this efficiency, total fry emigration from June 8 to September 19 was estimated at 10,094 (SE 1,823).

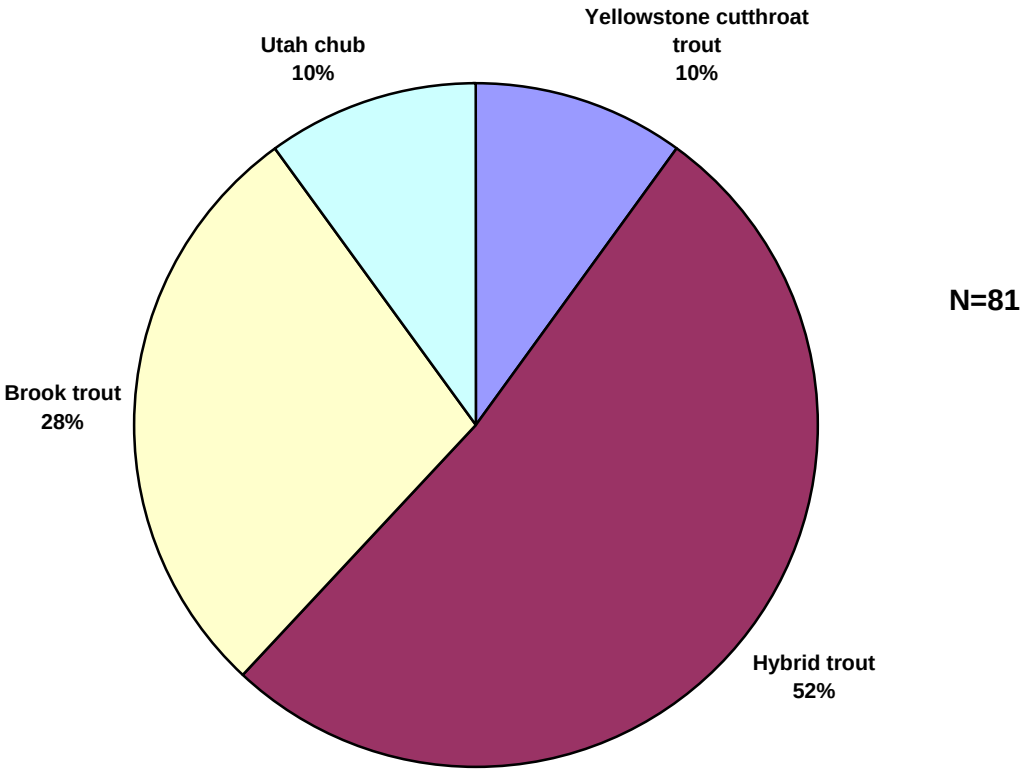


Figure 3. Catch composition of fish caught in six gill net nights of effort on Henrys Lake, 2000.

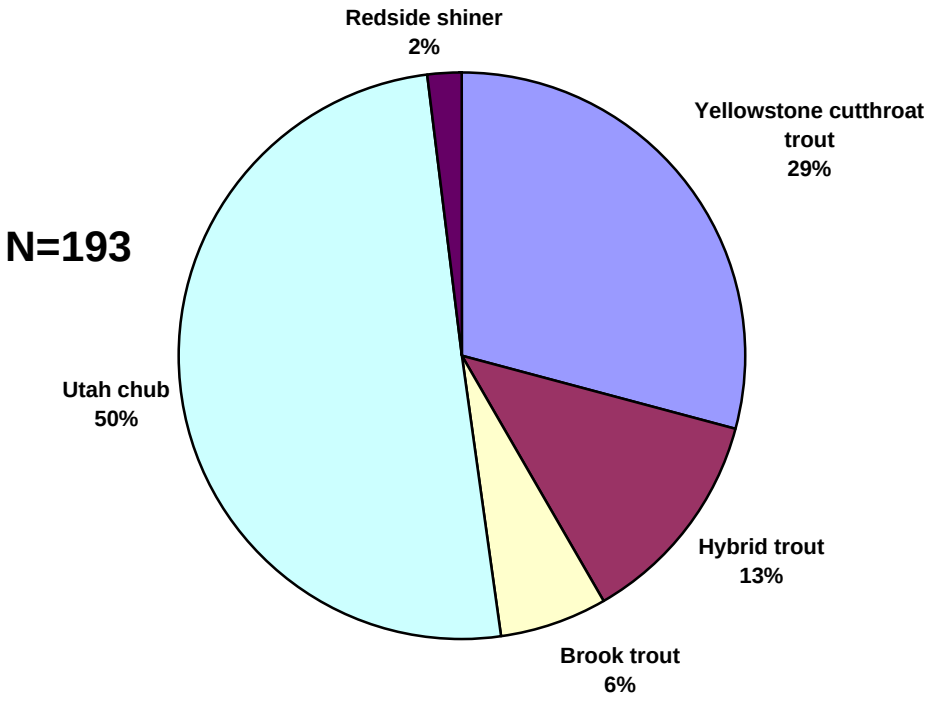


Figure 4. Catch composition of fish captured with six net nights of effort with experimental gill nets on Henrys Lake, 2000. Nets were targeting nongame fish.

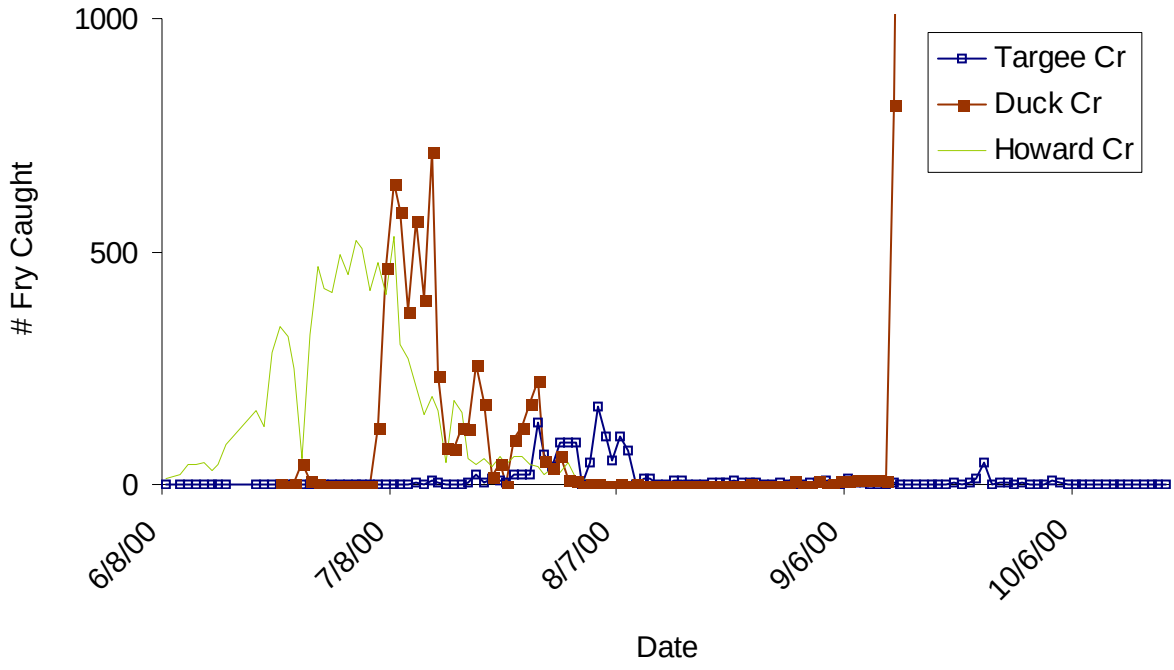


Figure 5. Timing of trout fry emigration from various tributaries to Henrys Lake, 2000. Fish were captured using Krey-Meekin fish traps.

The estimated total fry production from these three primary spawning tributaries was 138,640. Some additional emigration may have occurred outside our sampling period, but is considered minimal based on the declining catch rates observed by the end of the sampling period. Traps were run into the fall, anticipating another peak in emigration. However, because hatchery cutthroat trout fingerlings were stocked into tributaries in early to mid-September, traps were shut down at this time. Despite the uncertainty of fall migrations, production from these three tributaries appears minimal, especially placed in context of the 1,000,000 hatchery fingerlings stocked annually. Results from the 1999 creel survey also suggest that only naturally produced fish provides a small fraction of the fishery. Based on fin clips, virtually all of the cutthroat trout harvest in 1999 was hatchery fish. Additionally, if natural production was contributing a significant portion of the lake fishery, introgression levels in the lake-wide cutthroat trout population should have fallen somewhere between levels in tributary and hatchery ladder samples. In fact, introgression levels for phenotypic cutthroat trout selected randomly from the lake are almost identical to those at the hatchery ladder.

It is unclear why natural reproduction is poor in these tributaries. Large spawning runs are observed annually in each, although spawning escapement has never been quantified. Habitat enhancements such as riparian fences and canal fish screens have been in place for a decade, and spawning and rearing habitat appears to be excellent. We suggest that additional investigations focus on spawner inventories, redd counts, and perhaps egg-to-fry survival in Henrys Lake tributaries. Also, because whirling disease is present in the drainage, we suggest capturing and rearing naturally produced fry to monitor survival.

## Riparian Fencing and Fish Screening

The electric fencing was maintained throughout the summer and fall months of 2000. The equipment materials remained in good working order and functioned well throughout the season. Although maintenance requirements are high on the fencing, the additional benefit to the riparian environment has become apparent at the maintained sites and the tributary enhancement appears to be worth the cost.

The fish diversion screens functioned well throughout the season. However, maintenance costs are increasing and replacement of several screens and structures is in order. In light of the apparent low recruitment of natural production, newer screening and closer monitoring is warranted.

## Water Quality

Monitoring of the dissolved oxygen levels during the winter months has occurred since 1992 and valuable data has been gathered to establish procedures for the advent of low oxygen levels. Henrys Lake currently has a unique aeration system to reduce mortality in the advent of low oxygen levels.

Dissolved oxygen readings taken throughout the winter remained within established levels for fish health throughout this monitoring period. No winterkill was noted and the lake became ice-free early in April, which is earlier than normal. The aeration system was not needed during this reporting period; however, the system was tested and functioned properly.

## RECOMMENDATIONS

1. Continue annual standard gill net surveys to describe general population trends, plus additional experimental gillnetting at newly established sites to monitor distribution and status of the Utah chub population.

2. Continue to evaluate sterile hybrid production and stocking program; develop evaluation plans to assess triploid hybrid performance in Henrys Lake. Investigate alternative methods for triploidy induction.

3. Continue to use established methods for broodstock selection at the hatchery ladder. Use a third classification category for fish sorted in the hatchery ladder to reflect cutthroat trout that do not meet the stringent selection criteria for use as broodstock.

4. Increase emphasis on evaluating spawning escapement, spawning habitat, and natural recruitment in key tributaries.

## INTRODUCTION

The Mackay Fish Hatchery (MFH) is a specialty fish production facility located approximately 12 miles north of Mackay, in Custer County, Idaho. The hatchery produces salmonids of various species and strains, from 1- to 16-inches in length, for statewide distribution. Funding is obtained under contract from the Dingall-Johnson Act for wages, and from state license monies for fish feed and operational costs.

Three full-time and two part-time employees who share 18 months of temporary time man the hatchery. Wages, including benefits, cost $121,700 for the permanent employees and $29,200 for the temporary employees. The operating budget for the calendar year January through December 1999 was $62,590. Included in the year's production were 17 lots of fish, comprised of 6 species and 11 different strains.

Rainbow trout *Oncorhynchus mykiss*
- Arlee (Ennis NFH, MT) 3 year-classes
- Kamloops (Troutlodge, WA)
- Hayspur (Hayspur SFH)
- Hayspur steriles (Hayspur SFH)

Cutthroat trout *O. clarki*
- Westslope (McCall SFH)
- Henrys Lake (Henrys Lk. SFH) 2 year-classes
- Yellowstone (Jackson NFH, WY)

Brown trout *Salmo trutta*
- Crawford (Paint Bank SFH, VA)

Rainbow x cutthroat trout hybrids
- Henrys Lake cutthroat females x Hayspur SFH rainbow males

Kokanee salmon *O. nerka kennerlyi*
- Early (Deadwood Res.) 2 year-classes

Grayling *Thymallus arcticus* 3 year-classes

## WATER SUPPLY

Water for hatchery production is provided by three collection springs in an artesian area at the hatchery. The area is fenced off been dug out, then filled with cobblestone. The water volume available for hatchery production remained consistent with previous years. Flows ranged from 18 to 24 cubic feet per second (cfs). Lowest flows occurred during February, while highest flows occurred during July. Since the 1983 earthquake, temperatures have varied between the three different springs supplying the hatchery, one at 50°F, one at 51°F, and one at 54°F. Incubation temperature is 51°F.

## HATCHERY IMPROVEMENTS

- Driveways about the hatchery were covered with crushed gravel.
- The clean-and-waste ditch was cleaned out and deepened.
- New covers were constructed for the large raceways headrace.
- Covers were installed on any open water areas in the spring area.
- The stocking tank removal system was made safer for the 1-ton pickup truck.
- Reconstruction of the utility trailer was completed.
- The shop walls were repaired, washed, and painted.

## FUTURE NEEDS

- Residence #3 needs new siding and a new roof.
- Remodel the garage for residence #2, and build a garage for Residence #3.
- Residence #2 needs new siding installed.
- A fish-proof screen should be installed at the exit of the large raceway tailrace to keep feral fish out of the tailrace.

## FISH STOCKED

Fingerlings of various species and strains were stocked in six regions of the state (Appendix 1). These put-grow-and-take fish numbered 2,759,350 and weighed 35,900 lbs.

Catchable rainbow trout (10+ inches) were stocked in the Upper Snake and Salmon regions. These put-and-take fish numbered 79,830 and weighed 50,611 lbs. Catchable brown trout, numbering 7,267 and weighing 3,450 lbs, were planted in Region 6. Catchable cutthroat trout, numbering 4,870 and weighing 1,975 lbs, were stocked into Regions 6 and 7. Catchable browns, cutthroat, and grayling were donated to the Morrison-Knudsen Nature Center waters.

The hatchery also reared 14,000 cutthroat fry for planting into ten high mountain lakes in Regions 4 and 6. Four-wheelers, pack-stock, and foot travel were used to plant these fish.

The fish transport trucks assigned to MFH made 113 fish-stocking trips during the year, traveling 28,000 miles, and planting 33 different waters. Transport tankers assigned to Fish Transportation hauled nine loads of fish for the hatchery during the year.

## FISH FEED

A total of 98,030 lbs of fish feed was used during the year at a cost of $35,164. Feed conversion averaged 1.0 lbs of feed for every lb of fish produced. Conversion ranged from a high of 1.18 for the 1997 browns to a low of 0.79 for the 1999 Arlee rainbows. The browns were intentionally overfed in an effort to decrease competition and maintain fin quality. Naturally occurring foods supplemented hatchery foods, enabling the low conversions to occur. Average feed cost per lb of fish produced was $0.36.

State contract required that Rangen feeds be used exclusively. Semi-moist starters were used for some species, but most of the feed used was the dry diet. Fish health and performance showed no ill effects from the Rangen brand. All feeds used and amounts are shown in Appendix 3.

## FISH MARKING

Of the 1,000,000 cutthroat planted into Henrys Lake, 101,200 were adipose-fin-clipped prior to stocking. For the study occurring this season comparing sterile and regular catchable performance in Ririe Reservoir, left ventral fins from 8,660 sterile trout and right ventral fins from 8,900 regular trout were clipped. A crew of three did the clipping during the second week of August.

## PUBLIC RELATIONS

Approximately 800 people toured the hatchery during the year. The hatchery's remote location does not attract large crowds of people. Most visitors come to fish in the diversion pond below the hatchery. Scheduled tours were given to Mackay and Arco elementary classes, Boy Scout groups, and FFA groups. The hatchery is assisting Mackay High School in an aquaculture program. The hatchery crew and the local conservation officer participated in Idaho's "Adopt a Highway" litter control program. Six miles of Highway 93 along Mackay Reservoir are cleaned biannually. Assistance was also provided for the Hunter Education Program at Mackay School.

## ACKNOWLEDGEMENTS

During 1999, the Mackay Fish Hatchery crew included: Biological Aides Adam Broussard, and Bob Evans. Without their excellent assistance, we could not have accomplished all that we did during the year. Their care and concern enabled the hatchery to produce the quality of fish we do. Mel Hughes, Fish Culturist, Doug Young, Fish Culturist, Mick Hoover, Assistant Hatchery Manager, and Phil Coonts, Hatchery Manager, round out the hatchery's personnel.

Appendix 1. Fish Production at Mackay Fish Hatchery, January 1, 1999 to December 31, 1999.

| Species/strain | Lot | Source | Received As | Fish Number Received or Carried Into 1999* | Pounds Received or Carried Into 1999* | Yield Number | Yield Pounds | Destination |
|---|---|---|---|---|---|---|---|---|
| Arlee rainbow trout | 8-EN-RA | Ennis NFH | eyed eggs | 80,000 * | 36,360 * | 80,370 | 50,611 | 99 catchables |
| Arlee rainbow trout | 9-EN-RA | Ennis NFH | eyed eggs | 174,000 * | 961 * | 133,100 | 32,200 | 00 catchables |
| Arlee rainbow trout | 0-EN-RA | Ennis NFH | eyed eggs | 167,000 | eyed eggs | 105,400 | 400 | 01 catchables |
| Hayspur rainbow/sterile | 9-R9-T9 | Hayspur H | eyed eggs | 15,000 | eyed eggs | 8,603 | 2,705 | 00 catchables |
| Kamloops rainbow | 0-U-ID-K1 | Hayspur H | eyed eggs | 457,000 | eyed eggs | 320,000 | 220 | 00 Reg 1 |
| Shasta rainbow | 9-EN-R5 | Ennis NFH | eyed eggs | 344,500 | eyed eggs | 306,275 | 7,325 | 99 Island Pk |
| Henry's Lk cutthroat | 8-U-ID-C3 | Henry's Lk H | eyed eggs | 6,300 * | 2,275 * | 6,269 | 3,078 | 99 + 00 catchables |
| Henry's Lk cutthroat | 9-U-ID-C3 | Henry's Lk H | eyed eggs | 1,600,000 | eyed eggs | 1,270,200 | 7,800 | 99 Reg 5,6,7 |
| Yellowstone cutthroat | 9-C4 | Jackson NFH | eyed eggs | 15,000 | eyed eggs | 10,895 | 135 | experimental |
| rainbow/cuthroat hybrid sterile | 9-U-ID-RC | Henry's Lk H Hayspur H. | eyed eggs | 320,000 | eyed eggs | 203,550 | 3,600 | 99 Henry's Lk |
| Westslope cutthroat | 8-U-ID-C2 | McCall H. | fingerlings | 28,000* | 71 * | 23,760 | 1,555 | 99 Payette, Fish Lk |
| Deadwood kokanee | 8-U-ID-KE | Deadwood Res. | green eggs | 1,000,000 * | 1,000 * | 914,962 | 14,430 | 99 Reg 3,5,6 |
| Deadwood kokanee | 9-U-ID-KE | Deadwood Res. | green eggs | 1,600,000 | 650 | 1,300,000 | 3,300 | 00 Reg 1,2,3,4,5,6 |
| grayling | 7-GR | Ashton H. | fry | 27 * | 25 * | 23 | 23 | 99 Nature Center |
| grayling | 8-GR | Ashton H. | fry | 35 * | 15 * | 32 | 15 | 00 Nature Center |
| grayling | 9-GR | Ashton H. | fry | 45 | 10 | 40 | 5 | 01 Nature Center |
| Crawford brown trout | 7-PB-BN | Paint Bank, VA | eyed eggs | 7,300 * | 3,100 * | 7,267 | 3,450 | 99 Reg 7 |

Appendix 2. Mackay Hatchery Stocking Summary, 1999.

| Lot Number | Number Planted | Lbs. Planted | Size Planted |
|---|---|---|---|
| 8-EN-RA | 80,370 | 50,611 | catchable |
| 9-EN-R5 | 306,275 | 7,325 | fingerling |
| 9-EN-RA | 41,600 | 750 | fingerling |
| 7-PB-BN | 7,267 | 3,450 | catchable |
| 8-U-ID-C2 | 23,760 | 1,555 | fingerling |
| 8-U-ID-C3 | 6,269 | 3,078 | catchable |
| 9-U-ID-C3 | 1,270,000 | 7,800 | fingerling |
| 8-U-ID-KE | 914,962 | 14,433 | fingerling |
| 9-U-ID-RC | 203,550 | 3,600 | fingerling |
| 9-U-ID-C3 | 14,000 | 30 | fry |

**Total Fish Planted**

| | Numbers | Pounds |
|---|---|---|
| High Mtn. Fry - | 14,000 | 30 |
| Fingerlings - | 2,759,346 | 35,901 |
| Total Catchables - | 93,366 | 57,139 |
| rainbow - | 79,830 | 50,611 |
| cutthroat - | 6,269 | 3,078 |
| browns - | 7,267 | 3,450 |
| **Totals -** | **2,866,712** | **93,070** |

Appendix 3. Mackay Fish Feed Used, January 1 1999 through December 31, 1999

| | | Pounds Used | | Feed Cost |
|---|---|---|---|---|
| **Rangen Fish Feeds** | | | | |
| Semi-moist starters | | | | |
| 0 swim-up | - | 528 | | $ 562 |
| 1/32 "cut" | - | 2,302 | | 2,204 |
| 1/32 | - | 1,350 | | 1,330 |
| Trout and Salmon Starter | | | | |
| 0 swim-up | - | 500 | | 239 |
| #1 | | 2,550 | | 1,216 |
| # 2 | - | 10,050 | | 4,794 |
| # 3 | - | 15,350 | | 4,874 |
| # 4 | - | 4,400 | | 1,443 |
| Extruded 450 Pellets | | | | |
| Ext 3/32 | - | 10,100 | | 3,232 |
| Ext 5/32 | - | 50,900 | | 15,270 |
| **Total Pounds** | | **100,580** | **Total Cost** | **$ 36,380** |

Appendix 4. Mackay Fish Hatchery Lot Histories, 1999 Totals, except as noted.

| Lot | Fish Planted or On-Station | Pounds Gained | Pounds Feed | conv. | $ Feed | Feed Cost Per lb fish | Feed Cost Per fish |
|---|---|---|---|---|---|---|---|
| 8-EN | 79,830 | 29,010 | 31,904 | 1.1 | 10,033 | 0.34 | 0.125 |
| '98 totals | | 21,600 | 23,381 | | 9,308 | | |
| | | 50,610 | 55,285 | 1.08 | 19,341 | | |
| 9-EN | 92,000 | 32,200 | 25,591 | 0.79 | 7,850 | 0.24 | 0.085 |
| 9-R5 | 306,275 | 7,325 | 8,060 | 1.1 | 4,000 | 0.54 | 0.013 |
| 9-R9/T9 | 8,603 | 2,700 | 2,824 | 1.04 | 693 | 0.25 | 0.08 |
| 9-RC | 203,550 | 3,600 | 3,085 | 0.85 | 1,519 | 0.42 | 0.007 |
| 9-C3 | 1,255,199 | 7,800 | 7,494 | 0.96 | 3,750 | 0.48 | 0.002 |
| 8-C3 | 6,269 | 3,078 | 3,125 | 1.06 | 854 | 0.29 | 0.13 |
| 8-C2 | 23,760 | 1,129 | 1,235 | 1.09 | 406 | 0.35 | 0.017 |
| '98 totals | | 426 | 581 | | 261 | | |
| | | 1,555 | 1,816 | 1.16 | 667 | 0.44 | 0.028 |
| 8-KE | 914,962 | 14,430 | 14,759 | 1.02 | 5,852 | 0.4 | 0.006 |
| 7-BN | 7,267 | 989 | 1,185 | 1.2 | 396 | 0.4 | 0.05 |
| '98 totals | | 2,520 | 2,975 | | 935 | | |
| | | 3,509 | 4,160 | 1.18 | 1,331 | 0.39 | 0.18 |
| 9-C4 | 10,913 | 133 | 100 | 0.75 | 40 | 0.3 | 0.003 |
| 9-KE | 1,300,000 | 2,200 | 2,050 | 0.93 | 1,707 | 0.77 | 0.001 |

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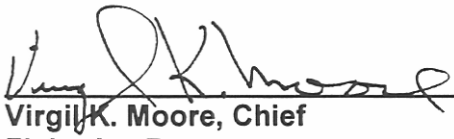

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