2000 STATEWIDE FISH STOCKING PROGRAM

PUT-GROW-AND-TAKE

F-81-D-11

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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 (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. Maximum hatchery capacity is 20 million eggs, with fish production of 16 million two-inch fry.

The CGFH is staffed with two permanent employees. 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 about 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, 1999. At that time, a mixture of the two water sources allowed incubation and early rearing water temperatures to be maintained around 49 degrees F (range 44.0°F to 49.5°F). Production water ranged from 38.5°F to 46.5°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 of rearing space in the hatchery building and the 1,500 cubic feet 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, which are 6 inches in diameter and eighteen inches high, are available. The smaller incubators have a maximum capacity of 30,000 kokanee eggs each. The 64 concrete raceways have rearing space of 31,000 cubic feet. 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 holding ponds (10-ft by 30-ft each).

PRODUCTION

Between January 1, 2000 and July 1, 2000, Cabinet Gorge Hatchery produced a total of 17,005,316 fish weighing 18,910 lbs (Appendix 1). On January 5, 2001, a total of 13,302,327 Lake Pend Oreille kokanee eggs and newly hatched fry were on hand (Appendix 2).

A total of 18,467 lbs of feed produced 15,814 lbs of gain for an overall (all species reared) feed conversion of 1.17. Total production cost (less capital outlay) was $181,378.00, resulting in a cost per lb of fish of $9.59, cost per inch of fish of $0.0070, and cost per thousand fish of $10.67 (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 and sorted and counted with the Jensorter JHC-114 model sorter. Fry were allowed to volitionally swim out of the incubators into the raceways at 1,500 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 47°F to 49°F using Rangen's Trout and Salmon starter (or Ewos Vextra starter #0) for 17 days. Feed training continued from day 18 to day 34 utilizing a 50:50 mix of Trout and Salmon starter and Trout and Salmon starter #1(or Ewos #0 and #1). On day 35 the fry were placed on Trout and Salmon starter #1 only. The fry normally would remain on Trout and Salmon starter #1 for the duration of rearing (with the exception of the Ewos feed test originally scheduled for 8 raceways, 2,000,000 fish).

Due to colder water available for early rearing, subsequent slower growth rates, and maximized swim-up fry loading rates, the majority of the kokanee on station sustained outbreaks of Bacterial Gill Disease. Chloramine-T was administered as a treatment at 10 ppm for three consecutive days. EWOS Vextra feed (which produces less waste) was fed as a "prophylactic feed", and a 1% salt bath was used as a follow-up prophylactic measure. By necessity, the feed test was abandoned. By the end of May, overall fish health had improved and all of the fry were exhibiting favorable recovery signs.

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 sixth 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 16,000,808 late kokanee fry were produced at an average length of 1.56 inches and an average weight of 865.5 fish per lb. These fish gained 15,581 lbs from 18,151 lbs of feed, resulting in a conversion rate of 1.16:1.0. Fish feed production cost was $9.65 per lb, $0.0071 per inch, and $11.14 per thousand.

Survival of green eggs to feeding fry was estimated at 84.0% (1999, 79.8%). Survival from first feeding to release was estimated at 95.6% (1999, 99.8%), resulting in survival from green egg to release of 80.3% (1999, 79.6%).

Fish Marking

To evaluate the success of a kokanee *Oncorhynchus nerka kennerlyi* stocking program in Lake Pend Oreille, an otolith thermal mass-marking (Volk, et al, 1990) program was utilized at Cabinet Gorge Hatchery. All kokanee fry received a thermally induced otolith pattern. In addition, the eyed eggs from Clark Fork Hatchery were transported back and forth (twice per lot) to Heath stacks set up in the adult holding ponds at Cabinet Gorge Hatchery. The IPN exposed eggs were held in isolation and subjected to a warmwater thermal mark during two sequential two-day periods while at this station. Differential temperature between the two stations was about 9°F. This resulted in two distinct broad (warmwater) bands, indicative of the BY 1999 thermal marking pattern. These swim-up released fry will be distinguishable from their wild counterparts by examining otolith growth rings for these distinctive bands.

Otolith marking normally occurs between eye-up and button-up stages, but plumbing at Cabinet Gorge Hatchery 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 near the end of button-up.

Analysis of pre-release voucher specimens (Grimm et al. 2000) 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, 1998 and 1999 Cabinet Gorge Hatchery kokanee brood was successful. Adjustments to spacing between thermal events will be made to the 2001 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 2000. 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 otolith (ear stones), they are able to determine wild fry from hatchery fry. To date, no results have been received from last year's samples.

Fish Liberation

Due to the large numbers of small fry (16,730,814) on station and the outbreak of Bacterial Gill Disease in some raceways, the decision was made to release some of the fry early to reduce raceway density indices. On May 3,4 and 5, 2000, 1,017,399 late kokanee fry were released into Johnson Creek, 1,976,710 late kokanee fry were released into Granite Creek, and 780,836 were released into Garfield Bay.

On June 13 and 14, 2000, 5,152,198 late kokanee fry were released into Sullivan Springs. On June 14, 2000, 1,009,262 late kokanee fry were released into Spring Creek. On June 15, 2000, 2,971,976 late kokanee fry were released from the Cabinet Gorge Hatchery into the Clark Fork River. On June 15, 2000, 3,092,427 late kokanee fry were released into Twin Creek. The selection of the Twin Creek site was chosen as a possible future adult trapping location to replace or supplement the erratic adult numbers returning up the fish ladder at Cabinet Gorge Hatchery.

Numbers at release were based upon 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 of fish 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 two raceways were released at one time. All unnecessary water was turned off prior to release to reduce fish congestion within the diversion box. The entire release took less than two hours.

The scheduled Sullivan Springs release group was transported in two Department tankers (3,000-gallon capacity). Loading densities of small fish in the tankers was kept below 0.60 lbs per gallon. Fish were planted below the bridge on the

access road to the Department patrol cabin. Two tankers made five releases during the period of June 13-14, 2000.

The early release groups were transported in the 2-ton tanker (1,000-gallon capacity) borrowed from the Clark Fork Hatchery. The tanker and truck were thoroughly disinfected before use. An additional 1,709,705 swim-up fry were released from Clark Fork Hatchery directly into Spring Creek via a PVC pipeline.

Other Species

On January 19, 2000, a total of 36,900 fall Chinook salmon were transferred to Nampa Fish Hatchery. The fish averaged 802 fish per lb (fpp) and were 1.61 inches in length.

On February 15 and 17, 2000, a total of 967,608 early kokanee salmon were transferred to Clearwater Hatchery. The fry averaged 2434 fpp and were 1.11 inches in length.

The fish transfers occurred to make room for 20 million late kokanee eggs taken from Lake Pend Oreille late kokanee adults. The early kokanee fry originated from Meadow Creek stock (in British Columbia). Meadow Creek early kokanee production cost was $7.31 per lb, $0.0027 per inch, and $3.00 per thousand. Meadow Creek early kokanee survival of eyed eggs to feeding fry was estimated at 94.6%. Survival from first feeding to release was estimated at 96.5%, resulting in survival from green egg to release of 91.3%. The Chinook stock came from Big Creek Hatchery in Astoria, Oregon. Fall Chinook salmon survival of eyed eggs to feeding fry was estimated at 84.0%. Production costs were negligible as the fry were transferred ten days after first feeding (Appendix 1).

HATCHERY IMPROVEMENTS

Repairs and Improvements

- The shaft to pump #8 broke off and had to be replaced just prior to the 2000 egg-taking operation.
- New check valves were installed on pumps #7 and #8.
- Additional fill material was purchased and used to fill in the erosion damage sustained in 1999 around the lower springs collection facility.
- A nine-person Ford Excursion sports utility vehicle was acquired primarily to safely transport the six to eight person spawntaking crew to Granite Creek during the months of November and December. It is also available for regional and hatchery complex use to transport large groups of people to Department functions.

- Two new electric ranges were purchased for hatchery residences to replace the original units installed in 1985.

- One of the old oven/range units was installed into the hatchery crew's quarters after extensive rewiring.

- The interior of residence number two was repainted after Brad Dredge was promoted to Hatchery Manager 2 and had moved to Rapid River Hatchery.

- Flagpole illumination was installed, so the hatchery flags could be flown at night.

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. Modification of existing pumping facilities or drilling additional wells at this location is warranted. The lower springs collects approximately 6 cfs of available water but the means to pump it is unavailable. Additional water at this location is also available for collection. 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 July 5, 2000 to December 21, 2000. Kokanee were first observed in the river on October 13, 2000. The first adult kokanee entered the trap on October 25, 2000, and trapping and spawning continued through the end of November. There were 320 adult kokanee trapped. Spawntaking records indicated 22.5% of the spawning run was female (67). From July 5, 2000 to October 16, 2000 the trap was used by Avista Corp. personnel to collect and sample bull trout. A total of 43 adult bull trout were trapped, tagged, held, and released. One male bull trout mortality was recorded. Also, one right ventral clipped female was trapped which was originally released by hatchery personnel in 1992. The fish was 751 mm long and weighed 9.12 lbs.

The Sullivan Springs trap was in operation from October 23, 2000 to January 5, 2001. The Sullivan Springs trap collected 94,941 (193,915 in 1999) adult kokanee salmon. Of these, 11,345 (14,476 in 1999) adults were passed above the trap to spawn naturally in Sullivan Springs Creek. Spawntaking records showed that 45.7% (36.2% in 1999) of the run was female (38,209).

Spawntaking and Eggs Received

Clark Fork River kokanee spawntaking began on November 9, 2000 and continued to November 30, 2000. Spawntaking activities occurred from October 30, 2000 to January 5, 2001 at the Sullivan Springs collection facility.

A total of 13,302,327 green fertilized kokanee eggs were collected during the 2000-2001 spawning season. Of those, 22,389 (2,382,672 in 1999) were obtained from 49 female kokanee at Cabinet Gorge Hatchery, and 13,279,938 (20,000,858 in 1999) were obtained from 33,623 female kokanee at the Sullivan Springs trap (Appendix 2).

FISH FEED

The fish produced during 2000 were fed a total of 18,467 lbs of feed. Fish feed was acquired from Rangen Inc., and a feed study was started with Ewos Vextra Feeds. The overall conversion was 1.17 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 local fishery to the local economy is presently estimated at over 5 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 250 people signed our guest registration 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. The staff would also like to thank CGFH Maintenance Craftsman Dave Heiman, and CGFH Biological Aides Beth Brown, Stacey Taylor, John Suhfras, Sheryl Skaggs, Gennie Hoyle, Joe Rakes, and David McElhaney for their dedication and hard work in making 2000 a successful year.

LITERATURE CITED

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APPENDICES

Appendix 1. Production Summary, all species, Cabinet Gorge Fish Hatchery, 2000.

Species	Number	Pounds	Length	Fish/lb	Feed Fed	Feed Cost A	Annual Cost B	Cost/lb. of fish	Cost/1,000 fish	Cost/inch of fish	Conversion
PdO KL	16,000,808	18,466	1.56	867	18,151	$7,437.27	$178,274.37	$9.65	$11.14	0.0071	1.16
Can. KE	967,608	398	1.11	2434	296	$77.32	$2,907.19	$7.31	$3.00	0.0027	1.34
Ore. FC	36,900	46	1.61	802	20	$0.00	$196.43	$4.27	$5.32	0.0033	1.85
Totals/ Average	**17,005,316**	**18,910**	**1.53**	**899**	**18,467**	**$7,514.59**	**$181,378.99**	**$9.59**	**$10.67**	**0.0070**	**1.17**

Appendix 2. Lake Pend Oreille kokanee spawntaking summary, 1999.

Spawntaking Site	Total Fish	Females Spawned	Green Eggs	Fecundity	Percent Females
-	-	-	-	-	-
Sullivan Springs	193,915	57,971	20,000,858	345	36.20%
Cabinet Gorge	31,625	7,326	2,382,672	325	31.42%
-	-	-	-	-	-
Totals/Average	**225,540**	**65,297**	**22,383,530**	**343**	**35.48%**

* includes male/female prespawn mortality

2000 ANNUAL PERFORMANCE REPORT

State of: Idaho | Program: Fisheries Management F-71-R-25

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

Job: b - Island Park Reservoir, Ririe Reservoir, Henrys Lake | Title: Lowland Lakes Investigations

Contract Period: July 1 2000 to June 30 2001

ABSTRACT

Gill nets were set on Island Park Reservoir on May 16 to assess species composition and monitor relative abundance of fish species. Gill net catch composition on Island Park Reservoir in May was 73% nongame fish (Utah chubs *Gila atraria*, Utah suckers *Catostomus ardens*, and redside shiners *Richardsonius balteatus*). Hatchery and wild rainbow trout *Oncorhynchus mykiss* comprised 18%, while splake (lake trout *Salvelinus namaycush* x brook trout *S. fontinalis*), kokanee salmon *O. nerka*, brook trout and mountain whitefish *Prosopium williamsoni* accounted for 9% of the catch.

Routine creel surveys were conducted on Ririe Reservoir to monitor catch rates and species composition, and to evaluate experimental stockings of catchable-size Yellowstone cutthroat trout O*. Clarki bouvieri* and sterile triploid rainbow trout. Overall catch rate from June 9 to September 18 averaged 0.69 fish/h and harvest rate averaged 0.43 fish/h. Harvest composition was 48% hatchery rainbow trout, 21% yellow perch *Perca flavescens*, 19% kokanee salmon, and 10% Yellowstone cutthroat trout. Smallmouth bass *Micropterus dolomieui* and splake comprised about 2% of the harvest. Hatchery Yellowstone cutthroat trout comprised 9% of the total trout stocked and 10% of the trout harvest. Evaluation of sterile triploid rainbow trout was inconclusive due to improper identification of marked fish in the creel.

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.

Assessments of genetic status of Yellowstone cutthroat populations in Henrys Lake and its tributaries were 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.

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METHODS

Island Park Reservoir

Since the 1992 drawdown and renovation of Island Park Reservoir, annual standardized gillnetting has been used to monitor species composition, relative abundance, and size structure of the fishery in the lake. On May 8-9, four sinking and three floating experimental gill nets were fished at standardized locations (seven net nights; Dillon et al. 2000). Set and pull times for each net were recorded, and all captured fish were identified, enumerated, and measured. Relative abundance data were compiled and compared to data from 1993-1999.

Ririe Reservoir

A routine creel survey was implemented on Ririe Reservoir to monitor catch and harvest rates and species composition in the harvest. Additional objectives in 2000 were to assess relative return to creel of sterile triploid and normal diploid hatchery rainbow trout *O. mykiss*, and to evaluate a stocking of catchable-size Yellowstone cutthroat trout *O. clarki bouvieri*. Triploid rainbow trout were given left pelvic fin clips, and diploids were given right pelvic fin clips. Hatchery cutthroat trout were obtained from Jackson National Fish Hatchery and reared at Mackay State Fish Hatchery to an average size of about 300 mm. Survey dates were June 8 to September 18, with random days and start times generated with the Department creel survey software. No angler counts were done. Creel clerks were instructed to identify and measure all fish observed in the harvest, and to inspect all harvested rainbow trout for fin clips.

Henrys Lake

Spawning Operation

The Hatchery Creek fish ladder was opened on March 1 and remained in operation until May 5. Fish ascending the ladder were identified as cutthroat trout *O. clarki* or hybrid trout (rainbow trout x cutthroat trout) and enumerated. A sub-sample of approximately 10% of each group was measured (fork length). 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 *Salvelinus fontinalis* 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 fish collected 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 July 13-15, ten 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). 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 of six net nights) on May 22-24. 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).

Because the gill nets used for standard monitoring at Henrys Lake do not effectively sample Utah chubs *Gila atraria*, 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 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 estimates of natural production in Howard Creek were 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 June 7-8 near the mouths of each tributary. On June 23 an additional trap was installed on Duck Creek, 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). When catch rates were sufficient, trapping efficiency was estimated by marking and releasing fry 200-400 m upstream of the trap. Marking was done by immersing 100-150 fry in a solution of Bismarck brown dye (0.75 g 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.

RESULTS AND DISCUSSION

Island Park Reservoir

A total of 718 fish were captured with a combined gillnetting effort of seven net-nights (Table 1). Catch composition included nine species. Game fish (trout, char, mountain whitefish *Prosopium williamsoni*, and kokanee salmon *O. nerka*) comprised 27% of the total catch, compared to 37% in May 1999 samples. Utah chub, Utah suckers *Catostomus ardens*, and redside shiners *Richardsonius balteatus* comprised 73% of the catch, compared to 62% in 1999. Hatchery and wild rainbow trout comprised 18% of the catch, down from 23% in 1999 samples. A total of seven splake (brook trout x lake trout *Salvelinus namaycush*) and four Lahontan cutthroat trout were sampled.

Ririe Reservoir

From June 9 to September 18 creel clerks interviewed 247 anglers who fished 497 hours, caught 341 fish, and harvested 214 fish. Mean catch rate was 0.69 fish/h and mean harvest rate was 0.43 fish/h. Harvest composition was 48% hatchery rainbow trout, 21% yellow perch *Perca flavescens*, 19% kokanee salmon, and 10% Yellowstone cutthroat trout. Only one smallmouth bass *Micropterus dolomieu* was observed in the harvest.

The experimental stocking of hatchery Yellowstone cutthroat trout appeared to be successful. The 1,500 fish stocked comprised about 9% of the total trout stocking and 10% of the observed trout harvest.

Comparisons of triploid and normal rainbow trout were compromised by inadequate identification of fin clips in the field. Creel clerks inspected each harvested fish for left pelvic clips (triploids), but did not record right pelvic clips (diploid). Despite this uncertainty, fish recorded as triploids comprised over 60% of the trout harvest, whereas fish recorded as unmarked comprised only 22%. This suggests that triploid fish return to creel at a higher rate than diploid fish, but clearly a more rigorous evaluation is needed.

Henrys Lake

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 fork length for male and female cutthroat trout was 440 and 433 mm, respectively (Figure 1). Combined average cutthroat trout fork 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 determining 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 that the 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%) 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%.

Tributary Fry Trapping

In each tributary, traps were installed prior to migration of trout fry back to Henrys Lake (June 7-8). 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 June 16 to July 26. Efficiency ranged from 14% to 41%. Total fry outmigration 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 outmigration from June 23 to September 12 was 86,809 (SE 30,175). Poor efficiency, particularly late in the outmigration 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 an 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).

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 additional emigration. However, because hatchery cutthroat trout fingerlings were stocked into tributaries from 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 a small fraction of the fishery is provided by naturally-produced fish. 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.

RECOMMENDATIONS

Island Park Reservoir

1. Continue spring gill net surveys to monitor changes in species composition.

2. Institute lake-wide creel survey to monitor effort, catch composition, size of catch and catch rates over the course of a fishing season.

Ririe Reservoir

1. Continue experimental stockings of hatchery Yellowstone cutthroat trout.

2. Institute a structured, lake-wide creel survey to monitor effort, catch rates, species composition, and relative returns of various groups of stocked hatchery fish. Survey should encompass the entire fishing season.

Henrys Lake

1. Continue annual standard gill net surveys to describe general population trends.

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. Increase emphasis on evaluating spawning escapement, spawning habitat and natural recruitment in key tributaries of Henrys Lake.

Table 1. Gill net catch composition in Island Park Reservoir, Idaho, May 2000.

		Species								
Net Location	**Soak time (hrs)**	**Utah Chub**	**Rainbow trout**	**Brook trout**	**Kokanee salmon**	**Mountain whitefish**	**Utah sucker**	**Redside shiner**	**Splake**	**Total**
Brush Pile	16.3	106	18	1	3	0	2	0	2	132
Bill's Island	18.3	171	14	3	30	1	54	24	2	299
Mill Creek	19.5	46	14	6	1	0	0	0	2	69
Trudes Bay	20.2	13	17	2	1	0	9	0	1	43
Goose Island	21.7	14	22	0	2	0	15	0	0	53
Goose box #25	20.2	18	19	0	2	1	1	0	0	41
Goose box #56	20.5	40	26	0	2	1	10	2	0	81
Total	**136.7**	**408**	**130**	**12**	**41**	**3**	**91**	**26**	**7**	**718**
%	**-**	**56.8**	**18.1**	**1.7**	**5.7**	**0.4**	**12.7**	**3.6**	**1.0**	**-**

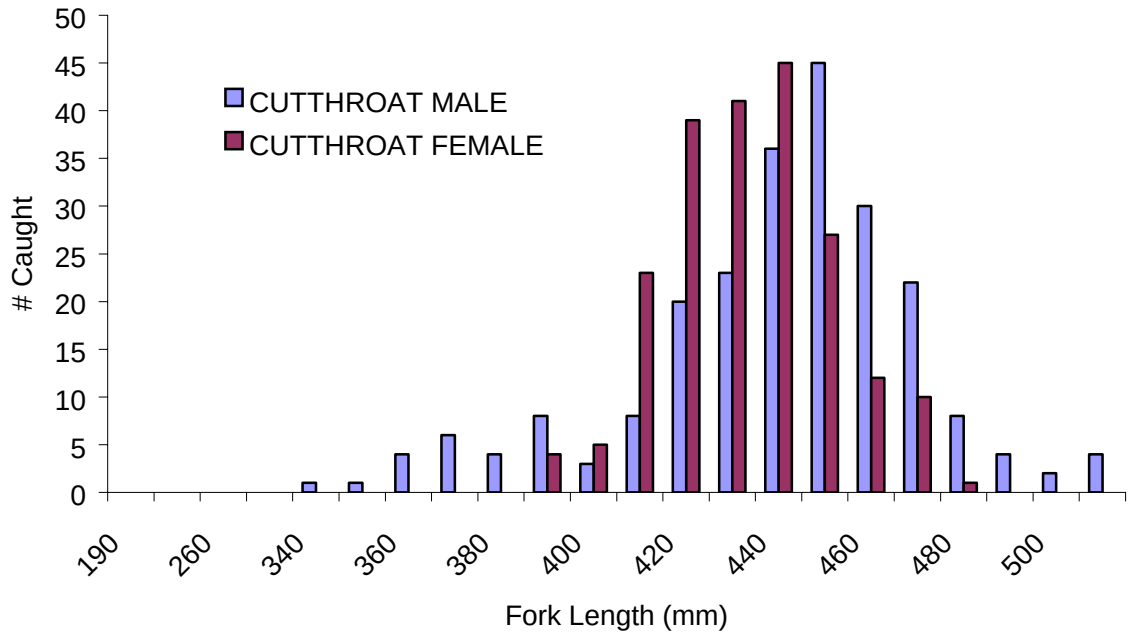

Figure 1. Length frequency distribution of cutthroat trout captured ascending the Hatchery Creek fish ladder, Henrys Lake, Idaho in 2000.

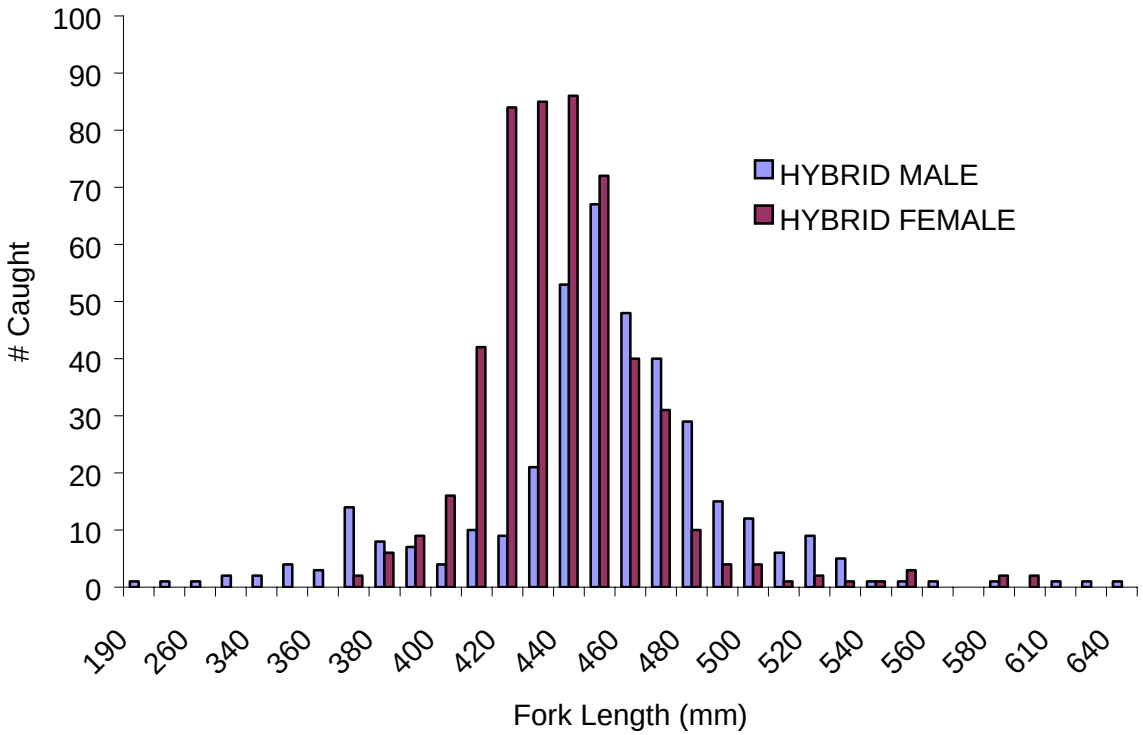

Figure 2. Length frequency distribution of hybrid trout captured ascending the Hatchery Creek fish ladder, Henrys Lake, Idaho in 2000.

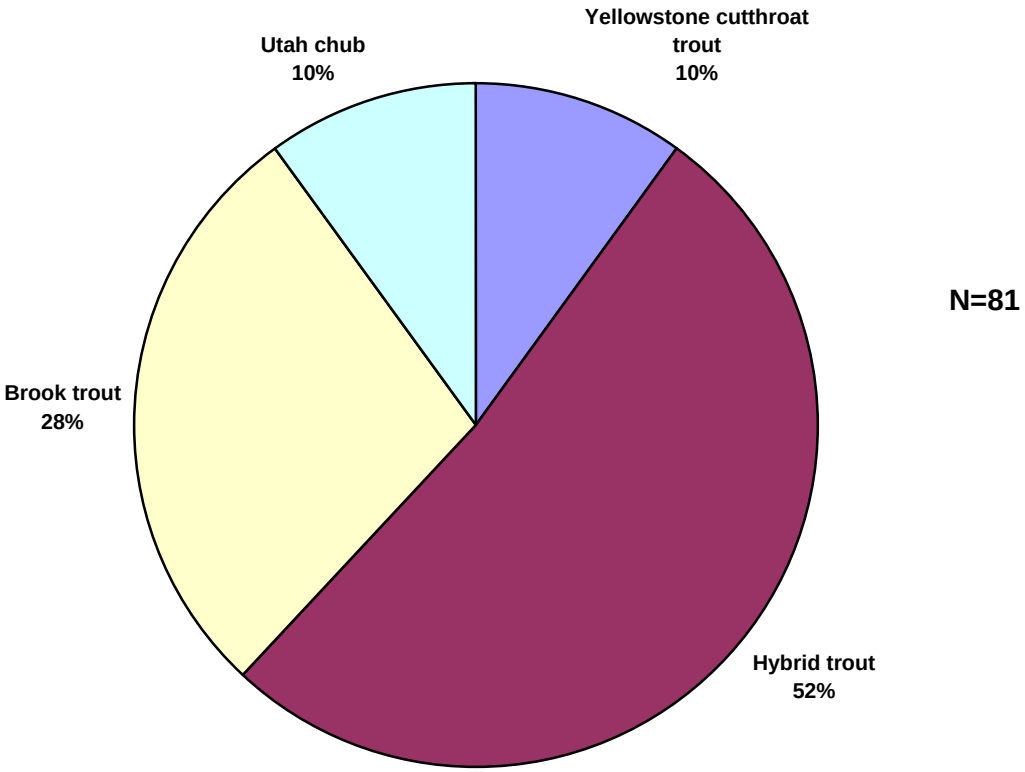

Figure 3. Catch composition of fish caught in six gill net nights of effort on Henrys Lake, Idaho in 2000.

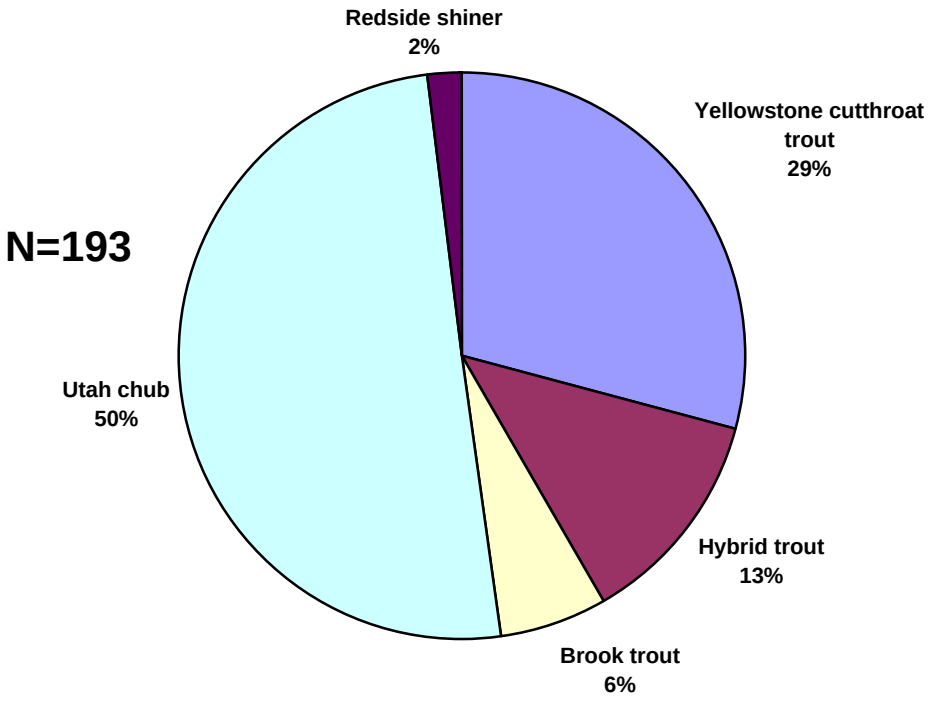

Figure 4. Catch composition of fish captured with six net nights of effort with experimental gill nets on Henrys Lake, Idaho in 2000. Nets were targeting nongame fish.

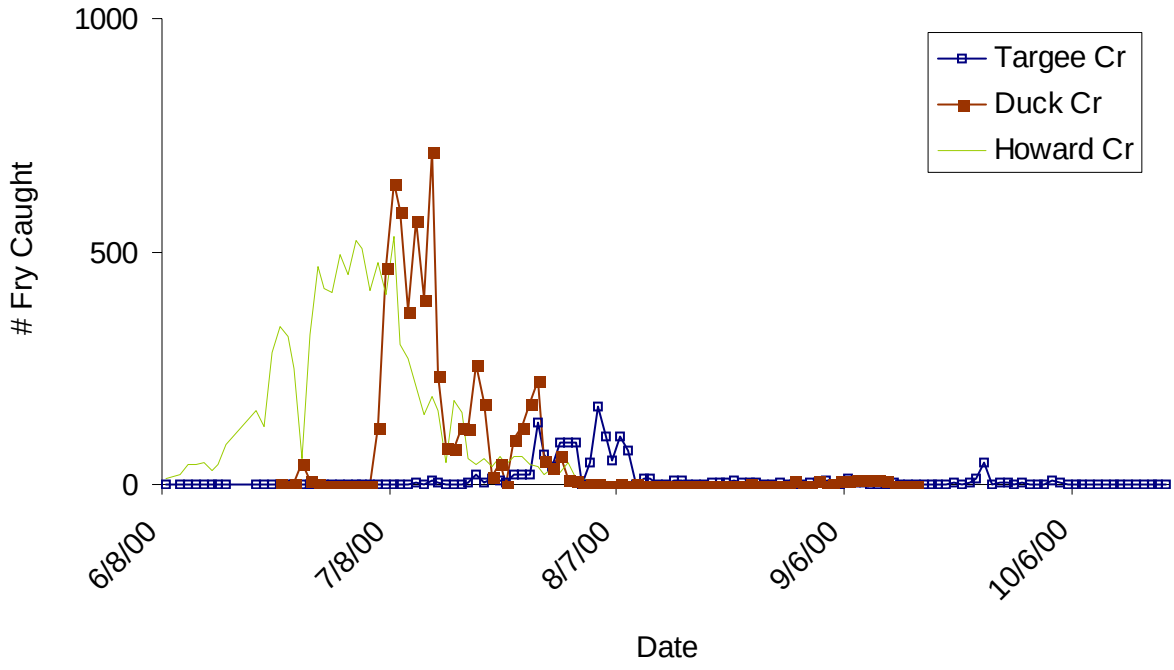

Figure 5. Timing of trout fry emigration from various tributaries to Henrys Lake, Idaho in 2000. Fish were captured using Krey-Meekin fish traps.

INTRODUCTION

The Mackay Fish Hatchery (MFH) is a specialty fish production facility located approximately 16 miles north of Mackay, in Custer County, Idaho. The hatchery produces salmonids of various species and strains, from 1 inch 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.

The hatchery is staffed with three full-time and two part-time employees. The part-time employees share 16 months of temporary time. Wages, including benefits, cost $138,484 for the permanent employees and $30,796 for the temporary employees. The operating budget for the calendar year, January through December 2000, was $51,000. Included in the year's production were 17 lots of fish, comprised of 5 species and 11 different strains.

Rainbow trout *Oncorhynchus mykiss*
- Arlee (Ennis NFH, MT) 3 year-classes
- Kamloops (Hayspur SFH)
- Eagle Lake (Ennis NFH, MT)
- Fish Lake (Ennis NFH, MT)
- Hayspur steriles (Hayspur SFH) (2 year classes)

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

Rainbow x Cutthroat trout hybrids
- Henry's Lake cutthroat females x Hayspur SFH rainbow males

Kokanee salmon *O. nerka kennerlyi*
- Early (Deadwood Res.) 2 year-classes
- Early (Strawberry Res., UT)
- October (Blue Mesa Res., CO)

WATER SUPPLY

Water for hatchery production is provided by three collection springs in an artesian area at the hatchery. The area was fenced off and 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 occur during February, while highest flows occur during July. Since the 1983 earthquake, temperatures have varied between the three different springs supplying the hatchery: one at 50ºF, one at 51ºF, and one at 54ºF. Incubation temperature is 51ºF.

HATCHERY IMPROVEMENTS

With the three permanent employees being “among the walking wounded” a good part of the year, fewer improvements were accomplished this season than normal. Some projects completed were:

- An additional settling pond was constructed to prevent overflow from the original settling pond.
- The south side of the four-stall garage was painted.
- The icemaker was repaired and thoroughly cleaned.
- Built and installed weir to measure flows in the waste effluent ditch
- Leaks in the early rearing troughs and header pipe were repaired.

HATCHERY NEEDS

- Residence #3 needs new siding, windows, and roofing installed.
- Residence #3 needs a garage built.
- Residence #2 needs the garage either rebuilt or improved.
- Residence #2 needs new siding installed.
- A fish-proof screen needs to be installed at the exit of the large raceway tailrace to keep feral fish out of the tailrace.
- Install a cement pad in front of the shop in order to perform vehicle maintenance work.

FISH STOCKED

Fingerlings of various species and strains were stocked in seven regions of the state (Appendix 1). These put-grow-and-take fish numbered 2,722,791 fish weighing 34,838 lbs.

Catchable rainbow trout (10-inches+) were stocked in the Upper Snake and Salmon regions. These put-and-take fish numbered 80,347 and weighed 57,440 lbs. Catchable cutthroat, Henrys and Yellowstones, numbering 10,500 fish and weighing 3,090 lbs, were planted into Regions 6 and 7.

The hatchery also reared 27,450 cutthroat and 12,800 rainbow fry for planting into forty-five 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 89 fish stocking trips during the year, planting 34 different waters and traveling 25,400 miles. Transport tankers assigned to Nampa Fish Hatchery hauled six loads of fish for the hatchery during the year.

FISH FEED

A total of 105,629 lbs of fish feed was used during the year at a cost of $33,978. Feed conversion averaged one pound of feed for every pound of fish produced. Conversions ranged from a high of 1.7 for the 1999 Hayspur steriles to a low of 0.7 for the 2000 Arlee rainbows. The steriles were intentionally overfed in an effort to duplicate sizes of an older lot of Ennis rainbow. Naturally occurring foods supplemented hatchery foods, enabling low conversions to occur. Average feed cost per lb of fish produced was $0.41.

State contract required Rangen feeds to be used exclusively. Semi-moist starter was used for kokanee, but the rest of the feed use was the dry diet. Fish health and performance showed no ill effects from the Rangen brand. All feed sizes and amounts used are shown in Appendix 3.

FISH MARKING

Of the one million cutthroat planted into Henrys Lake, 102,900 were adipose-fin clipped prior to stocking. This clipping is a never-ending study of natural vs. hatchery fish returning to the creel and ladder.

The hatchery planted equal numbers of Hayspur sterile and Ennis normal magnum catchables into Ririe Reservoir during the summer, in a return-to-creel study conducted by Region 6 fisheries biologists. No results were available at this time.

PUBLIC RELATIONS

Approximately 800 people toured the hatchery during the year. Most visitors come to fish in the diversion pond below the hatchery. Scheduled tours were given to Mackay and Arco elementary classes, Boy Scout 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 bi-annually. The hatchery became a “Passport Stamping Station”, the tourism promotion program.

ACKNOWLEDGEMENTS

At various times during 2000, the Mackay Hatchery crew included Biological-Aides: Bob Evans, Adam Broussard, Travis Drussel, Brett High, and Camron Wakefield. 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. Doug Young, Fish Culturist, Mick Hoover, Assistant Hatchery Manager, and Phil Coonts, Hatchery Manager, round out the hatchery's personnel.

APPENDICES

Appendix 1. Fish Production at Mackay Fish Hatchery, January 1 to December 31, 2000.

Species/strain	Lot	Source	Received as	Fish Number Received or Carried Into 00	Pounds Received or Carried Into 00	Number Planted	Pounds Planted	Destination
Arlee rainbow trout	9-EN-RA	Ennis NFH	eyed eggs	75,000	30,000	72,877	51,007	00 catchables
Hayspur rainbow sterile	9-R9-T9	Hayspur SFH	eyed eggs	7,600	3,000	7,470	6,433	00 catchables
Arlee rainbow trout	0-EN-RA	Ennis NFH	eyed eggs	130,635	5,844	18,525	925	01 catchables
Arlee rainbow trout	1-EN-RA	Ennis NFH	eyed eggs	159,700	eggs	0	0	02 catchables
Hayspur rainbow sterile	1-R9-T9	Hayspur SFH	eyed eggs	34,700	eggs	0	0	02 catchables
Kamloops rainbow	0-K1	Hayspur SFH	eyed eggs	457,000	eggs	317,217	3,822	00 fingerlings
Fish Lake rainbow	0-RF	Ennis NFH	eyed eggs	293,724	eggs	200,000	2,621	00 fingerlings
Eagle Lake rainbow	0-R7	Ennis NFH	eyed eggs	105,000	eggs	86,900	1,138	00 fingerlings
Henry's Lk cutthroat	8-U-ID-C3	Henry's Lk H	eyed eggs	1,550	1,000	1,520	1,650	00 catchables
Henry's Lk cutthroat	0-U-ID-C3	Henry's Lk H	eyed eggs	1,338,693	eggs	837,190	7,240	00 catchables
rainbow/cutthroat hybrid sterile	0-U-ID-RC	Henry's Lk H Hayspur H.	eyed eggs	308,286	eggs	242,830	482	00 Henry's Lk
Yellowstone cutthroat	9-C4	Jackson NFH	eyed eggs	10,913	135	9,000	1,440	00 and 01 catchables
Yellowstone cutthroat	0-C4	Jackson NFH	eyed eggs	13,048	85	0	0	01 catchables
Deadwood kokanee	9-U-ID-KE	Deadwood Res.	green eggs	1,150,022	10,826	1,119,404	18,095	00 fingerlings
Deadwood kokanee	0-U-ID-KE	Deadwood Res.	green eggs	848,761	9,500	0	0	01 fingerlings
Strawberry Res. kokanee	0-U-UT-KE	Strawberry Res.	green and eyed eggs	1,110,682	eggs	0	0	01 fingerlings
Blue Mesa kokanee	0-U-CO-KO	Roaring Judy, CO	eyed eggs	359,000	eggs	0	0	01 fingerlings

Appendix 2. Mackay Fish Hatchery Stocking Summary, 2000

Lot Number	# Planted	Pounds Planted	Size Planted
9-EN-RA	72,877	51,007	catchable
9-R9-T9	7,470	6,433	catchable
8-U-ID-C3	1,500	1,650	catchable
9-C4	9,000	1,440	catchable
0-EN-RA	18,525	925	fingerling
0-K1	317,217	3,822	fingerling
0-RF	200,000	2,621	fingerling
0-R7	86,900	1,138	fingerling
0-U-ID-C3	838,440	7,240	fingerling
0-U-ID-RC	151,830	482	fingerling
9-U-ID-KE	1,119,404	18,095	fingerling

Total Fish Planted

		Numbers	Pounds
High Mtn. Fry		40,250	54
Fingerlings		2,732,316	34,323
Total catchables		90,847	60,530
Rainbow	79,830	80,347	57,440
Cutthroat		10,500	3,090
Totals		**2,863,413**	**94,907**

Appendix 3. Mackay Fish Hatchery Feed Used, January 1 2000 through December 31, 2000

	Pounds Used		Feed Cost
Rangen Fish Feeds			
Semi-moist starter			
0 swim-up -	176		$ 187
Trout and Salmon Starter			
0 swim-up -	1,400		573
# 1 -	4,460		1,827
# 2 -	10,494		4,298
# 3 -	16,434		5,218
Extruded 450 Pellets			
Ext 3/32 -	3,769		1,206
Ext 5/32 -	68,896		20,669
Total Pounds	**105,630**	**Total Cost**	**$ 33,978**

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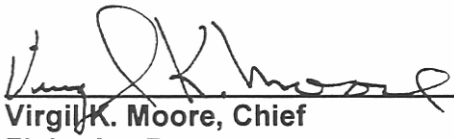

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