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Annual Progress Report

Lower Snake River Compensation Plan
Confederated Tribes of the Umatilla Indian Reservation
Evaluation Studies for 1989-90

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TABLE OF CONTENTS

SUMMARY

The Confederated Tribes of the Umatilla Indian Reservation (CTUIR) have been involved in the Lower Snake River Compensation Plan (LSRCP) since 1986. In 1990 funding became available for the first time to support a full-time project biologist to conduct hatchery evaluation research.

LSRCP cooperators have recognized that the ability to distinguish unmarked hatchery-produced from naturally-produced adult fish is important. A fin clip is used to mark hatchery steelhead in the Columbia River basin. No such mark is being used for salmon. A large percentage of the spring chinook salmon that have been artificially spawned and reared for release into the Snake River basin have not been recognizably marked. Scale Pattern Analysis has the potential to provide a discriminant model for distinguishing unmarked hatchery fish from naturally-produced fish. A total of 447 scales of naturally-produced fish, 1051 scales from hatchery fish and 605 scales from fish of unknown origin were received from Oregon Department of Fish and Wildlife (ODFW). A total of 49 scales of naturally-produced fish, 98 scales from hatchery fish and 70 scales from fish of unknown origin were received from Idaho Department of Fish and Game. Scales and data on fork length, sex, age, fin marks, tagcode (for hatchery fish) and site and date of collection were organized, entered onto a computer database and sent to ODFW Scale Reading Laboratory.

Enough scales were available from fish sampled in Oregon to produce models to discriminate naturally-produced from hatchery fish for the years 1986 through 1988, and a preliminary model for 1989. The number of scales available from Idaho was insufficient to produce a reliable model.

Work planned for the future to estimate the survival from egg deposition to fry emergence of spring chinook salmon precipitated an effort to gain experience in capping redds in a tributary of the Grande Ronde River. Two spring chinook salmon redds in Catherine Creek were capped and the emerging fry were enumerated. Fry were captured from 22 March to 9 April, 1990. One redd became partially covered with sand and only 91 fry were captured. Of these 57 were found dead in the trap. The number of fry captured from the second redd was 754, 95 of which were founbd dead in the trap.

The CTUIR assisted ODFW in sampling adults during spawning of summer steelhead and spring chinook salmon at the Lookingglass and Wallowa Hatcheries and Little Sheep Creek and Imnaha River Satellite Facilities. Assistance was provided in sampling juvenile fish before release at the hatcheries and acclimation facilities. Index and supplemental spawning ground surveys were completed in the Grande Ronde and Imnaha River basins.

ACKNOWLEDGMENTS

My thanks to Dan Herrig and Ed Crateau (United States Fish and Wildlife Service) for administering this contract, coordinating communication between CTUIR and other management and research entities and helpful comments in reviewing this report. Joe Richards and Gary James (CTUIR) provided administrative and technical support, particularly with numerous contract modifications and comments on several drafts of this report. Thanks go to ODFW Research and Development in La Grande, Oregon, Richard Carmichael, Rhine Messmer, Mike Flesher, Brian Jonasson and Tim Whitesel for their assistance in the field and the office. Special thanks go to personnel of the ODFW Scale Reading Laboratory, Lisa Borgerson, R. Kanani Bowden and Bob Mikus for spending numerous hours organizing and reading scales in Corvallis, Oregon.

LIST OF FIGURES

Number

INTRODUCTION

The Snake River drainage historically supported large populations of fall and spring chinook (Oncorhynchus tshawytscha), sockeye (O. nerka) and coho (O. kisutch) salmon as well as steelhead (O. mykiss). Many of the populations of these anadromous salmonids that once returned to the drainage are severely depleted, several to the point of extinction. Numerous human impacts are responsible for environmental changes which have resulted in depletion of these stocks. Some deleterious effects such as inundation of habitat, changes in flow patterns, obstruction of upstream and downstream migration, etc. are directly attributable to the construction and operation of the four lowest dams in the mainstem Snake River. The present environment produced by the dams presents obstacles to preserving, supplementing and re-establishing populations of these fish upstream of these structures.

The need for mitigation due to hydroelectric development in the Columbia River basin has been recognized and funded under a number of programs. The states of Oregon, Washington and Idaho and the U.S. Corps of Engineers, National Marine Fisheries Service and U.S. Fish and Wildlife Service negotiated a mitigation program to compensate for losses due to construction and operation of four major hydroelectric dams on the lower portion of the Snake River. Congress authorized the Lower Snake River Compensation Plan (LSRCP) under the Water Resources Development Act in 1976 to compensate for the resultant losses of anadromous and resident fishes and wildlife and their habitat. As one of the results of this plan, several hatcheries and satellite facilities were built to mitigate for losses of anadromous fish species (U.S. Army Corp of Engineers 1976).

Fish and wildlife populations and habitat within river basins which are affected by Snake River dams are within ceded lands and usual and accustomed areas where the Cayuse, Walla Walla and Umatilla tribes (Confederated Tribes of the Umatilla Indian Reservation, CTUIR) historically hunted and fished. Tribal hunting and fishing rights in these areas are preserved by the Treaty of 1855 with the United States Government. Meaningful exercise of fishing rights has been severely impacted by construction and operation of the dams and the resulting decline in fish populations. Preservation, restoration and rebuilding of salmon and steelhead populations in traditional tribal fishing areas are affected by the operation of hatcheries and satellite facilities built for mitigation. These include Irrigon, Lookingglass, Wallowa Fish Hatcheries (FH) and Imnaha River, Little Sheep Creek and Big Canyon Creek Satellite Facilities (SF) in northeast Oregon and Lyons Ferry and Tucannon FH and satellite facilities at Cottonwood Creek, Dayton Pond and Curl Lake in southeast Washington.

The extent to which re-establishment and augmentation of natural production have compensated for losses of fish through the LSRCP hatchery program is being evaluated using the criteria of returning fish "in place" and "in kind". Criteria for success currently involves returning adults to project areas for fall chinook salmon and above the four lowest Snake River dams for spring and summer chinook salmon and steelhead. The LSRCP did not authorize compensation for the detrimental affects of the dams on the populations and habitats of coho and sockeye salmon that returned upstream of Lower Granite Dam. Estimated losses of adults for which mitigation was provided were 18,300 fall chinook salmon, 58,700 spring and summer chinook salmon, and 55,100 steelhead (U.S. Army Corps of Engineers 1976). Trout (86,000 pounds) are to be planted and habitat improvements completed (in lieu of 7,000 pounds of production) to compensate for resident fish losses in Washington and Idaho. Compensation goals for programs within traditional tribal fishing areas of the CTUIR are: Irrigon and Wallowa FH (11,184 steelhead), Lookingglass Hatchery (9,072 spring chinook salmon), and Lyon's Ferry and Tucannon FH (1,152 spring chinook salmon, 18,300 fall chinook salmon and 4,656 summer steelhead) (Herrig 1990).

OBJECTIVES

Past and current objectives

From 1986 to 1989 the objectives of CTUIR have been to: 1) analyze how the LSRCP program addresses tribal needs in the Grande Ronde, Imnaha and Tucannon River basins, 2) assist Oregon Department of Fish and Wildlife (ODFW) and Washington Department of Fisheries (WDF) and Washington Department of Wildlife (WDW) with ongoing evaluation studies, 3) provide review and planning input regarding ODFW and WDF LSRCP hatchery operation and evaluation activities, and 4) develop a five-year plan for tribal involvement in LSRCP studies.

With funding becoming available to hire a full-time biologist starting 1 January, 1990, the following activities were scheduled for the 16-month contract period 1 September, 1989 to 31 December, 1990:

1) Obtain and organize scales to develop models using scale pattern analysis to distinguish between hatchery-produced and naturally-produced spring chinook salmon in the Snake River basin,
2) Develop techniques to monitor the success of adult salmon outplants,
3) Assist ODFW in ongoing research evaluating LSRCP activities,
4) Provide review and input regarding LSRCP activities in Oregon and Washington,

Scale Pattern Analysis

Management and research entities in the Columbia River basin have recognized the importance of the ability to distinguish unmarked hatchery-produced from naturally-produced adults. In the Columbia River basin hatchery steelhead have been marked with a fin clip. No such mark has been used for hatchery salmon. A large percentage of the spring chinook salmon of hatchery origin produced in the Snake River basin have not been marked. Although such a mark may be used in the future, to distinguish adults collected in the past and those that are currently being collected, another technique must be used.

Scale Pattern Analysis (SPA) is a technique which uses the spacing of circuli on scales to characterize populations of fish. Both genetic and environmental factors can produce patterns of growth in fish that are reflected in scale patterns. To the extent that genetic and/or environmental factors differ between two groups of fish, SPA can be used to distinguish between them. SPA has long been used for stock identification and classification of anadromous salmonid populations (Amos et al. 1963; Mosher 1963; Anas and Murai 1969; Major et al. 1978; Bethe and Krasnowski 1979; Bethe et al. 1980; Barber and Walker 1988).

ODFW initiated development of hatchery/wild discriminant analysis in 1989 and objectives are outlined in the ODFW LSRCP Study Plan for 1989-90 (Carmichael 1989). The study was designed to develop models to distinguish between populations of spring chinook salmon in the Snake River basin. Discriminant models would allow differentiation between: 1) naturally-produced and hatchery fish within the Grande Ronde, Imnaha, Salmon and Clearwater subbasins, 2) naturally-produced fish that originate in different subbasins, and 3) hatchery fish reared at different hatcheries. If models using SPA are able to distinguish between different populations of adult spring chinook salmon in the Snake River basin with a high degree of accuracy, LSRCP cooperators will be able to determine the origin of fish at different collection sites (e.g. Lower Granite Dam, weir facilities, spawning ground surveys, etc.). CTUIR was funded to assist in acquiring and organizing scales and data, interpreting and organizing the results, and preparing a report.

Monitor spawning success

In past years adult spring chinook salmon that returned to Lookingglass FH in excess of broodstock needs were outplanted to various tributaries in the Grande Ronde River basin. The intent was to increase natural production and provide additional subsistence fisheries at traditional fishing sites. From the years 1987 through 1989, 1,588, 1,688 and 169 adult spring chinook salmon were trucked to various areas in the Grande Ronde River basin. Outplanting sites were the Wallowa River and its tributaries, and Catherine Creek in 1987 - 1989 and the upper Grande Ronde River 1987 - 1988. A few fish were again observed or recovered at Lookingglass FH, during spawning ground surveys or in the tribal fishery. The majority of the fish were never relocated after release (Carmichael et al. 1988; Messmer et al. 1989; Messmer et al. in press).

Our objective was to estimate the contribution of these outplanted fish. To this end we planned to monitor the behavior, movement and survival of adult spring chinook salmon following outplanting into the Grande Ronde River basin. In addition, we planned to cap a large number of redds in the future to provide information about emergence of crosses of spring chinook salmon of different origins (hatchery x hatchery pairs, hatchery x wild pairs and wild x wild pairs). To gain experience in this technique we did some experimental redd capping.

Assist ODFW and other agencies with evaluation activities

The CTUIR assisted other agencies in the Grande Ronde and Imnaha River basins as a cooperator in research in basins affected by LSRCP.

METHODS

Scale pattern analysis

Scales to be used in SPA for the Grande Ronde and Imnaha Rivers in Oregon were from adult spring chinook salmon. Scales for the known wild collection had been collected on spawning ground surveys from 1976-1985. Scales for the known hatchery collection were from coded-wire tagged hatchery fish that had returned for the most part to Lookingglass FH, Big Canyon Creek or the Imnaha River SF.

Scales to be used for SPA for Idaho were also from adult spring chinook salmon. Starting in 1988 fish sampled during spawning ground surveys from the Middle Fork of the Salmon River and the Salmon and Selway Rivers were available. Starting in 1987 scales from fish returning to traps at the South Fork of the Salmon River, Powell Trap (Lochsa River), and Dworshak, McCall and Rapid River FH were used.

Date and location of sampling and fork length, sex, fin clips and coded-wire tag presence (if available) were recorded for each fish and entered on a computer database.

Scales from Oregon were grouped by date and sampling location and presence of fin clips and coded-wire tags. Scales from unmarked spring chinook salmon collected in the Grande Ronde River basin and designated as being from naturally-produced fish were those collected from unmarked jacks and adults from 1976 through 1984. In 1985 jacks were excluded because a large number of hatchery fish from the 1982 brood were expected to return to the basin as jacks. No unmarked fish collected after 1985 are designated as naturally-produced fish.

Scales from the fish from some tributaries in Oregon were excluded from being designated as naturally-produced because hatchery juveniles were released and expected to return there. Scales from unmarked jacks collected in 1983 and adults collected after 1983 in Catherine Creek were excluded. Scales from jacks in 1981 and all fish after 1981 collected from Lookingglass Creek were excluded.

The criteria for the designation of the origin of scales from IDFG was different. No scales were available from historic spawning ground surveys (when very few hatchery fish would be expected to be found in the spawning areas) and very few scales associated with coded-wire tagged fish were available. Because of this IDFG designated hatchery fish as those having adipose fin clips. Naturally-produced fish were designated as those that were collected in spawning areas where hatchery fish were not released and were not expected to return.

All scales collected in Oregon were cleaned and mounted on labeled scale cards and pressed against acetate sheets for four minutes at 82° C and 12,000 pounds per square inch. For scales collected in Idaho, acetate impressions were made of scales already mounted on scale cards. Scales from individual fish that were still in envelopes were cleaned and mounted at the ODFW Scale Reading Laboratory.

For models to distinguish unmarked hatchery fish from naturally-produced fish in Oregon basins, survival information from coded-wire tagged fish was used to estimate the proportional contributions of various releases of unmarked hatchery fish. The majority of the unmarked fish were part of various experimental groups, and coded-wire tagged fish in each group were used to represent unmarked fish. For releases of unmarked groups not represented by coded-wire tagged fish, size (number of fish per pound), stock of fish and timing of release were matched for each unmarked group with a coded-wire tag group. Each unmarked group contributed to the model depending on the number of fish released and the theoretical survival rate of the unmarked fish based on the survival rate of the coded-wire tagged fish for which data were available.

Monitor spawning success

Because no adults were available for outplanting, investigation of adult movement, survival and spawning was not completed.

CTUIR investigated capping of redds as a technique that might be used in the future to estimate timing and success of fry emergence. Two redds were capped in 1990. Rich Carmichael, ODFW, accompanied CTUIR personnel to Catherine Creek in November, 1989. High water had made the spring chinook salmon redds found during the spawning ground surveys more difficult to distinguish. One redd was located and a second site that was tentatively identified as a redd was also used. The approximate shape of each redd was outlined and a rectangle that fit over the redd was delineated and staked so that it could be recognized the next year. We measured the rectangle and added two feet to the length and width dimensions for netting to be buried around the redd. Redd sites were checked monthly until they were capped to make sure that stakes were still in place and the outline of the redd was discernible.

Nets were custom made by Research Nets, Inc. which supplied nets to the biologists at the Yakima Indian Nation (YIN). The nets were made of 1/8-inch mesh nylon material similar to that used by YIN bilogists to cap spring chinook salmon redds. Both nets were the same dimensions (2.7 meters wide by 4.6 meters long). An additional rectangular flap extending another 0.3 meters on each of the four sides of the rectangle were to be buried. A zipper on top allowed access to the covered area after installation. A circular polyvinyl chloride (PVC) collar (inside diameter 10.2 cm) had two interlocking pieces. One was attached to the trap with a metal band that tightened around the net, and the other was attached to the trap box. Trap boxes were built similar to those used by the YIN biologists (Fig. 1). The box was an elongated hexagonal design with the PVC collar purchased from Research Nets, Inc. attached on the upstream end. The collar was anchored in the box with countersunk screws. The downstream end of the trap had a Plexiglas door to allow removal of fry and debris. The top contained a piece of scratch-resistant safety glass which allowed viewing of the contents of the box. The downstream panels on either side of the Plexiglas sliding door were made of quarter-inch galvanized screen.

The lower redd was upstream of Catherine Creek State Park about rivermile (RM) 28 and the upper redd was located near RM 32. Redds were capped on 6 and 7 March, 1990. An ODFW employee assisted in installing the nets. A rectangular trough was dug around the redd between the stakes with care being taken not to disturb the redd. Troughs were dug as far down as was necessary to intercept any lateral movement of the fish in the gravel, until hitting compacted gravel about 15-20 cm down. The net was then laid in place across the upstream trough. The upstream flap was buried first, then the side flaps, and the downstream flap last. The cod end of the net hung over the back flap. Trap boxes were installed on 8 March, 1990. (Fig. 2).

Because the cod end of the net was laying flat against the gravel due to the current, fish might be likely to be washed against the backside of the net instead of finding the cod end to "escape". To inflate the cod end of the net two metal fence posts were pounded into the substrate behind the net on either side of the cod end with a third wired across the two posts in an "H" configuration. Two pieces of rope tied from the posts held to cod end up, allowing flow to create a smooth bag to the trap box. One section of the collar was attached to the net with a clamp. A sandbag was placed on the trap box to keep it from moving from side to side due to resistance to the flow. This movement could potentially pull the net out if the velocity was high enough. In addition, when the water was high enough, resistance could cause the whole trap box to twist in the current and the cod end of the net would be closed. Traps were checked once or twice a day from 9 March through 16 April. Date, time, number of live and dead fish and notes on maintenance and cleaning were recorded and all fish were removed each time the trap was checked.

Assist ODFW with evaluation activities

CTUIR assisted ODFW with numerous cooperative efforts that occurred in the Grande Ronde and Imnaha River basins. In addition, assistance was provided to other agencies conducting fisheries research in areas affected by LSRCP activities. The CTUIR was a

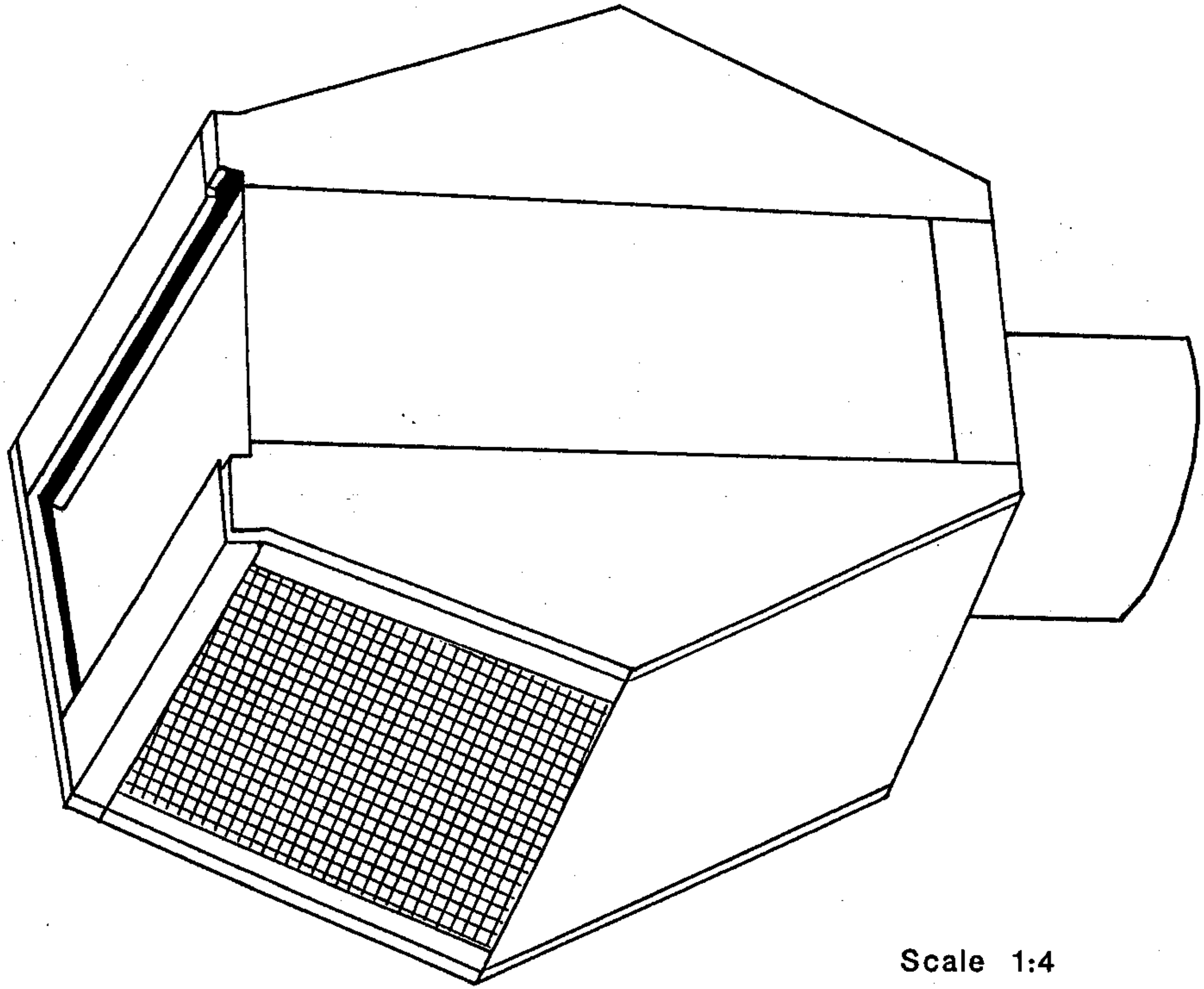

Figure 1. Trap box used to capture fry from redds capped in Catherine Creek, Oregon.

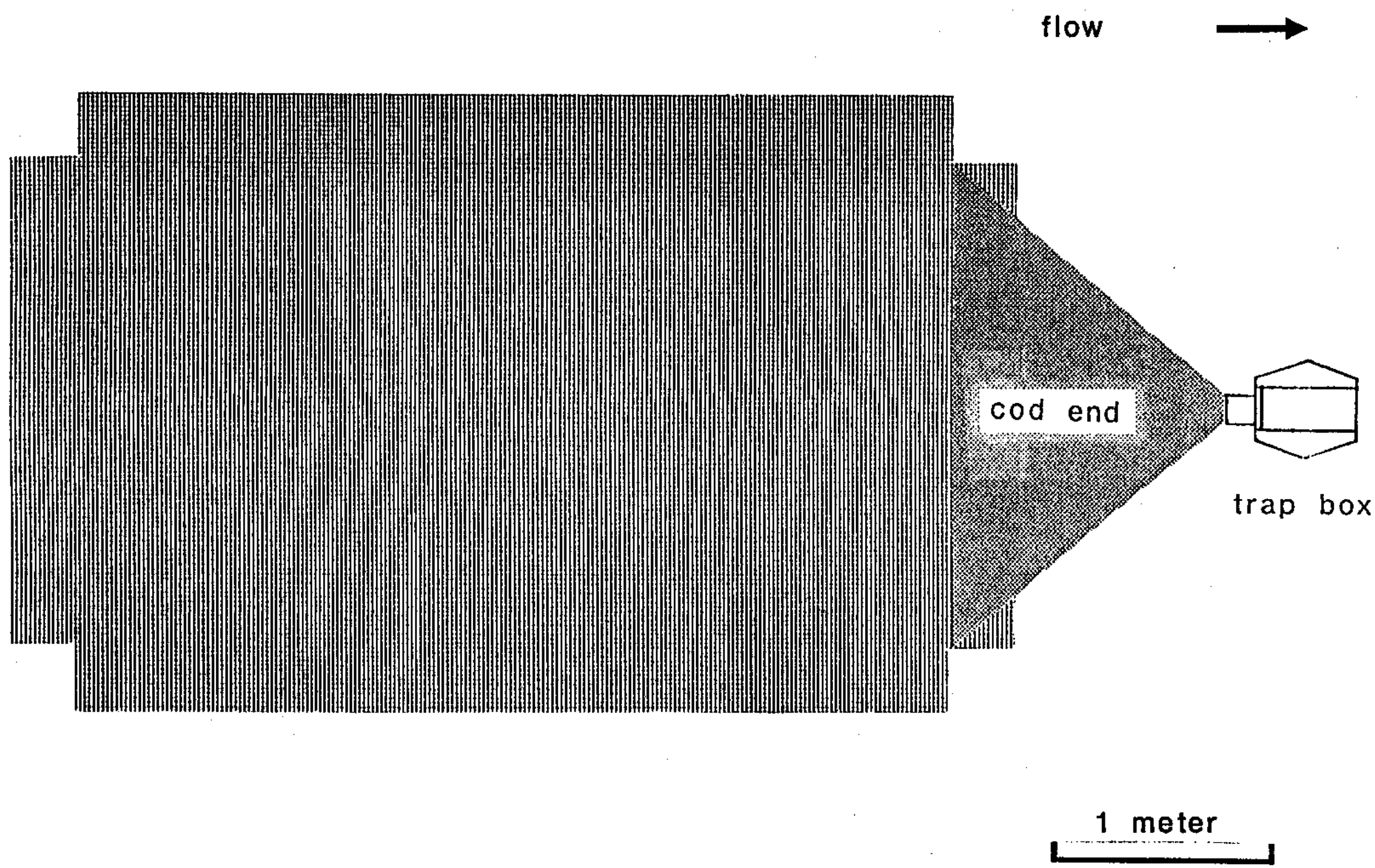

Figure 2. Configuration of netting and trap box used to capture fry in Catherine Creek, Oregon.

also member of the planning and review teams for development of state LSRCP hatchery and evaluation plans.

Assistance was provided to ODFW in conducting activities associated with the ongoing evaluation studies in the Grande Ronde and Imnaha River basins. Most assistance was in the form of collecting and analyzing data. Data were collected from adult spring chinook salmon and steelhead during spawning at Wallowa and Lookingglass FH and the Imnaha River, Little Sheep Creek and Big Canyon Creek SF. Pre-release data were collected from juvenile salmon and steelhead at all of these facilities and Irrigon FH as well. Spawning ground surveys on the Lostine and Imnaha Rivers and Lookingglass Creek were completed for spring chinook salmon. Assistance was provided for installation of the weir at the Imnaha River SF. Data were compiled and analyzed on the timing of the adult spawning migration, stock status and spawner recruitment analysis. Data for juveniles was used to estimate relative survival and provide information on the timing of downstream migration past Snake River dams.

Assistance was also provided to other agencies conducting activities in the basin. Spawning ground surveys for steelhead were completed on Chicken Creek, Little Sheep and Five Points Creek in cooperation with the ODFW and U.S. Forest Service. We assisted the National Marine Fisheries Service in capture and PIT tagging of juvenile chinook salmon on the Lostine and Imnaha Rivers and Catherine Creek as well as sampling of steelhead from Little Sheep, Big Canyon, Chesnimnus, Camp and Grouse Creeks for genetic analysis. The section of a report reviewing the status of sockeye salmon was included in a report submitted to Oregon Senator Hatfield by ODFW on the status of salmon populations in the Snake River drainage.

RESULTS

Scale pattern analysis

A large number of scales were available for producing SPA models for Oregon. From data provided by ODFW, 447 fish were designated as known naturally-produced fish, 1,051 as known hatchery fish, and all other fish (605) were treated as being of unknown origin. Scales for run years up to 1989 that were necessary to produce the models to discriminate hatchery from naturally-produced fish in the Imnaha and Grande Ronde River basins were sent to the scale reading laboratory and about half were read by December 1990.

Few scales were available for producing SPA models for Idaho. From designations received from IDFG, there were 49 naturally-produced fish (no marks), 98 hatchery fish (adipose fin-clipped) and 70 fish of unknown origin. Scales collected up to and including those from the 1989 run year were sent to the scale reading laboratory. All of the scales received from Idaho were read and returned to IDFG, along with results from the analysis. Sample sizes of hatchery and naturally-produced fish were too small to build an adequate model, particularly with the small number of scales from wild fish that were provided.

Monitor spawning success

The number of live fry captured from the upper redd was very small. During routine monthly checks, a sandbar was observed forming upstream of the upper redd. By the time the redd was capped, a considerable amount of sand had settled on it. No fry were observed from 8 to 21 March. On 22 March there were 47 dead and 1 live fry in the trap. The live fish had almost completely absorbed its yolk sac while all dead fry had not. Additional live fish were captured from 22 March to 6 April in the upper redd with a peak on the last day (Fig. 3). Of the 91 fry captured from the upper redd 57 were dead when the trap was checked.

The number of live fry captured from the lower redd was much larger. Live fish were captured from 23 to 30 March, with a peak on 29 March. Dead fish continued to show up in the lower trap until 9 April. The trap door was found partially open on 31 March, and no data were reported for this date (although 1 dead fry was observed) (Fig. 3). A total of 754 fry were trapped from the lower redd, 95 of which were dead.

Assist ODFW with ongoing evaluation activities

All results from activities associated with LSRCP will be included in the ODFW Annual Reports for 1989-90 (Messmer et al. in press) and 1990-91 (in preparation).

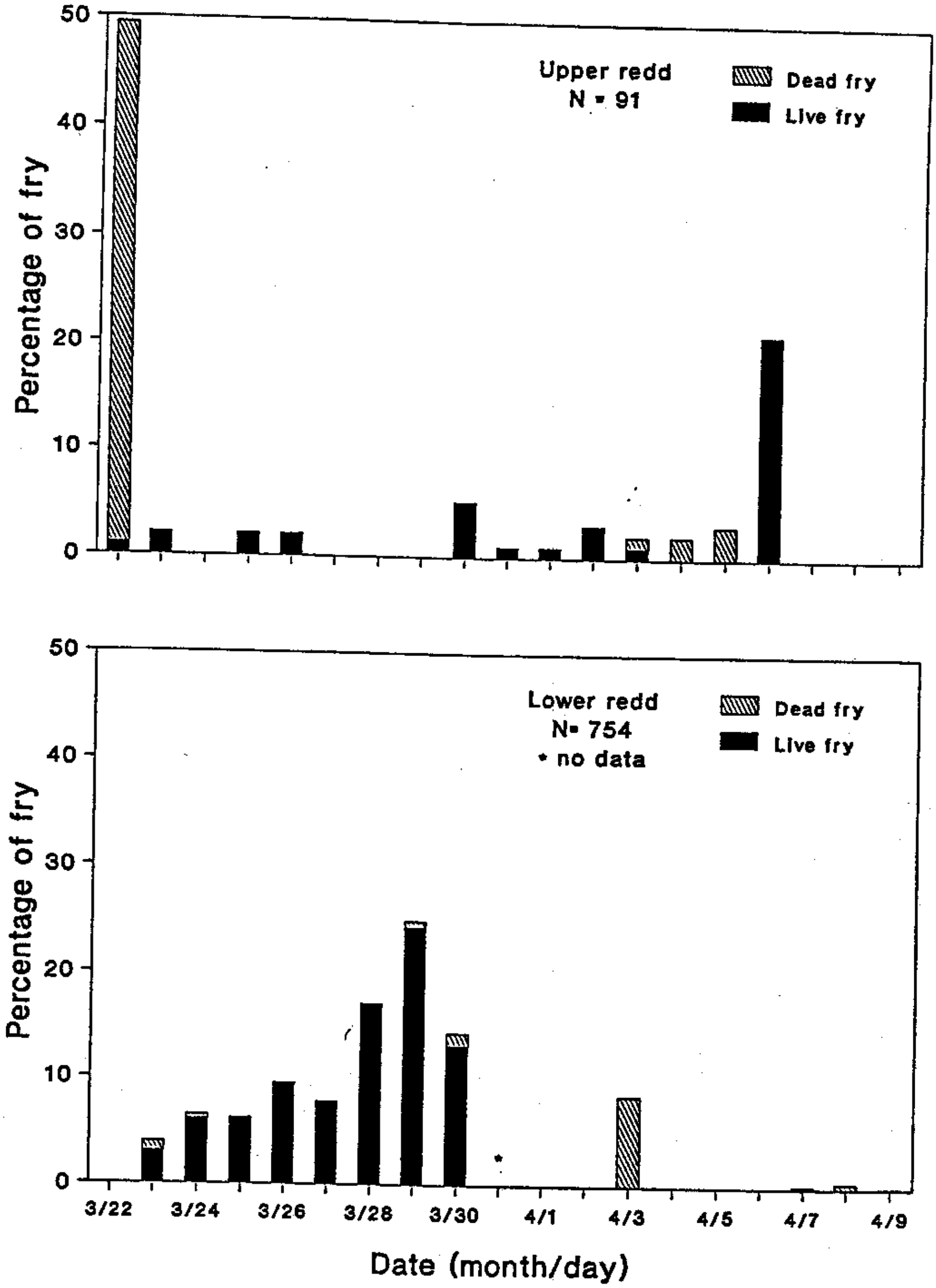

Figure 3. Timing of fry captured from two redds capped in Catherine Creek, Oregon in 1990.

DISCUSSION

Scale pattern analysis

When the rest of the scales from Oregon are read in 1991, the first models that will be developed will be used to determine the origin of adults that were sampled during spawning ground surveys from 1986 to 1989. Management agencies are interested in determining the potential impact that hatchery fish may have had on endemic populations in areas that have been heavily supplemented. In addition, and perhaps just as important, is the impact that straying has had on populations in the Imnaha River subbasin and tributaries in the Grande Ronde River which were not targeted for supplementation. Straying can be a result of juveniles releases and outplanted adult returns to the hatchery.

Generally, the percentage of recoveries of marked hatchery fish from juvenile releases in areas other than that of release was fairly small. This suggests that the stray rate of hatchery fish is relatively low. However, this takes into account only marked fish. In some cases the percentage of the fish released that were marked were relatively small, with a large expansion rate for each marked fish recovered. Therefore actual number of hatchery fish that return to naturally-spawn could have been quite large.

Enough adults returned to Lookingglass Hatchery during three of the years of operation that some could be outplanted. In 1987 and 1988 a total of about 3276 adults (1588 and 1688 respectively) were collected at Lookingglass FH and trucked to Catherine Creek, the upper Grande Ronde and the Wallowa River, with the assumption that those not harvested in the tribal fishery would spawn in the tributaries of release. The 169 fish available in 1989 were outplanted and split between the Wallowa River and Catherine Creek. Based on a subsample of the adults tagged over these three years, only about 18 to 39 percent of these fish were observed again on the spawning grounds, returning to Lookingglass FH or in the tribal fishery. The majority were never relocated (Carmichael et al. 1988; Messmer et al. 1989; Messmer et al. in press).

Idaho Department of Fish and Wildlife was interested in building models for recoveries on spawning grounds and traps, and particularly for mainstem dams. We had anticipated when the study was started that many more scales would be available from fish in Idaho. The Nez Perce Tribe has 400-500 scales collected in Idaho streams that are in the process of being sorted and pressed. Acetate impressions will be provided through IDFG sometime in early 1991 (Mike Bannock, Nez Perce Tribe, personal communication, February 1991), along with associated data. CTUIR and ODFW will pursue leads in 1991 that suggest that there may be other scales available from fish collected in Idaho.

When the criteria for inclusion in the models of the hatchery fish have been completed, LSRCP personnel will develop models for the Grande Ronde River basin for the individual years 1986-1988, and a preliminary model for 1989. Because of the small number of coded-wire tag codes for fish released in the Imnaha basin, there is not enough scales to develop models for individual years. Given the variability of sizes of juveniles at release, we will evaluate the usefulness of a single model for all years. It may be premature to develop a model for use at Lower Granite Dam using only the data that were available in 1990. Models for Idaho will be constructed if more scales can be located.

Monitor spawning success

Capping of the two redds in Catherine Creek provided some useful information regarding use of this technique in smaller streams. In addition, observations of the redd sites between the time they were staked and the time they were capped showed that such inspections may provide information about conditions during incubation that may affect survival.

The estimated percent survival rates observed for these two redds were within the ranges observed by other researchers. Using the equation provided by Galbreath and Ridenhour (1964) regressing fork length against fecundity for chinook salmon, a range of fecundities was estimated for the 7 females recovered during spawning ground surveys in Catherine Creek in 1989. The range of fork lengths was fairly narrow from 655 to 750 mm with a mean length of 712 mm. Six of these seven females were 4 years old. The estimated fecundities ranged from 3276 to 4384 eggs per female. Using these numbers, the percent of live fry captured from redds in this study (assuming 100% of the eggs end up in the redd) would be from about 15 to 20% for the lower redd and about 1% for the upper redd. Total percent of fry captured (live and dead combined) would range from 17 to 23% for the lower redd and 2 to 3% for the upper redd. Estimated total emergence for the lower redd is near the lower range for total emergence rates that were observed from redds capped during a three-year study in the Yakima River (21, 57 and 63%), but within the observed values of 13 to 90% for individual redds (Fast et al. 1986). Observations of three redds in the Yakima River that had been covered by sediment were similar to that for the upper redd. Two of the redds in the Yakima River had no fry emerge, and in one redd about 1% of the estimated number of eggs deposited were captured as fry (Fast et al. 1986). All fry from the two redds capped in Catherine Creek were captured within less than 20 days of the first fry observed, whereas the length of emergence time ranged from 24 to 73 days on the Yakima River with an average of 42 and 54 days in 1985 and 1986 (Fast et al. 1986).

Caution would be advised in using survival rates from redds that are capped to estimate survival rates of uncapped redds in the population. Installation and presence of the netting may have artificially increased or decreased the successful emergence of fry. Survival could have been artificially increased by excluding predators and scavengers. The flow pattern over the redd and upstream of the redd may have changed with the installation of the net, thus changing survival rates. No matter how much care was taken when the net is buried, some of the fine material that were disturbed probably ended up on the redds, potentially smothering them. The interstitial flow pattern within the redds may have been changed due to digging of the troughs and filling in with potentially finer or coarser materials (restricting or increasing flow respectively). Indications from other researchers suggest that the environment around the redd was not necessarily changed. Installation of a similar net was tested by installing standpipes in the gravel. Dissolved oxygen concentrations (Koski 1966) and gravel permeability (Phillips and Koski 1969) were not significantly different before and after installation of the net.

Most of the bodies of dead fry that were observed exhibited a high degree of deterioration by the time that they were retrieved from the trap box. These fish were either dead when they entered the trap (got dug up or pushed up through the gravel as others in the redd emerged) or died in the trap. Two circumstances were noted when there was good reason to infer that the presence of the net and trap box may have caused mortality.

The large number of mortalities on the first day of emergence from the upper redd was surprising. A log had gotten caught in front of the fence posts, changing the flow pattern immediately upstream. This may have dug up fry before they were ready to emerge. The large amount of sand in the trap suggested this was a possibility. These fry which had not absorbed their yolk sacs may have been particularly fragile. Because these fish have a reduced ability to negotiate currents within the trap compared to fish that have absorbed their yolk sacs, abrasion against the sides may have caused the death of these fry. Given the amount of sand that had been deposited on the redd and the few number of live fish that emerged from this redd over the season, these fish may also have been dead before they ended up in the trap.

Problems were encountered in keeping the trap box with the correct orientation at the lower redd site. On more than one occasion the sandbag fell off of the trap box between checks at the lower redd where the flow was faster and more turbulent. On one occasion the trapbox was in the correct position to safely capture fish. Usually a 90 degree turning of the trap box closed the opening in the cod end of the net (Fig. 3, note mortalities from the lower redd on March 30 and April 3). On April 3, I observed dead fry released into the trap box after the cod end was untwisted.

Debris built up on the upstream side of the suspended net and the fence posts tended to catch large debris that was moving downstream. In retrospect, a small, short, box-shaped frame could have been inserted within the cod end to hold the net open and produce the same effect. Resistance to the water flow and the amount of debris building up on the nets could have been reduced with the box frame instead of the fence posts.

Using nets and trap boxes to enumerate emerging fry seemed to work well in Catherine Creek, which is much smaller body of water than the Yakima River. However, mortalities found in the trap are a concern. Checking the trap often was important when a large number of fish began to appear, and when there was a lot of organic debris in the water. As might be expected, small twigs, algal material and sand were often found in the trap box, clogging up the 1/4-inch mesh on the downstream side of the trap box. Further investigation into the causes of dead fish being found in the trap would need to be investigated to determine if death is being caused by any components of the trapping system.

Outplanting of spring chinook salmon from Lookingglass FH will not be a priority in the foreseeable future. Returns of Carson stock will not be used as hatchery broodstock because the program is switching to Rapid River stock. A portion of the Rapid River stock that return to Lookingglass FH will be used for natural production above the hatchery. Because of this change in emphasis, further investigations into capping of redds will not continue in 1991.

Assist ODFW with ongoing evaluation activities

Assistance will again be provided to ODFW in 1991 with activities associated with LSRCP evaluations. However, new emphasis will be placed on activities for which CTUIR is the lead agency: developing an experimental design for evaluation of reintroduction of spring chinook salmon in Lookingglass Creek and developing a profile of clinical indices of stress and smoltification in juvenile salmonids.

Activities for 1991

Activities in 1991 will focus on:
1) developing a detailed experimental design to evaluate the reintroduction of spring chinook salmon above Lookingglass FH,
2) evaluating and comparing clinical indices of stress and smoltification for summer steelhead at Little Sheep and Big Canyon SF and
3) continuing work on scale analysis techniques and developing models for discriminating different groups of fish.

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