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Movement of Lost River and Shortnose Suckers through the Sprague River ladder at the Chiloquin Dam, Spring 2000

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Executive Summary

We sampled suckers from 8 March to 7 June 2001 in the Sprague River Dam fish ladder in Chiloquin OR. The fish ladder was sampled three times per week, with the exception of two days in April due to high river flows, and during the Memorial Day holiday. A total of 1415 suckers were collected, 647 (45.7%) of which were Lost River suckers, 228 (16.1%) Klamath largescale suckers, and 98 (6.9%) shortnose suckers. Additionally, we captured 442 (31.2%) "hybrid" suckers that displayed intermediate characteristics of two species, usually Lost River and Klamath largescale suckers. The timing of movement of suckers through the ladder varied among species. In March, the movement was comprised primarily of Klamath largescale and hybrid suckers and switched to Lost River suckers by mid- to late April. The number of suckers captured in the ladder began to decline in May and no suckers were captured after 22 May.

A total of 80 suckers were recaptured from sampling efforts in previous years, of which only 4 were Lost River suckers. Given the high percentage of Lost River suckers in the catch, and the few recaptures noted, we believe this group of fish has been relatively unsampled in past monitoring efforts. The remaining recaptured suckers were largely Klamath largescale or hybrid suckers (only one shortnose sucker was recaptured) originally tagged in the Sprague River Dam fish ladder. We believe that sampling at the fish ladder should be continued in future years as part of an overall sucker monitoring program for Upper Klamath Lake. This sampling will provide valuable information on the timing, abundance, and species composition of suckers utilizing the Sprague River for spawning. Continued sampling at the ladder will provide information on changes to the size structure of these populations and allow for comparisons to suckers captured at other

locations. Lastly, this sampling should provide additional information from recaptured fish on stock separation and survival of adult fish.

Acknowledgements

We appreciate the assistance of Derek Kimball and Manny Ochoa, Jr. from the Klamath Tribes and Matthew Coen, Greta Hossner, Andre Kohler, Chris Lorion, Mark Sreniawski and Darin Taylor from Johnson Controls in sampling the ladder. Additionally, Mark Buettner, Ron Larson (and others?) provided thoughtful comments on an earlier draft of this report.

Introduction

Historically, the majority of Lost River and shortnose suckers in Upper Klamath Lake (UKL) were believed to spawn in the Williamson and Sprague rivers (U.S. Fish and Wildlife Service, 1993). Perkins et al., (2000) cited several sources that indicated an early run of suckers spawn in the Upper Sprague River, and a later run of fish spawn in the Williamson River and Lower Sprague River. Monitoring of these spawning populations has occurred periodically since 1984, although efforts were often limited due to personnel and time constraints. In 1984 and 1985 the Klamath Tribes and Oregon Department of Fish and Wildlife conducted electrofishing surveys from the Sprague River Dam at Chiloquin downriver into the Lower Williamson River. These efforts were continued by the U.S. Fish and Wildlife Service (1987-1988) and the Klamath Tribes (1989-1991). In addition, the Klamath Tribes and the U.S. Geological Survey (USGS) periodically sampled the fish ladder at the Sprague River Dam from 1991 to 1999.

Beginning in 1995, the USGS began to systematically monitor spawning populations of suckers in the Lower Williamson River with trammel nets through a reimbursable agreement with the U.S. Bureau of Reclamation. This monitoring remains ongoing and has provided useful data (Perkins et al., 2000, Markle et al., 2000, Cunningham and Shively, this report). However, the sampling of fish at the Lower Williamson River does not distinguish between fish spawning in the Lower Williamson and Sprague rivers versus suckers that spawn in the upper Sprague River. The sampling of suckers at the Sprague River Dam fish ladder provides additional information regarding the movement of suckers as well as other fishes up the Sprague River. By regularly sampling in the fish ladder information on species composition, run timing for

various species, fish condition, sex, size structure, and recapture history can be obtained for these populations and can be compared with similar data from other locations.

Methods

We sampled the Sprague River Dam fish ladder (hereafter referred to as the fish ladder) three times per week from March 8 through June 7 except for two days in late April when river flows were high, and during the Memorial Day holiday. On most days sampling began by 1000 hours. To sample the ladder, we placed a removable screen over the outflow of the ladder to prevent fish from escaping and blocked the majority of the inflow to the ladder by sliding a board in front of the intake. This lowered water level in the cells to between 0.5 m in the upper cells to about 1.0 m in the lower cells. We used a combination of dip nets and a short trammel net to collect fish within the ladder and continued to sample each cell until no fish were captured. We are confident that the level of effort typically resulted in the capture of at least 90% of the suckers present in the ladder. Captured suckers were held in portable net-pens within the cells until all fish were collected. Depending on the sample size, the ladder was blocked from between 2 to 6 hours each day of sampling. On March 22, an Onset Optic StowAway® temperature logger was installed near the ladder intake and programmed to record hourly temperature readings through the remainder of the sampling season.

All suckers caught were identified to species and gender, measured to the nearest mm fork length (FL), and examined for spawning condition and for the presence of parasites, deformities, wounds, and eye or fin damage. Each sucker was examined for the

presence of tags (Floy tags and PIT tags). If no PIT-tags were detected, one was inserted with a hypodermic needle 1-2 cm anterior to the pelvic girdle. Beginning on 17 April, fish condition permitting, suckers were tagged both with PIT and Floy tags to examine tag retention rates for future sampling. When increased numbers of suckers were captured (>125 fish), physical affliction data was collected for every third fish sampled to speed processing. Other fishes caught in the ladder were identified to species, measured (fork length), and released.

The accuracy of field identifications of suckers captured in the ladder has been a concern of area biologists. The identification of some fish was difficult because individuals occasionally display morphological characteristics from more than one species. The primary morphological characteristics used for identification were derived in part by a key developed by Cavalluzzi and Markle (2000). Characteristics used include: lip position relative to the maxilla, the presence of a gap between the lower lip lobes, the fleshiness of the lip, lip position relative to body (terminal or sub terminal, ventral), head shape, and body shape. When a sucker presented characteristics from two or more species, the species appearing to be dominant was listed first. For example, a sucker with fleshy lips that were even with the maxilla, no gap between the lower lip lobes, with an elongated snout and robust body would have been called a Klamath largescale x Lost River sucker hybrid. However, if the body shape had been more elongated and narrow and a slight gap existed between the lobes of the lower lip or if the lip position was slightly anterior of the maxilla then this fish may have been called a Lost River x Klamath largescale sucker hybrid. We recognize this method of identification is subjective and identifications between field crews often varied. However, we feel

identifying fish in this manner provides valuable information on the difficulty of identifying these fish and may compliment proposed studies to examine the genetic origin of these fish. When there was no indicator of a dominant species, the fish was identified as an unknown sucker. For the purpose of analyses, all hybrid suckers were grouped into one category (i.e., hybrid).

We tested for the length frequency distributions for male and females of all species using the Shapiro-Wilks test. All length frequency distributions were non-normal and therefore further comparisons of these data sets were made using non-parametric tests. To compare median lengths of fish sampled we used a Mann-Whitney W test while comparisons of overall length frequency distributions were made using the Kolmogorov-Smirnov test. Statistical significance for all tests was set at an alpha of 0.05.

Results and Discussion

We sampled at the ladder a total of 33 days between March 8 and June 7, 2000, capturing a total of 1576 suckers. Of these, 148 were captured twice in 2000, and 13 were determined to be in post-spawn condition. Only the first records from the first capture and suckers in pre-spawn or ripe condition were considered as part of the upstream migration, leaving a total of 1415 suckers sampled. The majority of suckers captured were Lost River suckers (45.7%) followed by Klamath largescale (16.1%) and shortnose suckers (6.9%; Table 1). The remaining suckers captured (31%) displayed intermediate characteristics between two sucker species. The genetic origin of these fish is unknown and therefore uncertainty exists with their identification. We use the term

hybrid for descriptive purposes only. In addition to suckers, we also captured rainbow trout (*Oncorhynchus mykiss*) and Pacific lamprey (*Lampetra tridentata*).

Suckers were captured in the ladder from early March until late May with distinct peaks in the number of fish sampled. The early season catch was comprised primarily of Klamath largescale and hybrid suckers that displayed characteristics of Klamath largescale and Lost River suckers. There appeared to be two distinct pulses of this group from mid to late March (Figure 1). The next pulse of suckers occurred from mid to late April when a large number of Lost River suckers were captured in the ladder. This peak of Lost River suckers may have been related to a peak of Lost River suckers captured in the Lower Williamson River 2-3 weeks earlier. Comparisons of median fork lengths and overall length frequency distributions of males and females captured at each location indicated there were no significant differences between the two sites (Figure 2).

Catches of Klamath largescale, hybrid, and Lost River suckers appeared to be associated with increases in mean air temperatures (Figure 1). The relations between mean water temperature and river flow and sucker catches in the ladder were not as apparent, although water temperature data was not available for much of March (Figure 1). Shortnose suckers were never sampled in numbers comparable to Lost River or Klamath largescale suckers, and were not captured in substantial numbers until late April – early May. The number of suckers captured declined sharply after the first week in May and no suckers were captured after 22 May even though sampling was continued until 7 June.

There were distinct differences between the median length and sex ratios of sucker species captured (Figure 3). Lost River suckers were significantly larger than

other species captured (both males and females) and females were larger than males for all species captured. Females comprised the majority of the catch for Klamath largescale, Lost River, and shortnose suckers, while more males were captured in the hybrid group (Figure 3). In general, the length range of Lost River and shortnose suckers did not vary much over the sampling period as has been reported at shoreline spawning areas and the Lower Williamson River (Perkins et al. 2000). There was a slight decrease in the fork lengths of Klamath largescale and hybrid suckers over the course of the sampling season (Figure 4).

The majority (81%) of suckers recaptured from previous years sampling efforts were originally tagged at the fish ladder, suggesting a strong fidelity to the Sprague River as has been noted in other areas (Perkins et al. 2000, Shively et al. 2000). The remaining recaptured fish were either originally tagged in the Williamson River (14%) or in parts of Upper Klamath Lake (5%; Table 2). Most of these recaptures were identified as either Klamath largescale or hybrid suckers, while only 4 of the 647 (0.5%) Lost River suckers captured were tagged from previous sampling efforts. Continued sampling in the fish ladder should provide valuable information on recapture rates of Klamath largescale and hybrid suckers in the system as well as provide an additional area in which to tag and recapture Lost River suckers.

The rate of physical afflictions for fish captured in the fish ladder was similar to other areas sampled in 2000, particularly the Williamson River (see Cunningham and Shively, this report; Table 3). The occurrence of lamprey wounds was more prevalent in Lost River and shortnose suckers as would be expected for these lake-dwelling species. However, lamprey wounds were also present for about 30-35% of the Klamath largescale

and hybrid suckers (Figure 5). In addition to the afflictions noted in Table 3, field crews often noted the presence of leeches on fish captured, particularly on the gills.

This was the first year that the Sprague River Dam fish ladder was sampled systematically during the sucker-spawning season. This sampling provided useful information on species composition, run timing, length frequency, and other demographic parameters of sucker populations, particularly for Klamath largescale, Lost River, and hybrid suckers. Previous monitoring efforts at other locations have not provided much information on Klamath largescale suckers in the Klamath Basin. It is unclear whether the most of the suckers classified as hybrids are part Klamath largescale suckers or are a result of hybridization occurring between two or more species of suckers. Also, the relatively large number of Lost River suckers sampled and tagged in the fish ladder in 2000 represents a substantial increase of Lost River suckers captured during sampling conducted in the Lower Williamson River over the last five years. Continued sampling at the fish ladder should continue to provide valuable data for assessing the status of these populations and examining trends within the populations.

Table 1. Sprague River Ladder 2000 sampling effort with catch totals and percent composition of Lost River (LRS), shortnose (SNS), Klamath largescale (KLS), and hybrid (HYB) suckers. Excluded here are 13 suckers listed as spent, with soft ventral cavities, and 148 suckers which were tagged and recaptured within the 2000 spawning season. Included are 57 records for which no spawning status was noted. Given the timing, these individuals were likely in spawning condition (56 from 3/27 and 1 from 5/5). 4/21 and 4/24 were not sampled due to high flows.

Date Pulled	LRS	SNS	KLS	HYB	Total
3/8/2000	1	0	0	0	1
3/14/2000	1	0	4	3	8
3/15/2000	10	1	87	106	204
3/17/2000	9	0	29	73	111
3/20/2000	2	0	0	3	5
3/22/2000	6	0	1	5	12
3/24/2000	7	5	25	87	124
3/27/2000	4	1	19	119	143
3/29/2000	0	0	2	7	9
3/31/2000	0	0	0	1	1
4/3/2000	1	0	26	11	38
4/5/2000	6	5	9	9	29
4/7/2000	1	1	2	1	5
4/10/2000	0	0	1	0	1
4/12/2000	184	7	4	1	196
4/14/2000	133	6	0	5	144
4/17/2000	60	2	0	1	63
4/19/2000	2	0	0	0	2
4/27/2000	142	30	12	7	191
5/1/2000	28	6	1	0	35
5/3/2000	41	25	2	3	71
5/5/2000	0	1	0	0	1
5/8/2000	0	0	0	0	0
5/10/2000	0	0	0	0	0
5/12/2000	0	0	0	0	0
5/15/2000	0	0	0	0	0
5/17/2000	1	0	0	0	1
5/19/2000	3	4	2	0	9
5/22/2000	5	4	2	0	11
5/24/2000	0	0	0	0	0
5/26/2000	0	0	0	0	0
5/31/2000	0	0	0	0	0
6/2/2000	0	0	0	0	0
6/7/2000	0	0	0	0	0
Total	647	98	228	442	1415
% composition	45.7%	6.9%	16.1%	31.2%	100.0%

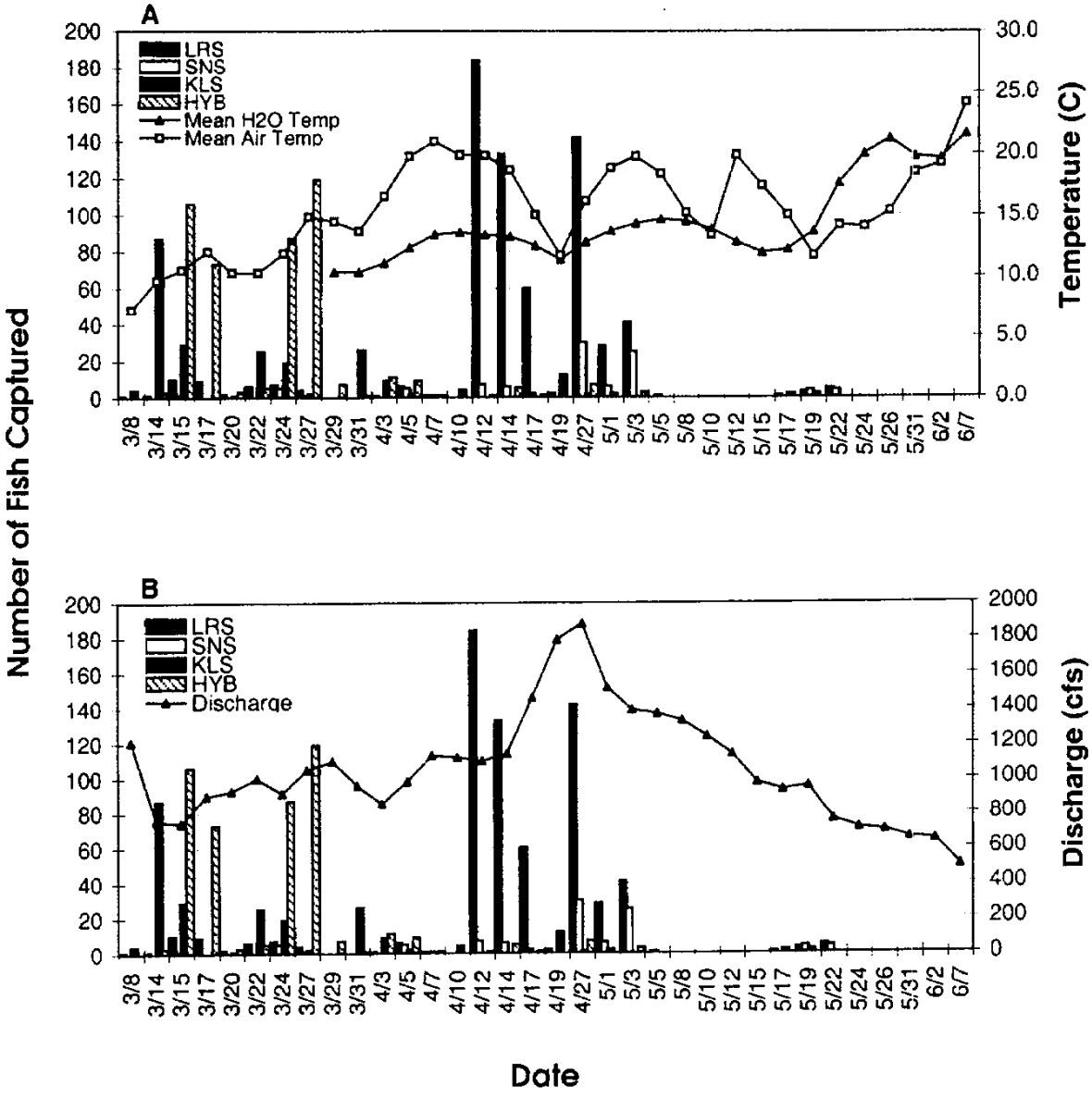

Figure 1. 2000 Sprague River catch summary with A) mean air and water temperature and B) river discharge. Air temperature was obtained from the Klamath Falls Interagency Fire Center weather station at Chiloquin. Water temperature data was collected from a thermograph installed 3/22/00 near the entrance of the ladder. Both air and water temperature are presented as a seven day moving mean. Flow data was obtained from the USGS Sprague River gauge (provisional data subject to revision). Only dates sampled are shown, with null values representing zero catch days.

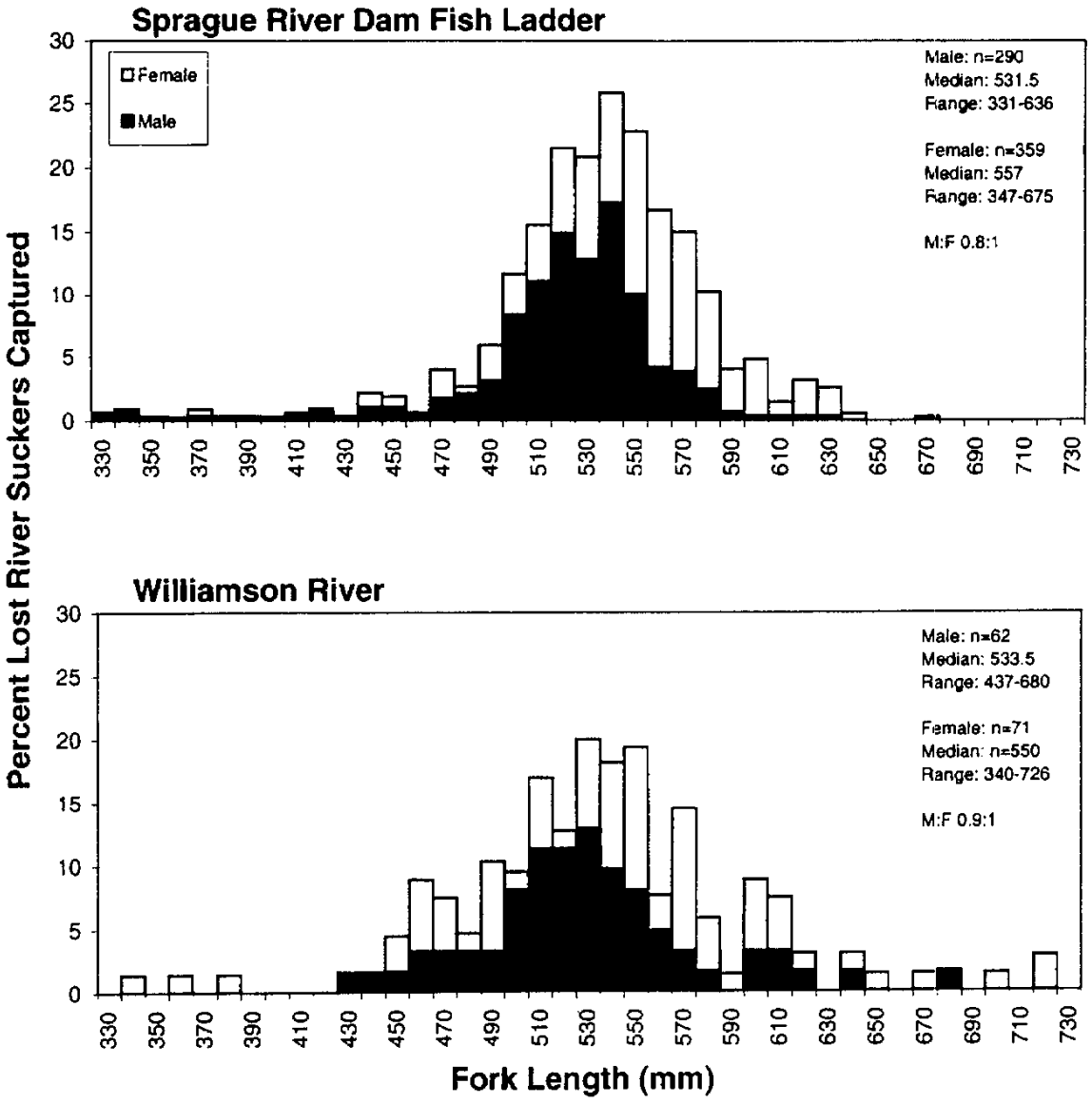

Figure 2. Comparisons of median fork lengths and overall length distributions of Lost River suckers in the Lower Williamson River and Sprague River Dam fish ladder.

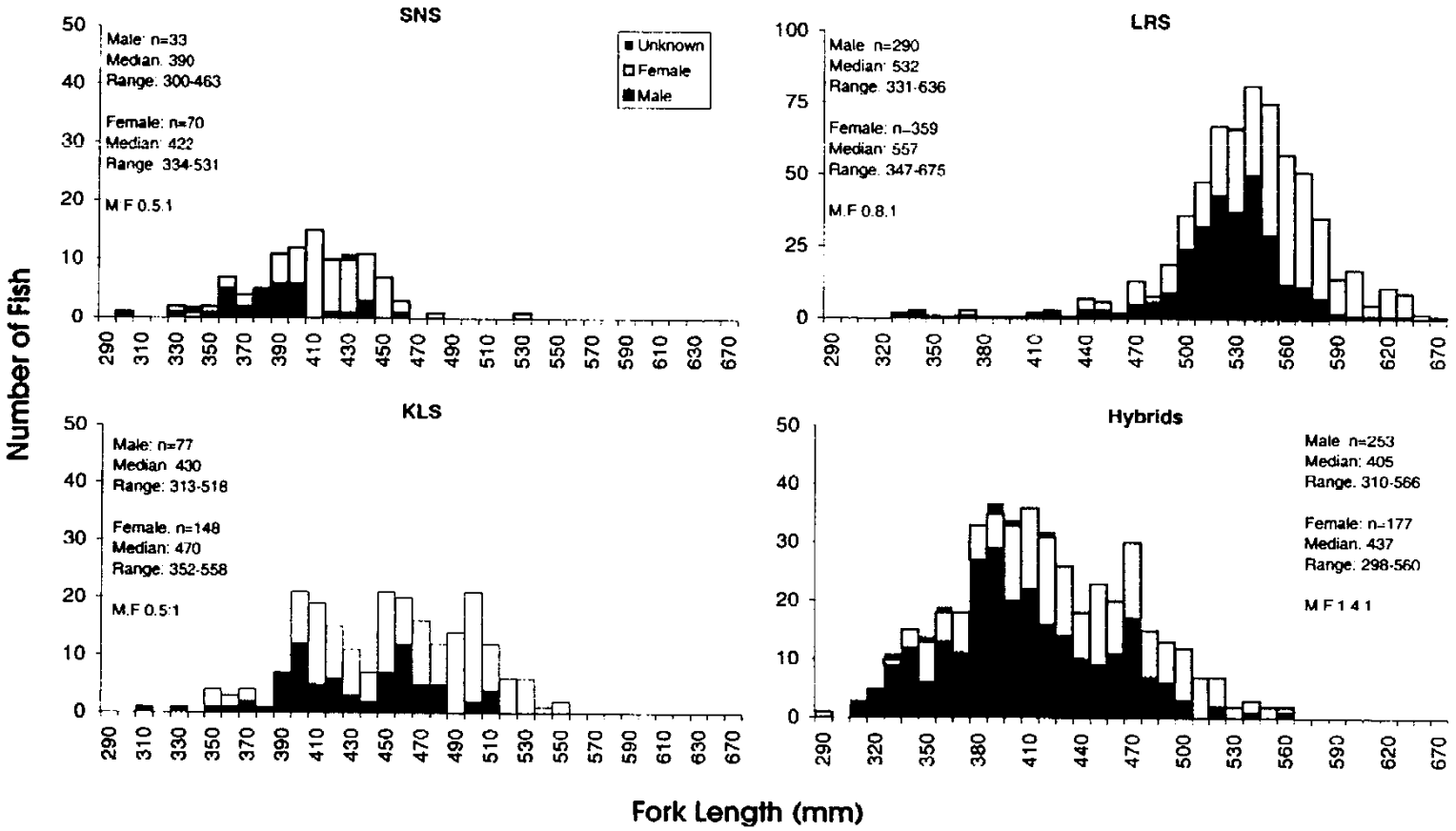

Figure 3. Sprague River Dam fish ladder length frequency by species and sex. Excluded were 10 fish for which fork lengths were not obtained, and 148 records for which the same fish was caught twice in 2000. Note change in scale between species.

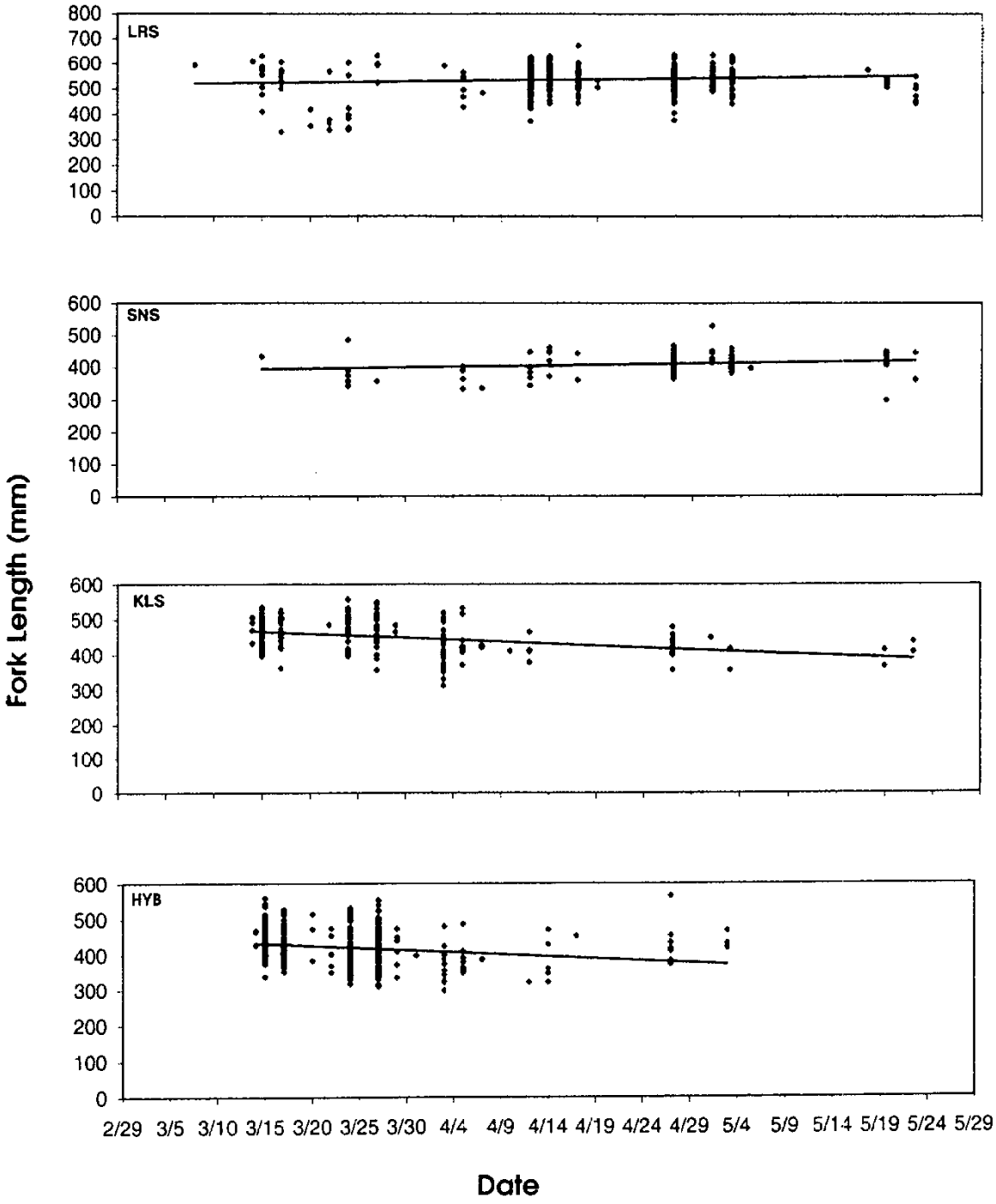

Figure 4. Scatterplot of fish lengths (mm) over time for Lost River (LRS), shortnose (SNS), Klamath largescale (KLS), and hybrid (HYB) suckers captured at the Sprague River Dam fish ladder, 2000.

Table 2. Summary of the historic recapture data for Klamath largescale (KLS), Lost River (LRS), shortnose (SNS), and hybrid suckers captured in the Sprague River Dam fish ladder, 2000. A total of 80 fish were recaptured in the Sprague River Dam fish ladder, which had been recaptured and/or tagged in previous years a total of 90 times (some fish were captured more than once). Of these 90 captures, 73 (81%) occurred at the Sprague River Dam ladder. 13 (14%) occurred in the Williamson River.

Site Originally Tagged or Previously Recaptured	Suckers Recaptured at Sprague River Dam Ladder in 2000					
	KLS	Hybrids	LRS	SNS	Unknown	Total
Fish Banks	1	0	0	0	0	1
Ball Point	0	0	0	1	0	1
Modoc Point	0	0	0	1	0	1
Sprague River	1	0	0	0	0	1
Sprague River Ladder	30	35	3	0	5	73
Williamson River	8	4	1	0	0	13
Total	40	39	4	2	5	90

Table 3. Percent occurrence of various afflictions noted in Lost River (LRS), shortnose (SNS), Klamath largescale (KLS) and hybrid suckers that were examined for afflictions in the Sprague River Dam fish ladder, 2000.

	LRS	SNS	KLS	Hybrids
	n=217	n=56	n=175	n=254
Eye Damage				
Blind	3%	3%	5%	5%
Damaged/ Missing	0%	0%	1%	2%
Exophthalmos	0%	0%	0%	0%
Total of population affected	3%	3%	5%	5%
Parasites				
Lamprey	42%	39%	27%	31%
Lernaea	34%	48%	29%	23%
Worms/ Leeches	0%	0%	0%	0%
Total of population affected	62%	70%	46%	48%
Deformities				
Mouth	0%	0%	1%	0%
Opercle	3%	1%	0%	1%
Spine	1%	0%	1%	0%
Body dented	0%	0%	0%	1%
Total of population affected	4%	2%	1%	2%
Fin Damage				
Damaged	12%	21%	24%	23%
Not Damaged	83%	71%	76%	77%
No Observation	5%	7%	0%	0%
Infection/Wounds				
Present	1%	7%	3%	2%
Absent	99%	87%	97%	98%
No observation	0%	0%	0%	0%

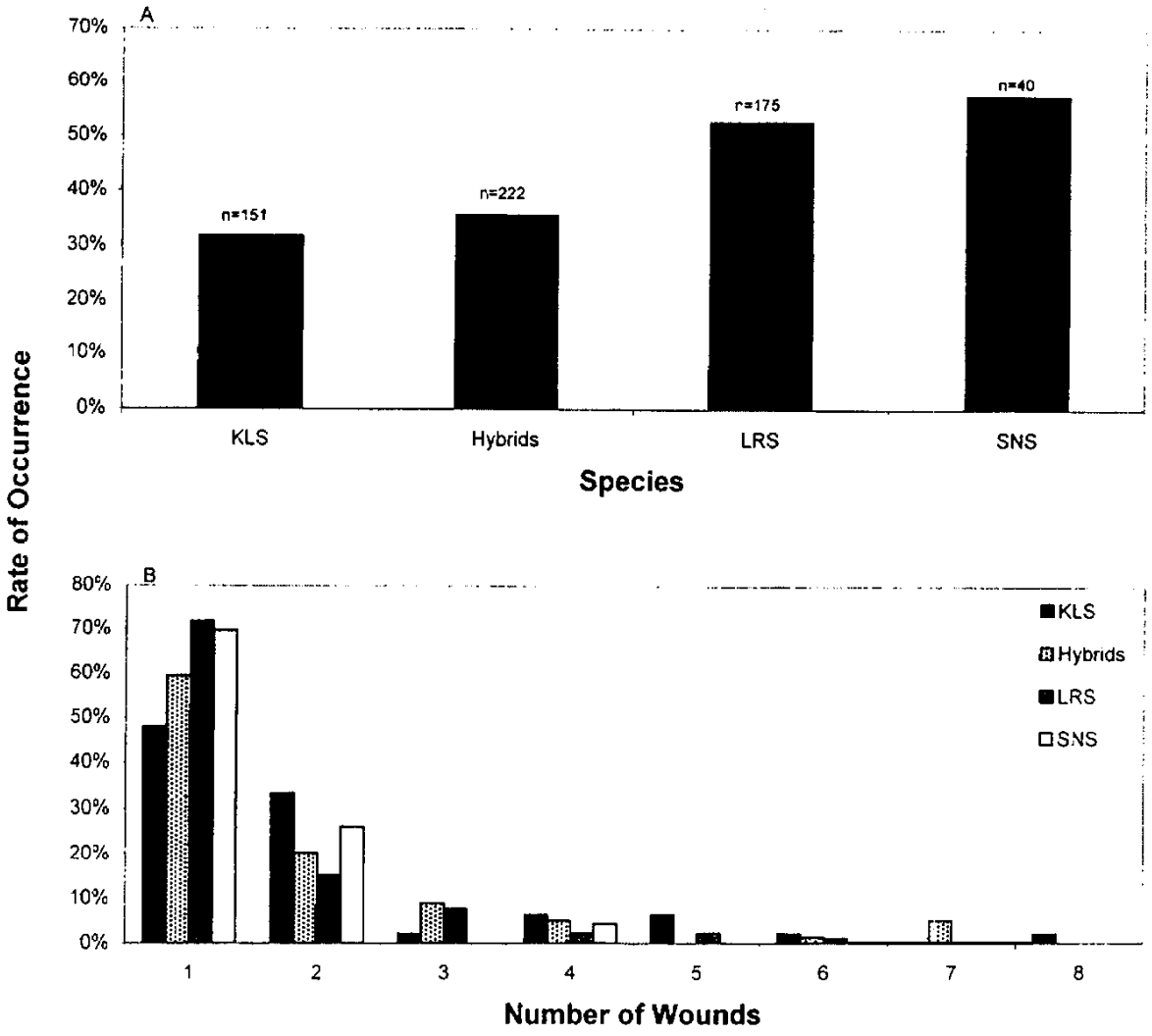

Figure 5. (A) Rate of occurrence of lamprey wounds among suckers captured at the Sprague River Dam ladder. The rate is equal to the number of suckers that had at least one lamprey wound relative to the total number of that species examined for the presence of parasites. N equals the number of suckers which were examined for evidence of parasites.
(B) Percentage of suckers with increasing numbers of lamprey wounds (fresh wounds or old scars) includes only those suckers that had at least one lamprey wound.

Flush Method (All Canals)

The intent of this procedure is to move target fish out of the canals through the planned release of water. The water from the canals will be released at a rate that assures that the canal structure is not damaged by sloughing caused from bank storage return flow. Water from the upper one-third of the canals will be removed slowly. This will allow bank stored water to seep slowly back to the canal and reduce bank sloughing. At that point, the water remaining in the canal will be rapidly removed. Increasing the rate of release of the water moves fish to the release sites. The rapid removal of fish by this method reduces the numbers of fish that have to be salvaged.

Accelerated drawdown is accomplished by adjusting the canal spillways and directing flows into rivers or open drain ditches that lead to rivers. Bottom drains have been installed in some of the canals. These drains allow for pooled areas to be drained very rapidly. Past experiences have shown that stranded water and fish can be simultaneous removed from the system in a short period of time using this procedure.

Fish Behavior/Collection Method (A-Canal)

After the Flush Method is considered complete, some water remains in the A-Canal. A small flow will be maintained in the A-Canal through the outlet structure for attraction flow and water quality tempering. Fish movement can be stimulated by water quality and habitat conditions.

Fish have been observed to move upstream and seek refuge at drop structures, crossings, tunnel areas, and near the ramp flume when water continued to be released after canal drawdown occurred. This has been demonstrated as refugial sites have been repeatedly worked, with continued success, over a period of several days.

Pooled Areas (Most Smaller Canals)

Pools occur mostly below drop structures and other features after the balance of the canal dries up. Collecting from these isolated pool areas removes all suckers.

Assess Salvage Sites

Onsite assessment by salvage teams may involve additional efforts in pools not previously identified. Team leaders will assess the entire length of canal for potential salvage areas and work the sites as determined necessary.

Salvage Methods

During six years of salvage operations, electrofishing was required at almost all sites because of irregular or rocky channel conditions. The few sites that were seined had poor capture efficiencies as indicated by catches in subsequent seine hauls. Suckers will be collected using pulsed direct current with voltage set at 200-300 volt and 0.1 to 2.0 amps output. Electrofishers are equipped with programmable output waveforms (POW). This feature allows for fine adjustment of the pulse frequency and pulse width. Pulse frequency and pulse width will be set to induce involuntary swimming action with minimum harm to the fish.

Short-term Holding

Holding tanks will be installed in holding trucks. The tanks will be equipped with bottled oxygen and diffusers to enhance the dissolved oxygen of the holding water. Tanks will be filled ahead of the collection activity. Water sources for filling the tanks will be the same as that from which the fish are captured from. Aeration shall be started prior to placing suckers into the tanks to assure adequate dissolved oxygen for the fish. Dissolved oxygen and temperature of each tank's water shall be monitored during the collection activity to assure proper levels. The holding period will not be prolonged unnecessarily (usually less than 4 hours).

Data Recording

Collected suckers will be measured prior to releasing them. Measurements will be recorded in millimeters.

Fish Tagging

Suckers greater than 100 mm will be PIT (Passive Integrated Transponder) tagged to aid in population studies.

Repeat Procedure

Collection sites will be worked as needed until no suckers are collected. The sites will be sampled to the extent that the maximum effective level of salvage has been accomplished.

Release Point

Upper Klamath Lake is the source of supply for the A-Canal , B-Canal, C-Canal, D-Canal, C-G Cut-off, G-Canal, and C-4 lateral. All suckers salvaged from these sites and other sites that are served exclusively from the Upper Klamath Lake will be relocated to Upper Klamath Lake at Cove Point.

Water from a variety of sources serve the D-3 lateral and J-Canal. Because of this mix, suckers salvaged from these sites may have originated from several spawning locations. These fish and suckers salvaged from similar sites, will be released to Tule Lake or Lost River below Anderson-Rose Dam. The suckers will be released at the end of each day of collection.

Mortalities

Sucker mortalities may result from handling of suckers during the collection and relocation process. The Service has allowed up to 125 individuals of the endangered sucker species to be taken (see page 40 of the biological opinion date July 22, 1992). Such mortalities will be labeled by the team leader and delivered to the USGS-Biological Resource Division Field Office located in the Klamath Falls, OR. Labeling will include date, time, collection method and location of the specimen.

Safety

Driving--Narrow Roadways

The canal roads are narrow and provide for one-way traffic. Should rainy conditions occur during the salvage activity, the canal roads could become slippery. Drivers should exercise caution on these roads.

Fire Hazard

Dry grasses and weeds are found on most of the canal roadways. This fuel is ready tinder for combustion by sparks, cigarettes, hot exhaust, etc. Use caution.

Oxygen Containers

Compressed oxygen will be used to aerate the water for holding fish during collection and transport to the release site(s). Containers of oxygen will be secured in the back of the truck to prevent damage to the container, regulator and/or other cargo.

Highway Traffic

Access to the canal roads will be via the public highways. Drivers are to use caution when entering and exiting the highways.

Public Curiosity

Teams may experience visits from members of the public at the collection sites. All personnel need to be alert for hazards that may exist for these people. Their presence may increase risk to themselves, the teams, and/or the suckers. Assertive interaction with these people may be necessary.

Canals--Slippery Footing

Canal banks may be wet and/or icy. Walking on these surfaces may be slippery. Teams may need to use ropes as hand lines to gain access to the site(s). Each team member is to exercise caution.

Falls

Some collection sites will have areas where falls could occur. This hazard will most likely be in areas that are not equipped with railing. Ladders and hand lines shall be used to prevent falls. Team work is needed in the use of these devices.

Large Rocks

Large rocks and debris may not be visible under the water surface. They could cause tripping or other footing hazards. Persons in the water will exercise caution to prevent injury. Wading shoes with felt bottoms are highly recommended to protect feet and ankle from injuries.

Deep Water

Generally, water depth at the collection sites will be less than four feet deep. Deeper water may occur at any site. Care must be taken to pre-assess the collection pools.

Electrofishing

A certified electrofishing operator/team leader is designated for each team. This person is responsible for the safe operation of the backpack units.

Unfamiliar Activity

The salvage activity may be new for some of the team members participating. Some of the staff will not be familiar with the area or irrigation systems. Each tank truck is equipped with Project two-way radios. Teams will coordinate efforts to maximize the efficient use of resources and to concentrate salvage efforts.

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