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STATUS OF THREE LACUSTRINE SUCKER SPECIES (catostomidae).

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DISCUSSION

Introduction

We, as human beings, have been given the responsibility to insure the existence of all living things. In the face of this responsibility there are at least two different philosophies. Leopold (1949:VII) expressed these as: "There are some who can live without wild things and some who cannot." For those that believe it is better that organisms continue to exist, than to become extinct, a commitment to the conservation of natural communities is paramount. Management of the natural community provides the opportunity for species fitness, the space necessary to exist, and temporal requirements both for the individual and the continuation of the species.

In south-central Oregon the existence of various species of suckers (Catostomidae) has shaped the existence of man for thousands of years. Sucker migrations up the Williamson and Sprague rivers signaled winter-end. For the Klamath and Modoc Indians this food source came at a time when winter foods could be exhausted. The heavy dependence upon this food for survival shifted to the opportunity for commercial enterprise with establishment of non-indians in the Klamath Basin. A factory was first built to process suckers into oil (Sutton, 1876, cited in Helfrich, 1972). Later, in 1892, a fish cannery was operated on the Lost River. Fish were also packed into barrels and shipped to market (Helfrich, 1972).

Three sucker species inhabit Upper Klamath Lake, Oregon: the shortnose (*Chasmistes brevirostrus*), Lost River (*Deltistes luxatus*), and Klamath largescale (*Catostomus snyderi*). General information on these species has been documented by Cope (1879), Gilbert (1898), Spier (1930), Cressman et al. (1956), Steven (1966), and Howe (1968). Classification of each species has been conducted by Cope (1879), Seale (1896), Gilbert (1898), Miller (1958), Bailey et al. (1970), Miller and Smith (1967), and Andreasen (1975). The occurrence and distribution has been reported by Coots (1965), Golden (1969), Sonnervil (1972), Bond (1974), and Andreasen (1975).

Since 1981 the Klamath Tribe has been concerned about the apparent decline in populations size of all three species of upper Klamath Lake suckers. Interest in these species by the scientific community has covered a lengthy period of time. However, in spite of these studies there was inadequate information on the life history and population dynamics of these fish. Consequentially, the status of each species of sucker had not been determined.

In 1983 the Klamath Tribe, Oregon Department of Fish and Wildlife (ODFW), and U.S. Fish and Wildlife Service (USFWS) initiated a cooperative study with the following objectives: 1) estimate the population size of each species of sucker that spawn in the lower Williamson and Sprague rivers, 2) estimate the number of suckers captured in the Williamson and Sprague river fisheries, 3) follow fish movements using radio-telemetry, 4) determine reproductive production with larval sampling, and 5) collect environmental data.

STUDY AREA

Our studies were conducted in Upper Klamath and Agency lakes, the lower Sprague, and Williamson rivers. These waters are located in south-central Oregon, and form the uppermost portion of the Klamath River Basin (Figure 1). The Williamson River flows out of Upper Klamath Marsh approximately 35 river miles (RM) upstream from Upper Klamath Lake and is stained brown because of the marsh. Spring Creek enters the Williamson at about RM 16 and adds approximately 300 c.f.s. of clear, 40 - 45 F water. At about RM 11, the Sprague River flows into the Williamson river. Although springs and snow runoff make up the bulk of the flow in the Sprague river, the water is generally discolored, due to approximately 85 miles of agricultural land the Sprague passes through. Water temperature in the Sprague warms much faster in the spring than does the Williamson.

The water elevation in the lower 5.6 miles of the Williamson is the same as that of Upper Klamath and Agency lakes. The lake elevation is controlled at the outlet by Link River Dam. At full pool, Upper Klamath and Agency lakes constitute about 90,000 acres of water with an average depth of approximately eight feet. The lake is highly eutrophic and experiences nuisance algae blooms and subsequent dissolved oxygen sags. The hydrogenism concentration in the lakes is very high during the summer (PH = 9-10), except in

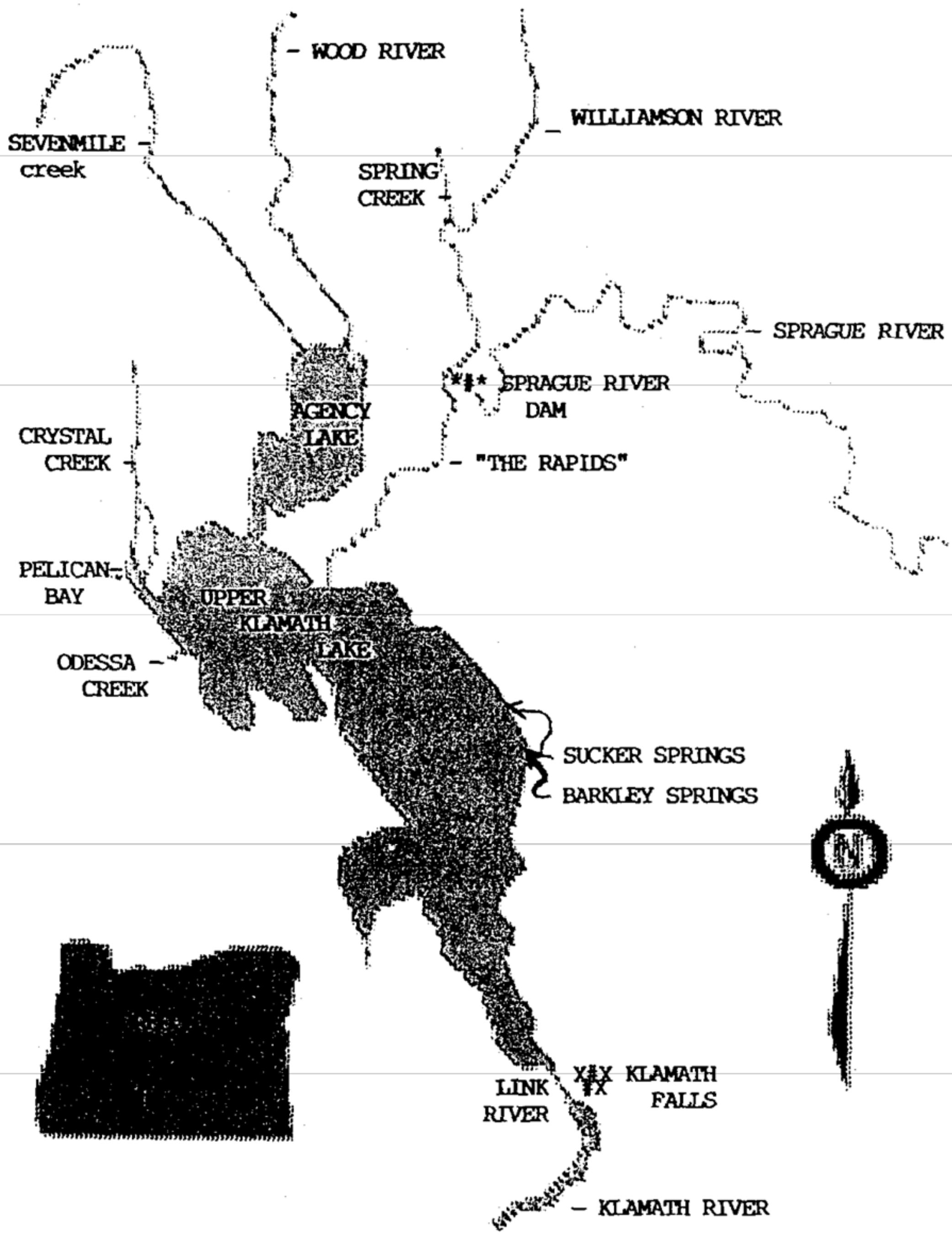

Figure 1. Map of Upper Klamath Agency lakes including major tributaries.

areas of spring or river water inflow.

METHODS

Population estimation

Population estimates for Lost River and Shortnose suckers were made using drift-boat mounted electrofishing gear. The converter box was a Coffelt model VVP IIC and was powered by a 1,200 W generator. We used the Schnabel multiple census equation with Chapmans modification (Ricker 1975) to process the data. Confidence intervals around the estimates were from a table for variables distributed in a poisson frequency distribution (Ricker 1975). In 1984, we made ten passes (13 April - 15 May) from the Sprague River Dam (RM 0.8) downstream to below the Hwy 97 bridge on the Williamson river (RM 6.5). In 1985, thirteen passes were made over the same area, beginning on 5 April and ending on 14 May. Captured suckers were placed in a live box and occasionally anesthetized with a light dose of MS222. At about 1/4 mile intervals, captured suckers were tagged with individually numbered Floy dart tags, identified for species and sex, measured to the nearest mm and released.

Population estimates for Klamath largescale suckers were made utilizing a Peterson single census method with Chapmans modification (Ricker 1975). Fish were captured in the Sprague River Dam fish ladder using a Smith Root Model 12 Backpack electrofisher. The 1984 population estimate was made using fish tagged in 1984 and recaptured in the ladder during 1985. Similarly, the 1985 estimate was made by tagging fish in 1985 and recapturing them in 1986. It was assumed that recruitment into the spawning population equalled the mortality of adults, and that tagged and untagged fish mortality were not significantly different.

Angler Catch

Angler catch of suckers during the spawning run was estimated using a roving creel survey. The survey was conducted from 5 March to 20 May in 1984, and 11 March to 15 May in 1985. The survey area included 0.8 miles of the Sprague River from the dam to the Williamson, and 4.3 miles of the Williamson River from the confluence of the Sprague River downstream to about 1/4 mile below the Hwy. 97 bridge. However, nearly all of the angling occurred at two locations; 1) just below the dam on the Sprague River, and 2) at the rapids on the Williamson River.

Anglers were surveyed 5 days per week, 8 hours per day. Survey days and early and late starting times were randomly selected. Pressure counts were made five times a day at two hour intervals and consisted of counting each angler. Expansion of the data was stratified for weekends and weekdays and by area (Sprague or Williamson rivers).

Suckers rearing in Upper Klamath and Agency lakes were captured using an Oneida trapnet with a 6 x 6 ft. box and 100 ft. of lead. We also used a hoop net with 30 ft. wings and 4 ft. hoops. Most sets were made in areas of the lake with dissolved oxygen levels at or above 6 ppm and water temperatures below 72 F. These areas were generally associated with inflow from springs or streams.

Radio - Telemetry

Klamath largescale and shortnose suckers were collected using two methods in 1983 and 1984. An Oneida trapnet set at the mouth of the Williamson River provided seven of eleven radiotagged fish (Table 1). Four Klamath largescale suckers were netted and tagged in the fish ladders at the dam on the Sprague River. Sampling was conducted extensively using electrofishing but this technique was never used to collect fish for the telemetry study. Fish were collected 5 times over a two-year period. Movements of tagged fish into spawning areas, migrations into Upper Klamath Lake and seasonal habitat use were recorded.

External radio transmitters, Telonics model RBS, were attached to the back of each captured fish using stainless steel wire. The method of attachment was described in detail by Scoppettone (1983). Each fish was kept in the water during the attachment process which usually lasted less than 10 minutes.

Radio transmitters weighed approximately 26 grams in air and eight grams in water. Each transmitter was to have a life of about six months, except one transmitter (151.657) which had a larger battery and was to last one year. All units transmitted in the 150.330 - 151.660 MHz frequency range, each with a unique signal so that individual fish could be identified. Pulse rates on some transmitters were ibrated to specific temperatures to verify selected water peratures. A Telonics scanning receiver (Tr2) enabled the vestigator to identify any particular frequency transmitted 150 to 152 MHz.

Omni-directional and pinpointing type (bidirectional) ntennas were used. Locations were triangulated from shore nd from a helicopter. Once migrations began, it was neces-ary to use a helicopter to cover large areas of both the

Table 1. Radio - transmitter frequencies attached to Klamath largescale and shortnose suckers during 1983 and 1984.

Location	Transmitter frequency	Date applied	Species*	Sex	Length(cm)
Lake	150.331	6/28/83	KLS		48.3
Lake	150.582	10/21/83	KLS	M	52.1
Lake	150.721	10/21/83	KLS	F	43.9
Lake	150.872	10/21/83	KLSxSN	M	?
Lake	151.061	10/21/83	KLS	F	56.6
Lake	151.351	10/21/83	SN	F	34.8
Dam	150.657	4/8/83	KLS	M	
Dam	150.112	4/4/84	KLS	F	
Lake	150.202	3/7/84	KLSxSN	M	47.5
Dam	150.223	3/7/84	KLS	M	45.5
Dam	151.520	4/4/84	KLS	F	

* Species identification
KLS - Klamath largescale
SN - Shortnose

rivers and lake. In addition, several fish could be located at the same time.

The location of a fish was recorded as a single contact when encountered. Specific information on movement and habitat preference was collected separately. During periods when fish were involved with spawning and major movements, daily observations were made. At other times locations were recorded on a weekly basis.

Preferred habitat data was collected if a fish remained in one location for 30 minutes. This data included general environment, microhabitat, substrate, water depth, and velocity. Water depth, velocity, and substrate measurements were taken only when fish moved to another location or after a 30-minute monitoring period. Water depths were recorded with a top-set wading rod and water velocity was measured with a Price AA current meter. Substrate type was classified by direct observation.

Larval Emigration

Emigration of sucker larvae was measured by using four plankton nets in the Sprague and Williamson rivers, downstream from the identified spawning areas. The nets had a mesh of 8 squares/cm, a rectangular mouth of 46 cm x 60 cm and a length of 125 cm. Collection of larvae was made in a PVC tube 6.2 cm in diameter and 15.3 cm long and lined with 1.3 mm mesh plastic screen.

In 1983 the larval survey was conducted at three locations. One survey point was on the Sprague River, river mile 5.9 (T 34S, R7E, Sec. 35) and at two points on the Williamson River, RM 13 (T 34S, R7E, Sec. 27) and RM 4.9 (T 35S, R7E, Sec. 30). At each location the four plankton nets were set across the stream (stations). In 1984 one net was set in the Modoc Irrigation diversion for six nights during a two week period. Each net was checked at least every half-hour, specimens collected were preserved for identification at a later time.

Larval emigration surveys were initiated on May 23, 1983. Initial surveys were conducted on Monday, Wednesday and Friday on a 24 hour basis. Information was recorded on the date, location, station, depth, time, air and water temperature, and flow. After 1983, we did not survey for larvae during daylight hours.

RESULTS

Angler Catch

We estimated that 1,262 suckers were harvested in the study area of the Sprague and Williamson rivers during 1984 (Table 2). In 1985, 687 suckers were harvested (Table 3). Approximately 92 percent of the 1985 angler harvest was Lost River suckers. Shortnose and Klamath largescale suckers represented less than 3 and 6 percent of the catch respectively. It was impossible to accurately estimate the number of each species caught in 1984 because of an identification problem. Apparently, the main creel surveyor identified shortnose suckers as Klamath largescale suckers and vice versa. We assume that most of the fish caught between 5 March and 8 April were Klamath largescale because concurrent electrofishing indicated few Lost River or shortnose suckers were in the Williamson or Sprague rivers during that period below RM 7. Most of the fish captured after 8 April were probably Lost river suckers, again based on species composition in the samples from electrofishing. Utilizing this information and the species composition from 1985 we arrived at a range within which the actual species composition probably occurred:

Species	Number Caught
Lost River	722 to 1,157
Shortnose	35 to 62
Klamath Largescale	70 to 475

Population estimation

We estimated the population of Lost River suckers was 23,123 in 1984 and 11,861 in 1985 (Table 4). These estimates were based on 5 and 14 recaptures in 1984 and 1985, respectively. The population of shortnose suckers was estimated to be 2,650 fish in 1984 (Table 4). We were able to recapture the minimum of four fish in 1984 (Robson and Regier 1968); however, in 1985 only one shortnose was recaptured and an unbiased population estimate was not possible.

Table 2. Estimated catch of Lost River, shortnose and Klamath largescale suckers in the Williamson and Sprague rivers during 1984.

time period	estimated catch (all species)
3/5 to 3/24	10
3/12 to 3/25	0
3/26 to 4/8	354
4/9 to 4/22	262
4/23 to 5/6/6	499
5/7 to 5/20	137
TOTAL	1,262

Table 3. Estimated catch of Lost River, shortnose and Klamath largescale suckers in the Williamson and Sprague rivers during 1985.

Time period	Estimated Catch: Lost River	Shortnose	Largescale
3/11 to 3/24	0	0	22
3/25 to 4/7	1	0	10
4/8 to 4.21	333	12	6
4/22 to 5/5	292	7	0
5/6 to 5/15	4	0	0
TOTAL	630	19	38

Table 4. Estimates of population size of Lost River, Shortnose, and Klamath largescale suckers in the Williamson and Sprague Rivers during 1984 and 1985.

Species	Population Estimate (95% confidence interval) 1984	1985
Lost River	23,123 (11,858 - 86,712)	11,861 (8,478 -19,763)
Shortnose	2,650 (1,026 - 10,461)	
Klamath largescale	8,698 (4,932 - 16,786)	6,986 (4,426 -11,393)

Table 5. Catch of suckers per electrofishing trip in the Williamson and Sprague Rivers, 1984-1986.

Year	Lost River suckers/trip	Shortnose suckers/trip
1984	56.5	17.6
1985	48.4	9.9
1986	23.9	3.3

Klamath largescale sucker populations were estimated to be 8,698 and 6,896 fish in 1984 and 1985, respectively (Table 4). Eight recaptures were made for the 1984 estimate, and the 1985 estimate was made from 14 recaptures.

Because we were unable to make a shortnose sucker estimate in 1985, or estimate any of the sucker population sizes in 1986, we utilized catch per electrofishing trip as an index to abundance. In 1986, we made three electrofishing trips between 9 and 28 April. The resulting index shows sharply decreasing abundance of both Lost River and shortnose suckers from 1984 to 1986 (Table 5).

Exploitation Rates

From the estimates of catch and population size, we calculated exploitation rates that ranged between 0.8 and 5.5 percent of the population (Table 6). The Lost River sucker appeared the most exploited; probably due to its large size and therefore, higher susceptibility to snagging.

Length and growth

Lost River suckers ranged in length from 43.3 to 77.3 cm during 1984 and 1985 (Table 7). Females averaged 5 to 6 cm longer than males and this difference was significant at $p < 0.01$ each year.

Shortnose suckers were much smaller than Lost River suckers ranging from 27.6 to 53.0 cm (Table 8). Like the Lost River sucker, sexual dimorphism was evident in shortnose suckers with females averaging about 2 cm longer than males. The difference in length between male and female shortnose suckers were significant at $p < 0.01$ in 1984 and $p < 0.05$ in 1985.

Eight Lost river and four shortnose suckers were tagged during electrofishing in 1984 and recaptured in 1985. Fork length measurements were taken from the fishing both years. The average change in fork length was less than 0.5 cm for each species. This difference is probably less than the sampling error we incurred when measuring the fish. However, these data appear to show very slow growth in both species of suckers, at least after maturity.

Table 6. Estimates of exploitation rates for Lost River shortnose, and Klamath largescale suckers in the Williamson and Sprague rivers during 1984 and 1985.

Species	1984 (a)	1985
Lost River	3.1 - 5.0	5.3
Shortnose	1.3 - 2.3	--
Klamath largescale	0.8 - 5.5	0.8

(a) Based on range between 1984 and 1985 species in the an gler catch.

Table 7. Fork length statistics for Lost River suckers captured by electrofishing in the Williamson and Sprague rivers during 1984 and 1985.

Year Sex	N	Fork length (cm) Mean	Stan. deviation	Range
1984 Male	319	61.6	3.7	43.3 - 73.1
1984 Female	245	66.8	4.6	43.5 - 75.8
1985 Male	345	61.5	4.0	45.8 - 70.0
1985 Female	265	67.7	3.8	50.5 - 77.3

Table 8. Fork length statistics for shortnose suckers captured by electrofishing in the Williamson and Sprague rivers during 1984 and 1985.

Year Sex	N	Fork length (cm) Mean	Stand. deviation	Range
1984 Male.	103	42.1	3.0	34.3.- 53.0
1984 Female	68	44.7	2.8	38.5 - 52.5
1985 Male	73	41.4	3.5	27.6 - 47.3
1985 Female	38	43.1	3.3	35.8 - 47.9

Hybridization between sucker species

During 1984, we did not systematically look for fish with hybrid characteristics. However, it was obvious that a large percentage of the shortnose sucker population was hybridized. In 1985, we recorded each hybrid observed and designated the dominant and secondary characteristics of each fish. Characteristics used to identify species were: body shape, length and color; head shape and length; position of the mouth; and number of papillae on the lips

Thirty-five percent of all fish observed with at least some shortnose sucker characteristics (N=176) were classified a hybrids (Table 9). Four percent of the suckers with Lost River characteristics (N=592) and 33 percent of the suckers with Klamath largescale characteristics (N=174) were hybridized. Table 9 Includes only those fish captured below the Sprague River dam and does not include Klamath largescale suckers captured in the fish ladder at the dam. In 1985, approximately one percent of the 288 Klamath largescale suckers captured in the ladder were hybridized.

Table 9. Percentage of hybridization between species of suckers in the Williamson and Sprague rivers as observed during electrofishing in 1985.

Secondary characteristics of fish	Number of fish (by dominant characteristics)a		
	Lost River	Shortnose	Klamath Largescale
Lost River	--	1	5
Shortnose	14	--	26
Klamath largescale	4	22	--
Total number of fish observed	586	136	148
Percentage hybridized	3.1	16.9	20.9

a/ Determine in the field by observing (in hand) each fish for dominant and secondary species characteristics.

Lake Studies

Between 2 July and 28 August 1986, we made 9 trapnet and 3 hoopnet sets in Upper Klamath and Agency lakes. One each of the trapnet and hoopnet sets dysfunctioned; however, the balance of the sets captured a large number and variety of fish (Tables 10 and 11).

We captured a total of 8 juvenile suckers in all of the trapnet and hoopnet sets and all were Klamath largescale. The remaining 18 suckers captured were adult fish and consisted of 15 shortnose (including 2 shortnose hybrids), 4 Lost River and 1 Klamath largescale (Tables 10 and 11).

We were unable to relate water quality to numbers of suckers caught because of the low number of sets made. However, on 27 August, we observed between 100 and 200 suckers in the cold, well oxygenated water of Pelican Bay. At the same time, the main body of Upper Klamath Lake had dissolved oxygen concentrations of less than 6 mg/L and a pH level of approximately 10 (Scoppettone and Coleman, unpublished data, USFS, Reno NV 1986).

During late July and August, we received reports from the public about dead suckers in Upper Klamath Lake. We found dead suckers floating in Upper Klamath Lake on 6,7, 26-28 August. These observations suggest that the suckers in Pelican Bay on 27 August, were there because of the poor water quality in the main body of the lake.

A length frequency histogram of Lost River Suckers captured in the Sprague and Williamson rivers during 1985, shows the majority of the fish ranged between 58 and 72 cm (Figure 2). The length frequency histogram for Lost River suckers found dead in Upper Klamath Lake in 1986 was similar to the 1985 histogram. The probability that the suckers found dead in 1986 are of the same population as those that ascended the Williamson and Sprague rivers in 1985 is increased by the fact that two of the dead Lost River suckers had been tagged in the Sprague River during 1985.

Table 10. Number of fish captured in 8 trapnet sets in Upper Klamath and Agency lakes during July and August, 1986

Common name	Scientific name	Catch Number	Catch Percentage
Native Species			
Blue chub	*Gila coerulea*	1,405	2.8
Tui chub	*Gila bicolor*	5,620	11.4
Klamath Largescale sucker	*Catostomus snyderi*	9	<0.1
Lost River sucker	*Deltistes luxatus*	4	<0.1
Shortnose sucker	*Chasmistes brevirostris*	11	<0.1
Rainbow trout	*Salmo gairdneri*	4	<0.1
Klamath lake sculpin	*Cottus princeps*		
Slender sculpin	*Cottus tenuis*	539	1.1
Marbled sculpin	*Cottus klamathensis*		
Pacific lamprey	*Lampetra trindentada*	27	<0.1
Introduced Species			
Fathead minnow	*Pimephales promelas*	31,310	63.5
Yellow perch	*Perca flavescens*	9,908	20.1
Pumpkinseed sunfish	*Lepomis gibbosus*	55	0.1
Brown bullhead	*Ictalurus nebulosus*	404	0.8
Brown trout	*Salmo trutta*	1	<0.1

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Brown bullhead	*Ictaluras nebulosus*	404	0.8
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Table 11. Number of fish captured in 2 hoopnet sets in Upper Klamath Lake (Pelican Bay), 26 to 28 August 1986.

Common name	Scientific name	Number	Percentage
	Native species		
Blue chub	*Gila coerula*	14	2.3
Tui chub	*Gila bicolor*	128	21.1
Marbled sculpin	*Cottus klamathensis*	6	1.0
Shortnose sucker	*Chasistes brevirostris*	2	0.2
Rainbow trout	*Salo gairdneri*	1	0.2
	Introduced species		
Yellow perch	*Perca flavescens*	455	75.1

Results

Larval Emigration

Information on downstream migrations of sucker larvae was collected in 1983 and 1984. Although surveys were initiated in May both years there were no larvae collected until mid-June. On June 24, 1983 samples were collected at three of the four stations in the Sprague River,(RM 5.9). Emigration at this point initiated at 12:30 AM and lasted until 4:30 AM. It appeared as though there were peaks in the downstream movement at 12:30, 2:30, and 4:30 AM. Estimates of swim-up larvae were made based on volume and not on actual numbers. No samples were collected past July 30, 1983.

Sucker larvae were never collected from 8:30 AM through 11:30 PM. Previous research has shown that emigration is primarily at night.(Scoppettone, et al., 1986, Clifford, 1972, Geen et al. 1966). The inability to collect young suckers was perhaps as valuable as the information that was positive

No larvae collected in the Williamson river at RM 13.0. This section of the Williamson river is upstream from the confluence with the Sprague river and suggests that suckers do not spawn upstream of this area. Based on the original theory that the major spawning activity for suckers was in the Sprague River and the Williamson River below RM 11.0, the larval collection supported the theory.

It appeared that the peak larval emigration occurred about eight days after the first larvae were captured. We found no conclusive relationship between peak emigration of larvae to peak migration of adults. Our results of radio-telemetry in 1983 showed adult downstream migration on May 28 and peak larval emigration on July 2 or 35 days later. In 1984 we had no telemetry fish to use in the correlation. Additional information on this possible relationship could be helpful.

Successful downstream emigration into the lake environment, is essential for species survival. In our study we did not find sucker larvae entering the lake environment. The survey point furthest downstream (Williamson river RM 4.9) did yield Klamath largescale suckers that were 200 mm long. Information on the absence of Lost river and shortnose larvae, although inconclusive and subjective, was supported by population dynamics information included elsewhere in this report.

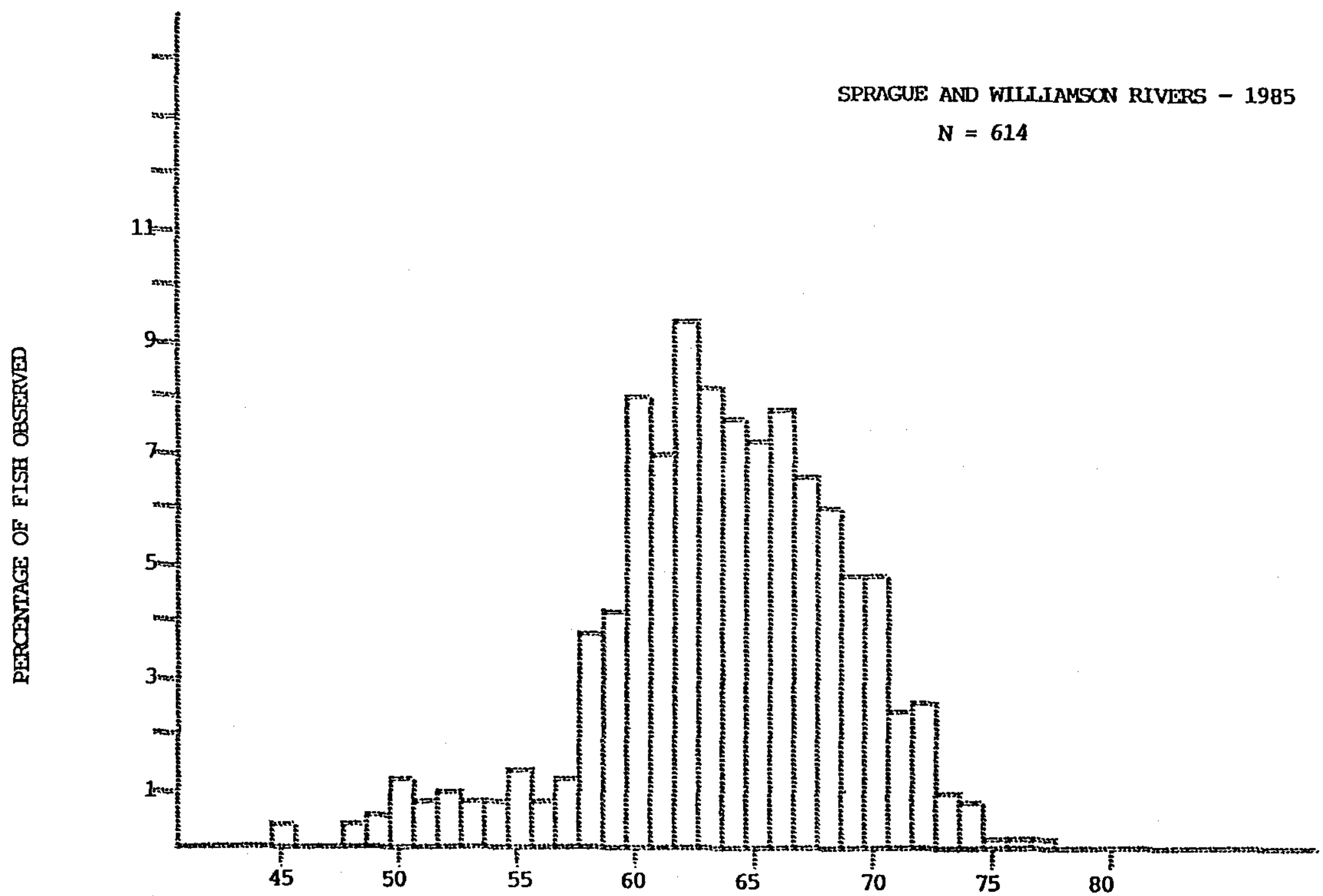

Figure 2. Length frequency of Lost River suckers captured by electrofishing in the Sprague and Williamson rivers during 1985 and those found dead in Upper Klamath Lake during 1986.

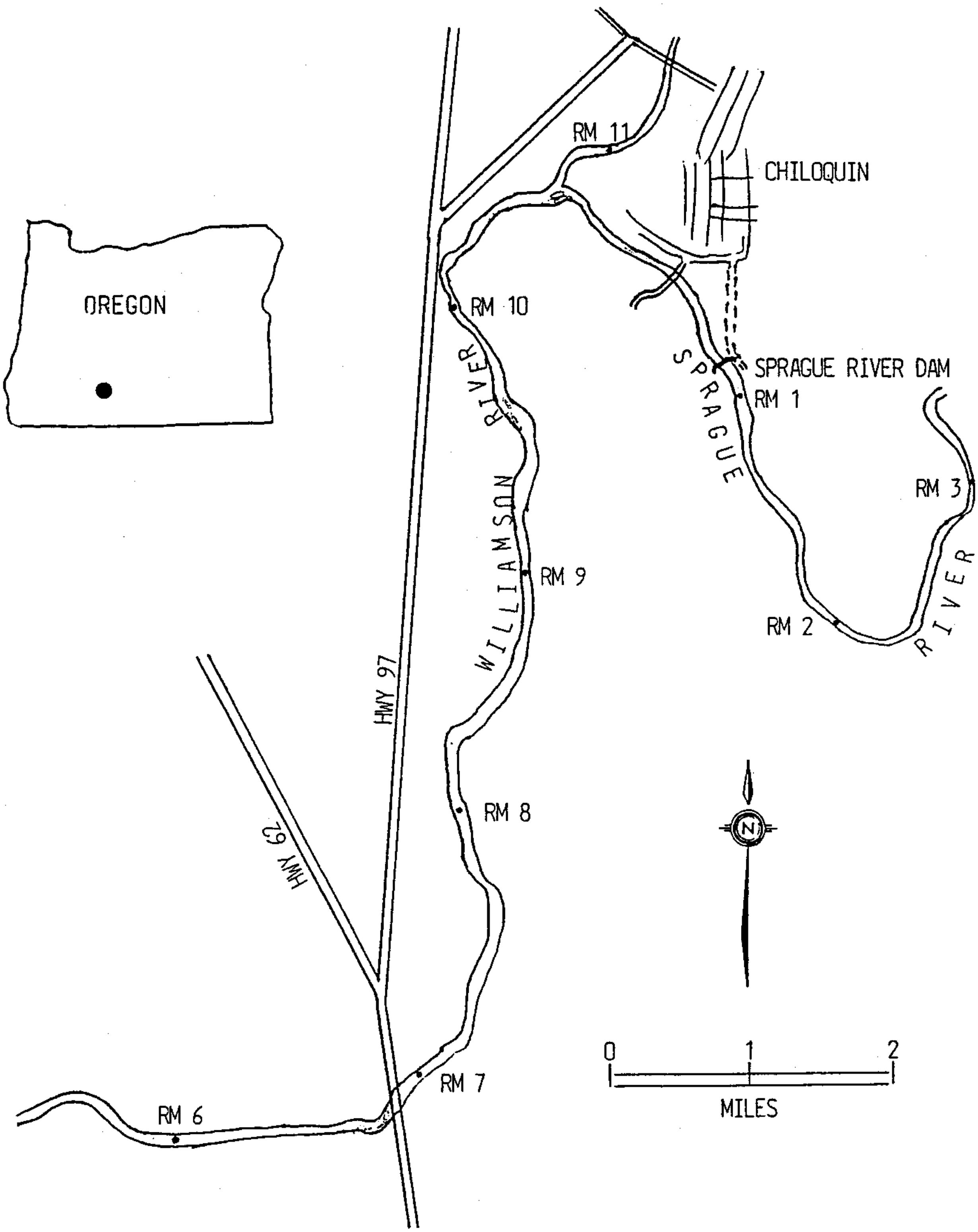

Figure 3. Areas of the Williamson and Sprague rivers where mature shortnose suckers were captured by electrofishing during 1984 and 1985 (assumed spawning areas).

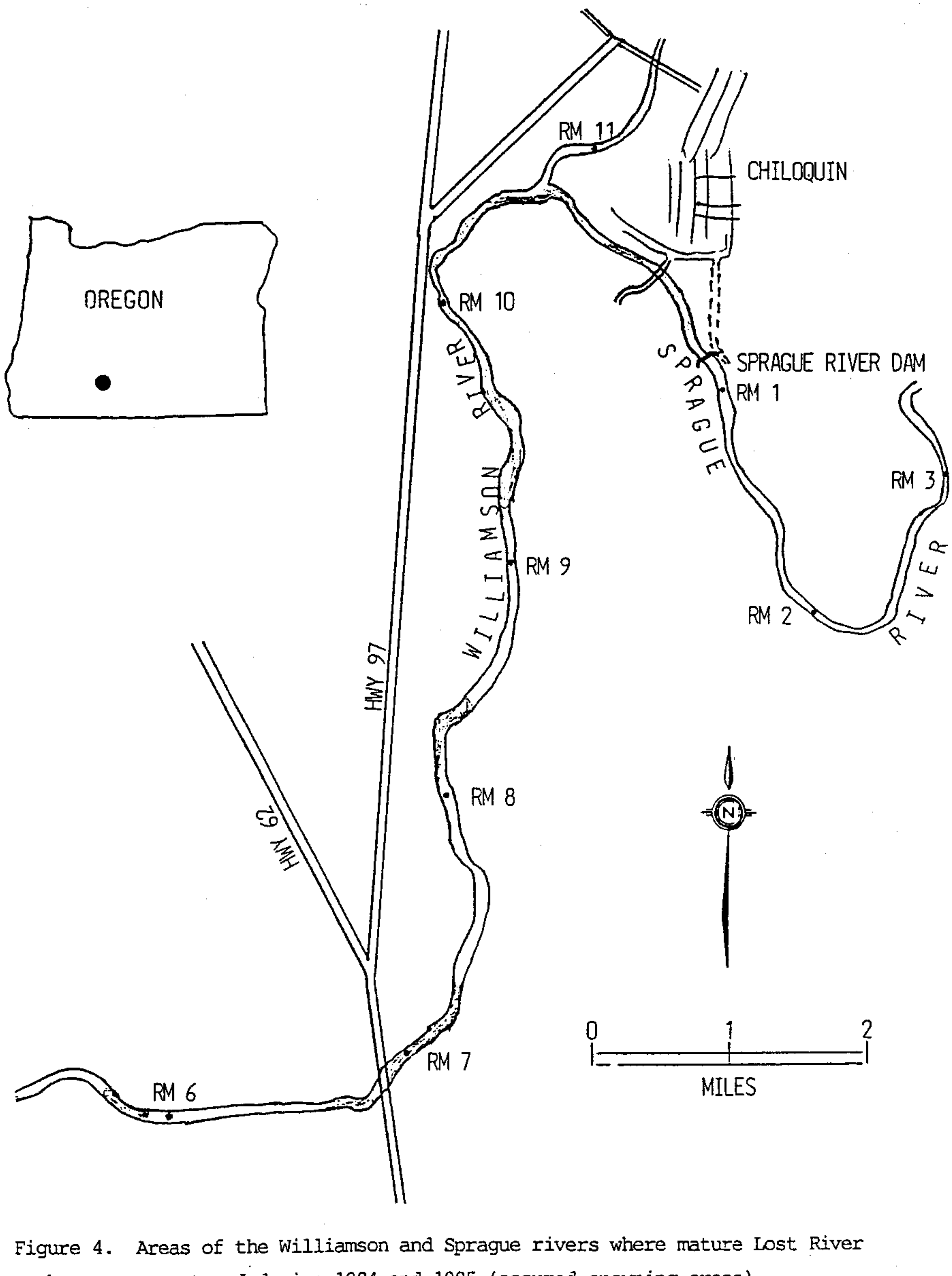

Figure 4. Areas of the Williamson and Sprague rivers where mature Lost River suckers were captured during 1984 and 1985 (assumed spawning areas).

Appendix Table 1. Number of suckers captured in trapnet and hoopnet sets in Upper Klamath and Agency lakes, with corresponding water quality data, 1986.

Date	Location	Number of suckers[1/]			Total number	Water	Dissolved	Hydrogen ion
		SNS	LRS	KLS	of fish	temp. (°F)	oxygen (mg/L)	activity (pH)
2 July	Outside Pelican Bay - Klamath	3	0	2	2,587	70	12	10+
11 July	Mouth of Odessa Cr. - Klamath	3	2	1	1,268	66	--	--
16 July	S. end of Govt. Hill - Klamath	0	0	0	2,184	65	8	10+
25 July	¼ mile up Crystal Cr. - Klamath	1	0	2	3,258	65	6	6.5
30 July	Near mouth of Wood R. - Agency	0	0	2	5,435	71	10	10+
26 August	Outside Pelican Bay - Klamath	1	2	0	4,637	68	7	10+
27 August	Mouth of Odessa Cr. - Klamath	0	0	0	28,359	67	3	8.5
28 August	Mouth Williamson R. - Klamath	3	0	2	1,569	60	9	8.0
				Hoopnet Sets				
27 August	Pelican Bay - Klamath	0	0	0	435	50	8	7.5
28 August	Pelican Bay - Klamath	2	0	0	171	51	11	7.5

1/ SNS = shortnose sucker; LRS = Lost River sucker; KLS = Klamath largescale sucker.

DISCUSSION

Shortnose Suckers

We found shortnose suckers to have the lowest population size of the three species in this study. In addition, the rate of hybridization is relatively high compared to the other two species. Approximately, 65 percent of the fish with at least some shortnose traits, possessed all of the characteristics of what we considered to be pure shortnose.

Populations of shortnose suckers exist in Clear Lake and in reservoirs on the Klamath River, however Miller and Smith (1981) concluded that these were introgressed populations. Shortnose suckers in these waters are apparently hybrids with either Catostomas snyderi or Crimmiculus.

1 The purity of shortnose suckers in Upper Klamath Lake has been discussed by Miller and Smith (1981) and Andereason (1975). Apparently some species characteristics from recently collected fish do not coincide with the holotype described by Cope in 1879. Andreasen does conclude that many of the shortnose suckers in Upper Klamath Lake are Chasmistes brevirostrus. Miller and Smith are less sure of the purity of the species, however, they did not examine a large number of specimens from Upper Klamath Lake and those they did had papillae on the lips. The majority of the specimens we examined did not possess lip papillae and therefore we tend to agree with Andreasen. It is possible that low population

size and hybridization with Klamath largescale and Lost river suckers could eventually cause the species to become introgressed.

The low population size is apparently caused by poor reproduction or juvenile survival. Spawning areas utilized appear to be limited to a few tailouts of pools and riffles in the Sprague River below the dam at Chiloquin and between RM 6.0 and 10.5 on the Williamson River (Fig. 3). Shortnose suckers may be selective towards smaller spawning substrate than Lost River Suckers . Most of the spawning sites located in this study had predominantly gravel size (less than 2.5) in substrate. Mature shortnose suckers were observed in the spawning areas between 16 April and 15 May 1984 and between 12 April and 14 May in 1985 (Appendix B). The proportion of shortnose suckers to other suckers tended to increase during May of both years.

Few shortnose suckers were found in the Sprague River ladder indicating little or no movement over the dam. Trapping in the ladder by ODFW in 1975-76 also indicated few shortnose suckers were utilizing it. We do not have data that positively documents shortnose sucker use of spawning areas in the Sprague River above the dam, however, good spawning substrate appears to be available.

The decline in qui-ui (Chasmistes cujus) population in Pyramid Lake was due mainly to the lack of available spawning areas (Scoppettone at al 1986). After access to traditional spawning areas was given to the qui-ui, the population rebounded. It is possible that the shortnose sucker population might rebound if given better access to the Sprague River above the dam, however we believe the problem is multifaceted.

The fact that we did not capture juvenile shortnose suckers is not clear evidence that these fish are not reproducing. It merely states that at the time of year and location of each set, juvenile shortnose suckers were probably not present. However, preliminary age data from ten fish found dead in Upper Klamath lake in August 1986, indicates six were at least 19 years old (unpublished). The remaining four fish were 12, 7, 7, and 4 years old. If these ages are representative of the entire shortnose population, then the number of juveniles being recruited into the adult population would likely be insufficient to maintain the population.

Lost River Suckers

Although our results show the Lost River sucker population falling precipitously, it does not appear as though angler harvest is a major cause. Exploitation rates were below 6 percent of the population in both years. We do not believe that exploitation of this magnitude could decrease the population greatly, provided recruitment of juvenile fish into the population continues. However, like the shortnose sucker, we did not find any juvenile Lost River Suckers during the 1986 Sampling.

Scoppettone and Coleman (unpublished data, USFS Reno, NV) examined 190 opercles from Lost River suckers that were found dead in Upper Klamath Lake during August 1986. Only about 10 percent of the fish examined were less than 19 years old. There were no fish between 10 and 15 year or less than 8 years old. Because of this apparent lack of recruitment in a sharply decreasing population, we have recommended that the harvest of suckers in Upper Klamath Lake and its tributaries be terminated. Spawning substrate and water velocity for Lost River Suckers appeared to be less specific than those of shortnose suckers and consequently a wider range in spawning area was observed (Fig.4). Lost River Suckers were found on the spawning sites on 13 April through 15 May in 1984 and between 5 April and 14 May in 1985 (Appendix B). We did not sample between 30 March and 13 April 1984 and therefore missed the beginning of the spawning run of this fish. Catches of Lost River Suckers by electrofishing dropped sharply after the first week in May during both years.

Although a large number of Lost River Suckers were congregated below Sprague River dam, we did not observe any appreciable movement of these fish through the ladders during either year. Sometime between 11 and 25 April 1985 a board blocked passage through the orifice on one of the lower steps to the ladder. However, subsequent sampling during May did not reveal any utilization of the ladder by suckers.

The population of Lost River suckers that inhabit Upper Klamath and Agency lakes is probably the largest of these known. Populations apparently exist in J.C. Boyle, Copco and Iron Gate reservoirs on the Klamath River and in Clear Lake on the Lost River. The number of fish in these populations appears small although the exact status is unknown at this time.

Our data indicates the spawning population of Lost River suckers in the Williamson and Sprague rivers have not been affected by hybridization to the degree that shortnose suckers have. This is probably due to the large number of Lost River Suckers in the population relative to the other two species in the spawning area.

Klamath largescale Suckers

The status of the Klamath largescale population in the upper Klamath watershed is good when compared with Lost River or shortnose sucker populations. Our population estimates did show a decrease of approximately 20 percent in the number of adult fish passing the ladder at the Sprague River dam. This decrease is cause for concern, however, we were able to capture juvenile Klamath largescale suckers in all study areas indicating that the fish are reproducing successfully to some extent. In addition, these suckers are found throughout the watershed in both lentic and lotic habitats. Reproducing populations exist in the upper Sprague and Williamson rivers, Gerber and J.C. Boyle reservoirs and the Klamath River.

The majority of the Klamath largescale suckers from Upper Klamath Lake appear to be spawning above the Sprague River dam. Unfortunately, we did not determine the range of the spawning areas utilized above the dam. Results from both electrofishing and radio tracking studies indicate movement over the dam begins in early March and peaks during to mid-April. During 1975 and 1976, a trap was operated in the ladder by ODFW. In 1975, peak catches of Klamath largescale suckers occurred between 21 April and 8 May, whereas the peak occurred between 7 and 23 April in 1976. This difference in timing between our study and the study in 1975 and 1976 may be explained by a change in the design of the ladder that was accomplished during 1980. The ladder had been originally designed for trout with moveable stop logs to adjust the pool depth and overflow height. In 1980, ODFW modified the stop logs to accommodate an orifice in each step. Because suckers are not known to jump well it is possible that the original ladder design delayed migration of Klamath largescale suckers to upriver areas.

The Klamath largescale sucker appears to have the only healthy population, of the three species of sucker that inhabit the Klamath basin above Link River Dam. Shortnose and Lost River suckers apparently have poor population numbers without immediate possibilities for strong recruitment.

Although simplistic, a few observations may have pertinence in finding a solution to the apparent recruitment problem for Lost River and Shortnose suckers:

1. Lost River and Shortnose appear headed for extirpation from Upper Klamath and Agency lakes; Klamath largescale suckers are probably not.

2. Lost River and shortnose suckers are apparently not spawning above Sprague River Dam; Klamath largescale suckers are.

3. Lost River and shortnose suckers depend on lacustrine rearing to mature; Klamath largescale suckers do not.

The fact that one of the three species is surviving leads us to believe that a solution may be attainable before the fish are lost.

MANAGEMENT IMPLICATIONS

First, we believe that the information collected to date warrants listing the Lost River and shortnose suckers on the Federal Endangered Species list. This should attract a greater amount of attention and resources to the problem and perhaps speed the eventual recovery of the species.

Second, all harvest on the Lost River and Shortnose Suckers should be terminated. Although exploitation was not found to be high we should be striving to allow as many fish as possible to spawn.

Third, initial research to determine solutions to the problem should be structured towards answering these questions:

1. Is spawning habitat available for Lost River and shortnose suckers above Sprague River dam?
2. Why are Lost River and shortnose suckers not passing above Sprague River dam?
3. When and where and at what life stage(s) is the loss of Lost river and shortnose suckers occurring.
4. Can artificial propagation be utilized to increase population size of Lost River and Shortnose suckers?

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