

EFFECTS OF FLOW ON THE MIGRATORY BEHAVIOR AND SURVIVAL
OF JUVENILE FALL AND SUMMER CHINOOK SALMON
IN JOHN DAY RESERVOIR

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ARSTRACT

The National Marine Fisheries Service in cooperation with the Bonneville Power Administration is conducting a 6-year study of the effects of instream flows on the passage time, survival, and migrational behavior of juvenile fall and summer (O-age) chinook salmon in John Day Reservoir. In 1982, the second year of the study, research activities concentrated on refining distribution and behavior data in John Day Reservoir and on releasing and recapturing marked fish needed to define flow/travel time relationships.

Twenty-two groups (61,887 fish) of marked O-age chinook salmon were wire-tagged, branded, and released into the tailrace at McNary Dam, and forty-four groups (13,128 fish) were branded and released into the reservoir at various other sites.

Sampling at the John Day Dam airlift facility captured 54,647 subyearling chinook salmon including 482 marked recoveries. Additional marks (279) were recovered from purse seine samples taken at various sites throughout the reservoir.

The average passage time to John Day Dam for marked O-age chinook salmon released in the McNary tailrace was 23 days. Weekend flow reductions at McNary Dam did not affect passage time of subyearling chinook salmon in John Day Reservoir.

There was no statistical evidence to indicate that instream flows affected either the rate of movement or residence time of O-age chinook salmon in John Day Reservoir.

INTRODUCTION

The National Marine Fisheries Service (NMFS), in cooperation with the Bonneville Power Administration (BPA), is conducting a 6-year study of the effects of flow on the migratory behavior and survival of juvenile fall and summer chinook salmon in John Day Reservoir (Lake Umatilla).

The objectives of this study are to:

1. Define the effect of instream flow on the passage time of O-age chinook salmon in John Day Reservoir.
2. Define the effect of weekend-flow reductions at McNary Dam on passage time of O-age chinook salmon in John Day Reservoir.
3. Define the effect of instream flow levels on the distribution and passage behavior of O-age chinook salmon in John Day Reservoir.
4. Define the effect of reservoir passage time on relative survival of O-age chinook salmon.

In 1982, the second year of the study, research activities concentrated on refining distribution and behavioral data in John Day Reservoir and releasing and recapturing marked fish needed to define flow/travel time relationships. This report summarizes the results of research activities conducted during 1982.

METHODS

Groups of O-age chinook salmon from early (24 June - 6 July), middle (13 - 5 August), and late (10 August - 3 September) segments of the 1982 migration entering John Day Reservoir were collected at McNary Dam, wire-tagged, freeze branded, and released into the tailrace below the dam.

Recoveries of these marks from the airlift fish collection facility at John Day Dam (Sims et al. 1982) were used to define reservoir travel and residence time.

Travel time for each release group was computed based on the first 25% of mark recoveries. This ensured that travel time estimates for each release group were based on actively migrating fish and adjusted for the possibility that later release groups may contain larger percentages of nonsmolting fish than earlier releases.

Average in-stream flows affecting each release group were calculated by averaging the daily river discharge at McNary Dam for the 10-day period following each release. Regression analysis was used to define the significance of travel time/flow relationships.

Residence time was calculated from the mean of the mark recoveries from each group. This ensured that the slower nonsmolting fish were included in the computation. The residence times calculated must be considered as minimum since they were based only on recoveries at John Day Dam through 17 December. Surviving fish still in the reservoir were **not** included. Subsequent recaptures, if any, at John Day Dam in the spring and summer of 1983 would increase the average residence time calculations.

An 11-m power block purse seiner (NMFS research vessel Columbia) was used to sample John Day Reservoir from 16 June to 11 November 1982. Purse seine fishing techniques were generally as described by Johnsen and Sims (1973). Sampling extended from the John Day Dam forebay (River Kilometer (Rkm) 3481 to Irrigon, Oregon, (Rkm 453)). A summary of limnological and

physical **data** for John Day Reservoir is given in Table 1. Seven sampling transects were established with sets made near each shore and at midreservoir (Table 2). These transects were grouped into three major areas of the reservoir: lower (Rkm 348-378), middle (Rkm 385-431), and upper (Rkm 454).

Recoveries of marked fish by the purse seine from releases in the McNary Dam tailrace and from the Columbia were used to define O-age chinook salmon distribution and migrational behavior in John Day Reservoir.

Purse seine catches were processed aboard the Columbia. Catches at John Day Dam were processed on site. All fish were anesthetized with MS-222) counted, and examined for marks. Those fish to be marked were freeze branded. A subsample was measured for fork-length. After processing, all fish were allowed to recover from the anesthetic and released on site.

RESULTS AND DISCUSSION

A total of 75,015 O-age chinook salmon were marked and released into John Day Reservoir in 1982. Twenty-two groups (61,887 fish) were wire-tagged, branded, and released into the tailrace at McNary Dam (Table 3). Of the twenty-two groups released, five groups (9,128) were released during the early migration (16 June - 6 July), nine groups (29,555) during the middle migration (13 July - 5 August), and eight groups (23,204) during the late migration (9 August - 3 September). An additional 13,128 fish from purse seine catches were marked and released at the seven reservoir sampling transects (Table-4).

Table 1.--Summary of limnological data for the John Day pool of the Columbia River, from Hjort et al. (1982), Maule et al. (1982) and unpublished data (Miller, NMFS). All data collected in August, 1979 except surface temperatures (1981, 1982) and Secchi depth (1981, 1982).

Characteristics	Range for John Day Pool
Water velocity (m/second)	0.1 - 1.4
Secchi depth (m) ^{1/}	0.3 - 2.9
Dissolved O ₂ (ppm) surface - bottom	16.0 - 18.0
Average surface temperature (°C)	7.0 - 24.5
Temperature profile surface - bottom (°C)	22.0 - 20.8
Pool width (km)	0.8 - 4.2
Mid-pool depth (m)	11.0 - 48.0
Pool length (km)	120

^{1/} Secchi readings taken June-November, 1981, 1982 at seven transects, John Day forebay to Irrigon.

Table 2. --Purse seine sampling transect locations by river mile and kilometer in John Day Reservoir, 1982.

River Mile (RM)	Kiver Kilometer (Rkm)	Area
216	348	John Day Dam Forebay
222	357	Goodnoe
232	373	Blalock
242	389	Arlington
253	407	Willow Creek
267	430	Crow Butte
282	453	Irrigon

Table 3.--Summary of 0-age chinook salmon wire-tagged, cold branded, and released in the McNary tailrace (24 June - 3 Sept.)^{a/} and recovered at John Day Dam.

Brand ^{b/}	Release date	Total released	Total recaptured	Date of first recapture	Mean recapture date	Date of last ^{c/} recapture	Minimum residence ^{d/} time (days)
LA H 1	06/24	2396	7	06/30	07/12	08/23	18
LA H 2	06/26	3235	17	07/01	07/15	08/30	19
LA IF 1	06/29	2690	9	07/12	07/21	12/10	22
LA IF 3	07/01	346	1	08/06	08/06	08/06	36
LA IC 1	07/06	461	2	08/06	---	09/27	36
LA IC 3	07/13	3035	15	07/16	07/30	10/26	17
LA IM 1	07/15	4323	13	07/22	08/05	11/17	21
LA IM 3	07/17	4012	17	07/23	07/30	08/30	13
LA IF 2	07/20	5001	16	07/26	08/11	11/25	22
LA IF 4	07/22	2012	19	07/28	08/24	11/15	33
LA IC 2	07/27	3262	33	08/03	08/23	11/29	27
LA IC 4	07/29	4500	44	08/05	08/27	11/22	29
LA IM 2	08/03	1007	7	08/09	09/13	11/01	41
LA IM 4	08/05	2383	29	08/09	08/31	11/19	26
LA +Y 1	08/10	3000	32	08/16	08/23	12/13	13
LA +Y 3	08/13	2571	31	09/18	09/29	11/03	47
LA +U 1	08/17	3450	46	08/23	09/27	11/29	41
LA +Y 2	08/20	3005	31	08/25	09/28	11/29	39
LA +U 3	08/24	1467	22	08/30	09/27	10/29	34
LA +Y 4	08/27	3581	35	09/08	09/27	11/09	31
LA +U 2	08/31	1589	16	09/09	09/23	11/29	23
LA +U 4	09/03	4541	16	09/10	10/08	12/13	35
TOTAL		61,887	458				

a/ Released at 2100 h.

b/ Position, brand, and orientation. LA indicates left anterior, LD indicates left dorsal, and LP indicates left posterior. Orientation refers to rotation of the brand around its center point. (i.e., 1 equals normal orientation ID, 2 equals , 3 equals  I, and 4 equals ).

c/ Last day of sampling, 12/17.

d/ Difference between mean date of recovery and median release date.

Table 4. --Summary of O-age chinook salmon captured by purse seining, cold branded, and released at various locations in John Day Reservoir, 24 June - 11 November 1982.

Mark ^{a/}	Release date	Number released	Release site (Rkm)
RA D 1	June 24	394	373
RA D 2	June 25	657	357
RAD 3	June 29	118	407
R A D 4	July 1	100	430
KDD 1	July 2	73	389
K D D 2	July 7	41	373
K D D 3	July 8	479	357
RDD 4	July 16	1916	389
KYD 1	July 20	262	373
K P D 2	July 21	419	357
K P D 3	July 22	1136	348
RP D 4	July 27	345	407
LA D 1	July 29	246	430
L A D 2	July 30	939	389
LA D 3	August 3	281	373
L A D 4	August 4	714	357
LD D 1	August 5	433	348
L D D 2	August 12	401	407
L D D 3	August 13	311	389
L D D 4	August 25	359	373
LP D 1	August 26	147	357
LP D 2	August 31	300	407
LP D 3	September 2	244	430
L Y D 4	September 3	215	389
RA HE 1	September 9	205	357
RA HE 2	September 30	164	357
RA HE 3	October 1	141	348
RAHE4	October 5	230	407
KD HE 1	October 6	177	430
KU HE 2	October 13	219	373
KD HE 3	October 14	214	357
RD HE 4	October 15	40	348
RP HE 1	October 19	187	407
RP HE 2	October 20	78	430
KY HE 3	October 21	43	389
RP HE 4	October 26	80	373
LA HE 1	October 27	159	357
LA HE 2	October 28	126	348
LA HE 3	November 2	162	407
LA HE 4	November 3	112	430
LD HE 1	November 4	83	389
LD HE. 2	November 9	36	373
LD HE 3	November 10	106	357
LD HE 4	November 11	36	348
TOTAL		13,128	

a/ Yosi tion, brand, and orientation. IA indicates left anterior, LD indicates left dorsal, and LD indicates left posterior. Orientation refers to rotation of the brand around its center point (i.e., 1 equals normal orientation, ID; 2 equals @, 3 equals , and 4 equals ).

The airlift collection facility at John Day Dam captured 54,647 O-age chinook salmon between 30 May and 18 December 1982 (Table 5). Total passage of O-age chinook salmon at John Day Dam during this period was estimated at 6.8 million fish (Sims et al. 1983). Airlift catches at John Day Dam included 458 marked fish from the McNary Dam tailrace releases and 24 marked fish from purse seine releases. Detailed mark recovery information is included in Appendix Table A-1.

Purse seine sampling began 16 June and was maintained on a 4-day a week schedule in the middle and upper reservoir and a 3-day a week schedule in the lower reservoir--when possible--through 13 November. In the 228 purse seine sets that were made, 16,975 O-age chinook salmon were captured (Tables 6 and 7). Purse seine catches included 239 marks from **the McNary Dam tailrace** releases and 41 marks from purse seine releases. Detailed purse seine mark recovery information is included in Appendix Table A-2.

Incidental purse seine catches of species other than juvenile salmonids in John Day Reservoir are summarized in Table 8. Juvenile shad were again the most abundant species taken; only small numbers of other species were taken. The number of squawfish dropped approximately 50% from the 1981 catch, with the majority again being caught in the John Day forebay area.

Migrational Behavior

The 1952 migration of O-age chinook salmon began to enter John Day Reservoir in early May, peaked at John Day Dam in late July with a minor peak in late September, and were continuing to pass through the dam on 18 December when monitoring was secured for the year (Table 5). The migratory

Table 5.--Weekly catch of subyearling chinook salmon in turbine intake Unit 3, John Day Dam and weekly estimated passage through John Day Dam, 30 May to 18 December 1982.

Date	Catch	Estimated passage
05/30 - 06/05	1,642	233, 187
06/06-06/12	2,789	369, 442
06/13-06/19	2,515	355, 073
06/20-06/26	2, 775	480, 650
06/27-07-03	3, 307	552, 500
07/04-07/10	1,669	276, 493
07/11-07/17	1,916	251, 634
07/18-07/24a/	6,719	1,619,654
04/25-07/31a	3, 435	931,728
08/01-08/07 a	3, 352	412,840
08/08-08/14	2, 701	202,261
08/15-08/21	2, 893	186,843
08/22-08/28	3. 181	187,720
08/29-09/04	3, 245	139,379
09/05-09/11	385	22,319
09/12-09/18	478	25, 526
09/19-09/25b/	1,092	47, 735
09/26-10/02	2, 503	108,800
10/03-10/09	1,188	55,946
10/10-10/16	937	47,415
10/17-10/23	575	34, 770
10/24-10/30	1,049	50, 582
10/31-11/06	703	46, 220
11/07-11/13	839	48, 501
11/14-11/20	807	45, 000
11/21-11/27	343	18, 384
11/28-12/04	867	51, 822
12/05-12/11	491	29, 150
12/12-12/18	221	12,640
TOTAL	54, 647	6, 844, 214

a/ Unit 3 shut down for repairs 7/20 to 8/3. Estimates based upon Unit 2 gatewell dipping (not airlift).

a/ Airlift pump operation Unit 3, ceased 9/24. Gatewell dipping Unit 3, commenced 9/26 and continued through 12/17.

Table 6.--Monthly summary of purse seine catches of subyearling chinook salmon in John Day Reservoir by major area, 16 June to 11 November 1982.

Date	Area ^{a/}	No. sets	Total catch	Catch/set
June	Lower	23	2,557	111
	Middle	4	106	27
	Upper	3	9	3
July	Lower	24	2,532	106
	Middle	18	4,037	224
	Upper	6	26	4
August	Lower	26	2,294	88
	Middle	8	1,122	140
	Upper	3	32	11
September	Lower	21	988	47
	Middle	14	728	52
	Upper	6	81	14
October	Lower	35	1,048	30
	Middle	16	836	52
	Upper	--	---	--
November	Lower	11	195	18
	Middle	10	384	38
Total		228	16,975	
Grand average				75

^{a/} Lower = Rkm 348-378
Middle = Rkm 385-431
Upper = Rkm 454

Table 7.--Weekly summary of purse seine catches in John Day Reservoir
16 June to 11 November 1982.

Date	No. sets	Chinook salmon subyearling catch	Catch/set
06/ 13-06/ 19	10	831	83
06/20-06/26	13	1,726	133
06/27-07/03	15	319	21
07/04-07/10	13	638	49
07/11-07/17	6	2,202	367
07/18-07/24	11	1,894	172
07/25-07/31	10	1,657	166
08/01-08/07	15	1,492	100
08/08-08/ 14	7	835	119
08/ 15-08/21	--	---	---
08/ 22-08/ 28	11	802	73
08/29-09/04	14	863	62
09/05-09/11	13	719	55
09/12-09/18	--	---	--
09/ 19-09/25	10	265	26
09/26-10/02	13	425	33
10/03-10/09	8	501	63
10/ 10-10/ 16	14	500	36
10/ 17-10/23	8	335	42
10/24-10/30	16	392	25
10/31-11/06	10	384	38
11/07-11/ 13	11	195	18
Total	228	16,975	
Grand average			75

Table 8.--Catch summary of salmonid and nonsalmonid fish captured by purse seine in John Day Reservoir, June to November 1982.

	June	July	August	Sept.	Oct.	Nov.	Total
Subyearling Chinook Salmon	2,672	6,595	3,448	1,797	1,884	579	16,975
Jack Chinook Salmon				1	17	3	21
Adult Chinook Salmon				4	13	2	19
Juvenile Sockeye Salmon	5	13	7	2	1		28
Adult Sockeye Salmon		4					4
Juvenile Steelhead	19	3			1	1	24
Adult Steelhead	1	4	13	7	37	3	65
Adult Walieye		2					2
Juvenile Black Bass		1	1				2
Juvenile Crappie					1		1
Juvenile Whitefish		5	4				9
Adult Whitefish	1	1			2		4
Juvenile Shad			1,400	68,000	22,300	500	92,200
Adult Shad		59	33	33			125
Juvenile Squawfish			1		1		2
Adult Squawfish	6	27	47	13	4	1	98
Juvenile Sucker		1					1
Adult Sucker	1		7				8
Adult Carp		1	3	1			5
Peamout n Chub	3	14	11	2	1		31
Chiselmouth Chub	18	28	Y	1			56

behavior exhibited by O-age chinook salmon within the reservoir was very similar to that observed in 1981 (Table 9). The average reservoir residence time of branded O-age chinook salmon released into the McNary Dam tailrace was 23 days (range 3 to 164+) in 1982 and 22 days (range 3 to 160) in 1981. This would indicate that a large portion of the O-age chinook salmon entering John Day Reservoir are not actively smolting. Average residence time during 1982 increased from 12 days for the early run to 33 days for the late run. In 1981, the average residence time increased from 16 to 30 days, respectively. This indicates that the percentage of non-smolting fish increases as the runs progress.

Purse seine recoveries of marked fish released at various locations within the reservoir (excluding McNary Dam tailrace releases) also indicate the presence of significant numbers of non-smolting O-age chinook salmon in John Day Reservoir. Over 50% of all such recoveries (26 out of 41) were either at the same site (5) or upstream (21) from the original release site (Table 10). For example, one fish released at Rkm 348 was recaptured 104 days later at Rkm 430--82 km upstream. This is not typical behavior of smolting fish. Similar behavior was noted in 1981.

Flow/Survival Relationships

Samples of the three segments of the O-age chinook salmon migration (early, middle, and late) entering John Day Reservoir in 1982 were wire-tagged and released into the tailrace at McNary Dam (Table 11). Adult returns from these releases will be used to determine relative survival of each segment. By plotting the survival estimates against the appropriate

Table Y.--Mean residence time of marked yearling and subyearling chinook salmon in John Day Reservoir based on mean date of recovery at John Day Dam - 1981, 1982. Kanges appear in parentheses.

Marked fish	Mean residence time in days	
	1981	1982
Yearling chinook salmon	6(3-20)	
Subyearling chinook salmon	22(3-160+)	<u>23(3-164+)a/</u>
Early run--24 June - 6 July	16(3-50+)	<u>12(5-162)b/</u>
Mid run--13 July - 5 August	24(3-160+)	<u>25(3-124)a/</u>
Late run--10 August to 3 Sept.	30(3-130+)	<u>33(5-125)a/</u>

a/ Marked fish possibly still in reservoir on last day of sampling, 18 December 1982.

b/ Marked fish, LA IF 1 released 29 June, recaptured 10 December Unit 3, John Day Dam.

Table 10.--Purse seine recoveries of marked, O-age chinook salmon taken at or above their reservoir release site.

Release site	Recapture site	Date released	Date recaptured	Time interval (days)	Distance traveled upstream
RKm 389	RKm 430	07/16	07/29	13	41
	430		09/02	48	41
373	373	07/20	08/25	36	0
348	389	07/22	07/30	8	41
	373	,	08/25	34	25
	407	,	08/31	40	59
	389	,	09/03	43	41
	430	,	11/03	104	82
407	453	07/27	08/11	15	46
	407		08/12	16	0
357	389	08/04	08/13	9	32
	407	,	08/31	27	50
	373	,	09/08	35	16
	430	,	11/03	91	73
3dY	430	08/13	09/02	20	51
357	373	08/26	09/08	13	16
	407	,	10/05	40	50
	430	,	10/20	55	73
357	407	09/09	10/19	39	50
357	389	09/30	10/07	7	32
	357		10/14	14	0
348	407	10/01	10/05	4	59
	373		11/09	3Y	25
357	357	10/14	10/27	13	0
	430		11/03	20	73
389	389	10/21	11/04	14	0

Table 11.--Recoveries of O-age chinook salmon (wire-tagged, cold branded, and released in McNary Dam Tailrace, 24 June to 3 September 1982) at John Day Dam.

<u>Brand</u> ^{a/}	Release date	Average river flow (kcfs) ^{b/}	Total recapture	Recapture ^{c/} date	Travel days	Time hours
LA H 1	06/24	393	7	07/01	7	149
LA H 2	06/26	386	17	07/02	6	145
LA IF 1	06/29	369	9	07/13	14	317
LA IF 3	07/01	349	1	08/06	36^{d/}	731^{d/}
LA IC 1	07/06	<u>304</u>	2	08/06	36^{d/}	852^{d/}
Average		360			9	203.7
LA IC 3	07/13	246	15	07/23	10	217
LA IM 1	07/15	227	13	07/26	11	251
LA IM 3	07/17	242	17	07/26	9	203
LA IF 2	07/20	205	16	07/30	10	226
LA IF 4	07/22	196	19	08/13	22	512
LA IC 2	07/27	193	33	08/08	12	289
LA IC 4	07/29	192	44	08/19	21	435
LA IM 2	08/03	190	7	08/20	17	391
LA IM 4	08/05	<u>180</u>	29	08/16	<u>11</u>	<u>266</u>
Average		208			14	310
LA +Y 1	08/10	160	32	08/18	8	193
LA +Y 3	08/13	147	31	08/27	14	315
LA +U 1	08/17	142	46	09/15	29	678
LA +Y 2	08/20	120	31	09/01	12	272
LA +U 3	08/24	118	22	09/06	13	309
LA +Y 4	08/27	112	35	09/23	27	628
LA +U 2	08/31	131	16	09/12	12	286
LA +U 4	09/03	<u>134</u>	16	09/24	<u>21</u>	<u>489</u>
Average		133			17	396.3

^{a/} Position, brand, and Orientation. LA indicates left anterior, LD indicates left dorsal, and LP indicates left posterior. Orientation refers to rotation of the brand around its center point (i.e., 1 equals normal orientation ID; 2 equals , 3 equals , and 4 equals ).

^{b/} For the 10-day period following each release date. Daily average river discharges at McNary Dam from 1 June to 30 September 1982 are given in Appendix A.

^{c/} 25% recovery.

^{d/} These travel times were not included in average because they were based upon too few recaptures.

river flows, a regression line will be developed to determine if a significant flow/survival relationship existed.

Flow/Travel Time Relationships

Travel time from McNary Dam to John Day Dam was calculated for the 22 groups of marked fish released into the McNary Tailrace in 1982 (Table 11). Average river flow for the 10-day period following each release ranged from 112 to 393 thousand cubic feet per second (kcfs). As can be seen, average travel time ranged from 6 to 29 days. Considerable variance in travel time occurred regardless of river flow. Average travel time for the early, middle, and late groups ranged from 9 to 17 days while river flows decreased from an average of 360 kcfs for the early group to 133 kcfs for the late group.

Regression lines were constructed by plotting the travel time of each release group against the appropriate river flow for the 20 groups in 1982 and for the combined 34 groups of 1981 and 1982 (Figures 1 and 2). The regression coefficient b (slope) of the line y was examined for significance by testing the null hypothesis that the population regression coefficient is equal to zero ($B = 0$). This was done by applying a sample t -test according to the formula: $t = \frac{b-B}{s_b}$ where b = slope
 s_b = standard error of the regression coefficient

For the 1982 data $t = -1.38$. Since $t < 0.05$ with 18 degrees of freedom = + 2.101, $B = 0$ is accepted. For the combined 1981 - 1982 data $t = 0.027$. Since $t < 0.05$ with 32 degrees of freedom = + 2.042, $B = 0$ is accepted. We conclude that the slopes (b) of these lines do not possess a significant statistical difference from zero.

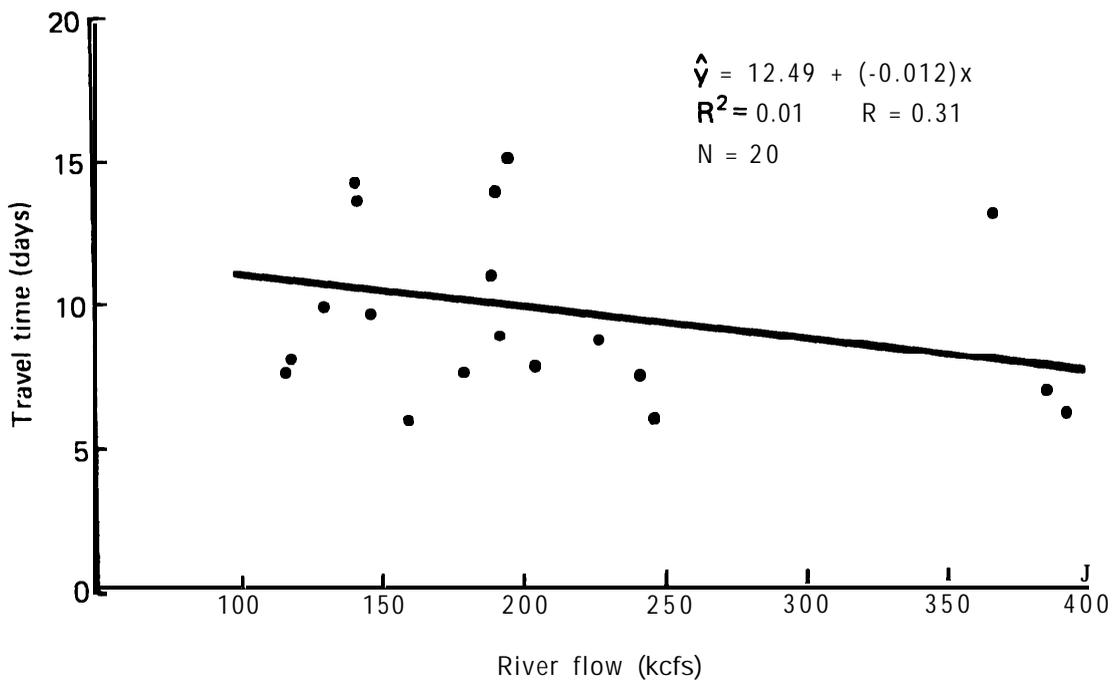


Figure 1.--Relationship of river flow to O-age chinook salmon travel time in John Day Reservoir (McNary Dam tailrace to John Day Dam), 1982.

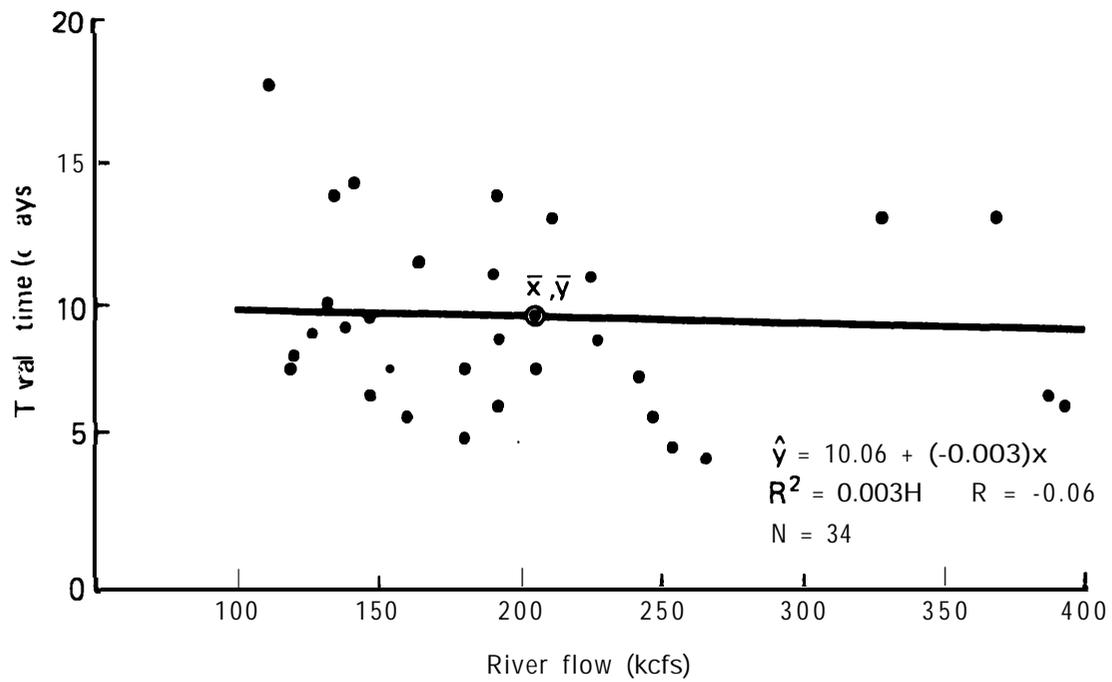


Figure 2.--Relationship of river flow to O-age chinook salmon travel time in John Day Reservoir (McNary Dam tailrace to John Day Dam), 1981-1982.

Based on the 34 data points developed in 1981 and 1982, there is no statistical evidence to indicate that river flows are affecting the rates of migration or residence times of O-age chinook salmon in John Day Reservoir.

In 1982, we began investigating the effect of weekend flow reductions at McNary Dam on passage time of O-age chinook salmon in John Day Reservoir. Passage time of marked fish released into the McNary tailrace on Friday evenings was compared to the passage time of fish released on Tuesday evenings. Average river flow for the 10-day period following each release ranged from 112 to 386 kcfs for the Friday evening releases and 118 to 369 kcfs for the Tuesday evening releases. To further refine these data, hourly travel times were used instead of days. Regression lines were constructed by plotting the travel time of each release group against the appropriate river flow for the six Friday evening release groups and for the six Tuesday evening release groups (Figure 3). Strangely, the Friday groups show a negative slope with travel times decreasing as river flow increased, whereas the Tuesday groups have a positive slope with travel time increasing as river flow increased. Again, using our sample t test of $t = \frac{b-B}{s_b}$ the Friday groups have $t = -1.86$, and the Tuesday groups have $t =$

U.46.

The $t_{0.05}$ at 4 d.f. value is: $+2.776$, so $B = 0$ is accepted. We then determined whether b_1 and b_2 were significantly different from each other, that is, the null hypothesis that $B_1 - B_2 = U$. For this we used the sample t test: $T = \frac{(b_1 - b_2) - (B_1 - B_2)}{s_{b_1 - b_2}}$

That defined above has a t distribution with $N_1 + N_2 - 4$ d.f., when the null hypothesis is true, and can be evaluated in terms of the table of

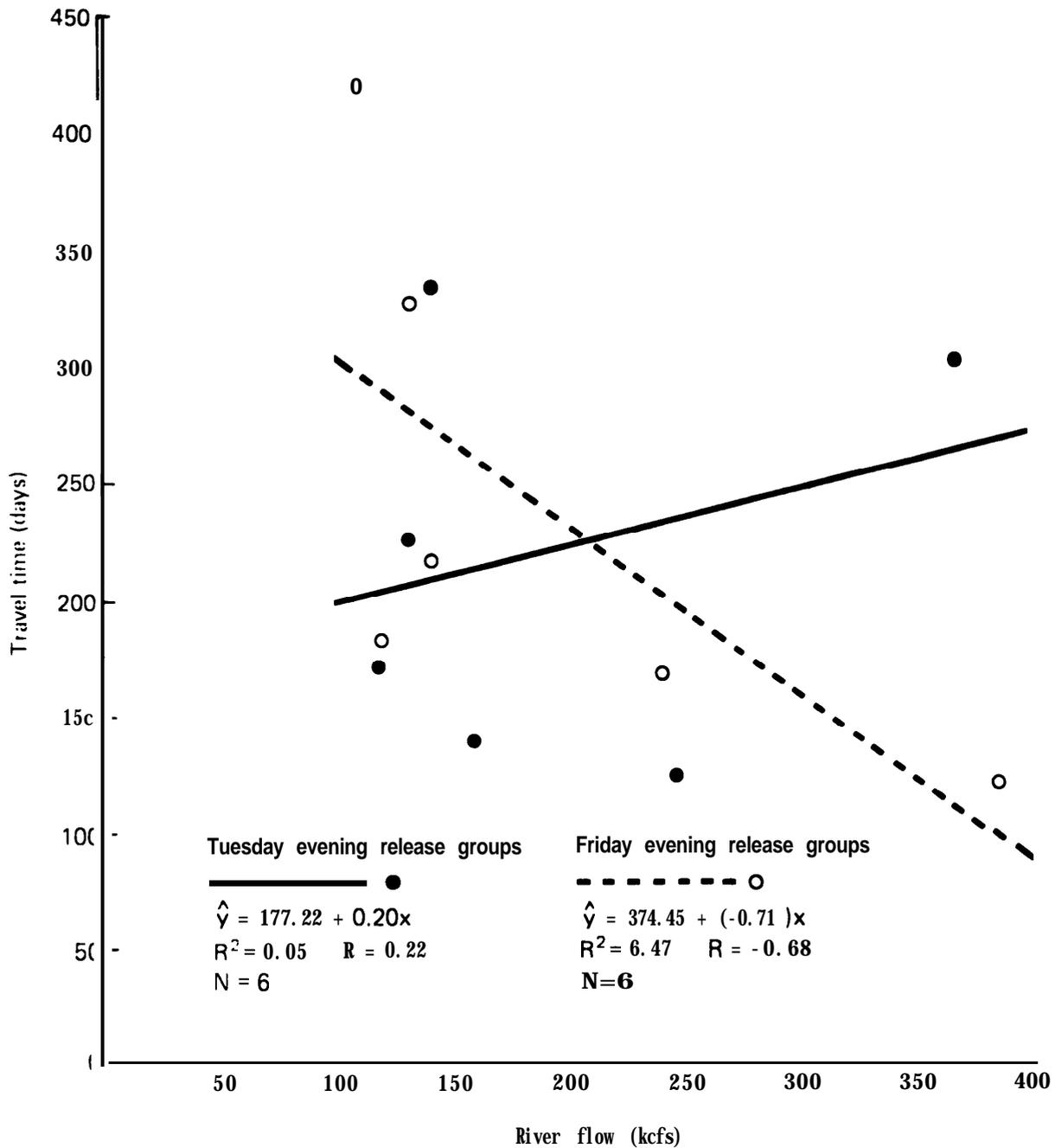


Figure 3. --Relationship of reduced weekend flows at McNary Dam to O-age chinook salmon travel time in John Day Reservoir (McNary Dam tailrace to John Day Dam), 1982.

t. As a test of the null hypothesis that $B_1 - B_2 = 0$, we have $t = -1.54$. From the table of t for 8 d.f, $t_{\alpha=0.05} = +2.306$, and $B = 0$ is accepted. We conclude that weekend flow reductions at McNary Dam in 1982 resulted in no statistically significant differences in passage time of O-age chinook salmon in John Day Reservoir.

This analysis is based on only 1 year's data and represents a very limited number of data points. Additional data points will be added in 1983.

SUMMARY AND CONCLUSIONS

1. Twenty-two groups of O-age chinook salmon (61,887 fish) were wire-tagged and branded at McNary Dam and released into the McNary Dam tailrace during the period 16 June - 3 September 1982.

2. Additional mark releases of 13,128 purse seine captured O-age chinook salmon were made at the seven reservoir sampling transects.

3. The airlift collection facility at Unit 3, John Day Dam captured 54,647 O-age chinook salmon between 30 May and 18 December 1982. Total passage, based on these collections, was estimated to be approximately 6.8 million fish.

4. Four hundred and fifty-eight marked U-age chinook salmon were recovered at John Day Dam.

5. During the O-age chinook salmon migration, 228 purse seine sets were made in John Day Reservoir. Purse seine catches totaled 16,975 O-age chinook salmon.

6. The average residence time in John Day Reservoir for marked O-age chinook salmon released into the McNary Dam tailrace was 23 days.

7. Sixty-three percent of purse seine mark recaptures of U-age chinook salmon were made at or above the original release sites.

8. From their length of residence and upstream movement, it appears that a large number of O-age chinook salmon in John Day Reservoir are not actively migrating.

9. Based on limited data developed in 1982, there is no statistically significant evidence to indicate that reduced weekend flows at McNary Dam have any effect on passage time of O-age chinook salmon in John Day Reservoir.

10. Based on the 34; data points developed in 1981 and 1982, there is no statistically significant evidence to indicate that river flows are affecting the rates of downstream movement or residence time of O-age chinook salmon in John Day Reservoir.

ACKNOWLEDGMENTS

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APPENDIX A

Brand Recapture Data

Appendix Table A1. --Brand recapture summary, O-age chinook salmon, John Day Dam (Turbine Unit 3), 1982.

Brand ^a /	Release site	Number released	Date released	Recaptures		Date recapture
				No.	Cumulative	
LAH1	Rkm 470 (McNary Dam)	2396	06/24	1	1	06/30
				1	2	07/01
				1	3	07/03
				1	4	07/12
				1	5	07/18
				1	6	08/09
				1	7	08/22
LAH2	Rkm 470	3235	06/26	1	1	06/30
				2	3	07/01
				1	4	07/02
				2	6	07/05
				1	7	07/09
				1	8	07/12
				1	9	07/15
				1	10	07/18
				1	11	07/19
				1	12	07/21
				2	14	07/23
				1	15	07/26
				1	16	08/15
				1	17	08/29
LA1F1	Rkm 470	2690	06/29	1	1	07/11
				1	2	07/13
				1	3	07/18
				1	4	07/21
				1	5	07/23
				1	6	07/26
				1	7	08/08
				1	8	09/29
				1	9	12/10
LA1F2	Rkm 470	5001	07/20	1	1	07/26
				1	2	07/27
				1	3	07/28
				1	4	07/30
				1	5	08/04
				3	8	08/06
				1	9	08/11
				1	10	08/13
				1	11	08/15
				1	12	08/20
				1	13	08/30
				2	15	09/29
				1	16	11/25

Appendix Table A1 .--Continued

Brand^a/	Release s i t e	Number released	Date released	Recaptures		Date recapture
				No.	Cumulative	
LAlF3	RKm 470	346	07/01	1	1	08/06
LAlF4	RKm 470	2012	07/22	1	1	07/28
				1	2	08/05
				1	3	08/06
				1	4	08/09
				1	5	08/13
				1	6	08/15
				3	9	08/22
				1	10	08/23
				1	11	08/29
				1	12	08/30
				2	14	09/27
				1	15	09/29
				1	16	10/04
				1	17	10/08
				1	18	11/08
				1	19	11/15
LAlC1	RKm 470	461	07/06	1	1	08/06
				1	2	09/27
LAlC2	RKm 470	3262	07/27	1	1	08/03
				3	4	08/04
				2	6	08/05
				1	7	08/06
				1	8	08/08
				1	9	08/09
				2	11	08/10
				1	11	08/13
				3	15	08/15
				1	16	08/17
				5	21	08/22
				1	22	08/27
				2	24	08/29
				2	26	09/12
				1	27	09/23
				2	29	09/24
				1	30	09/29
				1	31	10/01
				1	32	11/25
				1	33	11/29

Appendix Table A1. --Continued

Brand	Release site	Number released	Date released	Recaptures		Date recapture
				No.	Cumulative	
LA1C3	Rkm 470	3055	07/13	1	1	07/16
				1	2	07/18
				1	3	07/19
				1	4	07/23
				1	5	07/28
				1	6	07/29
				1	7	07/30
				1	8	08/06
				1	9	08/09
				1	10	08/12
				1	11	08/13
				1	12	08/16
				1	12	10/08
				1	14	10/25
				1	15	10/26
LA1C4	Rkm 470	4500	07/29	2	2	08/05
				2	4	08/06
				1	5	08/11
				3	8	08/15
				1	9	08/16
				1	10	08/18
				4	14	08/19
				6	20	08/22
				1	21	08/24
				1	22	08/25
				2	24	08/26
				2	26	08/27
				4	30	08/29
				3	33	08/30
				1	34	09/09
				1	35	09/17
				2	37	10/04
				2	39	10/08
				2	41	10/13
				1	42	11/05
1	43	11/08				
1	44	11/22				

Appendix Table A1. --Continued

Brand^a/	Release s i t e	Number released	Date released	Recaptures		Date recapture
				No.	Cumulative	
LAIM1	Rkm 470	4323	07/15	1	1	07/22
				1	2	07/23
				1	3	07/26
				1	4	07/28
				1	5	08/02
				1	6	08/04
				1	7	08/05
				1	8	08/12
				1	9	08/18
				1	10	08/22
				1	11	09/29
				1	12	10/01
				1	13	11/17
LAIM2	Rkm 470	1007	08/03	1	1	08/08
				1	2	08/20
				1	3	09/06
				1	4	09/12
				1	5	09/29
				1	6	10/14
				1	7	11/01
LAIM3	Rkm 470	4012	07/17	2	2	07/23
				3	5	07/26
				1	6	07/28
				1	7	07/29
				2	9	07/30
				1	10	08/02
				3	13	08/06
				1	14	08/09
				1	15	08/11
				1	16	08/19
1	17	08/30				

Appendix Table A1. --Continued

Brand ^a / site	Release site	Number released	Date released	Recaptures		Date recapture				
				No.	Cumulative					
LA1M4	Rkm 470	2383	08/05	1	1	08/09				
				1	2	08/10				
				2	4	08/12				
				1	5	08/13				
				2	7	08/16				
				1	8	08/18				
				4	12	08/22				
				1	13	08/27				
				1	14	08/29				
				1	15	08/30				
				1	16	09/24				
				1	17	09/29				
				1	18	09/30				
				1	19	10/01				
				2	21	10/04				
				1	22	10/08				
				1	23	10/18				
				2	24	10/19				
				1	25	10/21				
				1	26	10/22				
				1	27	10/28				
				1	28	11/10				
				1	29	11/19				
				LA+Y1	Rkm 470	3000	08/10	4	4	08/15
								2	6	08/16
								2	8	08/18
								1	9	08/19
								2	11	08/20
								4	15	08/22
1	16	08/25								
1	17	08/27								
1	18	08/29								
1	19	08/31								
1	20	09/02								
1	21	09/24								
1	22	09/27								
2	24	09/28								
2	26	09/29								
1	27	10/11								
1	28	10/18								
1	29	10/25								
1	30	10/26								
1	31	11/29								
1	32	12/13								

Appendix Table A1.--Continued

Brand ^a /	Release site	Number released	Date released	Recaptures		Date recapture				
				No.	Cumulative					
LA+Y4	Rkm 470	3581	08/27	4	4	09/08				
				1	5	09/12				
				1	6	09/14				
				2	8	09/21				
				4	12	09/23				
				2	14	09/24				
				4	18	09/27				
				2	20	09/28				
				3	23	09/29				
				1	24	10/04				
				1	25	10/05				
				3	28	10/06				
				1	29	10/11				
				3	32	10/12				
				1	33	10/13				
				1	34	10/21				
				1	35	11/09				
				LA+UI	Rkm 470	3450	08/17	2	2	08/22
								1	3	08/25
2	5	08/29								
3	8	08/30								
1	9	09/01								
1	10	09/06								
1	11	09/12								
1	12	09/15								
4	16	09/22								
3	19	09/24								
6	25	09/27								
5	30	09/29								
3	33	10/04								
1	34	10/06								
1	35	10/11								
1	36	10/15								
1	37	10/21								
4	41	10/25								
1	42	10/26								
1	43	11/01								
1	44	11/02								
1	45	11/25								
1	46	11/29								

Appendix Table A1.--Continued

Brand ^a /	Release site	Number released	Date released	Recaptures		Date recapture				
				No.	Cumulative					
LA+U2	Rkm 470	1589	08/31	2	2	09/09				
				1	3	09/10				
				2	5	09/12				
				1	6	09/13				
				1	7	09/21				
				1	8	09/23				
				1	9	09/27				
				2	11	09/28				
				1	12	10/06				
				1	13	10/08				
				1	14	10/18				
				1	15	10/25				
				1	16	11/29				
				LA+U3	Rkm 470	1467	08/24	1	1	08/29
								2	3	08/30
								1	4	08/31
1	5	09/02								
1	6	09/06								
1	7	09/09								
1	8	09/12								
1	9	09/22								
1	10	09/24								
1	11	09/27								
1	12	09/28								
4	16	09/29								
1	17	10/06								
1	18	10/07								
1	19	10/12								
2	21	10/22								
1	22	10/29								
LA+U4	Rkm 470	4541	09/03	1	1	09/09				
				1	2	09/12				
				1	3	09/22				
				1	4	09/24				
				1	5	09/27				
				1	6	09/29				
				1	7	10/07				
				1	8	10/08				
				1	9	10/18				
				1	10	10/25				
				1	11	10/29				
				1	12	11/01				
				1	13	11/05				
				1	14	11/22				
				1	15	12/10				
				1	16	12/13				

Appendix Table A1 --Continued

Brand ^a / site	Release site	Number released	Date released	Recaptures		Date recapture
				No.	Cumulative	
LAD1	Rkm 430 (purse seine)	246	07/29	1	1	08/04
				1	2	058/10
LAD2	Rkm 38Y	939	07/30	1	1	08/05
LDD1	Rkm 348	433	08/05	1	1	08/10
				1	2	08/29
RDD2	Rkm 373	41	07/07	1	1	09/08
RPD4	Rkm 407	345	07/27	2	2	08/10
RAHE1	Rkm 357	205	09/09	1	1	09/29
RAHE2	Rkm 357	164	09/30	1	1	10/26
				1	2	11/09
RAHE4	Rkm 407	230	10/05	1	1	10/22
				2	3	10/25
				1	4	11/04
RDHE1	Rkm 430	177	10/06	1	1	11/01
RDHE2	Rkm 373	219	10/13	1	1	10/22
				1	2	10/26
				1	3	10/28
RDHE3	Rkm 357	214	10/14	1	1	10/27
RDHE4	Rkm 348	40	10/15	1	1	10/25
RDHE1	Rkm 407	187	10/19	1	1	10/25
				1	2	11/01
LAHE3	Rkm 430	162	11/02	1	1	11/22

a/ Position, brand, and orientation, LA indicates left anterior, LD indicates left dorsal, and LP indicates left posterior. Orientation refers to rotation of the brand around its center point. (i.e., 1 equals normal orientation ID, 2 equals θ , 3 equals α , 4 equals β).

Appendix Table A2. --Brand recapture summary--purse seine catches of O-age chinook salmon in John Day Reservoir, 1982.

Brand^a/	Release site	Number released	Date - released	Recaptures		Date recapture	Recapture site (Rkm)
				No.	Cumulative		
LAH1	Rkm 470 (McNary Dam)	2396	06/24	1	1	07/16	389
				1	2	07/20	373
				1	3	07/21	357
				2	5	07/22	348
				1	6	07/30	389
LAH2	Rkm 470	3235	06/26	1	1	07/16	389
				1	2	07/20	373
				1	3	07/22	348
				2	5	07/30	389
				1	6	08/03	373
LAIF i	Rkm 470	2610	06/29	5	5	07/16	389
				1	6	07/21	357
				2	8	07/30	389
				1	9	08/03	373
LAIF2	Rkm 470	5001	07/20	1	1	08/04	357
				1	2	08/12	407
				1	3	08/31	407
				1	4	09/03	385
				1	5	09/08	373
				1	6	09/30	357
				1	7	10/20	430
LAIF3	Rkm 470	346	07/01	1	1	07/16	389
				1	2	07/22	348
				1	3	07/27	407
				1	4	07/30	389
				1	5	08/05	348
				1	6	08/24	348
				1	7	09/02	430
				1	8	09/09	357
				1	9	10/05	407
				1	10	11/13	373
LAIF4	Rkm 470	2012	07/22	1	1	07/27	407
				1	2	07/29	430
				2	4	07/30	389
				1	5	08/13	389
				1	6	09/02	430
				1	7	09/30	357
				1	8	11/10	357
				1	9	11/11	348

Appendix Table A2.--Continued

Brand^a/	Release site	Number released	Date released	Recaptures		Date recapture	Recapture site (Rkm)
				No.	Cumulative		
LAIC1	Rkm 470	461	07/06	1	1	07/16	389
				1	2	09/03	389
				1	3	09/08	373
LAIC2	Rkm 470	3262	07/27	1	1	07/29	430
				2	3	07/30	389
				1	4	08/03	373
				1	5	08/04	357
				1	6	08/12	407
				1	7	08/13	389
				1	8	08/24	348
				3	11	08/25	373
				1	12	08/26	357
				2	14	09/09	357
				1	15	09/30	357
				1	16	10/05	407
				1	17	10/14	357
				1	18	10/19	407
1	19	11/02	407				
LAIC3	Rkm 470	3055	07/13	1	1	07/21	357
				1	2	07/22	348
				1	3	08/12	407
				1	4	08/26	357
				2	6	09/30	357
				2	8	10/01	348
LAIC4	Mm 470	4500	07/29	2	2	08/04	357
				2	4	08/05	348
				2	6	08/13	389
				1	7	08/24	348
				1	8	08/25	373
				1	9	08/31	407
				1	10	09/03	389
				1	11	10/13	373
				1	12	10/14	357
				1	13	10/28	348
				1	14	11/04	389
LAIM1	Rkm 470	4323	07/15	2	2	07/22	348
				1	3	07/27	407
				1	4	07/30	389
LAIM2	Rkm 470	1007	08/03	1	1	08/12	407
				1	2	08/13	389
				1	3	08/25	373
				1	4	09/08	373
				1	5	09/09	357

Appendix Table A2.--Continued

Brand^a/	Release site	Number released	Date released	<u>Recaptures</u>		Date recapture	Recapture site (Rkm)
				No.	Cumulative		
LAIM3	Rkm 470	4012	07/17	1	1	07/22	348
				2	3	07/30	389
				1	4	08/05	348
				1	5	08/25	373
				1	6	08/26	357
				1	7	09/09	357
				1	8	10/01	348
				1	9	10/28	348
				1	10	11/04	389
				1	11	11/09	373
				LALM4	Rkm 470	2383	08/05
1	2	08/24	348				
1	3	08/25	373				
1	4	08/26	357				
1	5	09/02	430				
1	6	10/14	357				
1	7	10/19	407				
1	8	10/28	348				
LA+Y1	Rkm 470	3000	08/10	4	4	08/11	453
				1	5	08/12	407
				1	6	08/24	348
				3	9	08/25	373
				1	10	08/26	357
				1	11	09/02	430
				1	12	09/03	389
				1	13	09/08	373
				2	15	09/09	357
				1	16	10/01	348
				2	18	10/05	407
				1	19	10/06	430
				1	20	10/13	373
1	21	10/14	357				
1	22	10/21	389				
1	23	11/02	407				
LA+Y2	Rkm 470	3005	08/20	1	1	09/02	430
				1	2	09/08	373
				1	3	09/09	357
				1	4	09/22	407
				2	6	09/23	430
				2	8	09/30	357
				1	9	10/13	373
				2	11	10/19	407
				1	12	10/27	357
				1	13	11/02	407
				1	14	11/03	430
				1	15	11/04	389

Appendix Table A2.--Continued

Brand	Release site	Number released	Date released	Recaptures		Date recapture	Recapture site (Rkm)				
				No.	Cumulative						
LA+Y3	Rkm 470	2571	08/13	1	1	08/24	348				
				3	4	08/25	373				
				1	5	08/26	357				
				1	6	08/31	407				
				1	7	09/03	389				
				1	8	09/08	373				
				1	9	09/09	357				
				2	11	09/30	357				
				1	12	10/05	407				
				2	14	10/06	430				
				1	15	10/20	430				
				1	16	10/21	389				
				1	17	10/26	373				
				1	18	11/02	407				
				1	19	11/10	357				
				LA+Y4	Rkm 470	3581	08/27	3	3	08/31	407
								3	6	09/03	389
								3	9	09/08	373
								1	10	09/09	357
1	11	09/22	407								
1	12	09/29	373								
1	13	09/30	357								
2	15	10/01	348								
1	16	10/05	407								
1	17	10/07	389								
1	18	10/14	357								
1	19	10/19	407								
1	20	11/03	430								
LA+U1	Rkm 470	3450	08/17	1	1	08/24	348				
				1	2	08/25	373				
				1	3	08/26	357				
				1	4	08/31	407				
				1	5	09/08	373				
				1	6	09/22	407				
				2	8	09/29	373				
				1	9	10/05	407				
				1	10	10/13	373				
				1	11	10/19	407				

Appendix Table A2.--Continued

Brand^a/	Release site	Number released	Date released	Recaptures		Date recapture	Recapture site (Rkm)				
				No.	Cumulative						
LA+u2	Rkm 470	1589	08/31	3	3	09/01	453				
				1	4	09/02	430				
				1	5	09/03	389				
				2	7	09/08	373				
				1	8	10/01	348				
				1	9	10/05	430				
				1	10	10/06	430				
				1	11	10/28	348				
				1	12	11/09	373				
				1	13	11/11	348				
				LA+U3	Rkm 470	1467	08/24	1	1	08/31	407
								1	2	09/03	389
								1	3	09/08	373
1	4	09/09	357								
1	5	09/23	430								
1	6	09/30	357								
2	8	10/01	348								
1	9	10/07	389								
2	11	10/14	357								
1	12	10/15	348								
LA+U4	Rkm 470	4541	09/03					1	1	09/10	348
								1	2	09/30	357
				1	3	10/05	407				
				1	4	10/19	407				
				1	5	10/20	430				
				1	6	10/27	357				
				1	7	11/02	407				
RAD1	Rkm 373 (purse seine)	394	06/24	No recaptures							
RAD2	Rkm 357	657	06/25	No recaptures							
RAD3	Rkm 407	118	06/29	No recaptures							
RAD4	Rkm 430	100	07/01	No recaptures							
RDD1	Rkm 389	73	07/02	1	1	11/10	357				
RDD2	Rkm 373	41	07/07	No recaptures							
RDD3	Rkm 357	479	07/08	No recaptures							
RDD4	Rkm 389	1916	07/16	1	1	07/20	373				
				1	2	07/29	430				
				1	3	09/02	430				

Appendix Table A2. --Continued

Brand ^a /	Release site	Number released	Date released	Recaptures		Date recapture	Recapture site (Rkm)
				No.	Cumulative		
RPD1	RKm 373	262	07/20	1	1	08/25	373
RPD2	RKm 357	419	07/21	No recaptures			
RPD3	RKm 348	1136	07/22	1	1	07/30	389
				1	2	08/25	373
				1	3	08/31	407
				1	4	09/03	389
				1	5	11/03	430
RPD4	RKm 407	345	07/27	1	1	07/30	389
				1	2	08/05	348
				1	3	08/11	453
				1	4	08/12	407
				1	5	10/26	373
LAD1	RKm 430	246	07/29	1	1	09/09	357
LAD2	RKm 389	939	07/30	1	1	08/05	348
				1	2	10/13	373
LAD3	RKm 373	281	08/03	No recaptures			
LAD4	RKm 357	714	08/04	1	1	08/13	389
				1	2	08/24	348
				1	3	08/31	407
				1	4	09/08	373
				1	5	11/03	430
LDD1	RKm 346	433	08/05	No recaptures			
LDD2	RKm 407	401	08/12	No recaptures			
LDD3	RKm 389	311	08/13	1	1	08/26	357
				1	2	09/02	430
LDD4	RKm 373	359	08/25	No recaptures			
LPD1	RKm 357	147	08/26	1	1	09/08	373
				1	2	10/05	407
				1	3	10/20	430
LPD2	RKm 407	300	08/31	1	1	09/30	357
LPD3	RKm 430	244	09/02	No recaptures			
LPD4	RKm 389	215	09/03	1	1	09/29	373

Appendix Table A2. --Continued

Brand^{a/}	Release site	Number released	Date released	Recaptures		Date recapture	Recapture site (Rkm)
				No.	Cumulative		
RAHE1	RKm 357	205	09/09	1	1	10/15	348
				1	2	10/19	407
RAHE2	RKm 357	164	09/30	1	1	10/07	389
				1	2	10/14	357
RAHE3	RKm 348	141	10/01	1	1	10/05	407
				1	2	11/09	373
RAHE4	RKm 407	230	10/05	1	1	10/28	348
RDHE1	RKm 430	177	10/06	1	1	10/19	407
RDHE2	RKm 373	219	10/13	No recaptures			
RDHE3	RKm 357	214	10/14	1	1	10/27	357
				1	2	11/03	430
RDHE4	RKm 348	40	10/15	No recaptures			
RPHE1	RKm 407	187	10/19	No recaptures			
RPHE2	RKm 430	78	10/20	No recaptures			
RPHE3	RKm 389	43	10/21	1	1	11/04	389
RPHE4	RKm 373	80	10/26	No recaptures			
LAHE 1	RKm 357	157	10/27	No recaptures			
LAHE2	RKm 348	126	10/28	No recaptures			
LAHE3	RKm 407	162	11/02	No recaptures			
LAHE4	RKm 430	112	11/03	No recaptures			
LDHE1	RKm 389	83	11/04	No recaptures			
LDHE2	RKm 373	36	11/09	No recaptures			
LDHE3	RKm 357	106	11/10	No recaptures			
LDHE4	RKm 348	36	11/11	No recaptures			

a/ Position, brand, and orientation, LA indicates left anterior, LD indicates left dorsal, and LP indicates left posterior. Orientation refers to rotation of the brand around its center point. (i.e., 1 equals normal orientation ID, 2 equals , 3 equals , and 4 equals ).

Appendix Table A3.--Average daily discharge McNary Dam, 1982.

Date	Disch. (kcfs)	Date	Disch. (kcf s)	Date	Di sch. (kcf s)	Date	Disch. (kcfs)
June 1	322.5	July 1	396.8	August 1	158.1	September 1	120.5
2	315.5	2	417.8	2	183.5	2	128.8
3	338.8	3	372.4	3	167.5	3	117.1
4	312.1	4	368.6	4	171 .o	4	114.4
5	336.5	5	363.7	5	215.5	5	102.3
6	321.9	6	358.5	6	224.2	6	109.4
7	318.2	7	339.3	7	222 .o	7	140.4
8	336.1	8	321.2	8	188.8	8	160.7
9	302.1	9	338.5	9	197.5	9	158.2
10	305.9	10	327.5	10	185.9	10	161.5
11	299 .o	11	279.3	11	159.8	11	136.0
12	296.9	12	288.4	12	168.1	12	128.5
13	319.3	13	397.8	13	162.6	13	131 .o
14	344.4	14	287.4	14	169.8	14	141.2
15	395.9	15	284.0	15	124.3	15	139.4
16	399.2	16	269.1	16	147.1	16	134.0
17	398.5	17	250.3	17	153.2	17	133.4
18	389.1	18	230.6	18	171.3	18	113.4
19	427 .o	19	250.3	19	169.2	19	104.7
20	410.1	20	263.0	20	171 .1	20	109.7
21	405.0	21	219.5	21	129.9	21	106.7
22	434.6	22	206.3	22	103.5	22	121.1
23	441.8	23	198.6	23	130.8	23	105.3
24	443.6	24	188.2	24	155.9	24	110.0
25	417.5	25	188.8	25	127.7	25	90.5
26	379.2	26	205.2	26	134.6	26	99.1
27	385.1	27	217.8	27	122.2	27	101.6
28	404.2	28	209.6	28	195.6	28	109.6
29	371.6	29	208.6	29	84.2	29	122.1
30	416.7	30	214.7	30	109.7	30	81.7
		31	184.0	31	130.5		

APPENDIX B

Summary of Major Expenditures

SUMMARY OF EXPENDITURES

<u>Category</u>	<u>Amount</u>
Personnel	\$ 74,852.69
Travel	4,210.58
Transportation	1,074.96
Contract services	27,049.00
Supplies and materials	15,264.66*
Support	27,943.41
TOTAL	\$150,395.30

*Major individual expenditures exceeding \$500.00:

<u>Item</u>	<u>Amount</u>
Coded wire tags (40,000)	\$ 2,018.00