MONITORING OF DOWNSTREAM SALMON AND STEELHEAD AT FEDERAL HYDROELECTRIC FACILITIES -1986

Annual Report

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INTRODUCTION

The seaward migration of salmonid smolts was monitored by the National Marine Fisheries Service (NWFS) at four sites on the Snake-Columbia system. In addition, a fifth site was monitored by contract from WMFS to Washington Department of Game (WDG). This project was a part of the continuing monitoring program on Columbia Basin salmonid stocks coordinated by the Fish Passage Center (FPC). Funding was provided by the Bonneville Power Administration (BPA).

Major sampling sites were at Lower Granite, McNary and John Day Dam with a minor site at Lower Monumental Dam (by WDG) and collection of data from NMFS research units at Bonneville Dam, powerhouse #l and #2 (P.H. #1 & #2) as available per their testing schedule. Data from the major sites provided information mainly for evaluation of smolt survival, travel time, and migrational timing as required by FPC analysts. At Lower Monumental Dam, sampling provided data for an indication of smolt passage by species, and for comparison with the hydroacoustics passage index. To secure these data, it was necessary to monitor and index smolt passage at the three major sites. This involved: 1) the systematic sampling of the smolt migration from 5 April to 24 July at *Lower* Granite Dam, 26 March to 26 September at McNary Dam, and 28 March to 30 October at John Day Dam; 2) recovering and recording brands; and 3) daily reporting of all pertinent fish capture and river flow data for passage estimates and travel indices to the NMFS Fish Passage Data Information System (FPDIS) for the FPC. Catch or sample numbers, brand recapture and flow data were collected and reported from sampling operations at Lower Monumental Dam from 25 Marach to 23 August. Similar data from Bonneville Dam were reported from PH #l as available from late March dipnetting until the Downstream Migrant Facility (DSM) was placed in operation on 12 May and thereafter as available from testing operations through 26 November. Data from sampling at the PH #2 was available from 4 March through 25 November.

METHODS AND MATERIALS

Monitoring the smolt migration at Lower Granite and McNary Dams was as reported for 1984 (Johnsen, et. al., 1984) and continued in 1985; a portion of the total number of smolts from the gatewell collection system was sampled by time at a target rate of -- "the lesser of, 3% of the estimated weekly outmigration or, 10% of the weekly total of smolts collected or bypassed", based on the FTOT Annual Work Plan for 1986. In actuality some increase above the target rate was allowed to accommodate the needs of the transport evaluation study for sufficient numbers of markable yearling spring chinook smolts. (Details to be reported in the 1986 FTOT annual report). Sampling methods at John Day and Lower Monumental Dams were identical to 1985, i.e., the airlift pump system in Unit 3 (gatewell B) at John Day Dam, and a dipnet operation in Unit 3 (gatewells A, B and C) at Lower Wonumental Dam. At Bonneville Dam, sampling at PH #l was by gatewell dipnetting in the early spring migration and later from the DSM in the gatewell collection and

bypass channel, described by Gessel (1986); sampling at the PH #2 was from the DSM in the gatewell collection bypass described by McConnell and Muir (1982).. Smolt.capture data reported for PH #l and #2 were from the NMFS research operations: flow data was obtained from the Corps of Engineers (CoE).

The typical sampling frequency was as follows:

Site	
Lower Granite Dam	Daily: 24 hour cumulative sample.
Lower Monumental Dam	Five days per week: hourly, 8 hours per day plus a biweekly 24 hour diel.
McNary Dam	Daily: 24 hour cumulative sample.
John Day Dam	Daily: 24 hourly samples.
Bonneville Dam	Four to five days per week;
PH #l	Dipnet: 24 hour cumulative sample. DSM: 8 hourly samples plus periodic die1 samples;
PH #2.	24 hour cumulative sample.

Data was reported daily to the FPDIS or as requested by the FPC. The IBM-PC transmission system by phone line, initiated in 1985, was utilized for timely reporting. Each site reported directly to the FPDIS except Lower Monumental Dam which relayed their data through the Rufus Field Station the following weekday morning. Data verification was an on-going effort through the season, usually accomplished by on-site personnel. Brand recapture verification typically is the most time consuming and frequently difficult task, but its value justifies the effort.

Analysis and evaluation of these monitoring data are being performed by the FPC. Detailed data from each sampling site will be available from the FPDIS, Portland, Oregon and analysis in the FPC Columbia Basin Smolt Monitoring report for 1986.

RESULTS AND DISCUSSION

Sampling results for field season 1986 are-presented in Table 1. In brief, it summarizes the results of the hands-on assessments of smolt movement into or through the hydroelectric facilities at the listed sites.

Lower Granite Dam

Sampling at Lower Granite Dam this season was routine and essentially the same as 1985 except for the pre-anesthetiter modification: no other changes or problems were significant. The extensive redesign of the pre-anesthetizing system required thorough operational testing to develop reliable techniques for consistent

TABLE 1.--Summary of 1986 smolt Sampling activities at Lower Granite, Lower Monumental, McNary, John Day, and Bonneville Dams.

Species	Dam	Total[1/] number sampled	Total number of brands in sample	Est.[2/] total number collected	Number of days species occurred in sample
Chinook l's	Lower Granite	153,677	4,286	1,625,352	113/113
	Lower Monumental	16,496	1,676	16,496	82/110
	McNary	244,990	15,978	2,486,407	105/185
	John Day	92,591	6,084	92,591	144/216
	Bonneville PH #1	9,495	510	48,282	46/85
	Bonneville PH #2	10,917	254	10,917	70/146
Chinook O's	Lower Granite	4,661		51,628	63/113
	Lower Monumental	19,768	835	19,768	72/110
	McNary	462,346	5,373	6,135,379	180/185
	John Day	182,117	1,927	182,117	201/216
	Bonneville PH #l	23,252	104	86,220	85/85
	Bonneville PH #2	16,844	20	16,844	134/146
Steelhead	Lower Granite	237,856	3,027	3,089,551	113/113
	Lower Monumental	24,837	7,337	24,837	108/110
	McNary	73,931	10,595	716,335	135/185
	John Day	37,822	4,324	37,822	114/216
	Bonneville PH #1	3,753	244	19,181	21/85
	Bonneville PH #2	1,494	46	1,494	50/146
Coho	Lower Granite	4		85	4/113
	Lower Monumental	83		83	26/110
	McNary	7,841	6	80,436	111/185
	John Day	1,994	2	1,994	68/216
	Bonneville PH #1	11,538		54,181	62/85
	Bonneville PH #2	6,112		6,112	103/146
Sockeye	Lower Granite	554		7,410	32/113
	Lower Monumental	183		183	67/110
	McNary	78,793	1,638	797,040	155/185
	John Day	17,505	304	17,505	116/216
	Bonneville PH #1	2,883	51	14,350	24/85
	Bonneville PH #2	2,599	32	2,599	40/146

1/ Sample is actual collection at John Day, Lower Monumental and Bonneville Powerhouse #2.

2/ Total number collected may differ form other published summaries because of different hourly cut-off periods for daily estimates.

and efficient operation. It was necessary for operators to gain experience in determining appropriate concentrations, and for timely delivery of these fish at a manageable rate to the sorting trough. From our view and that of the NMFS research unit charged with transport marking [2/] the redesign was well worth the effort. There is yet room for improvement in the speed of operation and conservation of anesthetic quantities. We suggest improvements might be made: 1) in crowding fish into the pre-anesthetizer compartment: 2) in estimating the number of fish that enter the pre-anesthetizer each sequence, and; 3) in reducing the quantity of anesthetic required [3/].

Lower Monumental Dam

Operations at Lower Monumental Dam (contracted to WDG) were identical to those in 1985 and were performed in a very competent manner. Concurrent dipnetting and hydroacoustics monitoring occurred from 17 April to 18 June. A comparison of the daily fish passage index (FPI), all species combined, and the daily hydroacoustics index (HI), powerhouse and spillway combined, is shown in Figure 1. The graph only reflects fluctuations day to day and should be viewed accordingly; magnitude scales are different for each index and cannot be directly compared. A cursory view indicates some similarities and differences in the daily trends, however a more revealing comparison, likely, would be between the two indices for unit 3 only.

McNary Dam

Monitoring activities at McNary Dam were routine and no significant difficulties were encountered. We did note a significant increase in the number of small (45-55 mm, fork length) O-age chinook fry compared to recent years. From June 1st through June 17th, these fry were a substantial proportion of the chinook 0 component in the daily sample. Since a few fry are common each year, only estimates of their numbers were made the first few days they were present in the sample, but later actual counts were made. Assuming the estimates were reasonably accurate, approximately 75% of the chinook 0 portion of the sample were chinook fry. This expands to about 480,000 [4/] in the total collection for this 17 day period, a number sufficiently large to warrant special considerations in handling, holding and transportation techniques should this occur in future seasons. Their size makes them especially vulnerable to predation when held together with larger fish. The sensitivity of fry to anesthetic in the handling/sorting process of sampling also requires careful and rapid movement of the fry through and into fresh water. Though an estimate of numbers is desirable, it may be possible to

2/ Personal communication, Gene Mathews, NMFS Seattle, Washington.

3/ These suggestions have been discussed with NMFS research, CoE and FTOT representatives.

4/ Estimate by Mark Mobbs, WDF.

FISH PASSAGE INDEX VERSUS HYDROACOUSTICS

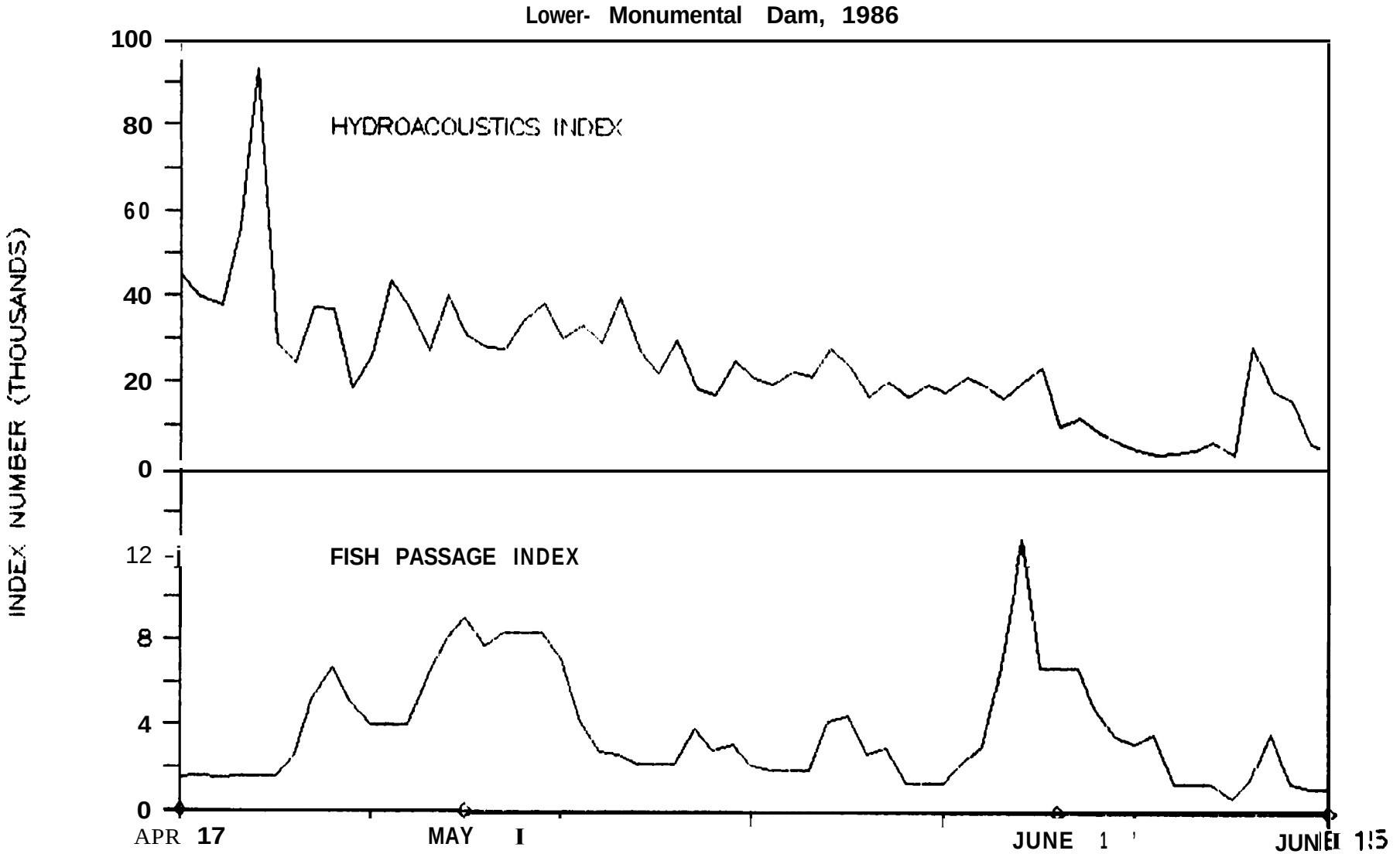

Figure 1. **Smolt index counts,** species **combined, compared with the** hydroacoustics **index for Lower Monumental Dam during concurrent sampling, 1986.**

accomplish this without subjecting the fry to the anesthetic. This will be attempted in the future.

John Day Dam

Monitoring activities at John Day Dam were of a routine nature and consistent with the latter portion of the 1985 spring season after completion of operational testing of the airlift pump system necessary with the STS installation. No major operational difficulties arose. A significant increase in the proportion of chinook fry was noted in early June, possibly as substantial as that found at McNary Dam. From June 4th to 20th these fry (40-55 mm, fork length) averaged about 60% of the chinook 0 catch. Though no specific data is available to separate fry from larger chinook O's in past years, in more than 10 years of observations of the smolt migration at John Day we have never observed the abundance of fry that was evident in 1986. (Large numbers of fry were also noted by NMFS research units evaluating STS effectiveness and the smolt bypass system in early to mid June [5/]).

In the hops of providing additional and useful data from John Day Dam, not previously covered in our or other summaries we are presenting the following, with or without comment: Unit 3 discharge (Appendix B, Figure 1); the seasonal passage pattern for each of the salmonid species (Appendix B, Figures 2-6). the weekly die1 catch pattern in Unit 3 (Appendix, Figures 1-53 [6/]) and, concurrent fish passage index and hydro-acoustics passage index in Figure 2.

The die1 passage patterns at John Day Dam in 1986 (Appendix A) with STS's in place affirms the dominant passage pattern documented by Sims, et. a1.(1976) and confirmed in the testing of the funnel airlift pump system (Sims,et. al., 1981). Though usually from 75 to 95% of the turbine passage occurs during night hours for all groups of salmonid smolts, some variations do occur. For example, in early April both Chinook l's (Appendix A, Figure 1) and Steelhead (Appendix A. Figure 34) show a tendency toward day passage, but not so evident later in the season. More dramatic was a one day reversal of the dominant night to day passage in mid August (Appendix A, Figure 24). Chinook fry, the major component (608) of Chinook 0 catches in early to mid June (Appendix A, Figures 13 & 14), also show about 70% day passage in contrast to the larger Chinook O's (typically >lOOmm fork length) which show a dominant night passage pattern (Appendix A, Figures 11-33) essentially the entire season.

The FPI and the HI are presented in Figure 2 for the concurrent sampling period of July 18th through August 15th. Although the FPI is based on Unit 3 catches only and the HI is estimated passage for the entire dam, it appears most daily trends, up and down are similar (the magnitude of the two indices are not comparable).

5/ Personal communication, Dean Brege, NMFS.

6/ Minimum weekly catch shown is: Chinook 1, 500; Chinook 0, 500: Steelhead, 500; Coho, 300: and Sockeye, 300.

FISH PASSAGE INDEX VERSUS HYDROACOUSTICS

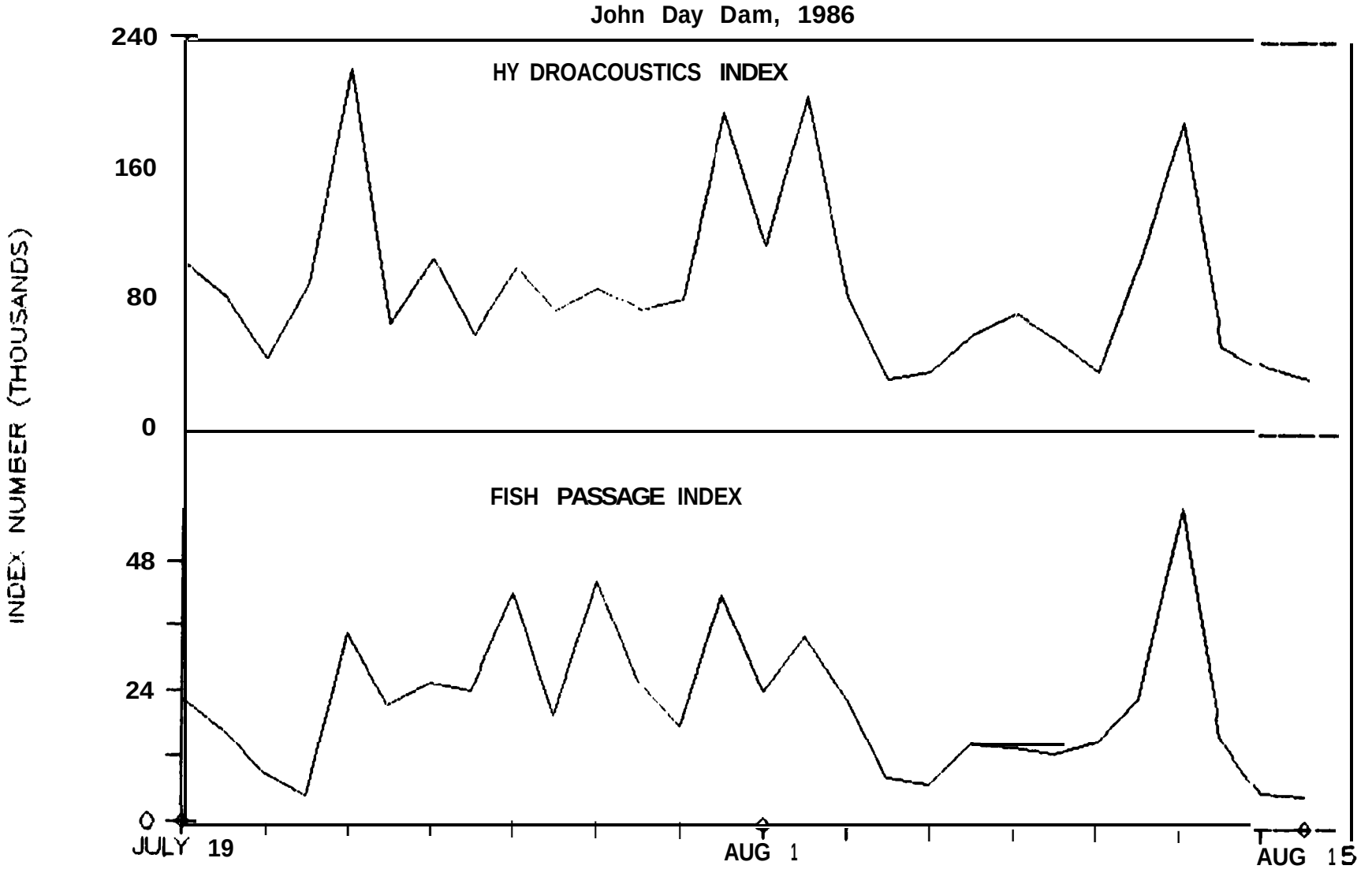

Figure 2. Smolt passage index counts compared with the hydroacoustics index *for* John Day Dam during cconcurrent sampling, 1986. Catches were nearly 99 percent O-age chinook.

Bonneville Dam

Smolt sample data, as mentioned, were available from NMFS research units according to their test schedules at both the first and second powerhouses. Our observer was available to supplement their staff when it was beneficial to their program.

Discharge data for Bonneville Dam was obtained through the courtesy of the CoE. It was not, however, available separately for each powerhouse. To separate the combined powerhouse discharge into distinct flows for PH #l and PH #2, required considerable time and special assistance from the CoE operations unit. For future considerations, simplifying this procedure is highly desirable.

The chronological pattern of sampling at Bonneville Dam is presented in Appendix C, Figures l-5 for Powerhouse #l and 6-10 for Powerhouse #2 Collection shown for PH #l are samples from the DSM trap expanded to an eight hour passage period and the samples from PH #2 are actual counts of fish from the ten percent separator accumulated over 24 hours. (Data from PH #l and PH #2 are not directly comparable). The patterns shown (Appendix C, Figures l-10) indicate that portion of the totals season's sample examined on a specific date, but may not necessarily reflect the complex actual passage pattern(s). The intermittent samples from PH #l (because of trap renovation and outages) provide only a partial picture of seasonal passage patterns. The consistent samples from PH #2, however, do provide an indication of seasonal passage and have direct practical value for future planning. The majority (10 to 90% segment) of the sample totals from PH #2 (Table I) occurred during the following periods:

Chinook l's	4/16 - 5/29
Chinook 0's	3/18 - 7/25
Steelhead	4/24 - 6/4
Coho	4/3 - 6/5
Sockeye	5/14 - 6/6

Cursory comparison of the above periods from PH #2 with the passage at John Day Dam (10 to 90% segments) indicates they are similar (within 10 days) for chinook l's, steelhead and the sockeye smolts; samples of chinook 0's and coho show an earlier starting date likely influenced by the numbers and timing of local hatchery releases in Bonneville pool.

SUMMARY

The 1986 smolt monitoring project of the National Marine Fisheries Service provided data on the seaward migration of juvenile salmon and steelhead at Lower Granite, Lower Monumental (by contract with Washington Department of Game), McNary, John Day, and Bonneville Dams. The number of fish sampled by species, brand recaptures, and pertinent flow data were provided for the Fish Passage Center for the purpose of evaluating smolt survival, travel time, and migrational timing.

7 Does not include fall release of Coho into the Bonneville Pool.

RECOMMENDATIONS

1. Coordination of all activities affecting sampling/monitoring with those individuals or groups directly involved in the sampling process continues to be of major importance. Where multi-agency programs interact at one site, coordination is essential if each unit is to effectively achieve its goals.

2. The best achievable brand quality at time of release must remain as a high priority consideration.

3. A more simplified means of identifying the discharge from PH #1 and PH #2 at Bonneville Dam would be very helpful for future data reporting.

ACKNOWLEDGMENTS

Support for this smolt monitoring project comes from the region's electrical ratepayers through the Bonneville Power Administration.

The success of this program continues to involve cooperative interaction with the Northwest and Alaska Fisheries Center, Coastal Zone and Estuarine Studies Division in both personnel and facilities of the Pasco and Rufus Field Stations. It is appreciated.

On-site biologists, assistants and others of the Corps of Engineers provided valuable guidance and assistance at each sampling site: Lower Granite, Lower Monumental, McNary, John Day, and Bonneville Dams.

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APPENDIX A

WEEKLY DIEL PATTERN
UNIT 3
JOHN DAY DAM
SMOLT MONITORING SEASON 1986

FIGURE	SPECIES/DATES	PAGE
	CHINOOK 1's	
1	APR 6-13	1
2	APR 13-20	1
3	APR 20-27	2
4	APR 27-MAY 4	2
5	MAY 4-11	3
6	MAY 11-18	3
7	MAY 18-25	4
8	MAY 25-JUNE 1	4
9	JUNE 1-8	5
10	JUNE 8-15	5
	CHINOOK 0's	
11	MAY 18-25	6
12	MAY 25-JUNE 1	6
13	JUNE 1-8	7
14	JUNE 8-15	7
15	JUNE 15-22	8
16	JUNE 22-29	8
17	JUNE 29-JULY 6	9
18	JULY 6-13	9
19	JULY 13-20	10
20	JULY 20-27	11
21	JULY 27-AUG 3	11
22	AUG 3-10	11
23	AUG 10-17	12
24	AUG 17-24	12
25	AUG 24-31	13
26	AUG 31-SEPT 7	13
27	SEPT 7-14	14
28	SEPT 14-21	14
29	SEPT 21-28	15
30	SEPT 28-OCT 5	15
31	OCT 5-12	16
32	OCT 12-19	16
33	OCT 19-26	17

FIGURE	SPECIES/DATES	PAGE
	STEELHEAD	
34	APR 6-13	18
35	APR 13-20	18
36	APR 20-27	19
37	APR 27-MAY 4	19
38	MAY 4-11	20
39	MAY 11-18	20
40	MAY 18-25	21
41	MAY 25-JUNE 1	21
42	JUNE 1-8	22
43	JUNE 8-15	22
	COHO	
44	MAY 18-25	23
45	MAY 25-JUNE 1	23
46	JUNE 1-8	24
	SOCKEYE	
47	APR 27-MAY 4	25
48	MAY 4-11	25
49	MAY 11-18	26
50	MAY 18-25	26
51	MAY 25-JUNE 1	27
52	JUNE 1-8	27

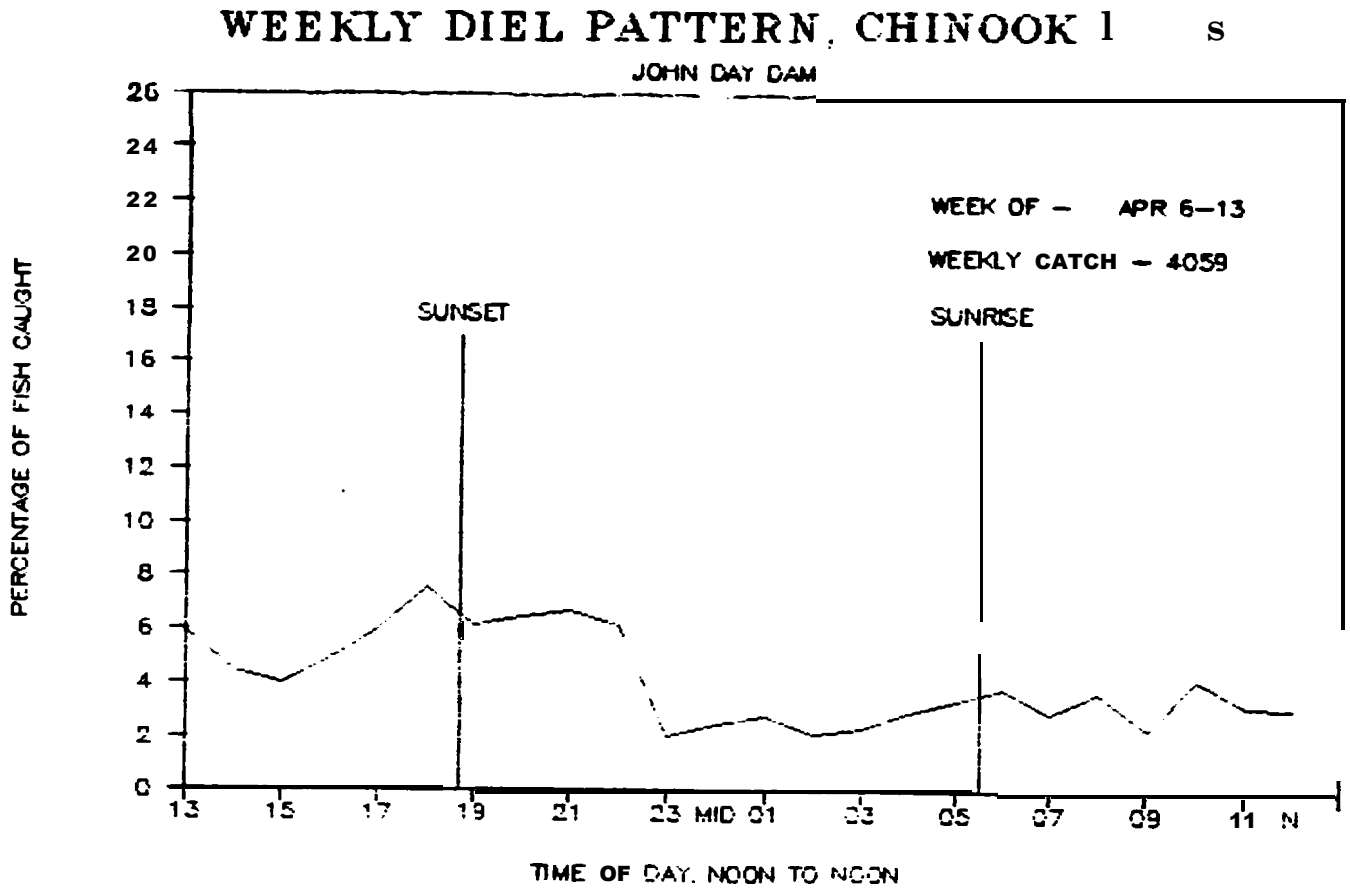

FIGURE 1

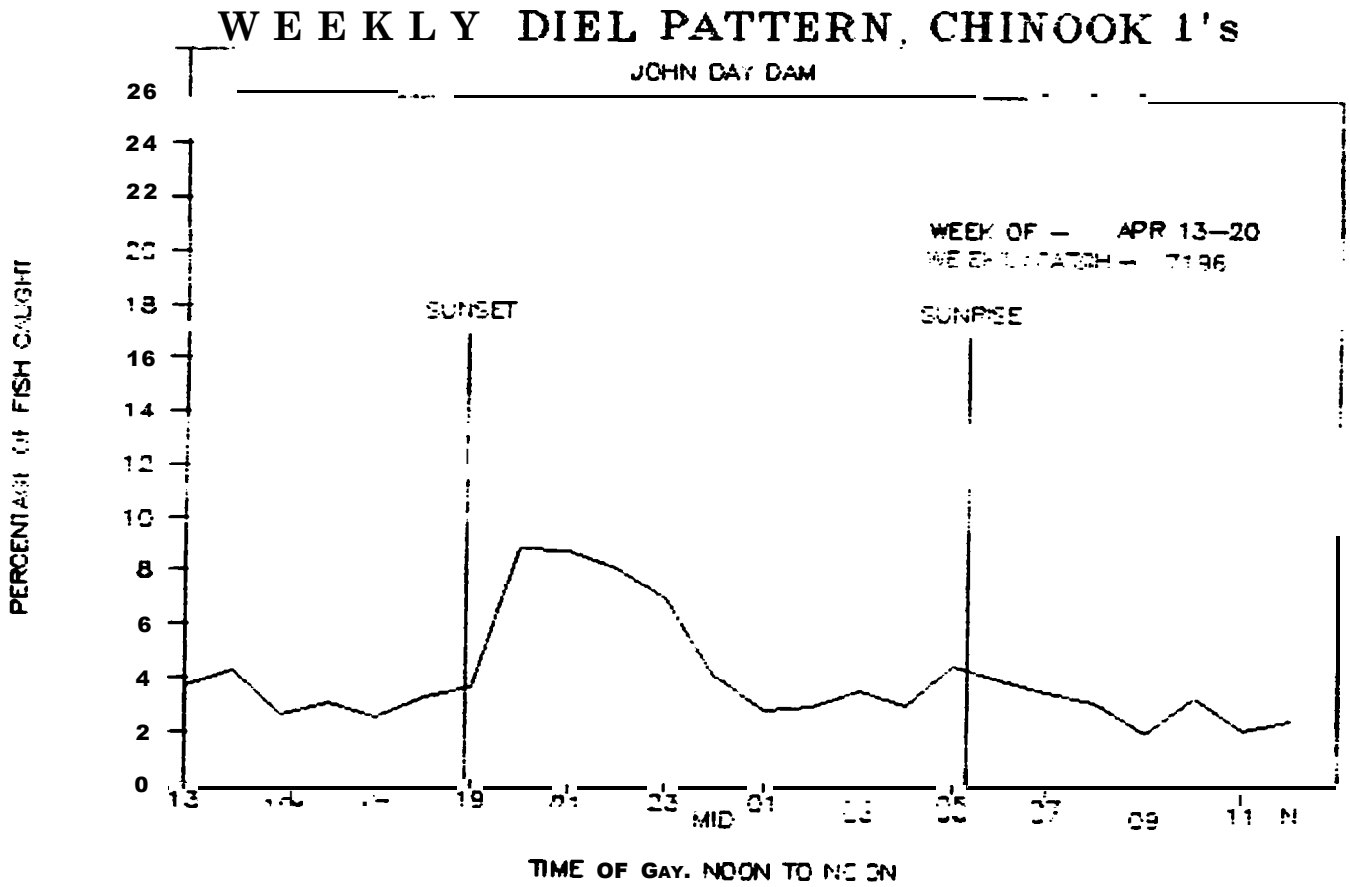

FIGURE 2

WEEKLY DIEL PATTERN, CHINOOK 1's

JOHN DAY DAM

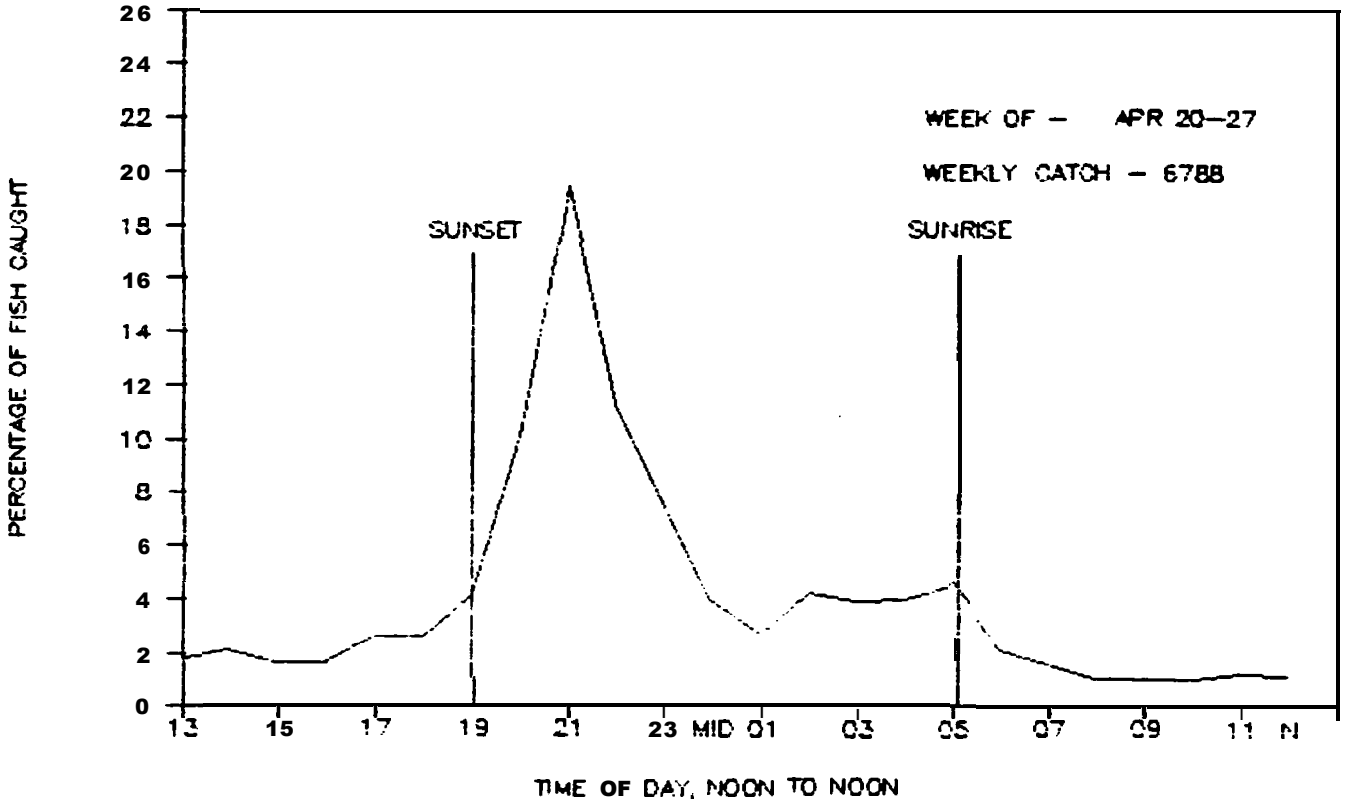

FIGURE 3

WEEKLY DIEL PATTERN, CHINOOK 1 s

JOHN DAY DAM

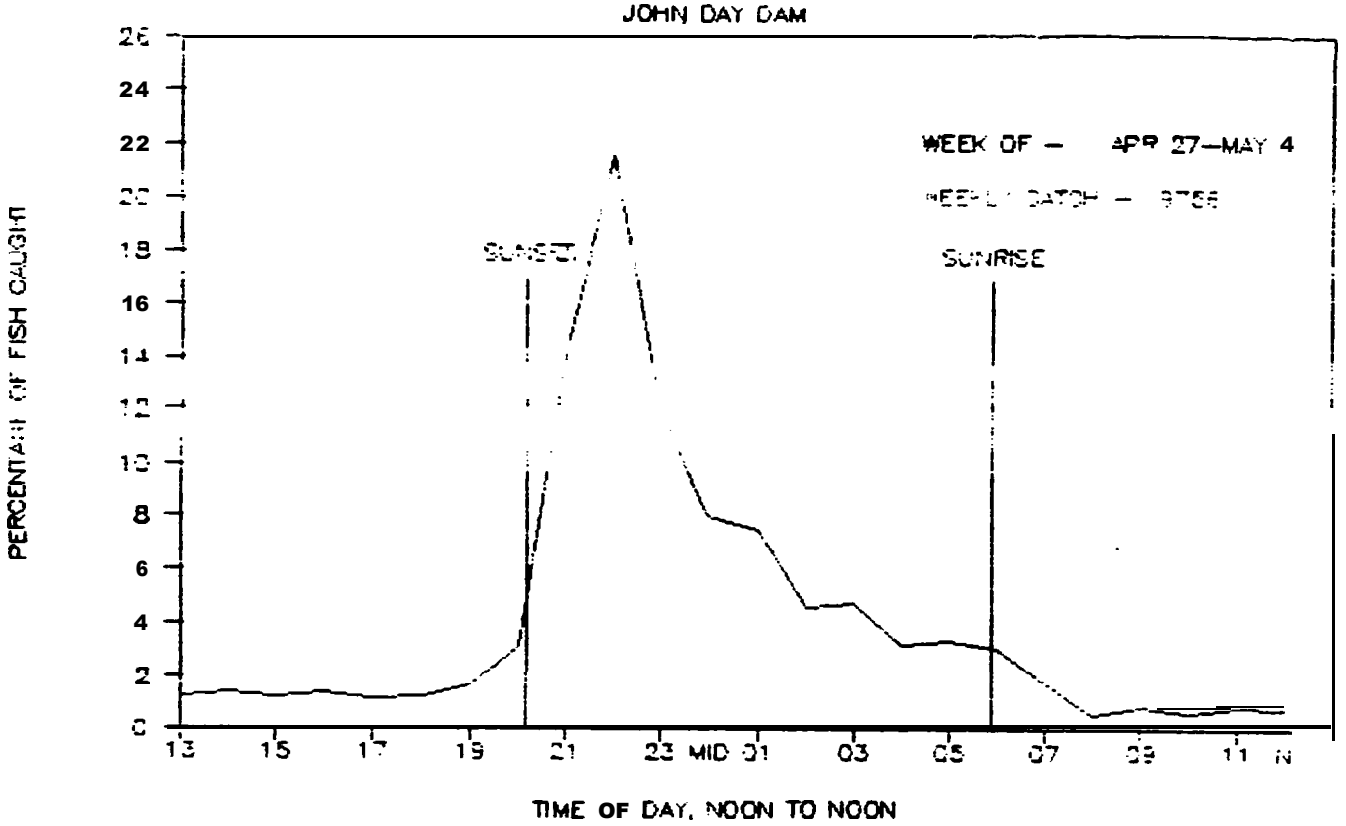

FIGURE 4

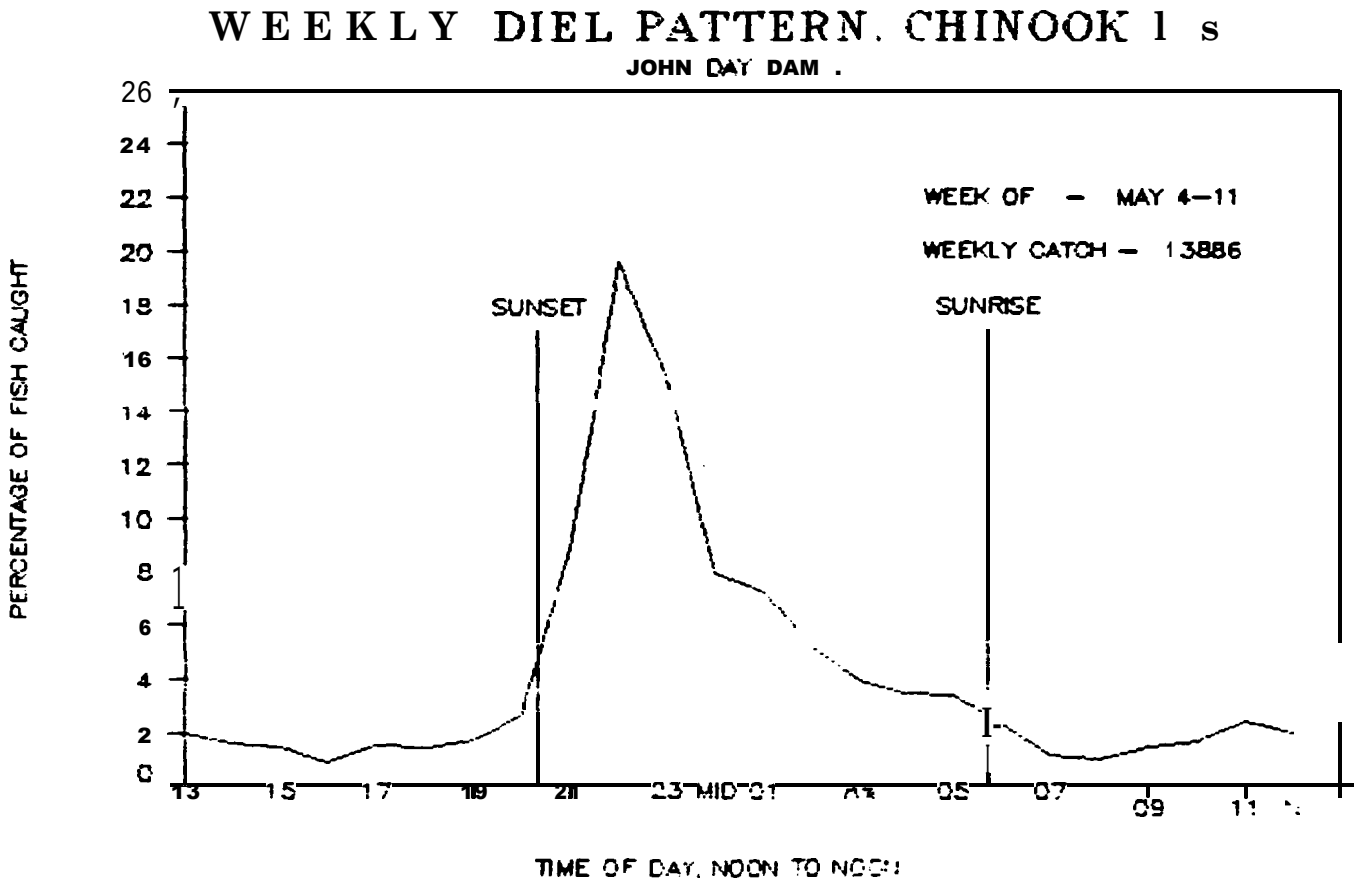

FIGURE 5

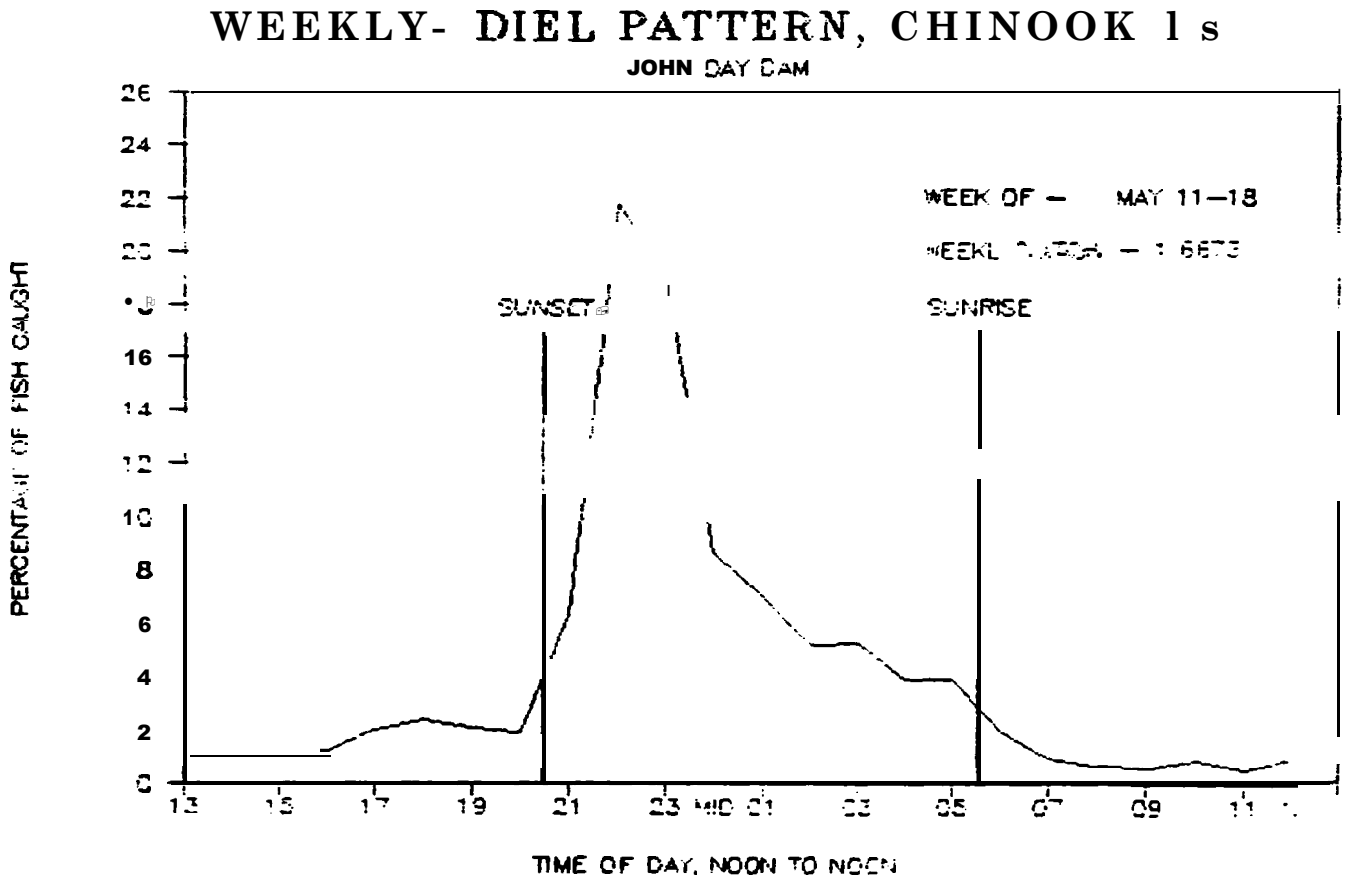

FIGURE 6

WEEKLY DIEL PATTERN, CHINOOK 1 s

JOHN DAY DAM

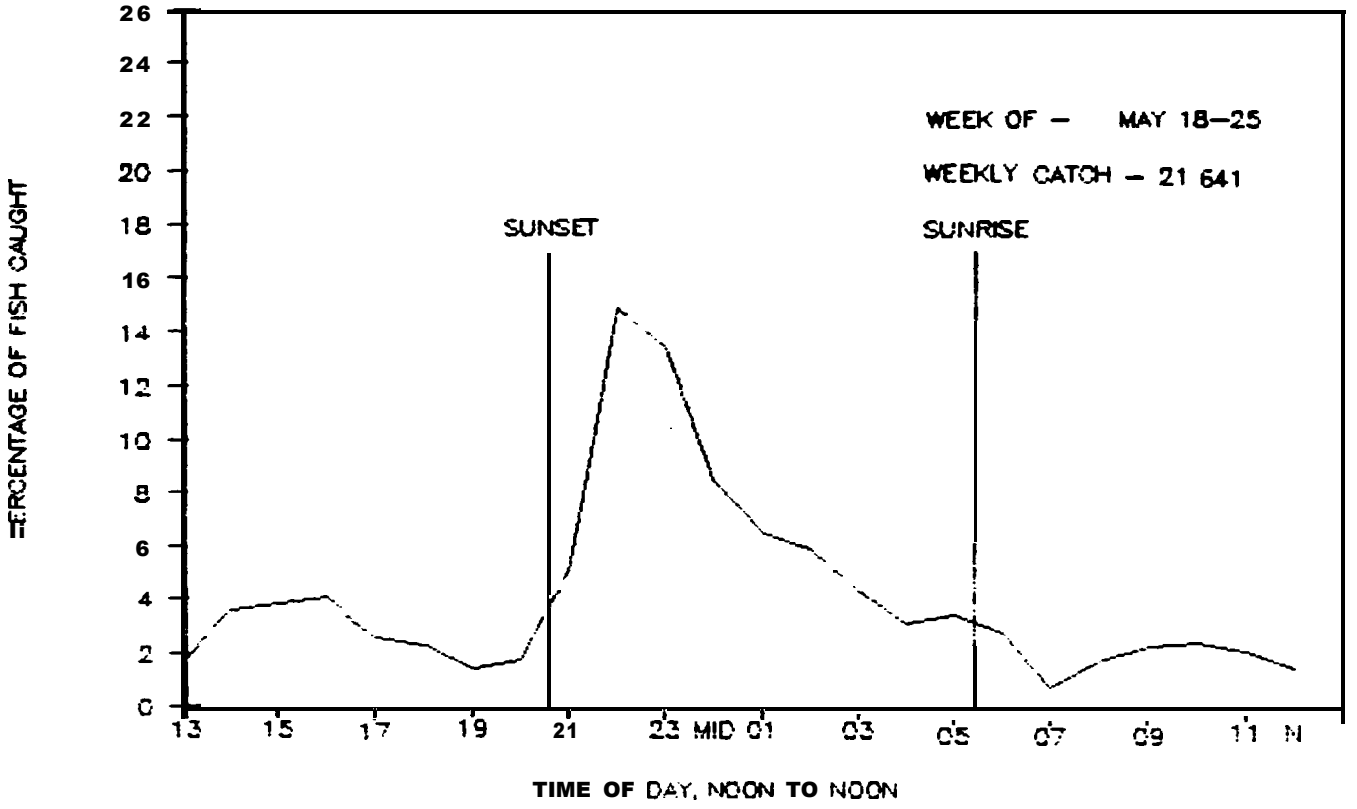

FIGURE 7

WEEKLY DIEL PATTERN, CHINOOK 1's

JOHN DAY DAM

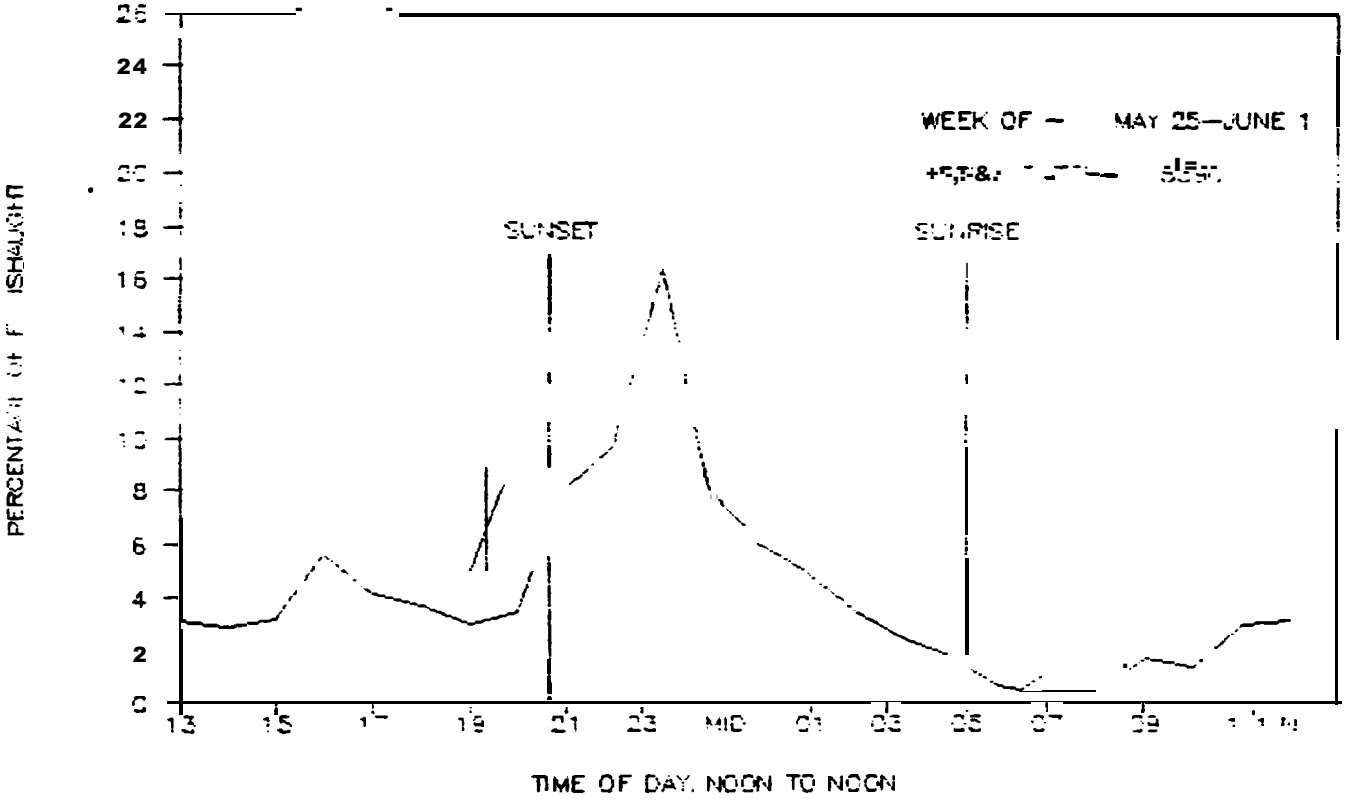

FIGURE 8

WEEKLY DIEL PATTERN, CHINOOK 1 s

JOHN DAY DAM

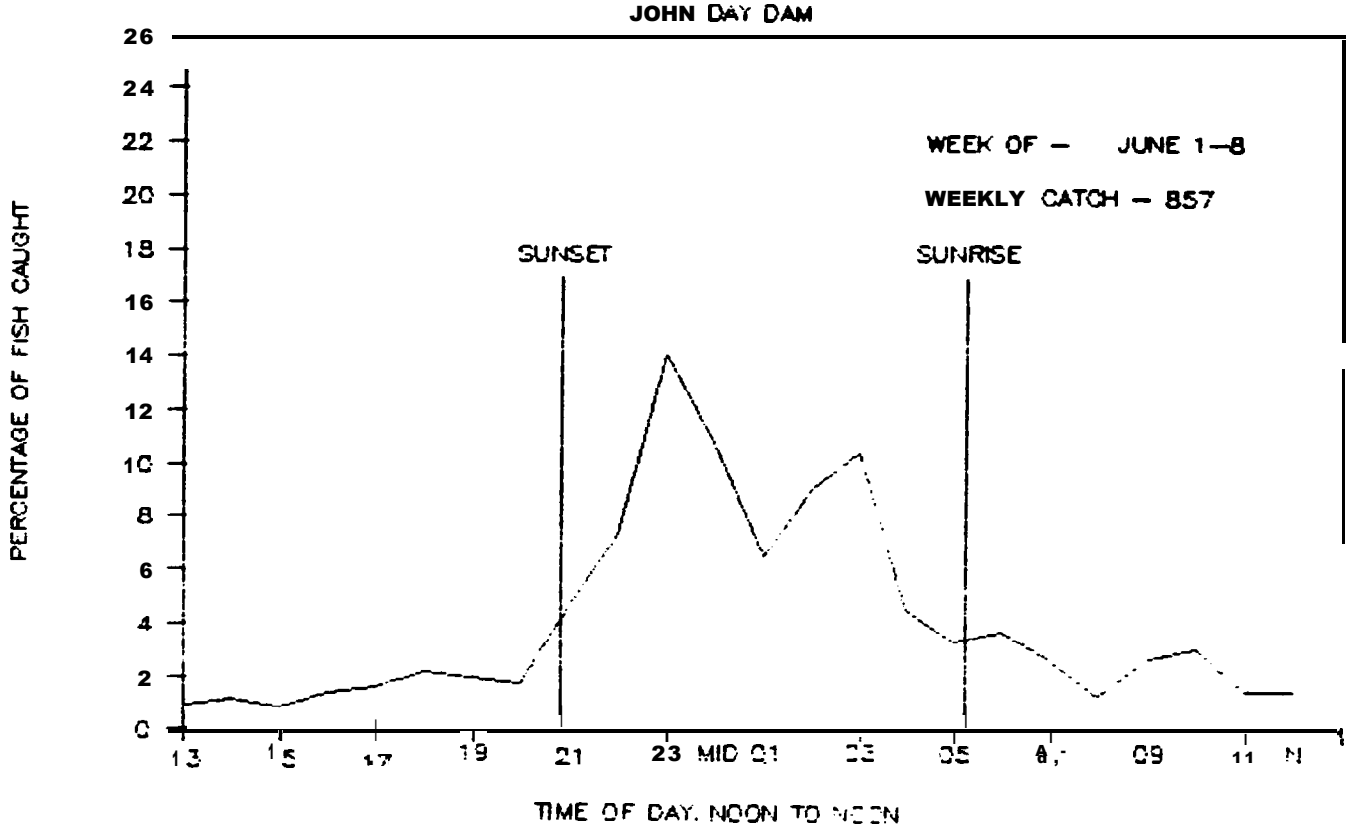

FIGURE 9

WEEKLY DIEL PATTERN, CHINOOK 1 s

JOHN DAY DAM

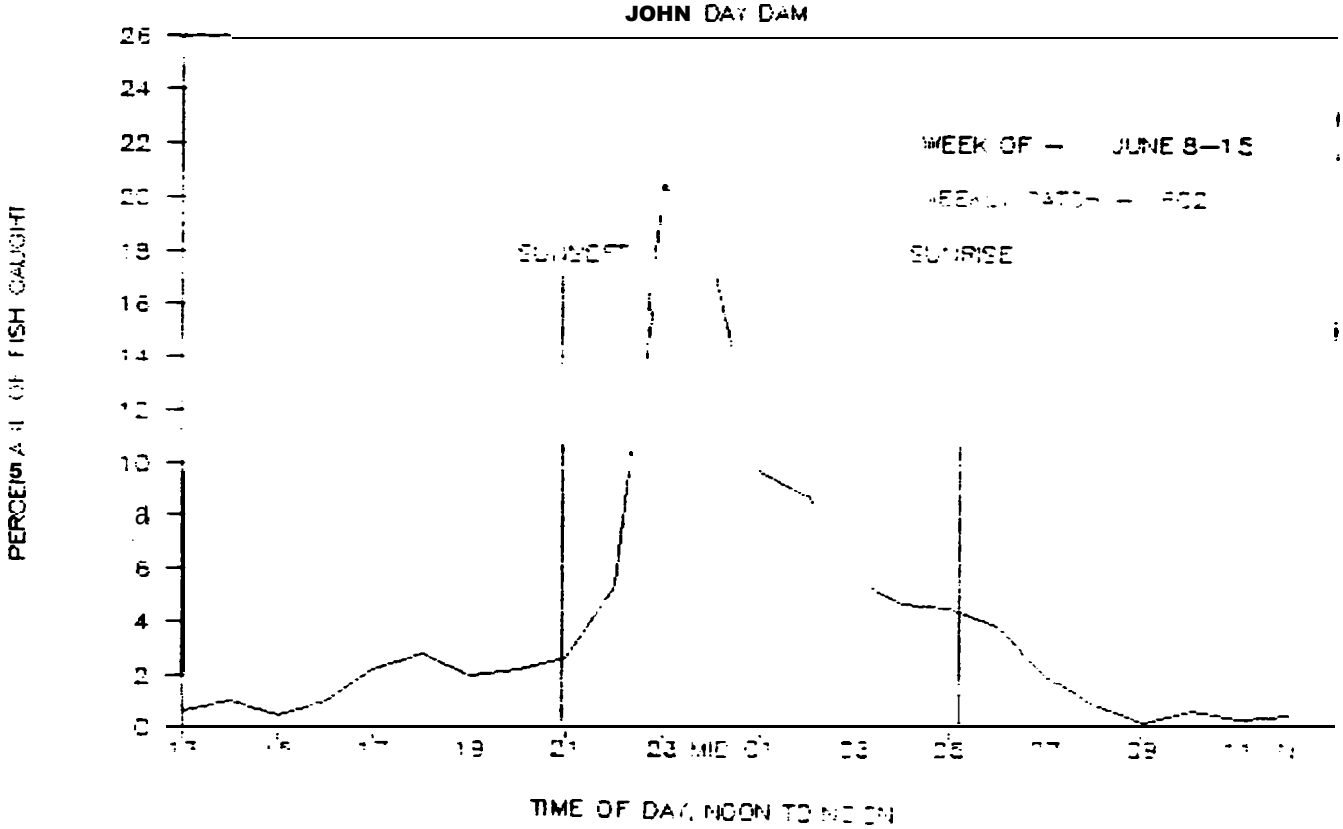

FIGURE 10

WEEKLY DIEL PATTERN, CHINOOK 0's

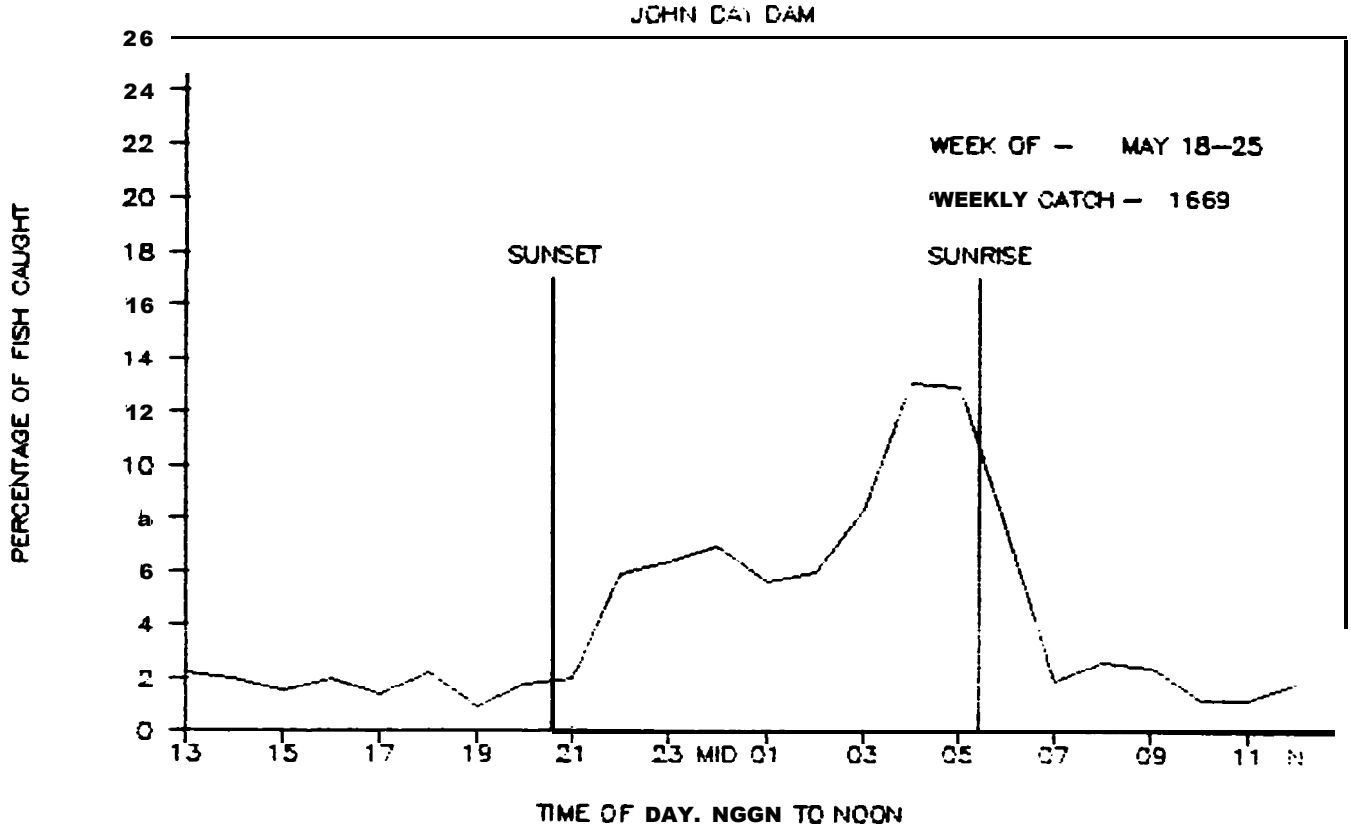

FIGURE 11

WEEKLY DIEL PATTERN, CHINOOK O s

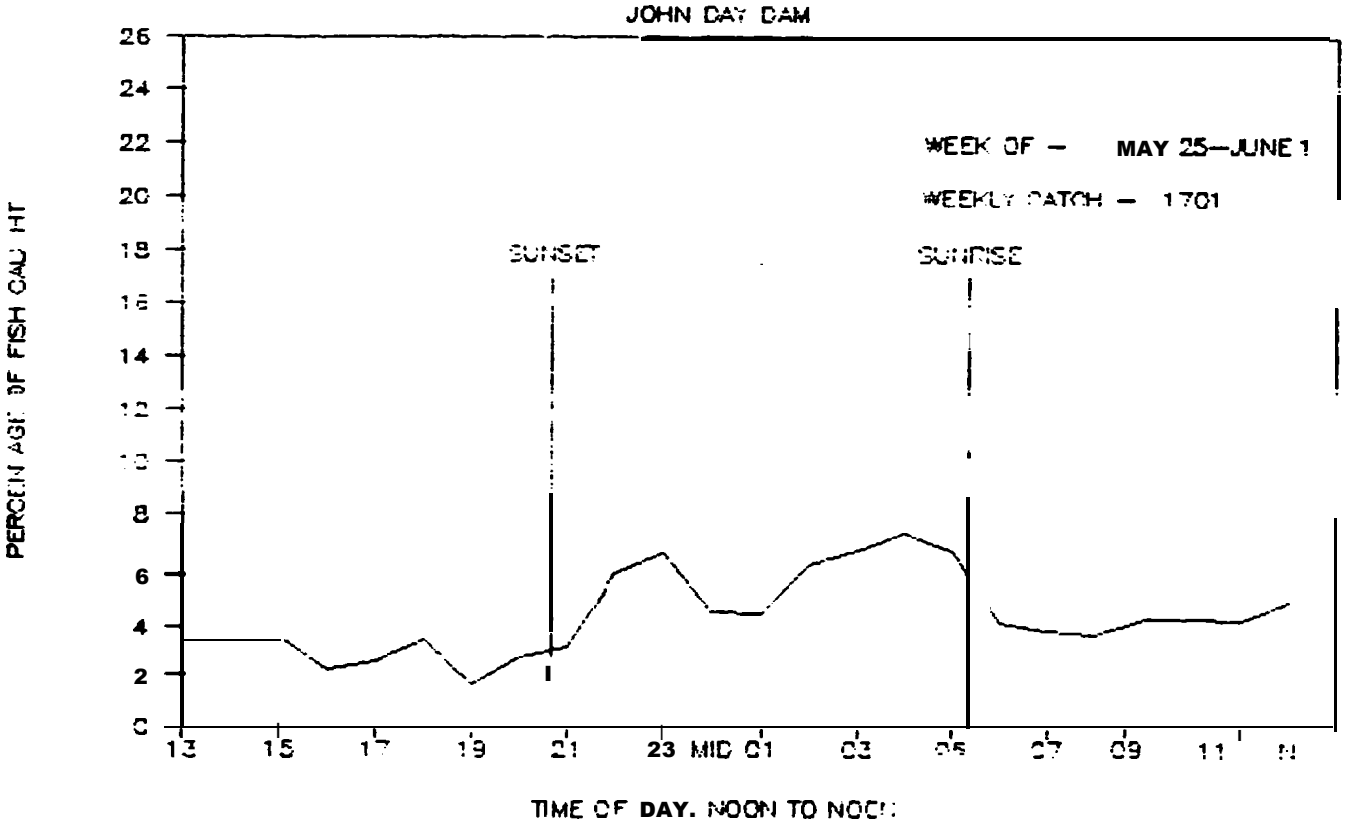

FIGURE 12

WEEKLY DIEL PATTERN, CHINOOK O's

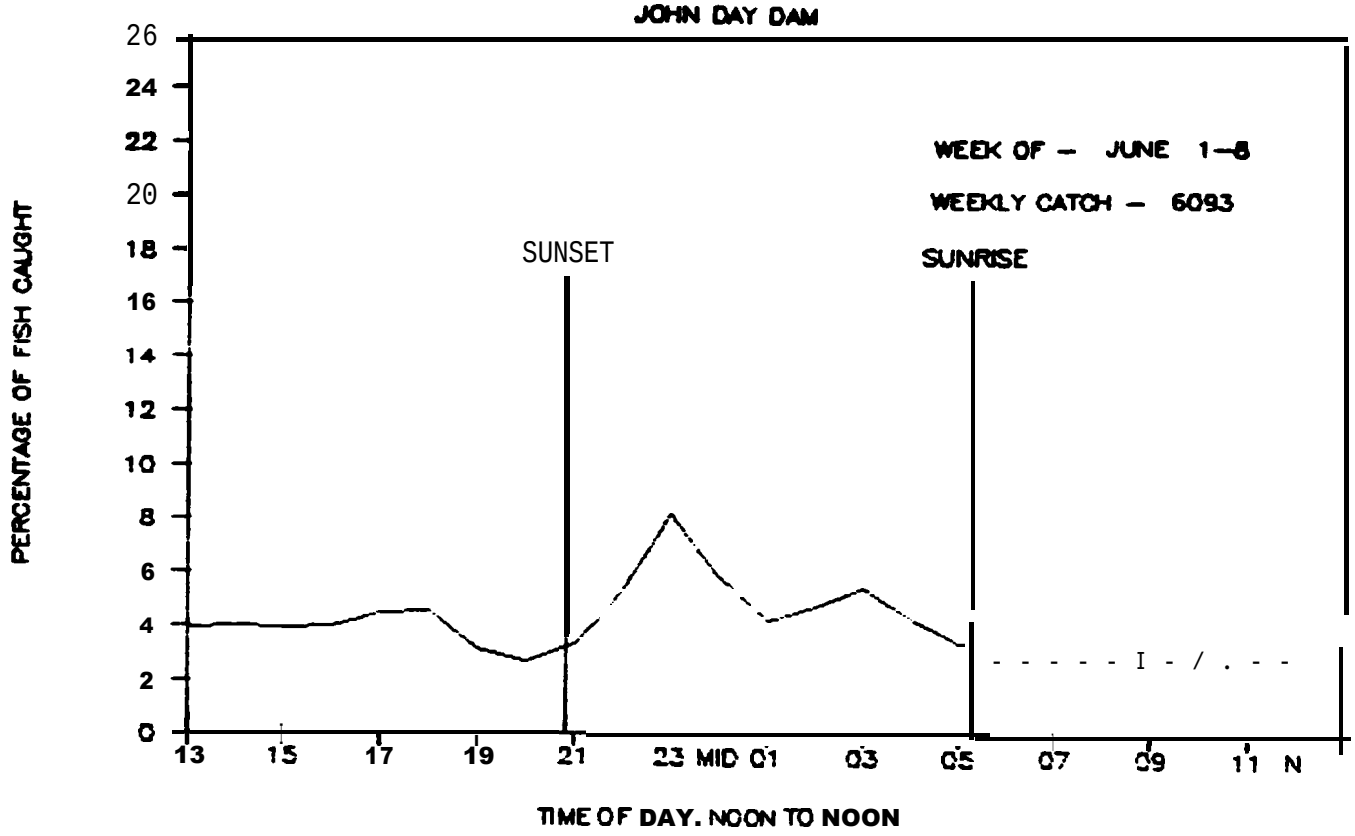

FIGURE 13

WEEKLY DIEL PATTERN, CHINOOK O's

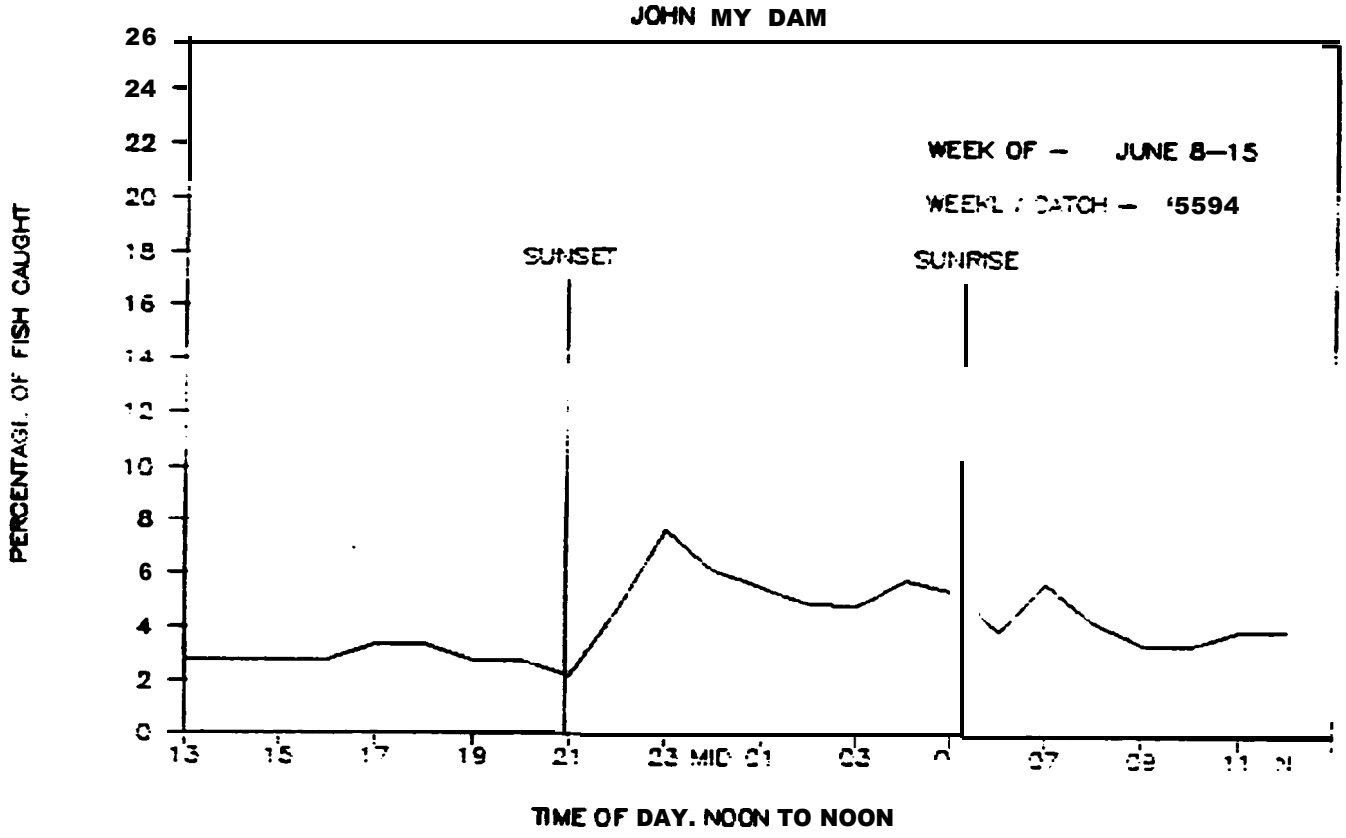

FIGURE 14

WEEKLY DIEL PATTERN, CHINOOK O's

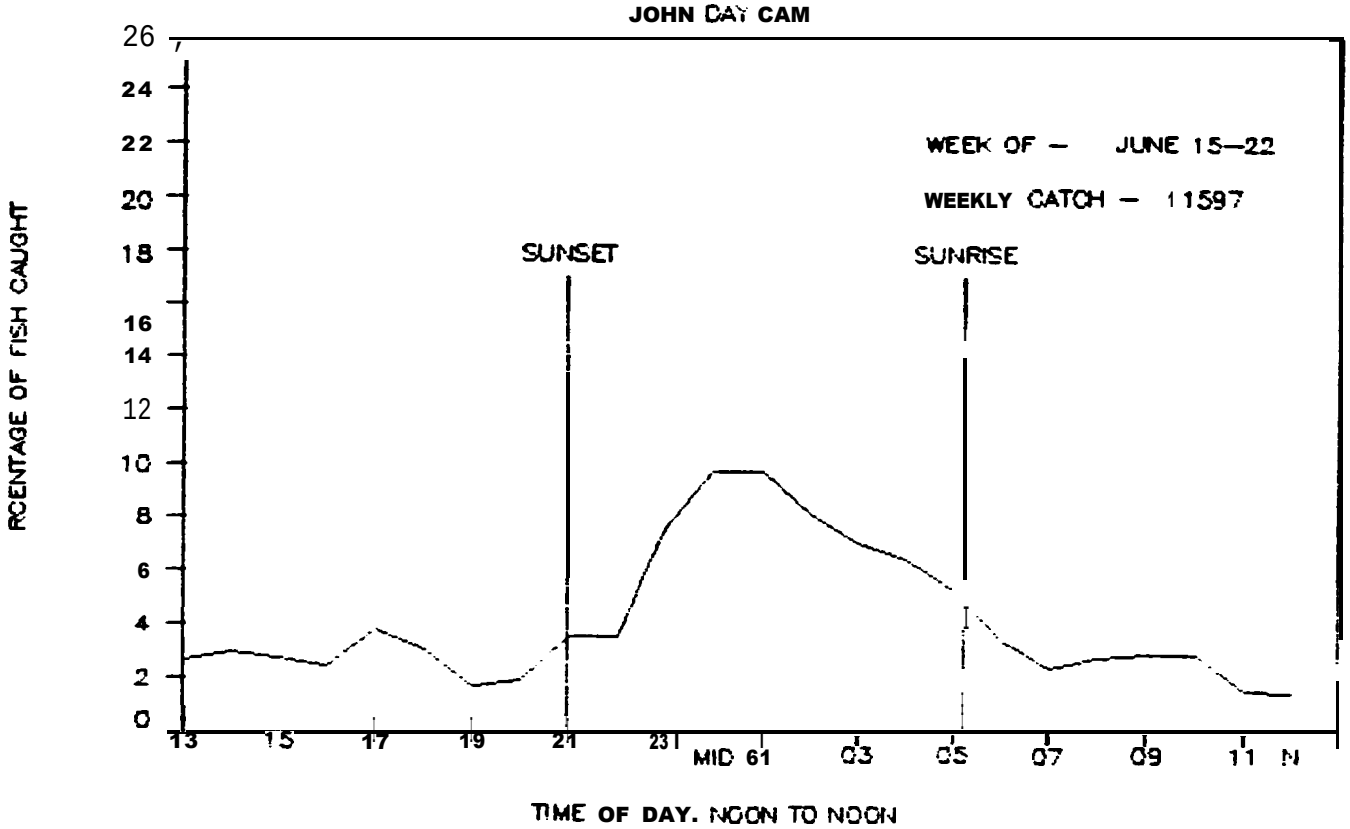

FIGURE 15

WEEKLY DIEL PATTERN, CHINOOK O s

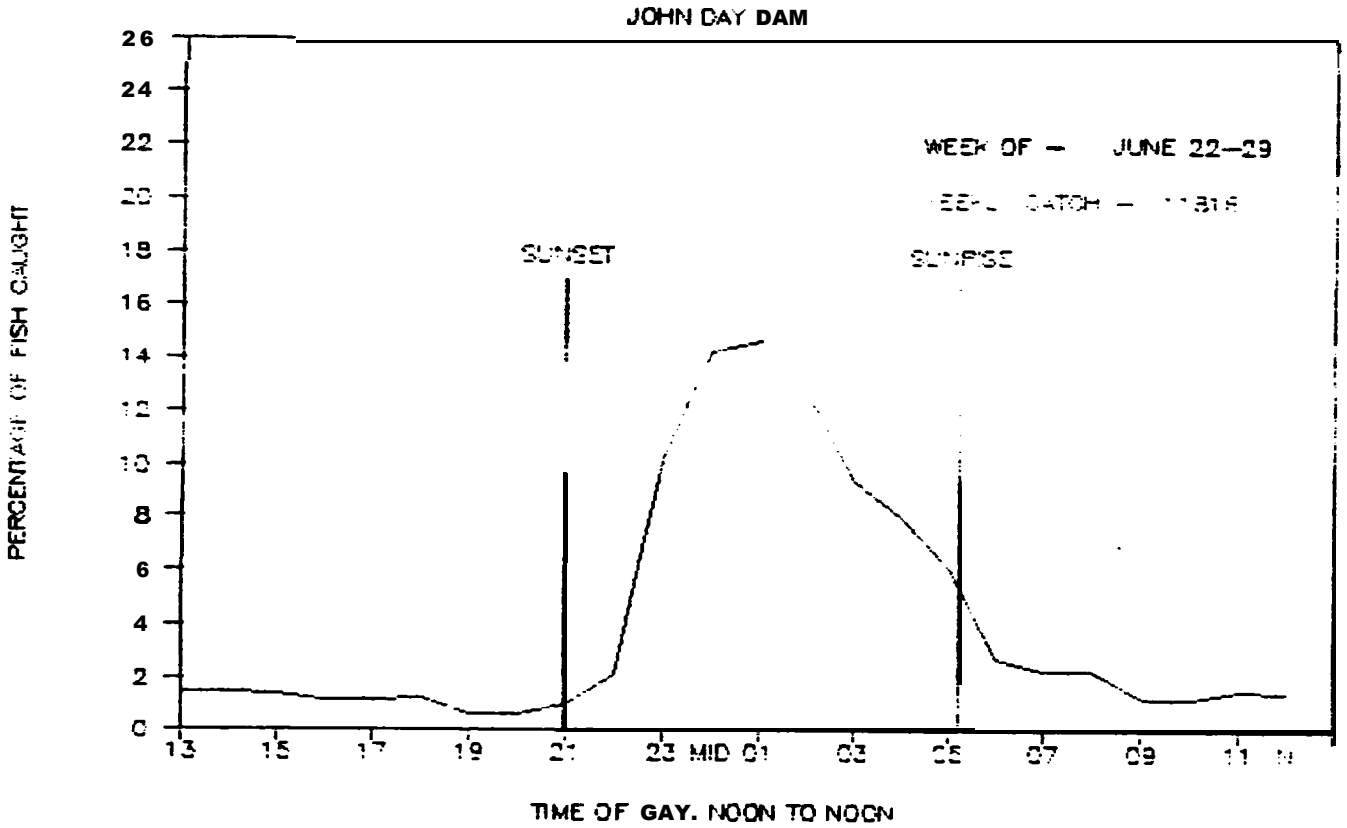

FIGURE 16

WEEKLY DIEL PATTERN, CHINOOK O's

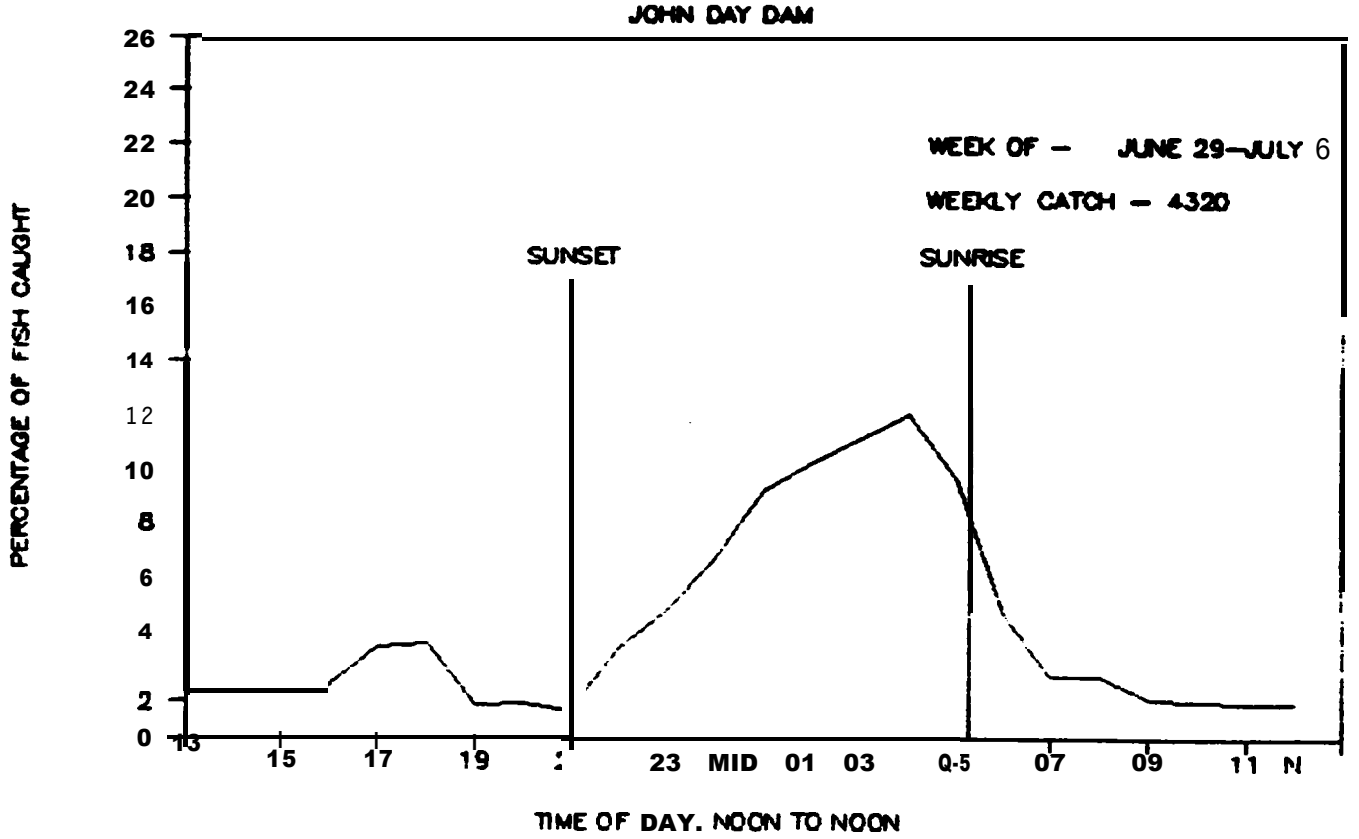

FIGURE 17

WEEKLY DIEL PATTERN, CHINOOK O's

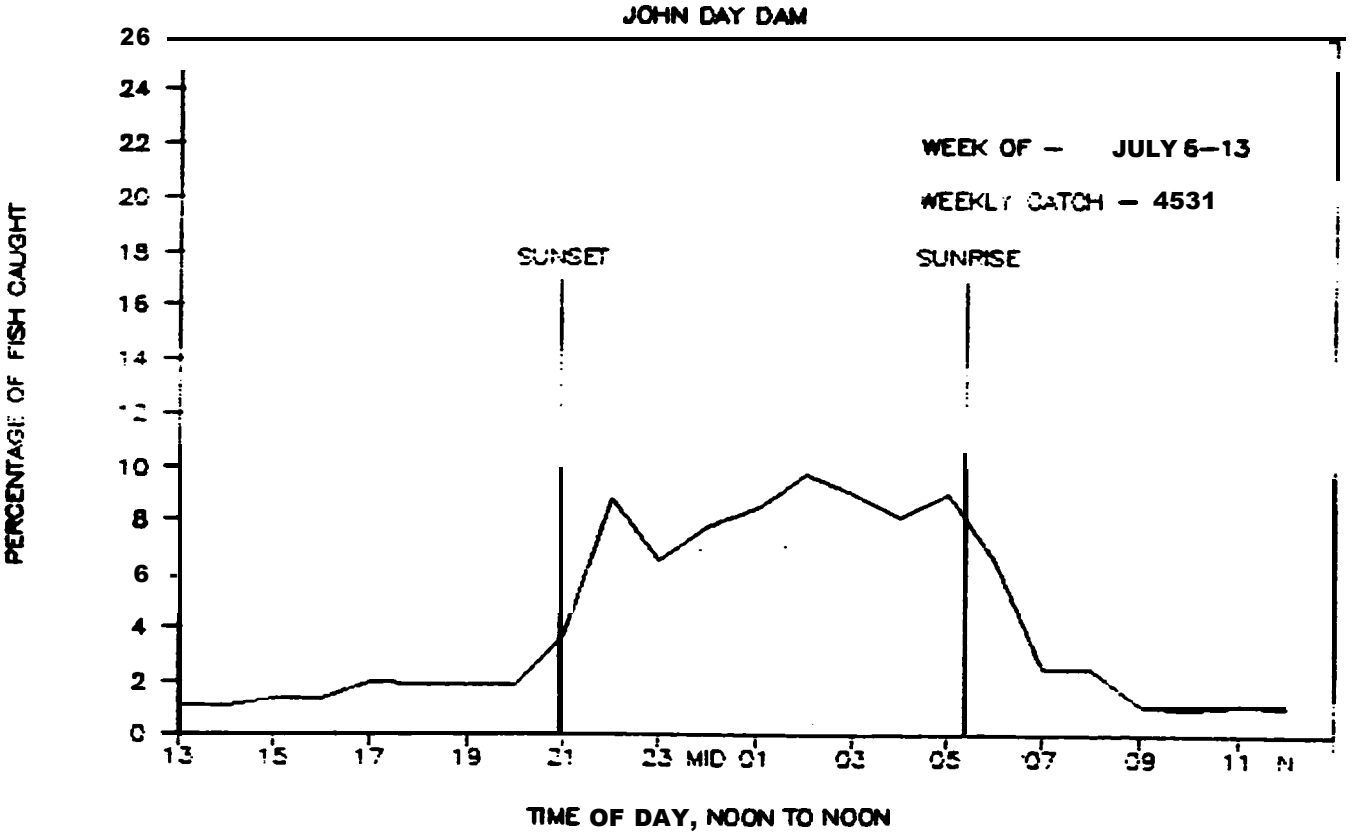

FIGURE 18

WEEKLY DIEL PATTERN, CHINOOK O's

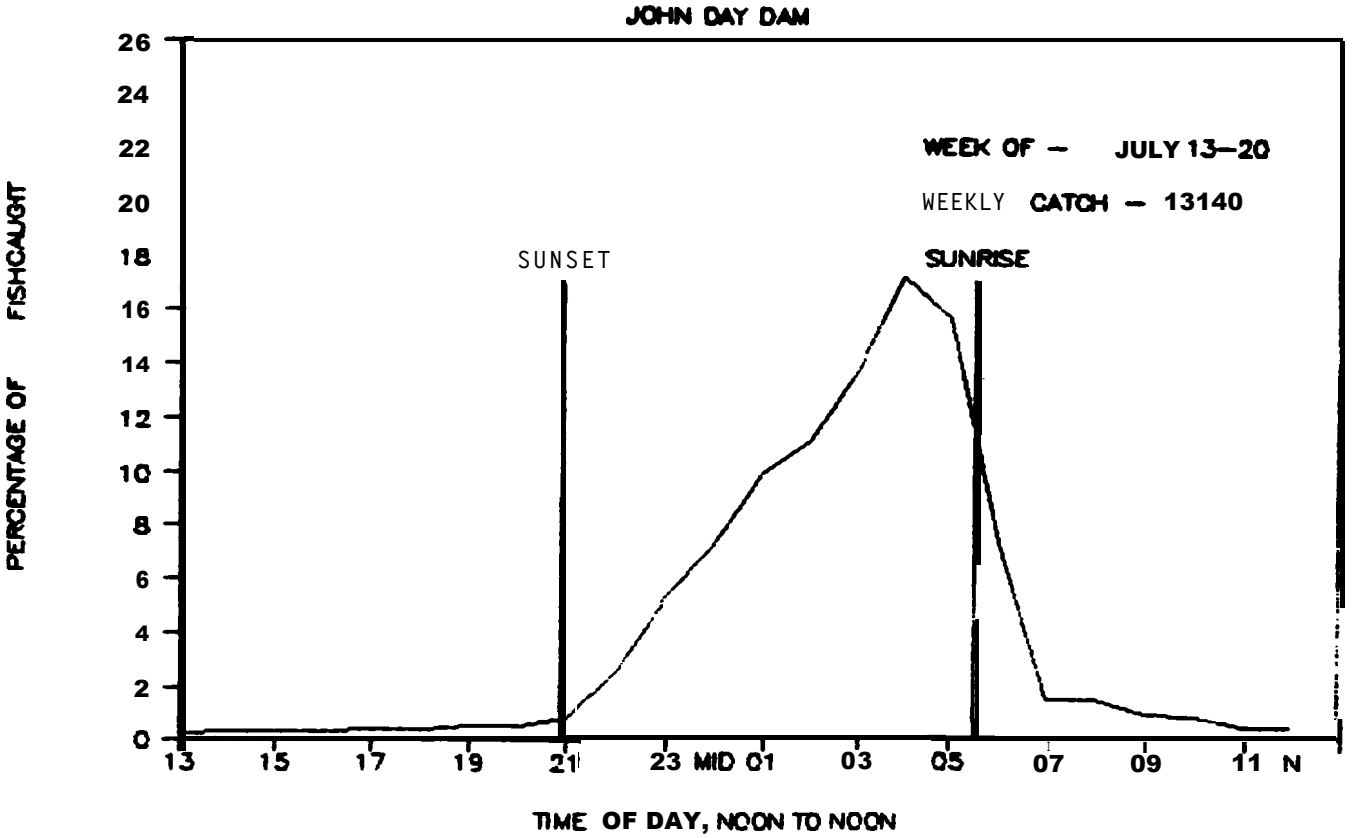

FIGURE 19

WEEKLY DIEL PATTERN, CHINOOK O's

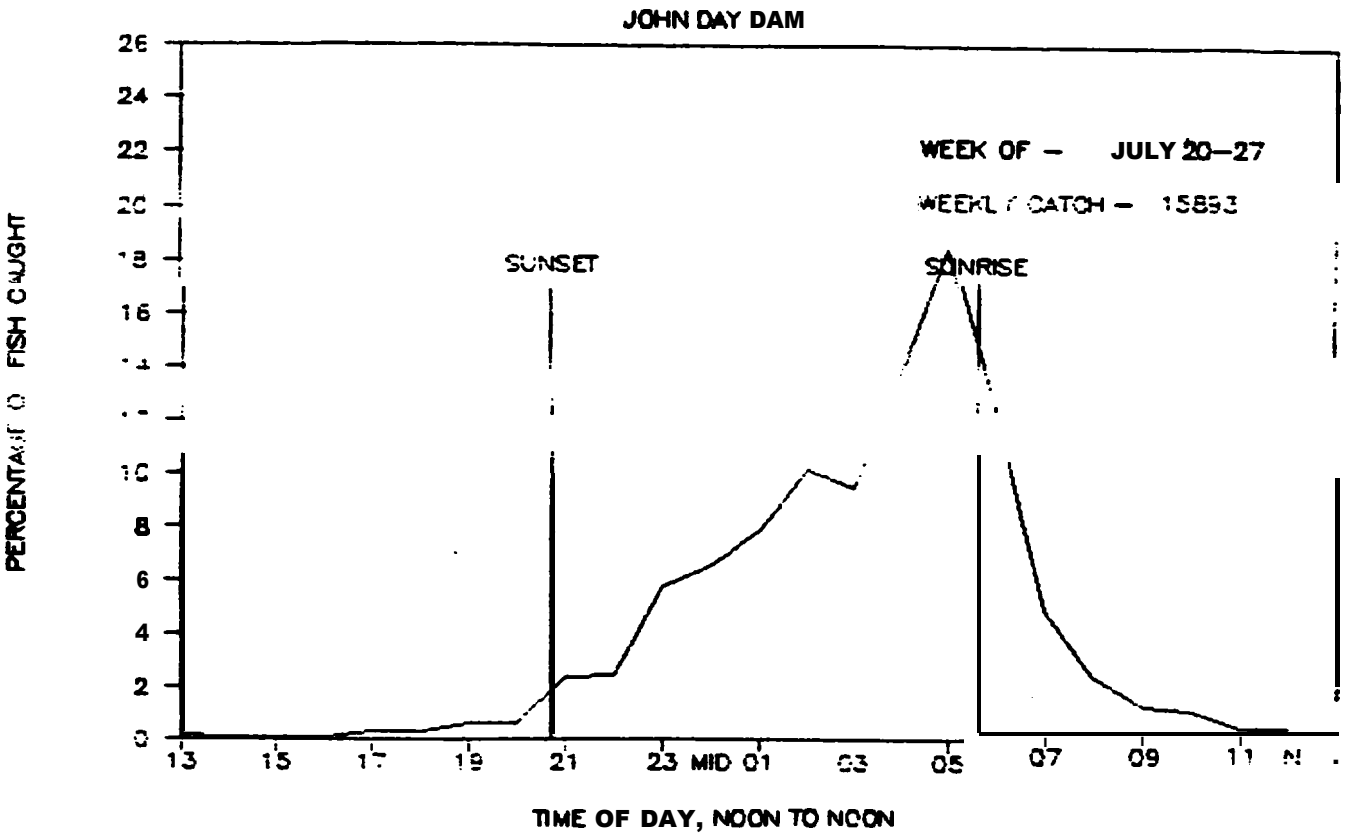

FIGURE 20

WEEKLY DIEL PATTERN, CHINOOK O's

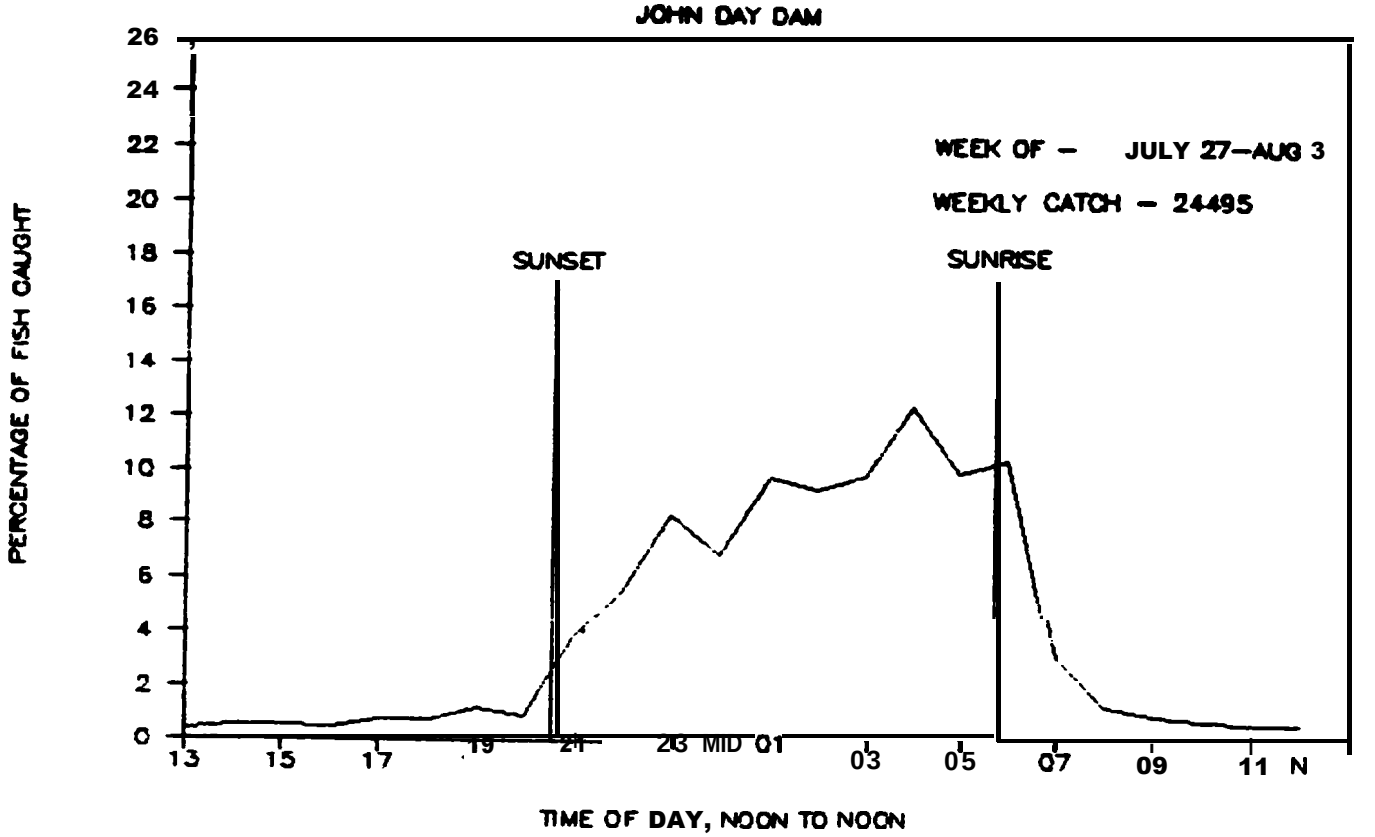

FIGURE 21

WEEKLY DIEL PATTERN, CHINOOK O's

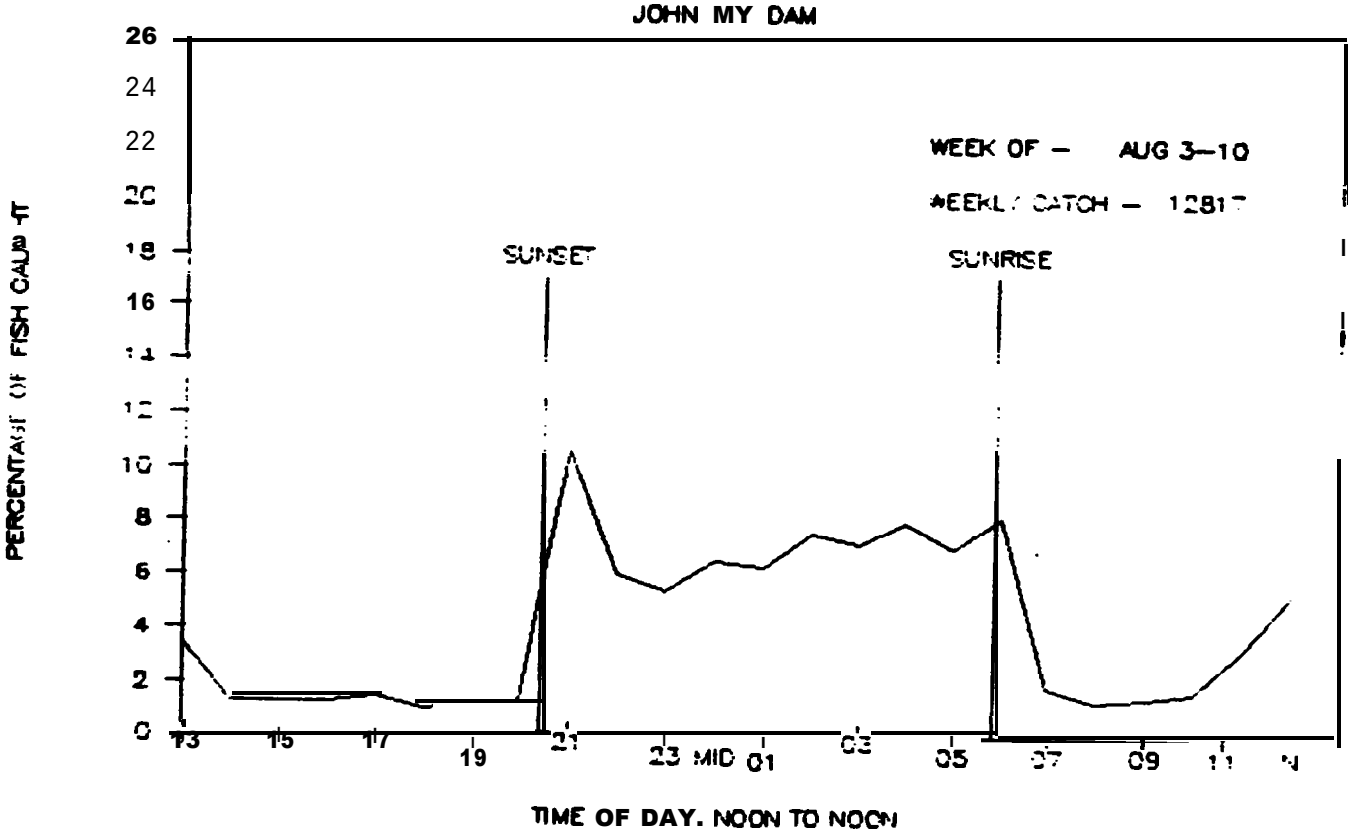

FIGURE 22

WEEKLY DIEL PATTERN, CHINOOK O s

JOHNDAYDAM

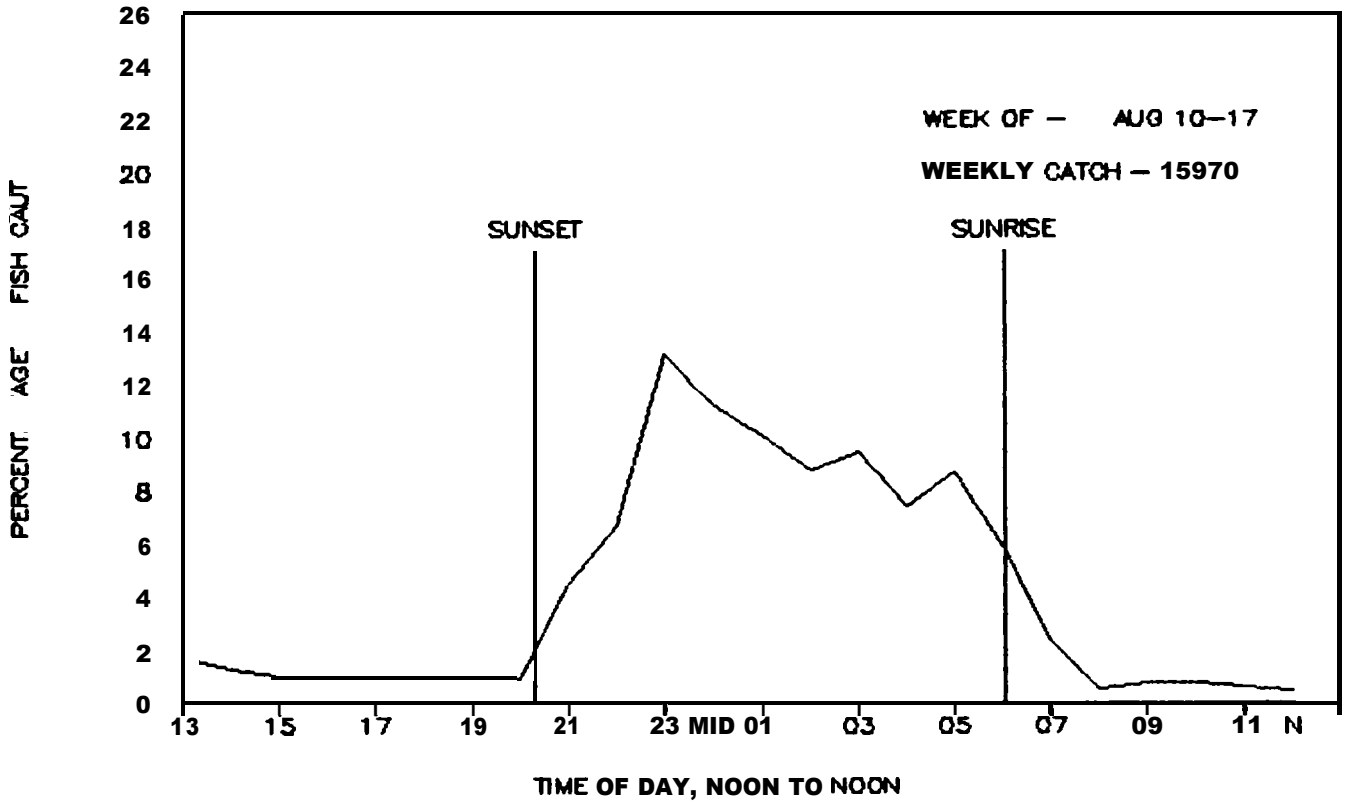

FIGURE 23

WEEKLY DIEL PATTERN, CHINOOK O s

JOHN DAY DAM

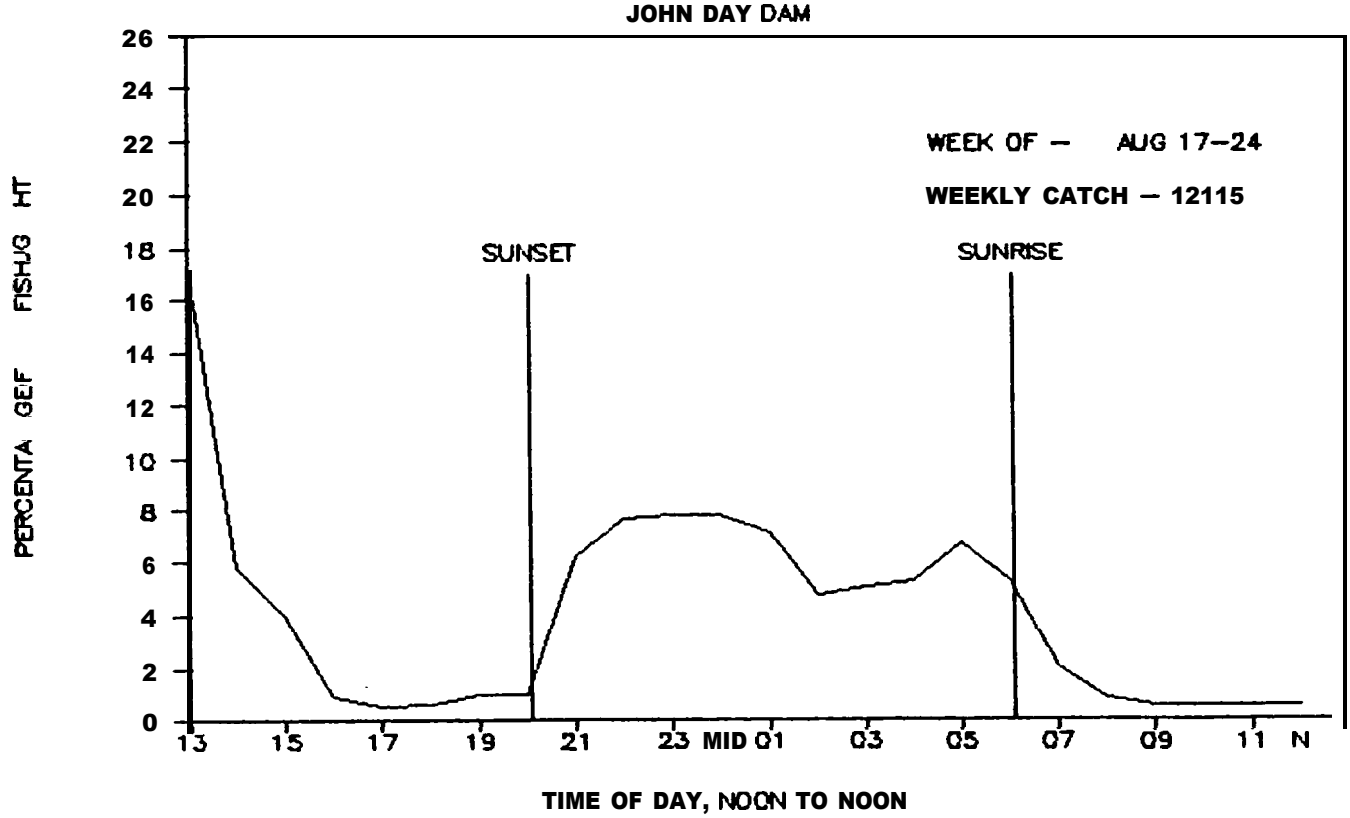

FIGURE 24

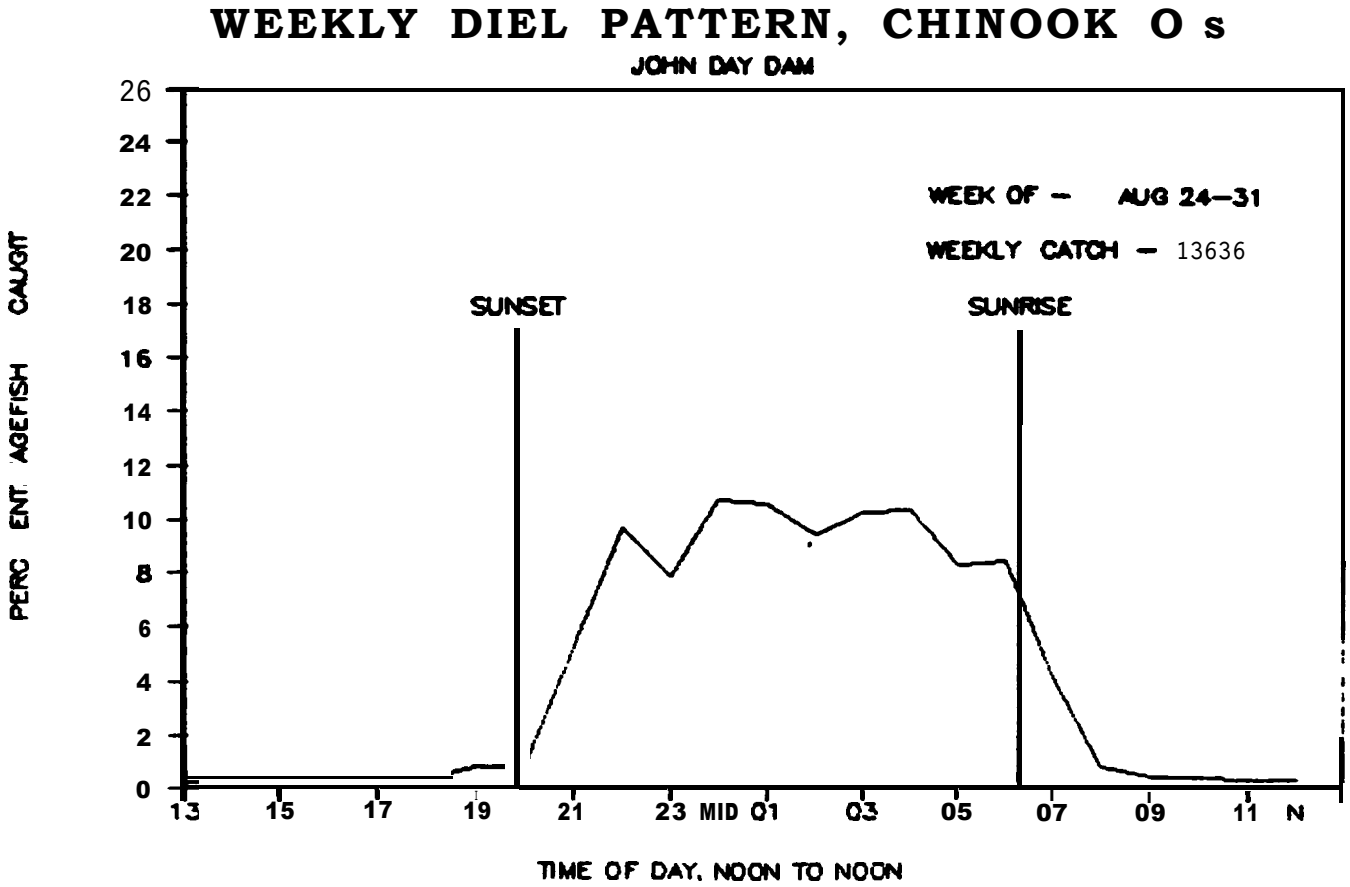

FIGURE 25

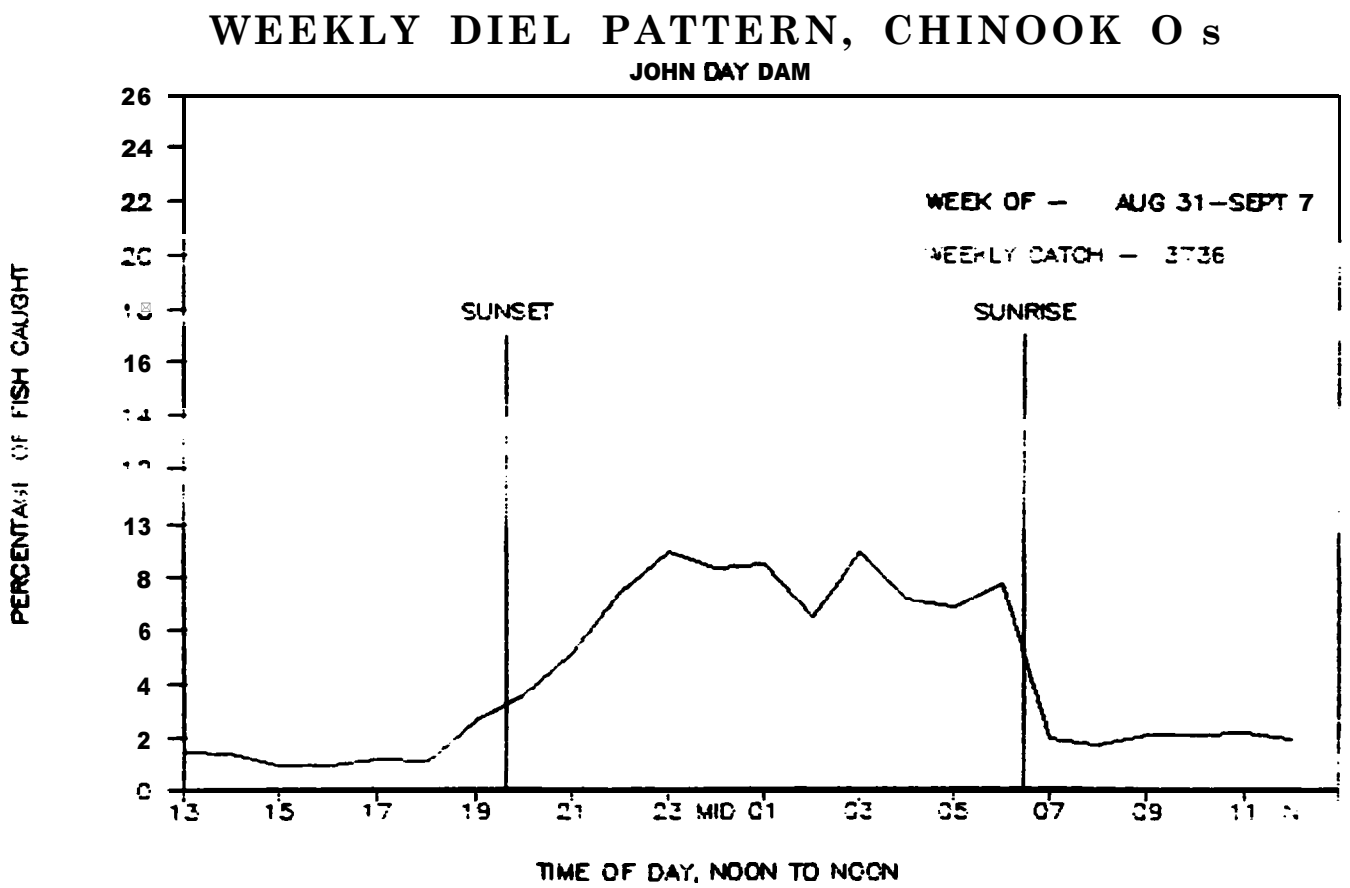

FIGURE 26

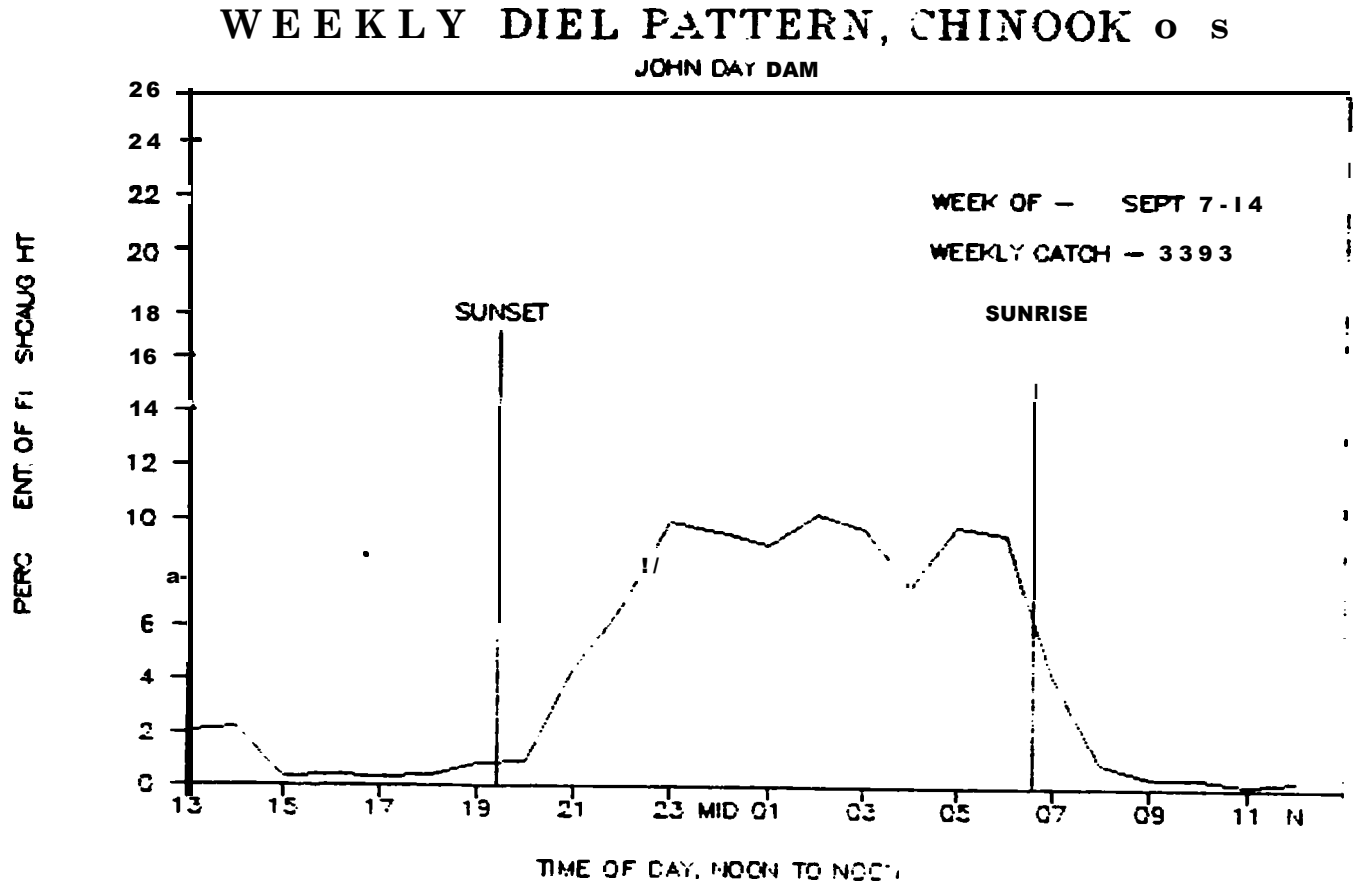

FIGURE 27

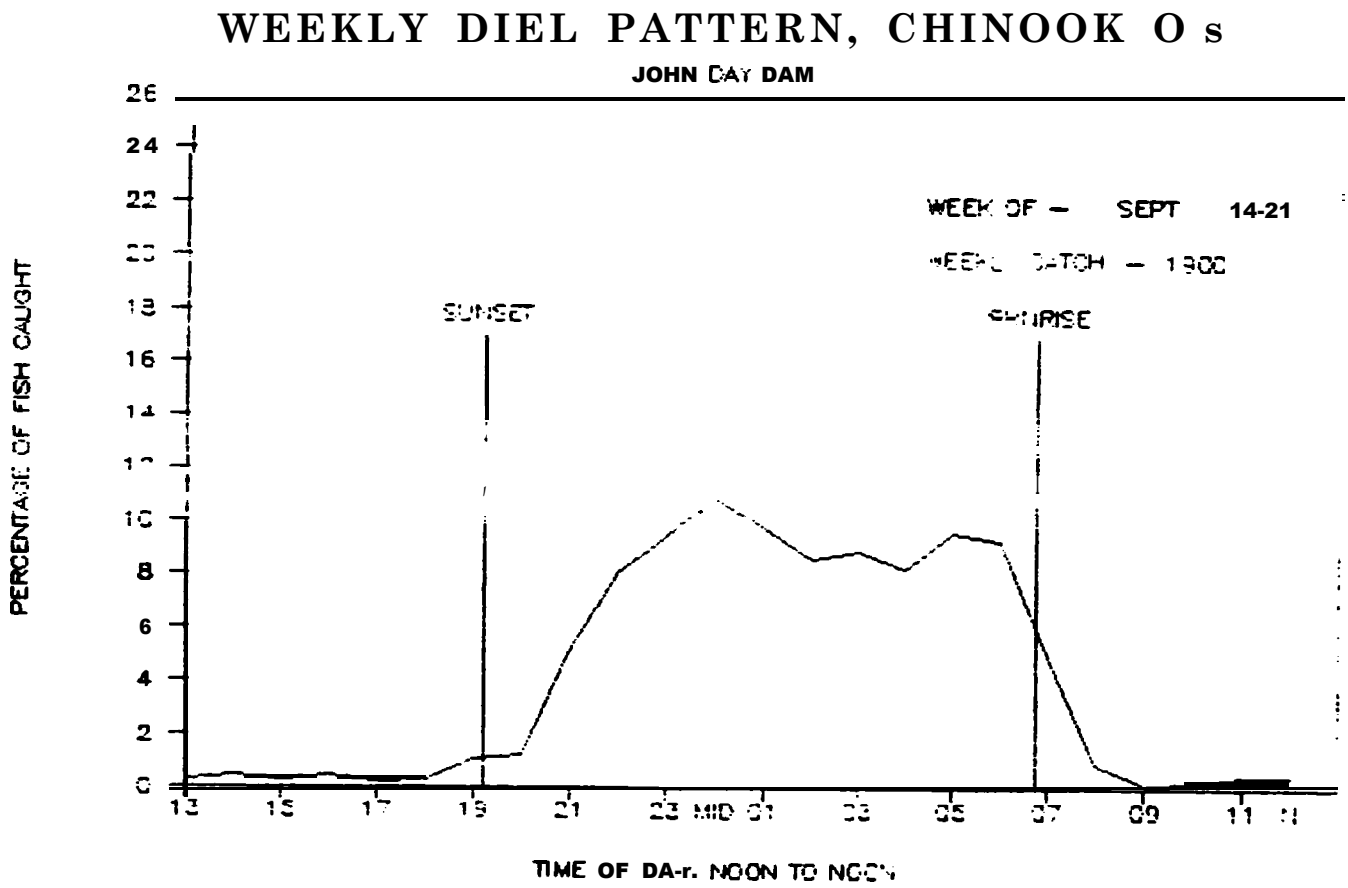

FIGURE 28

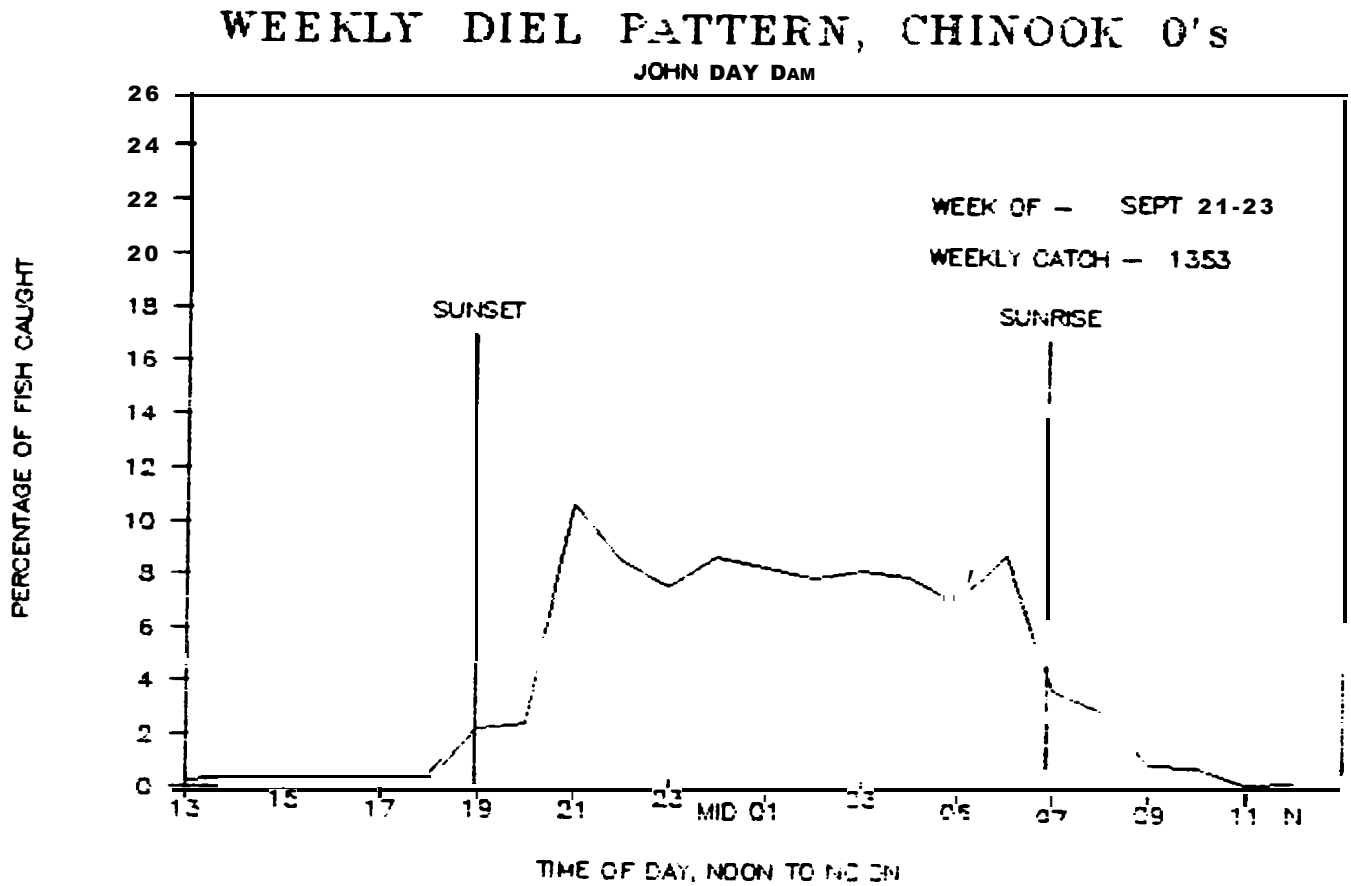

FIGURE 29

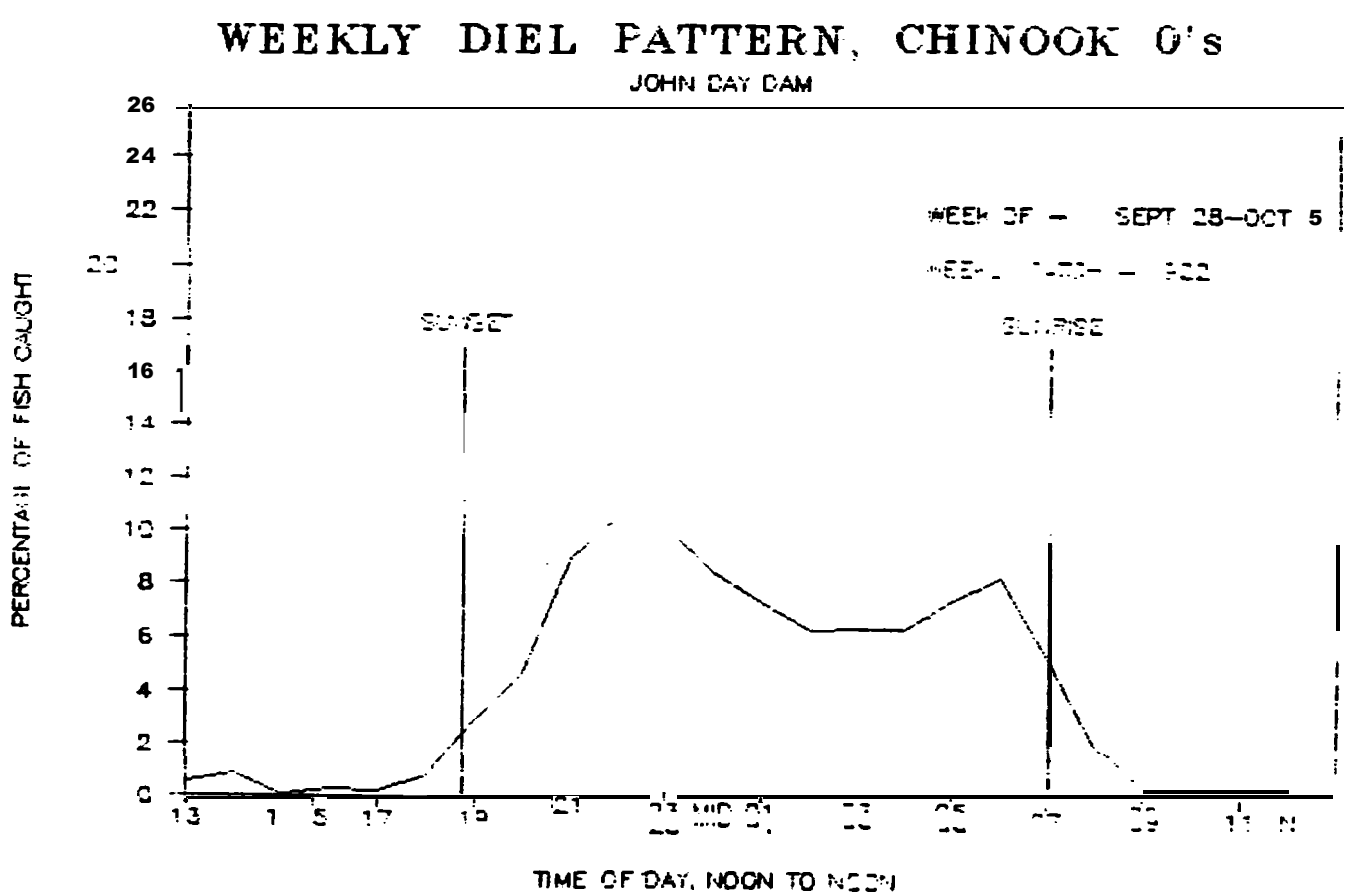

FIGURE 30

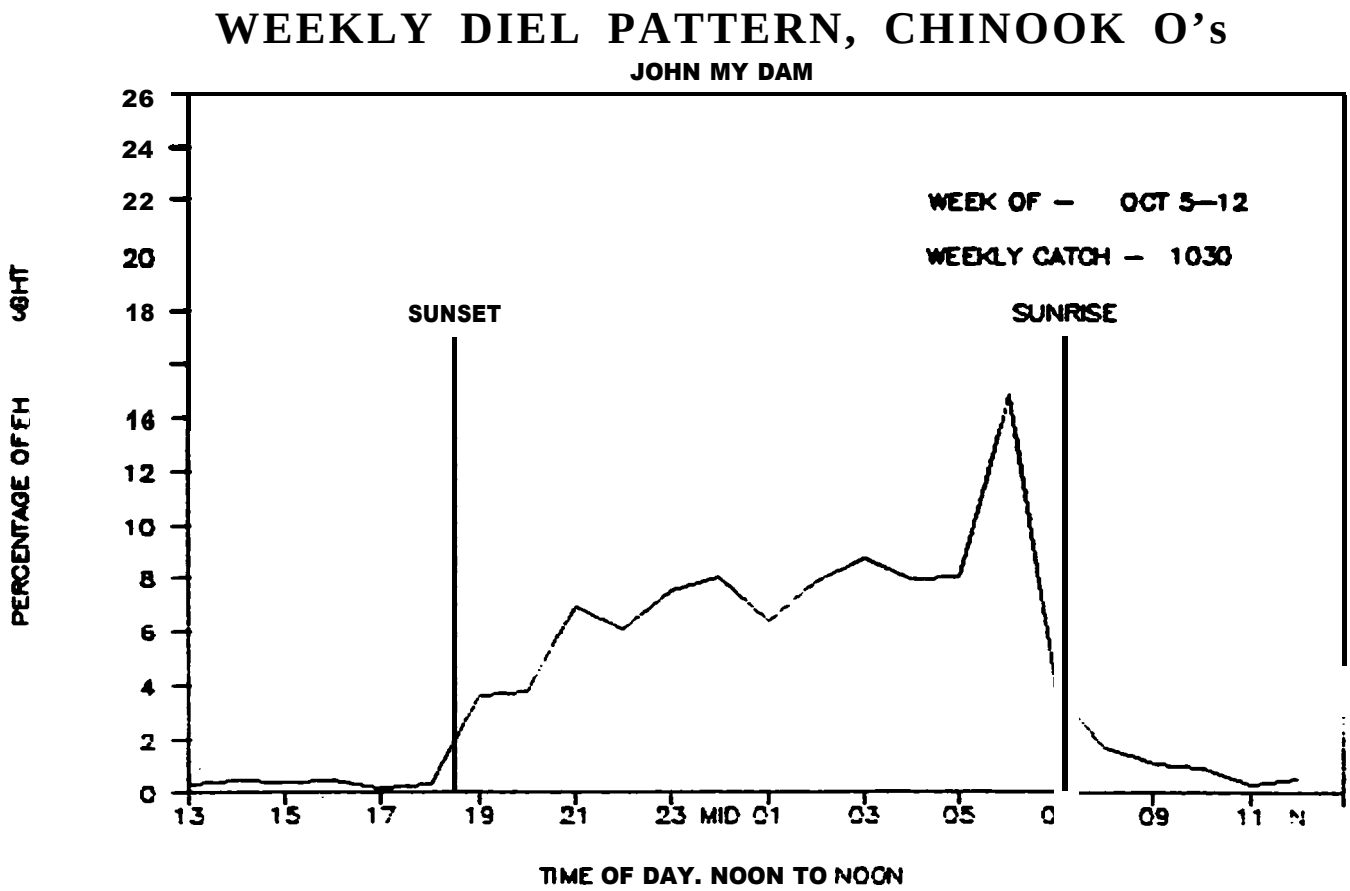

FIGURE 31

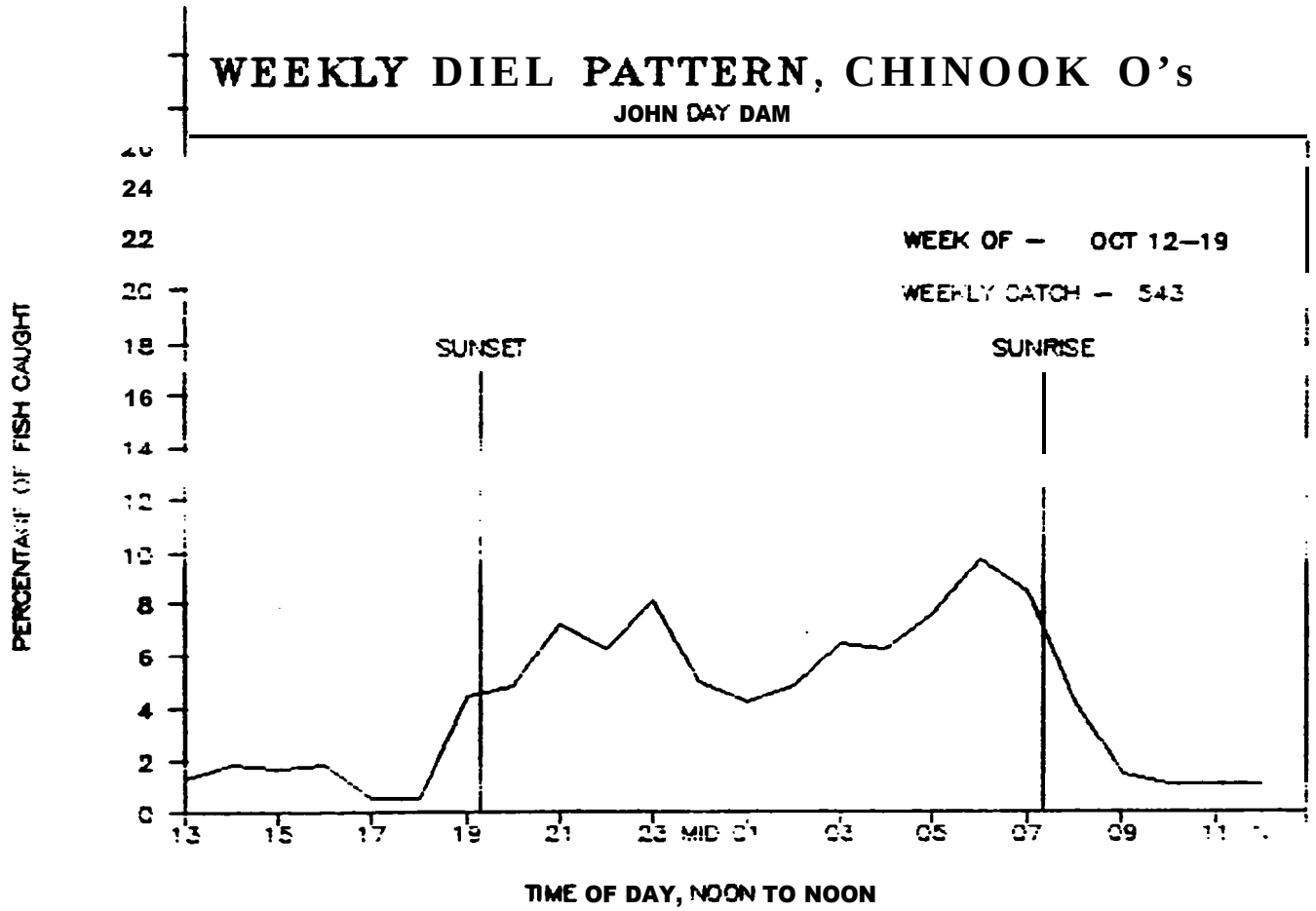

FIGURE 32

WEEKLY DIEL PATTERN, CHINOOK 0's

JOHN DAY DAM

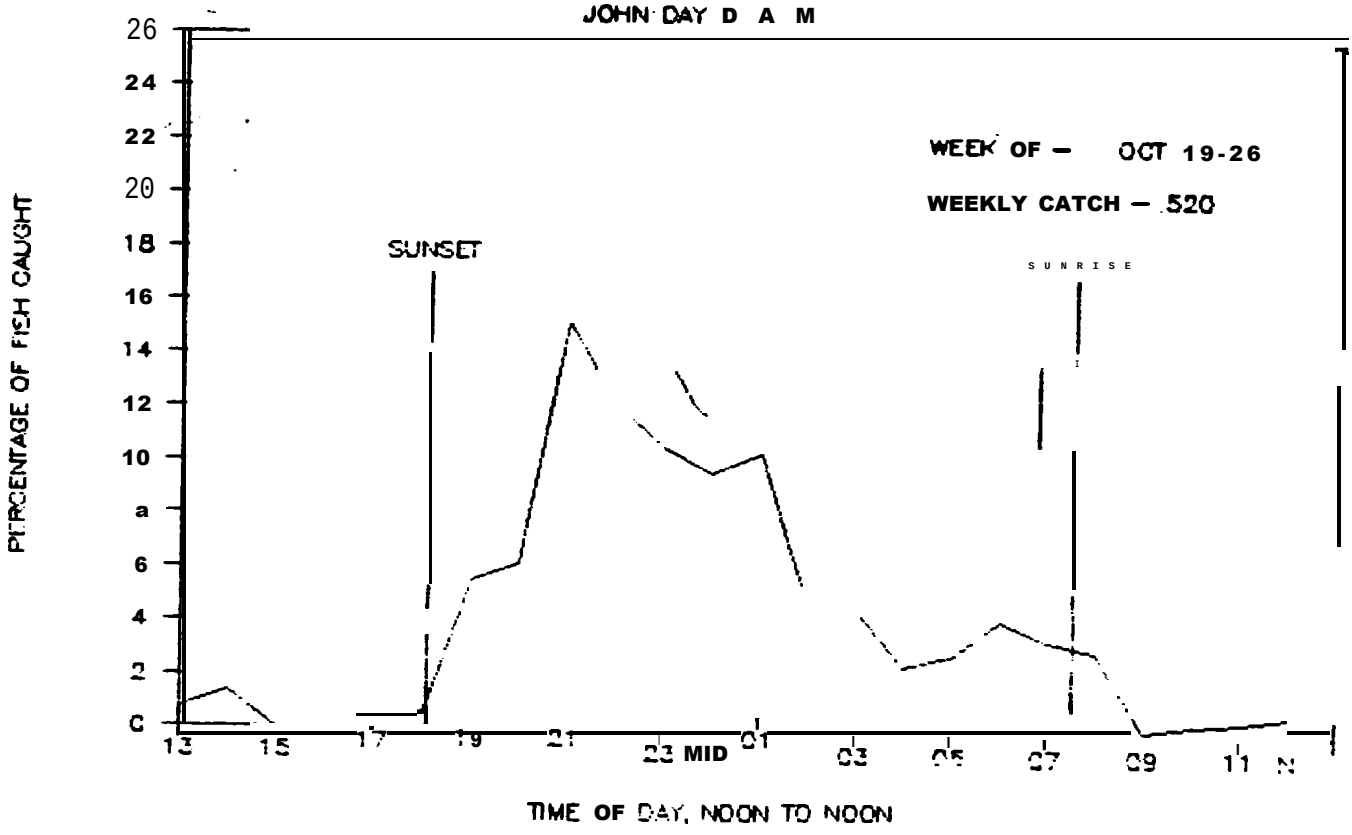

FIGURE 33

WEEKLY DIEL PATTERN, STEELHEAD

JOHN DAY DAM

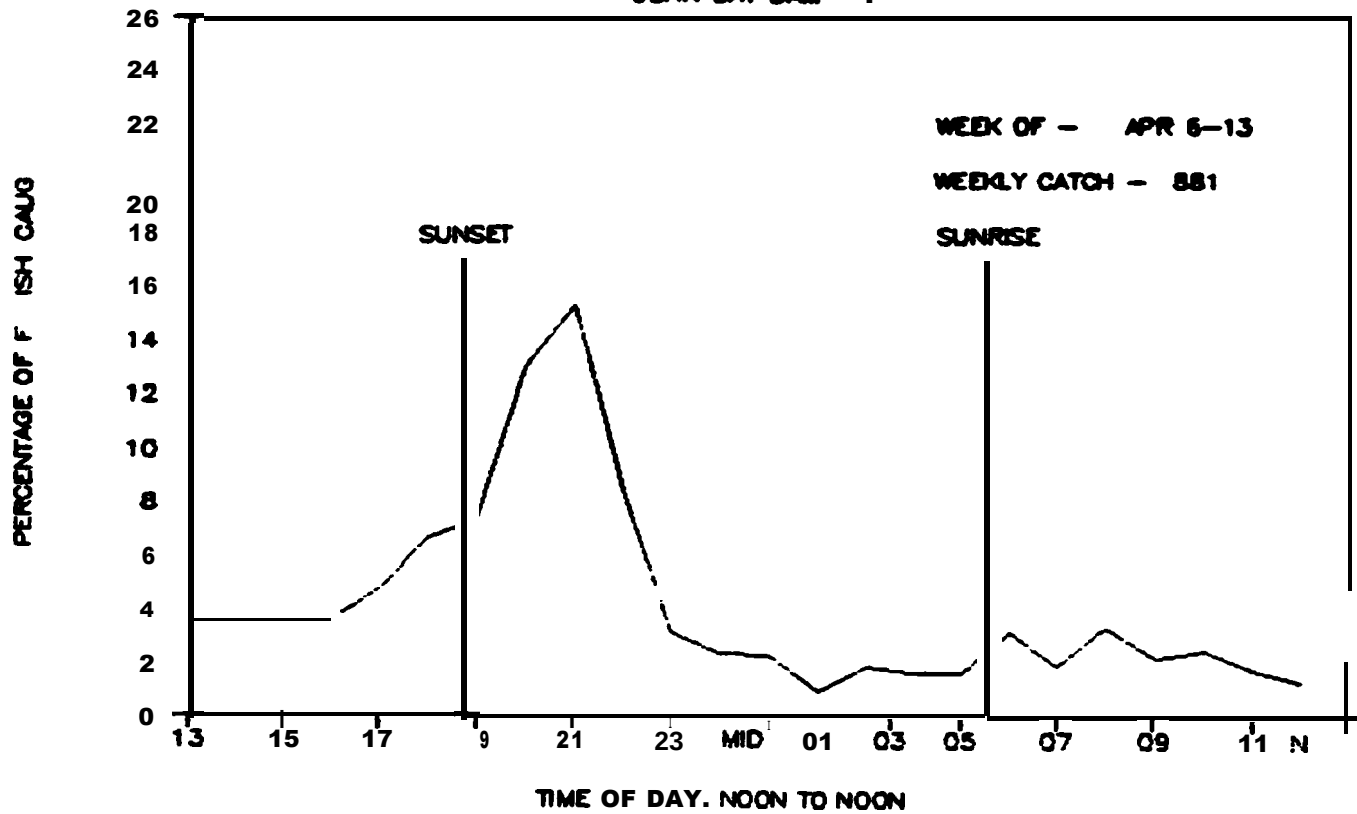

FIGURE 34

WEEKLY DIEL PATTERN, STEELHEAD

JOHN MY DAM

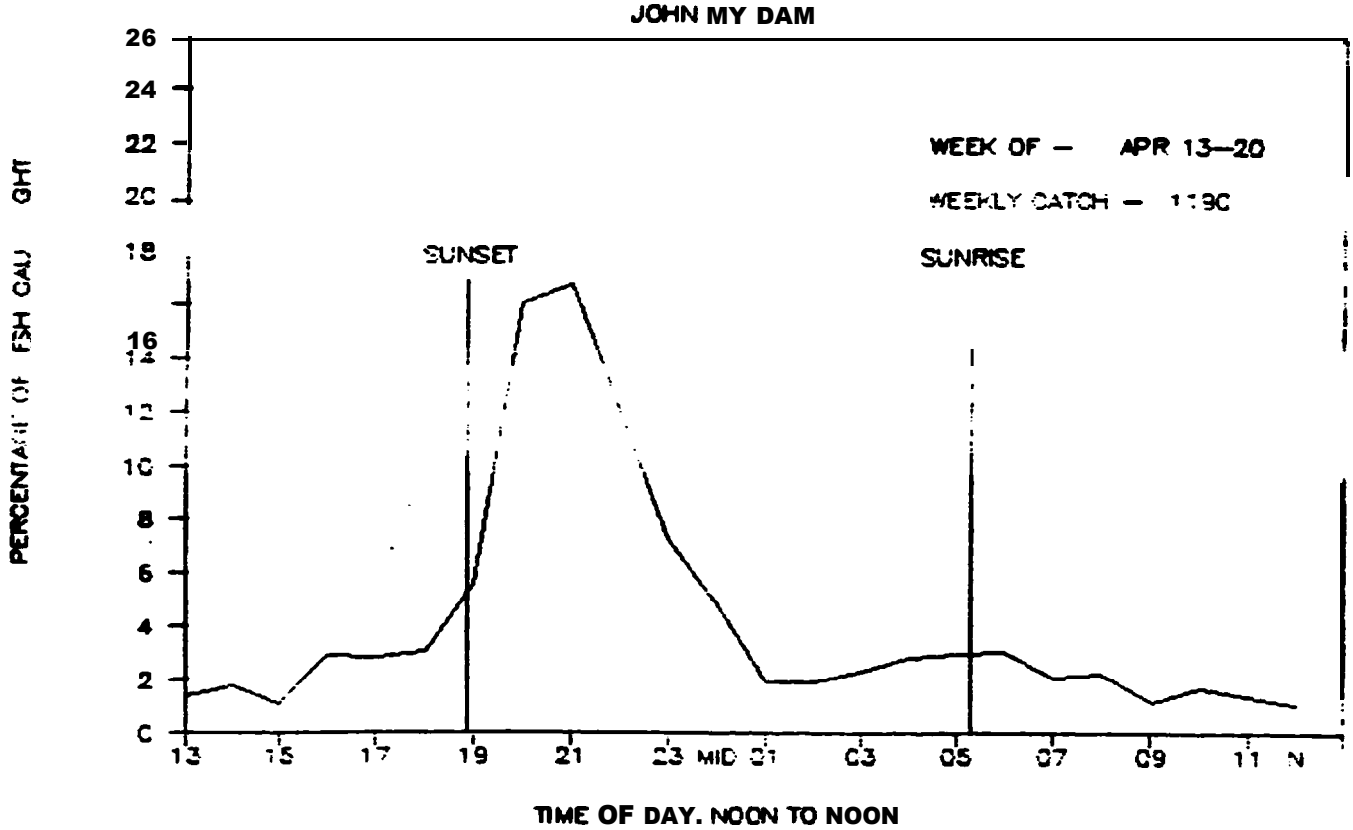

FIGURE 35

WEEKLY DIEL PATTERN, STEELHEAD

JOHN DAY DAM

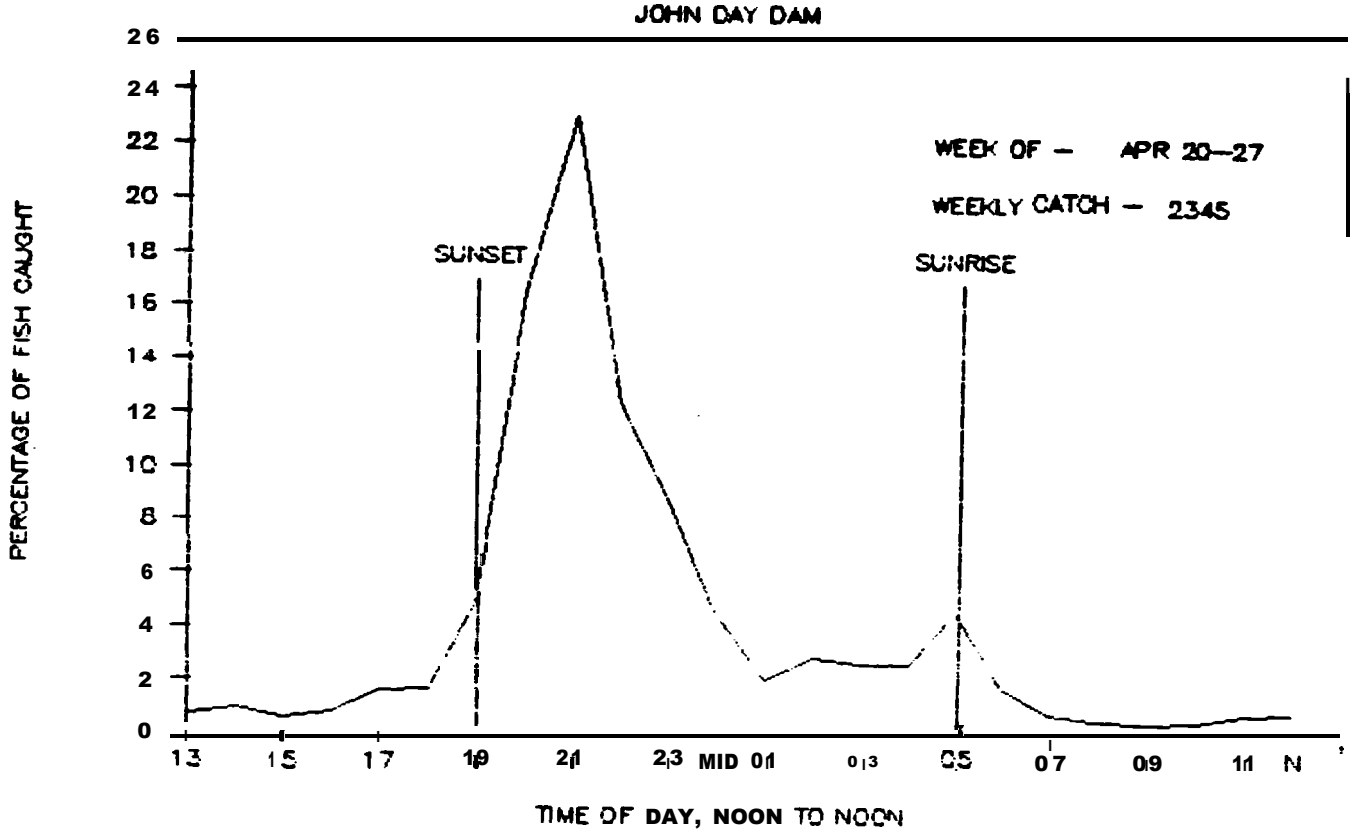

FIGURE 36

WEEKLY DIEL PATTERN, STEELHEAD

JOHN DAY DAM

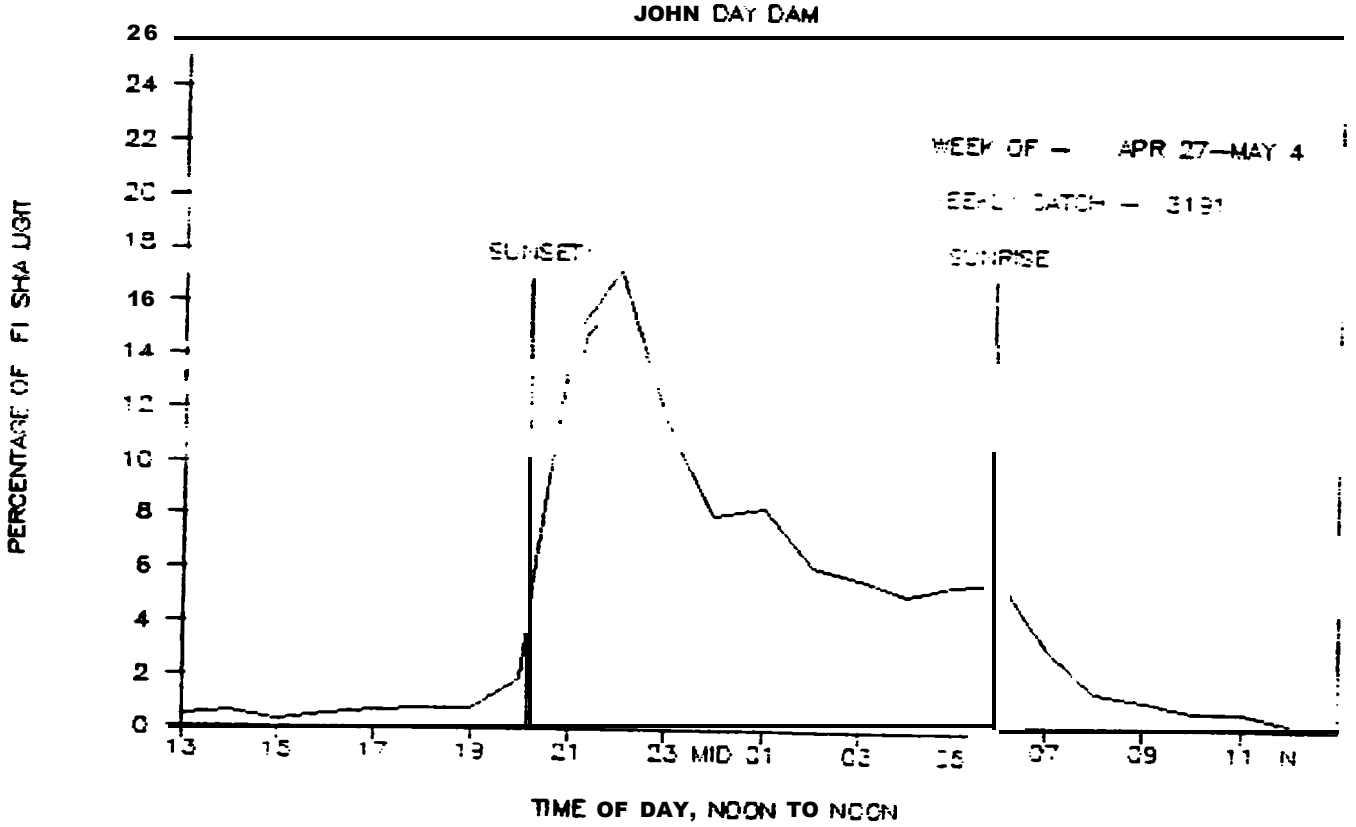

FIGURE 37

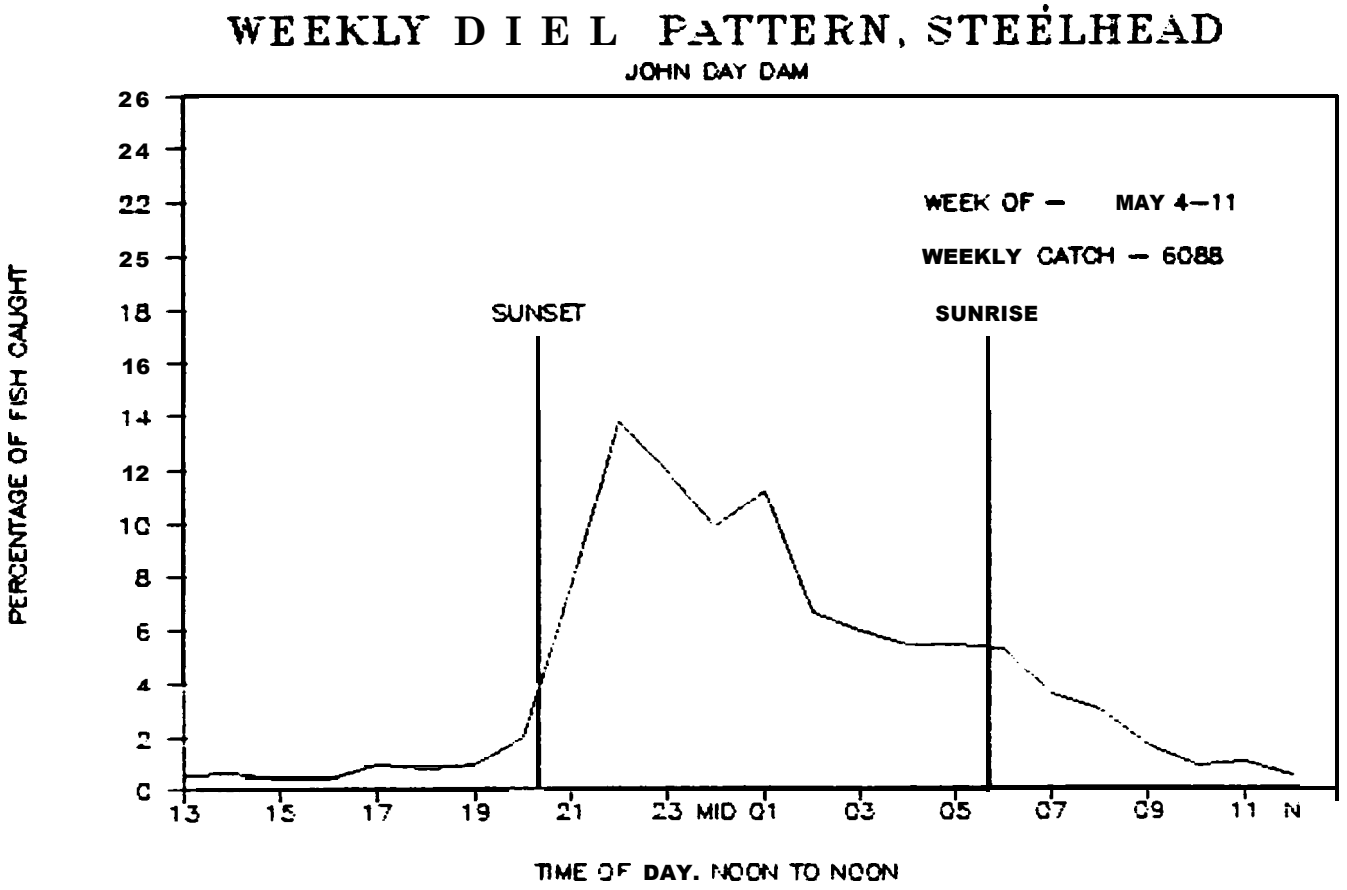

FIGURE 38

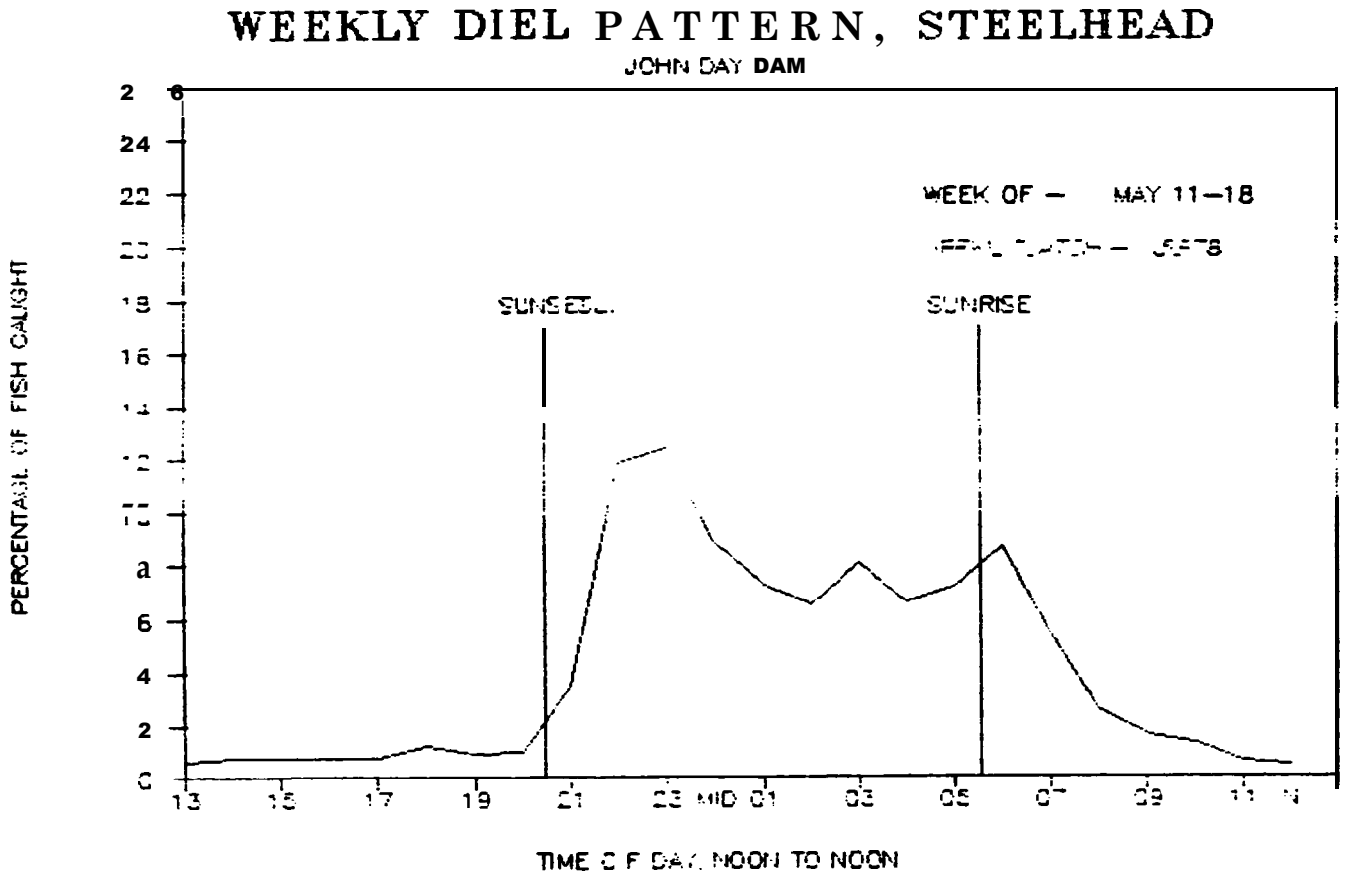

FIGURE 39

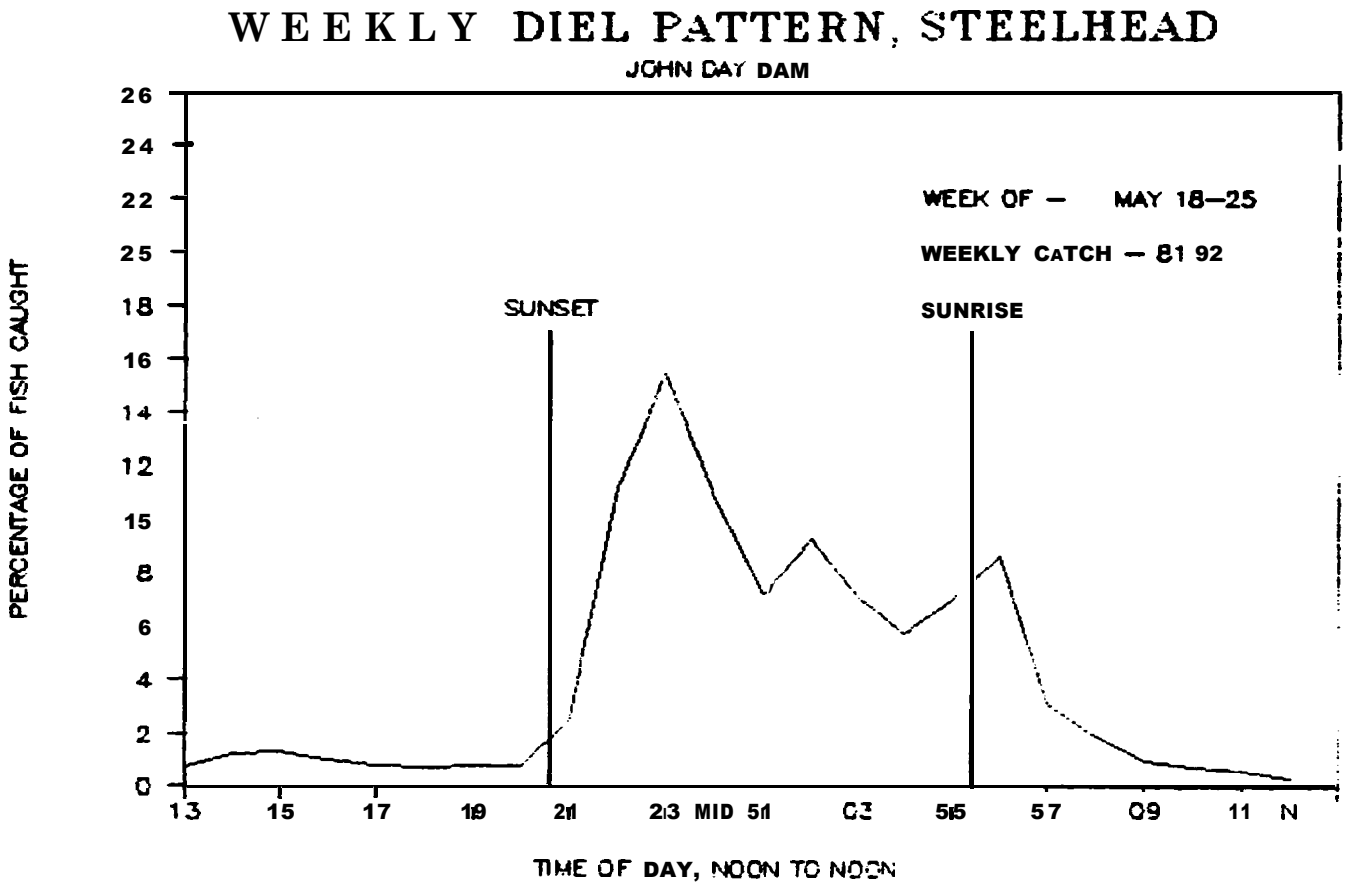

FIGURE 40

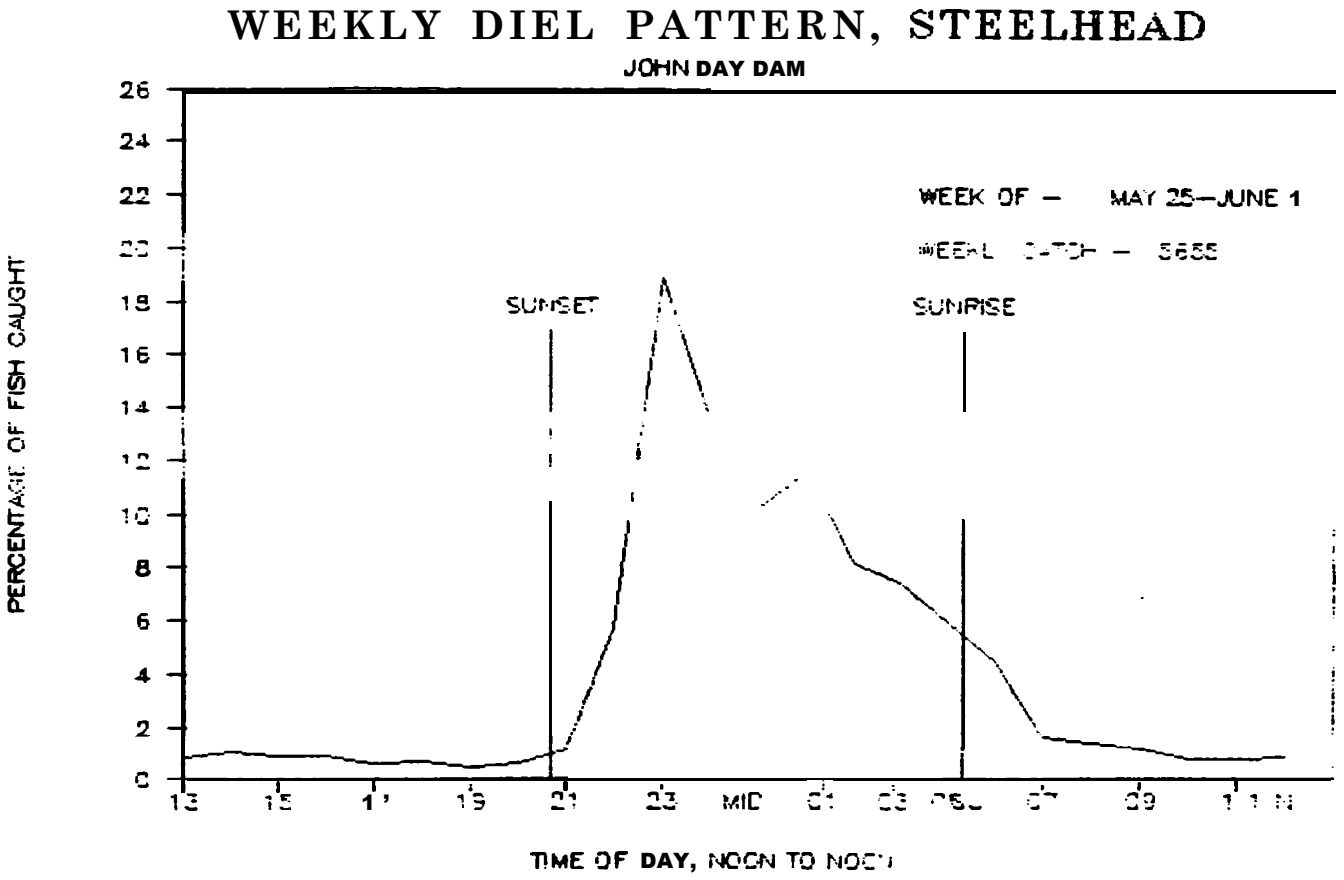

FIGURE 41

WEEKLY DIEL PATTERN, STEELHEAD

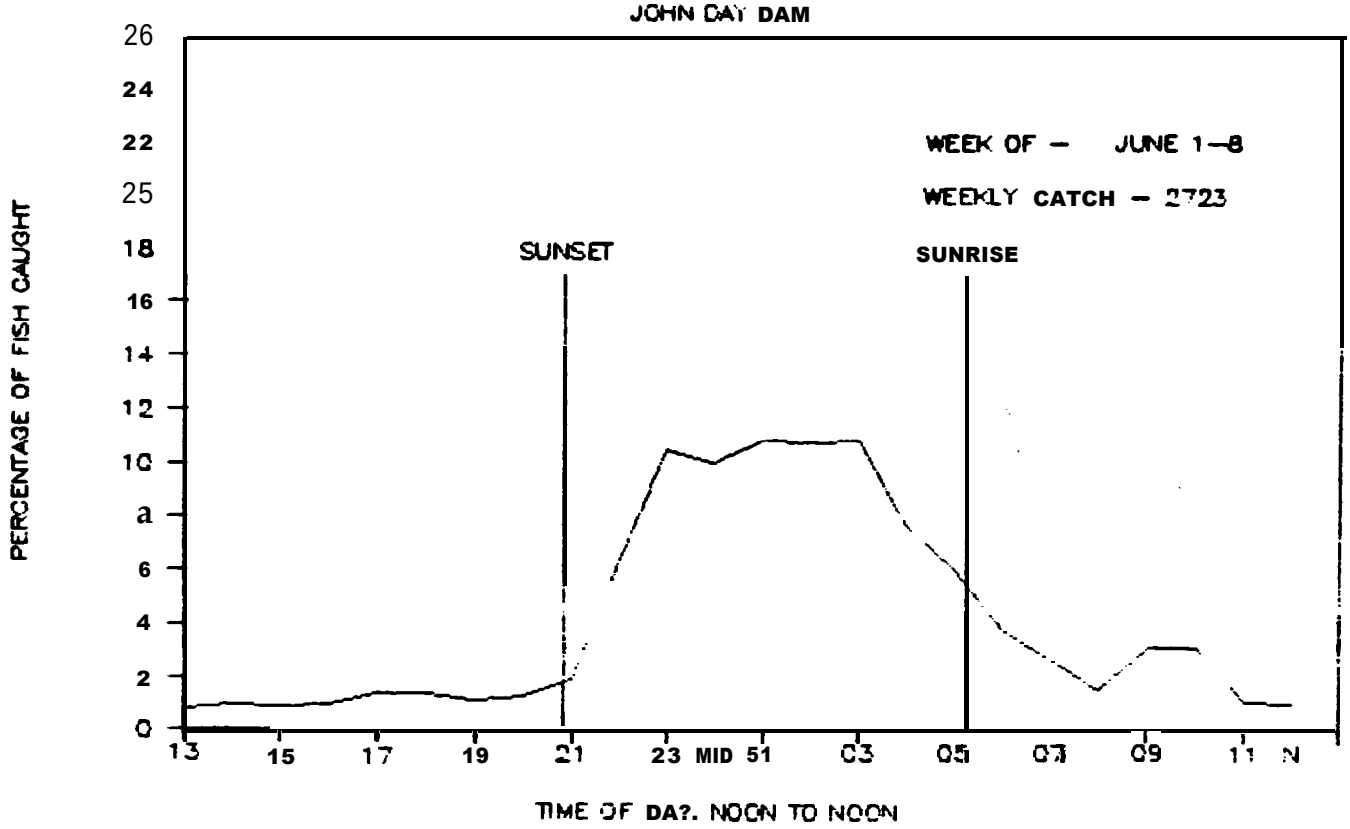

FIGURE 42

WEEKLY DIEL PATTERN, STEELHEAD

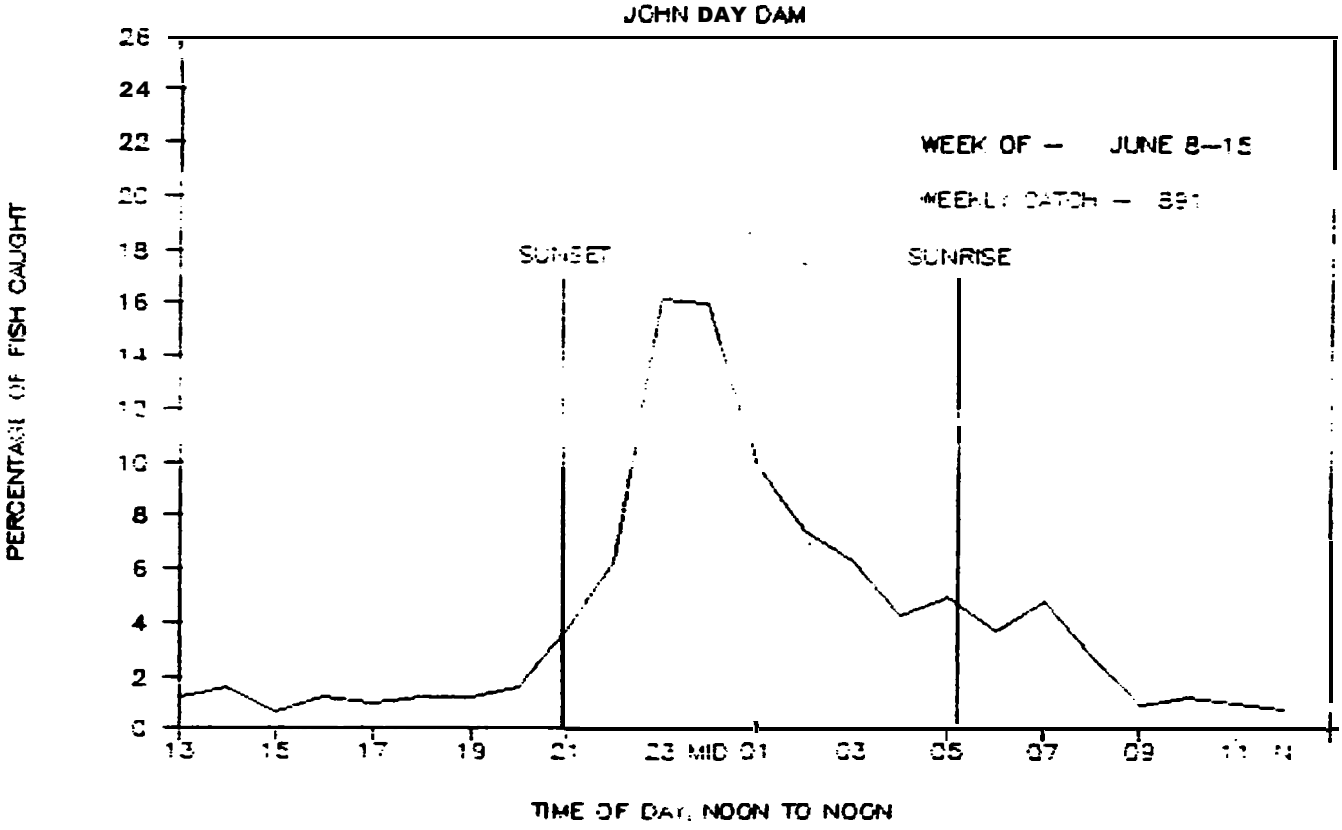

FIGURE 43

WEEKLY DIEL PATTERN, COHO

JOHN DAY DAM

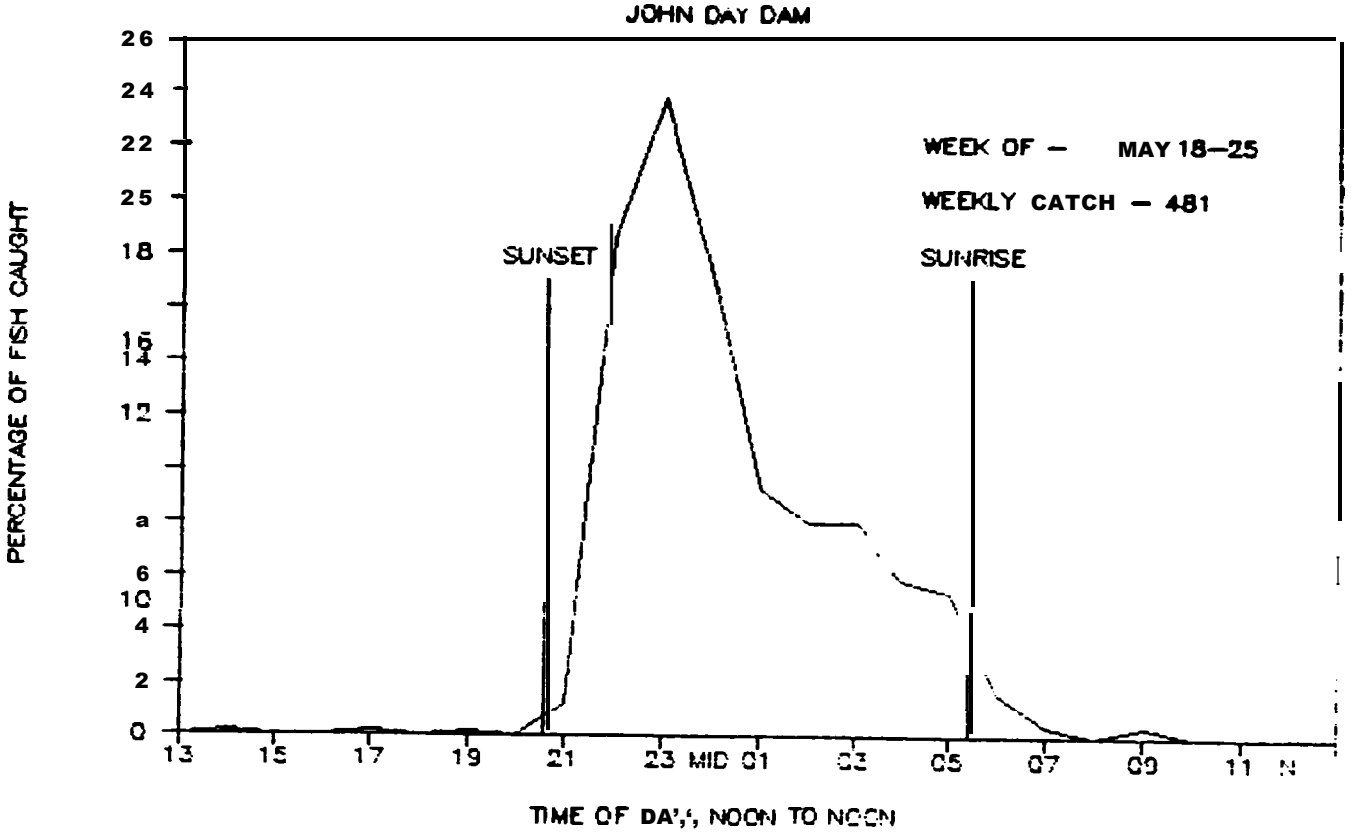

FIGURE 44

WEEKLY DIEL PATTERN, COHO

JOHN DAY DAM

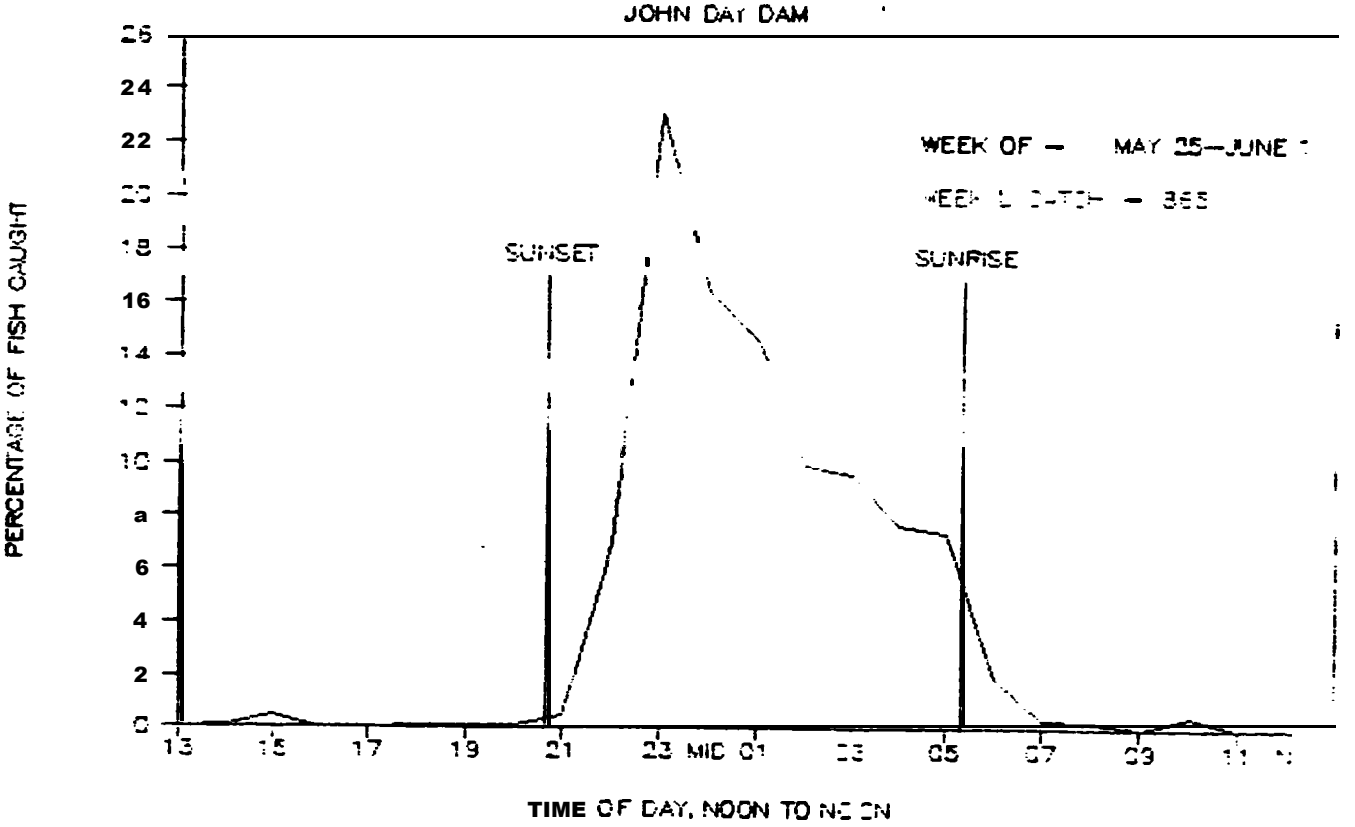

FIGURE 45

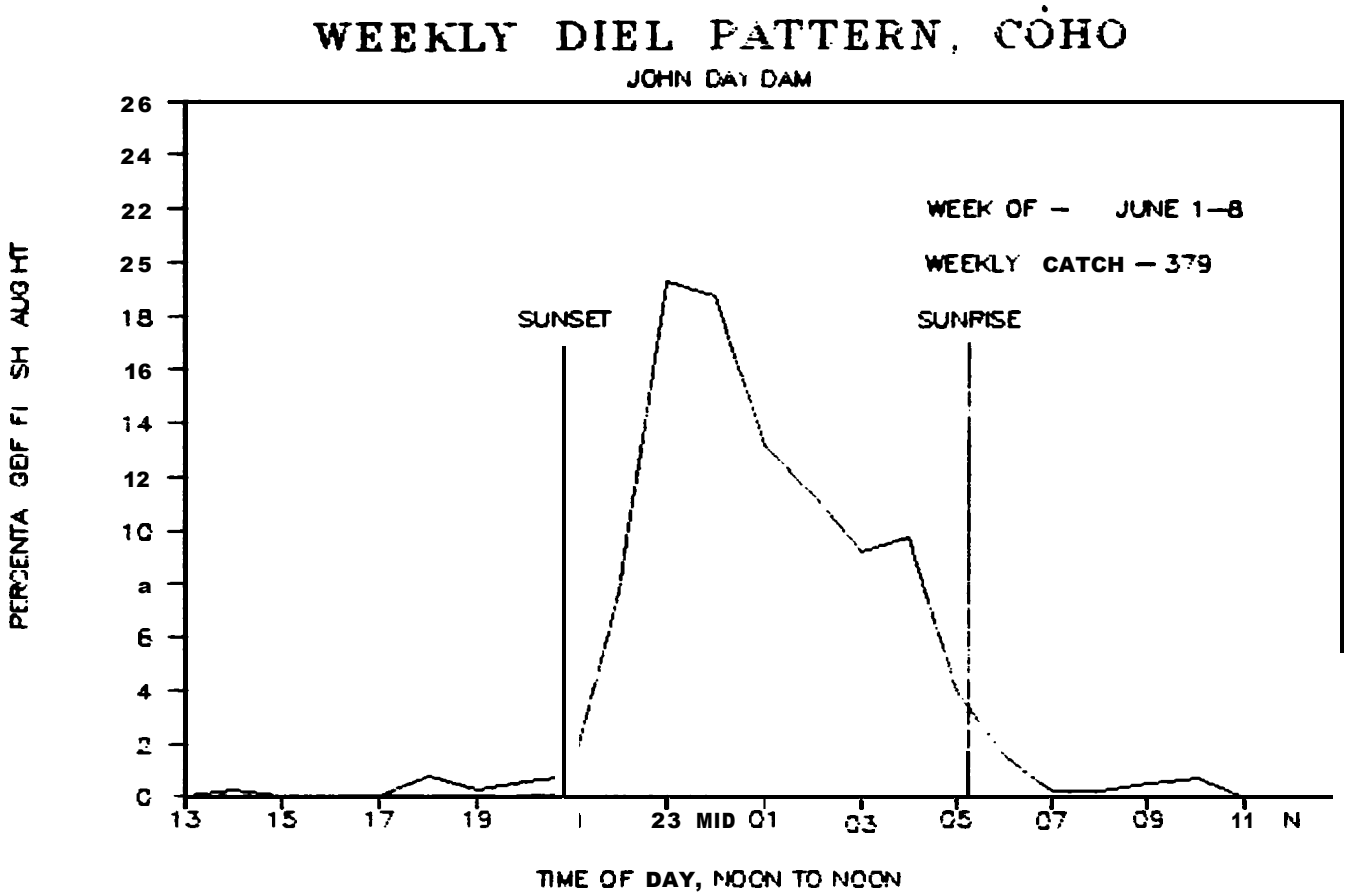
WEEKLY DIEL PATTERN, COHO
JOHN DAY DAM
WEEK OF — JUNE 1—8
WEEKLY CATCH — 379
SUNSET
SUNRISE
PERCENTA GE OF FI SH AUG HT
26
24
22
25
18
16
14
12
10
a
6
4
2
0
13
15
17
19
23 MID 01
03
05
07
09
11 N
TIME OF DAY, NOON TO NOON

FIGURE 46

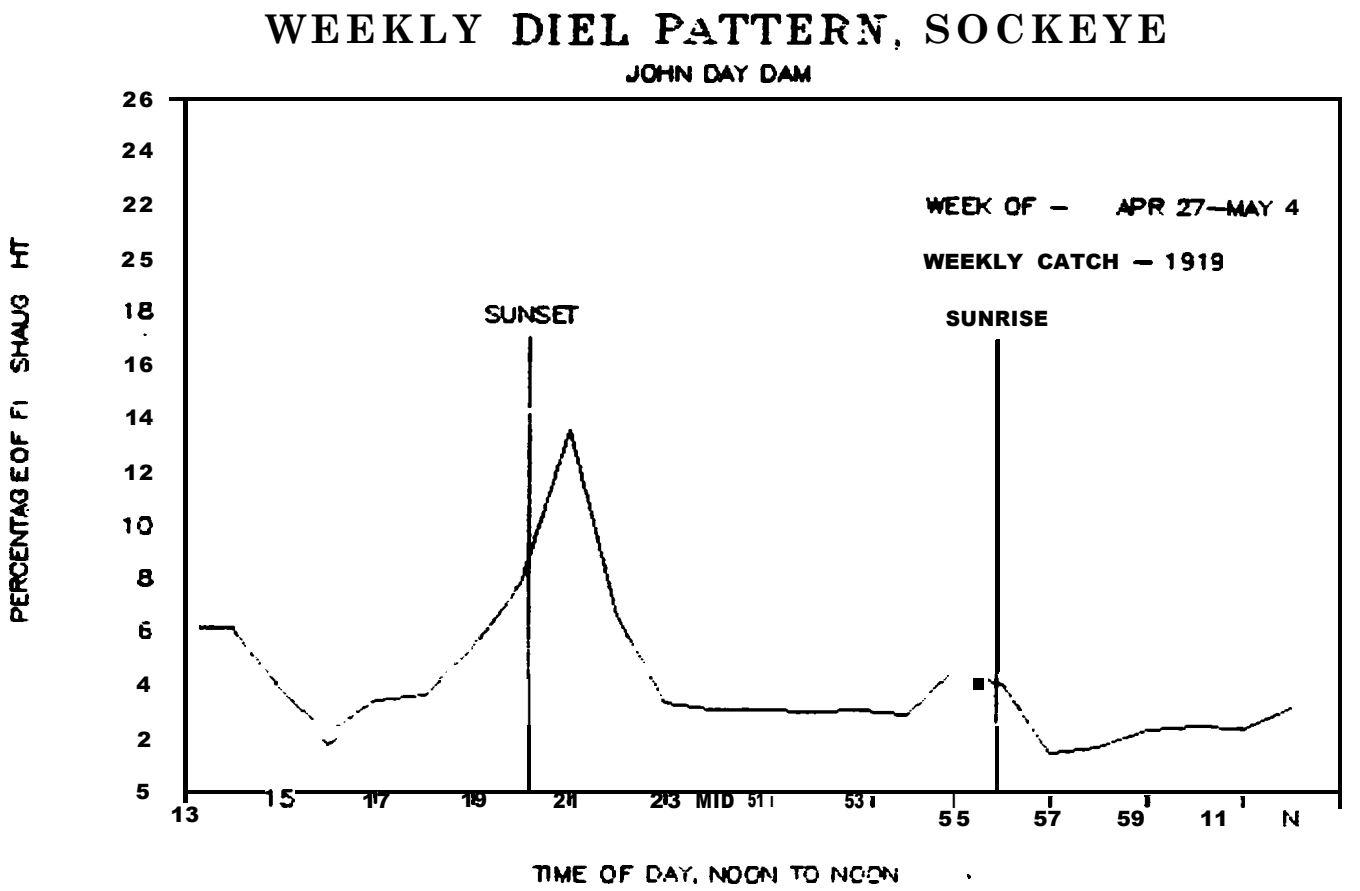

FIGURE 47

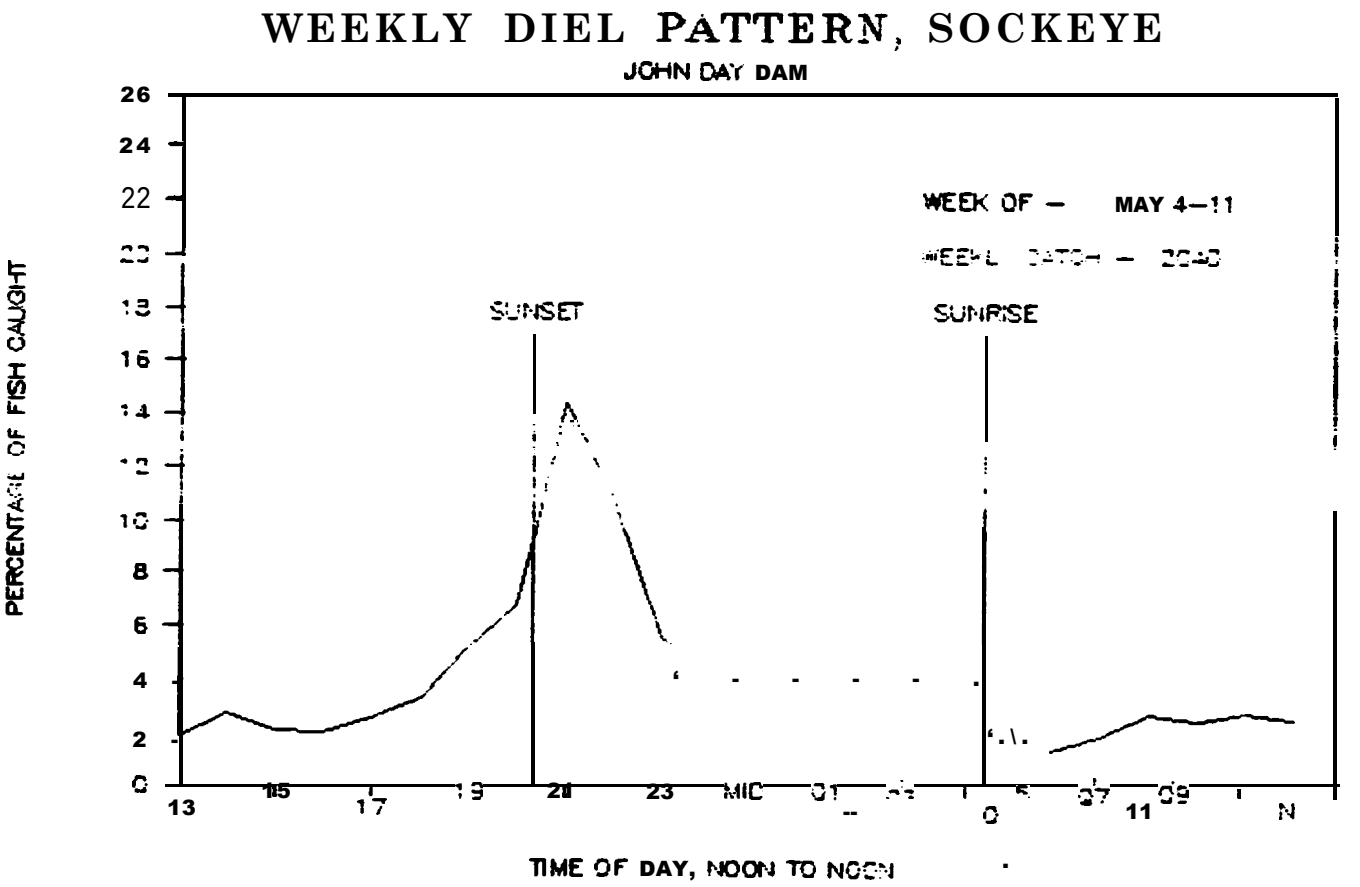

FIGURE 48

WEEKLY DIEL PATTERN, SOCKEYE

JOHN DAY DAM

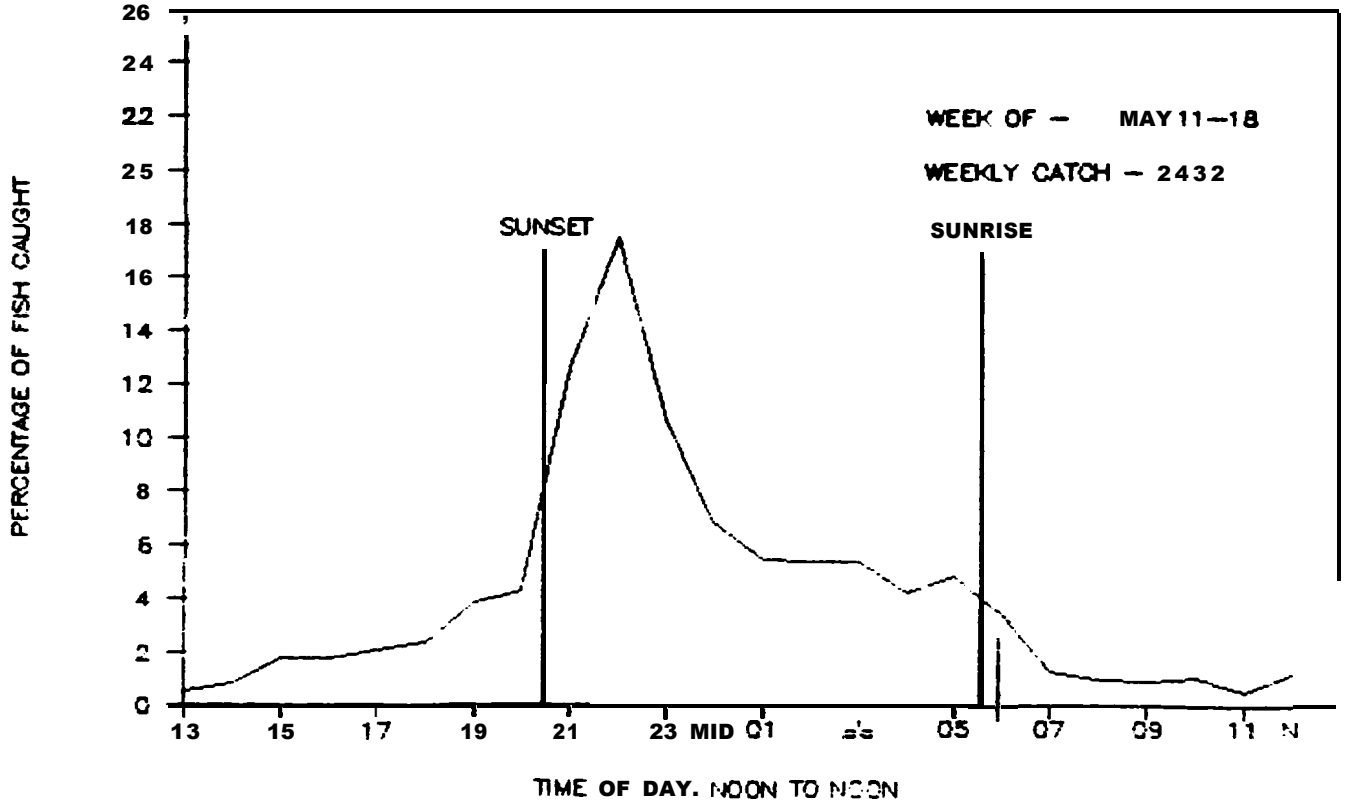

FIGURE 49

WEEKLY DIEL PATTERN, SOCKEYE

JOHN DAY DAM

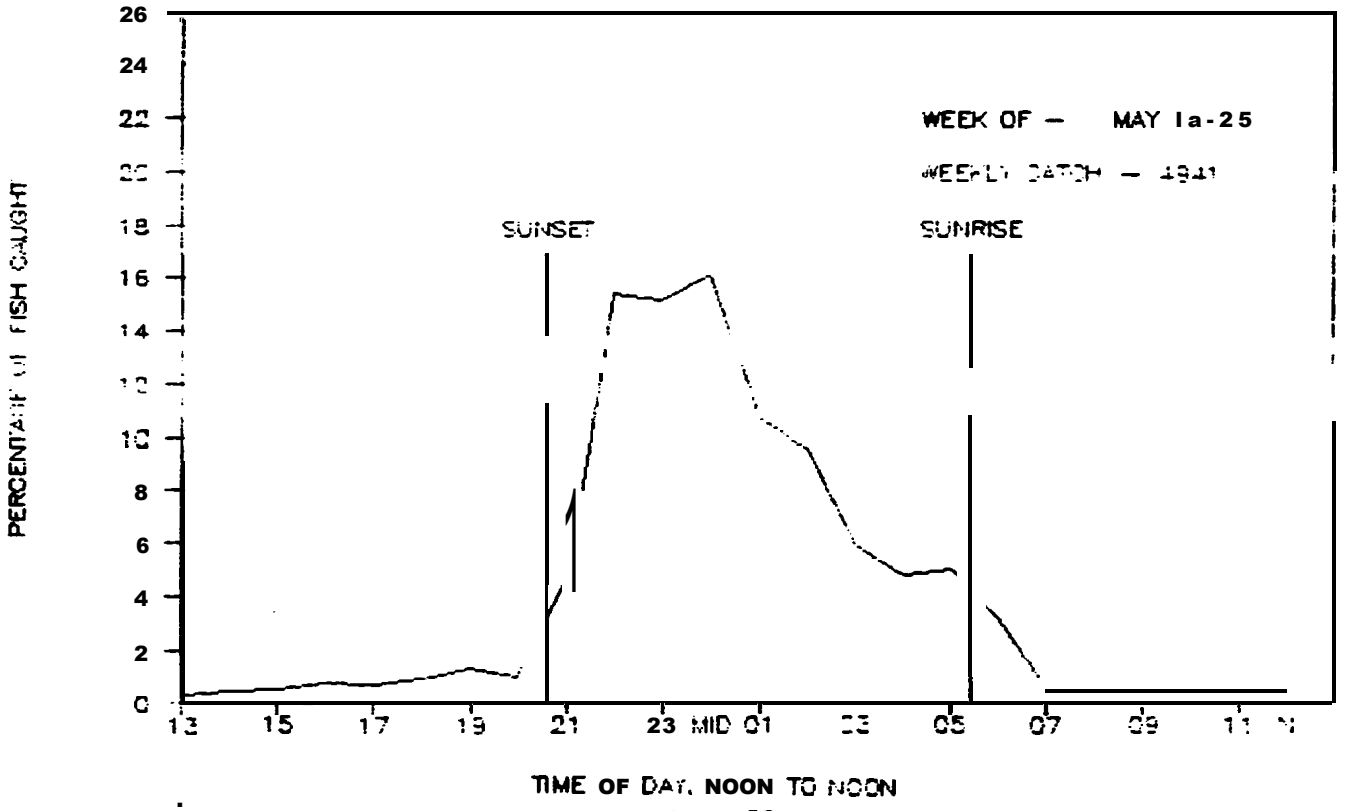

FIGURE 50

WEEKLY DIEL PATTERN, SOCKEYE

JOHN DAY DAM

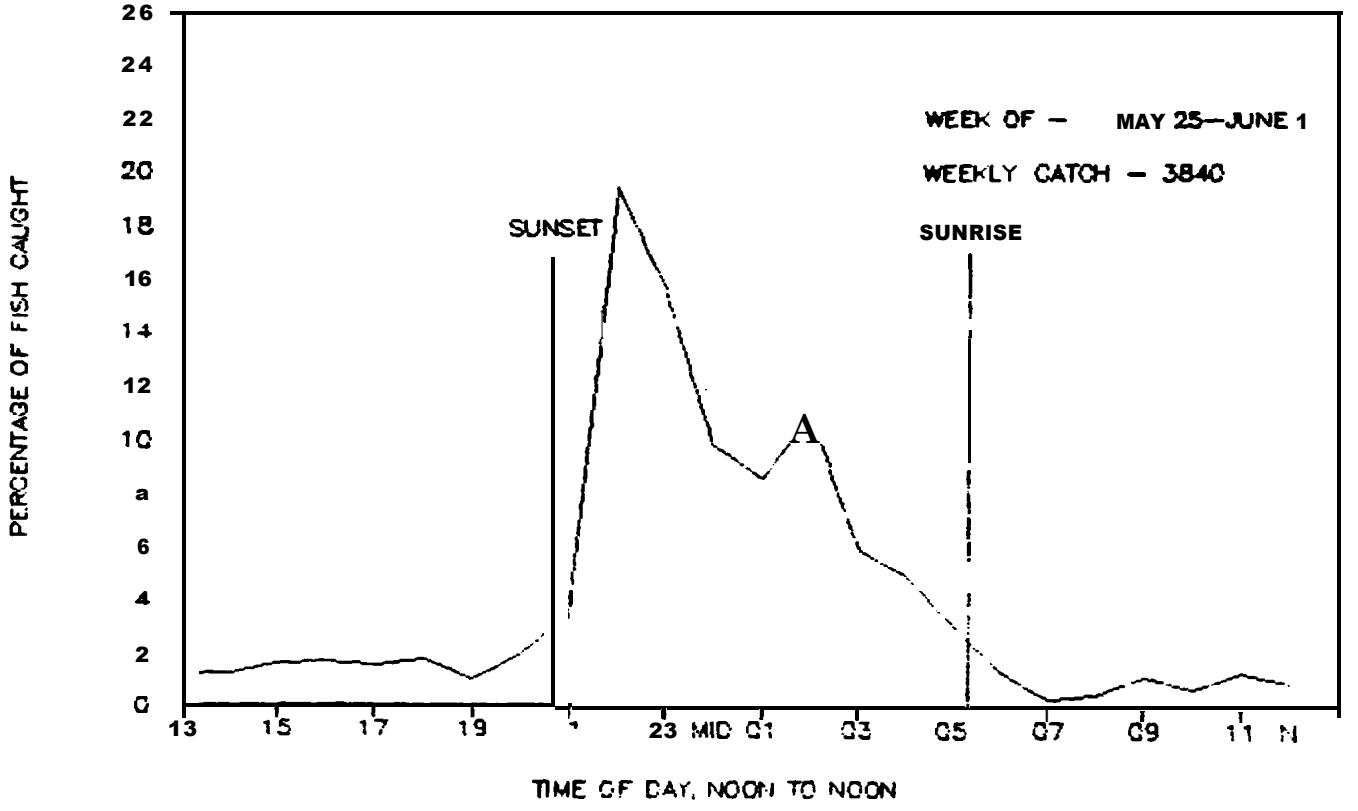

FIGURE 51

WEEKLY DIEL PATTERN, SOCKEYE

JOHN DAY DAM

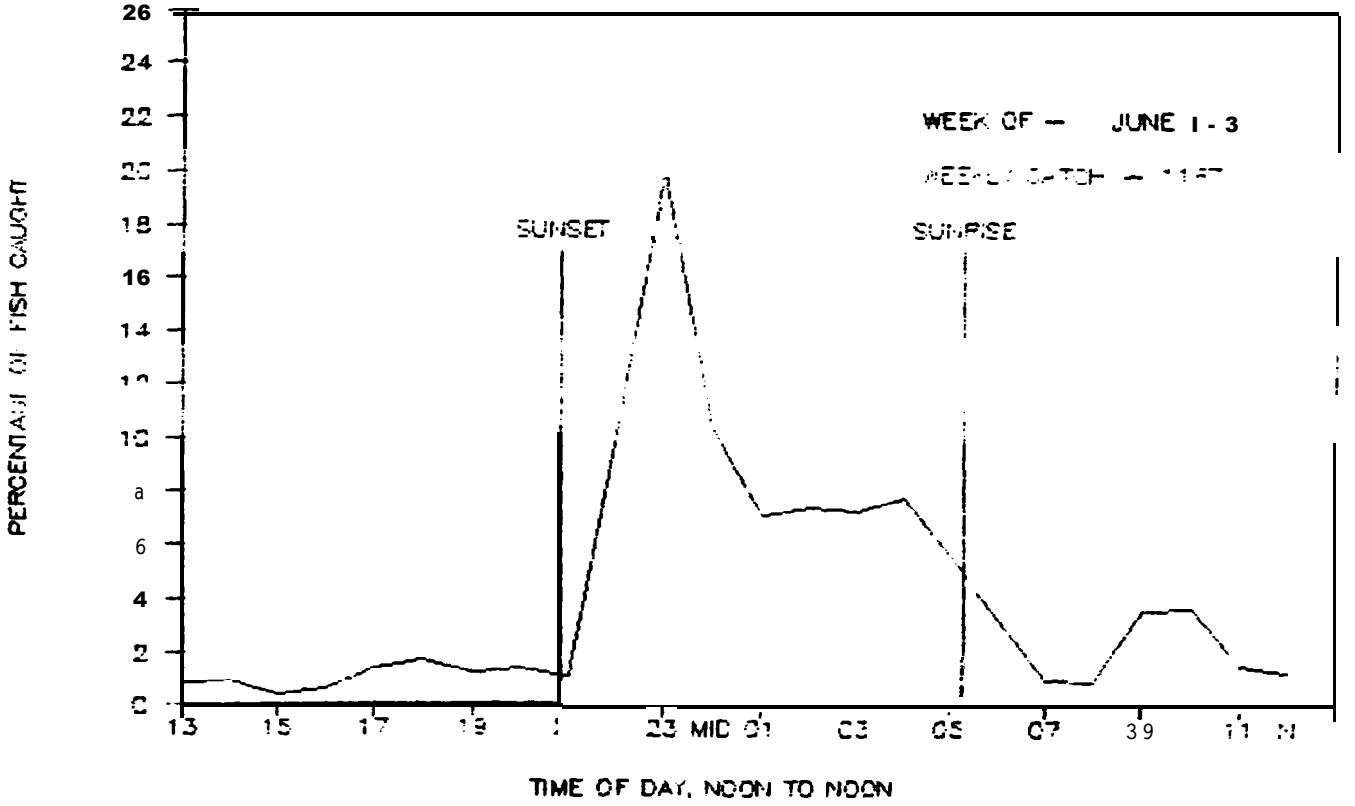

FIGURE 52

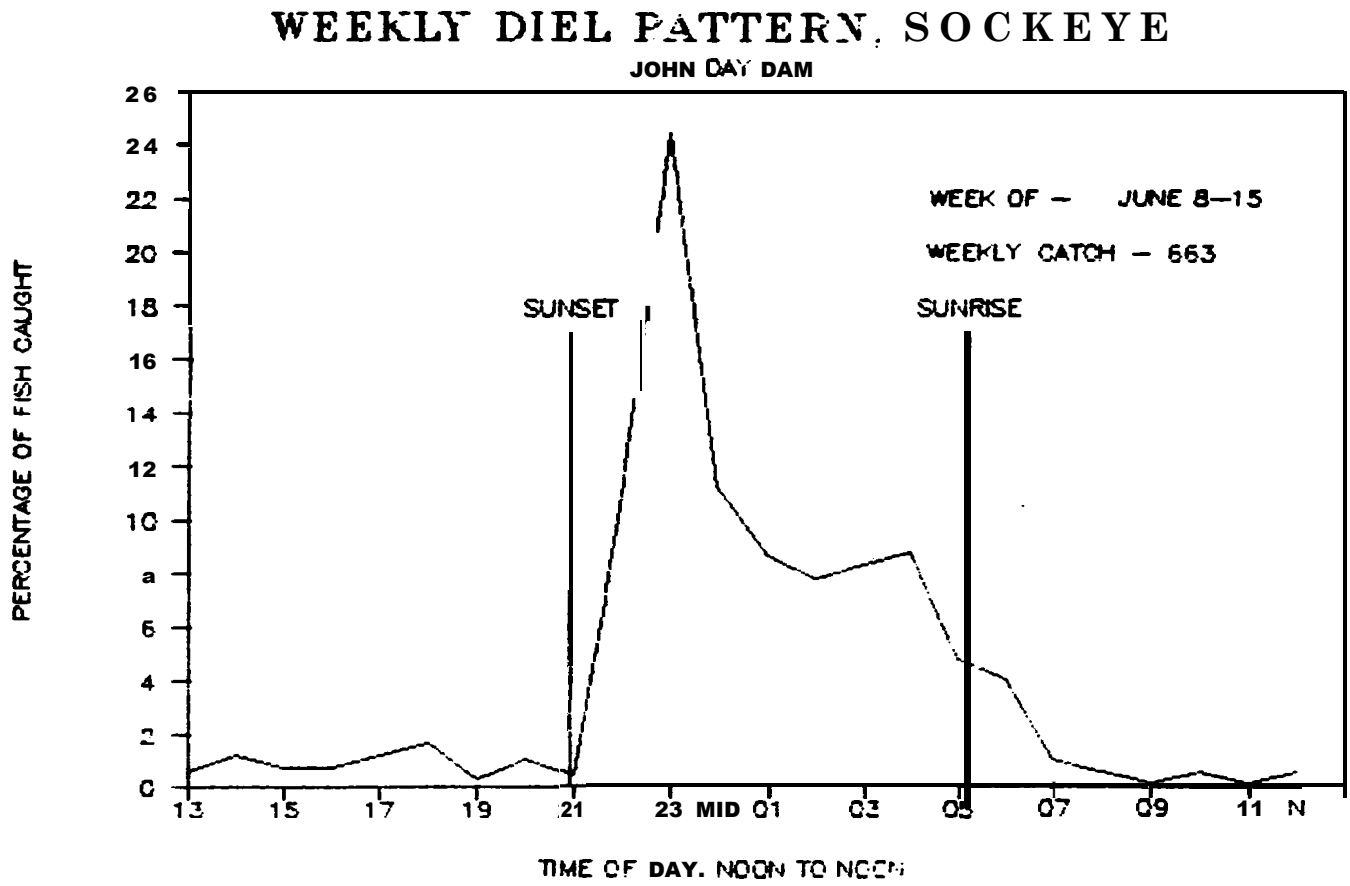
WEEKLY DIEL PATTERN, SOCKEYE
JOHN DAY DAM
PERCENTAGE OF FISH CAUGHT
26
24
22
20
18
16
14
12
10
a
6
4
2
0
WEEK OF — JUNE 8—15
WEEKLY CATCH — 663
SUNSET
SUNRISE
13
15
17
19
21
23 MID 01
03
05
07
09
11 N
TIME OF DAY. NOON TO NOON

FIGURE 53

APPENDIX B

FISH PASSAGE INDEX
FOR
JOHN MY DAM
SMOLT MONITORING SEASON 1986

FIGURE	SPECIES	PAGE
1	UNIT 3 DISCHARGE	B-1
2	CHINOOK l's	B-1
3	CHINOOK O's	B-2
4	STEELHEAD	B-2
5	COHO	B-3
6	SOCKEYE	B-3

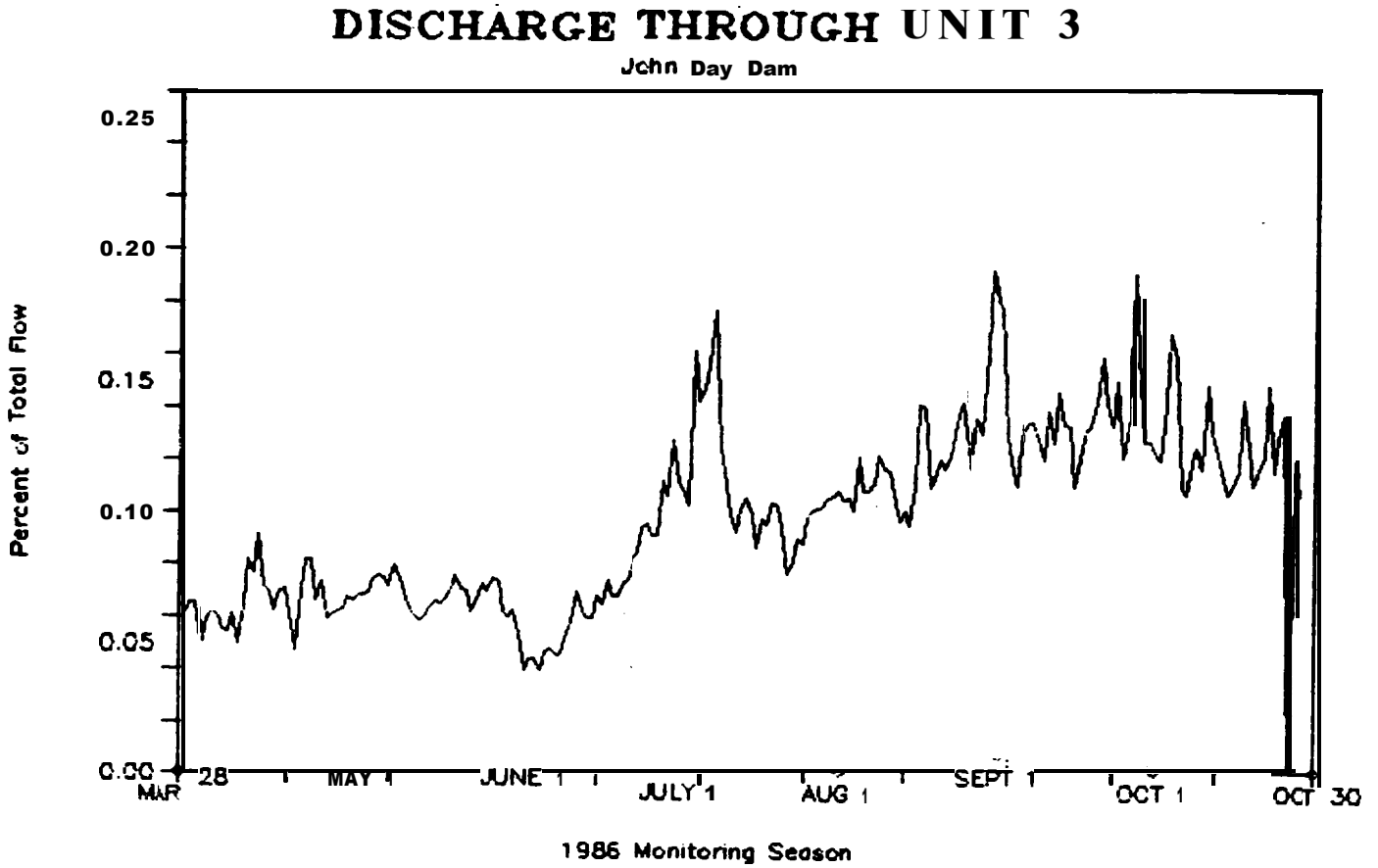

Figure 1

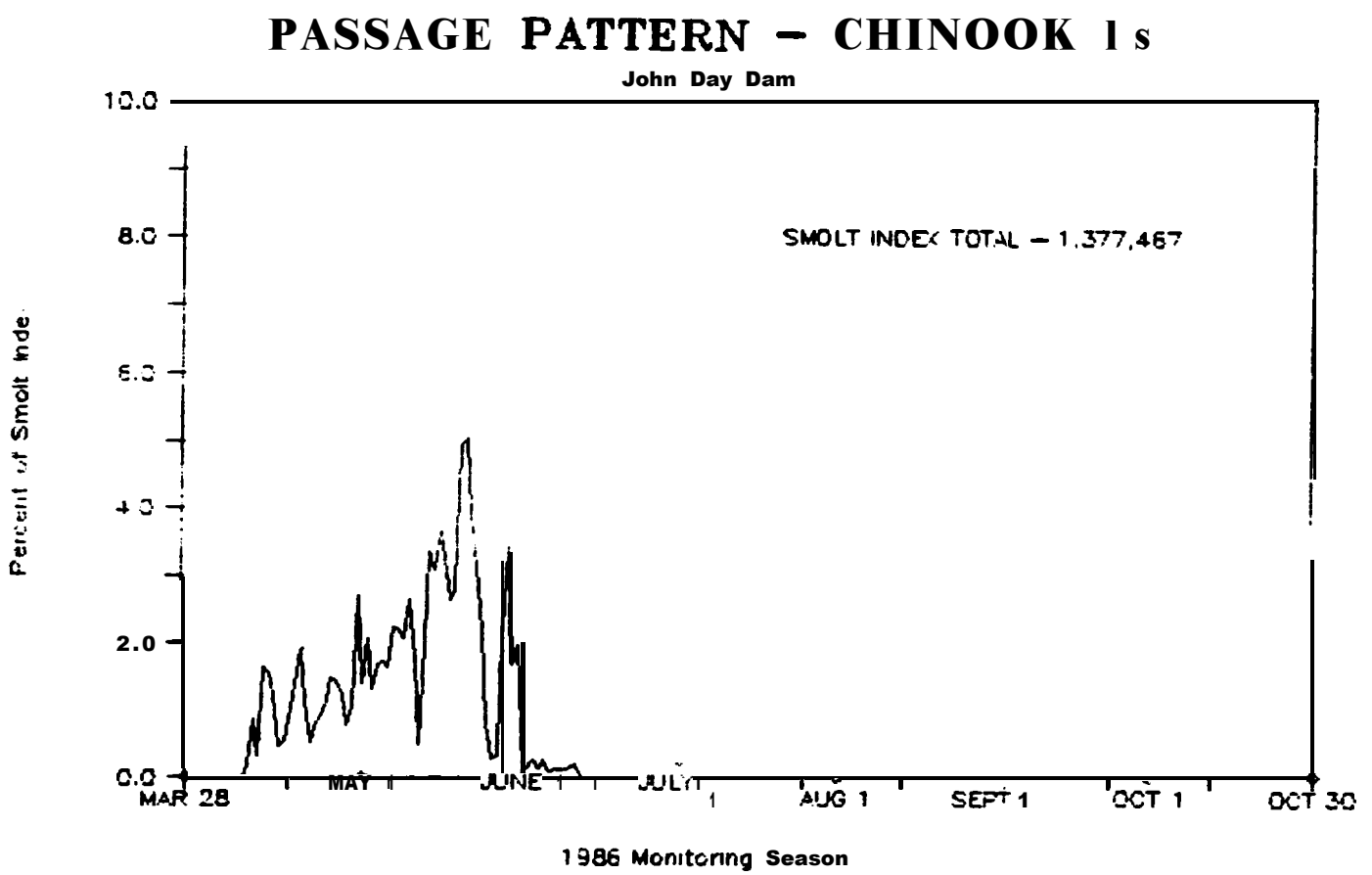

Figure 2

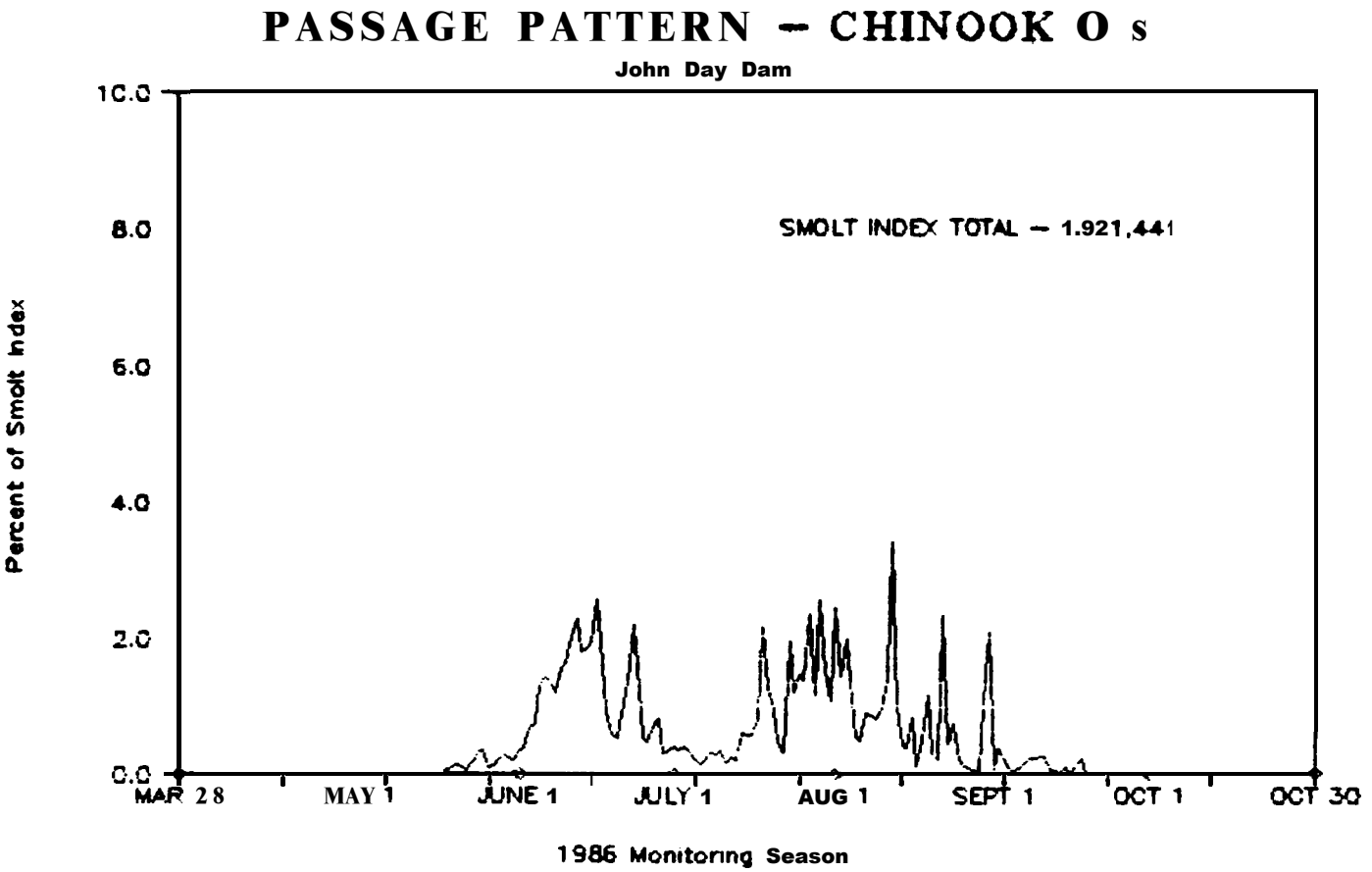

Figure 3

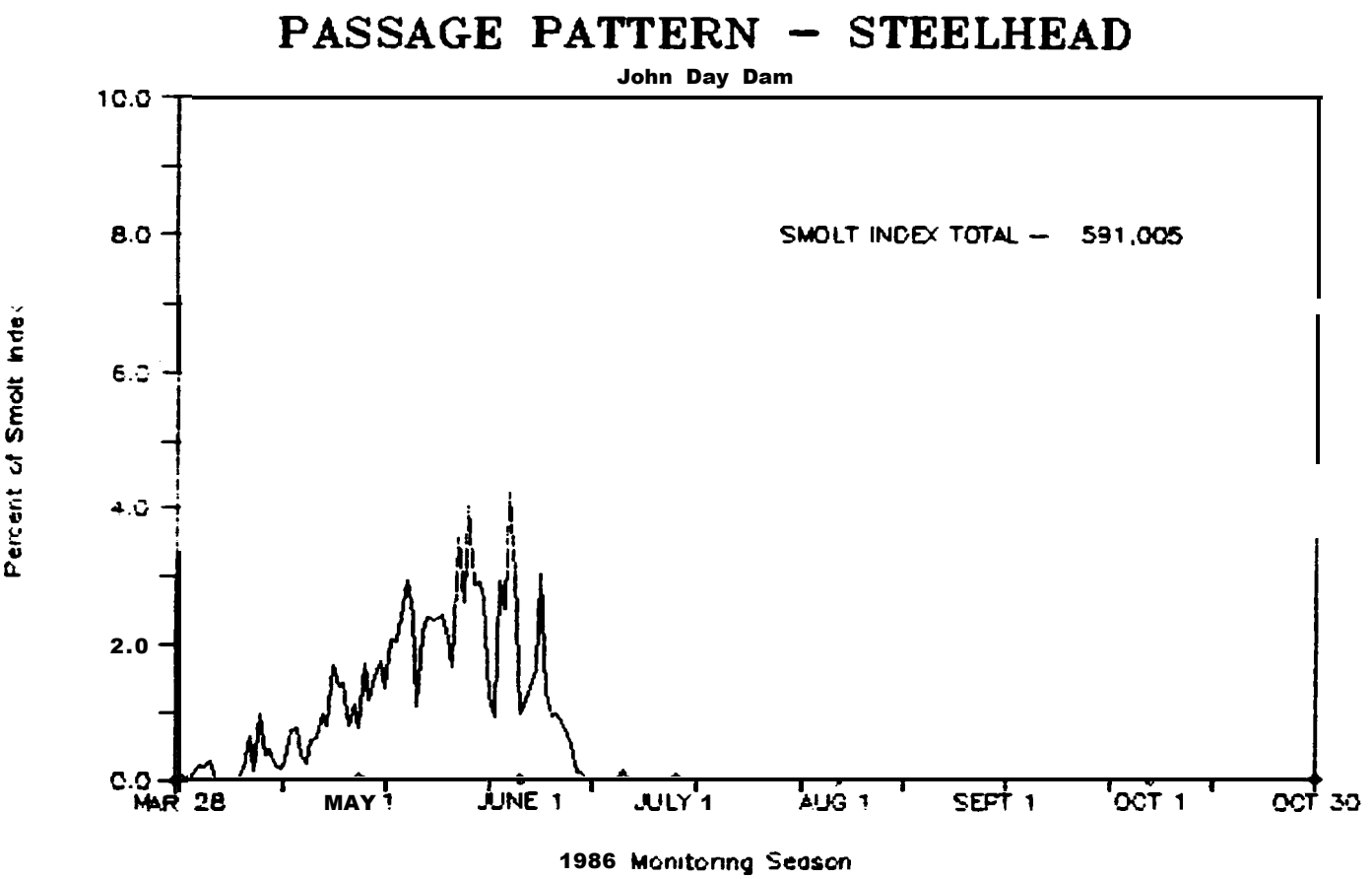

Figure 4

PASSAGE PATTERN – COHO

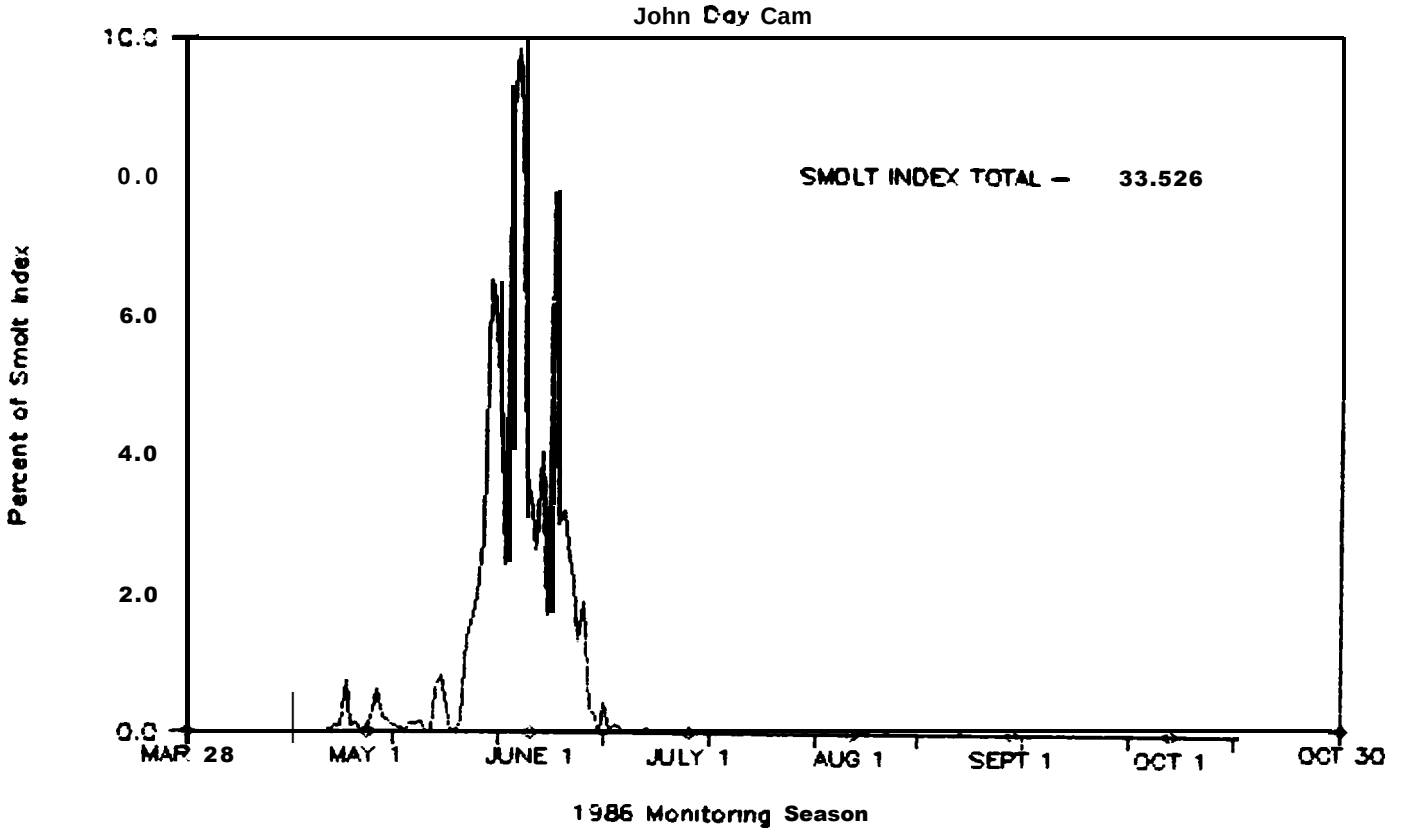

Figure 5

PASSAGE PATTERN – SOCKEYE

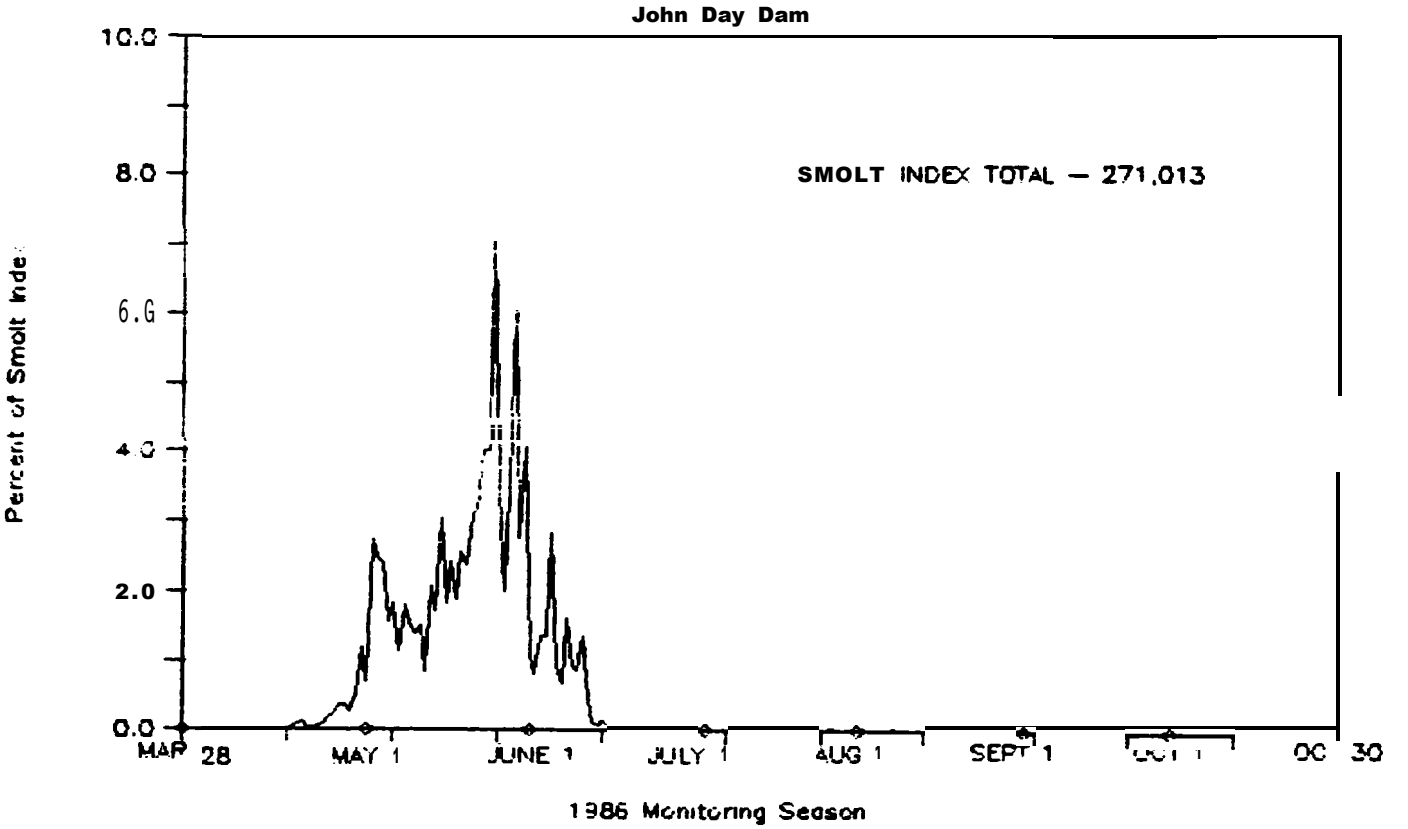

Figure 6

APPENDIX C

FISH CAPTURE PATTERN
FOR
BONNEVILLE DAM POWERHOUSE #1 & #2
SMOLT MONITORING SEASON 1986

FIGURE	POWERHOUSE	SPECIES	PAGE
1	#1	CHINOOK l's	C-l
2	#1	CHINOOK O'S	C-l
3	#1	STEELHEAD	c-2
4	#1	COHO	c-2
5	#1	SOCKEYE	c-3
6	#2	CHINOOK l's	c-4
7	#2	CHINOOK O's	c-4
8	#2	STEELHEAD	c-5
9	#2	COHO	c-5
10	#2	SOCKEYE	C-6

FISH CAPTURE PATTERN, CHINOOK 1s

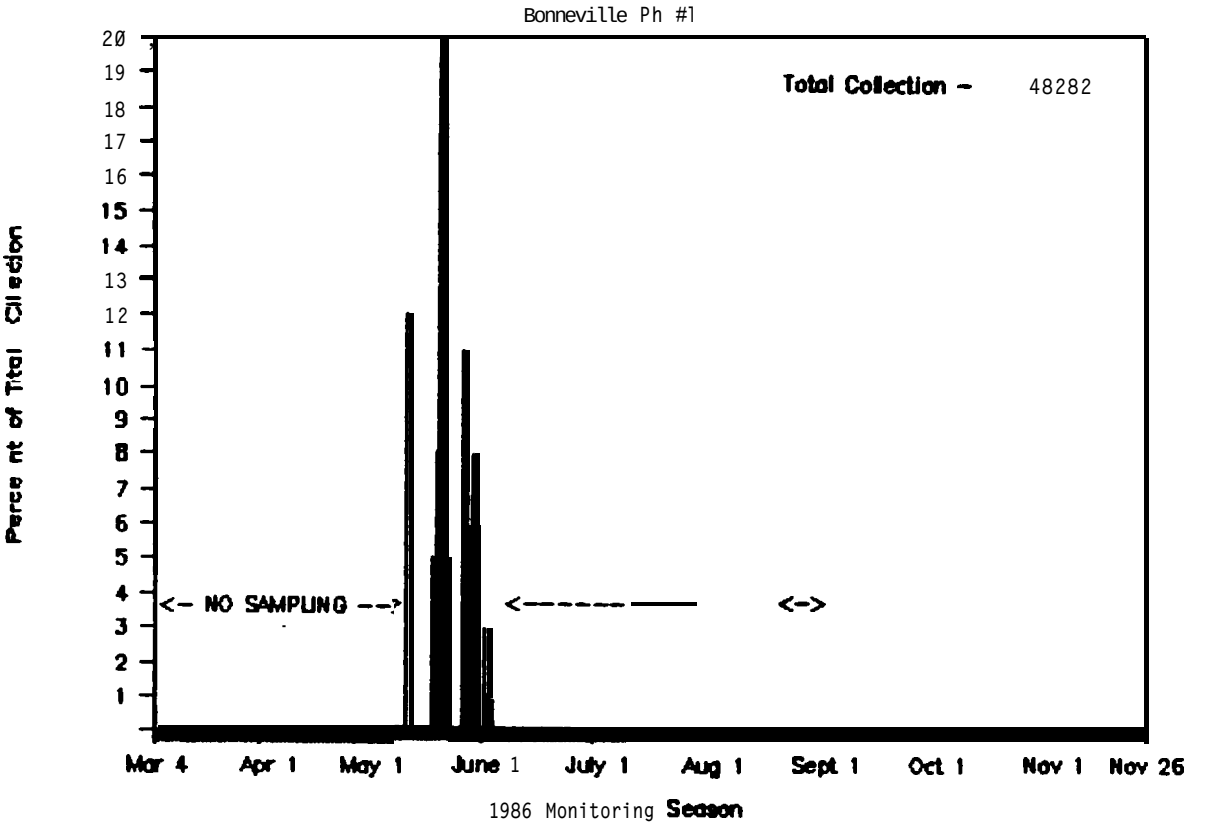

Figure 1.

FISH CAPTURE PATTERN, CHINOOK 0's

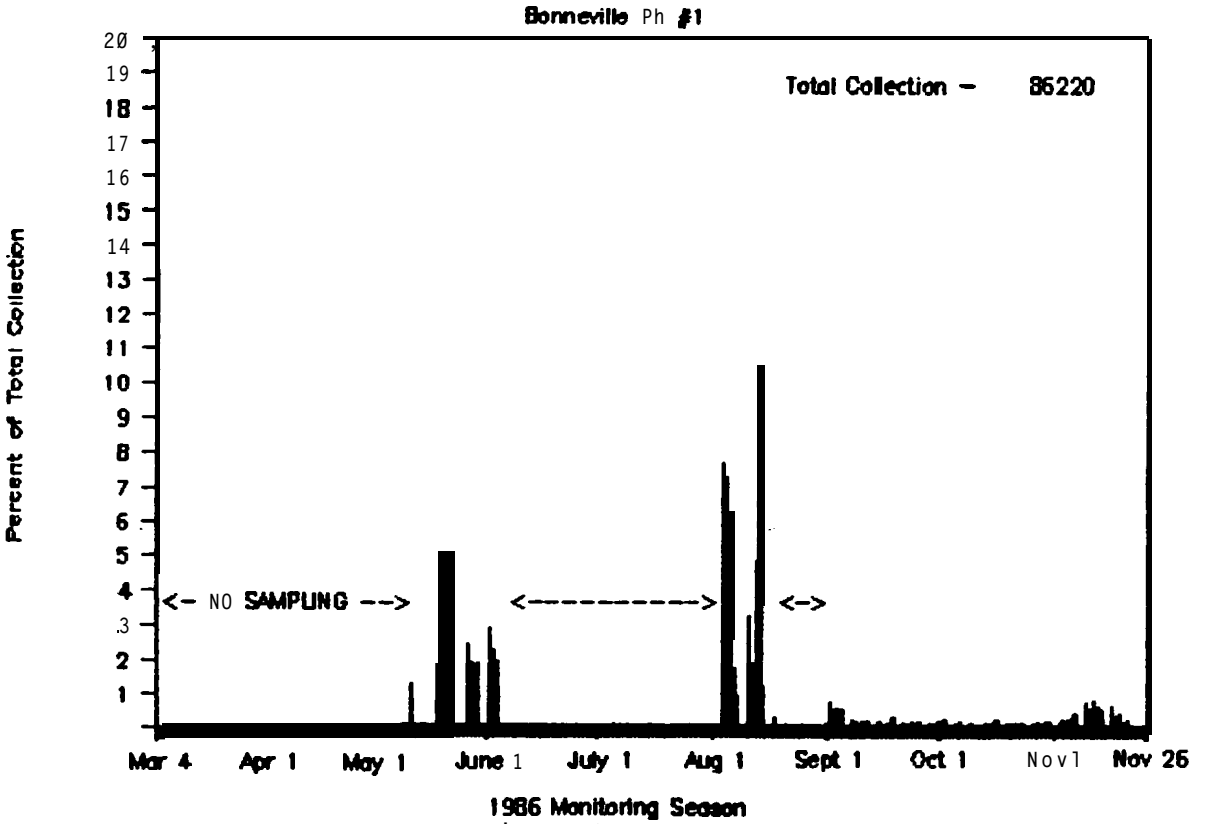

Figure 2.

FISH CAPTURE PATTERN, STEELHEAD

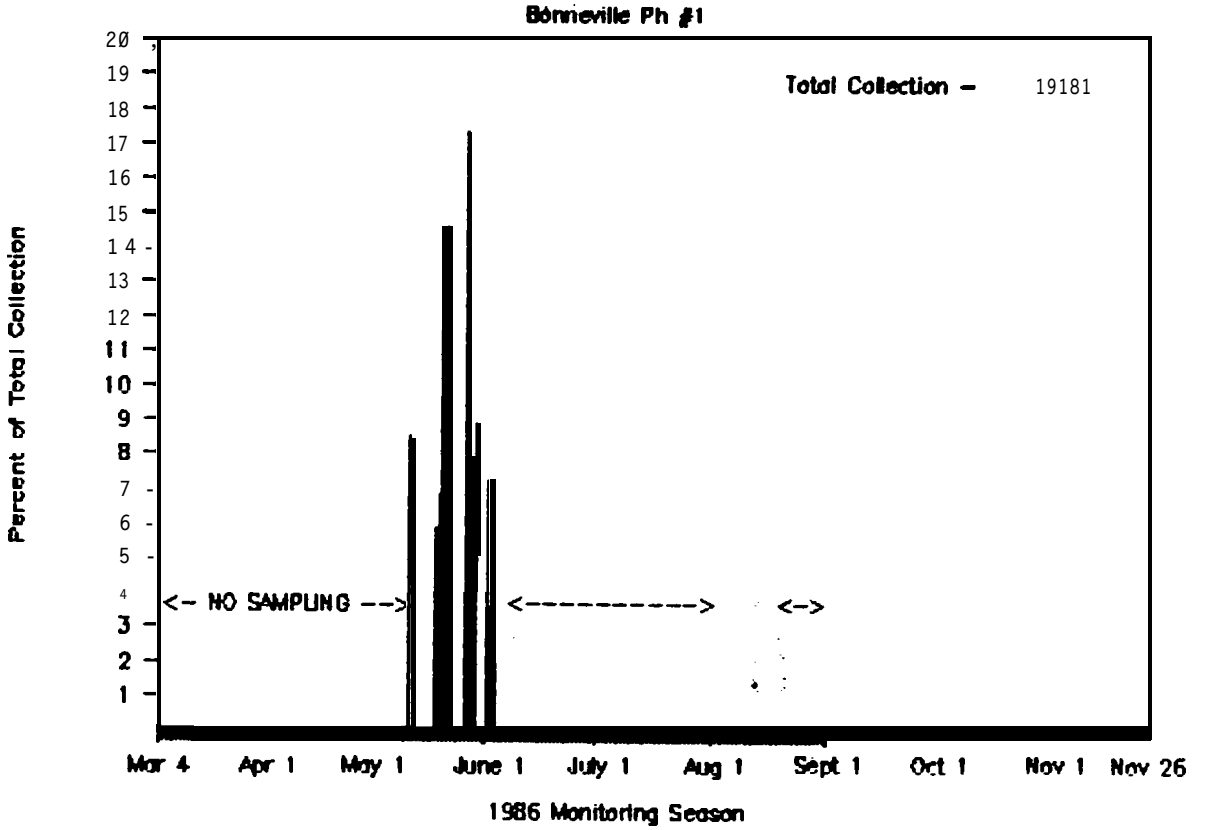

Figure 3.

FISH CAPTURE PATTERN, COHO

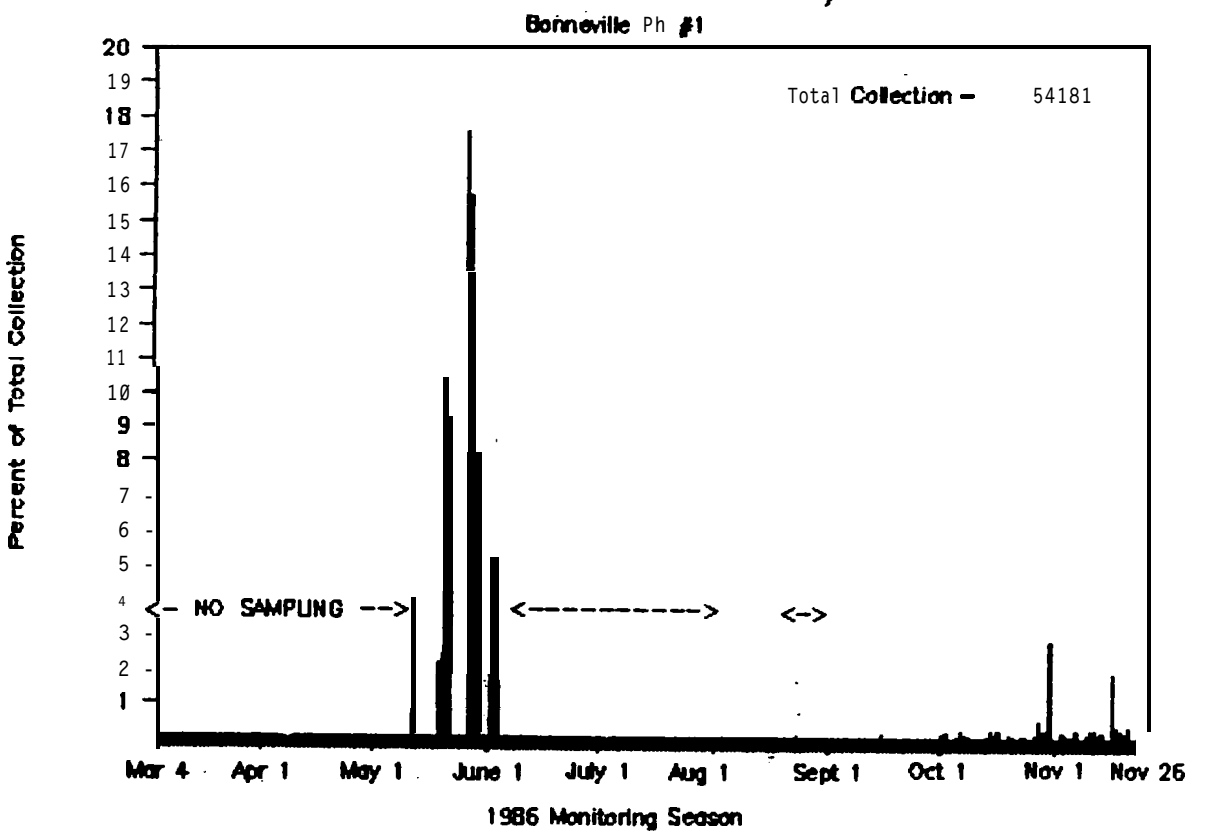

Figure 4.

FISH CAPTURE PATTERN, SOCKEYE

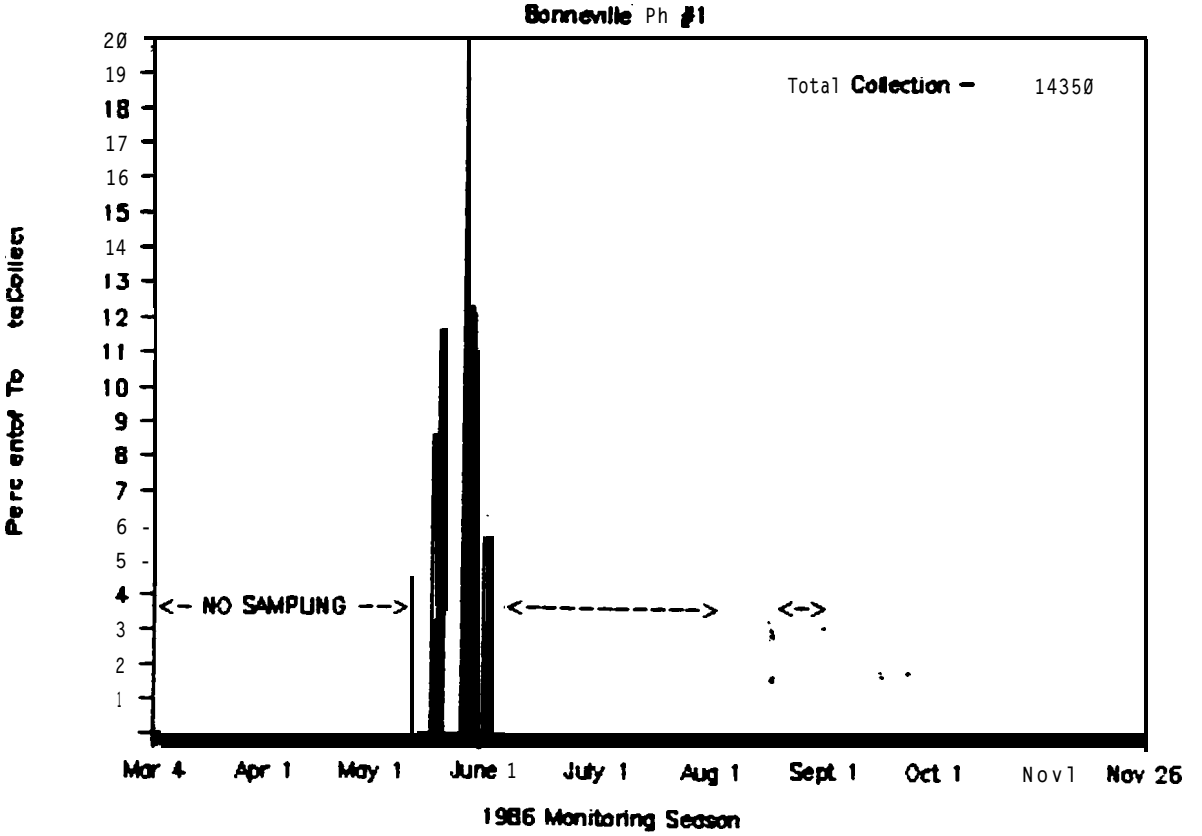

Figure 5.

FISH CAPTURE PATTERN, CHINOOK l's

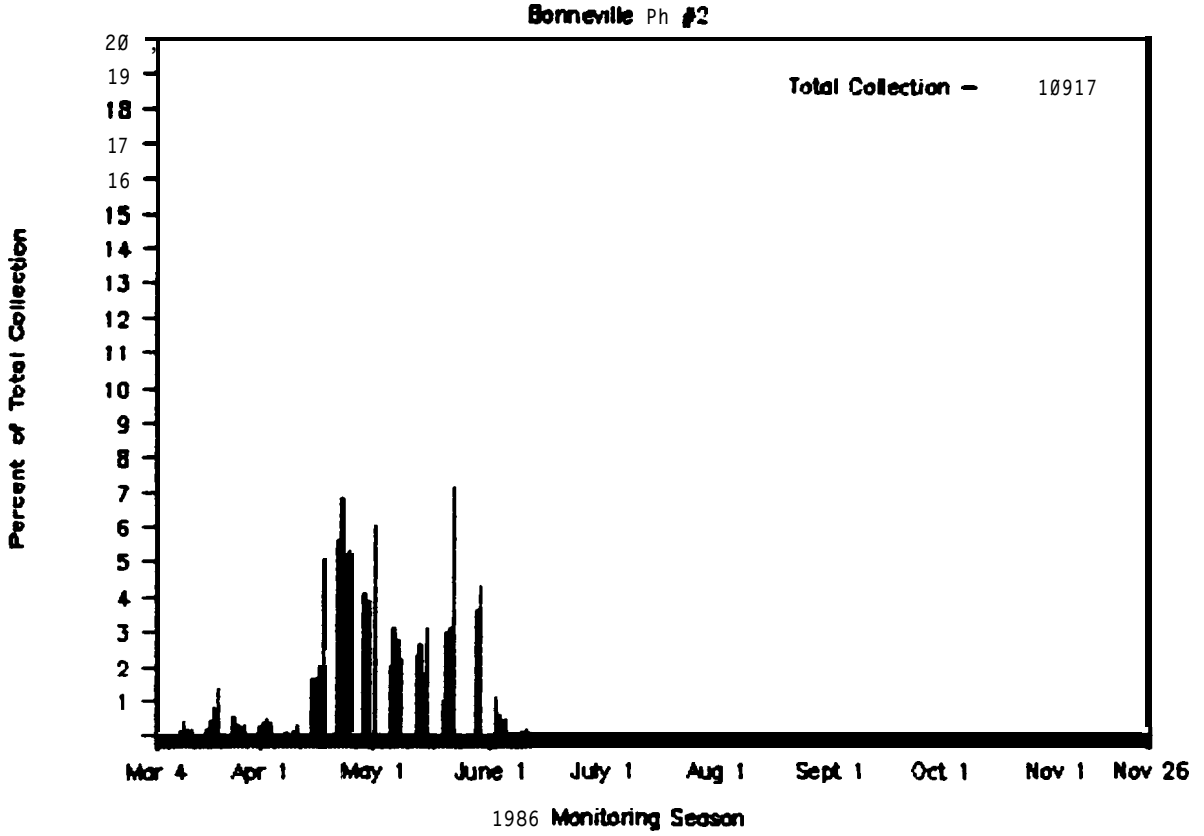

Figure 6.

FISH CAPTURE PATTERN, CHINOOK O s

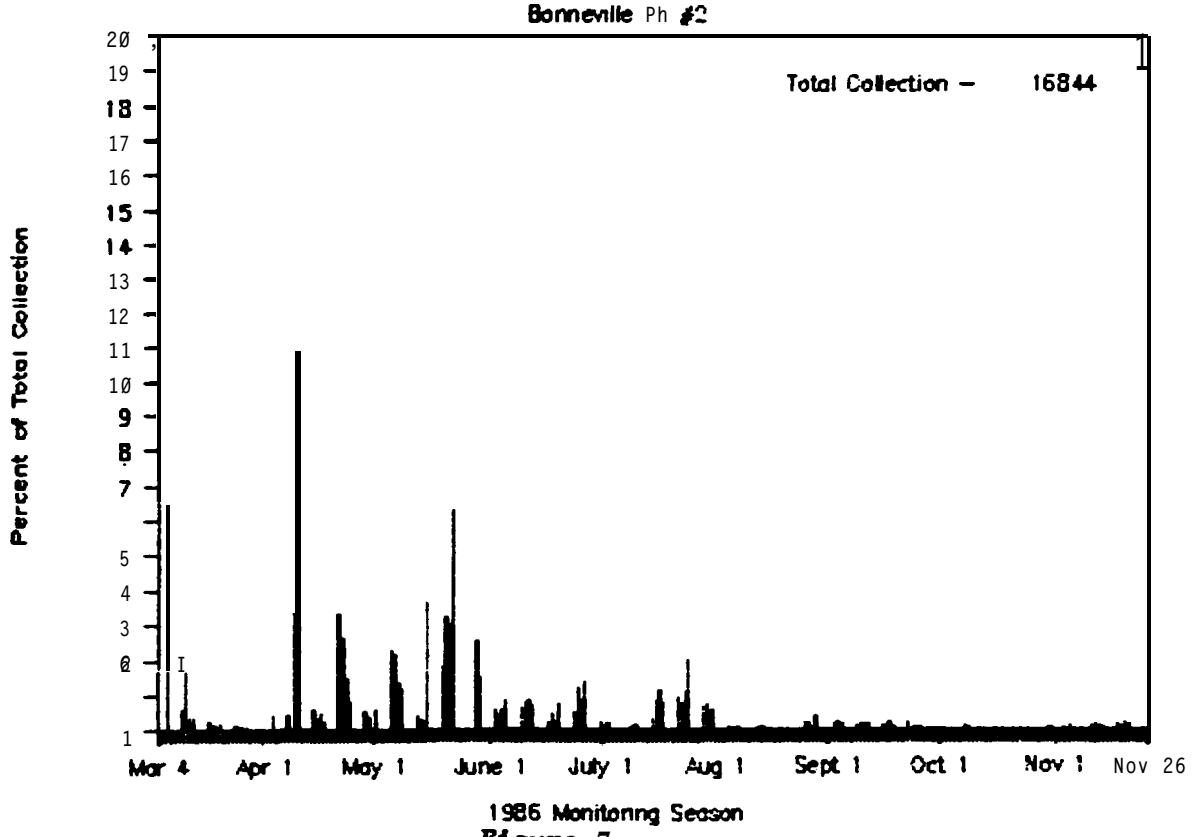

Figure 7.

FISH CAPTURE PATTERN, **STEELHEAD**

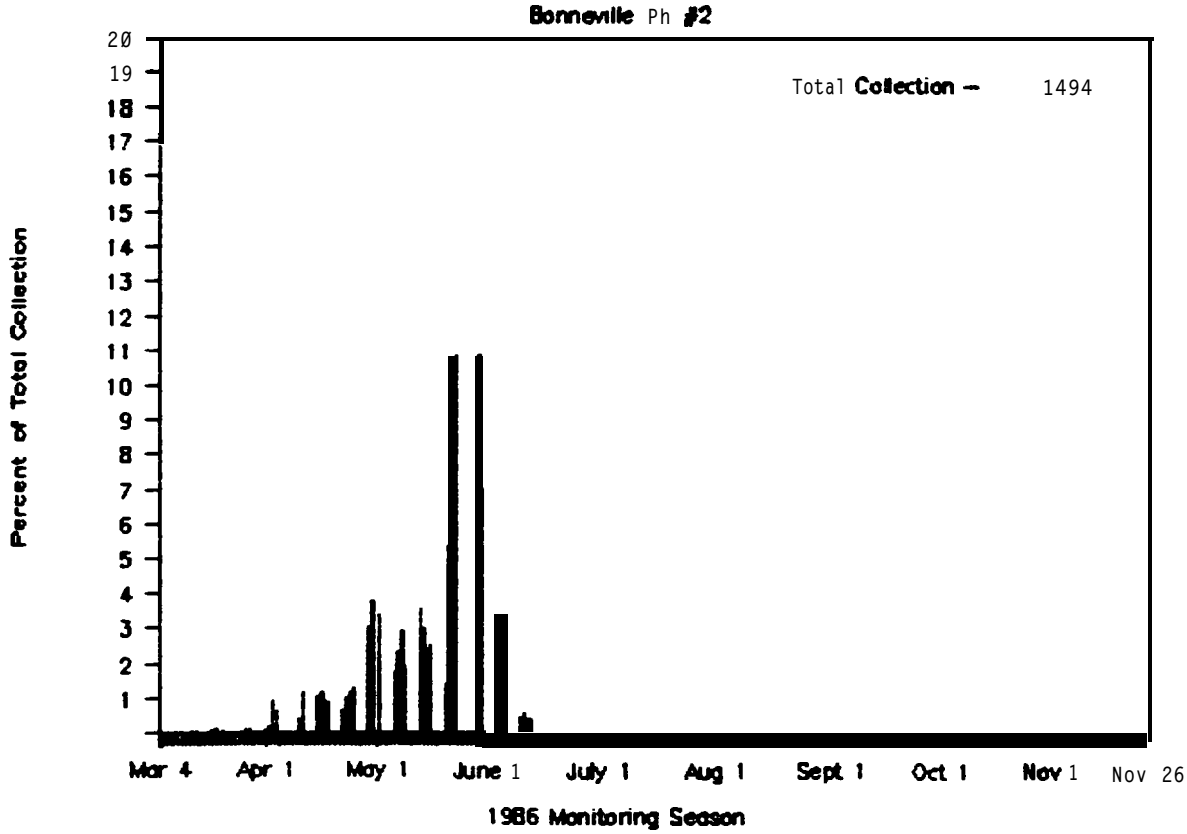

Figure 8.

FISH CAPTURE **PATTERN**, COHO

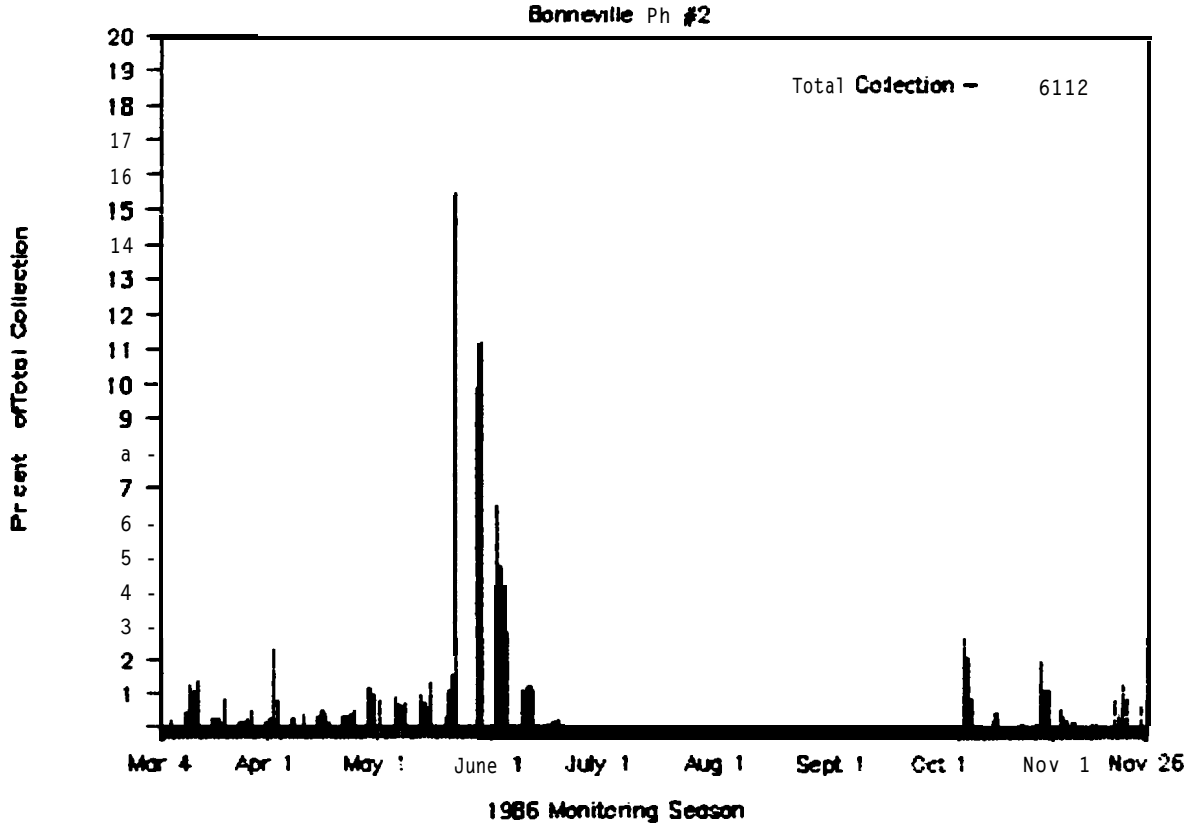

Figure 9.

FISH CAPTURE PATTERN, SOCKEYE

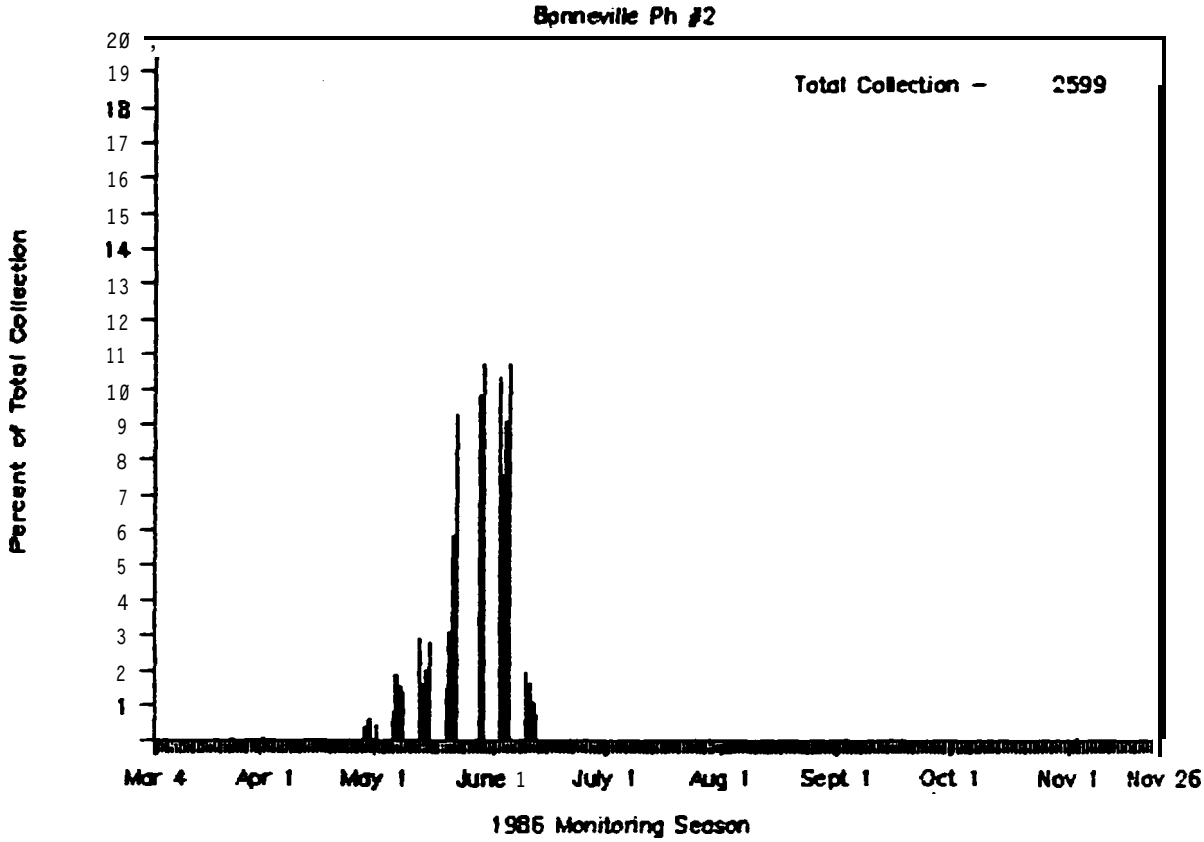

Figure 10.