Tom Zuckerman

U. S. FISH AND WILDLIFE SERVICE

EXHIBIT #3

1978 Hearing exhibit

Irrigation Diversion Study Summary

There are numerous water diversions along the Sacramento River and its tributary streams. Very few of these diversions are screened to prevent fish losses.

In view of the National interest in anadromous fish and the significant State and Federal investments in hatcheries and production of chinook salmon and steelhead, the California Department of Fish and Game assisted by the U.S. Fish and Wildlife Service conducted a pilot survey to evaluate the impact of water diversion structures on migrating juvenile salmonids.

Fyke nets with live boxes were used to sample the discharge. Initially, fyke nets with stretched mesh sizes varying from 1½ inch to 1 inch to ½ inch were used. To increase netting efficiency we switched to fyke nets of ½ inch stretched mesh. An inner fyke of ¼ inch stretch mesh was attached near the opening. Additionally, an experimental ¼ inch stretch mesh funnel net with inner fyke is being used.

Fyke nets were set as close to the discharge outlet as possible. The funnel net slid over a discharge pipe.

Nets were checked every 24 hours. All fish captured were recorded, measured and released. To identify previously captured fish, the upper lobe of the caudal fin was clipped.

To test net efficiency, chinook salmon fingerlings were marked and released, either into the pipe before it discharges into the ditch or directly in front of the discharge.

The selection of sampling locations was based primarily on the site's capacity to accommodate the net. Six sites were selected for use; four on Ryer Island and one each on Grand and Sherman Islands.

Ryer Island

1. water source: Steamboat Slough
   intake structure: siphon
   intake diameter: 20 inches
   diversion location: right side of Steamboat Slough approximately 0.9 mile upstream of Howard Landing Ferry
   average discharge flow: 10 cfs

WRINT CDWA Ex 3

2. water source: Miner Slough
   intake structure: siphon
   intake diameter: 30 inches
   diversion location: left side of Miner Slough approximately 0.2 mile upstream of State Highway 84 bridge
   average instantaneous flow: 19 cfs

3. water source: Miner Slough
   intake structure: siphon
   intake diameter: 18 inches
   diversion location: left side of Miner Slough approximately 0.5 mile upstream of the Elevator Road-Ryer Island
   average West Road intersection
   discharge flow: 4 cfs

4. water source: Cache Slough-Deepwater Ship Channel
   intake structure: siphon
   intake diameter: 14 inches
   diversion location: left side of Cache Slough-Deepwater Ship Channel approximately 3.1 miles downstream of the State 220-Ryer Island West Road intersection
   average discharge flow: 6 cfs

Grand Island

water source: Steamboat Slough
intake structures: (2) siphons and (1) pump
intake diameters: 18 inches and 14 inches respectively
diversion location: left side of Steamboat Slough approximately 0.3 mile downstream of the Howard Landing-Grand Island Road intersection
average instantaneous flow: 14 cfs

Sherman Island

water source: Sacramento River
intake structure: siphon
intake diameter: 20 inches
diversion location: left side of Sacramento River approximately 1.7 miles downstream of the Three Mile Slough bridge crossing
average discharge flow: 10 cfs

26 species of fish were captured. In addition, we captured large numbers of opossum shrimp, and crayfish, several muskrats, a bullfrog, pond turtle, and western fence lizard.

Fish species and numbers taken per site are listed below.

SPECIES		NUMBERS/SITE					
Common Name	Scientific Name	Ryer Island				Grand Is.	Sherm Is
		1	2	3	4		
Pacific lamprey	Entosphenus tridentatus	2	-	10	4	3	4
river lamprey	Lampetra ayressii	3	2	-	1	1	-
American shad	Alosa sapidissima	-	-	1	4	-	2
threadfin shad	Dorsoma petenense	-	-	3	-	-	7
longfin smelt	Spirinchus thaleichthys	8	68	17	4	-	183
chinook salmon	Oncorhynchus tshawytscha	164	14	32	16	-	4
steelhead trout	Salmo gairdnerii gairdnerii	1	-	1	-	-	-
carp	Cyprinius carpio	21	-	6	-	-	-
goldfish	Carassius auratus	5	3	11	-	-	-
Sacramento blackfish	Orthodon microlepidotus	-	6[1/]	-	-	-	-
Sacramento hitch	Lavinia exilicauda	8	16[2/]	4	-	93	-
Sacramento squawfish	Ptychocheilus grandis	17	23	5	-	1	-
white catfish	Ictalurus catus	143	225	271	66	24	96
channel catfish	Ictalurus punctatus	-	-	1	-	-	-
yellow bullhead	Ictalurus natalis	-	-	-	2	-	-
mosquito fish	Gambusia affinis	-	-	2	-	-	-
starry flounder	Platichthys stellata	-	-	-	-	-	1
striped bass	Morone saxatilis	1	1	2	-	-	-

SPECIES		NUMBERS/SITE					
Common Name	Scientific Name	River Island				Grand Is.	Sher Sh
		1	2	3	4		
largemouth bass	Micropterus salmoides	1	-	-	-	-	
smallmouth bass	Micropterus dolomieui	-	1[3]	-	-	-	
green sunfish	Lepomis cyanellus	23	20[4]	16	-	3	
bluegill	Lepomis macrochirus	-	1[5]	-	-	-	
black crappie	Pomoxis nigromaculatus	2	-	-	1	-	
log perch	Percinia caprodes	2	4[6]	3	-	-	
tule perch	Hysterocarpus traskii	43	13	40	21	4	
Pacific staghorn sculpin	Leptocottus armatus	-	3	1	3	1	
crayfish	Astacidae	-		-		-	
opossum shrimp	Neomysis spp.						
pond turtle	Clemmys marmorata	-	-	1	-	-	
bullfrog	Rana catesbeiana	-	1	-	-	-	
western fence lizard	Sceloporus occidentalis	1	-	-	-	-	
muskrat	Ondatra zibethica	-	-	-	-	-	1

1/ 2 taken with electro-shocker

2/ 9 " " "

3/ 1 " " "

4/ 7 " " "

5/ 1 " " "

6/ 2 " " "

DELTA UNSCREENED
IRRIGATION DIVERSIONS

There are an estimated 400 irrigation diversions in the Sacramento-San Joaquin Delta. This estimate reflects data compiled from DWR Bulletin 130-64, Volume II, N.E. California; May, 1966 which lists the number of diversions, at that time, for the San Joaquin River between Vernalis and Stockton; the Old River between the confluence of Tom Paine Slough and The Contra Costa Canal; and the Sacramento River between the Tower Bridge and Rio Vista as well as our best estimate of the number of diversions in the Delta.

Ryer Elevator

King Salmon

Numbers	Date	Size (mm)
0	4-8-76	-
0	4-12-76	-
3	4-13-76	52,42,62
2	4-14-76	67,69
1	4-15-76	72
2	4-16-17-18-76 1/	66,84
1	4-19-76	103
1	4-20-76	93
0	4-21-76	-
1	4-22-76	88
3 2/	4-26-76	90,81,88
37 2/	4-27-76	87,78,79,80,86,78,81, 77,92,90,84,83,82,75, 78,74,88,84,81,79,76, 87,80,86,80,75,82,70, 74,85,96,75,80,83,88, 76,80.
1	4-27-76	79
0	4-28-76 3/	-
2	4-29-76	85,82
18 2/	4-29-76	80,92,65,76,78,83,64, 76,77,70,70,71,77,79, 77,86,90

1/ Left net in over weekend.
2/ Taken with a 1/8" bobbinet beach seine.
3/ Began to use 1/4" mesh fyke nets.

Ryer Elevator (continued)

Numbers	Date	Size (mm)
7 1/	4-30-76	Not measured
21	5-3-76	77,78,82,77,72,75,80, 68,78,90,75,78,79,70, 79,77,75,74,70,75,75
2	5-4-76	90,84
6 1/	5-4-76	78,72,76,82,84,75,
1	5-5-76	82
2 1/	5-5-76	78,83
1	5-6-76	89
2	5-10-76	94,71
4 1/	5-10-76	86,84,100,80
0	5-11-76	-
3	5-12-76	85,87,81
1	5-13-76	82
4 1/	5-13-76	82,96,84,77
3	5-17-76 2/	88,87,78
5 1/	5-17-76	82,98,91,84,77
0	5-18-76	-
0	5-19-76	-
0	5-20-76	-
1	5-21-76	98
0	5-22-76	-
1 1/	5-23-76	98

1/ Taken with a 1/8" bobbinet beach seine.
2/ Began to use 1/8" funnel net.

Ryer Elevator (continued)

Numbers	Date	Size (mm)
0	5-24-76	-
0	5-25-76	-
4 [1/]	5-26-76	57,92,94
0	5-27-76	-
0	5-28-76	-
0	5-29-76	-
1	5-30-76	62
0	5-31-76	-
0	6-1-76	-
0	6-2-76	-
1 [2/]	6-3-76	75
0	6-4-76	-
0	6-5-76	-
0	6-6-76	-
0	6-7-76 [3/]	-
1	6-8-76	95
0	6-9-76 [3/]	-
0	6-10-76 [3/]	-
0	6-14-76	-
0	6-15-76	-

1/ Taken with 1/8" bobbinet beach seine.
2/ Includes partly digested remains of one king salmon.
3/ Ran efficiency test ~~100% recapture.~~

Ryer Elevator (continued)

Type of Trap & Number of Fish Taken		Dates Used	Number 1/ of hours
(1) Variable mesh trap	12	4-8-76 to 4-28-76	345 2/
(2) 1/4 inch mesh w/inner fyke	33	4-29-76 to 5-16-76	230 3/
(3) 1/8 inch bobbinet funnel w/inner fyke	10	5-17-76 to 6-15-76	621 3/
Total Fish Taken in Trap	55	Total Hours	1,196

Efficiency

	Number Planted	Number Recaptured	%
Variable mesh fyke	50	11	22
1/4" mesh fyke w/inner fyke	56	14	25
1/8" mesh funnel w/inner fyke	50	50	100

Take/hours/trap

Variable mesh 0.03

1/4 inch mesh fyke 0.14

1/8 inch mesh funnel 0.02

Total fish taken w/seine 88

Total hours seined 10

Take/hour 8.8

1/ 23 hours/day.

2/ includes hours efficiency test was run

Ryer North

King Salmon

Numbers	Date	Size (mm)
0	4-1-76	-
0	4-12-76	-
0	4-13-76	-
1	4-14-76	52
0	4-15-76	-
2	5-10-76 1/	75,85
4	5-11-76	77,87,101,86
0	5-12-76	-
1	5-13-76	85
0	5-17-76	-
0	5-18-76	-
1	5-19-76	105
1	5-20-76	94
0	5-21-76	-
0	5-22-76	-
1	5-23-76	68
0	5-24-76	-
1	5-25-76	98
0	5-26-76	-
0	5-27-76	-
0	5-28-76	-

1/ Began to use 1/4 inch mesh.

Ryer North (continued)

Numbers	Date	Size (mm)
1	5-29-76	98
0	5-30-76	-
1	5-31-76	62
0	6-10-76 1/	-
0	6-11-76 1/	-
0	6-14-76	-

Type of trap and number of fish taken		Dates Used	Number of hours 2/
Variable mesh	1	4-1-76 to 4-15-76	138 3/
1/4 inch mesh	13	5-10-76 to 6-14-76	483 3/
Total fish	14	Total hours	621

Efficiency

	Number Planted	Number Recaptured	%
Variable mesh	77	46	60
1/4 inch mesh	75	64	85

Fish take/trap/hour

Variable mesh 0.01

1/4 inch mesh 0.03

Volume of water sampled 975 acre feet

1/ Conducted efficiency test.
2/ 23 hours/day.
3/ Includes hours efficiency test was run.

Ryer Superintendent

King Salmon

Numbers	Date	Size (mm)
0	4-8-76	-
0	4-12-76	-
0	4-13-76	-
0	4-14-76	-
0	4-15-76	-
0	5-17-76 1/	-
8	5-18-76	84,73,75,59,78,74, 66,81
1	5-19-76	65
1	5-20-76	82
0	5-21-76	-
0	5-22-76	-
1	5-23-76	72
2	5-23-76 2/	102,83
1	5-24-76	60
1	5-25-76	71
1	5-26-76	61
0	5-27-76	-
0	5-28-76	-
0	5-29-76	-
0	5-30-76	-

1/ Utilizing 1/4 inch mesh nets.
2/ Seined delivery channel.

Ryer Superintendent (continued

Numbers	Date	Size (mm)
0	5-31-76	-
0	6-1-76	-
0	6-2-76	-
0	6-3-76	-
0	6-4-76	-
0	6-5-76	-
0	6-6-76	-
0	6-7-76	-
0	6-8-76	-
1	6-9-76	78
0	6-10-76 1/	-
0	6-11-76 1/	-

1/ Efficiency tests.

Ryer Superintendent (continued

Type of trap and number of fish taken		Dates Used	Number of hours [1]
Variable mesh	0	4-8-76 to 4-15-76	138 [2]
1/4 inch mesh	15	5-17-76 to 6-11-76	575 [2]
Total fish	15	Total hours	713

Efficiency

	Number Planted	Number Recaptured	%
Variable mesh	60	16	27
1/4 inch mesh w/inner fyke	58	10	17

Take/hour/trap

Variable mesh	0
1/4 inch mesh	0.03

Volume of water sampled 354 acre feet

Total fish taken w/seine 2

Total hours seined 0.5

Take/hour 4

1/ 23 hours /day.
2/ Includes hours efficiency test was run.

Numbers	Date	Size (mm)
0	5-21-76	-
1	5-22-76	102
0	5-23-76	-
4	5-24-76	65,86,102,86
2	5-25-76	71,94
0	5-26-76	-
3	5-27-76	73,95,92
0	5-28-76	-
0	5-29-76	-
1	5-30-76	65
0	5-31-76	-
1	6-1-76	93
0	6-2-76	-
0	6-3-76	-
1	6-4-76	68
0	6-5-76	-
0	6-6-76	-
0	6-7-76	-
0	6-8-76 1/	-
0	6-9-76	-
0	6-10-76	-
0	6-11-76 1/	-
0	6-14-76 1/	-
0	6-15-76 1/	-

1/ Efficiency tests conducted.

Ryer BM-9

King Salmon

Numbers	Date	Size (mm)
0	4-1-76	-
2 1/	4-19-76	78
0	4-20-76	-
1	4-21-76	82
1	4-22-76	79
0	4-26-76	-
0	4-27-76	-
0	4-28-76	-
0	4-29-76 2/	-
6	5-3-76	76,80,72,85,72,86
2	5-4-76	86,76
1	5-5-76	82
1	5-6-76	76
1	5-10-76	91
0	5-11-76	-
1	5-12-76	83
0	5-13-76	-
2	5-17-76	90,88
0	5-18-76	-
1	5-19-76	88
1	5-20-76	91

1/ Partly digested.
2/ Began to use 1/4 inch mesh fyke net.

Type of trap and number of fish taken		Dates Used	Number of hours 1/
Variable mesh	4	4-8-76 to 4-28-76	184 2/
1/4 inch w/inner fyke	29	4-29-76 to 6-15-76	828 2/
Total fish	33	Total hours	1,012

Efficiency

	Number Planted	Number Recaptured	%
Variable mesh	58	38	66
	53	45	85
1/4 inch w/inner fyke	94	27	29
	50	25	50

Fish take/hour/trap

Variable mesh	0.02
1/4 inch mesh	0.03

Volume of water sampled 334 ac. ft.

1/ Fished 23 hours/day.

2/ Includes hours efficiency test was run

Shelley Rch.

King Salmon

Numbers	Date	Size (mm)
0	4-1-76	-
0	4-8-76	-
0	4-16-17-18-76 1/	-
0	4-19 to 4-22-76	-
0	4-26 to 4-29-76 2/	-
0	5-3 to 5-6-76	-
0	6-1 to 6-8-76 3/	-

Fish taken 0 Hours fished 575 4/

Efficiency

	Numbers Planted	Numbers Recaptured	%
Variable mesh	76	6	8
1/4 inch mesh	50	29	58

Volume of water sampled 665 acre feet.

1/ Left net in over weekend.
2/ Began to use 1/4 inch mesh.
3/ Efficiency tests ran 6-7 and 6-8.
4/ 23 hours/day.

Sherman Is.

King Salmon

Numbers	Date	Size (mm)
0	4-8-76	-
0	4-12-76	-
0	4-13-76	-
1	4-14-76	71
0	4-15-76	-
0	4-19-76	-
1	4-20-76	95
0	4-21-76	-
0	4-22-76	-
0	4-26-76	-
0	4-27-76	-
0	4-28-76	-
0	4-29-76 1/	-
0	5-3-76	-
1	5-4-76	73
0	5-5-76	-
0	5-6-76	-
1	5-10-76	92
0	6-14-76 2/	-
0	6-15-76 2/	-

1/ Began to use 1/4 inch mesh.
2/ Efficiency tests run for 8 hours.

Sherman Is. (continued)

Type of trap and number of fish taken		Dates Used	Number of hours
Variable mesh	2	4-8-76 to 4-28-76	284 1/
1/4 inch mesh	2	4-29-76 to 5-10-76	146 1/
Total fish	4	Total hours	430

Efficiency

	Number Planted	Number Recaptured	%
Variable mesh	50	19	38
1/4 inch mesh	50	26	52

Fish take/hour/trap

Variable mesh 0.007

1/4 inch mesh 0.01

Volume of water sampled 355 acre feet.

1/ Includes 8 hours efficiency tests were run.