

Tom Zuckerman

U. S. FISH AND WILDLIF  
SERVICE

EXHIBIT #3

Irrigation Diversion Study Summary

1978 Hearing  
Exhibit

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  
West Road intersection  
average 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.	Sherman Is.
		1	2	3	4		
Pacific lamprey	<u>Entosphenus tridentatus</u>	2	-	10	4	3	4
river lamprey	<u>Lampetra ayressii</u>	3	2	-	1	1	-
American shad	<u>Alosa sapidissima</u>	-	-	1	4	-	2
threadfin shad	<u>Dorsoma petenense</u>	-	-	3	-	-	7
longfin smelt	<u>Spirinchus thaleichthys</u>	8	68	17	4	-	183
chinook salmon	<u>Oncorhynchus tshawytscha</u>	164	14	32	16	-	4
steelhead trout	<u>Salmo gairdneri gairdnerii</u>	1	-	1	-	-	-
carp	<u>Cyprinus carpio</u>	21	-	6	-	-	-
goldfish	<u>Carassius auratus</u>	5	3	11	-	-	-
Sacramento blackfish	<u>Orthodon microlepidotus</u>	-	6 <sup>1/</sup>	-	-	-	-
Sacramento hitch	<u>Lavinia exilicauda</u>	8	16 <sup>2/</sup>	4	-	93	-
Sacramento squawfish	<u>Ptychocheilus grandis</u>	17	23	5	-	1	-
white catfish	<u>Ictalurus catus</u>	143	225	271	66	24	96
channel catfish	<u>Ictalurus punctatus</u>	-	-	1	-	-	-
yellow bullhead	<u>Ictalurus natalis</u>	-	-	-	2	-	-
mosquito fish	<u>Gambusia affinis</u>	-	-	2	-	-	-
starry flounder	<u>Platichthys stellata</u>	-	-	-	-	-	1
striped bass	<u>Morone saxatilis</u>	1	1	2	-	-	-

## SPECIES

## NUMBERS/SITE

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

<u>Numbers</u>	<u>Date</u>	<u>Size (mm)</u>
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 <u>1/</u>	66,84
1	4-19-76	103
1	4-20-76	93
0	4-21-76	-
1	4-22-76	88
3 <u>2/</u>	4-26-76	90,81,88
37 <u>2/</u>	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	-
2 <u>3/</u>	4-29-76	85,82
18 <u>2/</u>	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)

<u>Numbers</u>	<u>Date</u>	<u>Size (mm)</u>
7 <u>1/</u>	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 <u>1/</u>	5-4-76	78,72,76,82,84,75,
1	5-5-76	82
2 <u>1/</u>	5-5-76	78,83
1	5-6-76	89
2	5-10-76	94,71
4 <u>1/</u>	5-10-76	86,84,100,80
0	5-11-76	-
3	5-12-76	85,87,81
1	5-13-76	82
4 <u>1/</u>	5-13-76	82,96,84,77
3	5-17-76 <sup>2/</sup>	88,87,78
5 <u>1/</u>	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 <u>1/</u>	5-23-76	98

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

Ryer Elevator (continued)

<u>Numbers</u>	<u>Date</u>	<u>Size (mm)</u>
0	5-24-76	-
0 <sup>1</sup>	5-25-76	-
4 <sup>2/</sup>	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 <sup>2</sup>	6-2-76	-
1 <sup>4/</sup>	6-3-76	75
0	6-4-76	-
0	6-5-76	-
0	6-6-76	-
0	6-7-76 <sup>3/</sup>	-
1	6-8-76	95
0	6-9-76 <sup>3/</sup>	-
0	6-10-76 <sup>3/</sup>	-
0	6-14-76	-
0	6-15-76	-

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- <sup>2/</sup> Taken with 1/8" bobbinet beach seine.  
<sup>4/</sup> Includes partly digested remains of one king salmon.  
<sup>3/</sup> Ran efficiency test ~~100%~~ recapture.



Ryer Elevator (continued)

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

Efficiency

	<u>Number Planted</u>	<u>Number Recaptured</u>	<u>%</u>
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 runs.

Ryer North  
King Salmon

<u>Numbers</u>	<u>Date</u>	<u>Size (mm)</u>
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 <sup>1/</sup>	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	-

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1/ Began to use 1/4 inch mesh.

Ryer North (continued)

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

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

Efficiency

	<u>Number Planted</u>	<u>Number Recaptured</u>	<u>%</u>
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

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

Ryer Superintendent

King Salmon

<u>Numbers</u>	<u>Date</u>	<u>Size (mm)</u>
0	4-8-76	-
0	4-12-76	-
0	4-13-76	-
0	4-14-76	-
0	4-15-76	-
0	5-17-76 <sup>1/</sup>	-
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 <sup>2/</sup>	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	-

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

Ryer Superintendent (continued)

<u>Numbers</u>	<u>Date</u>	<u>Size (mm)</u>
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 <sup>1/</sup>	-
0	6-11-76 <sup>1/</sup>	-

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<sup>1/</sup> Efficiency tests.

Ryer Superintendent (continued)

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

Efficiency

	<u>Number Planted</u>	<u>Number Recaptured</u>	<u>%</u>
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

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<sup>1/</sup> 23 hours /day.

<sup>2/</sup> Includes hours efficiency test was run.

<u>Numbers</u>	<u>Date</u>	<u>Size (mm)</u>
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- <del>27</del> -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 <sup>1/</sup>	-
0	6-9-76 <del>1/</del>	-
0	6-10-76	-
0	6-11-76 <sup>1/</sup>	-
0	6-14-76 <sup>1/</sup>	-
0	6-15-76 <sup>1/</sup>	-

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<sup>1/</sup> Efficiency tests conducted.

Ryer BM-9

King Salmon

<u>Numbers</u>	<u>Date</u>	<u>Size (mm)</u>
0	4-1-76	-
2 <u>1/</u>	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 <u>2/</u>	-
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

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1/ Partly digested.

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



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

Efficiency

	<u>Number Planted</u>	<u>Number Recaptured</u>	<u>%</u>
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.

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<sup>1/</sup> Fished 23 hours/day.

<sup>2/</sup> Includes hours efficiency test was run

Shelley Rch.

King Salmon

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

Fish taken 0                      Hours fished 575 <sup>4/</sup>

Efficiency

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

Volume of water sampled 665 acre feet.

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

Sherman Is.

King Salmon

<u>Numbers</u>	<u>Date</u>	<u>Size (mm)</u>
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 <sup>1/</sup>	-
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 <sup>2/</sup>	-
0	6-15-76 <sup>2/</sup>	-

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<sup>1/</sup> Began to use 1/4 inch mesh.

<sup>2/</sup> Efficiency tests run for 8 hours.

Sherman Is. (continued)

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

Efficiency

	<u>Number Planted</u>	<u>Number Recaptured</u>	<u>%</u>
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.

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<sup>1/</sup> Includes 8 hours efficiency tests were run.