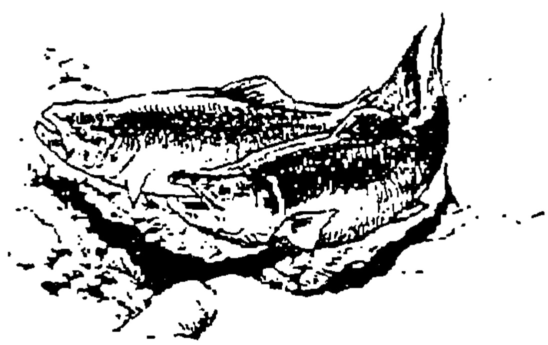
UNITED STATES DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE

THE RELATIONSHIP BETWEEN INSTREAM FLOW AND PHYSICAL HABITAT AVAILABILITY FOR CHINOOK SALMON IN THE STANISLAUS RIVER, CALIFORNIA



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THE RELATIONSHIP BETWEEN INSTREAM FLOW AND PHYSICAL HABITAT AVAILABILITY FOR CHINOOK SALMON IN THE STANISLAUS RIVER, CALIFORNIA

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ABSTRACT

In 1989 the U.S. Fish and Wildlife Service's Instream Flow Incremental Methodology (IFIM) was applied to the Stanislaus River between Goodwin Dam and the town of Riverbank, California (approximately 24 river miles). The purpose was to help determine the instream flow needs for chinook salmon, *Onchorhynchus tshawytscha*, in the Stanislaus River downstream of the New Melones Unit of the Central Valley Project. The streamflow versus physical habitat relationship is described using the physical habitat simulation (PHABSIM) model and is based on the relationship established for three calibration flows measured as releases below Goodwin Dam (1,250 cfs, 700 cfs, and 125 cfs).

An instream flow of 300 cfs provides the greatest amount of salmon spawning habitat. Available habitat for egg incubation is maximized at 150 cfs. Fry habitat appears to be relatively limited and does not increase or decrease appreciably with streamflow. Juvenile salmon habitat availability is highest at 200 cfs. In general, an annual fishery flow release of 156,000 acre-feet would provide maximum physical habitat availability within the 24 mile study reach.

Additional water is recommended, as provided in an interim agreement between the U.S. Bureau of Reclamation and the California Department of Fish and Game, for further investigations to define flow needs for: 1) spring outmigration; 2) water temperature control; 3) fall "attraction" of migrating adults; and 4) maintenance of water quality (i.e., dissolved oxygen) or other benefits to the salmon population. These investigations must be completed before the instream flow requirements for chinook salmon protection on the Stanislaus River can be determined.

ACKNOWLEDGEMENTS

This investigation was funded through Federal transfer monies provided by the U.S. Bureau of Reclamation, Mid-Pacific Region. The studies described, and this report, were completed as part of a cooperative Stanislaus River Fishery Investigation, involving the Bureau of Reclamation, the U.S. Fish and Wildlife Service, and the California Department of Fish and Game. Jim Denny was the Bureau of Reclamation contact throughout this investigation. Many others also contributed to the completion of this report, especially in gathering the field data. Fish and Wildlife Service personnel Phil North (field crew leader), Nadine Kanim, Roger Guinee, Vicky Campbell, Mike Sullivan, Rich Williams, and Larry Hanson all worked diligently in gathering the field data. Volunteer workers Steve Elliot and Rick Howard also provided valuable field assistance. James Carson, of the Service's Sacramento Field Office, helped with editorial review and Jeff Thomas provided a thorough review, and improved calibration, of the PHABSIM input data for the final analysis.

PREFACE

The draft of this report, dated February 20, 1992, was titled Instream Flow Requirements for Fall Run Chinook Salmon Spawning and Rearing, Stanislaus River, California. The title has been changed to more accurately reflect the product of this study, which is a description of the relationship between physical or micro-habitat availability (expressed as suitable combinations of water velocity, depth, and substrate) for chinook salmon and streamflow in the Stanislaus River, California. Additional studies describing the relationship between streamflow and suitable macrohabitat conditions, such as water quality or temperature and conveyance flows (also called migration or "pulse" flows) necessary for salmon survival, must be completed in order to fully describe the relationship between instream flow and suitable habitat conditions for chinook salmon in the Stanislaus River.

A water temperature model is currently being developed for the Stanislaus River by the Bureau of Reclamation and salmon survival studies are being conducted by the Department of Fish and Game as part of the Stanislaus River Fishery Investigation. Once completed, the results of the temperature model, salmon survival studies, and the instream flow study described in this report will be "integrated" so that the overall relationship between streamflow and suitable habitat conditions for chinook salmon can be described. Only then can instream flows necessary to protect and preserve the salmon population of the Stanislaus River be determined and long term instream flow requirements be established.

Furthermore, due to interest from Bureau of Reclamation and Department of Fish and Game staff, a PHABSIM analysis was added using habitat suitability criteria for resident rainbow trout and anadromous steelhead trout.

Finally, those readers who reviewed the draft report may notice some differences in the relationship between weighted usable area and streamflow as described in this report. The primary reason for these differences are the result of a more detailed, and exhaustive, review of the physical and hydraulic input data applied to the PHABSIM. In addition, rather than running three separate data sets (high, middle, and low flow) for each study site, as was done in the draft, all velocity data was combined into one input deck for each study site in the final analysis. The input decks were thoroughly calibrated so that predicted water depths and velocities best matched those actually recorded at the three measured stream flows. Through this process it was not necessary to combine the PHABSIM results from three separate runs for each study site to provide the best overall picture of the physical habitat versus streamflow relationship, as was done in the draft. Instead the results from the combined velocity data sets used in the final analysis for each study site can be used directly. Therefore, the results presented in this report supersede those presented in the February 20, 1992 draft and should be used in negotiations where the relationship between weighted usable area of habitat and streamflow needs to be understood.

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INTRODUCTION

Historically, the Stanislaus River, along with other San Joaquin River tributaries and the mainstem of the San Joaquin, had sizeable populations of chinook salmon, *Onchorhynchus tshawytscha*. Since the early 1900's, however, the number of salmon returning to the system each year to spawn has fallen dramatically. The spring-run chinook populations are extinct in the San Joaquin River system and the fall-run populations have declined significantly. Currently, there is no access for salmon to the upper San Joaquin River, due to diminished river flows. Spawning now occurs only in the major tributaries of the San Joaquin River -- the Merced, the Tuolumne, the Calaveras, and the Stanislaus Rivers.

Efforts are underway to protect, restore, or enhance the dwindling populations of fall-run chinook salmon within the San Joaquin River system. An early effort on the Stanislaus River began with the authorization of the New Melones Project, a Federal water project operated by the U.S. Bureau of Reclamation as part of the Central Valley Project. Among the authorized project purposes, (which include flood control, irrigation and municipal water supply, power generation, recreation, and water quality control) is fish and wildlife enhancement, including provision for fishery flows.

Pursuant to project authorization, the U.S. Fish and Wildlife Service (Service), the California Department of Fish and Game (Department), and the Bureau of Reclamation (Reclamation) have cooperatively undertaken a series of investigations aimed at determining the measures necessary to improve the chinook salmon population in the Stanislaus River. Study tasks were designed to identify factors limiting chinook salmon survival in the Stanislaus and to develop alternative management programs to increase the population. One task was specifically to conduct an instream flow study to assist in the identification of acceptable flow regimes for all life stages of chinook salmon which occur in the Stanislaus River. This report describes the instream flow study and presents the results.

DESCRIPTION OF STUDY AREA

General Setting

The headwaters of the Stanislaus River originate at an elevation of approximately 7,000 feet on the western slope of the Sierra Nevada, approximately 125 miles due east of the San Francisco Bay area. The Stanislaus flows in a southwesterly direction from the Sierra crest and joins the San Joaquin River on the floor of the Central Valley (Figure 1). Draining northward through the valley, the San Joaquin River meets the southward draining Sacramento River to form the Sacramento-San Joaquin Delta. Delta waters flow through the San Pablo Bay-San Francisco Bay complex and eventually into the Pacific Ocean, passing through San Francisco's Golden Gate.

Goodwin Dam is located in the Sierra foothills at an elevation of approximately 300 feet above mean sea level, and is a barrier to salmon migration on the Stanislaus River. Between the San Joaquin River and Goodwin Dam approximately 59 river miles of anadromous fish habitat is available in the Stanislaus. However, only the reach from approximately river mile 36 to Goodwin Dam (a distance of approximately 23 river miles) is defined as salmon spawning habitat by the California Department of Fish and Game (California Fish and Game code section 1505).

Field reconnaissance and aerial photos indicate that the lower Stanislaus

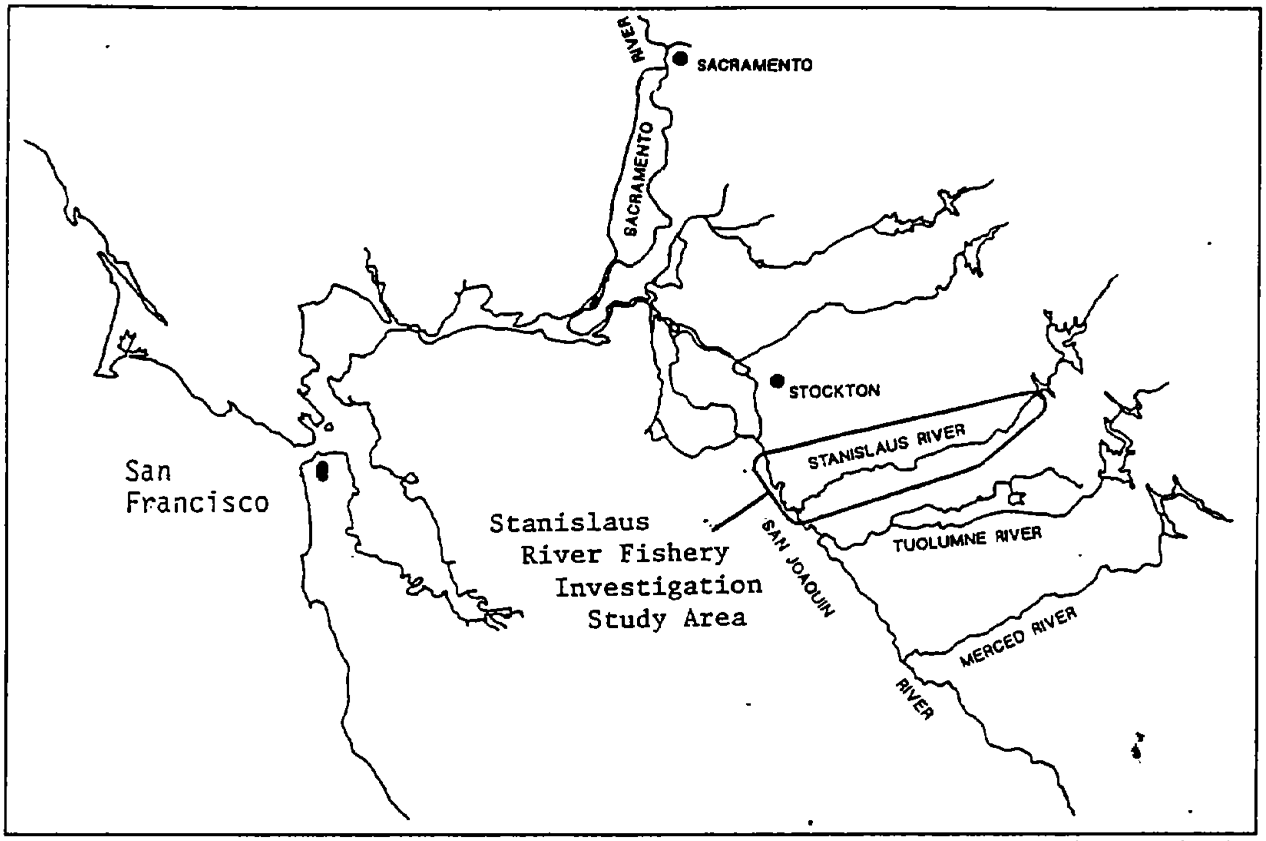


Figure 1. General location map of the Stanislaus River, California, and the Stanislaus River Fishery Investigation Study Area.

River(i.e., that section below Goodwin Dam) can be divided into upper, middle, and lower segments. They are distinguished from one another primarily by differences in stream gradient, substrate composition, and channel configuration. Two intermittent streams, Owl Creek and Wildcat Creek, enter the Stanislaus River in the upper and middle segments. Their contributions to river flow are generally not significant, however.

The upper river segment is the reach between Goodwin Dam and the town of Knights Ferry, a distance of approximately 4 river miles. Here the river is moderate in gradient (approximately 0.7%) and is confined by a narrow, steep-sided bedrock canyon. Approximately 80 percent of this river segment is composed of long deep pools and runs interspersed with short cascades. Substrate is predominantly sand and bedrock. The remaining 20 percent of this segment is lower in gradient and the channel is less confined. The primary habitat types here are pools, runs, and riffles with gravel and cobble the pre dominant substrate. Also, sand and bedrock are present to a lesser degree. Approximately 10 percent of all chinook salmon spawning in the Stanislaus River occurs within this river segment.

The middle river segment is the reach between the towns of Knights Ferry and Riverbank, a distance of approximately 20 river miles. As the river flows downstream from the upper, bedrock canyon segment, a well-defined channel continues with a low gradient (0.1%). Steep banks of erodible soils and of bedrock are common and are often situated opposite large flood plains. This river segment displays a typical pool, run, and riffle habitat-type sequence, although individual habitat areas are frequently long and often variable in occurrence. Large, deep dredge pools add to the diversity of stream habitat types within this river segment. The pre dominant substrate is sand, gravel, and cobble. Approximately 90 percent of all chinook salmon spawning in the Stanislaus River is found within this reach.

The lower river segment is the reach between the town of Riverbank and the San Joaquin River, a distance of approximately 35 river miles. As the river flows into the San Joaquin Valley the gradient is nearly flat (approximately 0.03%) and the river meanders more as it flows through the valley lowlands. Deep pool and run habitat types predominate. The river substrate is composed mainly of sand and fine organic material. Salmon use this segment primarily for migration, although some juvenile rearing occurs when water temperatures are satisfactory. No spawning has been observed within this segment.

<u>Hydrology</u>

River flows within the study reach are controlled by Reclamation through the

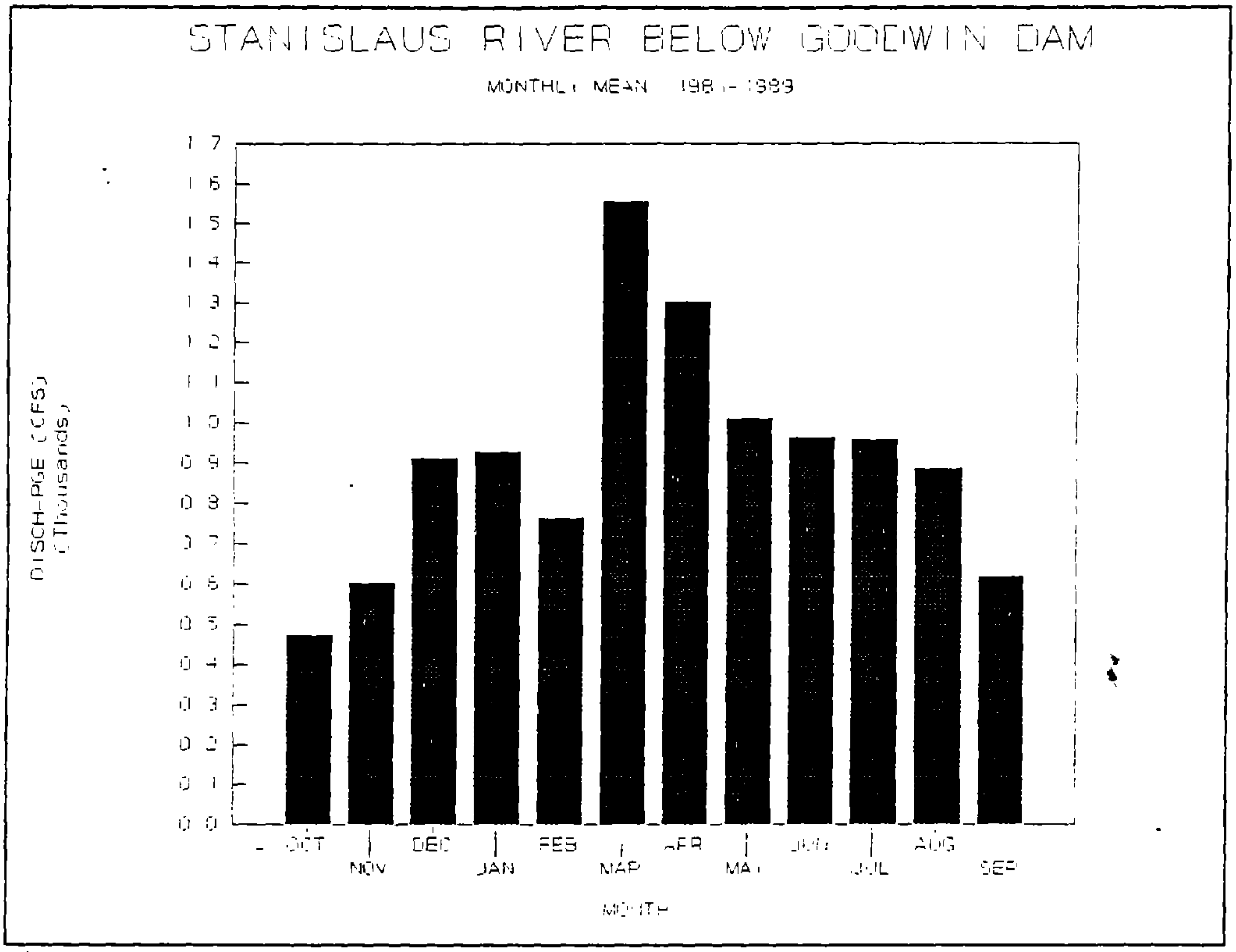


Figure 2. Mean monthly discharge (streamflow) for the Stanislaus River measured just below Goodwin Dam for years 1981 through 1989.

New Melones Unit of the Central Valley Project. The authorized fishery flow release from New Melones Reservoir is 98,300 acre-feet annually with provisions for release of 69,000 acre-feet in critically dry years. However, an interim agreement, executed in 1987, between the Bureau and the Department, provides for variable flow releases from 98,300 acre-feet to 302,000 acre-feet annually, based on inflow, reservoir storage, and water demands. In addition to the fishery flow agreement, the Bureau has an interim arrangement with the South Delta Water Agency to provide an annual release of up to 70,000 acre-feet or more, if adequate supply exists, for water quality control purposes. Recent mean monthly Stanislaus River flows measured at the U.S. Geological

Survey river gage just below Goodwin Dam are illustrated in Figure 2.

Fishery Resources

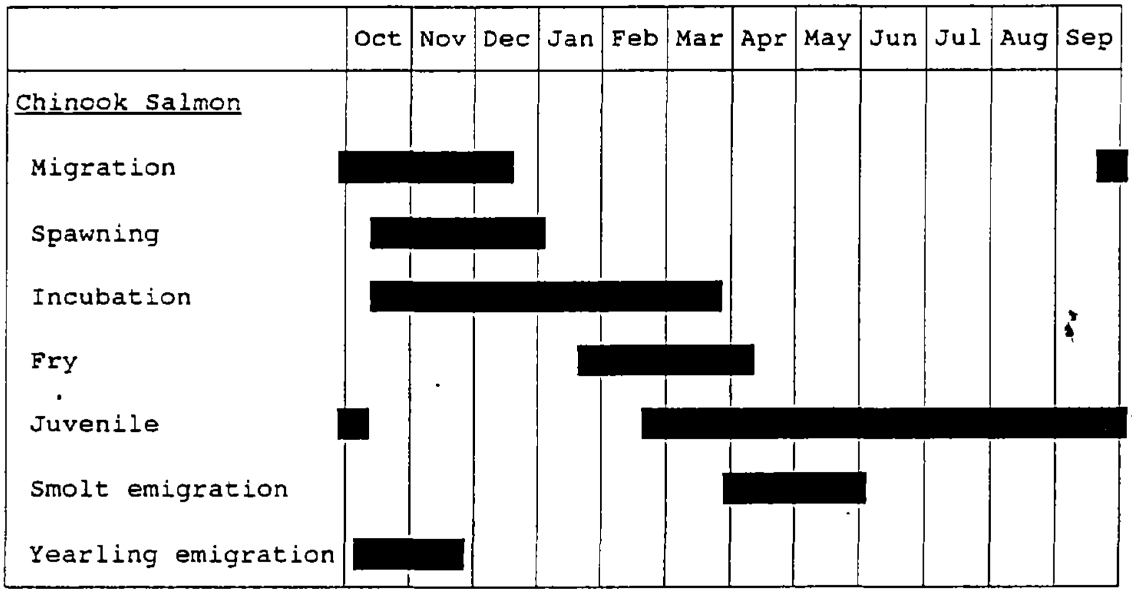
In addition to chinook salmon, a considerable population of resident rainbow trout, *Onchorhynchus mykiss*, exists within the Stanislaus River between Goodwin Dam and Riverbank. The Department also has anecdotal information regarding the occurrence of the anadromous steelhead trout within the Stanislaus River (Bill Loudermilk, DFG, personal communication). Striped bass, *Morone saxatilis*, and American shad, *Alosa sapidissima*, have been reported to have migrated to, and spawned in, the extreme lower reaches of the Stanislaus River. Sturgeon, *Acipenser spp.*, have also been reported within the lower Stanislaus but are not known to spawn in the river.

Fall-run chinook salmon generally begin to migrate into the lower Stanislaus in late September and continue through mid-December. Spawning begins in mid-October and continues through early January. Incubation, and fry and juvenile rearing, occur from the spawning period through mid-May. Juvenile smoltification begins as early as late March and generally continues to early June. Although most juvenile chinook salmon emigrate as smolts the first spring after hatching and emergence, some remain in the Stanislaus beyond this period. These yearling chinook juveniles have become more common within the Stanislaus in recent years (CDFG, 1987). Yearling chinook salmon have been observed in the river through the summer months and into early fall. Snorkeling surveys suggest that yearling emigration takes place when ambient air and water temperatures cool in October or November (CDFG, 1992).. Table I is a life stage periodicity chart for chinook salmon in the Stanislaus River.

Late fall-run chinook salmon are also reported to spawn and rear in the Stanislaus River below Goodwin Dam (Alice Low, CDFG, personal communication).

Late fall-run spawn from December through early March. Fry and juveniles remain in the river throughout the summer, and migrate out of the system the following fall. Although a much smaller part of the Stanislaus River chinook salmon fishery, the late fall-run, nevertheless, is an important component.

Table I. Life stage periodicity chart for fall-run chinook salmon in the Stanislaus River, California.



IFIM Study Reach

The study reach for habitat mapping and collection of hydraulic and physical habitat data within the Stanislaus River was located in the upper and middle river segments, between Goodwin Dam and the town of Riverbank (a distance of approximately 24 river miles). The study reach was divided into four study areas, each designated by the name given to the study site within the study area, as follows: 1) Two Mile Bar area - from Goodwin Dam to the covered bridge at Knights Ferry (approximately 3.5 river miles); 2) Six Mile Bar study

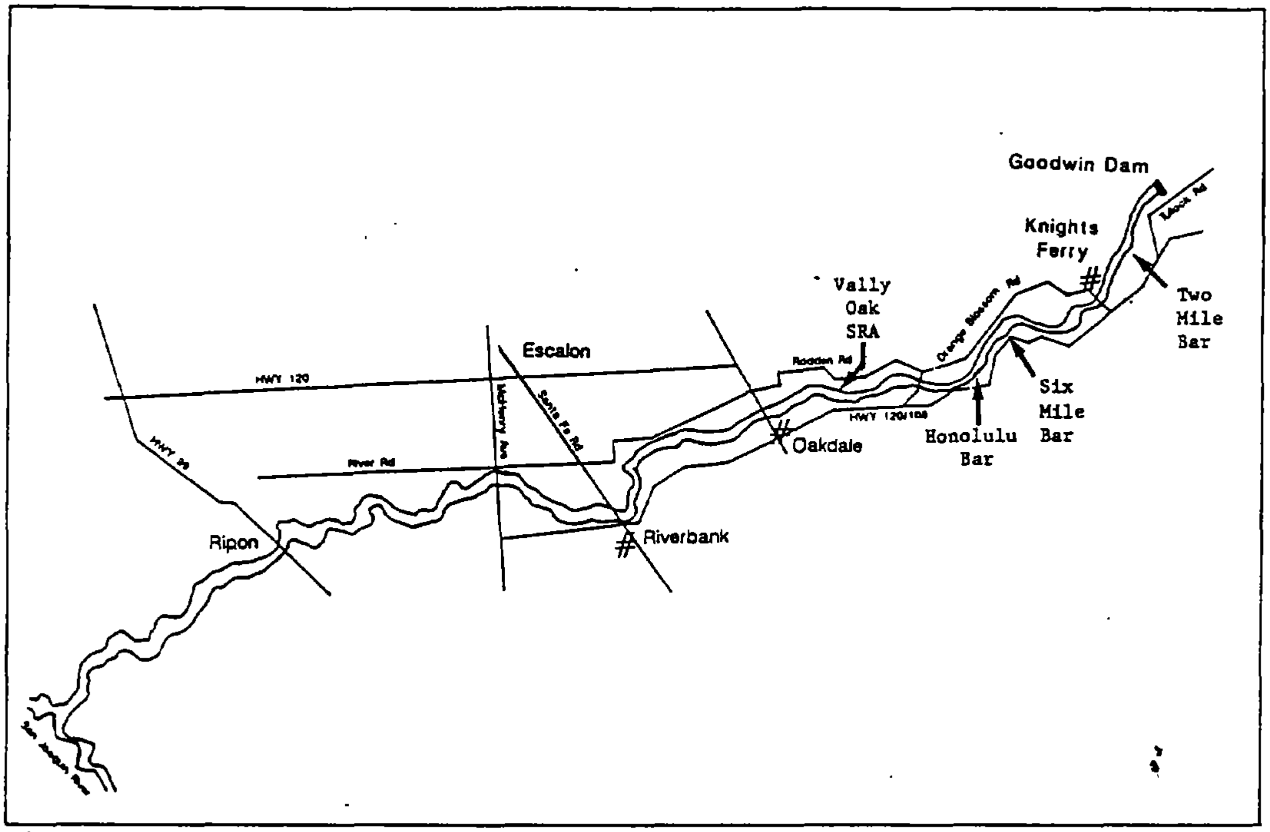


Figure 3. Location of IFIM study sites on the Lower Stanislaus River.

area - from the covered bridge at Knights Ferry to the upstream boundary of the Horseshoe Road Park (approximately 3.6 river miles); 3) Honolulu Bar study area - from Horseshoe Road Park to the Orange Blossom Road bridge (approximately 3.8 river miles); and, 4) Valley Oak State Recreation Area (SRA) study area - from the Orange Blossom Road bridge to about 1/2 mile upstream of the Santa Fe road bridge in Riverbank (approximately 13.1 river miles). Study site locations are shown in Figure 3.

The study sites were selected so that habitat types representative of the overall study areas were included, yet recognizing that each habitat type has variability between locations. For example, a pool by our definition is one that is over 4 feet in depth with an average water velocity of less than 1 foot per second. However, a given pool may be 6 feet deep and another 20 feet deep. Transects were established at the study sites to sample the major habitat types and provide enough repetition to account for natural variation. This resulted in 7 to 10 transects at each study site. Study site maps, including transect locations and habitat distribution, are included in Appendix A.

METHODS

The Service's Instream Flow Incremental Methodology (IFIM) (Bovee and Milhous 1978; Milhous et al. 1981; Bovee 1982) was used for this evaluation. The IFIM was developed to facilitate evaluation of water resource developments and effective stream management. Basically, the methodology uses a computer-based physical habitat simulation model (PHABSIM) to combine various stream hydraulic and physical parameters with fish habitat requirements. The product of the PHABSIM allows investigators to relate changes in streamflow to physical habitat availability. Important components of this technique are the development of a calibrated hydraulic stream model and knowledge of the suitability of specific microhabitat conditions (i.e., water depths, velocity, and substrate) for individual fish species and life stages.

Field Techniques

Permanent markers (pins) were placed at the ends of each transect and a benchmark established as reference points. For each transect, water velocities, depths, and substrates were recorded at vertical measuring points distributed across the wetted perimeter of the river for each of three "calibration" flows. Generally, the distance between each measuring point was kept constant. As needed, however, additional measuring points were added at gradient breaks in bottom profile or where significant changes in water velocities or substrate were observed. A rule of thumb was established that no more than 10 percent of the total measured streamflow for any transect would occur within any given "cell" (i.e., the area between vertical measuring points). As a result, the number of vertical measuring points varied from transect to transect depending on stream hydrology and streambed morphology. Generally, the number ranged between 20 and 30 per transect.

Water depths and velocities were measured at each transect for three release flows from Goodwin Dam and New Melones Reservoir. These "calibration" flows were 1,250 cubic feet per second (cfs), 700 cfs, and 125 cfs. The water velocity and depth data collected for the calibration flows where subsequently used to establish the water surface elevation (stage) versus streamflow (discharge) relationship and to calibrate the hydraulic simulation incorporated within the physical habitat simulation program. Data was collected on the following dates in 1989: May 2 to 6 for the 1,250 cfs release; July 10 to 13 for the 700 cfs release; and September 19 to 22 for the 125 cfs release. The flow for each study site was determined by calculating the mean of the flows recorded for each transect within the study site.

Mean water column velocities were measured at 0.6 of the total depth (measured from the water surface) for water depths less than or equal to 2.5 feet. At depths greater than 2.5 feet but less than or equal to 5.0 feet, velocities were measured at 0.2 and 0.8 of the total water depth. For water depths greater than 5.0 feet, velocities were measured at 0.2, 0.6 and 0.8 of the total water depth. Water velocity measurements were made with either a Price AA or Gurley water velocity meter. In extremely slow velocity areas, with water depths of less than 1 foot, a Pygmy water velocity meter was used. Mean water column velocities were calculated using standard formulas.

Water depths were measured to the nearest 0.1 foot with a top-setting wading rod in areas less than 8 feet deep. For depths greater than 8 feet, a boat-mounted sounding reel system with a cable and 15-pound sounding weight was used.

Substrate composition and fish cover were assessed in each observation cell. An observation cell is defined as having a width equal to the horizontal distance between midpoints of adjacent vertical measuring points, a height equal to the depth of the water column, and a length upstream and downstream to a point representing the "transition" point to the next habitat type. Substrate composition was described using a modified Brusven index system (Table II). An index was used for application of the PHABSIM model and is composed of a 6-digit substrate descripter based on dominant and subdominant substrate types. It is coded as xXyY.%E (where xX = dominant substrate, yY = subdominant substrate, and %E = percent embeddedness).

Cover was described using a three-digit code. The first digit of the code defines the size of the largest object(s) seen within the observation cell. The second digit defines any overhead cover which provides protection from

Table II. Substrate composition categories used in the Stanislaus River instream flow investigation.

Code	Substrate Type	Size Range (mm)
1	Organic Debris	---
2	Mud/Soft Clay	---
3	Silt	<.062
4	Sand	.062 - 2
5	Course Sand	2 - 4
6	Small Gravel	4 - 25
7	Medium Gravel	25 - 50
8	Large Gravel	50 - 75
9	Small Cobble	75 - 150
10	Medium Cobble	150 - 225
11	Large Cobble	225 - 300
12	Small Boulder	300 - 600
13	Medium Boulder	600 - 2000
14	Large Boulder	> 2000
15	Bedrock	---

Table III. Cover categories used in the Stanislaus River instream flow study, 1989.

Cover Object	Overhead Cover	Cover Quality
0 = None	0 = None	0 = None
1 = Objects < 6 inches	1 = Instream Overhead (undercut banks, rootwads, logs, etc.)	1 = Poor (<25%)
2 = Objects 6 to 12 inches	2 = Overhanging Overhead (within 18" of water's surface)	2 = Fair (25-50%)
3 = Objects > 12 inches	3 = Instream & Overhanging (both code 1 and 2)	3 = Good (50-75%)
------	-------	4 = Excellent (75-100%)

predators, sunlight, etc., within the observation cell. The third digit, which follows a decimal, describes the quality of the cover as poor, fair, good, or excellent. Cover codes and descriptions are listed in Table III. The cover index is coded as XY.Z (where X = object cover, Y = overhead cover, and Z = cover quality).

If no overhead cover was present in the observation cell, the linear distance to the nearest overhead cover was estimated to the nearest foot. General information recorded for each field day included sampling date and time, study area and site, estimated stream discharge, air and water temperatures, name of observer and recorder, observation method, water clarity, weather conditions, total length of study site and equipment used.

Data Analysis

Field data gathered was initially transcribed from the field data forms into microcomputer database files using dBASE II (Ashton-Tate, DBASE II, IBM PC-DOS, Version 2.43). These files were checked for errors and corrected where necessary. They then became the "raw" database files from which all subsequent data analyses were conducted. The edited DBASE files where then transcribed to LOTUS 1-2-3 spreadsheets (1-2-3, release 2.01, LOTUS Development Corp.) for further analysis, including mean column water velocity calculations and conversion of substrate and cover codes to appropriate index values. These data were then formatted to input data decks needed for the hydraulic simulation (IFG4) program by using FLOSORT, a program developed by Andrew Hamilton of the Service's Lewiston Suboffice, Lewiston, California. All files were checked for accuracy using the RCKI4 microcomputer program provided by the Service's National Ecology Research Center, Aquatic Systems Modeling Section.

Physical habitat simulation (PHABSIM) input data decks were built for each study site using the water surface elevation (stage), streamflow (discharge), and water velocity data collected during the field measurements at the three calibration flows. In order to accurately portray the entire study area described by study site, transect weighting factors were all set to 1 and reach lengths were adjusted so that the total percent area represented by habitat type was equal to that measured during the habitat mapping phase of this study. Table IV lists the habitat type, reach length, weighting factor, and percent area represented by each transect for each study site during the computer modelling phase of this study. The input data decks used in this evaluation are listed in Appendix B.

Water surface elevations for computation flows, ranging from 50 cfs to 1300 cfs, were calculated in the model using a rating curve defined by the stage-discharge relationship established by those measured in the calibration flows. Each input deck was run separately through the PHABSIM.

The PHABSIM analysis also requires, as separate input, suitability criteria for the target species being considered. Water depth, velocity, and substrate suitability criteria for chinook salmon adults, fry, and juveniles were

Table IV. Habitat type, reach length, weighting factor, and percent area represented by each IFIM transect, by study site.

Study Site	Transect	Habitat Type	Reach Length	Weighting Factor	Percent Area
Two Mile Bar	10.0	Deep Pool	323.50	1.00	32.35
	9.0	Run	70.80	1.00	7.08
	8.0	Run	23.20	1.00	2.32
	7.0	Run	70.90	1.00	7.09
	5.0	Riffle	23.20	1.00	2.32
	4.0	Shallow Pool[1/]	70.80	1.00	7.08
	3.0	Run	70.90	1.00	7.09
	2.0	Riffle	23.20	1.00	2.32
	1.0	Deep Pool	323.50	1.00	32.35
Six Mile Bar	1.0	Riffle	50.30	1.00	5.03
	2.0	Run	130.70	1.00	13.07
	3.0	Run	130.70	1.00	13.07
	4.0	Run	130.70	1.00	13.07
	5.0	Deep Pool	457.00	1.00	45.70
	6.0	Riffle	50.30	1.00	5.03
	7.0	Riffle	50.30	1.00	5.03
Honolulu Bar	7.0	Run	77.00	1.00	7.70
	6.0	Run	77.00	1.00	7.70
	5.0	Run	77.00	1.00	7.70
	4.0	Run	77.00	1.00	7.70
	3.0	Deep Pool	225.50	1.00	22.55
	2.0	Riffle	241.00	1.00	24.10
	1.0	Deep Pool	225.50	1.00	22.55
Valley Oak SRA	7.0	Deep Pool	409.00	1.00	40.90
	6.0	Run	84.60	1.00	8.46
	5.0	Run	84.60	1.00	8.46
	4.0	Run	84.60	1.00	8.46
	3.0	Run	84.60	1.00	8.46
	2.0	Riffle	168.00	1.00	16.80
	1.0	Run	84.60	1.00	8.46

[1/] Although this transect was described as a shallow pool, it more closely represented a run, especially, at high flows. Therefore, it was combined with the run transects in the PHABSIM.

determined through direct observation and field measurements of habitat use and availability within the Stanislaus River. These data were collected between November 4, 1986 and April 13, 1989 and have been reported previously

(Aceituno, 1990). Egg incubation criteria used are a composite of water velocity and depth suitability described by Bovee (1978) and substrate suitability determined for the spawning life stage during the investigations of 1986 through 1989. For convenience, the criteria used in this analysis are listed in Appendix C.

The product of the PHABSIM is an index of the habitat potential, called the weighted usable area (WUA). For each study site and each computation flow the WUA is equal to the suitability index for the combined characteristics measured (water velocity, water depth, and substrate or cover) and the total surface area represented by that study site. The WUA is unique to the streamflow, the study site, and the target species and life stage to which it applies. The term "weighted" refers to the influence of the habitat suitability criteria developed for each target species and life stage which is applied to the physical habitat simulation.

The fish habitat versus streamflow relationship determined through the physical habitat simulation model is expressed in terms of square feet of weighted usable area of habitat per 1,000 linear feet of stream. To provide an overall picture of the relationship between physical habitat availability and streamflow within the study reach, the PHABSIM results for each study site were combined. Since the four study sites represent study areas of different lengths on the Stanislaus River, a value of total weighted usable area was calculated by multiplying the PHABSIM results for each study site by the total distance represented by that site, divided by 1,000, and summing the totals. This gives an estimate of weighted usable habitat area for the entire study reach from Goodwin Dam to Riverbank, California (approximately 24 river miles).

RESULTS AND DISCUSSION

Measured river flows at the four study sites, along with the releases from Goodwin Dam recorded at the U.S. Geological Survey river gage near the dam, are provided in Table V.

Table V. Recorded and measured stream flows (cfs) at Goodwin Dam and the four IFIM study sites on the Stanislaus River, California, 1989.

USGS Gage @ Goodwin	Two Mile Bar	Six Mile Bar	Honolulu Bar	Valley Oak SRA
1,270	1,304	1,360	1,318	1,327
710	689	744	727	772
130	132	157	165	165

The total weighted usable area of habitat versus streamflow relationships for chinook salmon spawning, incubation, fry, and juvenile life stages are illustrated in Figure 4. Predicted weighted usable area of habitat (per 1,000

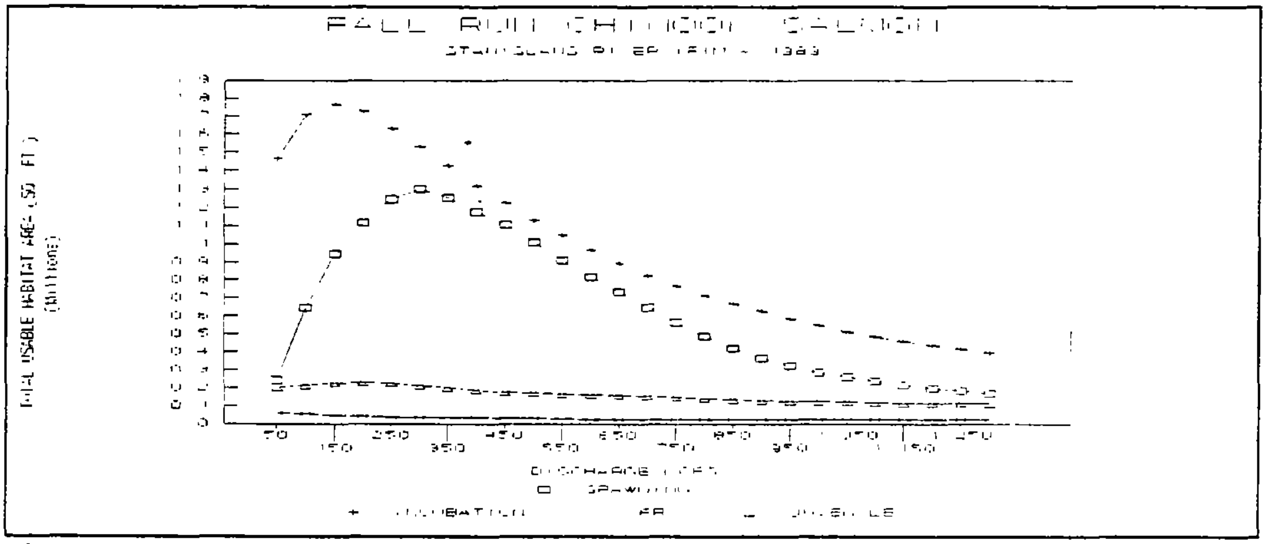


Figure 4. Total weighted usable area of habitat versus streamflow relationship for fall-run chinook salmon spawning, incubation, fry, and juvenile life stages in the Stanislaus River, California.

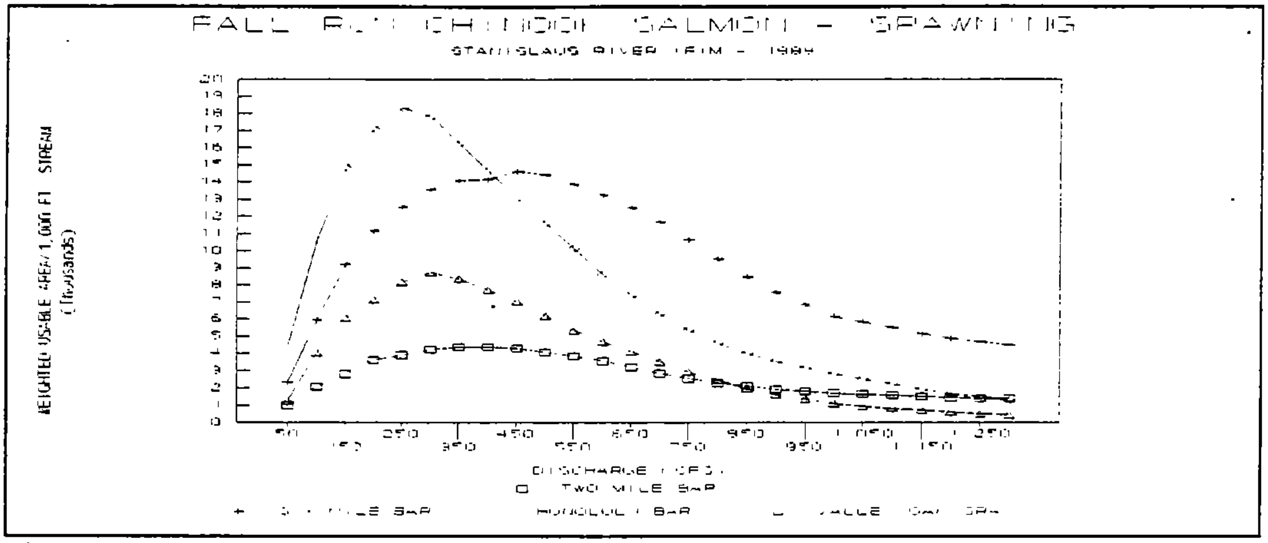


Figure 5. Weighted usable area of habitat (in square feet per 1,000 linear feet of stream) versus streamflow relationship for chinook salmon **spawning** at the four study sites on the Stanislaus River, California.

linear feet) versus streamflow relationships for each life stage, by study site, are illustrated in Figures 5 through 8. The weighted usable habitat area estimates used to generate these graphs are provided in Tables VI through IX.

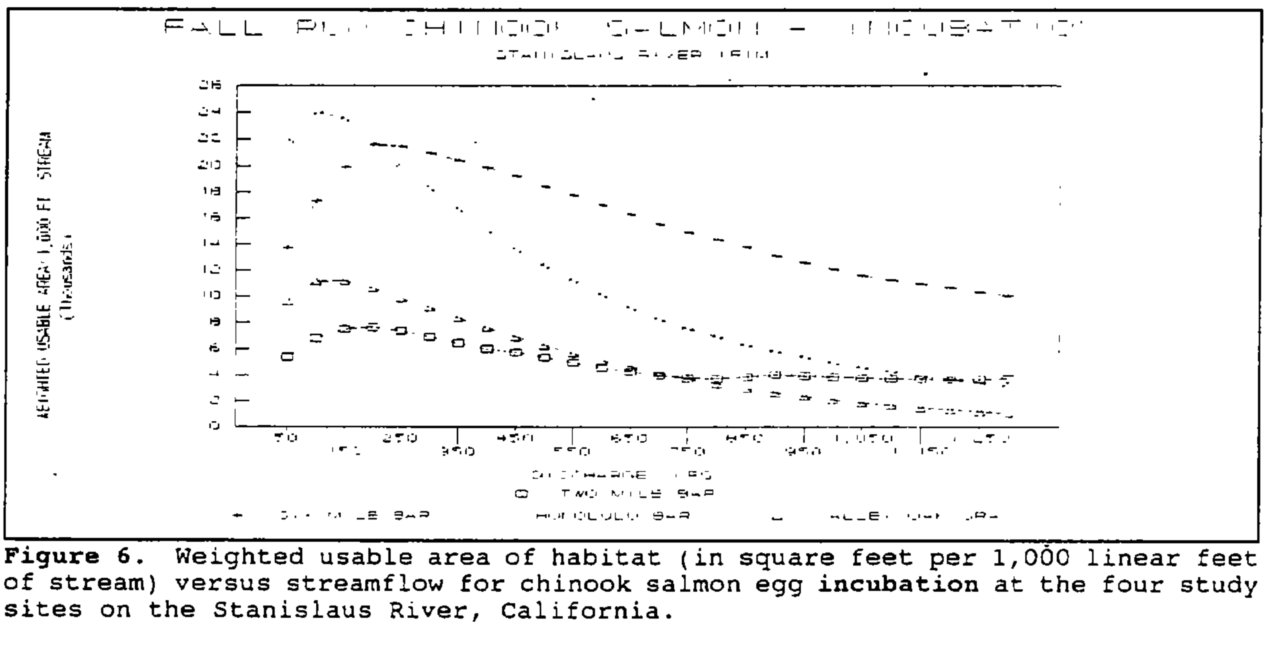


Figure 6. Weighted usable area of habitat (in square feet per 1,000 linear feet of stream) versus streamflow for chinook salmon egg **incubation** at the four study sites on the Stanislaus River, California.

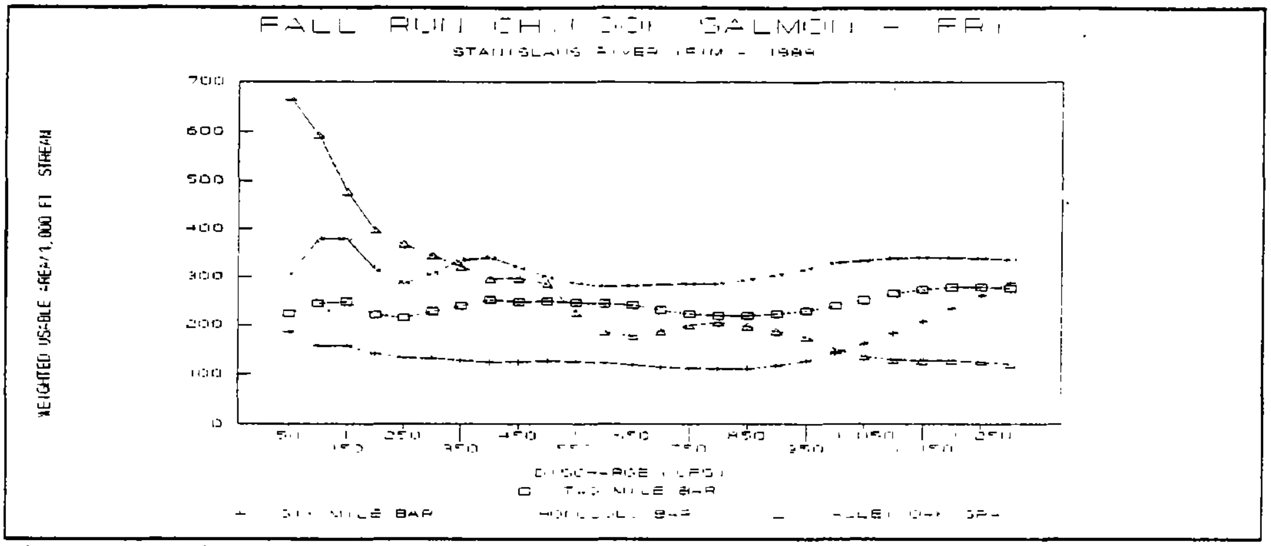


Figure 7. Weighted usable area of habitat (in square feet per 1,000 linear feet of stream) versus streamflow relationship for chinook salmon **fry** at the four study sites on the Stanislaus River, California.

Predictably, estimated weighted usable area of habitat for chinook salmon in the Stanislaus River varies considerably with streamflow below Goodwin Dam. Typically, weighted usable habitat area increases as flows increase and then begins to decline as streamflow continues to increase beyond an optimal level.

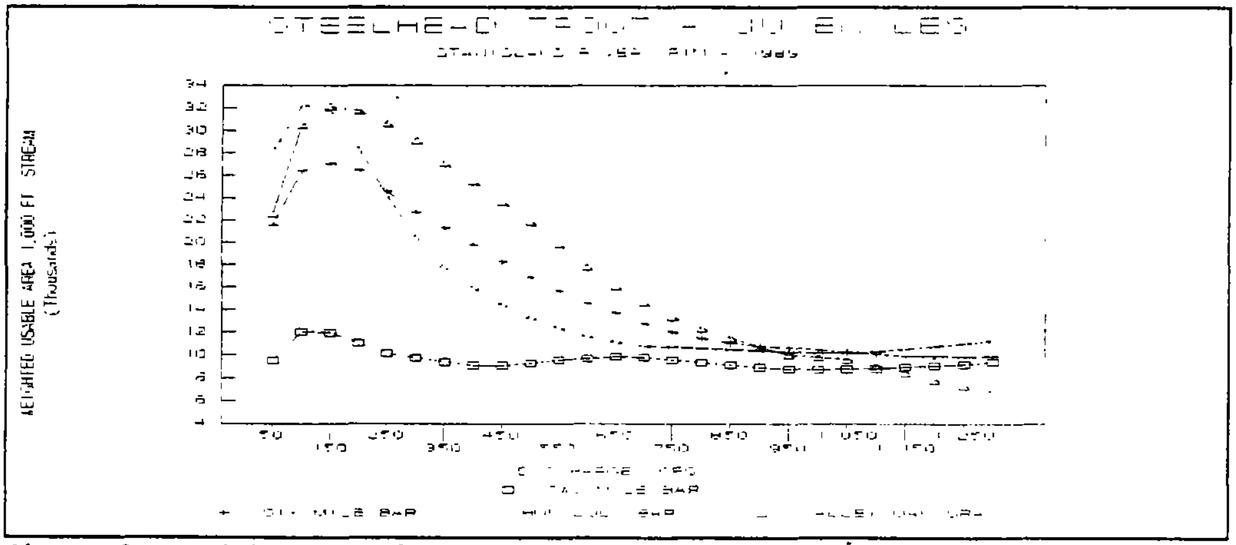


Figure 8. Weighted usable area of habitat (in square feet per 1,000 linear feet of stream) versus streamflow relationship for chinook salmon **juveniles** at the four study sites on the Stanislaus River, California.

Table VI. Streamflow versus weighted usable area (square feet per 1,000 feet) by study site, and total weighted usable area (square feet) for fall run chinook salmon **spawning** in the Stanislaus River, California.

Streamflow (cfs)	Two Mile Bar	Six Mile Bar	Honolulu Bar	Valley Oak SRA	Reach Total
25	351	666	1,345	226	62,145
50	1,007	2,354	4,397	1,272	240,387
100	2,079	5,910	10,634	4,028	644,143
150	2,824	9,203	14,859	6,061	946,290
200	3,618	11,186	17,087	7,134	1,117,916
250	3,904	12,526	18,321	8,175	1,245,320
300	4,232	13,562	17,834	8,730	1,299,496
350	4,383	14,073	16,236	8,349	1,253,539
400	4,380	14,138	14,660	7,684	1,177,151
450	4,312	14,616	13,035	7,017	1,106,286
500	4,083	14,432	11,582	6,165	1,010,593
550	3,848	13,859	10,159	5,353	910,630
600	3,576	13,253	8,606	4,683	816,489
650	3,207	12,514	7,420	4,121	732,814
700	2,858	11,673	6,304	3,533	647,199
750	2,565	10,633	5,381	2,950	563,092
800	2,292	9,534	4,630	2,449	487,304
850	2,114	8,453	3,996	1,974	417,915
900	1,938	7,560	3,546	1,623	364,279
950	1,813	6,837	3,165	1,354	321,941
1,000	1,720	6,136	2,835	1,121	284,078
1,050	1,646	5,825	2,526	953	258,954
1,100	1,587	5,504	2,237	822	236,864
1,150	1,526	5,129	1,919	715	214,706
1,200	1,460	4,873	1,673	609	196,325
1,250	1,408	4,688	1,511	512	181,924
1,300	1,392	4,495	1,302	436	168,419

The PHABSIM model developed in 1989 for the Stanislaus River considers only the relationship between physical habitat availability and streamflow for chinook salmon spawning, incubation, fry rearing and juvenile rearing life stages, within the river reach between Goodwin Dam and Riverbank (approximately 24 river miles). The results of the PHABSIM model indicate that a streamflow of

300 cubic feet per second provides the greatest amount of usable habitat for chinook salmon spawning. Available habitat for egg incubation is maximized at 150 cfs. Fry habitat appears to be generally limited and does not increase or decrease appreciably as streamflow changes. This is most likely due to the

Table VII. Streamflow versus weighted usable area (square feet per 1,000 feet) by study site, and total weighted usable area (square feet) for fall run chinook salmon **egg incubation** in the Stanislaus River, California.

Streamflow (cfs)	Two Mile Bar	Six Mile Bar	Honolulu Bar	Valley Oak SRA	Reach Total
25	3,825	9,344	15,525	4,328	862,406
50	5,379	13,724	21,763	9,603	1,463,666
100	6,818	17,333	24,050	11,139	1,711,446
150	7,505	19,950	23,507	11,185	1,766,492
200	7,639	21,575	21,832	10,620	1,727,374
250	7,376	21,469	19,991	9,851	1,630,332
300	6,935	20,973	18,314	9,144	1,530,088
350	6,458	20,431	16,655	8,374	1,424,348
400	6,021	19,885	15,043	7,603	1,320,071
450	5,747	19,216	13,562	6,906	1,224,309
500	5,353	18,449	12,338	6,266	1,133,519
550	4,970	17,750	11,183	5,673	1,048,838
600	4,555	17,036	10,076	5,132	967,859
650	4,270	16,290	9,084	4,639	894,345
700	3,987	15,542	8,235	4,167	825,070
750	3,761	14,896	7,570	3,728	764,897
800	3,719	14,359	6,916	3,324	712,809
850	3,864	13,793	6,303	2,960	667,305
900	4,028	13,144	5,793	2,633	625,165
950	3,952	12,601	5,339	2,343	584,286
1,000	3,871	12,107	4,925	2,082	546,999
1,050	3,785	11,633	4,560	1,847	512,732
1,100	3,724	11,235	4,274	1,644	484,246
1,150	3,674	10,970	3,954	1,465	459,500
1,200	3,648	10,662	3,654	1,304	435,992
1,250	3,684	10,327	3,386	1,160	414,902
1,300	3,706	10,023	3,141	1,027	395,452

fact that salmon fry are not well adapted to high velocity currents and spend most of their time along the shallow stream margins in slower water. In our observations during the habitat preference criteria development phase of this investigation, over 90 percent of all fry were found in areas of water velocity less than 0.5 foot per second and depths less than 2 feet (Aceituno, 1990). Chinook salmon juvenile weighted usable habitat area is highest at 200 cfs.

The Potential of Side-Channels

The potential of side-channel habitat areas for all chinook salmon life stages within the Stanislaus River should not be overlooked. For the fry and

Table VIII. Streamflow versus weighted usable area (square feet per 1,000 feet) by study site, and total weighted usable area (square feet) for fall run chinook salmon **fry** in the Stanislaus River, California.

Streamflow (cfs)	Two Mile Bar	Six Mile Bar	Honolulu Bar	Valley Oak SRA	Reach Total
25	250	224	372	813	72,236
50	225	187	302	670	59,840
100	246	157	380	593	56,012
150	249	157	379	478	48,115
200	222	142	316	398	40,574
250	215	134	285	368	37,599
300	229	132	306	344	36,598
350	240	128	335	321	35,755
400	253	125	341	295	34,272
450	248	125	320	297	33,877
500	250	127	300	286	32,807
550	247	125	286	227	28,379
600	245	123	280	185	25,311
650	242	119	281	177	24,640
700	232	115	284	187	25,151
750	223	113	285	200	25,817
800	220	111	285	205	26,102
850	219	112	293	197	25,701
900	223	118	303	187	25,437
950	229	127	316	174	25,092
1,000	240	143	329	151	24,232
1,050	252	161	333	136	23,866
1,100	266	183	338	130	24,253
1,150	273	208	340	128	24,759
1,200	278	235	340	128	25,416
1,250	279	262	339	126	25,753
1,300	276	288	336	120	25,740

juvenile life stages, significant habitat gains occur within the Honolulu Bar study site at streamflows above 450 cubic feet per second. This is because of the existence of a long side-channel at the site and the availability of more microhabitat in terms of low water velocities, shallower depths, and suitable substrate when this area becomes flooded.

Since side-channels are atypical of the lower Stanislaus River, representing less than 1 percent of the total habitat available, they are not included in the general habitat evaluation described in this report. Nonetheless, they could provide significant habitat enhancements beneficial to the dwindling chinook salmon population.

Table IX. Streamflow versus weighted usable area (square feet per 1,000 feet) by study site, and total weighted usable area (square feet), for fall run chinook salmon **juveniles** in the Stanislaus River, California.

Streamflow (cfs)	Two Mile Bar	Six Mile Bar	Honolulu Bar	Valley Oak SRA	Reach Total
25	677	633	1,390	1,992	189,543
50	752	677	1,378	2,118	200,225
100	729	772	1,438	2,274	213,544
150	728	841	1,563	2,397	225,783
200	731	835	1,617	2,424	228,703
250	742	806	1,602	2,371	224,444
300	749	763	1,511	2,226	211,896
350	741	717	1,392	2,081	198,561
400	723	675	1,300	1,924	184,792
450	722	649	1,249	1,822	176,204
500	735	626	1,235	1,746	170,513
550	745	601	1,246	1,677	165,685
600	751	581	1,229	1,619	161,158
650	760	569	1,200	1,561	156,508
700	763	562	1,173	1,522	153,219
750	761	556	1,149	1,436	146,694
800	761	549	1,131	1,353	140,481
850	762	536	1,124	1,275	134,743
900	759	522	1,127	1,207	129,830
950	751	510	1,139	1,143	125,285
1,000	745	500	1,150	1,112	123,084
1,050	739	495	1,155	1,085	121,154
1,100	733	493	1,163	1,037	117,862
1,150	735	494	1,178	997	115,458
1,200	740	498	1,196	966	113,910
1,250	739	505	1,214	949	113,201
1,300	739	515	1,220	933	112,407

The Importance of Pulse Flows

This study did not directly provide information on flows needed for smolt emigration in the spring. Preliminary data from smolt survival studies being conducted by the Department of Fish and Game indicate that flows of 1,250 to 2,000 cfs would provide for a high level of smolt survival in the Stanislaus River. In testimony to the State Water Resources Control Board, the Department has recommended increasing streamflow between April 15 and May 15 each year. The flow increase is based on the results of studies documenting increased survival of salmon smolts to the Sacramento-San Joaquin River Delta. Detailed monitoring efforts are also recommended by the Department to further evaluate and document the benefits of the pulse flows and to determine the duration required for smolt survival (CDFG, 1992).

Yearling and Late Fall-Run Salmon Flow Needs

Although river flows of 200 cfs provide maximum juvenile rearing habitat, higher flows may be necessary over the summer months. Not only is appropriate physical habitat needed for juvenile rearing (which is optimized at 200 cfs), but suitable water temperatures are also necessary during this period. In the past, flows released to meet water quality requirements have provided conjunctive benefits for fall-run yearling or late fall-run juvenile salmon rearing through the late spring and summer months. An exception has been when storage in New Melones Reservoir is severely depleted. The Bureau of Reclamation is developing a water temperature model for the Stanislaus River which will help determine the instream flow needs. In addition, studies are needed to determine the appropriate "carry over" storage to be maintained in upstream reservoirs, particularly New Melones, so that water temperatures in the river downstream can best be controlled for the benefit of juvenile salmon.

Rainbow Trout and Steelhead Concerns

Although an evaluation of the physical habitat versus streamflow relationship for other salmonid species was not originally a part of this study, staff from both the Bureau of Reclamation and the Department of Fish and Game have expressed an interest in seeing this relationship. Therefore, a PHABSIM analysis was conducted using habitat suitability criteria for resident rainbow trout and the anadromous steelhead rainbow trout. Table X lists the flows

which would provide the maximum amount of habitat for each life stage of rainbow and steelhead trout in the Stanislaus River. The complete results of

Table X. Instream flows (cfs) which would provide the maximum weighted usable area of habitat for rainbow trout and steelhead trout in the Stanislaus River between Goodwin Dam and Riverbank, California.

Life Stage	Rainbow Trout	Steelhead Trout
Spawning	100	200
Fry	50	50
Juvenile	150	150
Adult	400	500

this analysis are provided in Appendix D.

CONCLUSION

The results of this study show that microhabitat availability is highest for chinook salmon spawning at 300 cfs, egg incubation at 150 cfs, and for juvenile salmon at 200 cfs. Weighted usable area of habitat for chinook salmon fry is limited, restricted to shallow, low velocity areas along the stream margins. Table XI shows instream flows yielding the maximum weighted usable area of habitat for chinook salmon in the Stanislaus River. The incubation and fry life stages are combined since they overlap in occurrence. Considering such factors as possible redd dewatering, siltation, and the maintenance of suitable dissolved oxygen levels for development of incubating salmon eggs, the flow requirement for incubation is given priority.

Even though the PHABSIM model results indicate relatively little available fry habitat, overall, the potential exists to significantly increase its availability through the development of side-channels or other areas providing shallow, low velocity habitat.

While this report describes the water velocities, depths, and substrates suitable for chinook salmon life stages, a comprehensive instream flows regime

Table XI. Instream flows which would provide the maximum weighted usable area of habitat for chinook salmon in the Stanislaus River, between Goodwin Dam and Riverbank, California.

Life Stage	Dates	#Days	Goodwin Dam Release (cfs)	(acre-feet)
Spawning	October 15 - December 31	78	300	46,414
Egg Incubation/ Fry rearing	January 1 - February 15	46	150	13,686
Juvenile rearing	February 15 - October 15	241	200	95,605
	Totals	365		155,705

which would protect and preserve the Stanislaus River salmon resource cannot be determined from that data alone. Other macrohabitat conditions, such as water quality and temperature, and the value of conveyance and attraction flows, have yet to be fully described for the Stanislaus River.

Consideration of other macrohabitat conditions before recommending instream flows is consistent with the Instream Flow Incremental Methodology, which integrates the multitude of components and associated habitat variables important to evaluating potential impacts to rivers. As noted earlier, the Bureau of Reclamation is developing a comprehensive water temperature model for the Stanislaus River. In addition, the Department of Fish and Game is continuing investigations into the benefits of spring "pulse" flows and fall attraction flows as part of the overall Stanislaus River Fishery Investigation. Once these studies are completed, the results can be combined with the results described in this report. Only after integrating a variety of habitat variables and competing species life stage needs can a comprehensive instream flow schedule for the Stanislaus River be developed which will protect and preserve the chinook salmon resource.

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APPENDIX A

INSTREAM FLOW INCREMENTAL METHODOLOGY (IFIM) STUDY SITES, TRANSECT DESCRIPTIONS AND LOCATIONS FOR THE STANISLAUS RIVER INSTREAM FLOW STUDY, 1989

INSTREAM FLOW INCREMENTAL METHODOLOGY (IFIM) STUDY SITES, TRANSECT DESCRIPTIONS AND LOCATIONS FOR THE STANISLAUS RIVER INSTREAM FLOW STUDY, 1989

The Stanislaus River from Goodwin Dam to the confluence with the San Joaquin River was divided into three segments based on gross river morphology for the purposes of IFIM modeling. These three segments are: the 4 river miles between Goodwin Dam and Knights Ferry; the 20 river miles between Knights Ferry and the town of Riverbank; and, the 34 river miles from Riverbank to the confluence with the San Joaquin River. Within the upper two river segments one or more short sites were selected to represent the river segments, and to describe them via IFIM modelling procedures. Figure A-1 is a map showing the location of the IFIM study sites.

Each habitat type has variability between locations. For example a deep pool by our definition is any pool over 4 feet deep and with water velocity less than 1 foot per second. However, one pool may be 6 feet deep and another 20 feet deep. When the transects were established in the reaches they were placed to sample the variety of habitats within each study site and, by extrapolation, each segment.

The uppermost study segment, the 4 miles between Goodwin Dam and Knights Ferry, is defined by a steep walled bedrock gorge. The river channel has a moderate gradient (0.7%) and is made up of long pools interspersed with cascades. At a few locations large beds of gravel have gathered, forming gravel bars. Salmon spawning habitat on these gravel bars is excellent. The California Department of Fish and Game estimates that 10 percent of salmon spawning in the Stanislaus River occurs in these 4 miles of accessible river. One IFIM study site, Two Mile Bar, was established in this segment.

The second of the three river segments, the 20 miles between Knights Ferry and the town of Riverbank, is a low-gradient stream of 0.1 percent. Steep banks of erodible soils are commonly present with bedrock outcrops occurring irregularly. The segment is comprised of typical pool-run-riffle habitats, But with considerable variance in length and occurrence of each habitat. Large, deep dredge pools add to the inconsistency of stream habitat types. Sand, gravel and cobble provide most of the substrate, with an occasional bedrock outcrop. Ninety percent of the chinook salmon spawning occurs in this middle river segment.

We have established three IFIM study sites to sample the diversity in this river segment. They are designated as Six Mile Bar, Honolulu Bar, and Valley Oak State Recreation Area.

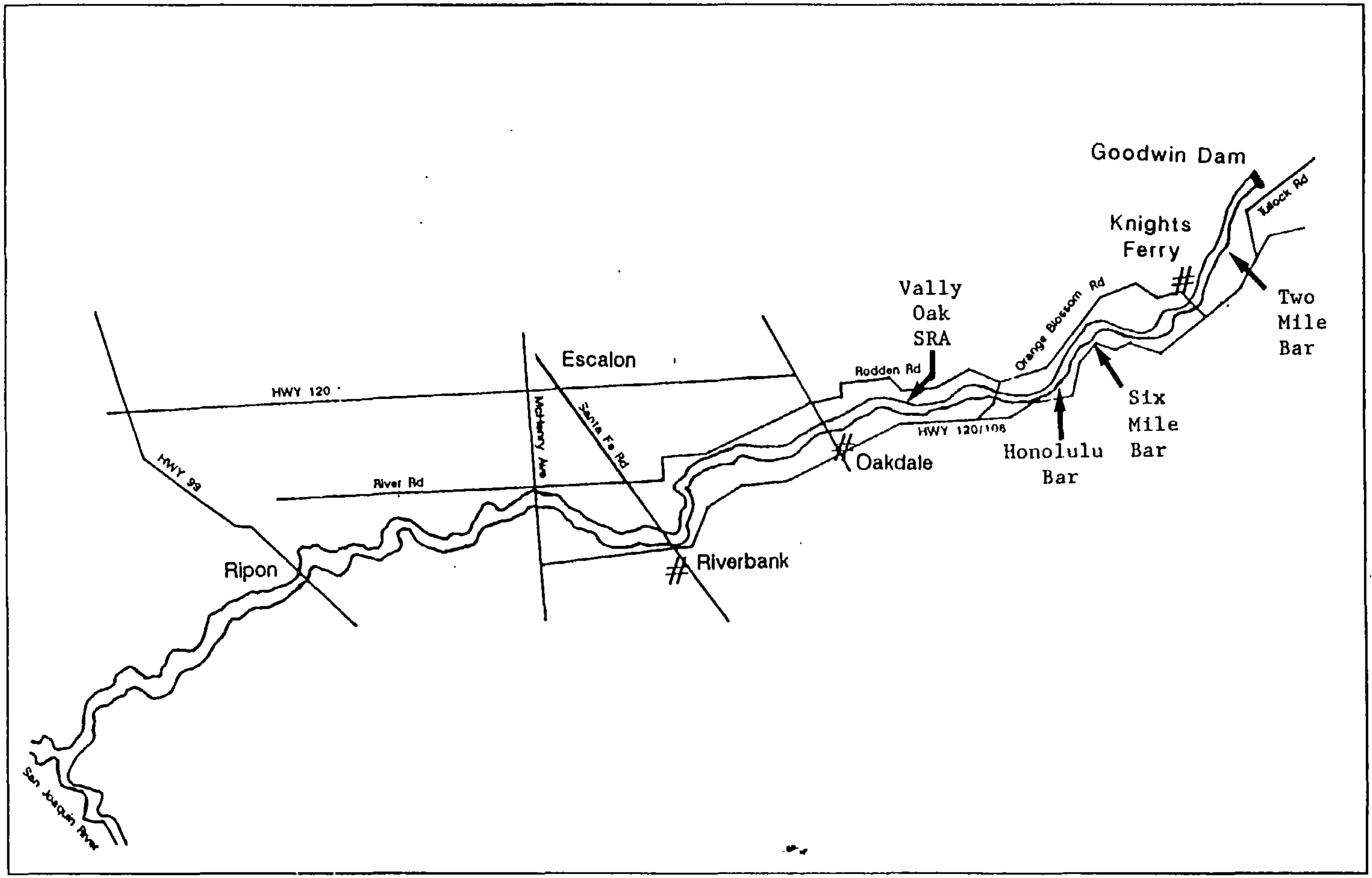

Figure A-1. Location map of the instream flow study sites used to model the Stanislaus River, California.

TWO MILE BAR STUDY SITE

At Two Mile Bar, 10 transects were used to describe the reach.

Transect 1 crosses a moderately deep pool which is a common feature in this upper section.

Transect 2 crosses the head of a riffle. This riffle is heavily used for spawning.

Transect 3 is through a deep fast run.

Transect 4 crosses a shallow pool. Velocity is relatively slow and aquatic vegetation is thick.

Transect 5 crosses a spawning area at the lower end of the shallow pool where it drops off as a short riffle into the run below.

Transect 6 crosses the split channel with a fast shallow run on one side and a shallow pool on the other. During high flows riparian vegetation on the island and on the left side of the channel is inundated, creating excellent cover and forage areas for juvenile salmon (this transect proved to be extremely difficult to model, however, and was dropped from the final PHABSIM analysis).

Transect 7 crosses the bottom of the split channel where water is fast on both sides of the island. Here, as in transect 6, high flows inundate vegetation on the edges, expanding useful rearing habitat.

Transects 8 and 9 cross a fast run where the river narrows below the split channel.

Transect 10 crosses a deep pool, 15 feet in depth. The channel is still relatively narrow here.

The distribution of habitat types and the locations of transects at Two Mile Bar are illustrated in Figure A-2.

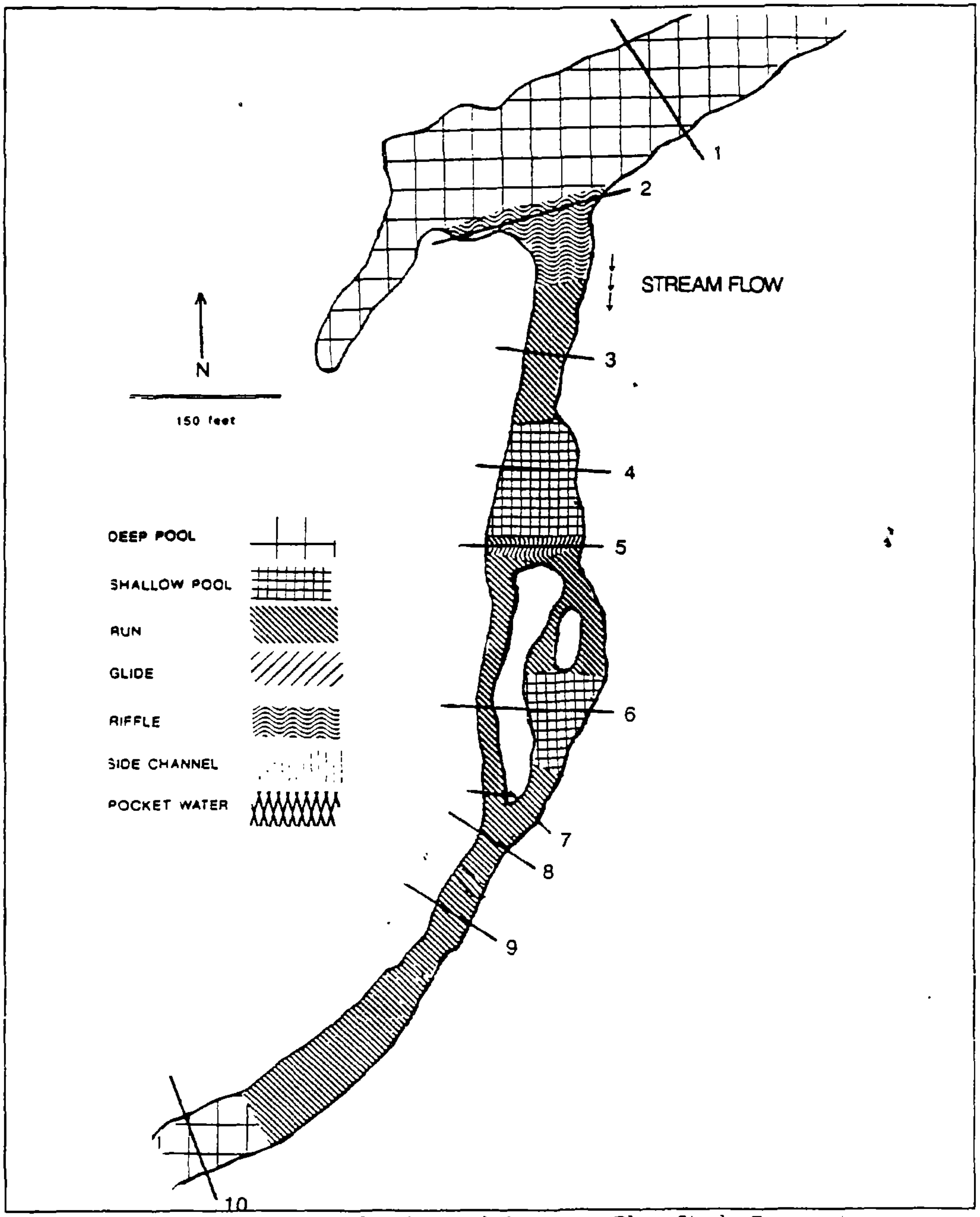

Figure A-2. Two Mile Bar Study Site and Instream Flow Study Transect Locations.

SIX MILE BAR STUDY SITE

The Six Mile Bar reach is a long reach with ten transects.

Transect 1 is across a spawning riffle at the bottom end of the study site.

Transects 2,3, and 4 are all across a long run/glide. They are placed to sample the variability in the run/glide type habitat that occurs throughout the section.

Transect 5 is across a deep pool below where a side channel returns to the main channel.

Transects 6 and 7 are across a riffle heavily used by salmon for spawning.

Habitat distribution and transect locations are illustrated in Figure A-3.

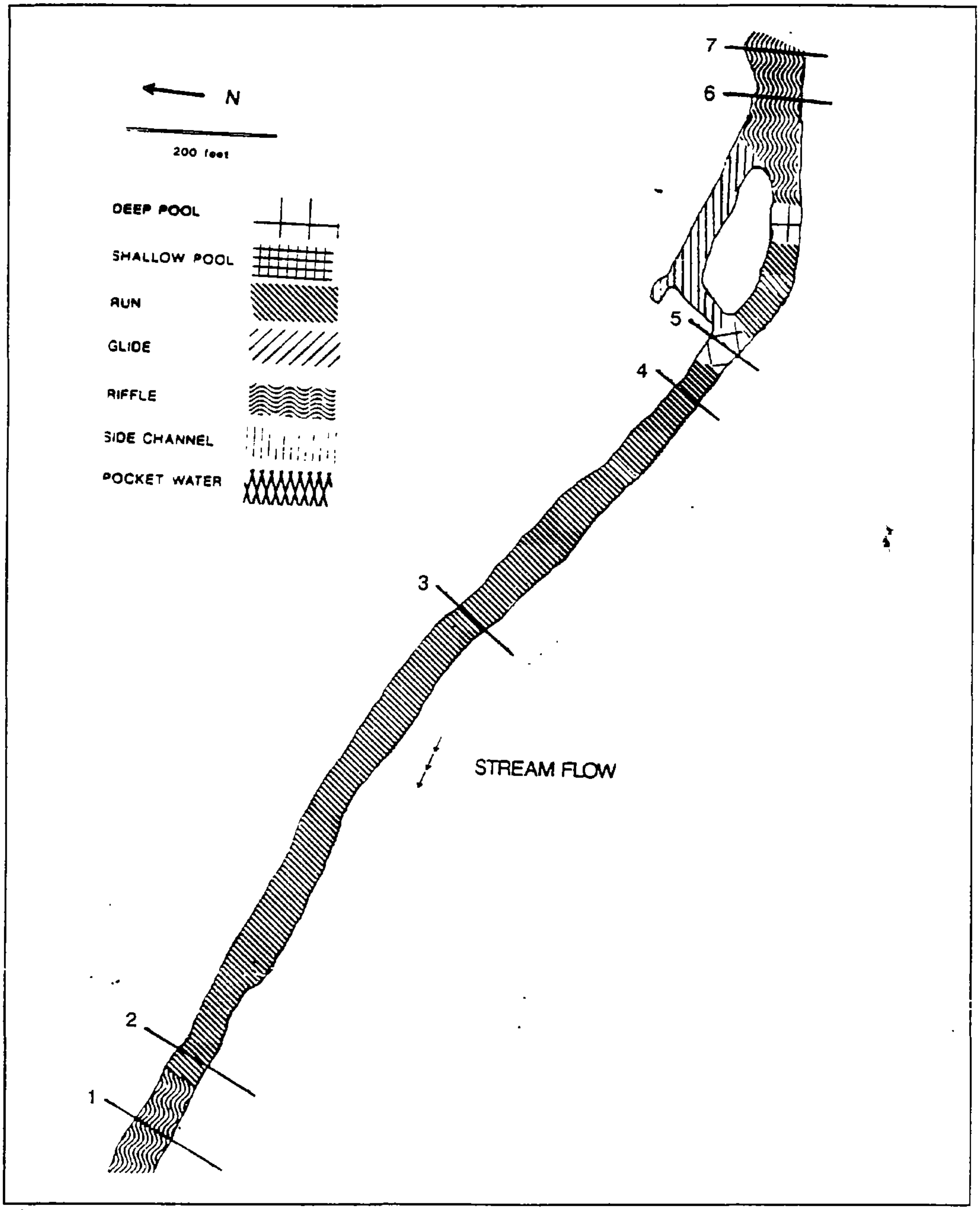

Figure A-3. Six Mile Bar Study Site and Instream Flow Study Transect Locations.

HONOLULU BAR STUDY SITE

The second IFIM sampling site for the middle segment is at Honolulu Bar. Here there is a long side channel that is extensively used for both spawning and fry and juvenile rearing when adequate water flows through the channel. The main channel has seven transects. This reach differs from Six Mile Bar in generally having a narrower river channel and steeper swifter run/glides.

Transect 1 in the main channel crosses a deep pool.

Transect 2 crosses a spawning area.

Transect 3 crosses another deep pool.

Transects 4,5,6 and 7 are placed to model the variation in a long run/glide.

Transect 4 also includes a backwater area.

Because the side channel feature found here is atypical of the lower Stanislaus River as a whole, it was not modelled in this analysis.

Figure A-4 shows the habitat distribution and transect locations.

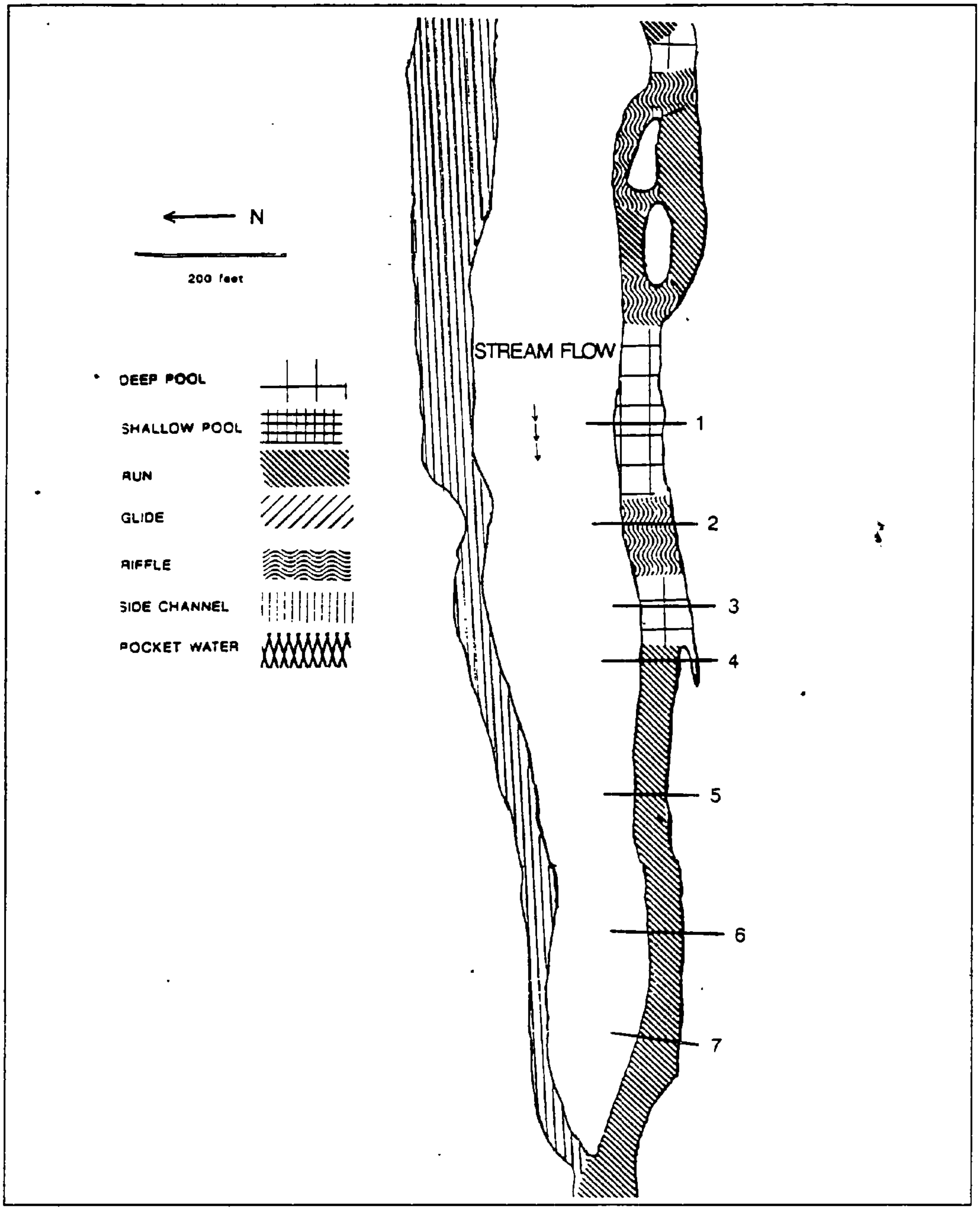

Figure A-4. Honolulu Bar Study Site and Instream Flow Study Transect Locations.

VALLEY OAK SRA STUDY SITE

The third IFIM study site for the middle river segment is at Valley Oak State Recreation Area. In the lower part of the segment, the river slows down a bit and riffles become shorter. Still, salmon do spawn in this segment. Five of the seven transects at this site are categorized as run/glide.

Transects 1, 3, 4, 5 and 6 cross run/glide habitat and sample the variability of runs in this lower part of the middle section of river.

Transect 2 crosses a spawning area.

Transect 7 crosses a deep pool.

Figure A-5 shows the distribution of habitats and location of transects.

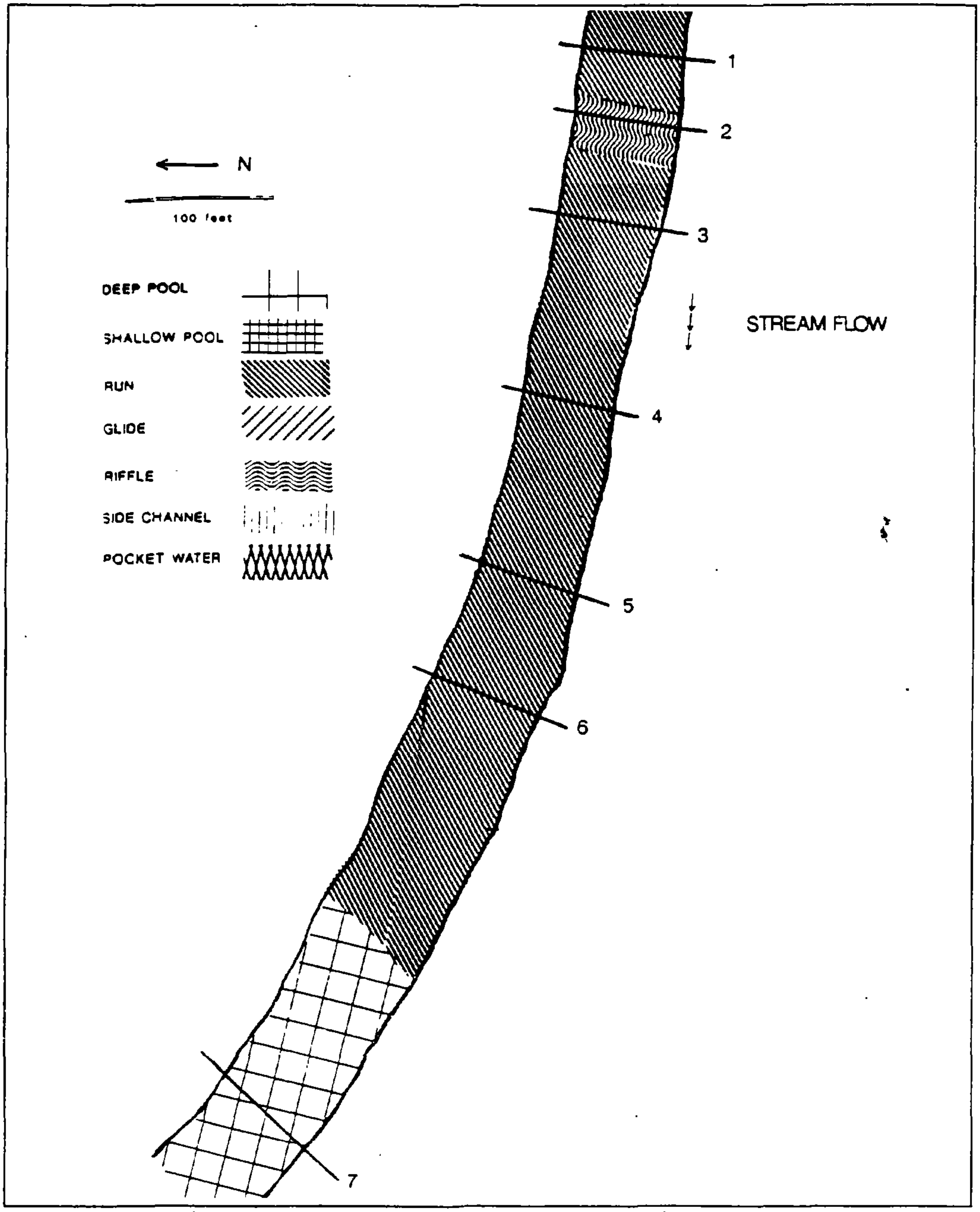

Figure A-5. Valley Oak SRA Study Site and Instream Flow Study Transect Locations.

The third segment of river is from Riverbank to the confluence of the Stanislaus with the San Joaquin River. It is 34 river miles long. The gradient of the river is low, 0.03% and the river actively meanders across its floodplain. The river is characterized by long sand bottomed run/glides, with some deep pools at the bends. No salmon spawn here.

No IFIM modeling sites were established within the segment. We determined that the site at Valley Oak State Recreation Area would adequately describe conditions found in the lower river segment as well.

APPENDIX B

IFG4 INPUT DATA DECKS FOR THE STANISLAUS RIVER INSTREAM FLOW STUDY, 1989

STANISLAUS RIVER FISHERY INVESTIGATION, 1989. TWO MILE BAR STUDY SITE
COMBINED FLOW VELOCITY DATA SET & WEIGHTED USING HABITAT MAPPING

```
IOC       0000100001001000000000
QARD  25.0
QARD  50.0
QARD 100.0
QARD 150.0
QARD 200.0
QARD 250.0
QARD 300.0
QARD 350.0
QARD 400.0
QARD 450.0
QARD 500.0
QARD 550.0
QARD 600.0
QARD 650.0
QARD 700.0
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QARD 900.0
QARD 950.0
QARD1000.0
QARD1050.0
QARD1100.0
QARD1150.0
QARD1200.0
QARD1250.0
QARD1300.0
XSEC  10.0        0.01.00     86.60    .00025
      10.0  0.0 97.1  2.0 94.1  4.0 92.1  8.0 90.2 12.0 88.3 16.0 84.7
      10.0 20.0 82.3 24.0 80.2 28.0 79.9 31.0 79.7 34.0 79.4 37.0 79.0
      10.0 40.0 78.9 43.0 78.6 46.0 78.8 49.0 78.8 52.0 81.4 55.0 84.1
      10.0 58.0 85.6 61.0 89.3 64.0 89.1 67.0 89.4 70.0 90.6 73.0 91.5
      10.0 76.0 92.0 79.0 92.9 83.0 93.6 88.0 95.7
NS    10.0 0.00 9.12 0.00 9.12 0.00 9.12 0.00 9.12 0.00 9.12 0.00 9.12
NS    10.0 0.00 9.12 0.00 9.12 0.00 9.12 0.0010.12 0.0010.12 0.0010.12
NS    10.0 0.0010.12 0.0010.12 0.0010.12 0.0010.12 0.0010.12 0.0010.12
NS    10.0 0.0010.12 0.0010.12 0.0010.12 0.0010.12 0.0010.12 0.0010.12
NS    10.0 0.0010.12 0.0010.12 0.0010.12 0.0010.12
CAL1  10.0     94.08    1304.30
VEL1  10.0           0.02  .50  .66  .93 1.21 1.91 2.43 2.77 3.07 3.56
VEL1  10.0 3.37 3.51 2.83 2.31 1.23  .66  .71  .62  .27  .23  .21  .02
VEL1  10.0  .30  .18  .02
CAL2  10.0     92.60     688.80
VEL2  10.0            .02  .10  .35  .59  .80 1.22 1.58 1.80 1.81 1.78
VEL2  10.0 1.92 1.77 1.79 1.19  .48  .45  .35  .28  .20  .15  .05  .02
VEL2  10.0  .05
CAL3  10.0     90.24     131.60
VEL3  10.0
VEL3  10.0
VEL3  10.0
XSEC   9.0     323.51.0      87.40    .00667
       9.0  0.0 99.0 13.0 94.2 17.0 93.4 21.0 92.4 25.0 91.5 29.0 91.0
       9.0 33.0 90.6 39.0 87.8 42.0 87.5 44.0 87.7 46.0 87.8 48.0 87.4
       9.0 50.0 87.6 52.0 87.6 54.0 87.5 56.0 87.8 58.0 88.1 60.0 88.5
       9.0 63.0 89.0 67.0 89.8 71.0 91.5 75.0 91.6 80.0 91.6 85.0 91.5
       9.0 90.0 93.7 94.0 94.2103.0 97.1
NS     9.0 0.00 9.12 0.00 9.12 0.00 9.12 0.00 9.12 0.00 9.12 0.00 9.12
NS     9.0 0.00 9.12 0.00 9.12 0.0010.12 0.0010.12 0.0010.12 0.0010.12
NS     9.0 0.0010.12 0.0010.12 0.0010.12 0.0010.12 0.0010.12 0.0010.12
```

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NS      9.0 0.0010.12 0.0010.12 0.0010.12 0.0010.12 0.0010.12 0.0010.12
NS      9.0 0.0010.12 0.0010.12 0.0010.12
CAL1    9.0     94.18     1304.30
VEL1    9.0               1.70  .90 1.70 2.60 3.30 3.70 5.70 6.90 7.70 7.20
VEL1    9.0 6.80 6.50 6.90 6.50 5.60 5.30 3.60 1.70 1.00  .20  .20  .10
VEL1    9.0 0.00
CAL2    9.0     92.60      688.80
VEL2    9.0                    0.00  .40  .50 2.50 3.10 6.40 5.70 7.80 7.50
VEL2    9.0 6.40 5.80 5.00 5.30 4.30 4.30 1.20  .60  .20  .20  .30 0.00
VEL2    9.0
CAL3    9.0     90.24      131.60
VEL3    9.0                                          .75 2.32 3.29 4.63 4.60
VEL3    9.0 3.96 3.01 1.98 1.33 1.22  .93  .18  .08
VEL3    9.0
XSEC     8.      70.81.0       89.80     .00653
         8.  0.0 95.9 10.0 93.2 12.0 93.1 15.0 92.9 20.0 92.2 25.0 90.7
         8. 30.0 90.3 35.0 90.7 40.0 90.7 45.0 90.2 50.0 90.1 55.0 90.2
         8. 50.0 91.9 65.0 91.3 70.0 90.6 75.0 90.5 80.0 90.2 85.0 89.8
         8. 90.0 91.1 95.0 92.4100.0 92.3105.0 92.9132.0 97.3
NS       8. 0.00 9.04 0.00 9.04 0.00 9.04 0.00 9.04 0.0010.13 0.00 7.06
NS       8. 0.0010.09 0.0013.09 0.0010.09 0.0010.09 0.0010.09 0.0010.09
NS       8. 0.00 9.04 0.00 9.08 0.00 9.08 0.00 9.08 0.00 9.08 0.00 9.08
NS       8. 0.0013.09 0.0013.09 0.0011.04 0.0013.03 0.0014.03
CAL1     8.     94.86    1304.30
VEL1     8.
VEL1     8.
CAL2     8.     93.20     688.80
VEL2     8.       0.0  0.7  0.7  1.3  0.3  4.2  4.0  6.5  5.3  4.3  1.4
VEL2     8.  2.9  4.2  4.4  4.3  3.6  2.9  2.7  0.8  0.0  0.0
CAL3     8.     91.29     131.60
VEL3     8.                           0.00 3.30 3.00 4.20 3.00 3.80 1.90
VEL3     8.            4.50 2.80 2.10 1.40  .40 0.00
XSEC     7.      23.21.0       90.40     .00602
         7.  0.0103.4 14.0 95.5 22.0 95.5 27.0 93.5 28.0 93.3 34.0 92.6
         7. 38.0 91.5 42.0 90.9 45.0 90.9 48.0 90.8 52.0 91.1 56.0 91.0
         7. 62.0 91.1 64.0 92.6 66.0 93.3 68.0 93.6 72.0 93.4 74.0 93.2
         7. 77.0 93.1 85.0 92.7 89.0 91.1 95.0 90.4100.0 90.5105.0 89.8
         7.110.0 90.3115.0 90.5120.0 90.7125.0 90.0130.0 90.7135.0 91.2
         7.140.0 92.8142.0 93.8152.0 94.2162.0 94.3167.0 94.4172.0 94.6
         7.180.0 94.7184.0 95.5186.0 96.5
NS       7. 0.00 6.07 0.00 6.07 0.00 6.07 0.00 6.07 0.00 6.07 0.00 3.04
NS       7. 0.00 6.07 0.00 9.08 0.00 9.09 0.00 9.08 0.00 9.08 0.00 9.08
NS       7. 0.0011.11 0.00 5.01 0.00 5.01 0.00 7.09 0.00 3.09 0.00 6.09
NS       7. 0.00 6.08 0.00 7.06 0.00 6.09 0.00 6.07 0.00 6.07 0.00 9.07
NS       7. 0.00 9.06 0.00 9.06 0.00 9.08 0.00 9.07 0.00 8.06 0.00 4.04
NS       7. 0.00 8.08 0.00 8.08 0.00 8.08 0.00 8.08 0.00 8.08 0.00 8.08
NS       7. 0.00 8.08 0.00 8.08 0.00 8.08
CAL1     7.     95.26    1304.30
VEL1     7.                1.10 2.20 3.50 5.60 6.70 7.30 6.70 5.90 4.50
VEL1     7. 3.80 1.90  .70  .70  .60  .40  .40 1.00 1.50 1.70 2.00 2.10
VEL1     7. 2.20 4.10 3.60 2.40 2.90  .70  .70  .80 2.40  .70  .50  .50
VEL1     7. 0.00
CAL2     7.     93.88     688.80
VEL2     7.                     0.9  1.6  0.9  3.9  5.6  5.9  5.4  4.9
VEL2     7. 4.0  2.4  1.7  0.4  0.4  0.1  0.1  0.4  0.6  1.4  1.9  2.9
VEL2     7. 3.4  2.8  2.3  2.5  2.5  1.5  0.6  0.4
VEL2     7.
CAL3     7.     92.15     131.60
VEL3     7.                           .10 1.08 2.25 2.42 2.42 2.25 2.06
VEL3     7. 1.50  .10                                .70 1.29 1.55 1.27
VEL3     7.  .70  .32  .20  .20  .20  .10  .10  .10
VEL3     7.
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XSEC      5.       70.91.0      92.10     .00098
          5.  0.0 97.1  1.5 96.6  6.0 95.4  7.0 95.2  8.0 95.0 12.0 94.4
          5. 15.0 92.5 20.0 92.5 25.0 92.9 30.0 93.3 35.0 93.5 40.0 93.3
          5. 45.0 93.0 50.0 92.3 55.0 92.5 60.0 92.1 65.0 92.4 70.0 92.7
          5. 75.0 92.7 80.0 92.7 85.0 93.2 90.0 92.9 95.0 92.7100.0 92.8
          5.105.0 92.9110.0 93.2115.0 93.5120.0 94.2125.0 95.1130.0 96.1
          5.136.0 97.4
NS        5. 0.00 2.06 0.00 2.06 0.00 2.06 0.00 2.06 0.00 2.06 0.00 2.06
NS        5. 0.00 5.05 0.00 6.09 0.00 6.08 0.00 8.07 0.00 8.09 0.00 8.09
NS        5. 0.00 9.06 0.0012.05 0.0010.06 0.0011.09 0.00 9.06 0.00 9.05
NS        5. 0.00 6.09 0.00 9.05 0.00 9.09 0.00 9.09 0.00 8.06 0.00 8.09
NS        5. 0.00 6.09 0.00 4.09 0.00 6.06 0.00 2.02 0.00 3.04 0.00 3.04
NS        5. 0.00 3.04
CAL1      5.      96.56     1304.30
VEL1      5.                .30  .30  .40  .40  .90 2.50 3.00 3.90 3.90 3.90
VEL1      5. 4.20 4.20 4.10 4.00 4.10 4.00 3.70 4.00 3.50 2.70 2.20 2.10
VEL1      5. 2.10 2.10 1.60 1.50 1.00 0.00
CAL2      5.      95.46      688.80
VEL2      5.                     0.00  .40  .10  .40 2.40 2.70 3.40 3.20 3.40
VEL2      5. 3.30 2.60 2.80 2.80 2.80 2.70 2.80 2.50 3.00 2.30 1.90 1.90
VEL2      5. 1.60 1.80 1.80 1.30  .30
CAL3      5.      94.04      131.60
VEL3      5.                               0.00 1.60 1.50 1.50 1.30 1.20
VEL3      5. 1.10 1.30 1.20  .90 1.10  .70  .90  .70  .90 1.10 1.30  .80
VEL3      5. 0.00  .40  .80
XSEC      4.       23.21.0      92.70     .00012
          4.  0.0 98.1  5.0 96.7 14.0 96.3 22.0 93.9 29.0 91.6 34.0 91.3
          4. 39.0 91.0 43.0 91.1 47.0 90.6 50.0 90.4 53.0 90.2 56.0 90.3
          4. 59.0 90.4 62.0 90.3 65.0 90.7 68.0 90.9 71.0 91.1 74.0 91.3
          4. 78.0 91.2 82.0 91.5 86.0 92.4 90.0 92.0 96.0 92.4104.0 92.5
          4.114.0 92.8124.0 95.5128.0 96.3130.0 96.7137.0 98.4
NS        4. 0.00 3.02 0.00 3.02 0.00 3.02 0.00 3.02 0.0011.07 0.0011.07
NS        4. 0.0011.07 0.0011.07 0.0011.08 0.0011.08 0.0011.08 0.0011.08
NS        4. 0.00 8.12 0.00 8.12 0.00 7.08 0.00 7.08 0.00 7.08 0.00 7.08
NS        4. 0.00 7.08 0.0010.07 0.0011.10 0.00 9.08 0.00 9.08 0.00 2.04
NS        4. 0.00 2.04 0.00 2.04 0.00 2.04 0.00 2.04 0.00 2.04
CAL1      4.      96.63     1304.30
VEL1      4.               0.02  .31 1.52 2.88 3.77 3.69 3.69 4.00 4.28 4.87
VEL1      4. 5.00 4.93 4.95 4.59 4.22 3.85 3.33 2.65 2.10 1.59 1.00  .39
VEL1      4.  .10  .02  .02
CAL2      4.      95.53      688.80
VEL2      4.                      .18  .45 1.24 2.31 2.84 2.80 2.50 2.91 2.85
VEL2      4. 3.10 2.69 3.10 2.91 2.77 2.39 2.23 1.67 1.37  .99  .73  .16
VEL2      4.  .18  .02
CAL3      4.      94.09      131.60
VEL3      4.                      .01  .01  .46  .63  .45  .68  .72  .70  .62
VEL3      4.  .75  .62  .62  .61  .62  .41  .49  .50  .30  .32  .35  .29
VEL3      4.
XSEC      3.       70.81.0      92.70     .00376
          3.  0.0 97.9 11.3 95.5 13.3 94.9 18.0 93.8 23.0 92.0 26.0 91.8
          3. 29.0 91.1 32.0 90.7 35.0 90.2 38.0 89.7 41.0 89.3 44.0 89.1
          3. 47.0 89.0 50.0 88.5 53.0 88.4 55.0 88.4 57.0 88.6 59.0 88.9
          3. 62.0 89.5 65.0 91.2 68.0 91.2 74.0 95.0 78.0 95.0 81.0 96.0
          3. 94.0 97.9
NS        3. 0.0012.10 0.0012.10 0.0012.10 0.0012.10 0.0010.07 0.00 6.05
NS        3. 0.00 6.05 0.00 6.05 0.00 9.07 0.00 9.07 0.00 9.07 0.00 9.07
NS        3. 0.0010.08 0.0010.08 0.0010.08 0.0010.08 0.0010.08 0.0011.09
NS        3. 0.00 3.11 0.0012.10 0.0011.09 0.0011.09 0.0012.10 0.0012.10
NS        3. 0.0012.10
CAL1      3.      96.60     1304.30
VEL1      3.      0.00  .20  .40  .50  .50  .50 1.60 3.60 4.50 4.60 6.40
VEL1      3. 6.60 6.50 6.60 6.20 6.20 5.90 4.00 1.20  .20  .80  .60 0.00
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VEL1     3.
CAL2     3.     95.58    688.80
VEL2     3.       0.0   0.0 -1.3 -0.9  0.4  0.5  0.8  1.8  3.0  3.8  4.2
VEL2     3.  4.6  5.5   5.4  4.6  3.4  2.0  1.2  0.9 -0.4 -0.4
VEL2     3.
CAL3     3.     94.11    131.60
VEL3     3.                 0.00 -.90 -.70 -.50 -.40  .10  .30  .60 1.10
VEL3     3. 1.70 1.90 2.20 2.30 2.20 1.10  .70 -.60 -.80
VEL3     3.
XSEC     2.      70.91.0      92.70     .00011
         2.  0.0 98.9 26.8 97.6 60.0 96.6 86.0 95.6 93.9 95.2103.0 94.8
         2.113.0 94.2123.0 94.0133.0 93.8140.0 93.7147.0 93.0154.0 93.1
         2.160.0 93.6166.0 92.4172.0 92.5178.0 92.4184.0 93.2190.0 93.6
         2.196.0 93.8202.0 93.9209.0 94.7216.0 95.2223.0 95.1230.0 95.2
         2.237.0 95.4244.0 96.3250.0 96.8258.0 97.6270.0 98.6
NS       2. 0.0010.08 0.0010.08 0.0010.08 0.0010.08 0.0010.08 0.0010.08
NS       2. 0.0011.08 0.0011.08 0.0011.08 0.0011.08 0.0011.08 0.00 9.11
NS       2. 0.00 9.11 0.00 9.11 0.00 9.11 0.00 8.11 0.00 8.11 0.00 8.11
NS       2. 0.00 8.11 0.00 7.08 0.00 7.08 0.00 7.08 0.00 7.08 0.00 2.07
NS       2. 0.00 2.07 0.00 2.07 0.00 2.07 0.00 2.12 0.00 2.12
CAL1     2.     97.58   1304.30
VEL1     2.           0.00  .20  .30 1.00 1.70 2.50 2.90 2.80 3.30 3.60
VEL1     2. 3.60 3.30 3.10 2.80 2.90 2.90 2.70 1.10 1.00 1.10 1.10 1.80
VEL1     2. 1.80 1.50  .90
CAL2     2.     96.21    688.80
VEL2     2.                  0.1  0.0  0.5  1.2  2.0  2.1  2.5  2.5  2.8
VEL2     2.  2.9  2.3  2.3  2.1  1.9  2.0  2.5  1.3  0.8  0.2  1.3  0.8
VEL2     2.  1.4  0.0
CAL3     2.     94.69    131.60
VEL3     2.                                .70  .60 1.20  .40 1.50 1.00
VEL3     2. 1.60 1.60 1.30 1.00 1.20 1.20 1.20 0.00
VEL3     2.
XSEC     1.      23.21.0      92.70     .00033
         1.  0.0 99.8  2.0 97.7  5.0 96.0 10.0 92.7 15.0 91.5 20.0 90.6
         1. 25.0 90.1 30.0 90.1 35.0 90.1 40.0 90.3 45.0 90.3 50.0 90.2
         1. 55.0 90.3 60.0 89.9 65.0 89.9 70.0 89.3 75.0 89.1 80.0 89.6
         1. 85.0 89.8 90.0 90.2 98.0 90.5106.0 90.9114.0 92.3122.0 93.4
         1.130.0 94.7138.0 97.3154.0 99.2
NS       1. 0.00 1.04 0.00 1.04 0.00 1.04 0.00 1.04 0.00 1.04 0.00 1.04
NS       1. 0.00 9.04 0.00 9.04 0.00 9.04 0.0010.08 0.0010.08 0.0010.08
NS       1. 0.0010.08 0.0010.08 0.0010.08 0.0010.08 0.0010.08 0.0010.08
NS       1. 0.0013.09 0.0013.09 0.0010.08 0.00 6.05 0.0014.06 0.0014.06
NS       1. 0.0014.06 0.0014.06 0.0014.06
CAL1     1.     97.67   1304.30
VEL1     1.           0.00  .10  .30  .90 1.60 1.80 2.00 2.30 2.70 2.60
VEL1     1. 2.60 2.30 2.10 2.00 1.60 1.50 1.30 1.20 1.10  .80  .80  .80
VEL1     1.  .30 0.00
CAL2     1.     96.32    688.80
VEL2     1.           0.00 0.00  .30  .70 1.20 1.00 1.10 1.50 2.00 2.10
VEL2     1. 2.10 1.70 1.50 1.30 1.00 1.00  .70  .70  .60  .40  .30  .40
VEL2     1. 0.00
CAL3     1.     94.75    131.60
VEL3     1.                 0.00  .10  .10  .20  .20  .40  .40  .60  .70
VEL3     1.  .70  .60  .40  .50  .40  .40  .20  .20  .10 0.00 0.00 0.00
VEL3     1.
XSEC    99.     323.50.0      92.70     .00033
        99.  0.0 99.8  2.0 97.7  5.0 96.0 10.0 92.7 15.0 91.5 20.0 90.6
        99. 25.0 90.1 30.0 90.1 35.0 90.1 40.0 90.3 45.0 90.3 50.0 90.2
        99. 55.0 90.3 60.0 89.9 65.0 89.9 70.0 89.3 75.0 89.1 80.0 89.6
        99. 85.0 89.8 90.0 90.2 98.0 90.5106.0 90.9114.0 92.3122.0 93.4
        99.130.0 94.7138.0 97.3154.0 99.2
NS      99. 0.00 1.04 0.00 1.04 0.00 1.04 0.00 1.04 0.00 1.04 0.00 1.04
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NS      99. 0.00 9.04 0.00 9.04 0.00 9.04 0.0010.08 0.0010.08 0.0010.08
NS      99. 0.0010.08 0.0010.08 0.0010.08 0.0010.08 0.0010.08 0.0010.08
NS      99. 0.0013.09 0.0013.09 0.0010.08 0.00 6.05 0.0014.06 0.0014.06
NS      99. 0.0014.06 0.0014.06 0.0014.06
CAL1    99.      97.67     1304.30
VEL1    99.           0.00  .10  .30  .90 1.60 1.80 2.00 2.30 2.70 2.60
VEL1    99. 2.60 2.30 2.10 2.00 1.60 1.50 1.30 1.20 1.10  .80  .80  .80
VEL1    99.  .30 0.00
CAL2    99.      96.32      688.80
VEL2    99.           0.00 0.00  .30  .70 1.20 1.00 1.10 1.50 2.00 2.10
VEL2    99. 2.10 1.70 1.50 1.30 1.00 1.00  .70  .70  .60  .40  .30  .40
VEL2    99. 0.00
CAL3    99.      94.75      131.60
VEL3    99.                0.00  .10  .10  .20  .20  .40  .40  .60  .70
VEL3    99.  .70  .60  .40  .50  .40  .40  .20  .20  .10 0.00 0.00 0.00
VEL3    99.
ENDJ
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STANISLAUS RIVER FISHERY INVESTIGATION, 1989. SIX MILE BAR STUDY SITE
COMBINED FLOW VELOCITY DATA SET & WEIGHTED BASED ON HABITAT MAPPING
IOC       0000100001001000000000
QARD  25.0
QARD  50.0
QARD 100.0
QARD 150.0
QARD 200.0
QARD 250.0
QARD 300.0
QARD 350.0
QARD 400.0
QARD 450.0
QARD 500.0
QARD 550.0
QARD 600.0
QARD 650.0
QARD 700.0
QARD 750.0
QARD 800.0
QARD 850.0
QARD 900.0
QARD 950.0
QARD1000.0
QARD1050.0
QARD1100.0
QARD1150.0
QARD1200.0
QARD1250.0
QARD1300.0
XSEC   1.0       0.01.00     91.10    .00025
       1.0  0.0 97.1  9.0 94.9 15.0 93.5 21.0 91.6 27.0 91.6 30.0 91.5
       1.0 33.0 91.1 39.0 91.3 45.0 92.0 48.0 92.1 51.0 92.1 54.0 92.0
       1.0 57.0 92.0 63.0 92.1 66.0 92.0 69.0 92.1 75.0 92.2 81.0 92.3
       1.0 87.0 92.9 90.0 92.7 93.0 92.8 98.0 93.3105.0 93.1111.0 93.3
       1.0117.0 93.8123.0 94.4129.0 94.4135.5 94.9141.0 97.2
NS     1.0      8.06      8.06      8.06      8.06      9.07      9.07
NS     1.0      9.07      9.08      9.08      9.08      8.09      8.09
NS     1.0      9.08      9.07      9.07      9.07      9.07      8.09
NS     1.0     10.09     10.09     10.09     10.09     10.09     10.09
NS     1.0     10.09     10.09     10.09     10.09     10.09
CAL1   1.0     93.45    157.00
VEL1   1.0                  .30 1.40 1.80 1.80 1.30 2.10 2.20 2.40 2.30
VEL1   1.0 2.00 1.30 1.20 1.60 1.00  .60  .50  .50  .50
VEL1   1.0
CAL2   1.0     94.86    744.00
VEL2   1.0             .90 1.10 2.70      3.00 2.50 3.50 3.60 4.10
VEL2   1.0 3.70 3.10      2.90 3.10 2.30 2.30      2.20 2.60 2.40 2.10
VEL2   1.0 2.00 1.10  .20
CAL3   1.0     95.92   1360.00
VEL3   1.0
VEL3   1.0
VEL3   1.0
XSEC   2.0      50.31.00     91.20    .00025
       2.0  0.0102.1 21.0 94.9 22.0 94.0 24.0 93.6 28.0 91.3 34.0 91.2
       2.0 40.0 91.7 46.0 92.2 52.0 91.5 58.0 91.5 64.0 91.4 66.0 91.5
       2.0 72.0 92.1 76.0 92.0 82.0 92.2 88.0 92.5 94.0 92.3100.0 91.8
       2.0106.0 91.9112.0 91.5118.0 91.6124.0 91.5130.0 91.6136.0 92.1
       2.0138.0 92.8139.0 93.5142.0 94.6143.2 94.6146.8 96.8
NS     2.0      8.06      8.06      8.06      8.06      8.06      8.06
NS     2.0      9.07      9.07      9.07      9.07     10.07     10.07
NS     2.0     10.07      9.07      9.07      9.07      9.07     10.08
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```
NS     2.0      9.07     10.08      9.07      8.06      5.08      5.08
NS     2.0      5.08      5.08      5.08      5.08      5.08
CAL1   2.0     93.52    157.00
VEL1   2.0                          1.50 1.60 1.40  .90 1.00  .90 1.00
VEL1   2.0  .90  .60  .30  .50  .40  .40 1.00  .50  .90  .20  .20  .50
VEL1   2.0  .60
CAL2   2.0     94.92    744.00
VEL2   2.0            .70      1.00 2.40 2.70 2.50 2.20 2.20 2.20
VEL2   2.0      2.30 2.40 2.40 2.40 2.40 2.20 1.40 1.20  .90  .80  .50
VEL2   2.0
CAL3   2.0     96.01   1360.00
VEL3   2.0
VEL3   2.0
VEL3   2.0
XSEC   3.0     130.71.00     91.20     .00016
       3.0  0.0 97.7  9.0 94.6 10.4 94.1 15.4 92.8 17.4 92.2 20.4 91.2
       3.0 25.4 90.4 30.4 89.7 34.4 89.4 38.4 89.2 41.4 89.0 44.4 89.0
       3.0 47.4 88.7 50.4 88.5 53.4 88.1 56.4 88.1 59.4 87.7 62.4 86.8
       3.0 65.4 86.6 68.4 87.7 71.4 88.7 74.4 89.6 78.2 89.1 82.2 91.0
       3.0 85.2 92.3 88.7 93.6 90.7 93.6 92.2 94.1 95.4 95.1 96.4 97.0
       3.0 99.0 97.0
NS     3.0      9.08      9.08      9.08     10.09     10.09     10.09
NS     3.0     10.09     10.05     10.05      9.08      9.08      9.08
NS     3.0      9.08      9.08      9.08      9.04      9.04      8.04
NS     3.0      8.04      9.08     13.09     13.09     13.09     13.09
NS     3.0     13.09     13.09     13.09     12.03     12.03     12.03
NS     3.0     12.03
CAL1   3.0     93.58    157.00
VEL1   3.0                      .30  .50  .70  .70  .70  .80  .70  .80
VEL1   3.0  .70  .80  .80  .70  .70  .30  .10  .10  .04  .05  .10  .20
VEL1   3.0
CAL2   3.0     95.08    744.00
VEL2   3.0                 .95      1.60 1.60 1.90 2.10 2.30 2.40 2.40
VEL2   3.0 2.40 2.20 2.30 2.20 2.20 2.20 1.80 2.30 1.10 1.00  .90  .70
VEL2   3.0  .40  .30  .10
CAL3   3.0     96.17   1360.00
VEL3   3.0                1.30      2.10 2.60 3.00 3.30 3.30 3.50 3.60
VEL3   3.0 3.80 3.70 3.70 3.80 3.70 3.20 3.20 2.90 2.00 1.40 1.70 1.20
VEL3   3.0 1.00  .20
XSEC   4.0     130.71.00     91.20     .00029
       4.0  0.0 97.9 19.0 95.0 22.0 93.8 25.0 92.8 28.0 91.6 31.0 91.1
       4.0 34.0 90.9 37.0 90.7 40.0 90.6 43.0 90.2 46.0 90.2 49.0 90.0
       4.0 52.0 89.9 55.0 89.7 58.0 89.6 61.0 89.3 64.0 89.2 67.0 89.9
       4.0 70.0 92.4 73.0 92.9 76.0 90.6 80.0 92.5 83.0 93.4 89.0 95.0
       4.0 96.0 96.0100.0 96.4
NS     4.0      9.06      9.06      6.07      8.07      9.08      8.04
NS     4.0      4.08      9.07      9.07      9.07      9.08      9.08
NS     4.0      9.08      9.08      8.09      9.12     12.09     12.09
NS     4.0     12.09     12.09     12.09      3.14      3.14      3.14
NS     4.0      3.14      3.14
CAL1   4.0     93.59    157.00
VEL1   4.0                                .30  .50  .90 1.40 1.60 1.70
VEL1   4.0 1.60 1.50 1.10  .90  .60  .70  .70  .40
VEL1   4.0
CAL2   4.0     95.14    744.00
VEL2   4.0            .10  .30  .50 1.20 2.00 2.60 3.60 4.50 4.50 5.00
VEL2   4.0 4.70 4.60 3.70 2.90 3.50 3.00 3.10 1.50  .40  .30
VEL2   4.0
CAL3   4.0     96.24   1360.00
VEL3   4.0                 .60 1.64      3.63 4.57      5.10 5.59 5.58
VEL3   4.0 5.54 5.61 5.59 5.59 4.98 4.29 2.42       .81       .17
VEL3   4.0
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XSEC    5.0      130.71.00      91.20     .00434
        5.0  0.0 98.5 69.0 95.3 71.0 94.9 73.0 94.1 76.0 93.2 80.0 92.6
        5.0 84.0 91.8 88.0 90.8 92.0 89.8 96.0 89.2 99.0 88.7102.0 88.5
        5.0105.0 88.3108.0 88.6111.0 88.5114.0 88.1117.0 88.3121.0 89.1
        5.0124.0 89.6127.0 90.6130.0 92.4133.0 94.3134.5 95.3135.0 95.5
        5.0145.0 96.5
NS      5.0      9.08       9.08       9.08       9.08       9.08       9.08
NS      5.0      9.07       9.08       9.08       9.08       9.08      10.09
NS      5.0      9.08       9.08       9.08       9.08      10.09       9.06
NS      5.0      4.06       4.06       4.06       4.06       4.06       4.06
NS      5.0      4.06
CAL1    5.0     93.60     157.00
VEL1    5.0                                   .38  .79 1.49 2.45 2.16 1.40
VEL1    5.0  .92  .53  .42  .70  .65  .41  .27  .11  .11
VEL1    5.0
CAL2    5.0     95.27     744.00
VEL2    5.0                              .80 1.50 2.40 3.70 4.50 5.40 4.60
VEL2    5.0 3.60 3.10 2.70 2.30 2.10  .80  .50  .40
VEL2    5.0
CAL3    5.0     96.38    1360.00
VEL3    5.0
VEL3    5.0
VEL3    5.0
XSEC    6.0      457.01.00      93.40     .00511
        6.0  0.0 98.6  3.0 97.8  6.8 97.0 11.0 95.8 15.0 95.1 22.0 94.3
        6.0 28.0 94.7 33.0 94.4 37.0 94.1 38.0 94.5 39.0 94.2 43.0 94.0
        6.0 47.0 94.0 51.0 93.9 55.0 94.0 58.0 93.4 61.0 93.4 64.0 93.7
        6.0 67.0 93.8 70.0 93.8 73.0 93.9 76.0 93.9 79.0 94.2 82.0 94.3
        6.0 86.0 94.4 90.0 94.7 94.0 94.7 98.0 95.2105.0 96.6112.0 97.3
        6.0116.0 97.8120.0 98.3
NS      6.0      9.08       9.08       9.08      10.09       4.04      10.09
NS      6.0      9.10       9.10      10.09      10.09      10.09      10.09
NS      6.0      9.10      10.09      10.09      10.09      10.09      10.09
NS      6.0     10.09       9.10       9.10      10.09       9.10       9.10
NS      6.0      9.10       9.08       9.08       8.04       4.04       4.04
NS      6.0      4.04       4.04
CAL1    6.0     95.41     157.00
VEL1    6.0                              .50 1.00 1.80 2.30 1.90 1.70  .90
VEL1    6.0 2.30 1.70 1.10 1.00 2.10 2.10 2.30 2.20 2.30 1.80 1.40 2.30
VEL1    6.0 2.10  .50  .70
CAL2    6.0     96.97     744.00
VEL2    6.0                              .70 2.50 2.80 3.80 4.40 3.60 3.60
VEL2    6.0 4.00 3.50 3.60 3.60 3.80 4.30 3.80 4.20 4.00 3.20 3.80 3.80
VEL2    6.0 3.40 2.60 2.10  .20
CAL3    6.0     97.80    1360.00
VEL3    6.0                .70  .30 1.60 4.30 5.30      6.30      5.70
VEL3    6.0 5.70 4.40 5.60 5.20 4.80 4.90 5.20 5.70 5.50 4.20 5.20 4.90
VEL3    6.0 4.30 2.30 2.20  .30
XSEC    7.0       50.31.00      93.60     .00511
        7.0  0.0100.2 20.0 98.3 21.0 97.8 26.0 97.6 30.0 97.3 34.0 97.1
        7.0 42.0 93.9 46.0 93.9 50.0 94.1 56.0 94.1 62.0 93.8 68.0 93.8
        7.0 74.0 93.6 80.0 94.0 86.0 94.4 92.0 94.3 98.0 94.5104.0 94.4
        7.0109.0 94.7112.0 94.8116.0 94.9121.0 95.5124.0 95.5127.0 95.6
        7.0133.0 96.8136.0 97.3138.5 98.3141.0100.0
NS      7.0      9.06       9.06       9.06       9.06       9.06       9.06
NS      7.0      9.08       9.10       9.10      12.10      12.10      10.12
NS      7.0     12.10      11.10      10.09      10.09      12.10      12.10
NS      7.0     10.09      10.09      10.04       3.03       3.03       3.03
NS      7.0      3.09       3.09       3.09      10.09
CAL1    7.0     95.73     157.00
VEL1    7.0                                   .40 1.30 1.00 1.30  .50  .90
VEL1    7.0 2.10 2.00 1.90 1.50 1.80 1.20 1.60 1.90  .30
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VEL1   7.0
CAL2   7.0      97.32     744.00
VEL2   7.0                                     .50 2.20 2.60 2.90 2.90 2.50 2.30
VEL2   7.0 3.00 3.40 3.40 3.40 3.20 3.10 3.10 3.40  .30  .80
VEL2   7.0
CAL3   7.0      98.15    1360.00
VEL3   7.0              .30 1.30      1.00 3.20 3.50 4.00 4.10 3.90 3.50
VEL3   7.0 3.90 4.30 4.80 4.40 4.20 4.40 4.20       .60  .20
XSEC  99.9       50.3 .00      93.60     .00511
      99.9  0.0100.2 20.0 98.3 21.0 97.8 26.0 97.6 30.0 97.3 34.0 97.1
      99.9 42.0 93.9 46.0 93.9 50.0 94.1 56.0 94.1 62.0 93.8 68.0 93.8
      99.9 74.0 93.6 80.0 94.0 86.0 94.4 92.0 94.3 98.0 94.5104.0 94.4
      99.9109.0 94.7112.0 94.8116.0 94.9121.0 95.5124.0 95.5127.0 95.6
      99.9133.0 96.8136.0 97.3138.5 98.3141.0100.0
NS    99.9       9.06       9.06       9.06       9.06       9.06       9.06
NS    99.9       9.08       9.10       9.10      12.10      12.10      10.12
NS    99.9      12.10      11.10      10.09      10.09      12.10      12.10
NS    99.9      10.09      10.09      10.04       3.03       3.03       3.03
NS    99.9       3.09       3.09       3.09      10.09
CAL1  99.9      95.73     157.00
VEL1  99.9                                          .40 1.30 1.00 1.30  .50  .90
VEL1  99.9 2.10 2.00 1.90 1.50 1.80 1.20 1.60 1.90  .30
VEL1  99.9
CAL2  99.9      97.32     744.00
VEL2  99.9                                     .50 2.20 2.60 2.90 2.90 2.50 2.30
VEL2  99.9 3.00 3.40 3.40 3.40 3.20 3.10 3.10 3.40  .30  .80
VEL2  99.9
CAL3  99.9      98.15    1360.00
VEL3  99.9              .30 1.30      1.00 3.20 3.50 4.00 4.10 3.90 3.50
VEL3  99.9 3.90 4.30 4.80 4.40 4.20 4.40 4.20       .60  .20
ENDJ
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STANISLAUS RIVER FISHERY INVESTIGATION, 1989. HONOLULU BAR STUDY SITE
MAIN CHANNEL TRANSECTS, ALL VELOCITY DATA SETS
IOC       000010000100100000000
QARD  25.0
QARD  50.0
QARD 100.0
QARD 150.0
QARD 200.0
QARD 250.0
QARD 300.0
QARD 350.0
QARD 400.0
QARD 450.0
QARD 500.0
QARD 550.0
QARD 600.0
QARD 650.0
QARD 700.0
QARD 750.0
QARD 800.0
QARD 850.0
QARD 900.0
QARD 950.0
QARD1000.0
QARD1050.0
QARD1100.0
QARD1150.0
QARD1200.0
QARD1250.0
QARD1300.0
XSEC   7.0      0.01.00     86.00    .00211
       7.0  0.0 94.1  5.0 89.1  6.0 88.7  9.0 88.2 12.0 87.4 15.0 87.0
       7.0 18.0 86.9 21.0 86.8 24.0 86.9 27.0 87.1 30.0 87.4 33.0 87.2
       7.0 36.0 87.2 39.0 87.2 42.0 86.9 45.0 86.6 48.0 86.6 51.0 86.4
       7.0 54.0 86.3 57.0 86.3 60.0 86.2 62.0 86.1 65.0 86.0 68.0 86.2
       7.0 71.0 86.5 74.0 87.7 77.0 88.9 78.0 89.1109.0 92.0
NS     7.0      4.03      4.03      4.06      4.06      6.07      9.08
NS     7.0      9.08      9.08      9.08      9.08      9.08      9.08
NS     7.0      9.08      9.08      9.08      9.08      9.08      9.08
NS     7.0      9.08      9.08      9.08      9.08      9.08      9.08
NS     7.0      9.08      9.08      9.07      9.10     10.04
CAL1   7.0     88.16    165.00
VEL1   7.0                     .30 1.20  .30  .60 1.90 1.00 2.30 2.80
VEL1   7.0 3.20 2.90 2.70 2.40 2.90 3.00 2.20 3.10 2.30 2.40 2.60 1.30
VEL1   7.0  .30
CAL2   7.0     89.13    630.00
VEL2   7.0                .20 1.70 2.40 3.50 3.50 3.60 4.60 5.10 5.40
VEL2   7.0 5.40 5.30 4.90 5.00 5.00 4.90 4.30 4.20 4.90 4.80 4.30 3.70
VEL2   7.0 2.30  .70  .20
CAL3   7.0     89.93   1000.00
VEL3   7.0
VEL3   7.0
VEL3   7.0
XSEC   6.0     77.01.00     86.00    .00211
       6.0  0.0 90.5  4.0 89.5  7.0 88.2 10.0 87.7 13.0 87.2 17.0 86.9
       6.0 21.0 86.8 24.0 86.7 27.0 86.6 30.0 86.5 33.0 86.5 36.0 86.4
       6.0 38.0 86.5 40.0 86.4 42.0 86.5 44.0 86.5 46.0 86.6 48.0 86.5
       6.0 50.0 86.2 52.0 86.0 54.0 86.0 56.0 85.7 59.0 85.8 62.0 87.4
       6.0 66.0 89.3 67.0 89.5 71.0 89.6 73.0 89.6 77.0 91.8
NS     6.0      4.03      4.03      4.03      4.03      4.08      9.08
NS     6.0      9.08      9.08      9.08      9.08      9.08      9.08
NS     6.0      9.08      9.08      9.08      9.08      9.08      9.08
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NS      6.0       9.08       9.08       9.08       9.08       9.08       4.09
NS      6.0       9.08       9.08       9.08       4.03       4.03
CAL1    6.0      88.43     165.00
VEL1    6.0                   .10 1.00 1.50 1.80 1.70 1.90 1.90 2.20 1.90
VEL1    6.0 2.20 2.20 2.20 2.20 2.20 2.10 1.90 1.50 1.40 1.50 1.00  .10
VEL1    6.0
CAL2    6.0      89.45     630.00
VEL2    6.0              .20  .70 2.70 3.60 4.20 4.60 4.80 4.90 4.90 4.70
VEL2    6.0 5.40 5.00 4.90 5.40 5.00 4.70 4.20 3.80 3.90 3.40 1.80  .60
VEL2    6.0
CAL3    6.0      90.19    1000.00
VEL3    6.0                        .50 1.80 4.10 4.90 5.40 5.70 5.80 5.60
VEL3    6.0 5.80 6.20 6.20 6.20 5.90 6.10 5.70 6.00 5.80 5.80 4.70 3.40
VEL3    6.0 1.90       .40
XSEC    5.0       77.01.00      86.30     .00364
        5.0  0.0 92.8  2.0 90.0  3.0 89.7  6.0 88.5  9.0 87.2 12.0 86.6
        5.0 15.0 86.5 18.0 86.4 21.0 86.4 24.0 86.5 27.0 86.6 30.0 86.5
        5.0 33.0 86.3 36.0 86.4 39.0 86.7 42.0 87.3 45.0 87.4 48.0 88.2
        5.0 53.0 88.0 55.0 88.3 57.0 89.2 59.0 89.5 60.0 90.0 75.0 93.0
NS      5.0       3.04       3.04       3.04       3.04       8.10       8.10
NS      5.0      11.09      10.09      10.09      10.09      10.09      10.09
NS      5.0      10.09      10.09      10.09       8.06       8.06       6.04
NS      5.0       4.06       4.06       3.04       3.04       3.04       3.04
CAL1    5.0      88.80     165.00
VEL1    5.0                   .20 1.40 1.90 2.90 2.40 2.60 2.80 2.70 2.40
VEL1    5.0 2.10 1.30 1.40  .90  .60
CAL2    5.0      89.95     630.00
VEL2    5.0                  1.30 3.70 5.20 5.50 5.90 5.50 5.60 5.50 5.60
VEL2    5.0 5.30 5.40 4.80 3.90 2.00  .60 1.30  .80  .80  .60
CAL3    5.0      90.68    1000.00
VEL3    5.0
VEL3    5.0
XSEC    4.0       77.01.00      88.20     .00502
        4.0  0.0 92.4  2.8 90.7  3.2 90.7  9.4 88.4 13.4 88.0 18.4 88.1
        4.0 23.4 87.8 27.4 87.7 30.4 87.9 33.4 87.8 37.4 88.1 41.4 88.1
        4.0 45.4 88.1 49.4 88.0 53.4 88.0 57.4 88.3 61.4 89.0 65.4 89.2
        4.0 68.4 89.5 70.4 89.5 72.0 89.9 74.0 91.0 79.0 91.2 83.0 91.0
        4.0 85.0 90.9 88.0 91.6111.6 91.6114.0 91.3116.0 91.6123.0 91.2
        4.0128.0 90.6133.0 90.5137.0 90.5144.0 90.9151.5 91.6159.5 93.5
NS      4.0       4.03       4.03       4.03       4.07       8.07       9.08
NS      4.0      10.09      10.09       9.10      10.09      10.09      10.09
NS      4.0       9.10       9.10      10.09      10.09      10.09       9.08
NS      4.0       9.08       9.08       4.05       7.04       8.04       8.04
NS      4.0       4.06       9.08       4.05       4.05       4.05       4.05
NS      4.0       4.05       4.05       4.05       4.05       4.05       4.05
CAL1    4.0      89.62     165.00
VEL1    4.0                   .30 1.30 2.60 2.50 1.60 2.20 2.00 2.20 2.20
VEL1    4.0 1.80 1.90 1.90 1.80 1.80 2.00
VEL1    4.0
CAL2    4.0      90.80     630.00
VEL2    4.0                  1.20 2.50 4.20 4.60 4.60 4.50 4.80 4.50 4.60
VEL2    4.0 4.30 4.00 4.70 5.00 4.40 2.90 1.90 1.00  .10
VEL2    4.0
CAL3    4.0      91.58    1000.00
VEL3    4.0                  1.20 3.00 4.70 5.50 5.40 5.70 5.40 5.30 5.20
VEL3    4.0 5.50 5.10 5.50 5.80 3.90 1.60  .80 3.30       .40 1.10 2.20
VEL3    4.0  .90            .50       .30  .40 1.00  .20
XSEC    3.0       77.01.00      88.20     .00297
        3.0  0.0 92.5  2.7 92.1 11.0 90.5 18.0 89.5 24.0 88.5 30.0 88.0
        3.0 36.0 87.2 40.0 86.1 44.0 85.4 48.0 84.5 51.0 83.7 53.0 83.3
        3.0 55.0 82.7 57.0 82.3 60.0 81.5 63.0 81.7 65.0 81.8 67.0 82.3
        3.0 70.0 83.9 73.0 85.1 77.0 87.3 81.0 88.7 87.0 89.0 93.0 88.9
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        3.0 94.0 88.8100.0 89.4110.0 91.5115.5 92.1121.2 94.9
NS      3.0       3.03        3.03        3.03        3.03        8.04        8.04
NS      3.0       8.10        8.10        8.10        7.10        7.10        7.04
NS      3.0       7.04        7.04        6.04        4.04        4.04        4.12
NS      3.0       4.12        4.04        4.04        4.04        4.04        4.06
NS      3.0       4.06        3.07        3.04        3.04        3.04
CAL1    3.0      89.72      165.00
VEL1    3.0                                          .30   .30   .90  1.90  2.50
VEL1    3.0  2.50  2.10  1.20
VEL1    3.0
CAL2    3.0      91.24      630.00
VEL2    3.0                    .20   .60  2.00  2.60  2.50  2.50  3.20  3.70  3.10
VEL2    3.0  2.60  2.40  2.30  2.20  2.20  2.10  1.10   .50
VEL2    3.0
CAL3    3.0      92.07     1000.00
VEL3    3.0                    .10  1.60  2.50  3.00  2.30  2.80  3.50  4.00  3.70
VEL3    3.0  2.70  1.60  2.10  2.40  2.70  2.70  1.90  1.10   .70   .50   .20   .30
VEL3    3.0
XSEC    2.0      225.51.00      88.20      .00139
        2.0   0.0 95.6  16.0 91.5  20.0 89.6  25.0 88.5  30.0 87.6  35.0 87.6
        2.0  40.0 87.5  45.0 88.3  50.0 88.8  55.0 88.8  60.0 88.6  65.0 88.6
        2.0  70.0 88.6  75.0 89.0  80.0 88.6  85.0 88.3  90.0 88.1  95.0 87.9
        2.0100.0 88.5105.0 90.1109.2 91.5116.5 94.5
NS      2.0       4.04        4.04       10.04       10.08       10.08        9.08
NS      2.0       9.08        9.08        9.08        9.08        9.08        9.08
NS      2.0       9.08        9.08        9.08        9.07        8.06        8.06
NS      2.0       4.03        3.04        3.04        3.04
CAL1    2.0      89.95      165.00
VEL1    2.0                    .80  1.10  1.30  1.30  1.70  1.80  1.90   .90  1.00
VEL1    2.0   .90  1.50  1.10   .80   .90  1.00
CAL2    2.0      91.47      630.00
VEL2    2.0              .70  1.30  2.10  2.30  2.50  3.20  3.40  3.00  2.60  2.80
VEL2    2.0  3.00  2.70  2.20  2.50  2.30  1.60  1.20   .80
CAL3    2.0      92.30     1000.00
VEL3    2.0
VEL3    2.0
XSEC    1.0      241.01.00      88.20      .00139
        1.0   0.0 93.8   2.2 92.4   5.0 91.3   7.0 89.8   9.0 89.5  16.0 87.0
        1.0  23.0 86.3  31.0 86.8  35.0 86.8  41.0 86.8  45.0 86.7  50.0 86.6
        1.0  54.0 86.5  58.0 86.3  61.0 86.2  64.0 86.0  67.0 86.0  70.0 86.0
        1.0  73.0 86.1  76.0 86.1  79.0 86.2  83.0 86.4  87.0 86.7  92.0 87.2
        1.0  97.0 87.9105.0 88.9110.0 89.7114.0 91.8118.0 95.2
NS      1.0       3.04        3.04        3.04        3.04        3.04        4.04
NS      1.0       4.04        4.04        4.04        4.04        4.04        4.04
NS      1.0       4.04        4.04        4.08        4.08        8.04        8.04
NS      1.0       8.04        8.04        8.04        8.04        4.08        4.06
NS      1.0       4.06        3.04        3.04        3.04        3.04
CAL1    1.0      90.00      165.00
VEL1    1.0                                                                  .20
VEL1    1.0   .30   .40   .60   .70   .90  1.00  1.10  1.20  1.30  1.30  1.20   .80
VEL1    1.0   .50
CAL2    1.0      91.60      630.00
VEL2    1.0                                      .10   .20   .30   .70   .80  1.40
VEL2    1.0  1.80  2.40  2.70  3.20  3.80  4.40  3.80  4.40  3.70  2.60  2.00  1.60
VEL2    1.0   .90   .20   .20
CAL3    1.0      92.41     1000.00
VEL3    1.0                                      .20   .50   .90  1.20  1.30  1.50
VEL3    1.0  2.30  2.90  3.50  3.80  4.10  4.10  4.00  3.50  3.20  2.70  2.40  1.60
VEL3    1.0  1.20   .30
XSEC   99.9      225.51.00      88.20      .00139
       99.9   0.0 93.8   2.2 92.4   5.0 91.3   7.0 89.8   9.0 89.5  16.0 87.0
       99.9  23.0 86.3  31.0 86.8  35.0 86.8  41.0 86.8  45.0 86.7  50.0 86.6
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      99.9 54.0 86.5 58.0 86.3 61.0 86.2 64.0 86.0 67.0 86.0 70,0 86.0
      99.9 73.0 86.1 76.0 86.1 79.0 86.2 83.0 86.4 87.0 86.7 92.0 87.2
      99.9 97.0 87.9105.0 88.9110.0 89.7114.0 91.8118.0 95.2
NS    99.9       3.04       3.04       3.04       3.04       3.04       4.04
NS    99.9       4.04       4.04       4.04       4.04       4.04       4.04
NS    99.9       4.04       4.04       4.08       4.08       8.04       8.04
NS    99.9       8.04       8.04       8.04       8.04       4.08       4.06
NS    99.9       4.06       3.04       3.04       3.04       3.04
CAL1  99.9      90.00     165.00
VEL1  99.9                                                               .20
VEL1  99.9  .30  .40  .60  .70  .90 1.00 1.10 1.20 1.30 1.30 1.20  .80
VEL1  99.9  .50
CAL2  99.9      91.60     630.00
VEL2  99.9                                .10  .20  .30  .70  .80 1.40
VEL2  99.9 1.80 2.40 2.70 3.20 3.80 4.40 3.80 4.40 3.70 2.60 2.00 1.60
VEL2  99.9  .90  .20  .20
CAL3  99.9      92.41    1000.00
VEL3  99.9                                .20  .50  .90 1.20 1.30 1.50
VEL3  99.9 2.30 2.90 3.50 3.80 4.10 4.10 4.00 3.50 3.20 2.70 2.40 1.60
VEL3  99.9 1.20  .30
ENDJ
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STANISLAUS RIVER FISHERY INVESTIGATION, 1989.  VALLEY OAK SRA SITE
COMBINED FLOW VELOCITY DATA SET
IOC         00001000010010000000000
QARD  25.0
QARD  50.0
QARD 100.0
QARD 150.0
QARD 200.0
QARD 250.0
QARD 300.0
QARD 350.0
QARD 400.0
QARD 450.0
QARD 500.0
QARD 550.0
QARD 600.0
QARD 650.0
QARD 700.0
QARD 750.0
QARD 800.0
QARD 850.0
QARD 900.0
QARD 950.0
QARD1000.0
QARD1050.0
QARD1100.0
QARD1150.0
QARD1200.0
QARD1250.0
QARD1300.0
XSEC     7.0        0.01.00      86.60     .00060
         7.0  0.0 99.6  7.0 90.5 11.0 89.1 24.0 86.2 32.0 85.6 39.0 85.3
         7.0 44.0 84.9 49.0 84.9 54.0 84.0 58.0 83.7 62.0 83.3 65.0 83.1
         7.0 68.0 82.9 71.0 82.9 74.0 82.6 77.0 82.6 80.0 82.5 83.0 82.5
         7.0 86.0 82.5 89.0 82.5 93.0 83.6 97.0 84.0105.0 85.0108.0 89.1
         7.0111.7 96.2
NS       7.0        3.04        3.04        3.04        1.04        1.04        1.04
NS       7.0        1.04        1.04        1.04        1.04        1.04        1.04
NS       7.0        1.04        1.04        1.04        1.04        1.04        1.04
NS       7.0        1.04        1.04        1.04        1.04        1.04        1.04
NS       7.0        1.04
CAL1     7.0       87.75      165.00
VEL1     7.0
VEL1     7.0
VEL1     7.0
CAL2     7.0       90.03      772.00
VEL2     7.0                  0.3  0.7  0.7  0.8  0.7  1.0  1.9  2.2  2.5  2.7
VEL2     7.0  2.6  2.6  2.5  2.5  2.2  2.1  2.2  2.1  1.9  0.9  0.5
VEL2     7.0
CAL3     7.0       91.52     1327.00
VEL3     7.0                       .55  0.8  1.1  1.3  1.4  2.3  2.7  2.8  3.0
VEL3     7.0  2.9  2.7  2.6  2.9  2.8  2.5  2.4  2.1  1.9  1.4  0.5
VEL3     7.0
XSEC     6.0      409.01.00      86.60     .00060
         6.0  0.0 95.4  5.8 91.5 13.0 87.4 19.0 86.3 24.0 85.5 28.0 85.6
         6.0 32.0 85.5 36.0 85.4 40.0 85.3 43.0 85.4 46.0 85.3 49.0 85.2
         6.0 52.0 85.2 55.0 85.2 58.0 85.3 61.0 85.7 64.0 85.8 67.0 86.0
         6.0 70.0 86.0 74.0 86.0 80.0 87.8 86.0 88.0 92.0 89.0104.2 91.5
         6.0111.4 94.5
NS       6.0        4.03        4.03        4.03        4.03        4.08        8.04
NS       6.0        8.07        8.07        8.07        8.07        5.07        8.06
NS       6.0        8.07        8.09       10.08       10.08       10.08       10.08
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NS     6.0     15.12     15.12     15.12      2.12      2.12      4.05
NS     6.0      4.05
CAL1   6.0     87.77    165.00
VEL1   6.0                  .10 1.10 2.30 1.90 2.70 2.50 2.30 2.20 1.80
VEL1   6.0  .90  .30  .10
VEL1   6.0
CAL2   6.0     90.11    772.00
VEL2   6.0
VEL2   6.0
VEL2   6.0
CAL3   6.0     91.64   1327.00
VEL3   6.0            .30 1.30 2.90 3.30 3.80 3.90 3.80 4.10 4.00 3.90
VEL3   6.0 3.90 3.80 3.80 3.90 3.40 3.30 3.70 3.50 2.30 1.20  .13
VEL3   6.0
XSEC   5.0      84.61.00      86.60     .00997
       5.0  0.0 97.0  4.0 88.9  6.0 87.8  8.0 87.2 10.0 87.1 15.0 86.7
       5.0 20.0 86.6 25.0 86.7 30.0 87.3 35.0 87.5 40.0 87.6 45.0 87.2
       5.0 50.0 87.2 55.0 87.0 60.0 87.0 65.0 87.2 70.0 87.0 75.0 86.9
       5.0 80.0 87.0 85.0 87.0 90.0 87.2 95.0 87.4100.0 87.6105.0 88.4
       5.0110.0 89.4113.7 90.3118.5 94.4
NS     5.0      3.04      3.04      3.04      3.04      4.03      7.05
NS     5.0      7.05      6.05      6.05      7.05      7.05      8.06
NS     5.0      8.07      8.07      9.08     10.08      9.08      8.07
NS     5.0      9.07      9.06      9.06     15.08     10.15     10.15
NS     5.0      3.02      3.02      3.02
CAL1   5.0     88.07    165.00
VEL1   5.0            .20  .20  .30 1.80 2.00 2.20 1.70 2.40 2.30 2.00
VEL1   5.0 2.40 2.50 2.40 2.60 2.30 1.60 1.00 1.40 1.60 1.20  .40
VEL1   5.0
CAL2   5.0     90.29    772.00
VEL2   5.0                 .40  .50 1.30 1.50 2.40 1.90 2.70 2.80 3.00
VEL2   5.0 3.10 3.20 3.30 3.20 3.10 3.00 2.80 2.60 2.30 2.10 1.50  .70
VEL2   5.0
CAL3   5.0     91.66   1327.00
VEL3   5.0
VEL3   5.0
VEL3   5.0
XSEC   4.0      84.61.00      86.60     .00073
       4.0  0.0 97.2 11.0 90.4 13.0 89.1 19.0 87.6 25.0 86.8 31.0 86.1
       4.0 34.0 85.9 36.0 85.8 40.0 86.2 44.0 86.4 48.0 86.5 52.0 86.4
       4.0 56.0 86.5 60.0 86.5 64.0 86.3 68.0 86.4 72.0 86.3 76.0 86.3
       4.0 80.0 86.3 85.0 86.4 90.0 86.4 96.0 86.4103.0 87.0112.0 89.2
       4.0113.9 90.4116.0 91.7120.7 91.7121.2 95.3
NS     4.0      3.03      3.03      3.03      3.03      3.03      3.03
NS     4.0      3.03      3.03      3.03      3.03      4.06      4.06
NS     4.0      6.04      6.07      7.04      7.08      6.07      6.07
NS     4.0      6.07      7.04      6.07      4.07     10.03      4.06
NS     4.0      4.06      3.03      3.03      3.03
CAL1   4.0     88.10    165.00
VEL1   4.0                           .40  .60  .60  .40  .40  .90 1.10
VEL1   4.0 1.60 2.00 2.30 2.40 2.40 2.00 1.70 1.20 1.00 1.10  .15
VEL1   4.0
CAL2   4.0     90.38    772.00
VEL2   4.0                 .50  .70 1.10 1.60 1.70 1.50 1.70 2.50 2.60
VEL2   4.0 2.90 3.00 3.10 3.00 3.00 3.10 3.20 3.10 2.40 1.90 1.40  .30
VEL2   4.0
CAL3   4.0     91.68   1327.00
VEL3   4.0            .30  .70 1.10 2.00 2.30 2.70 2.50 2.70 3.10 3.20
VEL3   4.0 3.30 3.40 3.30 3.50 3.50 3.50 3.50 3.50 3.00 2.40 1.70  .70
VEL3   4.0
XSEC   3.0      84.61.00      86.60     .00123
       3.0  0.0 99.7  5.0 90.5  6.5 87.7 12.0 86.5 17.0 86.4 23.0 86.6
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        3.0 28.0 87.1 33.0 87.7 38.0 87.7 43.0 88.0 48.0 88.1 53.0 88.0
        3.0 58.0 88.0 63.0 87.5 67.0 87.4 71.0 87.3 75.0 86.9 79.0 86.6
        3.0 83.0 86.0 89.0 85.7 91.0 85.8 95.0 86.0 99.0 86.2103.0 86.8
        3.0107.0 87.8111.0 89.2114.0 90.5117.0 91.6118.3 92.5
NS      3.0       4.03       4.03       4.03       4.03       4.03       4.03
NS      3.0       8.04       8.07       7.08       7.06       7.06       7.06
NS      3.0       7.06       7.06       7.06       7.06       7.06       7.06
NS      3.0       7.06       7.06       7.06       7.06       7.06       6.05
NS      3.0       6.05       8.09       7.09       7.09       7.09
CAL1    3.0      88.31     165.00
VEL1    3.0                           .20       2.00 2.20  .80 1.90 1.50 1.20
VEL1    3.0 2.20 2.40 2.60 2.90 2.40 2.20 1.50 2.30 1.90 1.10  .70  .40
VEL1    3.0  .20
CAL2    3.0      90.46     772.00
VEL2    3.0                 .10 1.20 1.20 1.60 1.50 2.30 2.30 2.60 2.60 3.30
VEL2    3.0 3.20 2.90 3.00 3.20 2.90 2.70 2.50 2.30 2.10 1.60 2.20 1.60
VEL2    3.0 1.10  .40
CAL3    3.0      91.78    1327.00
VEL3    3.0                      .90 1.60 1.80 2.00 2.80 3.00 3.40 3.60 3.90
VEL3    3.0 4.10 4.00 4.30 4.00 4.00 3.70 3.60 3.50 2.70 2.90 2.50 1.50
VEL3    3.0
XSEC    2.0      84.601.00      86.60     .00131
        2.0  0.0 96.1  5.5 91.7 11.0 89.4 18.0 87.7 26.0 87.5 34.0 87.2
        2.0 41.0 86.8 46.0 86.5 51.0 86.1 56.0 85.6 60.0 85.2 64.0 84.8
        2.0 68.0 85.0 72.0 84.8 76.0 84.9 80.0 85.0 84.0 85.2 88.0 85.9
        2.0 92.0 87.6 96.0 89.1100.0 90.5101.0 91.0101.7 91.6116.2 97.0
NS      2.0       4.03       4.03       4.03       4.03       4.05       4.05
NS      2.0       8.07       8.07       8.09       8.09       8.09       8.09
NS      2.0       8.09       9.08       9.08       9.08       9.08       9.08
NS      2.0       9.08       6.05       3.05       3.05       3.05       3.09
CAL1    2.0      88.49     165.00
VEL1    2.0                      .30  .20 1.10 1.20 1.20 1.20 1.30 1.10 1.10
VEL1    2.0 1.00  .90  .80  .80  .60  .40  .30
CAL2    2.0      90.54     772.00
VEL2    2.0                1.20 1.30 1.30 1.90 2.40 3.10 3.10 2.80 2.80 2.30
VEL2    2.0 2.60 2.40 2.50 2.60 2.50 2.10 2.00 1.40
CAL3    2.0      91.84    1327.00
VEL3    2.0                1.40 1.60 2.10 2.80 3.10 3.70 3.80 3.80 3.80 3.50
VEL3    2.0 3.40 3.30 3.60 3.50 3.60 3.20 3.00 2.60 2.10 1.90
X-SEC   1.0      168.01.00      86.60     .00131
        1.0  0.0 96.7  6.0 90.2 10.0 88.2 15.0 87.5 20.0 87.0 25.0 86.8
        1.0 30.0 86.6 35.0 87.1 40.0 86.5 45.0 86.1 50.0 85.9 54.0 85.8
        1.0 58.0 85.8 61.0 85.6 64.0 85.5 68.0 85.4 71.0 85.2 73.0 85.2
        1.0 77.0 85.0 81.0 85.1 86.0 85.1 92.0 85.5 98.0 86.1106.0 88.0
        1.0110.5 90.6111.0 94.3
NS      1.0       1.03       1.03       3.04       1.03       1.03       1.03
NS      1.0       1.03       1.04       1.04       8.04       8.04       8.04
NS      1.0       8.04       8.04       8.04       8.04       8.04       8.04
NS      1.0       8.04       8.04       8.04       8.04       4.03       3.04
NS      1.0       3.04       3.04
CAL1    1.0      88.54     165.00
VEL1    1.0                                                .10  .50  .70  .90
VEL1    1.0 1.00 1.10 1.10 1.20 1.20 1.20 1.00 1.00  .80  .60  .40
VEL1    1.0
CAL2    1.0      90.57     772.00
VEL2    1.0                 .30  .70 1.00 1.40 1.00 1.20 1.20 2.10 2.80 3.00
VEL2    1.0 3.20 3.00 2.90 2.60 2.40 2.40 2.20 2.30 2.40 2.20 1.60  .60
VEL2    1.0
CAL3    1.0      91.90    1327.00
VEL3    1.0
VEL3    1.0
VEL3    1.0
```

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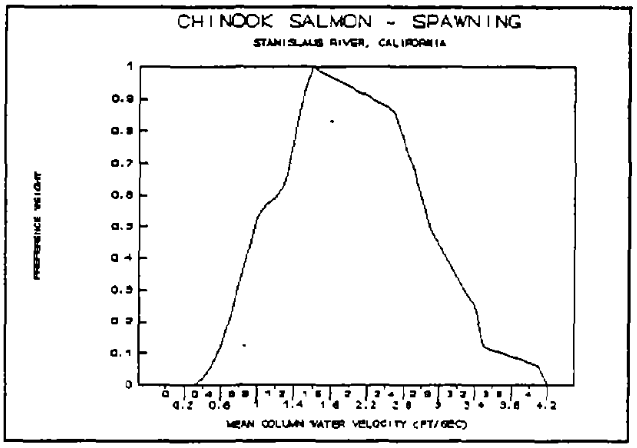
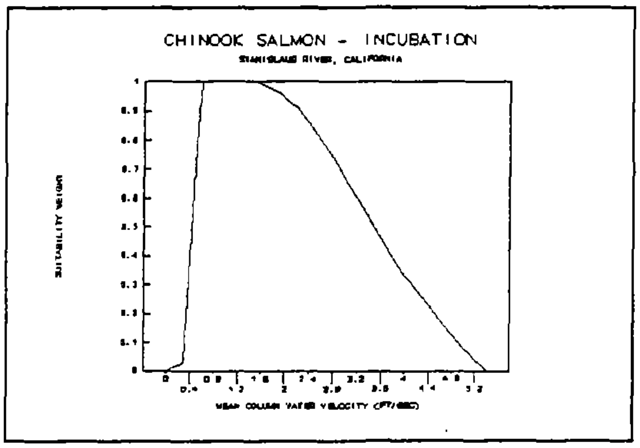
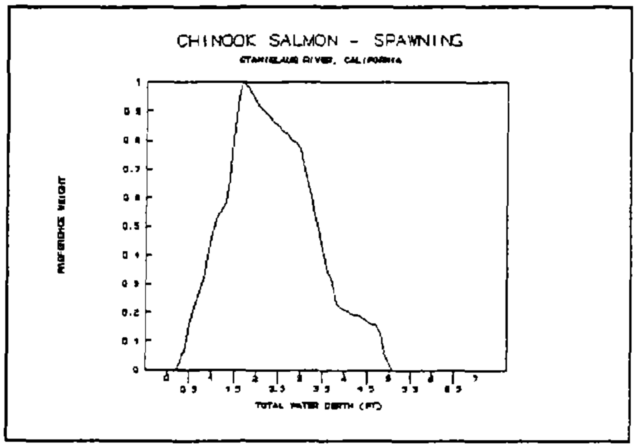
XSEC  99.9       84.61.00      86.60     .00131
      99.9  0.0 96.7  6.0 90.2 10.0 88.2 15.0 87.5 20.0 87.0 25.0 86.8
      99.9 30.0 86.6 35.0 87.1 40.0 86.5 45.0 86.1 50.0 85.9 54.0 85.8
      99.9 58.0 85.8 61.0 85.6 64.0 85.5 68.0 85.4 71.0 85.2 73.0 85.2
      99.9 77.0 85.0 81.0 85.1 86.0 85.1 92.0 85.5 98.0 86.1106.0 88.0
      99.9110.5 90.6111.0 94.3
NS    99.9       1.03      1.03      3.04      1.03      1.03      1.03
NS    99.9       1.03      1.04      1.04      8.04      8.04      8.04
NS    99.9       8.04      8.04      8.04      8.04      8.04      8.04
NS    99.9       8.04      8.04      8.04      8.04      4.03      3.04
NS    99.9       3.04      3.04
CAL1  99.9      88.54    165.00
VEL1  99.9                                          .10  .50  .70  .90
VEL1  99.9 1.00 1.10 1.10 1.20 1.20 1.20 1.00 1.00  .80  .60  .40
VEL1  99.9
CAL2  99.9      90.57    772.00
VEL2  99.9            .30  .70 1.00 1.40 1.00 1.20 1.20 2.10 2.80 3.00
VEL2  99.9 3.20 3.00 2.90 2.60 2.40 2.40 2.20 2.30 2.40 2.20 1.60  .60
VEL2  99.9
CAL3  99.9      91.90   1327.00
VEL3  99.9
VEL3  99.9
VEL3  99.9
ENDJ
```

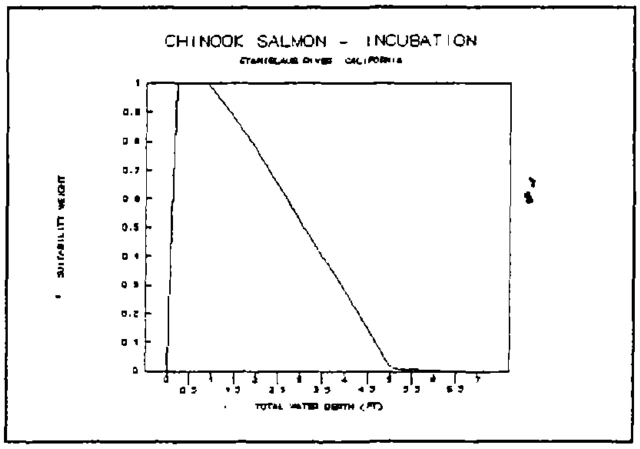
APPENDIX C

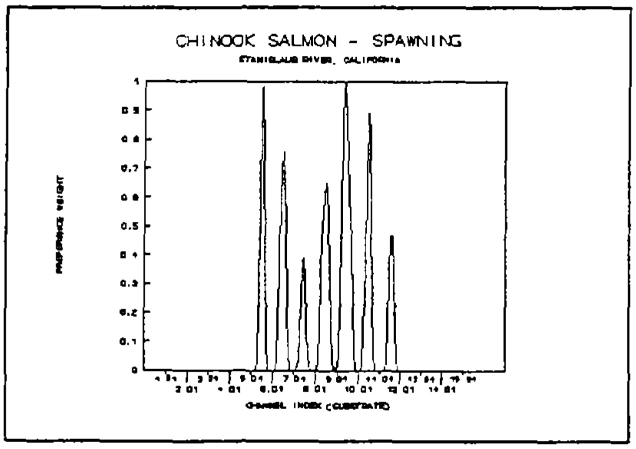
HABITAT SUITABILITY CRITERIA USED IN THE STANISLAUS RIVER INSTREAM FLOW STUDY, 1989

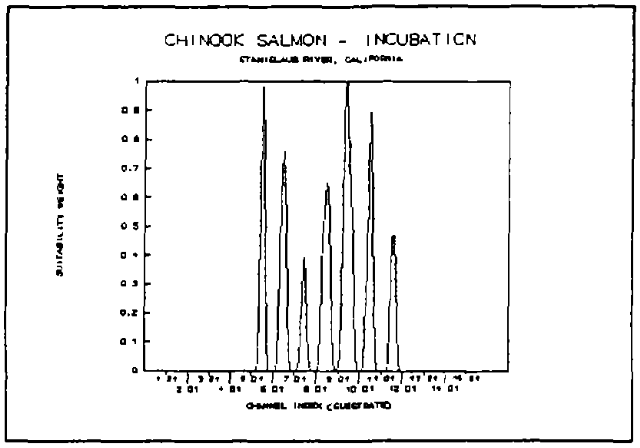

CHINOOK SALMON - SPAWNING
STANISLAUS RIVER, CALIFORNIA
PREFERENCE WEIGHT
MEAN COLUMN WATER VELOCITY (FT/SEC)

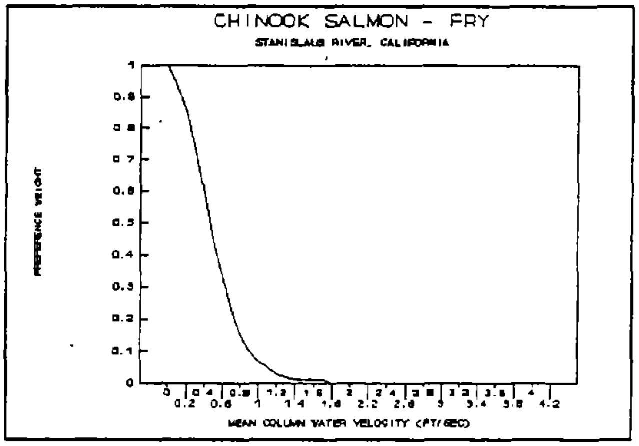

CHINOOK SALMON - INCUBATION
STANISLAUS RIVER, CALIFORNIA
SUITABILITY WEIGHT
MEAN COLUMN WATER VELOCITY (FT/SEC)

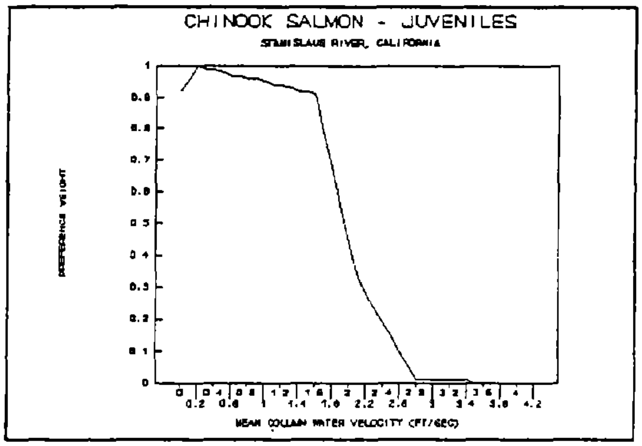

CHINOOK SALMON - SPAWNING
STANISLAUS RIVER, CALIFORNIA
PREFERENCE WEIGHT
TOTAL WATER DEPTH (FT)

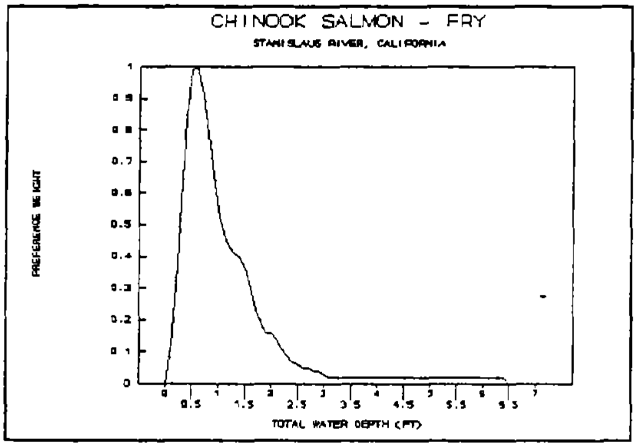

CHINOOK SALMON - INCUBATION
STANISLAUS RIVER, CALIFORNIA
SUITABILITY WEIGHT
TOTAL WATER DEPTH (FT)

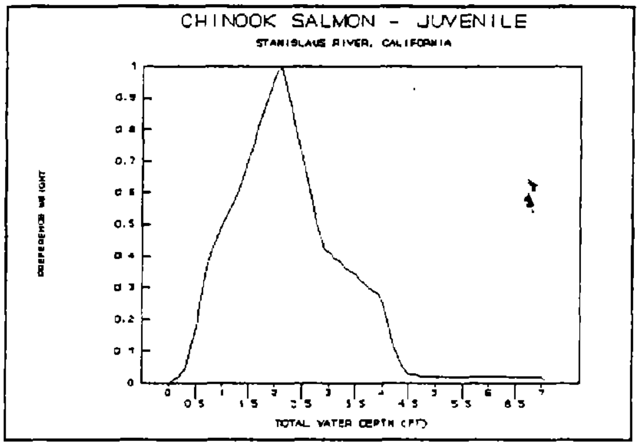

CHINOOK SALMON - SPAWNING
STANISLAUS RIVER, CALIFORNIA
PREFERENCE WEIGHT
CHANNEL INDEX (SUBSTRATE)

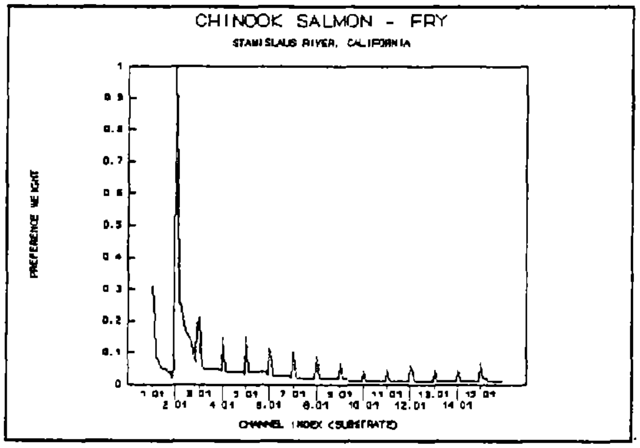

CHINOOK SALMON - INCUBATION
STANISLAUS RIVER, CALIFORNIA
SUITABILITY WEIGHT
CHANNEL INDEX (SUBSTRATE)

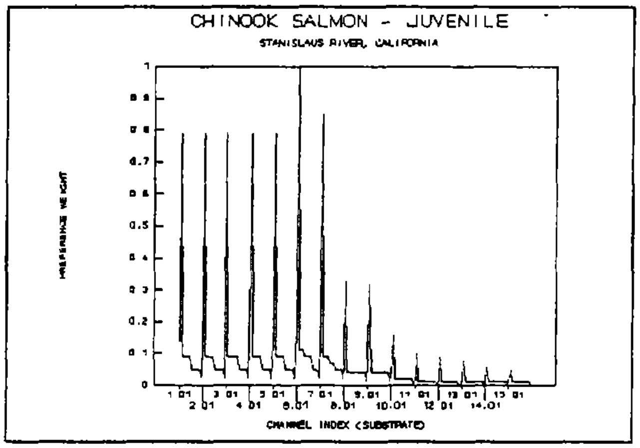

CHINOOK SALMON - FRY
STANISLAUS RIVER, CALIFORNIA
PREFERENCE WEIGHT
MEAN COLUMN WATER VELOCITY (FT/SEC)


CHINOOK SALMON - JUVENILES
STANISLAUS RIVER, CALIFORNIA
PREFERENCE WEIGHT
MEAN COLUMN WATER VELOCITY (FT/SEC)


CHINOOK SALMON - FRY
STANISLAUS RIVER, CALIFORNIA
PREFERENCE WEIGHT
TOTAL WATER DEPTH (FT)


CHINOOK SALMON - JUVENILE
STANISLAUS RIVER, CALIFORNIA
PREFERENCE WEIGHT
TOTAL WATER DEPTH (FT)


CHINOOK SALMON - FRY
STANISLAUS RIVER, CALIFORNIA
PREFERENCE WEIGHT
CHANNEL INDEX (SUBSTRATE)


CHINOOK SALMON - JUVENILE
STANISLAUS RIVER, CALIFORNIA
PREFERENCE WEIGHT
CHANNEL INDEX (SUBSTRATE)

STANISLAUS RIVER FISHERY INVESTIGATION, 1989.
COMBINED FLOW VELOCITY DATA SET & WEIGHTED USING HABITAT MAPPING

CURVE SET DEFINITION DATA WAS OBTAINED FROM THE FISHFIL FILE WHOSE TITLE LINE IS - STANISLAUS RIVER FISHERY INVESTIGATION

VELOCITY WEIGHTING FOR CHINOOK SALMON (FALL RUN)

SPAWNING		INCUBATION		FRY		JUVENILES	
VELOCITY	WEIGHT	VELOCITY	WEIGHT	VELOCITY	WEIGHT	VELOCITY	WEIGHT
0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.92
0.30	0.00	0.30	0.03	0.10	0.94	0.10	0.96
0.40	0.02	0.50	0.78	0.20	0.85	0.20	1.00
0.50	0.06	0.60	1.00	0.30	0.73	0.30	0.99
0.60	0.12	1.50	1.00	0.40	0.59	0.40	0.99
0.70	0.21	1.90	0.96	0.50	0.45	0.50	0.98
0.80	0.32	2.20	0.91	0.60	0.33	0.60	0.97
0.90	0.42	2.40	0.86	0.70	0.23	0.70	0.97
1.00	0.53	2.60	0.80	0.80	0.15	0.80	0.96
1.10	0.57	2.80	0.74	0.90	0.10	0.90	0.96
1.20	0.59	3.90	0.36	1.00	0.07	1.00	0.95
1.30	0.63	4.90	0.10	1.10	0.05	1.10	0.94
1.40	0.76	5.40	0.00	1.20	0.03	1.20	0.94
1.50	0.92	100.00	0.00	1.30	0.02	1.30	0.93
1.60	1.00			1.40	0.01	1.40	0.92
1.70	0.98			1.70	0.01	1.50	0.92
1.80	0.97			1.80	0.00	1.60	0.91
1.90	0.95			100.00	0.00	1.70	0.79
2.00	0.94					1.80	0.68
2.10	0.92					1.90	0.56
2.20	0.91					2.00	0.44
2.30	0.89					2.10	0.33
2.40	0.88					2.20	0.28
2.50	0.86					2.30	0.24
2.60	0.77					2.40	0.19
2.70	0.69					2.50	0.15
2.80	0.59					2.60	0.10
2.90	0.49					2.70	0.06
3.00	0.44					2.80	0.01
3.10	0.39					3.40	0.01
3.20	0.34					3.50	0.00
3.30	0.29					100.00	0.00
3.40	0.25						
3.50	0.12						
3.60	0.11						
3.70	0.10						
3.80	0.09						
3.90	0.08						
4.00	0.07						
4.10	0.06						
4.20	0.00						
100.00	0.00						

DEPTH WEIGHTING FOR CHINOOK SALMON (FALL RUN)

SPAWNING		INCUBATION		FRY		JUVENILES	
DEPTH	WEIGHT	DEPTH	WEIGHT	DEPTH	WEIGHT	DEPTH	WEIGHT
0.00	0.00	0.00	0.00	0.00	0.000	0.00	0.00
0.20	0.00	0.10	0.53	0.10	0.120	0.10	0.01
0.30	0.03	0.20	1.00	0.20	0.313	0.20	0.02
0.40	0.08	1.90	0.80	0.30	0.578	0.30	0.05
0.50	0.16	3.40	0.42	0.40	0.846	0.40	0.10
0.60	0.22	4.00	0.28	0.50	0.992	0.50	0.17
0.70	0.26	5.10	0.10	0.60	1.006	0.60	0.27
0.80	0.31	6.30	0.00	0.70	0.911	0.70	0.36
0.90	0.39	100.00	0.00	0.80	0.799	0.80	0.42
1.00	0.46			0.90	0.666	0.90	0.46
1.10	0.52			1.00	0.552	1.00	0.50
1.20	0.55			1.10	0.475	1.10	0.53
1.30	0.58			1.20	0.438	1.20	0.56
1.40	0.66			1.30	0.416	1.30	0.61
1.50	0.85			1.40	0.405	1.40	0.66
1.60	0.95			1.50	0.365	1.50	0.71
1.70	1.00			1.60	0.300	1.60	0.76
1.80	0.98			1.70	0.238	1.70	0.82
1.90	0.96			1.80	0.196	1.80	0.87
2.00	0.93			1.90	0.163	1.90	0.92
2.10	0.91			2.00	0.161	2.00	0.97
2.20	0.89			2.10	0.149	2.10	1.00
2.30	0.88			2.20	0.118	2.20	0.93
2.40	0.86			2.30	0.096	2.30	0.86
2.50	0.85			2.40	0.075	2.40	0.78
2.60	0.83			2.50	0.063	2.50	0.71
2.70	0.82			2.60	0.052	2.60	0.64
2.80	0.80			2.70	0.050	2.70	0.57
2.90	0.79			2.80	0.049	2.80	0.49
3.00	0.77			2.90	0.047	2.90	0.42
3.10	0.70			3.00	0.030	3.00	0.41
3.20	0.63			3.10	0.023	3.10	0.39
3.30	0.56			6.40	0.026	3.20	0.38
3.40	0.49			6.50	0.009	3.30	0.36
3.50	0.42			100.00	0.002	3.40	0.35
3.60	0.34					3.50	0.34
3.70	0.32					3.60	0.32
3.80	0.23					3.70	0.31
3.90	0.22					3.80	0.29
4.00	0.21					3.90	0.28
4.10	0.20					4.00	0.25
4.20	0.19					4.10	0.18
4.30	0.19					4.20	0.12
4.40	0.18					4.30	0.08
4.50	0.17					4.40	0.05
4.60	0.16					4.50	0.03
4.70	0.16					4.60	0.03
4.80	0.13					4.70	0.02
4.90	0.06					7.00	0.02
5.00	0.02					7.10	0.00
5.01	0.00					100.00	0.00
100.00	0.00						

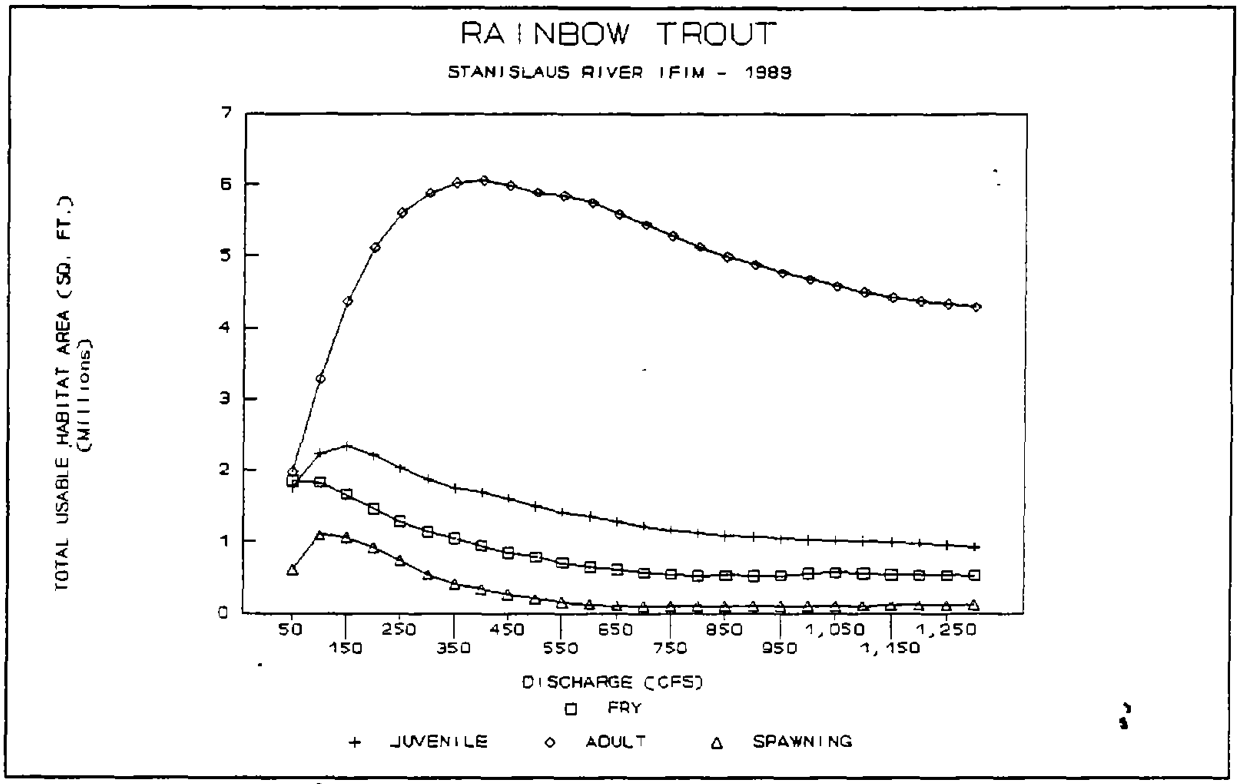
CHANNEL INDEX WEIGHTING FOR CHINOOK SALMON (FALL RUN)

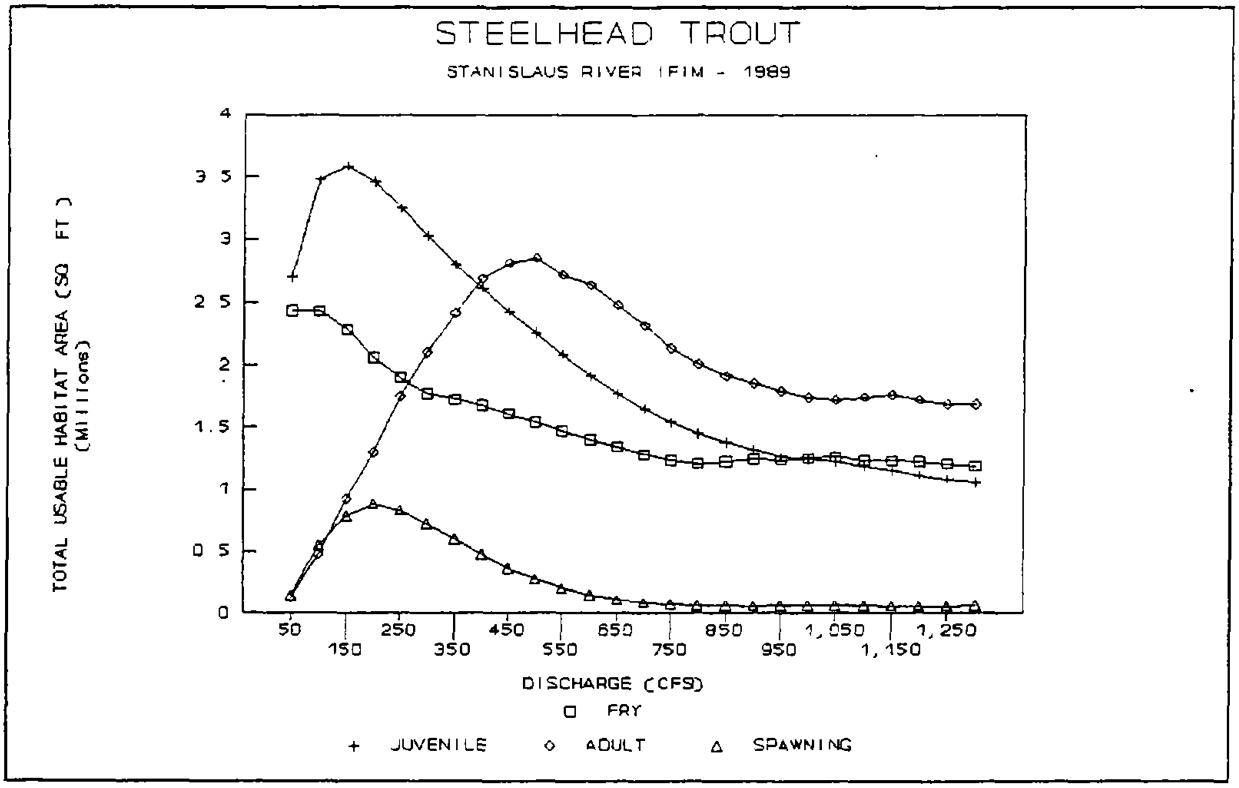
SPAWNING		INCUBATION	FRY		JUVENILE	
CHANNEL INDEX	WEIGHT	CHANNEL INDEX WEIGHT	CHANNEL INDEX	WEIGHT	CHANNEL INDEX	WEIGHT
0.00	0.00		0.00	0.00	0.00	0.00
5.04	0.00	APPLY CHANNEL	1.01	0.31	1.01	0.14
5.05	0.04	INDEX WEIGHTING	1.02	0.20	1.02	0.79
5.06	0.22	VALUES USED FOR	1.03	0.09	1.03	0.09
5.07	0.55	SPAWNING LIFE	1.04	0.08	1.09	0.05
5.08	0.91	STAGE	1.05	0.07	1.15	0.02
5.09	0.98		1.06	0.06	2.01	0.14
5.10	0.76		1.07	0.05	2.02	0.79
5.11	0.36		1.11	0.04	2.03	0.09
5.12	0.11		1.13	0.02	2.09	0.05
5.13	0.00		1.15	0.06	2.15	0.02
6.03	0.00		2.01	1.00	3.01	0.79
6.04	0.05		2.02	0.65	3.03	0.09
6.05	0.16		2.03	0.27	3.09	0.05
6.06	0.40		2.04	0.25	3.15	0.02
6.07	0.60		2.05	0.24	4.01	0.14
6.08	0.76		2.06	0.19	4.02	0.79
6.09	0.67		2.07	0.17	4.03	0.09
6.10	0.49		2.08	0.16	4.09	0.05
6.11	0.22		2.10	0.15	4.15	0.02
6.12	0.07		2.11	0.13	5.01	0.14
6.13	0.00		2.12	0.10	5.02	0.79
7.02	0.00		2.13	0.08	5.03	0.09
7.03	0.01		2.14	0.07	5.09	0.05
7.04	0.04		2.15	0.19	5.15	0.02
7.05	0.12		3.01	0.21	6.01	0.17
7.06	0.24		3.02	0.13	6.02	1.00
7.07	0.38		3.03	0.06	6.03	0.11
7.08	0.39		3.04	0.05	6.06	0.09
7.09	0.32		3.15	0.04	6.11	0.05
7.10	0.15		4.01	0.15	6.15	0.02
7.11	0.05		4.02	0.10	7.01	0.15
7.12	0.00		4.03	0.04	7.02	0.85
8.02	0.00		4.15	0.03	7.03	0.09
8.03	0.04		5.01	0.15	7.07	0.07
8.04	0.14		5.02	0.10	7.10	0.05
8.05	0.31		5.03	0.04	7.15	0.02
8.06	0.49		5.15	0.03	8.01	0.06
8.07	0.60		6.01	0.12	8.02	0.33
8.08	0.65		6.02	0.08	8.03	0.04
8.09	0.63		6.03	0.03	8.15	0.01
8.10	0.53		6.15	0.02	9.01	0.06
8.11	0.34		7.01	0.10	9.02	0.32
8.12	0.15		7.02	0.06	9.03	0.04
8.13	0.04		7.03	0.03	9.15	0.01
8.14	0.00		7.04	0.02	10.01	0.03
8.15	0.00		7.15	0.02	10.02	0.16
9.01	0.01		8.01	0.09	10.03	0.02
9.02	0.06		8.02	0.05	10.15	0.00
9.03	0.22		8.03	0.02	11.01	0.02
9.04	0.50		8.15	0.02	11.02	0.10
9.05	0.82		9.01	0.07	11.03	0.01
9.06	1.00		9.02	0.04	11.11	0.01
9.07	0.99		9.03	0.02	11.15	0.00
9.08	0.85		9.06	0.01	12.01	0.02
9.09	0.75		9.15	0.01	12.02	0.09

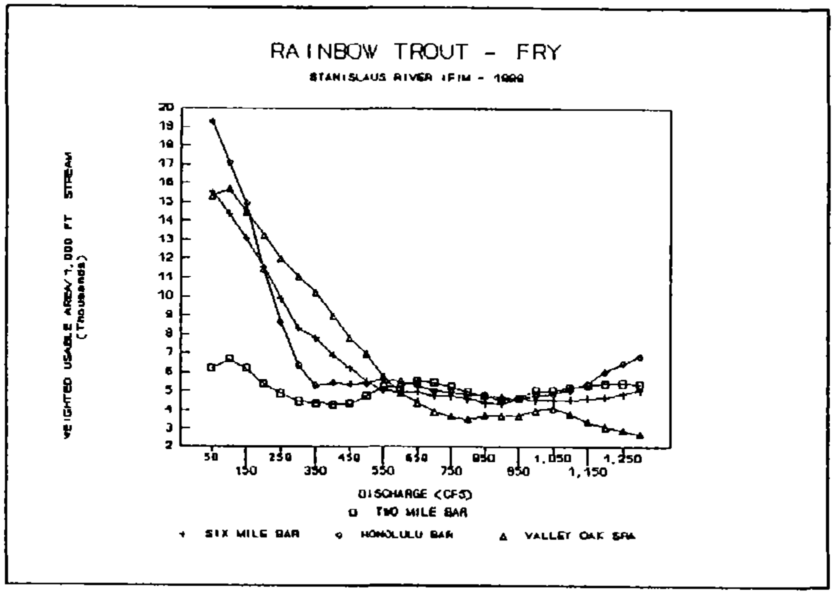
9.10	0.61	10.01	0.05	12.03	0.01
9.11	0.45	10.02	0.03	12.10	0.01
9.12	0.22	10.03	0.01	12.14	0.00
9.13	0.07	10.15	0.01	13.01	0.01
9.14	0.00	11.01	0.05	13.02	0.08
10.03	0.00	11.02	0.03	13.03	0.01
10.04	0.02	11.03	0.01	13.09	0.01
10.05	0.13	11.15	0.01	13.15	0.00
10.06	0.37	12.01	0.06	14.01	0.01
10.07	0.68	12.02	0.04	14.02	0.06
10.08	0.89	12.03	0.02	14.07	0.01
10.09	0.82	12.04	0.01	14.15	0.00
10.10	0.55	12.15	0.01	15.01	0.01
10.11	0.24	13.01	0.05	15.02	-0.05
10.12	0.06	13.02	0.03	15.03	0.01
10.13	0.00	13.03	0.01	15.15	0.00
11.05	0.00	13.15	0.01	100.00	0.00
11.06	0.04	14.01	0.05		
11.07	0.15	14.02	0.04		
11.08	0.33	14.03	0.01		
11.09	0.47	14.15	0.01		
11.10	0.47	15.01	0.07		
11.11	0.33	15.02	0.04		
11.12	0.15	15.03	0.02		
11.13	0.04	15.06	-0.01		
11.14	0.00	15.15	0.01		
100.00	0.00	100.00	0.00		

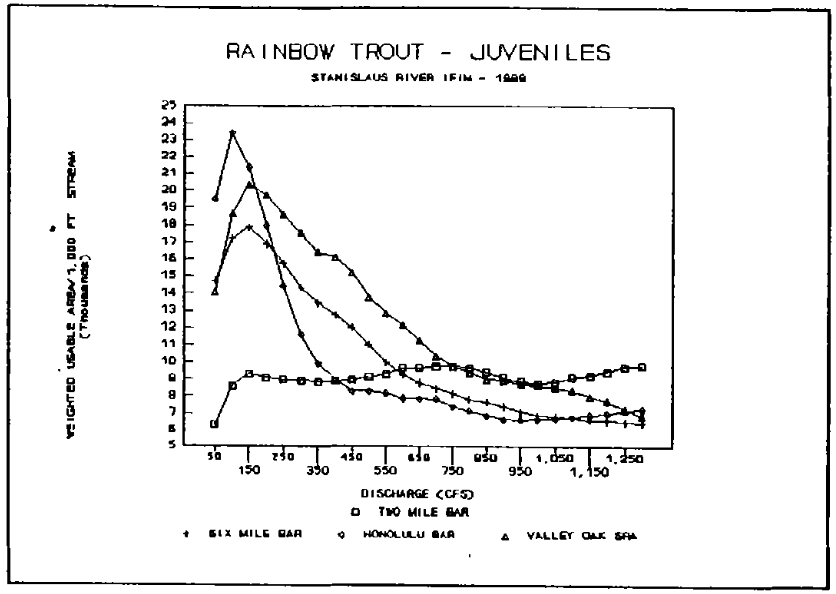
APPENDIX D

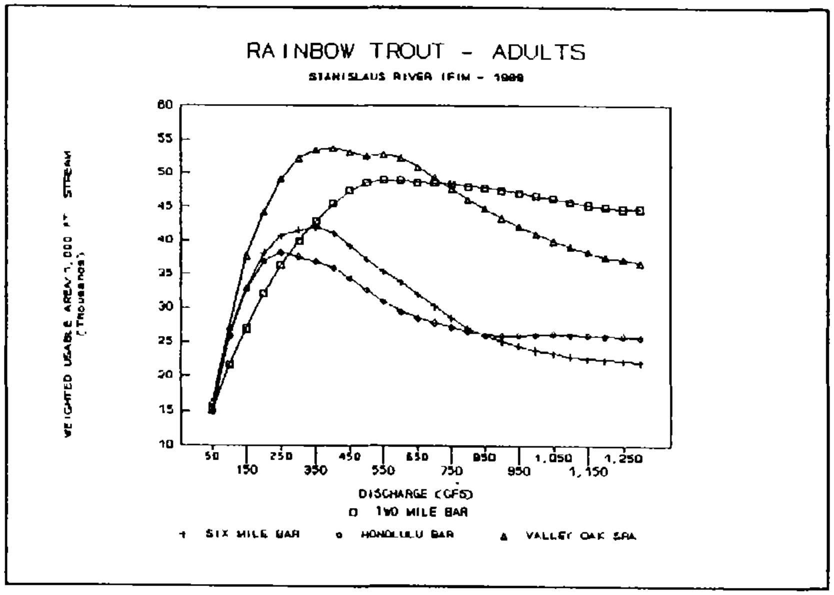
PHABSIM RESULTS FOR RAINBOW TROUT AND STEELHEAD RAINBOW TROUT IN THE STANISLAUS RIVER

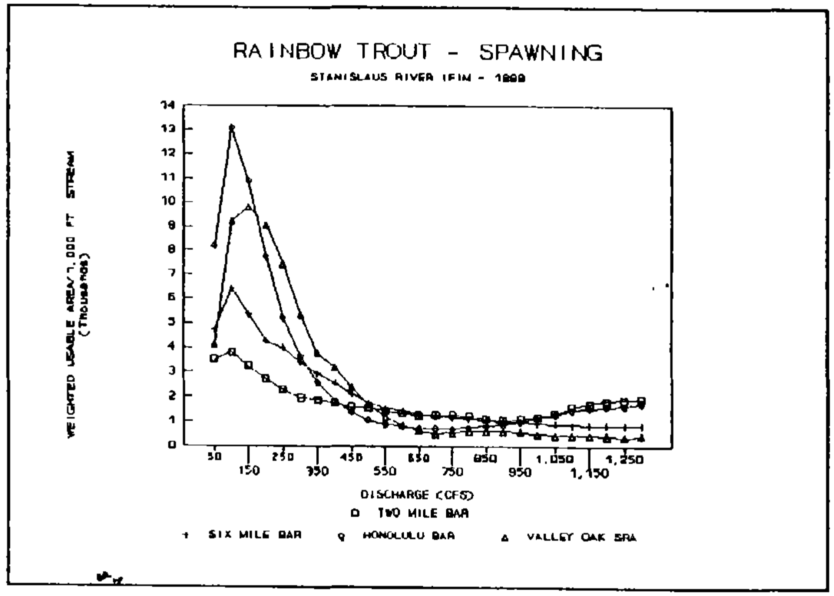

RAINBOW TROUT
STANISLAUS RIVER IFIM - 1989
TOTAL USABLE HABITAT AREA (SQ. FT.) (Millions)
DISCHARGE (CFS)
FRY
JUVENILE
ADULT
SPAWNING

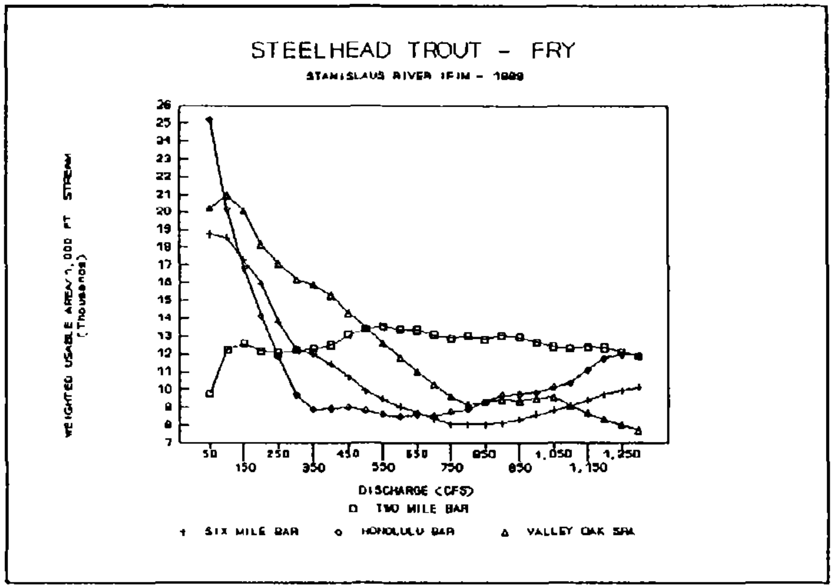

STEELHEAD TROUT
STANISLAUS RIVER IFIM - 1989
TOTAL USABLE HABITAT AREA (SQ FT) (Millions)
DISCHARGE (CFS)
FRY
JUVENILE
ADULT
SPAWNING

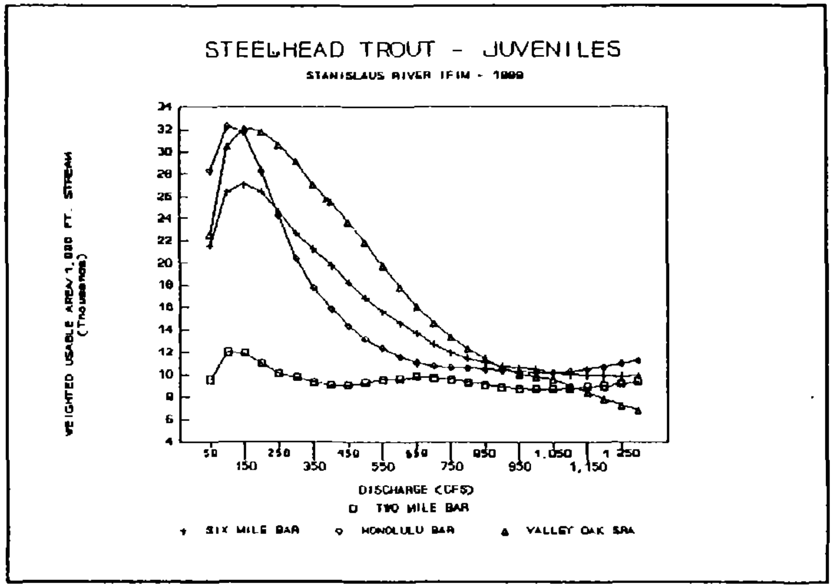

RAINBOW TROUT - FRY
STANISLAUS RIVER IFIM - 1989
WEIGHTED USABLE AREA/1,000 FT STREAM (Thousands)
DISCHARGE (CFS)
TWO MILE BAR
SIX MILE BAR
HONOLULU BAR
VALLEY OAK SRA

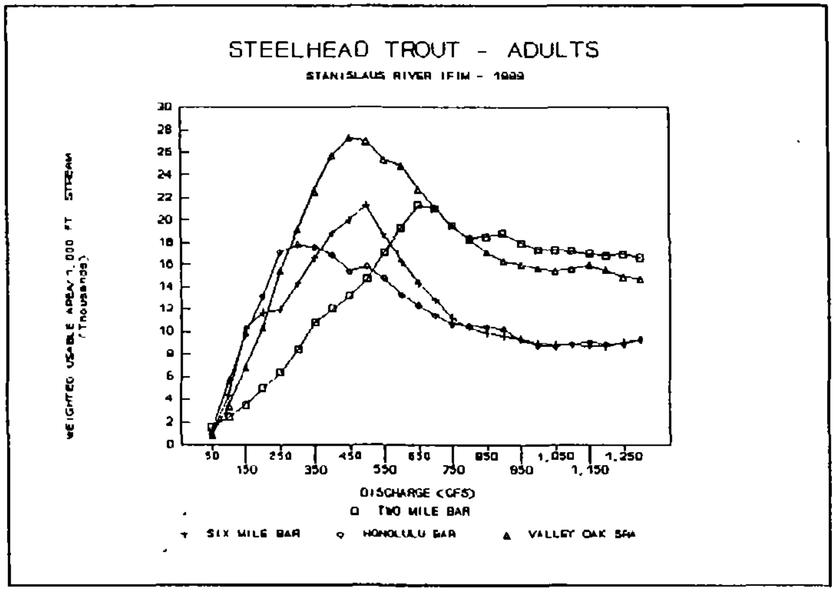

RAINBOW TROUT - JUVENILES
STANISLAUS RIVER IFIM - 1989
WEIGHTED USABLE AREA/1,000 FT STREAM (Thousands)
DISCHARGE (CFS)
TWO MILE BAR
SIX MILE BAR
HONOLULU BAR
VALLEY OAK SRA

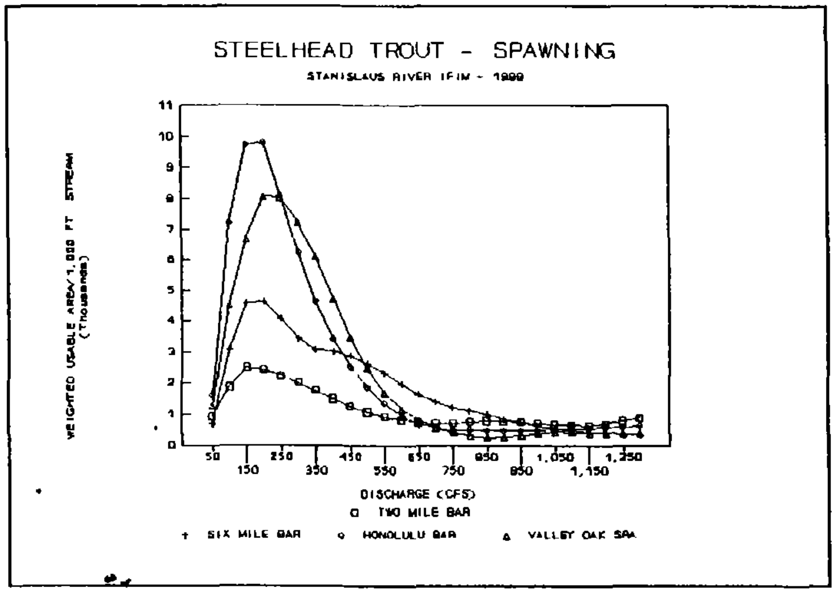

RAINBOW TROUT - ADULTS
STANISLAUS RIVER IFIM - 1989
WEIGHTED USABLE AREA/1,000 FT STREAM (Thousands)
DISCHARGE (CFS)
TWO MILE BAR
SIX MILE BAR
HONOLULU BAR
VALLEY OAK SRA


RAINBOW TROUT - SPAWNING
STANISLAUS RIVER IFIM - 1989
WEIGHTED USABLE AREA/1,000 FT STREAM (Thousands)
DISCHARGE (CFS)
TWO MILE BAR
SIX MILE BAR
HONOLULU BAR
VALLEY OAK SRA


STEELHEAD TROUT - FRY
STANISLAUS RIVER IFIM
WEIGHTED USABLE AREA/1,000 FT. STREAM (Thousands)
DISCHARGE (CFS)
TWO MILE BAR
SIX MILE BAR
HONOLULU BAR
VALLEY OAK SRA


STEELHEAD TROUT - JUVENILES
STANISLAUS RIVER IFIM
WEIGHTED USABLE AREA/1,000 FT. STREAM (Thousands)
DISCHARGE (CFS)
TWO MILE BAR
SIX MILE BAR
HONOLULU BAR
VALLEY OAK SRA


STEELHEAD TROUT - ADULTS
STANISLAUS RIVER IFIM
WEIGHTED USABLE AREA/1,000 FT. STREAM (Thousands)
DISCHARGE (CFS)
TWO MILE BAR
SIX MILE BAR
HONOLULU BAR
VALLEY OAK SRA


STEELHEAD TROUT - SPAWNING
STANISLAUS RIVER IFIM
WEIGHTED USABLE AREA/1,000 FT. STREAM (Thousands)
DISCHARGE (CFS)
TWO MILE BAR
SIX MILE BAR
HONOLULU BAR
VALLEY OAK SRA

RAINBOW TROUT - FRY WUA

	Q	TWO MILE BAR	SIX MILE BAR	HONOLULU BAR	VALLEY OAK SRA	TOTAL HAB. AREA(1)
1	25	4,234	12,596	17,222	12,421	1,521,677
2	50	6,224	15,529	19,295	15,318	1,855,802
3	100	6,697	14,396	17,103	15,711	1,825,436
4	150	6,226	13,071	14,932	14,505	1,664,499
5	200	5,388	11,524	11,358	13,241	1,459,939
6	250	4,882	9,867	8,645	11,984	1,277,500
7	300	4,466	8,339	6,404	11,046	1,130,609
8	350	4,391	7,819	5,324	10,215	1,040,373
9	400	4,331	6,908	5,464	8,983	940,141
10	450	4,358	6,237	5,391	7,829	847,200
11	500	4,769	5,527	5,438	6,971	783,446
12	550	5,242	5,045	5,661	5,790	706,617
13	600	5,221	4,950	5,522	4,907	641,009
14	650	5,549	4,984	5,305	4,401	608,659
15	700	5,444	4,769	4,999	3,898	561,924
16	750	5,264	4,731	4,953	3,682	542,024
17	800	4,949	4,586	4,824	3,531	520,423
18	850	4,759	4,392	4,823	3,728	526,604
19	900	4,551	4,353	4,710	3,707	518,260
20	950	4,675	4,624	4,634	3,710	524,478
21	1,000	5,041	4,530	4,767	3,976	550,400
22	1,050	5,041	4,525	4,865	4,116	561,927
23	1,100	5,198	4,557	5,095	3,809	549,086
24	1,150	5,326	4,636	5,412	3,395	531,045
25	1,200	5,411	4,690	6,021	3,089	525,020
26	1,250	5,436	4,865	6,465	2,903	525,160
27	1,300	5,377	5,064	6,873	2,722	523,696

RAINBOW TROUT - JUVENILE WUA

Q	TWO MILE BAR	SIX MILE BAR	HONOLULU BAR	VALLEY OAK SRA	TOTAL HAB. AREA(1)
25	3,345	7,909	14,989	8,024	1,068,523
50	6,325	14,719	19,506	14,082	1,761,702
100	8,605	17,202	23,422	18,681	2,246,769
150	9,304	17,879	21,383	20,380	2,347,893
200	9,082	16,907	17,979	19,735	2,211,827
250	8,974	15,740	14,442	18,588	2,036,984
300	8,927	14,351	11,627	17,540	1,880,536
350	8,850	13,470	9,924	16,416	1,750,535
400	8,889	12,752	8,906	16,123	1,696,727
450	8,997	11,999	8,329	15,212	1,610,161
500	9,102	11,023	8,309	13,793	1,495,731
550	9,312	9,992	8,182	12,889	1,415,389
600	9,655	9,278	7,880	12,140	1,350,642
650	9,653	8,794	7,862	11,232	1,278,685
700	9,761	8,474	7,835	10,375	1,215,287
750	9,772	8,180	7,404	9,738	1,157,448
800	9,669	7,829	7,161	9,360	1,117,951
850	9,411	7,672	6,885	8,991	1,079,197
900	9,105	7,430	6,656	8,912	1,058,784
950	8,897	7,107	6,626	8,744	1,036,560
1,000	8,777	6,889	6,656	8,671	1,025,760
1,050	8,846	6,847	6,691	8,501	1,015,266
1,100	9,134	6,758	6,799	8,348	1,010,667
1,150	9,239	6,613	6,898	8,029	989,963
1,200	9,449	6,565	7,001	7,756	976,321
1,250	9,739	6,507	7,174	7,267	950,685
1,300	9,810	6,413	7,268	6,828	922,011

RAINBOW TROUT - ADULT WUA

Q	TWO MILE BAR	SIX MILE BAR	HONOLULU BAR	VALLEY OAK SRA	TOTAL HAB. AREA(1)
25	8,661	9,115	7,914	9,914	1,176,960
50	15,056	14,790	14,768	16,363	1,986,597
100	21,621	26,095	25,648	27,229	3,291,797
150	26,882	32,857	32,644	37,685	4,378,630
200	32,104	38,105	36,861	44,240	5,111,850
250	36,285	40,695	38,210	49,130	5,602,346
300	39,865	41,534	37,541	52,257	5,886,212
350	42,863	42,016	36,833	53,493	6,021,885
400	45,524	41,028	35,910	53,770	6,052,998
450	47,422	39,188	34,352	53,219	5,983,774
500	48,596	37,171	32,652	52,560	5,887,471
550	48,972	35,443	30,929	52,835	5,845,238
600	48,916	33,853	29,513	52,237	5,744,035
650	48,650	32,058	28,529	50,886	5,592,033
700	48,560	30,297	27,838	49,334	5,436,231
750	48,398	28,566	27,245	47,715	5,277,014
800	48,093	27,154	26,586	46,149	5,123,470
850	47,844	26,011	26,109	44,732	4,990,073
900	47,487	25,108	25,982	43,375	4,870,487
950	47,128	24,434	26,011	42,134	4,766,331
1,000	46,703	23,837	26,110	41,030	4,673,296
1,050	46,244	23,373	26,182	39,969	4,584,477
1,100	45,779	22,993	26,057	39,063	4,503,904
1,150	45,271	22,674	26,007	38,271	4,432,939
1,200	44,920	22,462	25,874	37,562	4,371,003
1,250	44,692	22,284	25,793	37,205	4,337,195
1,300	44,701	22,083	25,697	36,666	4,294,628

RAINBOW TROUT - SPAWNING WUA

Q	TWO MILE BAR	SIX MILE BAR	HONOLULU BAR	VALLEY OAK SRA	TOTAL HAB. AREA(1)
25	2,127	2,034	3,698	1,631	265,624
50	3,522	4,710	8,200	4,097	603,443
100	3,805	6,405	13,094	9,197	1,090,281
150	3,257	5,343	10,906	9,811	1,057,320
200	2,718	4,271	7,731	9,073	911,708
250	2,288	4,002	5,192	7,437	734,806
300	1,965	3,414	3,658	5,345	542,868
350	1,894	2,964	2,587	3,792	404,681
400	1,770	2,573	1,834	3,191	338,453
450	1,613	2,143	1,404	2,399	264,175
500	1,573	1,785	1,072	1,704	202,235
550	1,451	1,561	901	1,198	157,484
600	1,332	1,467	842	855	128,745
650	1,272	1,314	763	656	109,417
700	1,296	1,238	744	521	98,776
750	1,282	1,201	740	573	101,256
800	1,225	1,131	785	635	104,070
850	1,127	1,075	835	622	101,251
900	1,061	1,031	899	618	100,190
950	1,124	982	1,006	596	101,132
1,000	1,201	938	1,164	520	99,738
1,050	1,341	913	1,279	468	100,576
1,100	1,612	883	1,469	462	108,540
1,150	1,743	865	1,544	453	111,565
1,200	1,833	865	1,597	425	112,385
1,250	1,902	872	1,634	394	112,469
1,300	1,914	856	1,740	433	117,226

STEELHEAD TROUT - FRY WUA

Q	TWO MILE BAR	SIX MILE BAR	HONOLULU BAR	VALLEY OAK SRA	TOTAL HAB. AREA(1)
25	7,007	16,837	22,945	14,697	1,927,000
50	9,787	18,748	25,224	20,220	2,440,600
100	12,245	18,573	20,191	20,990	2,433,822
150	12,573	17,328	16,852	20,116	2,288,378
200	12,166	15,976	14,123	18,178	2,066,617
250	12,071	13,800	11,840	17,105	1,903,207
300	12,192	12,271	9,723	16,220	1,772,566
350	12,279	11,985	8,894	15,887	1,729,046
400	12,480	11,436	8,945	15,291	1,682,477
450	13,069	10,715	9,030	14,288	1,612,637
500	13,368	9,931	8,831	13,480	1,543,765
550	13,560	9,463	8,602	12,599	1,473,316
600	13,374	9,028	8,469	11,806	1,404,415
650	13,346	8,716	8,566	10,987	1,343,788
700	13,074	8,374	8,529	10,279	1,282,790
750	12,894	8,078	8,746	9,624	1,233,308
800	13,002	8,070	8,897	9,180	1,207,747
1X850	12,830	8,057	9,360	9,328	1,223,813
900	13,043	8,134	9,689	9,439	1,243,590
950	12,939	8,320	9,735	9,342	1,239,493
1,000	12,675	8,607	9,856	9,489	1,252,620
1,050	12,413	8,822	10,116	9,564	1,262,247
1,100	12,291	9,104	10,382	9,075	1,237,222
1,150	12,384	9,413	11,081	8,695	1,232,966
1,200	12,337	9,721	11,739	8,314	1,225,281
1,250	12,094	9,939	11,962	8,021	1,209,341
1,300	11,880	10,127	11,961	7,716	1,187,987

STEELHEAD TROUT - JUVENILE WUA

Q	TWO MILE BAR	SIX MILE BAR	HONOLULU BAR	VALLEY OAK SRA	TOTAL HAB. AREA(1)
25	5,026	13,800	19,982	13,963	1,721,295
50	9,486	21,554	28,231	22,542	2,708,966
100	12,020	26,412	32,289	30,507	3,477,869
150	11,949	27,111	31,802	32,137	3,591,817
200	11,030	26,481	28,274	31,793	3,467,371
250	10,117	24,610	24,213	30,626	3,252,043
300	9,740	22,682	20,384	29,117	3,026,867
350	9,381	21,291	17,780	27,118	2,803,527
400	9,084	19,776	15,861	25,476	2,617,441
450	9,080	18,259	14,383	23,651	2,433,172
500	9,294	16,852	13,218	21,853	2,263,287
550	9,561	15,637	12,377	19,810	2,087,845
600	9,665	14,609	11,628	17,801	1,917,149
650	9,867	13,697	11,104	16,083	1,775,023
700	9,813	12,748	10,766	14,636	1,649,748
750	9,569	11,972	10,696	13,354	1,540,990
800	9,344	11,455	10,583	12,340	1,455,095
850	9,110	11,052	10,470	11,491	1,382,493
900	8,908	10,779	10,404	10,687	1,317,002
950	8,761	10,626	10,273	10,021	1,263,007
1,000	8,716	10,476	10,208	9,786	1,241,851
1,050	8,742	10,240	10,220	9,611	1,226,095
1,100	8,813	10,057	10,306	9,028	1,185,668
1,150	8,931	9,936	10,514	8,467	1,151,316
1,200	9,042	9,903	10,736	7,841	1,114,320
1,250	9,174	9,877	10,995	7,287	1,083,598
1,300	9,393	9,909	11,302	6,830	1,063,152

STEELHEAD TROUT - ADULT WUA

Q	TWO MILE BAR	SIX MILE BAR	HONOLULU BAR	VALLEY OAK SRA	TOTAL HAB. AREA(1)
25	979	408	401	499	68,511
50	1,570	955	1,308	830	131,080
100	2,450	4,348	5,661	3,426	478,890
150	3,514	10,262	9,678	6,830	927,036
200	4,949	11,678	13,153	10,391	1,295,703
250	6,319	11,913	17,148	15,441	1,753,179
300	8,389	14,291	17,770	19,169	2,105,723
350	10,786	16,554	17,592	22,560	2,422,776
400	12,043	18,856	16,859	25,730	2,692,826
450	13,203	20,034	15,429	27,282	2,814,479
500	14,697	21,345	15,828	27,022	2,857,783
550	17,085	18,718	14,790	25,412	2,720,629
600	19,315	16,216	13,282	24,797	2,641,715
650	21,354	14,322	12,301	22,765	2,484,302
700	21,036	12,799	11,421	21,148	2,320,464
750	19,489	11,244	10,625	19,554	2,136,290
800	18,420	10,349	10,517	18,308	2,011,478
850	18,501	9,812	10,376	17,086	1,916,109
900	18,832	9,509	10,093	16,299	1,856,794
950	17,959	9,284	9,210	15,998	1,797,561
1,000	17,343	8,976	8,660	15,595	1,741,382
1,050	17,300	8,819	8,687	15,424	1,726,337
1,100	17,234	8,854	8,879	15,674	1,746,793
1,150	16,988	8,718	9,056	15,966	1,763,206
1,200	16,792	8,711	8,918	15,510	1,725,427
1,250	16,940	9,092	8,910	14,885	1,692,417
1,300	16,616	9,279	9,305	14,753	1,688,902

STEELHEAD TROUT - SPAWNING WUA

Q	TWO MILE BAR	SIX MILE BAR	HONOLULU BAR	VALLEY OAK SRA	TOTAL HAB. AREA(1)
25	557	116	189	227	32,076
50	950	690	1,614	1,257	149,926
100	1,877	3,084	7,223	4,538	551,960
150	2,499	4,597	9,759	6,708	792,859
200	2,435	4,651	9,807	8,088	888,313
250	2,240	4,094	8,104	8,047	836,553
300	2,017	3,458	6,268	7,244	727,934
350	1,761	3,110	4,659	6,112	606,175
400	1,499	3,037	3,433	4,746	481,337
450	1,264	2,892	2,533	3,468	368,241
500	1,085	2,639	1,855	2,464	277,424
550	938	2,328	1,345	1,710	206,696
600	820	1,964	955	1,155	151,537
650	751	1,644	708	814	115,740
700	718	1,407	570	572	91,157
750	718	1,226	515	421	76,222
800	756	1,122	497	313	67,148
850	792	1,001	486	254	61,241
900	773	875	483	273	59,759
950	764	756	493	333	61,585
1,000	723	641	493	392	62,682
1,050	680	551	524	439	64,033
1,100	649	490	540	435	62,347
1,150	640	436	552	417	60,142
1,200	701	401	569	397	59,565
1,250	792	373	603	376	59,985
1,300	899	355	632	382	62,664

CURVE SET DEFINITION DATA WAS OBTAINED FROM THE FISHFIL FILE WHOSE TITLE LINE IS - TROUT SUITABILITY CRITERIA, STANISLAUS RIVER PHABSIM W/"PERFECT" SUBSTRATE

VELOCITY WEIGHTING FOR RAINBOW TROUT (BOVEE 78/01/24)

FRY		JUVENILE		ADULT		SPAWNING	
VELOCITY	WEIGHT	VELOCITY	WEIGHT	VELOCITY	WEIGHT	VELOCITY	WEIGHT
0.00	0.06	0.00	0.00	0.00	0.04	0.00	0.00
0.10	0.18	0.10	0.00	0.10	0.18	0.50	0.00
0.20	0.39	0.20	0.11	0.25	0.32	0.60	0.06
0.30	0.96	0.30	0.40	0.50	0.48	0.80	0.42
0.40	1.00	0.40	0.95	0.75	0.63	1.10	0.65
0.50	1.00	0.50	0.97	0.95	0.81	1.20	0.77
0.60	1.00	0.70	1.00	1.00	0.88	1.30	0.95
0.70	0.95	1.30	1.00	1.05	0.95	1.40	0.98
0.80	0.81	1.50	0.98	1.15	0.98	1.50	1.00
0.90	0.75	1.60	0.94	1.20	1.00	1.90	1.00
1.00	0.72	1.70	0.86	1.30	1.00	2.00	0.98
1.10	0.69	1.80	0.73	1.35	0.98	2.10	0.95
1.20	0.65	1.90	0.70	1.45	0.93	2.30	0.68
1.30	0.62	2.20	0.49	1.65	0.79	2.50	0.59
1.40	0.59	2.40	0.38	1.95	0.66	2.80	0.39
1.50	0.56	2.50	0.14	2.10	0.56	3.10	0.07
1.80	-0.38	2.60	0.10	2.25	0.42	3.20	0.00
2.00	0.26	2.70	0.07	2.40	0.30	100.00	0.00
2.20	0.14	2.80	0.06	2.90	0.00		
2.40	0.06	3.00	0.03	100.00	0.00		
2.70	0.00	4.00	0.00				
100.00	0.00	100.00	0.00				

DEPTH WEIGHTING FOR RAINBOW TROUT (BOVEE 78/01/24)

FRY		JUVENILE		ADULT		SPAWNING	
DEPTH	WEIGHT	DEPTH	WEIGHT	DEPTH	WEIGHT	DEPTH	WEIGHT
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.20	0.00	0.40	0.00	0.15	0.06	0.30	0.00
0.40	0.15	0.60	0.27	0.30	0.11	0.45	0.31
0.50	0.30	0.70	0.55	0.50	0.14	0.50	0.50
0.60	1.00	0.80	0.98	0.80	0.18	0.55	0.80
0.90	1.00	0.90	1.00	0.85	0.19	0.60	0.95
1.00	0.98	1.05	1.00	1.00	0.22	0.65	0.98
1.10	0.88	1.10	0.98	1.10	0.26	0.70	1.00
1.30	0.60	1.30	0.68	1.20	0.30	0.85	1.00
1.50	0.40	1.50	0.52	1.30	0.36	0.90	0.98
1.60	0.33	1.60	0.45	1.40	0.46	0.95	0.96
1.70	0.27	1.80	0.37	1.45	0.54	1.05	0.87
1.90	0.19	1.90	0.34	1.50	0.73	1.40	0.49
2.10	0.13	2.00	0.30	1.55	0.91	1.50	0.39
2.40	0.08	2.10	0.28	1.60	0.95	1.60	0.31
2.70	0.03	2.20	0.26	1.65	0.98	1.75	0.24
3.00	0.02	2.40	0.23	1.75	1.00	1.90	0.17
5.00	0.02	2.60	0.21	4.00	1.00	2.05	0.12
6.00	0.02	3.00	0.20	100.00	1.00	2.25	0.07
100.00	0.02	3.20	0.18			2.50	0.03
		3.50	0.15			3.20	0.00
		3.80	0.12			100.00	0.00
		4.10	0.10				
		5.00	0.10				
		6.00	0.10				
		100.00	0.10				

VELOCITY WEIGHTING FOR WINTER STEELHEAD (BOVEE, 1978)

FRY		JUVENILE		ADULT		SPAWNING	
VELOCITY	WEIGHT	VELOCITY	WEIGHT	VELOCITY	WEIGHT	VELOCITY	WEIGH
0.00	0.05	0.00	0.00	0.00	0.01	0.00	0.00
0.10	0.12	0.10	0.00	0.60	0.02	1.00	0.00
0.20	0.30	0.20	0.20	0.80	0.06	1.15	0.08
0.30	0.90	0.30	0.90	0.90	0.10	1.40	0.40
0.50	1.00	0.50	0.98	1.00	0.14	1.50	0.60
0.60	1.00	0.70	1.00	1.25	0.30	1.60	0.74
0.70	0.96	1.10	1.00	1.50	0.66	1.65	0.80
0.80	0.82	1.40	0.98	1.60	1.00	1.85	0.96
0.90	0.76	1.50	0.96	1.70	1.00	2.00	1.00
1.00	0.72	1.70	0.84	1.80	0.96	2.20	0.96
1.20	0.64	2.00	0.64	1.90	0.46	2.30	0.90
1.75	0.42	2.30	0.42	2.00	0.32	2.50	0.76
1.90	0.34	2.50	0.16	2.50	0.06	2.70	0.64
2.10	0.20	3.00	0.04	3.00	0.02	3.10	0.32
2.20	0.14	3.50	0.02	4.00	0.00	3.25	0.22
2.50	0.04	4.30	0.00	100.00	0.00	3.40	0.14
2.70	0.00	100.00	0.00			3.70	0.00
100.00	0.00					100.00	0.00

DEPTH WEIGHTING FOR WINTER STEELHEAD (BOVEE, 1978)

FRY		JUVENILE		ADULT		SPAWNING	
DEPTH	WEIGHT	DEPTH	WEIGHT	DEPTH	WEIGHT	DEPTH	WEIGHT
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.10	0.10	0.10	0.06	1.00	0.00	0.40	0.00
0.20	0.80	0.30	0.20	1.10	0.10	0.50	0.20
0.30	0.96	0.60	0.66	1.25	0.32	0.70	0.40
0.40	0.98	1.00	0.96	1.50	0.60	0.90	0.62
0.60	1.00	1.25	1.00	1.70	0.76	1.00	0.92
0.70	1.00	1.50	0.88	2.00	0.92	1.15	1.00
1.00	0.96	2.00	0.64	2.30	1.00	1.20	1.00
1.10	0.80	2.20	0.58	100.00	1.00	1.40	0.88
1.20	0.64	2.50	0.48			1.50	0.76
1.30	0.56	3.00	0.34			1.75	0.52
1.40	0.46	3.50	0.24			1.90	0.40
1.50	0.42	4.00	0.14			2.20	0.22
1.70	0.30	4.50	0.08			2.25	0.20
1.90	0.20	5.00	0.00			2.60	0.08
2.00	0.16	100.00	0.00			2.80	0.04
2.20	0.10					3.00	0.02
2.40	0.06					3.50	0.00
2.70	0.20					100.00	0.00
6.00	0.20						
100.00	0.00						