

Annual Project Performance Report *(rev. 7/07)*

1. State: California

Grant number: F-119-R-2

Grant name: Central Valley Angler Survey

Project number and name: F-119-R, Central Valley Angler Survey

2. Report Period: July 1, 2006 to June 30, 2007

Report due date: September 15, 2007 (October 31, 2007 extension provided)

3. Location of work: Central Valley, California including portions of the Sacramento, Feather, Yuba, American, Mokelumne, Calaveras, and Stanislaus rivers, and portions of the Sacramento-San Joaquin Delta within Congressional Districts 1 – 5, 7, 10 – 11, and 19; Shasta, Tehama, Glenn, Butte, Colusa, Sutter, Yuba, Yolo, Sacramento, San Joaquin, Calaveras, Stanislaus, Solano, and Contra Costa counties. The project is based in Sacramento, with a satellite office in Red Bluff.

4. Costs: This is no longer required by California Nevada Operations Office (USFWS).

5. Objectives:

a. Conduct an angler survey on the Sacramento River and its associated tributaries. The survey will ultimately also include the Stanislaus River in the lowermost San Joaquin River system, and a portion of the Sacramento-San Joaquin Delta, in part through collaboration with another California Department of Fish and Game (CDFG) project.

b. Analyze collected data and prepare reports describing angler use and catch for all species. Emphasis is on fisheries involving key anadromous species where contact with naturally produced Central Valley steelhead is most likely: Chinook salmon, steelhead/rainbow trout, sturgeon, striped bass, and American shad.

6. If the work in this grant was part of a larger undertaking with other components and funding, present a brief overview of the larger activity and the role of this project.

The Central Valley Angler Survey is the primary angler survey for anadromous fishes in the Central Valley, California. However, we will be coordinating this survey with the existing striped bass and sturgeon survey being conducted in the Sacramento-San Joaquin Delta (SFRA grant F-51-R, project: #71: Bay-Delta Sport Fish Resource Assessment Project - Striped Bass), to achieve greater geographic coverage while meeting co-equal project objectives.

The Central Valley Angler Survey also provides an estimate of Chinook salmon harvest in the Central Valley recreational fishery. This estimate complements Chinook salmon

harvest estimates for California ocean commercial and recreational fisheries generated by CDFG's Ocean Salmon Project. Combined, these estimates are used by the Pacific Fishery Management Council to forecast Chinook salmon harvest quotas in ocean waters off the coasts of Washington, Oregon, and California. The inland recreational harvest component, for Chinook salmon of both hatchery and wild origin, has been lacking throughout most of the management history of Chinook salmon fisheries supported by the Central Valley. The Central Valley Angler Survey fills this essential information gap.

7. Describe how the objectives were met. See “Supplemental Information” for additional requirements and “Attachments” for specialized tables.

Introduction

Field implementation of the Central Valley Angler Survey began in November 2006 in the lowermost Sacramento River, from Rio Vista upstream to Knights Landing (Tables 1 and 2). During early 2007, sections 4 and 5 were added, extending the survey on the Sacramento River upstream to Hamilton City. The American and Feather rivers were also added to the survey during the current reporting period. In all, 54 survey months were expended from November 2006 through June 2007 (Table 2).

Table 1. Survey section numbers and descriptions for river sections surveyed by the Central Valley Angler Survey, November 2006 through June 2007.

Section Number	Section Description
Sacramento River	
2.0	Rio Vista Bridge to mouth of American River
3.0	American River to Knights Landing (Hwy 113 bridge)
4.0	Knights Landing to Colusa
5.0	Colusa to Hamilton City (Hwy 32 bridge)
American River	
10.0	Interstate 80 bridge to the Nimbus Hatchery weir above Hazel Avenue
10.1	Nimbus Hatchery Weir to Nimbus Dam
Feather River	
11.1	Verona to Shanghai Rapids
11.2	Shanghai Rapids to Sunset Pumps
12.0	Sunset Pumps to Feather River Hatchery
12.1	Thermalito Afterbay River Outlet (only)

Table 2. Implementation schedule for each river section surveyed by the Central Valley Angler Survey, November 2006 through June 2007. X = survey conducted, NS = no survey conducted.

River:	Sacramento				American		Feather			
Section No.:	2	3	4	5	10	10.1	11.1	11.2	12	12.1
November	X	X	NS	NS	NS	NS	NS	NS	NS	NS
December	X	X	NS	NS	NS	NS	NS	NS	NS	NS
January	X	X	X	NS	X	X	NS	NS	NS	NS
February	X	X	X	NS	X	X	NS	NS	NS	NS
March	X	X	X	X	X	X	X	X	X	X
April	X	X	X	X	X	X	X	X	X	X
May	X	X	X	X	X	X	X	X	X	X
June	X	X	X	X	X	X	X	X	X	X
No. Months:	8	8	6	4	6	6	4	4	4	4

Job 1. Angler Survey – Field Component

Statistical Design

A stratified random sample design, based on the design used by the Sacramento River System Sport Fish Inventory (Wixom 1995) and Upper Sacramento River Sport Fishery (Smith 1950) was used to estimate the in-river harvest during the daytime sport fishery.

A three stage creel survey was used consisting of roving counts, roving Interview, and access point interviews. Roving counts and access interviews were used to estimate total effort, while roving interviews were used to estimate catch per unit effort (as catch/hour). Access interviews were used to construct an effort distribution model, evaluate fish contact rates between roving and access interview types, and to gather completed angler trip data. The effort distribution model determined the proportion of the whole represented by a single angler count. While a night fishery exists on Central Valley rivers, no effort was made during this reporting period to evaluate the harvest by nighttime sport anglers.

A total of 10 sections was surveyed (Table 1). Eight of the survey sections ranged in length from 4 to 56 river miles. Two survey sections, that represented unique fishery locations, were approximately one river mile in length. Sampling schedules and data summaries were compiled on a monthly basis. Months were chosen as a convenient time step for survey periods, in part because historical Central Valley angler surveys (e.g., Wixom 1995, Murphy et al. 1999) used a monthly time step, which will allow for time-based comparisons.

Each survey section was surveyed on eight randomly selected days per month: four weekdays and four weekend days. Weekdays and weekend days were placed in separate strata because more angling effort is commonly associated with weekend days.

Each survey section was surveyed by kayak or power boat, both propeller and jet driven. Kayaks were used in shallow, upstream reaches that could be routinely surveyed in a downstream direction. Power boats were used in rivers where tides, wind, and waves demanded the use of more seaworthy boats, and where the survey section was to be navigated against the current.

For each section surveyed on the main stem of the Sacramento River, a systematic start time and launch location were chosen. Start times were classified based on systematic sampling of access locations. Launch locations would either be at the upstream or downstream end of the sections to be surveyed. In those sections where kayaks were used, the launch location was always at the upstream end of the section and one of three start times representing the start, middle, and end of the day was randomly chosen for a given survey day.

All data collected were linked by river mile. Actual river miles were used for the Sacramento River sections. Each tributary was given a unique number series to identify it from other rivers in the database. The number series assigned to each tributary were as follows: Feather River, 400 series; American River, 500 series. River mile designations were marked in ascending order from downstream to upstream.

Data Collection

Three field data sets were required to calculate use and catch: hourly angling effort distribution models by month and survey section, angler counts, and angler catch data through interviews. Effort distribution models provide the proportion of the whole represented by the survey day angler count. Development of updated effort distribution models for the current survey is incomplete; instead, we used analogous data sets of hourly angler counts for each month and survey section developed by Wixom (1995). We assumed that effort distributions have not changed significantly over the past 15 years.

On each survey day, a high-speed pass was made through a given survey section, during which anglers were counted. Data collected during the angler count included: time of observation, location by river mile, number of boats, number of boat anglers, and the number of shore anglers. At the end of the angler count, a second pass was made traveling back through the section to conduct angler interviews. Prior to beginning the interviews, the survey crew determined the feasibility of interviewing all anglers counted during the angler count. If it was determined that this was not feasible given time restrictions, then they chose every N^{th} angler to be interviewed. Once an N^{th} angler interval was chosen, that interval was maintained through the entire survey section for that survey date. Data collected during each interview included: location by river mile, fishing method, number of hours fished, number of anglers in the group, target species, zip code, whether the trip was completed, and the number of fish kept and released by species. Access interviews were conducted at popular launch locations and were temporally scheduled to encompass all hours of a virtual day to be used in the effort distribution model, for that survey section, month, and day-type (weekday or weekend) stratum.

All common sport-fish species found in Central Valley rivers were considered "Target Species." Those species were: Chinook salmon, steelhead, rainbow trout, striped bass, sturgeon (all species), American shad, splittail, carp, catfish (all species), sunfish (all species), and black bass (all species).

The number of fish kept and released was recorded separately for each of the 11 target species. All other fish species caught were recorded separately by species in a column labeled "Other."

A length measurement was used to differentiate between steelhead and rainbow trout. On the Sacramento River above Colusa, all *O. mykiss* greater than 16 inches or marked externally with an adipose fin clip were considered to be steelhead. *O. mykiss* on the Feather and American rivers were considered to be juvenile steelhead. This length criterion was not used to distinguish target species by steelhead and rainbow trout; it was only applied to reported catch and fish measurements.

Job 2. Angler Survey Data Analysis and Reporting

A total of 392 survey days was conducted during the current reporting period, although the overall allocation of survey effort by survey section and month varied given the phased start dates for each section (Table 3). An average of 7.3 survey days was

expended in each survey section and month, thus nearly achieving the monthly target of 8 survey days per section. The cumulative survey effort resulted in an estimated 1,029,486 angler hours (Table 4), for an average of 19,065 angler hours per survey section and month.

Table 3. Total number of sample days by survey section and month, as determined by the Central Valley Angler Survey, November 2006 through June 2007.

River:	----- Sacramento -----				--- American ---		----- Feather -----			
Section No.:	2	3	4	5	10	10.1	11.1	11.2	12	12.1
November	8	9	No Survey	No Survey	No Survey	No Survey	No Survey	No Survey	No Survey	No Survey
December	7	8	No Survey	No Survey	No Survey	No Survey	No Survey	No Survey	No Survey	No Survey
January	8	8	8	No Survey	9	9	No Survey	No Survey	No Survey	No Survey
February	8	8	8	No Survey	6	6	No Survey	No Survey	No Survey	No Survey
March	6	8	8	3	6	6	8	7	7	7
April	8	7	8	8	6	6	7	6	7	7
May	5	7	8	5	5	5	9	9	9	9
June	8	8	7	8	8	8	5	5	9	9
TOTAL:	58	63	47	24	40	40	29	27	32	32

Table 4. Expanded estimates of angler hours by survey section and month, as determined by the Central Valley Angler Survey, November 2006 through June 2007.

River:	----- Sacramento -----				--- American ---		----- Feather -----			
Section No.:	2	3	4	5	10	10.1	11.1	11.2	12	12.1
November	32,928	18,440	No Survey	No Survey	No Survey	No Survey	No Survey	No Survey	No Survey	No Survey
December	11,703	4,176	No Survey	No Survey	No Survey	No Survey	No Survey	No Survey	No Survey	No Survey
January	11,260	4,309	3,414	No Survey	21,065	5,517	No Survey	No Survey	No Survey	No Survey
February	18,970	6,173	8,567	No Survey	14,449	4,935	No Survey	No Survey	No Survey	No Survey
March	48,815	28,230	24,389	18,641	10,709	2,381	26,642	4,626	3,657	1,607
April	74,061	73,421	109,237	22,050	9,027	1,114	21,956	2,957	5,609	2,911
May	63,095	50,759	41,448	15,037	12,322	777	14,170	3,878	4,728	7,595
June	47,126	21,266	12,118	13,419	28,168	3,951	7,304	2,654	12,839	8,886
TOTAL:	307,958	206,773	199,173	69,148	95,741	18,676	70,071	14,114	26,832	21,000
CI @ 80%:	22,345	15,747	21,351	7,267	13,955	4,237	8,189	2,681	2,991	3,492

Chinook Salmon Fishery

During the current reporting period, the angler survey covered much of the fall-run Chinook salmon fishery on the lower Sacramento River from Rio Vista to Knights Landing, the tail end of the fall- / late-fall-run Chinook salmon fishery and the June spring-run Chinook salmon fishery on the lower American River, and the first three months of the spring-run Chinook salmon fishery on the Feather River (Table 5). An estimated total of 67,307 angler hours targeted Chinook salmon, resulting in an estimated Chinook salmon harvest of 1,540 fish, and the catch-and-release of 1,321 Chinook salmon. About 54% of Chinook salmon caught were harvested. The overall catch-per-unit-effort (CPUE) for Chinook salmon was 0.04 / hr.

Steelhead Fishery

Essentially all (> 99.9%) of the sport angling effort estimated for steelhead during the current reporting period was expended on the lower American and Feather rivers (Table

6). An estimated total of 57,527 angler hours targeted steelhead, resulting in an estimated harvest of 638 fish, and a release of 5,885 fish. Thus, only about 10% of

Table 5. Expanded estimates of angler hours targeting Chinook salmon, and numbers of Chinook salmon kept and released, by survey section and month, as determined by the Central Valley Angler Survey, November 2006 through June 2007.

TOTAL NUMBER OF ANGLER-HOURS TARGETING CHINOOK SALMON

River:	Sacramento				American		Feather			
Section No.:	2	3	4	5	10	10.1	11.1	11.2	12	12.1
November	15,085	12,258	No Survey	No Survey	No Survey	No Survey	No Survey	No Survey	No Survey	No Survey
December	10	736	No Survey	No Survey	No Survey	No Survey	No Survey	No Survey	No Survey	No Survey
January	0	1,005	2	No Survey	0	801	No Survey	No Survey	No Survey	No Survey
February	0	0	0	No Survey	0	0	No Survey	No Survey	No Survey	No Survey
March	0	0	0	0	0	0	0	0	0	112
April	0	0	0	0	0	0	0	0	3,143	2,568
May	0	0	0	0	0	0	0	28	2,320	7,192
June	20	0	0	0	68	1,634	0	864	10,633	8,826
TOTAL:	15,115	13,998	2	0	68	2,435	0	893	16,097	18,698

TOTAL KEPT CHINOOK SALMON

River:	Sacramento				American		Feather			
Section No.:	2	3	4	5	10	10.1	11.1	11.2	12	12.1
November	316	231	No Survey	No Survey	No Survey	No Survey	No Survey	No Survey	No Survey	No Survey
December	0	20	No Survey	No Survey	No Survey	No Survey	No Survey	No Survey	No Survey	No Survey
January	0	0	0	No Survey	35	39	No Survey	No Survey	No Survey	No Survey
February	0	0	0	No Survey	0	0	No Survey	No Survey	No Survey	No Survey
March	0	0	8	0	0	0	0	0	0	0
April	0	0	0	0	0	0	0	0	110	62
May	0	0	0	0	0	0	0	0	129	293
June	0	0	0	0	0	0	0	40	74	182
TOTAL:	316	251	8	0	35	39	0	40	314	537

TOTAL RELEASED CHINOOK SALMON

River:	Sacramento				American		Feather			
Section No.:	2	3	4	5	10	10.1	11.1	11.2	12	12.1
November	53	58	No Survey	No Survey	No Survey	No Survey	No Survey	No Survey	No Survey	No Survey
December	0	0	No Survey	No Survey	No Survey	No Survey	No Survey	No Survey	No Survey	No Survey
January	0	13	0	No Survey	35	234	No Survey	No Survey	No Survey	No Survey
February	0	0	4	No Survey	0	122	No Survey	No Survey	No Survey	No Survey
March	0	0	0	0	34	0	0	0	71	75
April	0	0	0	0	0	0	0	0	0	0
May	0	0	0	0	0	0	0	0	90	220
June	0	0	0	0	0	0	0	0	204	109
TOTAL:	53	71	4	0	69	356	0	0	365	404

steelhead caught were harvested. While only an estimated 6 angler-hours of effort targeted steelhead on the Sacramento River from Rio Vista to Hamilton City, an estimated 132 steelhead were harvested and 265 were caught and released within the four survey sections comprising this river reach. Presumably, many of these steelhead were captured by anglers targeting other species. The overall CPUE for steelhead was 0.11 / hr.

Rainbow Trout Fishery

Relatively little angling effort, an estimated 2,190 hours, was directed toward rainbow trout during the current reporting period (Table 7). All harvested fish reported as rainbow trout within the survey sections covered were recorded as steelhead, given the strongly anadromous life history of the species in the lower Sacramento River system. Recognized resident rainbow trout fisheries on the upper Sacramento and Yuba rivers were not surveyed during the current reporting period, but are forthcoming during the 2007/08 project year.

Striped Bass Fishery

The angler survey work conducted during the current reporting period captured the heart of the striped bass fishery in the Sacramento River system. An estimated total of 574,681 angler hours targeted striped bass. About 86% of that effort occurred on the Sacramento River from Rio Vista to Hamilton City, 10% on the Feather River, and 4% on the lower American River (Table 8). Total angler effort resulted in an estimated striped bass harvest of 24,627 fish, and a catch-and-release of 65,541 fish. About 27% of striped bass caught were harvested. The overall CPUE for striped bass was 0.16 / hr.

Sturgeon Fishery

An estimated total of 110,238 angler hours targeted sturgeon during the current reporting period, and all of this effort occurred on the mainstem Sacramento River, from Rio Vista to Hamilton City (Table 9). The fishery resulted in an estimated harvest of 520 sturgeon, and the catch-and-release of 298 sturgeon. The harvest rate was about 64% of sturgeon caught by anglers. The overall CPUE for sturgeon was very low: < 0.01 / hr.

American Shad Fishery

With the exclusion of the Yuba River, much of the Central Valley American shad fishery was surveyed during the current reporting period. An estimated total of 105,036 angler hours targeted American shad (Table 10). About 70% of this effort occurred on the Sacramento River from Rio Vista to Hamilton City, 22% on the lower American River, and 8% on the Feather River. This effort resulted in an estimated harvest of 36,410 shad, and the catch-and-release of 29,741 shad. The harvest rate for American shad was about 55% of those caught by anglers. The American shad fishery was very successful as reflected in an overall CPUE of 0.63 / hr, the highest catch rate among the fisheries monitored in the angler survey.

Splittail Fishery

About 88% of the splittail fishery surveyed during the current reporting period occurred

Table 6. Expanded estimates of angler hours targeting steelhead, and numbers of steelhead kept and released, by survey section and month, as determined by the Central Valley Angler Survey, November 2006 through June 2007.

TOTAL NUMBER OF ANGLER-HOURS TARGETING STEELHEAD

River:	Sacramento				American		Feather			
Section No.:	2	3	4	5	10	10.1	11.1	11.2	12	12.1
November	0	0	No Survey	No Survey	No Survey	No Survey	No Survey	No Survey	No Survey	No Survey
December	0	0	No Survey	No Survey	No Survey	No Survey	No Survey	No Survey	No Survey	No Survey
January	0	6	0	No Survey	20,065	3,818	No Survey	No Survey	No Survey	No Survey
February	0	0	0	No Survey	12,961	4,935	No Survey	No Survey	No Survey	No Survey
March	0	0	0	0	5,541	2,088	0	0	2,450	112
April	0	0	0	0	430	0	0	0	2,002	21
May	0	0	0	0	11	51	0	0	1,393	140
June	0	0	0	0	17	293	0	0	1,193	0
TOTAL:	0	6	0	0	39,025	11,185	0	0	7,038	273

TOTAL KEPT STEELHEAD

River:	Sacramento				American		Feather			
Section No.:	2	3	4	5	10	10.1	11.1	11.2	12	12.1
November	0	0	No Survey	No Survey	No Survey	No Survey	No Survey	No Survey	No Survey	No Survey
December	0	0	No Survey	No Survey	No Survey	No Survey	No Survey	No Survey	No Survey	No Survey
January	14	0	0	No Survey	157	39	No Survey	No Survey	No Survey	No Survey
February	0	0	0	No Survey	76	41	No Survey	No Survey	No Survey	No Survey
March	0	86	0	0	34	0	0	0	71	0
April	0	32	0	0	0	0	0	0	44	0
May	0	0	0	0	0	0	0	0	26	0
June	0	0	0	0	0	0	0	0	19	0
TOTAL:	14	118	0	0	267	80	0	0	159	0

TOTAL RELEASED STEELHEAD

River:	Sacramento				American		Feather			
Section No.:	2	3	4	5	10	10.1	11.1	11.2	12	12.1
November	0	0	No Survey	No Survey	No Survey	No Survey	No Survey	No Survey	No Survey	No Survey
December	0	0	No Survey	No Survey	No Survey	No Survey	No Survey	No Survey	No Survey	No Survey
January	0	0	0	No Survey	909	78	No Survey	No Survey	No Survey	No Survey
February	0	0	0	No Survey	1,337	284	No Survey	No Survey	No Survey	No Survey
March	0	0	0	0	543	49	230	26	497	75
April	0	129	0	0	108	0	25	0	640	83
May	0	32	0	0	0	0	0	113	181	24
June	0	0	104	0	68	0	0	0	352	0
TOTAL:	0	161	104	0	2,964	411	255	139	1,669	182

Table 7. Expanded estimates of angler hours targeting rainbow, and numbers of rainbow trout kept and released, by survey section and month, as determined by the Central Valley Angler Survey, November 2006 through June 2007.

TOTAL NUMBER OF ANGLER-HOURS TARGETING RAINBOW TROUT

River:	Sacramento				American		Feather			
Section No.:	2	3	4	5	10	10.1	11.1	11.2	12	12.1
November	0	0	No Survey	No Survey	No Survey	No Survey	No Survey	No Survey	No Survey	No Survey
December	0	0	No Survey	No Survey	No Survey	No Survey	No Survey	No Survey	No Survey	No Survey
January	0	0	0	No Survey	26	410	No Survey	No Survey	No Survey	No Survey
February	0	0	0	No Survey	0	0	No Survey	No Survey	No Survey	No Survey
March	0	0	0	0	136	110	0	218	36	0
April	0	0	0	4	323	59	123	110	83	203
May	0	0	0	0	54	51	0	0	19	37
June	0	0	0	0	85	0	0	0	106	0
TOTAL:	0	0	0	4	624	630	123	327	244	239

TOTAL KEPT RAINBOW TROUT

River:	Sacramento				American		Feather			
Section No.:	2*	3*	4*	5	10*	10.1*	11.1*	11.2*	12*	12.1*
November	0	0	No Survey	No Survey	No Survey	No Survey	No Survey	No Survey	No Survey	No Survey
December	0	0	No Survey	No Survey	No Survey	No Survey	No Survey	No Survey	No Survey	No Survey
January	0	0	0	No Survey	0	0	No Survey	No Survey	No Survey	No Survey
February	0	0	0	No Survey	0	0	No Survey	No Survey	No Survey	No Survey
March	0	0	0	0	0	0	0	0	0	0
April	0	0	0	0	0	0	0	0	0	0
May	0	0	0	0	0	0	0	0	0	0
June	0	0	0	0	0	0	0	0	0	0
TOTAL:	0	0	0	0	0	0	0	0	0	0

TOTAL RELEASED RAINBOW TROUT

River:	Sacramento				American		Feather			
Section No.:	2*	3*	4*	5	10*	10.1*	11.1*	11.2*	12*	12.1*
November	0	0	No Survey	No Survey	No Survey	No Survey	No Survey	No Survey	No Survey	No Survey
December	0	0	No Survey	No Survey	No Survey	No Survey	No Survey	No Survey	No Survey	No Survey
January	0	0	0	No Survey	0	0	No Survey	No Survey	No Survey	No Survey
February	0	0	0	No Survey	0	0	No Survey	No Survey	No Survey	No Survey
March	0	0	0	0	0	0	0	0	0	0
April	0	0	0	15	0	0	0	0	0	0
May	0	0	0	0	0	0	0	0	0	0
June	0	0	0	0	0	0	0	0	0	0
TOTAL:	0	0	0	15	0	0	0	0	0	0

*Any rainbow trout reported as kept or released on the American and Feather rivers were assumed to be steelhead.

Table 8. Expanded estimates of angler hours targeting striped bass, and numbers of striped bass kept and released, by survey section and month, as determined by the Central Valley Angler Survey, November 2006 through June 2007.

TOTAL NUMBER OF ANGLER-HOURS TARGETING STRIPED BASS

River:	Sacramento				American		Feather			
Section No.:	2	3	4	5	10	10.1	11.1	11.2	12	12.1
November	12,867	2,710	No Survey	No Survey	No Survey	No Survey	No Survey	No Survey	No Survey	No Survey
December	1,865	1,360	Survey	Survey	Survey	Survey	Survey	Survey	Survey	Survey
January	1,480	0	0	Survey	44	0	Survey	Survey	Survey	Survey
February	2,421	1,423	37	Survey	38	0	Survey	Survey	Survey	Survey
March	27,919	15,979	5,028	5,499	2,885	171	23,849	2,015	0	0
April	67,999	69,001	102,072	17,864	5,137	0	20,905	2,040	72	0
May	25,771	34,912	36,112	8,970	5,687	242	6,124	962	171	98
June	23,523	13,756	9,666	4,946	7,571	49	2,192	1,116	134	0
TOTAL:	163,845	139,141	152,916	37,279	21,361	462	53,069	6,133	377	98

TOTAL KEPT STRIPED BASS

River:	Sacramento				American		Feather			
Section No.:	2	3	4	5	10	10.1	11.1	11.2	12	12.1
November	0	0	No Survey	No Survey	No Survey	No Survey	No Survey	No Survey	No Survey	No Survey
December	55	0	Survey	Survey	Survey	Survey	Survey	Survey	Survey	Survey
January	8	0	0	Survey	0	0	Survey	Survey	Survey	Survey
February	53	7	0	Survey	0	0	Survey	Survey	Survey	Survey
March	715	467	147	585	0	0	588	0	0	0
April	1,398	3,265	7,554	1,143	108	0	1,376	0	0	0
May	763	915	2,533	149	129	0	109	0	0	0
June	1,356	201	603	195	205	0	0	0	0	0
TOTAL:	4,348	4,855	10,837	2,072	441	0	2,074	0	0	0

TOTAL RELEASED STRIPED BASS

River:	Sacramento				American		Feather			
Section No.:	2	3	4	5	10	10.1	11.1	11.2	12	12.1
November	736	288	No Survey	No Survey	No Survey	No Survey	No Survey	No Survey	No Survey	No Survey
December	28	29	Survey	Survey	Survey	Survey	Survey	Survey	Survey	Survey
January	0	19	0	Survey	0	0	Survey	Survey	Survey	Survey
February	27	0	0	Survey	0	0	Survey	Survey	Survey	Survey
March	1,907	565	116	209	34	0	205	51	0	0
April	5,136	7,402	7,151	707	0	0	2,188	55	0	0
May	3,742	4,008	6,333	829	86	0	301	0	0	0
June	9,729	5,719	4,135	1,589	1,194	0	864	161	0	0
TOTAL:	21,305	18,030	17,734	3,334	1,314	0	3,557	267	0	0

Table 9. Expanded estimates of angler hours targeting sturgeon, and numbers of sturgeon kept and released, by survey section and month, as determined by the Central Valley Angler Survey, November 2006 through June 2007.

TOTAL NUMBER OF ANGLER-HOURS TARGETING STURGEON

River:	Sacramento				American		Feather			
Section No.:	2	3	4	5	10	10.1	11.1	11.2	12	12.1
November	2,442	1,415	No Survey	No Survey	No Survey	No Survey	No Survey	No Survey	No Survey	No Survey
December	8,991	0	No Survey	No Survey	No Survey	No Survey	No Survey	No Survey	No Survey	No Survey
January	9,025	1,526	3,257	No Survey	0	0	No Survey	No Survey	No Survey	No Survey
February	12,784	2,610	8,340	No Survey	0	0	No Survey	No Survey	No Survey	No Survey
March	13,598	4,600	16,772	12,567	0	0	0	0	0	0
April	52	711	3,647	3,217	0	0	0	0	0	0
May	1,178	631	142	1,925	0	0	0	0	0	0
June	797	0	0	8	0	0	0	0	0	0
TOTAL:	48,869	11,493	32,159	17,717	0	0	0	0	0	0

TOTAL KEPT STURGEON

River:	Sacramento				American		Feather			
Section No.:	2	3	4	5	10	10.1	11.1	11.2	12	12.1
November	0	0	No Survey	No Survey	No Survey	No Survey	No Survey	No Survey	No Survey	No Survey
December	14	0	No Survey	No Survey	No Survey	No Survey	No Survey	No Survey	No Survey	No Survey
January	8	0	0	No Survey	0	0	No Survey	No Survey	No Survey	No Survey
February	40	0	26	No Survey	0	0	No Survey	No Survey	No Survey	No Survey
March	60	0	8	167	0	0	0	0	0	0
April	0	0	115	15	0	0	0	0	0	0
May	0	0	0	0	0	0	27	0	0	0
June	40	0	0	0	0	0	0	0	0	0
TOTAL:	162	0	148.6426	182.3105	0	0	27.36769	0	0	0

TOTAL RELEASED STURGEON

River:	Sacramento				American		Feather			
Section No.:	2	3	4	5	10	10.1	11.1	11.2	12	12.1
November	0	0	No Survey	No Survey	No Survey	No Survey	No Survey	No Survey	No Survey	No Survey
December	0	10	No Survey	No Survey	No Survey	No Survey	No Survey	No Survey	No Survey	No Survey
January	0	0	5	No Survey	0	0	No Survey	No Survey	No Survey	No Survey
February	40	0	0	No Survey	0	0	No Survey	No Survey	No Survey	No Survey
March	30	0	0	0	0	0	0	0	0	0
April	0	0	115	15	0	0	0	0	0	0
May	0	0	0	43	0	0	0	0	0	0
June	40	0	0	0	0	0	0	0	0	0
TOTAL:	110	10	120	58	0	0	0	0	0	0

Table 10. Expanded estimates of angler hours targeting American shad, and numbers of American shad kept and released, by survey section and month, as determined by the Central Valley Angler Survey, November 2006 through June 2007.

TOTAL NUMBER OF ANGLER-HOURS TARGETING AMERICAN SHAD

River:	Sacramento				American		Feather			
Section No.:	2	3	4	5	10	10.1	11.1	11.2	12	12.1
November	0	0	No Survey	No Survey	No Survey	No Survey	No Survey	No Survey	No Survey	No Survey
December	0	0	No Survey	No Survey	No Survey	No Survey	No Survey	No Survey	No Survey	No Survey
January	0	0	0	No Survey	0	0	No Survey	No Survey	No Survey	No Survey
February	0	0	0	No Survey	0	0	No Survey	No Survey	No Survey	No Survey
March	0	0	0	0	0	0	13	0	0	0
April	524	1,155	0	60	54	0	0	0	0	0
May	30,257	10,309	768	3,254	4,104	0	5,419	1,642	0	0
June	12,918	3,296	1,184	6,762	17,008	122	792	121	0	0
July	2,073	0	0	642	2,098	281	0	0		178
TOTAL:	45,773	14,761	1,952	10,719	23,264	403	6,224	1,762	0	178

TOTAL KEPT AMERICAN SHAD

River:	Sacramento				American		Feather			
Section No.:	2	3	4	5	10	10.1	11.1	11.2	12	12.1
November	0	0	No Survey	No Survey	No Survey	No Survey	No Survey	No Survey	No Survey	No Survey
December	0	0	No Survey	No Survey	No Survey	No Survey	No Survey	No Survey	No Survey	No Survey
January	0	0	0	No Survey	0	0	No Survey	No Survey	No Survey	No Survey
February	0	0	0	No Survey	0	0	No Survey	No Survey	No Survey	No Survey
March	0	0	0	0	0	0	0	0	0	0
April	0	33	0	0	0	0	0	0	0	0
May	13,787	3,597	63	128	388	0	3,886	0	0	0
June	7,934	623	603	162	3,478	0	32	0	0	0
July	1,267	0	0	0	429	0	0	0	0	0
TOTAL:	22,988	4,253	666	290	4,295	0	3,918	0	0	0

TOTAL RELEASED AMERICAN SHAD

River:	Sacramento				American		Feather			
Section No.:	2	3	4	5	10	10.1	11.1	11.2	12	12.1
November	0	0	No Survey	No Survey	No Survey	No Survey	No Survey	No Survey	No Survey	No Survey
December	0	0	No Survey	No Survey	No Survey	No Survey	No Survey	No Survey	No Survey	No Survey
January	0	0	0	No Survey	0	0	No Survey	No Survey	No Survey	No Survey
February	0	0	0	No Survey	0	0	No Survey	No Survey	No Survey	No Survey
March	0	0	0	0	0	0	0	0	0	0
April	0	938	0	0	0	0	0	0	0	0
May	1,040	4,891	190	1,935	560	0	2,846	1,189	0	24
June	359	542	1,309	6,503	4,604	0	2,240	0	0	0
July	0	0	0	220	179	46	0	0	0	126
TOTAL:	1,399	6,371	1,499	8,659	5,342	46	5,086	1,189	0	150

on the lower Sacramento River from Rio Vista to Knights Landing (Table 11). The remaining 12% was on the Sacramento River from Knights Landing to Colusa and on the Feather River. At an estimated total effort of 10,404 angler hours, the splittail fishery was the second smallest fishery targeted in the angler survey. But with an estimated harvest of 2,442 splittail and a catch-and-release of only 200 splittail, this fishery had the highest harvest rate of 92%. The overall CPUE for splittail was 0.25 / hr.

Job 3. Stock Assessment and Steelhead Population Trend Analysis

This job was added to the grant for the 2007/2008 fiscal year, but project activity occurred during the current reporting period in preparation for implementation. Jeanine Phillips was hired as the lab biologist in December 2006 to implement age-and-growth assessments of the inland recreational catch of Chinook salmon, and of naturally produced steelhead sampled at Central Valley anadromous salmonid hatcheries. This position is also responsible for the processing of coded-wire tags recovered in the inland recreational fishery for Chinook salmon and steelhead.

Additional Studies

Comparative Analysis of Aerial and Ground Counts of Anglers

In its angler survey on the Feather River during 2006, the California Department of Water Resources (DWR) used aerial counts of anglers to determine effort on a given survey day. The Central Valley Angler Survey collaborated with DWR in a comparative study of aerial versus “ground” counts, in an attempt to assess the efficacy of the aerial counts. Of particular interest was the influence of river channel sinuosity and riparian cover on the accuracy of aerial counts. We assumed that angler counts made from boats on the river, so-called “ground counts”, would be nearly 100% accurate.

Replicated comparative counts were made in three river areas of contrasting character. The first was at the Thermalito Afterbay Outlet (TAO), a popular Chinook salmon fishing location on the Feather River. An aerial view of this location is relatively unobstructed, thus facilitating angler counts from the air. Twelve replicate aerial and ground counts were made at TAO (area 1) from August 23, 2006 through September 30, 2006.

The second area was a highly sinuous river reach with heavy riparian vegetation, from Sunset Pumps downstream to the Highway 20 bridge crossing at Yuba City. Because of obstructions to open viewing from the air, we anticipated that aerial counts of both boat and shore anglers on this section would be biased low because the airplane from which aerial counts were made could not directly follow portions of the river channel, and because riparian vegetation would hide shore anglers. Fourteen replicate counts were made on this river reach (area 2) from August 16, 2006 through November 18, 2006.

The third area was a river reach from the Highway 20 bridge crossing downstream to Shanghai Rapids. We anticipated that because the river channel was only mildly sinuous along this reach, that aerial counts of boat anglers would be relatively accurate, but that riparian vegetation would still hide many shore anglers. Sixteen replicate counts were made on this river reach (area 3) from August 23, 2007 through November

18, 2007.

In area 1, there were significant ($p \leq 0.001$) linear relationships between aerial and ground counts of both boat and shore anglers (Figure 1). However, the slope of the regression for boat angler counts was well below 1 ($b = 0.62$) and the y -intercept was significantly different from the origin ($p = 0.01$), which indicated that aerial counts tended to be lower than ground counts. In contrast, the slope of the regression for shore angler counts was essentially 1 ($b = 1.04$) and the y -intercept was not significantly different from the origin ($p = 0.69$), which indicated that in an open area like TAO, aerial counts of shore anglers provide the same result on average as ground counts. The model describing this relationship also had a relatively high coefficient of determination ($r^2 = 0.85$).

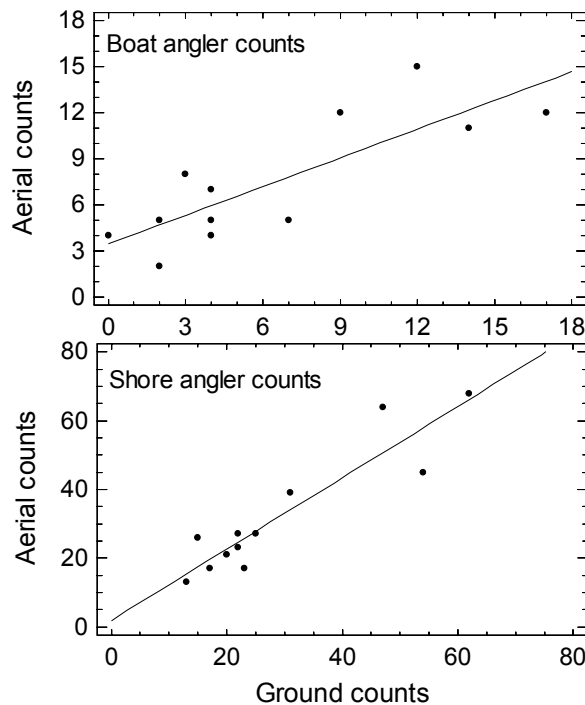


Figure 1. Linear relationships between aerial and ground counts of boat and shore anglers on the Feather River at the Thermalito Afterbay Outlet (TAO; area 1).

In area 2, with high river channel sinuosity and dense riparian vegetation, there was a significant ($p \leq 0.0001$) linear relationship between aerial and ground counts of boat anglers (Figure 2). However, the slope of the regression was well below 1 ($b = 0.49$), which indicated that aerial counts tended to be much lower on average than ground counts, as predicted. Aerial and ground counts of shore anglers were both mostly 0 in this area, which did not allow for regression analysis of the results.

In area 3, there was a significant ($p = 0.01$) linear relationship between aerial and ground counts of boat anglers (Figure 3). However, the slope of the regression was well below 1 ($b = 0.40$), which indicated that aerial counts tended to be much lower on average than ground counts, contrary to our prediction. In addition, the predictive ability of the model was poor, as reflected in the relatively low coefficient of determination ($r^2 =$

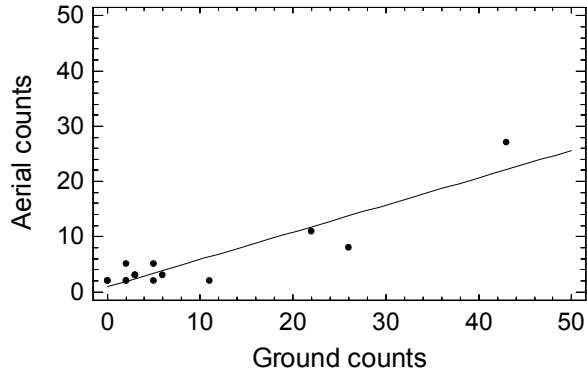


Figure 2. Linear relationship between aerial and ground counts of boat anglers on the Feather River from the Sunset Pumps to the Highway 20 bridge crossing (area 2). While aerial counts fell well below corresponding ground counts, the model has a high coefficient of determination ($r^2 = 0.84$) and the y -intercept is not significantly different from 0 ($p = 0.35$).

0.38). The y -intercept of the model was not significantly different from 0 ($p > 0.09$). As predicted, shore anglers were almost completely missed in the aerial counts (Figure 3), resulting in no useable predictive regression between aerial and ground shore angler counts for this area ($r^2 = 0.19$, $p = 0.10$).

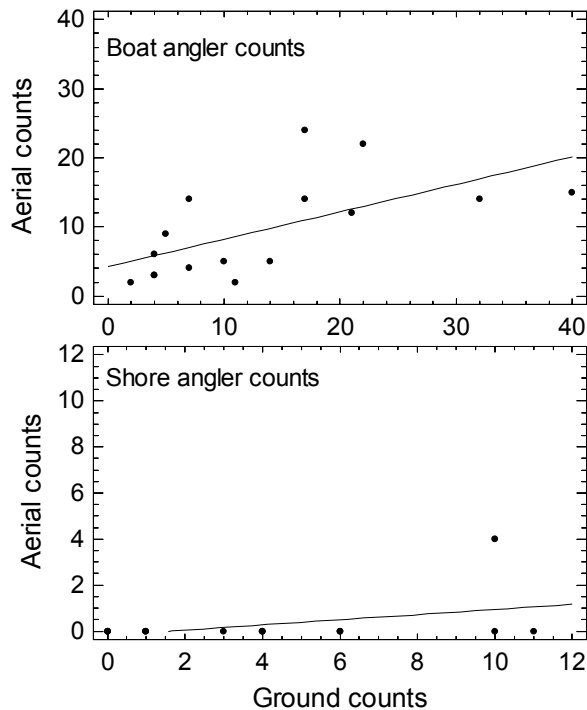


Figure 3. Linear relationships between aerial and ground counts of boat and shore anglers on the Feather River from the Highway 20 bridge crossing to Shanghai Rapids (area 3).

In summary, we concluded from this study that aerial counts of anglers could only be made reliably in open areas with stationary shore anglers. On survey sections with high river channel sinuosity and dense riparian vegetation, aerial counts on average fell well below ground counts, for both boat and shore anglers.

Hooking Mortality of Juvenile Central Valley Steelhead

Central Valley ESU steelhead are a federally listed threatened species under the Endangered Species Act (ESA). As a protective measure, angling regulations call for the release of all wild Central Valley steelhead. Catch-and-release angling of wild Central Valley steelhead may occur year-round, including during summer when high water-temperature conditions may not be conducive to post-release survival of steelhead.

As a means to begin an assessment of this management issue, we searched the literature for data on the relationship between hooking mortality and water temperature for trout caught and released using artificial flies and lures. We used data for steelhead, rainbow trout, and cutthroat trout (*O. clarki*), which are ecologically similar to *O. mykiss*, to develop a functional relationship.

We found that post-release mortality was relatively low ($\leq 10\%$) when mean water temperature was below 64°F , but increased sharply at water temperatures above that (Figure 4). Water temperature in Central Valley streams supporting steelhead often exceed this threshold, which could result in significant levels of post-release mortality in the catch-and-release fishery. We conclude that this question warrants further study in our assessment of fishery impacts on Central Valley ESU steelhead.

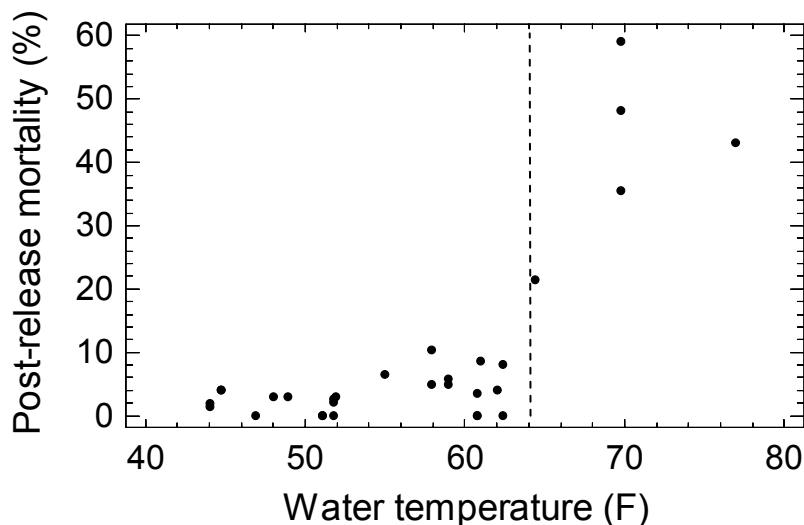


Figure 4. Relationship between post-release mortality and water temperature for steelhead/ rainbow and cutthroat trout caught and released with artificial flies and lures. Data are from Titus and Vanicek (1988) and references therein, and Taylor and Barnhart (year not given).

8. Discuss differences between work anticipated in grant proposal and grant agreement, and that actually carried out with Federal Aid grant funds; include differences between expected and actual costs.

N/A.

9. List any publications or in-house reports resulting from this work. Provide citations, including status (indicate if not completed), note any that are included with this report, and note where reports or publications may be obtained.

Brown, M. S., and R. G. Titus. Angler effort and harvest of anadromous fishes in the Central Valley river recreational fishery, 2006 – 2007. California Department of fish and Game, Inland Fisheries Administrative Report. *In prep.*

10. Name, title, phone number, and e-mail address of person compiling this report

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