Redd Dewatering and Juvenile Salmonid Stranding in the Lower Feather River, 2005-2006

Interim Report for NOAA Fisheries

Prepared by:

California Department of Water Resources
Division of Environmental Services
3251 S Street
Sacramento CA 95816

Contact:

Ryon Kurth
(530) 534-2505
rkurth@water.ca.gov

SUMMARY

Since 2001, DWR has conducted redd dewatering and juvenile salmonid stranding surveys to assess the impact of water operations on the population of juvenile salmonids in the Lower Feather River. Objectives of this long-term study are to determine the number of redds dewatered by reductions in flow; identify potential ponding areas; determine the relative abundance of stranded salmonids; and determine the biological significance of redd dewatering and juvenile stranding. This report summarizes data collected for the 2005/06 survey season. No dewatered redds were discovered during the survey. Discharge in the low flow channel ranged from 615 cfs to 80,000 cfs while the high flow channel ranged from 2,450 cfs to 80,000 cfs. We captured 1,713 stranded juvenile Chinook salmon and 10 juvenile steelhead. Due to the extent of flooding in 2006 we did not estimate the total number of stranded juvenile salmonids. However, we did calculate the relative density of stranded salmonids for three reaches of the lower Feather River.

1.0 INTRODUCTION

The 2004 Biological Opinion issued by NOAA Fisheries for the California State Water Project (SWP) requires the Department of Water Resources (DWR) to continue monitoring juvenile salmonid stranding and redd dewatering on the Feather River. Results from the monitoring program are to serve as a basis for establishing long-term ramping rate criteria to minimize the potential for stranding of juvenile salmonids. This report summarizes results from the 2005/06 survey year.

2.0 METHODS

2.1 Study Area

The Feather River drainage is located within the Central Valley of California, draining an extensive area of the western slope of the Sierra Nevada (Figure 1). The Feather River is of low gradient from the Oroville-Thermalito Complex downstream to the confluence with the Sacramento River. Oroville Dam and Thermalito Diversion Dam regulate flow into the lower Feather River below the reservoir. Under normal operations, the majority of the Feather River flow is diverted at Thermalito Diversion Dam into the Power Canal and Thermalito Forebay. The remainder of the flow, typically 600-cfs, flows through the historical river channel, the low flow channel. Water released by the Forebay is used to generate power before discharge into Thermalito Afterbay. Excluding local diversions and occasional pumpback operations, the water is returned to the Feather River through Thermalito Afterbay Outlet, then flows southward through the valley to the confluence with the Sacramento River at Verona.

DWR has been conducting fisheries research on the upper 23 miles of the lower Feather River for over seven years. Labeled as the Feather River study area, it consists of the low flow channel (lfc), which extends from the Fish Barrier Dam to the Thermalito Afterbay Outlet, and the high flow channel (hfc), which extends from the Outlet to Honcut Creek (Figure 2). Each reach has distinctive channel morphology, flow characteristics and salmonid abundance. The highest abundance of steelhead and spring-run salmon spawning and juvenile rearing is in the lfc (Sommer et al. 2001; DWR 2002). As previously mentioned, flows in the lfc remain constant year-round, and thus stranding or redd dewatering would only become an issue during flood control events. Another exception could occur during maintenance operations or, when flows may be manipulated to meet temperature criteria.

In the hfc, the channel is more complex and flow is more variable, which increases the risk of redd dewatering and juvenile stranding. Under normal operations, the hfc reach has the highest potential for juvenile stranding and redd dewatering.

2.2 Redd Dewatering

In the Feather River, Chinook salmon typically spawn from September through December and steelhead usually spawn from December through March (Sommer et al. 2001; DWR 2003). During this period, major spawning riffles were visited after each reduction in flow. Measurements included river mile, flow and the number of exposed redds. Redds were considered dewatered if the water surface elevation had completely dropped below bed elevation. Additionally, redds were classified as partially dewatered for instances where the water level of a redd was not below bed elevation, but the redd appeared to be adversely effected by a reduction in water elevation or reduced flow through the red.

The number of dewatered redds was compared with the estimated number of salmon redds constructed from the spawning seasons to determine redd losses as a proportion of the total in the river.

2.3 Juvenile Stranding

Surveys were conducted between January and May 2006. Surveys were not conducted during later summer months because emigration patterns of juvenile salmonids suggests there are relatively few rearing salmonids remaining in the Feather River beyond May (DWR 2002; Seesholtz et al. 2003; DWR 2004). Isolation basin type stranding was the primary focus of this study. Beach stranding was not considered due to the following factors: (1) this type of stranding is generally believed to be only a minor component of overall stranding potential in the lower Feather River; (2) ramping rates are very low (roughly 1 inch stage change per hour) and should minimize beach stranding impacts; (3) predation by birds before a survey could be conducted could frustrate any effort at accurate beach stranding survey results; (4) this type of stranding would occur in intragravel spaces and therefore be very difficult to quantify in any reliable quantitative manner.

Most stranding areas were identified in surveys from previous years (e.g. DWR 2002). However, searches for new stranding areas were completed for larger magnitude flow ranges not observed in previous survey years. Physical measurements recorded for each pond included: river mile, river flow, average depth and total surface area.

Once ponding occurred, a sub-set of ponds from the Thermalito Afterbay Outlet downstream to Honcut Creek was sampled by beach seine or snorkeling. Beach seining was used for ponds less than 1.2 meters (3.94 ft) deep and free of major obstructions. Snorkel transect surveys were used for ponds deeper than 1.2 meters (3.94 ft) or where obstructions precluded seining. Fish were identified and enumerated by species. The Fork Length (FL mm) of each species from snorkel surveys was estimated visually. Up to 50 salmon and 50 steelhead (and up to 20 individuals for non-salmonids) were measured when captured by beach seine. Fish were handled in accordance with the RST handling protocol documented in SP-F10, Task 4A. Run identification was based on a daily length table (Greene 1992) for Central Valley Chinook salmon. The proportion of spring-run sized fish in the sub-sample was used to estimate the number of spring-run sized salmon in the total catch.

Fish density (number of fish per area swept) was used to estimate species abundance for an entire pond. Mean fish density across all ponds was computed and multiplied by the total ponded area to estimate the number of salmonids stranded in the study area. The incidence of stranding was compared with emigration estimates from rotary screw trap operations to determine the stranding losses relative to the population of juvenile salmon in the river.

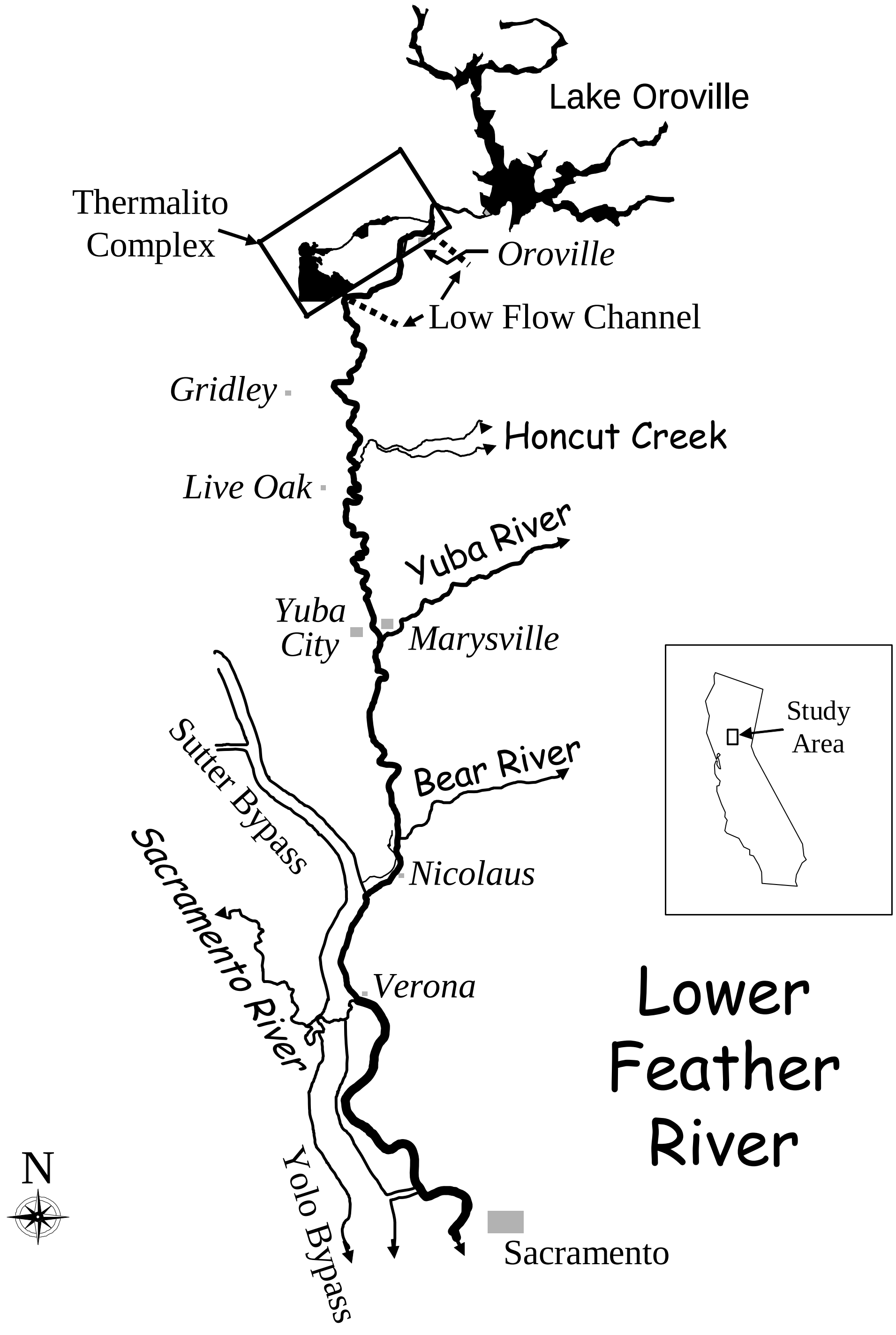


Figure 1. Map of the Lower Feather River

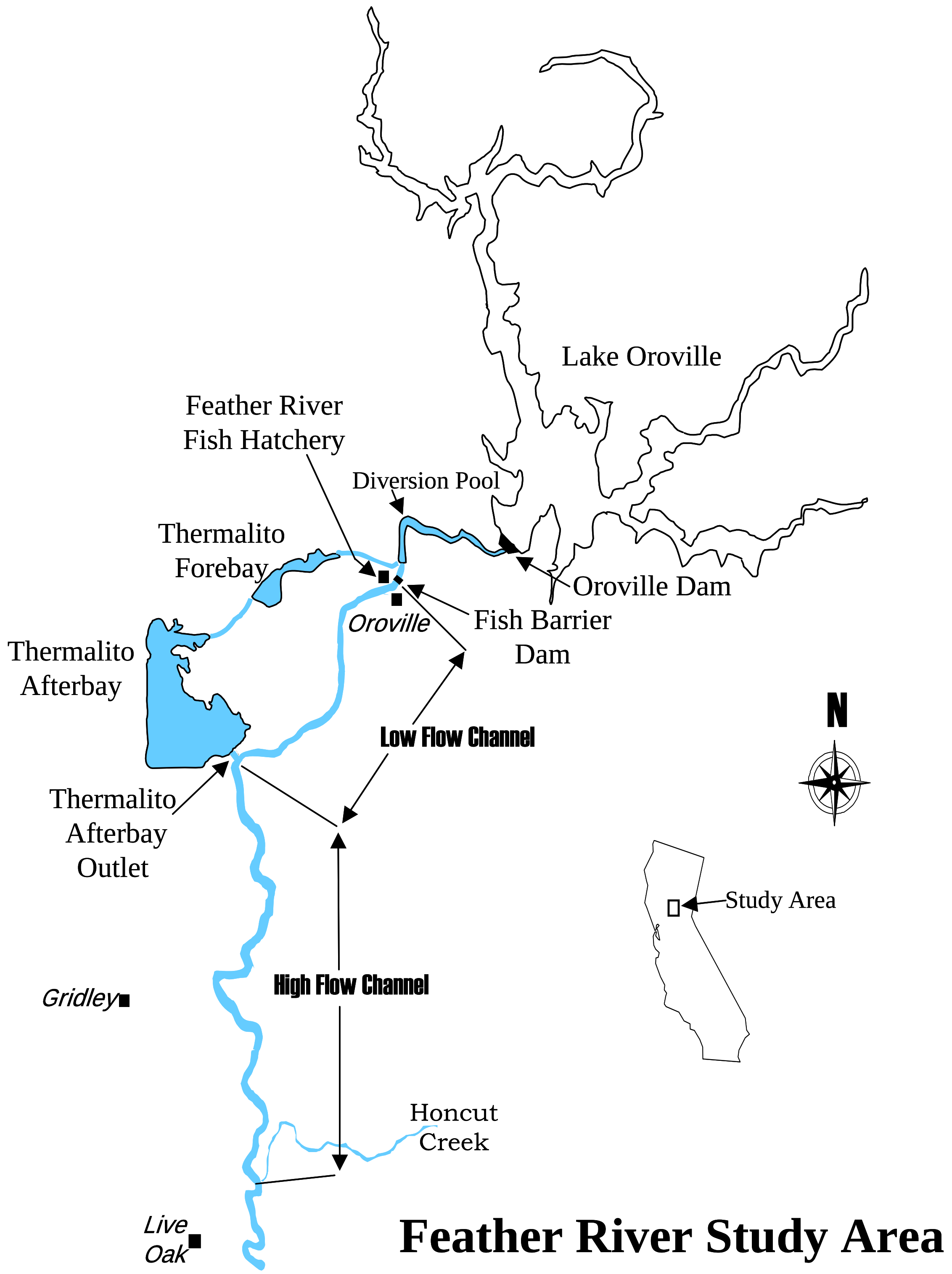
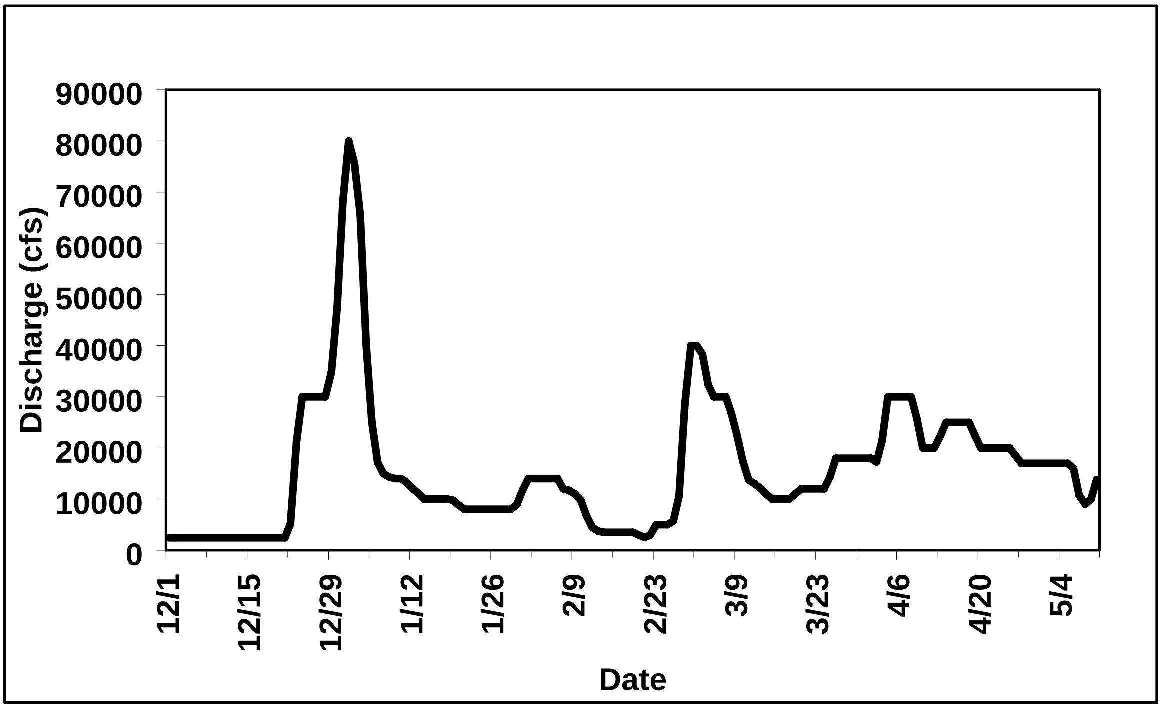


Figure 2. Map of the Feather River Study Area.

3.0 RESULTS AND DISCUSSION

In early January 80, 000 cfs was released from Oroville Dam for flood control (Figure 3). There were several other flow fluctuations of lesser magnitude occurring in February, March, April, and May.



Source: CDEC **2006**

Figure 3. Feather River discharge December 2005 through May 2006.

3.1 Redd Dewatering

During the 2005/2006 season, the water surface elevation of the river never fell below the level observed during the spawning season. Therefore, redd dewatering did not occur.

3.2 Juvenile Stranding

In late December, discharge into the Lower Feather steadily increased to 80,000 cfs by early January. There was extensive flooding throughout the study area. This may have lead to substantial amounts of juvenile salmonid stranding, but we only captured 1678 fall-run sized Chinook, 35 spring-run sized Chinook and 10 steelhead. It was challenging to sample the overwhelming amount of ponded area and it is likely a large proportion of stranded salmonids avoided capture. However the timing, magnitude, and duration of the winter flood control release may have flushed juvenile salmonids out of the upper river into the delta, reducing the incidence of stranding.

We were unable to estimate the total amount of ponded area; therefore we cannot estimate the total number of stranded salmonids. Instead, we investigated the relative density of stranded salmonids throughout the study area and compared that to previous years (Table 1).

Table 1. Relative density of stranded juvenile salmonids for 2006. Values reported are mean densities for all ponds sampled within each reach.

Month	FBD to TAO (67 – 59)	TAO to Yuba City (59 – 28)	Yuba City to Verona (28 – 0)
January	0.006	0.046	0.055
February	0.08	0.64	0.17
March	1.72	0.74	0.38
April	0.47	0.38	0.29
May	0	0.05	

Table 2 displays the mean density of stranded juvenile salmonids within each reach across all years. In general the reach with the highest stranding rate is the section between TAO and Yuba City. This is to be expected, because the highest frequency and magnitude of flow fluctuations occur in this reach. Discharge in the low flow channel (FBD to TAO) rarely fluctuates, accordingly stranding was only observed in two seasons. The greatest density of stranded salmonids occurred in 2004 and the lowest density was in 2006. This lends further support to the conclusion that the magnitude of the January release forced most juvenile salmonids out of the upper watershed. Also, juvenile salmonid catch in the rotary screw trap survey was relatively low compared to previous years following the January release. Although a multitude of factors combine to determine year class strength, perhaps adult return rates from the year class will assist us assessing the stranding impacts to juvenile salmonids in 2006.

Table 2. Relative density of stranded juvenile salmonids from 2001 through 2006. N.S. indicates when a sample was not collected. Values reported are mean densities for all ponds sampled within each reach for each season.

YEAR	FBD to TAO (67 – 59)	TAO to Yuba City (59 – 28)	Yuba City to Verona (28 – 0)
2001	N.S.	3.8	1.07
2002	N.S.	N.S.	N.S.
2003	N.S.	10.6	3.09
2004	4.85	31.46	9.98
2005	N.S.	0	2.58
2006	0.46	0.37	0.22

4.0 REFERENCES

California Data Exchange Center. Bulk Historical Data for Thermalito Afterbay Outlet (*THA*). Site accessed December 15, 2006. URL = http://cdec.water.ca.gov/cgi-progs/selectQuery?station_id=THA&dur_code=D&sensor_num=85&start_date=12/01/2005+00:00&05/31/2006+00:00_date=now.

DWR. 2002. Emigration of Juvenile Chinook Salmon in the Feather River, 1998-2001. Sacramento, CA. December 2002.

____. 2003. SPF-10 Task 3C: Redd Dewatering and Juvenile Steelhead and Spring-Run Salmon Stranding in the Lower Feather River. Sacramento, CA. June 2003.

____. 2003. SP-F10 Task 2B Report 2003: Lower Feather River Steelhead (Oncorhynchus mykiss) Redd Survey. Sacramento, CA. July 2003.

____. 2004. SPF- 10 Task 3A: Distribution and Habitat Use of Steelhead and Other Fishes in the Lower Feather River, 1999-2001. Sacramento, CA. April 2004.

Greene, S. 1992. Daily Fork Length Table From Data by Frank Fisher, California Department of Fish and Game. Sacramento (CA): California Department of Water Resources, Environmental Services Department.

National Oceanographic and Atmospheric Administration. 2004. Operation of the Federal Central Valley Project and the California State Water Project from December 1, 2004 through March 31, 2005. Biological Opinion submitted to the California Department of Water Resources and the United States Bureau of Reclamation. March 2004.

Seesholtz, A. et al. 2004. Juvenile Fishes of the Lower Feather River: Distribution, Emigration Patterns, and Associations with Environmental Variables. American Fisheries Society Symposium. 39: 141-166.

Sommer, T., D. McEwan, R. Brown. 2001. Factors Affecting Chinook Salmon Spawning in the Lower Feather River. In: Brown, R.L., editor. Fish Bulletin 179: Contributions to the biology of Central Valley salmonids. Volume 1. Sacramento (CA): Califronia Department of Fish and Game.