Redd Dewatering and Juvenile Salmonid Stranding in the Lower Feather River, 2004-2005

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 2004/05 survey season. No dewatered redds were discovered during the survey. Discharge in the low flow channel ranged from 615 cfs to 689 cfs while the high flow channel ranged from 1050 cfs to 6000 cfs. An estimated 7420 juvenile Chinook salmon were stranded. This represents only 0.0057% of the total number of estimated emigrating juvenile Chinook salmon.

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 2004/05 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 in May and June 2005. 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.

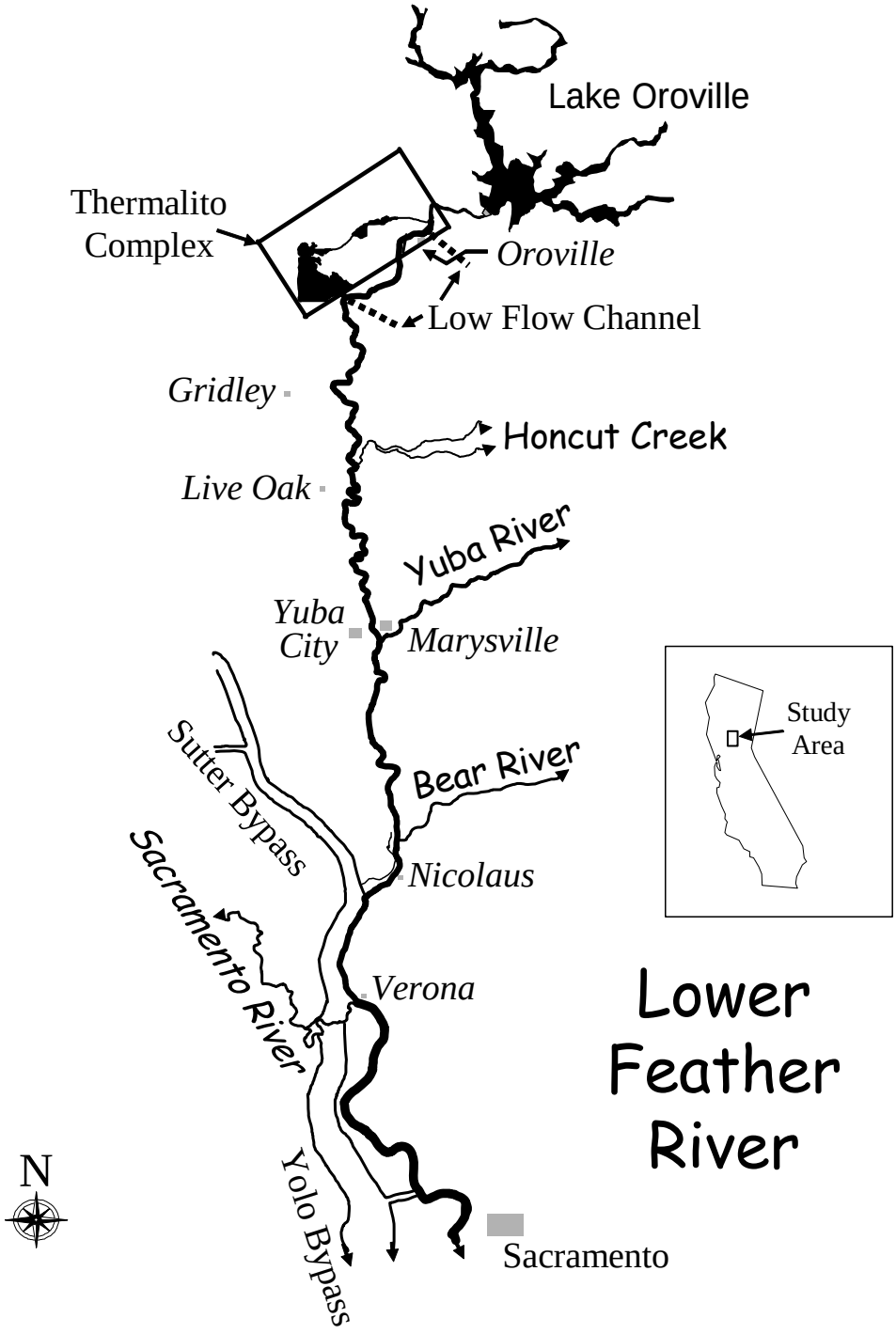


Figure 1. Map of the Lower Feather River

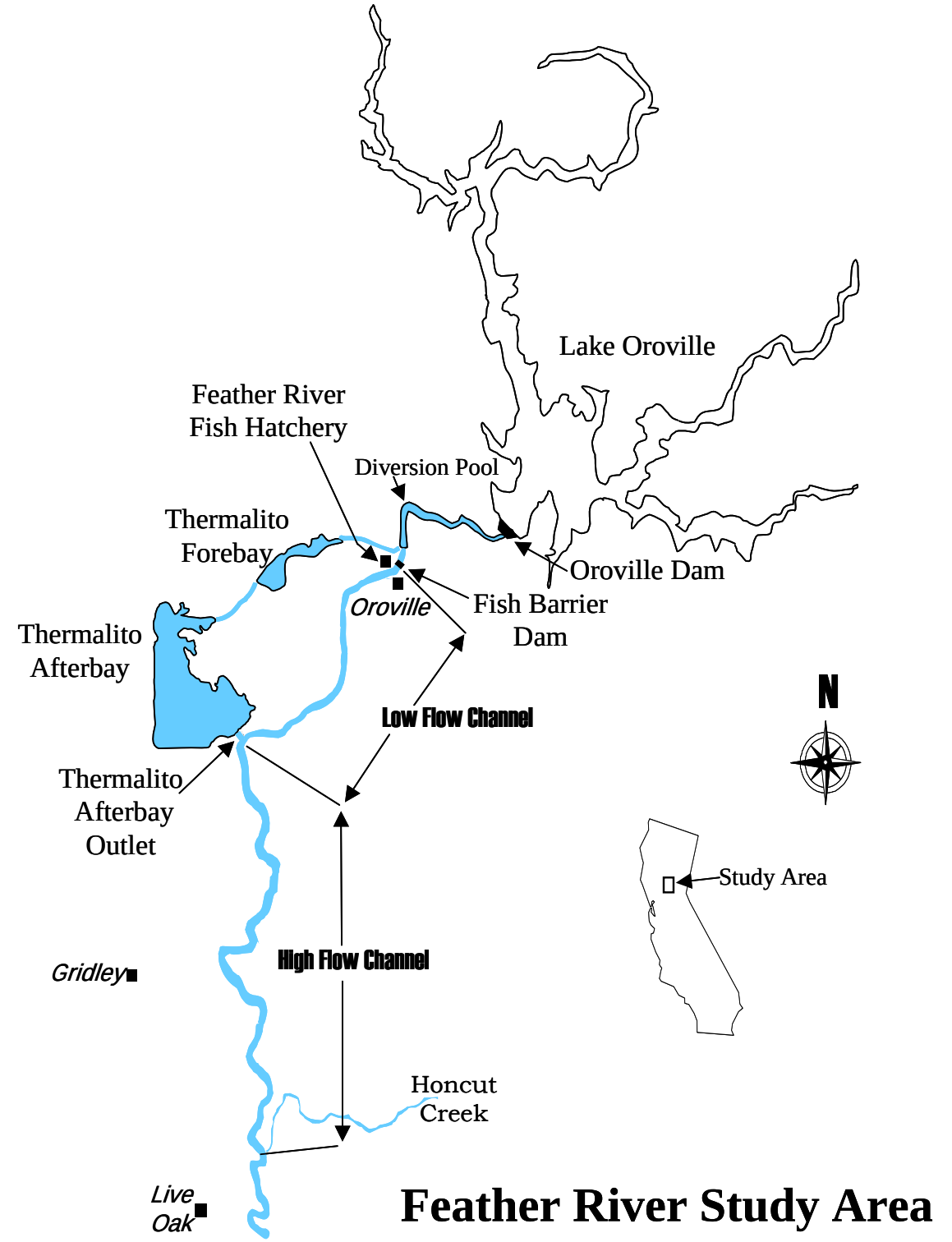
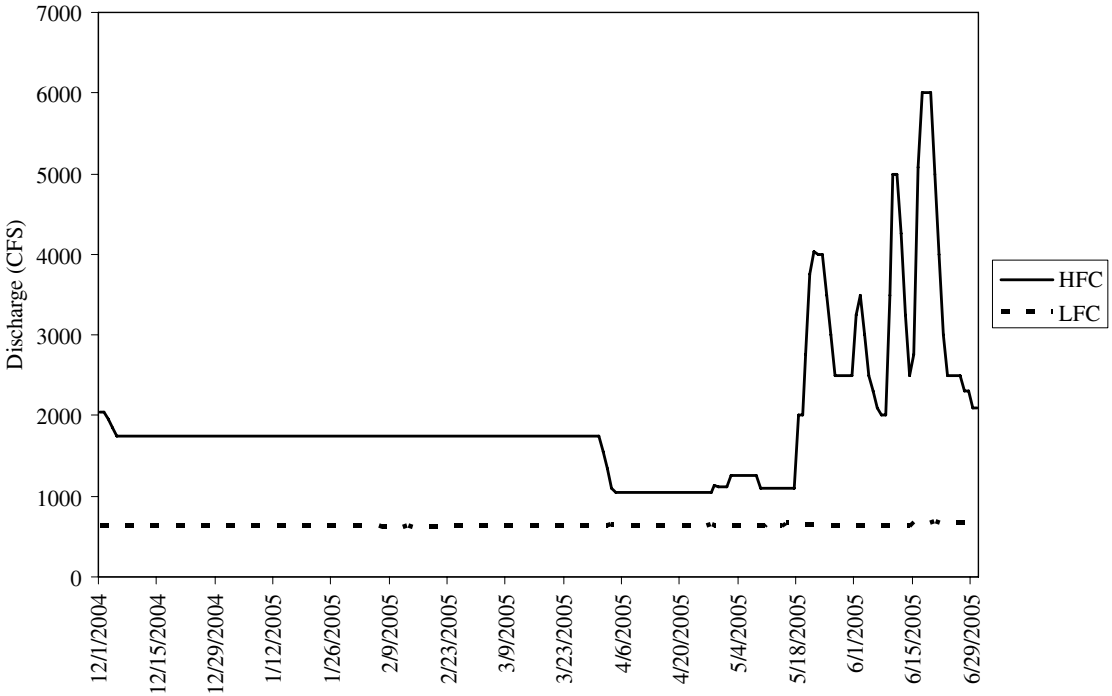


Figure 2. Map of the Feather River Study Area.

3.0 RESULTS

Several significant flow fluctuations occurred during the 2004/05 study period (Figure 3 and 4). The most significant event occurred when hfc discharge was decreased from 1750 cfs on March 31st to 1050 cfs on April 4th. A small fluctuation event occurred between April 28th and May 9th, followed by several larger events occurring in late May and through the month of June.



***Source: CDEC* 2005**

Figure 3. Feather River discharge December 2004 through June 2005.

3.1 Redd Dewatering

In 2005, no dewatered redds were discovered.

3.2 Juvenile Stranding

Each flow fluctuation caused some stranding of juvenile Chinook salmon and other native and non-native fish species inhabiting the Feather River Juvenile fall-run salmon, western mosquito fish, pikeminnow, and hardhead were the most abundant species sampled. Other species frequently collected include

largemouth bass, Sacramento sucker, and several *Lepomis* species. The total number of salmonids sampled was 987 fall-run sized Chinook and 2 spring-run sized Chinook.

The first significant event in April generated eleven isolated ponds. These eleven ponds had a combined surface area of approximately 18,081 m² (Table 3) and contained an estimated 7,405 stranded fall-run Chinook salmon and 2 spring-run Chinook salmon. The second flow fluctuation, occurring between the 18th and 27th of May, resulted in one isolated pond at Big Bar, in the hfc with a surface area of 780 m² (Table 3). No Chinook salmon were sampled during this event. The third significant event occurred between June 1st and 7th. In this event 6 isolated pools were sampled comprising an estimated 9,493 m² of surface area (Table 3). An estimated 13 fall-run Chinook salmon were stranded.

In total, an estimated 7,418 juvenile fall-run Chinook salmon and 2 spring-run Chinook salmon were stranded during the 2004/05 survey season; all in the hfc. This represents 0.0057% of the total estimated emigrating population of 12,940,409 fish (DWR, unpublished data).

Table 3. Pond location, date, surface area, and estimated number of stranded juvenile Chinook salmon resulting from Feather River flow fluctuations below the Oroville Fish Barrier Dam in 2005 .

Date	Location	lfc/hfc	River Mile	Pond Area (m^2)	Est. # Stranded CHNs
4/4/2005	Shallow Riffle	hfc	47	260	507
4/4/2005	Hour Bar #1	hfc	55.7	50	0
4/4/2005	Hour Bar #2	hfc	55.7	216	0
4/4/2005	Gridley Riffle	hfc	49.2	200	4
4/5/2005	Herringer Pond	hfc	46	9,196	40
4/5/2005	Gridley Side Channel	hfc	49.3	108	47
4/6/2005	Herringer Side Channel Upper Pond	hfc	46.2	279	2
4/6/2005	Herringer Side Channel Middle Pond	hfc	46.1	1820	2051
4/7/2005	Herringer Side Channel Lower Pond	hfc	46	252	4756
4/11/2005	½ mile Downstream of Star Bend Ramp	hfc	18	5700	0
5/25/2005	Big Bar	hfc	53.4	780	0
6/7/2005	Gridley Riffle #1	hfc	49.2	752	0
6/7/2005	Gridley Riffle #2	hfc	49.2	3306	0
6/7/2005	Gridley Riffle #3	hfc	49.2	567	0
6/7/2005	Herringer Side Channel Upper Pond	hfc	46.2	480	0
6/7/2005	Herringer Side Channel Lower Pond	hfc	46	2340	13
6/7/2005	Upper MacFarland	hfc	52.6	2048	0

4.0 DISCUSSION

4.1 Redd Dewatering

We did not encounter any dewatered redd this season. There was only one small draw down of 200 cfs during the salmon spawning and incubating time period.

4.2 Juvenile Stranding

No major flow fluctuations occurred in the lfc and we did not observe any pond formation between December 2004 and June 2005. Stranding risk in the lfc is minimized by the current prescribed flow conditions and channel morphology. Through an agreement with CDFG discharge in the lfc is normally maintained at a constant 600 cfs. In general the majority of the channel is constrained by levees with few floodable areas that could become isolated and strand juvenile salmonids. Based on data from previous surveys we expect that discharge around 3000 cfs or lower have little or no potential stranding potential on rearing juvenile Chinook salmon and Central Valley steelhead.

In the hfc, from the Afterbay Outlet to Honcut Creek, three significant flow fluctuations occurred during the study period. The 15 pools sampled indicate that events as high as 6,000 cfs do not significantly impact the juvenile Chinook salmon population. Though an estimated 7,420 juvenile Chinook salmon were stranded in the hfc, this represents only 0.005% of the total estimated emigrating population of 12,940,409 fish (DWR, unpublished data).

We observed several large flow fluctuations in 2005. Despite substantial fluctuations in discharge the impact of stranding on Chinook salmon and steelhead populations appeared to be very small especially when compared to the number of emigrants from the Feather River. The low number of stranded salmonids observed is likely attributable to the timing of the flow events. By late May and June, most juvenile salmonids have already emigrated the Lower Feather River. Therefore only a small proportion of the juvenile population was susceptible to the late season fluctuations of discharge. Also, the maximum discharge was low enough that the total amount of isolated ponds created was relatively small compared to years when discharge was over 8,000 cfs.

However, quantifying stranding is complicated by several logistical and biological issues, which may also explain why relatively few stranded juvenile salmonids were sampled. For example, many stranded fish may be lost to predation before being sampled or smaller, shallower ponds may dry up before they could sample. Thus, our observed number of stranded fish, to some degree, underestimates the total impact of salmonid stranding.

5.0 REFERENCES

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