

**FIELD NOTE**  
**July 23, 2023**  
**Adult Salmonid Sonar Monitoring Program**  
**South Fork Eel River, Tributary to Eel River**

California Trout has been using a sonar system to estimate abundance of spawning Chinook salmon, Coho salmon, and steelhead on the South Fork Eel River with support from the California Department of Fish and Wildlife. The sonar system (DIDSON) located 10 miles above the South Fork confluence with the Eel River records video of fish as they migrate upstream to their spawning grounds.

This Field Note is our second in-season update for our program partners and interested parties on the status of the operation and preliminary estimates of fish abundance for 2022-23. This sonar station operated during the salmon/steelhead spawning migration seasons of 2018-19 and 2019-20 but did not operate during 2020-21 and 2021-22. Previous seasons of data collection are summarized in Field Reports, which include background information on the deployment site and methods. This document does not contain final data; thus, the preliminary estimates of fish passage in this document should *not* be cited.

### **SONAR OPERATION**

The sonar equipment was first deployed October 31, 2022, before the Eel River's first flow increase of the rainy season. The deployment site for 2019-2020 and 2022-23 features on-site power but loses coverage of 10 miles of South Fork Eel River and some tributaries. The 2018-19 deployment site was only 1 mile from the South Fork-mainstem confluence but required daily battery changes.

With an early November hydrograph peak of only 262 cfs at the USGS Miranda gage, it was relatively easy to maintain correct positioning of the sonar unit until flows increased. At this November's flow levels, the channel was narrow enough to use a 10-meter window length setting on the sonar. This setting increases image resolution: thus, the resulting video is easier to review, and fish are more easily detected by reviewers. As water levels increased and the channel width grew wider, 20 and 40-meter window lengths were used, and the camera had to be removed at flows above approximately 5,000 cfs. Video data has now been reviewed for the entire deployment season, with preliminary passage estimates and uncertainties provided in this note.

### **SAMPLING AND UNCERTAINTY**

For the preliminary estimates provided here, the first 10 minutes of each hour were reviewed to reduce review time and the 40 cm minimum fish length was determined by making measurements with the sonar software. Hourly expanded counts from 10-minute samples are calculated as the net movement (upstream movements – downstream movements) multiplied by an expansion factor of six to represent the entire hour. Daily passage estimates are then calculated as the sum of hourly expanded counts.

We accounted for two sources of uncertainty around our escapement estimates: sampling error and camera downtime. While the V5 estimator of variance is the standard for systematically sampled sonar video data, a 5% sampling error has been used temporarily until the V5 analysis is complete. We considered three scenarios for estimating fish passage during missing hours and days, with progressively longer downtimes with progressively greater uncertainty. First, we interpolate missing hourly counts using counts from available adjacent days. Second, we extrapolate missing hourly counts from a generalized pattern of hourly passage rates. Third, we assess remaining missing days with no video at all and apply a similar day's passage total count. The total uncertainty for each month's estimate is listed in Table 1.

## POST-SPAWN DOWNSTREAM MIGRATION OF STEELHEAD

Steelhead migrating back downstream after completion of spawning (kelts) can mistakenly be subtracted from the steelhead spawning population estimate. January 1 was used to characterize the start of the downstream steelhead migration season. If all downstream movements past the camera from January through March are assigned as downstream migrating steelhead, rather than fish exhibiting milling behavior, the maximum possible number of steelhead kelts is 72. The number of kelts for January through March is likely lower, and downstream migration of steelhead likely continued through April and May.

The camera deployment ended March 31, when the majority of fish movement past the camera has, in previous years, changed to downstream migrating kelts. We suspect this was not the case in spring 2023. We did not observe a shift in fish passage from predominantly upstream to predominantly downstream prior to the end of deployment. Thus, the upstream migration of steelhead may have continued later into Spring than previous years of sonar operation. During the months of April and May, flows were high enough to allow steelhead migration into spawning reaches of tributaries and steelhead kelts were observed as late as May 11 at a weir near Piercy.

*Table 1. Expanded counts, degree of uncertainty for each month of the 2022-2023 South Fork Eel River sonar counting station at Meyers Flat. Total uncertainty combines sources from sampling variance and from camera downtime.*

	November	December	January	February	March	Total
<b>total # fish &gt;40 cm</b>	<b>1884</b>	<b>1994</b>	<b>285</b>	<b>362</b>	<b>332</b>	<b>4857</b>
max possible # of steelhead kelts	N/A	N/A	42	12	18	72
# hours using interpolation	9	29	39	0	36	113
# fish from interpolation	0	90	30	0	39	159
interpolation uncertainty (+/-)	3	54	24	0	9	90
# hours using extrapolation	0	89	77	38	44	248
# fish from extrapolation	0	49	14	8	20	91
# days with no video	0	6	3	2	10	21
# fish on days with no video	0	332	25	24	79	460
total uncertainty (+/-)	97	535	78	51	124	885

## PRELIMINARY FISH MIGRATION ESTIMATE

No fish were detected on October 31 when the sonar was first installed. Small numbers of fish began to pass upstream as flows increased slightly during November 1 – 5. Larger numbers of fish passed upstream before and during the hydrograph peak of 262 cfs at 3 am November 9 (measured at the USGS Miranda gage). As flows dropped below 100 cfs, upstream passage rates slowed (Figure 1), and some days in November saw no net upstream movement detected at the site.

Fish passage rates spiked again around the hydrograph increases around December 2-7. Fish passage estimates remained relatively low throughout the rest of the season with daily estimates not exceeding 100 fish per day. An estimated 4857 fish passed the counting station at Meyers Flat between October 31 and March 31 (Figure 1).

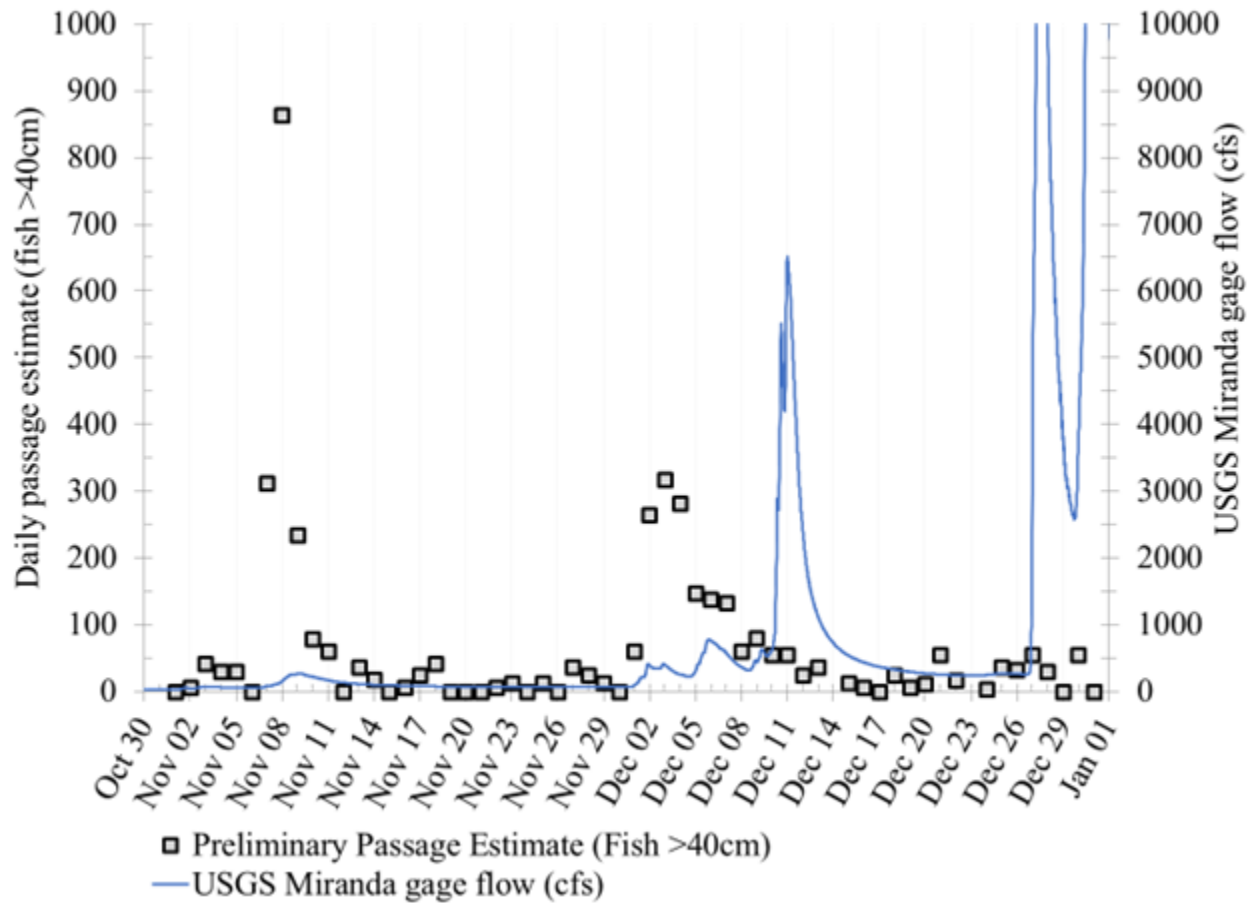


Figure 1. Hydrograph of South Fork Eel River near Miranda (USGS gage #11476500) with preliminary passage estimates of fish over 40cm total length entering the South Fork Eel River in 2022. During this time, an estimated 3,878 adult salmonids migrated upstream past the camera.

The sonar unit's resolution is not high enough to identify fish species from images alone, so spawning survey observations and run-timing are used to inform assignment of each sonar image as Chinook, Coho, or steelhead. Based on typical run times for the South Fork Eel River the estimated 3,878 fish over 40 cm passing the sonar in November and December have been preliminarily assigned as Chinook salmon. The 980 fish over 40 cm passing the sonar from January through March likely represent a mixture of Coho salmon and steelhead (Figure 2).

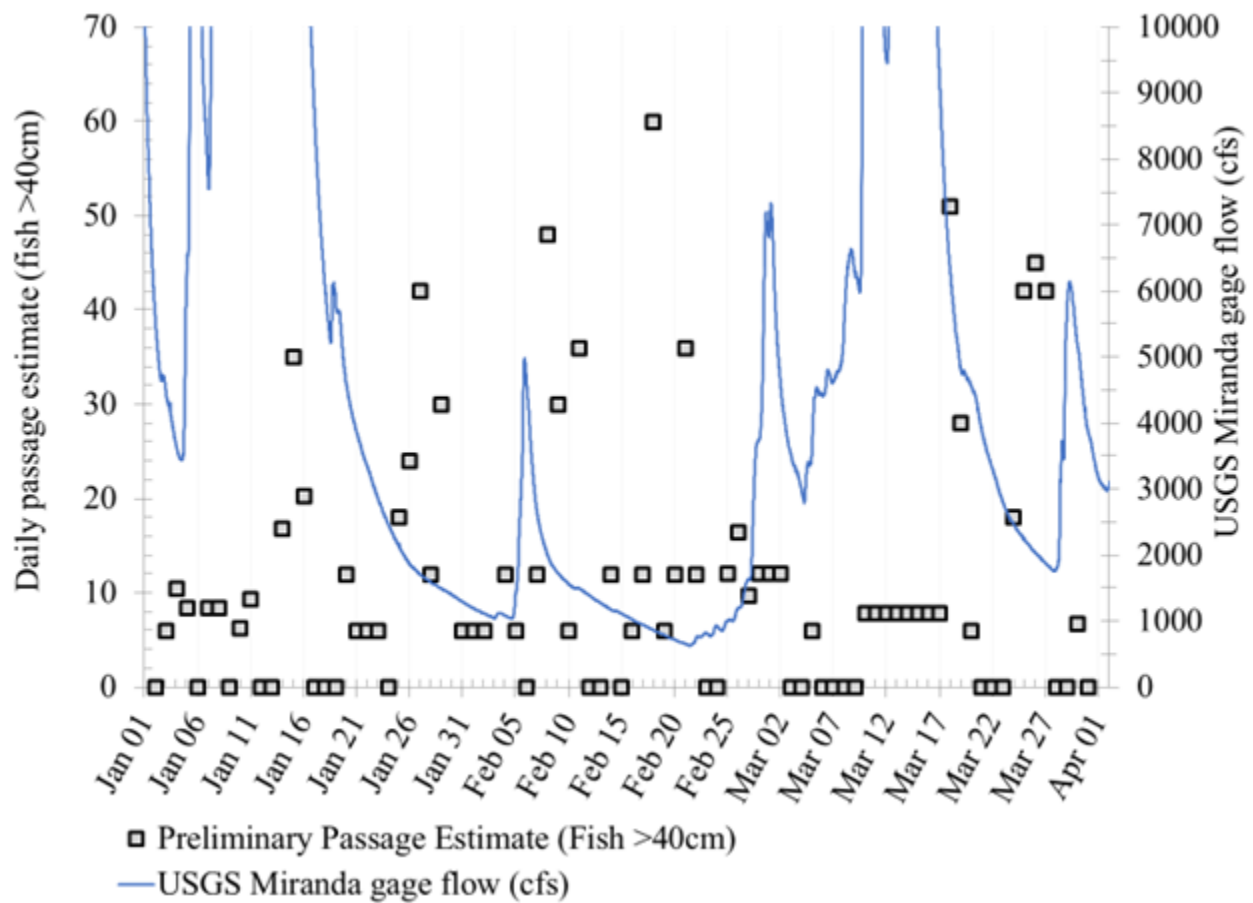


Figure 2. Hydrograph of South Fork Eel River near Miranda (USGS gage #11476500) with preliminary passage estimates of fish over 40 cm total length entering the South Fork Eel River in 2023. During this time, an estimated 980 adult salmonids migrated upstream past the camera.

In 2022 the timing of rain allowed South Fork Eel River Chinook salmon to migrate past the Meyer’s Flat site starting on November 2. When the sonar was operated in 2018 and 2019, passable migration flows in the South Fork Eel River did not occur until later in November. In all three years of operation on The South Fork Eel River, Chinook salmon began migrating past the sonar immediately as soon as flows increased above the summer baseline. Similar behavior has been observed on other nearby river systems operating sonar counting stations.

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