# Adult Salmonid Sonar Monitoring Program

# Lower Mainstem Eel River and South Fork Eel River

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# Sonar Technology on the Eel River

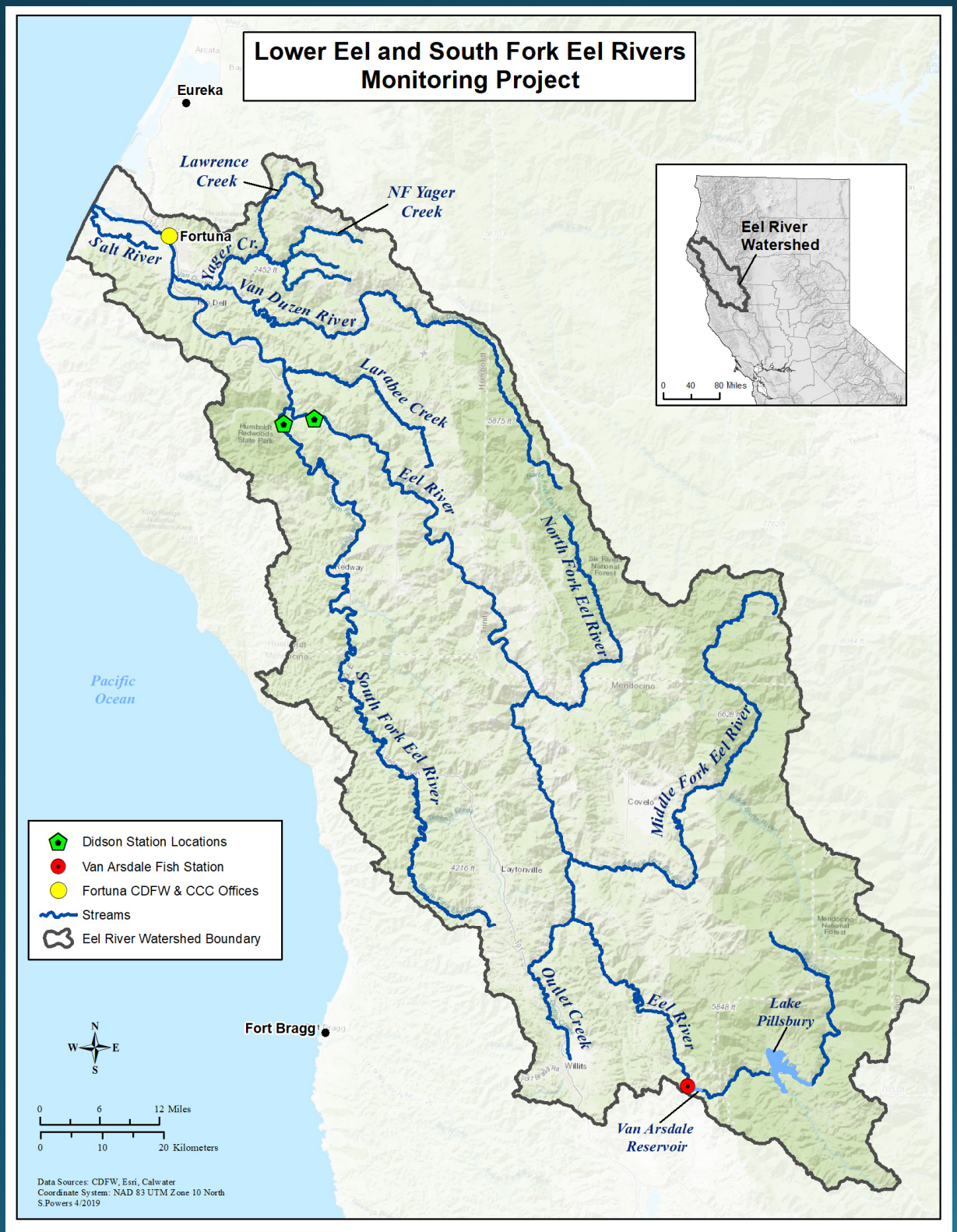
- The California Department of Fish and Wildlife in partnership with Trout Unlimited (TU) as well as California Trout in partnership with the California Conservation Corps (CCC) have explored using SONAR technology to enumerate the 2018/2019 spawning run of Chinook and Coho Salmon and Steelhead Trout on the both the mainstem Eel and South Fork Eel Rivers.
- Sound Metrics Dual Frequency Identification Sonar (DIDSON) cameras have been deployed at two sites in the watershed, which collectively provide salmon escapement data for a large portion of the Eel River Watershed.

# Project Overview

- 2-Year Pilot Study: Currently just completed the initial year of the study (2018-2019 fall/winter season).
- Study/projects began mid to late November 2018 and counted fall Chinook and Coho Salmon and Steelhead Trout till April 2019. The 2019-2020 may follow a similar timeline.
- Projects intended to collect information 7 days a week/ 24 hrs./day, but this is greatly determined by river flows and rainfall patterns.
- **Mainstem Eel River Project**: CDFW is providing project oversight and staffing as well as equipment and additional funding for implementation of the project. Trout Unlimited has partnered with CDFW and is providing consultation and additional equipment purchasing through its donors.
- **South Fork Eel River Project**: CalTrout project funded by a grant from the CDFW Fisheries Restoration Grant Program – and provided project oversight and a crew lead. Partnered with California Conservation Corps for field staff, vehicles, and office space for data review.
- Sonar cameras and associated sonar equipment have been provided by CDFW Fisheries Branch.

# DIDSON Counting Station Locations

- Mainstem Eel River: approximately 4 miles upstream confluence with SF Eel River
- South Fork Eel River: just downstream of confluence with Bull Creek

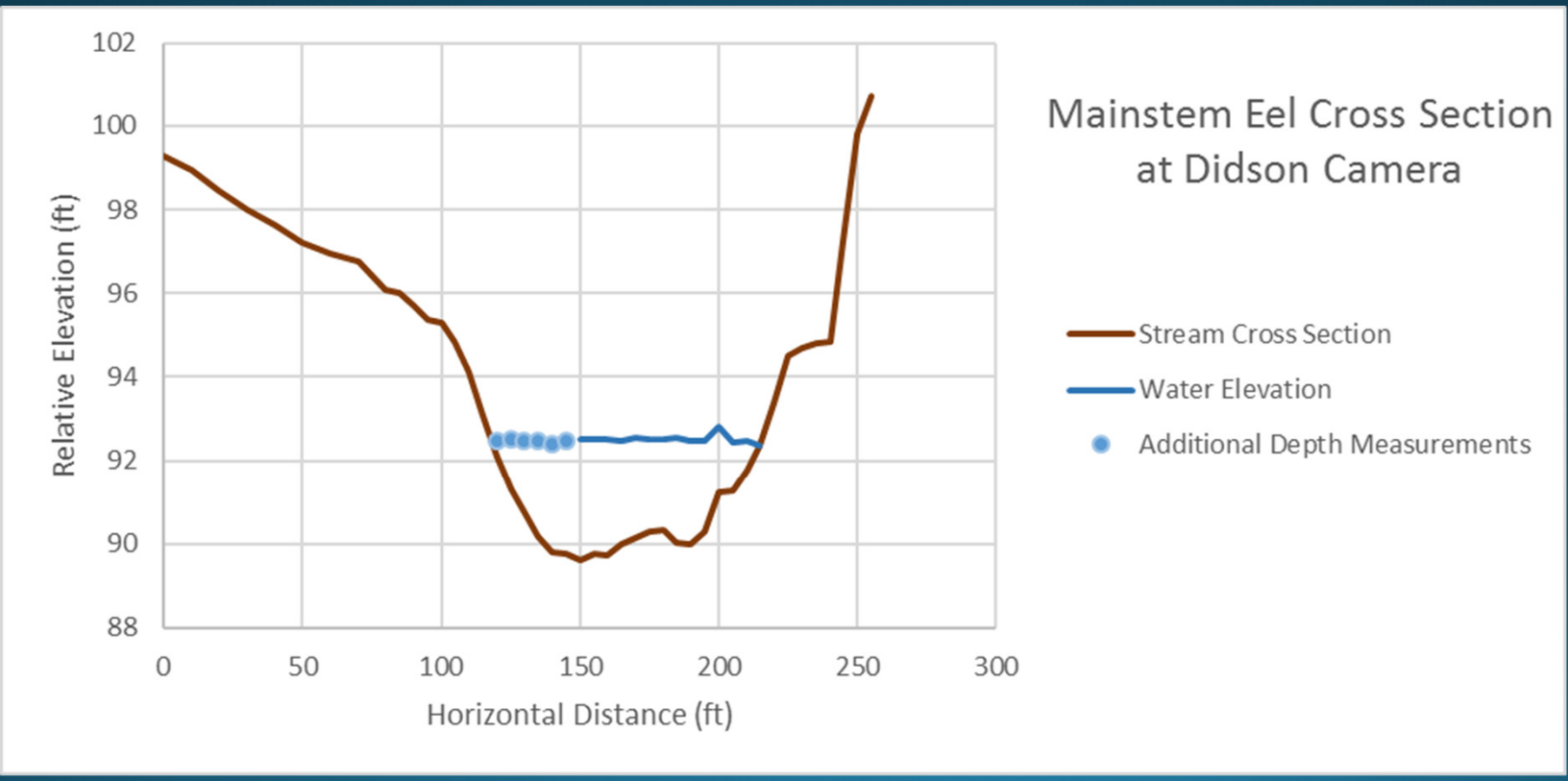


# Sonar Camera Site Location

Photo 1. View of potential DIDSON site looking downstream (June 18, 2018; cfs 265)

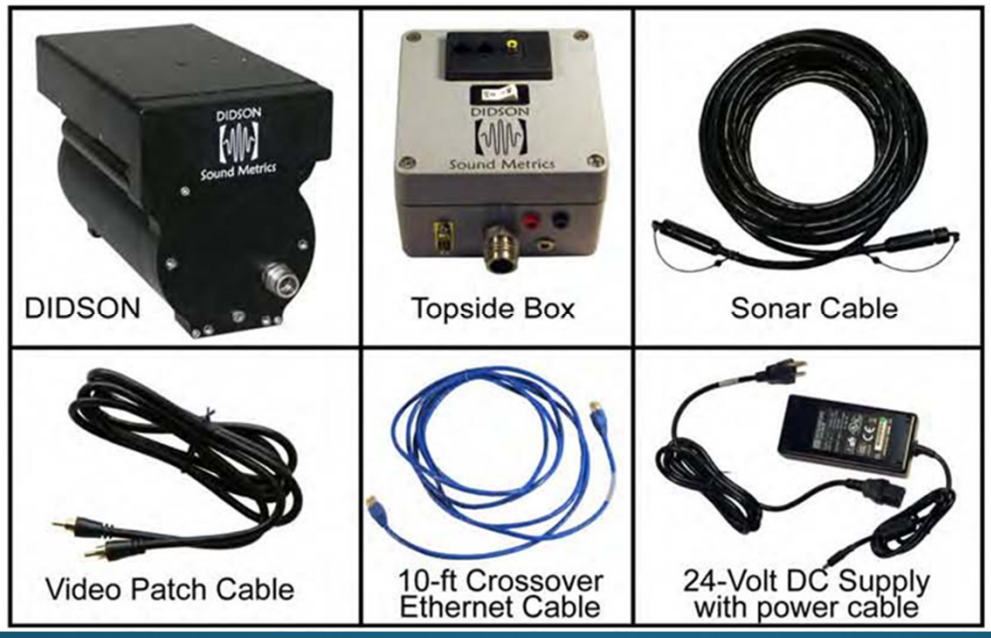
DIDSON Camera

Photo 2. View of potential DIDSON site and looking upstream.


Mainstem Eel Cross Section at Didson Camera
Relative Elevation (ft)
102
100
98
96
94
92
90
88
0
50
100
150
200
250
300
Horizontal Distance (ft)
Stream Cross Section
Water Elevation
Additional Depth Measurements

# Sonar Equipment

- Long Range DIDSON Sonar Camera, software, associated cables (including a 300 meter sonar cable), etc.
- Laptop computer to run camera software and record data files
- H-Brace for base station of the Sonar Camera that sits inside a locked box

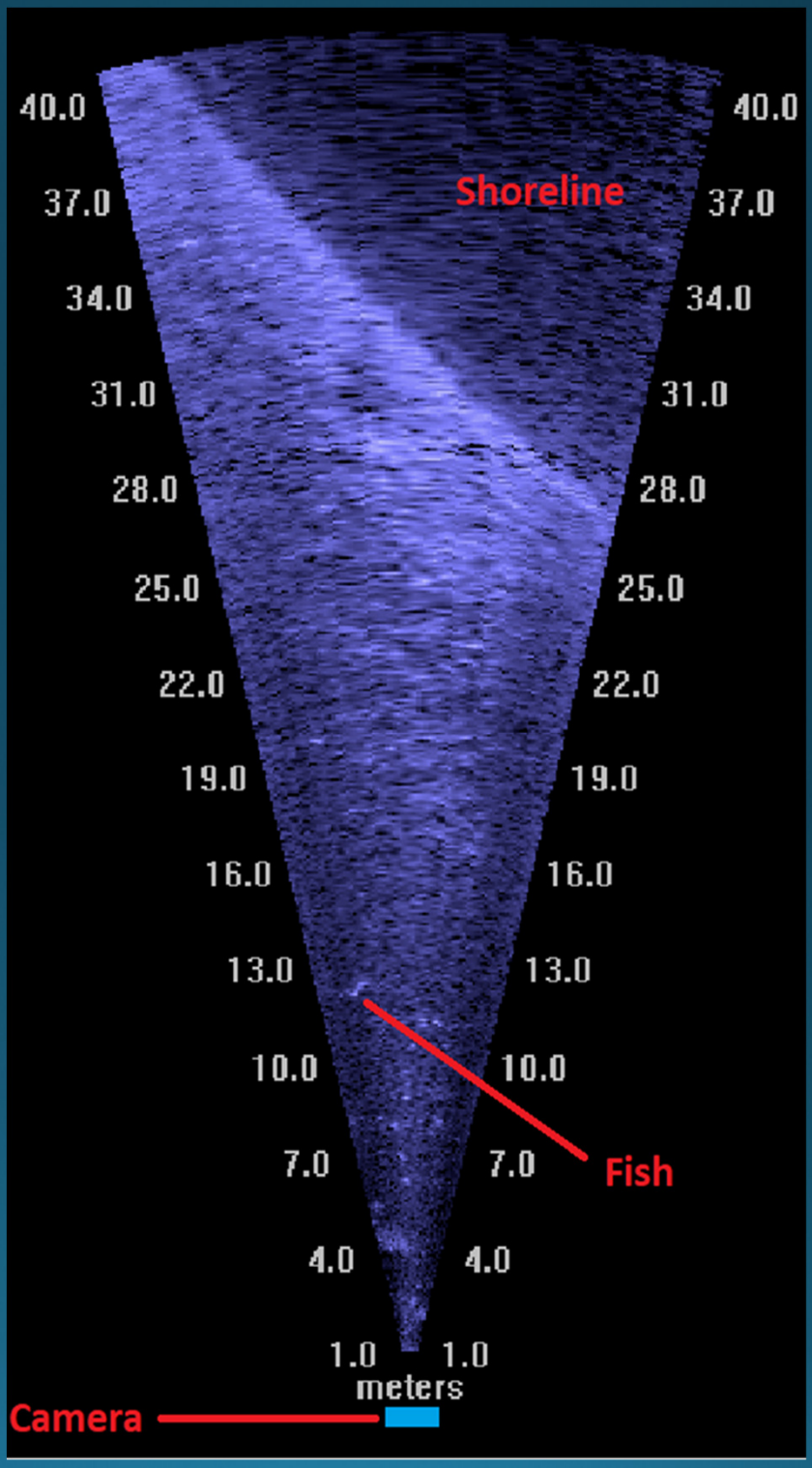


# Sonar Field Setup and Operations

- Both sites are located on large river bars without access to a power source. A temporarily placed structure houses the associated sonar equipment.
- Field equipment setup consists of a DIDSON camera inside a locked box, camera stand, an off grid power source, a laptop, and an external hard drive.
- Cameras operate 24 hours/7 days a week, beginning with the initial onset of the migration season and are removed during high flow events.
- Both cameras are adjusted daily as the flows fluctuate.

# Data Compilation and Review

- The DIDSON camera records the entire 24-hours for each day. In order to expedite the review process, the projects are reviewing only the first 20-minutes of each hour. Hourly expanded counts are calculated as the net movement in 20 minutes multiplied by an expansion factor. Daily passage estimates are calculated as the sum of these hourly expanded counts.
- Salmonid species cannot be determined by sonar images alone. Species assignment is based on the run timing of each species using current and historical observations at the Van Arsdale Fish Station (upper mainstem Eel River) and annual CDFW South Fork Eel River spawning ground surveys.

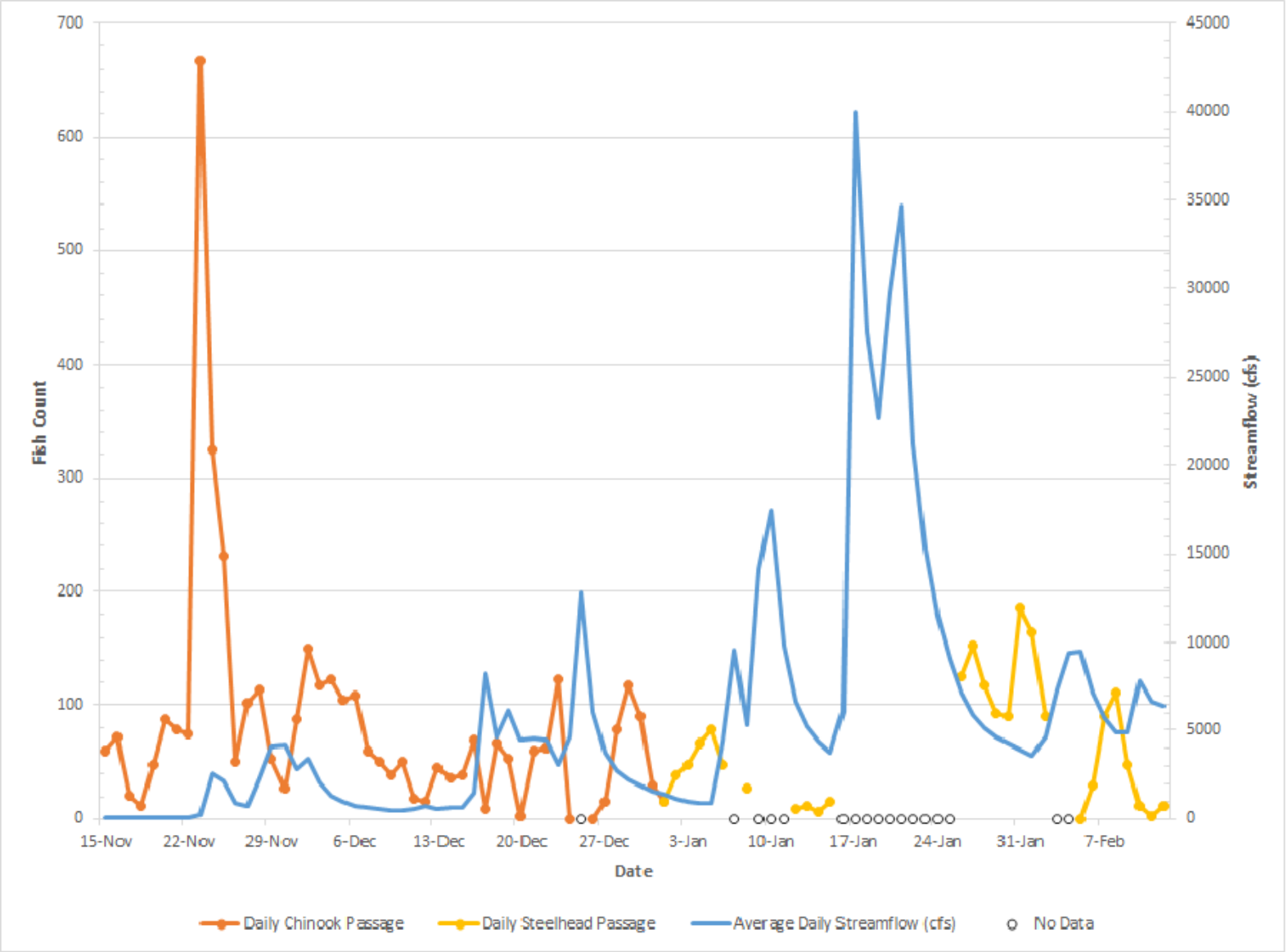


# Fish Migration Patterns

- The first significant rain event in the Eel River watershed did not occur until late November, which likely delayed the initial run timing of Chinook salmon. Large numbers of adult fish were observed at both sites shortly after this rain event.
- The month of December maintained additional pulses of fish, although these numbers were significantly less than what was observed in late November period. Subsequent, smaller pulses of fish appear linked to troughs in the hydrograph.
- For both sites, it is estimated the vast majority of the Chinook run ceased during the last week of December. This is largely based on two indicators: only 1 Chinook ascended the ladder at the Van Arsdale Fish Station (upper watershed, Figure 1); and CDFW South Fork Eel River spawning ground surveys detected almost no new Chinook entering the watershed in January.

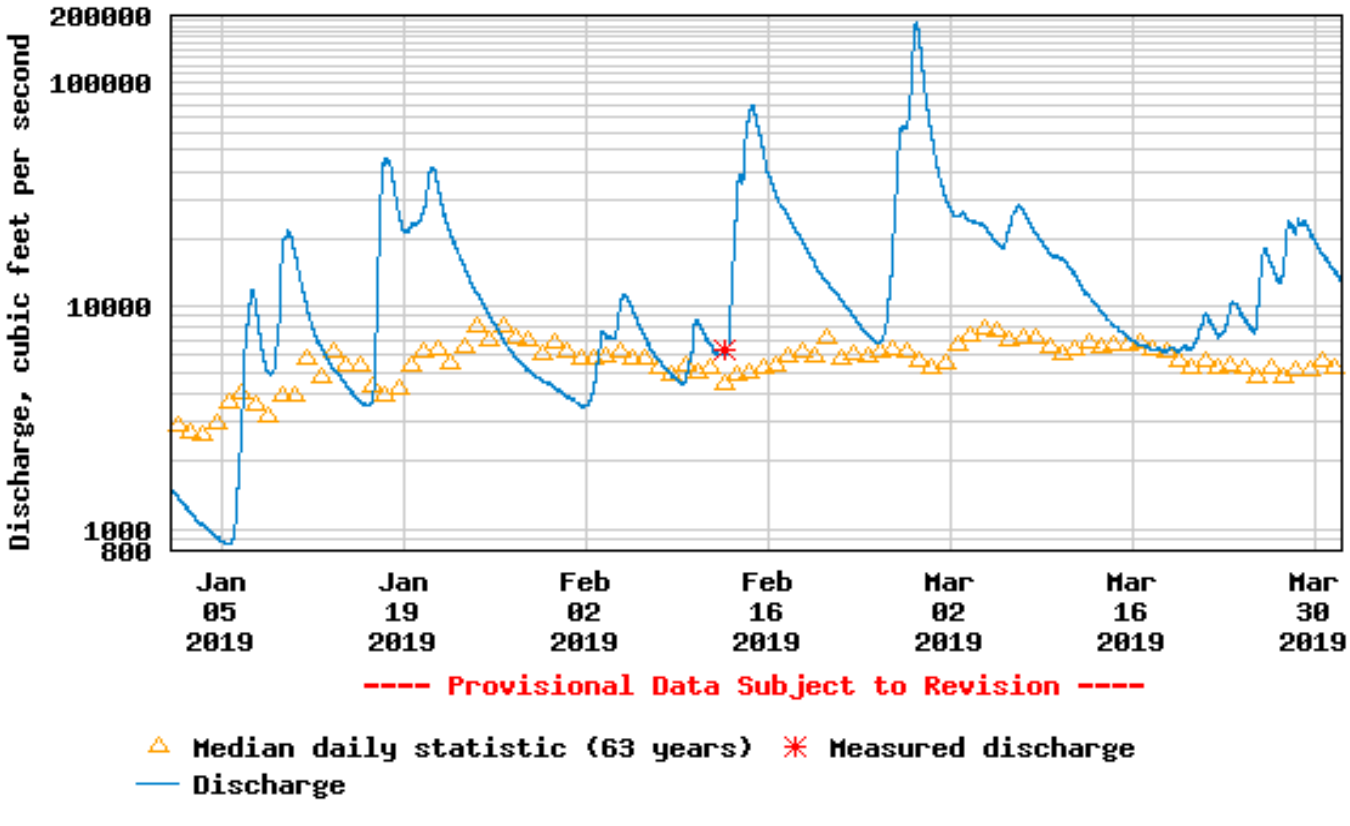
# Preliminary Fish Migration Estimates

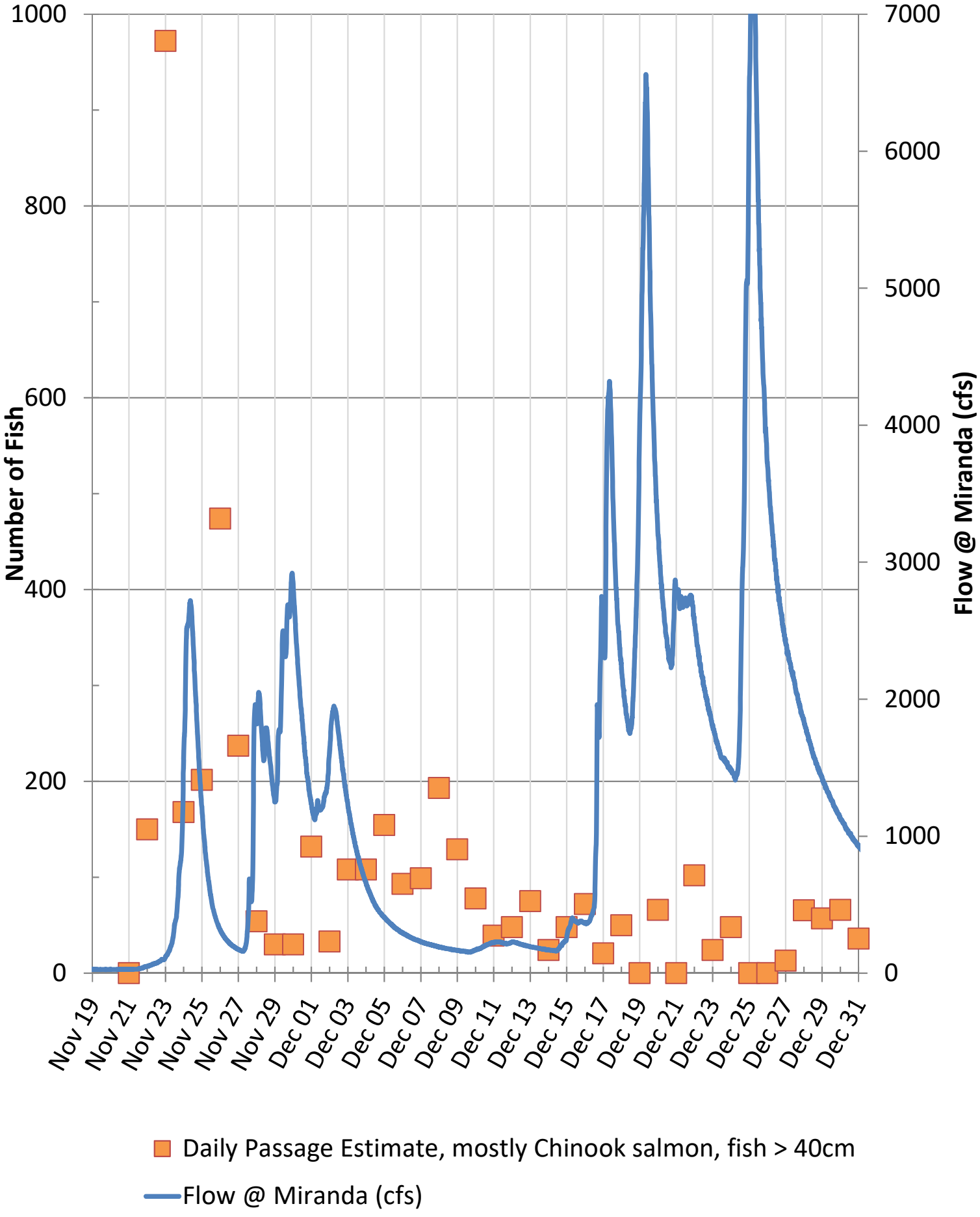
- Mainstem Eel: The initial migration pulse (Nov 22) contained the highest passage rate of fish during the Chinook run as the month of December witnessed smaller pulses of fish.
- During the camera's operational period (Nov 15th, 2018 to Feb 12th, 2019) the preliminary estimated net movement of fish over 39 cm was 5,239 (of this total the Chinook estimate is 3,844).

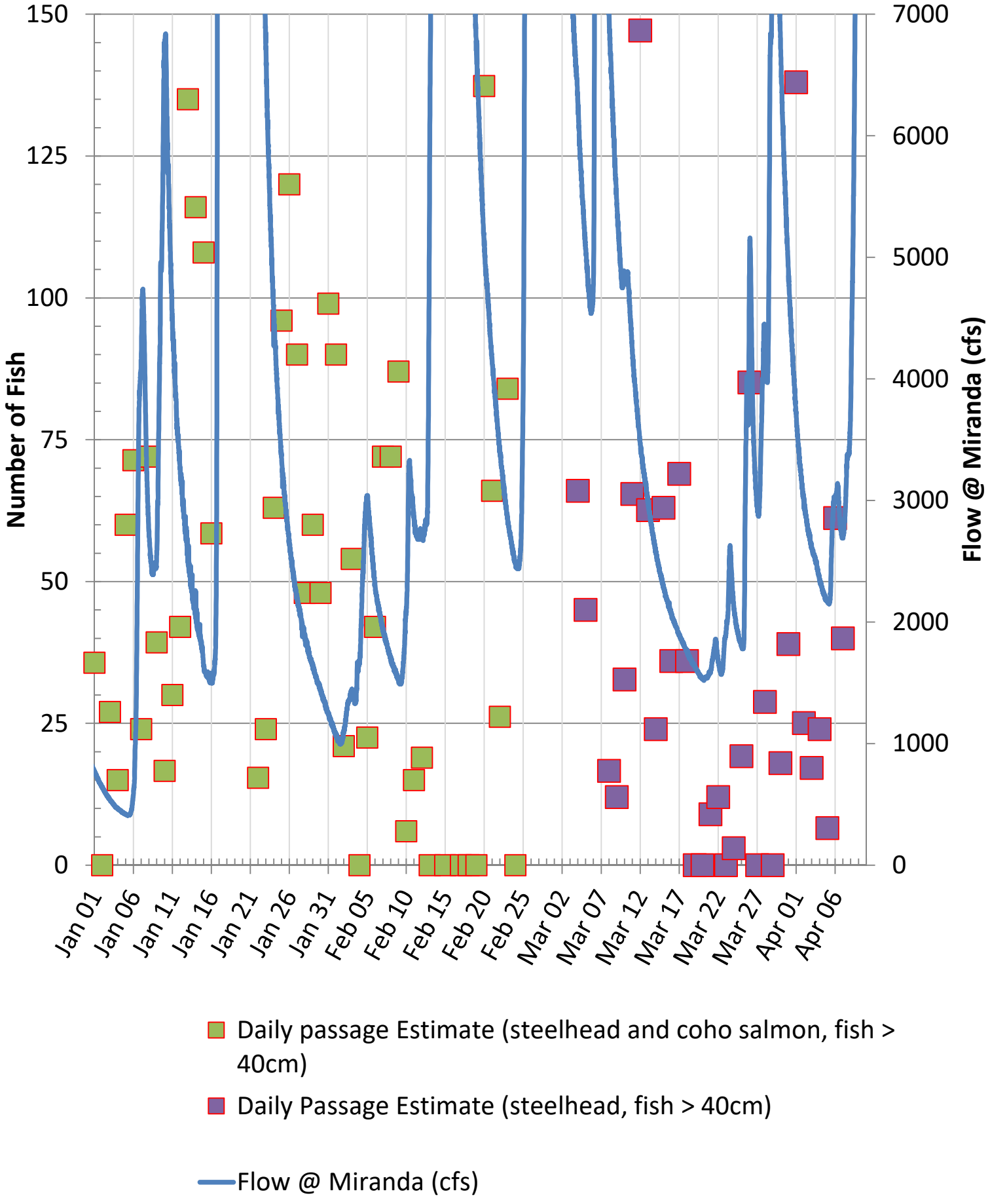


USGS

## USGS 11475000 EEL R A FORT SEWARD CA




1000
800
600
400
200
0
Number of Fish
7000
6000
5000
4000
3000
2000
1000
0
Flow @ Miranda (cfs)
Nov 19
Nov 21
Nov 23
Nov 25
Nov 27
Nov 29
Dec 01
Dec 03
Dec 05
Dec 07
Dec 09
Dec 11
Dec 13
Dec 15
Dec 17
Dec 19
Dec 21
Dec 23
Dec 25
Dec 27
Dec 29
Dec 31
Daily Passage Estimate, mostly Chinook salmon, fish > 40cm
Flow @ Miranda (cfs)


150
125
100
75
50
25
0
Number of Fish
7000
6000
5000
4000
3000
2000
1000
0
Flow @ Miranda (cfs)
Jan 01
Jan 06
Jan 11
Jan 16
Jan 21
Jan 26
Jan 31
Feb 05
Feb 10
Feb 15
Feb 20
Feb 25
Mar 02
Mar 07
Mar 12
Mar 17
Mar 22
Mar 27
Apr 01
Apr 06
Daily passage Estimate (steelhead and coho salmon, fish > 40cm)
Daily Passage Estimate (steelhead, fish > 40cm)
Flow @ Miranda (cfs)

- SONAR Advantages

- Best/only choice for larger river reaches
- Provides fish behavior
- Provides fish length
- Potential real-time data

- SONAR Disadvantages

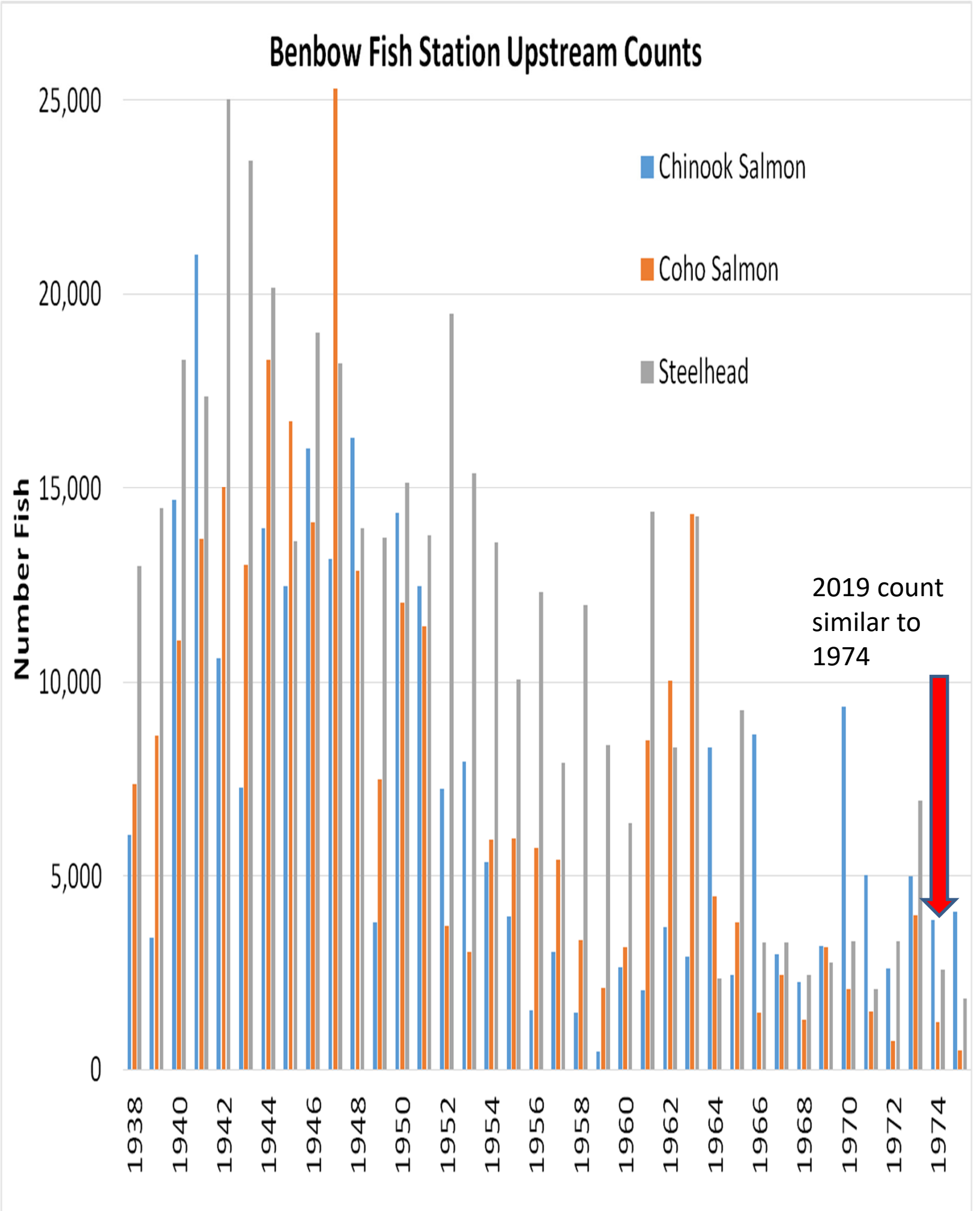
- Generally cannot id species from image
- Detections limited to low-intermediate flows
- Pikeminnow
- Down-running steelhead

# Species assignment

- Date of detection and length of fish inform model
  - Observations from spawner surveys, lower river staging, anglers, Benbow dam approximate run timing
  - Early, large fish assigned as Chinook
  - March-April fish assigned as steelhead
- Coho salmon present the most uncertainty
  - Overlap with steelhead and Chinook run times and sizes
  - Model is sensitive to relative number of coho observations
  - Disproportionally high Coho observations from surveys that target coho?

# How do these counts compare?

- Mad River:
  - 6,800 Chinook + 700 steelhead = 7,500 total fall run fish on average
  - 2018 count in progress: 16,000 total fish (Sep-Feb) = above average
  - 2019 guess: slightly below average (5,000 Chinook)
- Redwood Creek fall run:
  - Average of 3,000 Chinook


Benbow Fish Station Upstream Counts
25,000
20,000
15,000
10,000
5,000
0
Number Fish
Chinook Salmon
Coho Salmon
Steelhead
2019 count similar to 1974
1938
1940
1942
1944
1946
1948
1950
1952
1954
1956
1958
1960
1962
1964
1966
1968
1970
1972
1974

# CDFW redd abundance estimates

| | 2009-2010 | 2010-2011 | 2011-2012 | 2012-2013 | 2013-2014 | 2014-2015 | 2015-2016 |
|---|---|---|---|---|---|---|---|
| **Chinook Salmon** | | | | | | | |
| Humboldt Bay | x | 19 | 0 | 0 | 0 | 1 | 3 |
| Freshwater Creek | x | 12 | 0 | 0 | 0 | | |
| South Fork Eel River | | 1829 | 68 | 855 | 223 | 781 | 418 |
| Redwood Creek | 260 | 783 | 866 | 940 | 963 | 1063 | 740 |
| Prairie Creek | | 262 | 103 | 308 | 151 | 158 | 295 |
| **coho Salmon** | | | | | | | |
| Humboldt Bay | 194 | 1099 | 1738 | 763 | 630 | 1183 | 562 |
| Freshwater Creek | | 231 | 420 | 244 | 127 | 453 | 323 |
| South Fork Eel River | | 1284 | 1873 | 1340 | 939 | 2069 | 416 |
| Redwood Creek | 191 | 574 | 540 | 405 | 705 | 297 | 206 |
| Prairie Creek | | 344 | 387 | 365 | 538 | 160 | 180 |

# Project Partners and Field Staff


- **Mainstem Eel River**: – We are very grateful for our project partner, Trout Unlimited, who assisted with equipment purchasing set-up and additional supplementary funding. TU project members: Anna Halligan, Erik Young, Charlie Schneider, and Brian Johnson. Thanks to CDFW field staff for daily operations and data review: Joshua Gruver, Ellen Hensel, Alex Sudd-Sojka and Evan Hendricksen; CDFW Fisheries Branch for sonar cameras; CDFW Mike Sparkman, Northern Region Sonar Coordinator for technical expertise; Cardno Project lead: Nicholas Easterbrook; and Humboldt Redwood Company for landowner access.
- **SF Eel Project**: This California Trout project was funded by a grant from the CDFW Fisheries Restoration Grant Program - Steelhead Report and Restoration Card program. Thanks to CCC staff and members: Brian Starks, Daniel Osterman, Hannah Carroll, Omar Olivarez, Qing-Qui Swain; AmeriCorps Watershed Stewards Program: Mackenzie Spencer; Lead Technician: Kori Roberts; and thanks to CA State Parks for landowner access.