ENHANCED ACOUSTIC TAGGING, ANALYSIS, AND REAL-TIME MONITORING OF WILD AND HATCHERY SALMONIDS IN THE SACRAMENTO RIVER VALLEY

Semi-annual report April 1 to September 30, 2022

Prepared for:  
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# Introduction

This report summarizes the fieldwork, data collection, and analysis performed by UC Santa Cruz (UCSC) between April 1 and September 30, 2022, as part of the Cooperative Agreement R21AC10455 between the US Bureau of Reclamation (USBR) and UCSC. This is the second semi-annual report for the Cooperative Agreement R21AC10455, extending from October 1, 2021 to September 30, 2026. This semi-annual report outlines deliverables for the six tasks described by the agreement.

# Task 1. Deploy real-time array of JSATS receivers

There were 25 autonomous receivers deployed and/or retrieved during this quarter (Table 1). All acoustic receivers stationed in the Sacramento River, Delta, and Golden Gate were retrieved and deployed by UCSC.

All real-time receivers shown in Table 1 were operational during this quarter, except for temporary receiver outages due to SD cards ejecting, data glitches due to a potential leap year day, and to replace an ATS real-time receiver in Sacramento (Tower Bridge). Site visits were conducted at all locations for quarterly data downloads, maintenance, and SD card swaps. Maintenance for the instruments included updating firmware, and replacing a receiver. All SD cards were secured to the receiver so that future unexpected card ejections and data loss are unlikely to occur.

A detailed spreadsheet of all real-time receiver deployments can be found here: <https://docs.google.com/spreadsheets/d/1oBfEO3cIdP9PJaLxyN9kJ2yYpufTfGIIDvBtVnU8muo/edit#gid=79918077>

Table 1. Location of real-time JSATS receivers with the date first operational in real-time

| **Region** | **GPSname** | **Lat** | **Lon** | **rkm** | **RecMake** | **SN** | **StartTime** | **EndTime** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Lower Sac R | ButteBr2 | 39.45720 | -121.9950 | 344.109 | ATS SR3017 | 19030 | 2021-10-20 17:31:00 | 2022-04-12 16:06:00 |
| Lower Sac R | I80-50\_Br1 | 38.57058 | -121.5157 | 170.746 |  | 17048 | 2022-04-11 16:00:00 |  |
| Lower Sac R | ButteBr1 | 39.45690 | -121.9950 | 344.108 | ATS SR3017 | 18002 | 2022-04-12 16:15:00 | 2022-10-26 13:30:00 |
|  | MeridianBr\_RT1 |  |  |  | ATS SR3017 | 17134 | 2022-04-14 16:25:00 | 2022-10-26 10:34:00 |
|  | MeridianBr\_RT2 |  |  |  | ATS SR3017 | 17133 | 2022-04-14 16:25:00 | 2022-05-13 08:30:00 |
| Carquinez Strait | Benicia09 | 38.04748 | -122.1254 | 52.236 | ATS SR3017 | 18001 | 2022-10-24 10:28:00 |  |
| Carquinez Strait | Benicia10 | 38.04682 | -122.1248 | 52.237 | ATS SR3017 | 21154 | 2022-10-24 10:06:00 |  |
| Carquinez Strait | Benicia11 | 38.04529 | -122.1242 | 52.238 | ATS SR3017 | 17135 | 2022-10-24 10:48:00 |  |
| Carquinez Strait | Benicia01 | 38.04494 | -122.1269 | 52.041 | ATS SR3017 | 17130 | 2022-10-25 10:07:00 |  |
| Carquinez Strait | Benicia02 | 38.04377 | -122.1260 | 52.042 | ATS SR3017 | 18008 | 2022-10-25 09:57:00 |  |
| Carquinez Strait | Benicia03 | 38.04243 | -122.1250 | 52.043 | ATS SR3017 | 17145 | 2022-10-25 09:47:00 |  |
| Carquinez Strait | Benicia04 | 38.04123 | -122.1238 | 52.044 | ATS SR3017 | 17147 | 2022-10-25 09:37:00 |  |
| Carquinez Strait | Benicia05 | 38.03994 | -122.1230 | 52.045 | ATS SR3017 | 20046 | 2022-10-25 09:27:00 |  |
| Carquinez Strait | Benicia06 | 38.03896 | -122.1219 | 52.046 | ATS SR3017 | 17148 | 2022-10-25 09:17:00 |  |
| Carquinez Strait | Benicia07 | 38.03762 | -122.1211 | 52.047 | ATS SR3017 | 17143 | 2022-10-25 09:11:00 |  |
| Carquinez Strait | Benicia08 | 38.03645 | -122.1201 | 52.048 | ATS SR3017 | 17146 | 2022-10-25 08:58:00 |  |
| Carquinez Strait | Benicia12 | 38.04337 | -122.1234 | 52.239 | ATS SR3017 | 18006 | 2022-10-25 08:01:00 |  |
| Carquinez Strait | Benicia13 | 38.04241 | -122.1220 | 52.240 | ATS SR3017 | 17127 | 2022-10-25 08:14:00 |  |
| Carquinez Strait | Benicia14 | 38.04165 | -122.1211 | 52.241 | ATS SR3017 | 17125 | 2022-10-25 08:25:00 |  |
| Carquinez Strait | Benicia15 | 38.04016 | -122.1200 | 52.242 | ATS SR3017 | 17141 | 2022-10-25 08:34:00 |  |
| Carquinez Strait | Benicia16 | 38.03872 | -122.1193 | 52.243 | ATS SR3017 | 21150 | 2022-10-25 08:48:00 |  |
| Lower Sac R | I80-50\_Br2 | 38.57117 | -121.5163 | 170.747 | Tekno RT | 20080 | 2022-10-25 12:47:00 |  |
| Lower Sac R | I80-50\_Br3 | 38.57117 | -121.5163 | 170.748 | Tekno RT | 20075 | 2022-10-25 12:53:00 |  |
| Lower Sac R | TowerBr2 | 38.58044 | -121.5086 | 172.002 | Tekno RT | 17126 | 2022-10-25 13:39:00 |  |
| Lower Sac R | TowerBr3 | 38.58025 | -121.5082 | 172.003 | ATS SR3017 | 18003 | 2022-10-25 13:20:00 |  |

Deliverables 1-4 were met by posting data relating to survival and movement to the website: <https://oceanview.pfeg.noaa.gov/CalFishTrack>

## Deliverables

1. Web-accessible reporting status of real-time receivers
2. Real-time data available through ERDDAP data server, updated daily
3. Web-accessible real-time receiver data available in open data format
4. Web-accessible summary database of deployment of receivers
5. Data quality assurance of no more than 3 days of downtime before a site visit to reestablish real-time operations
6. Provide a semi-annual compiled raw data file for each real-time receiver along with deployment metadata to Arnold Ammann (NMFS)

# Task 2. Deploy autonomous array of JSATS and Vemco receivers

## Autonomous Receiver Deployment

There were 37 autonomous receivers retrieved and/or deployed during this quarter (Table 2). All acoustic receivers stationed in the Sacramento River, Delta, and Golden Gate were retrieved and deployed by UCSC. These locations include Mill Creek (2) the Sacramento River (17), Delta (8), and Golden Gate (10).

Table 2. Autonomous JSATS receivers deployed and retrieved between April 1, 2021, and September 30, 2022

| **Region** | **GPSname** | **Lat** | **Lon** | **rkm** | **RecMake** | **SN** | **StartTime** | **EndTime** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| West Delta | Three\_Mile\_North1 | 38.11094 | -121.6822 | 95.138 | ATS V3.1 | 13,025 | 2022-03-10 15:13:00 | 2022-06-30 13:03:00 |
| West Delta | Three\_Mile\_North3 | 38.11044 | -121.6822 | 95.178 | ATS V3.0 | 15,019 | 2022-03-10 15:57:00 | 2022-06-30 13:16:00 |
| West Delta | Three\_Mile\_South1 | 38.10680 | -121.6834 | 95.619 | ATS V3.1 | 13,022 | 2022-03-10 16:33:00 | 2022-06-30 13:32:00 |
| West Delta | Three\_Mile\_South2 | 38.10789 | -121.6849 | 95.508 | ATS V3.1 | 20,074 | 2022-03-10 17:10:00 | 2022-06-30 13:45:00 |
| South Delta | Delta\_TC\_1 | 37.99057 | -121.4594 | 132.000 | ATS V3.1 | 15,010 | 2022-03-15 15:07:00 | 2022-07-27 17:46:00 |
| South Delta | Delta\_TC\_2 | 37.99054 | -121.4597 | 131.970 | ATS V3.0 | 15,020 | 2022-03-15 15:25:00 | 2022-07-27 18:02:00 |
| South Delta | Delta\_TC\_5 | 37.98849 | -121.4647 |  | ATS V3.0 | 15,017 | 2022-03-15 15:43:00 | 2022-07-27 18:16:00 |
| South Delta | Delta\_TC\_6 | 37.98836 | -121.4651 |  | ATS V3.1 | 15,004 | 2022-03-15 16:07:00 | 2022-07-27 18:32:00 |
| Lower Sac R | Abv\_Fremont1 | 38.76009 | -121.6714 | 215.180 | ATS Stock | 20,104 | 2022-03-22 12:17:00 | 2022-06-29 12:26:00 |
| Lower Sac R | Abv\_Fremont2 | 38.75940 | -121.6716 | 215.179 | ATS Stock | 21,135 | 2022-03-22 12:32:00 | 2022-06-29 12:21:00 |
| Lower Sac R | Blw\_Fremont1 | 38.77015 | -121.6322 | 210.360 | ATS Stock | 20,124 | 2022-03-22 11:26:00 | 2022-06-29 12:40:00 |
| Lower Sac R | Blw\_Fremont2 | 38.77268 | -121.6320 | 210.359 | ATS Stock | 20,108 | 2022-03-22 11:11:00 | 2022-06-29 12:45:00 |
| Lower Sac R | BlwChinaBend2 | 38.88246 | -121.8177 | 240.619 | ATS Stock | 20,120 | 2022-03-22 14:41:00 | 2022-06-29 09:54:00 |
| Lower Sac R | BlwChinaBend3 | 38.88089 | -121.8178 | 240.617 | ATS Stock | 20,121 | 2022-03-22 14:29:00 | 2022-06-29 09:40:00 |
| Lower Sac R | FRConf1 | 38.77409 | -121.6004 | 203.468 | ATS Stock | 20,116 | 2022-03-22 10:23:00 | 2022-06-29 13:05:00 |
| Lower Sac R | FRConf3 | 38.77573 | -121.6018 | 203.470 | ATS Stock | 20,099 | 2022-03-22 10:43:00 | 2022-06-29 13:13:00 |
| Lower Sac R | Knights\_RST1 | 38.79248 | -121.6909 | 222.050 | ATS Stock | 20,117 | 2022-03-22 13:20:00 | 2022-06-29 10:43:00 |
| Lower Sac R | Knights\_RST2 | 38.79368 | -121.6907 | 222.051 | ATS Stock | 20,105 | 2022-03-22 13:37:00 | 2022-06-29 10:40:00 |
| Lower Sac R | KnightsBlwRST1 | 38.78877 | -121.6940 | 221.580 | ATS Stock | 20,100 | 2022-03-22 13:06:00 | 2022-06-29 10:52:00 |
| Lower Sac R | KnightsBlwRST2 | 38.78787 | -121.6937 | 221.570 | ATS Stock | 20,098 | 2022-03-22 12:52:00 | 2022-06-29 10:58:00 |
| Lower Sac R | AbvTisdale3 | 39.03640 | -121.8292 | 269.236 | ATS V3.1 | 13,036 | 2022-03-23 09:11:00 | 2022-06-29 15:12:00 |
| Lower Sac R | AbvTisdale4 | 39.03610 | -121.8290 | 269.238 | ATS V3.1 | 15,022 | 2022-03-23 09:59:00 | 2022-06-29 15:37:00 |
| Lower Sac R | BlwTisdale2 | 39.01862 | -121.8212 | 261.406 | ATS Stock | 20,115 | 2022-03-23 08:45:00 | 2022-06-29 16:00:00 |
| Lower Sac R | BlwTisdale3 | 39.01736 | -121.8234 | 261.407 | ATS Stock | 21,132 | 2022-03-23 08:32:00 | 2022-06-29 16:07:00 |
| SF Bay | GG1 | 37.82898 | -122.4741 | 0.801 | ATS V3.0 | 15,045 | 2022-03-31 16:24:00 | 2022-08-02 11:08:00 |
| SF Bay | GG2.1 | 37.82606 | -122.4694 | 0.804 | ATS V3.0 | 15,012 | 2022-03-31 16:33:00 | 2022-08-02 10:56:00 |
| SF Bay | GG3.1 | 37.82215 | -122.4662 | 0.806 | ATS V3.0 | 15,003 | 2022-03-31 16:38:00 | 2022-08-02 10:41:00 |
| SF Bay | GG4 | 37.81615 | -122.4680 | 0.808 | ATS V3.0 | 15,011 | 2022-03-31 16:44:00 | 2022-08-02 10:30:00 |
| SF Bay | GG5.1 | 37.81129 | -122.4667 | 0.810 | ATS V3.0 | 15,007 | 2022-03-31 16:51:00 | 2022-08-02 10:17:00 |
| SF Bay | GG6 | 37.83390 | -122.4680 | 1.711 | ATS V3.0 | 15,015 | 2022-03-31 09:37:00 | 2022-08-02 08:18:00 |
| SF Bay | GG7 | 37.83025 | -122.4638 | 1.713 | ATS V3.0 | 15,016 | 2022-03-31 10:23:00 | 2022-08-02 08:50:00 |
| SF Bay | GG7.5 | 37.82542 | -122.4599 | 1.715 | ATS V3.0 | 15,001 | 2022-03-31 10:44:00 | 2022-08-02 09:14:00 |
| SF Bay | GG8 | 37.81856 | -122.4576 | 1.717 | ATS V3.0 | 15,043 | 2022-03-31 11:17:00 | 2022-08-02 09:36:00 |
| SF Bay | GG9 | 37.81305 | -122.4560 | 1.719 | ATS V3.0 | 15,025 | 2022-03-31 11:47:00 | 2022-08-02 09:55:00 |
| Mill Ck | MillCk\_RST | 40.05479 | -122.0321 | 450.702 | Lotek 4350L | 200,084 | 2022-04-05 10:40:00 | 2022-07-01 14:20:00 |
| Mill Ck | MillCk3 | 40.04035 | -122.1044 | 443.262 | Lotek 4350L | 200,080 | 2022-04-05 13:17:00 | 2022-07-01 09:35:00 |
| Lower Sac R | TowerBr1 | 38.58046 | -121.5087 | 172.001 | SR3017 | 17,048 | 2022-10-25 13:35:00 |  |

## Vemco Receiver Deployment

UCSC deployed or retrieved 25 Vemco receivers between April 1, 2021 and September 30, 2022 (Table 3). All Golden Gate receivers were acoustic release style. These receivers are used to anchor JSATS receivers, but also serve a double purpose as a hydrophone for Vemco tags.

Table 3. Vemco receivers active, deployed, or retrieved between April 1, 2021, and September 30, 2022

| **GPSname** | **GeneralLocation** | **Genrkm** | **VemcoSN** | **StartTime** | **EndTime** |
| --- | --- | --- | --- | --- | --- |
| GG5.1 | GoldenGateW | 0.800 | 547648 | 2021-07-22 07:58:00 |  |
| AbvTisdale2 | AbvTisdale | 269.238 | 108505 | 2022-03-23 10:12:00 | 2022-06-29 15:37:00 |
| AbvTisdale3 | AbvTisdale | 269.238 | 106789 | 2022-03-23 09:43:00 | 2022-06-29 15:16:00 |
| AbvTisdale2 | AbvTisdale | 269.238 | 108505 | 2022-06-29 15:52:00 |  |
| AbvTisdale3 | AbvTisdale | 269.238 | 106789 | 2022-06-29 15:33:00 |  |
| PortOfStockton01 |  |  | 546166 | 2022-07-27 19:24:00 |  |
| PortOfStockton02 |  |  | 547645 | 2022-07-27 19:21:00 |  |
| SRVD\_2 | RioVistaDS | 97.456 | 547651 | 2022-07-28 09:07:00 | 2022-11-01 12:00:00 |
| SRVD\_3 | RioVistaDS | 97.456 | 547644 | 2022-07-28 09:16:00 |  |
| SRVD\_4 | RioVistaDS | 97.456 | 547183 | 2022-07-28 09:34:00 |  |
| SRVD\_5 | RioVistaDS | 97.456 | 546163 | 2022-07-28 09:30:00 |  |
| GG1 | GoldenGateW | 0.800 | 547649 | 2022-08-02 13:23:00 |  |
| GG3.1 | GoldenGateW | 0.800 | 547647 | 2022-08-02 13:29:00 |  |
| GG4 | GoldenGateW | 0.800 | 547643 | 2022-08-02 13:34:00 |  |
| GG5.1 | GoldenGateW | 0.800 | 547650 | 2022-08-02 13:38:00 |  |
| GG6 | GoldenGateE | 1.710 | 551251 | 2022-08-02 08:43:00 |  |
| GG7 | GoldenGateE | 1.710 | 551248 | 2022-08-02 09:07:00 |  |
| GG7.5 | GoldenGateE | 1.710 | 551249 | 2022-08-02 09:29:00 |  |
| GG8 | GoldenGateE | 1.710 | 551244 | 2022-08-02 09:49:00 |  |
| GG9 | GoldenGateE | 1.710 | 551252 | 2022-08-02 10:10:00 |  |
| MusselRock01 |  |  | 546976 | 2022-08-23 15:08:00 |  |
| DevilsSlide01 |  |  | 546162 | 2022-08-30 09:12:00 |  |
| Duxbury01 |  |  | 546977 | 2022-09-08 05:20:00 |  |
| PointBonita01 |  |  | 546699 | 2022-09-08 04:55:00 |  |
| TowerBr2 | TowerBridge | 172.000 | 108510 | 2022-10-25 14:32:00 |  |

## Deliverables:

1. Provide data to ITAG JSATS Database coordinator and web-accessible autonomous receiver data (via ERDDAP) within 30 days of downloading
2. Web-accessible semi-annual log of deployment and download activity including what sites were visited and operational coverage for each receiver

# Task 3. Source, obtain, and tag wild winter and spring-run Chinook salmon

No wild fish were tagged in the Sutter Bypass (Butte Creek) during this quarter due to extremely low flows which prevented a rotary screw trap (RST) from being deployed and actively collecting fish. Tags which were allocated for this study in 2022 (n=200) will be used during spring 2023 in Butte Creek.

As an alternative to tagging wild spring-run in Butte Creek, UCSC coordinated efforts with CDFW to capture and acoustic tag wild spring-run in Mill Creek. Over the course of three weeks (4/06/2022 - 4/29/2022) a total of 6 wild origin Chinook salmon smolts were tagged and released at the Mill Creek RST. Table 4 describes the fish tagged during this time period.

Table 4. Wild fish acoustic tagged between April 1 and Sept 30, 2022.

| **StudyID** | **Fish Type** | **Release Loc** | **Count** | **Release Date** | **Weight** | **Length** |
| --- | --- | --- | --- | --- | --- | --- |
| MillCk\_Wild\_CHK\_2022 | MillCk Chinook | MillCk\_RST\_Rel | 2 | 2022-04-06 | 16.5 | 110.5 |
| MillCk\_Wild\_CHK\_2022 | MillCk Chinook | MillCk\_RST\_Rel | 2 | 2022-04-27 | 14.6 | 104.0 |
| MillCk\_Wild\_CHK\_2022 | MillCk Chinook | MillCk\_RST\_Rel | 1 | 2022-04-28 | 7.2 | 81.0 |

## Deliverables:

1. Final Pre-season tagging plan available via the website
2. Web-accessible Telemetry Study Summary no more than 96 hours after the release of fish
3. Annual technical report summarizing results from the previous study year
4. Final report summarizing the results of the three study years
5. One peer reviewed publication

# Task 4. Implant AT into a portion of hatchery produced juvenile Chinook salmon juveniles and Steelhead

## Acoustic Tagging of Chinook Salmon juveniles

UCSC staff implanted acoustic tags into hatchery produced jumpstart winter-run and late-fall run Chinook smolts as part of the Seasonal Survival Study. Releases of these fish were spaced out across six weeks between 4/1/2022 - 5/12/2022 with the intention of gathering movement and survival data across a range of environmental conditions during the late spring. These fish were tagged at Coleman Fish Hatchery and transported to the Red Bluff Diversion Dam (RBDD\_Rel) to increase the sample size of fish in downstream reaches. Fish were available for tagging with the help and assistance of the U.S. Fish and Wildlife Service. The weekly release groups of tagged fish are shown in Table 5.

Preliminary movement and survival data can be found here: <https://oceanview.pfeg.noaa.gov/CalFishTrack/pageSeasSurv_2022.html>

Table 5. Hatchery fish acoustic tagged between April 1 and Sept 30, 2022.

| **StudyID** | **Fish Type** | **Release Loc** | **Raceway** | **Count** | **Release Date** | **Weight** | **Length** |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Seasonal\_Survival\_2022 | CNFH Fall Chinook | RBDD\_Rel | 33 | 180 | 2022-04-07 | 7.93 | 88.48 |
| Seasonal\_Survival\_2022 | CNFH Fall Chinook | RBDD\_Rel | 33 | 187 | 2022-04-08 | 7.77 | 88.39 |
| Seasonal\_Survival\_2022 | CNFH Fall Chinook | RBDD\_Rel | 22 | 150 | 2022-04-27 | 7.37 | 84.25 |
| Seasonal\_Survival\_2022 | CNFH Fall Chinook | RBDD\_Rel | 22 | 211 | 2022-04-28 | 6.96 | 84.71 |
| Seasonal\_Survival\_2022 | CNFH Fall Chinook | RBDD\_Rel | 22 | 175 | 2022-05-11 | 8.58 | 90.26 |
| Seasonal\_Survival\_2022 | CNFH Fall Chinook | RBDD\_Rel | 22 | 200 | 2022-05-12 | 8.31 | 90.15 |

## Acoustic Tagging of juvenile Steelhead

UCSC and US Fish and Wildlife Lodi staff implanted acoustic tags into hatchery produced Steelhead at the Mokelumne River Hatchery as shown in table 6. These fish were part of a continuation of the “6 Year Study” aimed at estimating survival, routing and movement rates through the lower San Joaquin River and Delta during the spring outmigration period of San Joaquin River Basin Steelhead. Fish were sourced and tagged at the Mokelumne River Hatchery with the assistance of Department of Fish and Wildlife and East Bay Municipal Utilities District, and transported to three release locations in the lower San Joaquin River and south Delta. The first release group of Steelhead occurred across three days, from 3/15/22 to 4/22/2022.

Preliminary movement and survival data can be found here: <https://oceanview.pfeg.noaa.gov/CalFishTrack/pageSJSTH_2022.html>

Table 6. Hatchery produced Steelhead acoustic tagged between April 1, 2021 and September 30, 2022.

| **Release Loc** | **StudyID** | **Fish Type** | **Count** | **Weight** | **Length** |
| --- | --- | --- | --- | --- | --- |
| Durham\_Ferry | SJ\_Steelhead\_2022 | Mokelumne\_Steelhead | 239 | 198.13 | 271.91 |
| Head\_of\_Old\_River | SJ\_Steelhead\_2022 | Mokelumne\_Steelhead | 145 | 200.18 | 271.46 |
| Stockton | SJ\_Steelhead\_2022 | Mokelumne\_Steelhead | 100 | 204.93 | 273.48 |

## Tag Retention Studies

### San Joaquin Steelhead Tag Retention Study

A tag retention study was conducted at the NMFS-SWFSC lab to examine the proportion of tags retained in Steelhead across the expected range of battery life (79 days). A random sample of 50 fish were tagged with “dummy” acoustic tags on 03/17/2022 and 4/21/2022 at the Mokelumne River Hatchery and transported to the NMFS-SWFSC lab where they were held on site. The fish were fed and tanks checked daily for expelled tags. Fish were measured and weighed at the start and end of the trial.

During the tag retention trial, 37 fish expelled their tags. At the end of the trial, an additional 7 fish were identified to have bulging at the implantation site, indicating the fish was in the process of expelling their tag. Date of tag loss was not available for 6 tags which were found in the stomach of one fish at the end of the tag retention study. The average fish growth (excluding fish that shed their tags) was 68.4mm and 261g.

Table 7. Date tagged, date shed, and number of days until tag shed for the 13 steelhead which expelled tags during the tag retention study.

| **Tag ID** | **Weight** | **Length** | **Tag Model** | **Date Tagged** | **Date Shed** | **Days To Shed** |
| --- | --- | --- | --- | --- | --- | --- |
| CBBE | 144.4 | 248 | SS300 | 2022-03-17 | 2022-04-12 | 26 |
| 6F8D | 168.2 | 262 | SS300 | 2022-03-17 |  |  |
| 7B63 | 173.9 | 258 | SS300 | 2022-03-17 |  |  |
| 73D9 | 107.8 | 272 | SS300 | 2022-03-17 |  |  |
| 6D0F | 172.3 | 261 | SS300 | 2022-03-17 | 2022-04-29 | 43 |
| 704B | 131.0 | 241 | SS300 | 2022-03-17 |  |  |
| C9C2 | 188.9 | 271 | SS300 | 2022-03-17 |  |  |
| 6F13 | 114.5 | 233 | SS300 | 2022-03-17 | 2022-06-09 | 84 |
| 71D7 | 120.8 | 235 | SS300 | 2022-03-17 |  |  |
| CBFA | 169.9 | 261 | SS300 | 2022-03-17 |  |  |
| 6C11 | 142.3 | 241 | SS300 | 2022-03-17 | 2022-04-15 | 29 |
| CC8E | 119.6 | 235 | SS300 | 2022-03-17 |  |  |
| 797B | 127.7 | 237 | SS300 | 2022-03-17 |  |  |
| CC14 | 162.8 | 255 | SS300 | 2022-03-17 |  |  |
| C57C | 185.4 | 266 | SS300 | 2022-03-17 |  |  |
| 6FB9 | 175.7 | 263 | SS300 | 2022-03-17 |  |  |
| 6CBF | 206.8 | 275 | SS300 | 2022-03-17 | 2022-04-19 | 33 |
| 7ABF | 185.9 | 273 | SS300 | 2022-03-17 | 2022-04-06 | 20 |
| C82E | 103.2 | 220 | SS300 | 2022-03-17 |  |  |
| C530 | 159.8 | 260 | SS300 | 2022-03-17 |  |  |
| CD8E | 198.5 | 285 | SS300 | 2022-03-17 | 2022-05-19 | 63 |
| 7377 | 123.2 | 240 | SS300 | 2022-03-17 |  |  |
| 7D3B | 156.1 | 250 | SS300 | 2022-03-17 |  |  |
| C6D8 | 152.5 | 250 | SS300 | 2022-03-17 |  |  |
| CEC2 | 189.9 | 265 | SS300 | 2022-03-17 |  |  |
| 9ED7 | 149.0 | 255 | SS300 | 2022-04-21 |  |  |
| 9BED | 126.0 | 242 | SS300 | 2022-04-21 |  |  |
| 8945 | 229.0 | 292 | SS300 | 2022-04-21 |  |  |
| A02B | 253.9 | 304 | SS300 | 2022-04-21 |  |  |
| A1BA | 135.4 | 246 | SS300 | 2022-04-21 |  |  |
| 8DED | 157.0 | 263 | SS300 | 2022-04-21 |  |  |
| 8A68 | 260.1 | 300 | SS300 | 2022-04-21 |  |  |
| A21D | 202.9 | 276 | SS300 | 2022-04-21 |  |  |
| 8AB0 | 216.5 | 283 | SS300 | 2022-04-21 |  |  |
| 85D1 | 144.7 | 251 | SS300 | 2022-04-21 |  |  |
| 85BA | 200.4 | 279 | SS300 | 2022-04-21 |  |  |
| 9057 | 167.5 | 247 | SS300 | 2022-04-21 |  |  |
| 9019 | 187.9 | 267 | SS300 | 2022-04-21 |  |  |
| 8529 | 148.0 | 255 | SS300 | 2022-04-21 |  |  |
| 9DB3 | 165.7 | 260 | SS300 | 2022-04-21 |  |  |
| 8566 | 165.7 | 266 | SS300 | 2022-04-21 |  |  |
| 9BCB | 189.8 | 275 | SS300 | 2022-04-21 |  |  |
| 9CEA | 192.7 | 278 | SS300 | 2022-04-21 |  |  |
| A089 | 186.0 | 271 | SS300 | 2022-04-21 |  |  |
| 9EE5 | 204.3 | 281 | SS300 | 2022-04-21 |  |  |
| C59E | 159.5 | 253 | SS300 | 2022-04-21 |  |  |
| 99A7 | 139.9 | 245 | SS300 | 2022-04-21 |  |  |
| 8893 | 178.3 | 267 | SS300 | 2022-04-21 |  |  |
| 9C4D | 201.1 | 270 | SS300 | 2022-04-21 |  |  |
| 7C29 | 163.1 | 265 | SS300 | 2022-04-21 |  |  |

### Seasonal Survival Tag Retention Study

As part of the Seasonal Survival Study, a total of 77 juvenile fall-run Chinook salmon were tagged at CNFH across three weeks (4/7/2022, 4/27/2022, 5/11/2022) and transported to the NMFS-SWFSC lab where they were held on-site. The fish were fed and the tanks checked daily for expelled tags. Fish were measured and weighed at the start and end of the trial. At the end of the six week tag retention study, all fish were processed and inspected for shed tags. During this trial, no shed tags were found and all tags remained inside study fish. A total of three fish were found dead behind the holding tank after escaping the holding tank.

## Tag Life Tests

### Seasonal Surival Tag Life Study

To monitor the battery life of the tags used for the Seasonal Survival Study, a 5% random sample was taken from the total proportion of tags used for each release group. In total, 21 SS400 tags were started (9 on 12/15/2021, 12 on 02/02/2022, 11 on 02/23/2022, 10 on 03/17/2022 and 18 on 4/07/2022) and placed in the tag life tank located at the NMFS-SWFSC lab for monitoring. Data collected in this study examined the range of battery life for these particular tags, in order to correct any discrepancies in survival estimates as a result of tags shutting off prematurely.

All but three tags in the 2022 Seasonal Survival tag life study made it to the warranty life of 71 days. The average run time was 112 days with a range of 45 to 167 days.

**Tags started week 1: 12/15/2021** A total of 9 acoustic tags (SS400) were randomly selected to be used in this tag life study. Tags were started on 12/15/2021 and placed into the tag life tank for the duration of the study. Not all tags in the RBDD Week 1 tag life study made it to the warranty life of 71 days with one tag being detected consistently until day 26 and then detected sporadically after that. All other tags made it past the warranty life of 71 days and were detected consistently.

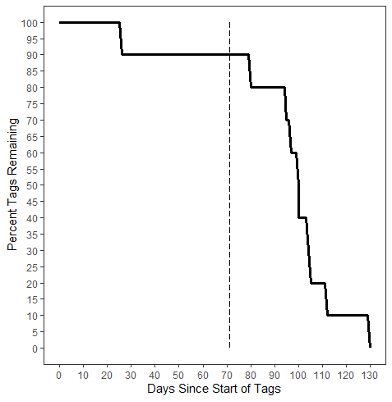


Figure 1: The percent tags remaining over the course of the study, the dashed line indicates the warranty life (71 days).

**Tags started week 2: 02/02/2022** A total of 12 acoustic tags (SS400) were randomly selected to be used in this tag life study. Tags were started on 02/02/2022 and placed into the tag life tank for the duration of the study. All tags in the RBDD Week 2 tag life study made it to the warranty life of 71 days and were detected consistently.

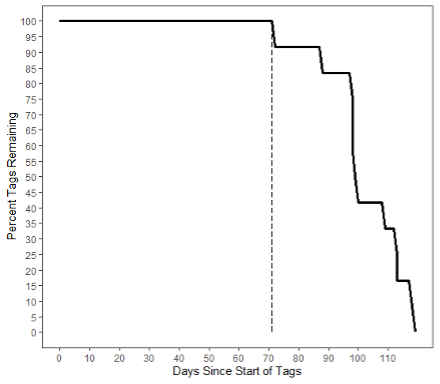


Figure 4: The percent tags remaining over the course of the study, the dashed line indicates the warranty life (71 days).

**Tags started week 3: 02/23/2022** A total of 11 acoustic tags (SS400) were randomly selected to be used in this tag life study. Tags were started on 02/23/2022 and placed into the tag life tank for the duration of the study. Not all tags in the RBDD Week 3 tag life study made it to the warranty life of 71 days with one tag dying on day 45.

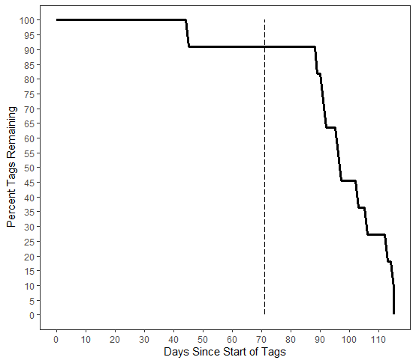


Figure 3: The percent tags remaining over the course of the study, the dashed line indicates the warranty life (71 days).

**Tags started week 4: 03/17/2022** A total of 10 acoustic tags (SS400) were randomly selected to be used in this tag life study. Tags were started on 03/17/2022 and placed into the tag life tank for the duration of the study. All tags in the RBDD Week 4 tag life study made it to the warranty life of 71 days and were detected consistently.

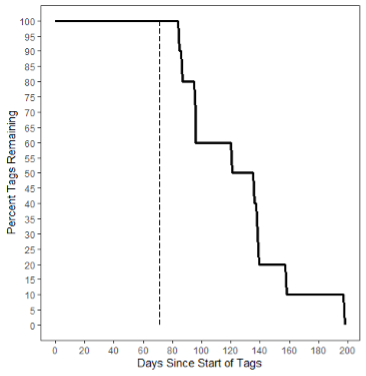


Figure 4: The percent tags remaining over the course of the study, the dashed line indicates the warranty life (71 days).

**Tags started week 5: 04/07/2022** A total of 18 acoustic tags (SS400) were randomly selected to be used in this tag life study. Tags were started on 04/07/2022 and placed into the tag life tank for the duration of the study. One tag in the RBDD Week 5 tag life study died before the warranty life of 71 days, all others were detected past this period.

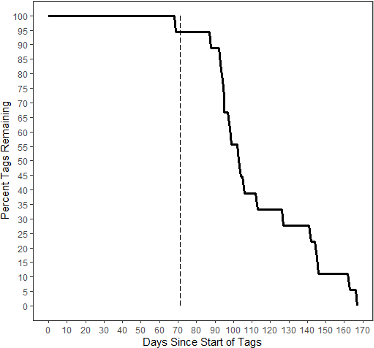


Figure 5: The percent tags remaining over the course of the study, the dashed line indicates the warranty life (71 days).

### San Joaquin Steelhead Tag Life Study

To monitor the battery life of the tags used for the San Joaquin Steelhead survival study, a 5% random sample was taken from the total proportion of tags used for each release group. In total, 33 SS300 bat 392 large battery tags were started on 03/17/2022 and placed in the tag life tank located at the NMFS-SWFSC lab for monitoring. Data collected in this study examined the range of battery life for these particular tags, in order to correct any discrepancies in survival estimates as a result of tags shutting off prematurely.

A total of 57 acoustic tags (SS300 bat 392) were randomly selected to be used in this tag life study. Tags were started on 03/17/2022 and placed into the tag life tank for the duration of the study. All tags in the SJ Week 1 tag life study made it to the warranty life of 79 days and were detected consistently.

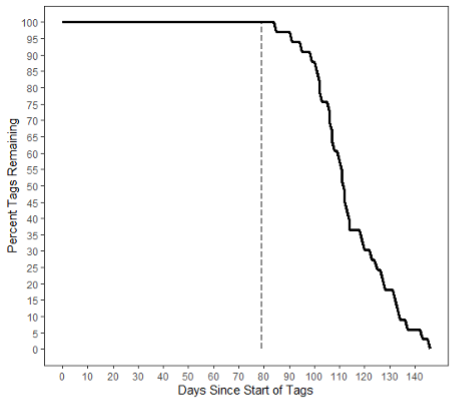


Figure 6: The percent tags remaining over the course of the San Joaquin Steelhead study, the dashed line indicates the warranty life (79 days).

## Deliverables:

1. Final Pre-season tagging plan available via the website
2. Web-accessible Telemetry Study Summary no more than 96 hours after the release of fish
3. Final memo/report on tag life results at end of year available via website
4. Final memo/report on tag effects results at end of year available via website
5. Annual technical report summarizing results from the previous study year
6. Final report summarizing the results of the three study years
7. Two peer reviewed publications

# Task 5. Produce and deliver real-time metrics

The project website was updated with new web pages describing unique tagging studies, including release metadata, travel time, number of fish detected at each real-time receiver, and detection efficiency for dual-line receiver locations (Sacramento, Benicia). <https://oceanview.pfeg.noaa.gov/CalFishTrack/>. Tagging data were updated two days after fish were tagged. Data from real-time receivers was automatically updated every hour.

## Deliverables:

1. Website and email daily updates of arrival times, movement rates, and percent detected for each release group beginning immediately after the release of the first group.
2. Website updated weekly with real-time data, summary statistics of real-time survival and routing, and predictions based on models fitted to historical late-fall Chinook data.

# Task 6. Project Management

Bi-weekly CVEAT conference calls and monthly ITAG virtual meetings were scheduled and moderated by ITAG facilitator Flora Cordoleani of UC Santa Cruz during the reporting period. These CVEAT calls facilitate close coordination on tagging events and receiver deployments between the many field operation leaders for the many different telemetry projects. Monthly ITAG meetings are for higher-level coordination and long-term planning for the Central Valley telemetry programs, and is attended by both field operation leaders as well as higher level agency representatives.

## Deliverables:

1. Semi-annual progress reports
2. The database coordinator will lead a data management workshop
3. The database coordinator will participate in the ITAG meetings and appropriate subgroup meetings
4. The database coordinator will work with agencies and stakeholders to address key data management questions
5. The ITAG facilitator will schedule meetings and take meeting notes, and make meeting notes accessible to public via an online platform
6. The ITAG facilitator will collect pre- and post-study summary forms from researchers and host them on the CalFishTrack website
7. The ITAG facilitator will provide a summary report of ITAG activities within 6 months of the completion of the last ITAG tagging effort for the water year