

# 2022 McCloud River Winter Run Chinook Salmon Reintroduction Pilot Project Summary Report



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## Summary

In spring of 2022 California was facing a third consecutive dry year, with the preceding January- March being the driest 3 months on record for many parts of California in what represents the heart of the state's precipitation season. Already depleted by a preceding dry year followed by municipal and agricultural demands in summer of 2021, Shasta Reservoir's storage stood at only 1.74-million-acre feet on April 1, 2022. These conditions left reservoir operators and fishery managers with great uncertainty regarding the ability to maintain suitable water temperatures for the federally and State listed as Endangered winter-run Chinook Salmon (*Oncorhynchus tshawytscha*) (winter-run) within the natural spawning population in the mainstem Sacramento River and the hatchery population at Livingston-Stone National Fish Hatchery (LSNFH) during the Shasta Temperature Management Season (May 1- October 31) in 2022. In response, managers representing the California Department of Fish and Wildlife (CDFW), the United States Fish and Wildlife Service, and National Marine Fisheries Service (NMFS) (Fish Agencies) agreed to implement a suite of five Emergency Drought Actions to support winter-run and other runs of Chinook Salmon in the mainstem Sacramento River. These actions are as follows:

1. Increase winter-run smolt production at LSNFH
2. Relocate a portion of adult winter-run trapped at Coleman National Fish Hatchery and the Keswick Trap to North Fork Battle Creek, upstream of Eagle Canyon Dam
3. Relocate adult spring-run Chinook Salmon collected incidentally at the Keswick Trap to Clear Creek
4. Initiate a secondary captive brood-stock population of winter-run at LSNFH
5. Incubate a portion of winter-run eggs sourced from Livingston Stone National Fish Hatchery on the McCloud River

The fifth Emergency Action is the focus of this summary report. The Fish Agencies, in coordination with the Winnemem Wintu Tribe (WWT), a California Native American Tribe whose ancestral home, prior to the construction of Shasta Dam, was the free-flowing McCloud River, initiated a pilot McCloud River winter-run reintroduction project (Pilot Project) in summer and fall of 2022. The Pilot Project consisted of transferring 40,000 eyed winter-run eggs from LSNFH to a United States Forest Service (USFS) Campground (Ah-Di-Na) located on the Lower McCloud River approximately five river miles downstream of the McCloud Reservoir Dam. The eyed-eggs were incubated in remote-site-incubators (RSIs)

set up along the shoreline of the McCloud River within the Ah-Di-Na campground. Winter-run eggs/embryos were incubated at Ah-Di-Na July 11 through September 28. A total of 35,313 juvenile winter-run were successfully incubated and reared to the fry life stage in the RSI's. Developed fry were released on-site at Ah-Di-Na to continue their development and downstream migration in the McCloud River. A trapping site, consisting of rotary screw traps (RSTs) and fyke nets was installed approximately 20 miles downstream of Ah-Di-Na and adjacent to a second USFS campground (McCloud Bridge). This trapping site is located very near the inundation zone of Shasta Reservoir at full pool. Our intention was to trap as many juvenile winter-run as possible before they entered Shasta Reservoir, and to release the fish in the Sacramento River near Redding, CA to continue their migration to the ocean. Figure 1 depicts a map of the project area. RST's and fyke nets were operated at McCloud Bridge September 6 through December 12. 1,634 juvenile winter-run were captured at the trapping site. Twenty-seven individuals were found dead in the traps. An additional seven fish died during transport from McCloud Bridge to Redding. 1,600 juvenile winter-run were successfully transported and released into the Sacramento River in Redding.

## **Introduction**

Winter-run historically accessed and spawned in the upper reaches of tributaries to the Sacramento River including the McCloud, Pit and Upper Sacramento Rivers. Upon completion of Shasta (1945) and Keswick (1950) Dams access to this historic spawning habitat was blocked and winter-run were forced to spawn in the mainstem Sacramento River downstream of Keswick Dam; an unnatural spawning habitat for the species that must be maintained through cold-water releases from Shasta reservoir. Initially stable and even increasing in number in the mainstem Sacramento River below Keswick, populations of winter-run declined throughout the late 1970's and 1980's, and in 1989 winter-run were listed as Endangered under the California Endangered Species Act and as Threatened under the Federal Endangered Species Act. In 1994 the population was relisted as endangered under the Federal Endangered Species Act. In addition to winter-run all four runs of Central Valley Chinook Salmon, steelhead (*Oncorhynchus mykiss*), called the McCloud River home prior to the construction of Shasta Dam in 1945 when all McCloud River anadromous fish populations were extirpated. Additionally, construction of Shasta Reservoir displaced remaining members of the WWT and inundated many sacred sites and historic villages.

The idea of restoring anadromous fish populations to the McCloud River is not new, and particular emphasis has been placed on reintroducing winter-run to the McCloud River to mitigate extinction risk for the species which have been restricted to spawning and rearing in a highly managed environment. The 2009 Biological Opinion on operation of the Central Valley and State Water Projects (NMFS 2009), the 2014 NMFS Recovery Plan (NMFS 2014), and the California Natural resources Agency Sacramento Valley Salmon Resiliency Strategy (CNRA 2017) all call out the priority need to reintroduce winter-run to the McCloud River. NMFS (2009) included a “Shasta Dam Fish Passage Evaluation” (SDFPE) which required the Bureau of Reclamation to coordinate with NMFS to develop a “Fish Passage Pilot Implementation Plan”. Work on this plan began in 2011 but ended in 2017. A new Biological Opinion on operation of the Central Valley and State Water Projects was finalized in 2019 but did not include an SDFPE element and work on McCloud River winter-run reintroduction remained idle.

The McCloud River upstream of McCloud Reservoir and downstream of McCloud Reservoir still maintains suitable water temperature and other habitat conditions required to support winter-run, whose spawn timing of late April through early August is unique amongst all races of North American Chinook Salmon. Due to a third consecutive year of drought, and projected May 1 Shasta Reservoir total storage and cold-water pool reserves for summer and fall of 2022, the Fish Agencies included the Pilot Project in a suite of Drought Emergency Actions centered on supporting listed and non-listed anadromous fish populations dependent on the mainstem Sacramento River for spawning and rearing. Importantly, concurrence with the WWT and their Spiritual and Cultural Leader Caleen Sisk was a key aspect of the project. Agreement on the approach to implementing the Pilot Project, including sourcing of eggs, egg incubation methods and location, and method and location for trapping juvenile winter-run was obtained following a series of meetings between Caleen Sisk, CDFW, and NMFS.

### **Sourcing eggs and egg transport**

The Pilot Project utilized fertilized winter-run eggs sourced from LSNFH at the “eyed” stage. Eyed eggs are hardy, and the most suitable early embryonic stage for transport. LSNFH is located at the base of Shasta Dam, north of Redding, California. When the Sacramento River winter-run population was relisted as endangered in 1994 LSNFH was deemed an essential component of species recovery and was established in 1997. In April 1998, the hatchery released their first winter-run into the Sacramento River and the hatchery has

remained in continuous operation to the present. Primarily designed as a “conservation hatchery” the hatchery is meant to support but not replace natural-origin winter-run in the Sacramento River and strict genetic protocols are followed to maintain diversity and prevent inbreeding. LSNFH has an annual production goal of 200,000 winter-run smolts. Increasing winter-run smolt production at LSNFH was part of the suite of 2022 Drought Emergency Actions, and this action allowed the Pilot Project to proceed without impacting the hatcheries normal production goals.

A total of 40,000 fertilized winter-run eggs were sourced from LSNFH for the Pilot Project. Moving eggs at the eyed stage provided optimal timing for hardiness while allowing ample for developing embryos to imprint on the McCloud River. LSNFH spawn winter-run from late April through mid-August, with maturation or spawn-readiness of fish following a bell-curve. It was decided to take eggs from middle and late stages on this bell-curve in support of the Emergency Action and Pilot Project since it was expected that later-spawning fish held at LSNFH would experience poorer water temperature conditions compared to earlier spawning fish. The first egg group from LSNFH consisted of parentage from eight female winter-run. Individual female eggs were divided into four subgroups where they were fertilized by four different males to maximize genetic diversity in the fish released at Ah-Di-Na. Each subgroup consisted of 625 eggs and totaled 2,500 eggs per female. The second group consisted of eggs from 14 females. All eggs were again fertilized by 4 different males. Eggs were delivered to Ah-Di-Na in two separate groups of 20,000, on July 11 and August 8.

On delivery date the eggs were placed into a soft-mesh bagged immersed into a round, 5-gallon insulated cooler (Figure 2). Water to fill the cooler was sourced from the hatchery’s water supply and measured 52 degrees Fahrenheit. The cooler was loaded into a Sport Utility Vehicle (SUV) which departed the hatchery at approximately 9:00am. Water temperature inside the cooler was periodically measured with a hand-held thermometer. A separate cooler containing cubed ice was kept in the SUV but was not needed. It took approximately two hours to drive from LSNFH to Ah-Di-Na. Upon arrival water inside the cooler was tempered with McCloud River water until both temperatures reached equilibrium.

The last 45 minutes of the drive into Ah-Di-Na is on a rugged, un-paved road. Although eyed eggs are quite hardy and LSNFH staff assured transport by SUV was safe (including drive time and rugged road), there was concern amongst some Pilot Project members that the bumpy road could have immediate or latent deleterious effects on embryo development. In response the second batch of 20,000 eggs was delivered by helicopter. All transfer protocols

mentioned above were followed, and after being picked up by SUV at LSNFH the eggs were transferred to a CDFW helicopter waiting at the Redding Airfield. After a short flight, the helicopter landed at a designated helicopter landing area at Ah-Di-Na.

### **Remote Site Incubation at Ah-Di-Na**

In the weeks leading up this project, CDFW staff met with the WWT at Ah-Di-Na to select a location to set up the RSIs. Careful consideration was given to locate an area on the river that provided both the proper hydraulic head and a level area to install and operate the equipment. A small beach at Ah-Di-Na Campground was selected as the final site for several reasons: the site is culturally significant to the Winnemem Wintu, it has the appropriate amount of elevation change to create enough hydraulic head for the RSI and was easily accessible for CDFW staff to provide maintenance as needed.

RSI's can take various forms or configuration. One common element however is that they all require plumbing to provide a continuous water supply, delivered at a sufficient rate (measured in gallons per minute), for the system to function properly. Our RSI system consisted of two chambers constructed of 50- and 35-gallon plastic barrel-shaped containers connected with 1.5-inch polyvinyl chloride (PVC) fittings (Figure 3). Approximately 200 feet of 1.5-inch irrigation tubing was used to achieve the hydraulic head required to achieve a 10-15 gallon per minute flow rate through our RSI system. The upstream end of the irrigation tubing was connected to a diversion screen, a fine-meshed screen metal box anchored to the streambed which kept debris out of the irrigation tubing. Diverted water first entered a 50-gallon clarifying tank which allowed particulates suspended in the water to fall out before flowing into a 35-gallon egg tank. One- and one-half inch PVC connections from the clarifying tank to the egg tank allowed water to enter the incubation tank at the bottom then flow upwards through the egg tank and finally exit an outlet at the top of the egg tank before overflowing. A wire mesh screen was nested near the bottom of the egg tank to prevent eggs from settling into any accumulating sediment at the bottom of the tank and allowing exchange of water through the egg tank. Discharge flow at the outlet of the RSI was tested twice per day to ensure suitable flow rate. A portable electric fence was erected around the RSIs to deter bears or other animals from accessing the eggs and embryos. Signage and literature were placed in the campground to educate the public on the Pilot Project.

## **Mud Creek Turbidity Event**

The first egg group was planted into the RSI on July 11<sup>th</sup>. On July 13, the turbidity in the McCloud River increased significantly due to glacial melt on Mud Creek (a tributary of the McCloud which enters McCloud Reservoir). The mud flow, which resulted in turbidity readings taken at Ah-Di-Na as high as 350 Nephelometric Turbidity Units (NTU), overwhelmed the ability of the clarifying tank to adequately filter water causing sediment to settle in the RSI egg tank both on top and underneath the eggs. There was great concern that this sedimentation would cause the eggs to suffocate. With the threat of high egg loss, CDFW staff quickly installed a new system that would allow the eggs and embryos to be cleaned more effectively and frequently.

The new system was comprised of a single half Heath Tray stack (eight trays) sourced from Mount Shasta Fish Hatchery plumbed into the existing system (Figure 4). The eggs were divided amongst five trays, where they would remain until hatching and release. Each tray was checked and cleaned daily, and all mortalities were carefully removed and counted. The heath tray set-up made picking mortalities, cleaning, and monitoring flows easier for CDFW staff.

The second group of eggs was brought in by helicopter on August 8<sup>th</sup> and this group was placed in a second half Heath Tray stack placed next to the first stack and plumbed with two-inch diameter irrigation tubing. Two-inch diameter tubing was selected for the second egg group to provide a wider range of gallon-per-minute diversion capacity. Both egg groups hatched into the heath trays as alevins and remained in the tray until their yolk sacks were fully absorbed.

## **Heath Tray Maintenance and Protocols**

CDFW staff camped at Ah-Di-Na campground seven days a week to maintain the egg incubation systems. Twice daily maintenance completed by staff included cleaning the diversion screen, cleaning the Heath Trays, removing any egg or alevin mortalities, monitoring water temperature, and monitoring flow through Heath Trays. Cleaning the diversion screen entailed wading into the river at the intake and physically removing any debris that may have accumulated, ensuring unimpeded flow. Heath tray routine maintenance included purging accumulated sediment in the tray bottoms and removing the lid of each tray to inspect the eggs/alevins for any mortalities to prevent spread of fungus. Twice daily air and water temperatures were checked and recorded. Morning water temperatures were between 46- and 49-degrees Fahrenheit.

Afternoon water temperature checks were between 49- and 54- degrees Fahrenheit. Flows through the heath trays were checked by removing a plug from one of the top trays and timing the rate at which it takes to fill a five-gallon bucket. Recorded daily flow rates through the heath trays were between 5 and 6 gallons per minute. Water temperature loggers were deployed in the McCloud River at the egg incubation site and were set to record water temperatures at 1-hour intervals. Daily min, max, and average water temperatures recorded during the egg incubation period are provided in a table in (Figures 11 and 12).

### **Hatch Success Between Egg Groups**

Egg hatch rate between the two groups of eggs from LSNFH were very similar, however developmental issues in group one presented at the alevin stage. Overall egg to fry survival was 80% for Group One and 96% for Group Two. Following hatching Group One alevins began to experience elevated daily mortality rates. A pathology report completed by CDFW concluded that the mortalities were associated with Curly-Q and Coagulated Yolk disease. While the ultimate cause of these afflictions could not be determined through their investigations, CDFW pathologist concluded that the cause was likely the result of an oxygen deficiency during the period of high turbidity before the eggs were transferred to the heath trays.

There was no evidence of Coagulated Yolk Disease observed in the second group of eggs. CDFW staff believe this is because the second group never endured an oxygen deprivation period in the RSI. The second group was placed directly in the heath tray system, where they were cleaned more effectively and received proper oxygen flow even while McCloud River turbidity levels remained elevated. The total mortality rate from the second group of eggs was only 3.60 percent, with a total combined egg and alevin mortality count of 719. Figure 5 depicts egg to fry survival for each group.

### **Juvenile Winter-Run Release at Ah-Di-Na**

After completing their development, the first egg group was released at Ah-Di-Na over a 10-day period directly from the heath trays into shallow pools constructed by the WWT along a rocky beach on the river. Our approach was to give the fish time to adjust to their new environment and enter the main flow of the river volitionally. Due to factors related to the Mud Creek turbidity event individuals from Group One did not develop at a consistent rate. In response, individuals ready for release were hand-selected based on maturity, netted into

buckets, and the buckets carried to the release site. This process was carried out over the period September 6<sup>th</sup> to 16<sup>th</sup>. A different approach was taken for egg Group Two. To allow for volitional entry into the McCloud River mature fry were transferred from the heath trays into a reconstructed RSI unit (barrel style). This unit was erected adjacent to the heath tray with the outlet terminating in a quiet back-water alcove of the McCloud River. Once in the alcove the fry dispersed into the McCloud River at their own pace. A total of 35,313 winter-run fry were released in the McCloud River or 87% of the eyed eggs taken from LSNFH survived to be released as fry.

### **Downstream Juvenile Winter Run Trapping**

Efforts to capture juvenile winter-run released at Ah-Di-Na began with carefully selecting a trap location which provided access for installation, daily maintenance, and avoidance of culturally sensitive areas. A site was selected adjacent to the McCloud Bridge Campground (Figure 1). A channel-spanning highline was first constructed. Two five-foot RSTs were suspended in the river channel from this high line. The RSTs could be adjusted longitudinally and laterally in the stream channel with the high line anchoring system. The RSTs were oriented to capture two distinct concentrated flow pathways located downstream of a large midstream boulder.

In addition to the two RSTs, CDFW installed two Frame Nets to maximize catch. The frame nets were positioned just downstream of the RSTs, on either bank, in low flow areas. The four pieces of gear were positioned to filter as much of the river as possible at the site to maximize fry capture. Figure 6 depicts the RST and Frame Net configuration. The Frame Nets were moderately successful in the beginning of the season, capturing 314 Chinook over a 43-day period. However, they became decreasingly effective as flows increased and debris load increased. Within 24 hours of a crew cleaning the nets, the nets were completely caked in brown algae and leaves. Once the nets were completely caked in debris, the nets would no longer allow water to flow through the trap rendering them ineffective.

To maximize capture efficiency of the RSTs two 100 by three-foot guide nets were installed on October 6<sup>th</sup> (Figure 7). Multiple attempts were made by CDFW staff to adjust the guide nets to get them fish tight and funneling water and fish into the RST efficiently. After an efficiency trial showed the guide net set up was not performing well (Table 1), and with an anticipated run of river flow release from McCloud Reservoir, the decision was made to remove the guide nets on October 19<sup>th</sup>.

## **Run of River Flow Event**

Due to equipment failure within the McCloud River Hydroelectric Project on October 23<sup>rd</sup>, PG&E was forced to shut down bypass flows from McCloud Reservoir to the Pit River. Once McCloud Reservoir filled and began spilling at its outlet, a run of river flow regime ensued below the dam, resulting in an increase in flow from a baseline of 290 cfs on October 22<sup>nd</sup> to 825 cfs by November 8<sup>th</sup>. This high flow event was maintained until November 18<sup>th</sup>. Our ability to maintain trapping gear and capture efficiency of the gear was greatly diminished during this period.

## **Trap Efficiency Trials**

During the trapping season, UC Davis and CDFW staff conducted four separate capture efficiency trials to determine trap performance and estimate total passage of fry at the site during the trapping period. The first efficiency trial took place on September 13<sup>th</sup>. The traps were in their original configuration: two RSTs and two Frame Nets in series across the channel. For the first trial, 294 juvenile winter-run Chinook sourced from LSNFH were marked with Bismark Brown and a caudal fin clip to differentiate them from fry released at Ah-Di-Na. The fish were released one and a quarter mile upstream of the trapping location. A total of 111 efficiency trial fish were caught by the traps, for an estimated trap efficiency of 38%.

A second efficiency trial was conducted on October 14<sup>th</sup>. At this time, the trapping site was configured with two RSTs, the guidance nets directing flow into the downstream RST in a V-shape, and the second RST positioned upstream of the guide nets. The Frame Nets were removed. A total of 95 LSNFH juvenile winter-run were marked and released. Eleven efficiency trial fish were caught, resulting in an estimated 12% trap efficiency. The guide nets were removed based on the trial results and the RSTs were returned to their original configuration and Frame Nets were re-installed. The third trap efficiency was conducted during run of river flow conditions. The Frame Nets had been removed due to debris load, and the two RSTs moved downstream of their original position due to the high flows. In this trial, 400 marked LSNFH juvenile winter-run were released at the same upstream location. Only 19 trial fish were captured, resulting in an estimated capture efficiency rate of 5%, the lowest of the season. McCloud River flows during this trial were 750 cfs, while the previous two efficiency trials were conducted while flows were between 270 and 290 cfs. For the fourth and final efficiency trial, only two RSTs were in place, in the original low-flow position. McCloud River flows had receded to 285 cfs. A total of 100

marked fish were released in the same upstream location. A total of 14 trial fish were captured, resulting in a 14% trap efficiency. Table 1 documents results of the four efficiency trials completed.

**Table 1.** McCloud River Pilot Project trapping site capture efficiency trials

<b>Date</b>	<b>Trap Configuration</b>	<b>Number of Fish Released</b>	<b>Number Fish captured</b>	<b>Calculated Capture Efficiency</b>
13-Sep-22	2 RSTs 2 Frame Nets low flows	294	111	38%
14-Oct-22	2 RSTs with guide net	95	11	12%
11-Nov-22	2 RSTs high flows	400	19	5%
30-Nov-22	2 RSTs low flows	100	14	14%

### **Total Juvenile Winter-Run Captured at the Trap Site**

During September 9, 2022, to December 12, 2022, trapping period a total of 1,634 juvenile winter-run were captured. Twenty-seven juveniles were found dead in the trap. All juvenile winter-run captured were enumerated. Early in the trapping season, when larger numbers of individuals were captured, not every fish was measured. Later in the season all captured winter-run were measured to nearest fork-length. Similar to observed juvenile winter-run emigration patterns in the Sacramento River, large numbers of fry released at Ah-Di-Na quickly dispersed downstream, ending up at our trapping site approximately 20 river miles downstream within three days after release. Smaller numbers of fish spent greater lengths of time rearing in the McCloud River, slowly out-migrating through the months of October, November, and early December. Juvenile winter-run were captured up to the last day of trapping, December 12, although infrequently and in small numbers. Figure 8 shows catch of juvenile winter-run in the McCloud River and average daily flow in cubic feet per second recorded at the California Data Exchange Center streamgauge (Station ID MSS) located approximately five miles upstream of the trapping site during the September 6 to December 12 trapping period. Figure 9 depicts length at date of juvenile winter-run captured at McCloud Bridge, illustrating the two observed life-history

strategies. A total of 1,600 juvenile winter-run Chinook released at Ah-Di-Na were successfully relocated and released into the mainstem Sacramento River in Redding, California.

### **Other Fish Species Encountered During Trapping**

In addition to juvenile winter-run bycatch of other fish in the RSTs occurred regularly. Individuals were identified to species, and number and fork-lengths were recorded. Bycatch included native and non-native fish species. Unidentified Cyprinid fry represented the most common bycatch, with 209 individuals documented. These fish were too small to positively identify to species in the field. Larger juvenile Hardhead (*Mylopharodon conocephalus*) and Sacramento Pikeminnow (*Ptychocheilus grandis*) were observed, but fewer than 10 were documented throughout the season. Juvenile Sacramento Sucker (*Catostomus occidentalis*) were regularly captured, with 156 recorded. A total of 110 Rainbow Trout (*Oncorhynchus mykiss*) were captured. The average Rainbow Trout measured between 6-9 inches fork-length but were observed as large as 21 inches.

Catches of non-native fish species included 98 Brown Trout (*Salmo trutta*) and 49 Spotted Bass (*Micropterus punctulatus*). Most Spotted Bass were captured during the first high flow event in early October. Brown Trout were caught throughout the season with most individuals being sub-adults. Adult Brown Trout were encountered in late November and December. During this period, post-spawn brown trout were captured as large as 24 inches fork-length.

### **Transport of Juvenile Winter-Run and release into Sacramento River**

A total of 1,607 live juvenile winter-run removed from the traps were transported and released into the Sacramento River in Redding. The release site was at or very near the Posse Grounds boat ramp. A total of seven fish died during transport, leaving a total of 1,600 fish successfully released. All juvenile winter-run removed from the traps were placed into a round, five-gallon cooler. A battery-operated air stone was placed in the cooler. Figure 10 illustrates winter-run juveniles in the round cooler with air-stone. Prior to leaving the trap site a final water change was completed to promote suitable temperatures and oxygenation during transport, which took approximately 50 minutes. Water temperature in the cooler was taken at time of departure and time of arrival and recorded. Once at the release site, the fish were provided an acclimation period to adjust to temperatures in the Sacramento River. This was

accomplished by removing 20% of the transport container water and then adding 20% Sacramento River water from the release site. Fish were released into backwater areas with cover to minimize risk of predation while fish adjusted to their new environment.

## **Conclusion**

From 1945 until 2022, the McCloud River had been devoid of Chinook Salmon. This changed in early September 2022 with successful implementation of the Pilot Project. In summary, 40,000 eyed winter-run eggs sourced from LSNFH were delivered to Ah-Di-Na campground in two batches of 20K, the first group by truck and the second by helicopter. The eggs/embryos were incubated in streamside remote site incubation systems plumbed with McCloud River water July 11 through September 28. After maturing in the RSI's 35,313 juvenile winter-run were released directly into the McCloud River over the period 9/4-9/14 and 9/26-9/28. Rotary screw traps and Frame Nets were operated on the McCloud River approximately 20 river miles downstream of Ah-Di-Na near the McCloud Bridge Campground September 6 through December 12. A total of juvenile 1,634 juvenile winter-run were captured at the trap site. Twenty-seven individuals were found deceased in the traps. Based on mark-recapture efficiency trials approximately 4,400 juvenile winter-run migrated to the trapping site during the trapping period. The fate of the other 30,913 juvenile winter-run released at Ah-Di-Na will remain unknown. A total of 1,607 captured juvenile winter-run were relocated to the Sacramento River in Redding to complete their journey to the ocean, 7 individuals died during transit with the remaining 1,600 were released successfully.

Remote site incubation on the McCloud River was highly successful despite challenging environmental conditions in 2022. Lessons learned will refine the approach of future efforts to incubate Chinook eggs and embryos on the McCloud River until adult populations are established. We captured non-trivial numbers of juvenile Chinook released into the McCloud River before they entered Shasta Reservoir with stand-alone pieces of trapping equipment. While attempts to improve capture efficiency with guide nets were not successful in 2022, the approach was sound, and refinements will be made and tested in the future.

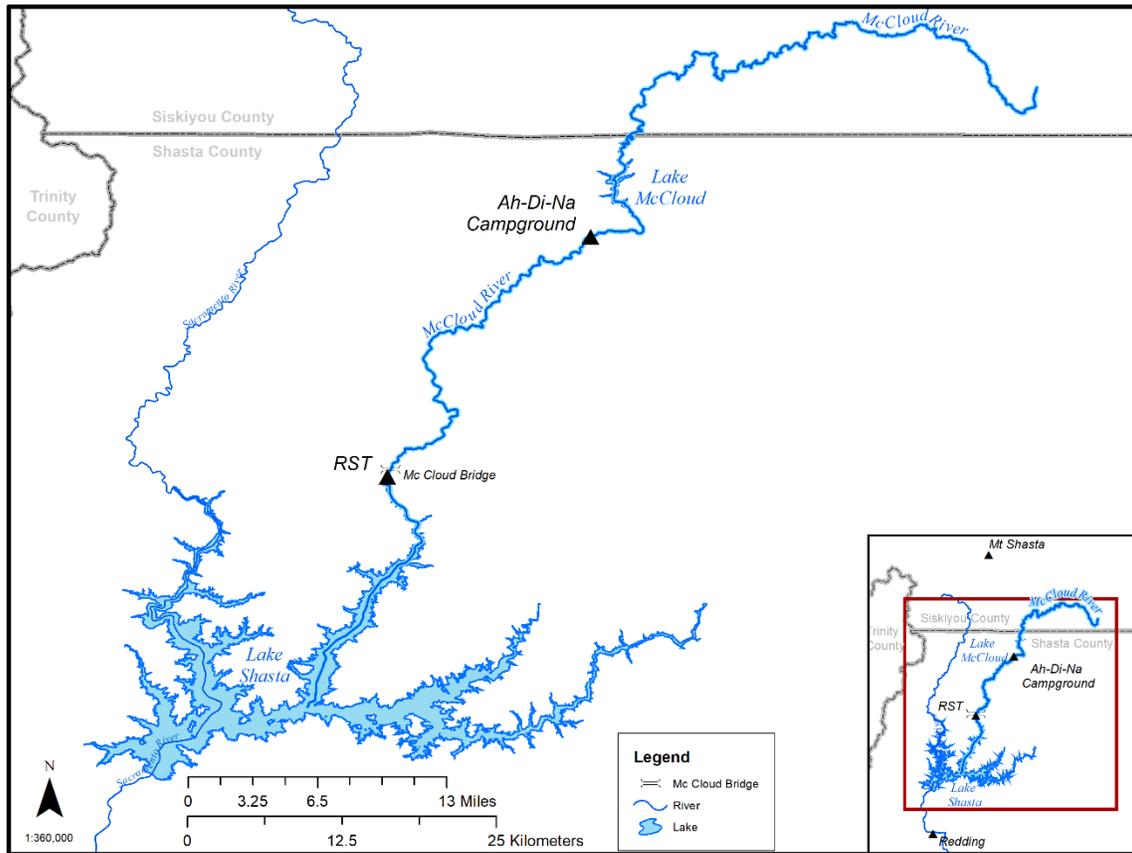
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### McCloud River Winter Run Chinook Reintroduction Project



**Figure 1.** Map of the McCloud River winter-run Chinook Salmon pilot reintroduction project showing egg incubation site (Ah-Di-Na Campground) and fish trapping site (McCloud Bridge Campground).



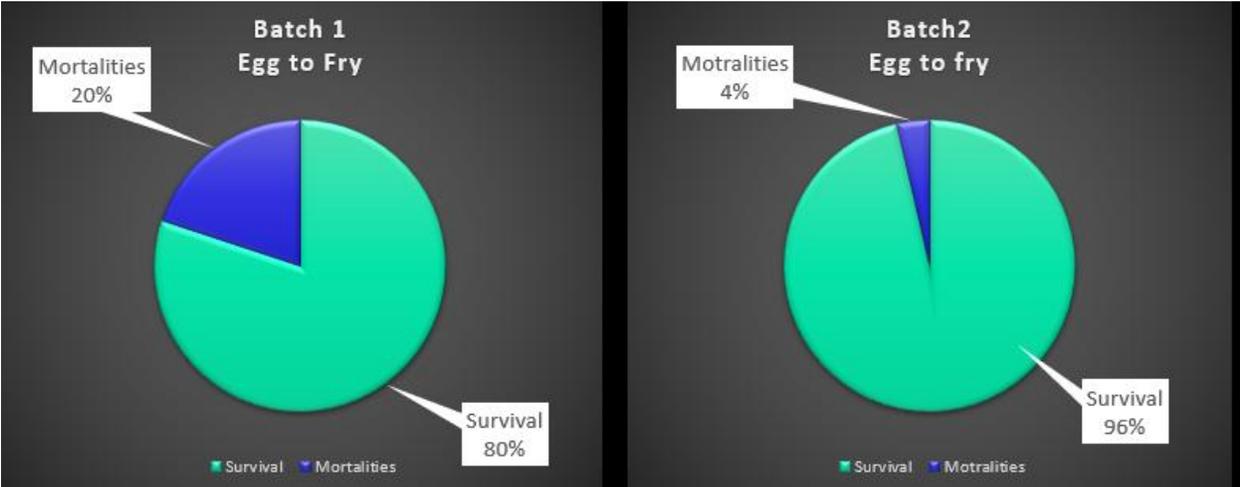
**Figure 2.** Staff from Livingston-Stone National Fish Hatchery place eyed winter-run Chinook Salmon in a cooler for transport to Ah-Di-Na.



**Figure 3.** McCloud River Pilot Project remote site incubation components consisting of 50- and 35-gallon barrels for clarifying water and incubating eggs, and 1.5" PVC connections.



**Figure 4.** Half Heath Tray stack plumbed into the RSI clarifying tank installed in response to extreme turbidity levels in the McCloud River discharging from Mud Creek. Eyed eggs were moved into the Heath Trays on July 14, 2022.



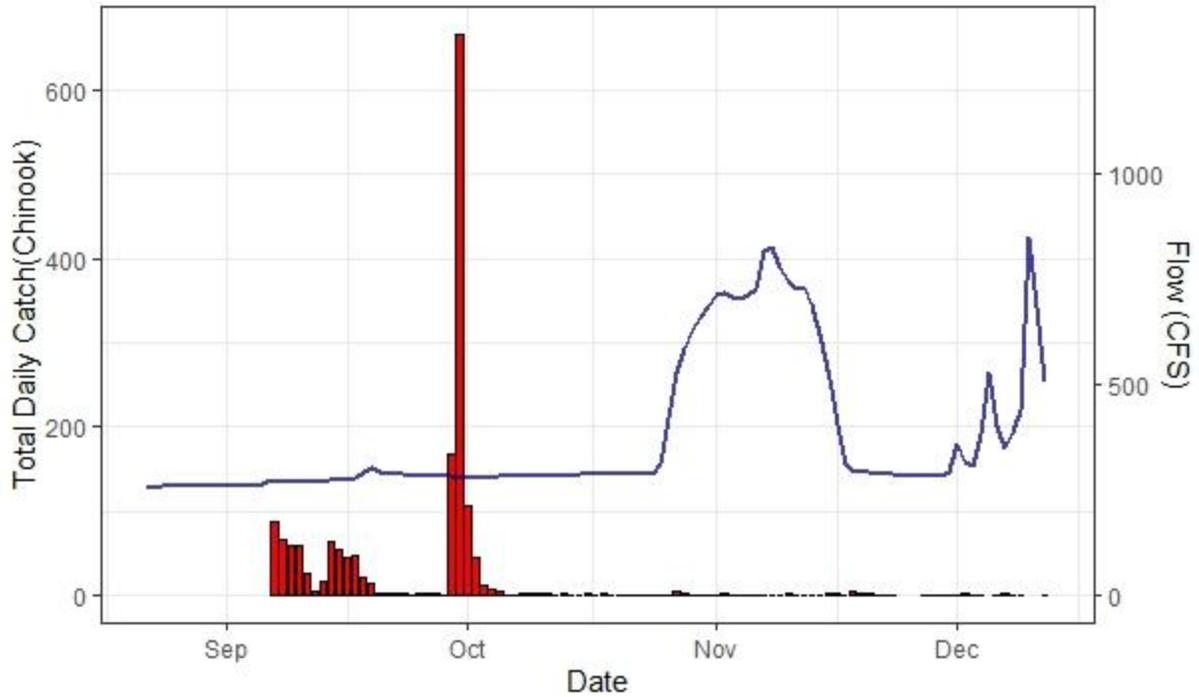
**Figure 5.** Egg to fry survival between Group 1 and Group 2.



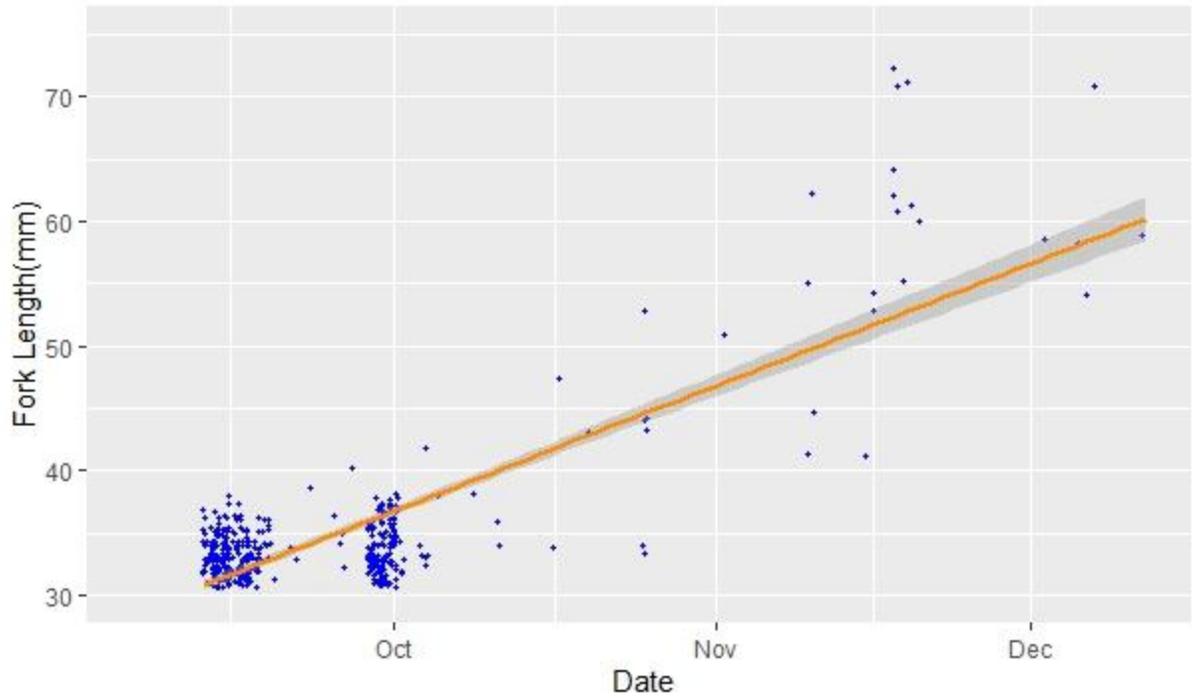
**Figure 6.** McCloud River juvenile winter-run Chinook trapping site at McCloud Bridge Campground. Two rotary screw traps and two Frame Nets were suspended from a wire rope "high-line" suspended across the river.



**Figure 7.** Guide net installed on downstream rotary screw trap in a V-Shape intended to maximize capture efficiency of the rotary screw trap. As second rotary screw trap operates upstream and independent of the guide net.



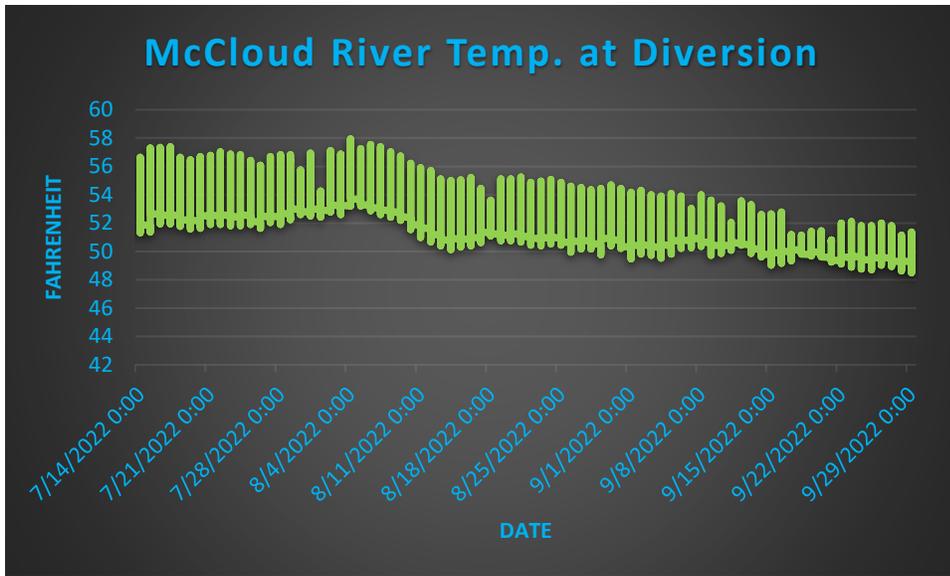
**Figure 8.** Catch of juvenile winter-run Chinook in the McCloud River and average daily flow in cubic feet per second recorded at the California Data Exchange Center streamgage (Station ID MSS) during the September 6 to December 12 trapping period.



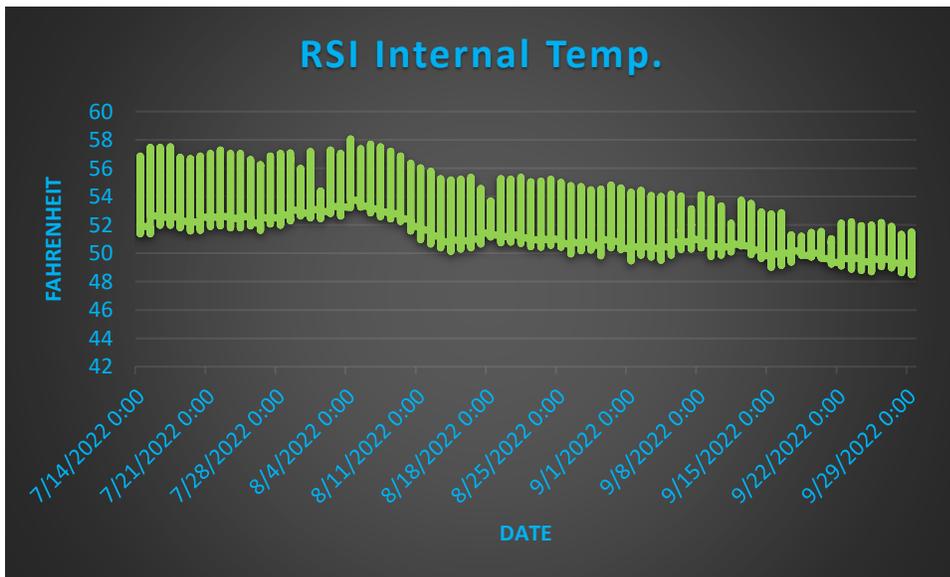
**Figure 9.** Length-at-date of juvenile winter-run captured at the McCloud Bridge trapping site September 6 through December 12, 2022.



**Figure 10.** Juvenile winter-run in 5-gallon round cooler with air stone used to transport fish from the McCloud Bridge trapping site to the Sacramento River in Redding, CA.



**Figure 11.** Daily temperature range in the McCloud at the diversion pipe feeding the RSI.



**Figure 12.** Daily temperature range inside the Heath Tray system at AhDiNa campground.