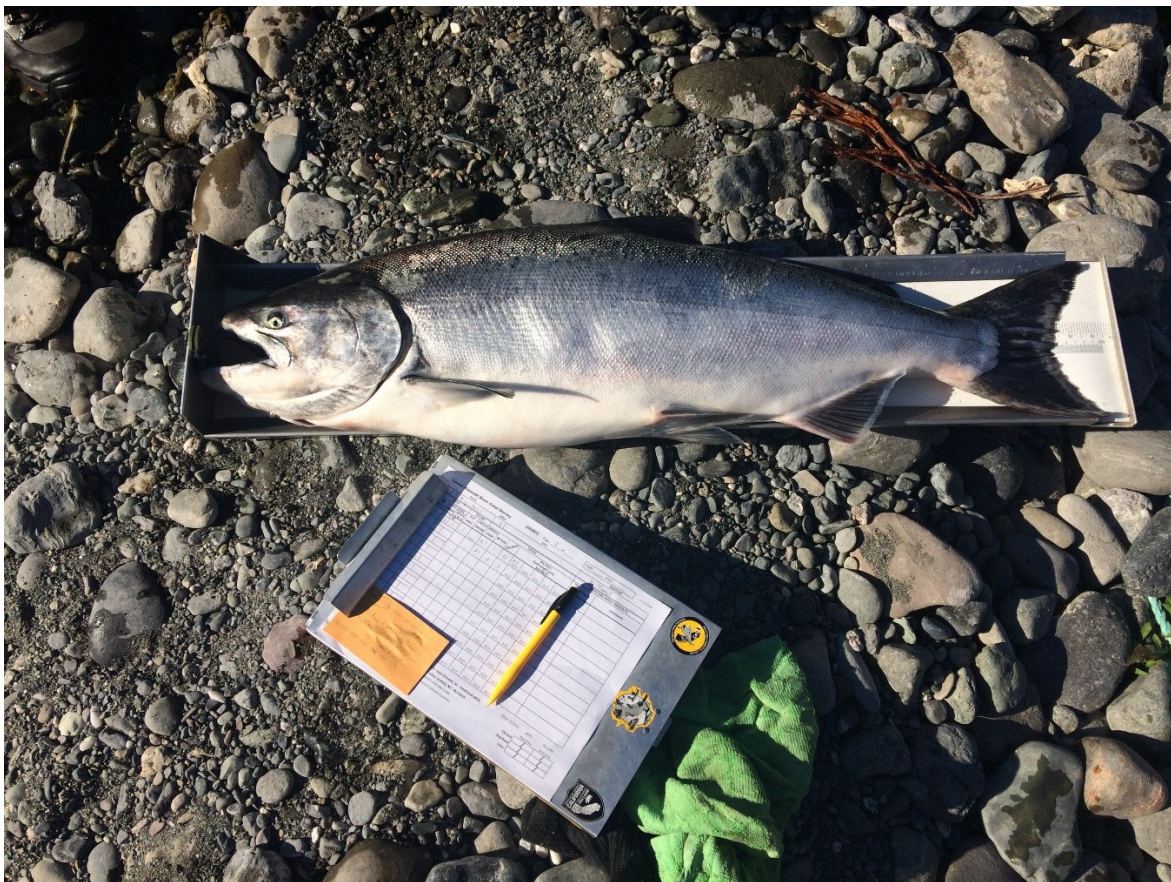


State of California
The Resources Agency
DEPARTMENT OF FISH AND WILDLIFE

ANNUAL REPORT

2021 ANGLER CREEL SURVEYS IN THE LOWER KLAMATH RIVER



On the cover: The largest Chinook salmon sampled during the 2021 season, taken at Klamath Glen.

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ANNUAL REPORT
KLAMATH RIVER PROJECT – Funded by Sport Fish Restoration Act

2021 ANGLER CREEL SURVEYS IN THE LOWER KLAMATH RIVER

by

Dan Troxel

Northern Region
Klamath - Trinity Program

601 Locust Street
Redding, CA 96001

July 2022

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ABSTRACT

A creel survey was conducted along the lower Klamath River (Pacific Ocean to Hwy 96 Bridge in Weitchpec) August 6, 2021 through November 4, 2021 to estimate the recreational fishery effort, catch and harvest of fall Chinook Salmon (*Oncorhynchus tshawytscha*), Coho Salmon (*Oncorhynchus kisutch*) and steelhead (*Oncorhynchus mykiss*). A goal of the creel survey is to help determine the contributions made by Trinity River Hatchery, Iron Gate Hatchery and naturally produced salmonids to the annual recreational harvest in the lower Klamath River. Information provided by the creel survey will help assess the production and harvest goals of the California Department of Fish and Wildlife, in addition to providing real-time monitoring needed for in-season recreational harvest management.

In 2021, the fall Chinook Salmon fishery was open to recreational fishing. Results from the 2021 creel survey and subsequent Klamath River Technical Team meeting indicate an estimated harvest of 3,448 (1,149 adult and 2,299 jack) fall Chinook Salmon and 125 (83 adults and 42 half-pounders) steelhead for the lower Klamath River. The 2021 in-river recreational quota was 1,221 adult fall Chinook Salmon for the entire basin, with a lower Klamath River sector quota of 611 adult fall Chinook Salmon. Hatchery-origin fall Chinook Salmon represent an estimated 361 fish (10.47 percent) of the estimated harvest in the lower Klamath River, comprised entirely of Trinity River Hatchery (173 fish) and Iron Gate Hatchery (188) fish. Seasonal summaries and interannual comparisons of angler effort, angler harvest, harvest timing, length frequencies, hatchery compositions and coded-wire tag recoveries are presented.

TASK OBJECTIVES

- Quantify total recreational harvest, angler effort, catch-and-release, and catch per effort of salmonids in the lower Klamath River.
- Determine the contribution to recreational harvest from fish produced at Trinity River and Iron Gate hatcheries.

Note: The lower Klamath River fall creel survey was removed from Trinity River Restoration Program funding sources as of October 1, 2020 and transferred to Sport Fish Restoration Act (SFRA) funding. This report for the 2021 season is the first report completed completely under SFRA.

INTRODUCTION

The Klamath River basin is regarded as one of the most important contributors of Chinook Salmon (*Oncorhynchus tshawytscha*) to California's commercial, tribal and recreational fisheries. The salmonid resources are composed of both naturally produced and hatchery produced salmonids originating from the Klamath and Trinity Rivers. Angler harvest of Chinook Salmon has been monitored by the California Department of Fish and Wildlife (Department/CDFW) to provide data for run-size estimates since 1978 (Boydstun 1979, 1980; Lee 1984a, 1984b, 1985, Lau 1992-1997; Pisano 1998; Borok 1999-2004, Hanson 2005-2009). This report presents the recreational creel survey results collected from the lower Klamath River between the river mouth at the Pacific Ocean and the Hwy 96 Bridge in Weitchpec (confluence of the Trinity River) from August 6, 2021 through November 4, 2021. The 2021 recreational fall creel survey continues CDFW's annual monitoring efforts and adds to existing recreational harvest baseline information.

A goal of the creel survey is to estimate the contributions made to the annual recreational fish harvest in the lower Klamath River by fish produced at Trinity River Hatchery (TRH), Iron Gate Hatchery (IGH) and in natural spawning areas. In addition, annual creel survey data helps measure progress towards meeting production and harvest objectives of the Trinity River Restoration Program and contributes to the management of fall Chinook Salmon stocks across the west coast by the Pacific Fishery Management Council. Information provided by the creel survey is also used by CDFW to determine, in real time, when recreational anglers have reached the in-river recreational harvest sub-quota of adult fall Chinook Salmon for each section of the lower Klamath River.

Recreational Quotas and Harvest Management

Each year an annual in-river recreational harvest quota for adult (age ≥ 3) fall Chinook Salmon returning to the Klamath Basin is recommended by the Pacific Fisheries Management Council. The quota is then considered and adopted by the California Fish and Game Commission. Of this quota, 50% is allocated to the lower Klamath River extending from the ocean to the Hwy 96 Bridge in Weitchpec [river kilometers (rkm) 0.0 to 68.8], and the remaining 50% is allocated to the mid Klamath River (17%) (rkm 68.8 to 306.0) and the Trinity River (33%). No quota is assigned to jacks (age 2). The Department monitors or models each of these areas for fall Chinook Salmon harvest and determines when the quota of each portion has been met. Once a sub-quota in any of the sections is met, an adult Chinook Salmon harvest closure goes into effect in that section of river. Within the lower Klamath River sub-quota area, a closure is enacted at the mouth of the river (spit area) when 15% of the basin quota is caught downstream of the Hwy 101 Bridge. Under current regulations, anglers are also required to cease fishing in this area when the adult component of their daily bag limit is met. Anglers would still be permitted to fish in other areas but must release any adult Chinook Salmon (>23 inches, total length) caught. Note that a regulation change was implemented in 2020 to increase the jack/adult size cut-off from 22" to 23" total length. Meanwhile, anglers in other portions of the river are still permitted to catch and release adult Chinook Salmon in the process of catching the jack component of the daily bag. After all sub-quotas are met, fishing for jack Chinook Salmon and other legal species is still permitted, but the entire river is closed to the harvest of adult Chinook Salmon. However, once TRH and IGH have reached mitigation egg take goals, special exempted fisheries for adult Chinook Salmon are permitted in the Klamath River between Iron Gate Dam and Interstate 5, and in the Trinity River between the Old Lewiston Bridge and the mouth of Indian Creek.

During the 2021 season, fishing regulations allowed for the harvest of up to two Chinook Salmon per day, with no more than one adult. Possession limits were equal to three daily bag limits, or six Chinook Salmon, with no more than three adults. These regulations went into effect on August 15, 2021 in the Klamath River and September 1, 2021 in the Trinity River. Anglers were also permitted to harvest two hatchery trout or two hatchery steelhead (*Oncorhynchus mykiss*) per day. The limit of hatchery steelhead for the Trinity River was also two per day and four in possession. No recreational harvest of Coho Salmon (*Oncorhynchus kisutch*) was permitted in the entire Klamath basin due to their current threatened status. Regulations stated that "hatchery" trout or "hatchery" steelhead could be harvested, which eliminates the harvest of cutthroat trout.

METHODS

Description of the Fishery and Creel Sample Areas

To estimate angler catch and effort, CDFW divides the mainstem Klamath River, from the mouth to Iron Gate Dam, into three areas. The mouth of the river to the Hwy 96 Bridge in Weitchpec (Areas 1 and 2) is included in this report. Areas upstream of the Hwy 96 bridge to Iron Gate Dam (Area 3) were not surveyed by CDFW in 2021. Chinook Salmon harvest in Area 3 is estimated using a ratio estimator based on catch in Areas 1 and 2. Additionally, the lower Trinity River sector is estimated from Hoopa Valley Tribe creel survey estimates, and the upper Trinity sector harvest estimates are derived from tag returns from fish originally tagged at the Willow Creek weir operated by CDFW's Trinity River Project. Note that this report does not include these sectors, and only provides estimates for the lower Klamath River creel survey. For 2021, sites denoted in red in Figure 1 were active "creel" sites for stationary or roving components of the survey. Sites denoted in blue were inactive "rover" sites, indicating that samplers could periodically check them throughout the season to see if effort and/or ability to access the site develops. No inactive rover sites were sampled in 2021.

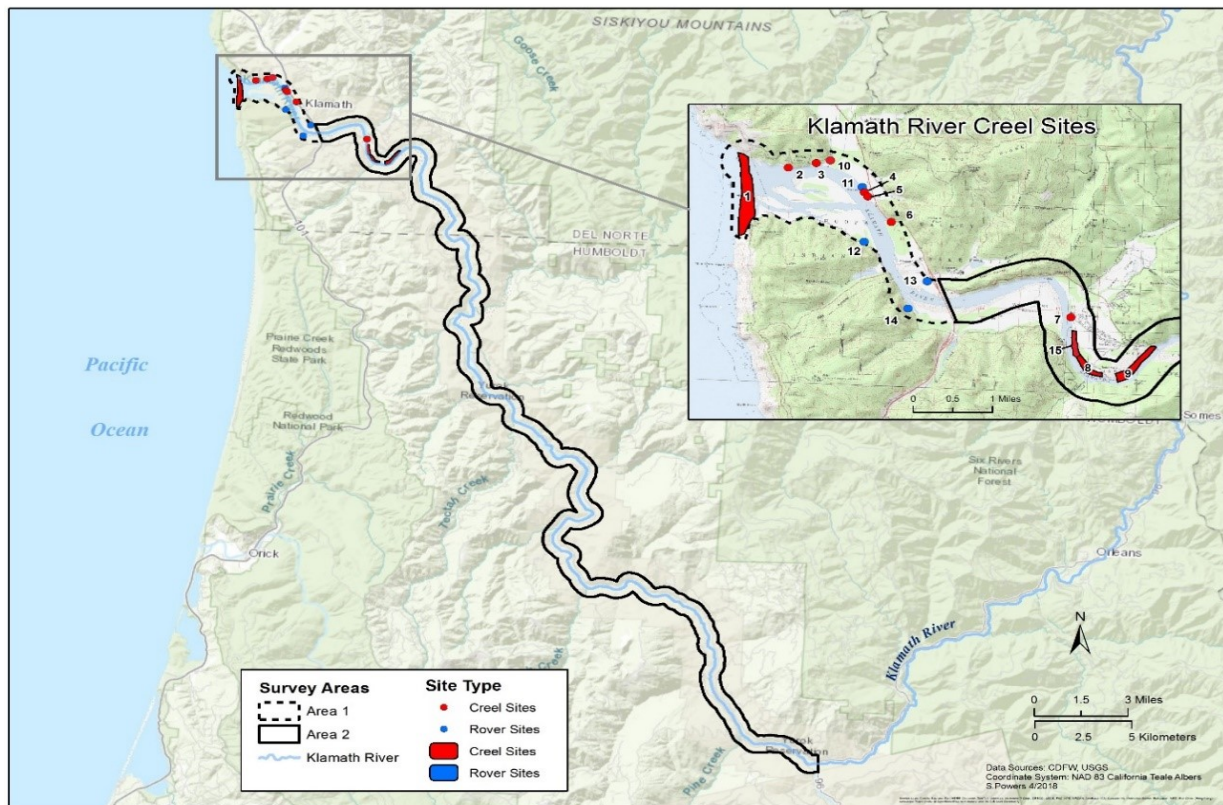


FIGURE 1. Map of lower Klamath River creel survey sites for 2021. Location names can be found in Table 1.

TABLE 1. Active and inactive sampling locations for the lower Klamath River fall creel survey.

Site Name	Site #	Area	Active (Y/N)
Mouth (North and South)	1	1	Y
Requa Boat Ramp	2	1	Y
Panther Glen ¹	3	1	Y
Riverside RV Park ²	4	1	Y
Golden Bear RV Park ²	5	1	Y
Townsite Ramp	6	1	Y
Roy Rook Boat Ramp	7	2	Y
Upper Klamath Glen ³	8	2	Y
Blakes Riffle ³	9	2	Y
Anglers Cove ¹	10	1	Y
Chinook RV Park	11	1	N
Kamp Klamath	12	1	N
Klamath RV Corral	13	1	N
Klamath River RV Park	14	1	N
Lower Klamath Glen ³	15	2	Y

^{1,2,3} = Adjacent sites; sampled concurrently

Area 1: This area consists of the 4.5 rkm between the mouth of the Klamath River and the Highway 101 bridge and is referred to as the estuary. Essentially all shore angling effort in this area took place at the mouth of the river. River mouth configuration, which changes annually, determines which side (north or south) affords better shore angling. Creel sampling of shore anglers was conducted primarily at the South Mouth, but anglers who accessed the mouth from the North side could be interviewed when intercepted by creel samplers.

Boat access locations in Area 1 include private resort docks and both public and private boat ramps below Highway 101 bridge. These include three resort docks (Golden Bear RV Park, Riverside RV Park, and Panther Creek RV Park) and two boat ramps (Old Townsite Boat Ramp and Requa Boat Ramp). All sites were sampled this season except Riverside RV Park, which was not sampled due to the Yurok Reservation COVID-19 closure.

Area 2: This area extends from the Highway 96 Bridge (rkm 68.0) in Weitchpec downstream to the Highway 101 Bridge at Klamath (rkm 4.5). The division between areas 2 and 3 was historically the falls at Coon Creek (rkm 54.4) near the community of Johnson's Riffle (Pecwan Creek), but it was moved to its current location in 1999 to make the distinction clearer for anglers.

Shore angling in the lower 5 rkm of Area 2 is generally confined to three popular and easily accessed riffles (Lower Klamath Glen, Upper Klamath Glen and Blake's Riffle). Angler access to these locations are limited to specific, well defined routes, which enables a complete accounting of angler effort and catch during a sample day at these locations. Shore angling access upstream of Blake's Riffle is limited to three access points: the mouth of Blue Creek (rkm 26.3), the mouth of Ah Pah Creek (rkm 27.5), and

Bear Riffle (rkm 29.8). Some of these points can be accessed by vehicle (some of which require access through private land) but have accounted for less than one percent of angling effort according to estimates in past surveys (Hopelain 2001). Boat traffic comprises the majority of effort in this area and is accounted for by data collected at the Roy Rook boat ramp.

Boat access in Area 2 is essentially confined to one public boat launch (Roy Rook Ramp), which enables complete sampling of angler effort and catch for each sample day. Occasional primitive boat launching occurs at the shore sites as well. During each sampling day in Area 2, creel surveys were conducted at all shore angling locations above Highway 101 bridge, and the boat access location (Figure 1 and Table 1).

Creel Survey Methods

Study methods and procedures used in Areas 1 and 2 during the 2021 season were essentially the same as those described for the 1983 - 1987 seasons (Hopelain 2001). Data are presented in standard Julian week (JW) format throughout this report. During the 2021 survey season, Julian weeks began on Thursdays and ended on Wednesdays (Appendix 1). Catch-and-release data are expanded in the same manner as harvest data in each area.

Selection of sampling days for 2021 was a simple random sample per JW, as no statistically significant difference in effort has been found between weekdays and weekend days. Areas 1 and 2 were each sampled three days per week, with no concurrent sampling of each Area. Beginning with JW 40 (week beginning October 1), two days per JW in each area were randomly selected to be surveyed. As a result of this sampling design, each area was surveyed three times per JW between August 6th and September 30th, and twice per JW beginning October 1st. Survey effort was decreased in October to accommodate personnel needs with concurrently operating field surveys and in response to diminished angling effort later in the season.

Each angling access site was sampled throughout the day to account for total catch and effort for that particular site. CDFW staff interviewed anglers as they departed fishing grounds and recorded the following information:

1. Was the angler or boat finished fishing for the day at this time?
2. What Area did the anglers' effort or catch come from? (Boats only)
3. Total hours spent fishing (to the nearest half hour).
4. The first three numbers of their ZIP Code (to identify general area of origination).
5. Harvested fish were identified to species, inspected for marks, external tags and unusual conditions, and measured to the nearest centimeter fork length. Also, a scale sample was collected for the purpose of aging the fish.
6. For Chinook Salmon missing an adipose fin, indicating presence of a coded wire tag, the head was removed and retained by staff.

7. The number and species of fish caught and released (actually released, not lost) was recorded by age class (grilse or adults) as reported by the angler.

Stationary and Roving Sampling

As noted above, sampling locations are relatively stable, but the survey does allow for effort shifts. New effort locations can be captured in the roving component of the survey.

In Area 1, stationary samplers were primarily located at three sites, River Mouth (South Access), Golden Bear RV Park, and the paired sites of Panther Glen and Anglers Cove Resorts. These individual access locations (three sampling sites) account for most of the recreational angling effort in Area 1. The roving sampler then primarily surveyed Requa Boat Ramp, Townsite Boat Ramp and River Mouth (North Access).

In Area 2, stationary samplers were located at Roy Rook Ramp, while Blakes Riffle, Klamath Glen, and primitive boat launches in the area were surveyed by a roving sampler.

Addition or subtraction of sampling sites is primarily based upon dominant effort levels as they occur over multiple seasons. Unless dictated by a drastic shift in effort locations, stationary and roving sites remain the same throughout an entire survey season. For 2021, all sampling sites remained constant throughout the season.

Harvest and Effort Estimating Procedures

Angler harvest, catch and release, and angler effort were estimated for each Julian week, creel survey area, and mode of angling (for Area 1 only) as follows:

$$\hat{Y}_j = \sum_{i=1}^n y_i I_i \left(\frac{N_j}{n_j} \right)$$

where: \hat{Y}_j = estimated harvest, catch and release, or effort in the j^{th} week

y_i = total counts of harvest, catch and release, or effort on the i^{th} day

N_j = number of legal fishing days in week j

n_j = number of sample days in week j

I_i = sampling ratio on day $i = \frac{\text{Total anglers or boats enumerated on day } i}{\text{number of anglers or boats sampled on day } i}$

Area 1: Angler harvest, catch and release, and angler effort were estimated separately for boat and shore angling groups in Area 1, then added to give an estimate of weekly totals. Estimation methods are the same for “mode of fishing” used by the angler. For shore-based recreational anglers, we record and account for missed anglers, refusals and language barriers, all of which are counted as missed interviews and thus expanded for by I_i in the above equation. Anglers who access fishing grounds by boat,

regardless of whether the boat is used for angling or simply for transport to a shore angling location, are expanded for in a similar manner. The exception is that a missed, refusal or language barrier boat is denoted on the field data with the boat being the sampling unit (as opposed to individual anglers on the boat). Missed boats are then factored into daily expansion within I_i as described above. Secondly, the roving component of the survey captures additional interviews and missed anglers/boats, refusals and language barrier data. Thirdly, there are some sites in Area 1 that have private boat access but do not allow CDFW staff on site. Samplers at neighboring sites monitor boats at inaccessible sites by recording the number of unsampled boats that return to those locations in a day. Combining all of these sources for daily expansion data, estimates of total effort for the given sampling area can be made for the entire day. It is important to note that there can also be substantial tribal fishing effort in Area 1, and samplers are trained to identify tribal shore anglers and boats using best judgement. Boats used in the tribal gillnet and subsistence angling fisheries are excluded from all counts.

For shore-based anglers, essentially all effort is captured from the River Mouth (South Access). However, the roving sampler collected additional data on shore-based anglers on the North side of the mouth, thus providing complete information for daily expansions of shore-based angling.

Area 2: Harvest estimates for the area upstream of Hwy 101 to the Hwy 96 Bridge at Weitchpec were calculated in the same manner as described above, with minor changes to sampling protocol. Boat access is almost exclusively limited to the one developed boat ramp in Area 2 (Roy Rook Ramp), but anglers may self-launch boats at the shore fishing sites as well. Samplers working the shore sites interview primitive boat launch anglers as available, or may note them as missed, refusal or language barrier as normal. The daily expansions for boat effort are calculated as described above, with the exclusion of any offsite missed boats, as this is unique to Area 1.

For shore-based effort, a roving sampler monitored effort along the three adjacent shore sites. Samplers conduct periodic effort counts to enumerate anglers throughout the day at each individual site. This, in conjunction with the number of completed interviews and missed anglers, refusals or language barriers is used to estimate the total number of angler trips for the day, I_i , in the equation above.

Daily Real-Time Harvest Estimates and Projections

The Klamath River Project monitors harvest rates in near real-time based on data provided from each sampling day. It is necessary to monitor current harvest and effort after each survey day as the fishery approaches an area or sub-area quota to implement fishery closures. The Department can generate one, two, and three-day harvest projections as needed, to allow lead time for potential adult Chinook Salmon fishery closures, as the regulatory process for closure usually takes two to three days. Harvest projections are used for the sub-area quota below Highway 101 bridge which

triggers the full closure of the fishery at the mouth of the river, as well as the closure for adult Chinook Salmon harvest for the remaining lower river quota. Additionally, the lower river closure date is used as a guideline for implementing the closure of the mainstem Klamath sector from Iron Gate Hatchery to the Highway 96 bridge at Weitchpec and the upper Trinity River sector from Old Lewiston Bridge to Cedar Flat.

Age Classification for Chinook Salmon and Steelhead

Recreational fishing regulations identify the size of adult Chinook Salmon as greater than 23 inches (58.4 centimeters) in total length. For management purposes, CDFW uses 22 inches (55.9 cm) fork length (FL) to make adult - jack determinations during the season and for real-time quota monitoring (this measurement is equal to the 23" regulation total length). However, the actual length separating jacks from adults varies among years, and proportions of each age class for Chinook Salmon are determined post season through scale analysis. Scales collected from harvested fish are mounted and read by the Yurok Tribal Fisheries Program and U.S. Fish and Wildlife Service, and proportions of each age class are estimated using bias corrections from known-age coded-wire tagged (CWT) hatchery fish collected within the harvest sample (KRTT 2022). Steelhead less than or equal to 42 cm FL are considered half-pounders, and those larger are considered adults.

Coded Wire Tag Recoveries, Processing, and Estimation of Hatchery Proportions

Coded-wire tag recovery is an important component in the creel survey. Recovery of CWTs allows for estimation of hatchery proportions and hatchery of origin. Additionally, CWT recovery is important for establishing run-timing during the early part of the season when the fishery transitions from the spring run to the fall run. All heads from adipose fin-clipped fish collected either during angler surveys or as non-random recoveries are assigned individual head tag numbers, which allows tracking of each head through the CWT extraction and decoding process.

Approximately 25% of Chinook Salmon produced at TRH and IGH receive CWTs and are externally marked by removal of the adipose fin. Trinity River Hatchery steelhead are marked at a targeted rate of 100% by the Hoopa Valley Tribe by removing the adipose fin. Both hatcheries strive to mark 100% of Coho Salmon by clipping the right (TRH) or left (IGH) maxillary bone. Successful clipping rates for Coho Salmon generally exceed 99% at TRH and IGH thus we assume a 100% marking rate. Successful marking rates of steelhead at TRH have generally exceeded 98% since 2006 (B. Matilton, Hoopa Valley Tribe Fisheries, unpublished data), so we also assume a 100% marking rate. Steelhead have not been produced at IGH since 2012. The proportion of total estimated harvest attributed to hatchery Chinook Salmon is estimated by expanding recovered CWTs by hatchery production multipliers. Contributions of hatchery Coho Salmon (if illegally harvested) and steelhead to harvest in the lower Klamath River is estimated from the proportion of marked fish recorded by creel surveyors.

RESULTS

Recreational fishery regulations for 2021 defined a cut-off date of August 14 as the end of the spring Chinook Salmon fishery. As the fall creel survey begins August 6, sometimes fall Chinook Salmon are harvested prior to the regulatory start of the fall fishery (August 15), or spring Chinook Salmon are caught after the fall quota begins.

Each year, the Klamath River Technical Team completes post-season analysis of lower Klamath River harvest data. Generally, this means either determining a cut-off date between spring and fall run Chinook Salmon or separating harvest estimates when there is overlap of the runs as informed by coded wire tag data. Regardless of which method is applied, spring harvest estimates are furnished in the spring annual report and fall harvest estimates are exclusively furnished below.

Estimated Angler Effort and Harvest

During the 2021 season, the creel survey for the lower Klamath River began on August 6 and ended November 4 (JWs 32 through 44). However, based upon CWT recoveries KRTT determined that the appropriate start date of fall Chinook Salmon harvest aligned with the August 15 regulatory start date of the season. Harvest and effort data prior to this date are included in the 2021 spring creel annual report as noted above. For the fall Chinook Salmon fishery anglers made a total of 7,339 trips in Areas 1 and 2 combined, 1,324 in Area 1 and 6,015 in Area 2 (Table 2). These trips resulted in a total effort of 33,106 fishing hours.

Table 2. Angler effort for fall Chinook Salmon fishery on the Lower Klamath River.

Mode	Area 1		Area 2		Combined	
	Trips	Hours	Trips	Hours	Trips	Hours
Shore	627	1892	1304	3734	1931	5626
Boat	698	2238	4711	25242	5409	27480
Total	1325	4130	6015	28976	7340	33106

A total of 757 harvested Chinook Salmon were observed and measured by samplers in the lower Klamath creel survey, with 155 fish from Area 1 and 602 from Area 2. They ranged in size from 34 to 94 cm (Figure 2, 3 and 4). Additionally, six harvested steelhead were observed and measured in the lower Klamath River creel survey ranging from 30 to 61 cm FL (Figure 5), and zero coho Salmon were estimated harvested in 2021.

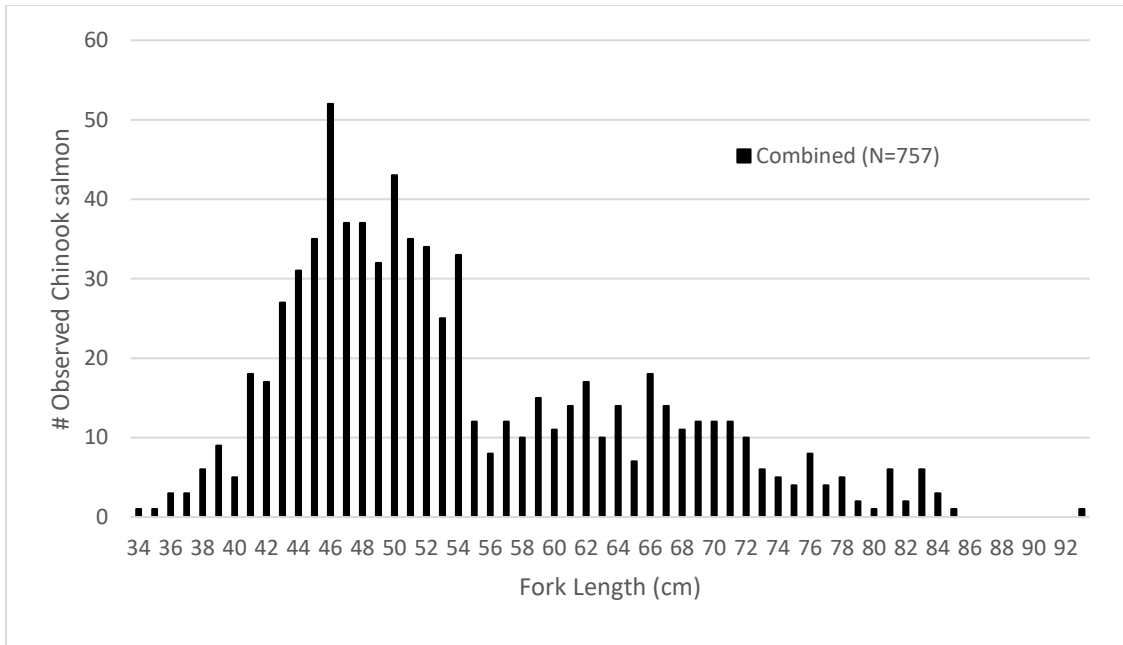


FIGURE 2. Fork length frequency of Chinook Salmon harvested in the lower Klamath River during the 2021 season.

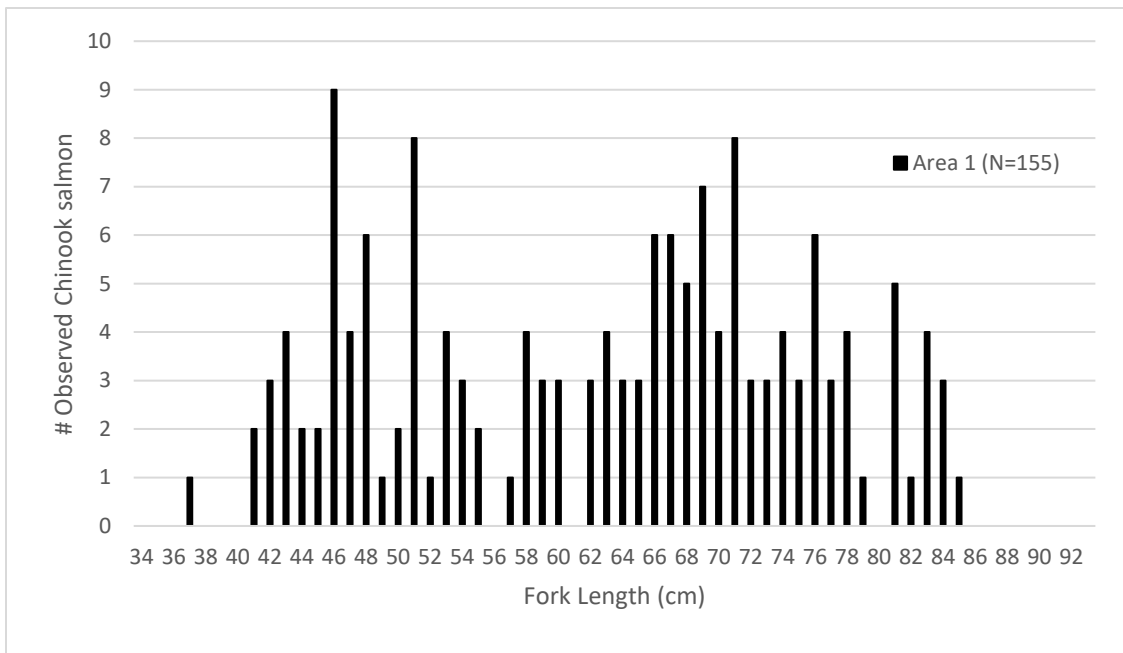


FIGURE 3. Fork length frequency of Chinook Salmon harvested below Highway 101 bridge (Area 1) during the 2021 season.

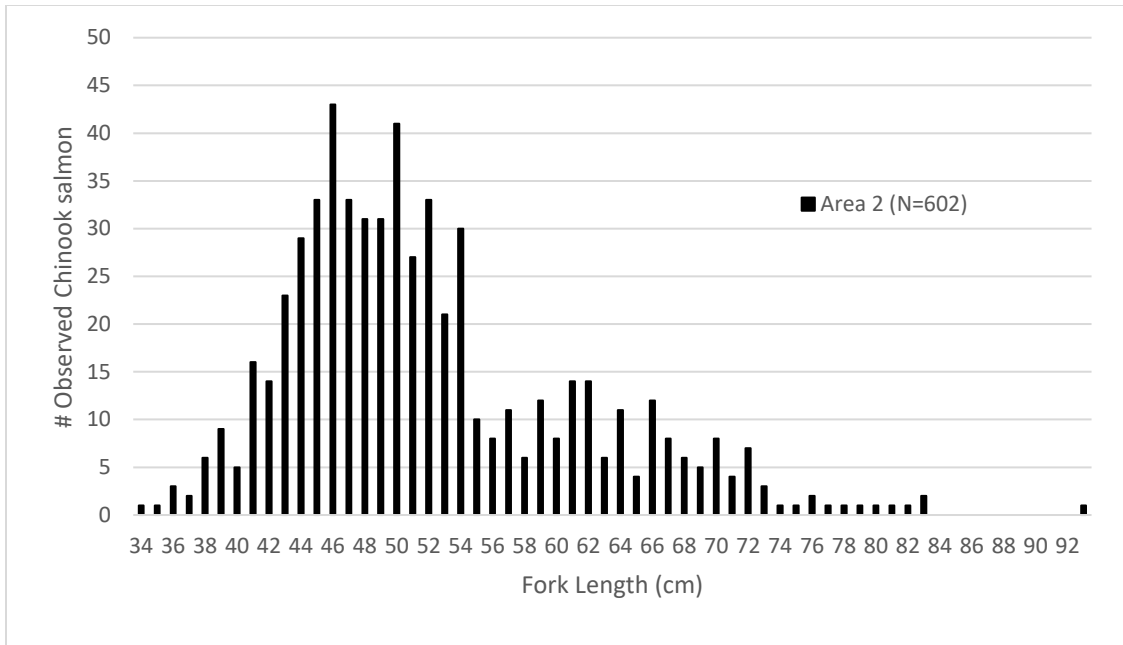


FIGURE 4. Fork length frequency of Chinook Salmon harvested above Highway 101 bridge (Area 2) during the 2021 season.

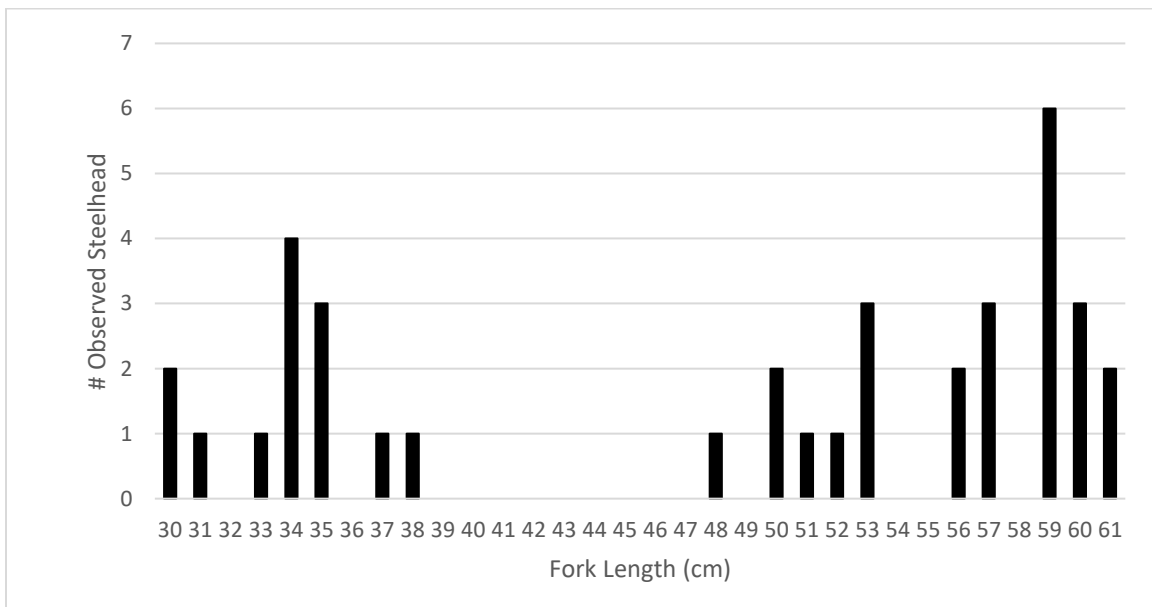


FIGURE 5. Fork length frequency of steelhead harvested in the lower Klamath River during the 2021 season.

Catch and Release

Catch-and-release information was recorded as part of the creel interview and is expanded by the weekly expansion factors in the same manner as harvest and angler effort data. Anglers were specifically asked if fish were released rather than lost. Because of the subjective nature of these data (relying on memory of anglers instead of direct observations made by trained observers), results should be considered with some caution. An estimated 4,608 half-pounders steelhead, 2,252 adult steelhead, and 1,005 jack and 1,834 adult Chinook Salmon were caught and released by anglers in 2021 (Figures 6 and 7). Additionally, there were an estimated 12 coho salmon (2 jacks and 10 adults) reported caught and released this season.

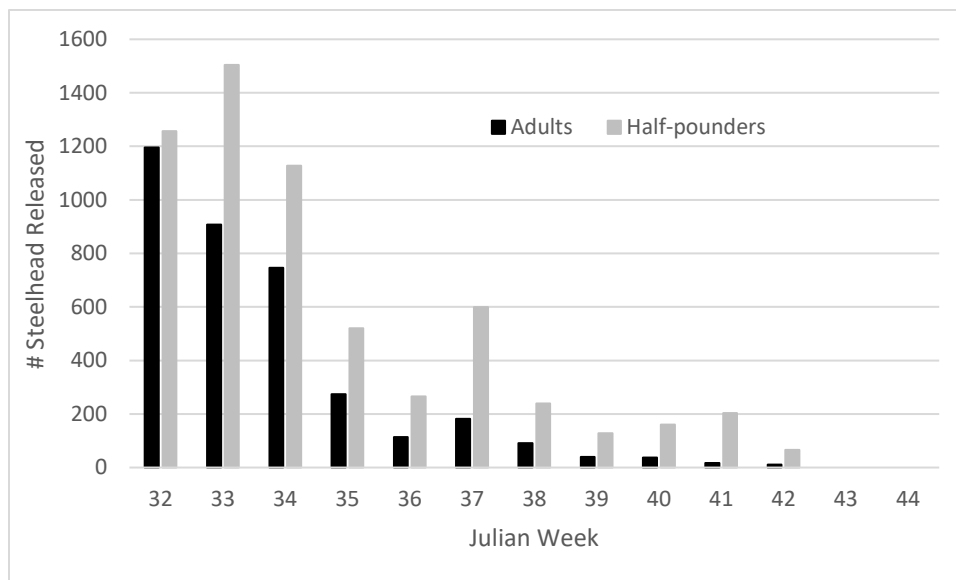


FIGURE 6. Estimates of steelhead caught and released by Julian week in the lower Klamath River during the 2021 season.

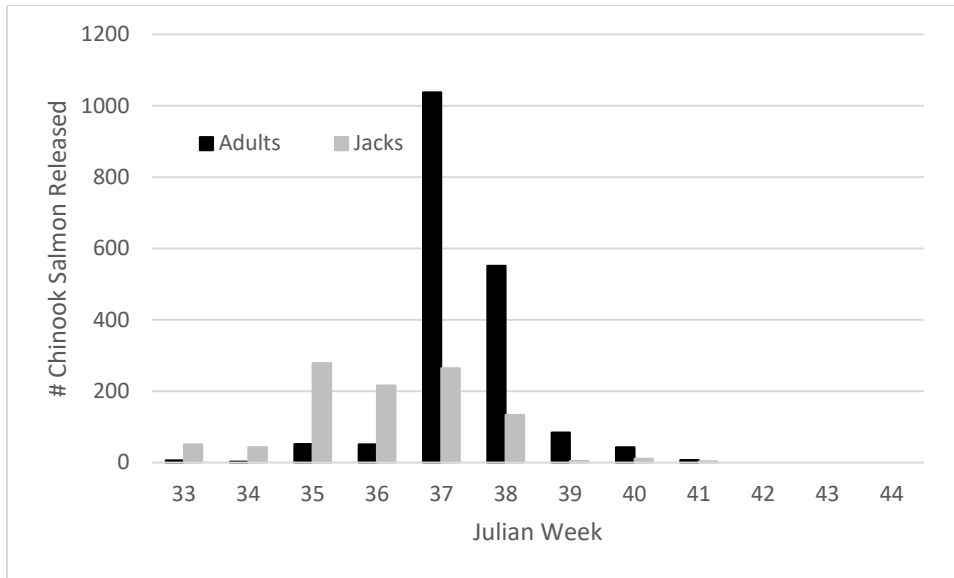


FIGURE 7. Estimate of Chinook Salmon caught and released by Julian week in the lower Klamath River during the 2021 season.

Angling Effort, Harvest Patterns and Demographics

Long term data sets are maintained for the lower Klamath River fall creel survey. These encompass data from the entire length of the fall creel survey (from August 6 through November 4) each year and are not affected by the annual harvest determinations made by the Klamath River Technical Team.

The average fishing trip length during the 2021 season was 4.3 hours, slightly longer than the 1992-2021 long-term average (Table 3). Harvest per unit effort decreased from 2020, with a combined jack/adult CPUE of 0.096 fish per hour (Figure 8).

TABLE 3. Number of angler trips, total angler hours, and average angler hours per trip in the lower Klamath River recreational fishery 1992 – 2021.

Year	Total Angler		Average Hours/Trip
	Trips	Hours	
1992	11,190	33,080	3.0
1993	16,081	51,889	3.2
1994	15,100	54,748	3.6
1995	19,881	63,369	3.2
1996	27,929	91,019	3.3
1997	18,402	67,154	3.6
1998	17,606	52,145	3.0
1999	11,852	45,109	3.8
2000	14,150	57,184	4.0
2001	20,116	88,053	4.4

2002	18,376	85,925	4.7
2003	16,514	79,228	4.8
2004	15,180	71,397	4.7
2005	12,629	61,000	4.8
2006	8,902	41,792	4.7
2007	13,913	64,101	4.6
2008	10,827	56,005	5.2
2009	14,736	67,160	4.6
2010	11,516	58,842	5.1
2011	11,833	56,759	4.8
2012	17,641	87,748	5.0
2013	22,402	102,381	4.6
2014	12,616	60,376	4.8
2015	16,756	77,228	4.6
2016	7,981	36,651	4.6
2017	4,070	16,678	4.1
2018	10,181	44,204	4.3
2019	14,339	60,747	4.2
2020	10,852	47,794	4.4
2021	8,557	37,094	4.3
Average	14,606	61,371	4.2

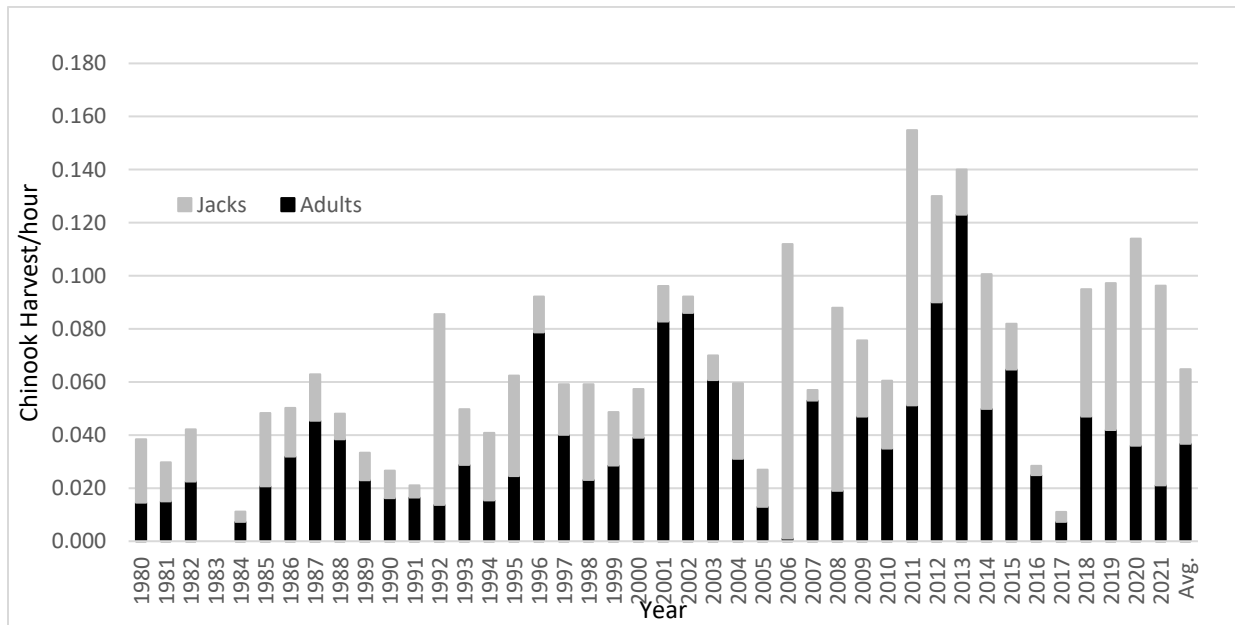
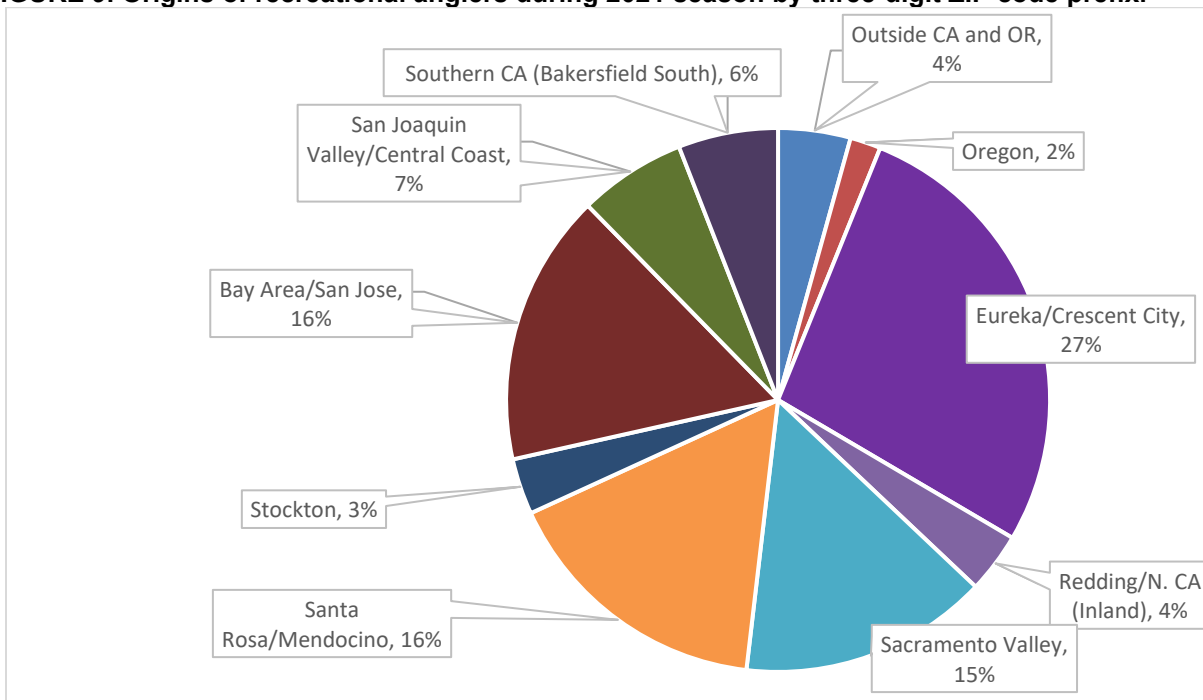


FIGURE 8. Chinook Salmon harvested per hour of angler effort during the lower Klamath River fall creel survey 1980-2021. Harvest occurred but no effort data was recorded in 1983, thus an HPUE cannot be generated. The fall Chinook Salmon fishery was closed in 2017 starting August 15.

As with previous years' surveys, anglers were asked for their home ZIP code. First reported in the 2018 annual report, this provides broad scale indications of the geographic distribution of recreational anglers participating in the fishery. In 2021, anglers from the local 955 ZIP prefix (Eureka, Crescent City, Arcata, etc.) accounted for 27% of anglers participating in the survey. In total, an estimated 94% of anglers originated in California, 2% were from Oregon, and an additional 4% originated from elsewhere (Figure 9).

FIGURE 9. Origins of recreational anglers during 2021 season by three-digit ZIP code prefix.



Harvest Timing

For the 2021 season, Chinook Salmon harvest increased steadily from the start of the season up through JW 38, coinciding with the closure of the adult fishery early in JW 37, after which jack harvest peaked for JW 37, remained high in JW 38, and declined rapidly over the next two weeks. Adult Chinook catch and release increased exponentially in JW 37, and remained high in JW 38, following the closure of the adult fishery, and then tapered off quickly in the following two weeks. Steelhead harvest peaked in JW 34 and remained low throughout the rest of the survey (Table 4).

TABLE 4. Harvest, catch-and-release and angler effort by Julian week during the 2021 lower Klamath River creel survey.

Julian Week			Harvest				Release			
	Angler		Steelhead		Chinook		Steelhead		Chinook	
	Trips	Hours	Grilse	Adult	Grilse	Adult	Grilse	Adult	Grilse	Adult
32	1110	3560	15	16	50	85	1257	1195	30	2
33	819	2942	3	22	75	32	1504	908	85	6
34	1252	4895	5	29	220	138	1128	746	43	3
35	1221	4843	3	1	639	216	520	274	279	52
36	1166	4820	3	4	314	285	265	114	216	51
37	1331	6613	3	3	886	15	599	182	264	1037
38	767	4382	6	3	449	3	240	92	134	551
39	375	2248	0	2	110	0	129	40	5	84
40	276	1618	0	4	43	7	161	37	11	43
41	189	907	0	0	0	0	203	18	4	7
42	49	270	4	0	0	0	67	11	0	0
43	0	0	0	0	0	0	0	0	0	0
44	4	4	0	0	0	0	0	0	0	0
Total	8559	37100	42	83	2786	782	6071	3615	1070	1837

Age Classification of Chinook Salmon

The scale-based age structure of fall Chinook Salmon harvested in the 2021 lower Klamath River recreational fishery is presented earlier in this report (Table 5). As noted, the fall Chinook Salmon harvest estimate was 3,448 fish (3,061 adults and 387 jacks). These scale-based age data were used to make final post-season estimates of harvest for jacks and adults in this report (as determined by the Klamath River Technical Team) and are reported to the Pacific Fishery Management Council as fall Chinook Salmon age structured abundance estimates, which are used for annual ocean abundance forecasts (KRTT 2022). Scales collected from harvested Chinook Salmon during the season were mounted and aged by the Yurok Tribal Fisheries Department and U.S Fish and Wildlife Service.

TABLE 5. Scale-based age composition of fall Chinook Salmon harvested in the 2021 lower Klamath River recreational fishery (KRTT 2022).

Recreational Harvest	Age				Total Adults	Total Run
	2	3	4	5		
Area 1 (below Hwy 101 bridge)	138	100	147	2	229	387
Area 2 (Hwy 101 to Weitchpec)	2,161	728	166	6	900	3,061
Total Harvest	2,299	828	313	8	1,129	3,448

Coded-Wire Tag Recovery

Over the course of the creel survey, 44 Chinook Salmon heads were recovered for extraction of CWTs. Among these, there were 10 non-random recoveries collected on non-sampling days (by anglers that retained for Department use and analyses) that are not used in apportionment but are used to validate run-timing and hatchery origin. Of the remaining 34 random heads, there were two heads in which a CWT was not present (designated 100,000s); zero tags were lost during the recovery process (200,000s); zero were observed by surveyors but not recovered (300,000s); and zero tags were unreadable during laboratory processing (400,000s).

We recovered 32 valid tags, all of which were from fall Chinook Salmon, originating from either IGH or TRH (Table 6). All tags were recovered following the start of the fall Chinook Salmon quota fishery (after August 15) and were used for hatchery apportionment as normal.

TABLE 6. Coded Wire Tag counts and juvenile release information recovered from Chinook Salmon during the 2021 fall creel survey. (Release Stage: Y=Yearlings, G = Fingerlings). Total estimates include expansion for sampling and hatchery production multipliers.

CWT	Count	Hatch	Brood Yr	Run	Rel Stage	ProdX	Total Est
060397	3	IGH	2019	Fall	G	6.57937	50.71645
061497	1	TRH	2017	Fall	Y	4.247159	10.13434
061526	1	IGH	2019	Fall	Y	1	3
061547	1	TRH	2018	Fall	G	4.065899	7.193527
061583	10	IGH	2018	Fall	Y	4.077212	104.6332
061903	1	TRH	2018	Fall	G	4.352589	7.402378
062009	2	IGH	2018	Fall	G	4.030903	14.16971
062020	1	TRH	2018	Fall	G	4.086529	6.949893
062022	6	TRH	2018	Fall	Y	4.103921	49.65671
062074	2	IGH	2019	Fall	Y	1	4.390484
062075	2	IGH	2019	Fall	Y	1	5.962371
062077	1	IGH	2019	Fall	Y	1	2.33
062078	1	IGH	2019	Fall	Y	1	2.33
	32						269

Hatchery Contribution

After expanding CWT recoveries for sampling and hatchery production multipliers, IGH fall Chinook Salmon accounted for an estimated 188 harvested fish. TRH fall Chinook Salmon accounted for an estimated 81 harvested fish. The Department recovered and decoded 22 tags from IGH fall Chinook Salmon, representing CWT release groups from brood years 2018 (12 tags) and 2019 (10 tags) (see Table 6). The Department recovered and decoded 10 tags from TRH fall Chinook Salmon, representing release groups from brood years 2017 (1 tags) and 2018 (9 tags) (see Table 6). When expanded for sampling and hatchery production multipliers, hatchery-origin fish account for 10.47 percent (361/3,448) of the total recreational harvest (Table 7). (*Note – BY 2019 fish from TRH were not tagged, and a proportion estimate is provided for this harvest component.*)

TABLE 7. Fall Chinook Salmon harvest proportioned by hatchery of origin in the 2021 lower Klamath River recreational fishery, expanded for creel sampling and hatchery production multipliers.

Chinook Salmon		Fall	Fall	Estimated	Percent
Age Class	Count	IGH Expanded	TRH Expanded	Total Hatchery	Hatchery
Jacks	387	69	92*	161	41.60
Adults	3,061	119	81	200	6.53
Total	3,448	188	173	361	10.47
% Total Harvest by Hatchery		5.45	5.02		

* - indicates estimated component of 2 year-old untagged Chinook Salmon from TRH.

DISCUSSION

Recreational harvest of fall Chinook Salmon in the lower Klamath River in 2021 was open for the fourth year following a closure in 2017. Generally, there exists an overlap in the run timing of spring and fall Chinook Salmon. This temporal extent of the overlap varies annually, however, a hard cut-off date (currently August 15) is necessary for development of annual fishing regulations. In 2021, there was no apparent overlap in harvest of spring and fall Chinook Salmon based on CWT recoveries, as no spring CWTs were recovered during the fall fishery and no fall tags were recovered during the spring fishery. This indicates that the timing of the spring and fall runs in 2021 may have been discrete, and for purposes of post-season analysis, were consistent with the regulatory guidelines.

The lower Klamath River recreational Chinook Salmon fishery is comprised of fish produced naturally in the Klamath and Trinity River basins and fish produced at IGH and TRH. Based on creel sampling and hatchery production multipliers, the estimated 2021 recreational harvest was comprised of approximately 7.80% hatchery-origin and 92.20% natural-origin fall Chinook Salmon. As noted above, TRH Chinook Salmon were not coded wire-tagged or adipose fin clipped in 2020 (2019 BY) due to the Covid pandemic. This likely biased the total hatchery contribution estimate, as TRH jacks can be a substantial component of the total harvest. Historically, proportions of hatchery fall Chinook Salmon within lower Klamath River Chinook Salmon recreational harvest have averaged 59% IGH Chinook Salmon and 41% TRH. In 2021, the hatchery component of estimated recreational harvest in the lower Klamath River was comprised of 69.89% IGH and 30.11% TRH fall Chinook Salmon. As noted above, the jack component of TRH returning fish was not identifiable due to lack of marks. To account for this missing portion of hatchery origin fish, KRTT 2022 utilized a long-term average for generating the run-size proportion estimates of age 2 TRH Chinook Salmon. Estimates were generated for six fishery and escapement sectors where untagged TRH BY 2019 fish were presumably encountered (including the lower Klamath recreational fishery). These estimates resulted in a total run size proportion of age 2 TRH account for 4% of the total age 2 Chinook Salmon harvest in the lower Klamath fishery. Applying this estimate to the total 2021 age 2 harvest; 92 fish would be attributed to TRH, as noted in Table 6, resulting in a corrected attribution of 52.07% IGH and 47.92% TRH origin fish in the hatchery harvest component. In relation to the hatchery component of the total run size, 2021 was substantially less than the average, with 13,473 fish returning to Klamath basin hatcheries (7,506 and 5,967 at IGH and TRH, respectively) compared to the 1978-2021 average of 24,967 (KRTT, 2022). Identifying the contribution of natural-origin Trinity stocks to the recreational fishery is beyond the scope of this report. Methods to produce quantitative estimates of natural-origin Chinook Salmon contributions from each of the Klamath and Trinity basins to the recreational fishery are being investigated.

In 2020, the smaller size of returning 3 year-olds when compared to recent years had presented challenges for harvest monitoring and post-season analysis. It was suggested that poor ocean growth during 2019 led to the size decreases. This was also

supported by indistinct scale markings (depressed growth rings), that made for difficult visual aging. In 2020, a substantial portion of adult fish have been shorter than the regulatory jack /adult size cut-off of 23" TL. This led to higher estimates of adult harvest in post-season analysis, resulting in substantial overages of adult fall Chinook Salmon quotas. In 2021 real-time CWT analysis was implemented as a possible preventative measure to better assess age structure during in-season monitoring. Fortunately, the proportion of small sized adults was not nearly as much of an issue as previous seasons. However, continued in-season CWT processing will be maintained, as it allows for efficient and timely data management, while still providing a potential safeguard for seasons in which returning salmon size is outside the expected norms.

In years in which the fishery is open, a ratio estimator is used to estimate harvest in the non-surveyed area above Highway 96 bridge (Area 3). Area 3 was surveyed from 1999-2002. For each year, a ratio of lower river (Areas 1 and 2 combined) to upper river (Area 3) adult fall Chinook Salmon harvest was generated, and these ratios were averaged across the four years to generate a ratio estimator for adult harvest in Area 3 of 50.4% of the lower river adult harvest. For 2021, KRTT applied this estimator as normal, thus estimating 579 adult fall Chinook Salmon harvested in Area 3. The subsequent jack harvest is estimated by expanding adult harvest by the proportion of jacks observed in upper Klamath River sectors (KRTT 2022), resulting in an additional 74 jacks, for a total Area 3 harvest of 653 fall Chinook Salmon. Staff have been assessing the feasibility of implementing a creel survey in Area 3 to update this estimator. As of this time, survey implementation is unlikely due to lack of funding, but staff are considering other data sets that may provide updated information for this method (e.g., salmon report cards).

It is worth noting that the 2021 fall creel season took place during lingering concerns of the Covid-19 pandemic. Although field operations and angler interaction returned to a mostly "normal" manner (boarding boats, handling all fish, entering fish bags/coolers, etc.), some continued constraints were still present. Consequently, fewer observed fish were measured for length and scale sampled. While the biological sampling rate was somewhat reduced, scales were collected from a sufficient number of fish to allow for scale-based age classification to be used in post-season analysis. As per standard protocol, if hatchery fish were identified, the fish would be processed as normal: measured to fork length, recover CWT via snout removal, and scale sampled.

The 2021 Klamath basin adult fall Chinook Salmon run-size estimate was approximately 8,000 fewer adult fish returning to the river than the projected adult river return being about 52,000 (KRTT, 2022), compared to a pre-season projection (with ocean fisheries) of about 62,000 (PFMC, 2021). The 2022 season (PFMC, 2022) on Klamath fall-run will allow for increased harvest opportunities over the previous season, but it will still be fairly limited. The approved quota for 2022 in-river recreational harvest is 2,119 adult fall Chinook Salmon for the entire Klamath River Basin. Bag and possession limits for 2022 will remain unchanged from 2021, potentially providing a slightly longer time frame for anglers to harvest adult Chinook Salmon. As usual, anglers will be able to harvest jacks following the closure(s) of sectors following the attainment of adult quotas.

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APPENDICIES

APPENDIX A. List of Julian weeks and their calendar equivalents.

Julian week	Inclusive dates			Julian week	Inclusive dates		
1	01-Jan	-	07-Jan	27	02-Jul	-	08-Jul
2	08-Jan	-	14-Jan	28	09-Jul	-	15-Jul
3	15-Jan	-	21-Jan	29	16-Jul	-	22-Jul
4	22-Jan	-	28-Jan	30	23-Jul	-	29-Jul
5	29-Jan	-	04-Feb	31	30-Jul	-	05-Aug
6	05-Feb	-	11-Feb	32	06-Aug	-	12-Aug
7	12-Feb	-	18-Feb	33	13-Aug	-	19-Aug
8	19-Feb	-	25-Feb	34	20-Aug	-	26-Aug
9 a/	26-Feb	-	04-Mar	35	27-Aug	-	02-Sep
10	05-Mar	-	11-Mar	36	03-Sep	-	09-Sep
11	12-Mar	-	18-Mar	37	10-Sep	-	16-Sep
12	19-Mar	-	25-Mar	38	17-Sep	-	23-Sep
13	26-Mar	-	01-Apr	39	24-Sep	-	30-Sep
14	02-Apr	-	08-Apr	40	01-Oct	-	07-Oct
15	09-Apr	-	15-Apr	41	08-Oct	-	14-Oct
16	16-Apr	-	22-Apr	42	15-Oct	-	21-Oct
17	23-Apr	-	29-Apr	43	22-Oct	-	28-Oct
18	30-Apr	-	06-May	44	29-Oct	-	04-Nov
19	07-May	-	13-May	45	05-Nov	-	11-Nov
20	14-May	-	20-May	46	12-Nov	-	18-Nov
21	21-May	-	27-May	47	19-Nov	-	25-Nov
22	28-May	-	03-Jun	48	26-Nov	-	02-Dec
23	04-Jun	-	10-Jun	49	03-Dec	-	09-Dec
24	11-Jun	-	17-Jun	50	10-Dec	-	16-Dec
25	18-Jun	-	24-Jun	51	17-Dec	-	23-Dec
26	25-Jun	-	01-Jul	52 b/	24-Dec	-	31-Dec

a/ Eight-day week in each leap year (years divisible by 4).

b/ Eight-day week every year.