# Recovery of Coded-Wire Tags from Chinook Salmon in California's Central Valley Escapement, Inland Harvest, and Ocean Harvest in 2022

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## INTRODUCTION

Each year, approximately 32 million fall-run Chinook salmon (*Oncorhynchus tshawytscha*) are produced at five hatcheries in California's Central Valley (CV): Coleman National Fish Hatchery (CFH), Feather River Hatchery (FRH), Nimbus Fish Hatchery (NIM), Mokelumne River Hatchery (MOK), and Merced River Hatchery (MER). Production from these hatcheries contributes to CV escapement and sport harvest while also supporting ocean fisheries in California and Oregon. Since 2007, a constant fractional marking (CFM) program has ensured that at least 25% of all CV hatchery production fish are tagged with a microscopic (≤ 1 mm) coded-wire tag (CWT). Each CWT contains a binary or alpha-numeric code that identifies a specific release group of salmon (e.g., agency, species, run, brood year, hatchery or wild stock, release size, release date(s), release location(s), number tagged and untagged). Each salmon containing a CWT is also externally marked with a clipped adipose fin (ad-clip) to allow for easy visual identification.

This is the 13$^{th}$ annual report on the recovery of CFM CWTs in the CV and ocean fisheries. In 2022, approximately 29,900 CWTs were recovered and successfully read from ad-clipped Chinook salmon sampled in CV fall-, winter-, spring-, and late-fall-run natural area spawning surveys, at CV hatcheries, in the CV angler sport harvest, and in commercial and sport ocean salmon fisheries south of Cape Falcon (i.e., California and most of Oregon).

This report will focus primarily on the results of analyses addressing the following questions:

- What are the proportions of hatchery- and natural-origin salmon in spawner returns to CV hatcheries and natural areas, in inland harvest, and in ocean fisheries? Of the hatchery component, what proportions originated from in-basin versus out-of-basin CWT release strategies?
- What are the relative recovery and stray rates for hatchery-origin salmon released in-basin versus salmon released into the waters of the Sacramento-San Joaquin River Delta, San Francisco-San Pablo bays, or coastal areas? How do recovery and stray rates differ between salmon acclimated in net pens and those released directly into the water? Are these metrics affected by transporting salmon smolts down their natal waterways by vessel and exposing them to river water prior to release in the bay?
- What are the relative recovery and contribution rates of hatchery-origin salmon, by run and release type, to ocean and inland harvests?

Please see earlier CFM reports (Kormos et al. 2012, Palmer and Kormos 2013, 2015) for more information and discussion regarding the CFM program, CWT recovery programs, and the methods and analyses used in this report. Additional information on salmon escapement monitoring can be found in the Central Valley Chinook Salmon Escapement Monitoring Plan (Bergman et al. 2012) and other CV salmon population

reports (e.g., Laubach 2023, Diviney and Tsao 2023, Kok and Tsao 2023, Kollmar and Tsao 2023).

## DATA AND METHODS

### Inland Escapement and River Sport Harvest Monitoring

During 2022, monitoring of salmon escapement occurred at all five salmon hatcheries[1] and on major rivers and tributaries throughout the CV. In addition, an angler creel survey was conducted on sport fisheries in the Sacramento, Feather, American, and Mokelumne river basins. It should be noted that the late-fall-run escapement in the upper Sacramento River and at CFH in this report is considered the 2023 return year, however the escapement monitoring period began in late 2022.

Sampling and estimation methods (e.g., carcass surveys, snorkel surveys, weir counts) continue to vary among natural spawner surveys throughout the CV (Table 1); however, most 2022 surveys on major rivers and in the hatcheries adequately sampled (sample rate ≥ 20%) for ad-clipped fish. The sampling rate was generally lower for smaller creeks where biodata was collected over a few days or in limited areas.

Of the approximately 100,400 Chinook salmon that returned to the CV basins analyzed in this report, roughly 55,300 salmon were sampled, 15,900 ad-clipped salmon were observed, and 14,800 heads were collected by various CV projects (Table 4). Monitoring agencies and projects included the California Department of Fish and Wildlife (CDFW), California Department of Water Resources (DWR), East Bay Municipal Utility District (EBMUD), Pacific States Marine Fisheries Commission (PSMFC), U.S. Bureau of Reclamation (BOR), U.S. Fish and Wildlife Service (FWS), and the Yuba Accord River Management Team (YARMT). Most inland heads were processed by CDFW at the West Sacramento CWT lab, except for 4,700 heads processed by FWS staff at CFH, 3 heads processed by FWS staff in Lodi, and 500 heads processed by CDFW staff in Red Bluff.

All estimates of CV escapement or harvest and the number of salmon sampled in this report were provided by individual monitoring projects or hatcheries.

### Ocean Harvest Monitoring

In 2022, California sport and commercial ocean salmon fisheries had decreased opportunities compared to the previous year due to poorer abundance forecasts for fall-run Chinook salmon from the Sacramento and Klamath basins (Table 2). Of the approximately 301,100 salmon harvested in California ocean fisheries during 2022, CDFW field staff sampled approximately 83,200 salmon and collected approximately 15,200 heads that were processed at the Santa Rosa CWT lab (Table 5). Approximately

[1] There is not direct salmon escapement to the Salmon Conservation and Research Facility (SCARF) or Livingston Stone National Fish Hatchery (LSNFH), however they are both represented in this report by the San Joaquin spring-run and Keswick Dam surveys, respectively.

1,600 heads collected in Oregon sport and commercial ocean fisheries during 2022 are also included in these analyses, since Sacramento River fall-run Chinook salmon is the primary stock harvested in fisheries south of Cape Falcon, Oregon (PFMC 2016).

Each year, CDFW validates and uploads all CWT recoveries in California, along with their respective catch-sample data, to the Regional Mark Processing Center (RMPC), which is the central repository for west coast CWT recoveries. All 2022 inland and ocean CWT recoveries are publicly available on the RMPC website at www.rmpc.org.

**CWT Data Analysis**

A master release database of CWT codes recovered in 2022 was created to determine species, brood year, run, stock origin (hatchery or natural), release site, release date(s), number of salmon tagged with CWTs, total number of salmon released, and any other pertinent release information (e.g., trucked, net pen acclimation, disease issues). Since almost all CV salmon recovered are between the ages of two and five, all CWT release data for Chinook salmon brood years 2017 through 2020 were downloaded from the RMPC. Approximately 133 million CV salmon were released for these brood years, of which 45 million were marked and tagged utilizing 434 unique CWT codes. Although a few thousand natural-origin salmon are often trapped, marked, and tagged annually, salmon produced by hatcheries make up 99% or greater of all CWT releases. In 2022, there were 295 individual CWT codes recovered in the CV, primarily from age-2, age-3, and age-4 salmon. The CWT master file was updated with any additional information obtained for special CV salmon releases and the production factor calculated for each CWT code. The production factor, $F_{prod,}$ is the ratio of the total number of salmon released to the total number of salmon marked containing a CWT. Thus, it is the total number of salmon (i.e., tagged and untagged) represented by each CWT recovery. $F_{prod}$ was calculated for each CWT code and is defined as,

$$F_{prod} = (Ad.CWT + Ad.noCWT + noAd.CWT + noAd.noCWT) / Ad.CWT,$$

where Ad.CWT is the number of salmon released with ad-clips and CWTs, Ad.noCWT is the number of salmon released with ad-clips but without CWTs (i.e., shed tags prior to release or CWT not correctly inserted), noAd.CWT is the number of salmon released without ad-clips but with CWTs, and noAd.noCWT is the number of salmon released without ad-clips and without CWTs. $F_{prod}$ allows expansion to total hatchery production from observed recoveries of CV CWTs. In some cases, where numbers of mortalities are unavailable in the release information, the resulting calculation for $F_{prod}$ may bias results.

For this analysis, each CV Chinook salmon CWT release was classified into a “release type” based on the following criteria: hatchery or natural stock, run, release location, and release strategy. All CV CWT codes were assigned by brood year into one of fourteen fall-run, two winter-run, two spring-run, or one late-fall-run release types:

**Sacramento River Basin Fall-run** Chinook salmon release types

| | |
|---|---|
| CFHF | Coleman National Fish Hatchery **F**all-run in-basin releases |
| CFHFn | Coleman National Fish Hatchery **F**all-run bay/delta **n**et pen releases |
| FRHF | Feather River Hatchery **F**all-run in-basin releases |
| FRHFn | Feather River Hatchery **F**all-run bay/delta **n**et pen releases |
| FRHFgg | Feather River Hatchery **F**all-run **G**olden **G**ate releases (no net pen acclimation) |
| NIMF | Nimbus Fish Hatchery **F**all-run in-basin releases |
| NIMFn | Nimbus Fish Hatchery **F**all-run bay/delta **n**et pen releases |
| NIMFgg | Nimbus Fish Hatchery **F**all-run **G**olden **G**ate releases |

**San Joaquin River Basin Fall-run** Chinook salmon release types

| | |
|---|---|
| MOKF | Mokelumne River Hatchery **F**all-run in-basin releases |
| MOKFn | Mokelumne River Hatchery **F**all-run bay/delta **n**et pen releases |
| MOKFnc | Mokelumne River Hatchery **F**all-run **c**oastal **n**et pen releases (Pillar Point/Santa Cruz/Monterey) |
| MOKFgg | Mokelumne River Hatchery **F**all-run **G**olden **G**ate releases (no net pen acclimation) |
| MERF | Merced River Hatchery **F**all-run in-basin releases |
| MERFn | Merced River Hatchery **F**all-run bay/delta **n**et pen releases |

**Sacramento River Winter-run** Chinook salmon release types

| | |
|---|---|
| SacW | Sacramento River **W**inter-run supplementation natural production releases (in-basin) |
| SacWbat | Sacramento River **W**inter-run **Batt**le Creek reintroduction releases (in-basin) |

**Central Valley Spring-run** Chinook salmon release types

| | |
|---|---|
| FRHS | Feather River Hatchery **S**pring-run in-basin releases |
| SJOSx | San Joaquin River **S**pring-run e**x**perimental reintroduction releases (in-basin) |

**Central Valley Late-fall-run** Chinook salmon release types

| | |
|---|---|
| CFHL | Coleman National Fish Hatchery **L**ate-fall-run in-basin releases |

Note that not all release types occur every year and that release sites or net pen use sometimes vary within a given release type (Table 3; Fig. 1). In several cases, CWT release type included fish released utilizing more than one strategy (e.g., two of the three MOKFnc coastal net pen release groups from the 2019 brood were not acclimated in net pens due to direct night releases). These cases often involved trucking to release sites similar to those used for net pen releases, however, the fish were not acclimated in net pens but were instead released directly into the water. Thus, we urge caution when analyzing or comparing CWT recovery data from certain release types.

To estimate the total escapement or harvest associated with each CWT recovery, each tag recovery was expanded by its respective $F_{prod}$ and sample expansion factor, $F_{samp}$, which is defined as,

$F_{\text{samp}} = 1 / (f_e \times f_a \times f_d)$,

where $f_e$ is the fraction of the total salmon escapement or harvest sampled and visually examined for an ad-clip, $f_a$ is the fraction of heads from ad-clipped salmon collected and processed, and $f_d$ is the fraction of observed CWTs that were successfully decoded (Tables 4 and 5).

Salmon sampled in CV carcass surveys are generally classified as 'fresh' or 'non-fresh' based on criteria such as condition of the eyes (clear vs. opaque) or gills (pink vs. grey). Often the ad-clipped (marked) status of a non-fresh (i.e., decayed) salmon cannot be determined due to the deteriorating condition of the carcass. While condition criteria are somewhat ambiguous and classification may vary among surveys, the ad-clip rate of fresh salmon sampled in 2022 was generally higher or similar to the rate observed in non-fresh fish (Appendix 1). Fresh carcass heads also usually contain CWTs at a higher rate than heads collected from non-fresh fish, although that was not the case for one survey done on the Upper Sacramento River in 2022. Furthermore, the sample sizes between fresh and non-fresh fish are usually very different with the number of fresh salmon sampled generally much greater than non-fresh salmon in surveys that collected both conditions.

Mohr and Satterthwaite (2013) demonstrated how the sampling differences noted above could negatively bias the estimates of hatchery contribution. However, they cautioned that using only CWT data from fresh fish could eliminate the occurrence of rare CWT codes in analyses due to the small sample sizes common with fresh carcasses in these surveys. As in previous CFM reports, the following equation developed by Mohr and Satterthwaite (2013) was used to calculate $F_{samp}$ for carcass surveys collecting fish condition data, thus reducing the potential to underestimate hatchery contribution while still incorporating CWT codes from both fresh and non-fresh fish:

$F_{\text{samp}} = (N \times p\_adc|fresh \times p\_cwt|fresh,adc) / (n_{valid\ cwt})$,

where $N$ = estimated total escapement, $p\_adc|fresh$ = proportion of fresh salmon sampled that were ad-clipped, $p\_cwt|fresh,adc$ = proportion of ad-clipped fresh salmon that contained a CWT, and $n_{valid\ cwt}$ = total number of valid CWTs collected from fresh and decayed salmon.

To help differentiate between raw CWT recoveries, CWT recoveries expanded for production, CWTs expanded for sampling, and CWTs expanded for production and sampling, the following nomenclature is used:

| | |
|---|---|
| $CWT$ | = Raw count CWT recoveries |
| $CWT_{prod}$ | = CWT recoveries expanded by their respective production factor, $F_{prod}$ |
| $CWT_{samp}$ | = CWT recoveries expanded by their respective sample expansion factor, $F_{samp}$ |
| $CWT_{total}$ | = CWT recoveries expanded by both $F_{prod}$ and $F_{samp}$ |

### Determining hatchery- and natural-origin proportions in CV escapement and harvest

To determine the contribution of hatchery- and natural-origin salmon, all $CWT_{\text{total}}$ were summed to estimate the total number of hatchery salmon in each survey. The contribution of natural-origin salmon for each survey was then determined by subtracting the total number of hatchery salmon from the total escapement estimate, as follows:

$$\text{Estimate of natural-origin salmon} = \text{Total escapement estimate} - \sum_{i=1}^{m} CWT_{total,i} \ ,$$

where $m$ = total number of hatchery-origin CWT release groups identified in an escapement survey or hatchery.

### Determining recovery rates of various release types in CV escapement and ocean harvest

To determine the relative CV recovery rate, $R_{cwt}$, of each unique CWT release group (i.e., code), all recoveries were expanded by their location-specific $F_{samp}$, summed over all recovery locations, and then divided by the total number of salmon tagged and released with this CWT. Since expanded recoveries for several individual CWT groups were less than 0.001% of the total number released, recovery rates are reported in recoveries per 100,000 CWT salmon released, as follows:

$$R_{cwt} = \sum_{j=1}^{l} CWT_{samp,j} \text{ recoveries} / (\text{CWT release group size} / 100{,}000),$$

where $j$ *(=1,2,3,…,l)* denotes recovery location.

Data from all CWT release groups belonging to the same brood year and release type (e.g., coastal net pen) were combined and an overall release type-specific CV recovery rate, $R_{\text{type}}$, was calculated as:

$$R_{type} = \sum_{j=1}^{l} \sum_{k=1}^{n} CWT_{samp,j,k} / (\sum_{k=1}^{n} \text{release group size of } CWT_{k} / 100{,}000),$$

where $k$ *(= 1,2,3,…,n)* denotes release group.

### Determining stray proportions of various release groups in CV escapement

To be consistent with previous reports (Kormos et al. 2012, Letvin et al. 2020, 2021, Palmer-Zwahlen and Kormos 2013, 2015, 2020, Palmer-Zwahlen et al. 2018, 2019a, 2019b), basin-of-origin is defined as the drainage within which a particular hatchery is located. Given the five hatcheries under consideration in this report, the CV is divided into five hatchery basins (hatchery code in parentheses): (1) upper Sacramento River,

including Battle Creek (CFH), (2) Feather River, including the Yuba River (FRH), (3) American River (NIM), (4) Mokelumne River (MOK), and (5) Merced River (MER). Hatchery-origin salmon not returning to their basin-of-origin or to streams and rivers not included in any hatchery basin (e.g., Butte Creek, Stanislaus River, Tuolumne River) are considered strays. Appendices 2 and 3 present alternative recovery and stray rates for CFH and FRH CWT releases based on the assumption that recoveries in the upper Sacramento River and Yuba River, respectively, are strays.

To determine the CV stray proportion, $S_{cwt}$, for each CWT code, the sum of all $CWT_{samp}$ recoveries collected outside the basin of origin was divided by total CV $CWT_{samp}$ recoveries for that release group, as follows:

$$S_{cwt} = \sum_{p=1}^{o} CWT_{samp,p} \text{ (out-of-basin locations)} / \sum_{p=1}^{q} CWT_{samp,p} \text{ (all CV locations)},$$

where $p$ denotes recovery location, $o$ denotes the number of out-of-basin recovery locations, and $q$ denotes the total number of recovery locations.

Data from all CWT releases belonging to the same brood year and release type were combined and release type-specific CV stray proportion, $S_{type,}$ was calculated as:

$$S_{type} = \sum_{p=1}^{o} \sum_{k=1}^{n} CWT_{samp,p,k} \text{ (out-of-basin)} / \sum_{p=1}^{q} \sum_{k=1}^{n} CWT_{samp,p,k} \text{ (all CV locations)}.$$

## RESULTS

### General overview of 2022 CV inland recoveries and California ocean harvest

All of the nearly 14,860 valid CWTs recovered in the CV during 2022 were from CV Chinook salmon releases. Most CWTs were brood year 2018 through 2020 releases (Table 6). About 92% of all $CWT_{total}$ were fall-run, followed by spring-run (4%) and late-fall-run (3%) salmon releases. Only 1% of $CWT_{total}$ were winter-run, some of which were collected from the first four cohorts of spawners to return to CFH as part of the FWS Battle Creek winter-run Jumpstart program (ages-2 thru -5). The remaining winter-run CWTs were all collected in the upper Sacramento River, which includes the Keswick Dam Fish Trap (KES) where winter-run are collected for broodstock purposes at Livingston Stone National Fish Hatchery (LSH). The majority of fall-run $CWT_{total}$ recovered in the CV were age-3 (73%) fish.

Most of the approximately 13,470 valid CWT recoveries from the 2022 California ocean harvest were CV salmon releases belonging to brood year 2019 (Table 7). Approximately 91% of all $CWT_{total}$ in the ocean harvest were CV fall-run, followed by CV late-fall-run (1%), CV spring-run (0.2%), and CV winter-run (0.1%) salmon. The remaining 8% of California ocean harvest $CWT_{total}$ originated primarily from the

Klamath-Trinity Basin and Smith River in northern California, the Elk River in Oregon, and the Columbia River Basin. Most of the hatchery-origin fish in the California ocean harvest were age-3 fish (83%), followed by age-4 (9%) and age-2 (8%) fish.

Of the nearly 1,520 valid CWT recoveries from the 2022 Oregon ocean harvest (south of Cape Falcon), 23% were CV fall-run salmon releases (Table 8). Recoveries of other CV run types were scarce off Oregon. Non-CV stocks made up 76% of the Oregon ocean harvest $CWT_{total}$, with most originating from the Columbia River Basin, coastal streams in Oregon, and the Klamath-Trinity Basin. Most of the hatchery-origin fish in the Oregon ocean harvest were age-3 (82%) and age-4 (14%) fish.

## 1. Proportion of Hatchery- and Natural-origin Salmon in CV Escapement

During 2022, approximately 41,510 fall-run Chinook salmon returned to spawn in the CV natural areas included in these analyses (Table 9, Fig. 2). There were an additional 350 fall-run salmon that spawned in natural areas of tributaries that are excluded here because sample rates and resultant CWT recoveries were too low to produce reliable results. Thresholds by which surveys are excluded from analyses because of low sample rates (those significantly lower than the standard 20%) and CWT recoveries are assessed on an annual basis, however these recoveries are still reported on RMPC. The proportion of hatchery-origin salmon in those areas sampled varied throughout the CV. The lowest fall-run hatchery proportion occurred in the upper Sacramento mainstem (26%), followed by the Yuba River (39%). The highest fall-run hatchery proportion occurred in the Tuolumne River (93%). The total CV fall-run hatchery proportion for all natural areas that were adequately sampled during 2022 was 68%.

One of the upper Sacramento Basin tributaries included in these analyses is Battle Creek, the hatchery proportion for this tributary was estimated using a surrogate since a CWT recovery program has not occurred in this waterway since 2005. The hatchery contribution and CWT release type composition in the Battle Creek fall-run escapement is assumed equivalent to the hatchery fall-run return sampled at CFH (K. Niemela, FWS, pers. comm.).

Of the 38,100 fall-run salmon returning to the four CV hatcheries, there was a combined hatchery proportion of 87% and ranged from 81% to 94% (Table 9, Fig. 3). The late-fall-run return to CFH was almost entirely hatchery-origin salmon (99%).

To help differentiate the hatchery composition, all CV release types from the same stock, run, and hatchery use the same shade of color in the pie chart figures: Blue = Sacramento River Basin fall-run releases, Green = San Joaquin Basin fall-run releases, Purple = Central Valley spring-run releases, Yellow = Sacramento River winter-run releases, and Orange = Central Valley late-fall-run releases (Fig. 4). Additionally, select patterns are used to designate different release types. All bay/delta net pen releases contain black dots, while coastal net pen releases are designated with a crisscross pattern. Golden Gate releases are shown with horizontal stripes. In-basin releases do not have any pattern. To present the data in a less complicated manner, several release

types have been merged in the pie chart figures and many of the tables. Please refer to the footnotes on Tables 9-10 and 12-15 for a description of which release types were merged.

**Upper Sacramento River Basin**

At CFH in 2022, the fall-run spawning period was considered early October through November, and the late-fall-run spawning period was considered November through April 2023. However, FWS staff ultimately parsed the final escapement into run types based on CWT recoveries and the dominant run type by date. All ad-clipped salmon were sampled during the entire run, and additionally during the late-fall-run period all unmarked salmon were electronically checked for CWTs. An additional 49 late-fall-run salmon were trapped at CFH after spawning operations ended. Also, 2022 was the fourth year of spawner returns to CFH for winter-run salmon that were spawned at LSH, raised at CFH, and released into North Fork Battle Creek as part of the FWS Jumpstart program.

Fall- and late-fall-run returns to CFH were predominantly hatchery-origin salmon, as were fall-run spawners in Battle Creek where CFH is located. Natural-origin spawners composed most of the winter-run returns to CFH, as well as winter- and fall-run returns to the upper Sacramento River mainstem (Figs. 5, 6). Winter-run spawners collected at KES and fall-run spawners in Clear Creek were primarily hatchery-origin fish. The late-full-run returns to the upper Sacramento River mainstem were excluded from further expansion due to a paucity of recoveries. The proportion of hatchery-origin fish (most prevalent release type shown in parentheses) at each of the following locations was:

- Winter-run returns CFH: 11% (SacW)
- Fall-run returns CFH: 86% (CFHF)
- Late-fall-run returns CFH: 99% (CFHL)
- Late-fall-run returns CFH (post-spawning): 86% (CFHL)
- Winter-run spawners upper Sacramento River: 5% (SacW)
- Fall-run spawners upper Sacramento River: 26% (CFHF, FRHFn)
- Fall-run spawners Clear Creek: 58% (FRHFn)
- Fall-run spawners Battle Creek: 86% (CFHF)

### Butte Creek and Feather River Basin

In Butte Creek, spring-run spawners were entirely of natural-origin. In the Feather Basin, spring- and fall-run returns to FRH and spawners in the Feather River were predominantly hatchery-origin, while spawners in the Yuba River were predominately natural-origin (Figs. 7, 8). The proportion of hatchery-origin fish (most prevalent release type shown in parentheses) at each of the following locations was:

- Spring-run returns FRH: 96% (FRHS)
- Fall-run returns FRH: 90% (FRHFn)
- Fall/spring-run spawners Feather River: 84% (FRHFn)
- Fall/spring-run spawners Yuba River: 39% (FRHFn, NIMFn)

In previous reports, separate escapement estimates were produced for the Yuba River above and below the Daguerre Point Dam (DPD) based on a combination of ad-clips observed via video weir and CWTs recovered during carcass surveys. Spawner returns and recoveries of CWTs below the DPD continued to be low in 2022. Thus, for this report, the Yuba River is reported as a single natural area escapement estimate.

### American River Basin

Fall-run returns to NIM and spawners in the American River were predominantly of hatchery-origin (Fig. 9). The proportion of hatchery-origin fish (most prevalent release type shown in parentheses) at each of the following locations was:

- Fall-run returns NIM: 81% (NIMFn)
- Fall-run spawners American River: 85% (NIMFn)

### Mokelumne, Stanislaus, and Tuolumne Rivers

Fall-run returns to MOK and Mokelumne River were predominantly hatchery-origin salmon. Spawners in the Stanislaus River were primarily natural-origin, while spawners in the Tuolumne River were predominantly of hatchery-origin (Fig. 10). The proportion of hatchery-origin fish (most prevalent release type shown in parentheses) at each of the following locations was:

- Fall-run returns MOK: 94% (MOKFn)
- Fall-run spawners Mokelumne River: 71% (MOKFn)
- Fall-run spawners Stanislaus River: 42% (MOKFn)
- Fall-run spawners Tuolumne River: 93% (MOKFn)

### Merced and upper San Joaquin Rivers

In 2022, escapement to the Merced and upper San Joaquin Rivers were low with only six total CWTs recovered (Table 4). Due to this, reliable results could not be produced, and the surveys were excluded from further expansion for this report.

## 2. Contribution of CV Release Types to Total Salmon Escapement

In 2022, 71% of the 92,800 salmon that returned to the CV hatcheries and natural areas included in these analyses were hatchery-origin fish (Tables 9, 10). The hatchery release types that contributed the most to total CV escapement were FRH fall-run bay/delta net pen releases (21%), followed by NIM fall-run bay/delta net pen and CFH fall-run in-basin releases (12%, each). FRH fall-run bay/delta net pen releases had the highest number of strays, while MER fall-run bay/delta net pen and SJO spring-run experimental reintroduction releases had the highest rates of straying (100%, each), closely followed by CFH fall-run bay/delta net pen releases (95%). About 24% of all recoveries occurred outside their basin-of-origin and ranged from 0% to 100%, depending on release type:

**Hatchery-origin contribution by $R_{type}$ to total CV salmon escapement**

| $R_{type}$ | Run | $CWT_{total}$ | % total escapement | # Stray | % stray |
|---|---|---|---|---|---|
| CFHF | Fall | 11,087 | 12% | 1,534 | 14% |
| CFHFn | Fall | 191 | <1% | 182 | 95% |
| FRHF | Fall | 411 | <1% | 0 | 0% |
| FRHFn | Fall | 19,280 | 21% | 3,987 | 21% |
| FRHFgg | Fall | 990 | 1% | 192 | 19% |
| NIMF | Fall | 4,905 | 5% | 20 | <1% |
| NIMFn | Fall | 10,801 | 12% | 1,824 | 17% |
| NIMFgg | Fall | 237 | <1% | 76 | 32% |
| MOKF | Fall | 8 | <1% | 2 | 25% |
| MOKFn | Fall | 6,133 | 7% | 3,637 | 59% |
| MOKFnc | Fall | 1,856 | 2% | 1,212 | 65% |
| MOKFgg | Fall | 4,070 | 4% | 2,702 | 66% |
| MERFn | Fall | 354 | <1% | 354 | 100% |
| SacW | Winter | 554 | 1% | 0 | 0% |
| FRHS | Spring | 2,688 | 3% | 21 | 1% |
| SJOSx | Spring | 35 | <1% | 35 | 100% |
| CFHL | Late-fall | 2,070 | 2% | 20 | 1% |
| Non-CV | | 0 | 0% | 0 | |
| | Total | 65,670 | 71% | 15,798 | 24% |

## 3. Hatchery Proportion and Contribution of CV Release Types to CV Sport Fishery

In 2022, 74% of the 4,800 salmon harvested in the CV river sport fishery were hatchery-origin fish (Table 9; Figs. 11, 12). The proportion of hatchery-origin fish (most prevalent release type shown in parentheses) in each of the following fisheries was:

- Upper Sacramento River fall-run harvest: 65% (CFHF)
- Feather River fall-run harvest: 85% (FRHFn)
- American River fall-run harvest: 79% (NIMFn)
- Upper Sacramento River late-fall-run harvest: 64% (CFHL)

Of all hatchery release types, CFH fall-run in-basin releases contributed the most (22%) to the total CV sport harvest, followed by FRH fall-run bay/delta net pen releases (19%). All release types were primarily harvested in their basin-of-origin, with little to no straying observed in 2022 (Tables 9, 10). Assumptions about hatchery contributions to the lower Sacramento River and Mokelumne River portions of the CV river sport fishery could not be made for 2022 due to low recoveries.

**Hatchery-origin contribution by $R_{type}$ to total CV river harvest**

| $R_{type}$ | Run | $CWT_{total}$ | % harvest |
|---|---|---|---|
| CFHF | Fall | 1,073 | 22% |
| CFHFn | Fall | 0 | 0% |
| FRHF | Fall | 0 | 0% |
| FRHFn | Fall | 912 | 19% |
| FRHFgg | Fall | 83 | 2% |
| NIMF | Fall | 266 | 6% |
| NIMFn | Fall | 656 | 14% |
| NIMFgg | Fall | 0 | 0% |
| MOKF | Fall | 0 | 0% |
| MOKFn | Fall | 131 | 3% |
| MOKFnc | Fall | 82 | 2% |
| MOKFgg | Fall | 82 | 2% |
| MERFn | Fall | 0 | 0% |
| SacW | Winter | 0 | 0% |
| FRHS | Spring | 12 | <1% |
| SJOSx | Spring | 12 | <1% |
| CFHL | Late-fall | 246 | 5% |
| Non-CV | | 0 | 0% |
| | Total | 3,555 | 74% |

## 4. Relative Recovery and Stray Rates of CV Release Types in Total Escapement

Release strategies vary among hatcheries from year to year. This variability has often been in response to annual fluctuations in the abundance of certain stocks or differing policies among agencies with respect to best release practices. The 2018 through 2020 brood year releases were more consistent than release types analyzed in earlier CFM reports (Kormos et. al. 2012, Palmer-Zwahlen and Kormos 2013, 2015; Table 3).

Table 11 summarizes total $CWT_{samp}$ recoveries and the escapement recovery rate, $R_{type}$, (in-basin and stray) for all release types collected in the CV escapement and ocean fisheries during 2022. The CWTs collected in the CV river sport fishery are not included since it is not possible to ascertain the location where these fish would have eventually spawned. Recovery rates are standardized utilizing total $CWT_{samp}$ recoveries per 100,000 tagged salmon released. Release types with less than 15,000 total fish released with CWTs are not reported below since just a few recoveries could result in relatively large recovery and stray rate estimates.

Figures 13 and 14 provide a graphical representation of $R_{type}$ for Sacramento River fall-run Chinook salmon and other CV stocks, respectively, and include the total number of salmon released with CWTs for each release type. Fall-run salmon that were released offsite, both those acclimated in net pens and those released directly into the water, had higher CV recovery rates than their respective in-basin releases, but offsite releases also had higher stray rates than their in-basin counterparts.

**Age-2 CV Escapement Recovery and Stray Rates**

| $R_{type}$ | Brood year | Run | # Recoveries per 100K Released | # Strays per 100K Released | % stray |
|---|---|---|---|---|---|
| CFHF | 2020 | Fall | 1 | 0 | 17% |
| CFHFn | 2020 | Fall | 22 | 21 | 95% |
| FRHFn | 2020 | Fall | 60 | 11 | 19% |
| FRHFgg | 2020 | Fall | 96 | 15 | 16% |
| NIMFn | 2020 | Fall | 53 | 17 | 32% |
| NIMFgg | 2020 | Fall | 35 | 11 | 32% |
| MOKFn | 2020 | Fall | 10 | 5 | 51% |
| MOKFnc | 2020 | Fall | 36 | 20 | 55% |
| MOKFgg | 2020 | Fall | 21 | 14 | 67% |
| MERFn | 2020 | Fall | 30 | 28 | 96% |
| FRHS | 2020 | Spring | 7 | 0 | 0% |
| SJOSx | 2020 | Spring | 0 | 0 | - |
| SacW | 2020 | Winter | 45 | 0 | 0% |
| SacWbat | 2020 | Winter | 0 | 0 | - |
| CFHL | 2021 | Late-fall | 23 | 0.2 | 1% |

**Age-3 CV Escapement Recovery and Stray Rates**

| $R_{type}$ | Brood year | Run | # Recoveries per 100K Released | # Strays per 100K Released | % stray |
|---|---|---|---|---|---|
| CFHF | 2019 | Fall | 63 | 6 | 10% |
| FRHF | 2019 | Fall | 41 | 0 | 0.0% |
| FRHFn | 2019 | Fall | 240 | 55 | 23% |
| NIMF | 2019 | Fall | 157 | 1 | 0.3% |
| NIMFn | 2019 | Fall | 471 | 67 | 14% |
| MOKFn | 2019 | Fall | 124 | 73 | 59% |
| MOKFnc | 2019 | Fall | 107 | 73 | 68% |
| MOKFgg | 2019 | Fall | 191 | 128 | 67% |
| MERFn | 2019 | Fall | 56 | 56 | 100% |
| FRHS | 2019 | Spring | 58 | 0 | 0.7% |
| SJOSx | 2019 | Spring | 8 | 8 | 92% |
| SacW | 2019 | Winter | 107 | 0 | 0% |
| SacWbat | 2019 | Winter | 5 | 0 | 0% |
| CFHL | 2020 | Late-fall | 117 | 1 | 0.6% |

**Age-4 CV Escapement Recovery and Stray Rates**

| $R_{type}$ | Brood year | Run | # Recoveries per 100K Released | # Strays per 100K Released | % stray |
|---|---|---|---|---|---|
| CFHF | 2018 | Fall | 30 | 7 | 22% |
| FRHF | 2018 | Fall | 7 | 0 | 0% |
| FRHFn | 2018 | Fall | 45 | 8 | 18% |
| NIMF | 2018 | Fall | 12 | 0 | 1% |
| NIMFn | 2018 | Fall | 24 | 2 | 9% |
| MOKF | 2018 | Fall | 2 | 1 | 25% |
| MOKFn | 2018 | Fall | 9 | 7 | 77% |
| MOKFnc | 2018 | Fall | 1 | 1 | 74% |
| MOKFgg | 2018 | Fall | 0 | 0 | - |
| MERFn | 2018 | Fall | 6 | 6 | 100% |
| FRHS | 2018 | Spring | 86 | 1 | 1% |
| SJOSx | 2018 | Spring | 9 | 8 | 92% |
| SacW | 2018 | Winter | 62 | 0 | 0% |
| SacWbat | 2018 | Winter | 4 | 2 | 53% |
| CFHL | 2019 | Late-fall | 82 | 1 | 1% |

## 5. Relative Recovery Rate of CV Release Types in the Ocean Harvest

The total recovery rate of CV hatchery releases in California and Oregon (south of Cape Falcon) sport and commercial ocean salmon fisheries varied by age and release type (Table 11). A higher percentage of age-2 CV hatchery salmon were recovered in the ocean sport fishery (Fig. 15) than the commercial fishery due to the smaller size limits in 2022 for the sport fishery compared to the commercial fishery (Table 2).

**Age-2 Ocean Harvest Recovery Rate; Percent taken in Sport Harvest**

| $R_{type}$ | Brood year | Run | # Recoveries per 100K Released | % sport |
|---|---|---|---|---|
| CFHF | 2020 | Fall | 2 | 86% |
| CFHFn | 2020 | Fall | 63 | 97% |
| FRHFn | 2020 | Fall | 82 | 96% |
| FRHFgg | 2020 | Fall | 114 | 98% |
| NIMFn | 2020 | Fall | 63 | 91% |
| NIMFgg | 2020 | Fall | 48 | 100% |
| MOKFn | 2020 | Fall | 37 | 97% |
| MOKFnc | 2020 | Fall | 215 | 96% |
| MOKFgg | 2020 | Fall | 103 | 93% |
| MERFn | 2020 | Fall | 55 | 100% |
| FRHS | 2020 | Spring | 16 | 93% |
| SJOSx | 2020 | Spring | 7 | 77% |
| CFHL | 2021 | Late-fall | 1 | - |

**Age-3 Ocean Harvest Recovery Rate; Percent taken in Sport Harvest**

| $R_{type}$ | Brood year | Run | # Recoveries per 100K Released | % sport |
|---|---|---|---|---|
| CFHF | 2019 | Fall | 74 | 26% |
| FRHF | 2019 | Fall | 44 | 16% |
| FRHFn | 2019 | Fall | 494 | 28% |
| NIMF | 2019 | Fall | 241 | 25% |
| NIMFn | 2019 | Fall | 1,230 | 27% |
| MOKFn | 2019 | Fall | 394 | 26% |
| MOKFnc | 2019 | Fall | 1,608 | 29% |
| MOKFgg | 2019 | Fall | 2,028 | 28% |
| MERFn | 2019 | Fall | 212 | 22% |
| FRHS | 2019 | Spring | 8 | 53% |
| SJOSx | 2019 | Spring | 5 | 41% |
| SacW | 2020 | Winter | 63 | 90% |
| SacWbat | 2020 | Winter | 12 | 100% |
| CFHL | 2020 | Late-fall | 105 | 47% |

**Age-4 Ocean Harvest Recovery Rate; Percent taken in Sport Harvest**

| $R_{type}$ | Brood year | Run | # Recoveries per 100K Released | % sport |
|---|---|---|---|---|
| CFHF | 2018 | Fall | 19 | 28% |
| FRHF | 2018 | Fall | 25 | 0% |
| FRHFn | 2018 | Fall | 57 | 30% |
| NIMF | 2018 | Fall | 14 | 17% |
| NIMFn | 2018 | Fall | 80 | 21% |
| MOKF | 2018 | Fall | 3 | 0% |
| MOKFn | 2018 | Fall | 16 | 12% |
| MOKFnc | 2018 | Fall | 22 | 29% |
| MOKFgg | 2018 | Fall | 25 | 22% |
| MERFn | 2018 | Fall | 0 | - |
| FRHS | 2018 | Spring | 1 | 88% |
| SJOSx | 2018 | Spring | 0 | - |
| SacW | 2019 | Winter | 2 | 100% |
| SacWbat | 2019 | Winter | 0 | - |
| CFHL | 2019 | Late-fall | 73 | 22% |

## 6. Hatchery Proportion and Contribution of CV Release Types to Ocean Salmon Fisheries

Over half of the nearly 336,600 Chinook salmon harvested in California and Oregon (south of Cape Falcon) ocean salmon fisheries were hatchery-origin fish (Fig. 16). The most prevalent CV release types recovered off both states were MOK Golden Gate releases followed by FRH fall-run bay/delta net pen releases.

**Hatchery-origin contribution by $R_{type}$ to CA and OR ocean harvest**

| $R_{type}$ | Run | $CWT_{total}$ | % harvest |
|---|---|---|---|
| CFHF | Fall | 11,197 | 3% |
| CFHFn | Fall | 560 | <1% |
| FRHF | Fall | 444 | <1% |
| FRHFn | Fall | 35,130 | 10% |
| FRHFgg | Fall | 1,183 | <1% |
| NIMF | Fall | 7,386 | 2% |
| NIMFn | Fall | 26,036 | 8% |
| NIMFgg | Fall | 326 | <1% |
| MOKF | Fall | 11 | <1% |
| MOKFn | Fall | 19,110 | 6% |
| MOKFnc | Fall | 23,726 | 7% |
| MOKFgg | Fall | 41,747 | 12% |
| MERFn | Fall | 1,414 | <1% |
| Other CV | Non-fall | 2,293 | 1% |
| Non-CV | | 32,013 | 10% |
| | Total | 202,576 | 60% |

## California ocean sport fishery

California anglers harvested approximately 89,900 Chinook salmon in the ocean sport fishery during 2022. The total contribution of hatchery-origin salmon to the California ocean sport fishery was 65%, ranging from 50% to 67% of the total harvest depending on major port area (Fig. 17). Most of the harvest occurred in the San Francisco port area (75%), followed by the Monterey (18%), Eureka/Crescent City (5%), and Fort Bragg (3%) port areas (Table 12).

Of all hatchery release types, FRH fall-run bay/delta net pen and MOK Golden Gate releases contributed the most (14%, each) to the total California ocean sport harvest, followed by NIM fall-run bay/delta net pen and MOK coastal net pen releases (9%, each). Non-CV releases composed 3% of the total sport harvest (Table 13).

**Hatchery-origin contribution by $R_{type}$ to CA ocean sport harvest**

| $R_{type}$ | Run | $CWT_{total}$ | % harvest |
|---|---|---|---|
| CFHF | Fall | 3,000 | 3% |
| CFHFn | Fall | 545 | 1% |
| FRHF | Fall | 68 | <1% |
| FRHFn | Fall | 12,804 | 14% |
| FRHFgg | Fall | 1,115 | 1% |
| NIMF | Fall | 1,735 | 2% |
| NIMFn | Fall | 8,284 | 9% |
| NIMFgg | Fall | 326 | <1% |
| MOKF | Fall | 0 | 0% |
| MOKFn | Fall | 5,697 | 6% |
| MOKFnc | Fall | 8,039 | 9% |
| MOKFgg | Fall | 12,619 | 14% |
| MERFn | Fall | 347 | <1% |
| SacW | Winter | 202 | <1% |
| FRHS | Spring | 247 | <1% |
| SJOSx | Spring | 16 | <1% |
| CFHL | Late-fall | 611 | 1% |
| Non-CV | | 2,435 | 3% |
| | Total | 58,089 | 65% |

## California ocean commercial fishery

California trollers harvested approximately 211,200 Chinook salmon in the commercial ocean fishery during 2022. The total contribution of hatchery-origin salmon to the California commercial ocean fishery was 57%, ranging from 53% to 59% of the total harvest depending on major port area (Fig. 18). San Francisco port area had the highest proportion of the harvest (46%), followed closely by the Monterey port area (44%), and Fort Bragg port area had the least amount of harvest (10%; Table 14). The Eureka/Crescent City port area was closed to commercial fishing during 2022.

Of all hatchery release types, MOK Golden Gate releases contributed the most (13%) to the total California commercial harvest, followed by FRH fall-run bay/delta net pen releases and NIM bay/delta net pen releases (10% and 8%, respectively). Non-CV releases contributed 5% to the total commercial harvest (Table 15).

**Hatchery-origin contribution by $R_{type}$ to CA ocean commercial harvest**

| $R_{type}$ | Run | $CWT_{total}$ | % harvest |
|---|---|---|---|
| CFHF | Fall | 7,820 | 4% |
| CFHFn | Fall | 16 | <1% |
| FRHF | Fall | 377 | <1% |
| FRHFn | Fall | 21,183 | 10% |
| FRHFgg | Fall | 48 | <1% |
| NIMF | Fall | 5,311 | 3% |
| NIMFn | Fall | 16,835 | 8% |
| NIMFgg | Fall | 0 | 0% |
| MOKF | Fall | 7 | <1% |
| MOKFn | Fall | 12,426 | 6% |
| MOKFnc | Fall | 15,369 | 7% |
| MOKFgg | Fall | 27,550 | 13% |
| MERFn | Fall | 1,040 | <1% |
| SacW | Winter | 20 | <1% |
| FRHS | Spring | 70 | <1% |
| SJOSx | Spring | 10 | <1% |
| CFHL | Late-fall | 1,108 | 1% |
| Non-CV | | 10,978 | 5% |
| | Total | 120,167 | 57% |

## 7. Relative Recovery and Stray Rates of Fall-run Experimental and Net Pen Release Types

In 2022, CWTs from many fall-run experimental and net pen release types were recovered in the CV escapement and ocean harvest, and this section will focus on those from brood years 2018 through 2020 (ages 2-4). Experimental releases include non-acclimated Golden Gate releases at Fort Baker which utilized approximately 4.8 million, 3.4 million, and 680,000 fall-run salmon from MOK, FRH, and NFH, respectively.

Net pen releases can be categorized into either bay/delta or coastal releases. Bay/delta net pen releases include those that are released in the western Delta (MOK and MER), and those that are released where the Carquinez Strait meets San Pablo Bay (CFH, FRH, and NIM). Coastal net pen releases include those coordinated by the Coastside Fishing Club in Pillar Point and those coordinated by the Monterey Bay Trout and Salmon Project in Santa Cruz and Monterey. Coastal releases with brood years that consisted of only releases where there was no net pen acclimation (i.e., released directly into the water) have been excluded from this section.

The experimental and net pen releases recovered in 2022 are differentiated into the following release types:

- CFHFn Coleman National Fish Hatchery **F**all-run bay/delta **n**et pens
- FRHFn Feather River Hatchery **F**all-run bay/delta **n**et pens
- FRHFgg Feather River Hatchery **F**all-run **G**olden **G**ate releases (no net pen acclimation)
- NIMFn Nimbus Fish Hatchery **F**all-run bay/delta **n**et pens
- NIMFgg Nimbus Fish Hatchery **F**all-run **G**olden **G**ate releases (no net pen acclimation)
- MOKFn Mokelumne River Hatchery **F**all-run bay/delta **n**et pens
- MOKFnp Mokelumne River Hatchery **F**all-run coastal **n**et pens – **P**illar Point
- MOKFns Mokelumne River Hatchery **F**all-run coastal **n**et pens – **S**anta Cruz
- MOKFgg Mokelumne River Hatchery **F**all-run **G**olden **G**ate releases (no net pen acclimation)
- MERFn Merced River Hatchery **F**all-run bay/delta **n**et pens

## Central Valley Escapement

The CV escapement recovery rate and percent stray for all fall-run experimental and net pen releases are included below to allow direct comparison among these release types (Table 16, Fig. 19).

**Age-2 CV Escapement Recovery and Stray Rates**

| $R_{type}$ | Brood year | Run | # Recoveries per 100K Released | # Strays per 100K Released | % stray |
|---|---|---|---|---|---|
| CFHFn | 2020 | Fall | 22 | 21 | 95% |
| FRHFn | 2020 | Fall | 60 | 11 | 19% |
| NIMFn | 2020 | Fall | 53 | 17 | 32% |
| NIMFgg | 2020 | Fall | 35 | 11 | 32% |
| MOKFn | 2020 | Fall | 10 | 5 | 51% |
| MOKFnp | 2020 | Fall | 36 | 22 | 61% |
| MOKFgg | 2020 | Fall | 21 | 14 | 67% |
| MERFn | 2020 | Fall | 30 | 28 | 96% |

**Age-3 CV Escapement Recovery and Stray Rates**

| $R_{type}$ | Brood year | Run | # Recoveries per 100K Released | # Strays per 100K Released | % stray |
|---|---|---|---|---|---|
| FRHFn | 2019 | Fall | 240 | 55 | 23% |
| NIMFn | 2019 | Fall | 471 | 67 | 14% |
| MOKFn | 2019 | Fall | 124 | 73 | 59% |
| MOKFnp | 2019 | Fall | 156 | 104 | 67% |
| MOKFgg | 2019 | Fall | 191 | 128 | 67% |
| MERFn | 2019 | Fall | 56 | 56 | 100% |

**Age-4 CV Escapement Recovery and Stray Rates**

| $R_{type}$ | Brood year | Run | # Recoveries per 100K Released | # Strays per 100K Released | % stray |
|---|---|---|---|---|---|
| FRHFn | 2018 | Fall | 45 | 8 | 18% |
| NIMFn | 2018 | Fall | 24 | 2 | 9% |
| MOKFn | 2018 | Fall | 9 | 7 | 77% |
| MOKFnp | 2018 | Fall | 1 | 1 | 74% |
| MOKFns | 2018 | Fall | 0 | 0 | - |
| MOKFgg | 2018 | Fall | 0 | 0 | - |
| MERFn | 2018 | Fall | 6 | 6 | 100% |

## Ocean Fishery Harvest

The recovery rate for all fall-run experimental and net pen releases in California and Oregon ocean salmon fisheries, and the percentage that occurred in the sport fishery, are shown below to allow direct comparison among these release types (Table 16, Fig. 20).

**Age-2 Ocean Harvest Recovery Rate; Percent taken in Sport Harvest**

| $R_{type}$ | Brood year | Run | # Recoveries per 100K Released | % sport |
|---|---|---|---|---|
| CFHFn | 2020 | Fall | 63 | 97% |
| FRHFn | 2020 | Fall | 82 | 96% |
| NIMFn | 2020 | Fall | 63 | 91% |
| NIMFgg | 2020 | Fall | 48 | 100% |
| MOKFn | 2020 | Fall | 37 | 97% |
| MOKFnp | 2020 | Fall | 156 | 94% |
| MOKFgg | 2020 | Fall | 103 | 93% |
| MERFn | 2020 | Fall | 55 | 100% |

**Age-3 Ocean Harvest Recovery Rate; Percent taken in Sport Harvest**

| $R_{type}$ | Brood year | Run | # Recoveries per 100K Released | % sport |
|---|---|---|---|---|
| FRHFn | 2019 | Fall | 494 | 28% |
| NIMFn | 2019 | Fall | 1,230 | 27% |
| MOKFn | 2019 | Fall | 394 | 26% |
| MOKFnp | 2019 | Fall | 2,254 | 28% |
| MOKFgg | 2019 | Fall | 2,028 | 28% |
| MERFn | 2019 | Fall | 212 | 22% |

**Age-4 Ocean Harvest Recovery Rate; Percent taken in Sport Harvest**

| $R_{type}$ | Brood year | Run | # Recoveries per 100K Released | % sport |
|---|---|---|---|---|
| FRHFn | 2018 | Fall | 57 | 30% |
| NIMFn | 2018 | Fall | 80 | 21% |
| MOKFn | 2018 | Fall | 16 | 12% |
| MOKFnp | 2018 | Fall | 23 | 26% |
| MOKFns | 2018 | Fall | 14 | 64% |
| MOKFgg | 2018 | Fall | 25 | 22% |
| MERFn | 2018 | Fall | 0 | - |

## 2022 CFM ANALYSES KEY POINTS

- Beginning in 2020 and continuing through 2022, California experienced a severe drought, with water year 2021 being one of the driest years in almost a century (DWR 2022). This significantly impacted release strategies, especially for brood year 2020, which saw the highest percentage of fall-run released out-of-basin compared to in-basin of any other brood year examined in this report (61% fish released out-of-basin). It was also the first brood year where CFH fish were released in bay/delta net pens since brood year 2014, in part due to unfavorable river conditions in the upper Sacramento River.

- The majority (71%) of the 2022 CV salmon escapement (all run-types) were hatchery-origin fish. This was an increase of 2% in hatchery contribution from the 2021 escapement. Between 2010 and 2021, the hatchery contribution to the total CV escapement averaged 74% and ranged between 57% and 88%. FRH fall-run bay/delta net pen releases had the highest contribution (21%) to the total 2022 CV escapement hatchery spawners, with CFH fall-run in-basin and NIM fall-run bay/delta net pen releases (12%, each) being the next highest contributors.

- The highest stray rates occurred with MER fall-run bay/delta net pen and San Joaquin River spring-run experimental reintroduction releases (100%, each), followed by CFH fall-run bay/delta net pen releases (95%). Additionally, offsite releases from MOK strayed at very high rates, with the highest being Golden Gate (66%), followed by coastal net pen (65%) and bay/delta (59%) releases. Offsite releases from other hatcheries strayed at lower rates, with the lowest being NIM fall-run bay/delta releases (17%), followed by FRH fall-run Golden Gate and bay/delta releases (19% and 21%, respectively).

- Salmon escapement into all CV hatcheries were predominately hatchery-origin fish. At all CV hatcheries the majority of their return was composed of their respective releases. NIM and MOK had the highest proportion of out-of-basin hatchery returns (29% and 25%, respectively), with most of those strays originating from MOK and NIM for each hatchery, respectively.

- Hatchery contributions to natural area escapements fell in-line with the average hatchery contribution since the CFM program was fully implemented. For fall-run specifically, the hatchery contribution across all CV natural areas was 68% compared to the 2010-2021 average of 69% (range: 51% - 81%). Most natural area spawners were primarily hatchery-origin fish. The exceptions were winter- and fall-run spawners in the upper Sacramento River mainstem, Yuba River, and Stanislaus River.

- The hatchery-origin component of the natural area escapement to the Feather, American, and Mokelumne Rivers consisted primarily of release types from the hatcheries located on each of the respective rivers. Strays from out-of-basin hatcheries made noticeable contributions to the natural area escapements in the Sacramento, American, and Mokelumne Rivers (53%, 35%, and 23% of the hatchery-

origin components, respectively). FRH fall-run bay/delta net pen releases made notable contribution to the Sacramento River (45% of the hatchery-origin component). FRH fall-run bay/delta net pen and MOK fall-run bay/delta net pen releases made almost equal contributions to the American River (11% of the hatchery-origin component, each). NIM fall-run bay/delta net pen releases were the only out-of-basin contributors to the Mokelumne River.

- Fall-run escapement in the upper Sacramento River mainstem was predominately natural-origin salmon (74% natural vs. 26% hatchery). The hatchery contribution was the lowest of all the natural area fall-run escapements. The total escapement to the upper Sacramento River was below the long-term average. CFH fall-run in-basin and FRH fall-run bay/delta net pen releases made the highest contributions to the Sacramento River mainstem fall-run escapement (47% and 45% of the hatchery-origin component, respectively).

- Fall- and spring-run escapement to the natural spawning areas of the Feather River was mostly hatchery-origin salmon. FRH fall-run bay/delta net pen releases had the highest contribution of any release type, followed by FRH spring-run releases (72% and 13% of the hatchery-origin component, respectively). In-basin fall-run releases from FRH composed 1% of the escapement.

- Returns to the Yuba River below DPD continued to be extremely low in 2022. As such, it was decided to combine the river sectors above and below the DPD for the purposes of this report. The escapement to the Yuba River was predominantly natural-origin salmon (61% natural vs. 39% hatchery). The hatchery-origin component was largely comprised of FRH fall-run bay/delta net pen and NIM fall-run bay/delta net pen releases (32% of the hatchery-origin component, each).

- Fall-run escapement to the natural spawning areas of the American River was dominated by hatchery-origin salmon (15% natural vs. 85% hatchery). NIM fall-run bay/delta releases were the highest contributing release types (42% of the hatchery-origin component), followed by NIM in-basin releases (23% of the hatchery-origin component).

- Fall-run escapement to the natural spawning areas of the Mokelumne River was predominantly hatchery-origin salmon (29% natural vs. 71% hatchery). MOK fall-run bay/delta net pen releases were the highest contributing release types (54% of the hatchery-origin component), followed by NIM fall-run bay/delta net pen releases (23% of the hatchery-origin component).

- Fall-run escapement to the Stanislaus River was mostly natural-origin salmon (58% natural vs. 42% hatchery), while the Tuolumne River was predominantly hatchery-origin salmon (7% natural vs. 93% hatchery). Stray MOK bay/delta net pen releases were the greatest contributors to the Stanislaus and Tuolumne Rivers (56% and 74% of the hatchery-origin component, respectively).

- Fall-run escapement to the natural spawning areas of the Merced River were low in 2022, with under 100 salmon returning and only four cwts recovered. Due to the low returns and paucity of recoveries of CWTs from ad-clipped salmon, no assumptions can be made about hatchery- and natural-origin contributions to the system as they were excluded from analysis.

- For age-2 fall-run salmon, FRH Golden Gate releases had the highest CV escapement recovery rate for their cohort (96 recoveries per 100,000 released), followed by FRH net pen releases (60 recoveries per 100,000 released).

- For age-3 fall-run salmon, NFH bay/delta net pen releases had the highest CV escapement recovery rates for their cohort (471 recoveries per 100,000 released), followed by FRH bay/delta releases (240 recoveries per 100,000 released).

- For age-4 fall-run salmon, FRH bay/delta releases had the highest CV escapement recovery rate for their cohort (45 recoveries per 100,000 released), followed by CFH in-basin releases (30 recoveries per 100,000 released).

- Offsite releases of fall-run salmon from MOK and MER strayed at the highest rates for ages-2, -3, and -4, ranging from 51-100%. Recoveries from other hatcheries and MOK in-basin strayed at much lower rates, except for age-2 CFH net pen releases (95%).

- Most of the total CV river sport harvest was comprised of hatchery-origin salmon (74%). Between 2010 and 2021, the hatchery contribution to the CV river sport harvest averaged 74% and ranged between 60% and 84%. The highest-contributing hatchery release types were CFH fall-run in-basin, FRH fall-run bay/delta, and NIM bay/delta releases.

- California ocean sport and commercial harvests were predominantly comprised of hatchery-origin salmon (65% and 57%, respectively). FRH fall-run bay/delta net pen and MOK fall-run Golden Gate releases were the highest contributors to the sport and commercial ocean fisheries, followed by NIM fall-run bay/delta and MOK fall-run coastal net pen releases. Non-CV hatchery production contributed little to the ocean harvest (3% for sport and 5% for commercial fisheries).

- Ocean recovery rates for NIM fall-run releases were higher than 2021. The bay/delta net pen releases from brood year 2019 had the third-highest age-3 ocean recovery rate of any release type analyzed in this report (1,230 recoveries per 100,000 released).

- Ocean recovery rates for Golden Gate releases continued to be high in 2022. The Golden Gate releases from MOK had the highest age-3 recovery rate of any release type analyzed in this report (2,028 recoveries per 100,000 released). For the ages at which they were present, their ocean recovery rates largely exceeded those of the bay/delta and coastal net pen releases from the same hatchery and brood, except for MOK and NIM Golden Gate releases from brood year 2020. The Golden Gate

releases from FRH and NIM strayed at lower rates than those produced at MOK. This is the first report to include Golden Gate releases from NIM.

- Coastal fall-run releases, all of which were from MOK, had the highest ocean recovery rates for ages-2 and -3, but had moderate age-4 recovery rates. CV escapement recovery rates were significantly lower than ocean recovery rates at all ages. The age-3 Santa Cruz releases had lower CV recovery rates than other offsite releases, and there were no CV recoveries of age-4 Santa Cruz releases.

- This is the sixth report in the series that has recovery data for non-experimental FRH fall-run in-basin releases, providing another year of recovery and stray rate comparisons between in-basin and out-of-basin FRH fall-run releases from the same brood year. Recovery rates of in-basin releases continue to be low, however, compared to the out-of-basin releases, there are significantly fewer releases using this strategy. FRH in-basin releases experienced no straying, while out-of-basin releases had higher stray rates for all brood years, 23% and 18% for ages-3 and -4, respectively, which was on par with previous years of reporting.

- FRH in-basin and out-of-basin releases co-occurred in ages-3 and -4 salmon. The out-of-basin releases for these age classes included only bay/delta net pen releases. The age-3 CV and ocean recovery rates of in-basin releases were 41 and 44 CWTs per 100,000 releases, respectively, and the age-4 CV and ocean recovery rates were 7 and 25 CWTs per 100,000 releases, respectively. The CV and ocean recovery rates of out-of-basin releases were significantly higher. For instance, age-3 CV and ocean recovery rates of out-of-basin releases was 240 and 494 CWTs per 100,000 releases. Additionally, the in-basin releases consisted of 1 release for each age class with approximately 1 million and 30,000 released salmon for ages-3 and -4, respectively. Contrastingly, the out-of-basin releases consisted of 12 releases for age-3 and 16 releases for age-4, which totaled approximately 5.4 million and 7.2 million released salmon for ages-3 and -4, respectively.

- The age-3 upper Sacramento River winter-run CV recovery rate of 107 CWTs per 100,000 released was the lowest recovery rate since the 2018 report, and the third lowest recovery rate since reporting began. Between 2012 and 2021, the age-3 winter-run CV recovery rate averaged 629 CWTs per 100,000 released and ranged between 72 and 1,896. The water year 2019/20 was a dry year with above average temperatures and below average precipitation throughout the state (DWR 2021), and, unlike in the previous year, the salmon were released further north at the Bonnyview Boat Ramp. Additionally, the 2022 winter-run escapement to the upper Sacramento River decreased significantly from the previous year.

- 2022 was the fourth year that winter-run salmon released into North Fork Battle Creek as part of the FWS Jumpstart program began to return as spawners and contribute to ocean harvest (ages-2 through -4). The CV and ocean recovery rates for this release type were lower than for winter-run released into the upper Sacramento River. Among

the winter-run that returned to the CV in 2022, those that were released into the upper Sacramento River and age-3 winter-run releases into Battle Creek returned entirely to their basins of origin, while age-4 winter-run releases into Battle Creek strayed at rates of 53%. There were no CV recoveries of age-2 releases into Battle Creek.

- Winter and spring-run were recovered at low rates in both inland and ocean fisheries comprising <1% of the hatchery component when encountered. In ocean sport and commercial fisheries, after expansion, 222 winter-run and 324 FRH spring-run were recovered. No winter-run and 12 spring-run were recovered in inland fisheries.

- This is the fourth report in the series that includes data for the upper San Joaquin River mainstem spring-run escapement. In most years such passage does not exist, and spawners must be trapped further downstream and translocated to the upper San Joaquin River. In 2022, only 3 spring-run salmon were captured in the upper San Joaquin River. Due to this, it cannot be determined what the composition of the expanded population looked like for 2022. However, because it is early in the reintroduction process and all fish that were captured were of hatchery-origin, it can be assumed that the escapement to this sector is overwhelmingly hatchery-origin salmon.

## CONCLUSION

A primary goal of this report is to provide information that will be useful in California salmon management, including CV hatchery assessment. As with each of the previous 12 CFM reports, the estimates of hatchery contribution and recovery rate by release type presented in this report should be viewed as a “single year snapshot” of salmon escapement and harvest in the CV and California ocean fisheries during 2022. Although no discussion section is included, as in earlier CFM reports covering the 2010, 2011, and 2012 escapement and harvest years, the authors plan to further analyze these data as these and additional tagged broods become complete. This report contains the data and analyses needed to determine the contribution of hatchery- and natural-origin salmon to hatchery and natural areas throughout the CV, evaluate hatchery release strategies and programs, improve California ocean and river salmon fisheries management, evaluate the effectiveness of habitat restoration, and determine if other goals of the CFM program are being met on an annual basis. This information, combined with other tools such as cohort reconstruction and harvest models, will allow resource managers to determine the total contribution of various release strategies to CV escapement and to ocean and inland fisheries by time and area.

The CFM program should be continued with the current design to provide comparable, consistent data needed for hatchery and harvest management. Securing permanent and comprehensive inland and ocean funding for this marking, tagging, monitoring, and evaluation program is critical. Such funding is essential to providing complete analyses of recovery and stray rates across release strategies and will allow critical data to be available by February of each year to manage CV salmon stocks, hatchery production, and California ocean and river fisheries using the most recent information, similar to the Klamath Basin fall-run Chinook salmon management process.

## ACKNOWLEDGEMENTS

We express sincere appreciation to the myriad of staff among many agencies that work tirelessly in the field to gather the necessary data and CWT recoveries that provide the basis for this report. They are too numerous to name individually, but without each of them, this valuable analysis would not be possible. We again thank the following agencies for providing 2022 CV escapement estimates and their respective salmon heads or CWT recoveries: CDFW, DWR, FWS, PSMFC, EBMUD, and YARMT. Special thanks are extended to staff at the following hatcheries for their cooperation in this monitoring effort: Coleman National Fish Hatchery, Feather River Hatchery, Nimbus Fish Hatchery, Mokelumne River Hatchery, Merced River Hatchery, and Livingston Stone National Fish Hatchery.

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## LIST OF ACRONYMS AND ABBREVIATIONS

- Ad-clipped clipped adipose fin
- BOR U.S. Bureau of Reclamation
- BY Brood year
- CDFW California Department of Fish and Wildlife
- CFH Coleman National Fish Hatchery
- CFM Constant Fractional Marking
- CV California Central Valley
- CWT coded-wire tag
- DPD Daguerre Point Dam (Yuba River)
- DWR California Department of Water Resources
- EBMUD East Bay Municipal Utilities District
- FRH Feather River Hatchery
- FWS U.S. Fish and Wildlife Service
- KES Keswick Dam Fish Trap
- LSNFH Livingston Stone National Fish Hatchery
- MER Merced River Hatchery
- MOK Mokelumne River Hatchery
- NMFS National Marine Fisheries Service
- NIM Nimbus Fish Hatchery
- OSP Ocean Salmon Project
- PFMC Pacific Fishery Management Council
- PSMFC Pacific States Marine Fisheries Commission
- RMPC Regional Mark Processing Center
- SCARF Salmon Conservation and Research Facility
- SFRA Sport Fish Restoration Act
- SJ San Joaquin
- TL Total length
- WD Woodbridge Dam (Mokelumne River)
- YARMT Yuba Accord River Management Team

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Table 1a. Estimation and sampling methods used for the 2022 CV Chinook hatchery escapement.

| Sampling Location | Estimation and Sampling Methods | Agency |
|---|---|---|
| **Hatchery Spawners** | | |
| Coleman National Fish Hatchery (CFH) Fall and Late-Fall (2023) | Direct count. All fish examined and bio-sampled[a/] for fin-clips, tags, marks. All ad-clipped fish sampled and heads collected for CWT recovery. The fall-run period is considered early Oct through Nov and the late-fall-run period is considered Nov through April. However, the final escapement is ultimately parsed into run types based on CWT code recoveries and dominant run type by date. During the late-fall-run period, all unmarked fish are electronically checked for CWTs. Some untagged phenotypic late-fall-run fish are released into Battle Creek above CFH. Grilse cutoff: 650 mm females, 710 mm males fall; 550 mm females, 590 mm males late-fall. | FWS |
| CFH Winter and Late-Fall (2023) Fish Trap | Direct count of winter-run which are identified by left pelvic fin-clips and CWTs, or late-fall-run that are trapped after CFH spawning operations cease. All fish examined and bio-sampled for fin-clips, tags, marks. All ad-clipped fish sampled and heads collected for CWT recovery, and all unmarked fish are electronically checked for CWTs. Any untagged phenotypic late-fall-run fish are released into Battle Creek above CFH. Any additional fish observed on video after trap removal are examined for fin-clips and added to escapement estimates. Grilse cutoff: 520 mm females, 590 mm males late-fall; 570 mm females, 610 mm males winter[b/]. | FWS |
| Keswick Fish Trap Winter and Late-Fall (2023) | Direct count. All fish examined and bio-sampled for fin-clips, tags, marks. During Feb-Jul, all retained unmarked fish electronically sampled for presence of CWT and genetically tested to ensure winter-run broodstock. To promote genetic integrity of CFH broodstock, Keswick fish trap was also utilized to collect late-fall-run during Jan-Feb. Grilse cutoff: 570 mm females, 610 mm males winter; 520 mm females, 590 mm males late-fall[b/c/]. | FWS |
| Feather River Hatchery (FRH) Spring and Fall | Direct count. All fish examined for fin-clips, tags, marks. Fish arriving at the hatchery May 4 - July 5 (n~ 2,166) were considered "spring-run" and marked with uniquely-numbered dart tags prior to release back into the Feather River. Only fish marked with dart tags returning to FRH in fall were spawned as spring-run. All remaining fish were considered fall-run. FRH fish ladder opened Sep 15 and spring spawning began Sep 20. All spring-run fish bio-sampled. Fall spawning occurred on Oct 3 for the cold water program and began normally on Oct 10. Fall spawning ceased on Nov 9. Systematic random bio-sample ~20% of all fish for fall-run. All ad-clipped fish were sampled and heads collected for CWT recovery. Grilse cutoff: 650 mm spring and fall. | CDFW |
| Nimbus Fish Hatchery (NIM) Fall | Direct count. NIM ladder was opened on Oct. 28. A terminal structure failure occurred which delayed the ladder's full closure until early May, but a barrier was constructed to prevent fish passage at the end of Feb. All fish examined for fin-clips, tags, marks. Systematic random bio-sample of 20% of total fish. All ad-clipped fish sampled and heads collected for CWT recovery. Grilse cutoff: 685 mm. | CDFW |
| Mokelumne River Hatchery (MOK) Fall | Direct count. MOK open Oct 1 - Mar 31. All fish examined for fin-clips, tags, marks. Systematic random bio-sample 20% of total fish. All ad-clipped fish sampled and heads collected for CWT recovery. Grilse cutoff: 650 mm females, 700 mm males. | CDFW |
| Merced River Hatchery (MER) Fall | Direct count. MER open Oct 1 - Nov 30. All fish examined for fin-clips, tags, marks. All ad-clipped fish were sampled and heads processed for CWT recovery. Grilse cutoff: 610 mm females, 670 mm males. | CDFW |

[a/] Biological sampling ("bio-samples" or "bio-data") of live fish or carcasses may include observed tags or marks, sex, fork length, scales, carcass condition, spawning condition, and heads collected from ad-clipped fish for CWT recovery.

[b/] A combination of Keswick and winter-run carcass data are used to determine grilse cutoffs, but they are generally not calculated, especially for females, due to low sample sizes.

[c/]Late-fall grilse cutoffs are determined based on CNFH returns.

Table 1b. Estimation and sampling methods used for the 2022 CV Chinook natural escapement. (Page 1 of 2)

| Sampling Location | Estimation and Sampling Methods | Agency |
|---|---|---|
| **Natural Spawners** | | |
| Upper Sacramento River Mainstem Winter, Fall, and Late-Fall (2023) | Population estimate for each run produced utilizing five-step process: 1) Superpopulation modification of the Cormack-Jolly-Seber mark-recapture estimate using all females within carcass survey area (Balls Ferry Bridge to Keswick Dam). 2) Total female escapement estimate in upper Sacramento River is derived using expansions for females spawning outside of the survey area (Princeton to Balls Ferry) through aerial redd surveys. 3) Adult male escapement estimated using adult sex ratio of live fish counts at CFH or Keswick Trap. 4) Grilse escapement estimated using survey ratio of fresh adult males to fresh grilse. 5) Addition of any fish removed for hatchery brood stock purposes. All fish in carcass survey examined for fin-clips, tags, marks, and condition (e.g., fresh, non-fresh, skeleton). Bio-data[a/] collected from all fresh fish. Systematic random bio-sample may occur if carcass counts expected to be high. All ad-clipped fish (fresh and non-fresh), including "unknown" ad-clipped status, were sexed, measured and heads collected for CWT recovery. Grilse cutoff: 525 mm females, 625 mm males winter; 610 mm females, 670 mm males fall; 660 mm late-fall. | CDFW, FWS |
| Clear Creek Fall | Video Station count used to estimate population. Supplemental bio-sampling survey used to estimate biological characteristics of the population (age, sex, hatchery-origin, spawn sucess). All fish in carcass survey examined for fin-clips, tags, marks, and condition (e.g., fresh, non-fresh, skeleton). Bio-data collected from all fresh fish. All ad-clipped fish (fresh and non-fresh), including "unknown" ad-clipped status, were sampled and heads collected for CWT recovery. Bio-sampling data from CFH used as a surrogate. | CDFW, FWS |
| Cow Creek Fall | Video weir count in lower creek used to determine total escapement. Kayak surveys conducted to collect bio-data from fresh fish. Opportunistic collection of CWTs, however only 4 carcasses observed. Bio-sampling data from CFH used as a surrogate. | CDFW |
| Battle Creek Fall | Video weir count (Aug 19 - Dec 9) in lower creek used to determine total fall-run escapement. Natural fall-run escapement into Battle Creek calculated by substracting CFH fall-run return from total run. Surrogate CWTs based on hatchery proportion and CWT composition of CFH fall-run return. Bio-sampling data from CFH used as a surrogate. | CDFW |
| Cottonwood Creek Fall | Video weir count (Sep 30 - Dec 15) in lower creek used to determine total escapement. Kayak surveys conducted to collect bio-data from fresh fish, however no carcasses were observed. Bio-sampling data from CFH used as a surrogate. | CDFW |
| Mill Creek Fall | Video counts at Ward Dam in lower Mill Creek plus expanded redd count between Ward Dam and the Sacramento River confluence used to determine total escapement. Bio-sampling surveys conducted to collect bio-data from fresh fish. All ad-clipped fish (fresh and non-fresh), including "unknown" ad-clipped status, were sampled and heads collected for CWT recovery, however no ad-clipped fish were encountered. Bio-sampling data from CFH used as a surrogate. | CDFW |
| Butte Creek Spring | Superpopulation modification of the Cormack-Jolly-Seber mark-recapture estimate for spring-run. All fish examined for fin-clips, tags, marks. Systematic random bio-sample of all fish. No ad-clipped fish were observed. Grilse cutoff: 600 mm. | CDFW |

Table 1b. Estimation and sampling methods used for the 2022 CV Chinook natural escapement. (Page 2 of 2)

| Sampling Location | Estimation and Sampling Methods | Agency |
|---|---|---|
| **Natural Spawners cont.** | | |
| Feather River Fall | Superpopulation modification of the Cormack-Jolly-Seber mark-recapture estimate. All fish examined for fin-clips, tags, marks. Systematic random bio-sample of fresh fish. All ad-clipped fresh fish sampled and heads collected for CWT recovery. Escapement estimate includes spring-run. Grilse cutoff: 650 mm. | DWR |
| Yuba River Fall | Above Daguerre Point Dam (DPD): Vaki Riverwatcher direct count of escapement and ad-clipped fish. Supplemental carcass survey to collect bio-data and heads from ad-clipped fish (fresh fish only). Below DPD: Superpopulation modification of the Cormack-Jolly-Seber mark-recapture estimate. All fish examined for fin-clips, tags, marks, and condition. All ad-clipped fresh fish sampled and heads collected for CWT recovery. Escapement estimate includes spring-run. Grilse cutoff: 650 mm. | CDFW, YARMT |
| American River Fall | Superpopulation modification of the Cormack-Jolly-Seber mark-recapture estimate. All fish examined for fin-clips, tags, marks, and condition. Systematic random bio-sample of all fish. All ad-clipped fish sampled and heads collected for CWT recovery. Grilse cutoff: 650 mm females, 720 mm males. | CDFW |
| Mokelumne River Fall | Video count at Woodbridge Irrigation District Dam (WIDD) used to determine total escapement and ad-clipped fish above WIDD. Natural spawner escapement estimate and ad-clip rate calculated by subtracting total count and number of ad-clipped fish returning to MOK. Supplemental carcass survey to collect bio-data from fresh fish and heads from all ad-clipped fish. Grilse cutoff: 700 mm. | EBMUD |
| Stanislaus River Fall | Superpopulation modification of the Cormack-Jolly-Seber mark-recapture estimate. All fresh fish examined for fin-clips, tags, marks. All fresh ad-clipped fish sampled and heads collected for CWT recovery. Grilse cutoff: 610 mm females, 700 mm males. | CDFW |
| Tuolumne River Fall | Superpopulation modification of the Cormack-Jolly-Seber mark-recapture estimate. All fish examined for fin-clips, tags, marks, and condition. All ad-clipped fish sampled and heads collected for CWT recovery. Grilse cutoff: 610 mm females, 700 mm males. | CDFW |
| Merced River Fall | Superpopulation modification of the Cormack-Jolly-Seber mark-recapture estimate. All fresh fish examined for fin-clips, tags, marks. All fresh ad-clipped fish sampled and heads collected for CWT recovery. Grilse cutoff: 610 mm females, 700 mm males. | CDFW |
| Upper San Joaquin River Mainstem Spring | Direct count of carcasses encountered in the upper San Joaquin Restoration Area. All fish examined for fin-clips, tags, marks, condition, and other bio-data. Heads collected for CWT recovery from all fish regardless of ad-clip status. Using various tags and later confirmed with CWTs, all fish classified as either: 1) volitional returns via the Eastside Bypass, 2) translocated from downstream traps, or 3) captive broodstock adult releases. Fish determined to be captive broodstock are removed from the escapement estimate. Fish found dead in downstream traps are bio-sampled in the same manner as other carcasses and are added to the escapement estimate. | FWS, CDFW |

[a/] Biological sampling ("bio-samples" or "bio-data") of live fish or carcasses may include observed tags or marks, sex, fork length, scales, carcass condition, spawning condition, and heads collected from ad-clipped fish for CWT recovery.

Table 1c. Survey design and open dates for the 2022 CV Chinook river sport harvest.

| Sampling Location | Survey Design and Open Dates | Agency |
|---|---|---|
| **Sport Harvest** | | |
| | **Survey Design** | |
| Central Valley Angler Survey (CVAS) | Stratified-random sampling design (four weekday and four weekend samples per month per section during the open season in each management zone) that included roving counts, roving interviews, access interviews, and sub-sampling of kept salmon. Almost all ad-clipped salmon sampled and heads collected for CWT recovery. Estimates of fishing effort, catch, and harvest of Chinook salmon made monthly for each survey section and then summed for the season total. CWT data was used to determine the proportion of grilse and adult Sacramento River Fall Chinook. | CDFW |
| | **Open Dates** | |
| Upper Sacramento River Fall and Late-Fall | Open Aug 1 - Dec 31 from the Deschutes Road Bridge to Red Bluff Diversion Dam and Jul 16 - Dec 16 from Red Bluff Diversion Dam to the Highway 113 bridge near Knights Landing. Nov 1 is used to delineate the cutoff between the fall-run fishery and the late-fall-run fishery. | |
| Feather River Fall | Open Jul 16 - Oct 31 from the unimproved boat ramp above the Thermalito Afterbay Outfall to 200 yards above the Live Oak boat ramp and Jul 16 - Dec 16 from 200 yards below the Live Oak boat ramp to the Sacramento River confluence. | |
| American River Fall | Open Jul 16 - Oct 31 from the USGS cable crossing to the Ancil Hoffman powerlines and Jul 16 - Dec 31 from the Ancil Hoffman powerlines to the confluence with the Sacramento River. | |
| Lower Sacramento River Fall | Open Jul 16 - Dec 16 from the Highway 113 bridge near Knights Landing to the Carquinez Bridge. | |
| Mokelumne River Fall | Open Jul 16 - Oct 15 from the Camanche Dam to the Elliot Road overcrossing and Jul 16 - Dec 16 from the Cosumnes River confluence to the Highway 12 overcrossing. | |
| | **Bag and Size Limit** | |
| All Areas | 2 Chinook salmon per day with a 4 salmon possession limit per angler; no minimum size limit. | |

Table 2. California ocean salmon sport and commercial fishery seasons by major port area, 2022.

| | Sport Fishery | | | Commercial Fishery | | |
|---|---|---|---|---|---|---|
| Major Port Area | Season | Size Limit[a/] | Days Open | Season | Size Limit[a/] | Days Open |
| Eureka/Crescent City (Klamath Mgmt Zone)[b/c/] | May 1 - 31 | 20" TL | 31 | Closed | | |
| | August 1 - September 5 | 20" TL | 36 | | | |
| | | | 67 | | | |
| Fort Bragg[b/] | May 1 - July 4 | 20" TL | 65 | July 8 - 12, 21 - 25 | 27" TL | 10 |
| | July 22 - September 5 | 20" TL | 46 | August 3 - 12 | 27" TL | 10 |
| | | | 111 | | | 20 |
| San Francisco | April 2 - May 15 | 24" TL | 44 | July 8 - 12, 21 - 25 | 27" TL | 10 |
| | May 16 - 31 | 20" TL | 16 | August 3 - 12 | 27" TL | 10 |
| | June 23 - October 31 | 20" TL | 131 | September 1 - 30 | 26" TL | 30 |
| | | | 191 | October 3 - 7, 10 - 14[d/] | 26" TL | 10 |
| | | | | | | 60 |
| Monterey[e/] | April 2 - May 15 | 24" TL | 44 | May 1 - 5, 10 - 15, 20 - 24 | 27" TL | 15 |
| | May 16 - October 2 | 20" TL | 140 | June 1 - 12 | 27" TL | 12 |
| | | | 184 | July 8 - 12, 21 - 25 | 27" TL | 10 |
| | | | | August 3 - 12 | 27" TL | 10 |
| | | | | | | 47 |
| California Total | | | 553 | | | 127 |

a/ Size limit in inches total length (TL).

b/ Boundary between the Klamath Management Zone and Fort Bragg Management Area was changed from Horse Mountain to the 40º10' Line near Cape Mendocino in 2021.

c/ Special Salmon Closures included Smith River mouth closed year round, Klamath River mouth closed year round and the closure expanded to the Klamath Control Zone in August, and Eel River mouth closed in August and September.

d/ Open Monday through Friday between Pt. Reyes and Pt. San Pedro.

e/ Regulations apply from the Monterey area to the U.S./Mexico border.

Table 3. Central Valley coded-wire tag (CWT) Chinook releases recovered in 2022 by age, run, stock, and release type. (Page 1 of 2)

**Age-2 CWT releases**

| Release type* | Brood year | Hatchery / wild | Stock origin | Run type | CWT codes | # CWT tagged | Total fish released | % CWT | Release strategy | Release locations / notes |
|---|---|---|---|---|---|---|---|---|---|---|
| SacW | 2020 | LSH | Sac R | Wint | 6 | 302,805 | 303,422 | 100% | In-basin | Sacramento River (Lake Redding Park) |
| SacWbat | 2020 | LSH | Sac R | Wint | 4 | 212,751 | 213,378 | 100% | Reintroduction | North Fork Battle Creek |
| FRHS | 2020 | FRH | Fea R | Spr | 4 | 993,132 | 1,012,735 | 98% | In-basin | Feather River (Boyds Pump Ramp) |
| SJOSx | 2020 | SJO | San Joa R | Spr | 6 | 206,180 | 207,042 | 100% | Reintroduction | San Joaquin River (Fremont Ford Bridge and Friant) |
| CFHF | 2020 | CFH | Sac R | Fall | 30 | 3,278,256 | 12,042,296 | 27% | In-basin | CFH and Sacramento River (Butte City) |
| CFHFn | 2020 | CFH | Sac R | Fall | 2 | 219,750 | 888,882 | 25% | Bay/Delta pens | San Pablo Bay (Pt San Quentin) net pen releases |
| FRHFn | 2020 | FRH | Fea R | Fall | 13 | 1,319,679 | 5,344,052 | 25% | Bay/Delta pens | San Pablo Bay (Mare Island, Wickland Oill, and Pt San Quentin) net pen releases |
| FRHFgg | 2020 | FRH | Fea R | Fall | 1 | 241,688 | 981,529 | 25% | Trucked | Golden Gate releases; trucked to Fort Baker |
| NIMFn | 2020 | NIM | Ame R | Fall | 8 | 842,638 | 3,389,452 | 25% | Bay/Delta pens | San Pablo Bay (Mare Island, Wickland Oil, and Pt San Quentin) net pen releases |
| NIMFgg | 2020 | NIM | Ame R | Fall | 1 | 169,117 | 678,942 | 25% | Trucked | Golden Gate releases; trucked to Fort Baker |
| MOKFn | 2020 | MOK | Mok R | Fall | 10 | 1,014,161 | 4,076,607 | 25% | Bay/Delta pens | 88% released in Western Delta (Sherman Island); 12% released in San Pablo Bay (Pt San Quentin) |
| MOKFnc | 2020 | MOK | Mok R | Fall | 3 | 508,672 | 1,070,666 | 48% | Coastal pens | 37% released in Pillar Point; 31% released in Santa Cruz; 32% released in Monterey |
| MOKFgg | 2020 | MOK | Mok R | Fall | 5 | 494,114 | 1,980,909 | 25% | Trucked | Golden Gate releases; trucked to Fort Baker |
| MERFn | 2020 | MER | Mer R | Fall | 1 | 74,909 | 266,294 | 28% | Bay/delta pens | Western Delta (Sherman Island) net pen releases |
| CFHL | 2021 | CFH | Sac R | Late | 14 | 1,009,914 | 1,038,384 | 97% | In-basin | CFH (includes spring surrogate releases) |
| | | | Total age-2 releases: | | 108 | 10,887,766 | 33,494,590 | 33% | | |

**Age-3 CWT releases**

| Release type* | Brood year | Hatchery / wild | Stock origin | Run type | CWT codes | # CWT tagged | Total fish released | % CWT | Release strategy | Release locations / notes |
|---|---|---|---|---|---|---|---|---|---|---|
| SacW | 2019 | LSH | Sac R | Wint | 4 | 247,216 | 249,119 | 99% | In-basin | Sacramento River (Lake Redding Park) |
| SacWbat | 2019 | LSH | Sac R | Wint | 3 | 165,858 | 168,144 | 99% | Reintroduction | North Fork Battle Creek |
| FRHS | 2019 | FRH | Fea R | Spr | 6 | 1,771,532 | 1,784,999 | 99% | In-basin | Feather River (Boyds Pump Ramp and Gridley) |
| SJOSx | 2019 | SJO | San Joa R | Spr | 13 | 232,903 | 238,855 | 98% | Reintroduction | San Joaquin River (Fremont Ford Bridge, Friant, and Owl Hollow) |
| CFHF | 2019 | CFH | Sac R | Fall | 33 | 3,352,800 | 12,392,944 | 27% | In-basin | CFH only |
| FRHF | 2019 | FRH | Fea R | Fall | 1 | 248,810 | 1,000,800 | 25% | In-basin | Feather River (Boyds Pump Ramp) |
| FRHFn | 2019 | FRH | Fea R | Fall | 12 | 1,335,074 | 5,398,892 | 25% | Bay/Delta pens | San Pablo Bay (Mare Island) net pen releases |
| NIMF | 2019 | NIM | Ame R | Fall | 4 | 796,467 | 2,594,954 | 31% | In-basin | American River (Sunrise Recreation Area) |
| NIMFn | 2019 | NIM | Ame R | Fall | 5 | 453,171 | 1,823,412 | 25% | Bay/Delta pens | San Pablo Bay (Mare Island) net pen releases |
| MOKFn | 2019 | MOK | Mok R | Fall | 10 | 1,068,378 | 4,276,402 | 25% | Bay/Delta pens | Western Delta (Sherman Island) net pen releases |
| MOKFnc | 2019 | MOK | Mok R | Fall | 3 | 508,729 | 1,105,544 | 46% | Coastal pens | 38% released in Pillar Point; 31% released in Santa Cruz; 31% in Monterey |
| MOKFgg | 2019 | MOK | Mok R | Fall | 4 | 486,615 | 1,947,732 | 25% | Trucked | Golden Gate release; trucked to Fort Baker |
| MERFn | 2019 | MER | Mer R | Fall | 2 | 109,375 | 1,220,123 | 9% | Bay/Delta pens | Western Delta (Sherman Island) net pen releases |
| CFHL | 2020 | CFH | Sac R | Late | 14 | 872,269 | 878,771 | 99% | In-basin | CFH (includes spring surrogate releases) |
| | | | Total age-3 releases: | | 114 | 11,649,197 | 35,080,691 | 33% | | |

Table 3. Central Valley coded-wire tag (CWT) Chinook releases recovered in 2022 by age, run, stock, and release type. (Page 2 of 2)

**Age-4 CWT releases**

| Release type* | Brood year | Hatchery | Stock origin | Run type | CWT codes | # CWT tagged | Total fish released | % CWT | Release strategy | Release locations / notes |
|---|---|---|---|---|---|---|---|---|---|---|
| SacW | 2018 | LSH | Sac R | Wint | 5 | 221,923 | 224,101 | 99% | In-basin | Sacramento River (Bonnyview Boat Ramp) |
| SacWbat | 2018 | LSH | Sac R | Wint | 3 | 180,252 | 182,758 | 99% | Reintroduction | North Fork Battle Creek |
| FRHS | 2018 | FRH | Fea R | Spr | 9 | 1,831,043 | 1,848,318 | 99% | In-basin | Feather River (Boyds Pump Ramp, Gridley, and Live Oak) |
| SJOSx | 2018 | SJO | San Joa R | Spr | 8 | 216,845 | 219,560 | 99% | Reintroduction | San Joaquin River (Fremont Ford Bridge, Friant, Owl Hollow) |
| CFHF | 2018 | CFH | Sac R | Fall | 32 | 3,448,504 | 12,835,143 | 27% | In-basin | CFH and Sacramento River (Scotty's Landing) |
| FRHF | 2018 | FRH | Fea R | Fall | 1 | 30,000 | 30,000 | 100% | In-basin | Sacramento River (Yolo Bypass) |
| FRHFn | 2018 | FRH | Fea R | Fall | 16 | 1,772,613 | 7,196,006 | 25% | Bay/Delta pens | San Pablo Bay (Mare Island) net pen releases |
| NIMF | 2018 | NIM | Ame R | Fall | 4 | 797,850 | 2,602,318 | 31% | In-basin | American River (Sunrise Recreation Area) |
| NIMFn | 2018 | NIM | Ame R | Fall | 5 | 439,333 | 1,763,232 | 25% | Bay/Delta pens | San Pablo Bay (Mare Island) net pen releases |
| MOKF | 2018 | MOK | Mok R | Fall | 2 | 398,991 | 400,493 | 100% | In-basin | Mokelumne River (Hatchery and Woodbridge Dam) |
| MOKFn | 2018 | MOK | Mok R | Fall | 14 | 1,403,247 | 4,419,995 | 32% | Bay/Delta pens | Western Delta (Sherman Island) net pen releases |
| MOKFnc | 2018 | MOK | Mok R | Fall | 2 | 873,909 | 878,603 | 99% | Coastal pens | 86% released in Pillar Point; 14% released in Santa Cruz |
| MOKFgg | 2018 | MOK | Mok R | Fall | 2 | 225,158 | 901,151 | 25% | Trucked | Golden Gate releases; trucked to Fort Baker |
| MERFn | 2018 | MER | Mer R | Fall | 3 | 169,854 | 666,149 | 25% | Bay/Delta pens | Western Delta (Sherman Island) net pen releases |
| CFHL | 2019 | CFH | Sac R | Late | 14 | 1,031,542 | 1,065,159 | 97% | In-basin | CFH (includes spring surrogate releases) |
| | | | Total age-4 releases: | | 120 | 13,041,064 | 35,232,986 | 37% | | |

**Age-5 CWT releases** (with recoveries in 2021)

| Release type* | Brood year | Hatchery | Stock origin | Run type | CWT codes | # CWT tagged | Total fish released | % CWT | Release strategy | Release locations / notes |
|---|---|---|---|---|---|---|---|---|---|---|
| SacW | 2017 | LSH | Sac R | Wint | 5 | 216,237 | 216,746 | 100% | In-basin | Sacramento River (Bonnyview Boat Ramp) |
| SacWbat | 2017 | LSH | Sac R | Wint | 7 | 212,136 | 213,546 | 99% | Reintroduction | North Fork Battle Creek |
| FRHS | 2017 | FRH | Fea R | Spr | 2 | 488,223 | 493,903 | 99% | In-basin | Feather River (Boyds Pump Ramp) |
| SJOSx | 2017 | SJO | San Joa R | Spr | 8 | 209,308 | 213,526 | 98% | Reintroduction | San Joaquin River (Fremont Ford Bridge and Friant) |
| CFHF | 2017 | CFH | Sac R | Fall | 16 | 1,369,512 | 5,498,252 | 25% | In-basin | CFH only |
| FRHF | 2017 | FRH | Fea R | Fall | 3 | 250,489 | 1,007,846 | 25% | In-basin | Sacramento River (Elkhorn Boat Ramp) |
| FRHFn | 2017 | FRH | Fea R | Fall | 2 | 1,496,598 | 6,005,638 | 25% | Bay/Delta pens | San Pablo Bay (Mare Island) net pen releases |
| FRHFgg | 2017 | FRH | Fea R | Fall | 8 | 609,272 | 2,460,352 | 25% | Trucked | Golden Gate releases; trucked to Fort Baker |
| NIMF | 2017 | NIM | Ame R | Fall | 2 | 334,047 | 1,336,727 | 25% | In-basin | American River (Jibboom Street Bridge and Sunrise Recreation Area) |
| NIMFn | 2017 | NIM | Ame R | Fall | 4 | 664,585 | 2,667,426 | 25% | Bay/Delta pens | San Pablo Bay (Mare Island and Wickland Oil) net pen releases |
| MOKF | 2017 | MOK | Mok R | Fall | 2 | 398,785 | 400,790 | 99% | In-basin | Mokelumne River (Hatchery and Woodbridge Dam) |
| MOKFn | 2017 | MOK | Mok R | Fall | 15 | 1,649,629 | 5,383,993 | 31% | Bay/Delta pens | Western Delta (Sherman Island) net pen releases |
| MOKFnc | 2017 | MOK | Mok R | Fall | 1 | 727,344 | 742,256 | 98% | Coastal pens | Pillar Point coastal net pen releases |
| MERFn | 2017 | MER | Mer R | Fall | 3 | 255,259 | 1,224,315 | 21% | Bay/Delta pens | Western Delta (Sherman Island) net pen releases |
| CFHL | 2018 | CFH | Sac R | Late | 14 | 881,364 | 901,122 | 98% | In-basin | CFH (includes spring surrogate and trap efficiency releases) |

***CWT release types:**

**Sacramento River fall Chinook release types (SFC)**

| | |
|---|---|
| CFHF | Coleman National Fish Hatchery fall in-basin releases |
| CFHFn | Coleman National Fish Hatchery fall bay/delta net pen releases |
| FRHF | Feather River Hatchery fall in-basin releases |
| FRHFn | Feather River Hatchery fall bay/delta net pen releases |
| FRHFgg | Feather River Hatchery fall Golden Gate releases (no net pens) |
| NIMF | Nimbus Fish Hatchery fall in-basin releases |
| NIMFn | Nimbus Fish Hatchery fall bay/delta net pen releases |
| NIMFgg | Nimbus Fish Hatchery fall Golden Gate releases (no net pens) |

**Other CV Chinook release types (OCV)**

| | |
|---|---|
| MOKF | Mokelumne River Hatchery fall in-basin releases |
| MOKFn | Mokelumne River Hatchery fall bay/delta net pen releases |
| MOKFnc | Mokelumne River Hatchery fall coastal net pen releases |
| MOKFgg | Mokelumne River Hatchery fall Golden Gate releases (no net pens) |
| MERFn | Merced River Hatchery fall bay/delta net pen releases |
| SacW | Livingston Stone National Fish Hatchery winter in-basin releases |
| SacWbat | Livingston Stone National Fish Hatchery winter Battle Creek reintroduction releases |
| FRHS | Feather River Hatchery spring in-basin releases |
| SJOSx | San Joaquin Salmon Conservation and Research Facility spring reintroduction releases |
| CFHL | Coleman National Fish Hatchery late-fall in-basin releases |

## Table 4. Central Valley hatchery and natural area escapement estimates, sport harvest, and sample data, 2022.

| Central Valley Survey | Run | Total Escapement or Harvest | Chinook Sampled[a/] | Observed Ad-Clips | Heads Processed | Valid CWTs | Sample rate (fe) | Ad-clips processed (fa) | Valid CWTs (fd) | CWT $F_{samp}$ |
|---|---|---|---|---|---|---|---|---|---|---|
| **Hatchery Escapement** | | | | | | | | | | |
| Coleman National Fish Hatchery | Winter | 109 | 109 | 15 | 15 | 12 | 1.000 | 1.000 | 1.000 | 1.00 |
| Keswick Dam Fish Trap | Winter | 455 | 455 | 296 | 295 | 292 | 1.000 | 0.997 | 1.000 | 1.00 |
| Feather River Hatchery | Spring | 1,391 | 1,391 | 1,340 | 1,340 | 1,317 | 1.000 | 1.000 | 0.995 | 1.00 |
| Coleman National Fish Hatchery | Fall | 9,245 | 9,245 | 2,324 | 2,322 | 2,268 | 1.000 | 0.999 | 0.996 | 1.01 |
| Feather River Hatchery | Fall | 14,277 | 14,277 | 3,704 | 3,697 | 3,611 | 1.000 | 0.998 | 0.996 | 1.01 |
| Nimbus Fish Hatchery | Fall | 9,524 | 9,523 | 2,086 | 2,083 | 2,025 | 1.000 | 0.999 | 1.000 | 1.00 |
| Mokelumne River Hatchery | Fall | 5,030 | 5,030 | 1,291 | 1,291 | 1,266 | 1.000 | 1.000 | 0.998 | 1.00 |
| Merced River Hatchery[f/] | Fall | 67 | 67 | 20 | 20 | 19 | 1.000 | 1.000 | 1.000 | 0.92 |
| Coleman National Fish Hatchery | Late-fall[c/] | 2,023 | 2,023 | 1,999 | 1,995 | 1,949 | 1.000 | 0.998 | 0.993 | 1.01 |
| Coleman Hatchery Fish Trap | Late-fall[c/] | 49 | 49 | 41 | 41 | 39 | 1.000 | 1.000 | 0.951 | 1.05 |
| Keswick Dam Fish Trap[f/] | Late-fall[c/] | 29 | 29 | 1 | 1 | 1 | 1.000 | 1.000 | 1.000 | 1.00 |
| **Total Hatchery Escapement** | | **42,199** | **42,198** | **13,117** | **13,100** | **12,799** | | | | |
| **Natural Area Escapement** | | | | | | | | | | |
| Upper Sacramento River (above Princeton) | Winter | 5,443 | 1,463 | 94 | 94 | 72 | 0.269 | 1.000 | 0.973 | 3.45[d/] |
| Butte Creek | Spring | 3,688 | 1,079 | 0 | 0 | 0 | 0.293 | - | - | - |
| Upper San Joaquin River (above Merced R.)[f/] | Spring | 3 | 3 | 3 | 2 | 2 | 1.000 | 0.667 | 1.000 | 1.50[d/] |
| Upper Sacramento River (above Princeton) | Fall | 4,680 | 630 | 56 | 56 | 51 | 0.135 | 1.000 | 1.000 | 6.75[d/] |
| Clear Creek | Fall | 2,997 | 253 | 57 | 57 | 50 | 0.084 | 1.000 | 1.000 | 9.44[d/] |
| Battle Creek | Fall | 1,620 | 0 | Video - no biodata collected | | 401[e/] | - | - | - | 1.00 |
| Mill Creek[f/] | Fall | 214 | 9 | Video - opportunistic CWTs | | 3 | 0.042 | - | - | 17.66 |
| Feather River | Fall | 6,577 | 915 | 276 | 273 | 265 | 0.139 | 0.989 | 1.000 | 7.27[d/] |
| Yuba River[i/] | Fall | 3,171 | 3,171 | 632 | 7 | 7 | 1.000 | 0.011 | 1.000 | 49.55[g/] |
| American River[h/] | Fall | 16,383 | 1,586 | 790 | 777 | 753 | 0.097 | 0.984 | 0.997 | 4.82 |
| Mokelumne River | Fall | 1,921 | 1,921 | 385 | 29 | 28 | 1.000 | 0.075 | 1.000 | 13.28[g/] |
| Stanislaus River | Fall | 3,721 | 1,204 | 288 | 288 | 279 | 0.324 | 1.000 | 0.993 | 1.48[d/] |
| Tuolumne River | Fall | 443 | 154 | 38 | 38 | 38 | 0.348 | 1.000 | 1.000 | 2.94[d/] |
| Merced River[f/] | Fall | 75 | 24 | 4 | 4 | 4 | 0.320 | 1.000 | 1.000 | 3.41[b/d/] |
| Upper Sacramento River (above Princeton)[f/] | Late-fall[c/] | 1,116 | 140 | 8 | 8 | 7 | 0.125 | 1.000 | 0.875 | 12.08[d/] |
| **Total Natural Area Escapement** | | **52,052** | **12,552** | **2,631** | **1,633** | **1,960** | | | | |
| **CV Sport Harvest** | | | | | | | | | | |
| Upper Sacramento River (above Feather R.) | Fall | 1,565 | 213 | 45 | 38 | 37 | 0.136 | 0.844 | 0.974 | 8.94 |
| Lower Sacramento River (below Feather R.)[f/] | Fall | 996 | 52 | 9 | 9 | 9 | 0.052 | 1.000 | 1.000 | 19.15 |
| Feather River | Fall | 1,044 | 86 | 21 | 21 | 21 | 0.082 | 1.000 | 1.000 | 12.14 |
| American River | Fall | 1,795 | 88 | 19 | 19 | 18 | 0.049 | 1.000 | 1.000 | 20.40 |
| Mokelumne River[f/] | Fall | 288 | 18 | 3 | 3 | 3 | 0.063 | 1.000 | 1.000 | 16.00 |
| Upper Sacramento River (above Feather R.) | Late-fall | 387 | 24 | 15 | 15 | 15 | 0.062 | 1.000 | 1.000 | 16.13 |
| **Total Sport Harvest** | | **6,075** | **481** | **112** | **105** | **103** | | | | |
| | **Total Sampled** | **55,231** | **15,860** | **14,838** | **14,862** | | | | | |

a/ Number of Chinook salmon sampled and visually checked for a clipped adipose fin or electronically scanned to check for the presence of a CWT.

b/ As calculated, the value for $F_{samp}$ resulted in a hatchery contribution greater than 100%, so it was adjusted downward until the hatchery contribution equaled 100%.

c/ Late-fall-run hatchery returns and natural area escapement occurred during late-fall of 2022 through early 2023 (return year 2023).

d/ Carcass survey sample expansion factor based on fresh fish only and expanded to all valid CWT recoveries if collected (see Appendix 1).

e/ Battle Creek fall natural escapement estimated using video count minus fall return to Coleman National Fish Hatchery (CFH). Surrogate CWTs based on CFH hatchery proportion and CWT recoveries.

f/ Due to the low sample rate and paucity of CWTs collected, this sector has been excluded from further analyses in this report.

g/ Natural area escapement CWTs collected on spawning grounds and expanded based on total ad-clip count observed via video weir (see Appendices 5 and 6).

h/ Prior versions of this report have evaluated "washbacks" on the Nimbus Fish Hatchery weir separately from the American River carcass survey downstream of the weir. Beginning in 2018, these two sectors were merged and one natural area escapement estimate is now calculated for the entire American Basin.

i/ Yuba River escapement for above and below the DPD merged for 2022 due to low returns.

**Table 5. Total harvest and sample data for 2022 ocean salmon sport and commercial fisheries by major port area.**

| Fishery - Port Area | Ocean Harvest | Chinook Sampled[a/] | Observed Ad-Clips | Heads Processed | Valid CWTs | Sample rate (fe) | Ad-clips processed (fa) | Valid CWTs (fd) | CWT $F_{samp}$ |
|---|---|---|---|---|---|---|---|---|---|
| **California Sport** | | | | | | | | | |
| Eureka/Crescent | 4,215 | 1,179 | 231 | 227 | 151 | 0.280 | 0.983 | 1.000 | 3.63 |
| Fort Bragg | 2,525 | 628 | 134 | 133 | 108 | 0.249 | 0.993 | 1.000 | 4.04 |
| San Francisco | 67,259 | 15,210 | 3,128 | 3,075 | 2,887 | 0.226 | 0.983 | 0.999 | 4.51 |
| Monterey | 15,892 | 3,229 | 629 | 617 | 595 | 0.203 | 0.981 | 0.998 | 5.03 |
| | **89,891** | **20,246** | **4,122** | **4,052** | **3,741** | **0.225** | **0.983** | **0.999** | **4.52** |
| **California Commercial** | | | | | | | | | |
| Eureka/Crescent[b/] | - | - | - | - | - | - | - | - | - |
| Fort Bragg | 21,669 | 7,830 | 1,395 | 1,395 | 1,105 | 0.361 | 1.000 | 1.000 | 2.77 |
| San Francisco | 97,577 | 27,561 | 4,952 | 4,950 | 4,109 | 0.282 | 1.000 | 0.999 | 3.55 |
| Monterey | 91,959 | 27,560 | 4,810 | 4,809 | 4,518 | 0.300 | 1.000 | 0.999 | 3.34 |
| | **211,205** | **62,951** | **11,157** | **11,154** | **9,732** | **0.298** | **1.000** | **0.999** | **3.36** |
| **California Total** | **301,096** | **83,197** | **15,279** | **15,206** | **13,473** | | | | |
| **Oregon Sport** | **5,022** | **1,627** | **210** | **210** | **185** | **0.324** | **1.000** | **0.984** | **3.14** |
| **Oregon Commercial** | **30,507** | **10,640** | **1,382** | **1,382** | **1,338** | **0.349** | **1.000** | **0.989** | **2.90** |
| **Oregon Total** | **35,529** | **12,267** | **1,592** | **1,592** | **1,523** | | | | |

a/ Number of salmon visually checked for a clipped adipose fin or electronically scanned to check for the presence of a CWT.

b/ The Eureka/Crescent City port area was closed to salmon fishing in 2022 for commercial fisheries.

Table 6. Raw and expanded Chinook CWT recoveries in the Central Valley by run type and brood year during 2022[a/].

| **Fall-run** | 2020 | 2019 | 2018 | 2017 | Total CV | |
|---|---|---|---|---|---|---|
| Age | 2 | 3 | 4 | 5 | CWTs | Total CV % |
| Raw CWT Recoveries | 1,509 (14%) | 7,477 (71%) | 1,462 (14%) | 11 (<1%) | 10,459 | 70% |
| Expanded $CWT_{total}$ | **8,296** (13%) | **47,487** (73%) | **8,780** (14%) | **162** (<1%) | 64,725 | 92% |

| **Spring-run** | 2020 | 2019 | 2018 | 2017 | Total CV | |
|---|---|---|---|---|---|---|
| Age | 2 | 3 | 4 | 5 | CWTs | Total CV % |
| Raw CWT Recoveries | 50 (2%) | 752 (38%) | 1,200 (60%) | | 2,002 | 13% |
| Expanded $CWT_{total}$ | **71** (3%) | **1,067** (39%) | **1,633** (59%) | | 2,770 | 4% |

| **Late-fall-run** | 2021 | 2020 | 2019 | 2018 | Total CV | |
|---|---|---|---|---|---|---|
| Age | 2 | 3 | 4 | 5 | CWTs | Total CV % |
| Raw CWT Recoveries | 218 (11%) | 1,009 (50%) | 791 (39%) | 4 (<1%) | 2,022 | 14% |
| Expanded $CWT_{total}$ | **268** (11%) | **1,193** (49%) | **946** (39%) | **4** (<1%) | 2,412 | 3% |

| **Winter-run** | 2020 | 2019 | 2018 | 2017 | Total CV | |
|---|---|---|---|---|---|---|
| Age | 2 | 3 | 4 | 5 | CWTs | Total CV % |
| Raw CWT Recoveries | 129 (34%) | 175 (47%) | 72 (19%) | | 376 | 3% |
| Expanded $CWT_{total}$ | **136** (25%) | **274** (49%) | **144** (26%) | | 555 | 1% |

| **All Runs** | | | | | Total CV | |
|---|---|---|---|---|---|---|
| Age | 2 | 3 | 4 | 5 | CWTs | Total CV % |
| Raw CWT Recoveries | 1,906 (13%) | 9,413 (63%) | 3,525 (24%) | 15 (<1%) | 14,859 | 100% |
| Expanded $CWT_{total}$ | **8,771** (12%) | **50,021** (71%) | **11,503** (16%) | **166** (<1%) | 70,461 | 100% |

a/ Recoveries of age-1, age-6+, and tagged natural-origin fish removed.

Table 7. Raw and expanded Chinook CWT recoveries in 2022 California ocean fisheries by run type and brood year[a/].

| **Fall-run** | 2020 | 2019 | 2018 | 2017 | Total Ocean | Total Ocean |
|---|---|---|---|---|---|---|
| Age | 2 | 3 | 4 | 5 | CWTs | % |
| Raw CWT Recoveries | 897 (7%) | 10,421 (87%) | 658 (5%) | 8 (<1%) | 11,984 | 89% |
| Expanded CWT$_{total}$ | **14,385** (9%) | **139,569** (86%) | **8,525** (5%) | **81** (<1%) | 162,560 | 91% |
| **Spring-run** | 2020 | 2019 | 2018 | 2017 | Total Ocean | Total Ocean |
| Age | 2 | 3 | 4 | 5 | CWTs | % |
| Raw CWT Recoveries | 37 (46%) | 36 (45%) | 7 (9%) | | 80 | 1% |
| Expanded CWT$_{total}$ | **177** (52%) | **140** (41%) | **24** (7%) | | 342 | 0.2% |
| **Late-fall-run** | 2021 | 2020 | 2019 | 2018 | Total Ocean | Total Ocean |
| Age | 2 | 3 | 4 | 5 | CWTs | % |
| Raw CWT Recoveries | 2 (<1%) | 243 (53%) | 216 (47%) | 1 (<1%) | 462 | 3% |
| Expanded CWT$_{total}$ | **9** (<1%) | **928** (54%) | **778** (45%) | **4** (<1%) | 1,719 | 1% |
| **Winter-run** | 2021 | 2020 | 2019 | 2018 | Total Ocean | Total Ocean |
| Age | 2 | 3 | 4 | 5 | CWTs | % |
| Raw CWT Recoveries | | 47 (98%) | 1 (2%) | | 48 | 0.4% |
| Expanded CWT$_{total}$ | | **217** (98%) | **5** (2%) | | 221 | 0.1% |
| **Non-CV stocks** | 2020 | 2019 | 2018 | 2017 | Total Ocean | Total Ocean |
| Age | 2 | 3 | 4 | 5 | CWTs | % |
| Raw CWT Recoveries | | 322 (36%) | 532 (59%) | 42 (5%) | 896 | 7% |
| Expanded CWT$_{total}$ | | **6,518** (49%) | **6,558** (49%) | **338** (3%) | 13,414 | 8% |
| **All Runs** | | | | | Total Ocean | Total Ocean |
| Age | 2 | 3 | 4 | 5 | CWTs | % |
| Raw CWT Recoveries | 936 (7%) | 11,069 (82%) | 1,414 (10%) | 51 (<1%) | 13,470 | 100% |
| Expanded CWT$_{total}$ | **14,572** (8%) | **147,371** (83%) | **15,890** (9%) | **423** (<1%) | 178,256 | 100% |
| CV Expanded CWT$_{total}$ (Proportion CV stocks) | 14,572 (100%) | 140,854 (96%) | 9,332 (59%) | 84 (20%) | 164,842 | 92% |

a/ Recoveries of age-1, age-6+, and tagged natural-origin fish removed.

Table 8. Raw and expanded Chinook CWT recoveries in 2022 Oregon ocean fisheries by run type and brood year[a/].

| **Fall-run** | 2020 | 2019 | 2018 | 2017 | Total Ocean | Total Ocean |
|---|---|---|---|---|---|---|
| Age | 2 | 3 | 4 | 5 | CWTs | % |
| Raw CWT Recoveries | | 522 (85%) | 87 (14%) | 6 (<1%) | 615 | 41% |
| Expanded CWT$_{total}$ | | **4,725** (83%) | **942** (16%) | **45** (<1%) | 5,711 | 23% |

| **Late-fall-run** | 2021 | 2020 | 2019 | 2018 | Total Ocean | Total Ocean |
|---|---|---|---|---|---|---|
| Age | 2 | 3 | 4 | 5 | CWTs | % |
| Raw CWT Recoveries | | | 2 (100%) | | 2 | 0% |
| Expanded CWT$_{total}$ | | | **3** (100%) | | 3 | 0% |

| **Spring-run** | 2020 | 2019 | 2018 | 2017 | Total Ocean | Total Ocean |
|---|---|---|---|---|---|---|
| Age | 2 | 3 | 4 | 5 | CWTs | % |
| Raw CWT Recoveries | | 2 (67%) | 1 (33%) | | 3 | 0% |
| Expanded CWT$_{total}$ | | **6** (84%) | **1** (16%) | | 7 | 0% |

| **Non-CV stocks** | 2020 | 2019 | 2018 | 2017 | Total Ocean | Total Ocean |
|---|---|---|---|---|---|---|
| Age | 2 | 3 | 4 | 5 | CWTs | % |
| Raw CWT Recoveries | 4 (<1%) | 394 (44%) | 356 (40%) | 142 (16%) | 896 | 59% |
| Expanded CWT$_{total}$ | **221** (1%) | **15,114** (81%) | **2,517** (14%) | **747** (4%) | 18,599 | 76% |

| **All Runs** | | | | | Total Ocean | Total Ocean |
|---|---|---|---|---|---|---|
| Age | 2 | 3 | 4 | 5 | CWTs | % |
| Raw CWT Recoveries | 4 (<1%) | 918 (61%) | 446 (29%) | 148 (10%) | 1,516 | 100% |
| Expanded CWT$_{total}$ | **221** (<1%) | **19,845** (82%) | **3,463** (14%) | **792** (3%) | 24,320 | 100% |
| CV Expanded CWT$_{total}$ (Proportion CV stocks) | | 4,731 (24%) | 946 (27%) | 45 (6%) | 5,722 | 24% |

a/ Recoveries of age-1, age-6+, and tagged natural-origin fish removed.

Table 9. Percentage[a/] of inland $CWT_{total}$ recoveries by location, run, and release type[b/] in hatchery returns, natural escapement and sport harvest during 2022.

| | | | CFH | | | FRH | | | | NIM | | | MOK | | | | MER | SJO | Non- | Total % | | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Location** | **Run** | **SacW** | **CFHL** | **CFHF** | **CFHFn** | **FRHS** | **FRHF** | **FRHFn** | **FRHFgg** | **NIMF** | **NIMFn** | **NIMFgg** | **MOKF** | **MOKFn** | **MOKFnc** | **MOKFgg** | **MERFn** | **SJOSx** | **CV** | **Hatchery** | **Natural** | **Run** |
| **Hatchery Spawners** | | | | | | | | | | | | | | | | | | | | | | |
| Coleman National Fish Hatchery | Winter | 11% | | | | | | | | | | | | | | | | | | 11% | 89% | 109 |
| Keswick Dam Fish Trap | Winter | 64% | | | | | | | | | | | | | | | | | | 64% | 36% | 455 |
| Feather River Hatchery | Spring | | | | | 95% | | 1% | | | | | | | | | | 1% | | 96% | 4% | 1,391 |
| Coleman National Fish Hatchery | Fall | | | 83% | 0% | | | 3% | 0% | | 0% | | | | 0% | 0% | | 0% | | 86% | 14% | 9,245 |
| Feather River Hatchery | Fall | | | 2% | 0% | 4% | 2% | 76% | 4% | 0% | 0% | | | 0% | 0% | 0% | 0% | 0% | | 90% | 10% | 14,277 |
| Nimbus Fish Hatchery | Fall | | | | 0% | | | 6% | 0% | 18% | 33% | 1% | 0% | 8% | 6% | 8% | 1% | | | 81% | 19% | 9,524 |
| Mokelumne River Hatchery | Fall | | 0% | | 1% | | | 4% | 0% | 0% | 18% | 2% | 0% | 35% | 11% | 23% | 1% | | | 94% | 6% | 5,030 |
| Coleman National Fish Hatchery | Late-fall[c/] | | 99% | | | | | | | | | | | | | | | | | 99% | 1% | 2,023 |
| Coleman Hatchery Fish Trap | Late-fall[c/] | | 86% | | | | | | | | | | | | | | | | | 86% | 14% | 49 |
| ***Total Hatchery Fall-run*** | | | ***0%*** | ***21%*** | ***0%*** | ***2%*** | ***1%*** | ***31%*** | ***1%*** | ***5%*** | ***11%*** | ***0%*** | ***0%*** | ***7%*** | ***3%*** | ***5%*** | ***0%*** | ***0%*** | | ***87%*** | ***13%*** | ***38,076*** |
| **Natural Spawners** | | | | | | | | | | | | | | | | | | | | | | |
| Upper Sacramento River | Winter | 5% | | | | | | | | | | | | | | | | | | 5% | 95% | 5,443 |
| Butte Creek | Spring | | | | | | | | | | | | | | | | | | | 0% | 100% | 3,688 |
| Upper Sacramento River | Fall | | | 12% | | 0% | | 12% | 1% | | 1% | | | | | 1% | | | | 26% | 74% | 4,680 |
| Clear Creek | Fall | | 0% | 26% | | | | 28% | 1% | | | | | | 0% | 1% | | 0% | | 58% | 42% | 2,997 |
| Battle Creek[d/] | Fall | | | 83% | 0% | | | 3% | 0% | | 0% | | | | 0% | 0% | | | | 86% | 14% | 1,620 |
| Feather River | Fall | | | 6% | | 11% | 1% | 60% | 1% | | 1% | | | 2% | 1% | | 0% | | | 84% | 16% | 6,577 |
| Yuba River[e/] | Fall | | | | | 2% | | 13% | 6% | | 13% | | | | | 6% | | | | 39% | 61% | 3,171 |
| American River | Fall | | | 0% | 1% | | | 9% | 0% | 19% | 35% | 0% | | 9% | 2% | 7% | 1% | | | 85% | 15% | 16,383 |
| Mokelumne River | Fall | | | | | | | | | | 17% | | | 39% | 5% | 11% | | | | 71% | 29% | 1,921 |
| Stanislaus River | Fall | | | | | | | 0% | 0% | | 2% | | | 24% | 4% | 11% | 1% | | | 42% | 58% | 3,721 |
| Tuolumne River | Fall | | | | | | | | | | | | | 69% | 4% | 8% | 10% | 1% | | 93% | 7% | 443 |
| ***Total Natural Area Fall-run*** | | | ***0%*** | ***8%*** | ***0%*** | ***2%*** | ***0%*** | ***18%*** | ***1%*** | ***8%*** | ***16%*** | ***0%*** | | ***8%*** | ***2%*** | ***5%*** | ***1%*** | ***0%*** | | ***68%*** | ***32%*** | ***41,513*** |
| In-basin $CWT_{total}$ | All | 1% | 3% | 12% | 0% | 3% | 1% | 20% | 1% | 6% | 12% | 0% | 0% | 3% | 1% | 2% | | | | 65% | 35% | 76,949 |
| Stray $CWT_{total}$ | All | | 0% | 10% | 1% | 0% | | 25% | 1% | 0% | 12% | 0% | 0% | 23% | 8% | 17% | 2% | 0% | | 100% | | 15,798 |
| **Total CV Spawners** | | **1%** | **2%** | **12%** | **0%** | **3%** | **0%** | **21%** | **1%** | **5%** | **12%** | **0%** | **0%** | **7%** | **2%** | **4%** | **0%** | **0%** | | **71%** | **29%** | **92,747** |
| **CV Sport Harvest** | | | | | | | | | | | | | | | | | | | | | | |
| Upper Sacramento River | Fall | | | 58% | | | | 7% | | | | | | | | | | | | 65% | 35% | 1,565 |
| Feather River | Fall | | | 16% | | 1% | | 61% | | | | | | 5% | | | | 1% | | 85% | 15% | 1,044 |
| American River | Fall | | | | | | | 9% | 5% | 15% | 37% | | | 5% | 5% | 5% | | | | 79% | 21% | 1,795 |
| Upper Sacramento River | Late-fall | | 64% | | | | | | | | | | | | | | | | | 64% | 36% | 387 |
| **Total Sport Harvest** | | | **5%** | **22%** | | **0%** | | **19%** | **2%** | **6%** | **14%** | | | **3%** | **2%** | **2%** | | **0%** | | **74%** | **26%** | **4,791** |

a/ Any non-zero values less than 0.5% of $CWT_{total}$ are displayed as 0%.

b/ Release types defined in Table 3; SacWbat recoveries merged with SacW, bay/delta trucked releases for FRHFt merged with FRHFn, bay/delta trucked releases for NIMFt merged with NIMFn, coastal trucked releases for MOKFt merged with MOKFnc, bay/delta trucked releases for MOKFt merged with MOKFn.

c/ Late-fall-run hatchery returns and natural area escapement occurred during late-fall of 2022 through early 2023 (return year 2023).

d/ Battle Creek natural area escapement $CWT_{total}$ based on hatchery proportions at CFH (FWS staff, per. comm).

e/ Yuba River escapement for above and below the DPD merged for 2022 due to low returns.

Table 10. Total inland $CWT_{total}$ recoveries by location, run, and release type[a/] in hatchery returns, natural escapement and sport harvest during 2022.

| | | | CFH | | | FRH | | | | NIM | | | MOK | | | | MER | SJO | Non- | Total $CWT_{total}$ | | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Location** | **Run** | **SacW** | **CFHL** | **CFHF** | **CFHFn** | **FRHS** | **FRHF** | **FRHFn** | **FRHFgg** | **NIMF** | **NIMFn** | **NIMFgg** | **MOKF** | **MOKFn** | **MOKFnc** | **MOKFgg** | **MERFn** | **SJOSx** | **CV** | **Hatchery** | **Natural** | **Run** |
| **Hatchery Spawners** | | | | | | | | | | | | | | | | | | | | | | |
| Coleman National Fish Hatchery | Winter | 12 | | | | | | | | | | | | | | | | | | 12 | 97 | 109 |
| Keswick Dam Fish Trap | Winter | 293 | | | | | | | | | | | | | | | | | | 293 | 162 | 455 |
| Feather River Hatchery | Spring | | | | | 1,316 | | 12 | | | | | | | | | | 8 | | 1,336 | 55 | 1,391 |
| Coleman National Fish Hatchery | Fall | | | 7,637 | 8 | | | 254 | 8 | | 8 | | | | 9 | 8 | | 2 | | 7,934 | 1,311 | 9,245 |
| Feather River Hatchery | Fall | | | 324 | 8 | 576 | 323 | 10,904 | 508 | 8 | 37 | | | 69 | 51 | 44 | 24 | 9 | | 12,885 | 1,392 | 14,277 |
| Nimbus Fish Hatchery | Fall | | | | 40 | | | 579 | 41 | 1,707 | 3,170 | 84 | 2 | 790 | 543 | 716 | 68 | | | 7,740 | 1,784 | 9,524 |
| Mokelumne River Hatchery | Fall | | 10 | | 37 | | | 182 | 12 | 12 | 893 | 76 | 6 | 1,752 | 548 | 1,156 | 53 | | | 4,737 | 293 | 5,030 |
| Coleman National Fish Hatchery | Late-fall[b/] | | 2,008 | | | | | | | | | | | | | | | | | 2,008 | 15 | 2,023 |
| Coleman Hatchery Fish Trap | Late-fall[b/] | | 42 | | | | | | | | | | | | | | | | | 42 | 7 | 49 |
| ***Total Hatchery Fall-run*** | | | ***10*** | ***7,961*** | ***93*** | ***576*** | ***323*** | ***11,919*** | ***569*** | ***1,727*** | ***4,108*** | ***160*** | ***8*** | ***2,611*** | ***1,151*** | ***1,924*** | ***145*** | ***11*** | | ***33,296*** | ***4,780*** | ***38,076*** |
| **Natural Spawners** | | | | | | | | | | | | | | | | | | | | | | |
| Upper Sacramento River | Winter | 249 | | | | | | | | | | | | | | | | | | 249 | 5,194 | 5,443 |
| Butte Creek | Spring | | | | | | | | | | | | | | | | | | | | 3,688 | 3,688 |
| Upper Sacramento River | Fall | | | 578 | | 21 | | 546 | 27 | | 27 | | | | | 27 | | | | 1,226 | 3,454 | 4,680 |
| Clear Creek | Fall | | 10 | 788 | | | | 840 | 38 | | | | | | 10 | 38 | | 10 | | 1,734 | 1,263 | 2,997 |
| Battle Creek[c/] | Fall | | | 1,338 | 1 | | | 45 | 1 | | 1 | | | | 2 | 1 | | | | 1,389 | 231 | 1,620 |
| Feather River | Fall | | | 403 | | 725 | 88 | 3,976 | 89 | | 59 | | | 116 | 37 | | 28 | | | 5,521 | 1,056 | 6,577 |
| Yuba River[d/] | Fall | | | | | 50 | | 401 | 201 | | 402 | | | | | 198 | | | | 1,252 | 1,919 | 3,171 |
| American River | Fall | | | 19 | 97 | | | 1,523 | 59 | 3,178 | 5,807 | 77 | | 1,466 | 394 | 1,215 | 113 | | | 13,948 | 2,435 | 16,383 |
| Mokelumne River | Fall | | | | | | | | | | 320 | | | 744 | 96 | 212 | | | | 1,372 | 549 | 1,921 |
| Stanislaus River | Fall | | | | | | | 18 | 6 | | 77 | | | 890 | 148 | 420 | 22 | | | 1,581 | 2,140 | 3,721 |
| Tuolumne River | Fall | | | | | | | | | | | | | 306 | 18 | 35 | 46 | 6 | | 411 | 32 | 443 |
| ***Total Natural Area Fall-run*** | | | ***10*** | ***3,126*** | ***98*** | ***796*** | ***88*** | ***7,349*** | ***421*** | ***3,178*** | ***6,693*** | ***77*** | | ***3,522*** | ***705*** | ***2,146*** | ***209*** | ***16*** | | ***28,434*** | ***13,079*** | ***41,513*** |
| In-basin $CWT_{total}$ | All | 554 | 2,050 | 9,553 | 9 | 2,667 | 411 | 15,293 | 798 | 4,885 | 8,977 | 161 | 6 | 2,496 | 644 | 1,368 | | | | 49,872 | 27,077 | 76,949 |
| Stray $CWT_{total}$ | All | | 20 | 1,534 | 182 | 21 | | 3,987 | 192 | 20 | 1,824 | 76 | 2 | 3,637 | 1,212 | 2,702 | 354 | 35 | | 15,798 | | 15,798 |
| **Total CV Spawners** | | **554** | **2,070** | **11,087** | **191** | **2,688** | **411** | **19,280** | **990** | **4,905** | **10,801** | **237** | **8** | **6,133** | **1,856** | **4,070** | **354** | **35** | | **65,670** | **27,077** | **92,747** |
| | % stray | | 1.0% | 14% | 95% | 0.8% | | 21% | 19% | 0.4% | 17% | 32% | 25% | 59% | 65% | 66% | 100% | 100% | | 24% | | 17% |
| **CV Sport Harvest** | | | | | | | | | | | | | | | | | | | | | | |
| Upper Sacramento River | Fall | | | 901 | | | | 109 | | | | | | | | | | | | 1,010 | 555 | 1,565 |
| Feather River | Fall | | | 172 | | 12 | | 638 | | | | | | 49 | | | | 12 | | 883 | 161 | 1,044 |
| American River | Fall | | | | | | | 165 | 83 | 266 | 656 | | | 82 | 82 | 82 | | | | 1,416 | 379 | 1,795 |
| Upper Sacramento River | Late-fall | | 246 | | | | | | | | | | | | | | | | | 246 | 141 | 387 |
| **Total Sport Harvest** | | | **246** | **1,073** | | **12** | | **912** | **83** | **266** | **656** | | | **131** | **82** | **82** | | **12** | | **3,555** | **1,236** | **4,791** |

a/ Release types defined in Table 3; SacWbat recoveries merged with SacW, bay/delta trucked releases for FRHFt merged with FRHFn, bay/delta trucked releases for NIMFt merged with NIMFn, coastal trucked releases for MOKFt merged with MOKFnc, bay/delta trucked releases for MOKFt merged with MOKFn.

b/ Late-fall-run hatchery returns and natural area escapement occurred during late-fall of 2021 through early 2022 (return year 2022).

c/ Battle Creek natural area escapement $CWT_{total}$ based on hatchery proportions at CFH (FWS staff, per. comm).

d/ Yuba River escapement for above and below the DPD merged for 2021 due to low returns.

Table 11. CWT recovery rate (recoveries per 100,000 CWTs released) by release type, brood year and recovery location in 2022. (Page 1 of 2)

**Age-2 CWT recoveries**

| Release type | Brood year | Run type | # CWT tagged | Central Valley total recoveries ($CWT_{samp}$) by basin | | | | | | | | | | CV $CWT_{samp}$ totals | | | % CV Stray | Ocean | Recovery rate per 100K released | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Bat Cr | Up Sac | Nat crks[a/] | Fea | Yub | Ame | Mok | Sta/Tuo | Mer | Up SJ | In-basin | Stray | CV total | | $CWT_{samp}$ | In-basin | Stray | **CV total** | **Ocean** |
| SacW[b/] | 2020 | Wint | 302,805 | | 136 | | | | | | | | | 136 | 0 | 136 | **0%** | 191 | 45 | 0 | **45** | **63** |
| SacWbat[b/] | 2020 | Wint | 212,751 | | | | | | | | | | | 0 | 0 | 0 | **-** | 26 | 0 | 0 | **0** | **12** |
| FRHS | 2020 | Spr | 993,132 | | | | 69 | | | | | | | 69 | 0 | 69 | **0%** | 160 | 7 | 0 | **7** | **16** |
| SJOSx | 2020 | Spr | 206,180 | | | | | | | | | | | 0 | 0 | 0 | **-** | 14 | 0 | 0 | **0** | **7** |
| CFHF | 2020 | Fall | 3,278,256 | 36 | | | 7 | | | | | | | 36 | 7 | 43 | **17%** | 77 | 1 | 0 | **1** | **2** |
| CFHFn | 2020 | Fall | 219,750 | 2 | | | 2 | | 34 | 9 | | | | 2 | 45 | 48 | **95%** | 139 | 1 | 21 | **22** | **63** |
| FRHFn | 2020 | Fall | 1,319,679 | 30 | 14 | 9 | 639 | | 75 | 18 | | 1 | | 639 | 147 | 786 | **19%** | 1,077 | 48 | 11 | **60** | **82** |
| FRHFgg | 2020 | Fall | 241,688 | 2 | 7 | | 146 | 50 | 23 | 3 | 1 | | | 196 | 37 | 233 | **16%** | 276 | 81 | 15 | **96** | **114** |
| NIMFn | 2020 | Fall | 842,638 | | | | 3 | | 301 | 130 | 7 | | | 301 | 141 | 442 | **32%** | 533 | 36 | 17 | **53** | **63** |
| NIMFgg | 2020 | Fall | 169,117 | | | | | | 40 | 19 | | | | 40 | 19 | 59 | **32%** | 81 | 24 | 11 | **35** | **48** |
| MOKFn | 2020 | Fall | 1,014,161 | | | | 4 | | 14 | 50 | 31 | 3 | | 50 | 52 | 102 | **51%** | 377 | 5 | 5 | **10** | **37** |
| MOKFnc | 2020 | Fall | 508,672 | 2 | | | 13 | | 70 | 83 | 15 | 2 | | 83 | 102 | 185 | **55%** | 1,091 | 16 | 20 | **36** | **215** |
| MOKFgg | 2020 | Fall | 494,114 | 1 | 19 | | 6 | | 28 | 34 | 13 | 2 | | 34 | 69 | 103 | **67%** | 509 | 7 | 14 | **21** | **103** |
| MERFn | 2020 | Fall | 74,909 | | | | | | 11 | 6 | 4 | 1 | | 1 | 21 | 22 | **96%** | 41 | 1 | 28 | **30** | **55** |
| CFHL | 2021 | Late | 1,009,914 | 215 | 12 | | | | | 2 | | | | 227 | 2 | 229 | **1%** | 9 | 23 | 0.2 | **23** | **1** |
| | | Total | 10,887,766 | 289 | 188 | 9 | 890 | 50 | 596 | 355 | 72 | 8 | | 1,816 | 641 | 2,457 | **26%** | 4,600 | | | | |

**Age-3 CWT recoveries**

| Release type | Brood year | Run type | # CWT tagged | Central Valley total recoveries ($CWT_{samp}$) by basin | | | | | | | | | | CV $CWT_{samp}$ totals | | | % CV Stray | Ocean | Recovery rate per 100K released | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Bat Cr | Up Sac | Nat crks[a/] | Fea | Yub | Ame | Mok | Sta/Tuo | Mer | Up SJ | In-basin | Stray | CV total | | $CWT_{samp}$ | In-basin | Stray | **CV total** | **Ocean** |
| SacW[b/] | 2019 | Wint | 247,216 | | 264 | | | | | | | | | 264 | 0 | 264 | **0%** | 5 | 107 | 0 | **107** | **2** |
| SacWbat[b/] | 2019 | Wint | 165,858 | 9 | | | | | | | | | | 9 | 0 | 9 | **0%** | 0 | 5 | 0 | **5** | **0** |
| FRHS | 2019 | Spr | 1,771,532 | | 7 | | 962 | 50 | | | | | | 1,012 | 7 | 1,019 | **0.7%** | 134 | 57 | 0 | **58** | **8** |
| SJOSx | 2019 | Spr | 232,903 | | | 9 | 5 | | | | 3 | | 2 | 2 | 17 | 19 | **92%** | 12 | 1 | 8 | **8** | **5** |
| CFHF | 2019 | Fall | 3,352,800 | 1,858 | 61 | 28 | 180 | | | | | | | 1,918 | 208 | 2,127 | **10%** | 2,493 | 57 | 6 | **63** | **74** |
| FRHF | 2019 | Fall | 248,810 | | | | 102 | | | | | | | 102 | 0 | 102 | **0%** | 109 | 41 | 0 | **41** | **44** |
| FRHFn | 2019 | Fall | 1,335,074 | 39 | 122 | 224 | 2,363 | 99 | 322 | 22 | 4 | 3 | | 2,462 | 737 | 3,199 | **23%** | 6,592 | 184 | 55 | **240** | **494** |
| NIMF | 2019 | Fall | 796,467 | | | | 1 | | 1,247 | 3 | | | | 1,247 | 4 | 1,251 | **0.3%** | 1,919 | 157 | 1 | **157** | **241** |
| NIMFn | 2019 | Fall | 453,171 | | 7 | | 20 | 99 | 1,830 | 166 | 10 | | | 1,830 | 302 | 2,132 | **14%** | 5,574 | 404 | 67 | **471** | **1,230** |
| MOKFn | 2019 | Fall | 1,068,378 | | | | 42 | | 454 | 548 | 264 | 18 | | 548 | 778 | 1,326 | **59%** | 4,206 | 51 | 73 | **124** | **394** |
| MOKFnc | 2019 | Fall | 508,729 | 1 | | 9 | 22 | | 292 | 172 | 47 | | | 172 | 372 | 544 | **68%** | 8,183 | 34 | 73 | **107** | **1,608** |
| MOKFgg | 2019 | Fall | 486,615 | 1 | | 9 | 5 | 50 | 455 | 308 | 101 | 2 | | 308 | 623 | 931 | **67%** | 9,870 | 63 | 128 | **191** | **2,028** |
| MERFn | 2019 | Fall | 109,375 | | | | 13 | | 26 | 8 | 13 | | | 0 | 61 | 61 | **100%** | 232 | 0 | 56 | **56** | **212** |
| CFHL | 2020 | Late | 872,269 | 1,001 | 13 | | | | | 6 | | | | 1,014 | 6 | 1,020 | **0.6%** | 919 | 116 | 1 | **117** | **105** |
| | | Total | 11,649,197 | 2,909 | 473 | 281 | 3,715 | 297 | 4,627 | 1,233 | 443 | 23 | 2 | 10,887 | 3,115 | 14,003 | **22%** | 40,245 | | | | |

Table 11. CWT recovery rate (recoveries per 100,000 CWTs released) by release type, brood year and recovery location in 2022. (Page 2 of 2)

**Age-4 CWT recoveries**

| Release type | Brood year | Run type | # CWT tagged | Central Valley total recoveries ($CWT_{samp}$) by basin | | | | | | | | | CV $CWT_{samp}$ totals | | | % CV Stray | Ocean | Recovery rate per 100K released | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Bat Cr | Up Sac | Nat crks[a/] | Fea | Yub | Ame | Mok | Sta/Tuo | Mer | Up SJ | In-basin | Stray | CV total | | $CWT_{samp}$ | In-basin | Stray | **CV total** | **Ocean** |
| SacW[b/] | 2018 | Wint | 221,923 | | 137 | | | | | | | | | 137 | 0 | 137 | **0%** | 0 | 62 | 0 | **62** | **0** |
| SacWbat[b/] | 2018 | Wint | 180,252 | 3 | 3 | | | | | | | | | 3 | 3 | 6 | **53%** | 0 | 2 | 1.9 | **4** | **0** |
| FRHS | 2018 | Spr | 1,831,043 | | 14 | | 1,566 | | | | | | | 1,566 | 14 | 1,579 | **1%** | 26 | 86 | 1 | **86** | **1** |
| SJOSx | 2018 | Spr | 216,845 | 2 | | | 12 | | | | 3 | | 2 | 2 | 17 | 19 | **92%** | 0 | 1 | 8 | **9** | **0** |
| CFHF | 2018 | Fall | 3,448,504 | 709 | 108 | 197 | 26 | | 5 | | | | | 817 | 228 | 1,044 | **22%** | 647 | 24 | 7 | **30** | **19** |
| FRHF | 2018 | Fall | 30,000 | | | | 2 | | | | | | | 2 | 0 | 2 | **0%** | 7 | 7 | 0 | **7** | **25** |
| FRHFn | 2018 | Fall | 1,772,613 | 5 | | 9 | 658 | | 122 | 5 | | | | 658 | 141 | 799 | **18%** | 1,013 | 37 | 8 | **45** | **57** |
| NIMF | 2018 | Fall | 797,850 | | | | 1 | | 91 | | | | | 91 | 1 | 92 | **1%** | 113 | 11 | 0 | **12** | **14** |
| NIMFn | 2018 | Fall | 439,333 | 2 | | | 1 | | 97 | 5 | 1 | | | 97 | 10 | 107 | **9%** | 351 | 22 | 2.2 | **24** | **80** |
| MOKF | 2018 | Fall | 398,991 | | | | | | 2 | 6 | | | | 6 | 2 | 8 | **25%** | 11 | 2 | 1 | **2** | **3** |
| MOKFn | 2018 | Fall | 1,403,247 | | | | | | 96 | 30 | 4 | | | 30 | 101 | 131 | **77%** | 229 | 2 | 7 | **9** | **16** |
| MOKFnc | 2018 | Fall | 873,909 | | | | | | 6 | 2 | | | | 2 | 6 | 8 | **74%** | 193 | 0 | 1 | **1** | **22** |
| MOKFgg | 2018 | Fall | 225,158 | | | | | | | | | | | 0 | 0 | 0 | **-** | 57 | 0 | 0 | **0** | **25** |
| MERFn | 2018 | Fall | 169,854 | | | | | | 10 | | | | | 0 | 10 | 10 | **100%** | 0 | 0 | 6 | **6** | **0** |
| CFHL | 2019 | Late | 1,031,542 | 789 | 48 | 9 | | | | 2 | | | | 838 | 11 | 849 | **1%** | 757 | 81 | 1 | **82** | **73** |
| | | Total | 13,041,064 | 1,510 | 310 | 216 | 2,265 | | 428 | 50 | 9 | | 2 | 4,247 | 544 | 4,790 | **11%** | 3,404 | | | | |

**Age-5 CV recoveries** (only release types with recoveries in 2022 are displayed)

| Release type | Brood year | Run type | # CWT tagged | Central Valley total recoveries ($CWT_{samp}$) by basin | | | | | | | | | CV $CWT_{samp}$ totals | | | % CV Stray | Ocean | Recovery rate per 100K released | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Bat Cr | Up Sac | Nat crks[a/] | Fea | Yub | Ame | Mok | Sta/Tuo | Mer | Up SJ | In-basin | Stray | CV total | | $CWT_{samp}$ | In-basin | Stray | **CV total** | **Ocean** |
| CFHF | 2017 | Fall | 1,369,512 | | | 9 | | | | | | | | 0 | 9 | 9 | **100%** | 4 | 0 | 1 | **1** | **0** |
| FRHFn | 2017 | Fall | 1,496,598 | | | | 20 | | | | | | | 20 | 0 | 20 | **0%** | 3 | 1 | 0 | **1** | **0** |
| FRHFgg | 2017 | Fall | 609,272 | | | 9 | 1 | | 1 | | | | | 1 | 10 | 11 | **91%** | 16 | 0 | 2 | **2** | **3** |
| NIMFn | 2017 | Fall | 664,585 | | | | | | | | | | | 0 | 0 | 0 | **-** | 5 | 0 | 0 | **0** | **1** |
| MOKFnc | 2017 | Fall | 727,344 | | | | | | | | | | | 0 | 0 | 0 | **-** | 16 | 0 | 0 | **0** | **2** |
| CFHL | 2018 | Late | 881,364 | 4 | | | | | | | | | | 4 | 0 | 4 | **0** | 3 | 1 | 0 | **1** | **0** |
| | | Total | 5,748,675 | 4 | | 19 | 21 | | 1 | | | | | 25 | 20 | 45 | **45%** | 47 | | | | |

a/ Natural creeks can include Clear Creek, Cow Creek, Cottonwood Creek, Paynes Creek, Mill Creek, Deer Creek, and Butte Creek, depending on survey year.
b/ Ocean recoveries of SacW and SacWbat are considered one year older than those of the same brood year recovered in the CV (i.e., brood year 2020 = age-3 in the ocean).

**Sacramento River fall Chinook release types (SFC)**

| | |
|---|---|
| CFHF | Coleman National Fish Hatchery fall in-basin releases |
| CFHFn | Coleman National Fish Hatchery fall bay/delta net pen releases |
| FRHF | Feather River Hatchery fall in-basin releases |
| FRHFn | Feather River Hatchery fall bay/delta net pen releases |
| FRHFgg | Feather River Hatchery fall Golden Gate releases (no net pens) |
| NIMF | Nimbus Fish Hatchery fall in-basin releases |
| NIMFn | Nimbus Fish Hatchery fall bay/delta net pen releases |
| NIMFgg | Nimbus Fish Hatchery fall Golden Gate releases (no net pens) |

**Other CV Chinook release types (OCV)**

| | |
|---|---|
| MOKF | Mokelumne River Hatchery fall in-basin releases |
| MOKFn | Mokelumne River Hatchery fall bay/delta net pen releases |
| MOKFnc | Mokelumne River Hatchery fall coastal net pen releases |
| MOKFgg | Mokelumne River Hatchery fall Golden Gate releases (no net pens) |
| MERFn | Merced River Hatchery fall bay/delta net pen releases |
| SacW | Livingston Stone National Fish Hatchery winter in-basin releases |
| SacWbat | Livingston Stone National Fish Hatchery winter Battle Creek reintroduction releases |
| FRHS | Feather River Hatchery spring in-basin releases |
| SJOSx | San Joaquin Salmon Conservation and Research Facility spring reintroduction releases |
| CFHL | Coleman National Fish Hatchery late-fall in-basin releases |

Table 12. Total $CWT_{total}$ recoveries by port area, month, and release type[a/] in the 2022 California ocean salmon sport fishery.

| | | CFH | | | FRH | | | | NIM | | | MOK | | | | MER | SJO | Non- | Total | Total $CWT_{total}$ | | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | SacW | CFHL | CFHF | CFHFn | FRHS | FRHF | FRHFn | FRHFgg | NIMF | NIMFn | NIMFgg | MOKF | MOKFn | MOKFnc | MOKFgg | MERFn | SJOSx | CV | CV | Hatchery | Natural | Harvest |
| **California Sport Harvest** | | | | | | | | | | | | | | | | | | | | | | |
| **Eureka/Crescent City** | | | | | | | | | | | | | | | | | | | | | | |
| May | | | 51 | | 5 | 15 | 168 | | 55 | 168 | | | 322 | 141 | 214 | 14 | | 542 | 1,154 | 1,695 | 1,855 | 3,550 |
| Aug | | | | | | | 15 | | | 34 | | | 15 | 15 | 20 | | | 4 | 98 | 102 | 120 | 222 |
| Sep | | 4 | | | | | 73 | | 4 | 58 | | | 43 | 30 | 115 | | | 4 | 326 | 330 | 113 | 443 |
| **Total** | | **4** | **51** | | **5** | **15** | **256** | | **59** | **260** | | | **380** | **185** | **349** | **14** | | **549** | **1,578** | **2,127** | **2,088** | **4,215** |
| | | | | | | | | | | | | | | | | | | | | | | **(5%)** |
| **Fort Bragg** | | | | | | | | | | | | | | | | | | | | | | |
| May | | | 5 | | 5 | | 83 | | | 15 | | | 15 | 64 | 82 | | | 68 | 268 | 336 | 294 | 630 |
| Jun | | | 33 | | | | 130 | | 16 | 13 | | | 13 | 50 | 134 | | | 44 | 388 | 433 | 230 | 663 |
| Jul | | | 15 | | | | 63 | | | | | | 29 | 33 | 41 | | | 4 | 180 | 183 | 100 | 283 |
| Aug | | 16 | 21 | | | | 43 | 40 | 21 | 104 | | | 42 | 53 | 77 | | | 11 | 417 | 428 | 289 | 717 |
| Sep | | | | | | | 14 | 14 | | 14 | | | 14 | 14 | 14 | | | 13 | 85 | 98 | 134 | 232 |
| **Total** | | **16** | **73** | | **5** | | **333** | **54** | **37** | **146** | | | **113** | **214** | **347** | | | **139** | **1,338** | **1,477** | **1,048** | **2,525** |
| | | | | | | | | | | | | | | | | | | | | | | **(3%)** |
| **San Francisco** | | | | | | | | | | | | | | | | | | | | | | |
| Apr | 15 | 22 | 141 | | 19 | | 328 | | 96 | 238 | | | 192 | 358 | 472 | | | 102 | 1,881 | 1,983 | 1,131 | 3,114 |
| May | 4 | 80 | 208 | | 14 | | 1,141 | 58 | 188 | 663 | | | 349 | 574 | 1,018 | | | 73 | 4,297 | 4,370 | 1,546 | 5,916 |
| Jun | 14 | 77 | 173 | 14 | 7 | 14 | 766 | 14 | 155 | 693 | 14 | | 413 | 840 | 908 | 39 | | 292 | 4,141 | 4,433 | 3,732 | 8,165 |
| Jul | 66 | 201 | 700 | 299 | 93 | | 4,687 | 616 | 544 | 3,577 | 217 | | 2,183 | 2,868 | 4,847 | 170 | | 955 | 21,068 | 22,023 | 11,059 | 33,082 |
| Aug | 25 | 50 | 373 | 190 | 43 | 21 | 2,900 | 275 | 232 | 1,053 | 77 | | 954 | 1,187 | 2,056 | 50 | 5 | 145 | 9,492 | 9,636 | 4,289 | 13,925 |
| Sep | | | 18 | 18 | 9 | | 203 | 18 | 101 | 312 | | | 293 | 552 | 511 | 34 | | 5 | 2,070 | 2,074 | 512 | 2,586 |
| Oct | | 10 | 19 | | 5 | | 20 | 19 | | 42 | 19 | | | 106 | 103 | | | | 344 | 344 | 127 | 471 |
| **Total** | **123** | **440** | **1,632** | **521** | **191** | **34** | **10,044** | **1,001** | **1,316** | **6,579** | **326** | | **4,384** | **6,486** | **9,916** | **293** | **5** | **1,572** | **43,291** | **44,863** | **22,396** | **67,259** |
| | | | | | | | | | | | | | | | | | | | | | | **(75%)** |
| **Monterey** | | | | | | | | | | | | | | | | | | | | | | |
| Apr | 24 | 81 | 806 | | 47 | 19 | 1,071 | | 156 | 496 | | | 287 | 490 | 873 | | 5 | 74 | 4,354 | 4,428 | 2,296 | 6,724 |
| May | 5 | 22 | 253 | | | | 463 | 22 | 44 | 241 | | | 218 | 228 | 348 | 21 | 5 | 67 | 1,870 | 1,937 | 1,366 | 3,303 |
| Jun | 17 | 19 | 159 | | | | 567 | 14 | 14 | 429 | | | 205 | 223 | 468 | | | 10 | 2,116 | 2,125 | 1,782 | 3,907 |
| Jul | 28 | 29 | 26 | 23 | | | 70 | 23 | 110 | 116 | | | 110 | 214 | 317 | 18 | | 26 | 1,084 | 1,110 | 732 | 1,842 |
| Aug | 4 | | | | | | | | | 18 | | | | | | | | | 22 | 22 | 76 | 98 |
| **Total** | **78** | **151** | **1,244** | **23** | **47** | **19** | **2,171** | **60** | **324** | **1,300** | | | **820** | **1,154** | **2,006** | **39** | **10** | **176** | **9,446** | **9,622** | **6,252** | **15,874** |
| | | | | | | | | | | | | | | | | | | | | | | **(18%)** |
| **California Total Sport Harvest** | | | | | | | | | | | | | | | | | | | | | | |
| | **202** | **611** | **3,000** | **545** | **247** | **68** | **12,804** | **1,115** | **1,735** | **8,284** | **326** | | **5,697** | **8,039** | **12,619** | **347** | **16** | **2,435** | **55,654** | **58,089** | **31,784** | **89,873** |
| ***Oregon Total Sport Harvest (South of Cape Falcon)*** | | | | | | | | | | | | | | | | | | | | | | |
| | | | ***10*** | | | | ***122*** | | ***65*** | ***125*** | | | ***178*** | ***87*** | ***258*** | | | ***1,982*** | ***846*** | ***2,827*** | ***2,195*** | ***5,022*** |

a/ Release types defined in Table 3; SacWbat recoveries merged with SacW, bay/delta trucked releases for FRHFt merged with FRHFn, bay/delta trucked releases for NIMFt merged with NIMFn, coastal trucked releases for MOKFt merged with MOKFnc, bay/delta trucked releases for MOKFt merged with MOKFn.

Table 13. Percentage[a/] of $CWT_{total}$ recoveries by port area, month, and release type[b/] in the 2022 California ocean salmon sport fishery.

| | | CFH | | | FRH | | | | NIM | | | MOK | | | | MER | SJO | Non- | Total | Total % | | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | SacW | CFHL | CFHF | CFHFn | FRHS | FRHF | FRHFn | FRHFgg | NIMF | NIMFn | NIMFgg | MOKF | MOKFn | MOKFnc | MOKFgg | MERFn | SJOSx | CV | CV | Hatchery | Natural | Harvest |
| **California Sport Harvest** | | | | | | | | | | | | | | | | | | | | | | |
| **Eureka/Crescent City** | | | | | | | | | | | | | | | | | | | | | | |
| May | | | 1% | | 0% | 0% | 5% | | 2% | 5% | | | 9% | 4% | 6% | 0% | | 15% | 33% | 48% | 52% | 3,550 |
| Aug | | | | | | | 7% | | | 16% | | | 7% | 7% | 9% | | | 2% | 44% | 46% | 54% | 222 |
| Sep | | 1% | | | | | 16% | | 1% | 13% | | | 10% | 7% | 26% | | | 1% | 74% | 74% | 26% | 443 |
| **Total** | | **0%** | **1%** | | **0%** | **0%** | **6%** | | **1%** | **6%** | | | **9%** | **4%** | **8%** | **0%** | | **13%** | **37%** | **50%** | **50%** | **4,215** |
| **Fort Bragg** | | | | | | | | | | | | | | | | | | | | | | |
| May | | | 1% | | 1% | | 13% | | | 2% | | | 2% | 10% | 13% | | | 11% | 43% | 53% | 47% | 630 |
| Jun | | | 5% | | | | 20% | | 2% | 2% | | | 2% | 7% | 20% | | | 7% | 59% | 65% | 35% | 663 |
| Jul | | | 5% | | | | 22% | | | | | | 10% | 12% | 14% | | | 1% | 63% | 65% | 35% | 283 |
| Aug | | 2% | 3% | | | | 6% | 6% | 3% | 14% | | | 6% | 7% | 11% | | | 1% | 58% | 60% | 40% | 717 |
| Sep | | | | | | | 6% | 6% | | 6% | | | 6% | 6% | 6% | | | 5% | 37% | 42% | 58% | 232 |
| **Total** | | **1%** | **3%** | | **0%** | | **13%** | **2%** | **1%** | **6%** | | | **4%** | **8%** | **14%** | | | **6%** | **53%** | **58%** | **42%** | **2,525** |
| **San Francisco** | | | | | | | | | | | | | | | | | | | | | | |
| Apr | 0% | 1% | 5% | | 1% | | 11% | | 3% | 8% | | | 6% | 12% | 15% | | | 3% | 60% | 64% | 36% | 3,114 |
| May | 0% | 1% | 4% | | 0% | | 19% | 1% | 3% | 11% | | | 6% | 10% | 17% | | | 1% | 73% | 74% | 26% | 5,916 |
| Jun | 0% | 1% | 2% | 0% | 0% | 0% | 9% | 0% | 2% | 8% | 0% | | 5% | 10% | 11% | 0% | | 4% | 51% | 54% | 46% | 8,165 |
| Jul | 0% | 1% | 2% | 1% | 0% | | 14% | 2% | 2% | 11% | 1% | | 7% | 9% | 15% | 1% | | 3% | 64% | 67% | 33% | 33,082 |
| Aug | 0% | 0% | 3% | 1% | 0% | 0% | 21% | 2% | 2% | 8% | 1% | | 7% | 9% | 15% | 0% | 0% | 1% | 68% | 69% | 31% | 13,925 |
| Sep | | | 1% | 1% | 0% | | 8% | 1% | 4% | 12% | | | 11% | 21% | 20% | 1% | | 0% | 80% | 80% | 20% | 2,586 |
| Oct | | 2% | 4% | | 1% | | 4% | 4% | | 9% | 4% | | | 23% | 22% | | | | 73% | 73% | 27% | 471 |
| **Total** | **0%** | **1%** | **2%** | **1%** | **0%** | **0%** | **15%** | **1%** | **2%** | **10%** | **0%** | | **7%** | **10%** | **15%** | **0%** | **0%** | **2%** | **64%** | **67%** | **33%** | **67,259** |
| **Monterey** | | | | | | | | | | | | | | | | | | | | | | |
| Apr | 0% | 1% | 12% | | 1% | 0% | 16% | | 2% | 7% | | | 4% | 7% | 13% | | 0% | 1% | 65% | 66% | 34% | 6,724 |
| May | 0% | 1% | 8% | | | | 14% | 1% | 1% | 7% | | | 7% | 7% | 11% | 1% | 0% | 2% | 57% | 59% | 41% | 3,303 |
| Jun | 0% | 0% | 4% | | | | 15% | 0% | 0% | 11% | | | 5% | 6% | 12% | | | 0% | 54% | 54% | 46% | 3,907 |
| Jul | 2% | 2% | 1% | 1% | | | 4% | 1% | 6% | 6% | | | 6% | 12% | 17% | 1% | | 1% | 59% | 60% | 40% | 1,842 |
| Aug | 5% | | | | | | | | | 18% | | | | | | | | | 23% | 23% | 77% | 98 |
| **Total** | **0%** | **1%** | **8%** | **0%** | **0%** | **0%** | **14%** | **0%** | **2%** | **8%** | | | **5%** | **7%** | **13%** | **0%** | **0%** | **1%** | **60%** | **61%** | **39%** | **15,874** |
| **California Total Sport Harvest** | | | | | | | | | | | | | | | | | | | | | | |
| | **0%** | **1%** | **3%** | **1%** | **0%** | **0%** | **14%** | **1%** | **2%** | **9%** | **0%** | | **6%** | **9%** | **14%** | **0%** | **0%** | **3%** | **62%** | **65%** | **35%** | **89,873** |
| ***Oregon Total Sport Harvest (South of Cape Falcon)*** | | | | | | | | | | | | | | | | | | | | | | |
| | | | ***0%*** | | | | ***2%*** | | ***1%*** | ***2%*** | | | ***4%*** | ***2%*** | ***5%*** | | | ***39%*** | ***17%*** | ***56%*** | ***44%*** | ***5,022*** |

a/ Any non-zero values less than 0.5% of $CWT_{total}$ are displayed as 0%.

b/ Release types defined in Table 3; SacWbat recoveries merged with SacW, bay/delta trucked releases for FRHFt merged with FRHFn, bay/delta trucked releases for NIMFt merged with NIMFn, coastal trucked releases for MOKFt merged with MOKFnc, bay/delta trucked releases for MOKFt merged with MOKFn.

Table 14. Total $CWT_{total}$ recoveries by port area, month, and release type[a/] in the 2022 California ocean salmon commercial fishery.

| | | CFH | | | FRH | | | | NIM | | | MOK | | | | MER | SJO | Non- | Total | Total $CWT_{total}$ | | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | SacW | CFHL | CFHF | CFHFn | FRHS | FRHF | FRHFn | FRHFgg | NIMF | NIMFn | NIMFgg | MOKF | MOKFn | MOKFnc | MOKFgg | MERFn | SJOSx | CV | CV | Hatchery | Natural | Harvest |
| **California Commercial Harvest** | | | | | | | | | | | | | | | | | | | | | | |
| **Eureka/Crescent City** | | | | | | | | | | | | | | | | | | | | | | |
| Jul | | | | | | | | | | | | | | | | | | | | | | |
| Aug | | | | | | | | | | | | | | | | | | | | | | |
| **Total** | | | | | | | | | | | | | | | | | | | | | | |
| **Fort Bragg** | | | | | | | | | | | | | | | | | | | | | | (0%) |
| Jul | | 67 | 467 | | 4 | 8 | 671 | | 263 | 684 | | | 472 | 763 | 1,335 | 30 | | 854 | 4,763 | 5,617 | 4,884 | 10,501 |
| Aug | | 109 | 269 | | 3 | 21 | 1,006 | 11 | 169 | 876 | | | 342 | 714 | 1,171 | 30 | | 1,076 | 4,719 | 5,795 | 5,373 | 11,168 |
| **Total** | | **176** | **735** | | **6** | **29** | **1,677** | **11** | **432** | **1,560** | | | **814** | **1,476** | **2,506** | **61** | | **1,930** | **9,482** | **11,412** | **10,257** | **21,669** |
| **San Francisco** | | | | | | | | | | | | | | | | | | | | | | (10%) |
| Jul | 4 | 319 | 1,511 | | 18 | 127 | 4,238 | 15 | 1,328 | 4,529 | | 4 | 3,593 | 4,532 | 7,566 | 183 | 3 | 5,307 | 27,971 | 33,277 | 33,607 | 66,884 |
| Aug | | 192 | 629 | 16 | 4 | 31 | 2,397 | | 485 | 1,774 | | | 1,334 | 1,550 | 3,245 | 61 | 4 | 1,754 | 11,723 | 13,477 | 8,132 | 21,609 |
| Sep | 4 | 53 | 30 | | 4 | | 258 | | 362 | 1,364 | | | 862 | 1,172 | 2,318 | 420 | | | 6,847 | 6,847 | 1,207 | 8,054 |
| Oct | 3 | 35 | | | 3 | | 26 | | 38 | 215 | | | 38 | 111 | 302 | | 3 | | 773 | 773 | 257 | 1,030 |
| **Total** | **11** | **599** | **2,170** | **16** | **29** | **159** | **6,919** | **15** | **2,213** | **7,882** | | **4** | **5,827** | **7,365** | **13,431** | **664** | **10** | **7,061** | **47,314** | **54,374** | **43,203** | **97,577** |
| **Monterey** | | | | | | | | | | | | | | | | | | | | | | (46%) |
| May | | 206 | 3,250 | | 27 | 162 | 7,608 | | 1,514 | 4,241 | | 3 | 3,594 | 3,151 | 5,901 | 236 | | 940 | 29,895 | 30,835 | 22,111 | 52,946 |
| Jun | | 86 | 1,521 | | 7 | 27 | 4,413 | | 1,064 | 2,879 | | | 1,935 | 2,988 | 5,236 | 80 | | 932 | 20,237 | 21,169 | 13,048 | 34,217 |
| Jul | 2 | 31 | 129 | | | | 453 | 8 | 73 | 146 | | | 214 | 272 | 309 | | | 87 | 1,638 | 1,725 | 1,964 | 3,689 |
| Aug | 7 | 11 | 14 | | | | 113 | 14 | 14 | 126 | | | 42 | 116 | 167 | | | 28 | 623 | 651 | 456 | 1,107 |
| **Total** | **9** | **333** | **4,914** | | **34** | **189** | **12,587** | **22** | **2,666** | **7,393** | | **3** | **5,785** | **6,528** | **11,613** | **316** | | **1,988** | **52,393** | **54,381** | **37,578** | **91,959** |
| **California Total Commercial Harvest** | | | | | | | | | | | | | | | | | | | | | | (44%) |
| | **20** | **1,108** | **7,820** | **16** | **70** | **377** | **21,183** | **48** | **5,311** | **16,835** | | **7** | **12,426** | **15,369** | **27,550** | **1,040** | **10** | **10,978** | **109,189** | **120,167** | **91,038** | **211,205** |
| ***Oregon Total Commercial Harvest (South of Cape Falcon)*** | | | | | | | | | | | | | | | | | | | | | | |
| | | ***3*** | ***367*** | | ***7*** | | ***1,021*** | ***20*** | ***274*** | ***792*** | | ***4*** | ***808*** | ***231*** | ***1,321*** | ***27*** | | ***16,617*** | ***4,876*** | ***21,493*** | ***9,014*** | ***30,507*** |

a/ Release types defined in Table 3; SacWbat recoveries merged with SacW, bay/delta trucked releases for FRHFt merged with FRHFn, bay/delta trucked releases for NIMFt merged with NIMFn, coastal trucked releases for MOKFt merged with MOKFnc, bay/delta trucked releases for MOKFt merged with MOKFn.

Table 15. Percentage[a/] of $CWT_{total}$ recoveries by port area, month, and release type[b/] in the 2022 California ocean salmon commercial fishery.

| | | CFH | | | FRH | | | | NIM | | | MOK | | | | MER | SJO | Non- | Total | Total % | | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | SacW | CFHL | CFHF | CFHFn | FRHS | FRHF | FRHFn | FRHFgg | NIMF | NIMFn | NIMFgg | MOKF | MOKFn | MOKFnc | MOKFgg | MERFn | SJOSx | CV | CV | Hatchery | Natural | Harvest |
| **California Commercial Harvest** | | | | | | | | | | | | | | | | | | | | | | |
| **Eureka/Crescent City** | | | | | | | | | | | | | | | | | | | | | | |
| Jul | | | | | | | | | | | | | | | | | | | | | | |
| Aug | | | | | | | | | | | | | | | | | | | | | | |
| **Total** | | | | | | | | | | | | | | | | | | | | | | |
| **Fort Bragg** | | | | | | | | | | | | | | | | | | | | | | |
| Jul | | 1% | 4% | | 0% | 0% | 6% | | 3% | 7% | | | 4% | 7% | 13% | 0% | | 8% | 45% | 53% | 47% | 10,501 |
| Aug | | 1% | 2% | | 0% | 0% | 9% | 0% | 2% | 8% | | | 3% | 6% | 10% | 0% | | 10% | 42% | 52% | 48% | 11,168 |
| **Total** | | **1%** | **3%** | | **0%** | **0%** | **8%** | **0%** | **2%** | **7%** | | | **4%** | **7%** | **12%** | **0%** | | **9%** | **44%** | **53%** | **47%** | **21,669** |
| **San Francisco** | | | | | | | | | | | | | | | | | | | | | | |
| Jul | 0% | 0% | 2% | | 0% | 0% | 6% | 0% | 2% | 7% | | 0% | 5% | 7% | 11% | 0% | 0% | 8% | 42% | 50% | 50% | 66,884 |
| Aug | | 1% | 3% | 0% | 0% | 0% | 11% | | 2% | 8% | | | 6% | 7% | 15% | 0% | 0% | 8% | 54% | 62% | 38% | 21,609 |
| Sep | 0% | 1% | 0% | | 0% | | 3% | | 4% | 17% | | | 11% | 15% | 29% | 5% | | | 85% | 85% | 15% | 8,054 |
| Oct | 0% | 3% | | | 0% | | 2% | | 4% | 21% | | | 4% | 11% | 29% | | 0% | | 75% | 75% | 25% | 1,030 |
| **Total** | **0%** | **1%** | **2%** | **0%** | **0%** | **0%** | **7%** | **0%** | **2%** | **8%** | | **0%** | **6%** | **8%** | **14%** | **1%** | **0%** | **7%** | **48%** | **56%** | **44%** | **97,577** |
| **Monterey** | | | | | | | | | | | | | | | | | | | | | | |
| May | | 0% | 6% | | 0% | 0% | 14% | | 3% | 8% | | 0% | 7% | 6% | 11% | 0% | | 2% | 56% | 58% | 42% | 52,946 |
| Jun | | 0% | 4% | | 0% | 0% | 13% | | 3% | 8% | | | 6% | 9% | 15% | 0% | | 3% | 59% | 62% | 38% | 34,217 |
| Jul | 0% | 1% | 4% | | | | 12% | 0% | 2% | 4% | | | 6% | 7% | 8% | | | 2% | 44% | 47% | 53% | 3,689 |
| Aug | 1% | 1% | 1% | | | | 10% | 1% | 1% | 11% | | | 4% | 10% | 15% | | | 3% | 56% | 59% | 41% | 1,107 |
| **Total** | **0%** | **0%** | **5%** | | **0%** | **0%** | **14%** | **0%** | **3%** | **8%** | | **0%** | **6%** | **7%** | **13%** | **0%** | | **2%** | **57%** | **59%** | **41%** | **91,959** |
| **California Total Commercial Harvest** | | | | | | | | | | | | | | | | | | | | | | |
| | **0%** | **1%** | **4%** | **0%** | **0%** | **0%** | **10%** | **0%** | **3%** | **8%** | | **0%** | **6%** | **7%** | **13%** | **0%** | **0%** | **5%** | **52%** | **57%** | **43%** | **211,205** |
| ***Oregon Total Commercial Harvest (South of Cape Falcon)*** | | | | | | | | | | | | | | | | | | | | | | |
| | | ***0%*** | ***1%*** | | ***0%*** | | ***3%*** | ***0%*** | ***1%*** | ***3%*** | | ***0%*** | ***3%*** | ***1%*** | ***4%*** | ***0%*** | | ***54%*** | ***16%*** | ***70%*** | ***30%*** | ***30,507*** |

a/ Any non-zero values less than 0.5% of $CWT_{total}$ are displayed as 0%.

b/ Release types defined in Table 3; SacWbat recoveries merged with SacW, bay/delta trucked releases for FRHFt merged with FRHFn, bay/delta trucked releases for NIMFt merged with NIMFn, coastal trucked releases for MOKFt merged with MOKFnc, bay/delta trucked releases for MOKFt merged with MOKFn.

## Table 16. CWT recovery rate (recoveries per 100,000 CWTs released) for experimental & net pen release types in 2022.

### Age-2 CWT recoveries

| Release type | Brood year | Run type | # CWT tagged | Central Valley total recoveries ($CWT_{samp}$) by basin | | | | | | | | | CV $CWT_{samp}$ totals | | | % CV Stray | Ocean $CWT_{samp}$ | Recovery rate per 100K released | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Bat Cr | Up Sac | Nat crks[a/] | Fea | Yub | Ame | Mok | Sta/Tuo | Mer | In-basin | Stray | CV total | | | In-basin | Stray | CV total | Ocean |
| CFHFn | 2020 | Fall | 219,750 | 2 | | | 2 | | 34 | 9 | | | 2 | 45 | **48** | **95%** | **139** | 1 | 21 | **22** | **63** |
| FRHFn | 2020 | Fall | 1,319,679 | 30 | 14 | 9 | 639 | | 75 | 18 | | 1 | 639 | 147 | **786** | **19%** | **1,077** | 48 | 11 | **60** | **82** |
| FRHFgg | 2020 | Fall | 241,688 | 2 | 7 | | 146 | 50 | 23 | 3 | 1 | | 196 | 37 | **233** | **16%** | **276** | 81 | 15 | **96** | **114** |
| NIMFn | 2020 | Fall | 842,638 | | | | 3 | | 301 | 130 | 7 | | 301 | 141 | **442** | **32%** | **533** | 36 | 17 | **53** | **63** |
| NIMFgg | 2020 | Fall | 169,117 | | | | | | 40 | 19 | | | 40 | 19 | **59** | **32%** | **81** | 24 | 11 | **35** | **48** |
| MOKFn | 2020 | Fall | 1,014,161 | | | | 4 | | 14 | 50 | 31 | 3 | 50 | 52 | **102** | **51%** | **377** | 5 | 5 | **10** | **37** |
| MOKFnp | 2020 | Fall | 185,794 | 1 | | | 6 | | 28 | 26 | 4 | 1 | 26 | 40 | **66** | **61%** | **290** | 14 | 22 | **36** | **156** |
| MOKFgg | 2020 | Fall | 494,114 | 1 | 19 | | 6 | | 28 | 34 | 13 | 2 | 34 | 69 | **103** | **67%** | **509** | 7 | 14 | **21** | **103** |
| MERFn | 2020 | Fall | 74,909 | | | | | | 11 | 6 | 4 | 1 | 1 | 21 | **22** | **96%** | **41** | 1 | 28 | **30** | **55** |

### Age-3 CWT recoveries

| Release type | Brood year | Run type | # CWT tagged | Central Valley total recoveries ($CWT_{samp}$) by basin | | | | | | | | | CV $CWT_{samp}$ totals | | | % CV Stray | Ocean $CWT_{samp}$ | Recovery rate per 100K released | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Bat Cr | Up Sac | Nat crks[a/] | Fea | Yub | Ame | Mok | Sta/Tuo | Mer | In-basin | Stray | CV total | | | In-basin | Stray | CV total | Ocean |
| FRHFn | 2019 | Fall | 1,335,074 | 39 | 122 | 224 | 2,363 | 99 | 322 | 22 | 4 | 3 | 2,462 | 737 | **3,199** | **23%** | **6,592** | 184 | 55 | **240** | **494** |
| NIMFn | 2019 | Fall | 453,171 | | 7 | | 20 | 99 | 1,830 | 166 | 10 | | 1,830 | 302 | **2,132** | **14%** | **5,574** | 404 | 67 | **471** | **1,230** |
| MOKFn | 2019 | Fall | 1,068,378 | | | | 42 | | 454 | 548 | 264 | 18 | 548 | 778 | **1,326** | **59%** | **4,206** | 51 | 73 | **124** | **394** |
| MOKFnp | 2019 | Fall | 192,201 | 1 | | | 11 | | 157 | 100 | 30 | | 100 | 200 | **300** | **67%** | **4,332** | 52 | 104 | **156** | **2,254** |
| MOKFgg | 2019 | Fall | 486,615 | 1 | | 9 | 5 | 50 | 455 | 308 | 101 | 2 | 308 | 623 | **931** | **67%** | **9,870** | 63 | 128 | **191** | **2,028** |
| MERFn | 2019 | Fall | 109,375 | | | | 13 | | 26 | 8 | 13 | | 0 | 61 | **61** | **100%** | **232** | 0 | 56 | **56** | **212** |

### Age-4 CWT recoveries

| Release type | Brood year | Run type | # CWT tagged | Central Valley total recoveries ($CWT_{samp}$) by basin | | | | | | | | | CV $CWT_{samp}$ totals | | | % CV Stray | Ocean $CWT_{samp}$ | Recovery rate per 100K released | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Bat Cr | Up Sac | Nat crks[a/] | Fea | Yub | Ame | Mok | Sta/Tuo | Mer | In-basin | Stray | CV total | | | In-basin | Stray | CV total | Ocean |
| FRHFn | 2018 | Fall | 1,772,613 | 5 | | 9 | 658 | | 122 | 5 | | | 658 | 141 | **799** | **18%** | **1,013** | 37 | 8 | **45** | **57** |
| NIMFn | 2018 | Fall | 439,333 | 2 | | | 1 | | 97 | 5 | 1 | | 97 | 10 | **107** | **9%** | **351** | 22 | 2 | **24** | **80** |
| MOKFn | 2018 | Fall | 1,403,247 | | | | | | 96 | 30 | 4 | | 30 | 101 | **131** | **77%** | **229** | 2 | 7 | **9** | **16** |
| MOKFnp | 2018 | Fall | 754,295 | | | | | | 6 | 2 | | | 2 | 6 | **8** | **74%** | **176** | 0 | 1 | **1** | **23** |
| MOKFns | 2018 | Fall | 119,614 | | | | | | | | | | 0 | 0 | **0** | **-** | **16** | 0 | 0 | **0** | **14** |
| MOKFgg | 2018 | Fall | 225,158 | | | | | | | | | | 0 | 0 | **0** | **-** | **57** | 0 | 0 | **0** | **25** |
| MERFn | 2018 | Fall | 169,854 | | | | | | 10 | | | | 0 | 10 | **10** | **100%** | **0** | 0 | 6 | **6** | **0** |

a/ Natural creeks can include Clear Creek, Cow Creek, Cottonwood Creek, Paynes Creek, Mill Creek, Deer Creek, and Butte Creek, depending on survey year.

**Central Valley fall Chinook experimental and net pen release types:**

CFHFn Coleman National Fish Hatchery fall bay/delta net pen releases
FRHFn Feather River Hatchery fall bay/delta net pen releases
FRHFgg Feather River Hatchery fall Golden Gate releases (no net pen acclimation)
NIMFn Nimbus Fish Hatchery fall bay/delta net pen releases
NIMFgg Nimbus Fish Hatchery fall Golden Gate releases (no net pen acclimation)
MOKFn Mokelumne River Hatchery fall bay/delta net pen releases
MOKFnp Mokelumne River Hatchery fall coastal net pen releases (Pillar Point)
MOKFns Mokelumne River Hatchery fall coastal net pen releases (Santa Cruz)
MOKFgg Mokelumne River Hatchery fall Golden Gate releases (no net pen acclimation)
MERFn Merced River Hatchery fall bay/delta net pen releases

| # | Release Type | Release Location |
|---|---|---|
| 1 | SacW | Lake Redding Park (Sac R) |
| 2 | SacW | Bonnyview Boat Ramp (Sac R) |
| 3 | SacWbat | Battle Creek |
| 4 | CFHF, CFHL | Coleman Fish Hatchery (Bat Cr) |
| 5 | CFHF | Scotty's Landing (Sac R) |
| 6 | CFHF | Butte City (Sac R) |
| 7 | FRHS | Gridley and Live Oak (Fea R) |
| 8 | FRHS, FRHF | Boyds Pump Boat Ramp (Fea R) |
| 9 | FRHF | Elkhorn Boat Ramp (Sac R) |
| 10 | FRHF | Yolo Bypass (Sac R) |
| 11 | NIMF | Sunrise Recreation Area (American R) |
| 12 | NIMF | Jibboom Street Bridge (American R) |
| 13 | MOKF | Mokelumne River Hatchery |
| 14 | MOKF | Woodbridge Dam (Mok R) |
| 15 | SJOSx | Fremont Ford Bridge (San Joaq R) |
| 16 | SJOSx | Friant Dam and Owl Hollow (San Joaq R) |
| 17 | MOKFn, MERFn | Sherman Island Net Pens (Delta) |
| 18 | FRHFn, NIMFn | Mare Island Net Pens (Bay) |
| 19 | FRFHn, NIMFn | Wickland Oil Net Pens (Bay) |
| 20 | CFHFn, FRHFn, NIMFn, MOKFn | Pt San Quentin (Bay) |
| 21 | FRHFgg, NIMFgg, MOKFgg | Trucked (via Fort Baker) |
| 22 | MOKFnc | Pillar Point Net Pens (Coastal) |
| 23 | MOKFnc | Santa Cruz Net Pens and Monterey Major Port (Coastal) |

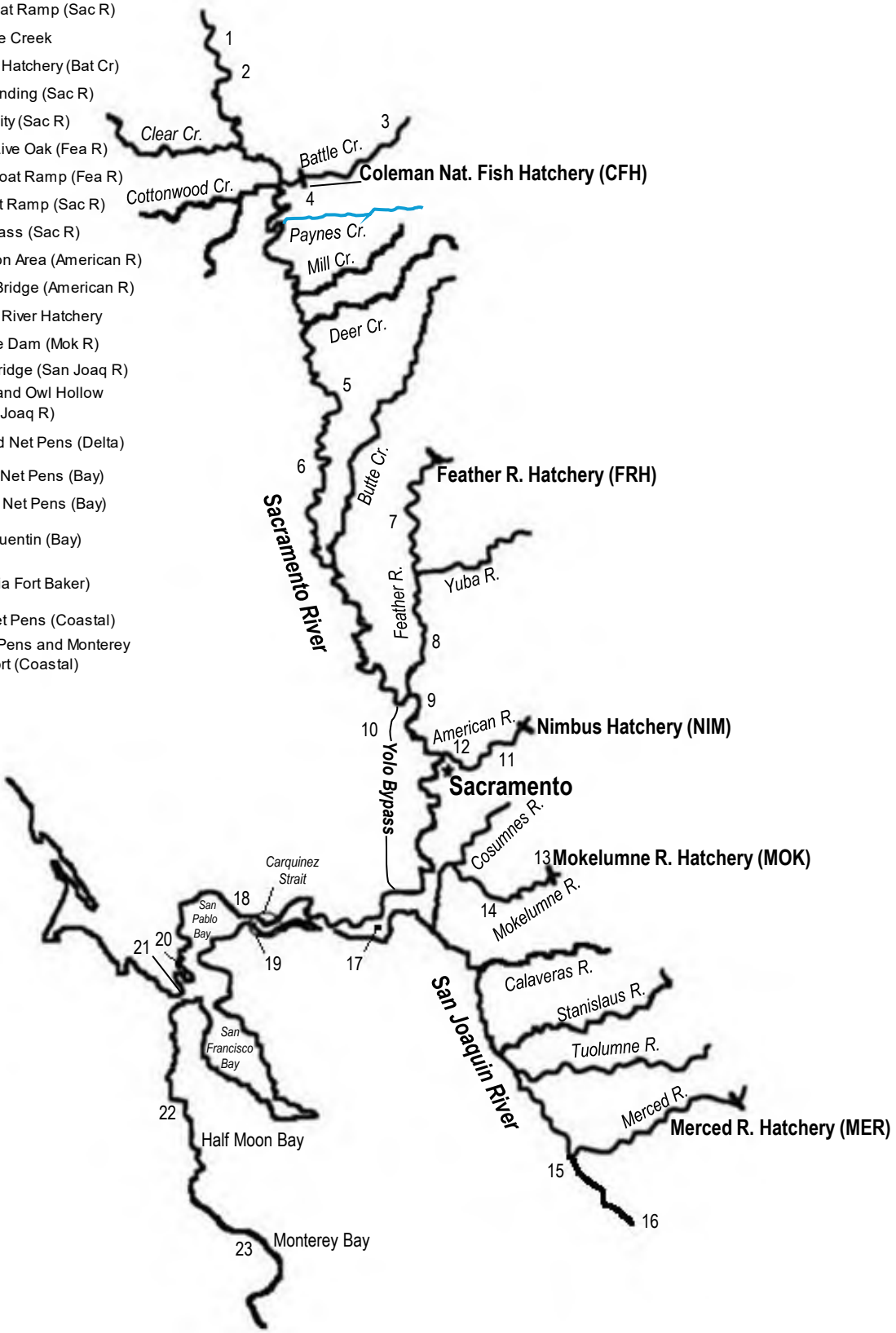



Figure 1. Map of release sites for CV hatchery release types, brood years 2017-2020.

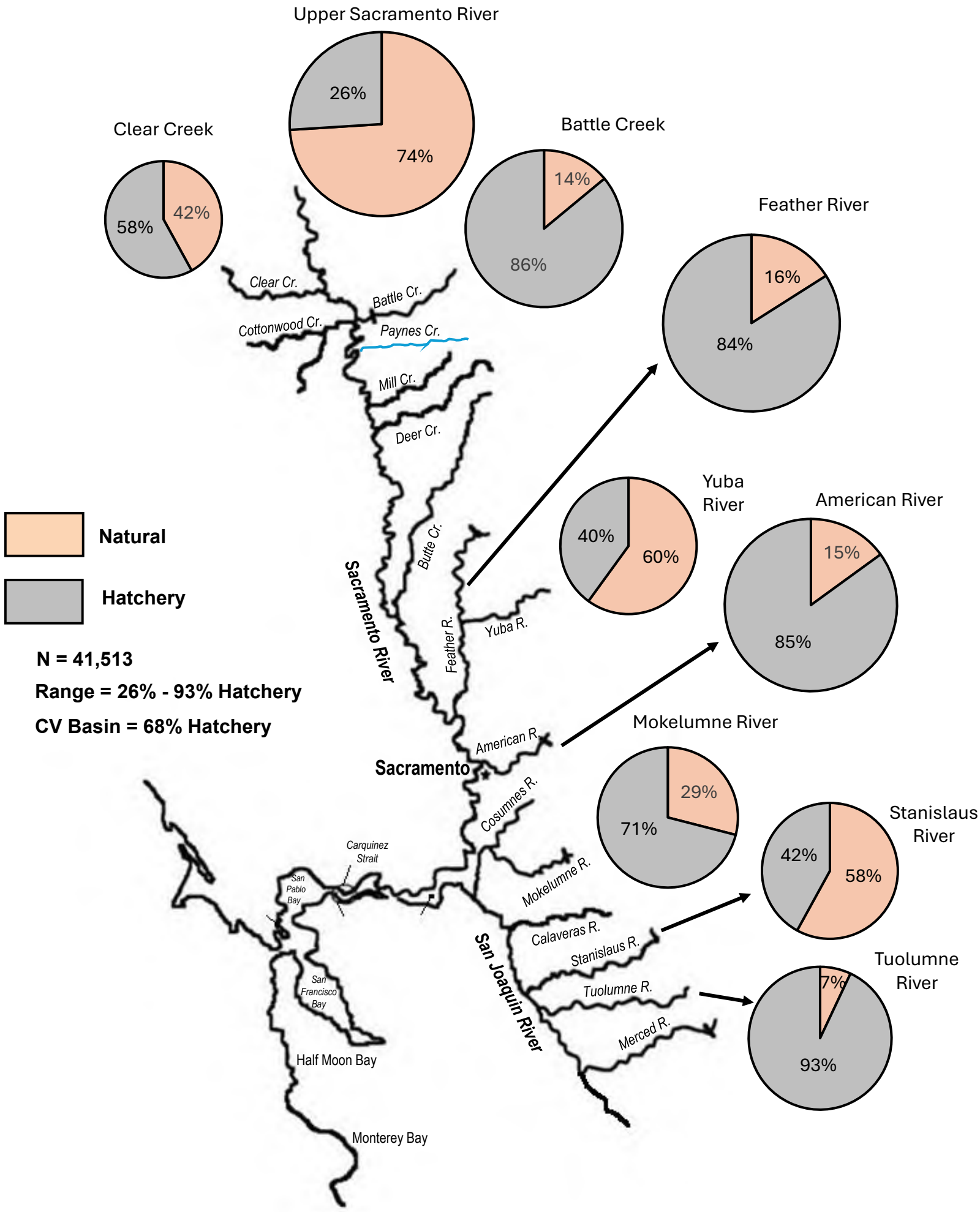



Figure 2. Fall-run CV natural area escapement, hatchery and natural proportions, 2022.

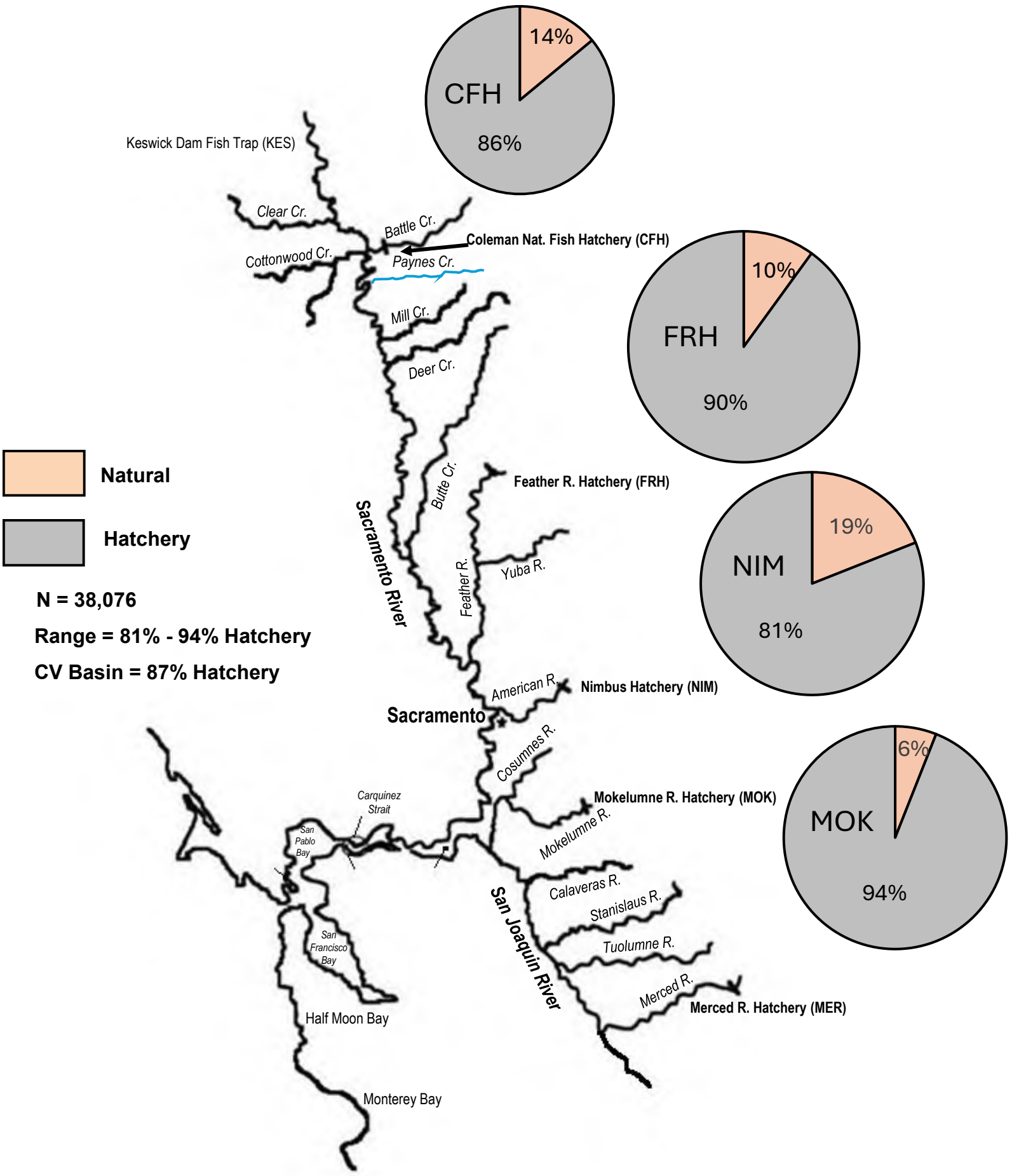



Figure 3. Fall-run CV hatchery escapement, hatchery and natural proportions, 2022.

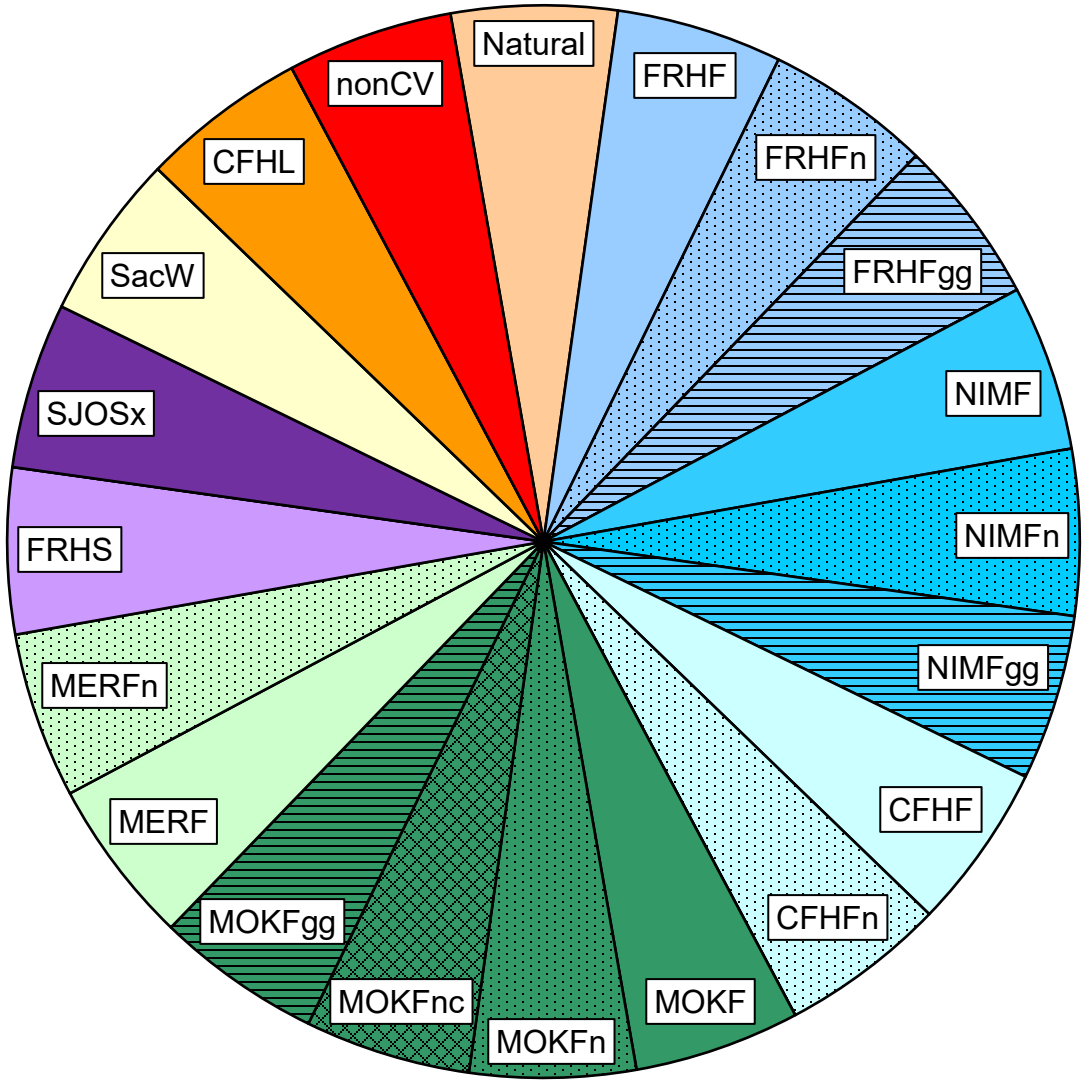



Figure 4. Color and pattern scheme used in all pie chart figures for Central Valley hatche
release types, brood years 2017-2020.

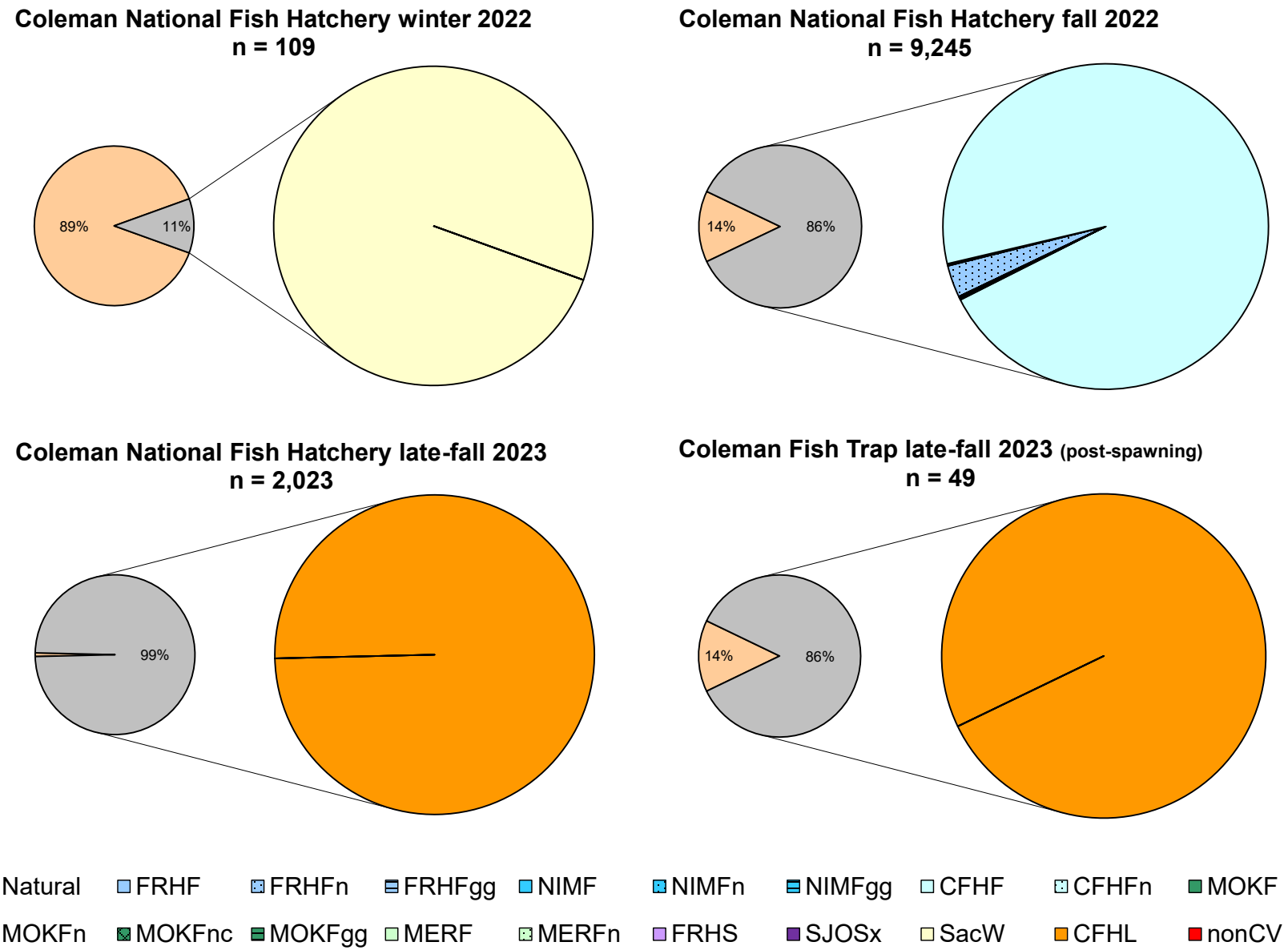



Figure 5. Proportion of hatchery- and natural-origin fish at Coleman National Fish Hatchery, 2022-23.

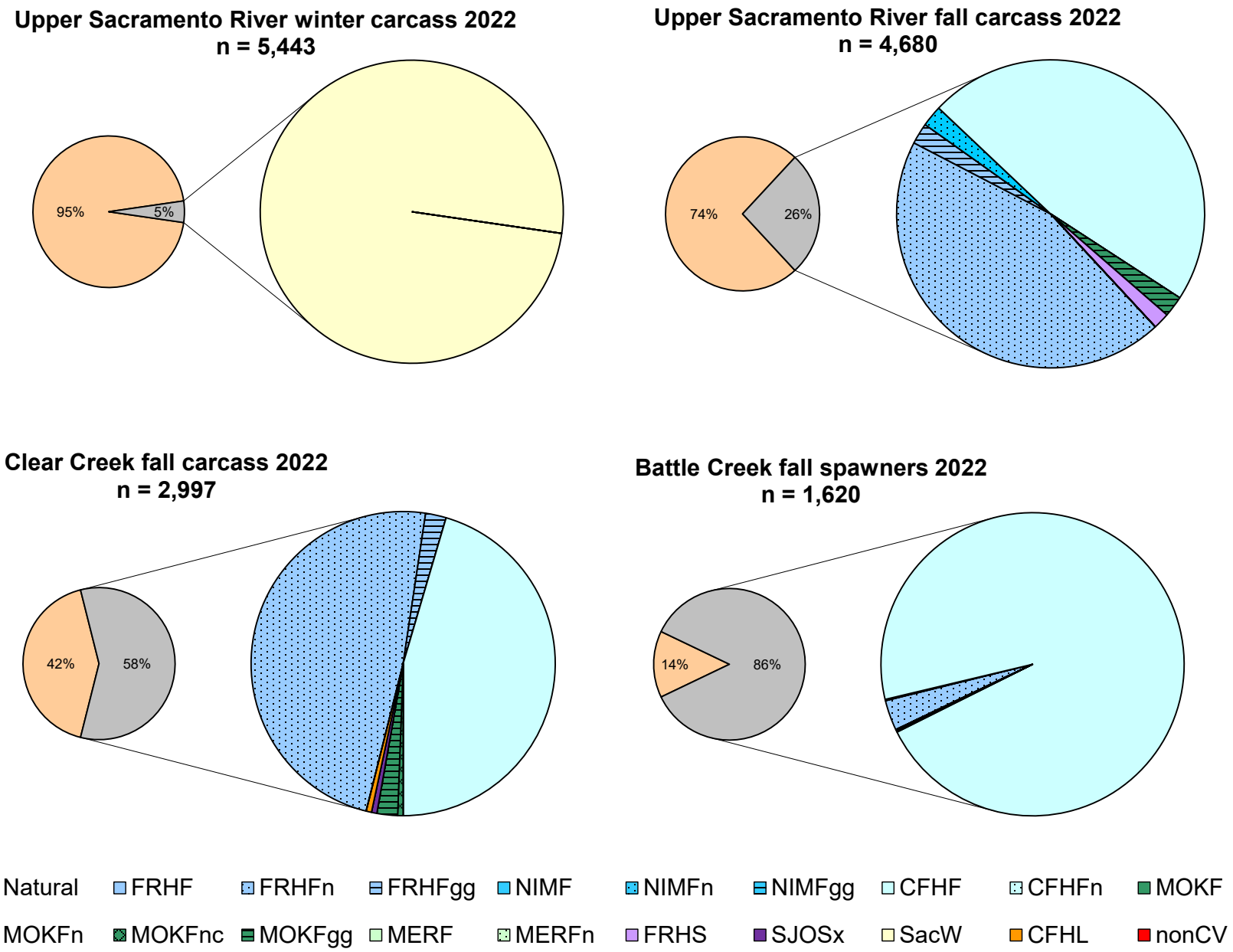



Figure 6. Proportion of hatchery- and natural-origin fish in Upper Sacramento River & tributaries, 2022-23.

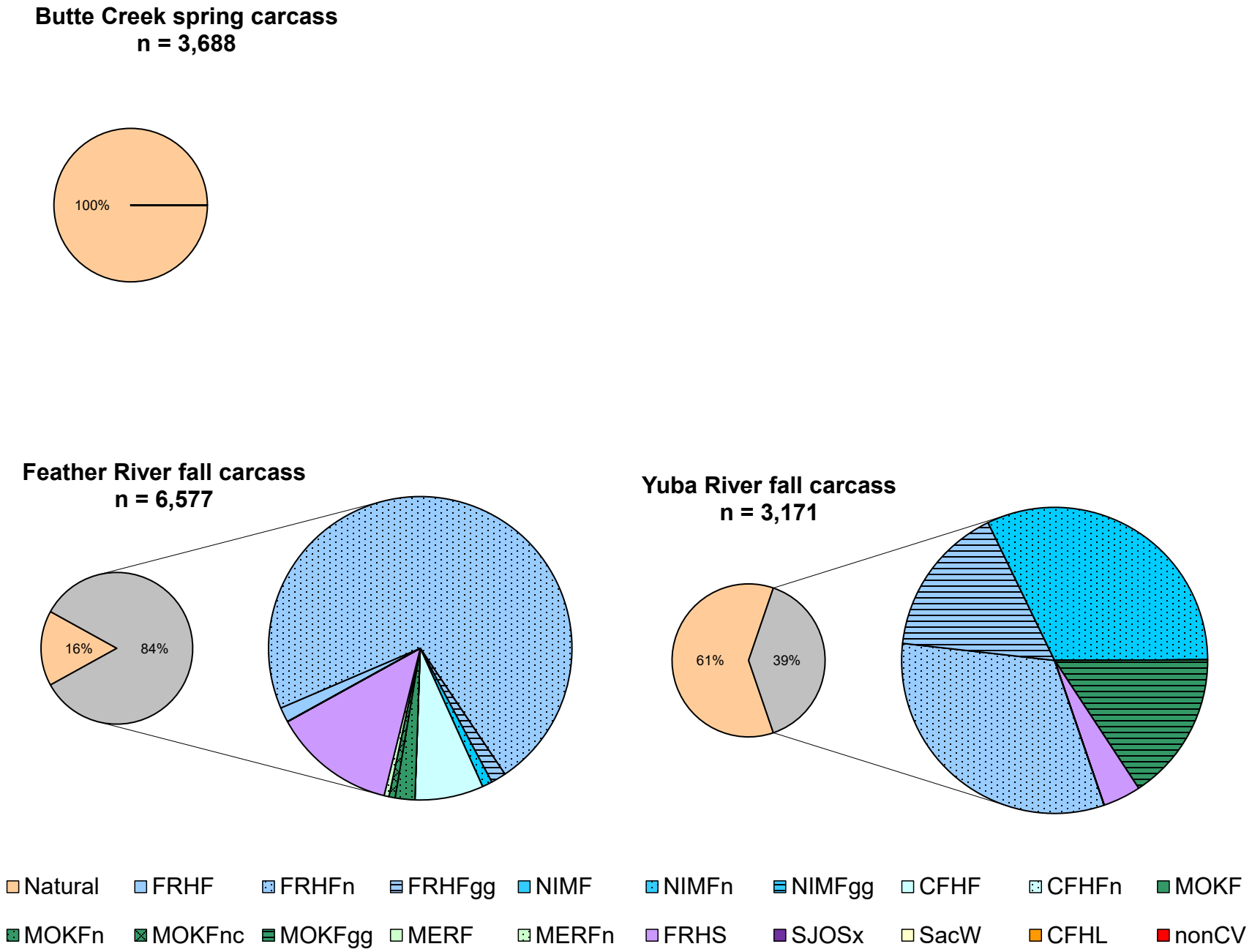



Figure 7. Proportion of hatchery- and natural-origin fish in Feather and Yuba River, 2022.

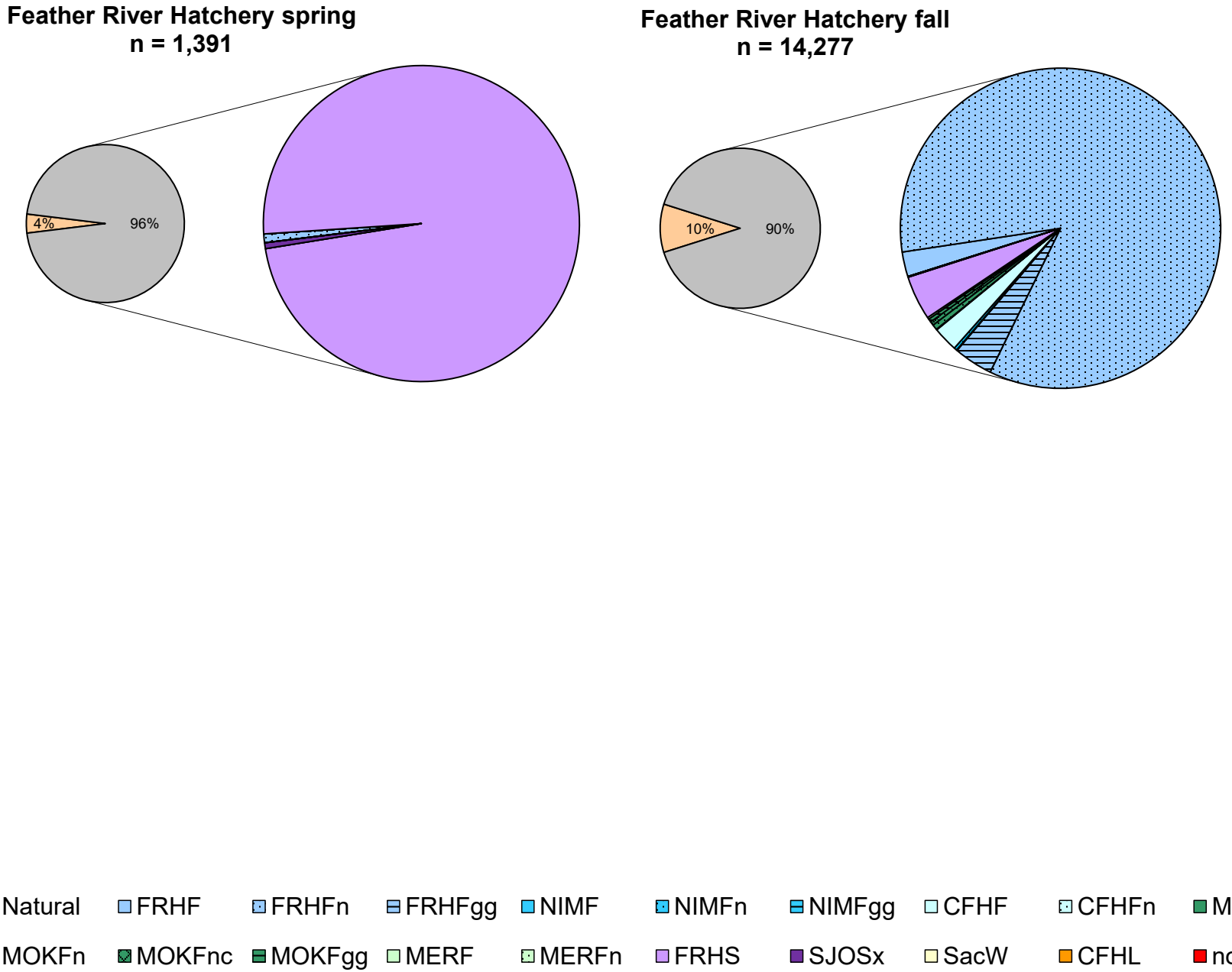



Figure 8. Proportion of hatchery- and natural-origin fish in the Feather River, 2022.

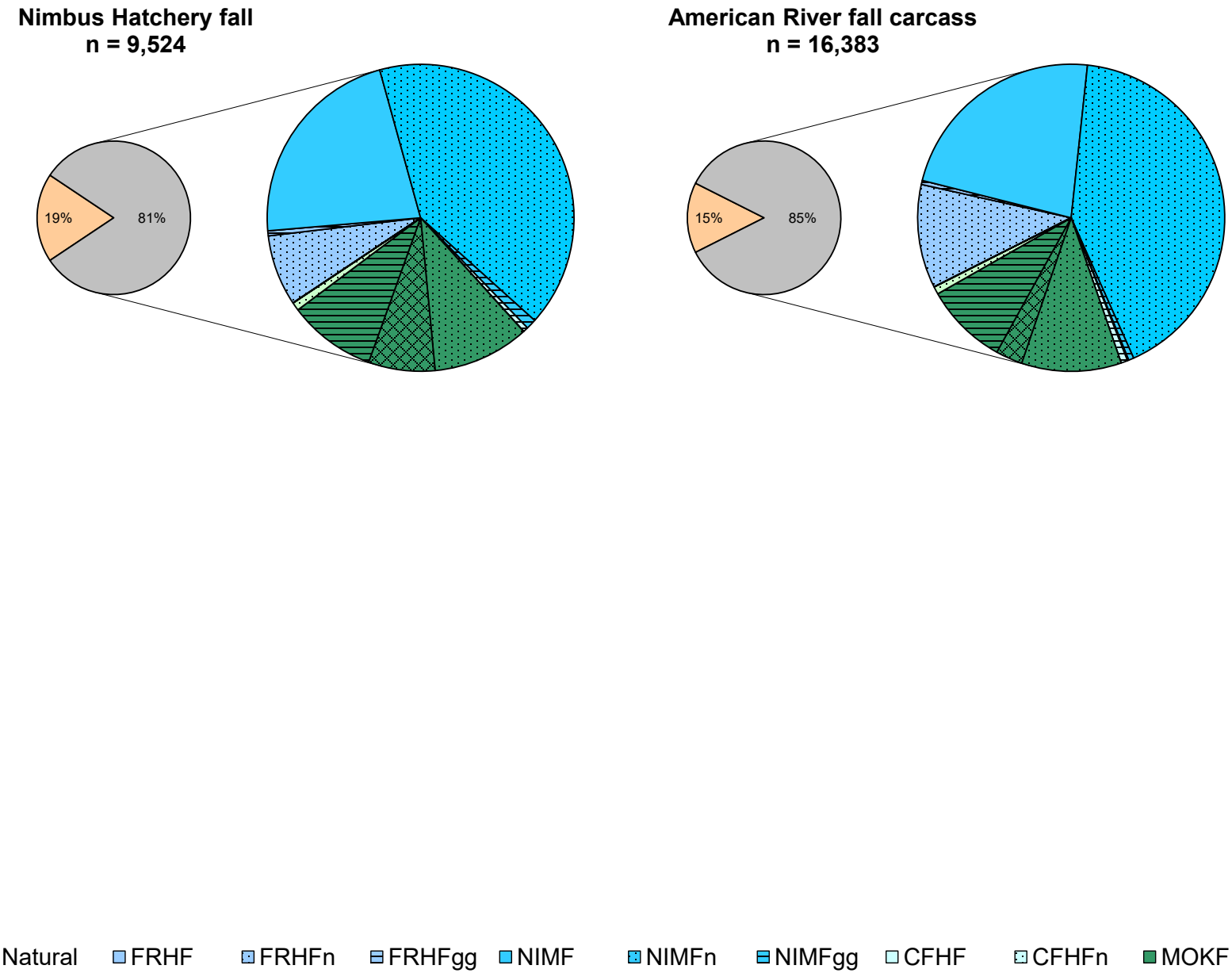



Figure 9. Proportion of hatchery- and natural-origin fish in the American River, 2022.

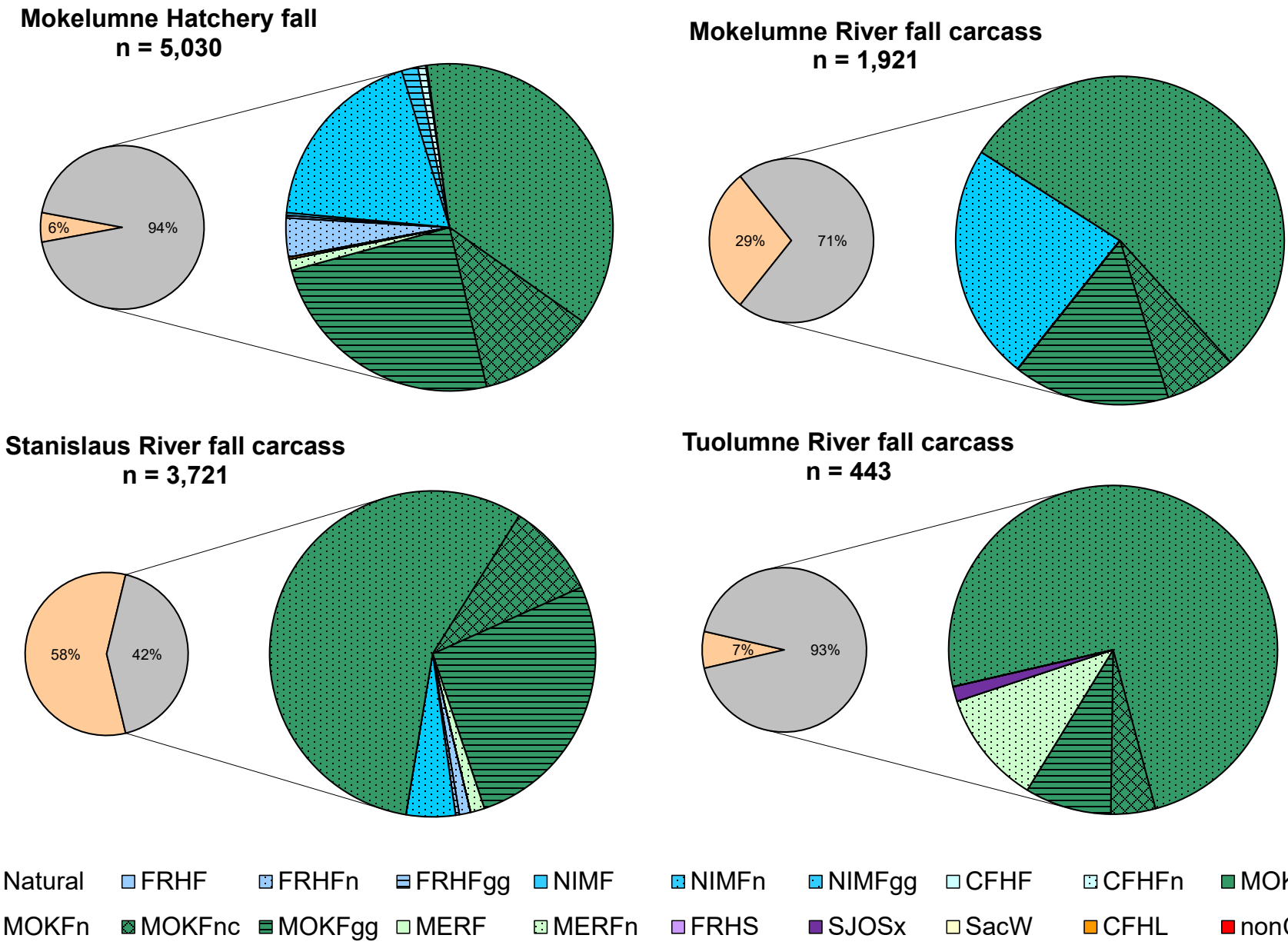



Figure 10. Proportion of hatchery- and natural-origin fish in the Mokelumne, Stanislaus, & Tuolumne rivers, 202

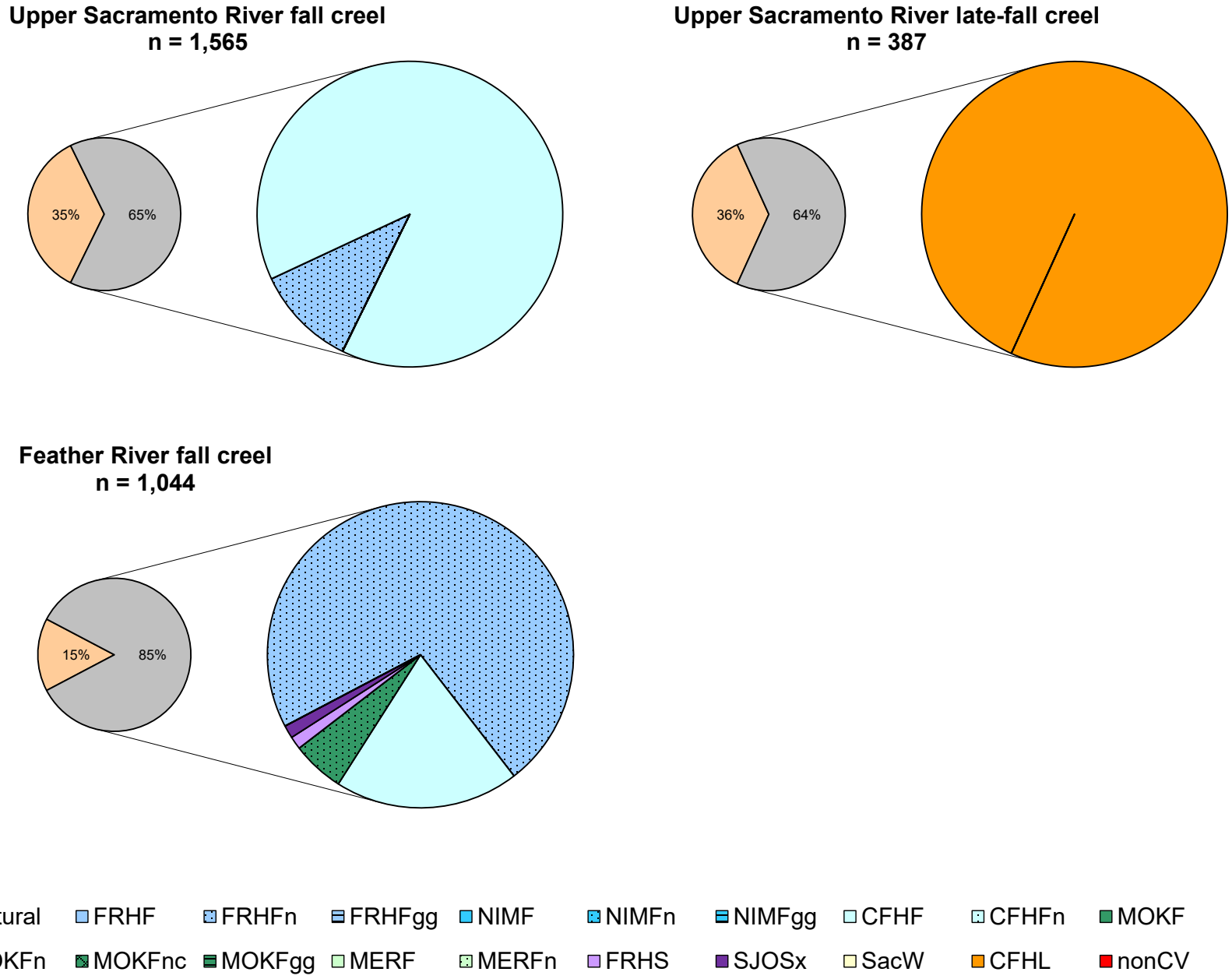
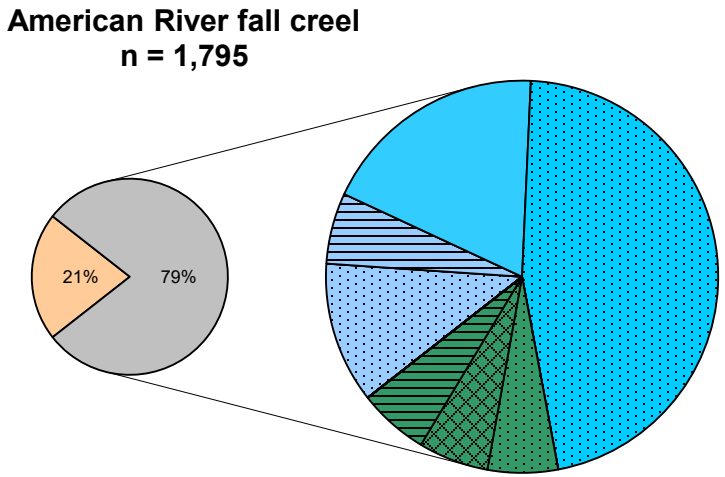
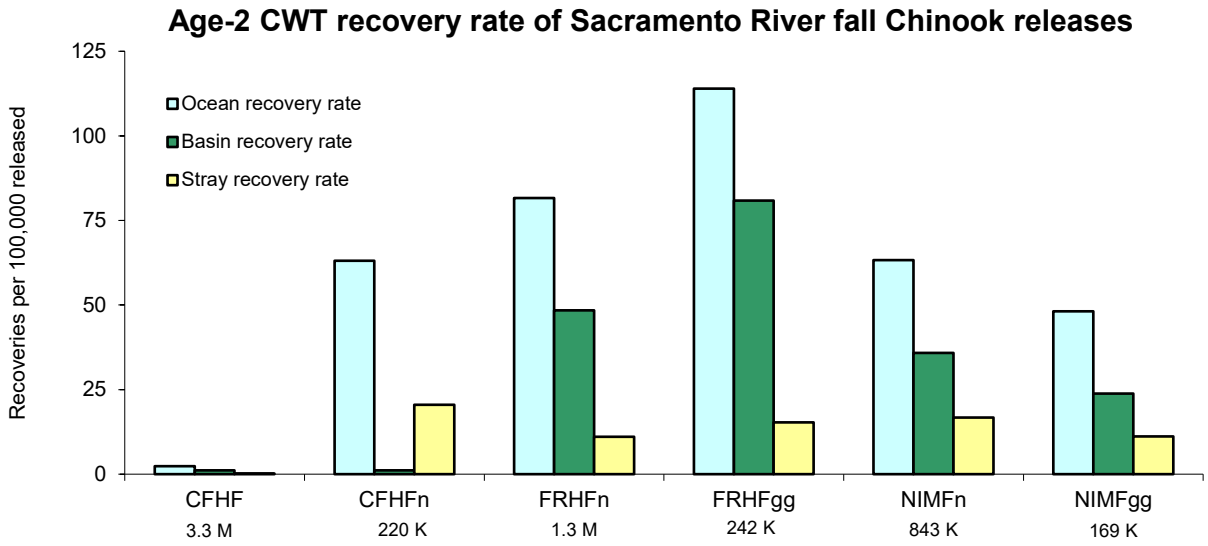


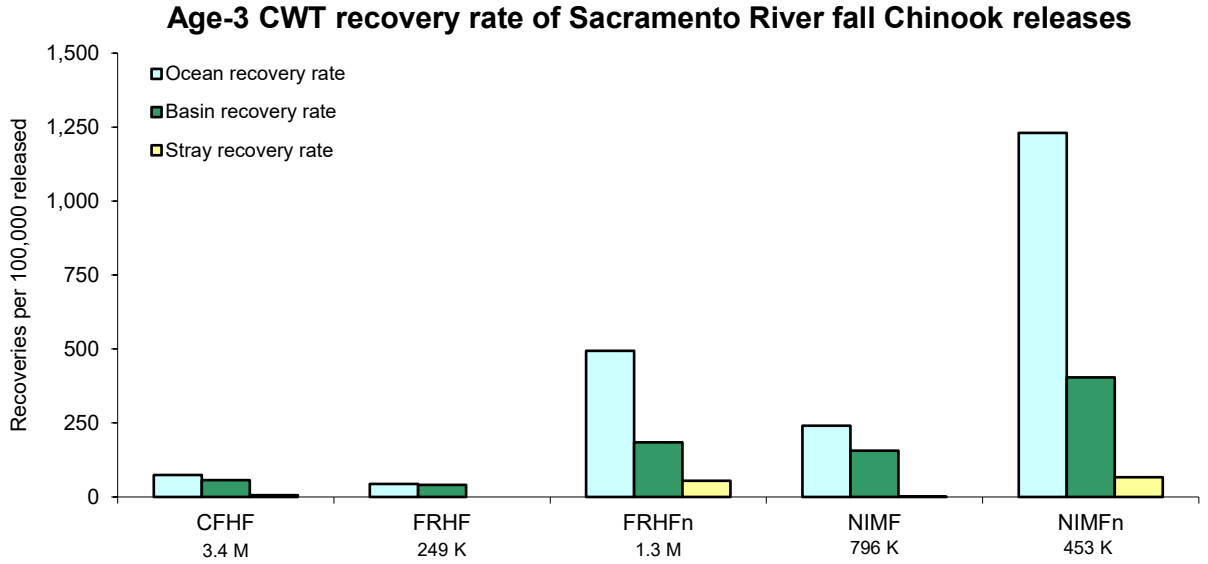

Figure 11. Proportion of hatchery- and natural-origin fish in sport harvest on the Sacramento & Feather Rivers, 2022.




Natural FRHF FRHFn FRHFgg NIMF NIMFn NIMFgg CFHF CFHFn MOKF
MOKFn MOKFnc MOKFgg MERF MERFn FRHS SJOSx SacW CFHL nonCV

Figure 12. Proportion of hatchery- and natural-origin fish in sport harvest on the American and Mokelumne Rivers, 2022.



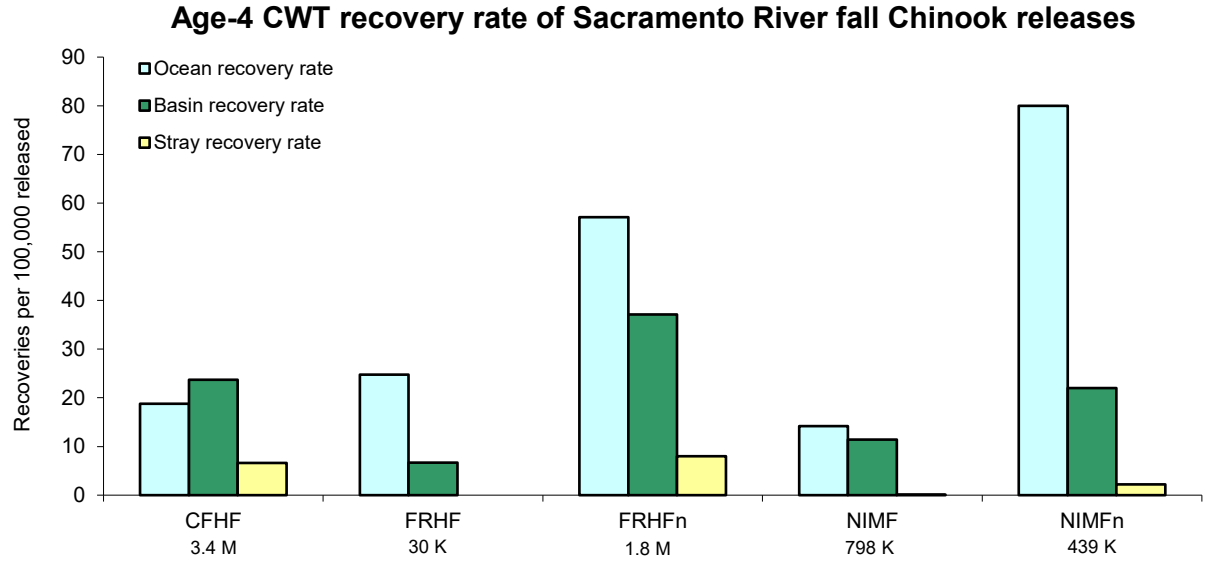




Figure 13. CWT recovery rates of Sacramento River fall Chinook releases by age in 2022.

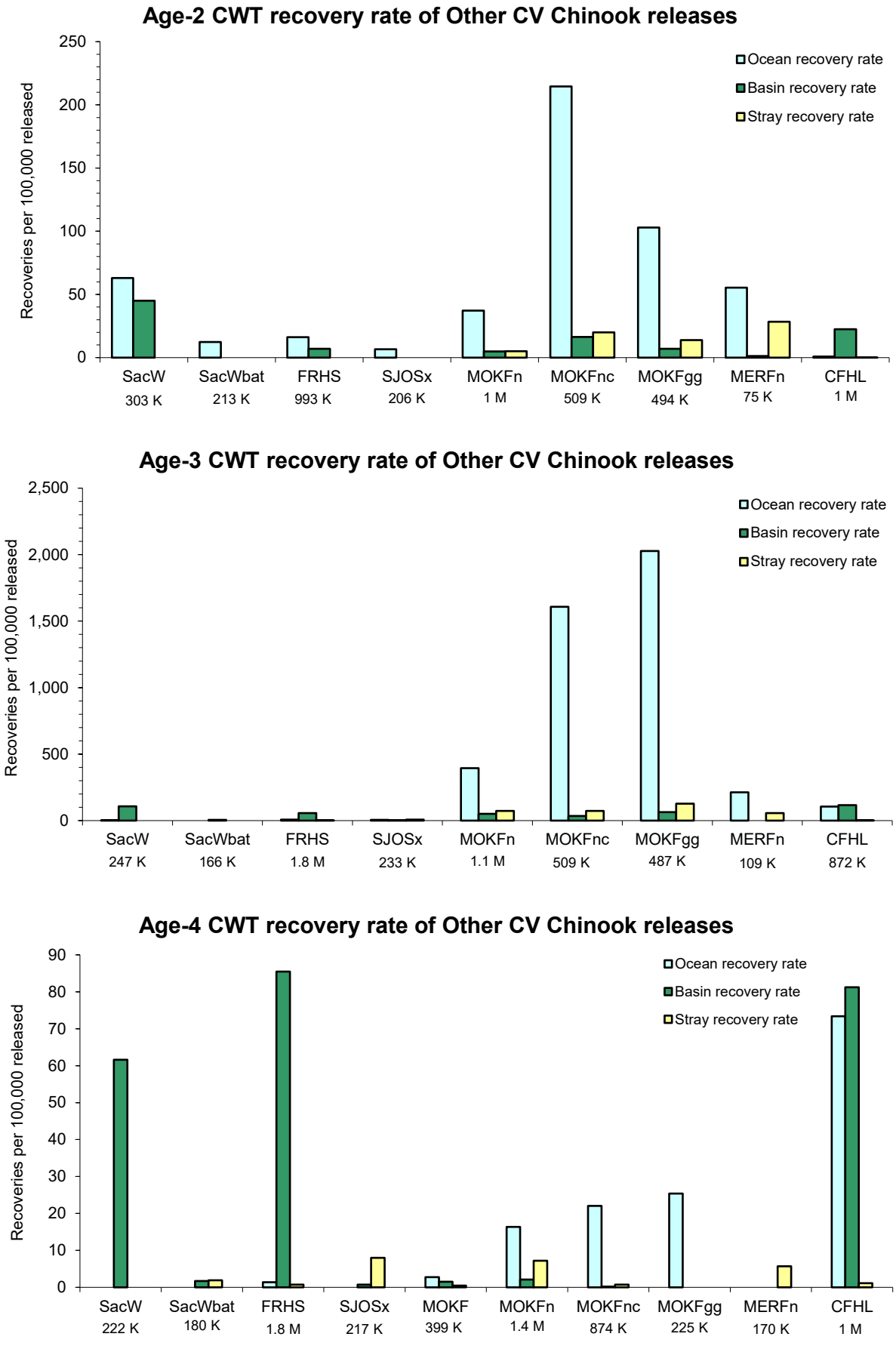



Figure 14. CWT recovery rates of Other CV Chinook releases by age in 2022.

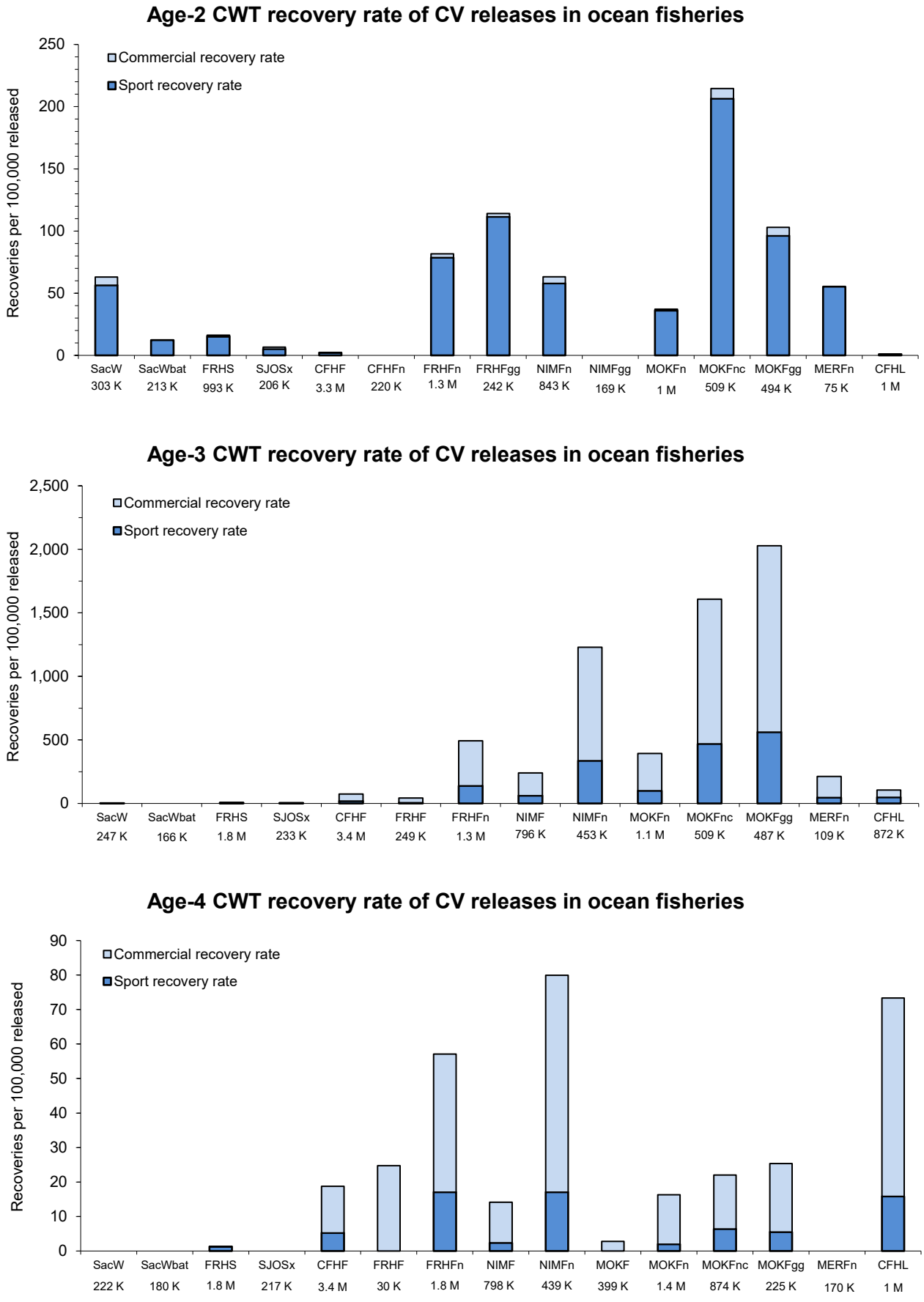



Figure 15. CWT recovery rates by release type in 2022 ocean salmon fisheries.

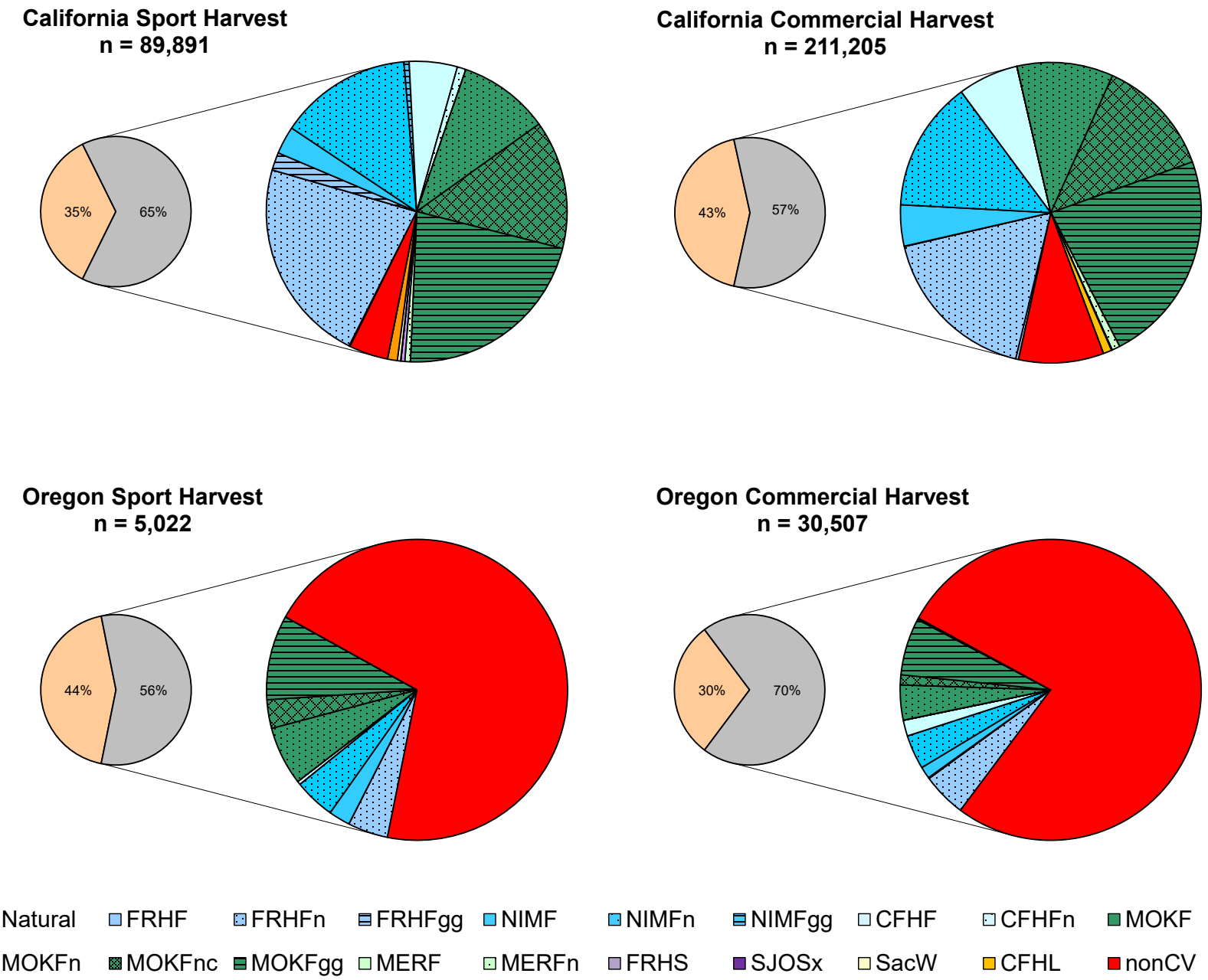



Figure 16. Proportion of hatchery- and natural-origin salmon in 2022 California and Oregon ocean fisheries.

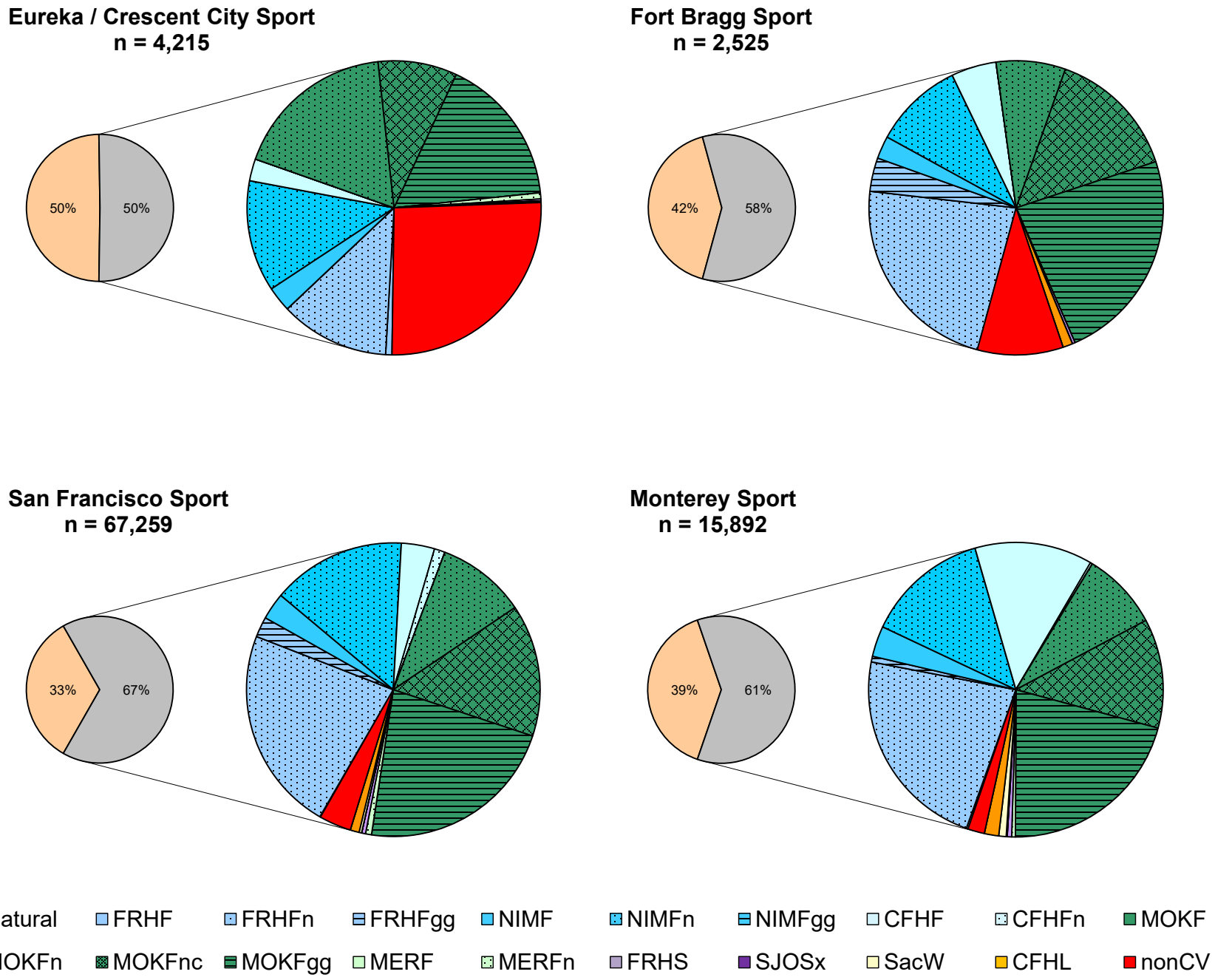



Figure 17. Proportion of hatchery- and natural-origin salmon in the 2022 California ocean sport fishery.

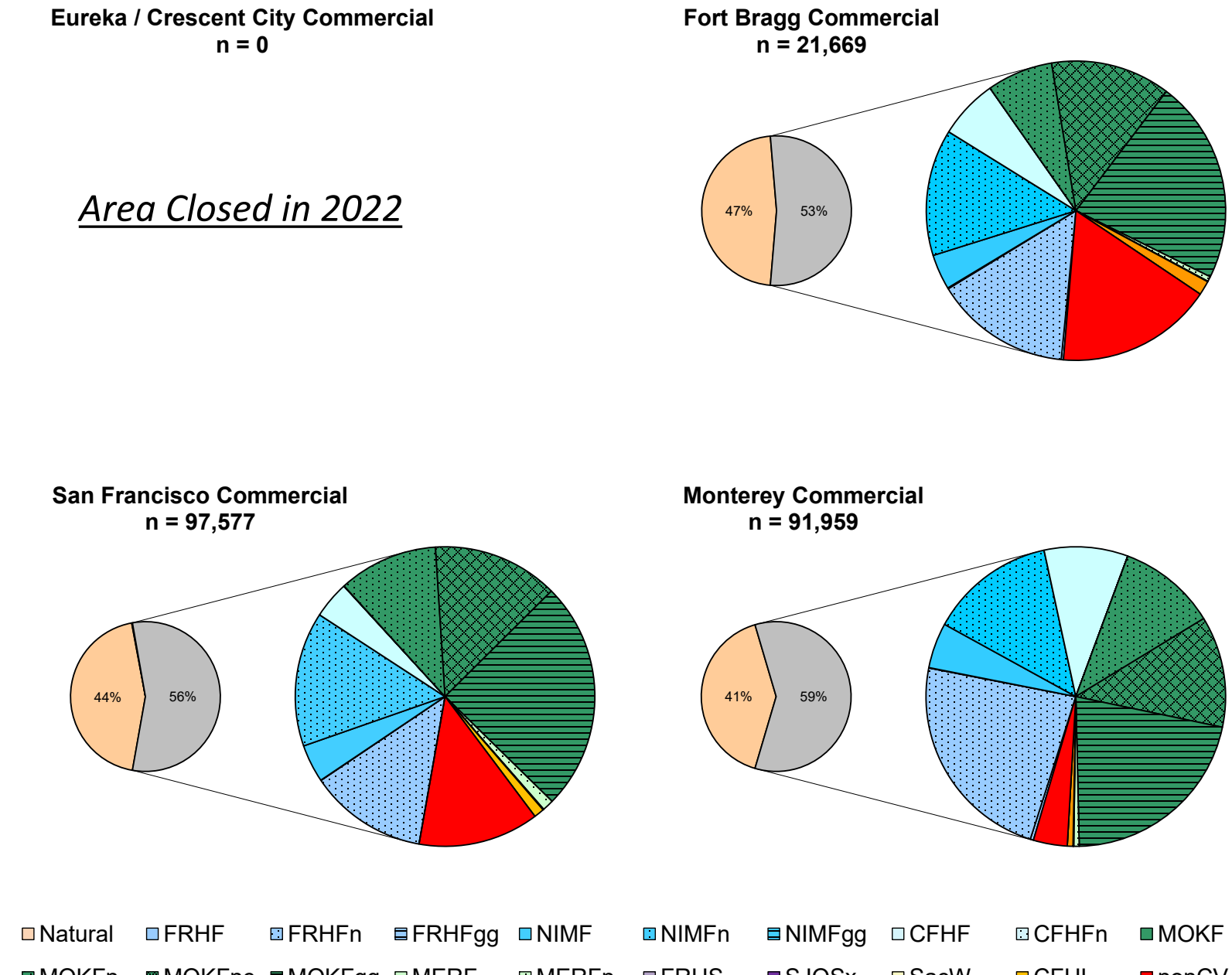



Figure 18. Proportion of hatchery- and natural-origin salmon in the 2022 California ocean commercial fishery.

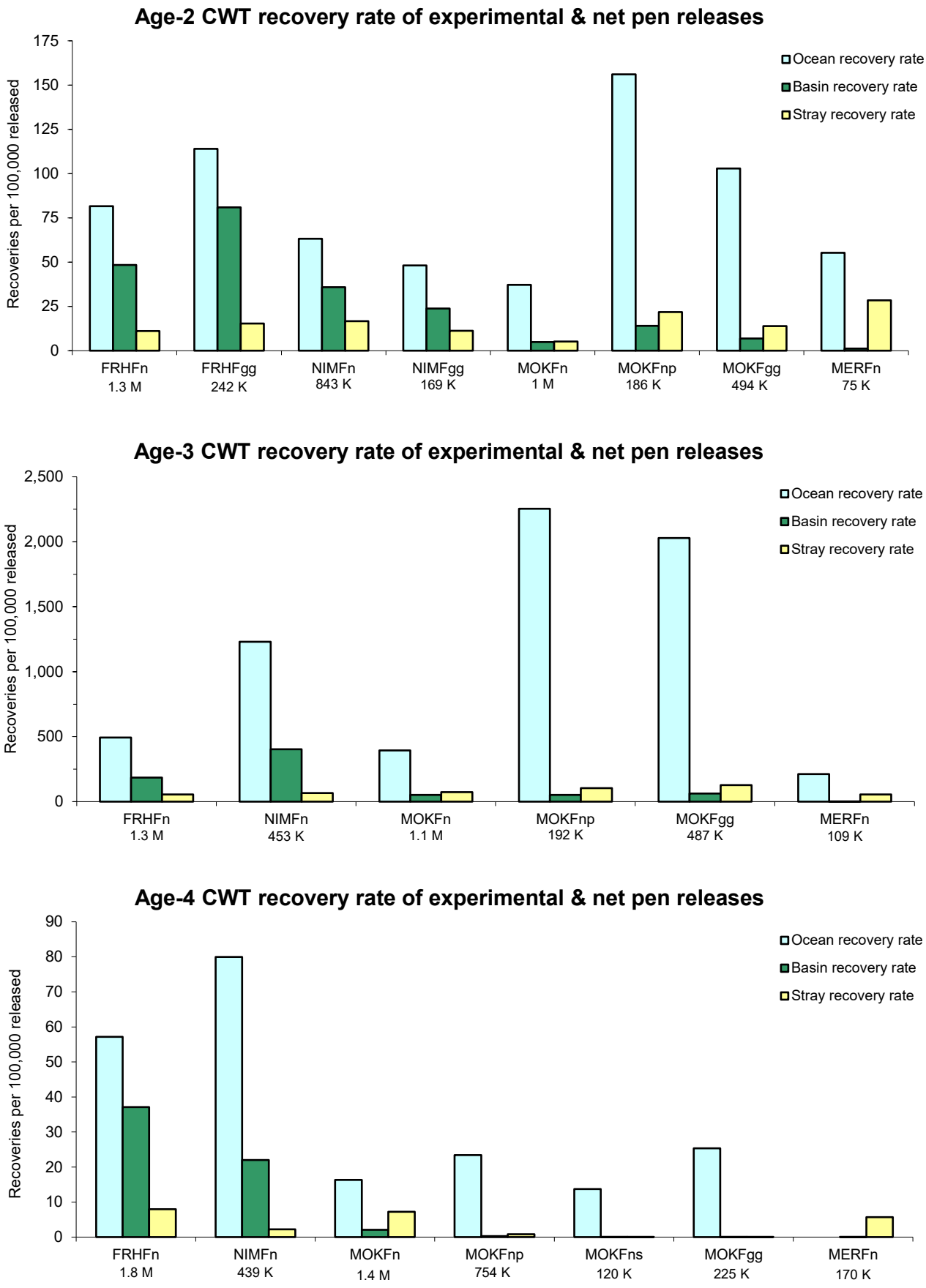



Figure 19. CWT recovery rates of experimental and net pen releases by age in 2022.

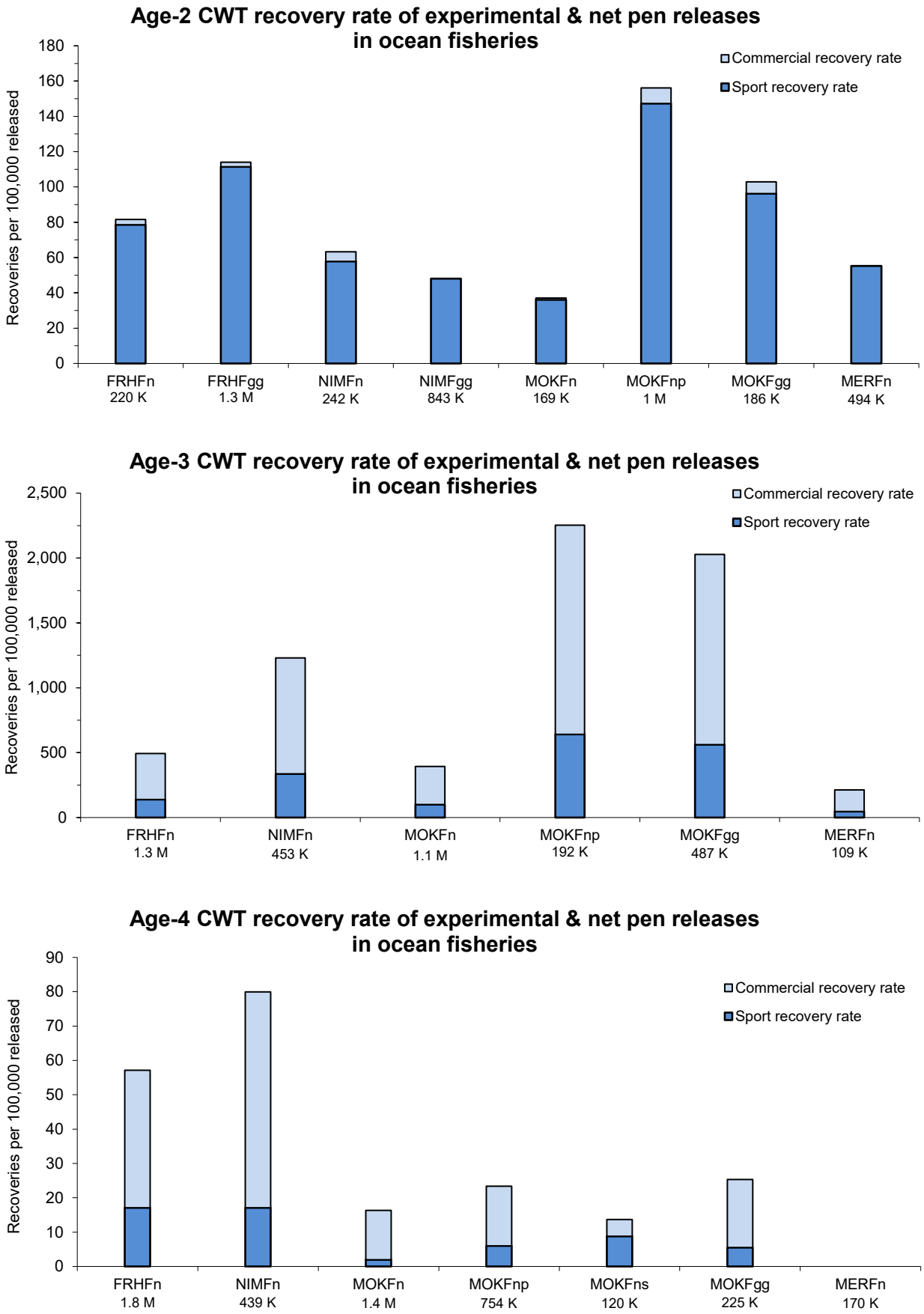



Figure 20. CWT recovery rates of experimental and net pen releases in 2022 ocean sport and commercial fisheries.

## Appendix 1. Sample expansion factors for Central Valley salmon carcass surveys collecting fish condition in 2022. (Page 1 of 2)

### Upper Sacramento River fall-run Chinook salmon carcass survey

| Condition | Escapement N | Chinook sampled (n) | Sample rate | Observed ad-clips | Ad-clips processed | CWTs recovered | Valid CWTs | *p_adc* | *p_cwt\|adc* | $F_{samp}$ | Avg $F_{prod}$ | $\sum_{i=1}^{m} CWT_{total,i}$ | % hatchery |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| fresh 37% | | 231 | 4.9% | 20 | 20 | 17 | 17 | **0.09** | **0.85** | 20.26 | 3.56 | 1,226 | 26% |
| non-fresh 63% | | 399 | 8.5% | 36 | 36 | 34 | 34 | 0.09 | 0.94 | | | | |
| total | **4,680** | 630 | 13.5% | 56 | 56 | 51 | **51** | | | **6.75** | **3.56** | **1,226** | **26%** |

### Clear Creek fall-run Chinook salmon carcass survey

| Condition | Escapement N | Chinook sampled (n) | Sample rate | Observed ad-clips | Ad-clips processed | CWTs recovered | Valid CWTs | *p_adc* | *p_cwt\|adc* | $F_{samp}$ | Avg $F_{prod}$ | $\sum_{i=1}^{m} CWT_{total,i}$ | % hatchery |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| fresh 93% | | 235 | 7.8% | 40 | 40 | 37 | 37 | **0.17** | **0.93** | 12.75 | 3.67 | 1,733 | 58% |
| non-fresh 7% | | 18 | 0.6% | 17 | 17 | 13 | 13 | 0.94 | 0.76 | | | | |
| total | **2,997** | 253 | 8.4% | 57 | 57 | 50 | 50 | | | **9.44** | **3.67** | **1,733** | **58%** |

### Feather River fall-run Chinook salmon carcass survey (only fresh fish sampled)

| Condition | Escapement N | Chinook sampled (n) | Sample rate | Observed ad-clips | Ad-clips processed | CWTs recovered | Valid CWTs | *p_adc* | *p_cwt\|adc* | $F_{samp}$ | Avg $F_{prod}$ | $\sum_{i=1}^{m} CWT_{total,i}$ | % hatchery |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| fresh 100% | | 915 | 13.9% | 276 | 273 | 265 | 265 | **0.30** | **0.97** | 7.27 | 2.87 | 5,521 | 84% |
| non-fresh | | | | | | | | | | | | | |
| total | **6,577** | 915 | 13.9% | 276 | 273 | 265 | **265** | | | **7.27** | **2.87** | **5,521** | **84%** |

### Yuba River fall-run Chinook salmon carcass survey (above and below DPD combined)

| Condition | Escapement N | Chinook sampled (n) | Sample rate | Observed ad-clips | Ad-clips processed | CWTs recovered | Valid CWTs | *p_adc* | *p_cwt\|adc* | $F_{samp}$ | Avg $F_{prod}$ | $\sum_{i=1}^{m} CWT_{total,i}$ | % hatchery |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| fresh 2% | | 64 | 2.0% | 7 | 7 | 7 | 7 | **0.11** | **1.00** | 49.55 | 3.61 | 1,253 | 40% |
| non-fresh | | | | | | | | | | | | | |
| total | **3,171** | 3,171 | 100.0% | 632 | 7 | 7 | **7** | | | **49.55** | **3.61** | **1,253** | **40%** |

### Stanislaus River fall-run Chinook salmon carcass survey (only fresh fish sampled)

| Condition | Escapement N | Chinook sampled (n) | Sample rate | Observed ad-clips | Ad-clips processed | CWTs recovered | Valid CWTs | *p_adc* | *p_cwt\|adc* | $F_{samp}$ | Avg $F_{prod}$ | $\sum_{i=1}^{m} CWT_{total,i}$ | % hatchery |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| fresh 100% | | 1,204 | 32.4% | 138 | 138 | 134 | 133 | **0.11** | **0.97** | 3.11 | 3.83 | 1,581 | 42% |
| non-fresh | | | | | | | | | | | | | |
| total | **3,721** | 1,204 | 32.4% | 138 | 138 | 134 | **133** | | | **3.11** | **3.83** | **1,581** | **42%** |

## Appendix 1. Sample expansion factors for Central Valley salmon carcass surveys collecting fish condition in 2022. (Page 2 of 2)

### Tuolumne River fall-run Chinook salmon carcass survey

| Condition | Escapement N | Chinook sampled (n) | Sample rate | Observed ad-clips | Ad-clips processed | CWTs recovered | Valid CWTs | *p_adc* | *p_cwt\|adc* | $F_{samp}$ | Avg $F_{prod}$ | $\sum_{i=1}^{m} CWT_{total,i}$ | % hatchery |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| fresh 64% | | 99 | 22.3% | 25 | 25 | 25 | 25 | **0.25** | **1.00** | 4.47 | 3.68 | 411 | 93% |
| non-fresh 36% | | 55 | 12.4% | 13 | 13 | 13 | 13 | 0.24 | 1.00 | | | | |
| total | **443** | 154 | 34.8% | 38 | 38 | 38 | **38** | | | **2.94** | **3.68** | **411** | **93%** |

### Upper Sacramento River winter-run Chinook salmon carcass survey

| Condition | Escapement N | Chinook sampled (n) | Sample rate | Observed ad-clips | Ad-clips processed | CWTs recovered | Valid CWTs | *p_adc* | *p_cwt\|adc* | $F_{samp}$ | Avg $F_{prod}$ | $\sum_{i=1}^{m} CWT_{total,i}$ | % hatchery |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| fresh 58% | | 855 | 15.7% | 50 | 50 | 39 | 37 | **0.06** | **0.78** | 6.71 | 1.01 | 250 | 5% |
| non-fresh 42% | | 608 | 11.2% | 44 | 44 | 35 | 35 | 0.07 | 0.80 | | | | |
| total | **5,443** | 1,463 | 26.9% | 94 | 94 | 74 | **72** | | | **3.45** | **1.01** | **250** | **5%** |

### Upper Sacramento River late-fall-run Chinook salmon carcass survey 2023

| Condition | Escapement N | Chinook sampled (n) | Sample rate | Observed ad-clips | Ad-clips processed | CWTs recovered | Valid CWTs | *p_adc* | *p_cwt\|adc* | $F_{samp}$ | Avg $F_{prod}$ | $\sum_{i=1}^{m} CWT_{total,i}$ | % hatchery |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| fresh 47% | | 66 | 5.9% | 5 | 5 | 5 | 4 | **0.08** | **1.00** | 21.14 | 1.45 | 123 | 11% |
| non-fresh 53% | | 74 | 6.6% | 3 | 3 | 3 | 3 | 0.04 | | | | | |
| total | **1,116** | 140 | 12.5% | 8 | 8 | 8 | **7** | | | **12.08** | **1.45** | **123** | **11%** |

*p_adc* = proportion of sampled fish that were ad-clipped; *p_cwt|adc* = proportion of ad-clipped fish containing CWTs

## Appendix 2. Alternative 2022 CWT recovery and stray rates (recoveries per 100,000 CWTs released) of CFH and FRH releases.[a/]

### Age-2 CWT recoveries

| Release | Brood | Run | # CWT | Central Valley total recoveries ($CWT_{samp}$) by basin | | | | | | | | | | $CV\ CWT_{samp}$ totals | | | % CV | Ocean | Recovery rate per 100K released | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| type | year | type | tagged | Bat Cr | Up Sac | Nat crks[b/] | Fea | Yub | Ame | Mok | Sta/Tuo | Mer | Up SJ | In-basin | Stray | CV total | Stray | $CWT_{samp}$ | In-basin | Stray | **CV total** | **Ocean** |
| CFHF | 2020 | Fall | 3,278,256 | 36 | | | 7 | | | | | | | 36 | 7 | 43 | 17% | 77 | 1 | 0 | 1 | 2 |
| CFHFn | 2020 | Fall | 219,750 | 2 | | | 2 | | 34 | 9 | | | | 2 | 45 | 48 | 95% | 139 | 1 | 21 | 22 | 63 |
| CFHL | 2021 | Late | 1,009,914 | 215 | 12 | | | | | 2 | | | | 215 | 14 | 229 | 6% | 9 | 21 | 1.4 | 23 | 1 |
| FRHFn | 2020 | Fall | 1,319,679 | 30 | 14 | 9 | 639 | | 75 | 18 | | 1 | | 639 | 147 | 786 | 19% | 1,077 | 48 | 11 | 60 | 82 |
| FRHFgg | 2020 | Fall | 241,688 | 2 | 7 | | 146 | 50 | 23 | 3 | 1 | | | 146 | 87 | 233 | 37% | 276 | 60 | 36 | 96 | 114 |
| FRHS | 2020 | Spr | 993,132 | | | | 69 | | | | | | | 69 | 0 | 69 | 0% | 160 | 7 | 0 | 7 | 16 |

### Age-3 CWT recoveries

| Release | Brood | Run | # CWT | Central Valley total recoveries ($CWT_{samp}$) by basin | | | | | | | | | | $CV\ CWT_{samp}$ totals | | | % CV | Ocean | Recovery rate per 100K released | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| type | year | type | tagged | Bat Cr | Up Sac | Nat crks[b/] | Fea | Yub | Ame | Mok | Sta/Tuo | Mer | Up SJ | In-basin | Stray | CV total | Stray | $CWT_{samp}$ | In-basin | Stray | **CV total** | **Ocean** |
| CFHF | 2019 | Fall | 3,352,800 | 1,858 | 61 | 28 | 180 | | | | | | | 1,858 | 269 | 2,127 | 13% | 2,493 | 55 | 8 | 63 | 74 |
| CFHL | 2020 | Late | 872,269 | 1,001 | 13 | | | | | 6 | | | | 1,001 | 19 | 1,020 | 2% | 919 | 115 | 2 | 117 | 105 |
| FRHF | 2019 | Fall | 248,810 | | | | 102 | | | | | | | 102 | 0 | 102 | 0% | 109 | 41 | 0 | 41 | 44 |
| FRHFn | 2019 | Fall | 1,335,074 | 39 | 122 | 224 | 2,363 | 99 | 322 | 22 | 4 | 3 | | 2,363 | 836 | 3,199 | 26% | 6,592 | 177 | 63 | 240 | 494 |
| FRHS | 2019 | Spr | 1,771,532 | | 7 | | 962 | 50 | | | | | | 962 | 56 | 1,019 | 6% | 134 | 54 | 3 | 57 | 8 |

### Age-4 CWT recoveries

| Release | Brood | Run | # CWT | Central Valley total recoveries ($CWT_{samp}$) by basin | | | | | | | | | | $CV\ CWT_{samp}$ totals | | | % CV | Ocean | Recovery rate per 100K released | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| type | year | type | tagged | Bat Cr | Up Sac | Nat crks[b/] | Fea | Yub | Ame | Mok | Sta/Tuo | Mer | Up SJ | In-basin | Stray | CV total | Stray | $CWT_{samp}$ | In-basin | Stray | **CV total** | **Ocean** |
| CFHF | 2018 | Fall | 3,448,504 | 709 | 108 | 197 | 26 | | 5 | | | | | 709 | 336 | 1,044 | 32% | 647 | 21 | 9.7 | 30 | 19 |
| CFHL | 2019 | Late | 1,031,542 | 789 | 48 | 9 | | | | 2 | | | | 789 | 60 | 849 | 7% | 757 | 77 | 6 | 82 | 73 |
| FRHF | 2018 | Fall | 30,000 | | | | 2 | | | | | | | 2 | 0 | 2 | 0% | 7 | 7 | 0 | 7 | 25 |
| FRHFn | 2018 | Fall | 1,772,613 | 5 | | 9 | 658 | | 122 | 5 | | | | 658 | 141 | 799 | 18% | 1,013 | 37 | 8 | 45 | 57 |
| FRHS | 2018 | Spr | 1,831,043 | | 14 | | 1,566 | | | | | | | 1,566 | 14 | 1,579 | 1% | 26 | 86 | 1 | 86 | 1 |

a/ CFH and FRH releases recovered in the Upper Sacramento River and Yuba River, respectively, are considered stray recoveries in this table.

b/ Natural creeks can include Clear Creek, Cow Creek, Cottonwood Creek, Paynes Creek, Mill Creek, Deer Creek, and Butte Creek, depending on survey year.

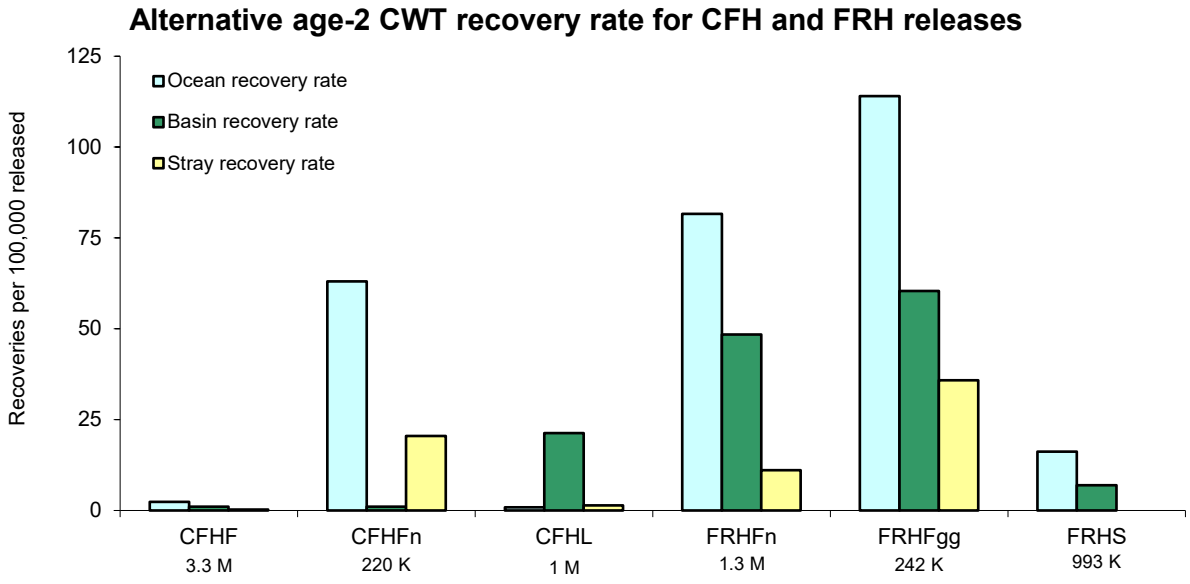
**Sacramento River fall Chinook release types (SFC)**

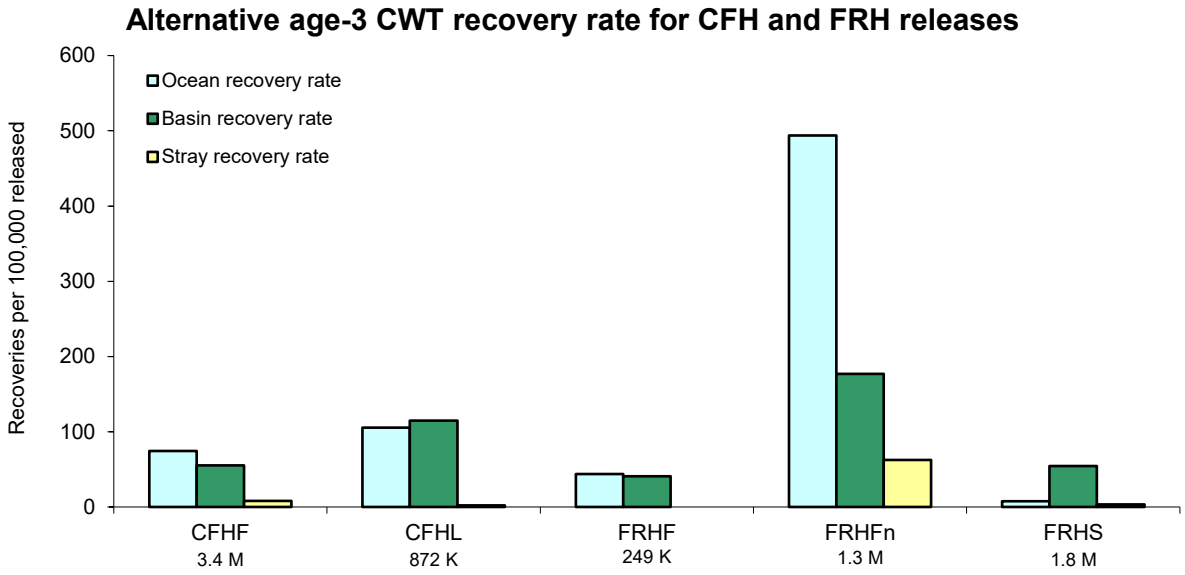
CFHF Coleman National Fish Hatchery fall in-basin releases
CFHFn Coleman National Fish Hatchery fall bay/delta net pen releases
FRHF Feather River Hatchery fall in-basin releases
FRHFn Feather River Hatchery fall bay/delta net pen releases
FRHFgg Feather River Hatchery fall Golden Gate releases (no net pens)

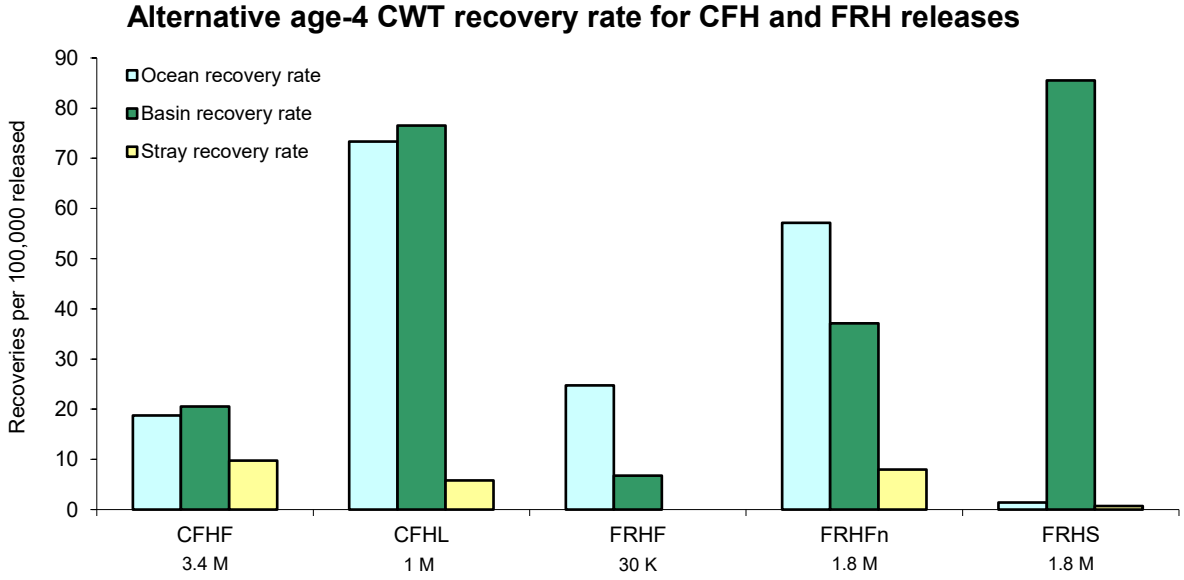
**Other CV Chinook release types (OCV)**

CFHL Coleman National Fish Hatchery late-fall in-basin releases
FRHS Feather River Hatchery spring in-basin releases

Appendix 3. Alternative CWT recovery rates for CFH and FRH releases by age in 2022.



Appendix 4. Sample expansion for CWTs recovered in the Mokelumne River above Woodbridge Dam (WD) in 2022.

| | Total count | Total ad-clips | % ad-clip |
|---|---|---|---|
| **Woodbridge Dam video** | 6,951 | 1,676 | 24.1% |
| **Mokelumne River Hatchery return** | 5,030 | 1,291 | 25.7% |
| **Mokelume River natural escapement** | **1,921** | **385** | 20.0% |

**Mokelume River natural area escapement above WD: Total video count minus hatchery return with supplemental carcass survey CWT data**

| Escapement N | Chinook sampled (n) | Sample rate | Observed ad-clips | Ad-clips processed | CWTs recovered | Valid CWTs | *p_adc* | *p_cwt\|adc* | $F_{samp}$ | Avg $F_{prod}$ | $\sum_{i=1}^{m} CWT_{total,i}$ | % hatchery |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1,921** | 1,921 | 100% | **385** | **29** | **28** | **28** | **0.200** | **0.966** | **13.28** | **3.69** | **1,372** | **71%** |
| Video count | | | Video count | | Carcass survey | | | | | | | |