Recovery of Coded-Wire Tags from Chinook Salmon in California's Central Valley Escapement, Inland Harvest, and Ocean Harvest in 2013

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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 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 fourth annual report on the recovery of CFM CWTs in the CV and ocean fisheries. In 2013, approximately 65,700 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 ocean salmon commercial and sport fisheries south of Cape Falcon (i.e., California and Oregon).

This report will focus primarily on the results of our 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 siblings released directly into the water? How are those same metrics impacted by transporting salmon down the Sacramento River using a vessel that exposes smolts to the river water as it goes?
- What are the relative recovery and contribution rates of hatchery-origin salmon, by run and release type, to the ocean and inland harvest?

Please see previous annual CFM reports (Kormos et al. 2012, Palmer and Kormos 2013, 2015) for more in-depth information and discussion regarding the CFM program, CWT marking and recovery programs in California, 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 (Killam et al. 2014).

DATA AND METHODS

Inland Escapement Monitoring

During 2013, monitoring of salmon escapement occurred at all five salmon hatcheries 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 2014 return year, however the escapement period began in late 2013.

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 surveys in 2013 adequately sampled (sample rate ≥ 20%) for ad-clipped fish.

There were approximately 216,500 salmon sampled, 51,600 ad-clipped salmon observed, and 37,200 heads collected by various CV projects. 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, U.S. Bureau of Reclamation, U.S. Fish and Wildlife Service (FWS), and the Yuba Accord River Management Team (YARMT). Most heads were processed by CDFW at their Santa Rosa and Sacramento CWT labs with the exception of heads collected at CFH, which were processed by FWS staff. A few hundred heads were collected and processed by CDFW projects in Red Bluff and La Grange.

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

Ocean Harvest Monitoring

In 2013, California sport and commercial ocean salmon fisheries (Table 2) continued to be less constrained than in the final years of the previous decade due to an increase in the ocean abundance forecast of both Sacramento River and Klamath River fall-run Chinook salmon. CDFW field staff sampled 135,000 salmon and collected 22,800 heads that were processed by the Santa Rosa CWT lab. An additional 8,900 heads collected in 2013 Oregon ocean sport and commercial fisheries are also included in the analyses since Sacramento River fall Chinook is the primary stock harvested in fisheries south of Cape Falcon (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 2013 inland and ocean CWT recoveries are publicly available at www.rmpc.org.

CWT Data Analysis

A “master” release database of CWT codes recovered in 2013 was created to determine species, brood year, run, stock origin (hatchery or natural), release site, release date(s), number of salmon CWT tagged, total number of salmon released, and any other pertinent release information (e.g., trucked, net pen acclimation, disease). Since almost all CV salmon recovered are between the

ages of two and five, all CWT release data for Chinook salmon brood years 2008 through 2011 was downloaded from the RMPC. Approximately 137 million CV salmon were released for these brood years (BY), of which 48 million were marked and tagged utilizing 545 unique CWT codes. Although a few thousand natural-origin salmon are trapped, marked, and tagged each year, salmon produced by hatcheries make up more than 99% of all CWT releases. In 2013, there were 294 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 (e.g., barge study) 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,

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

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.

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 holding strategy. All CV CWT codes were assigned by brood year into one of fourteen fall-run release types, two spring-run release types, one winter-run release type, and one late-fall-run release type:

Sacramento River Basin fall-run Chinook salmon release types

CFHFh	Coleman National Fish Hatchery fall-run **h**atchery releases (in-basin)
CFHFn	Coleman National Fish Hatchery fall-run bay **n**et pen releases (San Pablo Bay)
FRHFb	Feather River Hatchery fall-run **b**arge study releases
FRHFe	Feather River Hatchery fall-run **e**xperimental releases
FRHFn	Feather River Hatchery fall-run bay **n**et pen releases (San Pablo Bay)
FRHFnc	Feather River Hatchery fall-run **c**oastal **n**et pen releases (Santa Cruz and Pillar Point)
FRHFtib	Feather River Hatchery fall-run **Tib**uron net pen releases (held several months)
NIMF	Nimbus Fish Hatchery fall-run in-basin releases
NIMFn	Nimbus Fish Hatchery fall-run bay **n**et pen releases (San Pablo Bay)

San Joaquin River Basin fall-run Chinook salmon release types

MOKF	Mokelumne River Hatchery fall-run in-basin releases
MOKFn	Mokelumne River Hatchery fall-run bay **n**et pen releases (Sherman Island)
MOKFt	Mokelumne River Hatchery fall-run **t**rucked releases (no net pen acclimation)
MERF	Merced River Hatchery in-basin fall-run releases
MERFt	Merced River Hatchery fall-run **t**rucked releases (no net pen acclimation)

Central Valley spring-run Chinook salmon release types

FRHS Feather River Hatchery spring-run in-basin releases
FRHSn Feather River Hatchery spring-run bay **n**et pen releases

Sacramento River winter-run Chinook salmon release types

SacW Sacramento River winter-run supplementation natural production in-basin releases

Central Valley late-fall Chinook salmon release types

CFHLh Coleman National Fish Hatchery late-fall-run **h**atchery releases (in-basin)

Note that not all release types occur every year and that release sites sometimes vary within a given release type (Table 3; Fig. 1). There were also a few problem CWT releases where fish were released utilizing multiple strategies (e.g., 25% of BY 2010 MOKFt acclimated in net pens prior to release, 15% of BY 2011 FRHFn released directly into bay). Thus, we urge caution when analyzing or comparing CWT recovery data from these 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,

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

where f_e is the fraction of the total salmon escapement 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 be inconsistent among surveys, the ad-clip rate of fresh salmon sampled in 2013 was generally higher than the rate observed in non-fresh fish (Appendix 1). Fresh carcass heads also contained CWTs at a slightly higher rate than heads collected from non-fresh fish. Furthermore, the sample sizes between fresh and non-fresh fish are very different; the sampled number of non-fresh salmon (n=34,642) is much greater than fresh salmon (n=7,469).

Mohr and Satterthwaite (2013) demonstrated how the sampling differences noted above could negatively bias the estimates of hatchery contribution. They also 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 bias associated with these surveys:

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

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 only by their respective production factor, F_{prod}
CWT_{samp} = CWT recoveries expanded only 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_{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:

Estimate of natural-origin salmon = 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:

$R_{cwt} = \sum_{j=1}^{l} CWT_{samp,j}$ recoveries / (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 were combined and an overall release type-specific CV recovery rate, R_{type}, was calculated as:

$R_{type} = \sum_{j=1}^{l} \sum_{k=1}^{n} CWT_{samp,j,k}$ / ($\sum_{k=1}^{n}$ 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, Palmer-Zwahlen and Kormos 2013, 2015), basin-of-origin is defined as the drainage of any major river as it pertains to the geographic region of the CV where a hatchery is located. The CV is divided into five hatchery

basins: upper Sacramento River (including Battle Creek), Feather River (including the Yuba River), American River, Mokelumne River, and Merced River. Hatchery-origin salmon not returning to their basin-of-origin or to streams or rivers not included in any hatchery basin (e.g., Mill Creek, Butte Creek, Stanislaus 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 2013 CV inland recoveries and California ocean harvest

All except one of the 36,060 valid CWTs recovered in the CV during 2013 were from CV Chinook salmon releases. Most CWTs were brood year 2009 through 2011 releases (Table 6). More than 87% of all CWT_{total} recoveries were fall-run, followed by spring-run (10%), and late-fall-run (2%) salmon releases. Only 0.1% of all CWT_{total} recovered were winter-run, all of which were collected in their upper Sacramento River escapement survey. The lone non-CV salmon was recovered at Mokelumne Hatchery (age-2 fall-run Chinook salmon from Iron Gate Hatchery on the Klamath River). The majority of fall-run CWT_{total} recovered in the CV were age-3 (78%), age-4 (15%), and age-2 (6%) fish (Table 6).

Most of the 21,143 valid CWT recoveries in the 2013 California ocean harvest were CV salmon releases belonging to brood years 2009 through 2011 (Table 7). Approximately 86% of all CWT_{total} in the ocean harvest were CV fall-run, followed by CV spring-run (2%), CV late-fall-run (1%), and CV winter-run (0.1%) salmon. The remaining 11% of California ocean CWT recoveries originated from the Klamath-Trinity Basin in northern California and Oregon coastal streams. The majority of the hatchery-origin fish in the California harvest were age-3 (84%) and age-4 (14%) fish.

Like California, most of the 8,491 valid CWT recoveries in the 2013 Oregon ocean harvest were CV salmon releases (Table 8). Approximately 77% of all CWT_{total} in the ocean harvest were CV fall-run salmon. Non-CV stocks made up 20% of the harvest with most originating from the

Columbia River Basin, coastal streams in Oregon, and the Klamath-Trinity Basin. The majority of the hatchery fish in the Oregon harvest was age-3 (82%) and age-4 (17%) fish.

1. Proportion of hatchery- and natural-origin salmon in CV escapement

Almost 321,000 fall-run Chinook salmon returned to spawn in natural areas during 2013 and the proportion of hatchery-origin salmon varied throughout the CV. The lowest hatchery proportion occurred in Deer Creek (4%) while the highest proportion (90%) occurred in Battle Creek (Table 9, Fig. 2); however, Battle Creek is an "approximated" value since there has not been a carcass survey or CWT recovery program conducted in this waterway since 2005. The hatchery contribution and release type composition in Battle Creek is assumed to be equivalent to the hatchery fall-run return sampled at CFH (K. Niemela, FWS, pers. comm.). The total fall-run hatchery proportion for all natural areas surveyed in the CV was 69%.

The hatchery proportion of the 116,800 fall-run salmon returning to the five CV hatcheries ranged from 63% to 97% (Table 9, Fig. 3). Both the spring-run return to FRH and the late-fall-return to CFH were 99% hatchery-origin salmon. The fall-run hatchery proportion for all CV hatcheries combined was 90%.

To help facilitate the breakout of the hatchery proportion, all CV release types from the same stock, run, and hatchery are the same shade of color in the pie charts (Fig. 4): Blue = Sacramento River Basin fall-run releases, Green = San Joaquin Basin fall-run releases, Purple = Central Valley (FRH) spring-run releases, Yellow = Sacramento River winter-run releases, and Orange = Central Valley (CFH) late-fall-run releases. All bay net pen releases contain black dots while net pen coastal releases are designated with a criss-cross pattern. All Tiburon and trucked releases are designated with black stripes.

Upper Sacramento River Basin

At CFH, sampling of the fall-run return began in early October and continued through early December 2013 (Table 10). Due to the high number of ad-clipped salmon, marked fish were subsampled through mid-November. After a temporal break, CFH began late-fall sampling (100%) in late December and continued through early March 2014. Based solely on this run-timing, 70,324 salmon returned to CFH during the "fall" run period, and 4,487 salmon returned during the "late-fall" run period. Based on the composition of CWT recoveries, FWS staff determined there was significant overlap between runs, especially in late November through early December, and FWS staff adjusted the final escapement to 69,861 fall-run and 4,950 late-fall-run salmon. An additional 223 late-fall salmon were trapped at CFH after spawning operations ended in early March.

Fall- and late-fall-run returns to CFH were predominantly hatchery-origin salmon while spawners in natural areas were comprised of more natural-origin salmon with the exception of Paynes Creek (Figs. 5, 6, 7). The proportion of hatchery-origin fish (prevalent release type shown in parenthesis) at each of the following locations was:

- Fall-run returns CFH: 90% (CFHFh)
- Late-fall-run returns CFH: 99% (CFHLh)
- Winter-run spawners Upper Sacramento River: 6% (SacW)
- Fall-run spawners Upper Sacramento River: 34% (FRHFn)

- Late-fall-run spawners Upper Sacramento River: 17% (CFHLh)
- Fall-run spawners Clear Creek: 37% (CFHFh)
- Fall-run spawners Cottonwood Creek: 31% (CFHFh)
- Fall-run spawners Paynes Creek: 53% (CFHFh)
- Fall-run spawners Mill Creek: 31% (CFHFh)
- Fall-run spawners Deer Creek: 4% (FRHFn)
- Fall-run spawners Butte Creek: 7% (FRHFn)
- Spring-run spawners Butte Creek: no hatchery fish observed

Feather River Basin

Spring- and fall-run returns to FRH, (including preseason spring-run returns that died prior to release) and spawners in the Feather River were predominantly hatchery-origin while escapement to the Yuba River above and below Daguerre Point Dam (DPD) contained more natural-origin salmon (Figs. 7, 8). The proportion of hatchery-origin fish (prevalent release type shown in parenthesis) at each of the following locations was:

- Spring-run returns FRH: 99% (FRHS)
- Fall-run returns FRH: 97% (FRHFn)
- Fall/spring-run spawners Feather River: 84% (FRHFn)
- Fall/spring-run spawners Yuba River above DPD: 34% (FRHFn)
- Fall/spring-run spawners Yuba River below DPD: 46% (FRHFn)

American River Basin

Fall-run returns to NIM, "washbacks" collected on the NIM weir, and spawners in the American River were predominantly of hatchery-origin (Fig. 9). The proportion of hatchery-origin fish (prevalent release type shown in parenthesis) at each of the following locations was:

- Fall-run returns NIM: 86% (NIMF)
- Fall-run returns NIM weir: 71% (NIMF)
- Fall-run spawners American River: 65% (NIMF)

Mokelumne River Basin

Hatchery-origin salmon (Fig. 10) dominated fall-run returns to MOK and spawners in the Mokelumne River. The proportion of hatchery-origin fish (prevalent release type shown in parenthesis) at each of the following locations was:

- Fall-run returns MOK: 89% (MOKFn)
- Fall-run spawners Mokelumne River: 64% (MOKFn)

Merced River and other San Joaquin Basin Tributaries

Hatchery-origin salmon dominated fall-run returns to MER and spawners in the Stanislaus River (Fig. 11) while a higher proportion of natural-origin spawners occurred in Merced and Tuolumne rivers. The proportion of hatchery-origin fish (prevalent release type shown in parenthesis) at each of the following locations was:

- Fall-run returns MER: 63% (MOKFn)
- Fall-run spawners Merced River: 44% (MOKFn)
- Fall-run spawners Stanislaus River: 66% (MOKFn)
- Fall-run spawners Tuolumne River: 28% (MOKFn)

2. Contribution of CV Release Types to Total Salmon Escapement
Approximately 71% of the total 477,000 salmon escapement to CV hatcheries and natural areas during 2013-2014 were hatchery-origin fish (Table 11). The proportion of these fish that strayed from their basin-of-origin ranged from zero to 79 percent, depending on release type:

- CFHFh: 94,871 CWT_{total} 3,758 strays (4%)
- CFHFn: 10,562 CWT_{total} 8,247 strays (78%)

- FRHFb: 173 CWT_{total} 40 strays (23%)
- FRHFn: 133,144 CWT_{total} 11,893 strays (9%)
- FRHFnc: 752 CWT_{total} 122 strays (16%)
- FRHFtib: 708 CWT_{total} 93 strays (13%)

- NIMF: 22,725 CWT_{total} 190 strays (1%)
- NIMFn: 12,362 CWT_{total} 604 strays (5%)

- MOKF: 342 CWT_{total} 35 strays (10%)
- MOKFn: 17,478 CWT_{total} 10,300 strays (59%)
- MOKFt: 2,426 CWT_{total} 1,428 strays (59%)

- MERF: 168 CWT_{total} 11 strays (7%)
- MERFt: 128 CWT_{total} 101 strays (79%)

- FRHS: 26,051 CWT_{total} 0 strays (0%)
- FRHSn: 10,349 CWT_{total} 1,126 strays (11%)

- SacW: 367 CWT_{total} 0 strays (0%)

- CFHLh: 6,449 CWT_{total} 4 strays (0%)

3. Hatchery Proportion and Contribution of CV Release Types to CV Sport Harvest
In 2013, approximately 66% of the 66,600 salmon harvested in the CV river sport fishery were hatchery-origin fish (Table 9; Figs. 12, 13). The proportion of hatchery-origin fish (prevalent release type shown in parenthesis) in each of the following fisheries was:

- Upper Sacramento River fall-run harvest: 67% (CFHFh)
- Lower Sacramento River fall-run harvest: 63% (FRHFn)
- Feather River fall-run harvest: 72% (FRHFn)
- American River fall-run harvest: 63% (NIMF)
- Mokelumne River fall-run harvest: 85% (MOKFn)
- Upper Sacramento River late-fall-run harvest: 59% (CFHLh)

Of all hatchery release types, FRHFn contributed the most (22%) to the total CV sport harvest, followed by CFHFh (20%). Most of the CFHFh recoveries occurred in the Upper Sacramento River fall fisheries (Table 11).

- CFHFh: 13,413 CWT_{total} (20%)
- CFHFn: 2,656 CWT_{total} (4%)

- FRHFb: 54 CWT_{total}
- FRHFn: 14,913 CWT_{total} (22%)
- FRHFnc: 277 CWT_{total}
- FRHFtib: 205 CWT_{total}

- NIMF: 4,739 CWT_{total} (7%)
- NIMFn: 2,200 CWT_{total} (3%)

- MOKF: 22 CWT_{total}
- MOKFn: 2,809 CWT_{total} (4%)
- MOKFt: 478 CWT_{total} (1%)

- MERFt: 124 CWT_{total}

- FRHS: 291 CWT_{total}
- FRHSn: 236 CWT_{total}

- CFHLh: 1,547 CWT_{total} (2%)

4a. 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 2009 through 2011 brood year releases were more consistent than release types analyzed in earlier CFM reports (Kormos et. al. 2012, Palmer-Zwahlen and Kormos 2013, 2015) and only a few "mixed strategy" releases were identified (Table 3).

Table 12 summarizes total CWT_{samp} recoveries and the escapement recovery rate, R_{type} (in-basin and stray), for all release types collected in the CV and ocean fisheries during 2013. Recovery rates are standardized utilizing total CWT_{samp} recoveries per 100,000 tagged salmon released. All release types with less than 25,000 fish released with CWTs are noted below since a few recoveries may result in relatively large recovery and stray rate estimates. Figures 14 and 15 provide a graphical representation of R_{type} for Sacramento River fall-run 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 acclimated in bay and coastal net pens generally had higher CV recovery rates than their respective in-basin or trucked-only releases, but net pen and trucked release types also had higher stray proportions than their in-basin siblings did in most cases.

Age-2 CV (BY 2011) Escapement recovery rate; percent stray

- CFHFh: 14 recoveries/100K released; 6% stray

- FRHFb: 58 recoveries/100K released; 22% stray
- FRHFe: 0 recoveries/100K released (<11,500 released)
- FRHFn: 97 recoveries/100K released; 20% stray
- FRHFnc: 112 recoveries/100K released; 9% stray
- FRHFtib: 0 recoveries/100K released (<7,000 released)

- NIMF: 35 recoveries/100K released
- NIMFn: 30 recoveries/100K released; 10% stray

- MOKF: 22 recoveries/100K released
- MOKFn: 42 recoveries/100K released; 41% stray
- MOKFt: 50 recoveries/100K released; 36% stray

- MERF: 9 recoveries/100K released; 9% stray

- FRHS: 13 recoveries/100K released
- FRHSn: 5 recoveries/100K released

- SacW: 33 recoveries/100K released

- CFHLh: 108 recoveries/100K released

Age-3 (BY 2010) CV Escapement recovery rate; percent stray

- CFHFh: 489 recoveries/100K released; 6% stray
- CFHFn: 587 recoveries/100K released; 84% stray

- FRHFn: 1,031 recoveries/100K released; 5% stray
- FRHFnc: 134 recoveries/100K released; 27% stray
- FRHFtib: 694 recoveries/100K released; 12% stray

- NIMF: 556 recoveries/100K released; 1% stray
- NIMFn: 497 recoveries/100K released; 5% stray

- MOKF: 146 recoveries/100K released; 3% stray
- MOKFn: 264 recoveries/100K released; 63% stray
- MOKFt: 116 recoveries/100K released; 61% stray

- MERF: 113 recoveries/100K released; 6% stray
- MERFt: 76 recoveries/100K released; 59% stray (<6,700 released)

- FRHS: 2,090 recoveries/100K released
- FRHSn: 594 recoveries/100K released; 3% stray

- SacW: 248 recoveries/100K released

- CFHLh: 297 recoveries/100K released

Age-4 (BY 2009) CV Escapement recovery rate; percent stray

- CFHFh: 99 recoveries/100K released; 5% stray
- CFHFn: 164 recoveries/100K released; 73% stray

- FRHFn: 185 recoveries/100K released; 23% stray
- FRHFnc: 0 recoveries/100K released
- FRHFtib: 507 recoveries/100K released; 14% stray

- NIMF: 131 recoveries/100K released; 1% stray
- NIMFn: 306 recoveries/100K released; 5% stray

- MOKF: 173 recoveries/100K released; 18% stray
- MOKFn: 149 recoveries/100K released; 58% stray

- MERFt: 74 recoveries/100K released; 80% stray
- FRHS: 116 recoveries/100K released
- FRHSn: 312 recoveries/100K released; 26% stray
- CFHLh: 207 recoveries/100K released

4b. Relative Recovery Rate of CV Release Types in the Ocean Harvest

The relative recovery rate of CV hatchery releases in 2013 ocean salmon sport and commercial fisheries varied by age and release type (Table 12). Almost all CWTs from age-2 CV salmon were recovered in the ocean sport fishery, most likely due to smaller size limits in effect compared to the commercial fishery. Net pen releases (coastal and bay) generally had the highest ocean recovery rates for all ages (Fig. 16).

Age-2 Ocean Harvest recovery rate; percent taken in sport harvest

- CFHFh: 3 recoveries/100K released; 94% sport
- FRHFb: 19 recoveries/100K released; 94% sport
- FRHFe: 34 recoveries/100K released; 0% sport (<11,500 released)
- FRHFn: 24 recoveries/100K released; 88% sport
- FRHFnc: 81 recoveries/100K released; 90% sport
- FRHFtib: 62 recoveries/100K released; 100% sport (<7,000 released)
- NIMF: 4 recoveries/100K released; 85% sport
- NIMFn: 5 recoveries/100K released; 100% sport
- MOKF: 0 recoveries/100K released
- MOKFn: 8 recoveries/100K released; 77% sport
- MOKFt: 15 recoveries/100K released; 100% sport
- MERF: 0 recoveries/100K released
- FRHS: 7 recoveries/100K released; 78% sport
- FRHSn: 5 recoveries/100K released; 83% sport
- CFHLh: 4 recoveries/100K released; 92% sport

Age-3 Ocean Harvest recovery rate; percent taken in sport harvest

- CFHFh: 486 recoveries/100K released; 30% sport
- CFHFn: 1,374 recoveries/100K released; 30% sport
- FRHFn: 811 recoveries/100K released; 29% sport
- FRHFnc: 3,692 recoveries/100K released; 32% sport
- FRHFtib: 1,082 recoveries/100K released; 30% sport
- NIMF: 752 recoveries/100K released; 28% sport
- NIMFn: 662 recoveries/100K released; 29% sport
- MOKF: 117 recoveries/100K released; 52% sport
- MOKFn: 309 recoveries/100K released; 32% sport

- MOKFt: 137 recoveries/100K released; 27% sport
- MERF: 115 recoveries/100K released; 29% sport
- MERFt: 87 recoveries/100K released: 63% sport (<6,700 released)
- FRHS: 459 recoveries/100K released; 30% sport
- FRHSn: 105 recoveries/100K released; 28% sport
- SacW: 62 recoveries/100K released; 79% sport
- CFHLh: 120 recoveries/100K released; 40% sport

Age-4 Ocean Harvest recovery rate; percent taken in sport harvest

- CFHFh: 42 recoveries/100K released; 27% sport
- CFHFn: 112 recoveries/100K released; 31% sport
- FRHFn: 62 recoveries/100K released; 27% sport
- FRHFnc: 106 recoveries/100K released 31% sport
- FRHFtib: 370 recoveries/100K released; 23% sport
- NIMF: 75 recoveries/100K released; 23% sport
- NIMFn: 269 recoveries/100K released; 26% sport
- MOKF: 99 recoveries/100K released; 19% sport
- MOKFn: 137 recoveries/100K released; 24% sport
- MERFt: 68 recoveries/100K released; 15% sport
- FRHS: 4 recoveries/100K released; 44% sport
- FRHSn: 10 recoveries/100K released; 39% sport
- SacW: 5 recoveries/100K released; 0% sport
- CFHLh: 121 recoveries/100K released; 20% sport

5. Hatchery proportion and contribution of CV release types to ocean salmon fisheries

More than half of the 413,700 and 139,100 Chinook salmon harvested in California and Oregon fisheries, respectively, were hatchery-origin fish (Fig. 17). The majority of hatchery-origin salmon in all fisheries originated from the CV, with FRHFn contributing the most in all port areas.

California ocean sport fishery

California anglers harvested almost 116,100 salmon in the ocean sport fishery during 2013. The total contribution of hatchery-origin salmon to the California ocean sport fishery was 58%, ranging from 55% to 65% of the total harvest, depending on major port area (Fig. 18). Most of the harvest occurred in San Francisco (53%) and Eureka-Crescent City (29%), followed by Monterey (9%) and Fort Bragg (9%) port areas (Table 13).

Of all hatchery release types, FRHFn contributed the most (20%) to the total California ocean sport harvest, followed by CFHFh (13%). Non-CV releases (e.g., Klamath-Trinity River Basin, Smith River, Oregon and Washington hatchery stocks) contributed 5% to the total harvest (Table 14).

- CFHFh: 15,214 CWT_{total} (13%)
- CFHFn: 5,066 CWT_{total} (4%)

- FRHFb: 52 CWT_{total}
- FRHFn: 23,176 CWT_{total} (20%)
- FRHFnc: 2,275 CWT_{total} (2%)
- FRHFtib: 218 CWT_{total}

- NIMF: 5,117 CWT_{total} (4%)
- NIMFn: 2,977 CWT_{total} (3%)

- MOKF: 79 CWT_{total}
- MOKFn: 4,092 CWT_{total} (4%)
- MOKFt: 611 CWT_{total} (1%)

- MERF: 35 CWT_{total}
- MERFt: 14 CWT_{total}

- FRHS: 1,361 CWT_{total} (1%)
- FRHSn: 346 CWT_{total}

- SacW: 95 CWT_{total}
- CFHLh: 761 CWT_{total} (1%)
- NonCV: 5,773 CWT_{total} (5%)

California ocean commercial fishery

California trollers harvested more than 297,600 salmon in the ocean commercial fishery during 2013. The total contribution of hatchery-origin salmon to the California ocean commercial fishery was 49%, ranging from 46% to 55% of the total harvest, depending on major port area (Fig. 19). Most of the harvest occurred in San Francisco (48%) and Fort Bragg (39%), followed by Monterey (9%) and Eureka-Crescent City (3%) port areas (Table 15).

Of all hatchery release types, FRHFn contributed the most (16%) to the total California commercial harvest, followed by CFHFh (11%). Non-CV releases (e.g., Klamath-Trinity River Basin, Smith River, Oregon and Washington hatchery stocks) contributed 6% to the total harvest (Table 16).

- CFHFh: 31,710 CWT_{total} (11%)
- CFHFn: 10,402 CWT_{total} (3%)

- FRHFb: 6 CWT_{total}
- FRHFn: 47,930 CWT_{total} (16%)
- FRHFnc: 3,907 CWT_{total} (1%)
- FRHFtib: 490 CWT_{total}

- NIMF: 12,583 CWT_{total} (4%)
- NIMFn: 7,332 CWT_{total} (2%)

- MOKF: 123 CWT_{total}
- MOKFn: 7,629 CWT_{total} (3%)

- MOKFt: 1,386 CWT_{total}
- MERF: 87 CWT_{total}
- MERFt: 62 CWT_{total}
- FRHS: 2,353 CWT_{total} (1%)
- FRHSn: 652 CWT_{total}
- SacW: 32 CWT_{total}
- CFHLh: 1,625 CWT_{total} (1%)
- NonCV: 17,410 CWT_{total} (6%)

6. Relative Recovery and Stray Rates of Experimental and Net Pen Release Types

CWTs from several new release types were recovered for the first time in 2013, including salmon from a new coastal net pen project in Pillar Point Harbor that released approximately 185,000 BY 2011 FRH fall-run salmon. An additional 300,000 BY 2011 FRH fall-run salmon were also released as part of a pilot study to evaluate in-basin and trucked releases versus fish transported inside a "barge" from the Feather River-Sacramento River confluence to San Francisco Bay. To allow direct comparison among coastal net pens (FRHFnc) and barge study releases (FRHFb), these releases are differentiated into the following release types:

FRHFnp	Feather River Hatchery fall-run net pen coastal releases – **P**illar Point
FRHFns	Feather River Hatchery fall-run net pen coastal releases – **S**anta Cruz
FRHFbb	Feather River Hatchery fall-run barge study: trucked and released in SF **b**ay
FRHFbg	Feather River Hatchery fall-run barge study: bar**g**ed to SF Bay and released
FRHFbr	Feather River Hatchery fall-run barge study: released in-**r**iver (Feather River mouth)

The CV escapement recovery rate and percent stray for other fall-run salmon net pen releases are included below to allow direct comparison among these release types (Table 17, Fig. 20).

Age-2 (BY 2011) CV Escapement recovery rate; percent stray

- FRHFnp: 234 recoveries/100K released; 9% stray
- FRHFns: 19 recoveries/100K released; 11% stray
- FRHFbb: 56 recoveries/100K released; 45% stray
- FRHFbg: 27 recoveries/100K released; 4% stray
- FRHFbr: 90 recoveries/100K released; 14% stray
- FRHFn: 97 recoveries/100K released; 20% stray
- NIMFn: 30 recoveries/100K released; 10% stray
- MOKFn: 42 recoveries/100K released; 41% stray

Age-3 (BY 2010) CV Escapement recovery rate; percent stray

- FRHFns: 134 recoveries/100K released; 27% stray
- FRHFn: 1,031 recoveries/100K released; 5% stray
- FRHFtib: 694 recoveries/100K released; 12% stray
- CFHFn: 587 recoveries/100K released; 84% stray

- NIMFn: 497 recoveries/100K released; 5% stray
- MOKFn: 264 recoveries/100K released; 63% stray

Age-4 (BY 2009) CV Escapement recovery rate; percent stray

- FRHFns: 0 recoveries/100K released

- FRHFn: 185 recoveries/100K released; 23% stray
- FRHFtib: 507 recoveries/100K released; 14% stray
- CFHFn: 164 recoveries/100K released; 73% stray
- NIMFn: 306 recoveries/100K released; 5% stray
- MOKFn: 149 recoveries/100K released; 58% stray

The ocean harvest recovery rate and proportion taken in the sport fishery for other fall-run salmon net pen releases are included below to allow direct comparison among these release types (Table 17, Fig. 21).

Age-2 Ocean Harvest recovery rate; percent taken in sport harvest

- FRHFnp: 81 recoveries/100K released; 85% sport
- FRHFns: 81 recoveries/100K released; 93% sport

- FRHFbb: 19 recoveries/100K released; 80% sport
- FRHFbg: 17 recoveries/100K released; 100% sport
- FRHFbr: 20 recoveries/100K released; 100% sport

- FRHFn: 97 recoveries/100K released; 88% sport
- NIMFn: 30 recoveries/100K released; 100% sport
- MOKFn: 42 recoveries/100K released; 77% sport

Age-3 Ocean Harvest recovery rate; percent taken in sport harvest

- FRHFns: 3,692 recoveries/100K released; 32% sport

- FRHFn: 811 recoveries/100K released; 29% sport
- FRHFtib: 1,082 recoveries/100K released; 30% sport
- CFHFn: 1,374 recoveries/100K released; 30% sport
- NIMFn: 662 recoveries/100K released; 29% sport
- MOKFn: 309 recoveries/100K released; 32% sport

Age-4 Ocean Harvest recovery rate; percent taken in sport harvest

- FRHFns: 106 recoveries/100K released 31% sport

- FRHFn: 62 recoveries/100K released; 27% sport
- FRHFtib: 370 recoveries/100K released; 23% sport
- CFHFn: 112 recoveries/100K released; 31% sport
- NIMFn: 269 recoveries/100K released; 26% sport
- MOKFn: 137 recoveries/100K released; 24% sport

2013 CFM ANALYSES KEY POINTS

- Hatchery escapement was predominately hatchery-origin fish. The majority of hatchery-origin fish returning to each hatchery was comprised primarily of its respective releases with the exception of Merced River Hatchery, which was mostly MOKFn and MOKFt releases.
- Rivers and creeks with hatchery installations had the highest proportions of hatchery-origin spawners in natural areas, with the exception of Merced River. Most of the hatchery proportion consisted of release types from its respective hatchery with the exception of hatchery-origin spawners in the Merced River, which were primarily MOKFn and MOKFt releases.
- Fall-run escapement into the Upper Sacramento River and its tributaries was predominantly natural-origin salmon with the exception of Paynes Creek. CFHFh and FRHFn were the hatchery release types most often observed in these rivers and creeks.
- Fall-run escapement into the Butte Creek and the Yuba River was predominantly natural-origin salmon. Hatchery-origin fish were primarily FRHFn, MOKFn, and CFHFn release types.
- Fall-run escapement into non-hatchery tributaries of the San Joaquin Basin was predominantly natural-origin salmon with the exception of the Stanislaus River. MOKFn and MOKFt were the predominant hatchery release types observed in all other southern tributaries.
- For fall-run salmon, bay net pen releases generally had the highest CV recovery rates among all release types in their cohort. Bay net pen releases, along with trucked releases, also had higher stray rates. CFHFn and MERFt releases had the highest stray rates observed among all release types.
- Approximately two-thirds and more than half of the inland and ocean harvest, respectively, were hatchery-origin fish. FRHFn and CFHFh releases contributed the most to sport (inland and ocean) and commercial fisheries.
- Coastal net pen releases had the highest ocean recovery rates for all release types and ages. Their recovery rate was several times greater than other net pen releases for the same cohort, including sibling releases, and an order of magnitude greater than recovery rates for most in-basin releases. The age-2 ocean recovery rates for releases from the two coastal net pen projects were identical.
- Relatively few coastal net pen releases from Santa Cruz returned to the CV whereas coastal releases from Pillar Point had the highest CV recovery rate among all age-2 pen releases. The majority of FRHFnp recoveries in the CV occurred at Feather River Hatchery.
- Fish released directly into San Francisco Bay as part of the “barge study” strayed the most among the three release types in this study. Salmon barged down the Sacramento River had the lowest stray rate but also the lowest CV recovery rate. Fish released in-basin at the mouth of the Feather River had the highest recovery rate and strayed moderately. All three release types had near equivalent age-2 ocean recovery rates and were slightly less than the rate observed for their FRH siblings released in bay net pens.

CONCLUSION

A primary goal of this report is to provide information that will be useful in California salmon management, including CV hatchery assessment. 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. Although there is no discussion section as in previous reports, the authors have begun the process of analyzing these data for complete CFM broods over their respective life span. This 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.

We believe the CFM program should be continued with the current design to provide comparable, consistent data needed for hatchery and harvest management. Efforts are still ongoing to secure permanent funding for this program which 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 in real-time, similar to the Klamath River fall-run salmon management process.

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LIST OF ACRONYMS AND ABBREVIATIONS

Ad-clipped	clipped adipose fin
BOR	U.S. Bureau of Reclamation
BY	Brood year
CFM	Constant Fractional Marking
CFH	Coleman National Fish Hatchery
CV	California Central Valley
CWT	coded-wire tag
CDFW	California Department of Fish and Wildlife
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
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
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 2013 CV Chinook hatchery escapement.

Sampling Location	Estimation and Sampling Methods	Agency
Hatchery Spawners		
Coleman National Fish Hatchery (CFH) Fall and Late-Fall (2014)	Direct count. All fish examined and bio-sampled[a/] for fin-clips, tags, marks. Access upstream of the hatchery closed Aug 1-Sep 30. Fall-run period: Oct 2-Dec 3, Late-fall-run period: Dec 23-Mar 5. Sub-sampling of ad-clipped fish (~19%) occurred Oct 2-Nov 21; all ad-clipped fish sampled thereafter. CFH ladder closed between "fall" and "late-fall" spawning periods (Dec 4-22). Fish returning to CFH in mid-Nov and early Dec parsed into run-type based on CWT code recoveries and total run-type proportions by date. Grilse cutoff: 700 mm fall, 600 mm late-fall.	FWS
CFH Late-Fall Fish Trap	Direct count. All fish examined and bio-sampled for fin-clips, tags, marks. All untagged-phenotypic late-fall fish released into Battle Creek above CFH Nov 14-Apr 2. All ad-clipped fish sampled and heads collected for CWT recovery Mar 3-Apr 2 (after CFH spawning operations cease). Late-fall data from video weir Apr 2-Jun 30 added. Grilse cutoff: 600 mm.	FWS
Feather River Hatchery (FRH) Spring and Fall	Direct count. All fish examined for fin-clips, tags, marks. Fish arriving at the hatchery May 1-Jul 1 (n~ 20,000) were considered "spring-run" and marked with uniquely-numbered floytags prior to release back into the Feather River. Only fish marked with floytags returning to FRH in fall were spawned as spring-run. All remaining fish were considered fall-run. FRH fish ladder opened Sep 16 and spring spawning began Sep 19. All spring-run fish bio-sampled until Sep 23. Systematic random bio-sample ~33% of remaining spring-run fish occurred through Sep 28. Fall spawning began Oct 9 with systematic random bio-sample ~10% of all fish. All ad-clipped fish were sampled and heads collected for CWT recovery. Grilse cutoff: 650 mm spring and fall.	CDFW
FRH Trap Spring	Direct count of salmon that died during early processing of "spring-run" salmon returning to FRH during May-July. All fish examined for fin-clips, tags, marks. All ad-clipped fish were sampled and heads collected for CWT recovery. These fish are not included in FRH spring escapement. Grilse cutoff: 650 mm.	
Nimbus Fish Hatchery (NIM) Fall	Direct count. NIM ladder open Nov 4-Dec 11. All fish examined for fin-clips, tags, marks. Systematic random bio-sample ~10% of total fish returning. All ad-clipped fish sampled and heads collected for CWT recovery. Grilse cutoff: 700 mm.	CDFW
Nimbus Weir Fall	Direct count. Installed Aug 8 to force returning salmon into NIM; any salmon that migrated above prior to installation trapped between Folsom Dam (located 1/4 mile upstream) and weir. All "washback" fish examined for fin-clips, tags, marks. All ad-clipped fish sampled and heads collected for CWT recovery. Grilse cutoff: 700 mm.	CDFW
Mokelumne River Hatchery (MOK) Fall	Direct count. MOK open Oct 1-Jan 23. All fish examined for fin-clips, tags, marks. Systematic random bio-sample ~10% of total fish returning. All ad-clipped fish sampled and heads collected for CWT recovery. Grilse cutoff: 650 mm females, 710 mm males.	CDFW
Merced River Fish Facility (MER) Fall	Direct count. MER open Oct 21-Dec 27. All fish examined for fin-clips, tags, marks. All ad-clipped fish were sampled and heads processed for CWT recovery. Grilse cutoff: 640 mm females, 680 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.

Table 1b. Estimation and sampling methods used for the 2013 CV Chinook natural escapement. (pg 1 of 2)

Sampling Location	Estimation and Sampling Methods	Agency
Natural Spawners		
Upper Sacramento River Mainstem Winter, Fall, and Late-Fall (2014)	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: 626 mm females, 675 mm males winter; 610 mm females, 725 mm males fall; 610 mm females, 655 mm males late-fall.	CDFW, FWS
Clear Creek Fall	Same methodology as Upper Sacramento River Mainstem population estimates except sex ratio and grilse proportion determined from live fish counts at Clear Creek video station and CWT analysis. 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. Grilse cutoff: 625 mm females, 700 mm males.	CDFW, FWS
Cottonwood Creek Fall	Video weir count (Sep 15-Dec 15) in lower creek used to determine total escapement. Kayak 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. Grilse cutoff: 655 mm females, 675 mm males.	FWS, CDFW
Paynes Creek Fall	Redd count survey to determine total escapement. Walking surveys were conducted to count redds and 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. Grilse cutoff: 610 mm females, 725 mm males.	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. Kayak 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. Grilse cutoff: 620 mm females, 695 mm males.	CDFW
Deer Creek Fall	Redd count survey to determine total estimate. Sex ratio based on Mill Creek video count. Kayak 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. Grilse cutoff: 620 mm females, 695 mm males.	CDFW

Table 1b. Estimation and sampling methods used for the 2013 CV Chinook natural escapement. (pg 2 of 2)

Sampling Location	Estimation and Sampling Methods	Agency
Natural Spawners cont.		
Butte Creek Spring and Fall	Superpopulation modification of the Cormack-Jolly-Seber mark-recapture estimate for spring and fall. All fish examined for fin-clips, tags, marks. Systematic random bio-sample of all fish. All ad-clipped fish sampled and heads collected for CWT recovery. Grilse cutoff: 600 mm spring, 650 mm fall.	CDFW
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. Heads opportunistically collected from non-fresh ad-clipped fish. Escapement estimate includes spring-run. Grilse cutoff: 650 mm.	DWR
Yuba River Fall	Above Daguerre Point Dam: 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 Daguerre Point Dam: 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 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: 640 mm females, 700 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 collected 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. Opportunistic sampling of ad-clipped fish on Stanislaus Weir (i.e., "washbacks"). Grilse cutoff: 640 mm females, 680 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 head collected for CWT recovery. Grilse cutoff: 640 mm females, 680 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 head collected for CWT recovery. Grilse cutoff: 640 mm females, 680 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.

Table 1c. Estimation and sampling methods used for the 2013 CV Chinook sport harvest estimates.

Sampling Location	Estimation and Sampling Methods	Agency
Sport Harvest		
Upper Sacramento River Fall	Open Jul 16 - Oct 31 (Lower Red Bluff Boat Ramp to Highway 113 bridge) and Aug 1 - Oct 31 (Deschutes Road Bridge to the Red Bluff Diversion Dam). Stratified random sampling design (one weekday and one weekend sample per week per section during the open season per management zone) that included both roving and access interview components and sub-sampling of kept salmon. Almost all ad-clipped salmon sampled and heads collected for CWT recovery.	CDFW
Feather River Fall	Open Jul 16 - Oct 15 (unimproved boat ramp above the Thermolito Afterbay Outfall to 200 yards above the Live Oak boat ramp) and Jul 16 - Dec 16 (200 yards above the Live Oak boat ramp to the Sacramento River confluence). Stratified random sampling design (one weekday and one weekend sample per week per section during the open season per management zone) that included both roving and access interview components and sub-sampling of kept salmon. All ad-clipped salmon sampled and heads collected for CWT recovery.	CDFW
American River Fall	Open Jul 16 - Dec 31 (Nimbus dam to the Hazel Avenue Bridge), Jul 16 - Aug 15 (Hazel Avenue Bridge to the USGS cable crossing), Jul 16 - Oct 31 (USGS cable crossing to the SMUD power line crossing), Jul 16 - Dec 31 (SMUD power line crossing to the Jiboom Street Bridge), and Jul 16 - Dec 16 (Jiboom Street Bridge to the Sacramento River confluence). Stratified random sampling design (one weekday and one weekend sample per week per section during the open season per management zone) that included both roving and access interview components and sub-sampling of kept salmon. All ad-clipped salmon sampled and heads collected for CWT recovery.	CDFW
Lower Sacramento River Fall	Open Jul 16 - Dec 16 (Highway 113 bridge to the Carquinez Bridge). Stratified random sampling design (one weekday and one weekend sample per week per section during the open season per management zone) that included both roving and access interview components and sub-sampling of kept salmon. All ad-clipped salmon sampled and heads collected for CWT recovery.	CDFW
Mokelumne River Fall	Open Jul 16 - Oct 15 (Comanche Dam to the Highway 99 Bridge), Jul 16 - Dec 31 (Highway 99 Bridge to Woodbridge Dam, including Lodi Lake), and Jul 16 - Dec 16 (Lower Sacramento Road bridge to the San Joaquin River confluence). Stratified random sampling design (one weekday and one weekend sample per week per section during the open season per management zone) that included both roving and access interview components and sub-sampling of kept salmon. All ad-clipped salmon sampled and heads collected for CWT recovery.	CDFW
Upper Sacramento River Late Fall	Open Nov 1 - Dec 16 (Lower Red Bluff Boat Ramp to Highway 113 bridge, Deschutes Road Bridge to the Red Bluff Diversion Dam). Stratified random sampling design (one weekday and one weekend sample per week per section during the open season per management zone) that included both roving and access interview components and sub-sampling of kept salmon. All ad-clipped salmon sampled and heads collected for CWT recovery.	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 2. California ocean salmon sport and commercial fishery seasons by major port area, 2013.

	Sport Fishery			Commercial Fishery			
Major Port Area	Season	Size Limit[a/]	Days Open	Season	Size Limit[a/]	Days Open	Quota
Eureka/Crescent City (Klamath Mgmt Zone)	May 1 - Sep 8	20" TL	131	May 1-10	27" TL	10	3,000[b/]
				Jun 1-9, 11	27" TL	10	3,352[b/]
				Jul 15-21	27" TL	7	2,547[b/]
				Aug 1-3	27" TL	3	1,692[b/]
				Sep 16-30	27" TL	15	6,000[b/]
						45	
Fort Bragg	Apr 6 - Nov 10	20" TL	219	May 22-31	27" TL	10	
				Jun 1-8, 21-30	27" TL	18	
				Jul 15 - Aug 29	27" TL	46	
				Sep 1 - 30	27" TL	30	
						104	
San Francisco	Apr 6 - Jul 31[c/]	24" TL	105	May 1-31	27" TL	31	
	Aug 1 - Nov 10	20" TL	102	Jun 1-8, 21-30	27" TL	18	
			207	Jul 15 - Aug 29	27" TL	46	
				Sep 1 - 30	26" TL	30	
				Oct 1-5, 8-12[d/]	26" TL	11	
						136	
Monterey[e/]	Apr 6 - Oct 6[c/]	24" TL	172	May 1-31	27" TL	31	
				Jun 1-8, 21-30	27" TL	18	
				Jul 15 - Aug 29	27" TL	46	
				Sep 1 - 30	26" TL	30	
						125	
California Total			729			365	

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

b/ Klamath Management Zone quota fisheries; daily bag and possession limit of 20 salmon per day.

c/ Closed on Monday and Tuesday from June 1 through July 9.

d/ Open only between Pt. Reyes and Pt. San Pedro.

e/ Recreational and commercial regulations apply from the Monterey area to the U.S./Mexico border.

Table 3. Central Valley coded-wire tag (CWT) Chinook releases recovered in 2013 by age, run, stock, and release type.

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
FRHS	2011	FRH	Fea R	Spr	2	1,088,286	1,110,709	98%	In-basin	Feather River (Boyds Pump Ramp & Thermolito Bypass)
FRHSn	2011	FRH	Fea R	Spr	1	1,125,189	1,134,280	99%	Bay pens	San Pablo Bay net pen releases
CFHFh	2011	CFH	Sac R	Fall	28	3,117,042	12,508,161	25%	Hatchery	CFH only
FRHFb	2011	FRH	Fea R	Fall	3	297,089	297,969	100%	Barge study	3 release sites: Sacramento River, barged (SF Bay) & trucked (Ft Baker)
FRHFe	2011	FRH	Fea R	Fall	2	11,449	11,449	100%	Experimental	Yolo Bypass and San Joaquin River experimental releases
FRHFn	2011	FRH	Fea R	Fall	6	2,293,211	9,265,375	25%	Bay pens	San Pablo Bay net pen releases (approx. 15% released directly into bay)
FRHFnc	2011	FRH	Fea R	Fall	3	426,190	427,337	100%	Coastal pens	Santa Cruz and Pillar Point net pens; acclimated 1-2 weeks
FRHFtib	2011	FRH	Fea R	Fall	1	9,933	9,967	100%	Bay pens	Tiburon net pens, released as fingerlings (May)
FeaFw	2011	wild	Fea R	Fall	23	156,526	159,811	98%	In-basin	Thermalito Bypass & Feather River Outlet launch ramp
NIMF	2011	NIM	Ame R	Fall	3	1,078,191	3,492,113	31%	In-basin	American River (Howe Ave launch ramp)
NIMFn	2011	NIM	Ame R	Fall	2	328,073	1,312,930	25%	Bay pens	Mare Island net pens
MOKF	2011	MOK	Mok R	Fall	1	92,020	109,043	84%	In-basin	Mokelumne Hatchery (yearlings)
MOKFn	2011	MOK	Mok R	Fall	21	1,487,132	5,973,754	25%	Bay pens	Sherman Island net pens
MOKFt	2011	MOK	Mok R	Fall	2	110,737	448,659	25%	Trucked	Sherman Island, opposite Jersey Point
MERF	2011	MER	Mer R	Fall	9	262,108	262,108	100%	In-basin	Merced River Hatchery and Hatfield State Area
SacW	2011	LSH	Sac R	Wint	18	185,313	194,264	92%	In-basin	Sacramento River (Lake Redding Park)
CFHLh	2012	CFH	Sac R	Late	14	1,031,419	1,094,288	94%	Hatchery	CFH (includes spring surrogate & small experimental releases)
			Total age 2 releases:		139	13,099,908	37,812,217	35%	1% wild CWT releases	

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
FRHS	2010	FRH	Fea R	Spr	2	1,170,340	1,181,710	99%	In-basin	Feather River (Boyds Pump Ramp)
FRHSn	2010	FRH	Fea R	Spr	2	1,136,690	1,157,167	98%	Bay pens	San Pablo Bay net pen releases
CFHFh	2010	CFH	Sac R	Fall	25	2,835,420	11,369,732	25%	Hatchery	CFH
CFHFn	2010	CFH	Sac R	Fall	3	334,756	1,339,659	25%	Bay pens	Mare Island net pens
FRHFn	2010	FRH	Fea R	Fall	9	2,554,115	10,308,722	25%	Bay pens	San Pablo Bay net pens; Wickland Oil net pens
FRHFnc	2010	FRH	Fea R	Fall	2	185,985	187,022	99%	Coastal pens	Santa Cruz net pens; MBSTE project; held approx 1 week
FRHFtib	2010	FRH	Fea R	Fall	2	56,030	56,398	99%	Bay pens	Tiburon net pens, released as fingerlings (May) & yearlings (Oct)
FeaFw	2010	wild	Fea R	Fall	38	188,791	194,798	97%	In-basin	Thermalito Bypass
NIMF	2010	NIM	Ame R	Fall	3	1,014,340	3,259,868	31%	In-basin	American River (at Sunrise launch ramp & Discovery Park)
NIMFn	2010	NIM	Ame R	Fall	3	368,363	1,595,731	23%	Bay pens	Wickland Oil net pens
MOKF	2010	MOK	Mok R	Fall	1	100,215	100,467	100%	In-basin	Mokelumne Hatchery (yearlings)
MOKFn	2010	MOK	Mok R	Fall	12	1,126,781	4,548,348	25%	Bay pens	Sherman Island net pens (includes experimental Nimbus spawners)
MOKFt	2010	MOK	Mok R	Fall	5	473,268	1,898,828	25%	Trucked	Sherman Island (approx. 25% released into net pens)
MERF	2010	MER	Mer R	Fall	5	122,973	128,375	96%	In-basin	Merced River Hatchery and Hatfield State Area
MERFt	2010	MER	Mer R	Fall	1	6,669	6,762	99%	Trucked	San Joaquin River (Mossdale)
SacW	2010	LSH	Sac R	Wint	14	113,905	123,859	92%	In-basin	Sacramento River (Lake Redding Park)
CFHLh	2011	CFH	Sac R	Late	14	1,037,859	1,053,282	99%	Hatchery	CFH (includes spring surrogate releases)
			Total age 3 releases:		141	12,826,500	38,510,728	33%	1% wild CWT releases	

Table 3. Central Valley coded-wire tag (CWT) Chinook releases recovered in 2013 by age, run, stock, and release type. (Continued)

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
FRHS	2009	FRH	Fea R	Spr	1	1,026,954	1,040,645	99%	In-basin	Feather River (Boyds Pump Ramp)
FRHSn	2009	FRH	Fea R	Spr	6	1,058,635	1,085,409	98%	Bay pens	San Pablo Bay net pens
CFHFh	2009	CFH	Sac R	Fall	25	2,541,142	10,210,449	25%	Hatchery	CFH
CFHFn	2009	CFH	Sac R	Fall	3	337,919	1,359,012	25%	Bay pens	Mare Island net pens
FRHFn	2009	FRH	Fea R	Fall	11	2,367,209	9,536,050	25%	Bay pens	San Pablo Bay net pens; Wickland Oil net pens
FRHFnc	2009	FRH	Fea R	Fall	1	118,879	122,334	97%	Coastal pens	Santa Cruz net pens; MBSTE project; held approx. 1 week
FRHFtib	2009	FRH	Fea R	Fall	2	60,104	60,739	99%	Tibur. pens	Tiburon net pens, released as fingerlings (May) & yearlings (Oct)
FeaFw	2009	wild	Fea R	Fall	18	177,657	178,063	100%	In-basin	Thermalito Bypass
NIMF	2009	NIM	Ame R	Fall	3	1,000,559	3,221,137	31%	In-basin	American River (at Sunrise Launch Ramp & Discovery Park)
NIMFn	2009	NIM	Ame R	Fall	2	347,527	1,391,632	25%	Bay pens	Mare Island net pens
MOKF	2009	MOK	Mok R	Fall	1	99,048	99,157	100%	In-basin	Mokelumne Hatchery (yearlings)
MOKFn	2009	MOK	Mok R	Fall	13	2,015,730	2,023,958	100%	Bay pens	Sherman Island net pens
MERFt	2009	MER	Mer R	Fall	6	154,685	165,213	94%	Trucked	San Joaquin River (Jersey Pt)
SacW	2009	LSH	Sac R	Wint	19	183,644	198,582	92%	In-basin	Sacramento River (Lake Redding Park)
CFHLh	2010	CFH	Sac R	Late	13	992,047	1,018,422	97%	Hatchery	CFH (includes spring surrogate releases)
			Total age 4 releases:		124	12,481,739	31,710,802	39%	1% wild CWT releases	

***CV CWT release types:**

Sacramento River Basin Fall Chinook CWT release types

CFHFh	Coleman National Fish Hatchery fall hatchery releases
CFHFn	Coleman National Fish Hatchery fall net pen releases
FRHFb	Feather River Hatchery fall barge study releases
FRHFe	Feather River Hatchery fall experimental releases
FRHFn	Feather River Hatchery fall bay net pen releases
FRHFnc	Feather River Hatchery fall coastal net pen releases
FRHFtib	Feather River Hatchery fall Tiburon net pen releases
FeaFw	Feather River fall wild
NIMF	Nimbus Fish Hatchery fall in-basin releases
NIMFn	Nimbus Fish Hatchery fall net pen releases

Sacramento River Basin Winter Chinook CWT release types

SacW	Livingston Stone Hatchery winter in-basin releases

San Joaquin River Basin Fall Chinook CWT release types

MOKF	Mokelumne Hatchery fall in-basin releases
MOKFn	Mokelumne Hatchery fall net pen releases
MOKFt	Mokelumne Hatchery fall trucked releases (no net pens)
MERF	Merced River Hatchery fall in-basin releases
MERFt	Merced River Hatchery fall trucked releases (no net pens)

Central Valley Spring Chinook CWT release types

FRHS	Feather River Hatchery spring in-basin releases
FRHSn	Feather River Hatchery spring net pen releases

Central Valley Late-Fall Chinook CWT release types

CFHLh	Coleman National Fish Hatchery late fall hatchery releases

Table 4. Central Valley hatchery and natural escapement estimates, sport harvest, and sample data, 2013.

Escapement Survey	Run	Total Escapement	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										
Feather River Hatchery	Spring	4,291	4,291	4,107	4,106	4,043	100%	100%	100%	1.00
Feather River Hatchery Trap (pre-season)	Spring	56	56	56	56	56	100%	100%	100%	1.00
Coleman National Fish Hatchery	Fall	69,861	69,861	15,908	4,321	4,248	100%	27%	100%	3.69 [b/]
Feather River Hatchery	Fall	27,622	27,622	9,787	9,787	9,590	100%	100%	99%	1.01
Nimbus Fish Hatchery	Fall	9,076	9,076	2,611	2,610	2,554	100%	100%	100%	1.00
Nimbus Fish Hatchery Weir	Fall	3,969	3,969	861	861	785	100%	100%	100%	1.00
Mokelumne River Hatchery	Fall	5,181	5,181	1,620	1,620	1,588	100%	100%	100%	1.00
Merced River Hatchery	Fall	1,098	1,098	300	299	264	100%	100%	97%	1.03
Coleman National Fish Hatchery	Late-fall[c/]	4,950	4,950	4,836	4,673	4,620	100%	97%	100%	1.04 [b/]
Coleman National Fish Hatchery Trap	Late-fall[c/]	223	213	211	200	196	96%	95%	99%	1.12
Total Hatchery Escapement		**126,327**	**126,317**	**40,297**	**28,533**	**27,944**				
	fall	**116,807**	**116,807**	**31,087**	**19,498**	**19,029**				
Natural Area Escapement										
Upper Sacramento River (above RBDD)	Winter	5,920	3,020	155	155	130	51%	100%	100%	2.64 [d/]
Butte Creek	Spring	15,887	10,991	0	0	0	69%	-	-	-
Upper Sacramento River (above RBDD)	Fall	32,515	5,622	343	338	311	17%	99%	100%	11.53 [d/]
Clear Creek	Fall	13,337	5,735	292	290	269	43%	99%	100%	4.98 [d/]
Battle Creek	Fall	31,569	video		data not collected		-	-	-	- [e/]
Cottonwood Creek	Fall	2,774	1,148	96	95	88	41%	99%	99%	2.42 [f/]
Paynes Creek	Fall	175	166	23	23	22	95%	100%	100%	1.05
Mill Creek	Fall	2,197	148	14	14	14	7%	100%	100%	13.80 [f/]
Deer Creek	Fall	1,026	112	1	1	1	11%	100%	100%	9.16 [f/]
Butte Creek	Fall	2,200	1,554	33	33	31	71%	100%	100%	1.42
Feather River	Fall	151,209	9,099	3,503	3,496	3,269	6%	100%	100%	16.10
Yuba River above Daguerre Point Dam (DPD)	Fall	11,380	11,150	1,235	129	112	98%	10%	100%	9.77 [g/]
Yuba River below DPD	Fall	3,500	521	79	79	72	15%	100%	100%	6.72 [d/]
American River	Fall	54,259	25,813	2,178	2,162	2,041	48%	99%	100%	5.08 [d/]
Mokelumne River	Fall	7,071	7,071	1,967	456	431	100%	23%	99%	4.37 [g/]
Stanislaus River	Fall	2,845	865	245	245	222	30%	100%	96%	3.28 [d/]
Tuolumne River	Fall	1,926	1,725	150	150	128	90%	100%	96%	1.51 [d/]
Merced River	Fall	2,826	441	86	86	80	16%	100%	99%	6.49 [d/]
Upper Sacramento River (above RBDD)	Late-fall[c/]	7,950	1,129	123	123	115	14%	100%	97%	11.27 [d/]
Total Natural Area Escapement		**350,566**	**86,310**	**10,523**	**7,875**	**7,336**				
	fall	**320,809**	**71,170**	**10,245**	**7,597**	**7,091**				
CV Sport Harvest										
Sacramento River (above Feather River)	Fall	20,947	1,851	318	312	310	9%	98%	100%	11.53
Sacramento River (below Feather River)	Fall	20,489	714	147	146	145	3%	99%	100%	28.89
Feather River	Fall	12,649	708	159	159	155	6%	100%	99%	17.98
American River	Fall	9,967	338	69	69	68	3%	100%	100%	29.49
Mokelumne River	Fall	1,239	115	34	34	34	9%	100%	100%	10.77
Sacramento River (above Feather River)	Late-fall[c/]	1,265	120	70	70	68	9%	100%	99%	10.70
Total Sport Harvest		**66,556**	**3,846**	**797**	**790**	**780**				
Total		**543,449**	**216,473**	**51,617**	**37,198**	**36,060**				

a/ Number of Chinook salmon sampled and visually checked for a clipped adipose fin.
b/ Average sample expansion factor. Coleman National Fish Hatchery sample expansion factors calculated based on run-timing and sampling protocol; fall and late-fall counts parsed based on CWT codes.
c/ Late-fall hatchery returns, natural escapement, and sport harvest occurred during late fall of 2013 through early 2014 (return year 2014).
d/ Carcass survey sample expansion factor based on fresh fish only and expanded to all valid CWTs (Mohr and Satterthwaite, 2013; Appendix 1.
e/ Battle Creek fall Chinook natural escapement not sampled; escapement estimate based on total Battle Creek adult and jack video weir counts minus total return to Coleman National Fish Hatchery.
f/ Escapement estimate based on video counts; CWTs collected in separate survey (e.g., kayak survey).
g/ Natural escapement CWTs collected on spawning grounds and expanded based on total ad-clip count observed via video weir (e.g., Mokelumne River, Yuba River above Daguerre Point Dam).

Table 5. Catch estimates and sample data for 2013 Ocean Salmon Sport and Commercial Fisheries by major port area.

Port	Total Harvest Estimate	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	33,981	8,457	1,541	1,532	1,354	25%	99%	100%	4.05
Fort Bragg	10,168	2,361	416	414	388	23%	100%	99%	4.35
San Francisco	61,291	17,671	3,380	3,356	3,230	29%	99%	99%	3.52
Monterey	10,634	2,395	589	588	575	23%	100%	100%	4.47
	116,074	**30,884**	**5,926**	**5,890**	**5,547**				
California Commercial									
Eureka/Crescent	10,178	6,099	965	965	831	60%	100%	100%	1.67
Fort Bragg	116,158	31,672	4,816	4,772	4,218	27%	99%	100%	3.71
San Francisco	143,654	54,531	9,103	9,102	8,528	38%	100%	100%	2.64
Monterey	27,637	11,848	2,115	2,112	2,019	43%	100%	100%	2.34
	297,627	**104,150**	**16,999**	**16,951**	**15,596**				
California Total	**413,701**	**135,034**	**22,925**	**22,841**	**21,143**				
Oregon Sport	**28,316**	**9,724**	**1,741**	**1,734**	**1,637**	34%	100%	99%	2.95
Oregon Commercial	**110,812**	**40,389**	**7,141**	**7,131**	**6,852**	36%	100%	99%	2.77
Oregon Total	**139,128**	**50,113**	**8,882**	**8,865**	**8,489**				

a/ Number of salmon visually checked for a clipped adipose fin or electronically wanded to check for the presence of a coded-wire-tag.

Table 6. Raw and expanded Chinook CWT recoveries in the Central Valley by run type and brood year during 2013.

Fall-run	2012	2011	2010	2009	2008	Total CV	
Age	1	2	3	4[a/]	5	CWTs	Total CV %
Raw CWT Recoveries	3 (<1%)	1,967 (9%)	15,923 (75%)	3,375 (16%)	1 (<1%)	21,269	59%
Expanded CWT$_{total}$	**79** (<1%)	**20,887** (7%)	**240,664** (78%)	**47,819** (15%)	**1** (<1%)	309,449	87%

Spring-run		2011	2010	2009	2008	Total CV	
Age		2	3	4	5	CWTs	Total CV %
Raw CWT Recoveries		82 (<1%)	8,919 (93%)	631 (7%)		9,632	27%
Expanded CWT$_{total}$		**207** (<1%)	**31,970** (87%)	**4,750** (13%)		36,927	10%

Late-Fall-run		2012	2011	2010	2009	Total CV	
Age		2	3	4	5	CWTs	Total CV %
Raw CWT Recoveries		946 (19%)	2,786 (55%)	1,297 (26%)		5,029	14%
Expanded CWT$_{total}$		**1,648** (21%)	**3,957** (49%)	**2,392** (30%)		7,997	2%

Winter-run		2011	2010	2009	2008	Total CV	
Age		2	3	4	5	CWTs	Total CV %
Raw CWT Recoveries		23 (18%)	107 (82%)			130	0.4%
Expanded CWT$_{total}$		**64** (17%)	**304** (83%)			367	0.1%

All Runs						Total CV	
Age	1	2	3	4[a/]	5	CWTs	Total CV %
Raw CWT Recoveries	3 (<1%)	3,018 (8%)	27,735 (77%)	5,303 (15%)	1 (<1%)	36,060	100%
CV Expanded CWT$_{total}$	**79** (<1%)	**22,805** (6%)	**276,895** (78%)	**54,961** (15%)	**1** (<1%)	354,741	100%

a/ Includes brood year 2009 fall-run Chinook released from Iron Gate Hatchery on Klamath River.

Table 7. Raw and expanded Chinook CWT recoveries in 2013 California ocean fisheries by run type and brood year.

Fall-run	2011	2010	2009	2008	Total Ocean	Total
Age	2	3	4	5	CWTs	Ocean%
Raw CWT Recoveries	346 (2%)	15,076 (87%)	1,817 (11%)	1 (<1%)	17,240	82%
Expanded CWT$_{total}$	**3,631** (2%)	**163,518** (90%)	**15,441** (8%)	**12** (<1%)	182,601	86%
Spring-run	2011	2010	2009	2008	Total Ocean	Total
Age	2	3	4	5	CWTs	Ocean%
Raw CWT Recoveries	35 (2%)	1,464 (95%)	37 (2%)		1,536	7%
Expanded CWT$_{total}$	**121** (3%)	**4,483** (95%)	**107** (2%)		4,711	2%
Late-Fall-run	2012	2011	2010	2009	Total Ocean	Total
Age	2	3	4	5	CWTs	Ocean%
Raw CWT Recoveries	13 (2%)	383 (50%)	375 (49%)		771	4%
Expanded CWT$_{total}$	**44** (2%)	**1,224** (51%)	**1,118** (47%)		2,386	1%
Winter-run	2012	2011	2010	2009	Total Ocean	Total
Age	2	3	4	5	CWTs	Ocean%
Raw CWT Recoveries		34 (94%)	2 (6%)		36	0.2%
Expanded CWT$_{total}$		**121** (95%)	**6** (5%)		127	0.1%
Non-CV stocks	2011	2010	2009	2008	Total Ocean	Total
Age	2	3	4	5	CWTs	Ocean%
Raw CWT Recoveries	1 (<1%)	451 (29%)	1,050 (67%)	58 (4%)	1,560	7%
Expanded CWT$_{total}$	**17** (<1%)	**10,108** (44%)	**12,825** (55%)	**231** (<1%)	23,183	11%
All Runs					Total Ocean	Total
Age	2	3	4	5	CWTs	Ocean%
Raw CWT Recoveries	395 (2%)	17,408 (82%)	3,281 (16%)	59 (<1%)	21,143	100%
Expanded CWT$_{total}$	**3,813** (2%)	**179,455** (84%)	**29,497** (14%)	**243** (<1%)	213,008	100%
CV Expanded CWT$_{total}$ proportion CV stocks	3,796 (99.5%)	169,346 (94%)	16,672 (57%)	12 (5%)	189,826	89%

Table 8. Raw and expanded Chinook CWT recoveries in 2013 Oregon ocean fisheries by run type and brood year.

Fall-run	2011	2010	2009	2008	Total Ocean	Total
Age	2	3	4	5	CWTs	Ocean%
Raw CWT Recoveries	10 (<1%)	5,204 (87%)	782 (13%)	2 (<1%)	5,998	71%
Expanded CWT_{total}	**103** (<1%)	**51,334** (90%)	**5,425** (10%)	**19** (<1%)	56,882	77%
Spring-run	2011	2010	2009	2008	Total Ocean	Total
Age	2	3	4	5	CWTs	Ocean%
Raw CWT Recoveries	4 (<1%)	798 (98%)	12 (1%)		814	10%
Expanded CWT_{total}	**14** (<1%)	**2,163** (98%)	**38** (2%)		2,216	3%
Late-Fall-run	2012	2011	2010	2009	Total Ocean	Total
Age	2	3	4	5	CWTs	Ocean%
Raw CWT Recoveries		13 (25%)	40 (75%)		53	1%
Expanded CWT_{total}		**38** (26%)	**107** (74%)		145	0%
Non-CV stocks	2011	2010	2009	2008	Total Ocean	Total
Age	2	3	4	5	CWTs	Ocean%
Raw CWT Recoveries		507 (31%)	911 (56%)	208 (13%)	1,626	19%
Expanded CWT_{total}		**7,206** (48%)	**6,801** (45%)	**1,079** (7%)	15,086	20%
All Runs					Total Ocean	Total
Age	2	3	4	5	CWTs	Ocean%
Raw CWT Recoveries	14 (<1%)	6,522 (77%)	1,745 (21%)	210 (2%)	8,491	100%
Expanded CWT_{total}	**117** (<1%)	**60,741** (82%)	**12,372** (17%)	**1,098** (1%)	74,328	100%
CV Expanded CWT_{total} (proportion CV stocks)	117 (100%)	53,535 (88%)	5,570 (45%)	19 (2%)	59,242	80%

Table 9. Percentage of inland CWT_{total} recoveries by location, run, and release type[a/] in hatchery returns, natural escapement and sport harvest during 2013.

			CFH			FRH						NIM		MOK			MER		Total %		Total
Location	**Run**	**SacW**	**CFHLh**	**CFHFh**	**CFHFn**	**FRHS**	**FRHSn**	**FRHFb**	**FRHFn**	**FRHFnc**	**FRHFtib**	**NIMF**	**NIMFn**	**MOKF**	**MOKFn**	**MOKFt**	**MERF**	**MERFt**	**Hatchery**	**Natural**	**Run**
Hatchery Spawners																					
Feather River Hatchery	Spring					79%	16%		5%										99%	1%	4,291
Feather River Hatchery preseason	Spring					79%	20%		2%										100%	0%	56
Coleman National Fish Hatchery	Fall			87%	2%		-	-	1%	-	-		-		-	-	-		90%	10%	69,861
Feather River Hatchery	Fall			-	1%	11%	3%	0%	80%	0%	0%	-	0%	-	0%	-	-	-	97%	3%	27,622
Nimbus Fish Hatchery	Fall				2%				2%	-	-	35%	26%	0%	19%	4%		0%	86%	14%	9,076
Nimbus Fish Hatchery Weir	Fall			0%	2%		0%	0%	6%	0%	0%	28%	11%		21%	2%	-		71%	29%	3,969
Mokelumne River Hatchery	Fall		-		1%				4%	-	0%	0%	1%	5%	66%	12%		0%	89%	11%	5,181
Merced River Hatchery	Fall		0%		2%			0%	4%				3%		34%	9%	9%	1%	63%	37%	1,098
Coleman National Fish Hatchery	Late-fall[b/]		99%																99%	1%	4,950
Coleman Hatchery Fish Trap	Late-fall[b/]		97%																97%	3%	223
Total Hatchery Fall Run			**-**	***52%***	***1%***	***3%***	***1%***	***0%***	***20%***	***0%***	***0%***	***4%***	***2%***	***0%***	***5%***	***1%***	***0%***	**-**	***90%***	***10%***	***116,807***
Natural Spawners																					
Upper Sacramento River	Winter	6%																	6%	94%	5,920
Butte Creek	Spring																		0%	100%	15,887
Upper Sacramento River	Fall		-	8%	2%		3%	0%	20%	0%	0%	0%	0%		0%				34%	66%	32,515
Clear Creek	Fall			20%	2%		1%		14%	0%	0%				-				37%	63%	13,337
Battle Creek	Fall[c/]			87%	2%		-	-	1%	-	-		-		-	-	-		90%	10%	31,569
Cottonwood Creek	Fall			19%	3%				8%										31%	69%	2,774
Paynes Creek	Fall			53%															53%	47%	175
Mill Creek	Fall			15%	5%				10%		1%				1%				31%	69%	2,197
Deer Creek	Fall								4%										4%	96%	1,026
Butte Creek	Fall				1%				4%		0%				2%			0%	7%	93%	2,200
Feather River	Fall			-	2%	13%	5%	-	63%	0%	0%		0%	-	0%	-		-	84%	16%	151,209
Yuba - above	Fall				3%	0%	0%		24%	0%	0%	1%	1%		4%				34%	66%	11,380
Yuba - below	Fall			1%	7%	2%	0%	0%	29%	0%	0%	2%	1%		3%	1%			46%	54%	3,500
American River	Fall			0%	4%				2%	-		34%	17%	-	7%	1%		0%	65%	35%	54,259
Mokelumne River	Fall				1%				2%				1%	1%	54%	5%		0%	64%	36%	7,071
Stanislaus River	Fall				5%			0%	6%		0%		0%		49%	5%		1%	66%	34%	2,845
Tuolumne River	Fall				4%				4%				0%		18%	2%	0%	0%	28%	72%	1,926
Merced River	Fall				8%				1%				2%		25%	6%	2%	1%	44%	56%	2,826
Upper Sacramento River	Late-fall[b/]		16%				0%						1%						17%	83%	7,950
Total Natural Area Fall Run			**-**	***11%***	***3%***	***6%***	***3%***	**-**	***34%***	***0%***	***0%***	***6%***	***3%***	**-**	***3%***	***0%***	**-**	**-**	***69%***	***31%***	***320,809***
In-basin CWT_{total}	All	0%	1%	21%	1%	6%	2%	-	28%	0%	0%	5%	3%	0%	2%	0%	-	-	69%	31%	438,935
Stray CWT_{total}	All		-	10%	22%		3%	0%	31%	0%	0%	1%	2%	0%	27%	4%	-	0%	100%		37,958
Total CV Spawners		**0%**	**1%**	**20%**	**2%**	**5%**	**2%**	**-**	**28%**	**0%**	**0%**	**5%**	**3%**	**0%**	**4%**	**1%**	**-**	**-**	**71%**	**29%**	**476,893**
CV Sport Harvest																					0
Upper Sacramento River	Fall			59%	1%		1%		6%	0%	0%	0%							67%	33%	20,947
Lower Sacramento River	Fall		4%	5%	5%				28%	0%	0%	9%	5%		5%	1%		0%	63%	37%	20,489
Feather River	Fall			1%	5%	2%	1%	0%	60%	1%	1%				1%				72%	28%	12,649
American River	Fall				9%				2%	1%		28%	11%		10%	1%		1%	63%	37%	9,967
Mokelumne River	Fall		1%						7%				3%	2%	61%	10%			85%	15%	1,239
Upper Sacramento River	Late-fall[b/]		58%												1%				59%	41%	1,265
Total Sport Harvest			**2%**	**20%**	**4%**	**0%**	**0%**	**0%**	**22%**	**0%**	**0%**	**7%**	**3%**	**-**	**4%**	**1%**		**0%**	**66%**	**34%**	**66,556**

a/ Any values less than 0.05% of CWT_{total} are displayed as "-"; values equal or greater than 0.05% but less than 0.5% of CWT_{total} are displayed as 0%.

b/ Late-fall hatchery returns, natural escapement, and sport harvest occurred in late fall 2013 (return year 2014).

c/ No CWT recovery survey or ad-clip count available for Battle Creek natural escapement. CWT release groups and hatchery proportions assumed to be equivalent to fall return at CFH (FWS staff, per. comm).

Table 10. Fall- and late-fall-run (2014) Chinook salmon escapement at Coleman National Fish Hatchery based on run-timing and CWT sample rates.

Calculation of CFH sample expansion factors based on run-timing and sample rate

2013 CFH fall-run escapement (Oct 2, 2013 - Dec 3, 2013)

Run timing (CWT sample rate)	Escapement N	Chinook sampled (n)	Observed ad-clips	Heads processed	CWTs recovered	Valid CWTs	Sample rate (fe)	Ad-clips processed (fa)	Valid CWTs (fd)	F_{samp}	Total CWT Production	$\sum_{i=1}^{m} CWT_{total,i}$	Hatchery proportion
Oct 2 - Nov 21 (19%)	69,979	69,979	16,098	4,352	4,284	4,279	100%	27.0%	99.9%	**3.70**	16,999	62,833	
Nov 27 - Dec 3 (100%)	345	345	254	254	251	250	100%	100.0%	99.6%	**1.00**	288	289	
	70,324	**70,324**	**16,352**	**4,606**	**4,535**	**4,529**					**17,287**	**63,122**	**89.8%**

2014 CFH late-fall-run escapement (Dec 23, 2013 - Mar 5, 2014)

Run timing (CWT sample rate)	Escapement N	Chinook sampled	Observed ad-clips	Heads processed	CWTs recovered	Valid CWTs	Sample rate (fe)	Ad-clips processed (fa)	Valid CWTs (fd)	F_{samp}	Total CWT Production	$\sum_{i=1}^{m} CWT_{total,i}$	Hatchery proportion
Dec 23 - Mar 5 (100%)	**4,487**	**4,487**	**4,392**	**4,388**	**4,345**	**4,339**	100%	99.9%	99.9%	**1.00**	**4,457**	**4,463**	**99.5%**
Total CFH count	**74,811**	**74,811**	**20,744**	**8,994**	**8,880**	**8,868**					**21,744**	**67,585**	

Final CFH escapment based on CWT segregation and sample expansion factors F_{samp} calculated above

2013 CFH fall-run escapement

Run timing	Escapement N	Chinook sampled	Observed ad-clips	Heads processed	CWTs recovered	Fall CWTs	Sample rate (fe)	Ad-clips processed (fa)	Valid CWTs (fd)	Average F_{samp}	Total CWT Production	$\sum_{i=1}^{m} CWT_{total,i}$	Hatchery proportion
Oct 2 - Dec 3	**69,861**	**69,861**	**15,908**	**4,321**	**4,252**	**4,248**	100%	27.2%	99.9%	**3.69**	**17,000**	**62,669**	**89.7%**

2014 CFH late-fall-run escapement

Run timing	Escapement N	Chinook sampled	Observed ad-clips	Heads processed	CWTs recovered	Late fall CWTs	Sample rate (fe)	Ad-clips processed (fa)	Valid CWTs (fd)	Average F_{samp}	Total CWT Production	$\sum_{i=1}^{m} CWT_{total,i}$	Hatchery proportion
Nov 7 - Mar 5	**4,950**	**4,950**	**4,836**	**4,673**	**4,628**	**4,620**	100%	96.6%	99.8%	**1.04**	**4,744**	**4,916**	**99.3%**
Total CFH count	**74,811**	**74,811**	**20,744**	**8,994**	**8,880**	**8,868**					**21,744**	**67,585**	

Table 11. Total inland CWT_{total} recoveries by location, run, and release type[a/] in hatchery returns, natural escapement and sport harvest during 2013.

			CFH			FRH						NIM		MOK			MER		Total CWT_{total}		Total
Location	**Run**	**SacW**	**CFHLh**	**CFHFh**	**CFHFn**	**FRHS**	**FRHSn**	**FRHFb**	**FRHFn**	**FRHFnc**	**FRHFtib**	**NIMF**	**NIMFn**	**MOKF**	**MOKFn**	**MOKFt**	**MERF**	**MERFt**	**Hatchery**	**Natural**	**Run**
Hatchery Spawners																					
Feather River Hatchery	Spring					3,371	668		206										4,245	46	4,291
Feather River Hatchery preseason	Spring					44	11		1										56		56
Coleman National Fish Hatchery	Fall			60,877	1,053		4	4	682	15	7		4		15	4	3		62,668	7,193	69,861
Feather River Hatchery	Fall			4	267	2,991	855	62	22,234	128	75	8	16	1	57	8	4	2	26,712	910	27,622
Nimbus Fish Hatchery	Fall				144				137	1	1	3,163	2,343	8	1,710	321		9	7,837	1,239	9,076
Nimbus Fish Hatchery Weir	Fall			8	68		2	7	257	10	2	1,104	432		820	96	1		2,807	1,162	3,969
Mokelumne River Hatchery	Fall		1		56				193	2	5	4	72	241	3,394	647		4	4,623	558	5,181
Merced River Hatchery	Fall		3		25			1	46				34		378	99	96	6	688	410	1,098
Coleman National Fish Hatchery	Late-fall[b/]		4,915																4,915	35	4,950
Coleman Hatchery Fish Trap	Late-fall[b/]		216																216	7	223
Total Hatchery Fall Run			***4***	***60,889***	***1,613***	***2,991***	***861***	***74***	***23,549***	***156***	***90***	***4,279***	***2,901***	***250***	***6,374***	***1,175***	***104***	***21***	***105,335***	***11,472***	***116,807***
Natural Spawners																					
Upper Sacramento River	Winter	367																	367	5,553	5,920
Butte Creek	Spring																			15,887	15,887
Upper Sacramento River	Fall		12	2,727	786		998	23	6,362	47	35	46	46		58				11,140	21,375	32,515
Clear Creek	Fall			2,615	259		108		1,885	25	20				5				4,918	8,419	13,337
Battle Creek	Fall[c/]			27,509	476		2	2	308	7	3		2		7	2	1		28,319	3,250	31,569
Cottonwood Creek	Fall			533	87				234										855	1,919	2,774
Paynes Creek	Fall			93															93	82	175
Mill Creek	Fall			332	110				222		14				14				692	1,505	2,197
Deer Creek	Fall								37										37	989	1,026
Butte Creek	Fall				17				86		3				36			2	143	2,057	2,200
Feather River	Fall			65	3,676	19,545	7,662	64	95,101	485	523		79	16	308	65		17	127,606	23,603	151,209
Yuba - above	Fall				352	39	20		2,679	10	10	78	117		511				3,817	7,563	11,380
Yuba - below	Fall			27	242	61	7	7	1,030	7	7	54	27		108	27			1,603	1,897	3,500
American River	Fall			81	2,419				1,046	15		18,268	8,983	10	3,839	469		32	35,163	19,096	54,259
Mokelumne River	Fall				87				141				91	66	3,784	351		9	4,529	2,542	7,071
Stanislaus River	Fall				131			3	158		3		13		1,394	145		21	1,870	975	2,845
Tuolumne River	Fall				73				73				6		342	36	2	5	536	1,390	1,926
Merced River	Fall				234				26				52		698	156	61	21	1,248	1,578	2,826
Upper Sacramento River	Late-fall[b/]		1,302				12						45						1,359	6,591	7,950
Total Natural Area Fall Run			***12***	***33,982***	***8,949***	***19,645***	***8,797***	***99***	***109,388***	***596***	***618***	***18,446***	***9,416***	***92***	***11,104***	***1,251***	***64***	***107***	***222,569***	***98,240***	***320,809***
In-basin CWT_{total}	All	367	6,445	91,113	2,315	26,051	9,223	133	121,251	630	615	22,535	11,758	307	7,178	998	157	27	301,103	137,831	438,935
Stray CWT_{total}	All		4	3,758	8,247		1,126	40	11,893	122	93	190	604	35	10,300	1,428	11	101	37,958		37,958
Total CV Spawners		**367**	**6,449**	**94,871**	**10,562**	**26,051**	**10,349**	**173**	**133,144**	**752**	**708**	**22,725**	**12,362**	**342**	**17,478**	**2,426**	**168**	**128**	**339,062**	**137,831**	**476,893**
	%stray	0%	0%	4%	78%	0%	11%	23%	9%	16%	13%	1%	5%	10%	59%	59%	7%	79%	11%		8%
CV Sport Harvest																					
Upper Sacramento River	Fall			12,298	139		107		1,350	12	12	12							13,929	7,018	20,947
Lower Sacramento River	Fall		799	1,043	925				5,700	87	29	1,943	1,068		987	231		62	12,874	7,615	20,489
Feather River	Fall			72	648	291	129	54	7,538	90	164				72				9,058	3,591	12,649
American River	Fall				944				238	88		2,784	1,089		982	118		62	6,304	3,663	9,967
Mokelumne River	Fall		11						87				43	22	757	129			1,049	190	1,239
Upper Sacramento River	Late-fall[b/]		737												11				748	517	1,265
Total Sport Harvest			**1,547**	**13,413**	**2,656**	**291**	**236**	**54**	**14,913**	**277**	**205**	**4,739**	**2,200**	**22**	**2,809**	**478**		**124**	**43,962**	**22,594**	**66,556**

a/ Release types defined in Table 3.

b/ Late-fall hatchery returns, natural escapement, and sport harvest occurred in late fall 2013 (return year 2014).

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

Table 12. CWT recovery rate (recoveries per 100,000 CWTs released) by release type, brood year and recovery location in 2013.

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	Mer	SJ	In-basin	Stray	CV total			In-basin	Stray	**CV total**	**Ocean**
FRHS	2011	Spr	1,088,286				145						145		145		79	13		**13**	**7**
FRHSn	2011	Spr	1,125,189				58						58		58		54	5		**5**	**5**
CFHFh	2011	Fall	3,117,042	396		24							396	24	420	**6%**	101	13	1	**14**	**3**
FRHFb	2011	Fall	297,089	4	23		126	7	7		1	3	133	38	171	**22%**	55	45	13	**58**	**19**
FRHFe	2011	Fall	11,449														4			0	**34**
FRHFn	2011	Fall	2,293,211	46	161	96	1,669	113	88	26	4	19	1,782	441	2,224	**20%**	539	78	19	**97**	**24**
FRHFnc	2011	Fall	426,190	11		10	430	**7**	20	1			437	42	479	**9%**	345	102	10	**112**	**81**
FRHFtib	2011	Fall	9,933														6			0	**62**
NIMF	2011	Fall	1,078,191						381				381		381		41	35		**35**	**4**
NIMFn	2011	Fall	328,073						87	6		3	87	10	97	**10%**	17	27	3	**30**	**5**
MOKF	2011	Fall	92,020							20			20		20			22		**22**	
MOKFn	2011	Fall	1,487,132			4	2	16	112	365	29	93	365	256	622	**41%**	113	25	17	**42**	**8**
MOKFt	2011	Fall	110,737				1		6	35	3	10	35	20	55	**36%**	16	32	18	**50**	**15**
MERF	2011	Fall	262,108				1		1		20		20	2	22	**9%**		8	1	**9**	
SacW[b/]	2011	Wint	185,313		61								61		61			33		**33**	
CFHLh	2012	Late	1,031,419	991	124					1	2		1,115	3	1,118	**0%**	42	108		**108**	**4**
		Total	12,943,382	1,448	369	134	2,433	143	701	455	59	129	5,036	836	5,872	**14%**	1,413	546	82	**628**	**271**

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	Mer	SJ	In-basin	Stray	CV total			In-basin	Stray	**CV total**	**Ocean**
FRHS	2010	Spr	1,170,340				24,356	100					24,456		24,456		5,373	2090		**2090**	**459**
FRHSn	2010	Spr	1,136,690	4	196	15	6,507	26	2				6,534	217	6,751	**3%**	1,196	575	19	**594**	**105**
CFHFh	2010	Fall	2,835,420	12,638	438	749	17	7	22				13,076	795	13,872	**6%**	13,768	461	28	**489**	**486**
CFHFn	2010	Fall	334,756	230	81	108	731	96	585	35	52	46	311	1,653	1,964	**84%**	4,598	93	494	**587**	**1,374**
FRHFn	2010	Fall	2,554,115	95	657	332	24,137	780	234	47	14	35	24,918	1,414	26,332	**5%**	20,709	976	55	**1031**	**811**
FRHFnc	2010	Fall	185,985		46	15	181		6	1			181	68	249	**27%**	6,867	97	37	**134**	**3,692**
FRHFtib	2010	Fall	56,030	7	12	20	335	7	2	3		3	342	47	389	**12%**	606	610	84	**694**	**1,082**
NIMF	2010	Fall	1,014,340				2	26	5,605	1			5,605	29	5,634	**1%**	7,631	553	3	**556**	**752**
NIMFn	2010	Fall	368,363		12		18	16	1,747	24	15	2	1,747	86	1,833	**5%**	2,438	474	23	**497**	**662**
MOKF	2010	Fall	100,215				1		3	143			143	4	147	**3%**	118	142	4	**146**	**117**
MOKFn	2010	Fall	1,126,781	2	12	3	73	101	1,256	1,100	180	239	1,100	1,866	2,965	**63%**	3,485	98	166	**264**	**309**
MOKFt	2010	Fall	473,268	1			17	7	215	213	61	35	213	336	549	**61%**	650	45	71	**116**	**137**
MERF	2010	Fall	122,973	3			3				131	2	131	8	139	**6%**	141	107	6	**113**	**115**
MERFt	2010	Fall	6,669								2	3	2	3	5	**59%**	6	31	45	**76**	**87**
SacW[b/]	2010	Wint	113,905		282								282		282		115	248		**248**	**62**
CFHLh	2011	Late	1,037,859	2,762	349						1		3,111	1	3,112	**0%**	1,241	300		**300**	**120**
		Total	12,637,709	15,743	2,085	1,243	56,380	1,166	9,677	1,566	455	365	82,152	6,528	88,680	**7%**	68,942	6,900	1,035	**7,935**	**10,370**

Table 12. CWT recovery rate (recoveries per 100,000 CWTs released) by release type, brood year and recovery location in 2013. (Continued)

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	Mer	SJ	In-basin	Stray	CV total		CWT_{samp}	In-basin	Stray	**CV total**	**Ocean**
FRHS	2009	Spr	1,026,954				1,194						1,194		1,194		36	116		**116**	**4**
FRHSn	2009	Spr	1,058,635		784	90	2,423						2,423	873	3,296	**26%**	105	229	83	**312**	**10**
CFHFh	2009	Fall	2,541,142	2,147	242	118							2,390	118	2,508	**5%**	1,062	94	5	**99**	**42**
CFHFn	2009	Fall	337,919	33	115	10	254	53	72	1	13	5	148	407	555	**73%**	379	44	120	**164**	**112**
FRHFn	2009	Fall	2,367,209	28	761	183	3,331	26	36	10		3	3,358	1,021	4,379	**23%**	1,478	142	43	**185**	**62**
FRHFnc	2009	Fall	118,879														126			**0**	**106**
FRHFtib	2009	Fall	60,104		23	16	254	10	1	1			263	41	305	**14%**	223	438	69	**507**	**370**
NIMF	2009	Fall	1,000,559		12			7	1,296				1,296	18	1,314	**1%**	746	129	2	**131**	**75**
NIMFn	2009	Fall	347,527	1	11		2	20	1,013	8	6		1,013	49	1,062	**5%**	935	292	14	**306**	**269**
MOKF	2009	Fall	99,048				16		15	140			140	31	171	**18%**	98	141	32	**173**	**99**
MOKFn	2009	Fall	2,015,730	7	12	26	60	144	858	1,275	234	399	1,275	1,740	3,015	**58%**	2,761	63	86	**149**	**137**
MERFt	2009	Fall	154,685			1	18		38	13	24	21	24	92	116	**80%**	105	15	59	**74**	**68**
SacW[b/]		Wint															6				**5**
CFHLh	2010	Fall	992,047	1,244	811								2,055		2,055		1,196	207		**207**	**121**
		Total	12,120,438	3,461	2,771	445	7,553	259	3,329	1,448	277	428	15,579	4,391	19,970	**22%**	9,255	1910	513	**2423**	**1,480**

a/ Natural creeks include Clear Creek, Cottonwood Creek, Paynes Creek, Mill Creek, Deer Creek and Butte Creek.

b/ Ocean recoveries of SacW are considered one year older than those of the same brood year recovered in CV; Brood year 2011 = age-3 ocean, brood year 2010 = age-4 ocean.

Sacramento River fall Chinook release types (SFC)

CFHFh Coleman National Fish Hatchery fall hatchery releases
CFHFn Coleman National Fish Hatchery fall bay net pen releases
FRHFb Feather River Hatchery fall barge study releases
FRHFe Feather River Hatchery fall experimental (includes rice field releases @ Knaggs Ranch)
FRHFn Feather River Hatchery fall bay net pen releases
FRHFnc Feather River Hatchery fall coastal net pen releases (Santa Cruz and Pillar Point)
FRHFtib Feather River Hatchery fall Tiburon net pen releases (released as yearlings)
NIMF Nimbus Hatchery fall in-basin releases
NIMFn Nimbus Hatchery fall bay net pen releases

Other CV Chinook release types (OCV)

FRHS Feather River Hatchery spring in-basin releases
FRHSn Feather River Hatchery spring bay net pen releases
MOKF Mokelumne River Hatchery fall in-basin releases
MOKFn Mokelumne River Hatchery fall bay net pen releases
MOKFt Mokelumne River Hatchery fall trucked releases
MERF Merced River Hatchery fall in-basin releases
MERFt Merced River Hatchery fall trucked releases
SacW Livingston Stone Hatchery winter in-basin releases
CFHLh Coleman National Fish Hatchery late fall hatchery releases

Table 13. Percentage of CWT_{total} recoveries by port area, month and release type[a/] in 2013 California ocean salmon sport fishery.

		CFH			FRH						NIM		MOK			MER			Total	Total %		Total
	SacW	CFHLh	CFHFh	CFHFn	FRHS	FRHSn	FRHFb	FRHFn	FRHFnc	FRHFtib	NIMF	NIMFn	MOKF	MOKFn	MOKFt	MERF	MERFt	nonCV	CV	Hatchery	Natural	Harvest
California Sport Harvest																						
Eureka/Crescent City																						
May		0%	18%	3%	2%	0%		26%	1%	0%	5%	1%		6%				12%	64%	75%	25%	2,563
Jun		0%	11%	4%	1%	0%		18%	1%	0%	5%	1%		3%	1%		-	15%	45%	59%	41%	10,514
Jul		0%	10%	3%	1%	0%		19%	1%	0%	5%	3%	0%	4%	0%	-		10%	48%	57%	43%	11,305
Aug		0%	7%	3%	1%	0%		11%	1%	0%	5%	2%		6%	0%			13%	37%	49%	51%	9,160
Sep			8%	6%	1%		1%	11%	1%		27%	3%		14%					72%	72%	28%	439
Total		**0%**	**10%**	**3%**	**1%**	**0%**	**-**	**17%**	**1%**	**0%**	**5%**	**2%**	**-**	**4%**	**0%**	**-**	**-**	**12%**	**45%**	**57%**	**43%**	**33,981** (29%)
Fort Bragg																						
Apr				6%	3%			21%	1%					3%					34%	34%	66%	310
May			13%	3%	6%	3%		15%	1%		5%	3%		1%				1%	50%	51%	49%	695
Jun		0%	10%	5%	0%			12%	1%	0%	3%	1%		2%	1%			10%	36%	46%	54%	2,459
Jul		0%	18%	5%	0%	0%	0%	17%	2%	0%	6%	2%		5%	1%			1%	56%	57%	43%	5,145
Aug		1%	9%	1%	1%			23%	2%		5%	14%		5%		0%		1%	62%	63%	37%	1,296
Sep		2%	9%	9%				9%			45%	11%		11%	4%				100%	100%	0%	263
Total		**0%**	**14%**	**4%**	**1%**	**0%**	**0%**	**16%**	**2%**	**0%**	**6%**	**4%**		**4%**	**1%**	**-**		**3%**	**52%**	**55%**	**45%**	**10,168** (9%)
San Francisco																						
Apr		1%	13%	5%	3%	1%		22%	2%	0%	4%	4%	-	4%	1%	-		2%	60%	62%	38%	8,121
May	0%	1%	14%	5%	2%	1%		21%	1%	0%	3%	3%	0%	4%	0%	-		2%	55%	57%	43%	9,018
Jun		1%	12%	5%	1%	0%	-	18%	2%	0%	3%	2%	0%	2%	1%			5%	46%	51%	49%	12,204
Jul	-	1%	16%	5%	0%	0%	-	23%	2%	0%	3%	3%	0%	3%	0%	0%	-	2%	57%	59%	41%	21,798
Aug		1%	19%	6%	0%	0%	0%	23%	3%	0%	4%	2%	-	4%	0%		0%		63%	63%	37%	6,818
Sep		1%	7%	3%	0%			12%	1%	0%	12%	6%	0%	9%	3%				54%	54%	46%	1,891
Oct	1%	7%	5%		2%	1%	0%	16%	2%	0%	2%	3%	0%	3%	2%				45%	45%	55%	1,354
Nov		27%						9%	2%	2%	18%								58%	58%	42%	87
Total	**-**	**1%**	**14%**	**5%**	**1%**	**0%**	**0%**	**21%**	**2%**	**0%**	**4%**	**3%**	**0%**	**3%**	**1%**	**-**	**-**	**2%**	**55%**	**57%**	**43%**	**61,291** (53%)
Monterey																						
Apr		0%	16%	5%	7%	1%		29%	3%	0%	4%	2%	0%	0%	1%			1%	69%	71%	29%	5,225
May		1%	18%	1%	2%	1%		30%	2%	0%	3%	2%						1%	61%	62%	38%	1,624
Jun	0%	1%	15%	3%	0%			30%	4%	0%	5%	2%		3%					63%	63%	37%	1,066
Jul	2%	1%	18%	4%			0%	21%	6%	0%	5%	1%		1%		0%		0%	61%	61%	39%	2,261
Aug	6%	1%	6%	3%	1%			12%	8%		3%			3%					43%	43%	57%	440
Sep									52%										52%	52%	48%	18
Total	**1%**	**1%**	**16%**	**4%**	**4%**	**1%**	**0%**	**26%**	**4%**	**0%**	**4%**	**2%**	**-**	**1%**	**0%**	**-**		**1%**	**64%**	**65%**	**35%**	**10,634** (9%)
California Total Sport Harvest																						
	0%	**1%**	**13%**	**4%**	**1%**	**0%**	**-**	**20%**	**2%**	**0%**	**4%**	**3%**	**0%**	**4%**	**1%**	**-**	**-**	**5%**	**53%**	**58%**	**42%**	**116,074**
Oregon Total Sport Harvest																						
		0%	*9%*	*3%*	*1%*	*0%*		*17%*	*1%*	*0%*	*7%*	*4%*		*5%*	*1%*	*-*	*-*	*9%*	*49%*	*58%*	*42%*	*28,316*

a/ Any values less than 0.05% of CWT_{total} are displayed as "-"; values equal or greater than 0.05% but less than 0.5% of CWT_{total} are displayed as 0%.

Table 14. Total CWT_{total} recoveries by port area, month and release type in 2013 California ocean salmon sport fishery.

		CFH			FRH						NIM		MOK			MER			Total	Total CWT_{total}		Total
	SacW	CFHLh	CFHFh	CFHFn	FRHS	FRHSn	FRHFb	FRHFn	FRHFnc	FRHFtib	NIMF	NIMFn	MOKF	MOKFn	MOKFt	MERF	MERFt	nonCV	CV	Hatchery	Natural	Harvest
California Sport Harvest																						
Eureka/Crescent City																						
May		11	454	73	62	11		673	33	8	126	37		146				295	1,634	1,929	634	2,563
Jun		9	1,121	402	65	9		1,871	126	9	553	143		336	70		5	1,525	4,719	6,244	4,270	10,514
Jul		20	1,160	377	76	17		2,157	153	8	523	393	8	454	31	4		1,105	5,381	6,486	4,819	11,305
Aug		20	653	273	48	20		1,048	112	17	437	187		521	31			1,159	3,365	4,524	4,636	9,160
Sep			37	25	6		3	50	6		117	12		62					317	317	122	439
Total		**60**	**3,425**	**1,150**	**257**	**56**	**3**	**5,799**	**430**	**41**	**1,755**	**771**	**8**	**1,519**	**131**	**4**	**5**	**4,083**	**15,417**	**19,500**	**14,481**	**33,981** (29%)
Fort Bragg																						
Apr				18	9			66	4					8					104	104	206	310
May			90	19	41	18		108	9		35	18		10				5	346	351	344	695
Jun		6	240	121	12			300	28	4	69	32		57	16			243	885	1,128	1,331	2,459
Jul		14	916	240	20	9	9	869	94	4	291	127		243	52			29	2,888	2,917	2,228	5,145
Aug		13	121	17	14			292	26		65	182		64		4		17	798	815	481	1,296
Sep		6	23	23				23			117	29		29	11				262	262	1	263
Total		**39**	**1,389**	**438**	**96**	**27**	**9**	**1,657**	**161**	**8**	**577**	**387**		**411**	**79**	**4**		**295**	**5,284**	**5,578**	**4,590**	**10,168** (9%)
San Francisco																						
Apr		46	1,040	444	255	54		1,770	196	34	362	285	3	304	62	3		165	4,858	5,023	3,098	8,121
May	6	72	1,261	414	170	54		1,886	131	9	307	266	18	363	36	3		164	4,995	5,159	3,859	9,018
Jun		104	1,434	628	63	19	3	2,138	239	28	394	253	12	262	90			580	5,667	6,247	5,957	12,204
Jul	10	178	3,415	1,120	83	15	9	5,065	450	49	730	560	25	621	75	15	5	393	12,426	12,819	8,979	21,798
Aug		50	1,315	379	10	7	15	1,591	191	10	281	124	3	302	27		4		4,308	4,308	2,510	6,818
Sep		16	128	58	3			223	24	6	222	112	3	173	51				1,019	1,019	872	1,891
Oct	7	93	68		33	20	6	220	29	3	28	42	2	35	23				609	609	745	1,354
Nov		24						8	2	2	15								51	51	36	87
Total	**23**	**581**	**8,661**	**3,043**	**617**	**168**	**33**	**12,901**	**1,262**	**141**	**2,339**	**1,641**	**66**	**2,060**	**363**	**22**	**9**	**1,303**	**33,932**	**35,234**	**26,057**	**61,291** (53%)
Monterey																						
Apr		24	845	281	350	72		1,493	155	9	215	112	5	23	39			66	3,624	3,690	1,535	5,225
May		16	300	22	32	22		489	33	5	43	27						23	989	1,012	612	1,624
Jun	5	6	157	33	4			315	44	4	56	17		34					675	675	391	1,066
Jul	43	32	410	84			7	466	147	8	118	22		31		5		3	1,372	1,375	886	2,261
Aug	25	3	27	14	3			54	34		13			14					189	189	251	440
Sep									9										9	9	9	18
Total	**73**	**81**	**1,739**	**434**	**390**	**94**	**7**	**2,818**	**422**	**27**	**446**	**177**	**5**	**101**	**39**	**5**		**93**	**6,857**	**6,950**	**3,684**	**10,634** (9%)
California Total Sport Harvest																						
	95	**761**	**15,214**	**5,066**	**1,361**	**346**	**52**	**23,176**	**2,275**	**218**	**5,117**	**2,977**	**79**	**4,092**	**611**	**35**	**14**	**5,773**	**61,489**	**67,262**	**48,812**	**116,074**
Oregon Total Sport Harvest																						
		20	*2,645*	*895*	*356*	*84*		*4,858*	*263*	*26*	*1,976*	*1,100*		*1,477*	*167*	*8*	*6*	*2,548*	*13,880*	*16,428*	*11,888*	*28,316*

Table 15. Percentage of CWT_{total} recoveries by port area, month and release type[a/] in 2013 California ocean salmon commercial fishery.

		CFH			FRH						NIM		MOK			MER			Total	Total %		Total
	SacW	CFHLh	CFHFh	CFHFn	FRHS	FRHSn	FRHFb	FRHFn	FRHFnc	FRHFtib	NIMF	NIMFn	MOKF	MOKFn	MOKFt	MERF	MERFt	nonCV	CV	Hatchery	Natural	Harvest
California Commercial Harvest																						
Eureka/Crescent City																						
May		0%	5%	3%	1%	0%		12%	1%	0%	1%	1%		2%	0%		0%	16%	27%	43%	57%	2,688
Jun			10%	3%	0%			13%	1%	0%	5%	1%		2%		0%		16%	34%	50%	50%	2,924
Jul			8%	4%	0%	0%		9%	1%		2%	2%		2%	0%		0%	14%	29%	43%	57%	2,374
Aug		0%	11%	4%	1%			19%	2%	0%	6%	1%		2%	0%		0%	6%	47%	53%	47%	2,008
Sep		1%	7%	11%	1%			7%	2%		4%			4%					36%	36%	64%	184
Total		**0%**	**8%**	**3%**	**1%**	**0%**		**13%**	**1%**	**0%**	**3%**	**1%**		**2%**	**0%**	**-**	**0%**	**13%**	**34%**	**47%**	**53%**	**10,178** (3%)
Fort Bragg																						
May		0%	3%	1%	0%	0%		3%	0%		2%	1%		0%				24%	12%	35%	65%	4,352
Jun		0%	9%	3%	0%	0%		12%	1%	0%	3%	1%		2%	0%		-	12%	31%	43%	57%	23,785
Jul	-	0%	10%	3%	1%	0%	-	15%	1%	0%	4%	3%	-	3%	0%	-	-	7%	42%	49%	51%	68,781
Aug		1%	7%	4%	1%	0%		18%	1%	0%	9%	3%	0%	4%	0%			3%	48%	51%	49%	14,916
Sep		0%	1%					1%	0%	0%	3%	2%		1%	1%				10%	10%	90%	4,324
Total	**-**	**0%**	**9%**	**3%**	**1%**	**0%**	**-**	**14%**	**1%**	**0%**	**4%**	**2%**	**-**	**3%**	**0%**	**-**	**-**	**8.0%**	**38%**	**46%**	**54%**	**116,158** (39%)
San Francisco																						
May		0%	11%	4%	1%	0%		17%	2%	0%	3%	2%	-	2%	0%	-	-	5%	44%	48%	52%	56,365
Jun		1%	11%	3%	1%	0%	-	17%	1%	0%	4%	2%	0%	2%	0%	-	-	6%	43%	48%	52%	47,837
Jul		1%	12%	4%	1%	0%		21%	1%	0%	5%	4%	-	4%	1%	-	-	1%	55%	57%	43%	24,215
Aug	-	1%	20%	5%	0%	-		19%	1%	0%	5%	4%	0%	3%	0%	0%	0%		58%	58%	42%	7,819
Sep		2%	5%	2%	1%	0%		8%	1%	0%	11%	9%	0%	7%	1%	0%		0%	48%	48%	52%	6,477
Oct	1%	5%	2%	2%	1%	1%		7%	1%		7%	10%	1%	13%	2%				53%	53%	47%	941
Total	**-**	**1%**	**11%**	**4%**	**1%**	**0%**	**-**	**17%**	**1%**	**0%**	**4%**	**3%**	**0%**	**3%**	**1%**	**-**	**-**	**4%**	**46%**	**50%**	**50%**	**143,654** (48%)
Monterey																						
May		0%	16%	5%	2%	1%		23%	2%	0%	2%	1%	-	2%	0%			3%	55%	58%	42%	14,111
Jun	-	1%	13%	3%	1%	0%		18%	1%	0%	3%	3%		2%	1%	0%		4%	45%	49%	51%	10,003
Jul	0%	2%	19%	6%	0%	0%		19%	3%	0%	5%	2%		3%	1%	0%		2%	60%	62%	38%	2,900
Aug	1%	1%	8%	8%				22%	7%		14%	3%		5%					71%	71%	29%	514
Sep									29%										29%	29%	71%	109
Total	**0%**	**1%**	**15%**	**4%**	**1%**	**0%**		**21%**	**2%**	**0%**	**3%**	**2%**	**-**	**2%**	**0%**	**-**		**3%**	**52%**	**55%**	**45%**	**27,637** (9%)
California Total Commercial Harvest																						
	-	**1%**	**11%**	**3%**	**1%**	**0%**	**-**	**16%**	**1%**	**0%**	**4%**	**2%**	**-**	**3%**	**0%**	**-**	**-**	**6%**	**43%**	**49%**	**51%**	**297,627**
Oregon Total Commercial Harvest																						
		0%	*9%*	*3%*	*1%*	*0%*	*-*	*14%*	*1%*	*0%*	*5%*	*3%*	*-*	*4%*	*0%*	*-*	*-*	*11%*	*41%*	*52%*	*48%*	*110,812*

a/ Any values less than 0.05% of CWT_{total} are displayed as "-"; values equal or greater than 0.05% but less than 0.5% of CWT_{total} are displayed as 0%.

Table 16. Total CWT_{total} recoveries by port area, month and release type in 2013 California ocean salmon commercial fishery.

		CFH			FRH						NIM		MOK			MER			Total	Total CWT_{total}		Total
	SacW	CFHLh	CFHFh	CFHFn	FRHS	FRHSn	FRHFb	FRHFn	FRHFnc	FRHFtib	NIMF	NIMFn	MOKF	MOKFn	MOKFt	MERF	MERFt	nonCV	CV	Hatchery	Natural	Harvest
California Commercial Harvest																						
Eureka/Crescent City																						
May		2	147	67	23	5		333	14	5	34	18		65	6		2	429	720	1,149	1,539	2,688
Jun			286	74	11			369	27	3	140	31		50		3		480	995	1,475	1,449	2,924
Jul			179	106	8	6		221	14		47	44		53	8		2	336	689	1,025	1,349	2,374
Aug		3	217	74	14			388	43	2	125	20		50	7		2	114	944	1,058	950	2,008
Sep		2	13	20	2			13	3		7			7					67	67	117	184
Total		**7**	**843**	**342**	**58**	**11**		**1,325**	**101**	**9**	**353**	**114**		**223**	**21**	**3**	**6**	**1,358**	**3,415**	**4,774**	**5,404**	**10,178 (3%)**
Fort Bragg																						
May		16	147	32	21	8		149	13		66	32		18				1,033	502	1,536	2,816	4,352
Jun		23	2,041	620	114	23		2,739	246	36	750	334		444	40		7	2,797	7,417	10,214	13,571	23,785
Jul	4	342	6,972	2,261	448	95	4	10,452	746	87	2,904	1,848	22	2,026	318	23	11	5,036	28,562	33,598	35,183	68,781
Aug		108	1,081	587	100	11		2,690	157	13	1,328	421	13	536	67			433	7,111	7,544	7,372	14,916
Sep		7	58					58	7	7	143	86		36	29				430	430	3,894	4,324
Total	**4**	**496**	**10,299**	**3,500**	**683**	**138**	**4**	**16,087**	**1,170**	**143**	**5,191**	**2,720**	**34**	**3,060**	**453**	**23**	**18**	**9,299**	**44,022**	**53,321**	**62,837**	**116,158 (39%)**
San Francisco																						
May		161	6,348	2,136	622	234		9,632	915	131	1,932	1,089	15	1,086	264	11	10	2,674	24,586	27,260	29,105	56,365
Jun		253	5,082	1,643	357	103	2	8,102	674	67	1,785	1,018	26	989	204	7	17	2,861	20,331	23,192	24,645	47,837
Jul		260	3,019	1,090	224	22		4,984	354	70	1,309	915	11	955	193	11	3	355	13,418	13,774	10,441	24,215
Aug	3	68	1,584	362	19	3		1,471	71	8	381	304	15	205	35	11	9		4,548	4,548	3,271	7,819
Sep		157	295	133	44	5		516	49	13	727	572	13	477	73	8		18	3,082	3,099	3,378	6,477
Oct	6	50	22	22	11	8		66	8		64	93	6	119	22				497	497	444	941
Total	**9**	**948**	**16,351**	**5,385**	**1,278**	**375**	**2**	**24,773**	**2,071**	**289**	**6,198**	**3,991**	**86**	**3,830**	**790**	**48**	**38**	**5,909**	**66,462**	**72,371**	**71,283**	**143,654 (48%)**
Monterey																						
May		67	2,314	667	271	114		3,250	276	29	332	179	3	237	31			360	7,771	8,131	5,980	14,111
Jun	4	51	1,300	305	53	8		1,819	132	14	300	260		177	72	8		427	4,504	4,931	5,072	10,003
Jul	8	48	560	161	10	5		563	88	5	140	50		74	19	5		57	1,736	1,793	1,107	2,900
Aug	8	7	42	42				113	36		71	17		28					364	364	150	514
Sep									32										32	32	77	109
Total	**19**	**174**	**4,217**	**1,176**	**334**	**127**		**5,746**	**565**	**48**	**842**	**506**	**3**	**516**	**122**	**13**		**844**	**14,408**	**15,251**	**12,386**	**27,637 (9%)**
California Total Commercial Harvest																						
	32	**1,625**	**31,710**	**10,402**	**2,353**	**652**	**6**	**47,930**	**3,907**	**490**	**12,583**	**7,332**	**123**	**7,629**	**1,386**	**87**	**62**	**17,410**	**128,307**	**145,717**	**151,910**	**297,627**
Oregon Total Commercial Harvest																						
		125	*10,294*	*3,552*	*1,474*	*301*	*2*	*15,690*	*965*	*111*	*5,432*	*2,776*	*13*	*4,060*	*509*	*17*	*35*	*12,538*	*45,356*	*57,894*	*52,918*	*110,812*

Table 17. CWT recovery rate (recoveries per 100,000 CWTs released) for Experimental & Net Pen release types in 2013.

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	Mer	SJ	In-basin	Stray	CV total		CWT_{samp}	In-basin	Stray	**CV total**	**Ocean**
FRHFbb	2011	Fall	98,241	4	12		30		5		1	3	30	25	**55**	45%	**18**	31	25	**56**	**19**
FRHFbg	2011	Fall	98,947				19	7	1				26	1	**27**	4%	**17**	26	1	**27**	**17**
FRHFbr	2011	Fall	99,901		12		77		1				77	13	**89**	14%	**20**	77	13	**90**	**20**
FRHFnp	2011	Fall	185,303	11		5	390	7	20	1			397	37	**434**	9%	**149**	214	20	**234**	**81**
FRHFns	2011	Fall	240,887			5	40						40	5	**45**	11%	**196**	17	2	**19**	**81**
FRHFn	2011	Fall	2,293,211	46	161	96	1,669	113	88	26	4	19	1,782	441	**2,224**	20%	**539**	78	19	**97**	**24**
NIMFn	2011	Fall	328,073						87	6		3	87	10	**97**	10%	**17**	27	3	**30**	**5**
MOKFn	2011	Fall	1,487,132			4	2	16	112	365	29	93	365	256	**622**	41%	**113**	25	17	**42**	**8**

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	Mer	SJ	In-basin	Stray	CV total		CWT_{samp}	In-basin	Stray	**CV total**	**Ocean**
FRHFns	2010	Fall	185,985		46	15	181		6	1			181	68	**249**	27%	**6,867**	97	37	**134**	**3,692**
FRHFn	2010	Fall	2,554,115	95	657	332	24,137	780	234	47	14	35	24,918	1,414	**26,332**	5%	**20,709**	976	55	**1031**	**811**
FRHFtib	2010	Fall	56,030	7	12	20	335	7	2	3		3	342	47	**389**	12%	**606**	610	84	**694**	**1,082**
CFHFn	2010	Fall	334,756	230	81	108	731	96	585	35	52	46	311	1,653	**1,964**	84%	**4,598**	93	494	**587**	**1,374**
NIMFn	2010	Fall	368,363		12		18	16	1,747	24	15	2	1,747	86	**1,833**	5%	**2,438**	474	23	**497**	**662**
MOKFn	2010	Fall	1,126,781	2	12	3	73	101	1,256	1,100	180	239	1,100	1,866	**2,965**	63%	**3,485**	98	166	**264**	**309**

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	Mer	SJ	In-basin	Stray	CV total		CWT_{samp}	In-basin	Stray	**CV total**	**Ocean**
FRHFns	2009	Fall	118,879														**126**				**106**
FRHFn	2009	Fall	2,367,209	28	761	183	3,331	26	36	10		3	3,358	1,021	**4,379**	23%	**1,478**	142	43	**185**	**62**
FRHFtib	2009	Fall	60,104		23	16	254	10	1	1			263	41	**305**	14%	**223**	438	69	**507**	**370**
CFHFn	2009	Fall	337,919	33	115	10	254	53	72	1	13	5	148	407	**555**	73%	**379**	44	120	**164**	**112**
NIMFn	2009	Fall	347,527	1	11		2	20	1,013	8	6		1,013	49	**1,062**	5%	**935**	292	14	**306**	**269**
MOKFn	2009	Fall	2,015,730	7	12	26	60	144	858	1,275	234	399	1,275	1,740	**3,015**	58%	**2,761**	63	86	**149**	**137**

[a/] Natural creeks include Clear Creek, Cottonwood Creek, Paynes Creek, Mill Creek, Deer Creek and Butte Creek.

Central Valley Chinook Experimental and Net Pen release types

CFHFn Coleman National Fish Hatchery fall bay net pen releases
FRHFbb Feather River Hatchery fall barge study: trucked & released in SF Bay (@ Ft Baker)
FRHFbg Feather River Hatchery fall barge study: barged to SF Bay and released
FRHFbr Feather River Hatchery fall barge study: in-river releases
FRHFnp Feather River Hatchery fall coastal net pen releases - Pillar Point
FRHFns Feather River Hatchery fall coastal net pen releases - Santa Cruz
FRHFn Feather River Hatchery fall bay net pen releases
FRHFtib Feather River Hatchery fall Tiburon net pen releases
NIMFn Nimbus Hatchery fall bay net pen releases
MOKFn Mokelumne River Hatchery fall bay net pen releases

#	Release Type	Release Location
1	SacW	Lake Redding Park
2	CFHFh,CFHLh	CFH
3	FRHS	Thermalito High Flow Area
4	FRHS	Boyds Pump Ramp
5	FRHFbr	Elkhorn Boat Launch
6	NIMF	American River
7	NIMF	Discovery Park
8	FRHFe	Yolo Bypass
9	MOKF	Mokelumne River
10	MokFw	Mok R Vino Farms
11	MokFw	Woodbridge
12	MERF	Merced River
13	MERF	Hatfield State Area
14	MERFt	Mossdale
15	FRHFe	San Joaquin River (above mouth)
16	MOKFn, MOKFt	Sherman Island
17	FRHSn, NIMFn	Mare Island Net Pens
18	FRHFn,NIMFn	Wickland Oil Net Pens
17	CFHFn,FRHSn	San Pablo Bay Net Pens
18	FRHFn	(both Wickland & Mare Island)
19	FRHFtib	Tiburon Net Pens
20	FRHFbb, FRHFbg	Fort Baker (Golden Gate mouth)
21	FRHFnp	Pillar Point Net Pens
22	FRHFnc	Santa Cruz Net Pens

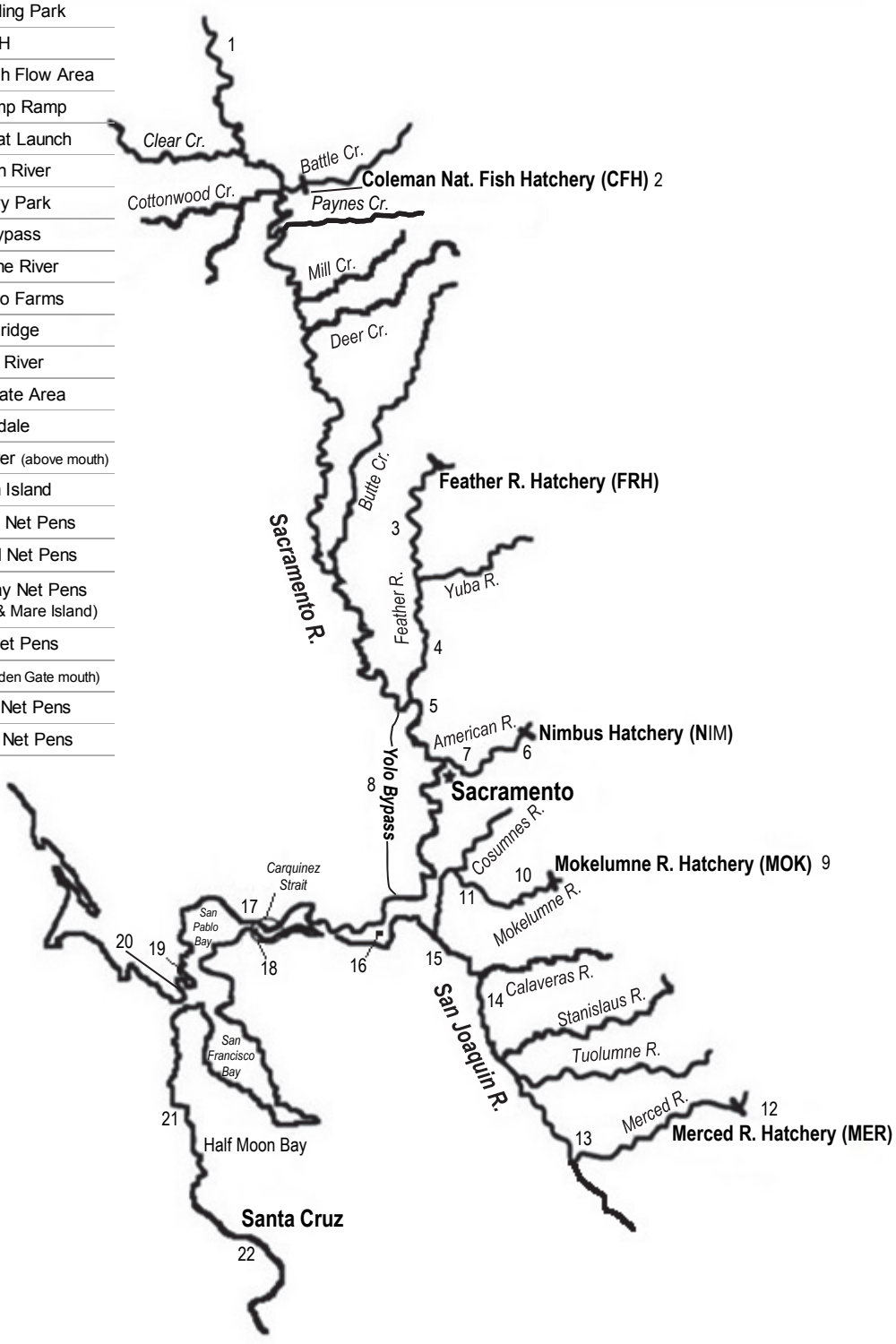


Figure 1. Map of release locations for CV hatchery release types, brood years 2009-2011.

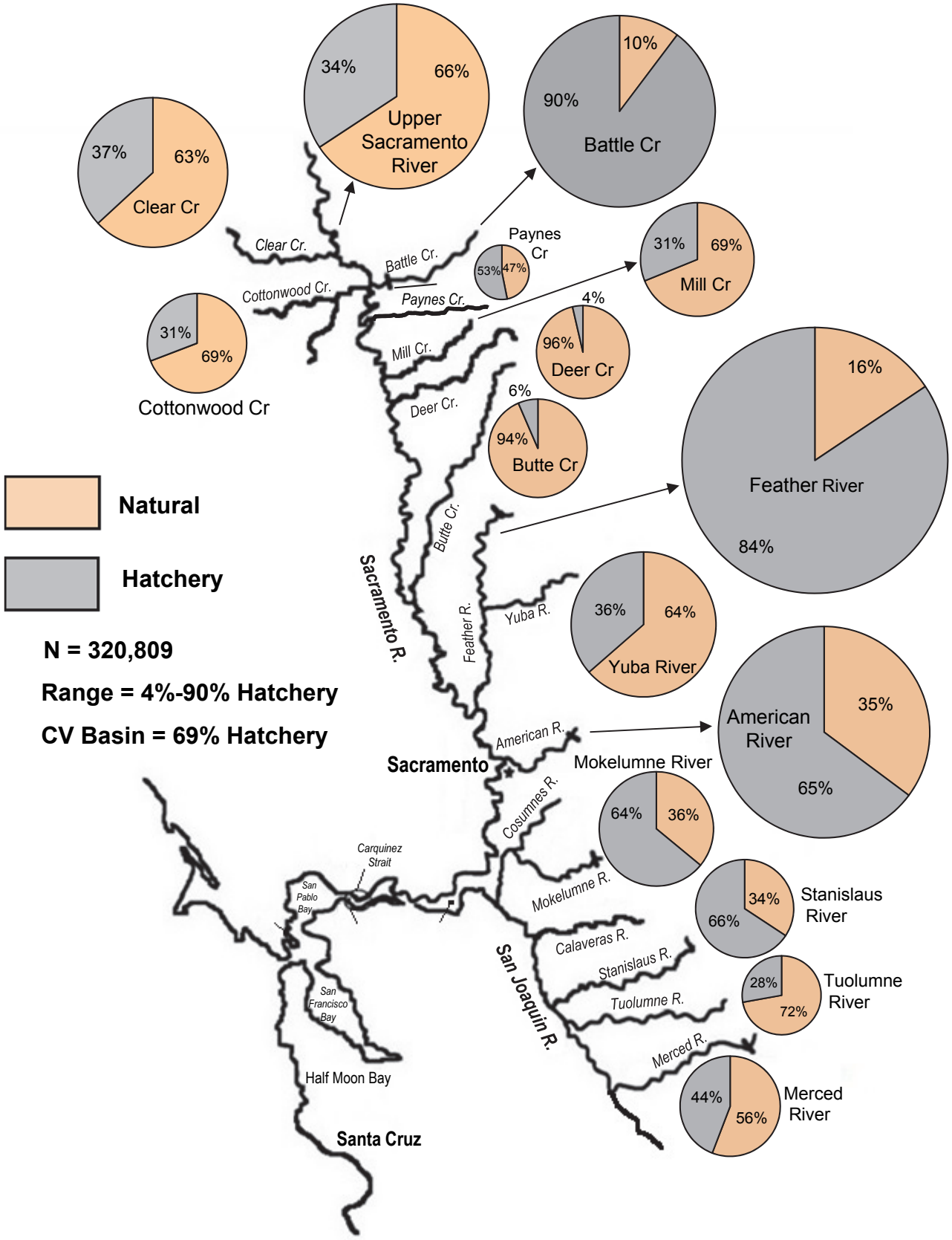


Figure 2. Fall-run CV Natural Area Escapement, Hatchery and Natural Proportions, 2013.

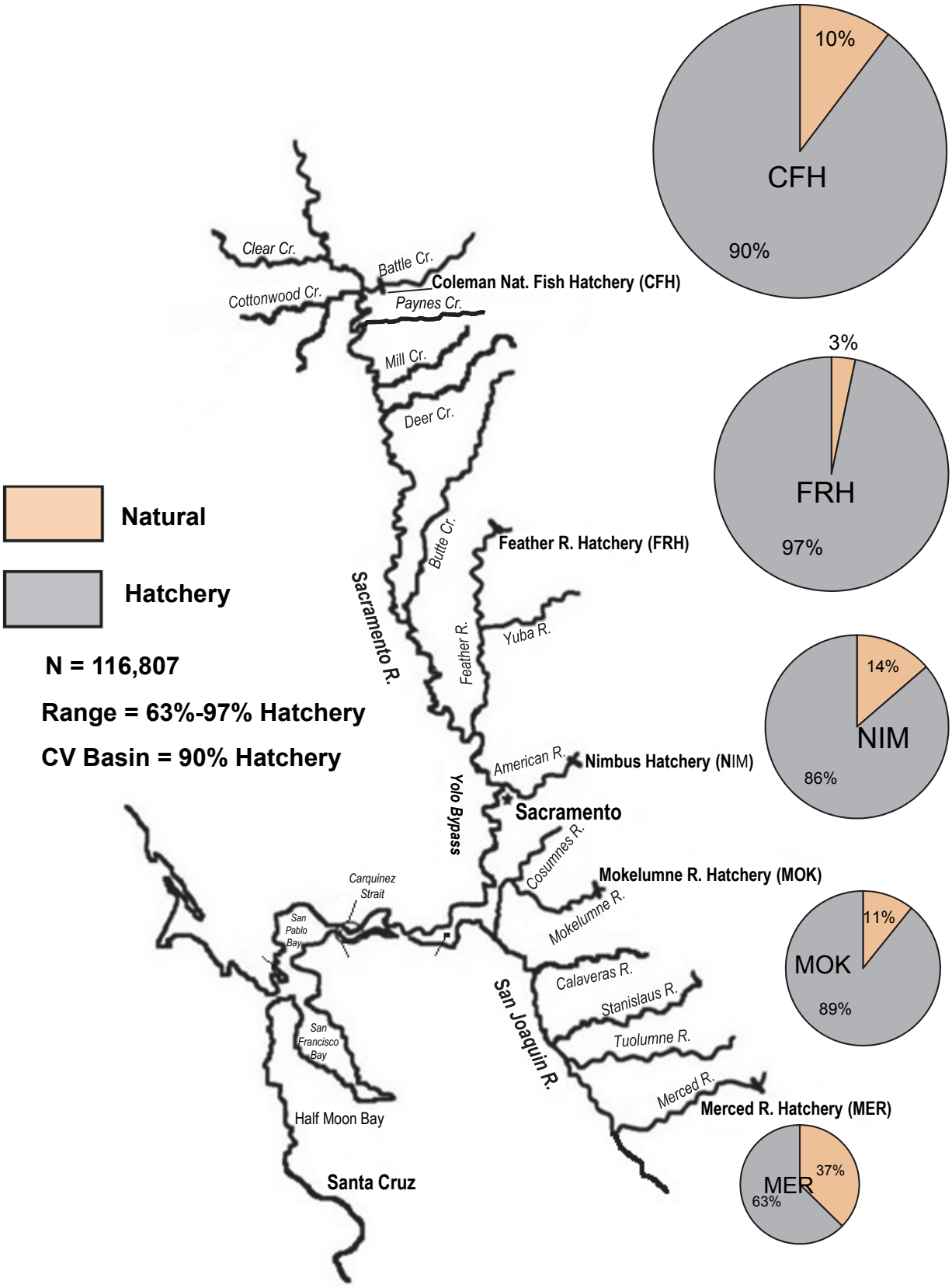


Figure 3. Fall-run CV Hatchery Escapement, Hatchery and Natural Proportions, 2013.

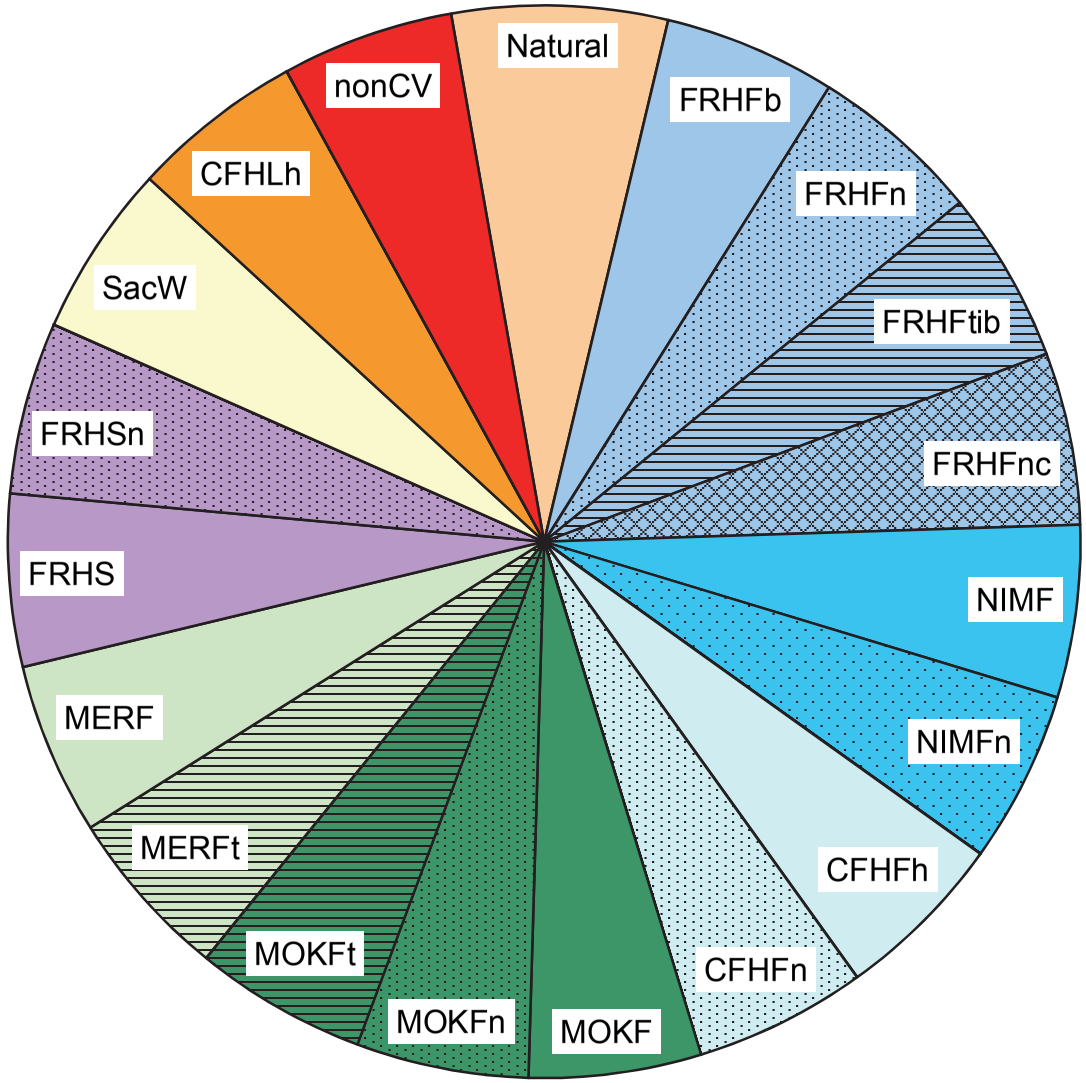


Figure 4. Color chart for Central Valley hatchery release types, brood years 2009-2011.

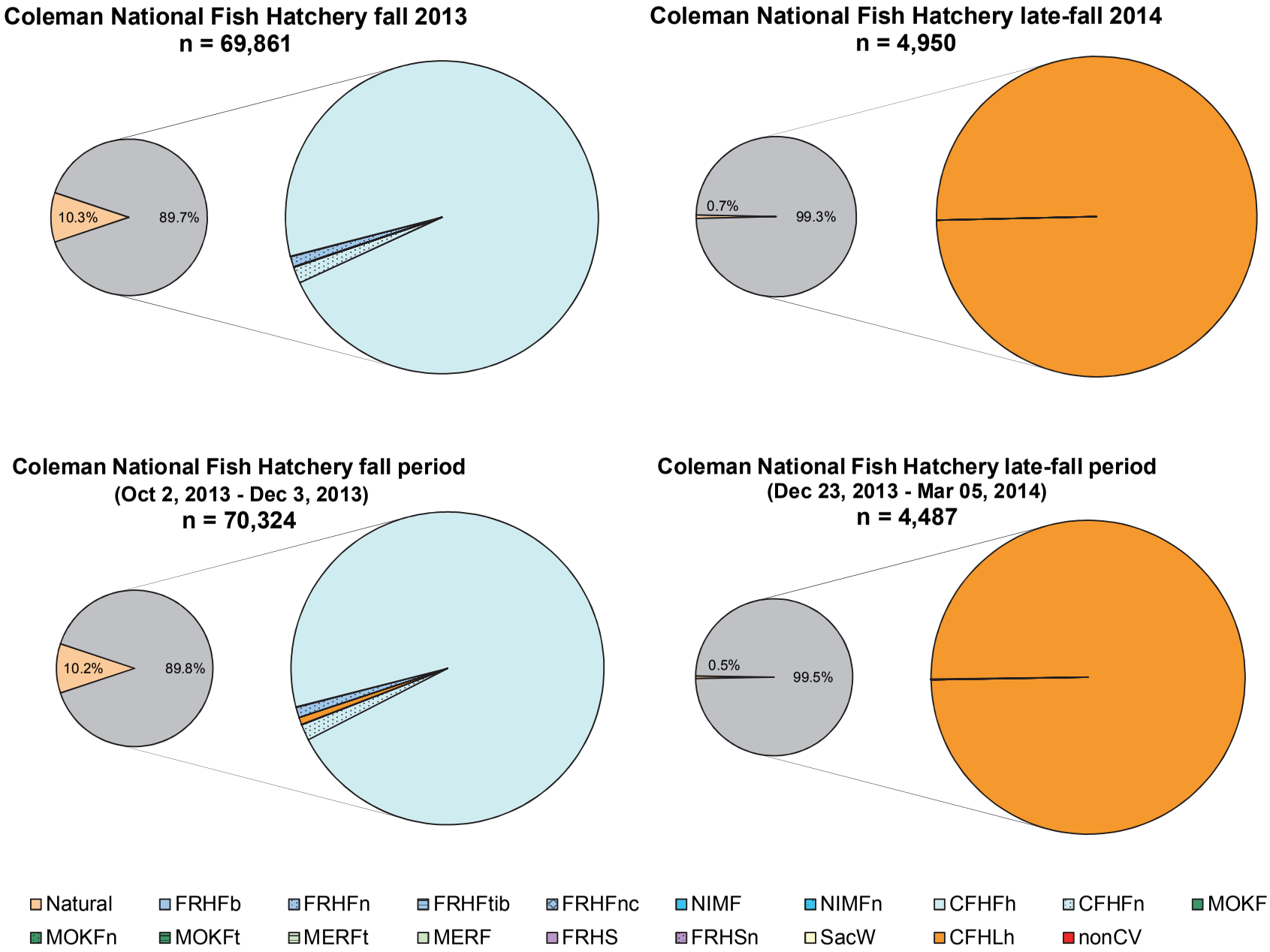


Figure 5. Proportion of hatchery- and natural-origin fish at Coleman National Fish Hatchery, 2013.

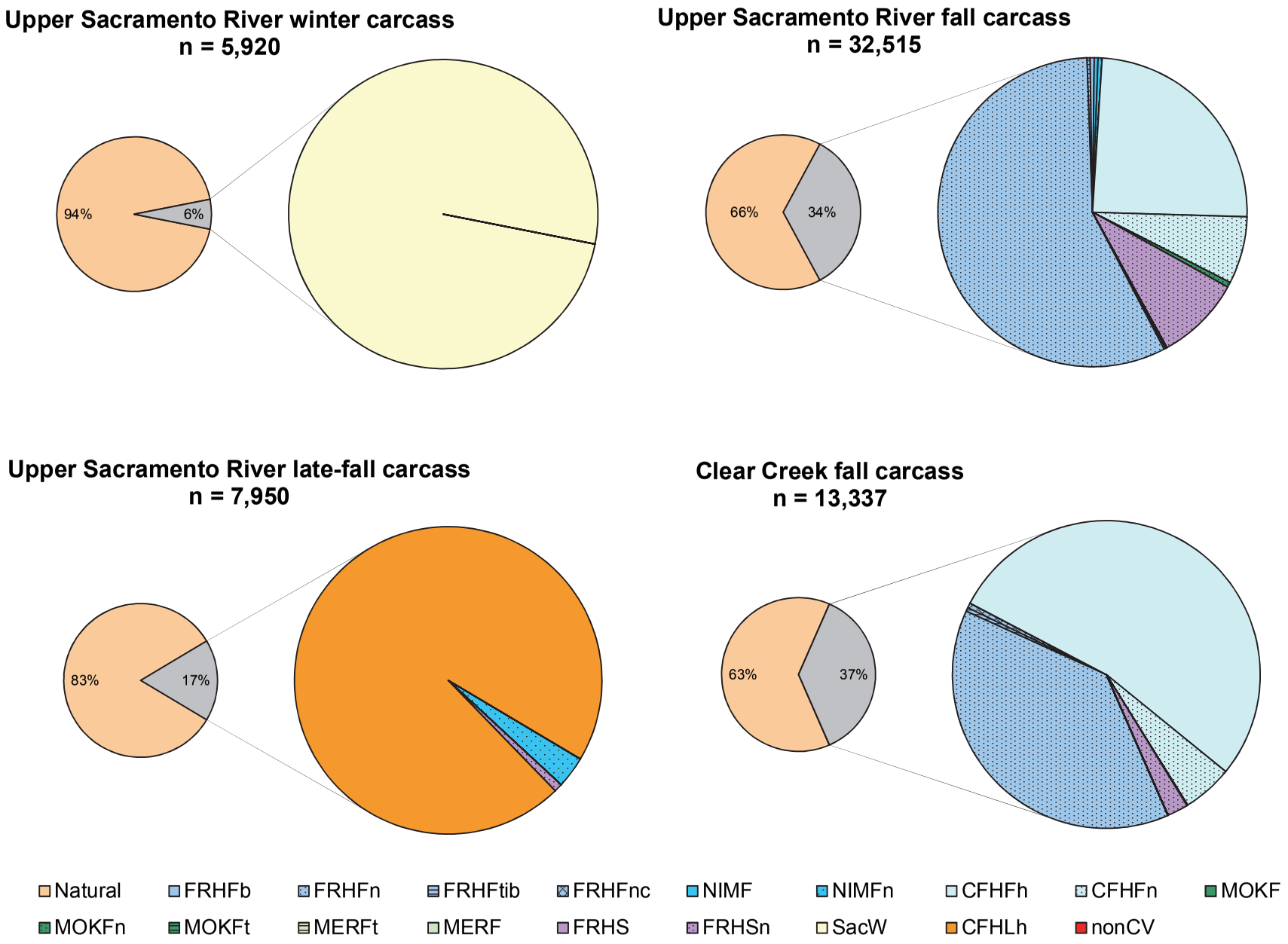


Figure 6. Proportion of hatchery- and natural-origin fish in Upper Sacramento River & tributaries, 2013.

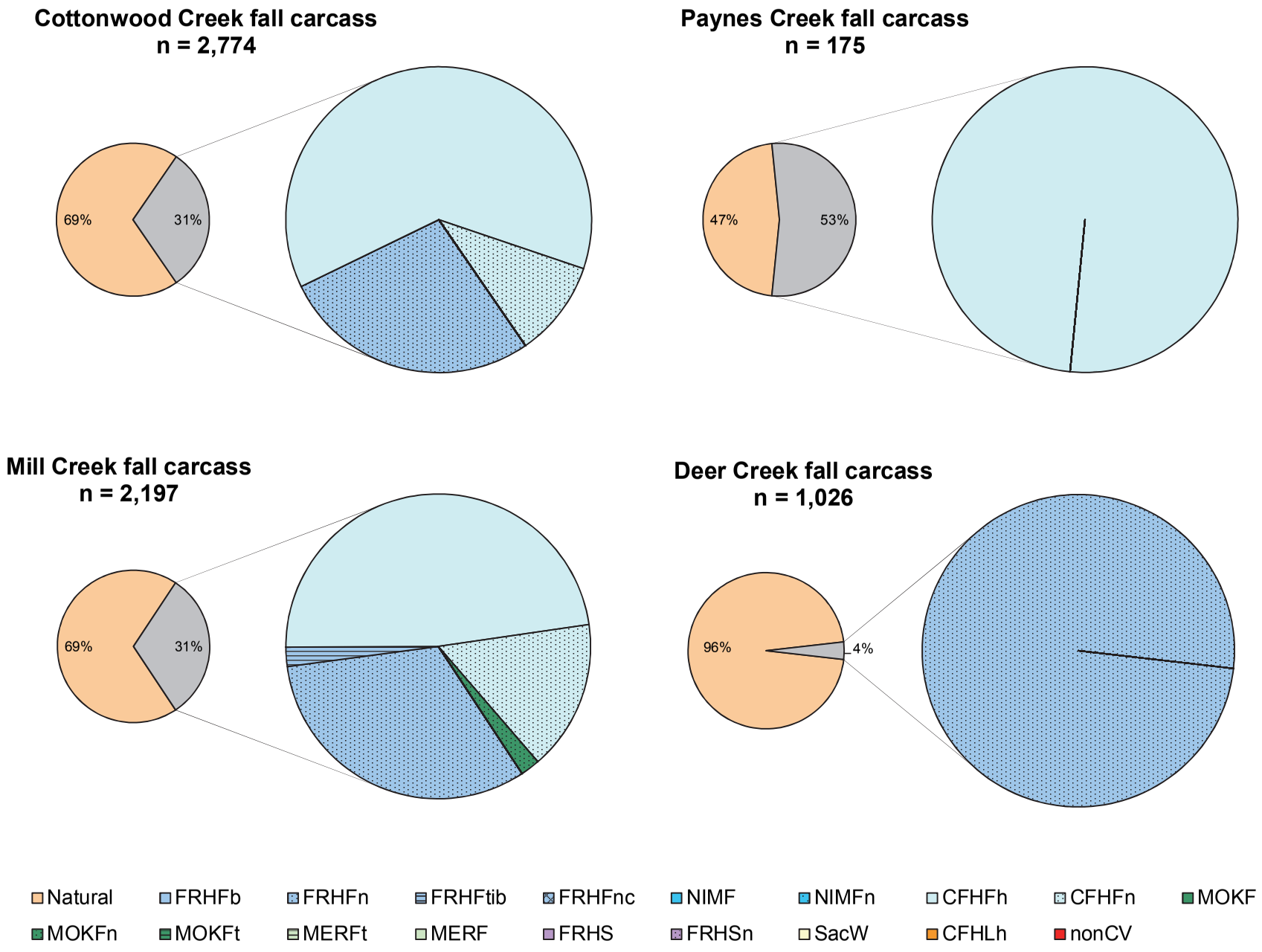


Figure 6. Proportion of hatchery- and natural-origin fish in Upper Sacramento River & tributaries, 2013 (continued).

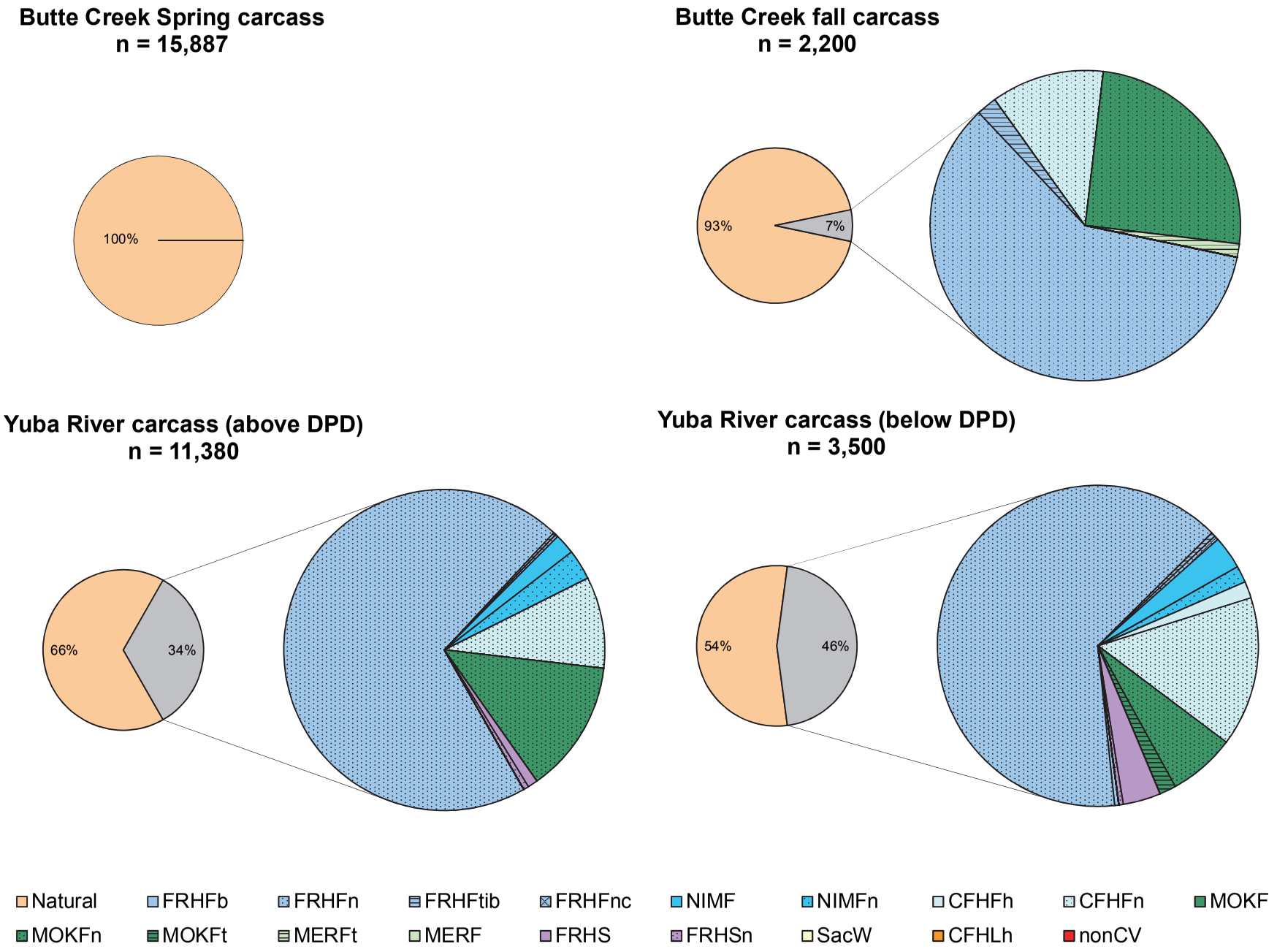


Figure 7. Proportion of hatchery- and natural-origin fish in Butte Creek & Yuba River, 2013.

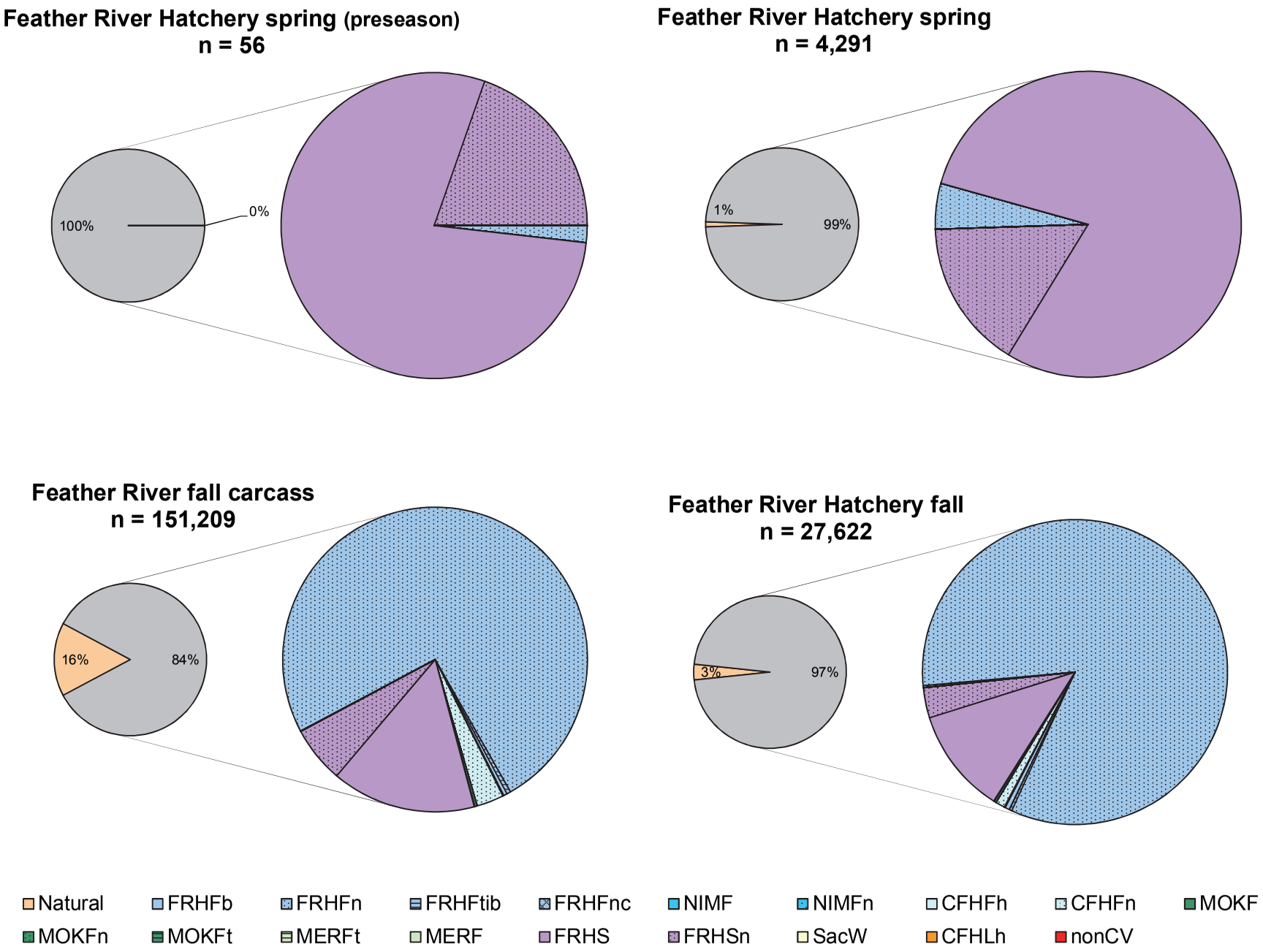


Figure 8. Proportion of hatchery- and natural-origin fish in the Feather River Basin, 2013.

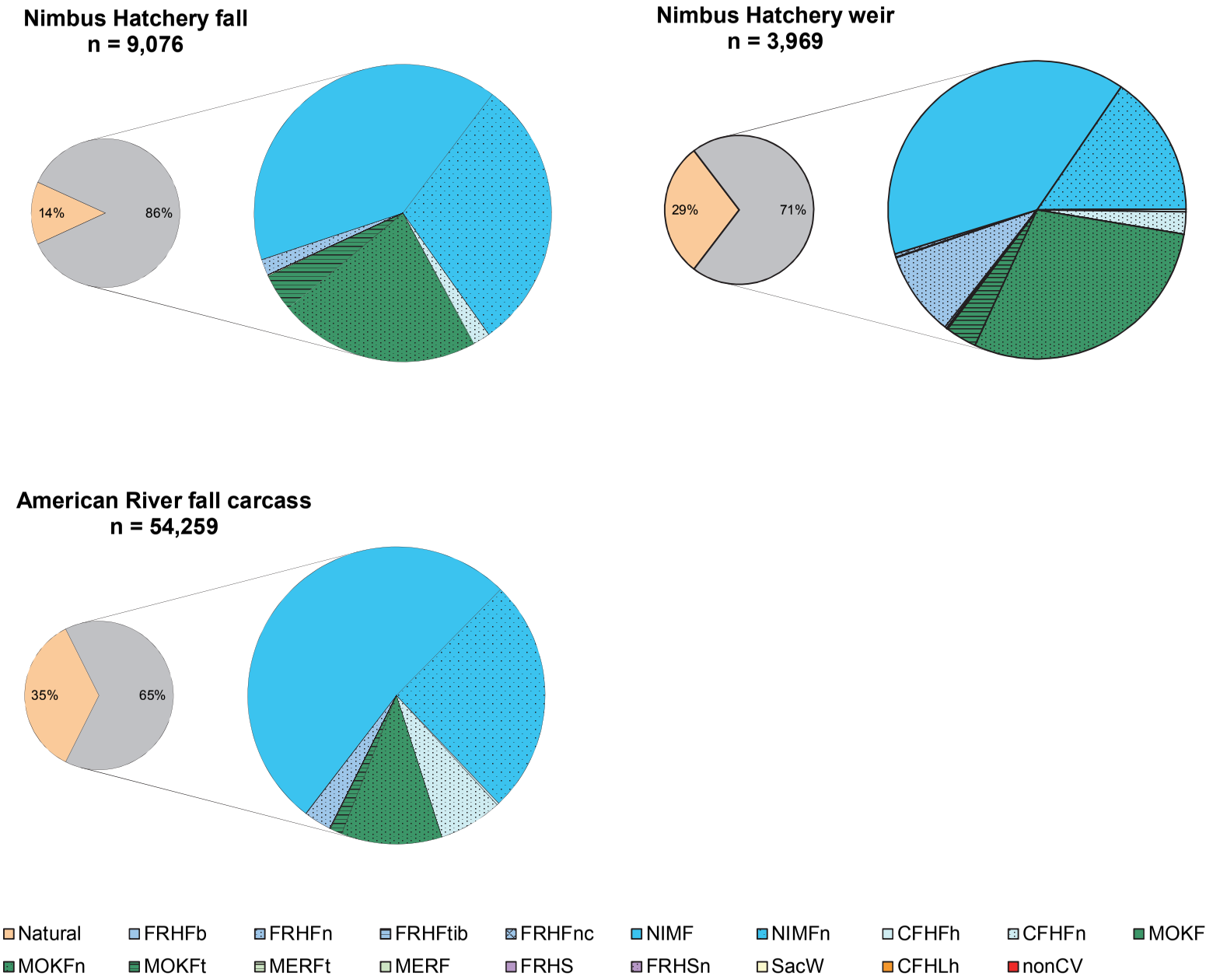


Figure 9. Proportion of hatchery- and natural-origin fish in the American River Basin, 2013.

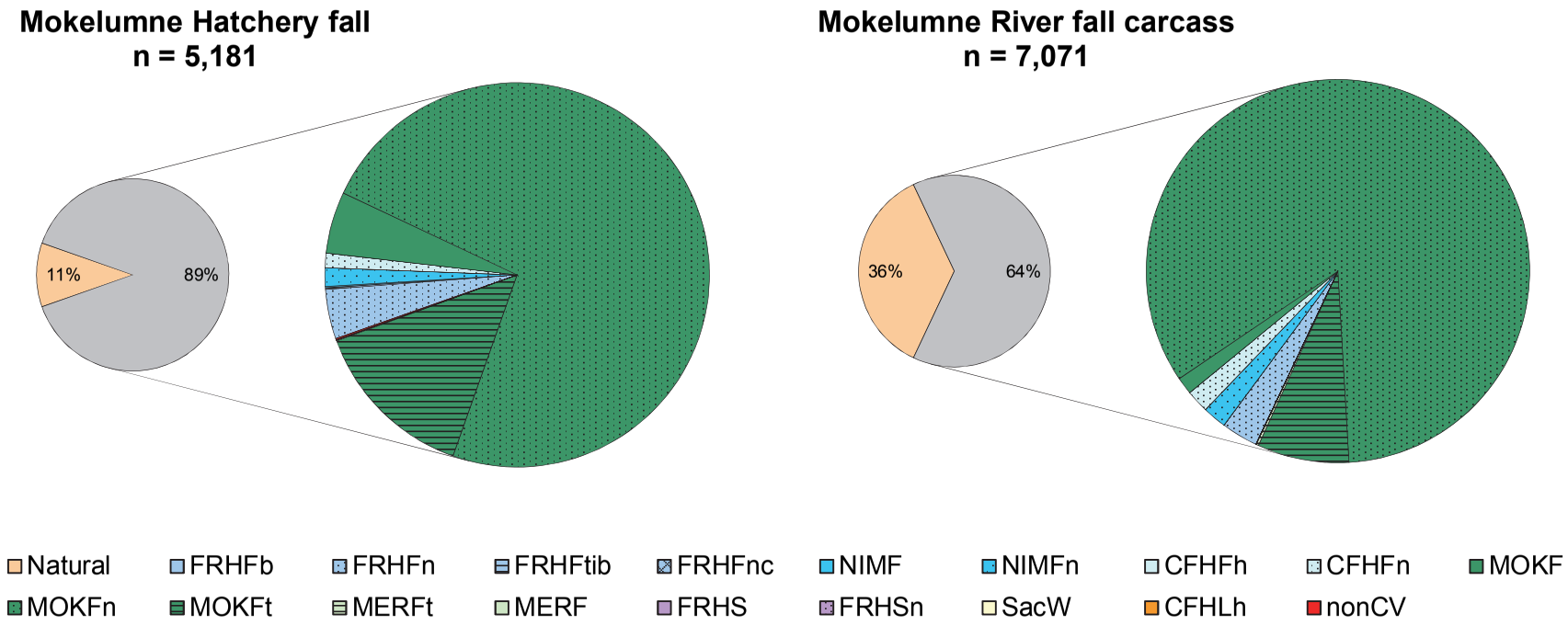


Figure 10. Proportion of hatchery- and natural-origin fish in the Mokelumne River Basin, 2013.

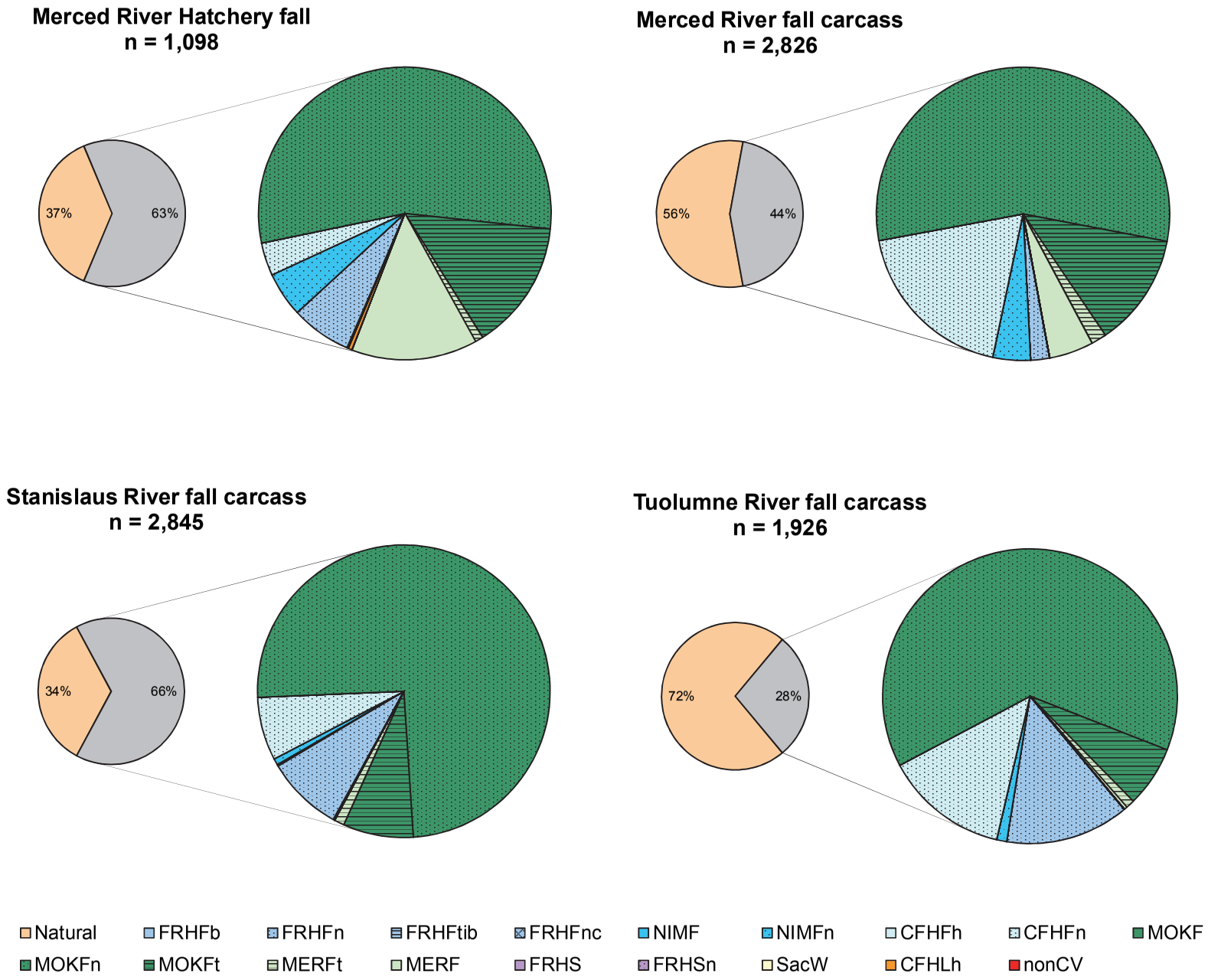


Figure 11. Proportion of hatchery- and natural-origin fish in Merced River & San Joaquin Basin tributaries, 2013.

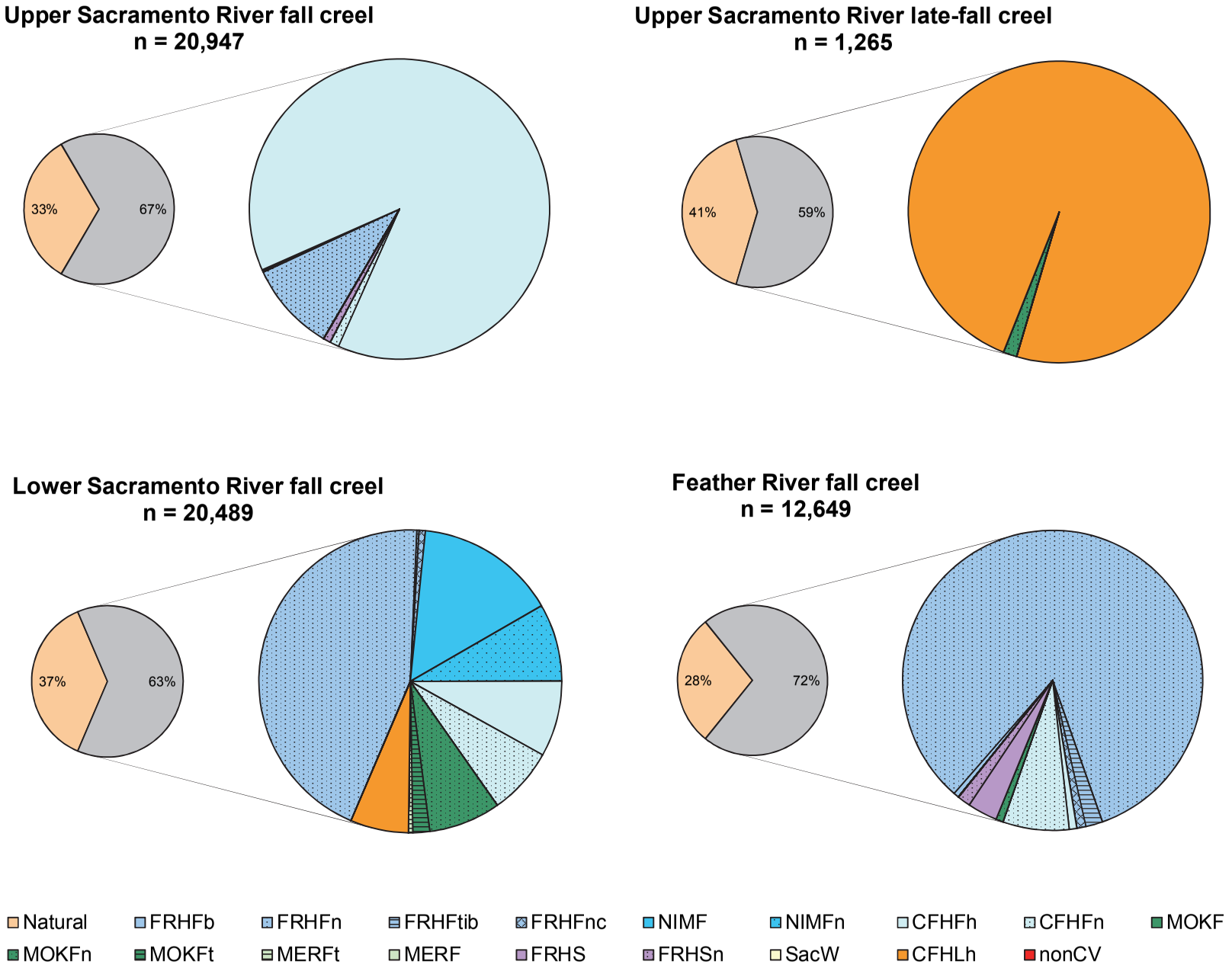


Figure 12. Proportion of hatchery- and natural-origin fish in sport harvest on Sacramento & Feather rivers, 2013.

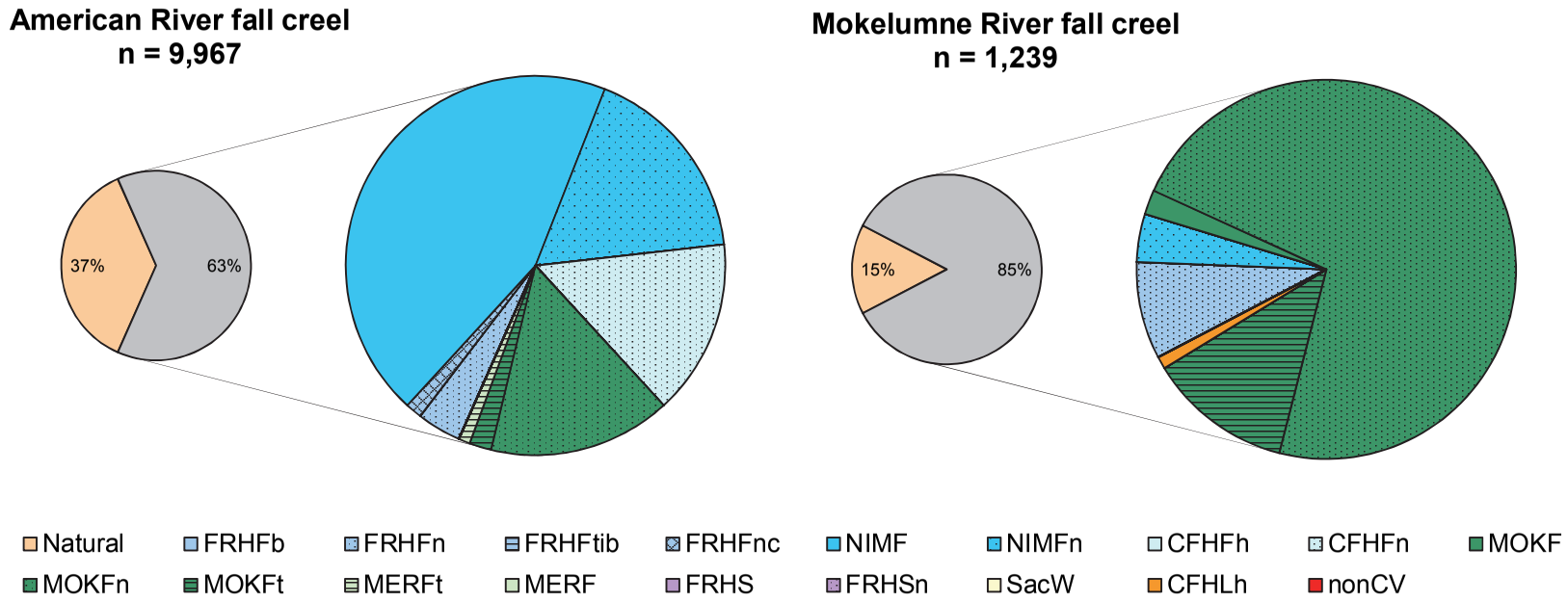


Figure 13. Proportion of hatchery- and natural-origin fish in sport harvest on American & Mokelumne rivers, 2013.

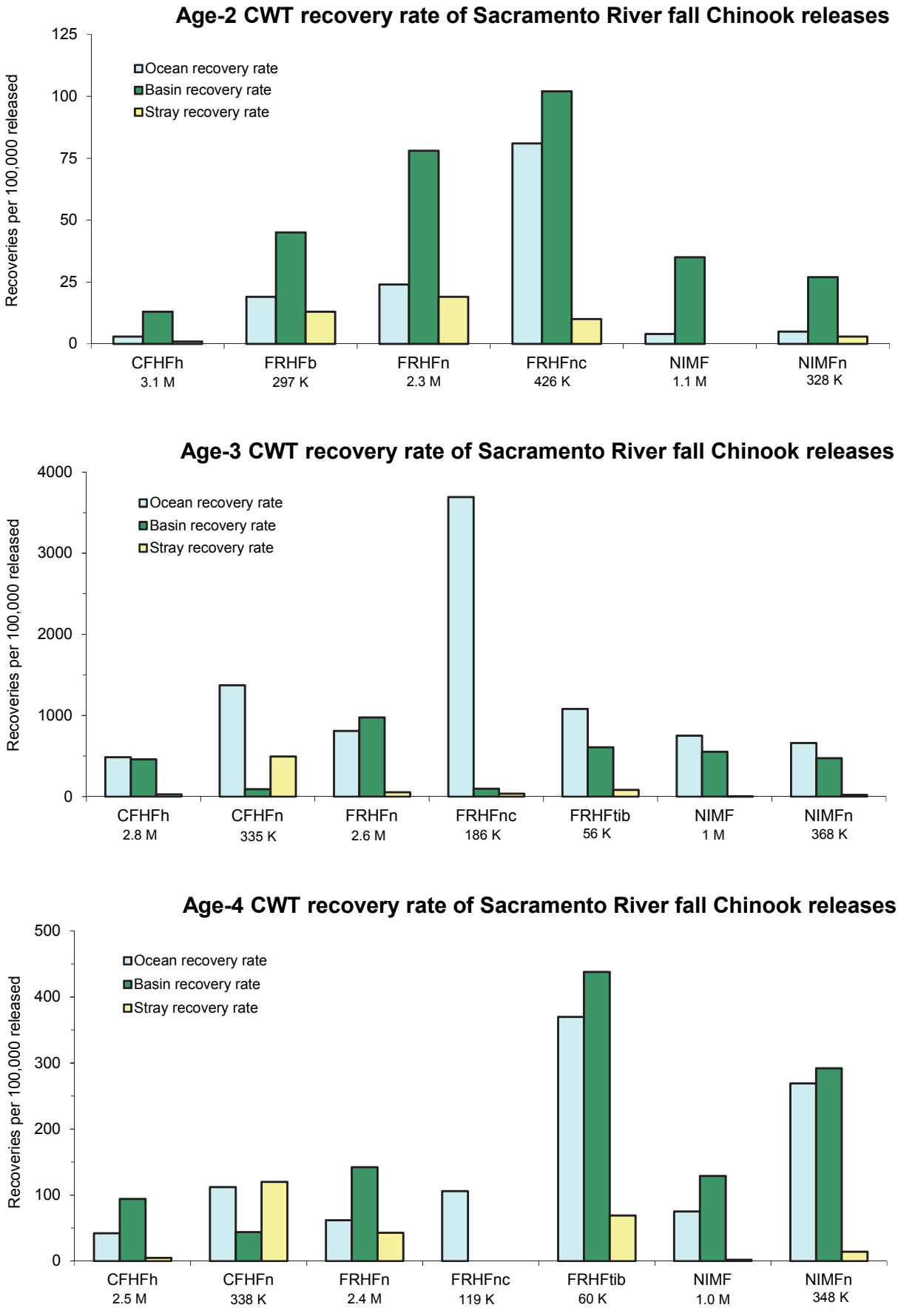


Figure 14. CWT recovery rates of Sacramento River fall Chinook releases by age in 2013.

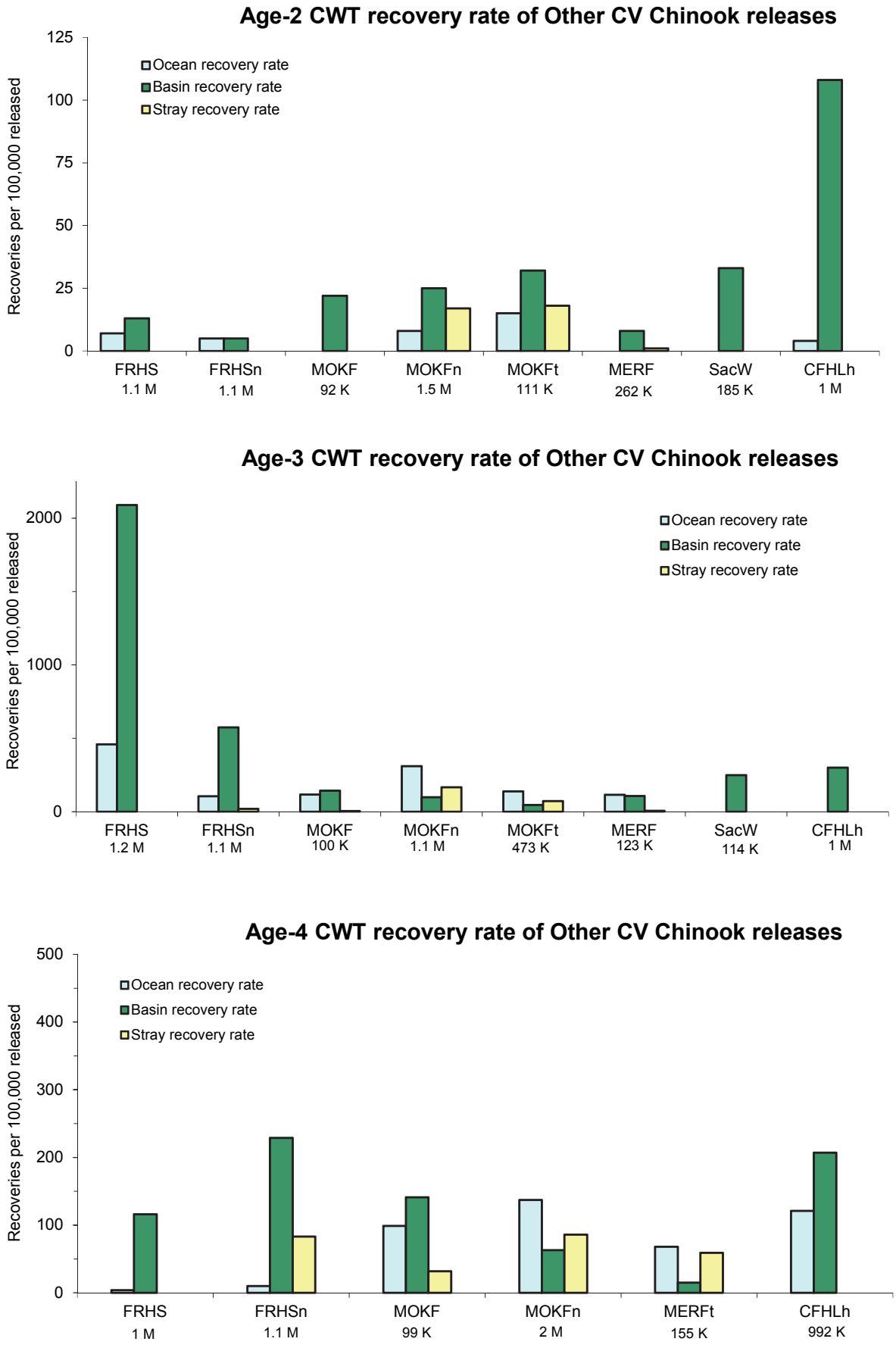


Figure 15. CWT recovery rates of Other CV Chinook releases by age in 2013.

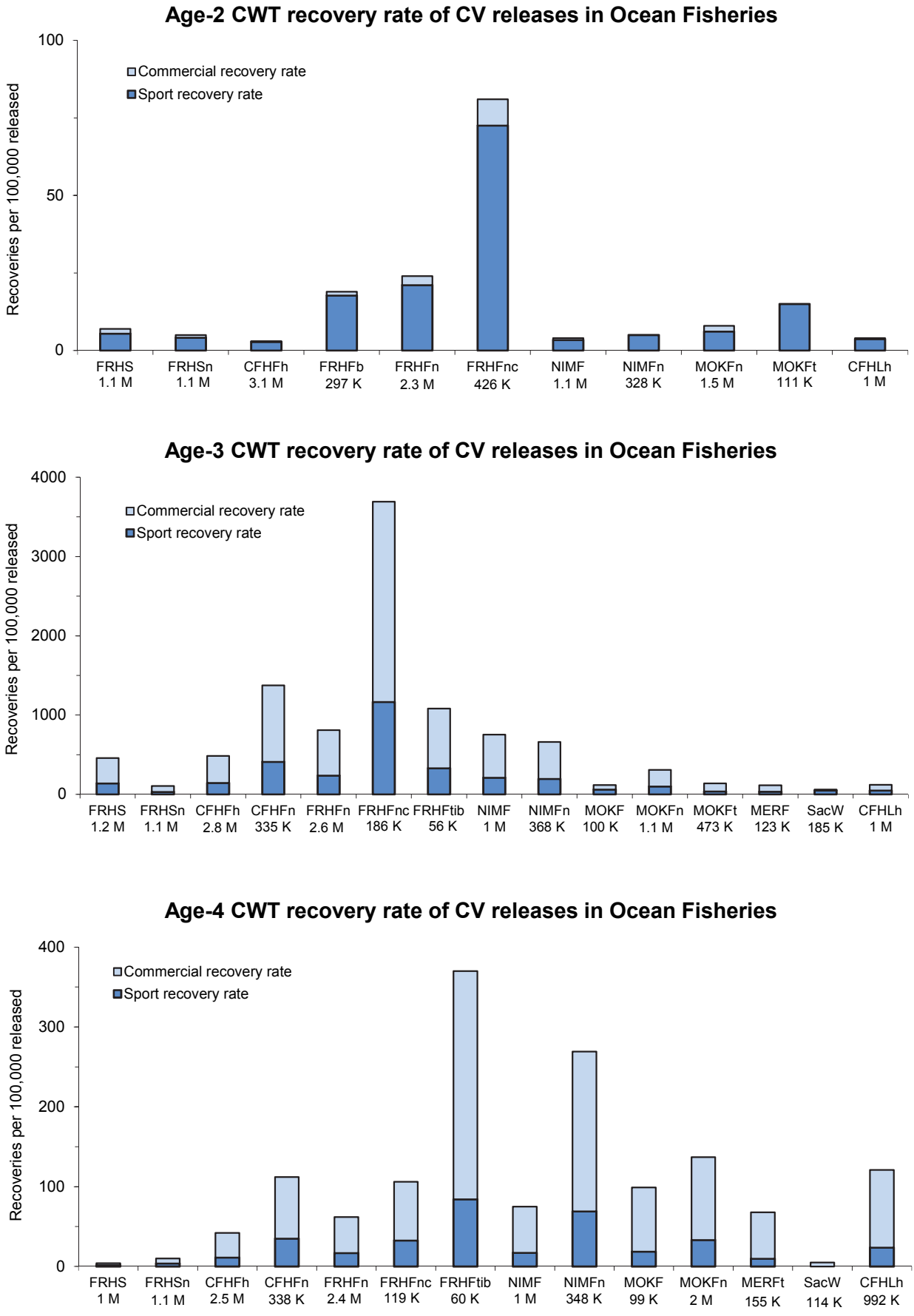


Figure 16. CWT recovery rates by release type in 2013 ocean fisheries.

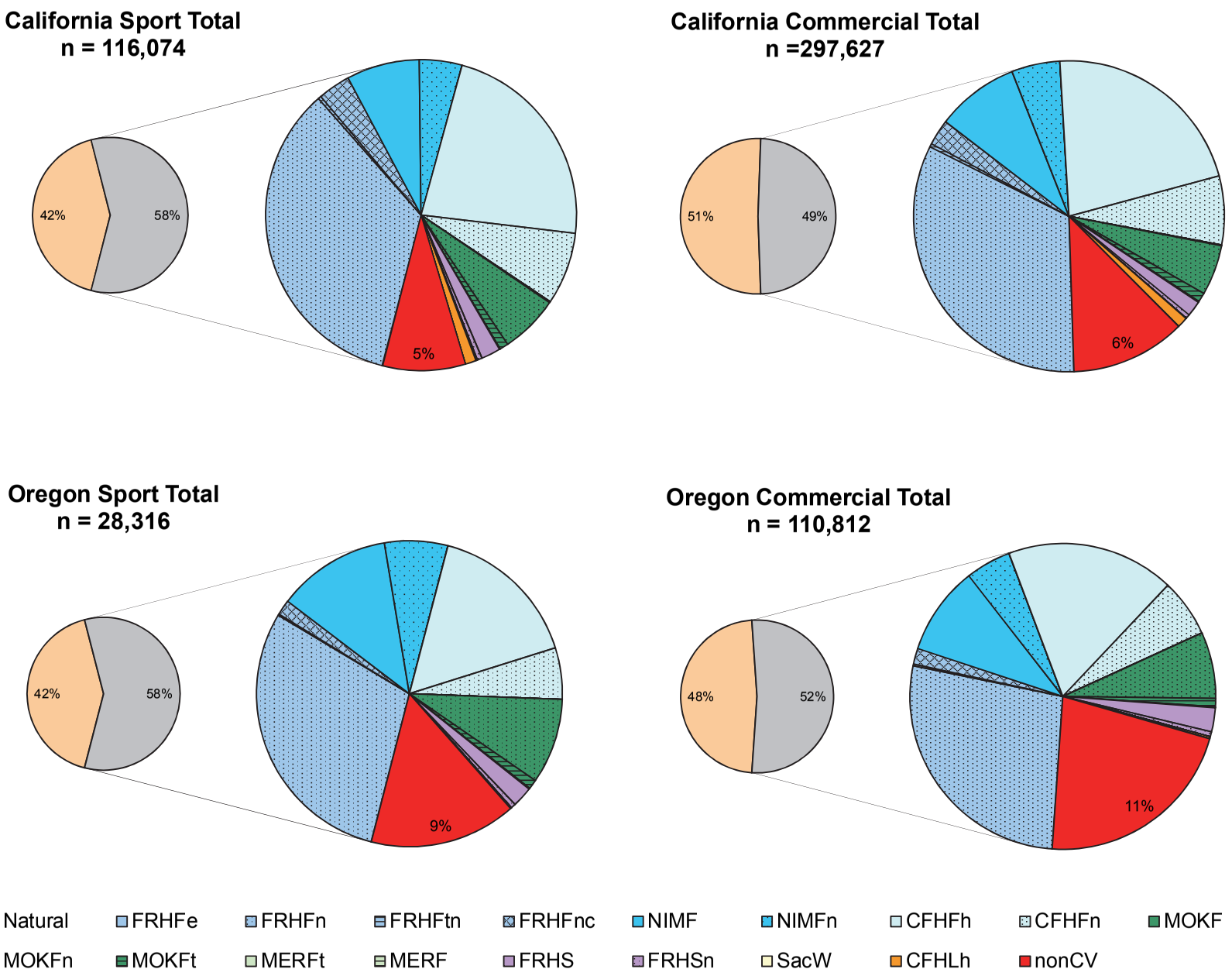


Figure 17. Proportion of hatchery- and natural-origin salmon in 2013 California and Oregon ocean fisheries.

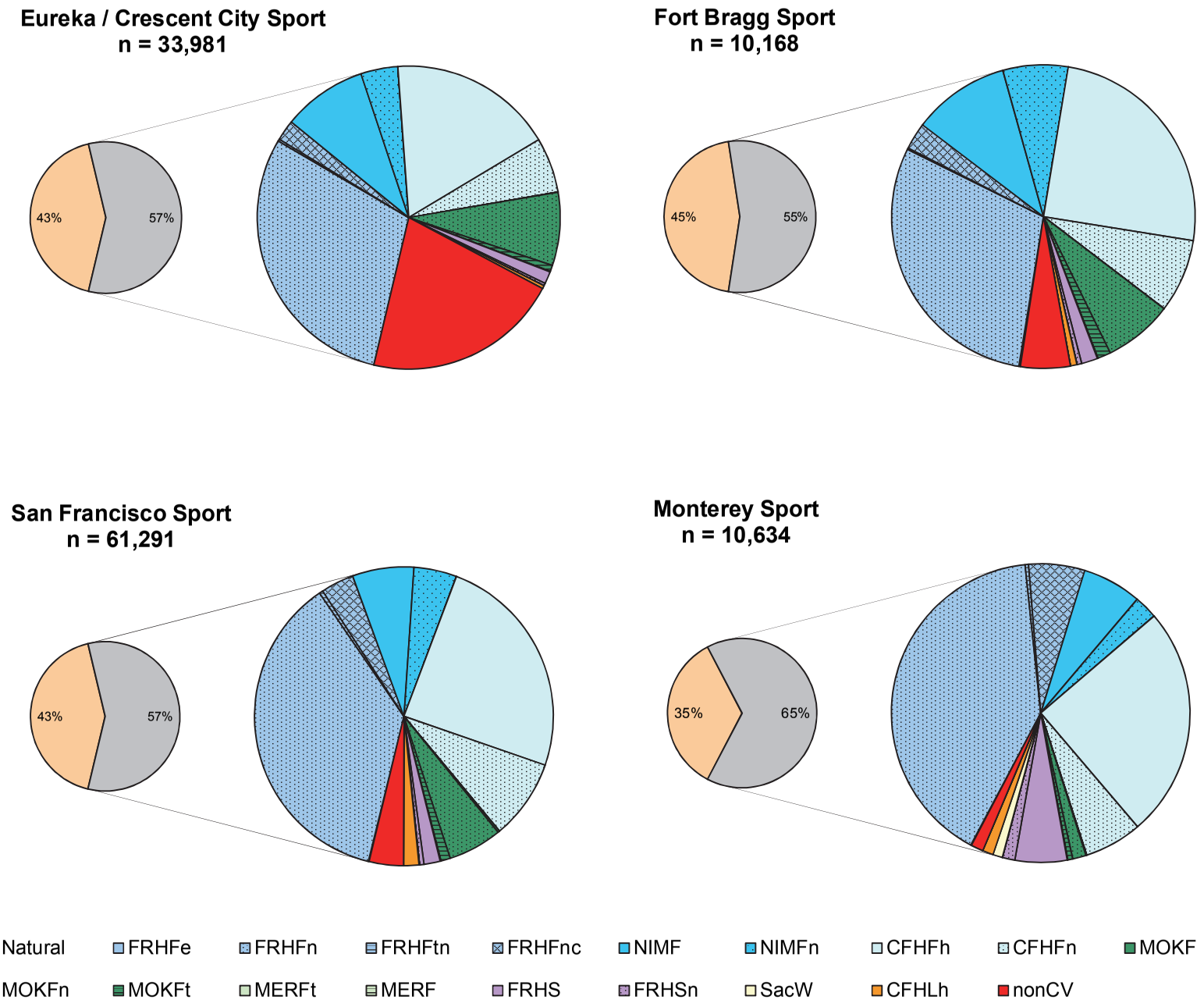


Figure 18. Proportion of hatchery- and natural-origin salmon in the 2013 California ocean sport fishery.

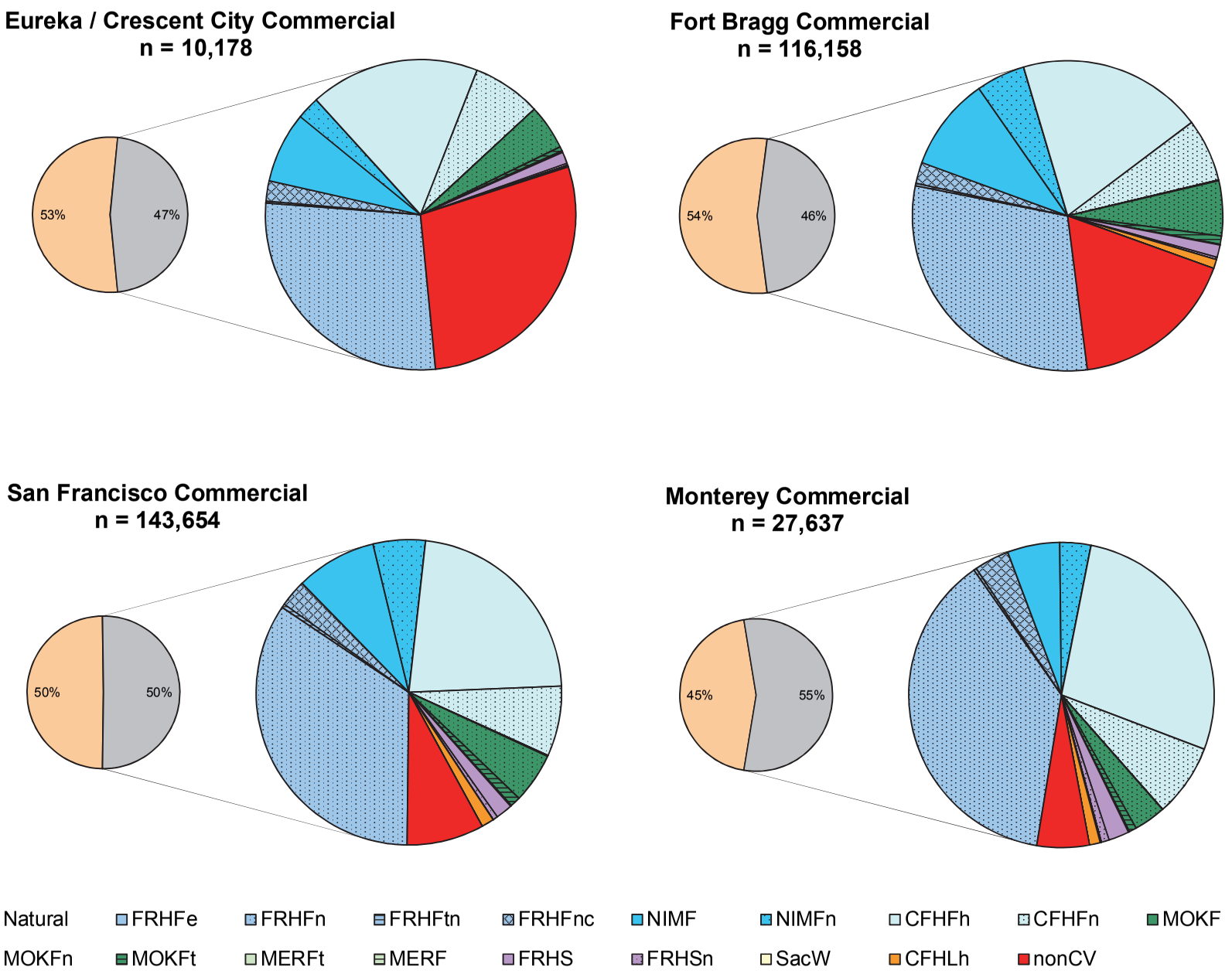
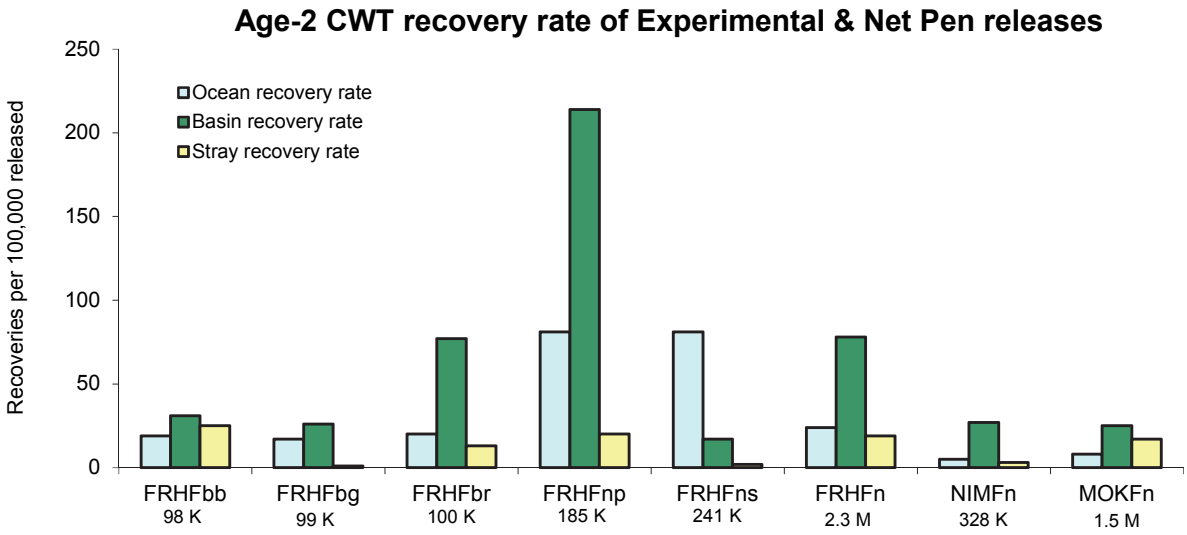
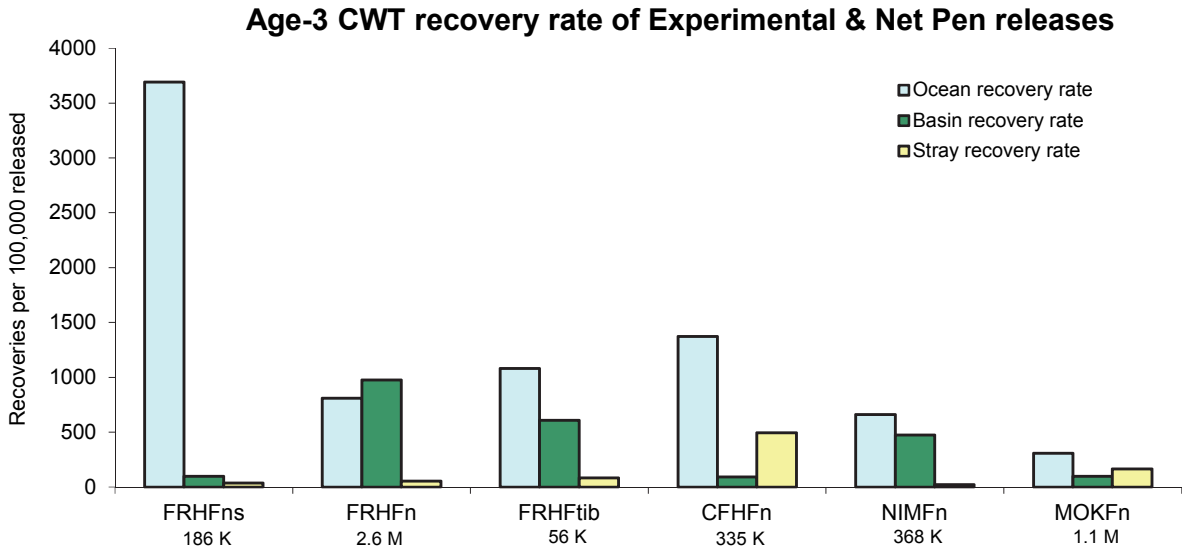


Figure 19. Proportion of hatchery- and natural-origin salmon in the 2013 California ocean commercial fishery.





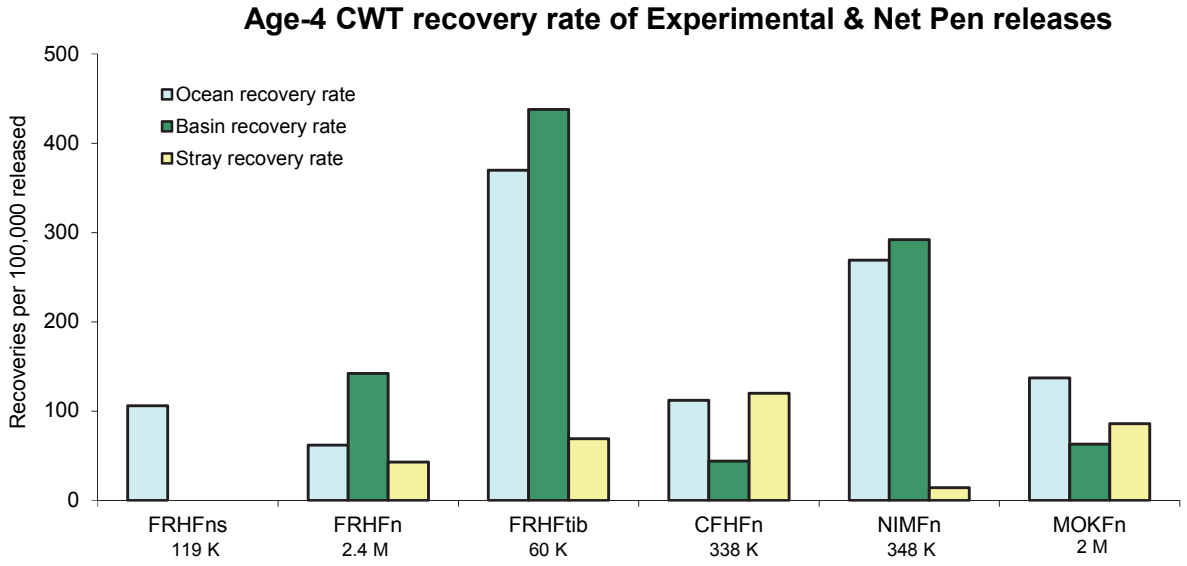
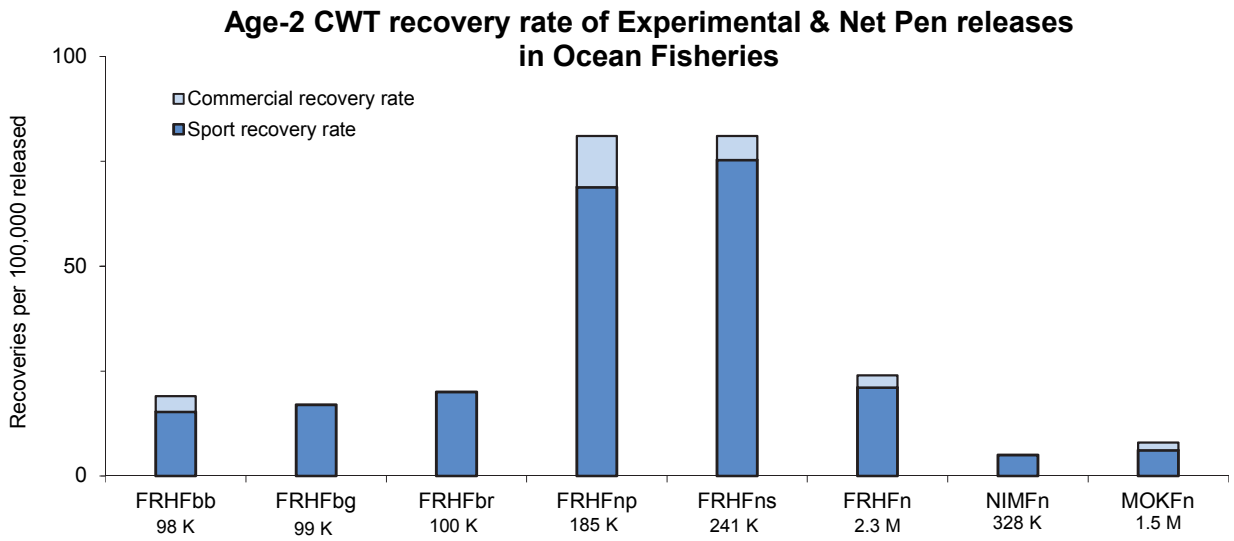
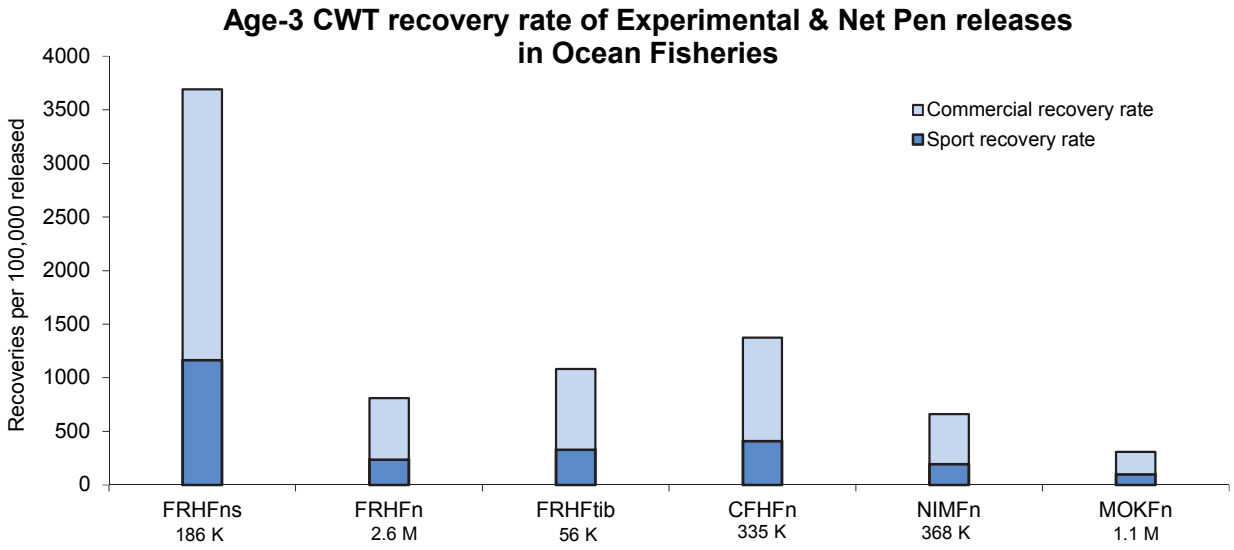


Figure 20. CWT recovery rates of Experimental and Net Pen releases by age in 2013.





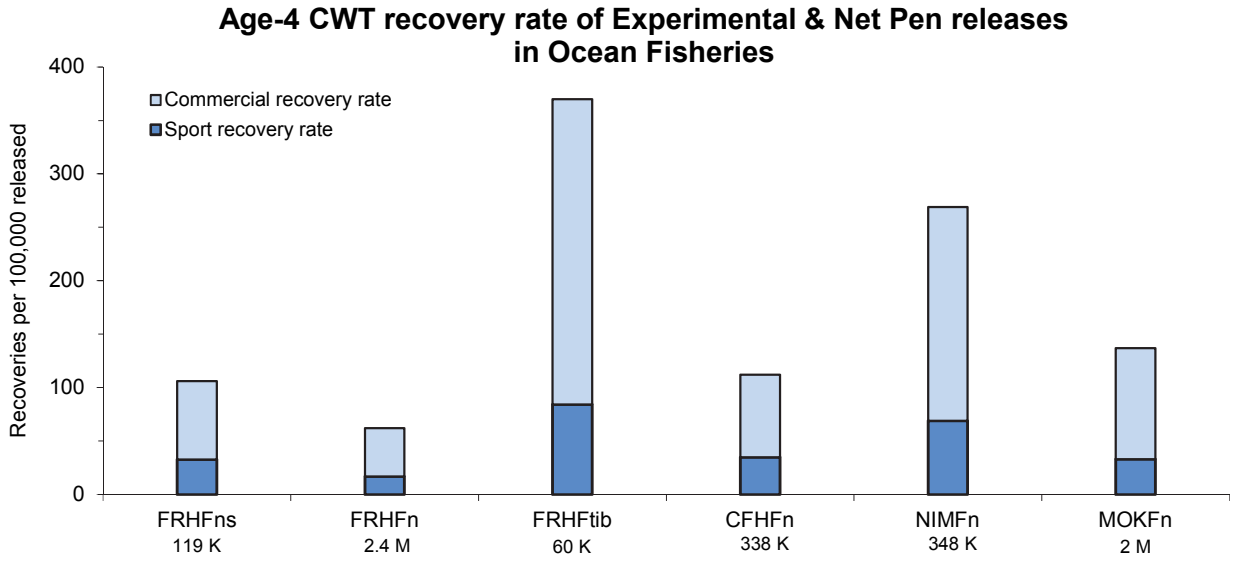


Figure 21. CWT recovery rates of Experimental and Net Pen releases in 2013 ocean sport and commercial fisheries.

Appendix 1. Sample expansion factors for Central Valley salmon carcass surveys collecting fish condition in 2013.

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 22%		1,259	3.9%	154	152	137	136	**0.12**	**0.90**	26.36	3.11	11,140	34.3%
nonfresh 78%		4,363	13.4%	189	186	175	175	0.04	0.94				
total	**32,515**	5,622	17.3%	343	338	312	**311**			**11.53**	**3.11**	11,140	**34.3%**

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 20%		1,126	8.4%	119	119	113	113	**0.11**	**0.95**	11.84	3.67	4,918	36.9%
nonfresh 41%		2,380	17.8%	173	171	157	156	0.07	0.92				
total	**13,337**	5,735	43.0%	292	290	270	**269**			**4.98**	**3.67**	4,918	**36.9%**

Cottonwood 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 23%		261	9.4%	20	20	20	20	**0.08**	**1.00**	10.63	4.01	855	30.8%
nonfresh 77%		887	32.0%	76	75	69	68	0.09	0.92				
total	**2,774**	1,148	41.4%	96	95	89	**88**			**2.42**	**4.01**	855	**30.8%**

Mill 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 61%		91	4.1%	8	8	8	8	**0.09**	**1.00**	24.14	3.58	692	31.5%
nonfresh 39%		57	2.6%	6	6	6	6	0.11	1.00				
total	**2,197**	148	6.7%	14	14	14	**14**			**13.80**	**3.58**	692	**31.5%**

Feather 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 100%		8,858	5.9%	3,279	3,272	3,077	3074	**0.37**	**0.94**	17.12	2.43	127,606	84.4%
nonfresh opportunistic		241		224	224	195	195						
total	**151,209**	9,099	0	3,503	3,496	3,272	**3,269**			**16.10**	**2.43**	127,606	**84.4%**

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

* Note: Feather River carcass survey included wild "FeaFw" CWT recoveries that were not included in CWT_{total}.

Appendix 2. Alternative 2013 CWT recovery and stray rates (recoveries per 100,000 CWTs released) of CFH and FRH releases.[a/]

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[b/]	Fea	Yub	Ame	Mok	Mer	SJ	In-basin	Stray	CV total		CWT_{samp}	In-basin	Stray	**CV total**	**Ocean**
CFHFh	2011	Fall	3,117,042	396	0	24	0	0	0	0	0	0	396	24	420	0%	101	13	1	13	3
CFHLh	2012	Late	1,031,419	991	124	0	0	0	0	1	2	0	991	127	1,118	9%	42	96	12	108	4
FRHFb	2011	Fall	297,089	4	23	0	126	7	7	0	1	3	126	45	171	0%	55	42	15	58	19
FRHFn	2011	Fall	2,293,211	46	161	96	1,669	113	88	26	4	19	1,669	554	2,224	0%	539	73	24	97	24
FRHFnc	2011	Fall	426,190	11	0	10	430	**7**	20	1	0	0	430	49	479	41%	345	101	11	112	81
FRHS	2011	Spr	1,088,286	0	0	0	145	0	0	0	0	0	145	0	145	0%	79	13	0	13	7
FRHSn	2011	Spr	1,125,189	0	0	0	58	0	0	0	0	0	58	0	58	6%	54	5	0	5	5

Age 3 CWT recoveries

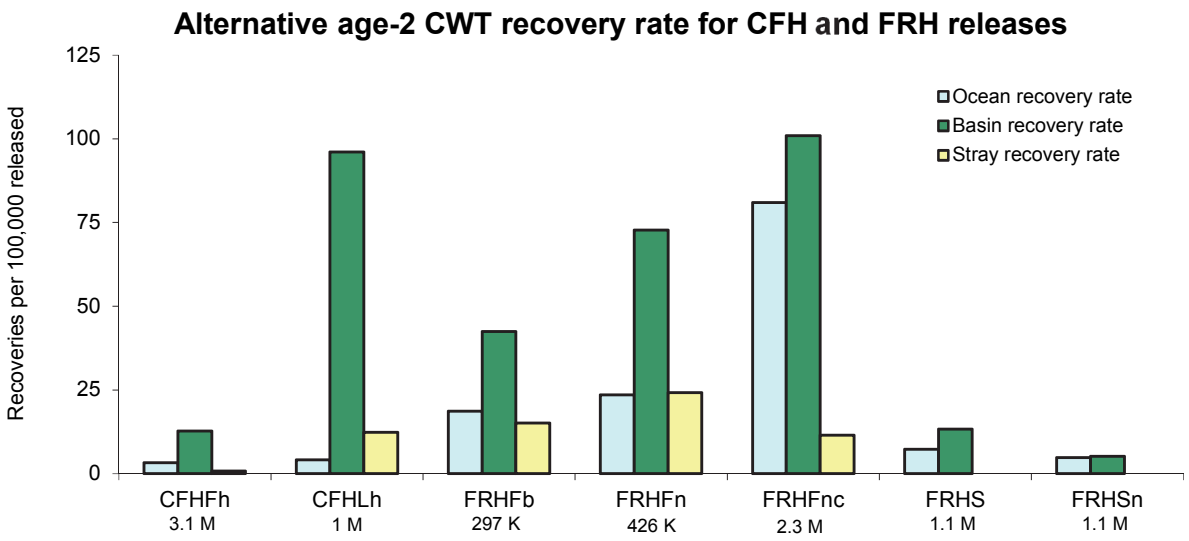
Release type	Brood year	Run type	# CWT tagged	Central Valley total recoveries (CWT_{samp}) by basin									CV CWT_{samp} totals			% CV Stray	Ocean	Recovery rate per 100K released			
				Bat Cr	Up Sac	Nat crks[b/]	Fea	Yub	Ame	Mok	Mer	SJ	In-basin	Stray	CV total		CWT_{samp}	In-basin	Stray	**CV total**	**Ocean**
CFHFh	2010	Fall	2,835,420	12,638	438	749	17	7	22	0	0	0	12,638	1,234	13,872	9%	13,768	446	44	489	486
CFHFn	2010	Fall	334,756	230	81	108	731	96	585	35	52	46	230	1,734	1,964	88%	4,598	69	518	587	1,374
CFHLh	2011	Late	1,037,859	2,762	349	0	0	0	0	0	1	0	2,762	350	3,112	11%	1,241	266	34	300	120
FRHFn	2010	Fall	2,554,115	95	657	332	24,137	780	234	47	14	35	24,137	2,194	26,332	8%	20,709	945	86	1031	811
FRHFnc	2010	Fall	185,985	0	46	15	181	0	6	1	0	0	181	68	249	27%	6,867	97	37	134	3,692
FRHFtib	2010	Fall	56,030	7	12	20	335	7	2	3	0	3	335	54	389	14%	606	598	96	695	1,082
FRHS	2010	Spr	1,170,340	0	0	0	24,356	100	0	0	0	0	24,356	100	24,456	0%	5,373	2081	9	2090	459
FRHSn	2010	Spr	1,136,690	4	196	15	6,507	26	2	0	0	0	6,507	243	6,751	4%	1,196	572	21	594	105

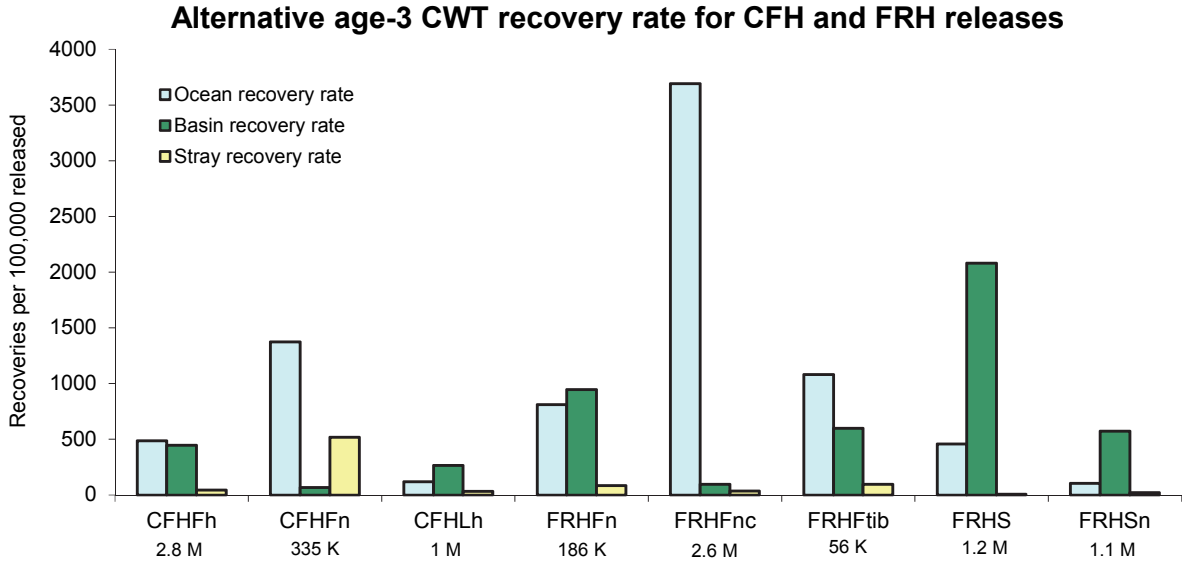
Age 4 CWT recoveries

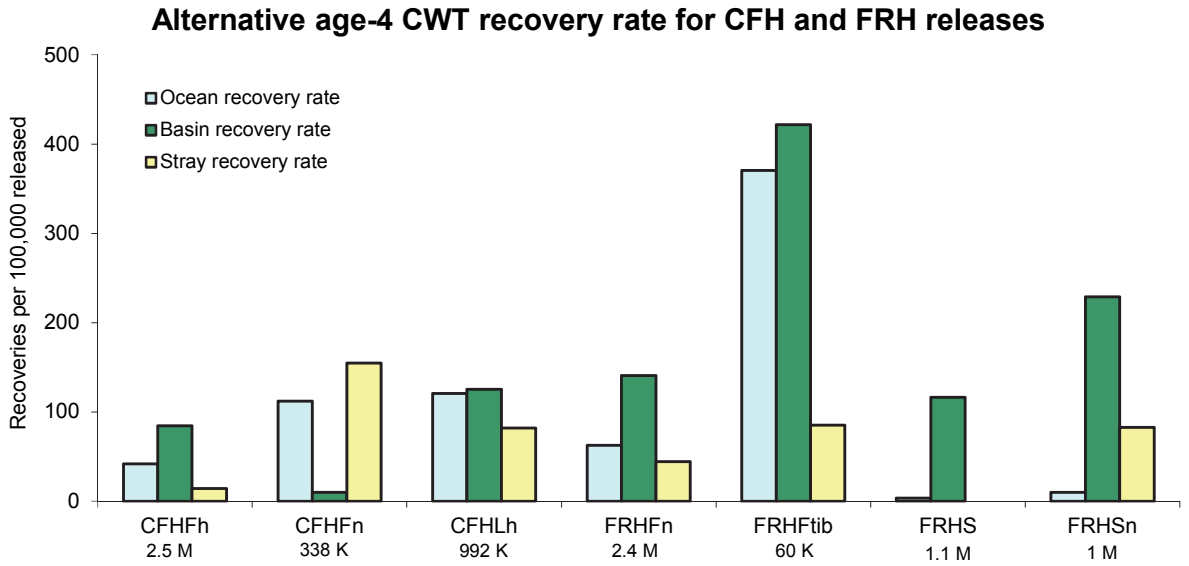
Release type	Brood year	Run type	# CWT tagged	Central Valley total recoveries (CWT_{samp}) by basin									CV CWT_{samp} totals			% CV Stray	Ocean	Recovery rate per 100K released			
				Bat Cr	Up Sac	Nat crks[b/]	Fea	Yub	Ame	Mok	Mer	SJ	In-basin	Stray	CV total		CWT_{samp}	In-basin	Stray	**CV total**	**Ocean**
CFHFh	2009	Fall	2,541,142	2,147	242	118	0	0	0	0	0	0	2,147	360	2,508	14%	1,062	85	14	99	42
CFHFn	2009	Fall	337,919	33	115	10	254	53	72	1	13	5	33	522	555	94%	379	10	155	164	112
CFHLh	2010	Late	992,047	1,244	811	0	0	0	0	0	0	0	1,244	811	2,055	39%	1,196	125	82	207	121
FRHFn	2009	Fall	2,367,209	28	761	183	3,331	26	36	10	0	3	3,331	1,047	4,379	24%	1,478	141	44	185	62
FRHFtib	2009	Fall	60,104	0	23	16	254	10	1	1	0	0	254	51	305	17%	223	422	85	507	370
FRHS	2009	Spr	1,026,954	0	0	0	1,194	0	0	0	0	0	1,194	0	1,194	0%	36	116	0	116	4
FRHSn	2009	Spr	1,058,635	0	784	90	2,423	0	0	0	0	0	2,423	873	3,296	26%	105	229	83	311	10

a/ CFH and FRH releases recovered in upper Sacramento River and Yuba River, respectively, considered stray recoveries.

b/ Natural creeks include Clear Creek, Cottonwood Creek, Paynes Creek, Mill Creek, Deer Creek and Butte Creek.







Appendix 3. Alternative CWT recovery rates for CFH and FRH releases by age in 2013.

Appendix 4. Sample expansion for CWTs recovered in Yuba River escapement above Daguerre Point Dam (DPD) based on video data, 2013.

DPD Vaki video	Total	% adclip	known status
no clip	9,915		9,915
adclip	1,235	11.1%	1,235
unknown clip	230		
total	11,380		**11,150**

Yuba River natural escapement above DPD: Total video count (known status) 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
11,380	**11,150**	98%	**1,235**	129	112	**112**	**0.111**	**0.868**	**9.77**	**3.49**	**3,817**	**33.5%**
video count	known status		video count		carcass survey							

Appendix 5. Sample expansion for CWTs recovered in Mokelumne River escapement above Woodbridge Dam (WD) based on video data, 2013.

	Total	Known ad status	% adclip
Woodbridge Dam video	12,252	3,587	29.3%
MRFI return	5,181	1,620	31.3%
Natural Escapement Mokelume River	**7,071**	**1,967**	27.8%

Mokelume River natural escapement above WD: Total video count minus MRFI 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
7,071	7,071	100%	1,967	456	437	**431**	**0.278**	**0.958**	**4.37**	**2.40**	**4,529**	**64.1%**
video count			video count		carcass survey							