Recovery of Coded-Wire Tags from Chinook Salmon in California's Central Valley Escapement, Inland Harvest, and Ocean Harvest in 2014

Melodie Palmer-Zwahlen[1/], Vanessa Gusman[2/], and Brett Kormos[2/]

December 2018

[1/]Pacific States Marine Fisheries Commission

[2/]California Department of Fish and Wildlife
Marine Region
Ocean Salmon Project
5355 Skylane Blvd, Suite B
Santa Rosa, CA 95403

This report is funded by the U.S. Bureau of Reclamation, East Bay Municipal Utilities District, and the California Department of Water Resources contracts with the Pacific States Marine Fisheries Commission (PSMFC). The work necessary to produce this report was a cooperative effort between the California Department of Fish and Wildlife and the PSMFC.

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 fifth annual report on the recovery of CFM CWTs in the CV and ocean fisheries. In 2014, approximately 63,000 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, Palmer et al. 2018) 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 2014, 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 2015 return year, however the escapement period began in late 2014.

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 on major rivers and tributaries in 2014 adequately sampled (sample rate ≥ 20%) for ad-clipped fish. The sampling rate was generally lower for smaller creeks where biodata was collected over a few days and/or limited areas.

There were almost 117,200 salmon sampled, 35,200 ad-clipped salmon observed, and over 32,800 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 also 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 monitoring projects or hatcheries.

Ocean Harvest Monitoring

In 2014, 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 89,400 salmon and collected 19,600 heads that were processed by the Santa Rosa CWT lab. An additional 13,000 heads collected in Oregon ocean sport and commercial fisheries during 2014 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 2014 inland and ocean CWT recoveries are publicly available at www.rmpc.org.

CWT Data Analysis

A "master" release database of CWT codes recovered in 2014 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 (BY) 2009 through 2012 was downloaded from the RMPC. Approximately 142 million CV salmon were released for these brood years, of which 51 million were marked and tagged utilizing 515 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 2014, there were 295 individual CWT codes recovered in the CV, primarily from age-2, age-3, and age-4 salmon. The CWT master file was updated with any additional information obtained for special CV salmon releases (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 **F**all-run **h**atchery releases (in-basin)
CFHFn	Coleman National Fish Hatchery **F**all-run bay **n**et pen releases (San Pablo Bay)
FRHFb	Feather River Hatchery **F**all-run **b**arge study releases
FRHFe	Feather River Hatchery **F**all-run **e**xperimental releases
FRHFn	Feather River Hatchery **F**all-run bay **n**et pen releases (San Pablo Bay)
FRHFnc	Feather River Hatchery **F**all-run **c**oastal **n**et pen releases (Santa Cruz and Pillar Point)
FRHFtib	Feather River Hatchery **F**all-run **Tib**uron net pen releases (held several months)
NIMF	Nimbus Fish Hatchery **F**all-run in-basin releases
NIMFn	Nimbus Fish Hatchery **F**all-run bay **n**et pen releases (San Pablo Bay)

San Joaquin River Basin Fall-run Chinook salmon release types

MOKF	Mokelumne River Hatchery **F**all-run in-basin releases
MOKFn	Mokelumne River Hatchery **F**all-run bay **n**et pen releases (Sherman Island)

MOKFt Mokelumne River Hatchery **F**all-run **t**rucked releases (no net pen acclimation)
MERF Merced River Hatchery in-basin **F**all-run releases
MERFt Merced River Hatchery **F**all-run **t**rucked releases (no net pen acclimation)

Central Valley Spring-run Chinook salmon release types
FRHS Feather River Hatchery **S**pring-run in-basin releases
FRHSn Feather River Hatchery **S**pring-run bay **n**et pen releases

Sacramento River winter-run Chinook salmon release types
SacW Sacramento River **W**inter-run supplementation natural production in-basin releases

Central Valley Late-fall Chinook salmon release types
CFHLh Coleman National Fish Hatchery **L**ate-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 vary among surveys, the ad-clip rate of fresh salmon sampled in 2014 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 number of non-fresh salmon sampled (n=30,223) is greater than fresh salmon (n=10,287).

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

underestimate hatchery contribution while still incorporating CWT codes from both fresh and non-fresh fish:

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

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, Palmer-Zwahlen et al. 2018), 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 and 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 2014 CV inland recoveries and California ocean harvest

All except two of the 31,845 valid CWTs recovered in the CV during 2014 were from CV Chinook salmon releases. Most CWTs were brood year 2010 through 2012 releases (Table 6). More than 89% of all CWT_{total} recoveries were fall-run, followed by spring-run (8%), and late-fall-run (4%) salmon releases. Only 0.2% of all CWT_{total} recovered were winter-run, all of which were collected in their upper Sacramento River escapement survey. The two non-CV salmon were spring-run Chinook released from Trinity River Hatchery. The majority of fall-run CWT_{total} recovered in the CV were age-3 (46%), age-4 (39%), and age-2 (15%) fish (Table 6).

Most of the 18,626 valid CWT recoveries in the 2014 California ocean harvest were CV salmon releases belonging to brood years 2010 through 2012 (Table 7). Approximately 92% of all CWT_{total} in the ocean harvest were CV fall-run, followed by CV spring-run (2%), CV late-fall-run (2%), and CV winter-run (0.1%) salmon. The remaining 4% 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 (67%) and age-4 (25%) fish.

Like California, most of the 12,522 valid CWT recoveries in the 2014 Oregon ocean harvest were CV salmon releases (Table 8). Approximately 67% of all CWT_{total} in the ocean harvest were CV fall-run salmon and 3% were CV spring-run. Non-CV stocks made up 30% 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 were age-3 (64%) and age-4 (34%) fish.

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

More than 187,100 fall-run Chinook salmon returned to spawn in natural areas during 2014 and the proportion of hatchery-origin salmon varied throughout the CV. The lowest hatchery proportion occurred in Butte Creek (21%) while the highest proportion (89%) occurred in Battle Creek (Table 9, Fig. 2). However, note that Battle Creek values are conjectured 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. Niemala, FWS, pers. comm.). The second highest hatchery proportion occurred in the Feather River (83%). The total fall-run hatchery proportion for all natural areas surveyed in the CV was 70%.

The hatchery proportion of the 62,200 fall-run salmon returning to the five CV hatcheries ranged from 86% to 96% (Table 9, Fig. 3). The fall-run hatchery proportion for all CV hatcheries combined was 89%. The spring-run return to FRH was almost entirely hatchery-origin fish while the late-fall-return to CFH was 98% hatchery-origin salmon.

To help differentiate the hatchery composition, all CV release types from the same stock, run, and hatchery use the same color scheme in the pie chart figures (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. Additionally, select patterns are used to designate different release types. All bay net pen releases contain black dots while net pen coastal releases are designated with a criss-cross pattern. Tiburon net pen and all 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 2014 (Table 10). All ad-clipped salmon were sampled during the entire run. CFH began late-fall sampling (100%) immediately following fall-run sampling and continued through mid-March 2015. Based solely on this run-timing, 18,981 salmon returned to CFH during the "fall" run sampling period, and 6,673 salmon returned during the "late-fall" run period. Based on the composition of CWT recoveries, FWS staff determined there was some overlap between runs, especially in late November through early December, and FWS staff adjusted the final escapement to 18,840 fall-run and 6,814 late-fall-run salmon. An additional 137 late-fall salmon were trapped at CFH after spawning operations ended in mid-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 fall-run spawners in the Upper Sacramento River, Clear Creek, and Paynes Creek (Figs. 5, 6, 7).

The proportion of hatchery-origin fish (prevalent release type shown in parentheses) at each of the following locations was:

- Fall-run returns CFH: 89% (CFHFh)
- Late-fall-run returns CFH: 98% (CFHLh)
- Winter-run spawners Upper Sacramento River: 16% (SacW)
- Fall-run spawners Upper Sacramento River: 54% (FRHFn)
- Late-fall-run spawners Upper Sacramento River: 3% (NIMFn)
- Fall-run spawners Clear Creek: 57% (FRHFn)
- Fall-run spawners Cottonwood Creek: 41% (CFHFh)
- Fall-run spawners Paynes Creek: 54% (CFHFh)
- Fall-run spawners Mill Creek: 45% (CFHFh, FRHFn)
- Fall-run spawners Butte Creek: 21% (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 parentheses) at each of the following locations was:

- Fall/spring-run spawners Yuba River above DPD: 49% (FRHFn)
- Fall/spring-run spawners Yuba River below DPD: 45% (FRHFn)
- Spring-run returns FRH: 100% (FRHS)
- Fall-run returns FRH: 95% (FRHFn)
- Fall/spring-run spawners Feather River: 83% (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 parentheses) at each of the following locations was:

- Fall-run returns NIM: 87% (NIMF)
- Fall-run returns NIM weir: 28% (MOKFn)
- Fall-run spawners American River: 64% (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 parentheses) at each of the following locations was:

- Fall-run returns MOK: 86% (MOKFn)
- Fall-run spawners Mokelumne River: 76% (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 parentheses) at each of the following locations was:

- Fall-run returns MER: 96% (MOKFn)
- Fall-run spawners Merced River: 58% (MOKFn)
- Fall-run spawners Stanislaus River: 65% (MOKFn)
- Fall-run spawners Tuolumne River: 65% (MOKFn)

2. Contribution of CV Release Types to Total Salmon Escapement

Approximately 73% of the total 264,400 salmon escapement to CV hatcheries and natural areas during 2014-2015 were hatchery-origin fish (Table 11). The proportion of these fish that strayed from their basin-of-origin ranged from zero to 84 percent, depending on release type:

R_{type}	Run	CWT_{total}	#Strays	(%)
CFHFh	Fall	47,882	4,764	(10%)
CFHFn	Fall	3,402	1,965	(58%)
FRHFb	Fall	2,075	449	(22%)
FRHFn	Fall	78,004	17,453	(22%)
FRHFnc	Fall	3,389	1,132	(33%)
FRHFtib	Fall	199	100	(50%)
NIMF	Fall	11,161	170	(2%)
NIMFn	Fall	6,748	357	(5%)
MOKF	Fall	288	24	(8%)
MOKFn	Fall	14,673	6,822	(46%)
MOKFt	Fall	1,919	1,072	(56%)
MERF	Fall	58	15	(26%)
MERFt	Fall	1,420	1,198	(84%)
FRHS	Spr	11,009	118	(1%)
FRHSn	Spr	3,664	461	(13%)
SacW	Wint	430	0	
CFHLh	Late	6,840	7	(0.1%)
	Total	193,161	36,107	(18.7%)

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

In 2014, approximately 74% of the 42,400 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 parentheses) in each of the following fisheries was:

- Upper Sacramento River fall-run harvest: 71% (CFHFh)
- Lower Sacramento River fall-run harvest: 63% (FRHFn)
- Feather River fall-run harvest: 72% (FRHFn)
- American River fall-run harvest: 83% (NIMF)

- Mokelumne River fall-run harvest: 98% (MOKFn)
- Upper Sacramento River late-fall-run harvest: 39% (CFHLh)

Of all hatchery release types, FRHFn contributed the most (24%) to the total CV sport harvest, followed by CFHFh (16%). Most of the CFHFh recoveries occurred in the Upper Sacramento River fall fisheries (Table 11).

Contribution of CV Release Types to CV Sport Harvest

R_{type}	Run	CWT_{total}	(% harvest)
CFHFh	Fall	6,796	(16%)
CFHFn	Fall	1,011	(2%)
FRHFb	Fall	516	(1%)
FRHFn	Fall	10,151	(24%)
FRHFnc	Fall	523	(1%)
FRHFtib	Fall	37	
NIMF	Fall	4,503	(11%)
NIMFn	Fall	1,685	(4%)
MOKF	Fall	15	
MOKFn	Fall	4,632	(11%)
MOKFt	Fall	432	(1%)
MERF	Fall	0	
MERFt	Fall	233	(1%)
FRHS	Spr	348	(1%)
FRHSn	Spr	381	(1%)
SacW	Wint	0	
CFHLh	Late	266	(1%)
	Total	31,529	

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 2010 through 2012 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 2014. 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 in most cases.

Age-2 CV Escapement recovery rate; percent stray

R_{type}	Brdyr	Run	# recoveries per 100K released	% stray	
CFHFh	2012	Fall	7		
FRHFb	2012	Fall	328	29%	
FRHFe	2012	Fall	3		
FRHFn	2012	Fall	195	26%	
FRHFnc	2012	Fall	188	29%	
FRHFtib	2012	Fall	50	20%	(<10,000 released)
NIMF	2012	Fall	32	3%	
NIMFn	2012	Fall	30	7%	
MOKF	2012	Fall	32	6%	
MOKFn	2012	Fall	117	38%	
MERFt	2012	Fall	93	84%	
FRHS	2012	Spr	50		
FRHSn	2012	Spr	83	11%	
SacW	2012	Wint	17		
CFHLh	2013	Late	14		

Age-3 CV Escapement recovery rate; percent stray

R_{type}	Brdyr	Run	# recoveries per 100K released	% stray	
CFHFh	2011	Fall	80	11%	
FRHFb	2011	Fall	359	14%	
FRHFe	2011	Fall	117		(<11,500 released)
FRHFn	2011	Fall	367	23%	
FRHFnc	2011	Fall	465	31%	
FRHFtib	2011	Fall	243		(<7,000 released)
NIMF	2011	Fall	125		
NIMFn	2011	Fall	276	8%	
MOKF	2011	Fall	168	8%	
MOKFn	2011	Fall	112	48%	
MOKFt	2011	Fall	255	50%	
MERF	2011	Fall	7		

FRHS	2011	Spr	485	1%
FRHSn	2011	Spr	172	15%
SacW	2011	Wint	196	
CFHLh	2012	Late	438	

Age-4 CV Escapement recovery rate; percent stray

R_{type}	Brdyr	Run	# recoveries per 100K released	% stray
CFHFh	2010	Fall	128	25%
CFHFn	2010	Fall	238	62%
FRHFn	2010	Fall	310	18%
FRHFnc	2010	Fall	48	94%
FRHFtib	2010	Fall	290	57%
NIMF	2010	Fall	181	2%
NIMFn	2010	Fall	183	1%
MOKF	2010	Fall	71	10%
MOKFn	2010	Fall	42	69%
MOKFt	2010	Fall	41	63%
MERF	2010	Fall	28	36%
FRHS	2010	Spr	428	1%
FRHSn	2010	Spr	73	10%
SacW	2010	Wint	15	
CFHLh	2011	Late	199	

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

The relative recovery rate of CV hatchery releases in 2014 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. Fall-run 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

R_{type}	Brdyr	Run	# recoveries per 100K released	% sport	
CFHFh	2012	Fall	3	77%	
FRHFb	2012	Fall	127	92%	
FRHFe	2012	Fall	0		
FRHFn	2012	Fall	87	76%	
FRHFnc	2012	Fall	511	84%	
FRHFtib	2012	Fall	150	59%	(<10,000 released)

NIMF	2012	Fall	11	76%
NIMFn	2012	Fall	8	81%
MOKF	2012	Fall	0	
MOKFn	2012	Fall	38	83%
MERFt	2012	Fall	28	100%
FRHS	2012	Spr	6	100%
FRHSn	2012	Spr	22	96%

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

R_{type}	Brdyr	Run	# recoveries per 100K released	% sport	
CFHFh	2011	Fall	202	23%	
FRHFb	2011	Fall	817	22%	
FRHFe	2011	Fall	67	41%	(<11,500 released)
FRHFn	2011	Fall	763	24%	
FRHFnc	2011	Fall	2,387	26%	
FRHFtib	2011	Fall	492	25%	(<7,000 released)
NIMF	2011	Fall	255	21%	
NIMFn	2011	Fall	579	23%	
MOKF	2011	Fall	139	39%	
MOKFn	2011	Fall	274	20%	
MOKFt	2011	Fall	638	20%	
MERF	2011	Fall	22	24%	
FRHS	2011	Spr	362	25%	
FRHSn	2011	Spr	184	22%	
SacW	2012	Wint	62	77%	
CFHLh	2012	Late	127	31%	

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

R_{type}	Brdyr	Run	# recoveries per 100K released	% sport
CFHFh	2010	Fall	114	25%
CFHFn	2010	Fall	397	23%
FRHFn	2010	Fall	190	23%
FRHFnc	2010	Fall	644	26%
FRHFtib	2010	Fall	378	25%
NIMF	2010	Fall	194	16%
NIMFn	2010	Fall	257	16%

MOKF	2010	Fall	43	29%
MOKFn	2010	Fall	61	14%
MOKFt	2010	Fall	56	13%
MERF	2010	Fall	28	25%
FRHS	2010	Spr	23	34%
FRHSn	2010	Spr	6	41%
SacW	2011	Wint	0	
CFHLh	2011	Late	120	17%

5. Hatchery Proportion and Contribution of CV Release Types to Ocean Salmon Fisheries
More than half of the 243,100 and 208,100 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.

California ocean sport fishery
California anglers harvested more than 74,800 salmon in the ocean sport fishery during 2014. The total contribution of hatchery-origin salmon to the California ocean sport fishery was 69%, ranging from 64% to 75% of the total harvest, depending on major port area (Fig. 18). Most of the harvest occurred in San Francisco (43%) and Eureka-Crescent City (21%), followed by Monterey (19%) and Fort Bragg (17%) port areas (Table 13).

Of all hatchery release types, FRHFn contributed the most (30%) to the total California ocean sport harvest, followed by CFHFh (11%). Non-CV releases (e.g., Klamath-Trinity River Basin, Smith River, Oregon and Washington hatchery stocks) contributed 2% to the total harvest (Table 14).

Contribution of CV Release Types to Ocean Salmon Sport Fishery

R_{type}	Run	CWT_{total}	(% harvest)
CFHFh	Fall	8,195	(11%)
CFHFn	Fall	1,016	(1%)
FRHFb	Fall	828	(1%)
FRHFn	Fall	22,435	(30%)
FRHFnc	Fall	5,371	(7%)
FRHFtib	Fall	62	
NIMF	Fall	2,440	(3%)
NIMFn	Fall	2,050	(3%)
MOKF	Fall	69	
MOKFn	Fall	4,572	(6%)
MOKFt	Fall	550	(1%)
MERF	Fall	18	
MERFt	Fall	385	(1%)

FRHS	Spr	1,048	(1%)
FRHSn	Spr	576	(1%)
SacW	Wint	87	
CFHLh	Late	611	(1%)
NonCV		1,200	(2%)
	Total	51,512	

California ocean commercial fishery

California trollers harvested almost 168,300 salmon in the ocean commercial fishery during 2014. The total contribution of hatchery-origin salmon to the California ocean commercial fishery was 59%, ranging from 56% to 75% of the total harvest, depending on major port area (Fig. 19). Most of the harvest occurred in San Francisco (49%) and Fort Bragg (46%), followed by Monterey (9%) and Eureka-Crescent City (<1%) port areas (Table 15).

Of all hatchery release types, FRHFn contributed the most (26%) 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 3% to the total harvest (Table 16).

Contribution of CV Release Types to Ocean Salmon Commercial Fishery

R_{type}	Run	CWT_{total}	(% harvest)
CFHFh	Fall	18,111	(24%)
CFHFn	Fall	2,647	(4%)
FRHFb	Fall	1,087	(1%)
FRHFn	Fall	43,028	(57%)
FRHFnc	Fall	6,025	(8%)
FRHFtib	Fall	156	
NIMF	Fall	6,377	(9%)
NIMFn	Fall	5,196	(7%)
MOKF	Fall	103	
MOKFn	Fall	7,723	(10%)
MOKFt	Fall	1,560	(2%)
MERF	Fall	42	
MERFt	Fall	0	
FRHS	Spr	1,215	(2%)
FRHSn	Spr	543	(1%)
SacW	Wint	28	
CFHLh	Late	1,706	(2%)
NonCV		4,377	(6%)
	Total	99,925	

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

Newer coastal net pen and barge study release types were recovered in both CV escapement and ocean sport harvest for a second year in 2014. In addition, CWTs from an experimental rice field study were recovered for the first time in 2014. Approximately 92,000 BY 2012 FRH fall-run salmon were released into rice fields in the Yolo Bypass with an additional 46,000 released in conjunction at Elkhorn Boat Ramp on the Sacramento River (just south of the Yolo Bypass northern entrance). The intention of these paired releases was to evaluate survival and recovery rates of juveniles reared in rice fields compared to siblings released in the mainstem Sacramento River. These experimental releases are differentiated into the following release types:

FRHFbb	Feather River Hatchery **F**all-run barge study: trucked and released in SF **b**ay
FRHFbg	Feather River Hatchery **F**all-run barge study: bar**g**ed to SF Bay and released
FRHFbr	Feather River Hatchery **F**all-run barge study: released in-**r**iver (Feather River mouth)
FRHFnp	Feather River Hatchery **F**all-run net pen coastal releases – **P**illar Point
FRHFns	Feather River Hatchery **F**all-run net pen coastal releases – **S**anta Cruz
FRHFkc	Feather River Hatchery **F**all-run rice field study: Elkhorn Boat Ramp (**K**naggs **c**ontrol group)
FRHFkr	Feather River Hatchery **F**all-run rice field study: Yolo Bypass (**K**naggs **R**anch)

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

Age-2 CV Escapement recovery rate; percent stray

R_{type}	Brdyr	Run	# recoveries per 100K released	% stray	
FRHFbb	2012	Fall	427	33%	
FRHFbg	2012	Fall	534	26%	
FRHFbr	2012	Fall	15		
FRHFnp	2012	Fall	267	29%	
FRHFns	2012	Fall	52	27%	
FRHFkc	2012	Fall	9		
FRHFkr	2012	Fall	0		
FRHFn	2012	Fall	195	26%	
FRHFtib	2012	Fall	50	20%	(<10,000 released)
NIMFn	2012	Fall	30	7%	
MOKFn	2012	Fall	117	38%	

Age-3 CV Escapement recovery rate; percent stray

R_{type}	Brdyr	Run	# recoveries per 100K released	% stray
FRHFbb	2011	Fall	338	27%
FRHFbg	2011	Fall	413	14%
FRHFbr	2011	Fall	326	2%

FRHFnp	2011	Fall	978	29%	
FRHFns	2011	Fall	71	46%	
FRHFe	2011	Fall	117		(<11,500 released)
FRHFn	2011	Fall	367	23%	
FRHFtib	2011	Fall	243		(<7,000 released)
NIMFn	2011	Fall	276	8%	
MOKFn	2011	Fall	112	48%	

Age-4 CV Escapement recovery rate; percent stray

R_{type}	Brdyr	Run	# recoveries per 100K released	% stray
FRHFns	2010	Fall	48	94%
FRHFn	2010	Fall	310	18%
FRHFtib	2010	Fall	290	57%
CFHFn	2010	Fall	238	62%
NIMFn	2010	Fall	183	1%
MOKFn	2010	Fall	42	69%

The ocean harvest recovery rate and proportion taken in the sport fishery for other fall-run experimental and 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

R_{type}	Brdyr	Run	# recoveries per 100K released	% sport	
FRHFbb	2012	Fall	251	92%	
FRHFbg	2012	Fall	128	94%	
FRHFbr	2012	Fall	0		
FRHFnp	2012	Fall	536	83%	
FRHFns	2012	Fall	467	85%	
FRHFkc	2012	Fall	0		
FRHFkr	2012	Fall	0		
FRHFn	2012	Fall	87	76%	
FRHFtib	2012	Fall	150	59%	(<10,000 released)
NIMFn	2012	Fall	8	81%	
MOKFn	2012	Fall	38	83%	

(% stray)	R_{type}	Brdyr	Run	# recoveries per 100K released	% sport
(33%)	FRHFbb	2012	Fall	251	92%
(26%)	FRHFbg	2012	Fall	128	94%
	FRHFbr	2012	Fall	0	

(29%)	FRHFnp	2012	Fall	536	83%
(27%)	FRHFns	2012	Fall	467	85%
	FRHFkc	2012	Fall	0	
	FRHFkr	2012	Fall	0	
(26%)	FRHFn	2012	Fall	87	76%
(20%)	FRHFtib	2012	Fall	150	59%
(7%)	NIMFn	2012	Fall	8	81%
(38%)	MOKFn	2012	Fall	38	83%

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

R_{type}	Brdyr	Run	# recoveries per 100K released	% sport	
FRHFbb	2011	Fall	954	21%	
FRHFbg	2011	Fall	775	28%	
FRHFbr	2011	Fall	725	18%	
FRHFnp	2011	Fall	2,722	27%	
FRHFns	2011	Fall	2,130	25%	
FRHFe	2011	Fall	0		(<11,500 released)
FRHFn	2011	Fall	763	24%	
FRHFtib	2011	Fall	492	25%	(<7,000 released)
NIMFn	2011	Fall	579	23%	
MOKFn	2011	Fall	274	20%	

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

R_{type}	Brdyr	Run	# recoveries per 100K released	% sport
FRHFns	2010	Fall	644	26%
FRHFn	2010	Fall	190	23%
FRHFtib	2010	Fall	378	25%
CFHFn	2010	Fall	397	23%
NIMFn	2010	Fall	257	16%
MOKFn	2010	Fall	61	14%

2014 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 releases.
- Rivers and creeks with hatchery installations generally had the highest proportions of hatchery-origin spawners in natural areas. 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 was mostly MOKFn releases.

- Fall-run escapement into the Upper Sacramento River and its sampled tributaries was predominantly hatchery-origin salmon with the exception of Cottonwood and Mill creeks. 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 releases.
- Fall-run escapement into the Feather River was predominantly hatchery-origin salmon, primarily FRHFn, FRHS, and FRHSn releases.
- Fall-run escapement into the American River was predominantly hatchery-origin salmon, primarily NIMF, NIMFn, and MOKFn releases.
- Fall-run escapement into all sampled tributaries of the San Joaquin Basin was predominantly hatchery-origin salmon. MOKFn, MOKFt, FRHFn, and MERFt were the predominant hatchery release types observed.
- Approximately three-fourths of the total 2014-2015 CV salmon escapement (all run-types) were hatchery-origin fish. FRHFn and CFHFh releases contributed the most to total escapement. Trucked MERFt and MOKFt releases, along with bay net pen CFHFn releases, strayed at the highest rates.
- For age-2 fall-run salmon, experimental barge FRHFb, bay net pen FRHFn and coastal net pen FRHFnc releases had the highest CV recovery rates for their cohort. Trucked MERFt and bay net pen MOKFn had the highest stray rates observed for age-2 releases.
- For age-3 fall-run salmon, coastal net pen FRHFnc, bay net pen FRHFn, and experimental barge study FRHFb releases had the highest CV recovery rates for their cohort. Trucked MOKFt and bay net pen MOKFn had the highest stray rates observed for age-3 release types.
- For age-4 fall-run salmon, bay net pen FRHFn, CFHFn, and NIMFn releases, along with in-basin NIMF releases, had the highest CV recovery rates for their cohort. Coastal net pen FRHFnc, bay net pen MOKFn and CFHFn, and trucked MOKFt releases had the highest stray rates observed for age-3 release types.
- Approximately three-fourths 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 salmon fisheries.
- Coastal net pen releases (FRHFnc) had the highest ocean recovery rates for all release types and ages. Their recovery rate was several times greater than that for other bay net pen releases of the same cohort and nearly an order of magnitude greater than that of most in-basin releases for the same age. The age-2 and age-3 ocean recovery rates for releases from the two coastal net pen projects (FRHFnp, FRHFns) were very similar.
- Coastal releases from Pillar Point net pens (FRHFnp) had highest CV recovery rates for all age-2 and age-3 net pen releases whereas relatively few coastal releases from Santa Cruz net pens (FRHFns) returned to the CV. The majority of FRHFnp recoveries took place in the

Feather River Basin whereas a fair share of the FRHFns recovered in the CV strayed into the upper Sacramento River Basin.

- Age-2 salmon barged down the Sacramento River (FRHFbg) had the highest CV recovery rate in their cohort with moderate straying. Fish released directly into San Francisco Bay (FRHFbb) strayed the most among the three barge study release types but were also recovered at higher rates in the ocean fisheries. Fish released in the Sacramento River at the mouth of the Feather River (FRHFbr) had the lowest CV recovery rate but seldom strayed. No age-2 FRHFbr releases were recovered in the 2014 ocean fisheries.

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 the 2010, 2011, and 2012 CFM reports, the authors hope to begin the process of analyzing these data for complete broods over their respective life span in the very near future. 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 on-going 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.

LITERATURE CITED

Bergman, J., R. Nielson, and A. Low. 2012. Central Valley Chinook Salmon In-River Escapement Monitoring Plan. California Department of Fish and Game. Fisheries Branch Administrative Report Number: 2012-1. January 2012

Killam, D., M. Johnson and R. Revnak. 2014. Chinook Salmon Populations of the Upper Sacramento River Basin in 2013. RBFO Technical Report No. 02-2014

Kormos, B., M. Palmer-Zwahlen, and A. Low. 2012. Recovery of Coded-Wire Tags from Chinook Salmon in California's Central Valley Escapement and Ocean Harvest in 2010. Fisheries Branch Administrative Report 2012-02.

Pacific Fishery Management Council (PFMC) 2014. Review of 2013 Ocean Salmon Fisheries: Stock Assessment and Fishery Evaluation Document for the Pacific Coast Salmon Fishery Management Plan. PFMC, 7700 NE Ambassador Place, Suite 101, Portland, Oregon, 97220-1384. February 2014.

Pacific Fishery Management Council (PFMC). 2016. Pacific Coast Salmon Fishery Management Plan for Commercial and Recreational Salmon Fisheries off the Coasts of Washington, Oregon, and California as Amended through Amendment 19. PFMC, 7700 NE Ambassador Place, Suite 101, Portland, Oregon, 97220-1384. March 2016.

Palmer-Zwahlen, M. and B. Kormos. 2013. Recovery of Coded-Wire Tags from Chinook Salmon in California's Central Valley Escapement and Ocean Harvest in 2011. Fisheries Branch Administrative Report 2013-02.

Palmer-Zwahlen, M. and B. Kormos. 2015. Recovery of Coded-Wire Tags from Chinook Salmon in California's Central Valley Escapement and Ocean Harvest in 2012. Fisheries Branch Administrative Report 2015-04.

Palmer-Zwahlen, M., V. Gusman, and B. Kormos. 2018. Recovery of Coded-Wire Tags from Chinook Salmon in California's Central Valley Escapement and Ocean Harvest in 2013. Joint PSMFC-CDFW Report October 2018.

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

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

Table 1a. Estimation and sampling methods used for the 2014 CV Chinook hatchery escapement.

Sampling Location	Estimation and Sampling Methods	Agency
Hatchery Spawners		
Coleman National Fish Hatchery (CFH) Fall and Late-Fall (2015)	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 4, Late-fall-run period: Dec 5-Mar 17. All ad-clipped fish sampled. Fish returning to CFH from mid-Nov through 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 unmarked untagged-phenotypic late-fall fish released into Battle Creek above CFH Dec 9-Apr 21. All ad-clipped fish sampled and heads collected for CWT recovery Mar 13-31 (after CFH spawning operations cease). Late-fall data from video weir Mar 31-Jun 30 added. Grilse cutoff: 600mm.	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-Jun 27 (n~ 7,300) were considered "spring-run" and marked with uniquely-numbered dart tags prior to release back into the Feather River. Only fish marked with dart tags returning to FRH in fall were spawned as spring-run. All remaining fish were considered fall-run. FRH fish ladder opened Sep 15 and spring spawning began Sep 19. All spring-run fish bio-sampled. Fall spawning began Oct 8 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-June. 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.	DWR
Nimbus Fish Hatchery (NIM) Fall	Direct count. NIM ladder open Nov 3-Dec 17. All fish examined for fin-clips, tags, marks. Systematic random bio-sample ~20% 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 13 to force returning salmon into NIM; any salmon that migrated above prior to installation trapped between Nimbus 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 14-Feb 12. 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, 700 mm males.	CDFW
Merced River Fish Facility (MER) Fall	Direct count. MER open Nov 6-Dec 31. All fish examined for fin-clips, tags, marks. All ad-clipped fish were sampled and heads processed for CWT recovery. Grilse cutoff: 660 mm females, 740 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 2014 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 (2015)	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: 540 mm females, 645 mm males winter; 640 mm females, 670 mm males fall; 610 mm females, 610 mm males late-fall.	CDFW, FWS
Clear Creek Fall	Video weir count adjacent to Redding City Wastewater Treatment Plant used to determine total escapement. DIDSON camera used during turbid periods to determine passage. Weekly bio-sampling surveys to supplement video escapement data. Carcasses 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
Cow Creek Fall	Video weir count in lower creek used to determine total escapement. DIDSON camera used during turbid periods to determine passage. One kayak survey 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: 640 mm females, 670 mm males.	CDFW
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: 610 mm females, 680 mm males.	FWS, CDFW
Paynes Creek Fall	Raw carcass count to determine total escapement. One late-season walking survey was conducted to count redds and collect bio-data from fresh fish. All ad-clipped fish, including "unknown" ad-clipped status, were sampled and heads collected for CWT recovery. Grilse cutoff: 610 mm females, 700 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. DIDSON camera used during turbid periods to determine passage. 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: 670 mm females, 700 mm males.	CDFW
Deer Creek Fall	Video counts at Stanford Vina Ranch Irrigation Company (SVRIC) Dam plus expanded redd count between SVRIC Dam and the Sacramento River confluence used to determine total escapement. Two 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: 670 mm females, 710 mm males.	CDFW

Table 1b. Estimation and sampling methods used for the 2014 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. 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. 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: 680 mm females, 720 mm males.	CDFW
Mokelumne River Fall	Video count at Woodbridge Irrigation District Dam (WIDD) used to determine total escapement and ad-clipped fish above WIDD. Natural spawner escapement estimate and ad-clip rate calculated by subtracting total count and number of ad-clipped fish returning to MOK. Supplemental carcass survey to collect bio-data from fresh fish and heads from all ad-clipped fish. Grilse cutoff: 700 mm.	EBMUD
Stanislaus River Fall	Superpopulation modification of the Cormack-Jolly-Seber mark-recapture estimate. All fresh fish examined for fin-clips, tags, marks. All fresh ad-clipped fish sampled and heads collected for CWT recovery. Opportunistic sampling of ad-clipped fish on Stanislaus Weir (i.e., "washbacks"). Grilse cutoff: 660 mm females, 740 mm males.	CDFW
Tuolumne River Fall	Superpopulation modification of the Cormack-Jolly-Seber mark-recapture estimate. All fish examined for fin-clips, tags, marks, and condition. All ad-clipped fish sampled and heads collected for CWT recovery. Grilse cutoff: 660 mm females, 740 mm males.	CDFW
Merced River Fall	Superpopulation modification of the Cormack-Jolly-Seber mark-recapture estimate. All fresh fish examined for fin-clips, tags, marks. All fresh ad-clipped fish sampled and heads collected for CWT recovery. Grilse cutoff: 660 mm females, 740 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. Survey design and open dates for the 2014 CV Chinook sport harvest.

Sampling Location	Survey Design and Open Dates	Agency
Sport Harvest		
	Survey Design	
Central Valley Angler Survey (CVAS)	Stratified-random sampling design (one weekday and one weekend sample per week per section during the open season in each management zone) that included both roving counts and access interview components and sub-sampling of kept salmon. Almost all ad-clipped salmon sampled and heads collected for CWT recovery. Estimates of fishing effort, catch, and harvest of Chinook salmon made monthly for each survey section and then summed for the season total.	CDFW
	Open Dates	
Upper Sacramento River Fall and Late-Fall	Open Jul 16 - Dec 16 From the Lower Red Bluff Boat Ramp to Highway 113 bridge and Aug 1 - Dec 16 from the Deschutes Road Bridge to the Red Bluff Diversion Dam. Nov 1 is used to delineate the cutoff between the fall-run fishery and the late-fall-run fishery.	
Feather River Fall	Open Jul 16 - Oct 15 from the unimproved boat ramp above the Thermolito Afterbay Outfall to 200 yards above the Live Oak boat ramp and Jul 16 - Dec 16 from 200 yards above the Live Oak boat ramp to the Sacramento River confluence.	
American River Fall	Open Jul 16 - Dec 31 from Nimbus Dam to the Hazel Avenue Bridge, Jul 16 - Aug 15 from the Hazel Avenue Bridge to the USGS cable crossing, Jul 16 - Oct 31 from the USGS cable crossing to the SMUD power line crossing, Jul 16 - Dec 31 from the SMUD power line crossing to the Jibboom Street Bridge, and Jul 16 - Dec 16 from the Jibboom Street Bridge to the Sacramento River confluence.	
Lower Sacramento River Fall	Open Jul 16 - Dec 16 from the Highway 113 bridge to the Carquinez Bridge.	
Mokelumne River Fall	Open Jul 16 - Oct 15 from Camanche Dam to the Highway 99 Bridge, Jul 16 - Dec 31 from the Highway 99 Bridge to Woodbridge Dam, including Lodi Lake, and Jul 16 - Dec 16 from the Lower Sacramento Road bridge to the San Joaquin River confluence.	

Table 2. California ocean salmon sport and commercial fishery seasons by major port area, 2014.

	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 10 - Sep 7	24" TL	121	Sep 12 - 30	27" TL	15	4,000[b/]
Fort Bragg	Apr 5 - Nov 9	20" TL	219	Jun 19 - 30	27" TL	12	
				Jul 15 - Aug 29	27" TL	46	
				Sep 1 - 30	27" TL	30	
						88	
San Francisco	Apr 5 - Jun 30	24" TL	87	May 1 - Jun 30	27" TL	61	
	Jul 1 - Nov 9	20" TL	132	Jul 15 - Aug 29	27" TL	46	
			219	Sep 1 - 30	26" TL	30	
				Oct 1 - 15[c/]	26" TL	11	
						148	
Monterey[d/]	Apr 5 - Oct 5	24" TL	184	May 1 - Jun 30	27" TL	61	
				Jul 15 - Aug 13	27" TL	30	
						91	
California Total			743			342	

a/ Size limit in inches total length (TL).
b/ Klamath Management Zone quota fishery; daily bag and possession limit of 20 salmon per day.
c/ Open Monday through Friday between Pt. Reyes and Pt. San Pedro.
d/ 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 2014 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	2012	FRH	Fea R	Spr	2	1,106,679	1,125,897	98%	In-basin	Feather River (Boyds Pump Ramp); Gridley (50% net pens)
FRHSn	2012	FRH	Fea R	Spr	1	1,015,285	1,033,174	98%	Net pens	Wickland Oil net pen releases
CFHFh	2012	CFH	Sac R	Fall	14	2,956,873	11,877,921	25%	Hatchery	CFH only
FRHFb	2012	FRH	Fea R	Fall	3	293,784	299,404	98%	Barge study	3 release sites: Sacramento River, barged (SF Bay) & trucked (Ft Baker)
FRHFe	2012	FRH	Fea R	Fall	12	138,888	138,888	100%	Experimental	Yolo Bypass experimental (Knaggs Ranch rice field study)
FRHFn	2012	FRH	Fea R	Fall	4	1,453,105	5,848,045	25%	Bay pens	San Pablo Bay net pen releases
FRHFnc	2012	FRH	Fea R	Fall	2	649,160	656,564	99%	Coastal pens	Santa Cruz and Pillar Point net pens; acclimated 1-2 weeks
FRHFtib	2012	FRH	Fea R	Fall	1	9,918	10,028	99%	Bay pens	Tiburon net pens
NIMF	2012	NIM	Ame R	Fall	3	1,026,596	3,277,594	31%	In-basin	American River (Jibboom Street bridge & Howe Ave launch ramp)
NIMFn	2012	NIM	Ame R	Fall	1	182,413	734,906	25%	Bay pens	Mare Island net pens (19% transportation mortality prior to release)
MOKF	2012	MOK	Mok R	Fall	1	99,548	100,306	99%	In-basin	Mokelumne Hatchery (yearlings)
MOKFn	2012	MOK	Mok R	Fall	13	1,275,158	5,123,986	25%	Bay pens	Sherman Island net pens
MERFt	2012	MER	Mer R	Fall	4	325,953	1,384,973	24%	In-basin	San Joaquin River at Jersey Point and Mossdale
SacW	2012	LSH	Sac R	Wint	16	169,967	181,857	92%	In-basin	Sacramento River (Lake Redding Park)
CFHLh	2013	CFH	Sac R	Late	14	960,075	984,977	97%	Hatchery	CFH (includes spring surrogate & small experimental releases)
			Total age 2 releases:		91	11,663,402	32,778,520	36%	0% 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	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
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 3 releases:		139	13,099,908	37,812,217	35%	1% wild CWT releases	

Table 3. Central Valley coded-wire tag (CWT) Chinook releases recovered in 2014 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	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%	Tibur. 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	1	1,126,781	4,548,348	25%	Bay pens	Sherman Island net pens (includes experimental Nimbus spawners)
MOKFt	2010	MOK	Mok R	Fall	13	473,268	1,898,828	25%	Trucked	Sherman Island (approx. 25% released into net pens)
MERF	2010	MER	Mer R	Fall	0	122,973	128,375	96%	In-basin	Merced River Hatchery and Hatfield State Area
MERFt	2010	MER	Mer R	Fall	4	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 4 releases:		136	12,826,500	38,510,728	33%	1% wild CWT releases	

Age 5 CWT releases

Release type*	Brood year	Hatchery	Stock origin	Run type	CWT codes	# CWT tagged	Total fish released	% CWT	Release strategy	Release locations / notes
FRHSn	2009	Spr	Fea R	Spr	6	1,058,635	1,085,409	98%	Bay pens	San Pablo Bay net pen releases
CFHFh	2009	Fall	Sac R	Fall	28	2,541,142	10,210,449	25%	Hatchery	CFH
FRHFn	2009	Fall	Fea R	Fall	11	2,367,209	9,536,050	25%	Bay pens	San Pablo Bay net pens; Wickland Oil net pens
NIMFn	2009	Fall	Ame R	Fall	2	347,527	1,391,632	25%	Bay pens	Mare Island net pens
MOKF	2009	Fall	Mok R	Fall	6	99,048	99,157	100%	In-basin	Mokelumne Hatchery (yearlings)
MOKFn	2009	Fall	Mok R	Fall	3	2,015,730	2,023,958	100%	Bay pens	Sherman Island net pens
CFHLh	2010	CNFH	Sac R	Late	13	992,047	1,018,422	97%	Hatchery	CFH (includes spring surrogate 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 pens

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

Sacramento River Basin Winter Chinook CWT release types

SacW	Livingston Stone Hatchery winter in-basin releases

Table 4. Central Valley hatchery and natural escapement estimates, sport harvest, and sample data, 2014.

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	2,776	2,776	2,637	2,637	2,594	100%	100%	100%	1.00
Feather River Hatchery Trap (pre-season)	Spring	23	23	16	16	16	100%	100%	100%	1.00
Coleman National Fish Hatchery	Fall	18,840	18,840	4,339	4,323	4,218	100%	100%	100%	1.01 [b/]
Feather River Hatchery	Fall	23,420	23,420	9,160	9,160	8,984	100%	100%	100%	1.00
Nimbus Fish Hatchery	Fall	8,343	8,343	2,068	2,068	1,975	100%	100%	98%	1.02
Nimbus Fish Hatchery Weir	Fall	1,972	1,972	178	178	159	100%	100%	98%	1.02
Mokelumne River Hatchery	Fall	8,820	8,820	2,126	2,126	2,085	100%	100%	100%	1.00
Merced River Hatchery	Fall	811	811	213	213	210	100%	100%	99%	1.01
Coleman National Fish Hatchery	Late-fall[c/]	6,814	6,814	6,700	6,694	6,569	100%	100%	100%	1.01 [b/]
Coleman National Fish Hatchery Trap	Late-fall[c/]	137	137	130	27	26	100%	21%	100%	4.81
Total Hatchery Escapement		**71,956**	**71,956**	**27,567**	**27,442**	**26,836**				
	Fall only	62,206	62,206	18,084	18,068	17,631				
Natural Area Escapement										
Upper Sacramento River (above RBDD)	Winter	2,627	1,293	195	191	167	49%	98%	100%	2.45 [d/]
Butte Creek	Spring	5,083	2,481	0	0	0	49%	-	-	-
Upper Sacramento River (above RBDD)	Fall	30,084	2,077	248	248	225	7%	100%	100%	22.24 [d/]
Clear Creek	Fall	15,794	988	172	172	165	6%	100%	99%	15.68 [d/]
Cow Creek	Fall	3,535	46	opportunistic sampling of CWTs			1%	-	-	-
Battle Creek	Fall	26,580	video	biodata not collected			-	-	-	- [e/]
Cottonwood Creek	Fall	1,940	108	11	11	11	6%	100%	100%	17.96 [f/]
Paynes Creek	Fall	72	66	9	8	8	92%	89%	100%	1.23
Mill Creek	Fall	2,488	147	26	26	23	6%	100%	100%	13.37 [f/]
Deer Creek	Fall	849	24	opportunistic sampling of CWTs			3%	-	-	-
Butte Creek	Fall	1,412	717	44	44	40	51%	100%	100%	1.97
Feather River	Fall	60,721	4,984	1,724	1,724	1,634	8%	100%	98%	12.38
Yuba River above Daguerre Point Dam (DPD)	Fall	9,135	8,886	1,393	58	53	97%	4%	100%	24.69 [g/]
Yuba River below DPD	Fall	2,569	382	59	59	53	15%	100%	100%	6.73 [d/]
American River	Fall	24,503	16,617	2,333	2,196	1,993	68%	94%	99%	2.24 [d/]
Mokelumne River	Fall	3,297	3,297	764	65	54	100%	9%	100%	11.75 [g/]
Stanislaus River	Fall	3,064	551	102	102	97	18%	100%	98%	5.49 [d/]
Tuolumne River	Fall	206	107	7	7	7	52%	100%	100%	5.35 [d/]
Merced River	Fall	860	92	17	17	16	11%	100%	100%	9.35 [d/]
Upper Sacramento River (above RBDD)	Late-fall[c/]	2,039	199	3	3	2	10%	100%	100%	10.25 [d/]
Total Natural Area Escapement		**196,858**	**43,062**	**7,107**	**4,931**	**4,548**				
	Fall only	187,109	39,089	6,909	4,737	4,379				
CV Sport Harvest										
Sacramento River (above Feather River)	Fall	13,322	1,045	204	202	201	8%	99%	100%	12.94
Sacramento River (below Feather River)	Fall	6,506	264	52	52	52	4%	100%	100%	24.64
Feather River	Fall	8,404	243	65	62	62	3%	95%	100%	36.26
American River	Fall	12,520	482	118	118	116	4%	100%	100%	25.98
Mokelumne River	Fall	1,380	92	23	23	23	7%	100%	100%	15.00
Sacramento River (above Feather River)	Late-fall[c/]	281	24	9	7	7	9%	78%	100%	15.05
Total Sport Harvest		**42,413**	**2,150**	**471**	**464**	**461**				
		Sample total	**117,168**	**35,145**	**32,837**	**31,845**				

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 2014 through early 2015 (return year 2015
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 2014 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	15,827	4,351	956	955	871	28%	100%	99%	3.66
Fort Bragg	12,540	2,572	648	642	614	21%	99%	99%	4.97
San Francisco	32,453	11,252	2,975	2,963	2,893	35%	100%	100%	2.91
Monterey	14,020	3,445	1,143	1,135	1,101	25%	99%	100%	4.11
	74,840	**21,620**	**5,722**	**5,695**	**5,479**				
California Commercial									
Eureka/Crescent	620	477	119	117	109	77%	98%	99%	1.33
Fort Bragg	76,931	28,816	6,144	6,143	5,811	38%	100%	99%	2.70
San Francisco	82,424	35,283	6,788	6,776	6,428	43%	100%	99%	2.36
Monterey	8,308	3,162	829	828	799	38%	100%	100%	2.64
	168,283	**67,738**	**13,880**	**13,864**	**13,147**				
California Total	**243,123**	**89,358**	**19,602**	**19,559**	**18,626**				
Oregon Sport	**16,174**	**5,333**	**1,019**	**1,016**	**925**	33%	100%	100%	3.05
Oregon Commercial	**191,914**	**73,885**	**12,003**	**11,999**	**11,597**	39%	100%	99%	2.62
Oregon Total	**208,088**	**79,218**	**13,022**	**13,015**	**12,522**				

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 2014.

Fall-run	2013	2012	2011	2010	2009	Total CV	
Age	1	2	3	4	5	CWTs	Total CV %
Raw CWT Recoveries	1 (<1%)	4,114 (22%)	8,390 (45%)	6,028 (33%)	4 (<1%)	18,537	58%
Expanded CWT$_{total}$	**1** (<1%)	**28,199** (16%)	**79,504** (45%)	**70,319** (39%)	**21** (<1%)	178,044	89%

Spring-run		2012	2011	2010	2009	Total CV	
Age		2[a/]	3	4[a/]	5	CWTs	Total CV %
Raw CWT Recoveries		904 (14%)	3,151 (48%)	2,469 (38%)	1 (<1%)	6,525	20%
Expanded CWT$_{total}$		**1,667** (11%)	**7,671** (49%)	**6,212** (40%)	**1** (<1%)	15,550	8%

Late-Fall-run		2013	2012	2011	2010	Total CV	
Age		2	3	4	5	CWTs	Total CV %
Raw CWT Recoveries		129 (2%)	4,500 (68%)	1,970 (30%)	17 (<1%)	6,616	21%
Expanded CWT$_{total}$		**131** (2%)	**4,843** (68%)	**2,112** (30%)	**21** (<1%)	7,107	4%

Winter-run		2012	2011	2010	2009	Total CV	
Age		2	3	4	5	CWTs	Total CV %
Raw CWT Recoveries		12 (7%)	148 (89%)	7 (4%)		167	0.5%
Expanded CWT$_{total}$		**31** (7%)	**381** (88%)	**18** (4%)		430	0.2%

All Runs						Total CV	
Age	1	2[a/]	3	4[a/]	5	CWTs	Total CV %
Raw CWT Recoveries	1 (<1%)	5,159 (16%)	16,189 (51%)	10,474 (33%)	22 (<1%)	31,845	100%
CV Expanded CWT$_{total}$	**1** (<1%)	**30,028** (15%)	**92,399** (46%)	**78,661** (39%)	**43** (<1%)	201,132	100%

a/ Includes spring-run Chinook released from Trinity River Hatchery in the Klamath River Basin.

Table 7. Raw and expanded Chinook CWT recoveries in 2014 California ocean fisheries by run type and brood year.

Fall-run	2012	2011	2010	2009	Total Ocean	Total
Age	2	3	4	5	CWTs	Ocean%
Raw CWT Recoveries	1,771 (11%)	11,088 (69%)	3,312 (20%)	10 (<1%)	16,181	87%
Expanded CWT$_{total}$	**11,733** (8%)	**95,812** (68%)	**32,440** (23%)	**62** (<1%)	140,047	92%
Spring-run	2012	2011	2010	2009	Total Ocean	Total
Age	2	3	4	5	CWTs	Ocean%
Raw CWT Recoveries	64 (6%)	975 (86%)	98 (9%)	1 (<1%)	1,138	6%
Expanded CWT$_{total}$	**225** (7%)	**2,877** (85%)	**277** (8%)	**3** (<1%)	3,383	2%
Late-Fall-run	2013	2012	2011	2010	Total Ocean	Total
Age	2	3	4	5	CWTs	Ocean%
Raw CWT Recoveries		452 (55%)	370 (45%)	6 (<1%)	828	4%
Expanded CWT$_{total}$	(<1%)	**1,321** (57%)	**979** (42%)	**16**	2,317	2%
Winter-run	2013	2012	2011	2010	Total Ocean	Total
Age	2	3	4	5	CWTs	Ocean%
Raw CWT Recoveries		31 (100%)			31	0.2%
Expanded CWT$_{total}$		**115** (100%)			115	0.1%
Non-CV stocks	2012	2011	2010	2009	Total Ocean	Total
Age	2	3	4	5	CWTs	Ocean%
Raw CWT Recoveries	4 (<1%)	106 (24%)	327 (73%)	11 (2%)	448	2%
Expanded CWT$_{total}$	**77** (1%)	**1,842** (33%)	**3,582** (64%)	**76** (1%)	5,577	4%
All Runs					Total Ocean	Total
Age	2	3	4	5	CWTs	Ocean%
Raw CWT Recoveries	1,839 (10%)	12,652 (68%)	4,107 (22%)	28 (<1%)	18,626	100%
Expanded CWT$_{total}$	**12,035** (8%)	**101,967** (67%)	**37,279** (25%)	**157** (<1%)	151,437	100%
CV Expanded CWT$_{total}$ proportion CV stocks	11,958 (99%)	100,125 (98%)	33,697 (90%)	81 (52%)	145,861	96%

Table 8. Raw and expanded Chinook CWT recoveries in 2014 Oregon ocean fisheries by run type and brood year.

Fall-run	2012	2011	2010	2009	Total Ocean	Total
Age	2	3	4	5	CWTs	Ocean%
Raw CWT Recoveries	36 (<1%)	5,617 (72%)	2,177 (28%)	9 (<1%)	7,839	63%
Expanded CWT$_{total}$	**267** (<1%)	**49,734** (71%)	**20,056** (29%)	**41** (<1%)	70,097	67%

Spring-run	2012	2011	2010	2009	Total Ocean	Total
Age	2	3	4	5	CWTs	Ocean%
Raw CWT Recoveries	20 (2%)	1,219 (96%)	32 (3%)		1,271	10%
Expanded CWT$_{total}$	**74** (2%)	**3,229** (96%)	**68** (2%)		3,370	3%

Late-Fall-run	2013	2012	2011	2010	Total Ocean	Total
Age	2	3	4	5	CWTs	Ocean%
Raw CWT Recoveries		23 (16%)	115 (82%)	2 (1%)	140	1%
Expanded CWT$_{total}$		**60** (17%)	**287** (81%)	**7**	354	0%

Non-CV stocks	2012	2011	2010	2009	Total Ocean	Total
Age	2	3	4	5	CWTs	Ocean%
Raw CWT Recoveries	6 (<1%)	765 (23%)	2,037 (62%)	464 (14%)	3,272	26%
Expanded CWT$_{total}$	**170** (<1%)	**13,894** (44%)	**15,291** (49%)	**1,953** (6%)	31,308	30%

All Runs					Total Ocean	Total
Age	2	3	4	5	CWTs	Ocean%
Raw CWT Recoveries	62 (<1%)	7,624 (61%)	4,361 (35%)	475 (4%)	12,522	100%
Expanded CWT$_{total}$	**510** (<1%)	**66,917** (64%)	**35,701** (34%)	**2,001** (2%)	105,129	100%
CV Expanded CWT$_{total}$ (proportion CV stocks)	340 (67%)	53,023 (79%)	20,410 (57%)	48 (2%)	73,821	70%

Table 9. Percentage of inland CWT_{total} recoveries by location, run, and release type[a/] in hatchery returns, natural escapement and sport harvest during 2014.

			CFH			FRH						NFH		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					81%	12%	-	7%										100%	0%	2,776
Feather River Hatchery preseaso	Spring					43%	22%		4%										70%	30%	23
Coleman National Fish Hatchery	Fall			85%	1%	-	-	0%	3%	0%	-		-		-			0%	89%	11%	18,840
Feather River Hatchery	Fall			-	0%	10%	4%	3%	74%	3%	0%	-	-	-	0%	-	-	0%	95%	5%	23,420
Nimbus Fish Hatchery	Fall				1%			0%	3%	0%		33%	24%	0%	21%	3%		1%	87%	13%	8,343
Nimbus Fish Hatchery Weir	Fall				1%	0%	0%	0%	4%	0%		8%	2%		8%	0%		4%	28%	72%	1,972
Mokelumne River Hatchery	Fall		0%	0%	0%			0%	3%	1%		-	1%	3%	67%	7%	-	4%	86%	14%	8,820
Merced River Hatchery	Fall		0%		0%				6%	2%			1%		55%	8%	2%	22%	96%	4%	811
Coleman National Fish Hatchery	Late-fall[b/]		98%																98%	2%	6,814
Coleman Hatchery Fish Trap	Late-fall[b/]		85%																85%	15%	137
Total Hatchery Fall Run			***-***	***26%***	***0%***	***4%***	***2%***	***1%***	***30%***	***1%***	***0%***	***5%***	***3%***	***0%***	***13%***	***2%***	***-***	***1%***	***89%***	***11%***	***62,206***
Natural Spawners																					
Upper Sacramento River	Winter	16%																	16%	84%	2,627
Butte Creek	Spring																		0%	100%	5,083
Upper Sacramento River	Fall			15%	4%	0%	1%	1%	30%	2%	0%								54%	46%	30,084
Clear Creek	Fall			21%	1%		1%	1%	30%	1%		0%			0%				57%	43%	15,794
Cow Creek	Fall						biodata not collected														3,535
Battle Creek	Fall[c/]			85%	1%	-	-	0%	3%	0%	-		-		-			0%	89%	11%	26,580
Cottonwood Creek	Fall			37%					4%										41%	59%	1,940
Paynes Creek	Fall			54%															54%	46%	72
Mill Creek	Fall			19%	4%				19%	2%									45%	55%	2,488
Deer Creek	Fall						biodata not collected														849
Butte Creek	Fall				1%			0%	15%	0%					3%	1%		1%	21%	79%	1,412
Feather River	Fall			0%	1%	10%	3%	1%	64%	2%	0%	0%	0%		0%				83%	17%	60,721
Yuba - above	Fall				5%	0%		1%	36%	2%			1%		2%	1%			49%	51%	9,135
Yuba - below	Fall				5%			1%	34%	3%	0%				2%				45%	55%	2,569
American River	Fall			0%	1%		-	-	1%	0%		33%	18%	-	9%	2%		0%	64%	36%	24,503
Mokelumne River	Fall								6%					1%	59%	6%		5%	76%	24%	3,297
Stanislaus River	Fall				1%				6%	2%				0%	42%	5%	0%	8%	65%	35%	3,064
Tuolumne River	Fall												21%		42%		3%		66%	34%	206
Merced River	Fall								9%	1%					31%	9%	3%	5%	58%	42%	860
Upper Sacramento River	Late-fall[b/]		0%										2%						3%	97%	2,039
Total Natural Area Fall Run				***17%***	***2%***	***3%***	***1%***	***1%***	***32%***	***1%***	***0%***	***4%***	***2%***	***-***	***3%***	***0%***	***-***	***0%***	***70%***	***30%***	***187,109***
In-basin CWT_{total}	All	0%	3%	19%	1%	5%	1%	1%	27%	1%	-	5%	3%	0%	3%	0%	-	0%	69%	31%	228,176
Stray CWT_{total}	All		-	12%	5%	0%	1%	1%	43%	3%	0%	0%	1%	0%	17%	3%	-	3%	89%		40,638
Total CV Spawners		**0%**	**3%**	**18%**	**1%**	**4%**	**1%**	**1%**	**29%**	**1%**	**0%**	**4%**	**3%**	**0%**	**5%**	**1%**	**-**	**1%**	**72%**	**28%**	**268,814**
CV Sport Harvest																					0
Upper Sacramento River	Fall			50%	3%		1%	1%	16%	1%									71%	29%	13,322
Lower Sacramento River	Fall		2%	2%	5%			1%	31%	2%		3%	8%		9%	2%			63%	37%	6,506
Feather River	Fall				2%	4%	2%	3%	55%	3%	0%				3%				72%	28%	8,404
American River	Fall				2%	0%	1%	1%	11%	0%		34%	10%		22%	2%		1%	83%	17%	12,520
Mokelumne River	Fall								4%			4%		1%	74%	9%		5%	98%	2%	1,380
Upper Sacramento River	Late-fall[b/]		39%																39%	61%	281
Total Sport Harvest			**1%**	**16%**	**2%**	**1%**	**1%**	**1%**	**24%**	**1%**	**0%**	**11%**	**4%**	**-**	**11%**	**1%**		**1%**	**74%**	**26%**	**42,413**

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 2014 (return year 2015).

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 Chinook salmon escapement at Coleman National Fish Hatchery in 2014 based on run-timing and CWT stock composition.

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

2014 CFH fall-run escapement (Oct 2, 2014 - Dec 4, 2014)

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 - Dec 4 (100%)	**18,981**	**18,981**	**4,500**	**4,484**	**4,400**	**4,381**	**100%**	**99.6%**	**99.6%**	**1.01**	**16,800**	**16,929**	**89.2%**

2015 CFH late-fall-run escapement (Dec 5, 2014 - Mar 17, 2015)

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 5 - Mar 17 (100%)	**6,673**	**6,673**	**6,539**	**6,533**	**6,437**	**6,406**	100%	99.9%	99.5%	**1.00**	**6,563**	**6,595**	**98.8%**
Total CFH count	**25,654**	**25,654**	**11,039**	**11,017**	**10,837**	**10,787**					**23,363**	**23,524**	

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

2014 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 17	**18,840**	**18,840**	**4,339**	**4,323**	**4,235**	**4,218**	100%	99.6%	99.6%	**1.01**	**16,690**	**16,817**	**89.3%**

2015 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 6 - Mar 17	**6,814**	**6,814**	**6,700**	**6,694**	**6,602**	**6,569**	100%	99.9%	99.5%	**1.01**	**6,673**	**6,707**	**98.4%**
Total CFH count	**25,654**	**25,654**	**11,039**	**11,017**	**10,837**	**10,787**					**23,363**	**23,524**	

Table 11. Total inland CWT_{total} recoveries by location, run, and release type[a/] in hatchery returns, natural escapement and sport harvest during 2014.

			CFH			FRH						NFH		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**	**nonCV**	**Hatchery**	**Natural**	**Run**
Hatchery Spawners																						
Feather River Hatchery	Spring					2,251	334	1	182											2,768	8	2,776
Feather River Hatchery preseason	Spring					10	5		1											16	7	23
Coleman National Fish Hatchery	Fall			15,961	153	1	2	12	579	58	4		4		8			35		16,817	2,023	18,840
Feather River Hatchery	Fall			4	76	2,360	930	660	17,288	723	30	4	10	1	40	4	1	42		22,173	1,247	23,420
Nimbus Fish Hatchery	Fall				45			17	217	14		2,794	1,996	5	1,769	259		111		7,227	1,116	8,343
Nimbus Fish Hatchery Weir	Fall				12	3	8	8	70	5		149	45		160	8		85		553	1,419	1,972
Mokelumne River Hatchery	Fall		6	8	16			10	245	48		4	92	240	5,906	658	2	357		7,592	1,228	8,820
Merced River Hatchery	Fall		1		4				45	14			12		447	65	14	178		780	31	811
Coleman National Fish Hatchery	Late-fall[b/]		6,707																	6,707	107	6,814
Coleman Hatchery Fish Trap	Late-fall[b/]		116																	116	21	137
Total Hatchery Fall Run			***7***	***15,973***	***306***	***2,364***	***940***	***707***	***18,444***	***862***	***34***	***2,951***	***2,159***	***246***	***8,330***	***994***	***17***	***808***		***55,142***	***7,064***	***62,206***
Natural Spawners																						
Upper Sacramento River	Winter	430																		430	2,197	2,627
Butte Creek	Spring																				5,083	5,083
Upper Sacramento River	Fall			4,639	1,068	113	271	247	9,126	580	90								100	16,233	13,851	30,084
Clear Creek	Fall			3,334	188		175	127	4,799	189		63			63					8,938	6,856	15,794
Cow Creek	Fall						opportunistic sampling of CWTs															3,535
Battle Creek	Fall[c/]			22,518	216	1	3	17	817	82	6		6		11			49		23,726	2,854	26,580
Cottonwood Creek	Fall			720					72											792	1,148	1,940
Paynes Creek	Fall			39																39	33	72
Mill Creek	Fall			483	107				483	41										1,113	1,375	2,488
Deer Creek	Fall						opportunistic sampling of CWTs															849
Butte Creek	Fall				16			2	214	6					40	8		9		294	1,118	1,412
Feather River	Fall			149	644	6,245	1,934	895	38,925	1,266	62	99	50		99				52	50,420	10,301	60,721
Yuba - above	Fall				494	25		50	3,287	200			99		198	100				4,452	4,683	9,135
Yuba - below	Fall				135			20	868	68	7				61					1,159	1,410	2,569
American River	Fall			27	206		2	9	324	36		8,048	4,350	5	2,297	397		89		15,790	8,713	24,503
Mokelumne River	Fall								189					24	1,945	189		165		2,511	786	3,297
Stanislaus River	Fall				22				198	50				13	1,280	155	6	256		1,981	1,083	3,064
Tuolumne River	Fall												43		86		6			134	72	206
Merced River	Fall								75	9					263	76	29	44		496	364	860
Upper Sacramento River	Late-fall[b/]		10										41							51	1,988	2,039
Total Natural Area Fall Run				***31,909***	***3,096***	***6,384***	***2,385***	***1,367***	***59,377***	***2,527***	***165***	***8,210***	***4,548***	***42***	***6,343***	***925***	***41***	***612***	***152***	***128,078***	***54,647***	***187,109***
In-basin CWT_{total}	All	430	6,833	43,118	1,437	10,891	3,203	1,626	60,551	2,257	99	10,991	6,391	264	7,851	847	43	222		157,054	71,122	228,176
Stray CWT_{total}	All		7	4,764	1,965	118	461	449	17,453	1,132	100	170	357	24	6,822	1,072	15	1,198	152	36,254	4,384	40,638
Total CV Spawners		**430**	**6,840**	**47,882**	**3,402**	**11,009**	**3,664**	**2,075**	**78,004**	**3,389**	**199**	**11,161**	**6,748**	**288**	**14,673**	**1,919**	**58**	**1,420**	**152**	**193,308**	**75,506**	**268,814**
%stray		0%	0%	10%	58%	0%	13%	22%	22%	33%	50%	2%	5%	8%	46%	56%	26%	84%		19%		15%
CV Sport Harvest																						
Upper Sacramento River	Fall			6,697	362		118	92	2,085	117										9,471	3,851	13,322
Lower Sacramento River	Fall		156	99	296			75	1,985	99		223	493		595	100				4,120	2,386	6,506
Feather River	Fall				145	295	184	218	4,663	255	37				291					6,088	2,316	8,404
American River	Fall				208	53	79	131	1,358	52		4,220	1,192		2,721	210		163		10,386	2,134	12,520
Mokelumne River	Fall								60			60		15	1,025	122		70		1,352	28	1,380
Upper Sacramento River	Late-fall[b/]		110																	110	171	281
Total Sport Harvest			**266**	**6,796**	**1,011**	**348**	**381**	**516**	**10,151**	**523**	**37**	**4,503**	**1,685**	**15**	**4,632**	**432**		**233**		**31,527**	**10,886**	**42,413**

a/ Release types defined in Table 3.

b/ Late-fall hatchery returns, natural escapement, and sport harvest occurred in late fall 2014 (return year 2015).

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 2014.

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	2012	Spr	1,106,679				528	25					553		553		71	50		**50**	**6**
FRHSn	2012	Spr	1,015,285		67	16	755		6				755	89	844	**11%**	222	74	9	**83**	**22**
CFHFh	2012	Fall	2,956,873	217		13							217	13	231	**6%**	98	7		**7**	**3**
FRHFb	2012	Fall	293,784	6	178	78	645	38	11	4			684	278	961	**29%**	372	233	95	**328**	**127**
FRHFe	2012	Fall	138,888				4						4		4			3		3	
FRHFn	2012	Fall	1,453,105	62	267	244	1,989	117	52	47	29	27	2,106	729	2,834	**26%**	1,271	145	50	**195**	**87**
FRHFnc	2012	Fall	649,160	33	67	124	614	258	12	47	23	44	872	351	1,223	**29%**	3,317	134	54	**188**	**511**
FRHFtib	2012	Fall	9,918	1			4						4	1	5	**20%**	15	40	10	50	**150**
NIMF	2012	Fall	1,026,596				13		320				320	13	333	**4%**	114	31	1	**32**	**11**
NIMFn	2012	Fall	182,413						50	4			50	4	54	**7%**	14	28	2	**30**	**8**
MOKF	2012	Fall	99,548						2	30			30	2	32	**7%**		30	2	**32**	
MOKFn	2012	Fall	1,275,158	2		4	16	7	284	934	99	148	934	560	1,494	**37%**	484	73	44	**117**	**38**
MERFt	2012	Fall	325,953	8		2	9		65	116	50	55	50	255	305	**84%**	93	15	78	**93**	**28**
SacW[b/]	2012	Wint	169,967		29								29		29		105	17		**17**	**62**
CFHLh	2013	Late	960,075	130									130		130			14		**14**	
test		Total	11,663,402	460	608	482	4,578	444	803	1,182	201	274	6,738	2,295	9,032	**25%**	6,175	894	345	**1,239**	**1,053**

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	2011	Spr	1,088,286		44		5,231		3				5,231	48	5,279	**1%**	3,935	481	4.0	**485**	**362**
FRHSn	2011	Spr	1,125,189	2	133	141	1,650		2				1,650	279	1,929	**14%**	2,074	147	25	**172**	**184**
CFHFh	2011	Fall	3,117,042	2,020	178	276			4				2,198	281	2,479	**11%**	6,288	71	9	**80**	**202**
FRHFb	2011	Fall	297,089	6	67	49	884	31	23	6			915	151	1,066	**14%**	2,428	308	51	**359**	**817**
FRHFe	2011	Fall	11,449				13						13		13		8	117		**117**	**67**
FRHFn	2011	Fall	2,293,211	47	1,068	747	5,885	568	62	30		22	6,453	1,976	8,429	**23%**	17,489	281	86	**367**	**763**
FRHFnc	2011	Fall	426,190	23	445	94	1,363	7	43	1		5	1,370	612	1,982	**31%**	10,175	321	144	**465**	**2,387**
FRHFtib	2011	Fall	9,933				17	7					24		24		49	243		**243**	**492**
NIMF	2011	Fall	1,078,191						1,348				1,348		1,348		2,755	125		**125**	**255**
NIMFn	2011	Fall	328,073		10		12	25	829	14	3	11	829	75	904	**8%**	1,899	253	23	**276**	**579**
MOKF	2011	Fall	92,020						1	143		11	143	12	155	**8%**	128	155	13	**168**	**139**
MOKFn	2011	Fall	1,487,132			4	17	25	503	866	76	181	866	805	1,671	**48%**	4,075	58	54	**112**	**274**
MOKFt	2011	Fall	110,737			2			79	141	33	27	141	142	282	**50%**	707	127	128	**255**	**638**
MERF	2011	Fall	262,108							1	19		19	1	20	**5%**	57	7		**7**	**22**
SacW	2011	Wint	185,313		363								363		363			196		**196**	
CFHLh	2012	Late	1,031,419	4,511						6			4,511	6	4,517	**0%**	1,311	437	1	**438**	**127**
		Total	12,943,382	6,609	2,308	1,313	15,074	662	2,898	1,207	131	257	26,074	4,387	30,460	**14%**	53,375	3,327	538	**3,865**	**7,308**

Table 12. CWT recovery rate (recoveries per 100,000 CWTs released) by release type, brood year and recovery location in 2014. (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 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	1	67		4,945						4,945	68	5,012	**1%**	274	422	6	**428**	**23**
FRHSn	2010	Spr	1,136,690		67	16	750		2				750	84	834	**10%**	68	66	7	**73**	**6**
CFHFh	2010	Fall	2,835,420	1,743	979	851	38		2	2			2,721	894	3,615	**25%**	3,221	96	32	**128**	**114**
CFHFn	2010	Fall	334,756	38	267	78	180	157	66	4	1	5	305	491	796	**62%**	1,329	91	147	**238**	**397**
FRHFn	2010	Fall	2,554,115	34	934	392	6,136	346	38	32	1		6,481	1,430	7,911	**18%**	4,844	254	56	**310**	**190**
FRHFnc	2010	Fall	185,985	1	67	16	6						6	83	89	**93%**	1,199	3	45	**48**	**644**
FRHFtib	2010	Fall	56,030	3	89		71						71	92	162	**57%**	212	126	164	**290**	**378**
NIMF	2010	Fall	1,014,340			16	12		1,804	1			1,804	29	1,833	**2%**	1,969	178	3	**181**	**194**
NIMFn	2010	Fall	368,363	1			2		668	5			668	8	676	**1%**	947	181	2	**183**	**257**
MOKF	2010	Fall	100,215				1		6	65			65	7	72	**10%**	43	64	7	**71**	**43**
MOKFn	2010	Fall	1,126,781			18	1	31	261	150	2	11	150	325	475	**68%**	692	13	29	**42**	**61**
MOKFt	2010	Fall	473,268				1	25	85	70	2	11	70	124	194	**64%**	266	15	26	**41**	**56**
MERF	2010	Fall	122,973				1			1	23	11	23	13	36	**36%**	34	18	10	**28**	**28**
SacW	2010	Wint	113,905		17								17		17			15		**15**	
CFHLh	2011	Late	1,037,859	2,056	10						1		2,066	1	2,067	**0%**	1,243	199		**199**	**120**
		Total	12,631,040	3,877	2,496	1,385	12,143	559	2,933	329	30	38	20,140	3,649	23,789	**15%**	16,340	1741	534	**2275**	**2,511**

Age 5 CV 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**
FRHSn	2009	Spr	1,058,635				1						1		1		3	<1		<1	<1
CFHFh	2009	Fall	2,541,142														3				<1
FRHFn	2009	Fall	2,367,209														8				<1
NIMFn	2009	Fall	347,527						4				4		4		6	1		1	2
MOKF	2009	Fall	99,048														5	<1	<1	<1	5
MOKFn	2009	Fall	2,015,730						2	1			1	2	3	0.691	23				1
CFHLh	2010	Late	992,047	21									21		21		23	2		2	2

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 2012 = age-3 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 pens 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 2014 California ocean salmon sport fishery.

		CFH			FRH						NFH		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%	12%	3%	1%	0%	0%	23%	2%	0%	3%	2%		4%				9%	50%	59%	41%	3,596
Jun		1%	9%	1%	1%	1%	1%	22%	3%		4%	3%		5%	1%	0%		6%	51%	56%	44%	5,279
Jul		0%	15%	1%	1%	1%	1%	30%	3%	0%	4%	4%		5%	0%			6%	65%	71%	29%	4,443
Aug		0%	9%	1%	0%	1%	1%	44%	5%		2%	3%		10%		0%	1%	1%	77%	78%	22%	2,206
Sep					2%	1%	1%	21%	4%		24%			18%	6%				75%	75%	25%	303
Total		**0%**	**11%**	**2%**	**1%**	**1%**	**1%**	**28%**	**3%**	**0%**	**4%**	**3%**		**6%**	**1%**	**-**	**0%**	**6%**	**59%**	**64%**	**36%**	**15,827** (21%)
Fort Bragg																						
Apr			7%	2%	2%	1%	1%	25%	4%			2%		3%				1%	46%	47%	53%	714
May		1%	22%	5%	3%			33%	5%		4%			5%				3%	77%	80%	20%	630
Jun		1%	5%	1%	1%	1%	1%	21%	4%		5%	3%		3%	3%	0%		2%	48%	50%	50%	1,358
Jul		1%	13%	2%	0%	0%	1%	33%	6%	0%	4%	4%	0%	5%	1%		1%	0%	72%	73%	27%	9,035
Aug		2%	8%		1%	1%		45%	6%		7%	9%		17%					96%	96%	4%	696
Sep		3%						14%	3%					28%					48%	48%	52%	107
Total		**1%**	**12%**	**2%**	**1%**	**0%**	**1%**	**32%**	**6%**	**-**	**4%**	**3%**	**0%**	**5%**	**1%**	**-**	**0%**	**1%**	**70%**	**70%**	**30%**	**12,540** (17%)
San Francisco																						
Apr		1%	9%	3%	2%	1%	0%	29%	5%	0%	3%	4%	0%	5%	3%			0%	64%	64%	36%	1,854
May		2%	10%	2%	2%	1%	0%	25%	5%	0%	2%	4%	0%	2%	2%			2%	57%	58%	42%	2,318
Jun	0%	3%	15%	2%	1%	1%	3%	28%	6%		3%	2%		4%	2%			2%	68%	70%	30%	559
Jul	0%	0%	16%	1%	0%	0%	2%	30%	9%	0%	1%	1%		3%			1%		65%	65%	35%	5,587
Aug	0%	1%	12%	2%	0%	0%	2%	33%	11%	0%	2%	2%	0%	6%	0%		1%		72%	72%	28%	12,679
Sep	0%	0%	5%	0%	0%	0%	1%	25%	10%	-	6%	3%	0%	13%	1%	-	1%	0%	68%	68%	32%	6,266
Oct	0%	2%			0%	0%	0%	7%	2%	0%	9%	11%	1%	23%	5%		3%		62%	62%	38%	3,065
Nov		23%			2%	2%			3%		7%			7%					44%	44%	56%	125
Total	**0%**	**1%**	**10%**	**1%**	**0%**	**0%**	**1%**	**28%**	**9%**	**0%**	**3%**	**3%**	**0%**	**8%**	**1%**	**-**	**1%**	**0%**	**67%**	**68%**	**32%**	**32,453** (43%)
Monterey																						
Apr	0%	1%	12%	1%	6%	2%	1%	35%	7%	-	2%	1%	0%	3%		-		1%	72%	74%	26%	11,356
May	2%	1%	6%		3%	2%	3%	56%	5%		4%	2%		2%					86%	86%	14%	964
Jun		1%	21%			0%	1%	31%	13%	0%	2%	2%		2%					74%	74%	26%	782
Jul	2%	3%	13%			1%	4%	40%	21%		7%			3%					93%	93%	7%	613
Aug	3%					3%		40%	38%										83%	83%	17%	267
Sep									68%										68%	68%	32%	34
Oct									100%										100%	100%		4
Total	**0%**	**1%**	**12%**	**1%**	**5%**	**2%**	**1%**	**37%**	**9%**	**0%**	**2%**	**1%**	**0%**	**3%**		**-**		**1%**	**74%**	**75%**	**25%**	**14,020** (19%)
California Total Sport Harvest																						
	0%	**1%**	**11%**	**1%**	**1%**	**1%**	**1%**	**30%**	**7%**	**0%**	**3%**	**3%**	**0%**	**6%**	**1%**	**-**	**1%**	**2%**	**67%**	**69%**	**31%**	**74,840**
Oregon Total Sport Harvest																						
		0%	*6%*	*1%*	*1%*	*1%*	*0%*	*16%*	*3%*	*0%*	*5%*	*2%*	*0%*	*5%*	*1%*	*-*	*0%*	*9%*	*42%*	*51%*	*49%*	*16,174*

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 2014 California ocean salmon sport fishery.

		CFH			FRH						NFH		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		3	416	112	21	8	8	827	61	3	112	74		142				330	1,787	2,117	1,479	3,596
Jun		40	486	58	48	28	29	1,173	168		186	156		258	56	4		291	2,690	2,981	2,298	5,279
Jul		20	646	64	38	29	42	1,333	147	5	158	161		232	20			246	2,895	3,140	1,303	4,443
Aug		7	204	30	11	15	31	965	113		37	56		216		3	16	21	1,704	1,725	481	2,206
Sep					5	2	2	63	11		72			54	18				227	227	76	303
Total		**70**	**1,753**	**263**	**121**	**82**	**112**	**4,361**	**500**	**8**	**564**	**447**		**904**	**94**	**7**	**16**	**888**	**9,302**	**10,190**	**5,637**	**15,827** (21%)
Fort Bragg																						
Apr			47	16	12	8	4	175	32			16		20				8	331	339	375	714
May		4	137	31	16			210	32		24			31				21	485	507	123	630
Jun		9	68	17	9	9	9	291	61		69	34		35	35	4		29	649	678	680	1,358
Jul		105	1,219	213	38	38	102	2,978	559	5	358	320	12	450	86		48	36	6,531	6,566	2,469	9,035
Aug		15	59		5	5		316	44		46	63		118					671	671	25	696
Sep		4						15	4					30					52	52	55	107
Total		**137**	**1,531**	**277**	**80**	**60**	**114**	**3,985**	**731**	**5**	**497**	**433**	**12**	**683**	**121**	**4**	**48**	**95**	**8,718**	**8,813**	**3,727**	**12,540** (17%)
San Francisco																						
Apr		17	158	51	40	17	3	538	99	3	49	75	3	88	49			5	1,188	1,193	661	1,854
May		38	222	37	42	23	9	587	120	5	36	94	6	50	42			36	1,311	1,347	971	2,318
Jun	3	17	84	9	7	5	15	159	33		14	9		20	9			9	383	392	167	559
Jul	10	21	909	79	13	13	111	1,656	505	10	64	69		145			46		3,650	3,650	1,937	5,587
Aug	23	71	1,554	193	9	40	206	4,242	1,450	15	230	201	15	726	36		124		9,136	9,136	3,543	12,679
Sep	7	21	341	11	9	29	54	1,567	657	3	389	209	10	805	59	3	63	8	4,237	4,245	2,021	6,266
Oct	3	66			3	6	6	217	49	6	262	334	16	708	139		88		1,902	1,902	1,163	3,065
Nov		29			2	2			4		9			9					55	55	70	125
Total	**45**	**280**	**3,267**	**381**	**125**	**135**	**404**	**8,966**	**2,918**	**41**	**1,052**	**992**	**49**	**2,550**	**335**	**3**	**320**	**58**	**21,862**	**21,921**	**10,532**	**32,453** (43%)
Monterey																						
Apr	9	98	1,338	95	691	263	142	3,984	811	4	229	140	8	381		4		159	8,197	8,356	3,000	11,356
May	16	5	61		31	20	25	545	50		40	20		20					833	833	131	964
Jun		5	168			4	7	239	103	4	15	18		15					577	577	205	782
Jul	10	16	78			5	24	248	130		43			19					572	572	41	613
Aug	7					7		108	101										223	223	44	267
Sep									23										23	23	11	34
Oct									4										4	4	0	4
Total	**42**	**124**	**1,644**	**95**	**721**	**299**	**199**	**5,123**	**1,223**	**8**	**327**	**178**	**8**	**435**		**4**		**159**	**10,430**	**10,588**	**3,432**	**14,020** (19%)
California Total Sport Harvest																						
	87	**611**	**8,195**	**1,016**	**1,048**	**576**	**828**	**22,435**	**5,371**	**62**	**2,440**	**2,050**	**69**	**4,572**	**550**	**18**	**385**	**1,200**	**50,312**	**51,512**	**23,328**	**74,840**
Oregon Total Sport Harvest																						
		43	*1,006*	*190*	*131*	*130*	*66*	*2,581*	*407*	*11*	*843*	*384*	*8*	*802*	*178*	*5*	*12*	*1,497*	*6,799*	*8,296*	*7,878*	*16,174*

Table 15. Percentage of CWT_{total} recoveries by port area, month and release type[a/] in 2014 California ocean salmon commercial fishery.

		CFH			FRH						NFH		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																						
Sep		**1%**	**11%**		**2%**	**1%**	**0%**	**20%**	**2%**		**11%**	**7%**		**16%**	**4%**			**1%**	**74%**	**75%**	**25%**	**620** (<1%)
Fort Bragg																						
Jun		1%	8%	1%	1%	0%	0%	18%	2%	-	3%	2%	-	3%	1%	-		6%	39%	45%	55%	23,126
Jul		1%	13%	2%	1%	0%	1%	29%	4%	0%	5%	4%	0%	5%	1%	-		2%	66%	68%	32%	45,563
Aug	0%	2%	13%	3%	0%	0%	1%	42%	4%	0%	4%	4%	-	6%	1%			1%	78%	79%	21%	7,788
Sep		4%	2%		1%			22%	2%		6%	10%		4%	2%				54%	54%	46%	454
Total	**-**	**1%**	**11%**	**2%**	**1%**	**0%**	**1%**	**27%**	**4%**	**0%**	**4%**	**3%**	**0%**	**4%**	**1%**	**-**		**3.2%**	**59%**	**62%**	**38%**	**76,931** (46%)
San Francisco																						
May		1%	8%	2%	2%	1%	0%	17%	3%	0%	2%	2%		2%	0%	-		4%	41%	44%	56%	30,605
Jun		1%	8%	1%	1%	0%	1%	19%	3%	0%	2%	3%	-	3%	1%			4%	42%	47%	53%	14,917
Jul		1%	16%	2%	1%	0%	1%	29%	4%	0%	3%	4%	0%	5%	0%			1%	67%	68%	32%	6,994
Aug	-	0%	17%	3%	-	0%	1%	38%	4%	0%	3%	1%	0%	3%	0%	-		-	71%	71%	29%	15,879
Sep	-	0%	6%	1%	-	-	1%	31%	3%	0%	9%	4%	0%	12%	2%	0%			69%	69%	31%	11,044
Oct		1%	1%			0%		6%	1%		14%	17%	0%	22%	5%	0%			68%	68%	32%	2,985
Total	**-**	**1%**	**10%**	**2%**	**1%**	**0%**	**1%**	**24%**	**3%**	**0%**	**4%**	**3%**	**0%**	**5%**	**1%**	**-**		**2%**	**54%**	**56%**	**44%**	**82,424** (49%)
Monterey																						
May		1%	14%	1%	2%	1%	1%	31%	6%	0%	2%	1%	0%	5%				0%	65%	66%	34%	4,341
Jun		1%	14%	3%	0%		0%	33%	7%	0%	1%	2%		3%	1%	0%		1%	66%	67%	33%	1,538
Jul	1%	4%	13%	1%	0%		0%	28%	9%		5%	3%		7%	1%				74%	74%	26%	2,011
Aug	1%	2%						5%	8%			3%		5%					24%	24%	76%	418
Total	**0%**	**2%**	**13%**	**1%**	**1%**	**0%**	**1%**	**29%**	**7%**	**0%**	**3%**	**2%**	**-**	**5%**	**0%**	**-**		**0%**	**66%**	**66%**	**34%**	**8,308** (9%)
California Total Commercial Harvest																						
	-	**1%**	**11%**	**2%**	**1%**	**0%**	**1%**	**26%**	**4%**	**0%**	**4%**	**3%**	**0%**	**5%**	**1%**	**-**		**3%**	**57%**	**59%**	**41%**	**168,283**
Oregon Total Commercial Harvest																						
		0%	*6%*	*1%*	*1%*	*1%*	*0%*	*14%*	*2%*	-	*3%*	*2%*	-	*4%*	*1%*	-		*16%*	*35%*	*50%*	*50%*	*191,914*

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 2014 California ocean salmon commercial fishery.

		CFH			FRH						NFH		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																						
Sep		5	69		14	4	1	123	11		68	43		96	27			3	461	464	156	620 (<1%)
Fort Bragg																						
Jun		125	1,742	179	151	68	101	4,064	569	6	623	551	3	713	170	3		1,414	9,067	10,481	12,645	23,126
Jul		627	5,966	784	270	150	347	13,266	1,850	37	2,064	1,782	52	2,114	611	16		971	29,937	30,909	14,655	45,563
Aug	6	147	975	207	11	13	64	3,252	293	11	301	311	3	433	57			41	6,086	6,127	1,661	7,788
Sep		18	11		4			99	10		28	45		19	11				244	244	210	454
Total	**6**	**917**	**8,693**	**1,171**	**437**	**231**	**512**	**20,680**	**2,723**	**54**	**3,016**	**2,689**	**58**	**3,279**	**849**	**19**		**2,426**	**45,334**	**47,761**	**29,171**	**76,931 (46%)**
San Francisco																						
May		298	2,500	462	472	208	122	5,200	992	39	720	539		704	137	5		1,224	12,396	13,620	16,985	30,605
Jun		125	1,147	162	126	35	78	2,889	460	8	287	386	6	478	152			629	6,337	6,966	7,951	14,917
Jul		83	1,120	135	51	14	67	2,038	284	12	222	267	11	329	32			60	4,664	4,725	2,269	6,994
Aug	3	47	2,774	538	7	10	195	6,038	561	25	423	161	9	433	10	3		3	11,235	11,237	4,642	15,879
Sep	3	24	692	75	4	4	64	3,437	381	6	1,002	446	7	1,308	169	8			7,630	7,630	3,414	11,044
Oct		43	31			3		176	26		414	522	9	656	157	5			2,043	2,043	942	2,985
Total	**6**	**619**	**8,263**	**1,371**	**659**	**273**	**526**	**19,778**	**2,703**	**90**	**3,069**	**2,321**	**42**	**3,908**	**656**	**21**		**1,916**	**44,305**	**46,221**	**36,203**	**82,424 (49%)**
Monterey																						
May		55	611	37	93	36	38	1,348	256	7	104	28	3	226				22	2,842	2,863	1,478	4,341
Jun		11	218	45	4		5	508	109	5	12	36		45	17	2		9	1,017	1,027	511	1,538
Jul	13	89	257	22	9		6	569	190		109	69		145	11				1,489	1,489	522	2,011
Aug	3	9						22	34			11		22					101	101	317	418
Total	**16**	**165**	**1,086**	**105**	**106**	**36**	**48**	**2,447**	**588**	**12**	**224**	**144**	**3**	**439**	**28**	**2**		**31**	**5,448**	**5,479**	**2,829**	**8,308 (5%)**
California Total Commercial Harvest																						
	28	**1,706**	**18,111**	**2,647**	**1,215**	**543**	**1,087**	**43,028**	**6,025**	**156**	**6,377**	**5,196**	**103**	**7,723**	**1,560**	**42**		**4,377**	**95,549**	**99,925**	**68,358**	**168,283**
Oregon Total Commercial Harvest																						
		311	*11,246*	*1,461*	*1,966*	*1,143*	*832*	*26,857*	*2,943*	*48*	*6,399*	*4,052*	*20*	*8,075*	*1,641*	*29*		*29,811*	*67,023*	*96,833*	*95,081*	*191,914*

Table 17. CWT recovery rate (recoveries per 100,000 CWTs released) for Experimental & Net Pen release types in 2014.

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
FRHFbb	2012	Fall	97,760	4	67	63	271	7	5	1			277	140	**417**	34%	**245**	284	143	**427**	**251**
FRHFbg	2012	Fall	99,192	2	111	16	360	31	6	3			392	138	**530**	26%	**127**	395	139	**534**	**128**
FRHFbr	2012	Fall	96,832				14						14		**14**			15		**15**	
FRHFnp	2012	Fall	412,360	31	44	124	524	258	10	45	23	38	782	317	**1,099**	29%	**2,211**	190	77	**267**	**536**
FRHFns	2012	Fall	236,800	2	22		90		2	2		5	90	34	**124**	28%	**1,106**	38	14	**52**	**467**
FRHFkc	2012	Fall	46,492				4						4		**4**			9		**9**	
FRHFkr	2012	Fall	92,396																		
FRHFn	2012	Fall	1,453,105	62	267	244	1,989	117	52	47	29	27	2,106	729	**2,834**	26%	**1,271**	145	50	**195**	**87**
FRHFtib	2012	Fall	9,918	1			4						4	1	**5**	20%	**15**	40	10	**50**	**150**
NIMFn	2012	Fall	182,413						50	4			50	4	**54**	7%	**14**	28	2	**30**	**8**
MOKFn	2012	Fall	1,275,158	2		4	16	7	284	934	99	148	934	560	**1,494**	37%	**484**	73	44	**117**	**38**

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
FRHFbb	2011	Fall	98,241		67	16	243		4	2			243	88	**332**	27%	**937**	248	90	**338**	**954**
FRHFbg	2011	Fall	98,947	2		31	321	31	19	4			352	56	**408**	14%	**767**	356	57	**413**	**775**
FRHFbr	2011	Fall	99,901	4		2	320						320	6	**326**	2%	**724**	320	6	**326**	**725**
FRHFnp	2011	Fall	185,303	19	378	94	1,271	7	41	1			1,278	533	**1,811**	29%	**5,044**	690	288	**978**	**2,722**
FRHFns	2011	Fall	240,887	4	67		92		2			5	92	78	**170**	46%	**5,130**	38	33	**71**	**2,130**
FRHFe	2011	Fall	11,449				13						13		**13**			117		**117**	
FRHFn	2011	Fall	2,293,211	47	1,068	747	5,885	568	62	30		22	6,453	1,976	**8,429**	23%	**17,489**	281	86	**367**	**763**
FRHFtib	2011	Fall	9,933				17	7					24		**24**		**49**	243		**243**	**492**
NIMFn	2011	Fall	328,073		10		12	25	829	14	3	11	829	75	**904**	8%	**1,899**	253	23	**276**	**579**
MOKFn	2011	Fall	1,487,132			4	17	25	503	866	76	181	866	805	**1,671**	48%	**4,075**	58	54	**112**	**274**

Age 4 CWT recoveries

Release type	Brood year	Run type	# CWT tagged	Central Valley total recoveries (CWT_{samp}) by basin									CV CWT_{samp} totals			% CV Stray	Ocean CWT_{samp}	Recovery rate per 100K released			
				Bat Cr	Up Sac	Nat crks[a/]	Fea	Yub	Ame	Mok	Mer	SJ	In-basin	Stray	CV total			In-basin	Stray	CV total	Ocean
FRHFns	2010	Fall	185,985	1	67	16	6						6	83	**89**	93%	**1,199**	3	45	**48**	**644**
FRHFn	2010	Fall	2,554,115	34	934	392	6,136	346	38	32	1		6,481	1,430	**7,911**	18%	**4,844**	254	56	**310**	**190**
FRHFtib	2010	Fall	56,030	3	89		71						71	92	**162**	57%	**212**	126	164	**290**	**378**
CFHFn	2010	Fall	334,756	38	267	78	180	157	66	4	1	5	305	491	**796**	62%	**1,329**	91	147	**238**	**397**
NIMFn	2010	Fall	368,363	1			2		668	5			668	8	**676**	1%	**947**	181	2	**183**	**257**
MOKFn	2010	Fall	1,126,781			18	1	31	261	150	2	11	150	325	**475**	68%	**692**	13	29	**42**	**61**

[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
FRHFkc Feather River Hatchery fall rice field study: Elkhorn boat ramp Sac River (control group)
FRHFkr Feather River Hatchery fall rice field study: Yolo Bypass Knaggs Ranch rice field
FRHFn Feather River Hatchery fall bay net pen releases
FRHFtib Feather River Hatchery fall Tiburon net pen releases
NIMFn Nimbus Hatchery fall bay net pens 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	Feather River (Thermalito High Flow Area, Gridley)
4	FRHS	Feather River (Boyds Pump Launch Ramp)
5	FRHFbr, FRHFkc	Sacramento River (Elkhorn Boat Launch)
6	NIMF	American River
7	NIMF	Discovery Park
8	FRHFe, FRHFkr	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	FRHFns	Santa Cruz Net Pens

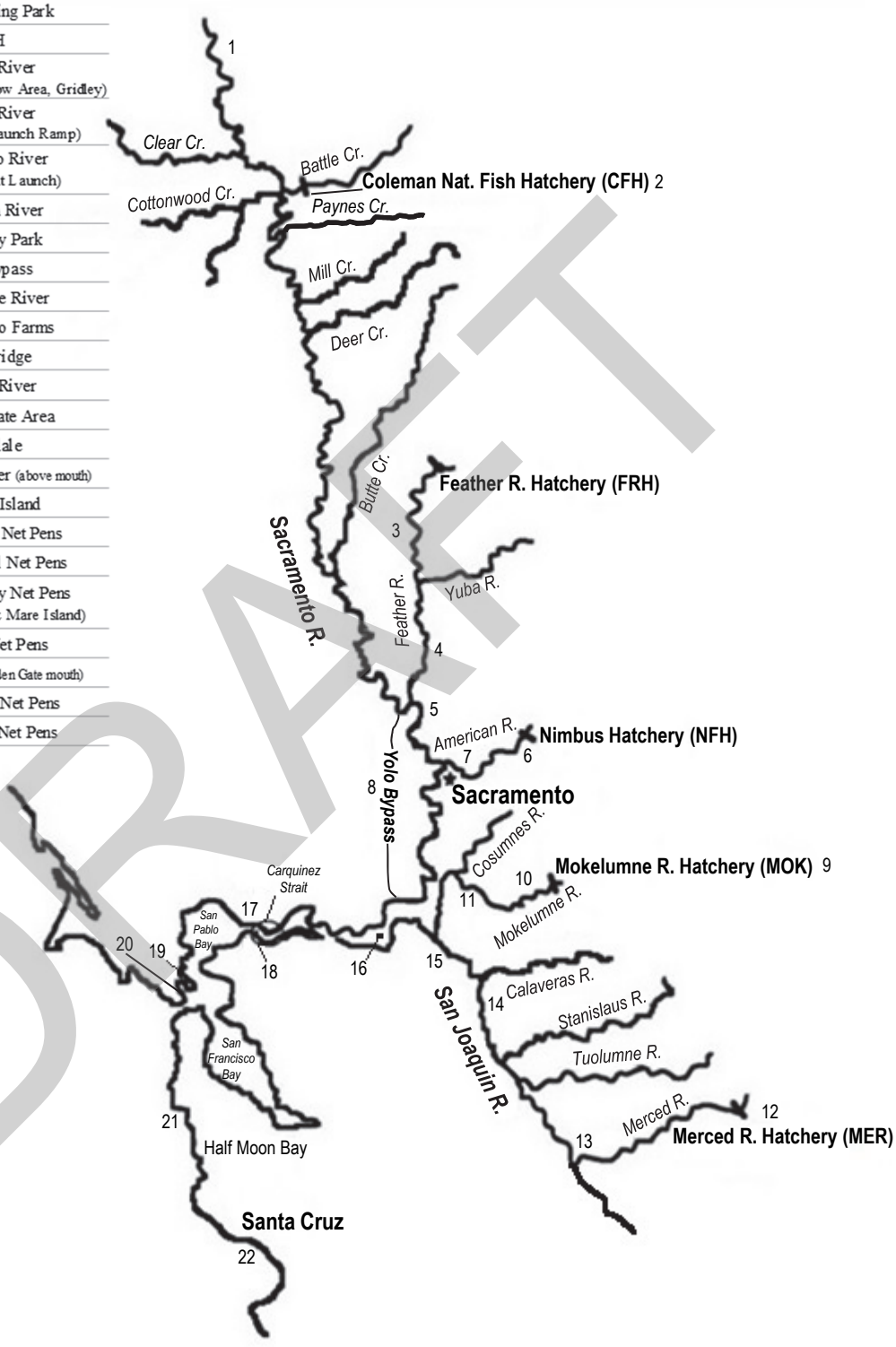


Figure 1. Map of release locations for CV hatchery release types, brood years 2009-2012.

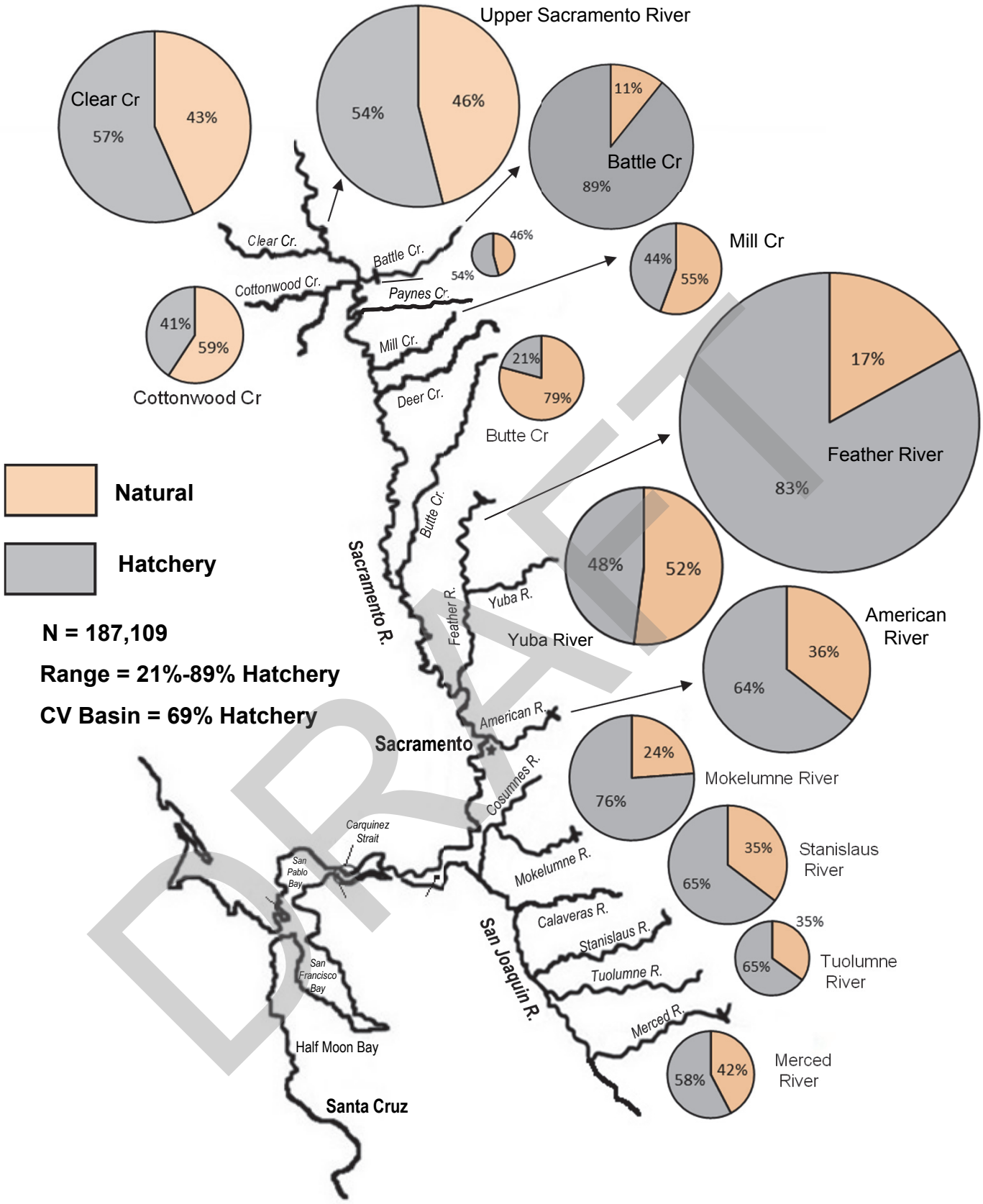


Figure 2. Fall-run CV Natural Area Escapement, Hatchery and Natural Proportions, 2014.

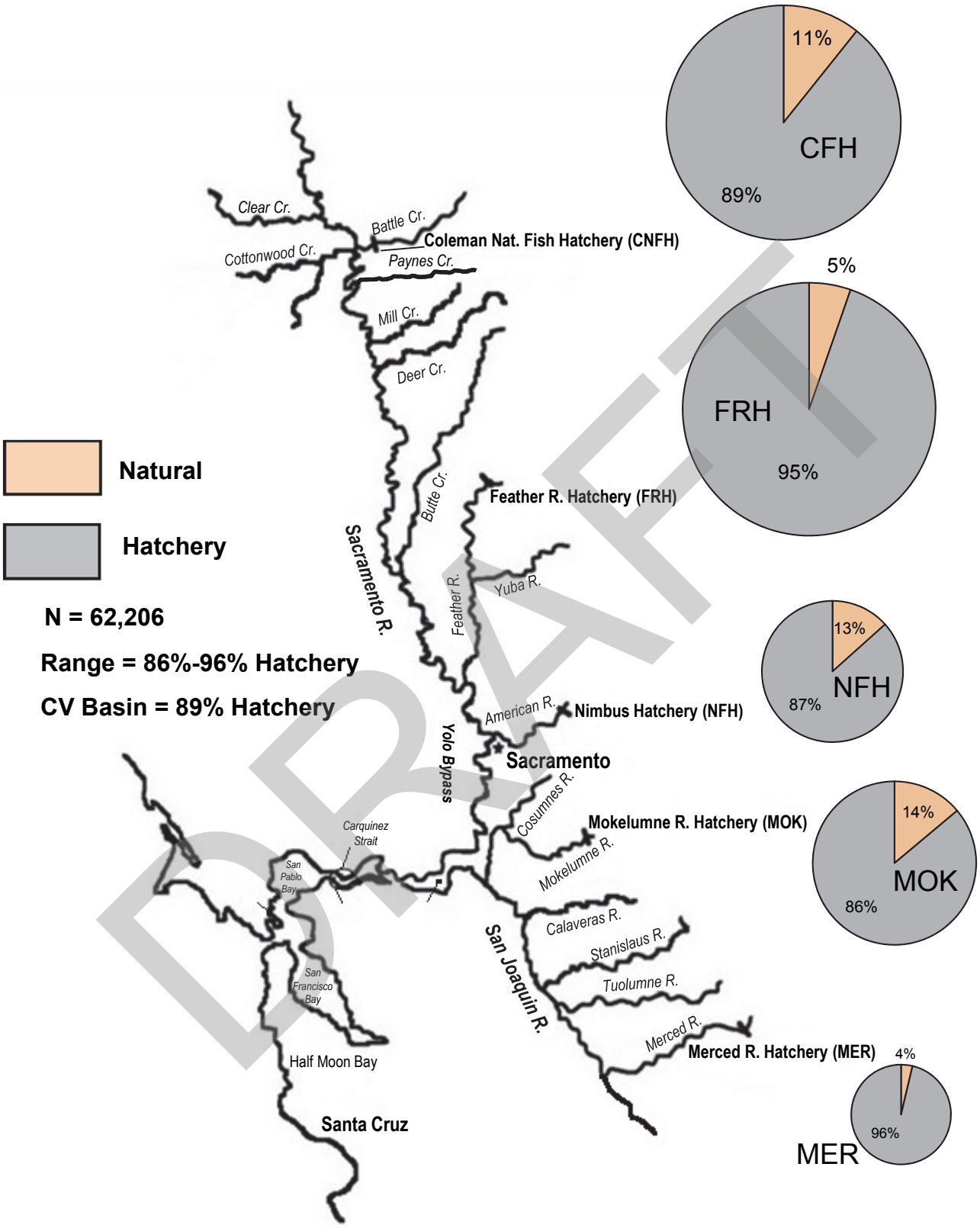


Figure 3. Fall-run CV Hatchery Escapement, Hatchery and Natural Proportions, 2014.

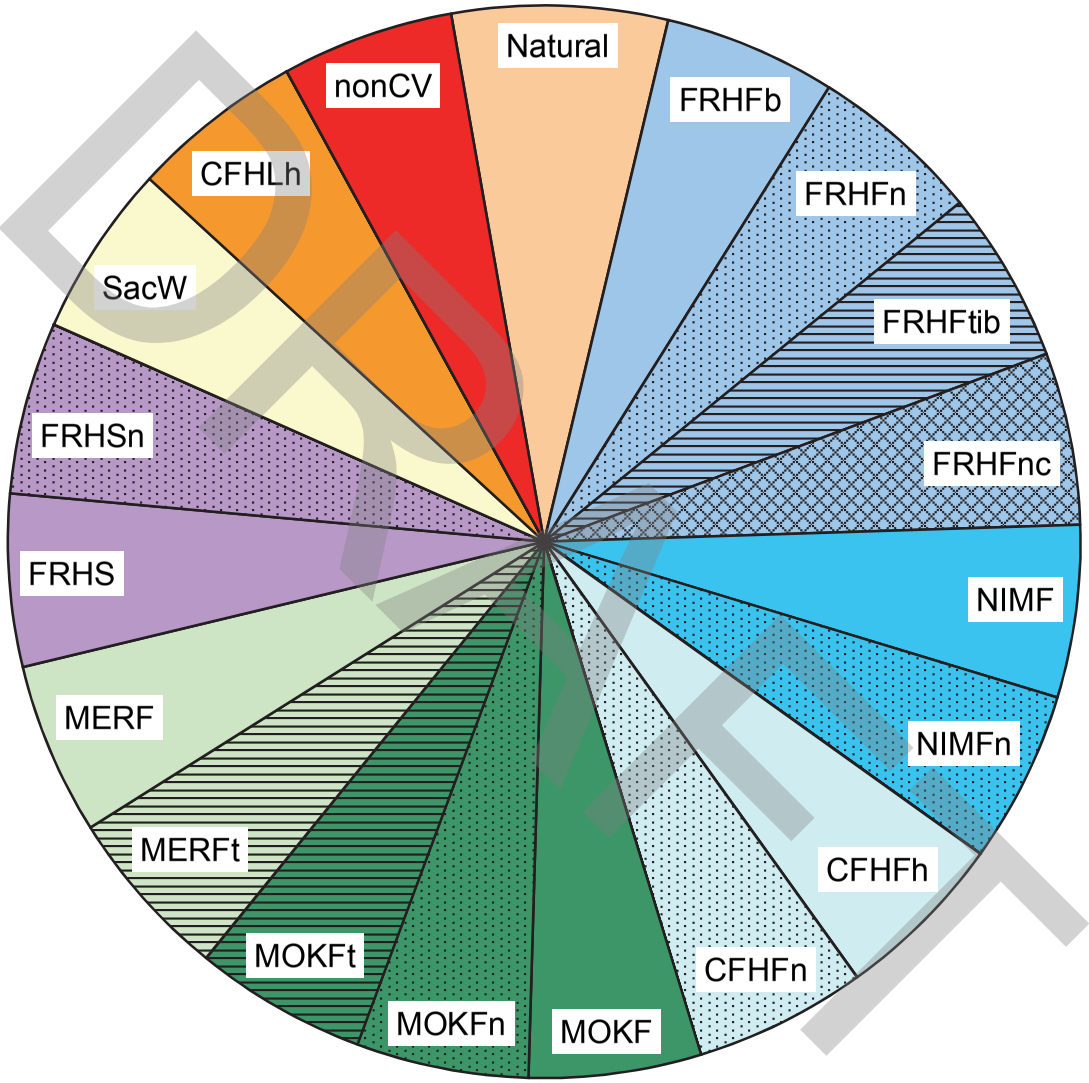


Figure 4. Color chart for Central Valley hatchery release types, brood years 2009-2012.

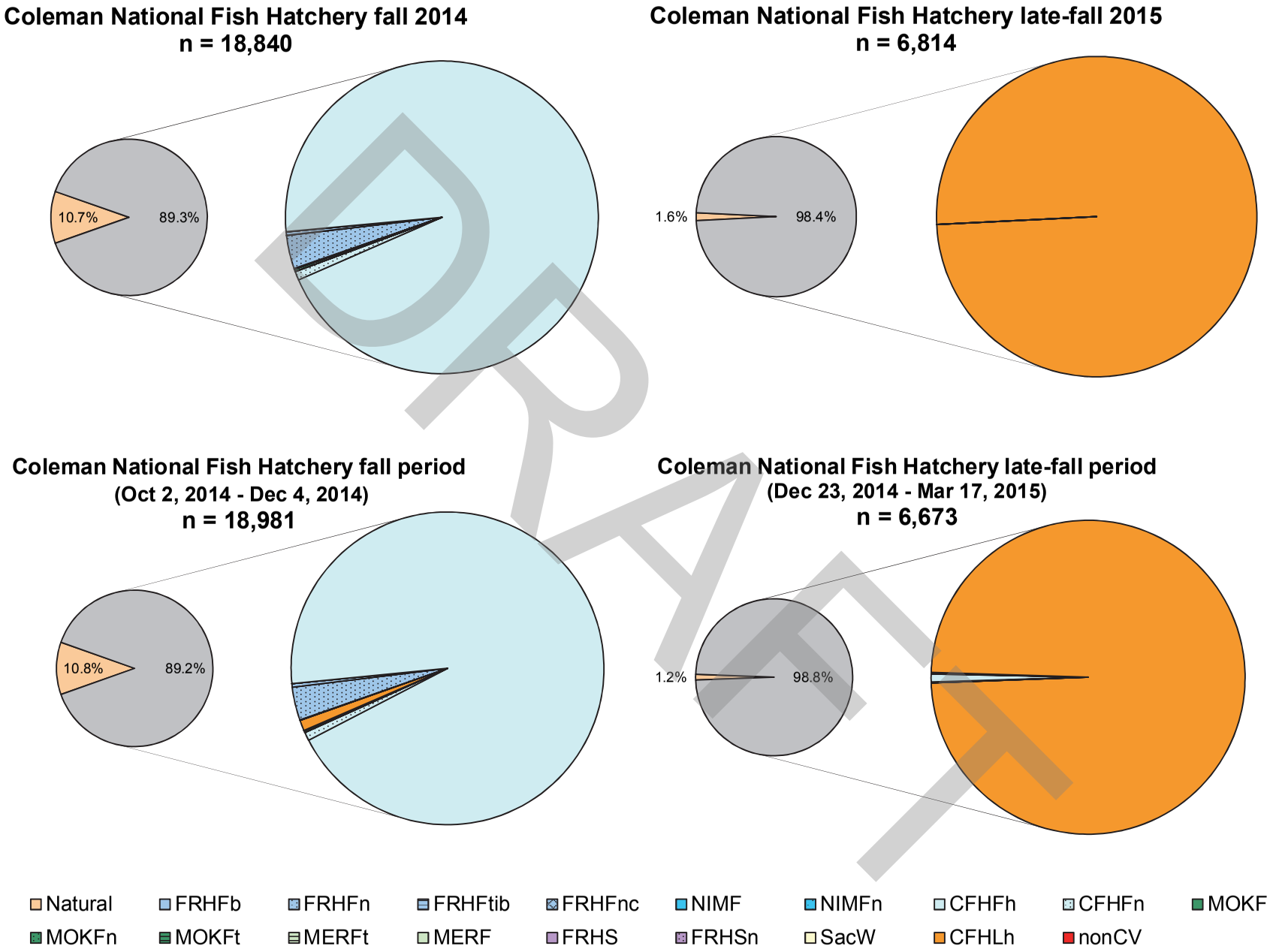


Figure 5. Proportion of hatchery- and natural-origin fish at Coleman National Fish Hatchery, 2014.

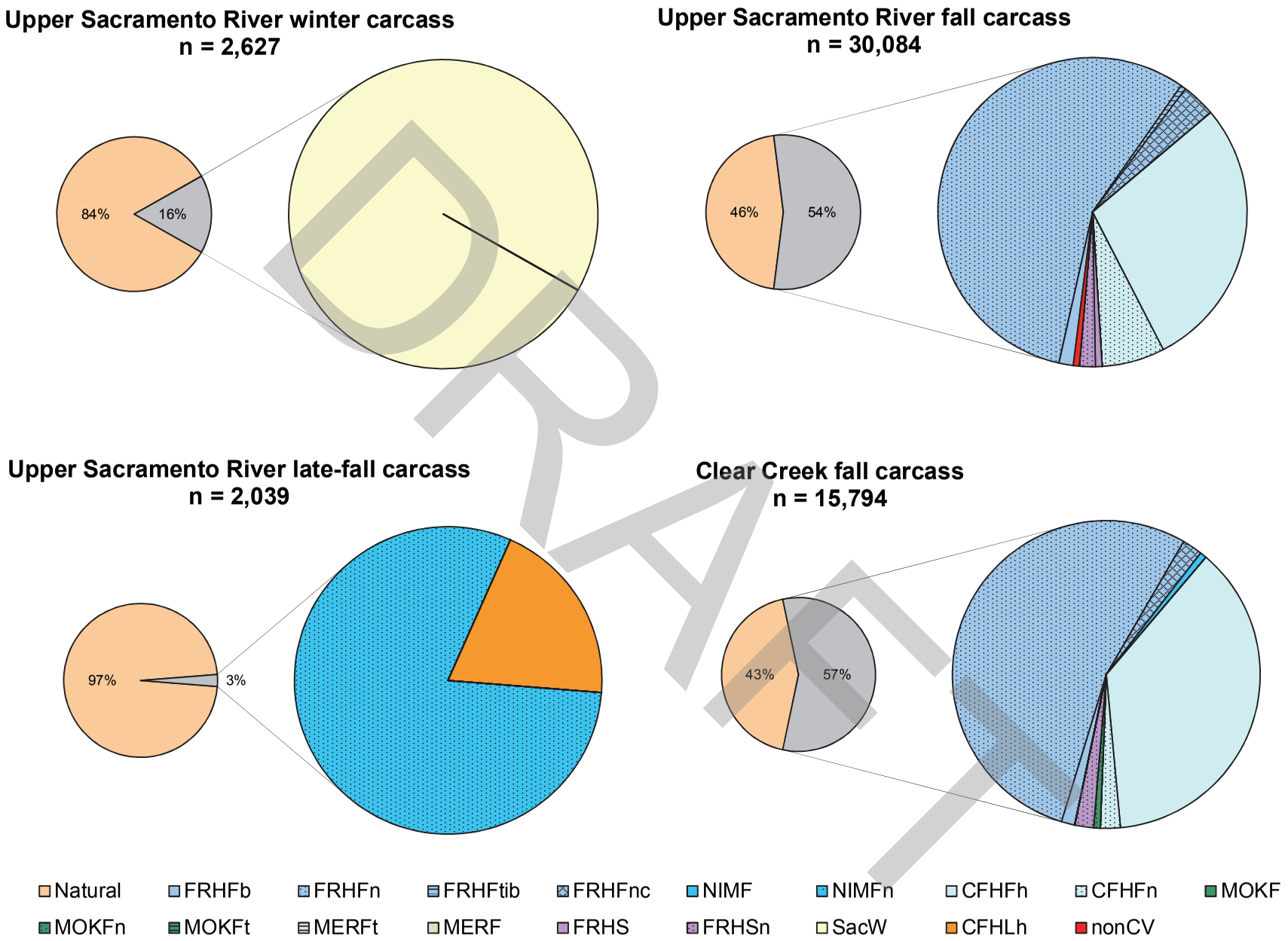


Figure 6. Proportion of hatchery- and natural-origin fish in Upper Sacramento River & tributaries, 2014.

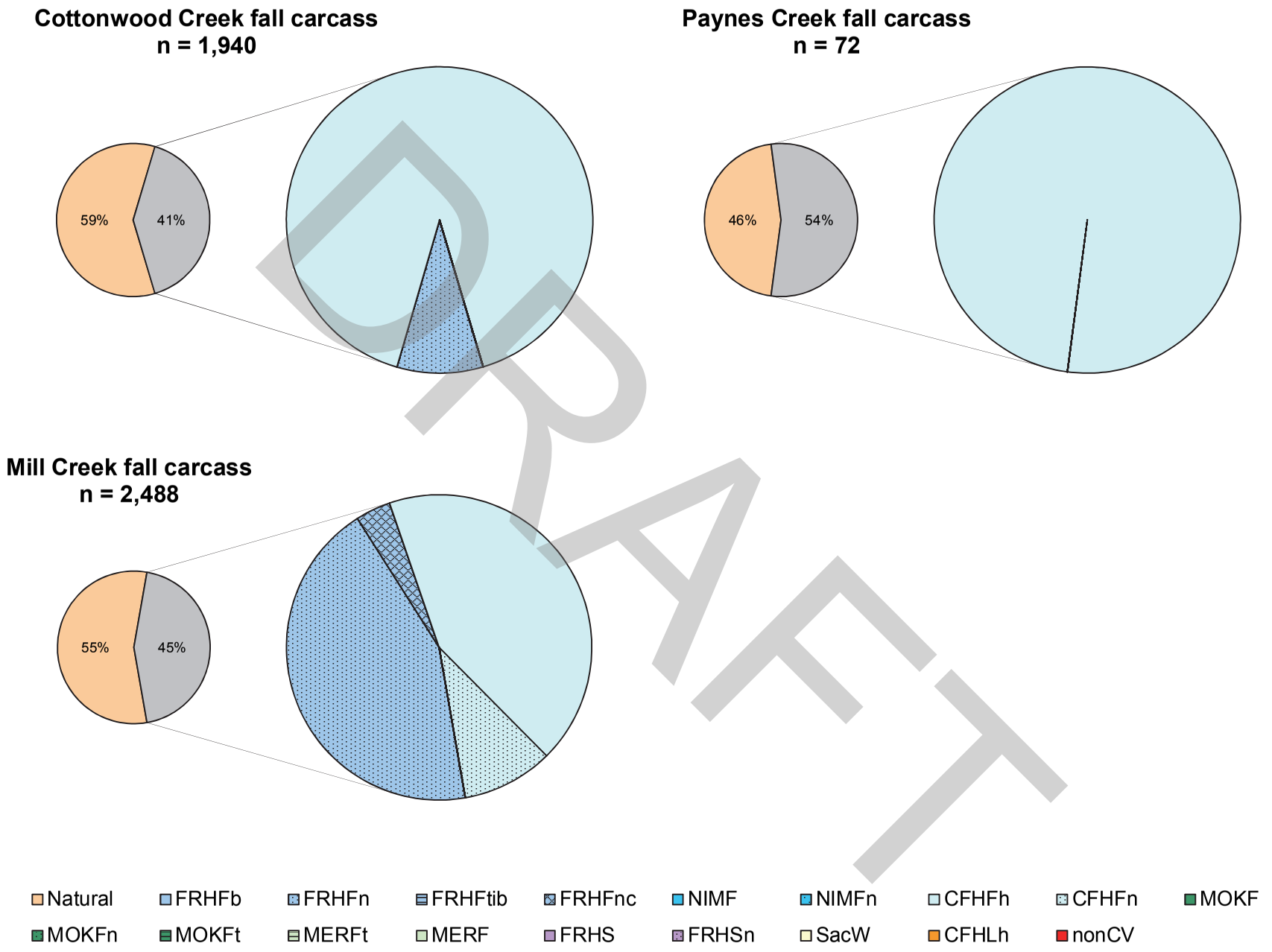


Figure 6. Proportion of hatchery- and natural-origin fish in Upper Sacramento River & tributaries, 2014 (continued).

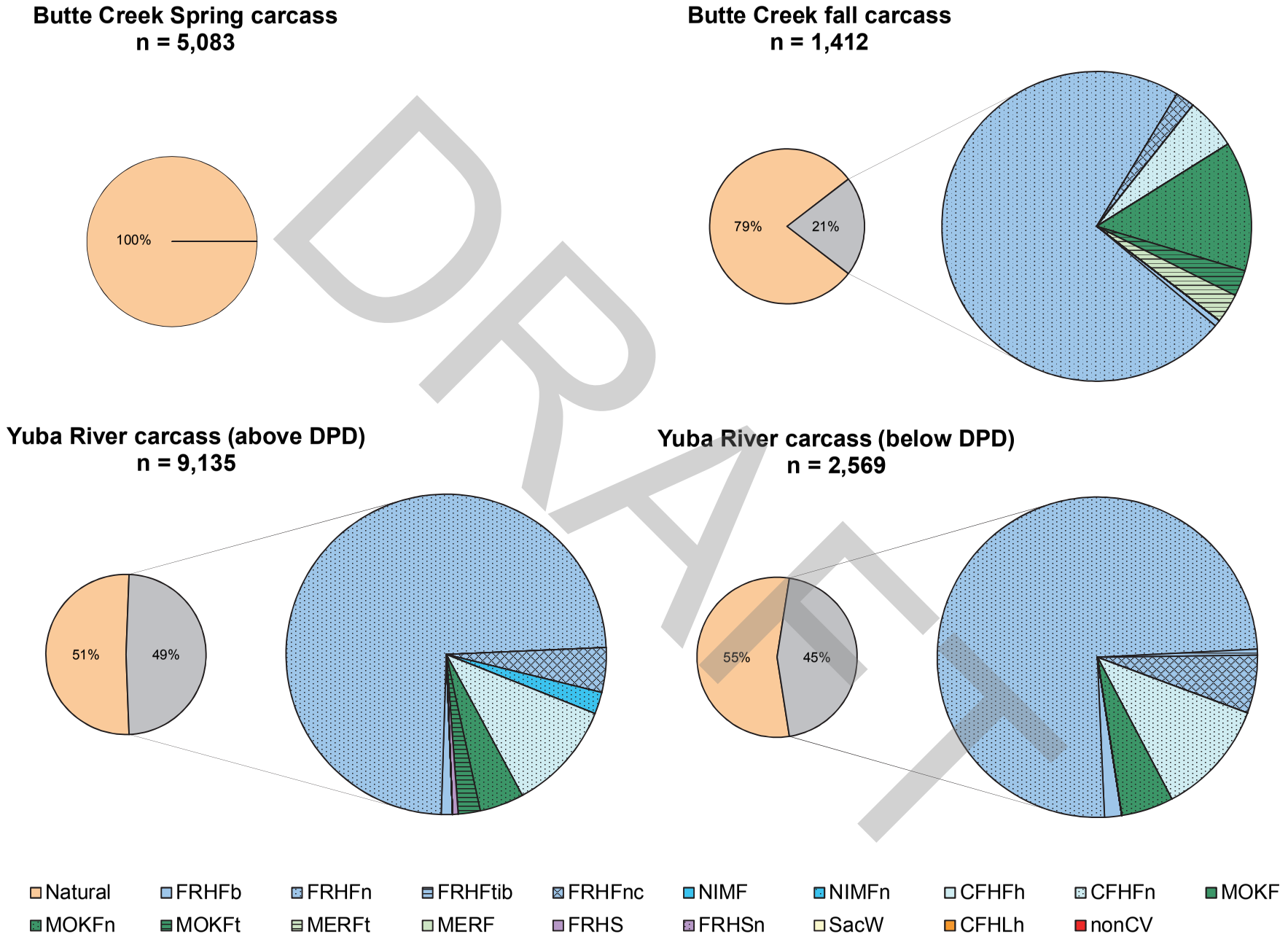


Figure 7. Proportion of hatchery- and natural-origin fish in Butte Creek & Yuba River, 2014.

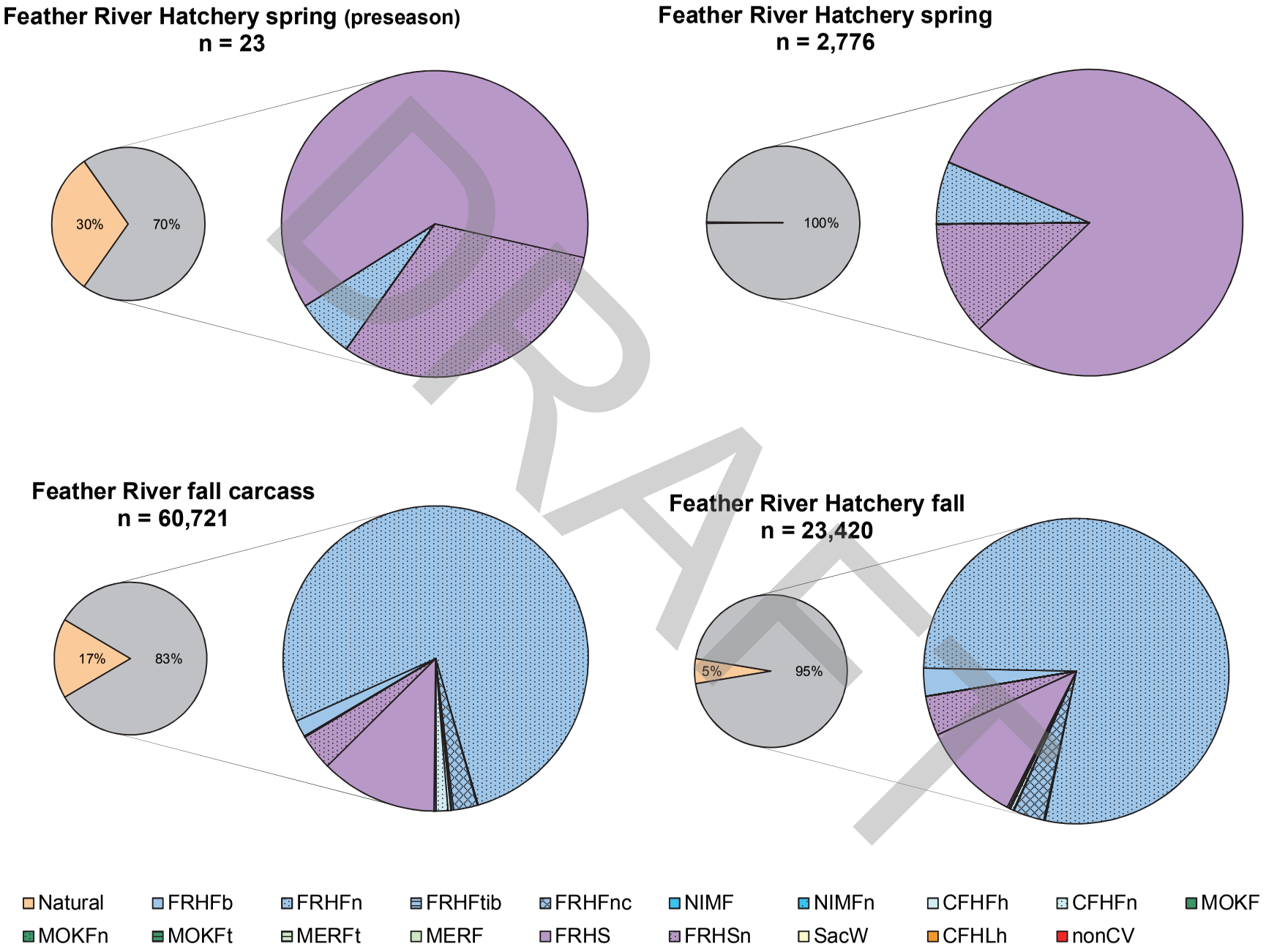


Figure 8. Proportion of hatchery- and natural-origin fish in the Feather River Basin, 2014.

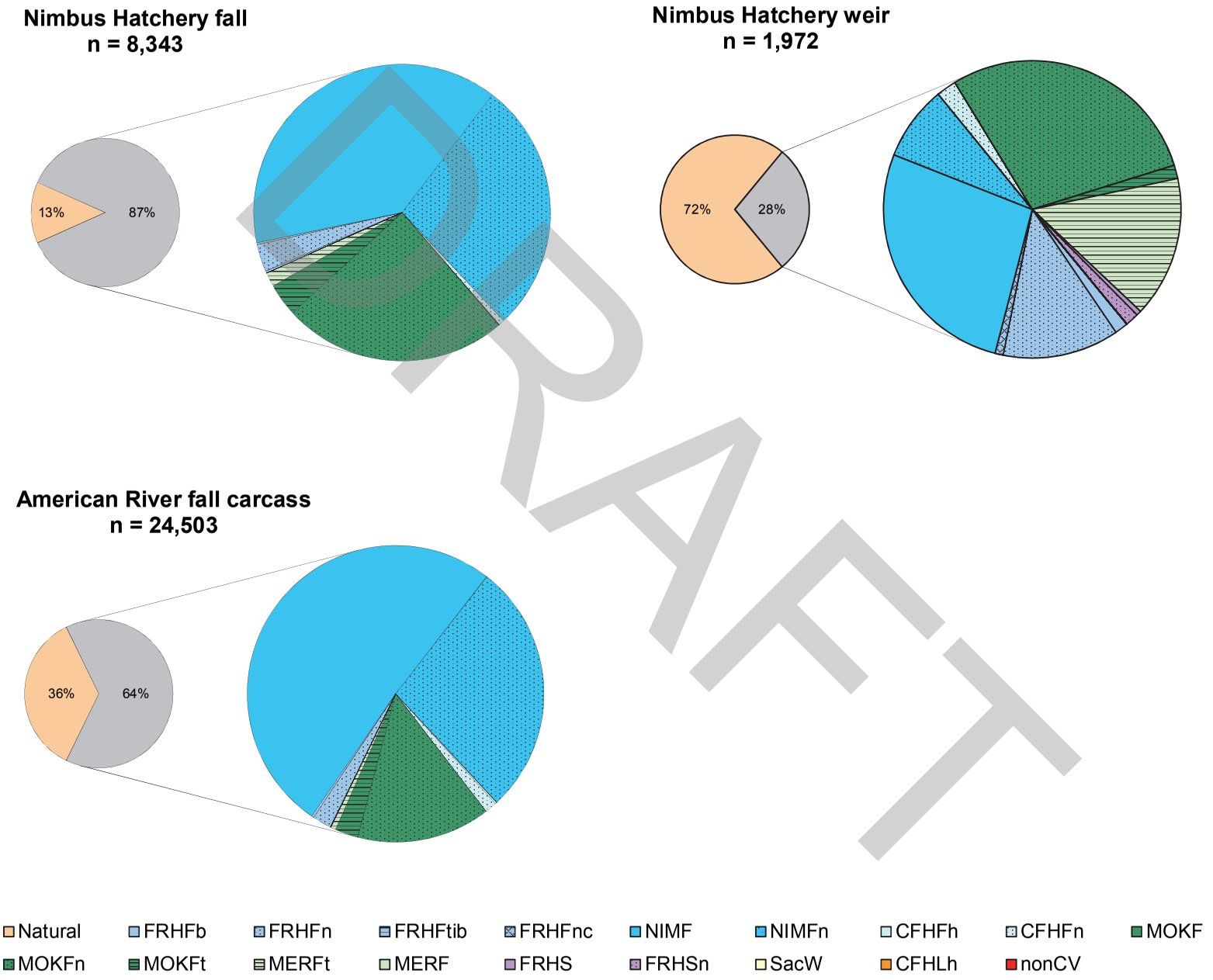


Figure 9. Proportion of hatchery- and natural-origin fish in the American River Basin, 2014.

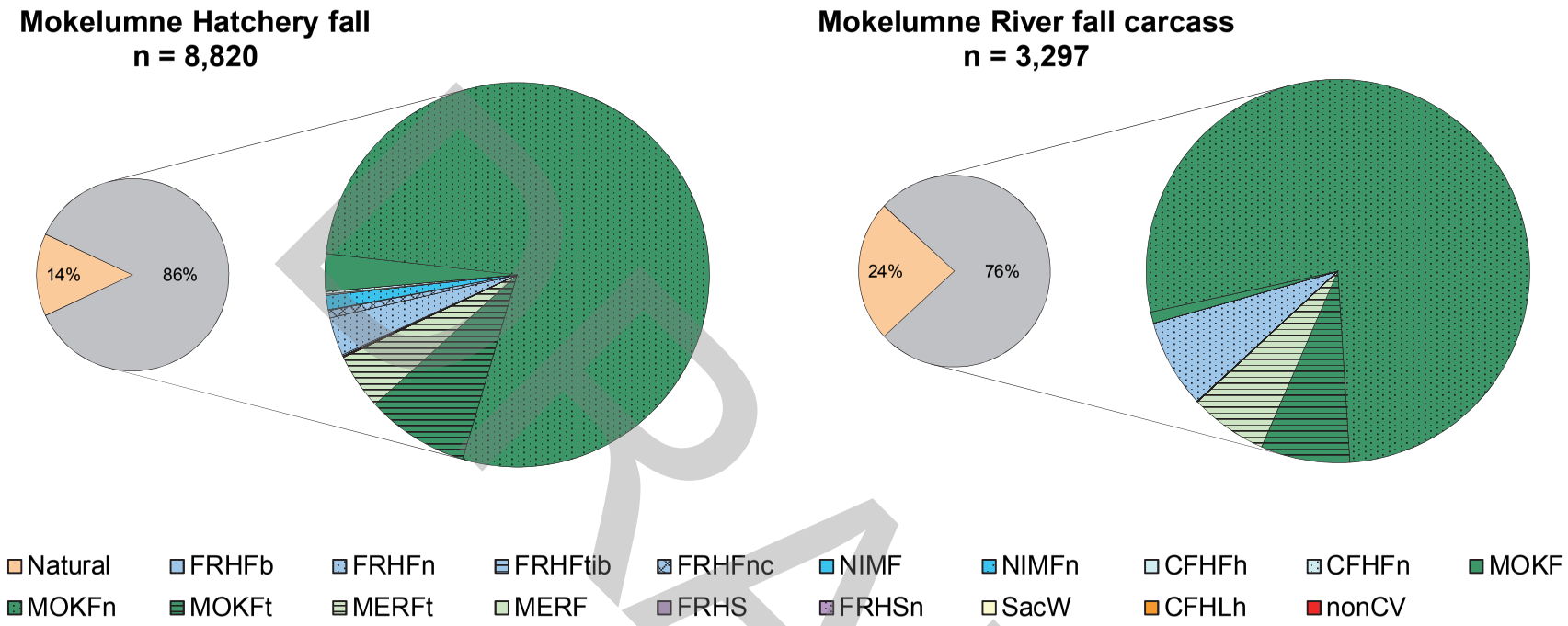


Figure 10. Proportion of hatchery- and natural-origin fish in the Mokelumne River Basin, 2014.

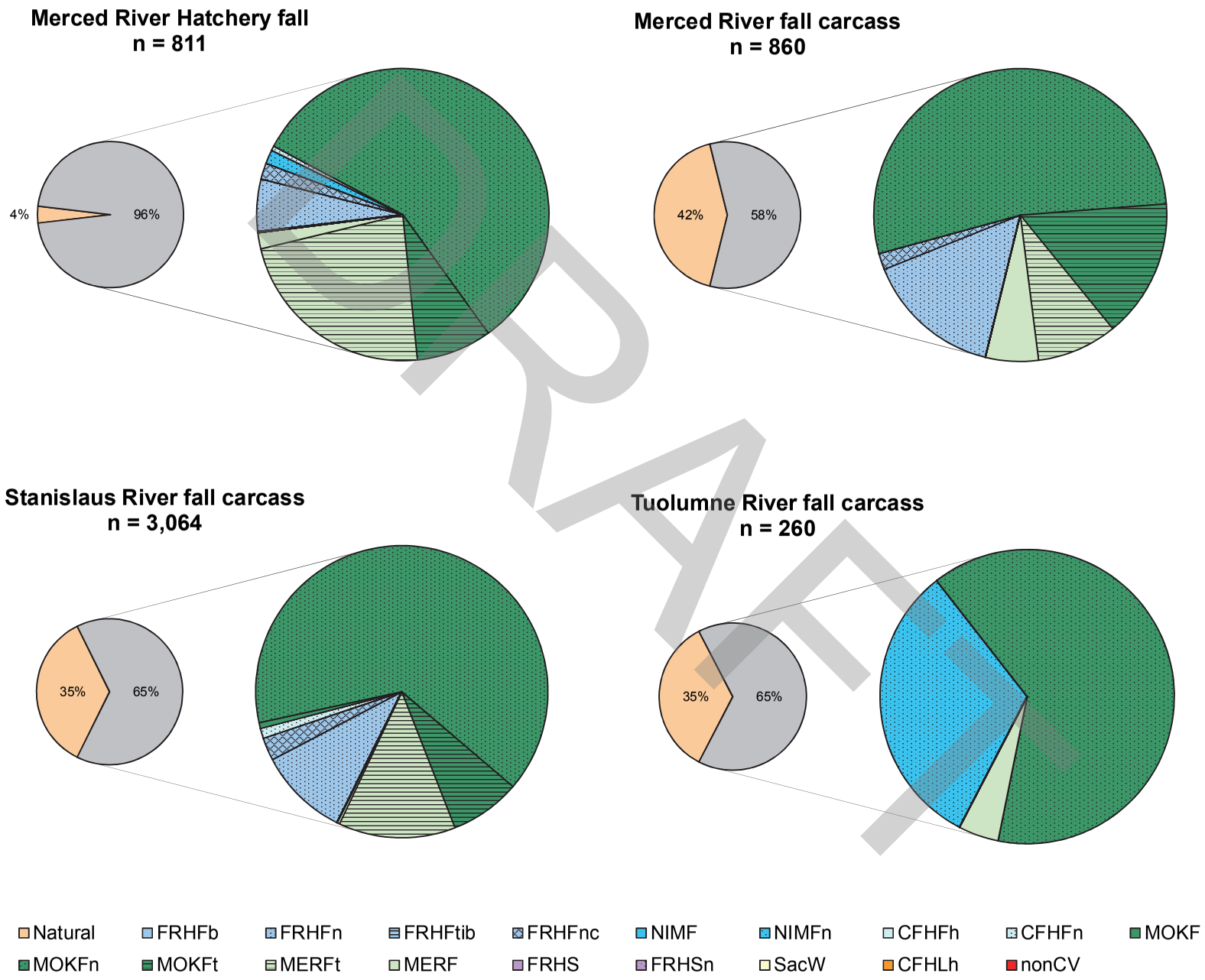


Figure 11. Proportion of hatchery- and natural-origin fish in Merced River & San Joaquin Basin tributaries, 2014.

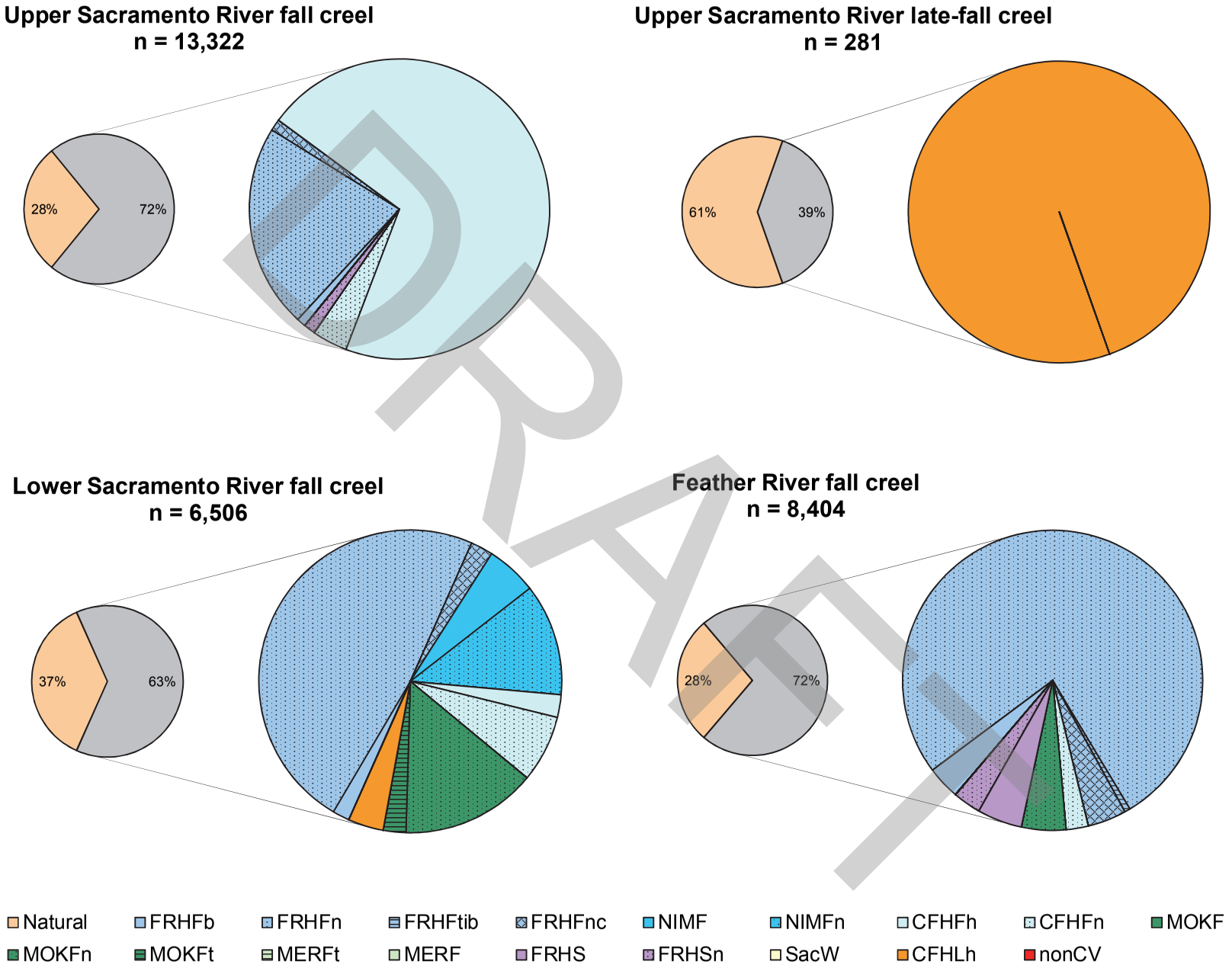


Figure 12. Proportion of hatchery- and natural-origin fish in sport harvest on Sacramento & Feather rivers, 2014.

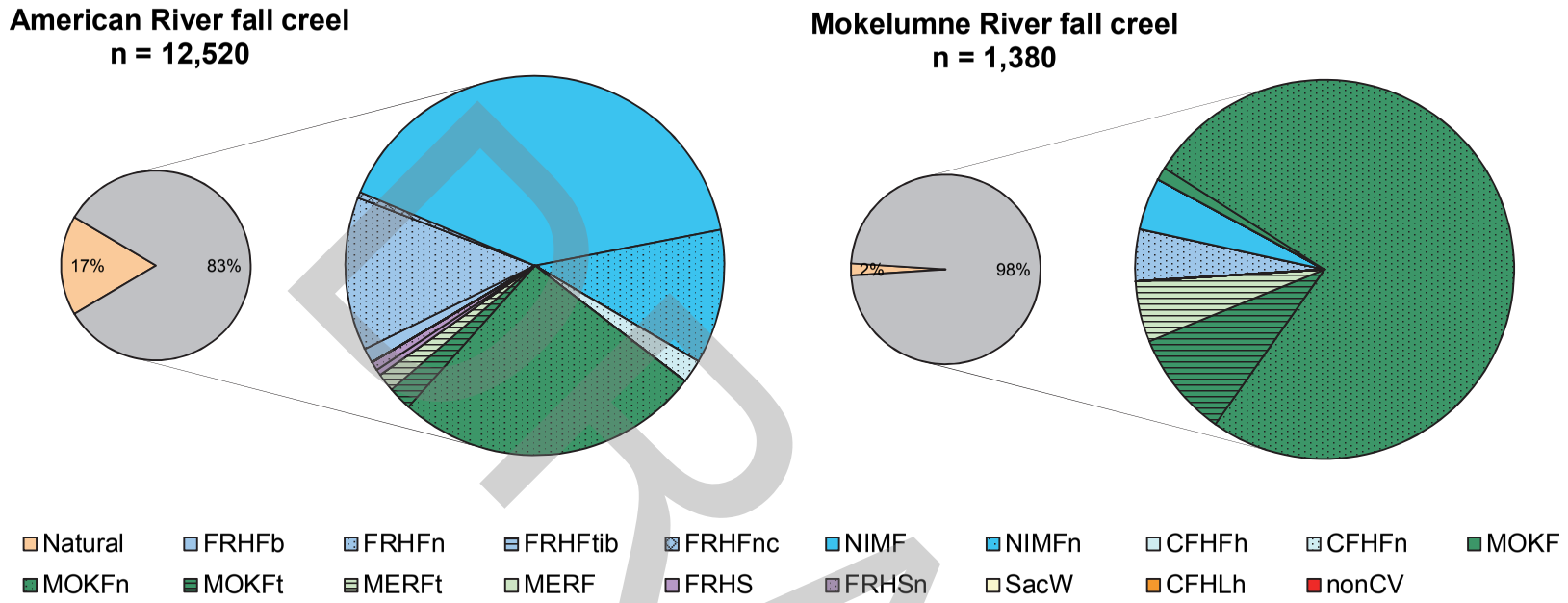


Figure 13. Proportion of hatchery- and natural-origin fish in sport harvest on American & Mokelumne rivers, 2014.

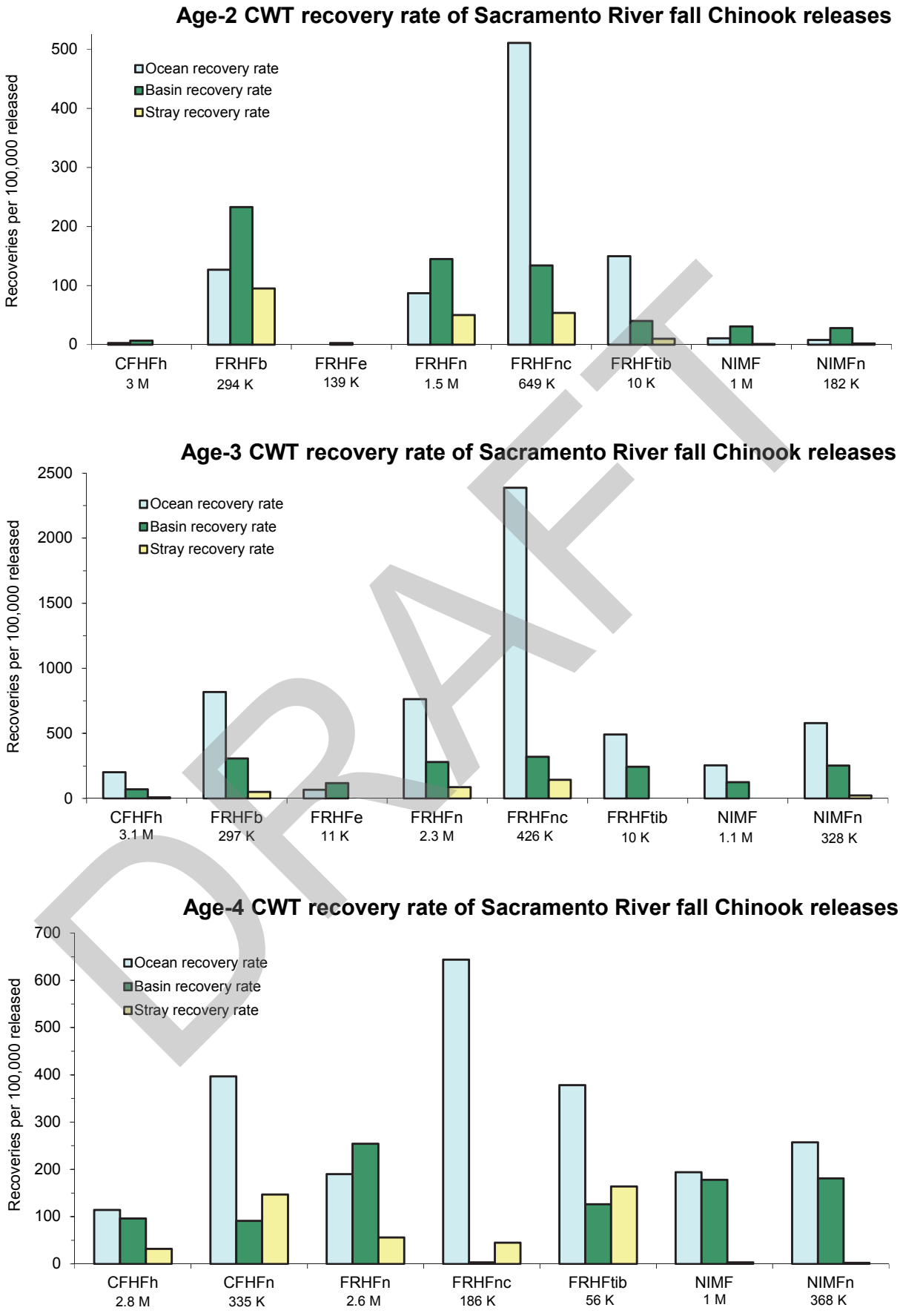


Figure 14. CWT recovery rates of Sacramento River fall Chinook releases by age in 2014.

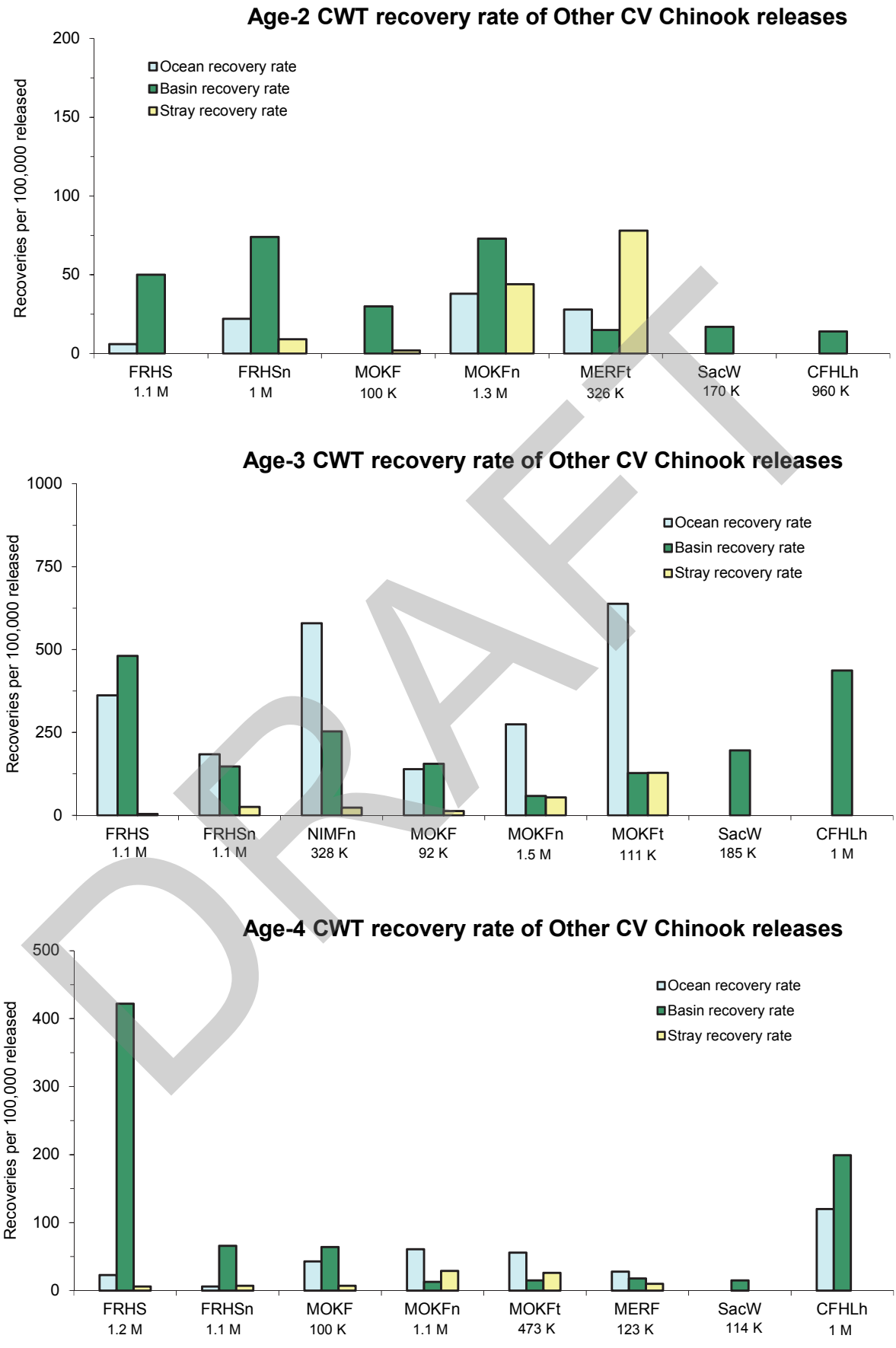
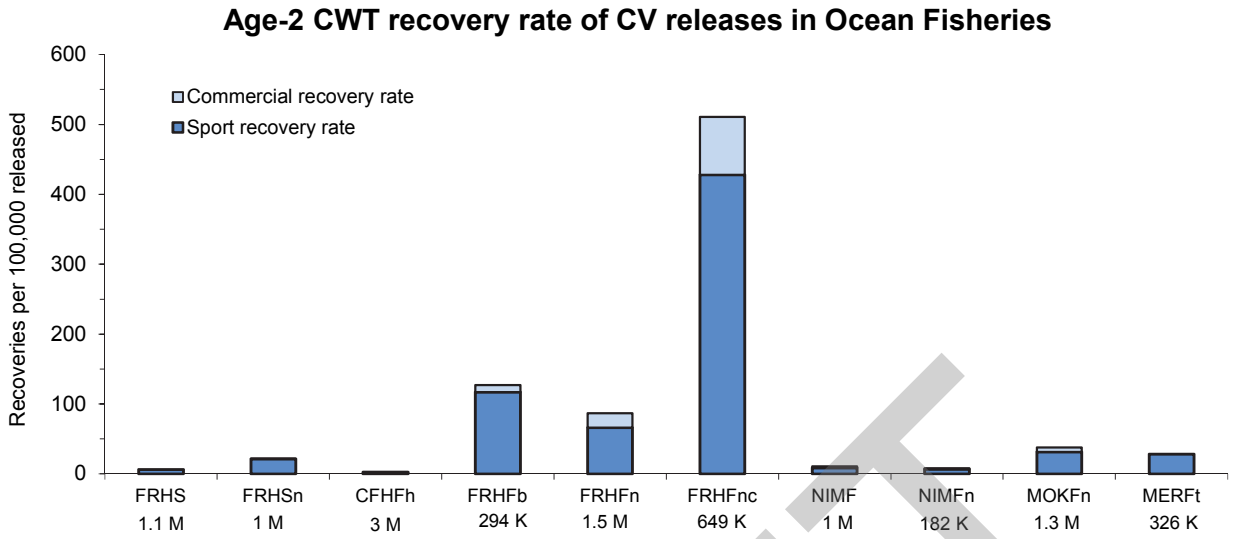
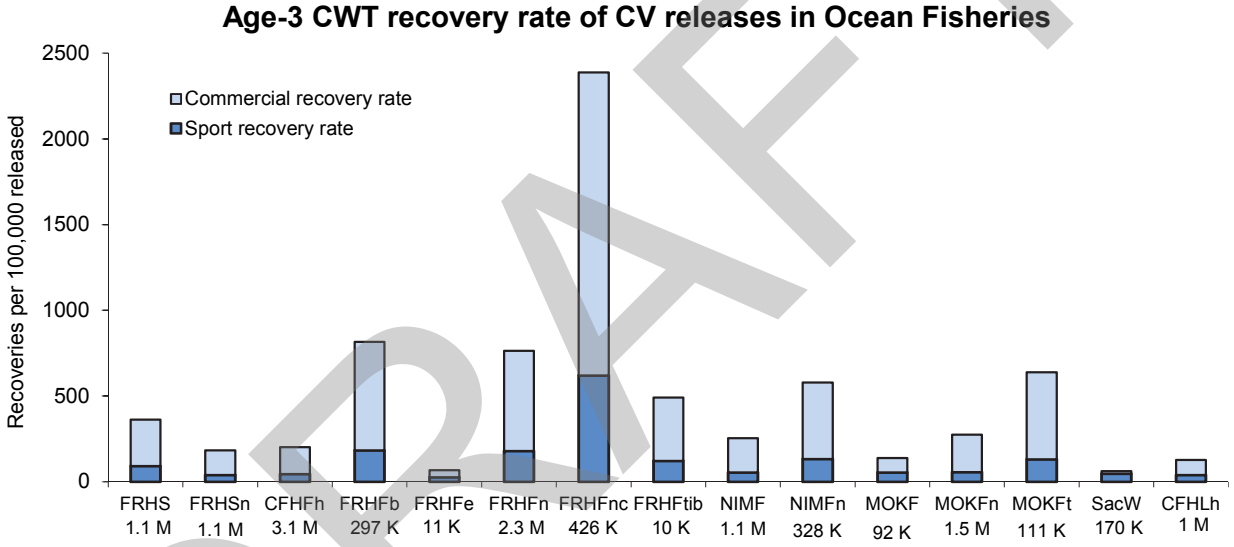


Figure 15. CWT recovery rates of Other CV Chinook releases by age in 2014.





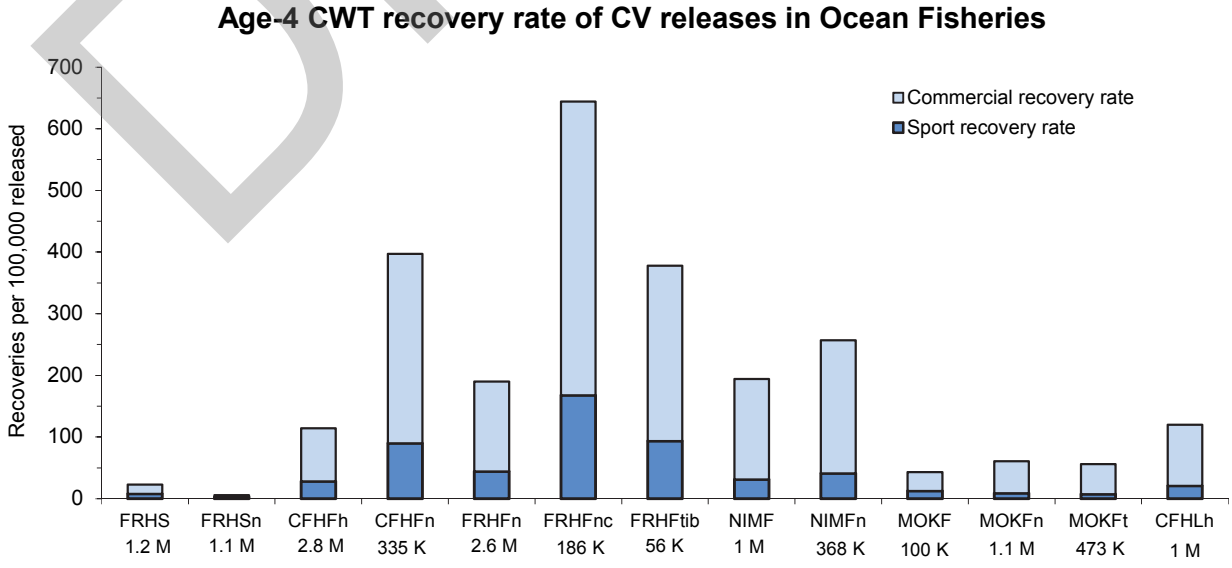


Figure 16. CWT recovery rates by release type in 2014 ocean fisheries.

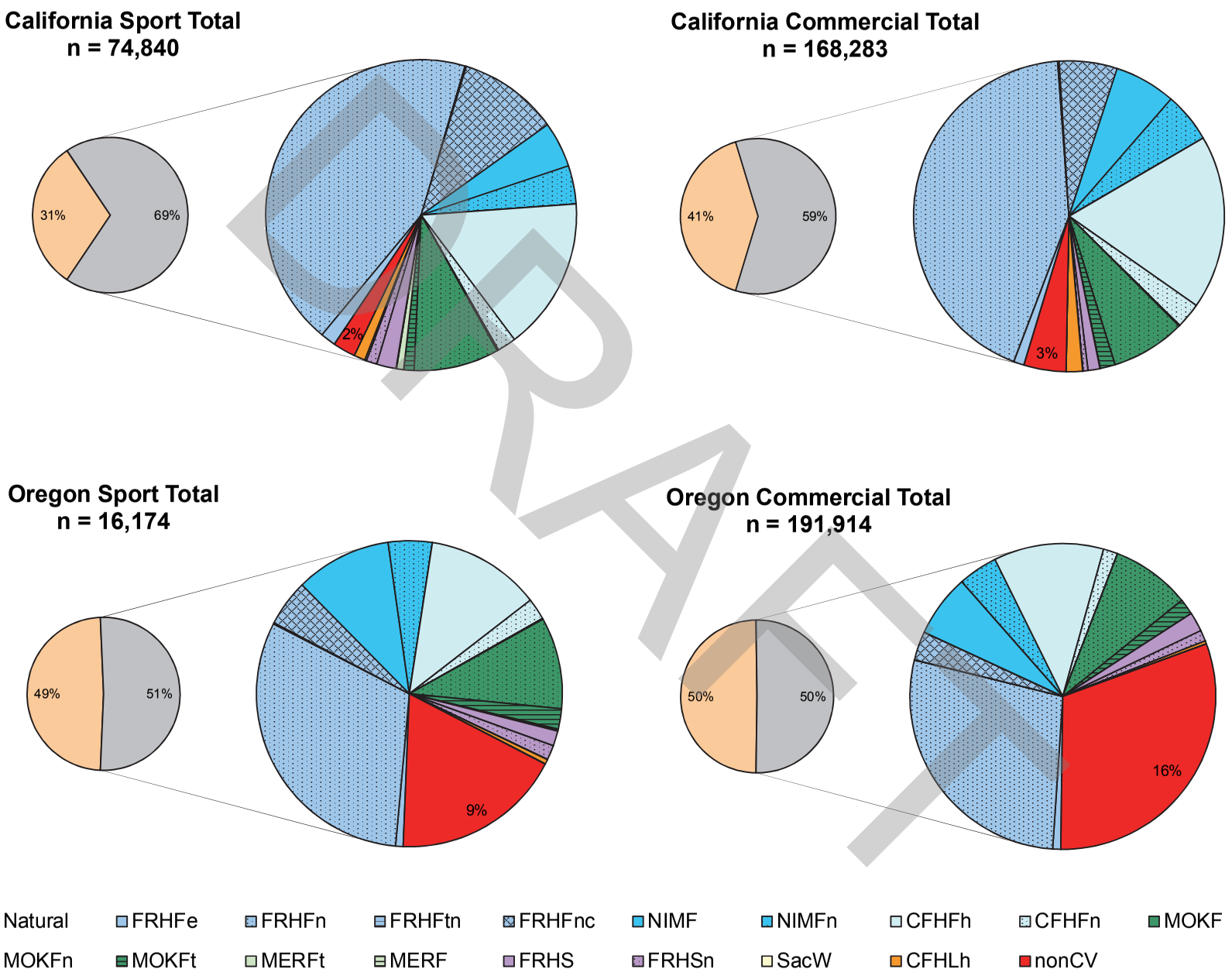


Figure 17. Proportion of hatchery- and natural-origin salmon in 2014 California and Oregon ocean fisheries.

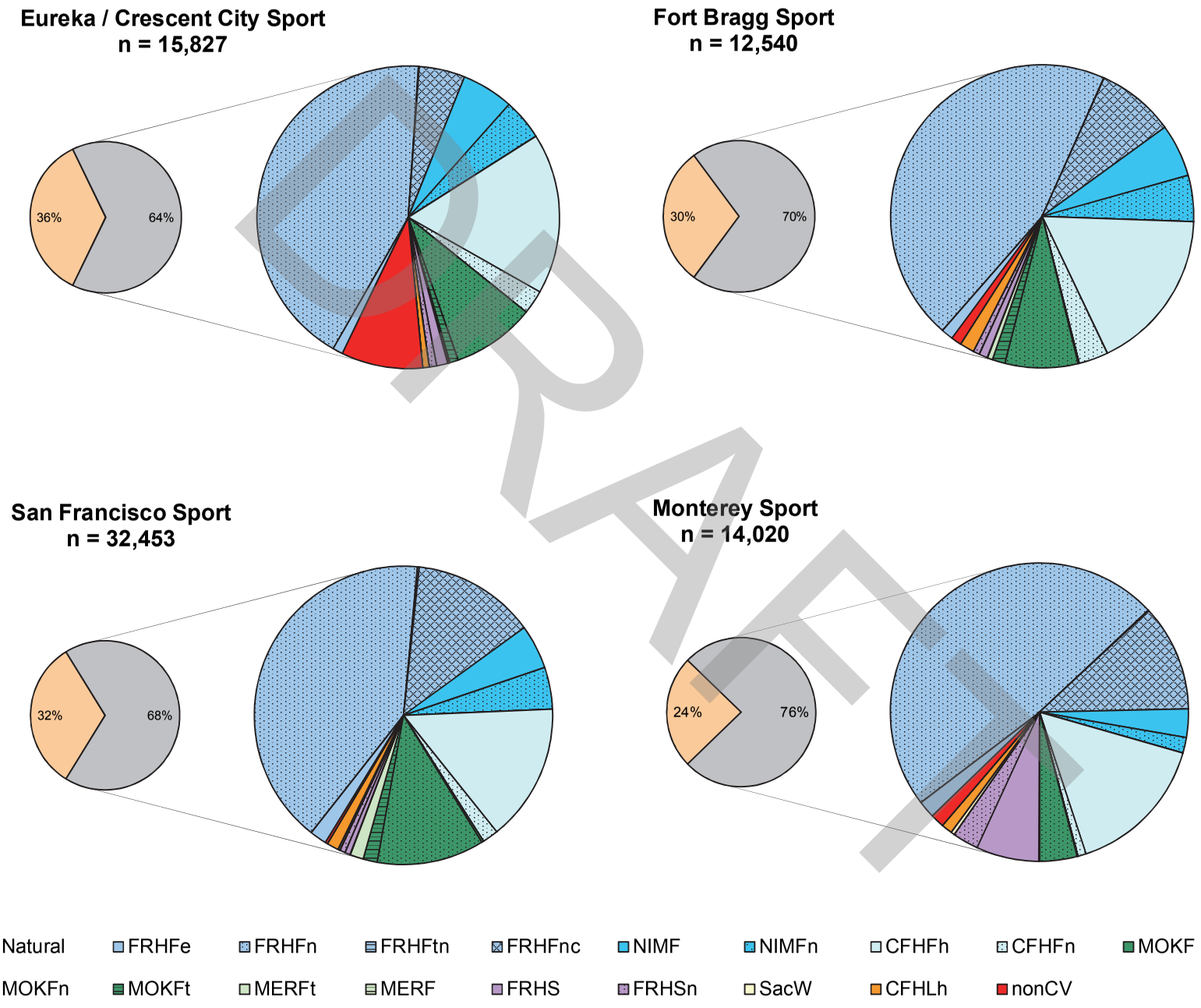


Figure 18. Proportion of hatchery- and natural-origin salmon in the 2014 California ocean sport fishery.

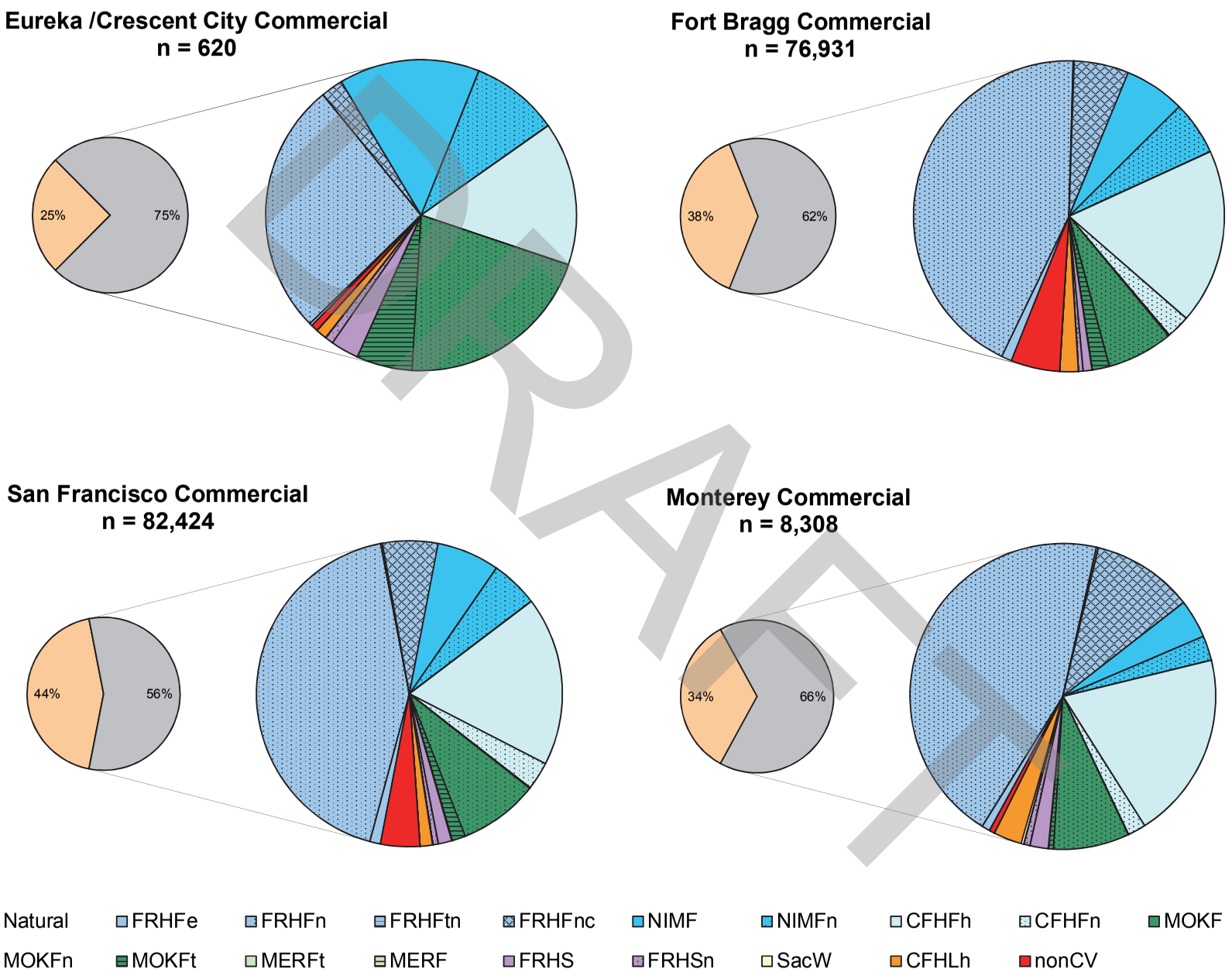


Figure 19. Proportion of hatchery- and natural-origin salmon in the 2014 California ocean commercial fishery.

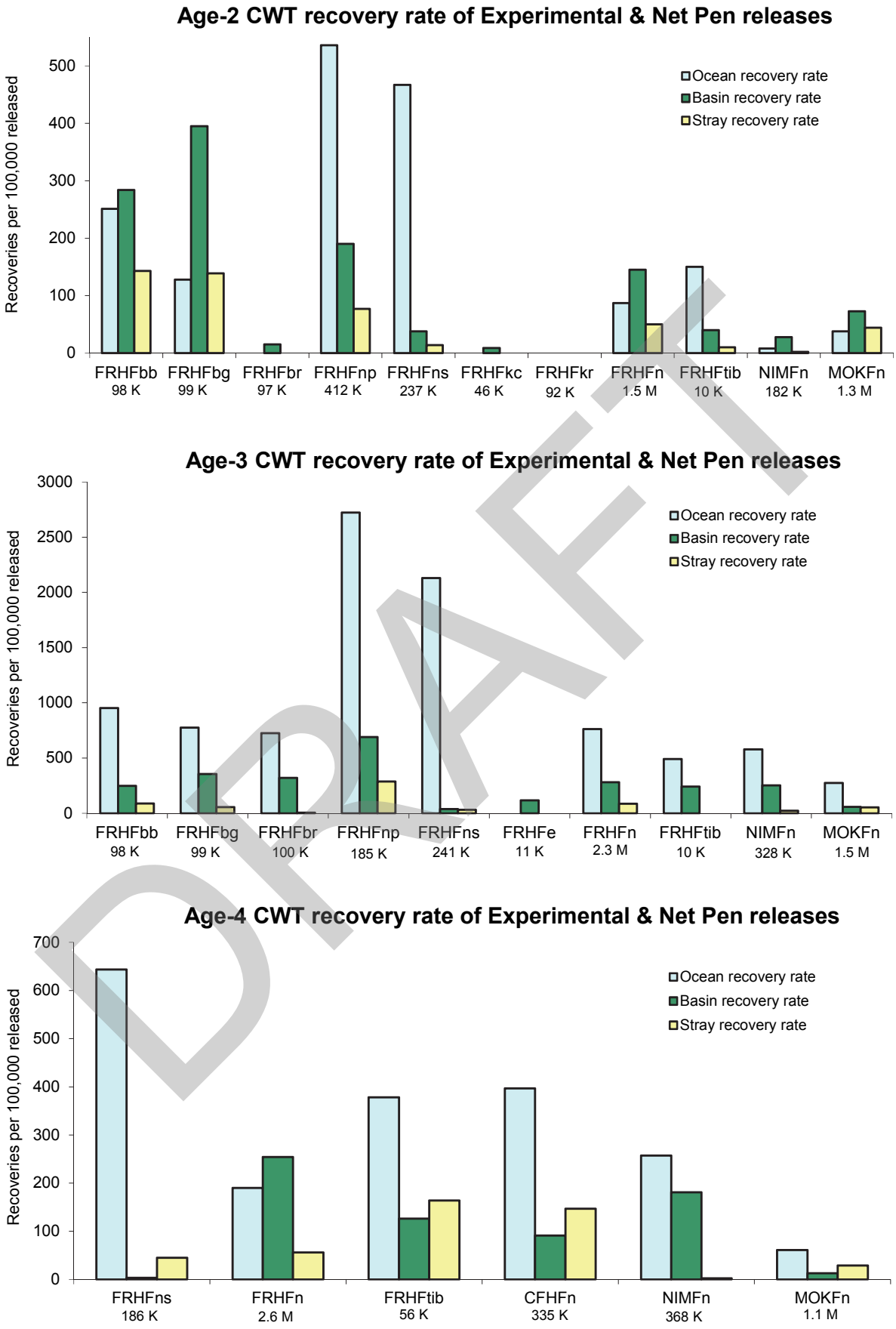
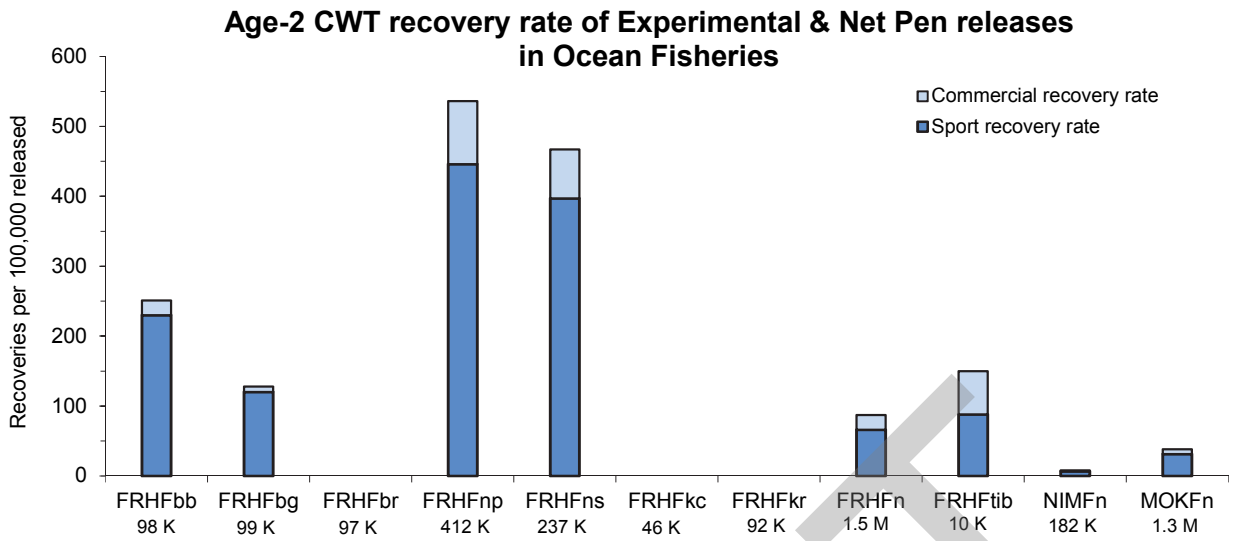
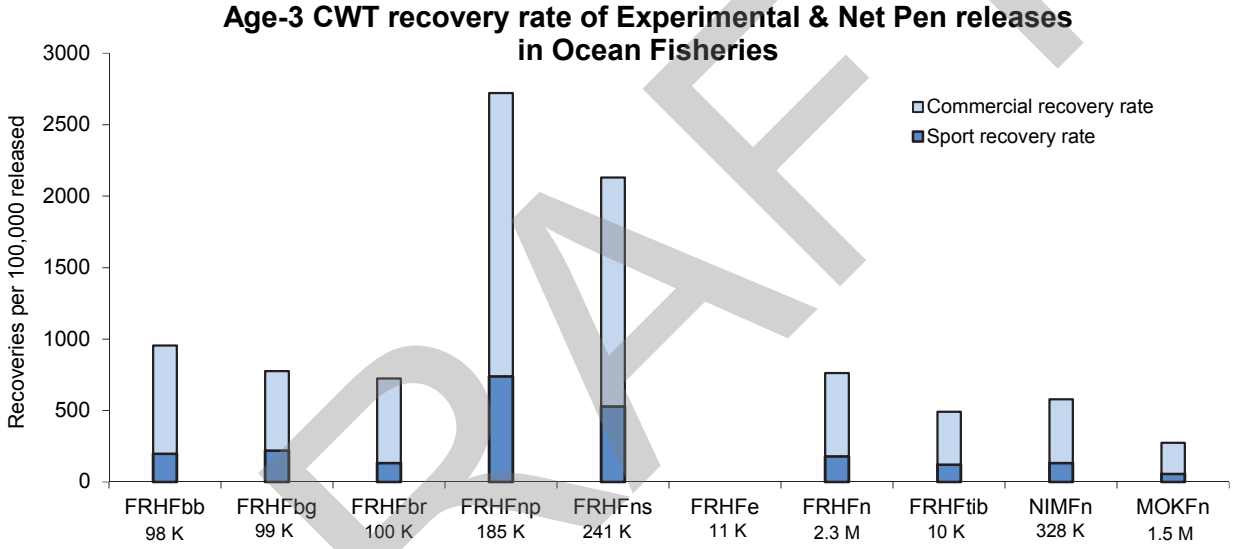


Figure 20. CWT recovery rates of Experimental and Net Pen releases by age in 2014.





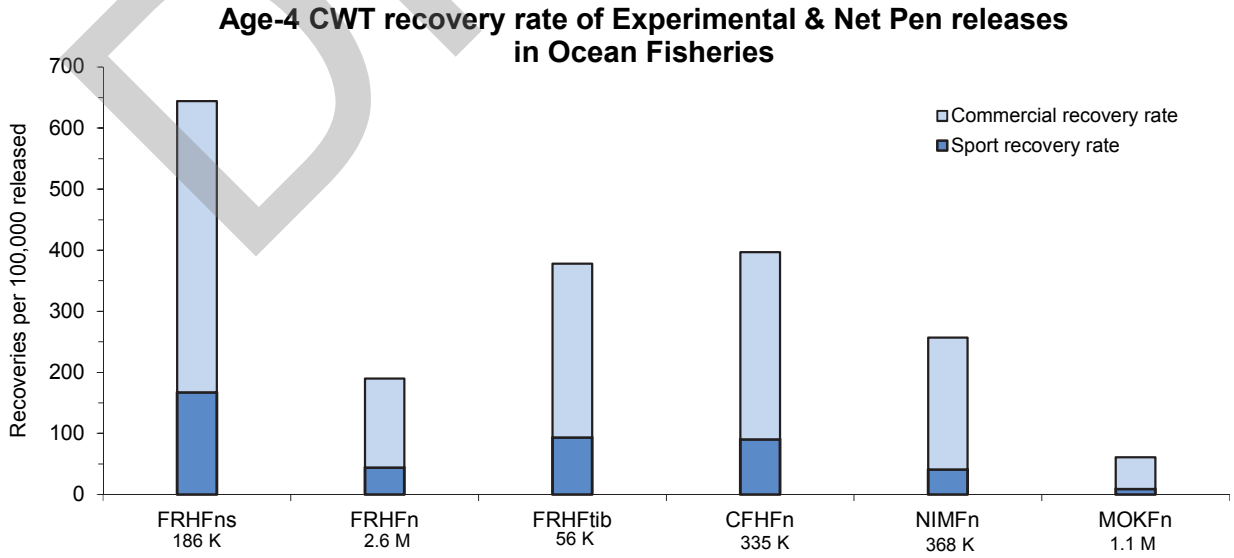


Figure 21. CWT recovery rates of Experimental and Net Pen releases in 2014 ocean sport and commercial fisheries

Appendix 1. Sample expansion factors for Central Valley salmon carcass surveys collecting fish condition in 2014.

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	23%	469	1.6%	81	81	78	78	**0.17**	**0.96**	64.14	3.24	16,233	54.0%
nonfresh	77%	1,608	5.3%	167	167	147	147	0.10	0.88				
total	**30,084**	2,077	6.9%	248	248	225	**225**			**22.24**	**3.24**	16,233	**54.0%**

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	99%	977	6.2%	166	166	160	159	**0.17**	**0.96**	16.27	3.46	8,938	56.6%
nonfresh	1%	11	0.1%	6	6	6	6	0.55	1.00				
total	**15,794**	988	6.3%	172	172	166	**165**			**15.68**	**3.46**	8,938	**56.6%**

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%	89	3.6%	13	13	11	11	**0.15**	**0.85**	27.96	3.62	1,113	44.7%
nonfresh	39%	58	2.3%	13	13	12	12	0.22	0.92				
total	**2,488**	147	5.9%	26	26	23	**23**			**13.37**	**3.62**	1,113	**44.7%**

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%	4,983	8.2%	1,724	1,724	1,660	1634	**0.35**	**0.96**	12.38	2.49	50,433	83.1%
nonfresh	opportunistic												
total	**60,721**	4,983	0	1,724	1,724	1,660	**1,634**			**12.38**	**2.49**	50,433	**83.1%**

Lower American 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	9%	1,566	6.4%	308	306	283	280	**0.20**	**0.92**	15.92	3.54	15,794	64.5%
nonfresh	91%	15,051	61.4%	2,025	1,890	1,722	1,713	0.13	0.91				
total	**24,503**	16,617	67.8%	2,333	2,196	2,005	**1,993**			**2.24**	**3.54**	**15,794**	**64.5%**

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 1. Sample expansion factors for Central Valley salmon carcass surveys collecting fish condition in 2014. (Continued)

Stanislaus 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	79%	437	14.3%	77	77	76	74	**0.18**	**0.99**	7.20	3.72	1,981	64.7%
nonfresh	21%	114	3.7%	25	25	23	23						
total	**3,064**	551	18.0%	102	102	99	**97**			**5.49**	**3.72**	**1,981**	**64.7%**

Tuolumne River fall-run Chinook salmon carcass survey

Condition	Escapement N	Chinook sampled (n)	Sample rate	Observed ad-clips	Ad-clips processed	CWTs recovered	Valid CWTs	*p_adc*	*p_cwt|adc*	F_{samp}	Avg F_{prod}	$\sum_{i=1}^{m} CWT_{total,i}$	% hatchery
fresh	31%	33	16.0%	6	6	6	6	**0.18**	**1.00**	6.24	2.77	536	260.2%
nonfresh	69%	74	35.9%	1	1	1	1	0.01	1.00				
total	**206**	107	51.9%	7	7	7	**7**			**5.35**	**2.77**	**536**	**260.2%**

Upper Sacramento River winter-run Chinook salmon carcass survey

Condition	Escapement N	Chinook sampled (n)	Sample rate	Observed ad-clips	Ad-clips processed	CWTs recovered	Valid CWTs	*p_adc*	*p_cwt|adc*	F_{samp}	Avg F_{prod}	$\sum_{i=1}^{m} CWT_{total,i}$	% hatchery
fresh	44%	570	21.7%	98	95	86	86	**0.17**	**0.91**	4.75	1.05	430	16.4%
nonfresh	56%	723	27.5%	97	96	81	81	0.13	0.84				
total	**2,627**	1,293	49.2%	195	191	167	**167**			**2.45**	**1.05**	**430**	**16.4%**

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

Appendix 2. Alternative 2014 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[a/]	Fea	Yub	Ame	Mok	Mer	SJ	In-basin	Stray	CV total		CWT_{samp}	In-basin	Stray	**CV total**	**Ocean**
CFHFh	2012	Fall	2,956,873	217		13							217	13	231	20%	98	7	0	8	3
CFHLh	2013	Late	960,075	130									130		130	84%		14		14	
FRHFb	2012	Fall	293,784	6	178	78	645	38	11	4			645	316	961	1%	372	220	108	327	127
FRHFe	2012	Fall	138,888				4						4		4	14%		3		3	
FRHFn	2012	Fall	1,453,105	62	267	244	1,989	117	52	47	29	27	1,989	845	2,834	7%	1,271	137	58	195	87
FRHFnc	2012	Fall	649,160	33	67	124	614	258	12	47	23	44	614	609	1,223	37%	3,317	95	94	188	511
FRHFtib	2012	Fall	9,918	1			4						4	1	5	4%	15	40	10	50	150
FRHS	2012	Spr	1,106,679				528	25					528	25	553	11%	71	48	2	50	6
FRHSn	2012	Spr	1,015,285		67	16	755		6				755	89	844	6%	222	74	9	83	22

Age 3 CWT recoveries

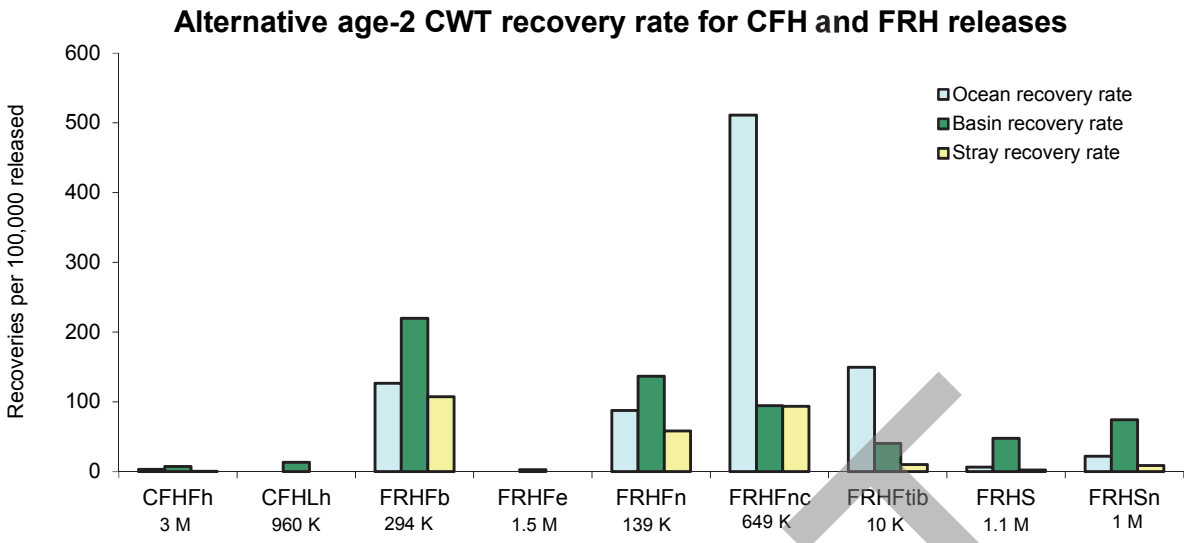
Release type	Brood year	Run type	# CWT tagged	Central Valley total recoveries (CWT_{samp}) by basin									CV CWT_{samp} totals			% CV Stray	Ocean	Recovery rate per 100K released			
				Bat Cr	Up Sac	Nat crks[a/]	Fea	Yub	Ame	Mok	Mer	SJ	In-basin	Stray	CV total		CWT_{samp}	In-basin	Stray	**CV total**	**Ocean**
CFHFh	2011	Fall	3,117,042	2,020	178	276			4				2,020	459	2,479	18%	6,288	65	15	80	202
CFHLh	2012	Late	1,031,419	4,511						6			4,511	6	4,517	0%	1,311	437	1	438	127
FRHFb	2011	Fall	297,089	6	67	49	884	31	23	6			884	182	1,066	17%	2,428	297	61	359	817
FRHFe	2011	Fall	11,449				13						13		13		8	117		117	67
FRHFn	2011	Fall	2,293,211	47	1,068	747	5,885	568	62	30		22	5,885	2,544	8,429	30%	17,489	257	111	368	763
FRHFnc	2011	Fall	426,190	23	445	94	1,363	7	43	1		5	1,363	619	1,982	31%	10,175	320	145	465	2,387
FRHFtib	2011	Fall	9,933				17	7					17	7	24	28%	49	175	68	243	492
FRHS	2011	Spr	1,088,286		44		5,231		3				5,231	48	5,279	1%	3,935	481	4	485	362
FRHSn	2011	Spr	1,125,189	2	133	141	1,650		2				1,650	279	1,929	14%	2,074	147	25	171	184

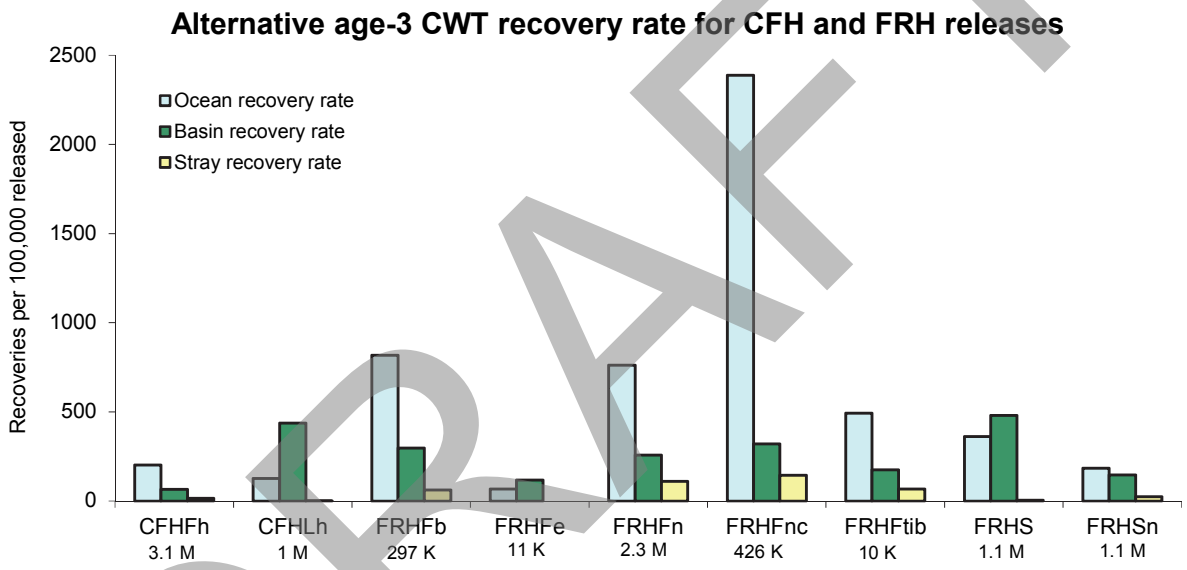
Age 4 CWT recoveries

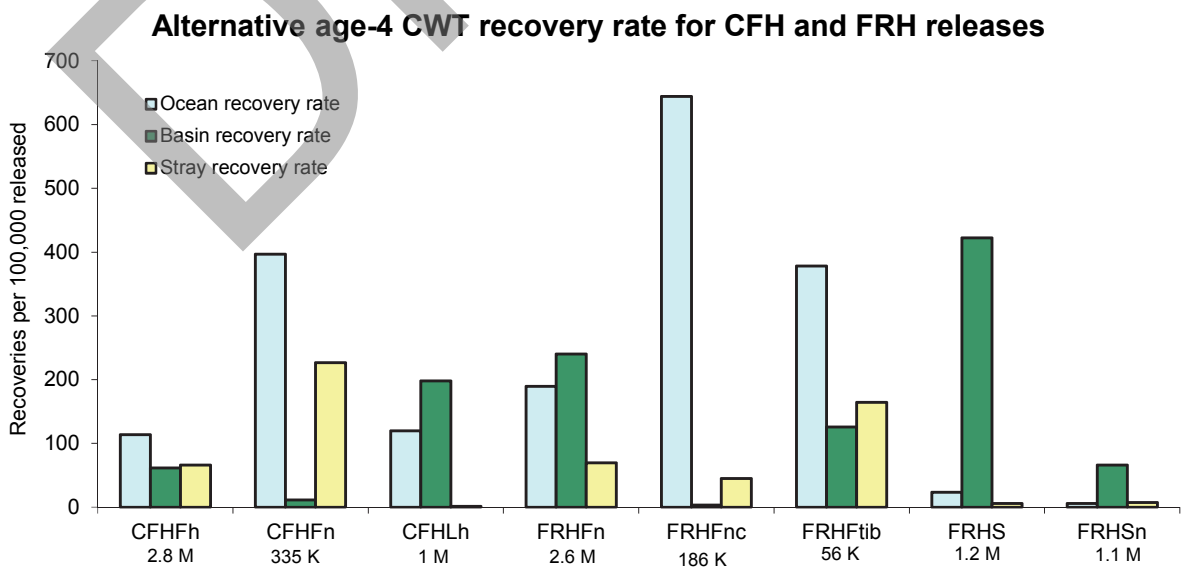
Release type	Brood year	Run type	# CWT tagged	Central Valley total recoveries (CWT_{samp}) by basin									CV CWT_{samp} totals			% CV Stray	Ocean	Recovery rate per 100K released			
				Bat Cr	Up Sac	Nat crks[a/]	Fea	Yub	Ame	Mok	Mer	SJ	In-basin	Stray	CV total		CWT_{samp}	In-basin	Stray	**CV total**	**Ocean**
CFHFh	2010	Fall	2,835,420	1,743	979	851	38		2	2			1,743	1,872	3,615	52%	3,221	61	66	128	114
CFHFn	2010	Fall	334,756	38	267	78	180	157	66	4	1	5	38	758	796	95%	1,329	11	226	238	397
CFHLh	2011	Late	1,037,859	2,056	10						1		2,056	11	2,067	1%	1,243	198	1	199	120
FRHFn	2010	Fall	2,554,115	34	934	392	6,136	346	38	32	1		6,136	1,776	7,911	22%	4,844	240	70	310	190
FRHFnc	2010	Fall	185,985	1	67	16	6						6	83	89	93%	1,199	3	45	48	644
FRHFtib	2010	Fall	56,030	3	89		71						71	92	162	57%	212	126	164	290	378
FRHS	2010	Spr	1,170,340	1	67		4,945						4,945	68	5,012	1%	274	422	6	428	23
FRHSn	2010	Spr	1,136,690		67	16	750		2				750	84	834	10%	68	66	7	73	6

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 2014.

Appendix 4. Sample expansion for CWTs recovered in Yuba River escapement above Daguerre Point Dam (DPD) based on video data, 2014.

DPD Vaki video	Total	% adclip	known status
no clip	7,493		7,493
adclip	1,393	15.7%	1,393
unknown clip	249		
total	9,135		8,886

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
9,135	**8,886**	97%	**1,393**	58	53	**53**	**0.157**	**0.914**	**24.69**	**3.40**	**4,452**	**48.7%**
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, 2014.

	Total	Known ad status	% adclip
Woodbridge Dam video	12,117	2,890	23.9%
MRFI return	8,820	2,126	24.1%
Natural Escapement Mokelume River	**3,297**	**764**	23.2%

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
3,297	3,297	100%	764	65	54	**54**	**0.232**	**0.831**	**11.75**	**3.96**	**2,511**	**76.2%**
video count			video count		carcass survey							