

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

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INTRODUCTION

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

This is the 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 their siblings released directly into the water? Are these metrics affected by transporting salmon smolts down the Sacramento River by vessel and exposing them to river water prior to release in the bay?
- What are the relative recovery and contribution rates of hatchery-origin salmon, by run and release type, to ocean and inland harvests?

Please see 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 $\geq 20\%$) 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 117,100 salmon sampled, 35,100 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 on the RMPC website at www.rmhc.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 issues). 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,

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

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)
CFHF _n	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
FRHF _n	Feather River Hatchery F all-run bay n et pen releases (San Pablo Bay)
FRHF _{nc}	Feather River Hatchery F all-run c oastal n et pen releases (Santa Cruz and Pillar Point)
FRHF _{tib}	Feather River Hatchery F all-run T iburon net pen releases (held several months)
NIMF	Nimbus Fish Hatchery F all-run in-basin releases
NIMF _n	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
MOKF _n	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 F all-run in-basin 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 (San Pablo Bay)

Sacramento River winter-run Chinook salmon release types

SacW	Sacramento River W inter-run supplementation natural production in-basin releases
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Central Valley Late-fall Chinook salmon release types

CFHLh	Coleman National Fish Hatchery L ate-fall-run h atchery releases (in-basin)
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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 FRHF_n 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,

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

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 is greater than fresh salmon in surveys that collected fish condition.

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

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

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

where N = estimated total escapement, $p_{\text{adc}|\text{fresh}}$ = proportion of fresh salmon sampled that were ad-clipped, $p_{\text{cwt}|\text{fresh,adc}}$ = proportion of ad-clipped fresh salmon that contained a CWT, and $n_{\text{valid cwt}}$ = 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:

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

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:

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

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

Data from all CWT release groups belonging to the same brood year and release type were combined and an overall release type-specific CV recovery rate, R_{type} , was calculated as:

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

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 31,951 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). About 90% of all CWT_{total} recoveries were fall-run, followed by spring-run (7%), and late-fall-run (3%) 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 (45%), age-4 (40%), 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

Almost 189,000 fall-run Chinook salmon returned to spawn in natural areas during 2014 (Table 4) and the proportion of hatchery-origin salmon in areas sampled 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). It should be noted that the Battle Creek hatchery proportion is estimated using a surrogate since there has not been a carcass survey or CWT recovery program conducted in this waterway since 2005. The hatchery contribution and CWT release type composition in the Battle Creek escapement is assumed equivalent to the hatchery fall-run return sampled at CFH (K. Niemela, 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 60,200 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 91%. 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 immediately following fall-run sampling and continued through mid-March 2015. Based solely on the run-timing above, 18,981 salmon returned to CFH during the “fall” run sampling period, and 6,673 salmon returned during the “late-fall” run period. However, based on the composition of CWT recoveries, FWS staff determined there was some overlap between runs, especially in late November through early December. As a result, the final escapement was adjusted 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 and fall spawners in most natural areas in the upper Sacramento River basin were predominantly hatchery-origin salmon with the exception of

Cottonwood and Butte creeks (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)
- Fall-run spawners Upper Sacramento River: 54% (FRHF_n)
- Fall-run spawners Clear Creek: 57% (FRHF_n)
- Fall-run spawners Battle Creek: 89% (CFHFh)
- Fall-run spawners Cottonwood Creek: 41% (CFHFh)
- Fall-run spawners Paynes Creek: 54% (CFHFh)
- Fall-run spawners Mill Creek: 45% (CFHFh, FRHF_n)
- Fall-run spawners Butte Creek: 21% (FRHF_n)
- Winter-run spawners Upper Sacramento River: 16% (SacW)
- Spring-run spawners Butte Creek: zero hatchery fish observed
- Late-fall-run spawners Upper Sacramento River: 3% (NIMF_n)

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% (FRHF_n)
- Fall/spring-run spawners Yuba River below DPD: 45% (FRHF_n)
- Spring-run returns FRH: 100% (FRHS)
- Fall-run returns FRH: 95% (FRHF_n)
- Fall/spring-run spawners Feather River: 83% (FRHF_n)

American River Basin

Fall-run returns to NIM and spawners in the American River were predominantly of hatchery-origin (Fig. 9) while “washbacks” collected on the NIM weir were primarily natural-origin salmon. 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 spawners American River: 64% (NIMF)
- Fall-run returns NIM weir: 28% (MOKF_n)

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% (MOKF_n)
- Fall-run spawners Mokelumne River: 76% (MOKF_n)

Merced River and other San Joaquin Basin Tributaries

Hatchery-origin salmon dominated fall-run returns to MER and spawners in the Merced,

Stanislaus, and Tuolumne rivers (Fig. 11). 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 264,200 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	47,848	4,764	(10%)
CFHF _n	Fall	3,394	1,965	(58%)
FRHFb	Fall	2,073	447	(22%)
FRHF _n	Fall	77,942	17,391	(22%)
FRHF _{nc}	Fall	3,385	1,128	(33%)
FRHF _{tib}	Fall	198	99	(50%)
NIMF	Fall	11,161	170	(2%)
NIMF _n	Fall	6,748	357	(5%)
MOKF	Fall	288	24	(8%)
MOKF _n	Fall	14,674	6,822	(46%)
MOKF _t	Fall	1,919	1,072	(56%)
MERF	Fall	58	15	(26%)
MERF _t	Fall	1,421	1,199	(84%)
FRHS	Spr	11,008	117	(1%)
FRHS _n	Spr	3,662	459	(13%)
SacW	Wint	430	0	
CFHLh	Late	6,840	7	(0.1%)
Total		193,049	36,036	(19%)

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% (FRHF_n)
- Feather River fall-run harvest: 72% (FRHF_n)
- 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, FRHF_n contributed the most (24%) to the total CV sport harvest, followed by CFHF_h (16%). Most of the CFHF_h 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)
CFHF _h	Fall	6,796	(16%)
CFHF _n	Fall	1,011	(2%)
FRHF _b	Fall	516	(1%)
FRHF _n	Fall	10,151	(24%)
FRHF _{nc}	Fall	523	(1%)
FRHF _{tib}	Fall	37	
NIMF	Fall	4,503	(11%)
NIMF _n	Fall	1,685	(4%)
MOKF	Fall	15	
MOKF _n	Fall	4,632	(11%)
MOKF _t	Fall	432	(1%)
MERF	Fall	0	
MERF _t	Fall	233	(1%)
FRHS	Spr	348	(1%)
FRHS _n	Spr	381	(1%)
SacW	Wint	0	
CFHLh	Late	266	(1%)
Total		31,529	(74%)

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 sibling releases in most cases.

Age-2 CV Escapement recovery rate; percent stray

R_{type}	Brdyr	Run	# recoveries per 100K released	% stray	
CFHFh	2012	Fall	19	2%	
FRHFb	2012	Fall	330	29%	
FRHFe	2012	Fall	3		
FRHFn	2012	Fall	201	28%	
FRHFnc	2012	Fall	195	31%	
FRHftib	2012	Fall	64	38%	(<10,000 released)
NIMF	2012	Fall	32	4%	
NIMFn	2012	Fall	30	7%	
MOKF	2012	Fall	32	7%	
MOKFn	2012	Fall	117	38%	
MERFt	2012	Fall	97	84%	
FRHS	2012	Spr	50		
FRHSn	2012	Spr	83	10%	
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	171	5%	
FRHFb	2011	Fall	362	15%	
FRHFe	2011	Fall	117		(<11,500 released)
FRHFn	2011	Fall	370	24%	
FRHFnc	2011	Fall	472	32%	
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	5%	

FRHS	2011	Spr	485	1%
FRHSn	2011	Spr	172	15%
SacW	2011	Wint	196	
CFHLh	2012	Late	438	0.1%

Age-4 CV Escapement recovery rate; percent stray

R _{type}	Brdyr	Run	# recoveries per 100K released	% stray
CFHFh	2010	Fall	214	15%
CFHFn	2010	Fall	254	58%
FRHFn	2010	Fall	312	19%
FRHFnc	2010	Fall	48	93%
FRH Ftib	2010	Fall	297	58%
NIMF	2010	Fall	181	2%
NIMFn	2010	Fall	184	1%
MOKF	2010	Fall	71	10%
MOKFn	2010	Fall	42	68%
MOKFt	2010	Fall	41	64%
MERF	2010	Fall	28	36%
FRHS	2010	Spr	428	1%
FRHSn	2010	Spr	73	10%
SacW	2010	Wint	15	
CFHLh	2011	Late	199	0.05%

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%	
FRH Fb	2012	Fall	127	92%	
FRH Fe	2012	Fall	0		
FRH Fn	2012	Fall	87	76%	
FRH Fnc	2012	Fall	511	84%	
FRH Ftib	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%
CFHLh	2013	Late	0	

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)
FRHFfn	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%
CFHFfn	2010	Fall	397	23%
FRHFfn	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%)
CFHFh	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	(69%)

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, FRHF_n contributed the most (26%) to the total California commercial harvest, followed by CFHF_h (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)
CFHF _h	Fall	18,111	(11%)
CFHF _n	Fall	2,647	(2%)
FRHF _b	Fall	1,087	(1%)
FRHF _n	Fall	43,028	(26%)
FRHF _{nc}	Fall	6,025	(4%)
FRHF _{tib}	Fall	156	
NIMF	Fall	6,377	(4%)
NIMF _n	Fall	5,196	(3%)
MOKF	Fall	103	
MOKF _n	Fall	7,723	(5%)
MOKF _t	Fall	1,560	(1%)
MERF	Fall	42	
MERF _t	Fall	0	
FRHS	Spr	1,215	(1%)
FRHS _n	Spr	543	(0%)
SacW	Wint	28	
CFHLh	Late	1,706	(1%)
NonCV		4,377	(3%)
Total		99,925	(59%)

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

New 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 below the northern entrance to the Yolo Bypass). 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 Fall-run barge study: trucked and released in SF bay
FRHFbg	Feather River Hatchery Fall-run barge study: barged to SF Bay and released
FRHFbr	Feather River Hatchery Fall-run barge study: released in-river (Feather River mouth)
FRHFnp	Feather River Hatchery Fall-run net pen coastal releases – Pillar Point
FRHFns	Feather River Hatchery Fall-run net pen coastal releases – Santa Cruz
FRHFkc	Feather River Hatchery Fall-run rice field study: Elkhorn Boat Ramp (Knaggs control group)
FRHFkr	Feather River Hatchery Fall-run rice field study: Yolo Bypass (Knaggs Ranch)

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	432	34%	
FRHFbg	2012	Fall	536	26%	
FRHFbr	2012	Fall	15		
FRHFnp	2012	Fall	277	32%	
FRHFns	2012	Fall	53	29%	
FRHFkc	2012	Fall	9		
FRHFkr	2012	Fall	0		
FRHFfn	2012	Fall	201	28%	
FRHftib	2012	Fall	64	38%	(<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	416	14%
FRHFbr	2011	Fall	332	4%

FRHFnp	2011	Fall	991	30%	
FRHFns	2011	Fall	73	48%	
FRHFe	2011	Fall	117		(<11,500 released)
FRHFfn	2011	Fall	370	24%	
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	93%
FRHFfn	2010	Fall	312	19%
FRHftib	2010	Fall	297	58%
CFHFfn	2010	Fall	254	58%
NIMFn	2010	Fall	184	1%
MOKFn	2010	Fall	42	68%

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		
FRHFfn	2012	Fall	87	76%	
FRHftib	2012	Fall	150	59%	(<10,000 released)
NIMFn	2012	Fall	8	81%	
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)
FRHFfn	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%
FRHFfn	2010	Fall	190	23%
FRHFtib	2010	Fall	378	25%
CFHFfn	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 net pen 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 their respective hatcheries with the exception of hatchery-origin spawners in the Merced River, which were primarily net pen 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. Hatchery CFHFh and net pen FRHFfn were the hatchery release types most often observed in these rivers and creeks.
- Fall-run escapement into Butte Creek and the Yuba River was predominantly natural-origin salmon. Hatchery-origin fish were primarily net pen FRHFfn releases.
- Fall-run escapement into the Feather River was predominantly hatchery-origin salmon, primarily net pen FRHFfn, along with spring-run FRHS and FRHSn releases.
- Fall-run escapement into the American River was predominantly hatchery-origin salmon, primarily in-basin NIMF, along with net pen NIMFn, and MOKFn releases.
- Fall-run escapement into all sampled tributaries of the San Joaquin Basin was predominantly hatchery-origin salmon, the vast majority of which were net pen MOKFn releases. Trucked

MOKFt and MERFt, along with net pen FRHF_n and NIMF_n, also contributed to hatchery-origin returns.

- Approximately three-fourths of the total 2014-2015 CV salmon escapement (all run-types) were hatchery-origin fish. Net pen FRHF_n and hatchery CFHF_h releases contributed the most to total escapement. Trucked MERFt and MOKFt, along with net pen CFHF_n and MOKF_n releases, had the highest stray proportions.
- For age-2 fall-run salmon, experimental barge study FRHF_b, net pen FRHF_n and coastal net pen FRHF_{nc} releases had the highest CV recovery rates for their cohort. Trucked MERFt and net pen MOKF_n had the highest stray proportions observed for age-2 releases.
- For age-3 fall-run salmon, coastal net pen FRHF_{nc}, net pen FRHF_n, and experimental barge study FRHF_b releases had the highest CV recovery rates for their cohort. Trucked MOKFt and net pen MOKF_n had the highest stray proportions observed for age-3 release types.
- For age-4 fall-run salmon, net pen FRHF_n and CFHF_n had the highest CV recovery rates for their cohort. Coastal net pen FRHF_{nc}, net pen MOKF_n and CFHF_n, and trucked MOKFt releases had the highest stray proportions observed for age-4 release types. Tiburon net pen FRHF_{tib} releases also had high recovery and stray rates but only 56,000 fish were released.
- Approximately three-fourths and one half of the inland and ocean harvest, respectively, were hatchery-origin fish. Net pen FRHF_n and hatchery CFHF_h releases contributed the most to sport (inland and ocean) and commercial salmon fisheries.
- Coastal net pen FRHF_{nc} releases had the highest ocean recovery rates for all release types and ages. Their recovery rate was several times greater than that for other 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 coastal net pen Pillar Point FRHF_{np} and Santa Cruz FRHF_{ns} releases were very similar.
- Pillar Point coastal net pen FRHF_{np} releases had highest CV recovery rates for all age-2 and age-3 net pen releases whereas relatively few coastal net pen releases from Santa Cruz FRHF_{ns} returned to the CV. The majority of Pillar Point FRHF_{np} recoveries occurred in the Feather River Basin whereas most of the few Santa Cruz FRHF_{ns} recovered in the CV strayed into the upper Sacramento River Basin.
- Age-2 salmon barged down the Sacramento River (FRHF_{bg}) had the highest CV recovery rate in their cohort with moderate straying. Fish released directly into San Francisco Bay (FRHF_{bb}) strayed the most among the three barge study release types as both age-2 and age-3 fish but were also recovered at higher rates in the ocean fisheries. Age-2 and age-3 salmon released in the Sacramento River at the mouth of the Feather River (FRHF_{br}) had the lowest CV recovery rate among the study releases but seldom strayed. The ocean recovery rate for all barge study releases, with the exception of age-2 FRHF_{br} releases, was generally higher than other bay net pen releases for the same cohort.

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 spans in the 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.

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LIST OF ACRONYMS AND ABBREVIATIONS

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

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Table 1a. Estimation and sampling methods used for the 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
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 Hatchery (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. (page 1 of 2)

Sampling Location	Estimation and Sampling Methods	Agency
<u>Natural Spawners</u>		
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 ^{ai} 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. Approximately 1% of total escapement sampled; opportunistic collection of CWTs. Grilse cutoff: 640 mm females, 670 mm males.	CDFW
Battle Creek Fall	Video weir count (Aug 20 - Nov 21) in lower creek used to determine total fall escapement. Natural fall escapement into Battle Creek calculated by subtracting CFH fall return from total run. Surrogate CWTs based on hatchery proportion and CWT composition of CFH fall return. Grilse cutoff: 700 mm fall.	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

Table 1b. Estimation and sampling methods used for the 2014 CV Chinook natural escapement. (page 2 of 2)

Sampling Location	Estimation and Sampling Methods	Agency
<u>Natural Spawners cont.</u>		
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. Approximately 3% of total escapement sampled; opportunistic collection of CWTs. Grilse cutoff: 670 mm females, 710 mm males.	CDFW
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
Nimbus Weir Fall	Direct count. Installed Aug 13 to force returning salmon into Nimbus Hatchery; salmon that migrated above prior to installation trapped between Nimbus Dam (located 1/4 mile upstream) and weir. All dead fish that washed back down river ("washbacks") onto weir examined for fin-clips, tags, marks. All ad-clipped fish sampled and heads collected for CWT recovery. Grilse cutoff: 700 mm.	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 river sport harvest.

Sampling Location	Survey Design and Open Dates	Agency
<u>Sport Harvest</u>		
	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. Grilse cutoff: 650 mm fall, 600 mm late-fall.	
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. Grilse cutoff: 650 mm.	
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. Grilse cutoff: 650 mm.	
Lower Sacramento River Fall	Open Jul 16 - Dec 16 from the Highway 113 bridge to the Carquinez Bridge. Grilse cutoff: 650 mm.	
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. Grilse cutoff: 700 mm.	
	Bag and Size Limit	
All Areas	2 Chinook salmon per day; no minimum size limit.	

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

Major Port Area	Sport Fishery			Commercial Fishery			
	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	<u>30</u> 88	
San Francisco	Apr 5 - Jun 30	24" TL	87	May 1 - Jun 30	27" TL	61	
	Jul 1 - Nov 9	20" TL	<u>132</u>	Jul 15 - Aug 29	27" TL	46	
			219	Sep 1 - 30	26" TL	30	
				Oct 1 - 15 ^{c/}	26" TL	<u>11</u> 148	
Monterey ^{d/}	Apr 5 - Oct 5	24" TL	184	May 1 - Jun 30	27" TL	61	
				Jul 15 - Aug 13	27" TL	<u>30</u> 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. (page 1 of 2)

Age 2 CWT releases

Release type*	Brood year	Hatchery / wild	Stock origin	Run type	CWT codes	# CWT tagged	Total fish released	% CWT	Release strategy	Release locations / notes
FRHS	2012	FRH	Fea R	Spr	2	1,106,679	1,125,897	98%	In-basin	Feather River (Boyd's Pump Ramp & Gridley 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)
FRHFh	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 (Boyd's 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
FRHFh	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. (Page 2 of 2)

Age 4 CWT releases

Release type*	Brood year	Hatchery	Stock origin	Run type	CWT codes	# CWT tagged	Total fish released	% CWT	Release strategy	Release locations / notes
FRHS	2010	FRH	Fea R	Spr	2	1,170,340	1,181,710	99%	In-basin	Feather River (Boyd's 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
CFHFh	2010	CFH	Sac R	Fall	3	334,756	1,339,659	25%	Bay pens	Mare Island net pens
FRHFh	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
FRHFh	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)

CWT release types:*Sacramento River Basin Fall Chinook CWT release types**

CFHFh	Coleman National Fish Hatchery fall hatchery releases
CFHFh	Coleman National Fish Hatchery fall net pen releases
FRHFb	Feather River Hatchery fall barge study releases
FRHFc	Feather River Hatchery fall experimental releases
FRHFh	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

Sacramento River Basin Winter Chinook CWT release types

SacW	Livingston Stone Hatchery winter in-basin releases
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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
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Table 4. Central Valley hatchery and natural escapement estimates, sport harvest, and sample data, 2014.

Central Valley Survey		Run	Escapement	Total	Chinook Sampled ^{a/}	Observed	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	2,776	2,637	2,637	2,594	100%	100%	100%	1.00
Feather River Hatchery Trap (pre-season)		Spring	23	23	23	16	16	16	100%	100%	100%	1.00
Coleman National Fish Hatchery		Fall	18,840	18,840	18,840	4,339	4,323	4,218	100%	100%	100%	1.01 ^{b/}
Feather River Hatchery		Fall	23,420	23,420	23,420	9,160	9,160	8,984	100%	100%	100%	1.00
Nimbus Fish Hatchery		Fall	8,343	8,343	8,343	2,068	2,068	1,975	100%	100%	98%	1.02
Mokelumne River Hatchery		Fall	8,820	8,820	8,820	2,126	2,126	2,085	100%	100%	100%	1.00
Merced River Hatchery		Fall	811	811	811	213	213	210	100%	100%	99%	1.01
Coleman National Fish Hatchery		Late-fall ^{c/}	6,814	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	137	130	27	26	100%	100%	100%	4.81
Total Hatchery Escapement			69,984	69,984	69,984	27,389	27,264	26,677				
Fall-run only			60,234	60,234	60,234	17,906	17,890	17,472				
Natural Area Escapement												
Upper Sacramento River (above RBDD)		Winter	2,627	2,627	1,293	195	191	167	49%	98%	100%	2.45 ^{d/}
Butte Creek		Spring	5,083	5,083	2,481	0	0	0	49%	-	-	-
Upper Sacramento River (above RBDD)		Fall	29,885	29,885	2,077	248	248	225	7%	100%	100%	22.09 ^{d/}
Clear Creek		Fall	15,794	15,794	988	172	172	165	6%	100%	99%	15.68 ^{d/}
Cow Creek		Fall	3,535	3,535	video	Opportunistic sampling of CWTs		106 ^{e/}	1%	-	-	-
Battle Creek		Fall	26,575	26,575	video	No biodata collected		11	-	-	-	-
Cottonwood Creek		Fall	1,940	1,940	108	11	11	11	6%	100%	100%	17.96 ^{f/}
Paynes Creek		Fall	72	72	66	9	8	8	92%	89%	100%	1.23
Mill Creek		Fall	2,488	2,488	147	26	26	23	6%	100%	100%	13.37 ^{f/}
Deer Creek		Fall	849	849	video	Opportunistic sampling of CWTs		40	3%	-	-	-
Butte Creek		Fall	1,412	1,412	717	44	44	40	51%	100%	100%	1.97
Feather River		Fall	60,721	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	9,135	8,886	1,393	58	53	97%	4%	100%	24.69 ^{g/}
Yuba River below DPD		Fall	2,569	2,569	382	59	59	53	15%	100%	100%	6.73 ^{d/}
American River		Fall	24,503	24,503	16,617	2,333	2,196	1,993	68%	94%	99%	2.24 ^{d/}
Nimbus Fish Hatchery Weir		Fall	1,972	1,972	1,972	178	178	159	100%	100%	98%	1.02
Mokelumne River		Fall	3,297	3,297	3,297	764	65	54	100%	9%	100%	11.75 ^{g/}
Stanislaus River		Fall	3,064	3,064	551	102	102	97	18%	100%	98%	5.49 ^{h/}
Tuolumne River		Fall	206	206	107	7	7	7	52%	100%	100%	5.35 ^{d/}
Merced River		Fall	860	860	92	17	17	16	11%	100%	100%	9.35 ^{d/}
Upper Sacramento River (above RBDD)		Late-fall ^{c/}	2,033	2,033	199	3	3	2	10%	100%	100%	10.22
Total Natural Area Escapement			198,620	198,620	44,964	7,285	5,109	4,813				
Fall-run only			184,493	184,493	40,991	7,087	4,915	4,644				
CV Sport Harvest												
Sacramento River (above Feather River)		Fall	13,322	13,322	1,045	204	202	201	8%	99%	100%	12.94
Sacramento River (below Feather River)		Fall	6,506	6,506	264	52	52	52	4%	100%	100%	24.64
Feather River		Fall	8,404	8,404	243	65	62	62	3%	95%	100%	36.26
American River		Fall	12,520	12,520	482	118	118	116	4%	100%	100%	25.98
Mokelumne River		Fall	1,380	1,380	92	23	23	23	7%	100%	100%	15.00
Sacramento River (above Feather River)		Late-fall ^{c/}	281	281	24	9	7	7	9%	78%	100%	15.05
Total Sport Harvest			42,413	42,413	2,150	471	464	461				
Total Sampled			117,098	117,098	35,145	32,837	31,951					

a/ Number of Chinook salmon sampled and visually checked for a clipped adipose fin or electronically scanned to check for the presence of a CWT.
b/ 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 natural escapement estimated using Battle Creek video count minus fall return to Coleman National Fish Hatchery (CFH). Surrogate CWTs based on CFH hatchery proportion and CWT recoveries.
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 DPD).
h/ Stanislaus natural escapement and sample expansion factor based on fresh fish only and expanded to all valid CWTs (e.g., 23 CWTs recovered from washbacks on Stanislaus Weir).

Table 5. Total harvest and sample data for 2014 Ocean Salmon Sport and Commercial Fisheries by major port area.

Fishery - Port Area	Ocean Harvest	Chinook Sampled ^{a/}	Observed Ad-Clips	Heads Processed	Valid CWTs	Sample rate (fe)	Ad-clips processed (fa)	Valid CWTs (fd)	CWT F_{sample}
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	<u>14,020</u>	<u>3,445</u>	<u>1,143</u>	<u>1,135</u>	<u>1,101</u>	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	<u>8,308</u>	<u>3,162</u>	<u>829</u>	<u>828</u>	<u>799</u>	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	<u>191,914</u>	<u>73,885</u>	<u>12,003</u>	<u>11,999</u>	<u>11,597</u>	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 scanned to check for the presence of a CWT.

Table 6. Raw and expanded Chinook CWT recoveries in the Central Valley by run type and brood year during 2014.

<u>Fall-run</u>		2013	2012	2011	2010	2009	Total CV CWTs	Total CV %
Age		1	2	3	4	5		
Raw CWT Recoveries		1 (<1%)	4,142 (22%)	8,429 (45%)	6,065 (33%)	4 (<1%)	18,641	58%
Expanded CWT _{total}		1 (<1%)	29,892 (15%)	91,215 (45%)	80,528 (40%)	21 (<1%)	201,657	90%
<u>Spring-run</u>			2012	2011	2010	2009	Total CV CWTs	Total CV %
Age			2 ^{a/}	3	4 ^{a/}	5		
Raw CWT Recoveries			904 (14%)	3,152 (48%)	2,470 (38%)	1 (<1%)	6,527	20%
Expanded CWT _{total}			1,666 (11%)	7,672 (49%)	6,212 (40%)	1 (<1%)	15,551	7%
<u>Late-Fall-run</u>			2013	2012	2011	2010	Total CV CWTs	Total CV %
Age			2	3	4	5		
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	3%
<u>Winter-run</u>			2012	2011	2010	2009	Total CV CWTs	Total CV %
Age			2	3	4	5		
Raw CWT Recoveries			12 (7%)	148 (89%)	7 (4%)		167	0.5%
Expanded CWT _{total}			31 (7%)	381 (88%)	18 (4%)		430	0.2%
<u>All Runs</u>			2012	2011	2010	2009	Total CV CWTs	Total CV %
Age			2 ^{a/}	3	4 ^{a/}	5		
Raw CWT Recoveries			5,187 (16%)	16,229 (51%)	10,512 (33%)	22 (<1%)	31,951	100%
CV Expanded CWT _{total}			31,721 (14%)	104,111 (46%)	88,870 (40%)	43 (<1%)	224,746	100%

a/ Includes one 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.

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

<u>Fall-run</u>		2012	2011	2010	2009	Total Ocean CWTs	Total Ocean%
Age		2	3	4	5		
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%
<u>Spring-run</u>		2012	2011	2010	2009	Total Ocean CWTs	Total Ocean%
Age		2	3	4	5		
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%
<u>Late-Fall-run</u>		2013	2012	2011	2010	Total Ocean CWTs	Total Ocean%
Age		2	3	4	5		
Raw CWT Recoveries			23 (16%)	115 (82%)	2 (1%)	140	1%
Expanded CWT _{total}			60 (17%)	287 (81%)	7	354	0%
<u>Non-CV stocks</u>		2012	2011	2010	2009	Total Ocean CWTs	Total Ocean%
Age		2	3	4	5		
Raw CWT Recoveries		6 (<1%)	765 (23%)	2,037 (62%)	464 (14%)	3,272	26%
Expanded CWT _{total}		163 (<1%)	13,894 (44%)	15,291 (49%)	1,953 (6%)	31,301	30%
<u>All Runs</u>		2012	2011	2010	2009	Total Ocean CWTs	Total Ocean%
Age		2	3	4	5		
Raw CWT Recoveries		62 (<1%)	7,624 (61%)	4,361 (35%)	475 (4%)	12,522	100%
Expanded CWT _{total}		503 (<1%)	66,917 (64%)	35,701 (34%)	2,001 (2%)	105,122	100%
CV Expanded CWT _{total} (proportion CV stocks)		340 (68%)	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.

Location		Run	SacW	CFH		FRH				NIM			MOK		MER		Total %		Total		
				CFHLh	CFHFh	FRHS	FRHSn	FRHFb	FRHFh	FRHFnc	FRHFtb	NIMF	NIMFn	MOKF	MOKFn	MERF	MERFt	Hatchery	Natural	Run	
<u>Hatchery Spawners</u>																					
	Feather River Hatchery	Spring				81%	12%	-	7%									100%	0%	2,776	
	Feather River Hatchery pre-season	Spring				43%	22%		4%									70%	30%	23	
	Coleman National Fish Hatchery	Fall		85%	1%	-	-	0%	3%	0%	-	-	-	-	-	0%	0%	89%	11%	18,840	
	Feather River Hatchery	Fall		-	0%	10%	4%	3%	74%	3%	0%	-	-	-	0%	21%	3%	95%	5%	23,420	
	Nimbus Fish Hatchery	Fall			1%			0%	3%	0%		33%	24%	0%	21%	1%	87%	13%	8,343		
	Mokelumne River Hatchery	Fall			0%			0%	3%	1%		-	1%	3%	67%	7%	4%	86%	14%	8,820	
	Merced River Hatchery	Fall			0%				6%	2%			1%		55%	8%	2%	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			-	27%	0%	4%	2%	1%	31%	0%	5%	4%	0%	14%	2%	-	91%	9%	60,234	
<u>Natural Spawners</u>																					
	Upper Sacramento River	Winter	16%																	2,627	
	Butte Creek	Spring																16%	84%	5,083	
	Upper Sacramento River	Fall		15%	4%	0%	1%	1%	30%	2%	0%							54%	46%	29,885	
	Clear Creek	Fall		21%	1%		1%	1%	30%	1%		0%						57%	43%	15,794	
	Battle Creek	Fall ^{c/}		85%	1%	-	-	0%	3%	0%	-	-	-			0%		89%	11%	26,575	
	Cottonwood Creek	Fall		37%					4%									41%	59%	1,940	
	Paynes Creek	Fall		54%														54%	46%	72	
	Mill Creek	Fall		19%						19%	2%							45%	55%	2,488	
	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 River above DPD	Fall			5%	0%		1%	36%	2%		1%	1%		2%	1%		49%	51%	9,135	
	Yuba River below DPD	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	
	Nimbus Fish Hatchery Weir	Fall			1%	0%	0%	0%	4%	0%		8%	2%		9%	0%	4%	28%	72%	1,972	
	Mokelumne River	Fall							6%					1%	59%	6%	5%	76%	24%	3,297	
	Stanislaus River	Fall			1%			6%	6%	2%				0%	42%	5%	0%	65%	35%	3,064	
	Tuolumne River	Fall											21%	0%	42%		3%	65%	35%	206	
	Merced River	Fall							9%	1%					31%	9%	3%	58%	42%	860	
	Upper Sacramento River	Late-fall ^{b/}		0%								2%						3%	97%	2,033	
	Natural Area Fall-run Total^{d/}				17%	2%	3%	1%	32%	1%	0%	5%	2%	-	4%	1%	-	70%	30%	184,493	
	In-basin CWT _{total}	All	0%	3%	19%	5%	1%	1%	27%	1%	-	5%	3%	0%	3%	0%	-	69%	31%	228,030	
	Stray CWT _{total}	All		-	13%	0%	1%	1%	48%	3%	0%	0%	1%	0%	19%	3%	-	100%		36,190	
	Total CV Spawners		0%	3%	18%	1%	4%	1%	29%	1%	0%	4%	3%	0%	6%	1%	-	73%	27%	264,220	
<u>CV Sport Harvest</u>																					
	Upper Sacramento River	Fall			50%		1%	1%	16%	1%								71%	29%	13,322	
	Lower Sacramento River	Fall		2%	2%			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%	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).

d/ Natural Area Fall-run total does not include unsampled escapement into Cow Creek (n=3,535) and Deer Creek (n=849).

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 _{sample}	Total CWT Production	$\sum_{i=1}^m CWT_{i,valid,i}$	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 _{sample}	Total CWT Production	$\sum_{i=1}^m CWT_{i,valid,i}$	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 escapement based on CWT segregation and sample expansion factors F _{sample} 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 _{sample}	Total CWT Production	$\sum_{i=1}^m CWT_{i,valid,i}$	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 _{sample}	Total CWT Production	$\sum_{i=1}^m CWT_{i,valid,i}$	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.

Location	Run	SacW	CFH			ERH			NIM			MOK			MER		nonCV	Total CWT _{total}		Total Run	
			CFHLh	CFHFh	CFHFn	FRHS	FRHSn	FRHFb	FRHFh	FRHFnc	FRHFib	NIMF	NIMFn	MOKF	MOKFn	MOKFt		MERF	MERFt		Hatchery
<u>Hatchery Spawners</u>																					
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		16,818	2,022	18,840
Feather River Hatchery	Fall		4	76		2,360	930	660	17,288	723	30	4	10	1	40	4	1	42	22,174	1,246	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
Mokelumne River Hatchery	Fall		6	8	16			10	245	48		4	92	240	5,907	658	2	357	7,595	1,225	8,820
Merced River Hatchery	Fall		1		4				45	14		12			447	65	14	178	781	30	811
Coleman National Fish Hatchery	Late-fall ^{av}		6,707															6,707	107	6,814	
Coleman Hatchery Fish Trap	Late-fall ^{av}		116															116	21	137	
Total Hatchery Fall Run			7	15,973	294	2,361	932	699	18,374	857	34	2,802	2,114	246	8,171	986	17	723	54,595	5,639	60,234
<u>Natural Spawners</u>																					
Upper Sacramento River	Winter	430																			
Butte Creek	Spring																				
Upper Sacramento River	Fall		4,608	1,060		112	269	245	9,064	576	89								16,123	13,762	29,885
Clear Creek	Fall		3,334	188			175	127	4,799	189		63			63				8,938	6,856	15,794
Battle Creek	Fall ^{c/}		22,515	216		1	3	17	817	82	6		6		11		50		23,724	2,851	26,575
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
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				50,420	10,301	60,721
Yuba River above DPD	Fall			494		25		50	3,287	200		99			198	100			4,452	4,683	9,135
Yuba River below DPD	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
Nimbus Fish Hatchery Weir	Fall		12			3	8	8	70	5		149	45		160	8	85		554	1,418	1,972
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 ^{av}		10									41							51	1,982	2,033
Natural Area Fall-run Total^{d/}			31,875	3,100		6,386	2,391	1,373	59,385	2,528	164	8,359	4,593	42	6,503	933	41	698	128,520	55,973	184,493
In-basin CWT _{total}	All	430	6,833	43,084	1,429	10,891	3,203	1,626	60,551	2,257	99	10,991	6,391	264	7,852	847	43	222	157,013	71,017	228,030
Stray CWT _{total}	All		7	4,764	1,965	117	459	447	17,391	1,128	99	170	357	24	6,822	1,072	15	1,199	36,190		36,190
Total CV Spawners		430	6,840	47,848	3,394	11,008	3,662	2,073	77,942	3,385	198	11,161	6,748	288	14,674	1,919	58	1,421	193,203	71,017	264,220
	%stray	0%	0.1%	10%	58%	1%	13%	22%	22%	33%	50%	2%	5%	8%	46%	56%	26%	84%	19%		14%
<u>CV Sport Harvest</u>																					
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 ^{av}		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, 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).

d/ Natural Area Fall-run total does not include unsampled escapement into Cow Creek (n=3,535) and Deer Creek (n=849).

Table 12. CWT recovery rate (recoveries per 100,000 CWTs released) by release type, brood year and recovery location in 2014. (page 2 of 2)

Age 4 CWT recoveries

Release type	Brood year	Run type	# CWT tagged	Central Valley total recoveries (CWT _{samp}) by basin												CV CWT _{samp} totals			% CV Stray	Ocean 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	2	66		4,945						4,945	69	5,013	1%	274	422	6	428	23		
FRHSn	2010	Spr	1,136,690		66	16	750	2					750	84	834	10%	68	66	7	73	6		
CFHFh	2010	Fall	2,835,420	4,202	972	851	38		2	2			5,174	894	6,068	15%	3,221	182	32	214	114		
CFHFh	2010	Fall	334,756	92	265	78	180	157	66	4	1	5	357	491	848	58%	1,329	107	147	254	397		
FRHFh	2010	Fall	2,554,115	83	928	392	6,136	346	38	32	1		6,481	1,472	7,954	19%	4,844	254	58	312	190		
FRHFnc	2010	Fall	185,985	2	66	16	6						6	84	90	93%	1,199	3	45	48	644		
FRHFtib	2010	Fall	56,030	7	88		71						71	96	166	58%	212	126	171	297	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	2			2		668	5			668	9	677	1%	947	181	3	184	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	0.05%	1,243	199	0.1	199	120		
Total			12,631,040	6,447	2,479	1,385	12,143	559	2,933	329	30	38	22,645	3,698	26,343	14%	16,340	1843	544	2387	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				3	0.1		0.1	0.2
CFHFh	2009	Fall	2,541,142														3				0.1
FRHFh	2009	Fall	2,367,209														8				0.3
NIMFn	2009	Fall	347,527						4				4		4		6	1	1	1	2
MOKF	2009	Fall	99,048														5				5
MOKFn	2009	Fall	2,015,730						2	1			1	2	3		23	0.1	0.1	0.1	1
CFHLh	2010	Late	992,047	21									21		21		23	2	2	2	2

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

b/ Ocean recoveries of SacW 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
 CFHFh Coleman National Fish Hatchery fall bay net pen releases
 FRHFb Feather River Hatchery fall barge study releases
 FRHFh Feather River Hatchery fall experimental (includes rice field releases @ Knaggs Ranch)
 FRHFnc 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
 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.

SacW		CFH			FRH				NFH			MOK			MER		nonCV	Total CV	Total %		Total Harvest
		CFHLh	CFHFh	CFHFt	FRHS	FRHSn	FRHFb	FRHFnc	FRHFt	NIMF	NIMFn	MOKF	MOKFn	MOKFt	MERF	MERFt			Hatchery	Natural	
California Sport Harvest																					
Eureka/Crescent City																					
May	0%	12%	3%	1%	0%	0%	23%	2%	0%	3%	2%	4%	1%	0%	9%	50%	41%	3,596			
Jun	1%	9%	1%	1%	1%	1%	22%	3%	0%	4%	3%	5%	1%	0%	6%	51%	44%	5,279			
Jul	0%	15%	1%	1%	1%	1%	30%	3%	0%	4%	4%	5%	0%	0%	6%	65%	29%	4,443			
Aug	0%	9%	1%	0%	1%	1%	44%	5%	2%	3%	3%	10%	6%	1%	1%	77%	22%	2,206			
Sep				2%	1%	1%	21%	4%	24%			18%				75%	25%	303			
Total	0%	11%	2%	1%	1%	1%	28%	3%	0%	4%	3%	6%	1%	-	0%	59%	36%	15,827 (21%)			
Fort Bragg																					
Apr		7%		2%	1%	1%	25%	4%			2%	3%			1%	46%	53%	714			
May	1%	22%	5%	3%			33%	5%		4%		5%			3%	77%	20%	630			
Jun	1%	5%	1%	1%	1%	1%	21%	4%		5%	3%	3%	3%	0%	2%	48%	50%	1,358			
Jul	1%	13%	2%	0%	0%	1%	33%	6%	0%	4%	4%	5%	1%	1%	0%	72%	27%	9,035			
Aug	2%	8%		1%	1%		45%	6%		7%	9%	17%				96%	4%	696			
Sep	3%						14%	3%				28%				48%	52%	107			
Total	1%	12%	2%	1%	0%	1%	32%	6%	-	4%	3%	5%	1%	-	0%	70%	30%	12,540 (17%)			
San Francisco																					
Apr	1%	9%	3%	2%	1%	0%	29%	5%	0%	3%	4%	5%	3%		0%	64%	36%	1,854			
May	2%	10%	2%	2%	1%	0%	25%	5%	0%	2%	4%	2%	2%		2%	57%	42%	2,318			
Jun	0%	15%	2%	1%	1%	3%	28%	6%		3%	2%	4%	2%		2%	68%	30%	559			
Jul	0%	16%	1%	0%	0%	2%	30%	9%	0%	1%	1%	3%		1%		65%	35%	5,587			
Aug	0%	12%	2%	0%	0%	2%	33%	11%	0%	2%	2%	6%	0%	1%		72%	28%	12,679			
Sep	0%	5%	0%	0%	0%	1%	25%	10%	-	6%	3%	13%	1%	1%	0%	68%	32%	6,266			
Oct	0%			0%	0%	0%	7%	2%	0%	9%	11%	23%	5%	3%		62%	38%	3,065			
Nov	23%			2%	2%		3%	3%		7%		7%				44%	56%	125			
Total	0%	10%	1%	0%	0%	1%	28%	9%	0%	3%	3%	8%	1%	-	0%	67%	32%	32,453 (43%)			
Monterey																					
Apr	0%	12%	1%	6%	2%	1%	35%	7%	-	2%	1%	3%			1%	72%	26%	11,356			
May	2%	6%		3%	2%	3%	56%	5%		4%	2%	2%				86%	14%	964			
Jun	1%	21%			0%	1%	31%	13%	0%	2%	2%					74%	26%	782			
Jul	2%	13%			1%	4%	40%	21%		7%		3%				93%	7%	613			
Aug	3%				3%		40%	38%								83%	17%	267			
Sep								68%								68%	32%	34			
Oct							100%									100%		4			
Total	0%	12%	1%	5%	2%	1%	37%	9%	0%	2%	1%	3%		-	1%	74%	25%	14,020 (19%)			
California Total Sport Harvest																					
0%	1%	11%	1%	1%	1%	1%	30%	7%	0%	3%	3%	6%	1%	-	1%	67%	31%	74,840			
Oregon Total Sport Harvest																					
	0%	6%	1%	1%	1%	0%	16%	3%	0%	5%	2%	5%	1%	-	0%	42%	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.

	SacW		CFH		FRH				NFH		MOK		MER		Total CV	Total CWT _{total}		Total Harvest				
			CFHLh	CFHFh	FRHS	FRHSn	FRHFb	FRHFh	FRHFnc	FRHFtub	NIMF	NIMFn	MOKF	MOKFn		MOKFt	MERF		MERFt	Hatchery	Natural	
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	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		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		88	49			5	1,188	1,193	661	1,854
May		38	222	37	42	23	9	587	120	5	36	94		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		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		805	59		63	8	4,237	4,245	2,021	6,266
Oct	3	66			3	6	6	217	49	6	262	334		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		381			4	159	8,197	8,356	3,000	11,356
May	16	5	61	31	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.

SacW		CFH			FRH				NFH			MOK			MER		nonCV	Total CV	Total %		Total Harvest
		CFHLh	CFHFh	CFHFt	FRHS	FRHSn	FRHFb	FRHFnc	FRHFib	NIMF	NIMFn	MOKF	MOKFn	MOKFt	MERF	MERFt			Hatchery	Natural	
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%	5%	4%	0%	5%	1%	-		2%	66%	68%	32%	45,563
Aug	0%	2%	13%	3%	0%	0%	1%	42%	4%	4%	4%	0%	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%	4%	3%	0%	4%	1%	-		3.2%	59%	62%	38%	76,931 (46%)
San Francisco																					
May		1%	8%	2%	2%	1%	0%	17%	3%	2%	2%	0%	2%	0%	-		4%	41%	44%	56%	30,605
Jun		1%	8%	1%	1%	0%	1%	19%	3%	2%	3%	0%	3%	1%	-		4%	42%	47%	53%	14,917
Jul		1%	16%	2%	1%	0%	1%	29%	4%	3%	4%	0%	5%	0%	0%		1%	67%	68%	32%	6,994
Aug	-	0%	17%	3%	-	0%	1%	38%	4%	3%	1%	0%	3%	0%	-		-	71%	71%	29%	15,879
Sep	-	0%	6%	1%	-	-	1%	31%	3%	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%	4%	3%	0%	5%	1%	-		2%	54%	56%	44%	82,424 (49%)
Monterey																					
May		1%	14%	1%	2%	1%	1%	31%	6%	2%	1%	0%	5%				0%	65%	66%	34%	4,341
Jun		1%	14%	3%	0%	0%	0%	33%	7%	1%	2%	0%	3%	1%	0%		1%	66%	67%	33%	1,538
Jul	1%	4%	13%	1%	0%	0%	0%	28%	9%	5%	3%		7%	1%				74%	74%	26%	2,011
Aug	1%	2%			1%	0%		5%	8%	3%	3%		5%					24%	24%	76%	418
Total	0%	2%	13%	1%	1%	0%	1%	29%	7%	3%	2%	-	5%	0%	-		0%	66%	66%	34%	8,308 (9%)
California Total Commercial Harvest																					
-		1%	11%	2%	1%	0%	1%	26%	4%	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.

SacW		CFH			FRH				NFH			MOK			MER		Total CV	Total CWT _{total}		Total Harvest	
		CFHLh	CFHFh	CFHFt	FRHS	FRHSn	FRHFb	FRHFnc	FRHFtib	NIMF	NIMFn	MOKF	MOKFn	MOKFt	MERF	MERFt		Hatchery	Natural		
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										Ocean CWT _{samp}
				Bat Cr	Up Sac	Nat crks ^{a/}	Fea	Yub	Ame	Mok	Mer	SJ	In-basin	% CV Stray
FRHFbb	2012	Fall	97,760	10	66	63	271	7	5	1			277	34%
FRHFbg	2012	Fall	99,192	5	110	16	360	31	6	3			392	26%
FRHFbr	2012	Fall	96,832				14						14	
FRHFnp	2012	Fall	412,360	75	44	124	524	258	10	45	23	38	782	32%
FRHFns	2012	Fall	236,800	5	22		90		2	2		5	90	29%
FRHFkc	2012	Fall	46,492				4						4	
FRHFkr	2012	Fall	92,396											
FRHFfn	2012	Fall	1,453,105	150	265	244	1,989	117	52	47	29	27	2,106	28%
FRHFtb	2012	Fall	9,918	2			4						4	
NIMFn	2012	Fall	182,413						50	4			50	7%
MOKFn	2012	Fall	1,275,158	5	4	4	16	7	284	935	99	148	935	38%
Age 3 CWT recoveries														
Release type	Brood year	Run type	# CWT tagged	Central Valley total recoveries (CWT_{samp}) by basin										Ocean CWT _{samp}
				Bat Cr	Up Sac	Nat crks ^{a/}	Fea	Yub	Ame	Mok	Mer	SJ	In-basin	% CV Stray
FRHFbb	2011	Fall	98,241		66	16	243		4	2			243	27%
FRHFbg	2011	Fall	98,947	5	31	321	31		19	4			352	14%
FRHFbr	2011	Fall	99,901	10		2	320						320	4%
FRHFnp	2011	Fall	185,303	46	376	94	1,271	7	41	1			1,278	30%
FRHFns	2011	Fall	240,887	10	66		92		2			5	92	48%
FRHFe	2011	Fall	11,449				13						13	
FRHFfn	2011	Fall	2,293,211	114	1,060	747	5,885	568	62	30		22	6,453	24%
FRHFtb	2011	Fall	9,933				17	7					24	
NIMFn	2011	Fall	328,073		10		12	25	829	14	3	11	829	8%
MOKFn	2011	Fall	1,487,132		4	4	17	25	503	866	76	181	866	48%
Age 4 CWT recoveries														
Release type	Brood year	Run type	# CWT tagged	Central Valley total recoveries (CWT_{samp}) by basin										Ocean CWT _{samp}
				Bat Cr	Up Sac	Nat crks ^{a/}	Fea	Yub	Ame	Mok	Mer	SJ	In-basin	% CV Stray
FRHFns	2010	Fall	185,985	2	66	16	6						6	93%
FRHFfn	2010	Fall	2,554,115	83	928	392	6,136	346	38	32	1		6,481	19%
FRHFtb	2010	Fall	56,030	7	88		71						71	58%
CFHFfn	2010	Fall	334,756	92	265	78	180	157	66	4	1	5	357	58%
NIMFn	2010	Fall	368,363	2			2		668	5			668	1%
MOKFn	2010	Fall	1,126,781		18	1	1	31	261	150	2	11	150	68%

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

Central Valley Chinook Experimental and Net Pen release types

CFHFfn	Coleman National Fish Hatchery fall bay net pen releases	FRHFkc	Feather River Hatchery fall rice field study: Elkhorn boat ramp Sac River (control group)
FRHFbb	Feather River Hatchery fall barge study: trucked & released in SF Bay (@ Ft Baker)	FRHFkr	Feather River Hatchery fall rice field study: Yolo Bypass Knaggs Ranch rice field
FRHFbg	Feather River Hatchery fall barge study: barged to SF Bay and released	FRHFfn	Feather River Hatchery fall bay net pen releases
FRHFbr	Feather River Hatchery fall barge study: in-river releases	FRHFtb	Feather River Hatchery fall Tiburon net pen releases
FRHFnp	Feather River Hatchery fall coastal net pen releases - Pillar Point	NIMFn	Nimbus Hatchery fall bay net pens releases
FRHFns	Feather River Hatchery fall coastal net pen releases - Santa Cruz	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 (both Wickland & Mare Island)
18	FRHFn	
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

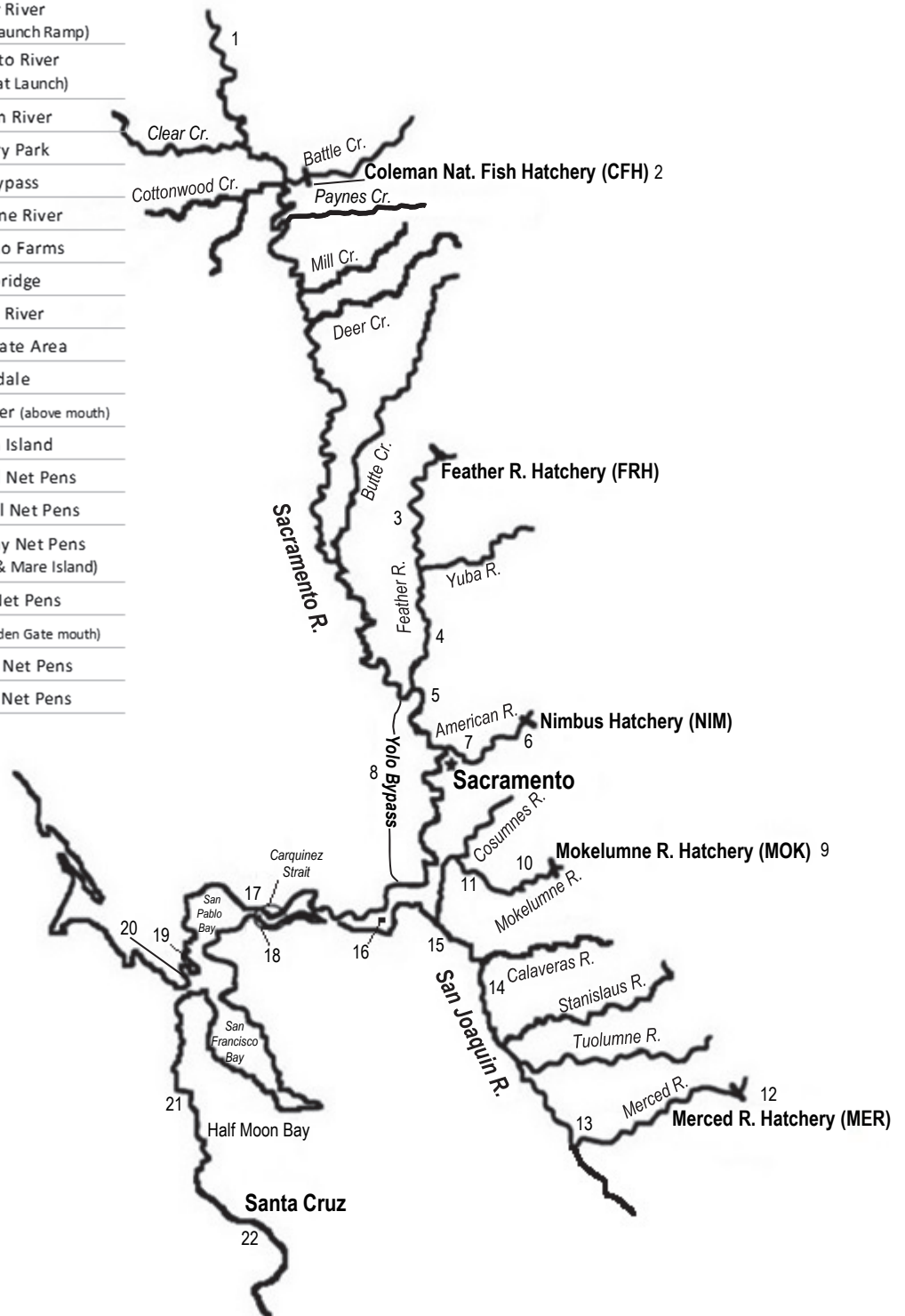


Figure 1. Map of release locations for CV hatchery release types, brood years 2009-2012.

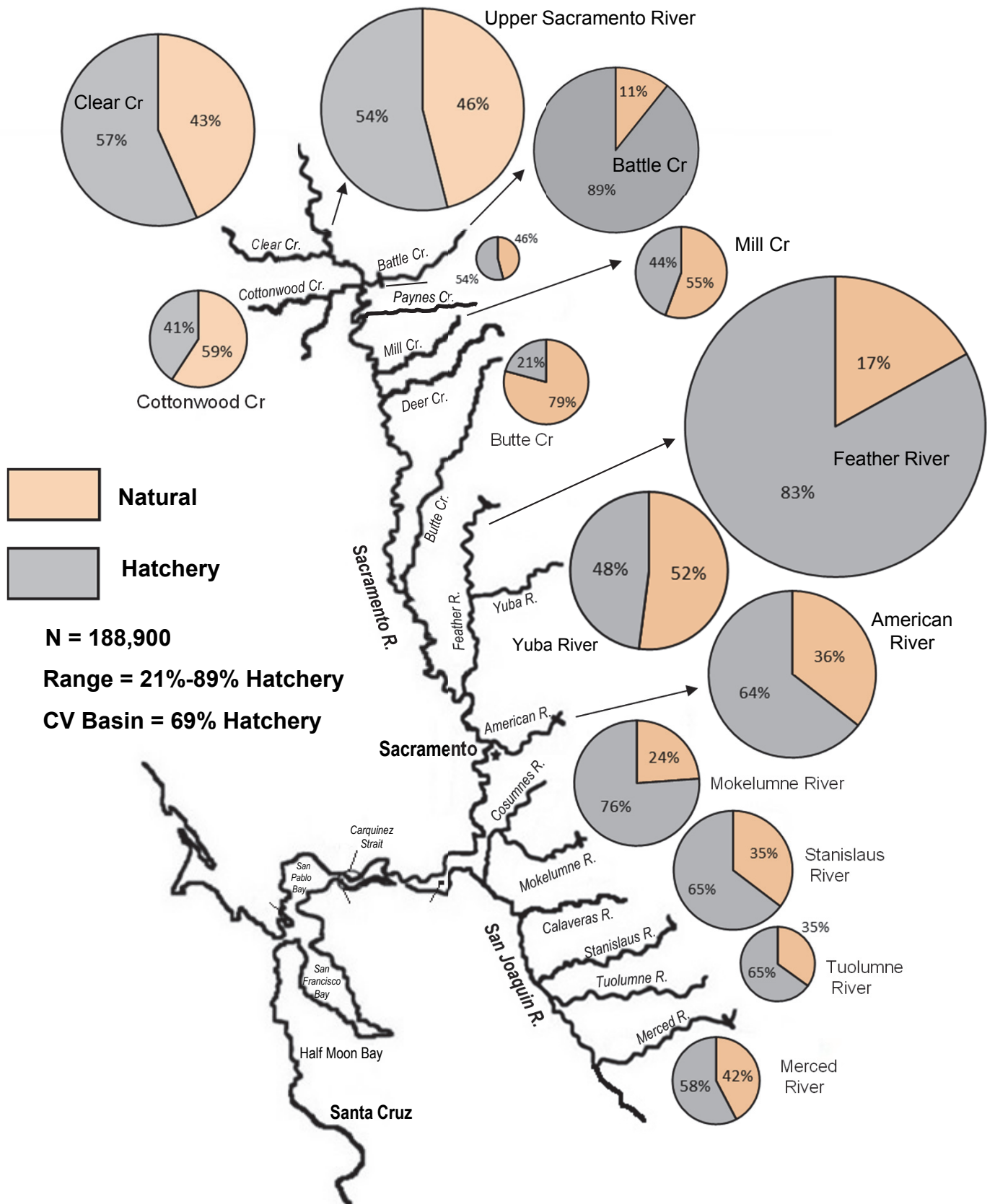


Figure 2. Fall-run CV Natural Area Escapement, Hatchery and Natural Proportions, 2014.

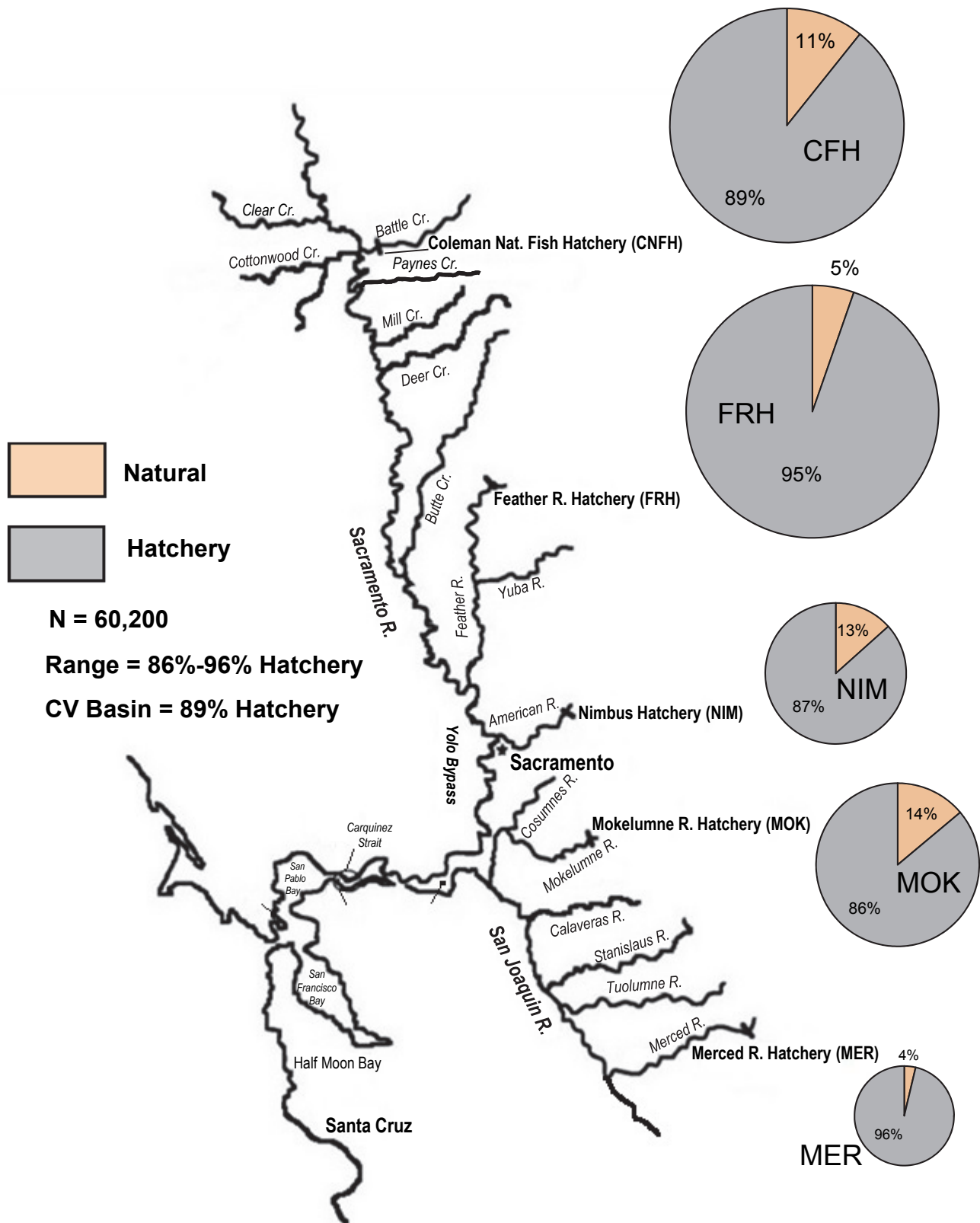


Figure 3. Fall-run CV Hatchery Escapement, Hatchery and Natural Proportions, 2014.

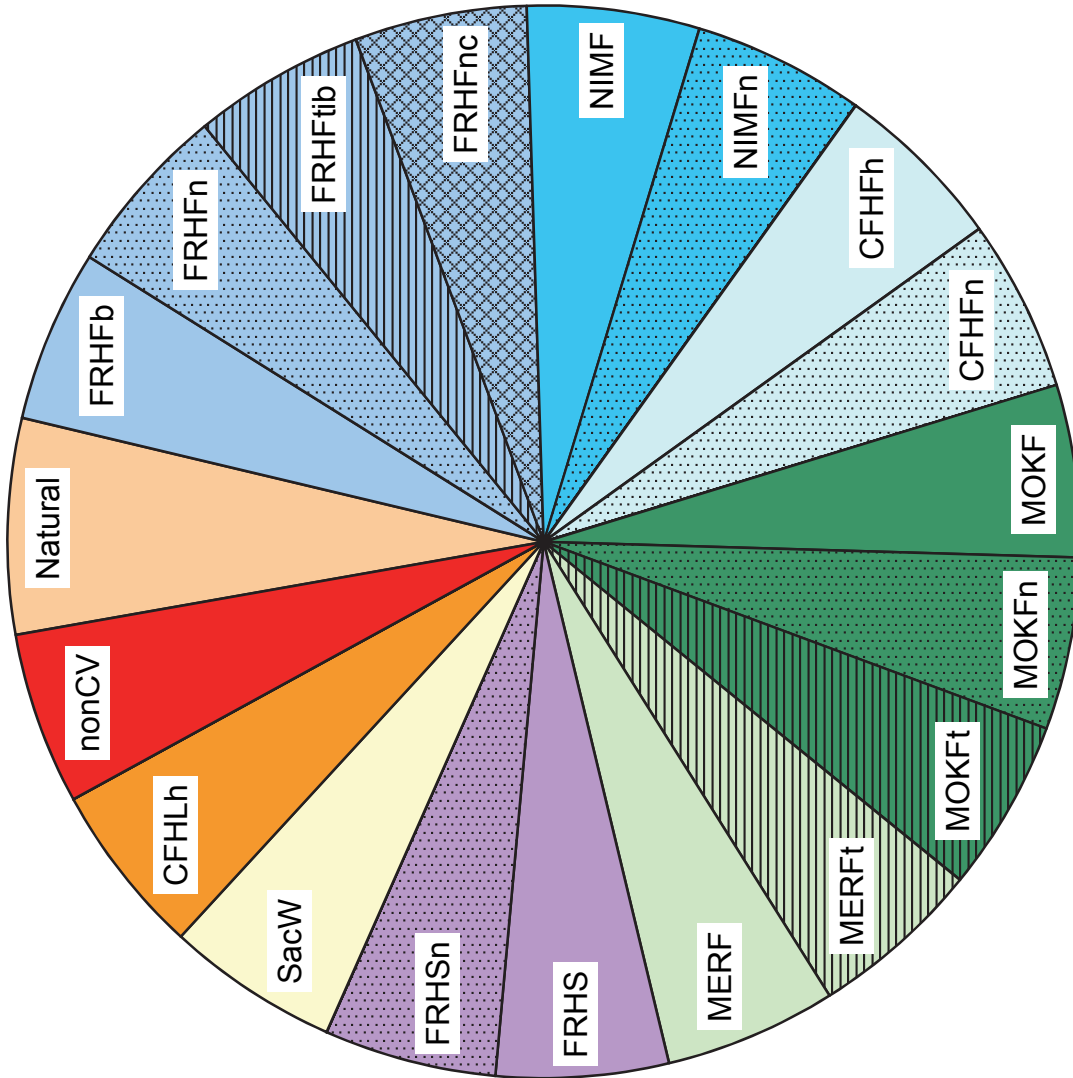


Figure 4. Color chart for Central Valley hatchery release types, brood years 2009-2012.

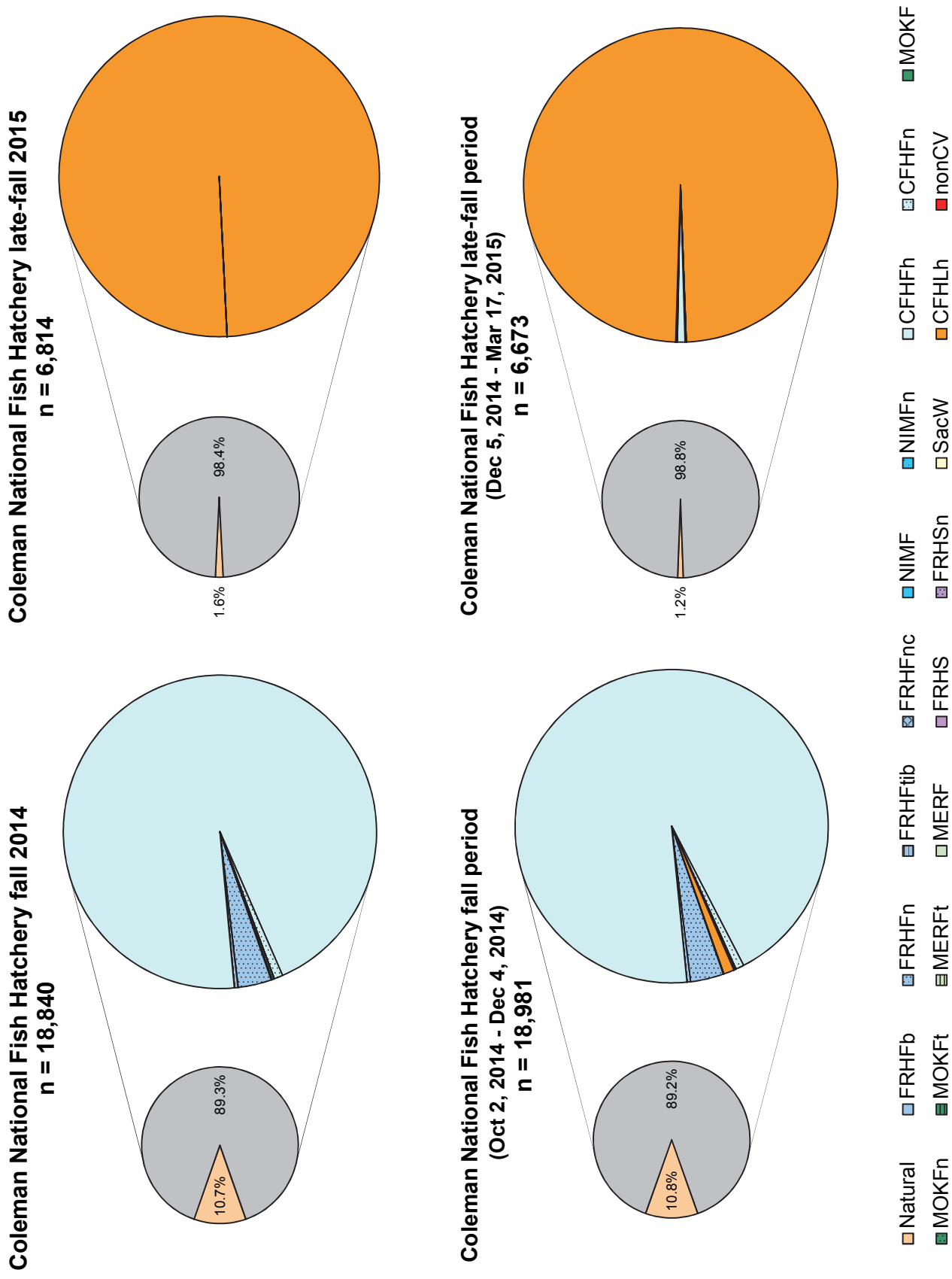


Figure 5. Proportion of hatchery- and natural-origin fish at Coleman National Fish Hatchery, 2014.

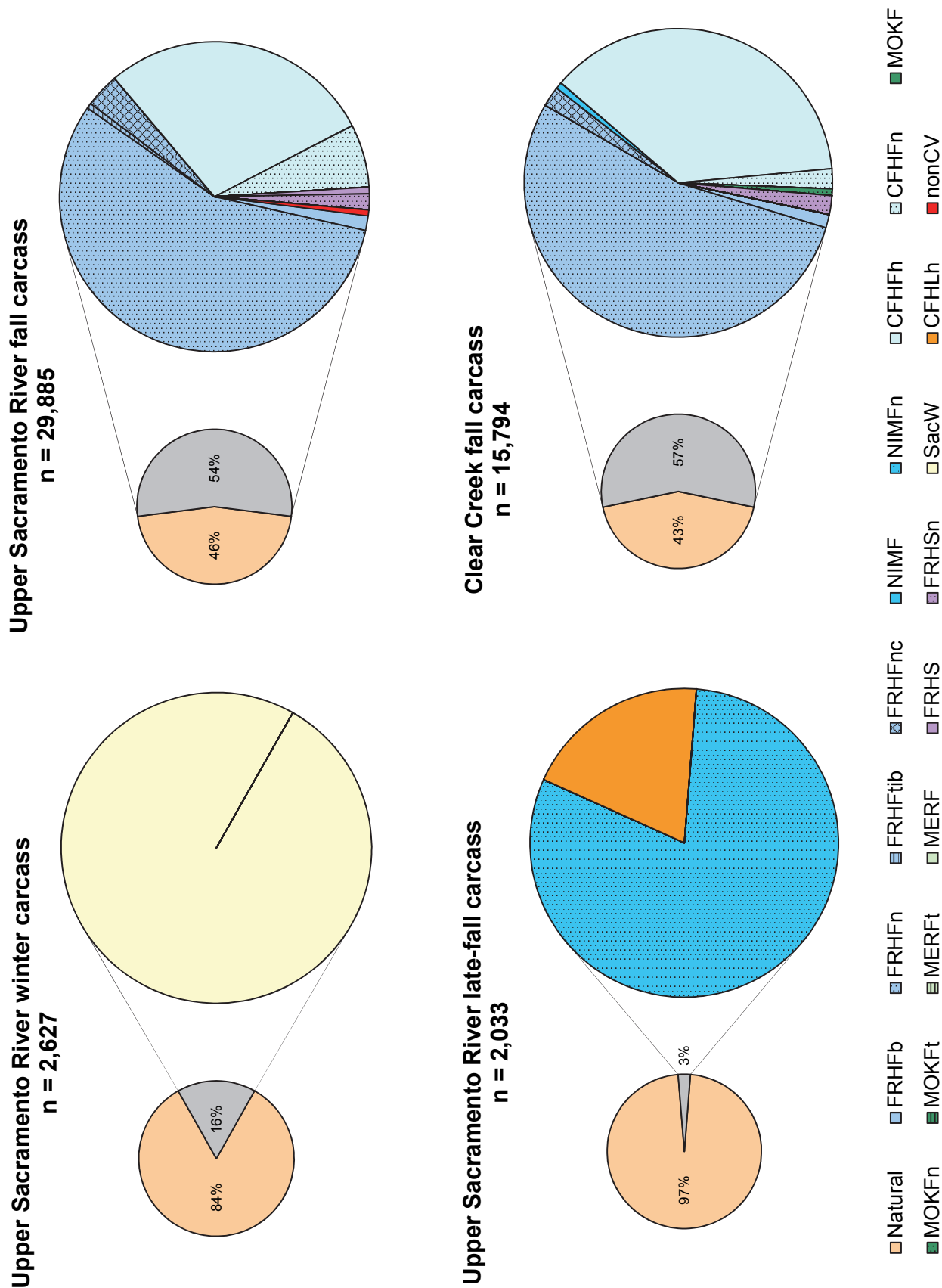


Figure 6. Proportion of hatchery- and natural-origin fish in Upper Sacramento River & tributaries, 2014. (page 1 of 2)

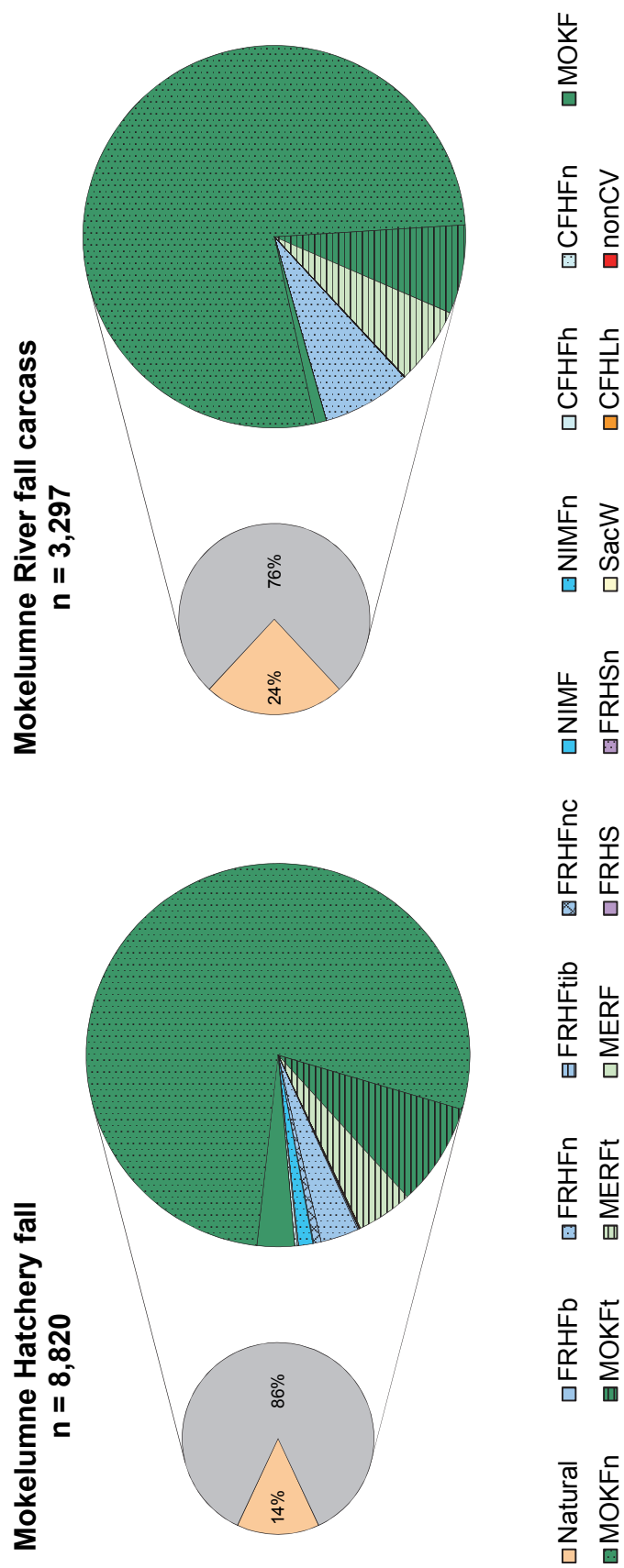
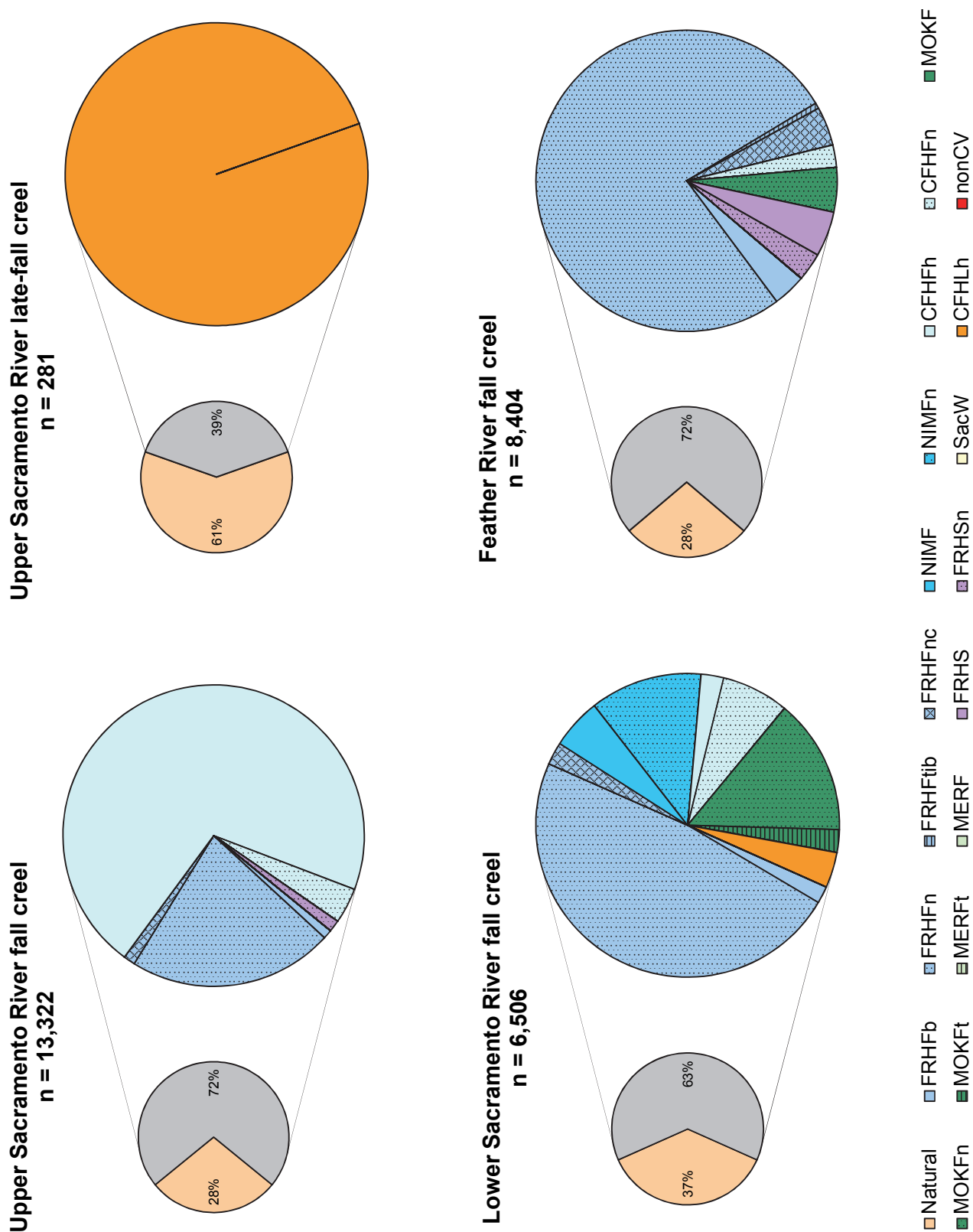


Figure 10. Proportion of hatchery- and natural-origin fish in the Mokelumne River Basin, 2014.



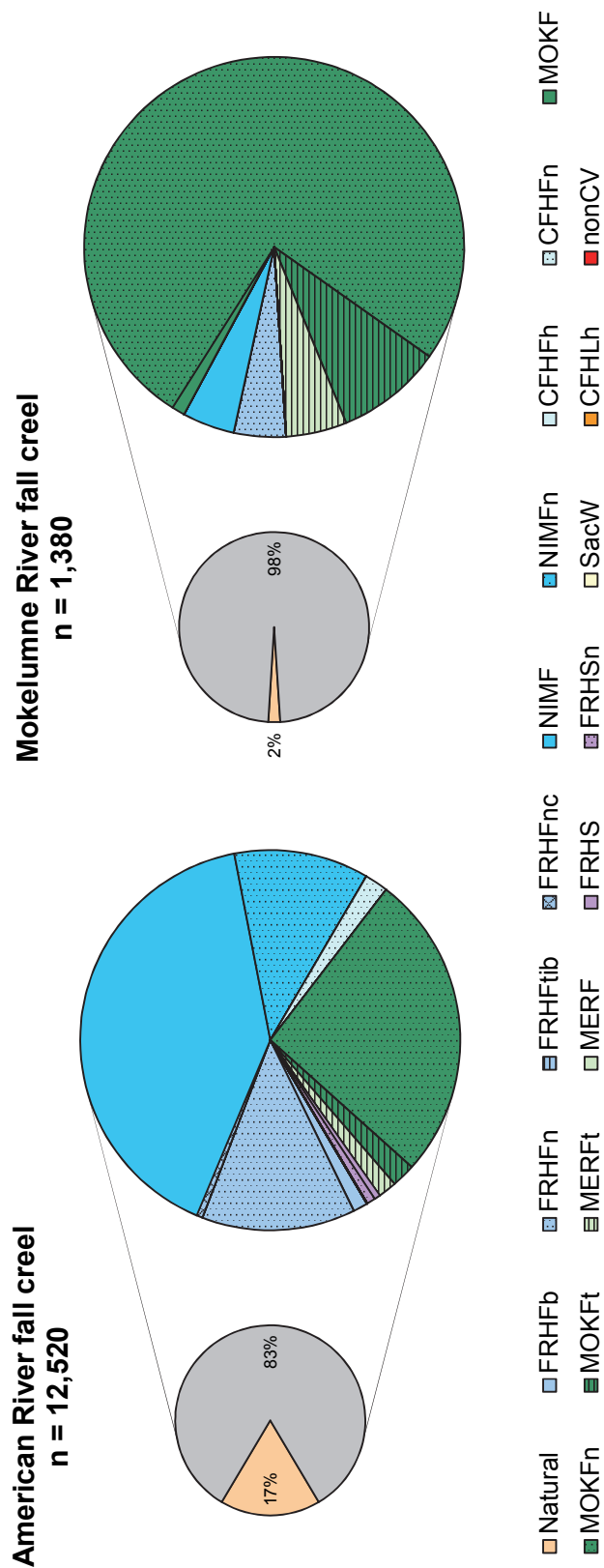


Figure 13. Proportion of hatchery- and natural-origin fish in sport harvest on American & Mokelumne rivers, 2014.

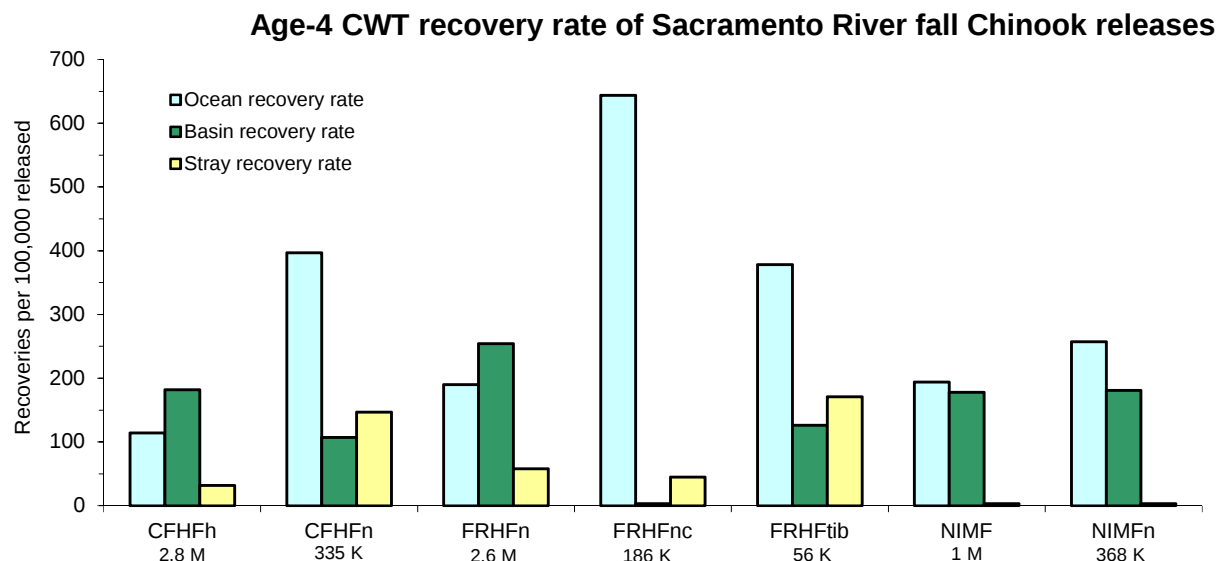
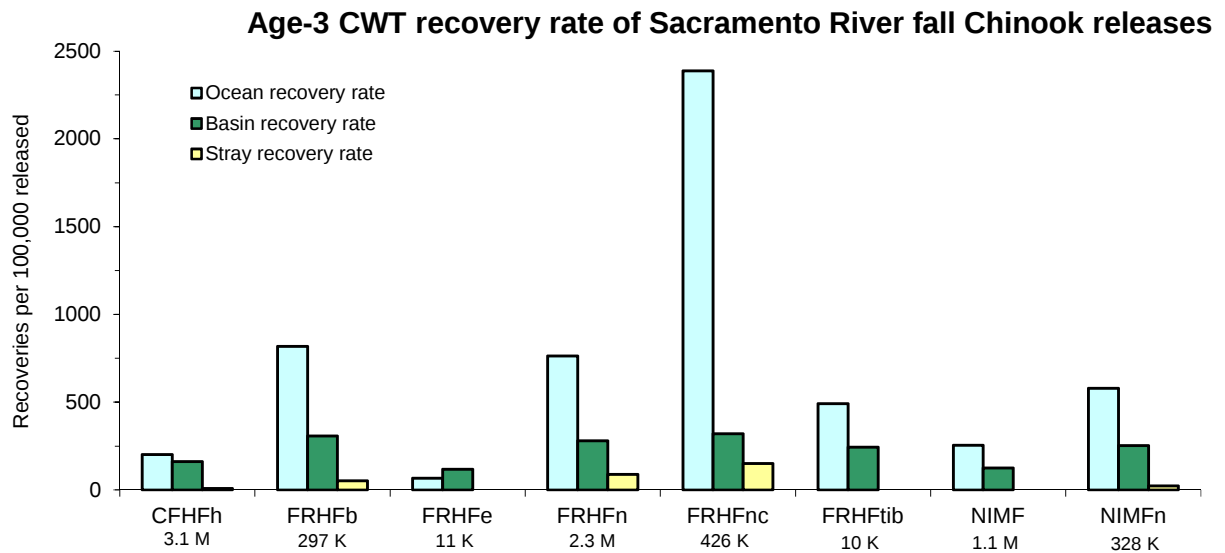
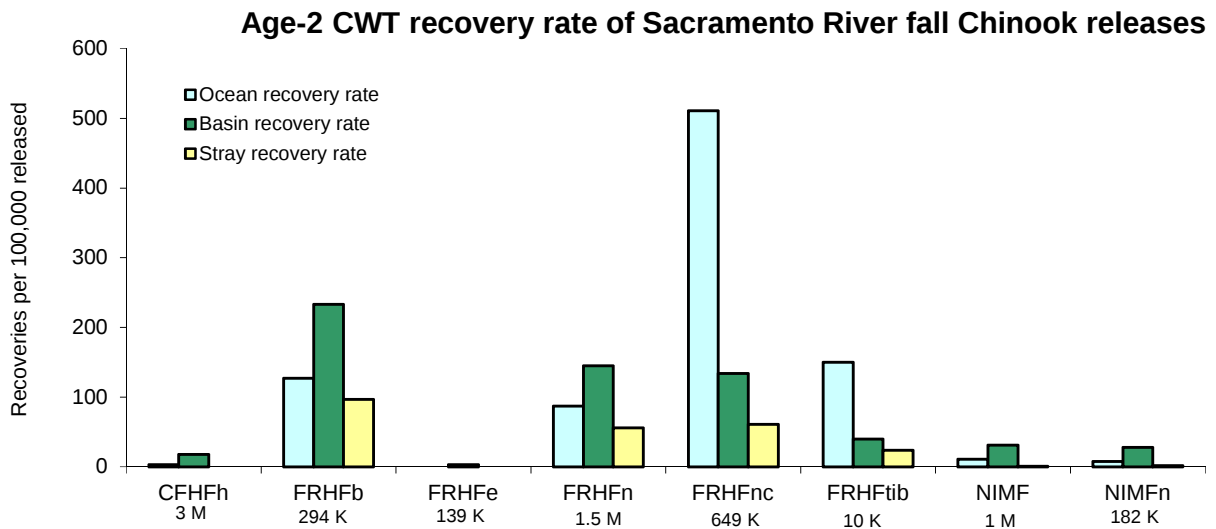


Figure 14. CWT recovery rates of Sacramento River fall Chinook releases by age in 2014.

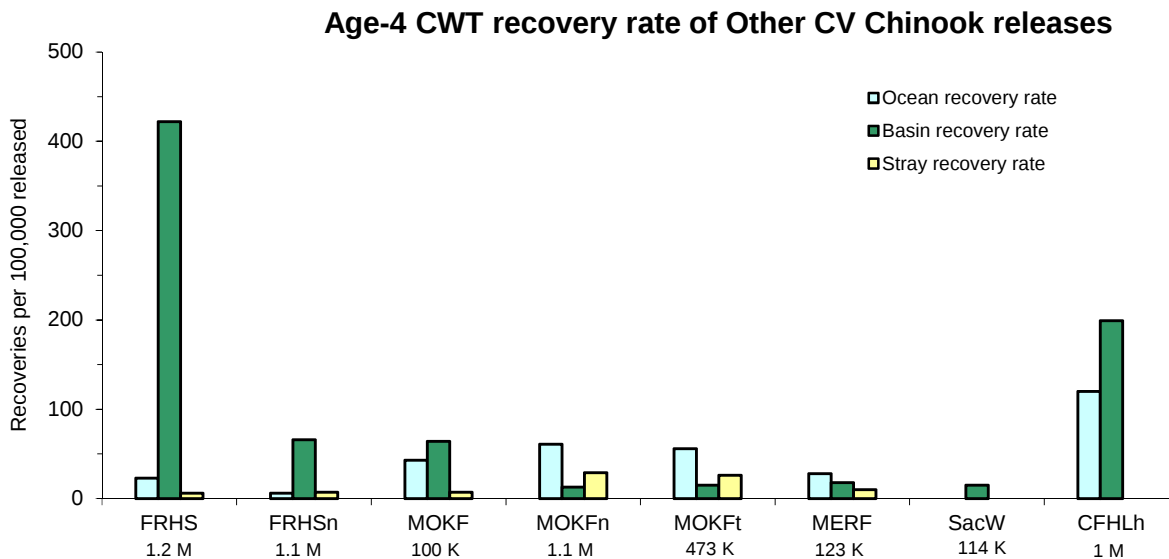
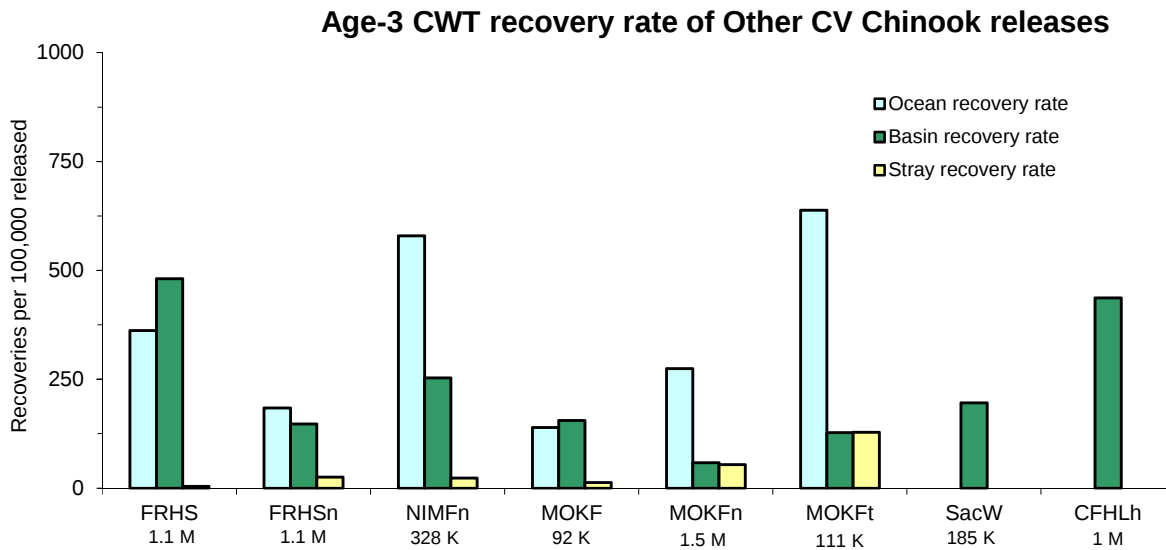
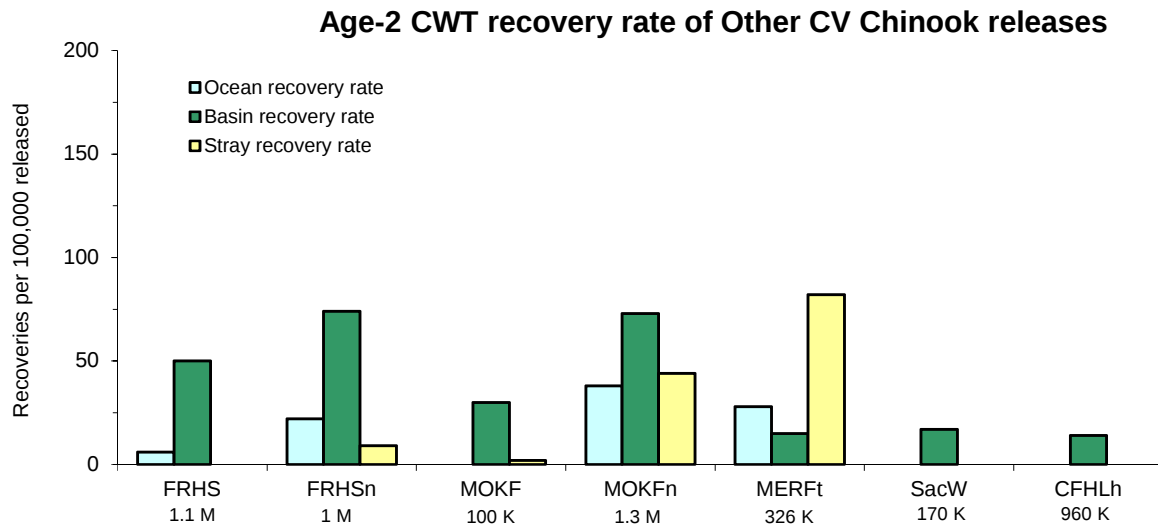


Figure 15. CWT recovery rates of Other CV Chinook releases by age in 2014.

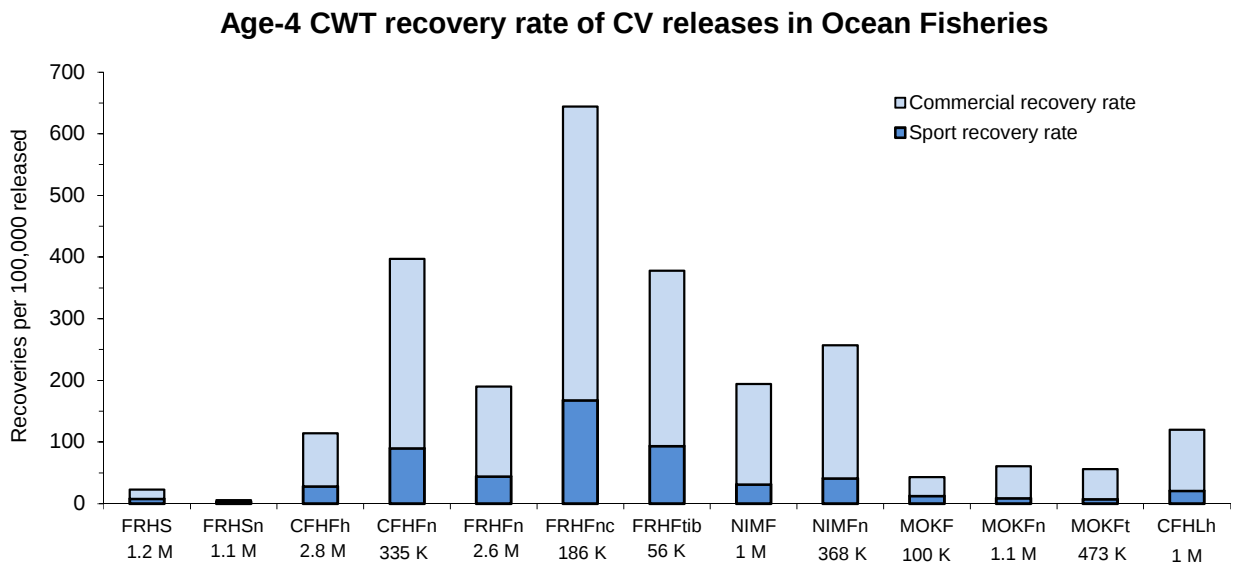
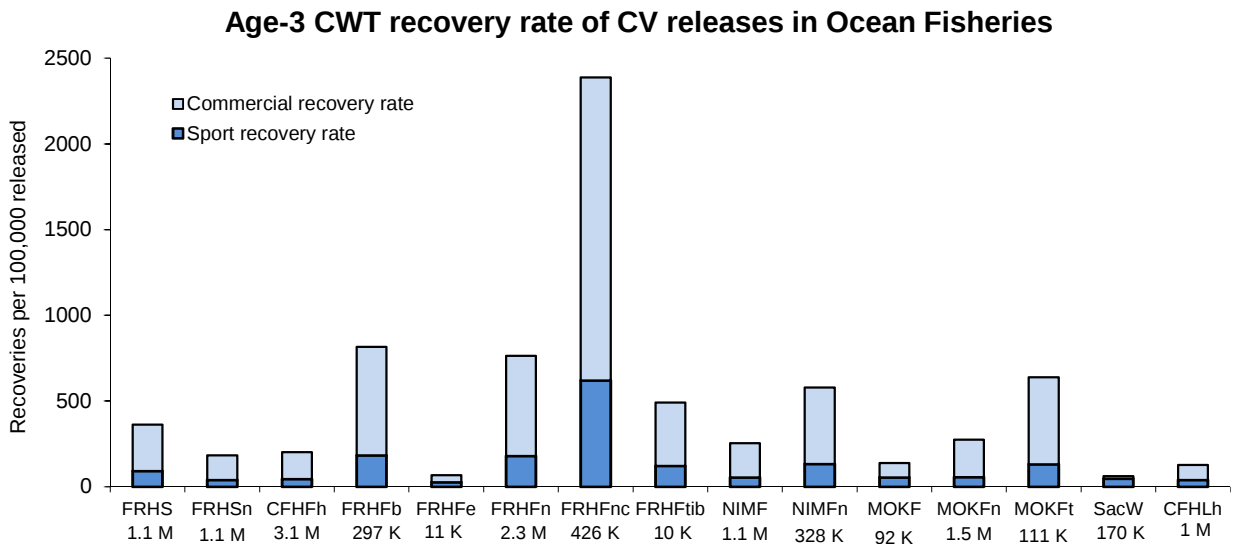
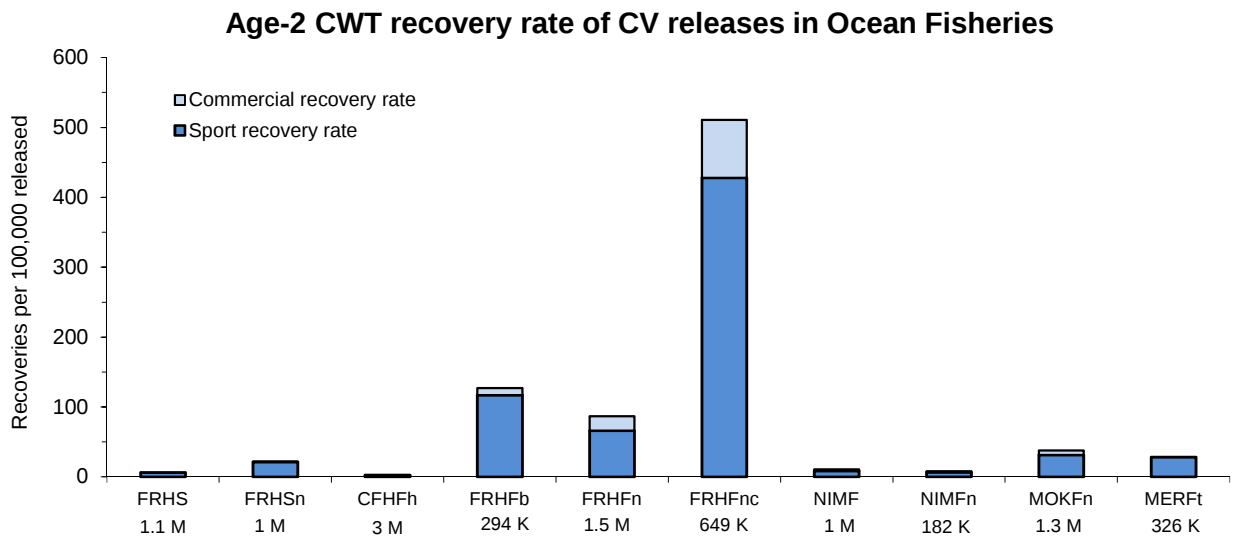


Figure 16. CWT recovery rates by release type in 2014 Ocean Salmon Fisheries.

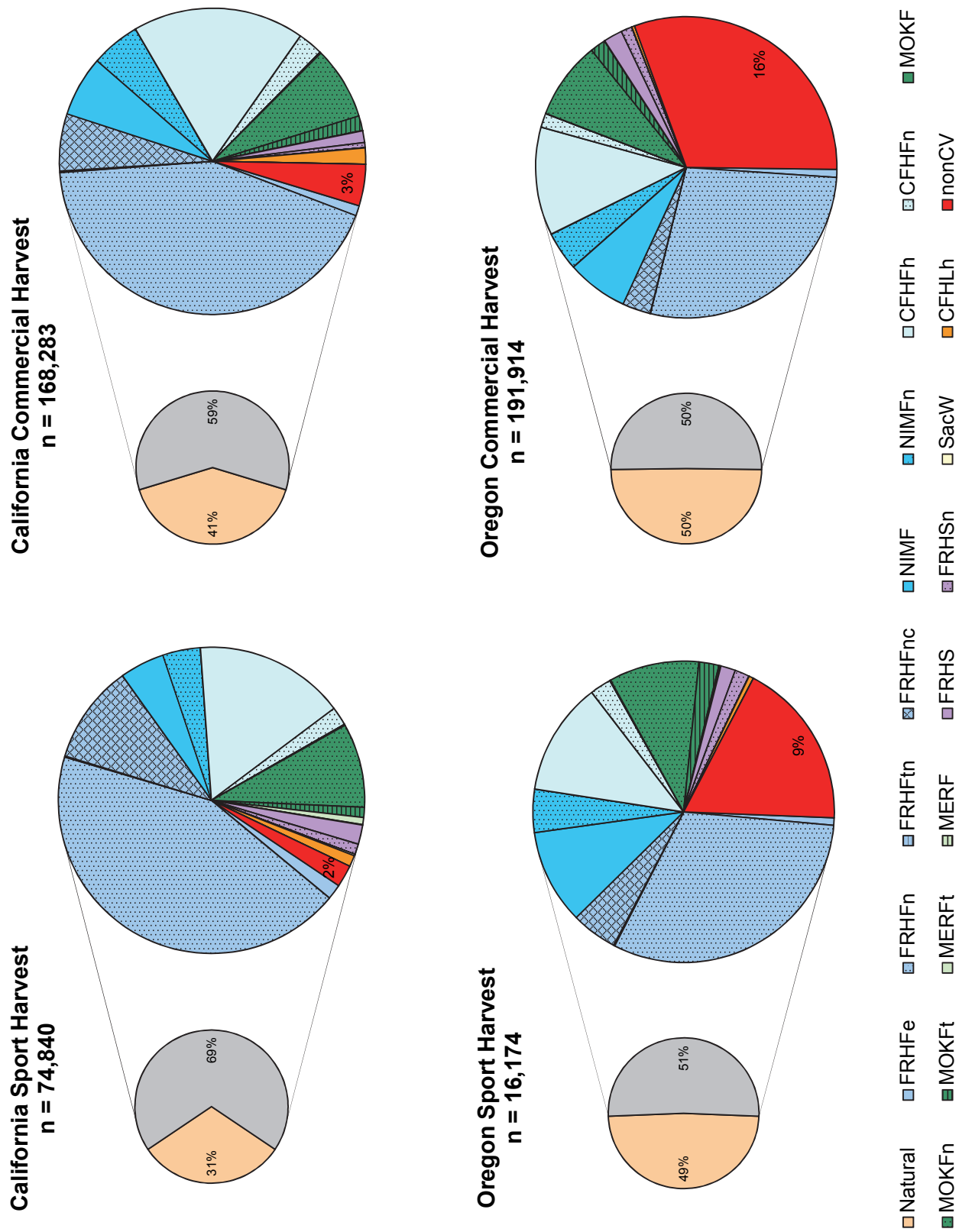


Figure 17. Proportion of hatchery- and natural-origin salmon in 2014 California and Oregon ocean fisheries.

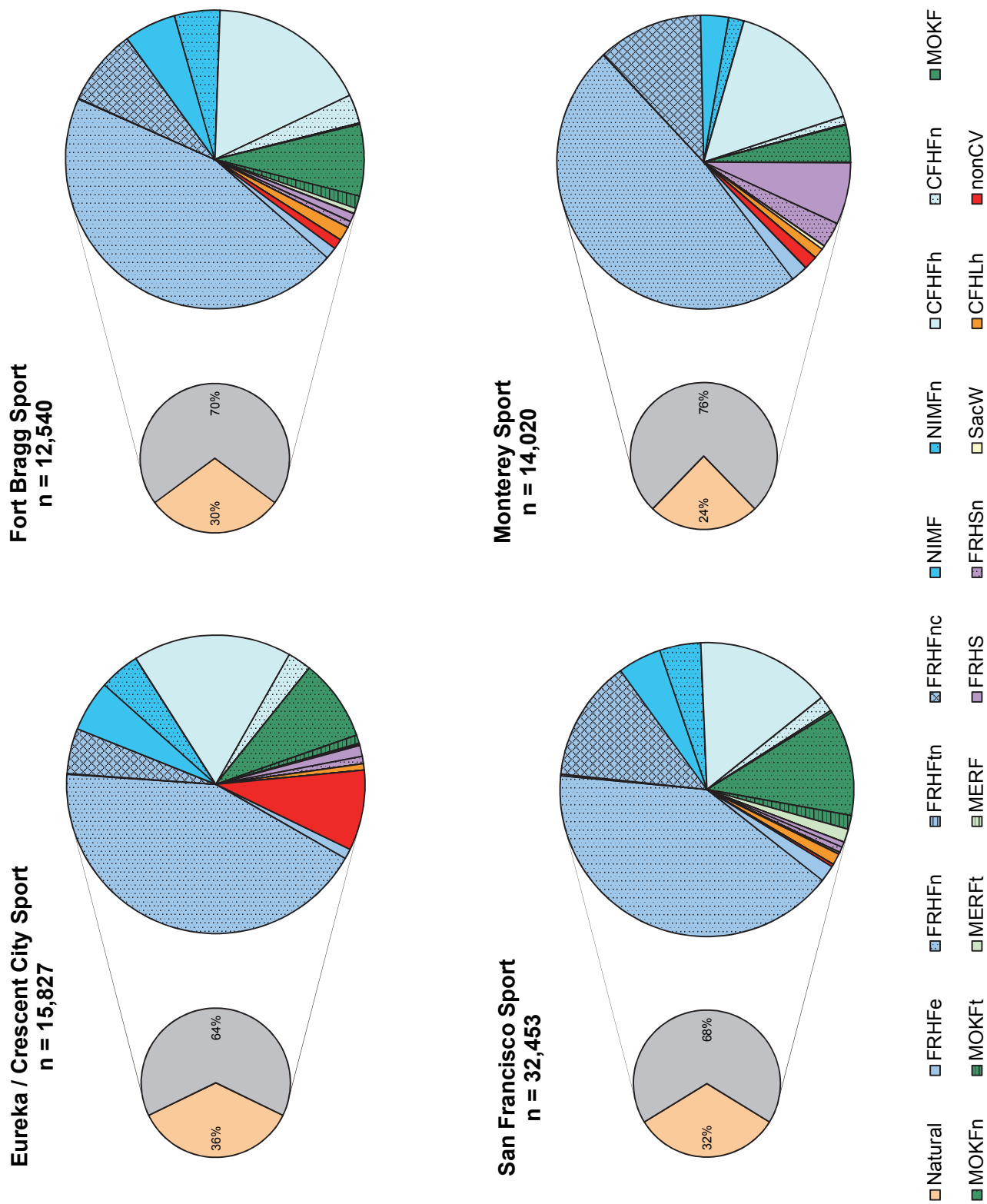


Figure 18. Proportion of hatchery- and natural-origin salmon in the 2014 California ocean sport fishery.

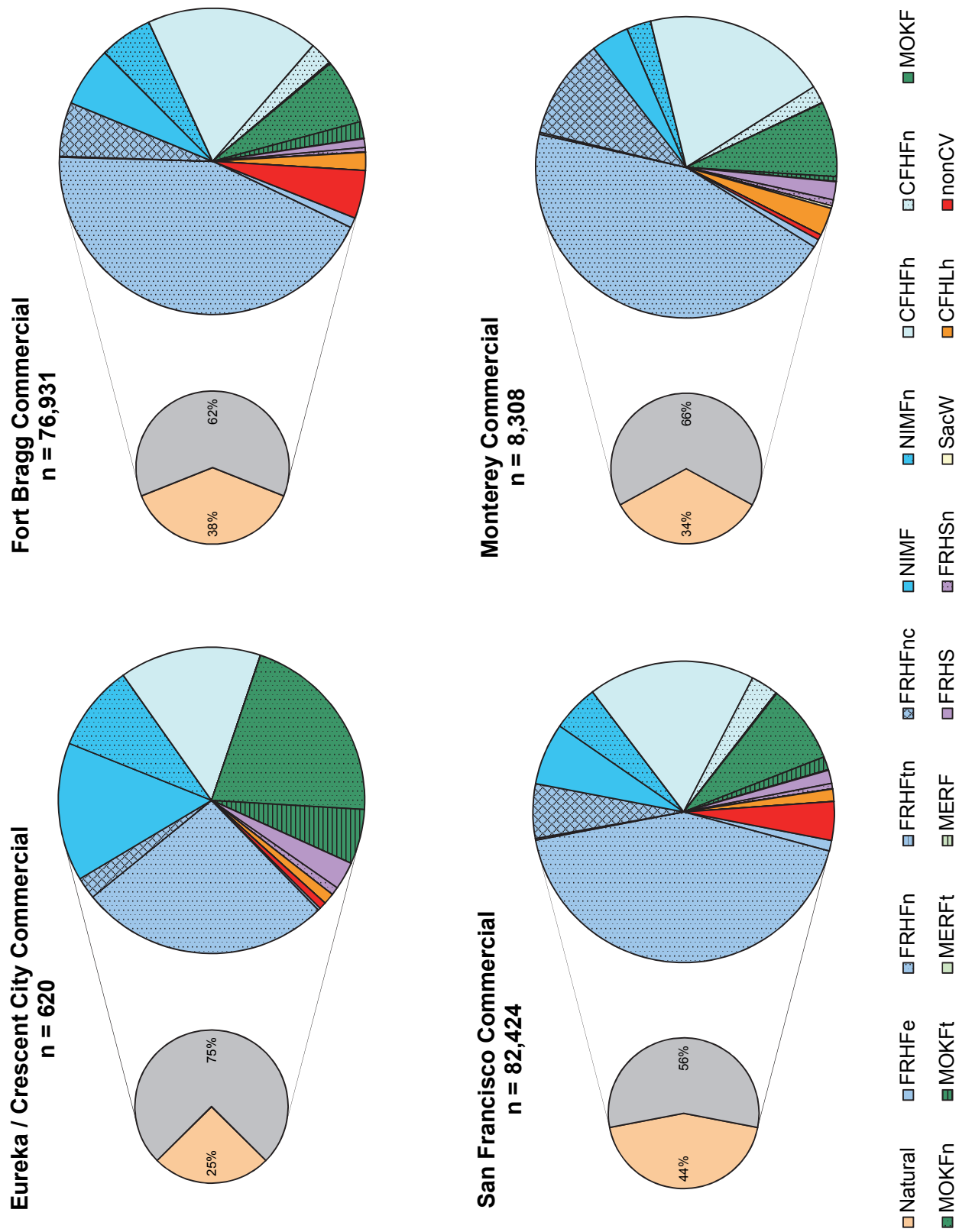


Figure 19. Proportion of hatchery- and natural-origin salmon in the 2014 California ocean commercial fishery.

Appendix 1. Sample expansion factors for Central Valley salmon carcass surveys collecting fish condition in 2014. (page 1 of 2)

Upper Sacramento River fall-run Chinook salmon carcass survey

Condition	Escapement	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	63.72	3.24	16,123	54.0%
nonfresh 77%		1,608	5.4%	167	167	147	147	0.10	0.88				
total	29,885	2,077	6.9%	248	248	225	225			22.09	3.24	16,123	54.0%

Clear Creek fall-run Chinook salmon carcass survey

Condition	Escapement	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	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 (fresh only)

Condition	Escapement	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%		4,984	8.2%	1,724	1,724	1,660	1,634	0.35	0.96	12.38	2.49	50,420	83.0%
nonfresh													
total	60,721	4,984	8.2%	1,724	1,724	1,660	1,634			12.38	2.49	50,420	83.0%

Lower American River fall-run Chinook salmon carcass survey

Condition	Escapement	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	15,790	64.4%
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	15,790	64.4%

Appendix 1. Sample expansion factors for Central Valley salmon carcass surveys collecting fish condition in 2014. (page 2 of 2)

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_{cwtadc}	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%
weir CWTs 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_{cwtadc}	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	3.59	134	65.0%
nonfresh 69%			74	35.9%	1	1	1	1	0.01	1.00				
total		206	107	51.9%	7	7	7	7			5.35	3.59	134	65.0%

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_{cwtadc}	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_{cwtadc} = 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 CWT _{samp}	Recovery rate per 100K released		Ocean
				Bat Cr	Up Sac	Nat crks ^{a/}	Fea	Yub	Ame	Mok	Mer	SJ	In-basin	Stray	CV total	In-basin			Stray	CV total	
CFHFh	2012	Fall	2,956,873	524		13							524	13	538	2%	98	18	0	3	
CFHLh	2013	Late	960,075	130									130		130			14		14	
FRHFb	2012	Fall	293,784	15	177	78	645	38	11	4			645	323	969	33%	372	220	110	127	
FRHFe	2012	Fall	138,888				4						4		4			3		3	
FRHFh	2012	Fall	1,453,105	150	265	244	1,989	117	52	47	29	27	1,989	932	2,921	32%	1,271	137	64	201	
FRHFnc	2012	Fall	649,160	80	66	124	614	258	12	47	23	44	614	655	1,269	52%	3,317	95	101	195	
FRHFtib	2012	Fall	9,918	2			4						4	2	6	38%	15	40	24	65	
FRHS	2012	Spr	1,106,679				528	25					528	25	553	4%	71	48	2	50	
FRHSn	2012	Spr	1,015,285		66	16	755		6				755	88	844	10%	222	74	9	83	

Age 3 CWT recoveries

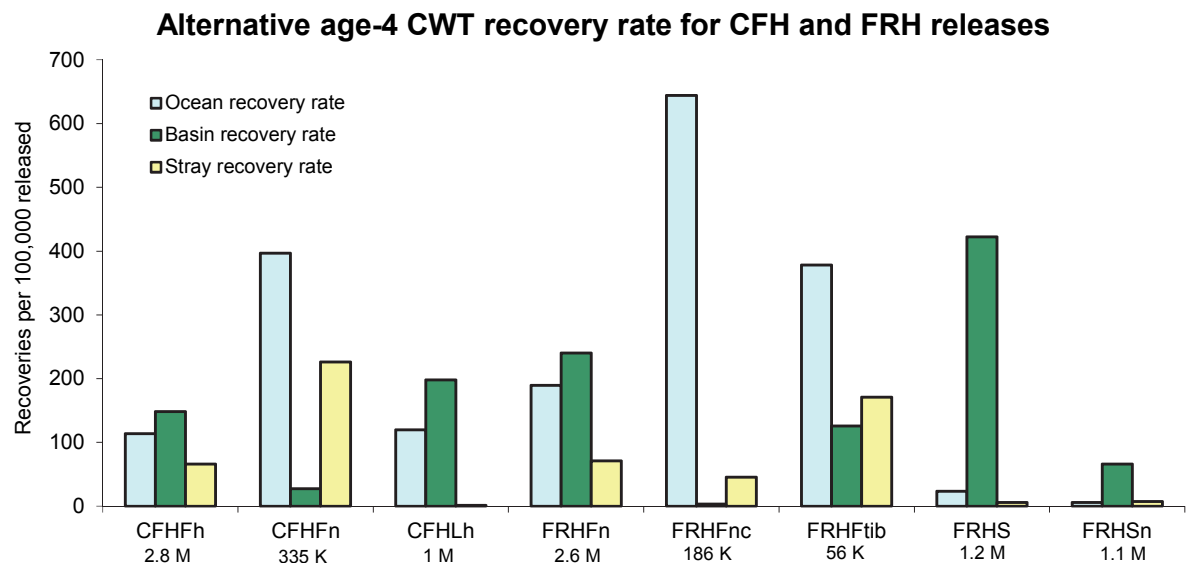
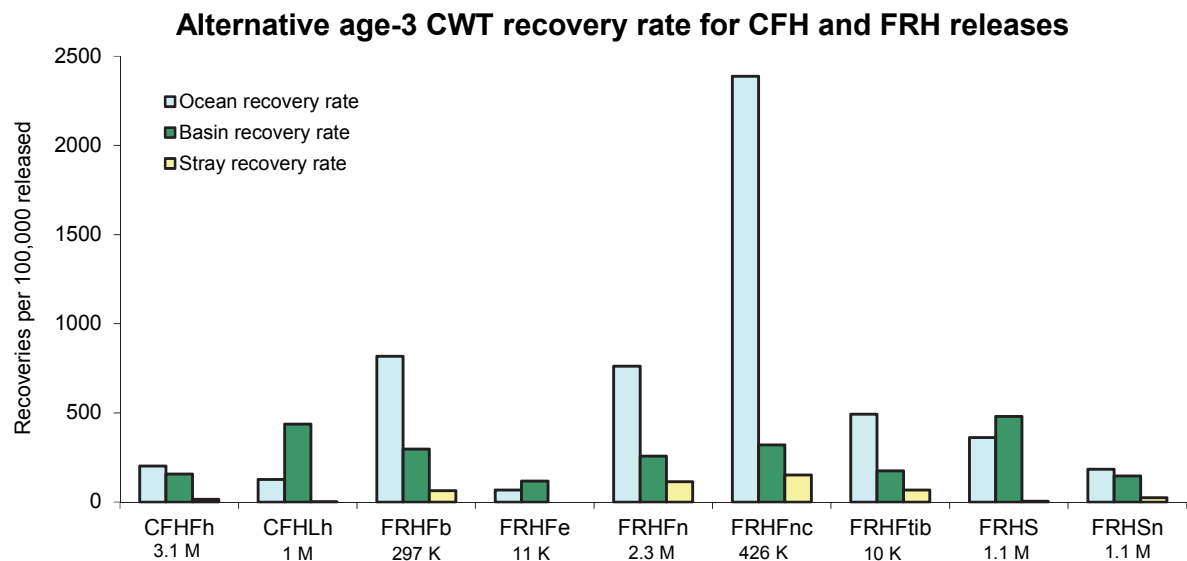
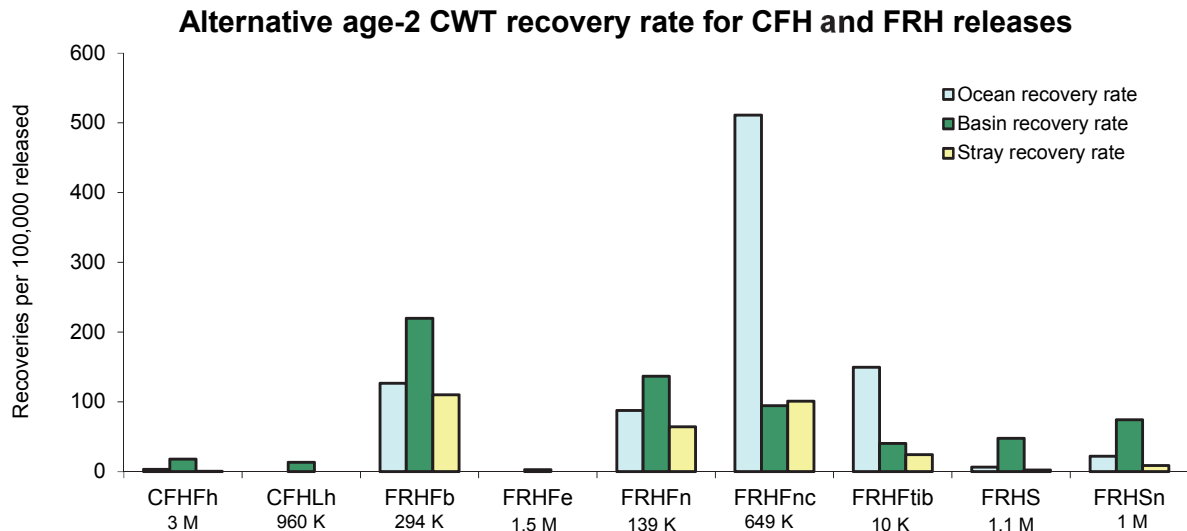
Release type	Brood year	Run type	# CWT tagged	Central Valley total recoveries (CWT _{samp}) by basin										CV CWT _{samp} totals			% CV Stray	Recovery rate per 100K released		Ocean CWT _{samp}	Recovery rate per 100K released		Ocean CWT _{samp}
				Bat Cr	Up Sac	Nat cks ^{a/}	Fea	Yub	Ame	Mok	Mer	SJ	In-basin	Stray	CV total	In-basin		Stray	CV total				
CFHFh	2011	Fall	3,117,042	4,870	177	276			4				4,870	457	5,328	9%	156	15	6,288	156	202		
CFHLh	2012	Late	1,031,419	4,511						6			4,511	6	4,517	0%	437	1	1,311	437	127		
FRHFb	2011	Fall	297,089	14	66	49	884	31	23	6			884	190	1,074	18%	297	64	2,428	297	817		
FRHFe	2011	Fall	11,449				13						13		13		117		8	117	67		
FRHFh	2011	Fall	2,293,211	114	1,060	747	5,885	568	62	30		22	5,885	2,603	8,489	31%	257	114	17,489	257	763		
FRHFnc	2011	Fall	426,190	56	442	94	1,363	7	43	1		5	1,363	648	2,011	32%	320	152	10,175	320	2,387		
FRHFtib	2011	Fall	9,933				17	7					17	7	24	28%	175	68	49	175	492		
FRHS	2011	Spr	1,088,286		44		5,231		3				5,231	47	5,279	1%	481	4	3,935	481	362		
FRHSn	2011	Spr	1,125,189	5	133	141	1,650		2				1,650	281	1,931	15%	147	25	2,074	147	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 CWT _{samp}	Recovery rate per 100K released			Ocean
				Bat Cr	Up Sac	Nat cks ^{a/}	Fea	Yub	Ame	Mok	Mer	SJ	In-basin	Stray	CV total	In-basin			Stray	CV total		
CFHFh	2010	Fall	2,835,420	4,202	972	851	38		2	2			4,202	1,866	6,068	31%	3,221	148	66	214	114	
CFHFh	2010	Fall	334,756	92	265	78	180	157	66	4	1	5	92	756	848	89%	1,329	28	226	253	397	
CFHLh	2011	Late	1,037,859	2,056	10						1		2,056	11	2,067	1%	1,243	198	1	199	120	
FRHFh	2010	Fall	2,554,115	83	928	392	6,136	346	38	32	1		6,136	1,818	7,954	23%	4,844	240	71	311	190	
FRHFnc	2010	Fall	185,985	2	66	16	6						6	84	90	93%	1,199	3	45	49	644	
FRHFTib	2010	Fall	56,030	7	88		71						71	96	166	58%	212	126	171	297	378	
FRHS	2010	Spr	1,170,340	2	66		4,945						4,945	69	5,013	1%	274	422	6	428	23	
FRHSn	2010	Spr	1,136,690		66	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 can include Clear Creek, Cow Creek, Cottonwood Creek, Paynes Creek, Mill Creek, Deer Creek and Butte Creek, depending on survey year.



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			known	
	Total	% adclip	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	Chinook	Sample	Observed	Ad-clips	CWTs	Valid	F _{samp}	Avg F _{prod}	$\sum_{i=1}^m CWT_{total,i}$	% hatchery
N	8,886	97%	1,393	58	53	53	24.69	3.40	4,452	48.7%
video count	known status		video count			carcass survey				

Yuba River natural escapement above DPD: Total video count (known status) with supplemental carcass survey CWT data

Escapement	Chinook	Sample	Observed	Ad-clips	CWTs	Valid	p_{adc}	$p_{cwt/adcl}$	F_{prod}	Avg	$\sum_{i=1}^m CWT_{total,i}$	%
N	sampled (n)	rate	ad-clips	processed	recovered	CWTs						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							

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Appendix 5. Sample expansion for CWTs recovered in Mokelumne River escapement above Woodbridge Dam (WD) based on video data, 2014.

Known ad						
Total	status	% adclip				
Woodbridge Dam video	12,117	2,890	23.9%			
MRFI return	8,820	2,126	24.1%			
Natural Escapement Mokelumne River	3,297	764	23.2%			
Mokelumne River natural escapement above WD: Total video count minus MRFI with supplemental carcass survey CWT data						
Escapement N	3,297	Chinook sampled (n)	100%	Observed ad-clips	Ad-clips processed	Valid CWT's recovered
				764	65	54
						carcass survey
						CWT's
						p_adc
						p_cwtadc
						F_samp
						Avg F_prod
						$\sum_{j=1}^m CWT_{total,i}$
						% hatchery
						76.2%