



7/6/2023

MEMORANDUM FOR: The Record

FROM: Cisco Werner, Director of Scientific Programs and Chief Science Advisor, National Marine Fisheries Service (NMFS)

SUBJECT: Certification of the California Department of Fish and Wildlife (CDFW) California Recreational Fishing Survey's (CRFS) Angler License Directory Online Survey (ALDOS) and Private/Rental Boat Recreational Fishing Surveys (PR1/PR2)

This memorandum certifies the California Recreational Fishing Survey's ALDOS and private boat survey designs PR1 and PR2 described herein as approved methods for derivation of recreational catch and effort estimates.

UNDERSTANDING CERTIFICATION

The steps of the certification process are described in detail in NMFS Procedural Directive 04-114-02 (see https://media.fisheries.noaa.gov/2021-06/04-114-02_06.28.2021_Howell%20signed.pdf?null). In summary, the certification of a survey design means:

- The design has been sufficiently documented, adheres to applicable standards, is statistically sound, and has been validated by a peer review.
- NMFS may fund use of this design and fund and/or provide technical support for similar designs proposed or used by partner organizations.
- The resulting estimates are eligible for use in federal stock assessments and management once they have been incorporated into the historical time series.

Note that certification is not always a guarantee that a survey design will be implemented, a program will receive financial or technical support, or the resulting estimates will be used immediately in stock assessments and management. The decision to implement any new survey design must consider the cost and practicality of changing methods, as well as the fit of any new estimates into science and management needs. Furthermore, the use of a new design's estimates in the federal stock assessment and management process requires the development and execution of a Transition Plan, pursuant to NMFS Policy Directive 04-114 (see <https://media.fisheries.noaa.gov/dam-migration/04-114.pdf>) and Procedural Directive 04-114-01 (see https://d23h0vhsm26o6d.cloudfront.net/04-114-01_Guidance_Transition_MRIP.pdf).

It should also be noted that if changes to the underlying survey design are made after this survey is certified, those design changes must be documented and re-reviewed for the survey to maintain its certification.

BACKGROUND

NOAA Fisheries' Marine Recreational Information Program (MRIP) is the state-regional-federal partnership that develops, implements, and continually improves a national network of recreational fishing surveys to estimate total recreational catch. MRIP was initiated in 2008 to replace the Marine Recreational Fisheries Statistics Survey (MRFSS) which was NOAA Fisheries' prior recreational data collection program that had been in operation on the Atlantic, Gulf, and Pacific coasts since 1979. MRFSS consisted of two primary surveys: the Coastal Household Telephone Survey (CHTS), a fishing effort telephone survey, and the Access Point Angler Intercept Survey (APAIS) where anglers were interviewed in-person at fishing access sites to obtain information about recreational catch. Catalysts for creating MRIP included an independent peer-review (National Academies of Sciences Engineering and Medicine, 2006) and the Magnuson-Stevens Fishery Conservation and Management Reauthorization Act of 2006. The new program revised the MRFSS survey methods to address issues identified by the review, and created the Fishing Effort Survey and a redesigned Access Point Angler Intercept Survey. These surveys have improved designs, implement more advanced statistical analyses, and address known sources of bias in the MRFSS surveys.

MRFSS was discontinued in Pacific coast states in 2004 prior to the initiation of MRIP. In 2004 in CA, MRFSS was replaced by the California Recreational Fisheries Survey (CRFS). CRFS was built off of MRFSS, using a telephone survey (Angler License Directory Telephone Survey, or ALDTS) coupled with intercept surveys, with adjustments to provide finer scale data on a faster timeframe than the MRFSS provided to meet state management needs. Over time, the ALDTS became cost prohibitive to implement, as it provided relatively imprecise effort data and could not detect effort in less populated districts in the state. This led to the development of ALDOS, which is an improved, and more cost-effective design compared to the ALDTS.

DESCRIPTION OF SURVEY METHODS

ALDOS is a monthly survey used to collect recreational effort information from anglers fishing from private or rental boats and from shore. Samples are drawn from an angler license directory of California sport fishing license holders. The survey is administered via email, which directs respondents to a link to fill out the questionnaire.

California's monthly private/rental boat surveys are conducted through angler intercepts at public access sites and are used to collect catch rate information. There are two components: a survey of primary sites (PR1) and a survey of secondary sites (PR2). Designation of sites as primary or secondary is based on the amount of expected effort and relative catch of species under active management, with increased sampling rates for PR1.

Together, ALDOS, PR1, and PR2 data are used to estimate catch and effort for all private and rental boat trips in California. Documentation of ALDOS, PR1 and PR2 survey designs and estimation methods, as well as peer review findings, are provided in the attachments listed below.

IMPLICATIONS AND CONSIDERATIONS

ALDOS: ALDOS is a new survey replacing ALDTS, as such, CDFW will need to work with NMFS to develop and execute a transition plan (which involves calibration if this change in methods results in changes to the magnitude of estimates) before estimates can be used in federal assessments and management. At the time of this certification, CDFW has initiated transition plan development for ALDOS.

PR1/PR2: PR1/PR2 are ongoing surveys with no major changes to the methodology occurring with this certification. As such, a transition plan may not be necessary at this time. However, following any survey design certification, partners coordinate to discuss transition planning needs. Even if changes are not being made to estimates, and calibration is not needed, a transition plan may be beneficial to ensure partners are on the same page with implementation of surveys. These are essential discussions that will be had among partners following certification. Certification of PR1/PR2 was pursued by California to comply with the NMFS survey and data standards and to maintain MRIP funding for these surveys - generally MRIP only funds recreational fishing surveys that have been appropriately validated by a peer review and certified.

ATTACHMENTS

ALDOS Survey Documentation

ALDOS Peer Review Documentation

CRFS_Methods_2022 (Includes Documentation for PR1 and PR2) PR1/

PR2 Peer Review Documentation

MRIP Program Management Team (PMT) Review and Recommendation

Executive Steering Committee Review and Recommendation

PLEASE NOTE

To receive a Microsoft Word version of this document with screen-readable equations and notations, please email fisheries.mrip@noaa.gov.

2. ANGLER LICENSE DIRECTORY ONLINE SURVEY

OVERVIEW

The Angler License Directory Online Survey (ALDOS) is a statewide off-site monthly survey which collects basic angler effort data for all marine recreational fishing modes. ALDOS uses email (and in future may also use text messages) to prompt licensed anglers to provide survey responses online. ALDOS samples are drawn from the state's directory of current sport fishing license holders. Survey data are used to estimate effort on beaches and banks and to estimate effort from private and rental boats not covered by the intercept surveys.

The present text will replace Chapter 2 of CRFS Methods 2022 and describes ALDOS as intended for implementation in early 2023. In 2023 ALDOS will become CRFS' sole offsite source of data for the effort estimates noted in the final sentence of the previous paragraph. Experience gained during 2023 may lead to changes and refinements in ALDOS and this text may be further updated to document such changes before update of the entire CRFS Methods 2022.

ALDOS effort measures and estimates are designed to permit integration and comparison with those from other CRFS surveys as well as from other surveys by CDFW, by federal agencies, and by other states. Accordingly, ALDOS employs the *angler day* as the standard unit of fishing effort for each mode. In many reports, and here below in descriptions of data collection and effort estimation, this unit may be termed 'trip' rather than 'day', but the same effort unit is intended (the term 'trip' can have a variety of other meanings when used in survey questions and as interpreted by angler survey respondents).

ALDOS Origins, Pilot Version, and Effort Comparison Study. Since its inception in 2004, CRFS has used intensive intercept surveys to provide monthly effort estimates of fishing effort in all modes, with three exceptions: party/charter vessels (PC), beaches and banks (BB), and the private-access or night fishing portion of private and rental boats (PR-PAN). For these three modes' effort estimates, offsite survey methods have been used consistently (apart from a few gaps due to budgetary restrictions). For PC effort, CRFS used a telephone survey of CPFV operators from 2004 to 2010 but has instead used Commercial Passenger Fishing Vessel logbooks since 2011. For BB and PR-PAN effort, CRFS has used a telephone survey to sample a directory of the state's license holders. During 2011-2022, this offsite survey was the Angler License Directory Telephone Survey (ALDTS: CRFS Methods 2022, Chapter 2).

In the years leading up to 2023, ALDTS costs rose to the point where the survey became

too costly. Meanwhile, the proportion of license holders providing email addresses trended upwards; from under 20% in 2015, to 28% in 2017 and 38% in 2022. Responding to these trends, CDFW conducted an effort comparison study during most of 2018-2022 which supplemented ALDTS and other CRFS surveys with a pilot version of ALDOS and a special BB effort-check intercept survey.

Prior accounts of ALDOS methods, by both CDFW and a contractor (CIC Research, Inc.), describe the pilot version and summarize first results of comparison of ALDTS and ALDOS data. Pilot study data are now being further analyzed to help learn which surveys or mix of surveys, both intercept and offsite, might most reliably and cost-effectively be used to derive total effort estimates for modes PR and BB. For each month during the study period, initial analysis has compared four licensee populations: all California licensees, licensees with email addresses, and ALDOS and ALDTS survey respondents. Similarities and differences among these populations have been identified in one-month and twelve-month avidity, angler age, angler gender, and coastal versus inland angler residence. By and large, licensees with email addresses well represent all licensees, and ALDOS responses track well with ALDTS responses.

The ALDOS' initial 2023 design matches the pilot version. Experience during 2023 may lead to near-term survey refinements and improvements. To increase ALDOS response and coverage, CDFW will encourage license holders to voluntarily provide email addresses and will explore supplementing ALDOS email invitations with text message invitations.

Use of ALDOS-based (as formerly other offsite-based) Effort Estimates. For boat mode PR, each district's total effort estimate derives from estimates from both the offsite survey and the PR intercept surveys (PR1 and PR2 surveys). The latter surveys do intensively cover the boat trips which return to public access sites in daylight (PR-PAD) but do not cover the boat trips which return to private access sites or at night (PR-PAN). The offsite survey generates distinct effort estimates for each of PR-PAD and PR-PAN. By use of the ratio of these offsite estimates, the intercept-survey-based estimate of PR-PAD effort yields an estimate also of PR-PAN effort, and then of total PR effort (see Chapter 3, Section C). For shore mode BB, the offsite effort estimates are used directly (see Chapter 6).

Apportionment of ALDOS-based Effort Estimates by Water Area and Trip Type. For both PR and BB modes, ALDOS (as did ALDTS formerly) does collect water area and trip type information, but the offsite surveys' small ~~effective sample sizes~~ have yielded overly high coefficients of variation for apportioned estimates based just on offsite data. As a result, apportionment of a PR-PAN district effort estimate by water area and trip type is based not on the offsite data but instead matches that of the PR-PAD effort estimate generated from the copious onsite data. For apportionment of a BB district effort estimate by water area, an additional challenge is that sample sizes are small also for the onsite BB catch-rate survey. As a result, the BB apportionment is based on

combining the offsite and onsite data. (See Chapter 3, Section C; and Chapter 6). If ALDOS sample sizes can be significantly increased, future apportionment by water area (i.e., offshore ocean, nearshore ocean, or inland) and trip type may be able to rely solely on ALDOS data.

Angler License Directory and ALDOS Frame. Starting with licenses sold in 2011, all California sport fishing licenses have been sold via the CDFW Automated License Data System (ALDS). ALDS enables online license purchase. In addition, about 1,500 retail license agents and staff at 10 CDFW offices use ALDS to sell and issue licenses on the spot. The ALDS database is updated and backed up daily and serves as a real-time directory of all state-licensed anglers. The ALDOS survey frame for each covered month comprises all records in this directory at month's end for adult (i.e., age 18 and greater) licensees who have provided email addresses.

California issues about 1.8 million sport fishing licenses each year. All sport fishing licenses are good for fishing in saltwater and freshwater and for sport harvest of finfish, invertebrates, amphibians and reptiles. Annual licenses (i.e., resident annual, non-resident annual, reduced fee and free licenses) are good for 365 days; short-term licenses (i.e., one-, two- and ten-day licenses) are good for specified dates within the calendar year. Persons with lifetime licenses are required annually to register and update their contact information. On November 15, 2022, CDFW introduced a 365-day license which replaces the annual licenses. The 365-day license is effective for a continuous 365 days from the purchase date as opposed to outgoing annual licenses that were effective for the calendar year of purchase. (For a license purchased after November 15, 2022 and before 2023, the 365 days began on January 1, 2023.) Sport fishing licenses are not required for anglers under age 16, for fishing of marine waters from public piers, or on two 'free fishing' days which the State schedules each year.

State regulation requires a contact telephone number from every license purchaser. A sole exception exists for 'quick sale' licenses sold at CPFV landings and valid just on the sale date. For these licenses, a telephone number is required only for every twentieth purchaser.

In the ALDS database each license record includes: type of license, date and location purchased, license validity dates (shown explicitly on each short-term license), and the license holder's name, date of birth, gender, address, telephone number (except for a CPFV quick sale) and - if volunteered by the licensee - email address.

Sampling Design

Scope and Staging: One statewide one-stage survey for the survey-covered calendar month.

Target Population: All the month's saltwater angler fishing days in California.

Frame and Stratification: All adults (at least 18 years of age) in the angler license directory (i.e., ALDS database) at the end of the survey-covered month who had a valid license for at least one day of that month and moreover provided an email address. For legal reasons, persons under 18 years of age are not contacted by the online survey, even though they may be contacted by the intercept surveys.

Eligible license holders are stratified into five license types for sample selection (but the estimation procedures treat the resulting sample as a non-stratified simple random sample of all licensees). The five license type strata are: resident annual (about 95 percent of this strata are resident annual licenses and about 5 percent of this strata are a combination of lifetime, disabled veteran, recovering service members, reduced fee low-income senior and free licenses), non-resident annual, one-day, two-day and ten-day. In future, other stratification schemes may be employed if analysis indicates their likely advantage.

Sample Rate: ALDOS aims for a monthly number of complete responses which matches that of the pilot version, which in turn was designed to closely match that of the former ALDTS. Monthly quota numbers, approximately proportional to monthly effort, range from about 1,500 to 2,700, with an approximate annual total of 26,000.

Sample rate and monthly goals will be reevaluated in the near future to ensure that both MRIP data standards and fisheries management needs are met. Online survey economics readily permits much more intensive sampling, which would benefit estimate precision and - as noted above - could enable more realistic apportionment of effort among water areas and trip types. General (non-fishery-specific) survey design practice cautions that attempt to intensify sampling may backfire: overly frequent selection may tend to irk potential respondents toward non-cooperation. However, it is not clear that this presumption holds for state-sponsored offsite angler surveys like ALDOS. These surveys provide opportunity for anglers to report their successes – and to an agency whose mission in large part is to enable those successes.

Sample Selection and Scheduling: Stratified random sampling is used. To meet each month's quota for complete responses, a larger number (based on past response rates) of eligible license holders is selected for attempted contact.

As selection is random and each month defines a distinct survey, a given angler may be contacted more than once during the year for participation in the online survey.

Survey Methods

Shortly (within ten days) after the month whose activity is surveyed, ALDOS contacts each selected licensee via an email message. Trends in response rate during early experience with ALDOS were used to optimize email message sending times during the week. A link in the message enables convenient response. Response typically occurs directly on reading or within a few days. The link takes a willing responder to an online interactive survey whose questionnaire (i.e., sequence of displayed questions) is designed so that later questions follow up on initial answers.

The current ALDOS questionnaire is that of the pilot version, which for comparison purposes conformed closely, both in sequencing and in terminology, to the former ALDTS questionnaire. The ALDOS questionnaire was the result of lessons learned from years of experience in direct interview of anglers.

In one key respect ALDOS differs from ALDTS (and also from CRFS intercept surveys). ALDOS responses which are ambiguous or incomplete or otherwise problematic cannot immediately be clarified by sampler follow-up. For example, for many anglers the phrase 'fishing trip' is directly meaningful without need of definition - but the precise meaning, in terms of quantified effort, often requires clarification: it can vary from angler to angler, and even from context to context for a given angler. As a result, prior to generation of effort estimates, ALDOS responses must be reviewed by CDFW analysts. A small but significant percentage (up to 5%) of responses now require manual additions and adjustments to data tables prior to deriving effort estimates. Accordingly, CDFW analysts have been working to design future small modifications to the questionnaire which would reduce the percentage of problematic responses.

In brief, the survey asks a responding angler to provide respective counts of all California marine fishing days during the prior calendar month, for each of the two fishing 'supermodes' – namely boat counts (BN) and shore counts (SN). The angler is then asked to profile (i.e., to describe in detail, as specified below) up to five of the total number ($TN = BN + SN$) of those fishing days.

If the total number TN of days is 5 or less then the angler will be asked to profile each of these days. If TN exceeds 5 then the angler will be asked to profile just five days, as follows: (1) If just one of BN and SN is positive then profile all five most recent days for the positive supermode; (2) If BN is positive and SN is 4 or more, profile the one most recent boat day and the four most recent shore days; (3) If SN is 1 or 2 or 3, profile the 5-SN most recent boat days and all SN shore days.

The above scheme, from the ALDOS pilot version, favors shore over boat fishing when TN>5. Continued use of this scheme will be reevaluated in the near future.

For each profiled day the angler is asked for information sufficient to determine the fishing mode within the supermode (e.g., PC versus PR for boat mode; BB versus MM for shore mode). For modes relevant to ALDOS (i.e., PR and BB), the angler is asked for further information: the landing or shore site's county (used to identify its CRFS district) and access type (public or private), the primary water area fished (offshore ocean, nearshore ocean, or inland), and time of day of departure from and return to shore for PR mode and time of arrival to and departure from the site for the BB mode.

Note. The former ALDTS asked the angler to profile all fishing days, not just five, so a valid ALDOS response may be less informative than the same angler's valid ALDTS response. However, this loss of per-response information seems more than offset by cost savings and increased response rates promoted by limiting the number of profiled days to make survey response rapid and convenient. In fact, 92 percent of ALDTS interviews completed in the 2018 phase of the pilot study reported less than six saltwater trips.

Key Data Elements Collected

The online survey questions largely parallel those of the telephone survey interview that came before it. (Example questionnaires used in each of the surveys appear in Appendix C.) ALDOS collects the following key data elements:

1. Demographic and avidity information
 - a. Country, state and county of permanent residence
 - b. Proportion of fishing days in freshwater and in saltwater in the past 12 months
 - c. Number of saltwater finfish fishing days in the prior month (i.e., the prior calendar month, which is the survey-covered month)
2. For each - of up to a total of five saltwater fishing days in the prior month:
 - a. For boat fishing, type of boat: (CPFV, private skiff, rental skiff, paddleboard, inflatable (e.g., Zodiac). If not CPFV, then also these data:
 - 1- Type of launch site (e.g., ramp, hoist, marina, or beach)
 - 2- Site access (public or private)
 - 3- Water area fished (off-shore, near-shore, or bay/estuary)
 - 4- Times of boat departures and returns
 - 5- Whether fishing occurred by dark only, daylight only, or both
 - 6- County where fishing ended (where the angler came ashore)
 - 7- Trip type (i.e., primary target species)

b. For shore fishing: type of shore or shore craft: man-made structure (pier, jetty, dock, bridge) beach, bank, float tube, surfboard. If not man-made structure, then also these data:

- 1- Site access (public or private)
- 2- Water area where the fishing activity occurred (ocean or bay/estuary)
- 3- Times of on-site arrival and departure
- 4- Whether fishing occurred by dark only, daylight only, or both
- 5- County where the fishing occurred

Estimation Procedures

An ALDOS estimate of effort, in angler days, can be generated for each domain of month, district and for each of the three modes (i.e., PR-PAD, PR-PAN and BB). ALDOS now provides basic estimates, and in future – as soon as required software can be developed and validated - will also provide refined estimates which can better reflect impacts of differences among various angler categories in regards to both fishing activity and survey response rate.

ALDOS effort estimates are adjusted to incorporate effort by unlicensed anglers, who are not in the survey frame. The adjustment uses a ratio of unlicensed to licensed anglers derived from the intercept surveys. The intercept surveys query anglers on what types of license they have, and CRFS samplers record numbers of licensed and unlicensed anglers. For each domain, it is assumed that per-angler effort is the same for unlicensed and licensed anglers and for licensed anglers under 18 years of age and those over 18 years.

Basic Effort Estimation. For any domain - defined by a mode and district – the basic ALDOS effort estimate $E1^{\wedge}$ is obtained by simple expansion from the effective sample of n anglers (i.e., those contacted who submitted complete responses) to the population of all N licensed anglers in the ALDS database at the end of the survey-covered month:

$$Eq.2.1 \quad E1^{\wedge} = N \bar{t}$$

Here \bar{t} is the sample's mean per-angler estimated number of days fished in the domain; i.e.,

$$\bar{t} = (1/n) \sum t^{\wedge}(i)$$

where summation is over the n anglers i in the sample, and estimated effort $t^{\wedge}(i)$ by each angler i is found by the following three steps:

-1- Let t_R = the number of fishing days reported (by angler i) in the given mode's supermode (i.e., boat supermode for mode PR-PAD or PR-PAN; and shore supermode for mode BB). Note that the boat supermode could include PC trips in addition to PR trips and the shore supermode count could include MM trips in addition to BB trips. If $t_R=0$, then set $t^{\wedge}(i) = 0$; otherwise continue to steps 2 and 3.

-2- Let t_P = the number (necessarily >0) of fishing days in the supermode which are profiled. Let t_V = the number among the t_P profiled fishing days which are validated as California saltwater fishing days for the given domain (i.e., given mode and district).

-3-. Set $t^{\wedge}(i) = t_R \cdot t_V / t_P$.

This procedure implements the default assumption that, within each supermode, each domain - defined by district and fishing mode - accounts (on average) for the same fraction of all the reported trips as of the profiled trips.

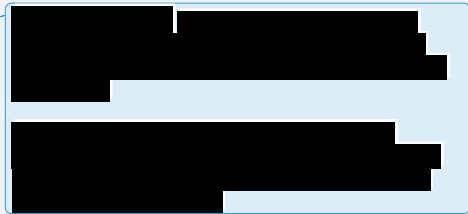
Note. Estimation by Water Area and Trip Type. The above procedure can also be used to derive effort estimates partitioned by water area (and, for PR-PAN, by trip type). One need only define the domain by water-area (and trip type) as well as by district and mode. This approach avoids recourse to intercept survey data but, as noted earlier, may yield high coefficients of variation due to small effective sample sizes.

The variance of the above effort estimate $E1^{\wedge}$ is estimated from the sample data by:

$$Eq. 2.2 \quad Var^{\wedge}(E1^{\wedge}) = [N^2/(n(n-1))] \sum (t^{\wedge}(i) - \bar{t})^2$$

Refined Effort Estimation. Eq. 2.1 assumes that the n survey respondents are representative (i.e., a size- n simple random sample) of all N licensed anglers in the ALDS database. A more refined approach can give distinct weights to the effort estimates of distinct respondents to account for differences in mean per-angler effort or in response rate among identifiable categories of anglers.

The license record data in the ALDS database provide (or allow deduction of) various angler attributes, such as birth year, residence county, and gender. Based on one or more such attributes, all licensees in the database may be partitioned into some number $L > 1$ of nonempty exclusive and exhaustive categories - alias 'levels', 'strata', 'post-strata', 'cells', or 'subpopulations'. In effect, basic estimation takes $L=1$ and uses just one category.



For any given month and mode of estimation, an analysis of recent past data on effort and response of various licensee types may suggest a useful system of $L > 1$ categories. To reduce bias and maintain precision, the category system should be one where each category typically accounts for a reasonably large number of responses, and where there is reason to expect differences among categories in effort per responding angler.

Definition of Categories: Example. For a hypothetical illustrative instance, suppose that birth year is used to assign each licensee to one of four age bins:

-A1: under 21, A2: 21-40; A3: 41-60; A4: 61 and over

Suppose further that residence county is used to assign each licensee to one of the following five county bins, based on the six CRFS coastal districts:

-C1: District 1; C2: Districts 2 and 3; C3: District 4; C4: Districts 5 and 6; C5: inland

Taken together, the bin assignments create $4 \times 5 = 20$ compound bins. If each compound bin is used to define a separate category, the result is a system of $L = 20$ categories.

However, quite likely it will be found that some compound bins account for relatively few responses, and that recent past data suggest that some compound bins will not significantly differ from others in regards to per-angler effort. For instance, suppose that all age bins together account for only a modest number of responses from each of C4 and C5, and that for each of C1, C2 and C3 the younger two age bins tend to closely agree in per-angler effort. In that case, a more effective category system would comprise just $L = 11$ categories, defined by the following list of 11 groups of compound bins:

A1-C1, A2-C1;

A3-C1;

A4-C1;

A1-C2, A2-C2;

A3-C2;

A4-C2;

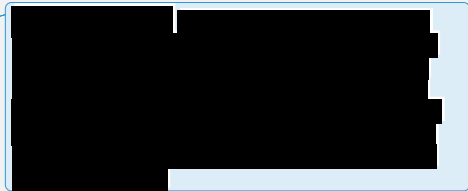
A1-C3, A2-C3;

A3-C3;

A4-C3;

A1-C4, A2-C4, A3-C4, A4-C4;

A1-C5, A2-C5, A3-C5, A4-C5.



Refined Estimation Procedure. Number the L chosen categories from 1 through L , and for each integer h ($1 \leq h \leq L$) let N_h be the size of category h , and let $W_h = N_h/N$ be the category's fraction of all licensees.

For any given survey-covered month at month's end, the ALDS database enables exact determination of all these values. Also, as soon as the survey response period closes, the total number n of respondents can be fully known, as well as, for each h ($1 \leq h \leq L$) the number n_h of respondents from category h , and the fraction $w_h = n_h/n$ of all respondents who are in category h .

For estimation of effort for a given domain defined by a mode and district, the basic principle is that the n_h available respondents in category h are taken to represent the N_h anglers in the full category h . The resulting refined estimate of effort is then given by:

$$\text{Eq. 2.3} \quad E1^\wedge = \sum [(N_h \bar{t}_h)]$$

where \bar{t}_h is the mean value of $t^\wedge(i)$ for the n_h respondents in category h , and the summation is over the L categories h ($1 \leq h \leq L$)

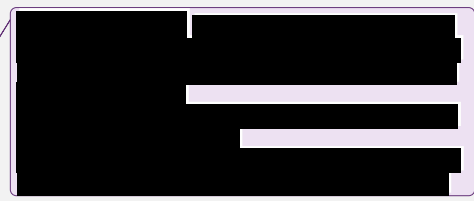
This estimate can also be expressed as (N/n) times a weighted sum, over all n respondents, of their individual effort values, namely as the sum of all values $t^\wedge(i)v_h$, where each respondent's estimated effort $t^\wedge(i)$ is multiplied by the respondent's category's weight value $v_h = W_h/w_h$.

The variance of the effort estimate given by Eq. 2.3. is estimated from the sample data by summing the L separate variances found from sample data by the procedure given by Eq. 2.2, with N_h and n_h replacing N and n . That is:

$$\text{Eq. 2.4} \quad \text{Var}^\wedge(E1^\wedge) = \sum [N_h^2/(n_h(n_h-1))] \sum (t^\wedge(i) - \bar{t}_h)^2$$

Here, the first summation is over the L categories h , and for each h the second summation is over the n_h respondents i in category h .

Technical Note. Eq. 2.4 is the usual estimate for variance of a stratified random sample estimate (where each 'finite population correction' factor is taken as 1, and therefore the estimate is slightly conservative, i.e., overlarge). The estimate $E1^\wedge$ given by Eq. 2.3, however, is a post-stratified estimate. A textbook approach would call for adding a small extra term in Eq. 2.4. Such an approach, however, is needless and dubious, for the following four reasons. (1) The extra term will be negligible for reasonably large values of all the n_h . (2) As noted, the above formula is itself already conservative. (3) The textbook case assumes that n is pre-fixed by design, so that – for



example - a given value of n_1 may significantly constrain n_2 . However, the above formula for the stratified case is actually correct not only when n and the n_h are pre-fixed in a stratification but also, more generally, in a post-stratification wherein the n_h vary independently. In the actual case at hand, n is a variable result of prompting M licensees, where M is multiple times n , so that the various values n_h do vary nearly independently. (4) The prior point not only drastically reduces the 'needed' size of adjustment, but also much complicates calculation of a good (i.e., better than zero) approximate value for it.

Adjustment for Unlicensed Anglers. BB and PR effort estimation must account for effort E_2 by unlicensed anglers which are not in the survey frame. To estimate this effort, intercept survey data (i.e., from the PR1 and PR2 intercept surveys or from the BB catch-rate survey) are first used to obtain estimates of the following:

p = proportion of anglers (in the fishing mode) who are unlicensed
 $q = 1-p$ = proportion of anglers (in the fishing mode) who are licensed
 r = ratio of unlicensed to licensed = p/q

From the intercept survey, p is estimated by $p^\wedge = U/n_A$ where n_A is the number of intercepted anglers and U is the number of those anglers without a license. Then q and r are estimated respectively by $q^\wedge = 1-p^\wedge$ and $r^\wedge = p^\wedge/q^\wedge$. Estimates p^\wedge and q^\wedge are unbiased and estimate r^\wedge is nearly so. Effort E_2 by unlicensed anglers then is estimated by

Eq. 2.5 $E_2^\wedge = r^\wedge E_1^\wedge$

A nearly unbiased variance estimate for E_2^\wedge is obtained from the unbiased estimator version of the Goodman formula for the variance of a product of independent random variables. Namely,

Eq. 2.6
$$\begin{aligned} \text{Var}^\wedge(E_2^\wedge) &= \text{Var}^\wedge(r^\wedge E_1^\wedge) \\ &= r^{\wedge 2} \text{Var}^\wedge(E_1^\wedge) + E_1^{\wedge 2} \text{Var}^\wedge(r^\wedge) - \text{Var}^\wedge(r^\wedge) \text{Var}^\wedge(E_1^\wedge) \end{aligned}$$

If n_A is large (> 1000 will suffice), the factor $\text{Var}^\wedge(r^\wedge)$ is negligible and the last two right-hand terms may be dropped in calculations. Otherwise, this formula for $\text{Var}^\wedge(E_2^\wedge)$ requires a value for $\text{Var}^\wedge(r^\wedge)$. A 'delta-method' - alias 'Taylor' - approximation gives the value $\text{Var}^\wedge(r^\wedge) = r^\wedge/[q^\wedge n_A(n_A-1)]$.

Total estimated effort E^\wedge for licensed and unlicensed anglers is the sum of the separate estimated effort values:

Eq. 2.7 $E^\wedge = E1^\wedge + E2^\wedge = (1+r^\wedge)E1^\wedge$

From the unbiased estimator version of the Goodman formula and the fact that $Var(1+r^\wedge)$ is just $Var(r^\wedge)$ (adding a constant to a random variable doesn't alter the variance), we obtain:

Eq. 2.8 $Var^\wedge(E^\wedge) = Var^\wedge[(1+r^\wedge)E1^\wedge]$
 $= (1+r^\wedge)^2 Var^\wedge(E1^\wedge) + E1^\wedge{}^2 Var^\wedge(r^\wedge) - Var^\wedge(r^\wedge)Var^\wedge(E1^\wedge)$

From the above formula for $Var^\wedge(E2^\wedge)$ the formula for $Var^\wedge(E^\wedge)$ can be rewritten as

Eq. 2.9 $Var^\wedge(E^\wedge) = Var^\wedge(E2^\wedge) + (1+2r^\wedge)Var^\wedge(E1^\wedge)$

Residual Bias: Persistence and CDFW Response. The above refined approach to estimation addresses bias which can owe to inter-category differences in mean per-angler effort and in survey response rates. However, the approach does not address the core of the long-time widespread concern over potential for high-biased effort estimates from offsite angler surveys. In itself the approach does not guarantee that respondents from each category sufficiently well match the non-respondents in regard avidity. As a result, there is no guarantee that, without big adjustments, effort estimates from an offsite survey are realistic in scale (as versus trend).

In CDFW's experience with the CRFS surveys, offsite-based estimates of PR-PAD effort have, on average, consistently overestimated (on average by factors close to 2) the effort actually measured in the intensive PR intercept surveys. For this reason, in 2008 the estimation of PR-PAN effort changed: in place of using the offsite estimate PR-PAN directly, the PR-PAN estimate has been deduced by use of the PR-PAD intercept estimate in conjunction with the ratio of PR-PAN and PR-PAD offsite effort estimates.

More generally, CDFW's experience suggests that ability to correctly scale offsite-based estimates to realistic scale requires occasional independent checks that allow for comparison of offsite-based estimates with corresponding intensive interception-based estimates. For this reason, CDFW plans to recurrently conduct such checks for modes PR and BB.

To enable such checks, and thereby permit 'apples to apples' comparison between intercept and offsite data, the ALDOS questionnaire (as did the former ALDTS questionnaire) by design contains questions which enable survey data to distinguish effort (e.g., PR-PAD effort) which is subject to intercept survey coverage from effort (notably PR-PAN) effort) which is not. This feature of the questionnaire is deemed essential and outweighs the need for maximum possible brevity.

END

TO: Rob Andrews, John Foster, Richard Cody
National Marine Fisheries Service (NMFS)
National Oceanic and Atmospheric Administration (NOAA)

FROM: Jill A. Dever, RTI International

DATE: January 17, 2023 (updated from prior submission on July 26, 2022)

RE: Updated Review of Materials for the California Department of Fish and Wildlife's (CDFW)
Angler License Directory Online Survey (ALDOS)

This memo summarizes an updated review of materials provided by CDFW for the Angler License Directory Online Survey (ALDOS) submitted to NMFS on 19 September 2022 and on 3 January 2023. The review focuses on NOAA's current Fisheries' Marine Recreational Information Program (MRIP) certification terms of reference (TORs). For documentation purposes, this memo also summarizes the materials made available for the certification. Relevant comments from prior review memos are included for context.

CDFW is complimented on the thoroughness of response to the most recent set of questions that have clarified many issues.

Comments on ALDOS Certification Terms of Reference

1. Does the survey design follow a formal probability sampling protocol with known inclusion probabilities at all stages and/or phases of sampling?

Response: Yes, TOR #1 is believed to be sufficiently satisfied.

Note, however, that questions remain on the efficiency of the design where stratification may prove of use to improve precision and thereby to lower cost.

[01/17/23] Per CDFW, "We do not think incorporating stratification by license type would be a good idea because small sample sizes from all but the top two license stratum will yield estimates of high variance." This is a valid consideration for sampling.

CDFW may wish to evaluate stratification by ZIP code to ensure coverage of each of the six districts (South, Channel, Central, San Francisco, Wine, and Redwood).

2. Do the estimation methods appropriately weight the sample data to account for the sampling design and produce design-unbiased point estimates and variance estimates?

Response: Please see question about investigation of a more refined nonresponse adjustment.

[01/17/23] The document *CRFS_Methods_ALDOS (2022_06_03).pdf* contains a description of the inverse probability weights used to generate estimates – see *Eq. XX.1*. “N” in this expression appears to be the total number of licenses *with an email address*, defined as roughly 38 percent of the complete list of licenses in 2021. The 3 January 2023 document further clarified that “N” is the total number of eligible license on the file regardless of email availability.

Per email communication with NMFS on 12/8/22, “[CDFW] CA is planning to incorporate weighting adjustments to account for the differential response/coverage.” An outline of the methodology was provided in September – see [09/19/22, CDFW Response #8] below. This effort is welcomed along with the associated documentation.

Revised Response: Yes, TOR #2 is believed to be sufficiently satisfied.

3. Are appropriate methods in place to measure and/or correct for potential biases due to undercoverage, nonresponse, or response errors?

Response: More information is needed to assess TOR #3. Statistically insignificant differences from ALDTS estimates are not sufficiently informative to quantify bias in the ALDOS estimates.

[09/19/22, CDFW Response #14] *Yes, agreement of ALDOS with ALDTS estimates does not tell us what sort of biases enter these estimates.*

But CDFW can measure and correct for biases through sufficiently frequent comparison of ALDOS estimates with corresponding field-based estimates (e.g., ongoing field survey for PR PAD and pilot study for BB effort check survey).

This comparison will enable CDFW to substantially adjust and correct ALDOS estimates for the net effect of all biases, even though we will not necessarily learn details on the individual sources of bias such as undercoverage of, or increased or reduced response from, certain subpopulations.

[01/17/23] The document *CRFS_Methods_ALDOS (2022_06_03).pdf* contains an estimate for unlicensed anglers tabulated by adjusting *Eq. XX.1* by a factor determined from the intercept survey – see *Eq. XX.4*. Additionally, the plan noted above appears appropriate to adjust for overall bias.

Revised Response: TOR #3 is believed to be sufficiently satisfied.

4. How sensitive is the accuracy of the survey to assumptions made about segments of the target population that are not covered by the survey frame? What can be done to reduce or limit that sensitivity?

Response: More information is needed to assess TOR #4. See TOR #3 response and comments in the accompanying document about anglers without internet access. As noted above and within the accompany documentation, augmenting the sample to include anglers providing cellular telephone numbers may improve sampling frame coverage.

[09/19/22, CDFW question] Per MRIPALDOSMethodsReview_CDFWResponse_09092022.pdf:
Could MRIP provide clarification on what reverse matching is and how investigating it would benefit CRFS?

[01/17/23] In response to the question above, reverse matching is a process where contact information is obtained for a person given other identifying information (e.g., name, address). CDFW may contract with a vendor to match available angler information – name, address, phone number – to identify one or more email addresses or cell phone numbers to expand eligibility in the sampling frame.

CDFW conducted an evaluation to determine if significant differences in avidity was detected among licensed anglers with and without providing an email address. Finding none, they concluded that using a subset of the license list was adequate for sampling. See comments for TOR #2.

Additional information is welcome on the text message pilot study when results become available. The 3 January 2023 communication indicates interest to include those with a cell phone number but without an email address. CDFW may consider evaluation of recruitment order (cell first followed by email recruitment vs. the opposite).

Revised Response: CDFW has conducted evaluations to evaluate coverage bias. The text message pilot will hopefully highlight a viable option to expand coverage for ALDOS in addition to lower participant burden across time (by increasing the frame size and reducing the change that an angler will be selected multiple times per year). TOR #4 is believed to be sufficiently satisfied.

5. How sensitive is the accuracy of the survey to other potential sources of nonsampling error? What can be done to reduce or limit that sensitivity?

Response: More information is needed to assess TOR #5. Please see comments on mail and text-based recruitment in the accompanying pdf files.

[01/17/23] CDFW responded to the nonsampling error questions posed in the previous review document. This information provided additional context for analyses conducted to assess several sources for nonsampling error. The relatively low response rates (that are in line with other online surveys of various topics) remain a concern; however, assessment of nonresponse adjustments to the analysis weights may prove beneficial to lower nonresponse bias. Consequently, TOR #5 is believed to be sufficiently satisfied.

6. How sensitive is the survey design to potential errors in implementation? What can be done to evaluate, reduce or limit that sensitivity?

Response: More information is needed to assess TOR #6 – see responses to TORs above.

[01/17/23] Based on responses provided in September 2022 and the reports evaluated in July 2022, the survey design (or more specifically, the data collection protocol) does not appear to be sensitive to errors of implementation. Consequently, TOR #6 is believed to be sufficiently satisfied.

7. **How does the survey design compare to the legacy survey design it would replace? Is it more statistically sound and efficient, or is it at least comparable in its statistical validity and efficiency? What design features are most important in supporting this assessment?**

Response: More information is needed to assess TOR #7 for the comparison of ALDTS and ALDOS point estimates and measures of precision.

[09/19/22, CDFW Response #15] *CDFW agrees that more information is needed for the requested comparison. CDFW analysts right now are working to analyze data collected between May 2018 and June 2022, in order to produce such comparisons - among others.*

Of equal or potentially greater importance in the future is the comparison of ALDOS estimates (and thereby evaluation of ALDOS design) with estimates from our best available 'ground truth' sources - primarily the PR-PAD and BB effort check field surveys. This comparison, if made and updated frequently enough, will enable CDFW to credibly adjust ALDOS estimates, thereby enabling ALDOS to be a useful source of effort information.

TOR 7 is framed in terms of replacement of a legacy survey but CDFW has no choice but to replace the legacy survey with a more affordable online survey due to rising operational costs and budgetary limitations.

[01/17/23] CDFW notes most recently in their 09/19/22 communication that an extensive set of comparisons of ALDOS and ALDTS were conducted with no detectable difference in the estimates. ALDOS is noted as being more cost effective than its predecessor telephone survey. Evaluation of the ALDOS analysis weights mentioned above should remain an area of focus in addition to expanding the eligible pool of anglers for sampling. TOR #7 is believed to be sufficiently satisfied.

8. **How does the survey design compare with other survey designs previously certified by MRIP for estimating fishing effort and/or catch for the same fishing mode(s)? Is it more statistically sound and efficient, or is it at least comparable in its statistical validity and efficiency? What design features are most important in supporting this assessment?**

Response: TOR #8 is outside the scope of this review.

9. **Is the survey collecting data and producing information products that will meet the needs of the primary customers (stock assessment scientists and fishery managers)?**

Response: TOR #9 is outside the scope of this review.

CDFW-ALDTS Materials – Comments and Responses

Document = *CDFW_Report_MRIP Cert-CRFS Methods_V2_170927.cr.pdf*

- 6 geographic districts for estimation (South, Channel, Central, San Francisco, Wine, and Redwood)
- Monthly survey to estimate effort. Questionnaire found in Appendix C.
- Frame = Automated License Data System; annual, short-term (1-, 2- and 10-day), and lifetime licenses
 - Undercoverage = youth (<18 yrs. [license requirement + frame exclusion]), anglers fishing on public piers in marine waters, and 2 ‘no license’ days
 - Phone number not required for 1-day license
 - What proportion of the frame are 1-day license to assess level of undercoverage?

[09/19/22, CDFW Response #1] *ALDTS estimation methods include an undercoverage adjustment for unlicensed anglers (includes youth <18 yrs). Counts of licensed and unlicensed anglers collected as part of the onsite field surveys inform the adjustment. The adjustment made to private and rental mode effort estimates requires the assumption that unlicensed proportion from private access or night fishing is the same as daytime fishing at public access sites.*

Regarding anglers fishing on public piers in marine waters, CRFS does not rely on data from ALDTS to estimate effort from anglers fishing on public piers. Onsite field data informs estimates of effort for the man-made mode.

Regarding phone number not required for 1-day license, phone numbers are required for majority of 1-day license sales. An exemption from the phone number requirement is limited to 1-day license sales at Commercial Passenger Fishing Vessel (CPFV) landings to speed up the purchase for groups of anglers prior to a CPFV trip. These 1-day license sales are referred to as quick sales.

Quick sales of 1-day sport fishing licenses accounted for 9% of total licenses sold in 2021. Phone numbers and other demographic information are only required for 1 in 20 quick sales. Quick sales represent the only undercoverage in one-day licenses and account for less than 9% of the frame. Since quick sales are made at CPFV landings we assume that all effort, or at least the vast majority of effort, associated with quick sales is for CPFV fishing. CPFV logs, as opposed to the offsite survey, are used to generate Party/Charter (PC) effort estimates. CDFW is evaluating removing quick sales from the ALDOS license frame to address undercoverage.

Other sales of 1-day sport fishing licenses accounted for 18% of total licenses sold in 2021. Phone number and other demographic information are required for all 1-day sport fishing licenses not sold as a quick sale.

- “Eligible license holders are stratified into five license types for sample selection (but the estimation procedures treat the resulting sample as a non-stratified simple random sample of all licensees)”: resident annual, non-resident annual, one-day, two-day and ten-day.

- Should look into variance estimation as their precision may be better than estimated if strata accounted for in the calculation. This could have implications for comparing the two surveys.

[09/19/22, CDFW Response #2] *The five license types used for sample selection are aggregates of California's ten license types. The resident annual license type accounted for approximately 68% of all license sales (excluding quick sales for which CDFW has no demographic data) in 2021. The one-day license type (with demographic data and including quick sales with demographic data) accounted for approximately 19% of all license sales in 2021. Non-resident annual accounted for less than 1%, two-day accounted for 4%, and ten-day accounted for less than 1% of license sales in 2021. We do not think incorporating stratification by license type would be a good idea because small sample sizes from all but the top two license stratum will yield estimates of high variance.*

In addition, ALDTS is used for estimation of effort for multiple modes. We worry that stratified sample selection that works for one mode may not work for other modes sampled by the same survey. Specifically, our assumption is that the majority of one-day license sales are likely purchased for boat trips in the party/charter (PC) mode (CDFW does not rely on ALDTS for estimation of PC mode effort) or possibly the private and rental (PR) boat mode. Our worry is that stratification by license type could result in small sample sizes from the one-day license type for the beach and bank fishing mode and possibly also for the PR mode.

Analytical and programming capacity is limited and CDFW will need to balance available resources with existing priorities to address this concern. CDFW will evaluate the workload in calculating variances and evaluate feasibility.

- Sample rate by strata is not provided, just an overall number of completed interviews. However, stratified simple random sampling (SRS) with counts proportional to frame size mentioned.
- There are no concerns about selecting a licensed angler multiple times across the season given effort needs (prior month trips).
 - However, recall bias may be at play for avid anglers and concern over respondent burden is appropriate (a topic visited in the most recent ALDOS Data Collection Report).

[09/19/22, CDFW Response #3] *Can you tell us more about what MRIP has learned about respondent burden? Our sample frame is composed exclusively of licensed anglers and we wonder if their dedication to the fisheries they participate in might reduce the impacts of respondent burden.*

ALDTS frame is robust compared to the sample size (i.e., 2.4%) so the probability of multiple selections is very low. However, with ALDOS, the probability is high enough to warrant concerns for burden. We are investigating using text messages to supplement the frame as well as increasing the email frame by encouraging anglers to provide an email address when they purchase a license.

- How likely are the addresses to map to the districts, a key analytic domain that could be used in the sampling design for improved efficiency?

[09/19/22, CDFW Response #4] *Can you tell us more about what MRIP has learned about*

ALDTS sample sizes can be small for some districts (i.e., northern California) so CDFW agrees that it is worth considering geographic stratification.

CRFS samplers record zip code for most of the anglers interviewed as part of the field survey. We plan to summarize CRFS field data for the BB and PR modes to determine zip code of residence by district for anglers interviewed to inform how angler zip code of residence compares to CRFS district boundaries.

Similar to stratification by license type, we worry that geographic stratification that works well for one mode may not work for other modes sampled by the same survey. For example, PR anglers may stay closer to home due to fuel costs associated with towing their boat or because they have their boat in a slip whereas BB anglers may travel more due to portability of fishing gear. Does MRIP have any recommendations for this concern?

Also similar to stratification by license type, the time of our programmer is limited and we worry about time needed to implement this change.

CDFW-ALDOS Materials – Comments and Responses

Document = *CRFS_Methods_ALDOS (2022_06_03).pdf*

- Assume ALDOS estimates will need to be down-weighted (Chp. 3, Sec. C in the ALDTS referenced document) “Step 2 – Apply a scaling factor to the direct estimates from ALDTS to account for an apparent bias in the direct ALDTS estimates.”
 - This is based on analytic results from 2014 – time to re-evaluate this assumption?

[09/19/22, CDFW Response #5] *Correct that our plan is to down-weight ALDOS estimates using the same methods described in Chp. 3, Sec. C in the ALDTS referenced document.*

We agree that it is time to update the scaling factor with more recent data and we plan to complete this work for both ALDTS and ALDOS as part of our effort comparison study. PR public access and daytime (PAD) effort estimates from the field survey will be compared to PAD effort estimates generated from ALDTS and ALDOS.

In addition, CDFW completed a pilot field study to collect data that can be used to generate daytime and public access estimates of BB effort. This pilot study ran from May 2018 to January 2019 and then November 2020 to June 2022. Effort estimates from this pilot study should allow CDFW to implement a similar scaling factor for BB effort estimates.

[01/17/23] CDFW is commended for these detailed and likely informative results.

- I would like to understand the frame coverage for ALDTS to know how it compares with 38% of the frame having email addresses. The ALDOS Data Collection Report indicates that the proportion of confirmed “bad email addresses” is relatively low (~2%).

[09/19/22, CDFW Response #6] *Telephone numbers are required with all license purchases except for 1-day licenses sold as quick sales as described in CDFW Response #1. Quick sales without demographic data accounted for less than 9% of licenses sold in 2021.*

Each month CIC Research Inc (CIC) provides a report that breaks call results into 17 different categories. CDFW summarized call results from the April, May, and June 2022 surveys and found that “bad” telephone numbers represented an average of 12% of calls made. The majority of “bad” telephone numbers each month were recorded as “number not in service”. Other categories of “bad” telephone numbers include “Fax/Modem”, “Wrong number”, “Blocked number”, and “Business”.

- Equations need to be revised to ensure a clear understanding. Assume it follows ALDTS.

[09/19/22, CDFW Response #7] *Could the consultant provide additional information to ensure we are interpreting this comment correctly?*

[01/17/23] *The formula in the pdf document appear to be corrupted making the information difficult to interpret.*

- Has CDFW evaluated a nonresponse adjustment that accounts for characteristics available on the frame (e.g., geography, age)?

[09/19/22, CDFW Response #8] *CDFW has not evaluated a nonresponse adjustment that accounts for characteristics available on the frame. Nonresponse adjustments are something we could research as time allows as long as we are able to fill several gaps in the data we received from CIC each month.*

The sample frame that was provided to CIC includes the following characteristics:

1. *License type*
2. *City*
3. *State*
4. *Zip*
5. *Country*
6. *Zip code and county where the license was purchased*
7. *Age in years*

License type purchased, U.S. home zip code, and foreign country are the only characteristics from the sample frame included in the data of completed ALDOS results that CIC shared with CDFW each month despite the fact that the sample frame included additional characteristics. In addition, CDFW did not request that CIC provide details of anglers who did not respond. CDFW is working with CIC to gain access to records of nonresponse as well as past sample frames with all characteristics that includes the unique ID CIC assigns to each angler that can be used to merge nonresponse and response results with characteristics from the frame.

Gender of angler was not included in the sample frame shared with CIC but gender is collected when a license is sold. CDFW plans to modify the data sharing agreement with Pacific States Marine Fisheries Commission and CIC so that gender can be included in future sample frames shared with CIC. Note that it may not be feasible to merge the sample frame used by CIC to CDFW license data to assign gender for the May 2018 to June 2022 survey results.

- Because the sampling design is much the same as ALDTS, the ALDTS questions also pertain to this design (sans stratification by license type). What is the rationale for simple random versus stratified simple random sampling?

[09/19/22, CDFW Response #9] *Please see CDFW Response #2 above.*

- How long does CDFW intend to conduct both ALDTS and ALDOS?

[09/19/22, CDFW Response #9] *ALDTS and ALDOS were both conducted May 2018 to January 2019 and then November 2020 to June 2022. We don't have future plans to conduct them in parallel aside from a separate short pilot study to assess the feasibility of text message invites to ALDOS.*

- Please see additional comments in the accompanying document, 2022_0701 CRFS_Methods_ALDOS (2022_06_03).pdf

[09/19/2022] CDFW provided clarification to comments – see *MRIPALDOSMethodsReview_CDFWResponse_09092022.pdf*

CDFW-ALDOS Data Collection Report, July 2021 to June 2022 – Comments and Responses

Document = *Final Report ALDOS 21 22 Final.pdf* (emailed to NMFS 12 July 2022)

- Please see comments under *CDFW-ALDOS Materials* above especially related to the sampling design.
- CDFW may wish to consider evaluating study recruitment via text message with available cell phones on the sampling frame to increase coverage beyond 38%.

[09/19/22, CDFW Response #11]. *CDFW is moving forward with a pilot study to test the feasibility of using text messages to invite license holders to participate in ALDOS. In the early spring of 2022, a sample of the ALDTS frame was pinged to determine the phone type. 83% of primary phone numbers provided during license purchases were cellular. License holders are prompted to voluntarily provide two other phone number types (i.e., evening phone and cell phone). CDFW plans to use cellular number then primary number when cellular number is null to increase the percentage of anglers in the text message pilot study above 83%*

The pilot study just received CDFW's Office of General Council, Office of Communication, Education and Outreach, and Data and Technology Division Information Security approval to send out text messages. We expect the pilot study will take six weeks from implementation to reporting with a final report late October. The pilot study will link license information (e.g., demographics) through survey completion. All metrics will be collected in the same format as ALDOS with the email invite.

Several configurations of text messages (i.e., sms mms) with varying formats and logos will be tested. In all 10,000 text messages will be sent and tracked through each step of the process (received, opened, opened link to survey invite, opted out, time spent on survey invite web page, opened link to survey through completion). Results will inform the decision to

incorporate text messages into ALDOS considering both survey needs and CDFW communication and information security policy requirements.

More information on the pilot study is available by request.

- Assuming reminder emails are relatively inexpensive, CDFW may also consider an additional reminder contact to the sample members to increase response.

[09/19/22, CDFW Response #12] *Please see CDFW's response to the consultant's question on ALDOS Data Collection Report page 3.*

- Additional information on the following aspects would provide further insights for this evaluation:
 - differences between the ALDOS and ALDTS estimates (overall and by subdomain) including results from statistical testing
 - email-based recruitment (e.g., subject line)

[09/19/22, CDFW Response #12] *Regarding differences between the ALDOS and ALDTS estimates, CDFW staff are working to produce ALDOS effort estimates for PR and BB for the full ALDOS time series and then will provide MRIP with comparisons to ALDTS statewide and by CRFS district.*

The initial letter provided in the CIC report is embedded in the body of the email. The Subject line = California Department of Fish and Wildlife Needs Your Help. We have not experimented with modifications to the email as we wanted branding to be consistent. CIC used the same provider throughout the duration of the survey. From previous experiences CIC found that there are not substantive differences in delivery capabilities among major companies but only minor differences in reporting options. Constant Contact provided all capabilities needed to link and track emails.

- Please see additional comments in the accompanying document, *2022_0712 Final Report ALDOS 21 22 Final .pdf*

[09/19/2022] CDFW provided clarification to comments – see *MRIPReviewOfCICDataCollectionReport_CDFWResponse_09092022.pdf*

CRFS_Methods_ALDOS_12292022.docx

- The document provides an update to details provided in September 2022.
- CDFW states that going forward comparisons of ALDOS to the intercept information is important especially with the close of ALDTS.
- The text message pilot to assess enhanced frame coverage may include an examination of mode order for license records with both email and cell phone. CDFW may wish to advertise recruitment via email / text to the angler community (e.g., message boards) to heighten awareness of the study and of the email / text.
- CDFW may investigate inclusion of district as strata in the ALDOS sampling design to enhance respondent information by district especially if nonresponse patterns differ by geography.

- CDFW may wish to investigate length of license (and number of license?) against ALDOS participation rates or responses to the survey as a measure of nonresponse bias or levels of avidity.
- Regarding possible confusion of terms in the questionnaire, has CDFW piloted the utility of definitions within the online instrument that could include examples for clarity?

California Recreational Fisheries Survey Methods



State of California
Natural Resources Agency
Department of Fish and Wildlife
2022

PREFACE

This document is an overall description of the California Recreational Fisheries Survey, as designed and administered by CDFW, and of the methods CDFW uses to produce recreational catch and effort estimates. This document updates the two prior versions of CRFS methods from years 2011 and 2017. This 2022 update is part of a CDFW effort, stimulated by the 2020 implementation of NOAA Fisheries' Recreational Fishing Survey and Data Standards, to improve documentation that supports CRFS operations, transparency, and continual evaluation and improvement of methodology.

The goal of this document is to be as useful as possible to data users, survey statisticians, stock assessors, fisheries scientists, and others that need or want a comprehensive understanding of the technical details of the survey's methodologies. As a result, CDFW intends to update it as needed to reflect survey redesigns and newly implemented estimation methods, as well as to improve its completeness and clarity. The preface of each future version will include a log of changes made since the latest prior version.

The following changes are reflected in this 2022 update of the 2017 version:

- Overview of anticipated changes in survey design and implementation.
- Description of legislative mandates that support CRFS.
- Description of intended uses, users of data products, and availability of data products.
- Description of data quality assurance and quality control.
- Description of the CRFS data system.
- Overview of historical planned changes in design as well as unplanned deviations from benchmark survey design.
- Addition, in Appendix H, of an alternate model-based method for estimating angler effort on private and rental boats that return to private-access sites or at night (PR-PAN). Funding constraints that prevent administering an off-site survey will cause the method described in Section C of Chapter 3 to be temporarily replaced by the model-based method. Funding constraints resulted in the temporary use of the method described in Appendix H January 2018 through October 2020. Future use of the model-based method will occur only if administration of off-site methods is prevented.
- Addition, in Appendix I, of a draft replacement for Section C of Chapter 3 that is pending MRIP review and is not yet implemented in the CRFS data system. The draft includes proposed variance formulas and calculation methods for estimates of PR-PAN angler effort as well as calculation methods for variance of estimates of total PR effort and catch. The methods in Appendix I, if certified, will replace Section C of Chapter 3 and will allow for calculation of variance that is not currently possible using existing methods.
- Minor changes to improve clarity.

ACRONYMS

ALDOS	Angler License Directory Online Survey
ALDTS	Angler License Directory Telephone Survey
BB	Beach and bank fishing
CDFW	California Department of Fish and Wildlife
CPFV	Commercial passenger fishing vessel
CRFS	California Recreational Fisheries Survey
MM	Man-made structure fishing
MRIP	National Marine Fisheries Service Marine Recreational Information Program
NMFS	National Marine Fisheries Service
PAD	Public-access and daytime fishing
PAN	Private-access or night fishing
PC	Party/Charter (CPFV)
PFMC	Pacific Fishery Management Council
PR	Private and rental boat fishing
PR1	Survey of primary private and rental boats public-access sites
PR2	Survey of secondary private and rental boats public-access sites
RecFIN	Pacific Recreational Fisheries Information Network

VARIABLES MOST COMMONLY USED IN THE FORMULAS

EFFORT

\hat{E} = the estimated total number of angler trips
 t = trips

CATCH

c = number of fish caught
 \hat{C} = the estimated total number of fish caught
 \hat{R} = catch rate (CPUE)

VARIANCE

\widehat{Var} = Variance

POPULATION AND SAMPLE SIZE

n = number of samples (e.g., number of contacted anglers, number of sample days); the number of sampling units in the sample
 N = population (e.g., all licensed anglers, number of site-days possible); the number of sampling units in the population

PROPORTIONS AND RATIOS

p = proportion
 q = $1-p$
 r = ratio

**California Recreational Fisheries Survey
Methods**

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California Recreational Fisheries Survey Methods

by
California Department of Fish and Wildlife
2022

1. INTRODUCTION

The California Recreational Fisheries Survey (CRFS) began in January 2004 to provide catch and effort estimates for marine recreational finfish fisheries. The goal of CRFS is to produce, in a timely manner, marine recreational fishery data needed for sustainable management of California's marine resources.

This document provides a general overview of CRFS and information about the sampling design, survey methods, key data elements collected and estimation procedures for each of the component surveys (Table 1.2). Detailed sampling procedures are available in the CRFS Sampler Manual (CDFW 2021).

When sufficient funds and personnel are available, all component surveys are conducted statewide each month at the sampling rates described in this document (full implementation). The methods described in this document represent the ideal representation of full implementation of the survey as of June 30, 2022. When funds or personnel are insufficient to cover all component surveys, sampling is reduced by lowering sampling rates or not sampling selected months, districts, or modes. A high priority is placed on meeting the data needs for species that are currently under active management when planning any sampling reductions. Chapter 7 includes a section that highlights deviations from full implementation that occurred between 2004 and 2021. All deviations after January 1, 2022 will be described in annual reports submitted to MRIP and RecFIN.

1.A. GENERAL OVERVIEW OF CRFS

Key Features of CRFS When Fully Implemented

- CRFS includes all recreationally caught marine finfish¹ in California.
- Catch and effort data are collected on the four major modes of fishing (i.e., the type of place or boat where the fishing occurred): private and rental boats, commercial passenger fishing vessels (CPFVs, also commonly called charter boats or party boats), man-made structures, and beaches and banks.
- Sampling generally occurs year-round for all modes.
- Monthly estimates of catch and effort are produced.

¹CRFS is not the exclusive source of data or estimates for California's marine recreational finfish fisheries. Most notably: (1) data from CRFS are used to estimate salmon catch but using different methods and estimation procedures that are described in Appendix A. Non-salmon catch from PR, BB, and MM trips targeting salmon are estimated by CRFS and reported in the CRFS estimates (2) California uses CPFV log summaries in combination with CRFS PR estimates for management of HMS.

- Estimates are produced for each of six geographic districts and for each fishing mode.
- The same methods are used statewide so the estimates from the six geographic districts are directly comparable.
- Preliminary estimates are typically available about 40 days after the end of the sampling period (typically a calendar month).

Legislative Mandates

NMFS and the CDFW have legislative requirements in place to support surveys of marine recreational anglers to gather information on catch, participation, and effort in marine recreational fishing as well as selected demographic characteristics.

NMFS is charged with supporting research and services relating to ocean and marine inland waters of the United States. Collecting statistics on marine recreational fisheries is authorized by:

- The Fish and Wildlife Act of 1956, (16 U.S.C. 742a) which provides for the collection and dissemination of statistics on commercial and recreational fishing.
- Migratory Game Fish Study Act of 1959 (16 U.S.C. 760e) which provides for continuing study of migratory marine fishes, including the effects of fishing the species.
- Magnuson-Stevens Fisheries Conservation and Management Act, 2007 (16 U.S.C. 1801 et seq.) requires the collection of statistics for fishery conservation and management to prevent overfishing and rebuild overfished stocks.
 - Modernizing Recreational Fisheries Management Act of 2018 (Public Law 115-405): an amendment that requires new reports, studies, and guidance for improving recreational fishing data and management of mixed-use fisheries.

CDFW collects sport fishery catch information to meet the conservation and management policies for California's living marine resources. The authority to collect this information is specified in the California Code of Regulations (CCR) and California Fish and Game Code (FGC) through the following sections:

- Section 1.73, Title 14, CCR: requires any person in possession of a recreationally taken salmon with a missing adipose fin to immediately relinquish the head of the salmon upon request by an authorized agent or employee of the CDFW to facilitate the recovery of any coded wire tag.
- Section 105.5, Title 14, CCR: requires commercial passenger fishing vessels to carry and accommodate state and federal fishery observers, ensuring the observer has reasonable and safe working conditions.
- Section 190, Title 14, CCR: requires commercial passenger fishing vessel owners to keep and submit complete and accurate records of fishing activities in the form of logbooks, with specific due dates for submission.
- Section 195, Title 14, CCR: requires commercial passenger fishing vessel owners to keep logbooks of fishing activity, and that all records are confidential.
- Sections 14000-14002 FGC: authorizes California to cooperate with Alaska, Idaho, Oregon, and Washington through the Pacific States Marine Fisheries Commission.
- Section 7050 FGC: requires the state to conserve and restore California's marine living resources for the benefit of all citizens.

- Section 7055 FGC: requires the conservation of sport and commercial fisheries to allow for long-term benefit of those fisheries.
- Section 7060(b) FGC: authorizes the department to obtain fisheries information for all marine fisheries managed by the state.

Intended Uses, Users of Data Products, and Availability of Data Products

CDFW works to manage marine and estuarine fisheries under state jurisdiction. CDFW works with NMFS, the states of Oregon and Washington, and the Pacific Fishery Management Council to manage groundfish, coastal pelagic, salmon, highly migratory species (HMS) and to incorporate ecosystem science into these management decisions. CRFS provides the primary source of recreational fisheries data and/or estimates needed to sustainably manage groundfish, salmon, coastal pelagic, HMS, and state-managed recreational fisheries. Management requires accurate and timely information on catch and effort to ensure harvest does not exceed allowable levels; in addition, catch location and biological data are used in stock assessments.

Note that data from CRFS are used to estimate salmon catch but using different methods and estimation procedures described in Appendix A. Salmon estimates are reported separately from CRFS. Another note is that California uses CPFV log summaries in combination with CRFS PR estimates for management of HMS.

CRFS monthly estimates as well as the sample data used to generate the estimates are transferred to Pacific States Marine Fisheries Commission (PSMFC) approximately 40 days after the last day of the month that the estimates are for. PSMFC makes the CRFS data and estimates available to the public through the Recreational Fisheries Information Network website (<https://www.recfin.org/>).

Districts

California has been divided into six geographic areas or districts for CRFS (Figure 1.1). The location of fishery management boundaries, distance recreational boats typically travel from major ports and county lines were taken into account when establishing district boundaries. Each district is briefly described below.

- 1. South District – Los Angeles, Orange and San Diego counties.** This highly urbanized district is home to more than 16 million people (43 percent of the state’s population). It has over 33,000 private boat slips and moorings contained in 22 boat basins and 27 public-access boat launch facilities. In addition, it has dozens of piers and other man-made structures that are heavily used by shore anglers as well as many miles of beaches and banks that are accessible to anglers. The coastal waters are influenced by sub-tropical currents from the south and are home to warm water pelagic species, such as tunas, yellowtail and barracuda. The nearshore coastal waters and the southern Channel Islands are fished for kelp and sand basses, white seabass and California halibut.
- 2. Channel District – Santa Barbara and Ventura counties.** This district is in an ecological transition zone that harbors both warm and cold water fish species. Warm water species like yellowtail, barracuda, bonito, white seabass and kelp bass are seasonally available and cold water species, including rockfishes, are also targeted. The Santa Barbara Channel and the northern Channel Islands are

fished year-round by private boats and CPFVs based in the four ports in the district.

- 3. Central District - Santa Cruz, Monterey and San Luis Obispo counties.** The Central District has five major ports for private boats and CPFVs and miles of open coast that are fished by surf anglers and rocky bank fishermen for surfperch, nearshore rockfish and cabezon. Boaters fish for chinook salmon in season and run offshore for albacore. Rockfish, cabezon and lingcod are also targeted by boat anglers throughout the district. Large sections of the coast in southern Monterey and San Luis Obispo counties remain inaccessible to shore anglers due to their remoteness or lack of public access.
- 4. San Francisco District – Sonoma, Marin, San Francisco and San Mateo counties on the coast, and the nine counties surrounding San Francisco and San Pablo bays (Alameda, Contra Costa, Solano, Napa, Sonoma, Marin, San Francisco, San Mateo and Santa Clara counties).** This highly urbanized district includes the state’s largest estuary and is home to some unique sport fisheries such as white sturgeon and striped bass. Chinook salmon and California halibut also migrate into the San Francisco Bay and are targeted by boat anglers. Rockfish are a top target around the Farallon Islands which sit about 25 miles offshore. Offshore anglers on private boats and CPFVs fish for chinook salmon, rockfish, lingcod and albacore. Anglers catch surfperch, jacksmelt and white croaker from piers in the bays. On the coastal beaches, anglers fish seasonally for surfperch, striped bass, surf smelt and night smelt.
- 5. Wine District - Mendocino County and the Shelter Cove section of Humboldt County.** Most fishing in this district is for chinook salmon, rockfish, lingcod, and cabezon. Private boats and CPFVs primarily operate out of Fort Bragg and Shelter Cove; these boats target chinook salmon and rockfish seasonally. Much of the shoreline is rocky and backed by high bluffs; angler access is frequently limited by the steep terrain. Shore anglers fish for rockfish, lingcod and cabezon. Surf fishermen fish for redtail surfperch and can net surf and night smelt on sandy beaches.
- 6. Redwood District - Del Norte County and most of Humboldt County (excluding the Shelter Cove section).** This district includes one of the state’s largest bays, Humboldt Bay, and several major river estuaries, including the Eel, Klamath and Smith rivers, where salmon are targeted. Private boat and CPFV anglers from Eureka, Trinidad and Crescent City target chinook salmon, lingcod, rockfish and Pacific halibut. Shore anglers fish for black rockfish, greenlings and lingcod, on rocky shores and jetties. Redtail and other surfperches are taken on sandy beaches and in Humboldt Bay.

California Recreational Fisheries Survey (CRFS) Districts



Figure 1.1. The location of CRFS' six districts.

Sites and Site Register

A fishing site refers to the location where anglers can be intercepted. All sites are discrete geographical areas with defined boundaries. A site may be an access point or a stretch of beach or bank with multiple access points. Each site has a unique name and

code number. CRFS maintains a list of all fishing sites (site register) that is updated as needed.

Public-access and Private-access Sites

CRFS classifies sites as public- or private-access. Public-access sites are accessible to the general public and are included in the CRFS field intercept surveys. Public-access sites can be publicly or privately owned. Private-access sites are not accessible to the general public and are not sampled by the field surveys. Private-access sites include publicly or privately owned marinas and moorings and docks at private residences.

Fishing Modes

A fishing mode is defined as the type of place or type of boat where the fishing occurred. CRFS collects data on four major fishing modes.

- **Private and rental boats:** This mode includes boats belonging to individuals for personal use as well as boats that are rented or leased (no captain or crew provided). CRFS stratifies the publicly accessible private and rental boat launch sites into two categories: primary and secondary. Separate surveys are conducted for each category. Within each district, the primary sites are those of high effort or which account for a high proportion of the catch of species under active management (e.g., species under harvest guidelines or quotas); the secondary sites are those of lesser effort and, as a group, account for less than 10 percent of the catch of species under active management.
- **Commercial passenger fishing vessels:** CPFVs are licensed by the State of California to take passengers for hire, and are operated by a licensed captain and crew. The number of passengers that the boats can accommodate ranges from a few to more than 100 anglers. CPFVs may take charter trips (also known as closed party trips, where an individual or group hires the boat, captain and crew for their exclusive use) or open party trips (also known as head boat trips, where individuals pay a fee to fish on a trip that is open to the general public).
- **Man-made structures:** This mode includes piers, docks, jetties and breakwaters.
- **Beaches and banks:** This mode includes stretches of beaches (shores consisting of sand or pebbles) and banks (rising land at the edge of the water, often rocks or a cliff). Each site has defined boundaries. A stretch of beach or bank may be divided into segments, and each segment is considered a separate site.

Trip Types

Each fishing trip is assigned a trip type based on the type of fish that was targeted during the trip (Table 1.1). Each angler who is interviewed in the field or on the telephone is asked what kind of fish he or she was targeting. Based on the angler's response, each trip is placed into a trip type category during the estimation process. Estimates for boat-based fisheries and fishing at man-made structures are stratified by trip type, while estimates of fishing at beaches and banks are assigned a single trip type.

CPFV operators are mandated by law to submit an activity record (i.e., log) for each day of fishing (or trip for trips less than 24 hours), and data from CPFV fishing logs are used to estimate CPFV fishing effort. The trips reported on the logs are placed into trip type categories based on the targets reported on the logs and the types of fish kept.

The criteria used to classify target species or groups into trip type categories are: Pacific Fishery Management Council (PFMC) management units (i.e., species that are managed under the same fishery management plan) and species that are typically caught together, found in the same habitat or vulnerable to the same fishing method.

Table 1.1. The trip type categories for the California Recreational Fisheries Survey (CRFS) and the composition of each category.

Trip type category	Examples of target species and/or groups in the trip type category
Anything	Angler targeting “anything”; unidentified fish
Coastal pelagic and coastal migratory	All species listed in the PFMC Coastal Pelagic Species Fishery Management Plan (northern anchovy, Pacific mackerel, jack mackerel and Pacific sardine); and other anchovies, Pacific barracuda, butterfish, flyingfish, jacks (jack family and yellowtail), mackerels (mackerel family, bullet, sierras, and Pacific bonito), Pacific saury and unidentified surface fish
Highly migratory	All species listed in the PFMC Highly Migratory Species Fishery Management Plan, and other billfishes, Pacific cutlassfish, sunfish, other pelagic sharks, pelagic stingray and other tunas
“Bottomfish”: Nearshore hard bottom, kelp beds, and shelf/slope hard and soft bottom	All species listed in the PFMC Pacific Coast Groundfish Fishery Management Plan except leopard shark, California skate, sand sole and starry flounder; all species listed in the California Nearshore Fishery Management Plan; and unidentified bottomfish or groundfish, blacksmith, black croaker, white seabass, other flounders, sea chubs, groupers, grunts, Pacific halibut, sea basses (except spotted sand bass), kelpfishes, sculpins, wrasses, ocean whitefish, some surfperches (black, kelp, pink, rainbow, reef, sharpnose and striped) and other flatfish and sharks found in the nearshore over hard bottoms and offshore
“Inshore”: Shore and nearshore soft bottom	Leopard shark, California halibut, California skate, sand sole, starry flounder, croakers/drums (except black croaker and white seabass), herring, spotted sand bass, smelts, and silversides; sharks, skates, rays, and flatfish found over nearshore soft bottoms; and the following surfperches: barred, calico, dwarf, pile, redtail, rubberlip, shiner, silver, spotfin, walleye and white
Salmonids	Salmon (chinook, pink, chum and sockeye)
Other anadromous (non-salmonid)	Striped bass, lampreys, shad and white sturgeon
Invertebrates	Fishing trips where the only target is an invertebrate and no finfish are caught

Fishing Depth and Location

CRFS collects information on fishing location and bottom depth during interviews with anglers who fished from boats, at each stop or drift when sampling onboard CPFVs and from CPFV logs. The locations are reported using latitude and longitude coordinates, CDFW Fishing Blocks or CRFS Micro Blocks. The waters off California are divided into 10-by-10 nautical mile Fishing Blocks for reporting purposes. These blocks have been used to report commercial catch and CPFV activity since the early 1900s. CRFS has divided each of the Fishing Blocks into 100 1-by-1 nautical mile Micro Blocks.

The fishing locations can be used for regulatory analyses (e.g., establishing area or depth closures) and stock assessors have used the information to determine reef-

specific or habitat-specific catch per unit effort. The depth information is used to estimate depth-dependent mortality of groundfish.

Water Areas

The estimates are provided by three water areas: ocean waters off California less than or equal to three miles from shore (i.e., state waters), ocean waters off California more than three miles from shore, and inland marine waters (i.e., enclosed bays and estuaries). CRFS has defined saltwater cutoff points for each bay and estuary. Anglers are screened to determine if they fished above the saltwater cutoff, and anglers who didn't fish in saltwater are excluded from the survey.

Day Types

Two day types are used: weekday (Monday-Friday except specified holidays) and weekend (Saturday, Sunday and specified holidays). The holidays included in the weekend day type are ones where fishing effort is expected to be similar to effort on Saturdays and Sundays of the month the holiday occurs.

Catch Types

Catch is defined as the number or weight of all fish caught whether those fish are kept or released. CRFS collects data on four catch types: kept catch that was observed by a CRFS sampler (kept-observed), fish the angler reported keeping but the sampler didn't observe (kept-unobserved), fish the angler reported releasing alive (released-alive) and fish the angler reported releasing dead (released-dead). For non-groundfish species, the estimates for the catch types released-alive and released-dead are derived directly from the angler reported data. For groundfish species, these two estimates are instead derived from the sum total of angler reported releases (live and dead) and the use of mortality rates specified by PFMC, as described below and in Appendix B.

Depth-dependent Mortality Estimates for Groundfish Species

Beginning in 2009, PFMC required that a mortality rate be applied to all groundfish (i.e., species designated as groundfish in the Pacific Coast Groundfish Fishery Management Plan) released in recreational hook-and-line fisheries. The mortality rates are provided by the PFMC and vary by species and bottom depth at the site of capture (PFMC 2016). The initial rates were for fish released at the surface of the water. In 2012, the PFMC adopted additional depth-dependent mortality rates for canary rockfish, cowcod and yelloweye rockfish released using a descending device and asked that these rates be applied retrospectively where adequate sample data existed (PFMC 2016). CRFS began collecting descending device usage data in 2013 but CDFW has only been able to apply descending device usage rates for calculating release mortality for groundfish using the methods described in Appendix B since 2015 due to data limitations that have prevented application of DDM.

Calculation of Average Weight per Fish and Estimates of Catch by Weight

Estimates of catch are first calculated in numbers of fish. The estimates in numbers of fish are multiplied by the average weight per fish for each species to arrive at estimates of total catch by weight. For each species and estimation domain (i.e., month, district, and water area in this case), the average weight per fish is calculated from at least 30 usable data. Data are pooled when less than the required number of usable data points for a species occurs in an estimation domain. The pooling rules and procedures for calculating average weight per fish are described in Appendix C.

1.B. DESCRIPTION OF SURVEY COMPONENTS

CRFS is a multi-part survey. Field sampling is conducted at over 450 publicly accessible sites during daylight hours to gather catch, effort and demographic data. An off-site telephone survey of licensed anglers is conducted to gather data on effort for all fishing modes and times, including those for which field observations of effort are not feasible (e.g., fishing at night and fishing from boats that return to private-access marinas). The data gathered from field sampling, the off-site telephone survey of licensed anglers, sport fishing license sales and the mandatory CPFV logs are combined to estimate catch and effort. The table below shows the surveys that are used for each mode of fishing, access type (public or private), and period of the day (daytime or nighttime).

Table 1.2. Surveys used in the California Recreational Fisheries Survey (CRFS) to collect data on fishing effort (Effort) and catch rates (catch per unit effort, CPUE).

Mode	Estimate	Public Access (sites accessible to the general public and covered by the field surveys)		Private Access (sites not accessible to the general public and not covered by the field surveys)	
		Day ☼	Night ■	Day ☼	Night ■
Private & Rental Boats	Effort	Field Surveys (separate surveys for primary and secondary sites)	Telephone Survey ¹	Telephone Survey ¹	Telephone Survey ¹
	CPUE	Field Surveys (separate surveys for primary and secondary sites)	Use estimate from public-access day	Use estimate from public-access day	Use estimate from public-access day
Commercial Passenger Fishing Vessels (CPFV)	Effort	CPFV logs and Field Checks ²	CPFV logs and Field Checks ²	Not Applicable	Not Applicable
	CPUE	Field Survey (onboard & dockside)	Field Survey (onboard & dockside)		
Man-made Structures	Effort	Field Survey	NO ESTIMATE	NO ESTIMATE	NO ESTIMATE
	CPUE	Field Survey			
Beaches & Banks	Effort	Telephone Survey ³	Telephone Survey ¹	Telephone Survey ¹	Telephone Survey ¹
	CPUE	Field Survey	Use estimate from public-access day	Use estimate from public-access day	Use estimate from public-access day

1. Angler License Directory Telephone Survey (ALDTS)
2. Operators of commercial passenger fishing vessels (CPFVs) are required as a condition of their license to submit logs for each day of fishing or trip for trips less than 24 hours. The CPFV logs and a field survey to estimate compliance (i.e., the proportion of trips for which logs are submitted at the time the estimates are made) are used to estimate.

The sampling design, survey methods, key data elements collected and estimation procedures for each of the surveys used by CRFS (i.e., each survey component) are described in chapters 2 through 6 of this report.

1.C. DATA SYSTEM

CDFW maintains a data system for CRFS that includes:

- A database which is backed-up nightly and maintains an audit history.
- A method to enter and upload raw sample data to the CRFS database.
- A data portal that acts as a partial interface to the CRFS database by offering CDFW staff functionality, reports, and extracts that partially automate quality assurance, quality control, and estimate production.
- A data warehouse created to enhance efficiency of CDFW's access and use of estimates.

CRFS currently uses paper forms to collect data in the field, though CRFS is in the process of migrating to a digital field data collection system. Paper forms are delivered to several CDFW office locations where the data from the paper forms is entered into custom Adobe LiveCycle data entry pdfs.

The data entry pdfs are the vehicle used to upload CRFS sample data to a SQL Server database through the CRFS data portal. Data can be entered from any CDFW computer by logging into the CRFS data portal and downloading a blank pdf data entry form. The data portal includes functionality to partially automate quality control upon upload. The data portal also partially automates quality control of data after upload as well as partially automating monthly and annual estimate production through the reports and data extracts (in Excel format) it produces.

Monthly and annual estimates and raw sample data outputs are saved to an internal CDFW shared drive once produced and verified. Estimates are also transferred to a data warehouse using an automated process that has been created to enhance the efficiency of CDFW Marine Region staff's access and use of estimates. The data warehouse is currently limited to a subset of years of estimates and does not include sample data. The data warehouse will be expanded to include additional years of estimates as well as sample data as time allows.

Access to CDFW's CRFS data portal, database, and data warehouse is limited to CDFW Marine Region staff. Limited access to CRFS data and estimates is available to the public through the Recreational Fisheries Information Network website (<https://www.recfin.org/>). RecFIN grants authorized users more complete access to CRFS data and estimates.

1.D. DATA QUALITY ASSURANCE AND QUALITY CONTROL

Each year CRFS staff complete about 6,500 assignments containing field interviews from over 60,000 angling parties with over 200,000 fish identified to species, and about 120,000 records of fish measurements. In addition, about 26,000 licensed anglers are interviewed by ALDTS. The data from CRFS assignments and ALDTS are uploaded into a relational database.

Extensive quality control and quality assurance measures have been put in place throughout the process from data collection to final estimate production. In addition, the estimation process is made transparent through output files that show each estimation

step from raw data to the final estimate. The following quality assurance and quality control measures result in a robust and accurate data set.

Quality Assurance

Field data collection quality assurance includes:

- All Field Samplers are provided with the most current CRFS Sampler Manual, a comprehensive guide containing more than 400 pages of detailed instructions on properly recording data for all modes of sampling.
- Standardized training on protocols and fish identification is provided to Field Samplers in the office and in the field. After training newly hired samplers shadow experienced staff in the field before they begin sampling independently.
- Field Samplers are subject to unannounced field checks by Fish and Wildlife Technicians or their CRFS Field Lead (Environmental Scientists who lead all CRFS Field Samplers in a District) while sampling on assignment. The samplers' gear will be inspected to make sure they have all items and the equipment is functional and properly calibrated. In addition, Field Samplers will be observed interviewing an angler and recording biological data including measurements and proper species identification.
- Field Samplers are required to attend monthly meetings to review proper data collection protocols and participate in monthly fish identification quizzes.
- CRFS field data sheets are designed in a compact manner allowing data to be recorded quickly with emphasis placed on the key data fields required for a complete CRFS interview.
- For each CRFS district, a highly experienced Field Sampler, Fish and Wildlife Technician, or CRFS Field Lead reviews data sheets from completed assignments before they are entered into the database. Staff are knowledgeable of their respective districts and able to detect anomalies in species composition, catch rates and location of catch.

The CRFS data portal authenticates users (by username and password) and then restricts each user's access to the appropriate system functionality and reports. If a user is authorized to perform data entry, they download blank pdf forms from the CRFS data portal. The forms are designed with specifically formatted fields and provide built in error checks with pop-up window warnings to minimize data entry errors. The following describes data entry quality assurance:

- Fields are linked together and automatically filter subsequent menus and activate or deactivate appropriate inputs.
- Numeric fields are formatted for an acceptable range.
- Alpha fields and alphanumeric fields are formatted for acceptable inputs by character position.
- Time and date fields are formatted and linked to survey identification number.
- Latitude and longitude coordinates are formatted by selected units and only allow inputs of acceptable range.
- Drop down menus are provided for all items with fixed input options.
- Required key data fields are highlighted in red until complete.
- Biological data by species is built into the form and triggers error messages for measurements outside of established acceptable ranges.
- Upon completion of data entry, summaries of selected effort and species information are automatically checked for accuracy across all samples.

- A unique identification number for the person who entered the data is added to the form and saved in the database for follow up or training purposes.
- Unique reference identification numbers for each form are automatically generated from selected data elements and used as a key field in the relational database.

The data in a completed CRFS data entry pdf form is extracted and transferred to a Microsoft SQL Server database using an upload process on the CRFS data portal. A series of error checks are run on the data before it is accepted into the database. Any errors will result in rejection of the form. Error messages are displayed on the website and emailed to the person who entered the data into the form.

- Any unresolved error warning remaining in the data entry form will cause the form to be rejected.
- Assignment identification numbers, survey site/port, survey date, and sampler identification numbers are checked against the month's assignment schedule stored in the database.
- Commercial Passenger Fishing Vessel (CPFV) registration numbers are checked against the CDFW's license database for validity.
- Key data fields are checked for completeness.
- Angler information and catch/discard information are checked for unmatched or missing information.
- Water areas are checked against applicable site designations.

Quality Control

An automated assignment tracking system, built into the CRFS data portal, ensures that all assignments for the month have been accounted for.

- Successfully uploaded data is automatically date stamped when uploaded with a completion date.
- Data portal automation ensures that all sites within a sampling cluster for applicable modes have data forms uploaded, even if there was no effort recorded for a survey.
- All samplers' data for single assignments with multiple samplers recording data is checked for missing survey forms.

When a month of data entry is complete, monthly review reports are available for download from the CRFS data portal. The CRFS Field Leads are required to review the monthly report for their district and submit corrections prior to estimate production. Corrections made in the monthly review report are automatically updated in the database by uploading the report back into the CRFS data portal. The monthly review report includes:

- Output of biological outliers based on length-weight regressions for each species that are maintained by CDFW,
- A report of catch that violates current fishing regulations (e.g., bag limits, zero retention),
- Output of all catch and biological data recorded for the month by CRFS district that aids CRFS Field Leads in identifying out-of-range species, patterns in biological data, and other district specific issues.

CDFW's Fisheries Analytics Project (FAP) conducts a final review of the CRFS data files and estimates before submitting the data and estimates to RecFIN for posting on the RecFIN website.

- CRFS data files are downloaded from the CRFS data portal and reviewed by FAP staff for any remaining potential errors.
- CRFS estimate programs for each mode are available to be run on the fly using the CRFS data portal. To make the estimation process transparent, output files include a summary of the estimate routine from the raw data to the final estimates formatted for submission. FAP staff review the files prior to another round of review completed by CRFS Field Samplers and other CDFW staff.
- CRFS preliminary estimates are added to a Power BI report used to contextualize current estimates and to identify anomalous estimates by comparing to long term trends. This report is reviewed by FAP, CRFS Field Samplers and other CDFW staff prior to submission of data and estimates to the Pacific RecFIN website.

Once preliminary estimates are made publicly available on the RecFIN website, any questionable or unusual data or estimates brought to FAP staff's attention by the public, CDFW staff or others is thoroughly investigated and corrected if in error. By June 30 of the following year, corrected "final" data and estimates are resubmitted to RecFIN.

- In addition to the files available on the Pacific RecFIN website, the data, estimates, and output files showing each step in the estimation process are also available via the CRFS data portal for use and review by CDFW staff.
- CRFS Field Leads use their expert local knowledge and familiarity with the month's data to qualitatively identify estimates that seem abnormal. In addition, CDFW fishery managers also review the preliminary data and estimates.

The CRFS quality assurance and quality control procedures are continually enhanced. The errors detected during the quality control processes are used to improve and expand the quality assurance procedures. In addition, Field Samplers provide suggestions on ways to make the field data sheets and data entry forms more intuitive and easier to use.

2. ANGLER LICENSE DIRECTORY TELEPHONE SURVEY

OVERVIEW

The Angler License Directory Telephone Survey (ALDTS) is a monthly survey that collects angler effort data for all fishing modes, both access types (public and private) as well as both daytime and nighttime fishing. Samples are drawn from a directory of license holders. The data are used to estimate effort on beaches and banks and to estimate effort from private and rental boat private-access or night fishing.

Pending MRIP certification and transition approval CDFW plans to replace ALDTS with the Angler License Directory Online Survey (ALDOS). ALDOS will use emails to invite licensed anglers to provide survey responses online. A new version of this methods document where ALDTS methods are replaced by ALDOS methods will be released once ALDOS has been certified.

Description of the Angler License Directory: Beginning with the sale of 2011 licenses, all California sport fishing licenses have been sold using the CDFW Automated License Data System (ALDS). About 1,500 retail license agents and staff at 10 CDFW offices issue licenses through internet point of sale equipment that is electronically linked to the ALDS database. In addition, licenses may be purchased online using ALDS. The ALDS database is updated and backed up daily, and serves as the directory for ALDTS.

California issues about 1.8 million sport fishing licenses each year. All sport fishing licenses are good for fishing in saltwater and freshwater and for sport harvest of finfish, invertebrates, amphibians and reptiles. Annual licenses (e.g., resident annual, non-resident annual, various reduced fee and free licenses) are good for the calendar year; short-term licenses (i.e., one-, two- and ten-day licenses) are good for specified dates within the calendar year. Individuals with lifetime licenses are required to register annually and update their contact information. Youth under 16 years of age and anglers fishing on public piers in marine waters are not required to have a sport fishing license. In addition, the state schedules two days per year when no license is required.

By state regulation, anglers are required to provide a telephone number when purchasing a license. However, an exception is made for one-day licenses sold at commercial passenger fishing vessel (CPFV) landings on the day the license is valid; for these “quick sales”, CPFV landings are only required to get the telephone number of every twentieth person buying a one-day license.

Data for each license includes: license year, type of license, date and location purchased, the dates the license is valid (one-, two-, and ten-day licenses are only valid for the day or days specified on the license) and the license holder’s name, address, telephone number (except for quick sales at CPFV landings) and date of birth. Providing an email address is voluntary but the proportion of license holders providing an email address has been increasing (e.g., from about five percent in 2015 to 38 percent in 2021).

Sampling Design

Scope and Staging: One statewide one-stage survey for the survey-covered month.

Target Population: All saltwater angler trips in California in the survey-covered month.

Frame and Stratification: All adults (at least 18 years of age) in the angler license directory (i.e., ALDS database) at the end of the survey-covered month who had a valid license for at least one day of the survey-covered month. For legal reasons, individuals under 18 years of age are not contacted in the telephone survey but are contacted in the field surveys.

Eligible license holders are stratified into five license types for sample selection (but the estimation procedures treat the resulting sample as a non-stratified simple random sample of all licensees). The five license type strata are: resident annual (about 95 percent of this strata are resident annual licenses and about 5 percent of this strata are a combination of lifetime, disabled veteran, recovering service members, reduced fee low-income senior and free licenses), non-resident annual, one-day, two-day and ten-day.

Sample Rate: The survey completes about 20,000 to 26,000 telephone interviews each year. The number of completed interviews decreased from 26,000 to 22,000 recently due to increased costs and level funding. For each month's survey an overall monthly quota (i.e., the desired number of completed interviews) is established. The monthly quota is proportional to expected fishing effort, and ranges from about 1,300 to about 2,700 completed interviews. The monthly quota is allocated to license type strata in proportion to stratum size in the directory, thereby yielding a quota number for each stratum.

Sample Selection and Scheduling: Stratified random sampling with proportional allocation is used. To meet each stratum's quota, a larger number of the stratum's license holders is selected for attempted contact (the number selected is based on past no-contact rates). Selection within each stratum is random and each month defines a distinct survey, so a given angler may be interviewed more than once during the year.

Survey Methods

Anglers contacted by the ALDTS are asked to provide information on all marine fishing trips made during the previous month. For each fishing trip taken, anglers are asked to provide fishing mode, water area (ocean or inland), trip type and access type (public or private). For private and rental boats, the starting and ending times of each trip is recorded to determine night trips (identified by both start and end times reported outside of daylight hours).

Key Data Elements Collected

An example of the questionnaire used in the telephone interview appears in Appendix D. The following key data elements are collected during the ALDTS:

1. Demographic and avidity information
 - a. Country, state and county of permanent residence
 - b. Occurrence of sport fishing activity in the last 12 months
 - c. Proportion of trips in freshwater and in saltwater in the last 12 months
 - d. Number of saltwater finfish fishing trips in the last month
2. For each saltwater finfish fishing trip in the survey-covered month
 - a. Date of the trip
 - b. Whether it was a boat or shore trip
 - c. For each boat-based trip
 - i. Type of boat (CPFV, private or rental)

- ii. For private and rental boats, type of access (private or public) and type of facility (e.g., launch ramp, hoist, marina, or beach)
- iii. Water area where fishing occurred
- iv. Number of days fished
- v. Time of departure and time of return
- vi. Whether fishing occurred at night
- vii. Location where the trip ended (where the angler came ashore)
- d. For each shore-based trip
 - i. Mode (i.e., beach/bank or man-made structure)
 - ii. County where the fishing activity occurred
 - iii. Water area where the fishing activity occurred (ocean or bay/estuary)

Estimation Procedures

For each month and district, ALDTS data are used to generate an effort estimate for each of three trip domains: beach and bank trips, private and rental boat trips which return to private-access sites or return at night (i.e., trips which are not covered by the private and rental boat field surveys) and private and rental boat trips which return to public-access sites during daylight hours (i.e., trips which are covered by the private and rental boat field surveys).

The ALDTS estimate of beach and bank effort is used to derive beach and bank effort estimates for each of two water areas (see Chapter 6). The ALDTS effort estimates for the private and rental boat domains (i.e., private-access or night, and public-access and day) are used, in conjunction with field survey estimate of private and rental boat effort (public-access and day), to generate effort estimates of anglers on private and rental boat that returned to private-access sites or private and rental boat anglers that fished at night. This is essentially an undercoverage adjustment for effort not covered by the field surveys (see Chapter 3 section C).

A domain's ALDTS effort estimate is obtained by simple expansion from the contacted sample of n anglers to the population of all N licensed anglers. To obtain a final effort estimate, the ALDTS estimate is then adjusted to account for unlicensed anglers, who are not in the telephone survey frame. This adjustment uses the ratio of unlicensed to licensed anglers; a ratio which is derived from the field intercept surveys. In those surveys, anglers are asked what type of license they have, and numbers of licensed and unlicensed anglers are recorded. For each domain, it is assumed that angler trip rates are the same for unlicensed and licensed anglers and for licensed anglers under 18 years of age and those over 18 years.

Effort by licensed anglers in any given trip domain is thus estimated by

Eq. 2.1

$$\widehat{E1} = \frac{N}{n} \sum_{i=1}^n t_i$$

where

t_i = the number of days fished in the trip domain by interviewed angler (license holder) i

n = the number of license holders who completed ALDTS interviews in the survey-covered month

N = the number of eligible license holders in the survey-covered month

Thus, for each trip domain, the average number of days fished per license holder who completed the ALDTS interview (\bar{t}) is multiplied by the total number of valid licenses for the survey-covered month (N).

The variance of this effort estimate is estimated as

Eq. 2.2

$$\widehat{Var}(\widehat{E1}) = N^2 \sum_{i=1}^n \frac{(t_i - \bar{t})^2}{n(n-1)}$$

where \bar{t} is the mean of the sampled values t_i .

Total effort includes estimated effort by unlicensed anglers ($\widehat{E2}$) who are not in the frame of the telephone survey. To estimate $\widehat{E2}$, data from the intercept surveys are first used to obtain estimates of the following:

- p = proportion of anglers who are unlicensed in the fishing mode
- q = $1-p$ = proportion of anglers who are licensed in the fishing mode
- r = ratio of unlicensed to licensed = p/q

From the intercept survey, p is estimated by $\hat{p} = U/n_2$, where n_2 is the number of intercepted anglers in the fishing mode and U is the number of those anglers without a license. Then q and r are estimated respectively by $\hat{q} = 1 - \hat{p}$ and $\hat{r} = \hat{p}/\hat{q}$. Estimates \hat{p} and \hat{q} are unbiased and estimate \hat{r} is nearly so. Effort by unlicensed anglers ($E2$) is estimated by

Eq. 2.3
$$\widehat{E2} = \hat{r}\widehat{E1}$$

A nearly unbiased variance estimate of $\widehat{E2}$ is obtained from an unbiased estimator version of the Goodman formula for the variance of a product of independent random variables. Namely,

Eq. 2.4
$$\widehat{Var}(\widehat{E2}) = \widehat{Var}(\hat{r}\widehat{E1}) = \hat{r}^2\widehat{Var}(\widehat{E1}) + \widehat{E1}^2\widehat{Var}(\hat{r}) - \widehat{Var}(\hat{r})\widehat{Var}(\widehat{E1})$$

This formula for $\widehat{Var}(\widehat{E2})$ requires a value for the estimated variance of \hat{r} . A delta-method calculation gives the value

Eq. 2.5

$$\widehat{Var}(\hat{r}) = \frac{\hat{r}}{\hat{q}^2} \frac{1}{(n_2 - 1)}$$

Total estimated effort for licensed and unlicensed anglers (\widehat{E}) is the sum of the separate estimated effort values:

Eq. 2.6
$$\widehat{E} = \widehat{E1} + \widehat{E2} = (1 + \hat{r})\widehat{E1}$$

From the unbiased estimator version of the Goodman formula and the fact that $\widehat{Var}(1 + \hat{r})$ is just $\widehat{Var}(\hat{r})$ (adding a constant to a random variable doesn't alter the variance), we obtain:

$$\text{Eq. 2.7} \quad \widehat{Var}(\hat{E}) = \widehat{Var}((1 + \hat{r})\hat{E}_1) = (1 + \hat{r})^2 \widehat{Var}(\hat{E}_1) + \hat{E}_1^2 \widehat{Var}(\hat{r}) - \widehat{Var}(\hat{r}) \widehat{Var}(\hat{E}_1)$$

From the above formula for $\widehat{Var}(\hat{E}_2)$, the formula for $\widehat{Var}(\hat{E})$ can be rewritten as

$$\text{Eq. 2.8} \quad \widehat{Var}(\hat{E}) = \widehat{Var}(\hat{E}_2) + (1 + 2\hat{r}) \widehat{Var}(\hat{E}_1)$$

3. PRIVATE AND RENTAL BOATS

OVERVIEW

There are hundreds of sites for launching, mooring and docking private and rental boats along the California coast and within its harbors and bays. Each month, two statewide field surveys, augmented by a telephone survey for effort (see Chapter 2, Angler License Directory Telephone Survey, ALDTS), collect data which enable estimation of both effort and catch for all private and rental boat trips in California's marine recreational fisheries.

The field surveys cover effort and catch for private and rental boats returning to public-access sites during daylight hours. Public-access sites are those sites that are accessible to the general public and can be either publicly or privately owned. To effectively focus field sampling effort, public-access private and rental boat sites are divided into primary sites (PR1) or secondary sites (PR2) each month and separate PR1 and PR2 surveys are conducted each month. Designation of sites as primary or secondary in a district and month is based on amount of expected effort and relative catch of species under active management. The sampling rate for PR1 is substantially higher than for PR2.

Private-access sites are not accessible to the general public and include publicly and privately owned marinas and moorings and facilities at private residences. It is neither economic nor logistically feasible to conduct field surveys which would intercept returning anglers at private-access sites or at night (PAN). Rather, effort for those trips is estimated by use of data from a telephone survey (ALDTS), as adjusted by use of data from the PR1 and PR2 field surveys. The catch rates from the field surveys are used as the estimates of catch rates for PAN trips.

The CRFS PR1, PR2 and PAN estimates together yield overall estimates of effort and catch for private and rental boats.

The effort and catch estimates for salmon species differ from those described in this Chapter. The salmon survey methods and estimation procedures are in Appendix A.

3.A. PRIMARY PUBLIC-ACCESS SITES FOR PRIVATE AND RENTAL BOATS (PR1)

The primary private and rental boats sites (PR1) are public ramps, hoists, and other launch facilities where the majority (at least 90 percent) of fishing effort for and catch of important management species by private skiffs and rental vessels occurs in California. PR1 sites are visited during daylight hours using an access point survey method (i.e., on-site, intercept design).

PR1 EFFORT AND CATCH RATE

Sampling Design

Scope and Staging: One statewide two-stage survey at PR1 sites in the survey-covered month.

STAGE 1 – Primary sampling units (PSUs) are all site-day pairs defined by a PR1 site and a fishing day during the given month at the site. Each PR1 assignment samples a unique PSU.

STAGE 2 – Secondary sampling units (SSUs) are all the boat trips within a site-day (PSU). In the second stage the samplers attempt to interview all or nearly all of the angler parties on recreational fishing boats which return to the site during daylight hours. The collected data thereby yield a census or near-census of the site-day's daytime private and rental boat effort and catches.

Target Population: All private and rental boat trips returning to PR1 sites during daylight hours in the survey-covered month.

Frame and Stratification: The sampling frame comprises all the PSUs (site-days) in the given month. Stratification is by site and day type (weekday or weekend/holiday).

Sampling Frequency: Each PR1 site typically is sampled on 6 or 7 days per month (ranging from 14 to 20 percent of the weekday site-days and from 20 to 30 percent of the weekend/holiday site-days).

Sample Selection and Scheduling: Within each month, site and day type stratum, PSUs (site-days) are randomly selected. If necessary, assignments can be rescheduled within the month to the same site and day type.

Survey Methods

Samplers receive their monthly PR1 assignments a week or two before the start of each month. Assignments are for a site-day (specific site and date) and cover the full span of daylight hours. Sampling is conducted from before the first boat returns until one of the following occurs: (1) the last boat returns, (2) it is nearing sunset or (3) there has been no recent activity and only a few trailers remain in the parking lot. The hours of daylight and the expected activity at the site determine the number of samplers on an assignment. General on-site procedures for PR1 assignments are described in sequential order below. Detailed sampling procedures are available in the CRFS Sampler Manual (CDFW 2021).

1. Seven PR1 sites are close to another PR site that has substantially less effort (e.g., in the same harbor) and the second site has similar catch rates as the PR1 site. In these cases, the boats landing at the second less active site are considered “missed boats” for the PR1 site. Before going to the assigned PR1 site, the sampler counts and records the trailers in the count area (typically a parking lot) of the other PR site (off-site start count).
2. Upon arriving at the PR1 site, the sampler counts and records the number of trailers in the count area (on-site start count) and records the time the count began.
3. The sampler stations him- or herself where he/she can intercept the boats returning to the site.
4. The sampler attempts to intercept as many returning boats as possible (preferably all boats) to determine the boat's activity (e.g., recreational saltwater fishing, commercial fishing). The sampler records the boat's activity, type (“regular”, kayak, personal watercraft, sail) and the time the boat was intercepted. The sampler also records the boat type of each boat he or she was unable to

intercept, each boat where the passengers declined to be interviewed, and each boat where the interview couldn't proceed due to a language barrier.

5. The sampler attempts to interview the angler parties on the private or rental boats where the passengers engaged in recreational saltwater fishing. The sampler uses a scripted questionnaire designed to collect demographic data on the angler (or one angler in a party), each angler's license status and the data elements used in the effort and catch rate estimates (see the section titled "Key Data Elements Collected" below).
6. At the end of the sampling day, the sampler counts and records the number of trailers in the count area for the PR1 site (on-site stop count) and the time the stop count began.
7. If the PR1 has an associated PR site, the sampler counts and records the number of trailers in the count area for the associated PR site (off-site stop count).

Key Data Elements Collected

The following key data elements are collected during the field survey and are used in the estimates of effort and catch rate. Data are recorded on the PR Form (Appendix E) and instructions for collecting and recording each data element are in the CRFS Sampler Manual (CDFW 2021).

1. General assignment data
 - a. Assignment identification number
 - b. Date
 - c. County code
 - d. Site name and number
2. Site effort data
 - a. Start and stop counts of boat trailers at the PR1 site and the associated site if one is designated
 - b. Number of returning boats the sampler did not interview at the site due to high activity, passengers' refusal to participate in an interview, or language barriers that prevented an interview
 - c. Number of boats interviewed
3. Data from each interviewed boat
 - a. CRFS sample number
 - b. Time of interview
 - c. Activity (saltwater recreational fishing, non-fishing, commercial, CPFV)
4. Data from each interviewed boat returning from a recreational saltwater fishing trip
 - a. Total number of anglers
 - b. Number of unlicensed anglers (use in expanding estimates based on data from the Angler License Directory Telephone Survey)
 - c. Number of days fished on the trip
 - d. If fished at night
 - e. Primary and secondary target species (used to determine trip type)
 - f. Water area (area where the majority of the fishing effort occurred) of the primary and secondary targets
 - g. Number of fish by species that were landed and examined by the sampler (kept-observed) and the lengths and weights of those fish

- h. Number of fish by species or lowest taxonomic order possible that the angler(s) reported caught, kept and not available for examination (kept-unobserved), the number released alive (released-alive), and the number released dead (released-dead). For angling parties, this information is gathered from each angler.
- i. For groundfish species released alive, whether those fish were released using a descending device (used for groundfish depth-dependent mortality estimates)
- j. Bottom depth where most fish were caught or bottom depth by species (used for groundfish depth-dependent mortality estimates)

Estimation Procedures - Effort

CRFS calculates PR1 effort estimates for each of two effort units: boat trip and angler days. A boat trip is a landing of a private or rental boat at a PR1 site during daylight hours without regard to number of anglers on the boat or the length of the trip. Each boat trip accounts for $A = a \times L$ angler days where a is the number of anglers onboard and L is the boat trip length in days.

PR1 catch estimates are based on boat trip as effort unit; whereas, a funding agency supporting CRFS requests effort in angler days for all fishing modes. In both cases, CRFS generates an estimate of PR1 effort for each domain of trips defined by a given month and district and by given values of two trip features: trip type and water area. The account below is for estimation in boat trips. Estimation in angler days proceeds similarly.

For each estimation domain (i.e., month, district, trip type and water area), the estimation of effort in boat trips involves three basic steps:

- Step 1 – Estimate effort in boat trips for each sampled site-day (i.e., each PR1 assignment) and combination of trip type and water area
- Step 2 – Estimate effort in boat trips for each sampling stratum (site and day type) and combination of trip type and water area
- Step 3 – Obtain the total effort for each estimation domain (i.e., month, district, trip type and water area) by summing the component estimates from Step 2

Step 1 – Effort Estimate for Each PR1 Assignment

For a given sampled site-day (i) and combination of trip type and water area (d), a separate effort estimate ($e_{i,d,b}$) is first calculated for each of three boat types (b): regular, kayak/personal watercraft and sail:

Eq. 3.A.1

$$e_{i,d,b} = t_{i,d,b} B_{i,b}$$

where

- $t_{i,d,b}$ = the sampled fishing boat trips of type b on the site-day i which took trips of the given trip type and water area
- $B_{i,b}$ = an adjustment factor to account for the fact that some returning boats of the given boat type b may be “missed” (i.e., not sampled because the sampler was not able to interview the passengers on a boat due to high

activity at the site, passengers refusal to participate in an interview, passengers not able to participate in the interview due to language barriers, trailers in the PR1 count site when the sampler leaves for the day and the maximum number of trailers at an associated PR site).

The adjustment factor is calculated as

Eq. 3.A.2

$$B_{i,b} = \frac{s_{i,b} + m_{i,b}}{s_{i,b}}$$

where

$s_{i,b}$ = the number of sampled boats of type b for site-day i

$m_{i,b}$ = the number of missed boats of type b for site-day i

Equations 3.A.1 and 3.A.2 implement the assumption that for each sampled site-day and boat type, the distribution among trip types and water areas of the missed boats matches that of the sampled boats.

Overall effort for the site-day and given trip type and water area ($E1_{i,d}$) is obtained as the sum of the effort values of the three boat types.

Eq. 3.A.3

$$E1_{i,d} = \sum_b e_{i,d,b}$$

Step 2 – Estimation for Each Stratum (i.e., Site and Day Type)

For a given sampling stratum (s , defined by site and day type) and combination of trip type and water area (d), estimate the mean number of boat trips by summing the $E1_{i,d}$ values from Step 1 and dividing by the number of days sampled in the stratum (n_s).

Eq. 3.A.4

$$\widehat{E1}_{s,d} = \frac{\sum_i E1_{i,d}}{n_s}$$

For a given month, the estimated number of boat trips for each site, day type, trip type and water area ($\widehat{E2}_{s,d}$) is estimated by

Eq. 3.A.5

$$\widehat{E2}_{s,d} = N_s \widehat{E1}_{s,d}$$

where N_s is the total number of site-days in stratum (N_s). Variance of each $\widehat{E2}_{s,d}$ is estimated by

Eq. 3.A.6

$$\widehat{Var}(\widehat{E2}_{s,d}) = N_s^2 \left(\frac{\sum_{i=1}^{n_s} (\widehat{E1}_{i,d} - \widehat{E1}_{s,d})^2}{n_s(n_s - 1)} \right)$$

The variance estimation formula may be derived from equation 2.21 on page 26 of Cochran 1977, *Sampling Techniques* (ed. 3).

Step 3 – District-wide Domain Estimates

For each domain defined by a month, district, trip type and water area, the final effort estimate (\hat{E}) is obtained by summing the Step 2 estimates ($\widehat{E2}_{s,d}$) for all the PR1 sampling strata (s) for the given district and month.

Eq. 3.A.7

$$\hat{E} = \sum \widehat{E2}_{s,d}$$

The corresponding variance estimate is the sum of the variances for the separate strata estimates: this simple procedure is enabled by the sampling design (stratified random sampling), whereby the strata are sampled independently. Namely,

Eq. 3.A.8

$$\widehat{Var}(\hat{E}) = \sum \widehat{Var}(\widehat{E2}_{s,d})$$

where (as above) summation is over all PR1 sampling strata (s) for a given district and month.

Estimation Procedures – Catch Rate

As with effort, PR1 catch rate is calculated as both catch per boat trip and catch per angler day. Catch per boat trip is used in the estimates of PR1 total catch. Catch per angler day is used in the estimates of total catch for private and rental boats returning to private-access sites or fishing at night (PAN). The PAN effort estimates are in the unit of angler days, because individual anglers are interviewed in the telephone survey (ALDTS). In addition, a funding agency supporting CRFS requests catch rates in angler days for all fishing modes. The account below is for estimation of catch rate as catch per boat trip. Estimation of catch rate as catch per angler day proceeds similarly.

The catch rate (\hat{R}) is estimated each month for each combination of district, trip type, water area, species and catch type (kept-observed, kept-unobserved, released-alive, released-dead) by

Eq. 3.A.9

$$\hat{R} = \frac{\sum_{i=1}^n c_i}{\sum_{i=1}^n t_i}$$

where

- c_i = the catch (of the given species and catch type) on sampled boats (trips) on site-day (i) and with the given combination of trip type and water area
- t_i = the number of sampled boats (trips) on site-day (i) with the given combination of trip type and water area
- n = the number of sampled PR1 site-days in the given month and district

The variance of the catch rate estimate is estimated by

Eq. 3.A.10

$$\widehat{Var}(\hat{R}) = \left(\frac{1}{\bar{t}^2}\right) \left(\frac{1 - \frac{n}{N}}{n}\right) \left(\frac{\sum_{i=1}^n (c_i - \hat{R}t_i)^2}{n - 1}\right)$$

Here N is the district and month's total number of site-days and \bar{t} is the mean number, per sampled site-day, of trips with the given combination of trip type and water area. The catch rate calculation, which aggregates unweighted sample data, is based on the plausible assumption that, for a given month and district, the catch rates for a given species depend primarily on trip type and water area, with only random effects owing to site or day type. Thus, the variance estimation formula may be derived from the discussion in Cochran (1977) equation 2.39 and ensuing text on pages 31-33.

PR1 TOTAL CATCH

Total catch for each species and catch type (\hat{C}) is estimated for each domain defined by a combination of month, district, trip type and water area by

Eq. 3.A.11
$$\hat{C} = \hat{E}\hat{R}$$

where for the domain, species and catch type,

\hat{C}	=	the estimated total number of fish caught
\hat{R}	=	the estimated catch per boat trip
\hat{E}	=	the estimated total number of boat trips

A nearly unbiased variance estimate of \hat{C} is obtained from an unbiased estimator version of the Goodman formula for the variance of a product of independent random variables. Namely,

Eq. 3.A.12
$$\widehat{Var}(\hat{C}) = \hat{R}^2\widehat{Var}(\hat{E}) + \hat{E}^2\widehat{Var}(\hat{R}) - \widehat{Var}(\hat{R})\widehat{Var}(\hat{E})$$

3.B. SECONDARY PUBLIC-ACCESS SITES FOR PRIVATE AND RENTAL BOATS (PR2)

Secondary private and rental boat sites (PR2) are publicly accessible launch facilities (e.g., launch ramps, hoists, beach tractors, rental shops) where less than 10 percent of the private and rental boat catch of important management species is landed in a district. PR2 sites typically have less effort than PR1 sites. PR2 sites are visited during daylight hours using an access point survey method (i.e., on-site, intercept design).

PR2 EFFORT AND CATCH RATE

Sampling Design

Scope and Staging: One statewide two-stage survey of PR2 sites in the survey-covered month.

STAGE 1 – Primary sampling units (PSUs) are all site-day pairs defined by a PR2 site and a fishing day during the given month at the site. Each PR2 sampling assignment, accounting for a sampler-day, samples a unique PSU.

STAGE 2 – Secondary sampling units (SSUs) are all boats within a site-day (PSU). In the second stage, the sampler attempts to interview all or nearly all of the angler parties on recreational fishing boats which return to the site during the daylight hours the sampler is at the site (typically, six to seven hours if there is fishing effort).

Target Population: All private and rental boat trips returning to PR2 sites during daylight hours in the survey-covered month.

Frame and Stratification: The PR2 survey's sampling frame comprises all the PSUs (site-days) in the given month.

Each calendar day is classed by day type as either weekday or weekend (includes weekend days and most major holidays).

Each of the month's PR2 sites is assigned a pressure category: low, medium or high. The pressure category reflects expected effort at the site during the month. The expected effort is based on historical data and expert opinion. A site's assigned pressure is relative to the other PR2 sites for the given district and month. For example, the expected effort at a high-pressure site in a district and month may be quite low from a statewide perspective or even for the same site in a different month. This pressure-level classification enables the month's PR2 sampling in each district to occur mainly at the higher effort sites.

The PSUs (site-days) are initially stratified by district, day type and pressure category. Thus, each given district and day type gives rise to three initial strata. Per rules which are outlined below and detailed in Appendix F, the sampling design may merge two or even all three of these initial strata. For the resulting final stratification, the sampling regime is stratified random sampling: the separate strata are randomly sampled independently.

For any given district and day type, the merge rules are as follows. Let n (assumed to be two or more) be the number of assignments (i.e., sampling days) allotted to the day type stratum and let initial strata S_1 , S_2 , and S_3 comprise the site-days for sites of low, medium and high pressures, respectively. Each site-day receives a weight of relative sampling importance based on the site's pressure category. The low, medium and high pressure categories are given respective importance weights 2, 3 and 5 (these values can be changed when required). As a result, each initial stratum S_i gets a total importance weight, and thereby a proportional share (not necessarily an integer) of the n assignments. The final strata are either the S_i themselves or are merged strata (either two adjacent pressure categories or of all three categories) when necessary to ensure that each final stratum is allocated at least two assignments (i.e., two sampled PSUs) to permit variance estimation.

Sampling Frequency: The number of PR2 assignments (sample days) is typically set at eight to ten percent of the possible site-days (PSUs) for the month and district. The sampling assignments are equally divided between weekdays and weekend days. Each month, district, day type and pressure category stratum is assigned at least two sampling days per month.

Sample Selection and Scheduling: For economy, a PR2 sampling assignment lasts about eight hours with about six to seven hours on-site. On-site sampling is scheduled to

include the peak hours when most of the boats return, plus either all the early-returning (early start time) or all the late-returning (late start time) boats.

Within each month, district, day type and pressure category (pressure category or merged categories) stratum, site-days are randomly selected without replacement. Each site-day within a stratum has an equal probability of being selected, but not all site-days are selected and therefore some sites may not be sampled in a month. The draw program randomly selects with equal probability the sampling start time as “early” or “late”. Field leads define “early” and “late” start times each month based on knowledge of the fisheries and the daylight hours available.

As necessary, assignments are rescheduled within a month and district to the same day type, to a site in the same pressure category (if at all possible the same site) and to the same start time.

Survey Methods

Samplers receive their monthly PR2 assignments a week or two before the start of each month. Assignments are for a site-day (specific site and date) and start time. An assignment typically is for a maximum of eight hours (travel time to and from the site plus six to seven hours on-site). Sampling is conducted from the start time until one of the following occurs: (1) the allotted sampling time is completed, (2) the last boat returns or (3) there has been no recent activity and only a few trailers remain in the parking lot. General on-site procedures for PR2 assignments are described in sequential order below. Detailed sampling procedures are available in the CRFS Sampler Manual (CDFW 2021).

1. In a few cases, PR2 sites are close to another PR2 site that has substantially less effort (e.g., in the same harbor) and the second site has similar catch rates as the sampled PR2 site. In these cases, the boats landing at the second less active site are considered “missed boats” for the sampled PR2 site. Before going to the assigned PR2 site, the sampler counts and records the trailers in the count area (typically a parking lot) of the other PR site (off-site start count).
2. Upon arriving at the sampled PR2 site, the sampler counts and records the number of trailers in the count area (on-site start count) and records the time the count began.
3. The sampler stations him- or herself where he/she can intercept the boats returning to the site.
4. The sampler attempts to intercept as many returning boats as possible (preferably all boats) to determine their activity (e.g., recreational saltwater fishing, commercial fishing). The sampler records the activity of the boat, the type of boat (“regular”, kayak, personal watercraft, sail) and the time the boat was intercepted. The sampler also records the boat type of each boat he or she was unable to intercept, each boat where the passengers declined to be interviewed, and each boat where the interview couldn’t proceed due to a language barrier.
5. The sampler attempts to interview the angler parties on the private or rental boats where the passengers engaged in recreational saltwater fishing. The sampler uses a scripted questionnaire designed to collect demographic data on

the angler (or one angler in a party), each angler's license status and the data elements used in the effort and catch rate estimates (see the section titled "Key Data Elements Collected" below).

6. At the end of the sampling period, the sampler counts and records the number of trailers in the count area for the PR2 site (on-site stop count) and the time the stop count began.
7. If the PR2 has an associated PR2 site, the sampler counts and records the number of trailers in the count area for the associated PR2 site (off-site stop count).

Key Data Elements Collected

The following key data elements are collected during the field survey and are used in the estimates of effort and catch rate. Data are recorded on the PR Form (Appendix E) and instructions for collecting and recording each data element are in the CRFS Sampler Manual (CDFW 2021).

1. General assignment data
 - a. Assignment identification number
 - b. Date
 - c. County code
 - d. Site name and number
2. Site effort data
 - a. Start and stop counts of boat trailers at the PR2 site and the associated site if one is designated
 - b. Number of returning boats the sampler did not interview at the site due to high activity, passengers' refusal to participate in an interview, or language barriers that prevented an interview
 - c. Number of boats interviewed
 - d. Time each boat launched (angler reported time interviewed boats launched and approximate time of boats that launched while the sampler was on site)
3. Data from each interviewed boat
 - a. CRFS sample number
 - b. Time of interview
 - c. Activity (saltwater recreational fishing, non-fishing, commercial, CPFV)
4. Data from each interviewed boat returning from a recreational saltwater fishing trip
 - a. Total number of anglers
 - b. Number of unlicensed anglers (use in expanding estimates based on data from the Angler License Directory Telephone Survey)
 - c. Number of days fished on the trip
 - d. If fished at night
 - e. Primary and secondary target species (used to determine trip type)
 - f. Water area (area where the majority of the fishing effort occurred) of the primary and secondary targets
 - g. Number of fish by species that were landed and examined by the sampler (kept-observed) and the lengths and weights of those fish
 - h. Number of fish by species or lowest taxonomic order possible that the angler(s) reported caught, kept and not available for examination (kept-unobserved), the number released alive (released-alive), and the number released dead (released-dead). For angling parties, this information is gathered from each angler.

- i. For groundfish species released alive, whether those fish were released using a descending device (used for groundfish depth-dependent mortality estimates)
- j. Bottom depth where most fish were caught or bottom depth by species (used for groundfish depth-dependent mortality estimates)

Estimation Procedures – Effort

For the same reasons as for PR1, CRFS calculates PR2 effort estimates for each of two effort units: boat trip and angler days. A boat trip is a landing of a private or rental boat at a PR2 site during daylight hours without regard to number of anglers on the boat or the length of the trip. Each boat trip accounts for $A = a \times L$ angler days where a is the number of anglers onboard and L is the boat trip length in days.

PR2 effort is estimated for each domain defined by month and district and by two trip features: trip type and water area. The account below is for estimation in boat trips. Estimation in angler days proceeds similarly.

For each estimation domain (i.e., month, district, trip type and water area), the estimation of effort in boat trips involves three basic steps:

- Step 1 – Estimate effort in boat trips for each sampled site-day (i.e., each PR2 assignment) and combination of trip type and water area
- Step 2 – Estimate effort in boat trips for each sampling stratum (each sampling stratum comprises the district and month’s site-days of a given day type and a given final site pressure category which may result from merger of two or all three of the initial pressure categories) and combination of trip type and water area
- Step 3 – Obtain the total effort for each estimation domain (i.e., month, district, trip type and water area) by summing the component estimates from Step 2

Step 1 – Effort Estimate for Each PR2 Assignment

For a given sampled site-day (i) and combination of trip type and water area (d), a separate effort estimate ($e_{i,d,b}$) is first calculated for each of three boat types (b): regular, kayak/personal watercraft and sail:

Eq. 3.B.1

$$e_{i,d,b} = (t_{i,d,b}B_{i,b})X_i$$

where

- $t_{i,d,b}$ = the sampled fishing boat trips of type b on the site-day i which took trips of the given trip type and water area
- $B_{i,b}$ = an adjustment factor to account for the fact that some returning boats of the given boat type b may be “missed” (i.e., not sampled because the sampler was not able to interview the passengers on a boat due to high activity at the site, passengers refusal to participate in an interview, passengers not able to participate in the interview due to language barriers, trailers in the PR2 count site when the sampler leaves for the day and the maximum number of trailers at an associated PR site).

X_i = an expansion factor depending only on the site-day (i) to account for boats returning before the sampler arrives at the site or for entire trips that take place during daylight hours after the sampler leaves the site (i.e., the boat both departs and returns after the sampler has conducted the trailer stop count). Currently, the factor is set at the default value of 1 while profiles of boat return patterns are developed for each site and month.

The “missed boat” adjustment factor is calculated as

Eq. 3.B.2

$$B_{i,b} = \frac{s_{i,b} + m_{i,b}}{s_{i,b}}$$

where

$s_{i,b}$ = the number of sampled boats of type b for site-day i

$m_{i,b}$ = the number of missed boats of type b for site-day i

Equations 3.B.1 and 3.B.2 implement the assumption that for each sampled site-day and boat type, the distribution among trip types and water areas of the missed boats matches that of the sampled boats.

Overall effort for the site-day and given trip type and water area ($E1_{i,d}$) is obtained as the sum of the effort values of the three boat types.

Eq. 3.B.3

$$E1_{i,d} = \sum_b e_{i,d,b}$$

Step 2 – Effort Estimate for Each Stratum

For a given sampling stratum (s , defined by month, district, day type and final pressure category) and combination of trip type and water area (d), estimate the mean number of boat trips by summing the $E1_{i,d}$ values from Step 1 and dividing by the number of days sampled in the stratum (n_s).

Eq. 3.B.4

$$\widehat{E1}_{s,d} = \frac{\sum_i E1_{i,d}}{n_s}$$

For a given month and district, the estimated number of boat trips for each day type, final pressure category, trip type and water area ($\widehat{E2}_{s,d}$) is estimated by

Eq. 3.B.5

$$\widehat{E2}_{s,d} = N_s \widehat{E1}_{s,d}$$

where N_s is the total number of site-days in stratum (N_s). Variance of each $\widehat{E2}_{s,d}$ is estimated by

Eq. 3.B.6

$$\widehat{Var}(\widehat{E2}_{s,d}) = N_s^2 \left(\frac{\sum_{i=1}^{n_s} (\widehat{E1}_{i,d} - \widehat{E1}_{s,d})^2}{n_s(n_s - 1)} \right)$$

The variance estimation formula may be derived from equation 2.21 on page 26 of Cochran 1977, *Sampling Techniques* (ed. 3).

An undercoverage expansion factor (U) is applied to each stratum estimate of the total effort for active PR2 sites ($\widehat{E2}_{s,d}$) to compensate for lack of sampling at inactive PR2 sites. The PR2 site register for the month may include PR2 sites that are designated as “inactive” due to extremely low activity or logistics (e.g., safety concerns). Inactive sites are not included in the draw for the month. The undercoverage expansion factor is currently calculated for each month and district and is based on past counts at the active sites (in the draw) and at the inactive sites. The adjusted effort estimate for each month, district, day type, final pressure category, trip type and water area domain ($\widehat{E3}_{s,d}$) is given by

Eq. 3.B.7

$$\widehat{E3}_{s,d} = \widehat{E2}_{s,d} \times U$$

Variance of each $\widehat{E2}_{s,d}$ is estimated by

Eq. 3.B.8

$$\widehat{Var}(\widehat{E3}_{s,d}) = U^2 \times \widehat{Var}(\widehat{E2}_{s,d})$$

Step 3 – District-wide Domain Estimates

For each domain defined by a month, district, trip type and water area, the final effort estimate (\widehat{E}) is obtained by summing the Step 2 estimates ($\widehat{E3}_{s,d}$) for all the PR2 sampling strata (s) for the given district and month.

Eq. 3.B.9

$$\widehat{E} = \sum \widehat{E3}_{s,d}$$

The corresponding variance estimate is the sum of the variances for the separate strata estimates: this simple procedure is enabled by the sampling design (stratified random sampling), whereby the strata are sampled independently. Namely,

Eq. 3.B.10

$$\widehat{Var}(\widehat{E}) = \sum \widehat{Var}(\widehat{E3}_{s,d})$$

where (as above) summation is over all PR2 sampling strata (s) for a given district and month.

Estimation Procedures— Catch Rate

The PR2 catch rate procedures are the same as for PR1. PR2 catch rate is calculated as both catch per boat trip and catch per angler day. Catch per boat trip is used in the estimates of PR2 total catch. Catch per angler day is used in the estimates of total catch for private and rental boats returning to private-access sites or fishing at night (PAN). The account below is for estimation of catch rate as catch per boat trip. Estimation of catch rate as catch per angler day proceeds similarly.

The catch rate (\hat{R}) is estimated each month for each combination of district, trip type, water area, species and catch type (kept-observed, kept-unobserved, released-alive, released-dead) by

Eq. 3.B.11

$$\hat{R} = \frac{\sum_{i=1}^n c_i}{\sum_{i=1}^n t_i}$$

where

- c_i = the catch (of the given species and catch type) on sampled boats (trips) on site-day (i) and with the given combination of trip type and water area
- t_i = the number of sampled boats (trips) on site-day (i) with the given combination of trip type and water area
- n = the number of sampled PR2 site-days in the given month and district

The variance of the catch rate estimate is estimated by

Eq. 3.B.12

$$\widehat{Var}(\hat{R}) = \left(\frac{1}{\bar{t}^2}\right) \left(\frac{1 - \frac{n}{N}}{n}\right) \left(\frac{\sum_{i=1}^n (c_i - \hat{R}t_i)^2}{n - 1}\right)$$

Here N is the district and month's total number of site-days and \bar{t} is the mean number, per sampled site-day, of trips with the given combination of trip type and water area. The catch rate calculation, which aggregates unweighted sample data, is based on the plausible assumption that, for a given month and district, the catch rates for a given species depend primarily on trip type and water area, with only random effects owing to site or day type. Thus, the variance estimation formula may be derived from the discussion in Cochran (1977) equation 2.39 and ensuing text on pages 31-33.

PR2 TOTAL CATCH

Total catch for each species and catch type (\hat{C}) is estimated for each domain defined by a combination of month, district, trip type and water area by

Eq. 3.B.13

$$\hat{C} = \hat{E}\hat{R}$$

where for the domain, species and catch type

- \hat{C} = the estimated total number of fish caught
- \hat{R} = the estimated catch per boat trip
- \hat{E} = the estimated total number of boat trips

A nearly unbiased variance estimate of \hat{C} is obtained from an unbiased estimator version of the Goodman formula for the variance of a product of independent random variables. Namely,

$$\text{Eq. 3.B.14} \quad \widehat{\text{Var}}(\hat{C}) = \hat{R}^2 \widehat{\text{Var}}(\hat{E}) + \hat{E}^2 \widehat{\text{Var}}(\hat{R}) - \widehat{\text{Var}}(\hat{R}) \widehat{\text{Var}}(\hat{E})$$

3.C. ANGLER EFFORT ON PRIVATE AND RENTAL BOATS THAT RETURN TO PRIVATE-ACCESS SITES OR THAT RETURN AT NIGHT

CRFS field surveys do not cover the entire population of private and rental boat sites or times boats return. Private-access sites for private and rental boats (i.e., sites not accessible to the general public) are not sampled directly by CRFS field surveys due to their inaccessibility and the large number of sites scattered throughout the state. For safety and budgetary reasons, CRFS field surveys sample public-access sites only during daylight hours.

In this section, private and rental boats returning to private-access sites (i.e., sites not covered by the PR1 or PR2 surveys) or returning at night are termed “PAN” (private-access or night) and private and rental boats returning during daylight hours to sites covered by the PR1 or PR2 surveys are termed “PAD” (public-access and daytime). Three surveys are used to estimate PAN effort: the Angler License Directory Telephone Survey (ALDTS), PR1 and PR2. Catch rates from the private and rental boat field surveys (PR1 and PR2) are used in the estimates of PAN catch.

For PR1, PR2 and other fishing modes, CRFS supplements each estimate of effort, catch rate or catch with a variance value. Owing to programming complexity, time constraints and more urgent priorities, CRFS is not currently estimating variances for PAN; CRFS plans to estimate variance for PAN estimates in the future.

PAN EFFORT

The sampling design, survey methods and key data elements collected for ALDTS are described in Chapter 2. The sampling design, survey methods and key data elements collected for the PR1 and PR2 field intercept surveys are described in sections A and B of this chapter.

Estimation Procedures – Effort

Estimating PAN effort in the domain of month, district, trip type and water area involves three basic steps:

- Step 1 – Obtain direct estimates from ALDTS with undercoverage adjustment for unlicensed anglers
- Step 2 – Apply a scaling factor to the direct estimates from ALDTS to account for an apparent bias in the direct ALDTS estimates
- Step 3 – Partition the scaled PAN estimates into trip type and water area domains using field survey data

Step 1 – Direct Estimates from ALDTS with Undercoverage Adjustment for Unlicensed Anglers

As described in Chapter 2, monthly estimates of angler days for PAN and PAD in the private and rental boat mode are based on data from ALDTS and the field intercept

surveys (PR1 and PR2). Effort estimates are calculated by expansion from the contacted sample of anglers in ALDTS (n) to the population of all licensed anglers in the survey month (N). Data from the field intercept survey are used to make an undercoverage adjustment for unlicensed anglers, who are not in the telephone survey frame. Chapter 2 provides the estimation procedures for direct ALDTS effort estimates for PAN (in this chapter labeled $\widehat{E1}_{A-PAN}$) and PAD (in this chapter labeled $\widehat{E1}_{A-PAD}$) which include trips by licensed and unlicensed anglers. The estimation domain for direct ALDTS estimates is month and district.

Step 2 – Apply a Scaling Factor to the Direct Estimates from ALDTS

Each district’s PAN effort in any given month ($\widehat{E2}_{PAN}$) is estimated by

Eq. 3.C.1
$$\widehat{E2}_{PAN} = (\widehat{F}_0)(\widehat{E1}_{A-PAN})$$

where, for each district and month,

- \widehat{F}_0 = a scaling factor based on long-term estimates of PAD effort from the field surveys and ALDTS (described below under the subheading “Scaling Factor Background”)
- $\widehat{E1}_{A-PAN}$ = the direct ALDTS estimate of PAN with undercoverage adjustment for unlicensed anglers (value from Step 1)

Scaling Factor Background

Monthly ALDTS estimates of a district’s effort in any mode are highly variable and, even when averaged over time, these estimates are credible in a relative sense but not in an absolute sense. These conclusions emerged from an analysis conducted in 2014, which exploited the fact that the PR1 and PR2 field surveys provide PAD estimates independent of those provided by the ALDTS. The analysis compared corresponding field and telephone monthly PAD estimates for all six districts and all months over several prior years.

The analysis found that each district’s telephone-based PAD effort estimates are far more variable (with high coefficients of variation) than the field-based estimates. This difference in variability evidently owes to the field-based estimates being based on data for a much larger number of private and rental boat anglers than the telephone-based estimates (e.g., in 2015, field-based estimates were based on information from about 27 times the angler trips as the telephone-based PAD estimates).

The analysis also found that, on average over time, a telephone-based PAD effort estimate is roughly twice the size of the corresponding field-based estimate. That is, given a district and month with actual PAD effort (E_{PAD}) and estimates of PAD from the field surveys (\widehat{E}_{F-PAD}) and ALDTS ($\widehat{E1}_{A-PAD}$), we can write:

Eq. 3.C.2
$$\widehat{E}_{F-PAD} = (F)(\widehat{E1}_{A-PAD})$$

where F is a scaling factor whose value typically approximates 0.5 and

Eq. 3.C.3

$$F = \frac{\hat{E}_{F-PAD}}{\hat{E}\hat{1}_{A-PAD}}$$

The field-based estimate (\hat{E}_{F-PAD}) is the sum of the effort estimates for PR1 (\hat{E}_{PR1}) and PR2 (\hat{E}_{PR2}). The field-based estimate is based on counts of returning boats (at a minimum of 8 percent of the site-days for PR2 and at a minimum of 14 percent of the site-days for PR1) and many real-time on-site interviews of all or nearly all anglers at representative site-days (see sections A and B of this chapter). By comparison, although the telephone survey does randomly sample all licensed anglers, the resulting estimate ($\hat{E}\hat{1}_{A-PAD}$) is based on relatively few off-site interviews which occur days and even weeks after fishing. These interviews may well reflect imperfect recall or tendency for greater response from the more avid anglers. As a result, a scaling factor value (F) which differs notably from 1 serves to indicate that the telephone-based estimate is notably less credible than the field-based estimate.

The analysis also obtained an affirmative finding which permits proxy estimation of PAD effort from just the telephone survey in case field data are lacking. Namely, for each of the six CRFS districts, the district's various monthly F-factor values closely approximate a long-term mean value (F_0) which depends just on the district. F_0 may be defined as the long-term ratio of two sums of monthly PAD effort estimates for a given district: the sum of all field-based estimates divided by the sum of all telephone-based estimates. The varying monthly values F result by adding small random perturbations to F_0 . Accordingly, absent field survey data, a proxy estimate of PAD effort ($\hat{E}\hat{2}_{PAD}$) is given from just the telephone survey by

Eq. 3.C.4
$$\hat{E}\hat{2}_{PAD} = (F_0)(\hat{E}\hat{1}_{A-PAD})$$

Although each district's long-term value F_0 is not precisely known, an estimate \hat{F}_0 can be used. \hat{F}_0 is got by averaging multiple months' F-factor values from recent past data. By use of these district estimates of the F-factor (\hat{F}_0), PAD effort can be estimated by

Eq. 3.C.5
$$\hat{E}\hat{2}_{PAD} = (\hat{F}_0)(\hat{E}\hat{1}_{A-PAD})$$

Each district's value \hat{F}_0 is based on "good" months (i) during the prior year or prior few years, where in a "good" month at least five ALDTS interviewees reported PAD trips in the district.

Eq. 3.C.6

$$\hat{F}_0 = \frac{\sum \hat{E}_{F-PAD,i}}{\sum \hat{E}\hat{1}_{A-PAD,i}}$$

For districts 1 to 4, \hat{F}_0 is based on estimates for the district in question. ALDTS data are sparse for districts 5 and 6, and as a result, districts 5 and 6 use a

common scaling factor value (\hat{F}_0) where each sum ($\sum \hat{E}_{F-PAD,i}$ and $\sum \hat{E}_{A-PAD,i}$) is over the “good” monthly cases from the two districts.

The use of \hat{F}_0 as a scaling factor for PAN relies on a plausible basic assumption that, on average, over the long-term, the same district scaling factors which work for PAD trips work also for PAN trips. The rationale for this assumption is that the various effects (e.g., imperfect recall and more response from more avid anglers) that combine to bias direct ALDTS effort estimates for PAD trips operate similarly for direct ALDTS estimates PAN trips on average over time.

Step 3 – Partition the Scaled PAN Estimates by Trip Type and Water Area

The estimation domain for ALDTS direct effort estimates and the scaled estimates of PAN from Step 2 are by month and district. To provide estimates of PAN effort and catch by month, district, trip type and water area, the estimates from Step 2 ($\widehat{E}_{2,PAN}$) are partitioned into trip type and water area using a proportion based on data from the field intercept surveys (PR1 and PR2). The PAN effort for a given month and district and combination of trip type and water area ($\hat{E}_{PAN,d}$) is estimated by

$$Eq. 3.C.7 \quad \hat{E}_{PAN,d} = (\hat{p}_d)(\widehat{E}_{2,PAN})$$

where, the proportion of a month and district's effort in a given combination of trip type and water area (\hat{p}_d) is estimated by

Eq. 3.C.8

$$\hat{p}_d = \frac{\hat{E}_{PR1,d} + \hat{E}_{PR2,d}}{\hat{E}_{PR1} + \hat{E}_{PR2}}$$

and

$\hat{E}_{PR1,d}$ = the estimate of PR1 effort in the given month, district, trip type and water area domain

$\hat{E}_{PR2,d}$ = the estimate of PR2 effort in the given month, district, trip type and water area domain

\hat{E}_{PR1} = the estimate of PR1 effort for the given month and district

\hat{E}_{PR2} = the estimate of PR2 effort for the given month and district

PAN CATCH RATE

For each combination of month, district, trip type, water area, species and catch type, PAN catch rate is taken to be the combined value obtained from the field surveys (PR1 and PR2) trips. As detailed in sections A and B of this chapter, the PR1 and PR2 catch rates are found separately, in each case from sample data. The combined catch rate is estimated by summing the PR1 and PR2 surveys' catch estimates and dividing by the sum of these surveys' effort estimates.

PAN TOTAL CATCH

Total catch for each species and catch type (\hat{C}) is estimated for each domain defined by a combination of month, district, trip type and water area by

Eq. 3.C.9

$$\hat{C} = \hat{E}\hat{R}$$

where for the domain, species and catch type,

\hat{C} = the estimated total number of fish caught
 \hat{R} = the estimated catch per angler trip
 \hat{E} = the estimated total number of angler trips

3.D. TOTAL PRIVATE AND RENTAL BOAT ESTIMATES

For a given combination of month, district, trip type and water area, total private and rental boat effort is estimated by summing the effort estimates for each submode (PR1, PR2 and PAN). Total private and rental boat catch for each species and catch type is estimated for each domain defined by a combination of month, district, trip type and water area by simple summation over the submodes. The combined PR1 and PR2 catch rate described in section C of this chapter is also total private and rental boat catch rate.

Owing to programming complexity, time constraints and more urgent priorities, CRFS is not currently estimating variances for PAN and the total private and rental boat values; CRFS plans to estimate these variances in the future.

4. Commercial Passenger Fishing Vessels

OVERVIEW

Commercial passenger fishing vessels (CPFVs) are vessels licensed by CDFW to take paying passengers on sport fishing trips. These vessels are also commonly known as party boats, charter boats and for-hire boats.

The owner of a boat, who permits, for profit, any person to take fish, is required by law to obtain an annual CPFV license from CDFW, and is required by law to submit to CDFW records of fishing activity (i.e., logs). CDFW is required by law to keep confidential all license and fishing activity records. CDFW may compile or publish summaries that do not disclose individual or business information.

CDFW sells about 400 to 450 CPFV licenses per year. Some of those vessels fish only in freshwater and are excluded in the CRFS estimates. The CRFS CPFV effort and catch estimates also exclude any trips where the fishing method involves diving (“dive trips”). The cost of capturing a representative catch rate sample from “dive trips” is prohibitive since the landing sites and times of landings tend to differ between “dive trips” and “angling trips”. In addition, most of the catch on “dive trips” is invertebrate species. The CRFS estimates for other modes include diving effort and finfish caught using dive gears.

CPFV effort estimates are derived from (1) mandatory logs which CPFV operators submit for each fishing trip (or each day of fishing for multiday trips) and (2) a dockside “effort check survey” conducted at CPFV landings resulting in an estimated compliance proportion (i.e., the fraction of the confirmed fishing trips from the effort check survey with a submitted CPFV log). An independent on-site, intercept survey is used to collect data on catch for catch rate calculations. The intercept survey is conducted either onboard CPFVs at sea or dockside at the end of the fishing trip. The effort and catch rate estimates are combined to produce estimates of total catch.

The effort and catch surveys for salmon differ from those described in this section; the salmon survey methods and estimation procedures are described in Appendix A. Daily boat counts are conducted of CPFVs targeting salmon north of Point Conception (Santa Barbara County) and at least 20 percent of the salmon CPFV trips in each half-month period of the salmon season are sampled at the dock for effort (angler trips equal to angler days) and catch.

CPFV EFFORT

Since 2011, CRFS has used a combination of self-reported data on fishing trips from CPFV owners and operators and an independent dockside effort check survey to estimate CPFV effort. This section describes the CPFV logs, the sampling design for the effort check survey and the procedures for estimating CPFV effort in angler days.

CPFV Logs

Since 1936, the owner or operator of a CPFV has been required by law to keep and submit a complete and accurate record of fishing activities on logs provided by CDFW. CPFV owners/operators are required to submit their completed CPFV logs to CDFW by

the 10th day of the month following the fishing trip. However, compliance is less than 100 percent for the fleet overall, and not all logs are submitted on time.

Historically, all logs were paper forms. Beginning in 2015, CPFV operators have had the option of submitting traditional paper logs to CDFW for data entry into an electronic database or submitting electronic logs via a web-based application. CDFW attempts to enter all submitted paper logs by the end of the month following the trip. Data from the paper and electronic logs undergo a series of error checks. A description of how the CPFV logs are used to estimate effort can be found the section of this chapter titled, “Estimation Procedures – Effort”.

Key Data Elements Collected – CPFV Logs

The following key data elements are collected from CPFV logs (Appendix G):

1. Vessel name and vessel registration number (CDFW Boat Number) – confidential information
2. Port of landing
3. Date of the fishing trip; departure and return time
4. Location (as a 10-by-10 nautical mile CDFW Fishing Block) and depth where most of the fish were caught or, if no fish caught, most of the fishing occurred
5. Kind of trip (e.g., Single Day, Multiday, Non-Paying)
6. Target species
7. Fishing methods
8. Number of anglers (the numbers are for anglers on the trip for trips lasting less than one calendar day or the number of anglers for the day of fishing for multiday trips)
9. Number of fish by species or species group that were caught and retained or caught and released

Effort Check Survey

If all CPFV operators complied with the law and submitted on time a log for each fishing day and all logs received by CDFW were entered by the time the estimates were made, a tally of angler trips from the logs could be used as a census of all effort for the month. Since there is not full compliance and data entry may be delayed, CRFS uses data from the effort check survey and the CPFV log database to estimate effort.

The aim of the effort check survey is to produce a plausible estimate of the proportion of the district-month’s CPFV trips for which logs are submitted and entered into the CPFV log database at the time the estimates are made. The estimate is based on direct confirming observations and descriptions by samplers of a sufficiently large and representative sample of the district-month’s CPFV fishing trips. Each verified CPFV fishing trip during the effort check survey is described by sampler in sufficient detail (i.e., boat identification, landing site, date of the trip, and trip target) to permit reliable matching of the trip to a unique CPFV log for the trip.

Sampling Design – Effort Check Survey

Scope: One statewide survey in the survey-covered month.

Target Population: All CPFV saltwater recreational fishing trips landing in California in the survey-covered month.

Stratification: by district.

Sample Selection and Scheduling: To ensure a large and representative sample of confirmed fishing trips, any encountered fishing CPFV trip is included in the effort check survey data. In addition to scheduled effort check surveys at CPFV landings in each district, the effort check survey data include information about every CPFV trip sampled in the CPFV catch rate survey (described below) and each CPFV trip which leaves from or returns to a launch site during a private/rental boat survey day. Effort check surveys are conducted daily at all CPFV landings in districts 3 through 6 during salmon season (and likewise in District 2 when salmon are present). In addition to providing data to estimate the compliance proportion, the data from these checks enable tracking of salmon landings to ensure that in each half-month period at least 20 percent of the salmon trips are sampled.

Sampling Rates: Over 16,000 CPFV fishing trips were confirmed during the effort check surveys in 2015; this represents over 40 percent of the estimated CPFV trips that year.

Survey Methods – Effort Check Survey

The sampler identifies and records the CPFVs at the landing by verifying boat names and registration numbers and ascertains if a particular boat is departing, returning or away from the landing on a fishing trip or for another reason. The information is recorded onto a PC (CPFV) Effort Check Form (Appendix E). Detailed sampling procedures are available in the CRFS Sampler Manual (CDFW 2021).

Key Data Elements Collected – Effort Check Survey

The following key data elements are collected during the effort check survey by field samplers and are recorded on a PC (CPFV) Effort Check Form (Appendix E). Detailed instructions for collecting and recording each data element are in the CRFS Sampler Manual (CDFW 2021).

1. Vessel name and vessel registration number (CDFW Boat Number) – confidential information
2. Name, county code and site number of the landing
3. Date of the vessel's activity
4. Source of information about the activity (direct observation by the sampler, sampled in the catch rate survey, information from the CPFV skipper, information from the CPFV landing, information from a website)
5. The activity in which the CPFV was engaged (e.g., recreational fishing, boat docked or trailered, non-recreational fishing trip). If recreational fishing, the target species.

Estimation Procedures – Effort

Effort is estimated for each domain defined by district, month, trip type and water area. However, the effort estimate utilizes an estimated compliance proportion (\hat{p}) that is dependent only on district and month and not on trip type or water area. The use of only district and month to estimate the compliance proportion assumes that the likelihood of an owner or operator submitting a CPFV log on time is not dependent on the type of fish targeted or the water area fished during the trip. However, to account for known regional and seasonal differences in compliance, the compliance proportion and resulting undercoverage correction ratio are estimated by district and month.

The estimated compliance proportion (\hat{p}) and its estimated variance ($\widehat{Var}(\hat{p})$) are for tractability based on the plausible assumption that the confirmed CPFV trips identified during the effort check survey are for practical purposes equivalent to a simple random sample of all CPFV trips for the given district-month. Namely, let n be the total number of the survey's confirmed CPFV fishing trips and let m be the total number of those trips with corresponding logs returned at the time the estimates are made. Then

Eq. 4.1

$$\hat{p} = \frac{m}{n}$$

Eq. 4.2

$$\widehat{Var}(\hat{p}) = \frac{\hat{p}(1 - \hat{p})}{n - 1}$$

The compliance proportion is used to calculate an undercoverage correction ratio (\hat{r}) for each district and month,

Eq. 4.3

$$\hat{r} = \frac{1}{\hat{p}} = \frac{n}{m}$$

with variance estimated by

Eq. 4.4

$$\widehat{Var}(\hat{r}) = \frac{(1 - \hat{p})}{(n - 1)\hat{p}^3}$$

While the compliance proportion and undercoverage correction ratio are based on CPFV boat trips, they are used in the expansion of angler effort measured in angler days. This procedure is based on the assumption that the likelihood of an owner or operator submitting a CPFV log on time is not dependent on the number of anglers on the trip or on the length of the trip.

One CPFV log is submitted for each trip lasting one calendar day or less (equals one trip in the estimate calculations) and one log is submitted for each day of a trip lasting more than one calendar day (each day that fishing occurred on a multiday trip is considered a trip in the estimate calculations). Each log lists the number of anglers who fished that day. Based on the information on the logs, the logs are grouped into domains defined by month, district, trip type and water area, and the number of angler days (angler trips) is summed for each domain.

A domain's total corrected value for CPFV angler effort in angler days is

Eq. 4.5

$$\hat{E} = \frac{y}{\hat{p}} = y\hat{r}$$

where y is the domain's total number of angler days reported on logs returned by the cut-off date. Variance is calculated by

Eq. 4.6

$$\widehat{Var}(\hat{E}) = \widehat{Var}(y\hat{r}) = y^2\widehat{Var}(\hat{r}) = y^2 \left(\frac{(1 - \hat{p})}{(n - 1)\hat{p}^3} \right)$$

In rare cases where the number of observed CPFV trips with corresponding logs (m) is zero for a given month and district, the undercoverage correction ratio (\hat{r}) would give an invalid result. In such cases, the compliance proportion from a neighboring district is used as a proxy. This situation occurs most often in districts 5 and 6 during periods of low effort.

CPFV CATCH RATE

To collect catch rate data, samplers interview anglers and inspect the anglers' catch at the end their fishing trip. The interviews and inspection of the catch may happen onboard the CPFV at sea or dockside. Both the onboard and dockside surveys collect additional information that is used to estimate average weight per fish, to conduct regulatory analyses and in stock assessments.

Sampling Design – Catch Rate Survey (Onboard and Dockside)

Scope and Staging: One statewide three-stage survey in the survey-covered month.

Target Population: All saltwater CPFV angler trips targeting finfish with angling gear (excludes trips with fishing methods that involve diving) in California waters or US waters off California in the survey-covered month.

Frame and Stratification:

STAGE 1 – The frame is all active sites where CPFVs targeting saltwater finfish with angling gear land (CPFV landings sites) and is stratified by district.

STAGE 2 – For each selected landing site, the frame is all scheduled CPFV boat trips targeting saltwater finfish with angling gear in California waters or US waters off California.

STAGE 3 – The frame is all anglers aboard each sampled boat trip.

Sampling Rate: The general sampling goal is to sample onboard at the historical sampling frequency of two to five percent of estimated CPFV trips of interest (e.g., trips targeting groundfish, inshore and coastal pelagic species) at each CPFV landing and to sample other CPFV trip types dockside. Salmon trips are sampled in a separate survey and at least 20 percent of all salmon CPFV trips are sampled at the dock (Appendix A).

Sample Selection and Scheduling:

Sample selection is a three step process:

1. Selection is by an automated draw program of landings and dates to sample. Each given landing and date pair constitutes an assignment. The number of assignments per landing is based on predicted effort (CPFV boat trips) at that landing in the survey month. Both estimates of past CPFV effort and the Field Leads' local knowledge of potential effort (e.g., season regulations, fishing

conditions, CPFVs using the site) for the month of the draw are used to predict effort. Separate draws are conducted for onboard and dockside assignments. For a drawn assignment, the Field Lead may specify the kind of trip (defined by trip duration or target species) to sample.

If no CPFVs at the assigned landing are fishing on an assigned date, the assignment may be reassigned to a different date. For onboard assignment, the sampler attempts to complete the assignment per the following CPFV onboard sampling hierarchy:

- a. Assigned kind of trip at the assigned landing.
- b. Different kind of trip at the assigned landing.
- c. Assigned kind of trip at the nearest alternate landing.
- d. Different kind of trip at nearest alternate landing.
- e. If alternatives a to d above aren't available, the sampler will reschedule the assignment to the nearest day when a CPFV is taking a trip from the assigned landing.

If an onboard trip is assigned and the sampler cannot ride the boat because the boat is at its U.S. Coast Guard capacity (legal limit for the number of persons onboard), the sampler may switch the assignment from an onboard sample to a dockside sample. Typically, this situation occurs near the end of the month when it is unlikely that another onboard sampling opportunity will occur.

2. Selection by the sampler of specific CPFV trips departing on the given date from the given landing: Each sampler attempts to sample a variety of boats at a given landing during the month since boats from the same landing targeting the same species may fish different locations and use different methods.
3. Selection by the sampler of the anglers to interview and inspect their catch: If the sampler cannot interview all the anglers on the boat, the sampler attempts to randomly select anglers to interview and inspect their catch.

In addition to collection from scheduled CPFV assignments, catch rate data are collected from CPFVs that land at private and rental boat sites during scheduled private and rental boat assignments. The private and rental boat assignments are selected via a random draw of site days (see chapters 3A and 3B).

Survey Methods – Catch Rate Survey

Detailed information about the survey methods can be found in the CRFS Sampler Manual (CDFW 2021). Catch data are collected by “bag”. The sampler inspects the contents of the bag (including bags with no catch) and determines the angler or anglers associated with the bag (i.e., angling party). The sampler interviews all the anglers associated with the bag to learn about any kept catch that isn't in the bag and all released fish.

Onboard: On trips with less than 30 anglers, the sampler generally tries to introduce him or herself to all the anglers on the way to the fishing grounds and to collect demographic information. When there are more than 30 anglers onboard or it is a short distance to the fishing grounds, the sampler will interview a random subsample of anglers or angling parties. On the ride back to the dock, the sampler interviews the anglers or angling

parties contacted at the start of the trip about the fish they kept or released and inspects and measures their kept catch.

Dockside: The sampler meets the CPFV at the dock as it returns from a fishing trip and interviews the anglers and inspects and measures their catch as they depart the vessel. If the vessel carries more than a few anglers, the sampler typically cannot interview all the anglers as they depart, because the anglers do not want to wait to be interviewed. The sampler systematically selects the anglers or angling parties to interview by picking every *n*th angler or angling party. More than one CPFV may be sampled during a dockside assignment. Dockside procedures are used for CPFVs that land at private and rental boat sites during a scheduled private and rental boat assignment.

The sampler determines the total number of anglers by counting the number of departing anglers and asking the captain and crew if they fished. The sampler asks the captain for information about the trip such as fishing locations, gear, fishing depths, targets and use of descending devices.

Data Elements Collected – Catch Rate Survey

The following key data elements for the catch rate estimates are collected in both the onboard and dockside samples. For the onboard samples, these data are reported on the CRFS PC (CPFV) Onboard Angler Form or CRFS PC (CPFV) Onboard Catch and Discard Form, and for the dockside samples, these data are reported on the CRFS PC (CPFV) Dockside Form (Appendix E). Instructions for collecting and recording each data element are in the CRFS Sampler Manual (CDFW 2021).

1. General assignment data
 - a. Assignment identification number
 - b. Date
 - c. County code
 - d. Site name and number
2. Boat trip information
 - a. CPFV name and registration number (CDFW Boat Number) – confidential information
 - b. Primary and secondary target species (used to determine trip type)
 - c. Water area (area where the majority of the fishing effort occurred) of the primary and secondary targets
 - d. For dockside samples, the location where most of the fish were caught, or if no fish were caught, where most of the fishing occurred. For onboard samples, information on location comes from stop-by-stop data (see Appendix B). These data are used for groundfish depth-dependent mortality estimates.
 - e. For dockside samples, the average bottom depth where most fish were caught or if no fish were caught, where most of the fishing occurred. For onboard samples, information on depth comes from stop-by-stop data (see Appendix B). These data are used for groundfish depth-dependent mortality estimates.
 - f. Number of anglers who fished on the CPFV
 - g. Gear used
 - h. The trip duration (departure and return dates and times)
 - i. The number of days fished
 - j. Whether a descending device was used on the trip

3. Data from each interviewed angler or angling party
 - a. Number of anglers who contributed to the bag
 - b. For each bag, the number of fish by species that were landed and examined by the sampler (kept-observed) and the lengths of those fish and, when possible, the weights of those fish
 - c. For each bag, the number of fish by species or lowest taxonomic order possible that the angler(s) reported caught, kept and not available for examination (kept-unobserved), the number released alive (released-alive) and the number released dead (released-dead). For angling parties, this information is gathered from each angler.

Estimation Procedures – Catch Rate

The estimated catch rate (\hat{R}), as catch per angler day, is calculated for each species and catch type in each domain (month, district, water area and trip type). Catch data are obtained by sampling bags and interviewing the angler or anglers assigned to a bag. More than one angler may contribute to a bag and, in very rare instances, a bag may contain catch for more than one day. A domain's catch rate is estimated by

Eq. 4.7

$$\hat{R} = \frac{\sum_{i=1}^b c_i}{\sum_{i=1}^b n_i}$$

where

- | | | |
|-------|---|---|
| b | = | the total number of sampled bags (shared and unshared) |
| c_i | = | a bag's catch (number of fish) |
| n_i | = | a bag's effort (number of angler days, which is the product of the number of anglers contributing to the bag and the number of days fished) |

Variance is estimated by

Eq. 4.8

$$\widehat{Var}(\hat{R}) = \left(\frac{b}{b-1} \right) \left(\frac{\sum (c_i - \hat{R}n_i)^2}{n^2} \right)$$

where

Eq. 4.9

$$n = \sum_{i=1}^b n_i$$

The catch rate estimate (Eq. 4.7) and its variance estimate (Eq. 4.8) are both based on the assumption that for practical purposes the sampled bags (b) are equivalent to a simple random sample from all the domain's bags.

CPFV TOTAL CATCH

Total catch for each species and catch type (\hat{C}) is estimated at the domain of month, district, trip type and water area by

$$\text{Eq. 4.10} \quad \hat{C} = \hat{E}\hat{R}$$

where

\hat{C}	=	the estimated total number of fish caught in the domain
\hat{R}	=	the estimated catch per angler day in the domain
\hat{E}	=	the estimated total number of angler days in the domain

A nearly unbiased variance estimate of \hat{C} is obtained from an unbiased estimator version of the Goodman formula for the variance of a product of independent random variables. Namely,

$$\text{Eq. 4.11} \quad \widehat{var}(\hat{C}) = (\hat{R})^2 \widehat{var}(\hat{E}) + (\hat{E})^2 \widehat{var}(\hat{R}) - \widehat{var}(\hat{R})\widehat{var}(\hat{E})$$

5. MAN-MADE STRUCTURES

OVERVIEW

An access point survey is used to collect catch and effort data at publicly accessible man-made structures such as piers, docks, and jetties during daylight hours. The sites are aggregated into groups (clusters of sites) based on geographic proximity. Assignments are for a cluster-day and samplers visit all sites in the cluster during an assignment.

The survey collects the requisite data for estimating effort and catch for public-access daytime fishing. No estimates are made of effort or catch at private-access sites or for night fishing. Sport fishing licenses are not required on most publicly owned man-made structures under California law. Thus, the CRFS Angler License Directory Telephone Survey is not useful in estimating night fishing effort at man-made structures.

MAN-MADE STRUCTURES EFFORT AND CATCH RATE

Sampling Design

Scope and Staging: One statewide two-stage survey of clusters of man-made structure sites in the survey-covered month.

STAGE 1 - Primary sampling units (PSUs) are all cluster-day pairs defined by the active man-made structure clusters (i.e., clusters with active sites) and the month's fishing days at each cluster during the survey month. Each man-made structure sampling assignment, accounting for a sampler-day, samples a unique PSU.

STAGE 2 - Secondary sampling units (SSUs) are all daily angler parties fishing at the active man-made structure sites during the month's daylight hours. In the second stage of sampling, samplers' select and interview angler parties (SSUs) encountered at sampled PSUs.

Target Population: All saltwater angler trips at California man-made structure sites during daylight hours in the survey-covered month.

Frame and Stratification: The man-made structure survey's sampling frame comprises all the PSUs for the month (i.e., all cluster-day pairs).

Each calendar day is classed by day type as either weekday or weekend (includes weekend days and most major holidays).

Each of the month's man-made structure clusters is assigned a pressure category: low, medium or high. The pressure category reflects expected effort at the cluster during the month. The expected effort is based on historical data and expert opinion. A cluster's assigned pressure is relative to the other man-made clusters for the given district and month. For example, the expected effort at a high-pressure cluster in a district and month may be quite low from a statewide perspective or even for the same cluster in a different month. This pressure-level classification enables the month's man-made structure sampling in each district to occur mainly at the higher effort clusters.

The PSUs (cluster-days) are initially stratified by district, day type and pressure category. Thus, each given district and day type gives rise to three initial strata. Per rules which are outlined below and detailed in Appendix F, the sampling design may merge two or even all three of these initial strata. For the resulting final stratification, the sampling regime is stratified random sampling: the separate strata are randomly sampled independently.

For any given district and day type, the merge rules are as follows. Let n (assumed to be two or more) be the number of assignments (i.e., sampling days) allotted to the day type stratum and let initial strata S_1 , S_2 , and S_3 comprise the cluster-days for clusters of low, medium and high pressures, respectively. Each cluster-day receives a weight of relative sampling importance based on the cluster's pressure category. The low, medium and high pressure categories are given respective importance weights 2, 3 and 5 (these values can be changed when required). As a result, each initial stratum S_i gets a total importance weight, and thereby a proportional share (not necessarily an integer) of the n assignments. The final strata are either the S_i themselves or are merged strata (either two adjacent pressure categories or all three categories) when necessary to ensure that each final stratum is allocated at least two assignments (i.e., two sampled PSUs) to permit variance estimation.

Sampling Rate or Frequency: The number of man-made structure assignments (sample days) is typically set at eight to ten percent of the possible cluster-days (PSUs) for the month and district. The sampling assignments are equally divided between weekdays and weekend days. Each month, district, day type and pressure category stratum is assigned at least two sampling days per month.

Sample Selection and Scheduling: Note: for the remainder of this Chapter, pressure category refers to high, medium or low pressure categories or merged categories. Within each month, district, day type and pressure category stratum, cluster-days are randomly selected without replacement. Each cluster-day within a stratum has an equal probability of being selected, but not all cluster-days are selected and therefore some clusters may not be sampled in a month.

The sampling assignment draw program randomly specifies two assignment features (start time and start site) to help ensure that sampling occurs randomly during the day and, in repetitions over time, adequately covers fishing at each site during all daylight hours.

- **Start Time:** The draw program randomly selects with equal probability the sampling start time as “early” or “late”. Field leads define “early” and “late” start times each month based on knowledge of the fisheries and the daylight hours available.
- **Start Site:** The draw program randomly selects with equal probability the site at which the sampler starts sampling during the cluster-day. The sampler will then visit the sites in a predetermined cyclic order. For instance, if the cluster has three sites that are ordered A, B and C and the drawn start site is C, then the specified sampling order will be C, A, B. Sometimes, though not often, the specified order will require excessive travel and the field leads are permitted to amend the start site.

As necessary, assignments are rescheduled within a month and district to the same day type, to a cluster in the same pressure category (if at all possible the same cluster), to the same start time and to the same start site designation.

There is no predetermined frame for the anglers fishing at man-made structures and the samplers don't know in advance how many they will encounter. Samplers try to interview as many anglers as possible during a sample day.

Description of Sites and Clusters: The site register includes all publicly-accessible man-made structures on the coast and in harbors and bays. The site register is continually updated and modified: new sites are added, sites that are closed are made inactive, sites that consistently have very low effort or no effort are classified as inactive and sites that are unsafe are classified as inactive. Inactive sites are periodically monitored and reclassified as active when appropriate.

The sites are grouped into clusters based on geographic proximity. The clusters are designed to allow the sampler to travel to each site in the cluster and conduct on-site interviews and angler counts for several hours at each site during an eight-hour work day. The number of sites per cluster varies depending upon the travel times among sites and distance from the sampler's work station. A typical cluster has two to three sites. The sites within a cluster need not be homogenous in terms of species caught or effort.

The list of sites in each cluster is fixed for a given month but may vary during the year. For example, in some areas, the number of sites per cluster decreases during the busy summer months to allow for longer travel times and the greater difficulty of finding parking at some sites.

Survey Methods

The samplers receive their assignments for the month a week or two before the start of the month. Each assignment lists a starting time and the starting site for the route of the assignment. The sampler follows a predetermined route and visits each site in the cluster during the assignment. Samplers may return to previously visited sites once all of the sites have been visited and angler counts are made at each site. Typically, samplers return to previously visited sites only when effort is low.

The amount of time on-site depends on travel times, the number of sites in the cluster and the observed angling effort. A typical assignment lasts eight hours with about six to seven hours on-site, but may be as short as two hours if no effort is found at any site in the cluster and it is unlikely that effort will develop (e.g., after peak fishing time, extreme weather conditions).

General on-site procedures for each site visited during the assignment are described in sequential order below. Detailed sampling procedures are available in the CRFS Sampler Manual (CDFW 2021).

1. Upon arriving at the site, the sampler counts and records the number of anglers present (start count) and records the time the count began.
2. The sampler stations him- or herself where he/she can intercept anglers leaving the site.

3. The sampler attempts to interview all angler parties who have completed fishing and are leaving the site. The sampler uses a scripted questionnaire designed to collect demographic data on the angler (or one angler in a party), each angler's license status, the angler's (or party's) trip length and the angler's (or party's) catch data. Data elements that are collected for use in the effort and catch estimates are listed below in the section titled "Key Data Elements Collected".
4. At least every 90 minutes while on-site, the sampler counts and records the number of anglers present and the time the count started. Such an "instantaneous" count may require a few minutes or even half an hour, depending on the site's extent.
5. When ready to end sampling at the site, the sampler counts and records the number of anglers (stop count) as well as the time the stop count began.
6. If time allows after the stop count is completed, the sampler may ask randomly selected angler parties or all remaining angler parties when they started to fish and how much longer they intend to fish to determine if the anglers have completed at least half of their trip. The sampler will interview those angler parties who have completed at least half of their trip. The data collected and procedures are the same as in step #3, above.

Key Data Elements Collected

The following key data elements are collected during the field survey and are used in the estimates of effort and catch rate. Data are recorded on the Shore Form (Appendix E) and instructions for collecting and recording each data element are in the CRFS Sampler Manual (CDFW 2021).

1. General assignment data
 - a. Assignment identification number
 - b. Date
 - c. County code
 - d. Site name and number
 - e. Cluster name
2. Site effort data
 - a. Time each angler count began: start count, instantaneous counts (conducted at least every 90 minute while on site) and stop count
 - b. Numbers of finfish anglers present at each angler count
3. Data from each interviewed angler party
 - a. CRFS sample number
 - b. Time of interview
 - c. Total number of anglers in the party
 - d. Trip length: Anglers' arrival time and the additional hours and minutes they intend to continue fishing (this will be zero for completed trips; trips must be 50 percent complete for interviews to be used in the estimates)
 - e. Primary and secondary target species (used to determine trip type)
 - f. Water area (area where the majority of the fishing effort occurred) of the primary and secondary targets
 - g. Number of fish by species that were landed and examined by the sampler (kept-observed) and the lengths and weights of those fish

- h. Number of fish by species or lowest taxonomic order possible that the angler(s) reported caught, kept and not available for examination (kept-unobserved), the number released alive (released-alive) and the number released dead (released-dead). For angling parties, this information is gathered from each angler.

Estimation Procedures – Effort

CRFS estimates effort and catch rate from man-made structures for each estimation domain defined by month, district, trip type and water area. The estimation of effort for each estimation domain involves three basic steps:

- Step 1 – Estimate effort in angler trips for each sampled cluster-day (i.e., each man-made structures assignment) and then partition that effort among trip type and water area combinations
- Step 2 – Estimate effort in angler trips for each sampling stratum (each sampling stratum comprises the district and month’s cluster-days of a given day type and a given final site pressure category which may result from merger of two or all three of the initial pressure categories) and combination of trip type and water area
- Step 3 – Obtain the total effort for each estimation domain of interest (i.e., month, district, trip type and water area) by summing the component estimates from Step 2

Step 1 – Effort Estimate of Each Man-made Structure Assignment (Cluster-day)

For each sampled cluster-day (*i*) get an estimate of the cluster-day’s pressure (\hat{P}_i , the average number of finfish anglers present during the daylight hours) and an estimate of the cluster-day’s total angler effort in angler trips ($\widehat{E1}_i$). The estimated pressure for a cluster-day is calculated by summing the mean angler counts for each site in the cluster on the sampled cluster-day:

Eq. 5.1

$$\hat{P}_i = \sum_j \bar{Q}_{i,j}$$

where

- i* = the sampled cluster-day
- j* = a site in the sampled cluster
- $\bar{Q}_{i,j}$ = the mean of all angler counts (start count, stop count, instantaneous count) at the site *j* on sampled-cluster day *i*

The estimate of the total angler effort for a cluster-day is calculated by

Eq. 5.2

$$\widehat{E1}_i = \hat{P}_i \times (L_i / \widehat{Lm}_i)$$

where

- \widehat{Lm}_i = estimate of the mean trip length of all the anglers interviewed on the cluster-day. The trip length for anglers interviewed when their trip was completed is calculated as the difference between time they leave the site and the time they arrived at the site. The trip length for anglers interviewed before they have completed their trip is calculated as the

difference between time they are interviewed at the site and the time they arrived at the site plus the additional time they expect to fish at the site that day.

L_i = day length (length of the daylight period at the location of the cluster on the cluster-day) derived from almanac data

For each sampled cluster-day (i), estimate the number of angler trips for each combination of trip type and water area (d)

Eq. 5.3

$$\widehat{E1}_{i,d} = \widehat{E1}_i \times \frac{t_{i,d}}{t_i}$$

where

$t_{i,d}$ = the number of angler trips by the cluster-day's interviewed anglers with a given combination of trip type and water area
 t_i = the total number of angler trip by the cluster-day's interviewed anglers

Step 2 – Effort Estimate for Each Stratum

Estimate the mean effort per cluster-day ($\widehat{E1}_{s,d}$) for each sampling stratum (s , defined by month, district, day type and pressure category) and combination of trip type and water area (d) by

Eq. 5.4

$$\widehat{E1}_{s,d} = \frac{\sum_{i=1}^{n_s} \widehat{E1}_{i,d}}{n_s}$$

where summation is over the sampled cluster-days (i) in sampling stratum s , and n_s is the number of those sampled cluster-days.

Estimate the total effort for active clusters ($\widehat{E2}_{s,d}$) for each sampling stratum (s , defined by month, district, day type and pressure category) and combination of trip type and water area (d) (i.e., each estimation domain defined by month, district, day type, pressure category, trip type and water area) by

Eq. 5.5

$$\widehat{E2}_{s,d} = N_s \widehat{E1}_{s,d}$$

where N_s is the number of possible cluster-days in the given sampling stratum s .

Variance of each $\widehat{E2}_{s,d}$ is estimated by

Eq. 5.6

$$\widehat{Var}(\widehat{E2}_{s,d}) = N_s^2 \left(\frac{\sum_{i=1}^{n_s} (\widehat{E1}_{i,d} - \widehat{E1}_{s,d})^2}{n_s(n_s - 1)} \right)$$

where summation is over the sampled cluster-days (i) in sampling stratum (s).

An undercoverage expansion factor (U) is applied to each estimate of the total effort for active clusters ($\widehat{E2}_{s,d}$) to compensate for lack of sampling at inactive man-made structure sites. The man-made structure site register for the month may include man-made structure sites that are designated as “inactive” due to extremely low activity or logistics (e.g., safety concerns). Inactive sites are not included in the draw for the month. The undercoverage expansion factor is currently calculated for each month and district and is based on past counts at the active sites (in the draw) and at the inactive sites. The adjusted effort estimate for each month, district, day type, pressure category, trip type and water area domain ($\widehat{E3}_{s,d}$) is given by

$$\text{Eq. 5.7} \quad \widehat{E3}_{s,d} = \widehat{E2}_{s,d} \times U$$

Variance of each $\widehat{E3}_{s,d}$ is estimated by

$$\text{Eq. 5.8} \quad \widehat{Var}(\widehat{E3}_{s,d}) = U^2 \times \widehat{Var}(\widehat{E2}_{s,d})$$

Step 3 – District-wide Domain Effort Estimates

For each domain defined by a month, district, trip type and water area, the final effort estimate (\widehat{E}) is obtained by summing the Step 2 estimates ($\widehat{E3}_{s,d}$) for all the man-made structure sampling strata (s) for the given district and month.

Eq. 5.9

$$\widehat{E} = \sum \widehat{E3}_{s,d}$$

Since sampling is independent among the strata, the estimated variance for this estimate is the sum of the variances for the separate stratum estimates:

Eq. 5.10

$$\widehat{Var}(\widehat{E}) = \sum \widehat{Var}(\widehat{E3}_{s,d})$$

where summation is over the sampling strata (s).

Estimation Procedures – Catch Rate

Catch rate (\widehat{R}) is estimated as catch per angler trip (equal to angler day for the man-made structure mode) for each species and catch type in each domain defined by month, district, water area and trip type. The sampling unit for catch rate is angler party and its bag (i.e., catch). An angler party may be comprised of a single angler or multiple anglers. A domain’s catch rate is estimated by

Eq. 5.11

$$\widehat{R} = \frac{\sum_{i=1}^b c_i}{\sum_{i=1}^b n_i}$$

where

b = the total number of sampled bags (shared and unshared)
 c_i = a bag’s catch (number of fish)

n_i = a bag's effort (number of angler trips which is equal to the number of anglers contributing to the bag)

Variance is estimated by

Eq. 5.12

$$\widehat{Var}(\hat{R}) = \left(\frac{b}{b-1}\right) \left(\frac{\sum (c_i - \hat{R}n_i)^2}{n^2}\right)$$

where

Eq. 5.13

$$n = \sum_{i=1}^b n_i$$

The catch rate estimate (Eq. 5.11) and its variance (Eq. 5.12) are both based on the assumption that the sampled bags (sampled angler parties) are for practical purposes equivalent to a simple random sample of all the domain's bags.

MAN-MADE STRUCTURES TOTAL CATCH

Total catch for each species and catch type (\hat{C}) is estimated at the domain of month, district, trip type and water area by

Eq. 5.14
$$\hat{C} = \hat{E}\hat{R}$$

where, in the domain (month, district, trip type and water area)

- \hat{C} = the estimated total number of fish caught
- \hat{R} = the estimated catch per angler trip (angler day)
- \hat{E} = the estimated total number of angler trips (angler days)

Variance is estimated by

Eq. 5.15
$$\widehat{Var}(\hat{C}) = \hat{R}^2\widehat{Var}(\hat{E}) + \hat{E}^2\widehat{Var}(\hat{R}) - \widehat{Var}(\hat{R})\widehat{Var}(\hat{E})$$

The formula for variance is an unbiased estimator version of the Goodman formula for variance of a product of independent variables.

6. BEACHES AND BANKS

OVERVIEW

Two surveys are used for the beach and bank fishing mode: the Angler License Directory Telephone Survey (ALDTS) for effort and a field intercept survey for catch rate and aspects of effort (e.g., undercoverage adjustment for unlicensed anglers). The catch data are collected at publicly accessible beaches and banks during daylight hours. Catch rates for trips that occur at night or at sites without public access are assumed to be the same as the catch rates for trips that occur at publicly accessible sites during daylight hours in the same domain.

The publicly accessible beach and bank sites in each district are aggregated into clusters for the field survey. Each active cluster in a survey-covered month is sampled. A sampling assignment is for a cluster and each active site in the cluster is visited during the assignment.

BEACH AND BANK EFFORT

The sampling design, survey methods and key data elements collected for ALDTS are described in Chapter 2. The sampling design, survey methods and key data elements collected for the beach and bank field intercept survey are described below in the “beach and bank catch rate” section.

Estimation Procedures – Effort

As described in Chapter 2, monthly estimates of angler trips (equal to angler days) in the beach and bank mode are based on data from ALDTS and the field intercept survey. Effort estimates are calculated by expansion from the contacted sample of anglers in ALDTS (n) to the population of all licensed anglers in the survey month (N). Data from the field intercept survey are used to make an undercoverage adjustment for unlicensed anglers, who are not in the telephone survey frame. Chapter 2 provides the estimation procedures for the overall effort estimate (\hat{E}), which includes trips by licensed and unlicensed anglers, and the variance formula for the overall effort estimate.

The estimation domain for the overall effort estimate from ALDTS is month and district. Estimated effort for each month and district (\hat{E}) is partitioned into water area using a proportion based on data from ALDTS and from the field intercept survey. Two water areas are possible in the beach and bank fishing mode: bay/estuary (inland marine) and ocean less than three miles from shore (nearshore). The effort for the bay/estuary water area in given district and month (\hat{E}_b) is estimated by

$$\text{Eq. 6.1} \quad \hat{E}_b = \hat{E} \hat{p}$$

where the proportion of angler trips (angler days) in the bay/estuary water area (\hat{p}) is estimated by

$$\text{Eq. 6.2} \quad \hat{p} = (t_{fb} + t_{tb}) / (t_f + t_t)$$

and, for the given district and month,

- t_{fb} = the number of beach or bank anglers counted fishing in the bay/estuary water area during the field survey
 t_{tb} = the number of beach or bank trips profiled in ALDTS that fished in the bay/estuary water area
 t_f = the total number of beach or bank anglers counted during the field survey
 t_t = the total number of beach or bank trips profiled in ALDTS

The effort for the ocean water area in given district and month (\hat{E}_o) is estimated by

$$\text{Eq. 6.3} \quad \hat{E}_o = \hat{E} \hat{q}$$

where the proportion of angler trips (angler days) for the given district and month in the nearshore water area (\hat{q}) is estimated by

$$\text{Eq. 6.4} \quad \hat{q} = 1 - \hat{p}$$

The variance of the overall effort (\hat{E}) is given in Chapter 2 by Equation 2.8. Variances of \hat{E}_b and \hat{E}_o are estimated by

$$\text{Eq. 6.5.a} \quad \widehat{Var}(\hat{E}_b) = \hat{E}^2 \widehat{Var}(\hat{p}) + \widehat{Var}(\hat{E}) \hat{p}^2 - \widehat{Var}(\hat{E}) \widehat{Var}(\hat{p})$$

and

$$\text{Eq. 6.5.b} \quad \widehat{Var}(\hat{E}_o) = \hat{E}^2 \widehat{Var}(\hat{q}) + \widehat{Var}(\hat{E}) \hat{q}^2 - \widehat{Var}(\hat{E}) \widehat{Var}(\hat{q})$$

and

$$\text{Eq. 6.5.c} \quad \widehat{Var}(\hat{p}) = \widehat{Var}(\hat{q}) = \frac{\hat{p} \hat{q}}{t_f + t_t - 1}$$

Equations 6.1 and 6.3 assume that for practical purposes the trips profiled in the field survey and the trips profiled in the telephone survey together constitute a simple random sample of all the district-month's beach and bank trips. Equations 6.5.a and 6.5.b are cases of the Goodman formula (see Equation 2.4 in Chapter 2). Use of this formula assumes that estimates \hat{E} and \hat{p} of E and p are unbiased and have independent estimation errors and their estimated variances are unbiased too.

BEACH AND BANK CATCH RATE

Sampling Design – Catch Rate Survey

Scope and Staging: One statewide two-stage survey of beach and bank site clusters in the survey-covered month.

Target Population: All saltwater finfish angler trips at California beach and bank sites during daylight hours in the survey-covered month.

Frame and Stratification:

STAGE 1 - All cluster-days for the given month stratified by district.

STAGE 2 – All angling parties fishing during a sampler’s visit at each site.

Frequency: Each active cluster is sampled one day per month. Hence, for each district and month, the number of sampling days equals the number of active clusters.

Sample Selection and Scheduling: Two-thirds of the sampling days are weekend/holiday days and one-third weekdays. For each district and month, sample days are randomly drawn for each day type (i.e., weekday, weekend/holiday), and the clusters are then randomly assigned to the selected sample days.

Samplers are required to vary their start time. If a sampler misses an assignment, the assignment is rescheduled to the next available day of the same type (i.e., weekday or weekend/holiday). Samplers try to interview as many anglers as possible during a sample day.

Description of Sites and Clusters: The site register includes all publicly accessible beaches and banks that are open to the ocean or are within saltwater bays and estuaries. This includes all natural shoreline and all man-made shoreline that does not project into open water to form a structure with water on both sides. The sites are defined as stretches of shoreline with range boundaries. Private-access shoreline is excluded.

The sites are clustered based on geographic proximity. The travel time between two adjacent sites in the cluster is no more than one hour and all sites in a cluster are in the same district. The number of sites per cluster varies depending on travel times among the sites and the distance from the sampler’s work station. Some clusters consist of a single stretch of shoreline while others consist of many pocket beaches.

The composition of sites in a cluster remains constant within a month, but may vary during the year. The site register is continually updated and modified: new sites are added, sites that are closed are made inactive, sites with consistently very low effort to no effort are classified as inactive and sites that are unsafe are classified as inactive. Sites which are inactive are periodically monitored and reclassified as active when appropriate.

Survey Methods – Catch Rate Survey

The samplers receive their assignments for the month a week or two before the start of the month. The sampler visits each site in the cluster during the assignment. Samplers may return to previously visited sites once all of the sites have been visited and the initial effort level at each site has been determined. The amount of time on-site depends on the number of sites in the cluster, travel time to the first site, travel time among the sites and angling effort. A typical assignment lasts eight hours with about six or seven hours on-site. General on-site procedures for each site visited during the assignment are described in sequential order below. Detailed sampling procedures are available in the CRFS Sampler Manual (CDFW 2021).

1. The sampler conducts a preliminary canvass to determine the number and location of anglers at the site. The sampler canvasses the entire area of the site which may include several access points. If the anglers are scattered or there are several access points, the sampler will contact the anglers to let them know about the survey and determine their approximate departure times.

2. The sampler will use the information gained during the canvass to pick a location for conducting interviews with anglers who have completed their fishing trips. The sampler stations him- or herself where he or she can easily approach departing anglers and is likely to intercept the greatest number of departing anglers.
3. The sampler attempts to interview all anglers or angling parties who have completed their fishing trip and are leaving the site. The sampler uses a scripted questionnaire designed to collect demographic data on the angler (or one angler is a party), each angler's license status, the angler's (or party's) trip length and the angler's (or party's) catch data (see section titled "Key Data Elements Collected", below).
4. If sampling becomes unproductive or it is time to move to another site in the cluster, the sampler asks the remaining anglers when they started to fish and how much longer they intend to fish. The sampler interviews anglers who have completed at least 30 minutes of fishing.

Key Data Elements Collected – Catch Rate Survey

The following key data elements are collected during the field intercept survey and are used in the estimates of catch rate, water area proportions and unlicensed angler proportions. Data are recorded on the Shore Form (Appendix E) and instructions for collecting and recording each data element are in the CRFS Sampler Manual (CDFW 2021).

1. General assignment data
 - a. Assignment identification number
 - b. Date
 - c. County code
 - d. Site name and number
 - e. Cluster name
2. Data from each interviewed angler party
 - a. CRFS sample number
 - b. Time of interview
 - c. The total number of anglers in the party
 - d. Number of unlicensed anglers in the party
 - e. Primary and secondary target species (used to determine trip type)
 - f. Water area (area where the majority of the fishing effort occurred) of the primary and secondary targets
 - g. The trip duration for a completed trip, or the amount of time the angler or angling party (for shared bags) has fished up to the time of the interview
 - h. Amount of time the angler or angling party (for shared bags) expects to fish after the interview
 - i. Number of fish by species that were landed and examined by the sampler (kept-observed) and the lengths and weights of those fish
 - j. Number of fish by species or lowest taxonomic order possible that the angler(s) reported caught, kept and not available for examination (kept-unobserved), the number released alive (released-alive) and the number released dead (released-dead). For angling parties, this information is gathered from each angler.

Estimation Procedures – Catch Rate

Catch rate is estimated as catch per angler trip (equal to an angler day for the beach and bank mode) for each species and catch type in each domain defined by month, district and water area. The estimation is based on the assumption that, for the given domain, for practical purposes the intercept survey's sampled angler trips constitute a simple random sample of all angler trips in the domain. Catch rate (\hat{R}) is calculated by multiplying the catch per minute by the average trip length for each domain:

$$\text{Eq. 6.6} \quad \hat{R} = (c/f)((f + g)/n)$$

where, in the domain (month, district and water area)

f = sum of the minutes the sampled anglers fished

g = sum of additional minutes the sampled anglers reported still to be fished

c = total number of fish of a given species and catch type caught by the sampled anglers

n = the number of angler trips (angler days) sampled in the domain

To derive a variance estimate for estimated catch rate, the catch rate estimate (\hat{R}) may be expressed as the product $\hat{c}_a \hat{r}$ of unbiased (for practical purposes) sample-based estimates of population parameters c_a and r . Here the population comprises all potential instances where an angler trip (in the given domain) is interviewed per the survey protocol, c_a equals the mean per trip catch prior to interview and r equals the trip length expansion ratio [(total trip length)/(trip length prior to the interview)]. Namely,

Eq. 6.7

$$\hat{c}_a = \left(\sum_{i=1}^n c_i \right) / n$$

where i indexes the sampled angler trips (n) each with pre-interview catch (c_i).

The trip length expansion ratio (r) is estimated by

Eq. 6.8

$$\hat{r} = \frac{f + g}{f} = \frac{\sum_{i=1}^n (f_i + g_i)}{\sum_{i=1}^n f_i}$$

The respective variances of estimates \hat{c}_a and \hat{r} are (for practical purposes) unbiasedly estimated by

Eq. 6.9

$$\widehat{Var}(\hat{c}_a) = \frac{\sum_{i=1}^n (c_i - \hat{c}_a)^2}{n(n - 1)}$$

and

Eq. 6.10

$$\widehat{Var}(\hat{r}) = \left(\frac{n}{n - 1} \right) \left(\frac{\sum_{i=1}^n ((f_i + g_i) - \hat{r} f_i)^2}{f^2} \right)$$

This last estimate derives from Equation 2.46 and the ensuing statement in W.G. Cochran, *Sampling Techniques* (Wiley, ed. 3, 1977; pp. 32-33), with sampling fraction n/N taken effectively as zero.

These two variance estimates may be used in an application of Goodman's formula, as above in Equations. 6.5.a and 6.5.b, provided that we also assume independence of estimation errors in the estimates \hat{c}_a and \hat{r} . Such assumption is a bit problematic, but still reasonable. Estimation errors owe both to random sampling and to inherent variation among trips in their values for pre-interview catch and for trip length expansion ratio. We may reasonably assume that random error in estimating either of the parameters c_a and r is independent of either kind of error for the other parameter. It is more debatable, but still reasonable, to assume independence of the inherent variations. On the one hand, the amount of pre-interview catch may influence the amount of time anglers stay at a site. On the other hand, the survey protocol demands focus on complete trips and, when complete trip interview is not possible, on incomplete trips of at least 30 minutes.

Application of the Goodman formula then yields:

Eq. 6.11

$$\widehat{Var}(\hat{R}) = \hat{c}_a^2 \widehat{Var}(\hat{r}) + \widehat{Var}(\hat{c}_a) \hat{r}^2 - \widehat{Var}(\hat{c}_a) \widehat{Var}(\hat{r})$$

BEACH AND BANK TOTAL CATCH

Total catch for each species and catch type is estimated at the domain of month, district and water area by

Eq. 6.12

$$\hat{C} = \hat{E} \hat{R}$$

where, in the domain (month, district and water area)

\hat{C} = the estimated total number of fish caught

\hat{R} = the estimated catch per angler trip (angler day)

\hat{E} = the estimated total number of angler trips (angler days)

Variance is estimated by

Eq. 6.13

$$\widehat{Var}(\hat{C}) = \hat{R}^2 \widehat{Var}(\hat{E}) + \hat{E}^2 \widehat{Var}(\hat{R}) - \widehat{Var}(\hat{R}) \widehat{Var}(\hat{E})$$

The variance estimate assumes that estimation errors for effort and catch rate are independent.

7. HISTORICAL CHANGES IN DESIGN AND IMPLEMENTATION

CRFS and its component surveys were implemented in January 2004. As with the two neighboring Pacific coast states (OR, WA), California's new state survey of marine recreational fishing replaced the long-running, federal, nation-wide MRFSS. MRFSS was comprised of two components: a telephone survey (CHTS) for estimation of fishing effort, and an on-site angler intercept survey for estimation of catch rates. These components were operated over the tri-state region by PSMFC, a consortium of the federal NOAA Fisheries and the three states' fisheries management agencies. PSMFC managed the MRFSS surveys (the telephone survey by contract, the intercept survey directly or by contract), processed and stored the survey data, and provided estimates and data to the public.

The transition from MRFSS to CRFS and the two other states' surveys, was made in order to enable sampling and estimates to be of a finer spatial and temporal resolution needed to meet west coast fisheries management needs. California's two sub-regions became six districts, and surveys became monthly rather than for each two-month wave. This higher resolution was aimed to enable more timely and localized management decisions for overfished Pacific coast stocks.

To provide a smooth transition, and to enable CDFW's well-paced acquisition of survey operation, PSMFC initially operated the CRFS surveys and processed their data to produce estimates. In several stages from 2004 to 2015, this operation and processing transitioned from PSMFC to CDFW. To date, RecFIN remains the primary vehicle for public access of CRFS estimates and data.

In 2011 MRIP statistical consultants reviewed the Pacific states' marine recreational surveys. Note that the first edition of the CRFS Methods (2011 version) was created to support that review. Additional support from the consultants in 2012-2013 enabled beneficial redesign of the MM and PR2 surveys. Consultants' suggestions made during the 2011 review and 2012-2013 redesign have been implemented, where feasible, as reported in a response that CDFW sent to MRIP in 2017 (along with the CRFS Methods second addition (2017 version)). Since 2017, review of CRFS surveys, with an end goal of their eventual certification is still ongoing. In 2019 MRIP consultants reviewed and provided suggestions for the PR and CPFV surveys, to which CDFW responded in 2021.

Planned Changes to Survey Design Over Time

Since its inception in 2004, CRFS has continued to refine its data collection and estimation methods to provide the highest quality recreational fisheries information to managers and the public. Below are key changes to the CRFS surveys over time:

Angler License Directory Telephone Survey (ALDTS)

The 2004 transition from MRFSS to CRFS minimally affected the basic design of the intercept surveys, as they continued to be operated directly by PSMFC, albeit at a higher intensity. However, due primarily to economic factors and trends, the transition profoundly changed both the role and design of the remote (i.e., telephone) angler survey (CHTS, transitioning to ALDTS).

The increased intensity of PR-PAD and MM sampling enabled effort for those modes to be estimated directly from on-site methods. However, other means were still needed to support estimation of effort for modes CPFV, PR-PAN (which is not intercepted at all) and BB (which is not cost-effective to intercept intensely). Initially a new telephone survey of only CPFV operators was employed to estimate CPFV effort. To estimate PR-PAN and BB effort, ALDTS was designed to replace the MRFSS CHTS as an angler telephone survey.

For each two-month wave the MRFSS CHTS telephone survey for effort data used a survey frame of all coastal-county household land-line telephones. Use of this frame was very costly and inefficient, since typically only a small percentage even of coastal-county households do any marine fishing in any given wave.

An affordable ALDTS survey required a new sampling frame which would yield a far higher proportion of usable interviews with active anglers. From 2004 to 2010 the ALDTS sampling frame was the Angler Licensee Database (ALDB) which contained licensee data based on sales from cooperating license vendors. For each book of (usually 20) licenses sold by a cooperating vendor, ALDB could receive contact information for a single cooperating licensee. This frame's size was limited as a result. For example, during a typical year the frame size was limited to at most approximately 20,000 of the year's nearly two million licensed state anglers. Moreover, the frame had serious potential bias including that whether and when an angler entered the frame depended on two self-selections (by vendor and then angler) and on the vendor's pace of license sales.

From 2011 onward, the ALDTS has used the Automated License Data System's (ALDS) complete list of current California fishing licenses for a far more complete and far less biased frame (collection of telephone contact information is mandatory for the majority of license sales through ALDS).

Private and Rental Boats that Return to Private-access Sites or that Return at Night (PR-PAN)

ALDTS data enables effort estimation for all modes, not just the modes for which effort estimation is needed (i.e., PR-PAN and BB). In particular, as ALDTS collects data on PR trip return hour and return site access (public vs. private), estimates can be made for each of the two modes PR-PAD and PR-PAN. For the PR-PAD mode, the effort estimates from ALDTS can be compared 'apples to apples' with those from the PR intercept survey.

Within the first few years of CRFS operation the ALDTS PR-PAN estimates were seen to be unrealistically high on average. Moreover, ALDTS estimates for PR-PAD effort typically far exceeded corresponding more credible estimates from the far more intensive PR-PAD intercept surveys. Accordingly, beginning in 2008 CRFS ceased using unamended ALDTS estimates for PR-PAN effort. Instead, several other approaches have been devised and used to enable estimation of PR-PAN effort from ALDTS data (current or recent).

Initially, a complex pooling method was used to secure sufficient sample sizes to enable the month's ALDTS data to yield a plausible estimate of each district's ratio of PR-PAN effort to PR-PAD effort. This approach gave way to a more systematic and direct method

whereby the PR-PAN effort estimate is found by multiplying the ALDTS estimate by a district-specific scaling factor ('F-factor') based on recent past data from both ALDTS and PR surveys. When ALDTS is not run, a third method ('H-factor') is used to derive current PR-PAN effort, namely from current PR-PAD effort and a district-specific value, based on historic data, for the ratio of PR-PAN effort to total PR (=PR-PAD + PR-PAN) effort.

Secondary Private and Rental Boat Sites (PR2)

From its inception, CRFS has employed two PR intercept surveys: the PR1 survey of trip-return sites of consistently high fishing activity, and the PR2 survey of less-active trip-return sites. For the purpose of maintaining and extending this valued long-term, high-quality time-series data set, PR1 sites have consistently been sampled at a minimum 20% sampling rate. For a few PR sites, the site's status, as PR1 versus PR2, can shift during the year. However, the overall roster of active PR sites has not greatly changed since 2004. For cost-effectiveness, a few sites which formerly were sampled in the PR2 surveys but are very close to PR1 sites, are now treated as sources of additional 'missed boats' in the PR1 surveys.

In 2014 CRFS made the biggest change to PR sampling methods to date by implementing an MRIP-supported redesign of both the PR2 and MM surveys that was based on a 2011 MRIP-sponsored review of CRFS. Prior to 2014, PR2 sites were clustered with MM sites to exploit the fact that PR2 sites tended to be near MM sites and vice versa. All PR2 and MM sites in a cluster were visited during an assignment. Each cluster was sampled three days per month: one weekday and two weekend days, per a constrained quasi-random design.

This legacy approach aided sampling logistics and suited MM fishing well since trips can end at any hour of the day. But the approach missed many PR2 trips because they tend to end later in the day. The redesign produced distinct decoupled surveys better tailored to this difference in trip end time.

For increased sampling efficiency and estimate precision, PR2 sites are now stratified by typical activity level, thereby permitting sampling to focus on higher-activity sites. A PR2 assignment now occurs at just one site and collects the same kinds of data as a PR1 assignment. PR1 and PR2 assignments now use a common PR sampling form as a result of the 2014 change in survey design.

An advanced random draw now specifies a PR2 sampler's on-site arrival time (i.e., early versus late). Early and late start times are set for each month and district based on available daylight hours.

For economy, a PR2 sampling assignment now lasts about eight hours with about six to seven hours on-site. Time on-site always includes peak hours when most of the boats return, plus either all early-returning (early start time) or all late-returning (late start time) boats.

Commercial Passenger Fishing Vessels (CPFV)

Since CRFS' inception, CPFV catch rates have been estimated by use of data from the CPFV on-board and dockside intercept surveys.

During 2004-2010, estimation of CPFV effort relied on the Party Charter Phone Survey (PCPS) that used a known directory of CPFV operators. A directory of CPFVs operating in marine waters in each CRFS district was compiled and maintained. This directory was used to conduct a weekly telephone survey of a random sample of each district's CPFV operators and to conduct dockside vessel checks to document CPFV activity and validate the telephone survey's self-reported data.

In 2011 the PCPS was discontinued, and thereafter CPFV effort has been based on the mandatory logs which the State of California has required from CPFV operators for nearly a century. The change was prompted by two factors: (1) complaints from operators that their responses to the CPFV telephone survey needlessly duplicated the already mandated log submissions; and (2) an MRIP study which recommended that, whenever and wherever possible in the USA, mandatory logs be used for collecting CPFV effort data.

Dockside vessel checks were retained when the methods were modified in 2011 and are now used to estimate the proportion of effort that is duly logged by CPFV operators. Total CPFV effort is estimated by dividing the logged effort by this proportion.

Man-Made Structures (MM)

As noted in the PR2 section above, in 2014 CRFS implemented upgraded designs for both the MM and PR2 surveys. Prior to 2014, PR2 sites were clustered with MM sites to exploit the fact that PR2 sites tended to be near MM sites and vice versa. All PR2 and MM sites in a cluster were visited during an assignment. Each cluster was sampled three days per month: one weekday and two weekend days, per a constrained quasi-random design.

The current MM survey, unlike the current PR2 survey, continues the former tactic where each sampling assignment covers not one but a cluster of nearby sites. However, each cluster is now comprised of just MM sites. For increased sampling efficiency and precision of estimates, MM clusters are now stratified by typical activity level, thereby permitting sampling to focus on higher-activity sites.

An advanced random draw now specifies a MM sampler's on-site arrival time (i.e., early versus late) and which site within each cluster is visited first. Early and late start times are set for each month and district based on available daylight hours. Site order follows a fixed cyclic order based on the random selection of which site is visited first (e.g., whether the assignment's sequence of visited sites is ABC, BCA, or CAB).

Sampling has also been simplified in the current man-made structure survey. Formerly, samplers were required to track arriving anglers and anglers who left the site without being interviewed. These requirements were onerous to samplers and of scant value for adequate data collection. MM samplers now only need to make counts upon arrival to and departure from the site in addition to instantaneous angler counts no more than every 90 minutes. The current survey also uses a simplified sampling form which is common to both shore modes (i.e., MM and BB).

Beaches and Banks (BB)

The beach-bank catch rate survey and estimation procedures were modified in 2015. In order to increase data collection, the catch rate field survey was modified to allow interviews of incomplete angler trips so long as a minimum fishing time threshold is met, rather than requiring interviewed anglers to have completed at least 50 percent of their fishing trip. To increase precision, effort estimates were partitioned by nearshore and bay/estuary water areas. Also beginning in 2015, historical averages based on field survey data were used to calculate the proportion of unlicensed BB anglers for adjusting BB effort estimates.

Depth Dependent Mortality Estimates (DDM)

Appendix B of the 2022 CRFS Methods Document describes the DDM calculations employed by CDFW starting in 2015 and still used currently. In 2012, the PFMC adopted additional depth-dependent mortality rates for canary rockfish, cowcod and yelloweye rockfish released using a descending device and asked that these rates be applied retrospectively where adequate sample data existed (PFMC 2016). CRFS began collecting descending device usage data in 2013 but CDFW has only been able to apply descending device usage rates using the methods described in Appendix B since 2015 due to data limitations. Pacific RecFIN is responsible for application of DDM prior to 2015. RecFIN has applied their own methods that may be different from the methods described in Appendix B. RecFIN is currently working to document the historical DDM methods and calculations.

Deviations from Intended Benchmark Survey Design

The following are instances where sampling or estimation routines deviated from what was described in the CRFS Sampler Manual or the CRFS Methods Document between 2004 and 2021. All deviations after January 1, 2022 will be described in annual reports submitted to MRIP and RecFIN.

1. The beach-bank catch rate survey shifted to weighted probability sampling in 2018, based on site effort check (SEC) data. Focusing sampling on higher effort beach-bank sites allows for greater efficiency in sampling, and greater precision in the estimates. Clusters with high effort have a higher probability of being sampled than those with lower effort. To reduce sampling bias, start times and site order within a cluster are pre-determined for each sampling assignment.
2. ALDTS was not conducted in 2018, 2019 and the first 10 months of 2020 due to funding limitations. A long-term average ratio (H-Factor described in Appendix H) was used to expand the PR estimate for undercoverage of private access or night trips. No beach-bank effort estimates were made during these years.
3. Access to funds increased in late 2020 allowing ALDTS and the beach-bank catch rate survey to be conducted in November and December. For November and December 2020, the PR total estimates were generated with F-factor, beach-bank effort estimates were made using ALDTS data, and beach-bank total estimates were generated. Between January and October 2020, a long-term average ratio (H-factor) was used to expand the PR estimate for undercoverage for private access or night trips in the absence of ALDTS data. No beach-bank estimations are available for January through October 2020.

4. In 2013 CDFW's Groundfish Project decided not to use PR-PAN estimates for management of the recreational Pacific halibut fishery. As a result, PR-total estimates for Pacific halibut have not included a PR-PAN component since 2013.
5. Safety concerns related to the COVID-19 pandemic resulted in the discontinuation of all CRFS sampling except for effort checks between late March 2020 and June 30, 2020. Sampling resumed July 1, 2020 using modified sampling protocols. Modified sampling protocols were created to maintain collection of key data elements needed to generate estimates while maintaining sampler safety, and modified sampling protocols evolved over time.

Sampling rates remained the same except for CPFV mode. CPFV onboard sampling ceased under modified sampling protocols. The CPFV dockside sampling rate was adjusted upward to compensate for the loss in efficiency of CPFV onboard sampling. The adjustments to sampling rates were made to collect the same amount of angler bag data compared to a normal year.

Even though modified sampling protocols continued to collect key data elements and sampling rates remained the same in most respects, there were still some impacts noted between July 2020 and the resumption of normal sampling in mid-to late 2021 including:

- CPFV onboard sampling was canceled forcing a reliance on dockside sampling.
 - Since CRFS does not sample overnight/multiday CPFV trips the switch to CPFV dockside sampling intercepted a greater proportion of longer-range trips.
- Reliance on angler-reported catch increased since samplers could not maintain social distancing while observing catch.
 - This had a major impact on rockfish estimates because there was a large increase in rockfish genus in the estimates. CRFS does not have weight conversion factors for the rockfish genus, therefore rockfish genus estimates are only presented in number of fish and not weight.

CRFS returned to the normal sampling protocol in August 2021 noting that a full return to regular CPFV onboard sampling took several additional months while samplers received the training necessary to sample onboard CPFVs.

8. FUTURE IMPROVEMENTS TO DESIGN AND IMPLEMENTATION

Over the past several years, CDFW has been conducting several initiatives towards a significant eventual upgrade of CRFS surveys and the CRFS data system.

Electronic data collection (EDC) for more cost-effective intercept survey

CRFS has long used paper forms to collect data in the field. EDC instead uses handheld electronic devices. For years, even decades, intercept survey operators have been intrigued by the potential advantages of this change. In particular, field data could be uploaded from EDC devices directly to the central data system, without need for a middle stage whereby data are entered - typically at considerable cost in time or reliability - from paper forms to a form that requires manual key-in prior to upload to the central data system.

CDFW is in the process of completing a data entry upgrade for CRFS. The goal of the upgrade is to replace the current paper forms, as well as the Adobe LiveCycle data entry system currently used to enter and upload the data to the CRFS database, with a digital platform for data collection that allows samplers to submit their data as soon as internet connectivity is available. A digital platform for data collection would result in increased efficiencies for CRFS because in field quality assurance of data would increase, paper forms would no longer need to be delivered to CDFW offices for entry, and in office data entry would no longer be necessary. To date, CDFW has conducted market research to select Power Apps as the solution to test, generated prototyping documentation needed for form development and purchased equipment required for testing. CDFW staff are currently working to assess the strengths and weaknesses of Power Apps by creating a form prototype for the private and rental mode. The PR prototype will undergo iterative rounds of in office and in field testing. If testing is successful CDFW will use the PR prototype as a template to create Power Apps forms for the other sampling modes.

Online data collection for more cost-effective off-site ('remote') survey

Since CRFS' inception, active telephone interviews have been the sole medium for off-site data collection from anglers. In terms of cost per usable response, use of this medium has become infeasible, whereas the opposite is true for online surveys (e.g., web-based data collection primed by email request).

In 2018, CDFW and a contractor developed ALDOS, an online angler survey which is aimed at replacing telephone contact and interview with email invites to a web-based questionnaire. During portions of 2018-2022, a pilot study was conducted to collect data for the BB on-site effort check survey, and the ALDTS and ALDOS surveys. Analysis is in progress, and results will compare effort estimates for PR-PAN and BB from both off-site surveys, along with effort estimates from the PR-PAD and BB intercept surveys. When complete, the analysis will evaluate the need to calibrate ALDOS and ALDTS estimates.

Cost per added ALDTS completed interview has become unaffordable, and the ALDOS survey has been shown to have a low cost per added completed ALDOS response. Accordingly, as of January 2023, CRFS plans to use ALDOS rather than ALDTS as the remote angler survey.

This change raises two notable issues, but these seem tractable. (1) Unlike telephone contact, California licensed anglers are not required to provide email contact information. However, in recent years the proportion of licensees voluntarily providing email contact has rapidly increased, from under 10% to over 30%. This 30+% may not be fully representative of all licensees' responses, but the calibration can correct for this. (2) A complete ALDTS telephone interview collects more data than does a typical willing ALDOS response. However, the data are needed for estimates only of PR and BB effort and not also of catch-rate nor for other modes. ALDOS-collected data can suffice, especially if the low cost per added response is exploited to expand sample sizes from those used for ALDTS.

Private and Rental Boats (PR)

When MRIP certification or PR is complete and when CDFW resources allow, CRFS will also implement amended versions of the PR intercept estimation methods. The amended versions aim is for more reliable estimation and at conforming more closely to features of the survey designs, so as to meet concerns raised in the 2011 and 2019 MRIP consultants' reviews.

As a methodological legacy of MRFSS, PR-PAD catch is estimated as the product of estimated effort and estimated catch rate. For each estimation domain (defined by district, month, trip type and water area), for computational convenience each catch rate is estimated from the aggregate PR-PAD sample data without weighting each site-day's contribution by the site-day's estimated PR-PAD effort. As MRIP consultants have noted, such weighting should be used.

To achieve the weighting, an alternative estimation approach has been developed whereby PR-PAD catch (of each species and type) is directly estimated in the same manner as effort, and then each domain's catch rate is derived as the ratio of catch to effort. CDFW plans to implement this approach as soon as MRIP certification is complete.

PR-PAN catch will continue to be estimated as the product of estimated effort (obtained from ALDTS or ALDOS) and estimated catch rate. To date, each domain's PR-PAN catch rates are modeled to match the PR-PAD catch rates. However, it is known from a CDFW study (SALS, conducted during 2008-2009) that the PR-PAN catch rates (and indeed trip type distribution) can differ significantly from the PR-PAD catch rates. For the longer term, CDFW plans to investigate feasibility of alternative models for PR-PAN catch rates.

CRFS does not currently calculate variances for PR-PAN and total PR effort and catch. Calculation methods and formulas have been proposed and are pending MRIP review. Proposed changes that are not yet implemented in the CRFS data system and not yet used when producing estimates are described in Appendix I. The new methods and formulas will be implemented in the CRFS data system and section 3.C will be replaced by text from Appendix I when the new methods and formulas are certified by MRIP.

Commercial Passenger Fishing Vessels (CPFV)

When MRIP certification is complete and when CDFW resources allow, CRFS will also implement an amended version of the CPFV intercept estimation methods. The

amended version aims at more reliable estimation and at conforming more closely to features of the survey designs, so as to meet concerns raised in the 2011 and 2019 MRIP consultants' reviews.

In their 2019 review of the CRFS CPFV surveys, MRIP consultants expressed several concerns and made recommendations for improving these surveys. In the near and mid-term, CDFW will strive to address the concerns and insofar as is possible, implement the recommendations.

The PEC survey uses both directed and opportunistic sampling of CPFV trips. The opportunistic component has led to concerns that the PEC-sampled CPFV trips are not fully representative of all CPFV trips. However, in five of the six CRFS districts (Districts 2-6) PEC sampling achieves a near-census of all CPFV trips. For these districts, CDFW will seek to achieve a full census. For the remaining CRFS district (District 1), CDFW will strive to improve the PEC design, to ensure representativeness of that district's sampled trips.

In order to allay similar concerns raised for the CPFV onboard and CPFV dockside surveys, CDFW will also strive to devise and document more explicit sampling protocols for those surveys, so that each choice which now may be at sampler's discretion will instead be either determined or else be a strictly random choice between defined alternatives. To the extent possible, CDFW will also adjust the catch-rate estimation routines to better match the survey design.

Beaches and Banks (BB)

Among CRFS surveys, the future of the BB surveys is the least certain. The species caught in BB fishing are of low management priority and moreover the ALDTS (or in the future, ALDOS) survey for effort and the BB intercept surveys (both the BEC effort survey and the BB catch rate survey) are relatively costly. The BB surveys are first to be impacted by funding cuts or constraints. In order to provide BB effort and catch estimates of sufficient precision, the survey period for this mode may be changed in the future from the CRFS standard for other surveys (i.e., monthly) to a longer period (e.g., by wave or quarterly) which will still be more than adequate for meeting management and MRIP precision goals.

During the Effort Comparison pilot study, CDFW intensified the BB catch rate survey and tested weighted probability sampling. In addition, CDFW designed and ran a BB effort check survey whose data may enable future calibration of ALDTS or ALDOS based effort estimates to credible field-observed scales of effort. When completed, analysis of data from the study is expected to help indicate how best to feasibly provide sufficient and improved BB effort and catch estimates.

9. PARTICIPATION

Angler participation is estimated on an annual basis as the total estimated number of trips divided by the estimated 12-month avidity.

10. LITERATURE CITED

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(<http://www.pcouncil.org/groundfish/safe-documents/>) For recreational mortality rates, see Table 1-12 and Table 1-15 (p.181 and p.183).

APPENDIX A

OCEAN SALMON PROJECT METHODOLOGY FOR ESTIMATING RECREATIONAL SALMON LANDINGS April 2003

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INTRODUCTION

This paper was prepared in response to a proposal of the West Coast states to develop their own marine recreational fishery sampling and estimation program. This is because of low confidence in the current methodology used by the Marine Recreational Fishery Statistics Survey (MRFSS) in estimating West Coast marine recreational fishery catches. The new program would be funded using resources provided by the National Marine Fisheries Service (NMFS) in support of the current or an augmented MRFSS program, additional resources provided by the member states, and, possibly, through redirection of existing sampling programs. One such on-going California program is the California Department of Fish and Game's (DFG's) Ocean Salmon Project (OSP), an operation that has provided recreational salmon landings information continuously since 1962. In the following we provide 1) a description of the OSP recreational fishery estimation program, and 2) a discussion of bias and possible estimation errors in the current program.

GOALS AND OBJECTIVES³

Goal Statement: To provide information necessary to sustainably manage California's ocean recreational salmon fishery and to meet biological and recovery goals for West Coast salmon populations

Recreation Fishery Sampling Objectives:

² Final document prepared April 1, 2003

³ The OSP also samples the commercial salmon fishery for average weight data that are used to estimate numbers of fish landed based on pounds landed and reported on DFG fish tickets and to collect CWTs which are reported to the PSMFC; provides technical assistance to inland salmon programs; extract and decode CWTs collected at Central Valley hatcheries and in Central Valley salmon carcass surveys; and participate in technical meetings of the Pacific Fishery Management Council and the Klamath Fishery Management Council.

- 1) Provide recreation fishery landings estimates by time, area and fishery strata for inseason management and for developing annual salmon fishery management plans.
- 2) Sample 20% of all recreational fishery salmon landings to provide postseason estimates of the salmon catch by species, angler effort, and the contribution of coded wire tagged (CWT) fish for reporting to the Pacific States Marine Fisheries Commission (PSMFC) by December 15 of each year.
- 3) Collect other biological and recreational fishery information as necessary to manage the fishery.

DATA STRATIFICATION

Fishery Sectors. The OSP makes separate estimates for Commercial Passenger Fishing Vessels (CPFVs) and private boats (PBs). Past experience has shown that very few salmon are taken from shore. The possible exceptions in some years include Pacifica Pier, Moss Landing jetties, and Humboldt Bay South Jetty.

Port Area Estimates. The OSP has traditionally produced salmon landing estimates for five statistical areas: 1. Crescent City (Oregon border to Big Lagoon), 2. Eureka (Big Lagoon to Horse Mountain near Shelter Cove), 3. Fort Bragg (Horse Mountain to Point Arena), 4. San Francisco (Point Arena to Pigeon Point), and 5. Monterey (Pigeon Point to the U.S.-Mexico border). The estimates normally are for area of landing rather than area of catch; however because of the large statistical areas, relatively few recreationally caught salmon are landed outside of the port areas in which they were caught.

Sampling normally extends from Crescent City Harbor to Avila Beach. In some years when there is a southern shift in the distribution of salmon, sampling may be extended south to include Santa Barbara, Ventura and Oxnard ports.

Temporal Strata. The estimates are generated by half-month period; i.e., 1-15 and 16-end of month. The 2003 salmon season dates, during which salmon sampling will be conducted in the respective areas, are shown in Table 1. The numbers of full-time samplers (by personnel month) that are to be employed to sample the recreational catch by statistical area are shown in Table 2. Primary sampling sites by major port area and fishery are shown in Table 3.

Day Type Strata. PB landing estimates are further stratified by day type including: 1) regular week days and 2) weekend and holiday days. Recognized salmon season holidays include President's Day, Memorial Day, Independence Day, Labor Day, and Columbus Day.

DATA ELEMENTS AND MARKED SALMON SAMPLING

OSP samplers collect the following data from each sampled vessel:

- 1) Number of anglers (includes CPFV skipper and crew if they retain salmon)
- 2) Fishing method: troll, mooch, or both
- 3) Number of salmon landed by species
- 4) Number of Ad-clipped (marked) salmon by species
- 5) Number of coho (an endangered species) released
- 6) Number of sublegal chinook released
- 7) Number of salmon lost to pinnipeds

In recent years, the samplers have collected the following additional data from salmon and non-salmon PBs:

- 8) Number of rockfish landed
- 9) Number of halibut landed
- 10) Number of lingcod landed
- 11) Number of all other species landed
- 12) Number of anglers in non-salmon boats

Salmon trips are defined as those trips in which salmon was the target species for all or part of the day. A combination trip, on which several species including salmon may be targeted, is considered a salmon trip

All Ad-clipped salmon recovered in the sampling are measured in the field for fork length (to the nearest mm) and their heads removed for later CWT extraction and decoding in the lab.

COMMERCIAL PASSENGER FISHING VESSEL (CPFV) ESTIMATION PROGRAM

A two-stage program is used to estimate effort and landings by CPFVs. Total effort is determined by counting the actual number of CPFVs that targeted salmon each day of the season by port and area. Local employees (mostly field samplers) visit the landing areas or make phone calls to get these counts, which are usually made on the same day the fishing trip was conducted. Post season, OSP staff compare the counts to the submitted logbooks (which are required by law) and may adjust the counts upwards if more logs are returned for a given port-day than the number of boats counted during the season. The OSP does not depend on log returns to estimate total salmon fishing effort (or catch) because of the highly variable return rate of these documents by individual skippers (average return rate has been about 75% in recent years, which is up from an average return rate of about 54% in the mid 1990s). However, there has been close agreement over the years between the salmon landings and angler effort observed by samplers in the field and the salmon landings and angler effort reported on submitted logs.

Sampling of completed CPFV salmon trips is conducted to estimate the various items (elements) of interest, explained above, and to recover marked salmon. Samplers are deployed to the major landing areas (see Table 1) with the intent of sampling 20% of the CPFV landings in each statistical area during each half-month time period. The number of landings made in each statistical area is used to gauge the number of boats to sample to achieve the 20% sampling objective. Note: The OSP only samples completed trips dockside and does not use at-sea sampling to estimate the total salmon catch, including released fish.

The sample-based estimator for individual items (\hat{Y}) in the CPFV fishery is:

$$(1) \quad \hat{Y}_{ij} = N_{ij} \frac{\sum_k y_{ijk}}{n_{ij}},$$

where:

\hat{Y}_{ij} = estimated total number of items in area i , time period j .

N_{ij} = total number of CPFV salmon trips taken in area i , time period j .

y_{ijk} = number of items sampled in area i , time period j , CPFV trip k .

n_{ij} = number of CPFVs sampled in area i , time period j .

Assuming the sampling of CPFV trips is at random without replacement in area i , time period j , the sampling variance of \hat{Y}_{ij} is estimated as

$$(2) \quad \hat{V}(\hat{Y}_{ij}) = N_{ij}^2 (1 - f_{ij}) \frac{s_{ij}^2}{n_{ij}},$$

with $f_{ij} = n_{ij} / N_{ij}$, the sampling fraction, and

$$s_{ij}^2 = \frac{1}{n_{ij} - 1} \left[\sum_k y_{ijk}^2 - \frac{1}{n_{ij}} \left(\sum_k y_{ijk} \right)^2 \right].$$

The estimated totals and variances are additive across strata so that, for example,

$$(3) \quad \hat{Y} = \sum_i \sum_j \hat{Y}_{ij}, \quad \text{and} \quad \hat{V}(\hat{Y}) = \sum_i \sum_j \hat{V}(\hat{Y}_{ij}).$$

PRIVATE BOAT FISHERY ESTIMATION PROGRAM

The OSP uses stratified random sampling to estimate salmon fishing effort and landings by private and rental boats (collectively referred to as private boats, PBs). The basic sampling unit is a sample area-day. The sample areas, grouped by statistical area, are shown in Table 1. One or two samplers are responsible for determining 100% of the salmon fishing effort and catch made on each sample area-day. Sample area-days are drawn at random, without replacement, prior to each month in each area.

In some areas, the samplers are not able to contact and sample all returning PBs. In these instances, a count is made of missed PBs either as they pass by the sampler's vantage point or based on the number of empty boat trailers in parking areas at the end of the day. When making these counts, the sampler makes a judgment whether the missed boat was a fishing boat such as the presence of fishing gear on the observed boat or the type of boat trailer type. Sail boats or sail boat trailers, for example, generally are not counted as missed fishing boats. On these occasions, the number of items for that particular sampled area-day is estimated as:

$$(4) \quad \hat{y}_{ijkl} = T_{ijkl} \frac{z_{ijkl}}{t_{ijkl}},$$

where:

\hat{y}_{ijkl} = estimated total number of items in area i , time period j , day-type k , day l .

z_{ijkl} = number of items sampled in area i , time period j , day-type k , day l .

t_{ijkl} = number of boat-trips sampled in area i , time period j , day-type k , day l .

T_{ijkl} = total number of boat-trips in area i , time period j , day-type k , day l .

Several boat landing areas are not sampled by the OSP because of previous experience showing that very few salmon are landed at these areas. These areas are believed to account for less than 5% of the total skiff salmon effort and catch.

The sample-based estimator for individual items (\hat{Y}) in the PB fishery is:

$$(5) \quad \hat{Y}_{ijk} = N_{ijk} \frac{\sum_l \hat{y}_{ijkl}}{n_{ijk}},$$

where:

\hat{Y}_{ijk} = estimated total number of items in area i , time period j , day-type k .
 N_{ijk} = total number of calendar days in area i , time period j , day-type k .
 \hat{y}_{ijkl} = (estimated) number of items in area i , time period j , day-type k , day l .
 n_{ijk} = number of calendar days sampled in area i , time period j , day-type k .

Ignoring the variance introduced through estimation of y_{ijkl} by \hat{y}_{ijkl} (typically \hat{y}_{ijkl} within 10% of z_{ijkl}), the variance of \hat{Y}_{ijk} is estimated as

$$(6) \quad \hat{V}(\hat{Y}_{ijk}) = N_{ijk}^2 (1 - f_{ijk}) \frac{s_{ijk}^2}{n_{ijk}},$$

with $f_{ijk} = n_{ijk} / N_{ijk}$, the sampling fraction, and

$$s_{ijk}^2 = \frac{1}{n_{ijk} - 1} \left[\sum_l \hat{y}_{ijkl}^2 - \frac{1}{n_{ijk}} \left(\sum_l \hat{y}_{ijkl} \right)^2 \right].$$

Again, the estimated totals and variances are additive across strata so that, for example,

$$(7) \quad \hat{Y} = \sum_i \sum_j \sum_k \hat{Y}_{ijk}, \quad \text{and} \quad \hat{V}(\hat{Y}) = \sum_i \sum_j \sum_k \hat{V}(\hat{Y}_{ijk}).$$

DATA BASE OUTPUTS

The OSP provides current year recreational salmon data to the Regional Mark Informational System of the PSMFC by December 15 of each year. These data include estimates of recreational salmon landings by species, CWT group, statistical area, and half-month time period. They also input the species estimates to the Pacific Fishery Management Council (PFMC) for use by the Salmon Technical Team (STT) in producing the PFMC's Annual Review of West Coast Ocean Salmon Fisheries. CWT estimates from the Klamath basin are forwarded to the Klamath River Technical Advisory Team for use in the Klamath Ocean Harvest Model, a tool for analyzing fishing impacts of proposed ocean salmon fishing regulations for the ensuing season.

DISCUSSION: BIAS AND POTENTIAL SOURCES OF ERRORS

The OSP has not computed confidence intervals for its estimates in recent years. Typically, the 95% interval for total season catch recreational landings is + or – 10% of the estimate itself. This narrow range can be attributed to large sample size. By counting all CPFVs each day of the season, the OSP eliminates the need to estimate total CPFV effort. Post-season analysis is done to verify or correct the OSP in-season counts. The OSP has learned that they cannot depend on logbook returns to estimate total CPFV effort or catch as many skippers fail (or refuse) to complete and submit their logs.

The OSP is able to move quickly through the boats, both CPFV and PB, on each sample day in part because they limit the number of questions that anglers are asked. They also do not collect data specific for an individual angler. Collection of CWT heads and biological data is the most time consuming part of the overall OSP field sampling program.

The program has been in place since 1962 and the staff has learned how to make optimal use of their limited resources. The fact the OSP does not sample some areas where salmon may occasionally be landed is not believed to be an important source of underestimation of landed catch. However, no study has been conducted and reported to document the relative importance of these unsampled areas to the total salmon catch.

Another program strength is that the field samplers attempt to sample all landings at an assigned facility on sample days. This reduces the potential for bias associated with time of day landings are made. However, the assumption that the catch and effort by unsampled boats on a port-day are the same as sampled boats has not been verified. Unsampled boats are quite often boats moored at a private facility or that continue to fish after the sampler has gone home. It is questionable whether these missed anglers have the same motivation in fishing for salmon (or any other species) as those that take their boat in and out of the water on the same day.

Weather conditions are the single greatest source of variation in the PB data. Salmon catches can be relatively high in an area then fall off to zero or very low levels with the onset of inclement fishing conditions. The OSP has not attempted to do post-season stratification of the data to isolated “bad” and “good” weather samples (however that would be defined). It is possible that published weather statistics (e.g., swell height or wind speed) could be used to do post-season weather stratification, but we can't be certain the resulting analysis would, in most cases, increase the precision of the estimates due to the increased stratification. There would also be the problem during some periods of the lack of samples for both weather strata.

Asking PB anglers for information on released or lost catch may be biased as it depends on the ability of anglers to accurately recall all the salmon encounters during the day and to differentiate the different salmon species in the released catch. Some fishermen may use the opportunity to complain about pinniped (primarily sea lion) encounters or fishery regulations that require them to release Chinook salmon below the minimum size and all coho salmon, an endangered species. This could result in exaggerated reporting by some individuals or deflated reporting by individuals wishing to downplay their incidental catches (for fear of more restrictive regulations).

Salmon are, by and large, landed on the same day they are caught; thus the OSP does not have to deal with the issue of sampling multiple-day trips. This is not to say that some fishermen do not on occasion catch and store salmon on their vessels for 2 or more days before landing their fish. Vessels that moor upstream from Rodeo near Carquinez Strait that make multiple day ocean fishing trips are not available to be sampled by OSP staff. Also, salmon are rarely taken at night; thus end-of-day sampling is efficient for examining all of the fish taken on a particular day of the season.

The OSP has begun to collect non-salmon landings data in recent years. This has been a trial program, and the additional sampling has not compromised their salmon sampling objectives. These data have not been analyzed as it is not clear how these data would be meaningful for the management of these other species.

Table 1. Season structure of 2003 ocean salmon recreational fishery (number of days open by port area and month)

Statistical Port Area	<u>Month</u>												Total
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEPT	OCT	NOV	DEC	
Crescent City					15 d	30 d	31 d	31 d	14 d				121 d
Eureka					15 d	30 d	31 d	31 d	14 d				121 d
Fort Bragg		14 d	31 d	30 d	31 d	30 d	31 d	31 d	30 d	31 d	16 d		275 d
San Francisco				19 d	31 d	30 d	31 d	31 d	30 d	31 d	15 d		218 d
Monterey			3 d	30 d	31 d	30 d	31 d	31 d	30 d				186 d
Total		14 d	34 d	79 d	123 d	150 d	155 d	155 d	118 d	62 d	31 d		921 d

Table 2. Budgeted sampler time by port area and month for 2003 ocean salmon recreational fishery.

Statistical Port Area	<u>Month</u>												Total
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEPT	OCT	NOV	DEC	
Crescent City					0.8 PM	1.0 PM	1.0 PM	1.0 PM	0.5 PM				4.3 PM
Eureka					1.5 PM	2.0 PM	2.0 PM	2.0 PM	1.0 PM				8.5 PM
Fort Bragg		0.5 PM	1.0 PM	1.0 PM	2.0 PM	2.0 PM	2.0 PM	2.0 PM	1.0 PM	1.0 PM	0.5 PM		13.0 PM
San Francisco				3.0 PM	4.5 PM	4.5 PM	4.5 PM	4.5 PM	4.5 PM	3.0 PM	1.0 PM		29.5 PM
Monterey			0.3 PM	3.0 PM	3.0 PM	3.0 PM	3.0 PM	1.5 PM	1.0 PM				14.8 PM
Total		0.5 PM	1.3 PM	7.0 PM	11.8 PM	12.5 PM	12.5 PM	11.0 PM	8.0 PM	4.0 PM	1.5 PM		70.1 PM

Table 3. Primary OSP sampling sites north of Pt Conception by major port area and fishery, 2003 season.

<u>Major port</u>	Private skiffs	CPFVs	Commercial
<u>Crescent City</u>			
Crescent City launch ramp	X		
Crescent City docks	X	X	X
<u>Eureka</u>			
Trinidad Hoist	X		
Trinidad docks	X	X	X
Eureka	X	X	X
Field's Landing	X		
<u>Fort Bragg</u>			
Shelter Cove	X	X	X
Fort Bragg/Noyo	X	X	X
<u>San Francisco</u>			
Bodega Bay/Westside	X	X	X
Sausalito	X	X	X
Berkeley/Emeryville	X	X	
San Francisco Wharf		X	X
Princeton	X	X	X
<u>Monterey</u>			
Santa Cruz	X	X	X
Moss Landing	X	X	X
Monterey	X	X	X
Morro Bay	X	X	X
Avila Beach	X	X	X
Total # of sites:	17	15	14

APPENDIX B

Methods for Incorporating Pacific Fishery Management Council Depth-dependent Mortality Rates Including Descending Device Usage

Background

Not all fish are expected to survive when caught and released by an angler. Groundfish species caught in deep water can experience barotrauma from the change in pressure when brought to the surface. The decreasing pressure causes internal gases to expand which can injure the fish and leave it too buoyant to swim back down when released. The extent of injury from barotrauma is directly related to the depth of capture and the species. To account for increased mortality depth-dependent mortality (DDM) rates have been incorporated into the California Department of Fish and Wildlife's (CDFW) California Recreational Fisheries Survey (CRFS) monthly catch estimates for groundfish species since 2009. The rates are provided by the Pacific Fishery Management Council (PFMC) and are subject to change as research findings become available (PFMC 2016).

PFMC also adopted a second series of DDM rates in 2014 for canary, cowcod and yelloweye rockfish with reduced mortality when fish are released with the aid of a descending device (DDM-DD) (PFMC 2016). A descending device recompresses fish by bringing them back down to depth reducing the effects of barotrauma resulting in a better chance of survival. CRFS has been collecting descending device usage data since 2013, and the DDM-DD rates began being applied with the 2015 estimates.

From 2009 to 2014, DDM rates were applied by the Recreational Fisheries Information Network (RecFIN). Beginning with the 2015 estimates, CDFW applied DDM and DDM-DD rates before submitting the estimates to RecFIN and CDFW uses the methods described in this document.

Method for Applying DDM and DDM-DD Rates

During the estimation process, CDFW applies the DDM and DDM-DD rates by species directly to the CRFS raw sample data for released groundfish.

CRFS' samplers ask anglers the number of fish released dead and the number released alive. In addition, when rockfish are released alive, CRFS samplers ask anglers the number released with a descending device. The sum of the angler-reported release alive fish and angler-reported released dead fish is used in the estimation of DDM and DDM-DD. For each sample and groundfish species,

Eq. 1
$$s_r = s_{rd} + s_{ra}$$

where

- s_r = all released fish of the species in the sample
- s_{rd} = the angler-reported released dead fish of the species in the sample
- s_{ra} = the angler-reported released alive fish of the species in the sample

For all groundfish in man-made structure and beach bank modes and all groundfish, except canary, cowcod and yelloweye rockfish, in private/rental boat and party/charter modes

When the groundfish species is not canary, cowcod or yelloweye rockfish, the estimated fish released dead (\hat{n}_d) and released alive (\hat{n}_a) are calculated as follows:

$$\text{Eq. 2} \quad \hat{n}_d = s_r(m_{b,no DD})$$

$$\text{Eq. 3} \quad \hat{n}_a = s_r(1 - m_{b,no DD})$$

where $m_{b,no DD}$ is the species specific mortality rate from PFMC for fish in depth bin b released without a descending device.

For canary, cowcod and yelloweye rockfish in the private/rental boat mode

When the species is canary, cowcod or yelloweye rockfish, DDM-DD rates may be applied. For the private/rental boat mode, CRFS collects the number fish released with a descending device as a subset of the number released alive. Thus, for each sample and sample of canary, cowcod or yelloweye rockfish in the private/rental mode, the number of fish released without a descending device ($s_{r,no DD}$) is

$$\text{Eq. 4} \quad s_{r,no DD} = s_r - s_{ra,DD}$$

where $s_{ra,DD}$ is the number of fish released with a descending device.

The estimated fish released dead ($\hat{n}_{d,no DD}$) and released alive ($\hat{n}_{a,no DD}$) are calculated as

$$\text{Eq. 5} \quad \hat{n}_{d,no DD} = (s_{r,no DD})(m_{b,no DD})$$

$$\text{Eq. 6} \quad \hat{n}_{a,no DD} = (s_{r,no DD})(1 - m_{b,no DD})$$

where $m_{b,no DD}$ is the species specific mortality rate from PFMC for fish in depth bin b released without a descending device.

For the canary, cowcod and yelloweye rockfish released with a descending device ($s_{ra,DD}$), the estimated fish released dead ($\hat{n}_{d,DD}$) and released alive ($\hat{n}_{a,DD}$) are calculated as

$$\text{Eq. 7} \quad \hat{n}_{d,DD} = (s_{ra,DD})(m_{b,DD})$$

$$\text{Eq. 8} \quad \hat{n}_{a,DD} = (s_{ra,DD})(1 - m_{b,DD})$$

where $m_{b,DD}$ is the species specific mortality rate from PFMC for fish in depth bin b released with a descending device.

For each canary, cowcod or yelloweye rockfish sample, the estimated fish released dead (\hat{n}_d) and released alive (\hat{n}_a) are

$$\text{Eq. 9} \quad \hat{n}_d = \hat{n}_{d,no DD} + \hat{n}_{d,DD}$$

Eq. 10
$$\hat{n}_a = \hat{n}_{a,no\ DD} + \hat{n}_{a,DD}$$

For canary, cowcod and yelloweye rockfish in the party/charter mode

Anglers in the party/charter mode often are unaware of the disposition of all their catch and don't know whether their released catch was released with a descending device. On larger boats, crew may take fish to a station to release them with a descending device. Therefore, during angler interviews for the catch rate survey, CRFS samplers don't ask party/charter anglers if fish were released with a descending device. The next section of this report describes the methods for estimating the proportion of canary, cowcod and yelloweye rockfish released with descending devices on party/charter boats.

For each canary, cowcod or yelloweye rockfish sample in the party/charter mode, the estimated number of fish released without a descending device ($\hat{s}_{r,no\ DD}$) and with a descending device ($\hat{s}_{r,DD}$) is calculated by

Eq. 11
$$\hat{s}_{r,no\ DD} = s_r(1 - \hat{p}_{DD})$$

Eq. 12
$$\hat{s}_{r,DD} = s_r(\hat{p}_{DD})$$

where \hat{p}_{DD} is the estimated species specific descending device usage rate in the party/charter mode for a district and year. See the next section for a description of the data and method used to estimate \hat{p}_{DD} .

To estimate the number of fish released dead and alive, follow equations 5 through 10 above except replace $s_{r,no\ DD}$ with $\hat{s}_{r,no\ DD}$ and $s_{r,a,DD}$ with $\hat{s}_{r,DD}$ in equations 5 through 8.

Methods for Determining Depth and Descending Device Usage

For each mode of CRFS sampling, there are different systems of collecting data both for bottom depths and descending device (DD) usage and varying amounts of data available. As a result, separate methods were developed for each mode to estimate average depths and apply the DDM and DDM-DD rates to the data. The procedures below were used beginning with the 2015 estimates posted on the RecFIN website. The details for CRFS sampling procedures, data collection forms and instructions for collecting and recording each data element are in the CRFS Sampler Manual (CDFW 2021).

1. Primary Private and Rental Boat (PR1) and Secondary Private and Rental Boat (PR2):

Depth: Angler-reported average bottom depth is, at a minimum, recorded for an interview, but can also be recorded by species (recorded on the CRFS PR Form). The values are recorded as "Depth A" and "Depth B" if two average depths are provided for different fishing locations. "Depth A" is used for DDM and DDM-DD if two depths are provided. If "Depth A" is missing, "Depth B" is used. If both "Depth A" and "Depth B" are missing, the Block-Box location is used to retrieve the depth from a lookup table of average depth per Block-Box. If no "Depth A", "Depth B" or Block-Box is available, released fish remain as recorded released alive or dead with no mortality rates applied.

Descending device: Angler-reported numbers of fish released with a DD are recorded at a species level for each rockfish reported released alive in the interview (recorded on the CRFS PR Form as a subset of released alive). DDM-DD rates are applied only to canary, cowcod and yelloweye rockfish recorded as released alive with a DD; DDM rates

are applied to all other groundfish (including canary, cowcod and yelloweye rockfish) released without a DD.

2. Beach and Bank and Man-Made Structure:

Depth: The 0-10 fm (0-60 ft) depth bin is used for groundfish caught in the shore modes.

Descending device: It is assumed that no DD were used.

3. Party and Charter Boat Onboard (PCO) and Party and Charter Boat Dockside (PCD):

PCO Depth: PCO depth is a single average bottom depth for the whole trip calculated from the stop-by-stop location data [recorded on the CRFS PC (CPFV) Onboard Location Form]. Fishing stops have a “Start Depth” and depending on the fishing method sometimes an “End Depth”. If a stop has both “Start Depth” and “End Depth” an average depth for the stop is calculated then an average of all stops is calculated to use for DDM and DDM-DD rates. If a PCO has no depth information available, the releases remains as recorded alive or dead with no mortality rate applied.

PCD Depth: PCD depths are recorded for the whole trip as the average depth where the majority of fish were caught [CRFS PC (CPFV) Dockside Form]. The values are recorded as “Depth A” and “Depth B” if two average depths are provided for different fishing locations. “Depth A” is used for DDM and DDM-DD if two depths are provided. If “Depth A” is missing, “Depth B” is used. If both “Depth A” and “Depth B” are missing, the Block-Box location is used to retrieve the depth from a lookup table of average depth per Block-Box. If no “Depth A”, “Depth B” or Block-Box is available, released fish remain as recorded released alive or dead with no mortality rates applied.

Descending device: DD usage is recorded at the trip level for both PCO and PCD [recorded on the CRFS PC (CPFV) Onboard Angler Form and the CRFS PC (CPFV) Dockside Form]. Additionally PCO samplers collect species level DD usage in the stop-by-stop location data by directly observing anglers [recorded on the CRFS PC (CPFV) Onboard Location Form]. Unlike PR1 and PR2, no DD usage information is collected during the interviews of PCO and PCD anglers as anglers on PCO and PCD boats are unlikely to know at the end of the trip if a fish they caught was released using a DD. Calculating a percentage of individual species released with a DD from the onboard stop-by-stop observations and applying that ratio to the CRFS interview data is the most accurate method available when compared to the trip level DD usage. However, due to the lack of access to sample onboard vessels in CRFS Districts 5 and 6, there are not enough observations available; so, the ratio of trip level DD usage is applied.

References

- PFMC. 2016. Status of the Pacific Coast Groundfish Fishery. 276 pp.
(<http://www.pcouncil.org/groundfish/safe-documents/>) For recreational mortality rates, see Table 1-12 and Table 1-15 (p.181 and p.183).
- CDFW. 2021. 2021 CRFS Sampler Manual.
(<https://www.wildlife.ca.gov/Conservation/Marine/CRFS>).

APPENDIX C

Calculation of Average Weight per Fish and Estimates of Catch by Weight

Estimates of catch are first calculated in numbers of fish. The estimates in numbers of fish are multiplied by the average weight per fish (called “average weight” in this appendix) for each species to arrive at estimates of total catch by weight.

For each species and catch type (i.e., kept-observed, kept-unobserved, released-alive and released-dead), total catch (by numbers and by weight) is estimated for each domain defined by a mode, month and district, and for each subdomain defined further by a water area and trip type. Each subdomain weight estimate uses the domain’s average weight. Subdomain sample sizes often are quite small, so separate subdomain average weights are not calculated.

For each species and domain, the average weight is calculated from at least 30 usable data, that is, field-collected sample values for fish weight or length. In calculating average weight, the sampled weight values are used directly. For sampled fish with recorded lengths but not weights, the power function $Weight = a * Length^b$ is used to calculate fish weights from recorded lengths. The parameters a and b are derived for each species from historical CRFS data or published literature.

In case a species and domain has fewer than the required number of usable data, such data are pooled. That is, the average weight calculation is based on data from not only the given domain but additional domains ‘nearby in space or time’. The pooled set of ‘nearby’ domains used for observed data is expanded level by level, in accord with the pooling rules given below, until the required number (30) of data is attained. If maximum pooling (i.e., to highest ‘level’) fails to yield this required number, then no catch-by-weight estimates are generated for the given species and domain (and its subdomains).

Owing to potential latitudinal variation in fish size and differing fishing depth restrictions among districts, pooling first extends to recent time (within the same area) rather than nearby districts. The rules allow pooling of up to five consecutive years – a span which is short enough to meet typical stock assessment requirements. For most estimates, the rules in fact restrict pooling to three years, as that span almost always suffices to yield the required sample size.

Pooling rules and estimation assumptions reflect the fact that only for certain combinations of mode and catch type does sampling yield usable data, so those combinations must serve as proxies for others. In particular:

- Not all sampler-observed fish are measured for length or weight. Measured fish serve as a proxy for unmeasured fish.
- Kept but sampler-unobserved fish do not yield usable data, so for each mode kept-observed fish serve as proxy for kept-unobserved fish, and it is assumed that kept-unobserved fish do not differ in weights from kept-observed fish.
- Usable data for released fish are routinely obtained only for commercial passenger fishing vessels (CPFVs) (party/charter boat mode); never for private/rental boat mode and rarely for shore mode. Hence, CPFV releases serve as proxy for all boat

releases. However, as fish weights typically differ between shore and boat modes, for shore releases the kept fish (from shore modes) serve as proxy.

- Data for live and dead releases are combined to increase sample sizes. It is assumed that in all modes fish weights do not differ between live and dead releases.

The pooling rules for average weights are as follows:

For kept catch observed by the sampler (kept-observed fish) and kept angler-reported catch not observed by the sampler (kept-unobserved fish) – for EACH MODE

- Level 1. Pool up to three years of CRFS usable kept-observed data by same district and same mode. Start with the most recent month and go back as far as needed, within the three years, to get 30 data. If the last added month has more data than are needed to reach 30 usable data, include the extra data.
- Level 2. Pool up to three years of CRFS usable kept-observed data by same district and super-mode. The boat super-mode includes CPFV and private/rental boat data, and the shore super-mode includes man-made structure and beach/bank data.
- Level 3. Pool up to three years of CRFS usable kept-observed data by ALL districts and super-mode (i.e., boat super-mode or shore super-mode).
- Level 4. Pool up to three years of CRFS usable kept-observed data by ALL districts and ALL super-modes.

Angler-reported fish released alive and fish released dead – for BOAT SUPER-MODE

- Level 1. Pool up to five years of CRFS data for fish released (alive or dead) by same district and boat super-mode. Start with the most recent month and go back as far as needed, to get at least 30 usable data. If the last added month has more data than needed to reach 30, include the extra data.
- Level 2. Pool up to five years of CRFS usable data for fish released (alive or dead) by boat super-mode and sub-region. The sub-regions are central/northern California (districts 3-6) and southern California (districts 1-2). A separate sub-region for northern California (districts 5-6) wasn't established, because CPFV onboard data for districts 5 and 6 are very limited.
- Level 3. Pool up to five years of CRFS usable data for fish released by boat super-mode and entire state.

Angler-reported fish released alive and released dead – for SHORE SUPER-MODE

Use shore-mode kept-observed usable data and the pooling rules given for kept-observed fish.

APPENDIX D – Angler License Directory Telephone Survey Questionnaire

California License-Frame Telephone Survey - #656

February 2017 (for January 2017 Fishing)

(Question number in parentheses is the question number in the data)

Hello. May I please speak to (license holder)? (ARRANGE CALLBACK OR CONTINUE)
Hello, my name is ____, and I'm calling for the California Department of Fish and Wildlife, which is collecting information about sportfishing. Your phone number was selected at random from all sportfishing license holders. May I ask you a few questions? The information you provide will be confidential.

- (Q1) Q1. First, In what state is your permanent residence?
State _____
Non-state of California or foreign country (specify) _____ (SKIP TO Q4)
- (Q1a) Q2. In what California County is your permanent residence?
California County _____(SKIP TO Q4)
-997. Don't Know (CONTINUE)
- (--) Q3. What city do you live in? _____
- (Q2) Q4. This is a very important study on sportfishing in California. By "sportfishing" I mean the primary purpose of fishing was for personal fun, relaxation or food – not for income or employment. For this entire study please exclude any non-sport fishing trips and trips outside of California. In the past 12 months, have you gone freshwater or saltwater sportfishing, including finfish and shellfish, in California or from a boat that left from California?
1. Yes (CONTINUE)
2. No (THANK & TERMINATE. COUNTS AS A COMPLETED INTERVIEW)
- (Q3) Q5. In the past 12 months, what percent of your California sportfishing trips have been freshwater and what percent have been saltwater?
_____ % freshwater (IF 100%, ASK (Q6 & 7), THEN THANK &
TERMINATE; COUNTS AS A COMPLETED INTERVIEW)
_____ % saltwater (IF 100%, SKIP TO Q8)
100%
- (Q4) Q6. I'd like to ask you about your most recent **freshwater** fishing, which includes fishing in ponds, lakes, reservoirs, and freshwater portions of rivers and streams. In **January** did you go **freshwater** sportfishing for fish in California?
1. Yes (CONTINUE)
2. No (SKIP TO Q8)
- (Q5) Q7. How many times did you go **freshwater** sportfishing for fish in California in **January**?

_____ Times

-997. Don't know

-998. Refused

(Q6a) Q8. Now I'd like to talk about your **saltwater** sportfishing. By "saltwater" I mean ocean, bays, estuaries and salty areas of rivers. In the past 12 months (from **February 2016** through **January 2017**), how many times did you go **saltwater** fishing or spearfishing for fish, not shellfish, in California or from a boat that left from California?

_____ Times (CANNOT BE 0; IF 0, SKIP BACK AND REVIEW Q5)

-997. Don't know (no. of days not established) (PROBE WELL FOR THEIR BEST GUESS AND CONTINUE. IF ABSOLUTELY CANNOT REMEMBER ANYTHING, THANK & TERMINATE; NOT A COMPLETE)

-998. Refused (no. of days not established) (THANK & TERMINATE; NOT A COMPLETE)

(Q6) Q10. Now thinking just about **January**, did you go **saltwater** sportfishing or spearfishing for fish, not shellfish, in California or a boat that left from California in **January**?

1. Yes (CONTINUE)

2. No (SKIP TO Q16)

(Q7) Q11. How many times did you go **saltwater** sportfishing for fish in California or from a boat that left from California in **January**?

_____ Times (NOTE: DO NOT EVER SNAP BACK AND CHANGE THIS NUMBER!)

-997. Don't know (no. of days not established) (PROBE WELL FOR THEIR BEST GUESS AND CONTINUE. IF ABSOLUTELY CANNOT REMEMBER ANYTHING, THANK & TERMINATE; NOT A COMPLETE)

-998. Refused (no. of days not established) (THANK & TERMINATE; NOT A COMPLETE)

(Q7) Q12. (INTERVIEWER: PLEASE INPUT THE # OF TRIPS HERE:)

of trips: _____ (IF 0, THANK & TERMINATE)

(--) Q13. Can you recall the approximate dates? I have a calendar here with me in case you need help. (IF RESPONDENT CANNOT REMEMBER SPECIFIC DATES, PROMPT FOR MONTH AND WHETHER WEEKDAY OR WEEKEND)

Dates: _____

(Q12 = 1, SAY:) Now I'd like to ask for a little more information about your fishing on that day.

(Q12 >1, SAY:) Now I'd like to ask for a little more information about your fishing on each of those days, starting with the most recent.

(Q9) Q14. Thinking about your saltwater fishing on (date), did you fish from a boat that day? . . . (Did you (also) fish from the shore that day? (CHECK ALL THAT APPLY & ANSWER "B" AND/OR "S" SECTIONS AS APPROPRIATE. IF MORE THAN ONE SHORE MODE, ASK ABOUT THE ONE USED LAST THAT DAY)

1. boat (GO TO BOAT SECTION)

2. beach or bank (GO TO SHORE SECTION)

3. jetty, dock, pier, bridge or other man-made structure (GO TO SHORE SECTION)

0. other (SPECIFY) _____ (GO TO SHORE SECTION)

-997. don't know (PROBE FOR DESCRIPTION AND RECORD UNDER "OTHER")

(Note: Man-made banks are 'beach and bank' unless the bank is surrounded by water on 3 sides, which are considered jetty 'structures'.)

BOAT SECTION

- (B1) B1. Was that on a charter, party or guide boat or a private or rental boat? (IF 2 TRIPS ON SAME DAY FROM DIFFERENT MODE CATEGORIES, RECORD AS 2 TRIPS; IF BOTH TRIPS FROM SAME MODE CATEGORY, ASK ABOUT THE ONE USED LAST THAT DAY)
1. charter or party boat (Category A) (CONTINUE)
 2. private boat (Category B) (SKIP TO B3)
 3. rental boat (Category B) (SKIP TO B3)
 97. DK (SKIP TO B3)
 98. refused (SKIP TO B3)
- (B2) B2. Were you the captain or a crew member of the charter or party boat on that trip?
1. yes (GO TO NEXT TRIP)
 2. no (CONTINUE)
 98. refused (CONTINUE)
- (B3) B3. Was most of that fishing in the ocean, a bay, an estuary or a river?
1. ocean (SKIP TO B7)
 2. bay or estuary (CONTINUE)
 3. river (SKIP TO B5)
 97. don't know (SKIP TO B7)
 98. refused (SKIP TO B7)
 99. other (SPECIFY) _____ (SKIP TO B7)
- (B4) B4. Which bay/estuary were you fishing in?
- | | |
|---|---|
| 1. Anahiem Bay | 18. Morro Bay – outside of harbor/jetties |
| 2. Arcata Bay | 19. Morro Bay – inside of harbor/jetties |
| 3. Balboa Bay | 20. Newport Bay |
| 4. Bodega Bay – inside of harbor/jetties | 21. Noyo Bay |
| 5. Bodega Bay – outside of harbor/jetties | 22. Pierpoint Bay |
| 6. Bolinas Bay | 23. Richardson Bay |
| 7. Crescent City – inside of harbor/jetties | 24. San Diego Bay |
| 8. Drakes Bay | 25. San Francisco Bay |
| 9. Estero Bay | 26. San Leandro Bay |
| * Grizzley Bay (fresh only) | 27. San Luis Obispo Bay – outside of harbor/jetties |
| 10. Half Moon Bay – inside of harbor/jetties | 28. San Luis Obispo Bay – inside of harbor/jetties |
| 11. Half Moon Bay – outside of harbor/jetties | 29. San Pablo Bay |
| * Honker Bay (fresh only) | 30. San Pedro Bay |
| 12. Humboldt Bay | 31. San Rafael Bay |
| 13. Long Beach Harbor | * Suisun Bay (fresh only) |
| 14. Los Angeles Harbor | 32. Tomales Bay |
| 15. Mission Bay | * Trinidad Bay (ocean) |
| 16. Monterey Bay – inside of harbor/jetties | 99. Other (SPECIFY) _____ (NOW SKIP TO QB7) |
| 17. Monterey Bay – outside of harbor/jetties | |
- (B5) B5. What was the name of the river you were fishing in?
- | | |
|------------------------------|--|
| 1. Albion River (Mendocino) | 8. Noyo River (Mendocino) |
| 2. Big River (Mendocino) | 14. Petaluma River (Sonoma) (cutoff = Hwy 37 bridge) |
| 3. Eel River (Humboldt) | 9. Redwood Creek (Humboldt) |
| 4. Kalmath River (Del Norte) | 10. Sacramento River (Solano/Contra Costa) |
| 5. Mad River (Humboldt) | 11. San Gabriel River (Los Angeles) |
| 6. Napa River (Napa) | 12. Smith River (Del Norte) |
| 7. Navaro River (Mendocino) | 13. Ten Mile River (Mendocino) |

0. Other (SPECIFY) _____(SKIP TO B7)

(B6) B6. Were you fishing upstream or downstream of (cutoff point)?

1. upstream (DELETE TRIP; GO TO NEXT TRIP)
 2. downstream (CONTINUE)
 3. both (CONTINUE)
- 997 DK
0998 Refused

(B7-B12 OF PRIVATE BOATS ONLY; PARTY/CHARTER & RENTAL BOATS SKIP TO B13)

(B7) B7. Does the public have access to the place from which the boat left, or is it private access? Public access sites are those where everyone in the general public has access, even though you may have to pay a fee to use the site. Private access sites usually have restricted access, such as locked gates or guards. Personal residences are also private access sites.

1. public has access (CONTINUE)
2. private access only (the public does not have access) (CONTINUE)
3. military (do not read) (ASK QB8, THEN B13)
4. DK (ASK QB8, THEN SKIP TO B12; UNLESS "SLIP" OR "BEACH," THEN FOLLOW QB8 SKIP PATTERN)
5. Refused (ASK QB8, THEN SKIP TO B12; UNLESS "SLIP," THEN FOLLOW QB8 SKIP PATTERN)

(B8) B8. Did you leave from a launch ramp, a beach launch, a hoist, or something else?

1. launch ramp (IF PUBLIC IN B7, SKIP TO B13; IF PRIVATE IN B7, SKIP TO B12)
2. hoist (SKIP TO B12)
3. slip (CONTINUE REGARDLESS OF WHETHER PUBLIC OR PRIVATE)
4. beach launch (SKIP TO B11)
5. something else (SPECIFY) _____
6. moored (CONTINUE REGARDLESS OF WHETHER PUBLIC OR PRIVATE)
7. berth (CONTINUE REGARDLESS OF WHETHER PUBLIC OR PRIVATE)
8. dock (CONTINUE REGARDLESS OF WHETHER PUBLIC OR PRIVATE)

(B8aa) B9. Do you or someone else pay to keep the boat there including mooring from a private residence or do you not have to pay to keep it there?

1. yes, I/they pay to keep the boat there (ASK B10)
2. no, I/they don't pay to keep the boat there (SKIP TO B12)
3. the boat is moored from a private residence (SKIP TO B13)

(B8bb) B10. To access the boat, do you have to go through a locked gate?

1. yes
2. no

(NOW SKIP TO B13)

(B8cc) B11. (IF BEACH LAUNCH, ASK:) What type of boat were you fishing from?

1. kayak
2. float tube
3. surfboard
4. inflatable (Zodiak, etc.)

(CONTINUE TO B12)

5. other (SPECIFY) _____

(B8a) B12. (ASK ALL EXCEPT PUBLIC LAUNCH RAMP & PRIVATE RESIDENCE MOORING:) What was the name of the place you left from? (name of launch ramp, marina, hoist, beach, etc.) _____

(IF B7 = 2 AND B8 = 1, ASK QP1)

(IF B7 = 2 AND B8 = 2, ASK QP2)

(IF B7 = 1 AND B8 = 3, 7 or 8, ASK QP3)

(IF B7 = 2 AND B8 = 3, 7 or 8, AND B9 = 2 AND B10 = 1, ASK QP4)

(IF B7 = 2 AND B8 = 3, 7 or 8, AND B9 = 1 AND B10 = 2, ASK QP5)

(IF B7 = 2 AND B8 = 3, 7 or 8, AND B9 = 2 AND B10 = 2, ASK QP6)

QP1. You said that (QB12) is a private launch. Is that correct?

yes (ASK QP1a)

no (GO BACK TO Q7 AND RE-ASK QUESTIONS)

QP1a. Most launch ramps are for public use. What makes this launch private? (IF RAMP TURNS OUT TO BE PUBLIC, GO BACK TO Q7 AND RE-ASK QUESTIONS)

QP2. You said that (QB12) is a private hoist. Is that correct?

yes (ASK QP2a)

no (GO BACK TO Q7 AND RE-ASK QUESTIONS)

QP2a. Most hoists are for public use. What makes this hoist private? (IF HOIST TURNS OUT TO BE PUBLIC, GO BACK TO Q7 AND RE-ASK QUESTIONS)

QP3. You said that (QB12) has public access. Is that correct?

yes (ASK QP3a)

no (GO BACK TO Q7 AND RE-ASK QUESTIONS)

QP3a. Typically (B8)'s are private access. What makes this (QB8) at (QB12) public? (IF SITE TURNS OUT TO BE PRIVATE, GO BACK TO Q7 AND RE-ASK QUESTIONS)

QP4. You said that (QB12) has private access but nobody pays to keep the boat there. Is that correct?

yes (ASK QP4a)

no (GO BACK TO Q7 AND RE-ASK QUESTIONS)

QP4a. Typically private (B8)'s aren't free. Can you tell me why there is no charge for the (B8)? (IF SITE TURNS OUT TO BE PUBLIC, GO BACK TO Q7 AND RE-ASK QUESTIONS)

QP5. You said that (QB12) has private access but you don't go through a locked gate to access the boat. Is that correct?

- yes (ASK QP5a)
- no (GO BACK TO Q7 AND RE-ASK QUESTIONS)

QP5a. Typically private (B8)'s have locked gates. Does anything prohibit the general public from getting to the (B8)? (IF SITE TURNS OUT TO BE PUBLIC, GO BACK TO Q7 AND RE-ASK QUESTIONS)

QP6. You said that (QB12) has private access but you don't pay to keep the boat there or go through a locked gate to access the boat. Is that correct?

- yes (ASK QP6a)
- no (GO BACK TO Q7 AND RE-ASK QUESTIONS)

QP6a. Typically private (B8)'s aren't free and they have locked gates. Can you tell me why there is no charge for the (B8)? And does anything prohibit the general public from getting to the (B8)? (IF SITE TURNS OUT TO BE PUBLIC, GO BACK TO Q7 AND RE-ASK QUESTIONS)

(B9) B13 Did the boat depart and return on the same calendar day? (ONE DAY TRIP).
 1. Yes (SKIP TO B17)
 2. No

(B10) B14. What date did the boat depart? _____ Date

(B11) B15. What date did the boat return? _____ Date

(B12) B16. During that trip, on how many calendar days did you actually fish? _____ Days

(B13) B17. To the nearest hour, what time did the boat leave?

- | | | |
|---------|------------------|--------------------------|
| 1. 1 am | 10. 10 am | 19. 7 pm |
| 2. 2 am | 11. 11 am | 20. 8 pm |
| 3. 3 am | 12. 12 pm (noon) | 21. 9 pm |
| 4. 4 am | 13. 1 pm | 22. 10 pm |
| 5. 5 am | 14. 2 pm | 23. 11 pm |
| 6. 6 am | 15. 3 pm | 24. 12 am (midnight) |
| 7. 7 am | 16. 4 pm | -997. DK (CONTINUE) |
| 8. 8 am | 17. 5 pm | -998. Refused (CONTINUE) |
| 9. 9 am | 18. 6 pm | |

(IF B17 = DK OR REF, ASK B18. ALL OTHERS SKIP TO B19)

(B14) B18. Did your boat leave after sunset?
 1. Yes
 2. No

(B15) B19. And, to the nearest hour, what time did the boat return?

- | | | |
|---------|------------------|-------------------------|
| 1. 1 am | 10. 10 am | 19. 7 pm |
| 2. 2 am | 11. 11 am | 20. 8 pm |
| 3. 3 am | 12. 12 pm (noon) | 21. 9 pm |
| 4. 4 am | 13. 1 pm | 22. 10 pm |
| 5. 5 am | 14. 2 pm | 23. 11 pm |
| 6. 6 am | 15. 3 pm | 24. 12 am (midnight) |
| 7. 7 am | 16. 4 pm | -997. DK (ask B20) |
| 8. 8 am | 17. 5 pm | -998. Refused (ask B20) |
| 9. 9 am | 18. 6 pm | |

- (B16) B20. Did your boat return before sunrise?
1. Yes 2. No

(IF B3 = 2 (BAY) OR 3 (RIVER), SKIP TO B23; ALL OTHERS CONTINUE)

- (B17) B21. Was most of your fishing that day more or less than 3 miles from the mainland or an island?
1. more than 3 miles (SKIP TO B23)
2. less than or equal to 3 miles (CONTINUE)

- (B18) B22. Were you fishing off the mainland or off an island?
1. off the mainland
2. off an island

- (B19p) B23. What was the primary kind of fish you were trying to catch that day? (SEE LIST; IF NO PRIMARY TARGET, CODE "ANYTHING"; IF NOT ON LIST, RECORD SPECIES UNDER "OTHER") (IF ANYTHING/NOTHING IN PARTICULAR, ASK B24)
-

- (B19a) B24. Were you bottom fishing or troll/drift fishing?
1. bottomfishing
2. troll/drift fishing
3. both

- (B19s) B25. Was there a secondary kind of fish you were trying to catch that day? (SEE LIST; IF NOT ON LIST, RECORD UNDER "OTHER") (IF NO SECONDARY TARGET, CODE "NONE")

- (B19b) B25a . (IF B1 = PRIVATE BOAT AND B3 = OCEAN AND B23 = TUNAS (SKIPJACK (96), ALBACORE (99), BLUEFIN (100), YELLOWFIN (101), BIG EYE (102), OR UNSPEC. TUNA (6) OR SHARKS (CODES 5, 7-13), ASK:) On that trip were you participating in an official (shark/tuna) tournament? (IF YES, CONFIRM WITH:) So you were fishing in a tournament where there was an official check-in station operated by independent tournament people and your only reason for the trip was to participate in a competitive tournament. And it wasn't just a betting pool or contest for the biggest fish caught. Is that correct?

1. yes
2. no

- (B20) B26. When your fishing trip ended, to what county did your boat return to shore?
- | | | |
|------------------------|---------------------|--------------------------|
| 1. Alameda | 9. Napa | 17. Santa Clara |
| 2. Contra Costa | 10. Orange | 18. Santa Cruz |
| 3. Del Norte (ASK B27) | 11. Sacramento | 19. Solano |
| 4. Humboldt (ASK B27) | 12. San Diego | 20. Sonoma |
| 5. Los Angeles | 13. San Francisco | 21. Ventura |
| 6. Marin | 14. San Luis Obispo | 22. Other _____(ASK B27) |
| 7. Mendocino | 15. San Mateo | 23. DK (ASK B27) |
| 8. Monterey | 16. Santa Barbara | |

(ALL EXCEPT DEL NORTE, HUMBOLDT, DK & OTHER SKIP TO B28)

- (B21) B27. What town was nearest to where your boat returned to shore?
Town _____
- (B22) B28. (IF SAN DIEGO, ORANGE OR LOS ANGELES COUNTY, ASK☺ Did you fish in Mexican waters on that trip?
1. yes (ASK B29) -997 DK (SKIP TO NEXT SECTION)
2. no (SKIP TO NEXT SECTION) -998Ref (SKIP TO NEXT SECTION)
- (B23) B29. Did you do some fishing in both Mexican and U.S. waters or were you fishing only in Mexican waters?
1. Both Mexican & U.S. waters 2. Mexican waters only

SHORE SECTION

- (S1) S1. Was most of your fishing that day in the ocean, a bay, an estuary, or a river?
1. ocean (SKIP TO S5)
2. bay or estuary (CONTINUE)
3. river (SKIP TO S3)
4. other (SPECIFY) _____ (SKIP TO S5)
5. don't know (SKIP TO S5)
6. refused (SKIP TO S5)
- (S2) S2. Which bay/estuary were you fishing in?
1. Anahiem Bay 18. Morro Bay – outside of harbor/jetties
2. Arcata Bay 19. Morro Bay – inside of harbor/jetties
3. Balboa Bay 20. Newport Bay
4. Bodega Bay – inside of harbor/jetties 21. Noyo Bay
5. Bodega Bay – outside of harbor/jetties 22. Pierpoint Bay
6. Bolinas Bay 23. Richardson Bay
7. Crescent City – inside of harbor/jetties 24. San Diego Bay
8. Drakes Bay 25. San Francisco Bay
9. Estero Bay 26. San Leandro Bay
* Grizzley Bay (fresh only) 27. San Luis Obispo Bay – outside of harbor/jetties
10. Half Moon Bay – inside of harbor/jetties 28. San Luis Obispo Bay – inside of harbor/jetties
11. Half Moon Bay – outside of harbor/jetties 29. San Pablo Bay
* Honker Bay (fresh only) 30. San Pedro Bay
12. Humboldt Bay 31. San Rafael Bay
13. Long Beach Harbor * Suisun Bay (fresh only)
14. Los Angeles Harbor 32. Tomales Bay
15. Mission Bay * Trinidad Bay (ocean)
16. Monterey Bay – inside of harbor/jetties 99. Other (SPECIFY) _____
17. Monterey Bay – outside of harbor/jetties
- (S3) S3. What was the name of the river you were fishing in?
1. Albion River (Mendocino) 14. Petaluma
2. Big River (Mendocino) 9. Redwood Creek (Humboldt)
3. Eel River (Humboldt) 10. Sacramento River (Solano/Contra Costa)
4. Klamath River (Del Norte) 11. San Gabriel River (L.A.)
5. Mad River (Humboldt) 12. Smith River (Del Norte)
6. Napa River (Napa) 13. Ten Mile River (Mendocino)
7. Navarro River (Mendocino) 0. Other (SPECIFY) _____
8. Noyo River (Mendocino)

- (S4) S4. Were you fishing upstream or downstream of (cutoff point)?
1. upstream (GO TO NEXT TRIP) -997 DK
 2. downstream (CONTINUE) -998 Refused
 3. both (CONTINUE)

- (S5) S5. Does the public have access to the place where you were fishing, or is it private? (Public access sites are those where everyone in the general public has access, even though you may or may not have to pay a fee to use the site. Private access sites often have restricted access, such as gates or guards like you find in clubs. Personal residences are also private access sites.)
1. public has access -997. DK
 2. private access only (the public does not have access) -998. Ref.
 3. military (DO NOT READ)

- (S6) S6. In what county were you fishing?
- | | | | |
|-----------------|----------------|---------------------|-------------------------|
| 1. Alameda | 7. Mendocino | 13. San Francisco | 19. Solano |
| 2. Contra Costa | 8. Monterey | 14. San Luis Obispo | 20. Sonoma |
| 3. Del Norte | 9. Napa | 15. San Mateo | 21. Ventura |
| 4. Humboldt | 10. Orange | 16. Santa Barbara | 22. Other ____ (Ask S7) |
| 5. Los Angeles | 11. Sacramento | 17. Santa Clara | 23. DK (S7) |
| 6. Marin | 12. San Diego | 18. Santa Cruz | |

(Q14 = 2 (BEACH/BANK) AND QS6 = 8 (MONTEREY CO.) OR 18 (SANTA CRUZ CO.) ASK QS8 AND QS9. IF QS6 = DK OR OTHER, ASK QS7, THEN SKIP TO QS10. ALL OTHERS, SKIP TO S10)

- (--) S7. What is the nearest town to where you did most of that fishing? Town _____

- (S7) S8. Was the majority of your beach fishing on sand?
1. yes (IF S6 = MONTEREY (8), ASK QS9; IF S6 = SANTA CRUZ (18), SKIP TO QS10)
 2. no (SKIP TO QS10) -997. DK (SKIP TO QS10)

- (S7a) S9. Was that sand beach north of Pt. Lobos (Carmel beaches northward)?
1. yes
 2. no -997. DK

- (S8p) S10. What was the primary kind of fish you were trying to catch that day? (SEE LIST; IF NO PRIMARY TARGET, CODE "ANYTHING"; IF NOT ON LIST, RECORD SPECIES UNDER "OTHER") _____

- (S8s) S11. Was there a secondary kind of fish you were trying to catch that day? (SEE LIST; IF NOT ON LIST, RECORD UNDER "OTHER") (IF NO SECONDARY TARGET, CODE "NONE") _____

- (S9) S12. What time did you start fishing?
- | | | | |
|---------|------------------|----------|----------------------|
| 1. 1 am | 8. 8 am | 15. 3 pm | 22. 10 pm |
| 2. 2 am | 9. 9 am | 16. 4 pm | 23. 11 pm |
| 3. 3 am | 10. 10 am | 17. 5 pm | 24. 12 am (midnight) |
| 4. 4 am | 11. 11 am | 18. 6 pm | -997. DK (CONT) |
| 5. 5 am | 12. 12 pm (noon) | 19. 7 pm | -998. Refused (CONT) |
| 6. 6 am | 13. 1 pm | 20. 8 pm | |
| 7. 7 am | 14. 2 pm | 21. 9 pm | |

- (S10) S13. At what time did you stop fishing?
- | | | |
|---------|------------------|----------------------|
| 1. 1 am | 10. 10 am | |
| 2. 2 am | 11. 11 am | 19. 7 pm |
| 3. 3 am | 12. 12 pm (noon) | 20. 8 pm |
| 4. 4 am | 13. 1 pm | 21. 9 pm |
| 5. 5 am | 14. 2 pm | 22. 10 pm |
| 6. 6 am | 15. 3 pm | 23. 11 pm |
| 7. 7 am | 16. 4 pm | 24. 12 am (midnight) |
| 8. 8 am | 17. 5 pm | -997 DK (ASK S14) |
| 9. 9 am | 18. 6 pm | -998 Refused (S14) |

(IF S12 OR S13 = DK OR REFUSED, ASK S14; OTHERWISE SKIP TO S15)

- (S11) S14. Did your fishing trip take place entirely at night?
 1. Yes 2. No -997. DK

- (S12) S15. Did you finish fishing on the same calendar day that you started?
 1. yes (GO TO NEXT TRIP OR Q15) -997. DK
 2. no (ASK S16)

- (S13) S16. How many hours was your total trip duration? _____ Hours -997. DK

ASK EVERYONE:

- (Q10) Q15. While we were talking, did you think of any other saltwater sportfishing you did in California in **January** that we have not discussed?
 1. yes (RETURN TO Q13 FOR THE DATE, THEN CONTINUE LOOP WITH Q14)
 2. No (THANK & TERMINATE)
 3. DK (THANK & TERMINATE)
 4. Ref (THANK & TERMINATE)

Those are all my questions. On behalf of the California Department of Fish & Game, I want to thank you very much for taking the time to answer these questions. You have been very helpful. Thanks again, and good luck on your next fishing trip.

- (Comment) (INTERVIEWER: IF Q11 AND Q12 ARE NOT THE SAME, PLEASE RECORD REASON THE NUMBER OF TRIPS CHANGED HERE:)
-

APPENDIX E - CRFS Forms

Date (MM/DD)		/		/		/		/		/		/		/											
		MON		TUE		WED		THU		FRI		SAT		SUN											
CPFV Boat Name	CDFW Boat #	Target Status	So.	Target Status	So.	Target Status	So.	Target Status	So.	Target Status	So.	Target Status	So.	Target Status	So.										
		Gear (circle)		Gear (circle)		Gear (circle)		Gear (circle)		Gear (circle)		Gear (circle)		Gear (circle)											
11		T	M	D	T	M	D	T	M	D	T	M	D	T	M	D	T	M	D	T	M	D			
12		T	M	D	T	M	D	T	M	D	T	M	D	T	M	D	T	M	D	T	M	D	T	M	D
13		T	M	D	T	M	D	T	M	D	T	M	D	T	M	D	T	M	D	T	M	D	T	M	D
14		T	M	D	T	M	D	T	M	D	T	M	D	T	M	D	T	M	D	T	M	D	T	M	D
15		T	M	D	T	M	D	T	M	D	T	M	D	T	M	D	T	M	D	T	M	D	T	M	D
16		T	M	D	T	M	D	T	M	D	T	M	D	T	M	D	T	M	D	T	M	D	T	M	D
17		T	M	D	T	M	D	T	M	D	T	M	D	T	M	D	T	M	D	T	M	D	T	M	D
18		T	M	D	T	M	D	T	M	D	T	M	D	T	M	D	T	M	D	T	M	D	T	M	D
19		T	M	D	T	M	D	T	M	D	T	M	D	T	M	D	T	M	D	T	M	D	T	M	D
20		T	M	D	T	M	D	T	M	D	T	M	D	T	M	D	T	M	D	T	M	D	T	M	D
Total salmon CPFVs sampled per day:		/		/		/		/		/		/		/		/		/		/					
Comments:																									

Fishing Target

- S = Salmon (circle Troll or Mooch)
- R = Rockfish
- L = Lingcod
- Z = Striped bass
- N = Sturgeon
- K = Shark

Non-Fishing Status

- T = Tuna
 - O = Other
 - H = CA Halibut
 - A = PA Halibut
 - D = Crab
- Note: Record the fishing target and circle gear D for dive trips; Record non-take dive trips (e.g., wildlife viewing) as 2.

Effort Source (So)

- 1 = boat docked (trailer)
 - 2 = non-fishing trip
 - 3 = non-CPFV fishing trip
- Initials = sampled by CDFW
 P = Personal observation
 C = Captain / deckhand
 O = Office contact
 W = Website

ASSN ID	Boat_of	Date (MM/DD/YY)	CNTY	SITE	OSP Port	Sampler #	Sampler Last Name				
DFG Boat #	Boat Name	Duration Type	PC Mode (P or C)	Departure & Return Date (MM/DD/YY) Time		DAYS fished	TOTAL ANGS	TARGET	AREA	GEAR	DD?
Captain:				Depart.				1st			Y/N
				Return				2nd			
SPECIFIC LOCATION & DEPTH INFO: <i>Location and depth where most of the fish caught, or most of the effort if no catch.</i>				LOCATION (block-box or Lat/Lon)				DEPTH Average Bottom (ft)			

EFFORT			CATCH			BIO DATA				
Sample # <i>or R, B, Boat Fish</i>	ANGS Total	DAYS FISHED 12 months Zip Code	SPECIES	KEPT	RELS	Fork length/Carapace size (mm), Sex (M/F/T)				
				obs	alive	Weight (decimal kg) or tag #				
				unobs	dead	1	2	3	4	5
A		12 mo zip		obs	alive					
				unobs	dead					
B		12 mo zip		obs	alive					
				unobs	dead					
C		12 mo zip		obs	alive					
				unobs	dead					
D		12 mo zip		obs	alive					
				unobs	dead					
E		12 mo zip		obs	alive					
				unobs	dead					
F		12 mo zip		obs	alive					
				unobs	dead					
G		12 mo zip		obs	alive					
				unobs	dead					
H		12 mo zip		obs	alive					
				unobs	dead					
I		12 mo zip		obs	alive					
				unobs	dead					
J		12 mo zip		obs	alive					
				unobs	dead					

*Use CRFS-OSP SALMON CPFV DOCKSIDE SAMPLE FORM for salmon trips.

Boat: (Boat #) of (Total # sampled per assignment)
Duration Type: 1/2 day, 3/4 to full day, Twilight, Overnight, Other-describe
PC Mode: Open Party, Charter
DD?: Was a descending device used on this trip? Yes or No

AREA (Water Area & Island): Water Area: Nearshore (<3mi), Offshore (>3mi), enclosed Bay/estuary/harbor, Mexico.
Island: 1-Coronado, 2-San Clemente, 3-Catalina, 4-Santa Barbara, 5-San Nicolas, 6-Anacapa, 7-Santa Cruz, 8-Santa Rosa, 9-San Miguel, F-Farallones
GEAR: Hook & line, Spear, Troll, Bait Net. Salmon gear only: Mooch, Both (mooch & troll).
 Invert gear only: Pot #, Flat # or Rigid # hoop net, snare, sCuba, free Diving

Sample #: # of interview, OR Refusal, Language Barrier, or Boat Fish. **Sample # Flag:** Crew

Kept	Rele	Kept	Rele	Kept	Rele	Kept	Rele	Kept	Rele
HALPA		RFYFY		RFCOW		RFCAN		RFBLK	

TOTAL ANGS: all eligible anglers (including crew if they take home fish)

ASSN ID	Date (MM/DD/YY)	CNTY	SITE	OSP Port	Sampler #	Sampler Last Name						
DFG Boat #	Boat Name	Duration Type	PC Mode (P or C)	Departure & Return Date (MM/DD/YY)		Time	DAYS fished	TOTAL ANGS	TARGET	AREA	GEAR	DD?
				Depart					1st			Y/N
				Return					2nd			

Captain:

Catch Recorded obs reported	ANGLER #	BAG #	Angler REFERENCE (angler name, description, etc.)	DAYS fished (12 mo)		Catch Recorded obs reported	ANGLER #	BAG #	Angler REFERENCE (angler name, description, etc.)	DAYS fished (12 mo)	
					Zip Code						Zip Code
obs					12 mos	obs					12 mos
unobs & RELS	A				Zip	unobs & RELS	I				Zip
obs					12 mos	obs					12 mos
unobs & RELS	B				Zip	unobs & RELS	J				Zip
obs					12 mos	obs					12 mos
unobs & RELS	C				Zip	unobs & RELS	K				Zip
obs					12 mos	obs					12 mos
unobs & RELS	D				Zip	unobs & RELS	L				Zip
obs					12 mos	obs					12 mos
unobs & RELS	E				Zip	unobs & RELS	M				Zip
obs					12 mos	obs					12 mos
unobs & RELS	F				Zip	unobs & RELS	N				Zip
obs					12 mos	obs					12 mos
unobs & RELS	G				Zip	unobs & RELS	O				Zip
obs					12 mos	obs					12 mos
unobs & RELS	H				Zip	unobs & RELS	P				Zip

Duration Type: 1/2 day, 3/4 to full day, Twilight, Overnight, Other-describe

PC Mode: Open Party, Charter

TOTAL ANGS: all eligible anglers (including crew if they take home fish)

AREA (Water Area & Island): Water Area: Nearshore (<3mi), Offshore (>3mi), enclosed Bay/estuary/harbor, Mexico

Island: 1-Coronado, 2-San Clemente, 3-Catalina, 4-Santa Barbara, 5-San Nicolas, 6-Anacapa, 7-Santa Cruz, 8-Santa Rosa, 9-San Miguel, F-Farallones

GEAR: Hook & line, Spear, Bait Net, Troll Salmon gear only: Mooch, Both (mooch & troll)

Invert gear only: Pot #, Flat # or Rigid # hoop net, snarE, sCuba, free Diving

DD? = Was a descending device used on this trip? Yes or No

Catch Recorded: Y = Yes, type of catch (obs or unobs/RELS) occurred and was recorded, N = No, Type of catch did not occur

DK = Don't know (didn't examine catch or didn't interview angler)

Angler #: Number or Refusal or Language Barrier Angler # Flag: Crew

ASSN ID	Date (MM/DD/YY)	CNTY	SITE	OSP Port	Sampler #	Sampler Last Name					
Catch Recorded obs reported	ANGLER #	BAG #	Angler REFERENCE (angler name, description, etc.)	DAYS		Catch Recorded obs reported	ANGLER #	BAG #	Angler REFERENCE (angler name, description, etc.)	DAYS	
				fished (12 mo)	Zip Code					fished (12 mo)	Zip Code
obs				12 mos		obs				12 mos	
unobs & RELS	A			Zip		unobs & RELS	L			Zip	
obs				12 mos		obs				12 mos	
unobs & RELS	B			Zip		unobs & RELS	M			Zip	
obs				12 mos		obs				12 mos	
unobs & RELS	C			Zip		unobs & RELS	N			Zip	
obs				12 mos		obs				12 mos	
unobs & RELS	D			Zip		unobs & RELS	O			Zip	
obs				12 mos		obs				12 mos	
unobs & RELS	E			Zip		unobs & RELS	P			Zip	
obs				12 mos		obs				12 mos	
unobs & RELS	F			Zip		unobs & RELS	Q			Zip	
obs				12 mos		obs				12 mos	
unobs & RELS	G			Zip		unobs & RELS	R			Zip	
obs				12 mos		obs				12 mos	
unobs & RELS	H			Zip		unobs & RELS	S			Zip	
obs				12 mos		obs				12 mos	
unobs & RELS	I			Zip		unobs & RELS	T			Zip	
obs				12 mos		obs				12 mos	
unobs & RELS	J			Zip		unobs & RELS	U			Zip	
obs				12 mos		obs				12 mos	
unobs & RELS	K			Zip		unobs & RELS	V			Zip	

Catch Recorded: **Y** = Yes, type of catch (obs or unobs/RELS) occurred and was recorded, **N** = No, Type of catch did not occur
DK = Don't know (didn't examine catch or didn't interview angler)

Angler #: Number **or** Refusal or Language **Barrier** **Angler # Flag:** **Crew**

ASSN ID	Date (MM/DD/YY)	OSP Port	Sampler #	Sampler Last Name	DFG Boat #	Boat Name

EFFORT			DISCARDS	CATCH		BIO DATA						
ANGLER #(s) from Angler Form	ANGS Total	BAG # (Sample #)		Stop #	SPECIES	KEPT obs unobs	RELS alive dead	Fork length / Carapace size (mm), sex (M/F/T) Weight (decimal kg) or tag #				
								1	2	3	4	5
A						obs	alive					
						unobs	dead					
B						obs	alive					
						unobs	dead					
C						obs	alive					
						unobs	dead					
D						obs	alive					
						unobs	dead					
E						obs	alive					
						unobs	dead					
F						obs	alive					
						unobs	dead					
G						obs	alive					
						unobs	dead					
H						obs	alive					
						unobs	dead					
I						obs	alive					
						unobs	dead					
J						obs	alive					
						unobs	dead					
K						obs	alive					
						unobs	dead					
L						obs	alive					
						unobs	dead					
M						obs	alive					
						unobs	dead					

ANGLER #(s): List the Angler # or #s from the Angler Form for all anglers contributing to the bag.

ANGS Total: Number of anglers associated with this bag.

Bag (=Sample): Record the bag number.

Boat Fish: Leave ANGLER # blank; write **Boat Fish** for BAG #.

For finfish, ANGS Total: TOTAL ANGTS from the PCO Angler Form (i.e., number of eligible anglers incl. crew if they take fish home). Record obs.

DISCARDS: Record the Stop # for measured discards; leave EFFORT columns blank; complete CATCH & BIO DATA columns.

Kept	Rele	Kept	Rele	Kept	Rele	Kept	Rele	Kept	Rele
HALPA		RFYFY		RFCOW		RFCAN		RFBLK	

CRFS PC (CPFV) ONBOARD LOCATION FORM - Check box if this is an ADDITIONAL SHEET

ASSN ID	Date (MM/DD/YY)	OSP Port	Stop #	ANGS	Stop #	ANGS	Stop #	ANGS
START	Lat.							
	Lon. 1							
	Time/Depth	Time	Depth (ft)	Time	Depth (ft)	Time	Depth (ft)	
END	Lat.							
	Lon. 1							
	Time/Depth	Time	Depth (ft)	Time	Depth (ft)	Time	Depth (ft)	
	GFMT	AREA	FType	SmpLoc	GFMT	AREA	FType	SmpLoc
	TARGET				TARGET			

Depth (BOTTOM): #feet, Refused, Unknown
 GFMT: 3=deg,min,sec 1=deg, xx.01 min
 FType=Fishing Type: Drift, Stat., Anchor, Troll
 SmpLoc=Sampler Location: Bow, Stern, SiDe
 w/DD: # RELS w/descending device

Common Name	SPECIES code	KEPT			RELS			KEPT			RELS			KEPT			RELS											
					alive	dead	w/DD (not subset)	alive	dead	w/DD (not subset)				alive	dead	w/DD (not subset)				alive	dead	w/DD (not subset)						
A																												
B																												
C																												
D																												
E																												
F																												
G																												
H																												
I																												
J																												
Stop continued on Additional Sheet?					Y	N		Y	N		Y	N		Y	N		Y	N		Y	N		Y	N		Y	N	

AREA (Water Area & Island): Water Area: Nearshore (<3mi), Offshore (>3mi), enclosed Bay/estuary/harbor, Mexico
 Island: 1-Coronado, 2-San Clemente, 3-Catalina, 4-Santa Barbara, 5-San Nicolas, 6-Anacapa, 7-Santa Cruz, 8-Santa Rosa, 9-San Miguel, F-Farallones

BACK OF SHEET

ASSN ID _____ Date (MM/DD/YY) _____ OSP Port _____

Dot-line System

3	::	<input type="checkbox"/>	8
4	::	<input checked="" type="checkbox"/>	9
5	!:	<input checked="" type="checkbox"/>	10

Depth (BOTTOM): #feet, Refused, Unknown
GFMT: 3=deg,min,sec 1=deg, xx.01 min
Ftyp=Fishing Type: Drift, Stat., Anchor, Troll
SmpLoc=Sampler Location: Bow, Stern, SiDe
w/DD: # RELS w/descending device

START	Lat.	Lon. 1	Stop #	ANGS			Stop #	ANGS			Stop #	ANGS				
			Time	Depth (ft)		Time	Depth (ft)		Time	Depth (ft)						
END	Lat.															
	Lon. 1															
	Time/Depth		Time	Depth (ft)		Time	Depth (ft)		Time	Depth (ft)		Time	Depth (ft)			
	GFMT	AREA	FTyp	SmpLoc	GFMT	AREA	FTyp	SmpLoc	GFMT	AREA	FTyp	SmpLoc	GFMT	AREA	FTyp	SmpLoc
	TARGET				TARGET				TARGET							

Common Name	SPECIES code	KEPT			RELS			KEPT			RELS			KEPT			RELS		
		alive	dead	w/DD (not subset)	alive	dead	w/DD (not subset)	alive	dead	w/DD (not subset)	alive	dead	w/DD (not subset)	alive	dead	w/DD (not subset)			
A																			
B																			
C																			
D																			
E																			
F																			
G																			
H																			
I																			
J																			
Stop continued on Additional Sheet?		Y N			Y N			Y N			Y N								

AREA (Water Area & Island): Water Area: Nearshore (<3mi), Offshore (>3mi), enclosed Bay/estuary/harbor, Mexico

Island: 1-Coronado, 2-San Clemente, 3-Catalina, 4-Santa Barbara, 5-San Nicolas, 6-Anacapa, 7-Santa Cruz, 8-Santa Rosa, 9-San Miguel, F-Farallones

CRFS-OSP SALMON CPFV DOCKSIDE FORM

Date (MM/DD/YY)	OSP Port	Sampler ID	Sampler Last Name	Other Samplers, ID (w/data)
				_____ (Y N) _____ (Y N)

EFFORT			CATCH					BIO DATA		
Boat Name Boat # time sampled	Gear (circle)	Total Angs	King		Coho		Sea Lion Take # Salm	Salmon		
			# Kept	# Rels	# Kept	# Rels		Headtag #	FL(mm)	NRS*
Boat Name	T									
Boat #	M									
Boat Name	T									
Boat #	M									
Boat Name	T									
Boat #	M									
Boat Name	T									
Boat #	M									
Boat Name	T									
Boat #	M									
Boat Name	T									
Boat #	M									
Boat Name	T									
Boat #	M									
Boat Name	T									
Boat #	M									

Comments:

TOTAL SAMPLED EFFORT & CATCH FOR THE DAY:							King			Coho		
# Boats	# Anglers	# Kept	# Rels	# Kept	# Rels	SL Take	# Ad-clips	# Sal Heads	# NRS			

* NRS (non-recovered species): check when unable to recover head from adipose-fin clipped salmon. Record headtag # on this sheet & write NRS in LARGE BOLD letters across the back of headtag if unable to attach to salmon.

CRFS SHORE FORM

MM BB

V12_11262018

For Assignment, Page ____ of ____

ASSN ID	Site Visit of	Date (MM/DD/YY)	CNTY	SITE	SITE NAME	CLUSTER	Sampler #	Sampler Last Name

MM COUNTS (inst. <i>at least</i> every 1.5 hr)	Start	Inst #1	Inst #2	Inst #3	Inst #4	Inst #5	Stop	BB Total Observed Anglers	OBS PR Accessed From BB
Time Count Began									
Finfish Anglers									

EFFORT				CATCH				BIO DATA								
SAMPLE # [or R or B]	ANGS Total (unic)	TRIP LENGTH		DAYS FISHED 12 months	TARGET		AREA	GEAR	SPECIES CODE	KEPT	RELS	Fork length/Carapace size (mm), Sex (M/F/T)				
		Arrival Time	Additional Time		1st	2nd				obs	alive	Weight (decimal kg) or (tag #)				
Time		hrs	min	Zip Code					unobs	dead	1	2	3	4	5	
A	()	time	12 mo	zip					obs	alive						
		ADD-hrs	ADD-min	zip					unobs	dead						
B	()	time	12 mo	zip					obs	alive						
		ADD-hrs	ADD-min	zip					unobs	dead						
C	()	time	12 mo	zip					obs	alive						
		ADD-hrs	ADD-min	zip					unobs	dead						
D	()	time	12 mo	zip					obs	alive						
		ADD-hrs	ADD-min	zip					unobs	dead						
E	()	time	12 mo	zip					obs	alive						
		ADD-hrs	ADD-min	zip					unobs	dead						
F	()	time	12 mo	zip					obs	alive						
		ADD-hrs	ADD-min	zip					unobs	dead						
G	()	time	12 mo	zip					obs	alive						
		ADD-hrs	ADD-min	zip					unobs	dead						
H	()	time	12 mo	zip					obs	alive						
		ADD-hrs	ADD-min	zip					unobs	dead						

Site Visit __ of __: (Visit #) of (Total Site Visits in cluster #) **SAMPLE #:** # of interview, **OR** Refusal, Language **B**arrier **Sample # Flag:** **T**ournament

TRIP LENGTH: Sample as many completed trips as possible. **MM:** valid incomplete trip: trip at least 50% completed **BB:** valid incomplete trip: angler/party fished at least 60 minutes

Arrival Time: Record the time the angler(s) arrived at the site.

Additional Time: Incomplete trips-record angler's estimate of additional time at the site in hours & minutes. Complete trips-record zero in the ADD-hrs & ADD-min boxes.

WATER AREA: **N**earshore (<3mi), enclosed **B**ay/estuary/harbor **GEAR:** **H**ook & line, **S**pear, Bait **N**et **I**nvert gear only: **P**ot #, **F**lat # or **R**igid # hoop net, snar**E**, s**C**uba, free **D**ive

RCVD ON/BY: _____ EDIT ON/BY: _____ SCAN ON/BY: _____

ENTR ON/BY: _____ UPLD ON/BY: _____ FILE ON/BY: _____

Assn # V17 6/1/21

CRFS ASSIGNMENT SUMMARY FORM

COMMENTS	SAMPLER NAME:	SAMPLER #	DATE (MM/DD/YY)	ASSN ID	MODE	PORT/ CLUS CNTYSITE	HOURS		
	OTHER SAMPLER(S): NAME & # (w/data)	OTHER SAMPLER(S): NAME & # (w/data)					ASSN DISP*	TOTAL	SAMPLING
	(Y / N) circle one	(Y / N) circle one					State Car or Pers Vehicle		TOT TRV
	MARINE CONDITIONS:						ODO START		TRV TIME HQ to site 1
	EFFORT:						ODO STOP		TRV TIME last site to HQ
CATCH:						MILEAGE		EDIT	
PC ACTIVITY:									
OTHER PERTINENT INFORMATION:									
HEAD TAGS USED (PR/PC):									

Round all hours to nearest 0.25 hour
 0.00hr = 53-07 mins
 0.25hr = 08-22 mins
 0.50hr = 23-37 mins
 0.75hr = 38-52 mins

*Assignment dispositions: 1=Complete, 2=Reassigned, 6=Canceled

Check box if continued on 2nd page <input type="checkbox"/>	HQ Departure Time: <input style="width:80%;" type="text"/>	Site Effort Check (if applicable)	PR Trailer Counts			
	HQ Return Time: <input style="width:80%;" type="text"/>		Onsite Start	Offsite Start	Onsite Stop	Offsite Stop

Row #	SITE NAME / SITE COMMENT	TIME		PR Trailer Counts			
		CNTY	ARRV	BB	ANGS	OBS	PR
1		SITE	START	MM			
		DISPO**	STOP	PR			
		HRS	DEPR				
2		SITE	START	MM			
		DISPO**	STOP	PR			
		HRS	DEPR				
3		SITE	START	MM			
		DISPO**	STOP	PR			
		HRS	DEPR				
4		SITE	START	MM			
		DISPO**	STOP	PR			
		HRS	DEPR				
5		SITE	START	MM			
		DISPO**	STOP	PR			
		HRS	DEPR				

PR & PC ONLY

Refusal + Barrier	Total Boats	Boats Salmon	Angs	Kept Kings	Rels Kings	Kept Coho	Rels Coho	Head Tags	Kept HALPA	Rels HALPA	Kept RFYEE	Rels RFYEE	Kept RFCOW	Rels RFCOW	Kept RFCAN	Rels RFCAN	Kept RFBLK	Rels RFBLK	ON Missed	OFF
-------------------	-------------	--------------	------	------------	------------	-----------	-----------	-----------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	-----------	-----

**Site dispositions: 0=Effort check, 1=Complete, 4=Low Effort, 5=Other (comment), 7=Roving (MM, BB clusters)

APPENDIX F

Stratification and Sample Selection Details for Surveys of Man-made Structures and Secondary Private and Rental Boat Sites

The following description is for the man-made structure survey. The same procedures are used for the survey of secondary private and rental boat sites except the private and rental boat survey uses sites and site-day rather than clusters and cluster-days.

For a given district, month and day type sampling is designed to favor clusters with higher pressure. This goal is achieved by use of a pressure weighted stratified random sampling design. Strata of PSUs (S_i) are defined by month, district, day type and pressure category. For each month, district and day type there are initially up to three strata: S_1 , S_2 and S_3 , corresponding respectively to low, medium and high pressure clusters. One or even two of the S_i may be empty for some district-month cases.

Each pressure category $i > 0$ defines a sampling importance score $c(i) > 0$ for each cluster of that category, and therefore (by summation), for each set or stratum of PSUs defined by month, district, day type and cluster pressure category. Default score values for the importance scores are: $c(1)=2$, $c(2)=3$, $c(3)=5$. These values can readily be changed and can even be customized to each district and month.

Based on the allotted sample size allotted to a month, district and day type (n , always at least 2), the draw program automatically creates a sample allocation in which each PSU's probability of being sampled is (as nearly as possible) proportional to its cluster's sampling importance score. The design uses stratified random sampling of up to three strata for each month, district and day type. Each stratum is either one of the S_i or results from merging two (or even all three) of the S_i . The design uses as little merging (and as many strata) as possible, subject to each resulting stratum having at least two sampled PSUs so as to permit variance estimation.

Tactical details

The chosen stratification results from one of the following four merge schemes (M_i , $i=1,2,3,4$) with H = number of strata:

- M1. $H=3$: Don't merge (the desired scheme, usual for larger sample sizes n)
- M2. $H=2$: Merge S_1 and S_2 (low and medium pressure cases)
- M3. $H=2$: Merge S_2 and S_3 (medium and high pressure cases)
- M4. $H=1$: Merge all three S_i into one stratum S

The scheme and its stratum sizes are chosen per the following steps.

Step 1: Prorate the available sample size n to each PSU in proportion to its cluster's score. Then test each scheme (of the above four) as follows. By summation, each stratum h in the scheme receives an initial sample size $n^*(h)$ (which need not be an integer). The scheme remains a viable candidate only if each value $n^*(h) \geq 1.5$. This last inequality minimally justifies taking final stratum sample size $n(h)$ to be at least 2 as is required for a variance estimate.

Step 2: From the remaining viable candidate schemes, choose one of maximum number of strata H . There will be just one such candidate, unless $H=2$ and both M2 and M3 are viable. In that special case, for each of M2 and M3 calculate the scheme's "imbalance" (i.e., the absolute difference between the two strata initial

sample sizes $n^*(h)$). Choose M2 if its imbalance is at most that of M3, otherwise choose M3.

Step 3: For the chosen scheme, for each stratum h change initial sample size $n^*(h)$ to final integer sample size $n(h) \geq 2$ as follows. If $n^*(h) < 2$ then $n(h) = 2$. Define each other $n(h)$ so that: (a) $n(h) \geq 2$; (b) all the $n(h)$ sum to N_s ; and (c) subject to conditions (a) and (b), the sum of the absolute changes $|n(h) - n^*(h)|$ is the least possible.

Examples

Example 1 - Suppose that a given district has four active MM clusters: one of low pressure, two of medium pressure and one of high pressure. For a given month and district, the weekend day type PSUs (cluster-days) are allotted 6 sampling days ($n = 6$ sampling days). Steps 1-3 then operate as follows.

Step 1: The total (over all the clusters) sampling importance score is $(1 \cdot 2) + (2 \cdot 3) + (1 \cdot 5) = 13$. From proration of the 6 available sampling days,

- the low pressure stratum S_1 gets $n^*(1) = (2/13) \cdot 6 \sim 0.9$ days
- the medium pressure stratum S_2 gets $n^*(2) = (6/13) \cdot 6 \sim 2.8$ days
- the high pressure stratum S_3 gets $n^*(3) = (5/13) \cdot 6 \sim 2.3$ days

Because $n^*(1) < 1.5$, schemes M1 and M3 are not viable, but schemes M2 and M4 remain viable.

Step 2: Scheme M2 provides $H=2$ strata but scheme M4 provides only $H=1$ stratum. Hence, scheme M2 is the chosen scheme, with one stratum for the combined low and medium pressure clusters and the other for the high pressure cluster.

Step 3: The respective initial numbers of sampling days for these strata are $n^*(1) \sim 3.7$ and $n^*(2) \sim 2.3$. These change to final integer values $n(1)=4$ and $n(2) = 2$. That is, samplers will make four visits to the three low and medium pressure clusters and two visits to the single high pressure cluster.

Example 2 – Same as Example 1, except that two clusters are of low pressure, one is of medium pressure and one is of high pressure. Step 1 gives: total score = 12, $n^*(1) = (4/12) \cdot 6 = 2$, $n^*(2) = (3/12) \cdot 6 = 1.5$, $n^*(3) = (5/12) \cdot 6 = 2.5$. All four schemes remain viable, so Step 2 chooses scheme M1 with $H=3$. Step 3 then calls for $n(1)=n(2)=n(3) = 2$: two visits to the low pressure clusters, two to the medium pressure cluster, and two to the high pressure cluster.

Example 3 – Same as Example 2, except that $n = 5$ rather than 6. Step 1 gives: total score = 12, $n^*(1) = (4/12) \cdot 5 \sim 1.67$, $n^*(2) = (3/12) \cdot 5 \sim 1.25$, $n^*(3) = (5/12) \cdot 5 \sim 2.08$. Scheme M1 is not viable, but the other schemes remain viable; and M2 and M3 are the schemes with the maximum number $H=2$ of strata. For Step 2, we calculate these schemes' initial stratum sizes: for M2 they are (approximately) 2.92 and 2.08, while for M3 they are 1.67 and 3.33. M2 and M3 have respective imbalances 0.84 ($=2.92-2.08$) and 1.66 ($=3.33-1.67$), so M2 is the chosen scheme. From Step 3, M2's final stratum sizes are $n(1)=3$ and $n(2)=2$: three visits are made to the low and medium pressure clusters and two visits to the high pressure cluster.

APPENDIX G - CPFV Logs



CENTRAL AND NORTHERN CALIFORNIA

SERIAL # **N**

VESSEL NAME	PORT OF LANDING
<input style="width:95%" type="text"/>	<input style="width:95%" type="text"/>

VESSEL ID NUMBER	PORT CODE	TARGET SPECIES	FISHING METHOD	BAIT	LIVE	DEAD
<input style="width:95%" type="text"/>	<input style="width:95%" type="text"/>	<input type="checkbox"/> SALMON <input type="checkbox"/> ROCKFISHES <input type="checkbox"/> LINGCOD <input type="checkbox"/> STRIPED BASS <input type="checkbox"/> STURGEON <input type="checkbox"/> SHARKS <input type="checkbox"/> TUNA <input type="checkbox"/> OTHER	<input type="checkbox"/> TROLLING <input type="checkbox"/> MOOCHING <input type="checkbox"/> ANCHORED <input type="checkbox"/> DRIFTING <input type="checkbox"/> DIVING <input type="checkbox"/> OTHER	ANCHOVIES SARDINES SQUID OTHER	<input type="checkbox"/>	<input type="checkbox"/>
MONTH DAY YEAR	TRIP TYPE					
<input style="width:30%" type="text"/> <input style="width:30%" type="text"/> <input style="width:30%" type="text"/>	<input type="checkbox"/> Multi-Day <input type="checkbox"/> Single Day <input type="checkbox"/> Non-Paying					
<div style="border: 1px solid black; padding: 5px; width: fit-content;"> No fishing activities for the month of: _____ </div>			DESCENDING DEVICE? <input type="checkbox"/> YES <input type="checkbox"/> NO		BIRD INTERACTION? <input type="checkbox"/> YES <input type="checkbox"/> NO	

DEPARTURE TIME	RETURN TIME	HOURS & MINUTES FISHED	NUMBER OF FISHERS	BLOCK WHERE MOST FISH CAUGHT	DEPTH (FEET)	SEA SURFACE TEMP °F
<input style="width:95%" type="text"/>	<input style="width:95%" type="text"/>	<input style="width:95%" type="text"/>	<input style="width:95%" type="text"/>	<input style="width:95%" type="text"/>	<input style="width:95%" type="text"/>	<input style="width:95%" type="text"/>

SPECIES	NUMBER KEPT	NUMBER THROWN BACK	LOST TO SEA LIONS	SPECIES	NUMBER KEPT	NUMBER THROWN BACK	LOST TO SEA LIONS
CHINOOK SALMON 302	<input style="width:95%" type="text"/>	<input style="width:95%" type="text"/>	<input style="width:95%" type="text"/>	ALBACORE 005	<input style="width:95%" type="text"/>	<input style="width:95%" type="text"/>	<input style="width:95%" type="text"/>
COHO SALMON 304	<input style="width:95%" type="text"/>	<input style="width:95%" type="text"/>	<input style="width:95%" type="text"/>	PACIFIC MACKEREL 051	<input style="width:95%" type="text"/>	<input style="width:95%" type="text"/>	<input style="width:95%" type="text"/>
LINGCOD 195	<input style="width:95%" type="text"/>	<input style="width:95%" type="text"/>	<input style="width:95%" type="text"/>	CALIFORNIA HALIBUT 222	<input style="width:95%" type="text"/>	<input style="width:95%" type="text"/>	<input style="width:95%" type="text"/>
CABEZON 261	<input style="width:95%" type="text"/>	<input style="width:95%" type="text"/>	<input style="width:95%" type="text"/>	SANDDAB 225	<input style="width:95%" type="text"/>	<input style="width:95%" type="text"/>	<input style="width:95%" type="text"/>
KELP GREENLING 290	<input style="width:95%" type="text"/>	<input style="width:95%" type="text"/>	<input style="width:95%" type="text"/>	OTHER FLATFISH 230	<input style="width:95%" type="text"/>	<input style="width:95%" type="text"/>	<input style="width:95%" type="text"/>
BLACK ROCKFISH 252	<input style="width:95%" type="text"/>	<input style="width:95%" type="text"/>	<input style="width:95%" type="text"/>	STRIPED BASS 335	<input style="width:95%" type="text"/>	<input style="width:95%" type="text"/>	<input style="width:95%" type="text"/>
BLUE ROCKFISH 665	<input style="width:95%" type="text"/>	<input style="width:95%" type="text"/>	<input style="width:95%" type="text"/>	GREEN STURGEON 471	<input style="width:95%" type="text"/>	<input style="width:95%" type="text"/>	<input style="width:95%" type="text"/>
BOCACCIO ROCKFISH 253	<input style="width:95%" type="text"/>	<input style="width:95%" type="text"/>	<input style="width:95%" type="text"/>	WHITE STURGEON 472	<input style="width:95%" type="text"/>	<input style="width:95%" type="text"/>	<input style="width:95%" type="text"/>
CANARY ROCKFISH 247	<input style="width:95%" type="text"/>	<input style="width:95%" type="text"/>	<input style="width:95%" type="text"/>	WHITE CROAKER 435	<input style="width:95%" type="text"/>	<input style="width:95%" type="text"/>	<input style="width:95%" type="text"/>
COPPER ROCKFISH 655	<input style="width:95%" type="text"/>	<input style="width:95%" type="text"/>	<input style="width:95%" type="text"/>	LEOPARD SHARK 153	<input style="width:95%" type="text"/>	<input style="width:95%" type="text"/>	<input style="width:95%" type="text"/>
COWCOD ROCKFISH 245	<input style="width:95%" type="text"/>	<input style="width:95%" type="text"/>	<input style="width:95%" type="text"/>	DUNGENESS CRAB 800	<input style="width:95%" type="text"/>	<input style="width:95%" type="text"/>	<input style="width:95%" type="text"/>
GOPHER ROCKFISH 263	<input style="width:95%" type="text"/>	<input style="width:95%" type="text"/>	<input style="width:95%" type="text"/>	ROCK SCALLOP 718	<input style="width:95%" type="text"/>	<input style="width:95%" type="text"/>	<input style="width:95%" type="text"/>
WIDOW ROCKFISH 269	<input style="width:95%" type="text"/>	<input style="width:95%" type="text"/>	<input style="width:95%" type="text"/>		<input style="width:95%" type="text"/>	<input style="width:95%" type="text"/>	<input style="width:95%" type="text"/>
YELLOWEYE ROCKFISH 265	<input style="width:95%" type="text"/>	<input style="width:95%" type="text"/>	<input style="width:95%" type="text"/>		<input style="width:95%" type="text"/>	<input style="width:95%" type="text"/>	<input style="width:95%" type="text"/>
UNSPECIFIED ROCKFISH 250	<input style="width:95%" type="text"/>	<input style="width:95%" type="text"/>	<input style="width:95%" type="text"/>		<input style="width:95%" type="text"/>	<input style="width:95%" type="text"/>	<input style="width:95%" type="text"/>

<input style="width:95%" type="text"/>	<input style="width:95%" type="text"/>	<input style="width:95%" type="text"/>	<input style="width:95%" type="text"/>
OPERATOR'S NAME (PRINT)	OPERATOR'S SIGNATURE	Number of crew who fished	Number of fish caught by crew



SOUTHERN CALIFORNIA

SERIAL # **S**

VESSEL NAME <input style="width:95%" type="text"/>	PORT OF LANDING <input style="width:95%" type="text"/>
---	---

VESSEL ID NUMBER <input style="width:95%" type="text"/>	PORT CODE <input style="width:95%" type="text"/>	TARGET SPECIES	FISHING METHOD	BAIT	LIVE	DEAD
MONTH DAY YEAR <input style="width:25%" type="text"/> <input style="width:25%" type="text"/> <input style="width:25%" type="text"/>	TRIP TYPE <input type="checkbox"/> Multi-Day <input type="checkbox"/> Single Day <input type="checkbox"/> Non-Paying	<input type="checkbox"/> TUNA <input type="checkbox"/> SHARK <input type="checkbox"/> ROCKFISHES <input type="checkbox"/> LINGCOD <input type="checkbox"/> SALMON <input type="checkbox"/> OTHER	<input type="checkbox"/> TROLLING <input type="checkbox"/> MOOCHING <input type="checkbox"/> ANCHORED <input type="checkbox"/> DRIFTING <input type="checkbox"/> DIVING <input type="checkbox"/> OTHER	ANCHOVIES SARDINES SQUID OTHER	<input type="checkbox"/>	<input type="checkbox"/>

No fishing activities for the month of:

DESCENDING DEVICE? YES NO
 BIRD INTERACTION? YES NO

DEPARTURE TIME <input style="width:95%" type="text"/>	RETURN TIME <input style="width:95%" type="text"/>	HOURS & MINUTES FISHED <input style="width:95%" type="text"/>	NUMBER OF FISHERS <input style="width:95%" type="text"/>	BLOCK WHERE MOST FISH CAUGHT <input style="width:95%" type="text"/>	DEPTH (FEET) <input style="width:95%" type="text"/>	SEA SURFACE TEMP °F <input style="width:95%" type="text"/>
--	---	--	---	--	--	---

SPECIES	NUMBER KEPT	NUMBER THROWN BACK	LOST TO SEA LIONS	SPECIES	NUMBER KEPT	NUMBER THROWN BACK	LOST TO SEA LIONS
BARRED 278 SAND BASS	<input type="text"/>	<input type="text"/>	<input type="text"/>	ALBACORE 005	<input type="text"/>	<input type="text"/>	<input type="text"/>
CALIFORNIA 260 SCORPIONFISH	<input type="text"/>	<input type="text"/>	<input type="text"/>	BARRACUDA 130	<input type="text"/>	<input type="text"/>	<input type="text"/>
CABEZON 261	<input type="text"/>	<input type="text"/>	<input type="text"/>	BLUEFIN TUNA 004	<input type="text"/>	<input type="text"/>	<input type="text"/>
HALFMOON 478	<input type="text"/>	<input type="text"/>	<input type="text"/>	DOLPHIN FISH 481	<input type="text"/>	<input type="text"/>	<input type="text"/>
KELP BASS 277	<input type="text"/>	<input type="text"/>	<input type="text"/>	PACIFIC BONITO 003	<input type="text"/>	<input type="text"/>	<input type="text"/>
LINGCOD 195	<input type="text"/>	<input type="text"/>	<input type="text"/>	PACIFIC 051 MACKEREL	<input type="text"/>	<input type="text"/>	<input type="text"/>
OCEAN 490 WHITEFISH	<input type="text"/>	<input type="text"/>	<input type="text"/>	SKIP JACK 002	<input type="text"/>	<input type="text"/>	<input type="text"/>
SHEEPHEAD 145	<input type="text"/>	<input type="text"/>	<input type="text"/>	WHITE 435 CROAKER	<input type="text"/>	<input type="text"/>	<input type="text"/>
BLUE 665 ROCKFISH	<input type="text"/>	<input type="text"/>	<input type="text"/>	WHITE 400 SEABASS	<input type="text"/>	<input type="text"/>	<input type="text"/>
BOCACCIO ROCKFISH 253	<input type="text"/>	<input type="text"/>	<input type="text"/>	YELLOWFIN TUNA 001	<input type="text"/>	<input type="text"/>	<input type="text"/>
CANARY 247 ROCKFISH	<input type="text"/>	<input type="text"/>	<input type="text"/>	YELLOWTAIL 040	<input type="text"/>	<input type="text"/>	<input type="text"/>
COPPER 655 ROCKFISH	<input type="text"/>	<input type="text"/>	<input type="text"/>	CALIFORNIA HALIBUT 222	<input type="text"/>	<input type="text"/>	<input type="text"/>
COWCOD 245 ROCKFISH	<input type="text"/>	<input type="text"/>	<input type="text"/>	SANDDAB 225	<input type="text"/>	<input type="text"/>	<input type="text"/>
GOPHER 263 ROCKFISH	<input type="text"/>	<input type="text"/>	<input type="text"/>	LOBSTER 820	<input type="text"/>	<input type="text"/>	<input type="text"/>
WIDOW 269 ROCKFISH	<input type="text"/>	<input type="text"/>	<input type="text"/>	ROCK 718 SCALLOP	<input type="text"/>	<input type="text"/>	<input type="text"/>
YELLOWEYE 265 ROCKFISH	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
UNSPECIFIED ROCKFISH 250	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>

OPERATOR'S NAME (PRINT) <input style="width:95%" type="text"/>	OPERATOR'S SIGNATURE <input style="width:95%" type="text"/>	Number of crew who fished <input style="width:95%" type="text"/>	Number of fish caught by crew <input style="width:95%" type="text"/>
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APPENDIX H

Model-based Method for Estimating Angler Effort on Private and Rental Boats that Return to Private-access Sites or at Night

An off-site survey is normally used to estimate angler effort from private and rental boats that return to private-access sites or at night (see Chapter 3 section C and/or the next two paragraphs for more information). Due to funding constraints, an off-site survey cannot always be run as was the case from January 2018 to October 2020. The methods described in this appendix were used to estimate PAN effort and resulting total PR effort from January 2018 to October 2020 and may be used again if an offsite survey cannot be administered.

Specifically CRFS field surveys do not sample from the entire population of private and rental boat trips (PR trips). For reasons of accessibility, safety, and economy, the surveys sample only those PR trips which return to public access sites (sites accessible to the general public) during daylight hours. These PR trips are termed the PAD (public-access and daytime) trips. As described in Chapter 3, two PR field surveys sample the PAD trips: the PR1 survey samples the trips which return to primary public access sites and the PR2 survey covers the trips which return to secondary public access sites.

The remaining PR trips are termed the PAN (private-access or night) trips. With many private-access sites (sites not accessible to the general public) in use throughout the state, the PAN trips do account for a considerable proportion of total PR effort. Section C of Chapter 3 describes the PAN effort estimation procedures in use from 2015 onward when an off-site survey is run.

The model-based approach described in this appendix is used to estimate PAN effort and resulting total PR effort only when an off-site survey is not administered. This approach uses current PR survey data and recent historic PR and off-site survey data.

PAN EFFORT

The sampling design, survey methods and key data elements collected for ALDTS (and with modifications for ALDOS) are described in Chapter 2. The sampling design, survey methods and key data elements collected for the PR1 and PR2 field intercept surveys are described in sections A and B of Chapter 3.

Estimation Procedures – Effort

PAD effort and variance

For each domain defined by month, district, trip type and water area, a total PAD effort estimate is obtained as $\hat{E}_{PAD} = \hat{E}_{PR1} + \hat{E}_{PR2}$ from the PR1 and PR2 effort estimates \hat{E}_{PR1} and \hat{E}_{PR2} . These two latter estimates are derived from the independent PR1 and PR2 surveys, so a variance estimate for \hat{E}_{PAD} is given by $\widehat{Var}(\hat{E}_{PAD}) = \widehat{Var}(\hat{E}_{PR1}) + \widehat{Var}(\hat{E}_{PR2})$. The right-hand variances are given by the respective Equations 3.A.8 and 3.B.10.

PAN effort. For each domain defined by month, district, trip type and water area, a PAN effort estimate \hat{E}_{PAN} is obtained from the PAD estimate \hat{E}_{PAD} by:

$$Eq. H.1 \quad \hat{E}_{PAN} = \hat{E}_{PAD} [\hat{H}/(1 - \hat{H})]$$

Here the value \hat{H} is an estimate, based on ALDTS recent historic data of the true proportion H of the domain's total PR effort E_{PR} (= PAD effort plus PAN effort, i.e. $E_{PR} = E_{PAD} + E_{PAN} = E_{PR1} + E_{PR2} + E_{PAN}$) which owes to PAN effort E_{PAN} . That is, $H = E_{PAN}/E_{PR}$, so that $E_{PAN} = E_{PAD} [H / (1 - H)]$ and then E_{PAN} is estimated by Eq. H.1.

For the following reasons, the estimate \hat{H} is taken to depend only on the district, and not also on the month or trip type or water area.

The non-dependence on trip type or water area owes to the paucity of ALDTS data: typically, a month's ALDTS data are too sparse for reliable partitioning of a district's PR trips by trip type or water area. For that reason, CRFS has always used the default partitioning of each district-month's PAN effort by trip type and water area, namely in the same manner as the total PAD effort, per data from the two PR field surveys.

The non-dependence on month owes to an analysis of the historic ALDTS data. For a given district, for each month i the ALDTS data yield an estimate of the true E_{PAN}/E_{PR} proportion H_i as $\hat{H}_i = t_{i,PAN}/t_{i,PR}$, where $t_{i,PAN}$ and $t_{i,PR}$ are the district's respective counts of PAN trips and all PR trips (i.e. PAN trips plus PAD trips) reported by ALDTS interviewees for month i . The analysis found that, for each district, the monthly values \hat{H}_i exhibit small and essentially random deviations from their mean, with no discernible seasonal effects.

On the other hand, the district means (of the monthly values \hat{H}_i) do differ markedly among the districts.

Each district's estimate \hat{H} is taken to be the district's 'historic' weighted mean of the values \hat{H}_i , i.e., the sum of all ALDTS PAN counts divided by the sum of all ALDTS PR counts, each sum taken over all n months in the historic reference period:

$$Eq. H.2 \quad \hat{H} = [\sum t_{i,PAN}] / [\sum t_{i,PR}] \quad (i=1 \text{ to } n \text{ in each sum})$$

This equation is used directly for each of districts 1 to 4. However, as ALDTS data are sparse for districts 5 and 6, these districts are in effect treated as a single district: the two districts' common value for \hat{H} is obtained from Equation H.2 by taking each monthly count – i.e. $t_{i,PAN}$ or $t_{i,PR}$ – as the sum of the respective counts for the two districts.

Background: the PAN effort estimation model

Given a district and month, the estimation method utilizes ALDTS historic data, via Equation H.1 and additional model assumptions, to 'calibrate' the PAN effort to the PAD effort - which in turn is estimated from the current PR field surveys. This calibration approach – rather than direct use of the historic ALDTS effort estimates - is adopted because monthly ALDTS estimates of a district's effort in any mode are highly variable. Even when averaged over time, these estimates are not credible in an absolute sense. These conclusions emerged from an analysis conducted in 2014 (and described further in Chapter 3, Section C). However, it is plausible to assume that ALDTS is credible in a relative sense, for comparison of PAD and PAN effort.

The estimation model thus assumes that the various effects (imperfect recall, more response from more avid anglers, etc.) that may bias ALDTS reports of PAD trips operate similarly for PAN trips. That is, it is assumed that ALDTS-interviewed anglers report PR-PAN and PR-PAD trips with the same proportional bias (i.e. same proportional over-count or under-count compared with the true mean number of such trips per angler in the entire population of licensed anglers). Thus, for a given district and month the two counts $t_{i,PAN}$ and $t_{i,PR}$ may be biased, but it is assumed that their ratio \hat{H}_i is an unbiased estimate of H_i .

For each district it is further assumed that:

- a) the true monthly ratios H_i vary randomly, with independent and identically distributed deviations, from the district's long-term mean value H^* ;
- b) each month's estimation error $\hat{H}_i - H_i$ is independent of the deviation $H_i - H^*$; and
- c) the months of the 'historical period' noted above are equivalent to a simple random sample of the months from a large population which includes the current month (for years 2018 onward).

Accordingly, for each district and any given near-future month j the true proportion H_j is estimated, nearly unbiasedly, by \hat{H} ; and then a nearly unbiased estimate of true PAN effort is given by the above Equation H.1.

Several variance calculations below require an estimate of the variance of \hat{H} , for \hat{H} as estimator of the true E_{PAN}/E_{PR} proportion H_j of any given current month j . Given the model assumptions, the following such estimate is nearly unbiased (but slightly conservative, i.e. high):

$$Eq. H.3. \widehat{Var}(\hat{H}) = [(n^*+1)/(n^*(n^*-1))] s, \text{ where } s = \sum (\hat{H}_i - \hat{H})^2$$

Here, the sum s is over the n^* historic 'usable' months, i.e. months i for which \hat{H}_i is defined, i.e. at least one PR trip was reported.

Technical note: derivation of Eq. H.3. The variance $Var(\hat{H})$ is the mean square of the sum of two independent errors, hence is the sum of these errors' mean squares. One error is the difference $\hat{H} - H^*$ and the other is the difference $H_j - H^*$. These errors are independent: the former difference arises from historic data, the latter from current-month data. Their respective mean squares are estimated by $s/[n(n-1)]$ and $s/(n-1)$, so that $Var(\hat{H})$ is estimated by the sum $[(n+1)/(n(n-1))] s$. (Both error estimates are nearly unbiased but slightly high: the former estimate would be unbiased were \hat{H} taken as the unweighted mean of the historic \hat{H}_i rather than as the weighted mean given by Eq. H.2; the latter estimate would be unbiased were all historic estimates exact, i.e. each $\hat{H}_i - H_i = 0$.)

Variance of estimated PAN effort. Equation H.1. finds estimate \hat{E}_{PAN} as the product of two estimates \hat{E}_{PAD} and $[\hat{H}/(1 - \hat{H})]$. These estimates' errors are independent, because \hat{E}_{PAD} is obtained from the current month's PR surveys whereas \hat{H} is obtained from past data. Accordingly, by the so-called Goodman formula (in its version for estimated rather than actual variances), an estimated variance for \hat{E}_{PAN} is given by:

$$Eq. H.4$$

$$\widehat{Var}(\hat{E}_{PAN}) = \widehat{Var}(\hat{E}_{PAD})[\hat{H}/(1 - \hat{H})]^2 + [(\hat{E}_{PAD})^2 - \widehat{Var}(\hat{E}_{PAD})]\widehat{Var}(\hat{H}/(1 - \hat{H}))$$

The factor $\widehat{Var}[\hat{H}/(1 - \hat{H})]$ found in Equation H.4 may be found in terms of $\widehat{Var}(\hat{H})$ (which is given by Equation H.3). Namely, a 'delta method' (alias 'Taylor expansion') argument yields an estimated variance for $[\hat{H}/(1 - \hat{H})]$, as an estimate of $[H/(1-H)]$ – and also (for use later) the same value of estimated variance for $[1/(1 - \hat{H})]$, as an estimate of $[1/(1-H)]$ – namely:

$$\text{Eq. H.5.} \quad \widehat{Var}[\hat{H}/(1 - \hat{H})] = \widehat{Var}[1/(1 - \hat{H})] = \widehat{Var}(\hat{H})/[1 - \hat{H}]^4$$

Hence, Equation H.4 yields the following alternative estimate of variance for \hat{E}_{PAN} :

$$\text{Eq. H.6} \quad \widehat{Var}(\hat{E}_{PAN}) = \widehat{Var}(\hat{E}_{PAD})[\hat{H}/(1 - \hat{H})]^2 + [(\hat{E}_{PAD})^2 - \widehat{Var}(\hat{E}_{PAD})][\widehat{Var}(\hat{H})/(1 - \hat{H})^4]$$

TOTAL PRIVATE AND RENTAL BOAT EFFORT ESTIMATES

For a given combination of month, district, trip type and water area, total private and rental boat effort E_{PR} is estimated by summing the effort estimates for each submode (PR1, PR2 and PAN).

$$\text{Eq. H.7} \quad \hat{E}_{PR} = \hat{E}_{PR1} + \hat{E}_{PR2} + \hat{E}_{PAN} = \hat{E}_{PAD} + \hat{E}_{PAN} = \hat{E}_{PAD} / (1 - \hat{H})$$

The Goodman formula yields an estimated variance for the estimate \hat{E}_{PR} , namely:

$$\text{Eq. H.8} \quad \widehat{Var}(\hat{E}_{PR}) = \widehat{Var}(\hat{E}_{PAD})/(1 - \hat{H})^2 + [(\hat{E}_{PAD})^2 - \widehat{Var}(\hat{E}_{PAD})]\widehat{Var}(1/(1 - \hat{H}))$$

Use of Equation H.5 yields the following alternative estimate of variance for \hat{E}_{PR} :

$$\text{Eq. H.9} \quad \widehat{Var}(\hat{E}_{PR}) = \widehat{Var}(\hat{E}_{PAD})[\hat{H}/(1 - \hat{H})]^2 + [(\hat{E}_{PAD})^2 - \widehat{Var}(\hat{E}_{PAD})][\widehat{Var}(\hat{H})/(1 - \hat{H})^4]$$

Note that the estimate \hat{E}_{PAN} depends on the estimate \hat{E}_{PAD} , rather than being independent of it. As a result, the variance of estimate \hat{E}_{PR} is not simply the sum of the separate variances for the estimates \hat{E}_{PAD} and \hat{E}_{PAN} . In fact, from comparison of Equations H.6 and H.9, we find that:

$$\text{Eq. H.10} \quad \widehat{Var}(\hat{E}_{PR}) = \widehat{Var}(\hat{E}_{PAN}) + \widehat{Var}(\hat{E}_{PAD}) [1 + (2\hat{H}/(1 - \hat{H}))]$$

APPENDIX I

Draft Update to Methods for Anglers on Private and Rental Boats That Return to Private-Access Sites or At Night (Section C of Chapter 3)

CRFS does not currently calculate variances for PR-PAN and total PR effort and catch. Proposed calculation methods and formulas are pending MRIP review and are documented in the text below. The new methods and formulas described below are not currently implemented in the CRFS data system but will be implemented once the new methods and formulas are certified by MRIP. Upon implementation in the CRFS data system, Section 3.C will be replaced by the text from this Appendix.

3.C. ANGLERS ON PRIVATE AND RENTAL BOATS THAT RETURN TO PRIVATE-ACCESS SITES OR AT NIGHT

CRFS field surveys do not sample from the entire population of private and rental boat trips (PR trips). For reasons of accessibility, safety, and economy, the field surveys sample only those PR trips which return to public access sites (sites accessible to the general public) during daylight hours. These PR trips are termed the PAD (public-access and daytime) trips. Sections A and B of this Chapter 3 describe the two PR field surveys which sample the PAD trips: the PR1 survey samples the trips which return to primary public access sites and the PR2 survey covers the trips which return to secondary public access sites.

Remaining PR trips are termed the PAN (private-access or night) trips. With many private-access sites (i.e., sites not public-access) in use throughout the state, the PAN trips account for a considerable proportion of total PR effort.

This Section 3.C describes the PAN effort and catch estimation procedures used in months when an off-site survey is run (i.e., the Angler License Directory Telephone Survey (ALDTS) through 2022, and thereafter the Angler License Directory On-Line Survey (ALDOS)). The procedures use data from the off-site survey and the PR1 and PR2 field surveys. (The details given below are for ALDTS as the off-site survey.)

Due to funding or logistic constraints, in some months an off-site survey may not be run. For those months, a model-based approach, which is detailed in Appendix H, is used to estimate PAN effort by use of historic (i.e., recent past years') off-site effort data along with current month effort data from the PR1 and PR2 surveys. PAN catch is then estimated by use of current catch rates from the PR1 and PR2 field surveys

PAN EFFORT

The sampling design, survey methods and key data elements collected for ALDTS are described in Chapter 2. The sampling design, survey methods and key data elements collected for the PR1 and PR2 field intercept surveys are described in sections A and B of this Chapter 3.

Estimation Procedures – Effort

PAN effort is estimated for each domain defined by a month, district, trip type and water area.

Owing to the nature of available data from ALDTS (and other remote angler surveys), PAN effort is estimated only for the unit angler trip and not also for the unit boat trip. In this section (3.C) and the next (3.D), all input and output effort measures and estimates are for the unit angler trip.

For each month, the estimation process involves three basic steps:

- Step 1 – For each district: from ALDTS obtain direct PAD and PAN district effort estimates for licensed anglers; then use the PR-surveys' field data to adjust these district estimates to cover unlicensed anglers
- Step 2 – Apply a district-specific scaling factor to the ALDTS PAN effort estimates, thereby correcting for an apparent bias in those estimates.
- Step 3 – Use the PR field survey data to partition the scaled PAN estimates into trip type and water area domains

Each of these steps is detailed below under a subheading. (Most of the lengthy detail concerns background and computations for the scaling factor of Step 2 and variances of estimates found in Step 3.)

Step 1 – Obtain, and then adjust, direct district effort estimates from ALDTS

This step is detailed in Chapter 2. In summary, ALDTS' sample of n completely interviewed anglers yield initial PAN and PAD effort estimates for each district, by expansion to all currently licensed anglers. By use of data from the month's PR (i.e., PR1 and PR2) field intercept surveys, these initial ALDTS-based estimates are then adjusted for undercoverage so as to account for effort by unlicensed anglers, who are not in the telephone survey frame. These adjusted ALDTS effort estimates are not the final CRFS PAN and PAD effort estimates actually utilized and reported, but they do aid calculation of the final PAN effort estimates as follows. In principle - though hitherto not in practice - the adjusted ALDTS estimates could also be used, per Step 2, to provide final PAD effort estimates, in case production of the more-precise field-based estimates is infeasible.

In this section the resulting adjusted ALDTS-based effort estimates of true total district PAN and PAD effort E_{PAN} and E_{PAD} are denoted \hat{E}_{A-PAN} and \hat{E}_{A-PAD} . (In Chapter 2, each such estimate of interest is denoted simply as \hat{E} , notably on the left-hand sides of Eqs. 2.6-2.8.) The PR field-survey-based effort estimates of PAD effort are denoted \hat{E}_{F-PAD}

Step 2 – Apply a scaling factor to the adjusted direct estimates from ALDTS

Each district's PAN effort E_{PAN} in any given month is estimated by

$$\text{Eq. 3.C.1} \quad \hat{E}_{PAN} = \hat{F} \hat{E}_{A-PAN}$$

where:

\hat{E}_{A-PAN} is the ALDTS estimate of PAN effort from Step 1 and \hat{F} (scaling factor obtained from recent-years' historic data for the given district, as described in scaling factor background section below) is an estimate of the ratio $E_{PAN} / \hat{E}_{A-PAN}$.

Eq. 3.C.2 below computes an approximate value for the variance of the estimate \hat{E}_{PAN} given by Eq. 3.C.1. To enable this computation, the quantities \hat{E}_{A-PAN} and \hat{F} are viewed as unbiased estimates of respective parameters E_{A-PAN} and F (for the given district and month) whose product is E_{PAN} . These parameters are defined as follows:

E_{A-PAN} = mean of all ALDTS PAN effort estimates (for the given district and month) which *a priori* could result from the ALDTS sampling design; and

$$F = E_{PAN} / E_{A-PAN}$$

The estimates \hat{F} and \hat{E}_{A-PAN} of F and E_{A-PAN} are not only unbiased but also have independent estimation errors: \hat{F} is based solely on historic data whereas \hat{E}_{A-PAN} is based solely on current-month data. Accordingly, an unbiased estimate of the variance of the estimate \hat{E}_{PAN} is given by the unbiased estimator version of the Goodman formula for the variance of a product of independent random variables, namely by:

$$\text{Eq. 3.C.2} \quad \hat{V}ar(\hat{E}_{PAN}) = \hat{F}^2 \cdot \hat{V}ar(\hat{E}_{A-PAN}) + \hat{V}ar(\hat{F}) \cdot (\hat{E}_{A-PAN})^2 - \hat{V}ar(\hat{F}) \cdot \hat{V}ar(\hat{E}_{A-PAN})$$

Here, the right-hand side value $\hat{V}ar(\hat{E}_{A-PAN})$ is computed by Eq. 2.8 with its \hat{E} taken as the present \hat{E}_{A-PAN} , and the value $\hat{V}ar(\hat{F})$ is given by Eq. 3.C.5 below.

Technical note: In the original version of the Goodman formula, the sign + replaces the sign – which occurs here (Eq. 3.C.2). The version here derives from the original version and the fact that, if a variable X has an unbiased estimator \hat{X} with estimation variance $Var(\hat{X})$, then an unbiased estimate of X^2 is given not by \hat{X}^2 but by $\hat{X}^2 - Var(\hat{X})$.

Scaling factor background: analysis, approach and assumptions.

An analysis conducted in 2014 exploited the fact that the PR field surveys (i.e. the PR1 and PR2 surveys) provide PAD effort estimates independent of those from ALDTS. The analysis compared corresponding field and telephone monthly PAD estimates for all six districts and all months over several years up through 2014.

The analysis found that monthly ALDTS estimates of a district's PAN or PAD effort are highly variable and, even when averaged over time, these estimates are credible as relative indices but not in an absolute sense – whereas the field-based estimates of PAD effort are highly credible in an absolute sense. Accordingly, estimation of PAN effort uses the ALDTS-based estimates, but only after adjusting them by use of scaling factors based on historic data, per Eq. 3.C.1.

This same approach – adjustment of ALDTS estimates by scaling factors - is also a backup option for PAD effort estimation, in cases where field-based data are lacking. The analysis in fact derived the district scaling factor values \hat{F} from historic PAD data. Use of these PAD values for PAN effort estimation relies on the following plausible assumption:

Basic Assumption: ALDTS PAN and PAD interview responses, and resulting direct ALDTS effort estimates, are similarly biased. That is, at least on average over time, the various effects (imperfect recall, more response from more avid anglers, etc.) that may bias ALDTS reports of PAD trips operate similarly for PAN trips, so that ALDTS-interviewed anglers report PR-PAN and PR-PAD trips with the same proportional bias (i.e. same proportional over-count or under-

count compared with the true mean number of such trips per angler in the entire population of licensed anglers).

In more detail, the 2014 analysis obtained and noted the following findings:

Averaged over many months, each district's monthly telephone-based PAD effort estimate tends to be roughly twice the size of the corresponding field-based estimate (reflected in the fact that each scaling-factor value \hat{F} approximates 0.5) and moreover is far more variable (with a high coefficient of variation) from month to month. The difference in variability evidently owes to the field-based estimates being based on data for many more private and rental boat anglers than are the telephone-based estimates (e.g., in 2015, 27 times as many).

The effort data collected by the PR field surveys are not only far more copious but are also notably more timely and reliably representative than those collected by the ALDTS telephone survey, so that each field-based PAD effort estimate \hat{E}_{F-PAD} (the sum of the effort estimates for PR1 and PR2) is far more credible as an unbiased estimate of true PAD effort than is the telephone-based estimate \hat{E}_{A-PAD} . Each field survey obtains counts for representative site-days of nearly all returning boats (for at least 8 percent of the site-days for PR2 and at least 14 percent of the site-days for PR1) and obtains real-time on-site interviews of all or nearly all the returning anglers. By comparison, although the telephone survey does randomly sample all licensed anglers, its off-site interviews occur days and even weeks after fishing and may well reflect imperfect recall or tendency for greater response from the more avid anglers.

The analysis also found that PAN (or PAD) estimation can credibly use fixed district-specific scaling factors to correct the ALDTS-based estimates. Namely, for each of the six CRFS districts, in any month i an observed monthly F -ratio is defined by:

$$\text{Eq. 3.C.3 } \hat{F}_i = \hat{E}_{F-PAD,i} / \hat{E}_{A-PAD,i}$$

The analysis found that for any district the varying observed monthly ratio values \hat{F}_i lack seasonal trend and all approximate a long-term mean value F^* which depends just on the district. Although each district's value F^* is not precisely known, a credible estimate \hat{F} is obtained by suitably averaging the district's historic (i.e. from recent past months) observed F -ratios \hat{F}_i .

The calculations below assume that the historic data are representative and moreover, for any given district: the observed monthly ratio values result by adding to F^* small random perturbations (independent and identically distributed) plus further independent random perturbations which are artifacts of the PR and ALDTS surveys' random sampling. That is:

a) the true monthly ratios $F_i = E_{F-PAD,i} / E_{A-PAD,i}$ vary randomly, with independent and identically distributed deviations, from the district's long-term mean value F^* ;

b) each month's estimation error $\hat{F}_i - F_i$ is independent of the deviation $F_i - F^*$; and

c) the 'historic' months noted above (in fact taken as all calendar months of 2014) are equivalent to a simple random sample of the months from a large population which includes all calendar months during 2015-2022.

Accordingly, for each district and any given current (i.e., non-historic) month j the true ratio F_j is estimated, nearly unbiasedly, by \hat{F} ; and then a nearly unbiased estimate of true PAN effort is given by the above Eq. 3.C.1.

Scaling factor computations

Each district's value \hat{F} is taken as a weighted average of the values \hat{F}_i for "good" months (i) during the reference historic period, where in a "good" month at least five ALDTS interviewees reported PAD trips in the district. Namely:

$$\text{Eq. 3.C.4} \quad \hat{F} = \frac{\sum \hat{E}_{F-PAD,i}}{\sum \hat{E}_{A-PAD,i}}$$

For each of districts 1 to 4, \hat{F} is based on estimates for the given district. ALDTS data are sparse for districts 5 and 6, and as a result, districts 5 and 6 use a common scaling factor value \hat{F} where each sum ($\sum \hat{E}_{F-PAD,i}$ and $\sum \hat{E}_{A-PAD,i}$) is over the "good" monthly cases from the two districts.

For any given district and current month j , the true scaling factor value $F_j (= E_{F-PAD,j}/E_{A-PAD,j})$ will differ from both F^* and \hat{F} . In Eq. 3.C.2 the term $\hat{V}ar(\hat{F})$ refers to an approximate value for the variance (i.e. mean square error) of \hat{F} as an estimate of F_j . Such an approximate value (nearly unbiased, but slightly conservative, i.e. biased slightly high) is given by the following equation:

$$\text{Eq. 3.C.5} \quad \hat{V}ar(\hat{F}) = [(n+1)/(n(n-1))] s$$

Where: $s = \sum (\hat{F}_i - \hat{F})^2$, \hat{F} is the district's F -factor value, the sum s is over all n good historic months i , and for each month i \hat{F}_i is the district's observed F -ratio (per Eq. 3.C.3).

Technical note: derivation of Eq. 3.C.5. The variance $Var(\hat{F})$ is the sum of two mean-squared-errors. One error is the difference $\hat{F} - F^*$ and the other is the difference $F_j - F^*$. These errors are independent, as the former error arises from historic data, the latter from current-month data – and are estimated respectively by $s/[n(n-1)]$ and $s/(n-1)$, so that $Var(\hat{F})$ is estimated by the sum $[(n+1)/(n(n-1))] s$. (Both error estimates are nearly unbiased but slightly high: the former estimate would be unbiased were \hat{F} taken as the unweighted mean of the \hat{F}_i rather than as the weighted mean given by Eq. 3.C.4; the latter estimate would be unbiased were all historic F -estimates exact, i.e. each $\hat{F}_i - F_i = 0$.)

Step 3 – Partition the scaled PAN effort estimates by trip type and water area

CRFS provides a PAN effort estimate $\hat{E}_{PAN,d}$ for each domain d defined by a given combination of month, district, trip type and water area. This domain effort is some proportion p_d of the total PAN effort for the given month and district. The actual value p_d of this proportion is unknown, but a plausible default model assumption is that, apart from random error (or utterly unknown bias), $p_d = p_{0,d}$, where $p_{0,d}$ is the PAD proportion for the same domain d . In other words, the default model assumption is that, for each given month and district, PAN trips are distributed among trip type and water area domains in the same manner (i.e. same proportions) as are the PAD trips.

Our estimate \hat{p}_d of p_d therefore is taken as our best available estimate, $\hat{p}_{0,d}$, for the domain- d proportion $p_{0,d}$ of PAD (i.e. PR1 and PR2) trips. This estimate $\hat{p}_{0,d}$ is derivable from data from the PR field intercept surveys (PR1 and PR2).

Then $\hat{E}_{PAN,d}$ is found from the above Step 2 estimate \hat{E}_{PAN} (for the given month and district) by:

$$\text{Eq. 3.C.7} \quad \hat{E}_{PAN,d} = \hat{p}_d \hat{E}_{PAN}$$

Where:

$$\text{Eq. 3.C.8} \quad \hat{p}_d = \hat{p}_{0,d} = \hat{E}_{PAD,d} / \hat{E}_{PAD}$$

and where:

$\hat{E}_{PAD,d}$ = estimated total PAD effort in domain d , = sum of the respective estimates $\hat{E}_{PR1,d}$ and $\hat{E}_{PR2,d}$ of PR1 and PR2 effort in domain d

\hat{E}_{PAD} = estimated total PAD effort in the given month and district, = sum of the respective estimates \hat{E}_{PR1} and \hat{E}_{PR2} of PR1 and PR2 effort in the given month and district.

Variations for PAN effort estimates by trip type and water area.

The estimates \hat{p}_d and \hat{E}_{PAN} have independent errors: the former estimate is based on current field data whereas the latter estimate is based on past field and current telephone data. Hence, by use of the Goodman formula, an unbiased estimate of variance of $\hat{E}_{PAN,d}$ is given by:

$$\text{Eq. 3.C.9} \quad \hat{V}ar(\hat{E}_{PAN,d}) = \hat{p}_d^2 \hat{V}ar(\hat{E}_{PAN}) + \hat{V}ar(\hat{p}_d) (\hat{E}_{PAN})^2 - \hat{V}ar(\hat{p}_d) \hat{V}ar(\hat{E}_{PAN})$$

Where: $\hat{V}ar(\hat{p}_d)$ is given below by Eq. 3.C.10 and $\hat{V}ar(\hat{E}_{PAN})$ is given above by Eq. 3.C.2.

To obtain the desired variance estimate $\hat{V}ar(\hat{p}_d)$, first note that error in the estimate \hat{p}_d is in fact the sum of two independent errors: error in estimation of $p_{0,d}$ as $\hat{p}_{0,d}$, and 'model' error from assuming that $p_d = p_{0,d}$. That is,

$$\text{Eq. 3.C.10} \quad \hat{V}ar(\hat{p}_d) = \hat{V}ar(\hat{p}_{0,d}) + \hat{m}_d$$

Where:

$\hat{V}ar(\hat{p}_{0,d})$ is given below by Eq. 3.C.12; and

\hat{m}_d is an estimate for domain d of mean-square model error. Hitherto, CRFS estimation has taken $\hat{m}_d = 0$ for all domains - a choice which assumes negligible error in the above-noted estimation model $p_d = p_{0,d}$.

The value $\hat{V}ar(\hat{p}_{0,d})$ in Eq. 3.C.10 is obtained by several computations, as follows. First, re-express the second part of Eq. 3.C.8 as:

$$\text{Eq. 3.C.11} \quad \hat{p}_{0,d} = \hat{r} \hat{p}_{1,d} + (1 - \hat{r}) \hat{p}_{2,d}$$

Where:

$$\begin{aligned} p_{1,d} &= E_{PR1,d}/E_{PR1} = \text{domain } d\text{'s fraction of the district and month's total PR1 effort;} \\ p_{2,d} &= E_{PR2,d}/E_{PR2} = \text{domain } d\text{'s fraction of the district and month's total PR2 effort;} \\ r &= E_{PR1}/E_{PAD}, \text{ the PR1 fraction (generally between 0.5 and 1) of the district and month's} \\ &\text{total PAD effort;} \\ \hat{p}_{1,d} &= \hat{E}_{PR1,d}/\hat{E}_{PR1} = \text{estimate of } p_{1,d}; \\ \hat{p}_{2,d} &= \hat{E}_{PR2,d}/\hat{E}_{PR2} = \text{estimate of } p_{2,d}; \\ \hat{r} &= \hat{E}_{PR1}/\hat{E}_{PAD} = \text{estimate of } r \end{aligned}$$

In Eq. 3.C.11 the three right-side estimates - $\hat{p}_{1,d}$, $\hat{p}_{2,d}$ and \hat{r} - may plausibly be assumed to have uncorrelated errors. (The first estimate concerns just PR1 trips, the second concerns just PR2 trips, and the third concerns how all PAD trips are apportioned between PR1 and PR2 trips.) Each of the three estimates is nearly unbiased. From Eq. 3.C.11, a Goodman-type derivation then yields:

$$\text{Eq. 3.C.12} \quad \hat{V}ar(\hat{p}_{0,d}) = \hat{r}^2 \hat{v}_1 + (1 - \hat{r})^2 \hat{v}_2 + \hat{v}_r(\hat{p}_{1,d} - \hat{p}_{2,d})^2 - \hat{v}_r(\hat{v}_1 + \hat{v}_2)$$

Where: $\hat{v}_1 = \hat{V}ar(\hat{p}_{1,d})$, $\hat{v}_2 = \hat{V}ar(\hat{p}_{2,d})$ and $\hat{v}_r = \hat{V}ar(\hat{r})$. These three variance estimates are given by the next three displayed equations.

$$\text{Eq. 3.C.12a} \quad \hat{v}_1 = (n_1/(n_1-1)) [\sum(y_i - \hat{p}_{1,d} x_i)^2]/[\sum x_i]^2$$

$$\text{Eq. 3.C.12b} \quad \hat{v}_2 = (n_2/(n_2-1)) [\sum(y_i - \hat{p}_{2,d} x_i)^2]/[\sum x_i]^2$$

In Eq. 3.C.12a both sums are over all the district and month's n_1 PR1-sampled boat trips and in Eq. 3.C.12b both sums are over all the n_2 PR2-sampled boat trips. In both equations, for each sampled boat trip i , y_i is the number of angler trips in domain d and x_i is the total number of angler trips. (Note that typically a boat trip fishes in just one domain - i.e. just one trip type and water area combination - so that typically for each trip i either $y_i=x_i$ or $y_i=0$.) Both equations follow from Eq. 2.46 at the bottom of page 32 in Cochran, Sampling Techniques, ed. 3, 1977 - with sampling fraction f assumed to be 0 for practical purposes.

$$\text{Eq. 3.C.12c} \quad \hat{v}_r = [\hat{E}_{PR1}^2 \hat{V}ar(\hat{E}_{PR2}) + \hat{E}_{PR2}^2 \hat{V}ar(\hat{E}_{PR1}) - 2 \hat{V}ar(\hat{E}_{PR1})\hat{V}ar(\hat{E}_{PR2})]/(\hat{E}_{PAD}^4)$$

Here each right-side variance (as well as effort) estimate is given above in this section or above in Sections A and B.

Note: Future upgraded estimation of PAN effort distribution by trip type and water area.

As noted above, the default model assumption is that, given month and district, PAN trips are distributed among trip type and water area domains in the same manner (i.e. same proportions) as are the PAD trips, i.e. that $p_d = p_{0,d}$. This model is largely - but not totally - supported by available data, notably from the Department's 2008-2009 Southern California Saltwater Anglers Study (SALS). The SALS data cover 3741 PR boat trips in Districts 1 and 2 which were logged by 1145 anglers: 441 who habitually took PAN trips and 704 who habitually took PAD trips. The SALS data do not account for water area but they do show that for each of six trip types (of eight available CRFS trip types) the observed difference between the annual proportions of PAD

and PAN effort in that trip type is small and can be ascribed to chance effect of random sampling.

However, for trip types NS (bottomfish targets) and HM (highly migratory targets) the SALS data notably depart from the model $p_d = p_{0,d}$. For both PAD and PAN trips, these two types together accounted for about 60% of all trips. However, compared with PAD, the PAN trips put about 12% less of total effort into NS (40% rather than 52%) and about 12% more of total effort into HM (20% rather than 8%). This difference may owe to HM fishing opportunities which occur near Southern California but typically much less so further north, in combination with the somewhat longer boats and larger crew sizes of typical PAN (as versus PAD) trips.

In future, PAN effort estimation will be upgraded. As a first step, for a domain d which is seen to notably depart from the existing model, the model variance value \hat{m}_d may be assigned a plausible nonzero value. For instance, based on the above SALS finding, $\hat{m}_d = (0.12)^2 \sim 0.015$ for District 1 and 2 domains d for trip types NS and HM.

Moreover, future study data may enable use for some domains d of a more accurate model for p_d . Simple adjustments to the existing model may well notably improve accuracy. For instance, in the SALS case, PAN differs significantly from PAD only in that, for certain pairs of domains, more effort goes into one domain $d1$ and correspondingly less in the other domain $d2$. A plausible adjusted model can assume that, compared with the PAD proportions, PAN effort in $d2$ is less by a fixed fraction c (whose value c is deduced from study data) and PAN effort in $d1$ is correspondingly more. That is, the adjusted model uses the equations: $p_{d1} = p_{0,d1} + c p_{0,d2}$, $p_{d2} = (1-c) p_{0,d2}$. (In the SALS case, $c \sim 12/52 \sim 0.23$.) The simplicity of the adjustment enables use of relatively simple but acceptable approximation formulas for variances of the estimates \hat{p}_{d1} and \hat{p}_{d2} , namely: $\hat{Var}(\hat{p}_{d1}) = \hat{Var}(\hat{p}_{0,d1}) + c^2 \hat{Var}(\hat{p}_{0,d2})$, $\hat{Var}(\hat{p}_{d2}) = (1-c)^2 \hat{Var}(\hat{p}_{0,d2})$.

PAN CATCH RATE

For each given species and catch type, and given domain d – i.e. month, district, trip type, and water area - the two field surveys (PR1 and PR2) each yield respective catch rate estimates $\hat{R}_{1,d}$ and $\hat{R}_{2,d}$ from sample data, per the above Sections A and B (with angler-day as effort unit). The domain's PAN catch rate estimate \hat{R}_d (for the given species and catch type) is taken as the overall PAD catch rate estimate, i.e. the sum of the two field catch estimates divided by the sum of the two field effort estimates (in angler days):

$$Eq. 3.C.13 \quad \hat{R}_d = (\hat{C}_{PR1,d} + \hat{C}_{PR2,d}) / (\hat{E}_{PR1,d} + \hat{E}_{PR2,d}) = (\hat{C}_{PR1,d} + \hat{C}_{PR2,d}) / \hat{E}_{PAD,d}$$

This estimated catch rate \hat{R}_d may also be expressed as the duly weighted average of the two field surveys' respective catch-rate estimates $\hat{R}_{1,d}$ and $\hat{R}_{2,d}$:

$$Eq. 3.C.13a \quad \hat{R}_d = \hat{r}_d \hat{R}_{1,d} + (1 - \hat{r}_d) \hat{R}_{2,d}$$

Where (in analogy with the above r^{\wedge}) $\hat{r}_d = \hat{E}_{PR1,d} / (\hat{E}_{PR1,d} + \hat{E}_{PR2,d})$.

Estimation errors in $\hat{R}_{1,d}$, $\hat{R}_{2,d}$ and \hat{r}_d may be assumed uncorrelated. (The first two estimates are from distinct field surveys, and the last estimate is obtained from estimates of effort, not of catch rate.) From this independence there follows a variance estimation formula similar to Eq. 3.C.12, namely:

$$\text{Eq. 3.C.14 } \hat{V}\text{ar}(\hat{R}_d) = \hat{\tau}^2 \hat{v}_1 + (1 - \hat{\tau})^2 \hat{v}_2 + \hat{v}_r (\hat{R}_{1,d} - \hat{R}_{2,d})^2 + - \hat{v}_r (\hat{v}_1 + \hat{v}_2)$$

Where: $\hat{v}_1 = \hat{V}\text{ar}(\hat{R}_{1,d})$, $\hat{v}_2 = \hat{V}\text{ar}(\hat{R}_{2,d})$ and $\hat{v}_r = \hat{V}\text{ar}(\hat{r}_d)$. The first two respective values are given by Eqs. 3.A.10 and 3.B.12, and the last by an analog of Eq. 3.C.12c, namely:

$$\text{Eq. 3.C.14a } \hat{v}_r = [(\hat{E}_{PR1,d})^2 \hat{V}\text{ar}(\hat{E}_{PR2,d}) + (\hat{E}_{PR2,d})^2 \hat{V}\text{ar}(\hat{E}_{PR1,d}) - 2 \hat{V}\text{ar}(\hat{E}_{PR1,d}) \hat{V}\text{ar}(\hat{E}_{PR2,d})] / (\hat{E}_{PAD,d}^4)$$

PAN TOTAL CATCH

Total PAN catch for each species and catch type (\hat{C}) is estimated for each domain defined by a combination of month, district, trip type and water area by

$$\text{Eq. 3.C.15 } \hat{C} = \hat{E} \hat{R}$$

where for the given domain, species and catch type,

$$\begin{aligned} \hat{C} &= \text{the estimated total number of fish caught} \\ \hat{R} &= \text{the estimated catch per angler trip} \\ \hat{E} &= \text{the estimated total number of angler trips} \end{aligned}$$

The estimates \hat{E} and \hat{R} have uncorrelated errors: the former estimate is based on current telephone-survey data plus past surveys' data, whereas the latter estimate is based on current field-survey data. Hence, by use of the unbiased estimator version of the Goodman formula, an unbiased estimate of variance of \hat{C} is given by:

$$\text{Eq. 3.C.16 } \hat{V}\text{ar}(\hat{C}) = \hat{E}^2 \hat{V}\text{ar}(\hat{R}) + \hat{V}\text{ar}(\hat{E}) \hat{R}^2 - \hat{V}\text{ar}(\hat{E}) \hat{V}\text{ar}(\hat{R})$$

3.D. TOTAL PRIVATE AND RENTAL BOAT ESTIMATES

For a given domain d (defined by a combination of month, district, trip type and water area), total private and rental boat effort, catch and catch rate are estimated as follows.

TOTAL PR EFFORT

Total PR effort for domain d is estimated simply by summing the effort estimates for each PR submode: PAD (=PR1 + PR2) and PAN:

$$\text{Eq. 3.D.1 } \hat{E}_{tot,d} = \hat{E}_{PAD,d} + \hat{E}_{PAN,d}$$

For some purposes, including variance estimation, an alternative (but equivalent) estimation formula is useful. Namely, for a given district and month, the allocation of PAN effort among domains is taken to match that of PAD effort; consequently, PAD trips, PAN trips, and all PR trips all allocate the same proportion of trips to domain d , namely p_d - which is estimated by \hat{p}_d as described above just before Eq. 3.C.7. The resulting alternative estimation formula for total domain- d effort is:

$$\text{Eq. 3.D.2 } \hat{E}_{tot,d} = \hat{p}_d \hat{E}_{tot} = \hat{p}_d (\hat{E}_{PAD} + \hat{E}_{PAN})$$

An estimate of variance is then given by:

$$\text{Eq. 3.D.3} \quad \hat{V}ar(\hat{E}_{tot,d}) = \hat{V}ar(\hat{\rho}_d) \hat{E}_{tot}^2 + \hat{\rho}_d^2 \hat{V}ar(\hat{E}_{tot}) - \hat{V}ar(\hat{\rho}_d) \hat{V}ar(\hat{E}_{tot})$$

Where: $\hat{V}ar(\hat{E}_{tot}) = \hat{V}ar(\hat{E}_{PAD}) + \hat{V}ar(\hat{E}_{PAN})$; and $\hat{V}ar(\hat{\rho}_d)$, $\hat{V}ar(\hat{E}_{PAD})$ and $\hat{V}ar(\hat{E}_{PAN})$ are all given above in Section C.

Equation 3.D.3, an application of the Goodman formula, appeals to the fact that the three estimates - $\hat{\rho}_d$, \hat{E}_{PAD} , \hat{E}_{PAN} - have uncorrelated estimation errors: the first estimate concerns a current field-observed proportion, not scale of effort; the second registers current field-observed scale of effort; and the third is obtained via the phone survey plus past years' field observations.

TOTAL PR CATCH

Total PR catch for domain d (for each species and catch type) is estimated similarly by summing the catch estimates for each PR submode:

$$\text{Eq. 3.D.4} \quad \hat{C}_{tot,d} = \hat{C}_{PAD,d} + \hat{C}_{PAN,d}$$

Again, for some purposes, including variance estimation, an alternative but equivalent formula is useful. Namely, we have both $\hat{C}_{PAD,d} = \hat{E}_{PAD,d} \hat{R}_d$ and $\hat{C}_{PAN,d} = \hat{E}_{PAN,d} \hat{R}_d$ so that:

$$\text{Eq. 3.D.5} \quad \hat{C}_{tot,d} = \hat{E}_{tot,d} \hat{R}_d$$

An estimate of variance is then given by:

$$\text{Eq. 3.D.6} \quad \hat{V}ar(\hat{C}_{tot,d}) = \hat{V}ar(\hat{E}_{tot,d}) \hat{R}_d^2 + \hat{E}_{tot,d}^2 \hat{V}ar(\hat{R}_d) - \hat{V}ar(\hat{E}_{tot,d}) \hat{V}ar(\hat{R}_d)$$

Where: $\hat{E}_{tot,d}$ and $\hat{V}ar(\hat{E}_{tot,d})$ are given by Eqs. 3.D.2 and 3.D.3; and $\hat{V}ar(\hat{R}_d)$ and $\hat{V}ar(\hat{R}_d)$ are given above by Eqs. 3.C.14a and 3.C.15.

Equation 3.D.6, another application of the Goodman formula, appeals to the fact that $\hat{E}_{tot,d}$ and \hat{R}_d have uncorrelated estimation errors. Estimate $\hat{E}_{tot,d}$ registers total effort - deduced from field and phone surveys - whereas estimate \hat{R}_d depends only on field-observed catch-rates and on the allocation of total PAD effort between PR1 and PR2 trips.

TOTAL PR CATCH RATE

In principle, total catch rate for domain d may be estimated as total catch divided by estimated total effort:

$$\text{Eq. 3.D.7} \quad \hat{R}_{tot,d} = \hat{C}_{tot,d} / \hat{E}_{tot,d}$$

However, as PAN catch rate is taken to be identical to PAD catch rate, it suffices simply to take estimated total catch rate $\hat{R}_{tot,d}$ as estimated PAN (as well as PAD) catch rate \hat{R}_d (which is given above by Eq. 3.C.14 and with variance estimate given above by Eq. 3.C.15). That is:

$$\text{Eq. 3.D.8} \quad \hat{R}_{tot,d} = \hat{R}_d$$

$$\text{Eq. 3.D.9} \quad \hat{V}ar(\hat{R}_{tot,d}) = \hat{V}ar(\hat{R}_d)$$

TO: Rob Andrews, John Foster, Richard Cody
National Marine Fisheries Service (NMFS)
National Oceanic and Atmospheric Administration (NOAA)

FROM: Jill A. Dever, RTI International

DATE: February 24, 2023

RE: Revised Review of MRIP Certification Materials for the California Department of Fish and Wildlife's (CDFW) Private/Rental Boat Survey

This memo summarizes a revised review of the most recent MRIP certification materials provided by CDFW for the Private/Rental Boat Survey Program. Updates to the memo are highlighted for ease of review.

The review focuses on NOAA's current Fisheries' Marine Recreational Information Program (MRIP) certification terms of reference (TORs). This memo also lists the documents by name included in the review along with summary notes for context.

Comments on CRFS PR1/PR2 Certification Terms of Reference

1. Does the survey design follow a formal probability sampling protocol with known inclusion probabilities at all stages and/or phases of sampling?

Response: Yes, TOR #1 is believed to be sufficiently satisfied.

As noted in the review by the prior consultant group, the protocol for the PR1 (primary private and rental boats public-access sites) and PR2 (secondary private and rental boats public-access sites) surveys incorporate formal probability sampling, i.e., a stratified two-stage design. However, additional clarification is recommended especially for the PR2 design.

For example, the PR2 sampling design discussion appears to have an inconsistency regarding the sampling strata. The discussion suggests that PSUs are randomly chosen within strata defined by day type (weekday vs. weekend days/holidays) and pressure category (low, medium, and high) within district. However, there is mention of only three initial strata. Though mutually exclusive strata are apparent, the MRIP certification material would benefit by additional clarification on the stratification variables.

Additional clarification may benefit the certification material on the protocol to assign PR2 PSUs to groups for differential sampling. For example, how does CDFW determine the "number of assignments (i.e., sampling days) allotted to the day type stratum" especially when the discussion suggests that the sample size is equal across weekday and weekend/holiday PSUs? Additionally, it is assumed that on-site sampling is scheduled based on the historical peak hours that may need to be re-evaluated, given appropriate resources.

2. Do the estimation methods appropriately weight the sample data to account for the sampling design and produce design-unbiased point estimates and variance estimates?

Response: Yes, TOR #2 is believed to be sufficiently satisfied.

The consultants' report indicated that the estimates do not appear to reflect the sampling designs that incorporate different PSU sampling rates by strata. This is more reflected in the estimated catch rate in *CDFW_Report_MRIP_Cert-CRFS_Methods_V2_170927.cr.pdf* that is linked to a formula for a simple random sample. However, the PR1 and PR2 sampling designs contain differential sampling of PSUs by strata, where the definition of strata appears to differ between the two studies. Consequently, the estimates by strata / domain should incorporate the differential PSU-level sampling weights.

CDFW revised the formulation – see equations 3.A.2 –3.A.6, 3.A.8, and 3.A.11 within Attachment A of *CDFW_Response_MRIP (03-18-2021).pdf* – to correctly reflect differential sampling at the PSU level (district by day type) and at the SSU level (boat type). Note that the “missed-boat adjustment factor $B_{i,b}$ (Eq. 3.A.1) can be considered an inverse probability (base) weight by boat type. Whether classified as a base weight or an adjustment, there is an assumption that the boats not interviewed (per the report, “not sampled because the sampler was not able to interview the passengers on a boat due to high activity at the site, passengers refusal to participate in an interview, passengers not able to participate in the interview due to language barriers, trailers in the PR1 count site when the sampler leaves for the day and the maximum number of trailers at an associated PR site”) are missing at random. If the sampling fraction ($1 / B_{i,b}$) is close to 1.0 (say, at least 0.9), then the assumption may be reasonable. Otherwise, a pilot study may help to inform any biases linked to differences in catch between the interviewed and missed boats.

The justification of the Goodman formula for calculation of precision (variance) with two independent estimates appears founded. Additional information is requested from CDFW on their progress towards calculating measures of precision for PAN and total survey program estimates.

3. Are appropriate methods in place to measure and/or correct for potential biases due to undercoverage, nonresponse, or response errors?

Response: Yes, TOR #3 is believed to be sufficiently satisfied.

Based on more recent interactions with CDFW, it is assumed that nonresponse remains at a low level. Consequently, any nonparticipation may be primarily linked to field staff abilities to conduct interviews with all boats in a sampled PSU so that a missing a random assumption could be assumed. However, additional information on the missed boats may be warranted to justify the assumption.

Though not mentioned in the documentation, it is assumed that boats entering/exiting a marina at the study PSU are eligible for sampling. If not, the exclusion could lead to undercoverage in the estimates especially if the associated trailers are not available for counting before/after the field staff interviewing shift.

For the PAN estimates, CDFW notes in the certification materials a difference in scaling between the PAD estimates and ALDTS, suggesting the need for an adjustment to the effort estimates. Has CDFW evaluated the need for a similar scaling factor between PAD and ALDOS under the assumption that the online survey has replaced ALDTS?

4. How sensitive is the accuracy of the survey to assumptions made about segments of the target population that are not covered by the survey frame? What can be done to reduce or limit that sensitivity?

Response: Yes, TOR #4 is believed to be sufficiently satisfied.

CDFW details adjustments to address undercoverage. As mentioned previously, with adequate resources, CDFW may wish to revisit the undercoverage adjustments with more recent pilot studies.

Regarding the adjusted PR2 effort estimate (Eq. 3.B.7) in *CDFW_Report_MRIP Cert-CRFS Methods_V2_170927.cr.pdf*, information is requested on the “U” component. This expansion factor is used to cover sites deemed “inactive” or unreachable. One may assume that these sites could contribute a zero value (i.e., no activity) to the survey program estimates. Has CDFW considered that such an expansion could introduce a positive bias in the estimates?

5. How sensitive is the accuracy of the survey to other potential sources of nonsampling error? What can be done to reduce or limit that sensitivity?

Response: Yes, TOR #5 is believed to be sufficiently satisfied.

My research indicates that anglers less than 16 years of age do not require a license. However, age of the angler is not collected but the number of unlicensed anglers is collected – see Key Data Elements Collected section of *CDFW_Report_MRIP Cert-CRFS Methods_V2_170927.cr.pdf*. The manual mentions that children are not eligible for ALDTS. Though not documented, it is assumed that field staff only interview (unlicensed) anglers who are at least 16 years old to ensure alignment between the Private/Rental Boat Survey Program and (now) ALDOS.

6. How sensitive is the survey design to potential errors in implementation? What can be done to evaluate, reduce or limit that sensitivity?

Response: Yes, TOR #6 is believed to be sufficiently satisfied.

The MRIP certification materials would benefit from the inclusion of any protocols related to the quality of the data alone or in aggregate (e.g., outlier responses).

Additionally, it is assumed that the “close” PR* sites with data collected along with the selected PR* PSU are identified by CDFW and not the field staff.

- 7. How does the survey design compare to the legacy survey design it would replace? Is it more statistically sound and efficient, or is it at least comparable in its statistical validity and efficiency? What design features are most important in supporting this assessment?**

Response: TOR #7 is outside the scope of this review.

- 8. How does the survey design compare with other survey designs previously certified by MRIP for estimating fishing effort and/or catch for the same fishing mode(s)? Is it more statistically sound and efficient, or is it at least comparable in its statistical validity and efficiency? What design features are most important in supporting this assessment?**

Response: TOR #8 is outside the scope of this review.

- 9. Is the survey collecting data and producing information products that will meet the needs of the primary customers (stock assessment scientists and fishery managers)?**

Response: TOR #9 is outside the scope of this review.

CDFW-Private/Rental Boat Survey Materials – Summary Notes

Document = *CDFW_Report_MRIP Cert-CRFS Methods_V2_170927.cr.pdf* (09/27/2017)

- Initial MRIP certification materials
- Given the date of the materials, we assume that the augmentation to the estimates is now made with the ALDOS instead of the ALDTS.
- Sites are labeled as public or private access:
 - Public-access sites are classified into and sampled from 2 groups (primary [PR1] vs. secondary [PR2]) for field surveys with higher sampling rates for PR1 *within district for each month in the season*
 - No field survey for private-access sites; estimated from ALDTS (now ALDOS) and PR1, PR2 field surveys
- PR1 survey design is 2-stage with:
 - PSU = site-fishing day pair *within district*, sampled 6/7 days per month with higher rates for weekend days/holidays
 - SSU = boat trip during daylight hours only, sampled with (mostly) certainty
- It is assumed that the PR1 sites are not eligible for PR2 sampling given the pressure designation and proximity.
- PR2 survey design is 2-stage with:
 - PSU = same as PR1 but with different sampling rates
 - SSU = same as PR1 but with a shorter data collection period at each site

Document = *CDFW_Response_MRIP (03-18-2021).pdf*

- Response to consultants' comments for TORs 1-6, 8
- TOR #1: The consultants note that the design is probability based but may benefit from a reallocation of sample from PR1 to PR2. CDFW indicates that the oversampling of PR1 sites benefits key species estimates as well as access to higher intensity sites.
- TOR #2: The consultants correctly state that the estimates (specifically for the catch rate) do not account for the unequal weighting through incorporation of based (inverse selection probability) weights, and note the missing covariance term to estimate precision. CDFW states that the point estimation procedure has been revised (Attachment A).
 - Review of Attachment A indicates the correct formulation for the estimated catch rate. CDFW mentions work to improve effort estimates for PAN (private-access sites and nighttime fishing from public- and private-access sites) because (as of now) ALDOS has replaced ALDTS.
 - With available resources, CDFW may conduct a pilot to understand if any bias adjustments are needed to address the change from ALDTS to ALDOS.Finally, CDFW provides updated information on variance estimates using the Goodman method by explicitly state that one component is based on historical information and therefore independent from the other “current” component (Attachment B).
 - Upon review, the justification in Attachment B appears reasonable.
- TOR #3: The consultants discuss adjustments for and issues surrounding nonresponse. CDFW justify their approach around missing at random, and note that substituting for missing PSUs is rare.

- TOR #4: The consultants summarize concerns regarding exclusions from the sampling frame (e.g., nighttime returns, private sites). CDFW references (now) old pilot studies to quantify undercoverage in light of the adjustments employed.
- TOR #5: The consultants applaud CDFW for applying a bias correction to ALDTS even though the information may be outdated. CDFW agrees that a new pilot study would be appropriate provided resources are available.
- TOR #6: The consultants state that the program appears to be of high quality and recommends on-going review and verification. CDFW agrees and summarizes areas of focus during the off-season quality review.
- TOR #8: The consultants summarize differences between this survey program and MRIP with particular focus on ALDTS vs. a mail survey. CDFW notes that ALDTS will be discontinued and replaced with an online survey (i.e., ALDOS).

Document = *CDFW_Manual_MRIP Cert-CRFS Sampler_2020.pdf* (05/21/2021)

- Sampling manual that includes roles and responsibilities for oversight and quality control

The MRIP Program Management Team (PMT) has completed its evaluation of the California Department of Fish and Wildlife's (CDFW) Angler License Online Directory Survey (ALDOS) and Private/Rental Boat Recreational Fishing Surveys (PR1 and PR2) certification peer reviews. The peer reviews of ALDOS, PR1 and PR2 note the surveys use appropriate probability-based sampling designs. For ALDOS, while there may be opportunities to improve the efficiency of the designs through stratification or weighting approaches, the review concluded that the surveys should produce design-unbiased point and variance estimates. Similarly for PR1 and PR2, while the peer review recommended additional clarifications to the documentation, the certification terms of reference were sufficiently satisfied.

The PMT has also completed its evaluation of the Washington Department of Fish and Wildlife's (WDFW) Ocean Sampling Program (OSP) certification peer review. The review highlighted the positive aspects of the OSP design, including adherence to probability-based sampling protocols and administration of pilot studies to evaluate noncoverage bias. The peer review also highlighted some deficiencies in the survey documentation that WDFW addressed iteratively working with the MRIP PMT and the peer reviewer.

The PMT agrees with the results of these peer reviews and recommends certification of each of these surveys.



Katherine Papacostas - NOAA Federal

MRIP Certifications

Gordon Colvin - NOAA Affiliate

Mon, Apr 10, 2023 at 10:21 AM

To: Katherine Papacostas - NOAA Federal

Cc: Richard Cody - NOAA Federal

Hi, Katherine. No feedback at all. So, they are ESC cleared and ready to send up.

On Mon, Apr 10, 2023 at 10:06 AM Katherine Papacostas - NOAA Federal wrote:

Hi Gordon,

Did you happen to receive any feedback from the ESC on these? Please lmk and I'll initiate seeking Evan's and Cisco's clearance of these certifications.

Thanks,
Katherine

On Thu, Mar 30, 2023 at 9:24 AM Gordon Colvin - NOAA Affiliate wrote:

Good morning, MRIP Executive Steering Committee:

The MRIP Program Management Team (PMT) has completed its evaluation of two of the west coast states' Pacific RecFIN Surveys, and is recommending their certification.

California: The California Department of Fish and Wildlife's (CDFW) Angler License Online Directory Survey (ALDOS) and Private/Rental Boat Recreational Fishing Surveys (PR1 and PR2) have completed certification peer review, and are recommended for certification. ALDOS is a monthly survey used to collect recreational effort information from anglers fishing from private or rental boats and from shore. Samples are drawn from an angler license directory of California sport fishing license holders. The survey is administered via email, which directs respondents to a link to fill out the questionnaire. California's monthly private/rental boat surveys are conducted through angler intercepts at public access sites and are used to collect catch rate information. There are two components: a survey of primary sites (PR1) and a survey of secondary sites (PR2). Designation of sites as primary or secondary is based on the amount of expected effort and relative catch of species under active management, with increased sampling rates for PR1.

Together, ALDOS, PR1, and PR2 data are used to estimate catch and effort for all private and rental boat trips in California.

The peer reviews of ALDOS, PR1 and PR2 note the surveys use appropriate probability-based sampling designs. For ALDOS, while there may be opportunities to improve the efficiency of the designs through stratification or weighting approaches, the review concluded that the surveys should produce design-unbiased point and variance estimates. Similarly for PR1 and PR2, while the peer review recommended additional clarifications to the documentation, the certification terms of reference were sufficiently satisfied.

Washington: The PMT has also completed its evaluation of the Washington Department of Fish and Wildlife's (WDFW) Ocean Sampling Program (OSP) certification peer review. OSP is used to produce estimates of total ocean recreational effort and catch by boat type (charter and private), port, catch area, and trip type (primary target species). Boat trip sampling is conducted randomly to generate estimates of catch for most ocean-caught species: salmon, rockfish and other groundfish, halibut, albacore, sharks, and cods. Estimates of released fish are also generated using angler interviews. Field samplers are stationed in all major coastal access sites in the state. Ports are monitored from May through September, with additional sampling occurring during March, April, and October in select areas.

The review highlighted the positive aspects of the OSP design, including adherence to probability-based sampling protocols and administration of pilot studies to evaluate noncoverage bias. The peer review also highlighted some deficiencies in the survey documentation that WDFW addressed iteratively working with the MRIP PMT and the peer reviewer.

The PMT agrees with the results of these peer reviews and recommends certification of each of these surveys. Copies of the survey documentation and peer reviews are available. Please get back to me oif you want to see any of them.

Please advise me and Evan by cob Friday, April 7 if you have any concerns or questions regarding these recommended certifications.

Thanks,

-Gordon

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