**Marine salmon sport harvest estimation using catch record cards**

**Card Issuance**

Catch cards are issued to anglers who purchase a fishing license and indicate their intent to fish for salmon or the other catch card species (steelhead, sturgeon, and halibut). It is illegal to fish for any of these species without possessing a valid catch card. This applies to everyone, including anglers under the age of fifteen who are not required to purchase an actual fishing license. The first catch card issued for an angler is free. If an angler fills their initial card with catch, additional cards can be purchased for an fee. The salmon reporting section on the card includes spaces for twenty-six salmon entries; there is no annual limit on salmon harvest.

Prior to 2006, catch cards were pre-printed and provided to license dealers for distribution with licenses. Charter cards are still distributed that way (see below) but most licenses and catch cards are printed on-demand from the Washington Interactive Licensing Database (WILD) system. WILD-issued cards are single-sided and variable in length, including sections for any or all of the four catch card species. (Separate catch cards are issued for Dungeness crab catch reporting.) In addition, each card includes the angler’s name, city of residence, and a unique identifier (the WILD ID) which is assigned to each angler in the licensing database. A fourteen-digit document number (DocID) is printed on each card. This number is specific to the individual card; a different DocID is generated for each document produced by the licensing system.

Pre-printed catch cards are provided to charter boat operators and fishing guides to be issued along with one-day charter licenses. These operators may not have computers available for access to the WILD system. The charter cards have unique seven-digit numbers printed on them. Anglers write their name/address information on the charter card “stub” which is retained by the operator and sent back to the agency. The same pre-printed cards may also be issued to anglers that purchase “Hot Key” licenses. These are temporary licenses sold through the WILD system, but without the requirement for an angler entry in the database. The angler name and address is entered on the stub, just as with charter licenses. Charter and hot key cards make up about three to five percent of the total card issuance annually.

**Card Returns**

The catch cards are due back on April 30, one month after the end of the license year, which runs from April 1 through March 31. For fish cards, there is no penalty associated with late return of cards, or failure to return cards, so many are mailed in well after the deadline. A processing cutoff date is set in August. Cards received by the cutoff date are processed as described below; those arriving after are treated as being out-of-sample and are not used for estimation.

Cards can be mailed in or dropped off at WDFW offices. In past years, some license dealers accepted cards from anglers and returned them to the agency. This practice is no longer officially sanctioned, but continues to a limited extent. If anglers lose their cards, they are allowed to contact the CRC unit and report their catch from memory.

The CRC unit randomly selects twenty-five percent of the cards issued each year for use in generating catch estimates. These cards are referred to as the “in-sample” group. Cards are selected based on the last two digits of the document numbers printed on the cards. Prior to the license year, a range of twenty-five sequential numbers is randomly selected: 1-25, 26-50, 51-75, or 76-00. Cards ending in the selected range are in-sample. Cards falling out of that range are referred to as “out-sample” and are not used for salmon estimation. (Out-sample cards are used for steelhead estimation, however.) For cards issued from the WILD system, the document numbers are assigned sequentially to all license documents. Since a single license transaction typically results in four or five documents, and transactions are occurring at hundreds of locations statewide, DocID assignment is essentially random. This is not true for charter cards, where operators are issued books of sequentially numbered cards. It is common for all members of a family, for instance, to be in the in-sample group if they went on a charter trip together.

Reminders are sent out to anglers with cards in the in-sample range, in an effort to increase return rates. The first reminder is a postcard mailed out in March, with instructions on how to mail in the cards. The second reminder is a letter sent out in May, after the reporting deadline. The letter mailing includes a form that anglers can fill in with their catch data in case they have lost or misplaced their card. It also includes a postage-paid business reply envelope for returning either the card or the form. In past years, a second letter has been sent out in June, but this practice was discontinued to save printing and postage costs.

**Card Processing**

Cards coming in to the CRC unit are sorted into in-sample and out-sample groups. The in-sample cards are grouped into batches, and the document numbers are entered into an MS Access database, along with information about the batch – catch or no-catch, response type (voluntary, after first reminder, after second reminder) and document type (actual card, reminder letter form, etc.)

In-sample cards with catch are inspected for missing, illegible or questionable entries. Edits are made directly on the cards. In some years, the staff has contacted anglers by phone to resolve issues with missing or questionable data prior to sending the cards to data entry, but recently due to staff reductions the editing has been limited to readability issues.

The cards with catch are sent to the data entry unit, where document numbers and catch data are entered and verified. For salmon, the catch data elements are:

Catch area code: a numeric code entered by the angler. Marine areas are 1-2 digits; freshwater areas are 3 digits. Missing data is entered as area 192.

Month: numeric 1-12, 99 for missing

Day: numeric, 99 for missing

Species: Anglers check a column indicating the salmon species. The data is keyed as a single letter code. Missing entries are entered as “U”.

Clip type: “H” for hatchery fish with a clipped adipose fin; “W” for wild fish with an intact adipose. Missing values are left blank.

Cards also have a question for each section, e.g. “Did you fish for Salmon?” with “Yes” and “No” choices. This choice is not consistently filled out by anglers, and is not entered by data entry.

After data entry, the cards with catch are scanned and the images saved for future reference. The actual cards are bundled by batch and stored in boxes which are ultimately sent to the state archives.

**Estimation**

The data input by the data entry group is run through an error-checking program. All of the CRC programs are written in SAS. Entries with missing data have the appropriate missing value code filled in. Checks are made for invalid dates and areas. (The data entry validation program includes a list of valid catch area codes; therefore few invalid areas make it through to this step.) Duplicate entries show up for various reasons – an angler may return both an actual card and a letter, or a card may inadvertently be batched twice; these issues are resolved here.

Next, the expansion factor is calculated. This is the ratio of total cards issued to cards returned. For cards issued through the Wild system, calculating the total sold is straightforward; canceled or voided cards are subtracted from the total issuance number to arrive at the number of valid cards that were available for use. For charter cards, the total issued is estimated. Some, but not all, of the name/address stubs are returned by the charter operators, and some, but not all, of the cards are returned by anglers. Thus, total issuance for charter cards is estimated as follows:

*NT* = total charter/hot key cards issued

*Nr* = in-sample name/address stubs returned

*nv* = total in-sample cards voluntarily returned (returned prior to reminder mailings)

*nm* = voluntary returns that match returned stubs

It is assumed that:

Therefore:

Charter and hotkey cards make up less than five percent of the total card issuance; thus, we assume that the uncertainty in the numbers does not have a large impact in the overall estimation process.

Catch from the returned in-sample cards is expanded out across all issued cards. The expansion factor is one over the in-sample return rate multiplied by the twenty-five percent sample rate. In-sample return rates in recent years have been in the 50 to 60 percent range. For example, in 2009 the return rate was about 56%, so the expansion factor was:

Estimates are generated for each catch area, species and statistical week (“statweek” - starts on Monday and ends the following Sunday). The salmon species is recorded on the catch card and entered by data entry. However, species identification can be problematic for anglers, particularly in salt water. Therefore, species composition proportions from Puget Sound creel sampling are substituted for those from the cards themselves. The salmon species proportions from the cards are used only for those locations and times where the creel data is not available.

The following estimation method was implemented after a five-year intensive study conducted in the late 1980’s (Conrad, Alexandersdottir, 1993). Variance is calculated using a random group method (Wolter, 1985) in which the in-sample returned cards are randomly assigned to four subgroups. Estimates are then calculated separately for each subgroup as well as for the entire group, and the variance is calculated using the deviations of the sample estimates from the over-all estimate.

Generally cards that are not returned have a lower mean catch per card than those that are returned. To adjust for this non-response bias, a correction factor is applied. For Marine Area 5, the correction factor is 1.0, indicating no difference in catch rate between responders and non-responders; for the other Puget Sound areas, the correction factor used is 0.68. (Conrad and Alexandersdottir, 1993)

The in-sample cards are randomly subdivided into four groups, and estimates for each area/statweek are calculated using each of those groups as follows:

= number of cards in subsample *i*

= total number of cards issued

= number of fish for subsample *i*

= estimated harvest based on subsample *i*

= non-response bias correction factor

Then the total estimate of salmon harvest is generated as follows

= total estimate

= variance of total estimate

The above process generates estimates for total salmon harvest for each area/statweek combination.

Time periods are variable based on fishing seasons and availability of creel data. Time periods are either statistical weeks, statistical months, or some combination. For instance, if the salmon season opens midway through a month, the first two statweeks of the month might be treated as a single time period, and the last two weeks might each be treated as a separate period. The time periods by area for each year are determined by salmon biologists and provided to the CRC unit. Estimates for a given time period are simply the sum of the estimates for each stat week within the period.

Next, the species proportions from the creel sampling data are applied to the total salmon estimates for each time period. If no creel data is available, the proportions used are those from the reported catch. Catch estimates by species and the variances are calculated as follows:

= sample proportion of species *s* from creel survey

= variance of proportion of species *s*

= total salmon estimate

= variance of total salmon estimate

= estimate for species *s*

= variance of estimate for species *s*

For those cases where creel data is not available, the variances of the species estimates are not calculated.

**Review**

The CRC catch estimates for each area/time period/species are routed to biologists (both state and tribal) for review. The biologists are asked to list those entries that are questionable, either because the area was closed to fishing during that time period or because the likelihood of encountering that species at that time/place was low. The review comments are compiled and used to draw up a list of those anglers reporting the questionable catch. CRC staff attempt to contact these anglers by phone in order to resolve the issues. If the anglers cannot be reached, the biologists make the decisions on how to handle the reports; generally if the catch is biologically feasible the report is left as is, otherwise it is changed to “unknown”.

Once the calls are completed to resolve possible errors, and the individual catch records are corrected accordingly, we rerun the estimation process. For recent years, this review cycle has been repeated at least twice for each year.

**Creel Substitution**

The Puget Sound Sampling Unit conducts intensive creel surveys for selective chinook and coho fisheries (Thiesfeld and Hagen-Breaux, 2005). These surveys combine CPUE estimates from dockside creel checks with effort estimates from on-the-water boat interviews. The resulting estimates are used in place of the catch card estimates, where available. Creel estimates are only used if they include an entire marine area and time period. For instance, if a selective chinook fishery is only open for the first day of a stat week, but the area remains open for coho fishing, the resulting creel estimates will be incomplete and will not replace the catch card estimates.

**References**

Conrad, R. and M. Alexandersdottir. 1993. Estimating the Harvest of Salmon by the Puget Sound Sport Fishery in Puget Sound: Evaluation and Recommendations. Northwest Fishery Resource Bulletin, Manuscript Series Report No. 1. 82 p.

Thiesfeld, S. and Hagen-Breaux, A. 2005. 2003 Chinook Selective Fishery, Marine Areas 5 and 6. Washington Department of Fish and Wildlife. Olympia, Washington.

Wolter, K.M. 1985. Introduction to Variance Estimation. In: Springer Series in Statistics. Springer-Verlag. New York. 427 p.

Example Catch Record Card

