Washington State Department of Fish and Wildlife
Ocean Sampling Program Overview

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Introduction

The Washington Department of Fish and Wildlife's Ocean Sampling Program (OSP) estimates 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.

The ocean fisheries have been sampled by the Washington Department of Fish and Wildlife since the early 1960's. Creel data are used exclusively in the ocean areas to estimate Washington recreational catch and effort.

Sampling Methods

Field samplers are stationed in all major coastal access sites: Ilwaco, Chinook, Cape Disappointment State Park, Westport, La Push, and Neah Bay. All ports are monitored from May through September, with some sampling occurring during March, April, and October in some areas.

The OSP mainly uses a two-stage design for each port, with days constituting the primary sampling units (PSU) and boats within each sampled day as the secondary sampling units (SSU). Selection of days follows simple random procedures. Although sampling of boats is approximately systematic (e.g., every k*th* boat), the selection procedure is not exact and this stage is treated as simple random for estimation purposes. Each port is sampled a minimum of 4 to 5 days per week and days are stratified by weekend and weekday. Typically, all weekend days and holidays are sampled and the remaining available sampling effort within a port is randomly assigned to the weekdays. Daily estimates are expanded over days within strata to produce weekly, monthly and annual estimates. Variations on this theme are employed when sampling the land-based fishery at the Columbia River North jetty; here, weekdays and weekend days are not distinguished.

Effort is measured in units of boat-trips and angler-trips, and on sampled days, is measured throughout the entire period of boat activity, i.e., from the time when the first boat leaves a port until the last boat returns. On a given sampling day, the total number of boats leaving or entering a port is counted. During periods of high effort, effort is measured through an exit count, where all boats exiting a port are counted throughout daylight hours. In Westport, this method includes boats exiting from Ocean Shores and all Grays Harbor launching sites. In Neah Bay, this method includes boats launching from the Snow Creek resort.

During periods of low effort, effort is measured through an entrance count: a count of all boats entering that marina. During an entrance count, boats that exited from Ocean Shores and other Grays Harbor launching sites are excluded from the Westport effort count; in Neah Bay, entrance counts include boats exiting from the Snow Creek resort.

The catch per boat is sampled through intercept surveys. Returning boats are systematically sampled at a minimum target rate of 20% within each boat type (charter and private). Every *k*th boat to enter the harbor is included in the sample regardless of size, mooring location, trip type, etc. The size of the sample (leading to the calculation of *m*) depends on the projected effort and the number of available samplers. Overall, the sampling rate in each port in a year averages over 50% for charter boats and over 40% for private boats.

Through year 2000, data collected from each sampled boat trip include target species, area fished, number of anglers, landed catch by species, released salmon by species, and other biological data. Beginning in 2001, data collected include released yelloweye and canary rockfish and beginning in 2002, releases of all marine fish by species were enumerated in the samples. Beginning in 2003, depth at which the majority of rockfish in the catch were hooked was added. Beginning in 2013, data were recorded on the use of descending devices by anglers targeting bottomfish; recorded data evolved such that by 2014, numbers of yelloweye and canary rockfish released using a descending device was added. In 2016, the Ocean Sampling Program transformed its data collection method from paper-based to electronic using Apple iPads and the iForms form-building platform.

Catch and Effort Estimation

The OSP generates preliminary estimates of catch and effort in-season to meet the demands of ocean fishery management. Catch estimates for quota fisheries (currently salmon and halibut) are generated weekly; catch estimates for all other species are generated monthly and provided to the RecFin database by the end of the following month. Final post-season catch and effort estimates for all species are generated by February 1 each year; these post-season estimates replace any existing in-season estimates.

OSP Estimated Stratum Totals (Primary Stage)

Combined (total) catch estimates are typically stratified by weekend/holiday and weekday. In some strata, every day is sampled. In those strata the combined estimates are simply sums of the daily catches. In other strata, where some days are not sampled, the average catch per day over all sampled days is multiplied by the number of days in the stratum to estimate the total catch.

Let:

a = the marine catch area,

i = trip type,

h = Weekend/holiday or Weekday stratum,

N_h = the number of days in stratum h,

T_h = collection of all days in stratum h,

N_h = the number of days sampled in stratum h, (rather than the number of boats sampled as above),

S_h = collection of sampled days in stratum h (when S=T, n=N),

Y_{haik} = estimated catch (or effort) on day k for stratum h in area a from trip type i,

C_{hai} = catch for stratum h in area a from trip type i,

Then

$$\hat{C}_{hai} = Nh \frac{\sum_{k \in Sh} \hat{Y}_{haik}}{n_h}$$

with estimated variance (Thompson 1992, p. 129):

$$\hat{V}\left(\hat{C}_{hai}\right) = \frac{N_h(N_h - n_h)}{n_h} \frac{\sum_{k \in S_h} \left(\hat{Y}_{haik} - \hat{\bar{Y}}_{hai}\right)^2}{n_h - 1} + \frac{N_h}{n_h} \sum_{k \in S_h} \hat{V}\left(\hat{Y}_{haik}\right)$$

where

$$\hat{\bar{Y}}_{hai} = \frac{\sum_{k \in S_h} \hat{Y}_{haik}}{n_h}.$$

For strata with all days sampled, $n_h = N_h$, and the catch and variance estimators reduce to:

$$\hat{C}_{hai} = \sum_{k \in T_h} \hat{Y}_{haik}$$

and

$$\hat{V}\left(\hat{C}_{hai}\right) = \sum_{k \in T_h} \hat{V}\left(\hat{Y}_{haik}\right).$$

OSP Daily Catch and Effort Estimation (Secondary Stage)

Both catch and effort are post-stratified by trip-type and area fished. Effort in terms of boat-trips is simply the sample number of boats for each trip-type and area expanded by the appropriate boat-type (charter or private) exit/entrance count. Effort in terms of

angler-trips is calculated as the mean number of anglers per boat (indexed by trip-type and area) expanded by the counted total population of boats.

The total catch for a given species on a sampled day is the product of the population of boats and the estimated catch per boat, again post-stratified by trip-type and area fished. Key assumptions in the current estimation procedures are that:

1) All boats exiting/entering a port are included in the exit/entrance count
2) Exit/entrance counts are made without error
3) The approximate systematic sample of boats can be treated as a simple random sample
4) Anglers answer questions accurately and do not conceal fish

In the following discussion, subscripts referring to port and boat-type are suppressed. Let:

M_t = total exit or entrance count for a given port on day *t* (assumed known without error),

m_t = total boats sampled on day *t*,

m_{tai} = number of boats sampled of trip type *i* fishing in area *a* on day *t*,

a_{taij} = number of anglers on the *j*th boat from trip type *i* fishing in area *a* on day *t*,

y_{taij} = number of species specific fish caught on the *j*th boat from trip type *i* in area *a* on day *t*, and

Y_{tai} = total catch of specific species caught from trip type *i* in area *a* on day *t*.

The estimate of the number of boat-trips of trip-type *i* and area *a* follows the procedure outlined in Lai et. al. (1991) where the proportion of boats in each category is estimated by:

$$\hat{p}_{tai} = \frac{m_{tai}}{m_t}$$

with estimated variance (Cochran 1977, p. 52):

$$V(\hat{p}_{tai}) = \frac{\hat{p}_{tai} \cdot (1 - \hat{p}_{tai})}{(m_t - 1)} \cdot (\frac{M_t - m_t}{M_t})$$

The estimated total boat-trips is then obtained by:

$$\hat{M}_{tai} = M_t \cdot \hat{p}_{tai}$$

with estimated variance:

$$\hat{V}(\hat{M}_{tai}) = M^2{}_t \cdot \hat{V}(\hat{p}_{tai})$$

Effort expressed in terms of angler-trips is the product of the average anglers per boat-trip times the total number of boat-trips. The mean number of anglers per boat-trip (for trip-type *i* and fishing area *a*) is estimated as:

$$\hat{\bar{a}}_{tai} = \frac{\sum_j a_{taij}}{m_t}$$

with variance:

$$\hat{V}(\hat{\bar{a}}_{tai}) = \frac{\sum_j (a_{taij} - \hat{\bar{a}}_{tai})^2}{m_t(m_t - 1)} \cdot (\frac{M_t - m_t}{M_t})$$

Thus the estimated total number of angler-trips is:

$$\hat{a}_{tai} = M_t \cdot \hat{\bar{a}}_{tai}$$

with variance:

$$\hat{V}(\hat{a}_{tai}) = M^2{}_t \cdot \hat{V}(\hat{\bar{a}}_{tai})$$

The catch (or number released) for a specific species on sampled day *t* in area *a* from trip type *i* is similarly estimated by:

$$\hat{Y}_{tai} = \frac{\sum_j y_{taij}}{m_t} M_t$$

with estimated variance:

$$\hat{V}\left(\hat{Y}_{tai}\right) = \frac{\sum_j \left(y_{taij} - \hat{\bar{y}}_{tai}\right)^2}{m_t\left(m_t - 1\right)} M_t\left(M_t - m_t\right)$$

This estimate and it's variance differs somewhat from that described in Lai et al. (1991) since the total count, M_t (assumed to be a known quantity), is used to expand the estimated CPUE (calculated over all sampled boats) rather than the estimated boat-trips by trip-type and area fished.

Staff and Training

Approximately 24 field samplers are employed each season to collect catch and effort data. Two full time biologists coordinate sampling activities, one full time biologist generates in-season groundfish catch estimates, and one full time technician provides data quality control. In addition, 2 onboard observers collect encounter, mark status, and other information from salmon fishing vessels participating in mark-selective fisheries.

Each season, new samplers are provided a general sampling manual and a sampling supplement specific to the port to which they are assigned. One or more days of office training is provided, followed by two or more days of intense field training. Field training and performance feedback continue throughout the season.

Budget and Data Collection Statistics

The OSP utilizes a budget of over $900,000 annually. This funding consists of both Federal and State sources. Some funds are specifically dedicated to certain data collection aspects while other funds are more general.

Since 1990, the OSP has conducted between 16,000 and 28,000 boat interviews per season coastwide. In 2014, for instance, 78,394 angler interviews were completed (38% of total estimated angler trips), and 16,271 chinook (34% of total estimated catch) and 41,013 coho (38% of total estimated catch) were examined and scanned for CWTs. Approximately 30,000 albacore, 141,000 black rockfish, 4,000 halibut, and 20,000 lingcod were examined and speciated.

Literature Cited

Cochran, W. G. 1977. Sampling techniques. 3rd ed. John Wiley. 428 pp.

Lai, H-L., R.Moore, and J. Tagart. 1991. Methodologies for estimating catch and effort statistics of ocean sport fishery off the Washington Coast with users guide for the program 'OSFP.FOR'. Prog. Report No. 289. Wash. Dept. of Fisheries, Olympia, WA. 35 pp.

Thompson, S.K. 1992. Sampling. John Wiley. 343 pp.