At-Sea Hake Observer Salmon Sampling Protocols

Sampling methods employed by the Northwest Fishery Science Center (NWFSC) Observer Program continue to be scientifically and statistically sound. The data collected by the At-Sea Hake Observer Program (A-SHOP) have been the basis for at-sea hake fishery management for 45 years, and data collected by the West Coast Groundfish Observer Program (WCGOP) have provided essential estimates of discard and total mortality in shoreside fisheries since 2002. Sampling methods, especially related to Chinook salmon, have been discussed at length by the Pacific Fishery Management Council (Council) in response to specific incidences of high bycatch. Most recently, at the April 2018 Council meeting, the National Marine Fisheries Service (NMFS) provided a report describing in detail the Chinook salmon sampling protocols used by the A-SHOP, WCGOP, and Catch Monitor Program (CMP). The WCGOP, A-SHOP, and CMP, as well as the Council, did not identify the need for any changes to the robust sampling procedures already in use.

The A-SHOP has a long history of working with the fleet to collect as large a species composition sample as possible. In 2005, after a tow with high canary rockfish bycatch, the observer program modified protocols to increase the percentage of every haul sampled from 30 to 50%, by weight. Additionally, through discussions with industry, informal plans were developed for vessels to assist observers to obtain larger samples during high bycatch events. In the rare circumstances when hauls have extremely high bycatch, observers have few options other than taking smaller, systematic samples, at randomly chosen times. Figure 1 provides a summary of 2019 sampling rates in the at-sea hake sectors. In the vast majority of hauls, observers follow the standard protocol of sampling 50% of the total catch weight.

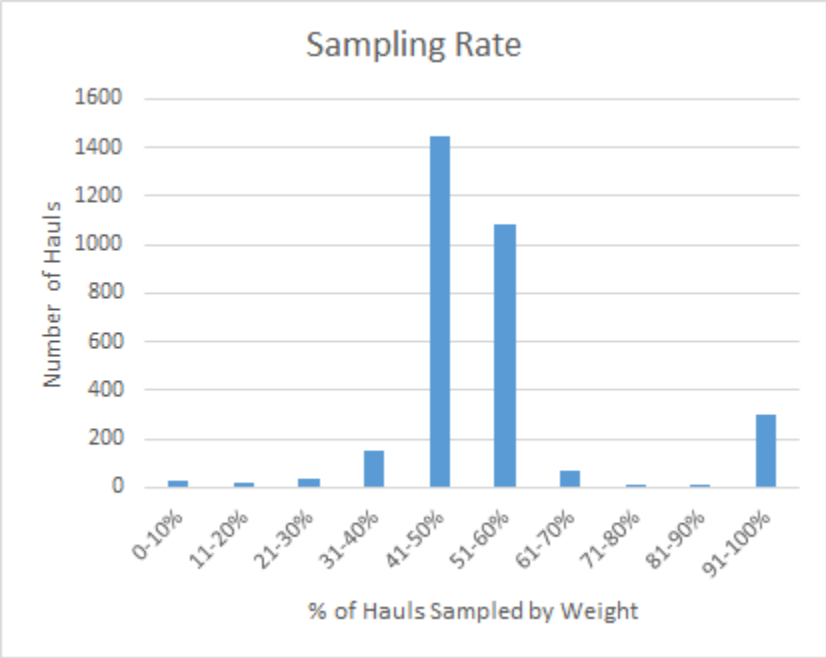

Figure 1. In 2019, A-SHOP sampled a total of 3156 hauls in the mothership and catcher processor sectors. The vast majority of hauls (2753, or 87%) were sampled using the standard protocol of randomly selecting 50% of the catch weight. Nearly 300 hauls were census or near-census sampled, which sometimes occurs on hauls smaller than 25 mt with typical bycatch or by request of the vessel, when possible. In less than 1% of hauls, the sample was 10% or less of the total catch weight.

Some level of uncertainty is inherent in estimating total haul-level bycatch from systematic random samples. Any given sample may result in an over- or under-estimate of the total bycatch, due to the random nature of sampling. However, random and systematic samples ensure that the expansion will produce a relatively accurate haul-level bycatch estimate on average across the fleet. For example, Figure 2 shows the distribution of estimated total bycatch in a theoretical haul containing 75 bycaught fish, where the observer hypothetically samples 1%, 25%, 50%, or 75% of the haul, simulated 10,000 times. The average bycatch estimate accurately reflects the true number of 75 fish, although individual estimates vary and reflect greater uncertainty when the sample is smaller. Although the estimate for any individual haul may not exactly match the true amount of bycatch, the estimate for the fleet as a whole encompasses both under- and over-estimates and accurately reflects the true fleet-wide bycatch.

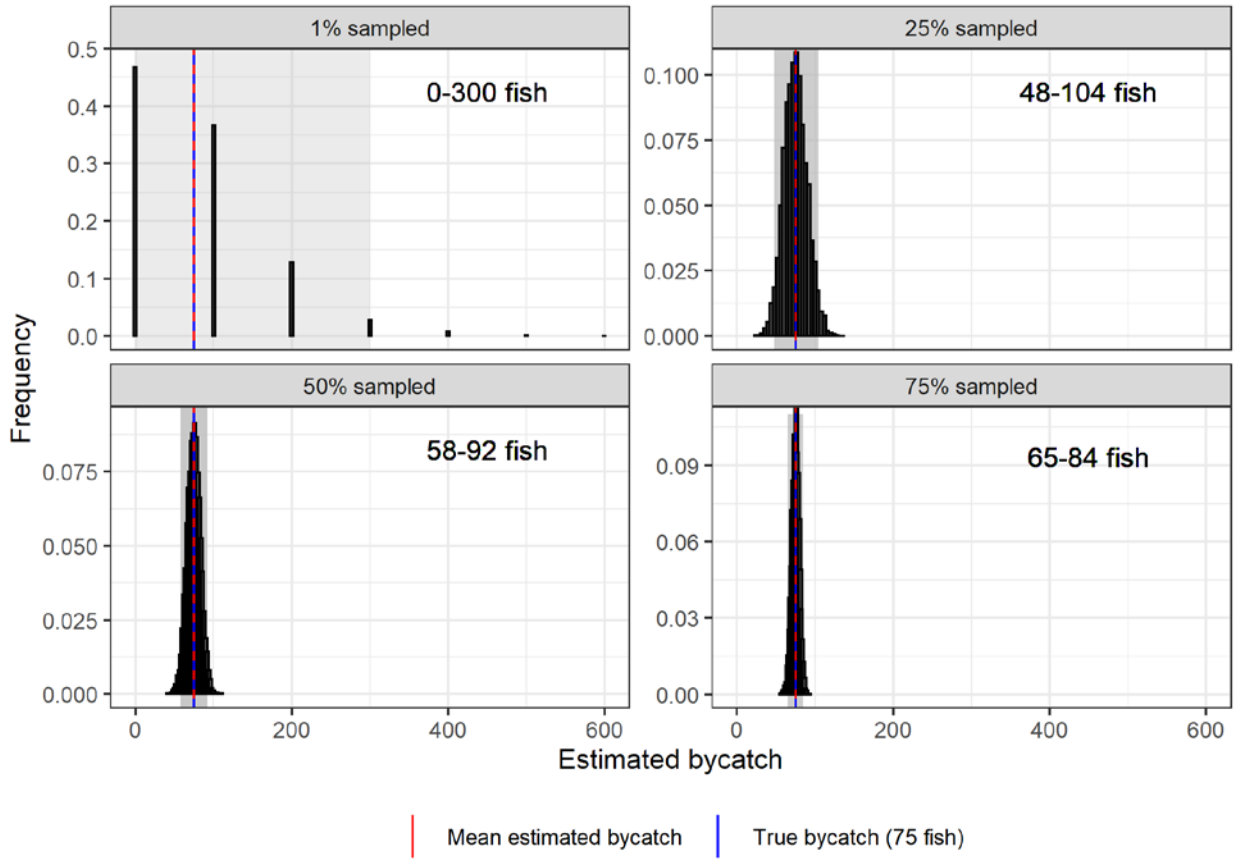

Figure 2. Estimated bycatch from 10,000 simulations of sampling 1%, 25%, 50%, or 75% of a haul containing 75 bycaught fish. Gray shading indicates the middle 95% of estimates, with the upper and lower values of this range indicated by the text in the upper right. At very low sample rates (1%), the most common estimate is an underestimate of true bycatch, but estimates can vary widely. As sampling rate increases, the range of estimates decreases towards the true value. Mean estimated bycatch is approximately equivalent to the true bycatch of 75 fish at all sampling levels. Note that less than 1% of hauls were sampled at a rate of less than 10%.

Over the last three years, bycatch in the at-sea hake fleet has steadily increased, with the observed bycatch rate in 2019 equivalent to 145% of the rate observed in 2016 (Figure 3). Observers face significantly greater burdens in sampling this catch, but have continued to use their training and experience to maintain large sample sizes and, when feasible and appropriate, request assistance from vessel crew.

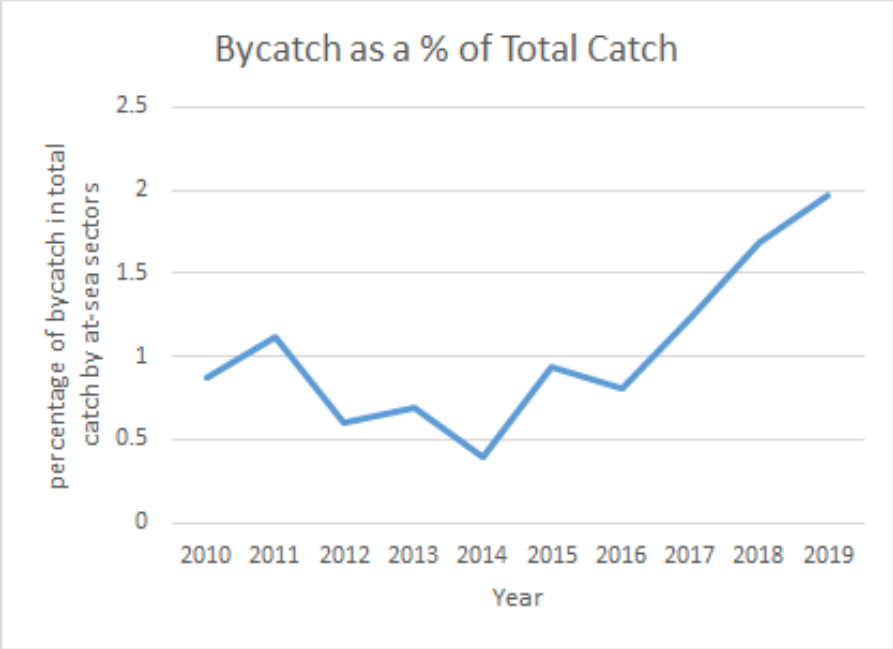

Figure 3. Bycatch as a percentage of total catch weight in the at-sea hake sectors from 2010 to 2019.

This report and the discussion around observer sampling was precipitated by a November 2019 tow that consisted of 57% bycatch by weight. A typical tow consists of <2% bycatch by weight. Fifty percent of the haul's weight consisted of just one bycatch species. Thirteen species were present in the haul, including Chinook salmon. When the codend was dumped, the crew and observer mutually agreed it to be a very high bycatch haul, and the presence of Chinook salmon was undetected at that point. Following sampling protocols, the observer indicated to the mate that smaller, systematic samples were the only viable option for such a high bycatch haul, and the mate accepted that determination. When the observer sampled the randomly-selected second half of the haul, 20-30 salmon had already been collected by the crew during the first half of the haul. Because these salmon were collected outside of the observer's species composition sample, the observer followed program protocol and requested they be discarded. The observer then recorded three Chinook salmon in their sample, which resulted in an expanded estimate of 132 salmon for the entire haul. The estimation method used by the observer program is statistically valid. Due to the nature of random sampling, we cannot rule out that this was, by chance, an overestimate of the true number, just as we cannot rule out that it was an underestimate. However, on average, these differences balance each other, and this method provides an accurate picture of fleet-wide bycatch of salmon and other sampled species.

The A-SHOP has demonstrated that sampling efforts have remained high, despite substantial increases in bycatch rate in recent years. Several changes the program will institute as a result of this internal review are:

1. When feasible, during extremely high bycatch events, small, systematic samples will be taken from throughout the haul and not just from the randomly chosen half, as has been

standard practice. This will require good communication between the vessel and observer to ensure it is possible and to identify hauls when this is appropriate, *before* the haul has begun to be processed. We expect this will result in more samples being taken and larger total sample size.

2. As a result of the increased bycatch rates, and also to address other issues which arose this year, the A-SHOP will again hold a pre-season meeting with industry to discuss current issues and trends, and reaffirm the fleet's commitment to helping and coordinating with observers.
3. As needed, the A-SHOP will arrange and attend pre-cruise meetings directly on the vessel, with crew and observers in attendance, to facilitate communication and cooperation.

The NWFSC Observer Program does not feel that any further changes are needed to continue to provide accurate and reliable fleetwide bycatch estimates that provide critical data for fishery management on the west coast. The NWFSC Observer Program believes salmon bycatch estimates are of sufficient accuracy and, combined with existing salmon bycatch mitigation and management tools, provide adequate options to manage salmon bycatch for the fleet.. However, if desired, the Council and NMFS could explore salmon retention regulations similar to those used in the Alaska Pollock fishery, and/or deploying additional observers to increase sampling rates. Either of these options would likely result in greater costs, either to implement a video-monitored salmon bin program or to increase observer program operations. The burden of costs will depend on the type of census program designed, and more analysis would be needed to determine the degree to which NMFS and industry are responsible for those costs.

Regardless of those potential changes, the NWFSC Observer Program will continue to use scientifically-sound procedures to accurately estimate bycatch of all species and provide reliable data for fishery management.