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Technical note

Documenting the reliability of species identifications in the North Pacific Observer Program

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ABSTRACT

Species composition data collected by observers in the North Pacific Observer Program are critical to the effective management of Alaska's commercial fisheries. However, there has been no attempt to quantify the reliability of observer species identifications. Digital cameras were issued to over 120 groundfish observers, who were instructed to document via digital photographs a pre-selected series of fish identifications and submit the photos for analysis at the end of their deployments. Identifications represented by the photos were then assessed visually by the author for identification accuracy. Over 3000 individual identifications were documented, and over 99% of those identifications were correct. Identification accuracy rates for each of the commercial species groups identified by observers (flatfishes, cods, rockfishes, and salmon) were over 98%. Accuracy rates for some non-target species groups, such as sculpins and smelts, were slightly lower. Identifications documented for this study represent a broad spectrum of target fisheries, gear types, and observer experience levels, and therefore are likely to be a reasonable representation of observer identification accuracy throughout the Observer Program. Although there are potential sources of bias that may have inflated these accuracy rates, this study suggests that the overall reliability of species identifications in the North Pacific Observer Program is quite high.

1. Introduction

The North Pacific Observer Program (Observer Program) places fisheries observers on vessels participating in commercial groundfish fisheries throughout the federal waters of Alaska's large marine ecosystems. Observers in Alaska collect a broad array of fishery-dependent data that are used by scientists and fishery managers for purposes such as inseason fishery management, stock assessment, and regulatory compliance. One of the primary duties of observers is to provide a detailed account of the species composition of the catch. They are required to identify all commercially targeted species of fishes and crabs, as well as elasmobranchs, forage fishes, and several species of sculpins to the species level, and all non-target fishes to the family level.

Observer trainees must complete an intensive 3-week training program, which includes at least 12 h of directed instruction on species identification and a laboratory identification exam, as well as annual refresher trainings to maintain their certification. Each observer is issued a suite of field identification guides developed by the Observer Program specifically for use by observers in Alaska's groundfish fisheries. In addition to these training requirements and tools, the Observer Program has instituted a series of inseason and post-deployment protocols designed to prevent and correct errors and to maintain the high quality of observer species composition data (Stevenson et al., 2016). However, observers at sea are essentially on their own, working independently, and often for long hours in difficult conditions. Species composition data cannot normally be independently verified or double-checked *in situ* for accuracy. Once a sample is identified and discarded, the observation cannot be repeated, and the specimens in the sample cannot be subsequently consulted to clarify suspected errors. Furthermore, industry-reported landings for even the most common species in some species complexes may be erroneous (Faunce, 2011). Thus, the reliability of observer species identifications is a critical component of data quality, and some large-scale method of verification is highly desirable.

Verification of observer species identifications could potentially take several forms, including whole specimen collections, genetic tissue or scale samples, and photographs. Unfortunately, space and budget limitations preclude the independent verification of species composition samples by a second observer at sea (e.g., Hobbs and Waite, 2010). Similar logistical limitations prohibit the collection of large numbers of specimens for shipment to National Marine Fisheries Service (NMFS) offices and subsequent verification. In fact, a pilot project for widespread specimen collections was initiated in the early 1990s, but quickly abandoned due primarily to the logistical difficulties associated

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Table 1
Count of correct and incorrect species identifications documented by digital photographs for this study, as well as total count of taxa documented by study participants and total count of taxa reported by all observers during the study period, separated by species group.

Species group	Correct	Incorrect	Total	(% correct)	Taxa documented	Taxa reported
Flatfishes (Pleuronectidae)	1439	3	1442	99.8	17	21
Cods (Gadidae)	502		502	100	3	3
Rockfishes (Scorpaenidae)	232	3	235	98.7	18	31
Salmon (Salmonidae)	56		56	100	2	5
Sculpins (Cottidae)	302	7	309	97.7	9	10
Skates (Rajidae)	299	1	300	99.7	10	11
Smelts (Osmeridae)	18	1	19	94.7	3	3
Sharks (Selachii)	7		7	100	2	5
Other fishes	322		322	100	23	42
Crabs	92	1	93	98.9	12	21
Total	3269	16	3285	99.5	99	152

with large specimen collections (J.W. Orr, AFSC, pers. comm.). The widespread collection of genetic samples for species verification, which has been explored in more limited fisheries (e.g., Garcia-Vazquez et al., 2012; Tillett et al., 2012), would potentially be feasible for observers at sea, but the analytical costs of processing such samples on a large scale are still prohibitive. In contrast, the quality of basic digital point-and-shoot cameras has steadily improved in recent years, and their cost has dropped to the point that purchasing a large number of digital cameras for deployment with observers is no longer cost-prohibitive.

The purpose of this study was to document the reliability of observer species identifications using digital photographs of pre-selected species composition samples from a large number of observers deployed in various fisheries and seasons throughout Alaska. A secondary goal of the study was to examine the relative identification accuracy rate for various species groups to identify potential program training issues and better target training resources.

2. Methods

Observers chosen to participate in this project were all prior observers who had completed at least one 90-day contract. Starting in May 2015, project participants were chosen at random within each 4-day briefing class, with the total number of participants dependent on camera availability. Participants were given a succinct overview of the project goals, expectations, and procedures during their annual briefing. Each was issued an Olympus Stylus 850 (8 mp) or Olympus Stylus Tough (12 mp) digital camera, charging cable, and a summary of project instructions.

Observers chosen for participation in this project were instructed to pre-select a series of samples for photographic documentation. Observers typically take several samples per haul, and the number of hauls sampled, as well as the number of samples taken per haul and the size of the samples, is determined by a number of factors (e.g., catch diversity, time and space considerations, available equipment, etc.). Although the sample selection method was left to the observer, thereby limiting the impact on standard sampling priorities, participants were encouraged to choose samples either at random or at set intervals. It was emphasized during training that each project sample must be pre-selected to minimize selection bias. For each selected sample, observers were instructed to document each species in the sample with digital photographs, including all fish species and prohibited crab species. Documentation of Pacific cod (*Gadus macrocephalus*), walleye pollock (*Gadus chalcogrammus*), and miscellaneous invertebrates was optional. For each species in the chosen sample, observers were instructed to select a representative specimen and photograph that specimen with a label including cruise number, vessel identification (Federal fisheries permit) number, haul and sample number, and species identification. Participants were encouraged to maintain their standard identification practices when completing this project, and were encouraged to take multiple photographs of each specimen, including close-focus photos documenting identification characteristics not visible in a lateral view of the whole specimen (e.g., gill rakers).

At the conclusion of their cruises, observers returned the digital cameras to the main Observer Program office in Seattle, where the photos were uploaded to a project database. The photos were examined by the author, aligned with species composition data in the main Observer Program database, and assessed for accuracy. Each species identification received a score of “correct” or “incorrect.” Overall identification accuracy was calculated two ways: first as the simple count of correct identifications divided by total identifications attempted for all observers combined, and second as the simple mean of identification accuracy figures calculated separately for each observer participant.

3. Results

From May 2015 through April 2017, 649 returning observers completed Observer Program annual training in Seattle. Approximately 19% of these observers (124 of 649) were issued digital cameras. Of the 124 observers issued cameras, 68% (84 of 124) submitted photos suitable for this project, and 3% (4 of 124) submitted photos during two separate deployments. Another 6% (8 of 124) of observers submitted photos not suitable for the project (due to labeling issues), and 5% (7 of 124) had some sort of technical issue with the camera. The remaining 17% (21 of 124) did not participate in the project. As of July 2017, a total of 84 observers had submitted 11,037 photos representing 3285 species identifications (Table 1). Approximately 99.5% (3269 of 3285) of the specimens documented in the photos were identified correctly. Only 16 (0.5%) of the 3285 specimens documented were clearly misidentified. In a small number of cases ($n = 26$), photographs did not provide enough information to determine the correct species-level identification. This set of identifications was primarily composed of specimens of the genera *Atheresthes* (arrowtooth and Kamchatka flounder) or *Lepidopsetta* (northern and southern rock soles) for which gill raker counts were not documented. These identifications were scored as “equivocal,” and they were excluded from the analyses. The 84 project participants each submitted 1–370 identifications (mean = 39.1), with 0–3 misidentifications per observer. Individual accuracy rates ranged from 80 to 100% (mean = 98.8%: Fig. 1), with 71 of 84 observers obtaining 100% accuracy.

Documented identifications were broken down by species group to assess the relative performance of participating observers on different fish and invertebrate taxa (Table 1). Nearly all species groups were identified correctly in 95% or more of specimens documented, and most groups were over 98% correct. The lowest success rate (94.7%) recorded was for smelts (Osmeridae), although this was the result of a single misidentification due to the small sample size for this group. A total of 99 fish and crab taxa were documented by observers participating in this project, which was 65% (99 of 152) of the taxa reported throughout the program during the study period (Table 1), and