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Species Identification in the North Pacific Observer Program: Training, Protocols, and Data Monitoring

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ABSTRACT

The Alaska Fisheries Science Center's Fisheries Monitoring and Analysis Division is responsible for development, implementation, and continuing operation of the North Pacific Observer Program. Observers in this Program are expected to accurately and consistently identify all commercially important fish and crab species as well as numerous other species, including forage fishes, elasmobranchs, and some species of sculpins. Because consistently accurate species identifications are such a critical facet of observer data collection, the Observer Program has implemented a series of policies and procedures to ensure that the species composition data collected by observers are as accurate and complete as possible. This document provides an overview of those procedures and policies. It is organized in three sections that correspond with the three phases of an observer's deployment sequence. The first section covers hiring and pre-deployment training, including hiring prerequisites, training procedures, certification exams, and field identification materials. The second section covers the actual deployment period, including species and species groups identified, confirmation procedures, inseason advising, and the special cases of species groupings used for longline data. The third and final section covers post-deployment debriefing and quality control measures, such as error checks, staff review of species identification forms, photographs, and collected specimens, and the evaluation of observer performance.

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INTRODUCTION

The Alaska Fisheries Science Center's Fisheries Monitoring and Analysis (FMA) Division is responsible for development, implementation, and continuing operation of the North Pacific Observer Program (Observer Program). The Observer Program places fisheries observers, which are provided by independent contracting agencies, on vessels participating in commercial groundfish fisheries in the federal waters of the Gulf of Alaska, Bering Sea, and Aleutian Islands region of the North Pacific Ocean. Fisheries observers in this region are expected to complete a number of complex tasks, with a multitude of responsibilities and duties that must often be accomplished in difficult conditions with minimal support while deployed at sea. To become a certified observer, new trainees must complete a 3-week intensive training class that covers all aspects of safety, sampling, regulations, species identification, and various other topics related to their responsibilities as groundfish observers. During their deployment, observers are supported remotely by an inseason advisor and by staff located in field offices in Anchorage, Dutch Harbor and Kodiak, Alaska. At the conclusion of the deployment, each observer participates in a debriefing interview, during which data checks are performed, data quality and sampling issues are discussed, and the observer's work is evaluated. Before returning for subsequent deployments, observers are required to participate in additional briefing and training classes.

One of the most important and challenging aspects of observer data collection is accurate and consistent identification of the species composition sample. Alaska's marine waters are inhabited by nearly 500 species of fishes (Mecklenburg et al. 2002), as well as several commercially important crab species and hundreds of other invertebrate taxa. Although catch

diversity varies considerably by fishery and region, an observer sampling in Alaska waters may encounter dozens of species in a single deployment. The diversity of potential primary and bycatch species, compounded by the often difficult working conditions and the enormous scale of these fisheries, creates a challenging environment for observers expected to collect quality scientific data. Consistent and accurate observer species composition data are vital to fishery managers, stock assessment authors, and other data users.

Because consistently accurate species identifications are such a critical facet of observer data collection, the Observer Program has implemented a series of policies and procedures to ensure that species composition data collected by observers and housed in FMA's internal relational database (nicknamed Norpac) are as accurate and complete as possible. These policies and procedures begin with the hiring prerequisites and pre-deployment training of new observers, continue with real-time assistance of observers while they are deployed at sea, and conclude with post-deployment debriefing and data quality control measures. The purpose of this document is to provide an overview of the policies and procedures that have been gradually implemented by the Observer Program since 1990 to ensure high-quality species composition data. These policies and procedures have been implemented gradually since the beginning of the domestic observer program in 1990. Data quality control is an ongoing process and is constantly improving with the addition of advanced technology, the expansion of Observer Program resources, and the accumulation of experience in Observer Program personnel. Therefore, this document serves only as a snapshot of the Observer Program as of 2016, and the practices documented here were not necessarily in place during previous years, nor can they be guaranteed to remain unchanged in the future.

This document is organized in three sections that correspond with the three phases of an observer's deployment sequence. The first section covers hiring and pre-deployment training, the second section covers the actual deployment period, and the third section covers post-deployment debriefing and quality control measures. Additional detailed documentation of observer operations, including an Observer Program overview, sampling manuals, and research, can be found on the FMA Division's web page: www.afsc.noaa.gov/FMA/default.htm.

Section 1: Pre-Deployment Training

Hiring Prerequisites

Observers working with the Observer Program are not employed directly by NMFS but are employees of several contracted observer provider companies. These observer providers screen applicants, provide employee administration and compensation, and oversee the logistics of observer placement and transportation. As of 2016, observers for the Observer Program are provided by the following five provider companies:

Alaskan Observers, Inc. (Seattle, WA)
A.I.S., Inc. (Seattle, WA)
MRAG Americas, Inc. (Anchorage, AK)
Saltwater, Inc. (Anchorage, AK)
TechSea International (Seattle, WA).

Although the observer provider companies handle the applicant screening and hiring, there are a series of hiring prerequisites that have been established by the Observer Program to ensure that all new trainees have a basic skill set before training begins. All prospective trainees must have the following qualifications before being admitted to the 3-week new observer training program:

1) A bachelor's degree or higher from an accredited college or university with a major in one of the natural sciences.
2) Successfully completed a minimum of 30 semester hours or equivalent in applicable biological sciences with extensive use of dichotomous keys in at least one course.
3) Successfully completed at least one undergraduate course each in math and statistics with a minimum of five semester hours total for both.

4) Computer skills that enable the candidate to work competently with standard database software and computer hardware.

Certified observers make extensive use of dichotomous keys in the field, apply sampling theory to produce unbiased data sets, and interact with both standard and proprietary database software to compile and transmit data. Requiring trainees to have some basic knowledge and skills in these areas reduces training time, and increases the probability that the trainees will successfully complete the initial training course and will become successful observers.

Lecture and Laboratory Study

New trainees must complete a 3-week training program to become certified observers. Once certified, observers do not have to repeat the 3-week training unless they demonstrate significant performance problems or are inactive as an observer for a period of 18 months or more. Returning observers must attend an annual 4-day refresher briefing in which updates to protocols and procedures are covered, and identification skills must again be demonstrated. Additional training may be required depending on the observer's performance during deployment.

The 3-week training program includes several components dedicated to species identification training; four 1-hour fish familiarization lectures, four 2-hour fish laboratory sessions, one 2-hour crab training and specimen study session, one 2-hour bird identification lecture and laboratory session, and one practice fish identification exam. Lectures and their corresponding lab sessions each cover a different species group: incidental families, flatfishes, rockfishes, and skates/sculpins/salmon. Lectures are primarily a review of slides using fish pictures to teach the use of the dichotomous keys and to introduce trainees to the important

anatomical characteristics of each group. Each lecture is followed by a 2-hour laboratory session with fish specimens available for study. Trainers are available during the labs to help trainees with identification tools, morphological characteristics, and general fish knowledge. The fish specimens used for training are most often preserved in ethanol, but at times frozen specimens are utilized. Observers generally do not see every fish that they may encounter in the field, but they are taught correct use of the identification tools to ensure all encountered fishes can be identified. The trainee should have the tools and knowledge from the fish identification lectures and lab sessions to pass the fish identification exam, and to accurately and consistently identify fishes in the field.

There is also a training component for the identification of crab species encountered in the North Pacific. The training for crab identification is less time consuming than fish identification due to the smaller number of species involved and the relatively straightforward nature of the identification characteristics. Crab identification training consists of a single 2-hour lecture and specimen study session. This training is done by reviewing slides of general morphology, species-specific anatomical characteristics, and the techniques for measuring particular crab species. The class then uses the rest of the session for individual study on preserved mounts of the crab species. This session ends with a short quiz in which identification and measuring skills are evaluated. This quiz is scored on a "pass/fail" basis, and if a trainee fails the quiz, they must retake the quiz (an alternate version) until they do pass.

Another portion of the identification training focuses on bird identification. The Observer Program started bird identification training in approximately 1993 due to potential regulatory impacts of interactions with endangered species and generally high seabird bycatch rates. This training again consists of a 2-hour lecture and laboratory session using "*Beached Birds –A*

COASST Field Guide to Alaska" (Parrish 2009). This field guide provides a key that uses foot type, bill shape and type, and other morphological features to identify birds. After the lecture, trainees study preserved mounts of all bird species likely to be encountered while deployed at sea. Trainees are also supplied with a plastic placard for identification of albatrosses on the wing. A quiz is given after the lecture/lab portion of seabird identification training. The quiz consists of questions on the use of identification materials, as well as three seabird specimens to be identified. This quiz is scored on a pass/fail basis, and if the trainee fails the quiz, they will be given an alternate version of the quiz and allowed a re-take.

Near the end of the second week of the 3-week training course, the trainees are given a short but comprehensive practical fish identification quiz. This practical quiz is designed to simulate the conditions and timing of the final identification exam and is administered after the fish training lectures and lab sessions, but before the final identification exam. This fish quiz is used as a learning tool, but also as a metric for the acquisition of the required skills gained in training. If trainees perform poorly on the practical, they may be removed from class. This process informs trainees, staff, and observer employers of issues related to poor species identification performance.

Fish Identification Exam

There are two different fish species identification exams, a certification exam for new trainees and an endorsement exam for returning observers. The 3-week certification exam for new trainees is more comprehensive than the annual endorsement exam, as new trainees need to show the total breadth of knowledge and skills gained, while returning observers need to demonstrate that they have retained these skills and knowledge. The two exams are similar in

that both are hands-on practical exams with previously frozen fish specimens and prepared crab specimens. For both exams, students must score a minimum of 80% correct on all sections in order to pass. However, the two exams are very different in terms of the amount of time required to complete, and in the scope of skills that must be demonstrated.

New trainees are allowed a total of 3 hours to complete the certification exam. It consists of five components: use of identification materials, use of salmon identification materials, measurement and sex determination of fishes and crabs, crab identification, and fish identification. The first three sections consist of written questions and skill stations in the classroom; the final two sections consist of fish and crab specimens in the lab.

The first section of the 3-week exam focuses on the use of the identification materials provided by the Observer Program and consists of 14 written questions that test the trainees' ability to find specific information using the provided identification materials. The written questions cover species distributions, identification protocols specific to the program, identification by written characteristics, and general morphology of fish species.

The second section covers the use of salmon identification materials and consists of five written questions about salmon identification using materials provided by the Observer Program. Salmon are considered a high profile species in North Pacific commercial fisheries, as excessive salmon bycatch may lead to closure of a fishery well before the primary species quota is obtained. This section of the exam requires trainees to demonstrate that they have the knowledge required to clearly and consistently identify these important species. The questions are in multiple-choice format, and focus on detailed identification characteristics for all six species of salmon found in the North Pacific Ocean.

The third section covers measurement and sex determination of fishes and crabs and consists of four components:

1. Four fish specimens must be measured correctly. The specimens include various caudal fin shapes and include roundfish as well as flatfish.
2. Four crab specimens must be measured correctly. Specimens include both Tanner (*Chionoecetes*) and king (*Lithodes*, *Paralithodes*) crabs.
3. Sex must be correctly determined from four laminated pictures of fish gonads. Various gonad types and fish taxa are represented.
4. Sex must be correctly determined for two crab specimens: a Tanner and a king crab. The fourth and fifth sections of the exam cover crab and fish species identification.

These sections consist of preserved crab specimens and previously frozen fish specimens that trainees must correctly identify in a laboratory setting. The crab section consists of six specimens, and includes shallow- and deep-water king crabs, shallow- and deep-water Tanner crabs, and incidental crab species. The fish section consists of 15 previously frozen fish specimens, including rockfishes, flatfishes, salmon, skates, sculpins, and various incidental species.

Trainees failing one or more sections of the exam may be allowed a second attempt to take the exam. The decision to allow a repeat exam is made on a case-by-case basis by the certification official with insight from the training staff. Trainees that have shown proficiency in the use of keys, and have stayed in good standing in all other matters are generally allowed to re-test. Only the failed sections of the exam are required to be repeated, using alternate written questions, specimens, or photos depending on the section(s) that must be repeated.

Returning observers with prior experience must pass an endorsement exam on fish and crab identification within the annual 4-day training before their first deployment of each year.

This exam consists of two sections. The first section is five written questions testing the observer's ability to find specific information about salmon identification using materials provided by the Observer Program. The second section is a laboratory practical exam in which observers must correctly identify 10 previously frozen fish specimens and 6 preserved crab specimens. As with new trainees, returning observers must score 80% or higher on each section of this exam to pass. Observers not scoring at least 80% on each section of the exam will be required to retake the failed section(s) of the exam at the next available opportunity.

Field Identification Materials

The Observer Program species identification manual contains the following components:

- Introductory material: Wanted List of Species Requiring Confirmation, Fish Identification: Methods and Definitions
- Dichotomous keys to the identification of various groups of fishes: Jawless and Cartilaginous Fishes, Families of Bony Fishes, Selected Sculpins, Flatfishes, Cods, Salmonids, Skates
- Keys to the identification of crabs and other invertebrates: Crabs, Guide to Corals and Other Invertebrates
- Key to right whale identification
- Albatross Guide

In addition to this species identification manual, observers are issued a color field guide to the rockfishes of Alaska, extracted from Orr et al. (2000), as well as a copy of *Beached Birds: A COASST Field Guide to Alaska* (Parrish 2009) for general bird identification. These guides are not dichotomous keys, but more complex instruments that guide observers through process-of-

elimination procedures to identify rockfishes and birds using various suites or morphological features.

Section 2: Field Practices During Deployment

Species Groups Identified

Observers are trained in the identification of several groups of species (Table 1). Top priority is given to commercially targeted fish species groups (e.g., rockfishes) and crabs, and the bulk of training resources are devoted to those groups. Although not necessarily targeted by commercial fisheries, several additional species groups (e.g., sharks and skates, sculpins), have been recognized as important components of Alaska's large marine ecosystems. Thus, observers are trained to identify several important non-target fish species groups as well. With the exception of commercially important crabs, invertebrates are considered low priority, and observers receive very little training and identification resources for invertebrate identification.

Confirmation Procedures

Species Identification forms (ID forms), completed while deployed, assist observers in accurate identification, aid debriefing staff in assessing the reliability of observer species identifications, and bolster data quality. Observers are required to complete an ID form for each species on first encounter, based on a specimen in hand. The ID forms are designed to prompt observers to examine and document specific anatomical features with forms unique to fish, crab and bird species groups, and thereby assist in accurate identification. The ID forms request information for the following anatomical characteristics by taxon group:

- **Flatfishes**: mouth size (in relation to orbit), preopercle and tail shape, eye size and position, lateral line shape (including accessory dorsal branch configuration if present),

distinctive markings or structures on body, right or left-eyed (pelvic fin symmetry), blindside color, gill-raker count, and anal spine (present or absent).

- **Rockfishes**: color category (red, black, red-black, banded and white-spotted), head spine strength and count, symphyseal knob (absent or present) and maxilla size, body markings, opercle markings, peritoneum color, anal-fin slant in relation to body, and suborbital spines (how many if present).
- **Skates**: thorn distribution and strength (on disc and tail), dorsal coloration, ventral coloration, and patterns of denticles on dorsal or ventral surfaces.
- **Sculpins**: placement of dorsal fins (adjacent or separate), dorsal scale band (if present), anal scale row (absent or present), stellate scales versus spinate scales, preopercular spine (single or branched), body pigment, pelvic fins, and caudal fin (shape, coloration, pattern).
- **Salmon**: silvering and/or spots on caudal fin, coloration at base of teeth, markings on operculum, caudal fin and body coloration, scale size, scale count and gill-raker count.
- **Crabs**: number of walking legs, segmentation of second abdominal plate, rostrum shape, ventral rostrum, lateral margin/branchial ridge, carapace description.
- **Miscellaneous species**: dorsal fin count, adipose fin (present or absent), pelvic fin and its position, caudal peduncle, and lateral line(s) configuration.
- **Birds**: foot type, bill shape and measurement, tarsus and wing cord measurement.

All forms require the observer's name, a unique number associated to an observer's deployment (cruise), assignment (name and a unique number associated to the vessel or plant), and specimen length and weight. Additionally, the forms include a space for the observer to sketch the specimen. If any datum is missing, then the form may be rejected and the observer will be asked to redo the form the next time the species is encountered.

Observers collect fish specimens to aid FMA staff in determining the validity of the identification, satisfy a specimen collection required for a rare species, or to fulfill a request by staff. Prior to or during deployment, observers are given a list of species requiring a specimen

collection. Additionally, staff may request a specimen collection for use in training or to verify suspicious or unusual records (See **Inseason Advising**). The specimen collection may be a frozen whole fish or one to several photographs of the fish that capture important characteristics. Whole fish collections labeled with observer's deployment information are usually dropped in a field office (Anchorage, Dutch Harbor, Kodiak) and shipped to Seattle for confirmation by a staff taxonomist. Rarely, observers are able to bring whole fish collections back to Seattle. Fish collections dropped in a field office are often not available until after the observer has completed the debriefing process, while photo collections are usually done with the observer's personal cameras and are usually available during debriefing.

Inseason Advising

Nearly all observers deployed at sea have an Inseason Advisor. The advisor monitors the observer's data and communicates through an FMA data application (ATLAS) to improve data quality during deployment. Advisors are expected to communicate regularly with observers and check data for errors at least once a week. Observers are expected to respond to advisor requests promptly, and make suggested data edits or changes to sampling methodology in order to maintain high data quality in near real-time.

A suite of automated error checks are applied to observer data during deployment to check for unlikely species. Inseason advisors are encouraged to use these error-checking tools to detect potential problems with species identification by deployed observers. These error checks include a sweep for species that have been reported outside of their normal geographic range, or length and weight records that are outside their normal size parameters, or are rare. Advisors use a suite of software tools to flag and find errors including ArcGIS (ESRI, Inc., Redlands, CA), InfoMaker (Sybase, Inc., Dublin, CA), and Microsoft Excel. Currently FMA uses ArcGIS

software to filter through tens of thousands of observer species records in order to provide staff with a list of species recorded outside their known geographic range. These records are referred to as outliers, and all are investigated and verified by inseason advisors or during debriefing. The speed and convenience of the GIS filter process allow quick detection of problems, and leads to early correction and reduction of future problems.

The GIS model scans all inseason observer records each week for outliers using polygons representing 103 species ranges. The resulting list of outliers is distributed to FMA staff as a spreadsheet. Advisors review the information and contact their observers to resolve or help document any identification issues that may have arisen.

In addition to GIS-based checks for geographic outliers, the FMA database contains a series of known size parameters for many fish and crab species. These include minimum and maximum weights as well as maximum lengths recorded for each species. Records falling outside these size ranges are flagged as outliers, and inseason advisors access flagged records using InfoMaker and FMA-built APEX (Oracle Application Express) applications.

Species Group Codes Used by Observers on Longline Vessels

Because of time and space restrictions in the collection of species composition data on vessels using longline gear (longliners), some taxa that would normally be identified to species are grouped to more general levels. Observer sampling on longliners consists of a tally period and a weighing period. During the tally period, the observer has a clear view of the longline as it is being retrieved and of the specimens coming out of the water, but specimens are not brought to hand, and in many cases must be grouped to more general taxonomic levels. During the weighing period, specimens are brought on board for definitive identification, weighing, and

sample collection. For some groups of morphologically similar species, a distant external visual assessment is insufficient for consistent and reliable identification, particularly for inexperienced observers. Thus, the Observer Program has established a series of rules for identifying morphologically similar species groups "on the line" during tally periods for longline sampling. The following is a list of those rules, by species group, and the rationale for implementing each of them. Boxed sections are reproduced from the 2016 Observer Sampling Manual.

Skates

> The two *Raja* skate species you may encounter are relatively easy to differentiate from each other and the *Bathyraja* group. Because of this, the Observer Program allows observers to tally the *Raja* skates to species on the line. The two Raja skates you can tally to species are:
>
> - ***Longnose skate***
> - ***Big skate***
>
> If you are unable to differentiate longnose skates from big skates on the line, use the category ***stiff snout skate*** (**Raja *spp***., code 167) for these animals.
>
> ***All the other skate species you will see fall into the* Bathyraja *(soft snout skate) group.*** The Observer Program does not allow observers to identify *Bathyraja* skates further to species without the skate in hand. ***This means that you cannot differentiate to species those* Bathyraja *skates during your tally period that were not collected.*** Use the *Bathyraja* spp. code (code 159 soft snout) for any *Bathyraja* skates not identified to species in hand.
>
> If you are unable to differentiate Bathyraja skates from Raja skates on the line, then you must use the skate unidentified code (code 90) for all tallied skates. Contact your inseason advisor as soon as possible about this problem. If you do not have an inseason advisor, contact FMA field staff as soon as possible.
>
> (AFSC, 2016)

Distinguishing skates in Alaska to the genus level is not particularly difficult, as there are only two common genera, *Raja* and *Bathyraja* (Stevenson et al. 2007). The two species of the genus *Raja* are large and have distinctive body and snout shapes. These skates can be identified during an observer's tally period. A quick look at the skate's ventral surface, or a good look at the dorsal surface, is generally sufficient to distinguish the two species of *Raja* from each other. However, there are at least 13 species of the genus *Bathyraja* in Alaska's waters and they are much more

difficult to distinguish from each other. The most reliable method for distinguishing species of *Bathyraja* from each other involves a careful examination of the thorn pattern on the dorsal surface of the specimen. The presence or absence of thorn groups (scapular thorns, nuchal thorns, mid-dorsal thorns), as well as the relative strength of these thorns, are crucial characters for accurately identifying these species. A close examination of the thorn pattern on the dorsal surface of a skate is generally not possible unless the skate is in hand. Thus, observers tallying skates on the line are unlikely to be able to identify species of *Bathyraja* accurately and consistently, and they are required to use the group code "*Bathyraja* sp." for specimens encountered during the tally period.

Sculpins

> There are two sculpin species groups and one sculpin species that can be identified on the line while tallying. They are:
>
> - ***Irish Lord unidentified***
> - ***Myoxocephalus unidentified***
> - ***Bigmouth sculpin***
>
> If the sculpin that you are seeing during the tally period do not fall into one of these categories, you must tally them as ***sculpin unidentified*** (code 400-*Cottidae spp.*).
>
> Specimens that you collected during your tally periods can be identified further to species when you have them in hand.
>
> (AFSC, 2016)

Although there are over 80 species of sculpins known from Alaska's marine waters, observers are only required to identify a small subset (9 species) of large-bodied, high-biomass species that represent important links in Alaska's marine food webs. Because the sculpins that observers identify are relatively large and belong to distinctive genera, identification to the genus level is a reasonable expectation for specimens on the line. Because one of the genera (*Hemitripterus*) is

only represented by a single species in Alaska, the bigmouth sculpin (*H. bolini*), a genus-level identification for that species is effectively a species-level identification. However, the sculpin genera *Hemilepidotus* (Irish lords) and *Myoxocephalus* are each represented by multiple species in Alaska.

Observers encounter at least four species of Irish lords (*Hemilepidotus* spp.) in Alaska's waters, and they are distinguished from each other by coloration and by the pattern of scales on the body. Although some specimens are easily recognizable by coloration alone, most are not, and confirmation using scale characteristics (including presence/absence of scale rows, count of scale rows in each scale band, and relative sizes of scales in each scale band) is not possible without the specimen in hand.

The genus *Myoxocephalus* includes several species, three of which are commonly encountered by observers. These three species can be distinguished from each other using characteristics of the pigment pattern and the presence/absence of stellate scales. As in Irish lords, some specimens of *Myoxocephalus* are readily distinguishable on the basis of coloration alone, although identification is further complicated in this genus by sexual dimorphism in the pigment pattern of all species. But again, confirmation using scale characteristics is not possible without the specimen in hand.

Kamchatka/Arrowtooth Flounder (*Atheresthes* spp.)

> Kamchatka and arrowtooth flounder are too similar in appearance to be tallied to species on the line. For this group, individuals in the tally sample period are tallied as code 149 or "Kamchatka/Arrowtooth." Specimens that you collected during your tally periods can be identified further to species when you have them in hand.
>
> (AFSC, 2016)

Two species of the flatfish genus *Atheresthes* are commonly encountered by observers in Alaska – arrowtooth flounder (*A. stomias*) and Kamchatka flounder (*A. evermanni*). The classic exterior characteristic used to distinguish these two species is the position of the eye relative to the dorsal ridge of the head. In arrowtooth flounder the upper eye is on the dorsal ridge of the head, and can therefore usually be seen from the blind side of the fish. In Kamchatka flounder the eye is on the side of the head, not on the dorsal ridge, and can therefore not be seen from the blind side. This is a characteristic that can be effectively evaluated at a glance when the fish is in hand. However, if the specimen is moving and twisting, the observer is not experienced, or the light conditions are not very good, this characteristic can be very difficult to evaluate at a distance with the fish on the line. Additionally, with the fish in hand, an observer can confirm the identity of the specimen by performing a simple gill-raker count, however this option is not available for specimens on the line.

Rock Soles (*Lepidopsetta* spp.)

> Northern and southern rock sole are too similar in appearance to be tallied to species on the line. For this group, individuals in the tally sample period are tallied as code 104 or "rock sole unidentified." Specimens that you collected during your tally periods can be identified further to species when you have them in hand.
>
> (AFSC, 2016)

Observers in Alaska encounter two species of rock soles (*Lepidopsetta* spp.) – northern rock sole and southern rock sole. Several characteristics are useful for separating northern from southern rock soles in the field, but none of them are 100% effective. Coloration in these two species is highly variable on the eyed side, and therefore generally not useful for identification purposes. On the blind side, southern rock soles tend to have glossy white bands highlighting the myomeres, while northern rock soles tend to be more uniform white in color. However, this characteristic is not consistent across all populations and requires experience to interpret, even if

the fish is in hand. The most useful field characteristic for distinguishing these two species is the gill-raker count, which requires the observer to have the fish in hand, and even that is only about 95% accurate because there is some overlap in the frequency distribution of gill-raker counts for the two species. The only completely effective characteristic for separating these two species is the count of the supraorbital pores, but these are microscopic and therefore cannot be used in the field. Thus, the best reasonable expectation for observers accurately interpreting field characteristics with the specimen in hand is about 95%, and for specimens identified on the line without the confirmation of gill-raker counts the expectation would be much lower than 95% accuracy.

Shortraker/Rougheye Rockfish (*Sebastes* spp.)

> For the Shortraker/Rougheye complex, both rockfish species in the tally sample period must be tallied as code 354 (shortraker/rougheye unidentified). Specimens collected during the tally period must be identified to species once in hand.
>
> Observers are asked to take the following additional information on shortraker and rougheye species:
>
> - Randomly collect 30-40 big red rockfish ***per haul from within your tally sample***.
> - Identify these fish in hand to species.
> - Weigh these fish by species and report them in your longline sample along with any other fish collected for the sample.
> - Collect otoliths according to the priority lists starting on page 13-27.
>
> You may choose to collect sex/length and otolith data from additional individuals outside your tally sample periods. If you do so, these data must be reported as subsample data.
>
> Bycatch of shortraker and rougheye rockfish is often high on sablefish vessels, and you should be able to collect 30-40 fish from within your samples on many sampled sets.
>
> Specimens that you collected during your tally periods can be taken further to species when you have them in hand.
>
> (AFSC, 2016)

Alaska's rockfish fauna includes four species of large, heavy-bodied red rockfishes regularly encountered by groundfish observers – rougheye rockfish (*Sebastes aleutianus*), shortraker rockfish (*S. borealis*), blackspotted rockfish (*S. melanostictus*), and yelloweye rockfish (*S.*

ruberrimus). Yelloweye rockfish exhibit a relatively consistent and distinctive yellowish-orange coloration on the body and head, and are therefore not particularly difficult to identify on the line. Blackspotted rockfish are morphologically almost identical to rougheye rockfish and can only be identified by experienced scientists with approximately 80-90% success. Therefore, it is not reasonable to expect observers to distinguish blackspotted rockfish from rougheye rockfish, even with the specimens in hand, with an acceptable level of accuracy and consistency. Thus, the rougheye rockfish code, in effect, is really "rougheye/blackspotted rockfish". This leaves rougheye and shortraker rockfish, both of which have somewhat variable pigment characteristics and can be very difficult to distinguish from each other at a glance. With the specimen in hand, an observer can produce an accurate and consistent identification by assessing the head spines and suborbital spines, but these characteristics cannot be evaluated while the fish is on the line.

Tanner Crabs/King Crabs

> Individuals within the Tanner crab group and king crab group are too similar in appearance to be tallied to species on the line. For these two groupings, individuals in the tally sample period are tallied by their respective group - either code 3 for "Tanner Crab unidentified" or code 2 for "King Crab unidentified." Specimens that you collected during your tally periods can be identified further to species when you have them in hand.
>
> (AFSC, 2016)

Observers in Alaska regularly encounter four species of Tanner crabs (genus *Chionoecetes*) and four species of king crabs (*Lithodes* and *Paralithodes*). Each species group contains two shallow-water species, generally found at shallow to moderate shelf depths, and two deep-water species, found at deep shelf and continental slope depths. Unfortunately for identification purposes, there is extensive overlap in the depth ranges of shallow and deep water species.

For Tanner crabs, the shallow-water species group can be distinguished from the deep-water species group by subtle carapace characters such as the relative protrusion of the lateral

margin in relation to the branchial region, and the prominence of a triangular pattern of spines on the dorsal surface. To distinguish among the individual species of each group of Tanner crabs additional, often subtle, characteristics of the carapace, eye color, and rostrum must be evaluated. None of these characteristics can be assessed consistently for specimens on the line, even by experienced observers.

For king crabs, it is tempting to base field identifications largely on color, as each of the species is ostensibly named after the predominant color of its carapace (red king crab, blue king crab, golden king crab, and scarlet king crab). However, this practice can lead to significant levels of misidentification, as carapace color can be highly variable, particularly in the shallow-water species. The shallow-water genus (*Paralithodes*) can be reliably distinguished from the deep-water genus (*Lithodes*) by the shape of the terminal rostral spine (single vs. forked), the presence/absence of a ventral rostral spine, and the number of plates forming the second abdominal segment (5 vs. 3). The two shallow-water king crabs (red king crab and blue king crab) are distinguished by the arrangement of spines on the rostrum and by the number of spines on the mid-dorsal plate of the carapace; the two deep-water species (golden king crab and scarlet king crab) are distinguished by the relative size of the marginal spines on the carapace and the arrangement of the spines on the rostrum. None of the rostral or spine characteristics can reliably be assessed without the specimen in hand.

Section 3: Post-Deployment Debriefing

As with the pre- and mid- deployment periods, a set of debriefing protocols are in place, ensuring consistency in quality assurance and control measures between different debriefing staff and observers. These protocols are documented in the *Debriefing Continuity Guide*, which is updated regularly to reflect changes in sampling methods or data recording procedures. In addition, all debriefing staff are required to attend an annual 4-day briefing. After completing their deployment, observers return for debriefing. During this time, a debriefing staff member (debriefer) reviews the observer's data and documentation, and conducts an in-person interview with the observer.

Error Checks for Species Composition Data

Debriefers are responsible for verifying and investigating any outliers in the species composition data and for finalizing the observer's data. The same suite of automated error checks applied to species composition data inseason (see **Inseason Advising** above) is also used during debriefing. Debriefers are expected to follow up on all outlier records listed in the reports generated by the automated error checks by either correcting the misidentification or documenting the reason for accepting a species reported out of range.

Debriefed data are swept for out-of-range records every three months to detect species reported out of their typical geographical range (outliers). If the outlier is considered valid, the debriefer responsible for the debriefing documents the reason for retaining the record in the database using an FMA-built application, thus providing metadata to support retention of these

outliers. If the outlier is not valid, then the debriefer changes the identification and the updated record will be eliminated from subsequent outlier reports.

Staff Review of Species Identification Forms

Observers are required to complete a species identification form for every species upon the first encounter in the field (see **Confirmation Procedures** above). As a part of the debriefing process, species ID forms are reviewed by staff and the observer is asked to verbally describe the characteristics of any unusual, out-of-range, or easily misidentified species they encountered during their deployment. The *Debriefing Continuity Guide*, which documents the procedures used during the debriefing process, is designed to assist debriefing staff with detection of species identification problems and to maintain consistency among debriefers. Additionally, every calendar year, all debriefing staff are expected to take and pass the species identification exam with a score of 80% or higher.

Debriefers use multiple tools to help detect species identification issues, including ArcGIS mapping of species ranges, the Species Identification Manual, and the *Debriefing Continuity Guide*, which lists guidelines to help debriefing staff detect deficiencies in species identification. Debriefers are expected to review all unverified species for the following:

1) Did the observer encounter any species listed on the "WANTED" poster? This list contains species that are rare and is updated by the staff ichthyologists as needed. Observers reporting any of these species, or species that are out of range must bring back a specimen or a photograph for confirmation.
2) Do any species occurring in the data set fall outside the normal species distribution, either depth range or geographical range (GIS outliers)? Depth ranges can be reviewed by referencing the Species Identification Manual as well as reviewing the data error report. GIS outliers can be reviewed in the ArcGIS mapping program.

3) Does the species abundance relative to the rest of the catch make sense? This can be particularly useful for flatfishes with overlapping ranges (Kamchatka/arrowtooth, Bering/flathead sole, flathead sole/petrale sole). A rare species that is recorded more often or in higher numbers than expected may indicate a problem with the identification of the species.
4) Are there any species that are outside of the expected weight or size range? An undersized specimen is not necessarily meaningful, but an oversized specimen is more likely to indicate a misidentification. For example, a skate or rockfish that's "too big" is probably a misidentification. A sculpin that's "too big" is more difficult to interpret.

To ensure all species are checked for accuracy, debriefers use an automated report that lists all species encountered by an observer for their deployment. The report list all species encountered, the number of times encountered and previous verification ratings for deployment being debriefed. The report is generated either through InfoMaker software or run within the Observer Species Identification (OSI) application. The OSI application archives all species ID verifications; including any identification forms, verbal descriptions, specimens, or photographs that are submitted by the observer on each deployment. Within the OSI application, debriefers can evaluate the observer's identification skills using the following four verification methods

(see **Confirmation Procedures** above):

1) Species identification form
2) Verbal description
3) Specimen collected
4) Photograph

Each of these verification methods are scored as Not Rated, Excellent, Good, Marginal, or Unacceptable.

During the debriefing interview, all species listed on the observer's species verification report are discussed, particularly those not previously verified or flagged as outliers. Forms that were submitted at the time of debriefing are reviewed and observers are asked to give verbal descriptions of each species. Any photographs or specimens that are available are also reviewed. If the forms and verbal descriptions are valid, then the species is recorded as "Verified" in the OSI data tables. If the form and the verbal descriptions are not consistent, then the debriefer can use photographs or specimens (if available) to help verify the documentation of the species. If there are still questions about the validity of the identification, then the staff taxonomist may be asked to review the species characteristics with the observer. The OSI record is then updated to reflect whether the species identification has been categorized as "Verified" or "Not Verified". This record remains associated with the observer and can be referenced on future deployments. The verification status for a previously verified species can be changed to "Not Verified" by debriefing staff on future deployments if the observer demonstrates identification issues, such as a new identification form that is not valid, misidentified specimens verified by staff taxonomist, or specimens out of weight/geographical range that cannot be verified.

Review and Assessment of Photographs

Most observers carry some form of camera into the field, as part of a cell phone, tablet, or stand-alone device. Although these devices are primarily used for personal photos, many observers take advantage of personal cameras to document various aspects of their observer experience, including living conditions, sampling station configurations, and unusual catches.

Any photos taken by observers while deployed are defined as observer data under the Magnuson-Stevens Act, and are therefore confidential and subject to restrictions on unauthorized public disclosure. Observers cannot be required to use their personal equipment for data collection, but occasionally personal cameras are used to photograph specimens documented on species identification forms, or as an independent source of documentation for unusual species. In these cases, the photos are reviewed by a staff member during the debriefing interview to assess the accuracy of the species identifications. If the photo documentation supports the observer identification, then the observer is given credit for a verified species identification. If the photos contradict the observer identification, then the species identification is corrected in the species composition data and any additional records of the species in question are assessed. If the debriefer determines that the observer may have a recurring problem with identification of a particular species or species group, then all records of that taxon within the current deployment may be amended. If the debriefer cannot confidently assess the identification of observer photos, the staff taxonomist is consulted. Species composition records suspected to be inaccurate are often amended to a group-level code of a higher taxonomic level (i.e., genus or family), based on the most precise taxonomic level at which the record is thought to be accurate.

In early 2015, the Observer Program received a small number of waterproof cameras from the Northeast Fisheries Science Center (NEFSC) Observer Program. These cameras are currently being issued to observers in all segments of the program as availability permits, with the goal of assessing and documenting the overall reliability of observer field identifications. This project (Documenting the Reliability of Observer Identifications – DROID) is in the early stages, but the results will help to identify problems with current identification protocols and direct training resources to the taxa that are indicated as most problematic.

Confirmation of Collected Specimens

Observers are encouraged and instructed to collect specimens of uncertain identification or unusual circumstances, such as a species found outside its known geographic, bathymetric, or size range or a specimen with unusual morphological characteristics (see **Confirmation Procedures** above). Collected specimens are stored frozen at the field office until a full shipment is amassed, at which time they are shipped to Seattle. Upon arrival in Seattle, the specimens are thawed and assessed by a staff taxonomist, and their identifications are confirmed and recorded. Identification confirmations are then distributed to the debriefing staff, so that species composition records and species verification histories can be updated, as necessary, for the observers that collected the specimens. When appropriate, confirmed specimens may be used to update known species size ranges or geographic distributions. Specimens of particular importance may be preserved and archived at the University of Washington fish collection in Seattle, WA.

Observer Evaluation and Assessment of Additional Training Needs

Program debriefing staff use an internal document known as the *Debriefing Continuity Guide* to help evaluate an observer's performance, including species identification skills. After any species ID forms, specimens, photos, and verbal descriptions are assessed, the debriefer scores the observer with "Meets or exceeds expectations", "Does not meet expectations" or "Not Applicable". Additionally, the observer is given an overall training requirement for the next deployment. If the observer "Does not meet expectations" in the fish identification element of the evaluation, that observer may be required to complete additional training and testing before the next deployment.

Debriefing Assessment and Evaluation of Species Identification. Debriefers use the guidelines in the *Debriefing Continuity Guide* to identify potential deficiencies in the observer's species identification and aid in scoring observer species identification performance. There are four ways that debriefing staff can assess the quality of species composition data and verify species identification skills that are explained in detail in **Confirmation Procedures**:

1) Species ID forms
2) Verbal descriptions
3) Photographs
4) Fish specimens.

Possible scores for species identification are "Not applicable", "Meets or exceeds expectations", or "Does not meet expectations". Guidelines within the Continuity Guide are

1) Were all questionable species sufficiently described?
2) Were all species ID forms detailed and completed?
3) If warranted, were unlikely and/or rare specimens collected?

The score of "Not Applicable" is generally given when an observer only encounters species during a deployment for which they have a verified record for previous deployments. A score of "Meets or exceeds expectations" is given when species ID forms have been completed for all newly encountered species, and the verbal descriptions support the identifications. Additionally, fish specimens and/or photographs can be collected to support the species identification. If an observer has completed a form and it is found unacceptable by FMA staff, or a form is not completed at all for newly encountered species, then a score of "Does not meet expectations" may be given. This score may also be given if verbal descriptions are inadequate or do not match

the documentation of the species ID form, pertinent information is missing from the form (i.e., weight or length), or if key features are not documented.

The three species identification guidelines listed above are considered when scoring species identification questions within the observer's evaluation. The species identification scores are considered along with the scores for the observer's other duties to form a deployment score. A deployment score may be 1 (Meets or exceeds expectations) or a 0 (Does not meet expectations), as defined in the *Debriefing Continuity Guide*:

> **Scoring a One = Meets or exceeds expectations**
> This is a level of good, sound, or high-quality performance. The performance represents a level of accomplishment expected of the great majority of observers. The data and reports are complete, accurate, and contain minimal errors at the time of the debriefing interview. When requested, the observer is willing to complete additional documentation (affidavits, reports, etc.) that is written well and effective for the data end-users.
>
> **Scoring a Zero = Does not meet expectations:**
> This is a level of performance, while demonstrating some positive contributions, shows notable deficiencies. Problems with quality, quantity, and/or timeliness are too frequent or too serious to ignore. Performance is inconsistent and performance deficiencies may result in unusable data. Not all data and reports are ready at the time of the debriefing interview. When requested, the observer refuses to complete additional documentation (questionnaires, statements, reports, etc.).

Briefing/Training Requirements Based on Species Identification. Deployment scores that "Meet or exceed expectations" will be accompanied by a 1-day briefing unless there are other deficiencies (not related to species identification) documented in the same evaluation. Observers whose data do not meet expectations for the species identification element of the final evaluation may be required to complete additional briefing/training. A 1-day briefing may be required if the observer made minor mistakes on the species ID forms, such as forgetting to complete header information, or if the observer did not complete a few species ID forms but was able to provide a strong verbal description or photo, but there is no negative impact on the data. A 2-day or 4-day briefing may be required if the observer meets one or more of the following points:

1) Multiple species ID forms were not completed during a deployment
2) Species ID forms were not completed with fish in hand
3) Species ID forms were not completed to program standards

4) Species ID forms have not been completed for multiple deployments (this will be noted in previous evaluations)
5) Previous debriefing staff gave warnings that score/briefing requirement will be negatively impacted if there are repeated issues with species ID forms.

The 4-day training requires the observer to attend species identification lectures and take a species identification exam. Similar to other testing requirements, observers must pass the exam with a score of 80% or better before redeploying. If the observer fails the exam, then they will be required to retake species identification exam during the next 4-day briefing and pass before being deployed.

Conclusion

The quality control process for species composition data in the Observer Program relies heavily on each of the three phases listed here. Pre-deployment training sets the stage for success, with motivated and well-trained observers that know what to expect during deployment and have the training to effectively collect data in a multitude of situations and under a wide range of conditions. Field practices during deployment are designed to minimize errors, and to correct errors as soon as possible, so that impacts to the data are minimized. Post-deployment debriefing provides an opportunity for a detailed review of the deployment with an experienced staff member to assess what went well and what needs to be corrected, which not only ensures that quality of the data already collected, but provides useful feedback for the observer to use in future deployments.

Species identification procedures used by the Observer Program are continually evolving to capitalize on advances in taxonomic knowledge, technological innovation, and changes in

program priorities and resources. These procedures are implemented and maintained to provide the best possible product for data users such as stock assessment authors and other fisheries managers. The sheer size of the Observer Program and the independent nature of fisheries observing interact to create significant challenges for quality control for all types of collected data. Yet without consistent and reliable species identification of catch composition, the value of all observer data is significantly diminished. Thus, maintaining the highest possible standards for species identification training, data tracking, and quality control are vital to the success of the North Pacific Observer Program.

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Citations

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Table 1. -- Groups of fish and crab taxa identified to the species level by North Pacific observers. All fishes not listed in this table are identified to family, and all invertebrates not listed are identified to various supraspecific levels depending on the group.

Common Name	**Taxa**	**Significance**
Rockfishes	*Sebastes* spp., *Sebastolobus* spp.	Numerous species targeted by commercial fisheries
Flatfishes	Pleuronectidae, Bothidae	Numerous species targeted by commercial fisheries
Cods and pollock	Gadidae	Two species support critical commercial fisheries
Salmon	Salmonidae	All species support commercial, sport, and subsistence fisheries
Sablefish	*Anoplopoma fimbria*	Targeted by commercial fisheries
Atka mackerel	*Pleurogrammus monopterygius*	Targeted by commercial fisheries
Lingcod	*Ophiodon elongatus*	Targeted by commercial fisheries
King crabs	*Lithodes* spp., *Paralithodes* spp., *Paralomis* spp.	Two species targeted by commercial fisheries
Tanner crabs	*Chionoecetes* spp.	Two species targeted by commercial fisheries
Sharks	Selachii	Large, long-lived species with small population sizes and vulnerable life history traits
Skates	Rajidae	Large, long-lived species with small population sizes and vulnerable life history traits
Sculpins	*Hemilepidotus* spp., *Hemitripterus* spp., *Myoxocephalus* spp.	High biomass populations of large-bodied species important in food web dynamics, particularly in the Bering Sea
Smelts and herring	Osmeridae, Clupeidae	Important forage fishes for numerous predators
Giant grenadier	*Albatrossia pectoralis*	Dominant biomass species on the upper continental slope throughout Alaska