Skipper Science Partnership 2022 Season Report & Updates

Compiled by: Hannah-Marie Garcia, Lauren Divine, Lindsey Bloom, Heather Bauscher, Bruce Robson, Chris Tran, Aaron Poe

February 2022

INDIGENOUS SENTINELS NETWORK

AOOS Alaska Ocean Observing System

TABLE OF CONTENTS

Supported in partnership with:

For more information visit: https://skipperscience.org/

Acknowledgments

This work is only made possible in our Alaskan communities through the support and encouragement of a large and dedicated community of fishermen and women and support organizations. We want to acknowledge and thank the Skipper Science community, as well as acknowledge that this work takes place on Indigenous lands and waters which have been stewarded for millennia by Alaska First Peoples. We honor with gratitude these lands and waters and the diversity of the relationships shared among these environments and the People who have stewarded these lands and waters throughout the generations.

EXECUTIVE SUMMARY

Alaskan communities and fisheries are disproportionately affected by climate-related ecosystem impacts including ocean acidification and temperature changes, extreme weather, and coastal hazards (e.g., harmful algal blooms, sea level rise, and erosion). Many Alaska fishing grounds host long-term stock assessment surveys and other monitoring efforts to help understand changes in the marine ecosystem, but they often are only snapshots of particular seasons (e.g., summer months) or are narrow in their scope. The Skipper Science Partnership program taps into the knowledge and observations of Alaska's fishermen, fishing communities, and fishing support industries, filling important data gaps. This program originated from conversations with fishermen throughout the state of Alaska. Fishermen are now using the program's tools and smartphone/tablet app to make valuable observations year-round, often at a finer scale than other efforts. These observations benefit from experience-based local knowledge, which can provide valuable information to managers, including documentation of shifts in species range and trends in fishery stocks.

Skipper Science builds off of the Indigenous Sentinels Network (ISN) platform which has been providing tools to communities in Alaska interested in collecting environmental data for monitoring programs for over 20 years. Since 2021, partners across the state have generated momentum to strengthen the Skipper Science program and we aim to deliver much-needed environmental and biological information from remote locations regarding rapid changes in ecosystems, fisheries, and species of concern. Importantly, Skipper Science has built relationships and trust between the fishing industry and scientists/managers to address conservation challenges driven by rapid and accelerating climate change in Alaska. In this report, we will discuss results from the 2022 season, which included the following efforts:

Over 150 fishermen signing on to participate in the partnership

- 80 environmental and biological observations collected
- Observations from across the state of Alaska including Southeast, the Gulf of Alaska, Prince William Sound, Bristol Bay and many points in between.
- Conversations with fishermen - the Skipper Science team met with fishermen in Kodiak, Cordova, Sitka, Juneau, Naknek, and beyond during dock-talk, mug-up, and other in-port events.

EXECUTIVE SUMMARY

- Bringing science, fishery managers, and fishermen together during a workshop hosted in partnership with NOAA's Alaska Fisheries Science Center. The workshop was attended by 18 fishermen and 22 scientists from various disciplines.

This report discusses designs and strategies used in the development of the program and highlights the expertise of individuals working within commercial fisheries across remote regions in order to enhance our collective understanding of the rapid climate-driven changes occurring in Alaska's marine ecosystems.

Introduction

The Skipper Science Partnership, launched in 2021, is a successful community-based environmental monitoring program that meaningfully engages fishermen, scientists, researchers, and other partners. Those involved in environmental monitoring programs use a variety of terms to describe their efforts, including citizen science, observing networks, contributory research, and participatory monitoring, among others (Sigman 2015). In this report, we use "community-based monitoring" (CBM) as a singular term for all of the efforts undertaken by Skipper Science that involve collaboration between commercial fishing members and partners, and which support the management and use of the observational data collected through the program. Here we use the terms "observations" and "data" interchangeably to refer to any and all information being collected through the program. All observations and data collected in the Skipper Science Partnership are wholly owned by the community of fishermen across Alaska who have voluntarily submitted observations.

Skipper Science serves as a platform to collect commercial fishermen's ecological observations, including changes in fisheries and ocean conditions, in order to deepen the understanding of shifts occurring in Alaska's fisheries and marine ecosystems. The program was launched by the Aleut Community of St. Paul Island Tribal Government (ACSPI), SalmonState's Salmon Habitat Information Program (SHIP), and the Aleutian Bering Sea Initiative (ABSI). More than fifteen public-private and tribal entities now support the program. One of Skipper Science's key tools is a smartphone application ("app") that allows fishermen to easily log observations in real-time from the fishing grounds without the need for wifi or cell signal. They upload the data to a centralized, privacy-protected online database when they return to internet connectivity.

Background

Alaska's marine and coastal environmental changes are among the most severe in the United States. Having warmed an average of 1.5°C over the last 60 years, more than twice as fast as the continental U.S., Alaska is often referred to as the "canary in the coal mine" for environmental and ecosystem change impacts. Alaska's coasts also support many of the world's most economically important fisheries, with over 50% of U.S. seafood production coming from the Bering Sea alone. In the face of rapid, climate-driven ecosystem changes, fishermen and scientists need mechanisms for information exchange that are mutually beneficial, streamlined, broad-reaching, and systematic.

Fisheries in all regions of Alaska — Southeast, Gulf of Alaska, Eastern, and Northern Bering Sea — are changing at a dramatic pace, increasing the necessity of ensuring effective communication processes between scientists and fishermen to monitor and understand these changes (Barbeaux et al. 2020; Peterson Williams et al. 2021).

With over 40,000 miles of coastline, three out of four Alaskans live either along the state's coast or near the rivers that bridge freshwater and marine coastal environments. Many Alaska fishing grounds host long-term stock assessment surveys and other monitoring efforts to help understand changes in the marine ecosystem, but the data generated are often only snapshots of what happens during particular seasons (e.g., summer months). Alaska is home to more than 31,000 fishermen whose industry supports 8,900 vessels homeported in numerous small communities (i.e., Table 1). In addition, most Alaskan communities, particularly Alaska Native tribes, depend on subsistence ways of life, which rely heavily on fishing, hunting, and gathering of local wild resources, and are built upon extensive traditional knowledge and cultural practices (e.g., Bering Sea Elders Group 2011, Gadamus 2013, Kawerak 2014). Furthermore, the inclusion of local, traditional, and Indigenous knowledge as a respected and valid approach adds value and insights to conventional resource management practices and research methods.

Table 1. The number of vessels participating in Alaska's commercial fishing sector in 2019 and 2020. Adapted from Alaska Seafood Marketing Institute Economic Impacts Report (2022).

Alaska Commercial Fishing Sector By the Numbers 2022 (ASMI 2022)*		
Key Figures	**2019**	**2020**
Skippers & Crews	31,300	24,200
Skippers	8,800	7,700
Crews	22,500	16,500
Percent Alaska Residents	65%	57%
Fishing & Related Vessels	8,900	85,000
Ex-Vessel Value ($millions)	$1,988	$1,457
Percent to Alaska Residents	39%	37%
Harvest Volume (millions, pounds)	5,658	5,056

Length (feet)	<23'	23' - 32'	33'- 49'	50' - 58'	59' - 99'	100' - 199'	200'+
Count	2,067	3,229	2,188	722	388	285	38

***** *At the time of publishing this Skipper Science report, no new data were available for 2022 or 2023*

Although Alaska leads international seafood production with over 8,000 registered commercial fishing vessels, structured use of these fleets to document changing marine species ranges and distributions and other biological and ecological anomalies was, prior to Skipper Science, limited.

The fishing community has been engaged in developing Skipper Science since a 2016 pilot project in Unalaska, AK. From May 2016 - December 2016, leaders from the Aleutians to the Chukchi Sea convened in four coastal resilience and adaptation workshops, spearheaded by the Aleutian Pribilof Islands Association (APIA), ABSI, and the Western Alaska Partnerships (WAP). During those workshops, 34 tribes, 15 state & federal agencies, and more than 200 participants met in Unalaska, Nome, King Salmon, and Kotzebue to explore strategies to adapt to unprecedented environmental changes threatening communities. Conversations during those workshops identified a lack of basic information on coastal ecosystems and the need for more active community involvement in data collection as a key priority for action (Pletnikoff et al. 2017). Notably, a comment from a crabbing vessel captain in Unalaska sparked the initial idea to develop a community-driven data collection program that would later become Skipper Science.

"Not much has been done to harvest the knowledge of fishermen; there is a lot more room to work with fisheries skippers and other industry people, whether logistical help traveling to remote communities or collecting marine observations. I hear a lot from locals who are full of observations, such as algae blooms, whale die-offs, and whales in areas they normally wouldn't [at that] time of year..."
(Aleutian Life Forum, 2016)

The 2016 pilot effort was a precursor to the current Skipper Science program and a result of collaborative efforts between the fishing industry, community experts, agency scientists, and NOAA National Marine Fisheries Service (NMFS). Efforts in 2016 focused on creating a digital field guide and developing standardized protocols for making scientific observations at sea with input from Bering Sea groundfish skippers, community members, resource managers, and regional scientists. This early attempt to build Skipper Science had some success in 2016, but there was limited capacity to promote and market the effort and bring fishermen into the program.

ACSPI, SHIP, and ABSI revived the program in 2021 in response to communities and fishermen continuing to express the need to actively involve skippers and fishing communities in data collection efforts. Today, the goal of Skipper Science is to collect a wide variety of observations to fill critical data gaps related to Alaska's fisheries and marine ecosystems. The program aims to develop an observation network for communities and fisheries groups, fostering collaboration between fishermen, scientists, and resource managers, and providing a better picture of changing species distributions.

Goals and Objectives

Skipper Science builds on work already being conducted through the Indigenous Sentinels Network (ISN) platform. ISN was developed by the Aleut Community of St. Paul Island (ACSPI) in the Pribilof Islands, in collaboration with the St. George Traditional Council and Community and Ecology Resources, LLC, and has been operating in Alaska for over 20 years. ISN is an online database tool for non-scientists in remote locations to record and communicate environmental and biological data. The focus of ISN is on effective ecological monitoring by non-scientists and is broad in scope, ranging from documenting coastal erosion rates to counts of locally and regionally important species and observations of environmental anomalies. The ISN online database was designed to be flexible and expandable in order to accommodate the diverse needs of multiple user groups and to allow for multiple detailed data formats, thus providing an already existing framework for adapting to fishermen's needs in Alaska. In recent years, ISN's high credibility as a tribally-led data collection program has allowed the expansion of data collection efforts to other coastal communities outside of the Pribilof Islands. At the same time, rigorous data standards have facilitated partnerships with management agencies to aid with documenting environmental changes.

As Skipper Science continues to evolve, the main objectives are to:

1. Continue establishing community-based monitoring programs that expand real-time data collection and surveillance monitoring for changes in ecosystems, fisheries, species at risk, and climate trends.

2. Systematically leverage the unique expertise, local knowledge, and observations of people working within fisheries and across remote regions to enhance the understanding of the rapid climate-driven changes occurring in Alaska.

3. Build trust and understanding between commercial fishermen, communities, tribes, resource managers, and academia through meaningful, shared work at the center of the effort.

4. Demonstrate a model of collaborative and adaptive science that shows how fishing communities and industry can work in mutually beneficial cooperation with managers and scientists on environmental issues.

5. Help scientists and managers identify locally determined priority areas for climate adaptation planning and research in frontline Alaskan fishing communities.

Many Alaska fishing communities make invaluable environmental and biological observations year-round, frequently at a finer scale than other efforts. Local communities also have long-term perspectives, helping to better interpret data. The Skipper Science program presents a unique opportunity for managers and scientists to work with fishermen, fishing communities, and the fishing industry to systematically turn observations into much-needed data to better inform management.

2022 Skipper Science Program Summary

During the 2022 summer commercial fishing season, fishermen and partners from the Alaska commercial fishing industry collaboratively participated in Skipper Science. The program asked fishermen to document the impacts of climate change in near real or real-time and, if interested, to participate in more targeted research opportunities. Sponsors of the program during the 2022 season included:

- The Aleut Community of St. Paul Island Tribal Government
- The Aleutian Bering Sea Initiative
- Commercial Fishermen for Bristol Bay
- Alaska Fisheries Development Foundation, Inc.
- Bristol Bay Regional Seafood Development Association
- Cordova District Fishermen United
- Yakobi Fisheries LLC. Wild-Caught Alaskan Seafood
- Alaska Marine Conservation Council
- Taku River Reds
- Sitka Conservation Society
- Indigenous Sentinels Network
- Central Bering Sea Fishermen's Association
- Su Salmon Co.
- Copper River Seafood Marketing Association
- SalmonState's Salmon Habitat Information Program (SHIP)
- Alaskans Own
- Central Bering Sea Crabbers
- Alaska Longline Fishermen's Association
- United Cook Inlet Drifters Association

Both the 2021 and 2022 season of the Skipper Science Program recruited and onboarded fishermen from coastal communities via social media, news outlets, other printed media, emails, phone calls, text messages, in-person dock walks, and website engagement. In 2021, the recruitment calls were the most effective method for inviting fishermen to be a part of the initial pilot program. However, in-person engagement on the docks, at conferences, or during community meetings proved to be the most effective method for inviting fishermen to be a part of the program during the 2022 season.

Fishermen got involved in the program by either signing up at www.skipperscience.org/signup or by downloading the Skipper Science app (available on Apple's App Store or Google Play) and then creating their account. Once fishermen were enrolled in the program, all participants received ongoing individualized support and technical assistance with data collection throughout the summer. Whether fishermen signed up online or created their own accounts, staff followed up individually to answer questions and walk through how to log an observation. Fishermen were also guided on the kind of information and data that is useful to record. Observation guides were emailed to the Skipper Science listserve and shared with fishermen as a method to communicate what types of data would be valuable to collect (Figure 1.1 - 1.2).

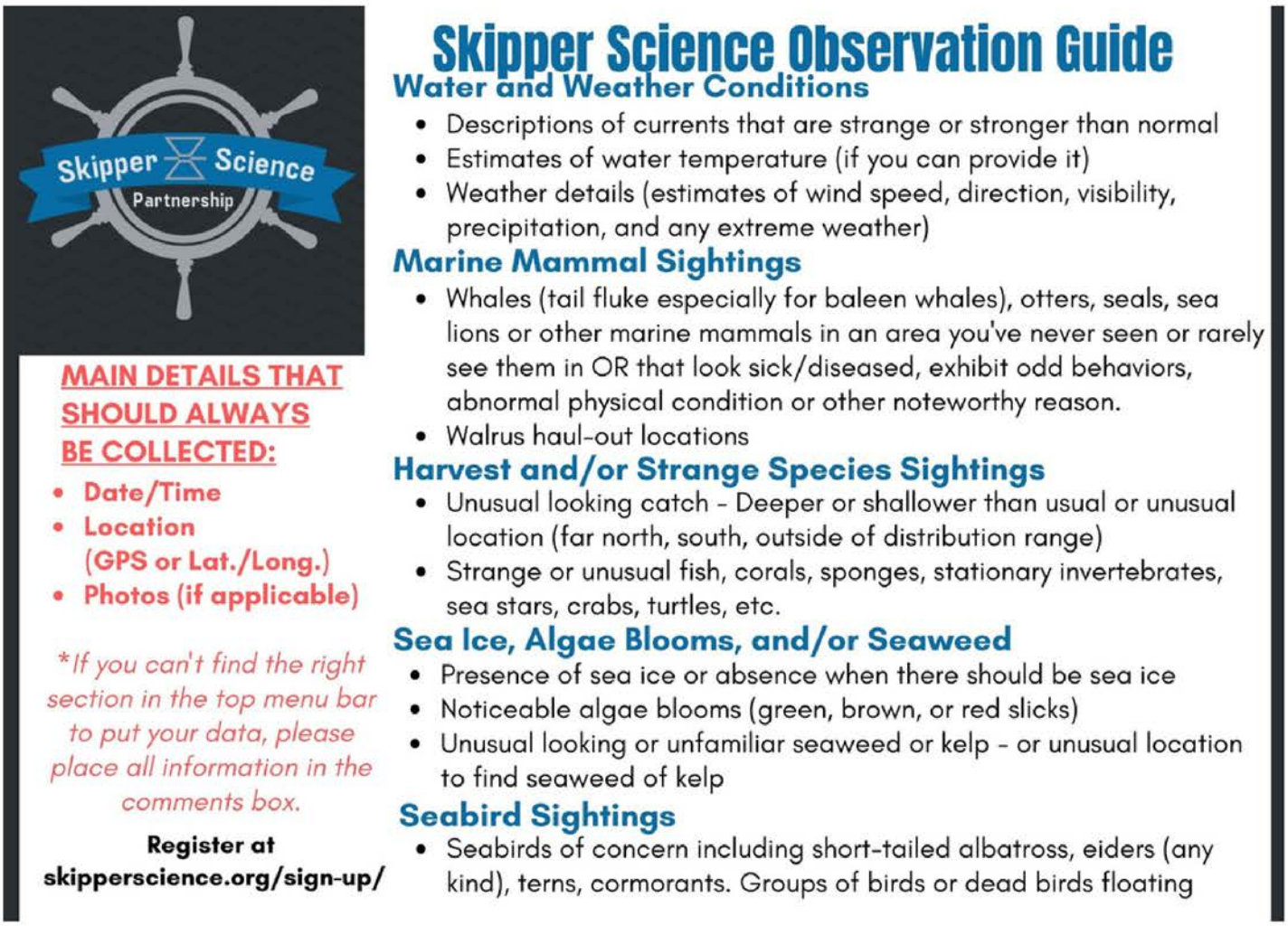


Figure 1.1 Observation guides that summarize important information to collect and how to log an observation.

How To Log An Observation:

1. Log Into the App and Click "+New Observation"

***We recommend saving your login information in a note on your phone so it's handy.*

***Almost all navigation in the app happens using the top menu bar located underneath the words "ISN SkipperScience"*

2. Input the date/time, location, and your name

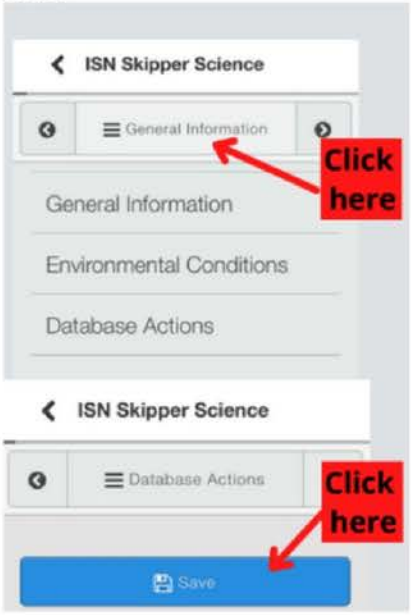
You will first put in the date/time, input your name, and add "SkipperScience" as your program. Then click on the top menu bar, go to "Database Action" and Click Save

3. After saving, click "+Add Observation Details"

In "Location Information" enter your GPS/location (It you do not have GPS enabled on your phone, you will enter it manually. If you are making an observation some time after the event occurred, approximate location is great!). Then click the top menu bar to see all options.

The menu bar has different sections that will prompt questions to help you gather as much information as possible about the observation. You may not be able to answer all sections for an observation. *When in doubt use the comment box*! The more information we have, the better we can respond to, follow-up, or categorize the event.

4. When you finish logging all your details, click on the top menu bar again, go to "Database Action" and click "Save"



5. Once you have Wi-Fi or Signal: from the main menu you will click the blue button that says "Upload now"

Figure 1.2 Observation guides that summarize important information to collect and how to log an observation.

2022 Season Highlights

- 163 new fishermen signed up for the program
- 19 Alaska-based fishing trade organizations supported and endorsed the program demonstrating strong interest from the industry
- 80 environmental and biological data entries collected and submitted by participants
- 124 new followers on Instagram in 2022, for a total of 190 followers
- 52 posts on Instagram (more than 730 "loves"; top video reached 4,000 views)
- 163 people "liked" the Facebook page with 195 people following the Facebook page

- 40 new individuals "liked" the Facebook page in 2022
- Presentation to the House Fisheries Committee, resulting in a letter of support for the program
- 8 presentations given at workshops, conferences, and/or meetings (see Table 2)
- 5 communities were visited by Skipper Science staff to walk docks and speak with fishermen about how to participate in the program

Table 2. Summary of all outreach activities and presentations given by Skipper Science staff in 2022.

Date 2022	Event	Engagement Type	Links and Resources
February	Skipper Science Virtual Workshop	Dialogue, relationship-building between scientists and fishermen	Recording of intro presentation
March 24 - 26	ComFish Alaska	Education booth, outreach, and presentation	Recording of presentation
April 12 - 14	2022 University of Alaska Mariculture Conference	Elevator pitch and poster session	PDF of poster
May 13	Copper River Prince William Sound Marketing Association community meeting	Presentation and fishermen recruitment during community meeting	N/A
August 5 - 7	Salmonfest 2022	Education booth/vendor, community outreach	N/A
October 2	Local Catch Network: 2022 Local Seafood Summit - Panel Session	Panel Presentation with Alaska Longline Fishermen's Association, Fisheries Friendly Climate Action Campaign, and Sitka Salmon Shares	Copy of presentation and workshop descriptions
October 14	United Fishermen of Alaska Fall Meeting	Virtual presentation to UFA board	N/A
December 1	Skipper Science and Alaska Fisheries Science Center Virtual Workshop	Dialogue, relationship building	Copy of agenda

Program Design and Sustaining Engagement

Community-based monitoring (CBM) is critical to understanding how much and how quickly environmental variability and climate change is affecting Alaska's commercial fisheries. CBM has been increasingly recognized for its ability to support communities in their own monitoring and resource management needs while also contributing to the detection of environmental shifts on local and global scales. CBM with commercial fisheries partners in the Skipper Science Partnership is unique in the sense that it involves individuals that are diverse both geographically — ranging from Ketchikan to St. Paul Island — and by vessel type and catch. The Skipper Science community is not "based" in one single location or community. As a CBM program, it is vital that Skipper Science remains flexible enough to adapt to community needs, feedback, and potential research priorities. Skipper Science utilizes methods and protocols that place emphasis on scientifically meaningful data in addition to opportunistic observations (i.e., guiding users on specific types of information to collect for baseline data development while also allowing users to input contextual and unique observations). Observations submitted by community members have quality control check mechanisms built-in for review and analysis of data, and data collection is scientifically rigorous. Skipper Science, as part of ISN, is one example of how information gained from local knowledge holders in Alaska's commercial fisheries can increase the capability of communities, resource managers, and government agencies to respond to changing conditions in an adaptive and collaborative way. Below we will discuss the details of how certain aspects of the Skipper Science program are designed and implemented.

App Development and Refinement

The Skipper Science app is available for free download for either iOS or Android devices from the Apple App Store and via Google Play, respectively. During the 2022 season, the Skipper Science app provided the team with a single platform for fishermen to systematically document physical and biological phenomena on the water. Fishermen who register and sign up to participate in the program receive a secure, unique login with a username and password. The app and database are designed to ensure that user information and sensitive knowledge are protected (i.e., fishing spots, personal information, etc.). The app is designed to guide the user through a series of pages that highlight what information may be valuable to collect. Once participants log into the app, individuals can start a "+new observation" and provide all of the following types of information:

- GPS location - using either the internal receiver on their phone or manually inputting coordinates
- General information - start and end dates/time, who's reporting the information, and an open comments field to include any additional contextual information
- Environmental conditions - weather conditions, wind speed, sea state, tides, air/water temperatures, weather observation method (on-site estimate, NOAA buoy, etc.)
- Observations details - species/object observed (examples: marine mammals, seabirds, various fish species, plants; or environmental monitoring - sea ice, marine debris, surface oil, hazards, etc.), presence/absence of species/object, etc.
- Additional details - location of the species/object observed, its movement, observation trend (increasing or decreasing numbers, less than expected, etc.), trend period (observed over a lifetime, in the season, since last week, etc.)
- Images - pictures can be taken directly from the app or selected from the user's photo gallery

It is important to note that users can either record information while out on the water or input information once they are back on land. The app is designed to not require wifi or a cell signal to use; rather, information just needs to be saved after data is collected. Users can make multiple observations throughout a season - each observation creates a file or a record of what is being observed (see Figure 2.1 - 2.2). For example, if users observe both a marine mammal and the absence of salmon normally seen while in a fishing area, then their observation would be two separate records (i.e., one for the marine mammal and one for the absence of salmon in a given area). All data is saved safely on a user's device until it can be securely uploaded with steady wifi or cell signal.

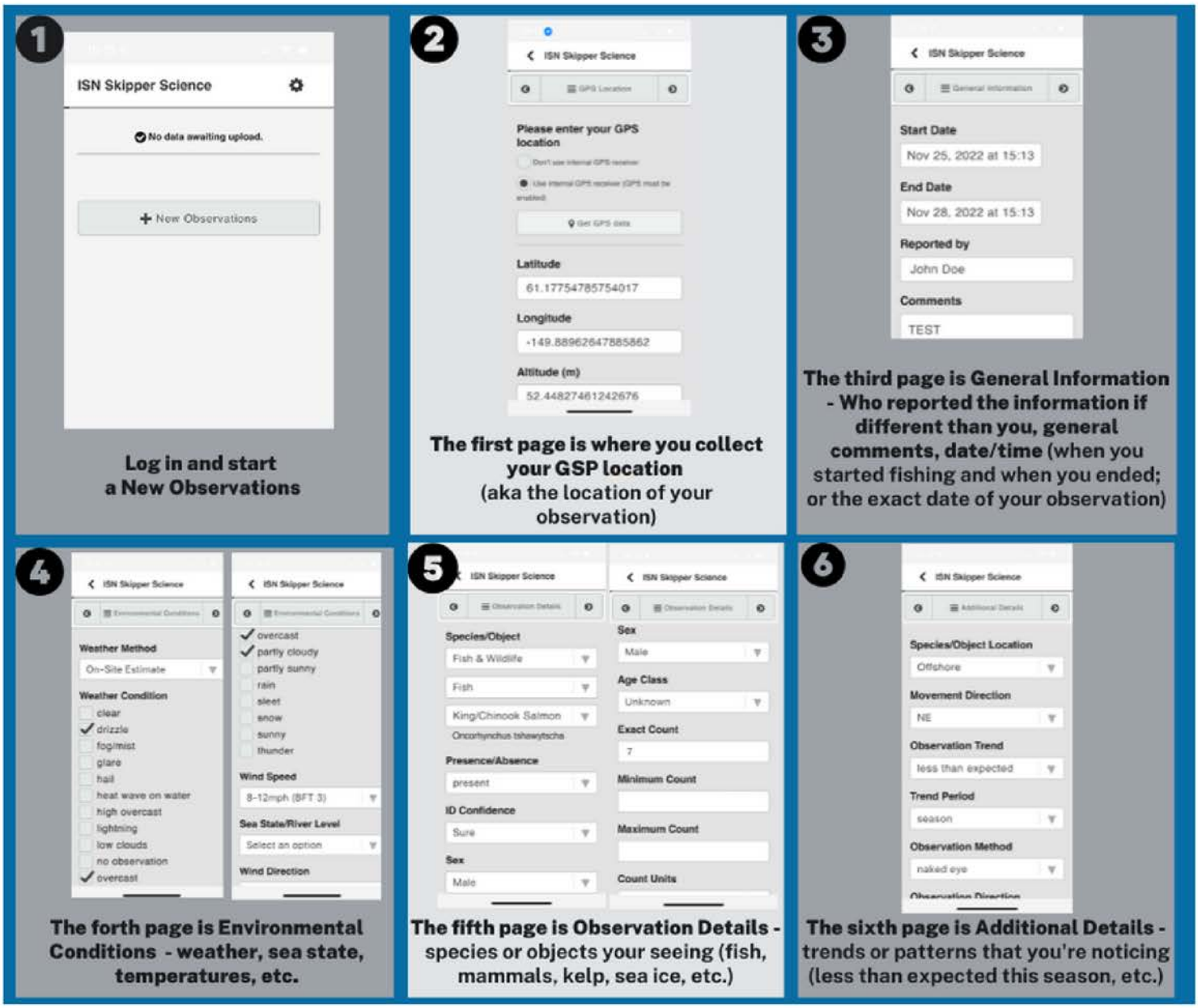


Figure 2.1 Step-by-step example of logging an observation in the ISN Skipper Science mobile app. In this specific example, a user would be observing that king salmon in the area are less than expected at this time in the season.

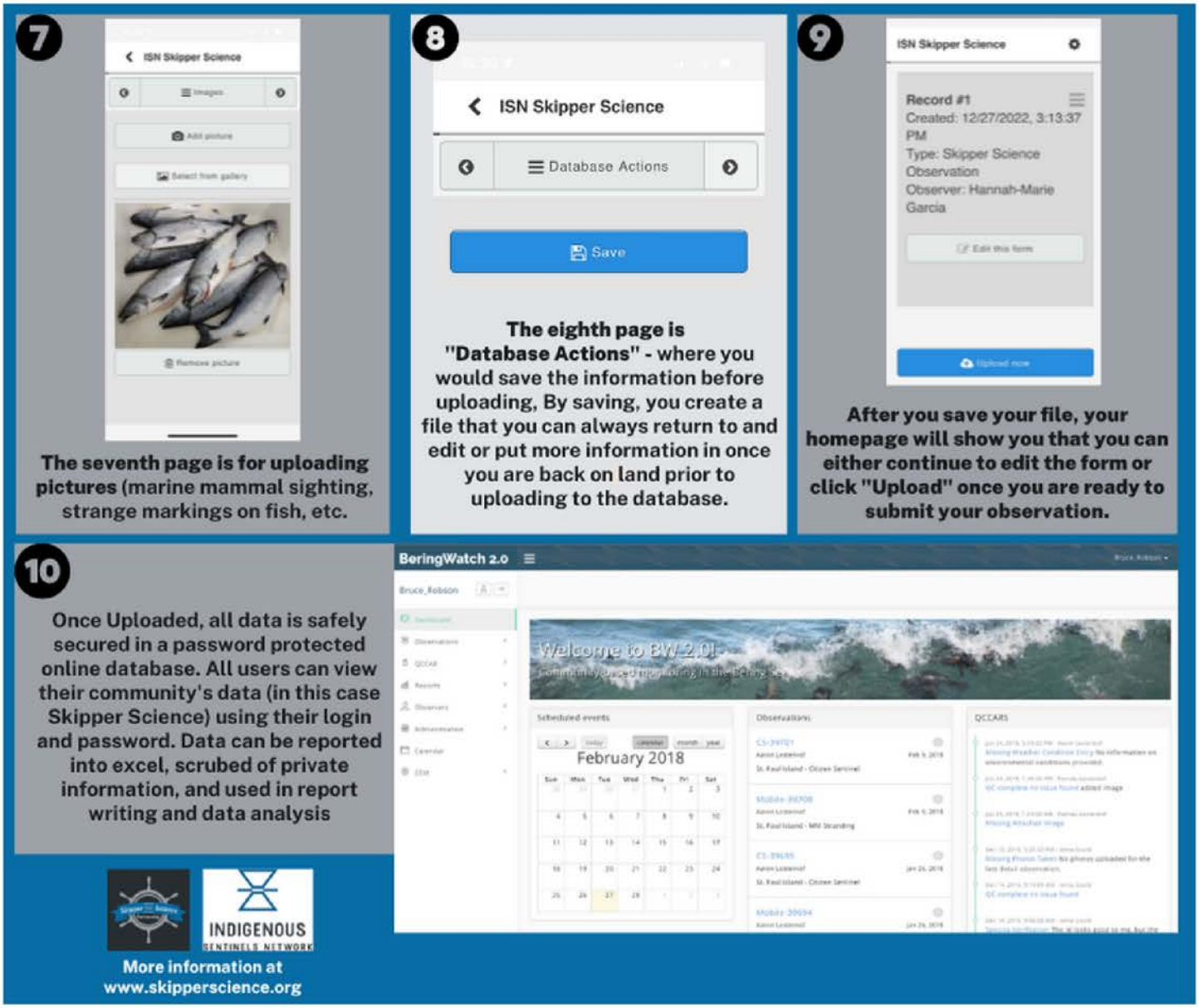


Figure 2.2 Step-by-step example of logging an observation in the ISN Skipper Science mobile app. In this specific example, a user would be observing that king salmon in the area are less than expected at this time in the season.

Methods and Results

Skipper Science Partnership activities mirror the fishing seasons, and engagement is higher during the spring and summer months. Fall and winter are dedicated to gathering feedback, engaging the network in dialogues and workshops, and analyzing the data that's been collected for that year. The engagement of the program participants usually occurs in three phases described in more detail below.

Phase I: The project team created a list of potential participants to target for recruiting prior to the start of the commercial fishing season. Targeted fishermen are recruited via emails to fishing trade organizations, phone calls, social media, Alaska Fisheries Report underwriting, traditional news stories, harbor and dockside posters, and word of mouth. Table 3 below highlights the articles and radio interviews that mentioned Skipper Science in their reporting during 2022.

Table 3. Summary of media outlets covering Skipper Science in 2022.

2022 Press Release written by Salmon Habitat Information Program
Skipper Science program is back and aims to engage fishermen as scientists in the Cordova Times written by Hannah-Marie Garcia
Alaska Magazine | Skipper Science App Helps Track a Changing Ocean
Skipper Science Program is a big success — and growing in Alaska Fish News written by Laine Welch
Fishing For Apps | Skipper Science in Salt Water Soldiers written by Juneautek
Groundbreaking citizen science program continues in 2022 article and radio interview posted by KCAW News
New SkipperScience app in development engages fishermen to report observations in Alaska Sea Grant news written by Anne Gore

In 2021, we offered the opportunity for participants to win $200. In 2022, we were able to increase the honorarium for participants and offer three participants the opportunity to win $500 each. In addition, we also offered $100 to every individual who logged at least one observation before July 1st. Out of all the individuals that signed up in 2022, 68 signed up in person, 73 signed up using the Google form on the website, and 23 signed up publicly by downloading the app and creating their own account.

During the 2022 season, the bulk of the new participant signups came from three main methods of recruitment: 25% from social media (Facebook, Instagram, etc.), 23.7% from word of mouth (friends, family, etc.), and 19.7% from Skipper Science team members walking docks and meeting fishermen in person (Figure 3). Social media ads targeted State of Alaska Commercial Fisheries Entry Commission (CFEC) permit holders, crew license holders, and Federal IFQ holders. The recruitment phase in 2022 was concentrated from March to July 2022. While targeted recruitment is heavy during the early months of every season, continued registration to the program remains open and available throughout the year. In July, however, the Skipper Science team's focus is on observation logging outreach and training.

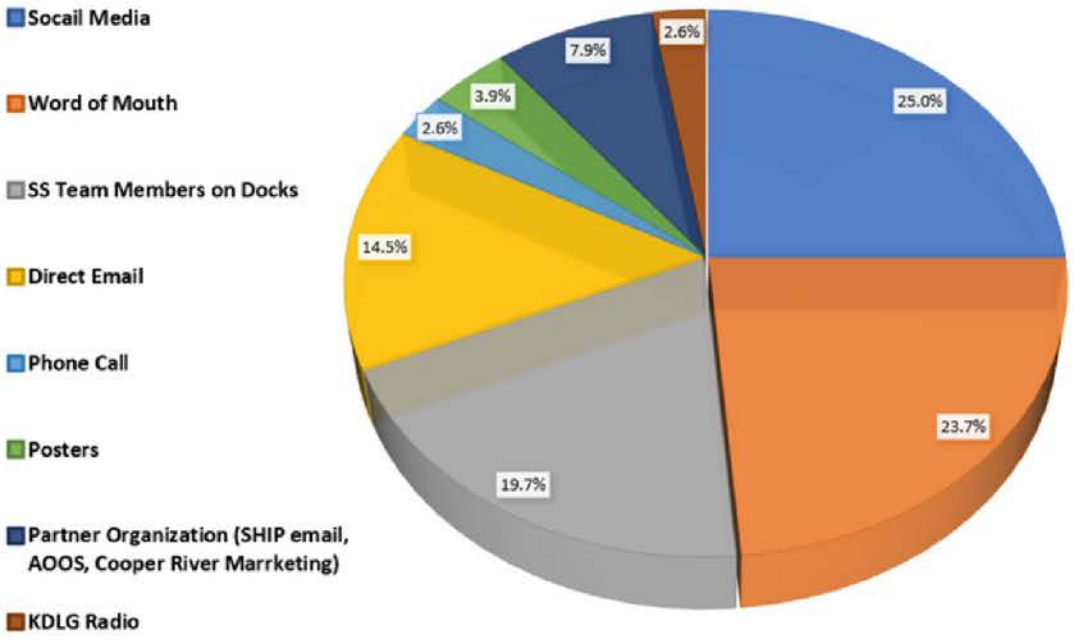


Figure 3. Chart displaying the methods by which participants heard about Skipper Science that resulted in sign-ups during the 2022 season.

For the 73 participants who signed up online using the Google form, we asked what fishing sector or industry they participated in as well as what their gear types and fisheries were. Of those that signed up for Skipper Science during the 2022 season, 76.1% participated in commercial fishing, 7.0% in recreational fishing, 2.8 % in subsistence fishing, 8.5% in all three sectors (commercial, recreational, subsistence), and 4.2% identified as being a researcher/biologist in fisheries (Figure 4).

Out of the same 73 participants, we asked individuals to specify their fishery and gear types. The majority of participants fished using gillnets (29); followed by trolling (16), longline (12), jigging (7), purse seine fishing (6), pot fishing (4), dive fishing (1), guiding (1), and kelp farming (1) (Figure 5).

Those participants that disclosed their fisheries included 40 individuals in the salmon fishery, 13 fishing for halibut, 6 for cod/black cod/sablefish, 5 for rockfish, 4 for crab, 2 for shrimp, 2 for skates, 2 for herring, and 1 targeting sea cucumbers (Figure 6).

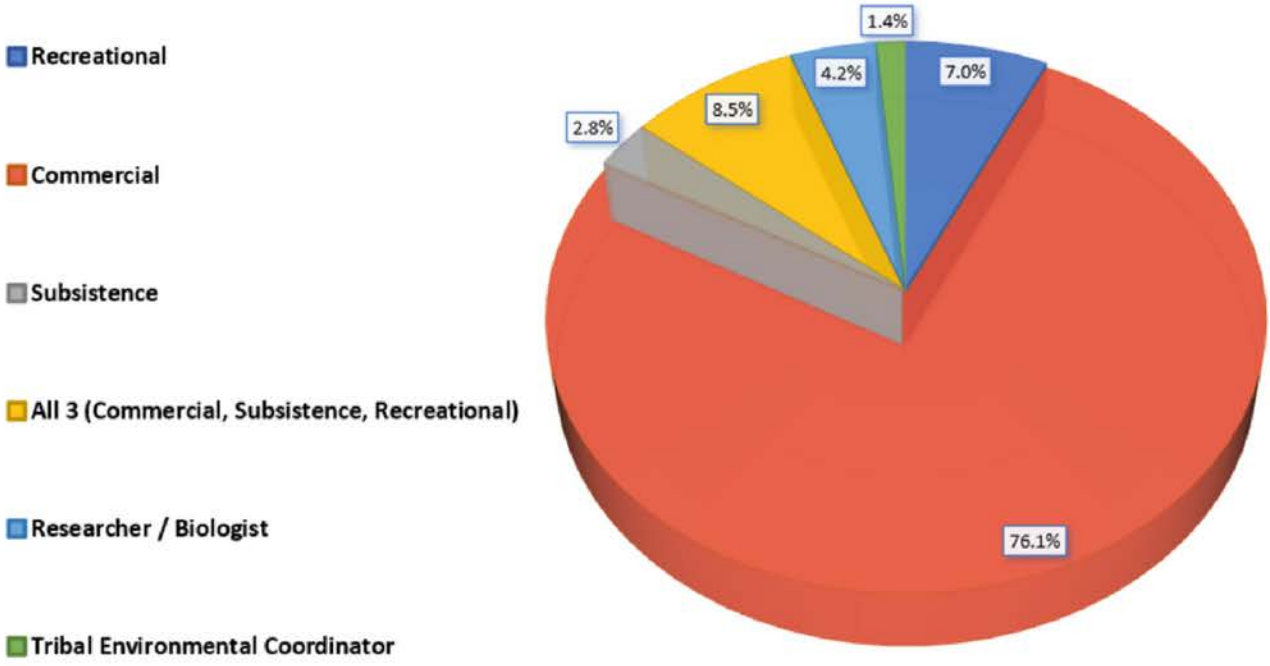


Figure 4. Chart showing the type of fishing industry/sector they worked in when signing up in 2022.

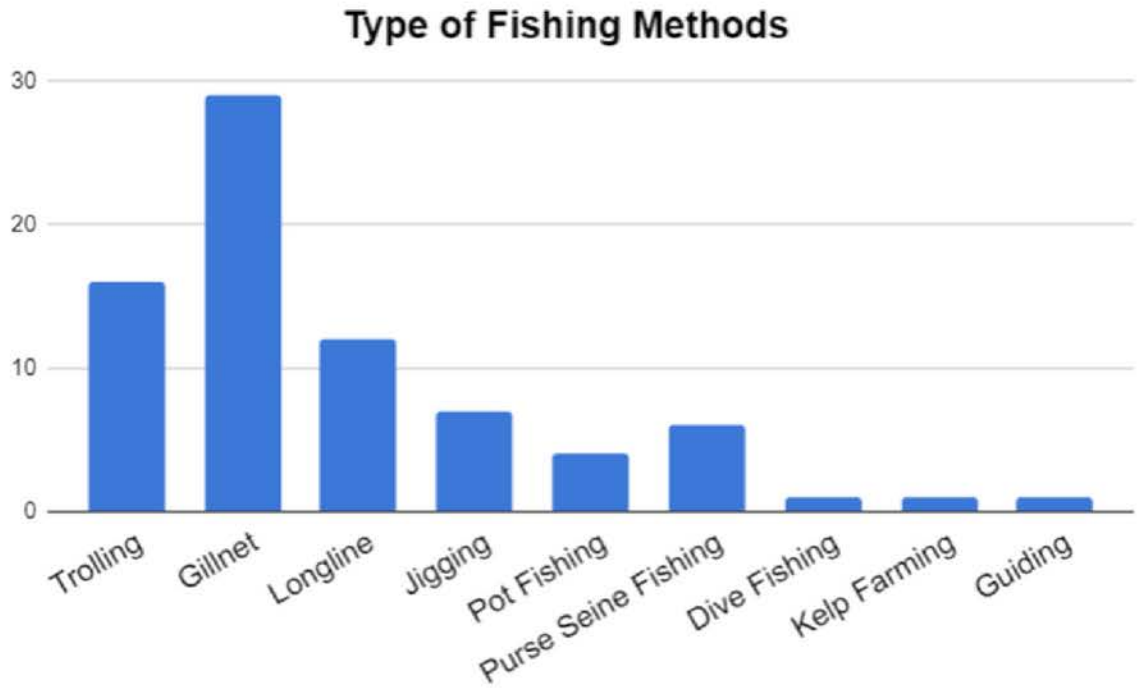


Figure 5. Chart showing the nine types of gear and/or fishing methods that participants identified as their main methods for fishing while participating in the 2022 season.

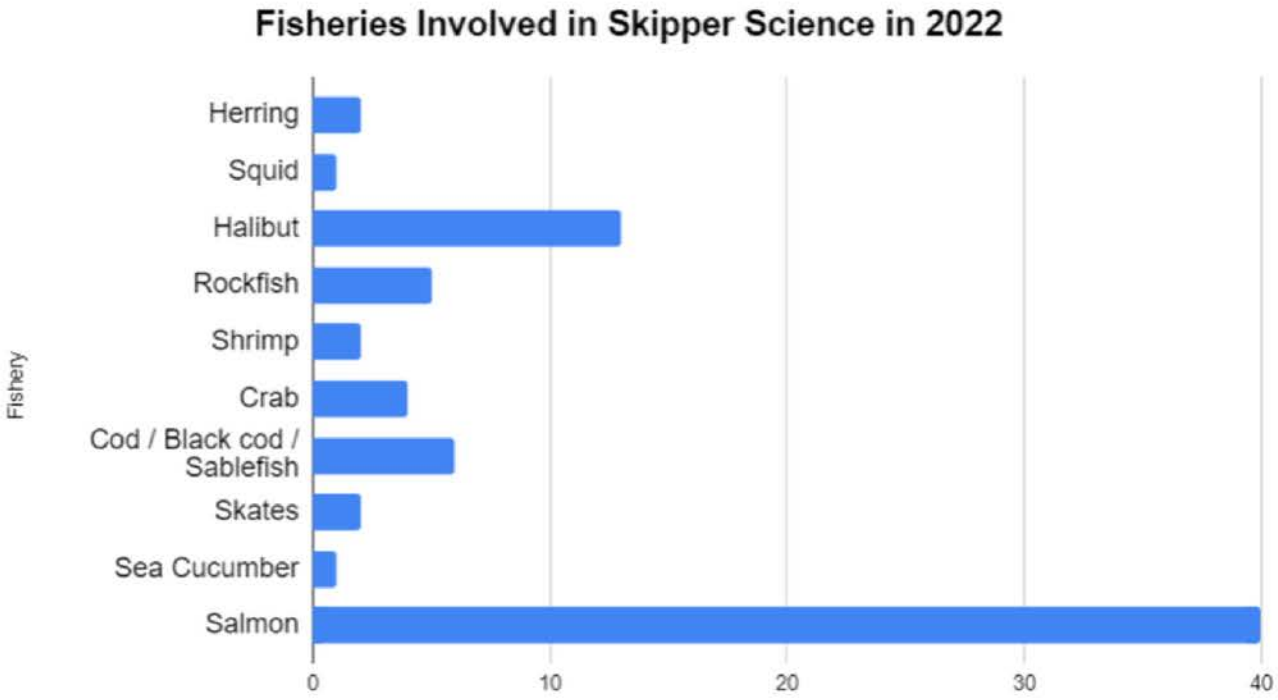


Figure 6. Ten different fisheries were represented by participants in Skipper Science in 2022, with a majority of participants representing salmon fisheries.

Phase II: Once summer fishing was fully underway in 2022, participating fishermen received consistent individualized support and technical assistance with data collection throughout the summer. Skipper Science staff emailed initial instructions about individual accounts, how to use the app, and whom to contact with questions. Throughout the season, in-season highlights and how-to-videos were provided via social media outlets to help facilitate continuous engagement and opportunities for participants to ask questions (Figure 7).

Phase III: As the fishing season came to a close in 2022, we sent announcements and individual reminders to participants via phone calls, social media posts, and emails to log any remaining observations and upload them to the database using the Skipper Science app. In 2022, for those uncomfortable using the app, we also offered the opportunity for individuals to write in their observations using a Google form. Skipper Science staff then manually added Google Forms or email submissions to the database. We concluded the official collection of 2022 observations on October 1, 2022, after which we held a drawing for participants. Each observation was treated as a raffle ticket for the chance to win a $500 “thank you for participating” honorarium. Three winners received a $500 honorarium and twenty-three participants received an additional $100 for submitting at least one observation before July 1st, 2022.

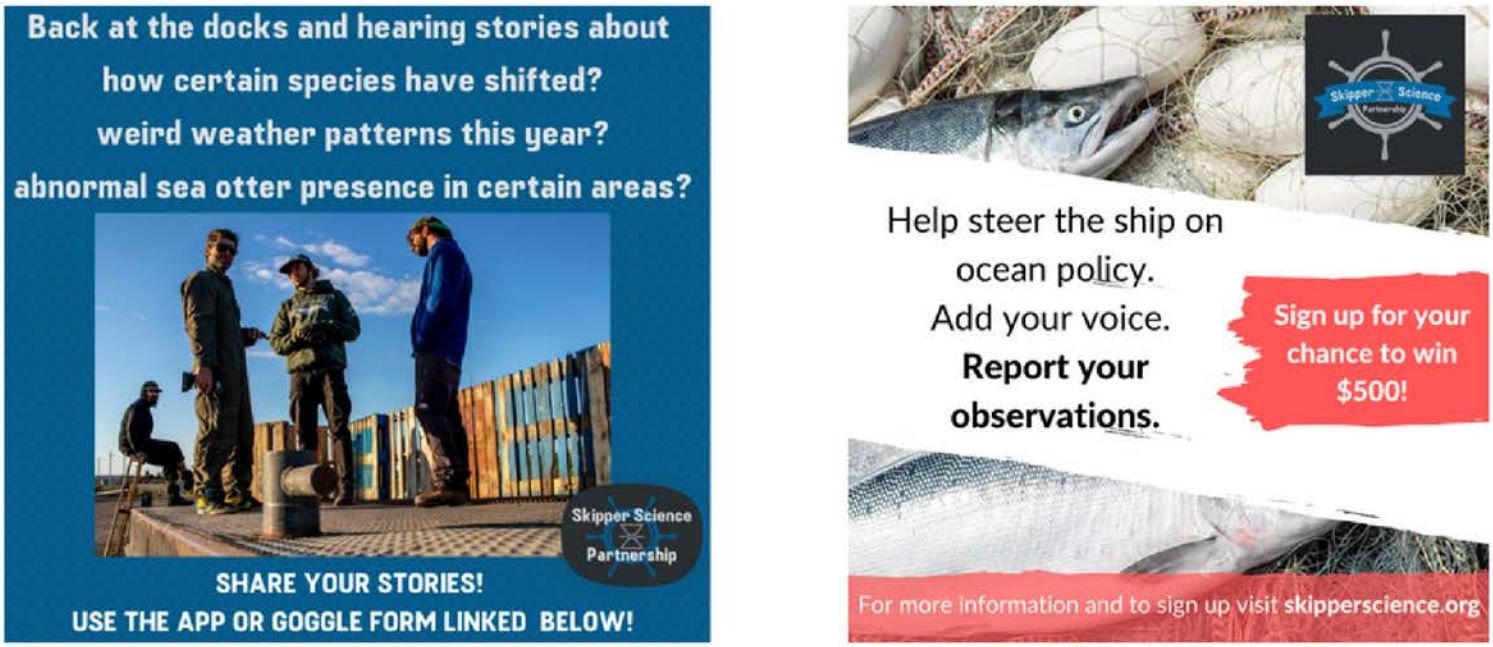


Figure 7. Examples of Skipper Science social media posts from the 2022 season.

Workshop Summaries

While Skipper Science provides a method to collect data directly from fishermen on the fishing grounds, it is also a partnership between fishermen and fisheries resource managers. As part of the program design, we facilitate opportunities for managers, researchers, scientists, and fishermen to come together and discuss research priorities, concerns, and paths forward for more collaborative and adaptive management. As a follow-up to both the 2021 and 2022 data collection seasons, staff hosted workshops and dialogues in order to build relationships between scientists, managers, and fishermen; with the intention of identifying mutually beneficial ways for fishermen to assist scientists to collect data and observations remotely.

The February 2022 workshop gathered feedback on the pilot season and identified future program priorities. Eleven agency scientists or staff and 16 fishermen attended, for a total of 27 participants (Table 4). The February 2022 workshop informed updates to the Skipper Science app and identified priority next steps for the summer 2022 season.

Table 4. Summary of February 2022 Skipper Science Workshop participants

Fishing Community Representation:	Agency Scientists or Staff Representation:
• Alaska Marine Conservation Council • Bristol Bay Regional Seafood Development Association • Prince William Sound Science Center • SalmonState • Sitka Conservation Society	• Alaska Ocean Observing System • National Ocean and Atmospheric Association • National Park ServiceUS Fish and Wildlife Service

In December 2022, at the end of the season, Skipper Science and NOAA's Alaska Fisheries Science Center (AFSC) hosted a workshop to review the outcomes of the 2022 season and confirm potential strategies for targeted data collection and scientist-fishermen exchanges in the Gulf of Alaska (GOA) specifically. The December workshop had the following objectives:

- **Objective 1** - Introduce Skipper Science as an opportunity for data collection and relationship-building that bridges the valuable local knowledge of fishermen with the important efforts of scientists working on climate change and fisheries management in the GOA.
- **Objective 2** - Identify one or more project opportunities in collaboration with AFSC to go forward as a potential funding proposal(s) using Skipper Science as a data collection tool with a focus on the GOA region.
- **Objective 3** - Introduce Skipper Science and AFSC activities/programs to fishermen, other partner agencies, and organizations to inspire ideas about how Skipper Science can work for their needs.

Seventy people registered for the workshop, indicating strong interest. Forty attended — 15 fishermen, 3 staff from fisheries organizations (Alaska Fisheries Development Foundation (AFDF), the Alaska Marine Conservation Council (AMSS), and SalmonState), and 22 scientists or agency staff (including representatives and staff from NOAA, Alaska Ocean Observing Network (AOOS), the Fish and Wildlife Service, and the US Geological Service).

The December workshop had two rounds of breakout rooms in which scientists/agency staff and fishermen could choose from three main themes - (1) ecosystem information and climate, (2) groundfish observations and research needs, and (3) seabird and marine mammal research.

Takeaways from the "Ecosystem Information and Climate" Room:

- Increase the ability for researchers and fishermen in Skipper Science to have two-way communication, gather feedback, and exchange information directly
- Give more guidance on what information is valuable to researchers and scientists; relating to issues around anomalies vs. baseline data
    - For example, there is a need for more baseline temperature data and the shifts occurring in ocean temperatures. One workshop participant referenced how there is a "real opportunity for the jig fleet to take the temperature at depth, already have machines out on the fleets."
- Improve standardization for those participating in the program (i.e., entering into this contract with specific individuals or fleets; setting a target number of observations to submit per individual, etc.)

Takeaways from the "Groundfish Observations and Research" Room:

- Interest in increasing sablefish research surveys. Currently, they take place only in summer so the science is skewed to what goes on during summer given the lack of fall and spring information.
- Using Skipper Science to collect photos could be an avenue for collaboration but we need to have a back-and-forth dialog on what can be done on the boats and on deck.
- There is an interest in finding a path forward for recording ocean temperature at depth; as it could be valuable for NOAA scientists working in GOA
- Interest in collecting information on the location and exact timing of spawning fish when fishermen notice those events to continue to build out the understanding of how species population dynamics may be shifting

Takeaways from the "Seabirds and Marine Mammals" Room:

- Continue building trust and dialogue around bycatch issues for seabirds and marine mammals. In dialogues, participants said it's important to have a place to report bycatch and marine mammal interactions without consequences — that reporting should be in the spirit of improving data and understanding.
- Be clear about where the data goes, and how it's being used, and credit the observers/community that the knowledge comes from. Some people said the ability to enter data anonymously is important and that is something Skipper Science can make possible through its suite of tools.

Data Analysis and 2022 Season Outcomes

The following section summarizes the types of data and information submitted during the 2022 Skipper Science season. The data below is summarized broadly and more detailed descriptions of observations can be provided upon request by contacting Skipper Science organizers at info@skipperscience.org.

Observation and Data Summaries

There were 80 observations logged from May 1st to September 17th, 2022 (Table 5). Of those observations, weather (126 observations) and fish (21 observations) were the most common focal categories reported. Other observations include sea state and tidal conditions (51), water temperature (16), marine mammals (30), sharks (2), seabirds (12), jellyfish (2), and sea ice (1). There were also 12 observations where individuals reported the absence of fish/wildlife; these data points indicate that contrary to expectations, the focal species were not found in the area where they were expected.

Table 5. Summary of the observations that were submitted by participants during the 2022 season..

Observation Category	Totals
Weather Observations	126
Sea State & Tidal Conditions	51
Water Temperature	16
Fish	35
Marine Mammals	30
Sharks	2
Seabirds	12
Jellyfish	2
Sea Ice	1
Absence of Fish/Wildlife	12

Other Observations of Note (Qualitative and Quotes):

- Sea Surface Temperatures: **Warmer than Usual** - Southeast Regions
  - Sep. 4th: 47°F - Chilkoot Inlet
  - Sep. 5th: 59°F - Chilkoot Inlet
  - Sep. 13th: 51°F - Chilkoot Inlet
  - Sep. 14th: 47°F - Sitka Sound
  - Sep. 30th: 50.5°F - Sitka Sound
- "Warship" seen passing (photo upon request) - In Chatham, Canadian Passage on 7/13/22
- "Shortage of deckhands" - reported from Southeast, in Pelican Cove
- "Increase of fuel prices since last year"
- "The price of fuel per gallon was almost identical to the price per lb trollers got for their king salmon this king opener"
- Trolling efforts shifts: 800 vessels (5 yr ago) to 500 vessels (2 yr ago) to 200-250 vessels this year (2022)
- Ocean Acidification increases have been noted by multiple observers

Figure 8. Examples of images submitted by Skipper Science observers. From top to bottom: 1 - Marine Debris observed as an O-ring wrapped around a salmon; 2 - observations of slime and algae coating gear and nets at an "increasing" rate throughout the season; 3 - the image of an increasing amount of strange lacerations and scars were observed on harvested salmon; 4 - an image of a large raft of sea otters (25-35) in Unalaska, AK).

Mapping Results

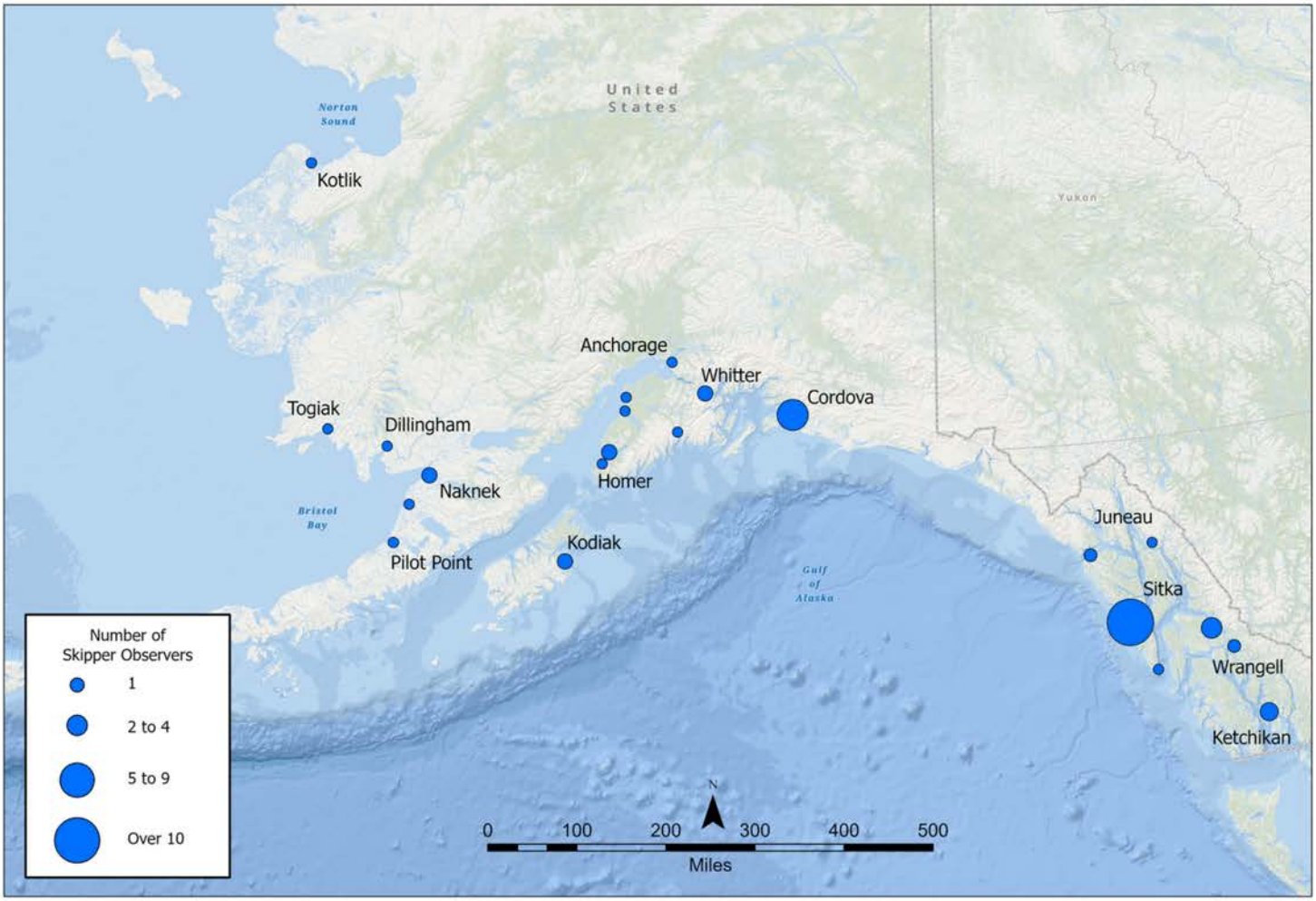


Figure 9. Map showing the homeport and primary locations of participants that signed up for Skipper Science either online or in-person during the 2022 season. (Map created 9/20/22).

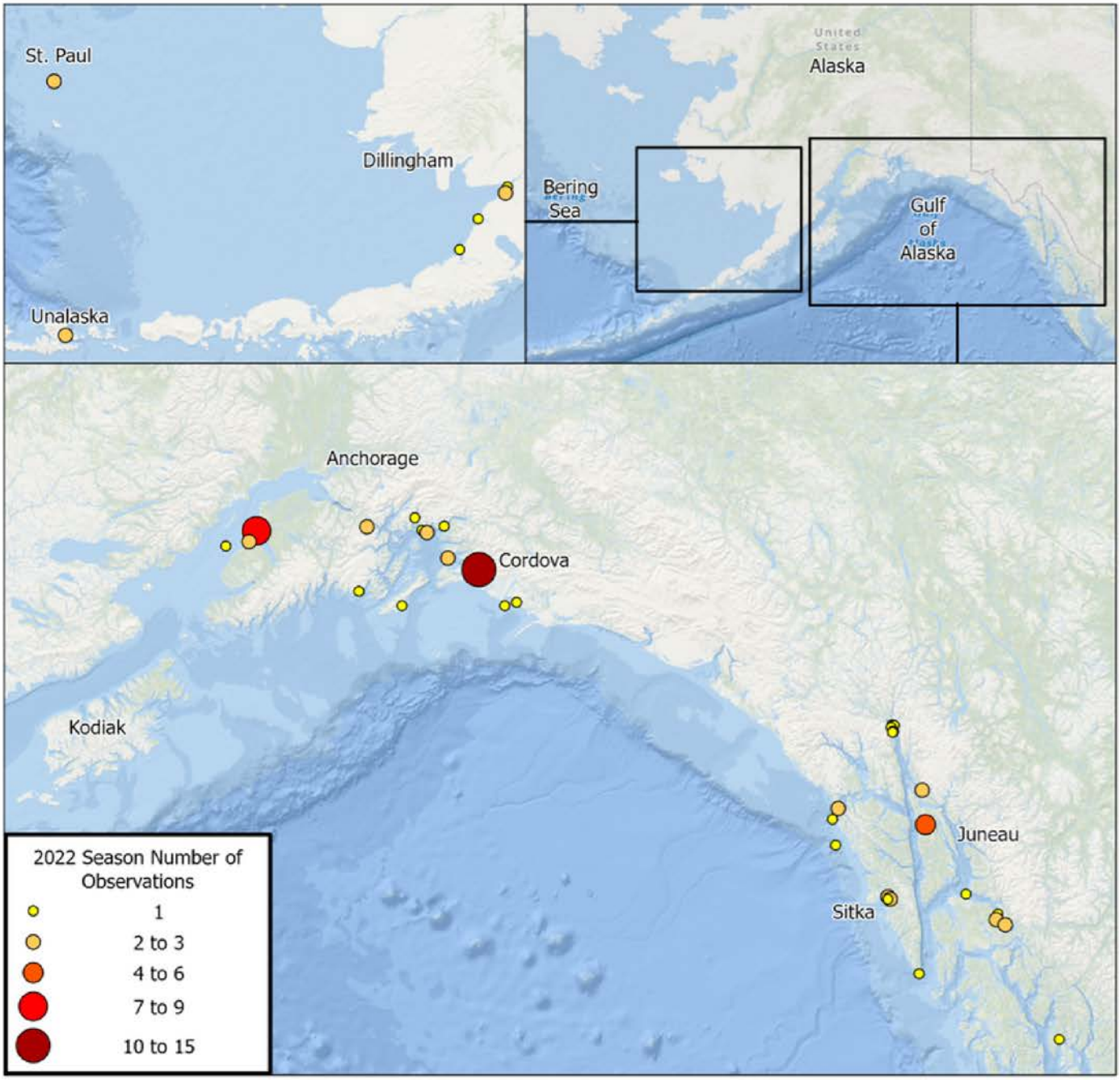


Figure 10. The map above shows the concentration of observations at given locations in the 2022 season. (Map by Chris Tran, 9/20/22)

End-of-Season Calls

Following the 2022 season, we conducted follow-up calls to 2021 and 2022 Skipper Science participants to receive feedback on their experience with the program and the app, gain insight on areas to improve and expand and determine interest in future participation. Conversations with participants were generally positive, and even those who did not submit observations cited a lack of time or getting sidetracked by other activities, rather than a lack of belief in the value of the program. There was general consensus that there was a need for this kind of data from fishermen and mariners and that the program should continue to expand and improve. Many participants who had submitted observations noted that the platform should be further simplified for app users to facilitate more efficient data entry. Specific feedback included recommendations for further outreach in the charter fleet and seine fisheries, as there are few participants from either group thus far. Comments also noted that future program efforts could look into developing protocols to track and record areas of the coast with particularly high quantities of plastics. The majority of respondents indicated that they would be interested in further training, either virtually and/or in person and that they would be interested in continuing to contribute to the program going forward.

Integrating Skipper Science into Management Decisions

In 2022, Skipper Science identified pathways for integrating observations into fishery management decisions. In early 2022, Skipper Science and SalmonState staff presented findings and recommendations from the 2021 pilot season to the Alaska State Legislature's House Fisheries Committee. That presentation highlighted support from the Alaska Fisheries Science Center (AFSC), Alaska Region Juneau and Anchorage Offices, AFSC Kodiak Laboratory, fishermen in the Bering Sea, Bristol Bay, Gulf of Alaska and Southeast, fishing industry organizations, Ecosystem Status Report (ESR) authors, Bering Sea FEP team members, and North Pacific Fisheries Management Council staff and Council bodies (e.g., Climate Change Taskforce, Ecosystem Committee). During the presentation to the House Fisheries Committee, we asked for support and emphasized that effective advocacy from decision-makers and elected officials in support of the Skipper Science Partnership could accelerate the expansion of the program, helping to ensure adequate funding and proper data integration into decision-making. As a result, Skipper Science received a full letter of support from the Alaska State Legislature House Fisheries Committee in March 2022.

> **"This program, if implemented statewide, provides an unmatched opportunity to elevate and incorporate fishing community voices into the management and research of our State's incredibly valuable fisheries and marine ecosystems."**
>
> **–Alaska State Legislature, House Fisheries Committee (March 2022)**

In the fall and winter of 2022, we've been working with NOAA's AFSC staff on identifying potential ways to incorporate data into their stock assessment reports, which are produced during seasonal assessments (Figure 11.1 - 11.2). Three potential pathways or reports where data can be incorporated include:

1. Preview of Ecosystem and Economic Conditions (PEEC) - spring meeting, Jan-Apr.
2. Ecosystem Status Reports (ESRs) - fall, large marine ecosystem (region of focus include - Gulf of Alaska, Eastern Bering Sea, Aleutian Islands), SAFE report
3. Ecosystem and Socioeconomic Profiles (ESPs) - fall, stock-specific ecosystem info, SAFE

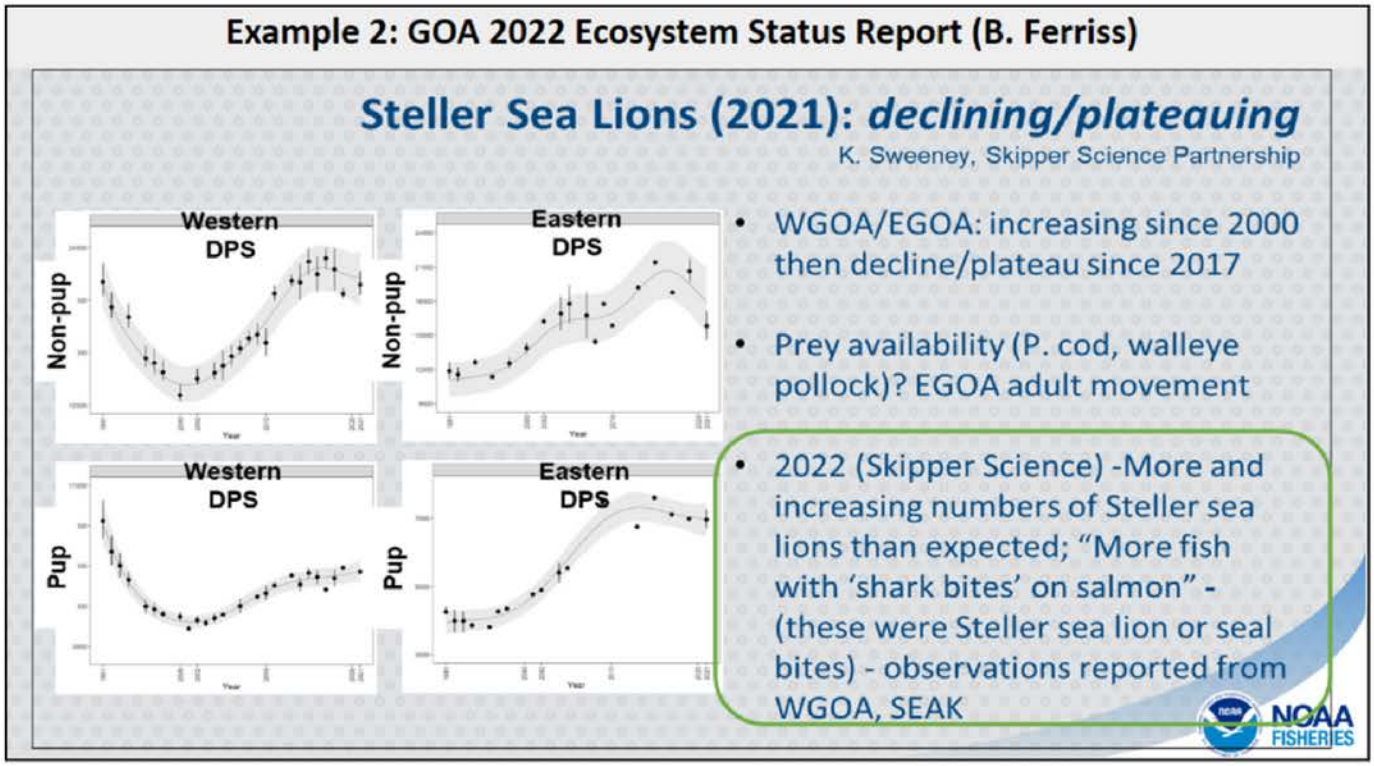


Figure 11.1. Example of how Skipper Sciene data has been credited and highlighted in NOAA's ecosystem status report summaries and stock assessment updates and presentations.

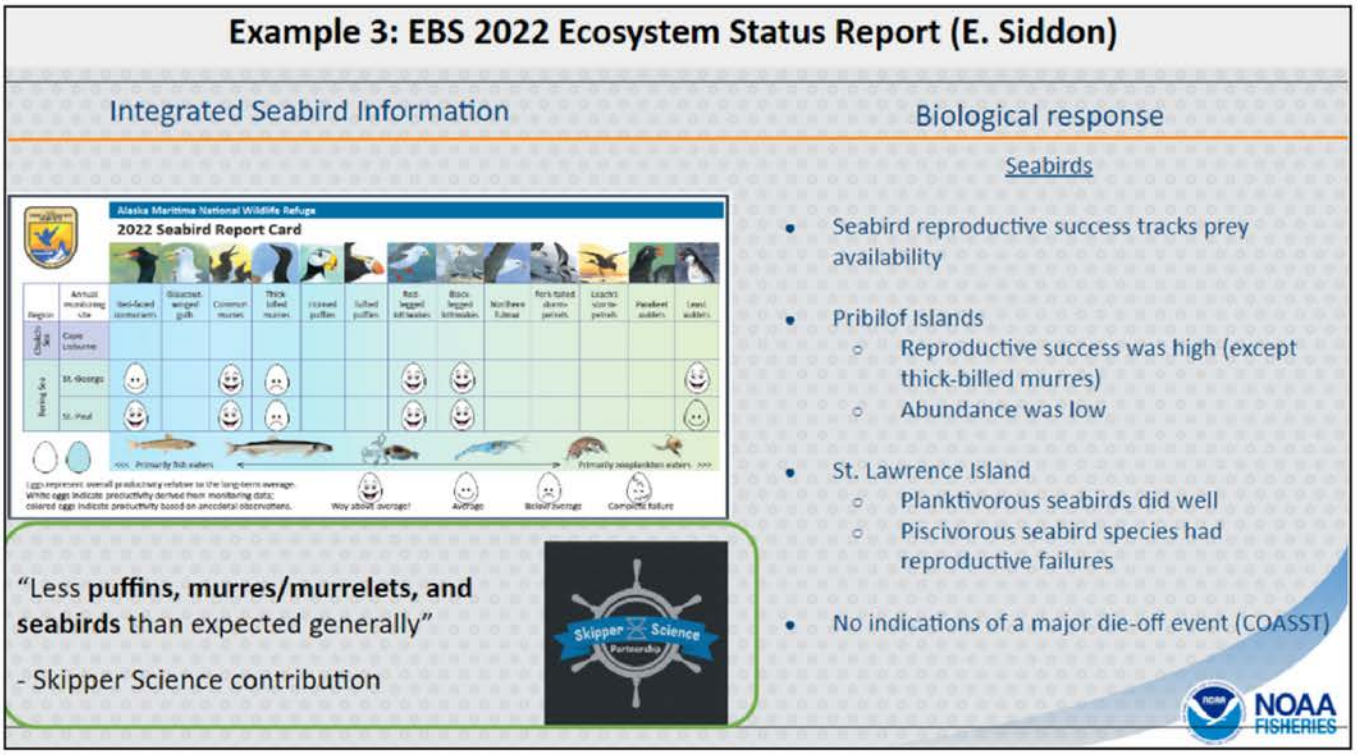


Figure 11.2. Example of how Skipper Sciene data has been credited and highlighted in NOAA's ecosystem status report summaries and stock assessment updates and presentations.

Targeted Research Efforts

Skipper Science started with the goal to collect broad observations from fishermen related to the environmental and biological shifts that they notice in Alaska's coastal ecosystems. However, after two successful seasons, the program is identifying opportunities for more targeted data collection via partnerships between the Skipper Science fleets and scientists/researchers. For example, Skipper Science participants and researchers from NOAA participated in a collaborative effort in 2022 to collect data on the stomach contents of sablefish in Alaska's oceans. In addition, the partnership is also exploring opportunities to collect information on seabird interactions with gillnet fleets in order to help improve the information base for MSC-certified fisheries. Each effort is summarized in more detail below.

Pilot Black Cod/Sablefish Stomach Contents Project

In the fall of 2022, Skipper Science began to work with NOAA scientists on groundfish food habitat information gathering. We piloted a project that used the app to collect photographs of prey contents found in sablefish stomachs. Individuals that participated in this pilot project took measurements of sablefish and photos of their stomach

contents and uploaded that information to the Skipper Science database. Skipper Science also received support from the Seafood Producers Cooperative in the launch of this project. Pilot project participants received a protocol guide for how to collect data co-developed by NOAA scientists and Skipper Science staff (Figure 12). To date, we've received 40 samples successfully uploaded into the database and we expect about 25 more to come in by March 2023. The data collected in this sablefish stomach content pilot project will hopefully be helpful in examining feeding habits and food web shifts from recent strong-year classes of sablefish in the eastern Gulf of Alaska.

Figure 12. Example of the protocol that was developed for the sablefish stomach contents collection pilot. A link to the full pilot protocol guide can be found here.

Monitoring Seabird Interactions with Fishing Vessels

In the fall of 2022, Skipper Science and the Alaska Fisheries Development Foundation (AFDF) partnered on two funding proposals for research on seabird interactions in the Alaska salmon gillnet fishery. The project highlights a more targeted approach to gathering data and utilizing relationships and networks that have grown out of the Skipper Science Partnerships. AFDF is a client of the Marine Stewardship Council (MSC)

AFDF is a client of the Marine Stewardship Council (MSC) sustainability certification program for the Alaska salmon fishery, and in response to a condition on the fishery, is interested in utilizing Skipper Science technology to collect data on interactions between fishing gear and seabirds. We are excited about this potential opportunity and partnership with AFDF. If funded in 2023, the project could provide valuable data to help to satisfy the condition of the fishery regarding seabird and gillnet interactions, allowing for continued MSC certification of Alaska salmon, while directly educating, involving, and building trust among fishermen and managers in the monitoring process.

Water Temperature Monitoring

Skipper Science and the Berring Data Collective (part of the Ocean Data Network) are working together to collect more near-shore data on Alaska's ocean conditions in 2023. Small-scale temperature sensors (Moana TD) attached to vessels will enable a cost-effective collection of ocean data. The sensors are small, can easily be attached to different gear types, and will collect data on temperature, salinity, and other critical physical oceanographic variables. Data collected will be securely transmitted to the database and to users in real time. Skipper Science is hoping to deploy six sensors in 2023.

Heat Wave and Near-Shore Environmental Monitoring with Kelp Mariculture

Lastly, the Skipper Science Partnership is exploring ways to improve push notifications for app users so that fishermen can be alerted of important information to collect during specific times (i.e., invasive species observations, wind speed, temperature, etc.). One application of improving real-time communication via push notifications could be improving monitoring efforts related to harmful algae blooms or marine heat waves, and their potential effects on mariculture such as kelp farming.

Next Steps for Skipper Science Partnership

As this report has emphasized, a community-driven environmental monitoring program like Skipper Science brings enormous value to Alaska's fisheries. Fishermen are making invaluable observations year-round at a finer scale than some stock surveys. Input from fishermen informs our understanding of the current changes occurring in Alaska's oceans. We have conducted two successful seasons of Skipper Science and will continue to expand to data collection efforts throughout 2023 across multiple fisheries. Skipper Science presents a unique opportunity to better inform marine management efforts in a way that is grounded in respect for local knowledge.

In the immediate future, the project team is working to secure more funding for program activities and will collaborate with partners on more targeted research efforts and proposals. We are also improving the technology and will have an improved app and platform to come before the 2023 fishing season starts. Overall, we are inspired by the past two years and the high interest and participation from communities and research partners. We will continue to seek ways to expand the scope and geographic range of Skipper Science. The wealth of fishermen's knowledge has great potential to deliver necessary climate-related information to fulfill state and federal fisheries' mandates, and provide decision-makers with the information they need to increase resilience to changing climate and ocean conditions. The outcomes of these data collection efforts, relationship-building opportunities, and knowledge sharing will inform future risks and management strategies for use in fishery stock assessments and fisheries management decisions. Skipper Science will continue to promote the kind of collaborative research and monitoring that brings industry, communities, tribes, and managers into a productive working relationship, which build the trust that is so critical for the sustainability of fisheries management.

Resources and References:

Alaska Seafood Marketing Institute. (2022). The Economic Value of Alaska's Seafood Industry. McKinley Research Group. Retrieved from: https://www.alaskaseafood.org/wp-content/uploads/MRG_ASMI-Economic-Impacts-Report_final.pdf

Pletnikoff, Karen, et.al. (2017). Promoting Resilience and Adaptation in Coastal Arctic Alaska, A Synthesis from Four Regional Workshops in the Alaskan Arctic with individual workshop summaries. Retrieved from: https://adaptalaska.org/wp-content/uploads/2017/10/ak-adaptation-workshop.pdf

Representative Geran Tarr, Representative Jonathan Kreiss-Tomkins, Representative Dan Ortiz, and Representative Andi Story. (2022). [Letter of Support from Alaska State Legislature, 2022]. Retrieved from https://drive.google.com/file/d/1AmOrBJJTBarWOSPbml0pA8UAxFXE3YMo/view?usp=share_link

Sigman, Marilyn (Ed.). (2017). Community-Based Monitoring of Alaska's Coastal and Ocean Environments. Alaska Sea Grant. Retrieved from: https://alaskaseagrant.org/wp-content/uploads/2017/10/CBM-Best-Practices_web.pdf

Learn more at
www.skipperscience.org