

Technological Advancement in Our Fisheries: Innovation Priorities and a Path Forward

2021 SURVEY RESULTS



Technology and U.S. Fisheries

The U.S. commercial fishing industry is an enormous economic engine with 25,000-27,000 vessels licensed to operate in the U.S. Exclusive Economic Zone (EEZ) in 2019.¹ These fishing vessels support 1.2 million jobs and generate \$165.1 billion in sales,² producing 9.3 billion pounds of seafood in 2019 alone.³

These statistics, while impressive, do not capture the challenges that face the commercial fishing industry today. Among these challenges are the impacts of climate change (shifting stocks, ocean acidification, warming waters), bycatch, marine mammal interactions, reliance on fossil fuels, and the “graying of the fleet” (i.e., fewer young people entering a fishing career path).

In some areas of the fishing industry, enormous strides have been made in technology, yet other areas lag behind. While some parts of the seafood industry have adopted cutting-edge technology to assist with traceability, safety, and sustainability, still too many commercial fishing vessels operate with outdated and inefficient technology. Compounding the problem, the commercial fishing industry varies widely throughout the country, whether by geography, gear types, fishing depths, vessel types and length, or target species. When it comes to technology for this industry, there are few “one-size-fits-all” solutions. Economies of scale are difficult to achieve, making it harder to incentivize tech companies to develop products or services that are scalable and affordable.



Fishing in Alaska ^o

Project Objectives

The **Seafood Harvesters of America**, along with **NOAA Fisheries** scientists, **Conservation X Labs**, and **Schmidt Marine Technology Partners**, and **Alaska Ocean Cluster**, conducted an online survey targeting members of the fishing industry to identify and better understand technology priorities and needs.

Using the survey data, we looked for common needs across regions and/or gear types that technology could address at scale. We anticipate the results of this survey will help guide technology investments and development to both:

- Benefit the commercial fishing industry; and
- Provide business opportunities for developing products that are needed by a large consumer base.



Captain at the helm ^o

¹ Food and Agriculture Organization of the United Nations. Fishery and Aquaculture Country Profiles: The United States of America. September 2019.

² National Marine Fisheries Service. *Fisheries Economics of the United States, 2018*.

³ National Marine Fisheries Service. *Fisheries of the United States, 2019*.

The Online Survey

From February to June 2021, we distributed an online survey to fishermen around the United States, targeting responses from as many regions, gear types, and fisheries as possible. The survey was divided into four focus areas: **Sustainability, Safety, Productivity, and Data**. For each of these areas, we asked respondents to:

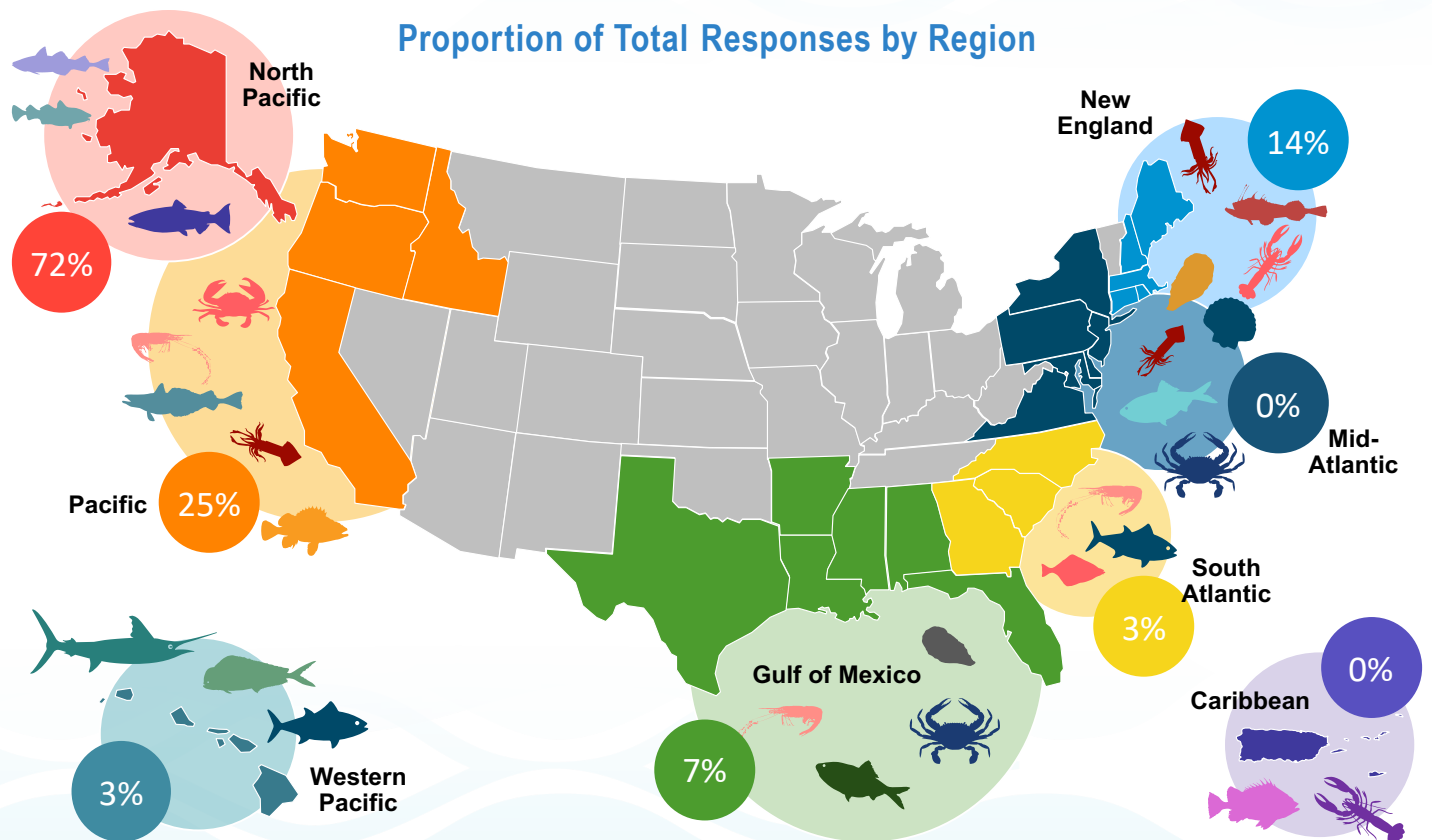
- Identify up to five of their top tech needs from a provided list of technologies (informed by discussions with fishing industry members).
- Identify their highest priority need from the list.
- Explain why they chose that priority.
- Provide any technology needs that were not included in the list.



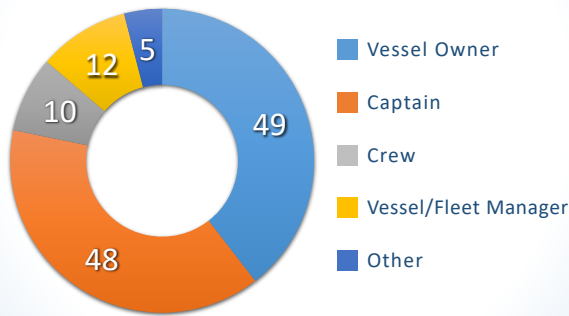
Fishermen pull in a seine net ^a

Survey Results: Overview

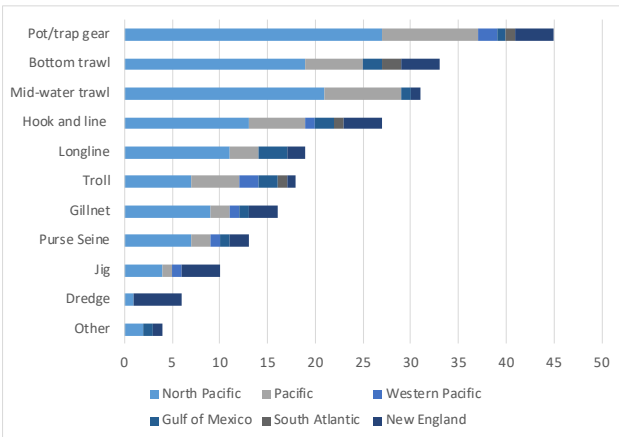
There were 186 total respondents and 71 of those completed the entire survey. Respondents represented six of the eight Fishery Management Council regions. There were no respondents from the Caribbean or Mid-Atlantic regions. Many respondents fished in multiple fisheries and regions and used more than one gear type. Because of that, for the included figures where data are presented by region, the total numbers are higher than the number of respondents.



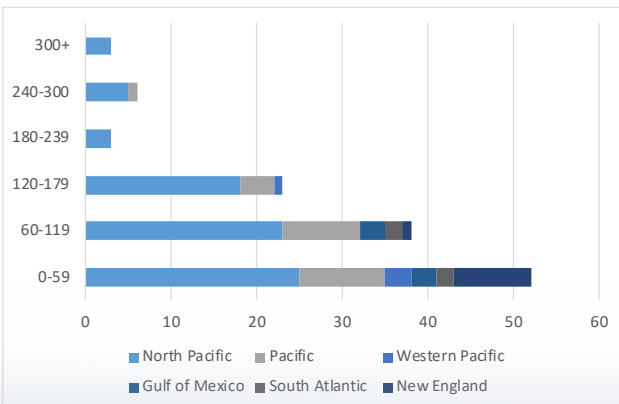
RESPONDENTS ROLE IN THE FISHERY



Number of Respondents by Gear Type and Region



Number of Respondents by Boat Length (ft) and Region



Reported boat lengths ranged from 17 ft to 360 ft. Pot/trap gear was the most common gear type selected, followed by bottom trawl, then hook-and-line and mid-water trawl gear types.

Respondents identified 42 target species that they harvest. Alaska pollock was the most common (16 respondents), followed by Pacific cod (15 respondents), Pacific salmon (15 respondents), and Bering Sea crab (14 respondents). Rockfishes, sablefish, Dungeness crab, Pacific halibut, Pacific whiting and other groundfishes, Atlantic whiting, lobster, Pacific shrimp, black seabass, and scallops were also among the target species identified.

More than half of the respondents were vessel owners and/or Captains. The remaining respondents identified as crew members or vessel/fleet managers. The majority of survey respondents (60 respondents) reported working in the fishing industry for more than 15 years.

The top technology priorities identified for each focus area were:

- **Sustainability:** bycatch reduction technology and energy-efficient engines, fish finding equipment, and live-feed underwater video.
- **Safety:** communication and data systems, and advanced/automated machinery to reduce risk for highly physical operations.
- **Productivity:** product tracking tools, gear modification to improve efficiency or product quality, and direct sale networks and apps.
- **Data:** communication and data network systems, weather and ocean monitoring, and electronic reporting and monitoring.

Based on our results, there are clear opportunities for technological advancements in the commercial fishing industry. However, technology development must be done in partnership with the industry and be matched to fishermen needs to ensure adoption and a market. We also note a clear need for better access to information about what technology already exists to address industry needs.

Many respondents also discussed the challenge of finding competent crew and younger people interested in participating in the commercial fishing industry, and expressed a need for training programs. The solution to this problem does not lie directly in new technology. However, it highlights an ongoing challenge in the industry where the use of technology may be able to assist in training and increase industry appeal by making the work safer and more efficient, sustainable, and profitable.

We hope the insights gathered from this survey will help focus the work of technology developers, investors, and funders, and will promote investment in technology to address problems identified by the commercial fishing industry. Smart investments in technological advancements for the fishing industry will help ensure our seafood remains sustainable, captains and crew stay safe, and our coastal communities continue to thrive.



Detailed Survey Results

SUSTAINABILITY TECHNOLOGY

The **Sustainability** section of the survey focused on technologies that would contribute to the sustainability of the fishing industry in a wide variety of ways. Some of the listed technologies addressed sustainability related to environmental and/or climate change impacts, to impacts to other marine life (mammals, bycatch, etc.), and to information and data needs to improve sustainability.

“[Energy-efficient engines are a] win-win, reduces emissions and saves money.”

Of the **Sustainability technologies** listed in the survey, the ones that the most respondents indicated were a priority for advancement included:

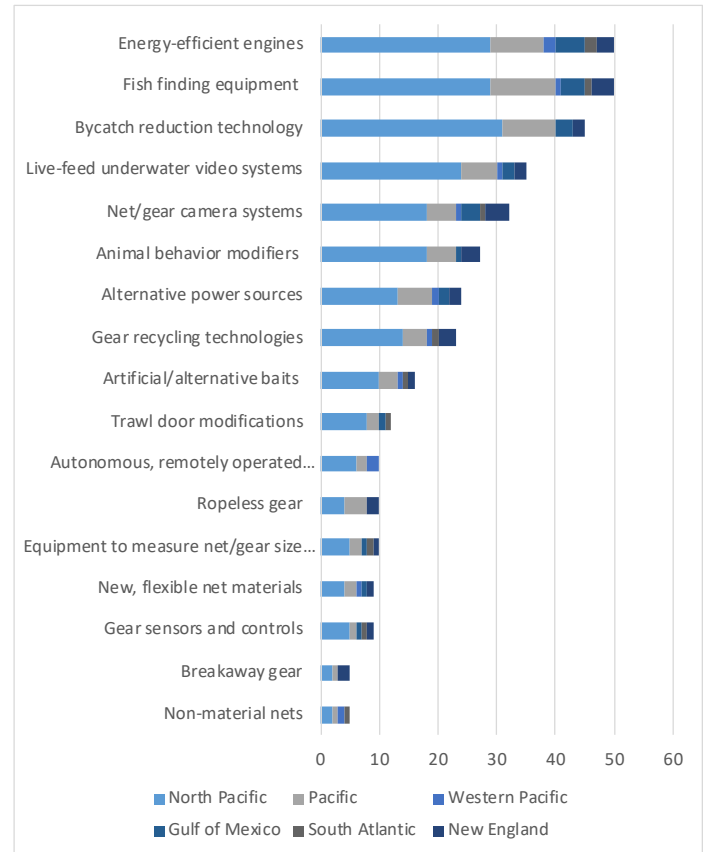
- Energy-efficient engines
- Fish finding equipment (sonars, echosounders, etc.)
- Bycatch reduction technology
- Live-feed underwater video systems
- Net and gear camera systems
- Animal behavior modifiers

However, respondents identified the following **Sustainability technology** as their top priority:

- Bycatch reduction technology
- Energy-efficient engines
- Fish finding equipment (sonars, etc.)
- Live-feed underwater video systems

When we asked respondents *why* they chose their top **Sustainability priority**, there were a few motivational patterns that emerged including environmental impacts, cost reduction, bycatch reduction, and fishing information/data. Seventeen respondents identified addressing the environmental impacts of commercial fishing as their motivation. Many of these 17 respondents identified climate change impacts on their fuel consumption as the motivation for advancing **Sustainability technologies**.

Sustainability – Number of Respondents by Region



“Bycatch avoidance is paramount to all fisheries.”

Sixteen respondents cited cost reductions as their motivation for improving the sustainability of the fishing industry. Many of their responses centered around the rising costs of diesel fuel.

Thirteen respondents stated their motivation for picking their top **Sustainability technology** was to reduce bycatch in fisheries. Most respondents noted that reducing bycatch would improve the health of fisheries and help avoid unwanted catch.

Lastly, 12 respondents noted that additional information provided by fish finding equipment and/or live-feed underwater video systems would allow them to fish more efficiently (i.e., set gear where they are certain there are fish).

“Putting gear in the correct location for the target species eliminates bycatch issues and increases efficiency. [There’s] less wasted time.”

Respondents provided additional **Sustainability technologies** that were not included on the survey list; however, there were few, indicating that our list of technologies was largely inclusive. Their responses also provided insight into how some of the technologies could be improved. Suggestions included biodegradable nets, acoustic counting of fish, and the ability to identify fish species via sonar technology.



SAFETY TECHNOLOGY

The **Safety** section of the survey focused on technologies that would improve fishing vessel safety. The listed technologies included communication and navigation systems, safety devices for fishermen (survival suits, PFDs, etc.), and vessel modifications that would address safety concerns, among others.

“Affordable, efficient communication equipment can create a backbone for all safety and navigation systems to run on.”

Of the **Safety technologies** listed in the survey, the ones that the most respondents indicated were a priority for advancement included:

- Communication and data systems
- Navigation systems and tools (GPS, radar, etc.)
- Fire prevention systems
- Survival suits and personal flotation devices (PDFs)
- Camera monitoring systems
- Advanced or automated machinery to reduce risk for highly physical operations
- Watch aides and systems

However, respondents identified the following **Safety technology** as their top priority:

- Communication and data systems
- Advanced or automated machinery to reduce risk for highly physical operations
- Camera monitoring systems
- Survival suits and personal flotation devices (PFDs)

When we asked respondents *why* they chose a particular **Safety technology** priority as their first choice, safety of the crew and captain and safer vessel operations emerged as the top motivations by a wide margin.

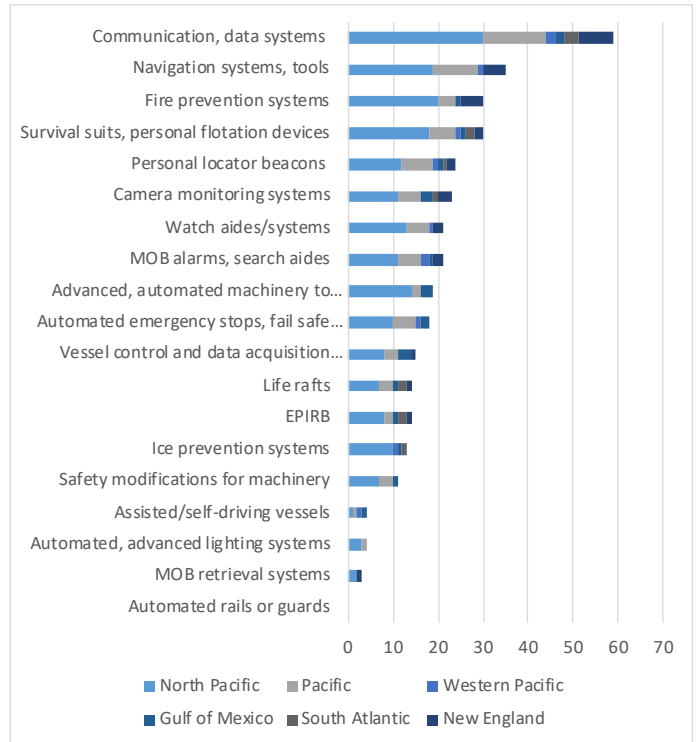
Twenty-eight respondents cited some form of improving the safety of crew and captains onboard a fishing vessel as their main motivation. Many of these respondents cited that improved communication systems would allow for faster and better communication in case of a man-overboard situation or other catastrophic situation.

“Better and more reliable communication when fishing offshore would decrease anxiety.”

Another 15 respondents provided motivations that aligned with improving the safety of general vessel operations. There was a general desire among these respondents to understand better what is going on around the vessel to address small mishaps that could turn dangerous.

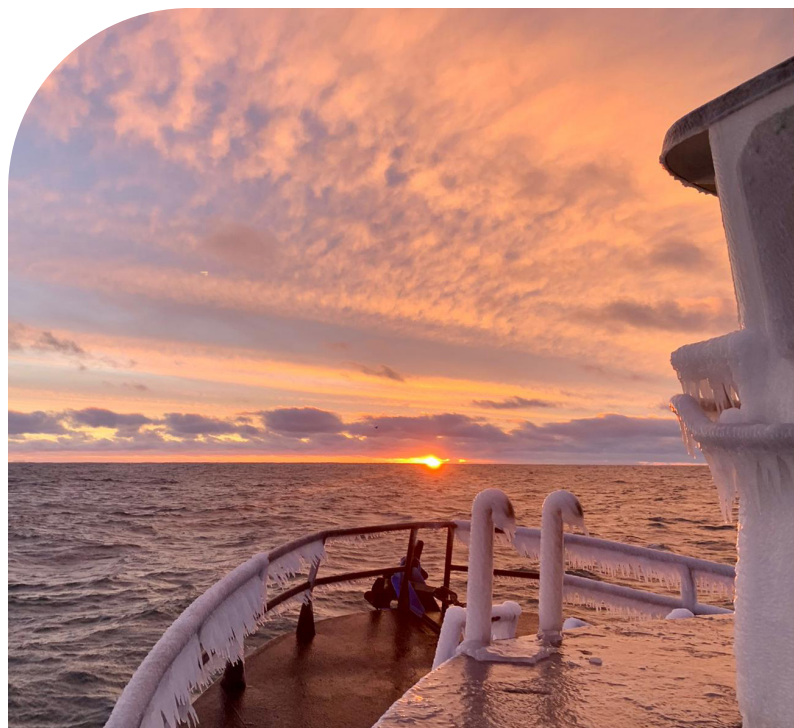
“Monitoring is a window to prevent and address safety concerns like fires, leaks (water, hydraulic fluids, etc.), winches, net drums, ramps, rails.”

Safety – Number of Respondents by Region



Respondents also noted that technology to aid in safe vessel operations would include technologies that can mitigate weather impacts on gear and/or the vessel. Some of the responses noted ice buildup on boats in the Bering Sea and other gear issues caused by weather.

Respondents were able to provide additional **Safety technologies** that were not included on the list in the survey. Suggestions provided here offered new ideas, as well as for how some of the technologies on our list could be improved. Responses included vessel stability, information technology, wired fire alarms for when vessels are moored, and a personal man-overboard device.



PRODUCTIVITY TECHNOLOGY

The **Productivity** section of the survey focused on technologies that would contribute to improvements in the productivity and efficiency of vessel and fishing operations.

Of the **Productivity technologies** listed in the survey, the ones that the most respondents indicated were a priority for advancement included:

- Sea-to-table tracking technology
- Gear modification to improve efficiency or product quality
- Direct sale networks and apps
- Hybrid engines
- Camera systems

However, respondents identified the following **Productivity technology** as their top priority:

- Product tracking tools
- Gear modification to improve efficiency or product quality
- Direct sales networks and apps

A few priorities emerged as top priorities. However, interest was spread across most of the available options.

When we asked respondents *why* they chose a particular **Productivity technology** as their top choice, environmental concerns rose to the top as the motivation. The environmental reasons cited included reducing bycatch and switching to hybrid engines. Many respondents simply wrote bycatch reduction as their reason for choosing their top priority while others noted their desire to move away from diesel engines.

“I would love to move away from diesel.”

Productivity – Number of Respondents by Region



Reducing operating costs and increasing products’ value, as well as improving traceability were the next most cited reasons for respondents choosing their top **Productivity technology** priority.

When respondents were asked about other **Productivity technologies** they are interested in that weren’t included on the provided list, they answered: improved refrigeration and freezing systems for small boats, and improved processing capabilities for smaller processors.

“[Product] quality is probably at the top of productivity and [product] tracking is a big part of quality.”



Processing catch ^a

DATA TECHNOLOGY

The **Data** section of the survey focused on technologies that would provide new sources of data, improve existing data collection systems, or improve vessel operations. Some of the listed technologies included weather/ocean monitoring systems, communication/data networks, electronic reporting and electronic monitoring, automated species recognition, automated catch measures, and onboard processing capabilities.

“Weather, current, and temperature are an important part of our daily fishing.”

Of the **Data technologies** listed in the survey, the ones that the most respondents indicated were a priority for advancement included:

- Weather and ocean monitoring (wind, current, surface, and bottom temps)
- Communication and data network systems
- Weather and ocean forecast models
- Oceanographic and environmental sensors
- Electronic reporting
- Electronic monitoring

“Many areas where we fish still do not have accurate weather reporting information. This is crucial to safe fishing.”

However, respondents identified the following **Data technology** as their top priority:

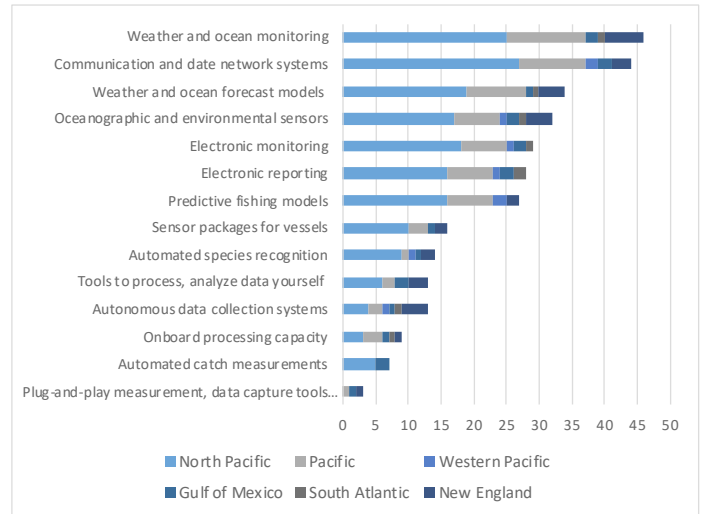
- Communication and data network systems
- Weather and ocean monitoring
- Electronic reporting
- Electronic monitoring
- Sensor packages for vessels
- Weather and ocean forecast models

“Having accurate weather information and oceanographic data saves time and keeps everyone safer.”

We saw again in the **Data technology** section a wide spread of top priorities selected from the technologies listed in the survey.

When we asked respondents *why* they chose a particular **Data technology** as their top choice, improving data quality was the

Data – Number of Respondents by Region



main motivation. Respondents cited that improvements in data quality and data access would improve many aspects of fishing. Improving fishing/vessel operations and safety were the next most common motivations for respondents’ when choosing their top **Data technology** priority.

A few respondents cited improving fisheries management as their reason for choosing their top priority.

“[There is a] need for more fishermen collected data to support the science that goes into stock assessment. [...] this is a big priority for me right now, figuring out how vessel [data collection] programs can become more widely used by scientists.”

When we provided space for respondents to suggest any **Data technologies** that were not included in the list provided, they noted bottom temperature sensors throughout the ocean with receivers on the hulls of vessels, and cheaper real-time gear tracking systems would be beneficial. A few respondents encouraged the incorporation of collected data into scientific models and fisheries management.

“[Data technology] helps the vessels be more productive on the water.”



Conclusion

Our results point to a clear opportunity for improvements and innovation in the technology used in the commercial fishing industry. The wide breadth of responses suggests numerous areas for investment and advancement by technology developers to improve the industry's sustainability, safety, productivity, and data systems.

The survey highlighted numerous tech needs. However, when we examined the top priority choices of respondents, a handful of top technology priorities emerged with significantly higher support than others.

The priority that garnered the most votes across focus areas was *Safety – Communication and data systems (satellite and cellular networks, VMS, AIS)*. The next most chosen priority was *Sustainability – Energy-efficient engines*.

These priorities were followed by:

- **Sustainability** – Fishing finding equipment (sonars, echosounders, etc.)
- **Data** – Weather and ocean monitoring (wind, current, surface, and bottom temperatures, etc.)
- **Sustainability** – Bycatch reduction technology (excluders, drop-chain sweeps, etc.)
- **Data** – Communication and data network systems (satellite and cellular networks)

These priorities emerged as those with the highest number of votes, suggesting a large need and significant industry interest.

It is important to acknowledge the skewed respondent pool where 79% of respondents who completed the survey indicated they fished at least part of the year in either the Pacific or North Pacific regions. To get feedback that is more representative of all regions and gear types, we plan to continue conducting this survey.



Pollock catch^b

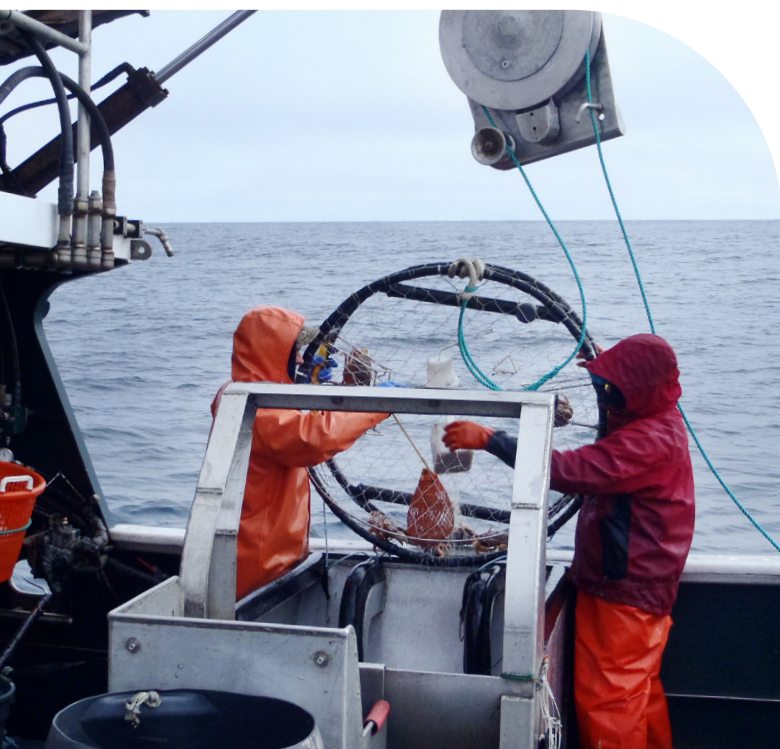
Our aim in sharing these data and results is to help inform impactful and relevant investment and technology development. We also hope to help facilitate better information sharing and dialogue between the fishing industry, investors, and technology companies.

With better information on where the potential users of fishing technology see opportunity, we hope investors and technology developers will be able to address both long-standing and emerging technology needs in the commercial fishing industry.

These results highlight a profitable market ripe for innovation and eager for changes that will make our fisheries more sustainable and successful.

As next steps, we plan to

- Disseminate the results of this survey to technology funders and developers; and
- Host a workshop in May 2022 to bring together members of the fishing industry, technology developers, and funders to discuss the results of this survey and opportunities for technology development.



Dungeness crab fishing^b

About Us

The **Seafood Harvesters of America** is a national association of commercial fishermen in the United States, representing 22 member organizations around the country from Alaska to Hawaii to Florida to Maine. SHA works to advance the sustainability of fishing businesses and fisheries resources by working with lawmakers, regulators, managers, and scientists.

The **National Marine Fisheries Service** (NOAA Fisheries) is responsible for the management and stewardship of our Nation’s ocean resources and their habitat. The Conservation Engineering group in the Midwater Assessment and Conservation Engineering (MACE) Program at the Alaska Fisheries Science Center (AFSC) collaborates with the fishing industry and other partners to evaluate fishing gear performance through innovative research on fish behavior and biology, gear design, and fishing technology.

Conservation X Labs is a technology and innovation company that creates solutions to stop the extinction crisis.

Schmidt Marine is a program of the Schmidt Family Foundation focusing on the advancement of novel ocean technologies to solve conservation and research challenges.

The **Alaska Ocean Cluster** is a non-profit accelerating innovation through work with the state’s seafood industry and ocean startups.



**SEAFOOD
HARVESTERS**
OF AMERICA



**NOAA
FISHERIES**



CONSERVATION X LABS

SCHMIDT MARINE



Heading into port ^b

