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**U.S. Efforts to Develop On-Demand Fishing Gear Technology 2022-2023 Updates**

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# U.S. Efforts to Develop On-Demand Fishing Gear Technology 2022-2023 Updates

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## Abstract

Bycatch in fishing gear is the leading source of human-caused mortality for marine mammals. Large whales, such as North Atlantic right whales, which are listed as endangered in the United States under the Endangered Species Act, become entangled in vertical lines associated with fixed gear fisheries. The U.S. has implemented various mitigation measures to reduce entanglement risk, including time area vertical line closures, where fixed gear fisheries that use vertical buoy lines are prohibited. One emerging solution that has the potential to both reduce risk to whales and alleviate such closures is on-demand fishing (also known as ropeless, buoyless, or pop-up) without persistent vertical buoy lines. These systems reduce entanglement risk by decreasing the amount of line in the water. The U.S. is currently working collaboratively with the commercial fishing industry, researchers, government, and non-government organizations (NGOs) to develop and test on-demand systems from various manufacturers. On-demand gear technology is improving and could reduce entanglement risk and allow fishing to continue in locations with high whale abundance.

## Introduction

Bycatch in fishing gear is the leading source of human-caused mortality for protected species, including marine mammals. Large whales become entangled in vertical buoy lines associated with fixed gear fisheries (e.g., trap/pot, gillnet). Entanglement can range from minor, temporary interactions to serious events that result in lethal injuries, which can have population level consequences. In the past decade, there have been an estimated 220 North Atlantic right whale deaths and fewer than 350 individuals remain (NOAA Fisheries 2022; Pace et al. 2021). The large number of observed right whale deaths that began in 2017 prompted the U.S. National Oceanographic and Atmospheric Administration's National Marine Fisheries Service (NOAA Fisheries) to declare an Unusual Mortality Event (UME)<sup>1</sup> for the species throughout its entire range, with vessel strikes and entanglements in fishing gear as the primary causes of mortality and serious injury where cause of death could be determined. As of March 27, 2023, the UME has documented 98 known cases, including 36 dead, 33 seriously injured, and 29 morbidity (sublethal injury or illness) individuals (see Lisi et al. 2023). With fewer than 70 reproductive females remaining (NOAA Fisheries 2022), the status of the population remains a serious concern. A recent assessment of right whale photos revealed that entanglement scarring injuries have increased, and that roughly 30% of the population is entangled every year (Hamilton et al. 2021). Much of the population has been entangled multiple times, and there is nearly a 90% chance that a healthy female will get entangled between each calving cycle potentially contributing to reduced calving rates (Hayes et al. 2018). NOAA Fisheries has

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<sup>1</sup><https://www.fisheries.noaa.gov/national/marine-life-distress/2017-2023-north-atlantic-right-whale-unusual-mortality-event>

implemented various mitigation measures to reduce entanglement risk to North Atlantic right whales, including time area closures, where fixed gear fisheries that use vertical buoy lines are prohibited. One emerging solution that both reduces risk to whales and alleviates such closures is on-demand fishing.

The U.S. is making a concerted effort to develop and test this technology with a primary focus in the U.S. East coast commercial lobster and crab trap/pot fisheries. In July 2022, NOAA Fisheries released the *Draft Ropeless Roadmap: A Strategy to Develop On-Demand Fishing*, with request for public input (NOAA NEFSC 2022). The document details past, ongoing, and future work in on-demand gear development to integrate these systems into U.S. East coast commercial fisheries. NOAA Fisheries is reviewing the comments and feedback received on the document and plans to release an update in 2023.

### **Overview of On-Demand Fishing Systems**

Traditional fixed fishing gear uses a vertical line that tethers a surface buoy to the pot, trap, or gillnet gear on the ocean floor and is used to both locate and retrieve the fishing gear. To replace the use of a persistent buoy and vertical line, on-demand gear must allow fishermen to locate gear, retrieve gear, and broadcast gear location to other ocean users. NOAA Fisheries and others have been collaborating with the commercial industry to test and evaluate on-demand systems during the documentation, design, and testing phases to address these challenges and develop gear that will have a higher level of acceptance and compliance within the fishing industry. This includes testing in the U.S. commercial Northeast lobster and Jonah crab trap/pot fishery, Gulf of Maine and mid-Atlantic gillnet fisheries, and Southeast black sea bass pot fishery.

#### Types of Systems

Three types of on-demand gear are commonly used. The first type is a stowed rope/pop-up buoy where the vertical line is coiled in a cage that is on the ocean bottom attached to a string of traps. When a signal is received from the boat, the buoy or cage lid is released from the cage. The line uncoils to the surface, allowing the fishing vessel to retrieve the gear. The second type is the Inflatable Lift Bag which consists of a deflated lift bag, attached to a cage connected to a string of lobster traps. When a signal is sent from the boat, the lift bag inflates and the cage rises to the surface. This allows the fisherman to retrieve the cage and the pots that are connected to it. The third type is the Buoyant Spool, which involves a line wrapped around a buoyant spool that is tethered to a weight on the bottom. When a signal is sent from the boat, the spool is released. As the spool ascends to the surface, the line unwinds from the spool and rises to the surface where the fishing vessel can retrieve it. More traditional methods are also used, including grappling hooks, which add increased retrieval time but are less costly to the fishing industry.

#### Geolocation and Broadcasting of Systems

In order to successfully implement on-demand fishing and mitigate large whale entanglement, a solution is needed to replace the information traditionally conveyed by the surface buoy (location, gear type, permit number), and to allow fishery managers to pull the traps to confirm compliance with regulations. These systems would provide gear location information to other impacted ocean users including mobile fishing gear fleets and offshore wind development survey vessels to avoid gear conflict. Presently, proprietary acoustics, applications, and databases that collect gear information are not sufficient, and an interoperable solution is needed to share information across systems. With a common framework in place, manufacturers can begin to develop the interoperable system needed to meet the demands of high-density fishing without persistent rope in the water column. This design also has the

potential to reduce gear loss and ghost gear, and allow for gear recovery during reduced visibility due to fog or low light conditions.

### NOAA Fisheries Gear Library and Testing

Since 2018, NOAA Northeast Fisheries Science Center, with the assistance of several NGOs, has created and used a “Gear Library” to meet the demand for on-demand fishing gear and increase testing capacity in collaboration with the fishing industry. NOAA Fisheries has lent on-demand systems from many different manufacturers to fishermen for trials, although the library is not exhaustive of all systems available. Fishermen and researchers can borrow on-demand systems from the Gear Library and in turn, provide NOAA Fisheries, their collaborators, and the manufacturers insight on the functionality of the systems. This includes feedback on how the gear operates on the vessel, any problems encountered, and suggestions for improving the technology. The Gear Library's emphasis on collaboration is what makes it both accessible and successful. The Gear Library has grown to include 270 systems from eight different manufacturers that have been used aboard 35 different fishing vessels with 2,790 hauls from 24 different fishermen in the 2022 season (Table 1), compared to the 178 systems that were available in January, 2022 (described in Gahm et al. 2022).

Table 1. A list of the on-demand hardware vendors and their current availability, as of March 2023, in the NOAA Fisheries Gear Library.

| Brand Name        | Model Name           | Development Stage    | No. of Units Available in Gear Library | Website                                                                                                                                       |
|-------------------|----------------------|----------------------|----------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|
| Ashored           | Mobi                 | Prototypes Available | 14                                     | <a href="https://ashored.ca/">https://ashored.ca/</a>                                                                                         |
| DBV               | Ropeless-RISER       | Prototypes Available | 5                                      | <a href="https://www.dbvtechnology.com/riser.html">https://www.dbvtechnology.com/riser.html</a>                                               |
| Desert Star       | ARC-2                | Available for Sale   | 6                                      | <a href="http://www.desertstar.com/ropeless-fishing">http://www.desertstar.com/ropeless-fishing</a>                                           |
| EdgeTech          | 5112                 | Available for Sale   | 173                                    | <a href="https://www.edgetech.com/fisheries-science-underwater-research/">https://www.edgetech.com/fisheries-science-underwater-research/</a> |
| FioMarine         | FioBuoy              | Available for Sale   | 2                                      | <a href="http://fiomarine.com/fiobuoy-models/">http://fiomarine.com/fiobuoy-models/</a>                                                       |
| Lobster Lift, LLC | Lobster Lift         | In development       | 0                                      | <a href="https://www.lobsterlift.com/">https://www.lobsterlift.com/</a>                                                                       |
| SMELTS            | Lobster Raft         | Prototypes Available | 26                                     | <a href="https://www.smelts.org/">https://www.smelts.org/</a>                                                                                 |
| Sub Sea Sonics    | AR50                 | Available for Sale   | 26                                     | <a href="https://www.subseasonics.com/ar50">https://www.subseasonics.com/ar50</a>                                                             |
| Sub Sea Sonics    | TR4RT (Timer device) | Prototypes Available | 16                                     | <a href="https://www.subseasonics.com/ropeless-fishing">https://www.subseasonics.com/ropeless-fishing</a>                                     |

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|---------------------------------------------|--------------|----------------------|---|---------------------------------------------------------------------------------------------------------------------------------------------------|
| Woods Hole Oceanographic Institution (WHOI) | On-Call Buoy | Prototypes Available | 2 | <a href="https://www.whoi.edu/oceanus/feature/how-would-on-call-buoys-work">https://www.whoi.edu/oceanus/feature/how-would-on-call-buoys-work</a> |
|---------------------------------------------|--------------|----------------------|---|---------------------------------------------------------------------------------------------------------------------------------------------------|

NOAA Fisheries also continues to work on integrating testing geolocation technology through collaborations with the EarthRanger program at the Allen Institute for Artificial Intelligence (AI2) and on-demand gear manufacturers (EdgeTech, Teledyne, SMELTS, and Blue Ocean Gear) (Table 2). The partnership with AI2, a non-profit organization with a focus on wildlife conservation and technological innovation, has shown promise to synthesize data from multiple manufacturers to facilitate gear geolocation. They have served as a separate third-party entity and are developing the “EarthRanger” software as a geolocation tool and interoperable cloud database system to manage gear locations on their EarthRanger platform. Additionally, NOAA Fisheries is convening a technical working group to draft open standards and protocols for acoustic communication, release triggering and localization. There are also efforts to improve the adaptation of geolocation technology in mobile fishing gear vessels by testing how accurately the electronic gear location marking applications marks the location of fixed gear and how helpful this information is to mobile fishermen when planning their tows.

Table 2. NOAA Fisheries collaborations exploring solutions to on-demand fishing gear geolocation.

| Partner                                          | Relationship                                              | Status                                                                                                       | Website                                                                                                                                       |
|--------------------------------------------------|-----------------------------------------------------------|--------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|
| Allen Institute for AI (AI2) EarthRanger program | Philanthropy mission to support global data solutions     | Blending data from multiple gear manufacturers into the EarthRanger platform                                 | <a href="https://www.earthranger.com/">https://www.earthranger.com/</a>                                                                       |
| EdgeTech                                         | Integrated with EarthRanger; Geolocation app Trap Tracker | Developed Trap Tracker app; integrated with the EarthRanger platform to both send and receive gear positions | <a href="https://www.edgetech.com/fisheries-science-underwater-research/">https://www.edgetech.com/fisheries-science-underwater-research/</a> |
| SMELTS                                           | Integrated with EarthRanger                               | Integrated with the EarthRanger platform (using both EdgeTech and Teledyne acoustics)                        | <a href="https://www.smelts.org/">https://www.smelts.org/</a>                                                                                 |
| Teledyne                                         | Integrated with EarthRanger                               | Integrated with the EarthRanger platform (using SMELTS gear)                                                 | <a href="http://www.teledynemarine.com/acoustic-modes">http://www.teledynemarine.com/acoustic-modes</a>                                       |
| Blue Ocean Gear                                  | Integrated with EarthRanger                               | Integrated with the EarthRanger platform                                                                     | <a href="https://www.blueoceangear.com/">https://www.blueoceangear.com/</a>                                                                   |

|                                                    |                                         |                                                                                 |                                                                                                                                                                                                     |
|----------------------------------------------------|-----------------------------------------|---------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| National Fish & Wildlife Foundation (NFWF)         | Grant provider for ropeless efforts     | They have and continue to disseminate grant funds with private investment match | <a href="https://www.nfwf.org/">https://www.nfwf.org/</a>                                                                                                                                           |
| NOAA Fisheries Vessel Monitoring System (VMS) team | Collaboration on geolocation strategies | Discussions on-going                                                            | <a href="https://www.fisheries.noaa.gov/national/enforcement/regional-vessel-monitoring-information">https://www.fisheries.noaa.gov/national/enforcement/regional-vessel-monitoring-information</a> |

Federal and state research permits are currently required for trials of on-demand fishing without a surface buoy in the U.S. For example, in August of 2022, the NOAA Northeast Fisheries Science Center was granted an exempted fishing permit (EFP) allowing up to 100 vessels to assist in testing and improving on-demand gear systems.<sup>2</sup> From February 1 through April 30, 2023, several of the federally permitted collaborating commercial fishermen completed hauls of on-demand gear within the restricted areas that were subject to seasonal closures due to the presence of North Atlantic right whales in both state and federal waters. On-demand gear hauls have improved over the past three fishing seasons, with greater success and fewer failures. The rate of successful on-demand gear hauls was 71% in 2020, 85% in 2021, and is now approximately 90% for the 2022 season. Data from the 2022 season are still being compiled, but it is anticipated that the success rate will continue to increase. This steady increase in success suggests that on-demand solutions, with adequate training and monitoring, could reduce the entanglement of protected species in vertical lines and provide flexibility for fishing operations in locations with high whale abundance. Additionally, in the Southeast U.S. the testing of on-demand gear through an EFP with the South Atlantic Fishery Management Council allowed black sea bass fishermen to fish during a closure where no gear was previously allowed. Initial testing has shown that on-demand systems move less than traditional gear in storms due to the absence of buoys and vertical lines that cause drag. Geolocation technology has also helped to relocate gear moved from storms or other activity. Overall, this testing improves the functionality of on-demand gear and provides feedback and recommendations to gear manufacturers, developers working on geolocation technologies, and improves the overall performance and operability of on-demand fishing.

#### Funding and Costs for On-Demand Systems

The U.S. Congress passed the Consolidated Appropriations Act in December of 2023, which included a mandate that, with limited exceptions, the 2021 Atlantic Large Whale Take Reduction Plan amendments “shall be deemed sufficient to ensure that the continued Federal and State authorizations of the American lobster and Jonah crab fisheries are in full compliance” with the Endangered Species Act and Marine Mammal Protection Act until December 31, 2028. The Act also prescribes and provides increased appropriations that support further development and implementation of innovative gear technologies, such as on-demand gear. Testing and adoption of on-demand fishing gear in the U.S. is supported through federal and state government funding, NGOs, and private programs. While current costs of on-demand gear are high, ranging from \$2,000 to \$25,000 for a deck unit and \$300 to \$10,000 for a release unit, it is widely accepted that the current prices of on-demand gear are reflective of research and development costs, and that economies of scale will be achieved in the future through increased production.

<sup>2</sup><https://www.fisheries.noaa.gov/new-england-mid-atlantic/science-data/2023-northeast-experimental-dem-and-gear-system-testing>

Overall, the costs<sup>3</sup> for a vessel transitioning from traditional to on-demand fishing gear depend greatly on multiple factors, including future market demand for the gear, supply chains of microchips and other materials, and the desired number of on-demand systems.

### **Conclusion and Next Steps**

On-demand fishing gear may support the market demand for sustainably harvested seafood, including green seafood labeling, Marine Stewardship Council certification, NGO endorsement, and increased marketing opportunities. The driving factor for on-demand fishing gear development has been the entanglement of large whales, particularly the North Atlantic right whale, in northeast U.S. lobster and crab trap and pot fisheries in the Northwest Atlantic. However, there are many additional benefits and large-scale applications expected for on-demand systems to other protected species and areas. For example, the use of on-demand systems may reduce ghost gear and gear conflict by allowing mobile fleets to identify the location of bottom traps/pots at night, which is currently an issue with surface-buoys. The innovation of on-demand fishing systems provides a new technology opportunity in the marine sector and a potential opportunity for large oceanographic data collection and further scientific cooperative research at a global scale.

NOAA Fisheries will continue to work on integrating on-demand systems into commercial fishing operations including meeting the needs of mobile gear fisheries (e.g., bottom and pelagic trawl fisheries) and enforcement. This will include addressing the challenges with geolocation, and work with developers on improving the technology needs including data flow and management, affordable data transmission methods (i.e., satellite WiFi, vessel monitoring systems, and other satellite data subscriptions), and improve the interoperability of on-demand systems through establishing open standards and protocols for acoustic communication, release triggering and localization. In order to operationalize on-demand fishing, investment is needed to familiarize the fishing industry with the gear, identify and address operational issues, and support manufacturers in developing more cost-effective systems. Additionally, best-practices for gear maintenance and utilizing gear long-term will continue to be identified as testing continues.

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<sup>3</sup>[https://www.clf.org/wp-content/uploads/2023/03/CLF-Economic-Analysis-On-Demand-Fishing\\_FINAL-03\\_2023.pdf](https://www.clf.org/wp-content/uploads/2023/03/CLF-Economic-Analysis-On-Demand-Fishing_FINAL-03_2023.pdf)

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