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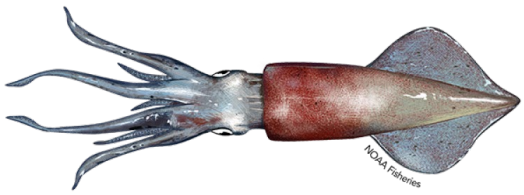
NEFSC Cooperative Research Update

October 2023 Council Meeting

Dr. Anna Mercer of the Cooperative Research Branch of the NMFS' Northeast Fisheries Science Center (NEFSC) will provide an update on several ongoing and recent initiatives. Several current project summaries and abstracts of recent publications are included as background.

Longfin Squid Biological Sampling Program (SQUIBS) Project Charter



Goal:

Advance understanding of longfin squid life history and provide data to support the 2026 longfin research track stock assessment.

Project Summary:

The longfin squid biological sampling program (SQUIBS) will collect longfin squid *(Doryteuthis pealeii*) from fishing vessels at ports throughout Massachusetts and Rhode Island and New Jersey every week for two years (2023-2024). Technicians will collect biological measurements from longfin squid using an electronic data collection system. Biological measurements will include, but are not limited to: mantle length, mantle width, body weight, sex, nidamental gland length, testes length, accessory gland length, spermatophore length, and quantity of eggs. Technicians will also extract and store statoliths (squid age structures) for aging. All biological sampling will occur at the Northeast Fisheries Science Center's Narragansett Laboratory in Narragansett, Rhode Island. These data will advance understanding of longfin squid life history, will be used in a new length-based assessment model for longfin squid, and will contribute to the 2026 longfin squid research track stock assessment.

Sampling Design:

- The NEFSC's Industry-Based Biological Sampling Program (InBios) will coordinate longfin squid collections for the SQUIBS project.
- 300 unculled squid will be collected every week from vessels harvesting longfin squid.
- Biological Sampling Requests (BSR) for 100 unculled longfin squid will be deployed on three vessels fishing for longfin squid every week (100 squid x 3 vessels = 300 squid per week).
    - Vessels providing samples will be rotated, as feasible, to provide information from across the longfin squid fishing fleet throughout the year.
    - If a vessel grades squid at sea (sort by size), samples will be requested from each size category.
- Squid samples will be collected to maximize representativeness of the population and fishery, with target areas adapting as fishing areas change throughout the year.

Sampling Protocols:

- InBios will coordinate the collection of whole longfin squid samples from fishing vessels every week.
- Samples will be delivered to NEFSC Narragansett Lab or picked up at the docks when a vessel lands.
    - Every set of samples will have a Biological Sampling Request form attached to identify the vessel, date and time when samples were collected, latitude/longitude and depth where samples were collected, and Vessel Trip Report (VTR) number.
- If possible, whole squid will be processed fresh. If sampling cannot occur immediately, squid will be frozen in the Narragansett Lab freezer. If samples were frozen at sea, they will be kept frozen until processing.
- The BLISS software on Android tablets will be used for data collection.
- BLISS connects to a Bluetooth BigFin measuring boards, Bluetooth Marel M1100 scales, and Bluetooth calipers to minimize data entry errors.
- The biological parameters that will be collected for each squid are listed below.

Organism Parameter	**Unit of Measure**
Organism weight	g
Mantle width (after cut longitudinally*)	mm
Mantle length	mm
Sex	male, female, unknown
Nidamental gland length (females)	mm
Testis length (males)	mm
Accessory gland length (females)	mm
Spermatophore length (males)	mm
Number of eggs	none, some, many
Statolith	Extracted from 10 squid per 100 (30 per week)
Tissue sample	Collected from 10 squid per 100 (30 per week)

- Statoliths will be extracted from 10 squid per sample (10 x 3 = 30 statoliths per week)
- Statoliths will be stored in 95% ethanol for 24 hours.
- Statoliths will be removed from ethanol and stored in barcoded envelopes for aging.
- Tissue samples will be collected from the mantle of the same 10 individuals statoliths are extracted from each week.
- Tissue samples will be stored in labeled vials with 95% ethanol.
- Tissue sample vials will be stored in barcoded envelopes in the freezer.

Data Access and Management:

- All data will be stored in the biological sampling (BSM) database, managed by the NEFSC Information Technology Division.
- Data will be accessible via the Oracle database or through direct access to database tables.

Responsibilities:

- Project PI: Anna Mercer
- Sampling design development: Sarah Salois, Andy Jones, Anna Mercer, Jason Didden, Mike Wilberg, Jim Gartland
- Squid collection coordination: Katie Burchard, Thomas Swiader
- Lab sampling: Gina Scott, Ricardo Hernandez, Thomas Swiader, Sarah Salois, Emma Fowler, Jacob Wilson
- Statolith aging: MAFMC contract
- IT Support: Josh Moser, Thomas Swiader
- Data Access: Josh Moser

Project Title: Piloting a Collaborative Hook and Line Survey to Ensure Data Continuity in Offshore Wind Energy Development Areas in the Northeast Region

PIs: Anna Mercer, Cooperative Research Branch Chief, NEFSC, anna.mercer@noaa.gov, (774 392-7603); Dave McElroy, Gulf of Maine Bottom Longline Survey Lead, Cooperative Research Branch, NEFSC.

Background:
Offshore wind energy development is rapidly advancing in the Northeast region, with over 22 million acres of ocean space planned or leased. Areas developed for offshore wind farms will be difficult or impossible to access using traditional mobile-gear surveys; thus, there is a critical need for novel survey techniques that can provide data on the distribution, abundance, biomass length compositions, and biological samples for federally managed species and their habitats. Hook and line surveys conducted aboard recreational fishing vessels have been used successfully in other regions to inform stock assessments and assess the impacts of ocean planning efforts (Harms et al. 2008). Hook and line gear can be safely deployed in any habitat type and alongside offshore wind turbines, can be used to collect biological samples and deploy tags on different fish species, and can provide opportunities for additional monitoring efforts (oceanographic, habitat, eDNA).

Approach:
This project would seek to develop and test the methodology for a new hook and line survey in the Northeast region. The specific objectives of this project would be to 1) Determine the operational feasibility of conducting a hook and line survey in collaboration with a fleet of recreational fishing vessels in the Northeast region, and 2) Assess the species and size selectivity of potential hook and line survey configurations in the Gulf of Maine, Southern New England, and Mid-Atlantic Bight. The following steps would be used to achieve these objectives:

- Determine specific gear configurations (hook types, bait types, terminal tackle, jigging techniques) and survey protocols (station siting and anchoring, day/night operations) to test in collaboration with industry partners.
- Develop station selection protocols, including stratification of areas planned for offshore wind development by depth and habitat type with comparative locations inside and outside wind energy areas.
- Determine the logistically feasible number of sampling stations per day in collaboration with industry partners (dependent on distance from shore and between sites).
- Select sampling stations in the Gulf of Maine, Southern New England, and Mid-Atlantic Bight to examine different species complexes and habitats.
    - Sampling stations in Southern New England and the Mid-Atlantic Bight would include areas where offshore wind turbines currently exist.
- Purchase four automatic jig machines and tackle, with specifications determined in collaboration with industry partners.
- If possible, adapt the data collection software and hardware used for the “Southern California Shelf Rockfish Hook and Line Survey” for this pilot survey or identify alternatives if not feasible.

- Conduct standardized gear sets aboard recreational fishing vessels for 5 days in the Gulf of Maine, 5 days in Southern New England, and 5 days in the Mid-Atlantic Bight.
    - Collect data on survey operations, including but not limited to steam times, set times, catch handling and processing times, staffing and crew requirements.
    - Collect data on species abundance, biomass, and size compositions using different gear configurations at every station.
        - Note: Gear configurations would be developed in collaboration with industry partners.
        - Note: All gear configurations would be tested at each sampling station.
- Evaluate the species and size composition of different hook and line gear configurations (hook type, bait type, jig speed) and survey methodologies (sampling time, day/night).

Timeline: 12 months

- Fall/Winter 2023: Set up contracts with recreational fishing vessels in GOM, SNE, MAB; Determine gear configurations; Select sampling stations; Procure jig machines, tackle, and sampling equipment
- Spring 2024: Conduct field work in GOM, SNE, MAB
- Summer 2024: Analyze data and synthesize findings
- Fall 2024: Write report and seeking funding for full survey development

This pilot project would guide the development of a long-term hook and line survey ranging from the Gulf of Maine through the Mid-Atlantic Bight. Additional survey components (oceanographic sampling, habitat monitoring, eDNA sampling, tagging studies) could be added as resources are available. A novel hook and line survey will provide critical data for assessing the cumulative impacts of offshore wind energy development on fisheries species and habitats.

Literature Cited:

Harms, J.H., Benante, J.A. and Barnhart, R.M. 2008. The 2004-2007 hook and line survey of shelf rockfish in the Southern California Bight: Estimates of distribution, abundance, and length composition. U.S. Department of Commerce, NOAA Technical Memorandum, NMFS-NWFSC-95, 110 pp.

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ORIGINAL ARTICLE

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Shelf break exchange processes influence the availability of the northern shortfin squid, *Illex illecebrosus*, in the Northwest Atlantic

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Abstract

The United States Northern Shortfin squid fishery is known for its large fluctuations in catch at annual scales. In the last 5 years, this fishery has experienced increased availability of *Illex illecebrosus* along the Northeast US continental shelf (NES), resulting in high catch per unit effort (CPUE) and early fishery closures due to quota exceedance. The fishery occurs within the Northwest Atlantic, whose complex dynamics are set up by the interplay between the large-scale Gulf Stream, mesoscale eddies, Shelfbreak Jet, and shelf-slope exchange processes. Our ability to understand and quantify this regional variability is requisite for understanding the availability patterns of *Illex*, which are largely influenced by oceanographic conditions. In an effort to advance our current understanding of the seasonal and interannual variability in this species' relative abundance on the NES, we used generalized additive models to examine the relationships between the physical environment and hotspots of productivity to changes in CPUE of

I. illecebrosus in the Southern stock component, which comprises the US fishery. Specifically, we derived oceanographic indicators by pairing high-resolution remote sensing data and global ocean reanalysis physical data to high-resolution fishery catch data. We identified a suite of environmental covariates that were strongly related to instances of higher catch rates. In particular, bottom temperature, warm core rings, subsurface features, and frontal dynamics together serve as indicators of habitat condition and primary productivity hotspots, providing great utility for understanding the distribution of *Illex* with the potential for forecasting seasonal and interannual availability.

KEYWORDS

environmental covariates, generalized additive model, *Illex illecebrosus*, northern shortfin squid, Northwest Atlantic, remote sensing, warm core rings

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Learning From the Study Fleet: Maintenance of a Large-Scale Reference Fleet for Northeast U.S. Fisheries

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Logbook data from commercial fisheries are a vital component in the machinery of management, including tracking the volume of catches and allocating catch spatially. At the same time, logbooks can provide a unique window into the ecological and sociological conditions in marine fisheries, where fishermen interact with marine species and environments frequently and broadly. Traditional logbooks, however, often are not sufficiently standardized (when personal logs), or lack the detail (when regulatory documents) required to adequately understand fisheries ecosystems. The Study Fleet program, operated by the Northeast Fisheries Science Center's Cooperative Research Branch, was developed to address these shortfalls by engaging members of the fishing industry in collecting high-resolution catch, effort, and environmental data using electronic logbooks. Since its inception, the Study Fleet has expanded from a small project focused on collecting detailed catch information from the New England multispecies groundfish fishery to a program with a wider scope encompassing a variety of fisheries, gears, and environmental parameters from North Carolina to Maine U.S. Over the years, a number of lessons have been learned about recruiting and supporting industry partners, managing the data, evolving technical specifications, and the challenges associated with analyzing and applying self-reported fisheries data. Here we describe the current state of the program and provide summaries of the Study Fleet program operations and outcomes from 2007-2020, with an eye towards successes, challenges, and applicability of the approach in other regions. We suggest other reference fleet programs, as well as other developing fishery dependent data collections (e.g., electronic monitoring programs), develop detailed roadmaps for each data collection to keep participants engaged as collaborators, target specific fisheries to keep resources from being stretched too thin,

and partner with data users early. Additionally, we suggest programs invest in the long-term participation of individual fishermen, carefully weigh the pros and cons of involvement in regulatory reporting, and plan data products and applications well in advance to ensure that the sampling scheme and granularity of the data meet the needs of stock assessment, ecosystem, and oceanographic scientists.

Keywords: logbook, CPUE, fishery dependent data, Northeast United States, self-reported data, cooperative research, reference fleet

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Bringing in the experts: application of industry knowledge to advance catch rate standardization for northern shortfin squid (*Illex illecebrosus*)

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Sources of fisheries information outside of fishery-independent surveys (e.g. fishery-dependent data) are especially valuable for species that support productive fisheries and lack reliable biological information, such as the northern shortfin squid (*Illex illecebrosus*). Fishery-dependent data streams are available for most species, however collaboration with industry members is critical to ensure that these fishery-dependent data are collected, applied, and interpreted correctly. Despite the need for collaboration and the frequency that fishery data are used in scientific research, there is limited literature on the structure of interactions and knowledge sharing that inform the analysis and application of fishery data. Between 2019 and 2022, a group of researchers collaborated with members of the northern shortfin squid fishing industry to bring together research data sets and knowledge from harvesters and processors to better describe the fishery dynamics, distribution, life history, and oceanographic drivers of the species. The collaboration focused on developing custom standardized fishery catch per unit effort (CPUE) indices to provide indicators of population trends that accounted for the impacts of technical and economic aspects of harvesting, processing and marketing on fishing effort, selectivity and landings of northern shortfin squid. We describe the methods used to inform and interpret the CPUE analyses, focusing on novel structure of interactions we had with industry members, and suggest best practices for integrating industry knowledge into CPUE standardization. The information shared and research products produced through this science-

industry research collaboration advanced understanding of northern shortfin squid population and fishery dynamics, and contributed directly to the 2022 stock assessment and management process. Given the complex and stochastic nature of the northern shortfin squid population and fishery, we found it critical to maintain open communication and trust with processors and harvesters, who have unique insight into the factors that may be driving changes in catch, landings, and productivity of the valuable resource species.

KEYWORDS

shortfin squid, stock assessment, cooperative research, local ecological knowledge, northeast United States, catch per unit effort, fisheries dynamics