Cataloging commercial fishermen's observations of ecosystem change in Narragansett Bay: Phase 2 Recommendations

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This set of recommendations is presented as an addendum to the November 2021 report, "Cataloging commercial fishermen's observations of ecosystem change in Narragansett Bay: A pilot project" (Schumann et al. 2021). In that report, we presented the results of a 2019 pilot project that systematically collected and synthesized "fishermen's ecological knowledge" (FEK) from 17 commercial fishermen about recent ecological changes Narragansett Bay. After publication of the report, the Narragansett Bay Estuary Program and Shining Sea Fisheries Consulting hosted four gatherings to discuss the report and opportunities to build on this work: a public informational presentation; a brainstorming workshop for scientists, estuary managers, and participating fishermen; and two meetings of a 5-person core of advisors (listed at the end of the document). All groups were invited to submit additional suggestions electronically or via phone call.

Drawing on these conversations and suggestions, the present addendum outlines several recommendations for future efforts to collect, synthesize, and utilize FEK in Narragansett Bay. We recommend future work along three tracks: (a) continued regular collection and synthesis of FEK, with well-defined pathways application of findings to science and management, (b) a short-term "joint fact-finding" initiative to establish shared understandings and objectives among commercial fishing, scientific, and management audiences; and (c) ongoing ad-hoc efforts to provide for engagement of scientists and fishermen in collaborative research to better understand the changes occurring in the Narragansett Bay ecosystem. We detail each proposed track below.

Track 1. Continued collection of FEK

The 2019 pilot project confirmed that fishermen possess extensive observations of ecological change, but that collecting and compiling it in a standardized format is vital to making it useful for informing management. The pilot project's open-ended structure proved valuable for uncovering themes of importance and major trends, but, a more closed-ended survey-style instrument might more efficiently generate greater amounts of data from a greater number of people in a more consistent format. Moving forward, we recommend a combination of two or more of the following FEK elicitation formats:

A. An annual survey-style instrument conducted via app, online survey, or phone survey. This instrument would elicit observations on interannual variation among a key set of taxa of interest. It would be disseminated broadly to quahoggers, lobster and other pot fishermen, aquaculture growers, and trawl fishermen, with the intention of compiling short-term observations from a large sample of diverse fishermen.

B. A seasonal (e.g., 4 times/year) interview with a core group of 8-10 fisherman key informants. Informants would be selected to reflect a range of ages, fishing areas, gear types, and species. Informants would be compensated and would also act as a steering committee for other bay-related fisheries projects that may come up (see below).
C. Periodic (e.g., every 5 years) open-ended interviews conducted in the field or over the phone with a mid-size sample (e.g., 20) diverse fishermen. Questions would focus on making comparisons between ecosystem status at multi-year intervals that match the interval between interviews. Interviews would help put the survey-style and seasonal interviews in the context of longer-term change and help reveal the relative salience of different trends in the bay on a longer time horizon.

We also suggest the development of specialized sub-components to these surveys/interviews that are geared towards specific fishery types, as described in the list below. These subcomponents can help drill down into species and locations that are significant to each gear type.

A. Quahoggers: The pilot project revealed that quahoggers are most likely to make observations in the northern half of the bay, and that their observations typically relate to sessile and mobile benthic invertebrates, seaweed, and abiotic factors. Because quahoggers' activities are concentrated in specific quahog hotspots, we recommend delineating these spots on a chart and using them as a reference framework for collecting quahogger observations (see bullet on spatial standardization, below). Quahogging has the least seasonal variability of the major fisheries practiced in the bay, so surveys with quahoggers could be carried out at any point during the year as long as it is consistent across years.

B. Lobstermen: The pilot project revealed that lobstermen are most likely to make observations in the southern half of the bay, and that their observations typically relate to mobile benthic invertebrates, seaweed, fouling invertebrates, and abiotic factors. Lobsterman-specific interview questions can drill down into these species and areas. Lobstering tends to take place in the bay between the spring and fall, so surveys could be conducted during the winter months to encapsulate observations over the course of the previous season. Many lobstermen also fish outside of the bay, and can provide observations that compare trends within the bay to trends in Rhode Island Sound, for example.

C. Trawl fishermen: The pilot project revealed that trawl fishermen are most likely to make observations related to finfish, seaweed, mobile benthic invertebrates, abiotic factors, and that their observations are made within trawl lanes located throughout Narragansett and Mount Hope Bays. Future work should engage trawl fishermen in delineating these lanes on a chart so that questions can be targeted directly to these locations. The loss of Narragansett Bay's formerly abundant winter flounder fishery means that there is now little trawling activity in the bay during the winter and early

spring, so surveys could be conducted during the winter months to encapsulate observations over the course of the previous season.

D. Aquaculture growers: Aquaculture growers have a unique perspective because of their daily, long-term interactions with specific places in the bay where their leases are located. This controls for spatial variable in aquaculture growers' observations, making it possible to derive rich longitudinal observations from this user group. The primary taxonomic groups that aquaculture growers are likely to interact with (besides the species that make up their crops) are fouling invertebrates, abiotic factors, and juvenile reef fish.

E. Conch/crab/fish pot and rod and reel fishermen: The pilot project did not include many fishermen who fish with conch traps, fish pots, crab pots, or rod and reel. Many fishermen who use these gear types also use one or more of the gear types listed above. Survey designs should consider the possibility of adding subcomponents geared towards these gear types as well.

The pilot project helped reveal a helpful "taxa + place + time + trend" framework for tabulating data, and future efforts should continue utilizing this framework, not only in analyzing but also when collecting data. For future work, we recommend developing *a priori* place and time designations so that data outputs can be more readily and consistently tabulated. Specifically, we recommend the following:

A. Standardize spatial units to align with the NBEP GIS Bay Segments map. When conducting surveys and interviews, present fishermen with a nautical chart that is pre-marked with Bay Segments and and prompt them to select which segments they fish in and wish to speak about. For quahoggers, design an additional map that is also pre-labeled with quahogging hotspots such as Mount Tom, Pine Hill, Ohio Ledge, Rocky Point, and Barrington Beach. This map should be designed with the help of a core group of quahoggers.

B. Standardize temporal units by comparing the present time to a specific baseline time
   - For seasonal interviews, ask about how the present season differs from the previous season, and about how the present season differs from the same season a year ago.
   - For annual surveys, ask how certain taxa have trended over the course of the previous year. For consistency, surveys should be conducted at the same time each year and should specify a reference season. For migratory species, the season should be defined based on the time period during which the species is found in the bay.
   - For longer-term (e.g., 5-year) interviews, can ask more open-ended questions like "what are the most pronounced changes you have seen in the last 5-10 years?"

Track 2: One-year joint fact-finding process

The pilot project and other recent initiatives have uncovered some significant epistemic barriers that stand in the way of great communication and collaboration between the fishing and the scientific management community. While we have not found any evidence of overt substantive disagreement about the ecological changes that are occurring in the bay (for the most part, our comparison of FEK and scientific monitoring datasets pointed by and large to concurrence), there has been a recent history of disagreement when it comes to interpreting the drivers of these changes and in locating these changes along a spectrum of desirability.

To overcome these barriers and enable construction of mutually credible understandings of what is taking place in Narragansett Bay, we recommend a short-term, concerted "joint fact-finding" initiative. Joint fact-finding is a practice for resolving factual disputes by forming a single fact-finding team comprised of experts and decision-makers representing *both* sides of a conflict. According to Schultz (2003), "The team works together in an effort to come to agreement regarding relevant facts, often in the form of scientific, technical, or historical claims. In this respect, joint fact-finding is really mediation within mediation -- an attempt to resolve a sub-conflict over facts as part of an effort to deal with the overall conflict."

Since joint fact-finding draws upon an established set of practices, we recommend bringing in an expert facilitator to plan and coordinate the process. To be effective, all participants, whether they be commercial fishermen, scientists, or managers, must agree to approach the exercise with open minds and true respect for other participants and their knowledge. Clear and mutually agreed-upon ground rules, goals, and timelines will need to be set by participants at the beginning. If these conditions can be met, we believe that joint fact finding can set the stage for a productive long-term dialogue that leads to the coupling of FEK and scientific data and the participation of fishermen in collection of data to inform management of Narragansett Bay. Without this preliminary step, future work may continue to be plagued by mistrust and disputes.

Although the joint fact-finding process that we recommend will be short-term in nature, we also recommend supplementing it with occasional check-ins after the fact (e.g., annually), in order to bring together the various communities of interest (fishermen, scientists, fisheries managers, water quality managers) to exchange observations and questions and reinforce their social connections and communications networks.

Track 3. Cooperative research

The pilot project and subsequent discussions also pointed to the value of cooperative research for adding new data streams to the monitoring portfolio. Cooperative research projects are designed jointly by fishermen and scientists. As a result, although data collection is typically carried out by fishermen, the data outputs from these projects look like, and meet the rigorous

standards of, scientific data. In this respect, they differ from FEK, which is experiential data that must be elicited and synthesized using social science methods.

We see several priority opportunities for cooperative research to add to the monitoring portfolio in Narragansett Bay. All of these opportunities either fill data gaps in the existing portfolio or expand the amount of data that is currently collected so as to provide greater spatial and/or temporal coverage in a cost-effective and engaging manner by leveraging fishermen's gear and time on the water.

A. Water clarity. We recommend the establishment of a program that engages commercial fishermen, aquaculture growers, and others in collecting water clarity data using Secchi disks. There is widespread precedent for citizen scientist Secchi data collection. For instance, the Secchi Disk Program has developed a smartphone app that is readily usable by commercial fishermen and others. We anticipate that fishermen's continuous presence on the water year-round can provide for a reliable and consistent data stream on water clarity, including in the coves where many dock their boats. If specific sampling locations or times are desired, individual fishermen can be assigned with target locations, times, and sampling frequencies. Participation can be supported through incentives for participation (e.g., raffle prizes based on number of entries), guidance on where/when to sample so that data is most usable for integration into scientific monitoring (e.g., would it be more helpful to sample the same locations every day, or to sample many locations less frequently? are there key areas or seasons where we need more data than others?), and training events where fishermen craft their own Secchi disks.

B. Dissolved oxygen sensors. In 2020, Oregon crabbers began attaching oxygen sensors to their crab pots through a collaboration with Oregon State University. According to Steinberg (2021), the collaboration produces near real-time data with extensive spatial coverage on hypoxic bottom water, including in key areas where crabs are most likely to be located. We recommend considering the replication of this project with Narragansett Bay lobstermen to understand the location of low dissolved oxygen in bottom waters and how these locations fluctuate across seasons.

C. Fouling plates. Lobstermen and oyster growers already observe fouling organisms on their traps and cages, but these observations are not standardized because of cleaning procedures, moving traps around among locations, and the irregular time intervals that traps and cages are placed at different locations. To standardize these observations, it would be useful to have lobstermen and growers set some "control" traps that are not hauled, cleaned, or moved. Traps could contain settlement plates so that surfaces are standardized and coverage is easily quantified. The Salem Sound Coastwatch Marine Invasive Species Benthic Fouling Study provides a useful model.

D. Seaweeds. Given the frequency and richness of fishermen's observations with relation to seaweeds, along with the relative scarcity of long-term scientific monitoring data on seaweeds compared to other taxonomic groups, we recommend a concerted FEK or

cooperative research effort focused on seaweeds. Gathering standardized observations on seaweeds is complicated by the fact that there are many different species which are often difficult to identify in the field (even for experts), and common names are not available for many species. In any FEK or cooperative research approach, the challenge of identification will add an extra layer of complexity when it comes to seaweeds, and planning of future seaweed-related research may require significant up-front planning and data quality control due to this extra layer of complexity.

E. Unmonitored shellfish. Our comparison of scientific monitoring sets with FEK revealed that there is currently no collection of data on the populations of "deckers" (*Crepidula fornicata*), a species that quahoggers regularly catch as incidental bycatch and which is, according to many interviewees, increasing dramatically in abundance as quahogs decline This species represents low-hanging fruit where FEK and cooperative research can easily lead to big gains in what is known about this species. We recommend convening quahoggers and fisheries managers to discuss paths forward, including the reconstitution of the Commercial Fisheries Research Foundation's Shellfish Research Fleet to gather data on this species.

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