

# NEW HAMPSHIRE SEA GRANT: Establishing a community-based climate ocean observing system in N.H.

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## Background

Temperature is a primary driver for ecosystem processes that fishermen see reflected in their daily catch. Fishermen repeatedly invoke temperature as the primary explanation for the historical and current patterns in fish availability. In the past few years, fishermen are reporting unusual patterns in fish availability that has presented significant challenges for them to fish their available quotas efficiently. Fisheries scientists are observing significant changes in the distribution of many commercially valuable fish stocks. Though substantial, fishermen's existing ecological knowledge remains largely uninformed by basic hydrographic information and ecological concepts. At the same time, advances from a scientific perspective remain largely un-informed by ecological knowledge and observations from fishermen based in decades of time on the water fishing. Furthermore, as the emerging realities of climate change come into focus in scientific and management circles, challenges remain regarding how best to engage fishermen in the study of climate change and fisheries and in the search for adaptive measure for fishing communities.

This project investigates relationships between catch and habitat characteristics and embodies a style and structure of collaborative research that addresses two critical needs of the current situation. First, it explores a previously untapped approach to improving the selectivity of fishing operations (building off existing ecological knowledge), an area of work that has traditionally focused on gear modification. Secondly, it engages fishermen in climate studies, thus gaining benefits from entraining their knowledge and experience while opening the doors for partnership with scientists and managers in developing adaptive strategies.

## Methods

We explored the relationship between catch and ocean temperature working with a single fisherman and his deck hands under their normal fishing effort (Capt. Jamie Hayward, *F/V Heidi and Elizabeth*). Ocean temperature measurements were collected from data-loggers deployed on three separate gillnet strings arranged at five locations on the string (Figure 1). Tags were programmed to record temperature every 7.2 minutes and tags recorded ocean temperature in increments of 0.5 °C. All tags were located approximately 1.5m above the led line with two tags on each end of the string and at three equally distributed in between. Data was retrieved wirelessly in between deployments and downloaded to a laptop. Catch was recorded for each haul.

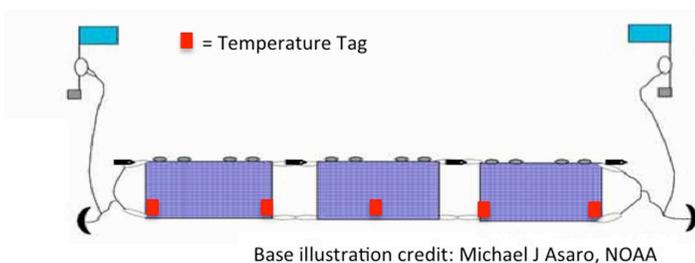


Figure 1: The arrangement of temperature tags on a gillnet.

## Results

Temperature and catch data were collected from 16 hauls over six days when two or three strings were fished. Research hauls were made during four days between 3-7 June and two days between 14-16 June, 2014. All soaks were 20-24 hours and the three strings remained in the same position throughout Phase I. Strings 1, 2 and 3 were oriented North-South along the Northwest slope of Jeffrey's Ledge at depths of 55m, 100m and 120m respectively (Figure 2).

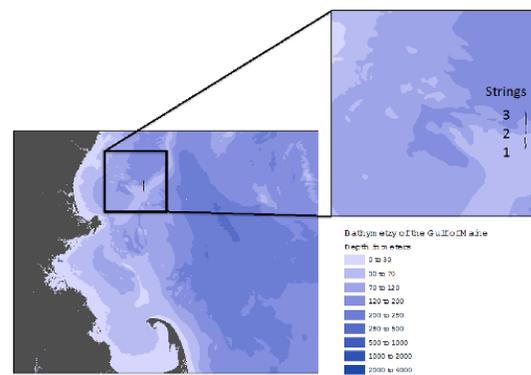


Figure 2: The location of strings fished during Phase I.

Overall, catch consisted of 5,410 pollock, 4,130 cod, 4,300 dogfish, 220 haddock, 50 black-backed flounder, and 10 yellowtail flounder. Generally, temperatures decreased with ocean depth and warmest temperatures were consistently measured from string 1 (Table 1). Bottom temperatures increased for all three strings between 3 June and 16 June (Figure 3).

| String | Depth (m) | Hauls | Mean Temp (°C) | Standard Deviation (°C) |
|--------|-----------|-------|----------------|-------------------------|
| 1      | 55        | 6     | 4.91           | 0.38                    |
| 2      | 100       | 6     | 4.41           | 0.42                    |
| 3      | 120       | 4     | 4.26           | 0.23                    |
| All    | --        | 16    | 4.56           | 0.45                    |

Table 1: The string depth, number of hauls and temperatures during Phase I.

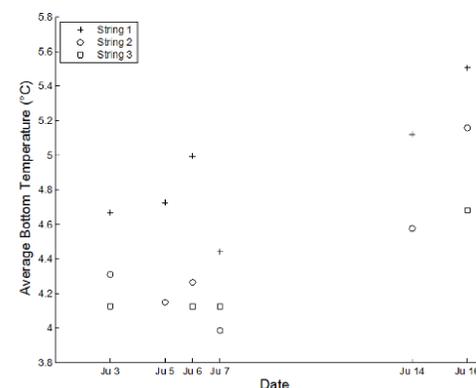


Figure 3: The mean temperatures recorded from tags on Strings 1-3 between 3-16 June, 2014.

With the temperature change, the assemblage of fish species landed changed dramatically between the 3-7 June hauls and the 14-16 June hauls. By 14 June, dogfish moved into the area and were caught in high numbers (Figure 4A and 4B). Catches of all other species appeared to decrease with the warmer temperatures and when dogfish moved into the fished area with catches of haddock, black backed and yellowtail flounder reduced to zero. Catches of pollock and cod also appear to have been reduced, but were still captured between 14-16 June in the warmer waters.

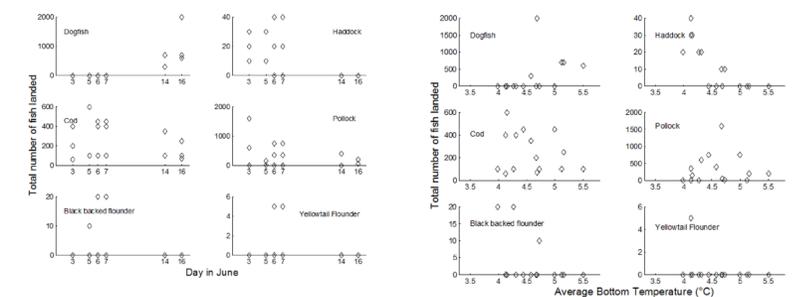


Figure 4A (left): The number of fish landed by species by day; Figure 4B (right): The number of fish landed by species by bottom temperature.

## Discussion

Time and temperature co-varied in this study and it's not clear whether community changes resulted from 1) a response of one species to temperature (e.g. dogfish) and subsequent ecosystem processes that affect community composition, or 2) from a response by all or some of the species directly to temperature variability. We were able to capture the influx of dogfish as water temperatures warmed. The influx of dogfish occurred as bottom temperatures increased above 4.5 to 5.0 °C and dramatic change in catch was observed with a reduction in catch of haddock and flatfish and a possible reduction in cod and pollock.

## Next Steps

In the fall of 2014, two additional vessels were set up with bottom-temperature systems and moving into 2015, an additional gillnet fishermen and a lobsterman will also be added to the program. During 2015, a total of four gillnet and one lobsterman will be involved in the program. A Conductivity (salinity), Temperature, Density (depth) sensor (CTD) will be used in combination with the temperature data tags to characterize the hydrography of the fished area and to inform a tag placement strategy. Data will be collected throughout the fishing year, beginning in May 2015.

In addition, a N.H. Community-Based Environmental Monitoring Working Group will be formed that will include participating and other interested fishermen, The Nature Conservancy, N.H. Sea Grant and the N.H. Groundfish Sectors. Additional partners may include NOAA Northeast Cooperative Research Program, Northeast Regional Association of Coastal Ocean Observing System, Shoals Marine Lab, and the Seacoast Science Center. This working group will meet three times during 2015 to plan data collection, to discuss and share results, and to build connections between fisheries scientists and fishermen.

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