Part 1

It's 4:00 AM and Captain Joe Fraser is leaving his house in Point Pleasant, NJ for his ship, the F/V Atlantis. He and his crew are setting out on their trip to haul for squid with trawl nets (*see Figure 1*) This has been his routine for as long as he can remember, beginning when he was a kid when he would assist his father and grandfather pull in their prey.

Figure 1: Fisher hauling squid from trawl net.
(Photo credit: https://www.seafoodnews.com/Story/941510/Innovative-squid-net-reduces-bycatch-dramatically-in-tests-off-Massachusetts/)

After loading up the supplies they need for the 2-day trip, he consults the navigational charts and the satellite data showing sea surface temperature to identify areas and conditions he knows from his grandfather and father that squid favor. But, over the past few years, he's been finding a totally different mix of species on his fishing grounds. Squid is becoming a smaller portion of his overall catch. Newcomers like black sea bass often fill the nets, but he doesn't have the quota to land them. Joe wonders if he can continue the legacy that his father and grandfather began.

Joe ran into fellow fishers, Sydney Shipbottom and Bill Longshore. Bill has been fishing off Rhode Island and has also experienced big changes. Bill says, "We're just loaded with black sea bass, overwhelmed with them. We used to catch them off New Jersey at the end of summer, but now they are more up in Rhode Island. We can't get away from that fish! We were going out after fluke, we got black sea bass. We were going after squid, we got sea bass. At all depths. See, species don't stay put in the ocean, like they do in a farm."

Bill has a big fishing boat, and often goes out for a week or more at a time. For him, going up to Rhode Island or further to find the fish they want is not a problem (though sometimes the cost of diesel fuel gets expensive). Sydney and Joe have smaller boats, however, and stays close to port. Following squid if they move elsewhere isn't an option for them. Sydney laments "it's left us as the original squid fishermen with no squid to catch unless we travel 100 miles, and we are not those types of wanderers."

Months later, Joe attends a joint meeting set up by the Mid-Atlantic Fishery Management Council (MAFMC). The MAFM manages species that occur between 3 and 200 miles offshore (in federal waters)

Funding provided by National Science Foundation Award 1426891
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to make sure that species are not overfished and that the habitat is maintained. At this meeting, he speaks with other fisherman and scientists, but of particular interest to Joe are the data presented by Dr. Steve Marlin of Coastal University (*see Figure 2 and Figure 3*). Dr. Marlin has been studying the movements of a variety of marine species over time and has identified numerous shifts in where they are found.

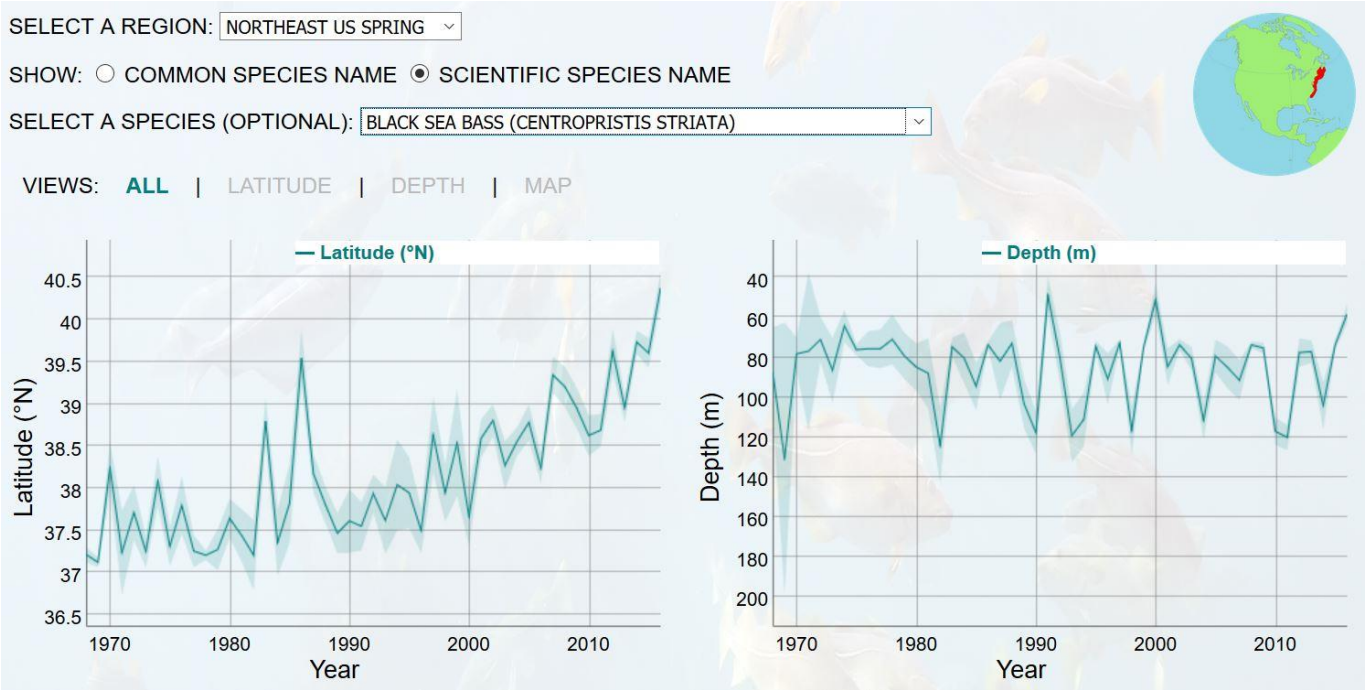

Figure 2: Population shift by latitude, depth and season (spring) for black sea bass (Centropristis striata).

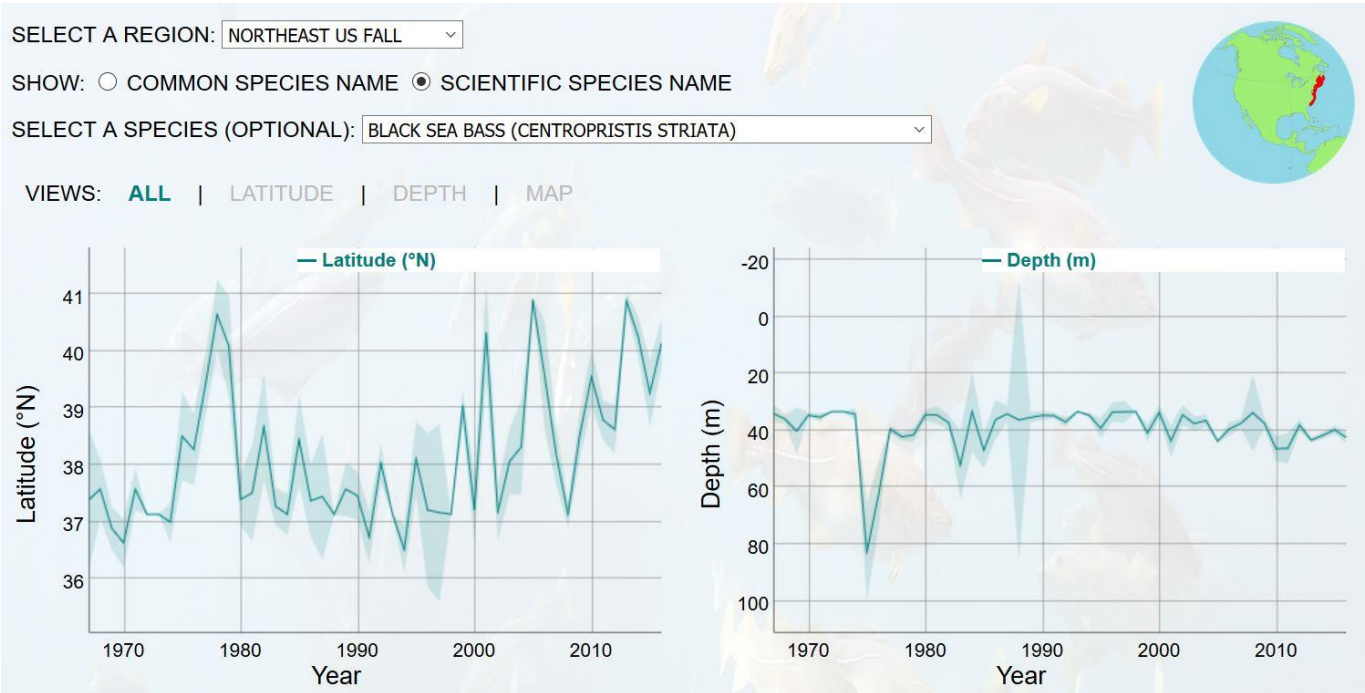

Figure 3: Population shift by latitude, depth and season (fall) for black sea bass (Centropristis striata).

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Questions

1. What changes have the fishermen been noticing on the water?

2. What could be the potential causes of these changes?

3. What evidence would we need to collect to determine whether these potential causes are in fact the source of the changes? What will this evidence show?

4. What are the potential effects of the shifting fish populations on marine ecosystems and the fishing industry? Create a diagram that models all the potential causes and effects related to this case.

5. The fishing industry is considered a "social-economic-ecological system." Describe what that means.

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