

"BY COMBINING 'LIVE' DATA WITH COMPLEX FISH AND ENVIRONMENTAL MODELS THEY ARE ABLE TO MAP FISH DISTRIBUTION IN REAL TIME IN THE GULF OF MAINE / GEORGES BANK".

Nowhere to hide – Managing fisheries in real time

Managing fish stocks in real time with forecast maps of fish distributions may sound like science fiction, but this is exactly what scientists on the east coast of the United States are developing the means to do. "Live" data are being combined with complex fish and environmental models to make experimental maps of fish distributions in near real time in the Gulf of Maine / Georges Bank area. The "live" data come from fishing boats, and in return both the fishermen and fisheries managers hope that more accurate estimates of stock abundances can be made. They believe that this will provide more opportunities to catch fish.

The system has been named Advanced Fishery Management Information System (AFMIS). It has been developed on two main principles. The first is that the distribution of fish stocks is closely related to variability in the ocean environment. The second is that forecasts of fish abundance and distribution, on time scales of days to weeks, can aid the management of multispecies fisheries. A major goal of AFMIS is to provide information for short-term management strategies such as localized area closures during spawning and/or recruitment events. The idea is that with shorter-term forecasts, fisheries management will be able to react more swiftly and effectively to major events in the fisheries. The more information we have about a fishery the better we can manage it.

What is AFMIS?

The present AFMIS system is a combination of:

- (1) A pair of coupled mathematical models of the physical environment and fish distributions in the Gulf of Maine / Georges Bank region.
- (2) Near real time fish and environmental data from a commercial groundfishing fleet.
- (3) Information from the Regional Fisheries Application Center Data and Information System.



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How the system works

Using a composite of the previous week's satellite-derived sea surface temperature (SST) images, a Gulfstream Ring and Front Analysis (GSRFA) is produced. The GSRFA provides valuable information about deep-ocean forcing of the Georges Bank / Gulf of Maine region. This is then combined with recent bottom temperature data from the fishing fleet and integrated into a set of complex numerical models to produce a suite of nowcasts and 3-day forecasts of water circulation and property fields. As fish species are strongly dependent on environmental conditions, the resulting physical forecast fields are then used with the fish model to forecast fish distributions.

As fish do not just stay in one place, the fish model is made as realistic as possible by incorporating predictions of their movements towards their preferred environmental conditions. For example the farther fish are from their favoured temperature, the faster they swim towards it. The model also incorporates an allowance for the random searching behaviour of fish, which among other things, prevents unrealistically high concentrations of fish in the model.

Data from the fishermen

A crucial part of the AFMIS system are the data provided from fishing boats. Since November 2000, fishermen on twenty trawlers have documented fish catch and associated environmental conditions, including bottom temperature, from 4468 trawls. The fishermen are working in a partnership with SMAST¹ researchers, the New Bedford area Trawler Survival Fund, the Massachusetts Fisheries Recovery Commission, and the Massachusetts Division of Marine Fisheries to conduct a high-resolution, industry-conducted survey of the regional ground fisheries. The partnership is currently funded by NOAA's² National Marine Fisheries Service.

How is AFMIS being used?

A prototype AFMIS fish model currently forecasts the distributions of Atlantic cod (*Gadus morhua*) and haddock (*Melanogrammus aeglefinus*) based on forecasted distributions of model bottom temperature, sediment type, and water depth. Figure 1 shows an example of a 3-day forecast for cod (presented in terms of catch per unit effort, cpue, in pounds/day) based on model bottom temperature distribution only. Although the full Gulf of Maine / Georges Bank fish model is still being tested,

¹ University of Massachusetts Dartmouth School for Marine Science and Technology (SMAST)

² National Oceanographic and Atmospheric Administration



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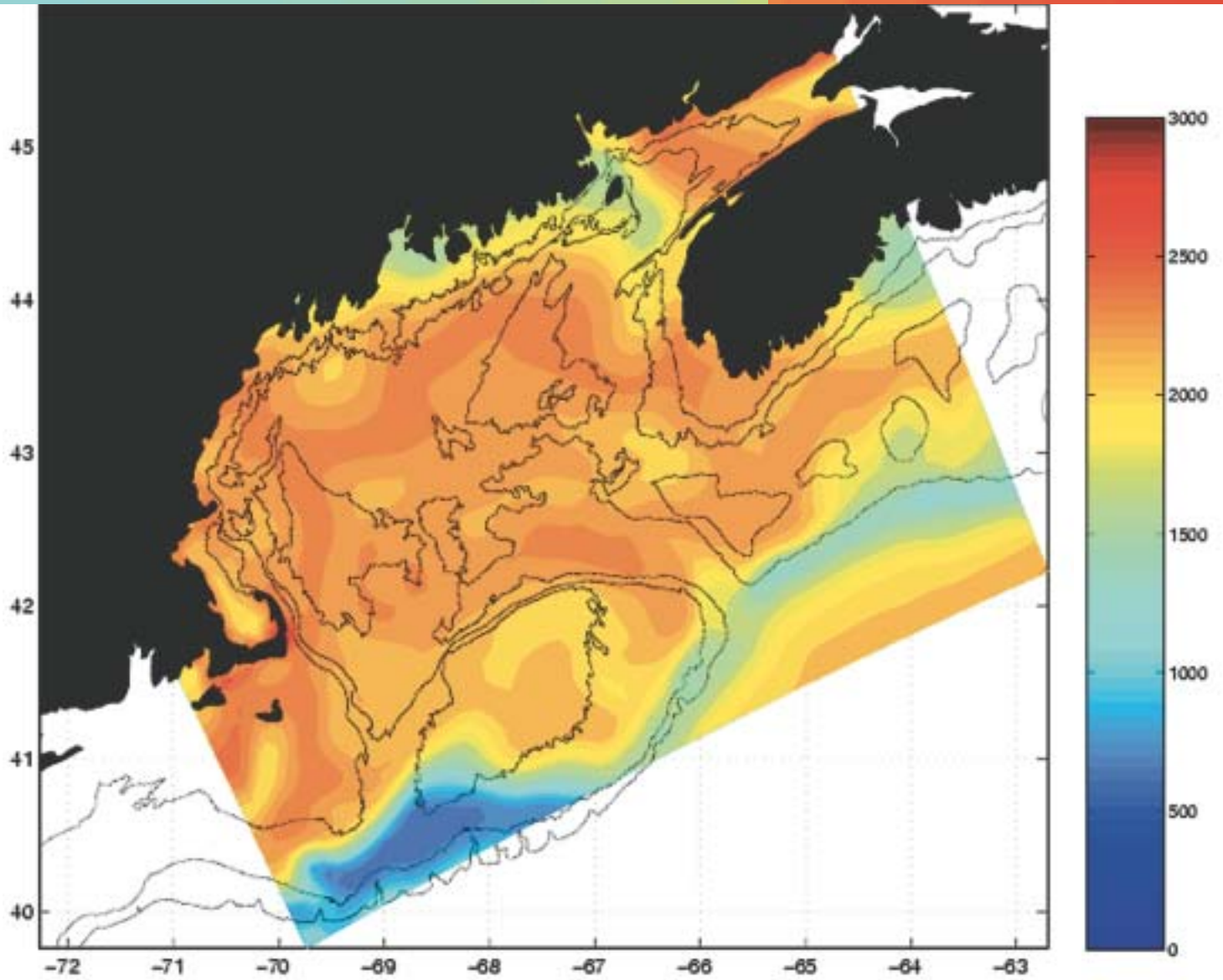


Figure 1. Fish forecasts: A 3-day model forecast of cod cpue (pounds/day) distributions in the Gulf of Maine / Georges Bank based on model bottom temperature for 10 September, 2001. Red areas indicate the best spots for catching cod.

initial model runs for Georges Bank indicate that bottom temperature alone can account for up to 20% of the observed distributions of both cod and haddock.

AFMIS has been developed by scientists at the University of Massachusetts Dartmouth School for Marine Science and Technology (SMAST) and Harvard University. They have been supported by the National Aeronautics and Space Administration and the Office of Naval Research.

For further information about AFMIS please try <http://rfac.smast.umassd.edu> or contact the author:

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