

# Metadata, Products, and Services of the Food Web Dynamics Program

Brian E. Smith\* and Laurel A. Smith

National Marine Fisheries Service, Northeast Fisheries Science Center,  
Woods Hole, Massachusetts, USA, \*Email: [Brian.Smith@noaa.gov](mailto:Brian.Smith@noaa.gov)  
Website: <http://www.nefsc.noaa.gov/femad/pbio/fwdp/>



## INTRODUCTION

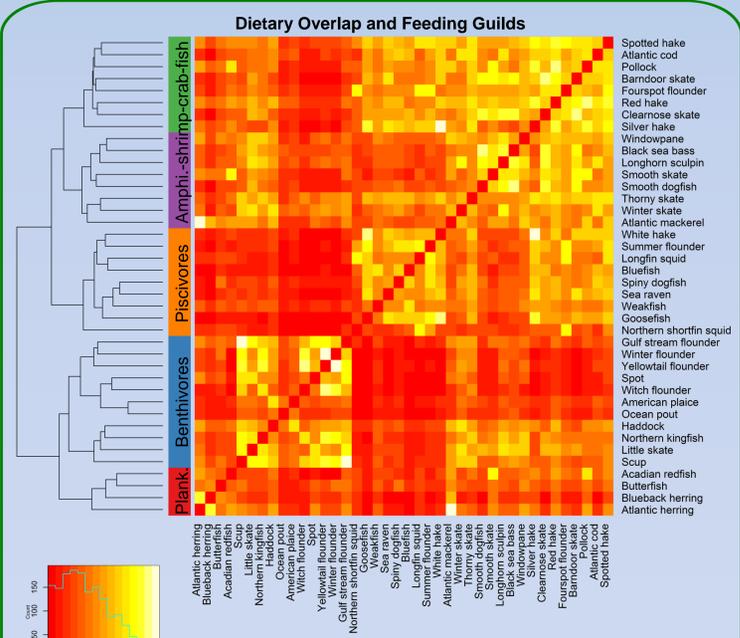
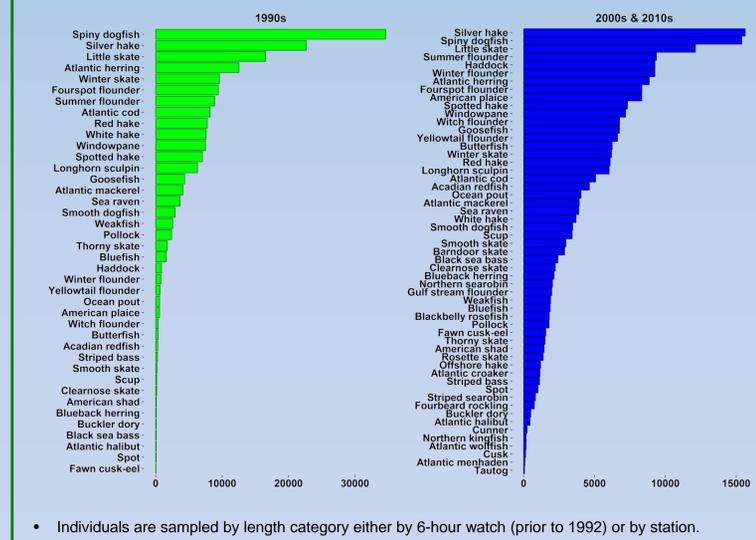
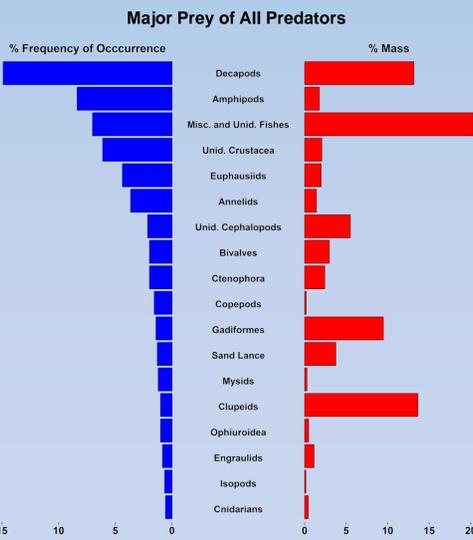
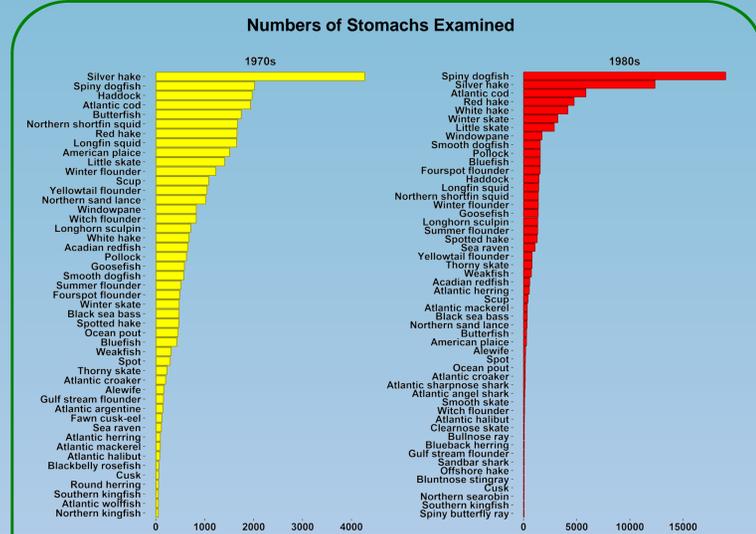
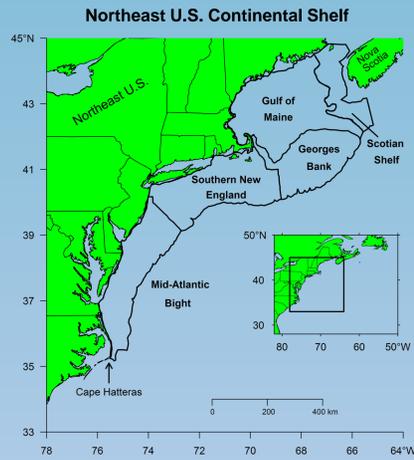
We provide an overview of the Northeast Fisheries Science Center's Food Web Dynamics Program (FWDP) and examine its products and services in the context of ecosystem-approaches to fisheries management. The FWDP has one of the world's largest fish diet databases with data from 1973 to the present for the Northeast U.S. continental shelf. The database contains approximately 1.5 million records from more than 197 predators, 615,000 stomachs, and 1,300 different prey items. Most species within this fish community are generalist feeders with broad diets as piscivores, benthivores, planktivores or a combination of these feeding guilds. The FWDP aims to identify patterns and processes of fish trophic interactions given various anthropogenic pressures and natural processes occurring over large spatial and temporal scales. In 2009, a formal program review of the FWDP was completed. The review report and summary documents are available upon request.

## BACKGROUND

The Food Web Dynamics Program (FWDP) has four main research objectives: 1) to assess predation mortality relative to fishing mortality for commercially important fishes; 2) to model species interactions that influence the status of these stocks; 3) relate diet variability to changes in population level processes; and 4) to advance our understanding of the Northeast U.S. continental shelf ecosystem.

The FWDP's diet database extends over 40 years of sampling, collecting data from the standardized, multi-species bottom trawl surveys conducted by the Northeast Fisheries Science Center from Cape Hatteras, NC, to Nova Scotia (~293,000 km<sup>2</sup>; Azarovitz 1981; NEFC 1988). Currently the bulk of the data being examined and analyzed come from two seasonal (spring and fall) surveys, sampling approximately 15,000 to 20,000 fish stomachs per year. See Smith and Link (2010) for more programmatic information.

An important component of understanding fish community structure and function is knowledge of fish diet and prey fields. These simple observations provide necessary building blocks for the application of ecosystem assessments.

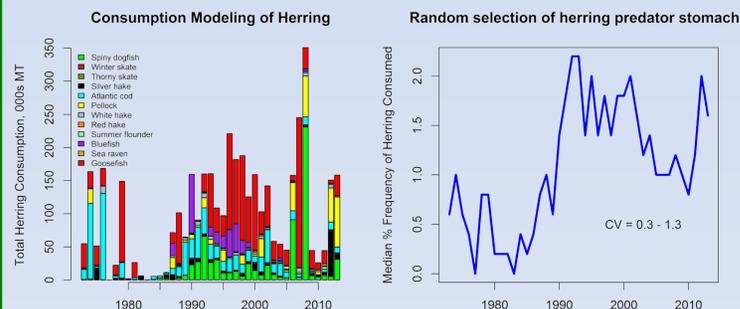


- Dietary overlap is moderate for these fishes (mean Schoener's Index = 0.3).
- Major feeding guilds were observed with predators clustering as planktivores, benthivores, piscivores, and a mixture of amphipod-shrimp-crab-fish feeders. Note, predator size was excluded given the number of predators considered.
- High overlaps exist among several Gadiformes, skates and some piscivores, and among some benthivores, black sea bass, longhorn sculpin, and skates.

- Small crustaceans, namely decapods and amphipods, are prominent prey by occurrence and mass.
- Unidentified fishes represent another abundant item. Although well digested, this group is largely composed of Gadiformes, clupeids, and sand lance.
- Euphausiids, annelids, cephalopods (mainly squids), bivalves, and Ctenophora are also important prey.

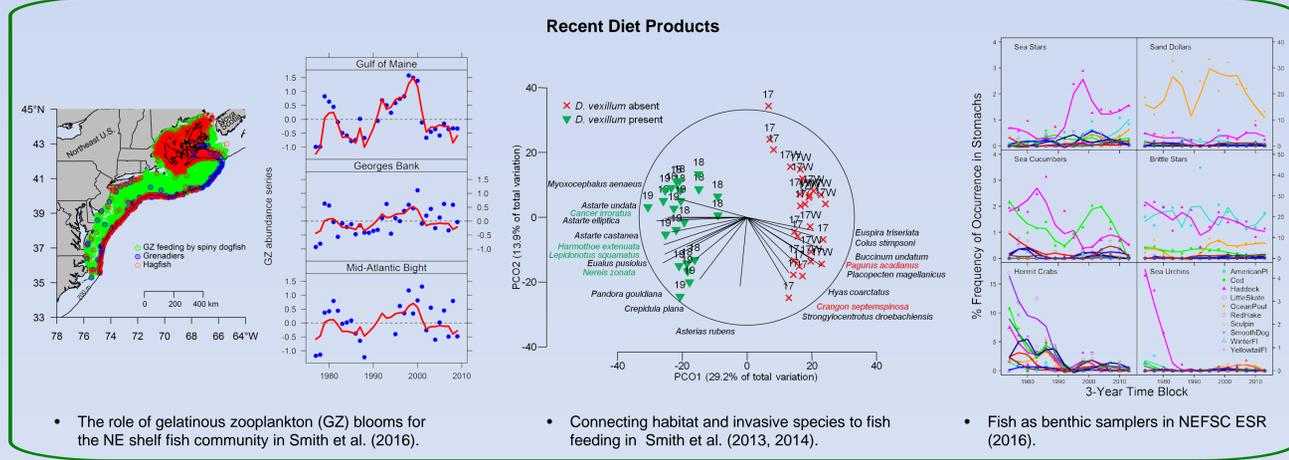
- Individuals are sampled by length category either by 6-hour watch (prior to 1992) or by station.
- The bulk of sampling occurs at sea with macroscopic examination of stomach contents. The data receive at-sea and in-lab audit checks to insure quality.
- At-sea versus in-lab diet comparisons also help to monitor data quality.
- Juveniles ( $\leq 12$  cm) are processed in the lab.
- Recently, we have sampled fewer stomachs per species, but a higher number of species.

## Products for Informing Natural Mortality



$$EQ 1: C_{annual} = ae^{\beta T_{fall}} \cdot 24 \cdot D_{fall} \cdot 182.5 + ae^{\beta T_{spring}} \cdot 24 \cdot D_{spring} \cdot 182.5$$

- Consumption estimated with the gastric evacuation rate method by predator (EQ 1; Eggers 1977; Elliott & Persson 1978) as C: annual per capita consumption;  $ae^{\beta T}$ : gastric evacuation with seasonal temperatures (T), conservative  $\alpha$ ,  $\beta$  parameters (e.g. Durbin et al. 1983); D: average mass of herring prey by season; 24: number of hours in a day; 182.5: number of days in a half-year. Multiplied by annual predator population abundance, per capita consumption is scaled to the population.
- In general, consumption time series tend not to be constant, suggesting time-variant natural mortality. This is particularly interesting for prey with commercial value as the magnitude also varies by prey size (e.g. predation of recruits not selected by fishing).
- Whether as absolute measures of removal or indices to gauge trends, these products are informative for assessing natural mortality and managing fish communities on a continental shelf-wide scale.



- The role of gelatinous zooplankton (GZ) blooms for the NE shelf fish community in Smith et al. (2016).
- Connecting habitat and invasive species to fish feeding in Smith et al. (2013, 2014).
- Fish as benthic samplers in NEFSC ESR (2016).

## CONCLUSIONS AND RECOMMENDATIONS

With interest in maintaining these priceless data streams, the FWDP actively contribute to fish stock assessments, peer-reviewed publications, and diet reports to highlight the value of these data while establishing multiple internal and external NOAA collaborations annually.

Monitoring trends in fish trophic interactions and predator abundances is critical for understanding the fish community structure of the NE US shelf. These data are central to developing ecosystem-approaches to fisheries management.

Given our wide knowledge of the trophic interactions and food web structure of this continental shelf, we will continue to answer questions regarding the shape, function, and trends of the fish community.

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