NORTHEAST AREA MONITORING & ASSESSMENT PROGRAM

VIMS | William & Mary
Virginia Institute of Marine Science

NEAMAP — Mid Atlantic / Southern New England

What is NEAMAP?

NEAMAP stands for **N**orth **E**ast **A**rea **M**onitoring and **A**ssessment **P**rogram. NEAMAP was developed by the Atlantic States Marine Fisheries Commission (ASMFC) to coordinate fisheries independent monitoring activities in the northeastern United States. The intent of NEAMAP is to coordinate and standardize procedures and improve data quality and accessibility.

Currently, three large-scale trawl based surveys exist under the NEAMAP banner. These are NEAMAP–Maine / New Hampshire (conducted by the Maine Department of Marine Resources), NEAMAP–Massachusetts (led by the Massachusetts Division of Marine Fisheries) and NEAMAP–Mid Atlantic which is housed at the Virginia Institute of Marine Science. NEAMAP–Mid Atlantic began with a pilot survey in the fall of 2006 and commenced regular twice-yearly (spring and fall) sampling cruises in September 2007 . The VIMS NEAMAP program samples from Cape Cod, MA south to Cape Hatteras, NC and targets both juvenile and adult fishes.

The Four Main Goals of NEAMAP:

1) Develop fishery-independent surveys for areas where current sampling is either inadequate or absent

2) Coordinate data collection among existing surveys as well as any new surveys

3) Provide efficient management and dissemination of data

4) Establish outreach programs

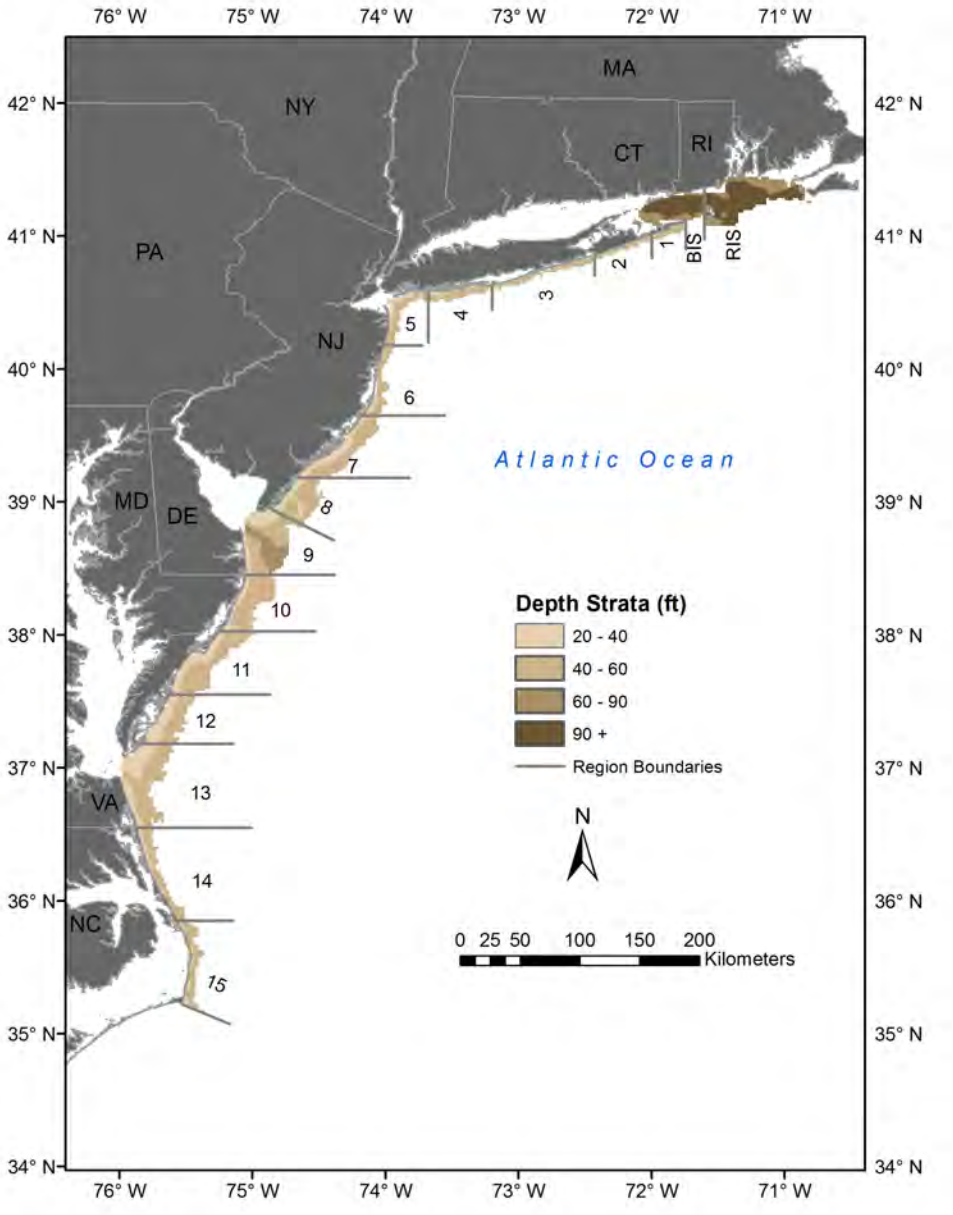
NEAMAP – Mid Atlantic operates in the waters bounded by the western edge of Cape Cod, Massachusetts to Cape Hatteras, North Carolina. From Montauk, New York and southward, sampling is bounded by the 60ft. (18.3m) depth contour. In the deeper near shore waters of southern New England the deepest stations extend to about 120ft. (36.6m). A moderately high sampling intensity (compared to other surveys) of ~1 station per 30 nm^2 is employed. The survey's technical objectives are:

1) Estimate the abundance, biomass, length-frequency distribution, age-structure, sex ratio, maturity schedules, diet - composition, and other assessment-related parameters of the various fishes of management interest inhabiting the sampling area
2) Estimate the abundance, biomass, and length-frequency distribution of all other fishes collected by the survey as well as invertebrates of management interest
3) Collect hydrographic and atmospheric data coincident with the monitoring of living marine resources
4) Identify and monitor essential fish habitat in the regions sampled by the survey
5) Serve as a platform for the collection of additional samples and data for collaborating investigators, as project resources allow.

Field Methods

Cruises

NEAMAP–Mid Atlantic conducts two cruises per year, one each in spring and fall, timed to roughly coincide with similar offshore surveys operated by the National Marine Fisheries Service's North East Fisheries Science Center (NEFSC). Each cruise samples at 150 stations distributed among 17 regions and four depth strata (all regions except region 9 contain only two of the four possible depth strata). At each station the trawl net is towed along the bottom for 20 minutes, at a target speed of 3.0 knots. All tows are completed during daylight hours and each cruise takes 28-35 days.



Vessel— NEAMAP fishes from the *F/V Darana R*, a 90' commercial trawler currently home ported in Hampton, VA. The *Darana R* is owned and operated by Captain Jimmy Ruhle of Wanchese, NC. The vessels crew includes First Mate and Relief Captain Bobby Ruhle and a deckhand. All fishing operations are conducted by the vessel crew.

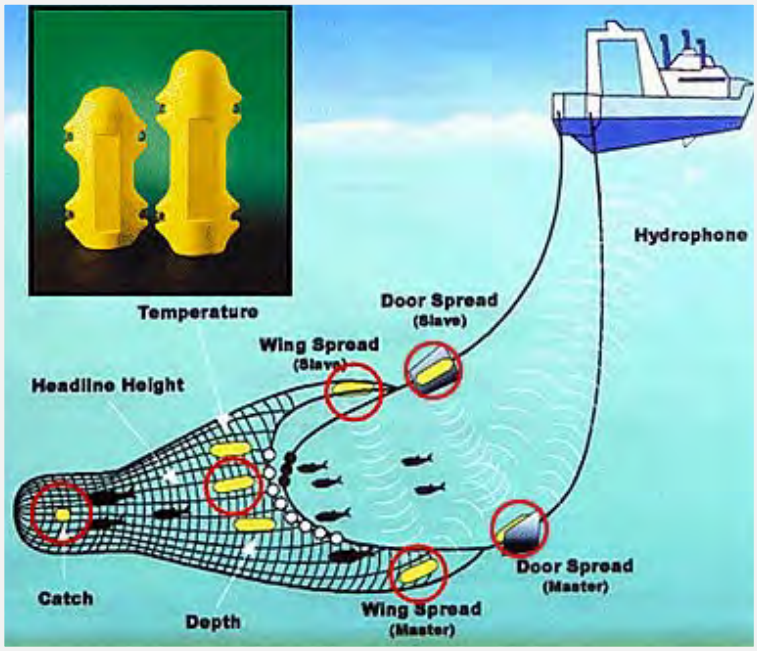
Gear— To assure maximum comparability with current NEFSC surveys NEAMAP – Mid Atlantic adopted the bottom trawl design developed for the NEFSC by the joint Mid-Atlantic/New England Trawl Survey Advisory Panel. The NEAMAP – Mid Atlantic Near Shore Trawl Survey fishes with a 400 x 12cm, 3-bridle 4-seam bottom trawl, with a 3" cookie sweep and 1" knotless liner in the cod end. The doors are 66" Thyboron Type IV.

Sensors—

During science operations, trawl monitoring sensors provide near-real-time measures of gear performance, enabling the Captain and crew to adjust tow speeds and scope to obtain the optimum fishing geometry of the net. Equally important, these data are saved to computer files which, when combined with tow distance information from the GPS, allow subsequent data analyses (such as the generation of abundance estimates) to be performed on an area-swept basis. Such analyses provide standard adjustments for tow-to-tow differences in tow speed, tow duration, current speed, and so on.

NEAMAP – Mid Atlantic / Southern New England uses a suite of Simrad PX net monitoring sensors to assure that tows are conducted in a consistent manner and that the net is fishing within specified limits :

- *Wing sensors:* To measure the width of the net mouth opening.
- *Headrope sensor:* To measure the height of the net at the head-line.
- *Door sensors:* To measure spread.
- *Bottom contact sensor:* Monitors constant sweep contact with seafloor.
- *Catch sensor:* To warn when the cod end of the net is filling (set to trip at approximately 5,000lbs).



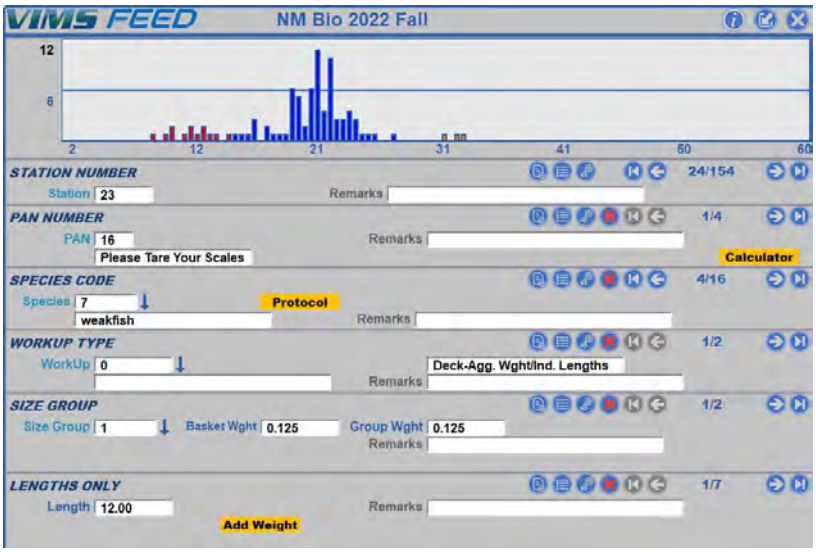
Data Collected

At each station, several standard variables are recorded. These include (but are not limited to):

- *Station identification parameters* — date, station number, stratum, station sampling cell number.
- *Tow parameters*— beginning & ending tow location (as well as recordings of the continuous GPS data stream), vessel speed & direction, engine RPMs, duration of tow, water depth.
- *Gear identification and operational parameters* — net type code & net number, door type code & door numbers, tow warp length, trawl door spread, wing spread, headline height & bottom contact of the footgear.
- *Atmospheric and weather data* — air temperature, wind speed & direction, barometric pressure, relative humidity, general weather state, sea state.
- *Hydrographic data* — water temperature, salinity, dissolved oxygen (full water column profile)

FEED — Fisheries Environment for Electronic Data

NEAMAP uses a computer program named Fisheries Environment for Electronic Data (FEED) to collect survey related data. At its core, FEED is an improved front-end for relational MS Access© databases and was developed by fishery scientists at the Virginia Institute of Marine Science. FEED is used to read and parse NMEA sentences from a GPS for collecting station specific positional data. FEED is also used to collect biological, species data. It is capable of collecting data directly from all major brands of fish measuring boards and motion compensating scales.



Species Data

After the completion of each tow, the catch is sorted by species and modal size groups. For species of management interest, a subsample from each size group is selected for detailed processing (described below). Experience shows that a subsample of 3-5 individuals (3 for very common species, 5 for all others) per species-size group per tow is sufficient for this full processing.

The data collected from each of these subsampled specimens includes:

- Length (to the nearest 5mm)
- Total Weight (kg)
- Sex (macroscopic)
- Maturity stage (macroscopic)
- Eviscerated weight (kg)

Species Selected for Detailed Processing:

Alewife	Red drum
All skate species	Scup
American shad	Silver hake
Atlantic cod	Smooth dogfish
Atlantic croaker	Spanish mackerel
Atlantic herring	Speckled trout
Atlantic mackerel	Spiny dogfish
Atlantic menhaden	Spot
Black drum	Striped bass
Black sea bass	Summer flounder
Blueback herring	Tautog
Bluefish	Weakfish
Butterfish	Windowpane
Haddock	Winter founder
Monkfish	Yellowtail flounder
Pollock	

Extra sampling to answer special management needs is routinely included as well. Beginning in fall 2012 we developed a relatively quick field-based method for determining sex and maturity of longfin inshore squid which are now subsampled for this sex-specific data. For specimens not selected for the detailed processing (for all species, managed and unmanaged), aggregate weights are recorded by species-size group, and individual length measurements (which also yield count data) are taken for either all or a representative **subsample.**

NEAMAP Total Catch by Priority Species

Species Name	Total Catch	Total Weight (kg)	Number Subsampled
Butterfish	4,186,244	94,758	19,125
Scup	2,806,397	68,802	19,369
Weakfish	1,366,544	88,533	14,104
Atlantic croaker	1,358,503	103,278	5,601
Spot	1,183,995	64,900	4,096
Blueback herring	188,687	2,642	3,636
Silver hake	176,774	6,022	7,601
Little skate	170,730	92,866	8,161
Bluefish	100,091	9,757	7,596
Menhaden	65,448	3,324	2,116
Winter skate	49,159	76,280	6,357
Alewife	47,984	2,495	4,147
Clearnose skate	45,223	56,698	8,305
Spiny dogfish	26,557	45,577	3,945
American shad	26,465	779	4,024
Atlantic herring	24,150	901	1,185
Winter flounder	20,628	6,342	7,163
Windowpane	17,501	3,282	4,782
Smooth dogfish	17,340	32,057	5,580
Summer flounder	15,978	8,540	11,674
Black seabass	13,863	5,022	5,628
Atlantic mackerel	3,912	269	434
Striped bass	3,795	13,148	706
Haddock	1,427	160	96
Tautog	878	649	528
Black drum	818	424	573
Spanish mackerel	639	104	161
Goosefish	332	807	320
Speckled trout	208	22	141
Yellowtail flounder	161	69	103
Red drum	116	1,496	80
Atlantic cod	48	49	48
Pollock	12	1	11

A portion of the total catch per station, species, and size class is subsampled for further analysis. Because very abundant species (i.e. scup) are more likely to occur at more stations and be comprised of multiple size classes, a smaller portion of the catch is subsampled. Conversely, the subsampled portion of the total catch of less commonly caught species (i.e. black drum) is higher because most or all of the catch is needed to fulfill the subsample protocol.

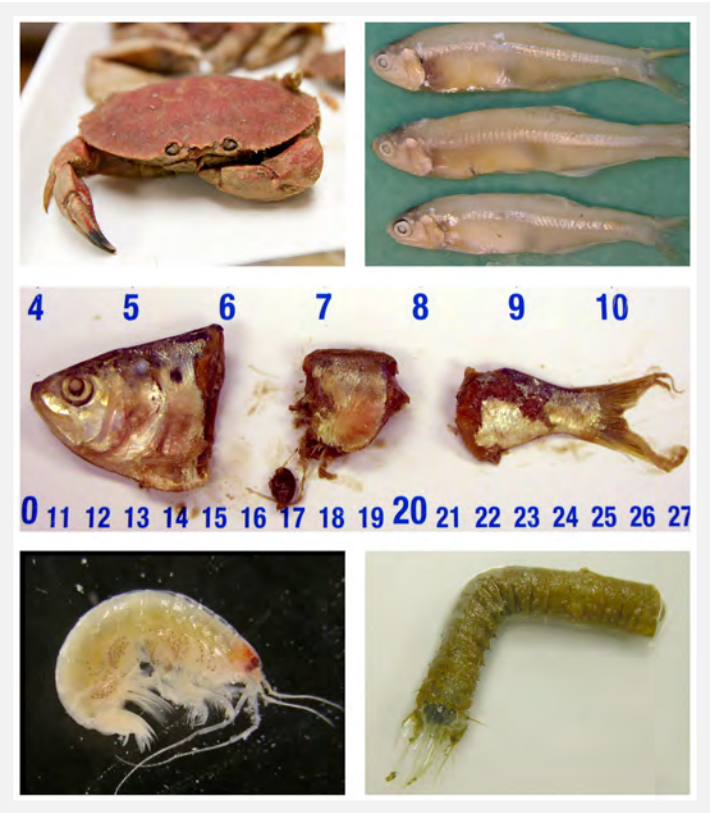
Laboratory Methods

Diet Analysis

It is well known that fishes distribute in temporally and spatially varying aggregations. The biological and ecological characteristics of a particular fish species collected by fishery-independent or -dependent activities inevitably reflect this underlying spatio-temporal structure. Intuitively, it follows then that the diets (and other biological parameters) of individuals captured by a single gear deployment (e.g., a NEAMAP tow) will be more similar to one another than to the diets of individuals captured at a different time or location. Under this assumption, the diet index percent by weight for a given species can be represented as a cluster sampling estimator since, as implied above, trawl collections essentially yield a cluster (or clusters if multiple size groups are sampled) of the species at each sampling site.

Identification of stomach contents:

The contents of each stomach are removed for identification to the lowest possible taxon. Prey encountered in the esophagus and buccal cavity are included for identification (and assumed not to be the result of net feeding because of a lack of retention of prey in large mesh gear), whereas prey in the intestines are ignored because of the difficulty associated with identifying digested prey items in advanced stages of decomposition. A total weight of the full stomach is recorded as well as an empty weight. All prey items are sorted, measured (either fork, total length, carapace width, mantle length etc., as appropriate and when possible) and the wet weight (0.001g) of each is recorded. Experienced laboratory personnel are able to process, on average, approximately 75 stomachs per day.



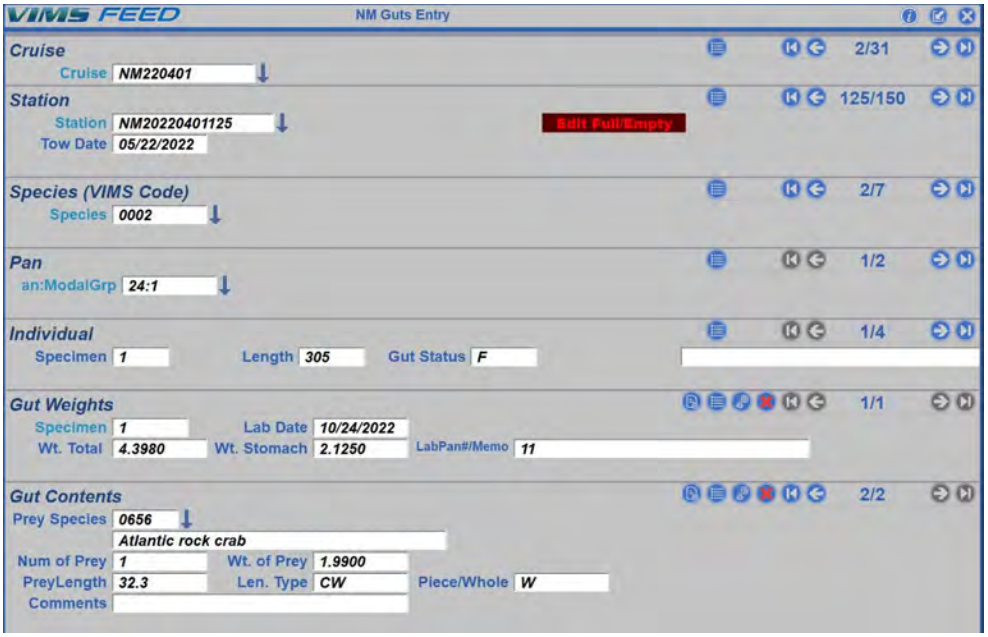
Top left: Atlantic rock crab | *Cancer irroratus*

Top right: Bay anchovy | *Anchoa mitchilli*

Middle: Atlantic menhaden | *Brevoortia tyrannus*

Bottom left: Four-eyed amphipod | *Ampelisca*

Bottom right: Broom worm | *Pherusa affinis*



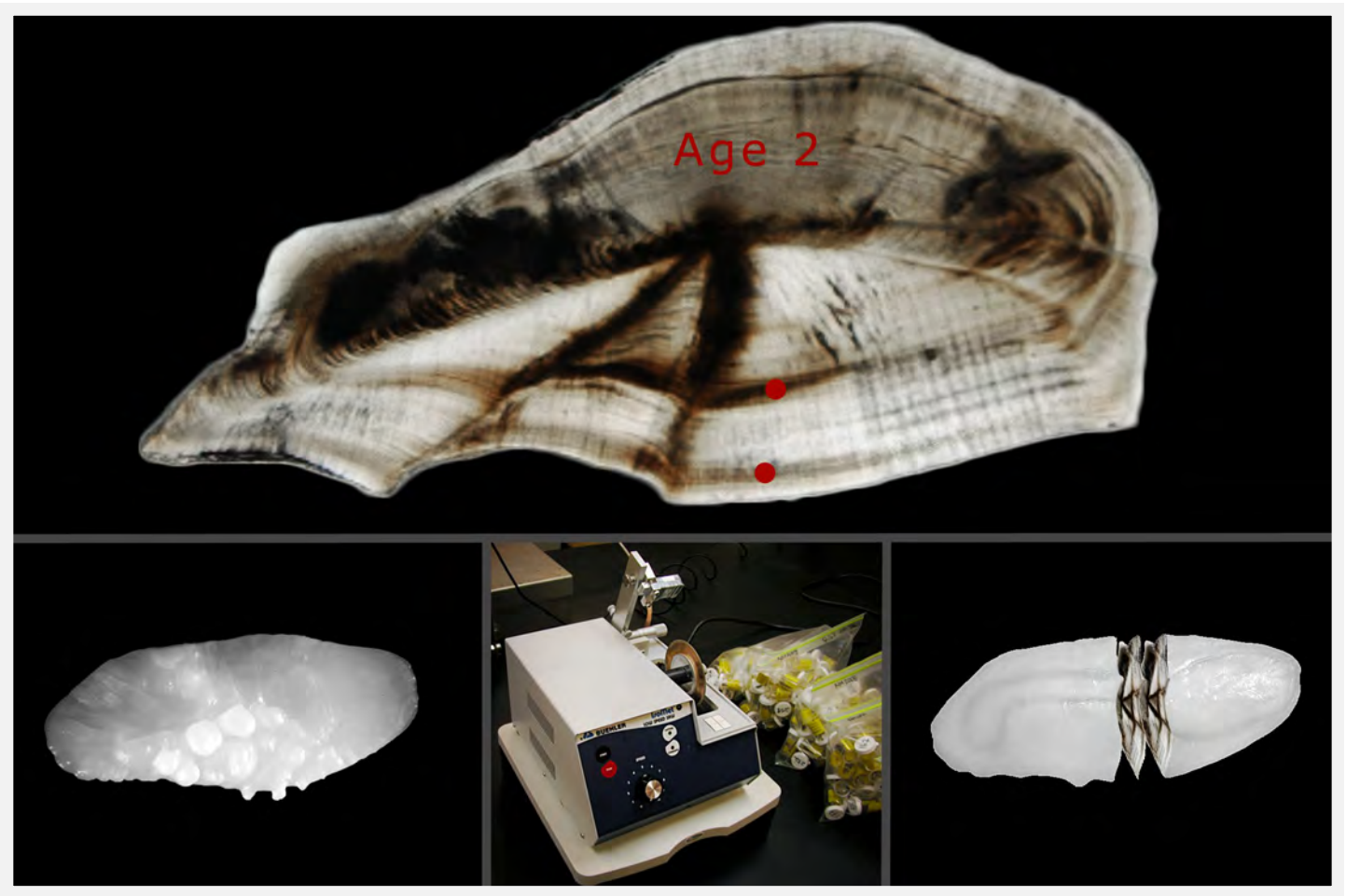
Pictured above: NEAMAP FEED direct data entry program for stomach contents

Age and Growth

Appropriate hard parts for ageing (otoliths, vertebrae, spines, operculum or scales) are removed from each fish that is subsampled for detailed workup and the structure is brought back to VIMS for subsequent analysis. Ageing structures are prepared according to methodology established by VIMS, the NEFSC, and Old Dominion University.

Typically, one otolith is selected and mounted on a piece of 100 weight paper with a thin layer of Crystal Bond. A thin transverse section is cut through the nucleus of the otolith, perpendicular to the sulcal groove, using two Buehler diamond wafering blades and a low speed Isomet saw. The resulting section is mounted on a glass slide and covered with Crystal Bond ™. The sectioned otolith is wet-sanded to an appropriate thickness before being covered with a thin layer of Crystal Bond ™. Some smaller, fragile otoliths are read whole. Both sectioned and whole otoliths are most commonly viewed using transmitted light under a dissecting microscope. Other structures such as vertebrae, opercles, and spines are processed and read using the standardized and accepted methodologies for each. For all hard parts, ages are assigned as the mode of three independent readings, one by each of three readers, and are adjusted as necessary to account for the timing of sample collection and species-specific mark formation.

The processed samples allow us to determine the age of the fish when it was caught. With these data, we can get a clear picture of the age structure of the population present in the near shore mid-Atlantic region. These data also allow us to develop such analyses as age-specific diet indices, length-at-age keys, and sex-specific age/growth differences.



Top: Sectioned 2 year old weakfish | *Cynoscion regalis*

Bottom left: Whole weakfish otolith

Bottom middle: Low speed Isomet saw equipped with two diamond wafering blades

Bottom right: Weakfish graphic representing the section to be removed for ageing

Fecundity & Histology

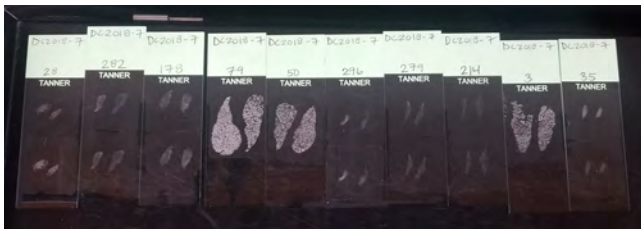
Understanding the fecundity of fish species is a vital part of fish stock management. Estimates of population-level fecundity offer improved measures of reproductive potential relative to spawning stock biomass.

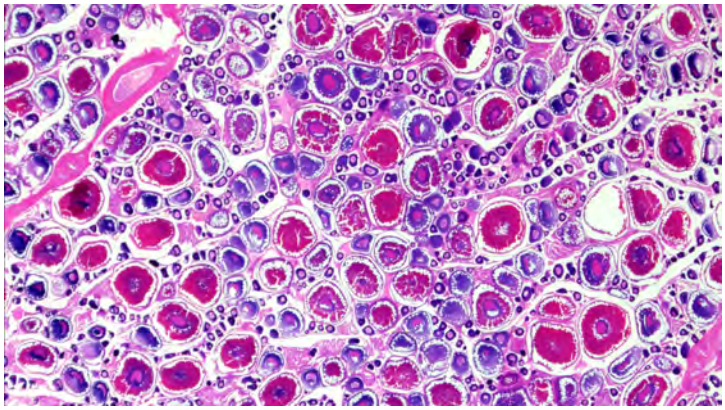
Objectives

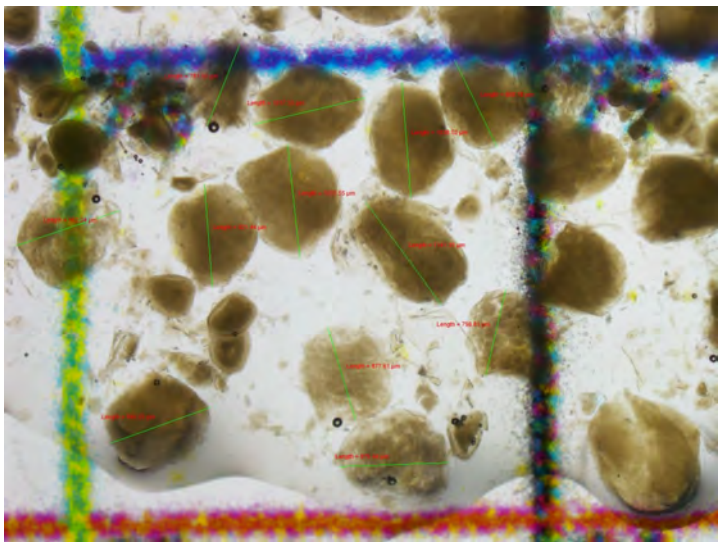
- Collect ovaries over all seasons throughout the Mid-Atlantic Bight
- Process ovaries using standard histological techniques. Information on maturity stages, spawning mode, seasonality & frequency.
- Count ova based on histological findings
- Model fecundity as a function of size & age.

Species studied:

- Atlantic Croaker
- Atlantic Menhaden
- Butterfish
- Summer Flounder
- Winter Flounder







Collaborative Ventures

Support of Stock-Assessment Activities (NMFS & ASMFC)

Data provided to & **incorporated** into past assessments:

- American lobster
- Atlantic croaker
- Atlantic mackerel
- Atlantic menhaden
- Atlantic sturgeon
- Black sea bass
- Bluefish
- Butterfish
- Longfin squid
- River herring (Alewife & Blueback)
- Scup
- Shortfin squid
- Spot
- Summer flounder
- Weakfish
- Windowpane flounder
- Winter flounder

Support of External Research Investigations

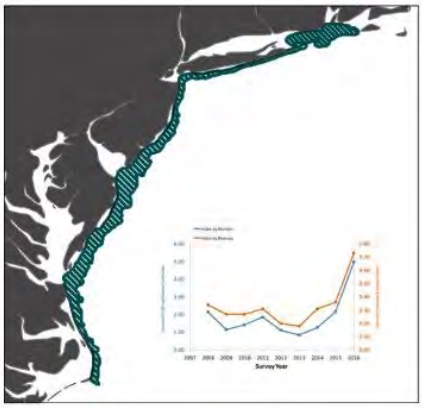
Biological Sample Requests, Data Requests & Collaborations:

- Boston University
- Dauphin Island Sea Lab
- Florida State University
- Georgetown University
- NOAA Fisheries
- Northeast Fisheries Science Center
- Old Dominion University
- Seton Hall University
- Smithsonian Environmental Research Center
- South Carolina Department of Natural Resources
- Texas A&M University
- University of California, Santa Cruz
- University of Madrid & Cornell University
- University of Maryland
- Virginia Marine Resources Commission

Data Requests / Collaborations

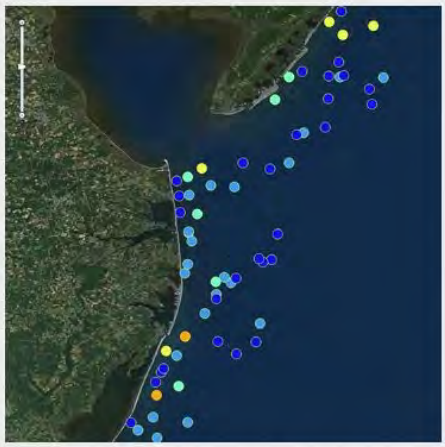
- Atlantic States Marine Fisheries Commission
- Biodiversity Research Institute
- Block Island Wind Farm
- Atlantic Shores Wind
- Dominion Wind
- Kitty Hawk Wind
- Coonamesset Farm
- UMass Dartmouth, School of Marine Science & Technology (SMAST)
- Georgia Department of Natural Resources
- Marine Stewardship Council
- Maryland Department of Natural Resources
- Massachusetts Division of Marine Fisheries
- Maine Department of Marine Resources
- Mid-Atlantic Fishery Management Council
- New York Department of Environmental Conservation
- NMFS Pascagoula Laboratory
- NMFS Sandy Hook Laboratory
- Northeast Fisheries Science Center, Apex Predator Program
- Rhode Island Department of Environmental Management
- Rutgers University
- Smithsonian Institution
- Southeast Area Monitoring & Assessment Program
- State University of New York (SUNY)
- The Nature Conservancy
- University of New Hampshire
- University of Rhode Island
- Virginia Polytechnic Institute of State University (Virginia Tech)

Online Data Interaction



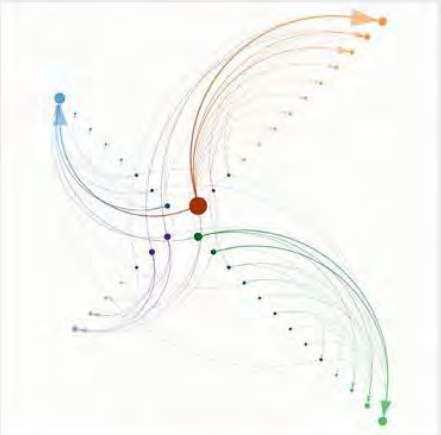
ABUNDANCE INDICES

MAPS



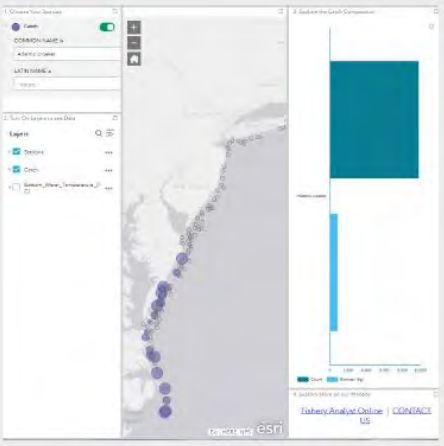
FISHERY ANALYST ONLINE

FISH FOOD HABITS



FOOD WEBS

DATA REQUESTS



NEAMAP CATCH MAPS

NEAMAP TIME SERIES

NEAMAP BIG ONES

Check out our website for more information:

https://www.vims.edu/fisheries/mrg

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The Virginia Institute of Marine Science

NEAMAP Interactive Poster

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