NEAMAP — Mid Atlantic @ VIMS

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 . 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) Developing fishery-independent surveys for areas where current sampling is either inadequate or absent

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

3) Providing for efficient management and dissemination of data

4) Establishing 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

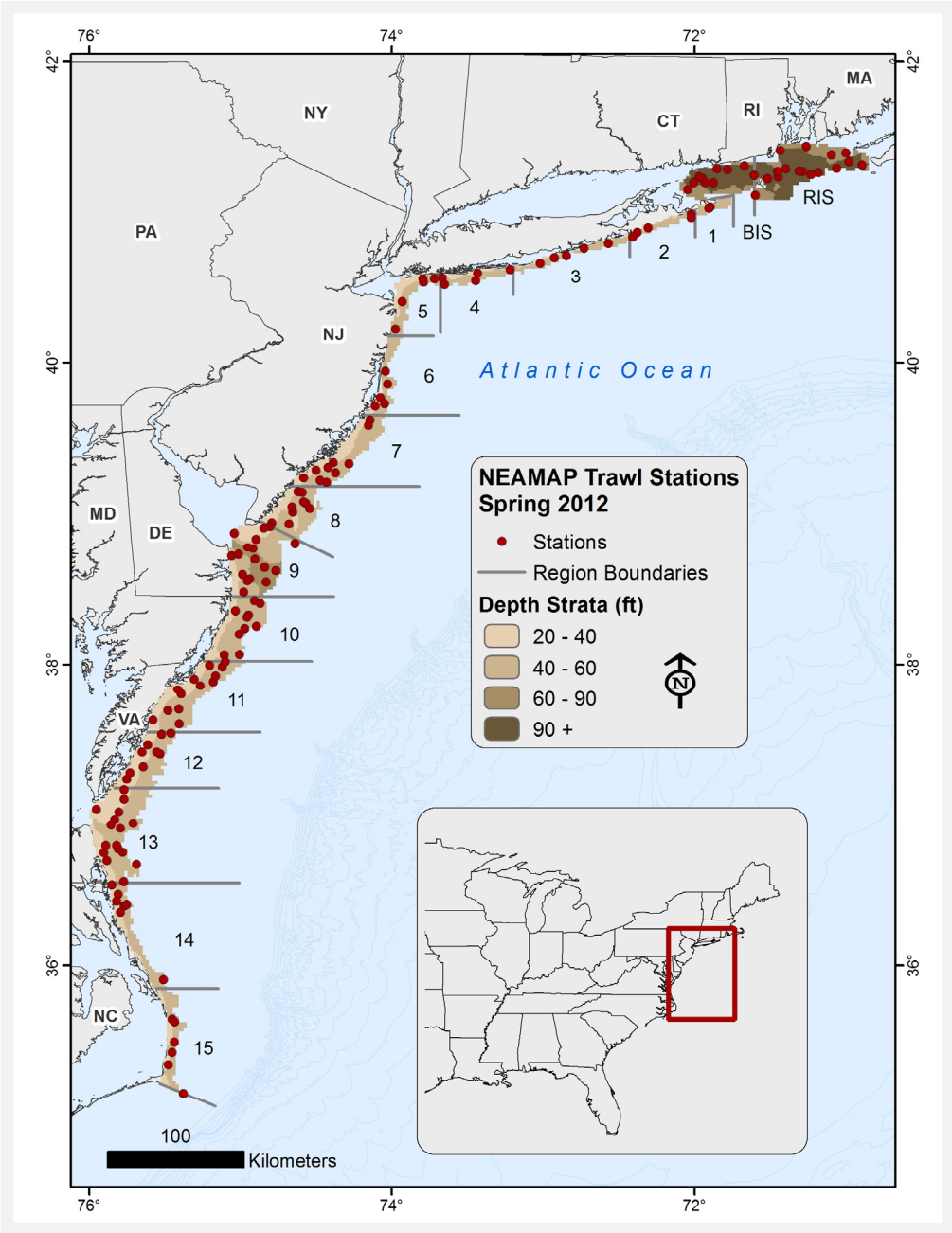
4) Identify and monitor essential fish habitat in the regions sampled by the survey

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.



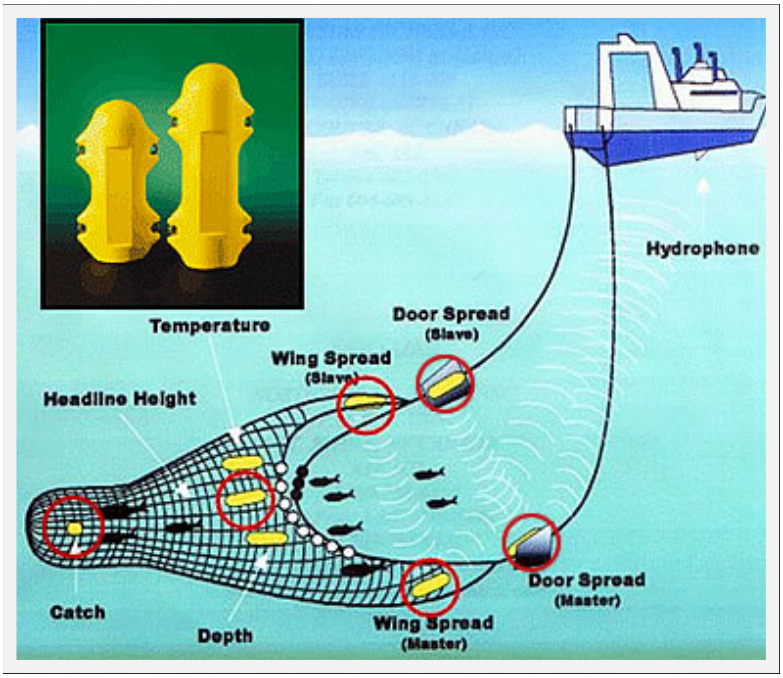
Vessel— NEAMAP fishes from the *F/V Darana R*, a 90' commercial trawler currently home ported in Hampton, VA. The *Darana R* is owned and operated by Captain Jimmy Ruhle of Wanchese, NC. The vessels crew includes First Mate and Relief Captain Bobby Ruhle and a deckhand. All fishing operations are conducted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

NEAMAP – Mid Atlantic uses a suite of 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 mouth opening.
- Headrope sensor: To measure the height of the net at the headline.
- Door sensors: To measure spread
- Catch sensor: To warn when the cod end of the net is filling (set to trip at approximately 5,000lbs).



Additional sensors will be introduced in 2013.

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

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 (profiles at 2m intervals).

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 (g)
- Sex (macroscopic)
- Maturity stage (macroscopic)
- Eviscerated weight (g)

Stomachs are removed and those containing prey are preserved onboard for subsequent examination at the shore-based VIMS laboratory. Otoliths or other appropriate ageing structures (e.g., opercles, vertebrae, etc.) are removed from each subsampled specimen for later age determination.

Species Selected for Detailed Processing:

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

Extra sampling to answer special management needs is routinely included as well. For example, we are currently taking both otoliths and scales from black sea bass and scup to facilitate hard part comparison efforts. Also, beginning in the fall 2012 we have 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 Subsampling

SPRING

Species Name	Total Catch	Number Subsampled	Percent Subsampled
scup	145,841	3,183	2.2
weakfish	116,860	1,306	1.1
blueback herring	97,617	1,202	1.2
silver hake	88,913	2,435	2.7
little skate	59,957	1,680	2.8
Atlantic croaker	57,984	331	0.6
alewife	15,437	1,390	9.0
winter skate	12,904	1,551	12.0
clearnose skate	11,922	1,095	9.2
Atlantic herring	9,770	423	4.3
winter flounder	8,482	2,374	28.0
American shad	6,485	1,411	21.8
summer flounder	4,234	2,447	57.8
spiny dogfish	3,794	1,209	31.9
smooth dogfish	2,986	1,045	35.0
bluefish	2,021	131	6.5
black seabass	913	718	78.6
striped bass	284	191	67.3
Atlantic mackerel	163	94	57.7
goosefish	122	118	96.7
yellowtail flounder	117	63	53.8
tautog	64	55	85.9
black drum	6	6	100.0
red drum	0	0	0.0

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.

FALL

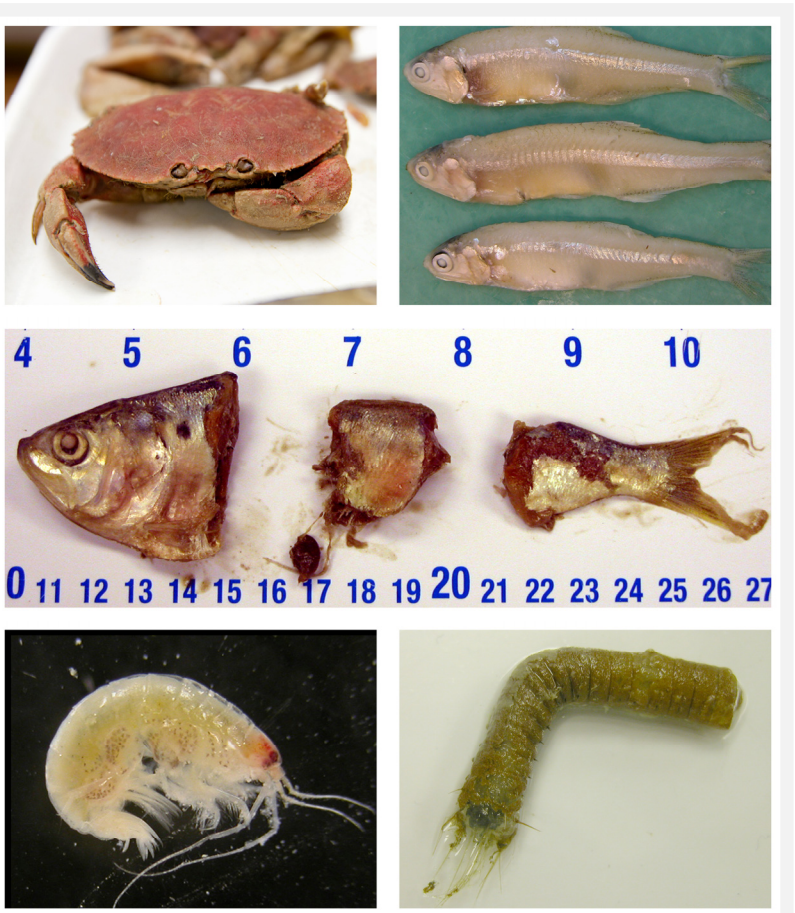
Species Name	Total Catch	Number Subsampled	Percent Subsampled
scup	709,061	3,724	0.5
weakfish	398,440	3,315	0.8
blueback herring	109	50	45.9
silver hake	6,438	539	8.4
little skate	33,490	1,283	3.8
Atlantic croaker	303,672	1,532	0.5
alewife	740	98	13.2
winter skate	5,835	665	11.4
clearnose skate	5,550	1,595	28.7
Atlantic herring	5,887	193	3.3
winter flounder	2,456	793	32.3
American shad	91	40	44.0
summer flounder	4,083	2,908	71.2
spiny dogfish	1,591	128	8.0
smooth dogfish	4,618	1,119	24.2
bluefish	38,147	2,729	7.2
black seabass	1,362	741	54.4
striped bass	2,895	136	4.7
Atlantic mackerel	10	10	100.0
goosefish	16	13	81.3
yellowtail flounder	5	5	100.0
tautog	217	87	40.1
black drum	188	177	94.1
red drum	31	26	83.9

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*

NEAMAP GUT CONTENTS STUDY

Cruise & Stat.: NM20120401- 100	Analysis Date: 10/ 04 /12	By: Parthree	Entered/?????
Species Code: 170	Stomach Full (g) : 8.224	Cap Date: 4/24/12	
Specimen No.: 3	Stomach Empty (g) : 4.744		

Prey Spc Code	Prey (Scientific Name)	Count	Weight (grams)	Length (mm)	Length Type	Piece (P) Whole(W)	Comments
7581	Pagurus longicarpus	1	0.425				
0612	Ovalipes ocellatus	1	0.435				
0816	Ensis directus		2.528				crushed pieces

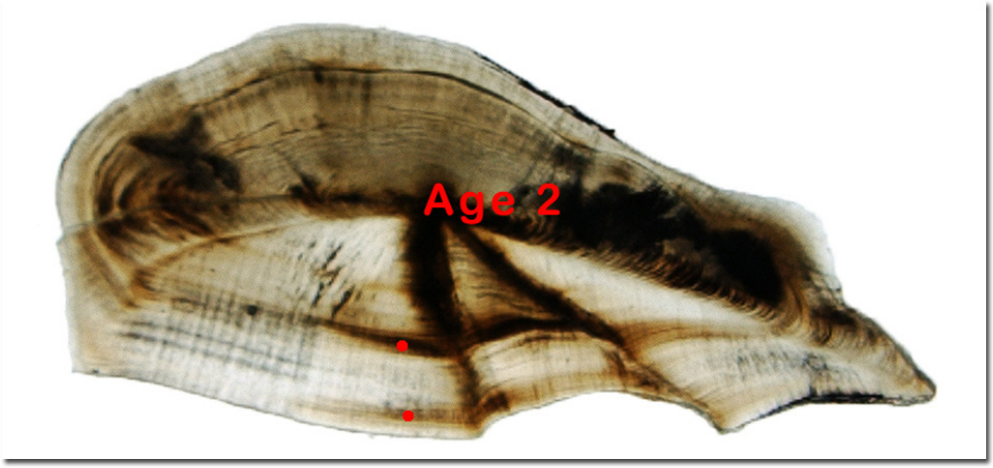
Pictured above: NEAMAP diet analysis data sheet from a clearnose skate

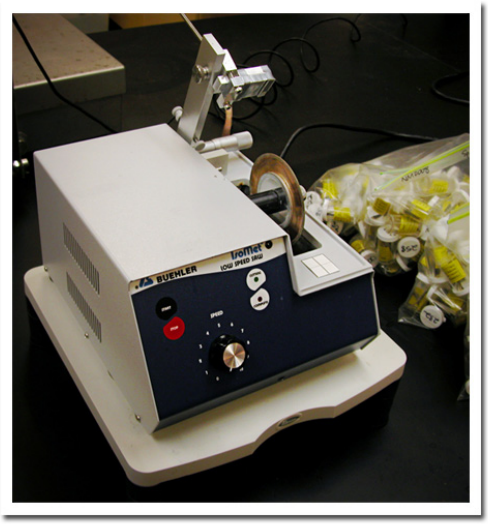
Age and Growth

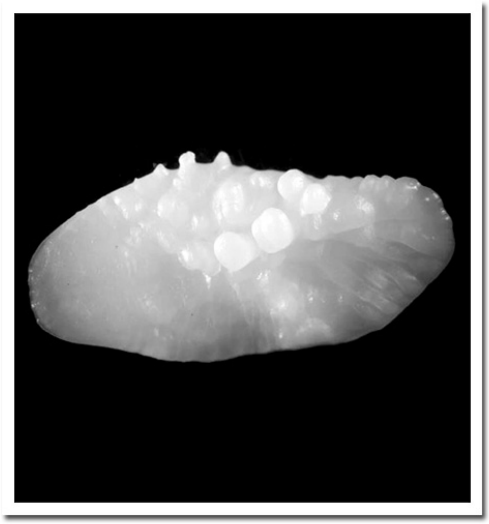
Appropriate hard parts for ageing (otoliths, vertebrae, spines, operculum or scales) are removed from each fish that is subsampled for detailed workup and the structure is brought back to VIMS for later analysis. Ageing structures are prepared according to methodology established by VIMS, the NEFSC, 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 3 year old summer flounder | *Paralichthys dentatus*

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

Collaborative Ventures

- Rhode Island Ocean Special Area Management Plan with the University of Rhode Island
- Age structure comparisons with Northeast Fisheries Science Center, Atlantic States Marine Fisheries Commission & Massachusetts Division of Marine Fisheries
- Dogfish genetics with Texas A & M
- Monkfish population delineation with the University of Madrid
- Atlantic sturgeon tagging with the U.S. Fish and Wildlife Service
- Coastal shark tagging with National Marine Fisheries Service - Highly Migratory Species Division
- Bat monitoring with the University of Maryland
- Drum stock structure investigations with SEAMAP
- Within the Virginia Institute of Marine Science
    - Summer flounder life history research
    - Striped bass Mycobacterium investigation
    - Bluefin tuna prey contaminant analysis
    - Restocking of Institute's 'Fish Library'

Online Data Interaction

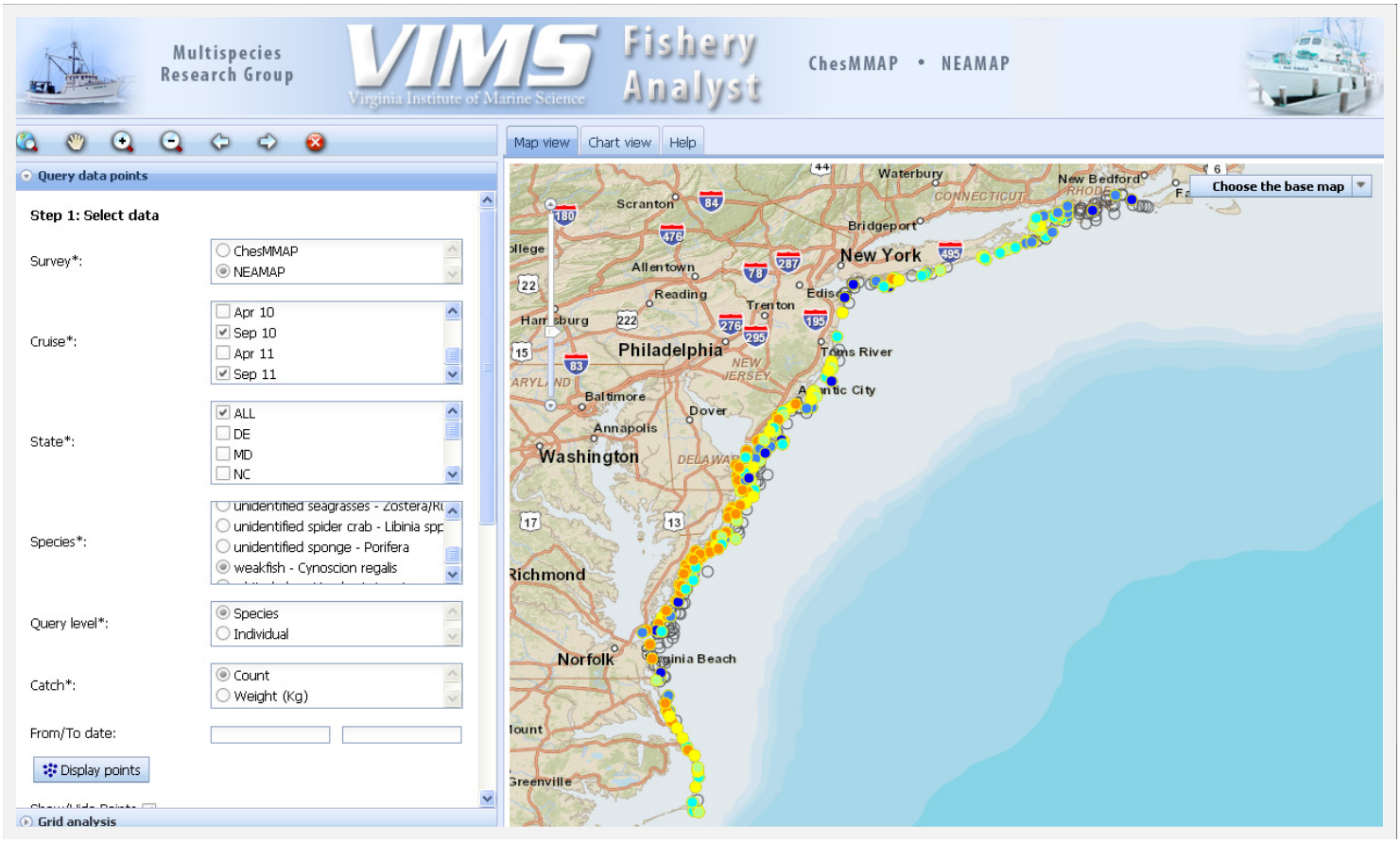
Fishery Analyst Online

To disseminate data products to fisheries management agencies, the fishing community, and the general public the Multi-species Research Group provides online access to our catch data via an interactive mapping application, Fishery Analyst Online (FAO).

FAO is a web GIS application aiming to analyze and visualize temporal and spatial patterns of fishery dynamics. The Date and Location of fishing, the Species caught in biomass or numerical abundance, and Individual Lengths are available to query at the Species level. Criteria to query on the Individual level are Date, Length, Sex and Maturity Stage among other characteristics in special cases.

All the query, analytical and configuration functionalities are grouped on the left side of the interface. Various types of output are organized in separated tabs at the top, including a map view, a chart view and a help page. A navigation toolbar provides the tools to navigate within the map (panning, zooming in and out and moving to full, previous and next extent). The chart view allows users to toggle between Catch by Cruise, Catch by State, Catch by Cruise and State, Length-Frequency Histogram, and Catch by Month.

(FAO User's Manual, Mappamondo GIS, 2012)

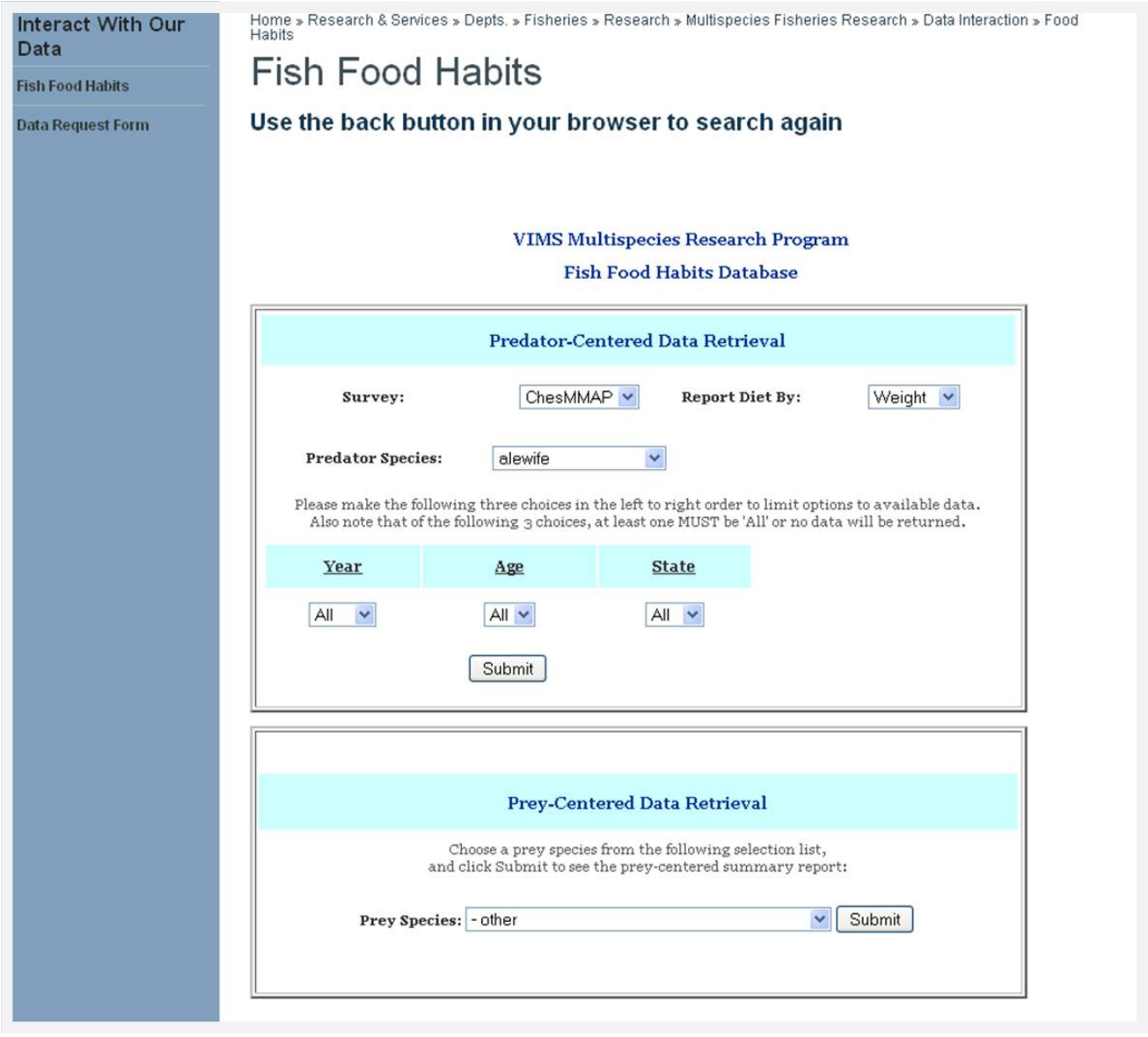


Screenshot of the Multispecies Fisheries Research Group's Fishery Analyst Online Web Application

Please visit: www.vims.edu/fisheries/fao/

Fish Food Habits Data Summary System

Our fish stomach diet analysis database contains approximately 35,000 individual stomach samples and is growing. The data base offers you the opportunity to choose to retrieve fish food habits analyses from either a predator or prey point of view. If you choose to view data from the predator's perspective you can select data by Survey, Predator Species, Year, Age, and State, summarized by either prey weight or prey numbers (we do not currently offer online summaries by frequency of occurrence though such data are available by request).



Screenshot of the Multispecies Fisheries Research Group's Fish Food Habits Database

Please visit: www.vims.edu/fisheries/fishfood

Data Access Request Form

If you have any additional questions and / or data requests please submit the Multispecies Fisheries Research Data Access Request Form and we will contact you as soon as possible.

Please visit: www.vims.edu/fisheries/datarequest

NEAMAP Staff

Christopher Bonzek	Principal Investigator	cfb@vims.edu	804.684.7291
Dr. Robert Latour	Principal Investigator	latour@vims.edu	804.684.7312
James Gartland	General Manager	jgartlan@vims.edu	804.684.7546
Debra Gauthier	Chief of Website / GIS Operations	parthree@vims.edu	804.684.7891
Jameson Gregg	Chief of Ageing Operations	jgregg@vims.edu	804.684.7321
Evan McOmber	Chief of Field Operations	emcomber@vims.edu	804.684.7453
Kevin Spanik	Chief of Diet Operations	kspanik@vims.edu	804.684.7521
Melanie Chattin	Field and Laboratory Technician / Webmaster	melanie@vims.edu	804.684.7927
Zach Boykin	Field and Laboratory Technician	zboykin@vims.edu	804.684.7462
Gregg Mears	Field and Laboratory Technician	mears@vims.edu	804.684.7893
Cameron Ward	Field and Laboratory Technician	cward@vims.edu	804.684.7462

The Virginia Institute of Marine Science