MID-ATLANTIC CHAPTER OF THE AMERICAN FISHERIES SOCIETY

2010 ANNUAL MEETING PROGRAM

BIDEN ENVIRONMENTAL TRAINING CENTER CAPE HENLOPEN STATE PARK, LEWES, DE NOVEMBER 18-19th, 2011

SCHEDULE

*** student presentation**

Day 1, Thursday November 3rd, 2011

9:00 – 10:15	**Registration and Continental Breakfast** *Lighthouse Center for Natural Resource Education, East Entrance (come 'round back)*
10:15 - 10:20	**Welcome** *Locandro Lodge* *Matt Fisher, Chapter President* *Pola Galie, Lighthouse Center*
10:20 – 10:40	***Summer flounder vertical movement: Observations of pelagic behavior in a presumed demersal species** *Matt Yergey*
10:40 – 11:00	**Sex-at-length of summer flounder (*Paralichthys dentatus)* landed in the New Jersey recreational fishery** *Jason Morson*
11:00 – 11:20	***Gear selectivity on sex in Black Sea Bass (*Centropristis striata*) off the coast of New Jersey** *Mikaela Provost*
11:20 – 11:40	**Modelling surfclam (*Spisula solidissima*) growth in a changing climate** *Daphne Munroe*
11:40 – 12:00	***Coupled physical and biological modeling of Atlantic surfclam larval transport and subpopulation connectivity in the middle Atlantic bight and George's bank** *Xinzhong (Peter) Zhang*
12:00 – 12:20	***Assessment of three artisianal fisheries in Northern Honduras: Río Esteban, Chachahuate Cay, Cayo Mejor/East End** *Elizabeth Evans*
12:20 – 12:40	**The incredible shrinking weakfish!** *Desmond Kahn*
12:40 – 1:30	**Catered Lunch**

1:30 – 1:45 **Travel to MATES; bus provided (bring your posters)**

1:45 – 2:15 **Tours of MATES (poster set up)**

2:15 – 3:15 *Keynote speaker Workshop*
Managing our Nations Fisheries; It all starts with data collection
Jessica Coakley, Mid-Atlantic Fishery Management Council

3:15 – 3:35 **"The Butterfish smackdown": towards the development of an operational seascape ecology in support of regional ecosystem management**
John Manderson

3:35 – 3:55 **Spawning biology of blue crabs, *Callinectes sapidus*, in Barnegat Bay, NJ**
Paul Jivoff

3:55 – 4:15 ***Determining the Best Substrate for Eastern Oyster (*Crassostrea virginica*) Spat Colonization in Greenbackville, Virginia**
James Geddis

4:15 - 5:15 **Poster Session**

5:15 **Bus departs for Lighthouse Center; Hotel/Lighthouse room check-in**

6:15 **Dinner**
Lighthouse center

7:00 **Social and Raffle**
Locandro Lodge in lighthouse center

Day 2, Friday November 4th, 2011

7:30 – 8:00 **Continental Breakfast**

8:00 – 8:20 ***Changing environments, changing behaviors: Gulf sturgeon residency in Choctawhatchee Bay, Florida**
Katherine Fleming

8:20 – 8:40 ***Coping with progress, Atlantic sturgeon spawning characteristics and locations in the Delaware River**
Matthew Breece

8:40 – 9:00	**The horrors of sturgeon matrimony in the Delaware Estuary-scutes of death** *Matt Fisher*
9:00 – 9:20	**Surplus production model accuracy in populations affected by a no-take marine protected area** *Jennifer Barkman*
9:20 – 9:40	***Diel and tidal periodicity of sand tigers (*Carcharias taurus*) in Delaware Bay** *Johnny Moore*
9:40 – 10:00	**Striped bass tagging in the Delaware Estuary** *Heather Corbett*
10:00 – 10:20	**New Jersey's voluntary collection program for bluefish (*Pomatomus saltatrix*)** *Steven Luell*
10:20 - 10:40	**Break (room clean out if staying at Lighthouse)**
10:40 – 11:00	**Patterns and processes in stock recoveries from depletion: preliminary findings from a global meta-analysis** *Philipp Neubauer*
11:00 - 11:20	**Early results from the Barnegat Bay sea nettle pilot project** *Jennifer Barny*
11:20 - 11:40	**Hudson Canyon: Multi-species habitat complexes as a geographic priority** *Vincent Guida*
11:40 – 12:00	**New Jersey's priceless resources – studying the Delaware River** *Jennifer Pyle and Maryellen Gordon*
12:00 - 12:20	**Oyster food supply: It's estimation in Delaware bay from a hydrodynamic model and the interaction with the oyster population** *Eric Powell*
12:20 - 1:00	**Awards and Annual Business Meeting**
1:00 - 2:00	**Catered Lunch**

ORAL PRESENTATION ABSTRACTS

***** Denotes student presentation

***Summer flounder vertical movement: Observations of pelagic behavior in a presumed demersal species**

Matthew Yergey

Recent evidence has begun to show many flatfish species exhibit pelagic behaviors for various essential functions, including feeding, migration and reproduction. We applied sensored acoustic telemetry techniques to determine if summer flounder (*Paralichthys dentatus*) demonstrate pelagic movements during the fall migration period. These acoustic tags allow us to monitor an individual's depth to a resolution of 0.68 meters. This study was conducted along the coast of southern New Jersey, between September and October 2009, and August and October 2010. Summer flounder (n=16; 380 – 610 mm) were collected in 2009 with a commercial otter trawl. In 2010, 13 summer flounder (378 – 511 mm) were collected in an adjacent estuary (hook and line, otter trawl, bycatch in crab pots), and held for up to 16 days. The fish were tagged, released, and monitored via fixed hydrophone array and mobile tracking with stereo hydrophones towed by boat. We show clear evidence that summer flounder exhibit substantial pelagic behavior, with 11 individuals (38%) exhibiting pelagic behavior for at least 1% of the observations, with four individuals (14%) spending more than 25% of their time up in the water column (defined as 2 meters above their maximum depth), and two (7%) spent greater than 60% of the time observed two meters or greater above the surface. These observations suggest that pelagic behavior of summer flounder may be a critical influence on the ecology and behavior of the species.

Sex-at-length of summer flounder (*Paralichthys dentatus)* landed in the New Jersey recreational fishery

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Summer flounder females grow faster than males and may experience a lower natural mortality rate. Sex-structured assessment models have been developed for other fishes with sexually dimorphic characteristics to more appropriately account for the population dynamics of those species. However, while a desire exists to develop similar assessment techniques for summer flounder, some prerequisite data needed to develop a sex-structured model are not available, including the sex of fish landed in the recreational fishery. Furthermore, summer flounder recreational landings are kept within harvest limits almost entirely by minimum size restrictions, a management scenario that could place a large portion of the recreational fishing mortality on the female portion of the stock. Collecting the first set of data on sex ratio of landings in the recreational fishery begins to fill a basic, but important data requirement to further advancing stock assessment of this species while also providing some insight on how current management strategies might impact the sex structure of the population. We collected sex and length data from summer flounder (n=4,437) landed in the New Jersey recreational fishery in 2009 and 2010. Female fish dominated the recreational catch in both years (95% female overall). At length, more female fish were landed in lower latitudes, earlier in the summer, and in 2010 compared to 2009. Extensive seasonal, annual, and spatial variability evident over such a local scale indicates a more robust dataset, over a wider geographic and temporal scale, would be necessary before separate male and female landings data could confidently be incorporated into an assessment.

***Gear Selectivity on Sex in Black Sea Bass (*Centropristis striata*) off the coast of New Jersey**

Mikaela Provost

Stock assessments for most sex-changing species, and in particular black sea bass (*Centropristis striata*), a protogynous hermaphrodite, do not track sex in gear selectivity measurements or estimations. Differential removal of male and female fish due to fishing mortality can result in skewed sex ratios with increased fishing pressure (Hamilton et al. 2007). In the absence of large males, female fish may undergo sex change at earlier ages to replace those males who became vulnerable to the fishery. By manipulating the ratio of female to male black sea bass in experimental tanks, studies have shown that when large males are removed, relatively large female black sea bass are triggered to change sex (Benton and Berlinksy 2006).

Skewed sex ratios are especially pronounced in protogynous species that form spawning aggregations. Similar to black sea bass in regards to habitat use and reproductive behavior, the proportion of male gag grouper (*Mycteroperca microlepis*) and scamp (*Mycteroperca phenax*) has decreased from 17% to 1% and 36% to 18%, respectively, with increased fishing pressure over the past 25-30 years (Coleman et al. 1996). If this is occurring in black sea bass populations, two implications must be considered:

(1) Fertilization is limited by the lack of male fish: a large proportion of eggs released into the water column may never be fertilized because male sperm is rare, or reproductive output by females is reduced for a lack of ideal and available mates.

(2) Fishing gear that selectively favors large males may encourage females in the wild to change sex at earlier ages, and therefore reducing female biomass, an important proxy for population productivity in stock assessments.

With respect to fishing mortality, our vision of how fishing gears affect population structure in a hermaphroditic species is quite blurred. Clearly describing the vulnerability differences between males and females to the fishery will help quantify more realistic effects of fishing mortality. This talk will present recent data collected from a black sea bass tagging study implemented off the coast of New Jersey between Little Egg Harbor Inlet and Sea Isle City during the summer of 2011. Data analysis will show the differences of pot (commercial) and hook and line (recreational) gear selectivity on sex for black sea bass. The implications of sex-related differences for fishing gear vulnerability will be discussed as well as their application for future black sea bass stock assessments.

Modelling Surfclam (*Spisula solidissima*) Growth in a Changing Climate

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The fishery for the Atlantic surfclam (*Spisula solidissima*) lands 22,000 metric tons annually, which in 2008 netted $39 million, making it one of the most valuable single species commercial fisheries in the US. Atlantic surfclams live on the continental shelf of the mid-Atlantic bight on sandy bottoms in 10 – 50 m water depth. Currently, the commercially exploitable population exists between Virginia and George's Bank. Since 1997, populations from southern inshore regions of Virginia through New Jersey have experienced significant mortality events. These mortality events were co-incident with warm bottom water temperatures (reaching 21-24°C in September) and have resulted in changes in population distribution that have major implications for the clam fishery. The processes underlying this shift were investigated using an individual-based model that simulates the growth of post-settlement surfclams. The individual-based simulations were then combined to construct cohort and population-level responses. The model includes phenotypic variability in metabolic energetics such that simulated populations containing multiple cohorts include a range of individual adaptation to environmental conditions. Hindcasts with the model reproduced the observed mortality events. Higher temperatures decreased ingestion, which resulted in stunted growth, reproductive failure, and eventual starvation and death. Additional simulations that examine changes in population range and demographics resulting from climate warming effects on circulation and thermal regimes will be used with socio-economic analyses to provide guidance that can be included as part of a proactive approach fishery management strategy for Atlantic surfclams.

***Coupled physical and biological modeling of Atlantic Surfclam larval transport and subpopulation connectivity in the Middle Atlantic Bight and Georges Bank**

Xinzhong (Peter) Zhang [1], Dale Haidvogel [1], John Klinck [2], Roger Mann [3], Eric Powell [4]

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The Atlantic Surfclam (*Spisula solidissima)* is one of the most commercially important species along the Northeast U.S. coast. In the past, systematic variations in the surfclam sub-populations in this region, thought to be associated with progressive environmental change, have been reported. The larval dispersal stage of the surfclam plays a key role in total recruitment rate and sub-population connectivity. With this in mind, we couple a physical circulation model, based upon the Regional Ocean Modeling System, and a surfclam individual-based larval model to simulate surfclam larval transport and sub-population connectivity throughout the Middle Atlantic Bight (MAB) and Georges Bank (GBK) regions. Preliminary results for the period 2006-2009 show the connection direction among the surfclam sub-populations inside the MAB and GBK to be downstream, from the northeast to the southwest. Typically, only two adjacent regions are closely connected. As expected from its retentive circulation, the GBK surfclam population is relatively isolated. The coupled simulations also confirm large inter-annual variation in surfclam sub-population connectivity patterns.

***Assessment of Three Artisanal Fisheries in Northern Honduras: Río Esteban, Chachahuate Cay, Cayo Mejor/East End**

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This study was done under the authority of the Honduran Coral Reef Fund to provide a baseline for future management. Three artisanal fisheries off northern Honduras in the vicinity of the Cayos Cochinos Marine Park and Río Esteban were assessed between June and August 2010. Catch effort, fishing area, target species, daily catch rates, fishing seasons, and current regulations for lobster and fin fisheries were determined through local fishermen interviews and taking landings data. The fin fisheries observed are either hook and line or net, and the lobsters are entirely dive caught. Findings suggest that a significant number of juvenile lobsters are being removed from the population. Interview data suggest that fish and lobster stocks have decreased drastically; however landing trends will require subsequent studies. The fishermen showing any significant profits are the owners of the lobster fishing boats. The fishing practices observed in Honduras are not as sustainable as those of similar fisheries in other areas of the Caribbean. The lobster fishery is the most attractive option to fishers however should be a concern due to dangerous fishing practices and harmful catch yields.

Keywords: Artisanal, Garifuna, Fisheries, Honduras, *Panulirus argue*, Cayos Cochinos Marine Park, Cayo Mejor, Río Esteban, Chachahuate, Bycatch, fishing area, fishing Depth, CPUE, annual catch rates, catch economics, national regulations, fishing trends, lobster diving, La Ceiba, Fishing seasons, HCRF, trawling nets, illegal fishing

The Incredible Shrinking Weakfish!

Desmond Kahn

Weakfish (*Cynoscion regalis*, Sciaenidae) have demonstrated large variation in maximum size over the last half century. Currently, a very small proportion of the total Mid-Atlantic population reaches or exceeds the recreational minimum size in many states of 330.2 mm (13 inches), total length. The production of young-of-year weakfish has not declined to a detectable degree in the same period, yet over the last decade, both commercial and recreational landings have reached record low levels. In contrast to the current maximum size, weakfish exceeding 750 mm (about 30 inches) were commonly caught in the 1970s and 1980s. Mid-Atlantic states distributed thousands of citations each year for recreational catches of 4 kgs (about 10 lbs)or more. While current regulations have restricted fishing mortality to levels below F = 0.3 (averaged over all ages), these restrictions on the fishery have not produced a lasting response. When regulations were first instituted coastwide by the mid-1990s, maximum sizes, age structure and catches did begin to increase for several years, but then declined again. In contrast, the period of the weakfish boom several decades back had virtually no regulations on either recreational or commercial landings. A similar boom period is described in the early years of the last century, and colonial accounts describe decades of weakfish scarcity followed by decades of weakfish dominance. The conclusion of the most stock assessments (2006, 2009) was that natural mortality has greatly increased due to predation of striped bass and spiny dogfish combined with evidence that competition for preferred prey of Atlantic menhaden has negatively affected weakfish growth and consequent survival. The large increase of estimated natural mortality has reduced survival of weakfish to the extent that the maximum size observed has declined drastically.

"The Butterfish smackdown": towards the development of an operational seascape ecology in support of regional ecosystem management

Danny Axellson
Lars Axellson (Lunds)
Eleanor Boecheneck, Rutgers University
Jason Didden (MAFMC)
Greg DiDomeico, Garden State Seafood
Wayne (Lunds)
Kyle Goodwin
Mr. Goodwin
Steven Gray, University of Hawaii
Jimmy Harris
John Hoey, NEFSC Cooperative Research
Olaf Jenson, Rutgers University
Josh Kohut, Rutgers University
John Manderson NEFSC, Behavioral Ecology
Matt Oliver, University of Delaware
Laura Palamara, Rutgers University
Chris Roebuck,
Joel Sonnen
Geir + 2 other fishermen

Ecosystem management, which explicitly considers important relationships among organisms and how they respond to the ocean environment including the ways humans influence and are affected by ecosystem change, has developed a variety of tactical tools for more effective resource management. One of these tools is spatial planning and space based management. However effective space and time based management in dynamic oceanic environments requires a regional scale environmentally explicit seascape ecology that puts and keeps the realities of the ocean and its ecology into a quantitative and applied framework. We have assembled a team of fisherman, oceanographers and habitat scientists to begin to develop a quantitative seascape ecology that can be operationalized within an integrated ocean observation system (IOOS). In a demonstration project within the Mid-Atlantic Bight ecosystem production region and supported by the NOAA/NEFSC cooperative research, we have developed a first generation statistical habitat model for butterfish to be coupled to MARACOOS ocean observations (Mid-Atlantic Regional Coastal Ocean Observing System) and used by the squid fishery to help avoid exceeding bi-catch limits set under the current regulatory regime. Later this year we will perform a field evaluation using fishing industry vessels of this first generation model. Our collaborative approach has engaged the fishing industry as active partners with ocean scientists to put and keep the realities of the ocean and its ecology into a quantitative framework supporting more effective stewardship of living marine resources in the sea.

Spawning biology of blue crabs, *Callinectes sapidus,* in Barnegat Bay, NJ

Jivoff, Paul R. Rider University, Lawrenceville, NJ 08648

Despite their economic importance in the mid-Atlantic region, we have a poor understanding of the factors influencing the (seasonal or lifetime) reproductive output of female blue crabs. Recent work in other regions suggests that female blue crabs produce more broods within a spawning season than previously thought. No research has examined aspects of spawning biology of blue crabs in coastal estuaries of New Jersey, close to the northern limit of the blue crab range. In 2010, I examined the abundance, size, and reproductive status of adult females as well as the size and egg viability of broods produced by female blue crabs near the two inlets to Barnegat Bay using field sampling with traps. I also held adult females in field enclosures to experimentally examine the following factors on seasonal female brood production: capture location (Barnegat Inlet versus Little Egg Inlet), carapace width (three size classes=small, medium and large), and food level (low=fed once per week or high=fed three times per week). Based on the presence of ovigerous females, the spawning season in Barnegat Bay extends from May-September; a shorter season than further south. Temporal and spatial variation in the abundance of ovigerous females suggests that many of these females move to the inlets from the western shore of the estuary through the central portion of the estuary as their time to spawn approaches. Brood size was negatively related to ovigerous stage and positively related to female size. Females held in field enclosures produced multiple successive broods, with one female producing five broods in succession. Successive broods were smaller and females fed once per week produced significantly smaller successive broods with more days between successive broods than females fed three times per week. I relate these results to our understanding of female reproductive potential and how that may inform management decisions particularly concerning the spawning stock.

*** Determining the Best Substrate for Eastern Oyster (*Crassostrea virginica*) Spat Colonization in Greenbackville, Virginia**

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The Eastern Oyster (*Crassostrea virginica*) is a vital shellfish, from both an environmental and economic viewpoint. This species once dominated the eastern shore of North America, filtering water and creating vast reef systems. However, since the arrival of colonists in North America this source of food has been exploited by humans. Over the last 200 years this species has been over harvested and its habitat has been destroyed. Recent decades have been equally hard on the Eastern Oyster (*Crassostrea virginica*) population, with diseases; such as Durmo and MSX, further decreasing the population. Greenbackville, Virginia was once the hub of the Eastern Oyster (*Crassostrea virginica*) harvest in Chincoteague Bay; however, it is currently a shadow of its former prosperity. In an attempt to assess the population of Eastern Oyster (*Crassostrea virginica*) in the area around Greenbackville, Virginia three transects were created along the southern shore of a point protruding from the marsh. In addition to determining the population of Eastern Oyster (*Crassostrea virginica*), this study attempted to determine the optimal substrate and depth for spat colonization. Each transect consisted of one testing module placed in three feet of water. A module consisted of three levels of substrate samples, placed directly at the water's surface, one foot in depth, and two feet in depth, all respective to the high tide depth. Each of the eight substrates being tested was placed at all three depths. Data was collected twice a week from July 5, 2011 to August 5, 2011. The results of this experiment suggest that type of substrate and depth does not have a significant effect on Eastern Oyster (*Crassostrea virginica*) spat colonization. Based on this data, populations of Eastern Oyster (*Crassostrea virginica*) are very low in the area around Greenbackville, Virginia in Chincoteague Bay.

***Changing environments, changing behaviors: Gulf sturgeon residency in Choctawhatchee Bay, Florida**

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Choctawhatchee Bay is a confined estuary located in the northwest Florida pan-handle that provides important foraging and migratory habitats for the federally threatened Gulf sturgeon (*Acipenser oxyrinchus desotoi*). The estuary's salinity regime is greatly influenced by flow from Choctawhatchee River, which provides the bay with 90% of its freshwater. Like many Gulf coast estuaries, the Choctawhatchee Bay watershed has been negatively impacted in recent years by rises in human population levels. Associated habitat transitions from rural/forested to urban/suburban coupled with apprehension regarding climate change have led to management concerns regarding modifications in water quality and degradation of benthic communities, which Gulf sturgeon are dependent upon for growth. Gulf sturgeon were captured in the Choctawhatchee River and implanted with acoustic transmitters (2009: n = 40; 2010: n = 55) to assess size-specific patterns of residency and habitat use. A passive acoustic array was deployed in near-shore areas of Choctawhatchee Bay where Gulf sturgeon have historically been documented. We noted marked differences in the timing of movement into estuarine habitats between years, with migration to the bay occurring earlier and over a shorter time span in 2009 than 2010. Habitat use appears to be influenced by individual size as adult Gulf sturgeon were significantly more likely to utilize marine waters and juveniles were more likely to overwinter exclusively within estuarine waters. Residency patterns within Choctawhatchee Bay shifted from the central/eastern portions of the bay in 2009 – 2010, to the central/western portions in 2010 – 2011. Inter-annual changes in site occupancy coincided with reduced mean daily discharge from Choctawhatchee River, and a transition from primarily mesohaline to polyhaline waters within the estuary. Our findings provide managers with an improved understanding of how changes in environmental characteristics impact Gulf sturgeon habitat selection.

***Coping with progress, Atlantic sturgeon spawning characteristics and locations in the Delaware River**

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The proposed listing of Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*) under the U.S. Endangered Species Act has increased demand for information on all life history phases of this species. Resource managers are in particular need of the location and characteristics of spawning since these habitats are vital to Atlantic sturgeon recovery. Central to rebuilding of Atlantic sturgeon stocks, the Delaware River has suffered numerous anthropogenic changes, including large scale dredging, altered flow regimes and deteriorated water quality, ultimately resulting in major alterations to spawning habitat. During 2006-2007 and 2009-2011, 154 adult Atlantic sturgeon were captured in the Delaware Bay and nearshore marine waters and implanted with long-lived acoustic transmitters to assist in the identification of spawning sites. A total of 21 potential spawning migrations from 10 adults were recorded in the Delaware River. Adult Atlantic sturgeon entered the freshwater portion of the river between April 16-May 30 and departed May 19-June 14. Mean water temperatures upon river entry (17.4°C (range 15.5-22.5°C) and departure (21.6°C (range 17.6-25.0°C) were markedly higher than historic records. The majority of adult Atlantic sturgeon occupied habitats slightly upstream of the freshwater/saltwater interface (<0.5ppt), which ranged annually from rkm 110 -140 at the likely time of spawning although three individuals made directed movements up to rkm 210 where they remained for several days before exiting the system. Through our efforts we have helped narrow the likely spawning region for Atlantic sturgeon while updating historic records providing managers with a better handle on protecting these vital habitats.

The Horrors of Sturgeon Matrimony in the Delaware Estuary - Scutes of Death

Matthew Fisher, Delaware Division of Fish and Wildlife, Smyrna, DE
Dr. Dewayne Fox, Delaware State University, Dover, DE

The Delaware Estuary Atlantic sturgeon population is a candidate species for Endangered Species Act listing. In a long lived, late maturing species the culling out of adults through anthropogenic sources of mortality can have a negative effect on an already depressed population. Accordingly, NOAA's proposed listing rule addresses vessel strikes as a threat. Approximately 3000 deep draft vessel's transit the estuary to reach the Philadelphia and Delaware River port complex (rkm 97-203) annually, making it the busiest freshwater port on the Atlantic coast. Vessels travel in a channel that has been dredged to a depth of 12.2 m and requires annual maintenance dredging by the U. S. Army Corp of Engineers to maintain depth. The high activity level of vessel transit so far into an estuary in a maintained channel is unusual and allows for a high frequency of sturgeon and vessel interaction. The Delaware Division of Fish and Wildlife receives sturgeon carcass reports from the public and in 2005 began tracking sturgeon carcass reports in the Delaware Estuary. In 2010, the Division began advertising their interest in sturgeon reports by providing a picture of a sturgeon and a contact phone number via their website and the Delaware Fishing Guide. The Division also networked with universities, environmental consultants and agencies to acquire additional reports. This additional effort increased reports from an average of 8.4 to 17.0 reports annually. Of the total 76 carcasses investigated 62% show signs of vessel strike (lethal gash's, severed body parts or blunt force trauma). The remaining 38% are often too decomposed to determine cause of death however a majority are also likely vessel strikes. Of the 76 carcasses, 36 are adult size (>1500 mm TL) and 26 adults were located during the spring spawning period as recent (<14 days) mortalities. Commonalities exist within the wounds and witness reports that indicate the trauma origins are not post mortem. Implications to a restoration of the population are discussed.

Surplus Production Model Accuracy in Populations Affected by a No-Take Marine Protected Area

Jennifer Barkman and Michael Wilberg

Marine protected areas (MPAs) are an increasingly used tool in fisheries management. However, implementation of an MPA violates common assumptions for fishery stock assessments that provide estimates of abundance and fishing mortality for management. Thus, it is important to understand the effects of MPAs on estimates from stock assessments. We conducted a simulation study to determine the effects of MPAs on accuracy of surplus production model (SPM) stock assessments. We simulated the dynamics of a population, which had part of its range in an MPA, and assessed the population with spatially-aggregated and spatially-explicit SPMs under a range of conditions including different sizes of MPAs, different migration rates between MPA and non-MPA regions, and scenarios with high and low observation error in the indices of abundance. We also considered a scenario in which no index of abundance was available within the MPA. We used the median of the absolute value of the relative error and median relative error from 200 replicates of each scenario to test the accuracy of the SPMs. Spatially-explicit SPMs performed better in both accuracy and bias than their spatially aggregated counterparts in most cases. The accuracy of the assessments also increased as the MPA size increased except in the scenario with no index of abundance within the MPA, which increased in accuracy as the MPA size decreased. Monitoring the stock within the MPA is essential for conducting accurate stock assessments in areas with MPAs.

*** Diel and tidal periodicity of sand tigers (*Carcharias taurus*) in Delaware Bay**

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Delaware Bay is one of the few known locations in North America where sand tigers (*Carcharias taurus*) are regularly encountered. In the United States, sand tigers were listed as a Species of Concern due to marked population declines and vulnerability to overfishing. Although sand tigers are the largest shark commonly encountered in Delaware Bay, data on essential habitat use and residency patterns for sand tigers are lacking, which hinders recovery efforts. We implanted 105 (55 ♂: 50 ♀) sand tigers with standard or pressure sensing acoustic transmitters (VEMCO Ltd. V-16-6H) (battery life: 2.5 - 6 years) and monitored their behavior horizontal and vertical movements through a series of passive acoustic receivers (VEMCO Ltd. VR2W). Over the course of this study the vast majority (73 of 105) of telemetered sand tigers returned to Delaware Bay the year following tagging, generally residing in the bay mid-June to early October. Sand tigers occupied significantly deeper portions of the bay at night during 2007 and 2009 although no significant difference was documented during 2008. Sand tigers were usually found close to the bottom during daytime. We observed higher rates of detection at night than during the day that could either be due to diel changes in behavior or to changes in detection efficiency. Preliminary analyses suggest that sand tigers occupy shallower water during daytime and move to deeper waters at night, possibly for foraging, as has been documented for other elasmobranchs. Although we hypothesize sand tigers in Delaware Bay switch habitats between day and night for foraging purposes, we cannot discount tidal influences or the reduction of noise in the system during night hours as reasons for increased detections. Published literature regarding information on sand tigers in Delaware Bay is limited, so the results from this study could be used to identify core areas of activity, most critical habitat, as well as diel patterns of habitat use throughout sand tiger residency in the bay. Resource managers could use this information for the formation of future conservation efforts for this species.

Striped Bass Tagging in the Delaware Estuary

Heather Corbett, NJDEP and Matt Fisher DE DFW

In the late eighties-early nineties the states of New Jersey, Delaware and Pennsylvania joined the efforts of other agencies from Massachusetts through North Carolina by entering the U.S. Fish and Wildlife Service's (USFWS) Cooperative Coastal Striped Bass Tagging Program. During 21 years of tagging within the Delaware Estuary, over 40,000 striped bass were tagged, with more than 9,000 recaptures from Maine to North Carolina.

Although both programs target striped bass in the Delaware Estuary, two different "schools" of fish are tagged. One survey (DE and PA) tags fish tags fish primarily on the spawning grounds while the other (NJ) tags the coastal migratory mixed stocks. The focus of this presentation will be to examine potential variations in migration patterns between the surveys. General methodologies will be provided such as survey location, method of capture and time of release. Length frequency, numbers tagged and released and recapture patterns will be explored to provide comparisons between the programs. In addition, some focus will concentrate on comparing recaptures from the Delaware Estuary to other coastal and producer area tagging programs participating in the USFWS Cooperative Program.

New Jersey's voluntary collection program for bluefish (*Pomatomus saltatrix*)

Steven M. Luell, Thomas Baum, Michael Celestino, and Heather Corbett
NJ Division of Fish & Wildlife

The bluefish (*Pomatomus saltatrix*) is an important marine fish species on the East Coast of the United States. They are popular amongst fishers, and are targeted both recreationally and commercially. Since 2005, the assessment of bluefish has been conducted via age structured assessment methods (ASAP). Concerns have been expressed about the adequacy of age information to assess this species. In an effort to help resolve these problems, the New Jersey Division of Fish and Wildlife initiated a pilot voluntary biological collection program in 2010. A number of sampling strategies was used to sample the recreational fishery, including: collections from volunteer anglers, fishing tournaments, party boats, and opportunistic collections associated with fishery-independent sampling programs for non-bluefish species. In 2010, otoliths were extracted from 219 bluefish harvested from a variety of locations in NJ between April and November. Thus far in 2011, otoliths were extracted from 214 bluefish. Comparison of the 2010 size frequency of bluefish from New Jersey with the coastal 2010 ALK shows that while there was some overlap, samples were often complementary but ALK gaps remain even when all data are combined.

Patterns and processes in stock recoveries from depletion: preliminary findings from a global meta-analysis.

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There has been a considerable debate in the relevant literature about whether depleted fish stocks are always recoverable, and especially about the main processes that govern recoveries or the lack thereof. We set out to investigate drivers of recoveries from depletion using the RAM legacy stock recruitment database. This global collection of stock assessments, biological and management information allows us to inspect past and current depletions and ask how recovery potential and time to recovery are related to life history, Fisheries management variables and ecosystem effects. Here we present some preliminary findings from this meta-analysis.

Early results from the Barnegat Bay Sea Nettle Barrier Pilot Project

Jennifer Barny, Nina Sassano, Jim Vasslides, Dr. L. Stanton Hales Jr.

Abstract: In recent years, Atlantic sea nettle (*Chrysaora quinquecirrha*) populations have been increasing in Barnegat Bay. Because little is known on how to reduce populations, we developed a project to test the effectiveness of a barrier net in protecting bathers from these stinging jellyfish. Two beaches were chosen for this pilot program: Windward Beach on the Metedeconk River in Brick, NJ, and Brooklyn Avenue Beach on Barnegat Bay in Lavallette, NJ. From June through September of 2011, a 1 ½-inch (38mm) square mesh gillnet was deployed twice a week at each beach, with the intent of preventing nettles from entering the beaches' bathing areas. Once a week, we pulled a 50-foot bag seine both inside and outside the barrier at each beach to test the barrier's efficacy at excluding nettles from the bathing areas. Peak jellyfish abundance occurred in the first two weeks of August, and coincided with the optimal water temperature range (26-30°C) established by researchers in the nearby Chesapeake Bay. However, we found peak abundance did not match the optimal salinity range established by previous research. In both Brick and Lavallette, peak abundance occurred when salinity was above the 16 psu threshold established in Chesapeake studies. Our results show a bell diameter distribution of 8-120mm, with a mean of 34.6mm in Brick and 44.5mm in Lavallette, and a mode of 30mm in Brick and 39mm in Lavallette. In general, the barrier was successful at excluding 59.9% of the jellyfish from the swim area in Brick, and 54.6% from the swim area in Lavallette. These seemingly wide ranges are likely a result of the different gillnet deployment methods utilized, as well as deteriorating barrier net conditions due to blue crabs. These preliminary results indicate that barrier nets may be useful at some bathing beaches in the Barnegat Bay with additional refinement of mesh size and other net properties.

Hudson Canyon: Multi-Species Habitat Complexes as a Geographic Priority

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Hudson Canyon, ~185 km southeast of New York City, is the largest eastern U.S. submarine canyon and a fisheries "hot spot". Its vicinity yields commercial and recreational catches including squid, butterfish, monkfish, whiting, black sea bass, fluke, red hake, tilefish, lobster, deep sea red crab, tunas and billfishes. It also supports a biodiverse fauna and may, like other east coast canyons, harbor sensitive deepwater corals and sponges. Oil and gas have been demonstrated there. Anticipating interest in Marine Spatial Planning, spatial management of fisheries, and deep corals and sponges, we undertook a study of benthic habitats in Hudson Canyon that included assembly of existing data plus field work: acoustic mapping, visual ground-truthing, hydrographic, sedimentological, and trawl data collections. Acoustic techniques included multibeam sonar mapping performed using the Autonomous Underwater Vehicle "Eagle Ray", producing ultra-high resolution (~1 m) in all water depths. Trawling was performed with 11 m otter and 2 m beam trawls to capture a wide variety of demersal nekton and benthic megafauna in every season. Visual ground-truthing and sediment collection were accomplished with the USGS drift vehicle "SeaBOSS" with video and stills cameras and grab sampler. Hydrographic sampling included Conductivity-Temperature-Depth casts and water sampling for dissolved methane analysis. Products to date include bathymetric, backscatter, and slope maps for about two thirds of the shelf portion of the canyon on scales relevant to the distribution of fishes and megabenthos, and databases for catch, hydrographic, and visual data. Analysis of data thus far has revealed a complex of geological structures and hydrological patterns that provide a wide range of physical habitats within a relatively small area. Among unanticipated findings were marked asymmetries in bathymetric morphology and sediment distribution between opposing walls of the canyon as well as large differences up- and down-canyon. There is evidence for a methane-based chemosynthetic contribution to energy production and to creation of hard bottom habitats, evidence of gravel beds and outcrops of semilithified clay and/or rock deep in the canyon that may serve as the basis for deepwater coral and sponge communities. Work proceeds on the development of a habitat classification model based on the NOAA Coastal and Marine Ecological Classification Standard to extend physical habitat distributions beyond very limited visual coverage, development of habitat suitability models for fisheries species, and further field work to cover portions of the canyon not yet mapped or characterized.

New Jersey's Priceless Resources – Studying the Delaware River

Jennifer Pyle and Maryellen Gordon, NJ F&W

This presentation provides historical information for species collected during the New Jersey Division of Fish & Wildlife's Delaware River Seine Survey. The survey was initiated in 1980 to develop a striped bass juvenile abundance index (JAI), and is the Division's longest running fishery-independent survey. The survey continues to provide a JAI for striped bass as well as providing annual abundance indices for several important target species. Not only does this survey tell us how many fish there are from year to year, but it also contributes to the development of Atlantic States Marine Fisheries Commission's fisheries assessments and management plans including striped bass, American shad, river herring and Atlantic menhaden.

Basic information about the survey will be presented, including sampling locations, equipment and methodology. Several protocol modifications have been made since the survey began, including the number of stations, station locations and dates sampled. However, survey equipment and methodology have remained consistent through the years. Today there are 32 fixed stations that are each sampled twice a month from June through November, resulting in 320 seine hauls per year.

The methodology used is designed to catch fish on their nursery grounds close to the shoreline. All fish captured are sorted by species, counted and subsamples of target species are measured. Abundance data and general information regarding selected target species are presented here for discussion. Additional information concerning environmental impacts and species diversity within the Delaware River will also be presented.

Keywords: Ecosystem Management, Fisheries Management, Habitat Enhancement, Marine Ecology and Marine Fishes

Oyster Food Supply: Its Estimation in Delaware Bay from a Hydrodynamic Model and the Interaction with the Oyster Population

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To evaluate oyster food supply, water samples were collected at eighteen sites in the Delaware Bay and River near-monthly in 2009 and 2010. Food was estimated as the sum of particulate protein, labile carbohydrate, and lipid. Delaware Bay shows a typical spring bloom, centered in March and April, with declining food supply thereafter into the early fall, followed sporadically by a minor fall bloom. The geographic and temporal structure of food was more predictable in summer to early fall, and considerably less predictable in the spring. Five variables each based on temperature and the spatial and temporal variability of temperature were significant contributors to a multiple regression (R^2=0.28). Cluster analysis on residuals identified two large groups of sites, one comprising most sites on the eastern side of the bay including all of the New Jersey oyster bed sites downestuary of the uppermost beds and one including most of the sites along the central channel and waters west. Food values over the New Jersey oyster beds were often depressed by 50% relative to the bay-wide mean. Food values did not follow an upestuary-downestuary trend anticipated from the salinity gradient. Rather, the differential was cross-bay and was distinctive throughout the estuarine salinity gradient, thus explaining the lack of significance of any salinity-related variable in the multiple regression.. The consequence is to minimize the usefulness of environmental variables observed or predicted from a hydrodynamic or other model to predict food supply. The cross-bay differential cannot be extracted from such datasets. The oyster reefs of Delaware Bay are dominantly sited on the New Jersey side. While not conclusive, this dataset suggests that oysters can influence food values on the New Jersey side of the bay at present biomass and this would explain the cross-bay gradient in food values as an outcome of oyster feeding.

POSTER ABSTRACTS

***Denotes a student poster**

***Effects of ocean acidification on otolith growth and behavior of the mummichog (*Fundulus heteroclitus*)**

Authors: Andrea Stoneman and Stacy Smith

Abstract

By the year 2100, it is projected that atmospheric CO_2 concentrations will rise to approximately 1000 ppm under a business-as-usual model. As a result of elevated atmospheric CO_2 concentrations, oceanic pH levels are expected to drop 0.5 units causing ocean acidification. Although the process of ocean acidification is well documented, the implications it has on marine organisms and their ability to adapt to increasing CO_2, are not well known. Scientists are becoming alarmed at the possible corrosive effects of ocean acidification on marine ecosystems and especially on calcifying, shell-forming organisms.

Most research to date has focused on calcifiers, such as coccolithophorids, corals and mollusks, while very little has been dedicated to researching its implications on fish. Thus far, three studies have examined the link between an increasingly acidic ocean and otolith growth in larval fish. Each study has yielded different results, which may depend upon the species under investigation and their early life histories. The mechanisms causing the above results are still poorly understood. To better understand these underlying mechanisms and consequences of ocean acidification, we will determine the effects of elevated *p*CO2 levels on the estuarine species, the mummichog (*Fundulus heteroclitus*), which incubates its eggs in open air in contrast to other species studied. We will grow mummichog larvae under three pCO_2 concentrations: the present atmospheric level of 400 ppm; the year 2100 projected level of 1000 ppm, and 2500 ppm. If a change in otolith size is observed in either of the elevated *p*CO2 treatments, further studies on behavior will be done to test the effects of varying otolith size in fish. The behavior studies will include, but are not limited to, predator avoidance, sensitivity and reaction to a range of sound frequencies, and habitat/shelter preferences. If no change in otolith size is observed, additional species may also be examined during the trials to enhance our knowledge of the potential implications ocean acidification have on fish.

***Black Sea Bass (*Centropristis striata*): A Look at Sex Ratios, Sneaker Male Strategies, and Growth Rates Using Scales**

Anthony Vastano
Rutgers SASHP Capstone

The scales, otoliths, vertebrae, and fin rays of a fish can be used to determine age, growth rates, and important life events. Scales and otoliths are the most frequently used structures when dealing with fish. Black sea bass (*Centropristis striata)* are protogynous hermaphrodites (they change sex, from female to male, between the ages of 2-5). This life history characteristic presents unique management challenges.
During the late spring, summer, and early fall of 2011, a large number of black sea bass were captured, tagged, and released as part of a tag/recapture study off the coast of New Jersey. We recorded each fish's length and sex, and collected scale samples from each specimen. We also collected numerous fish for dissection. Scales were used to determine the age of each specimen, and pair this information with the length of each fish to develop age – length growth curves for males and females. Scales will be photographed using a microscope and DSLR camera setup, making note of annuli and various other life history markings. Sex-specific growth curves are analyzed for evidence of sex dimorphism within the black sea bass population and signs of a "sneaker male" strategy. Sneaker males are males that restrict their growth to avoid direct competition with other, larger males for breeding opportunities. Large proportions of males were unexpectedly found in smaller length classes, suggesting that the sneaker male strategy may be more advantageous than originally thought. There could be evidence of such a population if we note that there are certain male specimens that are unusually small in size for their age (based on their measured lengths and how old they are based on scale samples). Since fishing regulations tend to favor catching larger fish, these sneaker males may have an advantage over their larger conspecifics when it comes to breeding. Since we are concerned with fertilization rates, the sneaker male strategy is an important one to investigate if we wish to conserve this valuable species.

Prey Determination and Feeding Seasonality of the Great BayHarbor Seal Colony (*Phoca vitulina concolor)

Linda J. Dotts*[1], Jacalyn L. Toth[2], Sarah A. Tanedo[3], Mark C. Sullivan[4], Steven P. Evert[5], Carol J. Slocum[4]
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Atlantic harbor seals (*Phoca vitulina concolor*) are a seasonally migratory species that have been documented overwintering in Great Bay, New Jersey since 1994. Observations in 2010-2011 reported a maximum of 160 individuals (March) - representing a 45% mean annual increase since 1994. Fecal prey remains analysis, particularly recovery of sagittal otoliths of fishes, is commonly used to determine the diet of piscivores. From 1996-2010, Dr. Carol Slocum and her students at The Richard Stockton College of New Jersey collected scat samples from known haul-out sites in Great Bay. Using elutriation techniques and nested sieves, unprocessed frozen samples from The New Jersey Seal Study were elutriated and identified. In total, 573 otoliths were extracted from these samples and combined with 216 previously processed samples (for a total of 832 otoliths). Despite erosion from transit through the digestive tract, otoliths were identified to order, family, and genus species levels, where possible. Fishes of the order Gadiformes (hake-like) were a dominant component in samples, followed by Clupeiformes (herring-like) and Pleuronectiformes (flatfish-like). Prey abundance / size histograms were constructed using otolith length as a proxy for fish length. Size classes of dominant prey varied by season and species. While fishes in the order Gadiformes were dominant prey during most months, there was a distinct seasonal shift to Clupeiformes during the month of May. Known fish migration patterns in the region support this seasonal variation in species composition and abundance.

***Mapping Spatiotemporal Patterns in Tiger Shark Habitats Using Satellite Technology**

D Haulsee[1], M Oliver[1], B Wetherbee[2], D Fox[3]

1. University of Delaware, Lewes, DE 2. University of Rhode Island, Kingston, RI
3. Delaware State University, Dover, DE

Twenty-two tiger sharks (*Galeocerdo cuvier*) were tagged with SPOT tags near Bermuda between 2009-2011. Shark tracks were filtered for quality and swimming behavior. We matched GPS locations of the sharks with ocean surface data (SST, Chla, ocean color, biome structure) measured by NASA's MODIS Aqua satellite, as well as bathymetry and distance to land measurements. Local regression and distance based modeling techniques will be applied to identify and predict ideal shark habitat type based on satellite data. Most tiger sharks follow similar migration patterns. Preliminary results show a strong interaction between shark location and solar properties as well as sea surface temperature. This is the first study to integrate tiger shark tracking efforts with the dynamic ocean properties that can be measured remotely by satellites. We will use these sharks to develop a dynamic habitat model that spatially and temporally predicts the location of tiger shark habitat. These habitat maps can then be integrated into ecosystem and climate models to test the interaction between apex predators and global change.

Larval Fish Spatial Variation in Great Bay, NJ: Preliminary Findings

Authors: Caridad, J.F., and K. W. Able

Weekly larval fish sampling has been occurring on night, flood tides in the vicinity of Little Egg Inlet at the entrance of Great Bay for over twenty years. This project provides information on ingress patterns, species densities, temporal changes, and, as the data set grows, insights into the effects of climate change. Because sampling has been occurring at the same location, Little Sheepshead Creek (mouth 2 km from Little Egg Inlet), since the start, it is important to know if the data collected is representative of the Great Bay system. Therefore, a spatial variation study was conducted, expanding the protocol to two other creeks (both mouths 5 km from Little Egg Inlet) on the peninsula. During eight sampling events from May 2010 to April 2011, a 1m length, 1mm mesh plankton net was set off each of the bridges for three 30 minutes tows (n=71). Most of the physical data collected did not vary much from creek to creek: flow ranged from 0.132-0.375 m^3/sec, average salinities ranged from 28.4 - 29.5 ppt, and average dissolved oxygen values ranged from 8.56 - 10.28mg/L. Temperatures varied during each sampling event by as much as 3°C, with Little Sheepshead Creek having the lowest temperatures during the warmer months (April, May, June, July, and August) and the highest temperatures during the colder months (December and February), due to its proximity to the ocean relative to the other creeks. The dominant species in all three creeks while sampling during the spring months (April, May) were winter flounder (*Pseudopleuronectes americanus)*, American eel (*Anguilla rostrata)*, and sand lance (*Ammodytes* sp). In the summer and fall months (June, July, August, and October), the dominant species were bay anchovies (*Anchoa mitchilli)*, pipefish (*Syngnathus fuscus)*, and goby species (*Gobiosoma bosc, Gobiosoma ginsburgi)*. In the winter months (December, February), the dominant species were Atlantic menhaden (*Brevoortia tyrannus)*, Atlantic croaker (*Micropogonias undulatus),*and summer flounder (*Paralichthys dentatus).* Preliminary findings show that there is some spatial variation for certain species. American eels during the month of December were most abundant in the creek with the lowest flow and lowest salinity. Atlantic croaker were most abundant at Little Sheepshead Creek even though this creek does not have the greatest flow. Further analyses will look at assembly structures and the differences between resident and non-resident species.

***Evaluating the Reproductive Contributions of Older, Larger Individuals to a Population**

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Key words: black drum, age, growth, reproduction

Abstract

Black drum, *pogonias cromis*, is the largest and longest-lived of the Atlantic coast sciaenids. These fish form at least three populations along the coastal United States, two in the Gulf of Mexico and one along the Atlantic coast from Florida to New Jersey. Concern over increased harvest in the recreational and commercial fisheries along the Atlantic coast has initiated the beginning steps of a coast-wide fishery management plan. However, limited knowledge on the life history of this species throughout its range reduces the ability to effectively manage this fishery. Black drum migrate up the Atlantic coast in the spring and enter the Delaware Bay in April where they form spawning aggregations. This spawning migration is age and size specific as only fish greater than five years old and 700 millimeters have been captured during this time of year in Delaware Bay. Black drum were sampled from recreational and commercial catches in Delaware Bay from 2009 and 2010. Sagittal otoliths and morphometric data were collected from both the recreational and commercial fisheries to assess age and growth of adult black drum. Mean length, weight, and age were 94.98 centimeters, 16.25 kilograms, and 18 years respectively. Gonadal weight and reproductive stage were assessed to gain insights on spawning and fecundity, and how these variables relate to size and age. Although some reproductive biology studies have been performed in the Gulf of Mexico region, little is known about the reproductive biology of black drum in the northern part of their range. Older, larger fish make up a greater proportion of the Delaware Bay landings relative to landings in southern states. Comparative analysis of batch fecundity estimates, spawning frequency, and patterns in oocyte development between northern and southern fish may yield insight on their respective contributions to the entire stock and could illuminate the functional relationship between size and fecundity

***The effects of different foods on the behavior of killifish**

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Fish foods are one of the major things that you have to think about if you are keeping fish. There is such a wide collection of different foods. So how do you know which is the best choice? Is there a certain fish food that makes your fish nice to each other, yet active and beautiful at the same time? The purpose of this experiment was to answer that very question. In order to do this, killifish were collected from the bay and kept in three separate groups (one group for each of the different foods being tested). The three different foods were sun-dried *Gammarus*, goldfish flakes, and frozen baby brine shrimp. The fish were observed in how they behaved on a regular basis. There was a very clear difference in the results of the three different groups. The group that was fed sun-dried *Gammarus* had a high mortality rate so their results were inconclusive. The fish that were fed the goldfish flakes maintained fairly average levels of activity and aggression. The fish that were in the group that was fed frozen baby brine shrimp had low levels of activity, but high levels of aggression. It was concluded that there may be a way to mix the foods using the different results to produce a food that keeps aggression low, activity levels up, and does not have a high mortality rate when fed to fish.

***What effects do various light sources and substrate have on shore shrimp (*Palaemontes sp.)*?**

Colleen McGrath, Marine Academy of Technology and Environmental Science, 195 Cedar Bridge Road, Manahawkin, New Jersey 08050

The Shore Shrimp is a species common to New England waters that is known to change color due to its surroundings and the food consumed by the shrimp. The bottom substrate plays the main role in the color change of shrimp, as well as the available lighting. The change in color may not be the only effect substrate and lighting has on shore shrimp. The behavior of shrimp was studied through multiple trials with two different substrate and three different forms of light. Data was recorded each day in order to see patterns of behavior due to the different surroundings. The data was analyzed and relationships between the lighting and substrate were displayed. Because natural sunlight is familiar to the shrimp, not many changes were present. Although in various other lighting, such as ultraviolet lighting, and different substrate the behavior of the shrimp was not normal. The results indicate that behavior and habits of shrimp can be affected by several forms of lighting and substrate.

Biological Impacts of Marine Outboard Motor Oil and Dispersants on *Artemia sp.

Mary Gibbs, Marine Academy of Technology and Environmental Science (MATES),195 Cedar Bridge Road, Manahawkin, New Jersey 08050

Dispersants, which primarily consist of surfactants, are chemicals used to alleviate the detrimental effects of oil spills. They reduce the interfacial tension between oil and water, thus cause oil to form into small droplets, which can facilitate its biodegradation. Droplets formed can disperse into the water column, where they come into contact with marine organisms that can negatively impact their health and degrade the health of marine and aquatic ecosystems. A common dispersant is bilge cleaner, which is used to remove residual oil that pools in bilges. Oil and dispersant mixtures that make it into the aquatic environment can make residual toxins bioavailable to species. In order to assess the effects of toxicity of dispersants and oil on aquatic organisms, a bioassay was performed using *Artemia sp.*, brine shrimp, exposed to various concentrations of TC-W3® outboard motor oil and Marine Pure Oceans Citrus® bilge cleaner for a three week period. Two tanks filled with brine shrimp were designated as controls tested with individual systems that were treated with various concentrations of oil (5 ppm and 500 ppm), and recommended used of bilge oil dispersants (8,000 ppm and 16,000 ppm). Two systems had a combination of the 8,000 ppm dispersant and the two oil concentrations respectively. The results of this experiment suggest that dispersants have a statistically significant impact on the survivorship of *Artemia sp.*, while outboard motor oil does not have a considerable effect. Based on this data, increased regulations concerning dispersants are necessary in order to preserve species in marine environments.

***A Projective Model of Optimal Growth of *Mercenaria mercenaria* in Barnegat Bay, N.J.**

Michelle Predi, Marine Academy of Technology and Environmental Science (MATES),195 Cedar Bridge Road, Manahawkin, New Jersey 08050

The hard clam (*Mercenaria mercenaria*) has long been an integral species of the Barnegat Bay, N.J. Throughout the years, the population of clams has plummeted in the Barnegat Bay, partially a result of rapidly changing water quality. Reclamation projects, have responded to this massive decline in the wild population by constructing numerous upwellers, large tanks used to store growing clam seed. Upwellers pump water directly from the bay, and are therefore susceptible to the bay changing parameters including salinity, pH, nutrients, and dissolved gases. In order to better assess the effects of changing water quality on the growth of *Mercenaria mercenaria*, water quality parameters such as salinity, pH, conductivity, and temperature were measured at upwellers along Long Beach Island. Measurements were made at the inflow of the upweller tanks, the outflow, and also inside of the upweller tanks. These data, along with regular hard clam growth measurements, were then compared to determine the parameters that would lead to optimal clam growth. The data was then compared to that of sampling buoys along the Barnegat Bay in order to create a projective model of areas within Barnegat Bay that, due to their mean water quality parameters, would be most conducive for hard clam growth. The model will help efforts to grow shellfish a better opportunity to pinpoint areas of Barnegat Bay to more effectively focus their clam growing efforts.

*** Development of a Regional Long-Term Monitoring Program for Brook Trout in North-Central Pennsylvania**

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Brook trout, *Salvelinus fontinalis*, are native to coldwater streams from Maine to northern Georgia and they provide a popular recreational fishery throughout their range. However, populations and distributions of brook trout have declined due to factors such as land use change, nonnative fish introductions, and pollution, generally restricting current populations to first and second order streams. Brook trout populations naturally exhibit high spatial and temporal variability due to both density-dependent and independent factors. Currently, much effort is being put forth in brook trout habitat restoration through partnerships such as the Eastern Brook Trout Joint Venture (EBTJV), but evaluation of the response of brook trout populations to habitat restoration projects is complicated by the inherent variability observed in brook trout populations. The purpose of this work is to monitor streams in the Sinnemahoning Creek watershed of north-central Pennsylvania that are relatively undisturbed by anthropogenic activities in order to: 1) Determine temporal trends in brook trout populations; 2) Determine the influence of density-dependent and independent factors on variation in brook trout population dynamics; and 3) Provide baseline measures of brook trout population dynamics that are representative of streams with minimal human influence (i.e., reference conditions) to aid in the evaluation of the success of brook trout restoration activities. In 2010, ten streams in the Sinnemahoning Creek watershed were selected for monitoring. These streams represent the "best of the best" streams in Pennsylvania and are currently designated as "Class A" brook trout streams (biomass $\geq$ 30 kg/ha) based on previous sampling by the Pennsylvania Fish and Boat Commission. Brook trout density (#/100m^2) and biomass (kg/ha) are being assessed annually using multiple pass electrofishing on a 400 m reach of each stream. In two years of sampling, we have already observed a high degree of inter-annual variation in density and biomass exhibited by brook trout populations. This variation was due to a strong year class in 2010, increasing biomass by > 100% in 2011 in some streams as the 2010 year class matured. Continued monitoring of these streams will provide valuable information on the population dynamics of brook trout allowing more informed decisions on appropriate population targets for brook trout restoration efforts.

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