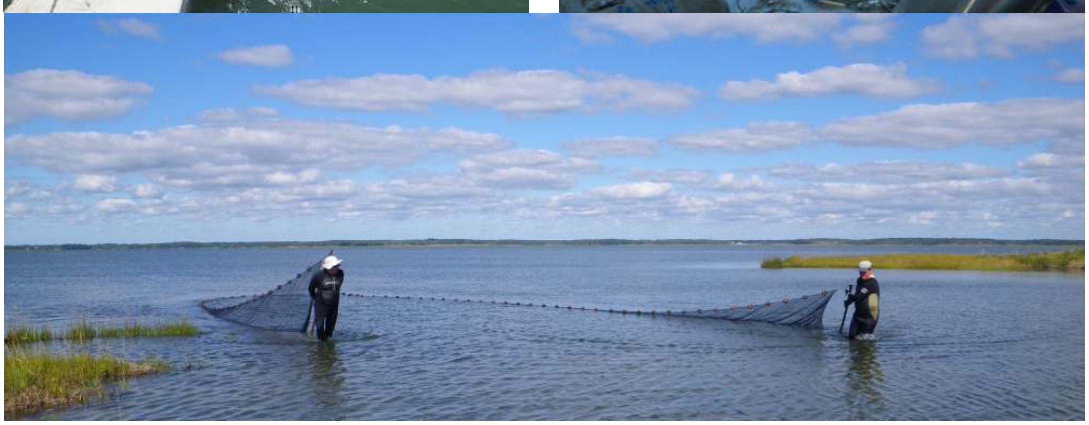
Investigation of
Maryland's Coastal Bays
and Atlantic Ocean Finfish Stocks

2013 Final Report



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Acknowledgements

The Coastal Bays Fisheries Investigation has been sampling fishes in the coastal bays for 41 years. Although the survey began in 1972, it did not have dedicated funding until 1989. Consistent funding allowed staff to specifically dedicate time and make improvements to the prior sampling routine that resulted in significant beneficial contributions to the fisheries of the coastal bays. We would like to thank the past and present staff that dedicated their careers to the Coastal Bays Fisheries Investigation for having the knowledge, initiative, and dedication to get it started and maintained. Additionally, staff of the Coastal Fisheries Program would like to thank all of the Maryland Department of Natural Resources (MDNR) Fisheries Service employees who assisted with the operations, field work, and annual reports over the years whether it was for a day or a few months. We would also like to extend our gratitude to the numerous volunteers from outside MDNR who assisted with field collection work over the years.

Supplemental adult finfish data would not have been possible without the assistance of the staff working at Southern Connection of Ocean City, Martins Seafood, and the captains and first mates working commercial vessels in Ocean City. Your patience and safe passage are appreciated.

Preface

Analyses of the Coastal Bay Fisheries Investigations (CBFI) Trawl and Beach Seine Survey data revealed seasonal and temporal biases in the data collection (1972-1988) which significantly effected the analyses of the overall time series dataset (1972-present). These biases resulted from prioritization of resources by the Maryland Department of Natural Resources coupled with limited staff availability and lack of funding prior to 1989.

Beginning in 1989, this survey was performed following a standardized sampling protocol, eliminating the biases of previous years. This report highlights trends resulting from data collected during the standardized (1989-present) time period. No historical data (1972-1988) are included in these analyses.

In 2006, modifications to the sampling protocol were implemented. Changes included:

- using a standardized datasheet;
- collecting GPS coordinates at each sample;
- collecting bottom water quality;
- using an anemometer;
- identifying macroalgae, sponges, and bryozoans and estimating their percent of the total volume collected per sample;
- measuring the first 20 individuals of all fishes;
- labeling estimates of counts and volume;
- measuring the total volume of jellyfishes;
- estimating the percent opening of the beach seine;
- identifying the bottom type at beach seine sites;
- developed a field identification guide of fishes and invertebrates; and
- began a voucher collection. A voucher collection review occurs annually at the beginning of each sampling season.

The SAV Habitat Survey was added to the CBFI in 2012. After the 2012 pilot year, the number of samples was reduced from 16 to 12 which resulted from combining the east and west Sinepuxent Bay zones into one for 2013.

Beginning in 2008, all data from the Trawl, Beach Seine, and Drop Net Surveys were incorporated into a centralized database using .Net technology on an SQL server. The new database was developed by MDNR Information Technology Services staff over a period of two years. Previously, these data were housed in Dbase, MS Excel, or MS Access. During 2009, all data imported into the new CBFI database from 1989 to the present were verified and cleaned using the original field sheets or related transcribed copies from that time. Since 2009, data from 1972, 1988-1978 have also been verified. Species codes were eliminated and common names plus the ITIS scientific name were used to ensure correct species identification. Additionally since 2009, current data were verified by someone that did not enter the data into the database.

Beginning in 2010, field data sheets were reviewed by a biologist that did not record the data after the sample workup was completed to reduce errors. The verification process includes checking for completeness, appropriate common names, legibility, and confusing information.

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Chapter 1

Coastal Bays Fisheries Investigations Trawl and Beach Seine Survey

Introduction:

This survey was developed to characterize fishes and their abundances in Maryland's Coastal Bays, facilitate management decisions, and protect finfish habitats. The Maryland Department of Natural Resources (MDNR) Fisheries Service has conducted the Coastal Bays Fisheries Investigations (CBFI) Trawl and Beach Seine Survey in Maryland's Coastal Bays since 1972, sampling with a standardized protocol since 1989. These gears target finfish although bycatch of crustaceans, molluscs, sponges, and macroalgae are common. This report includes data from 1989 – 2013.

Over 130 adult and juvenile species of fishes, 26 molluscs, and 23 macroalgae have been collected since 1972. This survey was designed to meet the following three objectives:

1. Characterize the stocks and estimate relative abundance of juvenile and adult marine and estuarine species in the Coastal Bays and near-shore Atlantic Ocean.
2. Develop annual indices of age and length, specific relative abundance and other needed information necessary to assist in the management of regional and coastal fish stocks.
3. Delineate and monitor areas of high value as spawning, nursery and/or forage locations for finfish in order to protect against habitat loss or degradation.

Methods:

Study Area

Maryland's Coastal Bays are comprised of Assawoman Bay, Isle of Wight Bay, Sinepuxent Bay, Newport Bay, and Chincoteague Bay. Also included are several important tidal tributaries: St. Martins River, Turville Creek, Herring Creek, and Trappe Creek. Covering approximately 363 km^2 (140 mi^2), these bays and associated tributaries average only 0.9 m (3 feet) in depth and are influenced by a watershed of only 453 km^2 (175 mi^2; MDNR 2005). The bathymetry of the Coastal Bays is characterized by narrow channels, shallow sand bars, and a few deep holes.

Two inlets provide oceanic influences to these bays. Ocean City Inlet is formed at the boundaries of south Fenwick Island and north Assateague Island and is located at the convergence of Isle of Wight Bay and Sinepuxent Bay. Chincoteague Inlet, in Virginia (VA), is approximately 56 km (34 mi) south of the Ocean City Inlet.

The Coastal Bays are separated from the Atlantic Ocean to the east by Fenwick Island (Ocean City) and Assateague Island. Ocean City, Maryland is a heavily developed commercial area and the center of a $2 billion dollar tourism industry catering to approximately 12 million visitors annually (CCMP 2005). Assateague Island is owned by the State of Maryland and the National Park Service (NPS). These entities operate one state

(Assateague State Park) and two national parks (Assateague Island National Seashore and Chincoteague National Wildlife Refuge). These properties have campgrounds, small buildings, dunes, beach front with some Off Road Vehicle (ORV) access, and marshes.

The Coastal Bays western shoreline habitat consists of forest, *Spartina* spp. marshes, small islands, residential development, and marinas. Assawoman Bay is bordered by Maryland and Delaware and is characterized by farmland, *Spartina* spp. marshes, a few small islands, and commercial/residential development. Isle of Wight Bay south into Sinepuxent Bay is a heavily developed commercial/residential area. Two seafood dealers, a public boat launch, and approximately 20 to 50 transient and permanent commercial fishing vessels utilize the commercial harbor located directly west of the Ocean City Inlet. In addition to the commercial harbor, the majority of marinas in Ocean City are located in Isle of Wight Bay. Residential development expansion has begun moving south into Chincoteague Bay. Vast *Spartina* spp. marshes and numerous small islands characterize Chincoteague Bay.

Submerged Aquatic Vegetation (SAV) and macroalgae (seaweeds) are common plants in these bays that can provide habitat and foraging sites for fishes and shellfish (Beck *et al.* 2003). Two species of SAV are common in Maryland's Coastal Bays: widgeon grass, *Ruppia maritima*, and eelgrass, *Zostera marina* (MDNR 2005). Common species of macroalgae include *Chaetomorpha* sp., *Agardhiella* sp., *Gracilaria sp.*, and *Ulva* sp.

Data Collection

A 25 foot C-hawk with a 225 horsepower Evinrude E-tec engine was used for transportation to the sample sites and gear deployment. Latitude and longitude coordinates (waypoints) in degrees and decimal minutes (ddmm.mmm) were used to navigate to sample locations. A GPS was used for navigation, marking sites, and monitoring speed.

Gears

<u>Trawl</u>

Trawl sampling was conducted at 20 fixed sites throughout Maryland's Coastal Bays on a monthly basis from April through October (Table 1, Figures 1-3). With the exception of June and September, samples were taken beginning the third week of the month. In 2013 samples were taken the first week of October for weather and scheduling reasons. Sampling began the second week in June and September in order to allow enough time to incorporate beach seine collections.

The boat operator took into account wind and tide (speed and direction) when determining trawl direction. A standard 4.9 m (16 ft) semi-balloon trawl net was used in areas with a depth of greater than 1.1 m (3.5 ft). Each trawl was a standard 6-minute (0.1 hr) tow at a speed of approximately 2.8 knots. Speed was monitored during tows using the GPS. Waypoints marking the sample start (gear fully deployed) and stop (point of gear retrieval) locations were taken using the GPS to determine the area swept (hectares). Time was tracked using a stopwatch, which was started at full gear deployment.

Waypoints marking the sample start (gear fully deployed) and stop (point of gear retrieval) locations were taken using the GPS to determine the area swept (hectares). Time was tracked using a stopwatch which was started at full gear deployment.

Seine

Seines were used to sample the shallow regions of the Coastal Bays frequented by juvenile fishes. Shore beach seine sampling was conducted at 19 fixed sites beginning in the second weeks of June and September (Table 2, Figures 1-3).

A 30.5 m X 1.8 m X 6.4 mm mesh (100 ft X 6 ft X 0.25 in. mesh) bag seine was used at 18 fixed sites in depths less than 1.1 m (3.5 ft.) along the shoreline. However, some sites necessitated varying this routine to fit the available area and depth. A 15.24 m (50 foot) version of the previously described net was used at site S019 due to it is restricted sampling area. GPS coordinates were taken at the start and stop points as well as an estimated percent of net open.

Water Quality and Physical Characteristics

For each sampling method, physical and chemical data were documented at each sampling location. Chemical parameters included: salinity (ppt), temperature (°C), and Dissolved Oxygen (DO; mg/L). Physical parameters included: wind direction and speed (knots), water clarity (Secchi disk; cm), water depth (ft), tide state, and weather condition. Data were recorded on a standardized project data sheet printed on Rite in the Rain All Weather paper (Appendices 1 and 2).

Salinity, water temperature, and DO were taken with a Yellow Springs Instrument (YSI) YSI Pro2030 at two depths, 30 cm (1 foot) below the surface and 30 cm (1 foot) from the bottom, at each trawl site. The YSI cord was marked in 1 ft intervals and the probe had a weight attached to it. The weight was used to keep the probe at the proper depth and as vertical as possible. Chemical data were only taken 30 cm below the surface for each seine site due to the shallow depth (<1.1 m). The YSI was calibrated at the beginning of each sampling round.

Water turbidity was measured with a Secchi disk. Secchi readings were taken on the shaded side of the boat without the user wearing sunglasses. The Secchi disk was lowered into the water until it could not be seen. It was then raised until the black and white pattern could just be seen. The biologist marked the position on the string with their fingers and measured the length of the string to the end of the disk. Both beginning and ending depths for each trawl were read on a depth finder and recorded. At seine sites, depth was estimated by the biologists pulling the seine. Wind speed measurements were acquired using a La Crosse handheld anemometer with digital readout. Measurements were taken facing into the wind. Tidal states were from the GPS tide feature or occasionally estimated by checking the published tide tables for the sampled areas. Difficulties determining tide resulted from inlet influences in Ocean City, MD and Chincoteague, VA, wind driven tidal influences, and lack of appropriate tide stations at some sites.

Sample Processing

Fishes and invertebrates were identified, counted, and measured for Total Length (TL; Table 3) using a wooden millimeter (mm) measuring board with a 90 degree right angle. A meter stick was used for species over 500 mm. At each site, a sub-sample of the first 20 fish (when applicable) of each species were measured and the remainder counted. On occasion, invertebrate species counts were estimated.

Blue crabs were measured for carapace width, sexed, and maturity status was determined. Sex and maturity categories included: male, immature female, mature female (sook), and mature female with eggs. A subsample of the first 50 blue crabs at each site was measured and the rest were counted. Sex and maturity status of non-sub-sampled blue crabs were not recorded

Jellyfishes, ctenophores, bryozoans, sponges, SAV and macroalgae were measured volumetrically (liters, L) using calibrated containers with small holes in the bottom to drain the excess water. Small quantities (generally ≤ 10 specimens) of invertebrates were occasionally counted. Slightly larger quantities of invertebrates were sometimes visually estimated. Bryozoans and macroalgae were combined for one volume measurement and a biologist estimated the percentage of each species in the sample.

Unknown species were placed in Ziploc bags on ice or kept in a bucket of water and taken to the office for identification. Rare, uncommon, and unrepresented species were fixed and preserved for the voucher collection that was started in 2006 (Appendix 3).

Data Analysis

Statistical analyses were conducted on species that historically were most abundant in the trawl and beach seine catch data. Additional species were added to the analyses dependent on their recreational importance and biological significance as forage for adult game fish and indicators of water quality. Species rarely encountered and/or not considered recreationally important, including forage significance, were removed from the analyses.

The Geometric Mean (GM) was calculated to develop species specific annual trawl and beach seine indices of relative abundance (1989-2013). That method was adopted by the Atlantic States Marine Fisheries Commission (ASMFC) Striped Bass Technical Committee as the preferred index of relative abundance to model stock status. The mean was calculated using catch per area covered for trawl and catch per haul for seine. The GM was calculated from the $\log_e(x+1)$ transformation of the catch data and presented with 95% Confidence Intervals (CIs; Ricker 1975). The GM and CIs were calculated as the antilog [$\log_e$-mean(x+1)] and antilog [$\log_e$-mean(x+1) ± standard error * (t value: α=0.05, n-1)], respectively. A geometric grand mean was calculated for the time series (1989-2013) and used as a point estimate for comparison to the annual (2013) estimate of relative abundance.

To investigate species specific habitat preference by finfish, an analysis of variance was performed on the catch data to determine if sites differed in mean abundance (CPUE) for each species by site for 1989-2013. A subsequent multiple pairwise comparison of means test (Duncan's Multiple Range Test) was performed to determine differences among sites in 1989-2013. Those results are reported for each species in this chapter. The site or groups of sites with the most abundant individuals per species were classified as primary sites. Secondary sites were second most abundant.

To evaluate water quality parameters observed during the CBFI, the combined average for each parameter (temperature, dissolved oxygen, salinity, turbidity) per bay (six systems) was derived from the adding together of both the surface and bottom temperature averages collected while trawling, from April to October, and calculating the mean of this total. The DO averages were reviewed to see if the system overall fell below 5.0 mg/L (critical level of hypoxia).

To summarize macroalgae presence in the CBFI, the data were imported into SAS for additional analyses such as Catch per unit of Effort (CPUE), Geometric Mean (2006-2013), Percent Frequency of Positive Hauls, Abundance by Area and Site Number in the Coastal Bays. Statistical analyses were conducted on all species to establish a time series baseline.

To summarize macroalgae presence in the CBFI, the number of samples with light, moderate and heavy macroalgae volume was identified. For trawls, ≤5 liters of macroalgae was considered a light load. Loads >5 and ≤69 liters of macroalgae were considered moderate, and loads <69 liters were considered heavy. For seines, ≤5 liters of macroalgae was also considered a light load. Loads >5 and ≤25 liters were considered moderate, and loads >25 liters were considered heavy.

Results and Discussion:

Finfish were the most abundant taxa captured in the survey. Specifically, they accounted for 21,853 fish caught trawling (14,213 fish) and beach seining (7,640 fish; Table 4) in 2013. The numbers of fish caught were greatly reduced from last year; Spot were significantly less abundant in 2013 (n=278) compared to 2012 (n=27,763), though most species had fewer individuals sampled in 2013 than in 2012. Collected fishes represented 76 species, which is a normal representation of species in a year. Below average indices were produced for Spot, Bluefish Weakfish, Silver Perch, Tautog, Pinfish, and Atlantic Menhaden in trawl and Spot and Silver Perch in the seine. In early March 2013, a nor'easter impacted Ocean City, Maryland. The storm first blew across the continental U.S., moved off the coast of Virginia, then became a nor'easter and moved up the coast. Many of the species we sample, including Spot, are coastal spawners and move into Maryland's Coastal Bays in the spring. We suspect this early season storm interrupted coastal spawning of some species and the distribution of others. Additionally, based on Eyes on the Bay (http://mddnr.chesapeakebay.net/eyesonthebay/index.cfm), fixed, monthly monitoring site DN2438 (March 26, 2014) 2013 surface water temperatures in Isle of Wight were less than they were in January through August 2012; however, all temperatures were within the time-series (2001-2012) range, and 2013 temperatures were close to the mean for the time series. Thus, minor environmental changes may have significant impacts on fisheries resources.

Not all results were low. Above average indices were produced in 2013 for Summer Founder and Pinfish in the seine. Nearly all other species of recreational and commercial interest had average indices of abundance. Additionally, there were 13 Red Drum collected by seine in 2013 which is unusually high for this species. In 2012, we noted an increase in Red Drum sampled, as well as an increase in recreational harvests. While 2013's recreational harvest estimate was not has high as 2012's, Red Drum were caught with some frequency in Maryland again in 2013. This only occurred 3 years in a 10-year time series (Personal communication from the National Marine Fisheries Service, Fisheries Statistics Division March 26, 2014).

Crustaceans were the second most abundant taxa captured in this survey. Specifically, they accounted for 8,279 specimens caught trawling (4,478 crustaceans) and beach seining (3,801 crustaceans; Table 5); estimates of these counts were included in the total numbers reported. The numbers of crustaceans were also greatly reduced when compared to the year before. The biggest declines were in Blue Crabs but substantial declines were also noted in Grass Shrimp and Sand Shrimp numbers. Fifteen crustacean species were identified, which is similar to the numbers of crustaceans found between 1989 and 2012.

The third most abundant taxa captured in the survey were molluscs. Specifically, they accounted for 1,335 specimens caught trawling (686 molluscs) and beach seining (644 molluscs; Table 6). Molluscs were represented by 20 different species.

Other types of animals captured trawling and beach seining included: terrapins, Horseshoe Crabs, ctenophores, tunicates, bryozoans and sponges (Table 7). Twenty-one of these species were identified. In addition to animals, plants (SAV and macroalgae) were also captured in the trawls and beach seines (Table 8).

Species Results: American Eel (*Anguilla rostrata*)

American Eel were captured in four of 140 trawls (2.9%) and in five of 38 beach seines (13.0%). A total of 31 American Eel were collected in trawl (11 fish) and seine (20 fish) samples conducted on Maryland's Coastal Bays in 2013 (Table 4). American Eel ranked 24th out of 76 species in overall finfish abundance. The trawl and beach seine CPUEs were 0.6 fish/hectare and 0.5 fish/haul, respectively.

GM indices of relative abundance were calculated and compared with the 1989-2013 time series grand mean. The point estimate of the time series grand mean was used as an indicator of central tendency of abundance, against which the 95% CIs of the GM indices of relative abundance were compared. The indices for the 2013 trawl and seine were both equal to the grand means (Figures 4 and 5). Since 1989, the trawl relative abundance index rarely (three years) varied from the grand mean, and the seine index also rarely (four years) varied from the grand mean.

Duncan's Multiple Range Test indicated that trawl sites T006, T012, and T015 had the highest level of abundance (CPUE) and these locations were classified as primary sites (Figure 6, Table 9). Secondary trawl sites included T001, T002, and T005. Beach seine sites

S001, S007, and S013 were determined to be a primary location and no sites were classified as secondary sites (Figure 6, Table 10).

Discussion
The abundance indices for trawl and seine were both equivalent to the grand mean (1989-2013). Both the trawl and seine abundance estimates vary little from year to year. Since American Eel spawn in an area north of the Bahamas known as the Sargasso Sea, environmental conditions and ocean currents may be a factor influencing relative abundance (Murdy *et al* 1997).

American Eel were most frequently caught in the trawls at three sites that were close to land in protected bays or creeks; Trawl site T006, is in Turville Creek where MDNR Fisheries Service's Eel Project does an annual elver survey further up the creek from our sampling site. The elver sampling site is located at a fish ladder and prodigious numbers of elvers are captured at this site every year. We attribute the large numbers of elvers being captured at this site to a moderately sized freshwater source close to the ocean inlet. The elvers are probably drawn to this area in search of fresh water in which to grow to adulthood. The scattered range of preferred seine sites for American Eels is due to their preference for near–shore, shallow, weedy areas.

Management
American Eel were managed by the State of Maryland in cooperation with Atlantic States Marine Fisheries Commission (ASMFC). In 2013, ASMFC adopted an addendum to their management plan in order to reduce mortality. The Addendum establishes new management measures for both the commercial and recreational eel fisheries, as well as implements fishery independent and fishery dependent monitoring requirements. Maryland's 2013 recreational American Eel regulations were comprised of a 25 fish creel and a 6 inch minimum size limit (Table 11). Commercial restrictions included a six inch minimum size (Table 12). Monitoring will continue in the CBFI Trawl and Beach Seine Survey.

Species Results: Atlantic Croaker (*Micropogonias undulatus*)
Atlantic Croakers were captured in 33 of 140 trawls (26.6%) and in three of 38 beach seines (7.9%). A total of 146 juvenile Atlantic Croakers were collected in trawl (141) and seine (5) samples conducted on Maryland's Coastal Bays in 2013 (Table 4). Atlantic Croakers ranked 14^h out of 76 species in overall finfish abundance. The trawl and beach seine CPUEs were 8.0 fish/hectare and <0.1 fish/haul, respectively.

GM indices of relative abundance were calculated and compared with the 1989-2013 time series grand mean. The point estimate of the time series grand mean was used as an indicator of central tendency of abundance, against which the 95% CIs of the GM indices of relative abundance were compared. Both the 2013 trawl and seine indices were equal to the grand mean (Figures 7 and 8). Since 1989, the trawl relative abundance indices frequently (12 years) varied from the grand mean.

Duncan's Multiple Range Test indicated that trawl site T001, T002, T003, T004, T005, T006, T007, T011, T012, T013, T014 had the highest level of abundance (CPUE) and these locations were classified as a primary sites (Figure 6, Table 9). Secondary trawl sites included T015, T016, T017, and T018. Seine sites are not included in this discussion because Atlantic Croakers were seldom caught in beach seines.

Discussion
The abundance index for trawl was equal to the grand mean. Since Atlantic Croakers spawn on the continental shelf, environmental conditions and ocean currents may be a factor influencing relative abundance. Winter weather conditions appear to heavily influence abundance by impacting overwintering young of the year more significantly and pushing spawning activity further south on the Atlantic Coast (Murdy *et al* 1997).

Juvenile Atlantic Croakers were more frequently caught in deeper water (trawl). Therefore, trawl indices better represent a more accurate picture of changes in relative abundance when compared to beach seine indices.

Primary and secondary trawl sites for Atlantic Croakers were located in the relatively protected areas of Assawoman Bay, the St. Martins River, and Newport Bay. Most of the Atlantic Croakers caught by the survey are very small and probably do not like the higher currents found in Sinepuxent Bay. Juvenile Atlantic Croakers seem to prefer the deeper sheltered coves and creeks, and share a similar pattern of distribution to Spot and Summer Flounder. Atlantic Croakers are a known prey item for Summer Flounder and that may explain the co-occurrence of these species (Latour, 2008).

Management
Atlantic Croakers were managed by the State of Maryland in cooperation with Atlantic States Marine Fisheries Commission (ASMFC). Maryland's 2013 recreational Atlantic Croakers regulations were comprised of a 25 fish creel and a 9 inch minimum size limit (Table 11). Commercial restrictions included a 9 inch minimum size and an open season year round. (Table 12). Monitoring will continue in the CBFI Trawl and Beach Seine Survey.

Species Results: Atlantic Menhaden (*Brevoortia tyrannus*)
Atlantic Menhaden were captured in 8 of 140 trawls (5.7%) and in 9 of 38 beach seines (23.78%). A total of 2,078 Atlantic Menhaden were collected in trawl (49 fish) and beach seine (2,029 fish) samples conducted on Maryland's Coastal Bays in 2013 (Table 4). Atlantic Menhaden ranked third out of 76 species in overall finfish abundance. The trawl and beach seine CPUEs were 2.8 fish/hectare and 53.4 fish/haul, respectively.

GM indices of relative abundance were calculated and compared with the 1989-2013 time series grand mean. The point estimate of the time series grand mean was used as an indicator of central tendency of abundance, against which the 95% CI of the GM indices of relative abundance were compared. Both the 2013 trawl and seine indices were below the standardized grand mean (Figures 9 and 10). Since 1989, the trawl index occasionally (11 years) varied from the grand mean and beach seine index has varied ten times from the grand mean.

Duncan's Multiple Range Test indicated that trawl sites T005 and T006 had the highest level of abundance (CPUE) and were classified as a primary sites (Figure 6, Table 9). There was one secondary trawl site for Atlantic Menhaden and that was T012. Beach seine site S019 was determined to be a primary location and seine sites S002, S003, S006, S007, S010, and S012 were classified as secondary sites (Figure 6, Table 10).

Discussion

The abundance index for trawl and seine were both below the grand mean. Atlantic Menhaden were caught more often in near-shore locations (beach seine). Therefore, the beach seine index represents a more accurate picture of changes in relative abundance when compared to trawl indices. Significant changes in relative abundance may reflect a combination of environmental conditions (nutrient levels, water temperature, salinity, and dissolved oxygen) and/or overfishing.

The primary trawl sites were in protected areas at the head of Turville Creek (T006) and the St. Martins River (T005). Turville Creek is known to have high nutrient levels and may attract the prey sources of Atlantic Menhaden (Maryland Department of the Environment, 2001). Trawl primary sites are up at the head of creeks and are likely to have high chlorophyll concentrations, a desirable characteristic for a filter feeder (Wazniak *et al*, 2004). The beach seine primary site (S019) for Atlantic Menhaden was located in a muddy protected creek. Primary and secondary seine sites displayed a geographically wide dispersion indicating preference for shallow water habitat with low flow characteristics.

Management

Atlantic Menhaden were managed by the State of Maryland in cooperation with ASMFC. There was no recreational creel or size limits for this species in 2013. There were new harvest limits for Atlantic Menhaden in the waters of the Atlantic Ocean, Maryland's Coastal Bays and the Chesapeake Bay in 2013. Recent action by ASMFC will reduce menhaden commercial harvest by 20% in coming years. A harvest cap of 109,020 metric-tons was implemented in 2006 (Table 12; ASMFC 2006). Maryland was assigned an initial 2013 quota of 5,116,976 pounds. This quota included a small subtraction for a New England set aside. Because the set aside was not used, Maryland ended the 2013 fishing year with a quota of 5,168,467 (5.2) million pounds. Monitoring will continue in the CBFI Trawl and Beach Seine Survey.

Species Results: Atlantic Silverside (*Menidia menidia*)

Atlantic Silversides were captured in 8 of 140 (5.7%) trawls and in 9 of 38 beach seines (23.7%). A total of 2,278 Atlantic Silversides were collected in trawl (543 fish) and beach seine (1,729 fish) samples conducted on Maryland's Coastal Bays in 2013 (Table 4). Atlantic Silversides ranked 2nd out of 76 species in overall finfish abundance. The trawl and beach seine CPUEs were 30.9 fish/hectare and 45.5 fish/haul, respectively.

GM indices of relative abundance were calculated and compared with the 1989-2013 time series grand mean. The point estimate of the time series grand mean was used as an indicator of central tendency of abundance, against which the 95% CI of the GM indices of relative abundance were compared. The 2013 trawl and seine indices were both equal to the grand means (Figures 11and 12). Since 1989, the trawl and seine relative indices seldom (one year trawl, five years seine) varied from the grand means.

Duncan's Multiple Range Test indicated that trawl site T002, T005, T006, T008, T009, T010, T015, T018, and T019 had the highest level of abundance (CPUE) and that locations were classified as a primary sites (Figure 6, Table 9). Beach seine sites S005, S006, S009, S010, and S019, were determined to be primary locations and S001, S003, S004, S007, S008, and S017 were classified as a secondary site (Figure 6, Table 10).

Discussion

The abundance indices for trawl and seine were equal to the grand means. Significant changes in relative abundance may reflect a combination of environmental conditions (nutrient levels, water temperature, salinity, and dissolved oxygen) and ecological changes including shifts in species composition and habitat type.

Atlantic Silversides were caught more frequently in near-shore locations (beach seine). Therefore, beach seine indices represent a more accurate picture of changes in relative abundance when compared to trawl indices. Last year Atlantic Silversides were below average abundance which was disconcerting because they are often found in shallow water their abundance may be an early indicator of a water quality changes due to land use or other disturbances, but predation could also have been a factor. It was nice to see the abundance recover in 2013.

Primary and secondary trawl and beach seine sites for Atlantic Silversides were located in the shallow, protected areas of Assawoman Bay, Isle of Wight Bay and its tributaries, Sinepuxent Bay, and Chincoteague Bay. They also prefer all sites in Sinepuxent Bay, which would indicate that they are not deterred by current. Similar characteristics of primary and secondary trawl and seine sites were their proximity to land and inlets. They do not seem to prefer large expanses of exposed open water. Atlantic Silversides are known to be a preferred forage species for larger game fish and have been found co-occurring with Spot and Summer Flounder at multiple sites in this survey.

Management

No management plan exists for Atlantic Silversides. There were no recreational or commercial fishing regulations for this species. Monitoring will continue in the CBFI Trawl and Beach Seine Survey.

Species Results: Bay Anchovy (*Anchoa hepsetus*)

Bay anchovies were captured in 98 of 140 trawls (70.0%) and in 30 of 38 beach seines (78.9%). A total of 13,182 Bay anchovies were collected in trawl (11,589 fish) and (1,593 fish) beach seine samples collected in Maryland's Coastal Bays in 2013 (Table 4). Bay anchovies ranked 1st out of 76 species in overall finfish abundance. The trawl and beach seine CPUEs were 660.0 fish/hectare and 41.9 fish/haul, respectively.

GM indices of relative abundance were calculated and compared with the 1989-2013 time series grand mean. The point estimate of the standardized time series grand mean was used as an indicator of central tendency of abundance, against which the 95% CIs of the GM indices of relative abundance were compared. The 2013 trawl and seine indices were both equal to the grand means (Figures 13 and 14). Since 1989, the relative abundance estimates seldom (six years trawl, four years beach seine) varied from the grand means.

Duncan's Multiple Range Test indicated that trawl site T001, T002, T003, T004, T006, T007, T010, T011, T012, and had the highest level of abundance (CPUE) and these locations were classified as primary sites (Figure 6, Table 9). T005, T009, and T013 were classified as a secondary trawl sites. Beach seine sites S003, S012, S015, and S017 were determined to be primary locations and S011, and S016 were classified as secondary sites (Figure 6, Table 10).

Discussion
The abundance index for trawl and seine were both equal to the grand means. Changes in relative abundance may reflect a combination of environmental conditions (nutrient levels, water temperature, salinity, and dissolved oxygen) and ecological changes including shifts in species composition and habitat type.

Bay anchovies were caught in both near-shore and open water locations indicating a wide distribution. Therefore, both indices represent an accurate picture of changes in relative abundance.

Primary and secondary trawl and beach seine sites for bay anchovies were located more in the northern bays for trawl and more in the southern bays for seine. Bay Anchovies are known to be a preferred forage species for larger game fish and have been found co-occurring with Spot and Summer Flounder at multiple sites in this survey.

Management
No management plan exists for bay anchovies. There were no recreational or commercial fishing regulations for this species. Monitoring will continue in the CBFI Trawl and Beach Seine Survey.

Species Results: Black Sea Bass (*Centropristis striata*)
Black Sea Bass were collected in 27 of 140 trawls (19.3%) and three of 38 seines (7.9%). A total of 56 juvenile Black Sea Bass were collected in trawl (47 fish) and beach seine (9 fish) samples conducted on Maryland's Coastal Bays in 2013 (Table 4). Black Sea Bass were ranked 18th out of 76 species in overall finfish abundance. The trawl and beach seine CPUEs were 2.7 fish/hectare and 0.2 fish/haul, respectively.

GM indices of relative abundance were calculated and compared with the 1989-2013 time series grand mean. The point estimate of the time series grand mean was used as an indicator of central tendency of abundance, against which the 95% CIs of the GM indices of relative abundance were compared. The 2013 trawl and beach seine indices were both equal to the standardized grand means (Figures 15 and 16). Since 1989, the trawl and seine indices frequently (seven years trawl, five years beach seine) varied from the grand means.

Duncan's Multiple Range Test indicated that trawl site T009 had the highest level of abundance (CPUE) and this location was classified as a primary site (Figure 6, Table 9). Secondary trawl sites included T003, T004, T007, T008, T016, and T020. Beach seine sites S002 and S018 were determined to be primary locations and sites S020, and S018 were classified as secondary sites (Figure 6, Table 10).

Discussion
The 2013 trawl and beach seine indices were both equal to the standardized grand means. Changes in relative abundance may reflect a combination of environmental conditions (nutrient levels, water temperature, salinity, and dissolved oxygen) and ecological changes including, shifts in species composition and habitat type.

Black Sea Bass were caught in all bays by trawl and in the northern bays by seine reflecting a wide range of preferred habitats. As natural and artificial reef increase structure necessary for Black Sea Bass habitat, there may be an increase in Black Sea Bass recruitment to Maryland waters. However, because Black Sea Bass do prefer reef habitat, trawls and seines are not ideal gears to sample Black Sea Bass.

Trawl and seine sites of primary and secondary preference were locations with or near structure such as channels, drop offs, rip rap, or crab pots. Many of the preferred sites have a hard shell bottom that provided the needed habitat structure that Black Sea Bass desire (Murdy *et al* 1997).

Management
Black Sea Bass were managed by the State of Maryland in cooperation with ASMFC, and the Mid-Atlantic Fishery Management Council (MAFMC). In 2013, like 2012, Maryland's recreational black sea bass regulations for 2013 included a 12.5 inch total length minimum size limit, 25 fish/day creel limit, and an open season from May 19 until October 14th, and November 1 through December 31st or as determined by NMFS (Table 11). Maryland's recreational regulations are based on a regional management approach, which is more appropriate given Black Sea Bass's life history. Commercial restrictions included an 11 inch minimum size and required a landing permit with an associated individual fishing quota issued by the State (Table 12). Commercially licensed fishermen without a landing permit were allowed to land 50 pounds per day as bycatch. Monitoring will continue in the CBFI Trawl and Beach Seine Survey.

Species Results: Bluefish (*Pomatomus saltatrix*)
Bluefish were collected in one of 140 trawls (0.1%) and in 12 of 38 beach seines (0.6%). A total of 23 juvenile Bluefish were collected in trawl (one fish) and beach seine (22 fish) samples conducted on Maryland's Coastal Bays in 2013 (Table 4). Bluefish ranked 28th out

of 76 species in overall finfish abundance. The trawl and beach seine CPUEs were 0.1 fish/hectare and 0.6 fish/haul, respectively.

GM indices of relative abundance were calculated and compared with the 1989-2013 time series grand mean. The point estimate of the time series grand mean was used as an indicator of central tendency of abundance, against which the 95% CIs of the GM indices of relative abundance were compared. The 2013 trawl index was below the grand mean and the beach seine index was equal to the grand mean (Figures 17 and 18, respectively). Since 1989, the indices occasionally (four years trawl, five years beach seine) varied from the grand means.

Duncan's Multiple Range Test indicated that trawl sites T003, T004, T005, T007, and T011 had the highest level of abundance (CPUE) and those locations were classified as a primary sites (Figure 6, Table 9). Site T002 was a secondary trawl site. Beach seine sites S001, S003, S005, and S006 were determined to be primary locations and site two was classified as a secondary site (Figure 6, Table 10).

Discussion

The 2013 trawl index was below the grand mean and the beach seine index was equal to the grand mean. Changes in relative abundance may reflect a combination of environmental conditions (nutrient levels, water temperature, salinity, and dissolved oxygen) and ecological changes including, shifts in species composition and habitat type.

Bluefish were caught more frequently in near shore (beach seine) locations. Therefore, beach seine indices represent a more accurate picture of changes in relative abundance when compared to trawl indices.

Primary and secondary trawl and beach seine sites for Bluefish were located in Assawoman Bay, Isle of Wight Bay, and Newport Bay. Primary sites trawl were all located north of the Ocean City Inlet with the exception of site T011. Bluefish may be drawn to the abundance of forage and the higher flushing rates of the areas close to the inlet.

Management

Bluefish were managed by the State of Maryland in cooperation with ASMFC and the MAFMC. Maryland's 2013 recreational Bluefish regulations were comprised of a 10 fish creel and an 8 inch minimum size limit (Table 11). Commercial restrictions included an eight inch minimum size and no seasonal closures (Table 12). Monitoring will continue in the CBFI Trawl and Beach Seine Survey.

Species Results: Pinfish (*Lagodon rhomboides*)

Pinfish were collected in one of 140 trawls (0.1%) and 16 of 38 seines (42.1%). A total of 294 Pinfish were collected in trawl (2 fish) and beach seine (292 fish) samples conducted on Maryland's Coastal Bays in 2013 (Table 4). Pinfish ranked 8th out of 76 species in overall finfish abundance. The trawl and beach seine CPUEs were 0.1 fish/hectare and 7.7 fish/haul, respectively.

GM indices of relative abundance were calculated and compared with the 1989-2013 time series grand mean. The point estimate of the time series grand mean was used as an indicator of central tendency of abundance, against which the 95% CIs of the GM indices of relative abundance were compared. The 2013 trawl and beach seine indices were both equal to the grand means (Figures 19 and 20). Since 1989, the indices frequently (15 years trawl, 17 years beach seine) varied from the grand means, indicating variability in abundance over the time period.

Duncan's Multiple Range Test indicated that trawl sites T005, T006, T009, T010, T017, T19 and T020 had the highest level of abundance (CPUE) and these locations were classified as primary sites (Figure 6, Table 9). Secondary trawl sites included T001 and T002. Beach seine sites S001, S002, and S010 were determined to be primary locations and S005, S006, S007, and S014 were classified as secondary sites (Figure 6, Table 10).

Discussion

The 2013 trawl index and the beach seine indices were both equal to the grand means. Since Pinfish spawn offshore, environmental conditions including global weather patterns, and ocean currents may be a factor influencing relative abundance (Murdy *et al* 1997). Pinfish were caught in both near shore (beach seine) and open water (trawl) locations however, they are more frequently caught in the seines.

Primary and secondary trawl and beach seine sites for Pinfish were located in Assawoman Bay, Isle of Wight Bay (tributaries), Sinepuxent Bay, and Chincoteague Bay. Pinfish were widely dispersed in the Coastal Bays as exhibited by a large number of primary and secondary preference sites. This indicates that most of the habitat of the Maryland Coastal Bays is favorable nursery habitat for this species.

Management

In the mid-Atlantic, Pinfish were not managed. There were no recreational or commercial fishing regulations for this species. Monitoring will continue in the CBFI Trawl and Beach Seine Survey.

Species Results: Silver Perch (*Bairdiella chrysoura*)

Silver Perch were collected in 27 of 140 trawls (19.3%) and 10 of 38 seines (26.3%). A total of 402 Silver Perch were collected in trawl (183 fish) and beach seine (219 fish) samples conducted on Maryland's Coastal Bays in 2013 (Table 4). Silver Perch ranked 5th out of 76 species in overall finfish abundance. The trawl and beach seine CPUEs were 10.4 fish/hectare and 5.8 fish/haul, respectively.

GM indices of relative abundance were calculated and compared with the 1989-2013 time series grand mean. The point estimate of the time series grand mean was used as an indicator of central tendency of abundance, against which the 95% CIs of the GM indices of relative abundance were compared. The 2013 trawl and beach seine indices were both below the grand means (Figures 21 and 22). Since 1989, the indices occasionally (10 years trawl, 1 year beach seine) varied from the grand means, indicating some variability in abundance over the time period.

Duncan's Multiple Range Test indicated that trawl sites T001, T002, T004, T006, T012 and T014 had the highest level of abundance (CPUE) and these locations were classified as primary sites (Figure 6, Table 9). Secondary trawl sites included: T005 and T011. Beach seine sites S001, S002, S005, S006, S010, S011, S017 and S018 were determined to be primary locations and S007, S012, S013, S014, and S016 were classified as secondary sites (Figure 6, Table 10).

Discussion
The 2013 trawl index and the beach seine indices were both below the grand mean. Since Silver Perch spawn offshore, environmental conditions including global weather patterns, and ocean currents may be a factor influencing relative abundance (Murdy *et al* 1997). Silver Perch were caught in both near shore (beach seine) and open water (trawl) locations. Therefore, both indices represent an accurate picture of changes in relative abundance.

Silver Perch were widely dispersed in the Coastal Bays as exhibited by a large number of primary and secondary preference sites. This indicates that most of the habitat of the Maryland Coastal Bays is favorable nursery habitat for this species.

Management
In the mid-Atlantic, Silver Perch were not managed. There were no recreational or commercial fishing regulations for this species. Monitoring will continue in the CBFI Trawl and Beach Seine Survey.

Species Results: Spot (*Leiostomus xanthurus*)
Spot were collected in 37 of 140 trawls (26.0%) and 27 of 38 seines (71.1%). A total of 278 Spot were collected in trawl (90 fish) and beach seine (188 fish) samples conducted on Maryland's Coastal Bays in 2013 (Table 4). Spot ranked 9th out of 76 species in overall finfish abundance. The trawl and beach seine CPUEs were 5.1 fish/hectare and 4.9 fish/haul, respectively.

GM indices of relative abundance were calculated and compared with the 1989-2013 time series grand mean. The point estimate of the time series grand mean was used as an indicator of central tendency of abundance, against which the 95% CIs of the GM indices of relative abundance were compared. The 2013 trawl and beach seine indices were both below the grand means (Figures 23 and 24). Since 1989, the indices frequently (23 years trawl, 18 years beach seine) varied from the grand means, indicating variability in abundance over the time period.

Duncan's Multiple Range Test indicated that trawl sites T001, T002, T005, T012, and T019 had the highest level of abundance (CPUE) and these locations were classified as primary sites (Figure 6, Table 9). Secondary trawl sites included: T003, T004, T014, T015 and T018.

Beach seine sites S001, S002, S003, S005, S006, S007, S008, S010, S011, S012, S013, and S017 were determined to be primary locations and S009, which was classified as a secondary site (Figure 6, Table 10).

Discussion
The 2013 trawl index and the beach seine indices were both below the grand mean. Since Spot spawn offshore, environmental conditions including global weather patterns, and ocean currents may be a factor influencing relative abundance (Murdy *et al* 1997). Spot drive the total number of fish caught in a given year, so a low catch of Spot is reflected in the low total number of fish captured in 2013. Spot were caught in both near shore (beach seine) and open water (trawl) locations. Therefore, both indices represent an accurate picture of changes in relative abundance.

Primary and secondary trawl and beach seine sites for Spot were located in Assawoman Bay, Isle of Wight Bay (tributaries), Sinepuxent Bay, Newport Bay, and Chincoteague Bay. Spot were widely dispersed in the Coastal Bays as exhibited by a large number of primary and secondary preference sites. This indicates that most of the habitat of the Maryland Coastal Bays is favorable nursery habitat for this species.

Management
In the mid-Atlantic, Spot were managed by the State of Maryland in cooperation with ASMFC. There were no recreational or commercial fishing regulations for this species. Monitoring will continue in the CBFI Trawl and Beach Seine Survey.

Species Results: Summer Flounder (*Paralichthys dentatus*)
Summer Flounder were collected in 92 of 140 trawls (65.7%) and 27 of 38 seines (71.0%). A total of 748 Summer Flounder collected in trawl (598 fish) and beach seine (142 fish) samples conducted on Maryland's Coastal Bays in 2013 (Table 4). Summer Flounder ranked 4th out of 76 species in overall finfish abundance. The trawl and beach seine CPUEs were 33.9 fish/hectare and 4.0 fish/haul, respectively.

GM indices of relative abundance were calculated and compared with the 1989-2013 time series grand mean. The point estimate of the time series grand mean was used as an indicator of central tendency of abundance, against which the 95% CIs of the GM indices of relative abundance were compared. The 2013 trawl index was equal to the grand mean and the seine index was above the grand mean (Figures 25 and 26, respectively). Since 1989, the trawl index frequently (12 years) varied from the grand mean and the seine index rarely (six years) varied from the grand mean.

Duncan's Multiple Range Test indicated that trawl sites T001, T002, T003, T004, T005, T006, T010, T011, T012, T015, T018, and T019 had the highest level of abundance (CPUE) and those location was classified as a primary sites (Figure 6, Table 9). Secondary trawl sites included: T007, and T014. Beach seine sites S012, and S013 were primary locations and seine sites S002, S006, S010, S015, and S017 were classified as secondary sites (Figure 6, Table 10).

Discussion
The 2013 trawl index was equal the grand mean and the seine index was above the grand mean. There was considerable improvement over the prior two years in the Summer Flounder indices in 2012 and 2013. Summer flounder are pelagic spawners, so they were probably subject to environmental conditions that may have affected spawning and juvenile success. Changes in relative abundance may reflect a combination of environmental conditions (nutrient levels, water temperature, salinity, and dissolved oxygen) and ecological changes including shifts in forage species composition and habitat type. However, spawning stock biomass has been increasing since approximately 2008, and while the last two years have not been statistically different from the grand mean, we have seen higher indices from the recent low in 2011. We hope that this trend continues as those year classes grow.

Summer Flounder were caught more frequently in open water (trawl). Therefore, trawl indices represent a more accurate picture of changes in relative abundance when compared to beach seine data, although not to the extent of some other species like Atlantic Croakers and Weakfish.

Primary and secondary trawl and beach seine sites were located in all bays and at most sites. There were many primary and secondary trawl and seine sites, which illustrated the quality of the Coastal Bays as habitat for Summer Flounder.

Management
Summer Flounder were managed by the State of Maryland in cooperation with ASMFC and the MAFMC. Maryland's 2013 recreational Summer Flounder regulations were comprised of a 4 fish creel and 16.0 inch minimum size limit. The open season was March 28th through December 31st (Table 11). Commercial restrictions included a 14 inch minimum size for all gears with the exception of hook-and-line which had size regulations consistent with recreational measures (Table 12). Permitted fishermen in the Atlantic Ocean and Coastal Bays can harvest 5,000 pounds per day while non-permitted fishermen can land 100 or 50 pounds per day in the Atlantic/Coastal Bays and Chesapeake Bay, respectively. Monitoring will continue in the CBFI Trawl and Beach Seine Survey.

Species Results: Tautog (*Tautoga onitis*)
Tautogs were captured in zero of 140 trawls (0%) and in one of 38 beach seines (2.6%) samples conducted on Maryland's Coastal Bays in 2013 (Table 4). Tautogs were ranked 63rd out of 76 species in overall finfish abundance.

GM indices of relative abundance were calculated and compared with the 1989-2013 time series grand mean. The point estimate of the time series grand mean was used as an indicator of central tendency of abundance, against which the 95% CIs of the GM indices of relative abundance were compared. The trawl indexes for 2013 was below the grand mean and the seine index was equal to the grand mean (Figures 27 and 28). Since 1989, the relative abundance trawl estimates occasionally (five years) varied from the grand mean.

Duncan's Multiple Range Test indicated trawl site T001, T002, T003, T007, and T009 had the highest level of abundance (CPUE) and were classified as a primary sites (Figure 6, Table 9). There were no secondary site trawl sites. Seine sites S002, S005, S006, and S010 were classified as primary sites, and S001, S003, S004, S007, and S011 were classified as secondary sites (Figure 6, Table 10).

Discussion

The abundance index for trawl was below the grand mean and the seine index was equal to the grand mean. Sporadic catches indicate that this survey may not be an effective means for determining Tautog juvenile abundance. Juvenile Tautogs prefer Submerged Aquatic Vegetation (SAV), and adult Tautogs prefer structured habitat. The gear used in the CBFI survey, and our survey locations, are not suited to those habitats. However, our survey in past years indicate a site preference for seine sites in the northern bays when they are present, and this may be the preferred habitat for Tautog in the Maryland Coastal Bays.

Management

Tautogs are managed by the State of Maryland in cooperation with Atlantic States Marine Fisheries Commission (ASMFC). Maryland's 2013 recreational Tautog regulations were comprised of a 16 inch minimum size limit and a 4 fish creel from January 1st to May 15th and November 1 through November 30, and a two fish creel from May 16th to October 31st. Tautog fishing is closed in Maryland for the month of December (Table 11). Commercial restrictions are consistent with recreational regulations (Table 12).

In 2011, an update stock assessment was performed that indicated fishing was occurring above the target fishing mortality. The model used for stock assessment was largely based on recreational harvests and does not account for recent increases in Tautog habitat along the Mid-Atlantic. However, there are no biological abundance surveys currently being conducted in our region targeting Tautogs. Maryland does collect Tautog age and growth samples from the commercial pot and the recreational head boat fleet.

Species Results: Weakfish (*Cynoscion regalis*)

Weakfish were collected in 26 of 140 trawls (18.6%) and one of 38 seines (2.6%). A total of 337 juvenile Weakfish were collected in trawl (336 fish) and beach seine (one fish) samples conducted on Maryland's Coastal Bays in 2013 (Table 4). Weakfish ranked 7th out of 76 species in overall finfish abundance. The trawl and beach seine CPUEs were 19.1 fish/hectare and <0.1 fish/haul, respectively.

GM indices of relative abundance were calculated and compared with the 1989-2013 time series grand mean. The point estimate of the time series grand mean was used as an indicator of central tendency of abundance, against which the 95% CIs of the GM indices of relative abundance were compared. The 2013 trawl index was below the grand mean and the seine index was equal to the grand mean (Figures 29 and 30, respectively). Since 1989, the relative abundance trawl estimates occasionally (nine years) varied from the grand mean.

Duncan's Multiple Range Test indicated that trawl sites T001, T002, T003, T004, and T020 had the highest level of abundance (CPUE) and these locations were classified as primary sites (Figure 6, Table 9). The secondary trawl sites of greatest abundance were T005 and T012. Seine sites S003, S012, S015, and S017 had the highest level of abundance (CPUE) and these locations were classified as primary sites (Figure 1, Table 9). The secondary seine sites of greatest abundance were S002, S005, S006, S007, S008, S010, S013, S016, and S019. (Figure 6, Table 10).

Discussion
The 2013 seine and trawl indices were below the grand means; changes in relative abundance may reflect a combination of environmental conditions (nutrient levels, water temperature, salinity, and dissolved oxygen) and ecological changes including, shifts in species composition and habitat type. Weakfish were considered depleted but not overfished. The recent declines appear to be due to natural mortality (NEFC 2009).

Weakfish were caught more frequently in open water (trawl). Therefore, trawl indices represent a more accurate picture of changes in relative abundance when compared to beach seine data.

Primary and secondary trawl for Weakfish were located in all bays indicating a broad range of distribution in the coastal bays.

Management
Weakfish were managed by the State of Maryland in cooperation with ASMFC. Since the 2009 stock assessment, Weakfish have been determined to be experiencing a recruitment failure, with depleted stocks. Maryland's 2013 recreational Weakfish regulations were comprised of a one fish creel and a 13 inch minimum size limit (Table 11). Commercial regulations in 2013 restricted fisherman to a 12 inch minimum size and included an array of season closures dependent upon the type of gear used and body of water being fished (Table 12). The commercial fishery is managed as a bycatch fishery with a 100 pounds catch limit on the Atlantic coast and a 50 pound limit on the Chesapeake Bay. Monitoring will continue in the CBFI Trawl and Beach Seine Survey.

Species Results: Winter Flounder (*Pseudopleuronectes americanus*)
Winter Flounder were collected in 16 of 140 trawls (11.4%) and 11 of 38 seines (28.9%). A total of 391 Winter Flounder were collected in trawl (46 fish) and beach seine (345 fish) samples conducted on Maryland's Coastal Bays in 2013 (Table 4). Winter Flounder ranked 6^{th} out of 76 species in overall finfish abundance. The trawl and beach seine CPUEs were 2.6 fish/hectare and 9.1 fish/haul, respectively.

GM indices of relative abundance were calculated and compared with the 1989-2013 time series grand mean. The point estimate of the time series grand mean was used as an indicator of central tendency of abundance, against which the 95% CIs of the GM indices of relative abundance were compared. The 2013 trawl and beach seine indices were both equal to the grand means (Figures 31 and 32). Since 1989, the indices occasionally (seven years trawl, six years beach seine) varied from the grand means, indicating variability in abundance over the time period.

Duncan's Multiple Range Test indicated that trawl sites T001, T002, T004, and T007 had the highest level of abundance (CPUE) and these locations were classified as primary sites (Figure 6, Table 9). Secondary trawl sites included: T003and T009. Beach seine sites S002, S003, S005, S006, S008, S010, S012, S013, S016, S017, and S018 were determined to be primary locations and there were no sites classified as secondary sites (Figure 6, Table 10).

Discussion
The 2013 trawl index and the beach seine indices were both equal to the grand mean. Winter Flounder were caught in both near shore (beach seine) and open water (trawl) locations. Therefore, both indices represent an accurate picture of changes in relative abundance. Seasonally Winter Flounder were most often caught in June, especially in the seine, but have also been caught in all the months sampled.

Primary and secondary trawl and beach seine sites for Winter Flounder were widely dispersed in the Coastal Bays as exhibited by a large number of primary and secondary preference sites. This indicates that most of the habitat of the Maryland Coastal Bays is favorable nursery habitat for this species.

Management
Winter Flounder were not managed by the State of Maryland. There were no recreational or commercial fishing regulations for this species. Monitoring will continue in the CBFI Trawl and Beach Seine Survey.

Additional Discussion on Habitat Preference by Bay

Northern Bays – Assawoman Bay, Isle of Wight Bay (St. Martins River)
All species had preferred sites for either trawl or seine in these bays. All the sites in these bays were preferred for Atlantic Croaker, Bay Anchovy, and Summer Flounder for trawl and Spot for seine. Winter Flounder, Weakfish, Silver Perch, Tautog, Spot and Bluefish had the most combined trawl and seine sites in these bays. T002 in Grey's Creek, and T006, in Turville Creek, are two of the shallowest trawl sites. The shallow depths of these locations are probably responsible for the trawl preference of these sites for many species. The combination of the habitat type, temperature, forage, tidal current, salinities, and dissolved oxygen make this area desirable for juvenile finfish production. There were many preferred seine sites in these bays indicating good habitat quality in the shallow waters of the northern bays.

Sinepuxent Bay
Atlantic Silversides had all preferred sites in this bay in the trawls and Atlantic Silversides and Spot had all preferred sites for seine samples in Sinepuxent Bay (Tables 9 and 10).

Trawl sites ranged from two to six species with a primary or secondary designation while seine sites ranged from two to twelve species. Seine site S010 had the greatest species diversity with primary or secondary classifications (n=12). It is located in a shallow, muddy, protected cove; ideal habitat for juvenile finfish. High tidal velocities probably inhibit abundance of Atlantic Croaker, Atlantic Menhaden, Bluefish, Silver Perch, Spot, and Weakfish in this bay's trawl sites.

Newport Bay and Chincoteague Bay

A wide variety of species had preferred sites for both trawl and seine samples in these bays, which is to be expected as the bays are large with a variety of habitats (Tables 9 and 10). Seine site S012 had the most diversity of the seine sites with eight species showing a preference for the site. It has great habitat, sand beach surrounded by marsh. Seine site S017 also had eight species that preferred this site. It is located in a shallow, muddy, protected cove which is an ideal habitat for juvenile finfish. It is a location that southern stingrays can be often be found at, as well as black drum, red drum, and spotted sea trout. Trawl site T012 showed the greatest trawl site diversity in the southern bays. It is a narrow gut between two marshes that funnels Trappe Creek. Atlantic Croaker, Bay Anchovy, Spot, and Summer Flounder appear to be the species that most preferred use of Newport and Chincoteague Bays as they had the most preferred trawl and seine sites combined.

Macroalgae and Submerged Aquatic Vegetation

Results

Time Series

This time series spans eight years from 2006 to 2013. To date, over 35 thousand L of macroalgae and SAV has been measured. Some immediate trends observed were peak abundance years and shifts in gear type results. In 2006, the total abundance was the lowest recorded for trawl and beach seine. Two years later in 2008, maximum abundance for the trawl was six times the value in 2006, and the seine total volume more than doubled. Since 2008, the trawl volume has steadily declined, with the second lowest level in total volume recorded in 2013 (Figure 33). The beach seine total volume has been variable over the time series, with two peaks in 2010 and 2013 (Figure 34). The seine surpassed the trawl for the first time in 2013 for total volume of macroalgae encountered. Area analysis for the time series showed that overall (combining both gear types), Assawoman Bay was the most productive for macroalgae until 2012, then it declined by more than 3,000 L in a single year (Figure 35). Chincoteague Bay was the most productive area for macroalgae in 2013 (Figures 33 and 34). Sinepuxent Bay followed by Chincoteague Bay have been the most productive areas in the Coastal Bays for SAV over the time series (Figure 36). The most abundant sites for macroalgae and SAV over the time series were T002, T006, T001, S007, S001 and S006 (Figures 37 and 38). In 2013, the most abundant sites were T006, T020, T011, S001, S007, S015, (Figures 39 and 40). Five beach seine sites (S001, S007, S010, S015, and S016) had a seasonal average that ranked as heavy (>69L) and zero trawl sites had a seasonal average that met the criteria for heavy (Figure 41).

Trends since 2006 showed that the red macroalgae were abundant during all sampling months from April to October, with peak volume in June (Figure 42). In 2013, peak months for red macroalgae were June and September, coinciding with the beach seine rounds (Figure 43). The other months were of low abundance except for October. Green macroalgae tended to be more abundant in April, May and June, and the trend over the time series is similar to red macroalgae with the exception that August had very low abundance (Figures 42 and 43). Brown and yellow-green macroalgae were most abundant in June for the time series as well as in 2013.

Assawoman Bay and the Isle of Wight Bay were the most abundant areas for red macroalgae in the time series (Figure 44). In 2013, proportions changed to represent an almost equal distribution of red macroalgae in the region, with the southern areas at a slight advantage in abundance (Figure 45). Green macroalgae, were present in all areas, but twice as abundant in the northern areas close to Ocean City. The brown and yellow-green macroalgae were predominantly encountered in Chincoteague Bay.

Agardh's Red Weed (*Agardhiella tenera*)

Agardh's Red Weed was the most dominant macroalga in the Coastal Bays for the time series. The frequency of positive hauls has increased over the sampling period with the highest values recorded last year. The trawl encountered Agardh's Red Weed on 79% of the tows, while the beach seine was a record 89% positive for Agardh's Red Weed in 2013 (Figure 46, Tables 13 and 14).

Over 15.8 thousand L of Agardh's Red Weed has been measured since 2006. Peak abundance in volume for both gears occurred in 2010, totaling 4,367 L, 74% of which was encountered by trawl. In 2013, the total volume for both gear types was 1,596 L; the beach seine encountered 71%, which was atypical, and the first time this has occurred in the time series (Figure 47, Tables 15 and 16). The 2013 trawl and beach seine CPUE values were 26.4 L/hectare and 29.8 L/haul, respectively (Tables 17 and 18). The situation of heavy loads encountered by the trawl has decreased since 2009, but in recent years the beach seine has encountered increased macroalgae volume (Figure 48).

GM indices of relative abundance were calculated and compared with the 2006-2013 time series grand mean. The point estimate of the time series grand mean was used as an indicator of central tendency of abundance, against which the 95% CIs of the GM indices of relative abundance were compared. The trawl and seine indices were statistically higher than the grand mean (Figure 49 and 50).

Graceful Red Weed (*Gracilaria sp.*)

Graceful Red Weed were dominant macroalgae in the Coastal Bays that have declined in the most recent years. The frequency of positive hauls has decreased over the time series with the lowest values recorded in 2013 for both gear types. The trawl encountered Graceful Red Weed on 2% of the tows, and the beach seine had 5% positive hauls in 2013 (Figure 51, Tables 13 and 14).

Over 8.9 thousand L of Graceful Red Weed has been measured since 2006. Peak abundance in volume occurred in 2008, totaling 3,145 L, of which 91% was encountered by trawl. In 2013, the total volume for both gear types was an all time low of only 13.3 L (Figure 52, Tables 15 and 16). The trawl and beach seine CPUE values were 0.52 L/hectare and 0.11 L/haul, respectively (Tables 17 and 18). The situation of heavy loads encountered by the trawl and beach seine peaked in 2008, but has decreased to zero in 2013 (Figure 53).

GM indices of relative abundance were calculated and compared with the 2006-2013 time series grand mean. The point estimate of the time series grand mean was used as an indicator of central tendency of abundance, against which the 95% CIs of the GM indices of relative abundance were compared. The 2013 trawl and beach seine indices were lower than the grand mean (Figure 54 and 55).

Sea Lettuce (*Ulva lactuca*)

Sea Lettuce was a common macroalga encountered in the Coastal Bays. The frequency of positive hauls has increased over the time series with the highest values recorded in 2013. The trawl encountered Sea Lettuce on 69% of the tows; the beach seine was 47% (Figure 56, Tables 13 and 14).

Over 2.9 thousand L of Sea Lettuce has been measured since 2006. Peak abundance in volume occurred in 2008, totaling 788 L, of which 95% was encountered by trawl. In 2013, the total volume for both gear types was 298.5 L; the trawl encountered 74% percent (Figure 57, Tables 15 and 16). The trawl and beach seine CPUE values were 12.7 L/hectare and 2.L/haul, respectively (Tables 17 and 18). Heavy hauls were uncommon for Sea Lettuce; 2008 and 2009 recorded the highest number of heavy and moderate hauls (Figure 58).

GM indices of relative abundance were calculated and compared with the 2006-2013 time series grand mean. The point estimate of the time series grand mean was used as an indicator of central tendency of abundance, against which the 95% CIs of the GM indices of relative abundance were compared. The 2013 trawl and beach seine indices were equal to the grand mean (Figure 59 and 60).

Tubed Weeds (*Polysiphonia sp.*)

Tubed Weeds were common macroalgae encountered in the Coastal Bays. The frequency of positive hauls has increased over the time series. The trawl encountered Tubed Weeds on 30% of the tows, the highest value in the time series. The beach seine frequency of positive hauls was 32% in 2013, the second highest value in the time series behind 2012, which was 34%. (Figure 61, Tables 13 and 14).

Over 1.7 thousand L of Tubed Weeds has been measure since 2006. Peak abundance in volume occurred in 2012, totaling 699 L, of which 78.2% was encountered by trawl. In 2013, the total volume for both gear types was 590 L; the trawl encountered 36% percent while the beach seine set a time series record of 375.7 L (Figure 62, Tables 15 and 16). The trawl and beach seine CPUE values were 12.23 L/hectare and 9.89 L/haul, respectively (Tables 17 and 18). The situation of heavy loads encountered has remained low over the time series, but the number of moderate and light loads has increased since 2009 (Figure 63).

GM indices of relative abundance were calculated and compared with the 2006-2013 time series grand mean. The point estimate of the time series grand mean was used as an indicator of central tendency of abundance, against which the 95% CIs of the GM indices of relative abundance were compared. The 2013 trawl index was higher than the grand mean and beach seine index was equal to the grand mean (Figure 64 and 65).

Green Hair Algae (*Chaetomorpha sp.*)
Green Hair Algae were commonly encountered macroalgae in the Coastal Bays and the most abundant representative of the Chlorophyta division. The frequency of positive hauls has varied over the time series with the highest values recorded in 2009. In 2013, the trawl encountered Green Hair Algae on 12% of the tows and the beach seine incidence was 18%. This was an increase from 2012, which measured only 1% and 5%, respectively (Figure 29, Table 1 and 2).

Over 1.5 thousand (L) of Green Hair Algae has been measured since 2006. Peak abundance in volume occurred in 2009, totaling 453.8 (L), of which 95% was encountered by trawl. In 2013, the total volume for both gear types was 341.3 (L); the trawl encountered 52% percent (Figure 30, Table 3 and 4). The trawl and beach seine CPUE values were 10.2 liters/hectare and 4.27 liters/haul, respectively (Table 5 and 6).

GM indices of relative abundance were calculated and compared with the 2006-2013 time series grand mean. The point estimate of the time series grand mean was used as an indicator of central tendency of abundance, against which the 95% CIs of the GM indices of relative abundance were compared. The 2013 trawl and beach seine indices were equal to the grand mean (Figure 68 and 69).

Water Felt (*Vaucheria sp.*)
Water Felt were commonly encountered macroalgae in the Coastal Bays and the only representative of the yellow-green genera. The frequency of positive hauls has increased over the time series with the highest values recorded in 2012. In 2013, the trawl encountered Water Felt on 15% of the tows and the beach seine value was 18%. This was a decrease from 2012, which measured 23% and 26%, respectively (Figure 70, Tables 13 and 14).

Over 500 L of Water Felt has been measured since 2006. Peak abundance in volume occurred in 2009, totaling 184 L, of which 96% was encountered by trawl. In 2013, the total volume for both gear types was 171.4 L; the trawl encountered 63% percent (Figure 71, Tables 15 and 16). The trawl and beach seine CPUE values were 6.11 L/hectare and 1.69 L/haul, respectively (Tables 17 and 18).

GM indices of relative abundance were calculated and compared with the 2006-2013 time series grand mean. The point estimate of the time series grand mean was used as an indicator of central tendency of abundance, against which the 95% CIs of the GM indices of relative abundance were compared. The 2013 trawl and beach seine indices were equal to the grand mean (Figure 72 and 73).

Barrel Weed (*Champia sp.*)
Barrel Weed were common macroalgae in the Coastal Bays. The frequency of positive hauls has remained low and steady over the time series, with the highest values recorded in 2008.

In 2013, the trawl encountered Barrel Weed on 6% of the tows and the beach seine value was 3%. This was a decrease from 2012, which measured 14% and 5% (Figure 74, Tables 13 and 14).

Approximately 470 liters of Barrel Weed has been measured since 2006. Peak abundance in volume occurred in 2008, totaling 269 L, of which 97% was encountered by trawl. In 2013, the total volume for both gear types was only 9.6 L (Figure 75, Tables 15 and 16). The trawl and beach seine CPUE values were 0.16 liters/hectare and 0.18 L/haul, respectively (Tables 17 and 18).

GM indices of relative abundance were calculated and compared with the 2006-2013 time series grand mean. The point estimate of the time series grand mean was used as an indicator of central tendency of abundance, against which the 95% CIs of the GM indices of relative abundance were compared. The 2013 trawl index was below the grand mean while the seine index was equal to the grand mean (Figure 76 and 77).

Green Fleece (*Codium fragile*)
Green Fleece was a common macroalga in the Coastal Bays. The frequency of positive hauls has remained low and steady over the time series. In 2013, the trawl encountered Green Fleece on 8% of the tows and the beach seine value was 13% positive per haul. This was a decrease from 2012 for the trawl, which measured 12% in 2013. However, the beach seine frequency increased slightly by 2% (Figure 78, Tables 13 and 14).

Over 170 L of Green Fleece has been measured since 2006. Peak abundance in volume occurred in 2012, totaling 79.6 L, of which 66% was encountered by beach seine. In 2013, the total volume for both gear types was only 25 L (Figure 79, Table 15 and 16). The trawl and beach seine CPUE values were 0.40 L/hectare and 0.47 L/haul, respectively (Tables 17 and 18).

GM indices of relative abundance were calculated and compared with the 2006-2013 time series grand mean. The point estimate of the time series grand mean was used as an indicator of central tendency of abundance, against which the 95% CIs of the GM indices of relative abundance were compared. The 2013 trawl and beach seine indices were equal to the grand mean (Figure 80 and 81).

Banded Weeds (*Ceramium sp.*)
Banded Weeds were common macroalgae in the Coastal Bays. The frequency of positive hauls has remained low but steady over the time series. In 2013, the trawl encountered Banded Weeds on 9% of the tows and the beach seine was 3% positive per haul. This was a decrease from 2012 for the trawl, which measured 16%, while the beach seine value remained the same (Figure 82, Tables 13 and 14).

Over 230 L of Banded Weeds have been measured since 2006. Peak abundance in volume occurred in 2012, totaling 47.7 L, of which 99% was encountered by the trawl. In 2013, the total volume for both gear types was 40.3 L (Figure 83, Tables 15 and 16). The trawl and beach seine CPUE values were 2.11 L/hectare and 0.09 L/haul, respectively (Tables 17 and 18).

GM indices of relative abundance were calculated and compared with the 2006-2013 time series grand mean. The point estimate of the time series grand mean was used as an indicator of central tendency of abundance, against which the 95% CIs of the GM indices of relative abundance were compared. The 2013 trawl and beach seine indices were equal to the grand mean (Figure 84 and 85).

Green Tufted Seaweed (*Cladophora sp.*)
Green Tufted Seaweeds were common macroalgae in the Coastal Bays. The frequency of positive hauls has remained low and steady over the time series. In 2013, the trawl encountered Green Tufted Seaweed on 4% of the tows and the beach seine was 5% positive per haul. This was a decrease from 2012 for the trawl, which measured 9% last year, while the beach seine increased slightly from 3% (Figure 86, Tables 13 and 14).

Over 725 L of Green Tufted Seaweed has been measured since 2006. Peak abundance in volume occurred in 2008, totaling 285.2 L, of which 93% was encountered by the beach seine. In 2013, the total volume for both gear types was only 12.0 L (Figure 87, Tables 15 and 16). The trawl and beach seine CPUE values were 0.54 L/hectare and 0.07 L/haul, respectively (Tables 17 and 18).

GM indices of relative abundance were calculated and compared with the 2006-2013 time series grand mean. The point estimate of the time series grand mean was used as an indicator of central tendency of abundance, against which the 95% CIs of the GM indices of relative abundance were compared. The 2013 trawl index was equal to the grand mean while the beach seine index was above the grand mean (Figure 88 and 89).

Hollow Green Weed (*Enteromorpha sp.*)
Hollow Green Weeds were common macroalgae in the Coastal Bays. The frequency of positive hauls has remained low but steady over the time series. In 2013, the trawl encountered Hollow Green Weed on 11% of the tows and the beach seine was 11% as well. This was no change from 2012 for either gear type (Figure 90, Tables 13 and 14).

Over 385 L of Hollow Green Weed has been measured since 2006. Peak abundance in volume occurred in 2012, totaling 91.0 L, of which 98% was encountered by the trawl. In 2013, the total volume for both gear types was 75.0 L, of which 89% was encountered by the beach seine (Figure 91, Tables 15 and 16). The trawl and beach seine CPUE values were 0.47 L/hectare and 1.75 L/haul, respectively (Tables 17 and 18).

GM indices of relative abundance were calculated and compared with the 2006-2013 time series grand mean. The point estimate of the time series grand mean was used as an indicator of central tendency of abundance, against which the 95% CIs of the GM indices of relative abundance were compared. The 2013 trawl and beach seine indices were equal to the grand mean (Figure 92 and 93).

Eel Grass (*Zostera marina*) and Widgeon Grass (*Ruppia maritima*)
Eel Grass was the dominant SAV in the Coastal Bays. Sinepuxent Bay, followed by Chincoteague Bay were the most productive areas in the Coastal Bays for SAV (Figure 36). Widgeon Grass was encountered too infrequently (0.1 L) to complete any analyses.

The majority of Eel Grass encountered was dead. On average, 75% sampled from the trawl and 68% from the beach seine was dead over the time series. The frequency of hauls encountering Eel Grass has been climbing over the times series with a peak in 2012. In 2013, the trawl encountered Eel Grass on 31% of the tows and the beach seine value was 45%. This was a decrease from 46% and 61% respectively in 2012 (Figure 94, Tables 13 and 14).

Over 700 liters of Eel Grass has been measured since 2006. Peak abundance in volume occurred in 2010, totaling 229.2 L, of which 59% was encountered by the beach seine. In 2013, the total volume for both gear types was 41.7 L, of which 40% was encountered by the beach seine (Figure 95, Tables 15 and 16). The trawl and beach seine CPUE values were 1.42 L/hectare and 0.44 L/haul, respectively (Tables 17 and 18). The situation of heavy loads encountered by the trawl has not occurred in the time series. Moderate loads peaked in 2009, but were not frequent. Light loads by both gears has been relatively stable since 2009 (Figure 96).

GM indices of relative abundance were calculated and compared with the 2006-2013 time series grand mean. The point estimate of the time series grand mean was used as an indicator of central tendency of abundance, against which the 95% CIs of the GM indices of relative abundance were compared. The 2013 trawl and beach seine indices were equal to the grand mean (Figure 97 and 98).

Discussion
Throughout the CBFI, large volumes of macroalgae were undesirable due to the difficulties of getting the sample onboard as well as sorting through it to find all of the fish and crustaceans. The fishing gear would bring the entire catch together and many species were hidden within the mass of seaweed. Pierce *et al* (1989) stated that fish entrapped in the advancing beach seine seem less agitated where macrophyte growth was extensive, and thus may have been less likely to find escape routes. That benefit may also have been encountered with the bottom trawl. Although large loads of macroalgae can be difficult to handle in samples, it can also be beneficial by providing cover, producing oxygen, and as a food source.

While the natural abundance level of macroalgae in Maryland's Coastal Bay ecosystem is unknown, the data showed that the northern bays (Assawoman Bay, St. Martin's River and Isle of Wight Bay) yielded 76% of the total volume measured in the 2006-2013 time series (Figure 35). The northern bays also contained many of the primary sites for fish abundance, which may indicate that macroalgae is good habitat for fishes (Figure 41; Olla *et al.* 1979, Stoner and Livingston 1980, Gore *et al.* 1981, Wilson *et al*. 1990, Sogard and Able 1991, Raposa and Oviatt 2000). In 2013 the number of primary preferred sites of finfish species for both gear types declined from 2012. The 2013 decrease in macroalgae in the northern bays may be one factor that contributed to the decrease in fish and crustacean abundance.

Agardh's Red Weed (*Agardhiella tenera*) and Graceful Red Weeds (*Gracilaria sp*.) were the most abundant and contributing macroalgae species in Assawoman Bay over the time series. In 2013, Graceful Red Weeds disappeared and while Agardh's Red Weed remained at 2012 levels, they were half of the historical volume in the 2009-2011 time series. Green Tufted Seaweed (*Cladophora sp.*) was recorded at moderate levels in 2012, but was also reduced to very low levels in 2013. Sea Lettuce (*Ulva lactuca*) also demonstrated a downward trend to about half of historical levels for Assawoman Bay in 2013. Sea Lettuce increased in Saint Martin's River and the Isle of Wight Bay, but has not been a competitor to the red weeds in the northern bays. The overall decrease of macroalgae may be related to water quality improvements, such as decreased nutrients, possibly a result of best management practices on land, or less favorable weather for macroalgae lifecycles. It will be of interest to monitor the status of Graceful Red Weed (*Gracilaria sp*.) in 2014.

Future Goals

Macroalgae are a part of a healthy estuarine ecosystem, and variations in abundance, distribution or composition of macroalgae can be related to natural environmental changes. Macroalgae abundance and composition could play an important role in fish and invertebrate composition and diversity. Several species of fishes (blennies, gobies, sticklebacks, pipefishes and Tautog) have been observed using macroalgae as refuge (Olla *et al.* 1979, Stoner and Livingston 1980, Gore *et al.* 1981, Wilson *et al*. 1990, Sogard and Able 1991, Raposa and Oviatt 2000). Macroalgae also provide habitat and foraging opportunities for several species of decapods (Wilson *et al*. 1990, Sogard and Able 1991), however, macroalgae are not considered an essential habitat for fish because it is variable and ephemeral (Sogard and Able 1991). *Ulva* also produce exudates which can be toxic to Winter Flounder and many invertebrates (Sogard and Able 1991).

An increase in macroalgae abundance or change in composition may be indicative of eutrophication. The conflicting studies on the advantages and disadvantages of macroalgae for nekton warrant further research. Therefore, continued monitoring is necessary to establish long term macroalgae trends in Maryland's Coastal Bays. Future analyses could also consider:

- trends between fish catch and/or species diversity with macroalgae abundance;
- trends in finfish species composition between macroalgae and SAV beds; and
- research to determine land based conditions that affect the abundance, distribution, and composition of macroalgae and SAV in the Coastal Bays Watershed.

Water Quality and Physical Characteristics Results

Temperature

Analysis of the 2013 CBFI Trawl Survey water quality data beginning in April showed increasing average water temperature through July for all bays. For both 2012 and 2013, the combined average temperatures were highest in July (Figure 99). The highest surface temperature (31.8 C) was recorded at site T016 on 7/18. Also on this day, two sites (T017 and T016) tied for highest bottom temperature (30.7 C). Both the lowest surface temperature (10.8 C) and lowest bottom temperature (10.1 C) for all bays were recorded in April at site T009. The lowest temperatures (surface and bottom) for 2012 also occurred in April, but at site T008.

The overall average from all samples was 22.4 C, which was similar to 2012 (22.9 C). Isle of Wight Bay was the warmest with a combined average of 23.3 C, and the system with the lowest combined average water temperature was Sinepuxent (20.6 C). Because the seine component comprises two months of the sampling season, related water quality information does not show the gradual progression of measurements (temperature, salinity, DO and turbidity) possible from graphically representing data. The June 2013 seine sites had a temperature range of 6.0 C (20.8 C to 26.8 C). Three months later in September of 2013, the range was slightly higher at 8.7 C (18.9 C to 27.6 C). Temperatures saw little change between the June seine sampling and the re-visiting of the same sites in September for Chincoteague, Isle of Wight, Sinepuxent and Assawoman Bays. The most abrupt changes were seen at the St. Martins River and Newport Bay sites in September with decreases in temperature (Figure 100).

Dissolved Oxygen

The dissolved oxygen (DO) patterns for each system are seen in Figure 101. As expected, DO levels generally decreased as water temperatures increased. Three systems, Assawoman Bay, St. Martins River, Isle of Wight Bay and Sinepuxent Bay all experienced decreases in DO through June, after which, DO rose. St. Martins River, Isle of Wight Bay and Sinepuxent Bay exhibited a dip in DO for August trawls. Newport and Chincoteague Bays reached the lowest combined average DO in July. As summer neared its end, temperatures began falling and DO started climbing until sampling was completed in October. For beach seine, three bays, Isle of Wight, Assawoman and Sinepuxent showed marked increases in DO from June to September. The St. Martins River and Newport Bay did not display as much variation between the two months. Chincoteague Bay experienced a decrease in DO the second time seine sites were visited (Figure 102).

Salinity

The majority of bays experienced a decrease in salinity from May to July. Salinity in Sinepuxent Bay reached its lowest point in June and then began an upward climb. Chincoteague Bay experienced a slight dip in salinity for August, but for the majority of the season, its salinity increased (Figure 103). When all the salinity averages were analyzed for each bay using trawl survey data, Chincoteague Bay had the highest combined average at 30.3 ppt and the St. Martin’s River had the lowest (23.9 ppt). For the beach seine, salinity changed little from June to September for sites in Assawoman Bay and Isle of Wight Bay. Salinity noticeably increased at sites in Sinepuxent Bay, Chincoteague Bay, Newport Bay and the St. Martin’s River during the seining component of the survey in September (Figure 104).

For 2013, the overall average salinity for all bays combined was 27.1 ppt, which is virtually identical with the overall average for 2012 of 27.0 ppt. Out of all the bays, Chincoteague Bay was the saltiest.

Turbidity

Results of Secchi analysis showed variations for turbidity levels from April to October for all systems (Figure 105). For trawls, the most turbid water system was Newport Bay with an overall average Secchi reading of 73.4 cm. The least turbid bay was Chincoteague Bay returning an overall average of 107.2 cm. This bay was also the least turbid last season, too. Over the course of the trawl survey, visibility in all systems followed a decreasing pattern as the summer progressed. For beach seines, all systems, except for Isle of Wight Bay, experienced an increase in visibility when the sites were visited in September (Figure 106).

A review of Secchi data from the years, 2013 and 2012 demonstrates a decrease in visibility across the warmer months. This metric is subject to variability as there are occasions when light penetration will experience improvement in the middle of summer. Upon viewing a combination of turbidity averages from every month for all bays, it is clear that 2013 was less turbid (92.2 cm) compared to 2012 (73.3 cm). The overall temperature average from all water systems was 22.4 C which was close to that number for 2012 (22.9 C).

Discussion

Differences in temperature, dissolved oxygen, salinity and turbidity were influenced by the flushing times of these systems. For example, the lower average water temperature observed in Sinepuxent Bay (20.6 C) was likely a result of an increased flushing rate based on its close proximity to the Ocean City Inlet (Atlantic Ocean). Lung (1994) presented data from two summers indicating flushing times of 21.1 to 21.3 days for Assawoman Bay and 8.0 to 15.8 days for the St. Martin's River. Flushing rates of the Isle of Wight Bay were reported to be 9.3 to 9.6 days. It was predicted by Prichard (1960) that Chincoteague Bay required 62 days to replace 99 percent of its water. Flushing rates for both Sinepuxent Bay and Newport Bay are not known (Wazniak, et al. 2004). Given the proximity to the Ocean City Inlet, one can assume that flushing rates for Sinepuxent Bay would be relatively fast (more like Isle of Wight Bay) while the flushing rate in Newport Bay would be much longer (more like Chincoteague Bay).

Of the water quality parameters, dissolved oxygen concentrations (DO) have the greatest immediate impact on fisheries resources. Some of the DO concentrations give rise to the concern that hypoxia is occurring in the Maryland Coastal Bays during the summer months. In a report by the Committee on Environmental Natural Resources (2000), hypoxia exists when dissolved oxygen levels can no longer support the majority of life; the DO level for this condition usually set below 2 mg/L. One quarter of the Virginian Province (the mouth of the Chesapeake Bay north to Cape Cod) suffers exposure to DO concentrations of $\leq$ 5 mg/L according to Strobel et al. (1995). In this area, hypoxia generally is associated with warmer water and therefore DO can experience a decline between May through October in the southern reaches of the Province. When temperatures decrease, mixing of top and bottom water occurs more frequently, eliminating the hypoxic regions that grew during the summer (EPA, 2000). For organisms in the Chesapeake Bay, 5.0mg/L is usually accepted as necessary for life, but can vary based on the organism. For example, a DO of 6mg/L is necessary for larvae and eggs of migratory fish, however, some animals such as crabs and bottom dwelling fish (Bay Anchovies) can tolerate DO levels as low as 3 mg/L (Chesapeake Bay Program, 2007). Of concern is the combined bottom average of 4.1 mg/L for the St. Martin's River in August due to readings of 4.84 mg/L and 3.29 mg/L at sites T004 and T005, respectively.

Research concerning low DO impact on various species was conducted in western Long Island Sound (Howell et al, 1994). Species abundance and diversity suffered noticeable reductions in relation to low bottom DO. When bottom DO ranged from 2.9 to 2.0 mg/L, the occurrence of Windowpane Flounder, Butterfish, and Winter Flounder was reduced significantly. As DO decreased, overall total catch per tow and the total species number also decreased. Sites where DO is above 3 mg/L can support more fish and other species compared to areas where bottom DO is below this value. Our data have not been examined to determine if this pattern holds true for our survey; however, based on results of the site preference analysis, species diversity does not appear to be affected by embayment (Figure 6).

Dissolved oxygen typically decreases from April through the warmer months and then increases again in the fall. Certainly, 2013 was no exception to this seasonal pattern. In 2012, precipitation during that time period was examined as far back as the 2010 season for possible impact on water quality parameters. Precipitation was not obviously the driving factor for DO, turbidity, temperature or salinity and it is assumed to be the case for 2013. Evidence appeared to point at some other factor, such as algal blooms, wind, or rain, in influencing these parameters. Visibility can be substantially lowered by a bloom of brown algae. Chlorophyll and turbidity data from Turville Creek were compared with the National Park Service precipitation data for 2004. Precipitation did not follow turbidity to the extent that chlorophyll *a* did (Dennison *et al*. 2009). For 2012, it seemed apparent that DO and turbidity were most likely influenced by phytoplankton abundance increasing in the summer months and decreasing in the early spring and fall. Presumably, this was expected to be the same explanation for these water quality parameters during the 2013 sampling season.

References:

Able, Kenneth W., Michael P. Fahay. 1998. The first year in the life of estuarine fishes in the Middle Atlantic Bight. Rutgers University Press. New Brunswick, NJ. 342 pp.

Abraham, Barbara J. 1985. Species profiles: life histories and environmental requirements of coastal fishes and invertebrates (Mid-Atlantic) Mummichog and Striped Killifish. U.S. Fish Wildl. Serv. Biol. Rep. 82(11.40). U.S. Army Corp. of Engineers. TR EL-82-4. 23 pp.

Amos, William H., Stephen H. Amos. 1998. Atlantic and Gulf Coasts. National Audubon Society Nature Guide. Chanticleer Press. New York. 671 pp.

Atlantic States Marine Fisheries Commission. November 2006. Addendum III to Amendment 1 to the Interstate Fishery Management Plan for Atlantic Menhaden. Available: http://www.asmfc.org/.

Beck, Michael W., Kenneth L. Heck, Jr., Kenneth W. Able, Daniel L. Childers, David B. Eggleston, Bronwyn M. Gillanders, Benjamin S. Halpern, Cynthia G. Hays, Kaho Hoshino, Thomas J. Minello, Robert J. Orth, Peter F. Sheridan, and Michael P. Weinstein. 2003. The role of nearshore ecosystems as fish and shellfish nurseries. Issues of Ecology. Ecological Society of America.

Bolinger, A., S. Doctor, C. Kennedy, A. Luettel and G. Tyler. 2009. Investigation of Maryland's Coastal Bays and Atlantic Ocean finfish stocks 2008 Report. Maryland Department of Natural Resources. Federal Aid Project No. F-50-R-17. Annapolis, MD.

CENR, 2000. Integrated assessment of hypoxia in the Northern Gulf of Mexico. National Science and Technology Council Committee on Environment and Natural Resources, Washington, D.C.

Common and Scientific Names of Fishes from the United States, Canada, and Mexico. 7th ed. American Fisheries Society, in prep.

Dennison, W. C., J. E. Thomas, C. J. Cain, T. J. B. Carruthers, M. R. Hall, R. V. Jesien, C. E. Wazniak and D. E. Wilson. 2009. Shifting sands: Environmental and cultural changes in Maryland's Coastal Bays. University of Maryland Center for Environmental Science, Cambridge, MD.

EPA, U.S., 2000. Ambient aquatic life water criteria for Dissolved oxygen (saltwater): Cape Cod to Cape Hatteras. U.S. Environmental Protection Agency. Office of Water. EPA-822-R-00-012, Washington, DC.

Gore, R. H., E. E. Gallager, L. E. Scotto and K. A. Wilson. 1981. Studies on decapod crustacean from the Indian River region of Florida. *Estuarine, Coastal and Shelf Science.* 12:485-508.

Goshorn, Dave, Margaret McGinty, Carrie Kennedy, Calvin Jordan, Cathy Wazniak, Kara Schwenke, and Kevin Coyne. 2001. An examination of benthic macroalgae communities as indicators of nutrients in middle Atlantic coastal estuaries – Maryland component, Final Report 1998-1999. Maryland Department of Natural Resources. Annapolis, MD.

Gosner, Kenneth L. 1978. Peterson Field Guide-Atlantic Seashore. Boston. Houton Mifflin Company. 329 pp.

Howell, Penelope, and David Simpson. 1994. Abundance of marine resources in relation to dissolved oxygen in Long Island Sound. Estuaries, 17 (2):394-402.

Latour, Robert J., James Gartland, Christopher Bonzek, RaeMarie A. Johnson. 2008. The trophic dynamics of Summer Flounder in Chesapeake Bay. Fishery Bulletin, January.

Luisi, Mike, Steve Doctor, and Staff of the MDNR Atlantic Program. 2005. Investigation of Maryland's Coastal Bays and Atlantic Ocean finfish stocks 2004 Report. Maryland Department of Natural Resources. Federal Aid Project Number F-50-R-14. Annapolis, MD.

Lung, W.S. 1994. Water quality modeling of the St. Martin River, Assawoman and Isle of Wight Bays. Maryland Department of the Environment, Final Report. 156 pp.

Maryland Coastal Bays Program. 2005. The Comprehensive Conservation and Management Plan for Maryland's Coastal Bays. Available: http://www.mdcoastalbays.org/. (February 16, 2007).

Maryland Department of the Environment. 2001. Total Maximum Daily Loads of Nitrogen and Phosphorus for Five Tidal Tributaries in the Northern Coastal Bays System Worcester County, Maryland.

Maryland Department of the Environment. 2008. Available: http://www.mde.state.md.us/assets/document/rainbyco-31dec2007.pdf.

Maryland Department of the Environment. 2010. Available http://www.mde.state.md.us/assets/document/RainByCo-2009dec31.pdf

Morand, P. and Merceron, M. 2005. Macroalgae population and sustainability. Journal of Coastal Research, 21(5), 1009-1020. West Palm Beach, FL.

Murdy, Edward, Ray S. Birdsong, and John M. Musick. 1997. Fishes of Chesapeake Bay. Smithsonian Institution Press. Washington, DC. 324 pp.

Nelson, Joseph S, Edwin J. Crossman, Héctor Espinosa-Pérez, Lloyd T. Findley, Carter R. Gilbert, Robert N. Lea, and James D. Williams. 2004. Common and Scientific Names of Fishes from the United States Canada and Mexico Sixth Edition. American Fisheries Society. 386 pp.

NOAA. 2009. Available: http://www.erh.noaa.gov/marfc/Maps/SOP_counties_sep2009_color.htm.

Northeast Fisheries Science Center. 2009. 48th Northeast regional stock assessment workshop (48th SAW) assessment summary report. US Dept Commerce, Northeast Fish Sci Cent Ref Doc. 09-10; 50 p. Available from: National Marine Fisheries Service, 166 Water Street, Woods Hole, MA 02543-1026, or online at http://www.nefsc.noaa.gov/nefsc/publications/

Olla, B. J., A. J. Bejda and A. D. Martin. 1979. Seasonal dispersal and habitat selection of cunner, *Tautogolabrus adspersus*, and young Tautog, *Tautoga onitis*, in Fire Island inlet, Long Island, New York. *Fishery Bulletin.* 77:255-261.

Prichard. D. W. 1960. Salt balance and exchange rate for Chincoteague Bay. Chesapeake Science 1(1): 48-57.

Raposa, K. B. and C. A. Oviatt. 2000. The influence of contiguous shoreline type, distance from shore, and vegetation biomass on nekton community structure in eelgrass beds. *Estuaries*. 23:46-55.

Ricker, W. 1975. Computation and interpretation of biological statistics of fish populations. Fisheries Research Board of Canada. Bulletin 191.

Robins, Richard C. and G. Carlton Ray. 1986. Petersons Field Guide: Atlantic Coast Fishes. Boston, Houton Mifflin Company. 354 pp.

Sogard, S. M. and K. W. Able. 1990. A comparison of eelgrass, sea lettuce macroalgae, and marsh creeks as habitats for epibenthic fishes and decapods. *Estuarine, Coastal and Shelf Science.* 33:501-519.

Stoner, A. W., and R. J. Livingston. 1980. Distributional ecology and food habits of the banded blenny *Paraclinus fasciatus* (Clinidae): a resident in a mobile habitat. *Marine Biology*. 56:239-246.

Strobel, Charles J., Henry W. Buffum , Sandra J. Benyi ., Elise A. Petrocelli., Daniel R. Reifsteck, and Darryl J. Keith. 1995. Statistical Summary: EMAP-Estuaries Virginian Provence-1990-1993 U.S. Environmental Protection Agency, National Health and Environmental Effects Research Laboratory, Atlantic Ecology Division, Narragansett, RI. EPA/620/R-94/026.

Sze, Philip.1998. A biology of Algae 3rd edition. McGraw-Hill. Boston.

Timmons, M. and K.S. Price. 1996. The macroalgae and associated fauna of Rehoboth and Indian River Bays, Delaware. *Botanica Marina* 39:231-238.

Tyler, R. M. 2010. Seaweed distribution and abundance in the inland bays. Delaware Department of Natural Resources and Environmental Control. FY09 Research and Demonstration Project. Dover, DE.

Wazniak, Catherine, Darlene Wells, and Matthew Hall. 2004. Maryland's Coastal Bays: Ecosystem Health Assessment. Pages 9-20 *in* Chapter 1.2: The Maryland Coastal Bays ecosystem. Maryland Department of Natural Resources, Document Number DNR-12-1 02-0009.

Wazniak, Catherine, David Goshorn, Matthew Hall, David Blazer, Roman Jesien, David Wilson, Carol Cain, William Dennison, Jane Thomas, Tim Carruthers, Brian Sturgis. 2004. State of the Maryland Coastal Bays. Maryland Department of Natural Resources. Maryland Coastal Bays Program. University of Maryland Center for Environmental Science, Integration and Application Network.

Wilson, K. A., K. W. Able and K. L. Heck, Jr. 1990. Predation rates on juvenile blue crabs in estuarine nursery habitats: evidence for the importance of macroalgae (*Ulva lactuca*). *Marine Ecology Progress Series*. 58:243-251.

Wyneken, Jeanette. 2001. Sea Turtle Anatomy: Standard Measurements. Available: http://courses.science.fau.edu/~jwyneken/sta/SeaTurtleAnatomy-Standard_Measurements.pdf.

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Table 1. MDNR Coastal Bays Fisheries Investigation trawl site descriptions.

Site Number	Bay	Site Description	Longitude	Latitude
T001	Assawoman Bay	On a line from Corn Hammock to Fenwick Ditch	38 26.243	75 04.747
T002	Assawoman Bay	Grey's Creek (mid creek)	38 25.859	75 06.108
T003	Assawoman Bay	Assawoman Bay (mid-bay)	38 23.919	75 05.429
T004	Isle of Wight Bay	St. Martin's River, mouth	38 23.527	75 07.327
T005	Isle of Wight Bay	St. Martin's River, in lower Shingle Ldg. Prong	38 24.425	75 10.514
T006	Isle of Wight Bay	Turville Creek, below the race track	38 21.291	75 08.781
T007	Isle of Wight Bay	mid-Isle of Wight Bay, N. of the shoals in bay (False Channel)	38 22.357	75 05.776
T008	Sinepuxent Bay	#2 day marker, S. for 6 minutes (North end of Sinepuxent Bay)	38 19.418	75 06.018
T009	Sinepuxent Bay	#14 day marker, S. for 6 minutes (Sinepuxent Bay N. of Snug Harbor)	38 17.852	75 07.310
T010	Sinepuxent Bay	#20 day marker, S. for 6 minutes (0.5 mile S. of the Assateague Is. Bridge)	38 14.506	75 09.301
T011	Chincoteague Bay	Newport Bay, across mouth	38 13.024	75 12.396
T012	Chincoteague Bay	Newport Bay, opp. Gibbs Pond to Buddy Pond, in marsh cut	38 15.281	75 11.603
T013	Chincoteague Bay	Between #37 & #39 day marker	38 10.213	75 13.989
T014	Chincoteague Bay	1 mile off village of Public Landing	38 08.447	75 16.043
T015	Chincoteague Bay	Inlet Slough in Assateague Is. (AKA Jim's Gut)	38 06.370	75 12.454
T016	Chincoteague Bay	300 yds off E. end of Great Bay Marsh, W. of day marker (a.k.a. S. of #20 day marker)	38 04.545	75 17.025
T017	Chincoteague Bay	Striking Marsh, S. end about 200 yds	38 03.140	75 16.116
T018	Chincoteague Bay	Boxiron (Brockatonorton) Bay (mid-bay)	38 05.257	75 19.494
T019	Chincoteague Bay	Parker Bay, N end.	38 03.125	75 21.110
T020	Chincoteague Bay	Parallel to and just N. of the MD/VA line, at channel	38 01.328	75 20.057

Table 2. MDNR Coastal Bays Fisheries Investigation beach seine site descriptions.

Site Number	Bay	Site Description	Latitude	Longitude
S001	Assawoman Bay	Cove behind Ocean City Sewage Treatment Plant, 62nd St.	38 23.273	75 04.380
S002	Assawoman Bay	Bayside of marsh at Devil's Island, 95th St.	38 24.749	75 04.264
S003	Assawoman Bay	Small cove, E. side, small sand beach; Sandspit, bayside of Goose Pond	38 24.824	75 06.044
S004	Isle of Wight Bay	N. side, Skimmer Island (AKA NW side, Ocean City Flats)	38 20.259	75 05.299
S005	Isle of Wight Bay	Beach on sandspit N. of Cape Isle of Wight (AKA in cove on marsh spit, E. and S. of mouth of Turville Creek)	38 21.928	75 07.017
S006	Isle of Wight Bay	Beach on W. side of Isle of Wight, St. Martins River (AKA Marshy Cove, W. side of Isle of Wight, N. of Rt. 90 Bridge)	38 23.627	75 06.797
S007	Isle of Wight Bay	Beach, 50th St. (next to Seacrets)	38 22.557	75 04.301
S008	Sinepuxent Bay	Sandy beach, NE side, Assateague Is. Bridge at Nat'l. Seashore	38 14.554	75 08.581
S009	Sinepuxent Bay	Sand beach1/2 mile S. of Inlet on Assateague Island,	38 19.132	75 06.174
S010	Sinepuxent Bay	Grays Cove, in small cove on N. side of Assateague Pointe development's fishing pier	38 17.367	75 07.977
S011	Chincoteague Bay	Cove, 800 yds NW. of Island Pt.	38 13.227	75 12.054
S012	Chincoteague Bay	Beach N. of Handy's Hammock (AKA N. side, mouth of Waterworks Cr.)	38 12.579	75 14.921
S013	Chincoteague Bay	Cove at the mouth of Scarboro Cr.	38 09.340	75 16.426
S014	Chincoteague Bay	SE of the entrance to Inlet Slew	38 08.617	75 11.105
S015	Chincoteague Bay	Narrow sand beach, S. of Figgs Ldg.	38 07.000	75 17.578
S016	Chincoteague Bay	Cove, E. end, Great Bay Marsh (AKA Big Bay Marsh)	38 04.482	75 17.597
S017	Chincoteague Bay	Beach, S. of Riley Cove in Purnell Bay	38 02.162	75 22.190
S018	Chincoteague Bay	Cedar Is., S. side, off Assateague Is.	38 02.038	75 16.619
S019	Chincoteague Bay	Land site - Ayers Cr. At Sinepuxent Rd.	38 18.774	75 09.414

Table 3. Measurement types for fishes and invertebrates captured during the 2013 Coastal Bays Fisheries Investigation Trawl and Beach Seine Survey.

Species	Measurement Type
Finfishes (most species)	Total length
Sharks	Total length
Rays and Skates	Wing span
Crabs	Carapace width
Shrimp	Rostrum to telson
Whelks	Tip of spire to anterior tip of the body whorl
Squid	Mantle length
Horseshoe Crabs	Prosomal width
Turtles	Carapace length

Table 4. List of fishes collected in Maryland's Coastal Bays Trawl (T) and Beach Seine (S) Surveys from April through October, 2013. Species are listed by order of total abundance. Total trawl sites = 140, total seine sites = 38.

Common Name	Scientific Name	Total Number Collected	Number Collected (T)	Number Collected (S)	CPUE (T) #/Hect.	CPUE (S) #/Haul
Bay Anchovy	*Anchoa mitchilli*	13,182	11,589	1,593	660.0	41.9
Atlantic Silverside	*Menidia menidia*	2,272	543	1,729	30.9	45.5
Atlantic Menhaden	*Brevoortia tyrannus*	2,078	49	2,029	2.8	53.4
Summer Flounder	*Paralichthys dentatus*	748	596	152	33.9	4.0
Silver Perch	*Bairdiella chrysoura*	402	183	219	10.4	5.8
Winter Flounder	*Pseudopleuronectes americanus*	391	46	345	2.6	9.1
Weakfish	*Cynoscion regalis*	337	336	1	19.1	<0.1
Pinfish	*Lagodon rhomboides*	294	2	292	0.1	7.7
Spot	*Leiostomus xanthurus*	278	90	188	5.1	4.9
Alewife	*Alosa pseudoharengus*	214	213	1	12.1	<0.1
Hogchoker	*Trinectes maculatus*	206	126	80	7.2	2.1
Mummichog	*Fundulus heteroclitus*	179	20	159	1.1	4.2
Bluegill	*Lepomis macrochirus*	175		175		4.6
Atlantic Croaker	*Micropogonias undulatus*	146	141	5	8.0	0.1
White Mullet	*Mugil curema*	100		100		2.6
Striped Killifish	*Fundulus majalis*	63		63		1.6
Striped Anchovy	*Anchoa hepsetus*	57	13	44	0.7	1.1
Black Sea Bass	*Centropristis striata*	56	47	9	2.7	0.2
Southern Kingfish	*Menticirrhus americanus*	45	11	34	0.6	0.9
Golden Shiner	*Notemigonus crysoleucas*	43		43		1.1
Smallmouth Flounder	*Etropus microstomus*	42	28	14	1.6	0.4
Common Carp	*Cyprinus carpio*	41		41		1.1
Oyster Toadfish	*Opsanus tau*	34	13	21	0.7	0.6
American Eel	*Anguilla rostrata*	31	11	20	0.6	0.5
Striped Mullet	*Mugil cephalus*	28		28		0.7
Dusky Pipefish	*Syngnathus floridae*	27	12	15	0.7	0.4
Pumpkinseed	*Lepomis gibbosus*	27		27		0.7
Bluefish	*Pomatomus saltatrix*	23	1	22	0.1	0.6
Naked Goby	*Gobiosoma bosc*	22	8	14	0.5	0.4
Northern Pipefish	*Syngnathus fuscus*	21	11	10	0.6	0.3
Striped Blenny	*Chasmodes bosquianus*	17		17		0.4
Northern Searobin	*Prionotus carolinus*	15	15		0.9	
Southern Stingray	*Dasyatis americana*	15	2	13	0.1	0.3
Striped Burrfish	*Chilomycterus schoepfii*	15	13	2	0.7	<0.1
Gizzard Shad	*Dorosoma cepedianum*	14	3	11	0.2	0.3
Lookdown	*Selene vomer*	14	14		0.8	
Atlantic Needlefish	*Strongylura marina*	13		13		0.3

Table 4. List of fishes collected in Maryland's Coastal Bays Trawl (T) and Beach Seine (S) Surveys from April through October, 2013. Species are listed by order of total abundance. Total trawl sites = 140, total seine sites = 38.

Common Name	Scientific Name	Total Number Collected	Number Collected (T)	Number Collected (S)	CPUE (T) #/Hect.	CPUE (S) #/Haul
Black Drum	*Pogonias cromis*	13	3	10	0.2	0.3
Halfbeak	*Hyporhamphus unifasciatus*	13		13		0.3
Northern Puffer	*Sphoeroides maculatus*	13	10	3	0.6	<0.1
Lined Seahorse	*Hippocampus erectus*	12	11	1	0.6	<0.1
Red Drum	*Sciaenops ocellatus*	11		11		0.3
Atlantic Herring	*Clupea harengus harengus*	10		10		0.3
Green Goby	*Microgobius thalassinus*	10	10		0.6	
Largemouth bass	*Micropterus salmoides*	10		10		0.3
Spotted Hake	*Urophycis regia*	10	10		0.6	
Spotted Seatrout	*Cynoscion nebulosus*	9		9		0.2
Brown Bullhead	*Ameiurus nebulosus*	8		8		0.2
Pigfish	*Orthopristis chrysoptera*	8	1	7	0.1	0.2
Inshore Lizardfish	*Synodus foetens*	6	6		0.3	
Sheepshead	*Archosargus probatocephalus*	6		6		0.2
Blackcheek Tonguefish	*Symphurus plagiusa*	5	3	2	0.2	<0.1
Fourspine Stickleback	*Apeltes quadracus*	5	5		0.3	
Gag	*Mycteroperca microlepis*	4	2	2	0.1	<0.1
Rainwater Killifish	*Lucania parva*	4	1	3	0.1	<0.1
Striped Bass	*Morone saxatilis*	4		4		0.1
Rough Silverside	*Membras martinica*	3		3		<0.1
Butterfish	*Peprilus triacanthus*	2	2		0.1	
Clearnose Skate	*Raja eglanteria*	2	2		0.1	
Planehead Filefish	*Stephanolepis hispida*	2	1	1	0.1	<0.1
Scup	*Stenotomus chrysops*	2	2		0.1	
Striped Searobin	*Prionotus evolans*	2	2		0.1	
American Shad	*Alosa sapidissima*	1		1		<0.1
Banded Killifish	*Fundulus diaphanus*	1		1		<0.1
Bluespotted Cornetfish	*Fistularia tabacaria*	1	1		0.1	
Cownose Ray	*Rhinoptera bonasus*	1		1		<0.1
Crevalle Jack	*Caranx hippos*	1		1		<0.1
Feather Blenny	*Hypsoblennius hentz*	1	1		0.1	
Mosquitofish	*Gambusia affinis*	1		1		<0.1
Northern Kingfish	*Menticirrhus saxatilis*	1	1		0.1	
Sheepshead Minnow	*Cyprinodon variegatus*	1		1		<0.1
Striped Cusk-eel	*Ophidion marginatum*	1	1		0.1	
Tautog	*Tautoga onitis*	1		1		<0.1
Unknown Juvenile Fish	*Unknown Juvenile Fish*	1	1		0.1	

Table 4. List of fishes collected in Maryland's Coastal Bays Trawl (T) and Beach Seine (S) Surveys from April through October, 2013. Species are listed by order of total abundance. Total trawl sites = 140, total seine sites = 38.

Common Name	Scientific Name	Total Number Collected	Number Collected (T)	Number Collected (S)	CPUE (T) #/Hect.	CPUE (S) #/Haul
White Perch	*Morone americana*	1		1		<0.1
Windowpane	*Scophthalmus aquosus*	1	1		0.1	
	Total Finfish	**21,853**	**14,213**	**7,640**		

Table 5. List of crustaceans collected in Maryland's Coastal Bays Trawl (T) and Beach Seine (S) Surveys from April through October, 2013. Species are listed by order of total abundance. Total trawl sites = 140, total seine sites = 38.

Common Name	Scientific Name	Total Number Collected	Number Collected (T)	Number Collected (S)	Estimated Count (T)	Estimated Count (S)	CPUE (T) #/Hect.	CPUE (S) #Haul
Grass Shrimp	*Palaemonetes sp.*	2,830	32	22	436	2,340	26.6	62.1
Blue Crab	*Callinectes sapidus*	2,787	2,145	642			122.2	16.9
Sand Shrimp	*Crangon septemspinosa*	1,528	97	1	1,340	90	81.8	2.4
Lady Crab	*Ovalipes ocellatus*	709	57	652			3.2	17.1
Say Mud Crab	*Dyspanopeus sayi*	122	114	8			6.5	0.2
Long-armed Hermit Crab	*Pagurus longicarpus*	119	85	34			4.8	0.9
Barnacles	*Cirripedia*	92		2	90		5.1	<0.1
White Shrimp	*Litopenaeus setiferus*	58	52	6			3.0	0.2
Mantis Shrimp	*Squilla empusa*	18	18				1.0	
Brown Shrimp	*Farfantepenaeus aztecus*	8	7	1			0.4	<0.1
Bigclaw Snapping Shrimp	*Alpheus heterochaelis*	3	2	1			0.1	<0.1
Atlantic Rock Crab	*Cancer irroratus*	2	1	1			0.1	<0.1
Flatclaw Hermit	*Pagurus pollicaris*	1	1				0.1	
Mud Crab	*Panopeus sp.*	1	1				0.1	
Portly Spider Crab	*Libinia emarginata*	1		1				<0.1
	Total Crustaceans	**8,279**	**2,612**	**1,371**	**1,866**	**2,430**		

Table 6. List of molluscs collected in Maryland's Coastal Bays Trawl (T) and Beach Seine (S) Surveys from April through October, 2013. Species are listed by order of total abundance. Total trawl sites = 140, total seine sites = 38.

Common Name	Scientific Name	Total Number Collected	No. Collect (T)	No. Collect (S)	Est. Cnt. (T)	Est. Cnt. (S)	Spec. Vol. (L) (T)	Spec. Vol. (L) (S)	Est. Vol. (L) (T)	Est. Vol. (L) (S)	CPUE (T) #/Hect.	CPUE (S) #Haul	CPUE Vol. (T) #/Hect	CPUE Vol. (S) #/Haul
Blue Mussel	*Mytilus edulis*	650			350	300					19.9	7.9		
Solitary Glassy Bubble Snail	*Haminoea solitaria*	272	2		270						15.5			
Eastern Mudsnail	*Nassarius obsoletus*	192		62		130						5.0		
Bruised Nassa	*Nassarius vibex*	134	7	27		100					0.4	3.3		
Atlantic Brief Squid	*Lolliguncula brevis*	33	33								1.9			
Convex Slippersnail	*Crepidula convexa*	25				25						0.7		
Thick-lip Drill	*Eupleura caudata*	5	5								0.3			
Dwarf Surfclam	*Mulinia lateralis*	4	4								0.2			
Lemon Drop	*Doriopsilla pharpa*	4	4								0.2			
Northern Quahog	*Mercenaria mercenaria*	3		3								<0.1		
Atlantic Oyster Drill	*Urosalpinx cinerea*	2	2								0.1			
Stout Tagelus	*Tagelus plebeius*	2	2								0.1			
Striped Nudibranch	*Cratena pilata*	2	2								0.1			
Atlantic Jackknife	*Ensis directus*	1	1								0.1			
Baltic Macoma	*Macoma balthica*	1	1								0.1			
Bivalves	*Heterodonta*	1	1								0.1			
Eastern Oyster	*Crassostrea virginica*	1	1								0.1			
Green Jackknife	*Solen viridis*	1	1								0.1			
Knobbed Whelk	*Busycon carica*	1		1								<0.1		
Marsh Periwinkle	*Littorina irrorata*	1		1								<0.1		
	Total Molluscs	**1,335**	**66**	**94**	**620**	**555**								

Table 7. List of other species collected in Maryland's Coastal Bays Trawl (T) and Beach Seine (S) Surveys from April through October, 2013. Species are listed by order of total abundance. Total trawl sites = 140, total seine sites = 38.

Common Name	Scientific Name	Total Number Collected	No. Collect (T)	No. Collect (S)	Est. Cnt. (T)	Est. Cnt. (S)	Spec. Vol. (L) (T)	Spec. Vol. (L) (S)	Est. Vol. (L) (T)	Est. Vol. (L) (S)	CPUE (T) #/Hect.	CPUE (S) #/Haul	CPUE (T) #/Hect.Vol.	CPUE (S) #/Haul Vol.
Sea Squirt	*Molgula manhattensis*	1,933	3		1,745	185	19.3				99.5	4.9	1.1	
Sea Nettle	*Chrysaora quinquecirrha*	325	249	9	67		22.3				18.0	0.2	1.3	
Moon Jelly	*Aurelia aurita*	249	198	51			1.5		50.0		11.3	1.3	2.9	
Hairy Sea Cucumber	*Sclerodactyla briareus*	204	203	1							11.6	<0.1		
Serpulid Worms	*Hydroides dianthus*	100	100				8.0				5.7		0.5	
Horseshoe Crab	*Limulus polyphemus*	43	31	12							1.8	0.3		
Comb Jellies	*Ctenophora*	41	16		25		331.8	15.6	11.8	0.8	2.3		19.6	0.4
Northern Diamondback Terrapin	*Malaclemys terrapin terrapin*	18	12	6							0.7	0.2		
Sand Dollar	*Echinarachnius parma*	3	3								0.2			
Lion's Mane	*Cyanea capillata*	1	1								0.1			
Unknown Cnidarian	*Unknown Cnidarian*	1	1								0.1			
White Anemone	*Diadumene leucolena*	1	1								0.1			
Forbes' Asterias	*Asterias forbesi*	1	1								0.1			
Bryozoans	*Ectoprocta*	1	1				98.2	40.6			0.1		5.6	1.1
Goldstar Tunicate	*Botryllus schlosseri*						2.9	5.4					0.2	0.1
Sea Pork	*Aplidium sp.*						36.2	1.7					2.1	<0.1
Rubbery Bryozoan	*Alcyonidium sp.*						12.4	8.6					0.7	0.2
Fig Sponge	*Suberites ficus*						24.0						1.4	
Halichondria Sponge	*Halichondria sp.*						36.9	14.1					2.1	0.4
Red Beard Sponge	*Microciona prolifera*						58.4	0.6					3.3	<0.1
Sulphur Sponge	*Cliona celata*						199.2						11.3	
	Total Other	**2,921**	**820**	**79**	**1,837**	**185.0**	**850.9**	**86.6**	**61.8**	**0.8**				

Table 8. List of Submerged Aquatic Vegetation (SAV) and macroalgae collected in Maryland's Coastal Bays Trawl (T) and Beach Seine (S) Surveys from April through October, 2013. Species are listed by order of total abundance. Total trawl sites = 140, total seine sites = 38.

Common Name	Genus	Specific Volume (L) (T)	Specific Volume (L) (S)	Estimated Volume (L) (T)	Estimated Volume (L) (S)
SAV					
Eel Grass	*Zostera*	25.0	16.7		
Widgeongrass	*Ruppia*	0.1	0.1		
	Total SAV	**25.1**	**16.8**		
Macroalgae					
Brown					
Common Southern Kelp	*Laminaria*	0.7		<0.1	
Sour Weeds	*Desmarestia*	0.6			
Brown Bubble Algae	*Colpomenia*	0.1			
Rockweed	*Fucus*	0			
		1.4		**<0.1**	
Green					
Sea Lettuce	*Ulva*	222.5	76.0	<0.1	
Green Hair Algae	*Chaetomorpha*	179.1	162.2		
Green Tufted Seaweed	*Cladophora*	9.5	2.5		
Hollow Green Weed	*Enteromorpha*	8.3	66.7		
Green Fleece	*Codium*	7.1	17.9		
Green Sea Fern	*Bryopsis*	1.1	2.0		
		427.6	**327.3**	**<0.1**	
Red					
Agardh's Red Weed	*Agardhiella*	463.9	1,132.3		
Tubed Weeds	*Polysiphonia*	214.7	375.7		
Banded Weeds	*Ceramium*	37.0	3.3		
Graceful Red Weed	*Gracilaria*	9.2	4.1		
Hairy Basket Weed	*Spyridia*	8.7	59.9		
Barrel Weed	*Champia*	2.7	6.9	<0.1	
		736.2	**1,582.3**	**<0.1**	
Yellow-Green					
Water Felt	*Vaucheria*	107.3	64.1		
		107.3	**64.1**		
	Total Macroalgae	**1,272.5**	**1,973.7**	**<0.1**	

Table 9. Coastal Bays Fisheries Investigations 2013 Primary and Secondary Trawl Species Site Preferences Based on Duncan's General Linear Model Procedure, sampled sites = 140/year.

	Assawoman Bay			**St. Martins River**		**Isle of Wight**		**Sinepuxent Bay**			**Newport Bay**		**Chincoteague Bay**							
	T001	T002	T003	T004	T005	T006	T007	T008	T009	T010	T011	T012	T013	T014	T015	T016	T017	T018	T019	T020
American Eel																1				
Atlantic Croaker	2	2	2	1	2	2			2			2		2						2
Atlantic Menhaden					1	1					2	2							2	
Atlantic Silverside																				
Bay Anchovy	2	2	2	2	2	2	1	2	2	2	2	2	2	1	2	2	2	2	2	2
Black Sea Bass	2		1				1	2	2	2							2			2
Bluefish						1														
Pinfish					1															
Silver Perch		2		2	2	1					2									
Spot	2	2	2	2	2	2	2	2			2	1	2	2	2	2				
Summer Flounder	1	1	1	1	1	1	1				1	1	1	1	1	1	1	1	1	2
Tautog																				
Weakfish	2	1	2	2	2															
Winter Flounder	2	2	2	2	2		1	2	2				2					2		

Table 10. Coastal Bays Fisheries Investigations 2013 Primary and Secondary Seine Species Site Preferences Based on Duncan's General Linear Model Procedure, sampled sites = 38/year.

	Assawoman Bay			**Isle of Wight**		**St. Martins River**	**IOW**	**Sinepuxent Bay**			**Newport Bay**		**Chincoteague Bay**						**Drainage Ditch**
	S001	S002	S003	S004	S005	S006	S007	S008	S009	S010	S011	S012	S013	S014	S015	S016	S017	S018	S019
American Eel	1						2					2							
Atlantic Croaker																			
Atlantic Menhaden																			
Atlantic Silverside	2	2	2		2	2	2	1	2	2	2	2	2	2	2	2	2	2	2
Bay Anchovy	2	2	2		2	2			2	2		1	2	2	1	1	1	2	
Black Sea Bass	2				1														
Bluefish	2				2	2		2	2			1		2		2	2	2	
Pinfish	2	2	2			2	2	2		1	2	2		2					
Silver Perch																			
Spot	2		1	2	2	2	2	1	2	1	1	2	1	2	2	1	2		
Summer Flounder		2	2	2	2			2	2	2		2	2	2	1		2		
Tautog										1									
Weakfish			1																
Winter Flounder																			

Table 11. Summary of Maryland recreational fishing regulations for 2013.

Species	Area	Minimum Size Limit (inches)	Creel (person/day)	Season
American Eel	A	6	25	Open Year Round
Atlantic Croaker	A	9	25	Open Year Round
Black Sea Bass	A	12.5	20	May 20 thru Oct. 14 Nov. 1 thru Dec. 31
Black Drum	A	16	1 6/boat	Open Year Round
Bluefish	A	8	10	Open Year Round
Red Drum	A	18 to 27	1	Open Year Round
Spotted Seatrout	A	14	10	Open Year Round
Summer Flounder	A	16	4	March 28 thru December 31
Tautog	A	16	4	January 1 thru May 15 and Nov. 1 thru Nov. 26
			2	May 16 thru Oct. 31
Weakfish	A	13	1	Open Year Round

A- Includes Atlantic Ocean, Coastal Bays, Chesapeake Bay, & all tributaries

Table 12. Summary of Maryland commercial fishing regulations for 2013.

Species	Area	Size (inches) gear	Commercial Season, Days, Times, & Area Restrictions	Quota/Creel/Special Conditions/Comments
American Eel	A	6	Open Year Round Mon-Sun	25/person/day if <6” No limit for over 6” If pot mesh < ½” x ½”, escape panel required
Atlantic Croaker	A	9 Seine, Trotline, Pot, Trap, Net, Hook & Line	Mar 16-Dec 31	Closed Jan 1-Mar 15
Atlantic Menhaden	A	None Gill Net, Pound Net, Fyke Net, Hoop Net, Fish Pot	Jan/1 - Jun/28	
Atlantic Menhaden	A	None Gill Net, Pound Net, Fyke Net, Hoop Net, Fish Pot	Closed Jun/29 Bycatch provisions in effect afterwards	1) For commercial licensees not in possession of an Atlantic Menhaden Bycatch Allowance Landing Permit: 1,500 pounds per vessel per day. 2) For commercial licensees in possession of an Atlantic Menhaden Bycatch Allowance Landing Permit issued in their name who have not been issued a Striped Bass pound net permit, or have been issued one Striped Bass pound net permit: 6,000 pounds per permittee per day. 3) For commercial licensees in possession of an Atlantic Menhaden Bycatch Allowance Landing Permit issued in their name who have also been issued two or more Striped Bass pound net permits: 12,000 pounds per permittee per day. Permittees must be in possession of both their Atlantic Menhaden Bycatch Allowance Landing Permit and their multiple Striped Bass pound net permits in order to take this amount of menhaden. 4) For vessels with permits on board, regardless of the number of permits, there is a 12,000 pound per vessel per day landing limit.
Black Sea Bass	A	11 Trawl, Pot, Trap Chesapeake Bay-No Trawl	Open Year Round	Quotas by permit Without permit 50 lbs
Black Drum	A	16 Hook, Line, Net, Pot, Trap, Trotline, Seine	No commercial harvest in Chesapeake Bay. Open Year Round	1,500 lbs. May only land Black Drum from waters of the Atlantic Ocean, not including Coastal Bays
Bluefish	A	8 Hook & Line, Pot, Trotline, Net	Open Year Round	Commercial quota of 272,000 lbs

Table 12 (con't). Summary of Maryland commercial fishing regulations for 2013.

Species	Area	Size (inches) gear	Commercial Season, Days, Times, & Area Restrictions	Quota/Creel/Special Conditions/Comments
Summer Flounder	C	14 Net, Pot, Trap, Trotline, Seine 16 Hook&Line	Open Year Round Mon through Sun	Quotas by permit. Without a Permit: 100 lbs/person/day
Summer Flounder	B	14 Net, Pot, Trap, Trotline, Seine 16 Hook&Line	Open Year Round Mon through Sun	Quotas by permit. Without a Permit: 50 lbs/person/day
Tautog	A	16 Hook&Line, Net, Pot, Trap, Trotline, Seine	Jan 1 - May 15 & Nov 1 – Nov 26 Mon through Sun	4 fish; A pot and trap shall have hinges on one panel/door made of untreated hemp or jute string 3/16" diameter or smaller, magnesium alloy fasteners or ungalvinized/uncoated iron wire of 0.094" diameter.
Tautog	A	16 Hook&Line, Net, Pot, Trap, Trotline, Seine	May 16 – Oct 31 Mon through Sun	2 fish; A pot and trap shall have hinges on one panel/door made of untreated hemp or jute string 3/16" diameter or smaller, magnesium alloy fasteners or ungalvinized/uncoated iron wire of 0.094" diameter.
Weakfish	B	12 Hook & Line	Aug. 1 thru Sep. 30 50 lbs./day or trip-whichever is longer. No bycatch allowed outside season.	
Weakfish	B	12 Pot, Trap, Seine, Trotline	Year Round 50 lbs./day or trip-whichever is longer.	The weight of the catch of the other species on board the vessel cannot be exceeded by weight of weakfish. Trawl mesh min. 3-3/8 inches square or 3-3/4 inches diamond stretched mesh Gill net mesh min. 3" stretched.
Weakfish	C	12 Trawl, Net, Pot, Trap, Trotline, Seine	Year Round (Monday - Friday) 100 lbs./day or trip-whichever is longer.	The weight of the catch of the other species on board the vessel cannot be exceeded by weight of weakfish. Trawl mesh min. 3-3/8 inches square or 3-3/4 inches diamond stretched mesh Gill net mesh min. 3" stretched Harvest with hook & line prohibited

A- Includes Atlantic Ocean, Coastal Bays, Chesapeake Bay, & all tributaries

B- Includes Chesapeake Bay & all tributaries

C- Includes Atlantic Ocean & Coastal Bay

Table 13. Macroalgae and Submerged Aquatic Vegetation percent frequency of positive hauls from 2006-2013 by the Coastal Bays Fisheries Investigation Trawl Survey.

Specimen Name	**Year**							
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
Agardh's Red Weed *(Agardhiella tenera)*	0.11	0.34	0.29	0.58	0.68	0.66	0.74	0.79
Banded Weeds *(Ceramium sp.)*	0.04	0.14	0.13	0.11	0.02	0.05	0.16	0.09
Barrel Weed *(Champia sp.)*	0.09	0.03	0.19	0.01	0.06	0.07	0.14	0.06
Brown Bubble Algae *(Colpomenia sinuosa)*							0.04	0.01
Common Southern Kelp *(Laminaria agardhii)*					0.01	0.04	0.01	0.03
Ectocarpus Genus *(Ectocarpus sp.)*			0.01					
Eel Grass *(Zostera marina)*	0.06	0.11	0.06	0.33	0.35	0.31	0.46	0.31
Enteromorpha intestinalis		0.01			0.03			
Graceful Red Weed *(Gracilaria sp.)*	0.51	0.33	0.53	0.23	0.22	0.31	0.17	0.02
Green Fleece *(Codium fragile)*	0.01	0.04	0.14	0.11	0.03	0.06	0.12	0.08
Green Hair Algae *(Chaetomorpha sp.)*	0.08	0.04	0.11	0.22	0.18	0.08	0.01	0.12
Green Sea Fern *(Bryopsis sp.)*						0.01		0.01
Green Tufted Seaweed *(Cladophora sp.)*	0.06	0.01	0.03	0.01		0.01	0.09	0.04
Hairy Basket Weed *(Spyridia sp.)*				0.03	0.01	0.06	0.04	0.01
Hollow Green Weed *(Enteromorpha sp.)*	0.01	0.03	0.05	0.08	0.02	0.10	0.11	0.11
Hooked Red Weed *(Hypnea sp.)*			0.01			0.01	0.01	
Rockweed *(Fucus sp.)*	0.01	0.01	0.01	0.01	0.01			0.01
Sea Lettuce *(Ulva sp.)*	0.31	0.38	0.61	0.67	0.53	0.60	0.52	0.69
Slurry *(Decaying Macroalgae)*				0.06	0.01			
Sour Weeds *(Desmarestia)*		0.01	0.07	0.01		0.04	0.01	0.01
Tubed Weeds *(Polysiphonia sp.)*	0.02	0.09	0.01	0.04	0.13	0.19	0.18	0.30
Unknown Macroalgae		0.01				0.02	0.01	
Water Felt *(Vaucheria sp.)*			0.02	0.11	0.11	0.11	0.23	0.15
Widgeongrass *(Ruppia maritima)*		0.01		0.10	0.14	0.08	0.06	0.02

Table 14. Macroalgae and Submerged Aquatic Vegetation percent frequency of positive hauls from 2006-2013 by the Coastal Bays Fisheries Investigation Beach Seine Survey.

Specimen Name	**Year**							
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
Agardh's Red Weed *(Agardhiella tenera)*	0.03	0.37	0.29	0.63	0.58	0.66	0.79	0.89
Banded Weeds *(Ceramium sp.)*	0.10	0.08	0.08	0.08		0.11	0.03	0.03
Barrel Weed *(Champia sp.)*		0.03	0.08	0.08	0.03	0.13	0.05	0.03
Brittlewort *(Nitella sp.)*				0.03				
Ectocarpus Genus *(Ectocarpus sp.)*			0.03					
Eel Grass *(Zostera marina)*	0.18	0.32	0.39	0.55	0.61	0.42	0.61	0.45
Enteromorpha intestinalis			0.03		0.16			
Graceful Red Weed *(Gracilaria sp.)*	0.38	0.21	0.55	0.26	0.29	0.26	0.08	0.05
Green Fleece *(Codium fragile)*	0.05	0.03	0.03	0.13		0.08	0.11	0.13
Green Hair Algae *(Chaetomorpha sp.)*	0.03		0.11	0.11	0.08	0.13	0.05	0.18
Green Sea Fern *(Bryopsis sp.)*				0.03				0.03
Green Tufted Seaweed *(Cladophora sp.)*	0.05	0.05	0.03	0.05	0.05	0.03	0.03	0.05
Hairy Basket Weed *(Spyridia sp.)*				0.03	0.05	0.18	0.03	0.11
Hollow Green Weed *(Enteromorpha sp.)*	0.15	0.05	0.13	0.11		0.16	0.11	0.11
Hooked Red Weed *(Hypnea sp.)*			0.03					
Rockweed (*Fucus sp*.)	0.03	0.03	0.03					
Sea Lettuce (*Ulva sp*.)	0.10	0.24	0.45	0.37	0.45	0.32	0.42	0.47
Slurry (Decaying Macroalgae)					0.05			
Sour Weeds (*Desmarestia*)			0.05			0.03	0.03	
Tubed Weeds (*Polysiphonia sp.*)	0.05	0.05	0.03	0.05	0.05	0.13	0.34	0.32
Unknown Macroalgae						0.08		0.00
Water Felt (*Vaucheria sp.*)			0.05	0.11	0.08	0.13	0.26	0.18
Widgeongrass (*Ruppia maritima*)		0.05	0.13	0.26	0.32	0.32	0.37	0.03

Table 15. Macroalgae and Submerged Aquatic Vegetation Total Volume (Liters) from 2006-2013 by the Coastal Bays Fisheries Investigation Trawl Survey, (n=140 per year).

Specimen Name	**Year**								
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**Total**
Agardh's Red Weed *(Agardhiella tenera)*	170.7	468.0	2,073	2,938	3,217	1,585	951.5	463.9	11,866
Banded Weeds *(Ceramium sp.)*	3.2	17.0	40.1	20.3	2.1	19.8	47.6	37.0	187
Barrel Weed *(Champia sp.)*	38.3	16.6	260.1	47.7	5.8	36.4	27.3	2.7	435
Brown Bubble Algae *(Colpomenia sinuos)*							0.8	0.1	1
Common Southern Kelp *(Laminaria agardhii)*						11.8	0.1	0.7	13
Eel Grass *(Zostera marina)*	5.8	4.8	54.0	132.3	95.1	13.2	23.6	25.0	354
Enteromorpha intestinalis									4
Graceful Red Weed *(Gracilaria sp.)*	663.8	462.7	2,882	339.8	725.9	1,697	1,205	9.2	7,986
Green Fleece *(Codium fragile)*		3.8	13.2	11.8	1.6	3.8	27.0	7.1	68
Green Hair Algae *(Chaetomorpha sp.)*	15.9	20.6	77.0	432.2	262.4	46.7	1.1	179.1	1,035
Green Sea Fern *(Bryopsis sp.)*						0.2		1.1	1
Green Tufted Seaweed *(Cladophora sp.)*	13.8	1.1	18.7			9.2	146.0	9.5	198
Hairy Basket Weed *(Spyridia sp.)*				5.3	3.3	4.2	51.4	8.7	73
Hollow Green Weed *(Enteromorpha sp.)*	0.5	6.0	44.0	19.0	16.0	16.8	88.8	8.3	199
Hooked Red Weed *(Hypnea sp.)*			0.6			1.4	0.5		2
Rockweed (*Fucus sp.*)	0.1	0.3		2.4	1.7				5
Sea Lettuce (*Ulva sp.*)	79.0	199.9	754.7	718.1	274.4	282.0	112.2	222.5	2,643
Slurry (Decaying Macroalgae)				137.2	1.6				139
Sour Weeds (*Desmarestia*)		0.1	172.2			42.3	0.6	0.6	216
Tubed Weeds (*Polysiphonia sp.*)	1.7	263.0	0.2	12.2	31.5	147.9	546.6	214.7	1,218
Unknown Macroalgae						31.0	13.2		44
Water Felt (*Vaucheria sp.*)			10.4	177.2	12.4	14.2	48.3	107.3	370
Widgeongrass (*Ruppia maritima*)				18.8	3.6	1.9	0.7	0.1	25
Total	**993**	**1,464**	**6,399**	**5,012**	**4,658**	**3,965**	**3,292**	**1,298**	**27,081**

Table 16. Macroalgae and Submerged Aquatic Vegetation Total Volume (Liters) from 2006-2013 by the Coastal Bays Fisheries Investigation Beach Seine Survey, (n=38 per year).

Specimen Name	**Year**								
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**Total**
Agardh's Red Weed *(Agardhiella tenera)*	0.3	284.4	54.6	270.3	1,150	453.9	628.9	1,132	3,975
Banded Weeds *(Ceramium sp.)*	19.4	7.0	1.4	0.5		15.5	0.1	3.3	47
Barrel Weed *(Champia sp.)*		3.7	9.0	10.1		1.6	3.6	6.9	35
Brittlewort *(Nitella sp.)*				3.5					4
Ectocarpus Genus *(Ectocarpus sp.)*			5.4						5
Eel Grass *(Zostera marina)*	13.3	26.6	17.5	73.5	134.1	30.0	48.7	16.7	360
Enteromorpha intestinalis			106.4		102.4				209
Graceful Red Weed *(Gracilaria sp.)*	222.3	109.1	264.9	56.9	274.2	50.0	2.2	4.1	984
Green Fleece *(Codium fragile)*	9.4			4.5		21.0	52.6	17.9	105
Green Hair Algae *(Chaetomorpha sp.)*	14.0		289.3	21.6	3.7	50.3	1.0	162.2	542
Green Sea Fern *(Bryopsis sp.)*				1.9				2.0	4
Green Tufted Seaweed *(Cladophora sp.)*	54.6	0.9	266.5	0.1	195.7	5.3	3.5	2.5	529
Hairy Basket Weed *(Spyridia sp.)*				0.7	2.7	55.2	3.3	59.9	122
Hollow Green Weed *(Enteromorpha sp.)*	35.0	0.1	6.6	43.1		35.2	2.2	66.7	189
Hooked Red Weed *(Hypnea sp.)*			6.5						7
Rockweed (*Fucus sp.*)	0.7		3.3						4
Sea Lettuce (*Ulva sp.*)	6.7	28.8	32.8	7.2	90.8	15.5	40.1	76.0	298
Slurry (Decaying Macroalgae)									
Sour Weeds (*Desmarestia*)			4.7			0.1			5
Tubed Weeds (*Polysiphonia sp.*)	4.0	2.6	1.8	0.1	0.6	4.6	152.3	375.7	542
Unknown Macroalgae						3.6			4
Water Felt (*Vaucheria sp.*)			2.0	6.8	22.7	37.9	29.2	64.1	163
Widgeongrass (*Ruppia maritima*)		1.1	14.9	35.2	12.6	2.6	4.4	0.1	71
Total	**380**	**464**	**1,088**	**536**	**1,990**	**782**	**972**	**1,990**	**8,202**

Table 17. Macroalgae and Submerged Aquatic Vegetation catch per unit of effort (CPUE) from 2006-2013 by the Coastal Bays Fisheries Investigation Trawl Survey. CPUE is calculated by total volume (liters) per hectare, (n=140 per year).

Specimen Name	**Year**							
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
Agardh's Red Weed *(Agardhiella tenera)*	9.72	26.65	131.79	166.12	223.68	145.04	59.95	26.42
Banded Weeds *(Ceramium sp.)*	0.18	0.97	2.28	1.15	0.12	1.13	2.71	2.11
Barrel Weed *(Champia sp.)*	2.18	0.95	16.19	2.69	0.33	2.07	1.55	0.16
Brown Bubble Algae *(Colpomenia sinuos)*							0.04	0.01
Common Southern Kelp *(Laminaria agardhii)*						0.67	0.01	0.04
Eel Grass *(Zostera marina)*	0.33	0.27	3.08	7.49	5.60	0.75	1.77	1.42
Enteromorpha intestinalis		0.03			0.17			
Graceful Red Weed *(Gracilaria sp.)*	37.80	26.35	175.94	25.36	41.34	202.37	129.93	0.52
Green Fleece *(Codium fragile)*		0.21	0.75	0.67	0.09	0.21	1.54	0.40
Green Hair Algae *(Chaetomorpha sp.)*	0.91	1.17	4.38	25.93	14.95	2.66	0.06	10.20
Green Sea Fern *(Bryopsis sp.)*						0.01		0.06
Green Tufted Seaweed *(Cladophora sp.)*	0.79	0.06	1.06			0.52	8.32	0.54
Hairy Basket Weed *(Spyridia sp.)*				0.35	0.19	0.24	2.93	0.49
Hollow Green Weed *(Enteromorpha sp.)*	0.03	0.34	2.50	1.08	0.91	1.36	5.05	0.47
Hooked Red Weed *(Hypnea sp.)*			0.04			0.08	0.03	
Rockweed (*Fucus sp.*)	0.01	0.01		0.15	0.10			
Sea Lettuce (*Ulva sp.*)	4.50	11.39	43.12	43.65	17.49	17.58	7.72	12.67
Slurry (Decaying Macroalgae)				7.76	0.09			
Sour Weeds (*Desmarestia*)			9.81			2.41	0.03	0.03
Tubed Weeds (*Polysiphonia sp.*)	0.10	14.98	0.01	0.69	1.79	10.45	31.13	12.23
Unknown Macroalgae						3.17	0.75	
Water Felt (*Vaucheria sp.*)			0.59	10.02	0.71	1.59	2.75	6.11
Widgeongrass (*Ruppia maritima*)				1.06	0.21	0.11	0.04	

Table 18. Macroalgae and Submerged Aquatic Vegetation catch per unit of effort (CPUE) from 2006-2013 by the Coastal Bays Fisheries Investigation Beach Seine Survey. CPUE is calculated by total volume (liters) per haul, (n=38 per year).

SPECIMEN NAME	**Year**							
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
Agardh's Red Weed *(Agardhiella tenera)*	0.01	7.48	1.44	7.11	30.27	11.95	16.55	29.80
Banded Weeds *(Ceramium sp.)*	0.50	0.18	0.04	0.01		0.41		0.09
Barrel Weed *(Champia sp.)*		0.10	0.24	0.27		0.04	0.09	0.18
Brittlewort *(Nitella sp.)*				0.09				
Ectocarpus Genus *(Ectocarpus sp.)*			0.14					
Eel Grass *(Zostera marina)*	0.34	0.70	0.46	1.93	3.53	0.79	1.28	0.44
Enteromorpha intestinalis			2.80		2.69			
Graceful Red Weed *(Gracilaria sp.)*	5.70	2.87	6.97	1.50	7.22	1.32	0.06	0.11
Green Fleece *(Codium fragile)*	0.24			0.12		0.55	1.38	0.47
Green Hair Algae *(Chaetomorpha sp.)*	0.36		7.61	0.57	0.10	1.32	0.03	4.27
Green Sea Fern *(Bryopsis sp.)*				0.05				0.03
Green Tufted Seaweed *(Cladophora sp.)*	1.40	0.02	7.01		5.15	0.14	0.09	0.07
Hairy Basket Weed *(Spyridia sp.)*				0.02	0.07	1.45	0.09	1.58
Hollow Green Weed *(Enteromorpha sp.)*	0.90		0.17	1.13		0.93	0.06	1.75
Hooked Red Weed *(Hypnea sp.)*			0.17					
Rockweed (*Fucus sp.*)	0.02		0.09					
Sea Lettuce (*Ulva sp.*)	0.17	0.76	0.86	0.19	2.39	0.41	1.05	2.00
Sour Weeds (*Desmarestia*)			0.12					
Tubed Weeds (*Polysiphonia sp.*)	0.10	0.07	0.05		0.02	0.12	4.01	9.89
Unknown Macroalgae						0.09		
Water Felt (*Vaucheria sp.*)			0.05	0.18	0.60	1.00	0.77	1.69
Widgeongrass (*Ruppia maritima*)		0.03	0.39	0.93	0.33	0.07	0.12	

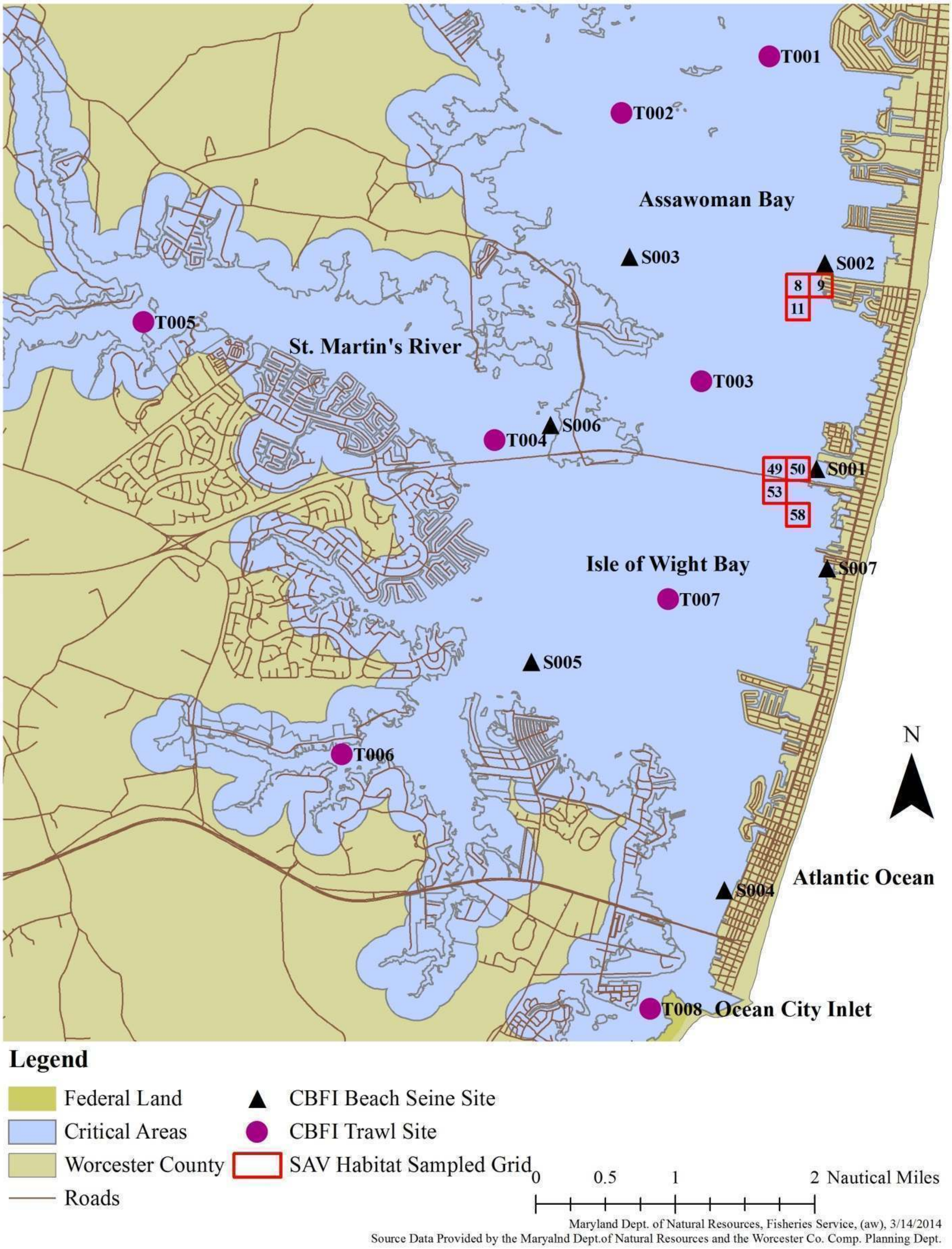

Figure 1. Coastal Bays Fisheries Investigation 2013 sampling locations in the northern Coastal Bays, Maryland.

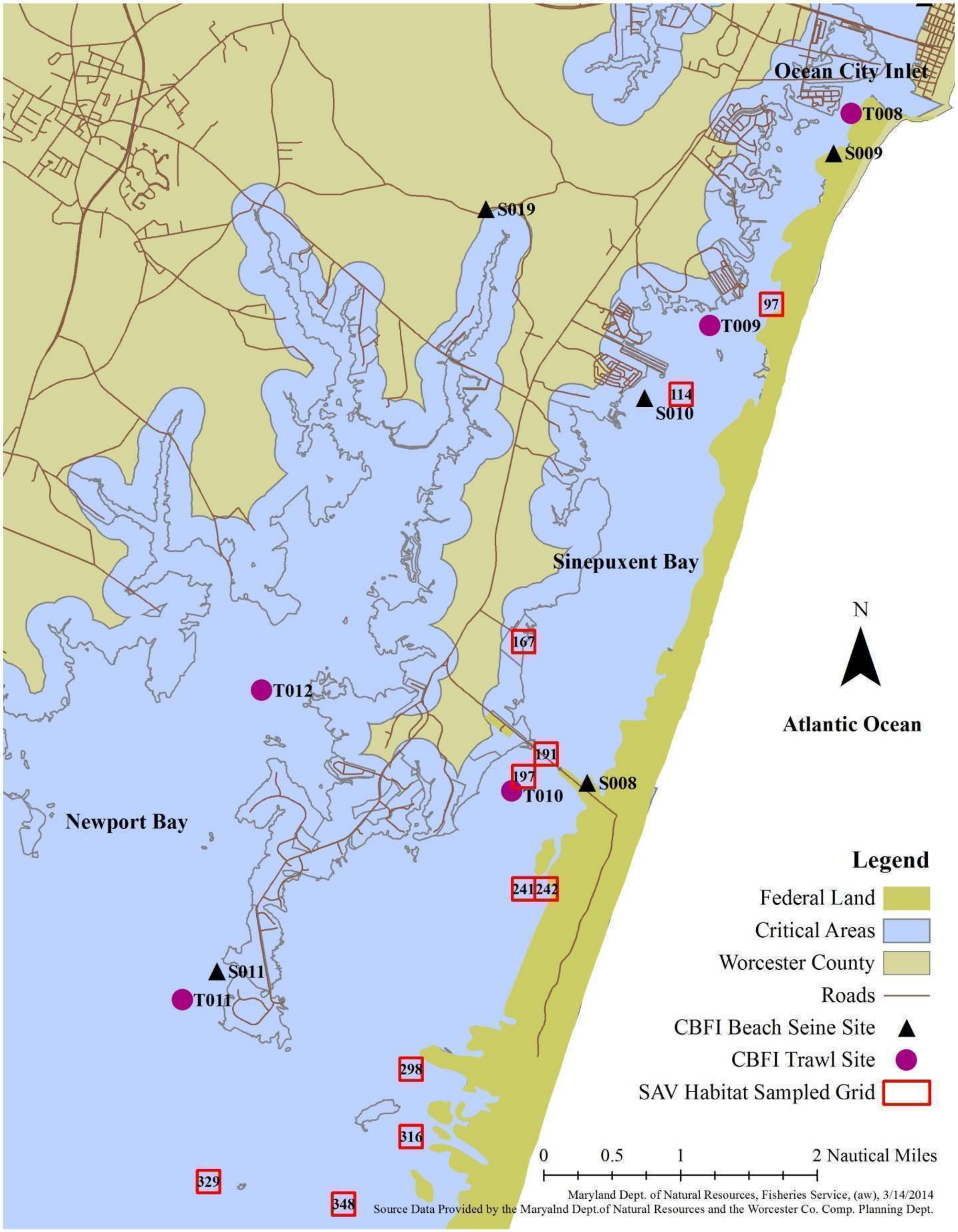

Figure 2. Coastal Bays Fisheries Investigation 2013 sampling locations in Sinepuxent and Newport Bays, Maryland.

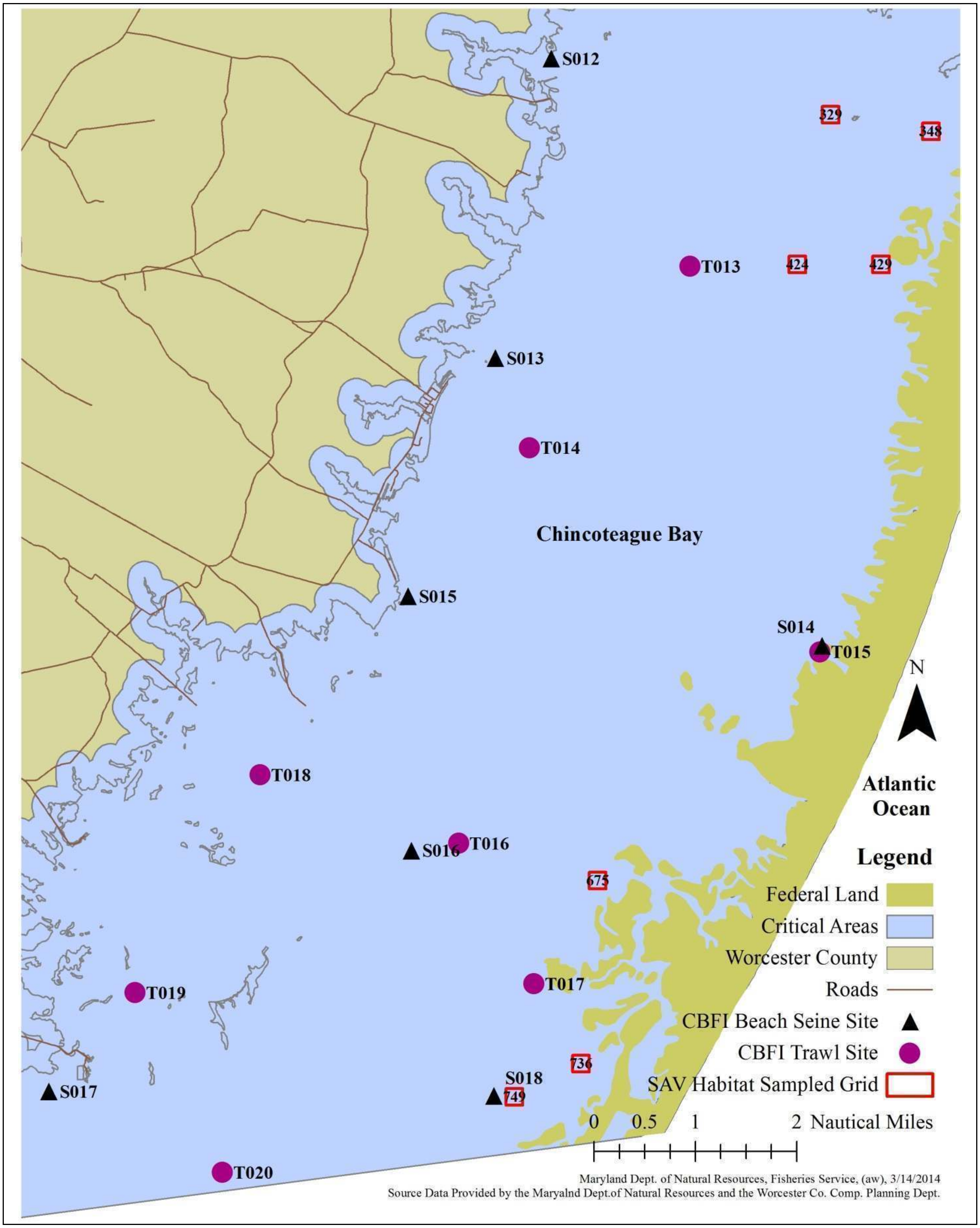

Figure 3. Coastal Bays Fisheries Investigation 2013 sampling locations in Chincoteague Bay, Maryland.

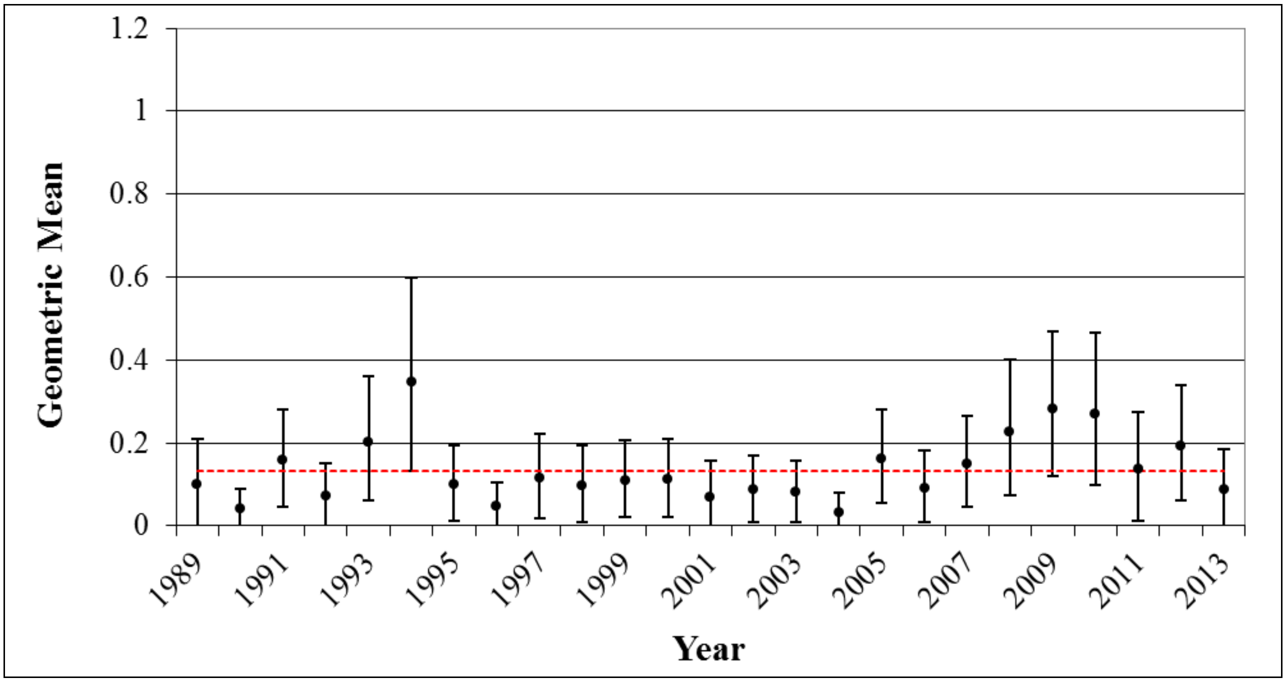

Figure 4. American Eel (*Anguilla rostrata)* trawl index of relative abundance (geometric mean) with 95% confidence intervals (1989-2013). Dotted line represents the 1989-2013 time series grand mean. Protocols of the Coastal Bays Fisheries Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=140/year).

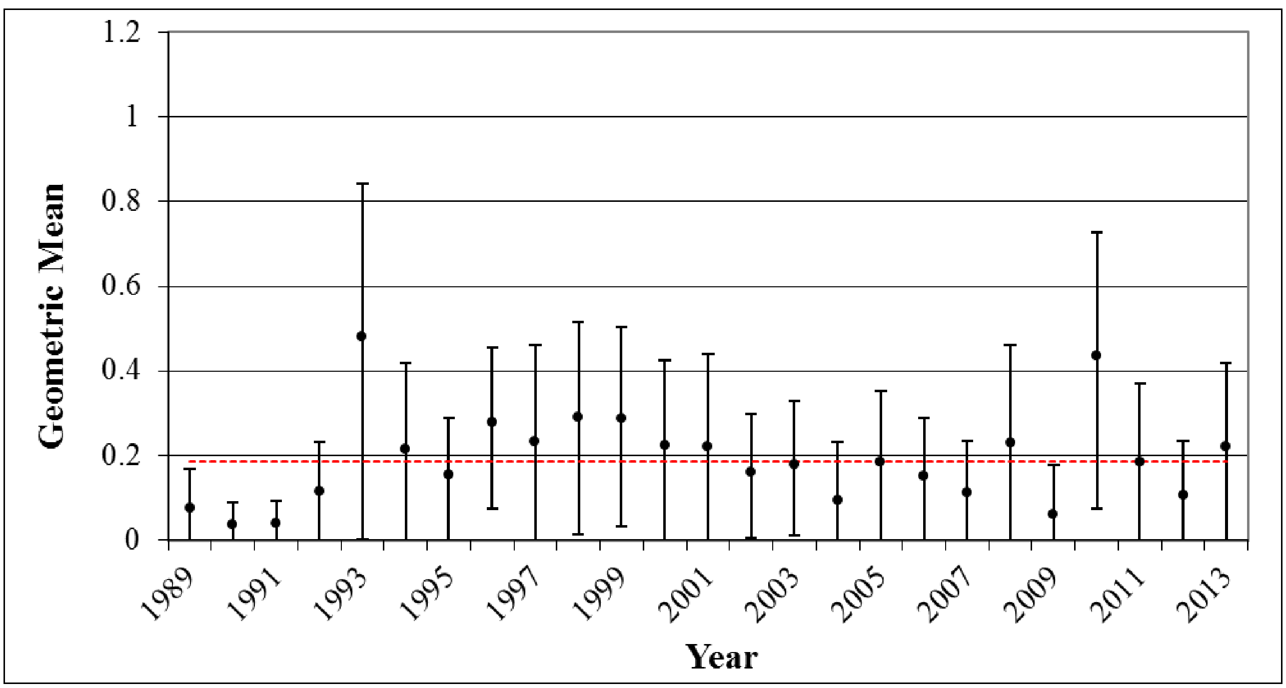

Figure 5. American Eel (*Anguilla rostrata)* beach seine index of relative abundance (geometric mean) with 95% confidence intervals (1989-2013). Dotted line represents the 1989-2013 time series grand mean. Protocols of the Coastal Bays Fisheries Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=38/year).

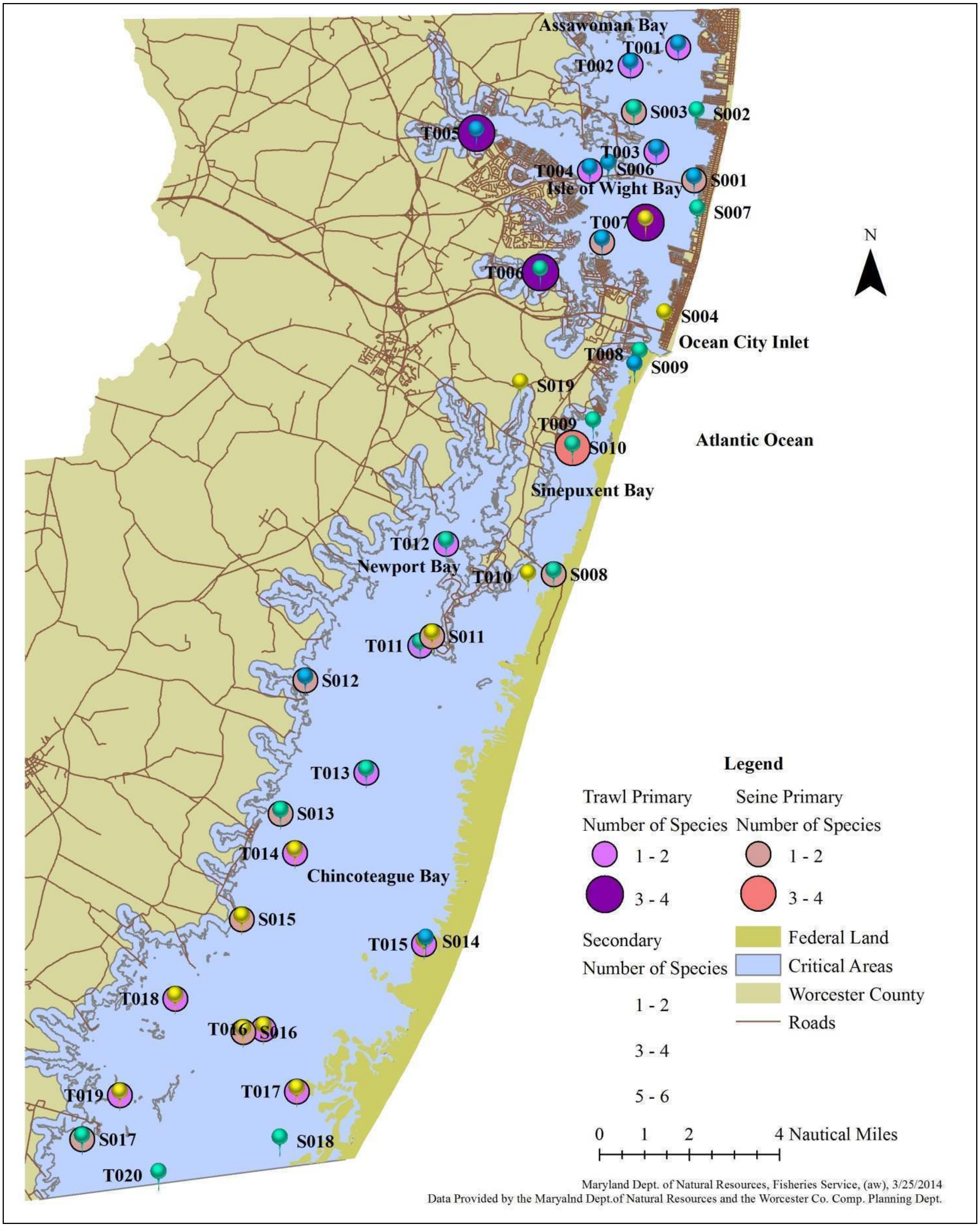

Figure 6. Coastal Bays Fisheries Investigation trawl and beach seine primary and secondary site preferences.

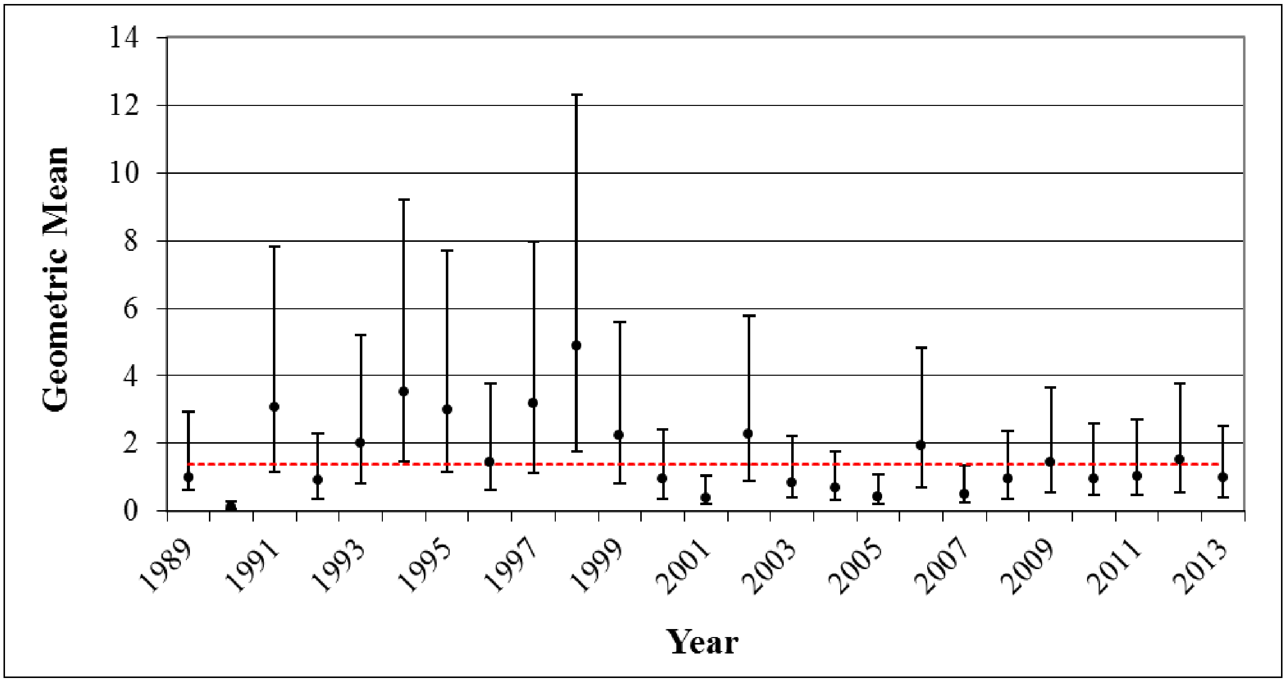

Figure 7. Atlantic Croaker (*Micropogonias undulates*) trawl index of relative abundance (geometric mean) with 95% confidence intervals (1989-2013). Dotted line represents the 1989-2013 time series grand mean. Protocols of the Coastal Bays Fisheries Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=140/year).

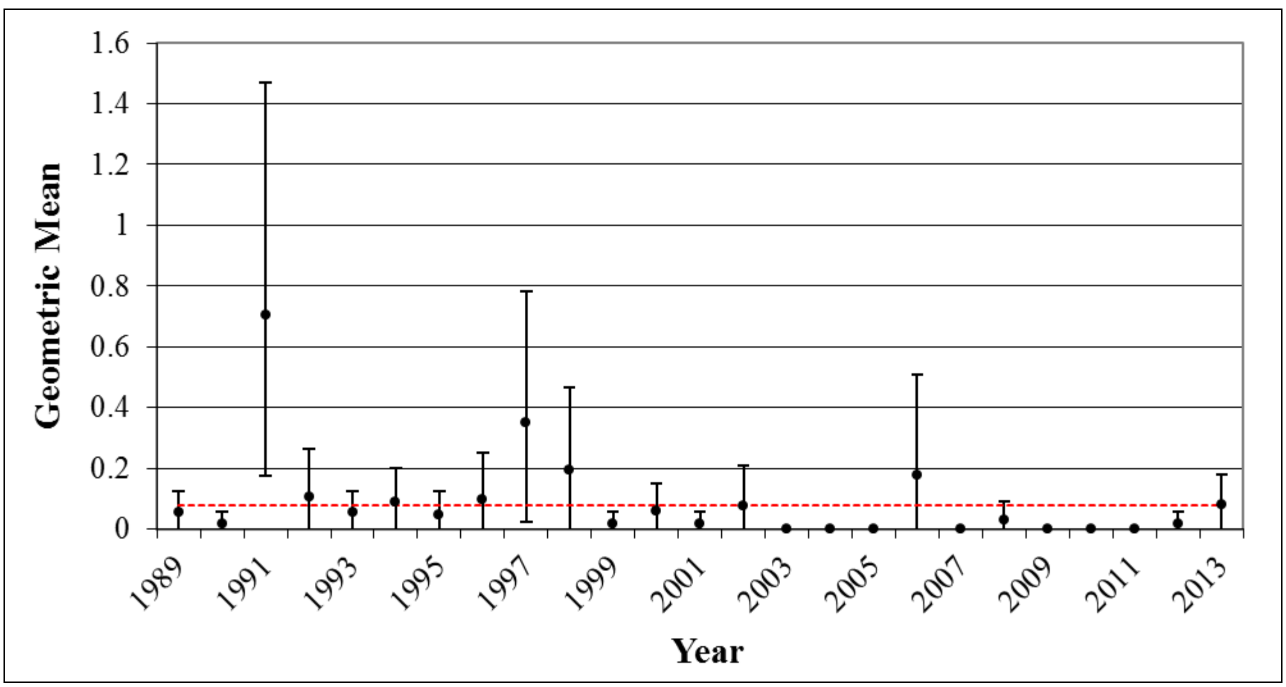

Figure 8. Atlantic Croaker (*Micropogonias undulates*) beach seine index of relative abundance (geometric mean) with 95% confidence intervals (1989-2013). Dotted line represents the 1989-2013 time series grand mean. Protocols of the Coastal Bays Fisheries Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=38/year).

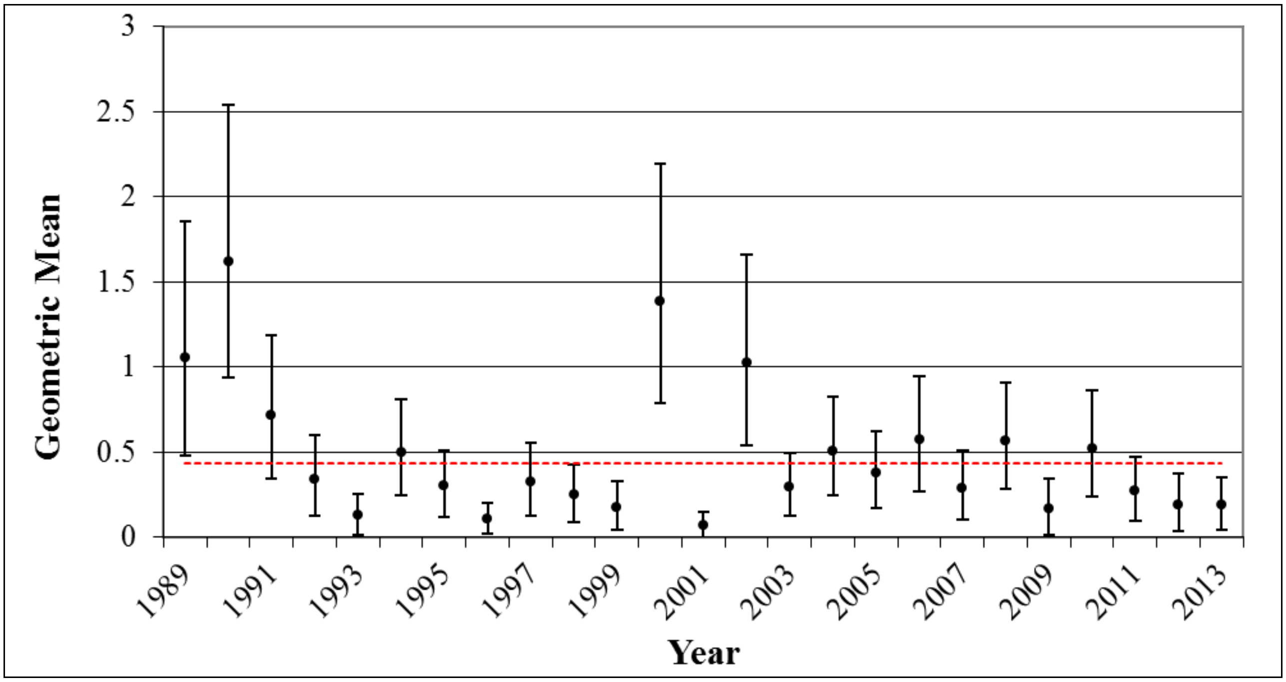

Figure 9. Atlantic Menhaden (Brevoortia tyrannus) trawl index of relative abundance (geometric mean) with 95% confidence intervals (1989-2013). Dotted line represents the 1989-2013 time series grand mean. Protocols of the Coastal Bays Fisheries Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=140/year).

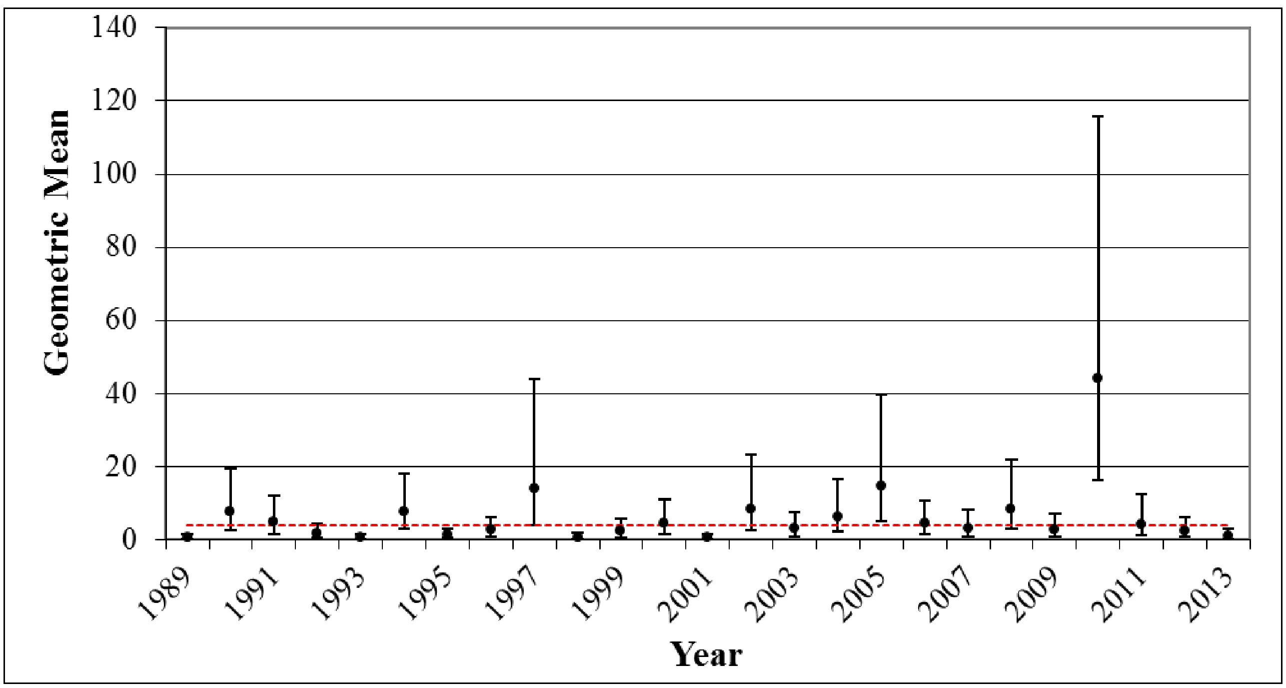

Figure 10. Atlantic Menhaden (*Brevoortia tyrannus*) beach seine index of relative abundance (geometric mean) with 95% confidence intervals (1989-2013). Dotted line represents the 1989-2013 time series grand mean. Protocols of the Coastal Bays Fisheries Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=38/year).

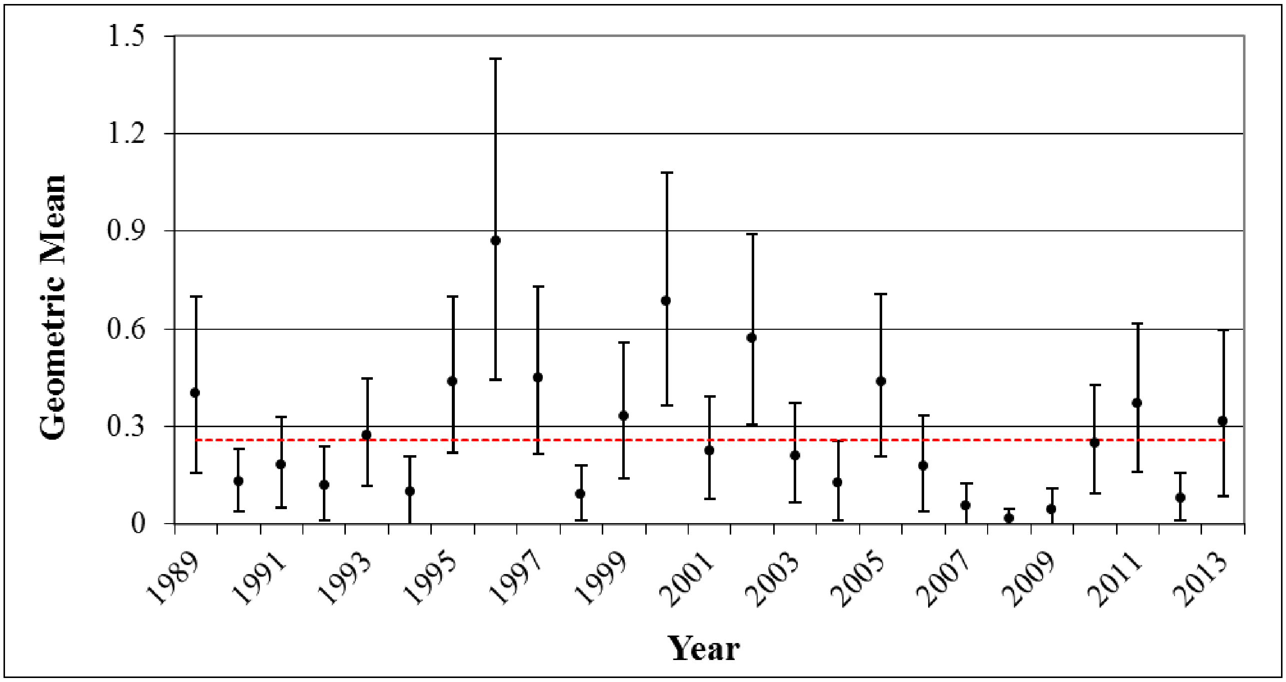

Figure 11. Atlantic Silverside (*Menidia menidia*) trawl index of relative abundance (geometric mean) with 95% confidence intervals (1989-2013). Dotted line represents the 1989-2013 time series grand mean. Protocols of the Coastal Bays Fisheries Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=140/year).

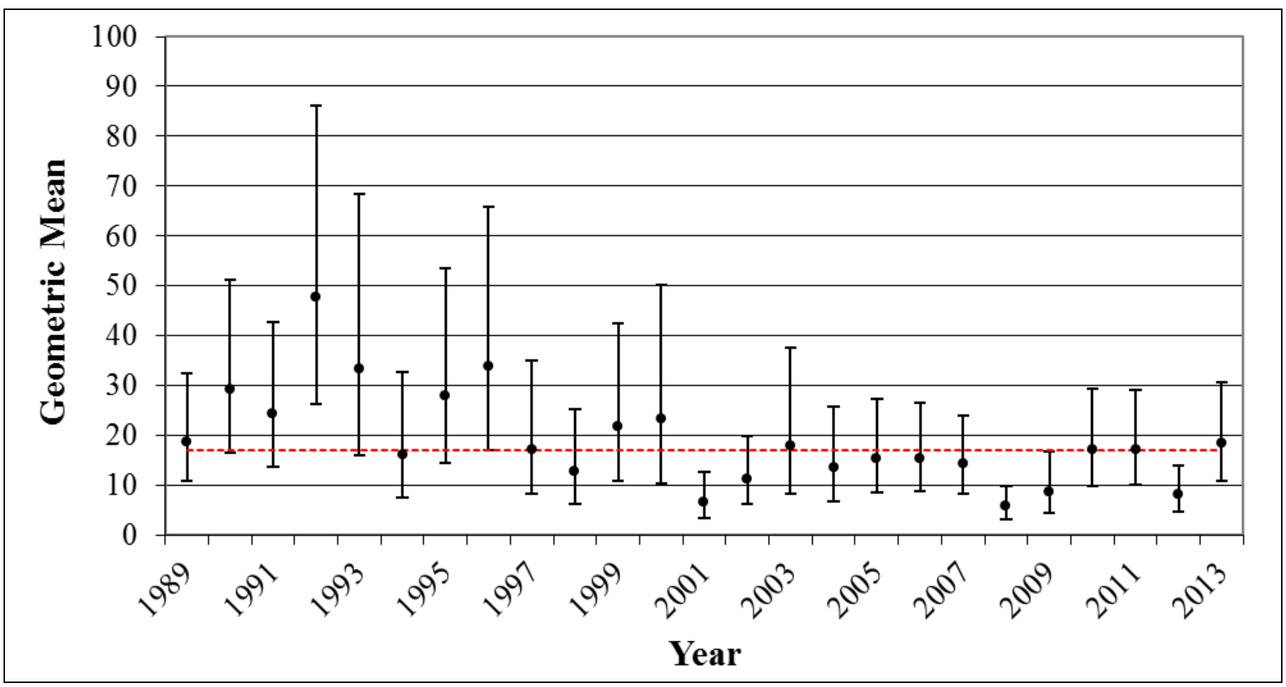

Figure 12. Atlantic Silverside (*Menidia menidia*) beach seine index of relative abundance (geometric mean) with 95% confidence intervals (1989-2013). Dotted line represents the 1989-2013 time series grand mean. Protocols of the Coastal Bays Fisheries Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=38/year).

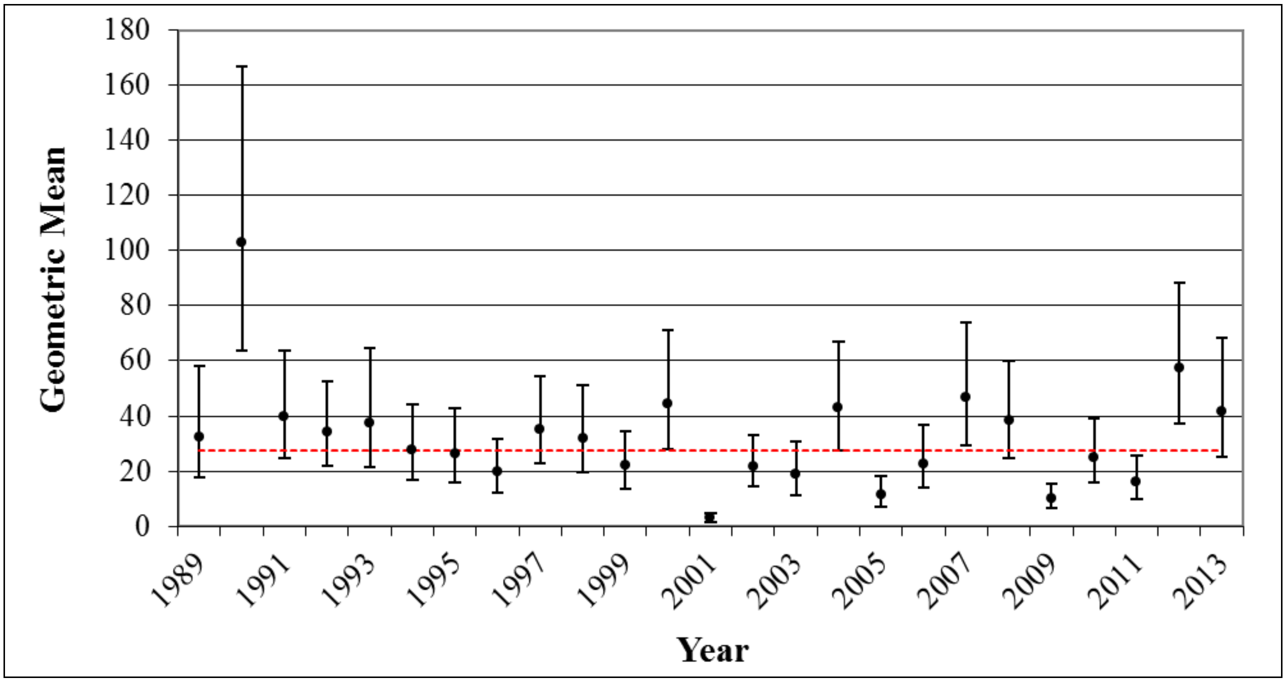

Figure 13. Bay Anchovy (*Anchoa mitchilli*) trawl index of relative abundance (geometric mean) with 95% confidence intervals (1989-2013). Dotted line represents the 1989-2013 time series grand mean. Protocols of the Coastal Bays Fisheries Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=140/year).

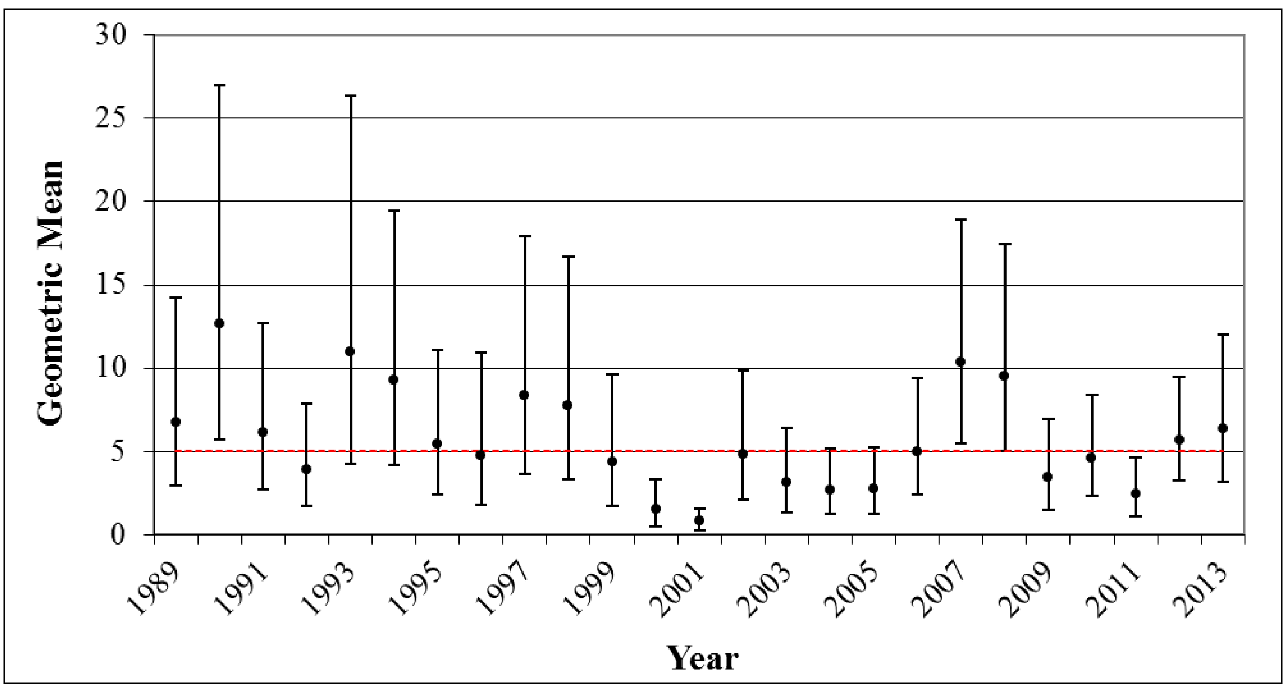

Figure 14. Bay Anchovy (*Anchoa mitchilli*) beach seine index of relative abundance (geometric mean) with 95% confidence intervals (1989-2013). Dotted line represents the 1989-2013 time series grand mean. Protocols of the Coastal Bays Fisheries Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=38/year).

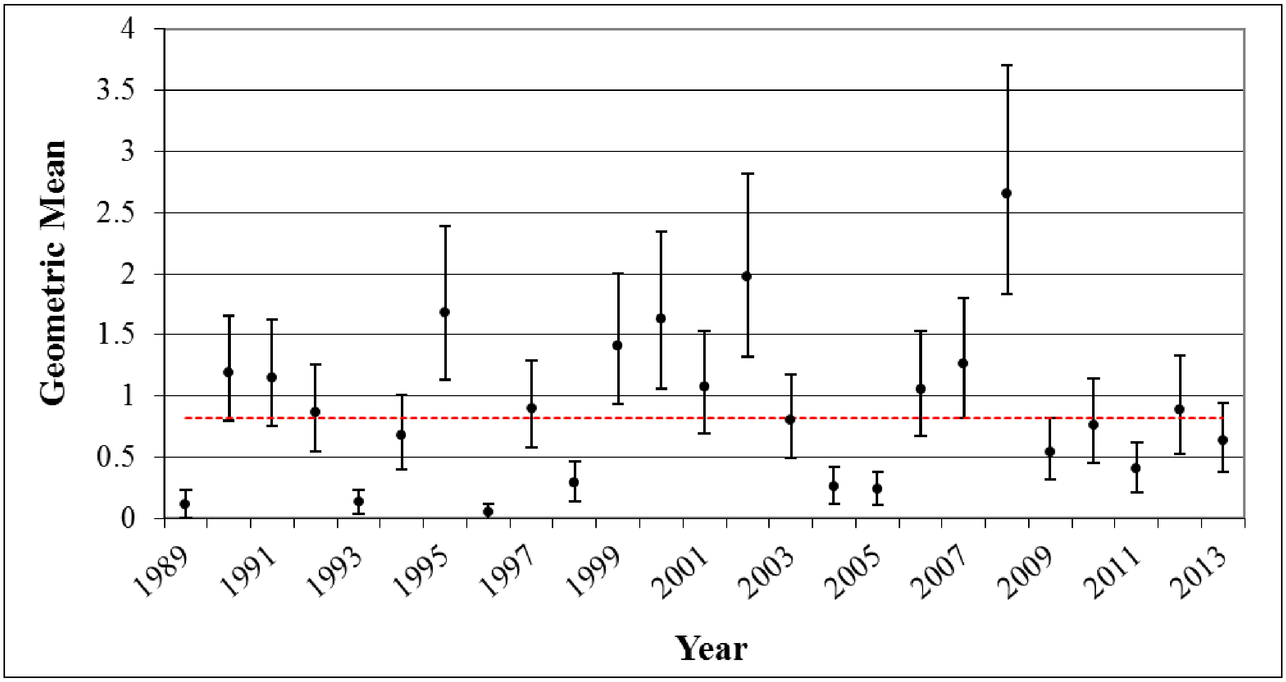

Figure 15. Black Sea Bass (*Centropristis* striata) trawl index of relative abundance (geometric mean) with 95% confidence intervals (1989-2013). Dotted line represents the 1989-2013 time series grand mean. Protocols of the Coastal Bays Fisheries Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=140/year).

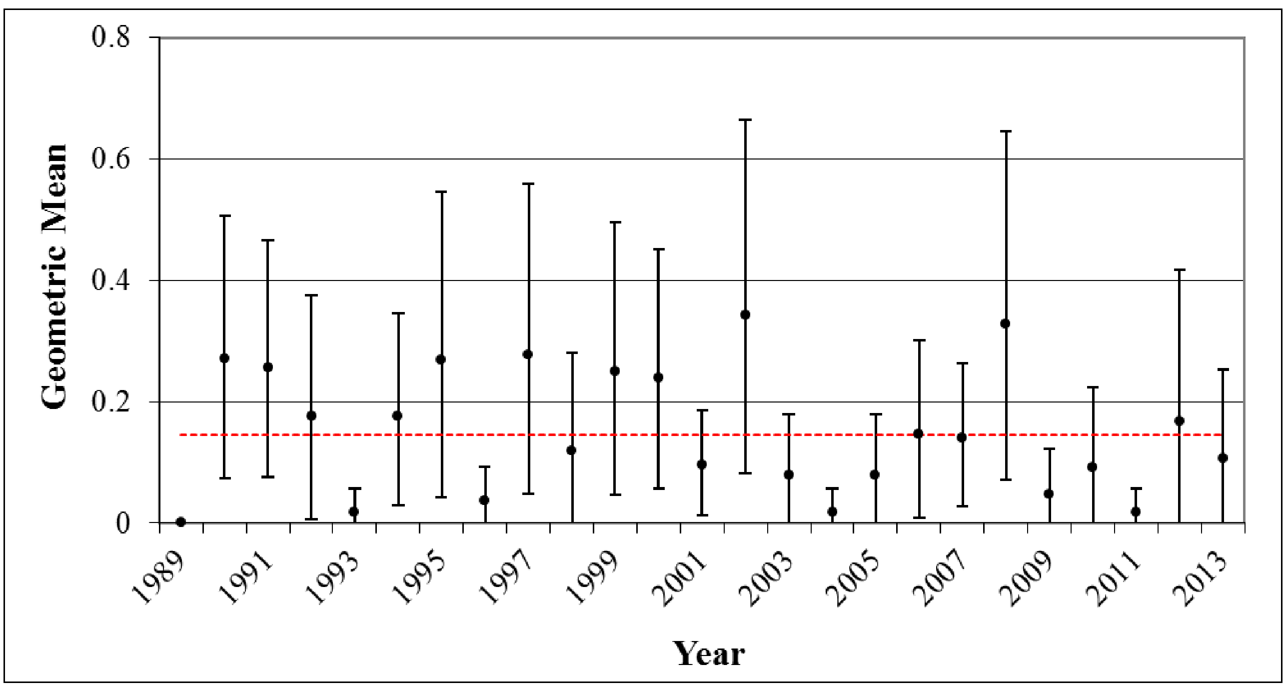

Figure 16. Black Sea Bass (*Centropristis* striata) beach seine index of relative abundance (geometric mean) with 95% confidence intervals (1989-2013). Dotted line represents the 1989-2013 time series grand mean. Protocols of the Coastal Bays Fisheries Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=38/year).

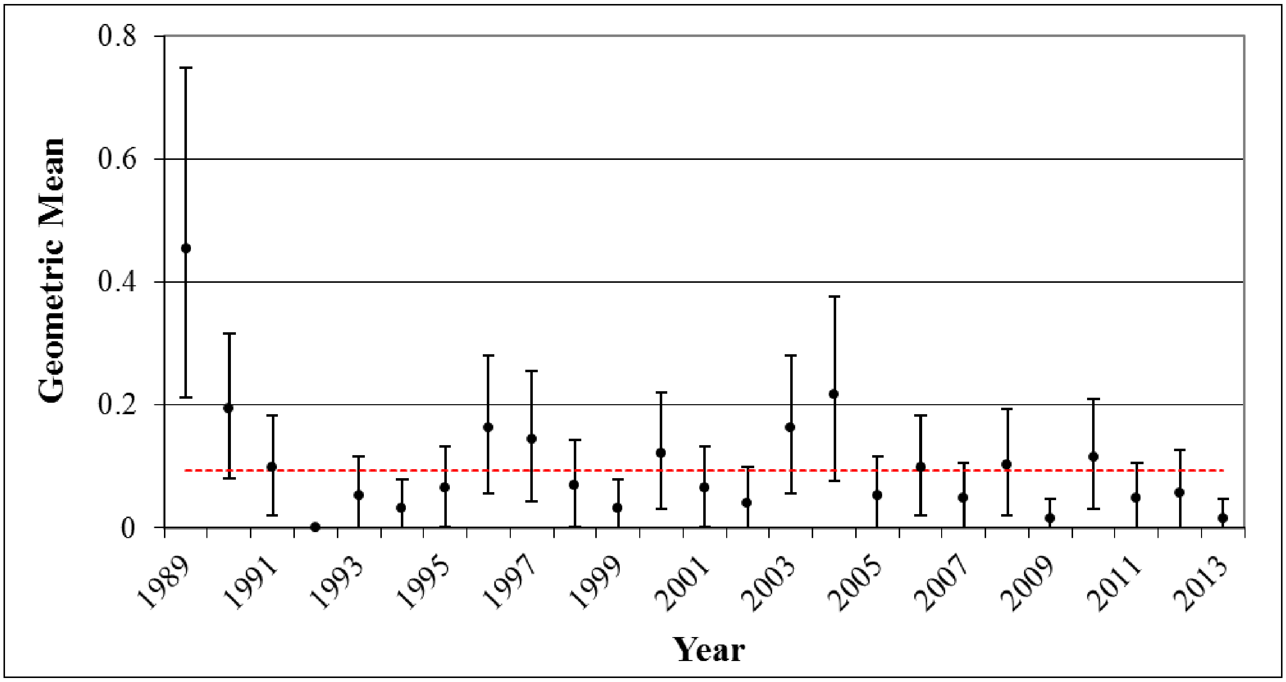

Figure 17. Bluefish (*Pomatomus saltatrix*) trawl index of relative abundance (geometric mean) with 95% confidence intervals (1989-2013). Dotted line represents the 1989-2013 time series grand mean. Protocols of the Coastal Bays Fisheries Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=140/year).

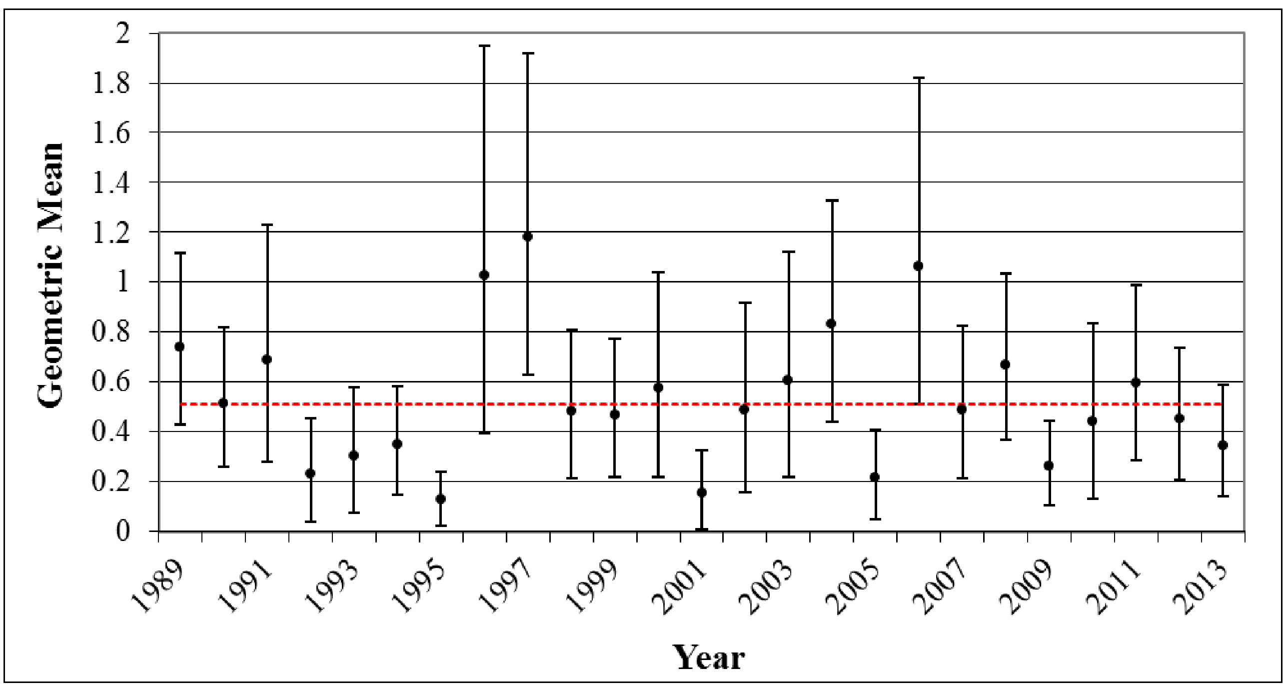

Figure 18. Bluefish (*Pomatomus saltatrix*) beach seine index of relative abundance (geometric mean) with 95% confidence intervals (1989-2013). Dotted line represents the 1989-2013 time series grand mean. Protocols of the Coastal Bays Fisheries Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=38/year).

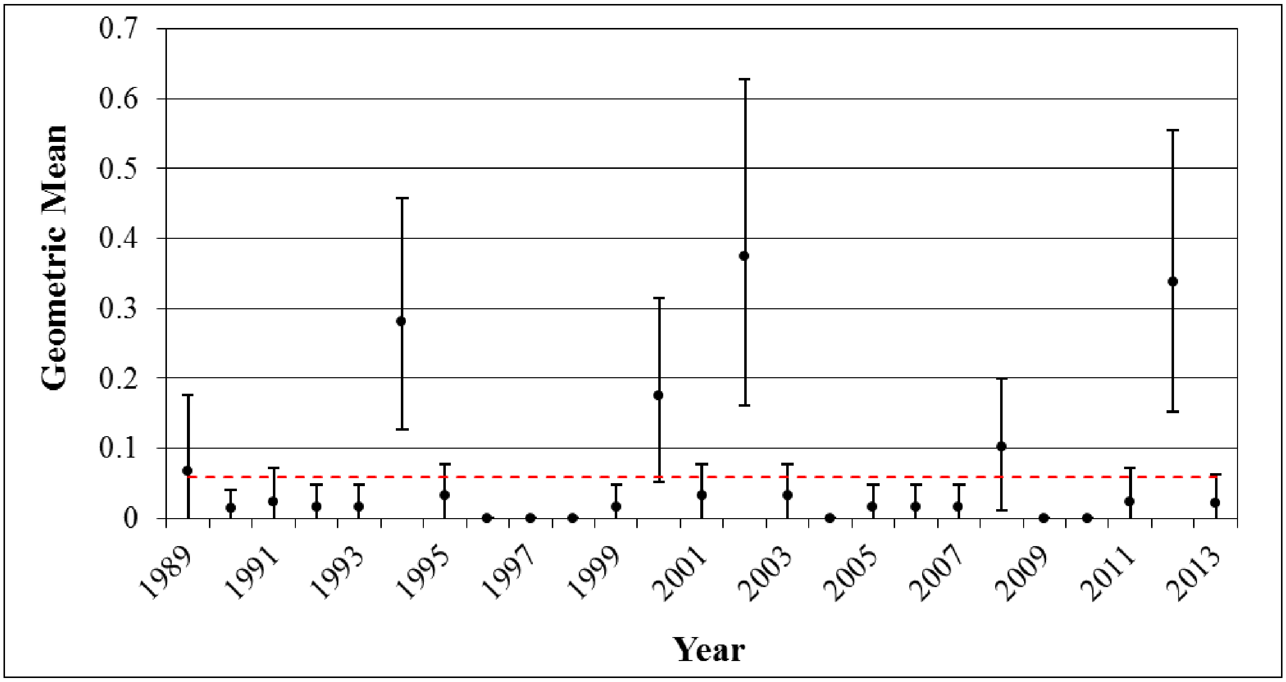

Figure 19. Pinfish (*Lagodon rhomboides*) trawl index of relative abundance (geometric mean) with 95% confidence intervals (1989-2013). Dotted line represents the 1989-2013 time series grand mean. Protocols of the Coastal Bays Fisheries Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=140/year).

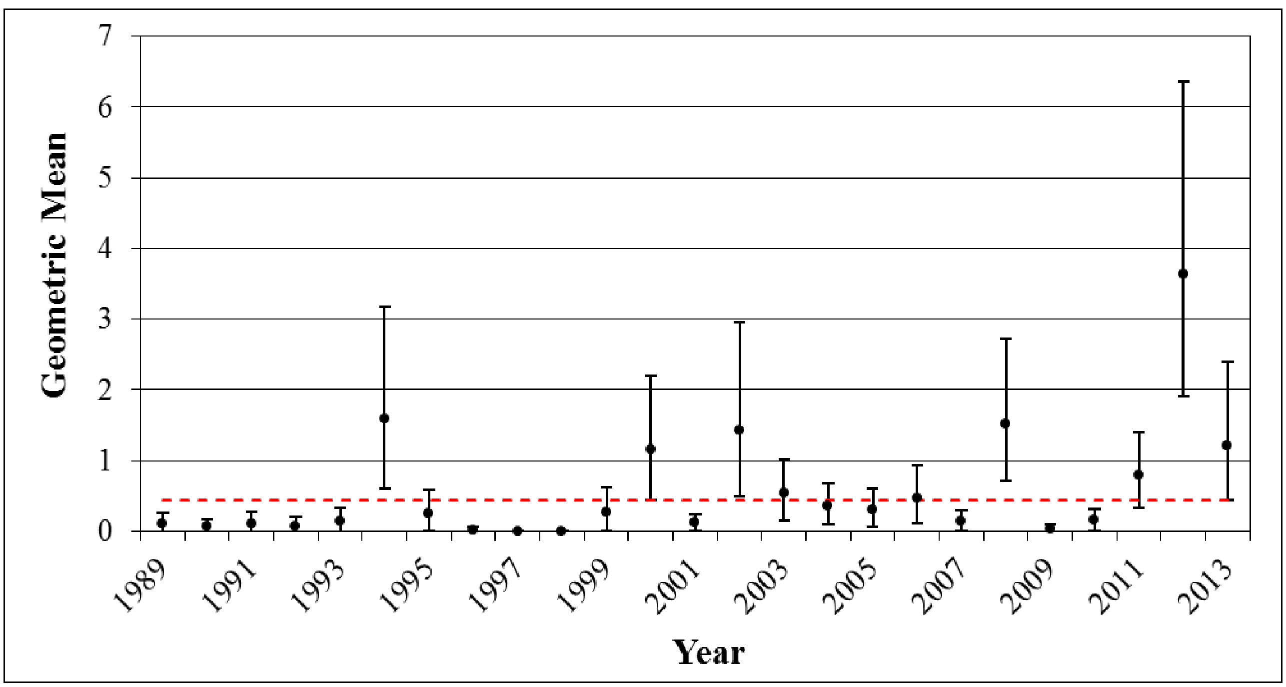

Figure 20. Pinfish (*Lagodon rhomboides*) beach seine index of relative abundance (geometric mean) with 95% confidence intervals (1989-2013). Dotted line represents the 1989-2013 time series grand mean. Protocols of the Coastal Bays Fisheries Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=38/year).

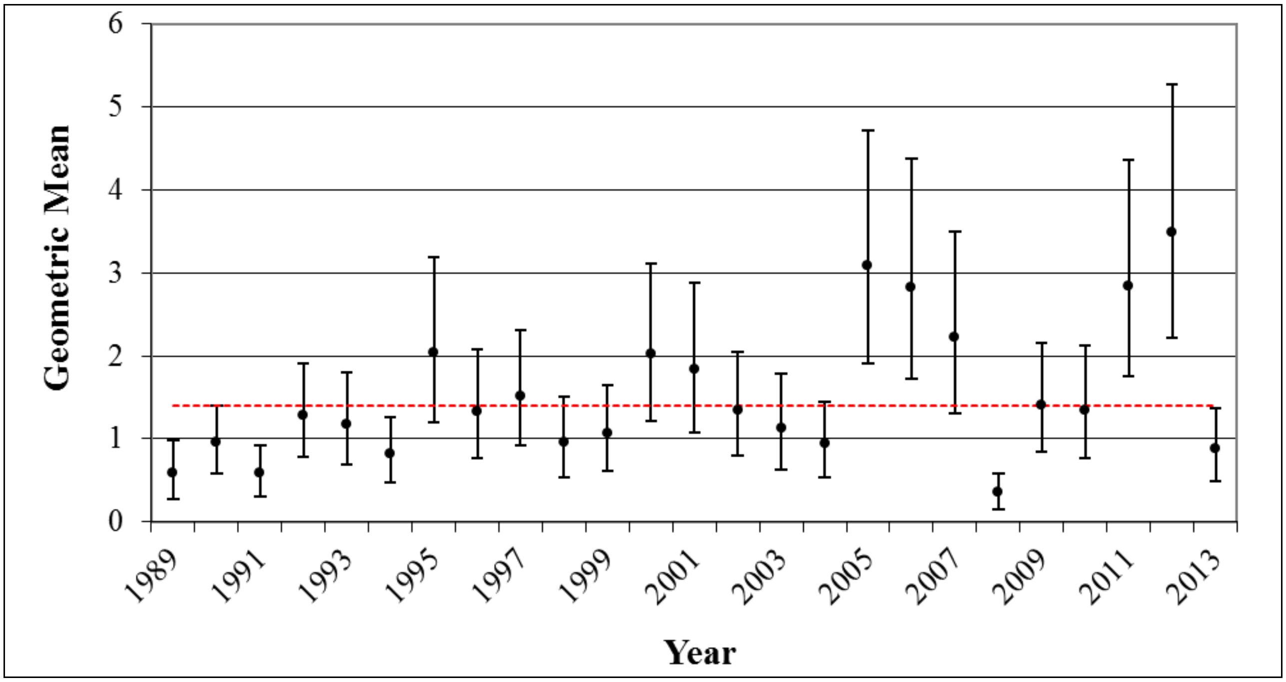

Figure 21. Silver Perch (*Bairdiella chrysoura*) trawl index of relative abundance (geometric mean) with 95% confidence intervals (1989-2013). Dotted line represents the 1989-2013 time series grand mean. Protocols of the Coastal Bays Fisheries Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=140/year).

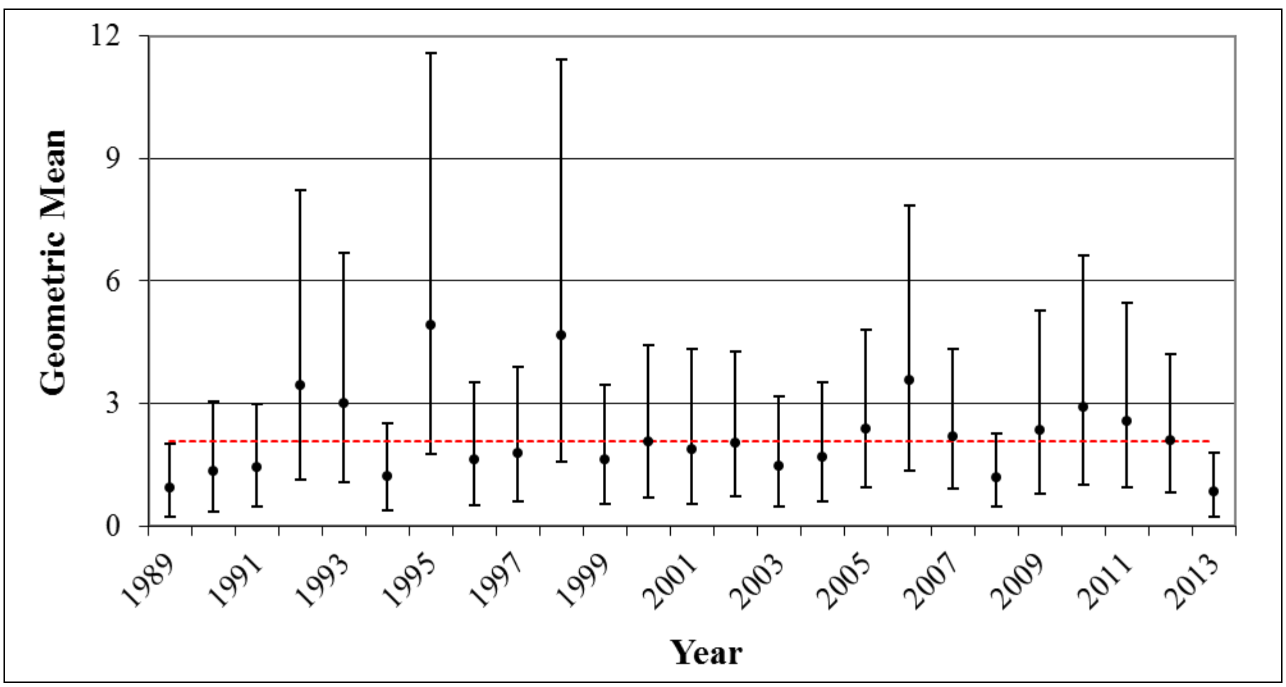

Figure 22. Silver Perch (*Bairdiella chrysoura*) beach seine index of relative abundance (geometric mean) with 95% confidence intervals (1989-2013). Dotted line represents the 1989-2013 time series grand mean. Protocols of the Coastal Bays Fisheries Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=38/year).

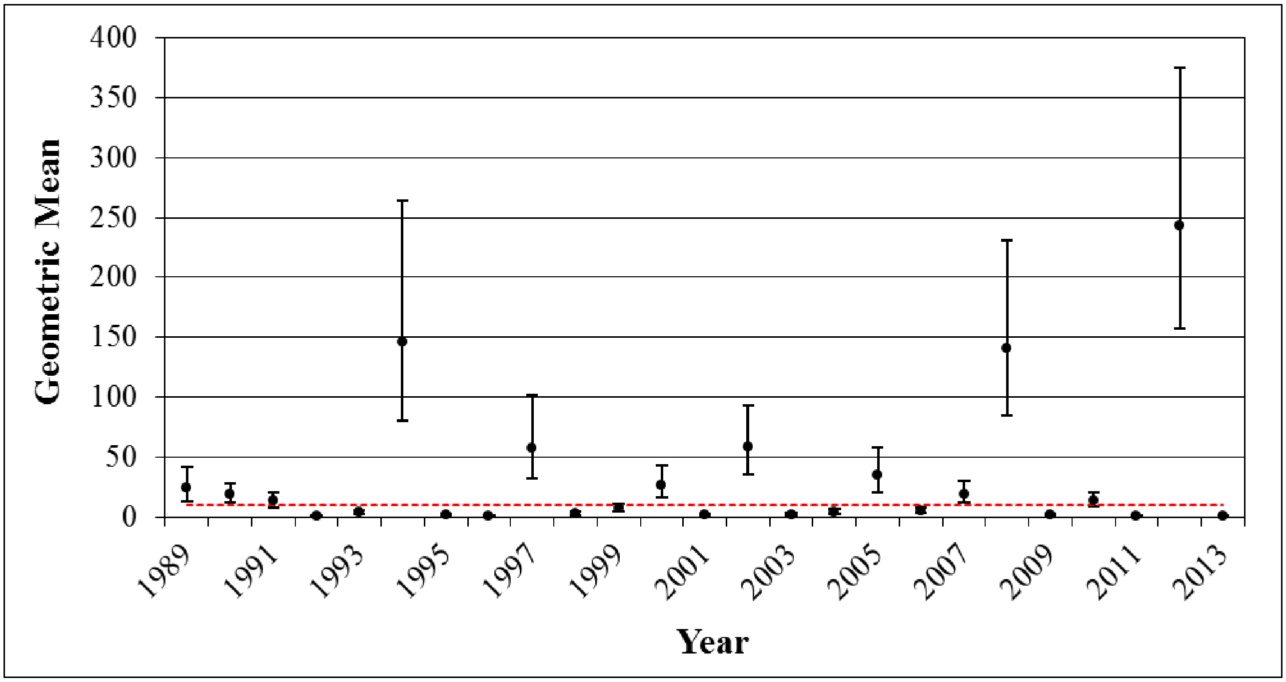

Figure 23. Spot (*Leiostomus xanthurus*) trawl index of relative abundance (geometric mean) with 95% confidence intervals (1989-2013). Dotted line represents the 1989-2013 time series grand mean. Protocols of the Coastal Bays Fisheries Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=140/year).

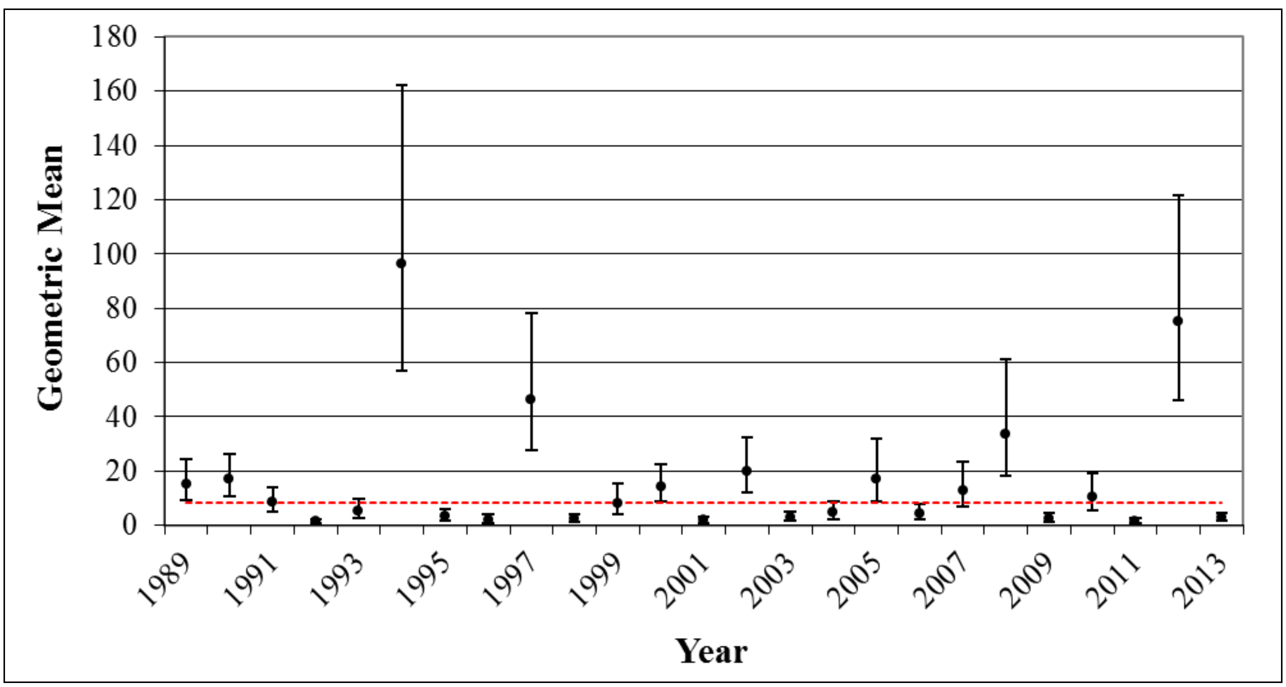

Figure 24. Spot (*Leiostomus xanthurus*) beach seine index of relative abundance (geometric mean) with 95% confidence intervals (1989-2013). Dotted line represents the 1989-2013 time series grand mean. Protocols of the Coastal Bays Fisheries Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=38/year).

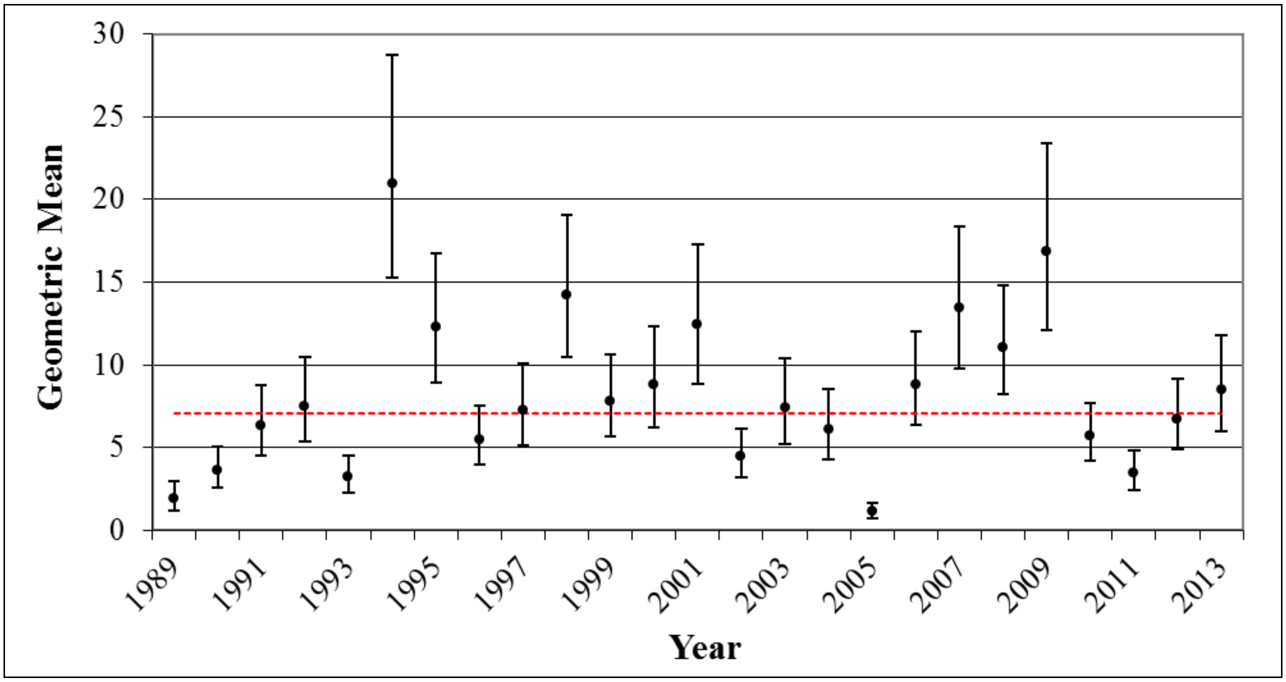

Figure 25. Summer Flounder (*Paralichthys dentatus*) trawl index of relative abundance (geometric mean) with 95% confidence intervals (1989-2013). Dotted line represents the 1989-2013 time series grand mean. Protocols of the Coastal Bays Fisheries Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=140/year).

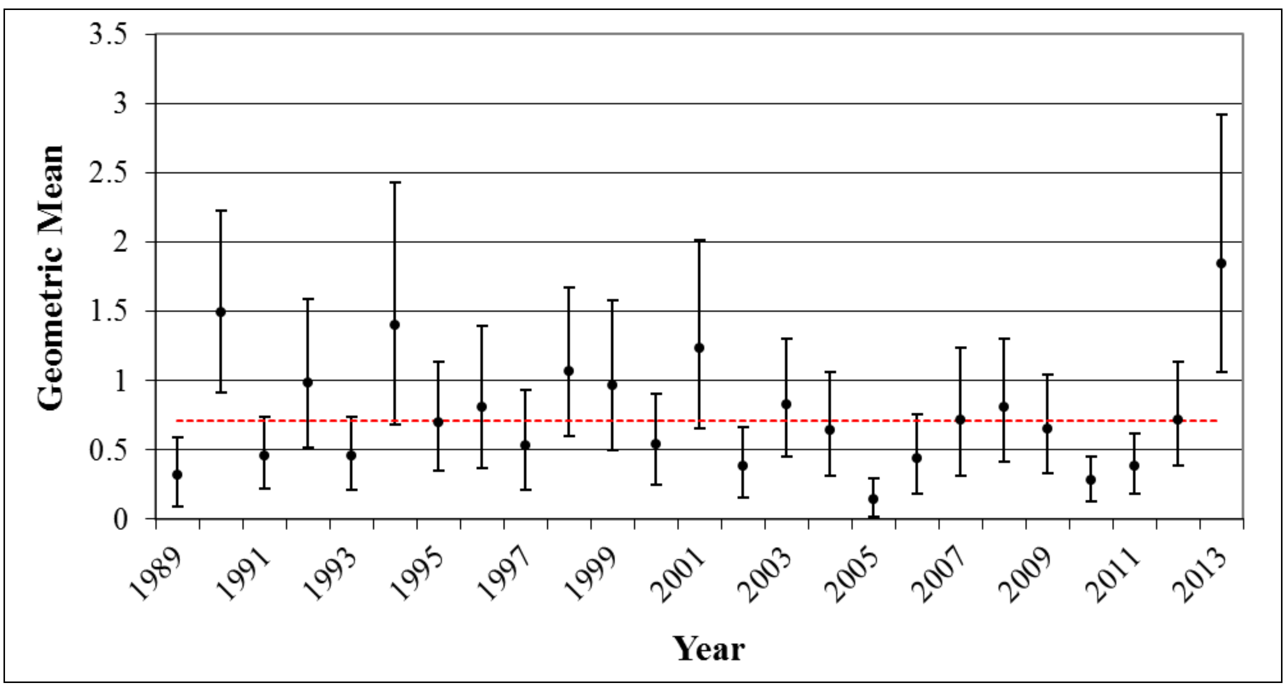

Figure 26. Summer Flounder (*Paralichthys dentatus*) beach seine index of relative abundance (geometric mean) with 95% confidence intervals (1989-2013). Dotted line represents the 1989-2013 time series grand mean. Protocols of the Coastal Bays Fisheries Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=38/year).

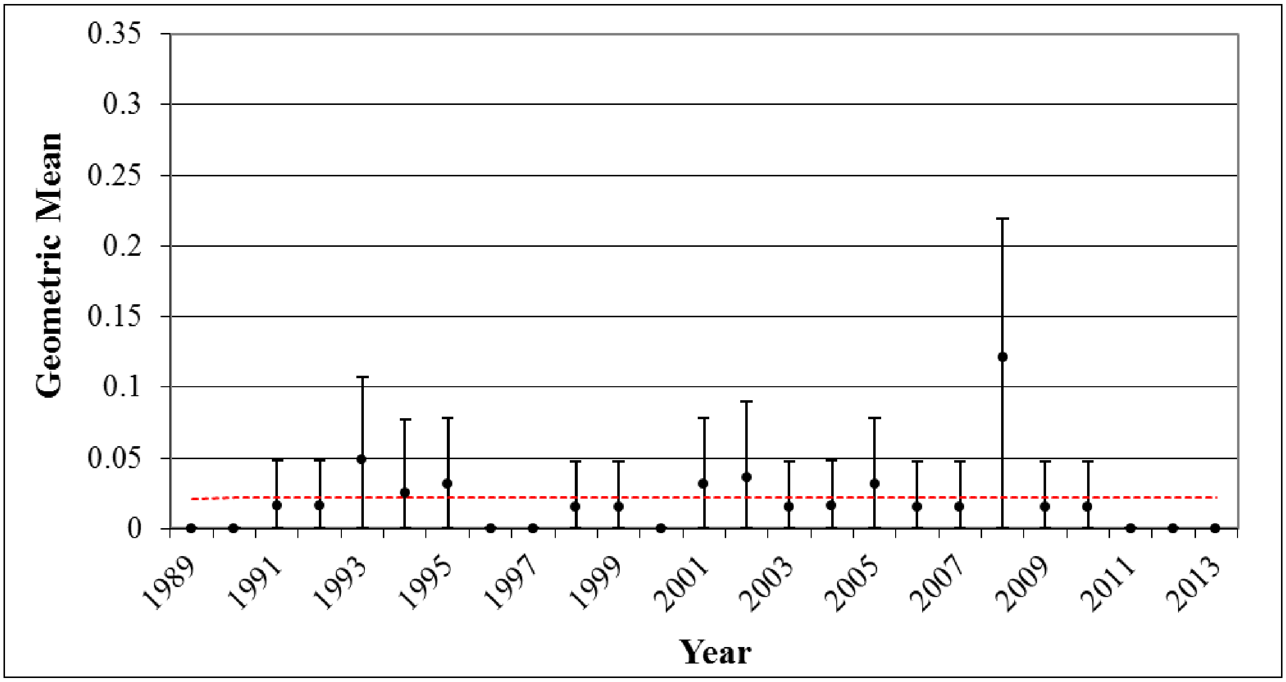

Figure 27. Tautog (*Tautoga onitis)* trawl index of relative abundance (geometric mean) with 95% confidence intervals (1989-2013). Dotted line represents the 1989-2013 time series grand mean. Protocols of the Coastal Bays Fisheries Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=140/year).

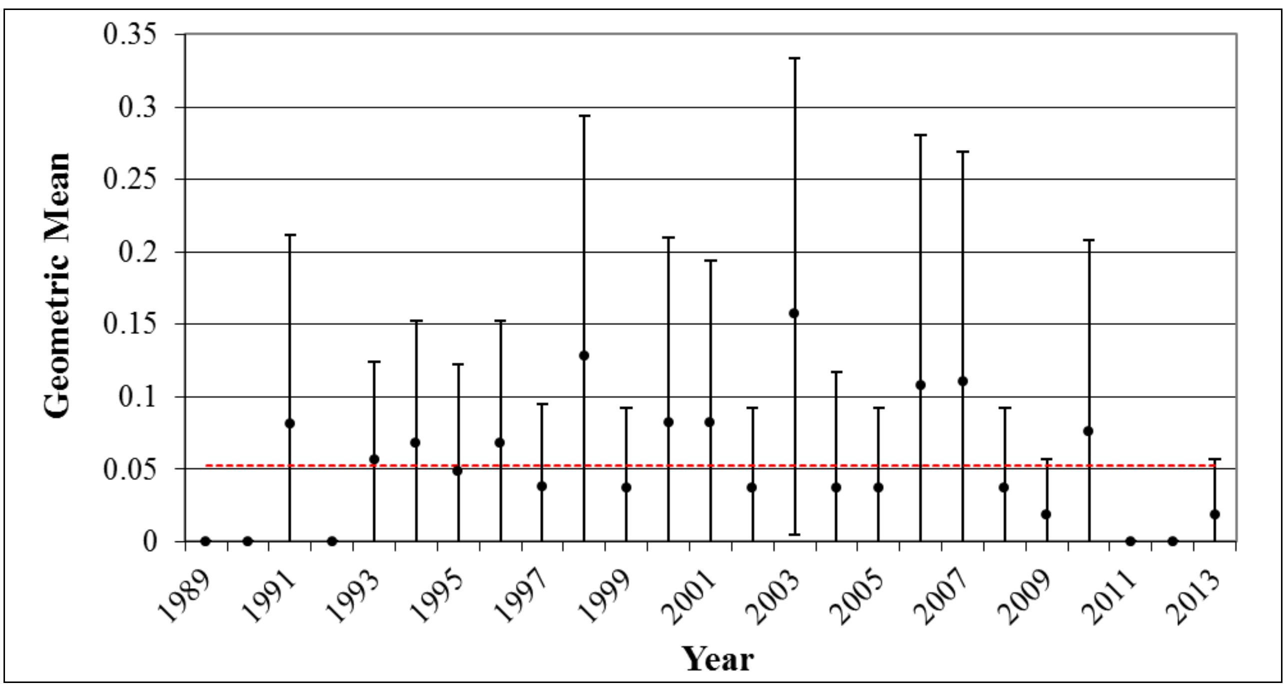

Figure 28. Tautog (*Tautoga onitis)* beach seine index of relative abundance (geometric mean) with 95% confidence intervals (1989-2013). Dotted line represents the 1989-2013 time series grand mean. Protocols of the Coastal Bays Fisheries Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=38/year).

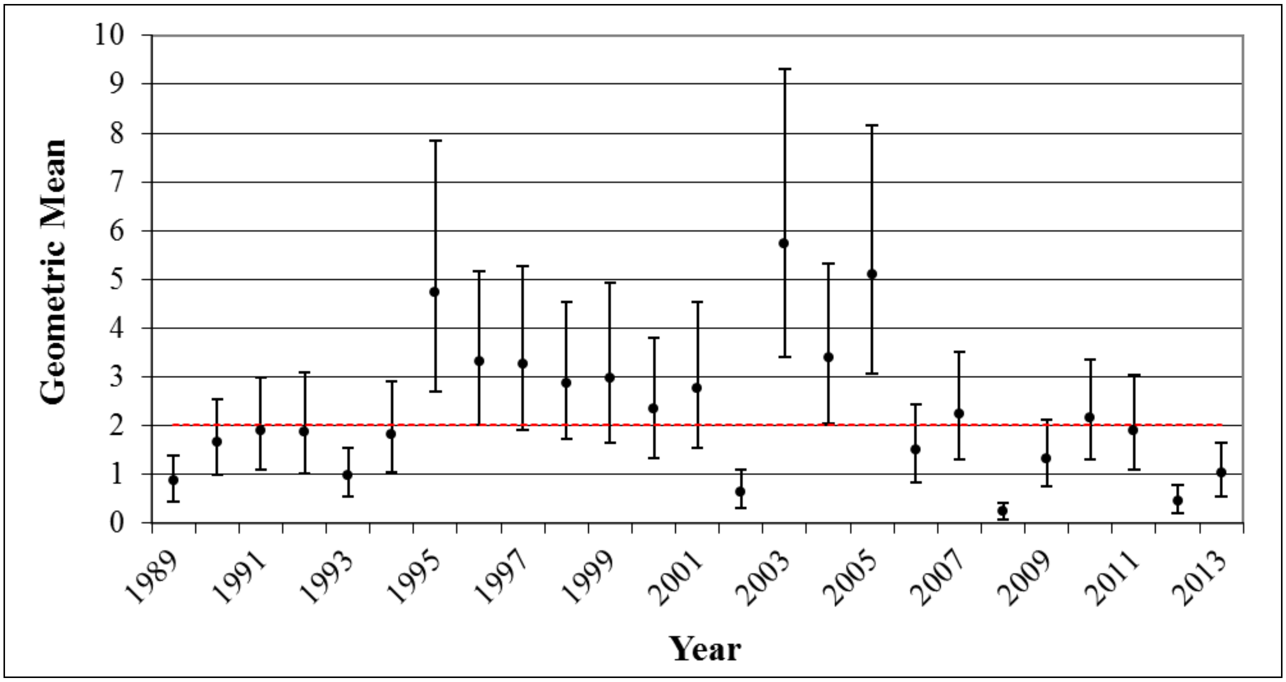

Figure 29. Weakfish (*Cynoscion regalis)* trawl index of relative abundance (geometric mean) with 95% confidence intervals (1989-2013). Dotted line represents the 1989-2013 time series grand mean. Protocols of the Coastal Bays Fisheries Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=140/year).

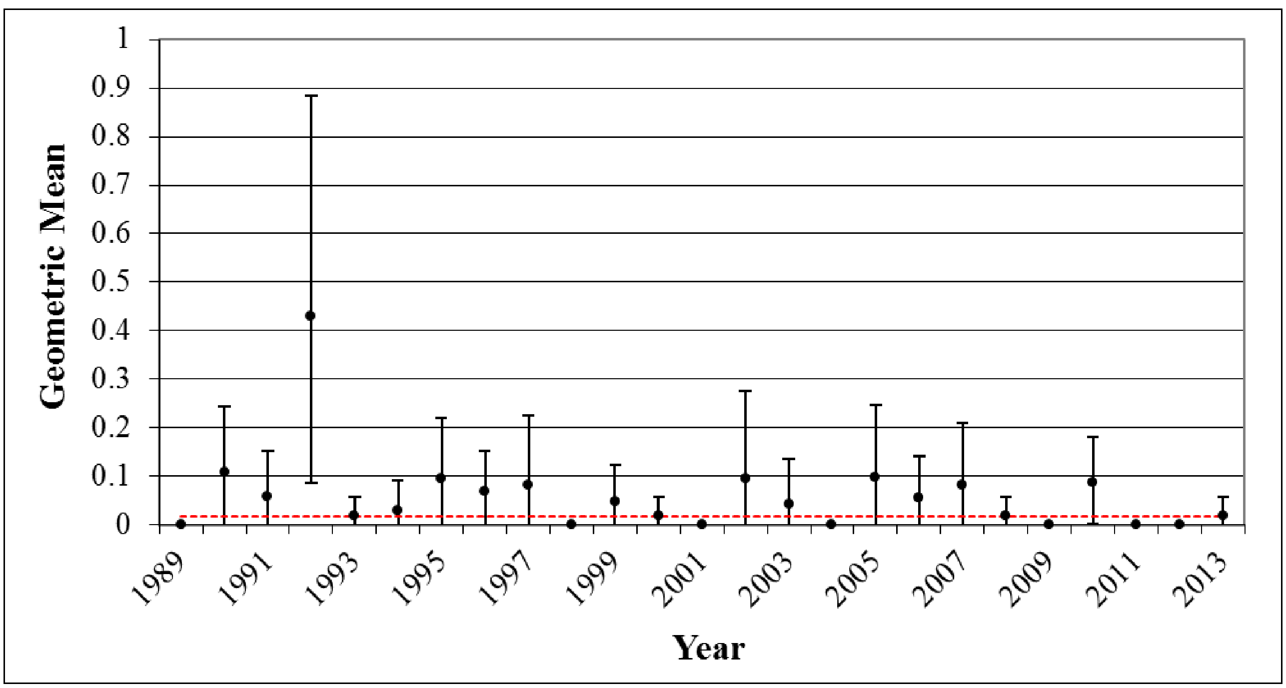

Figure 30. Weakfish (*Cynoscion regalis)* beach seine index of relative abundance (geometric mean) with 95% confidence intervals (1989-2013). Dotted line represents the 1989-2013 time series grand mean. Protocols of the Coastal Bays Fisheries Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=38/year).

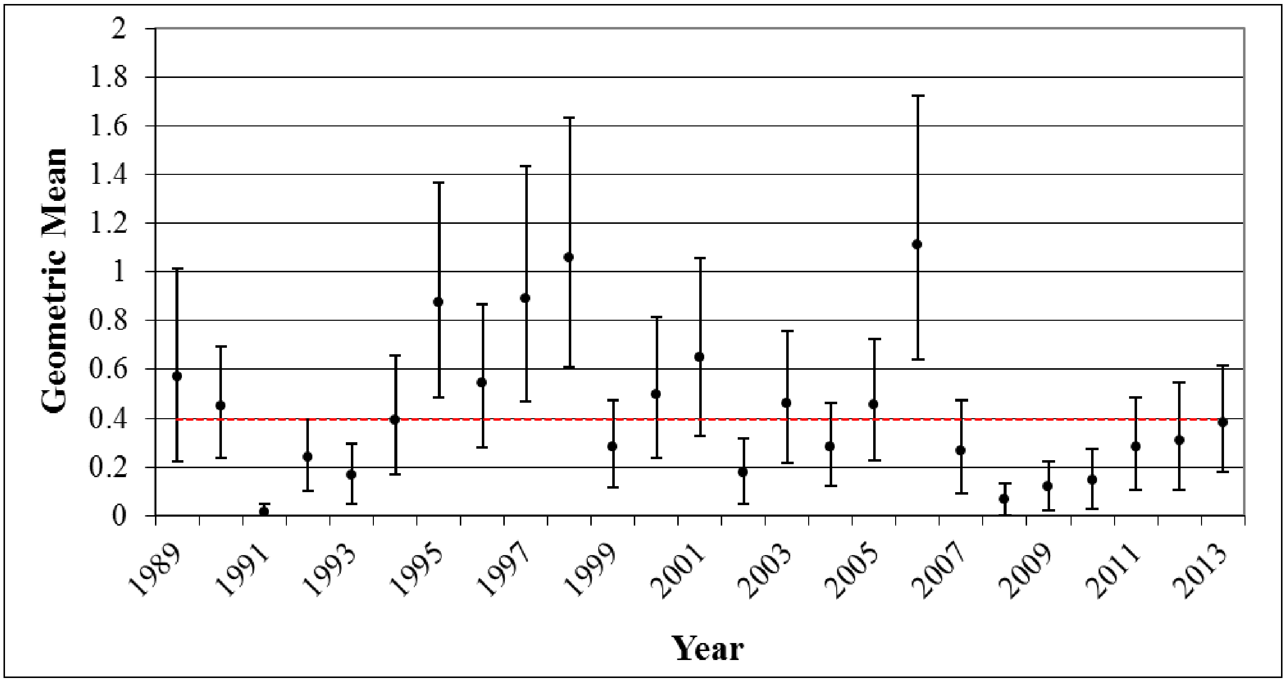

Figure 31. Winter Flounder (*Pseudopleuronectes americanus)* trawl index of relative abundance (geometric mean) with 95% confidence intervals (1989-2013). Dotted line represents the 1989-2013 time series grand mean. Protocols of the Coastal Bays Fisheries Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=140/year).

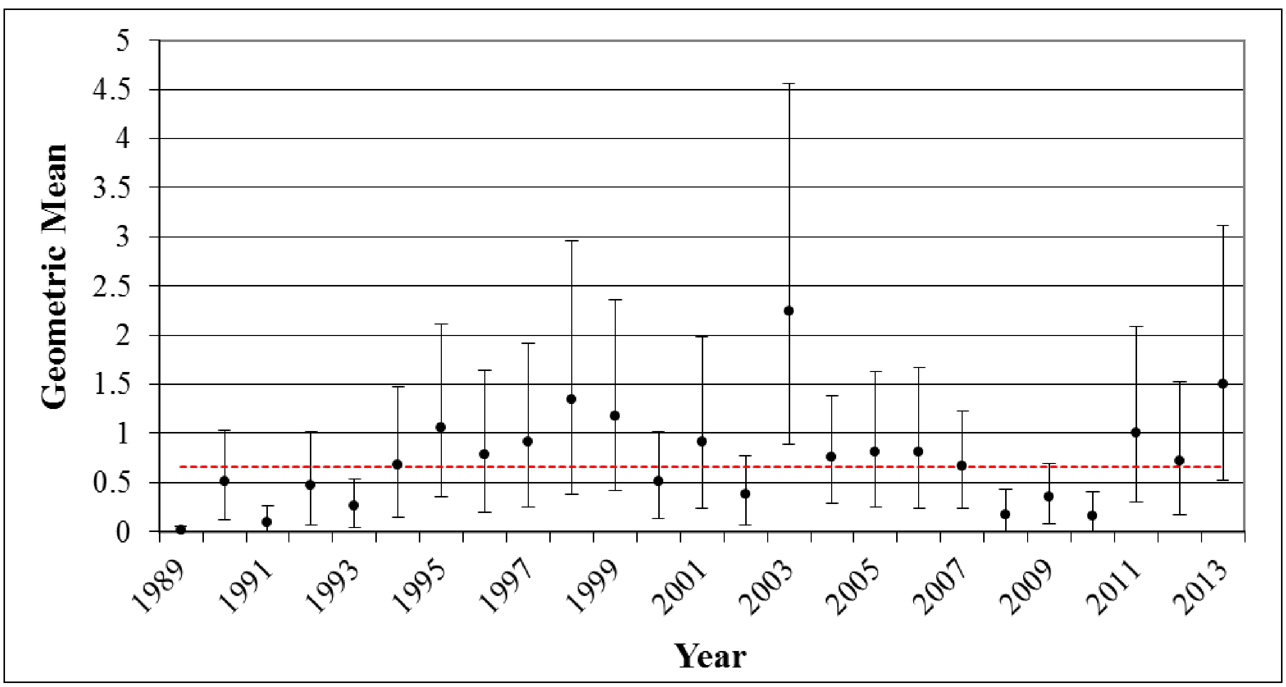

Figure 32. Winter Flounder (*Pseudopleuronectes americanus)* beach seine index of relative abundance (geometric mean) with 95% confidence intervals (1989-2013). Dotted line represents the 1989-2013 time series grand mean. Protocols of the Coastal Bays Fisheries Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=38/year).

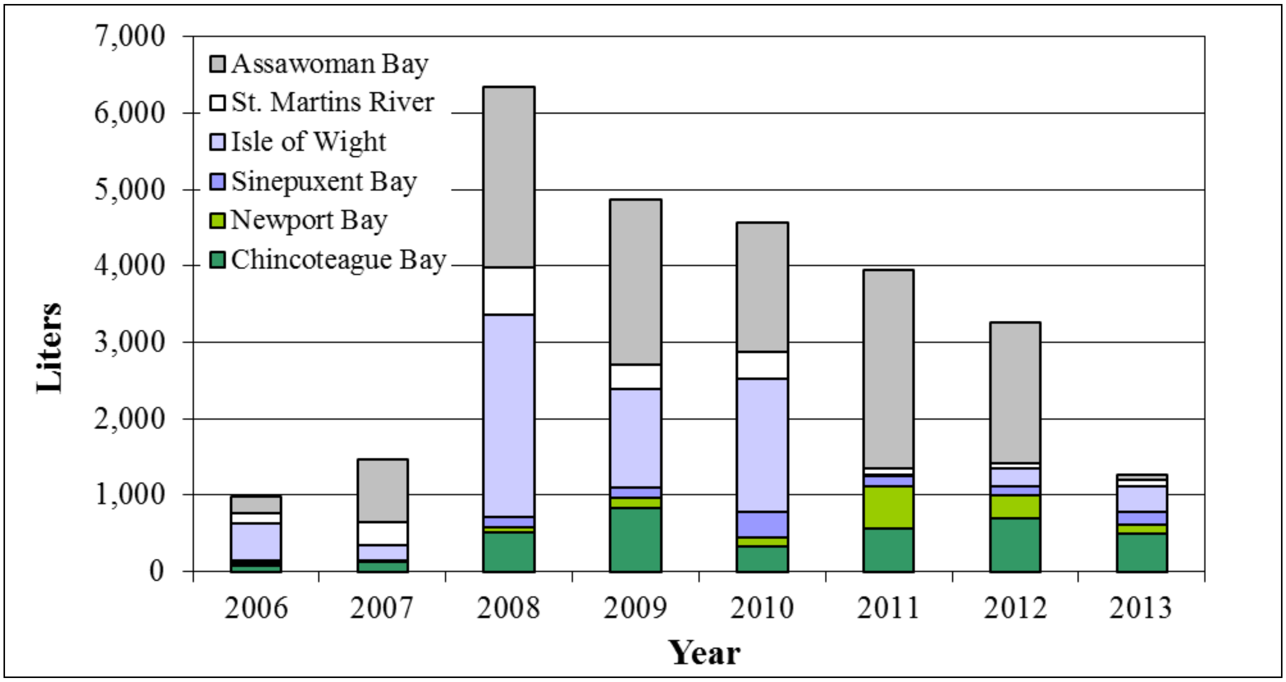

Figure 33. Macroalgae abundance by area and year from the Coastal Bays Fisheries Investigation Trawl Survey.

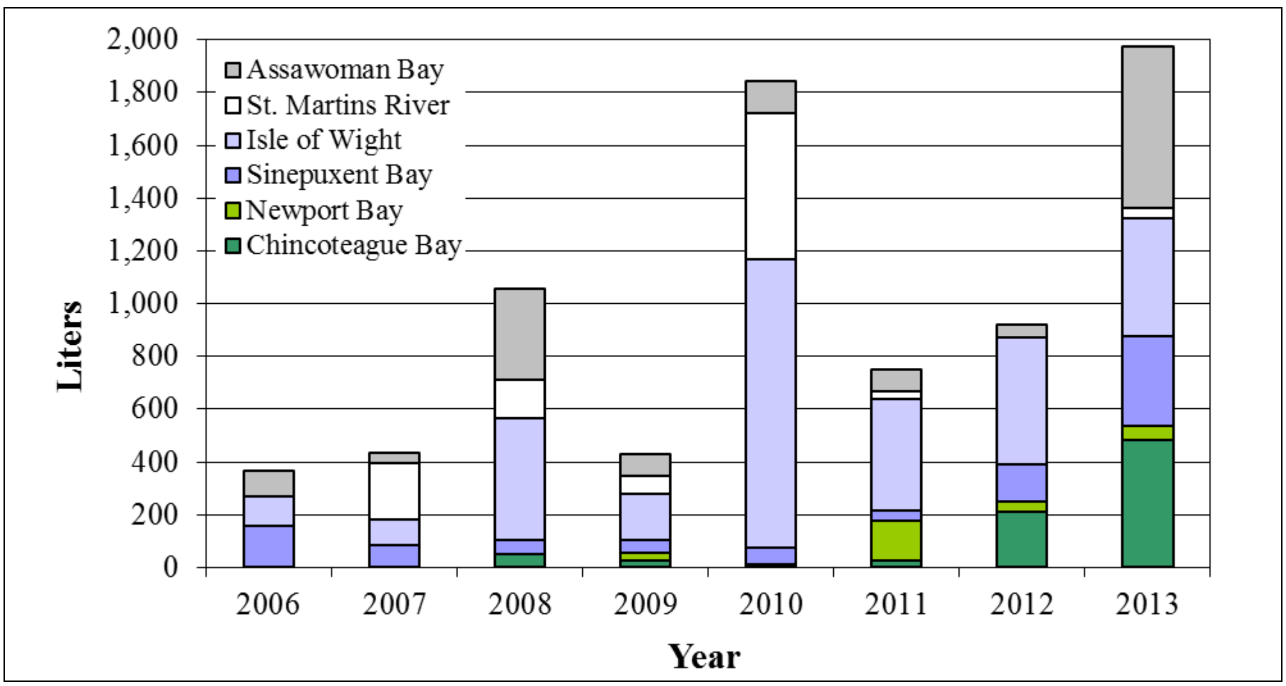

Figure 34. Macroalgae abundance by area and year from the Coastal Bays Fisheries Investigation Beach Seine Survey.

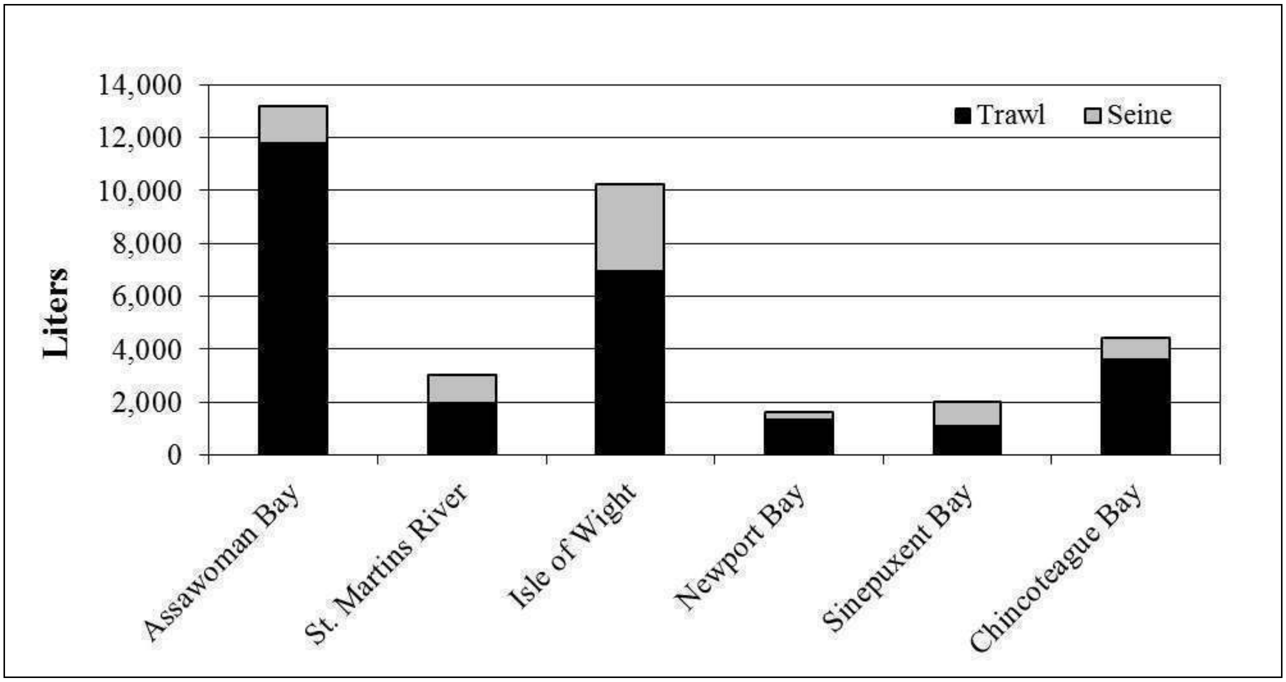

Figure 35. Total macroalgae abundance by area over the eight-year time series (2006-2013) from the Coastal Bays Fisheries Investigation Trawl and Beach Seine Survey.

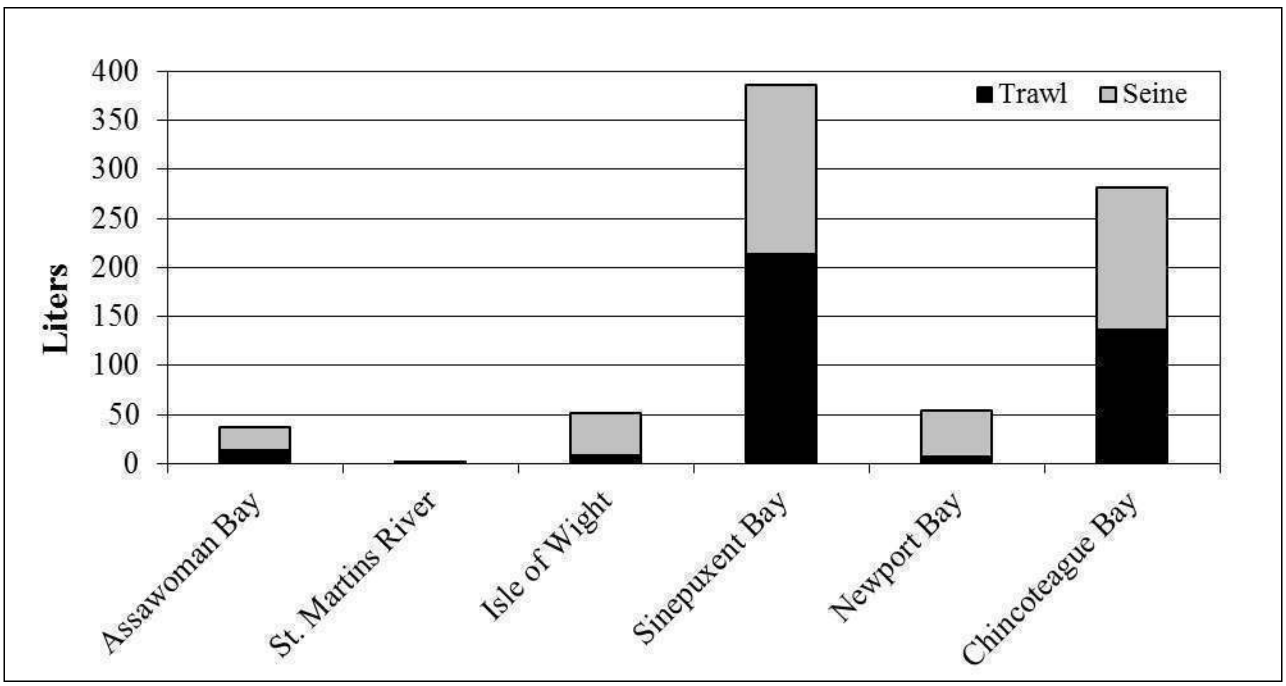

Figure 36. Total submerged aquatic vegetation abundance by area over the eight-year time series (2006-2013) from the Coastal Bays Fisheries Investigation Trawl and Beach Seine Survey.

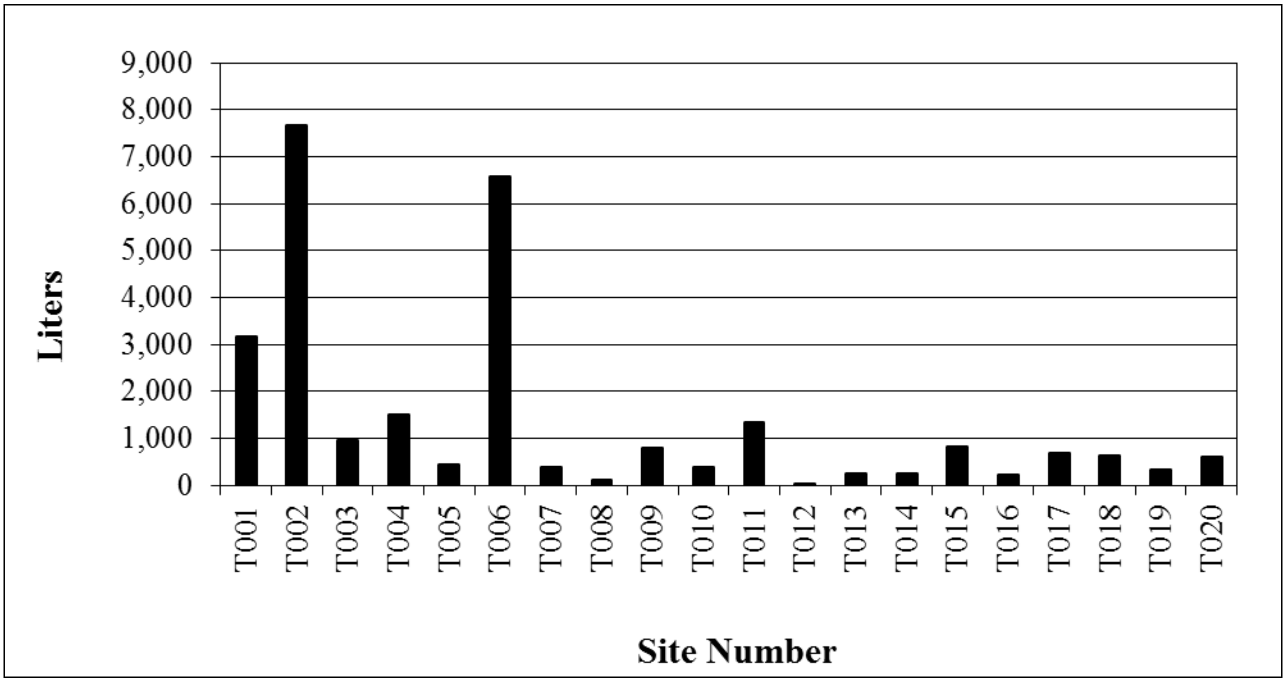

Figure 37. Total volume of macroalgae and submerged aquatic vegetation by site number in the 2006- 2013 time series by the Coastal Bays Fisheries Investigation Trawl Survey.

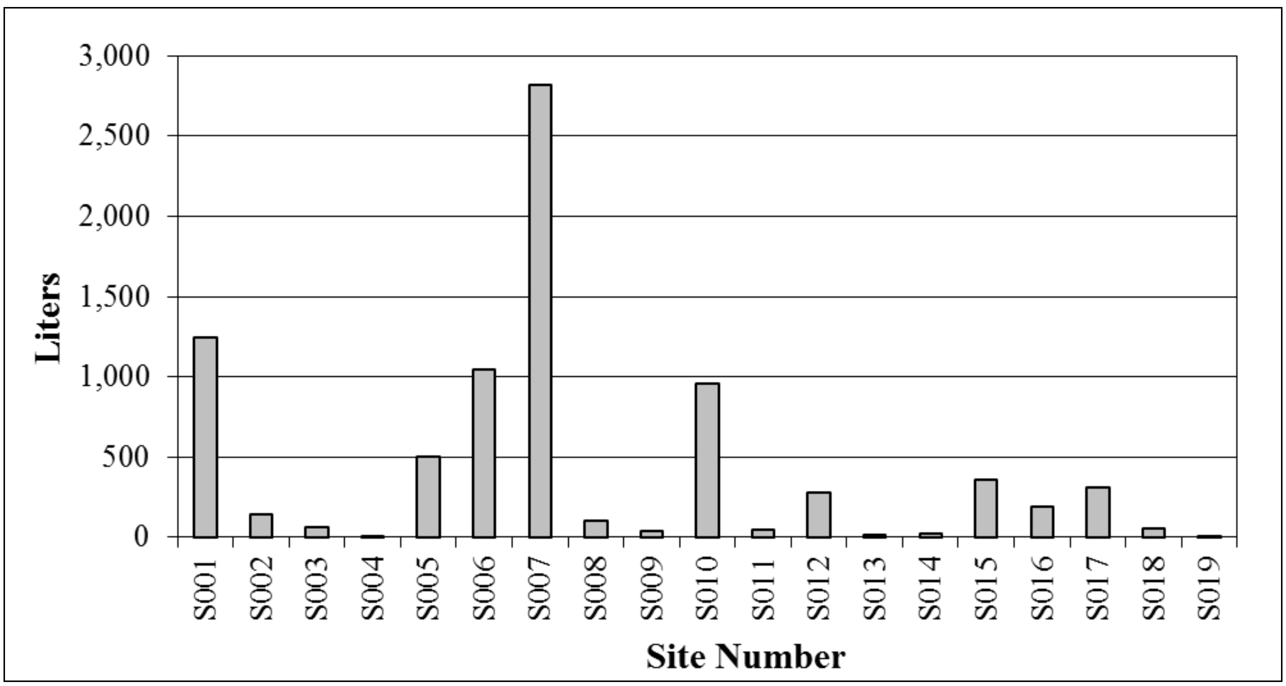

Figure 38. Total volume of macroalgae and submerged aquatic vegetation by site number in the 2006-2013 time series by the Coastal Bays Fisheries Investigation Beach Seine Survey.

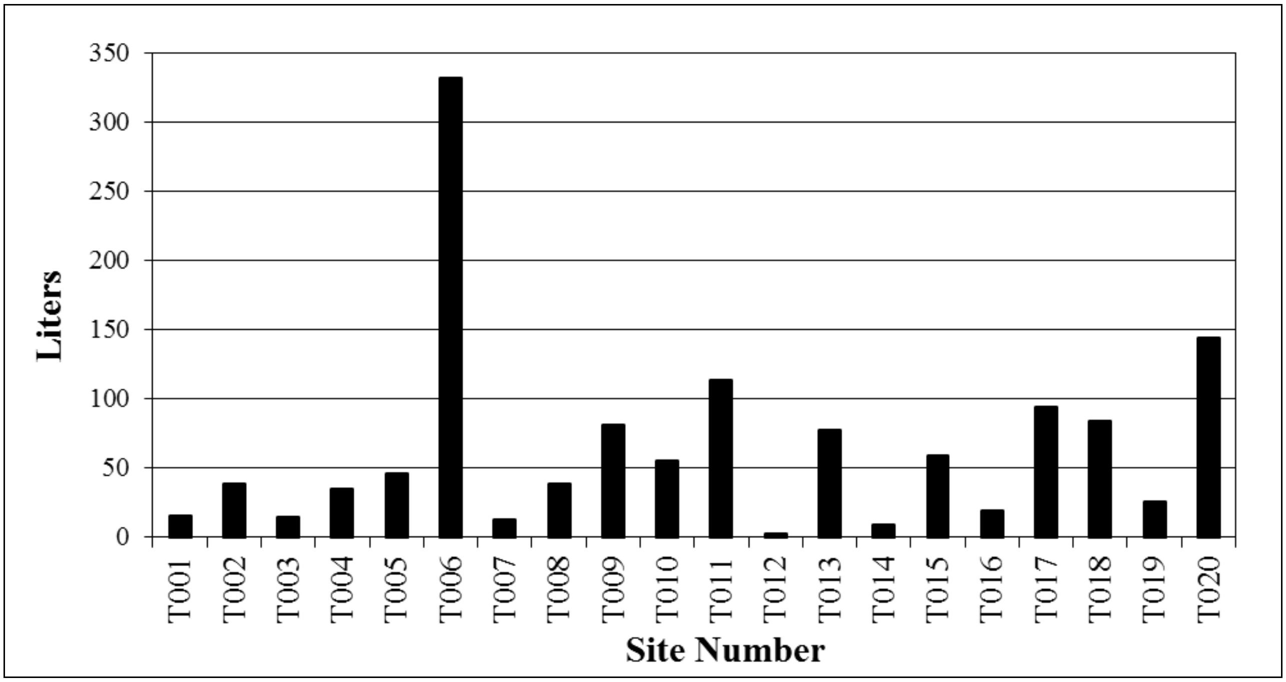

Figure 39. Total volume of macroalgae and submerged aquatic vegetation by site number in 2013 by the Coastal Bays Fisheries Investigation Trawl Survey.

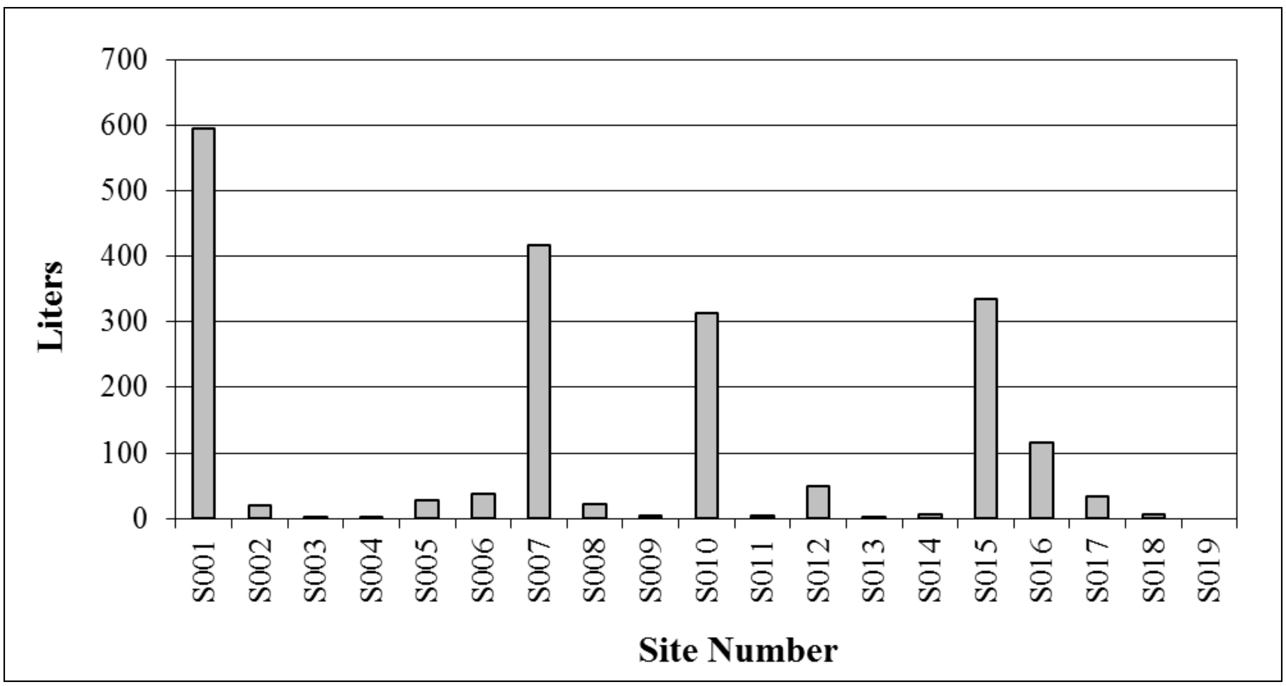

Figure 40. Total volume of macroalgae and submerged aquatic vegetation by site number in 2013 by the Coastal Bays Fisheries Investigation Beach Seine Survey.

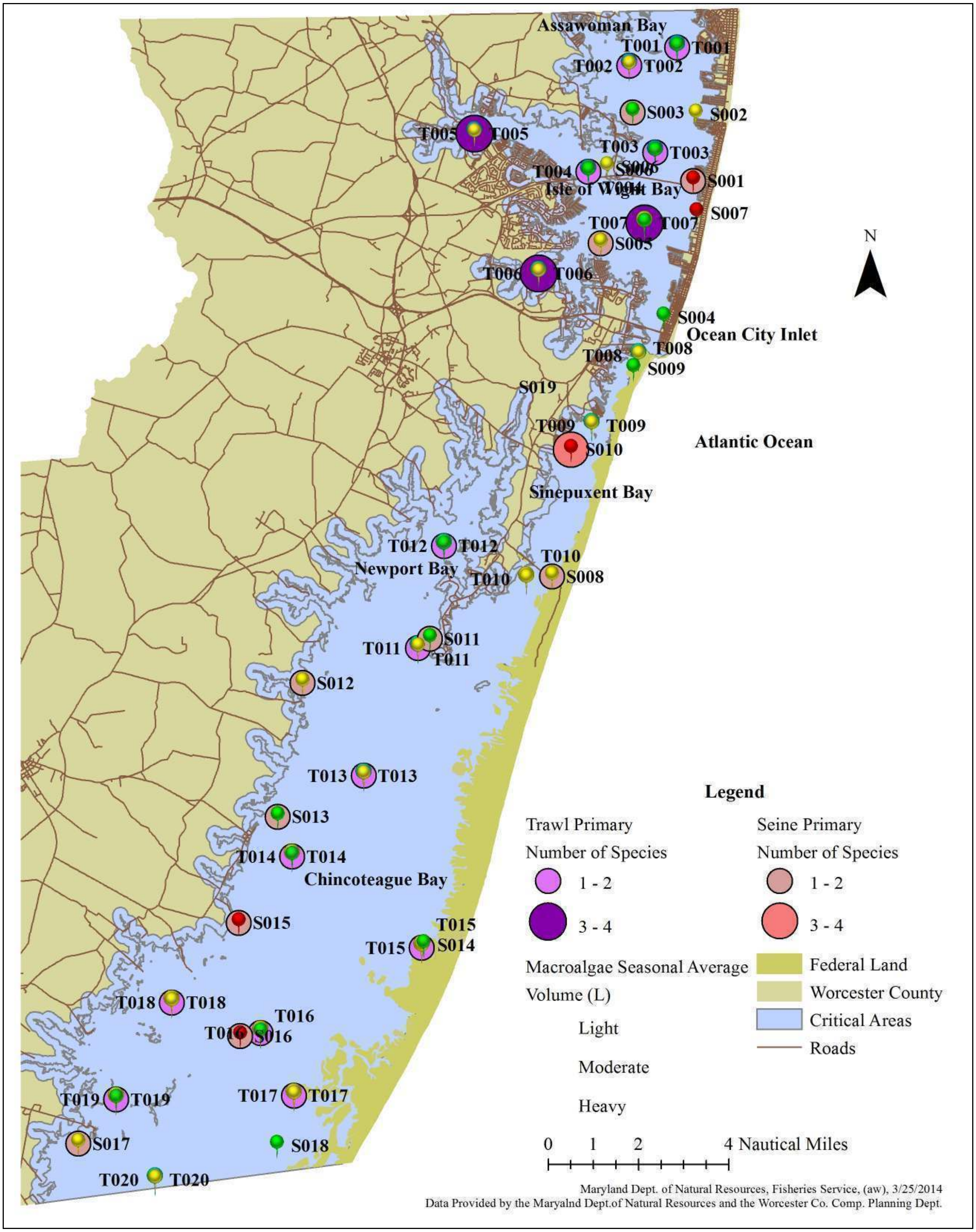

Figure 41. Coastal Bays Fisheries Investigation Trawl and Beach Seine Survey finfish primary site preferences and seasonal average macroalgae abundance.

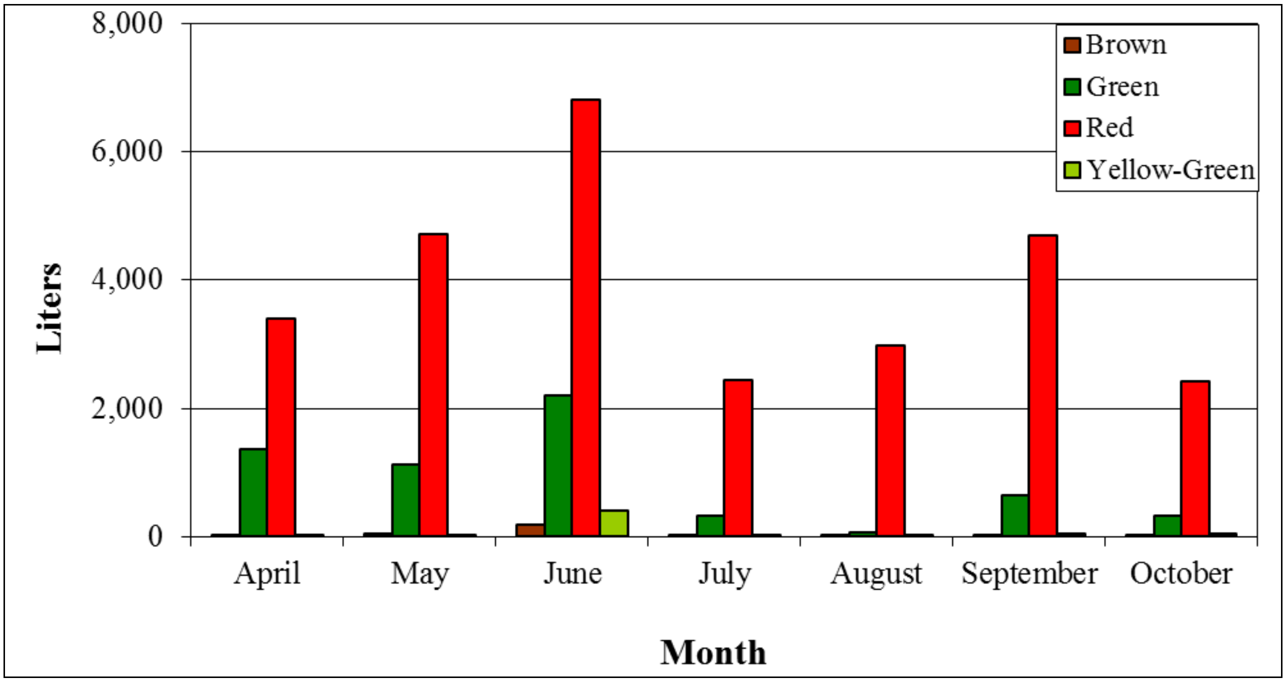

Figure 42. Total macroalgae abundance by color category by month for the time series (2006-2013) from the Coastal Bays Fisheries Investigation Trawl and Beach Seine Survey.

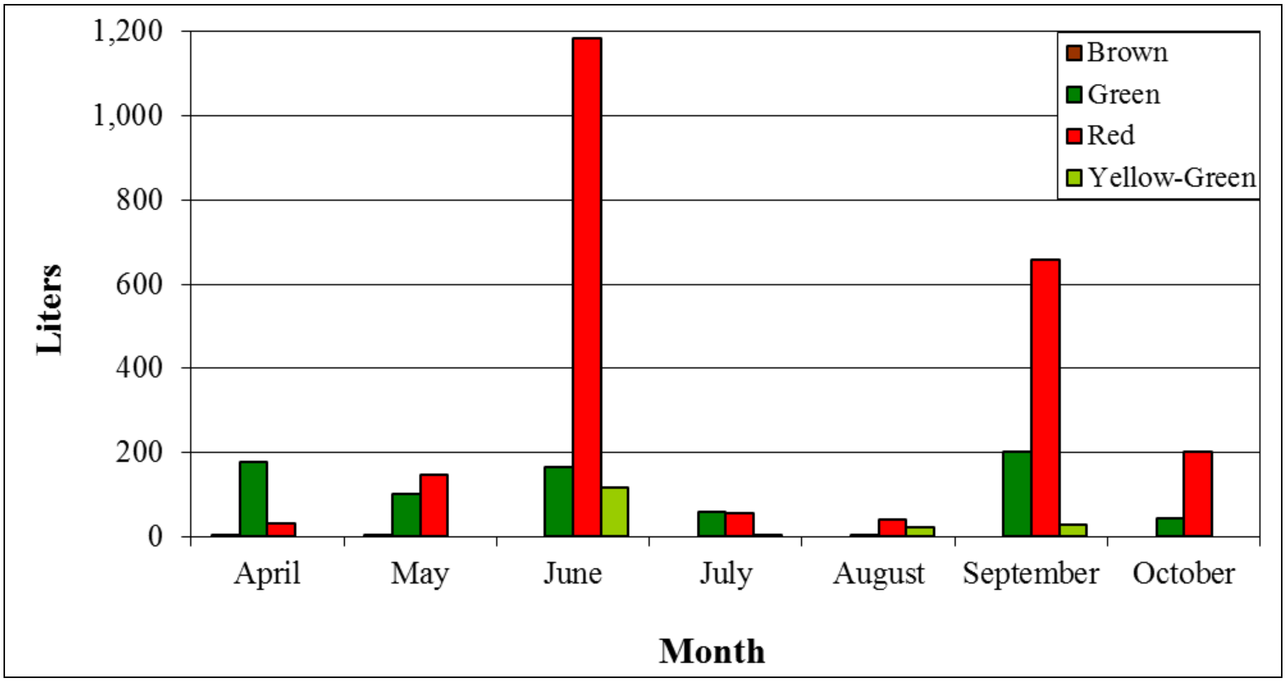

Figure 43. Total macroalgae abundance by color category by month in 2013 from the Coastal Bays Fisheries Investigation Trawl and Beach Seine Survey.

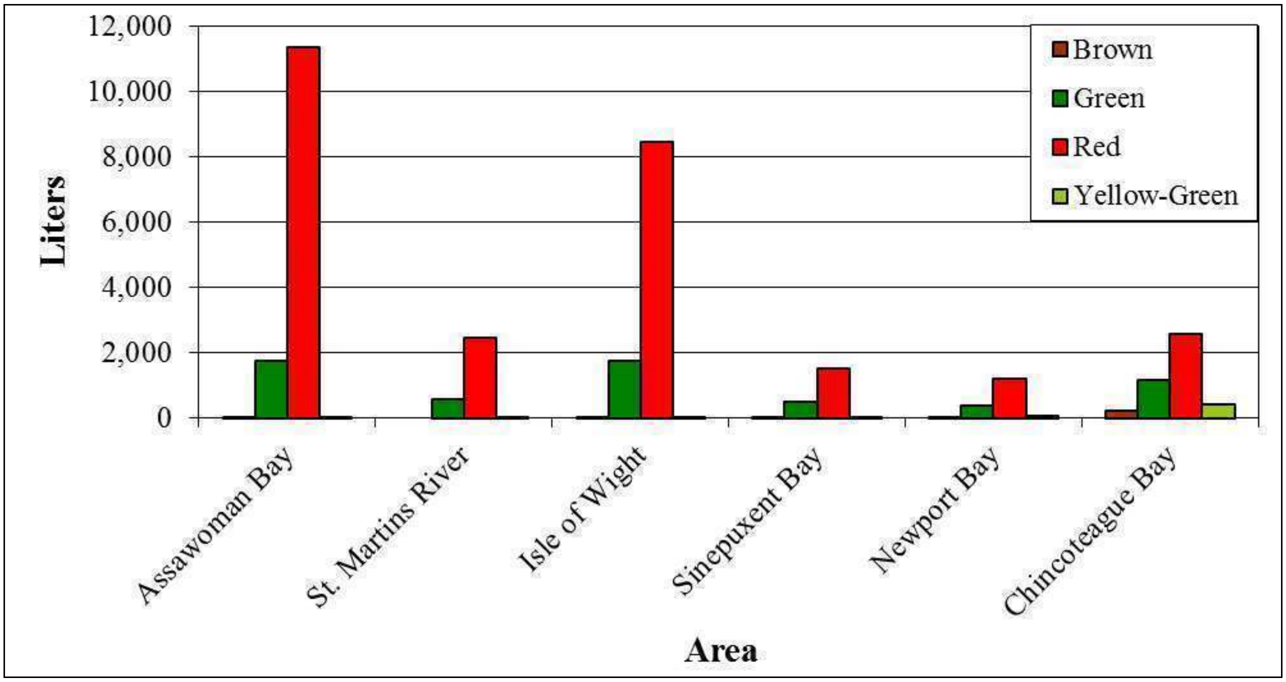

Figure 44. Total macroalgae abundance by color category by area for the time series (2006-2013) from the Coastal Bays Fisheries Investigation Trawl and Beach Seine Survey.

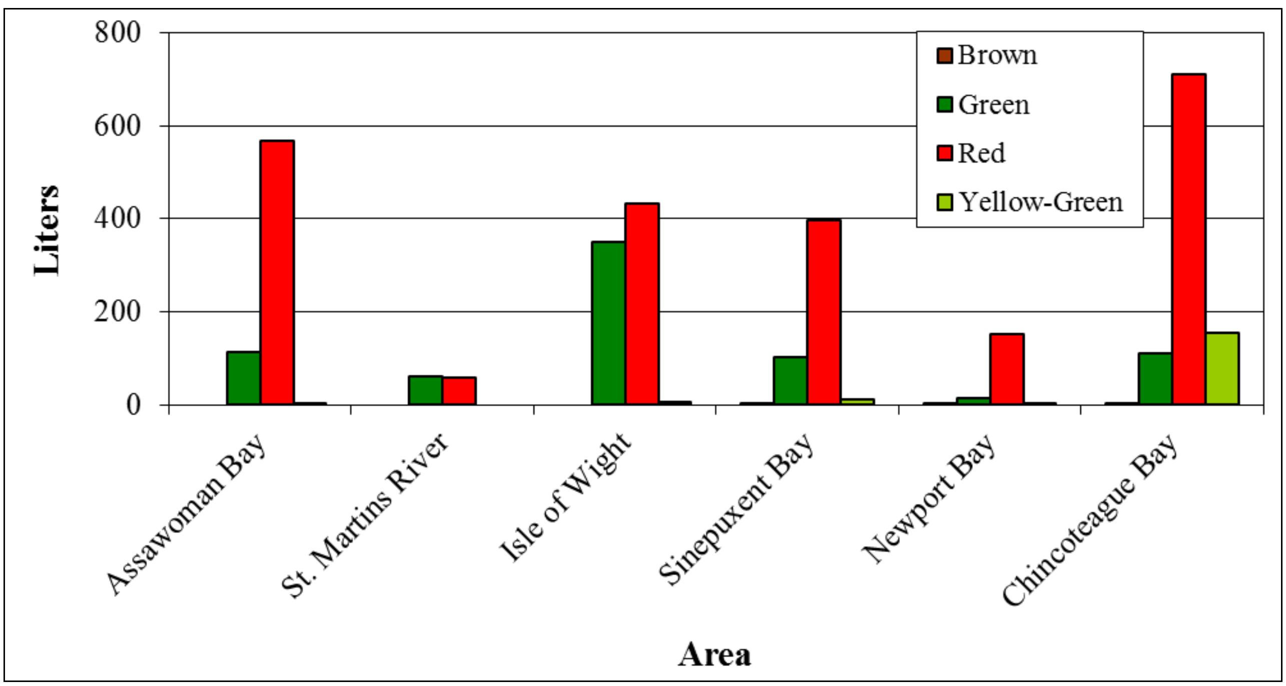

Figure 45. Total macroalgae abundance by color category by area for 2013 from the Coastal Bays Fisheries Investigation Trawl and Beach Seine Survey.

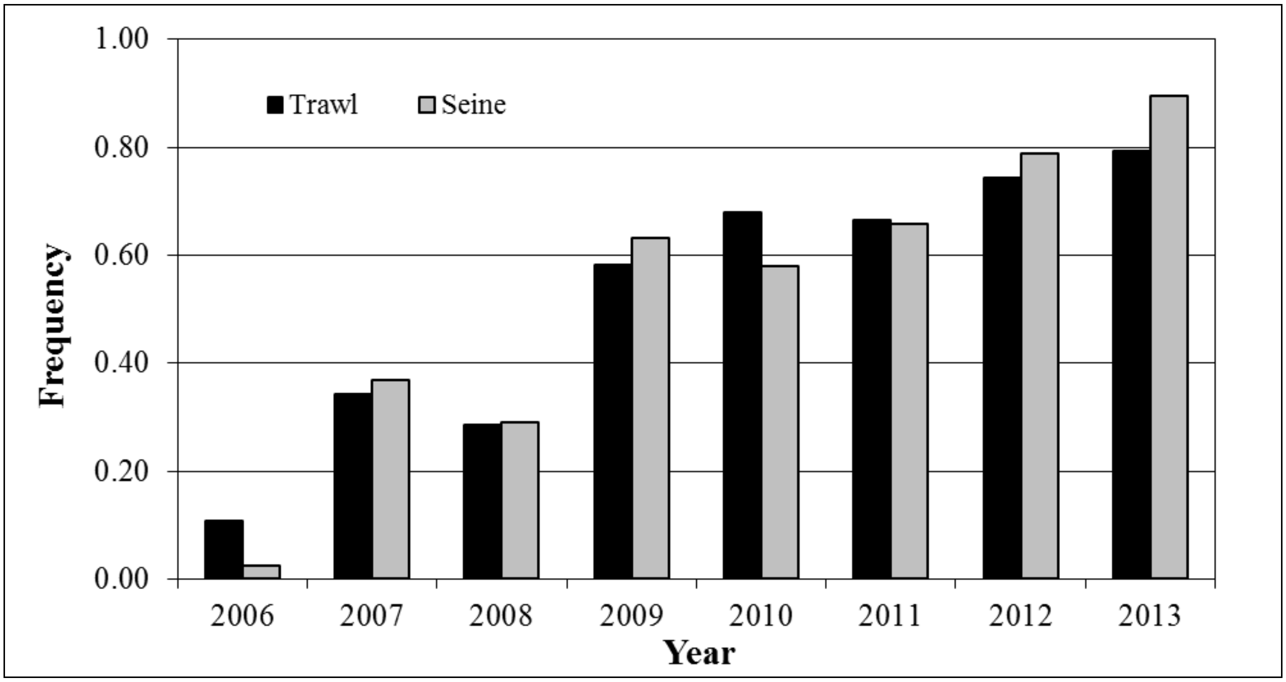

Figure 46. Agardh's Red Weed (*Agardhiella tenera*) abundance by percent frequency of positive hauls from 2006-2013 by the Coastal Bays Fisheries Investigation Trawl and Beach Seine Survey.

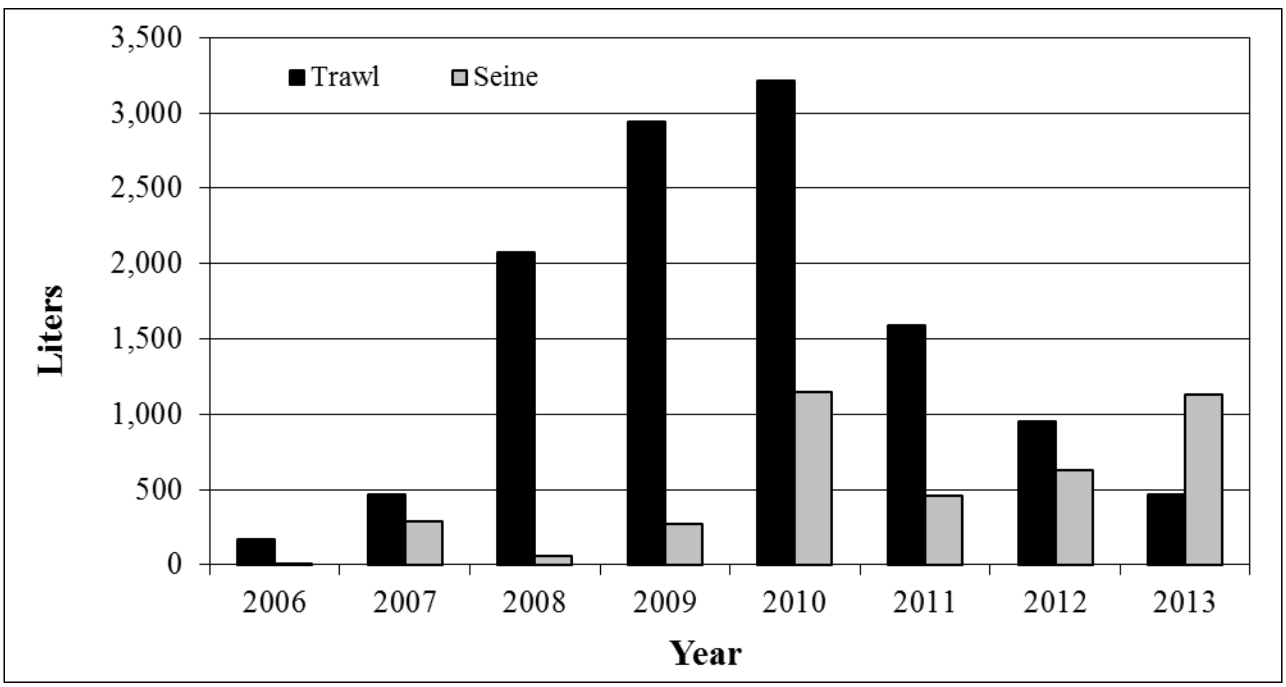

Figure 47. Agardh's Red Weed (*Agardhiella tenera*) abundance by volume collected from 2006-2013 by the Coastal Bays Fisheries Investigation Trawl and Beach Seine Survey.

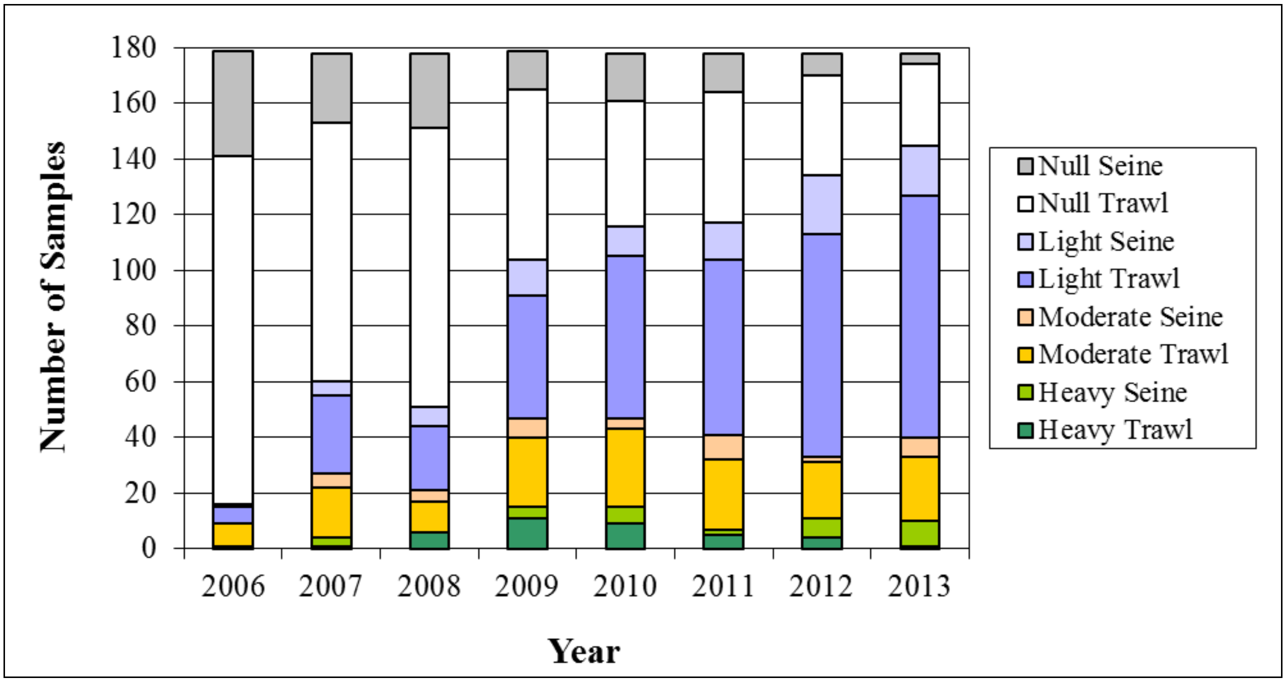

Figure 48. Agardh's Red Weed (*Agardhiella tenera*) volume load categories from 2006-2013 by the Coastal Bays Fisheries Investigation Trawl and Beach Seine Survey.

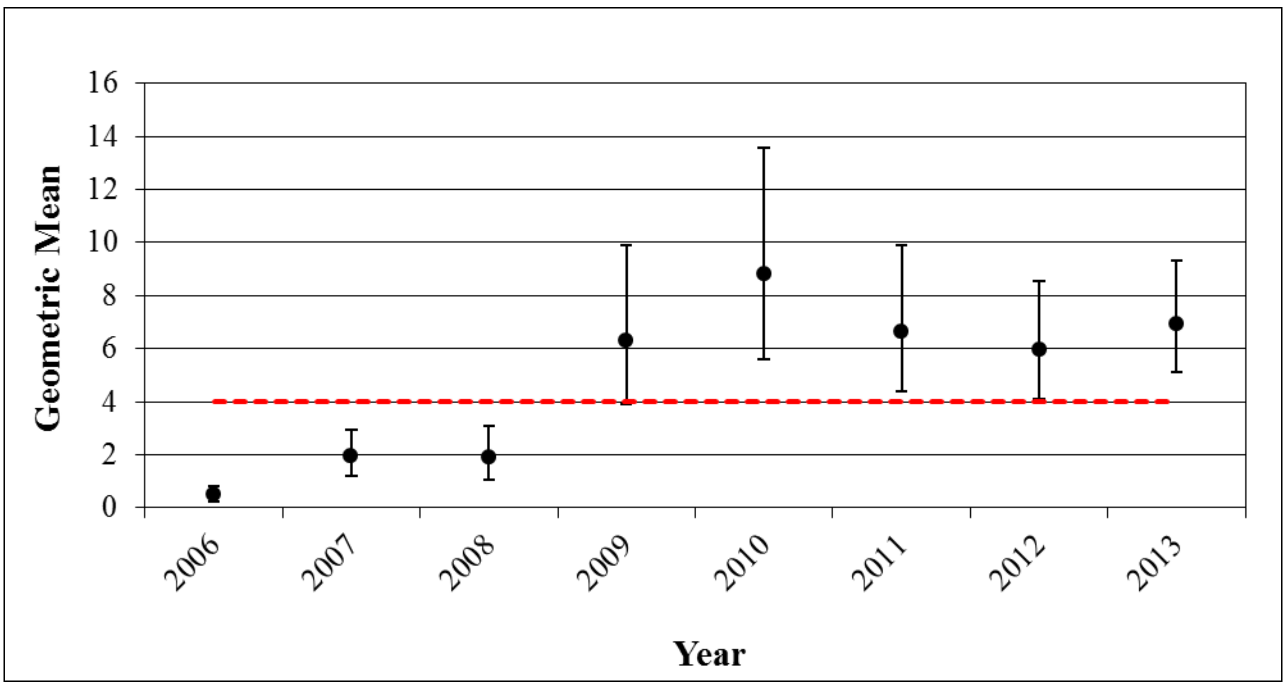

Figure 49. Agardh's Red Weed (*Agardhiella tenera*) trawl index of relative abundance (geometric mean) with 95% confidence intervals (2006-2013). Dotted line represents the 2006-2013 time series grand mean, (n=140/year).

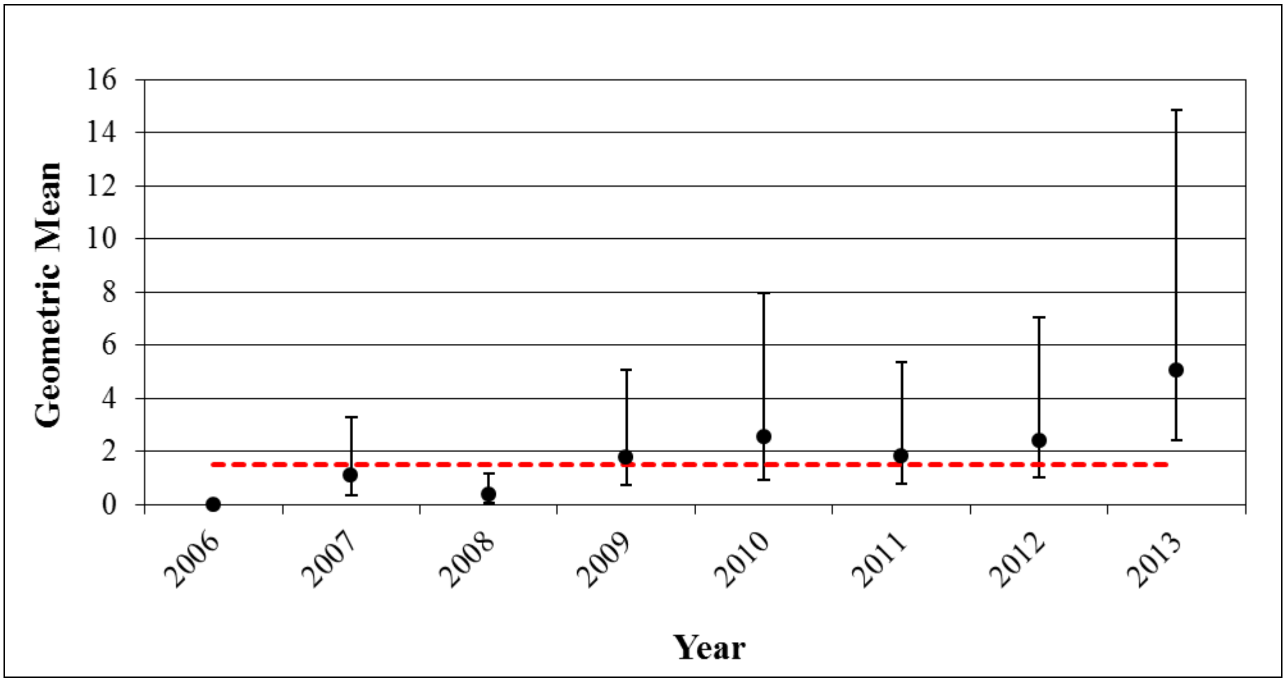

Figure 50. Agardh's Red Weed (*Agardhiella tenera*) beach seine index of relative abundance (geometric mean) with 95% confidence intervals (2006-2013). Dotted line represents the 2006-2013 time series grand mean, (n=38/year).

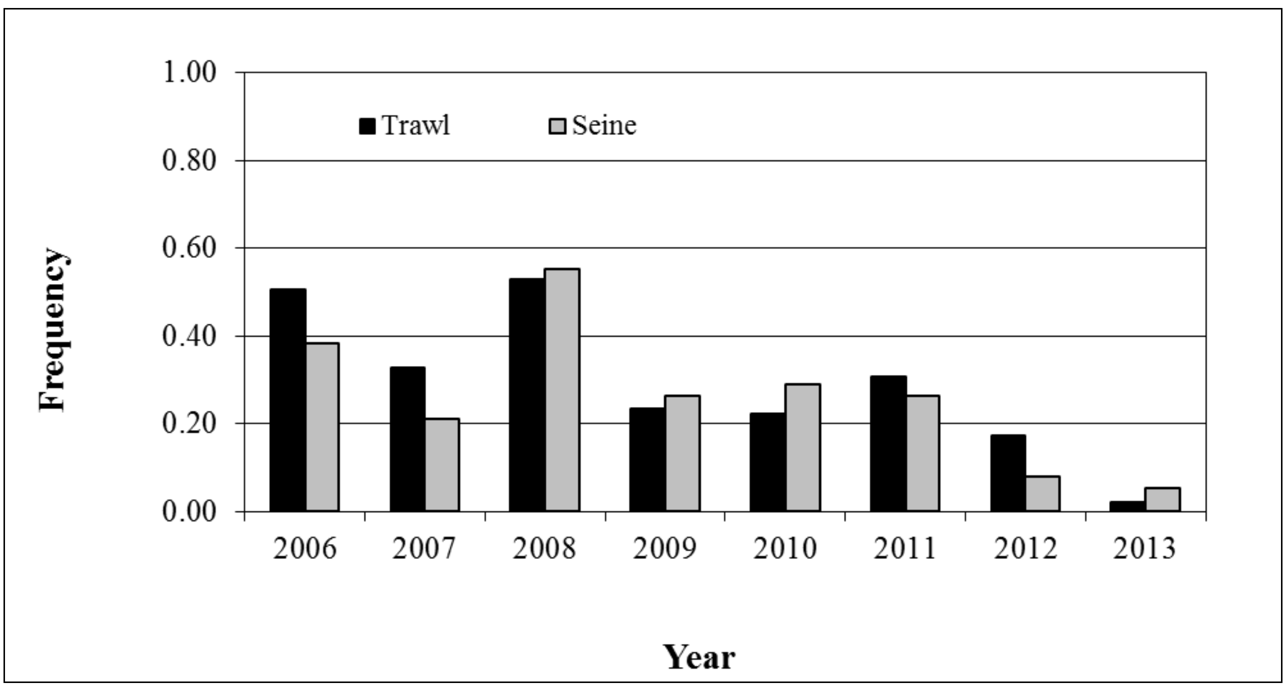

Figure 51. Graceful Red Weed (*Gracilaria sp.*) abundance by percent frequency of positive hauls from 2006-2013 by the Coastal Bays Fisheries Investigation Trawl and Beach Seine Survey.

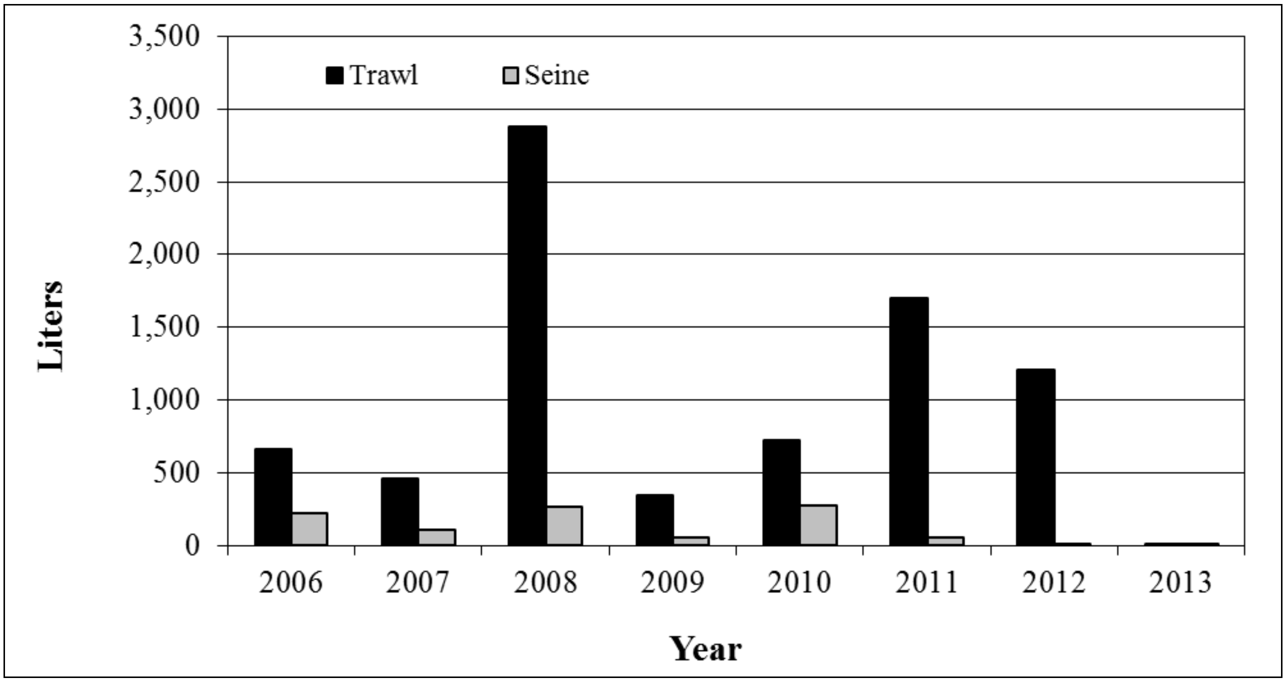

Figure 52. Graceful Red Weed (*Gracilaria sp.*) abundance by volume collected from 2006-2013 by the Coastal Bays Fisheries Investigation Trawl and Beach Seine Survey.

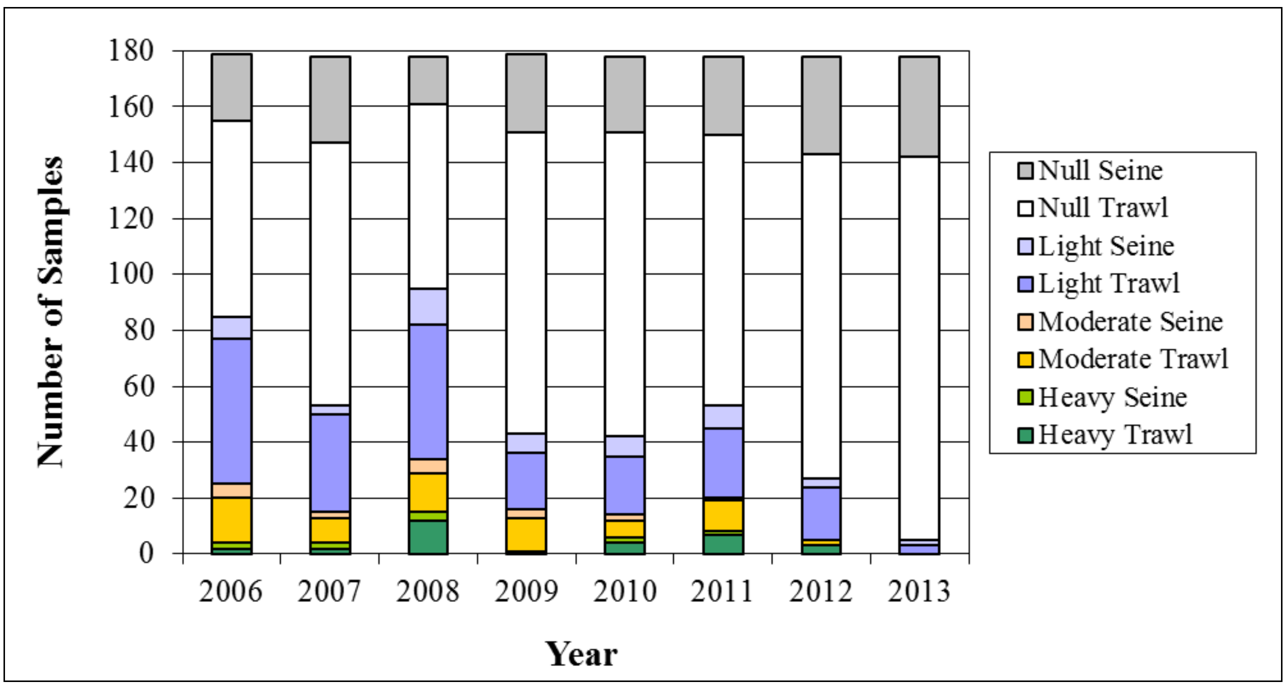

Figure 53. Graceful Red Weed (*Gracilaria sp.*) volume load categories from 2006-2013 by the Coastal Bays Fisheries Investigation Trawl and Beach Seine Survey.

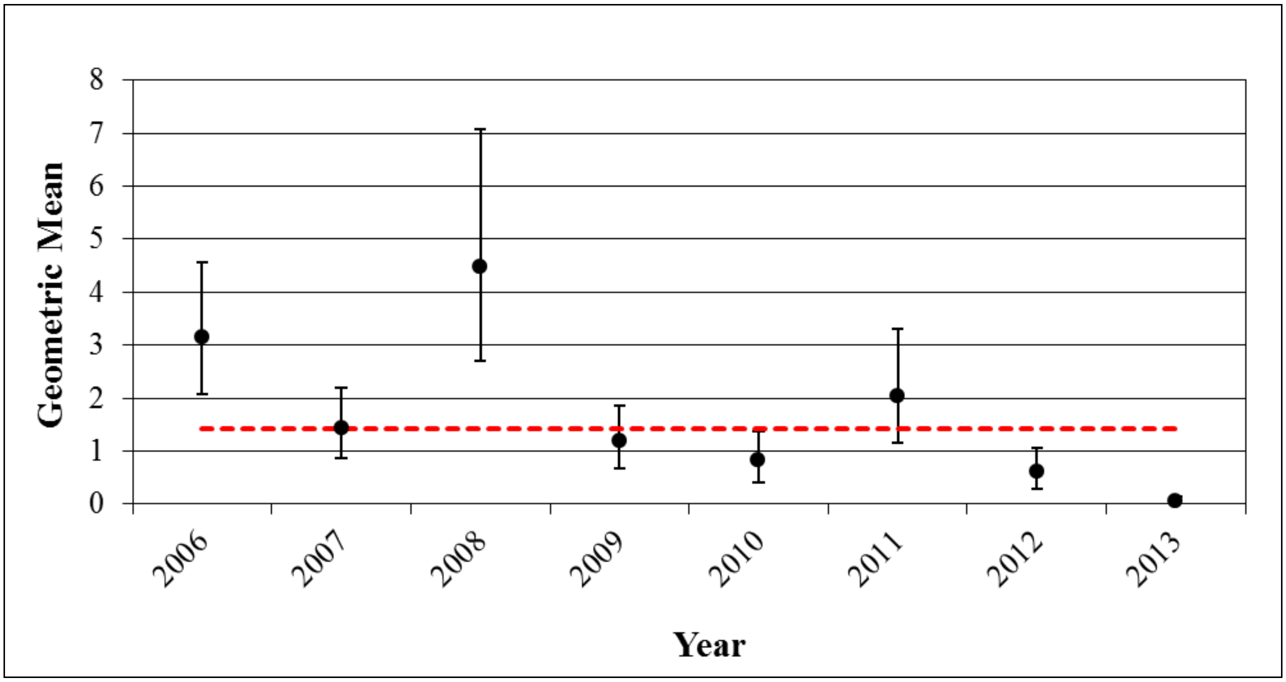

Figure 54. Graceful Red Weed (*Gracilaria sp.*) trawl index of relative abundance (geometric mean) with 95% confidence intervals (2006-2013). Dotted line represents the 2006-2013 time series grand mean, (n=140/year).

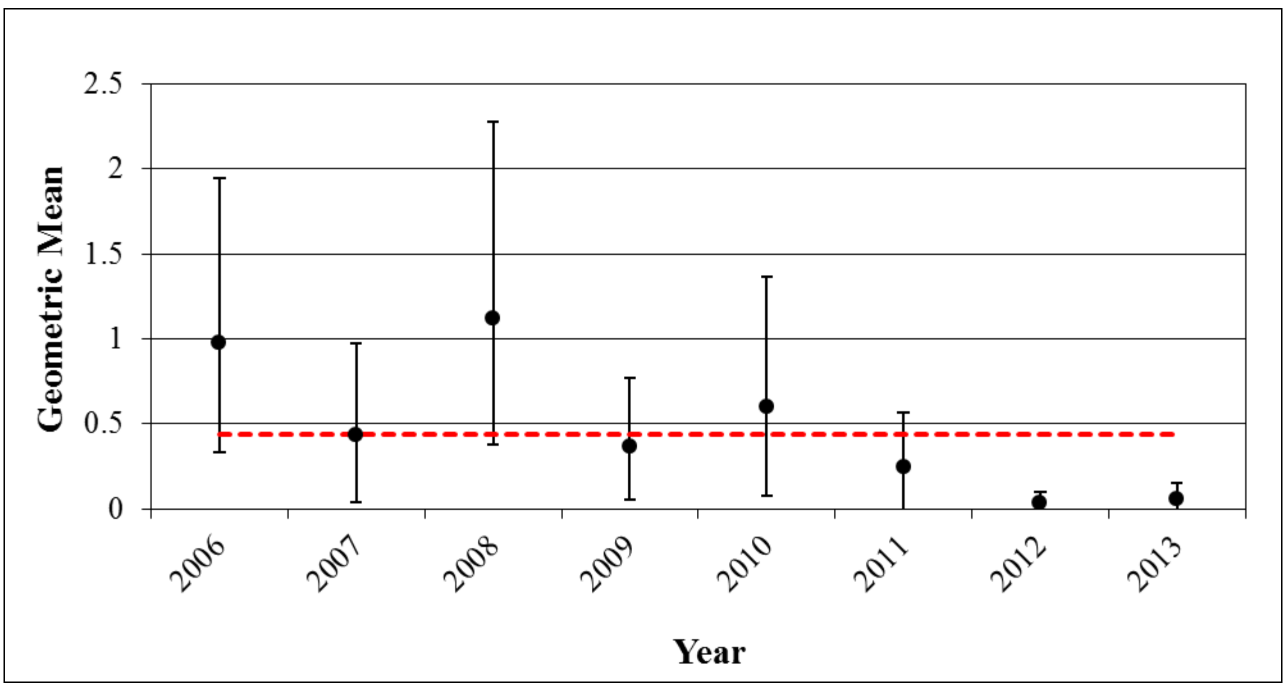

Figure 55. Graceful Red Weed (*Gracilaria sp.*) seine index of relative abundance (geometric mean) with 95% confidence intervals (2006-2013). Dotted line represents the 2006-2013 time series grand mean, (n=38/year).

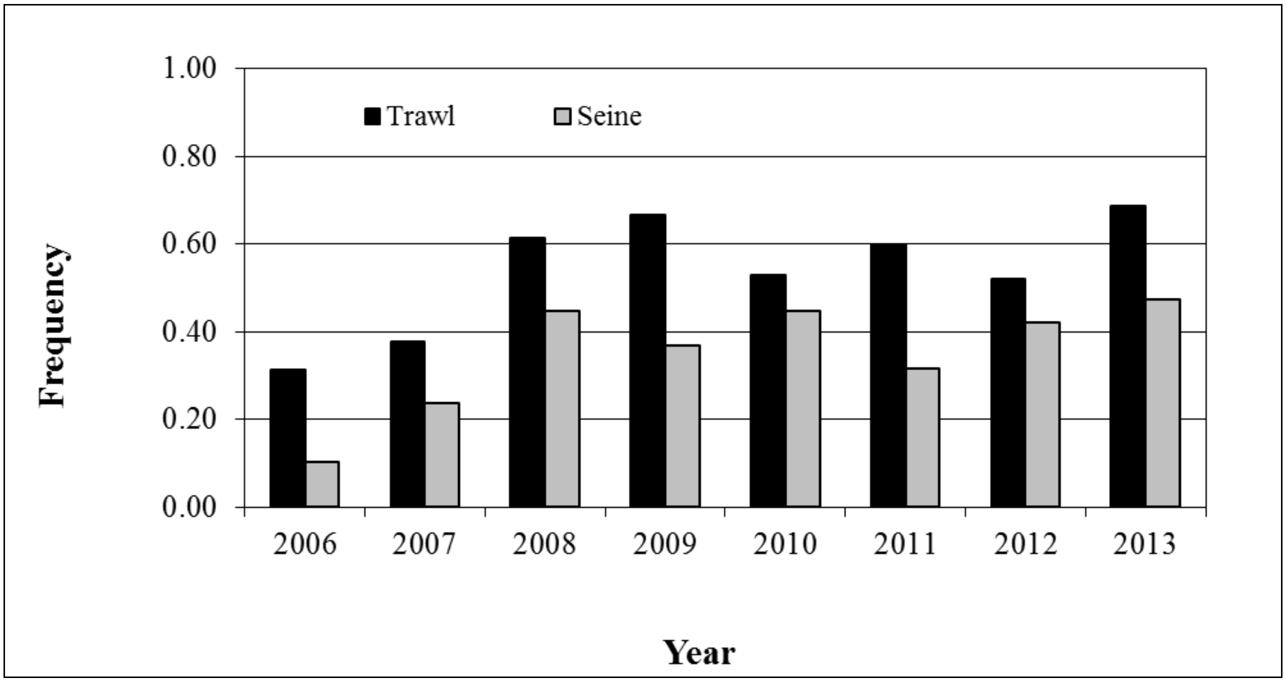

Figure 56. Sea Lettuce (*Ulva lactuca*) abundance by percent frequency of positive hauls from 2006-2013 by the Coastal Bays Fisheries Investigation Trawl and Beach Seine Survey.

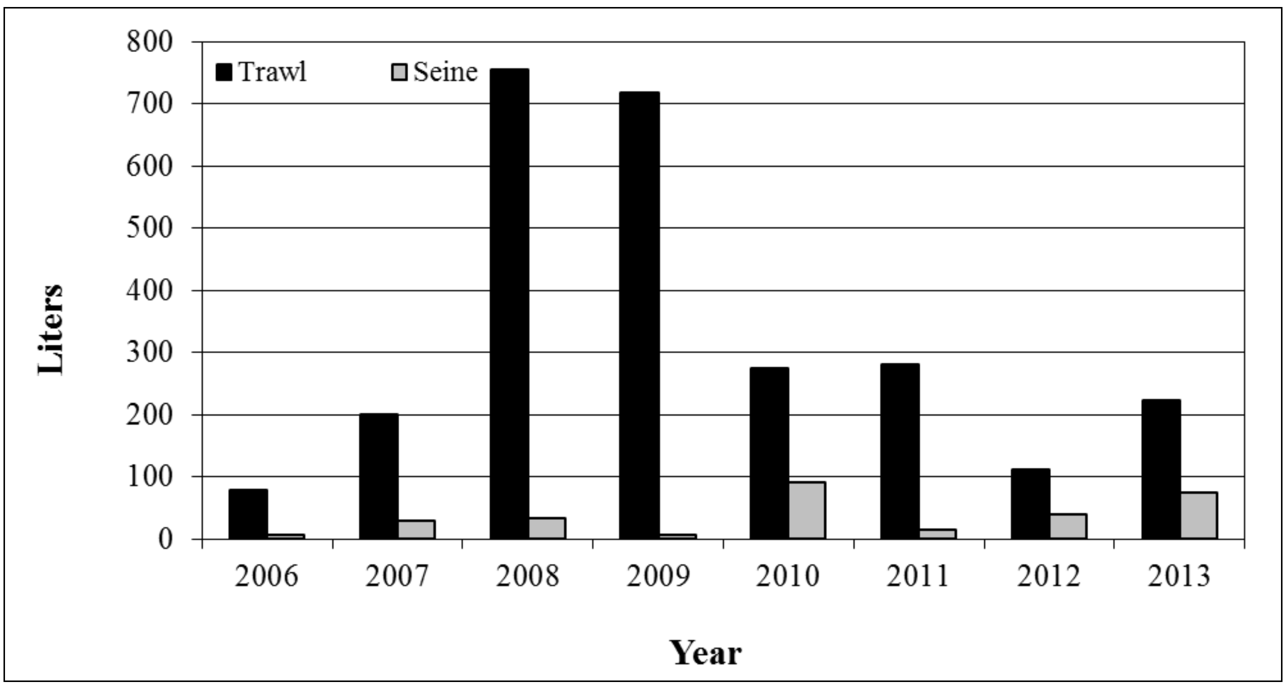

Figure 57. Sea Lettuce (*Ulva lactuca*) abundance by volume collected from 2006-2013 by the Coastal Bays Fisheries Investigation Trawl and Beach Seine Survey.

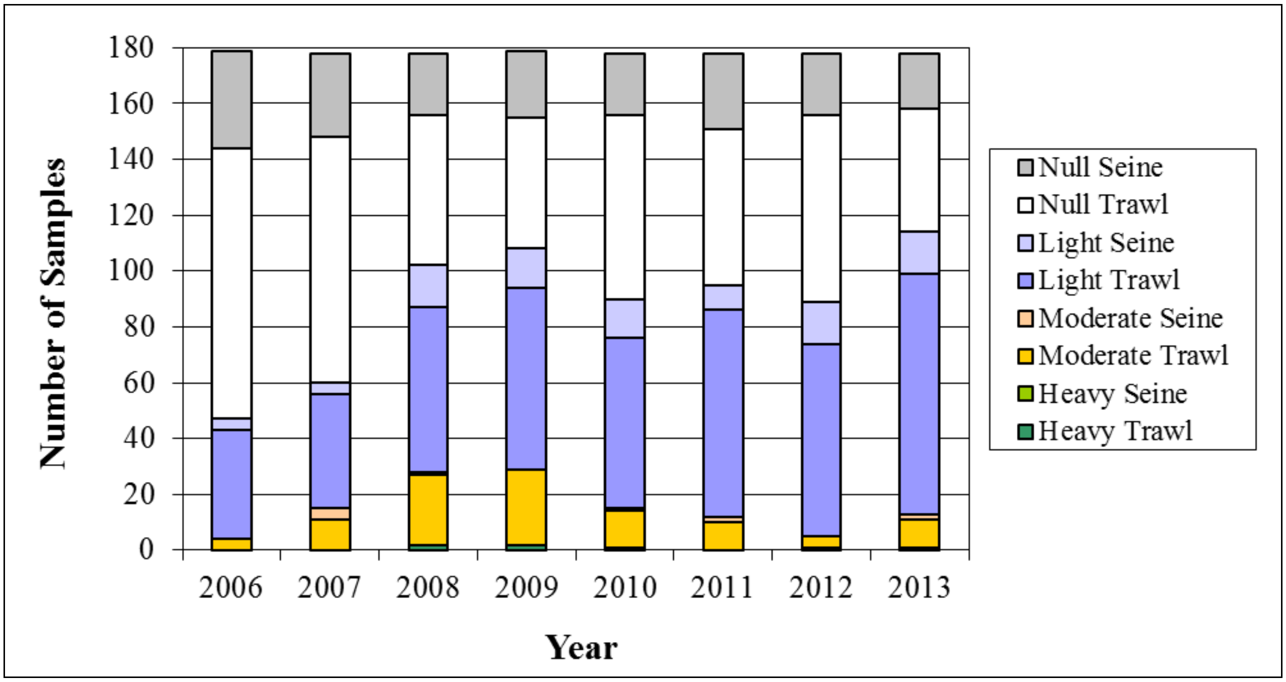

Figure 58. Sea Lettuce (*Ulva lactuca*) volume load categories from 2006-2013 by the Coastal Bays Fisheries Investigation Trawl and Beach Seine Survey.

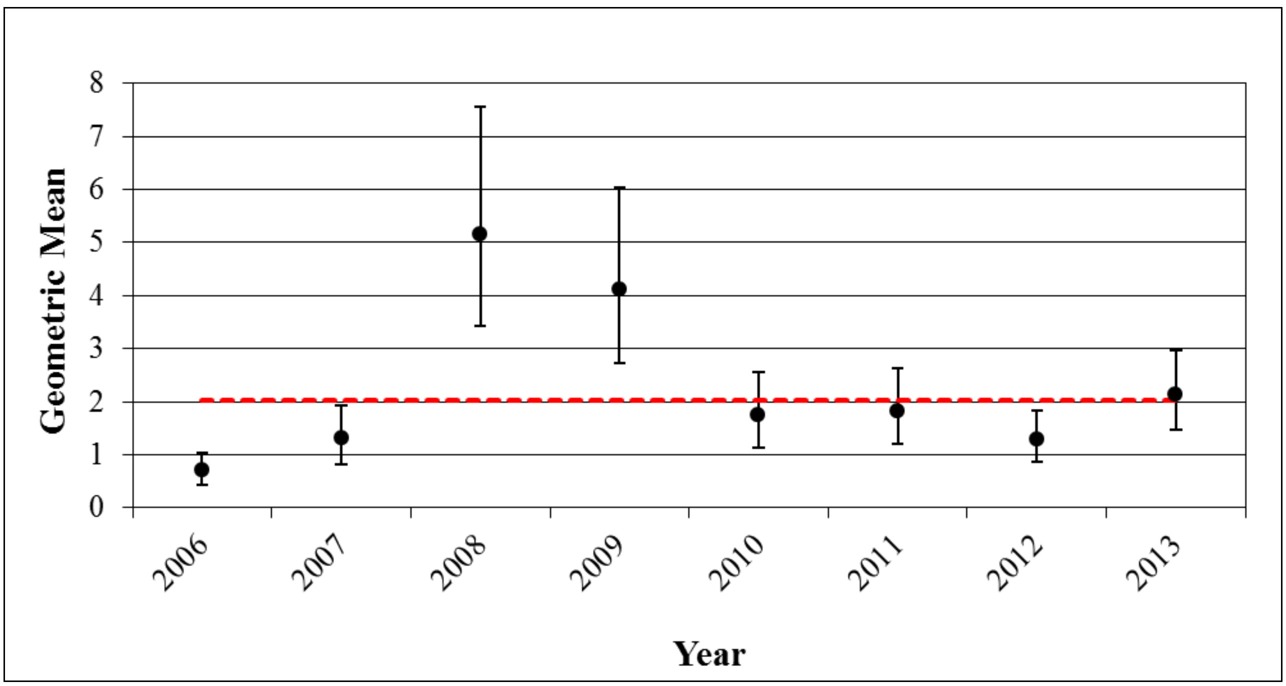

Figure 59. Sea Lettuce (*Ulva lactuca*) trawl index of relative abundance (geometric mean) with 95% confidence intervals (2006-2013). Dotted line represents the 2006-2013 time series grand mean, (n=140/year).

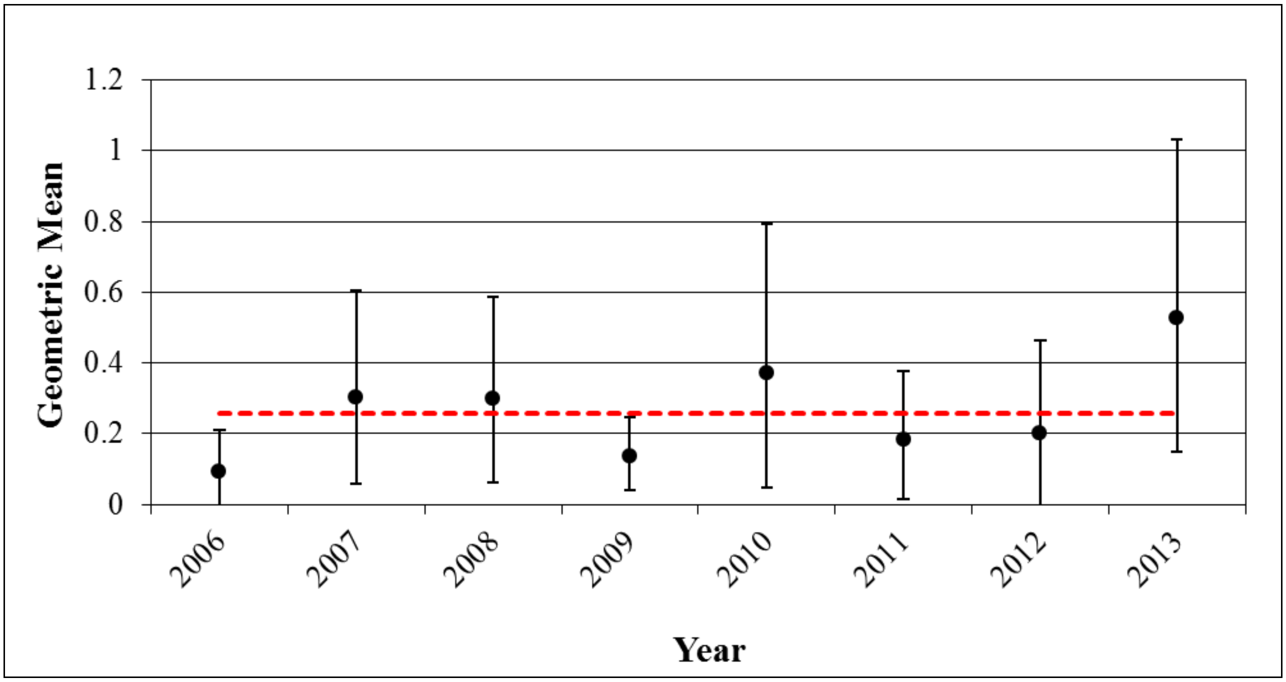

Figure 60. Sea Lettuce (*Ulva lactuca*) beach seine index of relative abundance (geometric mean) with 95% confidence intervals (2006-2013). Dotted line represents the 2006-2013 time series grand mean, (n=38/year).

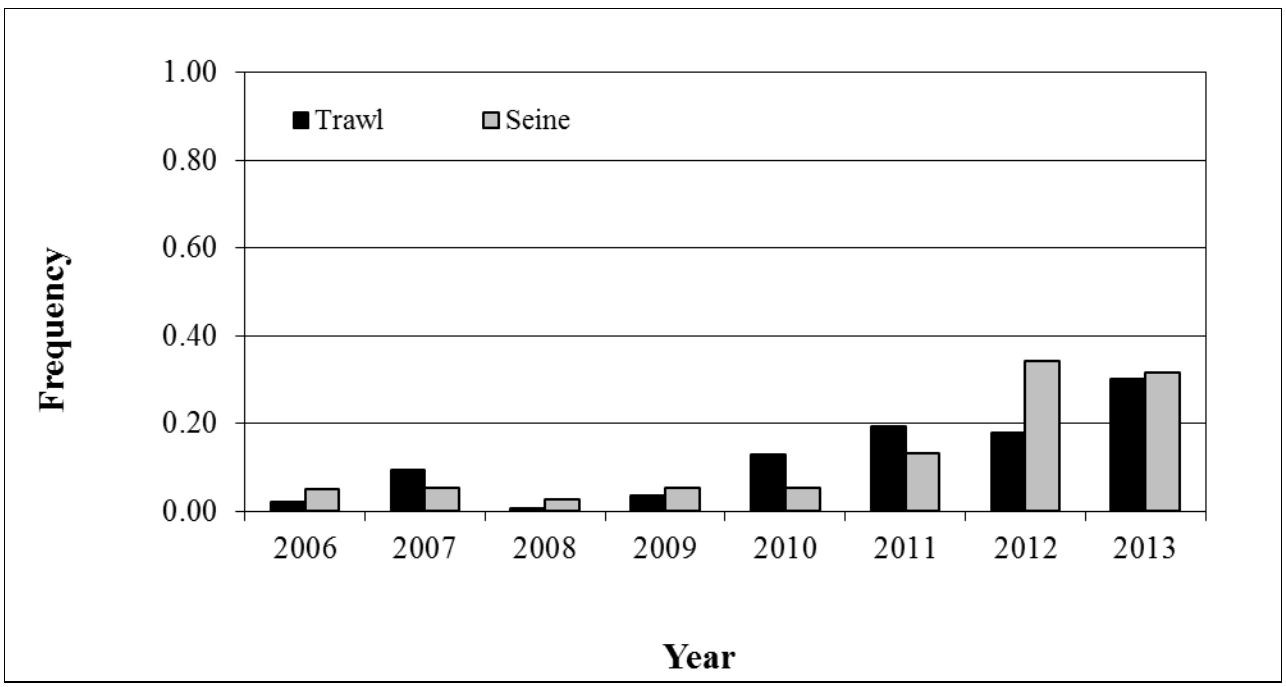

Figure 61. Tubed Weeds (*Polysiphonia sp.*) abundance by percent frequency of positive hauls from 2006-2013 by the Coastal Bays Fisheries Investigation Trawl and Beach Seine Survey.

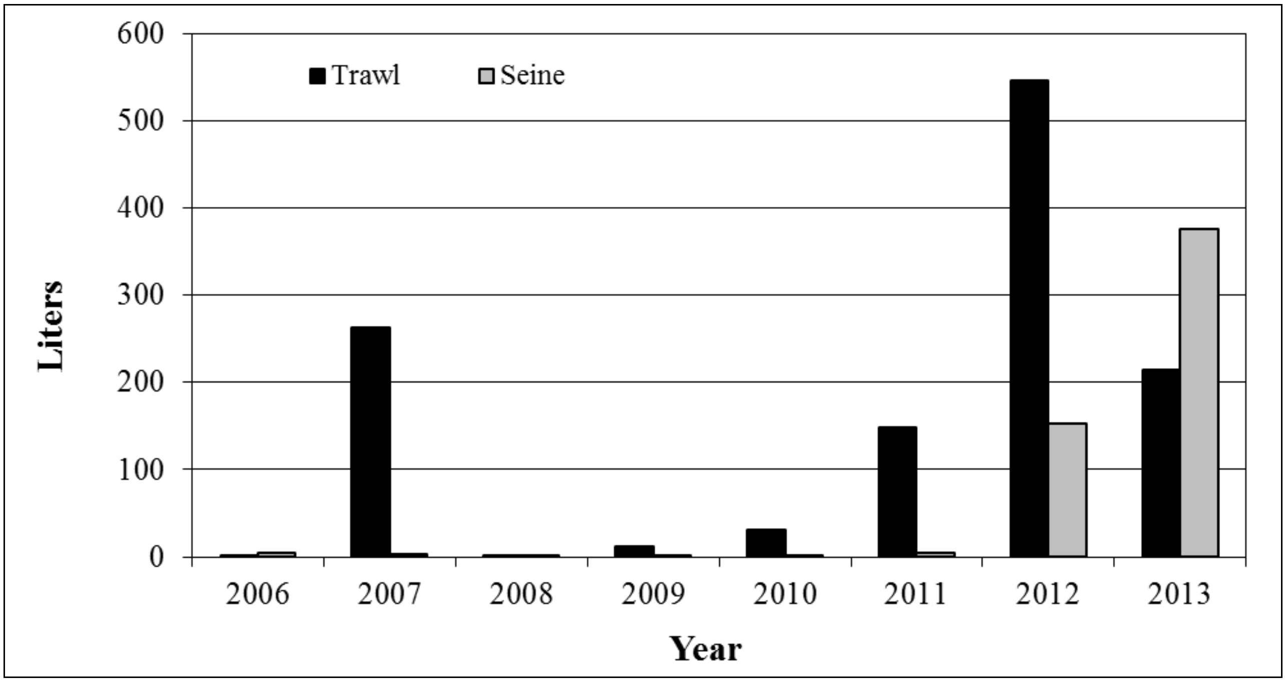

Figure 62. Tubed Weeds (*Polysiphonia sp.*) abundance by volume collected from 2006-2013 by the Coastal Bays Fisheries Investigation Trawl and Beach Seine Survey.

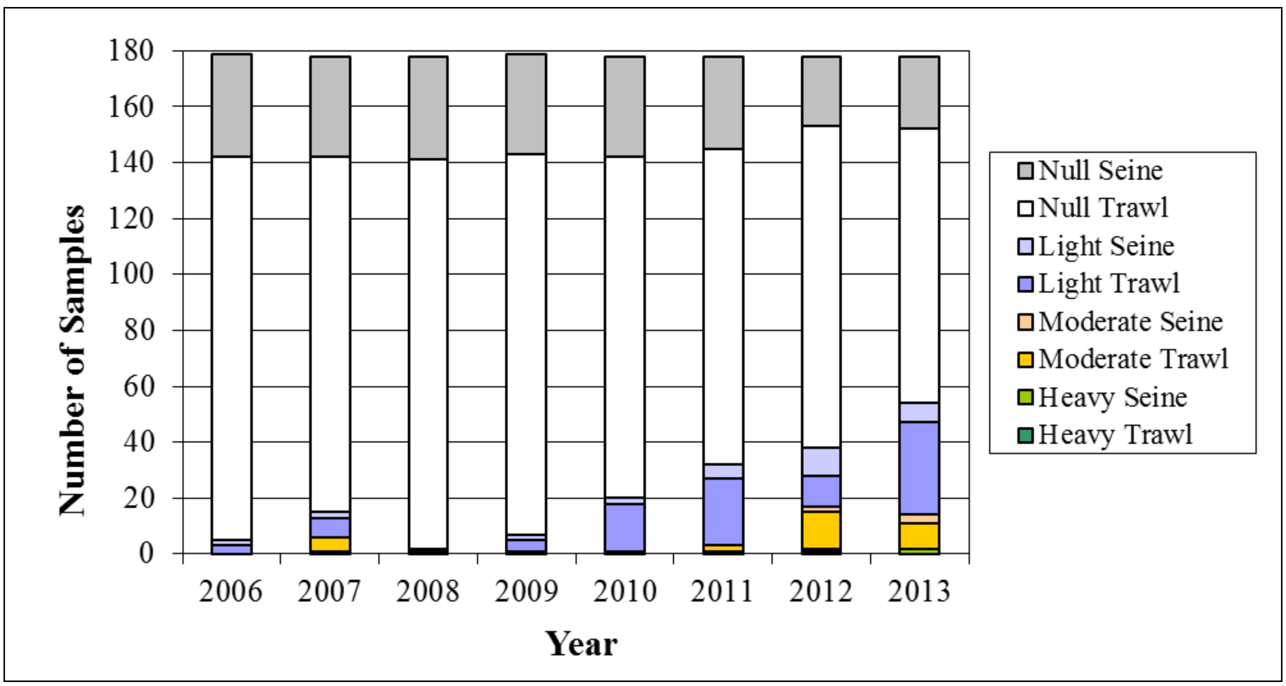

Figure 63. Tubed Weeds (*Polysiphonia sp.*) volume load categories from 2006-2013 by the Coastal Bays Fisheries Investigation Trawl and Beach Seine Survey.

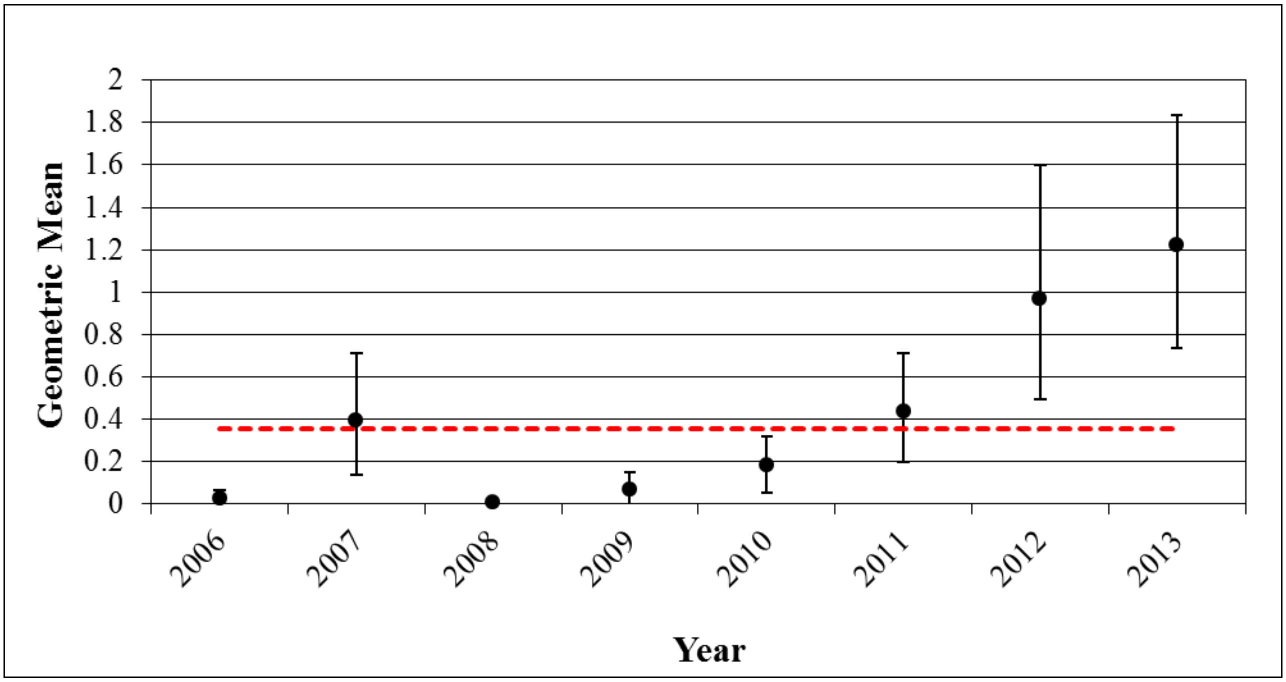

Figure 64. Tubed Weeds (*Polysiphonia sp.*) trawl index of relative abundance (geometric mean) with 95% confidence intervals (2006-2013). Dotted line represents the 2006-2013 time series grand mean, (n=140/year).

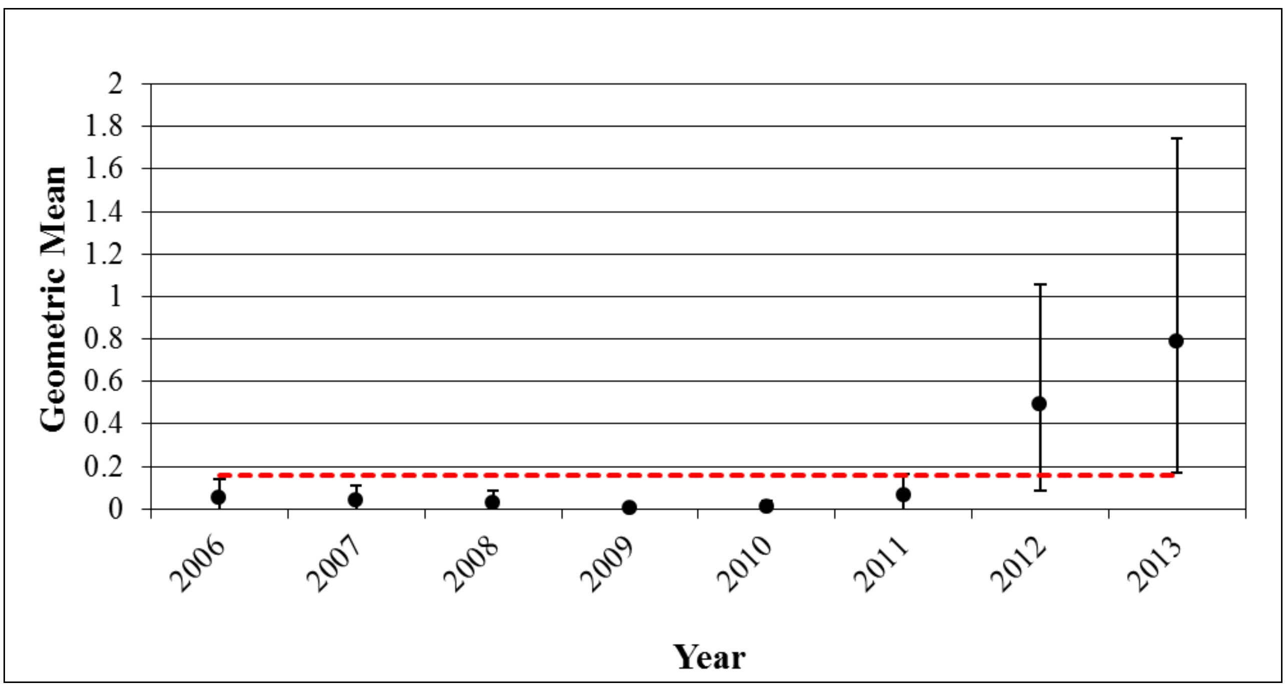

Figure 65. Tubed Weeds (*Polysiphonia sp.*) beach seine index of relative abundance (geometric mean) with 95% confidence intervals (2006-2013). Dotted line represents the 2006-2013 time series grand mean, (n=38/year).

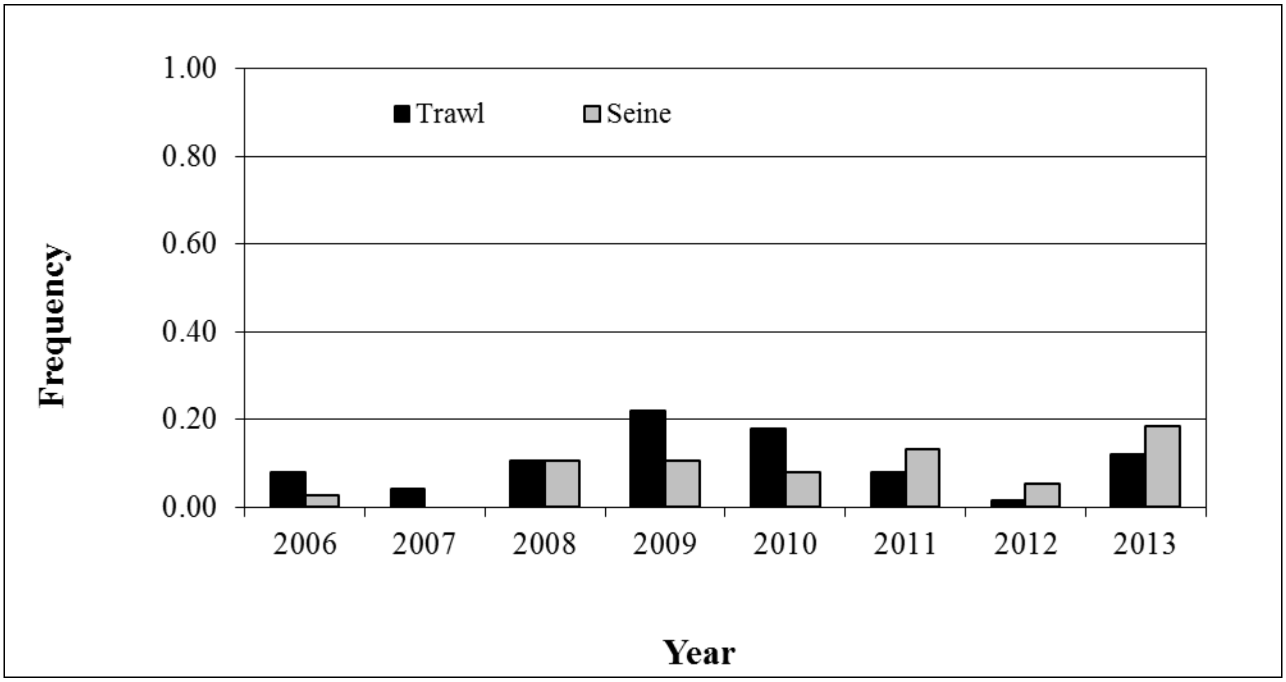

Figure 66. Green Hair Algae (*Chaetomorpha sp.*) abundance by percent frequency of positive hauls from 2006-2013 by the Coastal Bays Fisheries Investigation Trawl and Beach Seine Survey.

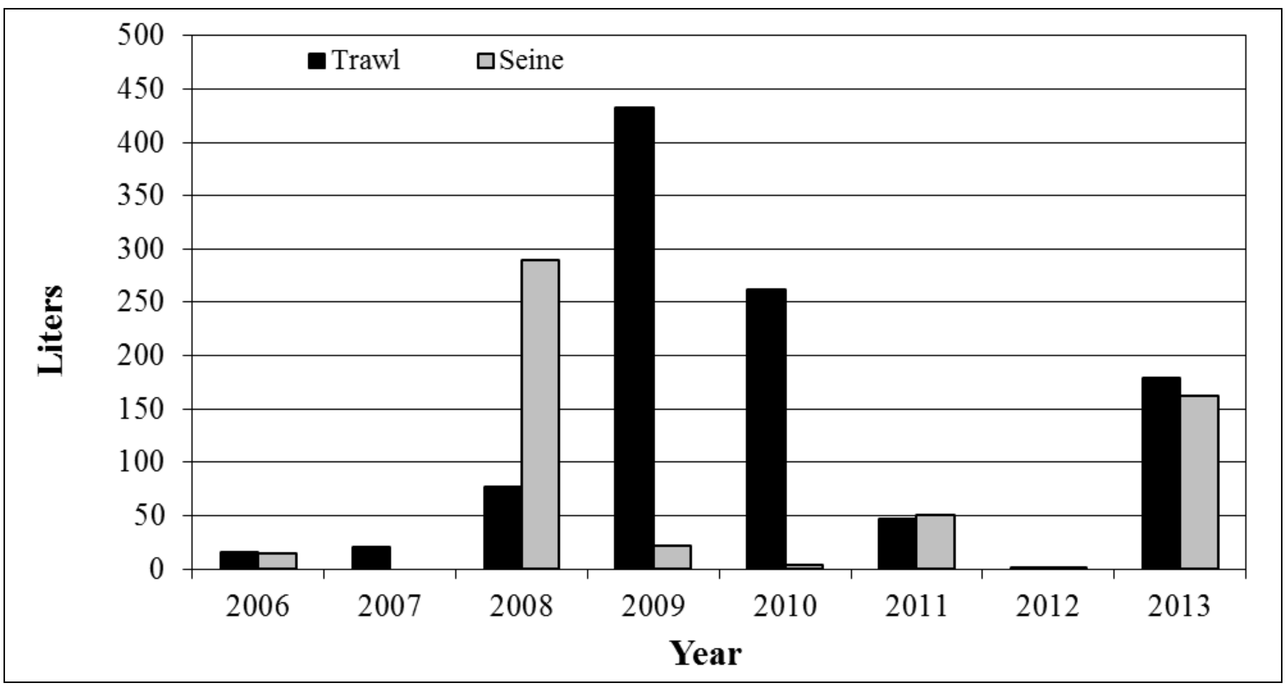

Figure 67. Green Hair Algae (*Chaetomorpha sp.*) abundance by volume collected from 2006-2013 by the Coastal Bays Fisheries Investigation Trawl and Beach Seine Survey.

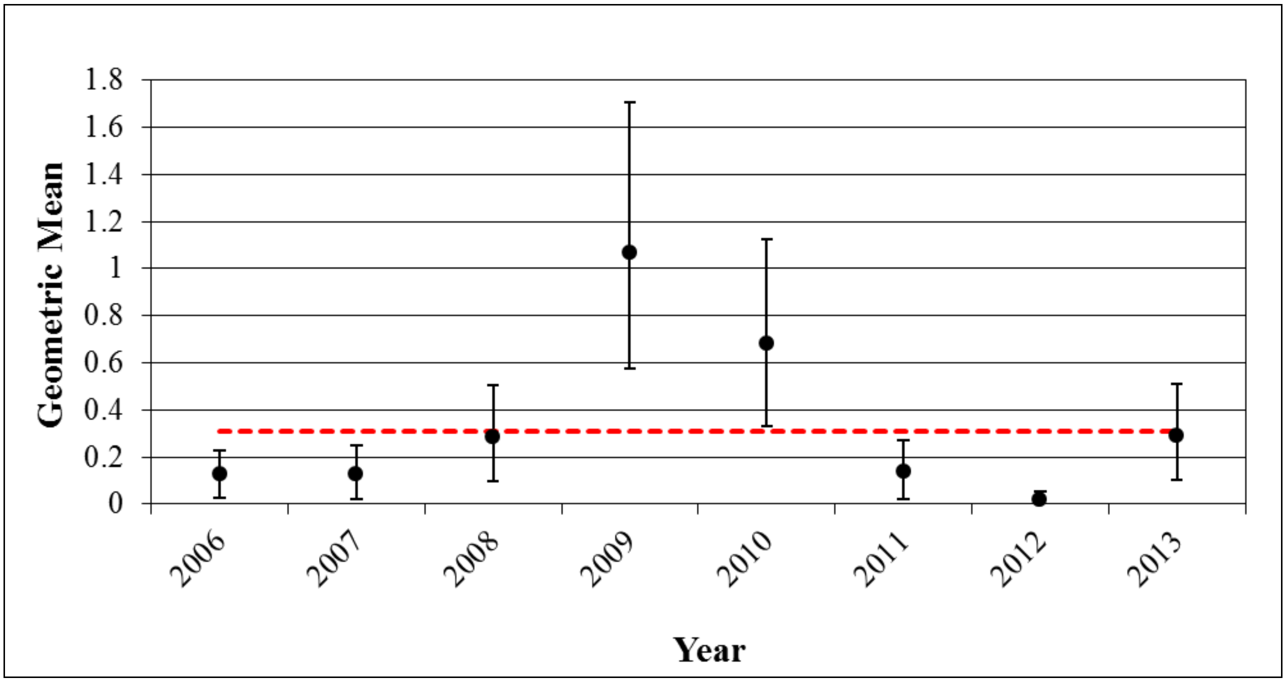

Figure 68. Green Hair Algae (*Chaetomorpha sp.*) trawl index of relative abundance (geometric mean) with 95% confidence intervals (2006-2013). Dotted line represents the 2006-2013 time series grand mean, (n=140/year).

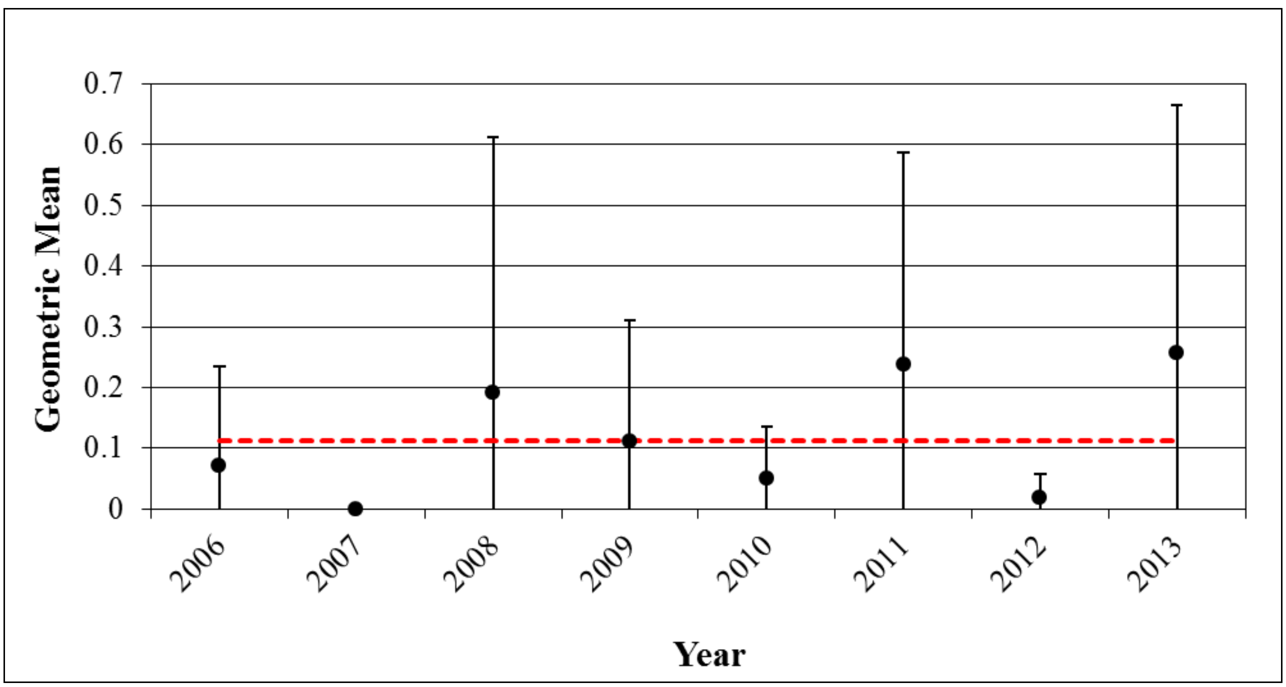

Figure 69. Green Hair Algae (*Chaetomorpha sp.*) beach seine index of relative abundance (geometric mean) with 95% confidence intervals (2006-2013). Dotted line represents the 2006-2013 time series grand mean, (n=38/year).

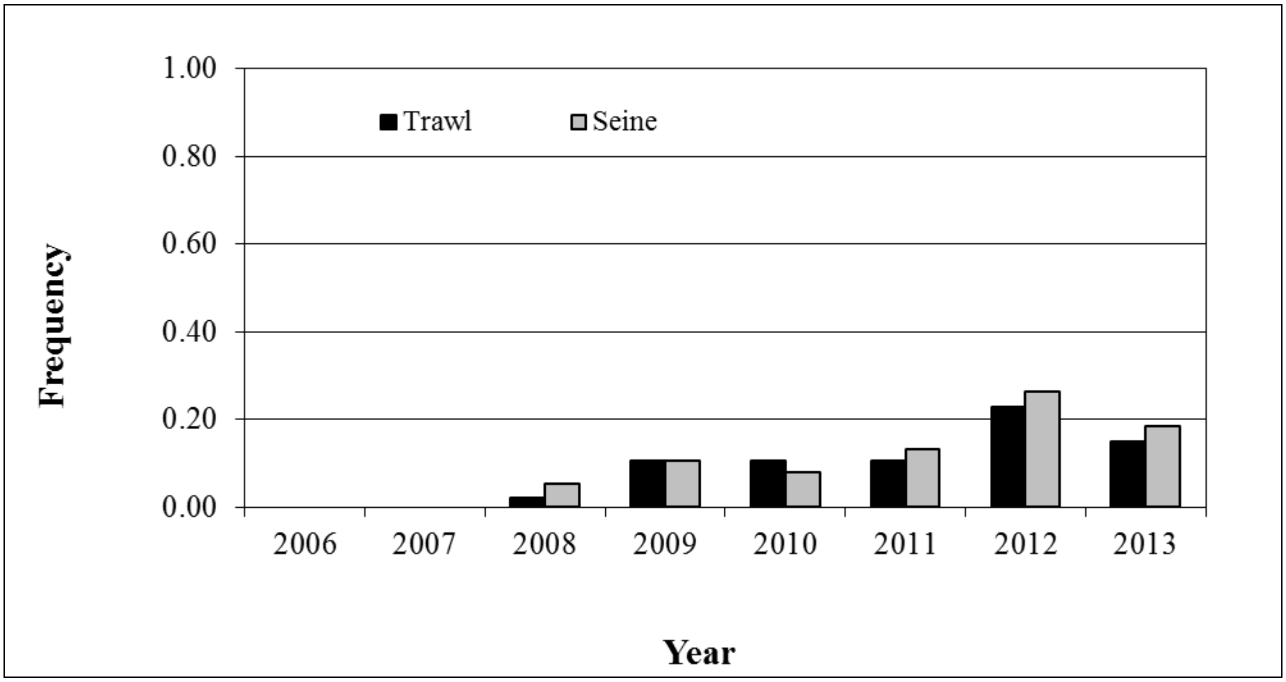

Figure 70. Water Felt (*Vaucheria sp.*) abundance by percent frequency of positive hauls from 2006-2013 by the Coastal Bays Fisheries Investigation Trawl and Beach Seine Survey.

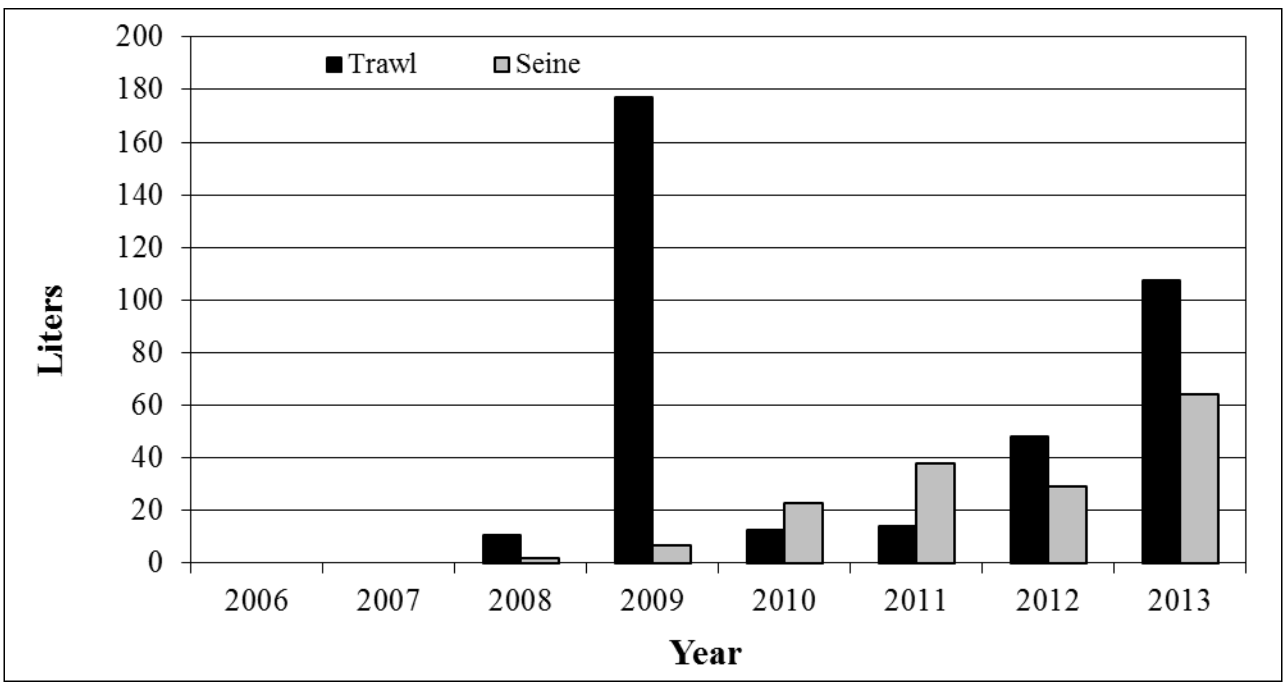

Figure 71. Water Felt (*Vaucheria sp.*) abundance by volume collected from 2006-2013 by the Coastal Bays Fisheries Investigation Trawl and Beach Seine Survey.

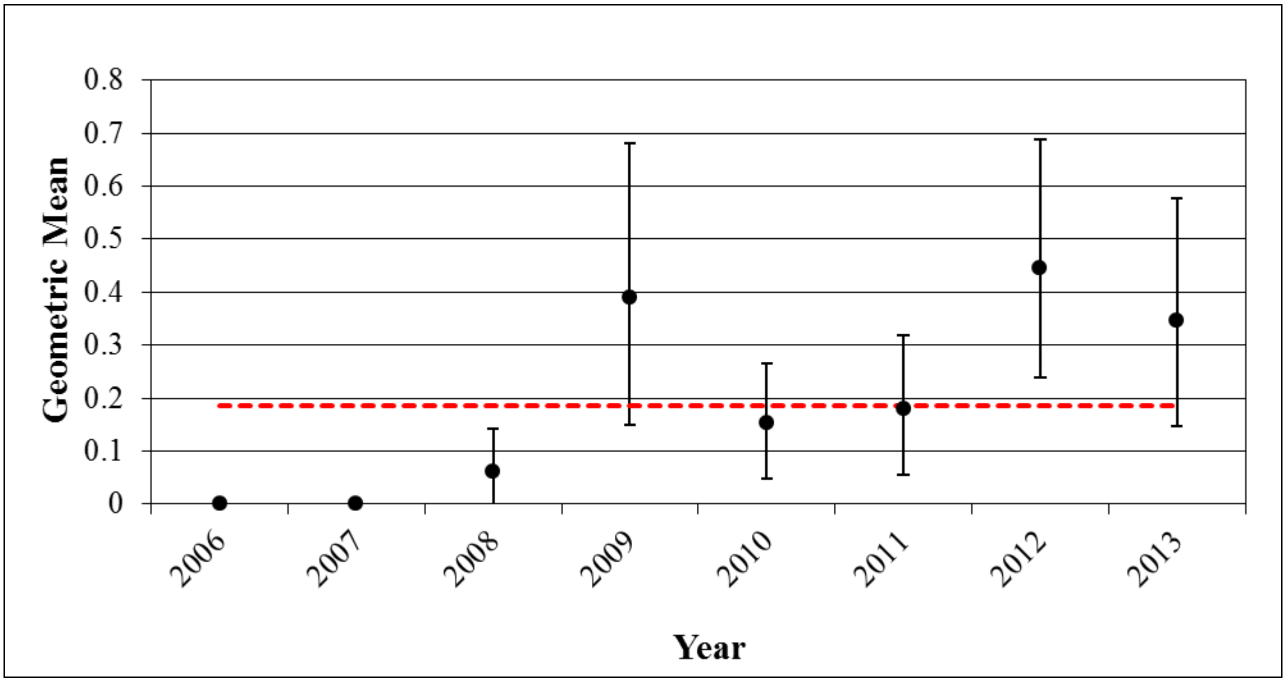

Figure 72. Water Felt (*Vaucheria sp.*) trawl index of relative abundance (geometric mean) with 95% confidence intervals (2006-2013). Dotted line represents the 2006-2013 time series grand mean, (n=140/year).

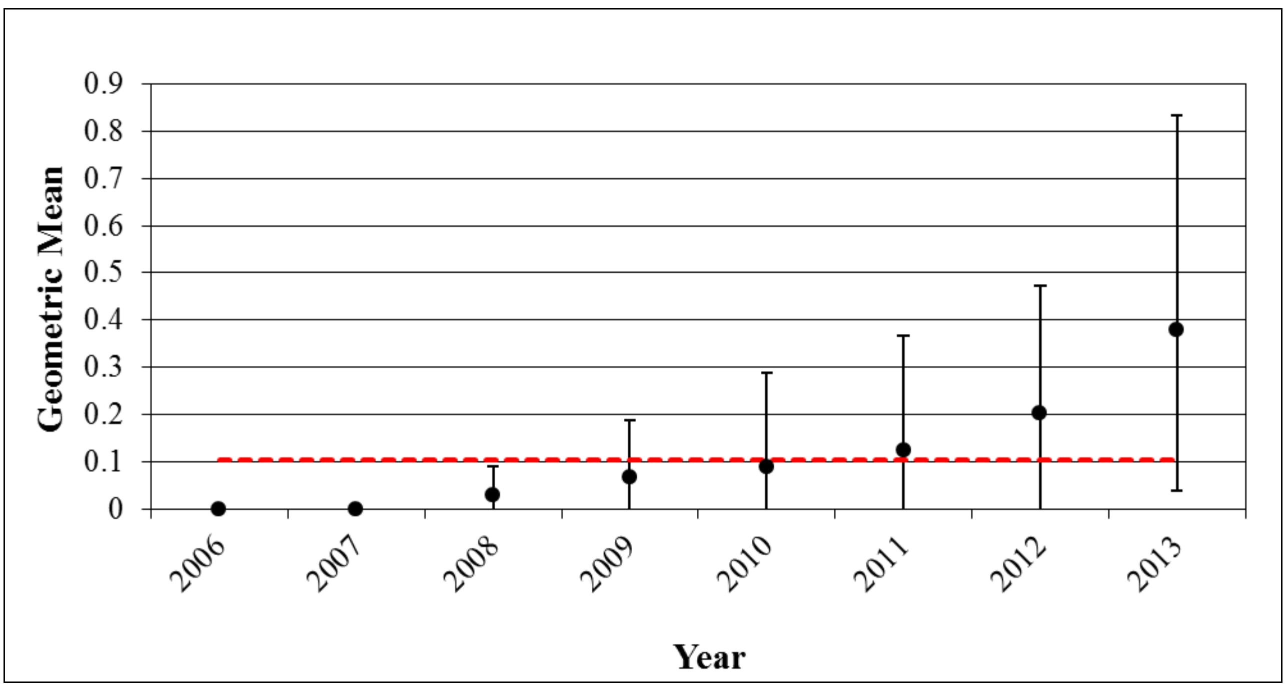

Figure 73. Water Felt (*Vaucheria sp.*) beach seine index of relative abundance (geometric mean) with 95% confidence intervals (2006-2013). Dotted line represents the 2006-2013 time series grand mean, (n=38/year).

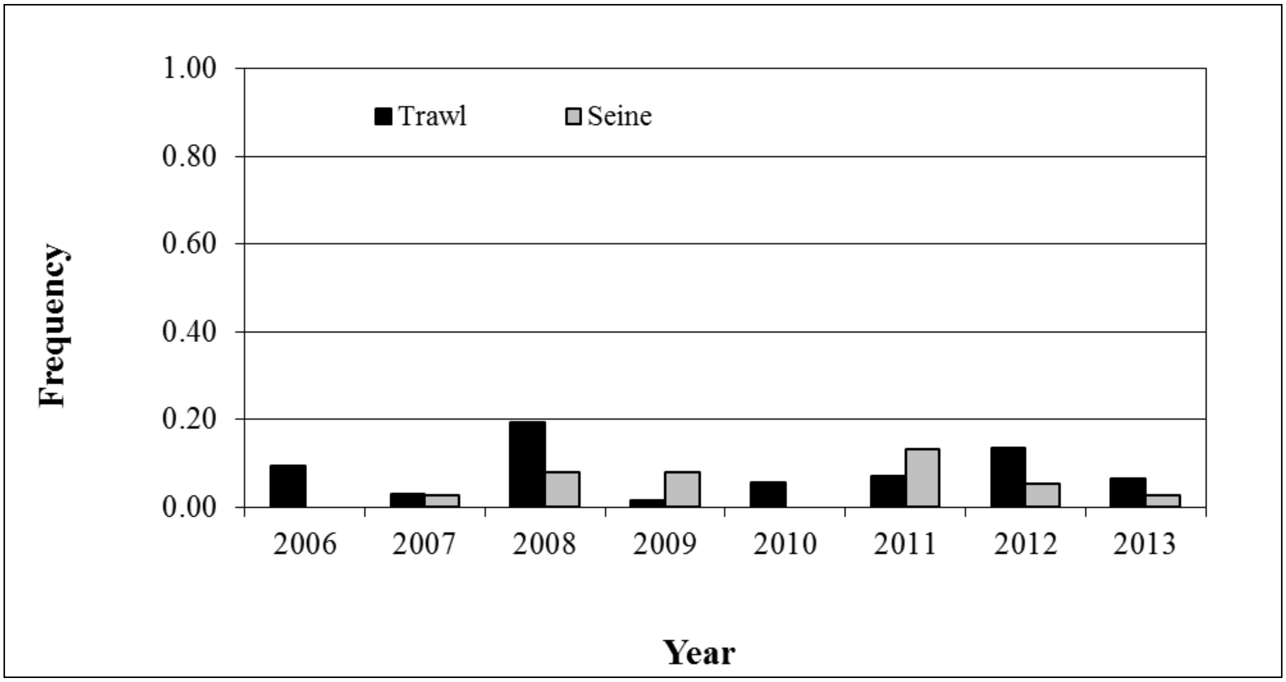

Figure 74. Barrel Weed (*Champia sp.*) abundance by percent frequency of positive hauls from 2006-2013 by the Coastal Bays Fisheries Investigation Trawl and Beach Seine Survey.

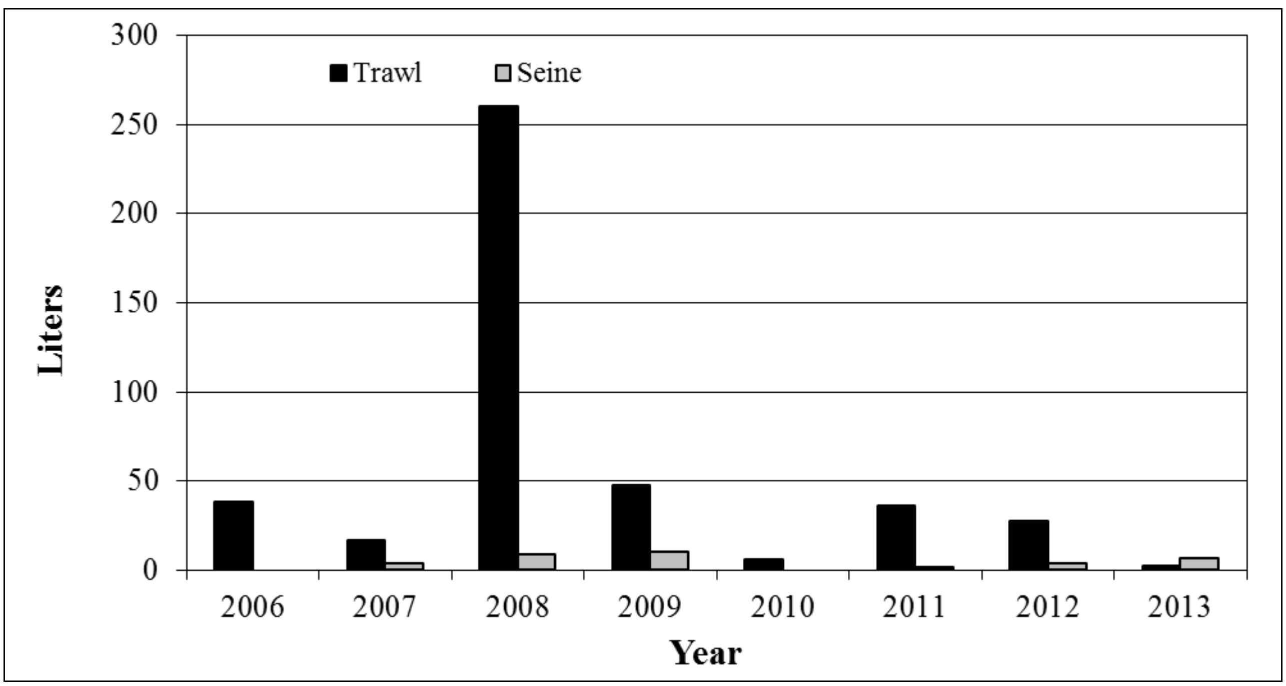

Figure 75. Barrel Weed (*Champia sp.*) abundance by volume collected from 2006-2013 by the Coastal Bays Fisheries Investigation Trawl and Beach Seine Survey.

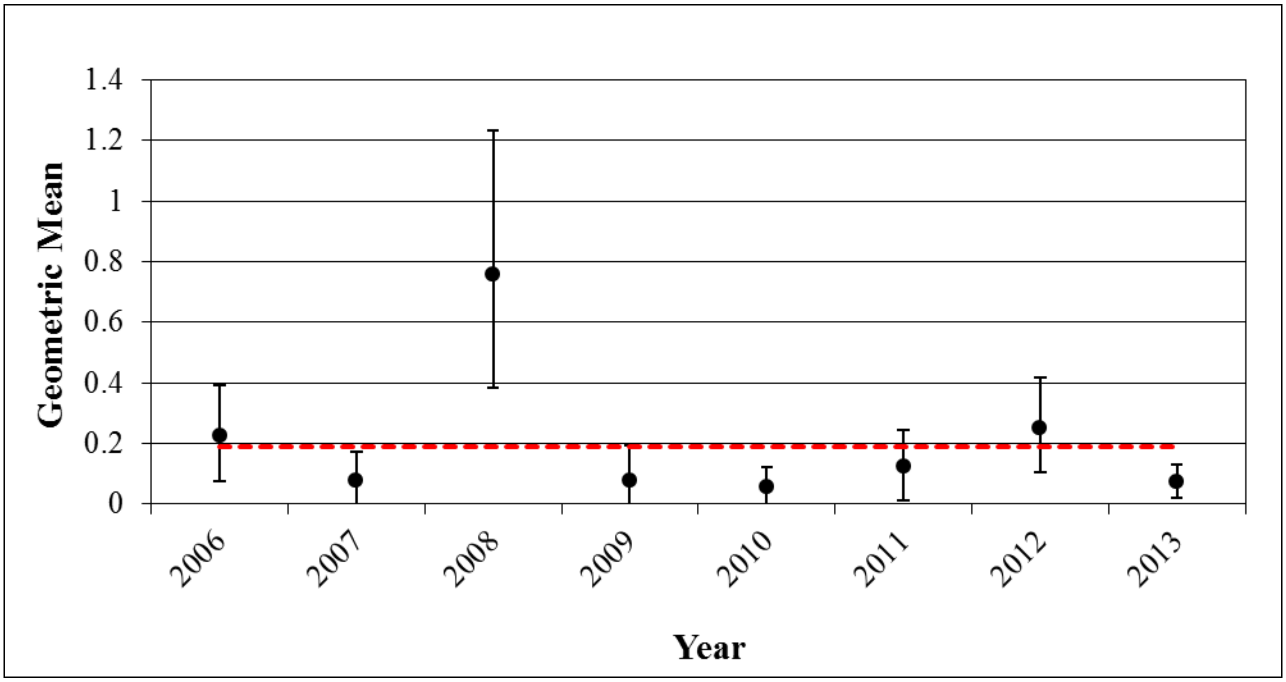

Figure 76. Barrel Weed (*Champia sp.*) trawl index of relative abundance (geometric mean) with 95% confidence intervals (2006-2013). Dotted line represents the 2006-2013 time series grand mean, (n=140/year).

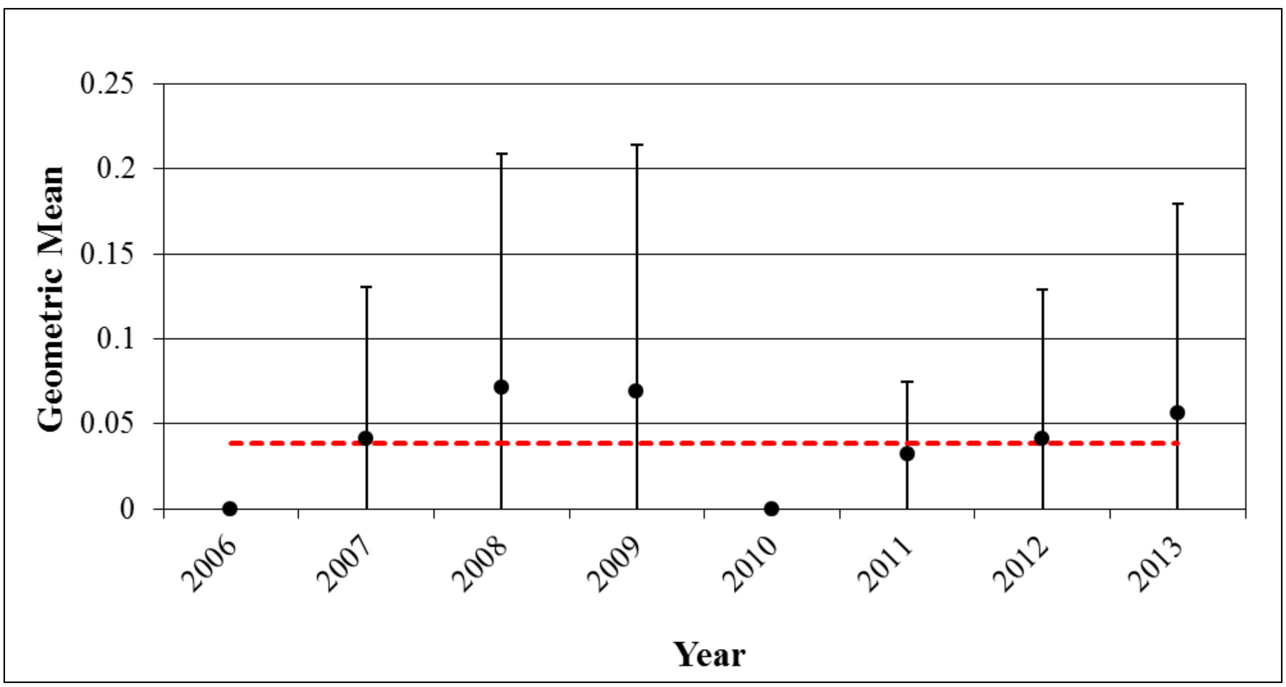

Figure 77. Barrel Weed (*Champia sp.*) beach seine index of relative abundance (geometric mean) with 95% confidence intervals (2006-2013). Dotted line represents the 2006-2013 time series grand mean, (n=38/year).

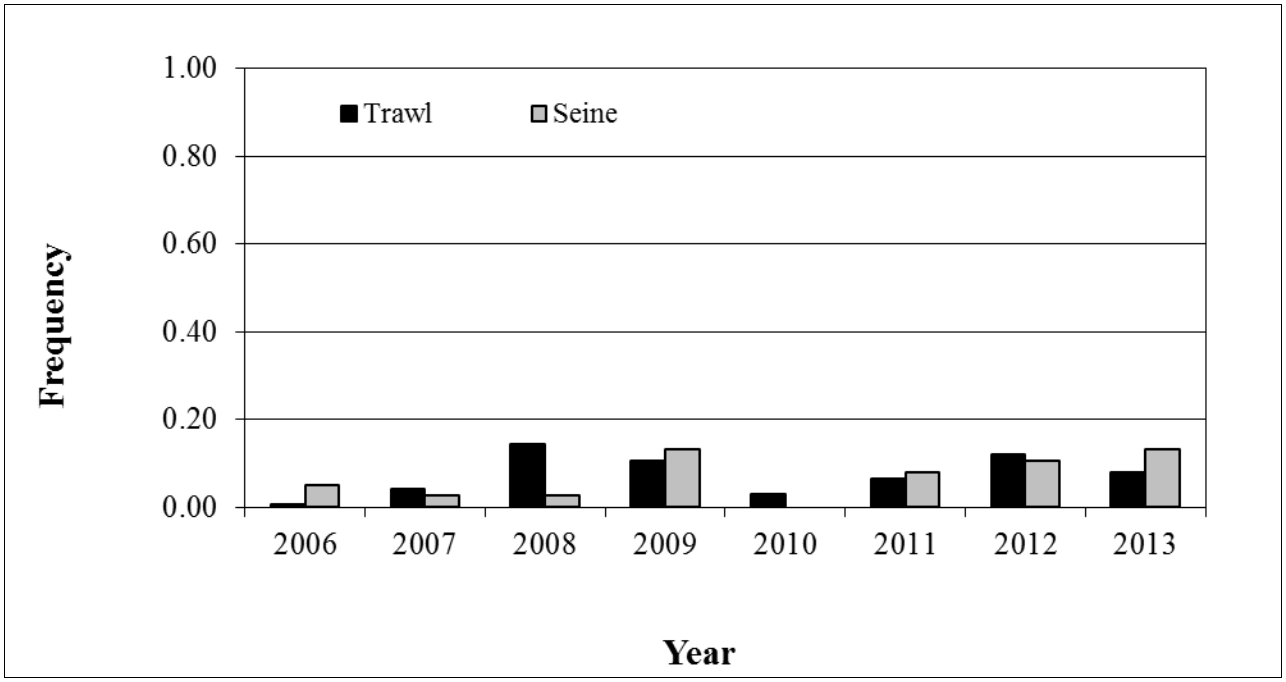

Figure 78. Green Fleece (*Codium fragile*) abundance by percent frequency of positive hauls from 2006-2013 by the Coastal Bays Fisheries Investigation Trawl and Beach Seine Survey.

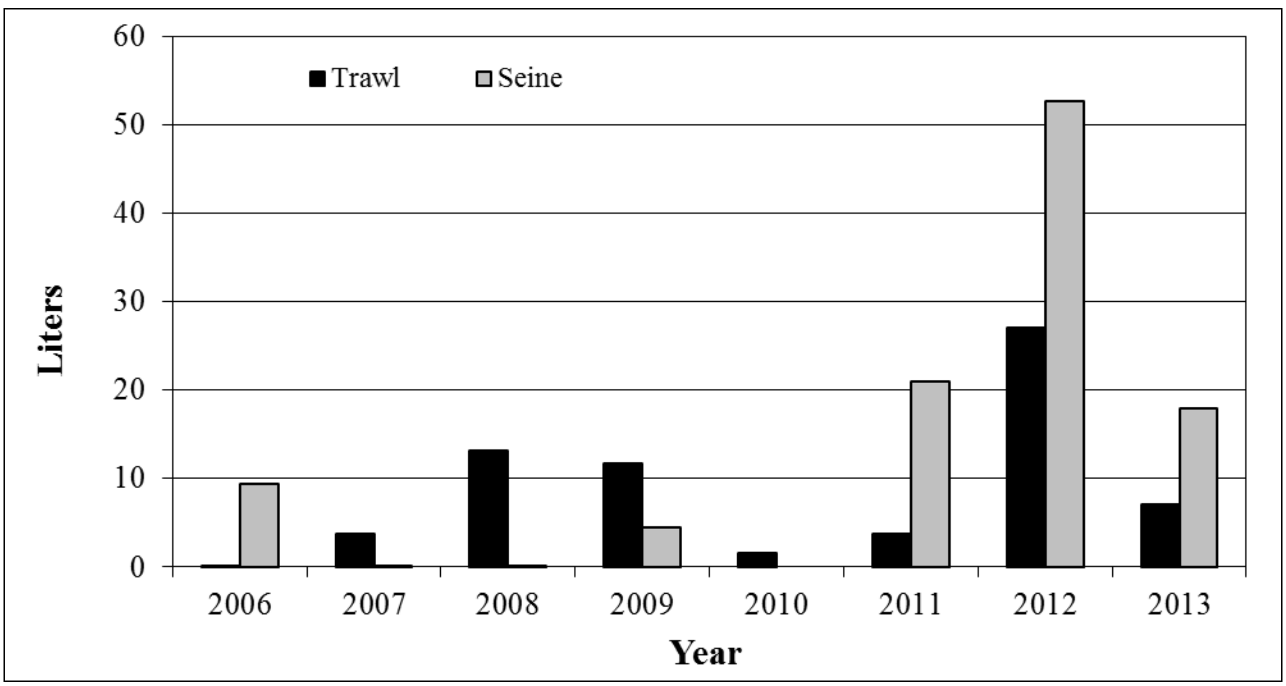

Figure 79. Green Fleece (*Codium fragile*) abundance by volume collected from 2006-2013 by the Coastal Bays Fisheries Investigation Trawl and Beach Seine Survey.

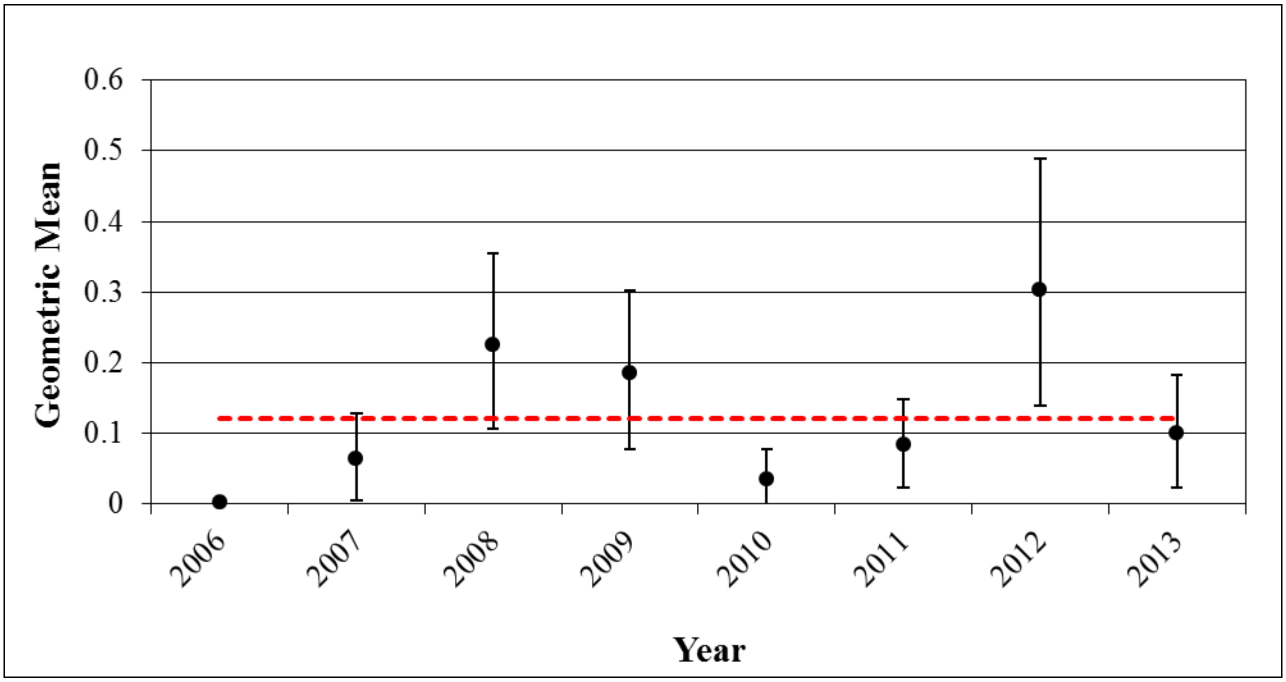

Figure 80. Green Fleece (*Codium fragile*) trawl index of relative abundance (geometric mean) with 95% confidence intervals (2006-2013). Dotted line represents the 2006-2013 time series grand mean, (n=140/year).

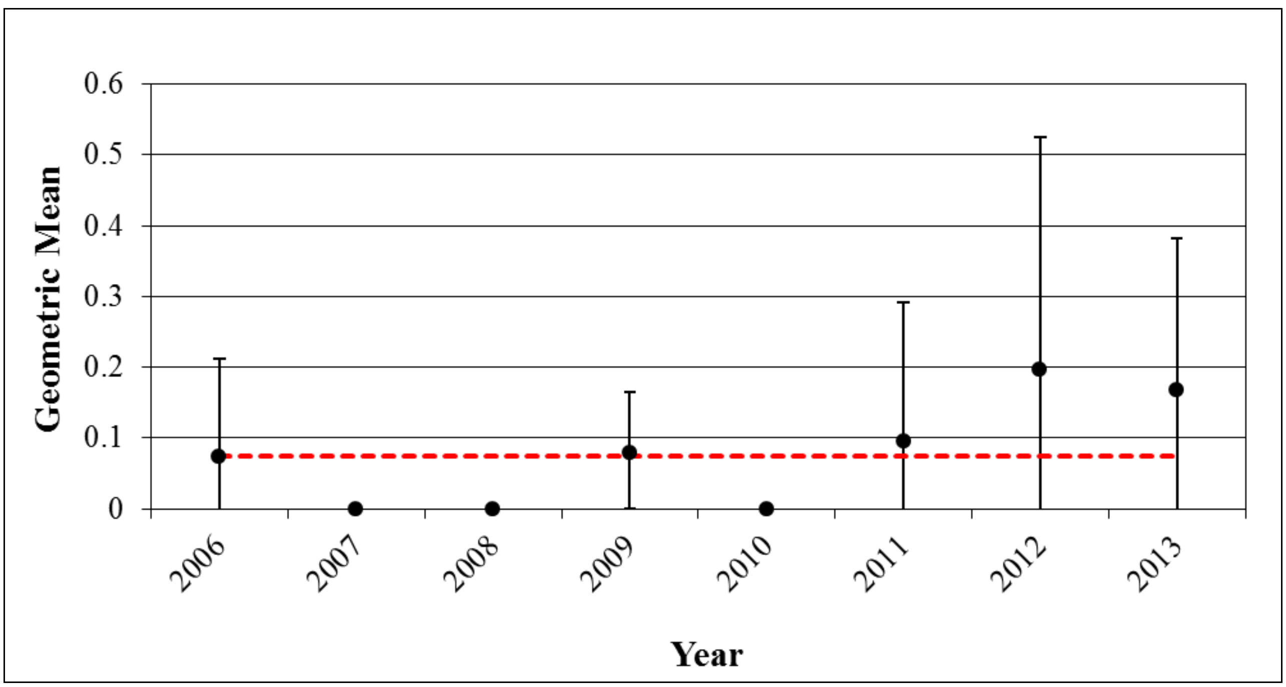

Figure 81. Green Fleece (*Codium fragile*) beach seine index of relative abundance (geometric mean) with 95% confidence intervals (2006-2013). Dotted line represents the 2006-2013 time series grand mean, (n=38/year).

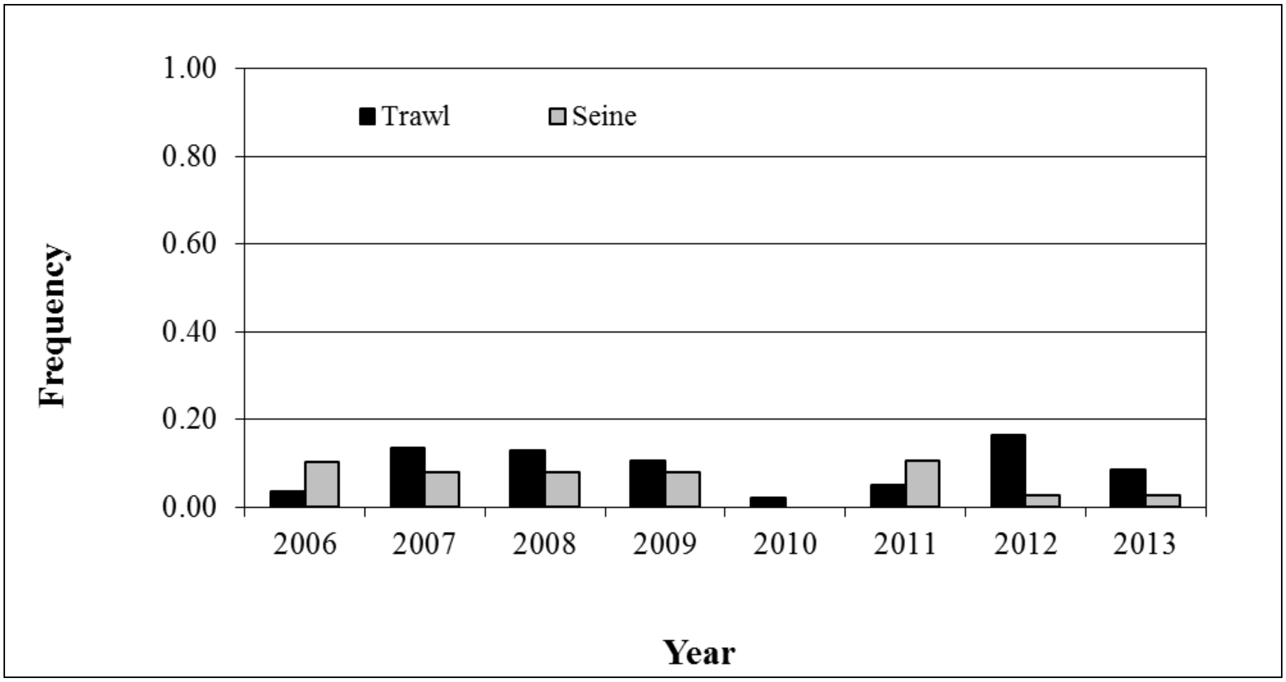

Figure 82. Banded Weeds (*Ceramium sp.*) abundance by percent frequency of positive hauls from 2006-2013 by the Coastal Bays Fisheries Investigation Trawl and Beach Seine Survey.

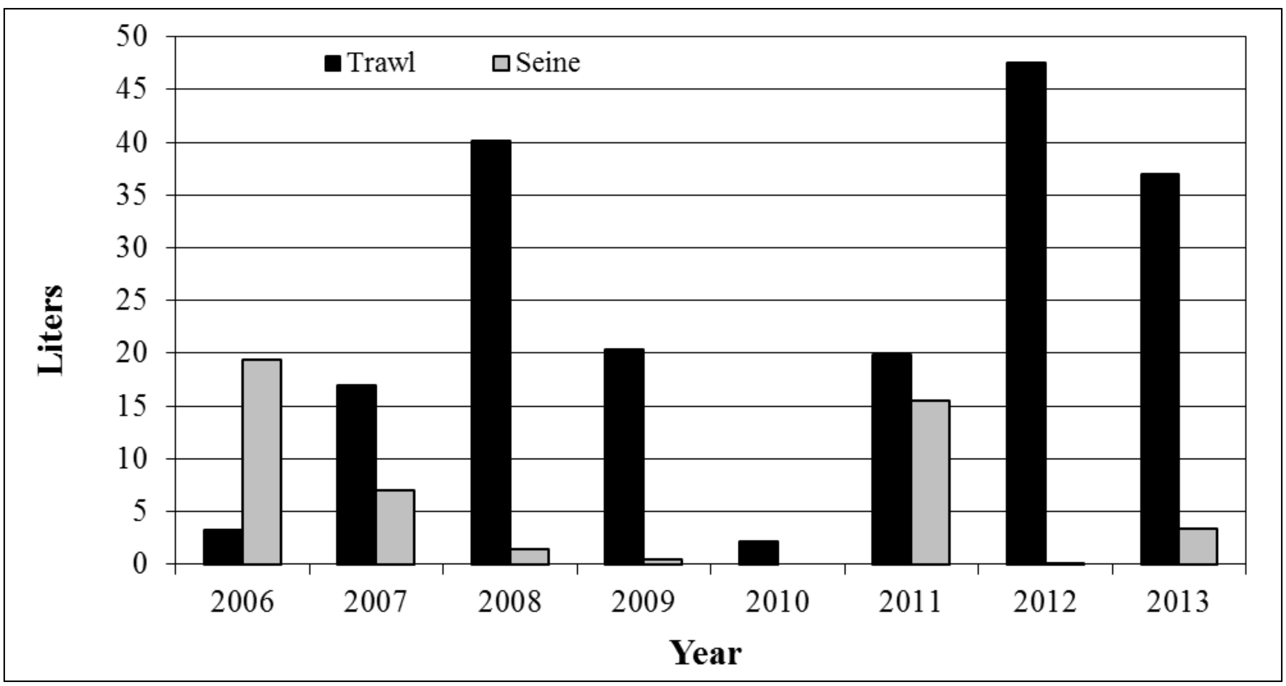

Figure 83. Banded Weeds (*Ceramium sp.*) abundance by volume collected from 2006-2013 by the Coastal Bays Fisheries Investigation Trawl and Beach Seine Survey.

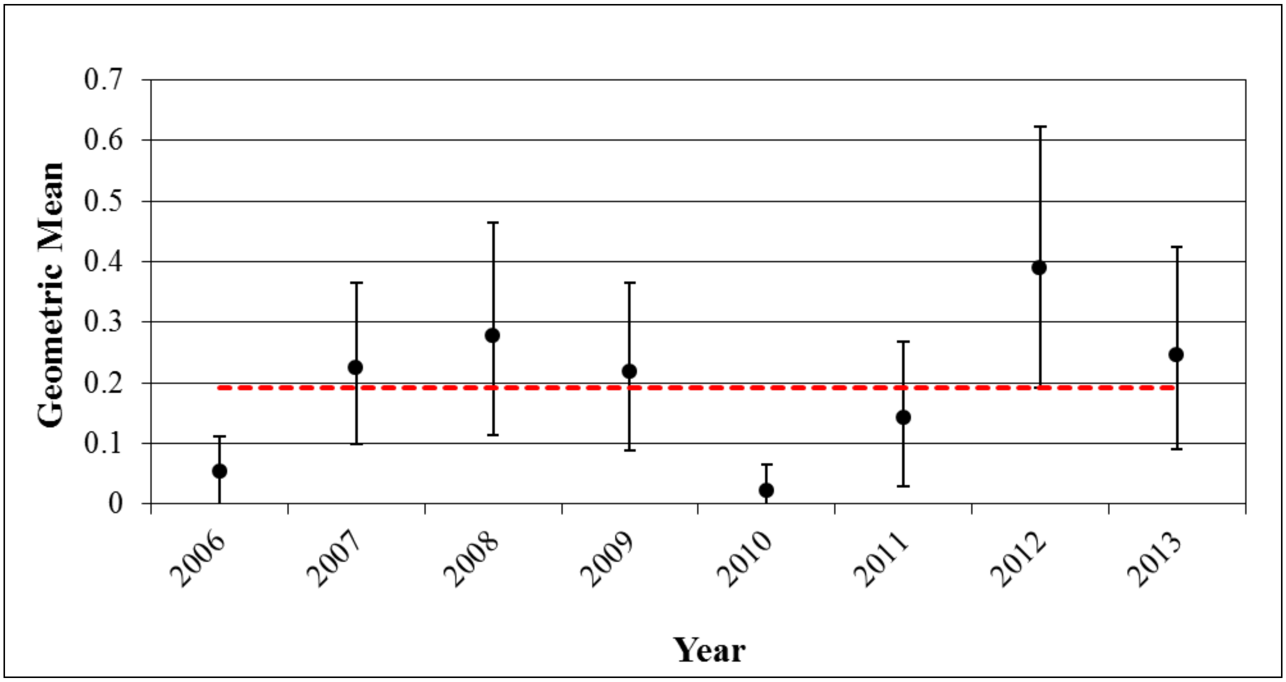

Figure 84. Banded Weeds (*Ceramium sp.*) trawl index of relative abundance (geometric mean) with 95% confidence intervals (2006-2013). Dotted line represents the 2006-2013 time series grand mean, (n=140/year).

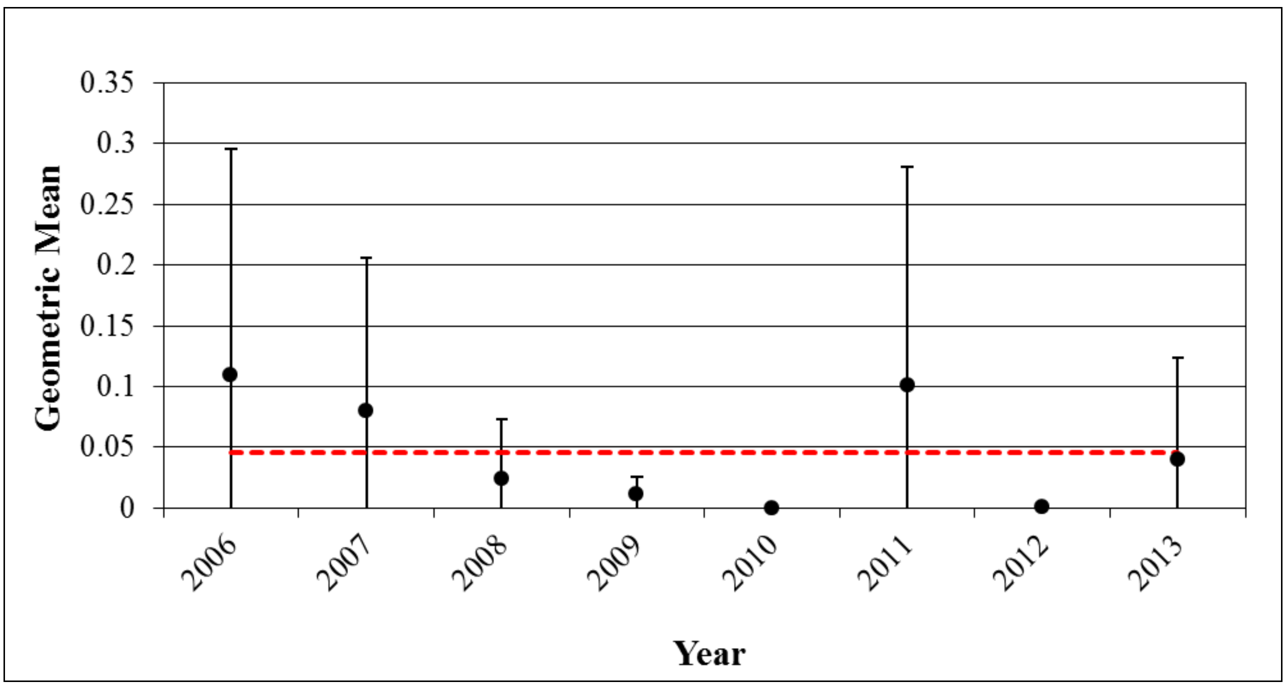

Figure 85. Banded Weeds (*Ceramium sp.*) beach seine index of relative abundance (geometric mean) with 95% confidence intervals (2006-2013). Dotted line represents the 2006-2013 time series grand mean, (n=38/year).

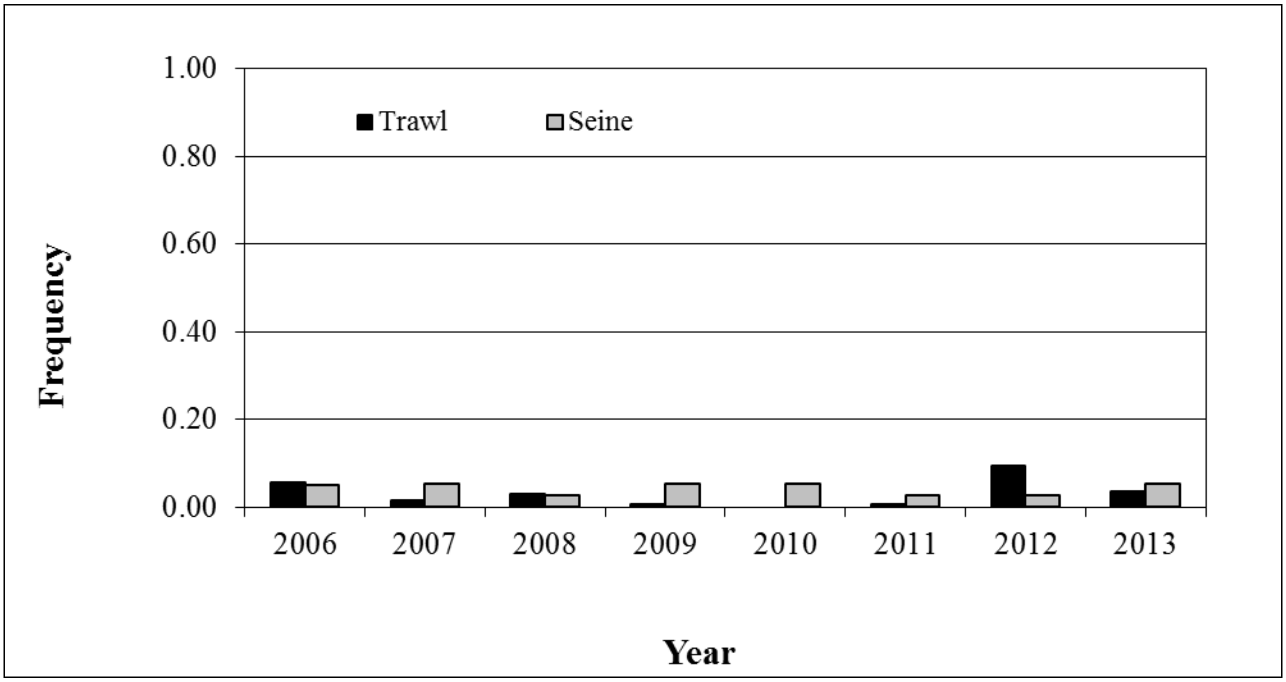

Figure 86. Green Tufted Seaweed (*Cladophora sp*.) abundance by percent frequency of positive hauls from 2006-2013 by the Coastal Bays Fisheries Investigation Trawl and Beach Seine Survey.

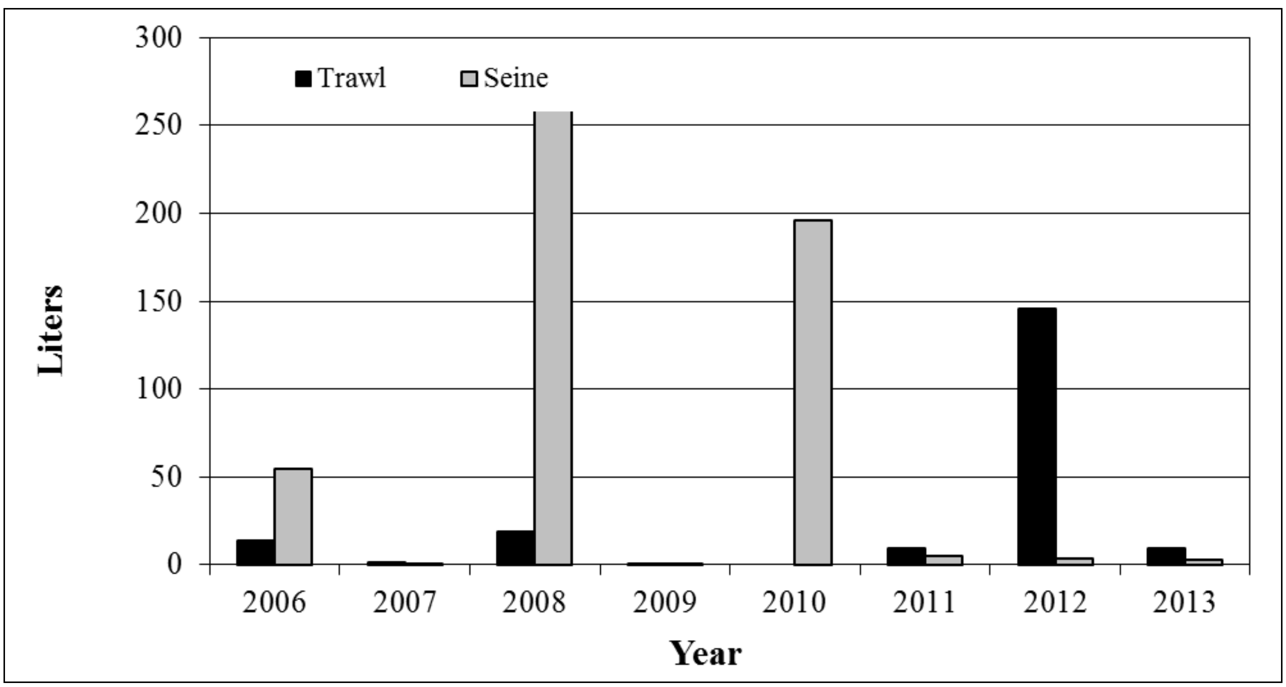

Figure 87. Green Tufted Seaweed (*Cladophora sp*.) abundance by volume collected from 2006-2013 by the Coastal Bays Fisheries Investigation Trawl and Beach Seine Survey.

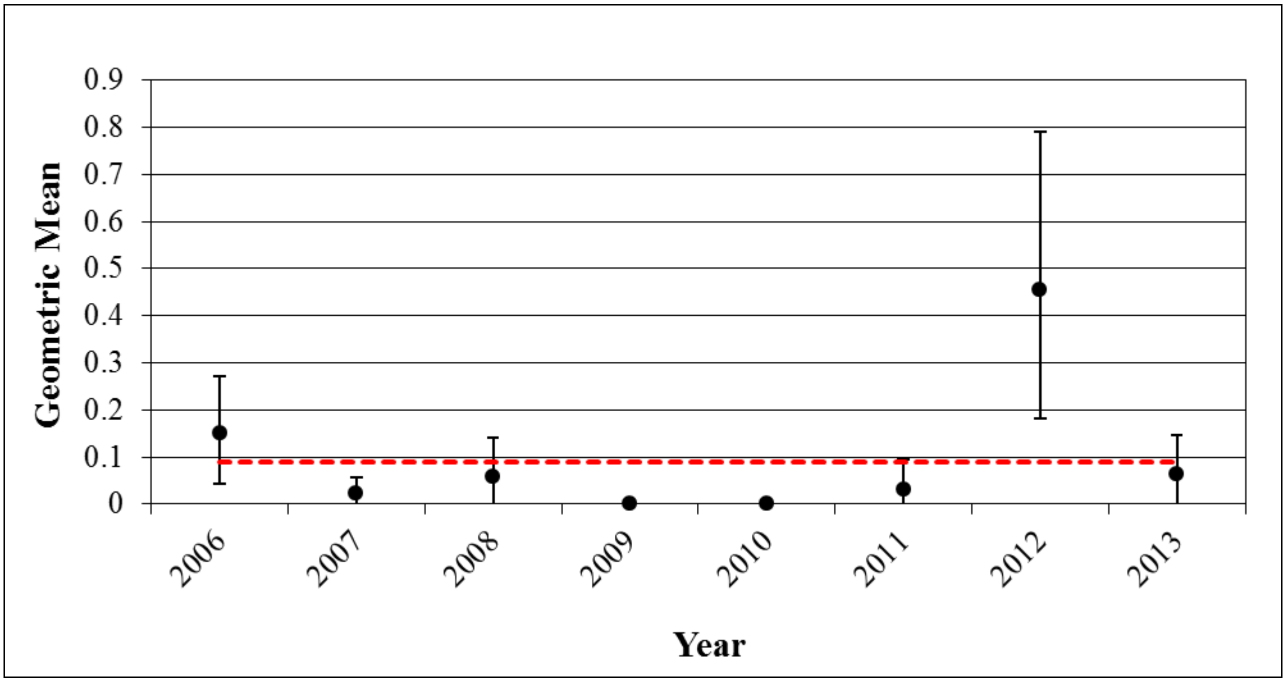

Figure 88. Green Tufted Seaweed (*Cladophora sp.*) trawl index of relative abundance (geometric mean) with 95% confidence intervals (2006-2013). Dotted line represents the 2006-2013 time series grand mean, (n=140/year).

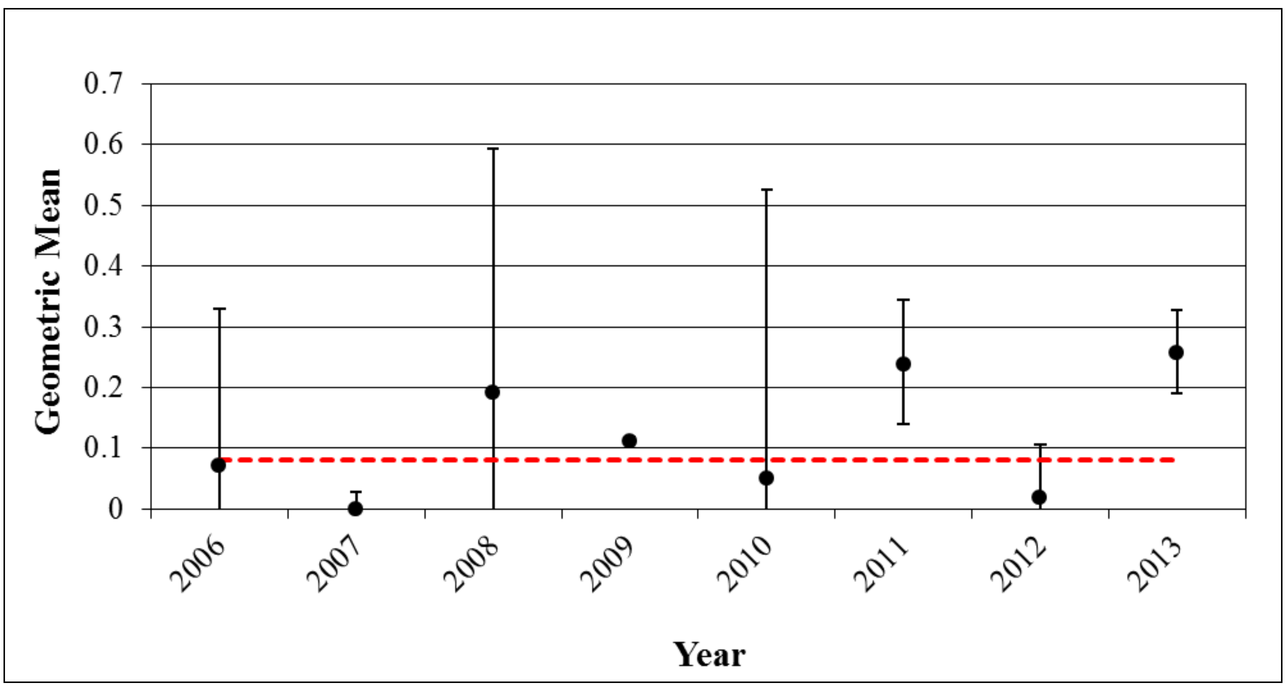

Figure 89. Green Tufted Seaweed (*Cladophora sp.*) beach seine index of relative abundance (geometric mean) with 95% confidence intervals (2006-2013). Dotted line represents the 2006-2013 time series grand mean, (n=38/year).

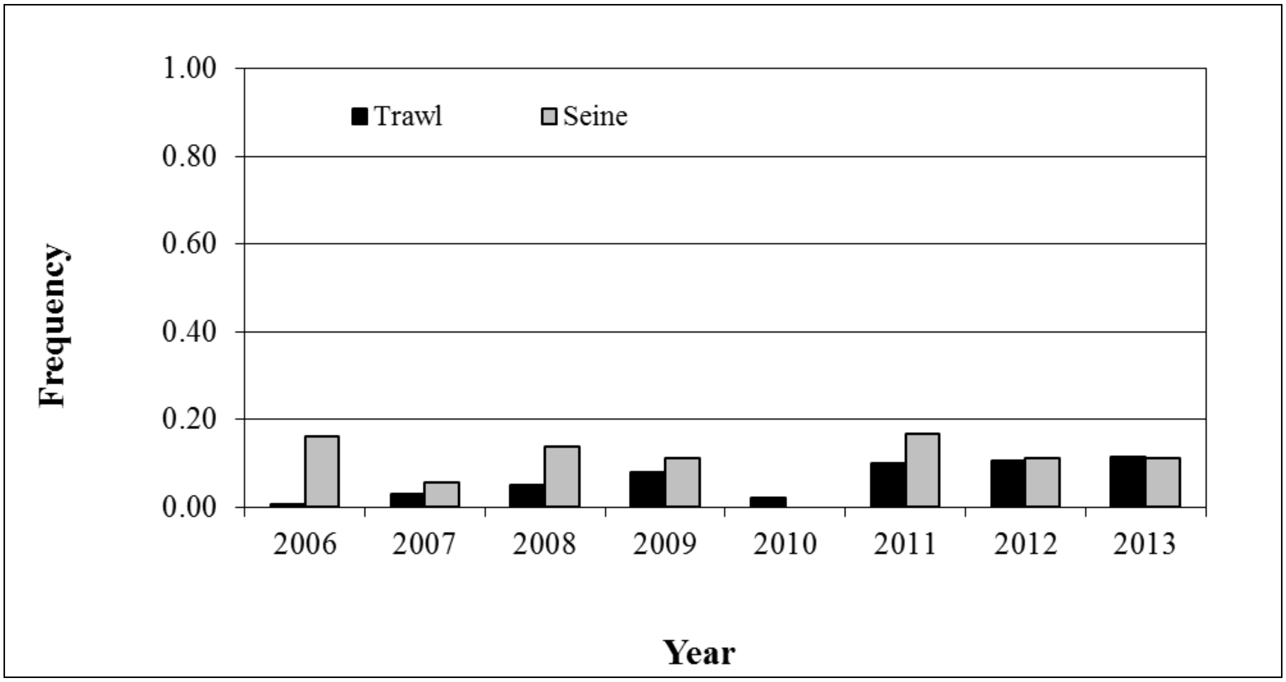

Figure 90. Hollow Green Weed (*Enteromorpha sp.*) abundance by percent frequency of positive hauls from 2006-2013 by the Coastal Bays Fisheries Investigation Trawl and Beach Seine Survey.

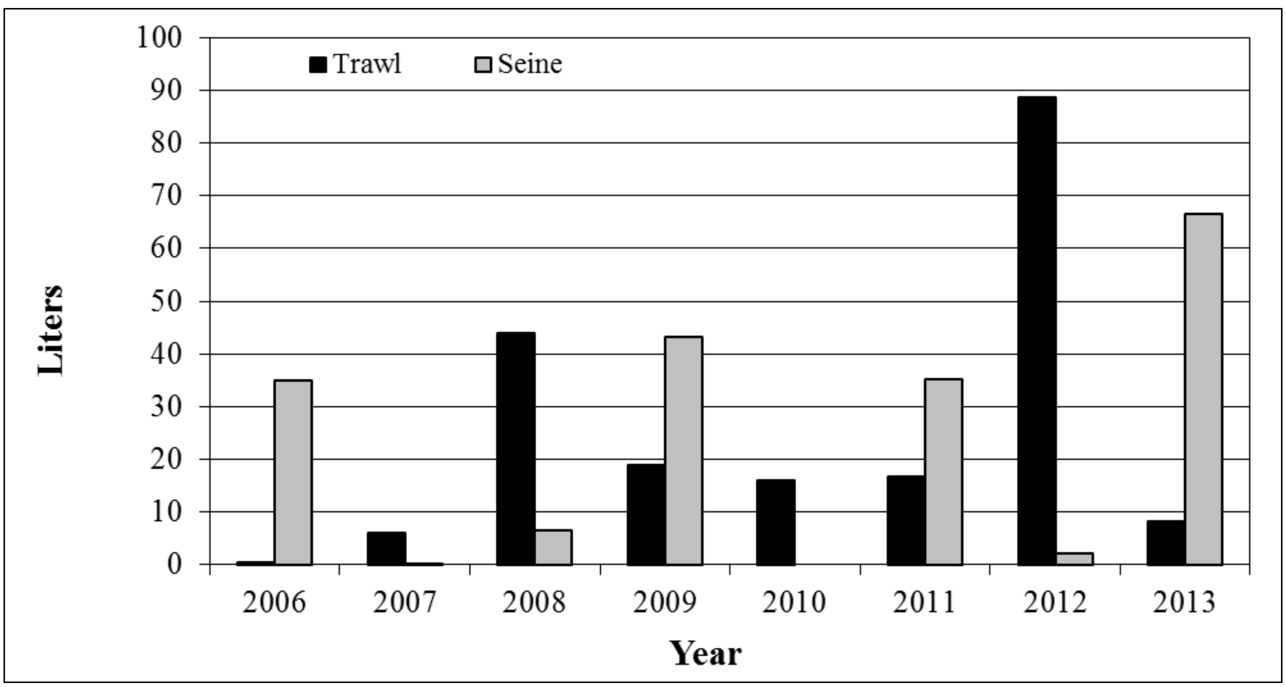

Figure 91. Hollow Green Weed (*Enteromorpha sp.*) abundance by volume collected from 2006-2013 by the Coastal Bays Fisheries Investigation Trawl and Beach Seine Survey.

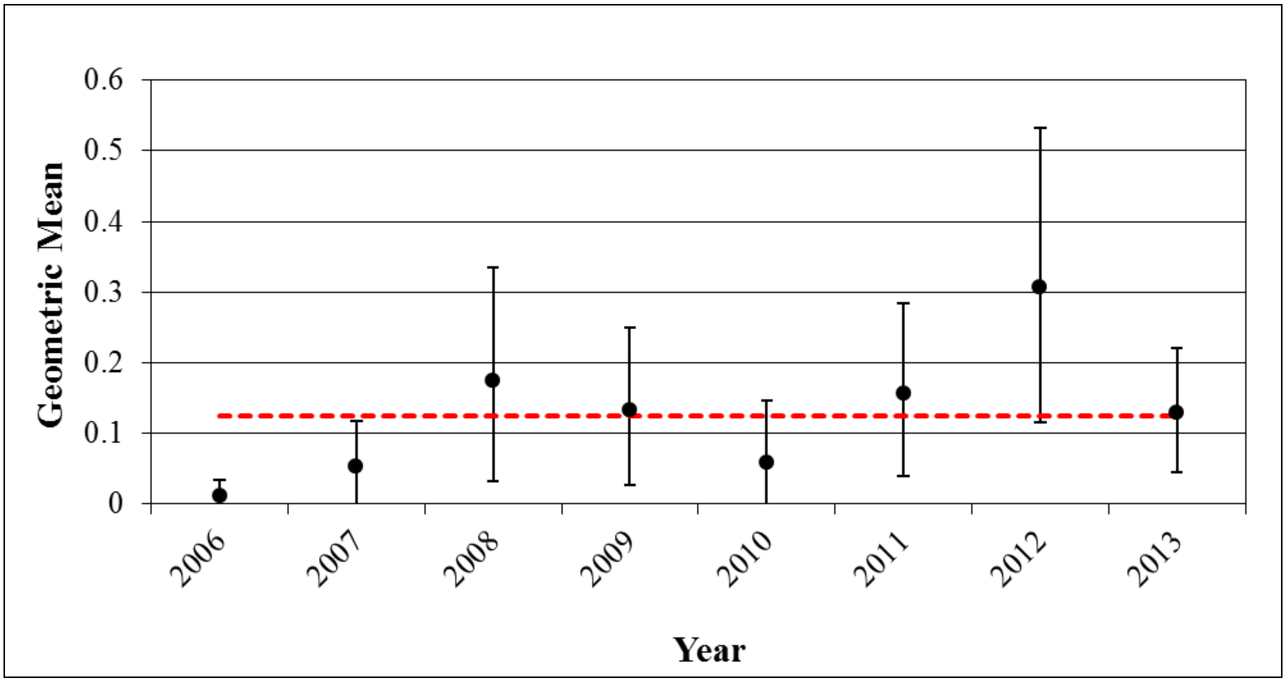

Figure 92. Hollow Green Weed (*Enteromorpha sp.*) trawl index of relative abundance (geometric mean) with 95% confidence intervals (2006-2013). Dotted line represents the 2006-2013 time series grand mean, (n=140/year).

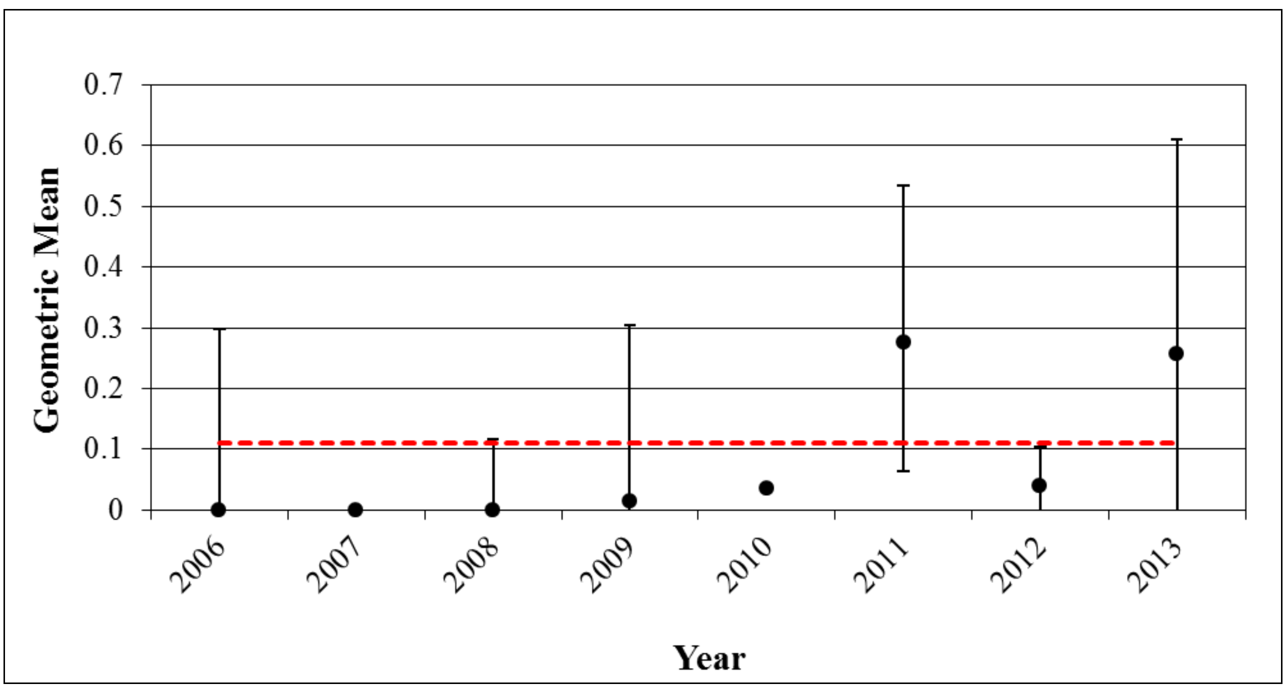

Figure 93. Hollow Green Weed (*Enteromorpha sp.*) beach seine index of relative abundance (geometric mean) with 95% confidence intervals (2006-2013). Dotted line represents the 2006-2013 time series grand mean, (n=38/year).

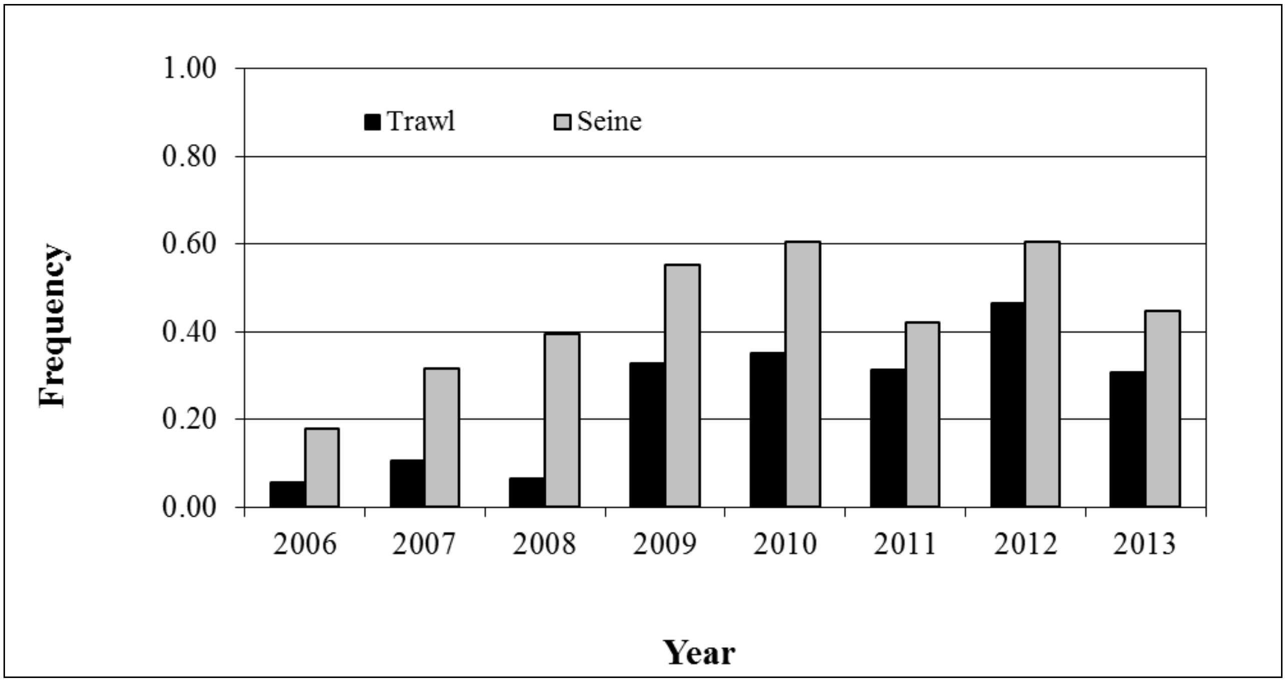

Figure 94. Eel Grass (*Zostera marina*) abundance by percent frequency of positive hauls from 2006-2013 by the Coastal Bays Fisheries Investigation Trawl and Beach Seine Survey.

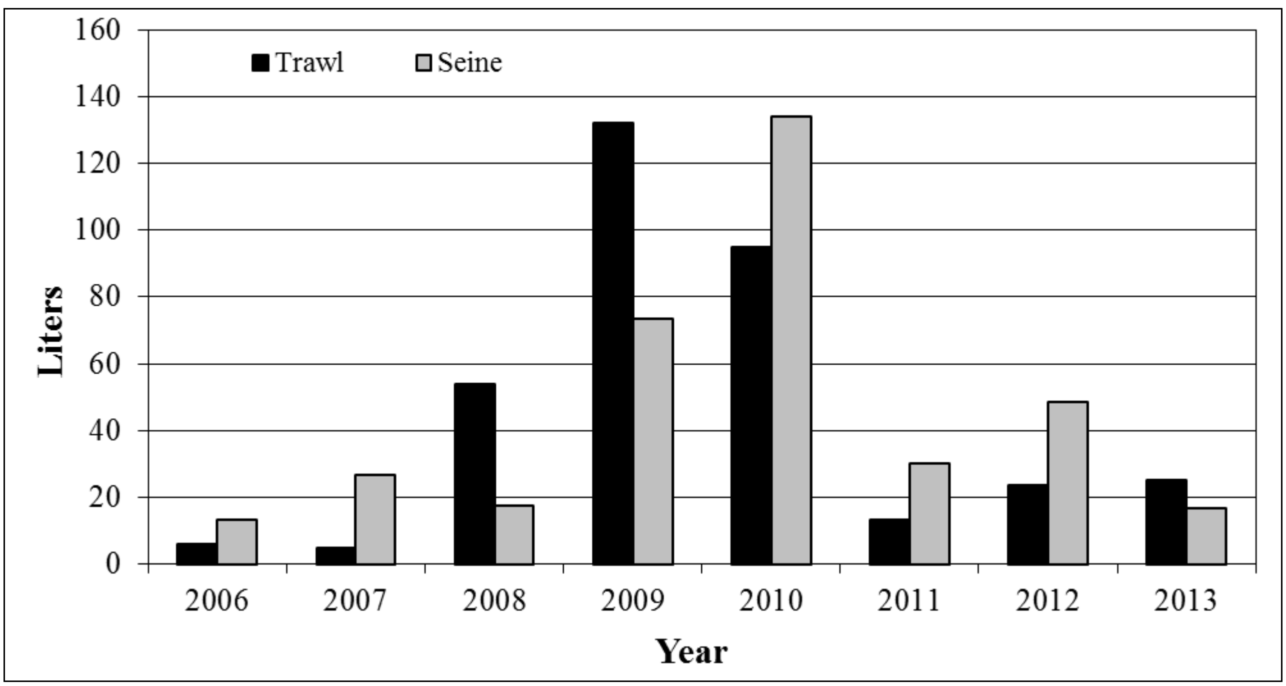

Figure 95. Eel Grass (*Zostera marina*) abundance by volume collected from 2006-2013 by the Coastal Bays Fisheries Investigation Trawl and Beach Seine Survey.

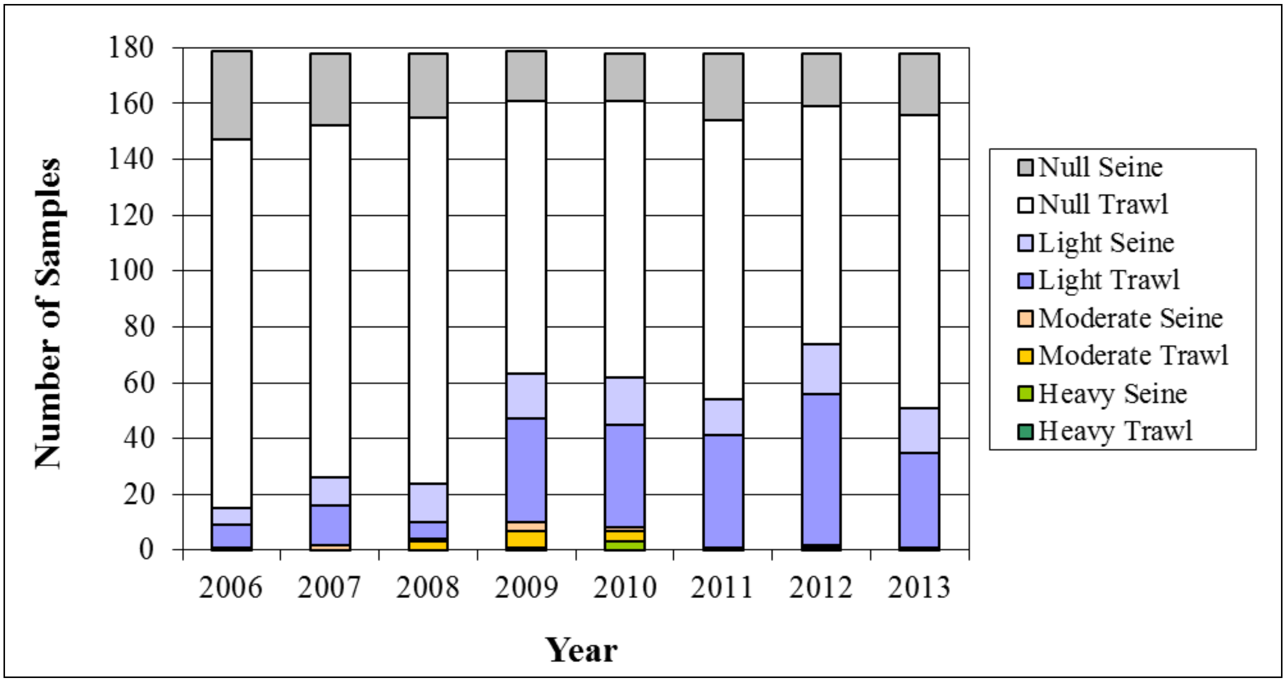

Figure 96. Eel Grass (*Zostera marina*) volume load categories from 2006-2013 by the Coastal Bays Fisheries Investigation Trawl and Beach Seine Survey.

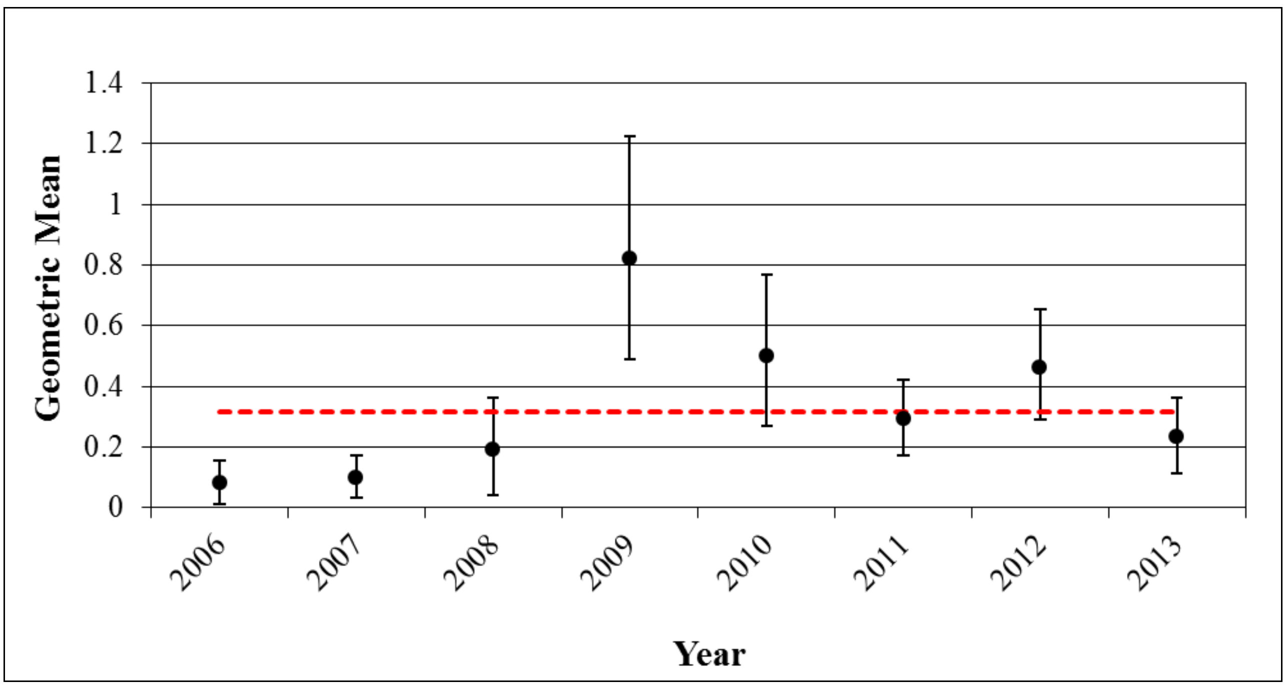

Figure 97. Eel Grass (*Zostera marina*) trawl index of relative abundance (geometric mean) with 95% confidence intervals (2006-2013). Dotted line represents the 2006-2013 time series grand mean, (n=140/year).

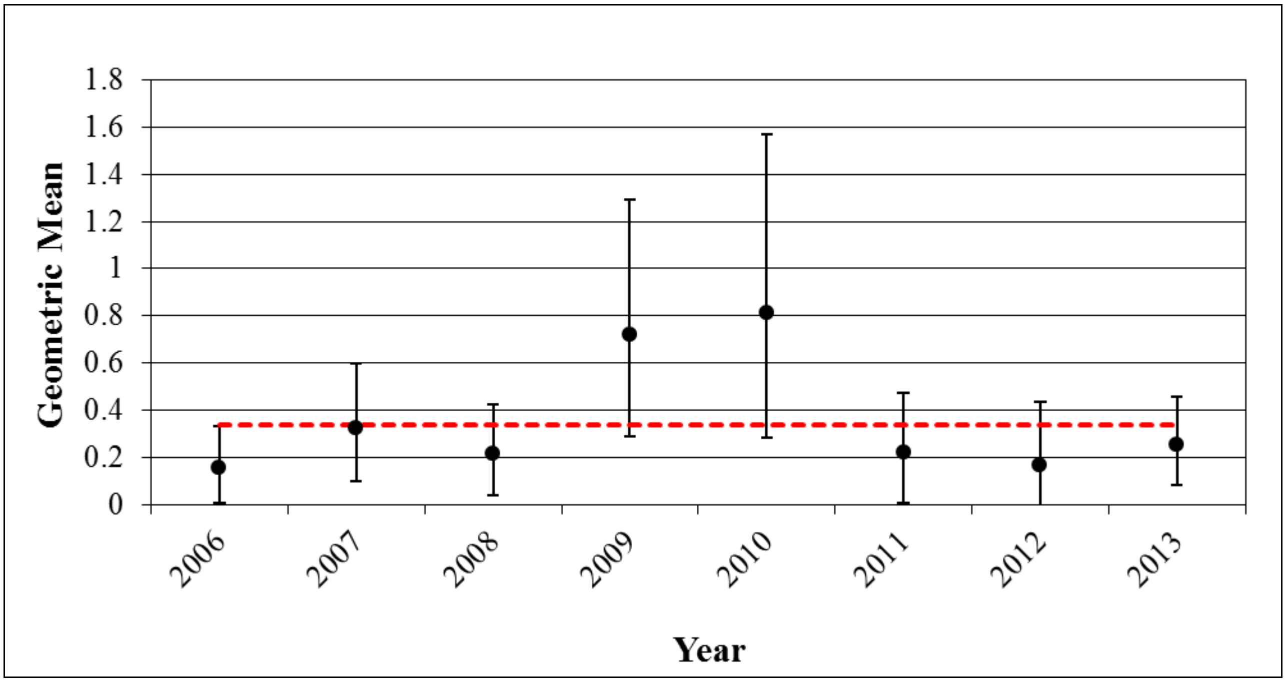

Figure 98. Eel Grass (*Zostera marina*) beach seine index of relative abundance (geometric mean) with 95% confidence intervals (2006-2013). Dotted line represents the 2006-2013 time series grand mean, (n=38/year).

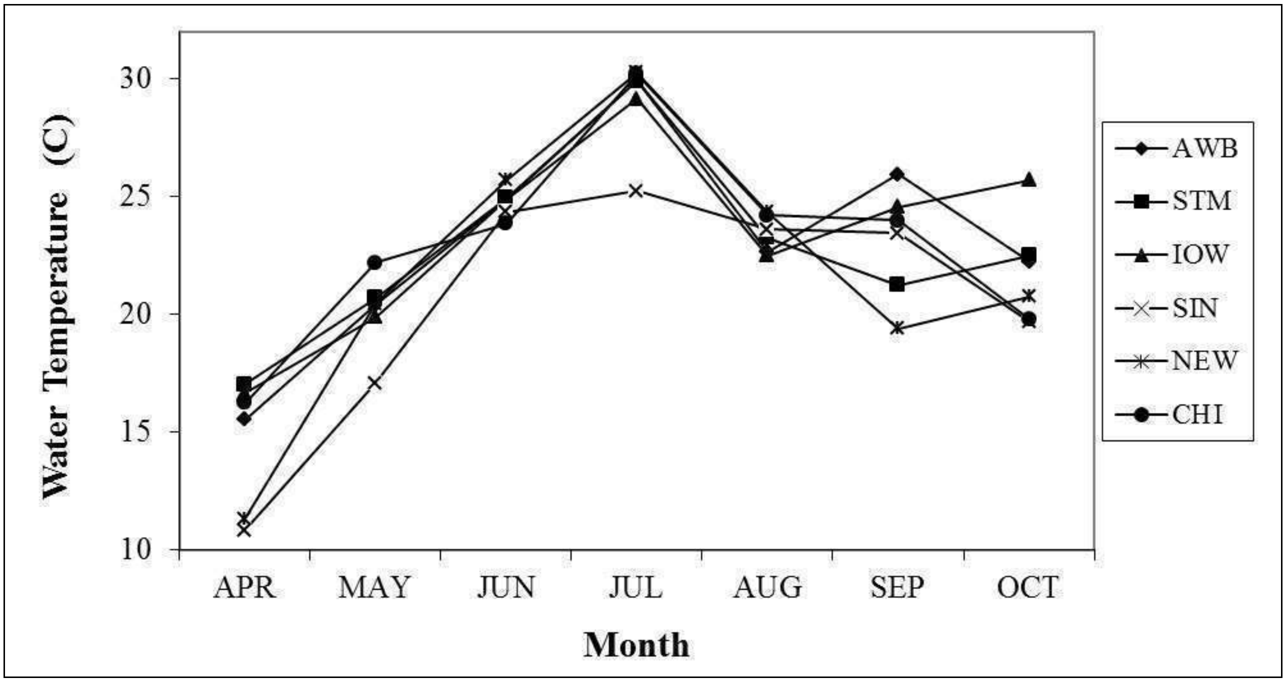

Figure 99. 2013 Coastal Bays Fisheries Investigations Trawl Survey mean water temperature (C) by month for Assawoman Bay (AWB), St. Martins River (STM), Isle of Wight Bay (IOW), Sinepuxent Bay (SIN), Newport Bay (NEW), and Chincoteague Bay (CHI).

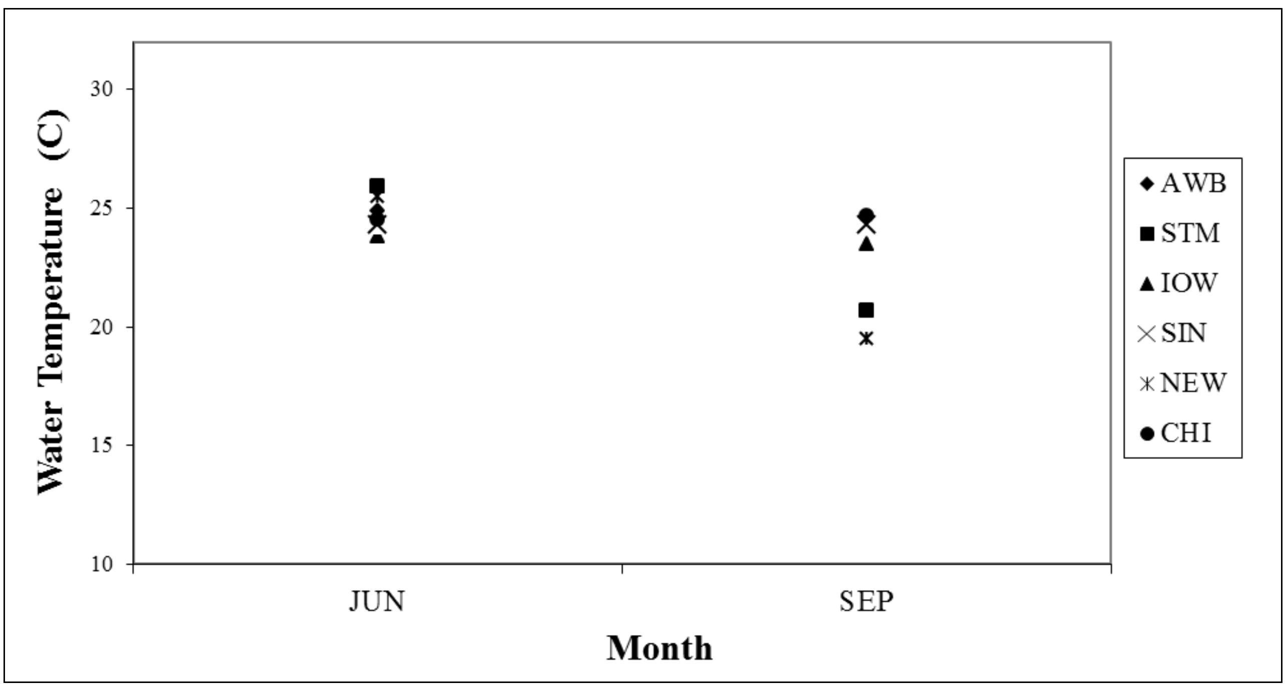

Figure 100. 2013 Coastal Bays Fisheries Investigations Beach Seine Survey mean water temperature (C) by month for Assawoman Bay (AWB), St. Martins River (STM), Isle of Wight Bay (IOW), Sinepuxent Bay (SIN), Newport Bay (NEW), and Chincoteague Bay (CHI).

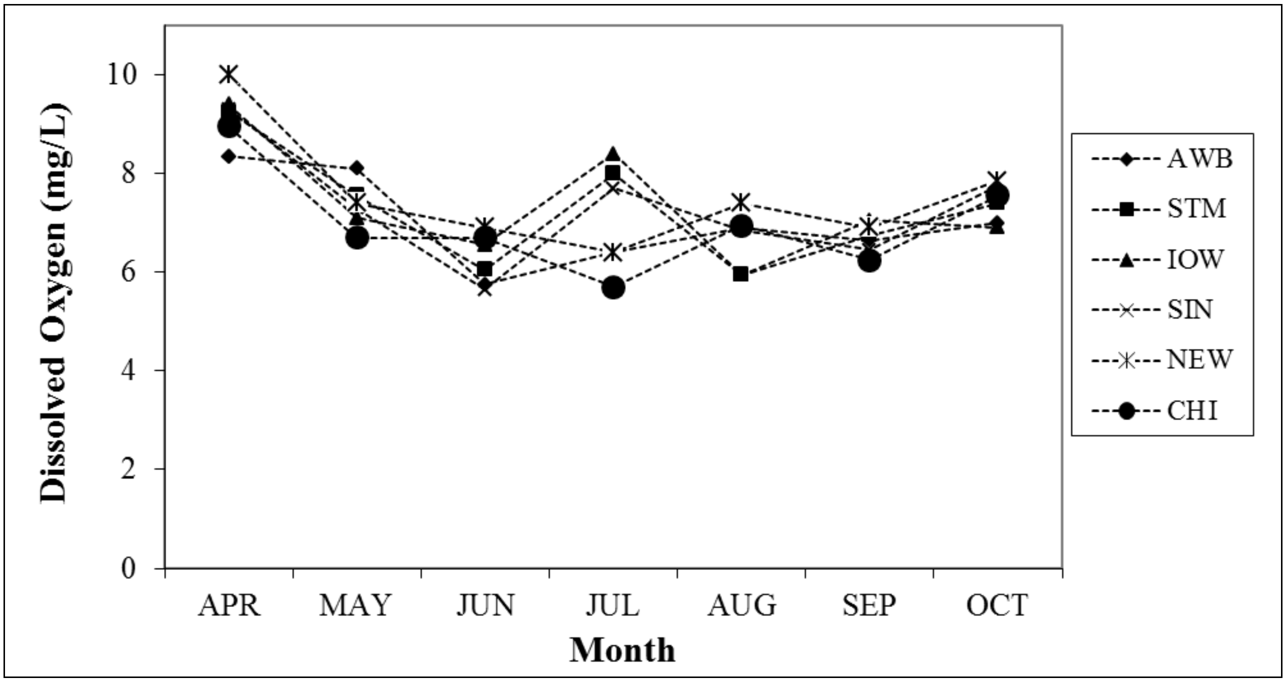

Figure 101. 2013 Coastal Bays Fisheries Investigations Trawl Survey mean dissolved oxygen (mg/L) by month for Assawoman Bay (AWB), St. Martins River (STM), Isle of Wight Bay (IOW), Sinepuxent Bay (SIN), Newport Bay (NEW), and Chincoteague Bay (CHI).

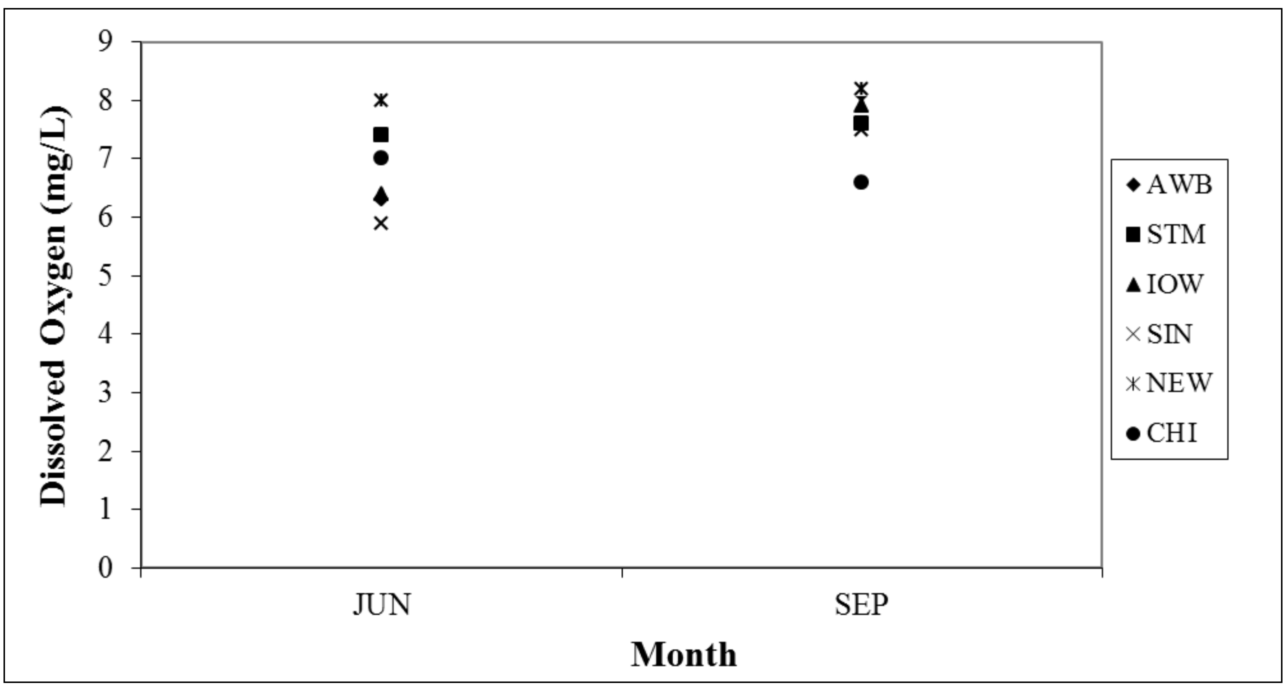

Figure 102. 2013 Coastal Bays Fisheries Investigations Beach Seine Survey mean dissolved oxygen (mg/L) by month for Assawoman Bay (AWB), St. Martins River (STM), Isle of Wight Bay (IOW), Sinepuxent Bay (SIN), Newport Bay (NEW), and Chincoteague Bay (CHI).

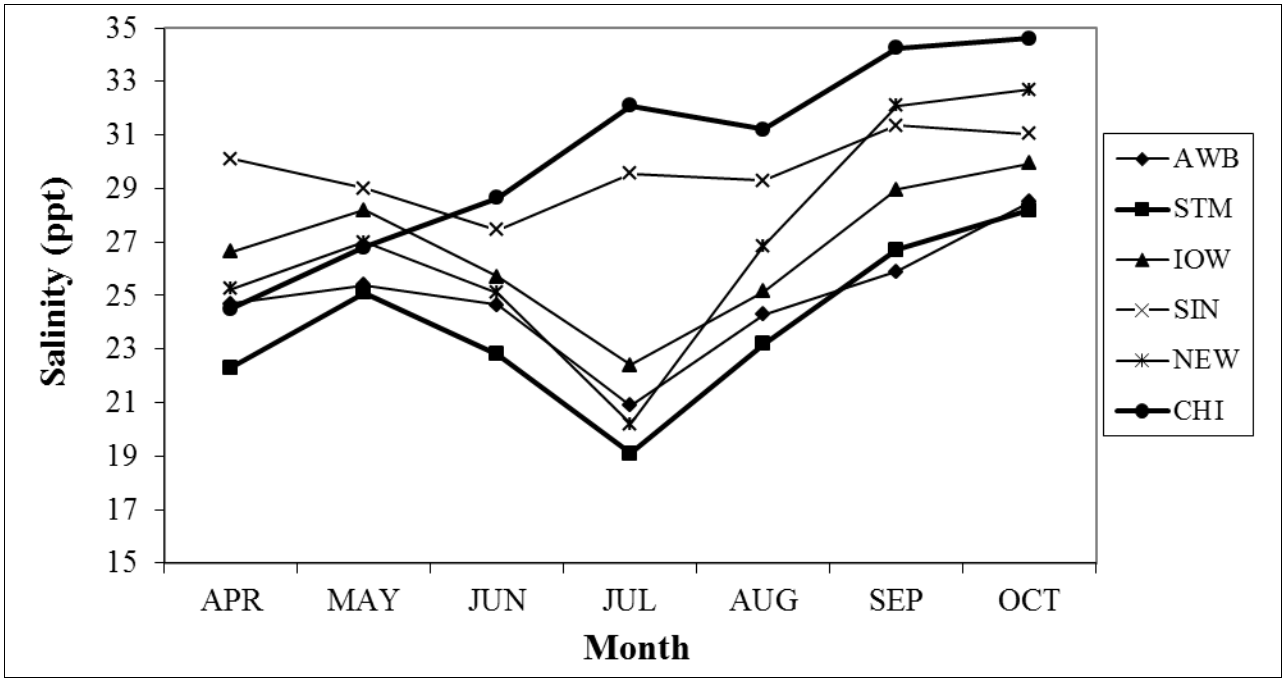

Figure 103. 2013 Coastal Bays Fisheries Investigations Trawl Survey mean salinity (ppt) by month for Assawoman Bay (AWB), St. Martins River (STM), Isle of Wight Bay (IOW), Sinepuxent Bay (SIN), Newport Bay (NEW), and Chincoteague Bay (CHI).

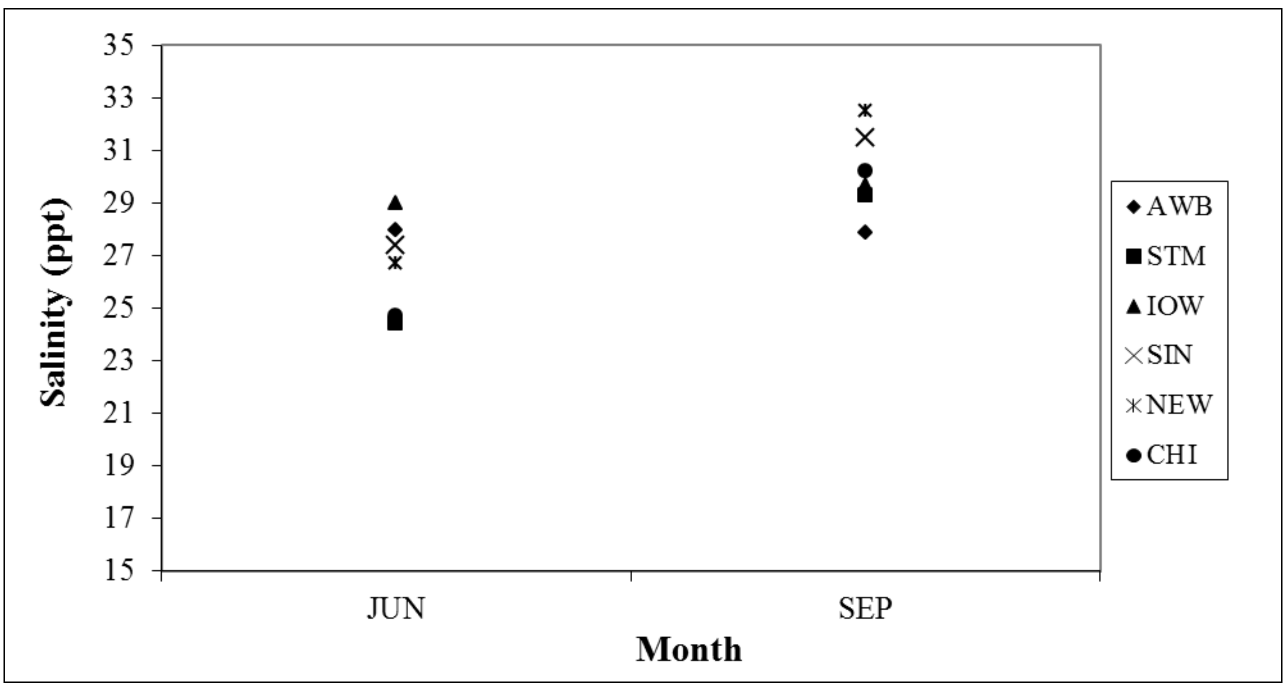

Figure 104. 2013 Coastal Bays Fisheries Investigations Beach Seine Survey mean salinity (ppt) by month for Assawoman Bay (AWB), St. Martins River (STM), Isle of Wight Bay (IOW), Sinepuxent Bay (SIN), Newport Bay (NEW), and Chincoteague Bay (CHI).

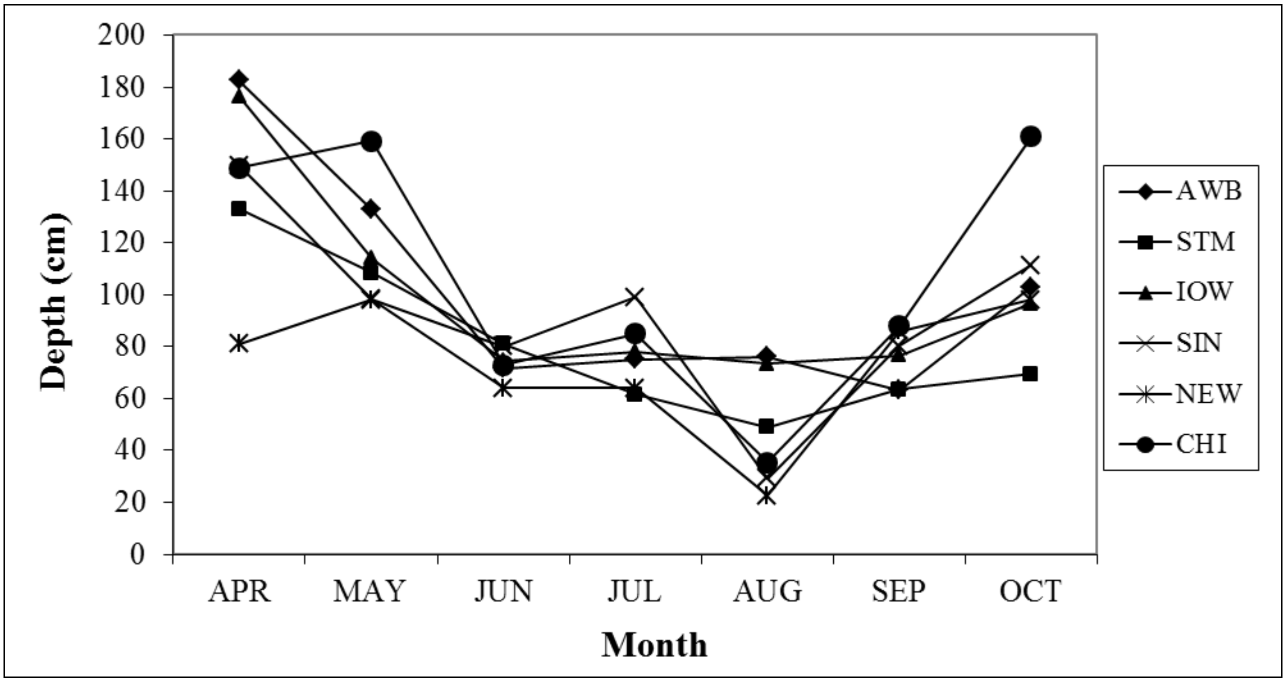

Figure 105. 2013 Coastal Bays Fisheries Investigations Trawl Survey mean turbidity (cm) by month for Assawoman Bay (AWB), St. Martins River (STM), Isle of Wight Bay (IOW), Sinepuxent Bay (SIN), Newport Bay (NEW), and Chincoteague Bay (CHI).

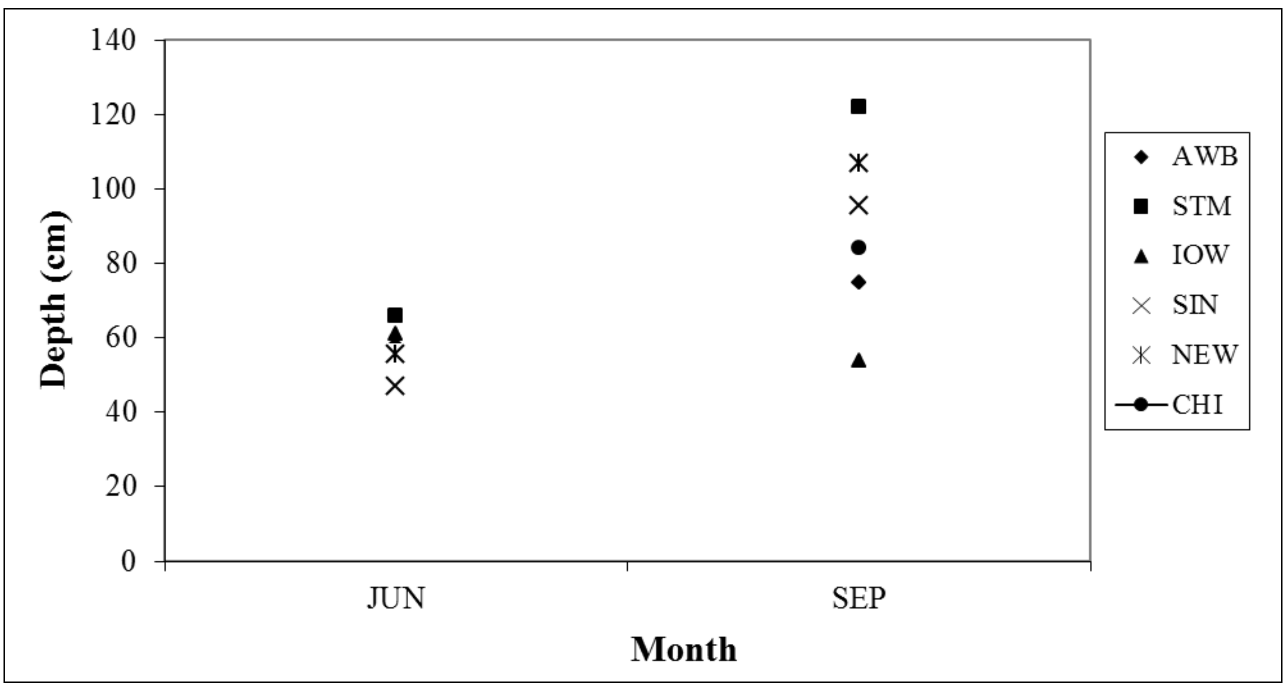

Figure 106. 2013 Coastal Bays Fisheries Investigations Beach Seine Survey mean turbidity (cm) by month for Assawoman Bay (AWB), St. Martins River (STM), Isle of Wight Bay (IOW), Sinepuxent Bay (SIN), Newport Bay (NEW), and Chincoteague Bay (CHI).

Chapter 2

Coastal Bays Fisheries Investigations: Submerged Aquatic Vegetation Habitat Survey

Introduction:

The Maryland Department of Natural Resources (MDNR) has been conducting the Coastal Bays Fisheries Investigations (CBFI) Trawl and Beach Seine Surveys since 1972, with a standardized protocol since 1989. These surveys are designed to characterize and quantify juvenile finfish abundance but they also encounter bycatch that includes crustaceans, molluscs, sponges, and macroalgae. The surveys rarely sample in Submerged Aquatic Vegetation (SAV). Currently, there is limited information specific to Maryland's Coastal Bays' SAV beds as critical or essential habitat for living resources.

Although there are many species of SAV in the Mid-Atlantic, there are only two species found in Maryland's Coastal Bays; Eel Grass (*Zostera marina*) and Widgeongrass (*Ruppia maritima*; Coastal Bays Sensitive Areas Technical Task Force 2004). While SAV beds are found throughout the Coastal Bays, they are not distributed evenly. The majority of the Eel Grass beds are located along the Assateague Island shoreline. Widgeongrass is also found in Sinepuxent and Chincoteague Bays, but not in the same abundance as Eel Grass. Both SAV species provide a wide variety of functions essential to the ecological health of the bays; foremost among them is as prime nursery habitat. The young of many commercially, recreationally, and ecologically important species depend upon the grass beds for protection and feeding at some point in their life cycle (Coastal Bays Sensitive Areas Technical Task Force 2004). With SAV playing such a significant role in the life cycle of many fishes and decapods and SAV's susceptibility to anthropogenic perturbations, the characterization of fisheries resources within these areas is important (Connolly and Hindell 2006). As a result, MDNR expanded the CBFI to include sampling the SAV beds in 2012. This survey was designed to meet the following two objectives:

1. identify areas of primary habitat in Maryland's Coastal Bays; and
2. use project data for recommending prioritized management decisions. This additional work provides a more comprehensive view of fisheries habitat usage in the Coastal Bays.

Field Methods:

Sampling Period

In 2012, sampling occurred monthly from May to September. Sampling in 2013 was scaled back to May and August based on statistical analysis of the 2012 data (Doctor *et al* 2013). The prolonged cool weather in the spring delayed SAV bed growth in 2013; therefore, sampling was delayed until June.

Study Area

Three zones were delineated; the Northern Bays (north of the Route 50 Bridge), Sinepuxent Bay, and Chincoteague Bay (everything south of South Point). Four randomly selected sites were sampled in each zone in June and August 2013 (Table 1, Figure 1). The sites were chosen using the Excel Random Number Generator (RANDBETWEEN function) and a 305 m x 305 m grid (created with GIS in 2012) overlaying areas where SAV beds had been present for at least five years based on data layers created from the Virginia Institute of Marine Sciences (VIMS) SAV survey. All potential sites were verified in ArcMap to make sure there was at least 600 m^2 of SAV for sampling were appropriate depth (less than 1.5 m) and accessible. Sites that did not meet the minimum SAV bed size were eliminated. In the field, if a primary site lacked SAV, was too deep, or was inaccessible, an alternate site was used.

Each zone was sampled entirely in one day. Multiple zones were sampled in one day providing there was enough time to complete sampling for each zone. There were no instances where severe weather or emergencies made it necessary to stop sampling before completing an entire zone.

Data Collection

A 25 foot C-hawk with a 225 horsepower Evinrude E-tec engine and a 19 foot Carolina Skiff with a 90 horsepower Evinrude E-tec engine were used for transportation to the sample sites and gear deployment. Latitude and longitude coordinates (waypoints) in degrees and decimal minutes (ddmm.mmm) were used to navigate to sample locations. The GPS was also used to obtain coordinates at the start and stop points of the seine haul.

A 15.24 m X 1.8 m X 6.4 mm mesh (50 ft X 6 ft X 0.25 in. mesh) zippered bag seine was used. A biologist estimated percent of net open and a range finder was used to quantify the distance of the seine haul. The target haul distance was 35 meters and rarely did field conditions require shorter or longer hauls. The seine was pulled across the SAV beds, swung up through the water column, and lifted out of the water using both the float and lead lines. Then the sample was shaken down into the bag and carried back to the boat for processing.

Water Quality and Physical Characteristic Data were collected using the same method and parameters described in Chapter 1. Only surface chemical data were collected due to the shallow depth (<1.5 m). Data were recorded on a standardized project data sheet printed on Rite in the Rain All Weather paper (Appendix 4).

Sample Processing

Samples were processed using the same methods described in Chapter 1. Fishes and invertebrates were identified, counted, and measured for Total Length (TL) using a wooden millimeter (mm) measuring board with a 90 degree right angle. A meter stick was used for species over 500 mm. At each site, a sub-sample of the first 20 fish (when applicable) of each species were measured and the remainder counted.

Blue Crabs were measured for carapace width, sexed, and maturity status was determined. Sex and maturity categories included: male, immature female, mature female (sook), and sook with eggs. A subsample of the first 50 Blue Crabs at each site was measured and the rest were counted.

Jellyfishes, ctenophores, bryozoans, sponges, and macroalgae were measured volumetrically (liters, L) using calibrated containers with small holes in the bottom to drain the excess water. Small quantities (generally ≤ 10 specimens) of invertebrates were occasionally counted. Larger quantities of invertebrates were estimated. Bryozoans and macroalgae were combined for one volume measurement and a biologist estimated the percentage of each species in the sample.

Data Analysis:

Catch per Unit of Effort (CPUE)
A measure of relative abundance was calculated for the SAV Survey based on catch per haul to investigate finfish and crustacean habitat preferences. , A Kruskal–Wallis test was conducted (McDonald 2009) to compare relative abundace by zone and percent SAV coverage. A Mann–Whitney U-test was conducted to compare relative abundance by substrate composition and water turbidity (McDonald 2009). All tests were performed on the 2012-2013 combined catch data because of low sample sizes in 2013. Descriptions of the categories analyzed are below:

- <u>zone</u>: Northern Bays (Assawoman Bay and Isle of Wight Bay), Sinepuxent Bay; and Chincoteague Bay;
- <u>percent coverage:</u> 25% SAV or less, 26-50% SAV, 51-75%, and 76-100%.
- <u>substrate</u>: mud and sand;
- <u>turbidity:</u> Secchi disk to bottom, Secchi disk not to bottom; and

Results:

Water Quality and Physical Characteristics
The water quality tested at all SAV Habitat Survey sites was consistent with finfish and crustacean habitat requirements. The average DO in June was 7.40 mg/L, and was 7.59 mg/L in August. The water temperature average was 23.1°C in June and was 28.3ºC in August, while the salinity remained constant at 29 ppt. The bottom was visible (depths up to 1.5m) at 66% of sites.

CPUE
There were 14 species of finfish and four species of crustaceans caught in the SAV Habitat Survey across 24 samples collected in June and August in 2013 (Tables 2 and 3). The mean finfish per haul dropped from 21.9 in 2012 to 10.5 in 2013. The mean crustacean per haul dropped from 28.2 in 2012 to 13.6 in 2013.

There was no significant difference in finfish mean abundance by zone ($p=0.063$; Table 4). Crustacean abundance by zone was significantly different ($p<0.001$; Table 4). Crustacean mean abundance by zone was highest in Sinepuxent Bay (35.7 crustacean/haul), followed by Chincoteague Bay (21.7 crustacean/haul) and then the Northern Bays (9.3 crustacean/haul).

There was no significant difference in finfish mean abundance by substrate (p=0.459; Table 4). There was no significant difference in crustacean mean abundance by substrate (p=0.833; Table 4). Shell substrate was rare (one sample site) and was removed from the analysis.

There was no difference in finfish mean abundance between sites where the Secchi disk was visible on the bottom and sites where the Secchi disk was not visible on the bottom (p=0.429; Table 4). Crustacean mean abundance was 40.8 crustaceans/haul in clear water and 14.0 crustaceans/haul where the Secchi disk depth was off bottom which was significantly different (p=0.020; Table 4).

Finfish mean abundance was significantly different by percent coverage of SAV (p=0.042; Table 5). More than half the total fish, averaging (31.3 fish/haul) in the two year survey, were caught in SAV beds ranging from 51-75% SAV coverage. Low abundance of finfish (2.0 fish/haul) was measured from sites that had less than 26% SAV coverage. The difference in crustacean mean abundance by percent coverage of SAV was not significant (p=0.100; Table 5).

Discussion:

The two years of this survey have demonstrated large inter-annual variability in environmental conditions and abundance. The 2013 mean April surface and bottom water temperatures from the Trawl Survey averaged 15°C and 13ºC, which were 2 and 4 degrees colder than the previous year. The prolonged cool spring weather delayed SAV bed growth, and likely resulted in the substantial decrease in finfish and crustacean abundance across surveys in 2013. This effect has been documented - broad environmental factors are capable of influencing habitat suitability and may explain recruitment variability observed in many estuarine fishes (Secor and Houde 1995; Austin 2002; Kraus and Secor 2005; Wood and Austin 2009).

There was no significant difference by zone, but finfish mean abundance was highest in beds with 51-75 percent SAV coverage. Relative abundance for finfish was poor at the sampling sites where the percent coverage of SAV was less than 26% (Table 5). These results show that finfish prefer denser areas of SAV in Maryland Coastal Bays compared to unvegetated or lightly vegetated areas. Since Silver Perch were the most sampled species in 2013, and finfish sampled in 2013 were most abundant in dense SAV areas, it appears that Silver Perch display a strong preference for SAV areas.

Future Study:

At the current sampling level, we can continue to monitor community assemblages over SAV beds and discern areas of primary fisheries habitat in Maryland's Coastal Bays. Sampling frequency was reduced in 2013 based on available staff time and resources. This level of sampling will not be enough to fully describe all facets of SAV as fisheries habitat within Maryland's Coastal Bays. In order to address relationships with water quality, SAV beds, and fish, and to identify species specific habitat preferences, some level of sampling between 2012 levels and 2013 levels will need to be conducted. We recommend that the sampling design be re-evaluated after the 2014 season to determine what level of sampling is required to improve sample sizes and accommodate some inter-annual variation.

References:

Austin, H.M. 2002. Decadal oscillations and regime shifts, a characterization of the Chesapeake Bay marine climate. Am. Fish. Soc. Symp. 32: 155–170.

Coastal Bays Sensitive Areas Technical Task Force. 2004. Maryland Coastal Bays Aquatic Sensitive Initiative. Edited by Conley, M. Maryland Department of Natural Resources Coastal Zone Management Division

Connolly, R. M. and J. S. Hindell. 2006. Review of nekton patterns and ecological processes in seagrass landscapes. Estuarine, Coastal and Shelf Science. 68:433-444.

Doctor, S., C. Jones, C. Kennedy, G. Tyler, and A. Willey. 2013. Investigation of Maryland's Coastal Bays and Atlantic Ocean finfish stocks 2012 Report. Maryland Department of Natural Resources. Federal Aid Project No. F-50-R-21. Annapolis, MD.

Kraus, R.T., and D.H. Secor. 2005. Application of the nursery role hypothesis to an estuarine fish. Mar. Ecol. Prog. Ser. 291: 301–305.

Lipcius, R.N., and W.T. Stockhausen. 2002. Concurrent decline of the spawning stock, recruitment, larval abundance, and size of the blue crab *Callinectes sapidus* in Chesapeake Bay. Mar. Ecol. Prog. Ser. 226:45-61.

Luo, J., and J. Musick. 1991. Reproductive biology of the bay anchovy in Chesapeake Bay. Trans. Am. Fish. Soc. 120:701-710.

MacGregor, J.M., and E.D. Houde. 1996. Onshore-offshore pattern and variability in distribution and abundance of bay anchovy *Anchoa mitchilli* eggs and larvae in Chesapeake Bay, Mar. Ecol. Prog. Ser. 138: 15-25.

Malyshev, A., and P. A. Quijón. 2011. Disruption of essential habitat by a coastal invader: new evidence of the effects of green crabs on eelgrass beds. ICES Journal of Marine Science, 68: 1852–1856.

McDonald, J.H. 2009. Handbook of Biological Statistics (2nd ed.). Sparky House Publishing, Baltimore, Maryland. 153-160 pp.

Murdy, E.O., R.S. Birdsong, and J.A. Musick, 1996. Fishes of Chesapeake Bay. Smithsonian Institution Press, Washington, D.C., and London.

Pierce, C. J., J. B. Rasmussen, and W. C. Leggett. 1990. Sampling littoral fish with a seine: corrections for variable capture efficiency. *Canadian Journal of Fisheries and Aquatic Science.* 47:1004-1010.

Secor, D.H., and Houde, E.D. 1995. Temperature efforts on the timing of striped bass egg production, larval viability, and recruitment potential in the Patuxent River (Chesapeake Bay). Estuaries, 18: 527–544.

University of Maryland Center for Environmental Science, Maryland Department of Natural Resources, and the Maryland Coastal Bays Program. 2013. Coastal Bays Report Card 2012. Maryland Coastal Bays Program.

Wazniak, C., M. Hall, C. Cain, D. Wilson, R. Jesien, J. Thomas, T. Carruthers, and W. Dennison. 2004. State of the Maryland Coastal Bays. Maryland Department of Natural Resources, Maryland Coastal Bays Program, and University of Maryland Center for Environmental Science.

Wood, R.J., and Austin, H.M. 2009. Synchronous multidecadal fish recruitment patterns in Chesapeake Bay, USA. Can. J. Fish. Aquat. Sci. 66: 496–508.

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Table 1. MDNR Coastal Bays Fisheries Investigation 2013 SAV Habitat Survey site descriptions.

Site Number	Bay	Site Description	Latitude	Longitude
V008	Assawoman Bay	SW of Devil's Island	38 24.579	75 04.557
V009	Assawoman Bay	At 94th Street; SW of Devil's Island	38 24.537	75 04.439
V011	Assawoman Bay	W of first canal at 90th street	38 24.502	75 04.542
V049	Assawoman Bay	N. of Rt. 90 Bridge; about 15 light posts from Ocean City	38 23.319	75 04.850
V050	Assawoman Bay	W. of OC water tower, N of Rt. 90 Bridge	38 23.259	75 04.631
V053	Isle of Wight Bay	S of Rt. 90 Bridge; W of Fager's Island	38 23.092	75 04.677
V058	Isle of Wight Bay	S of Rt. 90 Bridge, W of Fager's Island	38 23.040	75 04.649
V097	Sinepuxent Bay	Across from Eagles Nest, on Assateague side	38 17.990	75 06.812
V114	Sinepuxent Bay	S of Snug Harbor, East channel edge	38 17.340	75 07.677
V167	Sinepuxent Bay	S of red boathouse; S. of Fassett Pt. Vicinity Sandy Cove	38 15.584	75 09.124
V191	Sinepuxent Bay	Boat Launch W side of Verrazano Br. between pier and bridge	38 14.832	75 09.077
V197	Sinepuxent Bay	S of Verrazano Br.; E. of Sarbanes Center	38 14.686	75 09.243
V241	Sinepuxent Bay	SE of Verrazano Bridge and Sandy Point Island	38 13.755	75 09.250
V242	Sinepuxent Bay	Due South of Sandy Point Island	38 13.750	75 09.115
V298	Sinepuxent Bay	S of Assateague Kayak Launch; NE of Great Egging Island	38 12.517	75 10.316
V316	Chincoteague Bay	Between Great Egging Island and Little Egging Island	38 11.960	75 10.361
V329	Chincoteague Bay	W. of Bird Island on E edge of channel	38 11.636	75 12.056
V348	Chincoteague Bay	Southwest of Great Egging Island, due West of Lumber Marsh Island	38 11.483	75 10.991
V424	Chincoteague Bay	Due West of Crow Tump, East of channel, Vicinity Tingles Island	38 10.199	75 12.558
V429	Chincoteague Bay	Intersection- West Crow Tump and South of Outward Tump. Vicinity Tingles Island	38 10.131	38 10.162
V675	Chincoteague Bay	Off Striking Marsh; in Rum Harbor Cove	38 04.086	75 15.400
V736	Chincoteague Bay	NE of Cedar Island; in West Bay	38 02.334	75 15.592
V749	Chincoteague Bay	100 yds W of Cedar Island	38 01.937	75 16.497

Table 2. List of fishes collected in Maryland's Coastal Bays SAV Habitat Survey from June and August, 2013. Species are listed by order of total abundance.

Common Name	Scientific Name	Total Number Collected	Total Number Measured	CPUE SAV Habitat Survey #/Hectare
Silver Perch	*Bairdiella chrysoura*	166	59	173.1
Atlantic Silverside	*Menidia menidia*	50	46	52.1
Summer Flounder	*Paralichthys dentatus*	10	10	10.4
Pinfish	*Lagodon rhomboides*	6	6	6.3
Bay Anchovy	*Anchoa mitchilli*	4	4	4.2
Winter Flounder	*Pseudopleuronectes americanus*	4	4	4.2
Oyster Toadfish	*Opsanus tau*	3	3	3.1
Naked Goby	*Gobiosoma bosc*	2	2	2.1
American Eel	*Anguilla rostrata*	1	1	1.0
Lined Seahorse	*Hippocampus erectus*	1	1	1.0
Northern Pipefish	*Syngnathus fuscus*	1	1	1.0
Spot	*Leiostomus xanthurus*	1	1	1.0
Spotted Seatrout	*Cynoscion nebulosus*	1	1	1.0
Striped Anchovy	*Anchoa hepsetus*	1	1	1.0
	Total Finfish	**251**	**140**	

Table 3. List of crustaceans collected in Maryland's Coastal Bays SAV Habitat Survey from June and August, 2013. Species are listed by order of total abundance.

Common Name	Scientific Name	Total Number Collected	Total Number Measured	CPUE SAV Habitat Survey #/Hectare
Grass Shrimp	*Palaemonetes sp.*	222	0	231.6
Sand Shrimp	*Crangon septemspinosa*	51	0	53.2
Blue Crab	*Callinectes sapidus*	50	50	52.2
Say Mud Crab	*Dyspanopeus sayi*	3	0	3.1
	Total Crustaceans	**326**	**50**	

Table 4. Mean abundance by zone, primary substrate, and turbidity from the Coastal Bays Fisheries Investigation SAV Habitat Survey, 2012-2013, n=104.

	Zone		
	Northern Bays (n=28)	**Sinepuxent Bay** (n=48)	**Chincoteague Bay** (n=28)
Mean Number of Finfish	35.0	15.1	10.6
Mean Number of Crustaceans	9.3	35.7	21.7

	Primary Substrate	
	Mud (n=51)	**Sand** (n= 52)
Mean Number of Finfish	24.6	13.9
Mean Number of Crustaceans	26.8	22.8

	Turbidity	
	Secchi to Bottom (n=42)	**Secchi not to Bottom** (n= 62)
Mean Number of Finfish	15.8	21.6
Mean Number of Crustaceans	40.8	14.0

Table 5. Mean abundance by percent coverage of submerged aquatic vegetation from the Coastal Bays Fisheries Investigation SAV Habitat Survey, 2012-2013, n=104.

SAV Coverage	Total Samples	Mean Number of Finfish	Mean Number of Crustaceans
Up to 25%	10	2.0	2.7
26% - 50%	18	14.4	13.7
51% - 75%	37	31.3	29.8
76% - 100%	39	14.4	31.0

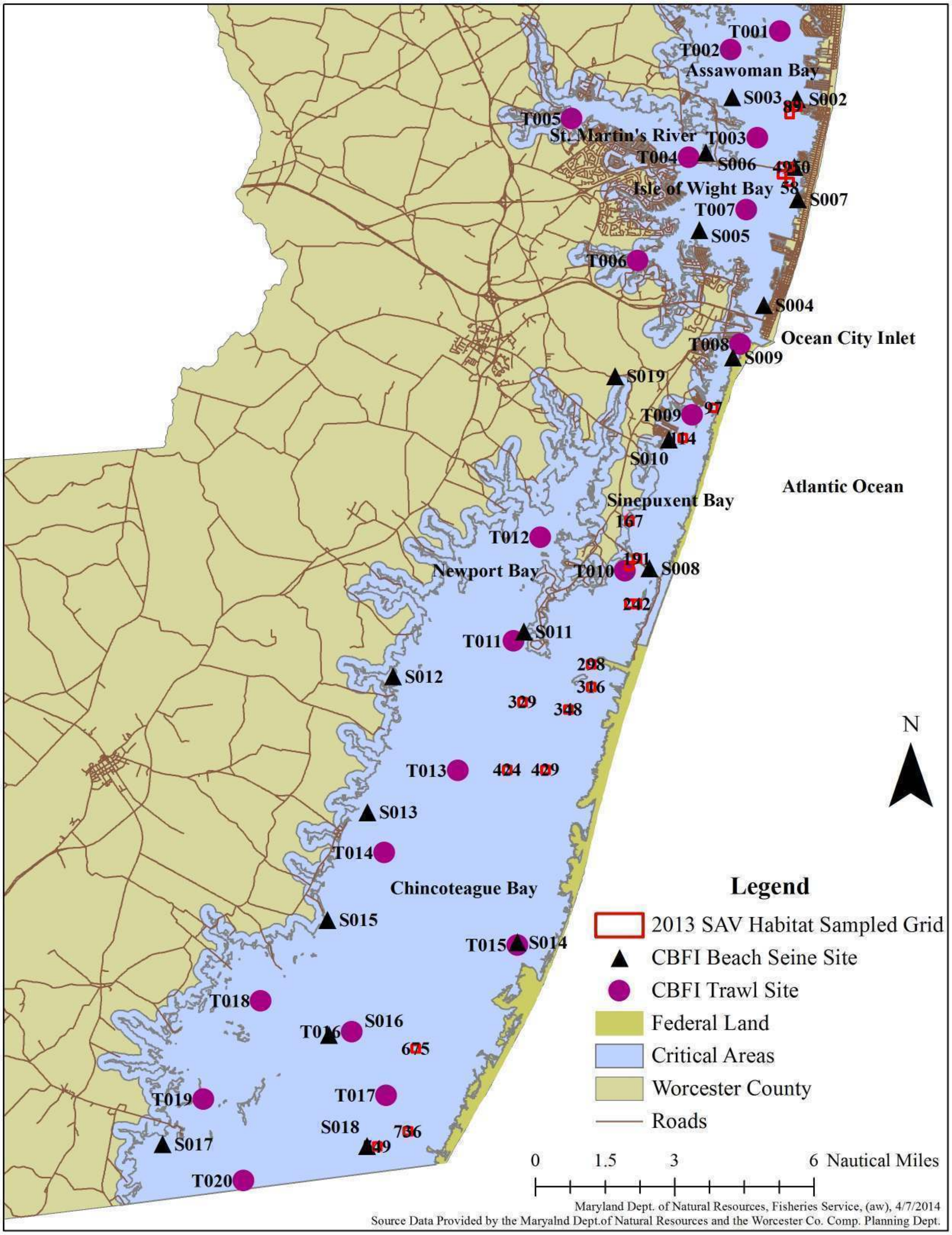

Figure 1. Coastal Bay Fisheries Investigation SAV Habitat Survey 2013 sample sites.

Chapter 3

Offshore Trawl Survey

Introduction:
In an effort to obtain information on adult fishes in the near-shore Atlantic waters, catches onboard cooperating commercial trawlers operating out of Ocean City, Maryland were sampled. Length and abundance data were taken and used to supplement the Coastal Bays Fisheries Investigation Trawl and Beach Seine Survey. Offshore sampling provides access to species and length groups not frequently available from Maryland's Coastal Bays. In addition, these data were used to meet Atlantic States Marine Fisheries Commission (ASMFC) data requirements and were included in compliance reports for Summer Flounder (*Paralichthys dentatus*), Weakfish (*Cynoscion regalis*), and Horseshoe Crabs (*Limulus polyphemus*).

Methods:

Time
Commercial sampling trips were conducted on June 18, July 29, August 25 and September 8. When targeting Horseshoe Crabs, trawls usually occurred at night in order to increase the legal size catch.

Gear and Location
Sampling was conducted on commercial trawlers targeting Horseshoe Crabs. The net used was a standard Summer Flounder bottom trawl net with a 15.24 cm mesh net body, with a 13.97 cm cod end. The head and foot rope widths for all outings were 18.3 m and 24.4 m, respectively. Start and stop depths (m) of each trawl sample were recorded. Sites were determined by the fishing vessel captains on a trip by trip basis depending on the target species.

Trawling
When the trawl was set (the net was 100% deployed) the sampler recorded the time, depth (ft), water temperature (C; available from onboard electronics), wind direction, wind speed (kts) using an anemometer, weather conditions, and Long Range Navigation (LORAN). At haul back, time, LORAN and depth will be recorded. LORAN information was collected from the shipboard electronics. When multiple trawls were conducted, the start data for the subsequent set was the same as the end data of the previous set. Data were recorded on a standardized data sheet (Appendix 5).

Sample Processing
A representative sub-sample of the catch was collected from each haul, and placed into a 1000 Liter (L) tub. All fishes were measured for total length (TL) in millimeters (mm). Wing span was measured on skates and rays. Horseshoe Crabs were measured for prosomal width. Based on morphological differences between and male and female horseshoe crabs, sex was determined for individuals in the samples. Crabs were measured for carapace width. Whelks were measured for length from the tip of the spire to the anterior tip of the body whorl. Staff biologists consulted the *Peterson Field Guide-Atlantic Seashore* (1978) and *Peterson Field Guide-Atlantic Coast Fishes* (1986) for assistance with species identification.

Total catch was estimated using two methods depending on the target species. The primary method was utilized when targeting Horseshoe Crabs. Commercial fishermen counted and sexed each horseshoe crab on every haul because there was a daily landing limit with a male to female ratio requirement. Watermen's counts were used to estimate the sub-sample to total haul ratio. This method also worked when Summer Flounder was the target species because the crew counted legal and sublegal fish. When the individuals of a target species could not be counted and compared to the total harvest from that haul, the sub-sample to catch ratio was estimated.

Data analysis
Staff biologists entered the data into a Microsoft Excel spreadsheet. Data on length, abundance, and length-frequency were analyzed using Excel or SAS for species of interest. Total catch was extrapolated from the subsample. For instance, if one third of the catch was sampled then the total catch was three times the amount sampled. If one half of the catch was sampled then the total catch was double the amount sampled. In the spreadsheet, the extrapolation factor was represented by the variable "X factor". Catch sampled times the X factor gives an estimate of the total catch.

Results:
Trawl time varied, with time ranging between 20 and 50 minutes. Water temperature ranged from a low of 17.4 C in June to a high of 23.9 C in August (Table 1). Depth over the course of the surveys ranged from 8.5 m to 17.1 m (Table 1).

The target species for all trips was the Horseshoe Crab. Numbers of species collected ranged from seven to 15 per trip (Table 2). Predominant species encountered from all the trawls were Horseshoe Crabs (*Limulus polyphemus*), Summer Flounder (*Paralichthys dentatus),* Clearnose Skate *(Raja eglanteria),* Spot *(Leiostomus xanthurus),* Nine-spined Spider Crab *(Libinia emarginata),* and Knobby Whelk (*Busycon carica*; Table 3).

From all trips combined, a total of 41 Summer Flounder were measured. Lengths ranged in size from 162 mm to 570 mm (Figure 1). The mean was 397.4 mm and the mode was 395 mm.

From June to September, prosomal widths were collected for 448 Horseshoe Crabs (Figure 2). Prosomal width ranged from 95 mm to 360 mm. There were 214 females with a mean prosomal width of 184.8 mm and mode of 140.0 mm. The rest were males (234) with a mean prosomal width of 180.3 mm and mode of 200.0 mm.

A total of 44 Knobby Whelks were collected over the course of the trawling season. Lengths ranged from 119 mm to 320 mm with a mean of 172.7 mm and mode of 121.0 mm (Figure 3). The widths ranged from 64 mm to 120 mm with a mean of 94.7 mm and mode of 97.0 mm.

Discussion:
The length frequency histogram for Summer Flounder shows an unbalanced population structure because there were not many smaller fish represented. The size structure shown in the histogram may be influenced by the small sample size and mesh size. The majority of fish captured had reached the length where they were sexually mature. Most were at or above the 355.6 mm (14") minimum size limit allowed commercially by net, pot, trap, trotline, or seine (Figure 1).

Horseshoe Crabs continued to be a productive resource for both biomedical and bait harvest. This survey indicated that the population appears to be robust (they are easily captured) and it supplies rare information that characterizes the Horseshoe Crab fishery. The Horseshoe Crab length-frequency histogram showed a robust juvenile and adult population. Females dominated from 250 mm up to 330 mm (Figure 2). The histogram depicts a maturing population of females and males with both mature and immature individuals well represented.

The Knobby Whelk lengths showed a reasonably wide distribution in Figure 3, though the number of samples was low (n=44). The majority of Knobby Whelk landed were well above the minimum size of 152.4 mm, however, very few have obtained the maximum size ascribed to this species. The mesh size of the trawl net is a deterrent to capturing sublegal sized whelks.

References:

Gosner, Kenneth L. 1978. Peterson Field Guide-Atlantic Seashore. Boston. Houton Mifflin Company.

Robins, Richard C. and G. Carleton Ray. 1986. Peterson Field Guide: Atlantic Coast Fishes. Boston. Houton Mifflin Company. 354 pp.

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Table 1. Temperature range (C), depth range and number of tows for each survey trip.

Trip Date	Temperature Range (C)	Depth Range (m)	Number of Tows
June 8	17.37-18.5	10.1-11.3	2
July 29	22.1-22.4	16.4-17.1	4
August 25	23.3-23.9	10.4-12.2	2
September 8	22.7-22.9	8.5-12.2	4

Table 2. Trip date, number of species, number of animals counted and number of measurements per trip. All trips targeted Horseshoe Crabs.

Trip Date	Number of Species	Number of Animals Counted	Number Measured
June 8	7	104	99
July 29	8	224	203
August 25	7	80	80
September 8	15	209	198

Table 3. List of species collected in sub-sampled commercial offshore trawls from June through September 2013 by the Maryland Department of Natural Resources, n= 617. Species were grouped (Finfish, Crustaceans, Mollusks, and Other) and listed by order of extrapolated total number, n=18,422 (numbers under total number column were extrapolated: number of individuals multiplied by X factor). The actual number of animal counts was presented under Total Number Counted.

Common Name	Scientific Name	Extrapolated Total Number Captured	Total Number Counted
Finfish Species			
Clearnose Skate	*Raja eglanteria*	1049	33
Spot	*Leiostomus xanthurus*	361	12
Southern Kingfish	*Menticirrhus americanus*	113	8
Summer Flounder	*Paralichthys dentatus*	41	41
Windowpane Flounder	*Scophthalmus aquosus*	30	1
Southern Stingray	*Dasyatis americana*	6	6
Smooth Butterfly Ray	*Gymnura micrura*	5	5
Bullnose Ray	*Myliobatis freminvillii*	1	1
	Total Finfish	**1,606**	**107**
Crustacean Species			
Portly Spider Crab	*Libinia emarginata*	283	8
Blue Crab	*Callinectes sapidus*	262	10
Rock Crab	*Cancer irroratus*	32	12
Lady Crab	*Ovalipes ocellatus*	27	1
Flatclaw Hermit Crab	*Pagurus pollicaris*	20	1
	Total Crustaceans	**624**	**21**
Mollusc Species			
Knobby Whelk	*Busycon carica*	1,274	44
Channeled Whelk	*Busycotypus canaliculatus*	122	4
	Total Molluscs	**1,396**	**48**
Other Species			
Horseshoe Crab	*Limulus polyphemus*	14,796	441
	Total Other	**18,422**	**617**

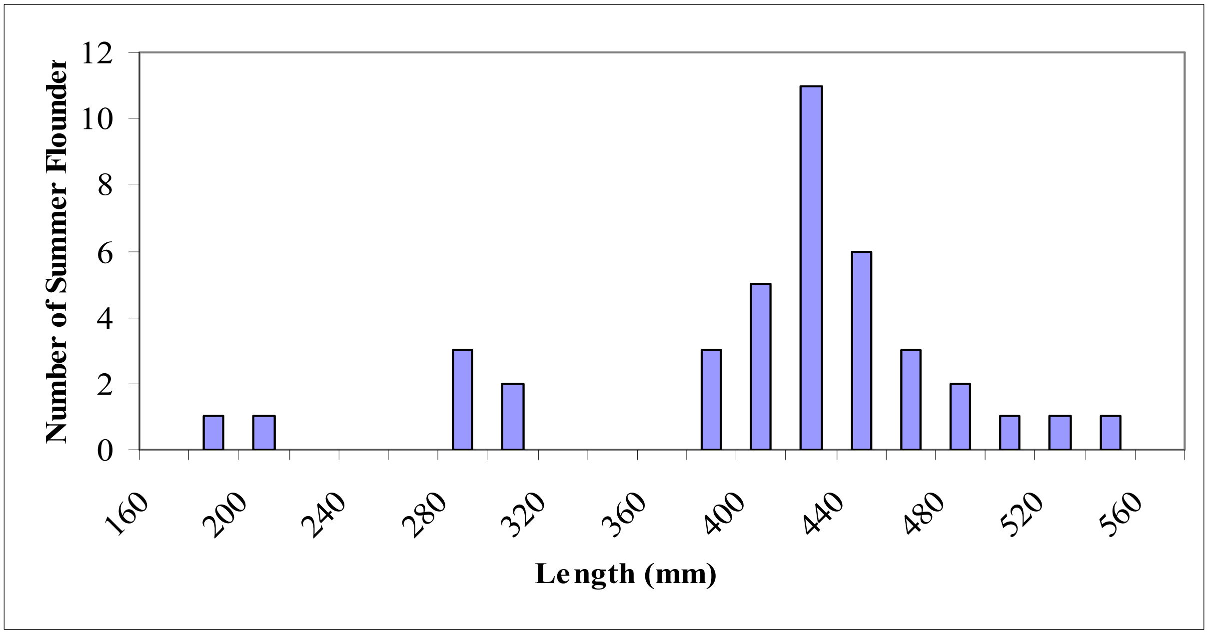

Figure 1. Summer Flounder (*Paralichthys dentatus)* length frequency from commercial offshore trawls sub-sampled by the Maryland Department of Natural Resources between June and September 2013, n= 41. Data were derived from four trawl trips taken at different water depths.

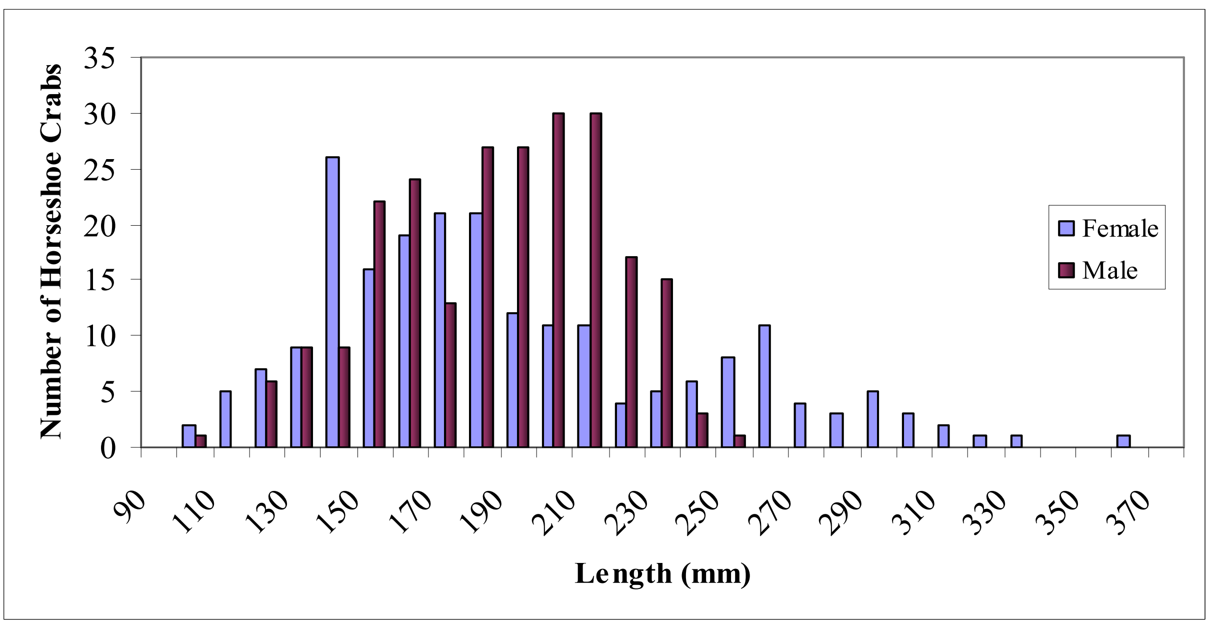

Figure 2. Horseshoe Crabs (*Limulus polyphemus*) length frequency from commercial offshore trawls sub-sampled by the Maryland Department of Natural Resources between June to September 2013, n= 448. Data were derived from four trawl trips taken at different water depths.

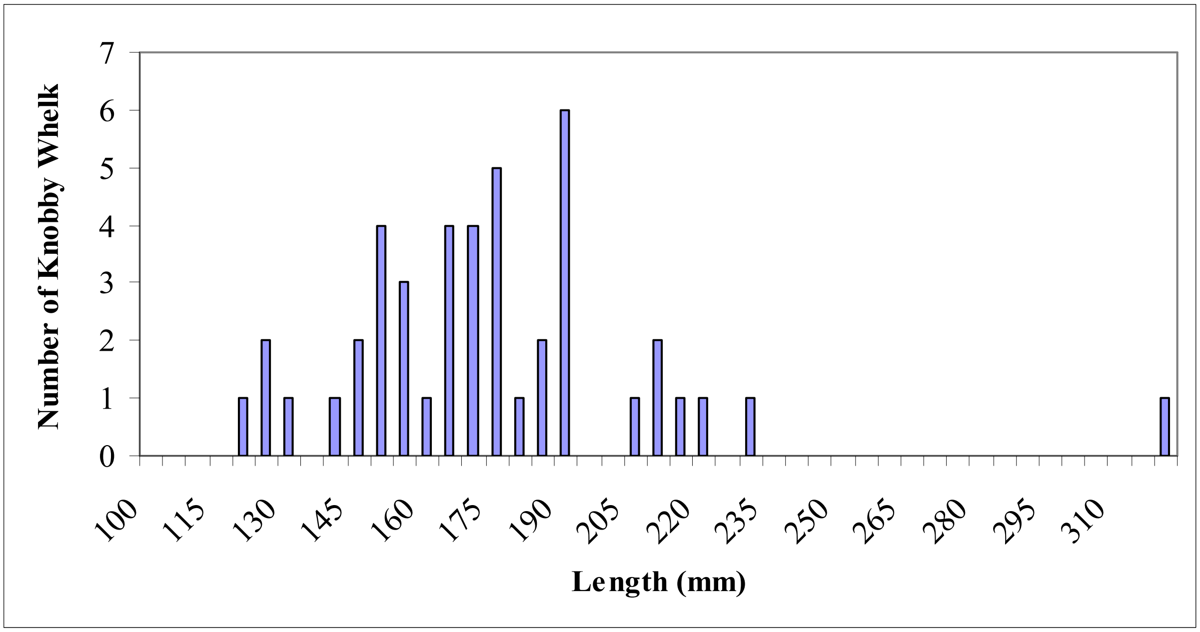

Figure 3. Knobby Whelks (*Busycon carica*) length frequency from commercial offshore trawls sub-sampled by the Maryland Department of Natural Resources between June to September 2013, n= 44. Data were derived from six trawl trips taken at different water depths.

Chapter 4
2013 Seafood Dealer Catch Monitoring

Introduction:
Dockside data have been collected in Maryland to fulfill compliance requirements of the Atlantic States Marine Fisheries Commission (ASMFC) for use in the coastal stock assessment for Weakfish (*Cynoscion regalis*) and Atlantic Croaker (*Micropogonias undulates)*. The ASMFC Weakfish and Atlantic Croaker stock assessment committees use age and size information of commercially harvested fish along the Atlantic coast to develop coastwide assessments for this species.

Methods:
CBFI staff evaluated the data needs for Seafood Dealer Catch Monitoring in 2012. Staff determined the species of immediate need and utilized the appropriate protocol for each species. Weakfish remained a top priority because of their scarcity and data were highly important. Atlantic Croaker was also a priority species because otoliths were needed for age analysis.

Fish were obtained from two Ocean City seafood dealers, Martin's Fish Market and Southern Connection Ocean City. MDNR staff had regular dialog with dealer contacts regarding the arrival status of target species. Once purchased, Weakfish and Atlantic Croakers were transferred to the Matapeake Work Center to be processed by the Migratory Species Project staff. Length, weight and age data for 2013 utilized in this report were provided by Harry Rickabaugh Jr as well as the preliminary 2013 landings (2014a and 2014b).

Results and Discussion:
Weakfish
Thirty-three Weakfish caught using gillnets were sampled in 2013. Those fish had a mean length of 438.21 mm (range 374-498 mm, 95% CI: $\pm$ 0.34) and a mean weight of 795.27 g (range 483.0-1181.0 g, 95% CI: $\pm$ 1.95; Table 1). Four fish were identified as males and their lengths were widely spread out (Figure 1). The majority of the female fish were 430 to 500 mm (Figure 1). The average age for Weakfish sampled in 2013 was the highest (2.5 years) compared to the previous four years (Table 2). All Weakfish sampled from Ocean City in 2013 were above the minimum commercial size limit (12 inches).

We expected a small sample from the coastal fishery for 2013, considering the reduction of total commercial landings over the past decade (Figure 2). The preliminary 2013 harvest of 2,014 pounds was potentially 0.8% of the mean yearly harvest of 1955 to 2012 (260,622 pounds). Preliminary 2013 landings were higher than 2012 (1,358 pounds; Rickabaugh Jr., 2014b). Historically, the Atlantic coast contributes the majority of Maryland commercial landings (97.72% in 2012). From the mid-nineteen-fifties through 2012, the Atlantic Ocean and Coastal Bays have provided 78.9% of commercial Weakfish landings (Rickabaugh Jr., 2014b). Landings were affected by stricter regulations implemented in 2010 to comply with Addendum IV (Rickabaugh Jr., 2013). Those regulatory changes allowed for a bycatch fishery in the Chesapeake Bay with a 50 pound per day or trip, whichever is longer, limit and in the Atlantic Ocean bycatch was set at 100 pounds per day or trip, whichever is longer. It was illegal to harvest Weakfish by commercial hook and line in the Coastal Bays or Atlantic Ocean.

Atlantic Croaker
Seventy Atlantic Croakers were caught using gillnets in 2013. The mean length was 282.99 mm (range 248-342 mm, 95% CI: ± 0.16; Table 3). The length frequency was highest for males from 265 mm to 310 mm (31 fish; Figure 3). The female length frequency was highest for females in the 260 to 315 mm range (29 fish; Figure 3). Mean weight was 278.29 g (range 181-455 mm, 95% ± 0.52; Table 3). Ages ranged from 1 to 5 years (Table 4). All Atlantic Croakers sampled from Ocean City for 2013 were above the minimum commercial size limit (9 inches).

The preliminary Atlantic Croaker harvest estimate for 2013 was 791,515 pounds, and was not broken down between the Chesapeake Bay and Atlantic coast (Rickabaugh, 2014b). This preliminary estimate could represent a 12.9% decrease from 2012 (908,619 pounds). It does, however, appear to potentially be 78.0% larger than the 1955 to 2012 harvest mean of 444,658 pounds. For the past 18 years, landings from the Atlantic coast contributed 16.8% of the Maryland harvest. Commercial harvest for both the Chesapeake Bay and Maryland's Atlantic coast has fluctuated over the years (Rickabaugh Jr., 2014b). For nearly two decades beginning in the mid-seventies, more of these fish were harvested from the Atlantic coast (Figure 4). Despite the local harvest fluctuations, the 2010 ASMFC benchmark assessment states that the Atlantic Croaker stock is not overharvested (ASMFC, 2010). Fluctuations within this fishery require further monitoring efforts at the Ocean City seafood dealers in future years.

References:

ASMFC 2009. Addendum IV to Amendment 4 to the Weakfish Fishery Management Plan. Washington DC.

ASMFC. 2010. Atlantic Croaker 2010 Benchmark Stock Assessment. Washington DC.

Rickabaugh Jr., Harry W. 2013. Maryland Weakfish (Cynoscion regalis) Compliance Report to the Atlantic States Marine Fisheries Commission- 2012. Maryland Department of Natural Resources. Maryland Department of Natural Resources. Annapolis, Maryland.

Rickabaugh Jr., Harry. Personal Communication. 16 Jan. 2014a. Email.

Rickabaugh Jr, Harry. Personal Communication. 30 Jan. 2014b. Email.

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Table 1. Weakfish (*Cynoscion regalis)* mean length and weight with ranges and confidence intervals for 2008 to 2013. No fish were sampled in 2011.

Year	Mean Length mm)	Length Range	Length CI	Mean Weight (g)	Weight Range	Weight CI
2008	354.3	280-495	± 8.90	496.0	265-1220	± 41.26
2009	364.3	330-392	± 4.84	551.4	346-726	± 24.95
2010	330.3	297-385	± 3.69	365.2	243-580	± 13.65
2012	351.3	315-424	± 0.20	436.86	255-686	± 0.76
2013	438.2	374-498	± 0.34	795.3	483-1181	± 1.95

Table 2. The number, mean age and age range for Weakfish (*Cynoscion regalis)* sampled along Maryland's coast from 2008 to 2013. No fish were sampled in 2011.

Year	Number Sampled	Mean Age	Age Range
2008	94	1.4	1-3
2009	41	1.2	1-2
2010	115	1.4	1-3
2012	51	1.5	1-3
2013	33	2.5	1-4

Table 3. Atlantic Croaker (*Micropogonias undulatus)* mean length and weight with ranges and confidence intervals for 2012 to 2013 n=84.

Year	Mean Length (mm)	Length Range	Length CI	Mean Weight (g)	Weight Range	Weight CI
2012	257.36	229-305	± 0.09	212.40	141-337	± 0.23
2013	282.99	248-342	± 0.16	278.29	181-455	± 0.52

Table 4. The number, mean age, and age range for Atlantic Croakers (*Micropogonias undulatus)* sampled along Maryland's coast 2012-3013, n=161.

Year	Number Sampled	Mean Age	Age Range
2012	91	3.0	1-4
2013	70	2.7	1-5

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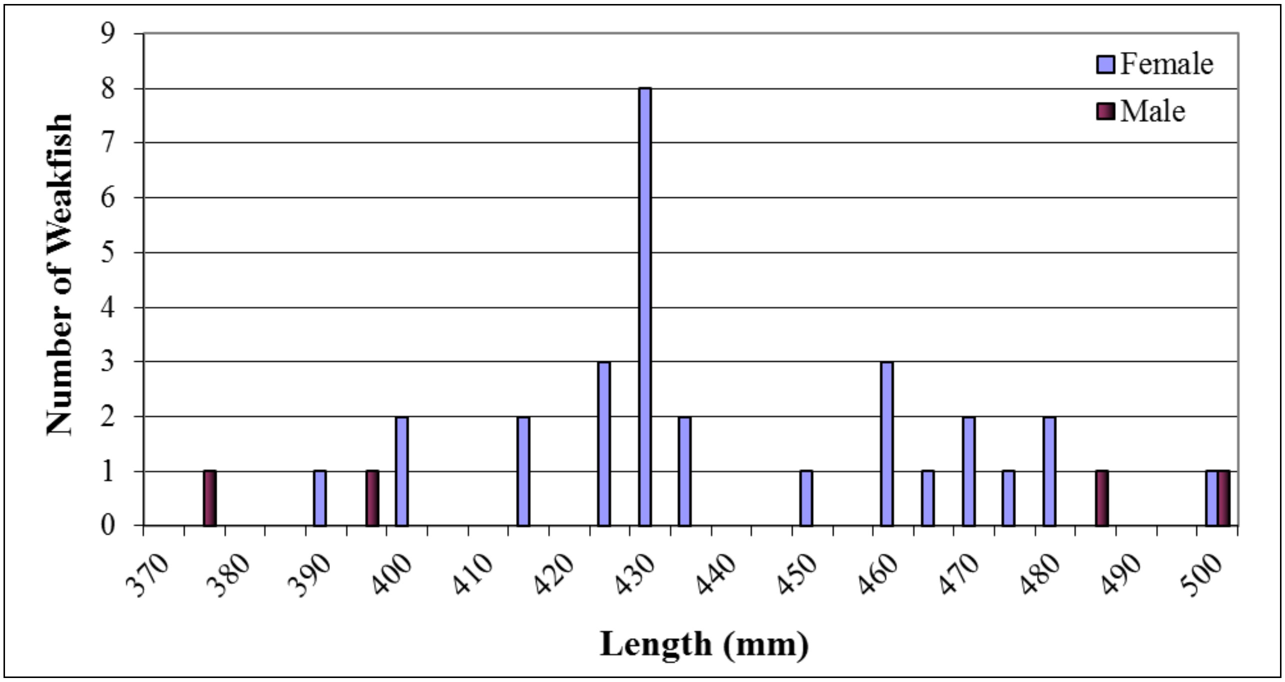

Figure 1. Weakfish (*Cynoscion regalis)* length frequency by sex from commercial gillnets sub-sampled by the Maryland Department of Natural Resources in 2013, n= 33.

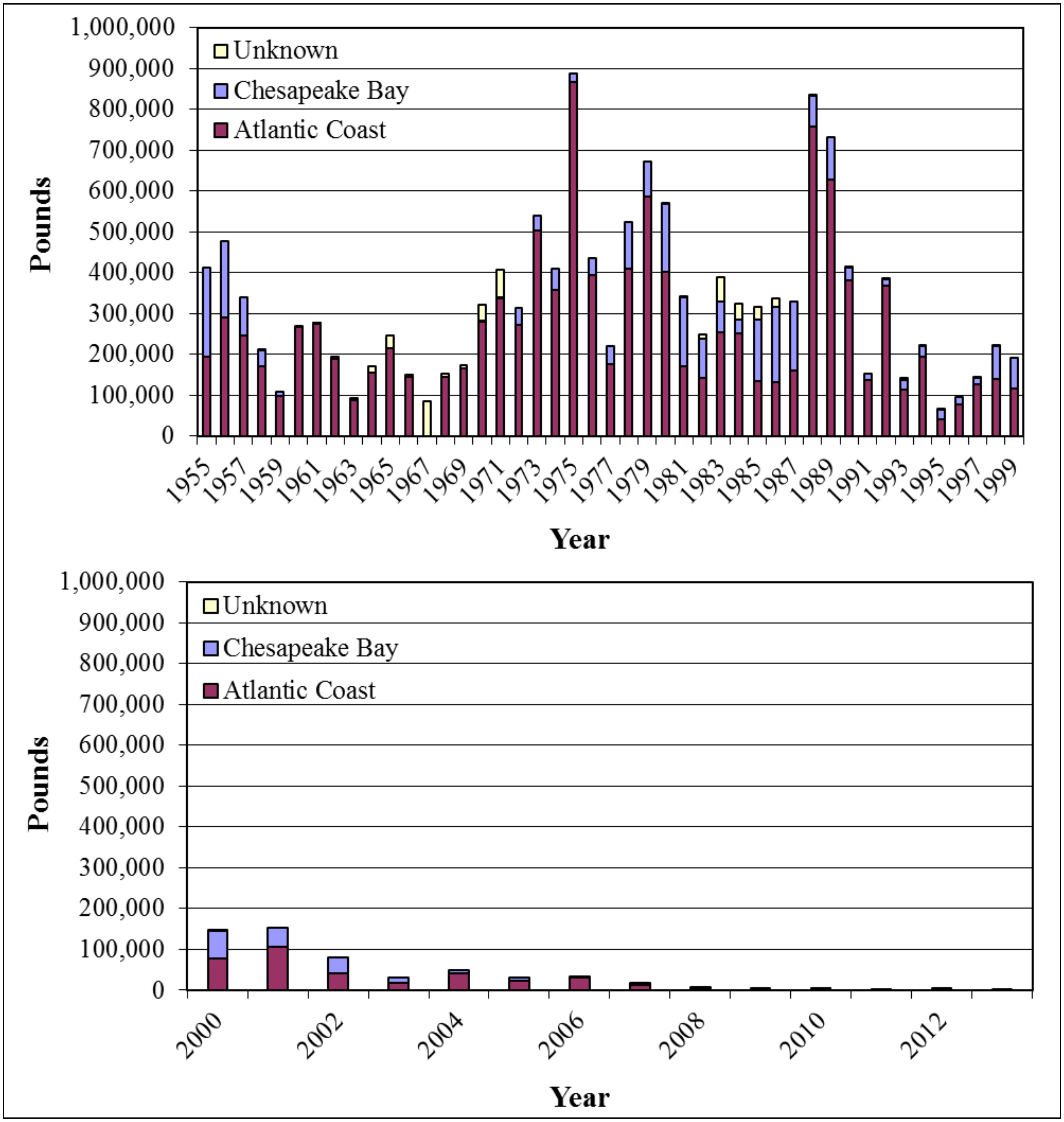

Figure 2. Maryland Weakfish (*Cynoscion regalis)* harvest from 1955 through 2013. Landings from 2013 are preliminary and subject to change.

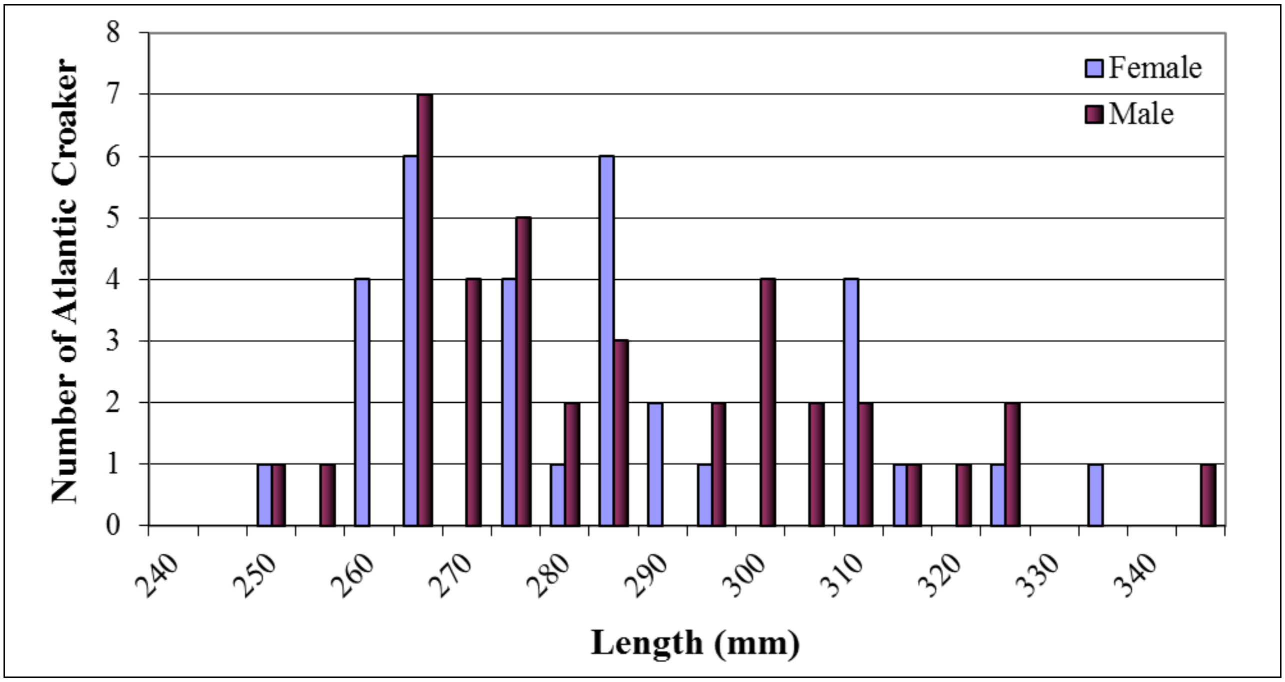

Figure 3. Atlantic Croaker (*Micropogonias undulatus)* length frequency by sex from commercial gillnets sub-sampled by the Maryland Department of Natural Resources in 2013, n= 70.

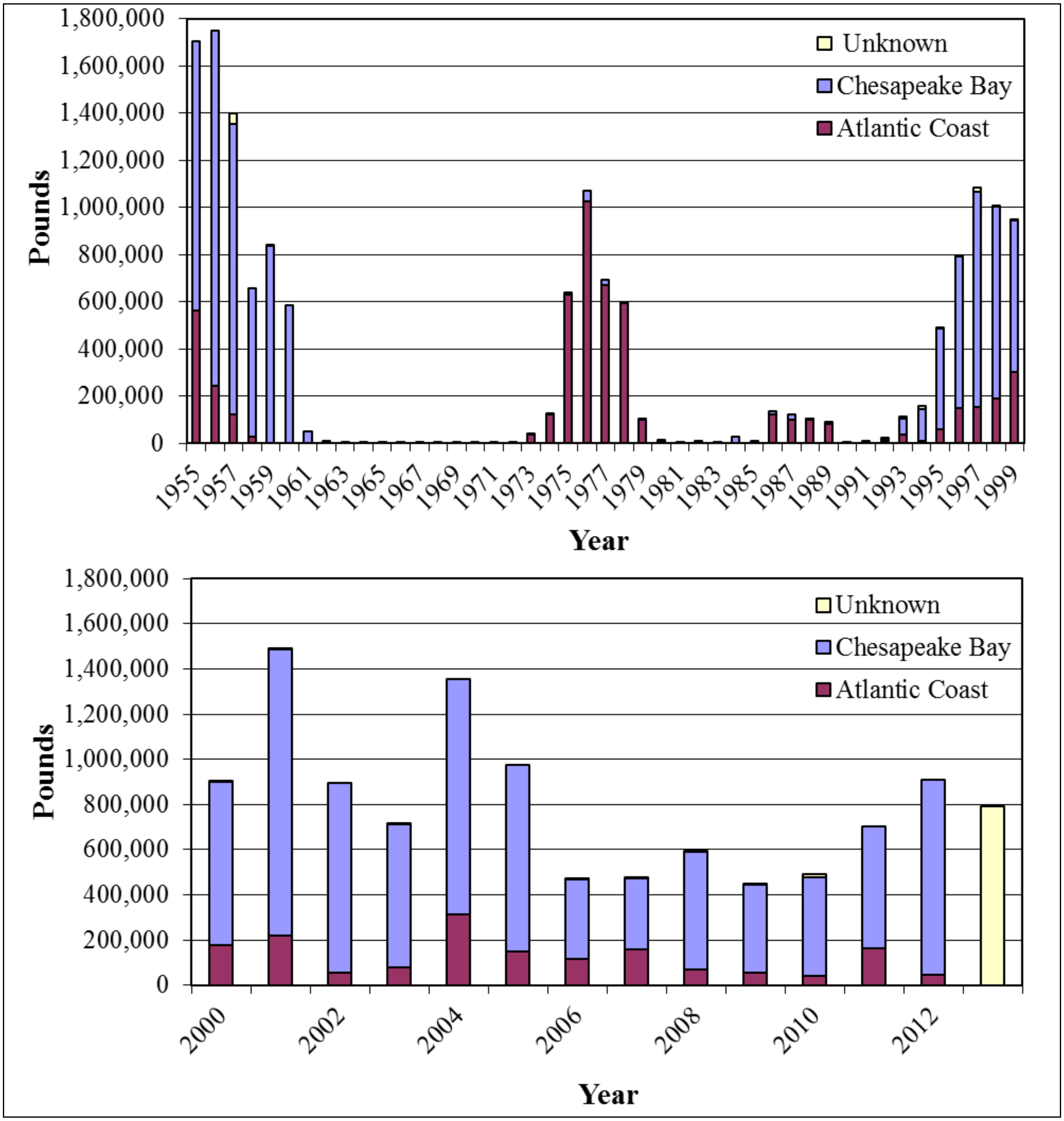

Figure 4. Maryland Atlantic Croaker (*Micropogonias undulatus)* harvest from 1955 through 2013. Landings from 2013 are preliminary and subject to change.

MD DNR Coastal Bays Trawl Data Sheet

Appendix 1.

Draw line separating ♂ and ♀ crabs. Start females in the right column and work towards the middle.
Place ● next to sook and a 2nd ● to indicate with eggs (ex: 60 mm sook with eggs is abbrev. 60●● and sook with no eggs 60●

♂ Blue Crab														♀ Blue crab
Cts												**Total Blue Crabs**		

Sp.	Sp.	Sp.	Sp.	Sp.	Sp.	Sp.	Sp.
Cts.	Cts.	Cts.	Cts.	Cts.	Cts.	Cts.	Cts.
Tot.	Tot.	Tot.	Tot.	Tot.	Tot.	Tot.	Tot.

Sp.	Sp.	Sp.	Sp.	Sp.	Sp.	Sp.	Sp.
Cts.	Cts.	Cts.	Cts.	Cts.	Cts.	Cts.	Cts.
Tot.	Tot.	Tot.	Tot.	Tot.	Tot.	Tot.	Tot.

Species Name	Counts	Total

Species Name	Counts	Total

MD DNR Coastal Bays Trawl Data Sheet

Date	Start Time (12 hr)	Collector	Set#	
_______/______/2013				
Site# T0	**Station Description**			

Waypoint Start	Waypoint Stop	Temp (C)	Sal (ppt)	DO (mg/L)
		Surface	Surface	Surface
		Bottom	Bottom	Bottom
Latstrt	**Latstop**	**Secchi (cm)**	**Weather**	**Tide**
38° .	38° .			
Longstrt	**Longstop**	**Depth (ft)** Start / Stop	**Wind Direction & Speed (Knots)** @	
75° .	75° .			

Tide Codes
HF ≡ High flood
HS ≡ High slack
HE ≡ High Ebb
LF ≡ Low flood
LS ≡ Low slack
LE ≡ Low ebb

Weather Codes
0 ≡ clear, no clouds
1 ≡ partly cloudy
2 ≡ overcast
3 ≡ Waterspout
4 ≡ fog, haze
5 ≡ drizzle
6 ≡ rain
7 ≡ mixed snow and/or rain
8 ≡ showers
9 ≡ thunderstorms

Bottom Type Codes
S ≡ Sand M ≡ mud
O ≡ shell R ≡ rubble
G ≡ gravel C ≡ clay
A = SAV NT ≡ not taken

Miscellaneous
Collector ≡ person taking data
Tot ≡ total
Cts ≡ Counts
Spp ≡ Species
WTR ≡ Water
Specvol ≡ Actual vol. measured in Liters (L)
Estimatevol ≡ Visual volume estimate in L
Estimatecnt ≡ Visual estimate of the number of individuals
% ≡ Percentage of catch
TotSpecVol ≡ Total volume of all species combined and within the bracket
Est. % Net Open ≡ Width of seine opening

People Checklist:
Lunch/H_20
Hat/Sunglasses/sun screen
Oil Skins

Boat Checklist:
Sharp knife/tools
Anchors/line
Gas/oil for generator/boat
Life Jackets, flares, sound device, throw ring, paddle
Sun block/first aid kit/horn
Gas card/credit card

List species collected for vouchers & quantities

21 L Bucket Cnt

Comments

Survey Checklist:
Datasheets/Protocol
Pencils/Sharpener
YSI, GPS
Depth Finder/Sounding Pole
AA Batteries
- YSI (6)
- GPS (2)
- Camera (2)

4 measuring boards
Stop watch
Buckets
Cell Phone
ID books/Keys
Plastic bags/sharpie/labels
Cooler
Digital Camera
Secchi Disk

Draw bracket for grouped spp.

MD DNR Coastal Bays Beach Seine Data Sheet

Appendix 2.

Date (MM/DD/YYYY) ______/_______/2013	**Start Time (12 hr)**	**Collector**	**Set#**
Site# S0	**Station Description**		
Seine Length: 100 foot 50 foot		**Temp (°C)**	**Sal (ppt)**
Waypoint Start	**Waypoint Stop**	**DO (mg/L)**	**Secchi (cm)**
Latstrt 38° .	**Latstop** 38° .	**Weather**	**Tide**
Longstrt 75° .	**Longstop** 75° .	**Depth (ft)**	**Est. % Net Open**
%SAV – Choose One 0–No SAV in sample area 1-up to 25% 2-26-50% 3-51%-75%, 4-76%-100% 5-SAV present 6-Undeterminable – give reason		**Bottom Type** 1. 2. Use N/A for line 2 if only 1 type	**Wind Direction & Speed (Knots)** @

Tide Codes
HF ≡ High flood
HS ≡ High slack
HE ≡ High Ebb
LF ≡ Low flood
LS ≡ Low slack
LE ≡ Low ebb

Weather Codes
0 ≡ clear, no clouds
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Miscellaneous
Collector ≡ person taking data
Tot ≡ total
Cts ≡ Counts
Spp ≡ Species
WTR ≡ Water
Specvol ≡ Actual vol. measured in Liters (L)
Estimatevol ≡ Visual volume estimate in L
Estimatecnt ≡ Visual estimate of the number of individuals
% ≡ Percentage of catch
TotSpecVol ≡ Total volume of all species combined and within the bracket
Est. % Net Open ≡ Width of seine opening

People Checklist:
Lunch/H_20
Hat/Sunglasses/sun screen
Oil Skins

Boat Checklist:
Sharp knife/tools
Anchors/line
Gas/oil for generator/boat
Life Jackets, flares, sound device, throw ring, paddle
Sun block/first aid kit/horn
Gas card/credit card

List species collected for vouchers & quantities

21 L Bucket Cnt

Comments

Subsample
Species:
Number of Fish/L:
L Count:

Survey Checklist:
Datasheets/Protocol
Pencils/Sharpener
YSI, GPS
Depth Finder/Sounding Pole
AA Batteries
YSI (6)
GPS (2)
Camera (2)
4 measuring boards
Stop watch
Buckets
Cell Phone
ID books/Keys
Plastic bags/sharpie/labels
Voucher buckets
Cooler
Digital Camera
Secchi Disk

EstimateVol (L)	EstimateCnt	SpecVol (L)	%	TotSpecVol (L)	Species Name
				Draw bracket for grouped spp.	

MD DNR Coastal Bays Beach Seine Data Sheet

Draw line separating ♂ and ♀ crabs. Start females in the right column and work towards the middle.
Place ● next to sook and a 2nd ● to indicate with eggs (ex: 60 mm sook with eggs is abbrev. 60●● and sook with no eggs 60●

♂ Blue Crab														♀ Blue crab
Cts													**Total Blue Crabs**	

Sp.		Sp.		Sp.		Sp.		Sp.		Sp.		Sp.		Sp.	
Cts.		Cts.		Cts.		Cts.		Cts.		Cts.		Cts.		Cts.	
Tot.		Tot.		Tot.		Tot.		Tot.		Tot.		Tot.		Tot.	

Sp.		Sp.		Sp.		Sp.		Sp.		Sp.		Sp.		Sp.	
Cts.		Cts.		Cts.		Cts.		Cts.		Cts.		Cts.		Cts.	
Tot.		Tot.		Tot.		Tot.		Tot.		Tot.		Tot.		Tot.	

Species Name	Counts	Total

Species Name	Counts	Total

Table 1. 2013 Species List for the CBFI voucher collection, n=231.

Family	Scientific Name	Common Name	Number of Specimens
Achiridae	Trinectes maculatus	Hogchoker	3
Anguillidae	Anguilla rostrata	American Eel	2
Atherinopsidae	Membras martinica	Rough Silverside	8
Atherinopsidae	Menidia beryllina	Inland Silverside	4
Atherinopsidae	Menidia menidia	Atlantic Silverside	2
Belonidae	Strongylura marina	Atlantic Needlefish	3
Blenniidae	Hypsoblennius hentz	Feather Blenny	1
Carangidae	Caranx crysos	Blue Runner	6
Carangidae	Caranx hippos	Crevalle Jack	2
Carangidae	Selene setapinnis	Atlantic Moonfish	1
Carangidae	Trachinotus falcatus	Permit	4
Catostomidae	Erimyzon oblongus	Creek Chubsucker	3
Centrarchidae	Lepomis gibbosus	Pumpkinseed	2
Centrarchidae	Pomoxis nigromaculatus	Black Crappie	1
Clupeidae	Alosa pseudoharengus	Alewife	2
Clupeidae	Brevoortia tyrannus	Atlantic Menhaden	3
Clupeidae	Clupea harengus harengus	Atlantic Herring	5
Clupeidae	Dorosoma cepedianum	Gizzard Shad	2
Cynoglossidae	Symphurus plagiusa	Blackcheek Tonguefish	1
Cyprinidae	Cyprinus carpio	Common Carp	2
Cyprinidae	Notemigonus crysoleucas	Golden Shiner	4
Cyprinodontidae	Cyprinodon variegatus	Sheepshead Minnow	1
Dasyatidae	Dasyatis americana	Southern Stingray	2
Diodontidae	Chilomycterus schoepfii	Striped Burrfish	3
Elopidae	Elops saurus	Ladyfish	1
Engraulidae	Anchoa hepsetus	Striped Anchovy	7
Engraulidae	Anchoa mitchilli	Bay Anchovy	3
Fistulariidae	Fistularia tabacaria	Bluespotted Cornetfish	2
Fundulidae	Fundulus diaphanus	Banded Killifish	5
Fundulidae	Fundulus majalis	Striped Killifish	4
Fundulidae	Lucania parva	Rainwater Killifish	2
Gasterosteidae	Apeltes quadracus	Fourspine Stickleback	1
Gasterosteidae	Gasterosteus aculeatus	Threespine Stickleback	6
Gerreidae	Eucinostomus argenteus	Spotfin Mojarra	2
Gobiidae	Ctenogobius pseudofasciatus	Slashcheek Goby	1
Gobiidae	Gobiosoma bosc	Naked Goby	3
Gobiidae	Microgobius thalassinus	Green Goby	6
Gymnuridae	Gymnura micrura	Smooth Butterfly Ray	1
Haemulidae	Orthopristis chrysoptera	Pigfish	4
Hemiramphidae	Hyporhamphus unifasciatus	Halfbeak	5
Ictaluridae	Ameiurus nebulosus	Brown Bullhead	3
Labridae	Tautoga onitis	Tautog	1
Labridae	Tautogolabrus adspersus	Cunner	1
Lutjanidae	Lutjanus griseus	Gray Snapper	3
Monacanthidae	Stephanolepis hispidus	Planehead Filefish	2
Moronidae	Morone americana	White Perch	1

Family	Scientific Name	Common Name	Number of Specimens
Mugilidae	Mugil cephalus	Striped Mullet	1
Mugilidae	Mugil curema	White Mullet	2
Ophidiidae	Ophidion marginatum	Striped Cusk-eel	2
Paralichthyidae	Etropus microstomus	Smallmouth Flounder	8
Paralichthyidae	Paralichthys dentatus	Summer Flounder	2
Phycidae	Urophycis regia	Spotted Hake	3
Pleuronectidae	Pseudopleuronectes americanus	Winter Flounder	1
Poeciliidae	Gambusia affinis	Mosquitofish	1
Pomatomidae	Pomatomus saltatrix	Bluefish	3
Priacanthidae	Pristigenys alta	Short Bigeye	2
Rachycentridae	Rachycentron canadum	Cobia	2
Sciaenidae	Bairdiella chrysoura	Silver Perch	3
Sciaenidae	Cynoscion nebulosus	Spotted Seatrout	1
Sciaenidae	Cynoscion regalis	Weakfish	3
Sciaenidae	Leiostomus xanthurus	Spot	4
Sciaenidae	Menticirrhus americanus	Southern Kingfish	6
Sciaenidae	Menticirrhus saxatilis	Northern Kingfish	2
Sciaenidae	Micropogonias undulatus	Atlantic Croaker	3
Sciaenidae	Pogonias cromis	Black Drum	1
Scombridae	Scomberomorus maculatus	Spanish Mackerel	2
Scophthalmidae	Scophthalmus aquosus	Windowpane	1
Serranidae	Centropristis striata	Black Sea Bass	5
Serranidae	Mycteroperca microlepis*	Gag	3
Sparidae	Archosargus probatocephalus	Sheepshead	3
Sparidae	Lagodon rhomboides	Pinfish	2
Sparidae	Stenotomus chrysops	Scup	3
Sphyraenidae	Sphyraena borealis	Northern Sennet	1
Stromateidae	Peprilus triacanthus	Butterfish	5
Syngnathidae	Hippocampus erectus	Lined Seahorse	1
Syngnathidae	Syngnathus floridae	Dusky Pipefish	2
Syngnathidae	Syngnathus fuscus	Northern Pipefish	5
Synodontidae	Synodus foetens	Inshore Lizardfish	3
Tetraodontidae	Sphoeroides maculatus	Northern Puffer	4
Trichiuridae	Trichiurus lepturus	Atlantic Cutlassfish	1
Triglidae	Prionotus carolinus	Northern Searobin	4
Triglidae	Prionotus evolans	Striped Searobin	5
		Total	**231**

Species with an asterisk (*) were added in 2013.

MD DNR Coastal Bays SAV Habitat Survey Data Sheet

Appendix 4.

Date (MM/DD/YYYY) ______/______/2013	**Start Time (12 hr)**	**Collector**	**Set#**
Zone: **NB SB** **CB**	**Grid Number/Site Description**		
	Seine Length: 50 foot **Distance of Haul: 35 meters**	**Temp (°C)**	**Sal (ppt)**
Waypoint Start	**Waypoint Stop**	**DO (mg/L)**	**Secchi (cm)**
Latstrt **38° .**	**Latstop** **38° .**	**Weather**	**Tide**
Longstrt **75° .**	**Longstop** **75° .**	**Depth (ft)**	**Est. % Net Open**
%SAV Present 1 – up to 25% 2 – 26%-50% 3 – 51%-75% 4 – 76%-100%	**SAV Species Present:** **1.** **2.** **Circle Dominant Species**	**Bottom Type** **1.** **2.** **SAV not an option**	**Wind Direction & Speed (Knots)** @

Tide Codes
HF ≡ High flood
HS ≡ High slack
HE ≡ High Ebb
LF ≡ Low flood
LS ≡ Low slack
LE ≡ Low ebb

Weather Codes
0 ≡ clear, no clouds
1 ≡ partly cloudy
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S ≡ Sand M ≡ mud
O ≡ shell R ≡ rubble
G ≡ gravel C ≡ clay
A = SAV NT ≡ not taken
N/A if only one type

Miscellaneous
Collector ≡ person taking data
Tot ≡ total
Cts ≡ Counts
Spp ≡ Species
WTR ≡ Water
Specvol ≡ Actual vol. measured in Liters (L)
Estimatevol ≡ Visual volume estimate in L
Estimatecnt ≡ Visual estimate of the number of individuals
% ≡ Percentage of catch
TotSpecVol ≡ Total volume of all species combined and within the bracket
Est. % Net Open ≡ Width of seine opening

People Checklist:
Lunch/H_20
Hat/Sunglasses
Oil Skins

Boat Checklist:
Sharp knife/tools
Anchors/line
Gas/oil for generator/boat
Life Jackets, flares, sound device, throw ring, paddle
Sun block/first aid kit/horn
Credit card

List species collected for vouchers & quantities

21 L Bucket Cnt

Comments:

Survey Checklist:
Datasheets/Protocol
Pencils/Sharpener
YSI, GPS
Rangefinder
Depth Finder/Sounding Pole
AA Batteries
YSI (6), GPS (2)
Camera (2)
4 measuring boards
Buckets
Cell Phone
ID books/Keys
Plastic bags/sharpie/labels
Digital Camera
Secchi Disk
Beach Seine

EstimateVol (L)	EstimateCnt	SpecVol (L)	%	TotSpecVol (L)	Species Name
				Draw bracket for grouped spp.	

MD DNR Coastal Bays SAV Habitat Survey Data Sheet

Draw line separating ♂ and ♀ crabs. Start females in the right column and work towards the middle.
Place ● next to sook and a 2nd ● to indicate with eggs (ex: 60 mm sook with eggs is abbrev. 60●● and sook with no eggs 60●

♂ Blue Crab														♀ Blue crab
Cts												**Total Blue Crabs**		

Sp.		Sp.		Sp.		Sp.		Sp.		Sp.		Sp.		Sp.	
Cts.		Cts.		Cts.		Cts.		Cts.		Cts.		Cts.		Cts.	
Tot.		Tot.		Tot.		Tot.		Tot.		Tot.		Tot.		Tot.	

Sp.		Sp.		Sp.		Sp.		Sp.		Sp.		Sp.		Sp.	
Cts.		Cts.		Cts.		Cts.		Cts.		Cts.		Cts.		Cts.	
Tot.		Tot.		Tot.		Tot.		Tot.		Tot.		Tot.		Tot.	

Species Name	Counts	Total

Species Name	Counts	Total

Appendix 5.

Date	Boat	Boat length (ft)	Captain	Collector

Set	Net codend mesh	Net body mesh	Head rope width	Foot rope width	Weather

Start time	End time	Sub-sample volume 1000 liters	Water Temp (C)	* If all individuals of a species are measured instead of sub-sampled, please circle the species name and put a check mark next to the species name.
LORAN start	Lat start Lat stop	Depth start	Depth end	
LORAN stop	Long start Long stop	Sub-sample percentage of catch	Wind Dir & Speed (knots)	

Draw line separating ♂ and ♀ crabs. Start females in the right column and work towards the middle. I for Immature

♂ Horseshoe crabs — 0142 — ♀ Horseshoe crabs

Counts

Total

Draw line separating ♂ and ♀ crabs. Start females in the right column and work towards the middle, start males on the left.

♂ Blue Crabs — ♀ Blue Crabs

Counts

Place ● next to sook and another ● to indicate with eggs (ex: 60 mm sook with eggs is abbrev. 60●● and sook with no eggs 60● — Total

Spp.					Spp.					Spp.				
Counts				Total	Counts				Total	Counts				Total

Spp.					Spp.					Spp.				
Counts				Total	Counts				Total	Counts				Total

Maryland DNR Offshore Trawl Survey

Date Set

Spp.					Spp.					Spp.				
Counts				Total	Counts				Total	Counts				Total

Spp.					Spp.					Spp.				
Counts				Total	Counts				Total	Counts				Total

Spp.					Spp.					Spp.				
Counts				Total	Counts				Total	Counts				Total

Spp. Code & Name	Counts	Total

Comments	**Survey Checklist:** Datasheets/Protocol ID books/Keys Plastic bags/sharpie/labels Measuring boards Digital Camera Live tank/ Sample Buckets Cell Phone Lunch/H_20 Pencils/ Sharpener