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

2008 Report

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Preface

Analyses of the Coastal Bay Fisheries Investigations 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.

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 are included in these analyses.

In 2008, all data from the Trawl and Beach Seine 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.

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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, mollusks, sponges, and macroalgae are common. Macroalgae appear in a variety of colors and forms. They are divided into five taxonomic divisions based on pigments: brown, golden-brown, green, red, and yellow-green. Some species appear as small furry clumps, moderate-sized branched specimens, or large leaf-type structures. Algae are major producers of organic material and oxygen, but can affect humans more directly. Negative effects of too much macroalgae include discolored waterways, fouling boat bottoms, and reducing water access for recreational purposes. Massive blooms may be toxic or deplete oxygen when cells decompose, causing fish kills, or contaminating commercially important marine animals (Sze, 1998).

Over 130 adult and juvenile species of fishes, 26 mollusks, and 11 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 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 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 175 Mercury Optimax engine was used for transportation to the sample sites and gear deployment. Latitude and longitude coordinates (waypoints) in decimal degrees, minutes, and fraction of minutes (ddmm.mmm) were used to navigate to sample locations. A Garmin e-Trex Legend C was used for navigation, marking sites, and monitoring speed.

Gears

Trawl

Trawl sampling was conducted at 20 fixed sites throughout Maryland's Coastal Bays on a monthly basis from April through October (Table 1, Figure 1). With the exception of June and September, samples were taken beginning the third week of the month. Occasionally, weather or mechanical issues required sampling to continue into the next month. 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 the tow 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.

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, Figure 1). Occasionally, weather or mechanical issues required sampling to continue into the next month.

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. A 15.24 m (50 foot) version of the previously described net was used at site S019 due to it is restricted sampling area. However, some sites necessitated varying this routine to fit the available area and depth. 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) 30 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 26 ounce weight attached to it with a string that measured 30 cm. 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 each week, and the unit was turned on at the beginning of each day and left on from that time until the last site readings were taken that day.

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 estimated by looking at fixed objects when possible, and checking the published tide tables for the sampled areas. Occasionally in Chincoteague Bay, this parameter was not recorded if tidal state could not be determined. Difficulties determining tide resulted from inlet influences in Ocean City, MD and Chincoteague, VA.

Sample Processing

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 (Table 3). 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 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, 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 4).

Data Analysis

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

Regression analyses were performed for individual species to determine significant trends over the time series (1989-2008). Data collected from 1972-1988 were not included because collection methods were not yet standardized. Catch data were transformed [$\log_e(x+1)$], where x represents the Catch Per Unit Effort (CPUE), and regressed by year for both trawl and beach seine data. One is added to all catches in order to transform zero catches, because the log of zero does not exist (Ricker 1975.) Significance was determined at $\alpha=0.05$.

The Geometric Mean (GM) was calculated to develop species specific annual trawl and beach seine indices of relative abundance (1989-2008). 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 GM was calculated from the $\log_e(x+1)$ transformation of the catch data and presented with 95% Confidence Intervals (CIs). The GM and CIs were calculated as the antilog [$\log_e$-mean(x+1)] and antilog [$\log_e$-mean(x+1) $\pm$ standard error * (t value: α=0.05, n-1)], respectively. A geometric grand mean was calculated for the time series (1989-2008) and used as a point estimate for comparison to the annual (2008) 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 the period 1989-2008. A subsequent multiple pairwise comparison of means test (Duncan's Multiple Range Test) was performed to determine differences among sites. The site or group of sites most abundant were classified as primary sites. Secondary sites were second most abundant.

Results and Discussion:

Finfish were the most abundant taxa captured in the survey. Specifically, they accounted for 44,448 specimens caught trawling (26,942 fish) and beach seining (17,506; Table 4). Collected fishes represented 67 species.

Poor year-classes were found for Atlantic silversides, Weakfish, Atlantic croaker, northern puffer, and silver perch. Above average year-classes were found for spot, black sea bass, and summer flounder.

Crustaceans were the second most abundant taxa captured in this survey. Specifically, they accounted for 7,607 specimens caught trawling (5,261 crustaceans) and beach seining (2,346 crustaceans; Table 5). Twenty crustacean species were identified.

The third most abundant taxa captured in the survey were Molluscs. Specifically, they accounted for 1,362 specimens caught trawling (802 molluscs) and beach seining (560 molluscs; Table 5). Molluscs were represented by 26 different species.

Other types of animals captured trawling and beach seining included: ctenophores, tunicates, and sponges (Table 6). Twelve of these species were identified.

In addition to animals, plants (SAV and macroalgae) were also captured in the trawls and beach seines (Table 7).

Species Results: Atlantic Croaker (*Micropogonias undulatus*)

Atlantic croakers were captured in 35 of 140 trawls (35.0%) and in one of 38 beach seines (2.6%). A total of 90 juvenile Atlantic croakers were collected in trawl (88 fish) and seine (2 fish) samples conducted on Maryland's Coastal Bays in 2008 (Table 4). Atlantic croakers ranked 14^{th} out of 67 species in overall finfish abundance. The trawl and beach seine CPUEs were 5.0 fish/hectare and 0.1 fish/haul, respectively.

Regression analysis was performed on the 1989-2008 data to determine if there was a trend in the annual relative abundance over the time series. Trawl catch data [$\log_e(x+1)$] showed a significant decreasing trend in relative abundance (P=0.0014, Figure 2). Regression of beach seine catch data [$\log_e(x+1)$] also showed a significant deceasing trend in relative abundance (P=0.0075, Figure 3).

GM indices of relative abundance were calculated and compared with the 1989-2008 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. Indices for the 2008 trawl and seine were below the grand mean (Figures 4 and 5).

Duncan's Multiple Range Test indicated that trawl sites T001, T002, T005, T012, and T014 had the highest level of abundance (CPUE) and these locations were classified as primary sites (Figure 1, Table 8). Secondary trawl sites included T003, T006, and T011. Beach seine site S006 was determined to be a primary location and S002, S003, S005, S011, S012, and S017 were classified as secondary sites (Figure 1, Table 9).

Discussion

Regression analysis indicated significant decreasing trends in the trawl and beach seine catch data. Both the trawl and seine data show a decreasing pattern in abundance, and the abundance indices for both trawl and seine were below the grand mean. Since Atlantic croaker spawn offshore, environmental conditions and ocean currents may be a factor influencing relative abundance (Murdy *et al* 1997).

Juvenile Atlantic croaker 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. Since 1989, the trawl relative abundance estimates frequently (12 years) varied from the grand mean.

Primary and secondary trawl and beach seine sites for Atlantic croaker were located in the relatively protected areas of Assawoman Bay, the St. Martins River, and Newport Bay. Juvenile Atlantic croaker seem to prefer the deeper sheltered coves and creeks, and share a similar pattern of distribution to spot and silver perch.

Management

Atlantic croaker are managed by the State of Maryland in cooperation with Atlantic States Marine Fisheries Commission (ASMFC). Maryland's 2008 recreational Atlantic croaker regulations were comprised of a 25 fish creel and a 9 inch minimum size limits (Table 10). Commercial restrictions included a 9 inch minimum size and a season closure from January 1 to March 15, 2008. Monitoring will continue in the CBFI Trawl and Beach Seine Survey.

Species Results: Atlantic Menhaden (*Brevoortia tyrannus*)

Atlantic menhaden were captured in 19 of 140 trawls (13.6%) and in 19 of 38 beach seines (55.3%). A total of 10,220 Atlantic menhaden were collected in trawl (98 fish) and beach seine (10,122 fish) samples conducted on Maryland's Coastal Bays in 2008 (Table 4). Atlantic menhaden ranked second out of 67 species in overall finfish abundance. The trawl and beach seine CPUEs were 5.6 fish/hectare and 266.4 fish/haul, respectively.

Regression analysis was performed on the 1989-2008 data to determine if there was a trend in the annual relative abundance over the time series. Trawl catch data [$\log_e(x+1)$] showed a significant decreasing trend (P=0.0252, Figure 6). Regression of beach seine catch data [$\log_e(x+1)$] also indicated a significant increasing trend in relative abundance (P=0.0071, Figure 7).

GM indices of relative abundance were calculated and compared with the 1989-2008 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 2008 trawl data and beach seine data were both equal to the standardized grand means (Figures 8 and 9, respectively).

Duncan's Multiple Range Test indicated that trawl sites T001 T002, T004, T012, and T014 had the highest level of abundance (CPUE) and that location was classified as a primary site (Figure 1, Table 8). Secondary trawl sites included T003, T006, T011, and T019. Beach seine site S019 was determined to be a primary location and S002, S003, S005, S006, S007, S010, S012, S013, S015, and S017 were classified as secondary sites (Figure 1, Table 9).

Discussion

Regression analysis indicated significant trends in the trawl catch data and the beach seine data; however, variation between gears makes it difficult to discern between an overall increasing or decreasing pattern. Significant changes in relative abundance may reflect a combination of environmental conditions (nutrient levels, water temperature, salinity, and dissolved oxygen) and/or overfishing.

Atlantic menhaden were caught more often 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. Since 1989, the beach seine relative abundance estimates occasionally (six years) varied from the grand mean.

Primary trawl sites were in protected areas like Assawoman Bay and Newport Bay and the distribution is similar to the distribution of Atlantic croaker. The beach seine primary site for Atlantic menhaden was located at the drainage ditch seine site on Trappe Creek (S019). Site S019 is likely to have high chlorophyll concentrations, a desirable characteristic for a filter feeder (Wazniak *et al*, 2004). Secondary seine sites displayed a geographically wide dispersion indicating preference for shallow water habitat.

Management

Atlantic menhaden are managed by the State of Maryland in cooperation with ASMFC. There was no recreational creel or size limits for this species in 2008. A Chesapeake Bay wide commercial harvest cap of 109,020 metric-tons was implemented in 2006 (Table 10; ASMFC 2006). Monitoring will continue in the CBFI Trawl and Beach Seine Survey.

Species Results: Atlantic Silverside (*Menidia menidia*)

Atlantic silversides were captured in one of 140 (0.7%) trawls and in 32 of 38 beach seines (84.2%). A total of 655 Atlantic silversides were collected in trawl (one fish) and beach seine (654 fish) samples conducted on Maryland's Coastal Bays in 2008 (Table 4). Atlantic silversides ranked 4th out of 67 species in overall finfish abundance. The trawl and beach seine CPUEs were 0.1 fish/hectare and 17.2 fish/haul, respectively.

Regression analysis was performed on the 1989-2008 data to determine if there was a trend in the annual relative abundance over the time series. Trawl catch data [$\log_e(x+1)$] showed no significant trend (P=0.2052, Figure 10). Regression of beach seine catch data [$\log_e(x+1)$] indicated a significant degreasing trend in relative abundance (P=0.0001, Figure 11).

GM indices of relative abundance were calculated and compared with the 1980-2008 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 2008 trawl and seine indices were below the grand means (Figures 12 and 13, respectively).

Duncan's Multiple Range Test indicated that trawl site T019 had the highest level of abundance (CPUE) and that location was classified as a primary site (Figure 1, Table 8). Secondary trawl sites included T002, T005, T006, T015, T017, and T018. Beach seine sites S005, S006, S009, and S010 were determined to be primary locations and S001, S003, S004, S008, and S017 were classified as secondary sites (Figure 1, Table 9).

Discussion

Regression analysis indicated variation without trend for trawl annual relative abundance. A significant declining trend in abundance was determined for beach seine catch data over the time period. It appears 2008 was a particularly low year for abundance of Atlantic silversides. The seine data also indicate a long, steady drop in abundance for this species over the time series. This is particularly disconcerting as this species spends a major part of their lifecycle in the coastal bays and therefore may be responding to trends in water quality. 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. Since 1989, the beach seine relative abundance estimates seldom (three years) varied from the grand mean.

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. Similar characteristics of primary and secondary trawl and seine sites were their proximity to land and inlets. Although some these sites were close to inlets, they were located away from fast moving water in protected coves or behind islands.

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 106 of 140 trawls (75.7%) and in 30 of 38 beach seines (78.9%). A total of 7,915 bay anchovies were collected in (6,729 trawl and 1,186 fish beach seine) samples collected in Maryland's Coastal Bays in 2008 (Table 4). Bay anchovies ranked 3rd out of 67 species in overall finfish abundance. The trawl and beach seine CPUEs were 383.2 fish/hectare and 31.2 fish/haul, respectively.

Regression analysis was performed on the 1989-2008 data to determine if there was a trend in the annual relative abundance over the time series. Both trawl and beach seine catch data [$\log_e(x+1)$] indicated significant trends (P=0.0001 and 0.0434, Figures 14 and 15, respectively).

GM indices of relative abundance were calculated and compared with the 1989-2008 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 2008 trawl and seine indices were equal to the grand mean (Figures 16 and 17, respectively).

Duncan's Multiple Range Test indicated that trawl sites T001, T002, T004, T011, and T012 had the highest level of abundance (CPUE) and these locations were classified as primary sites (Figure 1, Table 8). Secondary trawl site included site T0014. Beach seine sites S003 and S015 were determined to be primary locations and S006, S011, S013, S016, and S017 were classified as secondary sites (Figure 1, Table 9).

Discussion

Regression analysis indicated significant decreasing trends in the trawl and beach seine catch data. The trawl and seine indices dipped in 2001 and have recovered since then. 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.

Bay anchovies were caught in both near-shore and open water locations. Therefore, both indices represent an accurate picture of changes in relative abundance. Since 1989, the relative abundance estimates seldom (three years trawl, four years beach seine) varied from the grand means.

Primary and secondary trawl and beach seine sites for bay anchovies were located in Assawoman Bay, Isle of Wight Bay (tributaries), Newport Bay, and Chincoteague Bay. All sites were located on the west side of those coastal bays. The west side is generally marsh land with muddy bottoms. Primary and secondary sites were absent from Sinepuxent Bay, which may indicate a preference for slower moving water.

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 63 of 140 trawls (45.0%) and eight of 38 seines (21.0%). A total of 223 juvenile black sea bass were collected in trawl (188 fish) and beach seine (35 fish) samples conducted on Maryland's Coastal Bays in 2008 (Table 4). Black sea bass ranked 8th out of 67 species in overall finfish abundance. The trawl and beach seine CPUEs were 10.7 fish/hectare and 0.4 fish/haul, respectively.

Regression analysis was performed on the 1989-2008 data to determine if there was a trend in the annual relative abundance over the time series. The trawl catch data [$\log_e(x+1)$] showed a significant increasing trend and the seine catch data showed no significant trend in abundance (P=0.0001 and 0.9330, Figures 18 and 19, respectively).

GM indices of relative abundance were calculated and compared with the 1989-2008 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 2008 trawl index was above the grand mean and beach seine index was equal to the standardized grand mean (Figures 20 and 21, respectively).

Duncan's Multiple Range Test indicated that trawl sites T001, T003, T004, T006, T007, T009, T012, T016, and T020 had the highest level of abundance (CPUE) and these locations were classified as primary sites (Figure 1, Table 8). There was one secondary trawl site, T008. Beach seine sites S002, S005, S006, S009, and S010 were determined to be primary locations and S003, S004, S011, S015, S016, S017, and S018 were classified as secondary sites (Figure 1, Table 9).

Discussion

Regression analysis indicated an increasing trend in the trawl catch data and no significant trend in the beach seine catch data. 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 both near-shore (beach seine) and open-water (trawl) locations reflecting a wide range preferred habitats as long as structure is present. Since 1989, the relative abundance estimates frequently (11 years trawl, four years beach seine) varied from the grand means.

Primary and secondary trawl and beach seine sites for black sea bass were located in Assawoman Bay, Isle of Wight Bay, Sinepuxent Bay, and Chincoteague Bay. Trawl sites of primary and secondary preference were locations with or near structure such as channels, drop offs, rip rap, or crab pots. Seine sites S017 and S018 are relatively close to Chincoteague Inlet and have a hard shell bottom that provided the needed habitat structure that black sea bass desire (Murdy *et al* 1997).

Management

Black sea bass are managed by the State of Maryland in cooperation with ASMFC, and the Mid-Atlantic Fishery Management Council (MAFMC). Maryland's 2008 recreational black sea bass regulations were comprised of a 25 fish creel and a 12 inch minimum size limit with no closed season (Table 10). Commercial restrictions included an 11 inch minimum size and required a landing permit which contained an individual fishing quota issued by the State. Fishermen without a landing permit were permitted 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 six of 140 trawls (4.3%) and in 18 of 38 beach seines (47.0%). A total of 41 juvenile bluefish were collected in trawl (seven fish) and beach seine (39 fish) samples conducted on Maryland's Coastal Bays in 2008 (Table 4). Bluefish ranked 22nd out of 67 species in overall finfish abundance. The trawl and beach seine CPUEs were 0.4 fish/hectare and 1.0 fish/haul, respectively.

Regression analysis was performed on the 1989-2008 data to determine if there was a trend in the annual relative abundance over the time series. Both trawl and beach seine catch data [loge(x+1)] showed no significant trend (P=0.09 and 0.4514, Figures 22 and 23, respectively).

GM indices of relative abundance were calculated and compared with the 1989-2008 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 2008 trawl and beach seine indices were both equal to the grand means (Figures 24 and 25, respectively).

Duncan's Multiple Range Test indicated that trawl sites T004 and T005 had the highest level of abundance (CPUE) and that location was classified as a primary site (Figure 1, Table 8). Secondary trawl sites included: T002, and T003. Beach seine sites S001, S005, and S006 were determined to be primary locations and S002, S003, and S010 were classified as secondary sites (Figure 1, Table 9).

Discussion

Regression analysis indicated no significant trends in the trawl and beach seine catch data. 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. Since 1989, the relative abundance estimates occasionally (four years trawl, five years beach seine) varied from the grand means.

Primary and secondary trawl and beach seine sites for bluefish were located in Assawoman Bay, Isle of Wight Bay, and Sinepuxent Bay. Primary and secondary sites were all located north of the Ocean City Inlet with the exception of site S010 which was just south of the inlet. Bluefish may be drawn to the abundance of forage and the higher flushing rates of the areas close to the inlet.

Management

Bluefish are managed by the State of Maryland in cooperation with ASMFC and the MAFMC. Maryland's 2008 recreational bluefish regulations were comprised of a 10 fish creel and an 8 inch minimum size limit (Table 10). Commercial restrictions included an eight inch minimum size and no seasonal closures. Monitoring will continue in the CBFI Trawl and Beach Seine Survey.

Species Results: Hogchoker (*Trinectes maculatus*)

Hogchokers were collected in 26 of 140 trawls (18.6%) and zero of 38 seines (0%). A total of 92 hogchokers were collected in trawl (85 fish) and seven were collected in seine (seven fish) samples conducted on Maryland's Coastal Bays in 2008 (Table 4). Hogchokers ranked 12th out of 67 species in overall finfish abundance. The trawl and beach seine CPUEs were 4.8 fish/hectare and 0.2 fish/haul, respectively.

Regression analysis was performed on the 1989-2008 data to determine if there was a trend in the annual relative abundance over the time series. The trawl catch data [loge(x+1)] showed a significant decreasing trend and the seine catch data showed no significant trend (P=0.0168 and 0.362, Figures 26 and 27, respectively).

GM indices of relative abundance were calculated and compared with the 1989-2008 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 2008 trawl index was below the grand mean and the beach seine index was equal to the grand mean (Figures 28 and 29, respectively).

Duncan's Multiple Range Test indicated that trawl site T012 had the highest level of abundance (CPUE) and that location was classified as a primary site (Figure 1, Table 8). There was one secondary trawl site, T003. Beach seine site S012 was determined to be a primary location and S015 was classified as a secondary site (Figure 1, Table 9).

Discussion

Regression analysis indicated a significant declining trend in abundance in the trawl catch data. 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.

Hogchokers were caught more frequently in open water locations (trawl). Therefore, trawl indices represent a more accurate picture of changes in relative abundance when compared to beach seine indices. Since 1989, the relative abundance estimates seldom (three years trawl, five years beach seine) varied from the grand means.

Primary and secondary trawl and beach seine sites for hogchokers were located in Assawoman Bay, Newport Bay, and Chincoteague Bay. Habitat preference could not be explained based on the variation of habitats found at the primary and secondary classified sites.

Management

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

Species Results: Mummichog (*Fundulus heteroclitus*)

Mummichogs were captured in one of 140 trawls (0.7%) and in sixteen of 38 beach seines (42.0%). A total of 126 mummichogs were collected in trawl (3 fish) and beach seine (123 fish) samples conducted on Maryland's Coastal Bays in 2008 (Table 4). Mummichogs ranked 10th out of 67 species in overall finfish abundance. The trawl and beach seine CPUEs were 0.2 fish/hectare and 3.2 fish/haul, respectively.

Regression analysis was performed on the 1989-2008 data to determine if there was a trend in the annual relative abundance over the time series. Both trawl and beach seine catch data [$\log_e(x+1)$] showed no significant trends (P=0.8226 and 0.5527, Figures 30 and 31, respectively).

GM indices of relative abundance were calculated and compared with the 1989-2008 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 2008 trawl index was below he grand mean and the seine index was equal to the grand mean (Figures 32 and 33, respectively).

Duncan's Multiple Range Test indicated that trawl sites T005 and T006 had the highest level of abundance (CPUE) and these locations were classified as primary sites (Figure 1, Table 8). Secondary trawl sites included T012 and T019. Beach seine sites S001, S005, S007, S009, S010, S012, S013, S014, S018, and S019 were determined to be primary locations and S011 and S017 were classified as secondary sites (Figure 1, Table 9).

Discussion

Regression analysis indicated no significant trends in the trawl and beach seine catch data. 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.

Mummichogs 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 data. Since 1989, the relative abundance estimates seldom (two years trawl, four years beach seine) varied from the grand means.

Primary and secondary trawl and beach seine sites for mummichogs were located in Assawoman Bay, Isle of Wight Bay, Sinepuxent Bay, Newport Bay, and Chincoteague Bay. All primary and secondary preferences were shallow water sites with a wide salinity range. Site T012 is a deeper site but it is surrounded by extensive marsh.

Management

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

Species Results: Northern Puffer (*Sphoeroides maculatus*)

Northern puffers were captured in seven of 140 trawls (5.0%) and in five of 38 beach seines (13.2%). A total of fifteen northern puffers were collected in trawl (10 fish) and beach seine (five fish) samples conducted on Maryland's Coastal Bays in 2008 (Table 4). Northern puffers ranked 32nd out of 67 species in overall finfish abundance. The trawl and beach seine CPUEs were 0.6 fish/hectare and 0.1 fish/haul, respectively.

Regression analysis was performed on the 1989-2008 data to determine if there was a trend in the annual relative abundance over the time series. Both trawl and beach seine catch data [$\log_e(x+1)$] indicated significant decreasing trends (P=0.001 and 0.0001, Figures 34 and 35, respectively).

GM indices of relative abundance were calculated and compared with the 1989-2008 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 2008 trawl and seine indicies were below the grand mean (Figures 36 and 37, respectively).

Duncan's Multiple Range Test indicated that trawl sites T007, T009, and T010 had the highest level of abundance (CPUE) and these locations were classified as primary sites (Figure 1, Table 8). The secondary trawl site was T020. Beach seine sites S002, S003, S005, S006, S008, S009, and S011 were determined to be primary locations and S015 was classified as a secondary site (Figure 1, Table 9).

Discussion

Regression analysis indicated significant trends in the trawl and beach seine catch data. For the past four years, both the trawl and seine indices show a decreasing pattern in relative abundance. 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.

Northern puffers were most frequently caught in open water locations. Therefore, the trawl index represents the best picture of changes in relative abundance. Since 1989, the trawl relative abundance estimates frequently (ten years) varied from the grand mean.

Primary and secondary trawl and beach seine sites for northern puffers were located in Assawoman Bay, Isle of Wight Bay, Sinepuxent Bay, and Chincoteague Bay. Habitat preference results indicated that northern puffers prefer areas with higher salinity and close proximity to ocean inlets. In addition, deep channels and edges in open water may be preferred.

Management

No management plan exists for northern puffers. 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 captured in 14 of 140 trawls (10.0%) and in 14 of 38 beach seines (36.8%). A total of 251 silver perch were collected in trawl (45 fish) and beach seines (206 fish) samples conducted on Maryland's Coastal Bays in 2008 (Table 4). Silver perch ranked 6th out of 67 species in overall finfish abundance. The trawl and beach seine CPUEs were 2.6 fish/hectare and 5.4 fish/haul, respectively.

Regression analysis was performed on the 1989-2008 data to determine if there was a trend in the annual relative abundance over the time series. Trawl catch data [$\log_e(x+1)$] showed a significant increasing trend (P=0.0004, Figure 38). Regression of beach seine catch data [$\log_e(x+1)$] indicated no significant trend in relative abundance (P=0.7079, Figure 39).

GM indices of relative abundance were calculated and compared with the 1889-2008 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 2008 trawl index was below the grand mean and the beach seine index was equal to the grand mean (Figures 40 and 41, respectively).

Duncan's Multiple Range Test indicated that trawl sites T001, T002, T004, T006, T011, T012, T014, and T019 had the highest level of abundance (CPUE) and these locations were classified as primary sites (Figure 1, Table 8). Secondary trawl sites included T005 and T0013. Beach seine sites S001, S002, S006, S010, S011, and S017 were determined to be primary locations and S005 and S018 was classified as a secondary sites (Figure 1, Table 9).

Discussion

Regression analysis indicated a significant increasing trend in trawl relative abundance over the time period, whereas no significant trend was determined for beach seine catch data. 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.

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. Since 1989, the relative abundance estimates seldom (five years trawl, zero years beach seine) varied from the grand means. Silver perch like Atlantic silversides spend a good part of their life cycle in the costal bays and therefore their abundance may be an indicator of changes in water quality. Unlike Atlantic silversides however, the trawl index trend for this species is increasing except for a low value in 2008.

Primary and secondary trawl and beach seine sites for silver perch were located in Assawoman Bay, Isle of Wight Bay, Sinepuxent Bay, Newport Bay, and Chincoteague Bay. Distribution was similar distribution found for Atlantic Croakers. Silver perch may have avoided the trawl sites in Sinepuxent Bay because of their preference for low tidal current. Site S010 is further from the inlet than the other seine sites in Sinepuxent Bay, which would give it less tidal current and explain why silver perch do not prefer the other sites in Sinepuxent Bay.

Management

No management plan exists for silver perch. 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 110 of 140 trawls (78.6%) and 35 of 38 seines (92.1%). A total of 22,384 spot were collected in trawl (18527 fish) and beach seine (3857 fish) samples conducted on Maryland's Coastal Bays in 2008 (Table 4). Spot ranked 1st out of 67 species in overall finfish abundance. The trawl and beach seine CPUEs were 1055.2 fish/hectare and 101.5 fish/haul, respectively.

Regression analysis was performed on the 1989-2008 data to determine if there was a trend in the annual relative abundance over the time series. The trawl catch data [$\log_e(x+1)$] showed a significant increasing trend and the seine catch data showed no significant trend in abundance (P=0.0001 and 0.6731, Figures 42 and 43, respectively).

GM indices of relative abundance were calculated and compared with the 1989-2008 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 2008 trawl index and the beach seine index were both above the grand means (Figures 44 and 45, respectively).

Duncan's Multiple Range Test indicated that trawl sites T001, T002, T005, T011, and T012 had the highest level of abundance (CPUE) and these locations were classified as primary sites (Figure 1, Table 8). Secondary trawl sites included: T003, T004, T006, T014, T015, T018, and T019. Beach seine sites S001, S002, S003, S005, S006, S007, S008, S010, S011, S012, S013, S015, and S017 were determined to be primary locations and S015 was classified as a secondary site (Figure 1, Table 9).

Discussion

Regression analyses indicated significant increasing trends in the trawl abundance catch data; however, the variation among years makes it difficult to discern between an increasing or decreasing pattern. Since spot spawn offshore, environmental conditions and ocean currents may be a factor influencing relative abundance (Murdy *et al* 1997).

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. Since 1989, the relative abundance estimates frequently (ten years trawl, ten years beach seine) varied from the grand means, indicating variability in abundance over the time period.

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. Sinepuxent Bay was the only area that did not have primary or secondary trawl sites. Spot may have avoided those locations because of the strong tidal current and the presence of larger predators in this area.

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 106 of 140 trawls (75.7%) and 18 of 38 seines (47.4%). A total of 594juvenile summer flounder collected in trawl (538 fish) and beach seine (56 fish) samples conducted on Maryland's Coastal Bays in 2008 (Table 4). Summer flounder ranked 6th out of 67 species in overall finfish abundance. The trawl and beach seine CPUEs were 30.6 fish/hectare and 1.5 fish/haul, respectively.

Regression analysis was performed on the 1989-2008 data to determine if there was a trend in the annual relative abundance over the time series. The trawl catch data [$\log_e(x+1)$] showed a significant increasing trend in abundance while the seine catch data did not show a significant trend (P=0.0011 and 0.1845, Figures 46 and 47, respectively).

GM indices of relative abundance were calculated and compared with the 1989-2008 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 2008 trawl index was above the grand mean and the beach seine index was equal to the grand mean (Figures 48 and 49, respectively).

Duncan's Multiple Range Test indicated that trawl site T012 had the highest level of abundance (CPUE) and that location was classified as a primary site (Figure 1, Table 8). Secondary trawl sites included: T001, T002, T003, T004, and T006. Beach seine site S012 was the only primary location and S001, S002, S005, S006, S010, S013, S015, and S017 were classified as secondary sites (Figure 1, Table 9).

Discussion

Regression analysis indicated an increasing trend in the trawl catch data and no significant trend in the seine catch data. 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.

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. Since 1989, the trawl relative abundance estimates occasionally (ten years) varied from the grand mean.

Primary and secondary trawl and beach seine sites were located in Assawoman Bay, tributaries of Isle of Wight Bay, Sinepuxent Bay, and Chincoteague Bay. Site T012 was the only primary trawl site. That site was characterized by a muddy bottom, one deep hole, and undeveloped marsh. It is located at the head of Newport Bay and consistently produced the most juvenile summer flounder.

Management

Summer flounder are managed by the State of Maryland in cooperation with ASMFC and the MAFMC. Maryland's 2008 recreational summer flounder regulations were comprised of a 3 fish creel and 17.5 inch minimum size limit in the Atlantic Ocean and Coastal Bays, and a 1 fish creel and 16.5 inch minimum size limit in the Chesapeake Bay (Table 10). Commercial restrictions included a 14 inch minimum size for all gears with the exception of hook-and-line which had a 17.5 inch minimum in the Atlantic Ocean and Coastal Bays and a 16.5 inch minimum in the Chesapeake Bay. Permitted fishermen in the Atlantic Ocean and Coastal Bays could harvest 5,000 pounds per day while non-permitted fishermen could land 200 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*)

Tautog were captured in seven of 140 (5.0%) trawls and in two of 38 beach seines (5.3%). A total of 10 tautog were collected in trawl (eight fish) and beach seine (two fish) samples conducted on Maryland's Coastal Bays in 2008 (Table 4). Tautog ranked 37th out of 67 species in overall finfish abundance. The trawl and beach seine CPUEs were 0.5 fish/hectare and 0.1 fish/haul, respectively.

Regression analysis was performed on the 1989-2008 data to determine if there was a trend in the annual relative abundance over the time series. Trawl catch data [$\log_e(x+1)$] showed a significant increasing trend (P=0.0.0164, Figure 50). Regression of beach seine catch data [$\log_e(x+1)$] indicated no significant trend in relative abundance (P=0.0821, Figure 51).

GM indices of relative abundance were calculated and compared with the 1989-2008 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 2008 trawl index was above the grand mean and the beach seine index was equal to the grand means (Figures 52 and 53, respectively).

Duncan's Multiple Range Test indicated that trawl sites T001, T002, T003, T006, T007, T008, T009, T013, T014, T016, T018, and T020 had the highest level of abundance (CPUE) and these locations were classified as primary sites (Figure 1, Table 8). Zero secondary trawl sites were classified. Beach seine sites S002, S005, S006, S009, and S010 were determined to be primary locations and S001, S007, and S014 were classified as secondary sites (Figure 1, Table 9).

Discussion

Regression analysis indicated an increasing trend for trawl annual relative abundance whereas no significant trend was determined for beach seine catch data. 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.

Tautog 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. Since 1989, the beach seine relative abundance estimates seldom (3 years) varied from the grand mean.

Primary and secondary trawl and beach seine sites for tautog were located in Assawoman Bay, Isle of Wight Bay and its tributaries, Sinepuxent Bay, Newport Bay, and Chincoteague Bay. Primary and secondary trawl and seine sites were widespread, which may indicate their tolerance of diverse habitats such as inlets, channels, drop offs, rip rap, or crab pots.

Management

Tautog are managed by the State of Maryland in cooperation with ASMFC. The regulations in 2008 included a 14 inch size limit and four fish creel limit from January 1 through May 15, and November 1 through November 30. From May 16 through October 31 the creel limit is two fish per day (Table 10). The limits were the same for commercial and recreational anglers. Monitoring will continue in the CBFI Trawl and Beach Seine Survey.

Species Results: Weakfish (*Cynoscion regalis*)

Weakfish were collected in 9 of 140 trawls (6.4%) and one of 38 seines (2.6%). A total of 47 juvenile weakfish were collected in trawl (46 fish) and beach seine (one fish) samples conducted on Maryland's Coastal Bays in 2008 (Table 4). Weakfish ranked 21st out of 67 species in overall finfish abundance. The trawl and beach seine CPUEs were 2.6 fish/hectare and 0.1 fish/haul, respectively.

Regression analysis was performed on the 1989-2008 data to determine if there was a trend in the annual relative abundance over the time series. Both trawl and beach seine catch data [$\log_e(x+1)$] showed no significant trends in abundance (P=0.3792 and 0.1093, Figures 54 and 55, respectively).

GM indices of relative abundance were calculated and compared with the 1989-2008 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 2008 trawl and beach seine indices were both below the grand means (Figures 56 and 57, respectively).

Duncan's Multiple Range Test indicated that trawl sites T001, T002, T003, and T004 had the highest level of abundance (CPUE) and these locations were classified as primary sites (Figure 1, Table 8). The only secondary trawl site was T012. Beach seine sites S003 and S017 were determined to be primary locations and S002, S006, S012, S015, S016, and S019 were classified as secondary sites (Figure 1, Table 9).

Discussion

Regression analysis indicated no significant trend in trawl and seine annual relative abundance. Changes in relative abundance may reflect a combination of overfishing, environmental conditions (nutrient levels, water temperature, salinity, and dissolved oxygen) and ecological changes including, shifts in species composition and habitat type. Also, some scientists believed that the large biomass of adult striped bass are foraging heavily on weakfish and consequently, having an effect on weakfish abundance.

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. Since 1989, the relative abundance trawl estimates occasionally (seven years) varied from the grand mean.

Primary and secondary trawl and beach seine sites for weakfish were located in Assawoman Bay, Isle of Wight Bay and its tributaries, Newport Bay, and Chincoteague Bay. Primary and secondary sites were absent from Sinepuxent Bay, which may indicate a preference for slower moving water. In addition, open water sites in Chincoteague Bay were also notably absent from habitat preference results.

Management

Weakfish are managed by the State of Maryland in cooperation with ASMFC. Maryland's 2008 recreational weakfish regulations were comprised of an eight fish creel and a 13 inch minimum size limit (Table 10). Commercial regulations in 2008 restricted fisherman to a 12 inch minimum size and included an array of season closures dependant upon the type of gear used and body of water being fished (i.e. Atlantic Ocean, Coastal Bays, and Chesapeake Bay). Monitoring will continue in the CBFI Trawl and Beach Seine Survey.

Species Results: White Mullet (*Mugil curema*)

White mullet were captured in three of 140 trawls (2.1%) and in six of 38 beach seine samples (18.4%). A total of 73 white mullet were collected in trawl (7 fish) and beach seine (66) samples conducted on Maryland's Coastal Bays in 2008 (Table 4). White mullet ranked 15th out of 67 species in overall finfish abundance. The trawl and beach seine CPUEs were 0.4 fish/hectare and 1.7 fish/haul, respectively.

Regression analysis was performed on the 1989-2008 data to determine if there was a trend in the annual relative abundance over the time series. Both trawl and beach seine catch data [$\log_e(x+1)$] showed significant trends (P=0.0006 and 0.0106, Figures 58 and 59, respectively); trawl data incdicate and increasing trend, and seine data indicate a decreasing trend.

GM indices of relative abundance were calculated and compared with the 1989-2008 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 2008 trawl index was equal to the grand mean, and the seine index was below the grand mean (Figures 60 and 61, respectively).

Duncan's Multiple Range Test indicated that trawl sites T005 and T006 had the highest level of abundance (CPUE) and these locations were classified as primary sites (Figure 1, Table 8). Zero secondary trawl sites were classified at this time. Beach seine sites S005 and S007 were determined to be primary locations and S001 and S006 were classified as secondary sites (Figure 1, Table 9).

Discussion

Regression analysis indicated significant trends in the trawl and beach seine catch data; however, the variation among years makes it difficult to discern between an increasing or decreasing pattern. The trend in the trawl data appears to be increasing, but the seine data is harder to resolve. 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.

White mullet 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 data. Since 1989, the beach seine relative abundance estimates seldom (seven years) varied from the grand mean.

Primary and secondary trawl and beach seine sites for white mullet were located in Isle of Wight Bay and its tributaries. Similar characteristics of primary and secondary trawl and seine sites were their proximity to land, residential influence, and inlets.

Management

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

Species Results: Winter Flounder (*Pseudopleuronectes americanus*)

Winter Flounder were collected in 4 of 140 trawls (2.9%) and 3 of 38 seines (7.9%). A total of 31 juvenile winter flounder were collected in trawl (4 fish) and beach seine (27 fish) samples conducted on Maryland's Coastal Bays in 2008 (Table 4). Winter flounder ranked 24th out of 67 species in overall finfish abundance. The trawl and beach seine CPUEs were 0.2 fish/hectare and 0.7 fish/haul, respectively.

Regression analysis was performed on the 1989-2008 data to determine if there was a trend in the annual relative abundance over the time series. Trawl and beach seine catch data [$\log_e(x+1)$] both showed no significant trends (P=0.8132 and 0.0230, Figures 62 and 63, respectively).

GM indices of relative abundance were calculated and compared with the 1989-2008 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 2008 trawl and the beach seine indices were both below the standardized grand mean (Figures 64 and 65, respectively).

Duncan's Multiple Range Test indicated that trawl sites T001, T002, T003, T004, and T007 had the highest level of abundance (CPUE) and these locations were classified as primary sites (Figure 1, Table 8). There was one secondary trawl site, T006. Beach seine sites S002, S003, S004, S005, S006 and S009 were determined to be primary locations and S010 was classified as a secondary site (Figure 1, Table 9).

Discussion

Regression analysis indicated no significant trends in the trawl and beach seine catch data. 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.

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. Since 1989, the relative abundance estimates occasionally (seven years trawl, four years beach seine) varied from the grand means.

Primary and secondary trawl and beach seine sites for winter flounder were located in the shallow, protected areas of Assawoman Bay, Isle of Wight Bay including its tributaries, and Sinepuxent Bay. Similar characteristics of primary and secondary trawl and seine sites were their proximity to land, residential influence, and inlets.

Management

In the mid-Atlantic, winter flounder 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.

Additional Discussion on Habitat Preference by Bay

Northern Bays – Assawoman Bay, Isle of Wight Bay (St. Martins River)

All trawl and seine sites had at least one species that preferred its habitat (primary classification) in the northern bays (Tables 8 and 9). Several sites distinguished themselves as being primary and secondary sites for a majority of the species examined. Sites T001, T002, T003, T006, S001, S002, S003, S005, and S006 were the most preferred locations based on the analysis of primary and secondary site preference (Tables 8 and 9).

Many species including Atlantic croaker, Atlantic menhaden, bluefish, spot, summer flounder, tautog, weakfish, white mullet, and winter flounder showed an affinity to the northern bays (Tables). The combination of the habitat type, forage, tidal current, salinities, and dissolved oxygen make this area desirable for juvenile finfish production.

Sinepuxent Bay

All trawl and seine sites were preferred by at least one species (Tables 8 and 9). Beach seine sites in Sinepuxent Bay were more highly preferred when compared to the trawl sites. Seine sites ranged from three to 11 species with a primary or secondary designation while trawl sites ranged from one to three species. Seine site S010 had the greatest species diversity with primary or secondary classifications (11). It is located in a shallow, muddy, protected cove which is an ideal habitat for juvenile finfish (Atlantic menhaden, Atlantic silversides, black sea bass, mummichogs, summer flounder, silver perch, spot, tautog, winter flounder, bluefish, and pigfish). The strong tidal currents where trawls are conducted may deter many juvenile finfish; however, black sea bass, and tautog were the only species that primarily preferred these sites. These species are known to be found near structure. Structure may provide relief from stronger tidal currents that are common in Sinepuxent Bay.

Newport Bay and Chincoteague Bay

Six out of seven trawl, and five out of six seine sites had at least one species with a primary classification; however, six species for trawl and five species for seine had no sites classified as primary or secondary preference sites in these bays (Tables 8 and 9). Trawl sites ranged from two to six species with a primary or secondary designation while seine sites had a range of two to 10 species. Seine site S017 had the most species with primary or secondary classifications (10). It is located in a shallow, muddy, protected cove which is an ideal habitat for juvenile finfish (Atlantic croaker, Atlantic menhaden, Atlantic silversides, bay anchovy, black sea bass, mummichogs, silver perch, spot, summer flounder, and weakfish).

Chincoteague Bay had few species with primary trawl classifications (Table 9). The open water of Chincoteague Bay may deter many juvenile finfish. Support for this argument is provided by the relatively low number of species preferring the open water seine locations in the bay (S016, and S018; Table 9).

Macroalgae

In the 2008 CBFI Trawl and Beach Seine Survey, four of the five taxonomic algae divisions were represented in the catch (brown, green, red, and yellow-green; Table 7). Overall, red and green macroalgae were most frequently encountered. The results indicated gear specific differences in dominant algae divisions. Red algae dominated trawl samples (85%) whereas greens were most abundant beach seining (67%, Figures 66-69).

Gracilaria sp. and *Agardhiella tenera* had the highest biomass, but the green alga, *Ulva* sp., was more frequently encountered at trawl survey sites (Figures 66 and 68, Table 2). Similar results were documented in An Examination of Benthic Macroalgae Communities as Indicators of Nutrients in Middle Atlantic Coastal Estuaries – Maryland Component (Goshorn *et al*. 2001). A literature search has not confirmed that red algae prefer deeper, cooler water.

The inverse was witnessed in the beach seine survey. *Chaetomorpha* sp. and *Cladophora* sp. had the highest biomass, but the red alga *Agardhiella tenera* was more frequently encountered at beach seine sites (Figures 67 and 69, Table 3). Morand and Merceron (2005) suggested that low salinity gives an advantage to opportunistic green algae. Beach seine sites were located along the shoreline where freshwater inputs could influence salinity. That relationship could be investigated in the future.

In May through July trawl samples, macroalgae biomass, dominated by reds, was at least double the amount captured in April (Figure 70). A noticeable biomass reduction occurred in August and September, followed by an increase in October. A plausible explanation for the seasonal fluctuation may involve influxes of nutrients (from agriculture, sewage, and water runoff) in the spring causing eutrophication, followed by a die off due to high air temperatures in the summer, and then an increase of nutrients again in the fall from seasonal hurricanes and tropical storms, which causes runoff from harvested fields.

Beach seine samples were only collected in June and September, but showed similar seasonal fluctuations as the trawl data (Figure 71). Greens dominated the catch in June and were virtually nonexistent in September. The same plausible explanation may pertain to the beach seine biomass fluctuations.

Most of the macroalgae biomass collected by trawl and beach seine were from the upper bays (Assawoman Bay and Isle of Wight Bay; Figures 1, 72 and 73). Sites T001 (on a line from Corn Hammock to Fenwick Ditch), T002 (Grey's Creek, mid creek), and T006 (Turville Creek below the racetrack) were where over 75% of the total macroalgae trawl catch were collected. Sites S001 (cove behind Ocean City Sewage Treatment Plant, 62nd St.), S005 (beach on sand spit N. of Cape Isle of Wight), and S006 (beach on west side of Isle of Wight, St. Martins River) were where approximately 80% of the total macroalgae beach seine catch were collected. This was expected considering the geography of the areas. The upper bays were characterized by Ocean City, numerous commercial and recreational developments, marinas, a wastewater treatment facility, and a commercial harbor. In contrast, the southern bays have considerably fewer commercial and residential developments and only a handful of public boat ramps.

Recommendations

A detailed look into macroalgae is recommended for future reports. Since volumetric measurements of macroalgae have been recorded since 2006, it would be beneficial to analyze those data. Future analyses could include:

- changes in volume over time;
- relationships between water quality, volume, and species of macroalgae;
- relationships between macroalgae volume and catch; and
- relationships between impervious surfaces and population changes over time and how this has effected catch volumes.

Water Quality and Physical Characteristics

Analysis of the 2008 CBFI Trawl Survey water quality data showed an increase in the average water temperature from April through June in some bays and April through July in other with the highest temperature of 30.7°C recorded in Newport Bay on July 22, 2008 (Figure 74 and Table 11). The temperature peaked twice in Sinepuxent Bay, once in June and again in August, with a slight dip in temperature in July. Overall, Sinepuxent Bay had the lowest average water temperature at 20.4ºC, while Newport Bay had the highest with 22.8ºC. The lower water temperatures observed in Sinepuxent Bay were more likely a result of an increased flushing rate based on its close proximity to the Ocean City Inlet (Atlantic Ocean).

DO levels in the Coastal Bays decreased from April to July in St. Martins River, Isle of Wight Bay, Newport Bay and Chincoteague Bay (Figure 75). DO levels in Assawoman Bay decreased until July and remained level until beginning an increase in September. In Sinepuxent Bay, the DO hit the lowest levels in August and began to ascend in September. The lowest recorded level of 2.4 mg/L was collected on July 14, 2008 at lower Shingle Landing Prong in St. Martin's River (Table 11). Ad water temperatures increase, DO levels drop as a result of temperature's effect on water's solubility properties. In 2008, Newport Bay had the highest average DO at 6.70 mg/L and Assawoman Bay's average DO of 6.46 mg/L was the year's lowest

In addition to the water quality data collected along with trawl and seine sites, similar data were collected while conducting a relatively new project using drop nets to measure species abundance within submerged aquatic vegetation at two small sites in Sinepuxent Bay. The average water temperature of the two sites combined actually decreased until August (Figure 76), allowing the shared average DO to climb. In September, the temperature showed an increase, but the DO only dipped slightly.

Overall, the salinity recorded throughout the bays increased up to October (Table 11 and Figure 77) with some exceptions. Salinity recorded in the bays varied from 10.4-30.7 ppt. through the year. Some bays (Assawoman, Isle of Wight, Sinepuxent and Chincoteague) actually experienced a decrease in salinity from April to May. For Newport Bay, the salinity did not rise until June. The St. Martin's River had the lowest average salinity (25.6 ppt) and Chincoteague Bay (30.3 ppt) yielded the highest.

Results of secchi analysis showed variations for turbidity levels from April to September for all systems (Table 11 and Figure 78). Turbidity peaked twice in Assawoman Bay, St. Martins River, Isle of Wight Bay and Newport Bay. The first peak in turbidity for both Assawoman Bay and Newport Bay was reached in June while the other two systems experienced their first peak in July. The second peak in turbidity occurred in September for Assawoman Bay, Isle of Wight Bay and the St. Martin's river. The turbidity in Newport Bay increased again in August. Turbidity reached its highest level at only one point in both Chincoteague and Sinepuxent Bays. The lowest turbidity readings were found in April and October in different bays.

Differences in temperature, dissolved oxygen, salinity and turbidity are influenced by the flushing times of these systems. 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 and Newport Bay are not known (Wazniak, et al. 2004). Given the proximity to the Ocean City Inlet and results of the turbidity data (secchi) one can assume that flushing rates for Sinepuxent would be relatively fast (more like Isle of Wight) while the flushing rate in Newport Bay would be much longer (more like Chincoteague Bay).

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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 23.708	75 06.855
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 2008 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, 2008. 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
Spot	*Leiostomus xanthurus*	22384	18527	3857	1055.2	101.5
Atlantic Menhaden	*Brevoortia tyrannus*	10220	98	10122	5.6	266.4
Bay Anchovy	*Anchoa mitchilli*	7915	6729	1186	383.2	31.2
Atlantic Silverside	*Menidia menidia*	655	1	654	0.1	17.2
Striped Mullet	*Mugil cephalus*	617	1	616	0.1	16.2
Summer Flounder	*Paralichthys dentatus*	594	538	56	30.6	1.5
Silver Perch	*Bairdiella chrysoura*	251	45	206	2.6	5.4
Black Sea Bass	*Centropristis striata*	223	188	35	10.7	0.9
Pinfish	*Lagodon rhomboides*	201	10	191	0.6	5.0
Mummichog	*Fundulus heteroclitus*	126	3	123	0.2	3.2
Naked Goby	*Gobiosoma bosc*	98	92	6	5.2	0.2
Striped Killifish	*Fundulus majalis*	94	0	94	0	2.5
Hogchoker	*Trinectes maculatus*	92	85	7	4.8	0.2
Atlantic Croaker	*Micropogonias undulatus*	90	88	2	5.0	0.1
White Mullet	*Mugil curema*	73	7	66	0.4	1.7
Pigfish	*Orthopristis chrysoptera*	70	54	16	3.1	0.4
Oyster Toadfish	*Opsanus tau*	64	38	26	2.2	0.7
American Eel	*Anguilla rostrata*	63	30	33	1.7	0.9
Smallmouth Flounder	*Etropus microstomus*	57	54	3	3.1	0.1
Northern Pipefish	*Syngnathus fuscus*	50	39	11	2.2	0.3
Weakfish	*Cynoscion regalis*	47	46	1	2.6	<0.1
Bluefish	*Pomatomus saltatrix*	46	7	39	0.4	1.0
Dusky Pipefish	*Syngnathus floridae*	43	31	12	1.8	0.3
Winter Flounder	*Pseudopleuronectes americanus*	31	4	27	0.2	0.7
Northern Searobin	*Prionotus carolinus*	26	26	0	1.5	0
Blackcheek Tonguefish	*Symphurus plagiusa*	24	18	6	1.0	0.2
Striped Anchovy	*Anchoa hepsetus*	23	1	22	0.1	0.6
Rainwater Killifish	*Lucania parva*	21	1	20	0.1	0.5

Table 4 (con't). List of fishes collected in Maryland's Coastal Bays Trawl (T) and Beach Seine (S) Surveys from April through October, 2008. 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**
Green Goby	*Microgobius thalassinus*	18	18	0	1.0	0
Lined Seahorse	*Hippocampus erectus*	18	18	0	1.0	0
Scup	*Stenotomus chrysops*	17	17	0	1.0	0
Striped Cusk Eel	*Ophidion marginatum*	16	16	0	0.9	0
Northern Puffer	*Sphoeroides maculatus*	15	10	5	0.6	0.1
Atlantic Needlefish	*Strongylura marina*	14	0	14	0	0.4
Smooth Butterfly Ray	*Gymnura micrura*	13	13	0	0.7	0
Spotted Hake	*Urophycis regia*	11	11	0	0.6	0
Striped Blenny	*Chasmodes bosquianus*	10	7	3	0.4	0.1
Tautog	*Tautoga onitis*	10	8	2	0.5	0.1
Inshore Lizardfish	*Synodus foetens*	10	8	2	0.5	0.1
Sheepshead	*Archosargus probatocephalus*	8	0	8	0	<0.1
Striped Burrfish	*Chilomycterus schoepfii*	8	8	0	0.5	0
Feather Blenny	*Hypsoblennius hentz*	7	5	2	0.3	0.1
Clearnose Skate	*Raja eglanteria*	7	7	0	0.4	0
Spotfin Mojarra	*Eucinostomus argenteus*	6	0	6	0	0.2
Blue Runner	*Caranx crysos*	6	1	5	0.1	0.2
Spotted Seatrout	*Cynoscion nebulosus*	5	0	5	0	0.1
Web Burrfish	*Chilomycterus antillarum*	4	2	2	0.1	0.1
Lookdown	*Selene vomer*	4	2	2	0.1	0.1
Southern Stingray	*Dasyatis americana*	4	3	1	0.2	<0.1
Smooth Dogfish	*Mustelus canis*	4	4	0	0.2	0
Butterfish	*Peprilus triacanthus*	4	4	0	0.2	0
Cownose Ray	*Rhinoptera bonasus*	3	0	3	0	0.1
Black Drum	*Pogonias cromis*	3	1	2	0.1	0.1
Windowpane Flounder	*Scophthalmus aquosus*	3	3	0	0.2	0

Table 4 (con't). List of fishes collected in Maryland's Coastal Bays Trawl (T) and Beach Seine (S) Surveys from April through October, 2008. 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
Striped Searobin	*Prionotus evolans*	3	3	0	0.2	0
Skillet Fish	*Gobiesox strumosus*	3	3	0	0.2	0
Conger Eel	*Conger oceanicus*	3	3	0	0.2	0
Lady Fish	*Elops saurus*	2	0	2	0	0.1
Planehead Filefish	*Monacanthus hispidus*	2	2	0	0.1	0
Bluespotted Cornetfish	*Fistularia tabacaria*	2	2	0	0.1	0
Permit	*Trachinotus falcatus*	1	0	1	0	<0.1
Ballyhoo	*Hemiramphus brasiliensis*	1	0	1	0	<0.1
Red Drum	*Sciaenops ocellatus*	1	0	1	0	<0.1
Sheepshead Minnow	*Cyprinodon variegatus*	1	0	1	0	<0.1
Gizzard Shad	*Dorosoma cepedianum*	1	0	1	0	<0.1
Pipefish Genus	*Syngnathus*	1	1	0	0.1	0
Northern Kingfish	*Menticirrhus saxatilis*	1	1	0	0.1	0
	Total Finfish	**44,448**	**26,942**	**17,506**		

Table 5. List of crustaceans and molluscs collected in Maryland's Coastal Bays Trawl (T) and Beach Seine (S) Surveys from April through October, 2008. 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
Crustacean Species**								
Blue Crab	*Callinectes sapidus*	3524	2399	1125			136.6	29.6
Grass Shrimp	*Palaemonetes spp.*	1552	666	886		50	37.9	23.3
Sand Shrimp	*Crangon septemspinosa*	1438	1314	124			74.8	3.3
Lady Crab	*Ovalipes ocellatus*	333	220	113			12.5	3.0
Say Mud Crab	*Dyspanopeus sayi*	240	219	21			12.5	0.6
Brown Shrimp	*Farfantepenaeus aztecus*	172	122	50			6.9	1.3
Barnacle Infraclass	*Cirripedia*	152	152	0			8.7	0
Long-Clawed Hermit Crab	*Pagurus longicarpus*	55	36	19			2.1	0.5
Mantis Shrimp	*Squilla empusa*	41	41	0			2.3	0
Rock Crab	*Cancer irroratus*	28	28	0			1.6	0
White Shrimp	*Litopenaeus setiferus*	23	17	6			1.0	0.2
Nine-Spined Spider Crab	*Libinia emarginata*	13	13	0			0.7	0
Lesser Blue Crab	*Callinectes similis*	8	7	1			0.4	<0.1
Six-Spined Spider Crab	*Libinia dubia*	6	6	0			0.3	0
Mud Crab Genus	*Panopeus*	6	6	0			0.3	0
Iridescent Swimming Crab	*Portunus gibbesii*	5	5	0			0.3	0
Bigclaw Snapping Shrimp	*Alpheus heterochaelis*	4	4	0			0.2	0
Flat-Clawed Hermit Crab	*Pagurus pollicaris*	4	4	0			0.2	0
Atlantic Mud Crab	*Panopeus herbstii*	2	2	0			0.1	0
Green Crab	*Carcinus maenas*	1	0	1			0	<0.1
	Total Crustaceans	**7,607**	**5,261**	**2,346**				

Table 5 (con't). List of crustaceans and molluscs collected in Maryland's Coastal Bays Trawl (T) and Beach Seine (S) Surveys from April through October, 2008. 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
Mollusc Species**								
Blue Mussel	*Mytilus edulis*	605	105	500			6.0	13.2
Sponge Slug	*Doris verrucosa*	448	447	1			25.5	<0.1
Brief Squid	*Lolliguncula brevis*	109	109	0			6.2	0
Eastern Mud Snail	*Nassarius obsoletus*	50	0	50			0	1.3
Solitary Glassy Bubble Snail	*Haminoea solitaria*	39	37	2			2.1	0.1
Lemon Drop Nudibranch	*Doriopsilla pharpa*	35	35	0			2.0	0
Jingle Shell	*Anomia simplex*	24	24	0			1.4	0
Bruised Nassa	*Nassarius vibex*	12	9	3			0.5	0.1
Nudibranch Order	*Nudibranchia*	8	8	0			0.5	0
Purplish Tagelus	*Tagelus divisus*	6	6	0			0.3	0
Atlantic Oyster Drill	*Urosalpinx cinerea*	4	4	0			0.2	0
Stout Tagelus	*Tagelus plebeius*	3	3	0			0.2	0
Mudsnail Genus	*Nassarius*	2	0	2			0	0.1
Hard Shell Clam	*Mercenaria mercenaria*	2	1	1			0.1	<0.1
Atlantic Awningclam	*Solemya velum*	2	2	0			0.1	0
Convex Slipper Shell	*Crepidula convexa*	2	2	0			0.1	0
Channeled Whelk	*Busycon canaliculatum*	2	2	0			0.1	0
Marsh Periwinkle	*Littoraria irrorata*	1	0	1			0	<0.1
Slipper Shell Genus	*Crepidula*	1	1	0			0.1	0
Eastern Beaded Chiton	*Chaetopleura apiculata*	1	1	0			0.1	0
Thick-Lipped Oyster Drill	*Eupleura caudata*	1	1	0			0.1	0
Common Atlantic Slipper Shell	*Crepidula fornicata*	1	1	0			0.1	0

Table 5 (con't). List of crustaceans and molluscs collected in Maryland's Coastal Bays Trawl (T) and Beach Seine (S) Surveys from April through October, 2008. 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**
Threeline Mudsnail	*Nassarius trivittatus*	1	1	0			0.1	0
Blood Ark	*Anadara ovalis*	1	1	0			0.1	0
Narrow Macoma	*Macoma tenta*	1	1	0			0.1	0
Dwarf Surfclam	*Mulinia lateralis*	1	1	0			0.1	0
	Total Molluscs	**1,362**	**802**	**560**				

** CPUE was calculated only for number collected (T and S) but not for estimated counts, specific volumes, or estimated volumes.

Table 6. List of other species collected in Maryland's Coastal Bays Trawl (T) and Beach Seine (S) Surveys from April through October, 2008. 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)	Est. Cnt (T)	Spec. Vol. (L) (T)	Spec. Vol. (L) (S)	Est. Vol. (L) (T)	Est. Vol. (L) (S)	CPUE (T) #/Hect.	CPUE (S) #/Haul
Moon Jelly	*Aurelia aurita*	203	187	16						10.7	0.4
Sea Nettle	*Chrysaora quinquecirrha*	156	156	0						8.9	0
Hairy Sea Cucumber	*Sclerodactyla briareus*	98	59	39						3.4	1.0
Sea Squirt	*Mogula manhattensis*	87	87	0						5.0	0
Forbes Asterias Star	*Asterias forbesi*	36	36	0						2.1	0
Horseshoe Crab	*Limulus polyphemus*	16	15	1						0.9	<0.1
Northern Diamondback Terrapin	*Malaclemys terrapin terrapin*	15	7	8						0.4	0.2
Common Sea Cucumber	*Thyone briareus*	6	5	1						0.3	<0.1
Comb Jelly	*Beroe spp.*	6	6	0						0.3	0
Sea Cucumber	Thyonella gemmata	3	3	0						0.2	0
Sea Anemone Order	*Actiniaria*	1	1	0						0.1	0
Sand Dollar	*Echinarachnius parma*	1	1	0						0.1	0
	Total Other	**628**	**563**	**65**							

Table 7. 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, 2008. Species are listed by order of total abundance. Total trawl sites = 140, total seine sites = 38.

Common Name	Scientific Name	Specific Volume (L) (T)	Specific Volume (L) (S)	Estimated Volume (L) (T)	Estimated Volume (L) (S)	Frequency (T)	Frequency (S)
SAV							
Eel Grass	*Zostera marina*	54.05	17.49		0.03	9	15
Widgeon Grass	*Ruppia maritima*		14.87		0.03		5
	Total SAV	**54.05**	**32.36**		**0.06**	**9**	**20**
Macroalgae							
Brown							
Sour Weeds	*Desmarestia* sp.	172.16	4.73	0.03		9	2
	Ectocarpus sp.	0.09	5.44			1	1
Rockweed	*Fucus* sp.	0.02	3.29			1	1
		172.27	*13.46*	0.03		*11*	*4*
Green							
Sea Lettuce	*Ulva* sp.	755.29	32.77	0.03		85	16
Green Hair Algae	*Chaetomorpha* sp.	76.95	289.33	0.03		14	4
Hollow Green Weeds	*Enteromorpha* spp.	43.98	112.95			7	5
Green Tufted Seaweed	*Cladophora* sp.	18.67	266.49			4	1
Green Fleece	*Codium fragile*	13.17	0.02			20	1
		908.06	*701.55*	0.06		*130*	*27*
Red							
Graceful Red Weed	*Gracilara* sp.	2,881.53	264.91		0.03	74	20
Agardh's Red Weed	*Agardhiella tenera*	2,072.56	54.62			40	11
Barrel Weed	*Champia* sp.	260.12	8.97			27	3
Banded Weeds	*Ceramium* sp.	39.59	1.45	0.03		16	3
Hooked Red Weed	*Hypnea* sp.	0.63	6.53			1	1
Tubed Weeds	*Polysiphonia* sp.	0.21	1.75			1	1
		5,254.65	*338.22*	0.03	0.03	*159*	*39*
Yellow-Green							
Water Felt	*Vaucheria* sp.	10.39	1.96			3	2
	Total Macroalgae	**6,345.37**	**1,055.18**	**0.12**	**0.03**	**303**	**72**

** CPUE was calculated only for number collected (T and S) but not for estimated counts, specific volumes, or estimated volumes.

Table 8. Coastal Bays Fisheries Investigations 1989-2008 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
Atlantic Croaker	1	1	2	1	1	2					2	1		1						
Atlantic Menhaden	1	1	2	1		2					2	1		1					2	
Atlantic Silverside		2		1	2	2									2		2	2	1	
Bay Anchovy	1	1		1							1	1		2						
Black Drum*		1																		
Black Seabass	1		1	1		1	1	2	1			1				1				1
Bluefish		2	2	1	1															
Hogchoker			2									1								
Mummichog					1	1						2							2	
Northern Puffer							1		1	1										2
Pigfish			2			2	2										2		2	1
Silver Perch	1	1		1	2	1					1	1	2	1					1	
Spot	1	1	2	2	1	2					1	1			2					
Summer Flounder	2	2	2	2		2						1								
Tautog*	1	1	1			1	1	1	1				1	1	1			1		1
Weakfish	1	1	1	1								2								
White Mullet*					1	1														
Winter Flounder	1	1	1	1		2	1													

*Only primary/secondary sites(s) listed due to low sample size in remaining sites.

Table 9. Coastal Bays Fisheries Investigations 1989-2008 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
Atlantic Croaker		2	2		2	1					2	2					2		
Atlantic Menhaden		2	2		2	2	2			2		2	2		2		2		1
Atlantic Silverside	2		2	2	1	1		2	1	1							2		
Bay Anchovy			1			2					2	1	2		1	2	2		
Black Drum*			1		1								1						
Black Seabass	2	1	2	2	1	1			1	1	2				2	2	2	2	
Bluefish	1	2	2		1	1				2									
Hogchoker												1			2				
Mummichog	1				1		1		1	1	2	1	1	1			2	1	1
Northern Puffer		1	1		1	1		1	1		1				2				
Pigfish	1	1			1	2	1			2									
Silver Perch	1	1			2	1				1	1						1	2	
Spot	1	1	1		1	1	1	1		1	1	1	1		2		1		
Summer Flounder	2	2			2	2				2		1	2		2		2		
Tautog	2	1			1	1	2		1	1									
Weakfish		2	1			2						2			2	2	1		2
White Mullet	2				1	2	1												
Winter Flounder		1	1	1	1	1			1	2									

*Only primary/most abundant sites(s) listed due to low sample size in remaining sites.

Table 10. Summary of Maryland Recreational and Commercial Regulations for 2008

Recreational

Species	Area	Minimum Size Limit (inches)	Creel (person/day)	Closures
Atlantic Croaker	All Waters[A]	9	25	
Black Sea Bass	All Waters	12	25	
Bluefish	All Waters[A]	8	10	
Summer Flounder	Chesapeake Bay[B] Coastal Waters[C]	16.5 17.5	1 3	
Tautog, Jan 1 thru May 15 and Nov 1 thru Nov 30	All Waters[A]	14	4	December
Tautog, May 16 thru Oct 31	All Waters[A]	14	2	December
Weakfish	All Waters[A]	13	8	

Commercial

Species	Area	Minimum Size Limit (inches)	Commercial Season, Days, Times, & Area Restrictions	Special Conditions/Comments
Atlantic Croaker		9	Mar 16-Dec 31	CLOSED Jan 1-Mar 15
Atlantic Menhaden		None	None	Harvest cap of 109,020 metric-tons
Black Sea Bass		11	Landing Permit Required	Individual IFQ issued. Individual without a landing permit 50 lbs.
Bluefish		8	OPEN YEAR ROUND	
Summer Flounder	Ocean Bay	14 Hook & Line16.5 14 Hook & Line 17.5	Annual Quota Annual Quota	Individual IFQ issued. Individual without a permit: 100lbs./day All fishermen: 50 lbs./day
Tautog, Jan 1 thru May 15 and Nov 1 thru Nov 30	All Waters[A]	14	4	December
Tautog, May 16 thru Oct 31	All Waters[A]	14	2	December

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

Table 11. Coastal Bays Fisheries Investigations 2008 water quality data collected during trawl sampling. Mean values are reported with the range in parentheses.

Parameter	Location	April	May	June	July	August	September	October
				Assawoman Bay (Sites: T001, T002, and T003)				
Temp (°C)	Surface:	13.1	17.9	26.7	27.5	24.5	22.8	20.5
		(12.6-13.4)	(16.5-20.3)	(26.6-26.9)	(27.4-27.6)	(24.2-24.9)	(22.3-23.1)	(20.4-20.5)
	Bottom:	12.9	17.9	26.0	27.0	24.4	22.8	20.5
		(12.1-13.6)	(16.4-20.1)	(25.0-26.5)	(26.0-27.6)	(24.1-24.8)	(22.3-23.1)	(20.4-20.6)
DO (mg/L)	Surface:	7.6	7.1	5.8	5.9	5.4	7.4	6.7
		(7.4-7.8)	(7.0-7.2)	(5.5-6.0)	(5.7-6.1)	(4.9-6.1)	(6.2-8.0)	(5.6-7.5)
	Bottom:	7.8	7.0	4.9	5.1	5.5	7.3	7.0
		(7.6-8.1)	(6.5-7.4)	(4.2-5.3)	(4.9-5.3)	(5.1-5.8)	(6.1-7.9)	(5.8-7.7)
Salinity (ppt)	Surface:	25.8	23.2	26.0	27.7	30.6	30.9	30.4
		(25.2-26.9)	(21.9-25.3)	(25.0-27.7)	(26.6-28.9)	(30.1-31.5)	(30.7-31.3)	(30.2-30.7)
	Bottom:	26.4	23.3	26.9	28.0	30.7	30.9	30.4
		(25.7-27.5)	(22.2-25.4)	(25.5-28.8)	(26.8-29.9)	(30.1-31.6)	(30.7-31.4)	(30.2-30.7)
Secchi (cm)		199.6	147.7	66.3	88.0	91	75.0	98.7
		(176.8-212.0)	(124.0-179.0)	(61.0-70.0)	(73.0-96.0)	(71.0-128.0)	(55.0-100.0)	(61.0-171.0)
				Saint Martins River (Sites: T004 and T005)				
Temp (°C)	Surface:	15.4	22.1	29.1	28.1	25.8	22.4	12.0
		(14.4-16.3)	(20.8-23.4)	(28.3-29.8)	(27.4-28.7)	(25.5-26.0)	(22.2-22.5)	(11.9-12.1)
	Bottom:	15.1	21.7	29.0	28.2	25.7	22.3	12.1
		(14.0-16.1)	(20.4-22.9)	(28.2-29.7)	(27.4-29.0)	(25.4-25.9)	(22.1-22.5)	(12.1-12.1)
DO (mg/L)	Surface:	8.8	6.7	6.8	4.9	4.6	6.1	8.6
		(8.1-9.4)	(6.7-6.7)	(6.4-7.1)	(4.7-5.1)	(4.3-5.0)	(5.2-6.9)	(8.5-8.6)
	Bottom:	8.9	7.1	6.4	3.1	4.5	5.9	8.6
		(8.6-9.2)	(6.3-7.9)	(6.2-6.6)	(2.4-3.7)	(4.1-4.9)	(5.2-6.7)	(8.4-8.8)
Salinity (ppt)	Surface:	21.2	22.7	23.7	23.7	28.2	29.1	29.0
		(18.9-23.4)	(20.4-24.9)	(22.2-25.2)	(20.3-27.1)	(26.0-30.4)	(27.8-30.4)	(27.8-30.1)
	Bottom:	22.5	23.4	23.7	25.3	28.2	29.1	29.1
		(19.1-25.8)	(21.2-25.5)	(22.0-25.4)	(23.1-27.4)	(26.0-30.4)	(27.7-30.5)	(28.0-30.1)
Secchi (cm)		124.0	114.0	113.5	49.0	49.8	55	167
		(71.0-177.0)	(110.0-118.0)	(103.0-124.0)	(42.0-56.0)	(47.5-52.0)	(50.0-60.0)	(105.0-229.0)

Table 11 (con't). Coastal Bays Fisheries Investigations 2008 water quality data collected during trawl sampling. Mean values are reported with the range in parentheses.

Parameter	Location	April	May	June	July	August	September	October
				Isle Of Wight Bay (Sites: T006 and T007)				
Temp (°C)	Surface:	13.7	17.3	28.1	28.0	26.3	22.2	15.9
		(10.4-17.0)	(16.0-18.6)	(26.4-29.8)	(26.9-29.0)	(26.2-26.3)	(22.0-22.3)	(11.4-20.4)
	Bottom:	13.7	16.6	27.8	26.7	25.8	22.1	15.9
		(10.5-16.8)	(14.5-18.6)	(25.9-29.7)	(24.6-28.8)	(25.5-26.0)	(22.0-22.1)	(11.3-20.5)
DO (mg/L)	Surface:	8.2	7.6	5.5	5.3	5.1	6.0	8.3
		(7.9-8.6)	(7.3-8.0)	(5.2-5.9)	(4.9-5.7)	(4.5-5.7)	(6.0-6.0)	(7.9-8.7)
	Bottom:	8.6	7.3	5.2	5.4	5.0	5.7	8.4
		(8.5-8.8)	(6.6-8.1)	(4.6-5.9)	(4.8-6.0)	(3.9-6.0)	(5.5-6.0)	(7.9-8.8)
Salinity (ppt)	Surface:	25.0	23.0	25.9	26.7	30.9	31.0	30.5
		(20.9-29.0)	(20.5-25.5)	(23.7-28.0)	(23.9-29.4)	(30.5-31.2)	(30.5-31.4)	(30.1-30.9)
	Bottom:	24.9	25.0	26.3	27.4	30.9	31.0	30.5
		(20.9-28.9)	(20.5-29.4)	(24.4-28.2)	(24.1-30.7)	(30.5-31.3)	(30.6-31.4)	(30.1-30.8)
Secchi (cm)		143.0	124.5	107.5	82.5	109.5	76.5	201.8
		(93.0-193.0)	(69.0-180.0)	(55.0-160.0)	(40.0-125.0)	(50.0-169.0)	(71.0-82.0)	(185.5-218.0)
				Sinepuxent Bay (Sites: T008, T009, and T010)				
Temp (°C)	Surface:	11.9	20.7	25.1	23.0	24.4	22.9	15.4
		(11.1-13.1)	(20.2-21.2)	(23.5-26.2)	(17.1-27.7)	(22.4-25.6)	(20.8-24.8)	(15.1-15.7)
	Bottom:	12.0	20.6	25.1	21.9	24.4	22.8	15.4
		(11.3-13.2)	(20.2-21.0)	(23.6-26.2)	(16.7-27.6)	(22.3-25.6)	(20.8-24.8)	(15.2-15.7)
DO (mg/L)	Surface:	8.9	7.3	5.6	5.6	5.4	5.8	7.6
		(8.3-9.3)	(6.7-7.6)	(5.4-5.8)	(5.2-5.8)	(5.0-5.7)	(5.6-6.0)	(7.4-7.8)
	Bottom:	9.0	7.5	5.8	5.7	5.5	6.0	7.8
		(8.1-9.5)	(7.1-7.7)	(5.4-6.2)	(5.4-5.8)	(5.2-5.9)	(5.7-6.3)	(7.4-8.1)
Salinity (ppt)	Surface:	28.7	27.0	28.1	30.8	31.7	31.5	30.8
		(28.5-29.2)	(26.0-27.6)	(27.1-29.8)	(29.7-31.7)	(31.7-31.7)	(31.0-32.1)	(30.8-30.9)
	Bottom:	28.6	27.0	28.1	31.0	31.7	31.5	30.8
		(28.4-29.1)	(26.3-27.6)	(27.1-29.8)	(29.7-32.0)	(31.6-31.7)	(31.0-32.2)	(30.8-30.9)
Secchi (cm)		170.7	83.7	81.3	87.0	50.3	64.3	98.7
		(105.0-287.0)	(60.0-101.0)	(63.0-100.0)	(45.0-124.0)	(33.0-61.0)	(45.0-78.0)	(56.0-154.0)

Table 11 (con't). Coastal Bays Fisheries Investigations 2008 water quality data collected during trawl sampling. Mean values are reported with the range in parentheses.

Parameter	Location	April	May	June	July	August	September	October
				Newport Bay (Sites: T011 and T012)				
Temp (°C)	Surface:	15.9	20.6	28.6	30.1	25.9	24.8	14.9
		(15.6-16.2)	(20.2-21.0)	(28.5-28.7)	(29.5-30.7)	(25.8-25.9)	(24.6-25.0)	(14.6-15.1)
	Bottom:	15.4	19.5	28.2	29.4	25.7	24.7	14.9
		(14.7-16.0)	(19.1-19.8)	(27.9-28.4)	(29.4-29.4)	(25.7-25.7)	(24.4-25.0)	(14.6-15.1)
DO (mg/L)	Surface:	8.2	7.9	N/A	4.9	6.4	5.4	7.5
		(8.2-8.2)	(7.7-8.1)		(4.3-5.5)	(6.3-6.5)	(4.8-6.0)	(7.2-7.8)
	Bottom:	8.5	7.2	N/A	4.5	6.5	5.5	7.8
		(8.4-8.6)	(7.1-7.2)		(4.1-5.0)	(6.5-6.5)	(5.0-6.1)	(7.6-8.0)
Salinity (ppt)	Surface:	27.3	22.0	21.4	27.8	28.8	31.2	30.8
		(26.4-28.2)	(18.8-25.1)	(18.7-24.0)	(26.2-29.3)	(27.1-30.4)	(30.3-32.1)	(30.5-31.0)
	Bottom:	27.4	22.9	21.5	28.2	28.8	31.6	30.8
		(26.4-28.3)	(19.1-26.7)	(18.8-24.2)	(26.3-30.1)	(27.1-30.5)	(30.4-32.7)	(30.5-31.0)
Secchi (cm)		117.0	55.0	37.5	71.0	39.5	37.0	77.0
		(84.0-150.0)	(52.0-58.0)	(32.0-43.0)	(70.0-72.0)	(31.0-48.0)	(35.4-39.0)	(34.0-120.0)
				Chincoteague Bay (Sites: T013, T014, T015, T016, T017, T018, T019 and T020)				
Temp (°C)	Surface:	19.0	19.7	25.9	27.7	24.8	21.8	20.0
		(14.9-20.9)	(18.0-20.8)	(24.2-27.9)	(26.7-29.5)	(24.3-25.3)	(20.9-24.6)	(14.4-21.3)
	Bottom:	18.9	19.1	25.6	27.7	24.7	21.7	19.7
		(14.8-21.0)	(17.1-20.6)	(24.2-27.9)	(26.6-29.2)	(24.2-25.2)	(20.7-24.6)	(14.3-21.0)
DO (mg/L)	Surface:	7.5	7.3	6.0	5.5	5.8	6.8	6.6
		(6.6-8.1)	(6.7-7.8)	(5.5-6.7)	(5.2-6.0)	(4.9-6.4)	(5.5-8.4)	(5.7-7.7)
	Bottom:	7.6	7.2	6.0	5.3	5.8	6.8	6.7
		(6.8-8.4)	(6.7-7.5)	(5.4-7.1)	(4.9-5.9)	(4.9-6.5)	(5.8-8.2)	(6.0-7.5)
Salinity (ppt)	Surface:	28.4	27.4	28.0	31.4	33.3	31.5	32.0
		(27.3-29.7)	(26.7-27.9)	(25.4-29.6)	(28.0-33.0)	(31.5-34.6)	(30.5-33.2)	(31.4-32.7)
	Bottom:	28.3	27.4	27.9	31.6	33.2	31.5	31.9
		(27.3-29.7)	(26.9-27.9)	(25.4-29.6)	(29.5-32.9)	(31.5-34.5)	(30.5-33.2)	(31.1-32.6)
Secchi (cm)		129.9	60.1	64.9	46.9	58.3	72.6	66.5
		(80.0-249.0)	(43.0-79.0)	(50.0-81.0)	(29.0-62.0)	(38.0-77.5)	(38.0-164.0)	(37.0-144.0)

Table 11. Coastal Bays Fisheries Investigations 2008 water quality data collected during seine sampling. Mean values are reported with the range in parentheses.

Parameter	Location	June	September
		Assawoman Bay (Sites: S001, S002, and S003)	
Temp (°C)	Surface:	27.5 (26.8-28.4)	22.5 (22.1-22.8)
DO (mg/L)	Surface:	5.9 (4.3-7.4)	7.7 (7.2-8.3)
Salinity (ppt)	Surface:	28.4 (27.6-29.8)	31.1 (30.7-31.6)
Secchi (cm)		72.3 (57.0-91.0)	63.5 (59.5-66.0)
		Saint Martins River (Sites: S006)	
Temp (°C)	Surface:	25.6	22.0
DO (mg/L)	Surface:	4.9	7.2
Salinity (ppt)	Surface:	28.1	30.6
Secchi (cm)		30.0	75.0

Table 11 (con't). Coastal Bays Fisheries Investigations 2008 water quality data collected during seine sampling. Mean values are reported with the range in parentheses.

Parameter	Location	June	September
		Isle Of Wight Bay (Sites: S004, S005, and S007)	
Temp (°C)	Surface:	26.3 (24.6-29.5)	21.5 (20.7-22.7)
DO (mg/L)	Surface:	7.3 (5.5-8.2)	6.0 (5.2-7.1)
Salinity (ppt)	Surface:	28.3 (26.6-29.1)	31.2 (31.1-31.3)
Secchi (cm)		121.0 (65.0-210.0)	83.7 (75.0-90.0)
		Sinepuxent Bay (Sites: S008, S009, and S010)	
Temp (°C)	Surface:	26.8 (24.6-29.4)	22.3 (20.4-23.6)
DO (mg/L)	Surface:	6.1 (5.6-6.6)	6.3 (5.6-7.6)
Salinity (ppt)	Surface:	29.3 (27.9-30.1)	32.0 (30.9-32.9)
Secchi (cm)		58.7 (38.0-91.0)	43.7 (41.0-48.0)

Table 11 (con't). Coastal Bays Fisheries Investigations 2008 water quality data collected during seine sampling. Mean values are reported with the range in parentheses.

Parameter	Location	June	September
		Newport Bay (Sites: S011 and S012)	
Temp (°C)	Surface:	28.1 (27.6-28.5)	24.4 (24.0-24.8)
DO (mg/L)	Surface:	N/A	5.4 (4.0-6.8)
Salinity (ppt)	Surface:	25.9 (22.6-29.1)	32.1 (31.7-32.5)
Secchi (cm)		35.5 (32.0-39.0)	33.5 (26.0-41.0)
		Chincoteague Bay (Sites: S013, S014, S015, S016, S017, S018, S019)	
Temp (°C)	Surface:	25.7 (24.1-27.0)	21.7 (20.9-22.6)
DO (mg/L)	Surface:	5.9 (2.6-9.5)	6.9 (5.9-8.3)
Salinity (ppt)	Surface:	24.2 (0.1-29.9)	28.6 (14.0-32.3)
Secchi (cm)		48.4 (32.0-70.0)	51.6 (20.0-68.0)

Table 11 (con't). Coastal Bays Fisheries Investigations 2007 water quality data collected during trawl sampling. Mean values are reported with the range in parentheses.

Parameter	Location	April	May	June	July	August	September	October
Isle Of Wight Bay (Sites: T006 and T007)								
Temp (°C)	Surface:	16.8 (14.5-19.1)	20.0 (18.3-21.6)	20.1 (19.5-20.6)	26.9 (25.1-28.6)	25.2 (24.4-26.0)	21.4 (20.0-22.8)	20.0 (18.8-21.1)
	Bottom:	13.7 (11.5-15.8)	20.0 (18.2-21.8)	19.6 (19.3-19.8)	26.6 (24.6-28.6)	24.4*	21.5 (20.0-22.9)	19.5 (18.7-20.3)
DO (mg/L)	Surface:	10.1 (8.7-11.5)	6.9 (6.3-7.4)	6.0 (5.8-6.3)	5.3 (5.0-5.7)	5.4*	6.2 (5.6-6.8)	7.2 (6.7-7.8)
	Bottom:	10.0 (6.8-13.2)	5.5 (3.6-7.3)	5.4 (4.2-6.6)	4.8 (4.3-5.3)	5.2*	6.2 (5.6-6.9)	7.0 (6.6-7.5)
Salinity (ppt)	Surface:	20.4 (16.6-24.1)	25.4 (21.8-28.9)	27.9 (25.7-30.1)	30.5 (29.5-31.4)	32.0*	31.4 (31.3-31.4)	31.3 (30.1-32.5)
	Bottom:	27.2 (25.6-28.8)	25.7 (22.4-29.0)	29.1 (28.1-30.1)	30.7 (29.6-31.7)	32.0*	31.4 (31.4-31.4)	31.6 (30.5-32.6)
Secchi (cm)		85.0 (66.0-104.0)	72.0 (44.0-100.0)	62.5 (58.0-67.0)	68.3 (49.5-87.0)	63.0 (49.0-77.0)	36.0*	164.5 (76.0-253.0)
Sinepuxent Bay (Sites: T008, T009, and T010)								
Temp (°C)	Surface:	9.2 (8.5-9.7)	18.1 (14.4-20.1)	25.1 (23.5-26.0)	23.9 (18.3-26.8)	27.1 (23.8-31.7)	24.3 (24.2-24.5)	21.3 (21.1-21.4)
	Bottom:	9.0 (8.4-9.7)	18.1 (14.3-20.1)	25.1 (23.6-26.0)	23.8 (18.3-26.7)	27.1 (23.8-31.7)	24.3 (24.2-24.5)	21.3 (21.2-21.3)
DO (mg/L)	Surface:	9.0 (8.7-9.2)	7.5 (6.6-8.4)	5.8 (4.8-6.4)	5.2 (4.5-5.9)	7.2 (5.4-8.3)	5.9 (5.4-6.2)	6.5 (5.8-7.3)
	Bottom:	8.8 (8.2-9.2)	6.7 (6.2-7.5)	5.3 (4.6-5.8)	5.1 (4.5-5.5)	7.1 (5.2-8.1)	5.9 (5.4-6.3)	6.3 (5.7-7.2)
Salinity (ppt)	Surface:	28.5 (28.0-28.9)	30.6 (30.0-31.0)	29.8 (29.7-30.0)	31.7 (31.0-32.4)	28.5 (25.9-31.6)	32.6 (31.8-34.1)	33.3 (31.8-34.5)
	Bottom:	28.8 (28.7-29.0)	30.7 (30.1-31.0)	30.0 (29.8-30.2)	31.7 (31.1-32.5)	29.7 (25.9-31.6)	32.7 (31.8-34.1)	33.4 (31.8-34.5)
Secchi (cm)		115*	83.8 (49.0-107.0)	37.0 (26.0-50.0)	58.3 (38.0-87.0)	102.3 (73.0-143.0)	93.0 (38.0-145.0)	120.7 (58.0-154.0)

Table 11 (con't). Coastal Bays Fisheries Investigations 2007 water quality data collected during trawl sampling. Mean values are reported with the range in parentheses.

Parameter	Location	April	May	June	July	August	September	October
Newport Bay (Sites: T011 and T012)								
Temp (°C)	Surface:	10.0 (9.5-10.4)	20.3 (20.3-20.3)	25.7 (25.3-26.0)	27.5 (27.4-27.6)	28.1 (27.5-28.6)	20.1 (19.7-20.5)	21.4 (21.3-21.4)
	Bottom:	9.7 (9.5-9.8)	20.1 (19.9-20.2)	23.7 (22.8-24.6)	27.5 (27.4-27.5)	27.6 (27.2-27.9)	20.0 (19.5-20.5)	21.2 (21.1-21.3)
DO (mg/L)	Surface:	9.9 (9.9-9.9)	6.4 (6.2-6.7)	6.5 (6.1-6.9)	5.2 (4.5-6.0)	5.5 (5.5-5.5)	6.7 (6.5-6.8)	5.7 (5.3-6.1)
	Bottom:	9.6 (9.5-9.7)	6.1 (5.8-6.5)	6.0 (5.8-6.2)	5.1 (4.4-5.8)	4.6 (4.0-5.2)	6.5 (6.4-6.6)	5.3 (4.5-6.1)
Salinity (ppt)	Surface:	21.0 (18.3-23.7)	26.4 (25.4-27.3)	28.0 (26.9-29.1)	30.3 (29.8-30.8)	31.9 (31.2-32.6)	33.0 (32.2-33.8)	34.1 (33.4-34.8)
	Bottom:	22.9 (19.2-26.5)	26.5 (25.4-27.5)	28.5 (27.3-29.6)	30.3 (29.8-30.8)	32.1 (31.5-32.6)	33.1 (32.4-33.8)	34.1 (33.4-34.8)
Secchi (cm)		N/A	37.5 (34.0-41.0)	36.5 (32.0-41.0)	32.0 (29.0-35.0)	47.5 (37.0-58.0)	46.0*	54.0 (45.0-63.0)
Chincoteague Bay (Sites: T013, T014, T015, T016, T017, T018, T019 and T020)								
Temp (°C)	Surface:	17.5 (9.3-20.5)	19.9 (18.7-21.1)	26.8 (24.1-29.0)	27.0 (26.0-29.0)	27.6 (26.4-32.8)	24.5 (20.4-35.0)	15.2 (12.2-20.9)
	Bottom:	17.4 (8.9-20.5)	19.6 (18.5-21.1)	26.3 (23.6-27.8)	26.8 (25.4-29.0)	27.7 (26.4-32.8)	24.4 (20.4-35.0)	15.6 (12.5-20.9)
DO (mg/L)	Surface:	7.2 (6.4-9.7)	7.5 (6.8-8.1)	6.2 (5.5-7.0)	6.3 (5.1-7.4)	5.7 (5.2-6.5)	6.1 (5.5-6.8)	7.6 (6.2-9.3)
	Bottom:	7.3 (6.1-9.8)	7.6 (6.9-8.1)	5.8 (4.7-6.7)	6.0 (4.5-7.5)	5.3 (2.7-6.2)	5.9 (4.5-6.9)	7.8 (6.2-9.3)
Salinity (ppt)	Surface:	25.5 (24.0-28.0)	26.9 (26.2-28.1)	30.0 (29.0-30.9)	33.0 (30.5-34.1)	32.2 (26.9-34.3)	33.6 (24.3-36.0)	34.1 (32.0-35.0)
	Bottom:	25.6 (24.6-27.9)	26.8 (26.2-28.0)	30.5 (28.9-32.1)	33.0 (30.4-34.2)	32.7 (26.9-34.3)	33.6 (24.3-36.0)	34.1 (32.2-35.0)
Secchi (cm)		100.3 (39.5-220.0)	38.3 (27.0-44.0)	36.5 (25.0-74.0)	53.7 (33.0-80.0)	52.4 (38.0-87.0)	46.9 (18.0-60.0)	119.3 (44.0-248.0)

* = Only one measurement collected

Table 12. Coastal Bays Fisheries Investigations 2008 water quality data collected during beach seine sampling. Mean values are reported with the range in parentheses.

Parameter	Location	June	September
Assawoman Bay (Sites: S001, S002, and S003)			
Temp (°C)	Surface	24.9 (24.0-25.8)	20.0 (19.9-20.1)
DO (mg/L)	Surface	6.9 (6.8-7.0)	6.6 (5.9-7.5)
Salinity (ppt)	Surface	28.8 (28.3-29.4)	33.3 (32.7-33.5)
Secchi (cm)		50.5 (42.0-56.5)	63.8 (36.0-92.0)
Saint Martins River (Site: S006)			
Temp (°C)	Surface	19.8[A]	20.9[A]
DO (mg/L)	Surface	3.5[A]	9.7[A]
Salinity (ppt)	Surface	29.1[A]	32.7[A]
Secchi (cm)		65.0[A]	0[A]
Isle Of Wight Bay (Sites: S004, S005, and S007)			
Temp (°C)	Surface	23.6 (19.0-26.3)	21.6 (20.1-23.9)
DO (mg/L)	Surface	6.2 (5.7-6.9)	7.1 (6.8-7.7)
Salinity (ppt)	Surface	30.0 (29.9-30.2)	32.2 (32.0-32.4)
Secchi (cm)		58.8 (53.0-68.0)	68.0 (23.0-113.0)

Table 12 (con't). Coastal Bays Fisheries Investigations 2008 water quality data collected during beach seine sampling. Mean values are reported with the range in parentheses.

Parameter	Location	June	September
Sinepuxent Bay (Sites: S008, S009, and S010)			
Temp (°C)	Surface	23.6 (22.6-24.3)	22.5 (20.3-25.1)
DO (mg/L)	Surface	6.0 (5.6-6.4)	7.3 (5.8-8.4)
Salinity (ppt)	Surface	30.5 (30.2-30.7)	31.8 (31.6-32.1)
Secchi (cm)		59.7 (27.0-92.0)	71*
Newport Bay (Sites: S011 and S012)			
Temp (°C)	Surface	25.9 (25.7-26.0)	21.2 (21.0-21.3)
DO (mg/L)	Surface	5.4 (4.1-6.6)	5.6 (5.5-5.8)
Salinity (ppt)	Surface	28.9 (28.8-28.9)	33.7 (33.4-33.9)
Secchi (cm)		29.0 (19.0-39.0)	37.5 (33.0-42.0)
Chincoteague Bay (Sites: S013, S014, S015, S016, S017, S018, S019)			
Temp (°C)	Surface	26.3 (24.3-27.7)	22.9 (20.9-24.4)
DO (mg/L)	Surface	5.5 (1.3-7.5)	6.2 (5.7-6.9)
Salinity (ppt)	Surface	27.8 (12.5-31.3)	31.6 (10.7-35.7)
Secchi (cm)		33.0 (13.0-43.0)	42.2 (34.0-50.0)

A-One site sampled
*-Only one measurement collected

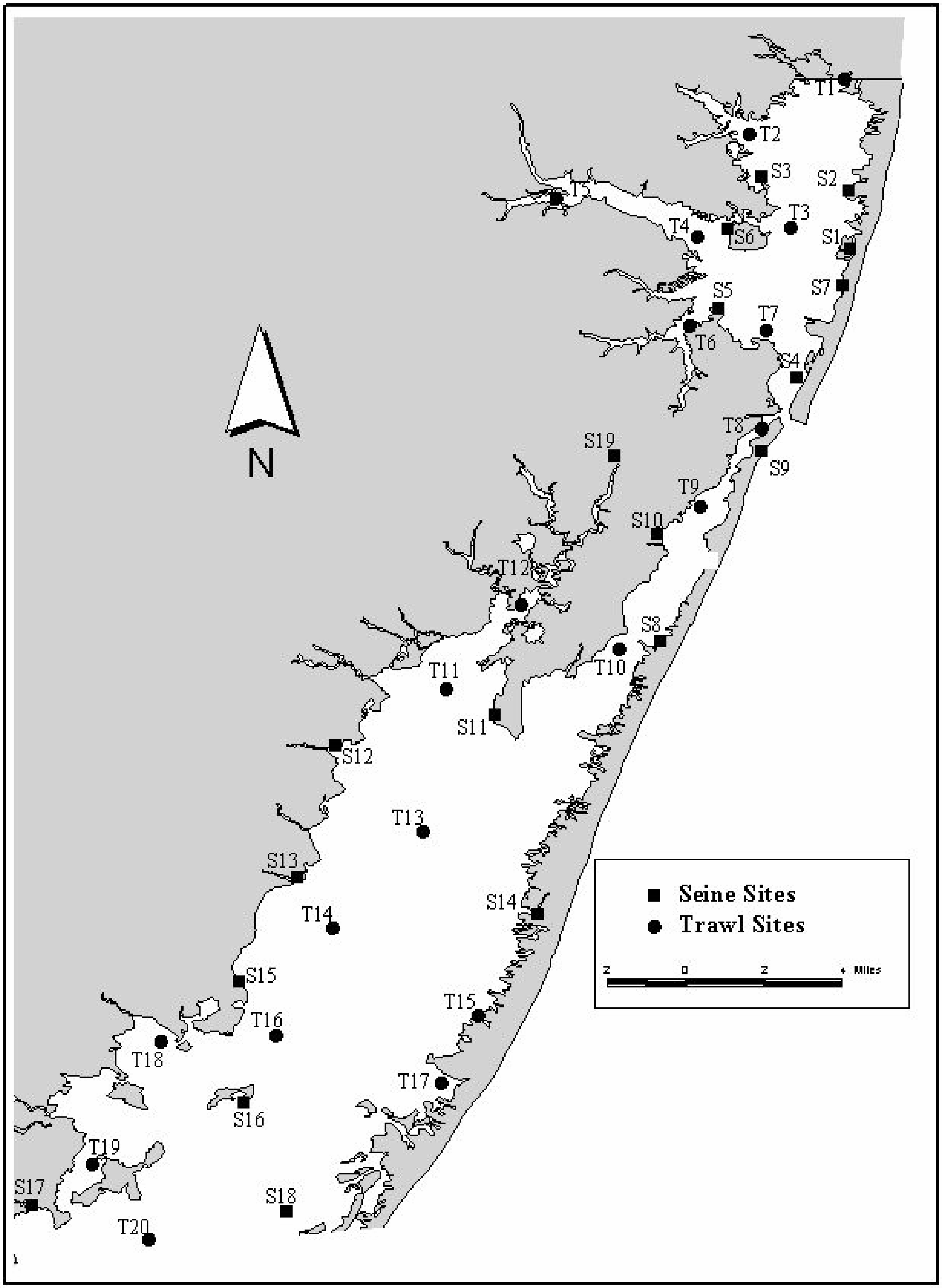


Figure 1. Site locations for the 2008 Coastal Bays Fishery Investigations Trawl and Beach Seine Survey.

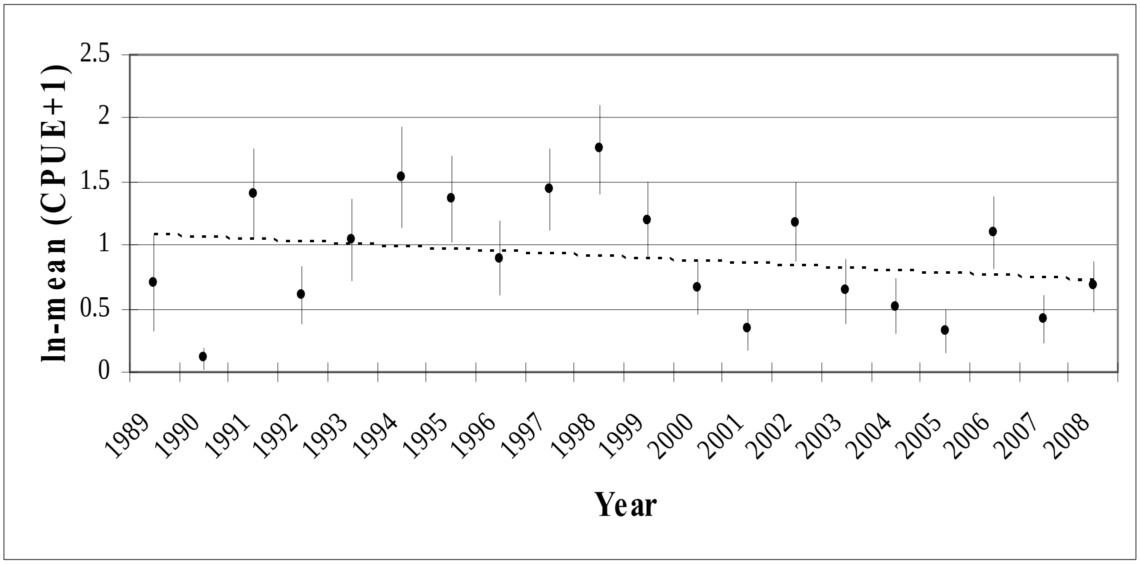


Figure 2. Atlantic croaker (*Micropogonias undulates*) trawl relative abundance (ln-mean CPUE+1) with 95% confidence intervals (1989–2008). Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=140/year).

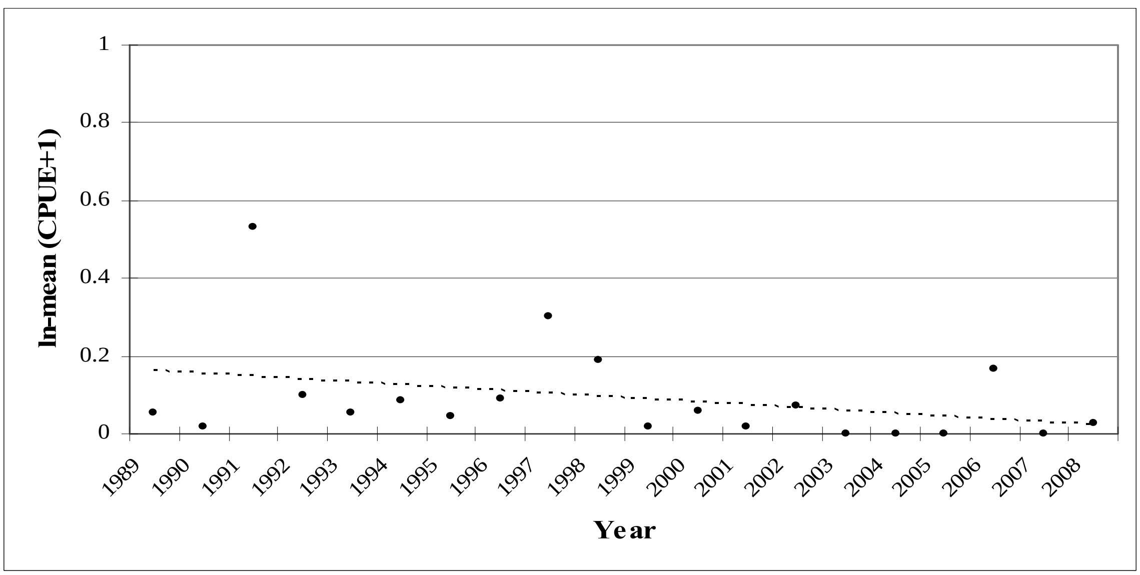


Figure 3. Atlantic croaker (*Micropogonias undulates*) beach seine relative abundance (ln-mean CPUE+1) (1989-2008). Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=38/year).

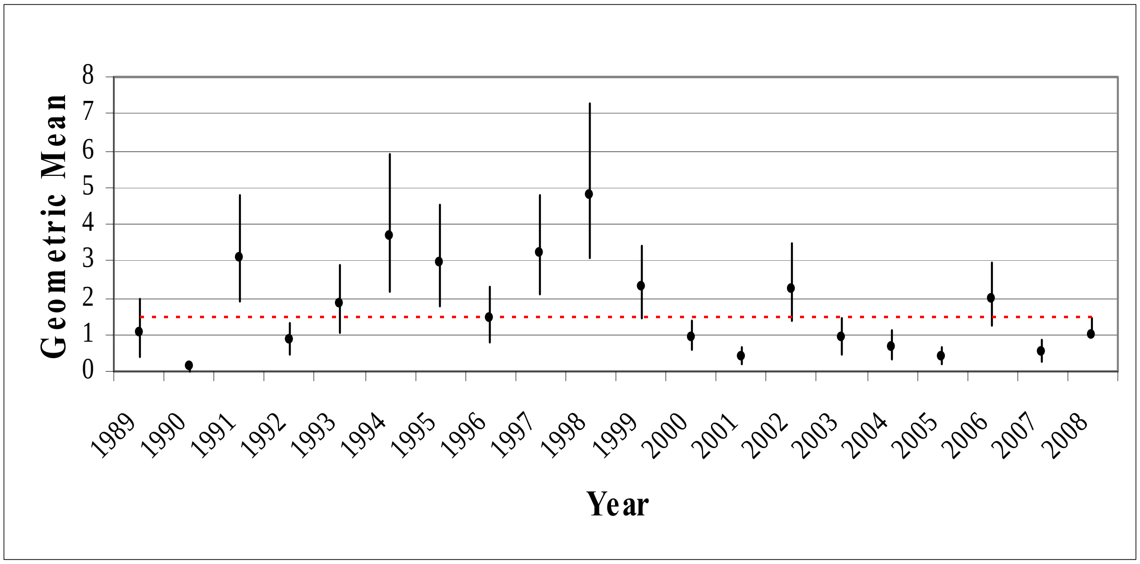


Figure 4. Atlantic croaker (*Micropogonias undulates*) trawl index of relative abundance (geometric mean) with 95% confidence intervals (1989-2008). Solid line represents the 1989-2008 time series grand mean. Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=140/year).

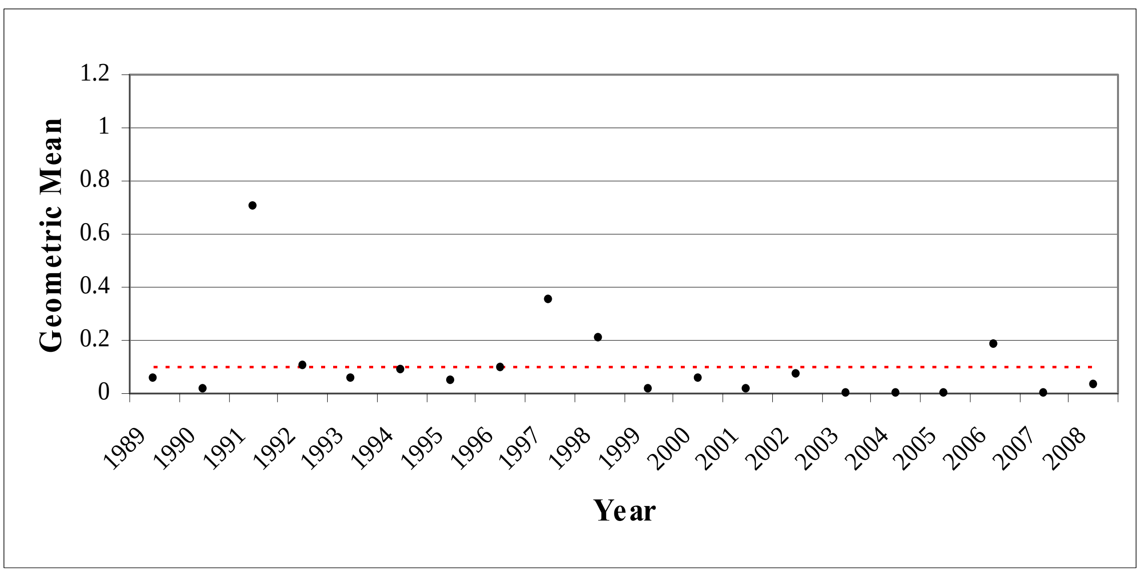


Figure 5. Atlantic croaker (*Micropogonias undulates*) beach seine index of relative abundance (geometric mean) (1989-2008). Solid line represents the 1989-2008 time series grand mean. Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=38/year).

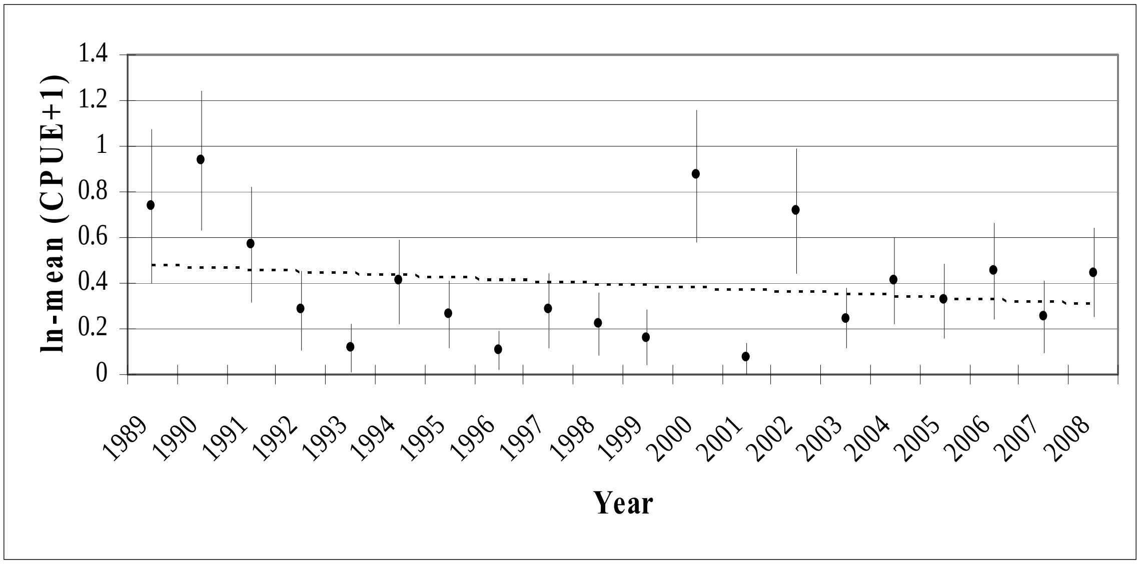


Figure 6. Atlantic menhaden (*Brevoortia tyrannus*) trawl relative abundance (ln-mean CPUE+1) with 95% confidence intervals (1989–2008). Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=140/year).

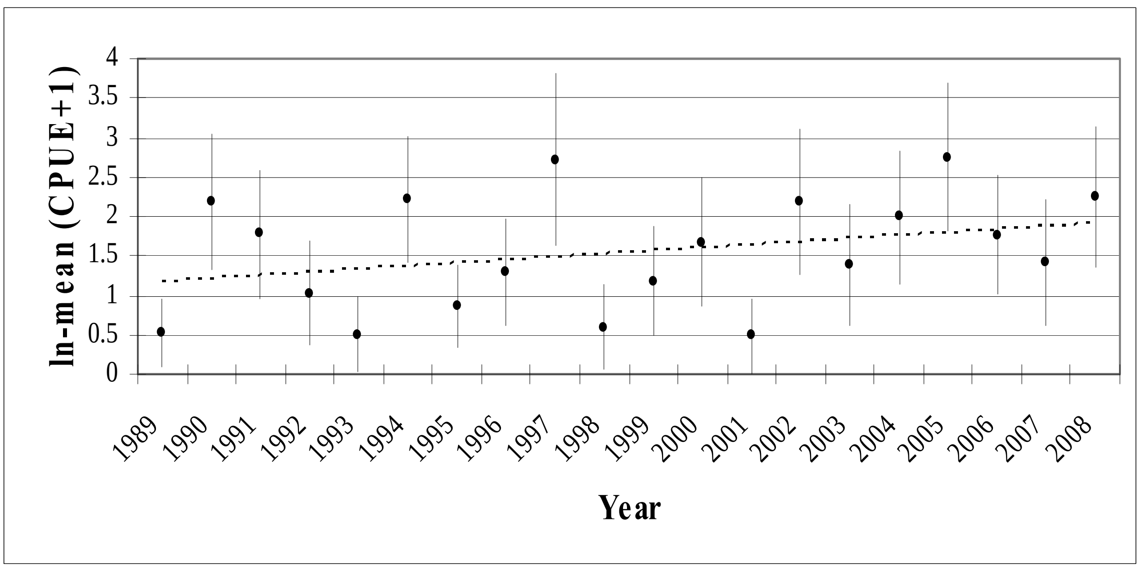


Figure 7. Atlantic menhaden (*Brevoortia tyrannus*) beach seine relative abundance (ln-mean CPUE+1) with 95% confidence intervals (1989-2008). Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=38/year).

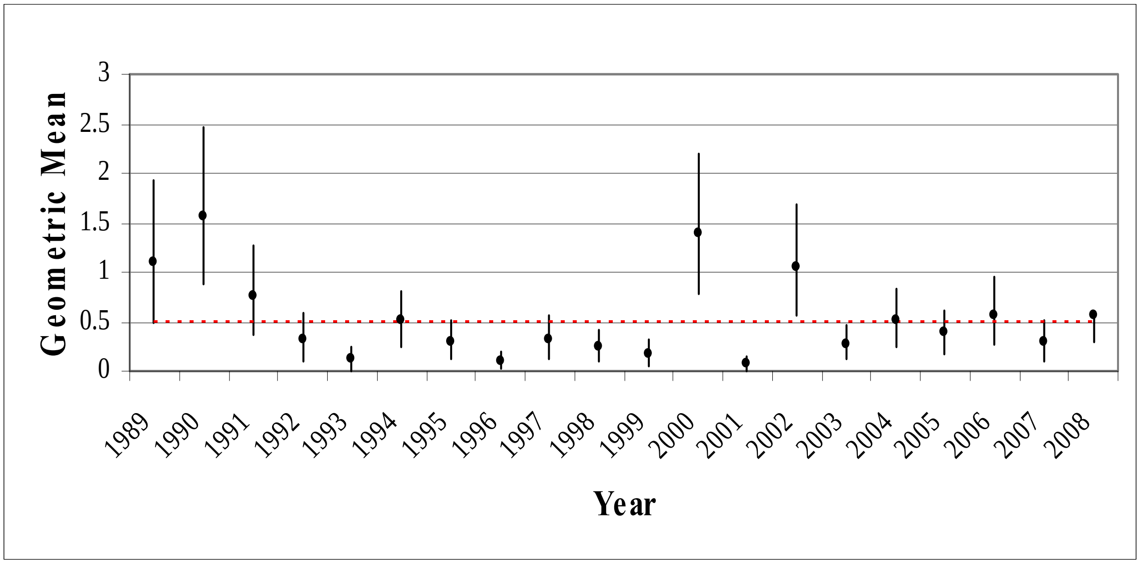


Figure 8. Atlantic menhaden (*Brevoortia tyrannus*) trawl index of relative abundance (geometric mean) with 95% confidence intervals (1989-2008). Solid line represents the 1989-2008 time series grand mean. Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=140/year).

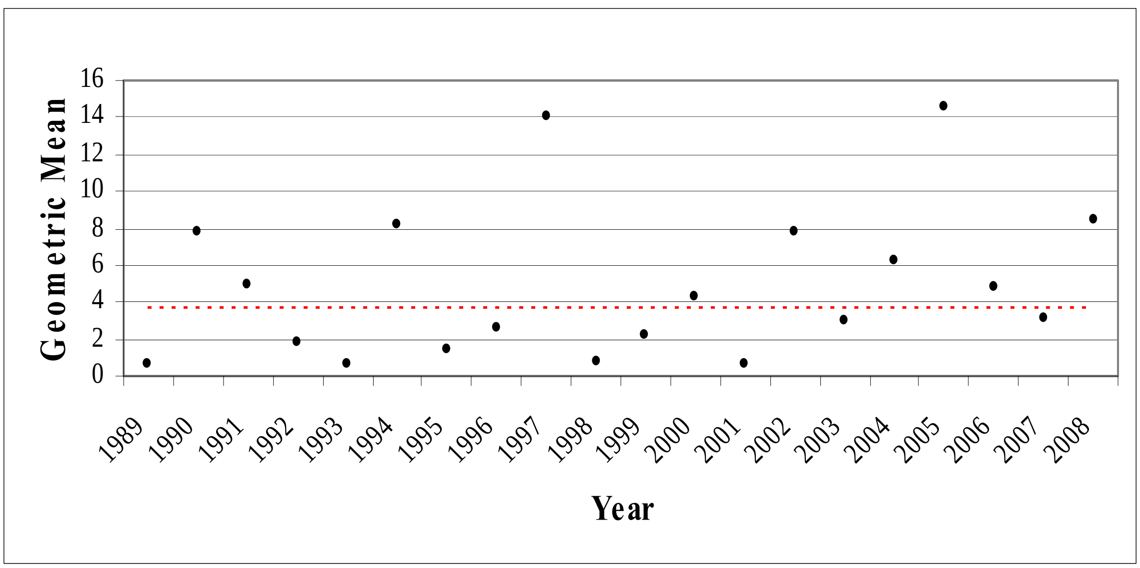


Figure 9. Atlantic menhaden (*Brevoortia tyrannus*) beach seine index of relative abundance (geometric mean) (1989-2008). Solid line represents the 1989-2008 time series grand mean. Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=38/year).

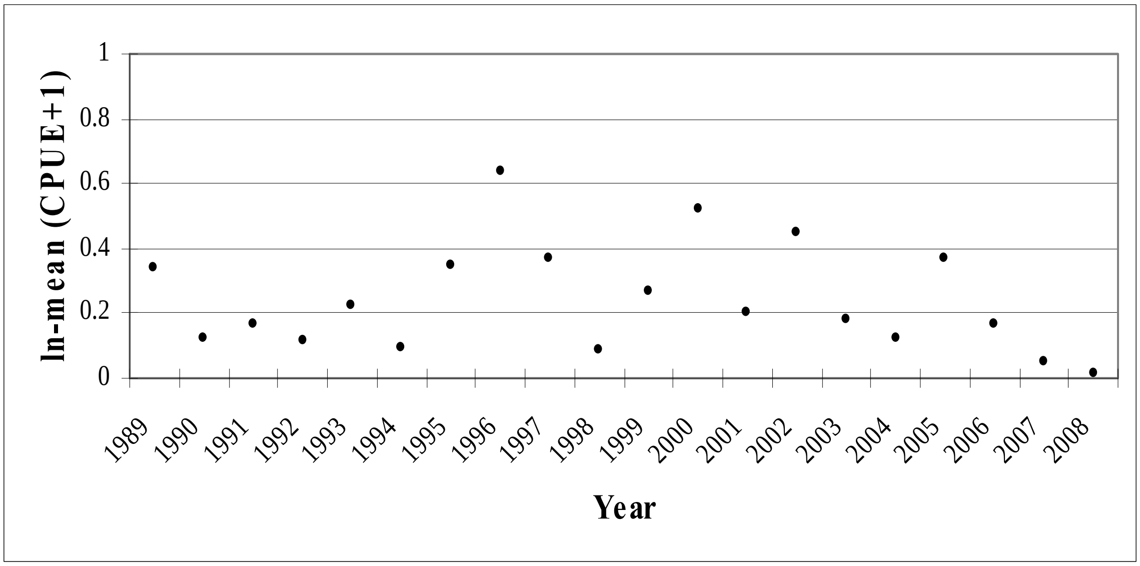


Figure 10. Atlantic silverside (*Menidia menidia*) trawl relative abundance (ln-mean CPUE+1) (1989–2008). Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=140/year).

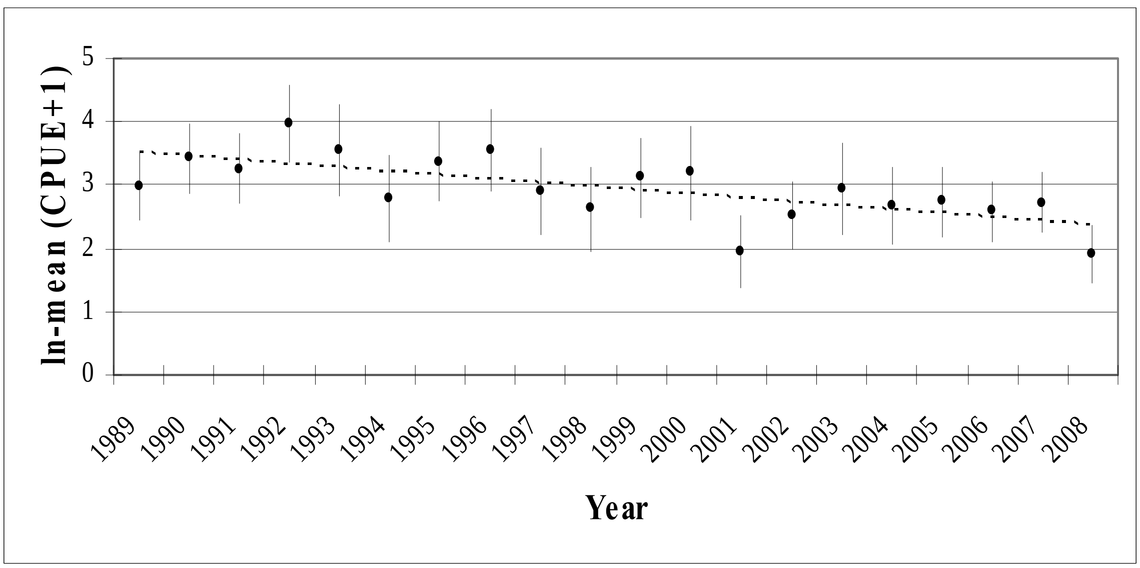


Figure 11. Atlantic silverside (*Menidia menidia*) beach seine relative abundance (ln-mean CPUE+1) with 95% confidence intervals (1989-2008). Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=38/year).

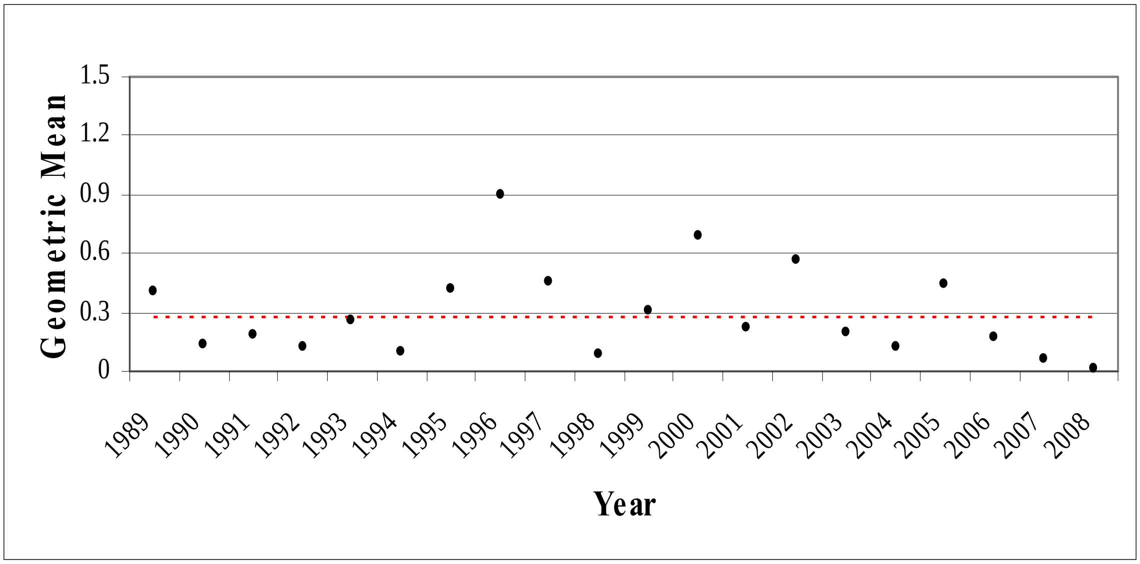


Figure 12. Atlantic silverside (*Menidia menidia*) trawl index of relative abundance (geometric mean) (1989-2008). Solid line represents the 1989-2008 time series grand mean. Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=140/year).

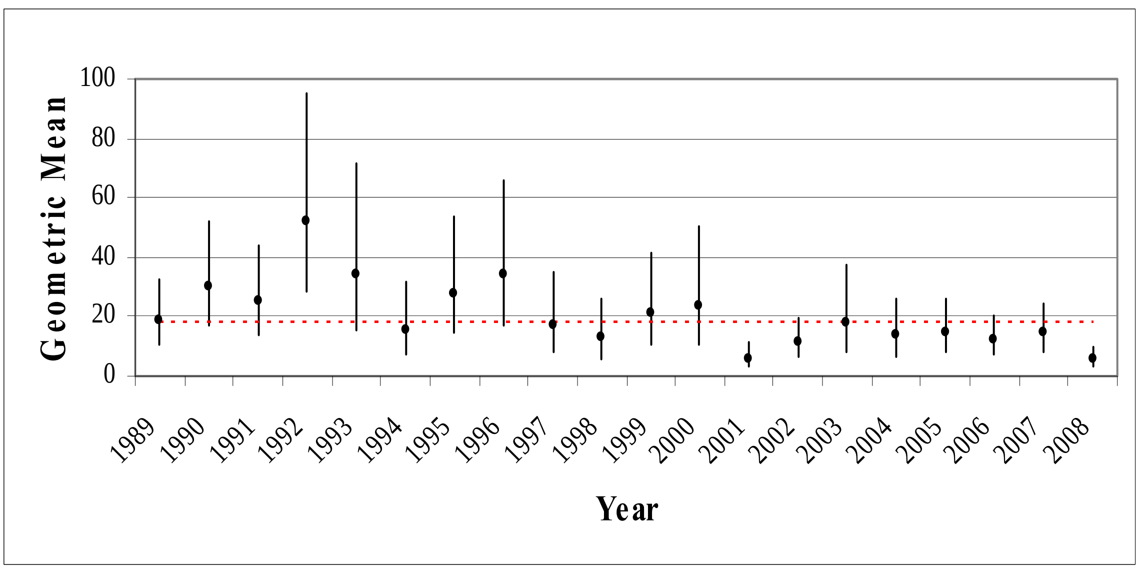


Figure 13. Atlantic silverside (*Menidia menidia*) beach seine index of relative abundance (geometric mean) with 95% confidence intervals (1989-2008). Solid line represents the 1989-2008 time series grand mean. Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=38/year).

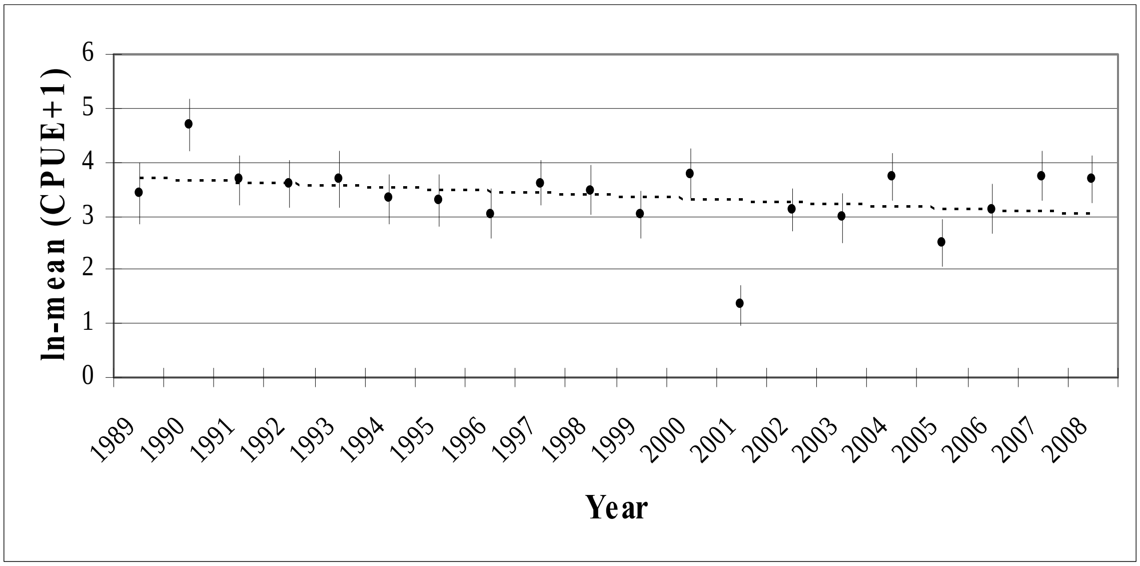


Figure 14. Bay anchovy trawl (*Anchoa mitchilli*) relative abundance (ln-mean CPUE+1) with 95% confidence intervals (1989–2008). Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=140/year).

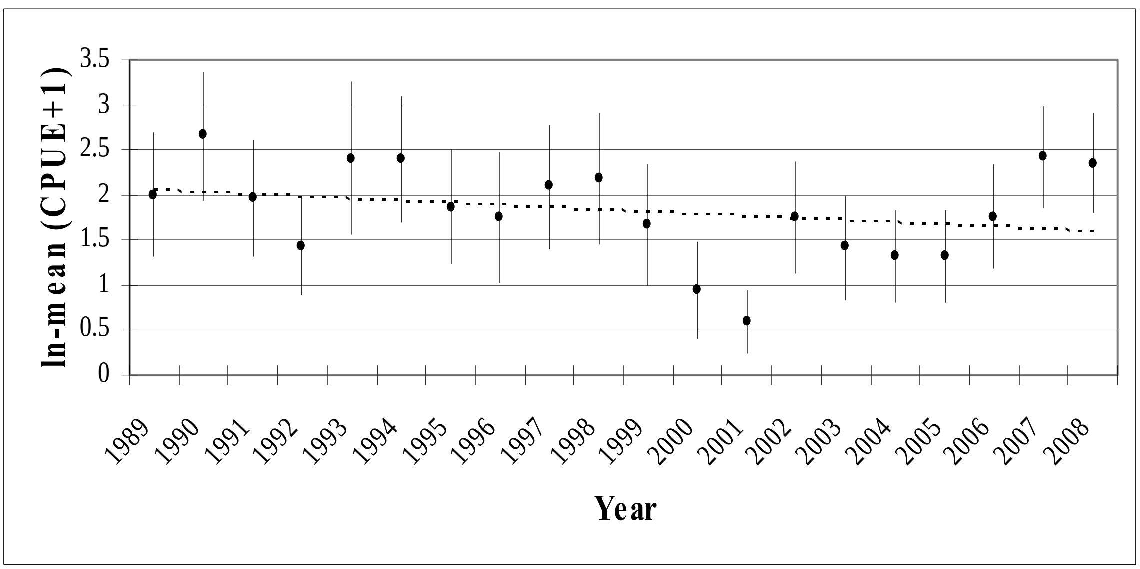


Figure 15. Bay anchovy (*Anchoa mitchilli*) beach seine relative abundance (ln-mean CPUE+1) with 95% confidence intervals (1989-2008). Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=38/year).

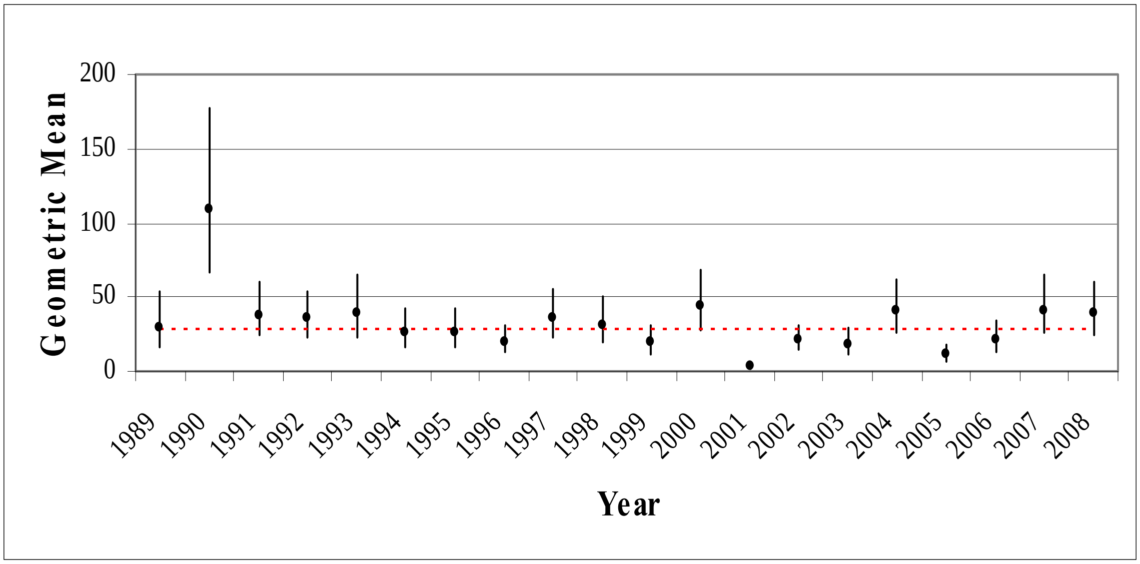


Figure 16. Bay anchovy (*Anchoa mitchilli*) trawl index of relative abundance (geometric mean) with 95% confidence intervals (1989-2008). Solid line represents the 1989-2008 time series grand mean. Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=140/year).

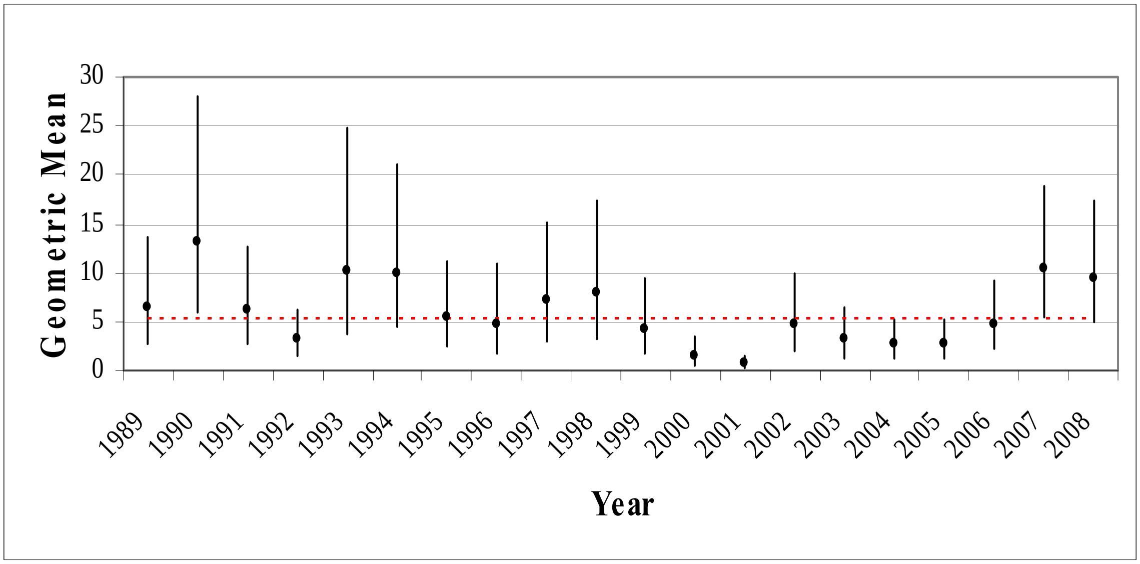


Figure 17. Bay anchovy (*Anchoa mitchilli*) beach seine index of relative abundance (geometric mean) with 95% confidence intervals (1989-2008). Solid line represents the 1989-2008 time series grand mean. Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=38/year).

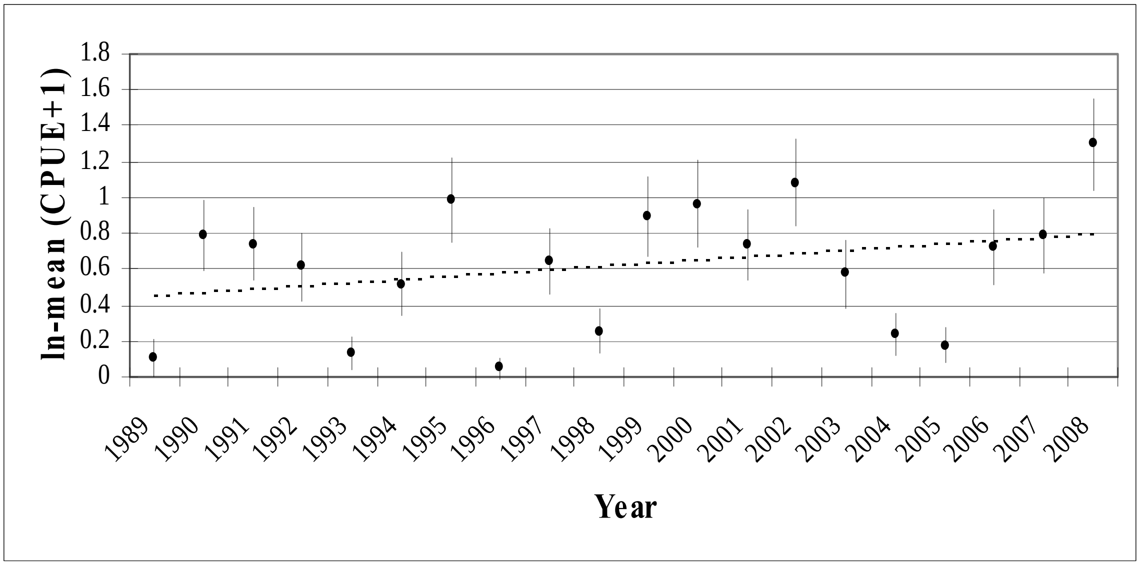


Figure 18. Black sea bass (*Centropristis striata*) trawl relative abundance (ln-mean CPUE+1) with 95% confidence intervals (1989-2008). Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=140/year).

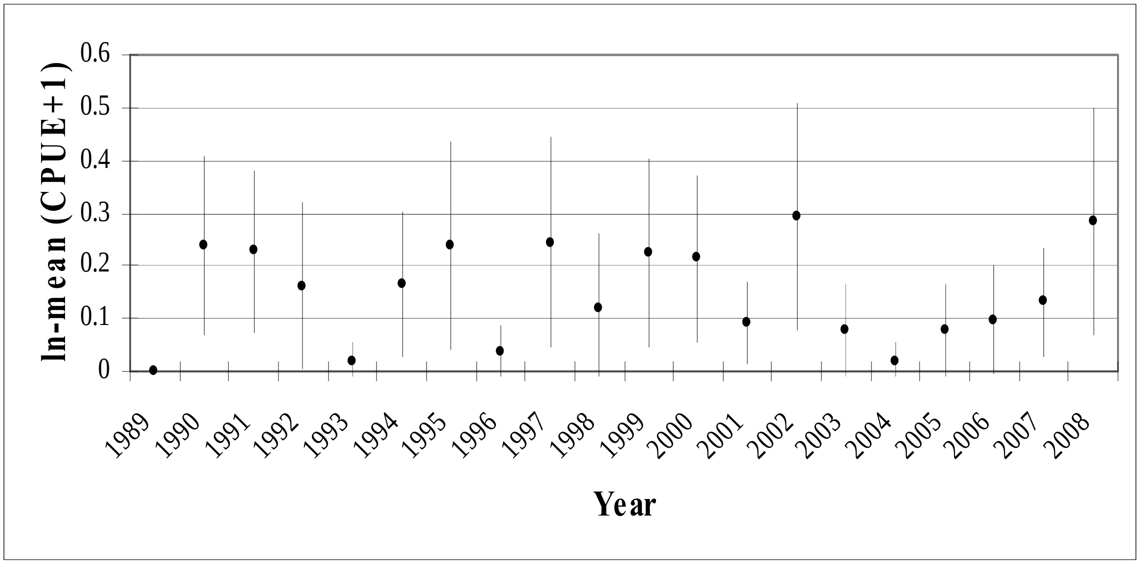


Figure 19. Black sea bass (*Centropristis striata*) beach seine relative abundance (ln-mean CPUE+1) with 95% confidence intervals (1989-2008). Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=38/year).

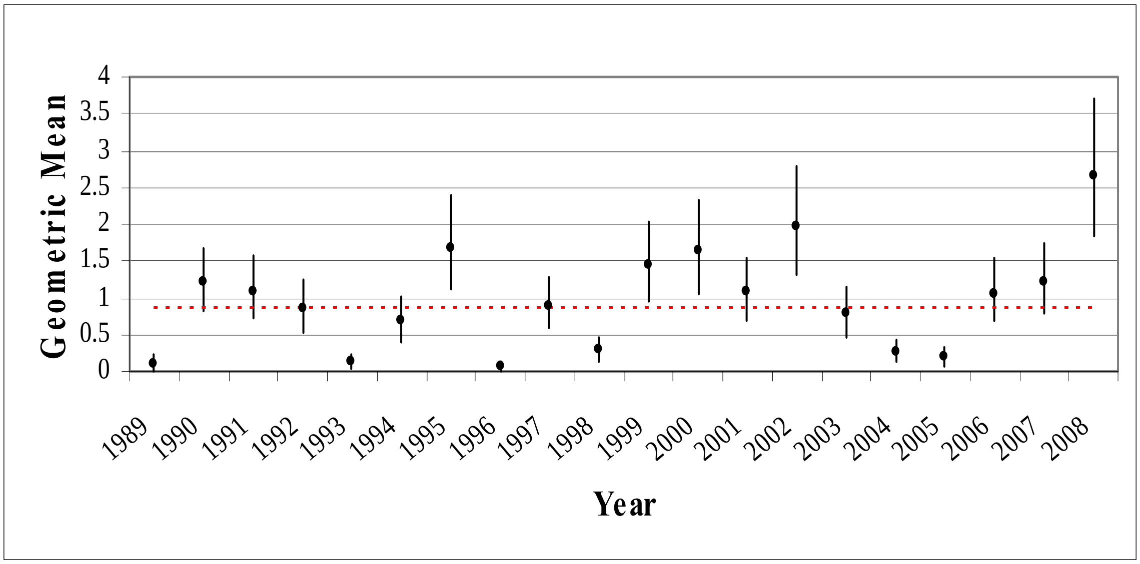


Figure 20. Black sea bass (*Centropristis striata*) trawl index of relative abundance (geometric mean) with 95% confidence intervals (1989-2008). Solid line represents the 1989-2008 time series grand mean. Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=140/year).

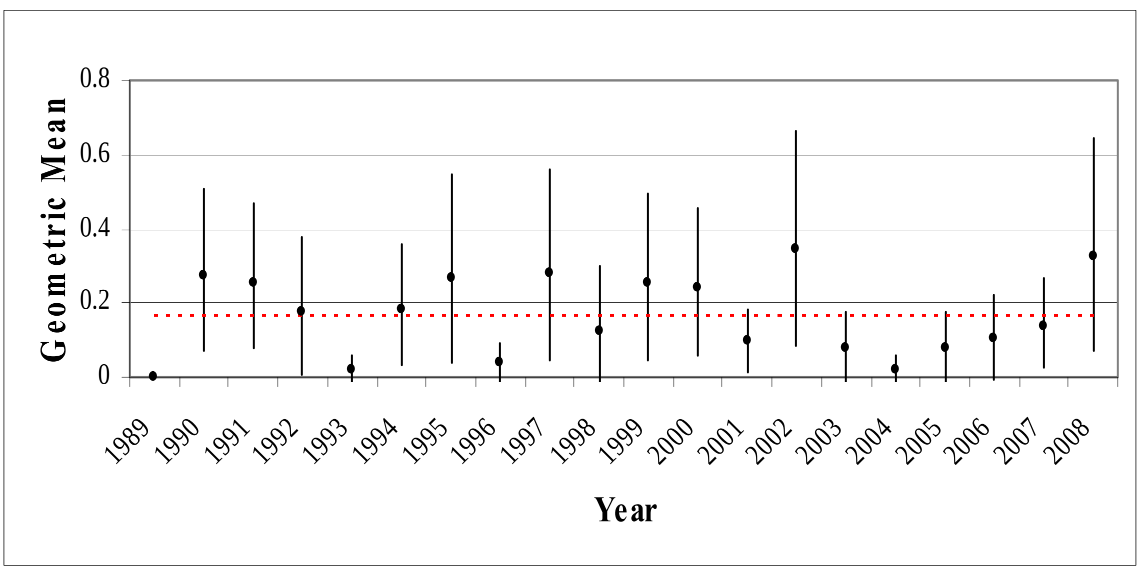


Figure 21. Black sea bass (*Centropristis striata*) beach seine index of relative abundance (geometric mean) with 95% confidence intervals (1989-2008). Solid line represents the 1989-2008 time series grand mean. Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=38/year).

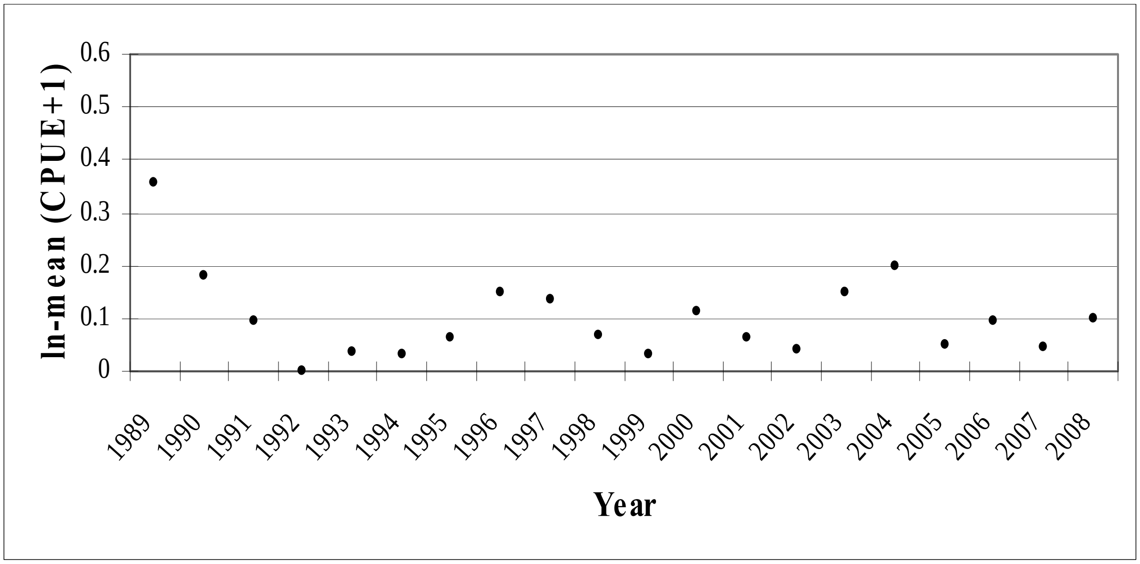


Figure 22. Bluefish (*Pomatomus saltatrix*) trawl relative abundance (ln-mean CPUE+1) (1989–2008). Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=140/year).

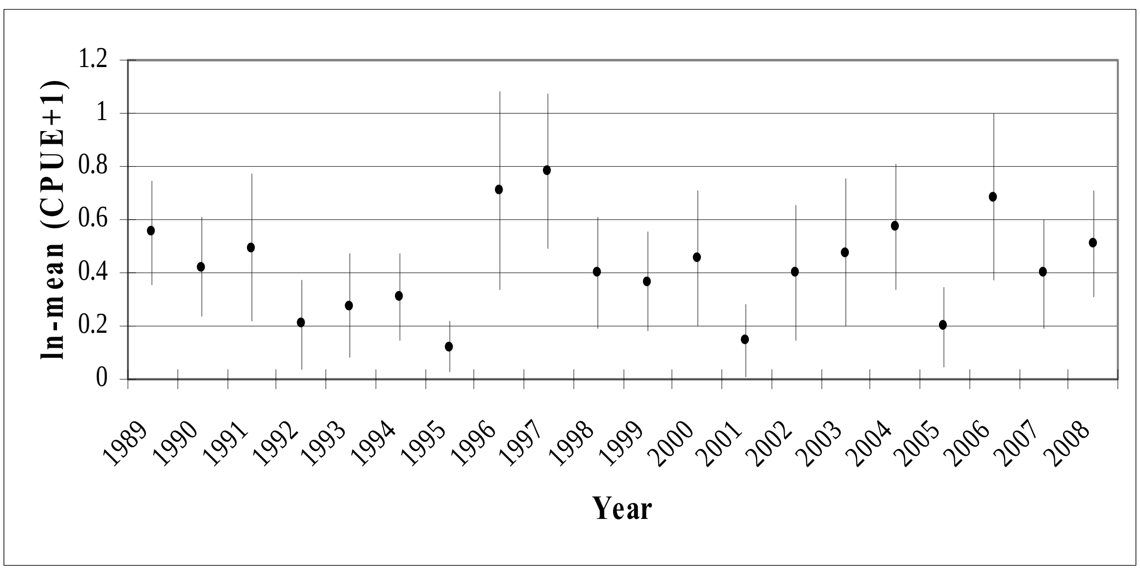


Figure 23. Bluefish (*Pomatomus saltatrix*) beach seine relative abundance (ln-mean CPUE+1) with 95% confidence intervals (1989-2008). Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=38/year).

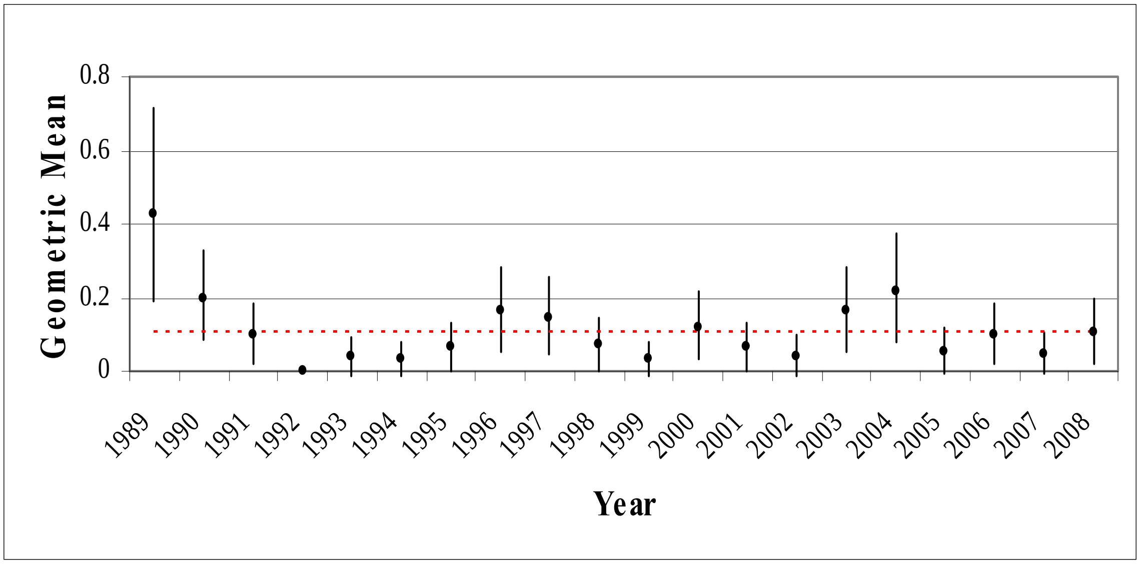


Figure 24. Bluefish (*Pomatomus saltatrix*) trawl index of relative abundance (geometric mean) with 95% confidence intervals (1989-2008). Solid line represents the 1989-2008 time series grand mean. Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=140/year).

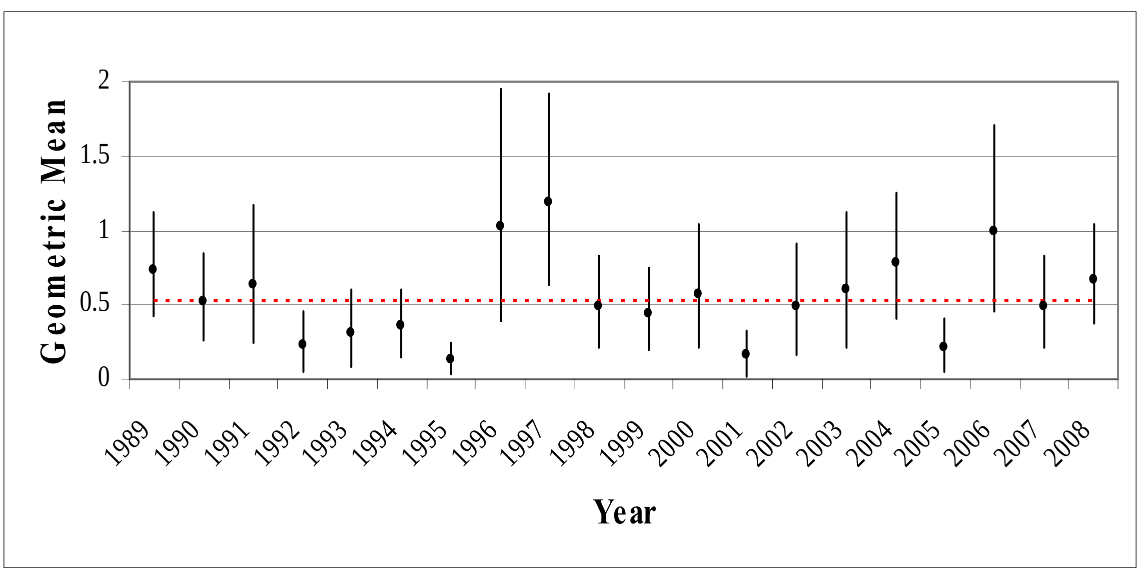


Figure 25. Bluefish (*Pomatomus saltatrix*) beach seine index of relative abundance (geometric mean) with 95% confidence intervals (1989-2008). Solid line represents the 1989-2008 time series grand mean. Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=38/year).

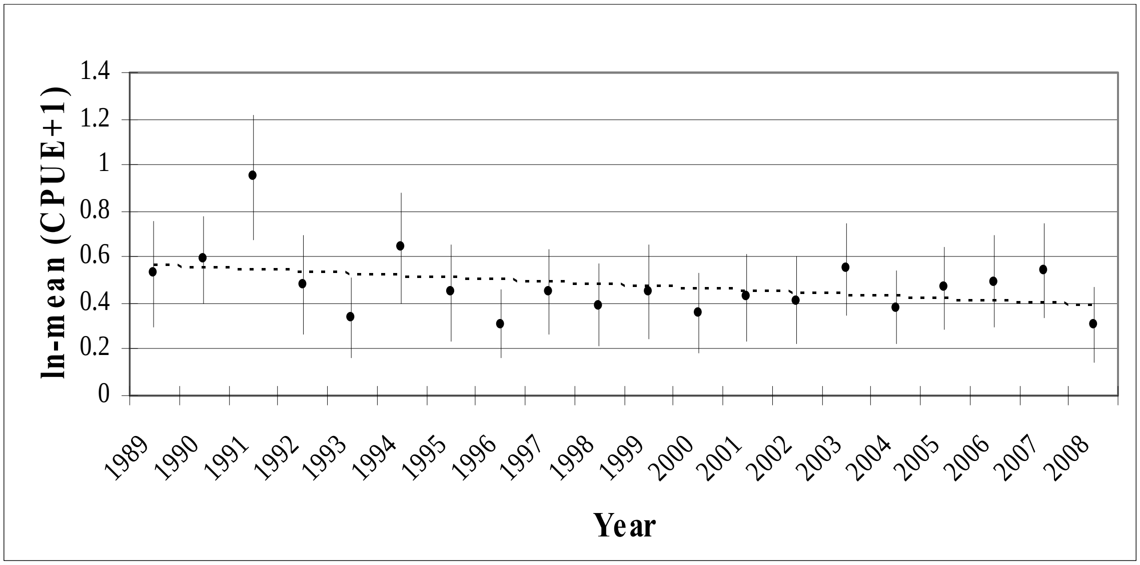


Figure 26. Hogchoker (*Trinectes maculatus*) trawl relative abundance (ln-mean CPUE+1) with 95% confidence intervals (1989–2008). Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=140/year).

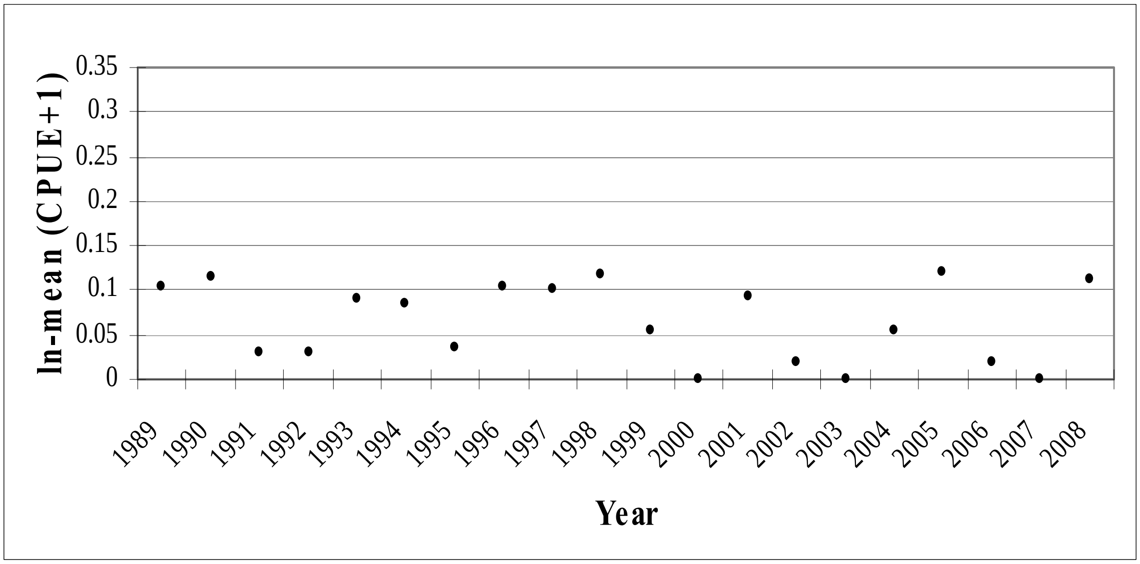


Figure 27. Hogchoker (*Trinectes maculatus*) beach seine relative abundance (ln-mean CPUE+1) (1989-2008). Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=38/year).

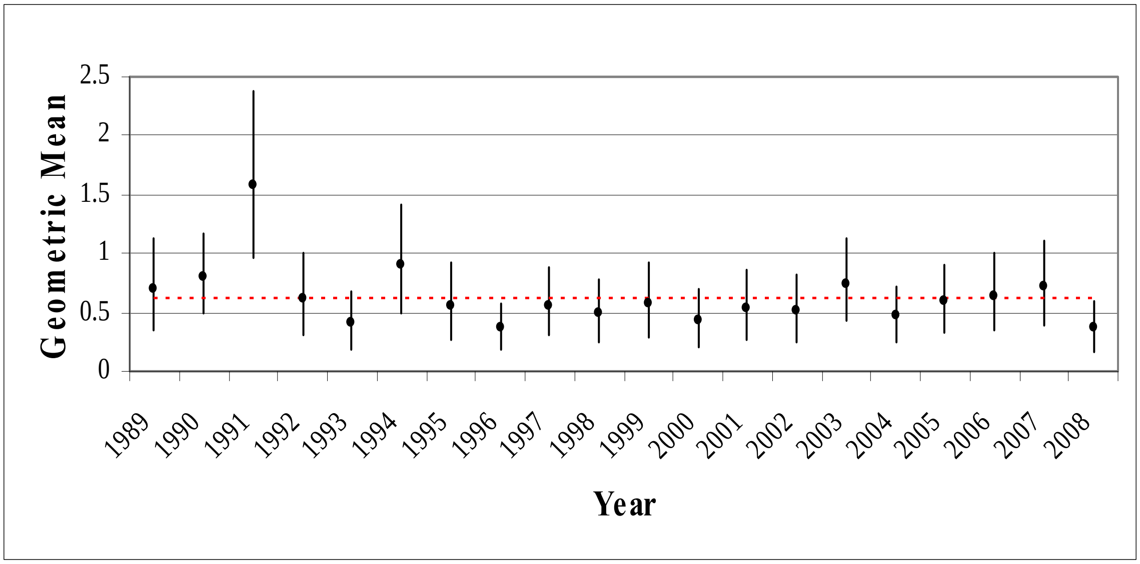


Figure 28. Hogchoker (*Trinectes maculatus*) trawl index of relative abundance (geometric mean) with 95% confidence intervals (1989-2008). Solid line represents the 1989-2008 time series grand mean. Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=140/year).

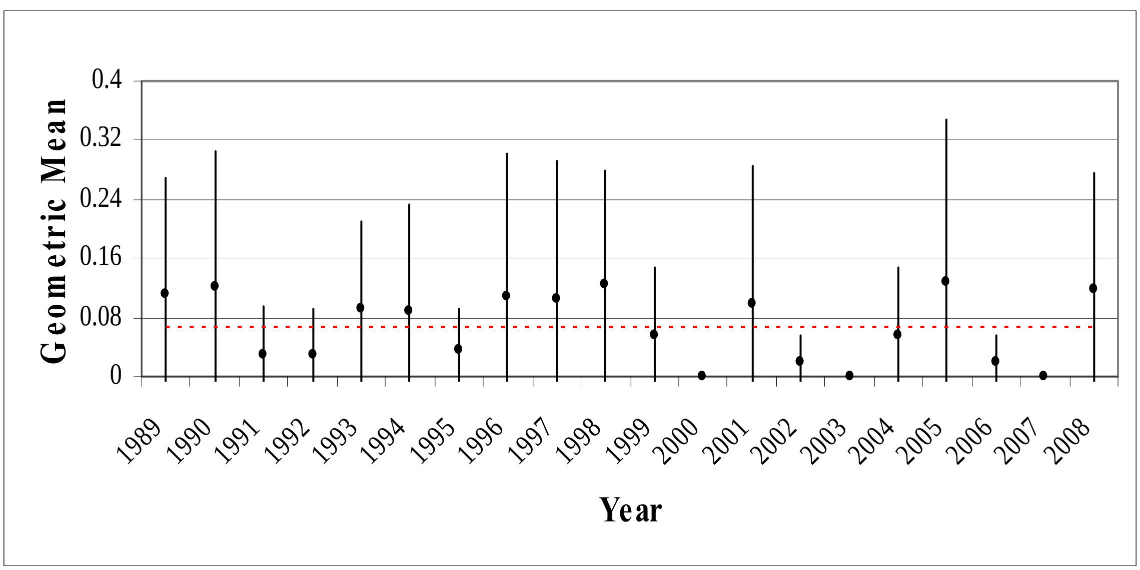


Figure 29. Hogchoker (*Trinectes maculatus*) beach seine index of relative abundance (geometric mean) with 95% confidence intervals (1989-2008). Solid line represents the 1989-2008 time series grand mean. Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=38/year).

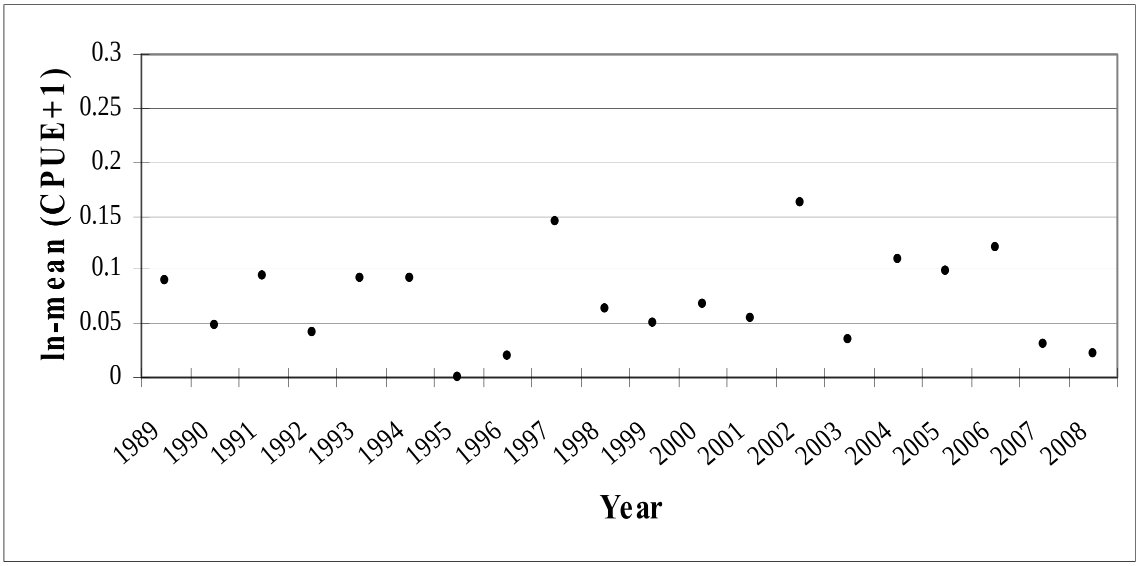


Figure 30. Mummichog (*Fundulus heteroclitus*) trawl relative abundance (ln-mean CPUE+1) (1989–2008). Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=140/year).

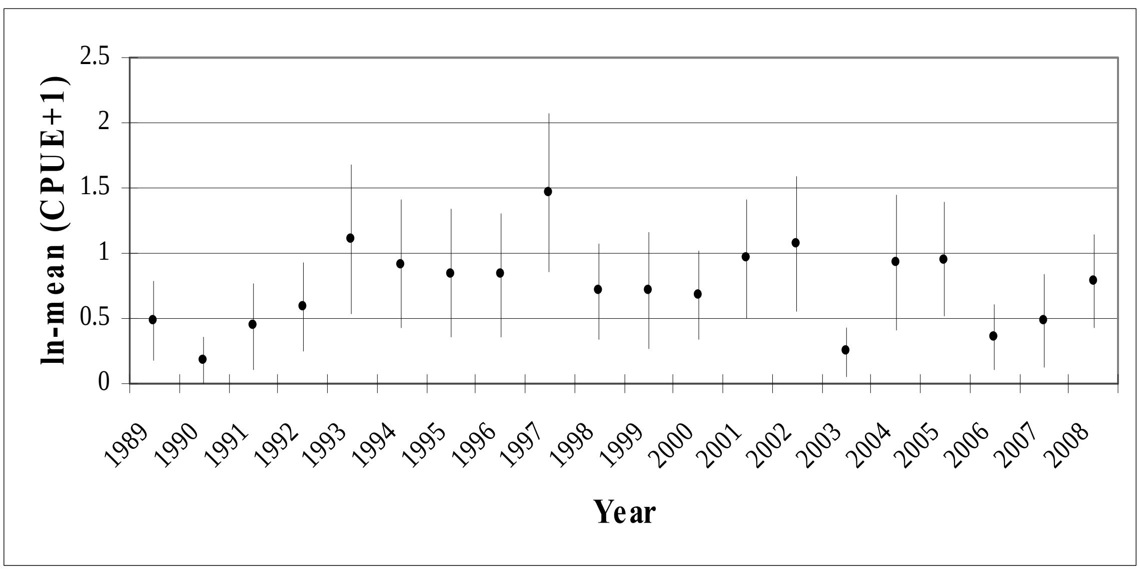


Figure 31. Mummichog (*Fundulus heteroclitus*) beach seine relative abundance (ln-mean CPUE+1) with 95% confidence intervals (1989-2008). Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=38/year).

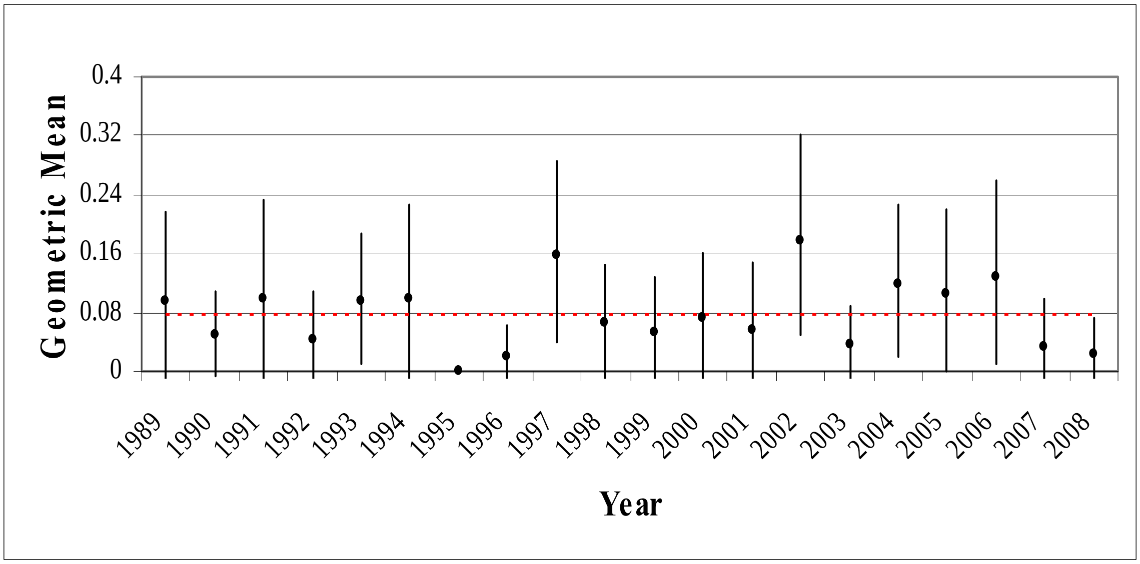


Figure 32. Mummichog (*Fundulus heteroclitus*) trawl index of relative abundance (geometric mean) with 95% confidence intervals (1989-2008). Solid line represents the 1989-2008 time series grand mean. Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=140/year).

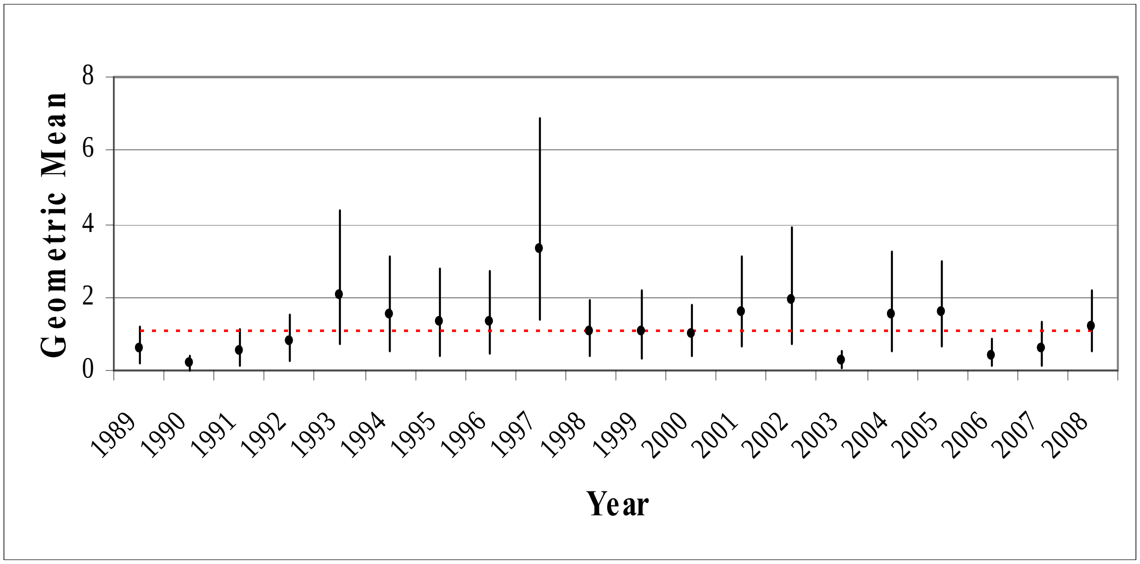


Figure 33. Mummichog (*Fundulus heteroclitus*) beach seine index of relative abundance (geometric mean) with 95% confidence intervals (1989-2008). Solid line represents the 1989-2008 time series grand mean. Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=38/year).

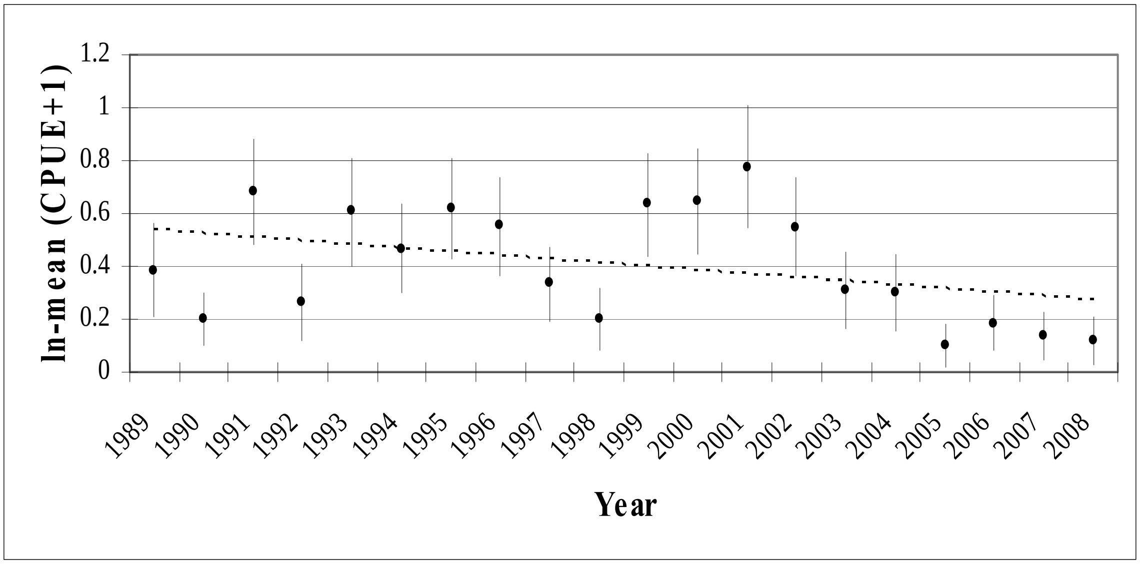


Figure 34. Northern puffer (*Sphoeroides maculatus*) trawl relative abundance (ln-mean CPUE+1) with 95% confidence intervals (1989–2008). Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=140/year).

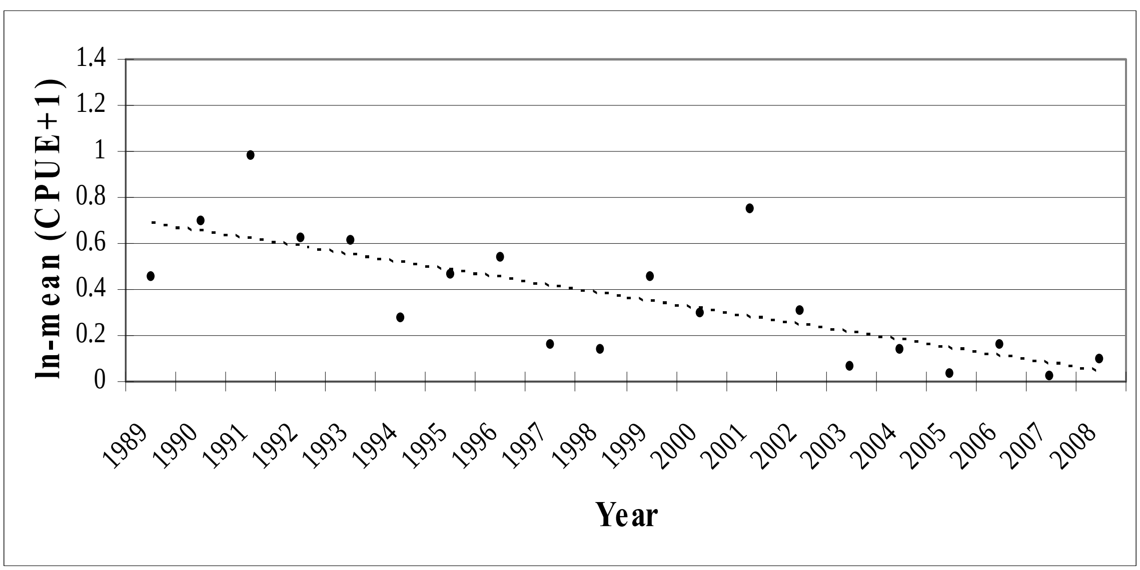


Figure 35. Northern puffer (*Sphoeroides maculatus*) beach seine relative abundance (ln-mean CPUE+1) (1989-2008). Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=38/year).

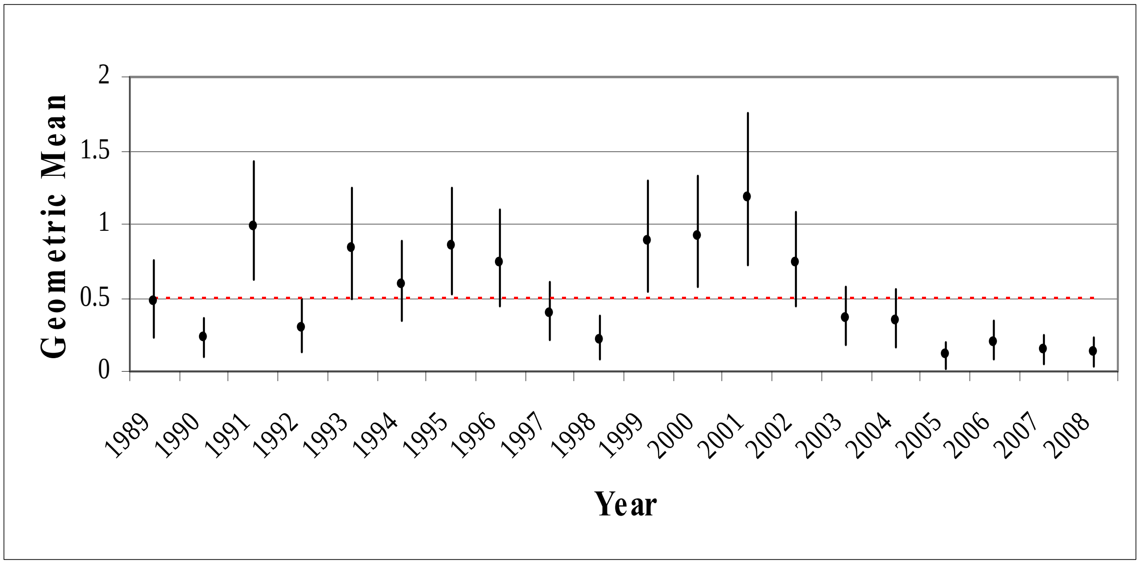


Figure 36. Northern puffer (*Sphoeroides maculatus*) trawl index of relative abundance (geometric mean) with 95% confidence intervals (1989-2008). Solid line represents the 1989-2008 time series grand mean. Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=140/year).

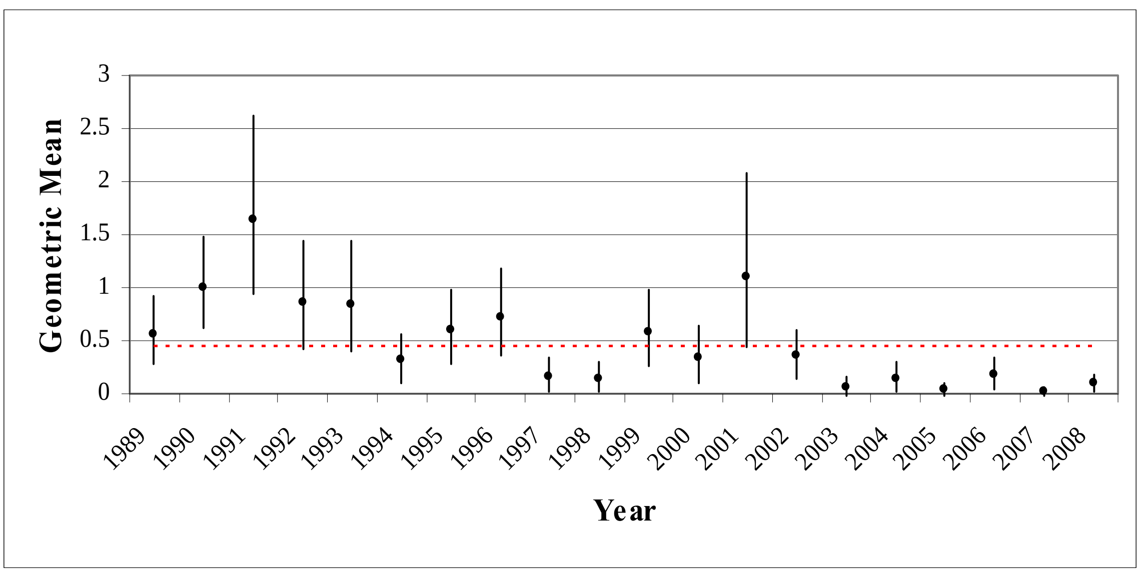


Figure 37. Northern puffer (*Sphoeroides maculatus*) beach seine index of relative abundance (geometric mean) with 95% confidence intervals (1989-2008). Solid line represents the 1989-2008 time series grand mean. Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=38/year).

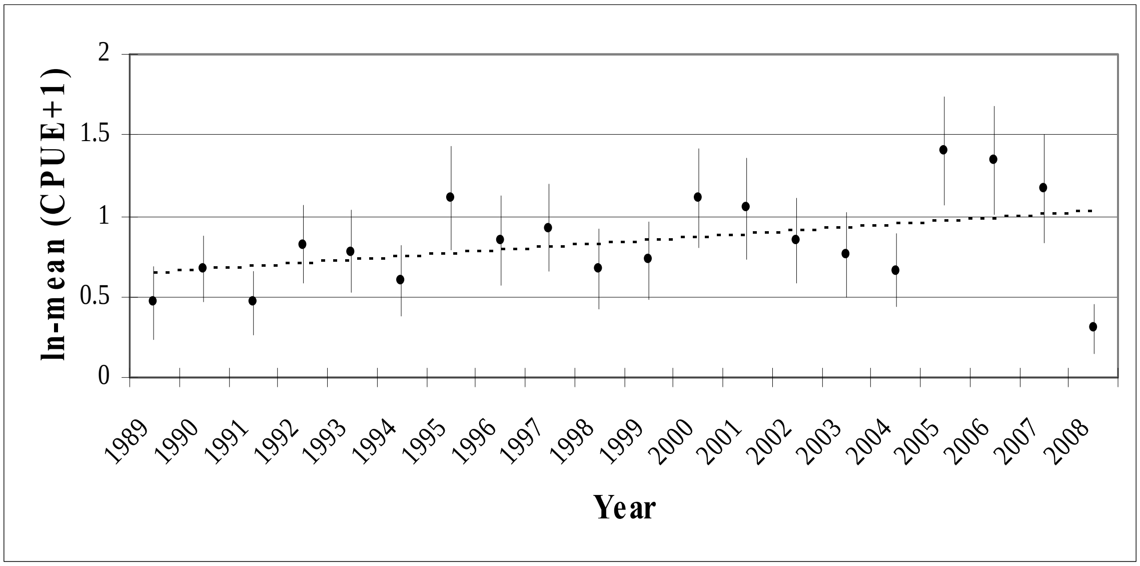


Figure 38. Silver perch (*Bairdiella chrysoura*) trawl relative abundance (ln-mean CPUE+1) with 95% confidence intervals (1989–2008). Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=140/year).

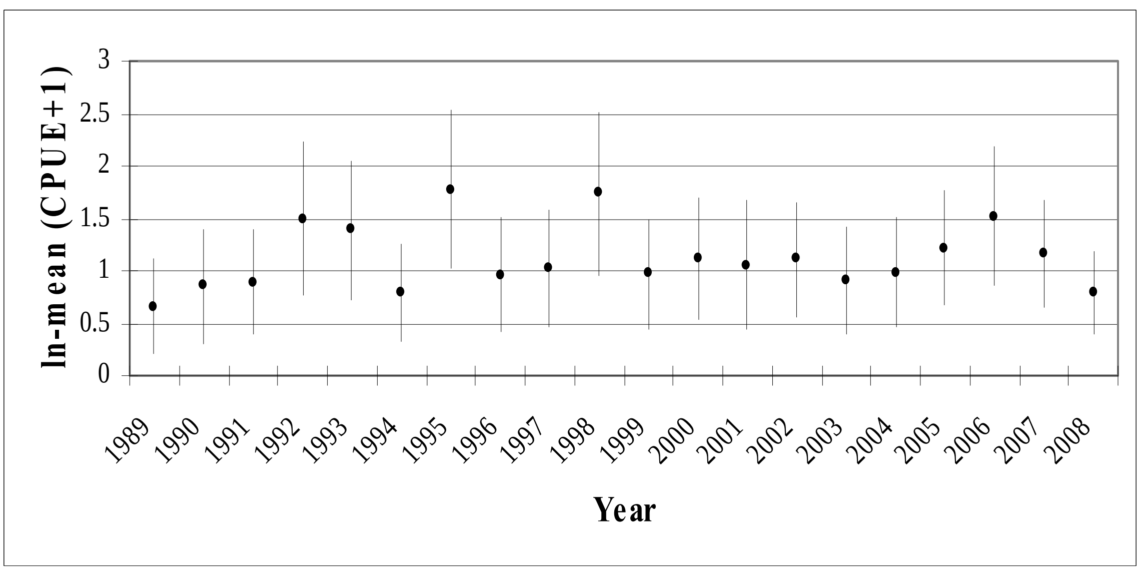


Figure 39. Silver perch (*Bairdiella chrysoura*) beach seine relative abundance (ln-mean CPUE+1) with 95% confidence intervals (1989-2008). Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=38/year).

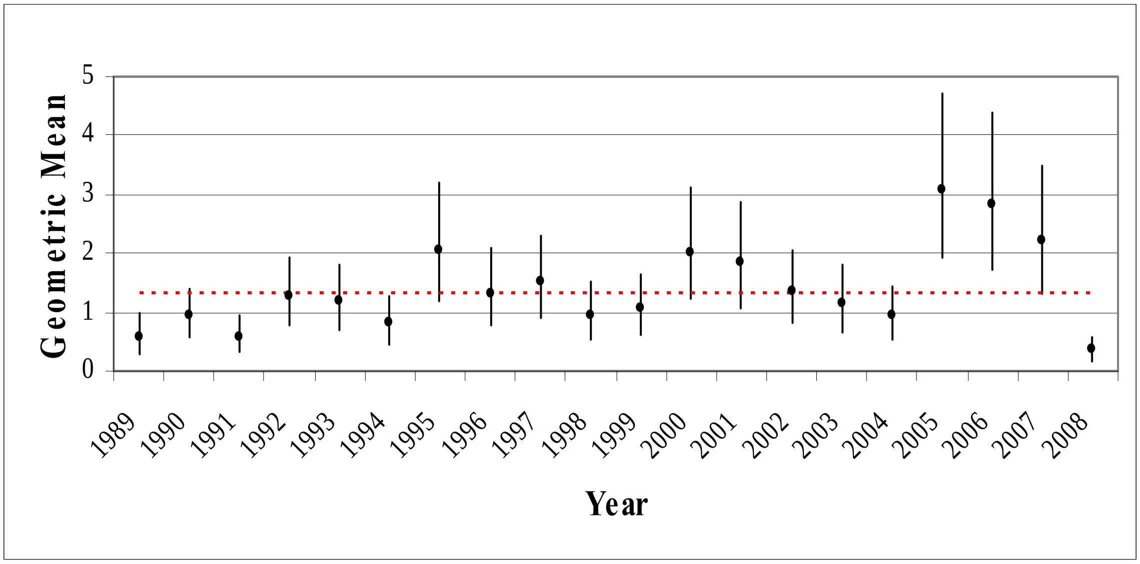


Figure 40. Silver perch (*Bairdiella chrysoura*) trawl index of relative abundance (geometric mean) with 95% confidence intervals (1989-2008). Solid line represents the 1989-2008 time series grand mean. Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=140/year).

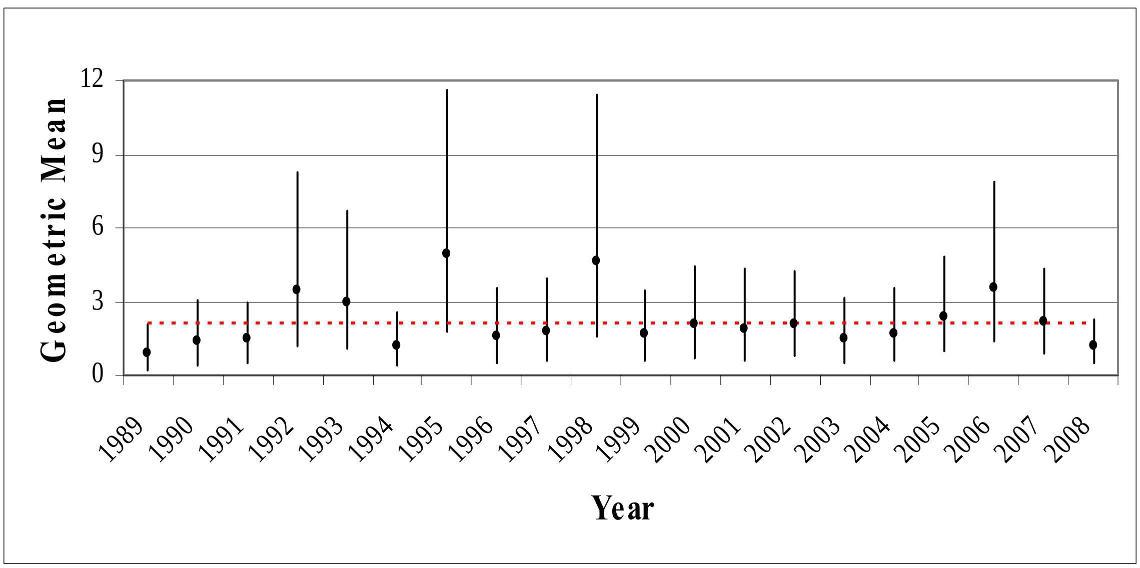


Figure 41. Silver perch (*Bairdiella chrysoura*) beach seine index of relative abundance (geometric mean) with 95% confidence intervals (1989-2008). Solid line represents the 1989-2008 time series grand mean. Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=38/year).

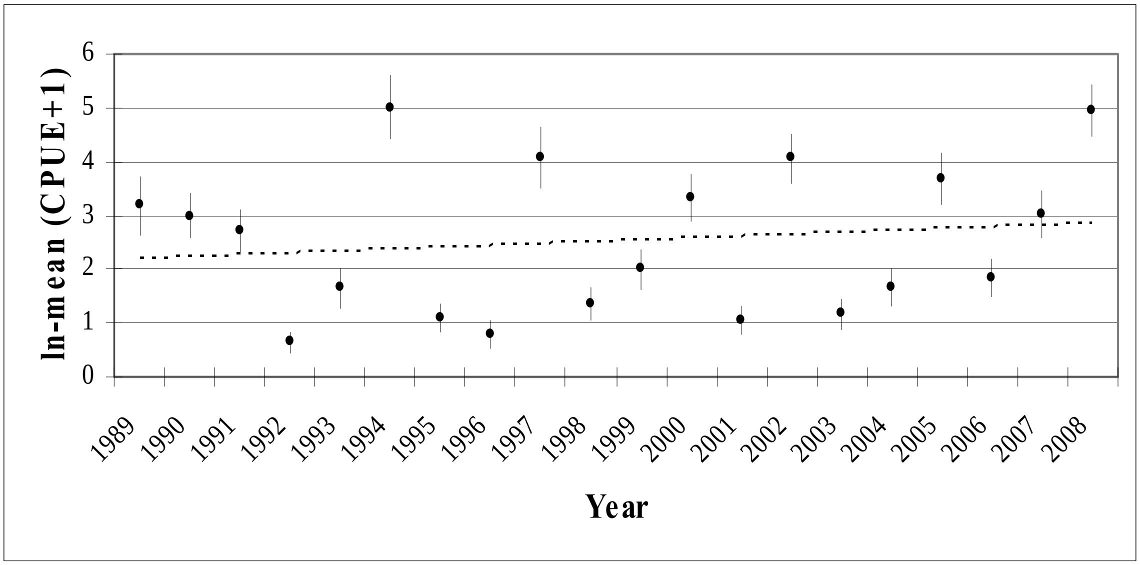


Figure 42. Spot (*Leiostomus xanthurus*) trawl relative abundance (ln-mean CPUE+1) with 95% confidence intervals (1989–2008). Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=140/year).

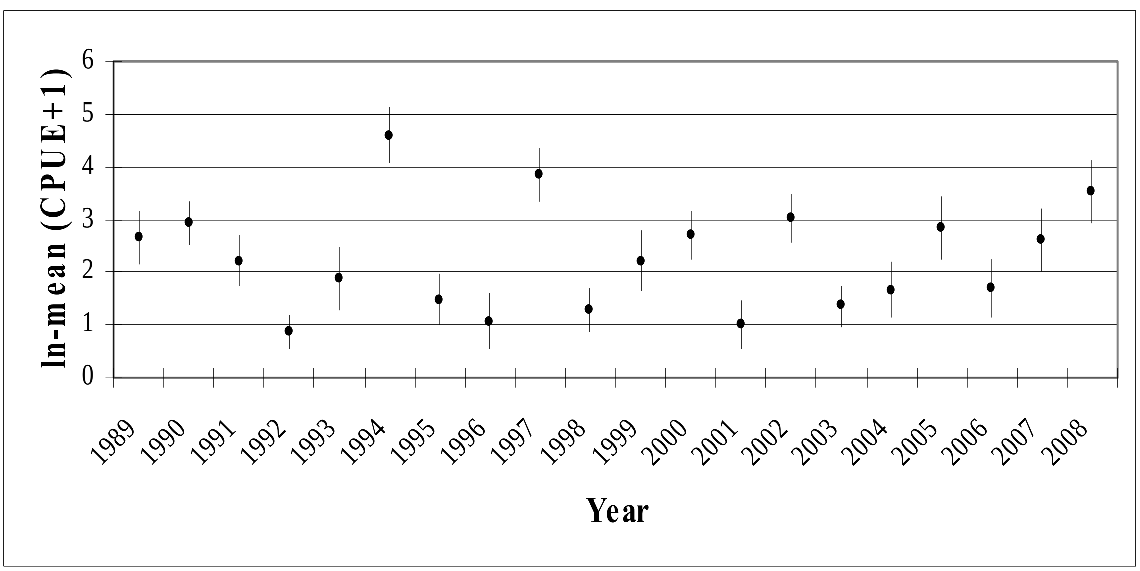
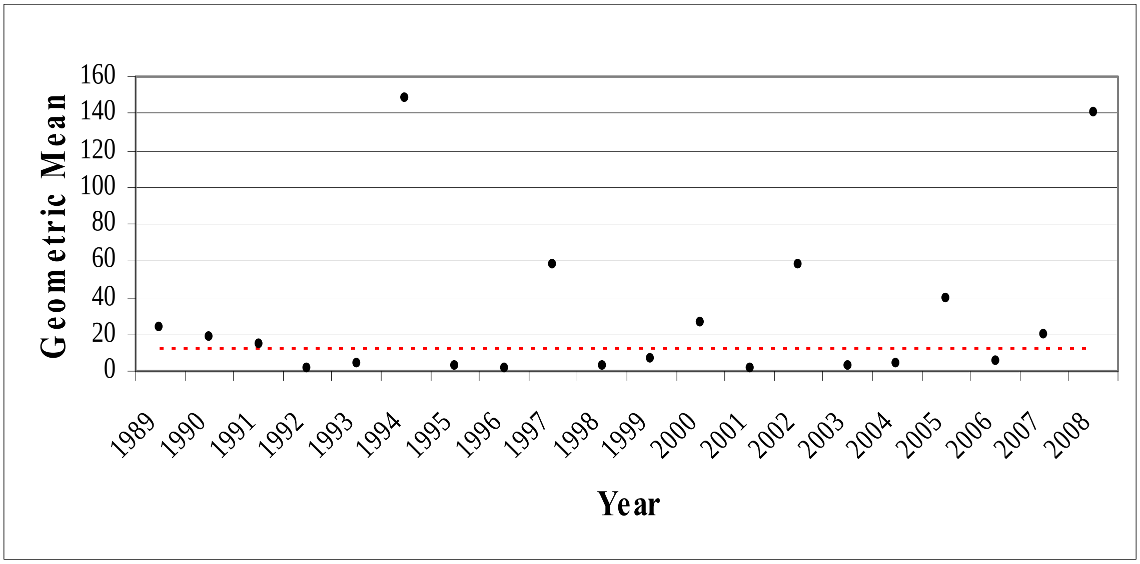


Figure 43. Spot (*Leiostomus xanthurus*) beach seine relative abundance (ln-mean CPUE+1) with 95% confidence intervals (1989-2008). Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=38/year).



Fgure 44. Spot (*Leiostomus xanthurus*) trawl index of relative abundance (geometric mean) (1989-2008). Solid line represents the 1989-2008 time series grand mean. Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=140/year).

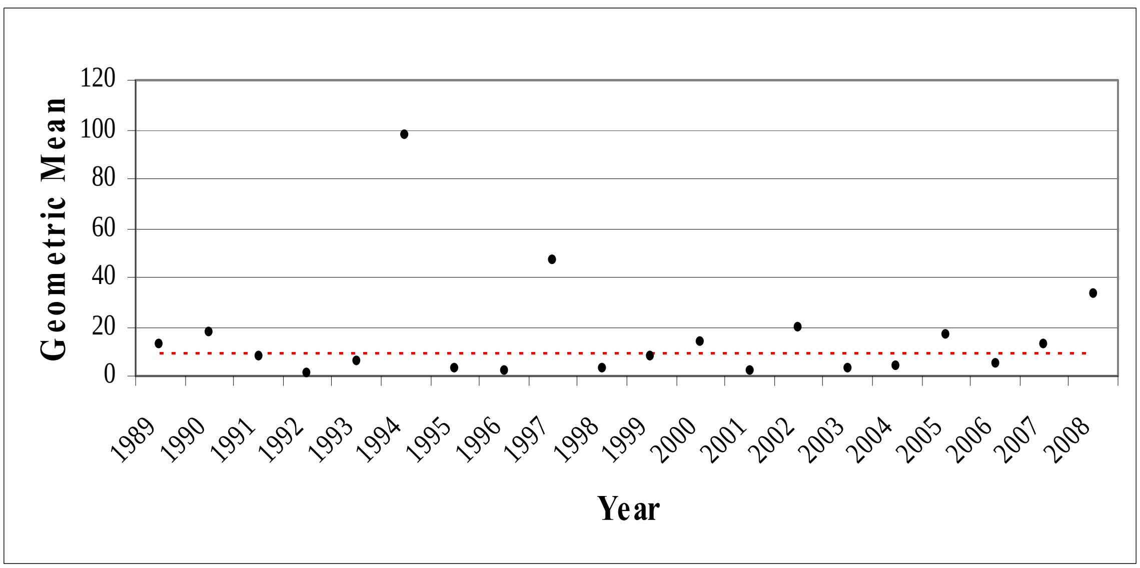


Figure 45. Spot (*Leiostomus xanthurus*) beach seine index of relative abundance (geometric mean) (1989-2008). Solid line represents the 1989-2008 time series grand mean. Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=38/year).

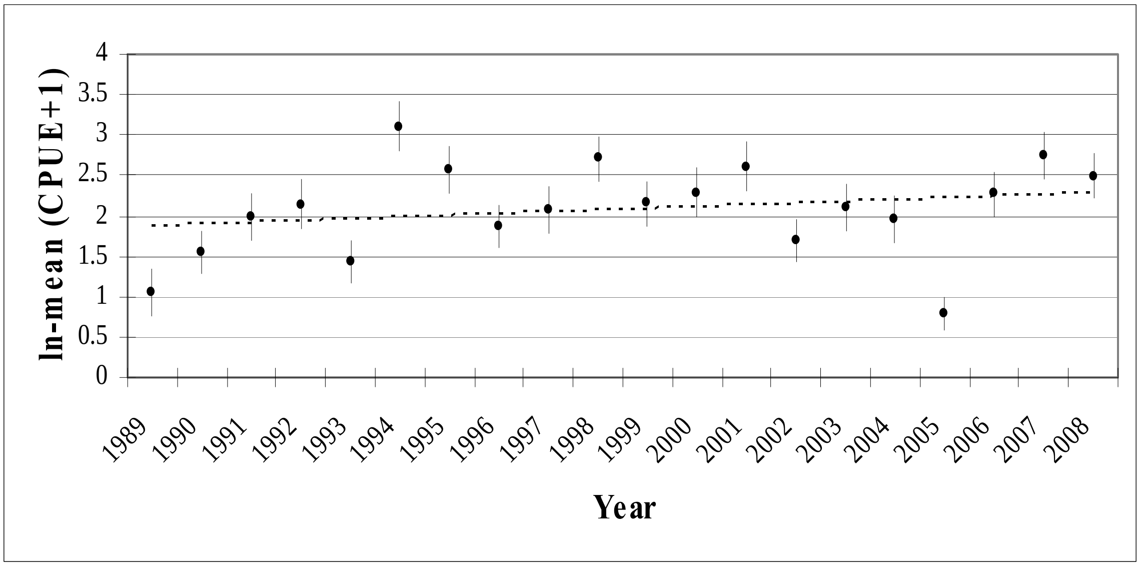


Figure 46. Summer flounder (*Paralichthys dentatus*) trawl relative abundance (ln-mean CPUE+1) with 95% confidence intervals (1989–2008). Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=140/year).

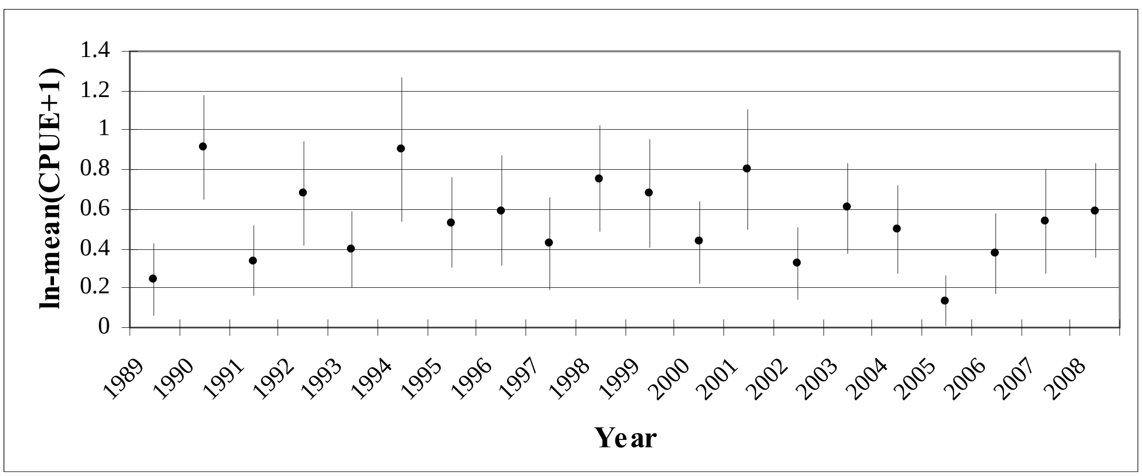


Figure 47. Summer flounder (*Paralichthys dentatus*) beach seine relative abundance (ln-mean CPUE+1) with 95% confidence intervals (1989-2008). Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=38/year).

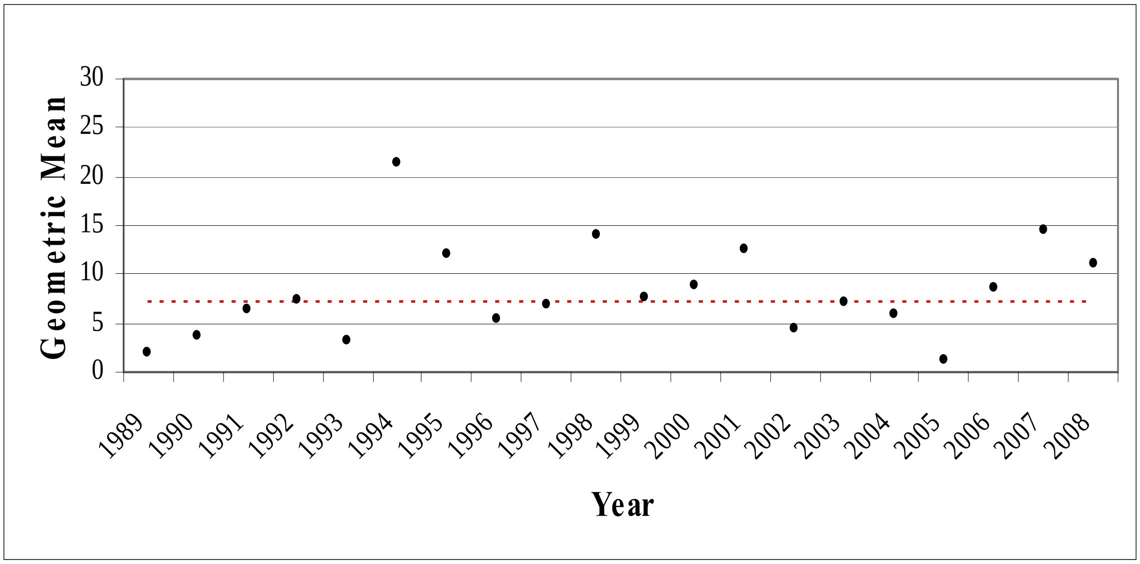


Figure 48. Summer flounder (*Paralichthys dentatus*) trawl index of relative abundance (geometric mean) (1989-2008). Solid line represents the 1989-2008 time series grand mean. Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=140/year).

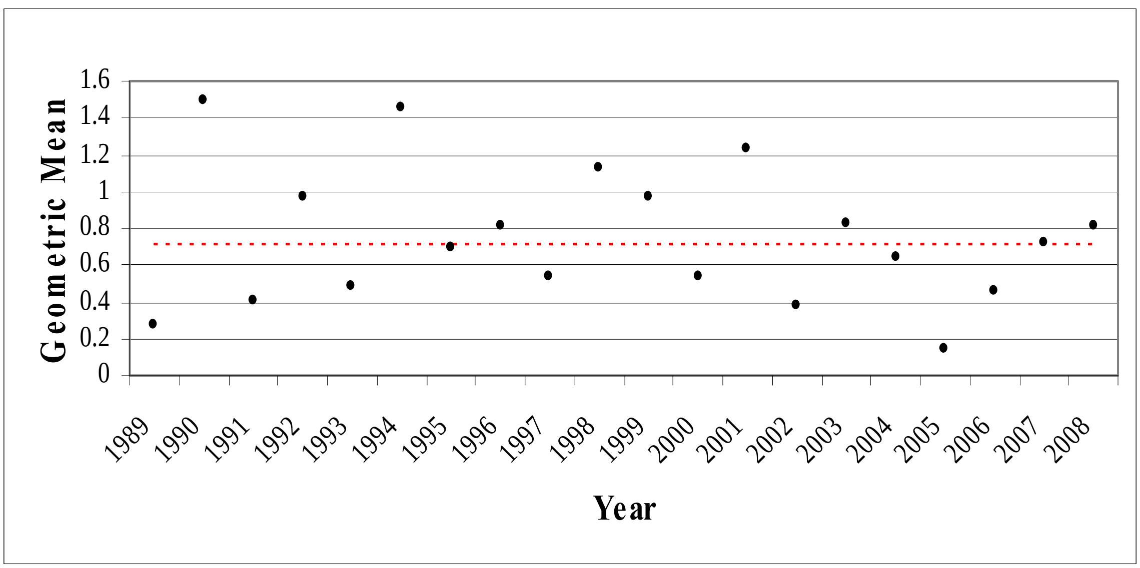


Figure 49. Summer flounder (*Paralichthys dentatus*) beach seine index of relative abundance (geometric mean) (1989-2008). Solid line represents the 1989-2008 time series grand mean. Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=38/year).

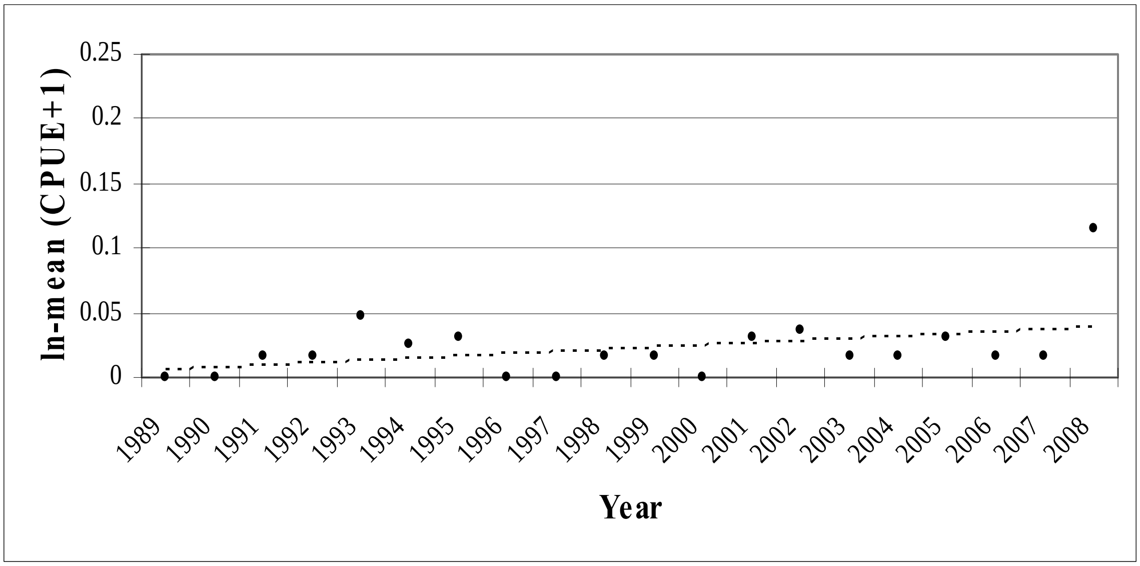


Figure 50. Tautog (*Tautoga onitis*) trawl relative abundance (ln-mean CPUE+1) (1989–2008). Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=140/year).

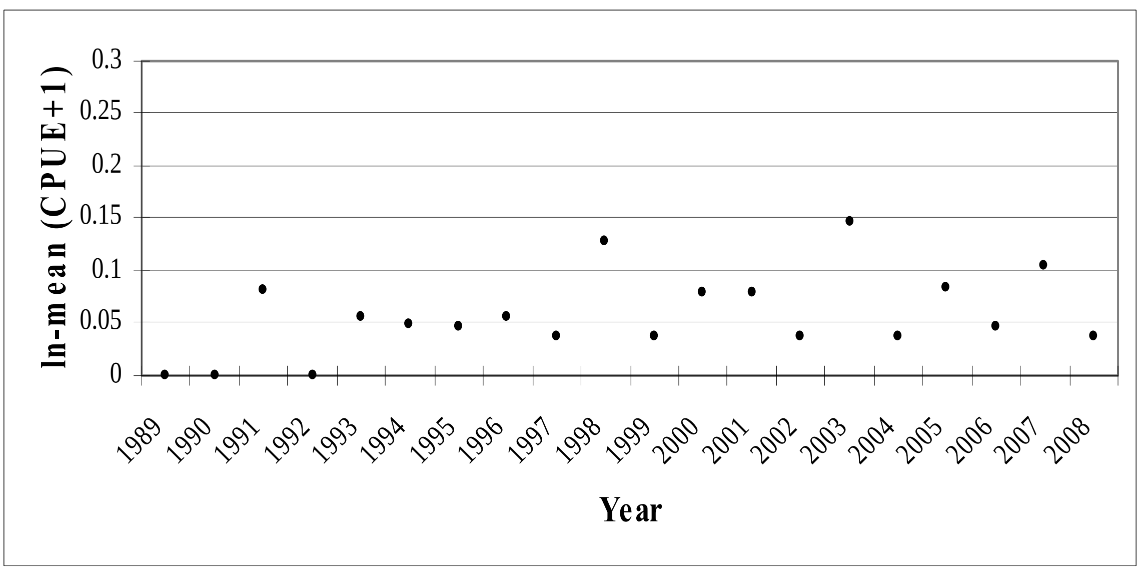


Figure 51. Tautog (*Tautoga onitis*) beach seine relative abundance (ln-mean CPUE+1) (1989-2008). Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=38/year).

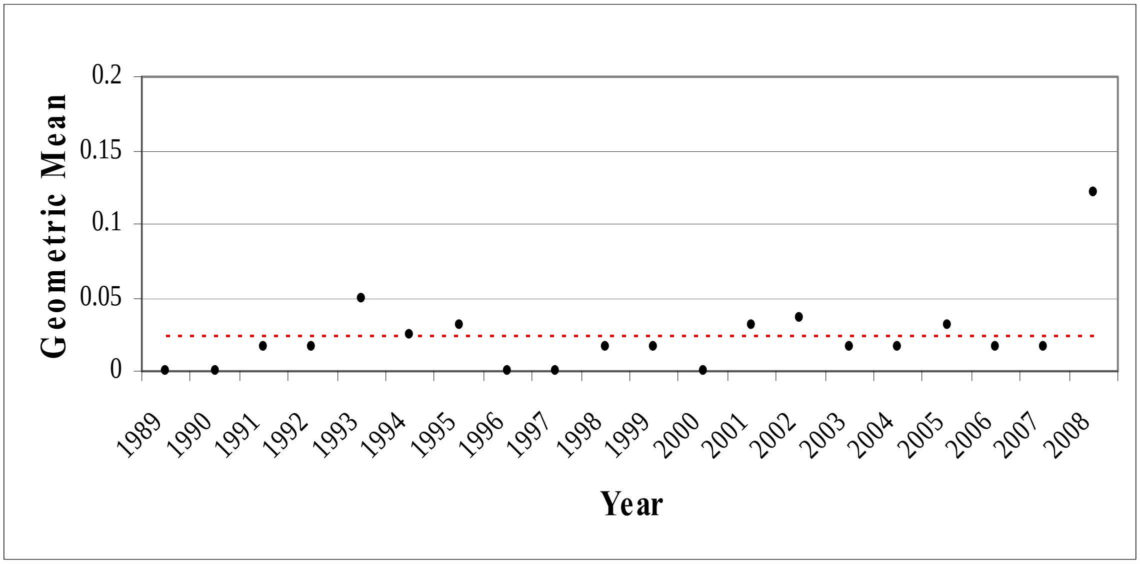


Figure 52. Tautog (*Tautoga onitis*) trawl index of relative abundance (geometric mean) (1989-2008). Solid line represents the 1989-2008 time series grand mean. Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=140/year).

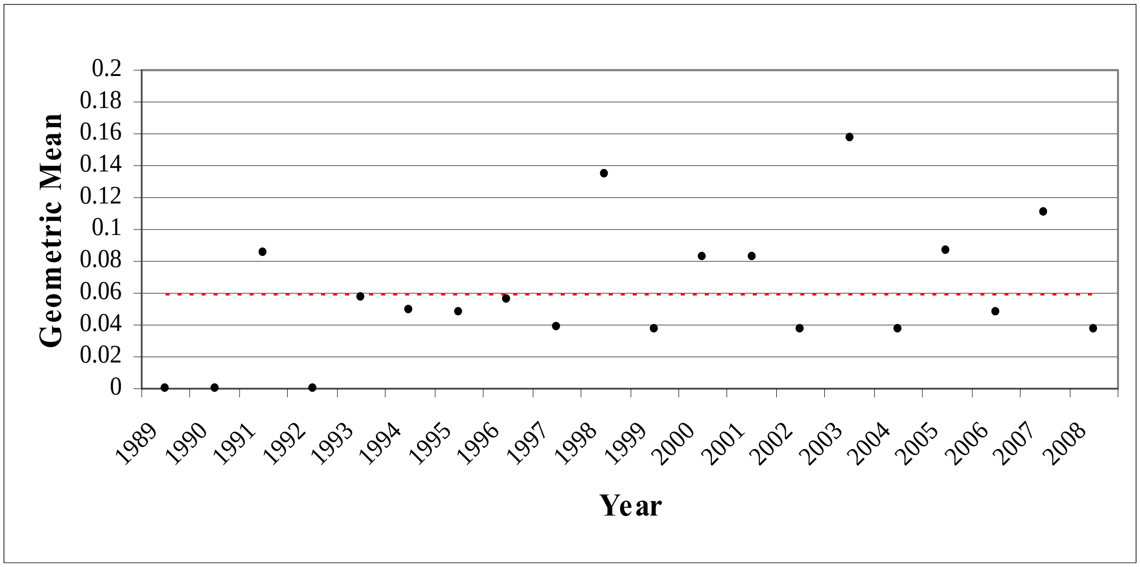


Figure 53. Tautog (*Tautoga onitis*) beach seine index of relative abundance (geometric mean) (1989-2008). Solid line represents the 1989-2008 time series grand mean. Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=38/year).

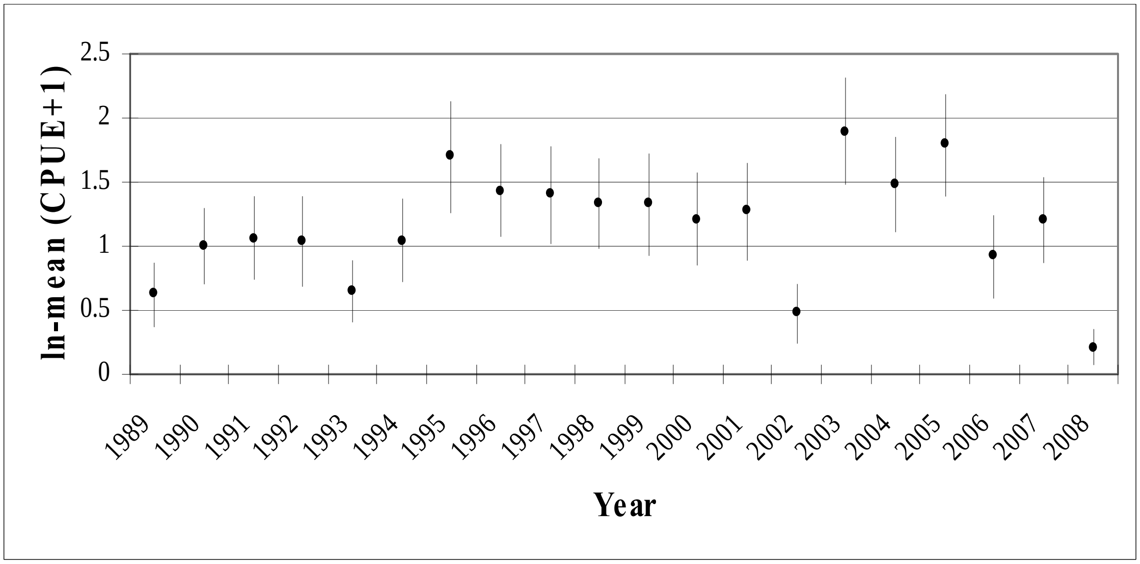


Figure 54. Weakfish (*Cynoscion regalis*) trawl relative abundance (ln-mean CPUE+1) with 95% confidence intervals (1989–2008). Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=140/year).

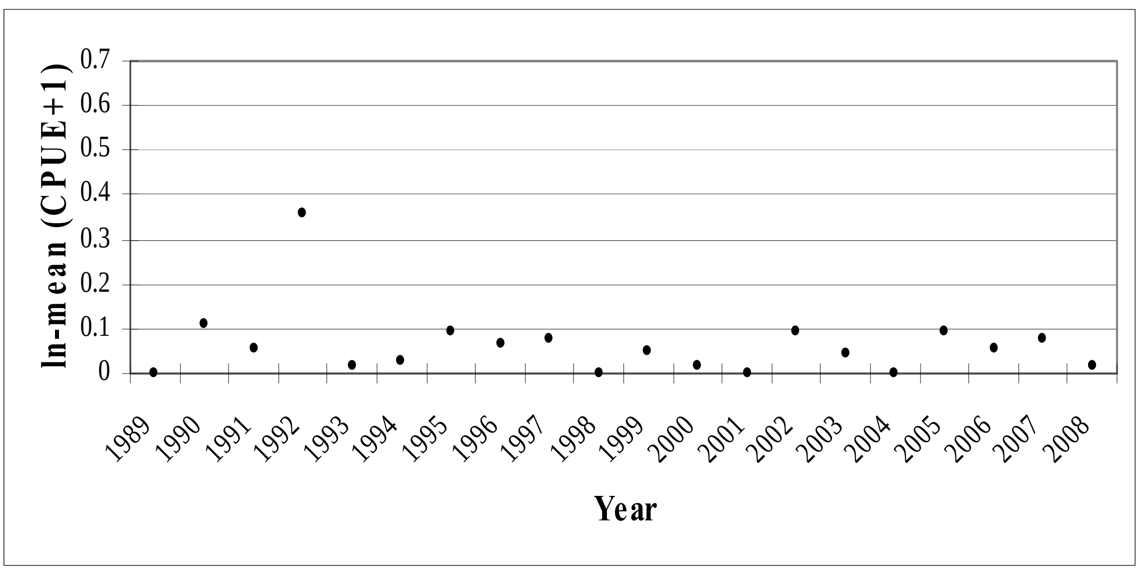


Figure 55. Weakfish (*Cynoscion regalis*) beach seine relative abundance (ln-mean CPUE+1) (1989-2008). Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=38/year).

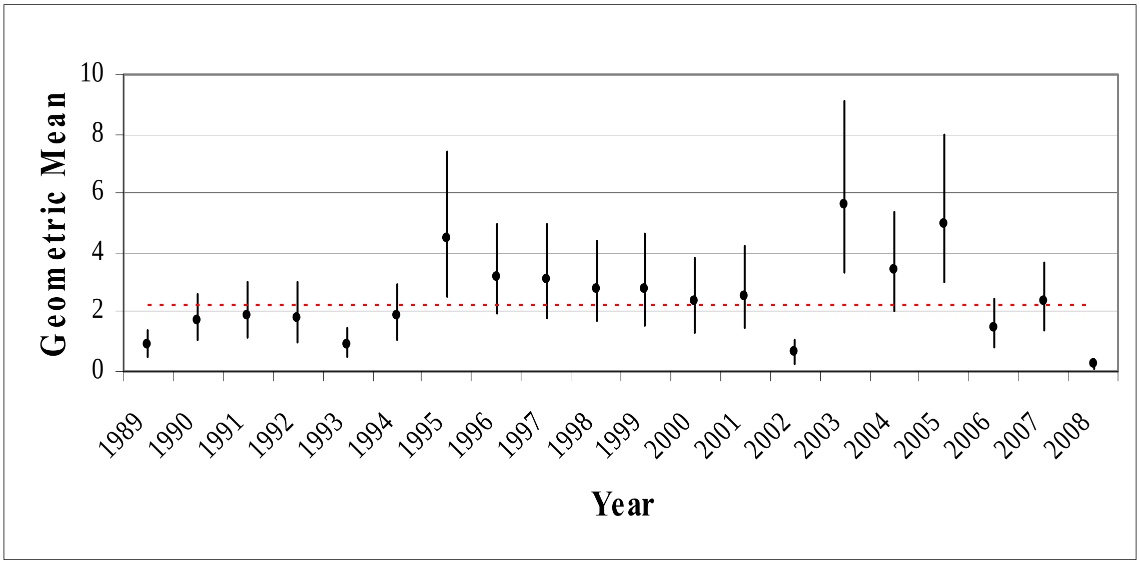


Figure 56. Weakfish (*Cynoscion regalis*) trawl index of relative abundance (geometric mean) with 95% confidence intervals (1989-2008). Solid line represents the 1989-2008 time series grand mean. Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=140/year).

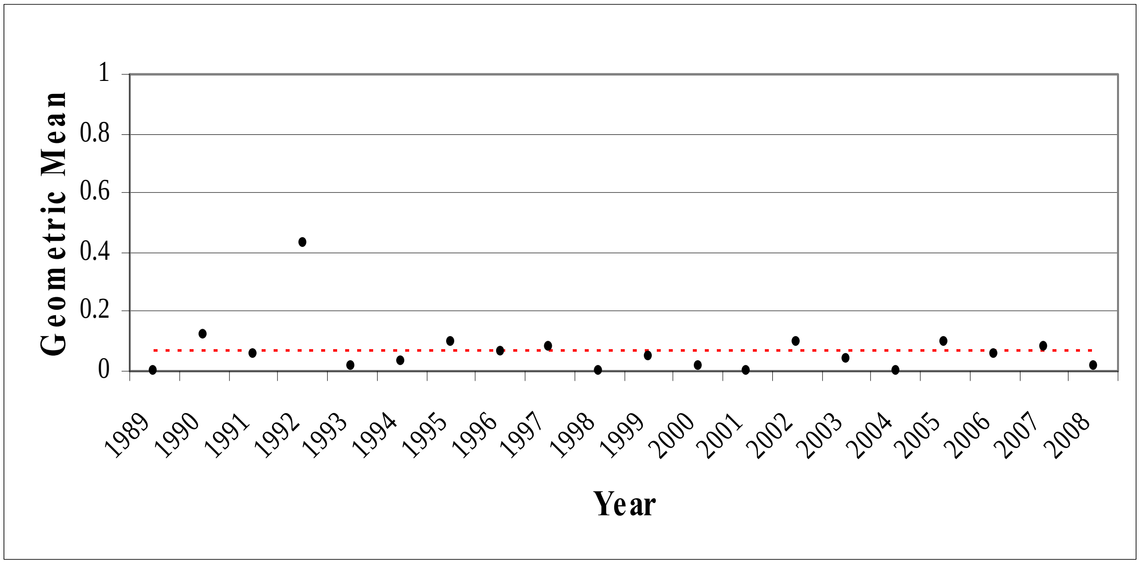


Figure 57. Weakfish (*Cynoscion regalis*) beach seine index of relative abundance (geometric mean) (1989-2008). Solid line represents the 1989-2008 time series grand mean. Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=38/year).

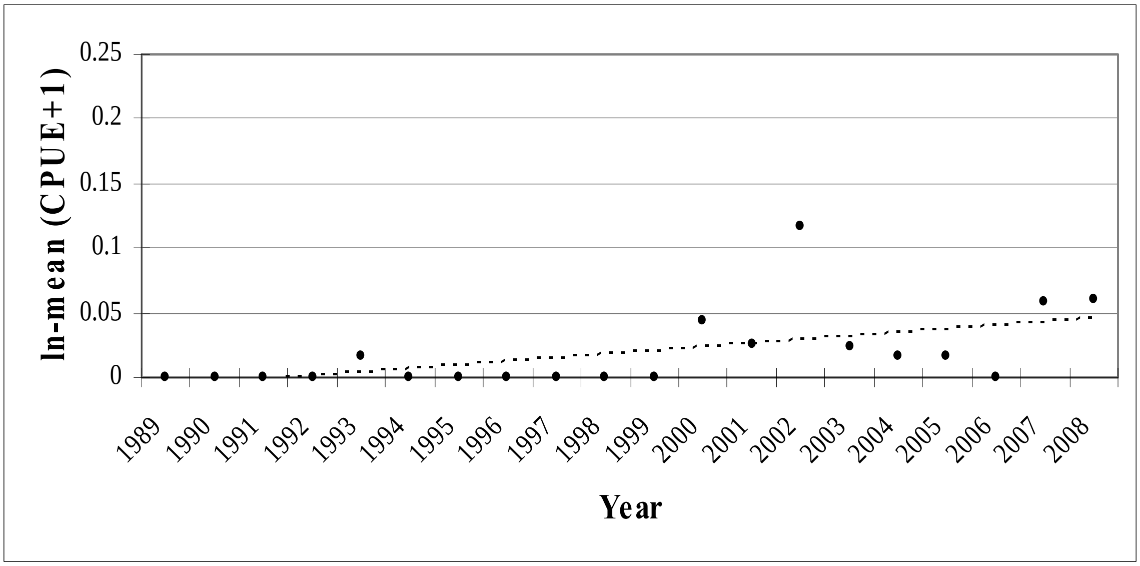


Figure 58. White mullet (*Mugil curema*) trawl relative abundance (ln-mean CPUE+1) (1989–2008). Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=140/year).

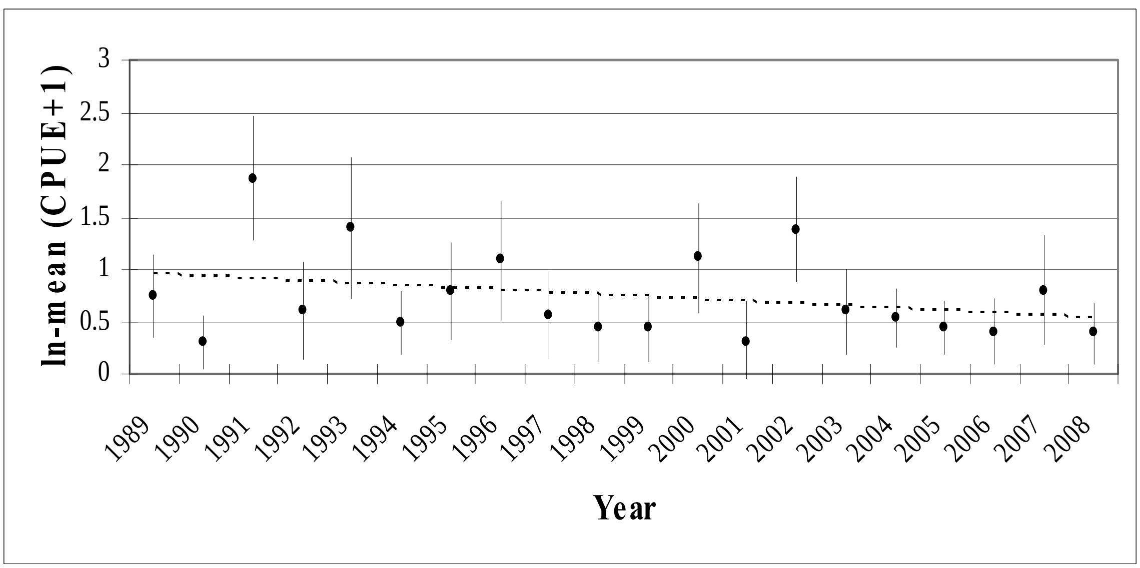


Figure 59. White mullet (*Mugil curema*) beach seine relative abundance (ln-mean CPUE+1) with 95% confidence intervals (1989-2008). Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=38/year).

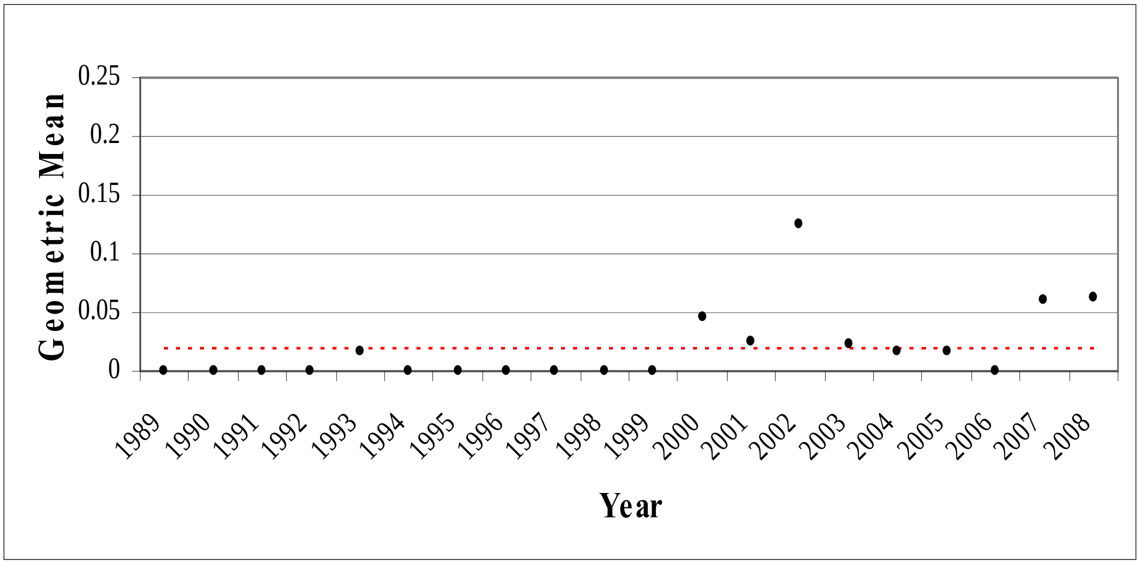


Figure 60. White mullet (*Mugil curema*) trawl index of relative abundance (geometric mean) (1989-2008). Solid line represents the 1989-2008 time series grand mean. Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=140/year).

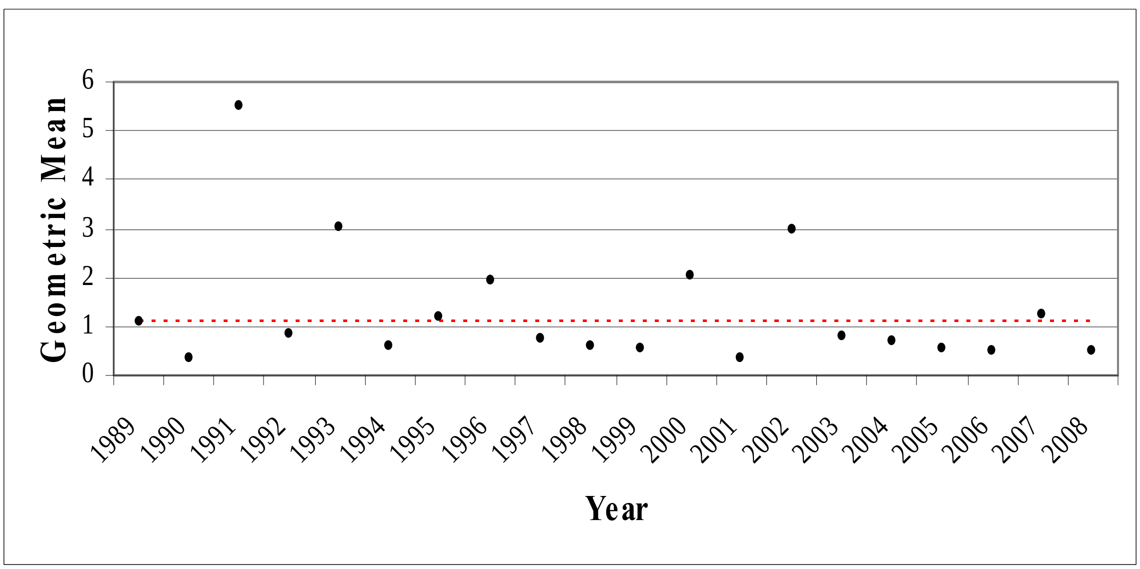


Figure 61 White mullet (*Mugil curema*) beach seine index of relative abundance (geometric mean) (1989-2008). Solid line represents the 1989-2008 time series grand mean. Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=38/year).

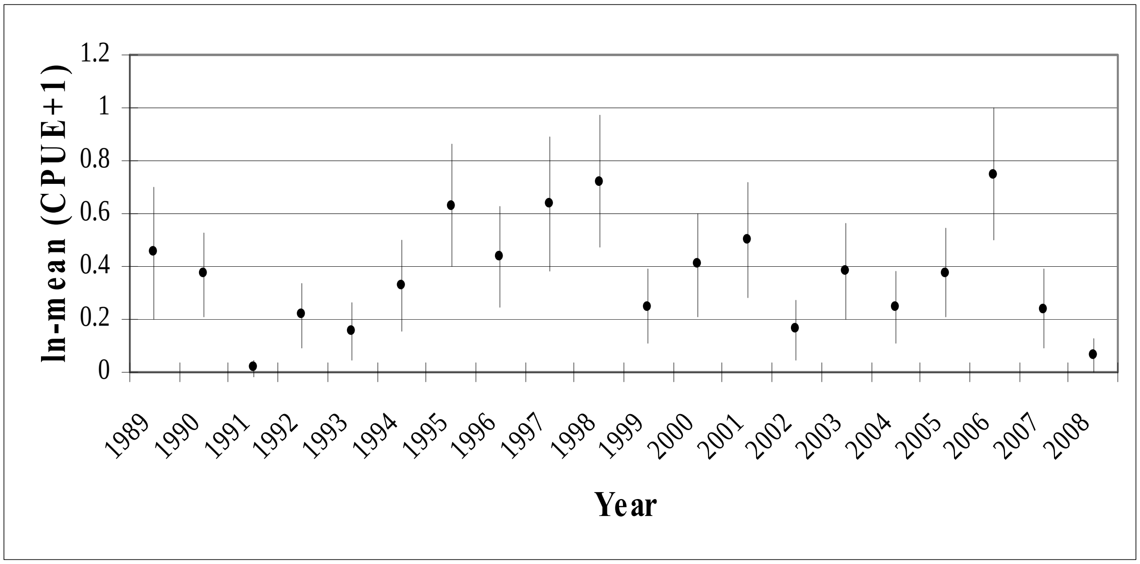


Figure 62. Winter flounder (*Pseudopleuronectes americanus*) trawl relative abundance (ln-mean CPUE+1) with 95% confidence intervals (1989–2008). Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=140/year).

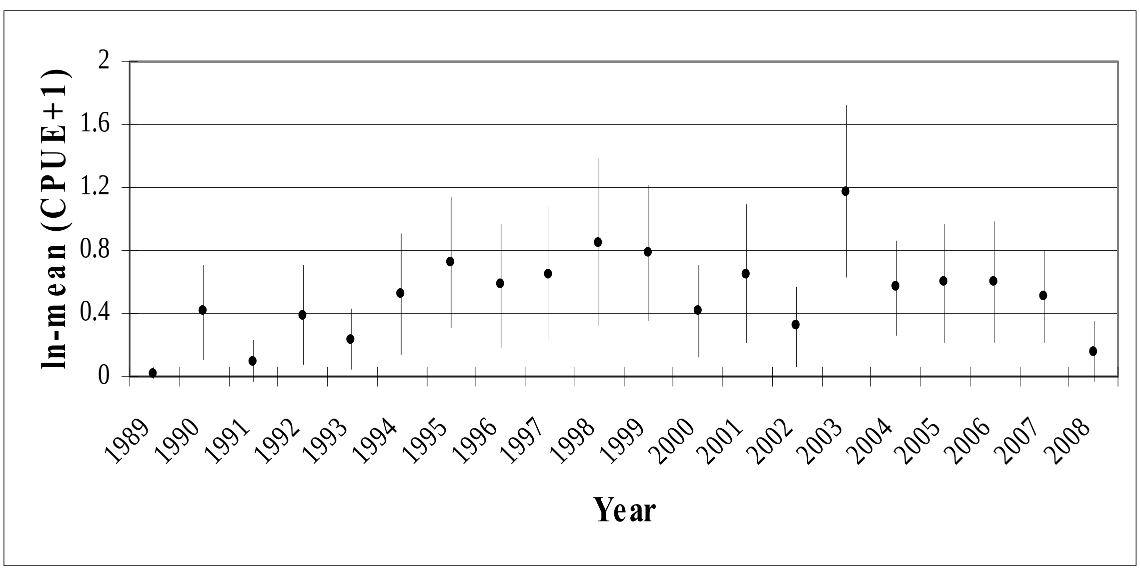


Figure 63. Winter flounder (*Pseudopleuronectes americanus*) beach seine relative abundance (ln-mean CPUE+1) with 95% confidence intervals (1989-2008). Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=38/year).

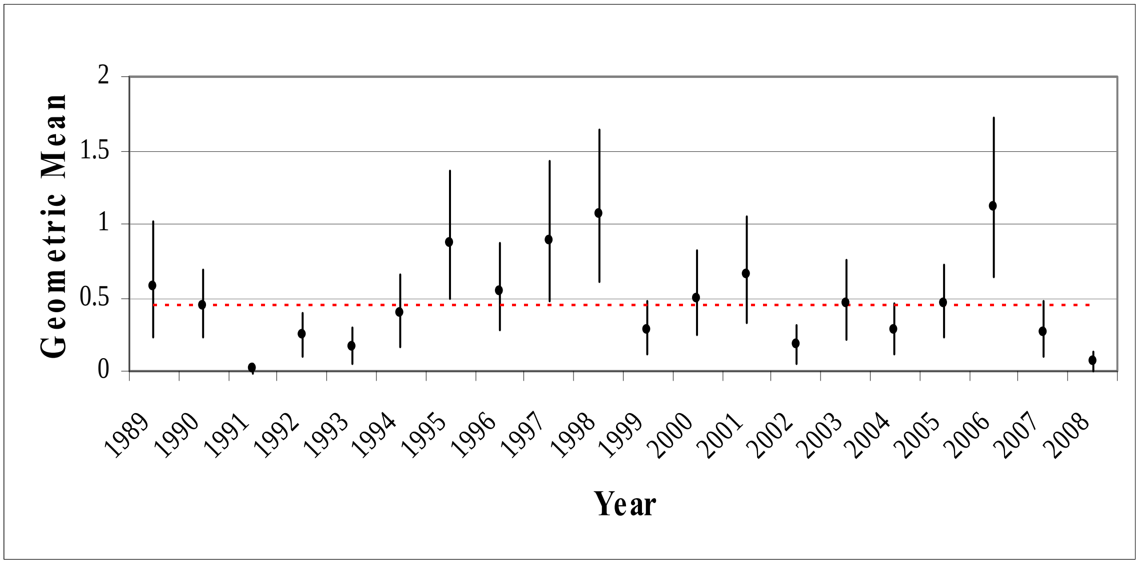


Figure 64. Winter flounder (*Pseudopleuronectes americanus*) trawl index of relative abundance (geometric mean) with 95% confidence intervals (1989-2008). Solid line represents the 1989-2008 time series grand mean. Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=140/year).

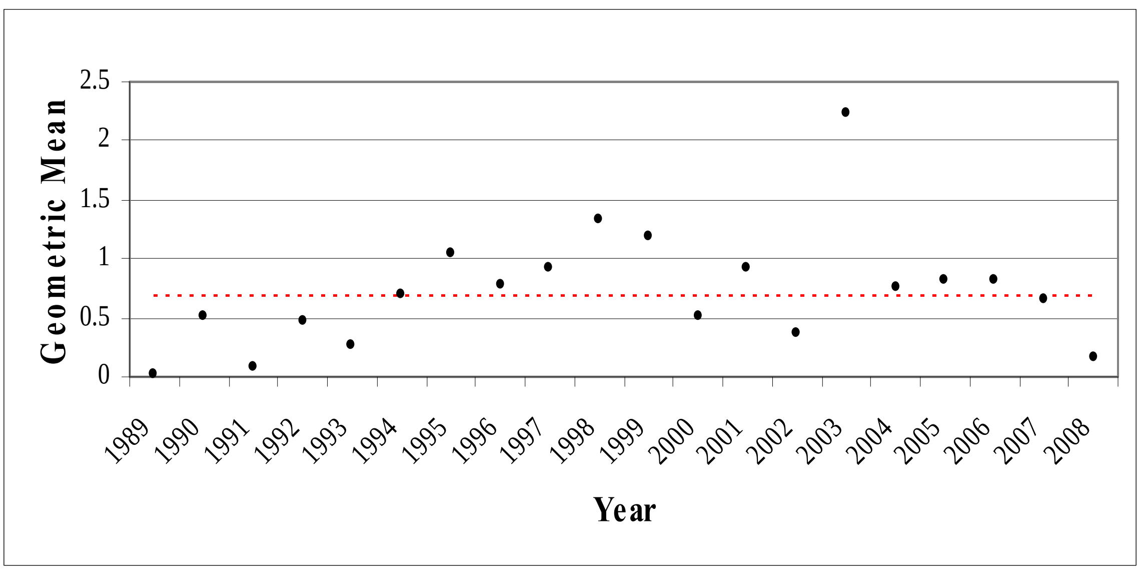


Figure 65. Winter flounder (*Pseudopleuronectes americanus*) beach seine index of relative abundance (geometric mean) (1989-2008). Solid line represents the 1989-2008 time series grand mean. Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=38/year).

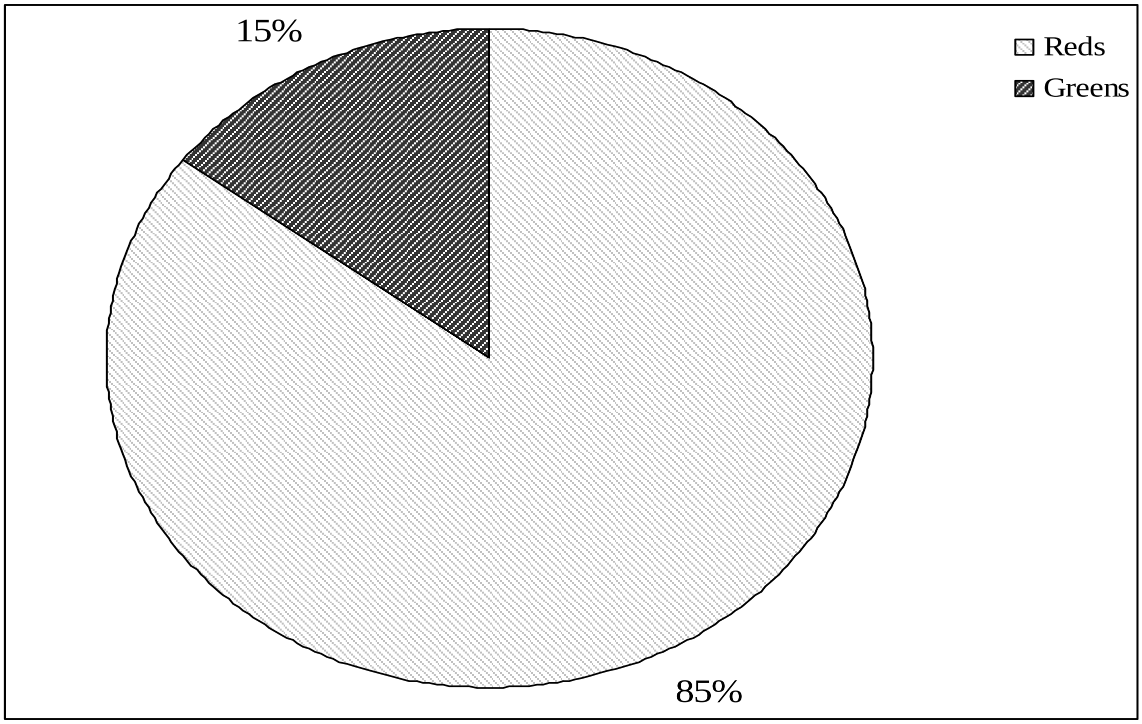


Figure 66. Percentages of red and green macroalgae biomass found in the 2008 Coastal Bays Fisheries Investigation Trawl Survey.

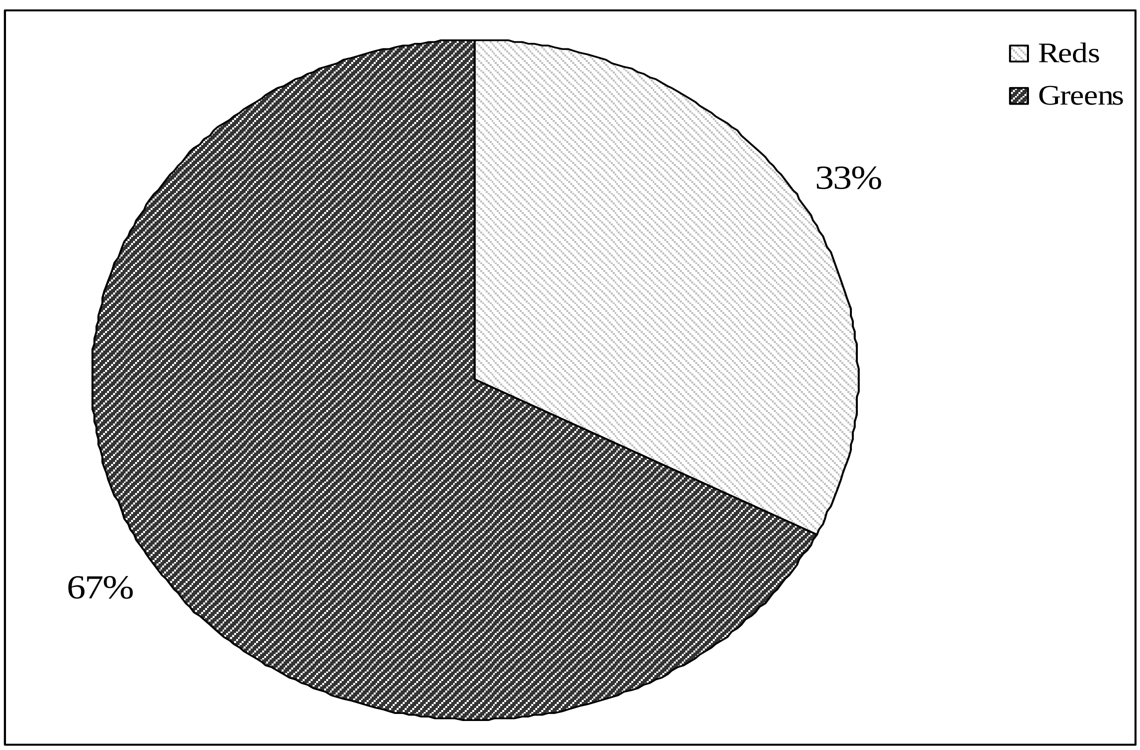


Figure 67. Percentages of red and green macroalgae biomass found in the 2008 Coastal Bays Fisheries Investigation Beach Seine Survey.

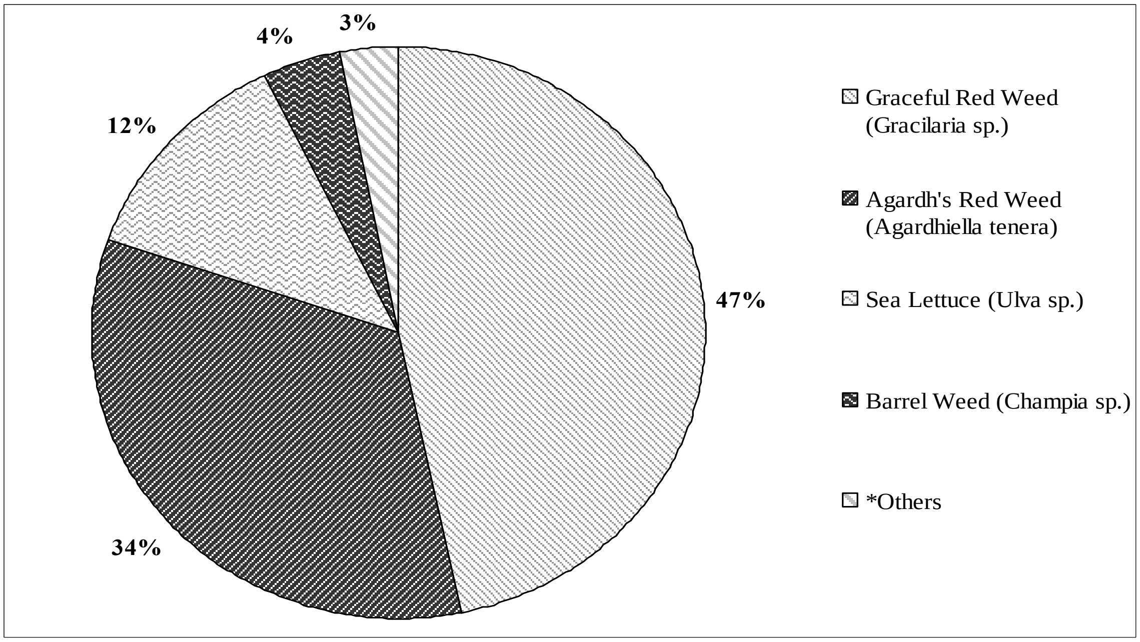


Figure 68. Percentages of macroalgae biomass collected in the 2008 Coastal Bays Fisheries Investigation Trawl Survey. *Others consisted of macroalgae species that were 1% or less of the total volume; Green Hair Algae (*Chaetomorpha* sp.), Hollow Green Weeds (*Enteromorpha* spp.), Banded Weeds (*Ceramium* sp.), Green Tufted Seaweed (*Cladophora* sp.), Green Fleece (*Codium fragile*), Hooked Red Weed (*Hypnea* sp.), and Tubed Weeds (*Polysiphonia* sp.).

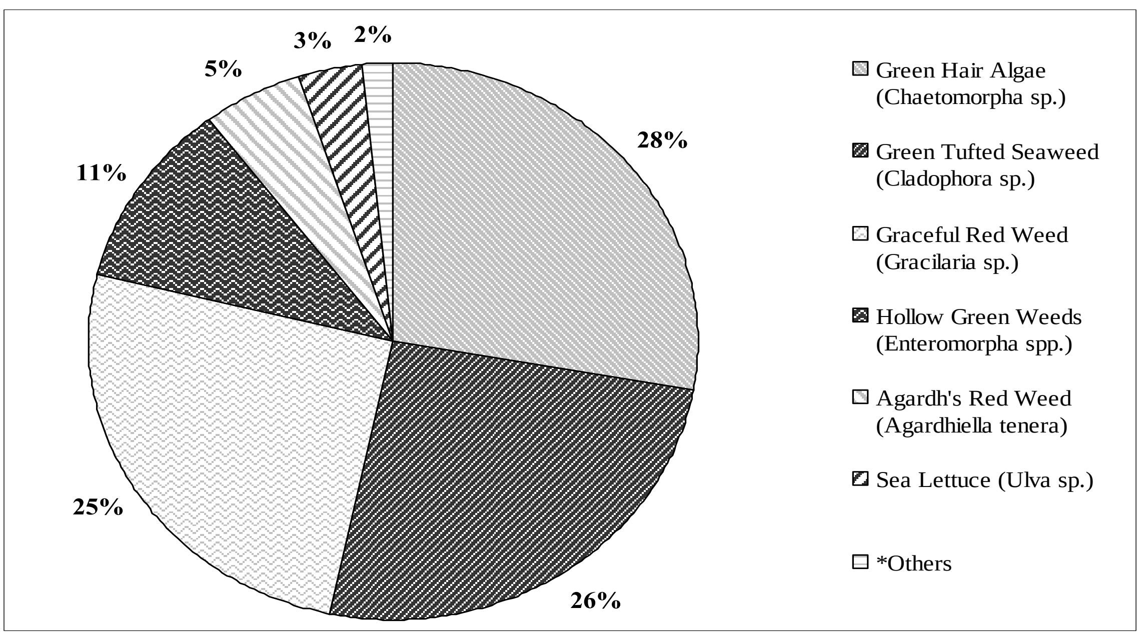


Figure 69. Percentages of macroalgae biomass collected in the 2008 Coastal Bays Fisheries Investigation Beach Seine Survey. *Others consisted of macroalgae species that were 1% or less of the total volume; Barrel Weed (*Champia* sp.), Hooked Red Weed (*Hypnea* sp.), Tubed Weeds (*Polysiphonia* sp.), Banded Weeds (*Ceramium* sp.), and Green Fleece (*Codium fragile*).

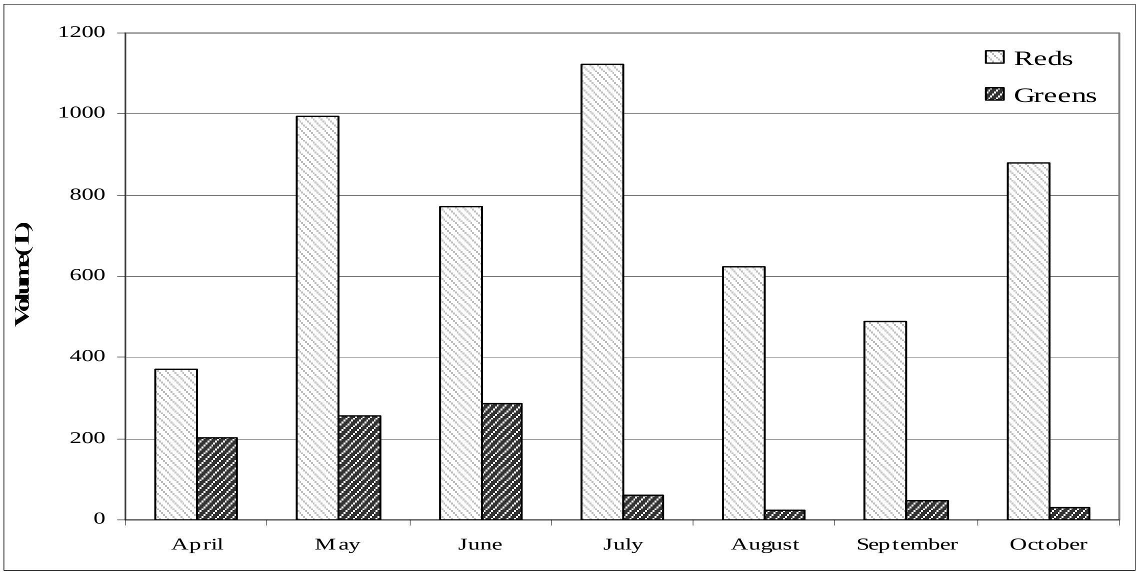


Figure 70. Biomass of red and green macroalgae by month found in the 2008 Coastal Bays Fisheries Investigation Trawl Survey.

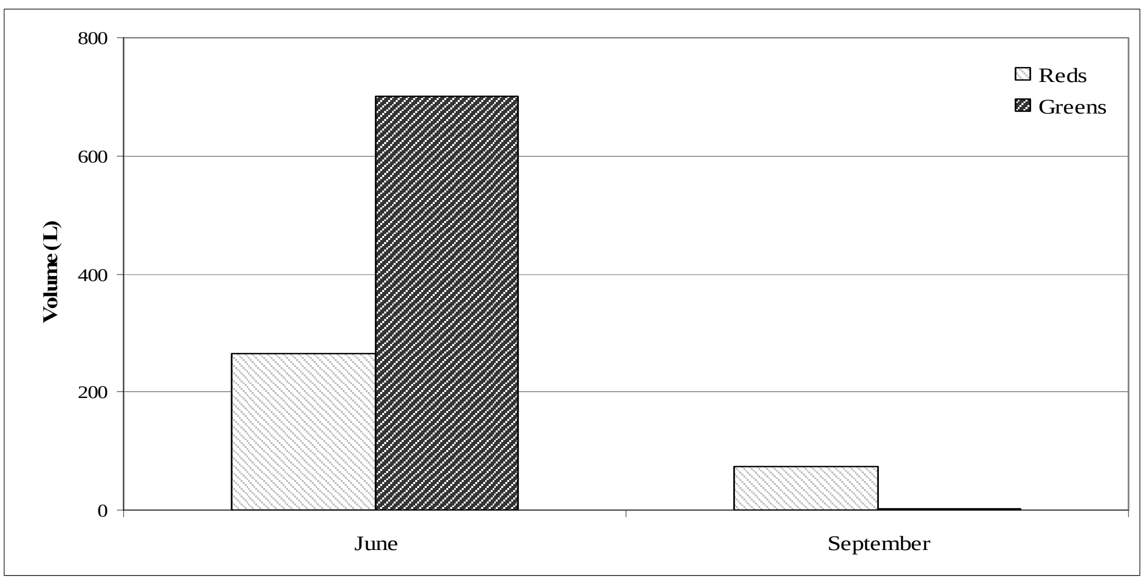


Figure 71. Biomass of red and green macroalgae by month found in the 2008 Coastal Bays Fisheries Investigation Beach Seine Survey.

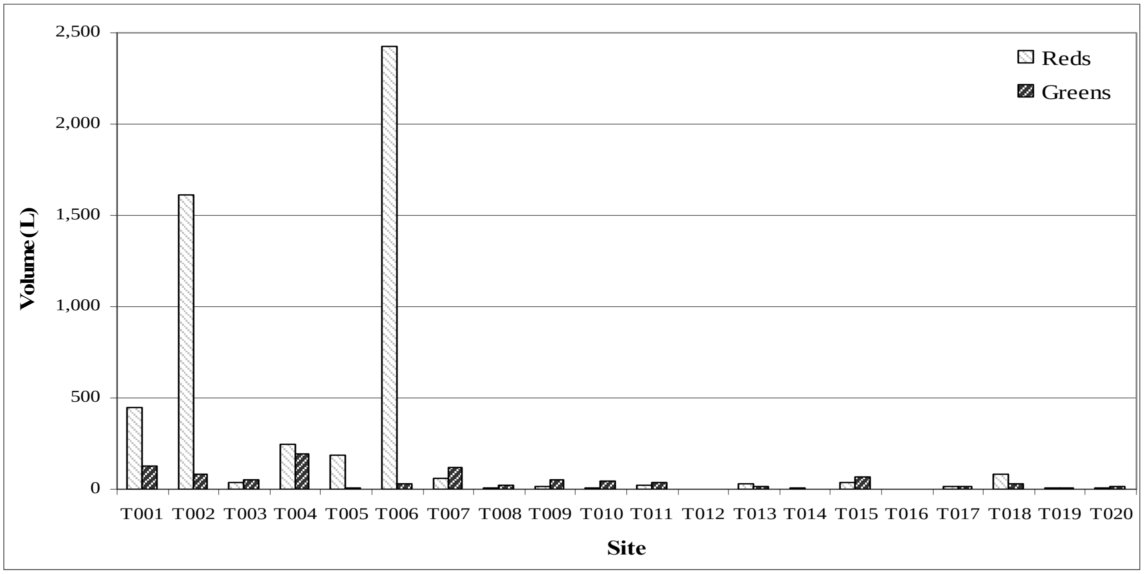


Figure 72. 2008 Coastal Bays Fisheries Investigation Trawl Survey macroalgae biomass by site.

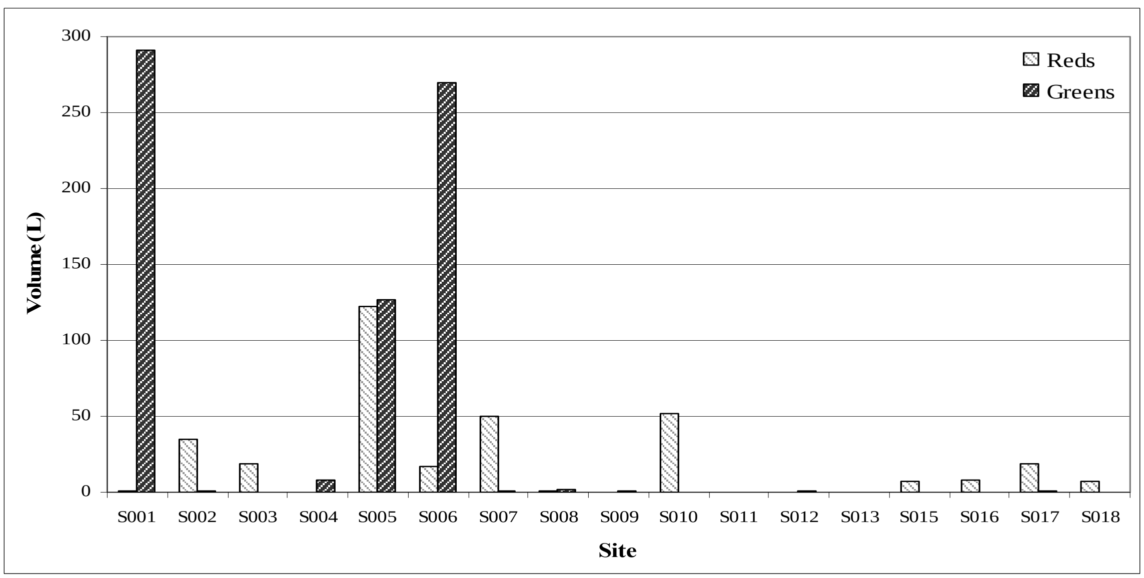


Figure 73. 2008 Coastal Bays Fisheries Investigation Beach Seine Survey macroalgae biomass by site.

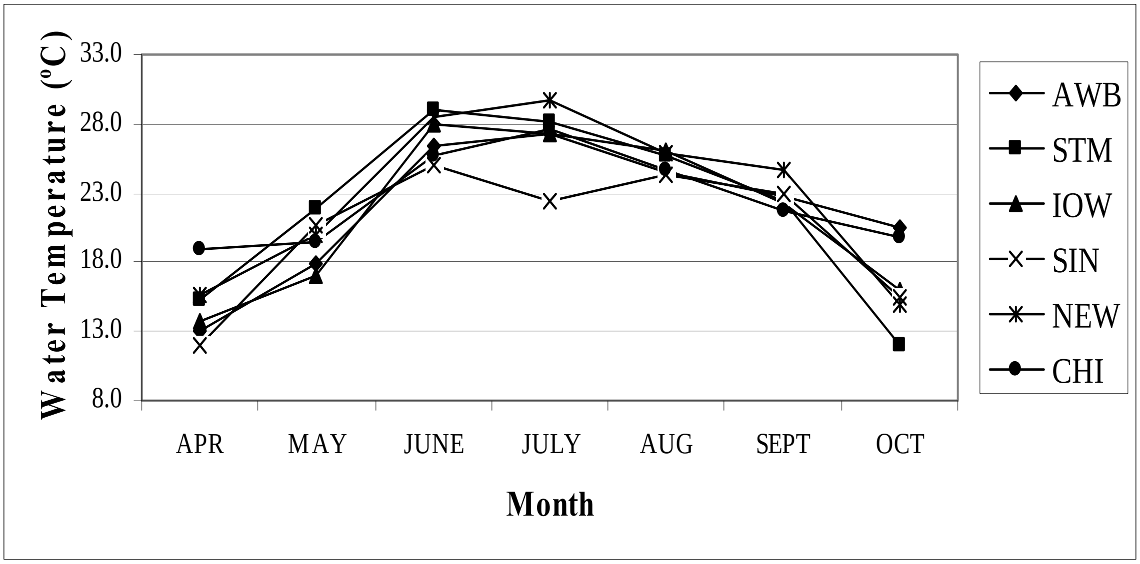


Figure 74. 2008 Coastal Bays Fisheries Investigations Trawl Survey mean water temperature (°C) by month for Assawoman Bay (AWB), St. Martins River (STM), Isle of Wight Bay (IOW), Sinepuxent Bay (SIN), Newport Bay (NEW), and Chincoteague Bay (CHI).

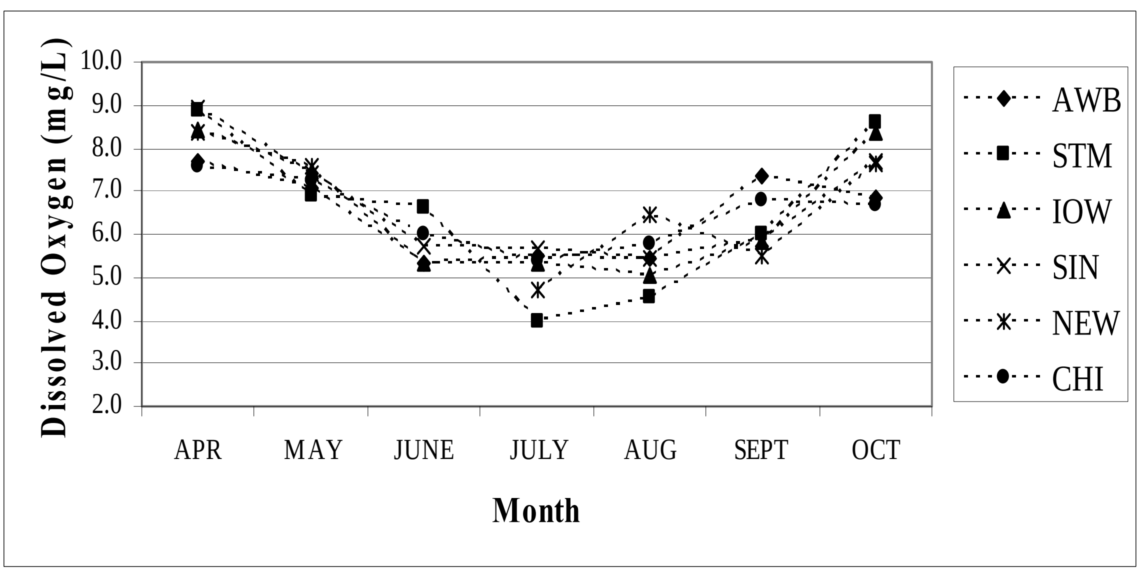


Figure 75. 2008 Coastal Bays Fisheries Investigations Trawl Survey mean dissolved oxygen (mg/L) by month for Assawoman Bay (AWB), St. Martins River (STM), Isle of Wight Bay (IOW), Sinepuxent Bay (SIN), Newport Bay (NEW), and Chincoteague Bay (CHI).

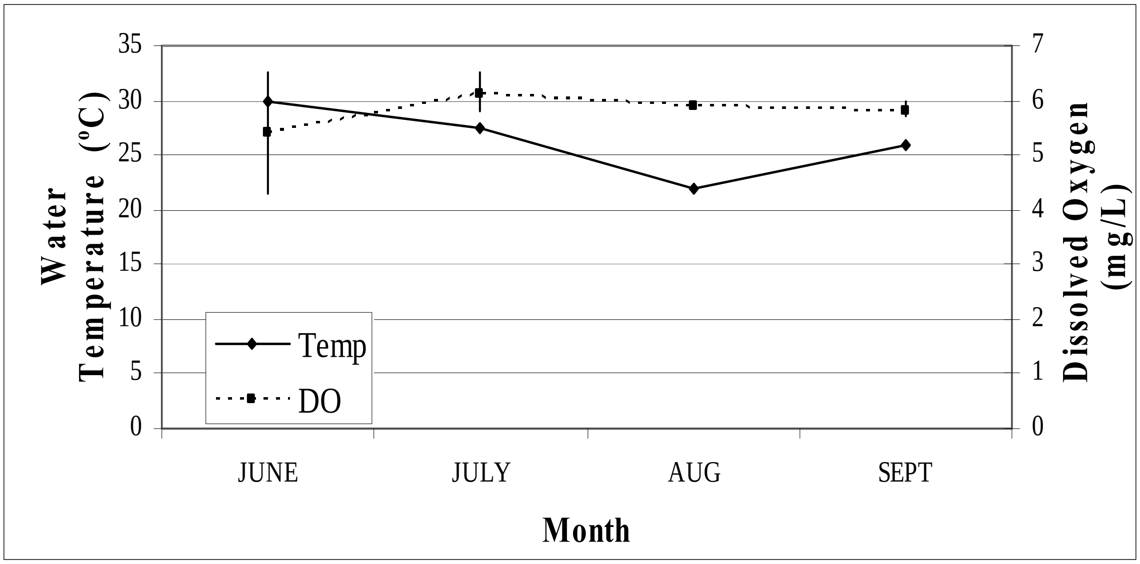


Figure 76. 2008 Coastal Bays Drop Net Survey site monthly mean temperatures (°C) and monthly mean dissolved oxygen (mg/L).

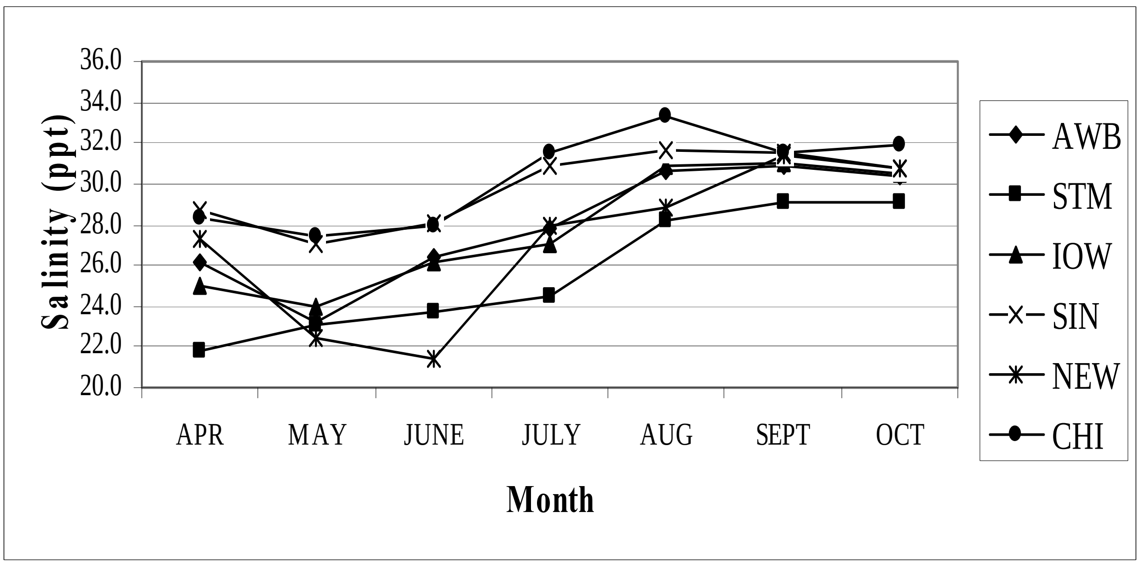


Figure 77. 2008 Coastal Bays Fisheries Investigations Trawl Survey mean salinity (ppt) by month for Assawoman Bay (AWB), St. Martins River (STM), Isle of Wight Bay (IOW), Sinepuxent Bay (SIN), Newport Bay (NEW), and Chincoteague Bay (CHI).

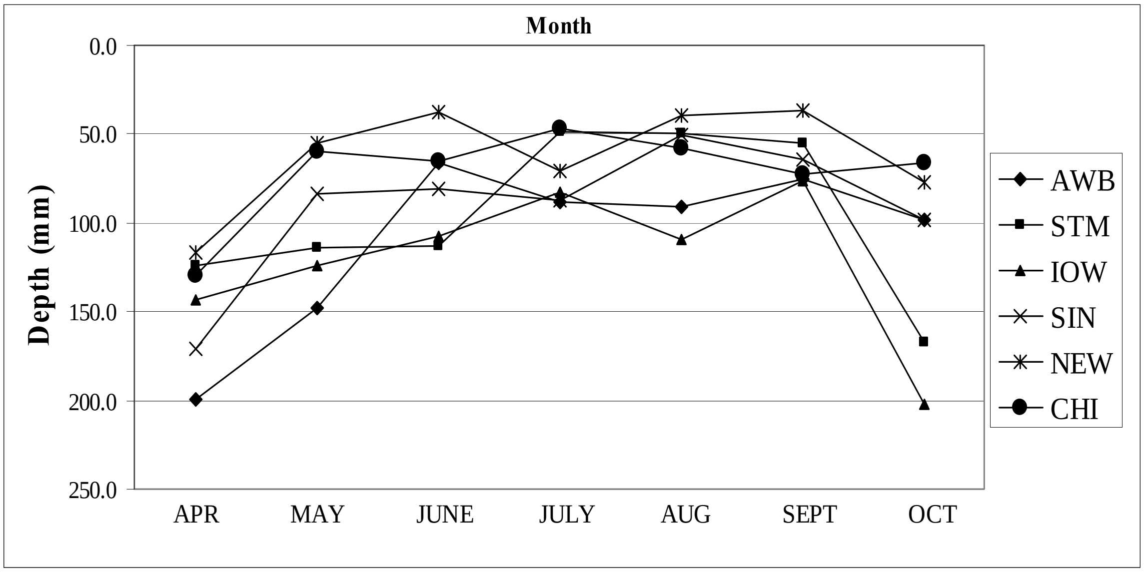


Figure 78. 2008 Coastal Bays Fisheries Investigations Trawl Survey mean secchi depth (mm) by month for Assawoman Bay (AWB), St. Martins River (STM), Isle of Wight Bay (IOW), Sinepuxent Bay (SIN), Newport Bay (NEW), and Chincoteague Bay (CHI). No averages available for Sinepuxent and Newport Bays in April.

Chapter 2

Submerged Aquatic Vegetation Drop Net Program

Introduction

Data describing nekton (fish, crustaceans) presence and abundance in Submerged Aquatic Vegetation (SAV) beds do not exist for the Maryland Coastal Bays. Currently, assumptions about fishes using SAV beds in Maryland's Coastal Bays are based on general life history information and data collected from the Coastal Bays Fisheries Investigation Trawl and Beach Seine Survey. Specific data qualifying and quantifying fishes in SAV could be valuable in defining/refining Essential Fish Habitat (EFH) and monitoring species diversity.

Documenting species diversity in SAV is important to fisheries management because it may indicate changes in the food web, displacement of native species, commercial and recreational fisheries dynamics, and anthropogenic behaviors. Species diversity can change over time through shifts in composition, range extension or contraction, and introductions of invasive species (Raposa and Roman 2001). Studies have shown that species diversity in SAV beds are sometimes equal to or greater than other habitats found in estuaries, including: non-vegetated areas adjacent to eelgrass and salt marshes (includes tidal creeks, pools; Raposa and Roman 2001, Clark *et al* 2004, Connolly and Hindell 2006). However, not all SAV beds are equal in importance to fish habitat. Variables such as shoot density, proximity to land (marsh, beach, etc.), or open water influence the quality of the SAV bed as habitat (Beck *et al.* 2003).

The primary goal of the 2008 drop net work was to update the species list for fishes and invertebrates utilizing SAV in Sinepuxent Bay. Comparing lengths of fishes from the drop net samples with those from nearby trawl and beach seine sites was a secondary goal.

Methods

Study Area

One sample location was chosen in Sinepuxent Bay. This site is located on the east side of the Bay just south of the Verrazano Bridge. Sample site selection criteria included:

- SAV was present 23 meters (75 ft) or more away from the shoreline;
- there was an area 23 m (75 ft) or more apart from the vegetated area without SAV;
- water depth was no more than 1 m (3.5 ft) at high tide.

The Verrazano site meets the above listed criteria. Assateague Island State Park borders this site to the east and residential and park properties were located to the west. Areas with SAV had a mud bottom and those without were hard sand.

Submerged aquatic vegetation and macroalgae (seaweeds) were common in Sinepuxent Bay and provided habitat and foraging sites for fishes and shellfishes (Beck *et al.* 2003). The common species of SAV was eelgrass, *Zostera marina*. *Agardhiella sp*., *Gracilaria sp.*, and *Ulva sp*. were common species of macroalgae found in Sinepuxent Bay.

Data Collection

A 7.6 m (25 ft) C-hawk with a 175 Mercury Optimax engine was used for transportation to the site. Latitude and longitude coordinates in degrees, minutes, and fraction of minutes (ddmm.mmm) were recorded to facilitate navigation back to the same site. A Garmin e-Trex Legend C was used for navigation and marking sites.

Gear - Drop Trap

Two 3 m x 3 m x 1.5 m (10' x 10'x 5') drop traps were deployed to target fishes inhabiting SAV and nearby non-vegetated areas. PVC measuring 7.62 cm in diameter (3 inch) was used to construct the frame. Trap legs were cut into 1.52 m (five foot) lengths with one end slanted at a 45° angle to allow posts to slide easier into the bottom. Posts were driven 30 cm (12 in.) into the bottom using a rubber mallet or twisting motion. The top of the frame attached to the vertical posts using 7.62 cm PVC T's. Top frame corners were made with 90° PVC parts. Nylon knotless seine netting (0.6 cm (¼ in.) mesh, 1.8 m (6 ft) height) was attached to the top frame using size 9 twine (84 lb. test) and 5/8th zinc plated chain was zip tied to the bottom of the net in each of the 4 segments. Velcro® connected the seams of the four net segments. Four, 36 cm (14 inch) surveyors steel pins placed in predrilled holes near the top of each vertical post supported the net in the upright position until deployment (Homer *et al* 1978). Zip ties connected the chain at each corner and reduced separation of the net panels when in the pre-deployment position. Size 4 diamond braid line (1.6 cm (1/8 in.), 500 lb. test) was tied to each surveyor steel pin and a snap swivel was attached to the end. Snap swivels were clipped to a central ring which attached to a single rope (main line). The end of the main line was 30 m (100 ft) from the trap and was connected to another PVC post for later retrieval (Homer *et al* 1978).

Deployment

Each trap was set in pre-deployment position and left alone for a minimum of one hour prior to dropping the net to minimize disturbance effects (Homer *et al* 1978). After the trap was deployed by pulling the main line, the lead line was tapped into the bottom to prevent escapement and the Velcro® corners checked to confirm closure. A 4.6 m (15 ft) bag seine with 0.6 cm (¼ in.) mesh wings was used inside the net to collect specimens. Seining continued until one empty haul occurred (Steele, *et al* 2006). Specimens from all seine hauls were placed into one tub for processing.

Water Quality and Physical Characteristics

Physical and chemical data were documented at each sampling location after the trap was deployed (Homer *et al* 1978). 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 data sheet printed on Rite in the Rain All Weather paper.

Salinity, water temperature, and DO were taken with a Yellow Springs Instrument (YSI) 30 at 30 cm (1 foot) below the surface at each site. The YSI cord was marked in 30 cm intervals and the probe had a 26 ounce weight attached to it with a string that measured 30 cm. The weight was used to keep the probe at the proper depth and as vertical as possible. The YSI was calibrated daily, and the unit was turned on at the beginning of each day and left on from that time until the last site readings were taken that day.

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. A biologist marked the position on the string with their fingers and measured the length of the string to the end of the disk.

Wind speed measurements were acquired using a La Crosse handheld anemometer with digital readout. Measurements were taken facing into the wind. Tidal states were estimated by looking at fixed objects when possible, and checking the published tide tables for the sampled areas.

Sample Processing

Fishes were identified, counted, and measured using a wooden millimeter (mm) measuring board with a 90° right angle. Total Length (TL) measurements were taken for most fishes. The first 20 fish of each species were measured and the remainder counted.

Small quantities (generally ≤ 10) of invertebrates were counted although blue crabs (*Callinectes sapidus*) were measured for carapace width, sexed, and maturity status determined. Sex and maturity categories included: male, immature female, mature female (sook), and mature female with eggs.

Results

Overall, 12 species of fishes and crustaceans were collected from monthly samples taken June through September (Tables 1 and 2). Four fishes (black sea bass (*Centropristis striata*), northern pipefish (*Syngnathus fuscus*), spot (*Leiostomus xanthurus*), and striped anchovy (*Anchoa hepsetus*)) and one crustacean, (Say mud crab (*Dyspanopeus sayi*)), were not previously captured in the first year of sampling (2007). Three fishes captured in 2007 were not captured in 2008 (oystertoad fish (*Opsanus tau*), silver perch (*Bairdiella chrysoura*), and summer flounder (*Paralichthys dentatus*)). Two additional species collected in 2008 were sponge (Porifera; 0.02 L) and comb jellies (Ctenophora*;* 2 L).

Since monthly catches were small, data were grouped. Vegetated samples had higher catches of fishes and crustaceans (406) versus 13 from non-vegetated (Tables 3 and 4). The highest catch for fishes and crustaceans at the vegetated site occurred in September (183 individuals) followed by June (117 individuals). June was the best catch month for sampling over non-vegetated (8 individuals). The dominant species captured in the monthly vegetated samples were grass shrimp (*Palaemonetes sp*.) with the exception of bay anchovies (*Anchoa hepsetus*) in August. Catch was too small to make a similar statement for non-vegetated samples.

Sample sizes were too small to compare lengths from the drop nets samples with those collected from nearby trawl and beach seine sites. All measured species were considered for this analysis.

Small amounts of macroalgae were collected from both sites although the vegetated site had more (Table 5). Graceful Red Weed (Gracilaria sp.) was the dominant macroalgae collected at both sites although sea lettuce (Ulva sp.)was nearly as dominant in the non-vegetated site.

Discussion

Adding more sampling rounds (June and July) did provide more data on peak catches than in 2007 (August and September); however, finfish catches were small. Smaller catches were expected during the hottest months of summer because eel grass is known for summer defoliation and die backs (Rhode and Duffy 2004). Due to the defoliation and die backs the shoot density may have changed, offering less desirable habitat.

The months with the highest catch in vegetated areas coincided with the CBFI Beach Seine Survey, which takes place in June and September. However, sample sizes were too small to compare fish lengths between gears on an annual or monthly basis. It is recommended to research the statistical validity of grouping data from previous years since increasing sample size was not a viable option at this time. Spot, bay anchovies, Atlantic silversides, and blue crabs are candidate species for that type of analysis if enough lengths were obtained.

Although current staffing issues limited the number of samples, this gear met the primary objective of monitoring SAV to develop a species list. With additional sampling years, data collected from this study could meet objective two of comparing lengths of fishes from the drop net samples with those from nearby trawl and beach seine sites. Therefore, it is recommended that this study continue at its present location and frequency for 2009 and be re-evaluated at the end of the season.

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List of Tables

Table 1. List of fishes collected during the 2008 Drop Net Study in Sinepuxent Bay, Maryland from June through September, n=113.

Common Name	Scientific Name	Number Collected Vegetated/Non-vegetated	Total
Anchovy, Bay	*Anchoa mitchilli*	45/0	45
Anchovy, Striped	*Anchoa hepsetus*	1/0	1
Atlantic Silverside	*Menidia menidia*	11/2	13
Black Sea Bass	*Centropristis striata*	1/0	1
Pipefish, Dusky	*Syngnathus floridae*	12/1	13
Pipefish, Northern	*Syngnathus fuscus*	3/0	3
Spot	*Leiostomus xanthurus*	32/5	37
Total Fishes		105/8	113

Table 2. List of crustaceans collected during the 2008 Drop Net Study in Sinepuxent Bay, Maryland from June through September, n=304.

Common Name	Scientific Name	Number Collected Vegetated/Non-vegetated	Total
Big Claw Snapping Shrimp	*Alpheus heterochaelis*	6/0	6
Blue Crab	*Callinectes sapidus*	12/3	15
Brown Shrimp	*Farfantepenaeus aztecus*	1/0	1
Grass Shrimp	*Palaemonetes spp.*	280/0	280
Say Mud Crab	*Dyspanopeus sayi*	2/0	2
Total Crustaceans		301/3	304

Table 3. Monthly totals of fish and crustaceans captured by drop net at the vegetated sample location in Sinepuxent Bay, n=406.

Month	Number of Fishes	Number of Crustaceans	Total
June	38	79	117
July	8	29	37
August	44	25	69
September	15	168	183
Totals	105	301	406

Table 4. Monthly totals of fish and crustaceans captured by drop net at the non-vegetated sample location in Sinepuxent Bay, n=13.

Month	Number of Fishes	Number of Crustaceans	Total
June	5	3	8
July	2	1	3
August	1	0	1
September	0	1	1
Totals	8	5	13

Table 5. List of macroalgae and Submerged Aquatic Vegetation (SAV) collected during the 2008 Drop Net Study in Sinepuxent Bay, Maryland from June through September.

Common Name	Scientific Name	Volume (L) Collected Vegetated/Non-vegetated	Total Volume (L)
Macroalgae			
Agardh's Red Weed	*Agardhiella tenera*	0/0.01	0.1
Banded Weeds	*Ceramium Sp.*	0.03/0	0.03
Graceful Red Weed	*Gracilaria Sp.*	3.5/0.53	4.03
Green Hair Algae	*Chaetomorpha Sp.*	0.05/0	0.05
Hollow Green Weed	*Enteromorpha Spp.*	0/0.01	0.01
Sea Lettuce	*Ulva Sp.*	0/0.05	0.05
	Totals	3.58/0.68	4.26
SAV			
Eel Grass	*Zostera marina*	5.22/0.22	5.44

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. Off-shore 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

Offshore commercial sampling trips were conducted on August 6, October 7 and December 8, 2008. The August trip targeted horseshoe crabs for bait and biomedical harvest, and October trip targeted horseshoe crabs for biomedical harvest only. The December trip target was summer flounder. The August and December trips were overnight. Trawl time varied, with trawls times ranging between 10 and 80 minutes. Shorter trawl times were associated with trawls targeting horseshoe crabs for biomedical harvest; longer trawl times could result in injuries to these animals.

Gear and Location

Sampling was conducted on commercial trawlers targeting summer flounder and horseshoe crabs. The net was a standard summer flounder bottom trawl net with a 15.24 cm (6.0 inch) mesh net body, with a 13.97 cm (5.5 inches) cod end. Long Range Navigation (LORAN) coordinates were recorded as well as start and stop depths (m) of each trawl sample.

In August and October trawling was conducted approximately two to three miles directly offshore of the Ocean City inlet in an area called the Pound Slew. In December trawling was conducted approximately 26 miles southeast of the Ocean City inlet at a near-shore shoal called the Jackspot.

Depth over the course of the surveys was similar between dates, and ranged from 12.8 m (42.0 feet) to 19.2 m (63.0 feet). On the trip during August the depth trawled ranged from 12.8 m to 17.7 m (42.0 feet to 58 feet). The depth trawled in October ranged from 16.5 m (54.0 feet) to 17.4m (57.0 feet). During Decmeber depths trawled ranged from 14.3 m (47.0 feet) to 19.2 m (63 feet).

Sample Processing

A representative sub-sample of the catch was collected from each haul, and placed into a 1000 Liter (L) tub. The sub-sample to catch ratio was estimated, or the individuals of a species (most often horseshoe crabs) were counted and compared to the harvest number from the same haul. There is a daily limit on how many horseshoe crabs are collected, so the watermen count each horseshoe crab by sex on every haul. This is useful when we are trying to estimate the sub-sample in relation to the total volume of the haul. All fishes were measured for Total Length (TL) in millimeters (mm). Wing span was measured for skates and rays. Horseshoe crabs were measured for prosomal width. Based on morphological differences between male and female spiny dogfish 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.

Water temperature was taken from shipboard transducer, and weather and wind direction and speed were estimated by the sampler.

Data were recorded on a standardized data sheet. Staff biologists consulted the *Peterson Field Guide-Atlantic Seashore* (1978) and *Common and Scientific Names of Fishes from the United States Canada and Mexico Sixth Edition* (2004) for assistance in species identification.

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 estimated by multiplying the number of fish in the sub-sample by the inverse of the proportion of catch the sample represented.

Results:

The mean daily water temperature was 71^0F in August, 67^0 in October, and 50.4^0F in December. Weather varied from partly cloudy to a continuous cloud layer.

From the first sampling in August, 411 individual animals were sampled representing 18 species. On the second trawl date in October, 15 species and 158 individual animals were sampled. On the third trawl trip, 12 species and 268 individual animals were sampled. The predominant species encountered from all the trawls were horseshoe crabs (*Limulus polyphemus*), summer flounder (*Paralichthys dentatus)*, clearnose skates (*Raja eglanteria*), little skates (*Leucoraja erinacea*), spiny dogfish (*Squalus acanthias),)*, and sea stars (*Asterias forbesi;* Table 1).

From all three trips combined a total of 253 summer flounder were collected and measured. Lengths ranged in size from 272 mm (10.7 in.) to 640 mm (25.2 in.) (Figure 1). The mode was 403 mm (15.9 in.) and the mean was 426.3 mm (16.8 in.). The next most numerous fish species encountered was the little skate. The mode and mean were 250 mm (9.8 in.) and 320.1 mm (12.6 in.) respectively.

Fifty-two little skate were measured (Figure 2), of which 26 were males and 26 were females. The mean width for males was 346.5 mm (13.6 in.) and the range for males was 188 mm (7.40 in.) to 760 mm (29.9 in.). The mean width for females was 293.7 mm. (11.6 in.) and the range was 203 mm (8.0 in.) to 485 mm (19.1 in.).

Thirty-seven spiny dogfish were measured, of which 35 were female and 2 were male. The mode and mean were 800 mm (31.5 in.) and 816.2 mm (32.1 in.) and the range for females was 650 mm to 930 mm (Figure 3). The two males were 950 mm and 951 mm.

Prosomal lengths were collected from 263 horseshoe crabs (Figure 4). There were 99 females with a mean carapace width of 220.4 mm (8.7 in.), and 160 males with a mean width of 195.1 mm (7.7 in). The sex could not be definitively determined for four immature individuals.

Discussion:

Sampling was limited in 2008 because of inclement weather and the trawlers doing more multiple day trips which precluded samplers on board. Catches were typical of what had been captured and sampled on trawls in recent years.

The mean length for summer flounder at 423 mm (16.7 in.) was similar to the 432 mm (17.0 in.) mean length in 2006 and 423 mm (16.7 in.) mean length in 2007. This indicates that there is little change in stock structure of the adult population sampled between years, and reflects the consistent recruitment of summer flounder found in the CBFI inshore sampling in recent years. The length frequency plot for summer flounder shows balanced population structure with a good number of adult fish in the population (Figure 1.).

This is the first year that spiny dogfish samples have been sexed. The large percentage of females was unexpected; recent stock assessments for the species have indicated that the inshore component is made up of mostly immature males. Collection of large adult males and females only indicate that this is not a nursery area late in the year samples were collected. The population appears to be recovering from the over-harvest of the late 1990's.

Examining the little skate samples by length and sex indicates that the range of lengths overlaps for males and females, with the males having the larger mean length (346.5 mm). However, little skate length frequencies show two distinct size classes. It would appear that at least two separate age-classes may have been present.

Horseshoe crabs continue to be a productive resource for both biomedical use and bait harvest in the state of Maryland. This survey indicates that the populations appear to be robust (they are easily captured), and supplies rare information to characterize the horseshoe crab fishery. The length-frequency data for horseshoe crabs shows a separation between a juvenile cohort and the adult population. The sex ratio is close to equal in the juvenile portion of the population, and the difference between the male and female adult terminal width can be seen in the right potion of the plot (Figure 4.).

No Atlantic Sturgeon were captured in 2008, however, a few are usually encountered each year. No sampling was done in the spring in 2008 when sturgeon are most frequently captured. Also, there was no mid-water trawl sampling done in 2008, but an attempt is made to get at least one trip in a year. There was very little mid-water trawling done out of Ocean City in 2008, as croaker and weakfish were not abundant in the area.

References:

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

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.

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Table 1. List of species collected in Sub-sampled Commercial Offshore Trawls from August through December 2008 by the Maryland Department of Natural Resources, n=837. Species are grouped (Finfish, Crustaceans, Mollusks, Other) and listed by order of Extrapolated Total Number, n=12,946(Numbers under Total Number Column are extrapolated: Number of individuals multiplied by X factor.). The actual number of animal counts is presented under Total Number Counted (not in order).

Common Name	Scientific Name	Extrapolated Total Number	Total Number Counted
Finfish Species			
Summer Flounder	*Paralichthys dentatus*	2,465	253
Clearnose Skate	*Raja eglanteria*	531	31
Little Skate	*Leucoraja erinacea*	310	52
Spiny Dogfish	*Squalus acanthias*	225	37
Striped Burrfish	*Chilomycterus schoepfii*	199	9
Sand Dab	*Scophthalmus aquosus*	125	18
Atlantic Croaker	*Micropogonias undulates*	59	11
Hogchoker	*Trinectes maculates*	46	2
Spot	*Leiostomus xanthurus*	41	2
Bluefish	*Pomatomus saltatrix*	40	6
Bullnose Ray	*Myliobatis freminvilli*	25	1
Northern Kingfish	*Menticirrhus saxatilis*	16	2
Spotted Hake	*Urophycis regia*	15	1
Red Hake	*Urophycis chuss*	15	1
Butterfish	*Peprilus triacanthus*	6	2
Atlantic Angel Shark	*Squatina dumerili*	-	4
Southern Kingfish	*Menticirrhus americanus*	-	4
Monkfish	*Lophius americanus*	-	1
Northern Puffer	*Sphoeroides maculates*	-	1
	Total Finfish	**4,118**	**438**
Crustacean Species			
Nine-Spined Spider Crab	*Libinia emarginata*	138	3
Rock Crab	*Cancer irroratus*	115	2
Lady Crab	*Ovalipes ocellatus*	75	15
Blue Crab	*Callinectes sapidus*	67	3
Broad-Clawed Hermit	*Pagurus pollicaris*	46	2
American Lobster	*Homarus americanus*	1	1
	Total Crustaceans	**442**	**26**

Table 1 (cont'd). List of species collected in Sub-sampled Commercial Offshore Trawls from August through December 2008 by the Maryland Department of Natural Resources, n=837. Species are grouped (Finfish, Crustaceans, Mollusks, Other) and listed by order of Extrapolated Total Number, n=12,946(Numbers under Total Number Column are extrapolated: Number of individuals multiplied by X factor.). The actual number of animal counts is presented under Total Number Counted (not in order).

Common Name	Scientific Name	Extrapolated Total Number	Total Number Counted
Mollusk Species			
Channeled Whelk	*Busycotypus canaliculatus*	314	13
Knobby Whelk	*Busycon carica*	241	9
Longfin Squid	*Loligo pealeii*	40	6
Lobed Moon Snail	*Polinices duplicatus*	22	1
	Total Mollusks	**617**	**29**
Other Species			
Horseshoe Crab	*Limulus polyphemus*	7,058	263
Sea Star	*Asterias forbesi*	711	81
	Total Other	**7,769**	**344**

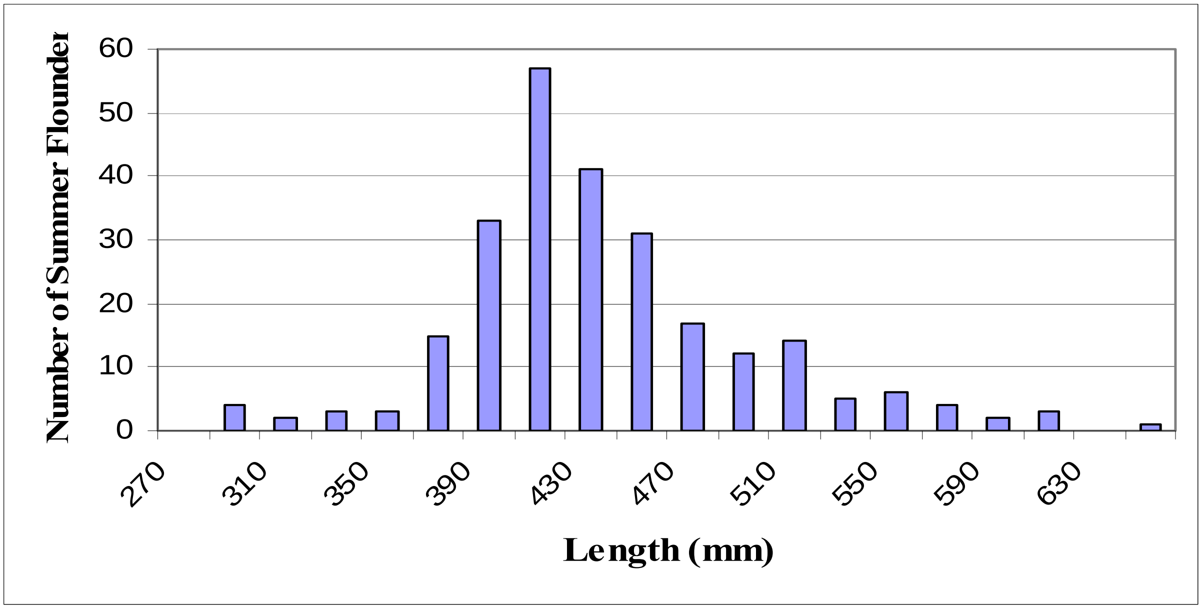

Figure 1. Summer Flounder (*Paralichthys dentatus)* Length Frequency from Commercial Offshore Trawls Sub-sampled by the Maryland Department of Natural Resources during August and December 2008 n=253. Data are derived from three trawl trips taken at different water depths.

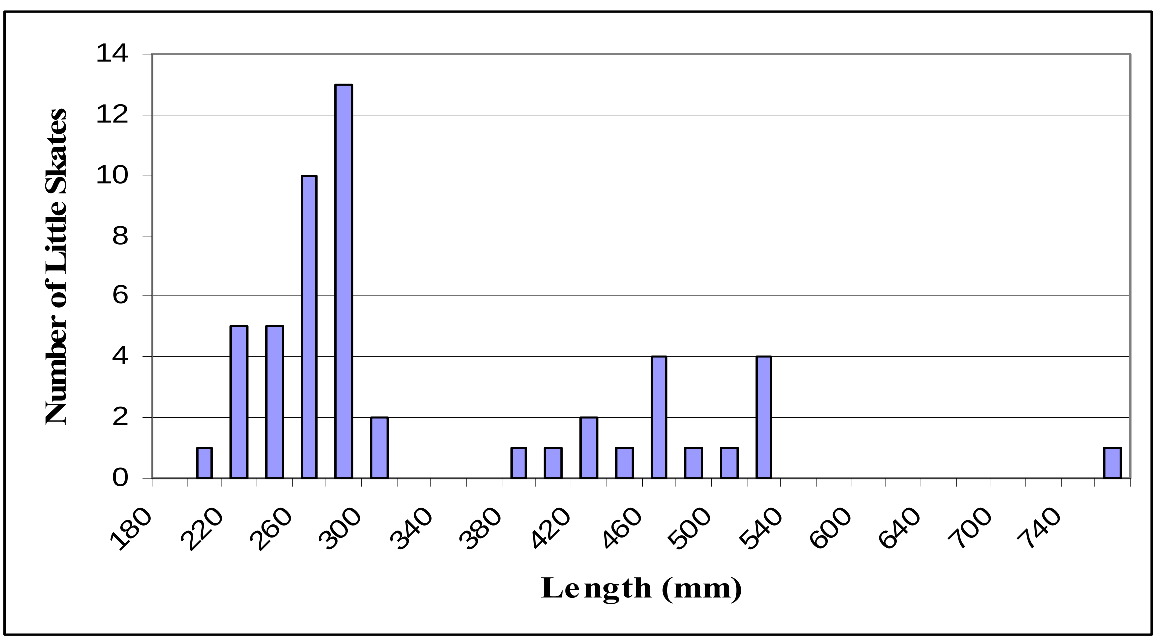

Figure 2. Little Skate (*Leucoraja erinacea)* Length Frequency from Commercial Offshore Trawls Sub-sampled by the Maryland Department of Natural Resources between August and December 2008 n= 52. Data are derived from three trawl trips taken at different water depths.

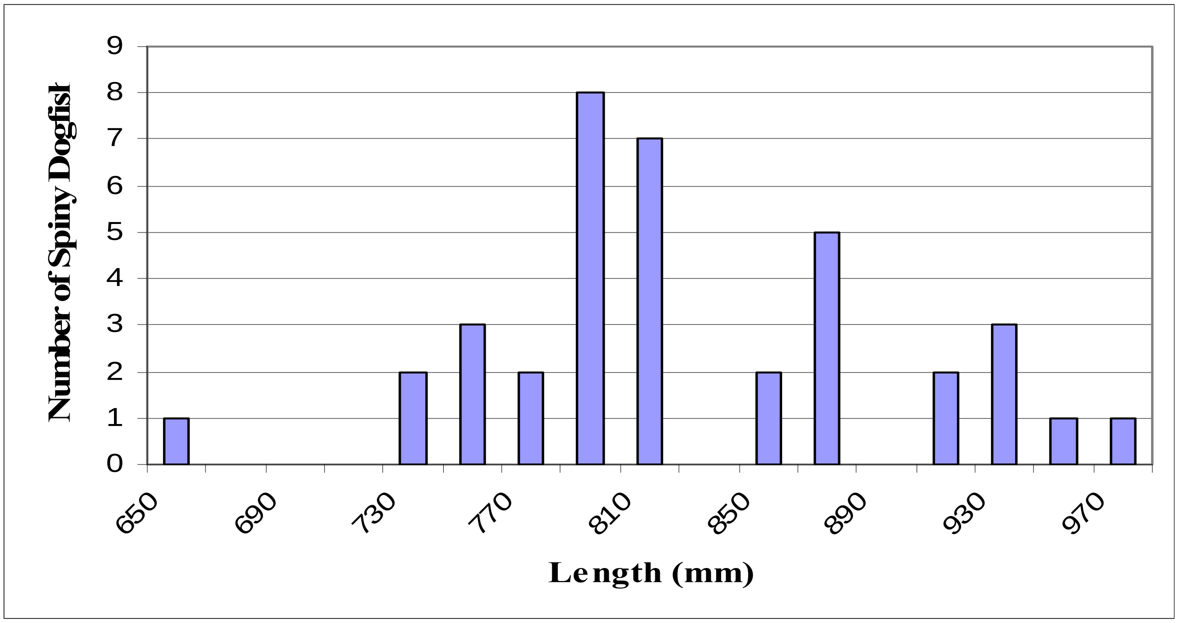

Figure 3. Spiny Dogfish (*Squalus acanthias*) Length Frequency from Commercial Offshore Trawls Sub-sampled by the Maryland Department of Natural Resources during August and December 2008 n= 37. Data is derived from three trawl trips taken at different water depths.

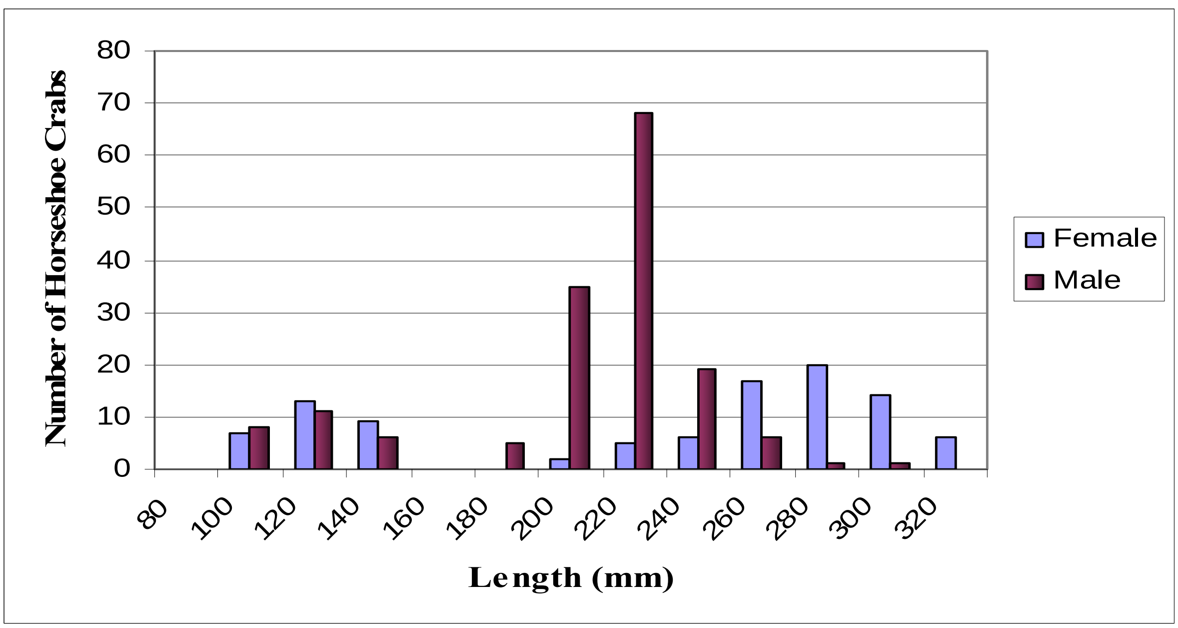

Figure 4. Horseshoe Crabs (*Limulus polyphemus*) Length Frequency from Commercial Offshore Trawls Sub-sampled by the Maryland Department of Natural Resources during August and December 2008 n= 263. Data is derived from three trawl trips taken at different water depths.

Chapter 4

2008 Seafood Dealer Catch Monitoring

Introduction:

Dockside data have been collected for several years 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*). The ASMFC weakfish stock assessment committee uses age and size information of commercially harvested fish along the Atlantic Coast to develop coastwise assessments for this species.

Methods:

Weakfish were purchased from local seafood dealers between November 12th and November 25th, 2008. These fish were measured for Total Length (TL) in millimeters (mm), weighed to the nearest gram (g), and sexed. Otoliths were extracted and sent to South Carolina Department of Natural Resources for ageing.

Results and Discussion:

A total of 94 weakfish were sampled from the commercial harvest in 2008. These fish had a mean length of 354.3 mm (13.9 inches; ranges 280-495 mm, 95% CI: $\pm$ 8.9). Mean weight was 496.0 g (1.09 lbs.; range 265-1220 g; 95% CI: $\pm$ 41.3). Table 1 is a table of mean lengths, weights and ages by sex. The sex for two of the fish was unknown. Age data was not available for three females. By comparing size distribution (i.e. length and weight) by sex, one can conclude that the size range of females harvested was larger than the males for both 2008 and 2007 (Figures 1 and 2). Gear specific comparison of the data from 2007 indicated that trawl gear appeared to capture a wider range of lengths when compared to the gillnet harvest (Figure 3).

At the time of last year's report, the ages for weakfish were not available. For 2007, the fish ranged in age from one to four years (yrs.) with a mean age of 2.0 years. For two specimens, age data was not available.

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Table 1. Average Weight, Lengths and Age (with Range) for Commercially Caught Weakfish out of Ocean City, Maryland in 2008 with a Bottom Trawl. Average Weight and Length n=92. Average Age, n=89.

Gender (n)	Avg. Weight (g)	Avg. Length (mm)	Avg. Age (yrs.)
Male (17)	447.5 (300-1080)	345.6 (294-470)	1.1 (1-2)
Female (75)	512.2 (265-1220)	357.4 (280-495)	1.5 (1-3)

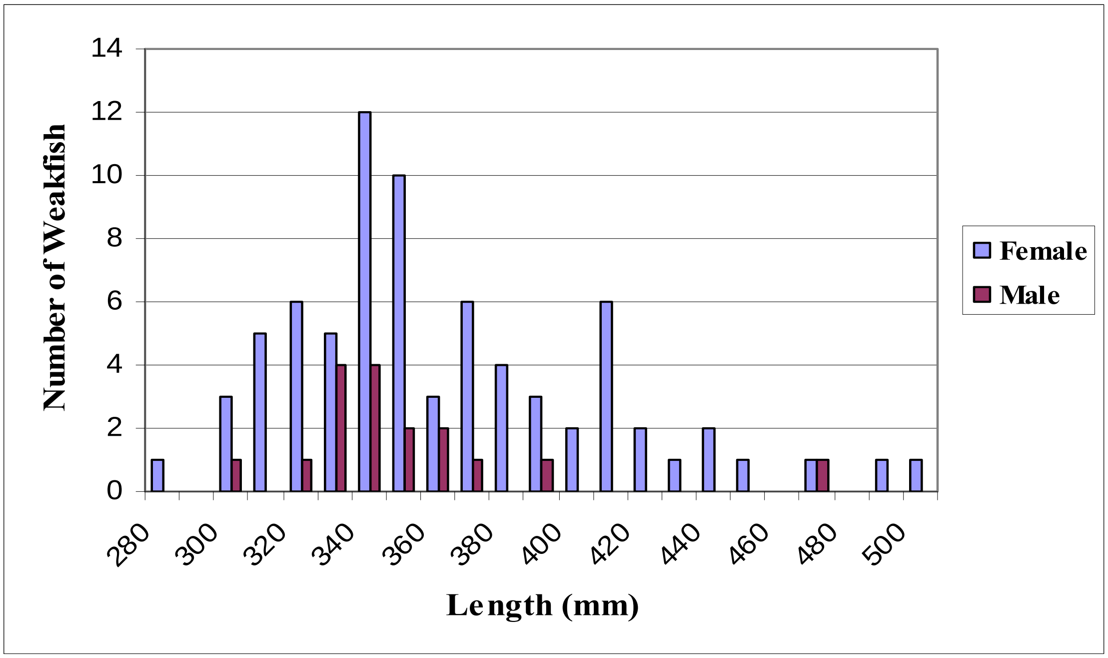

Figure 1. Weakfish (*Cynoscion regalis)* Male versus Female Length Frequency from Commercial Offshore Trawls Sub-sampled by the Maryland Department of Natural Resources in 2008, n=92. The sex of two fish was unknown.

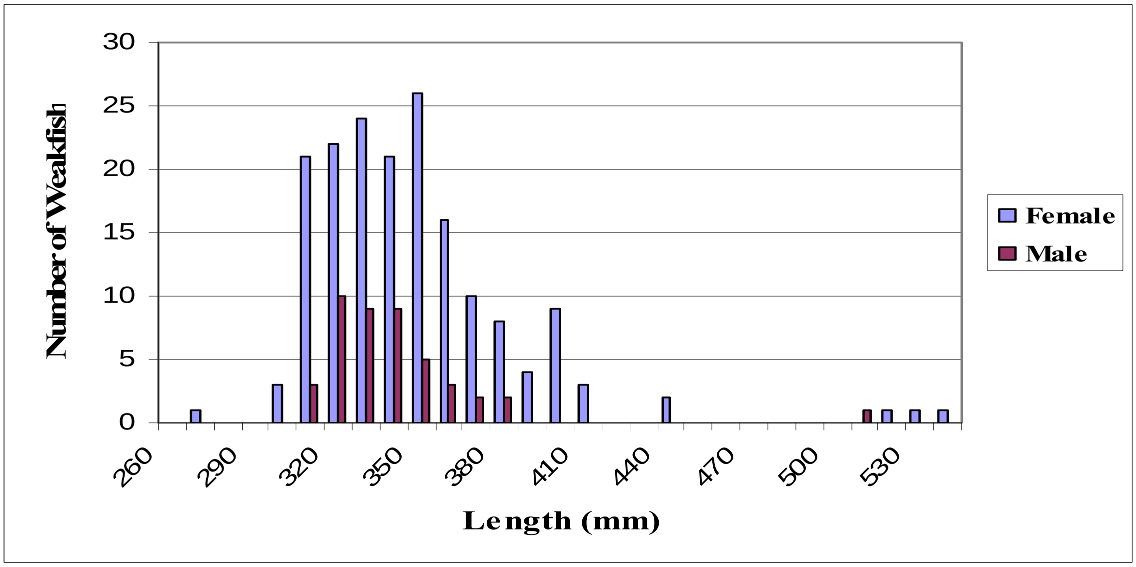

Figure 2. Weakfish (*Cynoscion regalis)* Male versus Female Length Frequency from Commercial Offshore Trawls and Gillnets Sub-sampled by the Maryland Department of Natural Resources in 2007, n=217.

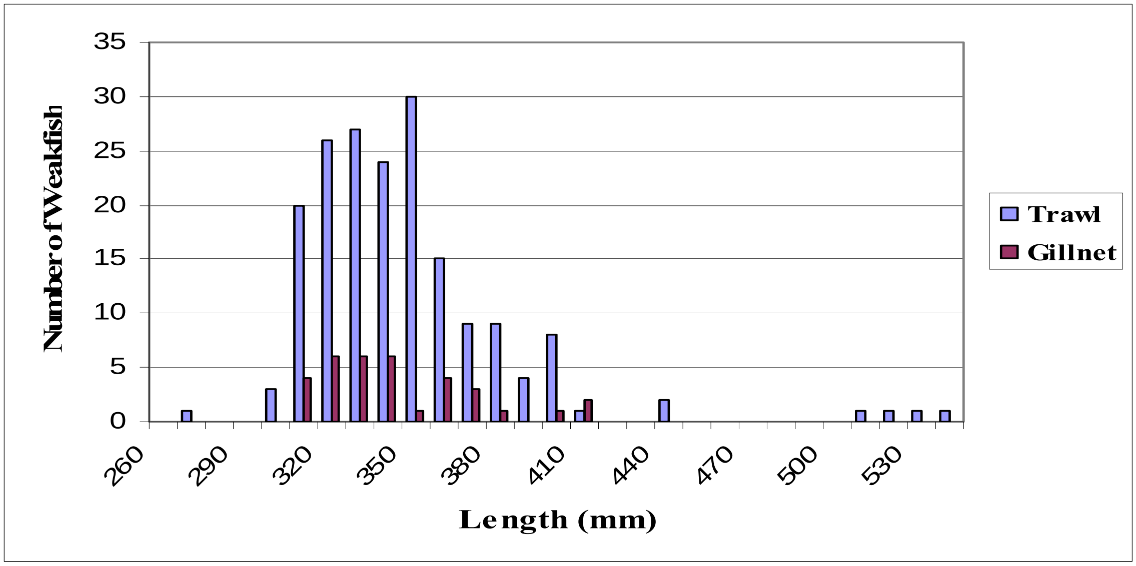

Figure 3. Weakfish (*Cynoscion regalis)* Length Frequency comparison between Commercial Offshore Trawls and Gillnets Sub-sampled by the Maryland Department of Natural Resources in 2007, n=217.

Chapter 5

Maryland Volunteer Angler Summer Flounder Survey (MVASFS)

Introduction:

The MVASFS began in 2002 after anglers expressed dissatisfaction with the Marine Recreational Fisheries Statistical Survey (MRFSS) harvest numbers which resulted in an increase in the minimum size and a creel reduction. Data collected from this survey have been used by the Maryland Department of Natural Resources (MDNR) Fisheries Service for the following:

- to fulfill the Atlantic States Marine Fisheries Commission reporting requirements in conjunction with other recreational flounder harvest data;
- to determine whether a certain size and creel limit affected the Chesapeake Bay differently than the Atlantic Coast;
- characterize the recreational catch of Summer Flounder (SF) in Maryland; and
- promote public participation in fisheries management and data collection.

In addition to Maryland's direct use of this survey, these data also influence management decisions along the Atlantic Coast. Fisheries managers in Virginia and Delaware have used these data for estimating creel and size limits. Until the state of Connecticut started a similar program, the MVASFS was one of the only sources of discard data for the recreational summer flounder fishery along the Atlantic coast.

Methods:

Data Collection

The survey was promoted by outdoor columnists writing for large local newspapers (Baltimore Sun, Washington Times, and Annapolis Capital) as well as several smaller newspapers catering to the maritime industry. Local sport fishing organizations, tackle shops, and marinas also promoted voluntary participation via newsletters, announcements at meetings, and Internet content. A brief description of the survey with contact information was included with fishing license sales in 2008 (Figure 1). Additional promotional techniques included:

- presentations to three different fishing clubs;
- 2008 summary content in the MDNR 2008 Fishing Report Year in Review http://www.dnr.state.md.us/fisheries/fishingreport/ (Figure 2);
- advertisements on the MDNR website home page http://www.dnr.state.md.us/fisheries/ (Figure 3);
- content on the Coastal Conservation Association-Maryland chapter website http://www.ccamd.org;
- distribution of survey materials (instruction sheets, paper forms, postage paid return envelopes, survey business cards, and summary of previous years results) at three winter fishing shows (Timonium Bass Expo & Boat Show, Pasadena Sportfishing Flea Market, and the Eastern Sports & Outdoor Show in Harrisburg, PA (Figures 4-6);
- printed MVASFS form in the weekly *Coastal Fisherman* in the summer of 2008 (Figure 7);

- post card survey form, specific to the Ocean City, MD area distributed at local sportfishing meetings, the 2008 Waterman's Expo, and area tackle shops (Figure 8).

The survey operated from April through the end of October 2008. In September 2008, managers predicted that recreational anglers overharvested; therefore, an emergency regulation closed the fishery six days before the end of this survey. Recreational anglers, charterboat captains, and partyboats were asked to count the total number of fish caught, measure only the first 20 summer flounder to the nearest ¼ of an inch, and indicate fate of fish (kept or released). Data collected included: number of anglers, time spent fishing, area fished, mode, and method used. Anglers were requested to complete a survey for trips targeting SF even if no fish were caught. All survey information was required to be submitted online or mailed by November 1st. Anglers were reminded not to submit the same information twice (i.e. use multiple reporting methods). Survey forms received in the mail were entered into the online survey to simplify data storage.

Statistical Analysis

After December 4, 2008 the data were downloaded, cleaned and descriptive statistics were calculated using Microsoft Excel. Descriptive statistics included total number of trips, total number of trips where no fish were caught, total number of anglers, total number of individuals that submitted a survey(s), total number of fish caught, total number of fish measured, total number of fish kept, total number of fish released, percent of legal sized fish in the survey, and mean length. An Analysis of Variance (ANOVA) was performed using Statistical Analysis Software (SAS) to determine if annual mean lengths were significantly different.

Length frequency was calculated for various Atlantic fishing modes (*Bay Bee*, private boat, and shore) to gather length information on encountered fish (Figure 9). All lengths were truncated and placed into one-inch intervals.

The partyboat, *Bay Bee*, submitted length data from its twice daily flounder fishing trips from April through October. The MVASFS 2002-2008 Atlantic data were reviewed to determine if *Bay Bee* data created bias in the survey results. For each year, a chi-square test of independence was performed to determine if a significant difference in the length frequency developed from *Bay Bee* data and measurements from all other recreational anglers' data.

Results and Discussion:

Individual participation, total number of trips, and reported catch for the 2008 Atlantic Coast survey was lower than 2007; however, those results were within the limits seen over the times series of this volunteer angler survey (Table 1). A decrease in trips may be attributed to increases in fuel costs early in the season and an increase in the minimum size limit.

The average length of measured seaside SF was 13.4 inches in 2008 (Table 1). An ANOVA test was preformed and found that the 2008 mean length of 13.4 inches was within the range of mean lengths observed in the time series of this survey (Table 1, Figure 10). Overall, 8% of the measured catch was equal to or greater than the 17.5 inch minimum size. A decrease in the percent of overall catch was expected because of an increase of the minimum size limit.

A chi-square test was performed to determine if there was a significant difference in the length frequency developed from *Bay Bee* data versus recreational angler data. Results from that test indicated no difference ($p = 0.300$). Therefore, *Bay Bee* measurements were pooled with data from recreational anglers to create an overall length frequency.

Historically, Catch Per Unit Effort (CPUE) was developed from the data. However, an examination of 2008 data revealed significant differences in Catch per Angler Trip by fishing mode. It was realized that the historical approach of pooling the data to create an overall angler CPUE was violating an assumption of insignificant difference by mode. Annual CPUEs developed from these data are biased according to the proportions of participants by mode of fishing. Because this survey cannot provide appropriate weighting factors, it cannot calculate a weighted overall CPUE. Therefore, results based on proportions by anglers are inappropriate. CPUE will no longer be calculated.

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Table 1. Summary of Summer Flounder Regulations and MVASFS data for the Atlantic Coastal Bays 2004–2008.

Year	2004	2005	2006	2007	2008
Regulations Creel @ Minimum Size (inches)	3 @ 16	4 @ 15.5	4 @ 15.5	4 @ 15.5	3 @ 17.5
Number of Individuals Submitting Surveys	103	65	46	166	105
Total Number of Trips	658	496	559	1098	829
Total Number of Trips without catches (Skunked Trips)	86	42	58	114	88
Total Number SF Caught	16,800	7,204	7,385	15,064	10,745
Kept	947	855	1,423	1,625	685
Released	15,853	6,349	5,962	13,439	10,060
Total Number SF Measured	6,421	4,549	4,952	9,563	7,291
Measured and Kept	502	619	1,026	1,325	499
Measured and Released	5,759	3,898	3,922	8,119	6,520
Unknown Fate	160	32	4	119	0
Mean Length (inches) of Measured SF	13.5	13.4	13.8	13.1	13.4
% of Measured SF ≥ Minimum Size	8%	13%	22%	15%	8%

Get Involved With Chesapeake Bay and Atlantic Coast Striped Bass and Summer Flounder Management!

The Cooperative Angler Striped Bass and Volunteer Angler Summer Flounder surveys are designed to obtain recreational harvest and release data that are not otherwise available to the MD DNR. Simply by submitting your fishing trip information when targeting these species, you can become an active participant in their management. To learn more or to become involved with the Cooperative Angler Striped Bass Survey, contact Harry T. Hornick at 1-877-620-8DNR ext. 8305 or via email at hhornick@dnr.state.md.us. Participate online at URL: http://www.dnr.state.md.us/fisheries/survey/sbsurveyintro.shtml.

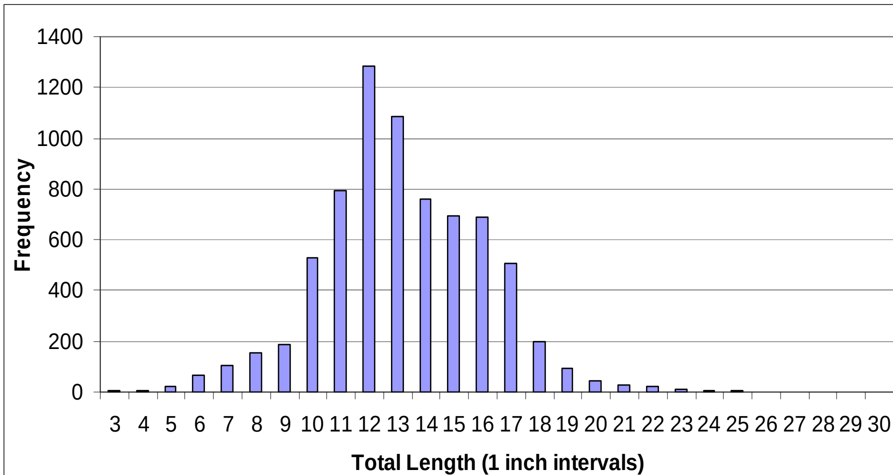
For information on the Volunteer Angler Summer Flounder Survey, contact Allison Luettel at 1-877-620-8DNR or via email at aluettel@dnr.state.md.us. Participate online at URL: http://www.dnr.state.md.us/fisheries/survey/sfsurveyintro.shtml.

Figure 1. MVASFS promotional message printed with all 2008 Maryland fishing license sales.

Maryland Department of Natural Resources (DNR) Fisheries Service
2008 Maryland Volunteer Angler Summer Flounder Survey Summary
December 2008

THE ANGLERS...

- 5,548 anglers fished
- 130 anglers reported
- Most were from MD, PA, DE
- 27% belonged to an organization



Length frequency of kept and released 2008 Atlantic Coast and Chesapeake Bay fish from the Maryland Volunteer Angler Summer Flounder Survey, n = 7,299.

THE FISH...

- 11,056 fish reported caught
- 7,299 fish measured
- Average length: 13.4 inches
- The length distribution of the overall summer flounder catch has been steady for the past 7 years (2002-2008).

THE TRIPS...

- 883 trips reported: 829 trips along the Atlantic Coast (94%), 54 trips in the Chesapeake Bay (6%).
- 93 skunked trips: 88 Atlantic coast (10%), 5 Chesapeake Bay (0.01%).

USES OF THESE DATA...
These data are used to calculate:

- population length distribution;
- perform creel (minimum size) analysis;
- and guide the management approach for Atlantic vs. Chesapeake Bay populations.

CONCLUSIONS...
Your participation in this survey is VERY important to summer flounder management along the East Coast. In addition to Maryland DNR, neighboring states of Delaware and Virginia have used these data to guide their management decisions for establishing creel, minimum size, and season limits. The success of this survey resulted in other states implementing a similar program.

For 2009, please continue to:

- encourage others to participate, including friends fishing the Chesapeake Bay where the average number of trips for the past few years is 30;
- measure to the nearest ¼ inch (very important for determining minimum size limits);
- continue to report trips where summer flounder were targeted but none were caught.

Figure 2. 2008 MVASFS Angler summary for the MDNR Fishing Report, winter edition (Jan. 2009).

MARYLAND
DEPARTMENT OF
NATURAL RESOURCES

DNR Encourages Anglers To Take Part In Summer Flounder Survey

Annual Survey Runs Until October, Provides Valuable Management Data

ANNAPOLIS, MD — With the summer fishing season underway, the Maryland Department of Natural Resources encourages anglers to participate in the Maryland Volunteer Angler Summer Flounder Survey to provide input to the management of one of the state's valuable commercial and recreational fisheries. DNR uses the survey to establish minimum size and creel limits for the season.

"Angler participation in this program is integral to the establishment of recreational limits for summer flounder," said Mike Luisi, DNR biologist. "Collecting data on these fish before they are returned to the water allows us to better understand the size distribution of flounder residing in Maryland waters."

The data will help guide the DNR's management approach for both the Chesapeake Bay and Atlantic Coast populations. In addition, it will be used to augment and enhance existing data from the National Marine Fisheries Services' Marine Recreational Fisheries Statistics Survey.

The average length of flounder caught has held relatively steady for the past six years, and in 2007 was 13.1 inches. In 2007 anglers reported 15,427 fish caught during 1,166 trips. Most angler activity occurred along the Atlantic coast, with less than 5 percent taking place in the Chesapeake Bay.

Anglers are asked to measure to the nearest ¼ inch and to include trips where summer flounder were targeted but not caught. DNR hopes to improve reporting this year from anglers targeting summer flounder in the Chesapeake Bay.

The survey runs from April to October of each year. To learn more or to participate in the survey online, visit http://www.dnr.maryland.gov/fisheries/survey/sfsurveyintro.html. Information and survey packets are also available by mail, through contacting Allison Luettel at 410-260-8343 or aluettel@dnr.state.md.us.

Flounder seekers are also encouraged to enter their catch in the 2008 Maryland Fishing Challenge this summer. Any angler who catches a citation award qualifying fish will be eligible to win one of the several grand prizes including, including a 2008 Toyota Tundra 4x4 pickup truck from Central Atlantic Toyota, a boat and trailer from Bass Pro Shops and $5,000 in fishing gear from Bill's Outdoor Center. More than 60 species of fish are eligible for the grand prizes in the summer-long contest that runs through Sept. 1.

Figure 3. Text placed on the MD DNR Home Page to promote the survey. This was advertised for a week each on March 31, 2008 and July 10, 2008.

Volunteer Angler Summer Flounder Survey Instructions

Thank you for interest in the Summer Flounder Volunteer Angler Survey. The information you provide will help the Maryland Department of Natural Resources obtain length data from summer flounder caught by recreational anglers in Chesapeake Bay and along the Atlantic Coast. In addition, the survey data will be used to augment and enhance existing federal data from the National Marine Fisheries Services' (NMFS) Marine Recreational Fisheries Statistics Survey (MRFSS).

- The survey will run through October of each year.
- All survey information must be submitted online or mailed by November 1st of the current year.
- Information may be submitted online or through the mail.
  Mailing to: Maryland Department of Natural Resources
  Fisheries Service
  Tawes State Office Building, B-2
  580 Taylor Ave.
  Annapolis, MD 21401
- If you submit the information online, please DO NOT mail in a paper version.
- Please fill out one survey for each trip even if no fish are caught.
- If more than one survey participant is fishing on the same boat, only one designated individual should fill out the survey form for the group for that day.
- Please record your legal first name. Please do not use abbreviations or nick names.
- Please record your legal last name.
- Please record your phone number.
- Please record the date that you are completing the form.
- Please indicate if you are a member of the Coastal Conservation Association (CCA), Maryland Saltwater Sports Fishermen's Association (MSSA), or Pasadena Sportfishing Group.
- Please record your location code on the survey form. The location codes may be found on the map on the back of the survey form.
- Please record the date of the fishing trip.
- Please record the time that the fishing trip started.
- Please provide the number of hours that fishing lines were in the water.
- Please provide the number of anglers on the trip.
- Please circle where you fished from on the survey form.
- Please circle what method was used to target summer flounder.
- Please record the total number of flounder your party kept and the total number of flounder your party released.
- Please record the total number of fish you caught. However, record the length for ***only*** the first 20 summer flounder you catch. It is very important to record the lengths from the first 20 fish whether they are kept or released. Do not provide a range of sizes (ex. 5 fish 17 - 22 in).

If you have further questions contact Allison Luettel via e-mail customerservice@dnr.state.md.us, or call 1-877-620-8DNR.

Figure 4. Instructions provided with paper forms for the 2008 MVASFS.

Summer Flounder Survey Form

First Name:__________________ Last Name: ___________________________

Phone No. _______ - _______ - ________ Today's Date:_________________________

Member of CCA, MSSA, or Pasadena Sportfish Yes:___ No:___

Location Code (See Map): _________ Date Fished:_________________________

Time Start: ________________AM./PM. Hours Fished:________________________

Number of Anglers: ____ Fished from (circle one): shore • surf • pier • boat • charter

Method (circle one): drifting • trolling • casting • bottom fishing • fly fishing

Catch Information

Total number of summer flounder kept:____ Total number of summer flounder released:____

For each trip, measure the first 20 summer flounder caught to the ¼", whether kept or released.

Place an X or √ in the appropriate column to indicate if the fish was kept or released.

Count	Total Length	Kept	Released
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			

Figure 5. Copy of the MVASFS paper form.

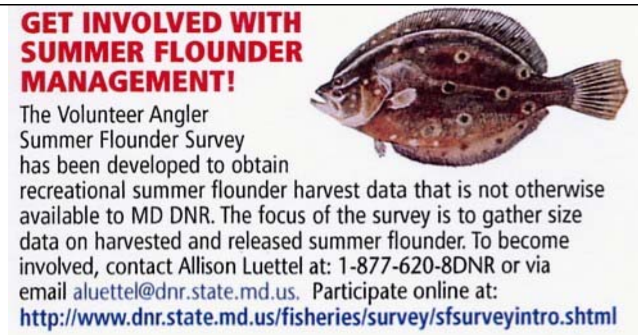


Figure 6. Copy of the MVASFS business cards, which were distributed at fishing shows, Maryland Sport Fishing Tournament Citation Centers, and presentations.

CF **Maryland Volunteer Angler Summer Flounder Survey**

Please mail survey for each trip to:
Maryland Dept. Natural Resources
Tawes State Office Building, B-2
ATTN: Summer Flounder Survey
580 Taylor Avenue
Annapolis, MD 21401

Name: ______________________

Phone Number: _______ - _______ - ________

Date: ________________

Location Code (circle one): Atlantic Ocean 012
Assawoman Bay 001 Isle of Wight Bay 049
Sinepuxent Bay 084 Chincoteague Bay 033

Time Started: _____ am/pm Hours Fished: _____

Number of Anglers: ________

Fished from (circle one): Shore Boat Pier Surf

Fishing Method (circle one):
Bottom Fishing Drifting Trolling

CATCH INFORMATION

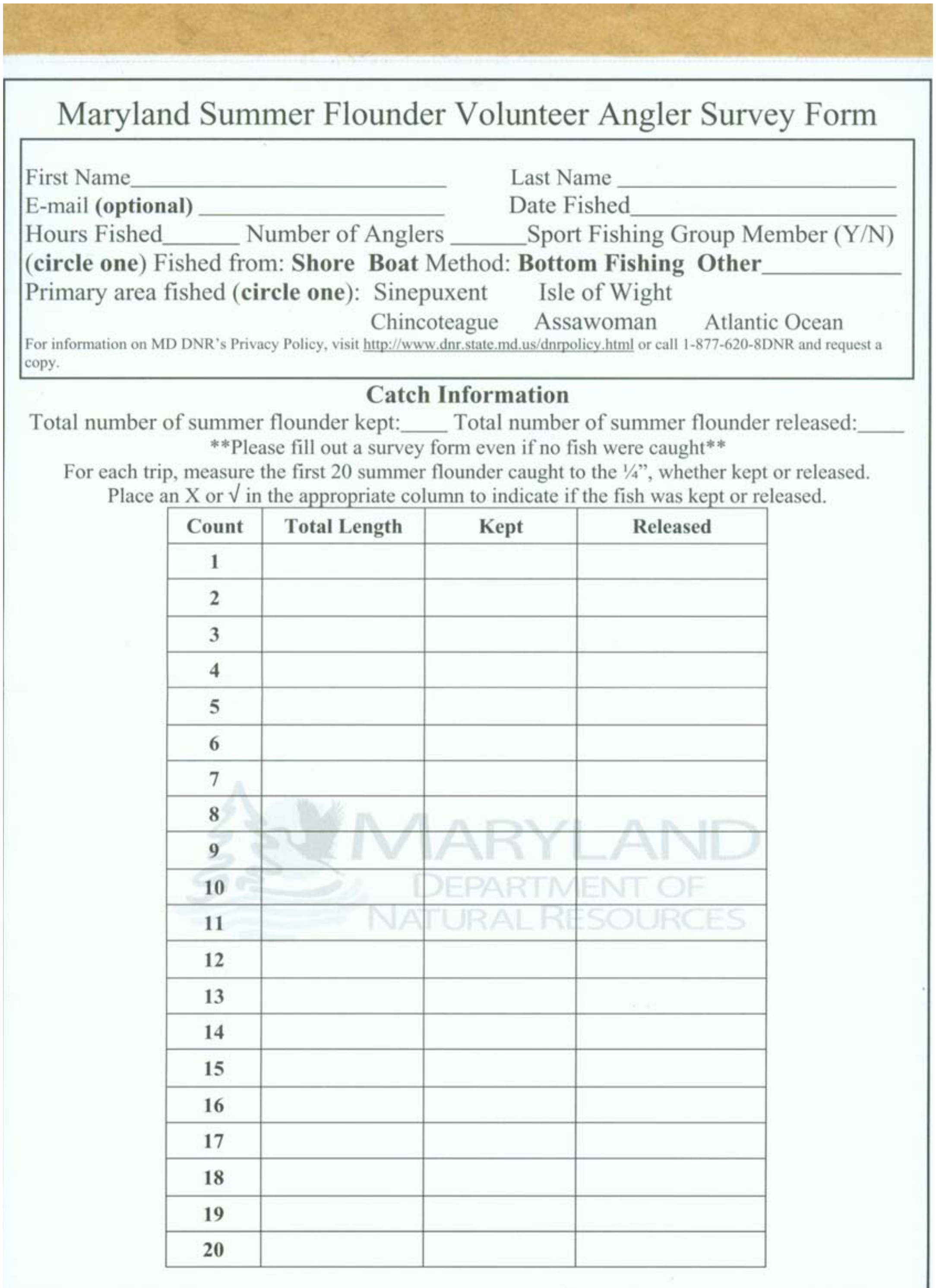
Total # of Summer Flounder Kept: ______

Total # of Summer Flounder Released: ______

For each trip, measure each summer flounder caught, kept or released, up to a maximum of 20. Place an "X" in the appropriate kept or released box for each summer flounder caught. If you don't catch any flounder during your trip, still complete the survey and mail to the Maryland DNR.

Length	Kept	Released	Length	Kept	Released

Figure 7. Copy of the MVASFS form printed weekly in the *Coastal Fisherman* in the summer of 2008.



Maryland Summer Flounder Volunteer Angler Survey Form

First Name______________________________ Last Name ___________________________
E-mail **(optional)** _______________________ Date Fished_________________________
Hours Fished_______ Number of Anglers _______Sport Fishing Group Member (Y/N)
(**circle one**) Fished from: **Shore Boat** Method: **Bottom Fishing Other**____________
Primary area fished (**circle one**): Sinepuxent Isle of Wight
Chincoteague Assawoman Atlantic Ocean

For information on MD DNR's Privacy Policy, visit http://www.dnr.state.md.us/dnrpolicy.html or call 1-877-620-8DNR and request a copy.

Catch Information

Total number of summer flounder kept:____ Total number of summer flounder released:____

Please fill out a survey form even if no fish were caught

For each trip, measure the first 20 summer flounder caught to the ¼", whether kept or released.
Place an X or √ in the appropriate column to indicate if the fish was kept or released.

Count	Total Length	Kept	Released
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			

Figure 8. Copy of the MVASFS postcard form that was available at local sportfishing meetings, the 2008 Waterman's Expo, and area tackle shops.

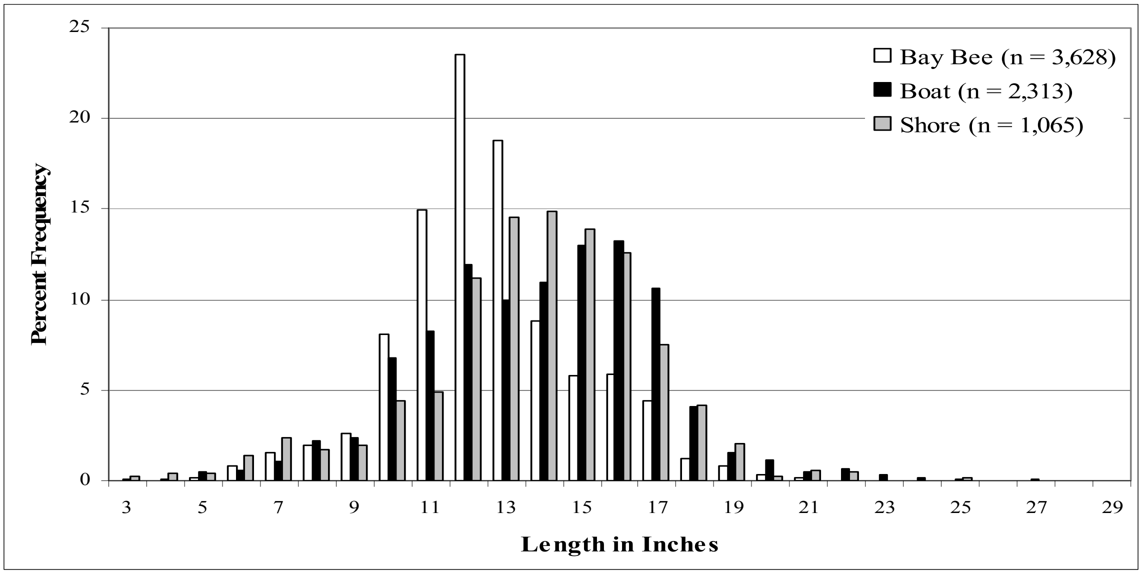


Figure 9. Percent length frequency of kept and released 2008 Atlantic Coast measured data by mode collected from the Maryland Volunteer Angler Summer Flounder Survey, n = 7,006 (13 fish lengths were listed without a fishing mode).

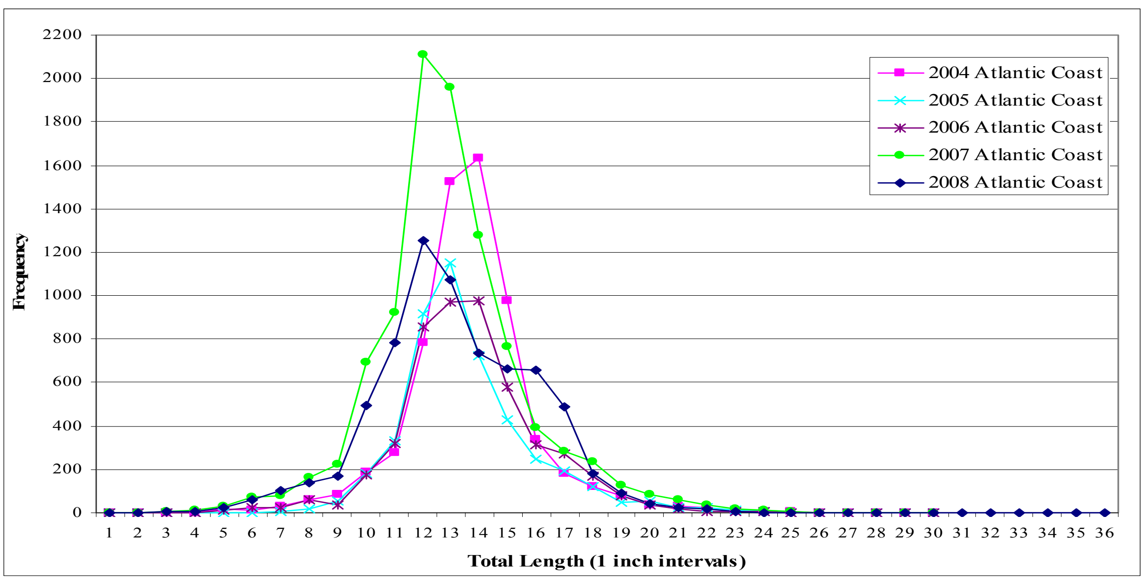


Figure 10. Length frequency of kept and released 2004-2008 Atlantic Coast measured data collected from the Maryland Volunteer Angler Summer Flounder Survey, n = 32,504 (2004 = 6,421, 2005 = 4,549, 2006 = 4,952, 2007 = 9,563, 2008 = 7,019).

List of Appendices

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#
______/______/2009			

Site#	Station Description
T0	

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)	Wind Direction & Speed (Knots)
75° .	75° .	Start	
		Stop	

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.

EstimateVol (L)	EstimateCnt	SpecVol (L)	%	TotSpecVol (L)	Species Name

MD DNR Coastal Bays Beach Seine Data Sheet

Appendix 2.

Date (MM/DD/YYYY) ______/_______/2009	**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 (use Comments)		**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
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_2$0
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
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

Appendix 3.

Date (MM/DD/YYYY)	Start Time (12 hr)	Stop Time (12 hr)	Collector - (Person taking data)	Set#
_______/_______/2009				

Site#	Station Desc.
D	

Temp (°C)	Sal (ppt)	DO (mg/L)	Secchi (cm)
Weather	**Tide**	**Depth Start (ft)**	**Depth Stop (ft)**
%SAV Choose One 0. 0 SAV in sample area 1. up to 25% 2. 26-50% 3. 51%-75%, 4. 76%-100% 5. SAV present 6. Undeterminable – give reason	**Wind Direction** **Speed (Knots)**		**Bottom Type** 1. 2.
Waypt Post NE **Lat** 38° . **Long** 75 ° .	**Waypt Post NW** **Lat** 38° . **Long** 75 ° .	**Waypt Post SW** **Lat** 38° . **Long** 75 ° .	**Waypt Post SE** **Lat** 38° . **Long** 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
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6 ≡ rain
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8 ≡ showers
9 ≡ thunderstorms
Bottom Type Codes
S ≡ Sand M ≡ mud
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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
People Checklist:
Lunch/$H_2$0
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

Comments

EstimateVol (L)	EstimateCnt	SpecVol (L)	%	TotSpecVol(L)	SpecName
				Draw bracket for grouped Species	

MD DNR Coastal Bays Drop Net 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 4.

Atlantic Program Fish Voucher Collection Protocol and 2008 Summary

Purpose:
Fish collected from the Maryland Coastal Bays and Atlantic Ocean will be used as identification vouchers and staff training.

Safety Information:
Safety goggles and disposable gloves should be worn whenever working with formalin or ethanol. Immediately wash any skin that comes in contact with these chemicals. Visit the OSHA website (http://www.osha.gov/SLTC/formaldehyde/) for more information.

Field Procedure:
1. Try to collect 3-5 specimens of a particular species at the same time. Keep any unusual or unknown specimens.
2. Photograph specimens if possible.
3. Place all specimens in a communal holding tank or bucket. Use battery operated aerator or change water frequently to keep specimens alive. Place any dead specimens in a separate container of water.
4. In the comments section of field datasheet record what fishes were collected from that sample.
5. Upon return to the field office:
    - Make a small incision in the belly on the right hand side for specimens 6 inches (150 mm) or longer and puncturing the swim bladder (Stranko 2006; AFS 1983) to facilitate fixation, which may not thoroughly occur without the incision.
    - Completely submerge specimens in a plastic container containing buffered 10% formalin solution (= 4% formaldehyde).
6. Place a label (make one out of Rite in the Rain paper) inside container with site number, latitude, longitude, date, species if known, and number of each species for each location. If the specimen was not part of the CBFI survey, include gear type on the label.

Laboratory Procedure:
In a well ventilated area:
1. Keep specimens in formalin for at least 24 hours.
2. Pour formalin off specimens into the hazmat 55 gallon drum using a funnel.
3. Cover specimens with water and soak for 24 hours.
4. Pour water off specimens into the hazmat 55 gallon drum using a funnel.
5. Cover specimens with water and soak for another 24 hours.
6. Pour water off specimens into the hazmat 55 gallon drum using a funnel.
7. Place specimens of the same species in glass jar(s) filled with 70% ethanol and capped with a polypropylene lid and polyethylene liner and new label. Larval fishes can be permanently fixed in 5% formalin solution (AFS, 1983).
    a. If specimens of the same species were collected at different locations and dates, then combine all into one jar with a label for each location and assign a separate catalog number for each.

b. If specimens of the same species were collected at different location on the same date, then combine all into one jar with a label for each location and assign the same catalog number.

Label Information:

<table>
<tr><td colspan="3">Maryland Dept. of Natural Resources - Fisheries Service - Atlantic Program Coastal Bays Fisheries Investigation (CBFI)</td></tr>
<tr><td colspan="3">Scientific Name:</td></tr>
<tr><td colspan="3">Common Name:</td></tr>
<tr><td colspan="2">Body of Water:</td><td>County: Worcester</td></tr>
<tr><td colspan="3">Collection Site:</td></tr>
<tr><td>Lat. 38°</td><td colspan="2">Long. 75°</td></tr>
<tr><td colspan="3">Collected By: MD DNR Fisheries Service Atlantic Program</td></tr>
<tr><td>Date Collected:</td><td colspan="2">Preservation Date:</td></tr>
<tr><td>Preservative: 70% ETOH</td><td>Catalog #:</td><td># Specimens</td></tr>
</table>

a. Scientific Name ≡ with older nomenclature if possible
b. Common Name ≡ name used in CBFI program
c. Body of Water ≡ main body of water that the specimen came from. Choices include Assawoman Bay, Isle of Wight Bay, Sinepuxent Bay, and Chincoteague Bay (includes Newport Bay)
d. County ≡ county where the specimen was collected
e. Collection Site ≡ description of where the specimen was collected. Includes CBFI site number when possible.
f. Lat. ≡ start latitude where the specimen(s) where collected
g. Long. ≡ start longitude where the specimen(s) where collected
h. Collected By ≡ program that collected the specimen(s)
i. Date Collected ≡ date that the specimen(s) where captured/collected. This is also when the specimen(s) would have been placed in 10% formalin for fixation.
j. Preservation Date ≡ date the specimen(s) where permanently preserved. Removal from fixative would have taken place two days prior to this date.
k. Preservative ≡ chemical used to permanently store the specimens. In most situations, this will be 70% ETOH.
l. Catalog ID ≡ unique code that relates each jar and or specimen back to the voucher database. Codes start at 0001.
m. # Specimens ≡ number of specimens & sex (when obvious from physical characteristics) For example, 2♀ ,1♂

Allow label to thoroughly dry before placing into the jar.

8. Add to voucher database
   a. Catalog ID ≡ assign a unique code. Codes start at 0001.

b. SiteID ≡ Site number used in the CBFI seine and trawl survey. SiteID is composed of a letter followed by 3 numbers. The letter S indicates the gear was a seine and T indicates the gear was trawl.
c. Family ≡ family name of the specimen. This information is located in the American Fisheries Society Special Publication 29, Common and Scientific Names of Fishes from the United States, Canada, and Mexico. 6^{th} edition.
d. Common Name ≡ name used in CBFI database
e. Scientific Name ≡ taken from the American Fisheries Society Special Publication 29 Common and Scientific Names of Fishes from the United States, Canada, and Mexico. 6^{th} edition.
f. Body of Water ≡ main body of water that the specimen came from. Choices include Assawoman Bay, Isle of Wight Bay, Sinepuxent Bay, and Chincoteague Bay (includes Newport Bay), Coastal Bays (generic term for when the field label was not completely filled out)
g. County ≡ county where the specimen was collected
h. Collection Site Description ≡ description of where the specimen was collected. Includes CBFI site number when possible.
i. Latitude ≡ start latitude where the specimen(s) where collected. This number should be taken off the datasheet.
j. Longitude ≡ start longitude where the specimen(s) where collected
k. Collected by ≡ program that collected the specimen(s); typically this program will be the MD DNR Fisheries Service Atlantic Program
l. Date Collected ≡ date that the specimen(s) where captured/collected. This is also when the specimen(s) would have been placed in 10% formalin for fixation.
m. Survey Name ≡ CBFI
n. No. Specimens ≡ number of specimens associated with the Catalog ID
o. Preserved by ≡ who placed the specimen(s) into the jar and added the preservative. In 2006, valid names are Angel Bolinger or Gary Tyler.
p. Preservation Date ≡ date the specimen(s) where permanently preserved. Removal from fixative would have taken place two days prior to this date.
q. Type ≡ generic label of what is in the container. Valid options include fish, mollusk, crustacean
r. Preservative ≡ chemical used to permanently store the specimens. In most situations, this will be 70% ETOH.
s. Storage Location ≡ location of where the jars are being stored
t. Species ID 1st Confirmed by ≡ who identified the specimen(s) back in the laboratory that are in the jar
u. Species ID 2nd Confirmed by ≡ who confirmed the first identification of the specimen(s) back in the laboratory that are in the jar
v. Photos ≡ Are there photos of the specimen? Photos may have been taken when the specimen was alive, dead, fixed, or preserved. Yes or no
w. Comments ≡ includes numbers by sex, combined specimens, etc.

Storage of specimens:
Store in a dark and climate controlled (60-65F) location. Check jars for evaporation and lid backing off twice a year. If evaporation has occurred, then completely replace the ethanol.

Disposal of Formalin:
Clean Harbors Environmental Services, Inc. **http://www.cleanharbors.com/**
EPA ID: **MDD980555189**

Phone Number: **410.244.8200**
Fax Number: **410.685.3061**
Address: **1910 Russell Street**
Baltimore, MD 21230

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Summary of the 2008 Coastal Bays Fisheries Investigations Trawl and Beach Seine Survey Voucher Collection

The CBFI voucher collection currently holds 79 fishes representing 49 families of which 8 species were added in 2008 (Table 1). Species encountered this year that were added to the voucher collection include; ballyhoo (*Hemiramphus brasiliensis)*, brown shrimp (*Farfantepenaeus aztecus*), creek chubsucker (*Erimyzon oblongus*), dusky pipefish (*Syngnathus floridae*), planehead filefish (*Stephanolepis hispidus*), threespine stickleback (*Gasterosteus aculeatus*), web burrfish (*Chilomycterus antillarum*), and white shrimp (*Litopenaeus setiferus*).

Recommendations

- Continue collecting vouchers for species that are not already included during the 2009 field season.

Table 1. Species list for the CBFI voucher collection, n=206.

Family	Scientific Name	Common Name	Number of Specimens
Achiridae	*Trinectes maculatus*	Hogchoker	3
Anguillidae	*Anguilla rostrata*	American Eel	2
Atherinopsidae	*Membras martinica*	Rough Silverside	5
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
Catostomidae	*Erimyzon oblongus**	Creek Chubsucker	3
Centrarchidae	*Lepomis gibbosus*	Pumpkinseed Sunfish	2
Centrarchidae	*Pomoxis nigromaculatus*	Black Crappie	1
Clupeidae	*Alosa pseudoharengus*	Alewife	2
Clupeidae	*Brevoortia tyrannus*	Atlantic Menhaden	3
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 antillarum**	Web Burrfish	2
Diodontidae	*Chilomycterus schoepfii*	Striped Burrfish	1
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 diaphanous*	Banded Killifish	5
Fundulidae	*Fundulus majalis*	Striped Killifish	4
Fundulidae	*Lucania parva*	Rainwater Killifish	2
Gasterosteidae	*Gasterosteus aculeatus**	Threespine Stickleback	6
Gasterosteidae	*Apeltes quadracus*	Fourspine Stickleback	1
Gerreidae	*Eucinostomus argenteus*	Spotfin Mojarra	2
Gobiidae	*Ctenogobius pseudofasciatus*	Slashcheek Goby	1
Gobiidae	*Gobiosoma bosc*	Naked Goby	3
Gobiidae	*Microgobius thalassinus*	Green Goby	6

Table 1. Species list for the CBFI voucher collection, n=206.

Family	Scientific Name	Common Name	Number of Specimens
Gymnuridae	*Gymnura micrura*	Smooth Butterfly Ray	1
Haemulidae	*Orthopristis chrysoptera*	Pigfish	4
Hemiramphidae	*Hemiramphus brasiliensis**	Ballyhoo	1
Hemiramphidae	*Hyporhamphus unifasciatus*	Halfbeak	2
Ictaluridae	*Ameiurus nebulosus*	Brown Bullhead	3
Labridae	*Tautoga onitis*	Tautog	1
Lutjanidae	*Lutjanus griseus*	Gray Snapper	3
Monacanthidae	*Stephanolepis hispidus**	Planehead Filefish	2
Moronidae	*Morone americana*	White Perch	1
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 chuss*	Spotted Hake	3
Pleuronectidae	*Pseudopleuronectes americanus*	Winter Flounder	1
Pomatomidae	*Pomatomus saltatrix*	Bluefish	3
Rachycentridae	*Rachycentron canadum*	Cobia	1
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	1
Scophthalmidae	*Scophthalmus aquosus*	Windowpane	1
Serranidae	*Centropristis striata*	Black Sea Bass	5
Serranidae	*Mycteroperca microlepis*	Gag Grouper	2
Sparidae	*Archosargus probatocephalus*	Sheepshead	3
Sparidae	*Lagodon rhomboides*	Pinfish	2
Sparidae	*Stenotomus chrysops*	Scup (Porgy)	3
Stromateidae	*Peprilus paru (=alepidotus)*	Harvestfish	4
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	3
Trichiuridae	*Trichiurus lepturus*	Atlantic Cutlassfish	1
Triglidae	*Prionotus carolinus*	Northern Searobin	4
Triglidae	*Prionotus evolans*	Striped Searobin	5
		Total	210

Species with an asterisk (*) were added in 2008.