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

2007 Report




Prepared by:
Angel Bolinger, Steve Doctor, Allison Luettel, Mike Luisi, and Gary Tyler
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Mike Luisi, Principal Investigator & Manager Atlantic Program Date

Approved By: ______________________________________
Tom O'Connell, Director, Fisheries Service Date

Approved By: ______________________________________
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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.

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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 in order to 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 fishes although bycatch of crustaceans, mollusks, sponges, and macroalgae are common. 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 shores, 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 farm land, *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 stop watch which was started at full gear deployment.

Seine

Seining sampled 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 week 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 (Table 3). 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 3).

Data Analysis

Statistical analyses were conducted on species that historically (1972–2006) represented 95 percent of 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 gamefish. Species rarely encountered (< 5% occurrence) 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 (1989-2007). 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 (1989-2007). 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) ± standard error * (t value: $\alpha=0.05$, n-1)], respectively. A geometric grand mean was calculated for the time series (1989-2006) and used as a point estimate for comparison to the annual (2007) estimate of relative abundance.

In order to compare species specific seasonal trawl relative abundance, a chi-squared analysis was performed. Time series (1989-2006) trends were compared to annual (2007) trends in order to determine any significant difference in seasonal abundance. Significance was determined at $\alpha=0.05$. Monthly abundance indices were determined by first calculating the sum-CPUE by month for the time series (1989-2006) and annual data (2007) using the raw (untransformed) catch data. Monthly percent-CPUE were calculated [(monthly sum CPUE)/(total CPUE)*100)] and used to represent the expected time series and observed (annual) values in the analysis.

To investigate species specific habitat preference for fishes, an analysis of variance was performed on the catch data to determine if sites differed in mean abundance (CPUE) for each species by site. 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:

Fishes were the most abundant taxa captured in the survey. Specifically, they accounted for 23,611 specimens caught trawling (13,317 fish) and beach seining (10,294; Table 4). Collected fishes represented 68 species, with six additional taxonomic rankings for those identified down to the genus or family levels.

Crustaceans were the second most abundant taxa captured in this survey. Specifically, they accounted for 11,494 specimens caught trawling (9,435 crustaceans) and beach seining (2,059 crustaceans; Table 5). Counts for two crustaceans species (sand shrimp (*Crangon septemspinosa*) and grass shrimp (*Palaemonetes Spp.*)) were estimated and accounted for an additional 4,275 individuals caught trawling (2,100 crustaceans) and beach seining (2,175 crustaceans). Sixteen crustacean species were identified as well as two additional taxonomic rankings down to the genus level.

The third most abundant taxa captured in the survey were Molluscs. Specifically, they accounted for 459 specimens caught trawling (315 molluscs) and beach seining (144 molluscs; Table 5). Counts for three species (solitary glassy bubble snails (*Haminoea solitaria*) nudibranchs (order), blue mussels (*Mytilus edulis*)) were estimated and accounted for an additional 2,510 individuals caught trawling (2,470 molluscs) and beach seining (40 molluscs). Molluscs were represented by 18 different species as well as two additional taxonomic ranking down to the order and genus levels.

Other types of animals captured trawling and beach seining included: ctenophores, tunicates, and sponges (Table 6). Over 222 L of comb jellies (*Beroe sp.*) were caught with the two gears. Sulphur sponge (*Cliona celata*; 179 L) and sea squirts (*Mogula manhattensis*; estimated count of 4000) were only captured trawling.

In addition to animals, plants (SAV and macroalgae) were also captured in the trawls and beach seines (Table 7). Overall, 1,437.49 L of SAV and macroalgae were caught trawling and 454.08 L were caught beach seining. An additional 66.45 L was estimated for the two gears. The dominate SAV and macroalga were eel grass (*Zostera marina*) and *Agardhiella tenera*, respectively.

Species Results: Atlantic Croaker (*Micropogonias undulatus*)

Atlantic croakers were collected in 20 of 140 trawls (14.2%) and in zero of 38 beach seines (0%). A total of 102 juvenile Atlantic croakers were collected in trawl (102 fish) samples conducted on Maryland's Coastal Bays in 2007 (Table 4). Atlantic croakers ranked 13th out of 74 species in overall finfish abundance. The trawl and beach seine CPUEs were 5.8 fish/hectare and 0 fish/haul, respectively.

Regression analysis was performed on the 1989-2007 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 trend in relative abundance (P=0.0001, Figure 2). Regression of beach seine catch data [$\log_e(x+1)$] also showed a significant trend in relative abundance (P=0.0134, Figure 3).

GM indices of relative abundance were calculated and compared with the 1989-2007 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 2007 trawl and beach seine were both below the grand means (Figures 4 and 5).

Chi-squared analysis was performed to determine if there was a significant difference between the 1989-2006 and 2007 monthly relative trawl abundance indices. Beach seine data were excluded from this analysis because sampling was restricted to June and September. Results indicated a significant difference (P=0.001, df=6, Figure 6).

Duncan's Multiple Range Test indicated that trawl sites T001, T002, T004, and T005 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, T011, T012, and T014. 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 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 gears was below the grand mean. Since Atlantic croakers spawn offshore, environmental conditions and ocean currents may be a factor influencing relative abundance (Murdy *et al* 1997).

Juvenile Atlantic croakers were more frequently caught in open 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 (11 years) varied from the grand mean.

Chi-squared analysis indicated a significant difference in monthly relative abundance in 2007 from the historical time series (1989-2006). Although a statistically significant difference was determined from this test, the 2007 monthly data follows a similar trend with the 1989-2006 time series. This difference may have resulted from a shift in the proportion of catch from a broad (1989–2006) to a narrow (2007) range in occurrence in the trawl data.

Primary and secondary trawl and beach seine sites for Atlantic croakers were located in the protected areas of Assawoman Bay, the St. Martins River, and Newport Bay. These areas are close to Ocean City Inlet. A possible explanation may be that most of the Atlantic croakers collected were very small (< 60 mm) and were unable to survive the high tidal current of Sinepuxent Bay or the open waters of Chincoteague Bay.

Management

Atlantic croakers are managed by the State of Maryland in cooperation with ASMFC. Maryland's 2007 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, 2007. Monitoring will continue in the CBFI Trawl and Beach Seine Survey.

Species Results: Atlantic Menhaden (*Brevoortia tyrannus*)

Atlantic menhaden were captured in 11 of 140 trawls (7.9%) and in 14 of 38 beach seines (36.8%). A total of 2,863 Atlantic menhaden were collected in trawl (75 fish) and beach seine (2,788 fish) samples conducted on Maryland's Coastal Bays in 2007 (Table 4). Atlantic menhaden ranked 3rd out of 74 species in overall finfish abundance. The trawl and beach seine CPUEs were 4.3 fish/hectare and 73.4 fish/haul, respectively.

Regression analysis was performed on the 1989-2007 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=0.2889, Figure 7). Regression of beach seine catch data [$\log_e(x+1)$] indicated a significant trend in relative abundance (P=0.0306, Figure 8).

GM indices of relative abundance were calculated and compared with the 1989-2007 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 2007 trawl and beach seine were both equal to the standardized grand means (Figures 9 and 10, respectively).

Chi-squared analysis was performed to determine if there was a significant difference between the 1989-2006 and 2007 monthly relative trawl abundance indices. Beach seine data were excluded from this analysis because sampling was restricted to June and September. Results indicated a significant difference (P=0.0001, df=6, Figure 11).

Duncan's Multiple Range Test indicated that trawl site 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, T006, T012, 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 no significant trend in the trawl catch data. The beach seine data indicted a significant trend; however, variation among years makes it difficult to discern between an 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.

Chi-squared analysis indicated a significant difference in monthly relative abundance in 2007 from the historical time series (1989-2006). Although a statistically significant difference was determined from this test, the 2007 monthly data follows a similar trend with the 1989-2006 time series. This difference cannot be explained at this time.

Primary trawl and beach seine sites for Atlantic menhaden were located at the headwaters of the St. Martins River (T005) and the drainage ditch seine site on Trappe Creek (S019). Both sites have a muddy bottom and nearby sources of runoff. Specifically, T005 has residential housing and S019 has nearby agriculture fields. In addition, sites T005 and S019 were more 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 2007. 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 three of 140 (2.1%) trawls and in 35 of 38 beach seines (92.1%). A total of 1,625 Atlantic silversides were collected in trawl (five fish) and beach seine (1,620 fish) samples conducted on Maryland's Coastal Bays in 2007 (Table 4). Atlantic silversides ranked 5th out of 74 species in overall finfish abundance. The trawl and beach seine CPUEs were 0.3 fish/hectare and 42.6 fish/haul, respectively.

Regression analysis was performed on the 1989-2007 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=0.6230, Figure 12). Regression of beach seine catch data [$\log_e(x+1)$] indicated a significant trend in relative abundance (P=0.0001, Figure 13).

GM indices of relative abundance were calculated and compared with the 1980-2007 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 2007 trawl index was below the grand mean, and beach seine index was equal to the grand mean (Figures 14 and 15, respectively).

Chi-squared analysis was performed to determine if there was a significant difference between the 1989-2006 and 2007 monthly relative trawl abundance indices. Beach seine data were excluded from this analysis because sampling was restricted to June and September. Results indicated a significant difference (P=0.001, df=6, Figure 16).

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. 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 (two years) varied from the grand mean.

Chi-squared analysis indicated a significant difference in monthly relative abundance in 2007 when compared to the time series (1989-2006). This difference may have resulted from too few Atlantic silversides captured trawling (1989-2007) for meaningful comparison of these data.

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 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 103 of 140 trawls (73.6%) and in 32 of 38 beach seines (84.2%). A total of 8,462 bay anchovies were collected in trawl (7,021 fish) and beach seine (1441 fish) samples conducted on Maryland's Coastal Bays in 2007 (Table 4). Bay anchovies ranked 1^{st} out of 74 species in overall finfish abundance. The trawl and beach seine CPUEs were 399.9 fish/hectare and 37.9 fish/haul, respectively.

Regression analysis was performed on the 1989-2007 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=0.0052 and 0.0117, Figures 17 and 18, respectively).

GM indices of relative abundance were calculated and compared with the 1989-2007 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 2007 trawl index was equal to the grand mean and the seine index was above the grand mean (Figures 19 and 20, respectively).

Chi-squared analysis was performed to determine if there was a significant difference between the 1989-2006 and 2007 monthly relative trawl abundance indices. Beach seine data were excluded from this analysis because sampling was restricted to June and September. Results indicated a significant difference (P=0.0001, df=6, Figure 21).

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 sites included: T003, T006, and T014. Beach seine sites S003, S011, S012, S013, S015, S016, and S017 were determined to be primary locations and S006 was classified as a secondary site (Figure 1, Table 9).

Discussion

Regression analysis indicated significant trends in the trawl and beach seine catch data. The trawl and beach seine indices show increasing trends for the past three years. 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.

Chi-squared analysis indicated a significant difference in monthly relative abundance in 2007 from the historical time series (1989-2006). Although a statistically significant difference was determined from this test, the 2007 monthly data follows a similar trend with the 1989-2006 time series. This difference may have resulted from a shift in the proportion of catch from a broad (1989-2006) to a narrow (2007) range in occurrence in the trawl data.

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 slow 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 Drum (P*ogonias cromis*)

Black drum were captured in one of 140 (0.7%) trawls and in nine of 38 beach seines (23.7%). A total of 49 black drum were collected in trawl (one fish) and beach seine (48 fish) samples conducted on Maryland's Coastal Bays in 2007 (Table 4). Black drum ranked 17th out of 74 species in overall finfish abundance. The trawl and beach seine CPUEs were 0.06 fish/hectare and 1.3 fish/haul, respectively.

Regression analysis was performed on the 1989-2007 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=0.7266, Figure 22). Regression of beach seine catch data [$\log_e(x+1)$] indicated a significant trend in relative abundance (P=0.0168, Figure 23).

GM indices of relative abundance were calculated and compared with the 1989-2007 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 2007 trawl index and beach seine indices were both equal to the grand means (Figures 24 and 25, respectively).

Chi-squared analysis was performed to determine if there was a significant difference between the 1989-2006 and 2007 monthly relative trawl abundance indices. Beach seine data were excluded from this analysis because sampling was restricted to June and September. Results indicated no significant difference (P=0.0734, df=3, Figure 26).

Duncan's Multiple Range Test indicated that trawl site T002 had the highest level of abundance (CPUE) and that location was classified as a primary site (Figure 1, Table 8). There were zero secondary trawl sites. Beach seine sites S003, S005, S012, and S013 were determined to be primary locations and S007 was classified as a secondary site (Figure 1, Table 9).

Discussion

Regression analysis indicated variation without trend for trawl annual relative abundance whereas a significant trend was determined for beach seine catch data. The beach seine index seems to indicate an increasing trend in abundance for black drum. 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.

Black drum 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 occasionally (six years) varied from the grand mean. .

Chi-squared analysis indicated no significant difference in monthly relative abundance in 2007 when compared to the time series (1989-2006). No significant difference may have resulted from too few black drum captured trawling (1989-2007) for meaningful comparison of these data.

Primary and secondary trawl and beach seine sites for black drum were located in Assawoman Bay, Isle of Wight 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. Black drum are known for utilizing muddy bottom (Amos 1998).

Management

Black drum are managed by the state of Maryland. Recreational anglers fish with a 16 inch minimum size and creel of one fish per angler with a daily maximum of six per boat (Table 10). Commercial regulations include a 16 inch minimum size with a 1,500 pound yearly quota on the coast. Monitoring will continue in the CBFI Trawl and Beach Seine Survey.

Species Results: Black Sea Bass (*Centropristis striata*)

Black sea bass were collected in 41 of 140 trawls (29.3%) and six of 38 seines (15.8%). A total of 92 juvenile black sea bass were collected in trawl (84 fish) and beach seine (eight fish) samples conducted on Maryland's Coastal Bays in 2007 (Table 4). Black sea bass ranked 14th out of 74 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 1989-2007 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=0.2216 and 0.4519, Figures 27 and 28, respectively).

GM indices of relative abundance were calculated and compared with the 1989-2007 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 2007 trawl and beach seine indices were both equal to the standardized grand means (Figures 29 and 30, respectively).

Chi-squared analysis was performed to determine if there was a significant difference between the 1989-2006 and 2007 monthly relative trawl abundance indices. Beach seine data were excluded from this analysis because sampling was restricted to June and September. Results indicated a significant difference (P=0.0001, df=6, Figure 31).

Duncan's Multiple Range Test indicated that trawl sites T001, T003, T004, T06, T007, T008, T009, 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, T012. Beach seine sites S002, S005, S006, S009, and S010 were determined to be primary locations and S003, S017, and S018 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.

Black sea bass were caught in both near shore (beach seine) and open water (trawl) locations**;** however, since black sea bass are structure oriented neither index accurately represents relative abundance. Since 1989, the relative abundance estimates frequently (10 years trawl, four years beach seine) varied from the grand means.

Chi-squared analysis indicated a significant difference in monthly relative abundance in 2007 when compared to the time series (1989-2006). That difference may have resulted from a shift in the proportion of catch to an earlier month. The peak in black sea bass trawl captures in 2007 was in June whereas the peak was usually in July.

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 2007 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 three of 140 trawls (2.1%) and in 13 of 38 beach seines (34.2%). A total of 36 juvenile bluefish were collected in trawl (three fish) and beach seine (33 fish) samples conducted on Maryland's Coastal Bays in 2007 (Table 4). Bluefish ranked 23rd out of 74 species in overall finfish abundance. The trawl and beach seine CPUEs were 0.2 fish/hectare and 0.9 fish/haul, respectively.

Regression analysis was performed on the 1989-2007 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=0.1358 and 0.6270, Figures 32 and 33, respectively).

GM indices of relative abundance were calculated and compared with the 1989-2007 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 2007 trawl and beach seine indices were both equal to the grand means (Figures 34x and 35, respectively).

Chi-squared analysis was performed to determine if there was a significant difference between the 1989-2006 and 2007 monthly relative trawl abundance indices. Beach seine data were excluded from this analysis because sampling was restricted to June and September. Results indicated a significant difference (P=0.001, df=5, Figure 36).

Duncan's Multiple Range Test indicated that trawl site T004 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, T003, T005, and T006. 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.

Chi-squared analysis indicated a significant difference in monthly relative abundance in 2007 when compared to the time series (1989-2006). This difference may have resulted from too few bluefish captured trawling (1989-2007) for meaningful comparison of these data.

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 2007 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 138 hogchoker were collected in trawl samples conducted on Maryland's Coastal Bays in 2007 (Table 4). Hogchoker ranked 12th out of 74 species in overall finfish abundance. The trawl and beach seine CPUEs were 7.9 fish/hectare and 0 fish/haul, respectively.

Regression analysis was performed on the 1989-2007 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=0.1373 and 0.1648, Figures 37 and 38, respectively).

GM indices of relative abundance were calculated and compared with the 1989-2007 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 2007 trawl index was equal to the grand mean and the beach seine index was below the grand mean (Figures 39 and 40, respectively).

Chi-squared analysis was performed to determine if there was a significant difference between the 1989-2006 and 2007 monthly relative trawl abundance indices. Beach seine data were excluded from this analysis because sampling was restricted to June and September. Results indicated a significant difference (P=0.0001, df=6, Figure 41).

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

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 (two years trawl, five years beach seine) varied from the grand means.

Chi-squared analysis indicated a significant difference in monthly relative abundance in 2007 from the historical time series (1989-2006). That difference may have resulted from a shift in the proportion of catch to a later month. The peak in hogchoker trawl captures in 2007 was in July whereas the peak was usually in June.

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 nine of 38 beach seines (23.7%). A total of 153 mummichogs were collected in trawl (10 fish) and beach seine (143 fish) samples conducted on Maryland's Coastal Bays in 2007 (Table 4). Mummichogs ranked 10th out of 74 species in overall finfish abundance. The trawl and beach seine CPUEs were 0.6 fish/hectare and 3.8 fish/haul, respectively.

Regression analysis was performed on the 1989-2007 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=0.5061 and 0.5902, Figures 42 and 43, respectively).

GM indices of relative abundance were calculated and compared with the 1989-2007 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 2007 trawl and seine indices were equal to the grand means (Figures 44 and 45, respectively).

Chi-squared analysis was performed to determine if there was a significant difference between the 1989-2006 and 2007 monthly relative trawl abundance indices. Beach seine data were excluded from this analysis because sampling was restricted to June and September. Results indicated a significant difference (P=0.0001, df=5, Figure 46).

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.

Chi-squared analysis indicated a significant difference in monthly relative abundance in 2007 when compared to the time series (1989-2006). This difference may have resulted from too few mummichogs captured trawling (1989-2007) for meaningful comparison of these data.

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 eight of 140 trawls (5.7%) and in one of 38 beach seines (2.6%). A total of nine northern puffers were collected in trawl (10 fish) and beach seine (one fish) samples conducted on Maryland's Coastal Bays in 2007 (Table 4). Northern puffers ranked 39th out of 74 species in overall finfish abundance. The trawl and beach seine CPUEs were 0.6 fish/hectare and 0.03 fish/haul, respectively.

Regression analysis was performed on the 1989-2007 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 0.0001, Figures 47 and 48, respectively).

GM indices of relative abundance were calculated and compared with the 1989-2007 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 2007 trawl and seine indices were both below the grand means (Figures 49 and 50, respectively).

Chi-squared analysis was performed to determine if there was a significant difference between the 1989-2006 and 2007 monthly relative trawl abundance indices. Beach seine data were excluded from this analysis because sampling was restricted to June and September. Results indicated a significant difference (P=0.0018, df=6, Figure 51).

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 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 three 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 (nine years) varied from the grand mean.

Chi-squared analysis indicated a significant difference in monthly relative abundance in 2007 from the historical time series (1989-2006). That difference may have resulted from a shift in the proportion of catch to a later month.

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: Pigfish (*Orthopristis chrysoptera*)

Pigfish were collected in five of 140 trawls (3.6%) and in six of 38 beach seines (15.8%). A total of 18 juvenile pigfish were collected in trawl (six fish) and beach seine (12 fish) samples conducted on Maryland's Coastal Bays in 2007 (Table 4). Pigfish ranked 30^{th} out of 74 species in overall finfish abundance. The trawl and beach seine CPUEs were 0.3 fish/hectare and 0.3 fish/haul, respectively.

Regression analysis was performed on the 1989-2007 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=0.7726 and 0.3850, Figures 52 and 53, respectively).

GM indices of relative abundance were calculated and compared with the 1989-2007 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 2007 trawl and beach seine indices were both equal to the grand means (Figures 54 and 55, respectively).

Chi-squared analysis was performed to determine if there was a significant difference between the 1989-2006 and 2007 monthly relative trawl abundance indices. Beach seine data were excluded from this analysis because sampling was restricted to June and September. Results indicated a significant difference (P=0.0003, df=5, Figure 56).

Duncan's Multiple Range Test indicated that trawl site T020 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, T007, T010, T017, T018, and T019. Beach seine sites S001, S002, S005, and S007 were determined to be primary locations and S006 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.

Pigfish were caught in both near shore (beach seine) and open water (trawl) locations. However, the trawl index may not accurately portray the relative abundance since historically few were caught in that gear. 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 frequently (eight years) varied from the grand mean.

Chi-squared analysis indicated a significant difference in monthly relative abundance in 2007 from the historical time series (1989-2006). That difference may have resulted from a shift in the proportion of catch from a broad (1989-2006) to a narrow (2007) range in occurrence in the trawl data.

Primary and secondary trawl and beach seine sites for pigfish were located in Assawoman Bay, Isle of Wight Bay, Sinepuxent Bay, and Chincoteague Bay. Habitat preference results indicated that pigfish 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 pigfish. 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 39 of 140 trawls (27.9%) and in 16 of 38 beach seines (42.1%). A total of 1,057 silver perch were collected in trawl (602 fish) and beach seines (455 fish) samples conducted on Maryland's Coastal Bays in 2007 (Table 4). Silver perch ranked 6th out of 74 species in overall finfish abundance. The trawl and beach seine CPUEs were 34.3 fish/hectare and 12.0 fish/haul, respectively.

Regression analysis was performed on the 1989-2007 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 trend (P=0.0001, Figure 57). Regression of beach seine catch data [$\log_e(x+1)$] indicated no significant trend in relative abundance (P=0.3769, Figure 58).

GM indices of relative abundance were calculated and compared with the 1889-2007 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 2007 trawl and beach seine indices were both equal to the grand means (Figures 59 and 60, respectively).

Chi-squared analysis was performed to determine if there was a significant difference between the 1989-2006 and 2007 monthly relative trawl abundance indices. Beach seine data were excluded from this analysis because sampling was restricted to June and September. Results indicated a significant difference (P=0.0001, df=6, Figure 61).

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, S005, S006, S010, S011, and S017 were determined to be primary locations and S018 was classified as a secondary site (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 (four years trawl, zero years beach seine) varied from the grand means.

Chi-squared analysis indicated a significant difference in monthly relative abundance in 2007 from the historical time series (1989-2006). Although a statistically significant difference was determined from this test, the 2007 monthly data follows a similar trend with the 1989-2006 time series. This difference cannot be explained at this time.

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. 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 87 of 140 trawls (62.1%) and 31 of 38 seines (81.6%). A total of 4392 spot were collected in trawl (3154 fish) and beach seine (1238 fish) samples conducted on Maryland's Coastal Bays in 2007 (Table 4). Spot ranked 2nd out of 74 species in overall finfish abundance. The trawl and beach seine CPUEs were 179.6 fish/hectare and 32.6 fish/haul, respectively.

Regression analysis was performed on the 1989-2007 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=0.0075 and 0.0026, Figures 62 and 63, respectively).

GM indices of relative abundance were calculated and compared with the 1989-2007 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 2007 trawl index was above the grand mean, and the beach seine index was equal to the grand mean (Figures 64 and 65, respectively).

Chi-squared analysis was performed to determine if there was a significant difference between the 1989-2006 and 2007 monthly relative trawl abundance indices. Beach seine data were excluded from this analysis because sampling was restricted to June and September. Results indicated a significant difference (P=0.0001, df=6, Figure 66).

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, and T015. Beach seine sites S001, S002, S003, S005, S006, S007, S008, S010, S011, S012, S013, S015, and S017 were determined to be primary locations and S014 was classified as a secondary site (Figure 1, Table 9).

Discussion

Regression analyses indicated significant trends in trawl and beach seine relative 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 (nine years trawl, nine years beach seine) varied from the grand means.

Chi-squared analysis indicated a significant difference in monthly relative abundance in 2007 from the historical time series (1989-2006). That difference may have resulted from a shift in the proportion of catch to an earlier month.

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 109 of 140 trawls (77.9%) and 15 of 38 seines (39.5%). A total of 862 juvenile summer flounder collected in trawl (797 fish) and beach seine (65 fish) samples conducted on Maryland's Coastal Bays in 2007 (Table 4). Summer flounder ranked 8^{th} out of 74 species in overall finfish abundance. The trawl and beach seine CPUEs were 45.4 fish/hectare and 1.7 fish/haul, respectively.

Regression analysis was performed on the 1989-2007 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=0.1266 and 0.1055, Figures 67 and 68, respectively).

GM indices of relative abundance were calculated and compared with the 1989-2007 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 2007 trawl index was above the grand mean and the beach seine index was equal to the grand mean (Figures 69 and 70, respectively).

Chi-squared analysis was performed to determine if there was a significant difference between the 1989-2006 time series and 2007 monthly relative trawl abundance indices. Beach seine data were excluded from this analysis because sampling was restricted to June and September. Results indicated a significant difference (P=0.0036, df=6, Figure 71).

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, S014, S015, 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.

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 (nine years) varied from the grand mean.

Chi-squared analysis indicated a significant difference in monthly relative abundance in 2007 from the historical time series (1989-2006). That difference is surprising considering how similar the plots of the data were, and may be caused by some slight monthly differences.

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 2007 recreational summer flounder regulations were comprised of a 4 fish creel and 15.5 inch minimum size limit in the Atlantic Ocean and Coastal Bays, and a 2 fish creel and 15 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 15.5 inch minimum in the Atlantic Ocean and Coastal Bays and a 15 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*)

Tautogs were captured in one of 140 (0.7%) trawls and in three of 38 beach seines (7.9%). A total of 12 tautogs were collected in trawl (one fish) and beach seine (11 fish) samples conducted on Maryland's Coastal Bays in 2007 (Table 4). Tautogs ranked 36th out of 74 species in overall finfish abundance. The trawl and beach seine CPUEs were 0.06 fish/hectare and 0.3 fish/haul, respectively.

Regression analysis was performed on the 1989-2007 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=0.8839, Figure 72). Regression of beach seine catch data [$\log_e(x+1)$] indicated a significant trend in relative abundance (P=0.0409, Figure 73).

GM indices of relative abundance were calculated and compared with the 1989-2007 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 2007 trawl and beach seine indices were both equal to the grand means (Figures 74 and 75, respectively).

Chi-squared analysis was performed to determine if there was a significant difference between the 1989-2006 and 2007 monthly relative trawl abundance indices. Beach seine data were excluded from this analysis because sampling was restricted to June and September. Results indicated a significant difference (P=0.0165, df=5, Figure 76).

Duncan's Multiple Range Test indicated that trawl sites T001, T002, T003, T006, T007, T008, T009, T013, T014, 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, S003, S004, S007, S008, S011, and S014 were classified as secondary sites (Figure 1, Table 9).

Discussion

Regression analysis indicated variation without trend for trawl annual relative abundance whereas a significant trend was determined for beach seine catch data. The seine data indicates an increasing trend in 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.

Tautogs 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.

Chi-squared analysis indicated a significant difference in monthly relative abundance in 2007 when compared to the time series (1989-2006). This difference may have resulted from too few tautog captured trawling (1989-2007) for meaningful comparison of these data.

Primary and secondary trawl and beach seine sites for tautogs were located in Assawoman Bay, Isle of Wight Bay and its tributaries, Sinepuxent Bay, Newport Bay, and Chincoteague Bay. Few tautogs were caught trawling therefore primary and secondary classifications may not be accurate. 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

Tautogs are managed by the State of Maryland in cooperation with ASMFC. The regulations in 2007 included a 14 inch size limit and five fish creel limit, with the season open all months except December. 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 41 of 140 trawls (29.3%) and two of 38 seines (5.3%). A total of 831 juvenile weakfish were collected in trawl (824 fish) and beach seine (seven fish) samples conducted on Maryland's Coastal Bays in 2007 (Table 4). Weakfish ranked 8th out of 74 species in overall finfish abundance. The trawl and beach seine CPUEs were 46.9 fish/hectare and 0.2 fish/haul, respectively.

Regression analysis was performed on the 1989-2007 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=0.0647 and 0.1816, Figures 72 and 73, respectively).

GM indices of relative abundance were calculated and compared with the 1989-2007 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 2007 trawl and beach seine indices were both equal to the grand means (Figures 74 and 75, respectively).

Chi-squared analysis was performed to determine if there was a significant difference between the 1989-2005 and 2006 monthly relative trawl abundance indices. Beach seine data were excluded from this analysis because sampling was restricted to June and September. Results indicated a significant difference (P=0.0001, df=6, Figure 76).

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). Secondary trawl sites included T005 and 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 (six years) varied from the grand mean.

Chi-squared analysis indicated a significant difference in monthly relative abundance in 2007 from the historical time series (1989-2006). Although a statistically significant difference was determined from this test, the 2007 monthly data follows a similar trend with the 1989-2006 time series. That difference may have resulted from a shift in the proportion of catch to a later month.

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 slow 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 2007 recreational weakfish regulations were comprised of an eight fish creel and a 13 inch minimum size limit (Table 10). Commercial regulations in 2007 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 two of 140 trawls (1.4%) and in 12 of 38 beach seine samples (31.6%). A total of 1876 white mullet were collected in trawl (15 fish) and beach seine (1861) samples conducted on Maryland's Coastal Bays in 2007 (Table 4). White mullet ranked 4th out of 74 species in overall finfish abundance. The trawl and beach seine CPUEs were 0.9 fish/hectare and 49 fish/haul, respectively.

Regression analysis was performed on the 1989-2007 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=0.0088 and 0.0060, Figures 82 and 83, respectively).

GM indices of relative abundance were calculated and compared with the 1989-2007 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 2007 trawl and beach seine indices were both equal to the grand means (Figures 84 and 85, respectively).

Chi-squared analysis was not performed to determine if there was a significant difference between the 1989-2005 and 2006 monthly relative trawl abundance. Beach seine data were excluded from this analysis because sampling was restricted to June and September. Results indicated a significant difference (P=0.0354, df=5, Figure 86).

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 (six years) varied from the grand mean.

Chi-squared analysis indicated a significant difference in monthly relative abundance in 2007 from the historical time series (1989-2006). Although a statistically significant difference was determined from this test, the 2007 monthly data follows a similar trend with the 1989-2006 time series. That difference may have resulted from a shift in the proportion of catch to a later month.

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 11 of 140 trawls (7.9%) and 12 of 38 seines (31.6%). A total of 159 juvenile winter flounder were collected in trawl (83 fish) and beach seine (76 fish) samples conducted on Maryland's Coastal Bays in 2007 (Table 4). Winter flounder ranked 9th out of 74 species in overall finfish abundance. The trawl and beach seine CPUEs were 4.7 fish/hectare and 2.0 fish/haul, respectively.

Regression analysis was performed on the 1989-2007 data to determine if there was a trend in the annual relative abundance over the time series. Trawl and beach seine catch data [$\log_e(x+1)$] showed significant trends (P=0.0336 and 0.0012, Figures 87 and 88, respectively).

GM indices of relative abundance were calculated and compared with the 1989-2007 time series grand mean. The point estimate of the 1989-2007 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 2007 trawl and the beach seine indices were equal to the standardized grand mean (Figures 89 and 90, respectively).

Chi-squared analysis was performed to determine if there was a significant difference between the 1989-2006 and 2007 monthly relative trawl abundance indices. Beach seine data were excluded from this analysis because sampling was restricted to June and September. Results indicated a significant difference (P=0.0001, df=5, Figure 91).

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 S001 and S010 were classified as secondary sites (Figure 1, Table 9).

Discussion

Regression analysis indicated significant trends in the trawl and beach seine catch data. The variation among years makes it difficult to discern between an increasing or decreasing pattern; however, there does appear to be an increasing trend for winter flounder especially for the seine 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 (6 years trawl, 4 years beach seine) varied from the grand means.

Chi-squared analysis indicated a significant difference in monthly relative abundance in 2007 from the historical time series (1989-2006). Although a statistically significant difference was determined from this test, the 2007 monthly data follows a similar trend with the 1989-2006 time series. That difference may have resulted from a shift in the proportion of catch to a later month.

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 8-9). Several sites distinguished themselves as being primary and secondary sites for a majority of the species examined. Sites T002, T003, T006, S002, S003, S005, and S006 were the most preferred locations based on the analysis of primary and secondary site preference (Tables 8-9).

Many species including Atlantic croakers, bluefish, spot, summer flounder, tautogs, weakfish, white mullet, and winter flounder showed an affinity to the northern bays (Tables 8-9). 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; however, few sites were classified as primary or secondary locations by more than four species (Tables 8-9). Beach seine sites in Sinepuxent Bay were more highly preferred when compared to the trawl sites. Seine sites ranged from four to 11 species with a primary or secondary designation while trawl sites ranged from two 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 seabass, 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, tautogs, and northern puffers were the only species that primarily preferred these sites. These species are known to be structure oriented. Structure may provide relief from stronger tidal currents that are common in Sinepuxent Bay.

Newport Bay and Chincoteague Bay

Five out of seven trawl and all seine sites had at least one species with a primary classification; however, few trawl sites were classified as primary or secondary for more than four species (Tables 8-9). Trawl sites ranged from two to five 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 seabass, mummichogs, silver perch, spot, summer flounder, and weakfish).

Chincoteague Bay had few species (Atlantic silversides, black seabass, silver perch, and tautogs) with primary trawl classifications (Table 8). 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, S018, and S019; Table 9).

Water Quality and Physical Characteristics

Analysis of the 2007 CBFI Trawl Survey water quality data showed an increase in the average water temperature of the bays from April through August, with a high temperature of 35.0°C recorded in Boxiron Bay on September 24, 2007 (Figure 92 and Table 11). Overall, Isle of Wight Bay had the lowest average water temperature at 20.4ºC, while Chincoteague Bay had the highest with 22.6ºC. The lower water temperatures observed in Isle of Wight Bay were more than likely a result of an increased flushing rate based on its close proximity to the Ocean City Inlet (Atlantic Ocean).

Generally, DO levels in the coastal bays decreased from April to August (Figure 93 and Table 11). The lowest recorded level of 2.73 mg/L was collected on August 27, 2007 in Chincoteague Bay. Typically, as water temperatures increase, DO levels drop as a result of temperatures effect on water's solubility properties (Figures 94-99). In Sinepuxent Bay, an exception to this trend was observed. As water temperatures increased from July to August, the average DO level also increased from 5.15 mg/L to 7.15 mg/L, respectively (Figure 97). This occurrence observed in Sinepuxent Bay was probably a result of the Ocean City Inlet and tidal influence at the time the samples were taken. In 2007, Assawoman Bay had the highest average DO at 6.80 mg/L and Newport Bay's average DO of 6.44 mg/L was the years lowest (Figures 94 and 98).

Overall, the salinity recorded throughout the bays increased from April through October (Table 11 and Figure 100). Salinity recorded in the bays varied from 8.0-35.0 ppt through the year. St. Martins River had the lowest average salinity (26.5 ppt) while Sinepuxent Bay and Chincoteague Bay were nearly equal with the highest average salinity values of 30.9 ppt and 30.8 ppt, respectively. Although St. Martins River receives significant freshwater inputs from its headwater tributaries, low precipitation in 2007 resulted in higher salinities in the river.

Results of secchi analysis indicated that in 2007 all bays generally showed an increase in turbidity from April to June before leveling off (July – August) and decreasing towards the end of the survey (October; Figure 101). Assawoman, Isle of Wight, and Sinepuxent Bays all exhibited their highest turbidity levels in June. Turbidity increased more gradually in St. Martins River, reaching its highest average level in August. Of all the systems, Assawoman had the clearest water with an average turbidity of 96.0 mm for the year, while Newport Bay had the most turbid water with averaging 41.5 mm.

Differences in temperature, dissolved oxygen, salinity and turbidity are influenced by the flushing rates 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 St. Martin River. Flushing rates of 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 unknown (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).

Water quality data from beach seine sites were collected; however, no seasonal trend analyses were performed because data were only collected in June and September (Table 12).

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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 2007 Coastal Bays Fisheries Investigation Trawl and Beach Seine Survey.

Species	Measurement Type
Fishes (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, 2007. Species are listed by order of total abundance. Total trawl sites = 140, total seine sites = 38.

Common Name	**Scientific Name**	**Total Number Collected**	**Number Collected (T)**	**Number Collected (S)**	**CPUE (T) #/Hect.**	**CPUE (S) #/Haul**
Bay Anchovy	*Anchoa mitchilli*	8462	7021	1441	399.9	37.9
Spot	*Leiostomus xanthurus*	4392	3154	1238	179.6	32.6
Atlantic Menhaden	*Brevoortia tyrannus*	2863	75	2788	4.3	73.4
White Mullet	*Mugil curema*	1876	15	1861	0.9	49.0
Atlantic Silverside	*Menidia menidia*	1625	5	1620	0.3	42.6
Silver Perch	*Bairdiella chrysoura*	1057	602	455	34.3	12.0
Summer Flounder	*Paralichthys dentatus*	862	797	65	45.4	1.7
Weakfish	*Cynoscion regalis*	831	824	7	46.9	0.2
Winter Flounder	*Pseudopleuronectes americanus*	159	83	76	4.7	2.0
Mummichog	*Fundulus heteroclitus*	153	10	143	0.6	3.8
Striped Killifish	*Fundulus majalis*	148	0	148	0	3.9
Hogchoker	*Trinectes maculatus*	138	138	0	7.9	0
Atlantic Croaker	*Micropogonias undulatus*	102	102	0	5.8	0
Black Sea Bass	*Centropristis striata*	92	84	8	4.8	0.2
Striped Anchovy	*Anchoa hepsetus*	91	19	72	1.1	1.9
Northern Searobin	*Prionotus carolinus*	64	64	0	3.6	0
Black Drum	*Pogonias cromis*	49	1	48	0.1	1.3
Northern Pipefish	*Syngnathus fuscus*	44	32	12	1.8	0.3
Atlantic Needlefish	*Strongylura marina*	43	0	43	0	1.1
Naked Goby	*Gobiosoma bosc*	42	37	5	2.1	0.1
Smallmouth Flounder	*Etropus microstomus*	42	41	1	2.3	<0.1
Spotfin Mojarra	*Eucinostomus argenteus*	38	3	35	0.2	0.9
Bluefish	*Pomatomus saltatrix*	36	3	33	0.2	0.9
Striped Mullet	*Mugil cephalus*	27	0	27	0	0.7
Striped Cusk Eel	*Ophidion marginatum*	27	25	2	1.4	0.1
Oyster Toadfish	*Opsanus tau*	26	15	11	0.9	0.3
Dusky Pipefish	*Syngnathus floridae*	22	16	6	0.9	0.2

Table 4 (con't). List of fishes collected in Maryland's Coastal Bays Trawl (T) and Beach Seine (S) Surveys from April through October, 2007. 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**
American Eel	*Anguilla rostrata*	20	11	9	0.6	0.2
Rainwater Killifish	*Lucania parva*	18	3	15	0.2	0.4
Pigfish	*Orthopristis chrysoptera*	18	6	12	0.3	0.3
Green Goby	*Microgobius thalassinus*	17	17	0	1.0	0
Lined Seahorse	*Hippocampus erectus*	15	15	0	0.9	0
Spotted Seatrout	*Cynoscion nebulosus*	14	1	13	0.1	0.3
Blue Runner	*Caranx crysos*	13	8	5	0.5	0.1
Sheepshead	*Archosargus probatocephalus*	12	0	12	0	0.3
Tautog	*Tautoga onitis*	12	1	11	0.1	0.3
Spotted Hake	*Urophycis regia*	12	12	0	0.7	0
Pinfish	*Lagodon rhomboides*	11	1	10	0.1	0.3
Northern Puffer	*Sphoeroides maculatus*	11	10	1	0.6	<0.1
Butterfish	*Peprilus triacanthus*	10	10	0	0.6	0
Pipefish Genus	*Syngnathus*	8	1	7	0.1	0.2
Smooth Butterfly Ray	*Gymnura micrura*	8	2	6	0.1	0.2
Southern Stingray	*Dasyatis americana*	8	3	5	0.2	0.1
Blackcheek Tonguefish	*Symphurus plagiusa*	7	4	3	0.2	0.1
Striped Burrfish	*Chilomycterus schoepfii*	7	7	0	0.4	0
Rough Silverside	*Membras martinica*	6	0	6	0	0.2
Northern Kingfish	*Menticirrhus saxatilis*	6	1	5	0.1	0.1
Windowpane Flounder	*Scophthalmus aquosus*	6	6	0	0.3	0
Striped Blenny	*Chasmodes bosquianus*	5	1	4	0.1	0.1
Southern Kingfish	*Menticirrhus americanus*	5	4	1	0.2	<0.1
Scup	*Stenotomus chrysops*	5	5	0	0.3	0
Common Halfbeak	*Hyporhamphus unifasciatus*	4	0	4	0	0.1
Striped Searobin	*Prionotus evolans*	4	3	1	0.2	<0.1

Table 4 (con't). List of fishes collected in Maryland's Coastal Bays Trawl (T) and Beach Seine (S) Surveys from April through October, 2007. 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**
Clearnose Skate	*Raja eglanteria*	4	4	0	0.2	0
Gray Snapper	*Lutjanus griseus*	3	0	3	0	0.1
Permit	*Trachinotus falcatus*	3	0	3	0	0.1
Inshore Lizardfish	*Synodus foetens*	3	2	1	0.1	<0.1
Snapper Genus	*Lutjanus*	2	0	2	0	0.1
Blenny Family	*Blenniidae*	2	0	2	0	0.1
Skillet Fish	*Gobiesox strumosus*	2	0	2	0	0.1
Striped Bass	*Morone saxatilis*	2	0	2	0	0.1
Shad, Herring Genus	*Alosa*	2	2	0	0.1	0
Feather Blenny	*Hypsoblennius hentz*	2	2	0	0.1	0
Lookdown	*Selene vomer*	2	2	0	0.1	0
Sheepshead Minnow	*Cyprinodon variegatus*	2	2	0	0.1	0
Stickleback Family	*Gasterosteidae*	1	0	1	0	<0.1
Kingfish Genus	*Menticirrhus*	1	0	1	0	<0.1
Bluespotted Cornetfish	*Fistularia tabacaria*	1	0	1	0	<0.1
Fourspine Stickleback	*Apeltes quadracus*	1	0	1	0	<0.1
Spanish Mackerel	*Scomberomorus maculatus*	1	1	0	0.1	0
Atlantic Moonfish	*Selene setapinnis*	1	1	0	0.1	0
Crevalle Jack	*Caranx hippos*	1	1	0	0.1	0
Atlantic Herring	*Clupea harengus*	1	1	0	0.1	0
Alewife	*Alosa pseudoharengus*	1	1	0	0.1	0
	Total Finfish	**23,611**	**13,317**	**10,294**		

Table 5. List of crustaceans and molluscs collected in Maryland's Coastal Bays Trawl (T) and Beach Seine (S) Surveys from April through October, 2007. 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*	8547	7050	1497			401.5	39.4
Sand Shrimp	*Crangon septemspinosa*	1570	1497	73	1325	400	160.7	12.6
Grass Shrimp	*Palaemonetes spp.*	643	233	410	775	1775	57.4	57.5
Lady Crab	*Ovalipes ocellatus*	279	254	25			14.5	0.7
Brown Shrimp	*Farfantepenaeus aztecus*	158	130	28			7.4	0.7
Long-Clawed Hermit Crab	*Pagurus longicarpus*	99	88	11			5.0	0.3
Say Mud Crab	*Dyspanopeus sayi*	84	79	5			4.5	0.1
Nine-Spined Spider Crab	*Libinia emarginata*	38	38	0			2.2	0
Mantis Shrimp	*Squilla empusa*	25	25	0			1.4	0
Lesser Blue Crab	*Callinectes similis*	15	7	8			0.4	0.2
Flat-Clawed Hermit Crab	*Pagurus pollicaris*	11	11	0			0.6	0
Atlantic Mud Crab	*Panopeus herbstii*	11	11	0			0.6	0
Rock Crab	*Cancer irroratus*	4	3	1			0.2	<0.1
Spider Crab Genus	*Libinia*	2	2	0			0.1	0
Iridescent Swimming Crab	*Portunus gibbesii*	2	2	0			0.1	0
White Shrimp	*Litopenaeus setiferus*	2	2	0			0.1	0
Bigclaw Snapping Shrimp	*Alpheus heterochaelis*	3	3	0			0.2	0
Green Crab	*Carcinus maenas*	1	0	1			0	<0.1
	Total Crustaceans	**11,494**	**9,435**	**2,059**	**2,100**	**2,175**		
Mollusc Species**								
Solitary Glassy Bubble Snail	*Haminoea solitaria*	155	155		1700		105.6	0
Mudsnail Genus	*Nassarius*	121	7	114			0.4	3.0

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, 2007. 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
Nudibranch Order	*Nudibranchia*	52	52		50		5.8	0
Brief Squid	*Lolliguncula brevis*	33	33				1.9	0
Bruised Nassa	*Nassarius vibex*	24	24				1.4	0
Blue Mussel	*Mytilus edulis*	22	2	20	720	40	41.1	1.6
Eastern Mud Snail	*Nassarius obsoletus*	14	6	8			0.3	0.2
Lemon Drop Nudibranch	*Doriopsilla pharpa*	14	14				0.8	0
Atlantic Oyster Drill	*Urosalpinx cinerea*	5	4	1			0.2	<0.1
Thick-Lipped Oyster Drill	*Eupleura caudata*	4	4				0.2	0
Hard Shell Clam	*Mercenaria mercenaria*	2	1	1			0.1	<0.1
Channeled Whelk	*Busycon canaliculatum*	2	2				0.1	0
Green Jackknife Clam	*Solen viridis*	2	2				0.1	0
Narrow Macoma	*Macoma tenta*	2	2				0.1	0
Dwarf Surfclam	*Mulinia lateralis*	2	2				0.1	0
Atlantic Awningclam	*Solemya velum*	1	1				0.1	0
Stout tagelus	*Tagelus plebeius*	1	1				0.1	0
Slipper Shell Genus	*Crepidula*	1	1				0.1	0
Shark Eye	*Neverita duplicata*	1	1				0.1	0
Convex Slipper Shell	*Crepidula convexa*	1	1				0.1	0
	Total Molluscs	**459**	**315**	**144**	**2,470**	**40**		

** 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, 2007. 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**
Sea Squirt	*Mogula manhattensis*	264	264	0	4000	41.55				242.9	
Moon Jelly	*Aurelia aurita*	87	67	20		1				3.8	0.5
Common Sea Cucumber	*Thyone briareus*	47	39	8						2.2	0.2
Sea Nettle	*Chrysaora quinquecirrha*	43	39	4	400	4.75	2	0.5		25	0.1
Horseshoe Crab	*Limulus polyphemus*	25	21	4						1.2	0.1
Cnidarian	*Cnidaria*	18	18	0						1.0	
Northern Diamondback Terrapin	*Malaclemys terrapin terrapin*	17	3	14						0.2	0.4
Forbes Asterias Star	*Asterias forbesi*	15	15	0						0.9	
Hairy Sea Cucumber	*Sclerodactyla briareus*	6	5	1		33				0.3	<0.1
Golden Star Tunicate	*Botryllus schlosseri*	6	6	0	50					3.2	
Comb Jelly	*Beroe spp.*	4	0	4		178.87	44	77.4	1.5		0.1
Sea Pork	*Amaroucium stellatum*	4	4			10.27		0.5		0.2	
White Anemone	*Diadumene leucolena*	2	2	0						0.1	
Sea Anemone Order	*Actiniaria*	1	1	0						0.1	

Table 6 (con't). List of other species collected in Maryland's Coastal Bays Trawl (T) and Beach Seine (S) Surveys from April through October, 2007. 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**
Sulphur Sponge	*Cliona celata*					179		0.25			
Sponge Class	*Demospongiae*					32.5	1.47				
Bryozoan	*Gymnolaemata*					120.38	4.45	5.3			
	Total Other	**541**	**485**	**56**	**4450**	**601.32**	**51.92**	**83.95**	**1.5**		

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

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, 2007. 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)**
SAV					
Eel Grass	*Zostera marina*	4.51	23.77	0.29	2.8
Widgeon Grass	*Ruppia maritima*	0.04	1.08		
	Total SAV	**4.55**	**24.85**	**0.29**	**2.8**
Macroalgae					
Graceful Red Weed	*Gracilara sp.*	435.91	101.85	22.15	7.2
Agardh's Red Weed	*Agardhiella tenera*	468.36	284.38	4.0	
Green Hair Algae	*Chaetomorpha sp.*	20.59			
Green Tufted Seaweed	*Cladophora sp.*	1.05	0.9		
Hollow Green Weeds	*Enteromorpha sp.*	5.95	0.1	0.5	
Tubed Weeds	*Polysiphonia sp.*	293.01	2.55		
Barrel Weed	*Champia sp.*	16.6	3.65		
Banded Weeds	*Ceramium sp.*	14.24	7.02	2.75	
Sea Lettuce	*Ulva sp.*	173.61	28.75	26.26	
Green Fleece	*Codium fragile*	3.55	0.01	0.25	
Rockweed	*Fucus sp.*		0.02	0.25	
Sour Weeds	*Desmarestia sp.*	0.07			
	Total Macroalgae	**1,432.94**	**429.23**	**56.16**	**7.2**

Table 8. Coastal Bays Fisheries Investigations 1989-2007 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	2		2						
Atlantic Menhaden		2			1	2						2							2	
Atlantic Silverside		2			2	2									2		2	2	1	
Bay Anchovy	1	1	2	1		2					1	1		2						
Black Drum*		1																		
Black Seabass	1		1	1		1	1	1	1			2				1				1
Bluefish		2	2	1	2	2														
Hogchoker			2									1								
Mummichog					1	1						2							2	
Northern Puffer							1		1	1										2
Pigfish			2			2	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
Weakfish	1	1	1	1	2							2								
White Mullet*					1	1														
Winter Flounder	1	1	1	1		2	1													

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

Table 9. Coastal Bays Fisheries Investigations 1989-2007 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					1	1	1		1	1	1		
Black Drum			1		1		2					1	1						
Black Seabass		1	2		1	1			1	1							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			1	1				1	1						1	2	
Spot	1	1	1		1	1	1	1		1	1	1	1	2	1		1		
Summer Flounder	2	2			2	2				2		1	2	2	2		2		
Tautog	2	1	2	2	1	1	2	2	1	1	2			2					
Weakfish		2	1			2						2			2	2	1		2
White Mullet	2				1	2	1												
Winter Flounder	2	1	1	1	1	1			1	2									

Table 10. Summary of Maryland Recreational and Commercial Regulations for 2007

Recreational

Species	Area	Minimum Size Limit (inches)	Creel (person/day)	Closures
Atlantic Croaker	All Waters[A]	9	25	
Black Sea Bass	Chesapeake Bay[B]	12	25	
	Coastal Waters[C]	12	25	
Bluefish	All Waters[A]	8	10	
Summer Flounder	Chesapeake Bay[B]	15	2	
	Coastal Waters[C]	15.5	4	
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	14 Hook & Line 15.5	Annual Quota	Individual IFQ issued. Individual without a permit: 100lbs./day
	Bay	14 Hook & Line 15	Annual Quota	All fishermen: 50 lbs./day
Weakfish		12	**Chesapeake Bay**: Aug 5-Sep 30 **Ocean**: <u>All gear except trawl</u>: Mar 25-Apr 26, & Sep 2-Nov14; Sun closed. <u>Trawl</u>: Oct 18-Dec 25; Sat & Sun closed.	Trawl mesh min. 3 ¾" stretched; Gill net mesh min. 3" stretched. Chesapeake Bay Hook & Line season is closed Oct 1. Hook & Line may not land by-catch during closed weakfish season. During a closed weakfish season, 150 lbs./day of legal sized by-catch is permitted for any gear other than hook & line provided that at least equal poundage of other species is landed.

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 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
				Assawoman Bay (Sites: T001, T002, and T003)				
Temp (°C)	Surface:	15.3	18.5	24.7	25.0	24.7	23.6	19.4
		(14.7-15.8)	(17.9-19.1)	(24.1-25.1)	(24.8-25.1)	(24.6-24.8)	(23.4-23.9)	(19.3-19.5)
	Bottom:	14.6	18.4	24.2	24.6	24.5	23.6	19.0
		(13.9-15.1)	(17.7-19.0)	(24.1-24.3)	(24.5-24.8)	(24.4-24.6)	(23.3-23.8)	(18.8-19.2)
DO (mg/L)	Surface:	9.1	7.2	6.8	6.6	5.0	6.4	7.5
		(8.8-9.3)	(6.6-7.8)	(6.6-7.2)	(6.2-7.0)	(4.8-5.1)	(6.0-7.2)	(7.0-8.2)
	Bottom:	9.3	7.2	6.1	5.9	4.4	6.3	7.4
		(9.1-9.4)	(6.5-7.7)	(5.3-6.6)	(5.5-6.2)	(3.6-4.9)	(5.8-7.1)	(6.7-8.2)
Salinity (ppt)	Surface:	21.9	25.9	28.3	31.1	32.1	33.3	33.0
		(20.5-23.3)	(24.2-27.6)	(27.4-29.4)	(30.8-31.4)	(32.0-32.2)	(32.8-33.5)	(32.9-33.2)
	Bottom:	22.2	25.9	28.3	31.1	32.2	33.3	33.1
		(20.7-23.5)	(24.2-27.6)	(27.5-29.4)	(30.8-31.6)	(32.0-32.4)	(32.9-33.6)	(33.0-33.2)
Secchi (cm)		141.3	94.7	33.2	63.0	71.3	80.0	188.3
		(128.0-153.0)	(78.0-116.0)	(27.0-40.5)	(48.0-82.0)	(70.0-74.0)	(34.0-122.0)	(156.0-224.0)
				Saint Martins River (Sites: T004 and T005)				
Temp (°C)	Surface:	17.2	21.4	20.4	28.9	26.5	20.4	20.1
		(15.9-18.4)	(20.2-22.5)	(20.2-20.6)	(28.2-29.5)	(26.0-27.0)	(20.3-20.4)	(19.8-20.4)
	Bottom:	15.8	21.3	20.5	28.8	N/A	20.3	19.6
		(15.6-15.9)	(20.2-22.4)	(20.2-20.8)	(28.1-29.4)		(20.2-20.4)	(19.6-19.6)
DO (mg/L)	Surface:	11.3	6.0	5.6	5.2	N/A	5.8	7.3
		(9.9-12.6)	(5.4-6.7)	(5.0-6.2)	(5.2-5.2)		(5.7-6.0)	(6.5-8.1)
	Bottom:	11.2	5.8	5.0	4.0	N/A	5.9	6.5
		(9.8-12.6)	(5.2-6.3)	(4.3-5.8)	(3.7-4.3)		(5.8-6.0)	(6.4-6.6)
Salinity (ppt)	Surface:	20.5	22.7	25.4	27.9	N/A	30.5	30.1
		(19.2-21.7)	(19.1-26.3)	(22.2-28.6)	(25.6-30.2)		(28.7-32.2)	(28.3-31.9)
	Bottom:	22.8	22.8	25.9	28.4	N/A	30.5	30.6
		(21.9-23.7)	(19.2-26.4)	(23.0-28.7)	(26.6-30.2)		(28.7-32.2)	(29.1-32.0)
Secchi (cm)		85.5	64.5	59.5	54.0	41.5	51*	82.5
		(85.0-86.0)	(52.0-77.0)	(55.5-64.0)	(43.0-65.0)	(37.0-46.0)		(49.0-116.0)

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 2007 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 2007 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

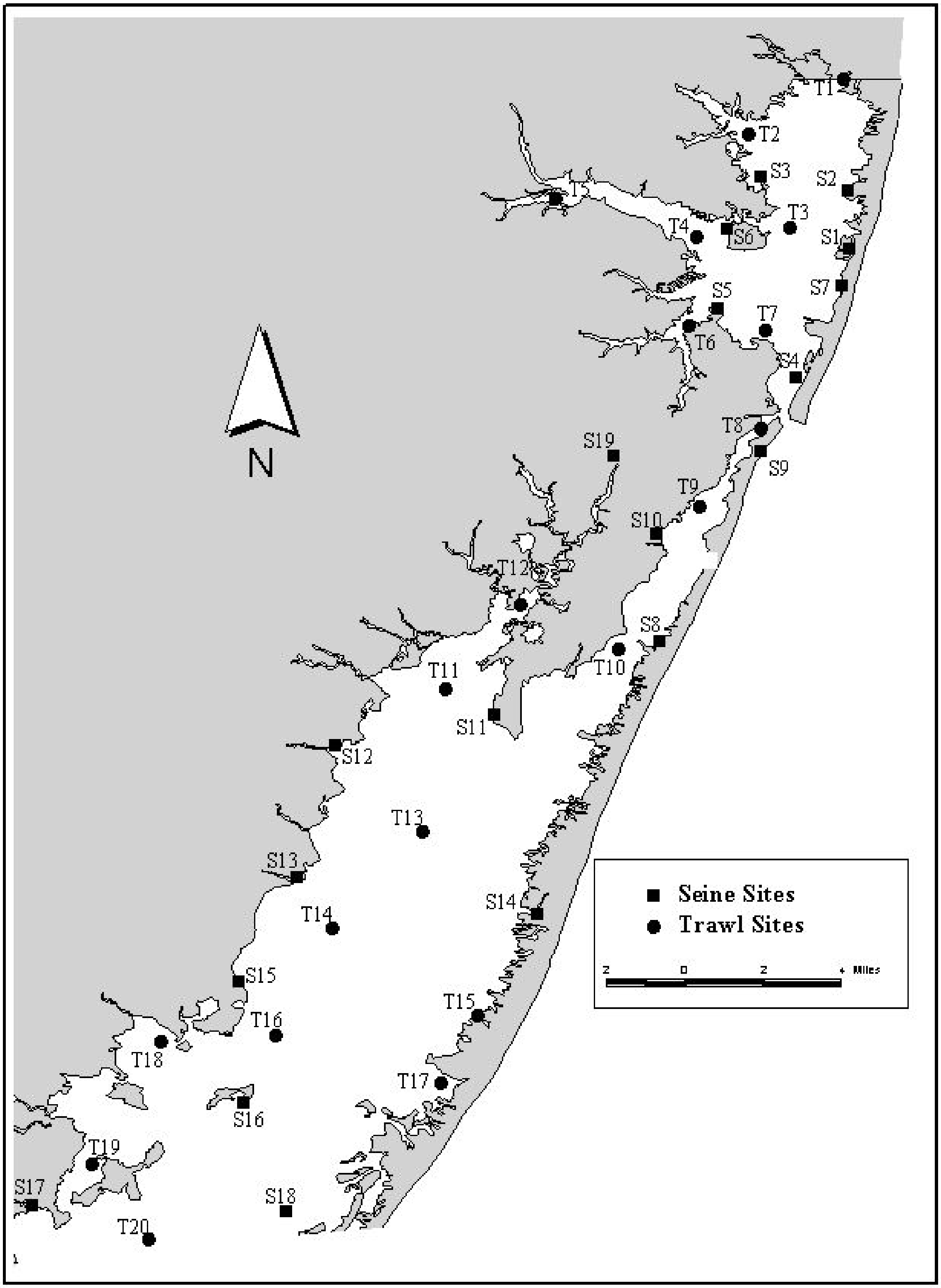

Figure 1. Site locations for the 2007 Coastal Bays Fishery Investigations Trawl and Beach Seine Survey.

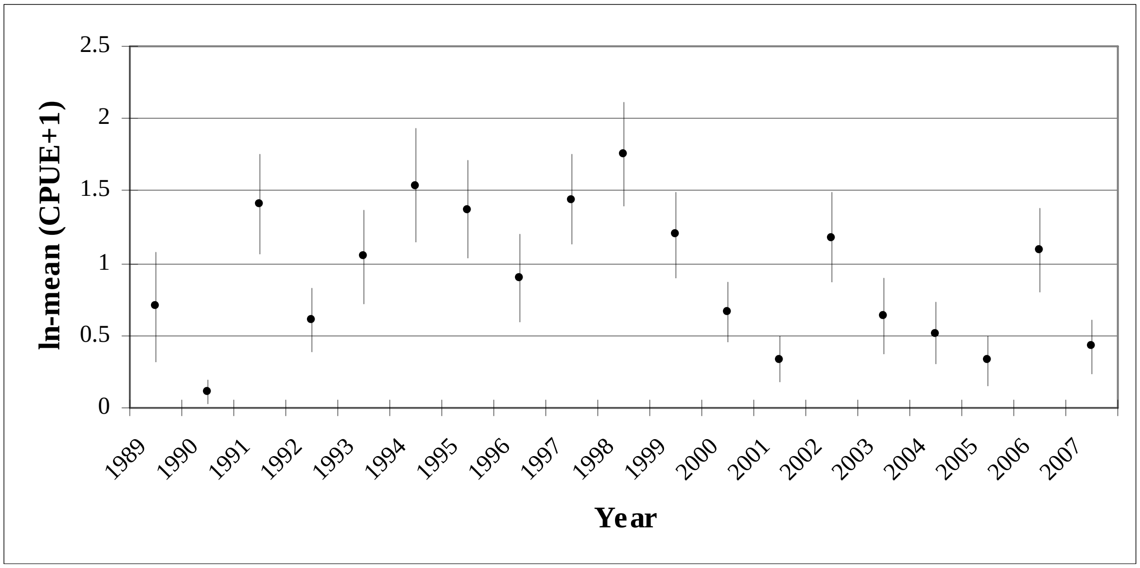

Figure 2. Atlantic croaker (*Micropogonias undulates*) trawl relative abundance (ln-mean CPUE+1) with 95% confidence intervals (1989–2007). Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=140/year).

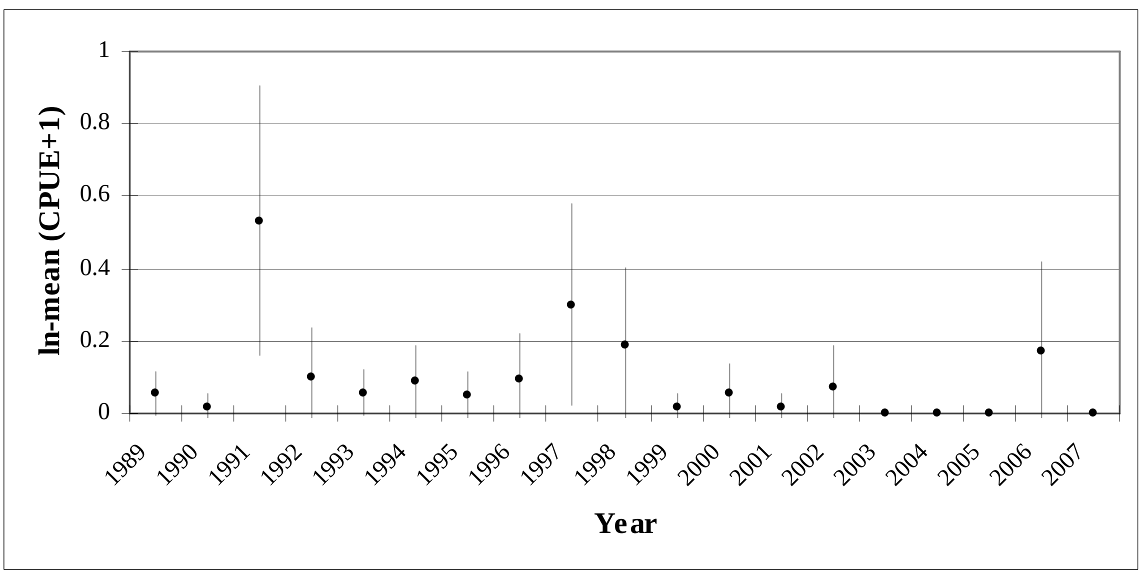

Figure 3. Atlantic croaker (*Micropogonias undulates*) beach seine relative abundance (ln-mean CPUE+1) with 95% confidence intervals (1989-2007). Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=38/year).

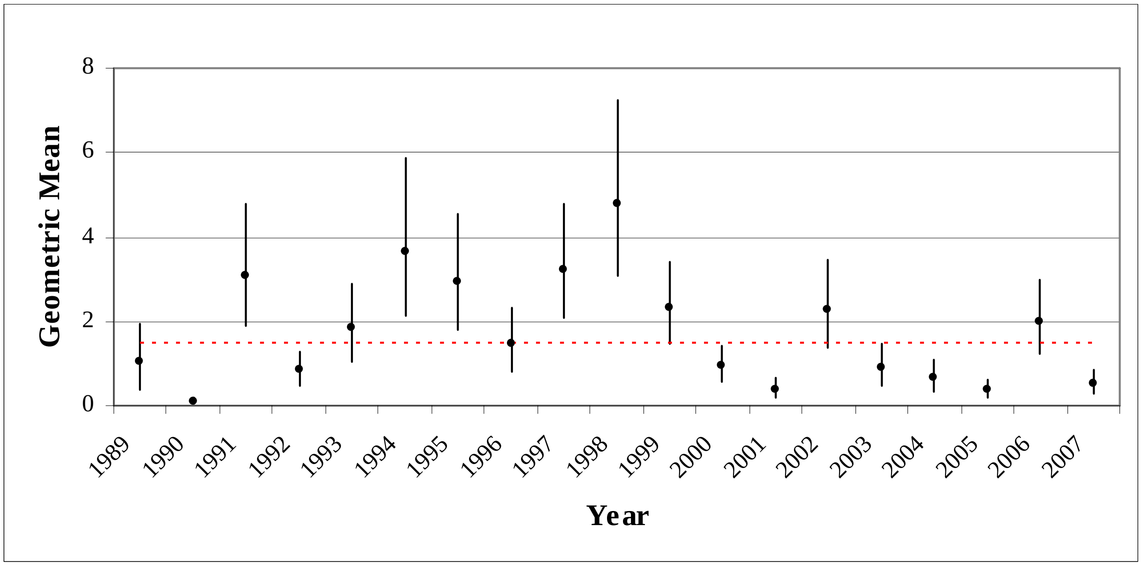

Figure 4. Atlantic croaker (*Micropogonias undulates*) trawl index of relative abundance (geometric mean) with 95% confidence intervals (1989-2007). Solid line represents the 1989-2007 time series grand mean. Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=140/year).

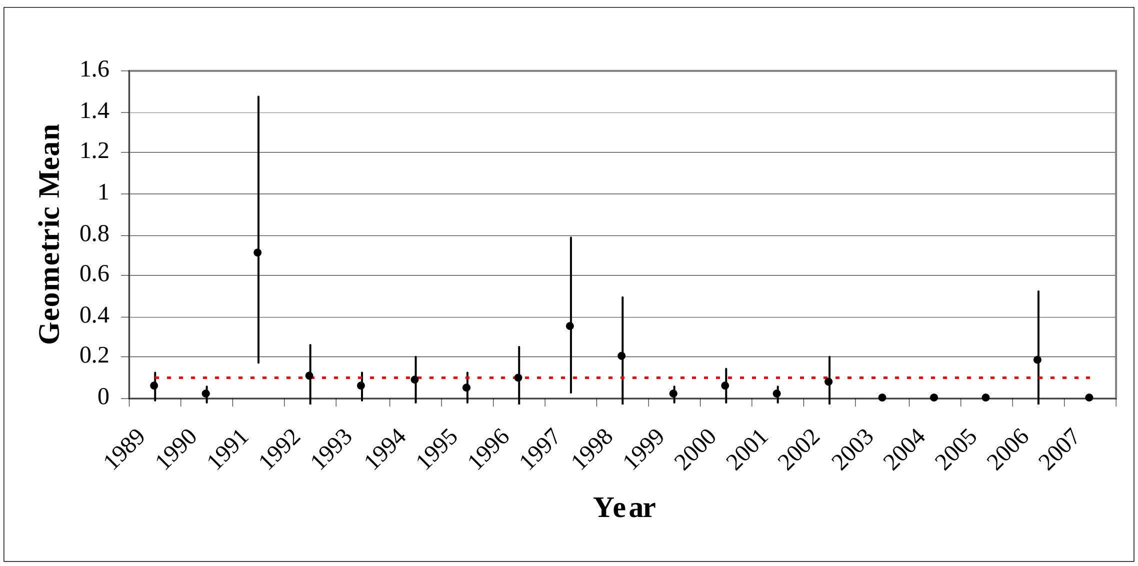

Figure 5. Atlantic croaker (*Micropogonias undulates*) beach seine index of relative abundance (geometric mean) with 95% confidence intervals (1989-2007). Solid line represents the 1989-2007 time series grand mean. Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=38/year).

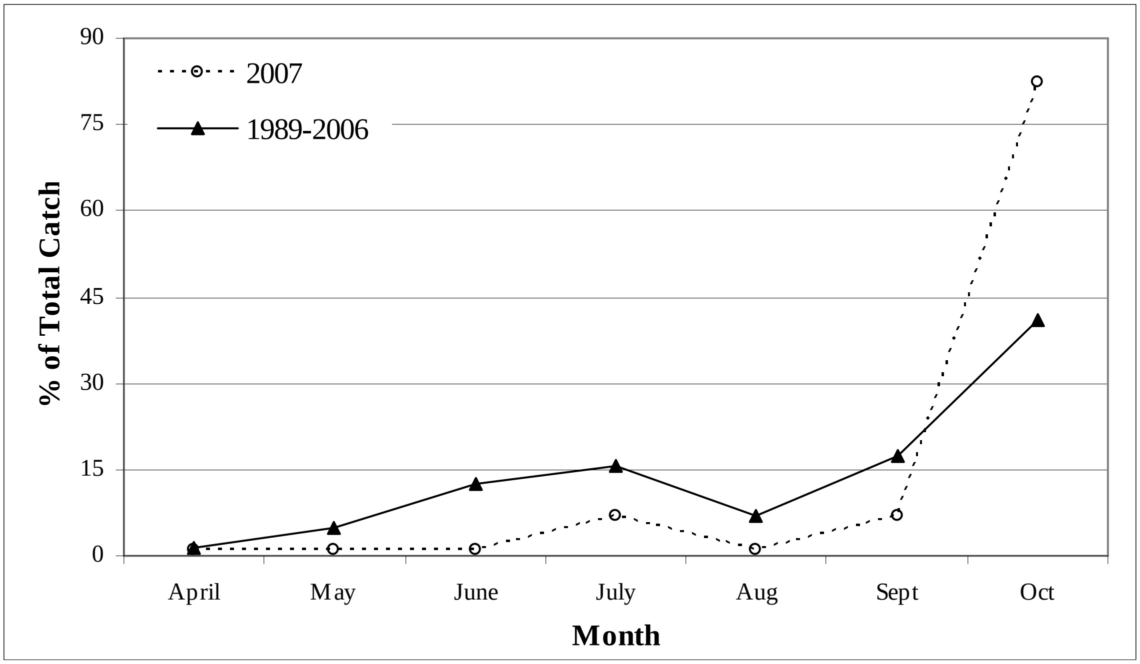

Figure 6. Coastal Bays Fisheries Investigation Trawl Survey comparison of the 1989-2006 time series and 2007 seasonal Atlantic croaker (*Micropogonias undulates*) percent catch by month.

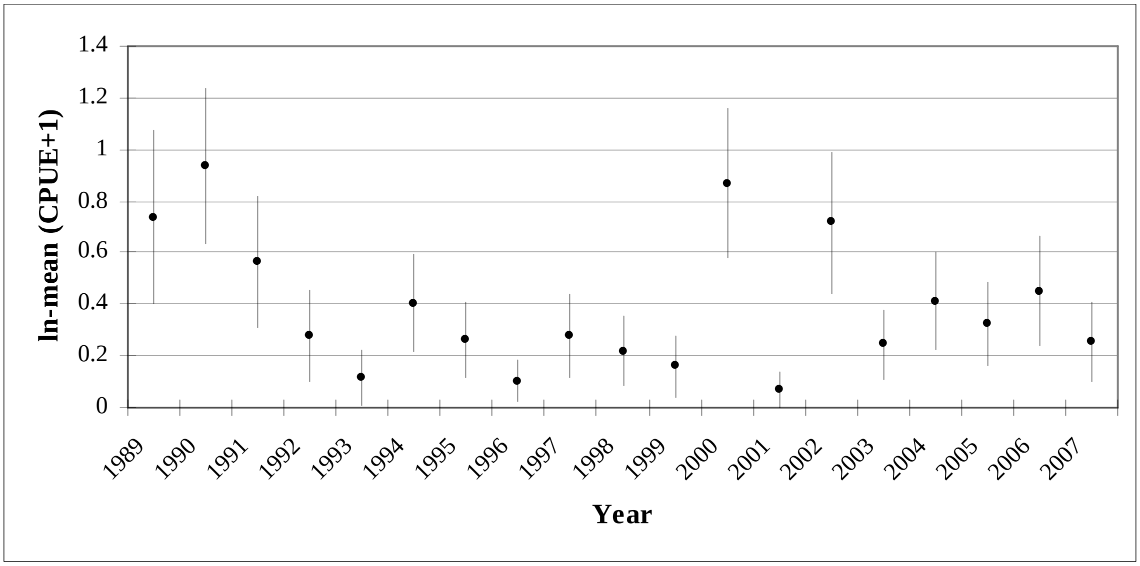

Figure 7. Atlantic menhaden (*Brevoortia tyrannus*) trawl relative abundance (ln-mean CPUE+1) with 95% confidence intervals (1989–2007). Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=140/year).

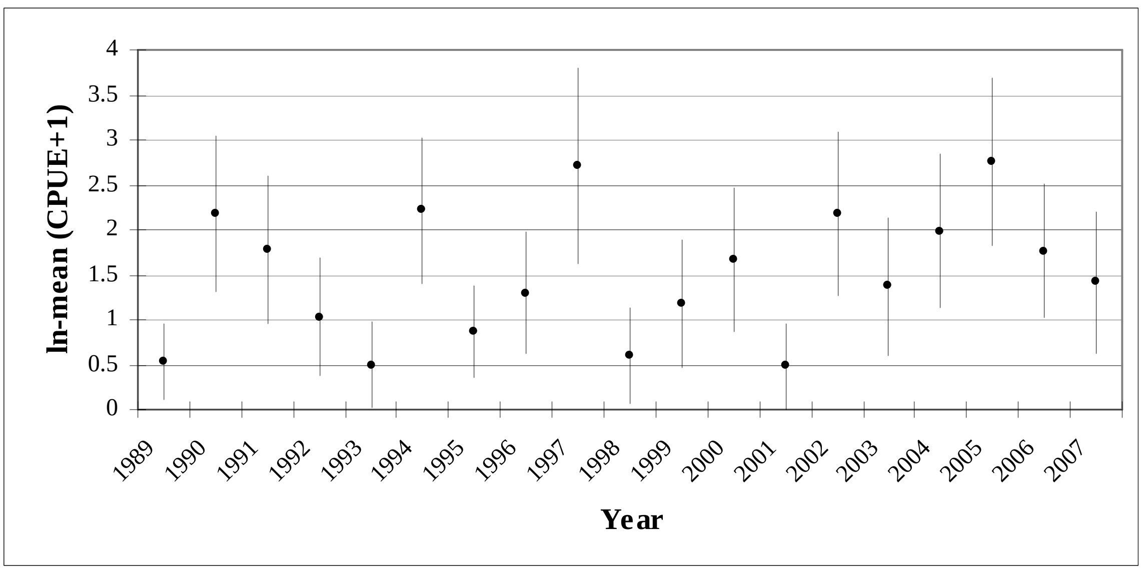

Figure 8. Atlantic menhaden (*Brevoortia tyrannus*) beach seine relative abundance (ln-mean CPUE+1) with 95% confidence intervals (1989-2007). Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=38/year).

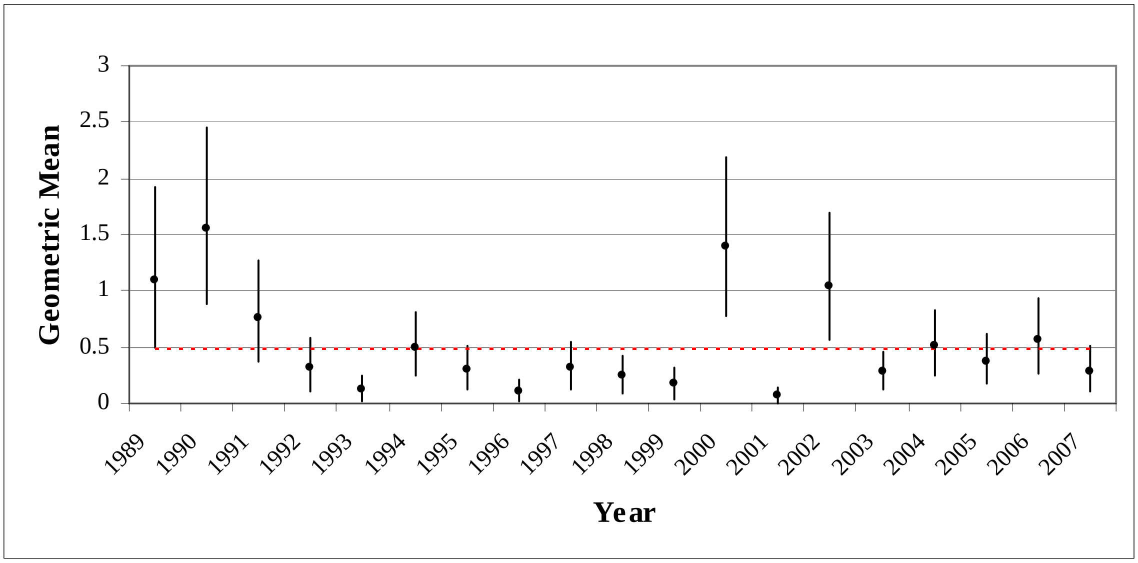

Figure 9. Atlantic menhaden (*Brevoortia tyrannus*) trawl index of relative abundance (geometric mean) with 95% confidence intervals (1989-2007). Solid line represents the 1989-2007 time series grand mean. Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=140/year).

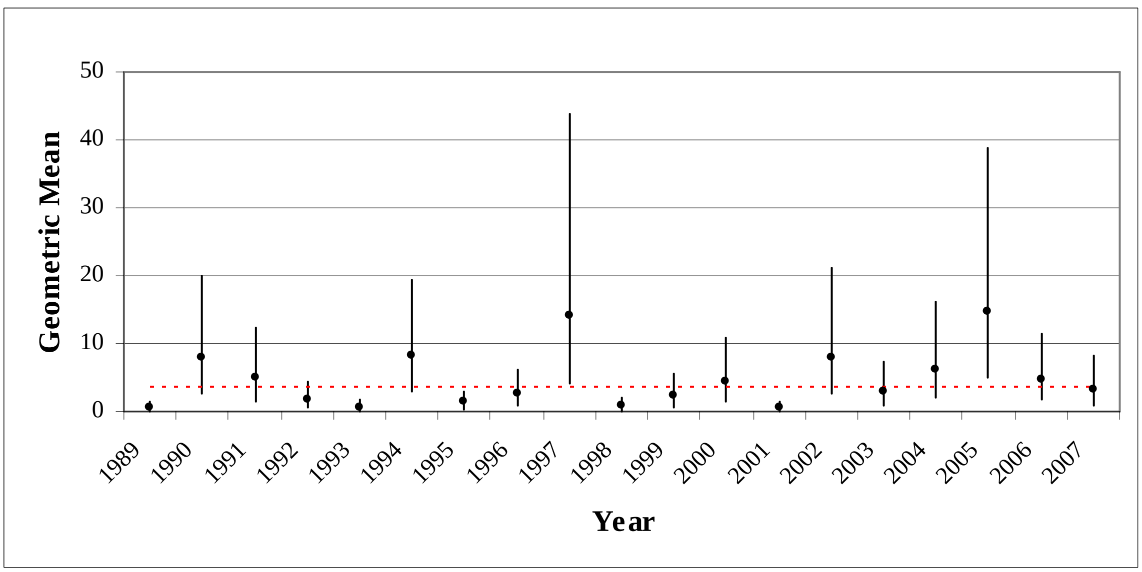

Figure 10. Atlantic menhaden (*Brevoortia tyrannus*) beach seine index of relative abundance (geometric mean) with 95% confidence intervals (1989-2007). Solid line represents the 1989-2007 time series grand mean. Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=38/year).

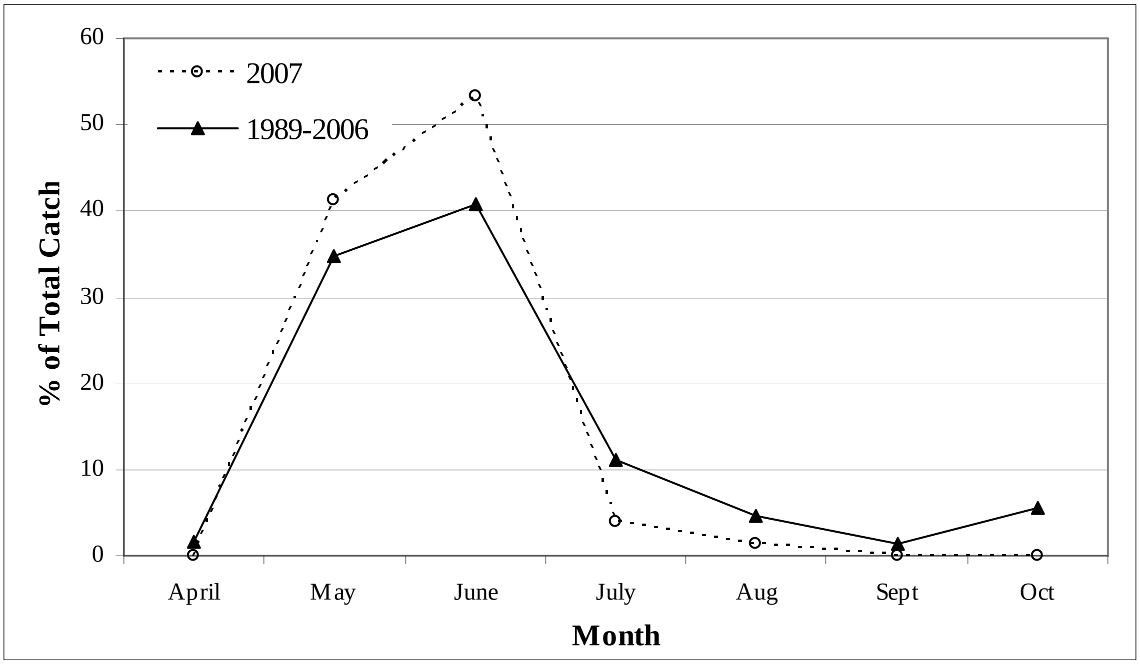

Figure 11. Coastal Bays Fisheries Investigation Trawl Survey comparison of the 1989-2006 time series and 2007 seasonal Atlantic menhaden (*Brevoortia tyrannus*) percent catch by month.

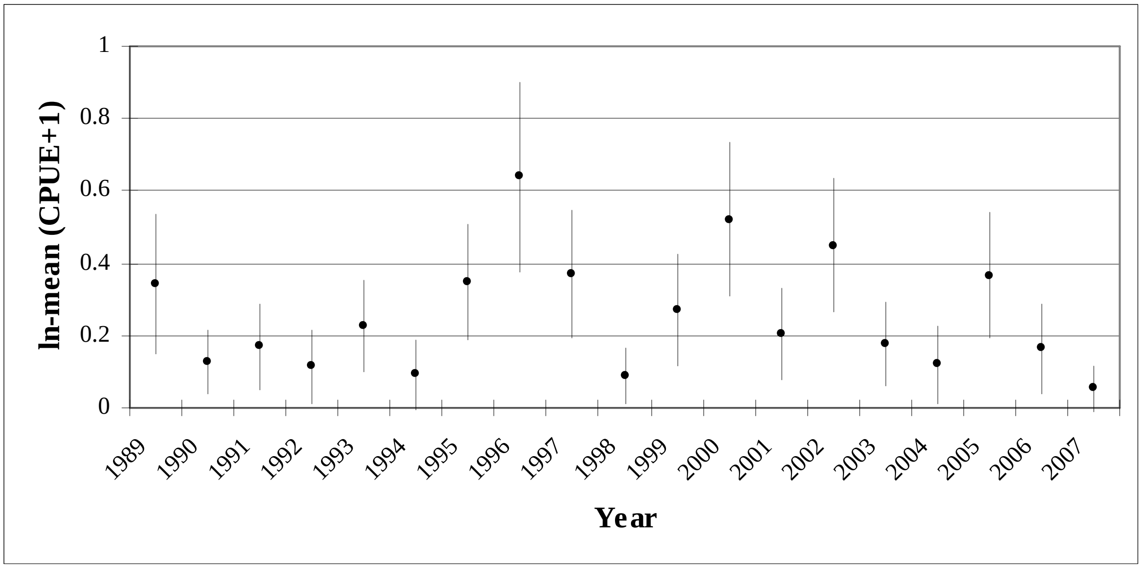

Figure 12. Atlantic silverside (*Menidia menidia*) trawl relative abundance (ln-mean CPUE+1) with 95% confidence intervals (1989–2007). Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=140/year).

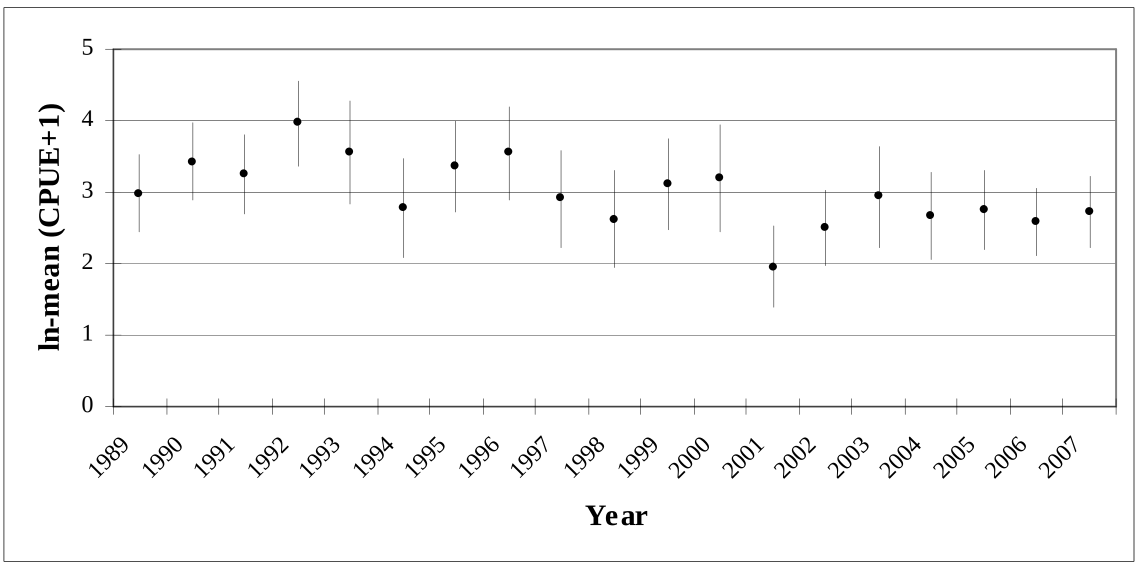

Figure 13. Atlantic silverside (*Menidia menidia*) beach seine relative abundance (ln-mean CPUE+1) with 95% confidence intervals (1989-2007). Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=38/year).

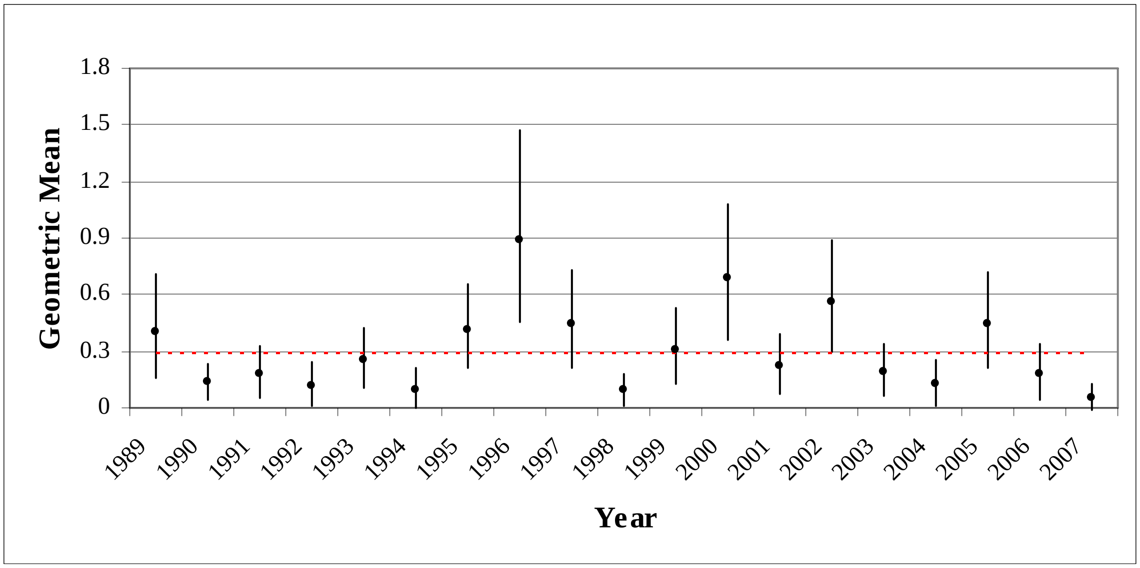

Figure 14. Atlantic silverside (*Menidia menidia*) trawl index of relative abundance (geometric mean) with 95% confidence intervals (1989-2007). Solid line represents the 1989-2007 time series grand mean. Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=140/year).

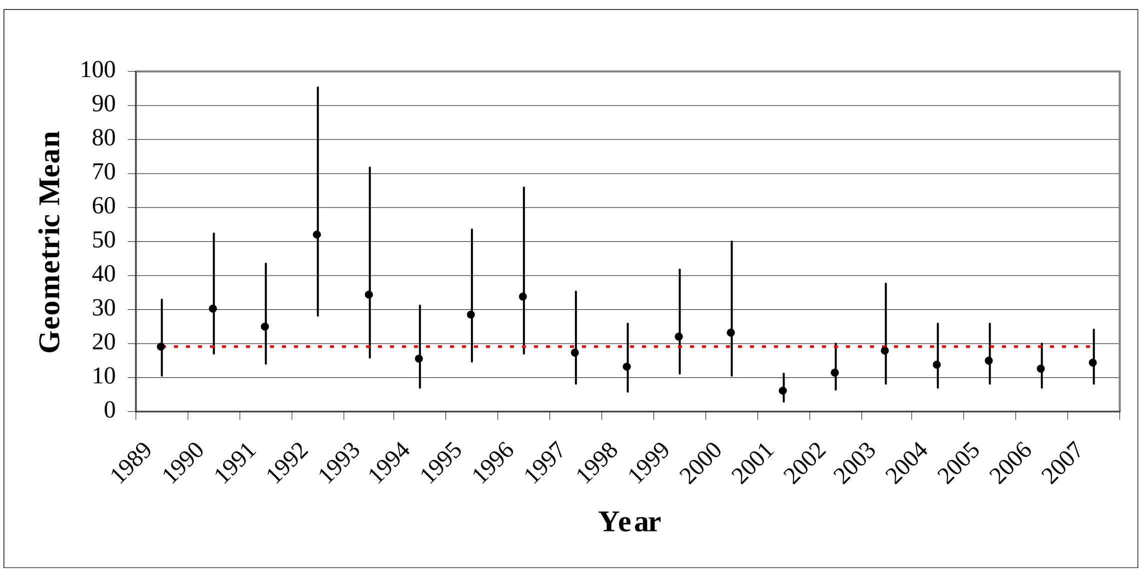

Figure 15. Atlantic silverside (*Menidia menidia*) beach seine index of relative abundance (geometric mean) with 95% confidence intervals (1989-2007). Solid line represents the 1989-2007 time series grand mean. Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=38/year).

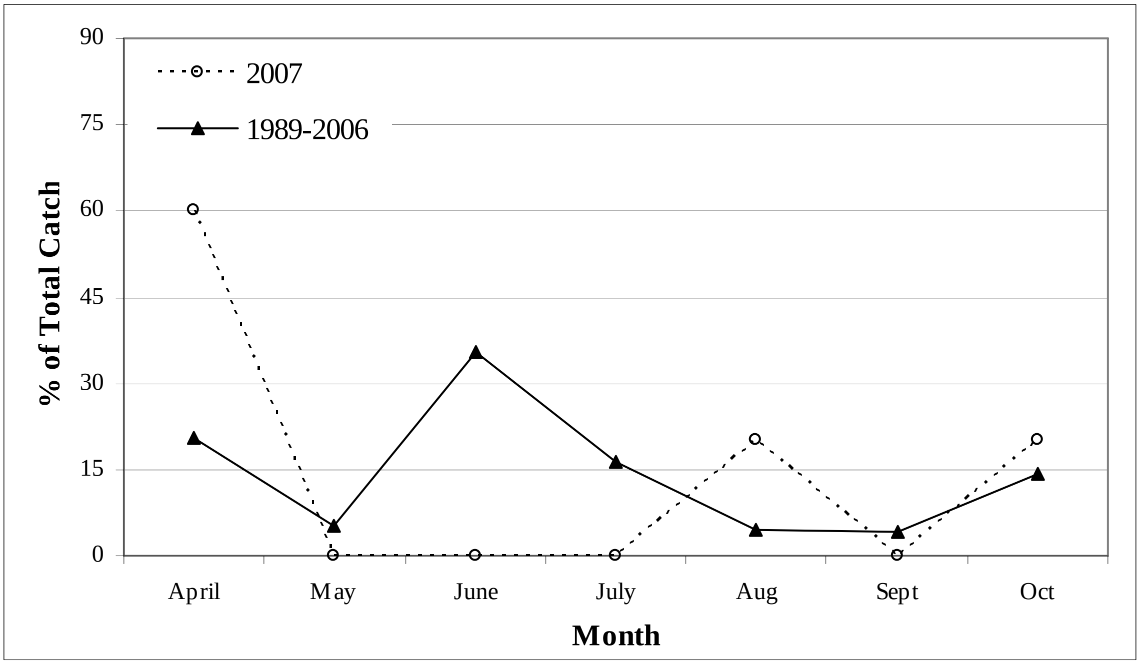

Figure 16. Coastal Bays Fisheries Investigation Trawl Survey comparison of the 1989-2006 time series and 2007 seasonal Atlantic silverside (*Menidia menidia*) percent catch by month.

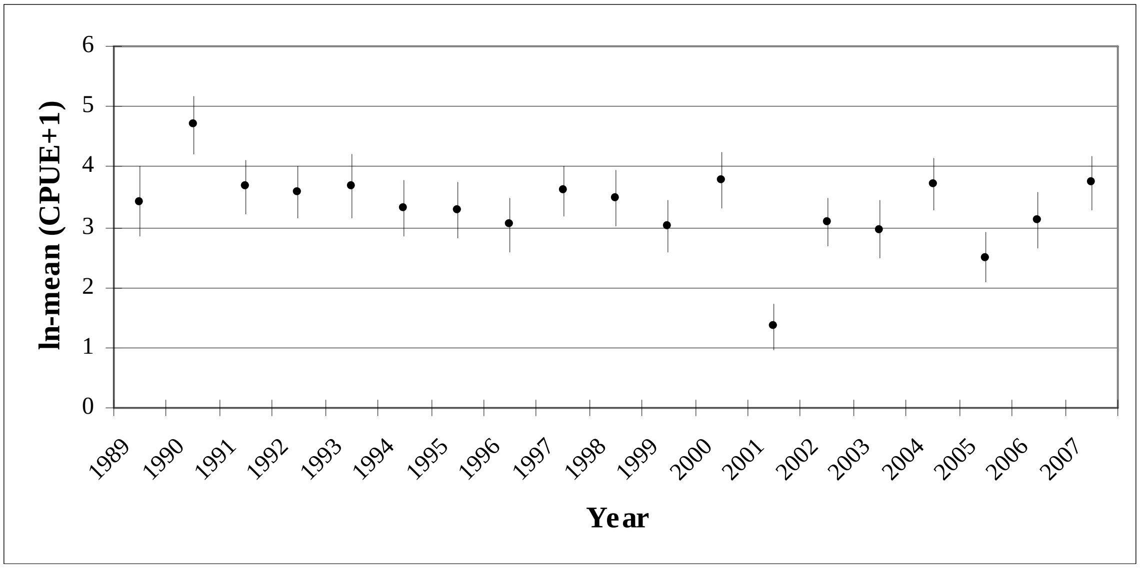

Figure 17. Bay anchovy trawl (*Anchoa mitchilli*) relative abundance (ln-mean CPUE+1) with 95% confidence intervals (1989–2007). Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=140/year).

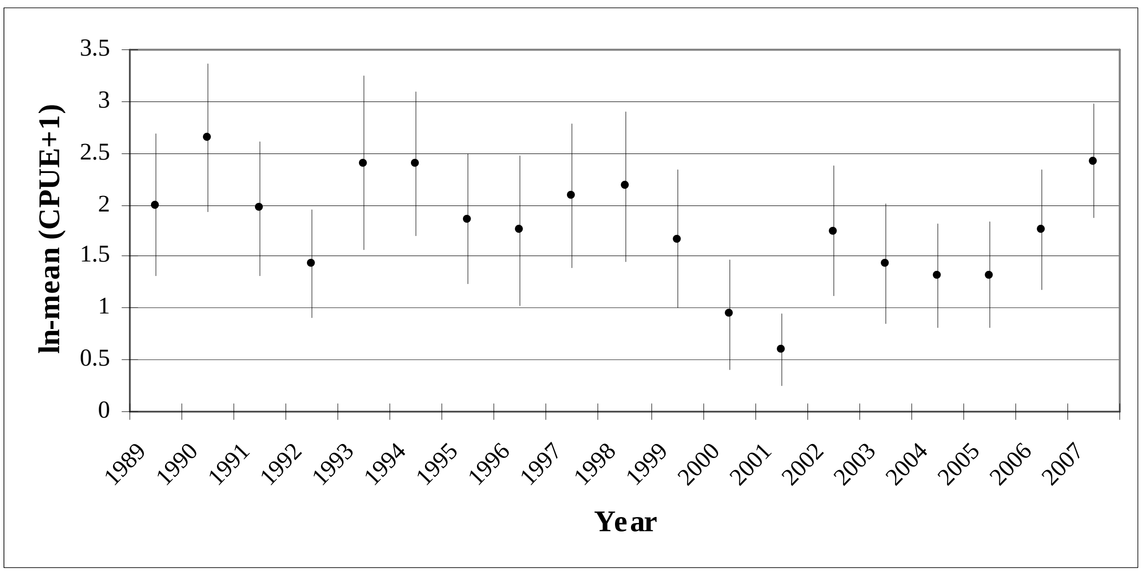

Figure 18. Bay anchovy (*Anchoa mitchilli*) beach seine relative abundance (ln-mean CPUE+1) with 95% confidence intervals (1989-2007). Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=38/year).

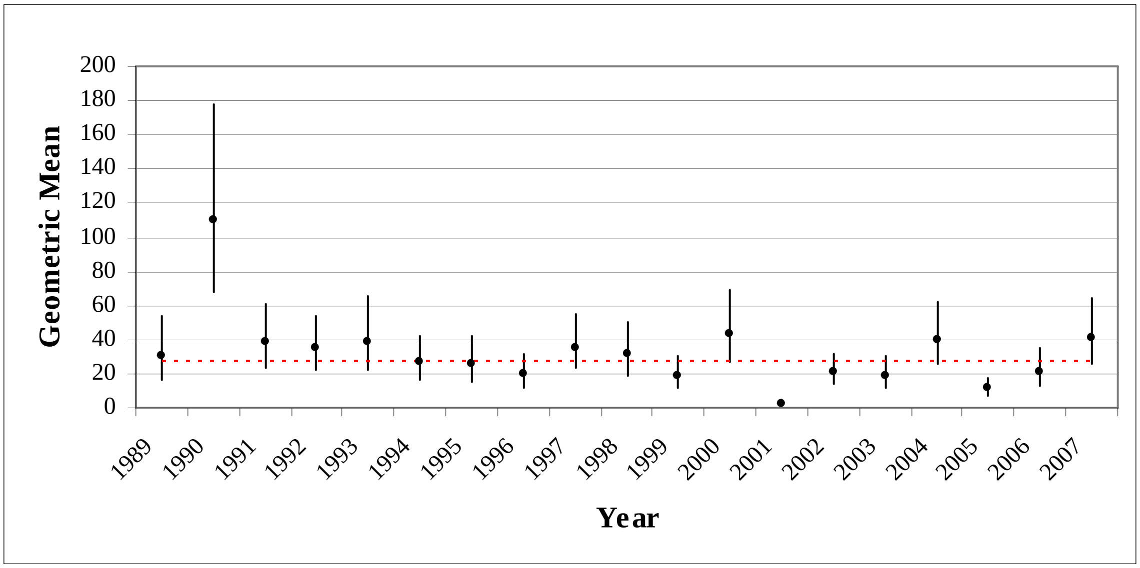

Figure 19. Bay anchovy (*Anchoa mitchilli*) trawl index of relative abundance (geometric mean) with 95% confidence intervals (1989-2007). Solid line represents the 1989-2007 time series grand mean. Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=140/year).

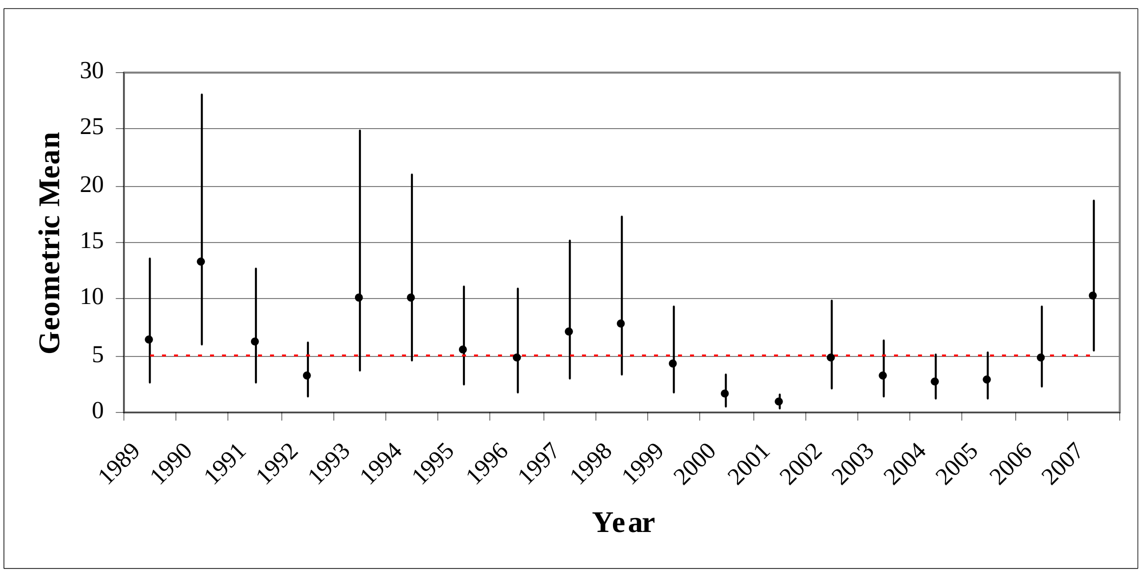

Figure 20. Bay anchovy (*Anchoa mitchilli*) beach seine index of relative abundance (geometric mean) with 95% confidence intervals (1989-2007). Solid line represents the 1989-2007 time series grand mean. Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=38/year).

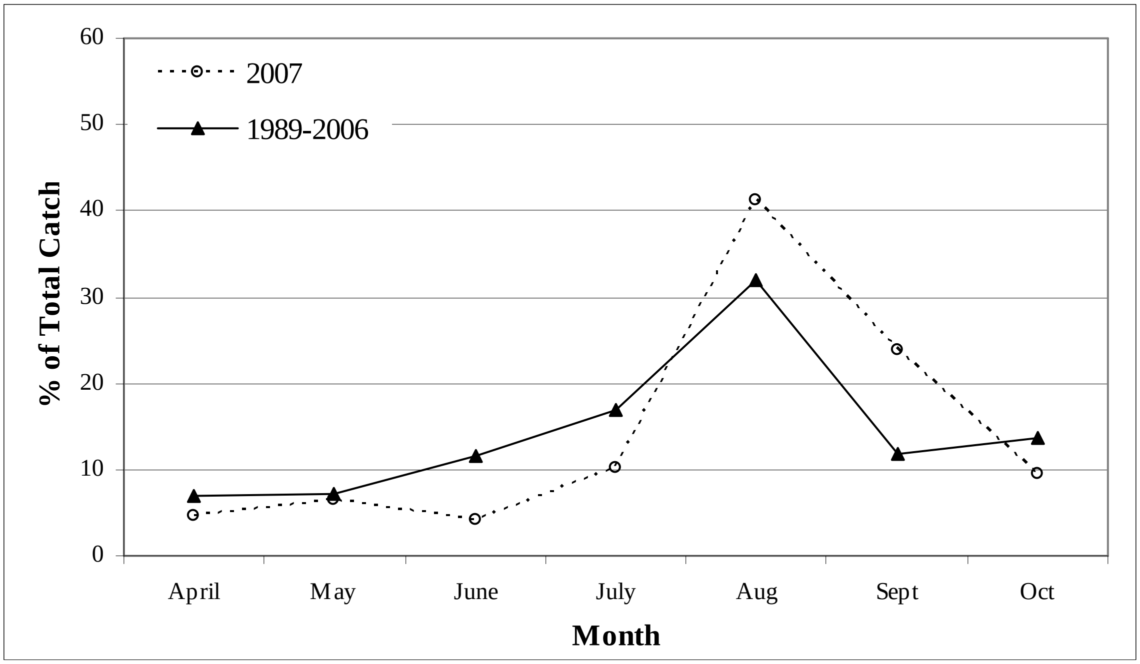

Figure 21. Coastal Bays Fisheries Investigation Trawl Survey comparison of the 1989-2006 time series and 2007 seasonal bay anchovy (*Anchoa mitchilli*) percent catch by month.

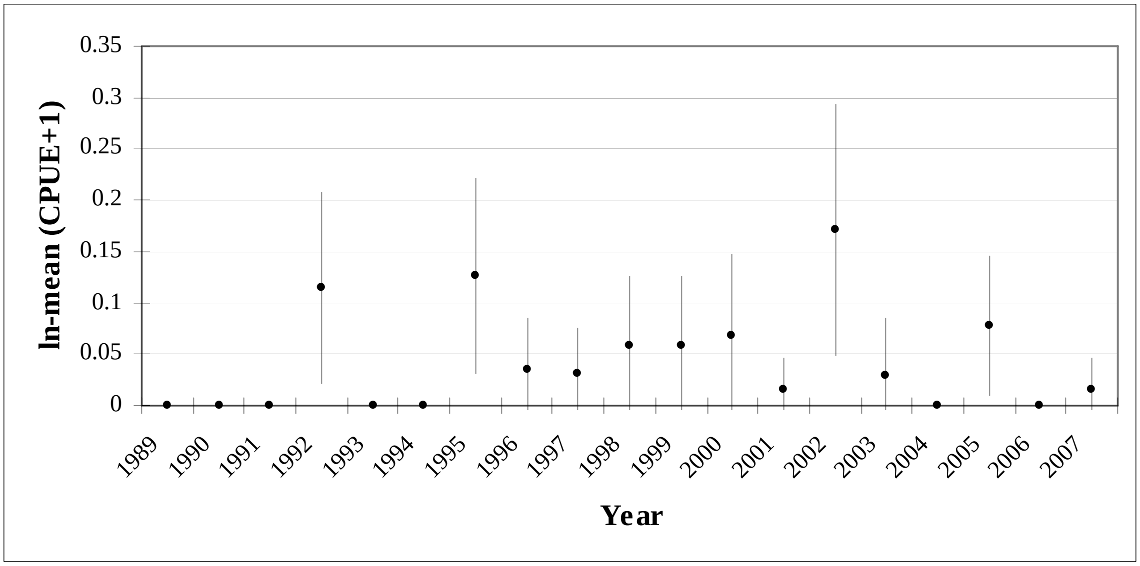

Figure 22. Black drum (*Pogonias cromis*) trawl relative abundance (ln-mean CPUE+1) with 95% confidence intervals (1989–2007). Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=140/year).

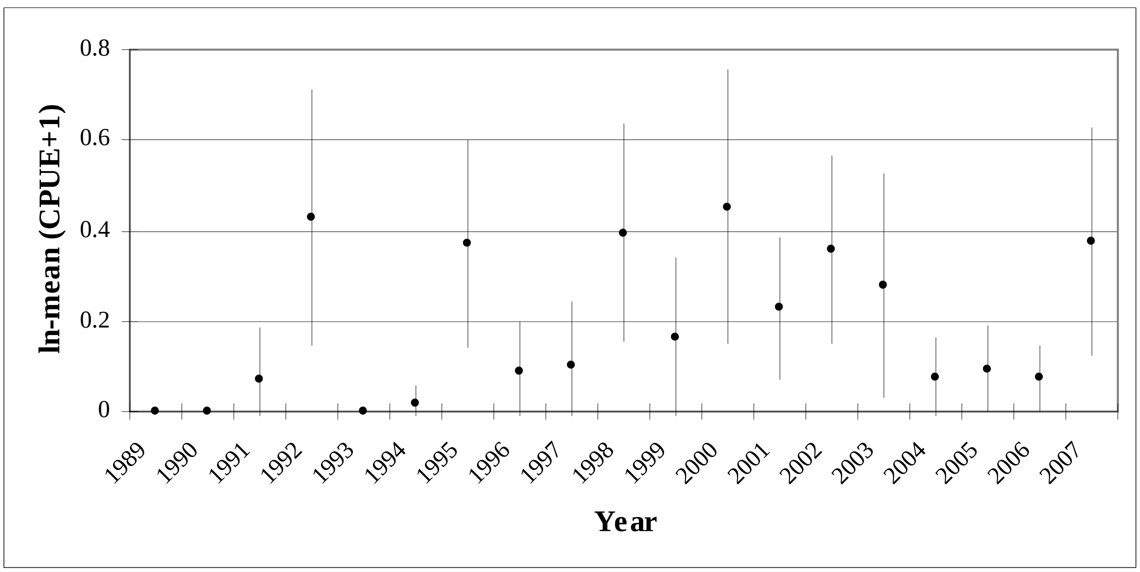

Figure 23. Black drum (*Pogonias cromis*) beach seine relative abundance (ln-mean CPUE+1) with 95% confidence intervals (1989-2007). Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=38/year).

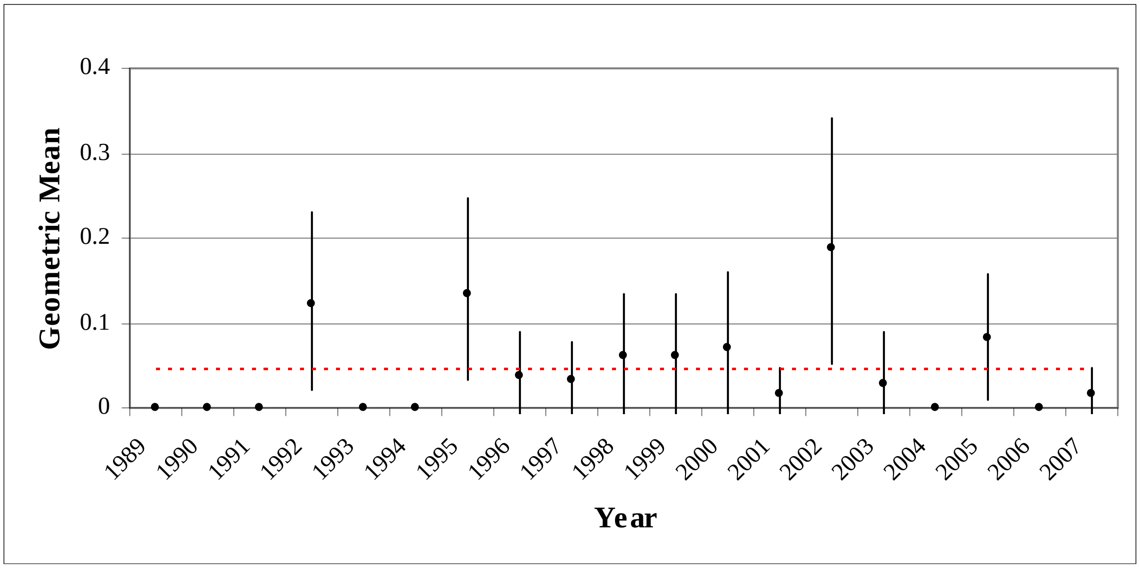

Figure 24. Black drum (*Pogonias cromis*) trawl index of relative abundance (geometric mean) with 95% confidence intervals (1989-2007). Solid line represents the 1989-2007 time series grand mean. Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=140/year).

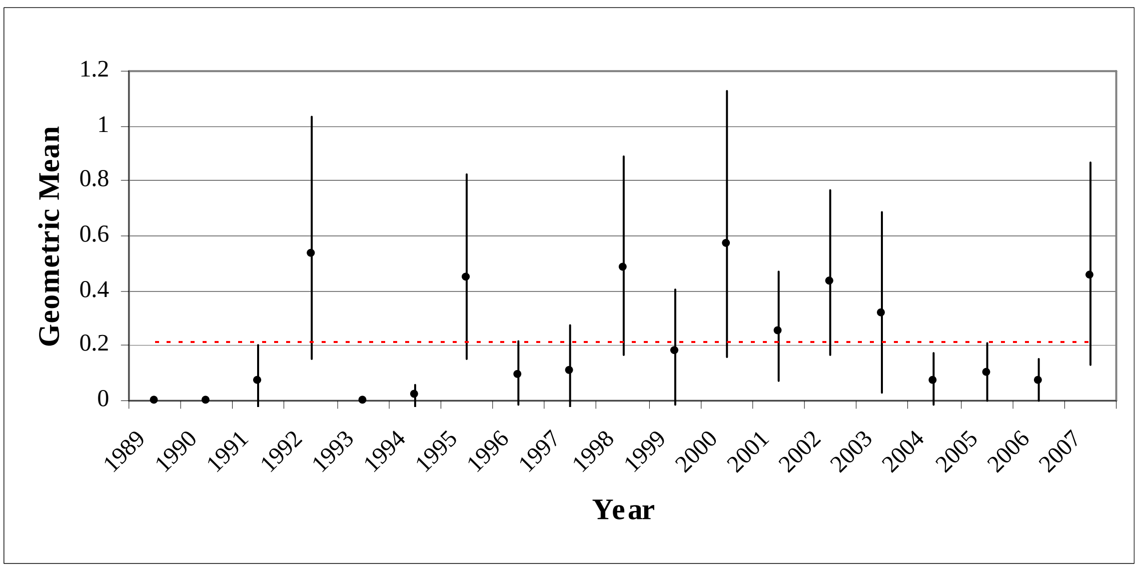

Figure 25. Black drum (*Pogonias cromis*) beach seine index of relative abundance (geometric mean) with 95% confidence intervals (1989-2007). Solid line represents the 1989-2007 time series grand mean. Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=38/year).

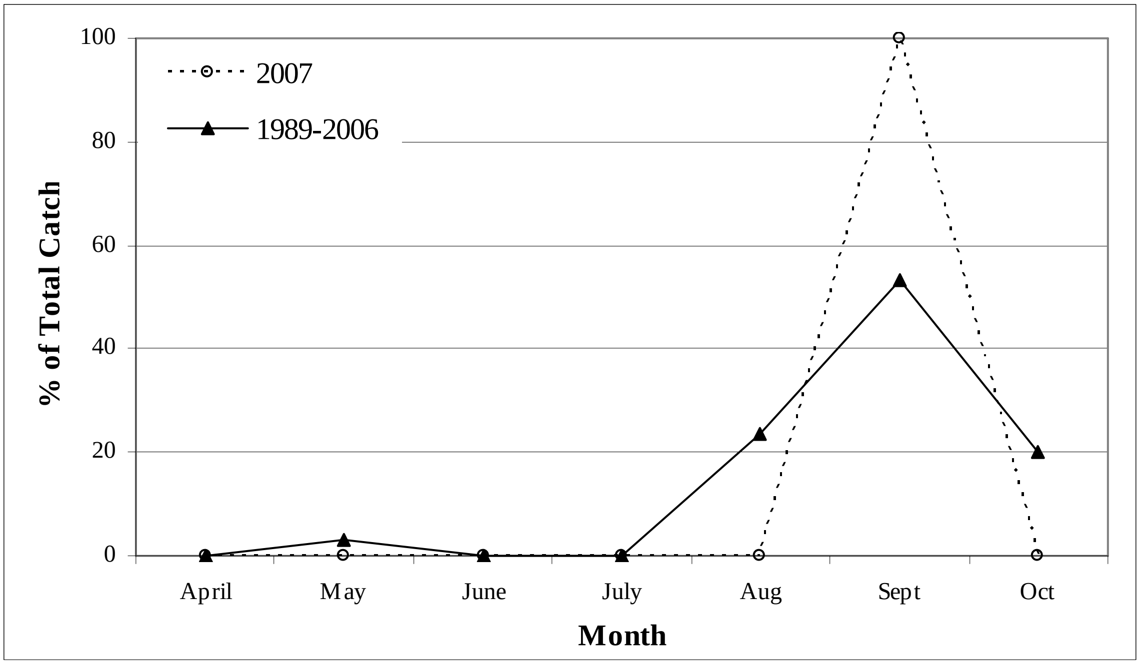

Figure 26. Coastal Bays Fisheries Investigation Trawl Survey comparison of the 1989-2006 time series and 2007 seasonal black drum (*Pogonias cromis*) percent catch by month.

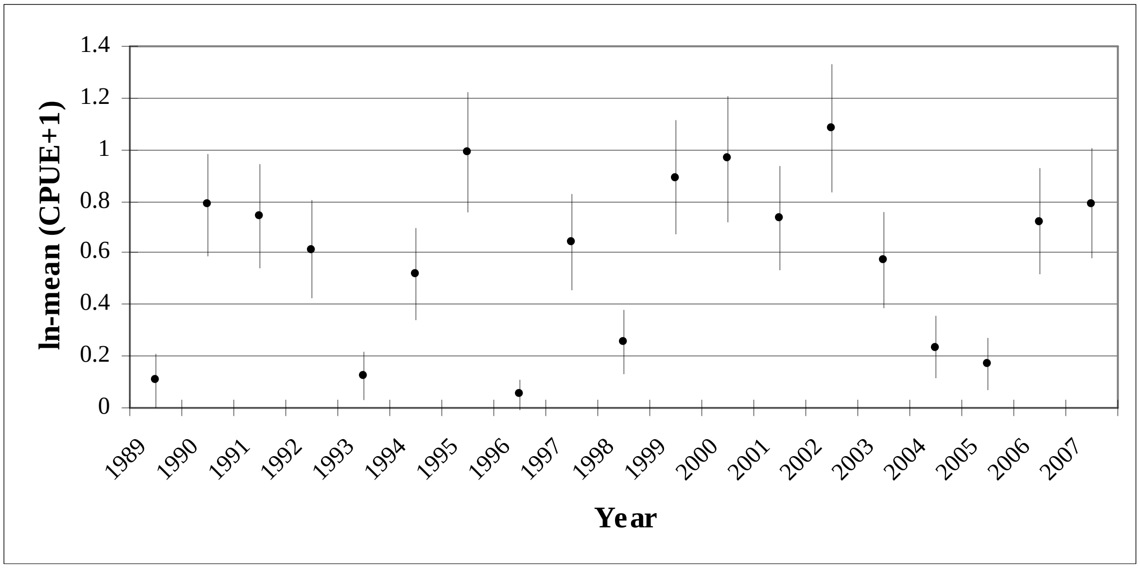

Figure 27. Black sea bass (*Centropristis striata*) trawl relative abundance (ln-mean CPUE+1) with 95% confidence intervals (1989-2007). Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=140/year).

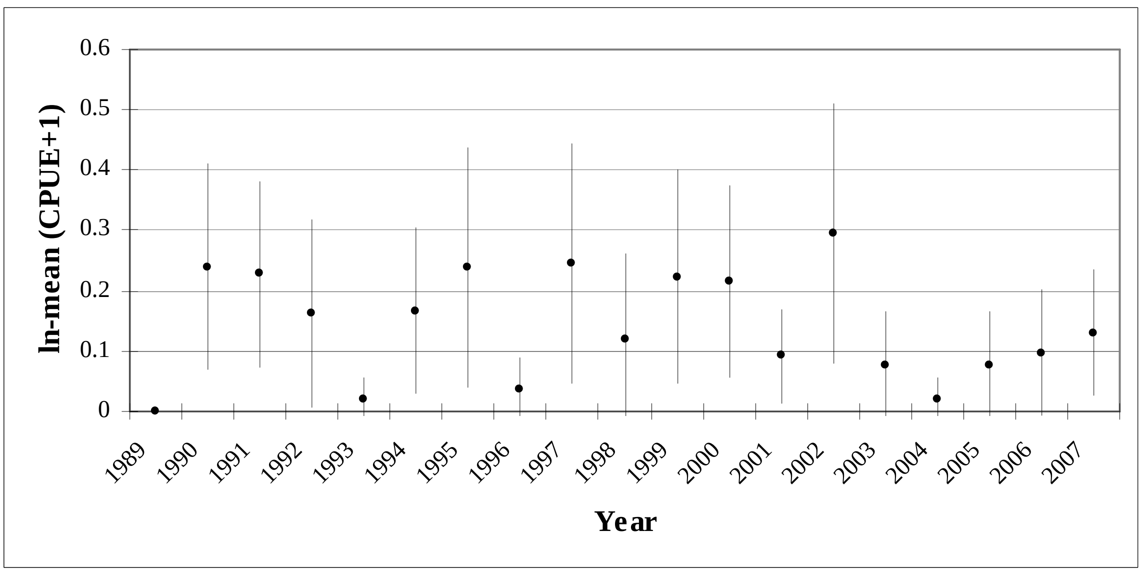

Figure 28. Black sea bass (*Centropristis striata*) beach seine relative abundance (ln-mean CPUE+1) with 95% confidence intervals (1989-2007). Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=38/year).

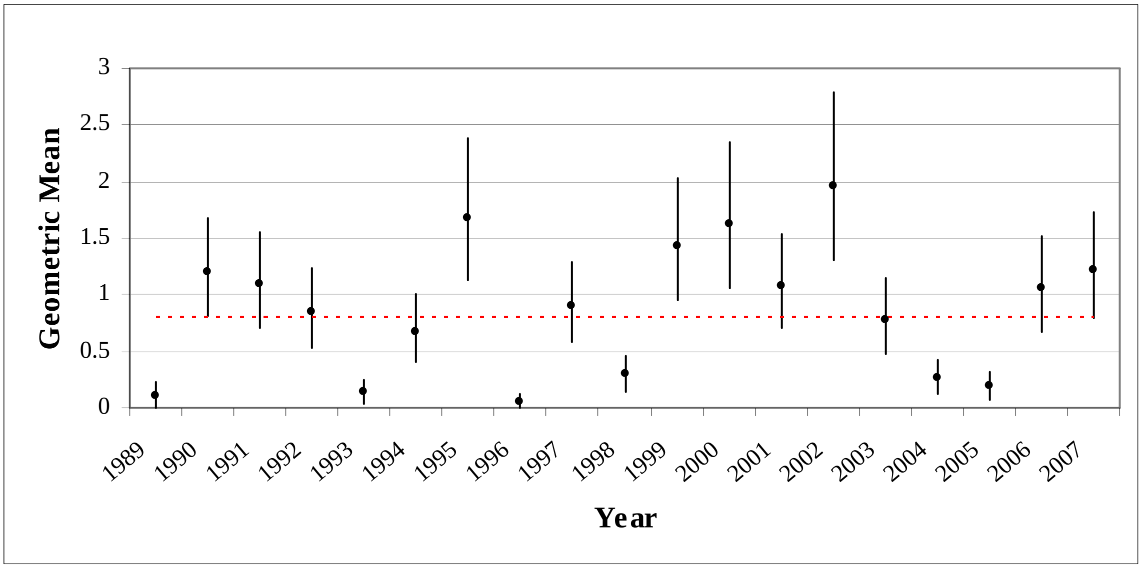

Figure 29. Black sea bass (*Centropristis striata*) trawl index of relative abundance (geometric mean) with 95% confidence intervals (1989-2007). Solid line represents the 1989-2007 time series grand mean. Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=140/year).

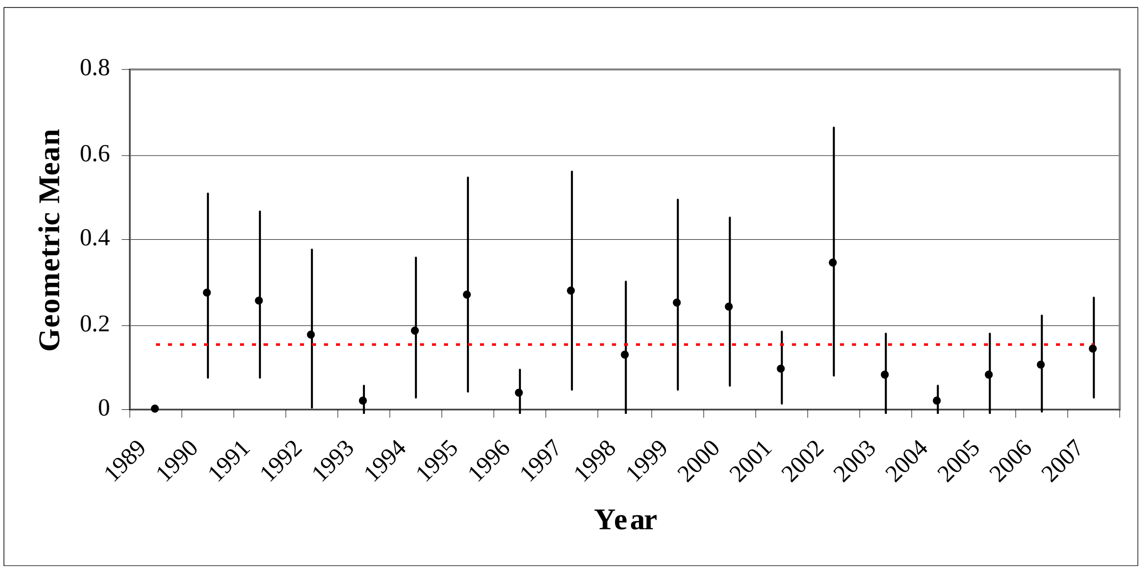

Figure 30. Black sea bass (*Centropristis striata*) beach seine index of relative abundance (geometric mean) with 95% confidence intervals (1989-2007). Solid line represents the 1989-2007 time series grand mean. Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=38/year).

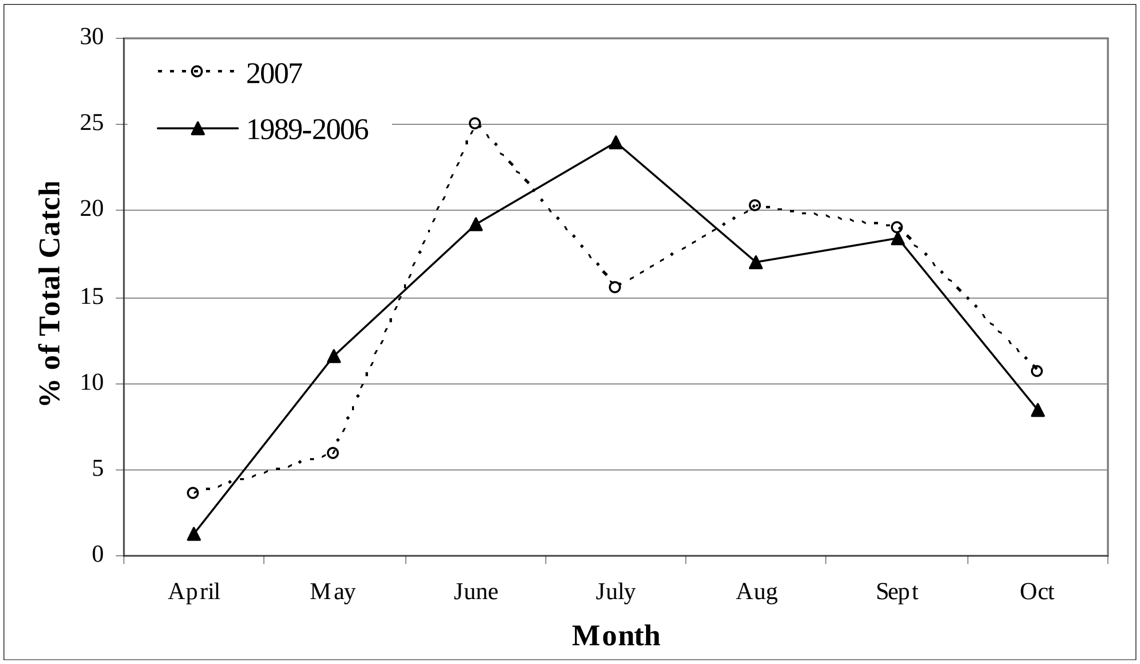

Figure 31. Coastal Bays Fisheries Investigation Trawl Survey comparison of the 1989-2006 time series and 2007 seasonal black sea bass (*Centropristis striata*) percent catch by month.

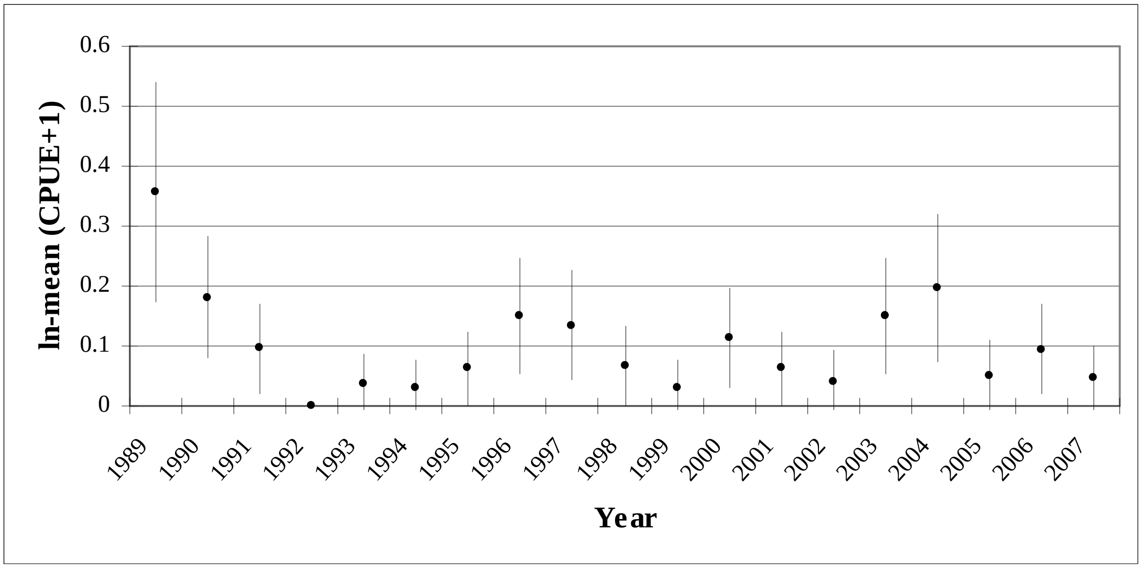

Figure 32. Bluefish (*Pomatomus saltatrix*) trawl relative abundance (ln-mean CPUE+1) with 95% confidence intervals (1989–2007). Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=140/year).

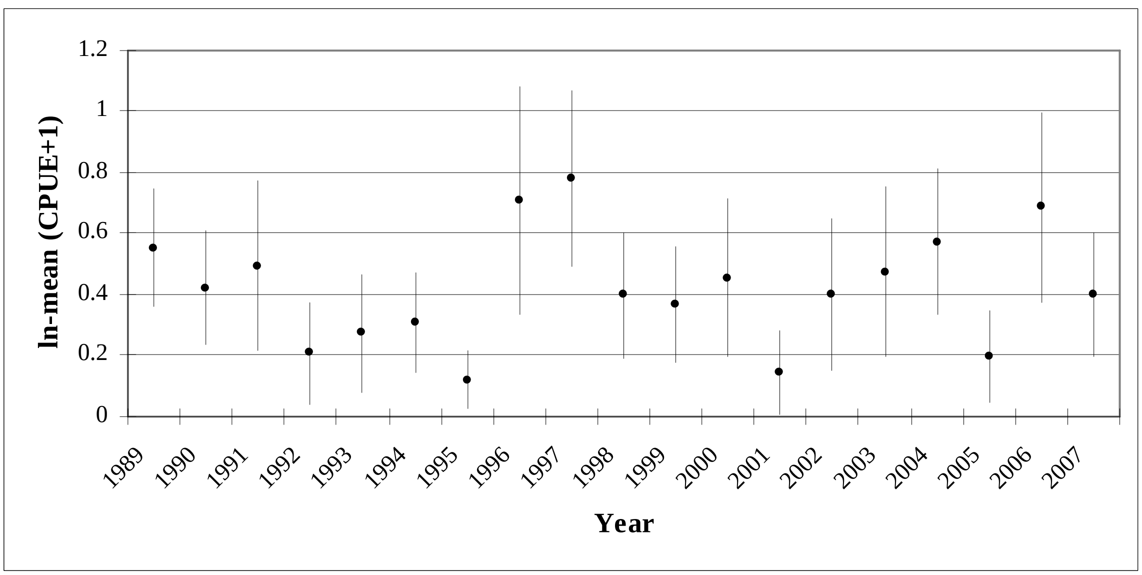

Figure 33. Bluefish (*Pomatomus saltatrix*) beach seine relative abundance (ln-mean CPUE+1) with 95% confidence intervals (1989-2007). Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=38/year).

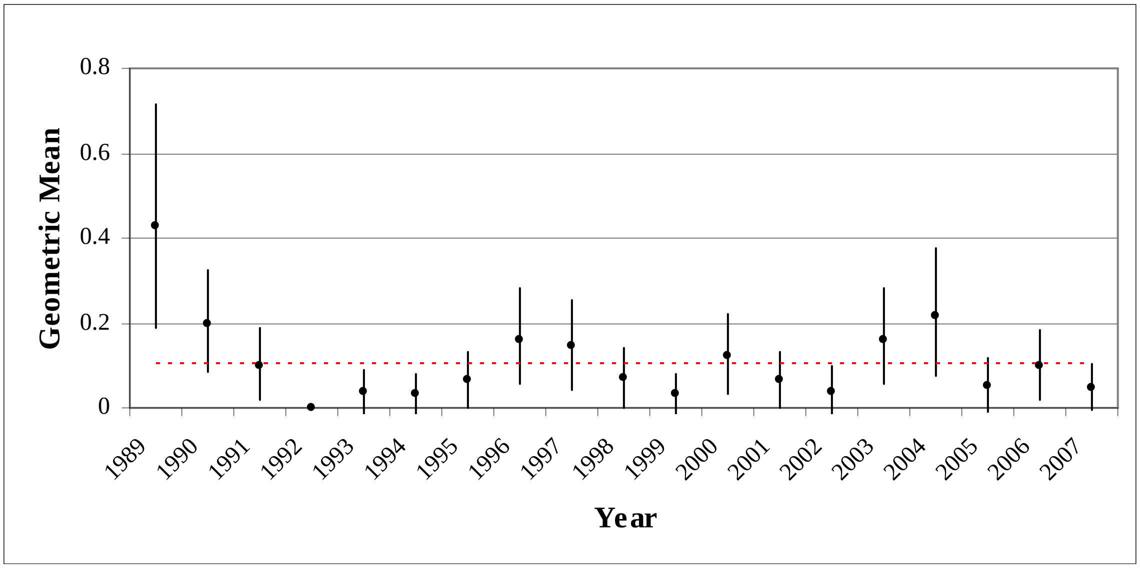

Figure 34. Bluefish (*Pomatomus saltatrix*) trawl index of relative abundance (geometric mean) with 95% confidence intervals (1989-2007). Solid line represents the 1989-2007 time series grand mean. Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=140/year).

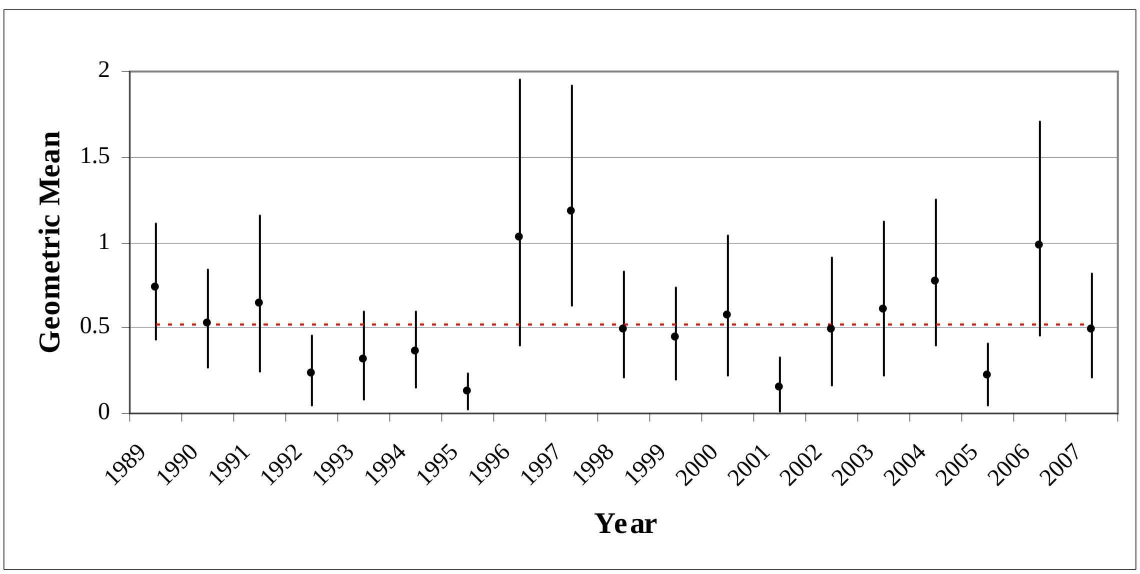

Figure 35. Bluefish (*Pomatomus saltatrix*) beach seine index of relative abundance (geometric mean) with 95% confidence intervals (1989-2007). Solid line represents the 1989-2007 time series grand mean. Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=38/year).

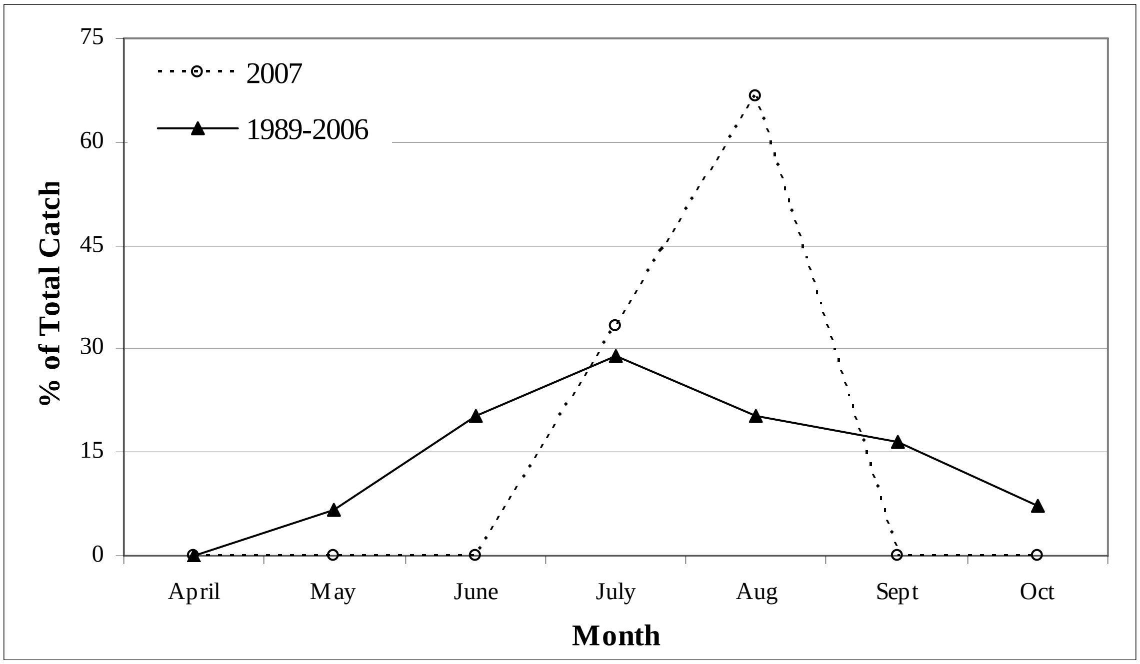

Figure 36. Coastal Bays Fisheries Investigation Trawl Survey comparison of the 1989-2006 time series and 2007 seasonal bluefish (*Pomatomus saltatrix*) percent catch by month.

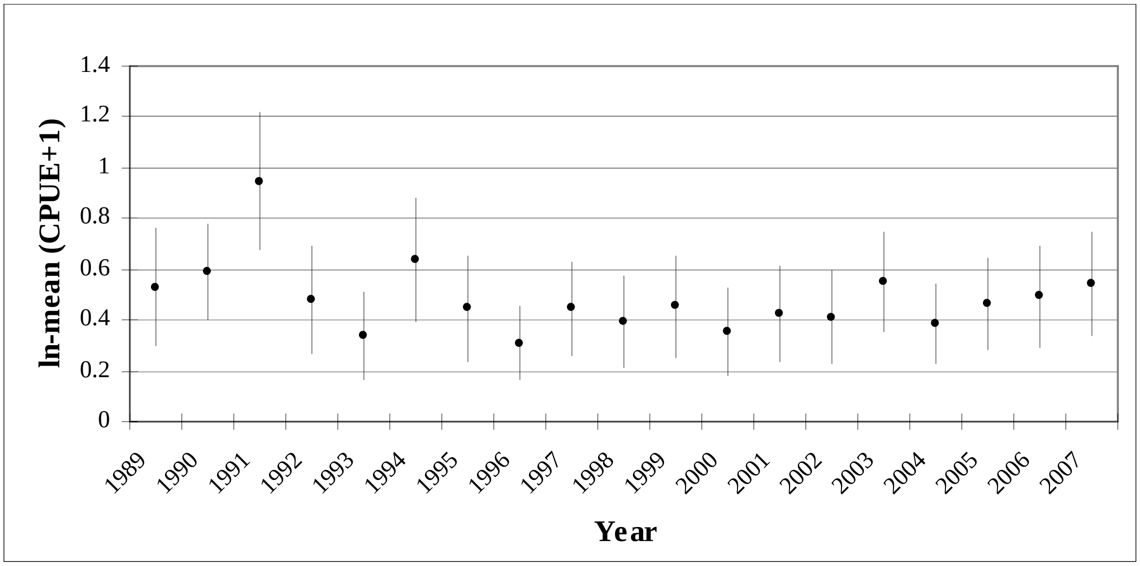

Figure 37. Hogchoker (*Trinectes maculatus*) trawl relative abundance (ln-mean CPUE+1) with 95% confidence intervals (1989–2007). Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=140/year).

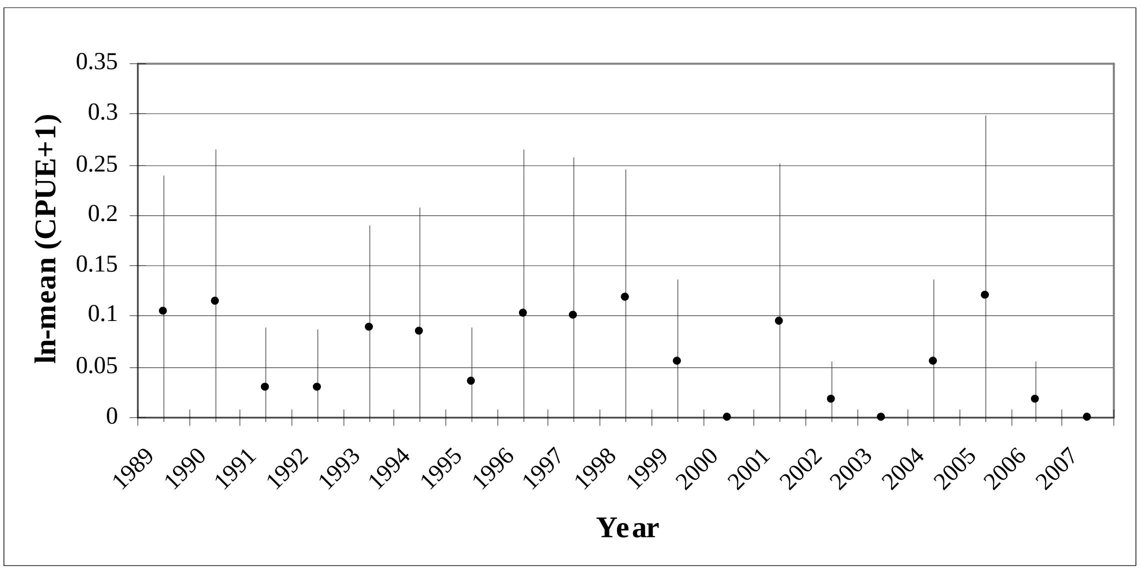

Figure 38. Hogchoker (*Trinectes maculatus*) beach seine relative abundance (ln-mean CPUE+1) with 95% confidence intervals (1989-2007). Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=38/year).

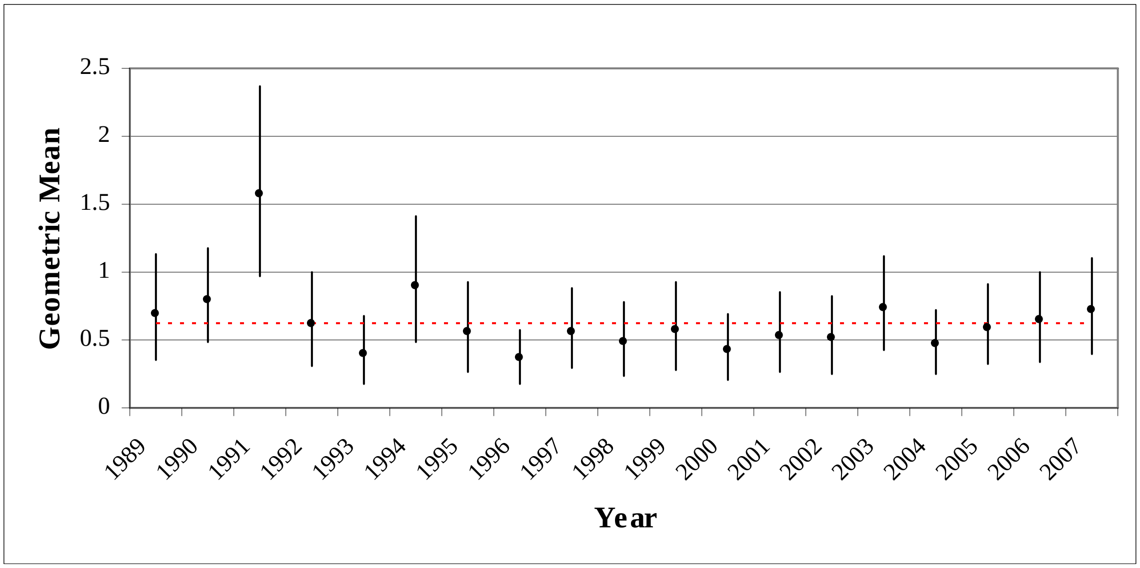

Figure 39. Hogchoker (*Trinectes maculatus*) trawl index of relative abundance (geometric mean) with 95% confidence intervals (1989-2007). Solid line represents the 1989-2007 time series grand mean. Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=140/year).

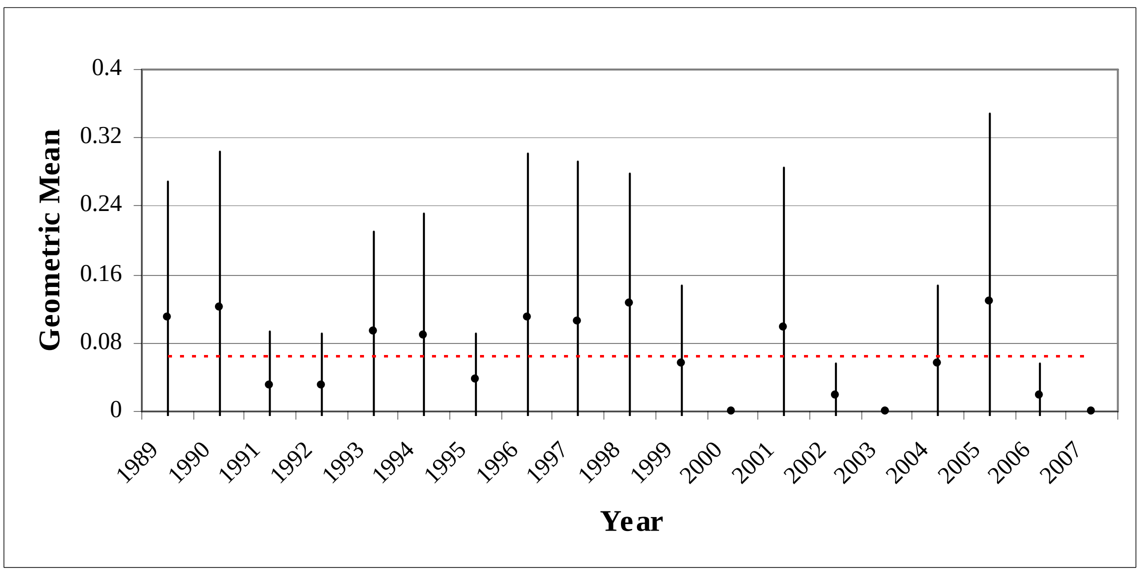

Figure 40. Hogchoker (*Trinectes maculatus*) beach seine index of relative abundance (geometric mean) with 95% confidence intervals (1989-2007). Solid line represents the 1989-2007 time series grand mean. Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=38/year).

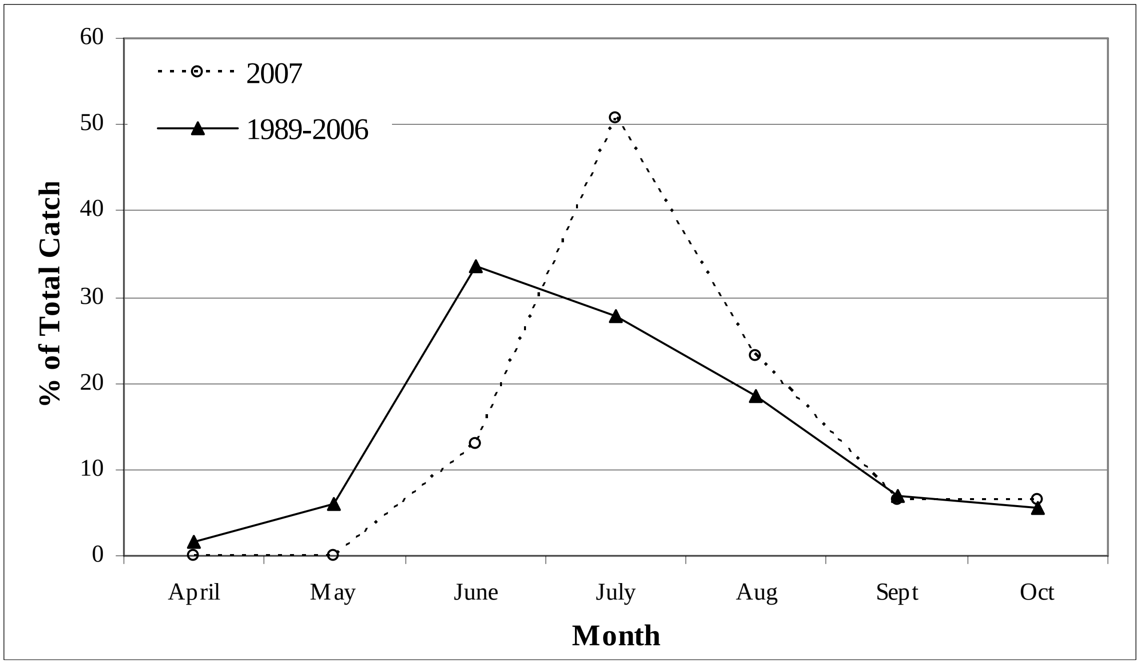

Figure 41. Coastal Bays Fisheries Investigation Trawl Survey comparison of the 1989-2006 time series and 2007 seasonal hogchoker (*Trinectes maculatus*) percent catch by month.

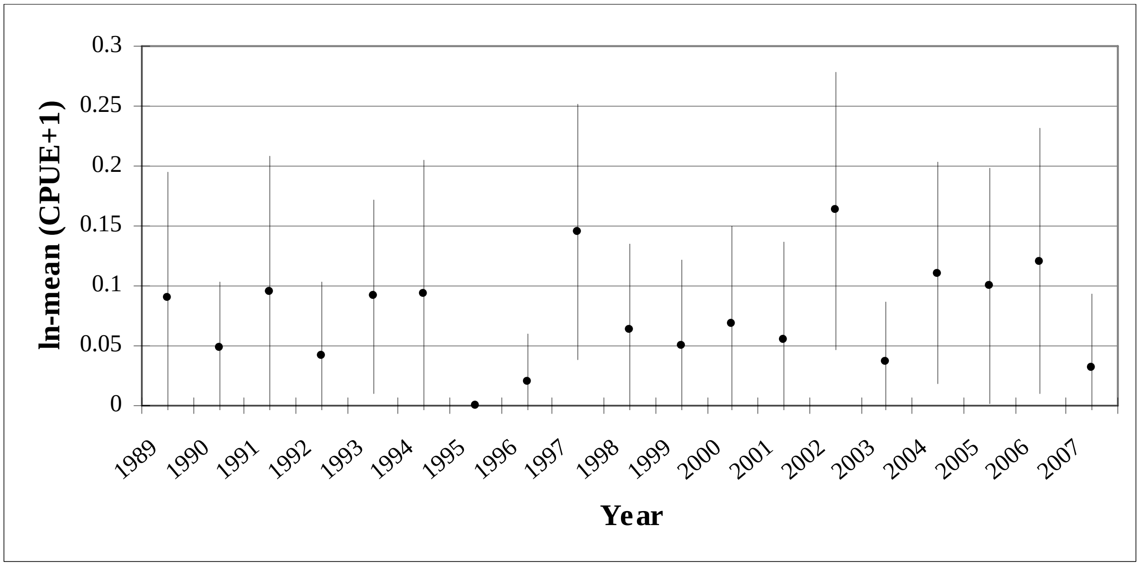

Figure 42. Mummichog (*Fundulus heteroclitus*) trawl relative abundance (ln-mean CPUE+1) with 95% confidence intervals (1989–2007). Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=140/year).

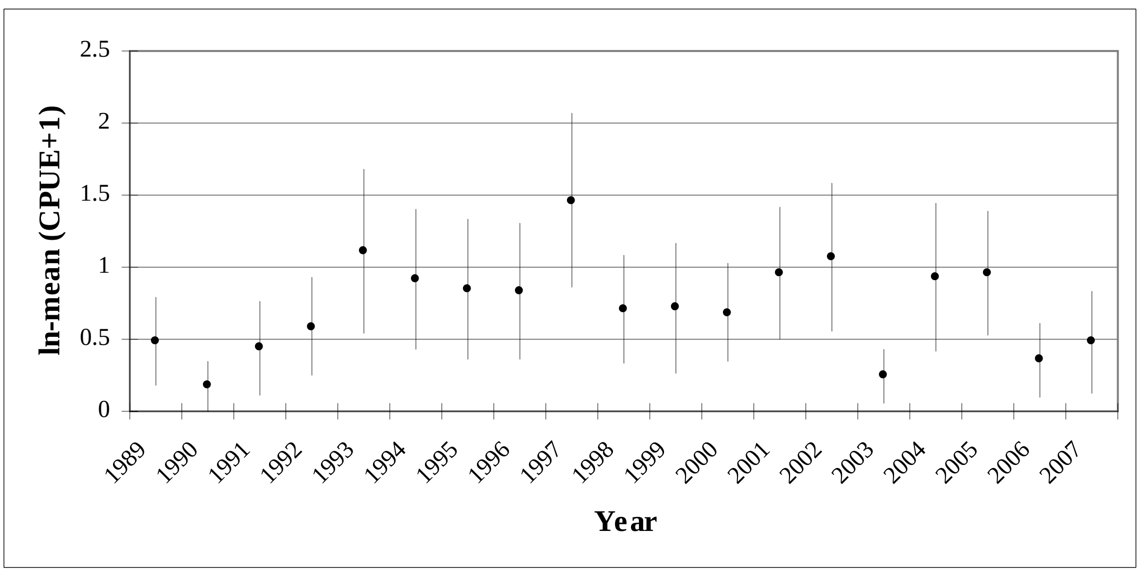

Figure 43. Mummichog (*Fundulus heteroclitus*) beach seine relative abundance (ln-mean CPUE+1) with 95% confidence intervals (1989-2007). Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=38/year).

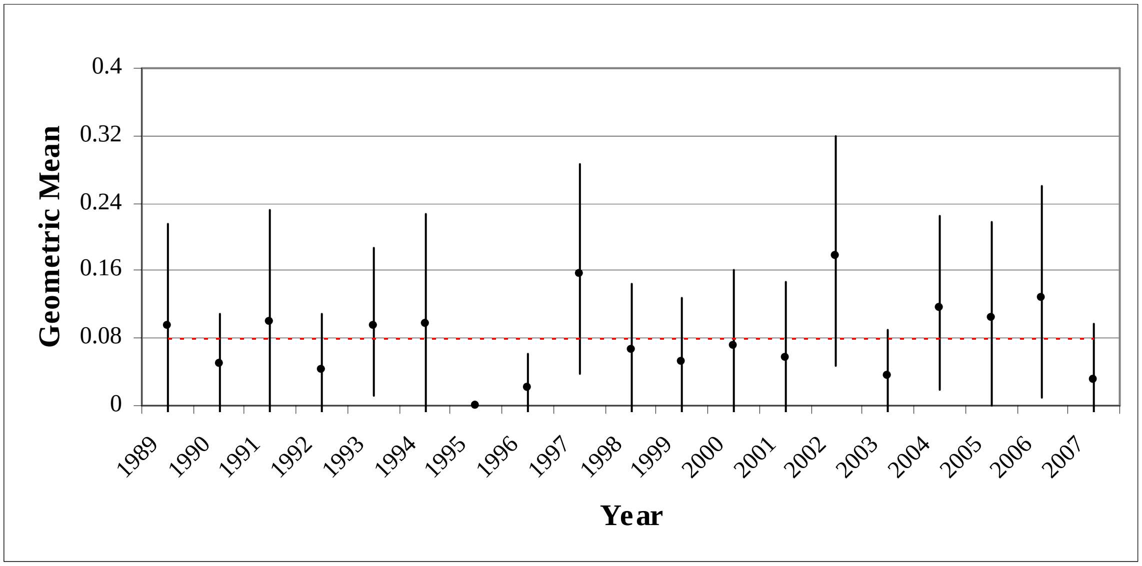

Figure 44. Mummichog (*Fundulus heteroclitus*) trawl index of relative abundance (geometric mean) with 95% confidence intervals (1989-2007). Solid line represents the 1989-2007 time series grand mean. Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=140/year).

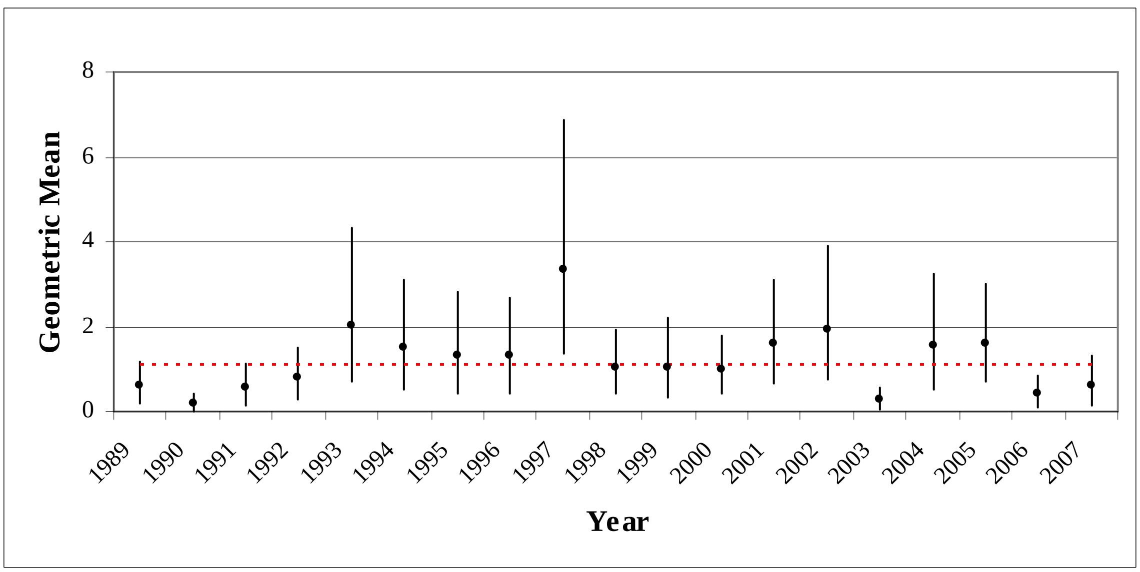

Figure 45. Mummichog (*Fundulus heteroclitus*) beach seine index of relative abundance (geometric mean) with 95% confidence intervals (1989-2007). Solid line represents the 1989-2007 time series grand mean. Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=38/year).

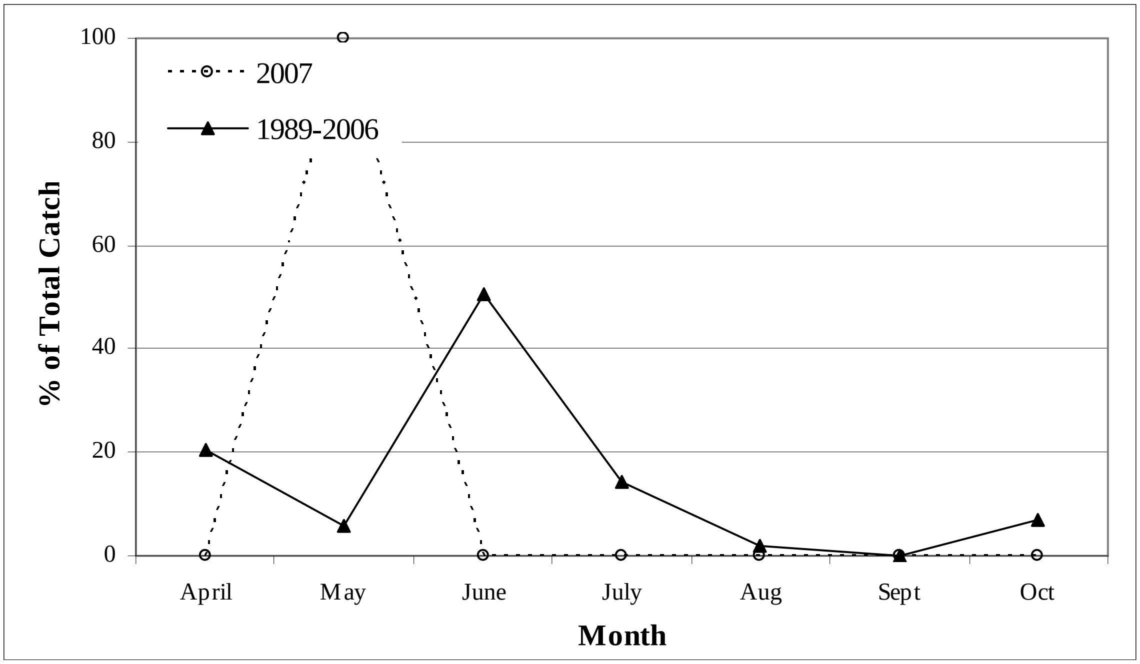

Figure 46. Coastal Bays Fisheries Investigation Trawl Survey comparison of the 1989-2006 time series and 2007 seasonal mummichog (*Fundulus heteroclitus*) percent catch by month.

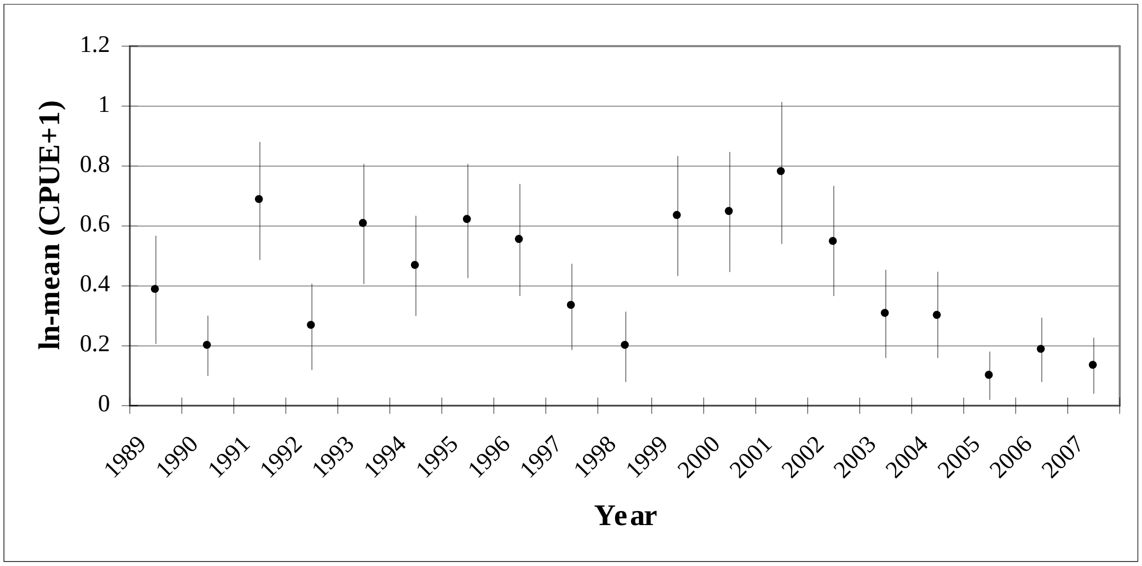

Figure 47. Northern puffer (*Sphoeroides maculatus*) trawl relative abundance (ln-mean CPUE+1) with 95% confidence intervals (1989–2007). Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=140/year).

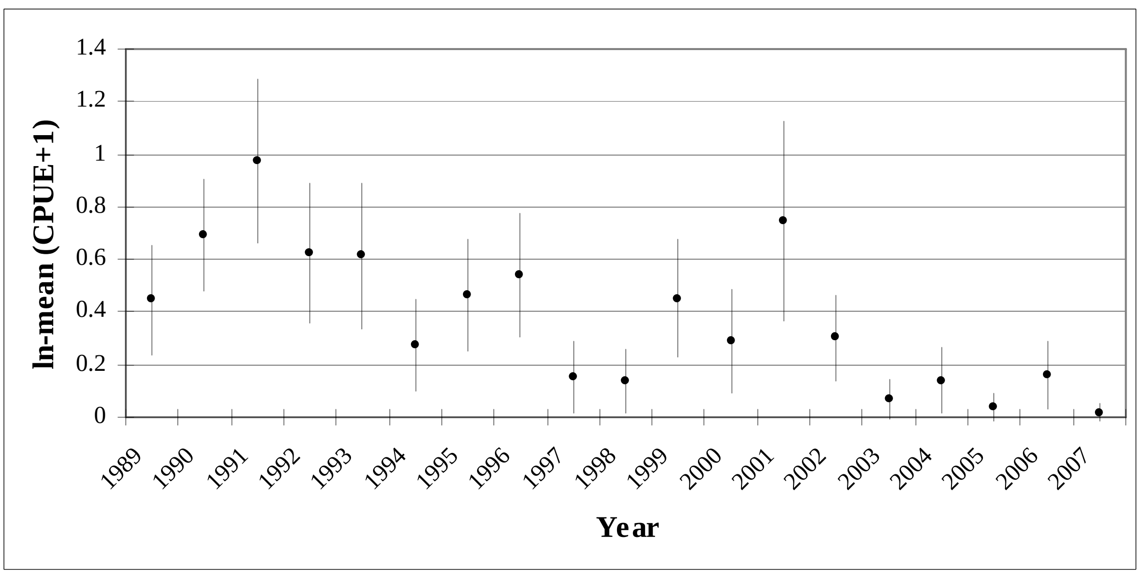

Figure 48. Northern puffer (*Sphoeroides maculatus*) beach seine relative abundance (ln-mean CPUE+1) with 95% confidence intervals (1989-2007). Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=38/year).

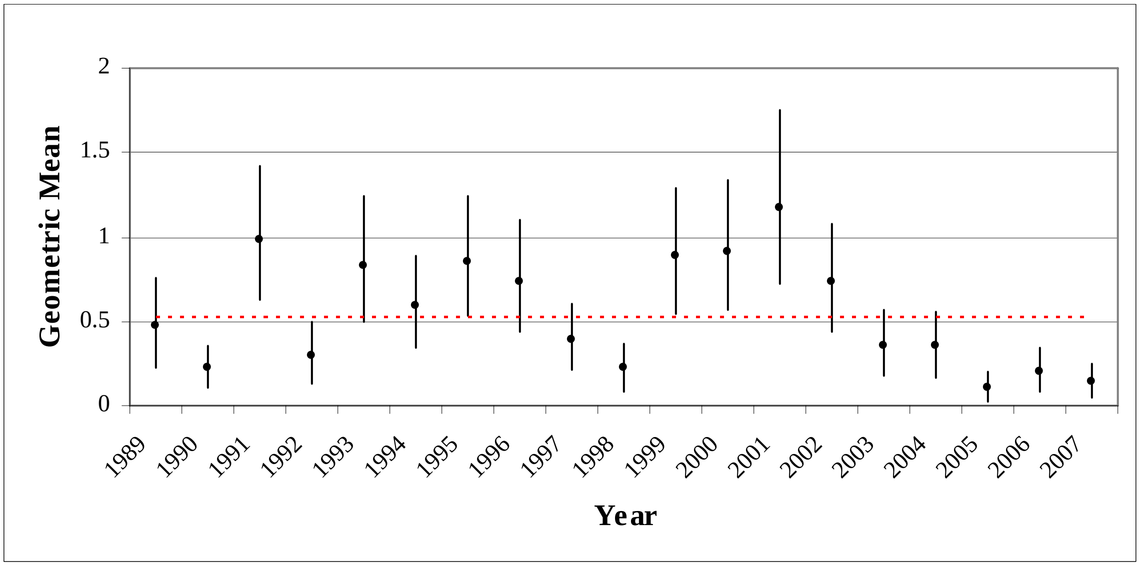

Figure 49. Northern (*Sphoeroides maculatus*) puffer trawl index of relative abundance (geometric mean) with 95% confidence intervals (1989-2007). Solid line represents the 1989-2007 time series grand mean. Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=140/year).

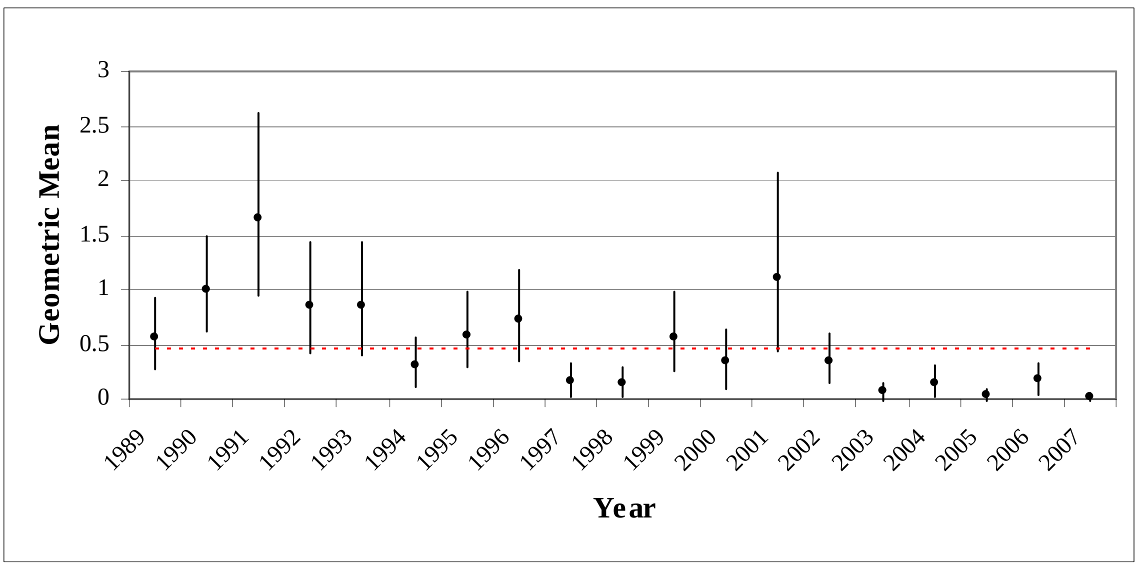

Figure 50. Northern puffer (*Sphoeroides maculatus*) beach seine index of relative abundance (geometric mean) with 95% confidence intervals (1989-2007). Solid line represents the 1989-2007 time series grand mean. Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=38/year).

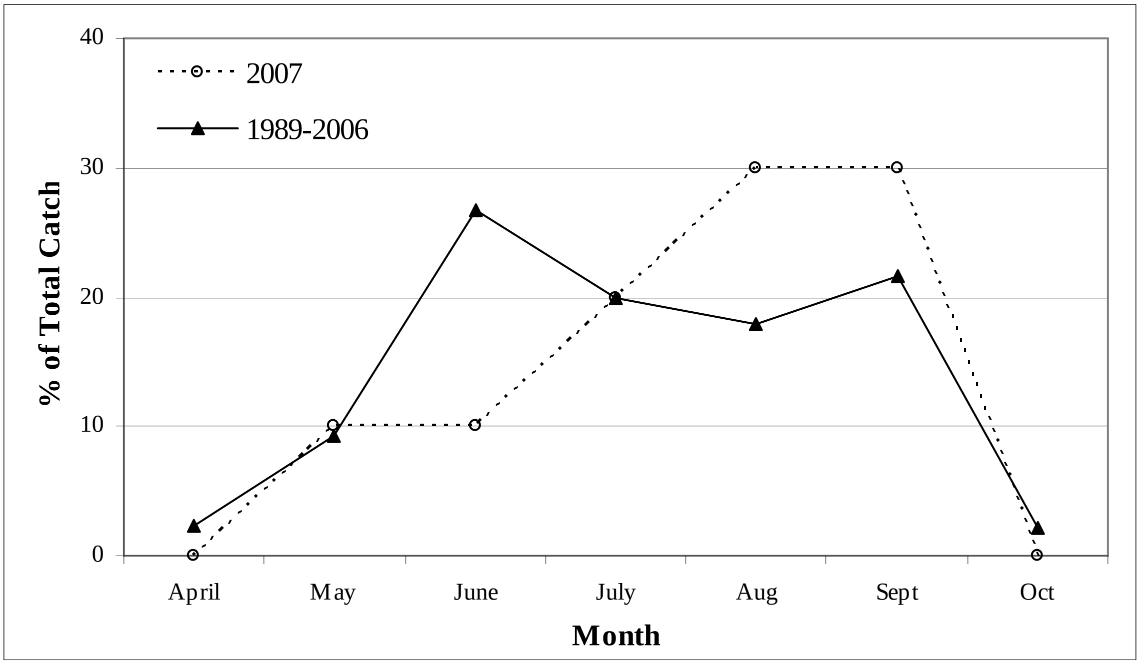

Figure 51. Coastal Bays Fisheries Investigation Trawl Survey comparison of the 1989-2006 time series and 2007 seasonal northern puffer (*Sphoeroides maculatus*) percent catch by month.

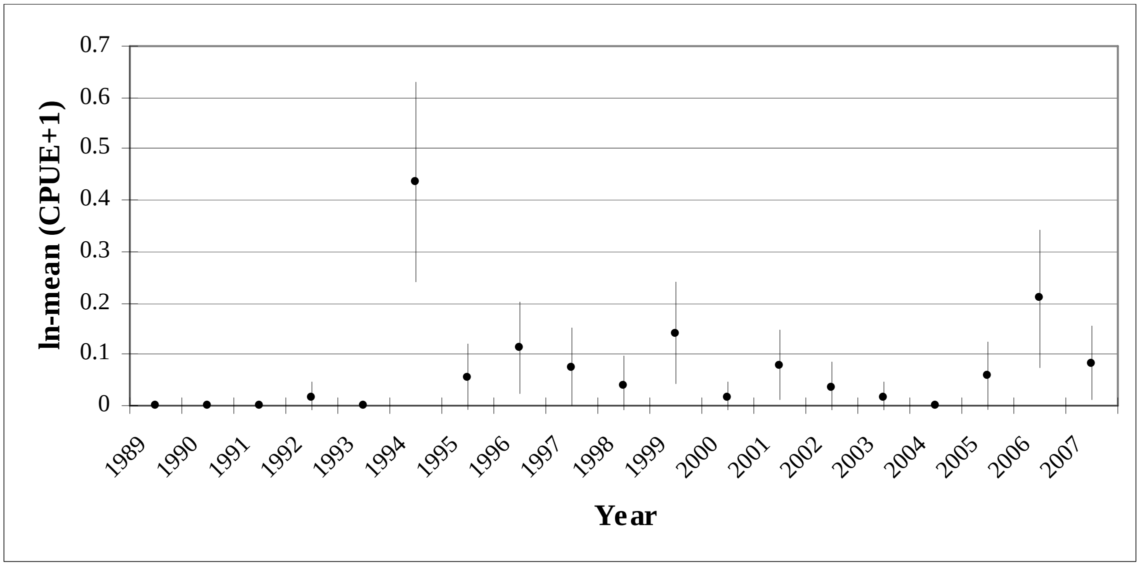

Figure 52. Pigfish (*Orthopristis chrysoptera*) trawl relative abundance (ln-mean CPUE+1) with 95% confidence intervals (1989–2007). Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=140/year).

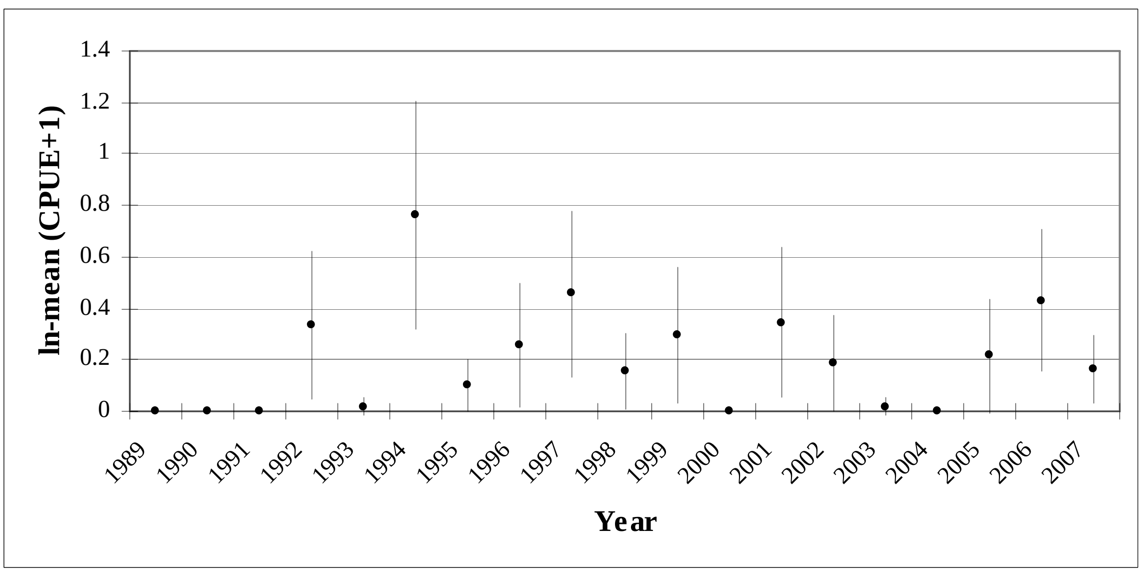

Figure 53. Pigfish (*Orthopristis chrysoptera*) beach seine relative abundance (ln-mean CPUE+1) with 95% confidence intervals (1989-2007). Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=38/year).

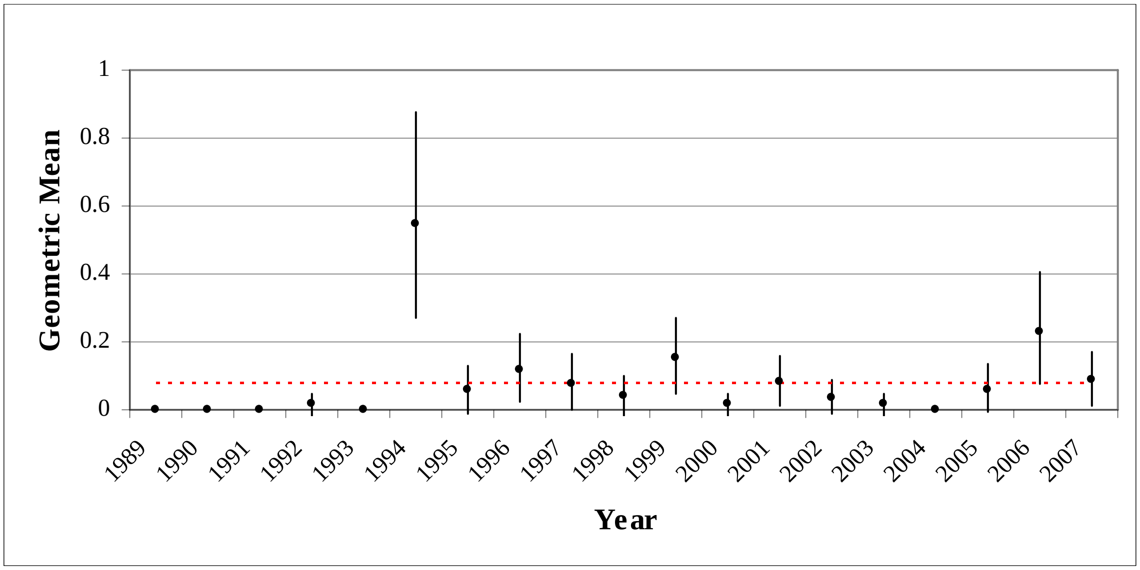

Figure 54. Pigfish (*Orthopristis chrysoptera*) trawl index of relative abundance (geometric mean) with 95% confidence intervals (1989-2007). Solid line represents the 1989-2007 time series grand mean. Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=140/year).

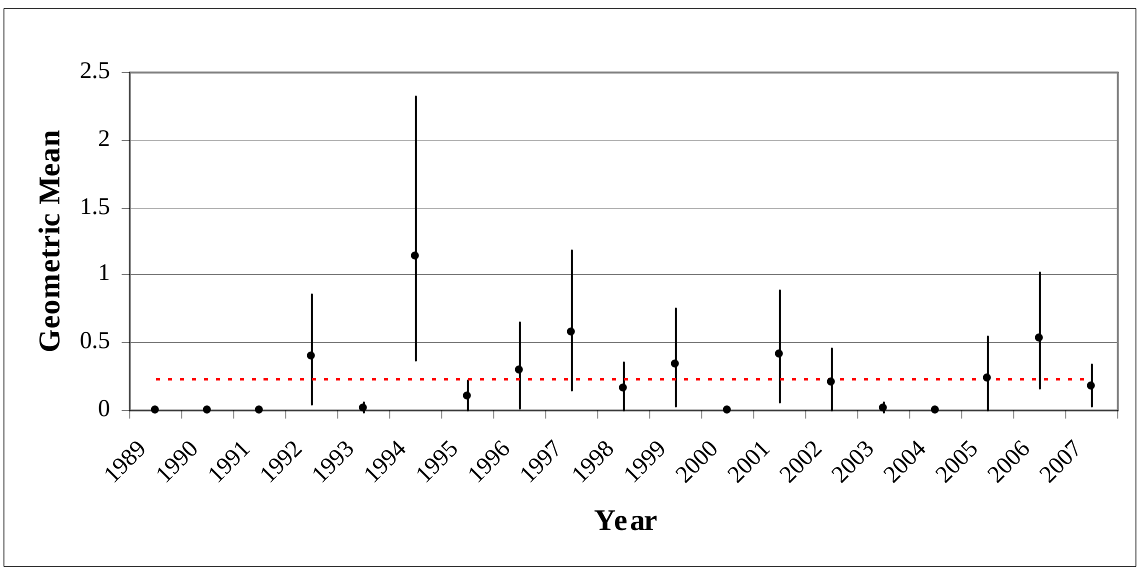

Figure 55. Pigfish (*Orthopristis chrysoptera*) beach seine index of relative abundance (geometric mean) with 95% confidence intervals (1989-2007). Solid line represents the 1989-2007 time series grand mean. Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=38/year).

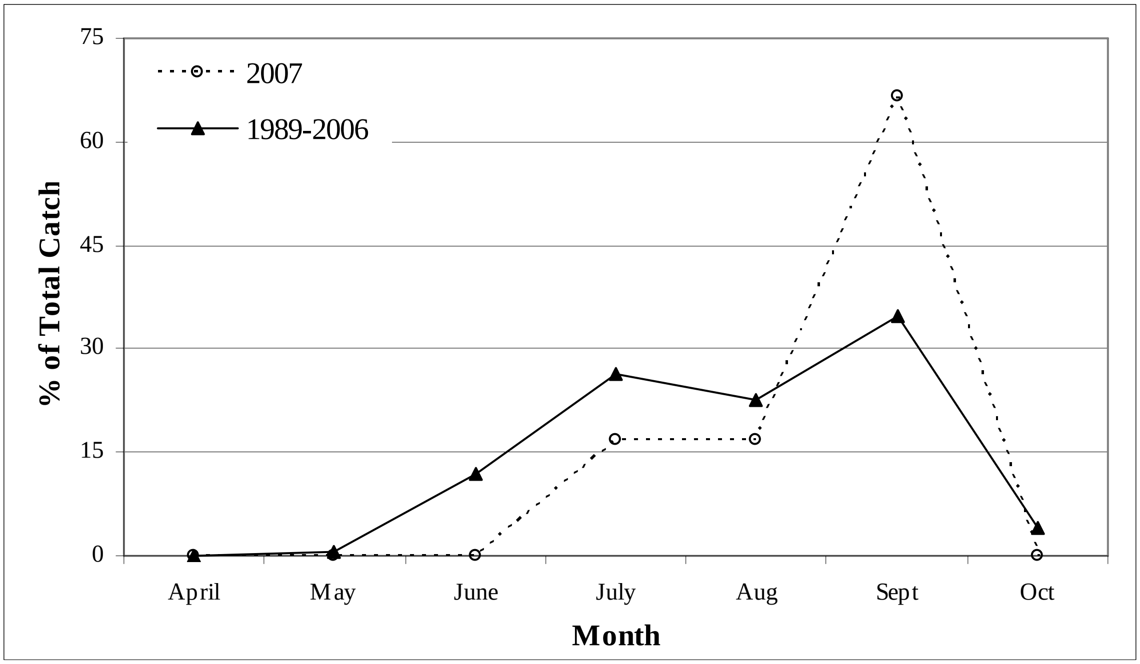

Figure 56. Coastal Bays Fisheries Investigation Trawl Survey comparison of the 1989-2006 time series and 2007 seasonal pigfish (*Orthopristis chrysoptera*) percent catch by month.

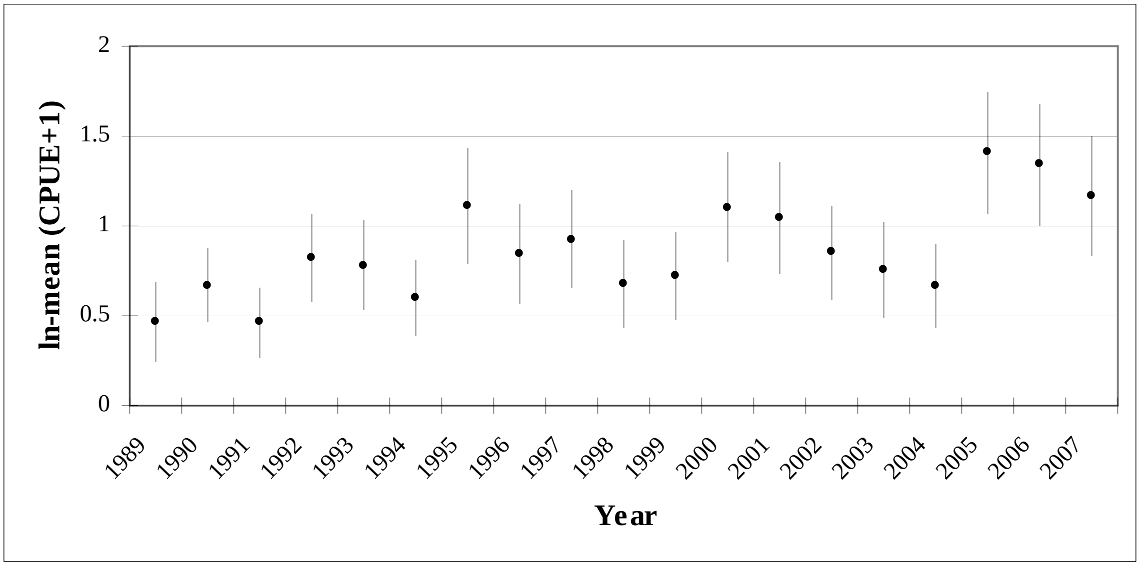

Figure 57. Silver perch (*Bairdiella chrysoura*) trawl relative abundance (ln-mean CPUE+1) with 95% confidence intervals (1989–2007). Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=140/year).

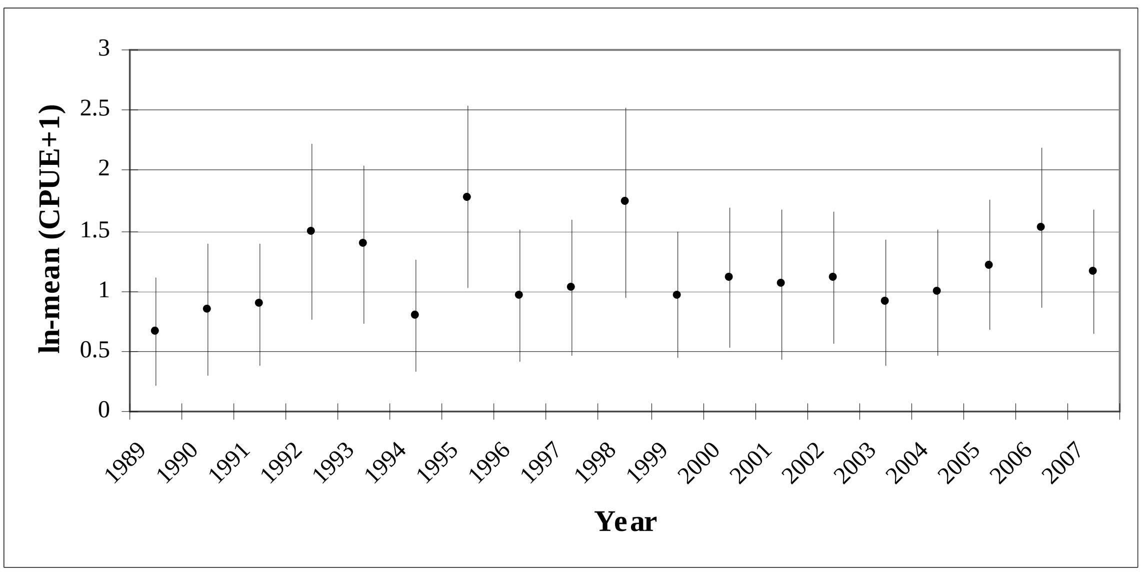

Figure 58. Silver perch (*Bairdiella chrysoura*) beach seine relative abundance (ln-mean CPUE+1) with 95% confidence intervals (1989-2007). Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=38/year).

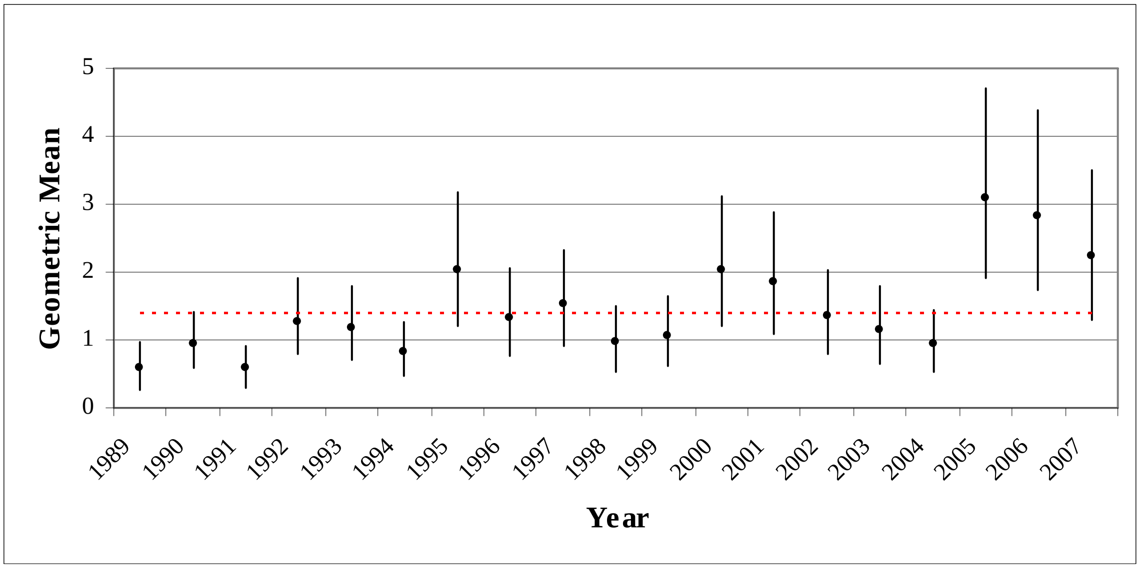

Figure 59. Silver perch (*Bairdiella chrysoura*) trawl index of relative abundance (geometric mean) with 95% confidence intervals (1989-2007). Solid line represents the 1989-2007 time series grand mean. Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=140/year).

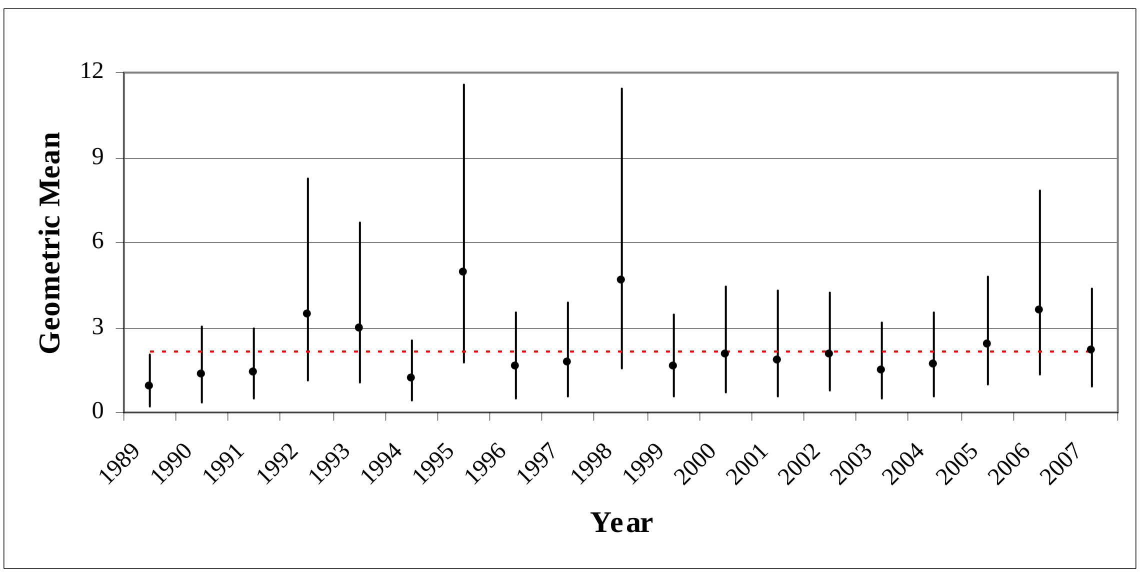

Figure 60. Silver perch (*Bairdiella chrysoura*) beach seine index of relative abundance (geometric mean) with 95% confidence intervals (1989-2007). Solid line represents the 1989-2007 time series grand mean. Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=38/year).

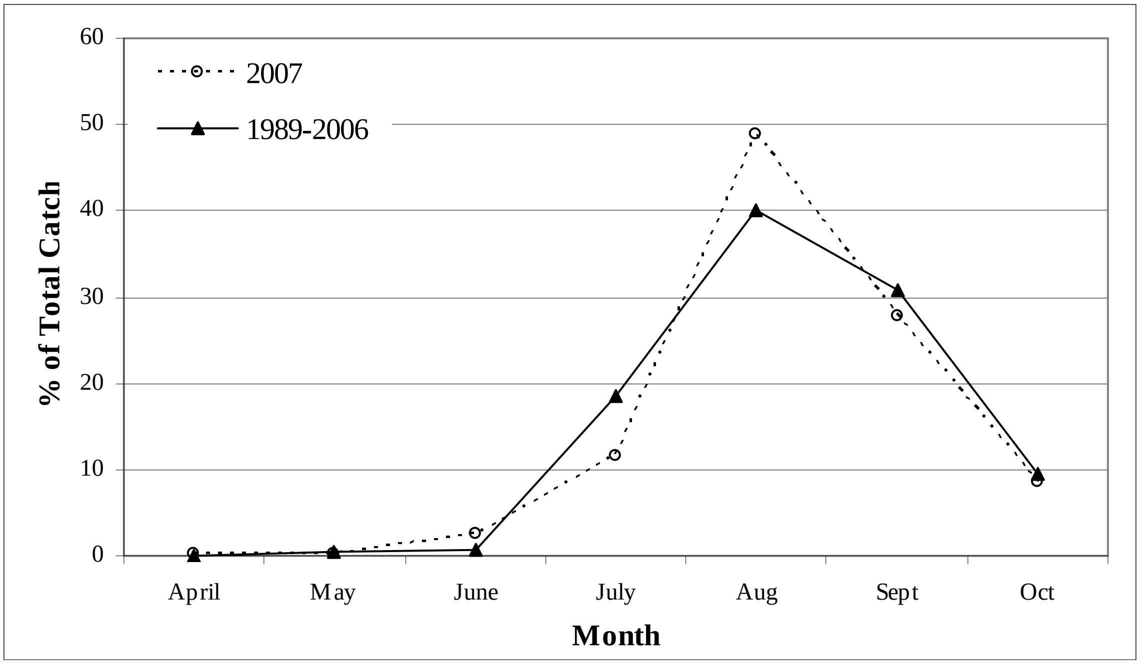

Figure 61. Comparison Coastal Bays Fisheries Investigation Trawl Survey comparison of the 1989-2006 time series and 2007 seasonal silver perch (*Bairdiella chrysoura*) percent catch by month.

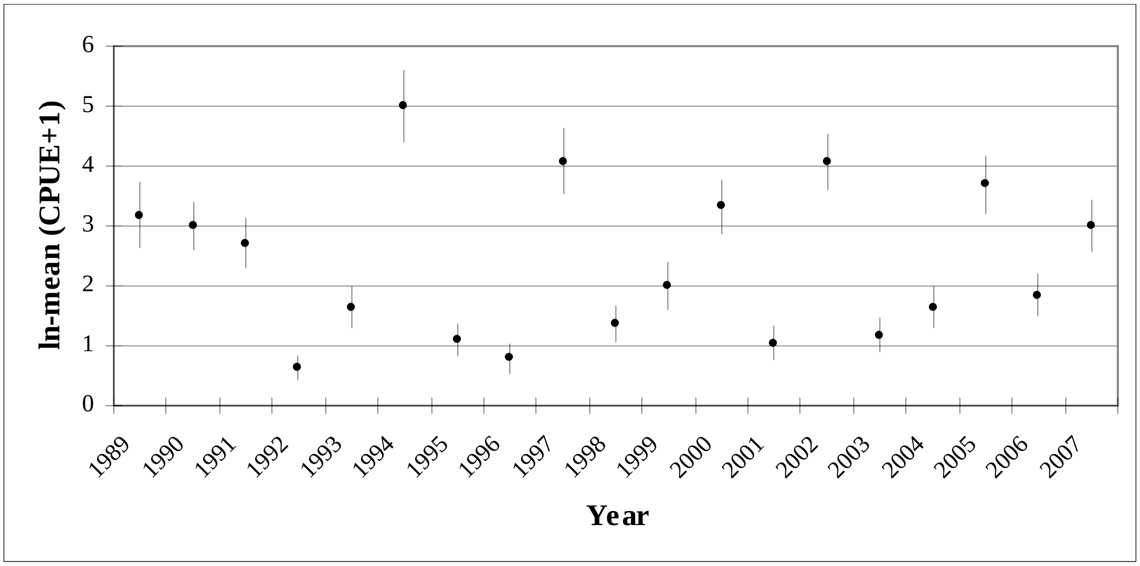

Figure 62. Spot (*Leiostomus xanthurus*) trawl relative abundance (ln-mean CPUE+1) with 95% confidence intervals (1989–2007). Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=140/year).

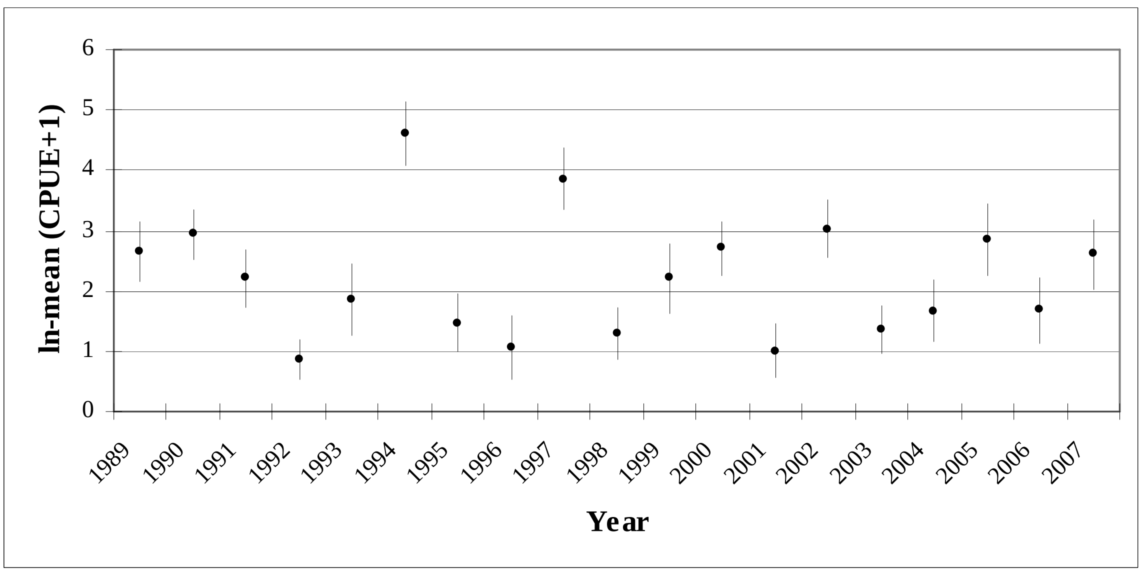

Figure 63. Spot (*Leiostomus xanthurus*) beach seine relative abundance (ln-mean CPUE+1) with 95% confidence intervals (1989-2007). Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=38/year).

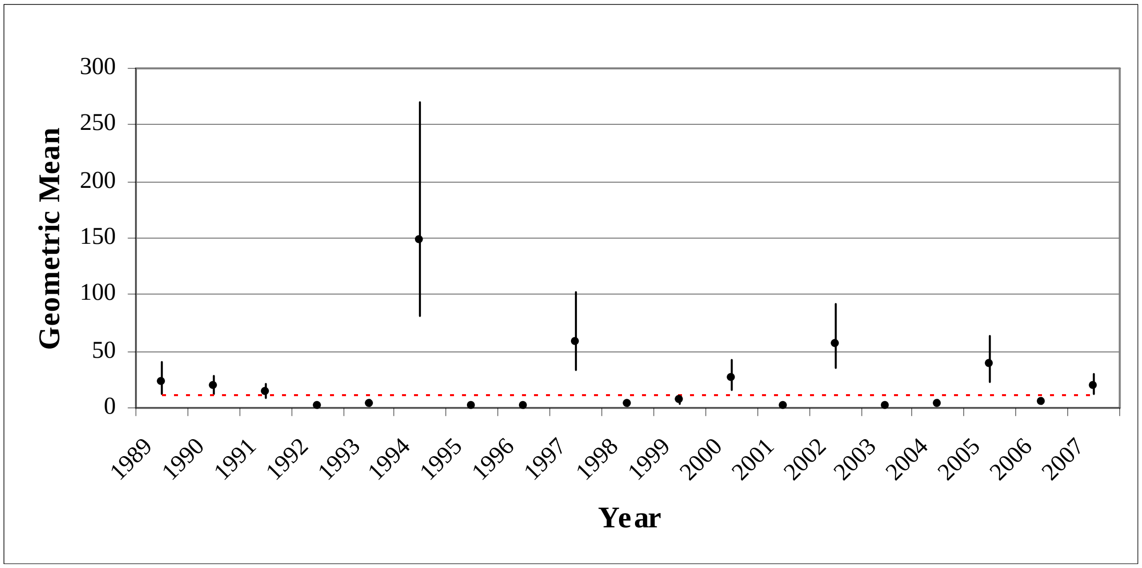

Figure 64. Spot (*Leiostomus xanthurus*) trawl index of relative abundance (geometric mean) with 95% confidence intervals (1989-2007). Solid line represents the 1989-2007 time series grand mean. Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=140/year).

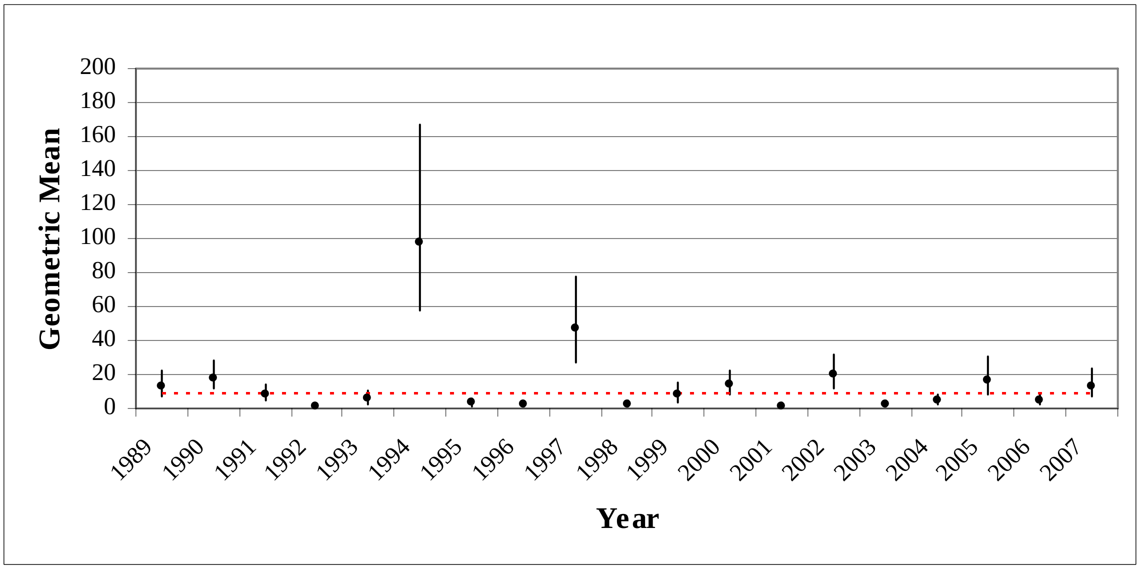

Figure 65. Spot (*Leiostomus xanthurus*) beach seine index of relative abundance (geometric mean) with 95% confidence intervals (1989-2007). Solid line represents the 1989-2007 time series grand mean. Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=38/year).

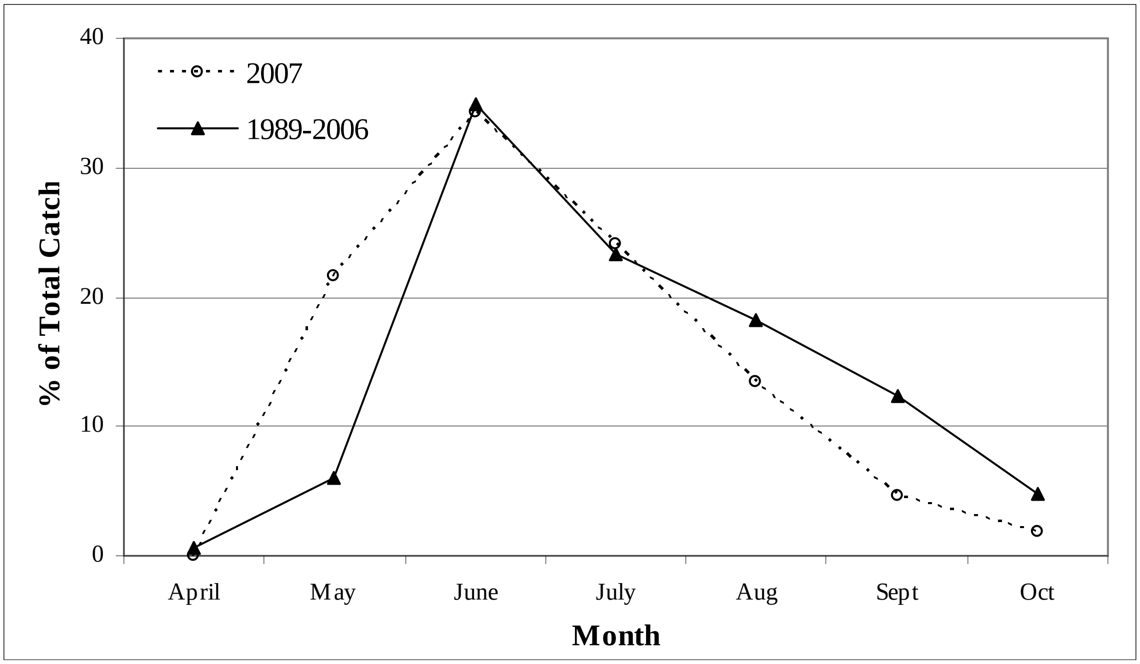

Figure 66. Comparison Coastal Bays Fisheries Investigation Trawl Survey comparison of the 1989-2006 time series and 2007 seasonal spot (*Leiostomus xanthurus*) percent catch by month.

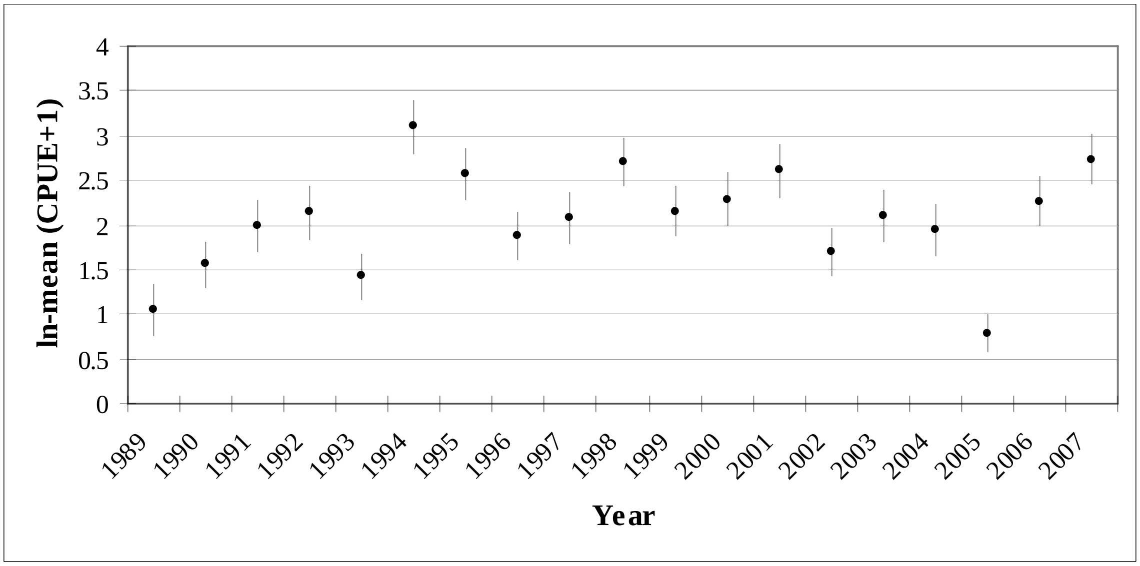

Figure 67. Summer flounder (*Paralichthys dentatus*) trawl relative abundance (ln-mean CPUE+1) with 95% confidence intervals (1989–2007). Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=140/year).

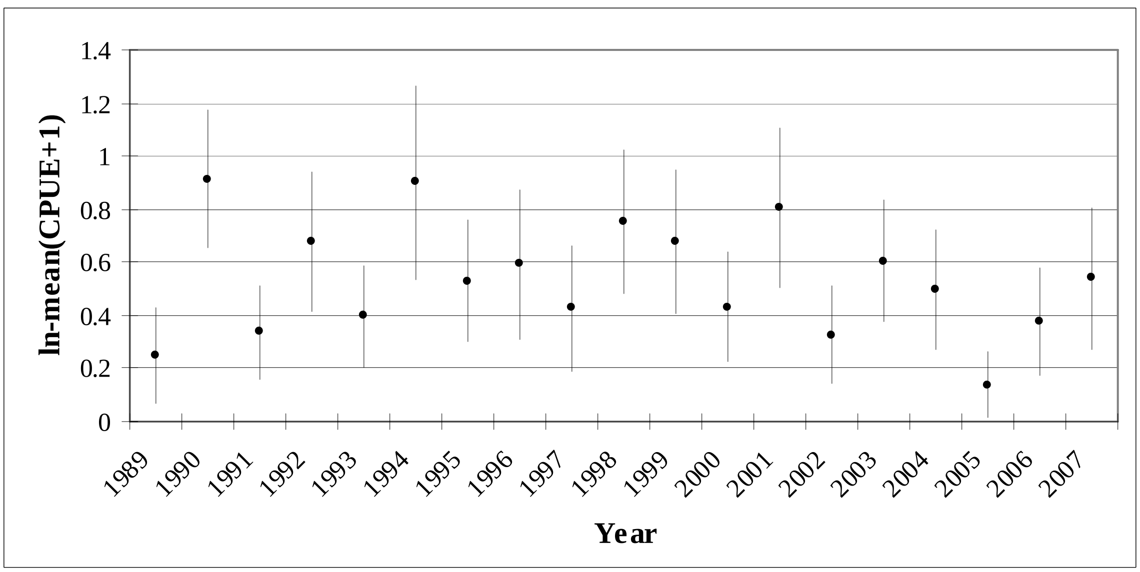

Figure 68. Summer flounder (*Paralichthys dentatus*) beach seine relative abundance (ln-mean CPUE+1) with 95% confidence intervals (1989-2007). Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=38/year).

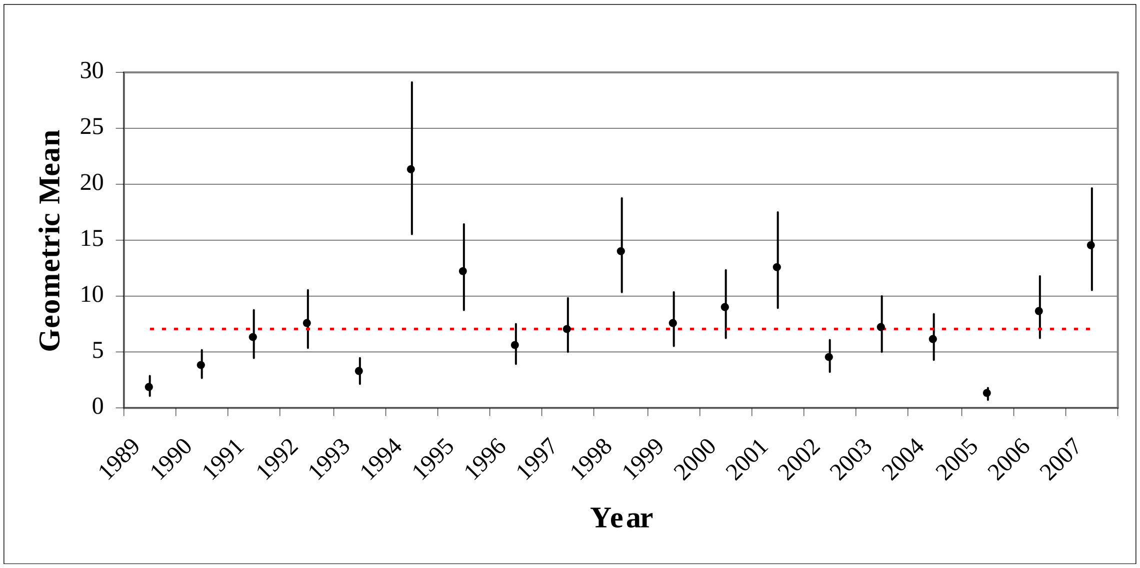

Figure 69. Summer flounder (*Paralichthys dentatus*) trawl index of relative abundance (geometric mean) with 95% confidence intervals (1989-2007). Solid line represents the 1989-2007 time series grand mean. Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=140/year).

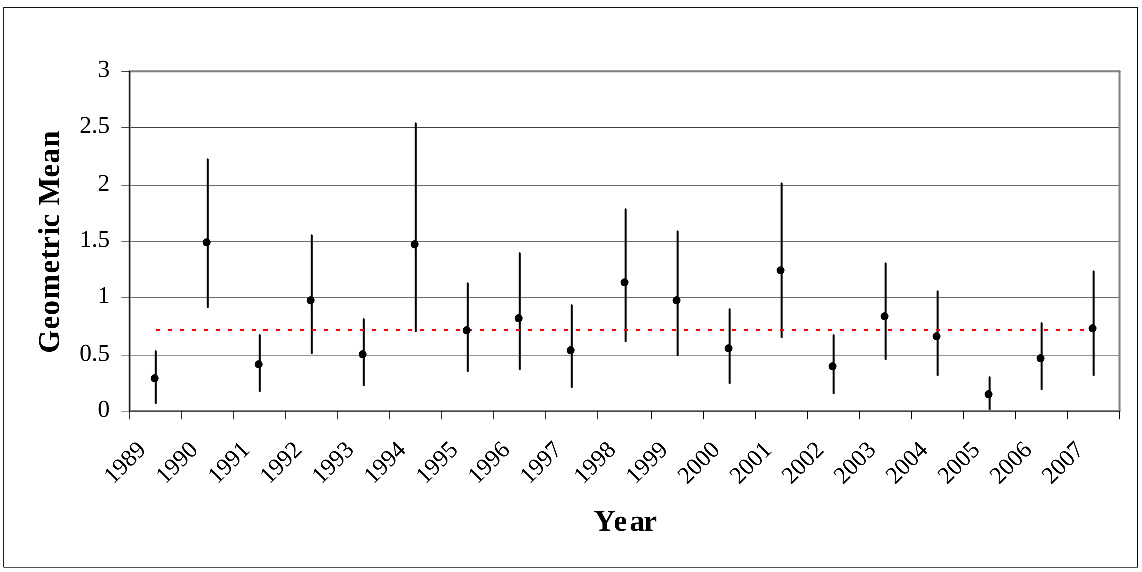

Figure 70. Summer flounder (*Paralichthys dentatus*) beach seine index of relative abundance (geometric mean) with 95% confidence intervals (1989-2007). Solid line represents the 1989-2007 time series grand mean. Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=38/year).

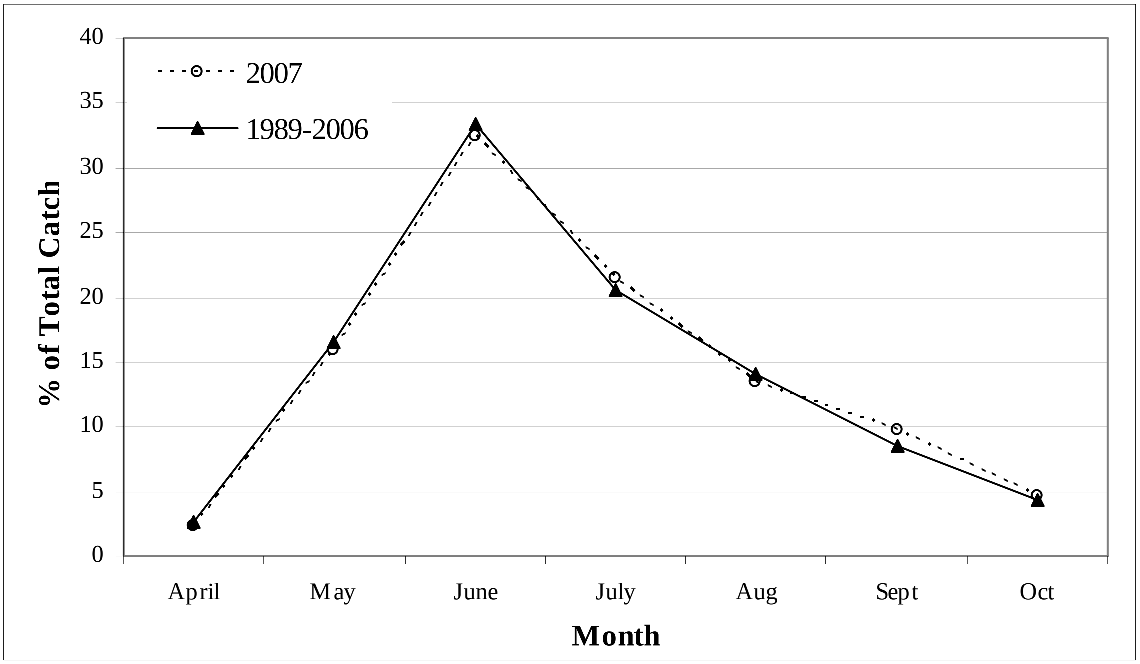

Figure 71. Coastal Bays Fisheries Investigation Trawl Survey comparison of the 1989-2006 time series and 2007 seasonal summer flounder (*Paralichthys dentatus*) percent catch by month.

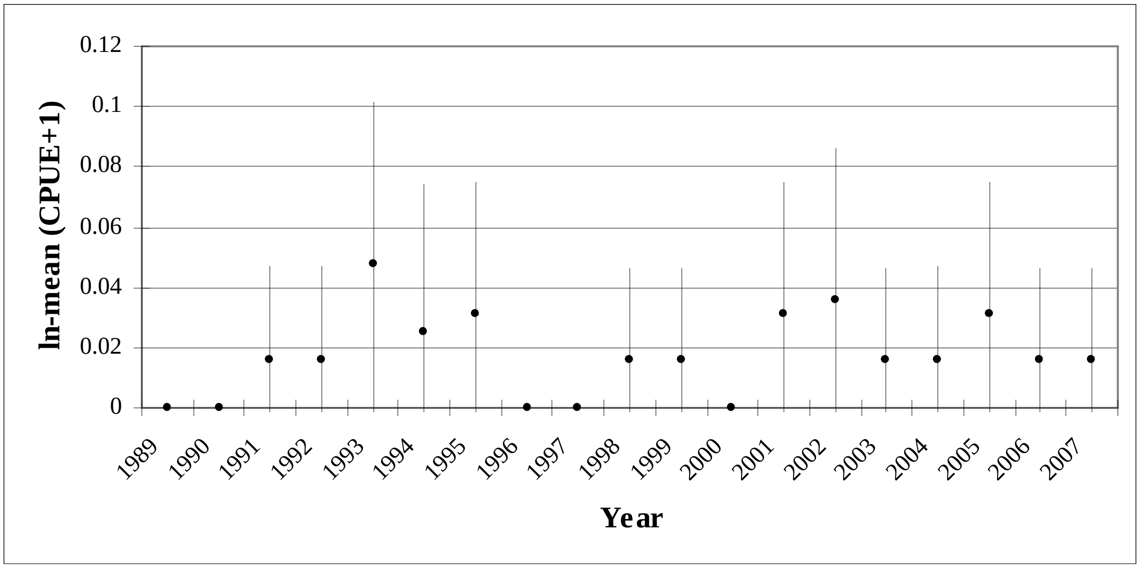

Figure 72. Tautog (*Tautoga onitis*) trawl relative abundance (ln-mean CPUE+1) with 95% confidence intervals (1989–2007). Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=140/year).

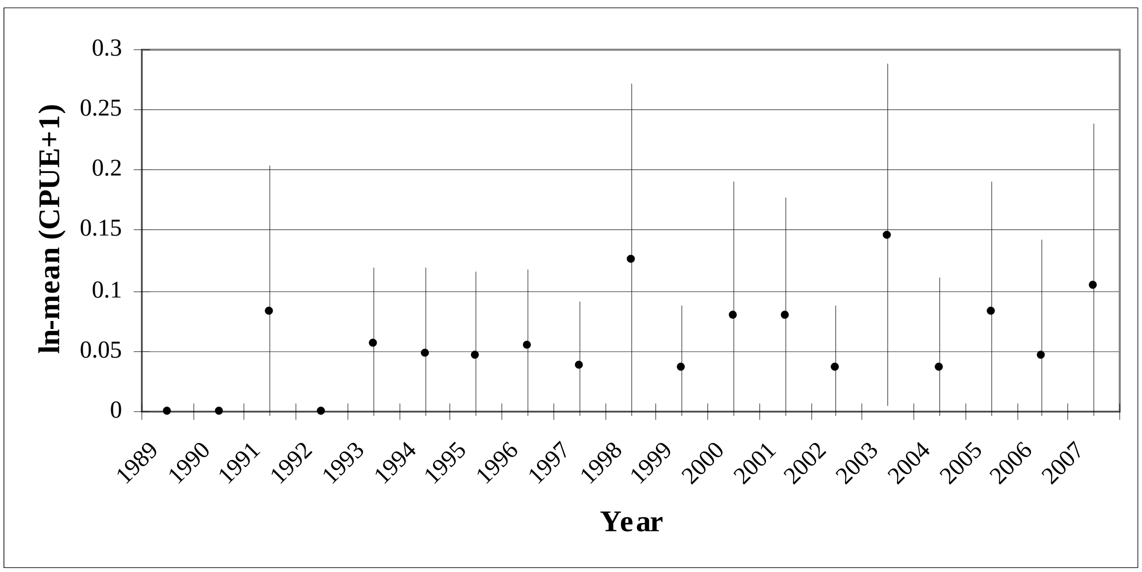

Figure 73. Tautog (*Tautoga onitis*) beach seine relative abundance (ln-mean CPUE+1) with 95% confidence intervals (1989-2007). Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=38/year).

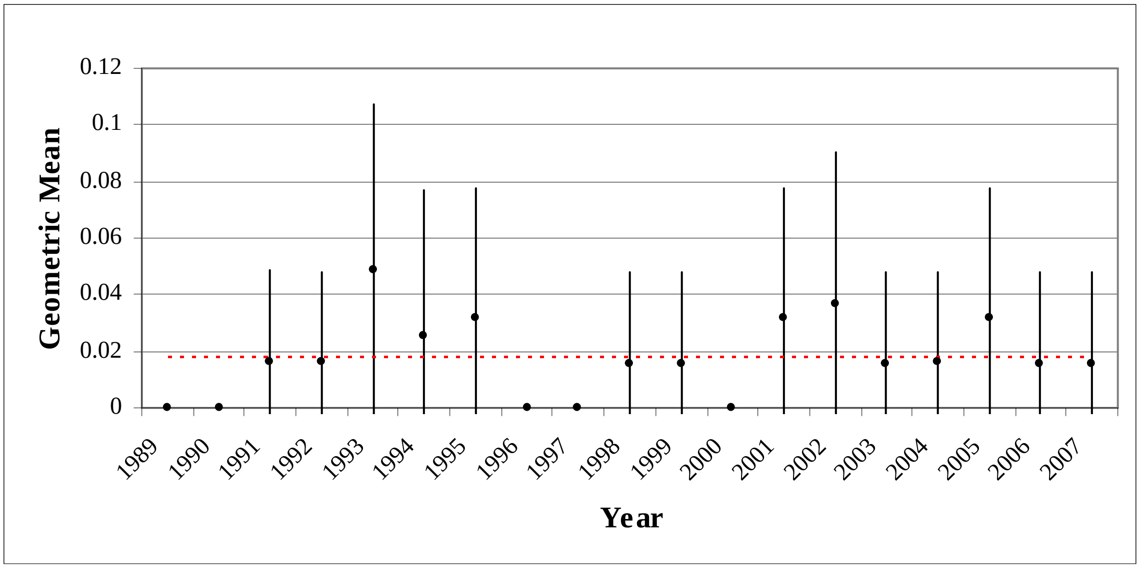

Figure 74. Tautog (*Tautoga onitis*) trawl index of relative abundance (geometric mean) with 95% confidence intervals (1989-2007). Solid line represents the 1989-2007 time series grand mean. Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=140/year).

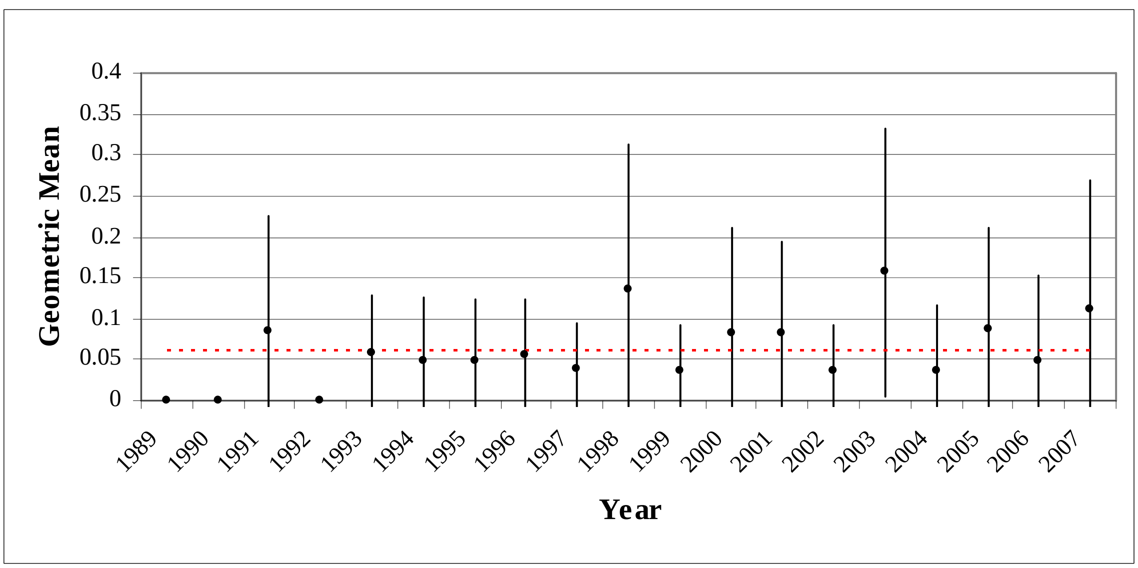

Figure 75. Tautog (*Tautoga onitis*) beach seine index of relative abundance (geometric mean) with 95% confidence intervals (1989-2007). Solid line represents the 1989-2007 time series grand mean. Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=38/year).

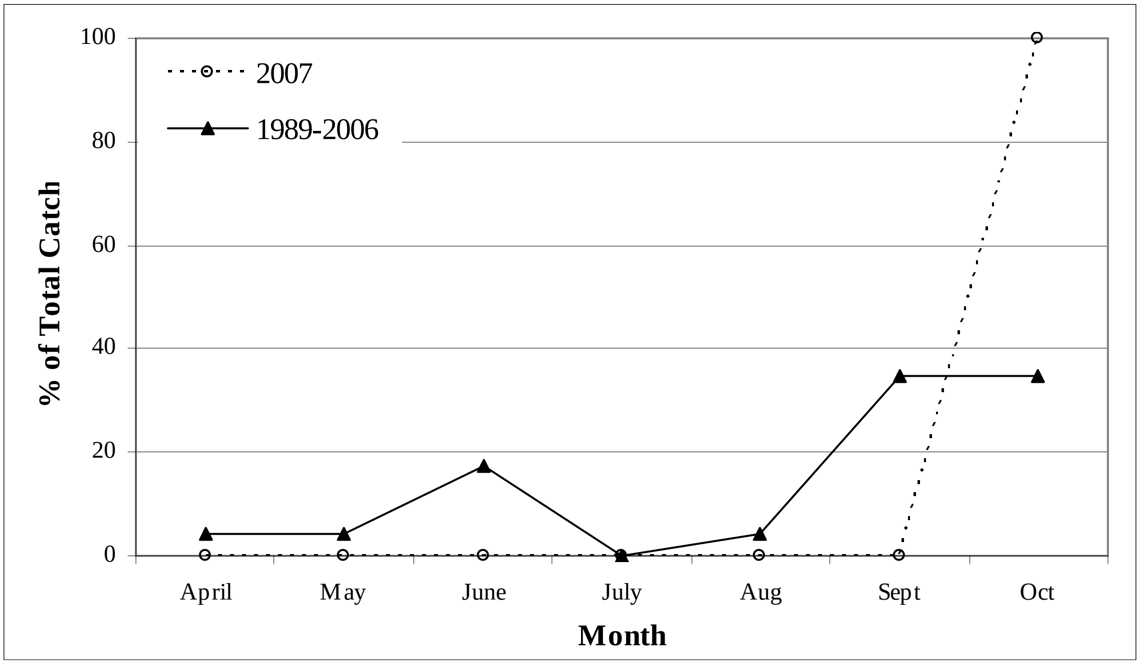

Figure 76. Coastal Bays Fisheries Investigation Trawl Survey comparison of the 1989-2006 time series and 2007 seasonal Tautog (*Tautoga onitis*) percent catch by month.

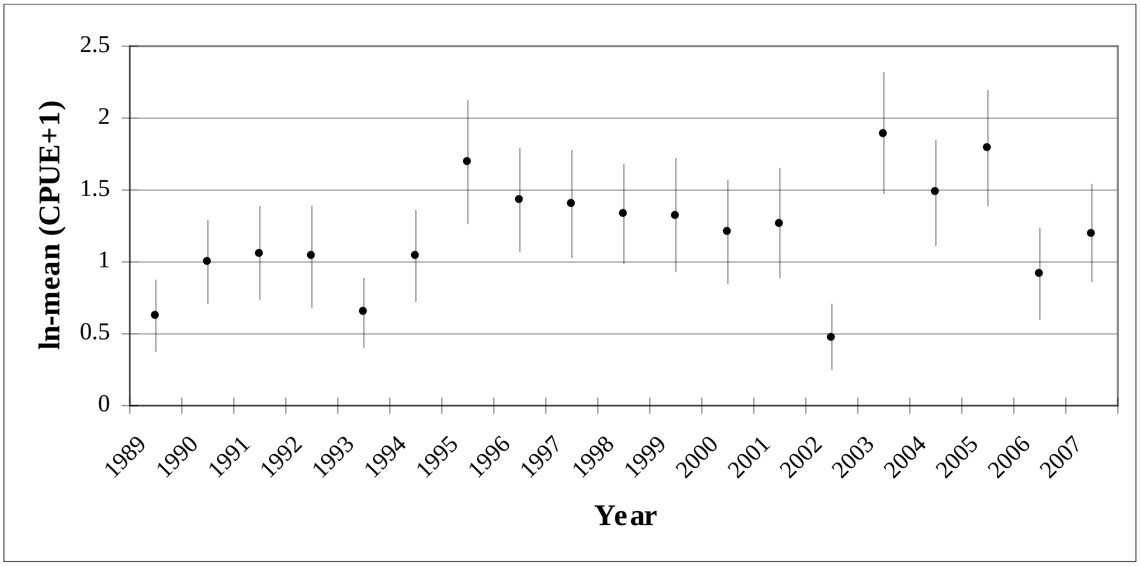

Figure 77. Weakfish (*Cynoscion regalis*) trawl relative abundance (ln-mean CPUE+1) with 95% confidence intervals (1989–2007). Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=140/year).

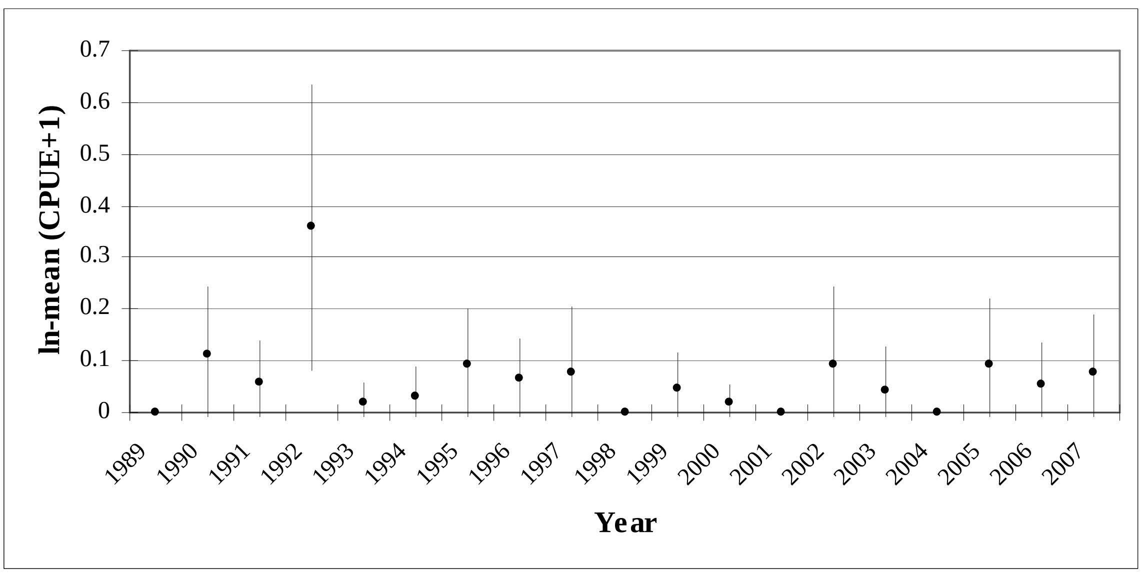

Figure 78. Weakfish (*Cynoscion regalis*) beach seine relative abundance (ln-mean CPUE+1) with 95% confidence intervals (1989-2007). Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=38/year).

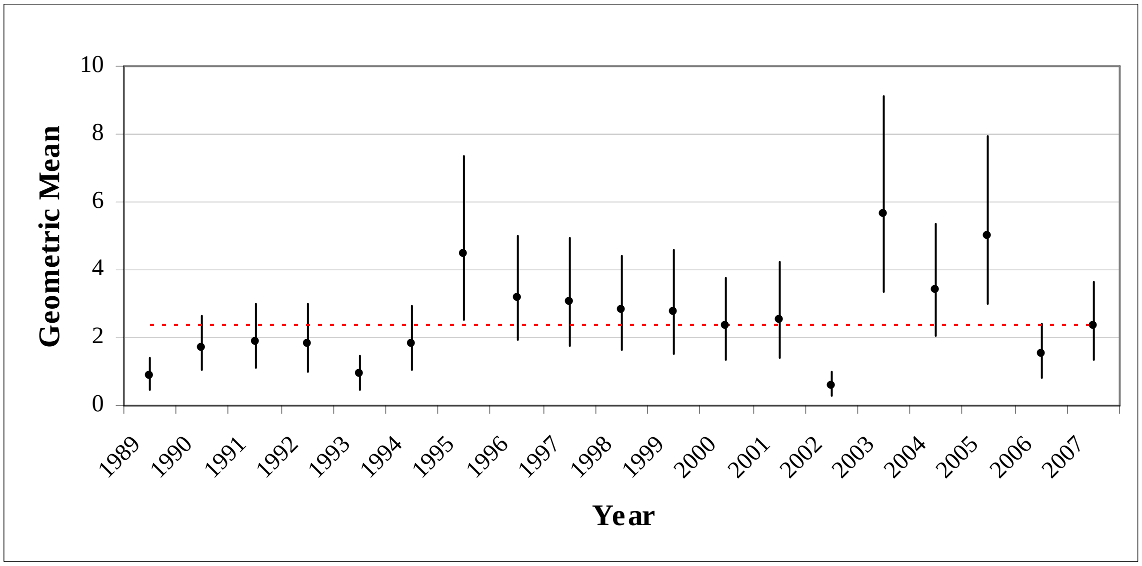

Figure 79. Weakfish (*Cynoscion regalis*) trawl index of relative abundance (geometric mean) with 95% confidence intervals (1989-2007). Solid line represents the 1989-2007 time series grand mean. Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=140/year).

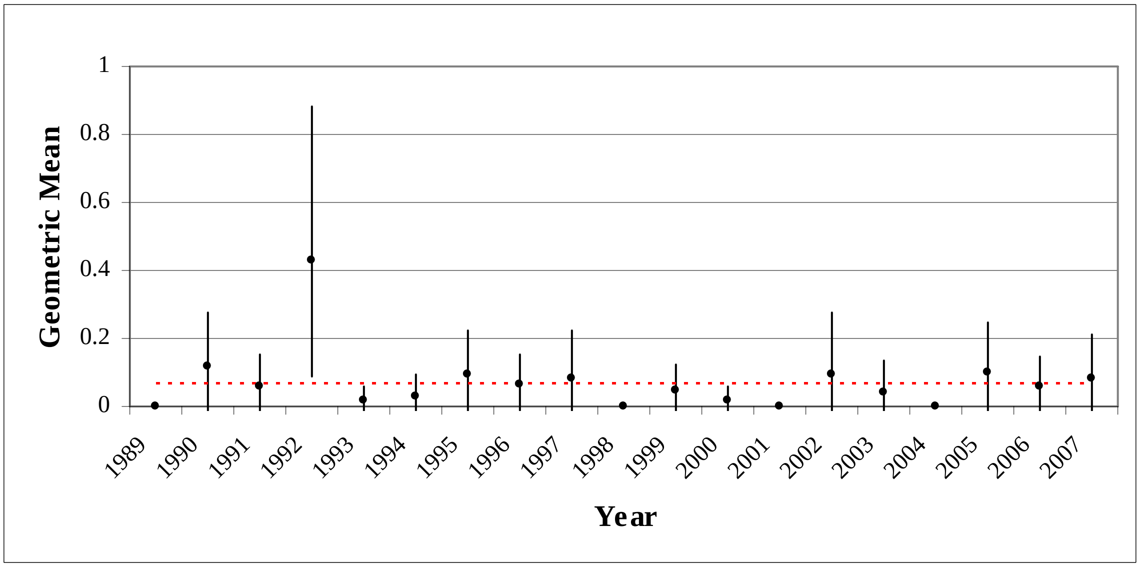

Figure 80. Weakfish (*Cynoscion regalis*) beach seine index of relative abundance (geometric mean) with 95% confidence intervals (1989-2007). Solid line represents the 1989-2007 time series grand mean. Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=38/year).

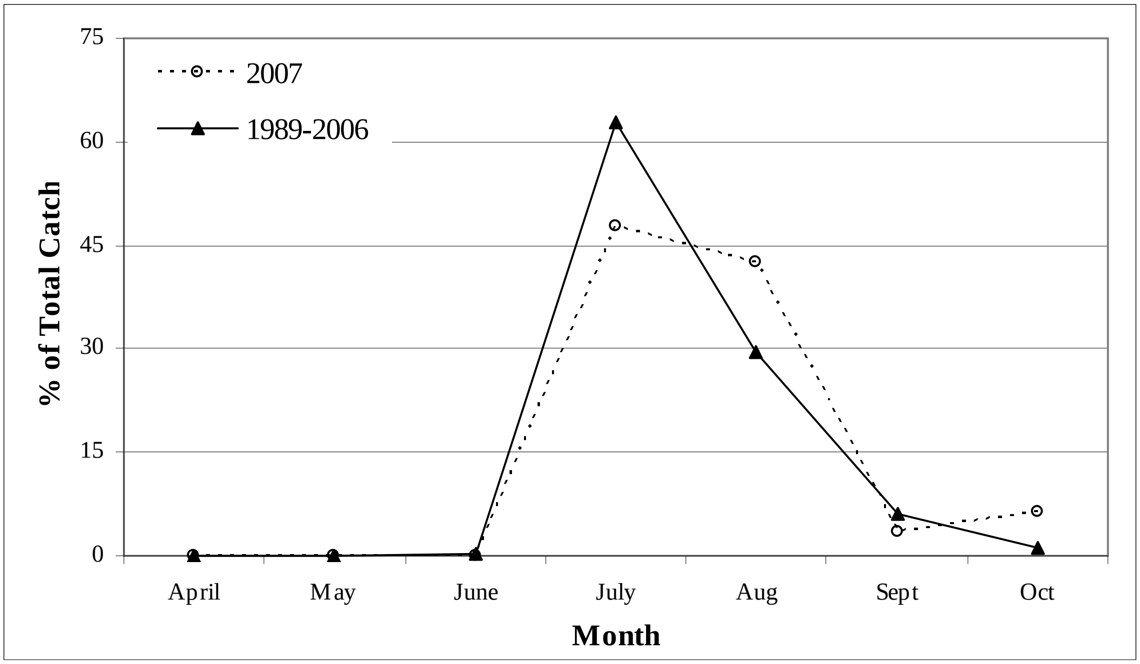

Figure 81. Coastal Bays Fisheries Investigation Trawl Survey comparison of the 1989-2006 time series and 2007 seasonal weakfish (*Cynoscion regalis*) percent catch by month.

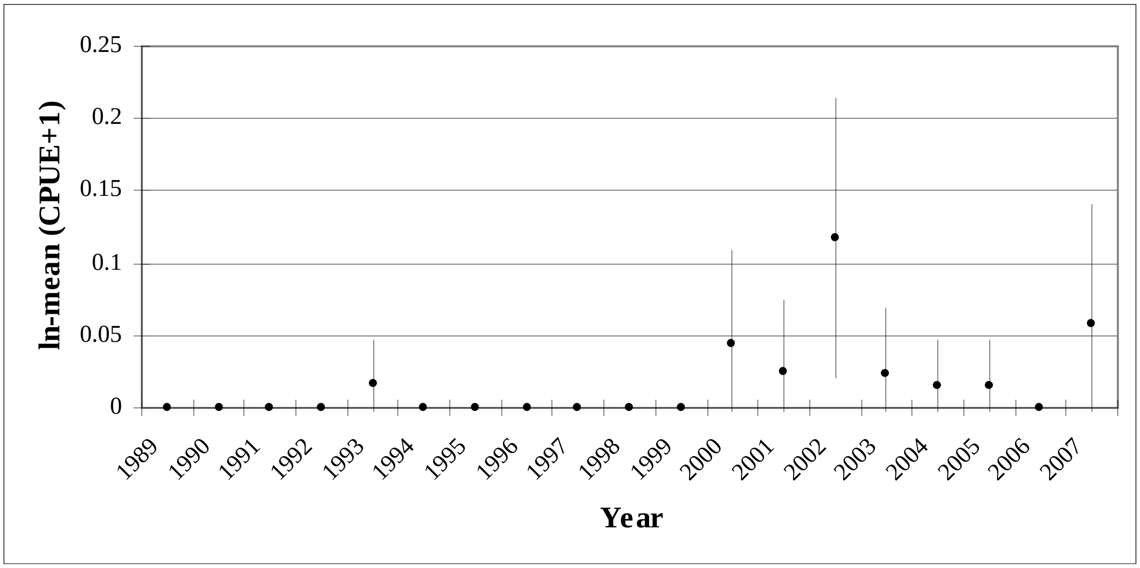

Figure 82. White mullet (*Mugil curema*) trawl relative abundance (ln-mean CPUE+1) with 95% confidence intervals (1989–2007). Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=140/year).

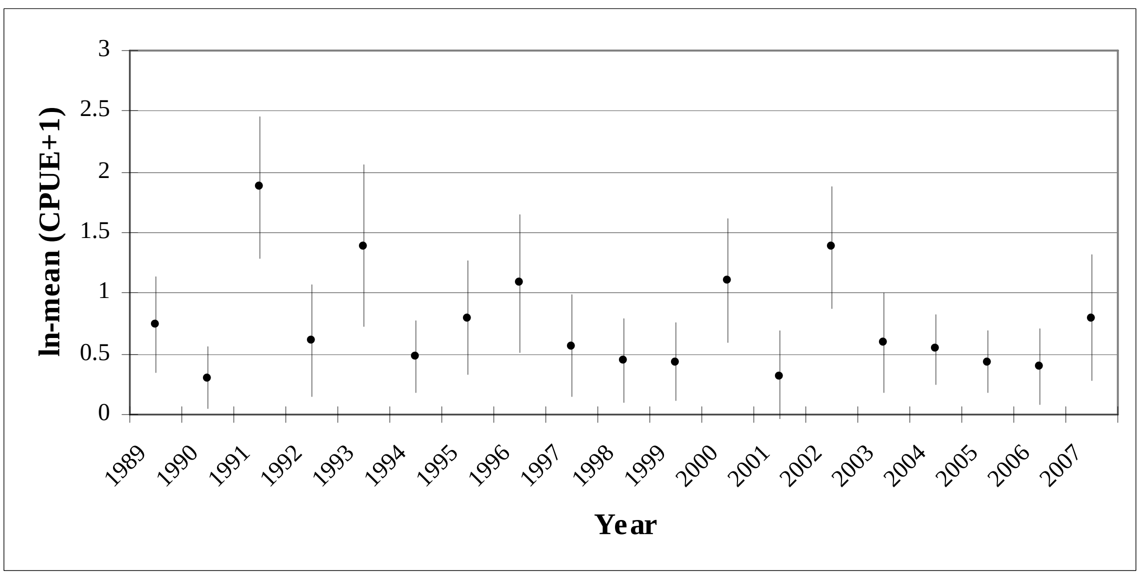

Figure 83. White mullet (*Mugil curema*) beach seine relative abundance (ln-mean CPUE+1) with 95% confidence intervals (1989-2007). Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=38/year).

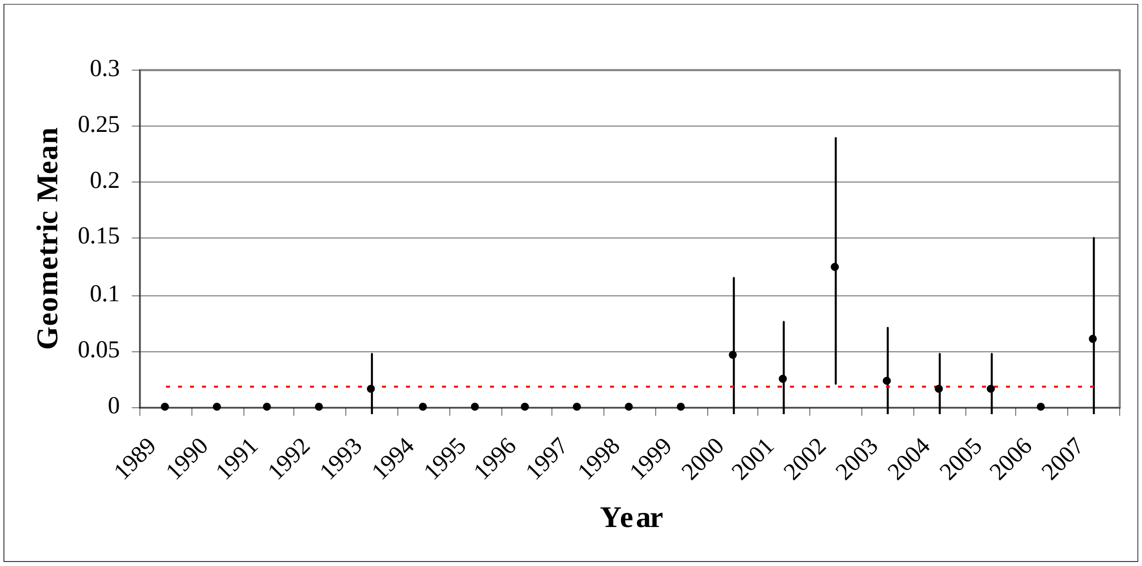

Figure 84. White mullet (*Mugil curema*) trawl index of relative abundance (geometric mean) with 95% confidence intervals (1989-2007). Solid line represents the 1989-2007 time series grand mean. Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=140/year).

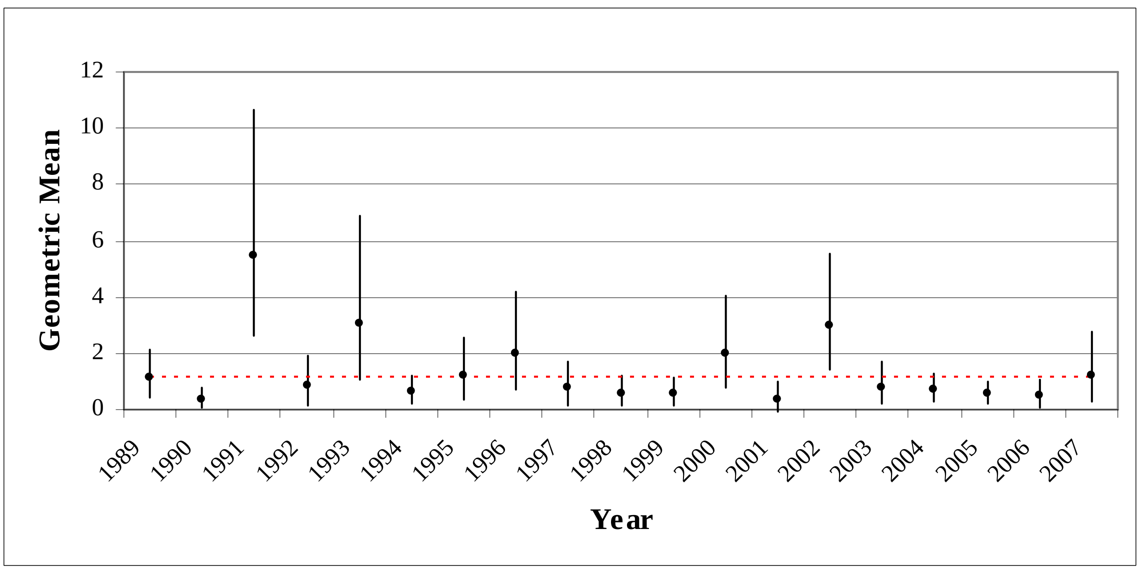

Figure 85. White mullet (*Mugil curema*) beach seine index of relative abundance (geometric mean) with 95% confidence intervals (1989-2007). Solid line represents the 1989-2007 time series grand mean. Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=38/year).

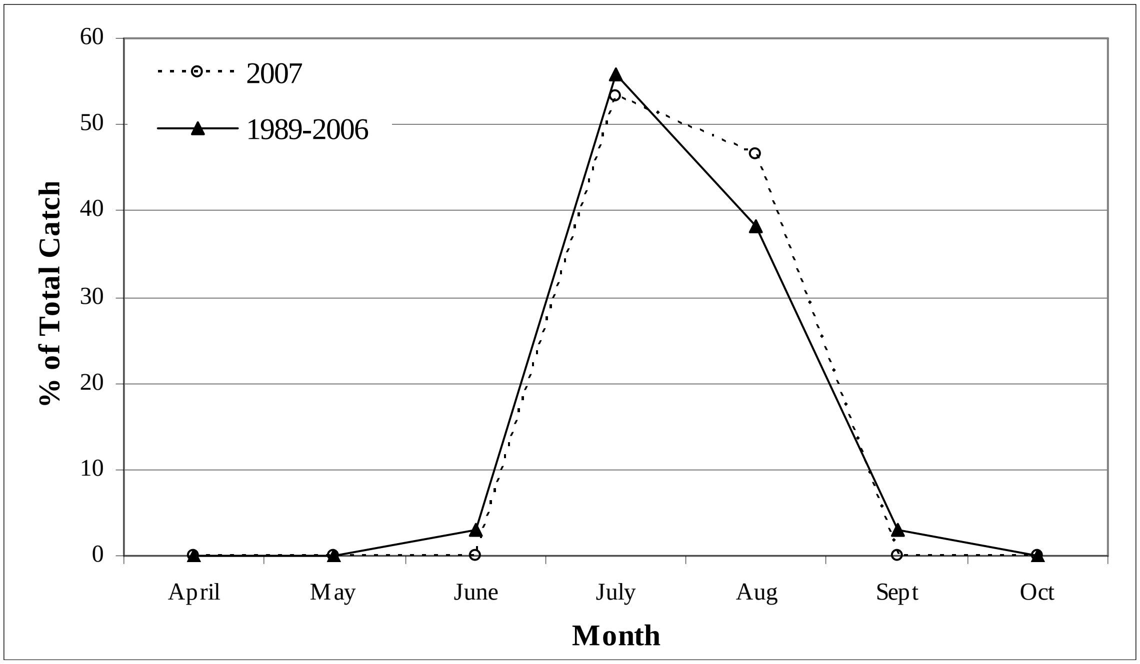

Figure 86. Comparison Coastal Bays Fisheries Investigation Trawl Survey comparison of the 1989-2006 time series and 2007 seasonal white mullet (*Mugil curema*) percent catch by month.

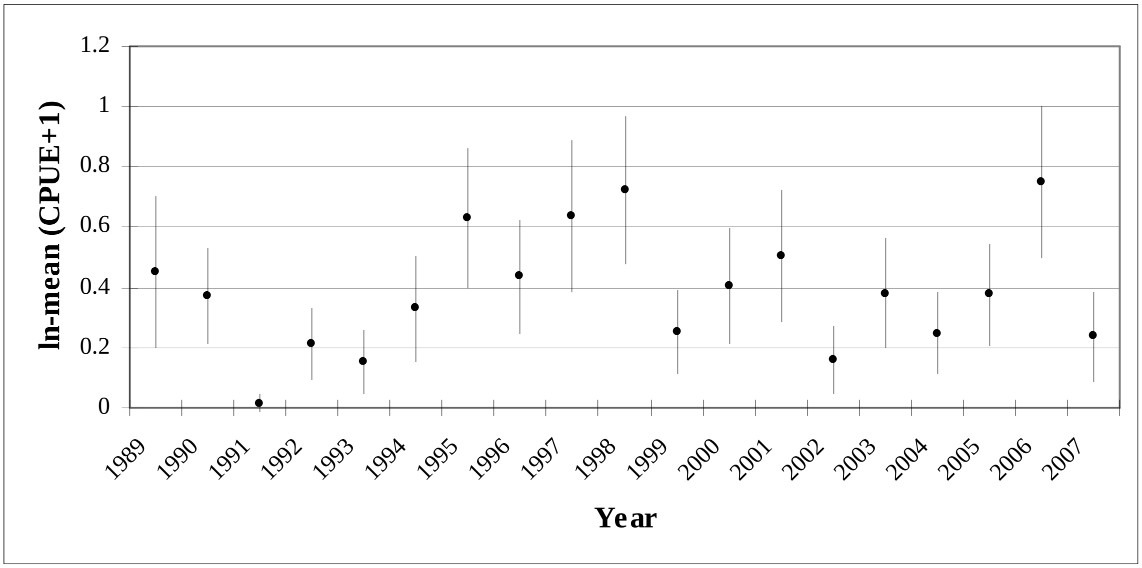

Figure 87. Winter flounder (*Pseudopleuronectes americanus*) trawl relative abundance (ln-mean CPUE+1) with 95% confidence intervals (1989–2007). Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=140/year).

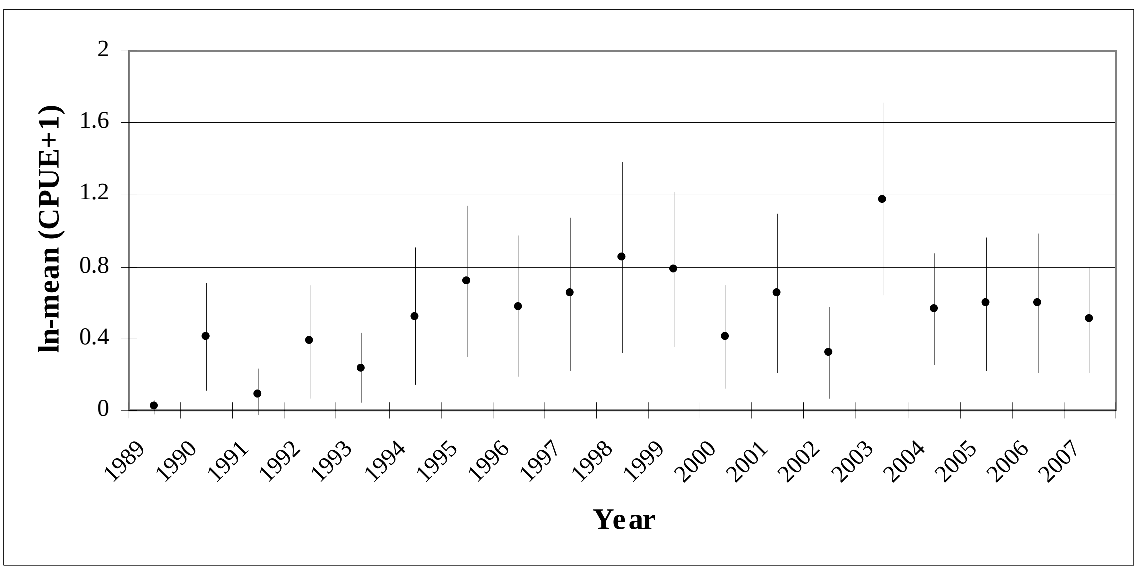

Figure 88. Winter flounder (*Pseudopleuronectes americanus*) beach seine relative abundance (ln-mean CPUE+1) with 95% confidence intervals (1989-2007). Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=38/year).

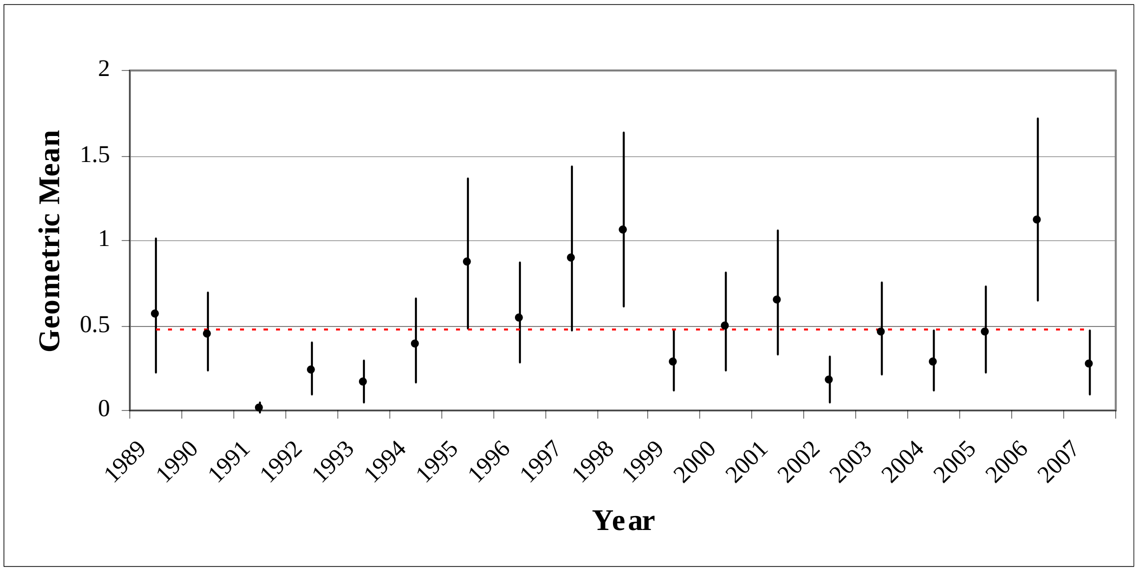

Figure 89. Winter flounder (*Pseudopleuronectes americanus*) trawl index of relative abundance (geometric mean) with 95% confidence intervals (1989-2007). Solid line represents the 1989-2007 time series grand mean. Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=140/year).

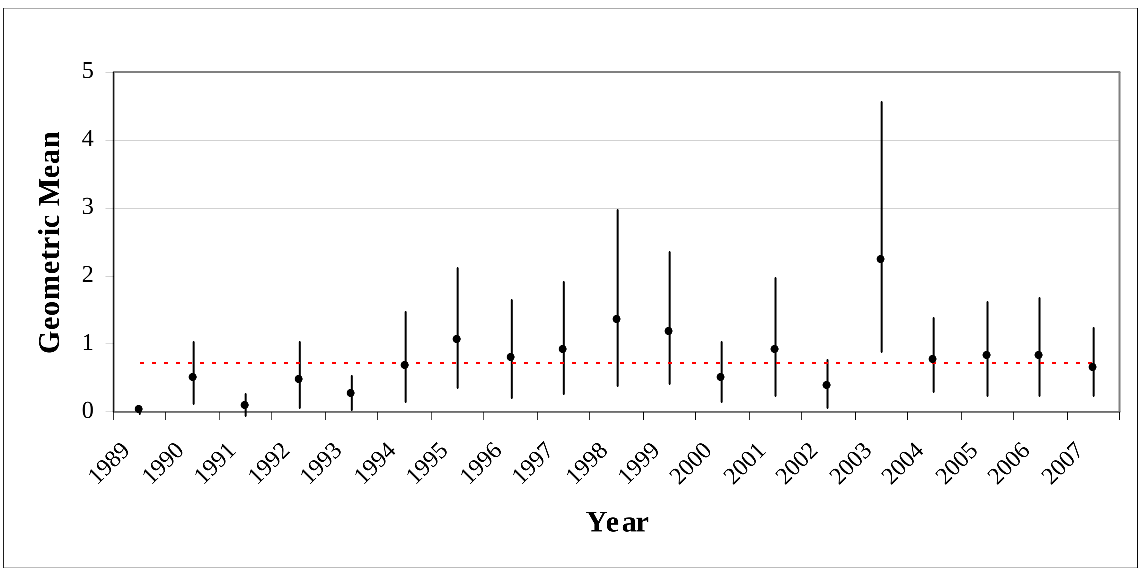

Figure 90. Winter flounder (*Pseudopleuronectes americanus*) beach seine index of relative abundance (geometric mean) with 95% confidence intervals (1989-2007). Solid line represents the 1989-2007 time series grand mean. Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=38/year).

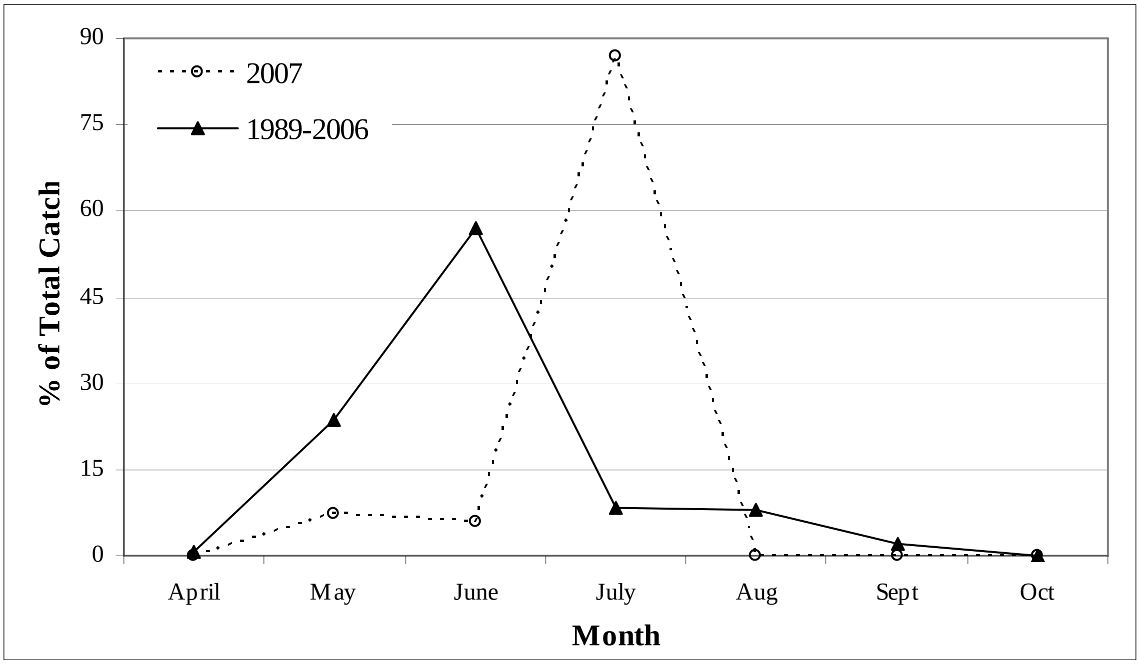

Figure 91. Comparison Coastal Bays Fisheries Investigation Trawl Survey comparison of the 1989-2006 time series and 2007 seasonal winter flounder (*Pseudopleuronectes americanus*) percent catch by month.

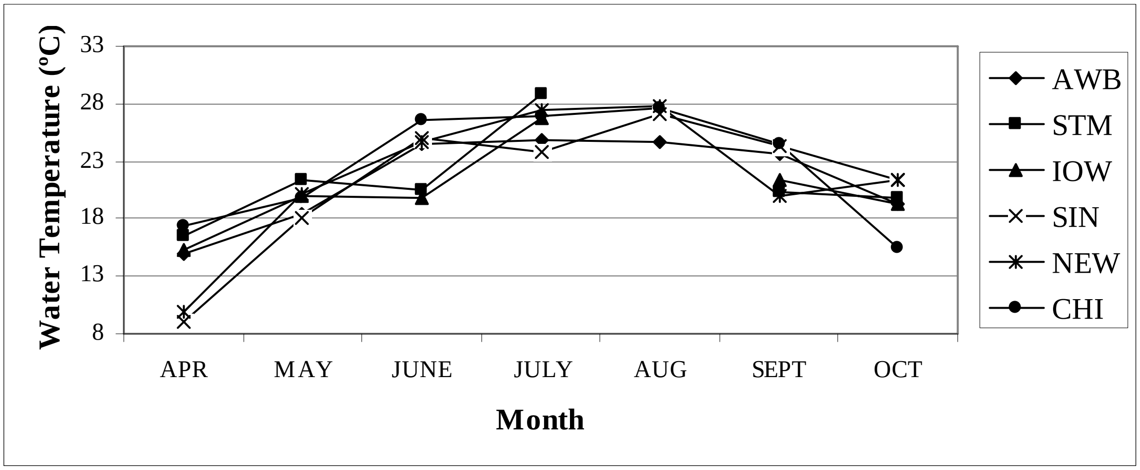

Figure 92. 2007 Coastal Bays Fisheries Investigations Trawl Survey mean water temperature (^{0}C) by month for Assawoman Bay (AWB), St. Martins River (STM), Isle of Wight Bay (IOW), Sinepuxent Bay (SIN), Newport Bay (NEW), and Chincoteague Bay (CHI). August data are not available for both St. Martins River and Isle of Wight Bay.

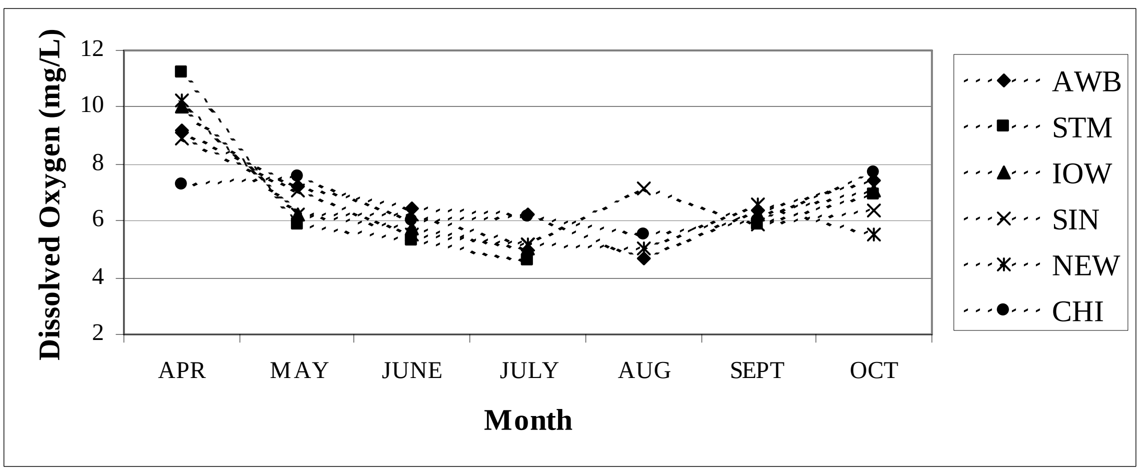

Figure 93. 2007 Coastal Bays Fisheries Investigations Trawl Survey mean dissolved oxygen (mg/L) by month for Assawoman Bay (AWB), St. Martins River (STM), Isle of Wight Bay (IOW), Sinepuxent Bay (SIN), Newport Bay (NEW), and Chincoteague Bay (CHI). August data are not available for both St. Martins River and Isle of Wight Bay.

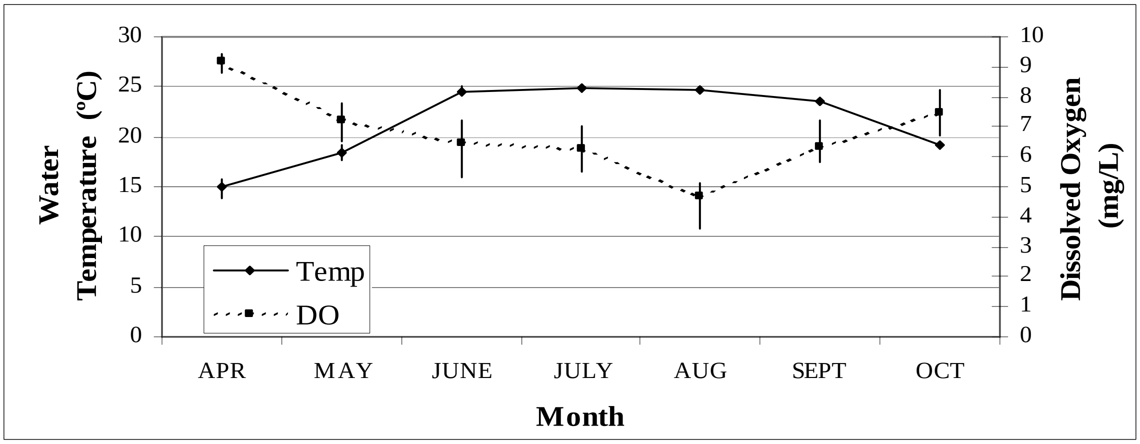

Figure 94. 2007 Coastal Bays Fisheries Investigations Trawl Survey mean water temperature (^{0}C) and dissolved oxygen (mg/L) by month in Assawoman Bay. Error bars represent the range of values collected.

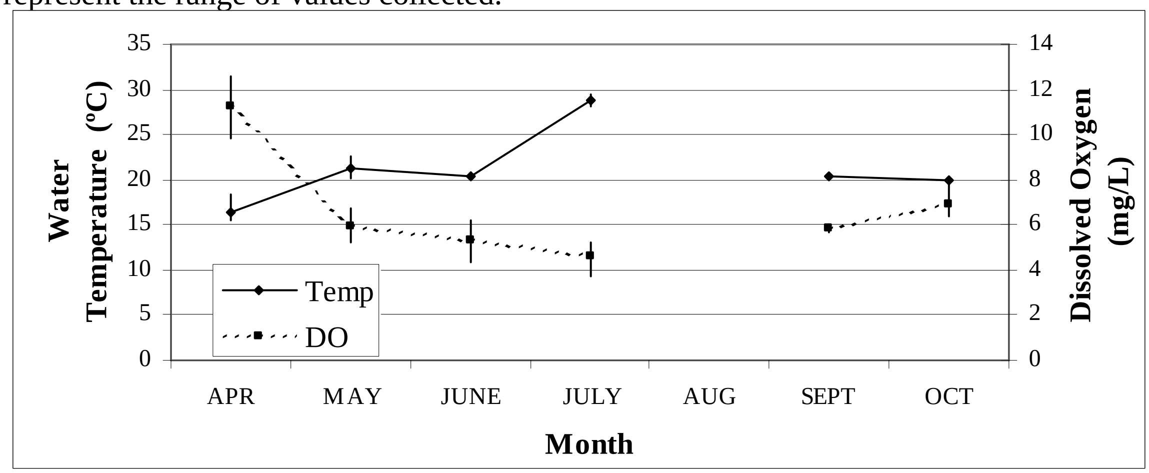

Figure 95. 2007 Coastal Bays Fisheries Investigations Trawl Survey mean water temperature (^{0}C) and dissolved oxygen (mg/L) by month in St. Martins River. Error bars represent the range of values collected. August data are not available for this river.

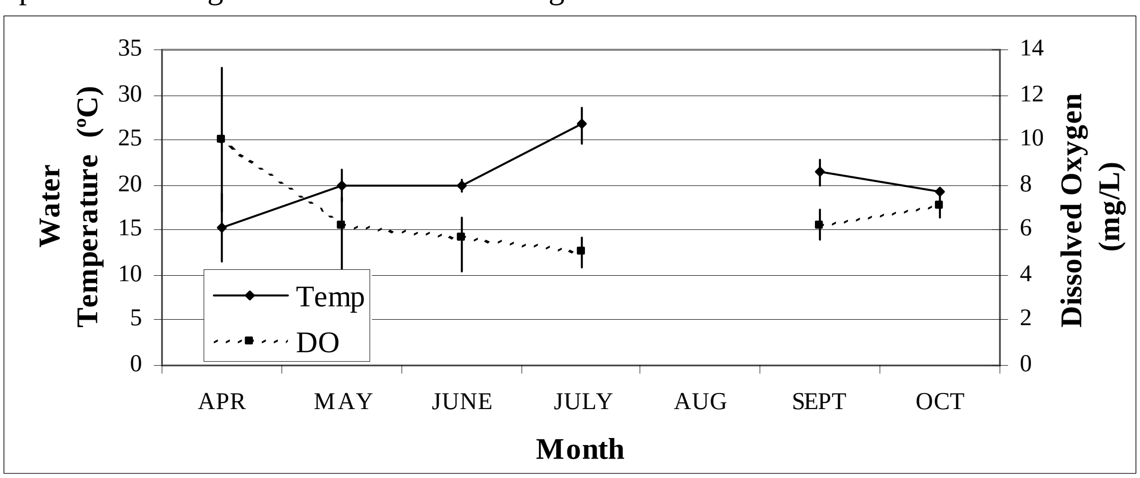

Figure 96. 2007 Coastal Bays Fisheries Investigations Trawl Survey mean water temperature (^{0}C) and dissolved oxygen (mg/L) by month in Isle of Wight Bay. Error bars represent the range of values collected. August data are not available for this bay.

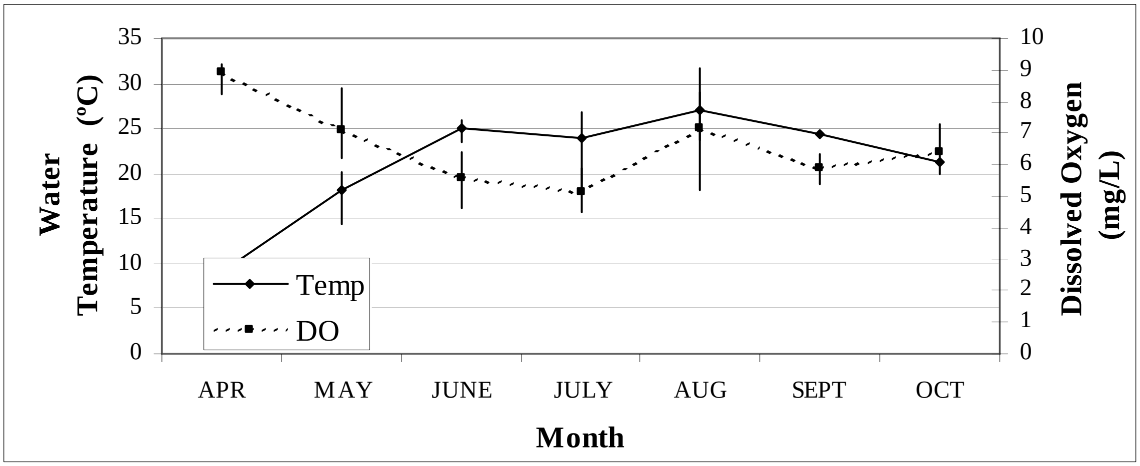

Figure 97. 2007 Coastal Bays Fisheries Investigations Trawl Survey mean water temperature (^{0}C) and dissolved oxygen (mg/L) by month in Sinepuxent Bay. Error bars represent the range of values collected.

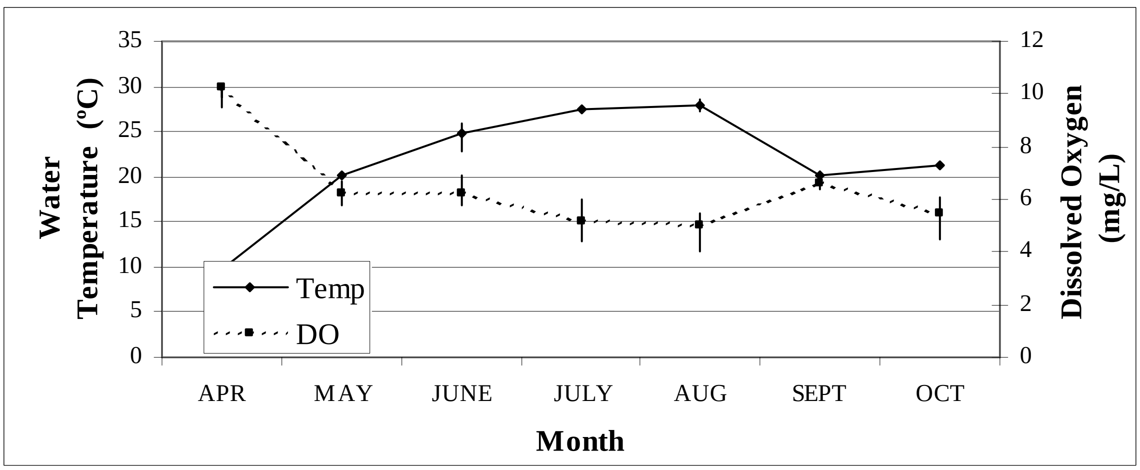

Figure 98. 2007 Coastal Bays Fisheries Investigations Trawl Survey mean water temperature (^{0}C) and dissolved oxygen (mg/L) by month in Newport Bay. Error bars represent the range of values collected.

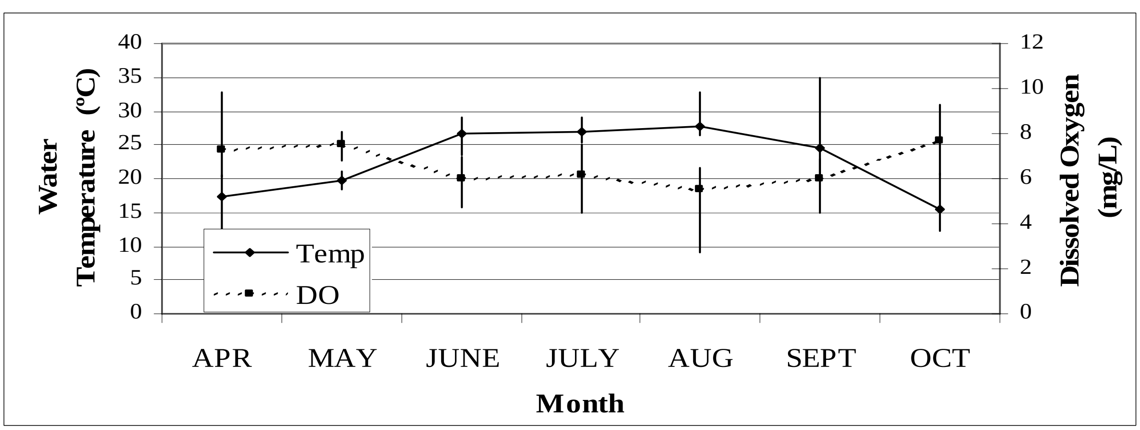

Figure 99. 2007 Coastal Bays Fisheries Investigations Trawl Survey mean water temperature (^{0}C) and dissolved oxygen (mg/L) by month in Chincoteague Bay. Error bars represent the range of values collected.

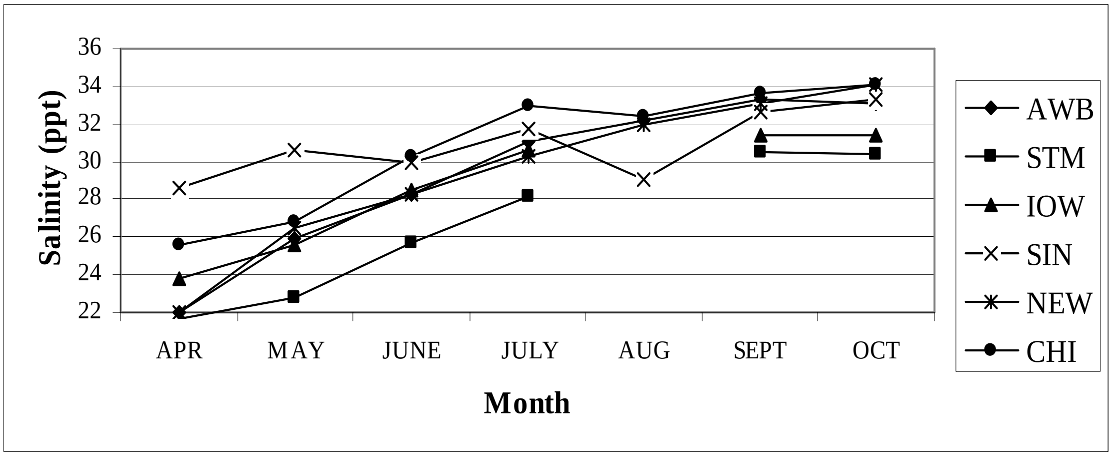

Figure 100. 2007 Coastal Bays Fisheries Investigations Trawl Survey mean salinity (ppt) by month for Assawoman Bay (AWB), St. Martins River (STM), Isle of Wight Bay (IOW), Sinepuxent Bay (SIN), Newport Bay (NEW), and Chincoteague Bay (CHI). August data are not available for both St. Martins River and Isle of Wight Bay.

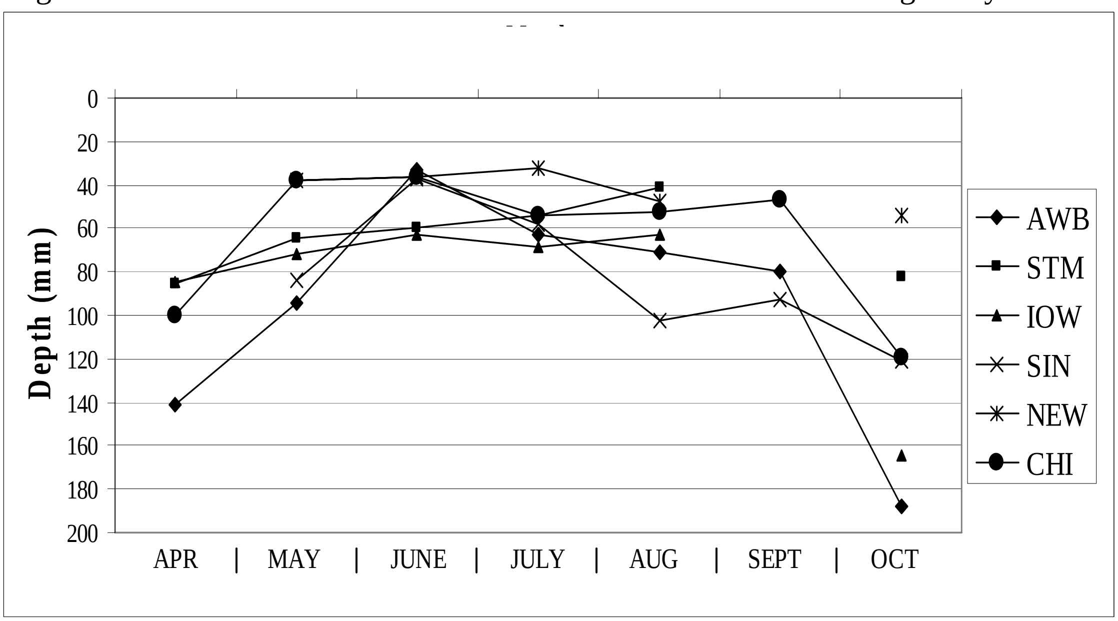

Figure 101. 2007 Coastal Bays Fisheries Investigations Trawl Survey mean secchi depth (mm) by month for Assawoman Bay (AWB), St. Martins River (STM), Isle of Wight Bay (IOW), Sinepuxent Bay (SIN), Newport Bay (NEW), and Chincoteague Bay (CHI). No averages available for Sinepuxent and Newport Bays in April. Only one measurement was taken for the St. Martins River, Isle of Wight Bay and Newport Bay in September making no average available.

Chapter 2

Submerged Aquatic Vegetation (SAV) Drop Net Pilot Program

Introduction:

Data describing nekton (fish, crustaceans) presence and abundance in Submerged Aquatic Vegetation (SAV) beds does not exist for the Maryland Coastal Bays. Currently, assumptions about fishes using SAV beds are based off data collected from the Coastal Bays Fisheries Investigation Trawl and Beach Seine Survey and general life history information. 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 of its potential impacts to changes in the food web, displacement of native species, commercial and recreational fisheries, 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 were 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 were equal in importance to fish habitat. Variables such as shoot density, proximity to land (marsh, beach, etc.), or open water influenced the quality of the SAV bed as habitat (Beck *et al.* 2003). The primary goal of the drop net pilot program was to produce a trap capable of sampling fishes in SAV beds.

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 plants in Sinepuxent Bay that provided habitat and foraging sites for fishes and shellfishes (Beck *et al.* 2003). The common species of SAV was eelgrass, *Zostera marina*. Common species of macroalgae found in Sinepuxent Bay included *Agardhiella sp*., *Gracilaria sp.*, and *Ulva sp*.

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. The 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:

Two samples were conducted. On August 5, 2007, 7 species (three fishes, three crustaceans, and one mollusc) and 151 individuals were collected over vegetated bottom (Table 1). No fishes or invertebrates were collected over the non-vegetated bottom. A second sample, conducted on September 12, 2007, yielded six species (four fishes and two crustaceans) and 101 individuals over vegetated bottom. Four species (three fishes, one crustacean) and 10 individuals were collected from non-vegetated bottom (Table 1).

Discussion:

The absence of a catch in the August 5, 2007 non-vegetated sample may have been related to tears discovered in the net. These tears may have resulted from over-stretching the net panels. This problem was resolved by adding a single two foot wide panel to each trap to alleviate stress at the corners on the panels prior to the September test. In addition, all tears were repaired. Both nets functioned well during the second test. Despite difficulties seining in the sampling gear, drop net sampling appears to be an inexpensive method to sample in SAV beds.

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Table 1. List of fishes and invertebrates collected during two deployments of the 2007 Drop Net Pilot Study in Sinepuxent Bay, Maryland, n=260.

Fishes

Common Name	Scientific Name	Number Collected 8/5/07 Vegetated*	Number Collected 9/12/07 Vegetated/Non-vegetated	Total
Atlantic Silverside	*Menidia menidia*	0	0/1	1
Bay Anchovy	*Anchoa mitchilli*	0	8/7	15
Oystertoad fish	*Opsanus tau*	0	1/0	1
Pipefish	*Syngnathus Spp.*	1	0/0	1
Pipefish, Dusky	*Syngnathus floridae*	0	2/0	2
Silver Perch	*Bairdiella chrysoura*	6	4/1	11
Summer Flounder	*Paralichthys dentatus*	1	0	1
Total Fishes		7	15/9	32

Invertebrates

Common Name	Scientific Name	Number Collected 8/5/07 Vegetated	Number Collected 9/12/07 Vegetated/Non-vegetated	Total
Big Claw Snapping Shrimp	*Alpheus heterochaelis*	1	0/0	1
Blue Crab	*Callinectes sapidus*	5	5/0	10
Brown Shrimp	*Farfantepenaeus aztecus*	0	0/1	1
Grass Shrimp	*Palaemonetes spp.*	136	81/0	217
Atlantic Awningclam	*Solemya velum*	1	0/0	1
Total Invertebrates		143	86/1	230

*No fish were captured from the non-vegetated sample on August 5, 2007.

Chapter 3

Offshore Trawl Survey

Introduction:

In an effort to obtain information about 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 results were used to supplement the Coastal Bays Fisheries Investigation Trawl and Beach Seine Survey. In addition, these data were used to supplement Atlantic States Marine Fisheries Commission (ASMFC) data requirements in compliance reports for summer flounder (*Paralichthys dentatus*), weakfish (*Cynoscion regalis*), and horseshoe crabs (*Limulus polyphemus*).

Methods:

Sample Dates

Offshore commercial sampling trips conducted on November 7, November 14, and December 19, 2007.

Gear, Trawl Time, and Depth

On November 7 and December 19, samples were collected aboard a commercial trawler targeting horseshoe crabs and summer flounder, respectively, using 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. On November 14, butterfish (*Peprilus triacanthus*) and Atlantic croaker (*Micropogonias undulatus*) were targeted using a high rise mid water trawl with a 7.72 cm (3 inch) cod end mesh. For each sample, Long Range Navigation (LORAN) coordinates were recorded as well as weather, water temperature, start and stop times, and beginning and ending depths (feet).

Sample Processing

A sub-sample of the catch for each haul was collected by separating a representative proportion scooping a representation of the catch into a 1000 Liter (L) tub. All fishes were measured for Total Length (TL) in millimeters (mm). Wing span was measured for skates and rays. 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. Horseshoe crabs were measured for prosomal width and sexed. Data were recorded on a standardized data sheet. Staff biologists consulted the *Peterson Field Guide-Atlantic Seashore* (1978) and the *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 and data on length and abundance were analyzed using Excel. 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:

Water temperature was warmest in November (16.0^0 C) and dropped to 10.6^0 C in December. Trawl time varied between 30 and 95 minutes, depending on volume and condition of the catch. A total of six trawls averaged 37.6 minutes on November 7th. On November 14th, six trawls averaged 64.7 minutes. Nine trawls were conducted on December 19th and resulted in an average tow time of 69.9 minutes.

Depth over the course of the surveys ranged from 13.2 m (43.3 feet) to 27.4 m (90 feet). On November 7th, the depth ranged from 14.1 to 16.0 m (46.3 to 52.6 feet). The depth for the November 14th trip ranged from 13.2 to 19.8 m (43.3 to 65.0 feet). The greatest variation in depth was recorded on the December 19th trip when a range of 14.6 to 27.4 m (48.0 to 90 feet) was sampled.

A total of 12 and 8 species were represented in bottom trawl samples collected on November 7th and December 19th, respectively. The mid water trawl sample on November 14th had a greater species diversity (28 spesies) being when compared to the bottom trawl. The predominant species encountered from all the trawls were summer flounder, weakfish, Atlantic croaker, butterfish, and horseshoe crab (Table 1).

A total of 291 summer flounder were collected and measured. Lengths ranged in size from 235 to 620 mm (9.3 to 24.4 in.) and the mean was 423.3 mm (16.7 in., Figure 1).

A total of 132 weakfish were collected and measured. Lengths ranged from 215 to 415 mm (8.5 to 16.3 in.) and had a mean length of 273.9 mm (10.78 inches, Figure 2).

The sub-samples contained 92 Atlantic croakers, which were measured and had a mean length of 287.6 mm (11.32 inches, Figure 3). Atlantic croakers ranged from 215 to 490 mm (8.5 to 19.3 in; Figure 3).

A total of 89 butterfish were collected and measured. Lengths ranged from 160 to 260 mm (6.3 to 10.2 in) with a mean length was 205.1 mm (8.07 inches, Figure 4).

Based on the morphological differences between male and female horseshoe crabs and spiny dogfish (*Squalus acanthias)*, sex was determined for each individual in the sub-sample. Prosomal lengths were collected from 184 horseshoe crabs. Of those, 111 were females with a mean carapace width of 198.1 mm (7.8 in.). A total of 73 males were measured with a mean carapace width of 188.1 mm (7.4 in., Figure 5). Out of the 68 spiny dogfish measured, 55 were female, four were males, and sex was undeterminable for nine fish.

Discussion:

Very little can be concluded from the 2007 offshore trawl survey based on a lack of seasonal diversification of sampling, differences in gears used, and limited sample size. These collections could be improved by increasing sampling frequency and diversifying by gear type. Larger species diversity and overall catch in the high-rise mid-water trawl net is typical when compared to bottom trawl gear. Each net fishes a different part of the water column which results in the difference in species diversity and overall catch between the two net types.

The size of fish captured varies from year to year; however, month, gear, and area sampled are also important. A non-statistical comparison of the weakfish and summer flounder length frequency data indicates similarities between the 2006 and 2007. A large number of juvenile horseshoe crabs in the 2007 data was encouraging, and possibly the result of strict harvest regulations put in place in the mid-Atlantic since 1998.

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 November through December 2007 by the Maryland Department of Natural Resources. Species are grouped (Finfish, Crustaceans, Mollusks, Other) and listed by order of Extrapolated Total Number (Number of individuals in a sample multiplied by the inverse of the proportion of the total catch), n=68,701.

Common Name	**Scientific Name**	**Extrapolated Total Number**	**Total Number Counted**
Weakfish	*Cynoscion regalis*	25896	706
Butterfish	*Peprilus triacanthus*	18790	452
Atlantic Croaker	*Micropogonias undulatus*	7534	133
Windowpane Flounder	*Scophthalmus aquosus*	1579	94
Winter Skate	*Raja ocellata*	1404	113
Summer Flounder	*Paralichthys dentatus*	1183	291
Spiny Dogfish	*Squalus acanthias*	814	68
Atlantic Menhaden	*Brevoortia tyrannus*	710	19
Smooth Dogfish	*Mustelus canis*	670	20
Spotted Hake	*Urophycis regia*	630	26
Clearnose Skate	*Raja eglanteria*	596	37
Spot	*Leiostomus xanthurus*	550	11
Scup	*Stenotomus chrysops*	330	14
Bluefish	*Pomatomus saltatrix*	200	11
Silver Perch	*Bairdiella chrysoura*	185	9
Southern Kingfish	*Menticirrhus americanus*	168	12
Northern Stargazer	*Astroscopus guttatus*	85	4
Striped Searobin	*Prionotus evolans*	80	4
Red Hake	*Urophycis chuss*	65	3
Black Drum	*Pogonias cromis*	60	3
Sheepshead	*Archosargus probatocephalus*	25	1
Pigfish	*Orthopristis chrysoptera*	25	1
Smallmouth Flounder	*Etropus microstomus*	20	1
Northern Searobin	*Prionotus carolinus*	20	1
Atlantic Sturgeon*	*Acipenser oxyrinchus*	-	7
Monkfish*	*Lophius americanus*	-	5
Striped Bass*	*Morone saxatilis*	-	4
Atlantic Cutlassfish*	*Trichiurus lepturus*	-	1
Gray Triggerfish*	*Balistes capriscus*	-	1
Striped Burrfish*	*Chilomycterus schoepfii*	-	1
	Total Finfish	**61,619**	**2,053**

Table 1 (Con't). List of species collected in Sub-sampled Commercial Offshore Trawls from November through December 2007 by the Maryland Department of Natural Resources. Species are grouped (Finfish, Crustaceans, Mollusks, Other) and listed by order of Extrapolated Total Number (Number of individuals in a sample multiplied by the inverse of the proportion of the total catch), n=68,701.

Common Name	**Scientific Name**	**Extrapolated Total Number**	**Total Number Counted**
Crustacean Species			
Nine-Spined Spider Crab	*Libinia emarginata*	55	3
Atlantic Rock Crab	*Cancer irroratus*	42	4
Mantis Shrimp	*Squilla empusa*	40	2
Portunid Crab	*Portunus spinimanus*	40	2
Lesser Blue Crab	*Callinectes similis*	20	1
	Total Crustaceans	**197**	**12**
Common Name	**Scientific Name**	**Total Number**	
Mollusk Species			
Blood Ark	*Anadara ovalis*	760	38
Longfin Squid	*Loligo pealeii*	490	13
Channeled Whelk	*Busycotypus canaliculatus*	100	5
Knobby Whelk	*Busycon carica*	100	5
	Total Mollusks	**1,450**	**61**
Other Species			
Horseshoe Crab	*Limulus polyphemus*	3615	184
Sea Star	*Asterias forbesi*	1820	94
	Total Other	**5,435**	**278**

* All species in the catch were sampled and no extrapolations were made.

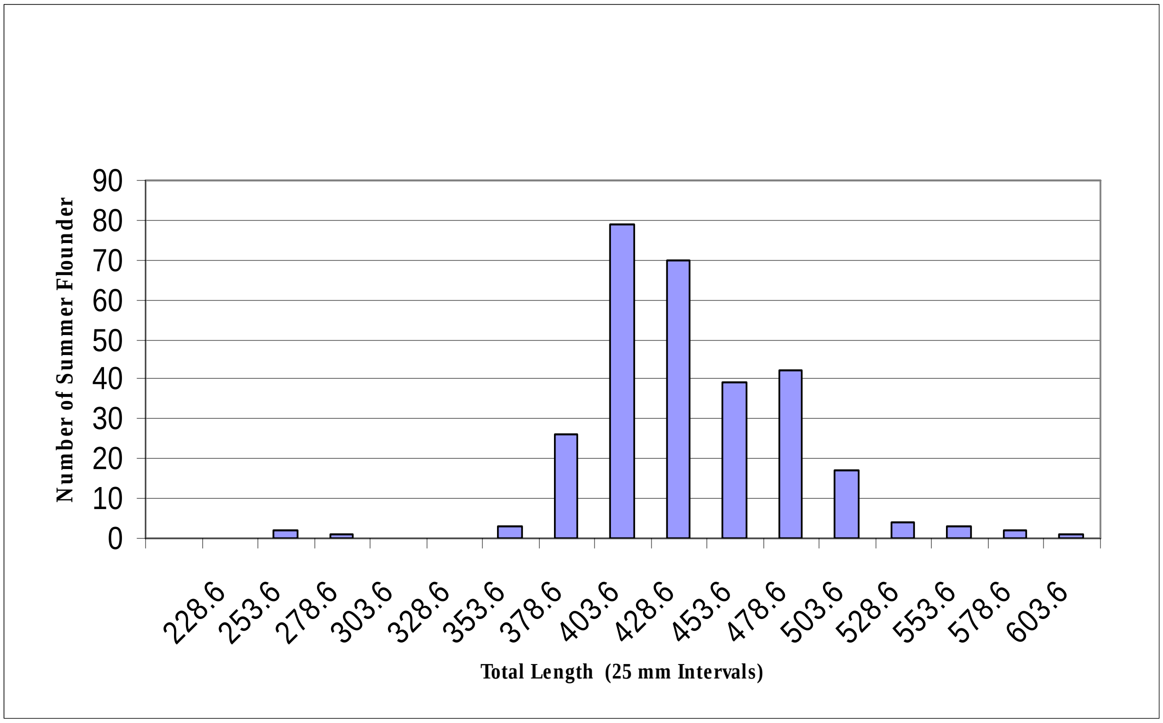

Figure 1. Summer Flounder (*Paralichthys dentatus)* Length Frequency from Commercial Offshore Trawls Sub-sampled by the Maryland Department of Natural Resources during November and December 2007 (n=291). Data was derived from three trawls employing different gear sizes and taken at different water depths.

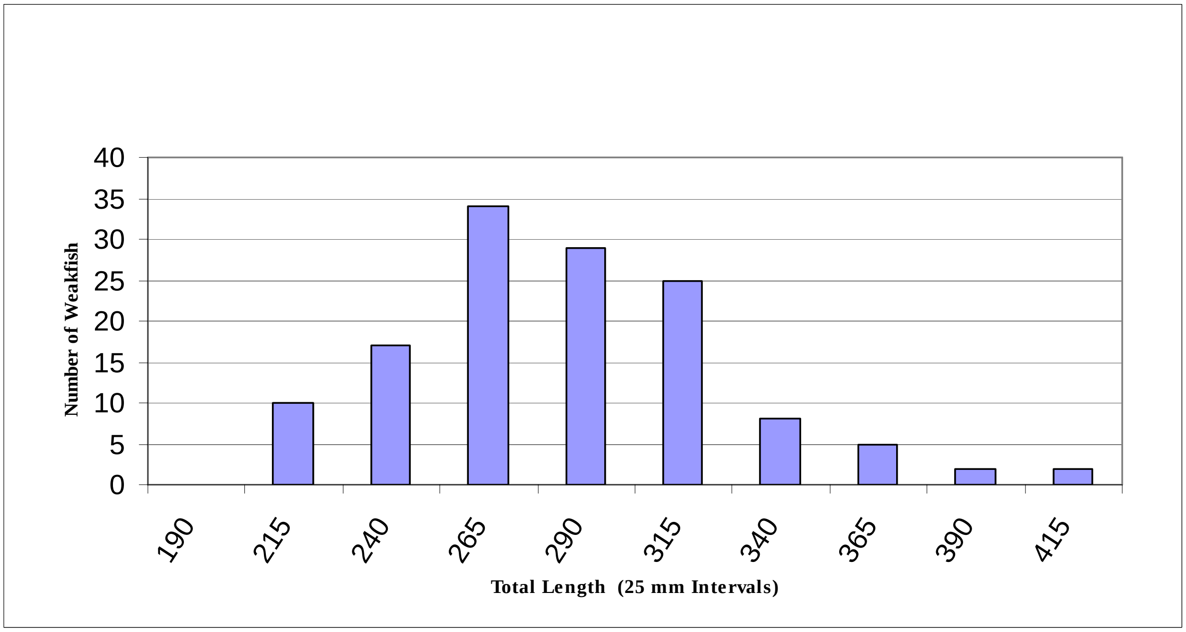

Figure 2. Weakfish (*Cynoscion regalis)* Length Frequency from Commercial Offshore Trawls Sub-sampled by the Maryland Department of Natural Resources during November and December 2007 (n= 132). Data was derived from three trawls employing different gear sizes and taken at different water depths.

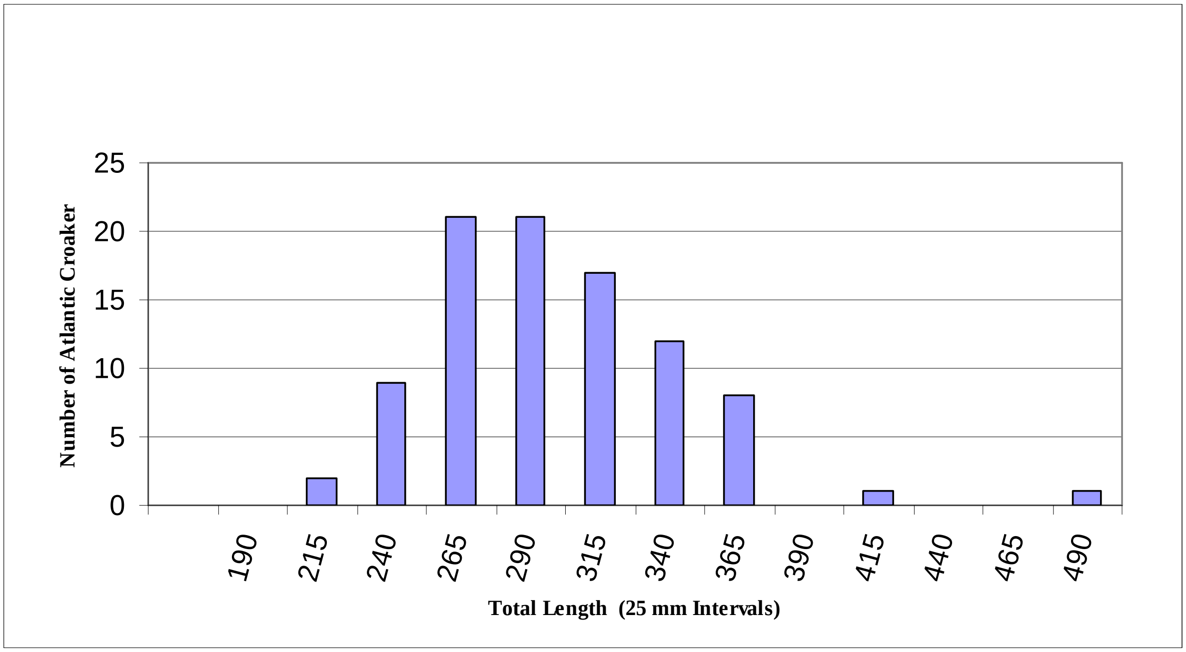

Figure 3. Atlantic Croaker (*Micropogonias undulatus)* Length Frequency from Commercial Offshore Trawls Sub-sampled by the Maryland Department of Natural Resources during November and December 2007 (n= 92). Data was derived from three trawls employing different gear sizes and taken at different water depths.

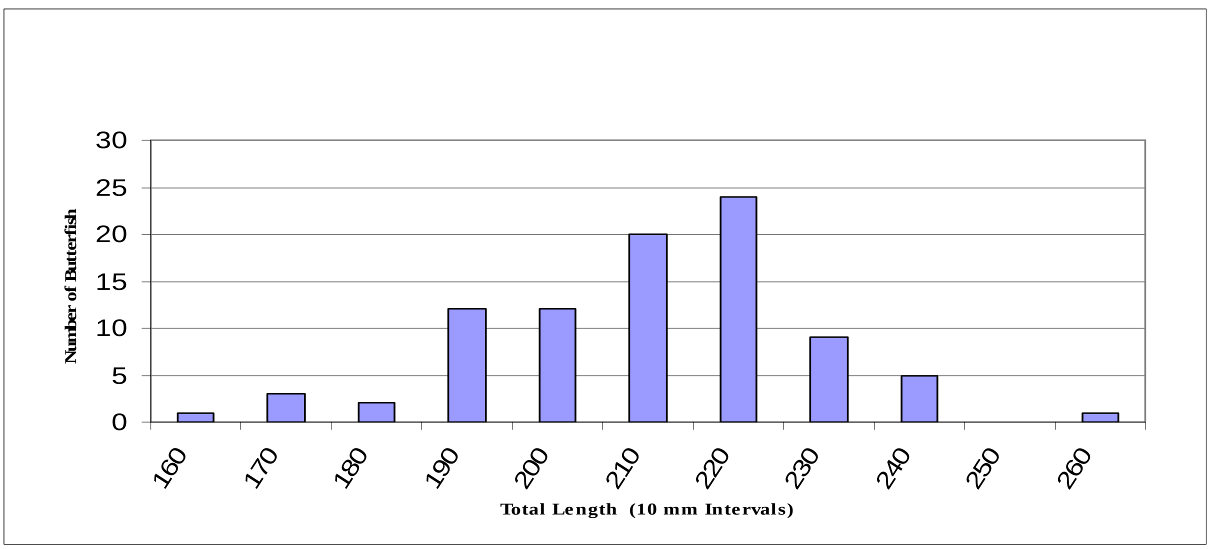

Figure 4. Butterfish (*Peprilus triacanthus*) Length Frequency from Commercial Offshore Trawls Sub-sampled by the Maryland Department of Natural Resources during November and December 2007 (n= 89). Data was derived from three trawls employing different gear sizes and taken at different water depths.

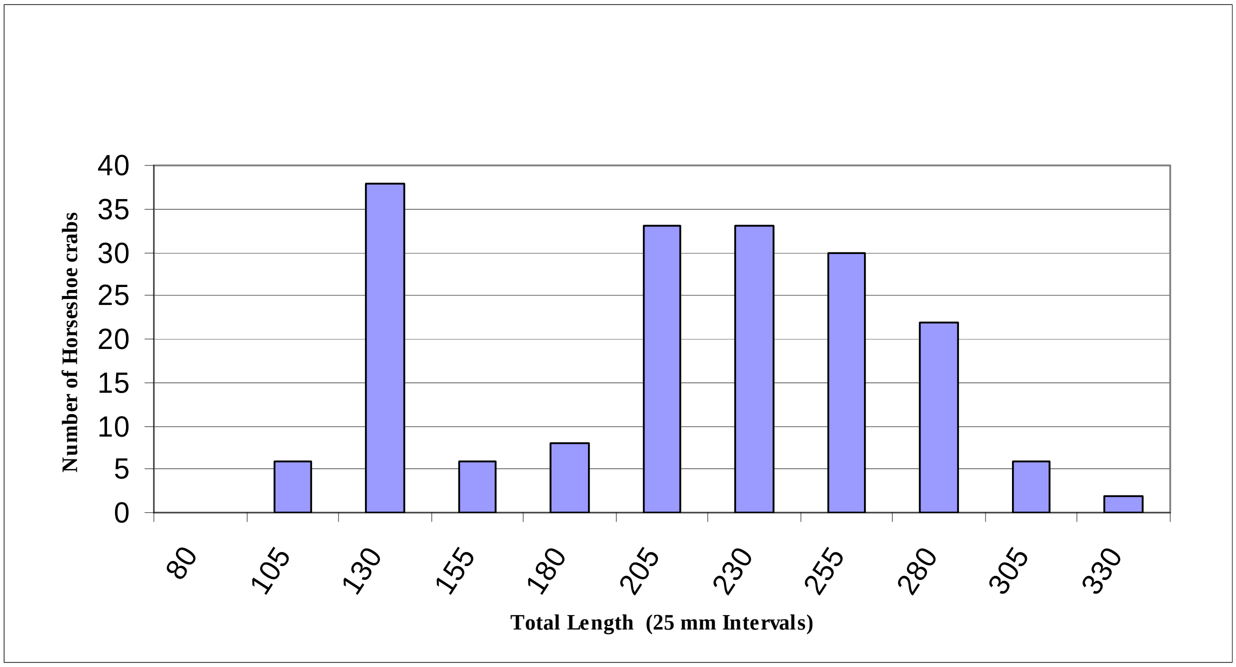

Figure 5. Horseshoe Crabs (*Limulus polyphemus*) Length Frequency from Commercial Offshore Trawls Sub-sampled by the Maryland Department of Natural Resources during November and December 2007 (n= 184). Data was derived from three trawls employing different gear sizes and taken at different water depths.

Chapter 4

2007 Seafood Dealer Catch Monitoring

Introduction:

Dockside data have been collected for several years in Maryland to fulfill data collection 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 coastwide assessments for this species.

Methods:

Weakfish were purchased from a local fish dealer between October 18 and December 11, 2007. 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 Charlie Wenner at South Carolina Department of Natural Resources for ageing.

Results and Discussion:

A total of 217 weakfish were sampled from the commercial harvest in 2007. These fish had a mean length of 343 mm (13.5 inches; range 269-532 mm; 95% CI: ± 4.84) and a mean weight of 425 g (0.94 lbs; range 250-1600 g; 95% CI: ± 22.8). The minimum length for commercially caught weakfish in Maryland in 2007 was 304.8 mm (12 inches).

Gear specific comparison of the data (183 trawl fish; 34 gill net fish) indicated that trawl gear captured a wider range of lengths and weights when compared to gill net harvest in 2007 (Table 1 and 2); however, this varies from year to year without trend. 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 the bottom trawl and gill net gear (Table 1 and 2).

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Table 1. Average Weight and Lengths (with Range) for Commercially Caught Weakfish out of Ocean City, Maryland in 2007 with a Bottom Trawl, n=183.

Gender (n)	**Avg. Weight (g)**	**Avg. Length (mm)**
Male (41)	395 (270-1300)	337 (308-509)
Female (142)	434 (250-1600)	345 (269-532)

Table 2. Average Weights and Lengths (with Range) for Commercially Caught Weakfish out of Ocean City, Maryland in 2007 with a Gill Net, n=34.

Gender (n)	**Avg. Weight (g)**	**Avg. Length (mm)**
Male (3)	412 (385-440)	339 (329-354)
Female (31)	426 (280-700)	339 (301-406)

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. Survey design was based off the successful Maryland Striped Bass Cooperative Angler Survey. 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;
- as a comparison to the MRFSS;
- 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;
- 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. National Marine Fisheries Service annually used these data for estimating the size structure of released (undersized) fish. 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 2007 (Figure 1). Additional promotional techniques included:

- presentations to fishing clubs;
- 2007 summary content in the MDNR 2007 Fishing Report Year in Review http://www.dnr.state.md.us/fisheries/fishingreport/index.asp (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 2007 (Figure 7).

The survey operated from April through the end of October, 2007. 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). In order to calculate Catch Per Unit Effort (CPUE), anglers provided total number of anglers and time spent fishing. Anglers were informed to complete a survey for trips targeting SF where zero 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 November 15, 2007 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. A length frequency histogram was created from the measured lengths. All lengths were truncated and placed into one-inch intervals.

CPUE was calculated for various Atlantic data groupings (overall, measured kept, measured legal, partyboat, without partyboat). To calculate the overall CPUE the following were performed:

Angler Hours per Trip = Number of anglers * Number of Hours Fished
Total Angler Hours = ∑ Angler Hours per Trip
Overall CPUE = ∑SF/Total Angler Hours

Since all legal fish may not have been kept, CPUE was also calculated for all catches that measured 15.5 inches or greater.

CPUE measured kept = Total number of measured kept SF/ Total Angler Hours
CPUE measured legal = Total number of measured legal SF/ Total Angler Hours

The partyboat, *Bay Bee*, submitted length and effort data from its twice daily flounder fishing trips from April through October. The MVASFS 2002-2007 Atlantic data were reviewed to determine if *Bay Bee* data created bias in the survey results (Appendix 4). 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. Atlantic CPUE was calculated with and without *Bay Bee* data.

Total length data were used in a study to determine if reductions in the 2008 Total Allowable Landings (TAL) would require Maryland to change harvest regulations. Summer Flounder harvest was predicted for 2008 as a result of various adjustments to minimum size and creel limits. Methods used to develop 2008 SF size limit options were described by MDNR Fisheries Service Technical Memo 45 (Bolinger et al. 2006).

Results and Discussion:

Individual participation (166 people) increased in the 2007 Atlantic Coast survey as well as the number of trips in comparison to 2006 (Table 1). An increase in trips may be attributed to better fishing, meaning more fish were available or the fish were more susceptible to being caught. More SF were caught (15,064 SF) in 2007 than in 2006 (7,385 SF) which explains the increase in the number of measured fish (Table 1). There were 114 instances of no catch trips (zero SF caught), which was higher than 2006 (58 trips). The increase in reporting no catch trips may be related to public presentations reminding anglers of the importance of those data.

The average length of measured seaside SF was 13.1 inches in 2007 (Table 1, Figure 8). Historical results indicated slight fluctuations in the mean length over the years (Table 1, Figure 9). Anglers kept approximately 23% more measured fish in 2007 (1,325 SF) than 2006 (1,026 SF). This was the greatest number of measured fish kept since the survey began in 2002 (663 kept SF). The number of measured releases increased in 2007 with a difference of 4,197 SF. Overall, 15% of the measured catch was equal to or greater than the 15.5 inch minimum size.

A chi-square test was performed to determine if there was a significant difference in the length frequency developed from *Bay Bee* data versus those from recreational anglers (Appendix 4). Results from that test indicated no differences (P = 0.138). Therefore, including *Bay Bee* measurements with those submitted from recreational anglers should result in an overall length frequency without bias.

The CPUE for all fish caught in the survey was less than one fish per angler hour (Table 1). Although that CPUE increased from 2006, the CPUE for measured, kept fish slightly decreased. CPUE for legal fish increased (regardless of fate). These results were expected since the minimum size and creel was status quo with 2006 (Table 1). Results from testing *Bay Bee* data against that submitted by recreational anglers showed that no bias existed for effort (Table 1, Appendix 4).

References:

Bolinger, Angel, Steve Doctor, Allison Luettel, Michael Luisi, and Gary Tyler. 2006. Investigation of Maryland's Coastal Bays and Atlantic Ocean Finfish Stocks. Maryland Department of Natural Resources, Federal Aid, Project F-50-R-15:154-167. Final Report Annapolis, MD.

SAW Southern Demersal Working Group. 2006. Summer Flounder Stock Assessment Summary for 2006. National Marine Fisheries Service. Northeast Fisheries Science Center. Woods Whole, MA.

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Table 1. Summary of Summer Flounder Regulations and MVASFS data for the Atlantic Coastal Bays 2002–2007.

Year	2002	2003	2004	2005	2006	2007
Regulations Creel @ Minimum Size (inches)	8 @ 17	8 @ 17	3 @ 16	4 @ 15.5	4 @ 15.5	4 @ 15.5
Number of Individuals Submitting Surveys	107	102	103	65	46	166
Total Number of Trips	723	597	658	496	559	1098
Total Number of Trips without catches (Skunked Trips)	97	95	86	42	58	114
Total Number SF Caught	7,982	5,494	16,800	7,204	7,385	15,064
Total Number SF Measured	5,212	4,063	6,421	4,549	4,952	9,563
Measured and Kept	663	653	502	619	1,026	1,325
Measured and Released	4,549	3,401	5,759	3,898	3,922	8,119
Unknown Fate	0	9	160	32	4	119
Mean Length (inches) of Measured SF	13.7	13.4	13.5	13.4	13.8	13.1
% of Measured SF ≥ Minimum Size	14%	15%	8%	13%	22%	15%
Total Angler Hours (A-Hr)	25,860	18,785	17,771	15,451	20,741	23,425
CPUE (Fish/A-Hr)	0.35	0.31	1	0.47	0.37	0.58
CPUE (Measured Kept SF/A-Hr)	0.03	0.04	0.06	0.06	0.07	0.06
CPUE (Measured Legal SF/A-Hr)	0.04	0.04	0.03	0.05	0.05	0.06
CPUE *Bay Bee*	0.33	0.31	1.03	0.46	0.31	0.54
CPUE without *Bay Bee*	0.41	0.34	0.87	0.51	0.6	0.91

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 2007 Maryland fishing license sales.

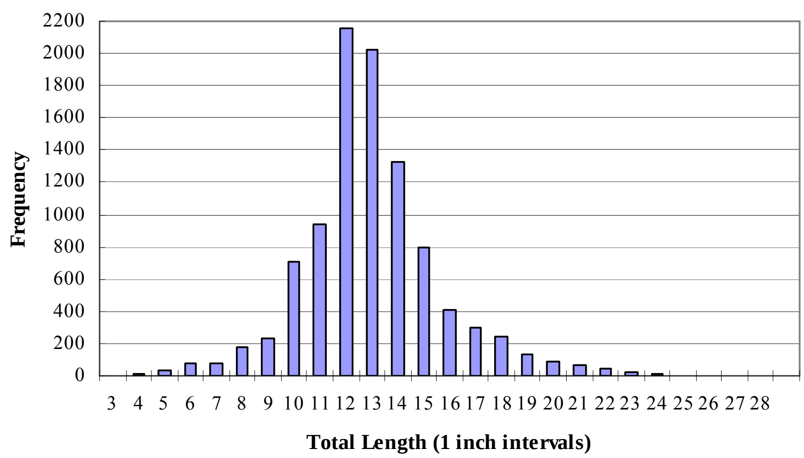
Maryland Department of Natural Resources (DNR) Fisheries Service
2007 Maryland Volunteer Angler Summer Flounder Survey Summary
December 2007

THE ANGLERS...

- 5,955 anglers fished
- 190 anglers reported
- Most were from MD, PA, DE
- 21% belonged to an organization

THE FISH...

- 15,472 fish reported caught
- 9,896 fish measured
- Average length: 13.1 inches
- The length distribution of the overall summer flounder catch has been steady for the past 6 years (2002-2007).



Length frequency of kept and released 2007 Atlantic Coast and Chesapeake Bay fish from the Maryland Volunteer Angler Summer Flounder Survey, n = 9,896.

THE TRIPS...

- 1,166 trips reported: 1,098 trips along the Atlantic Coast (94%), 54 trips in the Chesapeake Bay (5%), and 14 trips were reported without a location (1%).
- 122 skunked trips: 114 Atlantic coast (10%), 7 Chesapeake Bay (13%), and 1 unknown location (7%).

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 2008, 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. 2007 MVASFS Angler summary for the MDNR Fishing Report, winter edition (Jan. 2008).

Get Involved with Maryland Chesapeake Bay and Atlantic Coast Summer Flounder Management!

The Maryland Volunteer Angler Summer Flounder Survey (MVASFS) is 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 summer flounder, you can become an active participant in summer flounder management. These data are used to perform minimum size analysis, as a comparison to the federal harvest data, and much more! To learn more or to become involved with the Maryland Volunteer Angler Summer Flounder Survey, contact Allison Luettel at 410-260-8343 or via email at aluettel@dnr.state.md.us.

Web URL: www.dnr.state.md.us/fisheries/survey/sfsurveyintro.shtml

Figure 3. Text placed on the MD DNR Home Page to promote the survey. This was advertised for a week each on the following dates, April 1, 2007, May 2, 2007, June 20, 2007, and July 4, 2007.

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 2007 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.

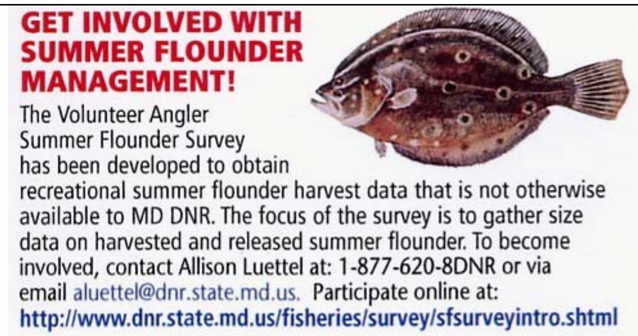
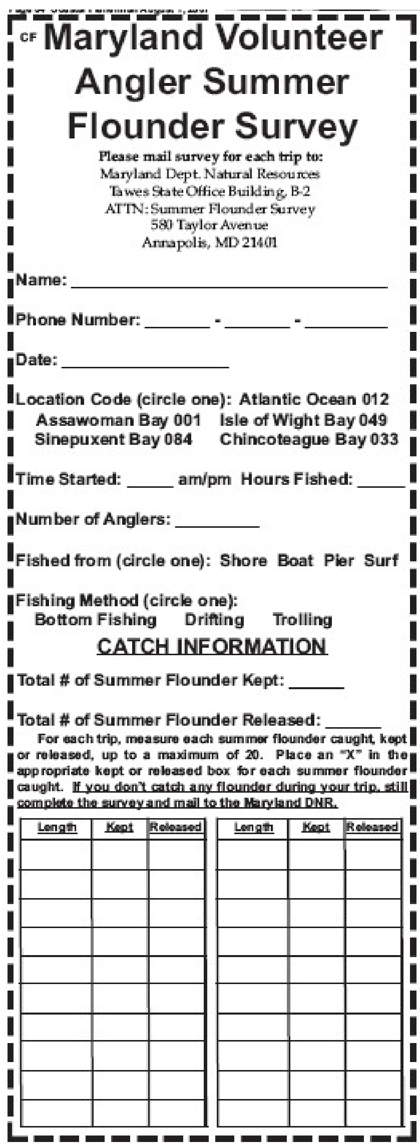


Figure 6. Copy of the MVASFS business cards, which were distributed at fishing shows, Maryland Sport Fishing Tournament Citation Centers, and presentations.



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 2007.

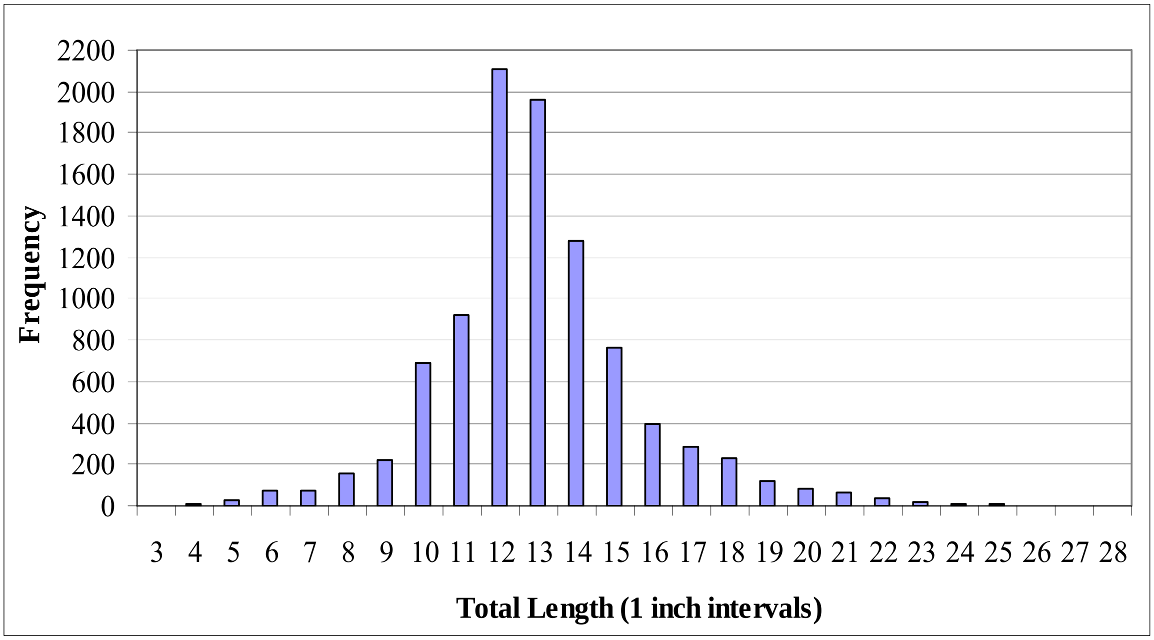


Figure 8. Length frequency of kept and released 2007 Atlantic Coast measured data collected from the Maryland Volunteer Angler Summer Flounder Survey, n=9,563 (mean = 13.1 inches).

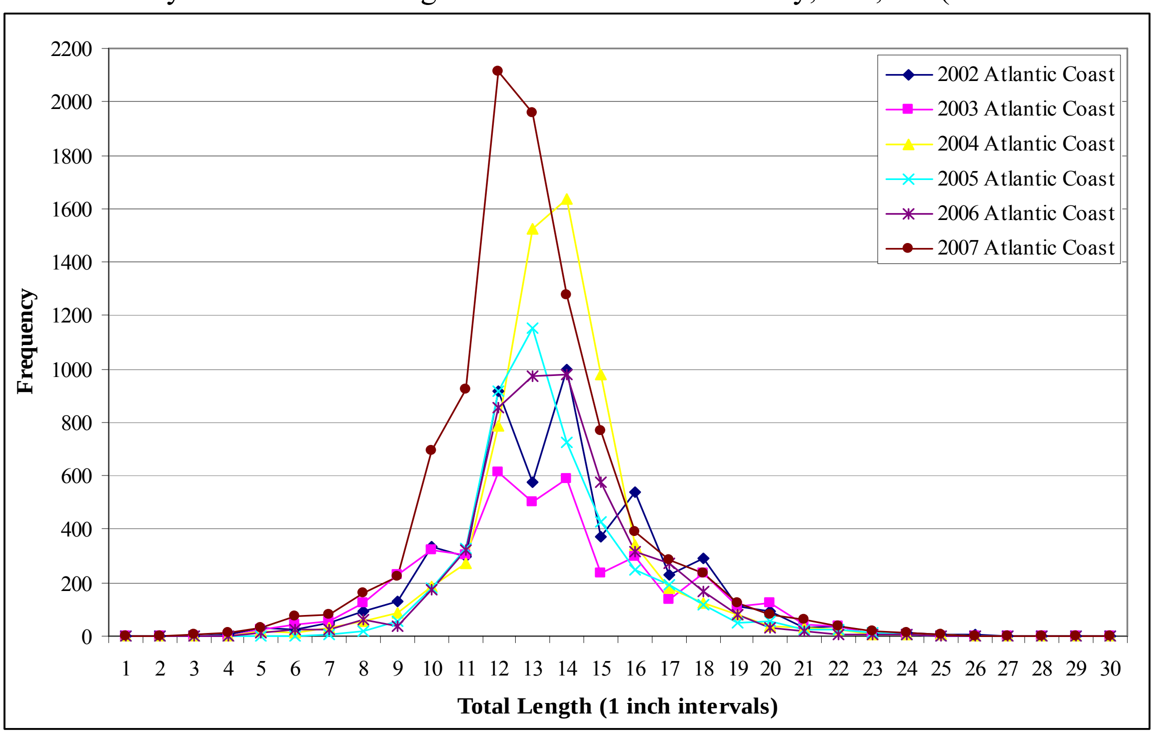


Figure 9. Length frequency of kept and released 2002-2007 Atlantic Coast measured data collected from the Maryland Volunteer Angler Summer Flounder Survey, n = 34,752 (2002 = 0.35, 2003 = 0.31, 2004 = 1, 2005 = 0.47, 2006 = 0.37, 2007 = 0.58).

List of Appendices

Appendix 1.

MD DNR Coastal Bays Trawl Data Sheet

Draw line separating ♂ and ♀ crabs. Start females in the right column and work towards the middle.														
♂ Blue Crab							0102						♀ Blue crab	
Cts														
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●														

Sp.		Sp.		Sp.		Sp.		Sp.		Sp.		Sp.		Sp.	
Cts.		Cts.		Cts.		Cts.		Cts.		Cts.		Cts.		Cts.	
Total		Total		Total		Total		Total		Total		Total		Total	

Sp.		Sp.		Sp.		Sp.		Sp.		Sp.		Sp.		Sp.	
Cts.		Cts.		Cts.		Cts.		Cts.		Cts.		Cts.		Cts.	
Total		Total		Total		Total		Total		Total		Total		Total	

Species Name	Counts	Total

Species Name	Counts	Total

MD DNR Coastal Bays Trawl Data Sheet

Date ______/_____/2008	**Start Time**	**Collector**	**Set#**

Site#
T0

Station Desc.

Waypoint Start	**Waypoint Stop**	**Temp (C)** Surface / Bottom	**Sal (ppt)** Surface / Bottom	**DO (mg/L)** Surface / Bottom
Latstrt 38° .	**Latstop** 38° .	**Secchi (cm)**	**Weather**	**Tide**
Longstrt 75° .	**Longstop** 75° .	**Depth (ft)** Start / Stop	**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
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 measured in L
Estimatecnt ≡ Visual estimate of the number of individuals
% ≡ Percentage of catch

List species collected for vouchers & quantities

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

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

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

EstimateCnt	SpecVol (L)	EstimateVol (L)	%	SpecName

MD DNR Coastal Bays Beach Seine Data Sheet

Appendix 2.

Date ______/_____/2007	**Start Time**	**Collector**	**Set#**
Site# **S0**	**Station Desc.**		
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)**	**Width of seine opening** **Est. % Net Open**
%SAV 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.	**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
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

List species collected for vouchers & quantities

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

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

EstimateCnt	**SpecVol (L)**	**EstimateVol (L)**	**%**	**SpecName**

MD DNR Coastal Bays Beach Seine Data Sheet

Draw line separating ♂ and ♀ crabs. Start females in the right column and work towards the middle.														
♂ Blue Crab							0102						♀ Blue crab	
Cts														
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●														

Sp.		Sp.		Sp.		Sp.		Sp.		Sp.		Sp.		Sp.	
Cts.		Cts.		Cts.		Cts.		Cts.		Cts.		Cts.		Cts.	
Total		Total		Total		Total		Total		Total		Total		Total	

Sp.		Sp.		Sp.		Sp.		Sp.		Sp.		Sp.		Sp.	
Cts.		Cts.		Cts.		Cts.		Cts.		Cts.		Cts.		Cts.	
Total		Total		Total		Total		Total		Total		Total		Total	

Species Name	Counts	Total	Species Name	Counts	Total

Appendix 3.

Atlantic Program Fish Voucher Collection Protocol and 2007 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:

Maryland Dept. of Natural Resources - Fisheries Service - Atlantic Program Coastal Bays Fisheries Investigation (CBFI)

<table>
<tr><td colspan="4">Scientific Name:</td></tr>
<tr><td colspan="4">Common Name:</td></tr>
<tr><td colspan="3">Body of Water:</td><td>County:
Worcester</td></tr>
<tr><td colspan="4">Collection Site:</td></tr>
<tr><td colspan="2">Lat. 38°</td><td colspan="2">Long. 75°</td></tr>
<tr><td colspan="4">Collected By: MD DNR Fisheries Service Atlantic Program</td></tr>
<tr><td colspan="2">Date Collected:</td><td colspan="2">Preservation Date:</td></tr>
<tr><td>Preservative: 70% ETOH</td><td colspan="2">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

References:

East Carolina University Office of Environmental Health and Safety. Formalin. Online. http://www.ecu.edu/oehs/HazWaste/formalin.htm. Accessed March 27, 2006.

Fink, William L., Karsten E. Hartel, William G. Saul, Ellie M. Koon, Edward O. Wiley. 1979. A Report on Current Supplies and Practices used in Ichthyological Collections. Online. http://www.asih.org/coms/ihcc/news/1979.pdf. Accessed March 27, 2006. American Society of Ichthyologists and Herpetologists. Ad hoc Subcommittee on Curatorial Supplies and Practices of the Ichthyological Collection Committee.

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http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=10076

OSHA. Safety and Health Topics Formaldehyde. Online. http://www.osha.gov/SLTC/formaldehyde/. Accessed March 27, 2006.

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Summary of the 2007 Coastal Bays Fisheries Investigations Trawl and Beach Seine Survey Voucher Collection

The CBFI voucher collection currently holds 71 fishes representing 45 families of which 12 species were added in 2007 (Table 1). Species encountered nearly every year since 1989 include banded killifish (*Fundulus diaphanus*), fourspine stickleback (*Apeltes quadracus*), green goby (*Microgobius thalassinus*), rough silverside (*Membras martinica*), sheepshead minnow (*Cyprinodon variegatus*), spotted hake (*Urophycis chuss*), and white perch (*Morone americana*). Alewife (*Alosa pseudoharengus*), gray snapper (*Lutjanus griseus*) and Spanish mackerel (*Scomberomorus maculatus*) were periodically captured since 1989. Blue runners, *Caranx crysos*, were only captured one other time back in 1998. A juvenile cobia (*Rachycentron canadum*) was dip netted from the water by an NRP officer while obtaining fuel at the white marlin marina. Cobia were only collected eight times by this project.

Recommendations

- Continue collecting vouchers for species that are not already included during the 2008 field season.

Table 1. Species list for the CBFI voucher collection, n=180.

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
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	1
Cyprinodontidae	Cyprinodon variegatus*	Sheepshead Minnow	1
Dasyatidae	Dasyatis americana	Southern Stingray	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 diaphanus*	Banded Killifish	1
Fundulidae	*Fundulus majalis*	Striped Killifish	4
Fundulidae	*Lucania parva*	Rainwater Killifish	2
Gasterosteidae	*Apeltes quadracus**	Fourspine Stickleback	1
Gerreidae	*Eucinostomus argenteus*	Spotfin Mojarra	2
Gobiidae	*Ctenogobius pseudofasciatus*	Slashcheek Goby	1

Table 1. Species list for the CBFI voucher collection, n=180.

Family	Scientific Name	Common Name	Number of Specimens
Gobiidae	*Gobiosoma bosc*	Naked Goby	3
Gobiidae	*Microgobius thalassinus**	Green Goby	3
Gymnuridae	*Gymnura micrura*	Smooth Butterfly Ray	1
Haemulidae	*Orthopristis chrysoptera*	Pigfish	4
Hemiramphidae	*Hyporhamphus unifasciatus*	Halfbeak	2
Ictaluridae	*Ameiurus nebulosus*	Brown Bullhead	3
Labridae	*Tautoga onitis*	Tautog	1
Lutjanidae	*Lutjanus griseus**	Gray Snapper	3
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 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	180

Species with an asterisk (*) were added in 2007. **The cobia was dipped out of the water by a Natural Resources Police Officer at the White Marlin Marina.

Appendix 4

Analysis of the Maryland Volunteer Angler Summer Flounder Survey (MVASFS)

Prepared by
Linda Barker and Allison Luettel
Maryland Department of Natural Resources
Fisheries Service

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Introduction

The Maryland Volunteer Angler Summer Flounder Survey (MVASFS) provided critical data used to guide the management approach for Atlantic and Chesapeake Bay populations of Summer Flounder (SF; Barker *et al* 2004). Analysis of the data provided the following information about population structure:

- population length distribution;
- relative measure of population abundance (effort data);
- catch-at-age analysis, which provides guidance for creel and minimum size limits;
- comparison against federal harvest data from the Marine Recreational Fisheries Statistical Survey (MRFSS).

Data submitted from the partyboat *Bay Bee* contributed 41% of the measured fish and 55% of the total number of fish caught in 2007. In previous years the *Bay Bee* provided a larger portion of the surveys length data (a minimum of 62% in 2002 and 2006 and a maximum of 77% in 2005). This was due to submitting measurements from twice daily fishing trips that took place April through October. To determine if *Bay Bee* data interjected bias in the data analyses, chi square test of independence and Catch Per Unit of Effort (CPUE) comparisons were performed.

Methods

A chi-square test of independence was performed to determine if there was a significant difference in the length frequencies developed from *Bay Bee* data and recreational anglers' data (Luettel and Barker, 2008). The comparison was performed using the website located at URL: http://www.physics.csbsju.edu, accessed on January 3, 2008.

A similar concern existed that *Bay Bee* data influenced CPUE. Therefore, effort calculations were performed after separating *Bay Bee* data from the rest of the Atlantic. CPUE was calculated in the following manner using Microsoft Excel:

$$\text{Angler Hours per Trip} = \text{Number of Anglers} * \text{Number of Hours Fished} \quad \text{Eqn1}$$

$$\text{Total Angler Hours} = \sum \text{Angler Hours per Trip} \quad \text{Eqn2}$$

CPUE = ∑SF/Total Angler Hours Eqn3

The following questions were asked:

- What was the mean CPUE?
  (Bay Bee CPUE + Atlantic without *Bay Bee)/2*
- What was the annual percent difference between the two?
  ((Bay Bee CPUE – Atlantic without *Bay Bee)/Bay Bee CPUE)*100*
- Was there a bias over time (*Bay Bee* CPUE consistently larger or smaller)?
- What was the percent influence of *Bay Bee* data on the Atlantic CPUE?
  *((*Atlantic with *Bay Bee CPUE - Bay Bee* CPUE*)/* Atlantic with *Bay Bee CPUE)*100*

Results and Discussion

The 2007 MVASFS length measurements were reviewed to determine if *Bay Bee* data created bias in the length frequency distributions. Results from the chi square test indicated no differences between *Bay Bee* length data and measurements from recreational anglers ($p = 0.138$). Therefore, including *Bay Bee* measurements with those submitted from recreational anglers should result in an unbiased length frequency distribution.

As in 2006, the 2007 the percent difference between CPUEs (57%) was higher than previous years (2002-2005). The difference between all previous Bay Bee and Bay Bee-excluded CPUEs were less than 20%, and there was no consistent pattern through time (Table 1). The *Bay Bee* CPUE (0.54) was higher than the baseline CPUE value around 0.31 – 0.33 which was inconsistent with the partyboat angler stereotype (consistent low level of angler skill and pattern of operation). Plausible explanations for this increased effort included:

- changes in gear (gear efficiency improvements);
- more favorable weather patterns;
- an increase in participation;
- and an increase in skilled anglers. .

The CPUE for recreational anglers ("Without *Bay Bee*") showed this same jump in 2004. In contrast to the *Bay Bee* CPUE, the recreational angler CPUE did not return to a lower baseline CPUE after the movement of this year class through the fishery, but remained at a high level. This may be a function of the non-random nature of these survey data since they were provided by highly motivated and possibly skilled anglers. Additional analysis of those data could verify that participation of skilled anglers created a bias that artificially inflated the 2007 CPUE. Other possible causes for the increased CPUE value included:

- changes in gear (gear efficiency improvements);
- more favorable weather patterns;
- and an increase in participation.

Angler participation increased during 2007 due to an outreach effort to revitalize the MVASFS. Recruitment techniques included:

- dissemination of survey materials at sport fishing shows and tackle shops on the Eastern and Western shores;
- public appearances and PowerPoint presentations to sport fishing groups; and

- a coastal fishing paper, *Coastal Fisherman*, published a weekly survey form throughout the fishing season.

Recommendations

Based on these results, the following procedures have been adopted:

- Annual review of data to ensure that *Bay Bee* percentage contribution to length frequency and effort data remain relatively constant.
- Annual review of data to ensure that *Bay Bee* lengths do not create bias in the length frequency distribution.
- Omit *Bay Bee* data from effort calculations for technical reports and management decisions, since effort values developed from a more heterogeneous data set are more defensible. Inclusion of *Bay Bee* data is considered acceptable for non-technical public presentations of survey results.
- Summarize angler participation by year to determine if regular participants of this survey are influencing the CPUE. If recreational anglers (that do not fish from a partyboat) are biasing the CPUE, then an adjustment may be appropriate.

Literature Cited

Barker, Linda, Alexei Sharov, and Steve Doctor. March 2004. Fisheries Technical Report 45: Development of Summer Flounder Size Limit Options for Maryland's 2004 Fishing Season. Maryland Department of Natural Resources. Fisheries Service. Annapolis, MD.

Bolinger, Angel, Steve Doctor, Allison Luettel, Mike Luisi, and Gary Tyler. 2007. 2006 Coastal Bays Fisheries Investigation. Maryland Department of Natural Resources. Fisheries Service. Annapolis, MD.

Table 1. 2002 – 2007 Maryland Volunteer Angler Summer Flounder Survey (MVASFS) Catch Per Unit of Effort (CPUE), Percent Difference, and Percent Influence by Year and Category for its Atlantic Coast.					
Year	***Bay Bee* *CPUE***	**Without *Bay Bee CPUE***	**With *Bay Bee CPUE***	**% Difference between w/ & w/o *Bay Bee***	**% (Difference) Influence**
2007	0.54	0.91	0.58	-57	7
2006	0.32	0.6	0.37	-62	14
2005	0.46	0.51	0.47	-9	2
2004	1.03	0.87	1.00	13	-3
2003	0.31	0.34	0.31	-10	0
2002	0.33	0.41	0.35	-17	6
Mean				28*	5
* The mean % Difference between w/ & w/o *Bay Bee* was calculated using the absolute values.					

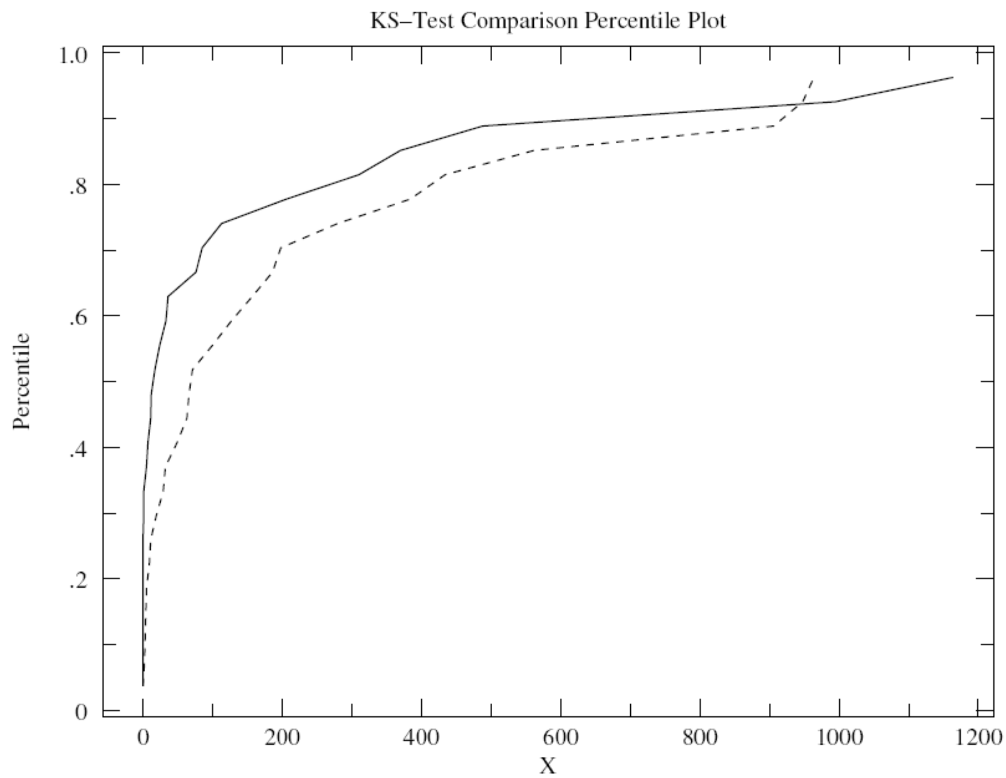

Figure 1. 2007 Maryland Volunteer Angler Summer Flounder Survey (MVASFS) Kolmogorov-Smirnov (KS) Comparison Percentile Plot of *Bay Bee* Data and Atlantic without partyboat Contributions from http://www.physics.csbsju.edu, n=9,563 (p-value = 0.138). Accessed on January 3, 2008.